TP115086

ARTERIAL ROADS WITHIN HIGHWAY 427 INDUSTRIAL SECONDARY PLAN AREA (AREA 47) – PART A

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

6 OCTOBER 2022

WSP
3450 HARVESTER ROAD, SUITE 100
BURLINGTON, ON L7N 3W5

T +1 905-335-2353
WSP.COM

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WSP E&I CANADA LIMITED
3450 HARVESTER ROAD, SUITE 100
BURLINGTON, ON L7N 3W5
CANADA

T +1 905-335-2353

wsp.com

Executive Summary

Study Introduction

The Region of Peel (Region) and the City of Brampton (City), the study proponents, have undertaken a Schedule 'C' Municipal Class Environmental Assessment (Class EA) Phases 3 & 4 study for Arterial Roads within the Highway 427 Industrial Secondary Plan Area (Area 47) to consider a wide range of options for transportation improvements to satisfy future capacity needs.

The City and Region have retained WSP E&I Canada Limited (Formerly Wood Environment & Infrastructure Solutions), to address the requirements of the Class EA for Area 47. This study considered development and commuter demands within Area 47 through provision of new and expansion of existing, arterial roadways. Due to the complexity of the study area and related roadway improvements, the Class EA is divided into two parts, with Part 'A' is being undertaken by the Region and Part 'B' is being undertaken by the City.

The roadways within Part 'A' will be owned and operated by the Region and will include the following:

- Arterial A2 – a new six (6) lane north-south roadway that connects Major Mackenzie Drive to Mayfield Road; and
- Coleraine Drive – an existing roadway which will be widened to four (4) lanes and be upgraded to include curb and gutter and multi-use pathways (MUP).

The roadways within Part 'B' will be owned and operated by the City and will include the following:

- Countryside Drive - an existing roadway which will be widened to four (4) lanes and be upgraded to include curb and gutter and MUP.
- Clarkway Drive – an existing roadway which will have portions widened to four (4) lanes and upgraded to include storm sewers, sidewalks and cycle lanes
- East-West Arterial – a new four (4) lane roadway connecting The Gore Road to Arterial A2.

The Environmental Study Report is focused on Part A only. The study examines the need and feasibility for new roadway(s) and improvements to existing arterials to address short-term and long-term issues related to planned future growth, including operational, geometric, capacity, structural and drainage issues for the horizon year of 2031 and 2041.

Engagement and Consultation

The study was initiated in October 2015 and compliant consultation activities were conducted during Phase 3 of the Class EA process for this project, with the Public, Indigenous Nations, Municipal Groups, Technical Agencies, including Utilities, Conservation Authorities and Provincial Government, and Landowner and Developer Groups.

Stakeholders were notified and requested to provide input at the onset and throughout the duration of the Study, at each of two Public Information Centers and at study completion.

City and Region representatives, Indigenous Nations, relevant technical agencies, and Landowner and Developer Groups were also given additional consideration and engagement through direct discussions, correspondence and meetings.

Existing and Future Conditions

The study area for this Class EA is the Highway 427 Industrial Secondary Plan Area located within the City of Brampton, in the Regional Municipality of Peel. Immediately north of Mayfield Road is the Town of

Caledon. The City of Vaughan and Regional Municipality of York are located on the east side of Regional Road 50. The Class EA area of focus includes the Arterial A2 corridor between Mayfield Road and Regional Road 50 and extends along Coleraine Drive from Mayfield Road to Arterial A2.

In order to identify constraints and sensitivities, a review of the following components was undertaken:

- Socio-Economic Environment
- Land Use Planning Initiatives
- Transportation and Traffic
- Natural Environment
- Vegetation and Aesthetic Assessment
- Stage 1 Archeological Assessment
- Built and Cultural Heritage
- Contamination Overview Study
- Stormwater Management
- Fluvial Geomorphology
- Geotechnical Investigation
- Hydrogeology Investigation
- Road Traffic Noise Impact Study

Development and Evaluation of Alternative Planning Solutions

The evaluation of alternation planning solutions was primarily completed as part of the Area 47 TMP. However, the Project Team revisited and refined the Planning Solutions during the current Study. The Project Team also completed supplementary studies to help inform and support the planning solutions, such as the Access Management Plan.

In order to meet the requirements of Phase 1 and Phase 2 of the Class EA process, three (3) long term transportation planning alternatives were assessed and evaluated based on 2031 travel demands.

- Alternative Planning Solution 1- Do Nothing
- Alternative Planning Solution 2 - As Planned
- Alternative Planning Solution 3 - Increased Network Connectivity

A series of three (3) sub-alternatives were developed for Alternative Planning Solution 3. An evaluation criterion was developed based on four (4) performance indicators: transportation services, policy environment, social, natural and cultural heritage environment and economy. A screenline analysis was also conducted in the westbound and northbound (peak) directions for all Alternative Planning Solutions in order to identify any significant network deficiencies.

Following the specific evaluations, an overall evaluation of the three (3) Alternative Planning Solutions (including the three (3) options associated with Alternative 3) was completed. It was concluded that Alternative 3C was the preliminary preferred Alternative Planning Solution. Based on comments received during a PIC held in June 2012, Alternative 3C was refined and developed into the recommended road network.

Alternative Alignments – Special Policy Areas, New Roadways and Critical Intersection and Rainbow Creek Crossing

During Phases 3 of the Class EA process, alternative design concepts were developed and evaluated using evaluation criteria that was developed to reflect the concerns of various stakeholders, as communicated through consultation. These included high-level alternatives for intersection configurations within the two Special Policy Areas (SPA), the two new arterial roadways (Arterial A2 and East-West Arterial), as well as the critical intersection of Arterial A2 / Major Mackenzie Drive at Regional Road 50, and Rainbow Creek Crossing.

Special Policy Area 1 (SPA 1)

SPA 1 was defined as pertaining to the intersection of Mayfield Road and Arterial A2. Arterial A2 is to function as an east-west arterial until such time as Highway 427 is extended beyond Major Mackenzie Drive. Once Highway 427 is extended, Arterial A2 will function as a north-south arterial.

A number of alternative intersection configurations were developed for SPA 1 – all of which were presented to the Municipal Advisory Group, Technical Agency Committee, Stakeholder Group, and the general public (at PIC #1) for review and comment.

Based on the results of the evaluation process, Alternative 3: T-intersection of Arterial A2 at Mayfield Road was chosen as the preferred alternative for SPA 1. The benefits of this alternative include reduced impacts to existing property, no requirement for an additional crossing of Clarkway Creek, no significant traffic impacts compared to other alternatives, and lowest construction and property acquisition costs. Challenges associated with this alternative include existing driveways on Mayfield Road that are located within the limits of the future Arterial A2/Mayfield Road intersection.

Special Policy Area 2 (SPA 2)

SPA 2 includes the intersections of Arterial A2 with each of Regional Road 50, Coleraine Drive and East-West Arterial, as well as Rainbow Creek. The area roughly extends from Clarkway Drive in the west to Regional Road 50 in the east, and from the TransCanada Pipeline Corridor to the south to approximately 1 km north of that corridor.

During completion of the Area 47 TMP this area was identified as a SPA requiring additional study due to significant environmental, transportation and development concerns and construction of the Highway 427 extension and GTA West. The alternatives investigated for SPA 2 have taken into consideration these diverse elements and have been developed in consultation with the City and Region, as well as key development stakeholders.

High-level alternative configurations for SPA 2 were developed to balance the objectives of the TMP, the MESP, and planned development within the area. These alternatives were presented for review and comment during the initial round of stakeholder and public consultation in November 2016.

Based on the results of the evaluation process, Alternative 3 was identified as the preferred configuration for SPA 2. The benefits of this alternative include its ability to eliminate issues with traffic from Regional Road 50 queuing back through the Coleraine Drive intersection, compatibility with a potential future interchange at Regional Road 50 / Major Mackenzie Drive, as well as its potential to limit the number of crossings of Rainbow Creek to one (albeit longer) structure.

Identified issues with Alternative 3 specifically relate to impacts to the Rainbow Creek NHS and proposed development plans. A series of refined alternatives to the original Alternative 3 concept were developed and reviewed with impacted developers.

The recommended intersection configuration for SPA 2 is Alternative 3D. This configuration consists of a single intersection of Arterial A2, Coleraine Drive and East-West Arterial centered on a single Rainbow Creek crossing. In order to reduce impacts to adjacent development, design speeds on Coleraine Drive and East-West Arterial may be reduced to 70 km/h (posted at 60 km/h).

New Arterial Roadways - Arterial A2

This new, six-lane, major arterial roadway will run north-south between Mayfield Road and the intersection of Major Mackenzie Drive/ Regional Road 50. Its northern extent falls within the limits of SPA 1, while its southern extent is located within SPA 2. As the preferred alternative alignments through these two areas govern the overall alignment of Arterial A2, no further development or evaluation of alternatives is required for this roadway.

Existing Arterial Roadways: Coleraine Drive

Coleraine Drive is an existing arterial roadway, and as such, alignment alternatives are limited based on the desire to make use of the existing ROW (and thereby minimize property impacts). Alternatives considered include widening symmetrically about the existing centreline, widening to the east, widening to the west, or a combination of all three to limit impacts to existing properties, wildlife habitat and structures. Additional alternatives were considered for the southern portion of Coleraine Drive which falls within the limits of SPA 2. These alternatives were previously discussed and are not revisited in this section.

Based on the detailed evaluation, the preferred alignment for Coleraine Drive north of SPA 2 is Alternative 1, which keeps the existing ROW centerline and widens evenly to the east and west. This alignment was assumed during development of the Industrial Tertiary Plans.

Critical Intersection: Regional Road 50 at Arterial A2 / Major Mackenzie Drive

Three intersections were identified as requiring particular attention, either due to issues with alignment or as a result of inability to provide at least a LOS of 'D' or better by the 2041 planning horizon regardless of implementation of auxiliary lanes or signal timing. The intersections of Regional Road 50 with each of Coleraine Drive and Countryside Drive were identified as requiring modification to address issues with alignment. Coleraine Drive will no longer intersect Regional Road 50 and so this intersection will no longer be a concern. The third critical intersection is Regional Road 50 at Arterial A2 / Major Mackenzie Drive, where an interchange is being considered to address anticipated poor LOS. Countryside Drive will be assessed under Part B.

The grade separation alternatives at the intersection of Regional Road 50 and Major Mackenzie Drive (Arterial A2) have undergone a significant amount of evaluation to determine the preferred alternative. The alternative assessment was completed through a workshop in May 2018 with the City and Region. Another evaluation was completed analyzing a high-level 'Vision Zero'- based assessment of the short-listed grade-separation alternative designs.

Based on the qualitative assessed number of potential risks and available tools to mitigate those risks, the results of the overall ranking of alternatives were as follows:

Most Preferred Overall Solution: At-Grade Intersection:

- Most significant safety concerns are associated with congestion (potential rear-end collisions) and significant pedestrian crossing distances; and
- Mitigation techniques are available to the City/Region to address these concerns.

It is recommended that this solution be implemented until such time as congestion becomes a significant concern.

Rainbow Creek Crossing

The crossing design alternatives considered were:

- Alternative 0: TMP Road Network Configuration (Base Case for Comparison Only). The roadway configuration associated with this alternative is not considered acceptable due to the unacceptable queuing that results from insufficient intersection spacing.
- Alternative 1 – Single Intersection Within the NHS
    - Alternative 1A – Parallel Box Culverts
    - Alternative 1B – 25 m Structural Culvert
- Alternative 2 – Two Separate Crossings, Intersection West of NHS
    - Alternative 2A – Parallel Box Culverts
    - Alternative 2B – 12 m and 15 m Structural Culverts
    - Alternative 2C – Structures That Span the Meander Belt

Based on the detailed evaluation, Alternative 1 – the single intersection within the NHS is the preferred alternative, with no significant indication of preference for structural alternative. However, given the fact that hydraulic function of the multi-culvert alternative could be impacted by build up of debris, the single opening alternative is considered to be the preliminary preferred solution.

Description of Preferred Design

The preferred design for Part A includes the following:

- Arterial A2 (new, six (6)-lane cross-section, Region of Peel); and
- Coleraine Drive (realignment, four (4)-lane cross-section, Region of Peel).

Additionally, Cadetta Road, a minor east-west industrial dead-end road that connects to Regional Road 50, will be realigned to intersect further south on Regional Road 50, reducing the intersection skew and providing better access for transport trucks.

An Access Management Report was completed, focusing on access management along Arterial A2, Coleraine Drive, Clarkway Drive, Countryside Drive, the new East-West Arterial and Mayfield Road. The Access Management Report discussed the existing properties with accesses that will be impacted, the existing standards, and future mitigation procedures as well as suggested intersection and accessway locations as per the TAC and Region of Peel Guidelines. It is proposed that proper measures are taken in regards of the proposed locations of future intersections and accesses. Following the Region of Peel's new access bylaw and standards should be adhered to improve transitions between regional and municipal roads.

Environmental Issues and Commitments

Natural Environment - Terrestrial Resources

The vegetation communities within the study area have been created by human disturbance and are classified as cultural vegetation types, residential areas, and predominately agricultural fields. Species of

conservation concern should be considered as they may be present. However, the severe agricultural landscape limits the candidacy of Significant Wildlife Habitat (SWH), as habitat required to delineate the Significant Wildlife Habitat is not available. The most substantial impact on terrestrial wildlife will be the change from a relatively penetrable landscape to an impenetrable landscape due to the increase in roads. A number of potential impacts related with road infrastructure are identified. Many of the usual impacts associated with a direct loss of flora and fauna are not the case for this study area as the severe agricultural landscape limits the amount of natural area and inherent resiliency. A number of recommended mitigation measures related to erosion and sediment control measures are also suggested.

As for habitat compensation, the NHS contains various ecological components that are important to the City and the Region. The proposed removal of natural features to facilitate the proposed project (that are deemed acceptable to the City / Region and TRCA) is to be totaled, and further consultation with TRCA is to occur during detail design. Peel Region will continue to work together with TRCA to identify appropriate compensation opportunities. Peel Region understands that ecosystem compensation will follow in principle the TRCA's Guideline for Determining Ecosystem Compensation, dated June 2018. Compensation will be approved by TRCA and Peel Region in advance of TRCA permit approvals. Additionally, the removal of trees from hedgerows and other areas will require compensation. Compensation is currently estimated to be 1,900 compensation trees which will be further refined in detailed design.

Natural Environment - Aquatic Resources

Possible impacts from the proposed construction and improvements may include the alteration of water levels and the change in the pattern of surface water flow and shallow groundwater movement. Surface water runoff from the proposed roadways may also introduce contaminants. Potential impacts to fish and fish habitat are anticipated to be limited, however several recommendations are made in the report.

Development opportunities and constraints, including stormwater management, will have to be assessed as development proceeds through future Block or Tertiary Planning and associated environmental studies. A monitoring program will be established to ensure that mitigation measures are undertaken. The key impacts to the environment are the short-term impacts that require monitoring during construction. Standard construction practices will need to be complied with, including erosion and sedimentation control, dust and noise control, protection of existing vegetation, assurance of traffic safety and maintenance of traffic flow without causing unnecessary delays, etc.

The environmental impacts are considered normal impacts associated with roads construction. The established standard construction practices outlined as the mitigating measures will be incorporated in the contract documents. Should unforeseen environmental concerns and/or issues arise during the construction period, the appropriate ministry and agencies will be contacted, and appropriate measures will be taken to mitigate the environmental concerns / issues.

Vegetation and Aesthetic Assessment

A number of streetscape treatment opportunities are outlines for Arterial A2 and Coleraine Drive, regarding boulevard trees, wetland/riparian zone restoration, ROW planting and low impact development. Additionally, a Vegetation Assessment will be required, prepared by a certified International Society of Arboriculture arborist. All existing vegetation removed as part of this project should be inventoried. A number of mitigation measures during construction and recommendations for the street tree planting and streetscape design are suggested for detailed design.

Archaeological Assessment

Two Stage 1 Archaeological Assessments were undertaken, both of which recommended the need for a Sage 2 Archaeological Assessment required during detailed design.

Built Heritage Resources and Cultural Heritage Landscapes

The Built Heritage Resources and Cultural Heritage impact assessment determined that no indirect impacts are anticipated to Part A roadways. Direct impacts are anticipated to Coleraine Drive (rural road) and to one heritage property (5556 Countryside Drive) due to proposed road widening. A heritage impact assessment (HIA) should be completed for this roadscape and property at the outset of detailed design.

Contamination Overview Study

The Contamination Overview Study recommended further environmental studies of the high and medium ranked properties directly impacted by project activities to confirm the environmental conditions in support of property acquisitions, environmental due diligence, and management of excess soils and materials. These investigations may include Phase One and Phase Two Environmental Site Assessments. If contamination is identified, mitigation measures may need to be developed and implemented.

Stormwater Management

The Stormwater Management Assessment made a number of recommendations including the following:

- The stormwater facilities are to be designed to service the City of Brampton and Region of Peel owned ROW for the water quantity, water quality, and erosion control stormwater requirements. The road reconstruction retention volume requirements, as well as the short-listed Low Impact Development Best Management Practices, should be further reviewed and refined.
- The developer group has agreed to locate the proposed storm water management pond near the intersection of Coleraine Drive and future Arterial Road A2 that will accommodate storm run-off from the realigned Coleraine Drive. Further, the exact pond location, dimensions and design details will be determined during future phases of work. The Region of Peel will arrange for the design and construction of the stormwater management pond and the City of Brampton will accept conveyance and maintenance of the pond after the maintenance / warranty period.
- It is recommended that the proposed crossings of Coleraine Drive and Arterial A2 be advanced to the detailed design stage.
- It is recommended that the Region's four (4) step process for considering climate change resiliency in the design of stormwater infrastructure should be implemented at the detailed design stage.
- It is recommended that Rainbow Creek alterations or floodproofing measures associated with adjacent developable lands for the reach from Coleraine Drive to Mayfield Road be designed / implemented to achieve a near zero change in computed results between existing and proposed conditions or to accommodate minor changes in computed water surface elevations.

Fluvial Geomorphology

The Fluvial Geomorphology Investigation revealed the need to realign channels due to road widening and construction works. It recommended that new crossing structures accommodate a minimum span of three (3) times the bankfull width of the channel or the maximum existing meander amplitude. These recommendations will reasonably minimize the risk due to natural erosion hazards within the watercourse corridors, but all recommended structures will still be within the recommended meander belt widths.

At new culvert crossings, it is recommended that the structure be placed at an optimal skew perpendicular to the meander axis to ensure long term channel and bank stability. At bridge crossings, the channel will have to be realigned to pass through the axis of the intersection. At all crossing locations, natural channel

design principles will need to be implemented when considering upstream and downstream tie-in points as well as bed and bank treatments.

The proposed road widening works also provide opportunity for channel enhancement and restoration in a variety of locations where watercourses may be impacted by the construction. Reaches currently serving as roadside ditches or that flow parallel to the existing roads can be realigned to achieve a more sinuous planform within the recommended meander belt width corridor, while reducing erosion on the banks and minimizing the risk to new infrastructure.

Geotechnical Investigation

The geotechnical investigation recommends a number of mitigation measures suggested for detailed design, related to pavement design alternatives for the new roads / road widening, foundation design for culverts, slope stability analysis for embankments (where required), roadway cut and fill operations, dewatering requirements, and chemical analyses and disposal requirements of surplus materials in conformance to the MOE Clean-up guidelines for this project.

Hydrogeological Investigation

The hydrogeological investigation recommends a number of mitigation measures suggested for detailed design, including the following:

- Permitting may be required if dewatering rates exceed the thresholds for EASR registration and a PTTW because of surface water, storm water and wetland water influx into excavations.
- Record the amount of water taking during each day of dewatering to ensure the maximum water taking does not exceed the thresholds for EASR registration or a PTTW.
- To be diligent, it is recommended that a private well survey be completed to confirm the location of depth of and water level in water supply wells 4907185 and 4904154 near Coleraine Drive and water supply wells 4902856, 4902866 and 4905894 near Clarkway Drive.
- 0Stream diversion may be necessary to install the culverts. Any dewatering system should be designed by a dewatering contractor and should take the stream surface water flow into consideration.
- Use standard erosion and sediment control measures that meet or exceed OPSS to discharge the abstracted water into the adjacent wetlands, streams or other natural surface water body.
- The quality of the water discharged into the adjacent wetlands, streams or other natural surface water body should meet upstream water quality and/or the Ontario Provincial Water Quality Objectives.

Road Traffic Noise Impact Study

A Road Traffic Noise Impact Study was undertaken for both Part A and Part B roadways in accordance with the provincial guidelines (MOE / MTO Protocol) and the Region and City's Noise Policies. Based on the noise modelling results, a noise barrier/mitigation investigation was completed for eight (8) receptors: mitigation consideration was warranted for two (2) receptors in accordance with the MOE / MTO Protocol, two (2) receptors with both the MOE / MTO Protocol and the Region and City's Noise Policies, and four (4) receptors with Region/City Policies only. Three (3) barrier heights were considered in this investigation: 2.4 m, 3 m and 4 m. As per the noise policies, in order to be warranted, the barrier must achieve a minimum 5 dB reduction at a targeted receptor. An objective level of 55 dBA (16-hour Leq) was also considered as per the MOE / MTO Protocol. The investigation results indicated that none of the barriers with lower heights (e.g., 3 m and 2.4 m) can achieve the 5 dB minimum reduction requirement at the target receptors, except Barrier 7 which is expected to provide 7 dB and 5 dB reductions at receptor RD08 with heights of 3 m and 2.4 m, respectively. However, the mitigated future "build" levels at RD08 under both cases would remain above the MOE / MTO Protocol objective level of 55 dBA by at least 3 dBA. As a result, 5 barriers (each 4

m high) were considered feasible and recommended for implementation. The proposed barrier height may be achieved via a combination of earth berm and barrier. The use of earth berm may also require other considerations such as slope requirement and potential effects on nearby properties and/or development lands. Further investigations to verify the noise wall locations and heights are recommended during the detailed design stage. In addition, as the assessed receptors were identified based on existing conditions, should land uses be updated in the future, the mitigation recommendation may require a re-evaluation.

Monitoring

A monitoring program will be established to ensure that the mitigation measures are undertaken. The key impacts to the environment are the short-term impacts that require monitoring during construction. The construction of this project will be monitored on site by the Region to ensure that the Contractor is implementing standard construction practices. This will include erosion and sedimentation control, dust and noise control, protection of existing vegetation, assurance of traffic safety and maintenance of traffic flow without causing unnecessary delays, etc. The overall performance and effectiveness of the environmental mitigating measures specified are to be monitored and assessed during and subsequent to the construction of the project.

The environmental impacts outlined are considered as normal impacts associated with roads construction. The established standard construction practices outlined as the mitigating measures will be incorporated in the contract documents. The Contract Administrator is to ensure that these mitigating measures are undertaken during construction. Should unforeseen environmental concerns and/or issues arise during the construction period, the appropriate ministry and agencies will be contacted, and appropriate measures will be taken to mitigate the environmental concerns / issues.

Commitments to Further Investigations

Commitments to further investigation during the detailed design stage are:

- Utilities coordination and possible sub-surface utility engineering (SUE) to determine types, location, and depths of the existing and any new facilities;
- Detailed stormwater management design and coordination with agencies;
- Landscape design;
- Property acquisition;
- Detailed cost estimate;
- Construction phases/implementation;
- Construction staging & detour; and
- Additional investigations identified by agencies.

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List of Acronyms

AADT	Annual Average Daily Traffic
AFN	Alderville First Nation
Area 47	Arterial Roads within Highway 427 Industrial Secondary Plan
AT	Active Transportation
Aux	Auxiliary Lane

BRES	Bolton Residential Expansion Study
City	City of Brampton
Class EA	Schedule 'C' Municipal Class Environmental Assessment
CLFN	Curve Lake First Nation
CLI	Stormwater Consolidated Linear Infrastructure
CSA	Canadian Standards Association
CZ	Clear Zone
dB	decibels
dBA	A-weighted decibels
DFO	Department of Fisheries and Oceans Canada
e.g.,	Example
EA Act	*Environmental Assessment Act*
EASR	Environmental Activity and Sector
EB	eastbound
ECA	Environmental Compliance Approval
ESA	Endangered Species Act
ESC	Erosion and Sediment Control
ESR	Environmental Study Report
GGH	Greater Golden Horseshoe
GTA West	Greater Toronto Area Transportation Corridor
GTA	Greater Toronto Area
HFN	Hiawatha First Nation
HIA	Heritage Impact Assessment
HOV	High Occupancy Vehicles
Hwy 427 TMP	Highway 427 Extension Transportation Master Plan
K	Proportion of AADT on a roadway segment or link during the Design Hour, e.g., the hour in which the 30th highest hourly traffic flow of the year takes place.
Km	kilometre
LCFSP	License to Collect Fish for Scientific Purposes
Leq	Equivalent continuous sound pressure level
LID	Low Impact Development
LOS	Level of Service
M	metres
MBCA	Migratory Birds Convention Act
MECP	Ministry of the Environment, Conservation and Parks
MESP	Master Environmental Servicing Plan
MNO	Métis Nation of Ontario
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of Environment
MSIFN	Mississaugas of Scugog Island First Nation
MTO	Ministry of Transportation
MUP	Multi-Use-Pathway
NB	northbound
NHS	Natural Heritage Systems
OPA	Official Plan Amendment
OPSS	Ontario Provincial Standards and Specifications
OTM	Ontario Traffic Manual
PHT	Peak Hour Traffic

PIC	Public Information Centre
PPS	Provincial Policy Statement
PTTW	Permit to Take Water
Region	Region of Peel
ROW	Right-of-Way
SABE	Settlement Area Boundary Expansion
SAR	Species at Risk
SB	southbound
SP47 TMP	Highway 427 Industrial Secondary Plan Area 47 Transportation Master Plan
SPA	Special Policy Area
TAC	Transportation Association of Canada
TRCA	Toronto and Region Conservation Authority
wsel	Water Service Elevation Level
WSP	WSP E&I Canada Limited
YPBATS	York-Peel Boundary Area Transportation Study
YR	York Region

1.0 Introduction and Background

1.1 Introduction

The Region of Peel (Region) has completed a Schedule 'C' Municipal Class Environmental Assessment (Class EA) Study for Arterial Roads within the Highway 427 Industrial Secondary Plan Area (Area 47) to consider a wide range of options for transportation improvements to satisfy future capacity needs. This study considered development and commuter demands within Area 47 through provision of new and expansion of existing, arterial roadways. Due to the complexity of the study area and related roadway improvements, the Class EA is divided into two (2) parts, as illustrated in Figure 1-1; Part 'A' is being undertaken by the Region and Part 'B' is being undertaken by the City of Brampton (City).

The roadways within Part 'A' will be owned and operated by the Region and will include the following:

- Arterial A2 – a new six (6) lane north-south roadway that connects Major Mackenzie Drive to Mayfield Road; and
- Coleraine Drive – an existing roadway which will be widened to four (4) lanes and be upgraded to include curb and gutter and multi-use pathways (MUP).

The roadways within Part 'B' will be owned and operated by the City and will include the following:

- Countryside Drive - an existing roadway which will be widened to four (4) lanes and be upgraded to include curb and gutter and MUP;
- Clarkway Drive – an existing roadway which will have portions widened to four (4) lanes and upgraded to include storm sewers, sidewalks and cycle lanes; and
- East-West Arterial – a new four (4) lane roadway connecting The Gore Road to Arterial A2.

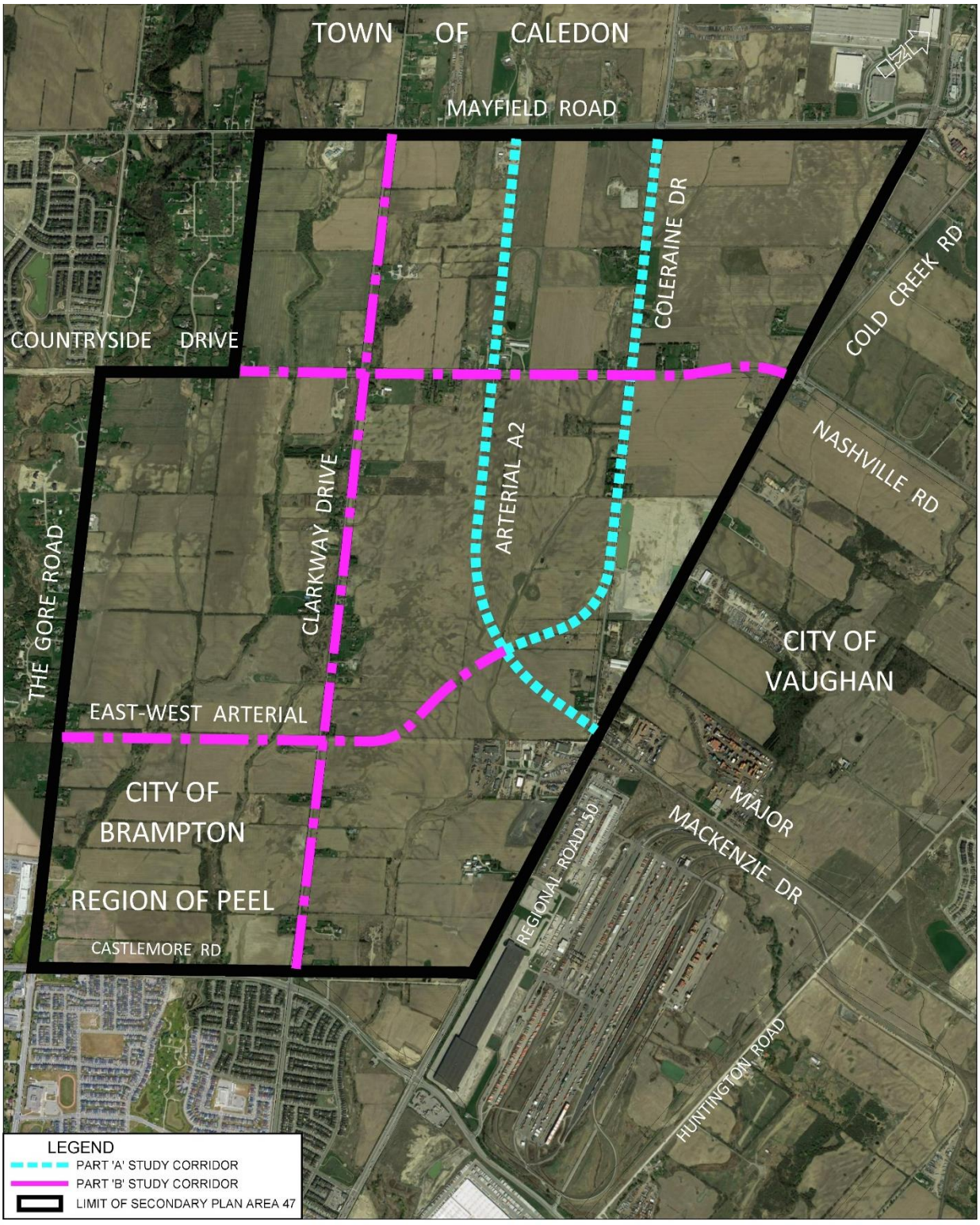


Figure 1-1: Study Area / Key Plan

The City of Brampton is projecting significant growth in Area 47. In order to service this growth, new infrastructure is required to address capacity needs of planned growth and the objectives of protecting established communities and businesses. The study examined the need and feasibility for new roadway(s)

and improvements to existing arterials to address short-term and long-term issues related to planned future growth, including operational, geometric, capacity, structural and drainage issues for the horizon year of 2031 and 2041. In order to best address the deficiencies within Area 47, a number of road improvement alternatives were examined as part of the Study, including a future north-south transportation corridor, as well as widening of the roadway, cross-section and intersection improvements, and enhanced traffic control along Coleraine Drive. In addition, the impact of such improvements on the social and natural environment was explored.

WSP E&I Canada Limited (Formerly Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited), was retained by the Region and City to complete both Part A and Part B studies.

1.2 Environmental Assessment

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

No undertaking that falls under the scope of the EA Act is allowed to proceed until such time as the Minister of the Ministry of the Environment, Conservation and Parks (MECP) provides approval of the submitted environmental assessment documentation. This includes resolution of public appeals made in accordance with section 7.2(3) of the EA Act.

1.2.1 Municipal Class Environmental Assessment

The Class EA process is a mechanism by which planning, and approval of municipal infrastructure is provided in an efficient, timely, economical and environmentally responsible manner. It represents a consistent, streamlined and easily understood process for planning and implementing municipal infrastructure projects. Under the EA Act, projects are classified as approved, subject to screening, subject to a Class EA, or subject to a full Environmental Assessment. This Area 47 study, is classified as being subject to the Class EA process. It is being conducted according to the requirements outlined in the Municipal Engineers Association document titled *Municipal Class Environmental Assessment (October 2000, as amended in 2007, 2011 & 2015).*

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

1. Protection of the environment, including natural, social and economic components of the environment.
2. Participation of a broad range of stakeholders in the study process to allow for sharing of ideas, education, testing of creative solutions and developing alternatives.
3. Documentation of the study process in compliance with all phases of the Class EA process.

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

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

This study is being completed under the requirements of a Schedule C Municipal Class EA. The following Schedule C trigger, as noted in the Municipal Engineers Association's Municipal Class EA Document (*October 2000, as amended in 2007, 2011 & 2015*), applies to this Project:

- Reconstruction or widening where the reconstructed road or other linear paved facilities (e.g., High Occupancy Vehicles (HOV) lanes) will not be for the same purpose, use, capacity or at the same location (e.g., additional motor vehicle lanes, continuous centre turn lane) (Description 20) and Construction of new roads or other linear paved facilities (e.g. HOV lanes) (Description 21) where the estimated cost is greater than $2.4 million *(Adjusted for inflation in 2019 to $2,600,000)*.

The following Class EA planning phases apply:

- ***Phase 1*** – Identify the problem (deficiency) or opportunity.
- ***Phase 2*** – Identify and evaluate alternative solutions to address the problem or opportunity by taking into consideration the existing environment and establish the preferred solution considering public and review agency input.
- ***Phase 3*** – Identify Alternative Design Concepts for the preferred solution implementation by taking into consideration the existing environment and establish the preferred design concept by considering public and review agency input.
- ***Phase 4*** – Document the Environmental Assessment including the design and consultation process in an Environmental Study Report (ESR) for public review.
- ***Phase 5*** – Complete contract drawings and documents and proceed to construction and operation. Monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facility.

The Class EA requires notification of, and consultation with, relevant stakeholders. The Project Team have ensured stakeholders are notified early in the planning process and throughout the Study. Should stakeholders raise issues that cannot be resolved through discussion, these concerns will be referred to the MECP for resolution. This process is further detailed in Section 1.2.3 and 1.2.4.

A simplified version of the Class EA process for this project is illustrated in Figure 1-2. Requirements of Phases 1 and 2 for the current study were met through completion of the related Transportation Master Plan and Master Environmental Servicing Plan, which is detailed in Section 1.5. Once approved, this Schedule C Class EA will prove that requirements of Phases 3 and 4 of the process were met.

Phase 1 and 2

Identify and Describe the Problem(s) and Alternative Planning Solutions

- Identify Problems and Opportunities
- Identify and Evaluate Alternative Planning Solutions
- Identify Preferred Planning Solution
- Opportunity for Public and Stakeholder Input

The requirements of Phases 1 and 2 were met through completion of the The City of Brampton's Secondary Plan Area 47 Transportation Master Plan.

Phase 3

Alternative Design Concepts for the Preferred Solutions

- Issue Notice of Study Commencement
- Opportunity for Public and Stakeholder Input (PIC #1 in November 2016)
- Confirm Findings of Previous Studies
- Develop the Alternative Design Concepts for the Roadway Designs
- Identify and Evaluate Alternate Designs for Preferred Solution
- Complete Environmental Inventory and Impact Assessment
- Identify Preliminary Preferred Design
- Opportunity for Public and Stakeholder Input (PIC #2 in November 2019)
- Use Public and Stakeholder Input to Refine Preliminary Design

Phase 4

Environmental Study Report

- Project Documentation (ESR)
  - Existing and Future Conditions;
  - Confirmation of Needs and Opportunities;
  - Record of Public Input;
  - Alternative Designs and Evaluation; and
  - Environmental Impacts and Mitigations.
- Issue Notice of Study Completion: **October 2022**
- Place ESR on Public Record for 30 Calendar Days for Review
- Notify the Public and Government Agencies of Completion of the ESR and of the Section 16 Order Provision in the EA Act
- Address Comments Received During the 30-day Review Period

Phase 5

Implementation

- Proceed to Construction of the Project
- Monitor Environmental Provisions and Commitments

Figure 1-2: General Municipal Class Environmental Assessment Process

1.2.2 Environmental Study Report (ESR)

This ESR documents the rationale for the Project, the background to the Project, existing and future conditions within the study area, the planning, design and consultation process leading to the preferred alternative, anticipated positive and negative impacts and proposed mitigation measures.

1.2.3 Filing of the ESR

All parties having expressed an interest in the study will be notified by letter, regarding the completion of the project and filing of the ESR. In addition, a Notice of Study Completion will be placed in the local newspaper, the *Brampton Guardian, Caledon Enterprise and Vaughan Citizen* newspapers, in accordance with the requirements of the Class EA process.

Copies of the ESR will be made available at the following locations, as well as virtually:

Gore Meadows Library Branch
10150 The Gore Road
Brampton, ON L6P 0A6

Tel: 905-793-INFO (4636)

Hours:
Monday – Thursday: 10:00 a.m. - 9:00 p.m.
Friday – Sunday: 10:00 a.m. - 6:00 p.m.

A review period of no less than thirty (30) days will be provided, during which comments will be received from stakeholders and agencies. If members of the public, interest groups and/or government agencies feel that their concerns have not been addressed through the Class EA study process, a person or party may request the MECP to make an order for the project to comply with Section 16 of the EA Act (referred to as a Section 16 Order). More information on Section 16 Order requests is provide in Section 1.2.4; however, it is anticipated that all concerns will be resolved through discussion between the Region and the concerned party(ies).

1.2.4 Section 16 Order Request Process

The Class EA process provides an opportunity for the public and other stakeholders to appeal the Class EA process undertaken by the Project Team. Under the provisions of Section 16 of the amended *EA Act*, there is an opportunity under the Class EA planning process for the Minister to review the status of a project. Members of the public, interest groups and review agencies may request the MECP for an order requiring a higher level of study (e.g., requiring an individual / comprehensive Environmental Assessment approval before being able to proceed), or that conditions be imposed (e.g. require further studies), only on the grounds that the requested order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. The procedure for dealing with concerns that may result in the Minister, by order, requiring the proponent to comply with Section 16 of the *EA Act* is outlined in the Municipal Class EA document. It is anticipated that all concerns will be resolved through discussion between the Region and the concerned party(ies).

The Requests should specify what kind of order is being requested (request for additional conditions or a request for an individual / comprehensive environmental assessment), how an order may prevent, mitigate or remedy those potential adverse impacts, and any information in support of the statements in the request. This will ensure that the ministry is able to efficiently begin reviewing the request. Requests should also include the requester contact information and full name for the ministry.

The request should be sent in writing or by email and copy the Region of Peel:

Minister - Ministry of the Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto, ON M7A 2J3
minister.mecp@ontario.ca

Director - Environmental Assessment Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, ON M4V 1P5
EABDirector@ontario.ca

Project Manager - Region of Peel
10 Peel Centre Drive, Suite B, 4th Floor
Brampton, ON L6T 4B9
Tel: 905-791-7800, ext. 7801

1.3 Study Organization

The Project Team consists of staff from the City of Brampton, Region of Peel, WSP E&I Canada Limited, CIMA+, Parish Aquatic Services, McWilliam & Associates and Moon-Matz Ltd. The proponent of the project is the Region of Peel.

Proponent:	**Region of Peel** Project Manager
Co-Proponent (Part 'B'):	**City of Brampton** Project Manager
Prime Consultant:	**WSP E&I Canada Limited** Project Manager Environmental Planner Structural Engineer Biologist Water Resources Engineer Consultation Lead Archaeologist Cultural Heritage Specialist Geotechnical Engineer Geoscientist Hydrogeologist

	Acoustics and Vibration Engineer
Sub Consultants:	CIMA+ Matrix Solutions McWilliam & Associates Moon-Matz Ltd.

1.4 Previous Studies and Adjacent Projects

1.4.1 Region of Peel Highway 427 Extension Transportation Master Plan (2009)

The Region of Peel Highway 427 Extension Transportation Master Plan (Hwy 427 TMP; 2009) built upon the York-Peel Boundary Area Transportation Study and was completed to identify roadway requirements to serve the future needs of the Region in proximity to the future extension of Highway 427. The study area focused on approximately the same area that is covered under this Class EA, with the exception that it considered development north to Healey Road in Caledon and the residential and industrial development in that area.

The Hwy 427 TMP involved updates to traffic forecasts and identified significant inadequacies in the spacing and capacity of east-west arterials and collectors within the study area. In addition to widening of existing arterial roads, a new arterial road, Alternative A2, was recommended. Arterial A2 is to provide an east-west connection between Mayfield Road and Major Mackenzie Drive at Regional Road 50 to accommodate inter-regional traffic between the Regions of Peel and York. With extension of Highway 427 beyond Major Mackenzie Drive, Arterial A2 is to function as a north-south link to accommodate growth in south Bolton.

Issues with intersections of Regional Road 50 and both Countryside Drive and Coleraine Drive were formally identified within the Hwy 427 TMP study. The Region of Peel road grid is offset approximately 30° from that of the Region of York, resulting in poor east-west arterial alignment at intersections along Regional Road 50. Issues at the intersection of Countryside Drive and Regional Road 50 result from a multi-leg approach (Countryside Drive, Regional Road 50, Nashville Road, Cold Creek Road), as well as the aforementioned 30° skew. The intersection of Coleraine Drive and Regional Road 50 / Major Mackenzie Drive is skewed, with Coleraine Drive and Regional Road 50 intersecting at approximately 60°.

1.4.2 York - Peel Boundary Area Transportation Study (2002)

The York-Peel Boundary Area Transportation Study (2002) was completed to address transportation issues at the southern limit of the York-Peel inter-regional boundary. The study, which involved the cities of Brampton and Vaughan, and the Town of Caledon, identified a long-term (2031) transportation and transit plan. The primary outcome from the study was the identified need to extend Highway 427 north from its current terminus.

1.4.3 City of Brampton Transportation Master Plan (2015)

The City of Brampton's Transportation Master Plan (TMP, 2015) was completed to provide a planning vision for implementing the multi-modal transportation system required to support growth within, and adjacent to the City. The particular relevance to the current study is the infrastructure recommendations, planning horizons and budgets for proposed roadworks. TMP recommended facilities for all roads

covered under this Area 47 Class EA include sidewalks on both sides of the roadway; MUP along Arterial A2, Coleraine Drive and East-West Arterial; on-road cycle lanes along Countryside Drive and Clarkway Drive; and infrastructure to support secondary transit corridors. Additionally, Coleraine Drive is identified as a primary regional truck route and both Arterial A2 and East-West Arterial are identified as potential City truck routes. Planning horizons and budgets for the roads covered under this Area 47 Class EA study are provided in Table 1-1.

Table 1-1: Planning Horizon and Budgets for Arterial Roads within Area 47 per Brampton TMP

Roadway		Planning Horizon	Summary of Works	Budget (Millions)
Arterial A2		2021	New four (4) lane roadway between Regional Road 50 and Mayfield Road	$7.88
Coleraine Drive		2021	Widen to four (4) lanes between Regional Road 50 and Mayfield Road	$12.44
Clarkway Drive	Castlemore to Countryside	2031	Widen to four (4) lanes	$16.88
	Countryside to Mayfield	2031	Widen to four (4) lanes	$9.91
Countryside Drive		2031	Widen to four (4) lanes between The Gore Road and Regional Road 50	$23.85
East-West Arterial		2021	New four (4) lane roadway between The Gore Road and Arterial A2	$11.33

1.4.4 Highway 427 Industrial Secondary Plan Area 47 Transportation Master Plan (2014)

The Highway 427 Industrial Secondary Plan Area 47 Transportation Master Plan (SP47 TMP, 2014) was completed to assess and recommend the transportation infrastructure required to support the full buildout of Secondary Plan Area 47 by 2031. This included recommendations for road widening and realignment of Coleraine Drive, Clarkway Drive, and Countryside Drive; as well as the construction of the new East-West (EW) Arterial and Arterial A2 (as identified within the Peel Hwy 427 TMP). Design and construction of these roadways will require coordination between the City of Brampton and Region of Peel as the major arterials fall under regional jurisdiction. The SP47 TMP-recommended roadway concepts are summarized in Table 1-2 and Figure 1-3.

Table 1-2: SP47 TMP-Recommended Arterial and Collector Road Design Criteria

Roadway	Classification	# of Lanes	ROW (m)	Cycling Facilities		Transit Corridor Type
				Off-Road	On-Road	
Arterial A2 (New)	Major Arterial	6	45-50	X		Secondary
Coleraine Drive	Major Arterial	4	40-45	X		Secondary

Clarkway Drive	Castlemore to East-West Arterial	Minor Arterial	4	36		X	Community
	East-West Arterial to Countryside	Major Collector	2	30		X	Secondary
	Countryside to Mayfield	Major Collector	2-4	30		X	Secondary
Countryside Drive		Minor Arterial	4	36		X	Secondary
East-West Arterial (New)		Minor Arterial	4	36	X		Secondary

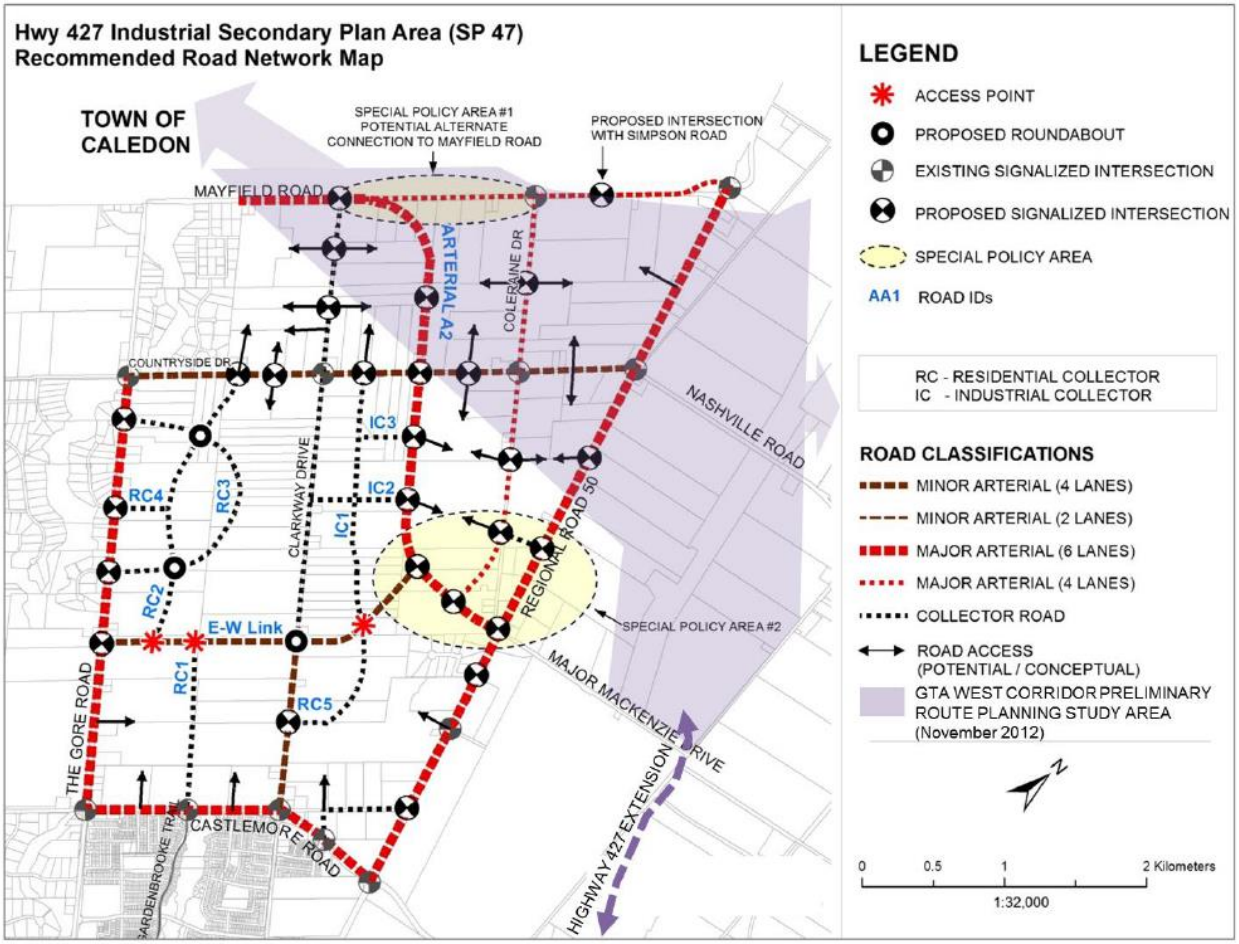


Figure 1-3: SP47 TMP-Recommended Road Network

In addition to the recommended road network, the SP47 TMP provides a set of guidelines that are to shape the planning, design and implementation process. The guiding principles are summarized as follows.

Relevant guiding principles (HDR, 2014):

- A sustainable and multi-modal transportation network;
- Transportation network planned to minimize impact on the natural and cultural environment;
- Roads designed to consider and accommodate all users: pedestrians, cyclists, transit buses, autos and trucks;
- Integrated transit facility locations with active transportation routes;
- Opportunity for streetscape / landscape enhancements; and
- On-street parking in support of mixed-use, main street areas.

The recommendations made for Coleraine Drive and Arterial A2 are further evaluated as part of this Class EA. Recommendations made for the East-West Arterial, Clarkway Drive and Countryside Drive are further evaluated under separate cover.

1.4.5 Master Environmental Servicing Plan: Highway 427 Industrial Secondary Plan Area and Addendum (2019)

A Master Environmental Servicing Plan (MESP) was prepared for the Highway 427 Industrial Secondary Plan Area in 2016. The plan was completed in two (2) phases: the first established the existing environmental conditions, and the second identified stormwater and natural heritage management strategies related to future development impacts. An addendum to the MESP was released in 2019, focusing on providing an alternative Rainbow Creek restoration and enhancement plan.

1.4.5.1 Existing Environmental Conditions

In addition to cataloguing the existing geology, hydrology, and groundwater at the site, the MESP identified a number of surface water features, wetlands, woodlands, fish and wildlife habitat, and species of flora and fauna.

The MESP identified the need to maintain the following surface water features:

- The Gore Road Tributary;
- Clarkway Tributary;
- Rainbow Creek; and
- Headwater drainage feature three (3) of Clarkway Creek.

The MESP also identified a number of significant flora and fauna within the study area, as well as two (2) unique cultural heritage features. Two (2) Species at Risk (SAR) were identified as having the potential to be present: Bobolink and Barn Swallow. The desire to maintain habitat for endangered and significant flora and fauna species was identified for the following existing features (the location of which are identified in Figure 7.1 of the MESP):

- Three (3) significant woodlots;
- Colonial nesting bird sites;
- Two (2) woodland amphibian breeding ponds; and
- Three (3) dugout agricultural ponds which provide habitat for regionally rare flora.

1.4.5.2 Stormwater and Natural Heritage Management Strategies

The MESP identified a number of impact management strategies to mitigate the effects of development on the natural environment.

Key components of the stormwater management strategy include the following recommendations:

- Use of Low Impact Development (LID) measures for handling stormwater, including the installation of:
  - Bioswales / dry swales;
  - Bioretention systems / rain gardens;
  - Filter (buffer) strips; and
  - Soak away pits / infiltration chambers.
- Provision of stormwater ponds at the end of the drainage network;
- Adequately sized roadway crossing structures over study area streams; and
- Stream restoration and grading works on the Rainbow Creek Tributary.

Additional recommended mitigation measures of particular relevance to the preliminary design phase of the arterial road network include the following:

- Planting of salt-tolerant species along the edges of parking lots and roads to mitigate the effects of salt spray and runoff on existing natural vegetation.
- Ensure consistency with the City of Brampton's Woodlot Edge Management (724) and Woodlot Protection (725) design guidelines.
- Low mast lighting, directed downward or shielded is recommended.
- Road Crossings:
  - As much as possible, future road crossings should make use of existing crossings where they do not conflict with other sensitive features (e.g., significant flora, etc.);
  - Road crossings should avoid significant and/or sensitive aquatic habitat, including riparian wetlands;
  - To the extent possible, road crossings should be located within watercourse reaches subject to previous disturbances and/or those where the disturbance or removal of riparian vegetation can be minimized;
  - Crossing structures should be perpendicular to the watercourse and should not be placed where the stream meanders;
  - Crossing structures should be perpendicular to the valley / watercourse corridor and should not be placed where stability and erosion hazards could be increased;
  - If culverts are used, they should be either open-bottomed or embedded a minimum of 20% with material similar to adjacent segments lining the bed; and
  - Crossings should be wide enough to allow for small wildlife passage during dry weather flow conditions. A minimum span of two (2) times the bankfull width is recommended.
- East-West linkages:
  - Existing tableland woodland between The Gore Road and Clarkway Tributaries (approximately 380 metre (m) south of Countryside Drive) is to be enhanced to ensure continued wildlife movement between corridors (not impacted by proposed arterial road network); and
  - Opportunities for enhancement of wildlife corridor along the existing TransCanada Pipelines Limited lands should be investigated.

1.4.6 Ministry of Transportation Highway 427 Extension (2021)

The Ministry of Transportation (MTO) completed the extension of Highway 427 from its current terminus at Highway 7 north to Major Mackenzie Drive (a distance of 6.6 kilometre (km)). The extension addresses issues related to the highway's current terminus, access to the Canadian Pacific Rail Vaughan Inter-Modal Terminal (east of Regional Road 50 between Rutherford Road and Major Mackenzie Drive) and inter-regional traffic at the York-Peel boundary. The extended highway includes six (6) lanes north to Rutherford Road and four (4) lanes north to Major Mackenzie Drive, including a free flow ramp for westbound traffic. Protection for a dedicated Transitway, and three (3) transit stations, is provided along the west side of the extension.

Extension of Highway 427 to Major Mackenzie Drive alleviates pressure on Highway 7 but will result in the need for additional westbound capacity through the Area 47 study area. Significant impacts are anticipated at the Major Mackenzie / Regional Road 50 / Coleraine Drive intersection. Construction was completed in 2021.

1.4.7 Greater Toronto Area Transportation Corridor / Highway 413 (Ongoing)

The Greater Toronto Area Transportation Corridor (GTA West) Environmental Assessment study, also known as Highway 413 was initiated in 2007 by the MTO to address anticipated demand for improved routing and connectivity, greater economic vitality and reduced commute times for the fastest growing urban region in Canada – the Greater Golden Horseshoe (GGH). To partially address the needs of the anticipated growth in the GGH, the GTA West project proposes a new transportation corridor that will feature a new 400 series highway, a transitway and potential goods movement priority features. The route planning study area locates the east-west transportation corridor primarily south of the greenbelt, from a connection at Highway 400, between Kirby Road and King Road, to a connection at Highway 401 near the Highway 401 / 407 Express Toll Route interchange.

Highway 413 will extend from Highway 400, between King Road and Kirby Road, to the 401 / 407 Express Toll Route interchange near Mississauga, Milton and Halton Hills. Further information regarding the GTA West route can be found in Section 6.10.

1.4.8 Region of Peel Highway 50 and Mayfield Road Schedule 'C' Class EA (2012)

A Schedule 'C' Class EA was completed for the widening of Regional Road 50 between Castlemore Road / Rutherford Road and Mayfield Road / Albian-Vaughan Road in 2012. Recommendations included the widening of Regional Road 50 to six (6) lanes from Castlemore Road to Mayfield Road, provision of right and left-turn auxiliary lanes, implementation of transit priority measures, and provision of enhanced pedestrian facilities (including a MUP on the west side). Mayfield Road is also to be widened to four (4) lanes between Coleraine Drive and Regional Road 50, with a roundabout to be constructed at the intersection of Mayfield Road and Pillsworth Road.

The detailed designs for these sections of Regional Road 50 and Mayfield Road are currently being completed.

1.4.9 Major Mackenzie Drive Construction (2021)

Major Mackenzie Drive was widened to six (6) lanes between Highway 400 and Regional Road 50 through a series of four (4) construction phases – the first three (3) of which were completed in 2016. Phase 4, which includes the segment between the Canadian Pacific Railway tracks and Regional Road 50, was coordinated with the extension of Highway 427 from Highway 7 to Major Mackenzie Drive. Work on this section of Major Mackenzie Drive included realignment of the roadway to accommodate an interchange, with construction completed in 2021. In addition to the widening, improvements to the roadway will include provision of sidewalks, a MUP, storm sewers, street lighting and landscaped medians.

1.4.10 Mayfield Road (Regional Road 14) Schedule 'C' Class EAs

Two (2) Schedule 'C' Class EAs have been completed for the section of Mayfield Road adjacent to the study area: one between Airport Road and Coleraine Drive, and another as part of the Regional Road 50 Class EA summarized in Section 1.4.8. The Class EA completed for the section of Mayfield Road between Airport Road and Coleraine Drive recommends a staged widening to four (4) lanes with a 6.0 m continuous two-way left-turn lane and semi-urban cross-section by 2017, and then further widening to six (6) lanes with a 6.0 m continuous two-way left-turn lane and urban cross-section by 2031. Widening of the Mayfield Road / Coleraine Drive intersection is addressed within the Mayfield Road Class EA; however, widening of the Mayfield Road / Clarkway Drive intersection is not. A 3.0 m wide MUP is to be constructed along the south side of the roadway, adjacent to the study area of Part A and Part B. Widening of the Mayfield Road / Coleraine Drive intersection Class EA was completed prior to commencement of the current Area 47 Class EA.

1.4.11 The Gore Road Schedule 'C' Class EA (2006)

A Class EA for the widening of The Gore Road from 300 m north of Castlemore Road to 1,000 m north of Mayfield Road was completed by the Region of Peel in 2006. Recommendations from this Class EA included the widening of The Gore Road from two (2) lanes to four (4) lanes from the south study limit to Mayfield Road, with a generally rural cross-section. The future alignment will be shifted west north of Beamish Court to mitigate impacts to St. Patrick's Church and Cemetery and residential homes north of Mayfield Road. The 2019 update to the Region of Peel Long Range Transportation Plan indicates that the intent to widen The Gore Road from four (4) lanes to six (6) lanes between Castlemore Road and Countryside Drive is no longer required and instead corridor improvements are recommended instead.

1.5 Confirmation of Completion of Phases 1 and 2 of Municipal Class Environmental Assessment

In accordance with the Municipal Class Environmental Assessment process, the following tasks are required for completion under Phases 1 and 2 of the process:

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

Phase 2: Identify alterative solutions to address the problem or opportunity by taking into consideration the existing environment and establish the preferred solution taking into account public and review agency input. At this point, determine the appropriate Schedule for the undertaking and document decisions in a Project File for Schedule B projects, or proceed through [Phases 3-5] for Schedule C Projects.

1.5.1 Works Done to Meet the Requirements of Phase 1

The need to provide higher level of service (LOS) and capacity, as well as improved connectivity through Secondary Plan Area 47 – particularly following extension of Highway 427 to Major Mackenzie Drive, has been thoroughly documented in several previously completed studies. These earlier studies include the *Region of Peel Highway 427 Extension Area Transportation Master Plan (2009),* the *City of Brampton Transportation and Transit Master Plan (2009)* and the *Highway 427 Industrial Secondary Plan Area 47 Transportation Master Plan (2014)*. These studies, particularly the *Region of Peel Highway 427 Extension Area Transportation Master Plan*, meet the requirements of Phase 1 of the Municipal Class Environmental Assessment process.

1.5.2 Works Done to Meet the Requirements of Phase 2

Phase 2 of the Municipal Class Environmental Assessment process is completed to ensure that due-diligence efforts will be expended to identify alternative solutions that minimize impacts to both the natural and human environments. It is completed through a series of steps, as outlined below:

Step 1	Identification of alternative solutions to the problem.
Step 2	Preparation of a physical description of the area where the project is to occur, and a general inventory of the natural, social and economic environments.
Step 3	Identification of the net positive and negative effects of each of the alternatives developed in Step 1, including potential mitigating measures.
Step 4	Evaluation of all reasonable alternative solutions identified in Step 1, taking into consideration the environmental and other factors identified in Steps 2 and 3. Identification of the preliminary preferred alternative solution.
Step 5	Mandatory consultation with review agencies and the public to solicit comment and input.
Step 6	Selection or confirmation of the preferred solution.

For Industrial Secondary Plan Area 47, Phase 2 of the Municipal Class EA process was completed in conjunction with the *Planning Act*. As such, much of the requirements were addressed during completion of the SP47 TMP. Phase 2 requirements and the associated sections of the SP47 TMP are summarized in Table 1-3.

Table 1-3: Summary of Previous Studies that Addressed the Phase 2 EA Requirements

Required Component	SP47 TMP Reference and Summary of Content / Action
Step 1	**Section 5 – Development of Planning Alternatives** A total of three (3) planning alternatives were evaluated: Do nothing; As planned in the Brampton Transportation Master Plan; and Increased network connectivity.
Step 2	**Section 3 – Existing Conditions** The following studies were completed:

	Master Environmental Servicing Plan Cultural Heritage Study
Step 3	**Section 6 – Evaluation of Transportation Alternatives** The section provides an evaluation of the three (3) alternative solutions in terms of transportation service, environmental policy, natural and cultural environment and economic environment.
Step 4	**Section 6 – Evaluation of Transportation Alternatives** The section provides an evaluation of the three (3) alternative solutions in terms of transportation service, environmental policy, natural and cultural environment and economic environment.
Step 5	**Section 1.6 – Environmental Assessment Process and Consultations** Consultation was completed through a notice of study commencement, stakeholder workshop and a public open house.
Step 6	**Section 7 – Recommended Transportation System** Details of the recommended solution are provided. Recommended environmental impact mitigation measures are summarized in the associated Master Environmental Servicing Plan.

Since completion of the SP47 TMP, and in support of changes in legislature which reflect the recommendations of the Truth and Reconciliation Commission of Canada, more comprehensive consultation with Canada's First Nations is required than was previously completed. This additional consultation is included within the scope of the current Class EA study.

1.6 Problem and Opportunity Statement

1.6.1 Problem Being Addressed

The Regions of Peel and York are some of the most rapidly developing areas of the GTA, partially as a result of the planned extension of Highway 427 (to Major Mackenzie Drive by 2017) and the proposed GTA West Transportation Corridor within their boundaries. By 2041, the Region of Peel's population is projected to grow by 35.3%, while Region of York is expected to grow by 49.1% (Hemson Consulting, 2012). Employment projections follow similar trajectories, with growth in Peel projected at 30.2% and growth in York expected at 46.8% (Hemson Consulting, 2012). To accommodate the expected growth, the Regions, and their constituent municipalities, are actively planning and building a robust transportation network that will serve the anticipated population and employment growth.

The Highway 427 Industrial Secondary Plan Area is strategically located at the York / Peel Boundary and in close proximity to the future convergence point of three (3) of the most important transportation / goods movement corridors within the GGH – Highway 427, GTA West, and the Canadian National (CN) Rail Line. At full buildout, this area will provide housing and employment for almost 50,000 people, as well as essential connections between the major transportation corridors and the municipalities of Brampton and Vaughan and Caledon. Comprehensive planning, design and integration of the Area 47 arterial roads network is essential for efficient inter-regional goods movement and ensuring that regional population and employment growth projections are met.

1.6.2 Problem and Opportunity Statement

Area 47 is projected to be home to an estimated 31,120 residents and support 8,130 jobs by 2041. Additional transportation capacity is required in response to travel demand and mobility needs of future residents, employees and businesses within Area 47.

The Hwy 427 TMP first identified the need to provide enhanced inter-regional connectivity (Arterial A2) and capacity through the study area in response to the extension of Highway 427 to Major Mackenzie Drive. Required operational and safety improvements to the intersections along the York-Peel Regional boundary (Regional Road 50) were also identified by this study. The City of Brampton SP47 TMP further built upon the Regional study, identifying the need for increased east-west connectivity, as well as increased capacity for arterial roads within the study area.

Based on the results of previously completed studies, review of existing field conditions and updated traffic assessment the following problems / opportunities are identified:

- Provide enhanced inter-regional connectivity;
- Provide access to proposed development;
- Address anticipated capacity issues resulting from extension of Highway 427 to Major Mackenzie Drive, as well as development of the study area;
- Improve roadway geometrics to meet or exceed City and Regional standards;
- Provide pedestrian and cycling facilities;
- Improve traffic, pedestrian and cyclist safety;
- Improve intersection safety and operations;
- Improve watercourse crossings to enhance hydraulics, stream function and fisheries and wildlife passage;
- Address structural deficiency; and
- Improve pavement conditions.

2.0 Engagement and Consultation Summary

2.1 Consultation Schedule

The study was initiated in October 2015. Comments received from stakeholders and the written responses from the Project Team are contained in Appendix A and Appendix C. Project consultation milestones follow in Table 2-1.

Table 2-1: Consultation Schedule

Consultation Event	Date
Start-up Meeting with Region of Peel	October 6, 2015
Notice of Commencement published in newspapers (Brampton Guardian, Caledon Enterprise and Vaughan Citizen) and mailed to review agencies and affected public.	Mailed on December 8, 2015 Published on December 10 and 17, 2015
Technical Agency Meeting #1 with Ministry of Natural Resources and Forestry and Toronto and Region Conservation Authority.	January 14, 2016
Municipal Group Meeting #1 with City of Vaughan, MTO (Highway 427 Extension), Town of Caledon and Region of York.	February 17, 2016
Municipal Group Meeting #2 with City of Vaughan, MTO (Highway 427 Extension), Region of Peel, Town of Caledon and Region of York.	October 24, 2016
Technical Agency Meeting #2 with Hydro One Brampton, Bell Canada and Toronto and Region Conservation Authority.	November 2, 2016
Stakeholder Group Meeting #1.	November 17, 2016
Notice of Public Information Centre No. 1 published in newspaper (Brampton Guardian) and mailed to review agencies and affected public.	Mailed on November 7, 2016 Published on November 10 and 17, 2016
Public Information Centre No. 1.	November 24, 2016
Technical Agency / Municipal Group Meeting #3 with MTO, Toronto and Region Conservation Authority, City of Vaughan and York Region.	May 17, 2019
Stakeholder Group Meeting #2.	May 30, 2019
Notice of Public Information Centre No. 2 published in newspapers (Brampton Guardian, Caledon Enterprise and Vaughan Citizen) and mailed to review agencies and affected public.	Mailed on October 31, 2019 Published on October 31 and November 7, 2019
Public Information Centre No. 2.	November 14, 2019
Notice of Completion published in newspapers (Brampton Guardian, Caledon Enterprise and Vaughan Citizen) and mailed to review agencies and affected public.	October 6, 2022 to November 7, 2022

2.1.1 Notice of Study Commencement

A Notice of Study Commencement, detailing the study area, summarizing the objectives of the study and requesting comments, was submitted to relevant property owners, agencies, stakeholders, and organizations by mail on December 8, 2015. In addition, a Notice of Study Commencement was published in the Brampton Guardian, Caledon Enterprise and Vaughan Citizen newspapers on December

10 and 17, 2015, by the City of Brampton. Copies of the newspaper advertisement, as well as letters to stakeholders and agencies, are contained in Appendix A.

2.1.2 Study Mailing List

A Project Mailing List was generated by WSP. Additional contacts were added by request, including through completion of comment forms at public meetings. To respect privacy laws, the mailing list is not provided in the appendix.

2.2 Agency Consultation

2.2.1 Technical Agency Meetings

Members of utility groups, provincial and federal agencies were offered the opportunity to be a participant of the project Technical Agency Committee. Individuals who volunteered to participate met with the Project Team twice throughout the duration of the study to solicit feedback on key aspects of the study. The format of the meetings consisted of presentations and roundtable discussions. Table 2-2 presents the agency representatives invited to the Technical Agency Committee meetings:

Table 2-2: Technical Agency Meeting Participations

Type	Agency
Utilities	TransCanada Pipelines Limited
	Bell Canada Municipal Operations Centre
	Hydro One Networks Inc.
	Enbridge Gas Distribution
	Rogers Communication
	Cogeco Cable Inc.
	Telus Network
Conservation Authorities	Toronto and Region Conservation Authority
Provincial Government	Ministry of Natural Resources and Forestry

2.2.1.1 Technical Agency Meeting #1

The first Technical Agency Meeting was held on January 14, 2016, at the City of Brampton's Flower City Community Campus. The purpose of the meeting was to introduce the project, provide an overview of the Class EA process and obtain initial comments from the agencies. Key items discussed included the City of Brampton's MESP, TMP and SAR. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.1.2 Technical Agency Meeting #2

The second Technical Agency Meeting was held on November 2, 2016, at the City of Brampton's Flower City Community Campus. The purpose of the meeting was to provide a project overview and status, present Public Information Centre No. 1 presentation information and review agency comments and recommendations. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.2 Municipal Group Meetings

Staff of local municipalities (City of Brampton, City of Vaughan, Region of Peel, Town of Caledon and York Region) were offered the opportunity to be a participant of the project Municipal Group Committee (Municipal Group). Individuals who volunteered to participate met with the Project Team twice throughout the duration of the study to solicit feedback on key aspects of the project. Although not a representative of a local municipality, the MTO offered to participate as a member of the Municipal Group. The format of the meetings consisted of presentations and roundtable discussions.

2.2.2.1 Municipal Group Meeting #1

The first Municipal Group Meeting was held on February 17, 2016, at the City of Brampton's Flower City Community Campus. The purpose of the meeting was to introduce the project, provide an overview of the Class EA process and receive input from the participants regarding proposed development and transportation plans that may influence Area 47. Key items discussed included adjacent transportation projects, adjacent development, and coordination of design criteria and roadway connections. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.2.2 Municipal Group Meeting #2

The second Municipal Group Meeting was held on October 24, 2016, at the City of Brampton's Flower City Community Campus. The purpose of the meeting was to provide an update about the study, present the Public Information Centre (PIC) material, including traffic modelling results, proposed alternative alignment and alternative cross-section and provide an update on the 427 extension and GTA West. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.2.3 York Region Consultation

York Region was consulted during this Class EA study and additional consultation will be carried out with York Region during detailed design. Major Mackenzie Drive, which forms the east leg of the Highway 50 and Arterial Road A2 intersection, is under York Region's jurisdiction. To address the issues identified at the intersection of Highway 50 and Arterial Road A2, a single-point urban interchange (SPUI) has been proposed as the preferred ultimate configuration. This intersection will continue to be monitored through future studies, in consultation with York Region, to determine when the preferred ultimate configuration will be warranted. For the interim condition, Arterial A2 should be designed in conjunction with the future Highway 50 / Major Mackenzie Drive intersection proposed design.

2.2.2.4 Caledon Consultation

During their review of the Draft ESR, the Town of Caledon expressed concerns related to the proposed alignment of Arterial Road A2 at Mayfield Road, specifically regarding how the T-intersection configuration would operate under 2051 conditions. Significant employment and population growth is planned to 2051 for South Bolton, immediately north of the study area, as recently demonstrated through the Town's Bolton Residential Expansion Study (BRES) and the Region's Settlement Area Boundary Expansion (SABE) Study (2022) for the 2051 Official Plan review.

Additional traffic analysis for the A2 and Mayfield Road intersection was completed by CIMA+ based on the latest available land use forecasting data developed for the SABE Study (including BRES), dated September 2021. The results showed that the A2 and Mayfield Road intersection is expected to generally perform at an acceptable level of service by 2051. The Region will confirm these results and recommendations through its upcoming TMP and will continue, through subsequent stages of this project, to consult with the Town to ensure best outcomes. The upcoming TMP will assess the traffic operations at the intersections of Mayfield Road with Humber Station Road, Coleraine Drive, and Arterial Road A2.

2.2.3 Joint Technical Agency and Municipal Group Meeting

A joint Technical Agency and Municipal Group Meeting was held on May 17, 2019, at the Williams Parkway Operations Centre (Training Room 1C). The purpose of the meeting was to:

- Provide an update on the status of the study;
- Provide an overview of the study's schedule moving forward;
- Discuss the process used to evaluate alternatives and arrive at preliminary preferred solutions;
- Detail elements of the preliminarily preferred design; and
- Solicit input on any design concerns ahead of taking the preliminary preferred design to the Stakeholders Group on May 30, 2019.

Table 2-3 presents the agency and municipal group representatives invited to the meeting and their attendance, including the number of attendees in brackets. The meeting invite was sent out on May 1, 2019.

Table 2-3: Technical Agency and Municipal Group Meeting Participations

Type	Agency	Attendance
Utilities	Alectra Utilities	
Conservation Authorities	Toronto and Region Conservation Authority	√ (4)
Provincial Government	Ministry of Natural Resources and Forestry	
	Ministry of Transportation	√ (1)
Regional	Regional Municipality of Peel	√ (3)
	Regional Municipality of York	√ (1)
Municipal	City of Vaughan	
	City of Brampton	√ (2)
	Town of Caledon	

The format of the meeting consisted of presentations and roundtable discussions. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.4 Toronto and Region Conservation Authority (TRCA) Meetings

2.2.4.1 Toronto and Region Conservation Authority Meeting #1

A meeting was held with the TRCA on May 4, 2017, to review the proposed alternatives for Special Policy Area 2 and proposed crossing alternatives for the Rainbow Creek Natural Heritage System (NHS). Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.4.2 Toronto and Region Conservation Authority Meeting #2

A meeting was held with the TRCA on May 11, 2017, to Introduce the Project, review the hydraulic model for Rainbow Creek, including plans, profiles and cross-sections, review catchment boundaries, drainage areas and impervious coverages for new developments, review rating curves for stormwater ponds within planned developments and review the planned approach and scheduling. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.4.3 Toronto and Region Conservation Authority Meeting #3

A meeting was held with the TRCA on February 14, 2018 to provide a Project update, provide a status update of the MESP Addendum and Hydraulic Model and the Humber River Watershed Model Update, review the level of accuracy associated with use of the currently available models for completion of the Highway 427 Industrial Secondary Plan Area 47 Arterial Roads Class EA, review anticipated timelines for receipt of approved models and timelines for completion of the Class EA. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.4.4 Toronto and Region Conservation Authority Meeting #4

A meeting was held with the TRCA on November 16, 2018, to provide an update on the Block Plans, including the appeal process and timelines. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.2.4.5 Toronto and Region Conservation Authority Meeting #5

A workshop was organized on April 16, 2019, with TRCA to discuss the Rainbow Creek Crossing and determine the preferred design. The workshop presented an overview of the project and timelines, reviewed the preliminary preferred design solution, discussed any potential design concerns and established the preferred alternative design, with associated principles. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.3 Stakeholder Consultation

2.3.1 Stakeholder Group

Adjacent landowners, businesses owners and developers identified as project stakeholders were offered the opportunity to participate in the project Stakeholder Group. Individuals who volunteered to participate met with the Project Team twice throughout the duration of the project. These meetings were open to the public and any interested person(s) was invited to attend without identifying themselves as a formal member.

These meetings provided a smaller forum for discussion and dialogue between the Project Team and stakeholders with specific interests and those that may be directly affected.

2.3.1.1 Stakeholder Group Meeting #1

The Stakeholder Group Meeting #1 was held on November 17, 2016, at the Cardinal Ambrozic Catholic Secondary School. The purpose of the meeting was to present the results of technical studies completed

to date, solicit feedback on preliminary alignment alternatives, and identify any design or environmental issues. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.3.1.2 Stakeholder Group Meeting #2

The Stakeholder Group Meeting #2 was held on May 30, 2019, at the Ebenezer Community Hall. The purpose of the meeting was to provide an update on the status of the study, provide an overview of the study's schedule moving forward, discuss the process used to evaluate alternative road improvements and arrive at preliminary preferred design, detail elements of the current design and identify issues relevant to the study. Details of the specific concerns and opportunities discussed in the meeting are recorded in Appendix C.

2.3.2 Landowner and Developer Group Meetings

The following meetings were held with interested landowner and developer groups. Details of the specific concerns and opportunities discussed in the meetings are recorded in Appendix A.

- August 31, 2016: Review the status of the project and development plans for lands south of Countryside Drive between Arterial A2 and Regional Road 50.
- March 11, 2017: Review the proposed alternatives for Special Policy Area 2, including a potential grade-separation of Arterial A2 / Regional Road 50, as well as Special Policy Area 1. Alternative alignments for Countryside Drive at Regional Road 50 were also reviewed.
- September 9, 2019: Review the updated schedule and discuss the feasibility of developer' proposal to advance land development.
- February 7, 2017: Review and discuss comments submitted from the Blocks 47-1 and 47-2 Landowners Groups.
- February 10, 2017: Review and discuss potential alternative alignments and crossings of the Rainbow Creek corridor in Special Policy Area 2.
- October 6, 2017: Review the status of the Block Plans.

2.3.3 Cadetta Road Access Design Workshop

2.3.3.1 Design Workshop

In early 2020, WSP was notified by the City regarding a new Bus Maintenance facility planned at southwest quadrant of Highway 50 and Cadetta Road. The coordination was made with WSP to understand impacts due to proposed design of future Arterial A2 at Highway 50. For such, a design workshop was held on April 22, 2020, with the City, Region, WSP, Brampton Transit, and IBI Group in order to discuss access considerations for Cadetta Road on Regional Road 50. The workshop was organized and facilitated by the Region. The purpose was to explore design concepts for a safe, full-movement access at the existing location of Cadetta Road on Regional Road 50, under the ultimate planning scenario for a proposed interchange at Arterial Road A2 and Regional Road 50. The objective of the workshop was to confirm the screening of three (3) alternatives to relocate the Cadetta Road access and to determine the feasibility of design concepts for existing Cadetta Road access.

The next steps resulting from the workshop were the following:

- Prepare preliminary functional design;
- Arrange meeting to review functional design;
- Prepare traffic analysis and an update to EA documentation;
- Update Brampton Transit on workshop results through ongoing discussions; and
- Brampton Transit to update building design team for the potential number of bus arrivals and departure.

2.3.3.2 Follow-up Meeting

Following the meeting held on April 22, 2020, a secondary meeting was held on April 28, 2020, to review modifications to the preliminary functional design for proposed Single Point Urban Interchange (SPUI) at Highway 50 / Arterial A2 / Major Mackenzie intersection with full moves access to Cadetta Road. The agenda for the meeting included a function design overview presented by WSP, feedback on the functional design and next steps.

The next steps resulting from the workshop were the following:

- Minor revisions to design based on discussion and circulation;
- Discuss next steps for traffic analysis and EA documentation; and
- Coordinate traffic volume assumptions for Highway 50.

It was mutually agreed upon by the City, Region, WSP and IBI Staff that a modified SPUI with a SBT lane, separated by a raised median south of Arterial A2 would provide safe maneuver and is acceptable to provide a full access to Cadetta Road intersection at Highway 50.

2.4 Utilities Consultation

Utility companies were contacted during the Notice of Commencement and invited to participate in the Technical Agency Meeting. The initial email was sent on May 25, 2016, to MTS Allstream, Bell Canada Municipal Operations Centre (Telecon), Cogeco Cable Solutions, Enbridge Gas Distribution Inc., Enbridge Pipelines Inc., Hydro One Brampton, Hydro One Telecom, Rogers, Telus and TransCanada Pipeline. Responses are summarized in Table 2-4.

Table 2-4: Utilities Responses

Utility Company	Response
MTS Allstream	No existing plant within the study area
Bell Canada Municipal Operations Centre (Telecon)	Existing and/or proposed Bell Canada underground plant
Enbridge Gas Distribution Inc.	Existing Enbridge infrastructure within the study area
Enbridge Pipelines Inc.	No existing assets within the study area
Hydro One Brampton	Existing Hydro One Brampton infrastructure within the study area
Hydro One Telecom	No existing plant within the study area Existing overhead on Hydro poles along Castlemore Road, The Gore Road and Mayfield Road
Telus	No existing fibers within the study area
TransCanada Pipeline	Pipeline intersects with Arterial A2

Based on the responses, there are various utilities present within the study area and further consultation and coordination will be required during detailed design to confirm conflicts and determine any required relocations. Information received from utilities can be found in Appendix C.

2.5 Public Consultation

2.5.1 Public Information Centre #1

The Region and City held a joint Public Information Centre (PIC) for Part A and Part B on November 24, 2016 from 6:30 pm to 8:30 pm at Cardinal Ambrozic Catholic Secondary School, Cafeteria (10 Castle Oaks Crossing, Brampton, ON L6P 3A2). Notification of the PIC was sent to stakeholders, local residents and agencies by mail on November 7, 2016 and advertised in the Brampton Guardian on November 10, 2016. Information was also available on the City website - https://www.brampton.ca/EN/residents/Roads-and-Traffic/Planning-and-Projects/Pages/Area-47-Arterial-Roads.aspx

The session included a series of 31 poster boards displayed around the room detailing the progress of the project, initial findings of background studies, alternatives being considered, and next steps in the study. Study Team members were on hand to guide attendees through the information, discuss the study and answer questions. Attendees were encouraged to sign-in and complete a Comment Form. There were 31 attendees that signed into the PIC and five (5) completed comment forms returned. Responses to comments received were prepared and mailed to all recipients. Completed comment forms and responses can be found in Appendix A.

All information presented at the PIC was posted to the City's project webpage on November 29, 2016, including:

- Notice of PIC No. 1 Meeting;
- Comment Forms;
- Display Boards; and
- Constraint and alternative alignment mapping.

Details of this PIC are presented in Appendix A.

2.5.2 Public Information Centre #2

The Region held a PIC for Part A only on November 14, 2019, from 6:00 pm to 8:00 pm at Gore Meadows Community Centre – Community Room (10150 The Gore Road, Brampton, ON L6P 0A6). Notification of the PIC was sent to stakeholders, local residents and agencies by mail on October 31, 2019 and published in the Brampton Guardian, Caledon Enterprise and Vaughan Citizen on October 31 and November 7, 2019. Information was also available on the City and Region's website –

- Region's Website: https://www.peelregion.ca/pw/transportation/construction/environmental-assessment/arterial-roads-hwy-427.asp.
- City's website: https://www.brampton.ca/EN/residents/Roads-and-Traffic/Planning-and-Projects/Pages/Area-47-Arterial-Roads.aspx

The session included a series of 26 poster boards displayed around the room detailing the progress of the project, proposed design, alternative design concepts being considered, and next steps in the study.

Study Team members were on hand to guide attendees through the information, discuss the study and answer questions. Attendees were encouraged to sign-in and complete a Comment Form. There were 34 attendees that signed into the PIC and one (1) comment sheet was received during the PIC and six (6) emails were received after the PIC. Ten (10) emails were received immediately before and after the comment period. Details of this PIC are presented in Appendix A.

2.6 Indigenous Engagement

Indigenous engagement is a key component of the Class EA process. The MECP delegated the procedural aspects of the duty to consult to the Region of Peel and the City of Brampton in its response to the Notice of Commencement on December 23, 2015. Copies of all Indigenous engagement documents can be found in Appendix B.

2.6.1 Identification of Indigenous Communities

In consultation with the MECP, the City of Brampton sought direction on the identification of Indigenous Nations that may have an interest in the study. A list of potentially interested Indigenous Nations was prepared based on knowledge of the area and past projects and provided to the MECP on March 14, 2016. It was confirmed over the phone on March 18, 2016, with MECP that engagement should proceed with the Mississaugas of the Credit First Nation (MCFN; formerly known as Mississaugas of the New Credit First Nation), Six Nations of the Grand River (SNGR), Haudenosaunee Development Institute (HDI), and Métis Nation of Ontario (MNO).

Following understood consultation protocols with these Indigenous Nations, WSP shared community-specific letters, a plain language project summary and Notice of Commencement with MCFN, SNGR, HDI, and MNO on March 23, 2016. WSP followed up by phone with each community to determine each community's interest. This included:

- MCFN: March 29, 2016, phone call and arrangement for a meeting for April 20, 2016.
- SNGR: March 29, 2016, phone call and message left; April 1, 2016, phone call and message left with follow-up email; May 26, 2016, phone call where the community identified an interest in being kept informed.
- HDI: March 29, 2016, phone call and message left; March 30, 2016, phone call and arrangement for a meeting on April 18, 2016.
- MNO: March 29, 2016, phone call and message left; April 1, 2016, phone call and message left with follow-up email.

A discussion was held with the MECP's Aboriginal Advisor on March 29, 2016, to discuss additional Indigenous Nations that the City identified. MECP identified that the list appears to be a historic list from the Federal government, which does not consider the specific location or technical aspects of the Project. The list was shared by email with the MECP on March 29, 2016. The MECP responded on April 4, 2016, and identified that the additional Indigenous Nations that should be engaged included: Alderville First Nation (AFN), Curve Lake First Nation (CLFN), Hiawatha First Nation (HFN), Mississaugas of Scugog Island First Nation (MSIFN), and Métis Nation of Ontario (including Credit River Métis Council).

Following understood consultation protocols with these Indigenous Nations, WSP shared community-specific letters, a plain language project summary and Notice of Commencement with AFN, CLFN, HFN,

and MSIFN on April 22, 2016. Following MNO consultation protocols, engagement with Credit River Métis Council was conducted through MNO in the March distribution.

WSP followed up by phone with each community to determine each community's interest. This included:

- AFN: May 26, 2016, phone call during which the community identified that the Project is not within the community's area (traditional territory) and that they do not need to be consulted.
- CLFN: May 4, 2016, phone call during which the community identified that they do not believe they have any specific concerns, but expect to be notified of any archaeological findings, receive copies of archaeological reports, and be notified if changes to the Project occur or if environmental impacts are identified.
- HFN: April 26, 2016, response letter received acknowledging that the study area falls within HFN's Traditional and Treaty Territories; that the Project is deemed to have little, if any impact on their territories; and requested to be contacted in the event of any Project updates, archeological findings, and/or environmental impacts that may occur.
- MSIFN: May 4, 2016, phone call during which the community identified that the Project falls within their Traditional and Treaty Territories; however, they will defer to MCFN regarding archaeology and expressed interest in the potential impacts to the environment, and as such would like to be kept informed.

2.6.1.1 Mississaugas of the Credit First Nation

WSP contacted MCFN on March 23, 2016, by email to share a letter, Project Summary and the Notice of Commencement. WSP followed up with MCFN by phone on March 29, 2016, during which a meeting date of April 20, 2016, was proposed to further discuss the potential implications of the Project. This meeting was later postponed until April 28, 2016.

During the April 28, 2016 meeting, the City and WSP shared details about the Project. MCFN requested that two (2) of their Field Liaison Representatives to be on location whenever fieldwork is taking place within its traditional territory.

MCFN shared a copy of their draft agreement for inclusion of Field Liaison Representatives with the City on April 29, 2016. The City reviewed the agreement and an agreement for inclusion of Field Liaison Representatives was reached on September 12, 2016.

On January 24, 2017, MCFN contacted the City to request a meeting. WSP followed up with MCFN by phone on January 26, 2017. On February 2, 2017, WSP shared information about the current status of the Project, including a link to the PIC No. 1 boards as well as the meeting notes from the April 2016 meeting.

WSP contacted MCFN on December 16, 2021 and followed-up on January 27, 2022 to provide an update on the Study, a summary of consultation completed to date and the archaeology reports completed to date.

WSP contacted MCFN on May 25, 2022 to provide the draft ESR for review. No comments were received on the draft ESR. Further consultation will occur with MCFN during detailed design.

2.6.1.2 Six Nations of the Grand River

WSP contacted SNGR on March 23, 2016, by email to share a letter, Project Summary and the Notice of Commencement. WSP followed up with SNGR by phone on March 29 and April 1, 2016, and by email on April 1, 2016.

WSP reached out again on May 26, 2016, and discussed the Project. As a follow-up to that discussion, WSP sent an email to confirm the discussion that SNGR wished to be kept informed, requested copies of Stage 1 Archaeological Assessment and asked for advanced notice of any further archaeological work (Stage 2 and higher).

WSP contacted SNGR on December 16, 2021, and followed-up on January 27, 2022 to provide an update on the Study, a summary of consultation completed to date and the archaeology reports completed to date. SNGR responded on January 28, 2022, noting no issues with the archaeology studies, however identified interest in the overall project.

WSP contacted SNGR on May 25, 2022 to provide the draft ESR for review. No comments were received on the draft ESR. Further consultation will occur with SNGR during detailed design.

2.6.1.3 Haudenosaunee Development Institute

WSP contacted HDI on March 23, 2016, by email to share a letter, Project Summary and the Notice of Commencement. Meetings with HDI were held on April 18, 2016, with the City of Brampton and April 26, 2016, with Peel Region. On April 19, 2016, HDI sent WSP an application for Consideration and Engagement for Development. After this was signed, WSP sent HDI the Environmental and Archaeological Monitors Agreement on September 12, 2016. In January, HDI proposed some additional conditions to the document which the City of Brampton agreed to. A new agreement was drafted and signed by HDI on May 11, 2017.

WSP contacted HDI on December 16, 2021, to provide an update on the Study, a summary of consultation completed to date and the archaeology reports completed to date. HDI responded on January 7, 2022, accepting the invitation for a site visit, providing the monitoring agreement for the next phase and identifying interest in minimal weekly inspection visits to observe Erosion and Sediment Control (ESC) measures, vegetation removal, work near watercourses, and any wildlife sweeps that may occur. The Project Team and HDI agreed to have a meeting to discuss HDI's interests. This meeting occurred on February 3, 2022, and minutes were provided on February 16, 2022. It was agreed upon during the meeting to conduct the site visit during detailed design and construction, and document HDI's interests as commitments in the ESR. HDI also requested funding for the review of the ESR and HDI forwarded the application to review to the Project Team on February 8, 2022. The City identified that a new agreement will not be signed at this time and instead requested HDI to provide a list of reports that they are interested in reviewing and associated fees. On February 24, 2022, HDI requested a copy of the original agreement to review and understand if it is applicable to Municipal Class EAs.

WSP contacted HDI on May 25, 2022 to provide the draft ESR for review. No comments were received on the draft ESR. Further consultation will occur with HDI during detailed design.

2.6.1.4 Curve Lake First Nation

WSP contacted CLFN on April 22, 2016, by email to share a letter, Project Summary and the Notice of Commencement. WSP reached out by phone on May 4, 2016 and was informed that CLFN had not received the email. Information was shared over the phone and CLFN identified that they do not believe they have any specific concerns. CLFN noted a letter would be forthcoming but that their expectations are to be notified of any archaeological findings as well as sharing of archaeological reports. They also requested to be notified if changes to the project occur or if environmental impacts are identified. On May 25, 2022, WSP contacted CLFN to share the draft ESR. On June 9, 2022, CLFN noted that the project is located outside of the Williams Treaty First Nations territory, and as such falls outside the scope of the consultation requirements. CLFN recommended consulting the appropriate rights holders in the project area.

2.6.1.5 Hiawatha First Nation

WSP contacted HFN on April 22, 2016, by email to share a letter, Project Summary and the Notice of Commencement. A response was received on April 26, 2016, acknowledging that the study area falls within HFN's Traditional and Treaty Territories. They also recognized that the proposed project is deemed to have little, if any impact on their territories. HFN requested to be contacted in the event of any project updates, archeological findings, and/or environmental impacts that may occur. If archeological artifacts are found during the process, HFN requires a trained archeological liaison to be present at the site and a report forwarded to them once completed. In addition, any maps pertaining to the project should be forwarded to HFN in a shape file.

WSP contacted HFN on May 25, 2022 to provide the draft ESR for review. No comments were received on the draft ESR. Further consultation will occur with HFN during detailed design.

2.6.1.6 Mississaugas of Scugog Island First Nation

WSP contacted MSIFN on April 22, 2016, by email to share a letter, Project Summary and the Notice of Commencement. On May 4, 2016, WSP reached out by phone and left a message for MSIFN. A response was received on May 17, 2016, acknowledging that the study area falls within MSIFN's Traditional and Treaty Territories; however, they will defer to MCFN regarding archaeology and expressed interest in the potential impacts to the environment. MSIFN would like to be kept updated regarding potential environmental impacts to the area. WSP followed up with MSIFN on May 26, 2016, by email to acknowledge receipt of the MSIFN interests.

WSP contacted MSIFN on May 25, 2022 to provide the draft ESR for review. No comments were received on the draft ESR. Further consultation will occur with MSIFN during detailed design.

3.0 Existing and Future Conditions

3.1 Study Area

The study area for this Class EA is the Highway 427 Industrial Secondary Plan Area located within the City of Brampton, in the Regional Municipality of Peel. Immediately north of Mayfield Road is the Town of Caledon. The City of Vaughan and Regional Municipality of York are located on the east side of Regional Road 50. The Class EA area of focus includes the Arterial A2 corridor between Mayfield Road and Regional Road 50 and extends along Coleraine Drive from Mayfield Road to Arterial A2 (ref. Figure 1-1: Study Area / Key Plan).

3.2 Socio-Economic Environment

The following sections provide a summary of the existing and planned land use within the study area.

3.2.1 Population and Employment

While Secondary Plan Area 47 currently hosts less than 100 households and 300 jobs, development plans for the area will significantly change this condition over the next 25 years. Population and employment forecasts for Area 47, as well as Brampton as a whole, are summarized in Table 3-1 below.

Table 3-1: Area 47 and the City of Brampton Population and Employment Forecasts to 2041

Horizon Year	Population Forecasts		Employment Forecasts	
	Area 47	Brampton	Area 47	Brampton
2021	360	698,200	90	210,500
2031	31,030	863,720	7,640	276,430
2041	31,120	930,730	8,130	314,910

Source: City of Brampton Planning (2021)

The City's Area 47 TMP (2014) identifies 2,010 residents and 400 jobs within Area 47, and that the population of this area will reach full build out in approximately 2031 with 31,030 persons and 7,640 jobs.

3.2.2 Existing Land Use

Within the study area, the land use is primarily agricultural and rural residential with some industrial and commercial land use concentrated at the intersection of Coleraine Drive, Regional Road 50 and Major Mackenzie Drive. South and west of the study area, land use is predominately residential with many open space areas associated with Rainbow Creek, the Clarkway and Gore Road tributaries, and the West Humber River. Land use north and east of the study area is predominately agricultural and rural residential. Light industrial / commercial land use fronts Mayfield Road between Coleraine Drive and Regional Road 50 and the Canadian National Railway rail yard is located immediately east of Regional Road 50 between Major Mackenzie Drive and Castlemore Road.

Within the study area, the existing land use contiguous to the proposed Arterial A2 and Coleraine Drive is primarily rural on the west and east sides of both roads. Industrial and commercial land use is concentrated at the intersection of Coleraine Drive, Regional Road 50 and Major Mackenzie Drive.

3.2.3 Existing Land Use Designation

The City of Brampton's 2006 Official Plan September 2015 Office Consolidation (Schedule A) designates general land use within the study area. The study area is identified as a Special Study Area and Corridor Protection Area, with lands designated as industrial and residential east and west of Clarkway Drive, respectively, and open space along the tributaries traversing the study area. The City's 2015 Official Plan identifies a significant increase in population and employment over the next 15 years (planning horizon of 2031).

Schedules B and B1 of the City's 2015 Official Plan, as well as Schedule E of the Region's 2021 Official Plan classifies Arterial A2 and Coleraine Drive as a major arterial road. As per Schedule F of the Region's 2021 Official Plan, Coleraine Drive is identified to have a 36 m mid-block right-of-way (ROW) and Arterial A2 is identified to have a 45 m ROW.

3.2.4 Future Land Use

Future land use within Area 47 was proposed by the City of Brampton through an Official Plan Amendment (OPA) for Area 47. Land use within the study area was proposed based on planning studies undertaken for the Highway 427 Industrial Secondary Planning Area (Area 47) (e.g., Retail and Institutional Land Use Study 2012 and Employment Maximization Study 2012). The network of arterial and collector roads identified builds upon the City's Transportation and Transit Master Plan, the joint municipal Peel-Highway 427 Extension Area Transportation Master Plan Study and analysis undertaken as part of the Area 47 Transportation Master Plan and is generally consistent with the Growth Plan Conformity Amendment (OPA 43).

The proposed land use of the amendment for the Highway 427 Industrial Secondary Plan Area refines the Official Plan and contains the level of detail that is generally representative of a secondary plan land use schedule. The land use designations proposed within the OPA include:

- Residential (low, medium, executive);
- Employment;
- Commercial;
- Institutional;
- Natural Heritage System; and
- Recreational Open Space and Other.

The land use identifies the proposed Arterial A2 within employment designated lands. Prestige industrial and business park are the primary employment land uses proposed west and east of Arterial A2. A proposed office node is shown northwest of the intersection of Arterial A2 and Regional Road 50. Proposed land use adjacent to Coleraine Drive is also identified as employment, with business park proposed west of the roadway, prestige industrial proposed east of the roadway north of Countryside Drive, and logistic warehouse / transportation proposed east of the roadway south of Countryside Drive. A proposed valley land natural heritage system land use is located between Arterial A2 and Coleraine Drive along Rainbow Creek. The northeastern corner of the Area 47 falls within the MTO's corridor protection area for the proposed GTA West Corridor. Land use in the corridor protection zone may be revised once further project details are available from the MTO.

3.2.4.1 Proposed Development Plans

Several developments are proposed within the study area and are currently under review by the City of Brampton Planning and Development department. All of these developments fall under Block Plan 47-1, 47-2 and 47-3.

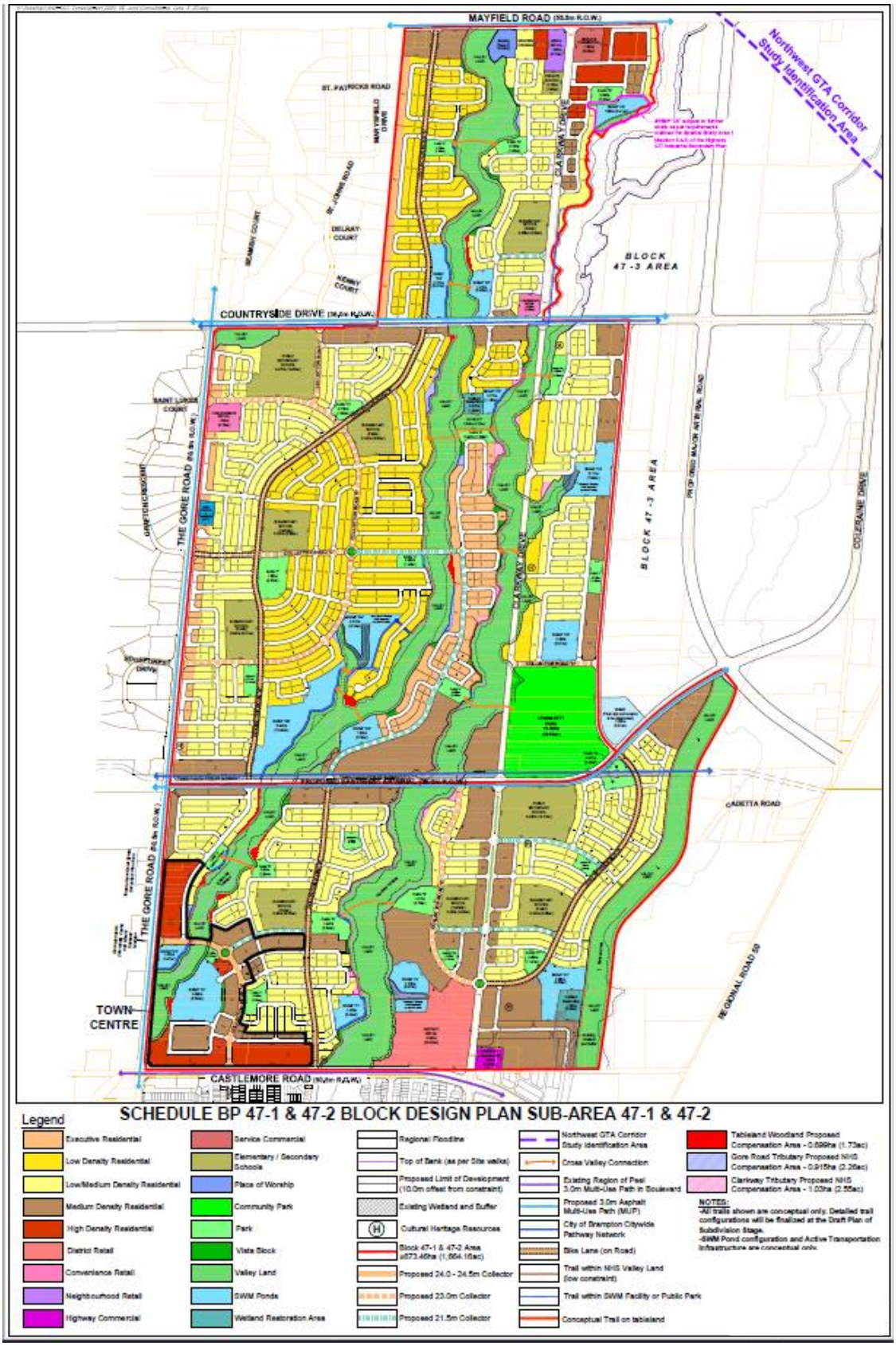


Figure 3-1: 47-1 and 47-2 Block Design Plan

3.3 Land Use Planning Initiatives

The following provincial planning documents were reviewed to determine their applicability to the study area:

- Provincial Policy Statement (2020);
- The Growth Plan for the Greater Golden Horseshoe (2020); and
- Region of Peel (2021) and City of Brampton Official Plans (2015).

These policies were reviewed to ensure the study is in line with the policies contained within them.

3.3.1 Provincial Policy Statement (2020)

The Provincial Policy Statement (PPS) provides for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. The PPS supports improved land use planning and management, which contributes to a more effective and efficient land use planning system. Relevant policies from the PPS that support potential improvements to Area 47 is identified in Table 3-2.

Table 3-2: Policies from the Provincial Policy Statement Relevant to the Study

Section	Policies Relevant to the Study
Section 1.1	
Subsection 1.1.1	"Healthy, livable and safe communities are sustained by: f. Improving accessibility for persons with disabilities and older persons by addressing land use barriers which restrict their full participation in society. g. Ensuring that necessary infrastructure public service facilities are or will be available to meet current and projected needs. h. Promoting development and land use patterns that conserve biodiversity and i. Preparing for the regional and local impacts of a changing climate."
Section 1.6 - Infrastructure and Public Service Facilities	
Subsection 1.6.1	"Infrastructure and public service facilities shall be provided in an efficient manner that prepares for the impacts of a changing climate while accommodating projected needs."
Subsection 1.6.1	"Planning for infrastructure and public service facilities shall be coordinated and integrated with land use planning so that they are: a. Financially viable over their life cycle, which may be demonstrated through asset management planning; and, b. Available to meet current and projected needs."
Subsection 1.6.2	"Planning authorities should promote green infrastructure to complement infrastructure."
Subsection 1.6.3	"Before consideration is given to developing new infrastructure and public service facilities: a. The use of existing infrastructure and public service facilities should be optimized; and, b. Opportunities for adaptive re-use should be considered, wherever feasible."
Subsection 1.6.4	"Infrastructure and public service facilities should be strategically located to support the effective and efficient delivery of emergency management services, and to ensure the protection of public health and safety in accordance with the policies in Section 3.0: Protecting Public Health and Safety."
Subsection 1.6.5	"Public service facilities should be co-located in community hubs, where appropriate, to promote cost-effectiveness and facilitate service integration, access to transit and active transportation."
Section 1.6.7 - Transportation Systems	
Subsection 1.6.7.1	"Transportation systems should be provided which are safe, energy efficient, facilitate the movement of people and goods, and are appropriate to address projected needs."

Section	Policies Relevant to the Study
Subsection 1.6.7.2	"Efficient use shall be made of existing and planned infrastructure, including through the use of transportation demand management strategies, where feasible."
Subsection 1.6.7.3	"As part of a multimodal transportation system, connectivity within and among transportation systems and modes should be maintained and, where possible, improved including connections which cross jurisdictional boundaries."
Subsection 1.6.7.4	"A land use pattern, density and mix of uses should be promoted that minimize the length and number of vehicle trips and support current and future use of transit and active transportation."
Section 1.6.8 Transportation and Infrastructure Corridors	
Subsection 1.6.8.1	"Planning authorities shall plan for and protect corridors and rights-of-way for infrastructure, including transportation, transit and electricity generation facilities and transmission systems to meet current and projected needs."
Subsection 1.6.8.2	"Major goods movement facilities and corridors shall be protected for the long term."
Subsection 1.6.8.3	"Planning authorities shall not permit development in planned corridors that could preclude or negatively affect the use of the corridor for the purpose(s) for which it was identified." "New development proposed on adjacent lands to existing or planned corridors and transportation facilities should be compatible with, and supportive of, the long-term purposes of the corridor and should be designed to avoid, mitigate or minimize negative impacts on and from the corridor and transportation facilities."

The proposed improvements discussed in this report are consistent with policies included in the PPS.

3.3.2 A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2020)

The A Place to Grow: Growth Plan for the Greater Golden Horseshoe was prepared and approved under the *Places to Grow Act, 2005* and replaces the Growth Plan for the Greater Golden Horseshoe, 2017. The Plan provides a framework for implementing Ontario's vision for building stronger, prosperous communities by managing growth in the region and provides a long-term framework for where and how the region will grow. The Growth Plan envisions an integrated transportation network which will allow people to easily travel within and between urban centres throughout the region. Automobiles are anticipated to be one of a variety of effective choices for transportation, along with transit and active transportation, in order to create an efficient urban transportation system.

3.3.3 Region of Peel Official Plan (Office Consolidation 2021)

The Regional Official Plan provides direction to the Region of Peel in terms of land use policies, sustainable development framework and long-term regional strategic policy framework for growth. The goals of the plan are the following:

- "To create healthy and sustainable regional communities for those living and working in Peel which is characterized by physical, mental, economic and social well-being; minimized crime, hunger and homelessness; a recognition and preservation of the region's natural and cultural heritage; and an emphasis on the importance of Peel's future as a caring community";
- "To recognize, respect, preserve, restore and enhance the importance of ecosystem features, functions and linkages, and enhance the environmental well-being of air, water, land resources and living organisms";
- "To recognize the importance of a vital, competitive and diverse economy and a sound tax base, and manage and stage growth and development in accordance with the financial goals and overall fiscal sustainability of the Region"; and

- "To support growth and development which takes place in a sustainable manner, and which integrates the environmental, social, economic and cultural responsibilities of the Region and the Province".

The study is consistent with the Region of Peel Official Plan, as the road improvements will not be occurring in a key natural heritage feature area or hydrologically sensitive area. The improvements will also protect any existing natural features and will not negatively impact the environment. The road improvements are undertaken in order to support future growth and development within the Region of Peel, which will ultimately contribute to a competitive and diverse economy.

3.3.4 2006 City of Brampton Official Plan (Office Consolidation 2015)

The City of Brampton Official Plan provides direction for land use, development and infrastructure decisions for issues such as land use, built form, transportation and the environment.

The Official Plan sets out the following objectives for the transportation system:

- "a) To develop a balanced, integrated and accessible multi-modal transportation system which provides for the safe, economic and efficient movement of people, including persons with disabilities, as well as goods and services";
- "b) To ensure the provision of adequate and accessible road, transit, pedestrian and bicycle links within Brampton and between Brampton and adjacent municipalities";
- "c) To promote the development of an efficient transportation system and land use patterns that foster strong live-work relationships and encourage greater use of public transit";
- "d) To promote a high standard of environmental management and aesthetic quality in the routing, design and construction of transportation and associated structures, including green infrastructure and stormwater management practices in the right-of-way of new and retrofitted existing roads"; and,
- "e) To work cooperatively with the Region of Peel, neighbouring municipalities and other regional municipalities, the Province and its agencies (e.g. Metrolinx) to develop an integrated transportation plan".

Relevant policies:

- 4.5.1.7: "The City shall undertake new road construction and road improvements and widening with regard to environmental health, including conserving natural heritage features and linkages, and avoiding, minimizing and mitigating impacts to natural areas and functions."
- 4.5.1.8: "The City shall undertake new road construction and road improvements and widening with regard to human health by incorporating opportunities for active transportation including cycling and walking."

The study is consistent with the City of Brampton Official Plan as the road improvements align with the objectives and the relevant policies. The study takes into account natural heritage features, with consideration to avoid or mitigate impact on natural areas and provide appropriate stormwater management features. The study also provides opportunities for active transportation, through the inclusion of a MUP. Overall, the road improvements proposed will aid in creating an efficient transportation system within the City of Brampton.

3.4 Transportation and Traffic

The following sections outline the existing transportation network within the study area. Further details can be found in Appendix D.

3.4.1 Existing Roadway Network

Roads within Area 47 currently consist of a network of Region of Peel urban arterials (at the boundaries) and City of Brampton rural collectors (within the study area).

Regional roads include Regional Road 14 - Mayfield Road (north boundary), Regional Road 50 (east boundary), and Regional Road 8 – The Gore Road (west boundary). Regional Road 73 – Castlemore Road (south boundary) is currently under the jurisdiction of the City of Brampton. All of these roadways have been the subject of recent Schedule 'C' Class EAs related to road widening. Study recommendations and anticipated construction dates for the Region of Peel roadways are summarized in Table 3-3.

Table 3-3: Anticipated Regional Road Widenings

Roadway	Proposed / Ongoing Works	Anticipated Implementation Date
Regional Road 14 – Mayfield Road	Widen to four (4) lanes between Coleraine Drive and Regional Road 50	By 2031
	Widen to four (4) lanes in the interim and to six (6) lanes ultimately between Airport Road and Coleraine Drive	By 2031
Regional Road 50	Widen to six (6) lanes between Castlemore Road and Mayfield Road	By 2031
Castlemore Road	Widen to six (6) lanes	Widening pending update to TMP
Regional Road 8 – The Gore Road	Widen to four (4) lanes from north of Castlemore Road to south of Mayfield Road	Complete

The remaining roads within the study area that currently fall under the jurisdiction of the Region of Peel, and are subject to the current EA, are described in more detail below.

3.4.1.1 Coleraine Drive

Coleraine Drive is a two-lane roadway with a rural cross-section that runs from north of Mayfield Road to the Major Mackenzie Drive / Regional Road 50 intersection in the south. Existing lane widths range from 3.5-3.9 m with narrow gravel shoulders. It has been identified as a primary truck route as part of the Region's Strategic Goods Movement Network. The posted speed limit is 70 km/h.

Figure 3-2: Coleraine Drive North of Countryside Drive

Identified issues include: a poorly aligned intersection at Regional Road 50 / Major Mackenzie Drive, lack of

Accessibility for Ontarians with Disabilities Act compliant pedestrian facilities, some non-recoverable side-slopes, as well as seasonal flooding due to proximity to Rainbow Creek (York Region and Peel Region, 2002).

3.4.2 Existing Active Transportation and Public Transit

There are currently no active transportation facilities or transit routes operating on the roadways covered under this study. Some parts of the study area include a gravel shoulder.

The following transit routes operate along the perimeter of the study area:

- Route 36 (Queen Street East, Gardenbrooke Trail, Squire Ellis Drive) runs along The Gore Road;
- Route 35 (Queen Street East, Castlemore Road, Brampton Civic Hospital) runs along Castlemore Road and a small part of The Gore Road; and
- Route 50 (Humber College, The Gore Road, Gore Meadows Community Centre) runs along Castlemore Road and a small part of The Gore Road.

Provision of transportation facilities that support all users through increased modal share and active transportation were identified as key components of both Brampton's TMP Update (2015) and the Highway 427 Industrial Secondary Plan TMP.

Off road MUP facilities are recommended for Coleraine Drive and Arterial A2 (HDR, 2014). In accordance with regional and city standards, sidewalks are to be constructed where MUPs are not also offered. Cycling and pedestrian facilities are to provide both active transportation and connectivity to the TMP recommended transit facilities. Cycling facility types and routing as proposed in the Highway 427 Industrial Secondary Plan TMP are illustrated in Figure 3-3.

The actual transit service design for the community, including service levels to be provided, will be further refined through Brampton Transit's long range strategic planning process, and the Annual Transit Service Plan process. The timing of implementation of services in the development will be dependent on the pace of development and the completion of the necessary infrastructure required to support regular transit operations.

All arterial roadways covered under the current study are to support Secondary Corridor transit services. It is anticipated that Community GO Shuttle service will also operate on the East-West Arterial, Arterial A2 south of East-West Arterial, and Clarkway Drive north of Countryside Drive. Transit facility types and routing as proposed in the Area 47 TMP are illustrated in Figure 3-4. It should be noted that the headways identified in the exhibit may change in future.

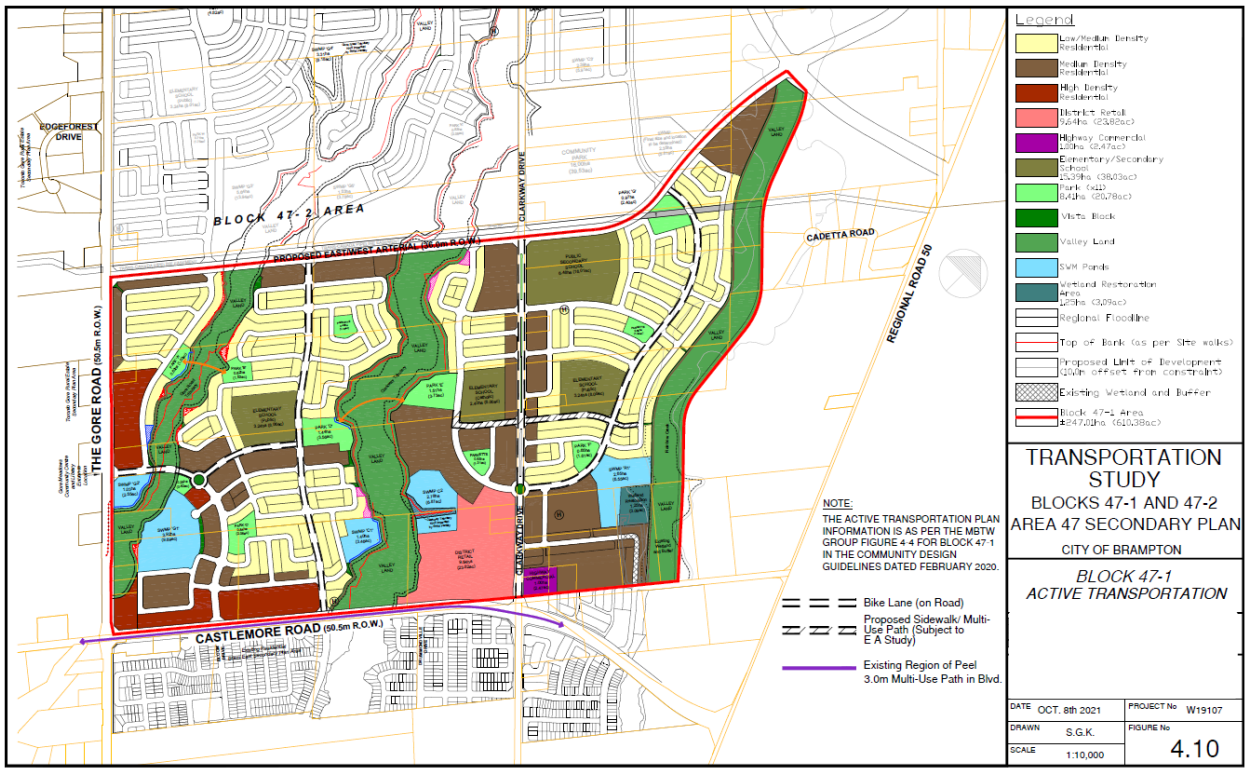


Figure 3-3: Area 47 TMP - Proposed Cycling Facilities with Secondary Plan Area 47

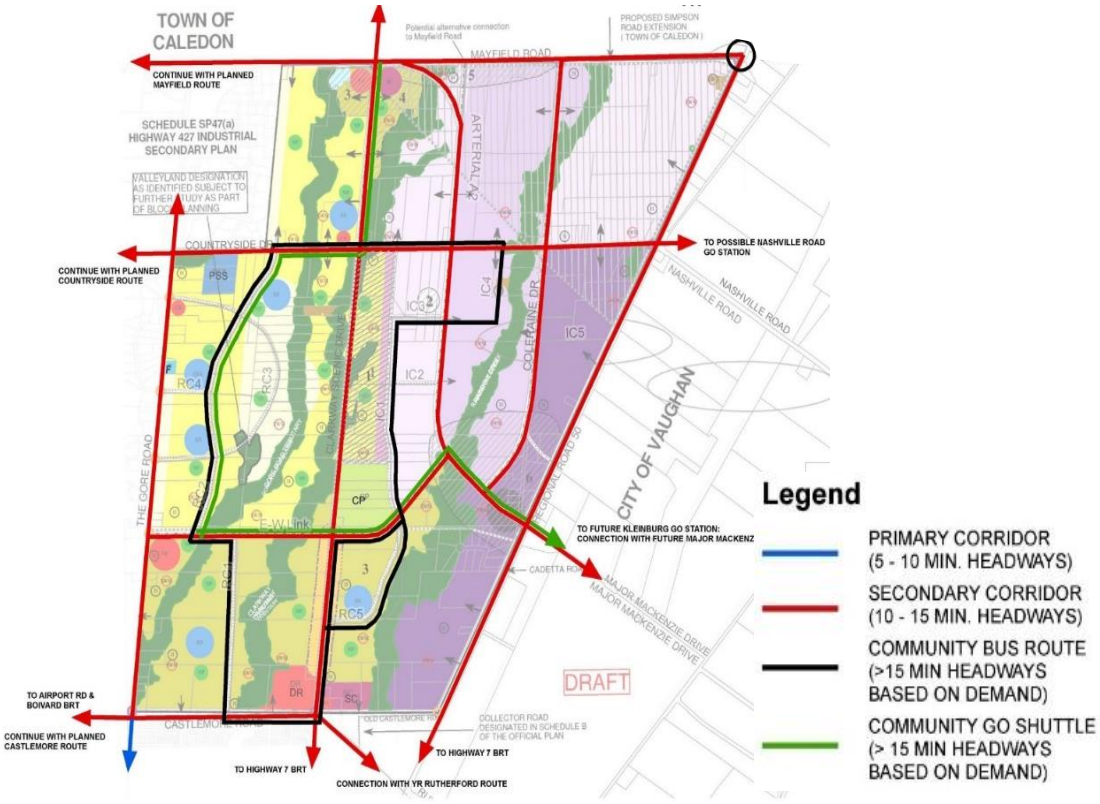


Figure 3-4: Area 47 TMP - Proposed Transit Facilities within Secondary Plan Area 47

3.4.3 Existing Traffic Conditions

All existing intersections with Regional Roads (study area boundaries) are signalized; all other intersections within the study area are currently stop controlled. Existing intersection configurations are summarized in Table 3-4.

Table 3-4: Existing Intersection Configurations

Intersection North-South at East-West	Control Type		Lane Configuration by Approach							
	Signal	Stop Sign	East		West		North		South	
			Thru	Aux	Thru	Aux	Thru	Aux	Thru	Aux
Coleraine Drive at Countryside Drive		Yes 4-Way	1		1		1		1	
Coleraine Drive at Mayfield Road	Yes		2	Left	2	Left	2	Left	2	Left
Regional Road 50 at Coleraine Drive / Major Mackenzie Drive	Yes		1		1		2	Left	2	Left

3.4.4 Future Traffic Conditions

When developed, Special Policy Area 2 will include two (2) new arterial roadways: a six (6) lane north-south extension of Major Mackenzie Drive known as Arterial A2, and a four (4) lane east-west arterial linking Arterial A2 to The Gore Road. As identified within both the *Region of Peel Highway 427 Extension Area Transportation Master Plan* (2009) and the *Highway 427 Industrial Secondary Plan Area 47 Transportation Master Plan* (2014), Arterial A2 is to act as an east-west arterial linking Major Mackenzie Drive to Mayfield Road until such time as Highway 427 is extended further to the north and Arterial A2 is extended into Bolton. Coleraine Drive will also be realigned to tie into Arterial A2, correcting the issues with its alignment at the existing intersection with Regional Road 50.

It should be noted that the SP47 TMP study states that intersection operations documented in the TMP study report were preliminary in nature. As such, the traffic study completed as part of the TMP was not sufficient to recommend intersection configurations. For the same and other reasons, the TMP study recommended a special policy area around the intersection of Coleraine Drive and Arterial A2 restricting developments until road alignments are finalized through the current EA process.

Traffic analysis completed by the City of Brampton (updated City-wide EMME model) and CIMA+ (as part of the current EA study) indicate significant issues with queuing of vehicles extending from the intersection of Arterial A2 at Regional Road 50 back through the SP47 TMP-proposed intersection with Coleraine Drive. For this reason, alignment and intersection configurations that increase the spacing between the intersection of Arterial A2 and each of Regional Road 50 and Coleraine Drive have been contemplated as part of the current study.

To address the issues identified at the intersection of Arterial Road A2 and Regional Road 50, and increase spacing, a SPUI has been proposed as the preferred ultimate configuration. Through a VISSIM Microsimulation modelling exercise conducted by the City of Brampton in 2018, analysis results indicated that of the three (3) short-listed alternatives, a SPUI would best address the identified issues at the intersection of Arterial Road A2 and Regional Road 50. The microsimulation analysis showed no queuing or weaving problems adjacent to this intersection, improving the overall intersection delay by 2041. This intersection will continue to be monitored through future studies, to determine when the preferred ultimate configuration will be warranted.

3.5 Natural Environment

A Natural Environment Assessment was undertaken for Part A roadways to consider impacts to the aquatic and terrestrial resources. Further details can be found in Appendix E.

A MESP was originally issued in 2016, followed by an addendum in 2019 focusing on the Rainbow Creek realignment and restoration. The MESP is one of several studies undertaken to support the secondary planning process for Area 47. The purpose of the MESP was to investigate and inventory the natural resources which could potentially be impacted by future urban development and to identify constraints and opportunities. The findings were used to develop a comprehensive Management Plan, consisting of appropriate stormwater management and natural heritage strategies to protect the natural environment.

3.5.1 Terrestrial Resources

3.5.1.1 Ecological Land Classification

The majority of the land use within the study area includes residential areas, agricultural fields, and cultural meadows. Many of the vegetation communities are created by human disturbance and are classified as cultural. The most significant vegetation communities are the fragments of woodland / forest. These fragments of forest, plantation and cultural woodland often buffer the watercourses throughout the terrestrial study areas and are a relatively significant feature in the study area landscape, given that the area is characterized by a high degree of agriculture and development.

In total, 47,286 plant species were compiled from secondary sources, of which 137 (48%) are not native to Ontario. WSP investigations documented 84 plant species within the study area, of which 44 (52%) are not native to Ontario. Despite the somewhat even split in overall percentage, non-native species far outweigh native species in terms of coverage and biomass.

Anthropogenic lands comprise a small percent of the overall study area. In the Part 'A' Study Corridor Commercial and Institutional lands comprise 7.6% and roads 3.9%. These areas are strictly anthropogenic in nature and provide minor or negative function in habitat for native species or landscape linkages between natural habitats. Residential properties comprise 10.90% of the study area. Agricultural lands comprise 68.1% of the study area.

Dry – Moist Old Field Meadows result from, or are maintained by, cultural or anthropogenic based disturbances. This community type is characterized by ≤25% tree and shrub cover. Across the study area Cultural Meadows comprised of 3.52% of the land cover (5.92 ha) in the study area. White Pine Coniferous Plantation (0.13 ha) make up only around 0.08% of the study area. Despite the anthropogenic origin and monoculture nature of this community type, they can provide habitat for edge species and Brown-Headed Cowbirds. Depending on the size and shape of the stand, these woodlots can also support forest interior species. Mineral Cultural Savannah Ecosite (0.93 ha) are characterized by 25% to 35% tree cover. The Mineral Cultural Savannah community was a mix of European Buckthorn, Hawthorn species, Manitoba Maple, Green Ash, Willow species, Black Walnut, Spruce and Pine species. The ground cover was composed of grasses and Tall Goldenrod.

Cultural Woodlands are characterized by 35% to 65% tree cover. This community was dominated by European Buckthorn, Willow species, Green Ash and Manitoba Maple. Two (2) polygons were identified as Forb Mineral Meadow Marsh Ecosites (0.49 ha). One polygon was mapped along Rainbow Creek Tributary where it crosses Countryside Drive and the other polygon is situated along Rainbow Creek Tributary within an agricultural field. This community is dominated by grasses and sedges, Broad-leaved Cattail, Reed Canary Grass, Tall Goldenrod, Black Bulrush and Common Water Plantain. Two (2) polygons were identified as Reed Canary Grass Graminoid Mineral Meadow Marsh Type (1.00 ha). Several small polygons (0.49 ha) were identified as Mixed Forb Mineral Meadow Marsh Type, all of which are associated with watercourses within the study area. One (1) small community of Graminoid Bedrock Shallow Marsh (0.02 ha) was identified surrounding a pond east of Coleraine Drive in the MESP. This community was removed due to construction sometime after 2015.

Three (3) polygons were identified as Cattail Mineral Shallow Marsh Type (0.35 ha) within the study area. One (1) polygon was identified as a Willow Mineral Deciduous Thicket Swamp (0.07 ha) within the study

area. One (1) narrow band of Willow Mineral Deciduous Swamp Type (0.05 ha) was identified within the study area around a pond located within a pasture / horse track on a farm property.

Three (3) areas of open water (0.18 ha) were identified within the study area. The first is a reach of the Clarkway Tributary just north of Mayfield Road. Another is a pond within a pasture / horse track behind a barn, and the last is an area that could not be confirmed as it is surrounded by active construction and may no longer be present. Other areas of Open Water may be present on residential properties but were often small and could not always be confirmed due to access limitations.

3.5.1.2 Tree Inventory

The Tree Inventory documented a total of 353 trees greater than 10 cm Diameter at Breast Height in the study area. Many of the trees were in fair to good condition. No tree SAR were identified during the field visits. Species composition ranged from native to non-native species or cultivar species. There is a total of 282 trees, most of which are currently on private property that will need to be removed to accommodate construction. Trees listed as injured are trees outside the project footprint, but the construction footprint is still within the minimum Tree Protection Zone for the individual tree. A total of 26 trees, mostly private, may be injured by construction activities. Tree protection measures have been identified for 71 trees, those identified for preservation (45) and those identified for injury (26).

3.5.1.3 Breeding Bird Surveys

A total of 116 bird species were documented in the secondary source review as having records within the study areas. During the breeding bird point count survey, a total of 36 of the 116 secondary source species were identified within the study area and one (1) additional bird was recorded; Broad-winged Hawk. Almost all bird species recorded within the applicable Ontario Breeding Bird Atlas 10 km grid squares are provincially (sub-national) ranked S5 (very common, demonstrably secure), or S4 (common, apparently secure). One (1) species, Acadian Flycatcher, is ranked S2S3B.

Barn Swallow is listed as Threatened under the Endangered Species Act (ESA) and therefore is afforded individual and habitat protection. There were 29 individual Barn Swallows recorded at 13 breeding bird survey locations. Three (3) bird nests were observed under the bridge structure at crossing GT4 of The Gore Road Tributary, which can likely be attributed to Cliff Swallow (S4B) and not Barn Swallow.

3.5.1.4 Mammals, Amphibians, Reptiles and Invertebrates

In total, 42 species of mammals were found to have habitat ranges overlapping the study area. Most mammal ranges recorded within the applicable atlas' are for species that are provincially ranked S5 (very common, demonstrably secure), S4 (common to very common, apparently secure), or SNA (not applicable for conservation activities). Four (4) mammal species are listed as provincially vulnerable or species of conservation concern; all four (4) species are bats, Eastern Small-footed Myotis, Northern Myotis, Tri-colored Bat, Little Brown Myotis.

Eight (8) reptiles and 11 amphibian species have habitat ranges that overlap with the study area. The majority of reptile and amphibian species recorded within the applicable area are provincially ranked S5 , S4 , or SNA . Four (4) herptile species are listed as provincially vulnerable or species of conservation concern, Western Chorus Frog, Blanding's Turtle, Northern Map Turtle and Snapping Turtle.

Two (2) invertebrate species were documented in the MESP, Monarch butterfly and a chimney crayfish species. In addition to the chimney crayfish findings in the MESP, investigations found two (2) crayfish chimneys and a crayfish moulted exoskeleton during the August 2017 aquatic field investigations. Subsequent year records indicate that crayfish are currently utilizing the area.

3.5.2 Aquatic Resources

The proposed project includes 20 drainage feature crossings, one (1) drainage feature parallel to Clarkway Drive, and one (1) watercourse realignment. Many of the drainage features where crossings are located or proposed are ephemeral drainage swales providing indirect or no fish habitat.

Four (4) Clarkway Tributary crossings occur within the study area. Of these crossings, only one (1) is associated with the main branch of Clarkway Tributary and has direct fish habitat. Each of the other crossings are associated with independent drainage features originating in adjacent agricultural fields and converging with the main branch. The watercourse drains primarily though natural creek valleys but has been channelized and straightened at some locations, presumably to accommodate the surrounding agricultural and rural residential land use. No fisheries limitations were observed within the direct fish habitat of the main branch of Clarkway Tributary.

The Rainbow Creek Tributary is an agricultural swale for much of its length. Rainbow Creek Tributary is primarily defined as ephemeral within the study area and provides indirect fish habitat at crossings.

3.6 Vegetation and Aesthetic Assessment

The Highway 427 Industrial Secondary Plan Area is largely a productive agricultural area, planted predominantly in forage and grain crops. Remnants of windrows and residual patches of riparian forest frame expansive fields. Aging farm structures punctuate open fields from time to time, underscoring the overall rural character. Residential sites are adjacent to the few major arteries and follow a traditional site layout of windbreaks and sod yards surrounding structures, composed of a mix of evergreens and large deciduous trees. Along with wind rows and riparian zone remnants, these sites represent the bulk of discernable "forested" patches. The topography is considerably flat at the Southern portion of the site where views are expansive. As one moves North, the terrain becomes more rolling and articulated, at times limiting views and giving a slight sense of enclosure. Roadsides are mostly defined by immediately adjacent agricultural land where soils are worked annually. This continuous disturbance creates an edge of grasses and forbs containing several species of Asters, Goldenrods, and the occasional ragweed. Other areas show the establishment of various shrubs, likely dispersed by animals and wind. The three (3) main riparian corridors add significant character to the area. They create noticeable topographic and vegetative variation and provide habitat for the multitude of bird species animating the skyline throughout the day. Further details can be found in Appendix F.

3.7 Stage 1 Archeological Assessment

Two (2) separate Stage 1 Archaeological Assessments were completed for the entire study (Part A and Part B) due to the updates to the preferred alignment, as the study progressed. The first Stage 1 Archaeological Assessment was completed in 2017, receiving final Ministry of Tourism, Culture and Sport approval on June 12, 2018, and entered into the Ontario Public Register of Archaeological Reports. The second Stage 1 Archaeological Assessment was completed in 2020, receiving final Ministry of Tourism,

Culture and Sport approval on November 5, 2020, and entered into the Ontario Public Register of Archaeological Reports.

3.7.1 2018 Stage 1 Archaeological Assessment

The 2018 Stage 1 Archaeological Assessment addressed a total of 269.1 hectares, of which 227.2 hectares (84%) was deemed to have archaeological potential. The balance (41.83 hectares) was observed to have had archaeological potential removed by previous road work and the footprints of buildings (residential, industrial, and commercial).

3.7.2 2020 Stage 1 Archaeological Assessment

In 2020, another Stage 1 Archaeological Assessment was completed that indicated that the study area has general archaeological potential and warrants Stage 2 property assessment for the following reasons:

1. Natural water sources are located within 300 m of Areas 2 to 4 (Refer to Appendix G for figures), including a tributary of the Humber River;
2. Areas 1, 2 and 4 (Refer to Appendix G for figures) are located within historical roadways as shown in the 1859 and 1877 historical atlas mapping;
3. A schoolhouse is depicted within 100 m of Area 1 (Refer to Appendix G for figures) as depicted in the 1859 Tremaine map;
4. A homestead / orchard is depicted within 100 m of Areas 1, 2 and 3 (Refer to Appendix G for figures) as depicted in the 1877 historical atlas map; and
5. Eight (8) registered archaeological sites are located within a 1 km radius of the study area, two (2) of which are located within 250 m of Areas 1 and 4 (Refer to Appendix G for figures).

The Stage 1 archaeological assessment of the additional lands determined that 0.3 ha (18%) of the study area is disturbed. The remaining 1.4 ha (82%) of the study area retains archaeological potential and requires a Stage 2 archaeological assessment using either pedestrian or test pit survey at 5 m intervals. Further details can be found in Appendix G.

3.8 Built Heritage Resources and Cultural Heritage Landscapes

Through background research, information gathering and a field review, three (3) built heritage resources and 12 cultural heritage landscape resources were identified within, or adjacent to, the study area. Two (2) properties, 10955 Clarkway Drive and 10300 The Gore Road are designated under Part IV of the *Ontario Heritage Act*. Ten (10) properties are listed on the City of Brampton Municipal Register of Cultural Heritage Resources, and three (3) resources were identified during the original field review in 2016. Further details can be found in Appendix H.

3.9 Contamination Overview Study

A Contamination Overview Study was undertaken for both Part A and Part B roadways in order to identify and review properties / areas within the study area with actual or potential site contamination that may impact the development of the study area and to identify appropriate future environmental work and mitigation measures to be implemented during preliminary design, detail design, and construction phases of the Project. 36 properties were identified as having a "high" potential for soil and groundwater contamination. Ten (10) properties within the study area have been identified as having "medium"

potential for soil and groundwater contamination. In addition to the properties rated as high or medium, there were 13 spill records which represent 13 locations in the study area which have significant historical spills and are also considered as having "high" potential for contamination. Further details can be found in Appendix I.

3.10 Stormwater Management

The Part A study area is located within the Humber River Watershed and contributes drainage to the Main Humber subwatershed. There is one (1) tributary that drains through the study area, namely a tributary of the Rainbow Creek. Under existing conditions, approximately 9.35 ha of existing ROW (imperviousness = 22.03%) (e.g., Coleraine Drive and Countryside Drive) contributes stormwater runoff to Rainbow Creek. The existing ROWs consist of rural cross-sections with ditches. Overland drainage from external lands enters the existing ROWs at various points and is conveyed by the existing ditches to the watercourse receiver (e.g., Rainbow Creek).

All existing roads within the study area are proposed to be classified as Urban Arterial in the future and have been assessed on this basis. It is noted that the Ministry of Natural Resources and Forestry (MNRF) criteria are not relevant for the proposed conditions since the travelled way is required to be flood-free for the Regional Storm as directed by Region of Peel requirements. However, the existing conditions assessment has considered these criteria for information purposes. The criteria for safe passage have been applied assuming ingress / egress for pedestrians. The existing study area crossing (Coleraine Drive culvert) does not meet either the MTO or MNRF design criteria, nor the Region's design criteria to convey the Regional Storm event without overtopping the roadway. Therefore, the existing crossing must be resized for the proposed conditions, in addition to the new crossing for Arterial A2. Further details can be found in Appendix J.

3.11 Fluvial Geomorphology

The fluvial geomorphology investigation characterized the existing conditions of the area watercourses with respect to channel form, function, and stability to understand their interactions with road crossings. The proposed works will modify and/or create two (2) watercourse crossings of West Humber tributary Rainbow Creek. A fluvial geomorphic assessment of all proposed and existing watercourse crossings is required to mitigate the impact of proposed works to watercourses and to inform the design of crossing structures and road designs. The assessment specifically involved:

- Desktop and historical assessment (delineation of reaches, assessment of lateral migration potential of channel);
- Field investigation to characterize channel geometry and document existing fluvial geomorphology;
- Conditions and channel stability within the vicinity of the road crossings;
- Meander belt width analysis; and
- Risk-based assessment of watercourse crossings.

Watercourse crossings in the study area predominantly consist of channels that have been highly impacted by agricultural practices. In several cases, reaches have been historically straightened, making it difficult to quantify rates of lateral channel migration. Rapid geomorphic assessment reveals the majority of watercourses are transitional or stressed, making them sensitive to future changes with respect to their hydraulic or sediment regimes. The primary mode of adjustment for these channels is widening,

commonly observed through exposed tree roots, extensive basal scour, and bank slumping. Further details can be found in Appendix K.

3.12 Geotechnical Investigation

The study area is within the physiographic region identified as the Peel Plain. The Peel Plain covers an area of about 300 square miles and extends towards the northeast from the Niagara Escarpment through the central portions of the York, Peel, and Halton municipalities. The Peel Plain consists of a till, containing shale and limestone fragments, that was originally deposited within a glacial lake basin (Lake Peel). The study area is the northern part of the Peel Plain that contains a bevelled till plain, that consists of fine-medium sand, and laminated silt and clay. Based on Quaternary Geology, Bolton, Southern Ontario, the study area consists of Lacustrine-Wildfield Till Complex of stratified or non-stratified silt loam, silty clay loam or clay deposits, which may contain grits, silt balls or pebbles or may be interbedded with layers of till-like material. The Peel Plain is underlain by Middle to Upper Ordovician sediments of the Georgian Bay Formation, Blue Mountain Formation, Billings Formation, Collingwood Member, and Eastview Member. The Georgian Bay Formation is characterized by interbedded grey-green to dark grey shale and fossiliferous calcareous siltstone to limestone. The Blue Mountain and Billings formations consist of dark blue-grey to brown to black shales with thin interbeds of limestone or calcareous siltstone. The Collingwood and Eastview members are characterized by black, organic-rich, fissile, very fine-grained limestones.

Overall, the project site along Coleraine Drive consists of surficial cover (topsoil, asphaltic concrete, concrete and/or exposed granular fill) underlain by fill soils (granular and/or silty clay / clayey silt) overlying native silty clay / clayey silt till. The fill soils extend to depths varying from about 0.9 m to 2.3 m (Elevations 214.0 m to 229.2 m) below the existing ground surface. The silty clay / clayey silt till is confirmed to a depth of about 9.4 m (up to Elevation 213.1 m) below existing ground surface through deeper boreholes drilled at the structure location. Groundwater depths measured in these boreholes and monitoring wells varies from 0.9 m to 8.2 m (Elevations 221.9 m to 213.6 m) below the ground surface.

The subsurface soil profile at the proposed Arterial A2 site consists of surface covering materials (topsoil, asphalt, and/or fill) overlying native soils. The thickness of topsoil ranged from 100 mm to 300 mm, and asphaltic concrete ranges from 140 mm to 200 mm where encountered (at the intersection of Highway 50 and Coleraine Drive, and at a location in Countryside Drive). Granular fill material (gravelly sand and sand and gravel) ranges from 400 mm to 660 mm, and silty clay fill material is present to the maximum depth of 3.7 m. The native soils (silty clay / clayey silt till, silty sand / sand and silt, silty sand / sandy silt till) extend to the termination depths of the boreholes, which range from 1.7 m to 9.8 m. The termination depths of the open and dry boreholes range from 1.5 m to 5.2 m below ground surface.

Based on the pavement condition survey along Coleraine Drive, the existing asphaltic concrete surface condition is rated from Poor to Very Poor Condition due to the ravelling & coarse aggregate loss, wheel track rutting / distortion, and longitudinal, centreline, pavement edge, and transverse cracking.

The project site may be classified as Site Class D ("stiff soil") of the Canadian Highway Bridge Design Code Canadian Standards Association (CSA) S6-19.

Based on analysis of soil samples from 33 boreholes drilled along Coleraine Drive and 31 boreholes drilled along the alignment of new Arterial A2, the soil analysis indicates the corrosive potential of the soils with respect to buried metallic structures at Coleraine Drive, but not at the proposed Arterial A2. Headspace

combustible organic vapour (COV) and Total organic vapour (TOV) concentration measurements recorded in the soil samples were non-detectable. No other evidence (e.g., visual / olfactory) of potential environmental impacts were observed in any of the soil samples collected from this project area. Further details can be found in Appendix L.

3.13 Hydrogeology Investigation

Existing conditions were evaluated within a 500 m study area around the section of Coleraine Drive that will be reconstructed. The entire Coleraine Drive study area is in the Peel Plain physiographic region consisting of bevelled till plains. Surface geology along the majority of the Coleraine Drive study area consists of glaciolacustrine deposits of clay and silt. Along the northwestern portion, clay to silt till predominates. The underlying bedrock is composed of limestone, interbedded with shale at depth, in the Georgian Bay Formation from the Ordovician Period. 24 boreholes and one (1) monitoring well were installed along Coleraine Drive. The stratigraphy beneath the road alignment consists of one (1) to two (2) m of fill, underlain by stiff to hard silty clay to clayey silt with trace sand and gravel, occasionally some sand, to the maximum depth of investigation, up to 9.8 m below ground surface. WSP identified the presence of 78 water well records within 500 m of the proposed road reconstruction. Of the 78 water well records, 29 are listed as water supply wells. These wells are spread out throughout the study area.

The primary land use around Coleraine Drive is agricultural, with a few rural residences and scattered wetlands, meadows and forests along streams, along with a large vacant lot and an industrial lot both situated northeast of Coleraine Drive at the southeastern end of the study area. Most of the Coleraine Drive study area is within the Humber River Watershed. The main watercourses are Rainbow Creek, Clarkway Drive Tributary and Gore Road Tributary flowing southeast across the Site. Streamflows measured in these three (3) watercourses in May 2020 ranged from 0.2 l/s (16 m^3/day) to 10 l/s (875 m^3/day). The greatest flows were measured in Clarkway Drive Tributary and the lowest flows were measured in Gore Road Tributary. Significant reductions in flow were observed at the stations downstream of proposed Culvert S5 along Rainbow Creek and existing Culvert S16 along Clarkway Drive Tributary because of relatively large wetland meadows at these locations which probably serve to retain and retard flow and also provide multiple channels for water to flow through, all of which may not have been captured during the flow measurements. Rainbow Creek is the main watercourse that provides drainage in the study area and is part of the headwaters for the Humber River. Rainbow Creek starts around Mayfield Road, approximately 400 m northeast of Coleraine Drive, and flows south-southeast across the Site, intersecting Coleraine Drive approximately 625 m southeast of Mayfield Road at monitoring well S1. From here, some water flows beneath Coleraine Drive through a box culvert, named Culvert S1, and continues along a channel along the southwestern side of the road, and some water flows along the northeastern side of the road. Approximately 360 m further downstream at a smaller pipe culvert, the stream continues to flow southeast of Coleraine Drive. These are the only two (2) culverts along Coleraine Drive within the study area. Streamflow monitoring was completed in Rainbow Creek upstream and downstream of Culvert S1 on 12 May 2020. The water depths at both stations were approximately 0.2 m but there was no measurable flow upstream, while the flow downstream of the box culvert was approximately 1.1 litres per second (l/s), equivalent to 99 m^3/day. The natural habitat within the study area includes a few disconnected meadows, wetlands and one (1) wooded area, most along Rainbow Creek. One (1) larger strip of land is classified as a meadow that extends from Coleraine Drive southwest to Rainbow Creek in the southeastern portion of the study area.

The results of the single well response tests in seven (7) of the eight (8) monitoring wells across the Site indicated hydraulic conductivity values of the clay, silt and sand to range from 3.7×10^{-9} to 1.2×10^{-6} m/s.

The conservatively estimated dewatering rates (groundwater influx and not surface water influx from streams, storms or wetlands) ranged from 1 to 21 m^3/day for the proposed excavations to install culverts and underground utilities.

No Environmental Activity and Sector (EASR) registration nor a Permit to Take Water (PTTW) would be required for groundwater extraction. The conservatively estimated zones of influence ranged from 2 to 21 m. Most of the identified water supply wells are more than 10 m deep, below the expected maximum depth of excavation of 4 m below ground surface and outside the zones of influence and are thus not expected to be affected by construction dewatering because the dewatering rates are relatively low, dewatering is expected to be of short duration and the excavations are expected to be relatively shallow.

WSP observed no visual evidence of groundwater seeps near the existing or proposed box culverts or along the creeks within 50 m upstream and downstream of the culverts. Given that the groundwater levels in the monitoring wells at the existing culverts ranged from 0.9 to 3.2 m below ground surface in May 2020 and January 2022, there may be a hydraulic connection to sections of the creeks, with some groundwater recharge occurring, although this was not measured. The groundwater level in S5 at proposed Culvert S5 was above the ground surface, indicating possible groundwater discharge into Rainbow Creek.

Dewatering effects on surface water are expected to be localized and temporary. With the streams temporarily diverted around the culverts to be installed, local dewatering may only be required on a temporary basis to maintain dry working conditions long enough for the culverts to be installed and no permanent impact is expected from the culverts. Further details can be found in Appendix M.

3.14 Road Traffic Noise Impact Study

A Road Traffic Noise Impact Study was undertaken for both Part A and Part B roadways. The results indicate that the noise impacts within the study area are predicted to be more than 5 decibels (dB) for a total of 12 receptors when comparing the Future "build" 2041 and Future "no-build" 2041 scenarios. However, the overall sound levels of the Future "build" scenario at eight (8) of the identified receptors are at or below the 55 A-weighted decibels (dBA) criterion. Therefore, in accordance with the Ministry of Environment (MOE) / MTO protocol, consideration of noise mitigation is not required for those receptors. For the other four (4) receptors, consideration of noise mitigation is required in accordance with the MOE / MTO protocol. The Peel Region and the City of Brampton Noise Attenuation Policies identify a 60 dBA criterion for consideration for noise mitigation. The Future "build" levels are at or above the 60 dBA criterion at 6 reverse frontage or side exposure locations. Therefore, these locations were assessed for possible noise mitigation in accordance with the Peel Region and City of Brampton Noise Attenuation Polices. Further details can be found in Appendix N.

4.0 Development and Evaluation of Alternative Planning Solutions

The evaluation of alternation planning solutions was primarily completed as part of the Area 47 TMP. However, the Project Team revisited and refined the Planning Solutions during the current Study. The Project Team also completed supplementary studies to help inform and support the planning solutions, such as the Access Management Plan.

4.1 Problem and Opportunity Statement

Area 47 is projected to grow substantially to house 31,120 residents and support 8,130 jobs by 2041. The current transportation system will be supported by planned future upgrades to surrounding regional and municipal roads, but due to the expected growth, the internal Area 47 network will require improvements as well, including capacity upgrades.

4.2 Identification of Alternatives

In order to meet the requirements of Phase 1 and Phase 2 of the Class EA process, three (3) long term transportation planning alternatives were assessed and evaluated based on 2031 travel demands.

4.2.1 Alternative Planning Solution 1- Do Nothing

This alternative assumes that current road conditions are carried over to 2031, with no changes occurring to roads within the study area but does account for the planned road network and transit improvements surrounding the study area.

4.2.2 Alternative Planning Solution 2 - As Planned

This alternative builds on alternative one (1) by considering both planned improvements outside of the study areas as well as increasing capacity to the arterial network within the study area. Methods considered for increasing network capacity within the study area include:

- Major Mackenzie Drive extension (Arterial A2) from Regional Road 50 to Mayfield Road;
- East-West Arterial and Coleraine Drive intersecting at Arterial A2;
- Widening of Regional Road 50, The Gore Road and Mayfield Road up to six (6) lanes;
- Widening of Coleraine Drive, Countryside Drive and Clarkway Drive to four (4) lanes;
- MUP along all arterial and collector roads; and
- Brampton Transit bus services on Regional Road 50, Countryside Drive and The Gore Road.

4.2.3 Alternative Planning Solution 3 - Increased Network Connectivity

The primary focus of this alternative is to provide increased connectivity throughout the network as well as increased mobility options. This alternative focused on implementing an integrated active transportation network, increasing roadway capacity and limiting the impacts that these changes may have on the environment. Three (3) transportation network options were created for this alternative and they share many traits, including:

- East-West Arterial connecting to Arterial A2 west of Rainbow Creek to minimize environmental impacts;

- Realigned Coleraine Drive;
- Arterial A2 at six (6) lanes between Regional Road 50 and East-West Arterial road; and
- System of minor collectors introduced within the study area residential and employment sectors.

A series of three (3) sub-alternatives were developed for Alternative Planning Solution 3. These are summarized in the following sections.

4.2.3.1 Transportation Network Option 3A

Transportation network design aspects specific to option 3A include:

- Realigned Coleraine Drive connected to Arterial A2 west of Regional Road 50;
- Transit service provided on all arterial roads;
- Countryside Drive and Castlemore Road transit routes extended to serve the collector roads;
- Connectivity with Highway 427 Transitway, York Region Transit and high order transit network provided via Arterial A2 / Major Mackenzie Drive;
- Connectivity with potential Kleinburg GO Station provided via Arterial A2 / Major Mackenzie Drive; and
- Active transportation facilities on arterial and collector roads.

4.2.3.2 Transportation Network Option 3B

Transportation network design aspects specific to option 3B include:

- Realigned Coleraine Drive connected directly to Regional Road 50 north of Major Mackenzie Drive / Arterial A2; and
- Transit system and active transportation network similar to option 3A.

4.2.3.3 Transportation Network Option 3C

Transportation network design aspects specific to option 3C include:

- Realigned Coleraine Drive connected to Arterial A2 west of Regional Road 50;
- Arterial A2 at six (6) lanes between Regional Road 50 and Mayfield Road (entire length);
- Clarkway Drive remains at its present two (2) lane rural cross-section between East-West Arterial and Mayfield Road;
- Transit service provided on all major arterial roads;
- Community-based service on collector roads;
- Better connectivity with Highway 427 Transitway, York Region Transit and high-order transit network provided via Arterial A2 / Major Mackenzie Drive;
- Connectivity with future potential Kleinburg GO Station provided via Arterial A2 / Major Mackenzie Drive;
- Connectivity with future potential Nashville Road GO Station via shuttle service; and
- Active transportation network similar to option 3A.

4.3 Evaluation Criteria

The three (3) Alternative Planning Solutions discussed above were evaluated based on four (4) performance indicators: transportation services, policy environment, social, natural and cultural heritage environment and economy. These performance indicators are summarized below in Table 4-1.

Table 4-1: Alternative Planning Solution Evaluation Criteria

Performance Indicator	Description
Transportation Services	Minimize travel delay Road capacity and volumes consistent with its function Provides multi-modal opportunities
Policy Environment	Support for Provincial, Regional and local municipal policy goals of building sustainable, multi-modal transportation networks capable of supporting growth Addresses study goals
Social, Natural and Cultural Heritage Environment	Minimize adverse effects on natural heritage resources, including natural vegetation, aquatic habitat and air quality, as well as archaeological and cultural heritage factors
Economy	Minimize congestion and maximize accessibility for goods movement and planned industry Supports planned development

4.3.1 Screenline Analysis

A screenline analysis was conducted in the westbound and northbound (peak) directions for all Alternative Planning Solutions in order to identify any significant network deficiencies. Barring the "Do Nothing" alternative, all options yielded similar results and provide ample capacity across the majority of the network. The only major difference between these alternatives is the improved volume to capacity ratio at the Rainbow Creek south screenline, which fell from approximately 0.93 to 0.83 when Arterial A2 is widened to six (6) lanes.

4.3.1.1 Transportation Services

The three (3) Alternative Planning Solutions were evaluated relative to Transportation Services across the following criteria:

- Trips by transit;
- Internal Area 47 travel time;
- Congested lane-km;
- Network utilization;
- Annual greenhouse gas due to congestion;
- Supports alternative travel modes; and
- Network connectivity.

It was found that there was very little difference between the alternatives, though it was noted that Option 3C supports transit and the auto passenger travel modes better because of the planned HOV lane along Arterial A2. However, Option 3B was noted as creating the fewest greenhouse gas emissions.

4.3.1.2 Policy Environment

The Alternative Planning Solutions were evaluated with respect to their ability to address study, municipal, regional and provincial policy goals. Although it was found that each of the Alternative 3 network options supports these goals, Alternative 3C more fully addressed policy in two (2) distinct ways. These include avoiding construction along Clarkway Drive between Countryside Drive and the East-West Arterial (an environmentally sensitive area) and optimization of the capacity of the new Arterial A2 facility.

4.3.1.3 Natural and Cultural Heritage Environment

The following criteria were used to evaluate the Alternative Planning Solutions in regard to natural and cultural heritage resources:

- Impact on aquatic resources;
- Impact on air quality; and
- Impact on archaeological resources.

As expected, the "Do Nothing" approach has no impact on aquatic or archaeological resources but would cause the greatest impact to air quality due to the forecasted increased network congestion.

Alternative 2 would have the greatest impact on aquatic resources as it would require four (4) new creek crossings, followed closely by all Alternative 3 options, which require three (3) new creek crossings. Of the Alternative 3 options, Alternative 3C would have the least amount of impact on aquatic resources as it does not require the widening of Clarkway Drive over the Clarkway Tributary. Alternative 3B would have the least amount of impact on air quality based on predicted traffic congestion, followed close behind by Alternative 3C. Alternative 2 and all Alternative 3 options would have similar impacts on archaeological resources.

For the above noted reason, it can be concluded that Alternative 3C would create the least amount of natural and cultural environment impact, excluding the "Do Nothing" alternative, but is preferred to the "Do Nothing" alternative as planned growth makes the latter option infeasible.

4.3.1.4 Economic Environment

Impact to the economic environment was evaluated using the following two (2) criteria:

- Maximizes access for goods movement and planned industry; and
- Supports planned development.

It was concluded that Alternative 3C "performs the best in this indicator for both the access for goods movement and planned development criteria" due, in part, to the potential for HOV lane in the future on Arterial A2, which increases capacity for trucks (HDR, 2014).

4.4 Preliminary Preferred Solution

Following the specific evaluations, an overall evaluation of the three (3) Alternative Planning Solutions (including the three (3) options associated with Alternative 3) was completed. It was concluded that Alternative 3C was the preliminary preferred Alternative Planning Solution. Based on comments received during a PIC held in June 2012, Alternative 3C was refined and developed into the recommended road network (Refer to Figure 4-1).

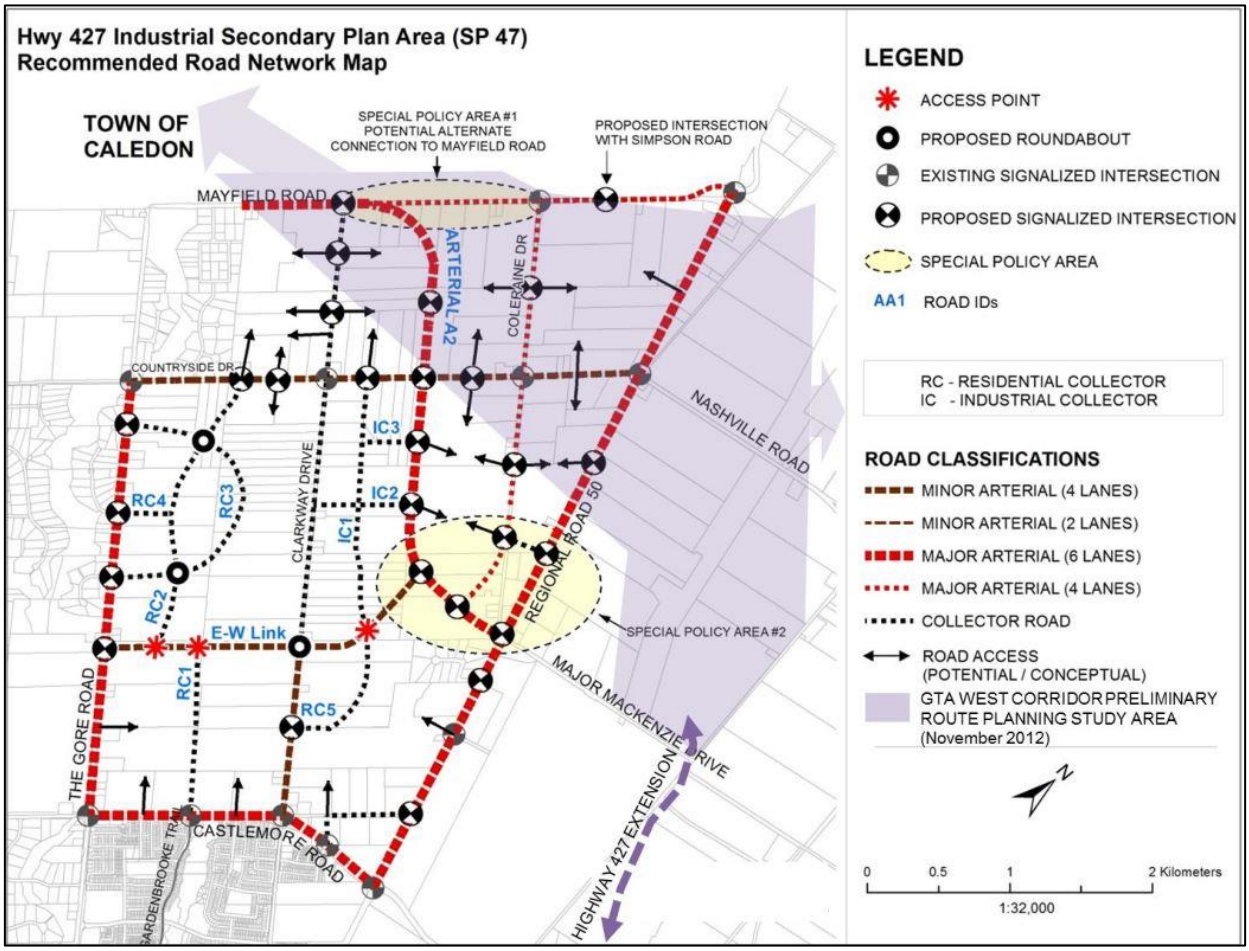


Figure 4-1: Area 47 TMP-Proposed Road Network

5.0 Alternative Alignments – Special Policy Areas, New Roadways, Critical Intersection and Rainbow Creek Crossing

5.1 Overview

The following sections provide details related to the development and evaluation of high-level alternatives for intersection configurations within the two (2) Special Policy Areas (SPA), the two (2) new arterial roadways (Arterial A2 and East-West Arterial), as well as the critical intersection of Arterial A2 / Major Mackenzie Drive at Regional Road 50.

5.2 Special Policy Areas (SPA)

Two (2) SPAs were identified as requiring additional study during completion of Phases 3 and 4 of the Class EA process (current study). The Area 47 TMP specifically stated that the traffic study completed was not sufficient to recommend intersection configurations in these two (2) areas, deferring identification of a preferred alternative to the current study. The locations of the two (2) SPAs are illustrated in Figure 5-1.

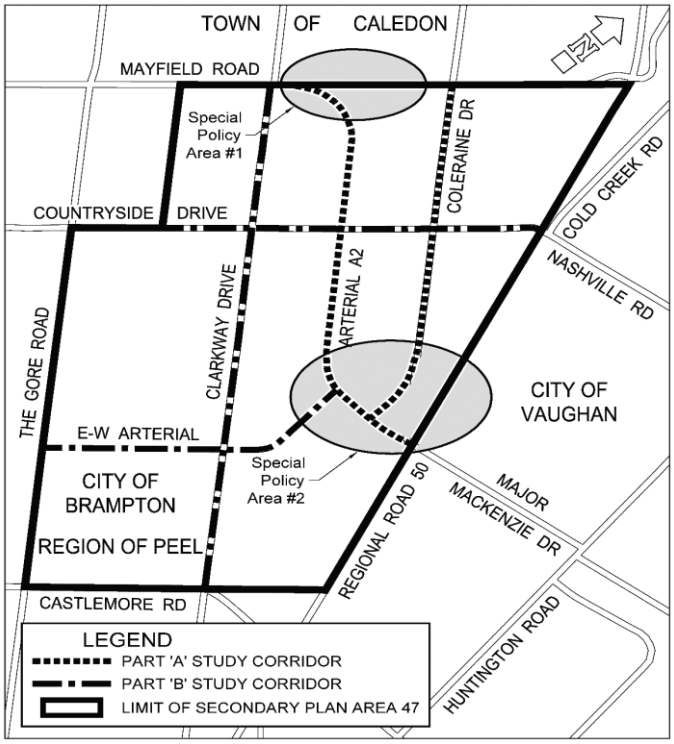


Figure 5-1: Locations of SPA1 and 2 Relative to the Main Study Roads

5.2.1 Special Policy Area 1 (SPA 1)

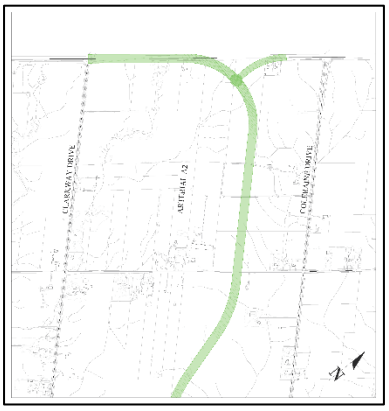
SPA 1 was defined as pertaining to the intersection of Mayfield Road and Arterial A2. As previously discussed, Arterial A2 is to function as an east-west arterial until such time as Highway 427 is extended beyond Major Mackenzie Drive. Once Highway 427 is extended, Arterial A2 will function as a north-south arterial.

5.2.1.1 Alternative Solutions

A number of alternative intersection configurations were developed for SPA 1 – all of which were presented to the Municipal Advisory Group, Technical Agency Committee, Stakeholder Group, and the general public (at PIC #1) for review and comment. Descriptions of the Alternatives are provided in Table 5-1.

Table 5-1: SPA1 Alternatives

Alternatives	Descriptions	Design
Alternative 1	Alternative 1 was contemplated during completion of the Area 47 TMP, with a single complex (5 leg) intersection between Mayfield Road and Arterial A2. This alternative would require a new crossing of Clarkway Creek (estimated span of at least 26.2 m), as well as have impacts to an existing business located at 8190 Mayfield Road.	
Alternative 2	This alternative aligns Arterial A2 such that it becomes the easterly extension of Mayfield Road, making it a true east-west connection between the area east of The Gore Road and west of Regional Road 50 (towards Highway 427). The remaining portion of existing Mayfield Road between Clarkway Drive and Regional Road 50 would then tee into Arterial A2. This alternative would require a new crossing of Clarkway Creek (estimated span of at least 26.2 m), as well as have impacts to an existing business located at 8190 Mayfield Road.	
Alternative 3	This alternative has Arterial A2 tee into existing Mayfield Road. This alternative would not require an additional structure over Clarkway Creek near Mayfield Road and would permit the business at 8190 Mayfield Road to remain.	

Alternative 4	This alternative has a similar roadway configuration as SPA 1 – Alternative 2, with the exception of the fact that the curve on Mayfield Road / Arterial A2 is relocated sufficiently to the east to eliminate the need for a new crossing of Clarkway Creek. This option does, however, split properties slated for industrial development along the TMP-proposed Arterial A2 alignment.	

5.2.1.2 Results of Updated Traffic Study

The Vissim model developed for the study area was used to evaluate traffic impacts associated with the alternative intersection configurations developed for SPA 1.

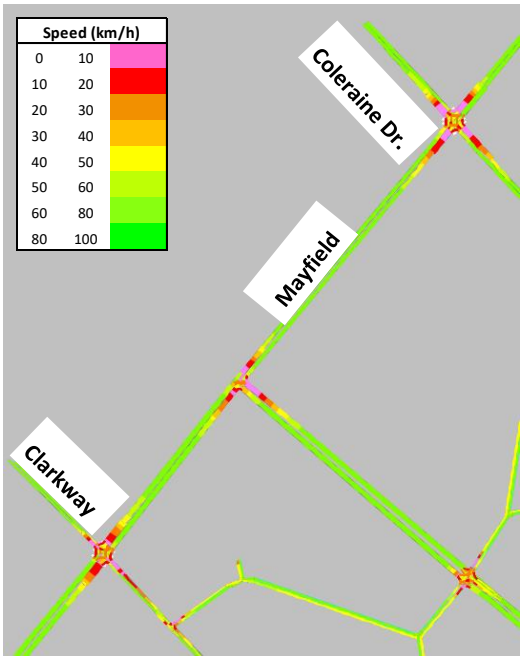


Figure 5-2: Travel Speeds for SPA 1 - Alternative 3 During 2041 P.M. Peak

Models were developed for Alternatives 2 and 3, with the complex configuration of Alternative 1 assumed to function more poorly than Alternative 2 and Alternative 4 assumed to function similarly to Alternative 2. Based on the completed analysis, Alternative configurations 2-4 would be expected to function at LOS C or better, with minor improvements in delay (10 seconds) and maximum queue length (30 m) afforded by the T-intersection.

Figure 5-2 illustrates anticipated travel speeds through SPA 1 during the 2041 p.m. peak using the Alternative 3 intersection configuration.

5.2.1.3 Evaluation of Alternatives

The four (4) alternative configurations for SPA 1 were evaluated against a series of key criteria to determine a preferred alternative. The formal evaluation is summarized in Table 5-2.

Table 5-2: Evaluation of Alternative Intersection Configurations for SPA1

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment with 5-leg intersection at Clarkway Drive	Alternative 2 Arterial A2 as Easterly Extension of Mayfield Road	Alternative 3 Arterial A2 connects to Mayfield Road at a T-Intersection	Alternative 4 Arterial A2 as Easterly Extension of Mayfield Road, with Increased Separation from Clarkway Drive
Engineering	Addresses Problem and Opportunity Statement:	• Provide enhanced inter-regional connectivity.	• Arterial A2 functions as an east-west connection between Mayfield Road and Major Mackenzie Drive / Highway 427, improving inter-regional connectivity.	• Arterial A2 functions as an east-west connection between Mayfield Road and Major Mackenzie Drive / Highway 427, improving inter-regional connectivity.	• Arterial A2 primarily functions as a north-south connection between Mayfield Road and Major Mackenzie Drive / Highway 427, paralleling the function of Coleraine Drive.	• Arterial A2 functions as an east-west connection between Mayfield Road and Major Mackenzie Drive / Highway 427, improving inter-regional connectivity.
						
		• Provide access to proposed development.	• Provides access to proposed development.	• Provides access to proposed development.	• Provides access to proposed development.	• Provides access to proposed development.
						
		• Address anticipated capacity issues resulting from extension of Highway 427 to Major Mackenzie Drive, as well as development of the study area.	• Provides additional east / west and north / south arterial capacity within the study area.	• Provides additional east / west and north / south arterial capacity within the study area.	• Provides additional north / south arterial capacity within the study area.	• Provides additional east / west and north / south arterial capacity within the study area.
						
		• Provide pedestrian and cycling facilities.	• Active transportation facilities will be provided on both sides of the roads within SPA 1.	• Active transportation facilities will be provided on both sides of the roads within SPA 1.	• Active transportation facilities will be provided on both sides of the roads within SPA 1.	• Active transportation facilities will be provided on both sides of the roads within SPA 1.
						
		• Improve traffic, pedestrian and cyclist safety.	• Complex intersection configuration may be difficult for pedestrians and cyclists to navigate, particularly as a result of the number of intersection approach legs (5). • Complex intersection configuration will not be familiar to drivers.	• Pedestrian / cyclist only cycle will be required to facilitate crossing of Arterial A2. • Familiar, easily navigable intersection and mid-block configurations.	• Pedestrian / cyclist only cycle will be required to facilitate crossing of Arterial A2. • Familiar, easily navigable intersection and mid-block configurations.	• Pedestrian / cyclist only cycle will be required to facilitate crossing of Arterial A2. • Familiar, easily navigable intersection and mid-block configurations.
						
		• Improve intersection safety and operations.	• Complex intersection configuration would not offer the level of pedestrian and vehicular safety / wayfinding provided by more conventional T or four (4) way intersections.	• Intersection of Arterial A2 and Mayfield Road will be located on a curve, which is not preferred in terms of potential impacts to intersection visibility.	• Traditional intersection design offers ease of operation and clear visibility.	• Intersection of Arterial A2 and Mayfield Road will be located on a curve, which is not preferred in terms of potential impacts to intersection visibility.
						
		• Improve watercourse crossings to enhance hydraulics, stream function and fisheries and wildlife passage.	• No existing creek crossings will be impacted, although a new crossing will be required.	• No existing creek crossings will be impacted, although a new crossing will be required.	• No existing creek crossings will be impacted.	• No existing creek crossings will be impacted.

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment with 5-leg intersection at Clarkway Drive	Alternative 2 Arterial A2 as Easterly Extension of Mayfield Road	Alternative 3 Arterial A2 connects to Mayfield Road at a T-Intersection	Alternative 4 Arterial A2 as Easterly Extension of Mayfield Road, with Increased Separation from Clarkway Drive
						
	Transportation Network Safety (includes natural hazards)	Safety related factors include roadway geometrics, roadside hazards, intersection design, and control, accommodating pedestrians and cyclists.	• Complex intersection configuration would not offer the level of pedestrian and vehicular safety / wayfinding provided by more conventional T or four (4) way intersections.	• Moderately complex design and control. • Would provide a higher level of pedestrian and vehicle safety / wayfinding. • Intersection of the easterly portion of Mayfield Road with Arterial A2 would be located on a curve, which is not preferred due to potential issues with sight distances.	• Simple, traditional, design and control. • Would provide a higher level of pedestrian and vehicle safety / wayfinding.	• Moderately complex design and control. • Would provide a higher level of pedestrian and vehicle safety / wayfinding. • Intersection of the easterly portion of Mayfield Road with Arterial A2 would be located on a curve, which is not preferred due to potential issues with sight distances. • Reduced intersection spacing between Arterial A2 and Coleraine Drive.
						
	Transportation Network Connectivity		• No significant difference between alternatives.			
	Transportation Network Capacity	Impacts of traffic on local roads and outside the study area. Transportation network improvement and accommodation of goods movement.	• Provides additional capacity for vehicles moving between the northwest and southeast.	• Provides additional capacity for vehicles moving between the northwest and southeast. • Does not provide a direct route for vehicles traveling east-west along Mayfield Road.	• Provides additional north-south capacity. • Maintains existing east-west connection along Mayfield Road.	• Provides additional capacity for vehicles moving between the northwest and southeast. • Does not provide a direct route for vehicles traveling east-west along Mayfield Road.
						
	Promotion of Active Transportation	Adheres to Brampton's Active Transportation Policies and Initiatives as Defined in the TMP / (Active Transportation (AT) TMP.	• Complex intersection would require pedestrians and cyclists to navigate through two (2) more lanes of traffic than with a more traditional intersection. • Larger, more complex intersections deter use by cyclists / pedestrians.	• No significant difference among alternatives. Provides similar LOS for AT users.		
						
	Transit Supportive Development	Potential adverse impact on transit service. Assessment of impact on planned transit service improvements.	• Direct east-west connection between areas west of The Gore Road and that east of Major Mackenzie Drive is anticipated to provide travel times, and hence improved service, along this route. • Proposed intersection configuration will not provide a northbound (NB) to eastbound (EB) connection to the Mayfield Road/Regional Road 50 GO Park & Ride Lot.	• Direct east-west connection between areas west of The Gore Road and that east of Major Mackenzie Drive is anticipated to provide travel times, and hence improved service, along this route. • Route connectivity to the GO Park & Ride at Mayfield Road / Regional Road 50 can be accomplished with this configuration.	• Linkages to east-west service on Mayfield Road will require a transit transfer stop at the intersection of Arterial A2 and Mayfield Road. • Route connectivity to the GO Park & Ride at Mayfield Road / Regional Road 50 can be accomplished with this configuration.	• Direct east-west connection between areas west of The Gore Road and that east of Major Mackenzie Drive is anticipated to provide travel times, and hence improved service, along this route. • Route connectivity to the GO Park & Ride at Mayfield Road / Regional Road 50 can be accomplished with this configuration.
						

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment with 5-leg intersection at Clarkway Drive	Alternative 2 Arterial A2 as Easterly Extension of Mayfield Road	Alternative 3 Arterial A2 connects to Mayfield Road at a T-Intersection	Alternative 4 Arterial A2 as Easterly Extension of Mayfield Road, with Increased Separation from Clarkway Drive
	Structural Impacts	Potential adverse impact on existing structures.	No impact to existing structures with any alternative. No difference among alternatives.			
		Need for additional bridge structures.	• New crossing of Clarkway Creek will be required.	• New crossing of Clarkway Creek will be required.	• No new creek crossings required.	• No new creek crossings required.
						
	Hydraulics and Hydrology Impacts (Creeks)	Impact on floodplain, existing flood depths at proposed crossing locations, and existing flood return period.	• Approximately 4,200 m^2 of new linear infrastructure to be constructed within the floodplain of Clarkway Creek. • Significant impact to hydraulics and hydrology.	• Approximately 4,200 m^2 of new linear infrastructure to be constructed within the floodplain of Clarkway Creek. • Significant impact to hydraulics and hydrology.	• No new linear infrastructure to be constructed within the floodplain. • No impact to hydraulics or hydrology.	• No new linear infrastructure to be constructed within the floodplain. • No impact to hydraulics or hydrology.
						
	Utility Relocation	Ability to minimize effects on existing and proposed utilities.	• Would require relocation of approximately 200 m of Bell and overhead Hydro.	• Would require relocation of approximately 1,000 m of overhead Hydro (lines on both sides of Mayfield Road), as well as 1,500 m of Bell infrastructure (two (2) parallel runs on north side, one (1) run on south side of Mayfield Road).	• Would require relocation of Hydro and Bell through future intersection (approximately 60 m).	• Would require relocation of approximately 1,000 m of overhead Hydro (lines on both sides of Mayfield Road), as well as 1,500 m of Bell infrastructure (two (2) parallel runs on north side, one (1) run on south side of Mayfield Road).
						
Financial	Capital Costs	Function of total road length and width, AT facilities provided, intersection infrastructure, structural area required, and amount of utility relocation.	• New structure with >28.5 m span would be required. • 2,450 m of new roadway required beyond the limits of SPA 2. • Complex intersection at Mayfield Road. • High capital cost.	• New structure with >28.5 m span would be required. • 2,850 m of new roadway required beyond the limits of SPA 2. • High capital cost.	• No new structure required. • 2,000 m of new roadway required beyond the limits of SPA 2. • Low / moderate capital cost.	• No new structure required. • 3,000 m of new roadway required beyond the limits of SPA 2. • Moderate capital cost.
						
	Operating Costs	Function of road length and number of traffic signals.	• Two (2) signalized intersections within SPA 1. • 2,450 m of new roadway required beyond the limits of SPA 2. • Two (2) creek crossing structures to be maintained.	• Three (3) signalized intersections within SPA 1. • 2,850 m of new roadway required beyond the limits of SPA 2. • Two (2) creek crossing structures to be maintained.	• Three (3) signalized intersections within SPA 1. • 2,000 m of new roadway required beyond the limits of SPA 2. • One (1) creek crossing structure to be maintained.	• Three (3) signalized intersections within SPA 1. • 3,000 m of new roadway required beyond the limits of SPA 2. • One (1) creek crossing structure to be maintained.
						
	Property Acquisition		• Approximate property required to limit of SPA 2 is 12.7 ha. • Requires buy out of two (2) properties. • Moderate property acquisition costs.	• Approximate property required to limit of SPA 2 is 14 ha. • Requires buyout of three (3) properties. • High property acquisition costs.	• Approximate property required to limit of SPA 2 is 10.7 ha. • Requires buyout of two (2) properties. • Moderate property acquisition costs.	• Approximate property required to limit of SPA 2 is 14.6 ha. • Requires buyout of two (2) properties. • Moderate / high property acquisition costs.

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment with 5-leg intersection at Clarkway Drive	Alternative 2 Arterial A2 as Easterly Extension of Mayfield Road	Alternative 3 Arterial A2 connects to Mayfield Road at a T-Intersection	Alternative 4 Arterial A2 as Easterly Extension of Mayfield Road, with Increased Separation from Clarkway Drive
						
Social / Cultural Environment	Conformance to Planning Objectives (Growth Plan, Official Plan, Secondary Plan, Area 47 TMP)		• Conforms to Area 47 TMP. • Conforms with the Secondary Plan.	• Similar to what was indicated in the Area 47 TMP. • As such, is in line with both the Secondary Plan and Area 47 TMP.	• This alternative was noted as an option during completion of both the Area 47 TMP and Secondary Plan. • Would provide more regularly shaped development blocks along Arterial A2 at Mayfield Road.	• This alignment varies significantly from what was proposed during completion of the Area 47 TMP. The alignment may impact ability to provide the same LOS to planned industrial development along Arterial A2.
						
	Residential / Business Access and Displacement	Existing residences and businesses.	• Would require relocation of two (2) residences at Countryside Drive.	• Would require relocation of one (1) business at Mayfield Road and two (2) residences at Countryside Drive.	• Would require relocation of two (2) residences at Countryside Drive.	• Would require relocation of two (2) residences on Mayfield Road.
						
		Planned residential, commercial and industrial developments.	• Aligns with planned development.	• Aligns with planned development. • T-intersection would be aligned outside of the limits of the Clarkway Tributary.	• Aligns with planned development. • Would provide more regularly shaped development blocks along Arterial A2 at Mayfield Road.	• Divides planned commercial blocks between Mayfield Road and Countryside Drive.
						
	Emergency Services (Police, Fire, Ambulance)	Potential to reduce response times.	• Would permanently impact driveway access to Mayfield Road for four (4) existing residential properties which would be located immediately adjacent to the new complex intersection. • Right-in / right-out only access will be required for these properties. • Emergency services will be required to approach from the east or cross the median. • No significant change in response times anticipated.	• Would change access to nine (9) residential and commercial properties, requiring modification to existing driveways. • Right-in / right-out only access will be required for these properties. • Emergency services will be required to approach from the east or cross the median. • No significant change in response times anticipated.	• Would require permanent relocation of entrances to four (4) properties (to coincide with the future intersection), as well as impacts to two (2) additional properties for which access will be right-in / right-out in the future. • Emergency services will be required to approach from the east or cross the median. • No significant change in response times anticipated.	• Would change access to four (4) residential properties in close proximity to the future intersection of Mayfield Road and Arterial A2. • Right-in / right-out only access will be required for these properties. • Emergency services will be required to approach from the east or cross the median. • No significant change in response times anticipated.
						
	Noise Level Impacts	Potential effects of traffic related noise on residences, community facilities, or institutions adjacent to and/or within the study area.	• Increased noise resulting from two (2) arterial road segments (Mayfield Road and Arterial A2) and complex intersection will increase noise levels for six (6) adjacent residential properties and one (1) existing commercial property.	• Decreased noise levels as the arterial roadways will be relocated further from six (6) residential and one (1) commercial property compared to existing condition.	• Increased noise levels for one (1) commercial property and one (1) residential property resulting from new intersection and arterial road segment.	• No net increase in noise levels as arterial roadways are moved further from two (2) residential properties and closer to two (2) others.
						

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment with 5-leg intersection at Clarkway Drive	Alternative 2 Arterial A2 as Easterly Extension of Mayfield Road	Alternative 3 Arterial A2 connects to Mayfield Road at a T-Intersection	Alternative 4 Arterial A2 as Easterly Extension of Mayfield Road, with Increased Separation from Clarkway Drive
Natural Environment	Cultural Heritage Impacts	Potential adverse impacts on archaeological resources and built heritage adjacent to and/or within the study area.	All undeveloped land within the study area has archaeological potential. No identified archaeological sites or cultural heritage properties are impacted by any of the alternative alignments. No significant difference among alternatives.			
	Agricultural Impacts	Impact on existing agricultural properties.	• Alignment runs between property limits. Minimal impact to agricultural properties.	• Alignment runs between property limits. Minimal impact to agricultural properties.	• Alignment runs between property limits. Minimal impact to agricultural properties.	• Alignment divides four (4) farm properties and occupies a large proportion of a farm property at Mayfield Road.
						
	Impact to Designated Natural Heritage Features including wetlands	Proximity to, and significance of, impact to designated feature.	No designated natural heritage features within the study area. No difference among alternatives.			
	Impact to Natural Heritage Features such as vegetation and watercourses	Proximity, size, characteristics, and sensitivity of significant rural areas, terrestrial ecosystems, and wetlands. Potential impact or loss of natural areas, terrestrial ecosystems or wetland areas, function or habitat.	• Would require a new crossing of Clarkway Creek Tributary, resulting in some loss of natural areas. • The crossing location was identified as direct fish habitat.	• Would require a new crossing of Clarkway Creek Tributary, resulting in some loss of natural areas. • The crossing location was identified as direct fish habitat.	• No significant impact to identified natural heritage features.	• No significant impact to identified natural heritage features.
						
	Impact to Avian, Wildlife and Plant SAR	Potential effects to SAR habitat.	• Approximately 0.42 ha of potential Bobolink habitat impacted by proposed alignment. • Compensation may be required.	• Approximately 0.42 ha of potential Bobolink habitat impacted by proposed alignment. • Compensation may be required.	• No identified impacts to SAR habitat.	• No identified impacts to SAR habitat.
						
	Groundwater Impacts	Potential for adverse effects on existing groundwater resources (water quality and/or quantity).	• 12.7 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods. Preferred method to be confirmed based on hydrogeological and geotechnical assessments.	• 14 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods. Preferred method to be confirmed based on hydrogeological and geotechnical assessments.	• 10.7 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods. Preferred method to be confirmed based on hydrogeological and geotechnical assessments.	• 14.6 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods. Preferred method to be confirmed based on hydrogeological and geotechnical assessments.
						
OVERALL RANKING (Percentage of Total Available Score)						
PREFERRED ALTERNATIVE			**The Preferred Alternative for SPA 1 is Alternative 3.**			

Legend: Good ⟷ Poor

5.2.1.4 Roundabout Screening

The intersection of Arterial A2 and Mayfield Road was identified in the SP47 TMP as a potential location for implementation of a roundabout. Based on analysis completed using Synchro, it was determined that a two (2) lane roundabout would be insufficient to handle anticipated traffic volumes even if right bypass lanes were introduced. As three (3) lane roundabouts introduce additional levels of navigational complexity and collision risk and are not currently employed within the City of Brampton or Peel Region, it was determined that this would not be an appropriate location for implementation of a roundabout.

5.2.1.5 Preferred Alternative

The preferred alternative for SPA 1 is Alternative 3: T-intersection of Arterial A2 at Mayfield Road. The benefits of this alternative include reduced impacts to existing property, no requirement for an additional crossing of Clarkway Creek, no significant traffic impacts compared to other alternatives, and lowest construction and property acquisition costs. Challenges associated with this alternative include existing driveways on Mayfield Road that are located within the limits of the future Arterial A2 / Mayfield Road intersection.

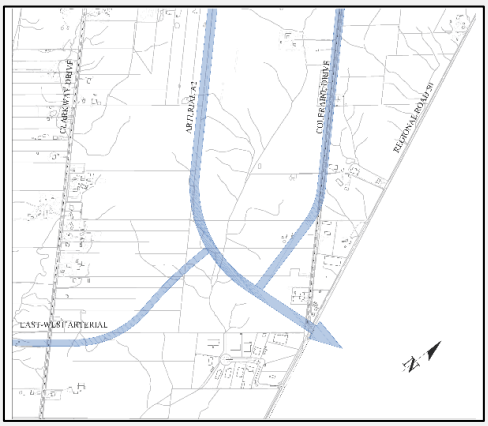
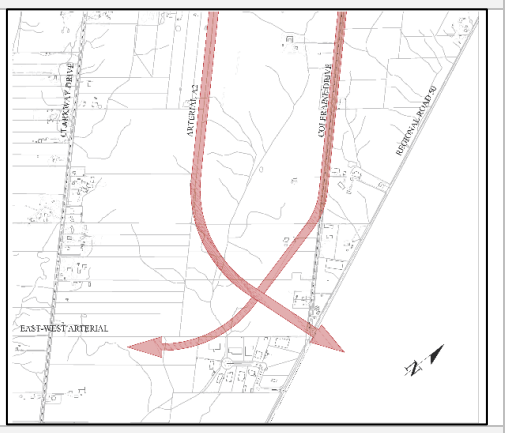
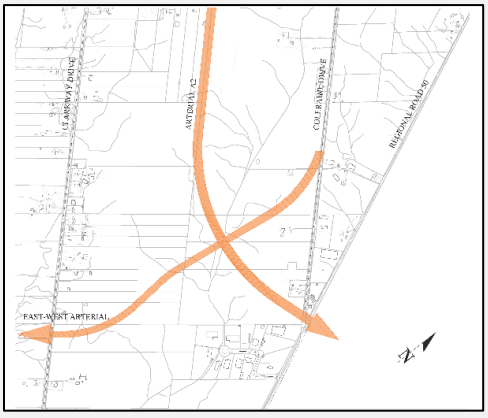
5.2.2 Special Policy Area 2 (SPA 2)

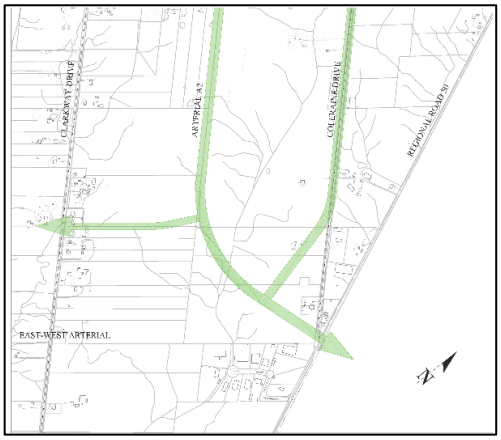
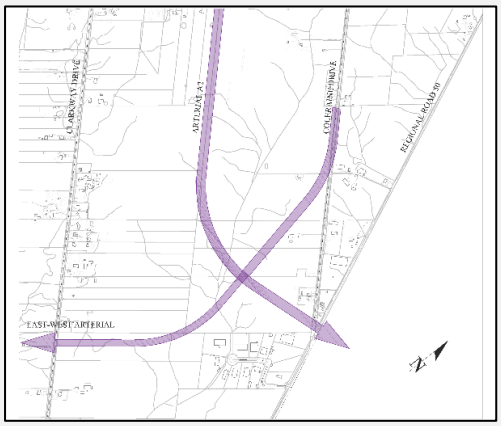
SPA 2 includes the intersections of Arterial A2 with each of Regional Road 50, Coleraine Drive and East-West Arterial, as well as Rainbow Creek. The area roughly extends from Clarkway Drive in the west to Regional Road 50 in the east, and from the TransCanada Pipeline Corridor to the south to approximately 1 km north of that corridor. During completion of the Area 47 TMP this area was identified as a SPA requiring additional study due to significant environmental, transportation and development concerns and construction of the Highway 427 extension and GTA West. The alternatives investigated for SPA 2 have taken into consideration these diverse elements and have been developed in consultation with the City and Region, as well as key development stakeholders.

5.2.2.1 Alternative Solutions

The following high-level alternative configurations for SPA 2 were developed to balance the objectives of the TMP, the MESP, and planned development within the area. These alternatives were presented for review and comment during the initial round of stakeholder and public consultation in November 2016.

Table 5-3: SPA 2 Alternatives

Alternatives	Descriptions	Design
Alternative 1: TMP Proposed Configuration	As part of the Highway 427 Industrial Secondary Plan Area 47 TMP, a network configuration consisting of two (2) T-intersections was considered for the arterial-to-arterial connections of Arterial A2 and each of East-West Arterial and Coleraine Drive. Under this alternative configuration, intersection spacing of approximately 350 m is provided between Regional Road 50, Coleraine Drive and East-West Arterial. This is slightly less than the Transportation Association of Canada (TAC) recommended 400 m minimum between major arterials. The Area 47 TMP configuration has the benefit of having a single six (6) lane crossing of the Rainbow Creek NHS.	
Alternative 2: East-West Arterial Realigned to TMP-Proposed Coleraine Drive	Alternative 2 considered a single intersection linking Coleraine Drive to the East-West Arterial in an effort to reduce the number of signalized intersections on Arterial A2 and improve traffic movement between the two (2) roadways. The industrial development group for properties bordering Coleraine Drive requested that the study team contemplate locating that single intersection such that the Area 47 TMP alignment of Coleraine Drive not be compromised. This alternative necessitates two (2) crossings of the Rainbow Creek NHS.	
Alternative 3: Single Intersection at Narrowest Crossing of Rainbow Creek	Alternative 3 contemplates a single intersection linking Coleraine Drive to the East-West Arterial at the narrowest existing portion of the Rainbow Creek NHS. By relocating the single intersection to be coincident with the creek crossing, the number of crossings required for a single intersection configuration is reduced to one. Additionally, by relocating the intersection further west, the spacing between the intersections of Arterial A2 with each of Coleraine Drive and Regional Road 50 is increased. This mitigates the impact that queuing at Regional Road 50 would have on Coleraine Drive.	

Alternative 4: Shift East-West Arterial Further North	Alternative 4 considered shifting the alignment of the East-West Arterial further to the west in order to improve intersection spacing along Arterial A2 and locate the East-West Arterial such that its impacts on The Gore Tributary were minimized. This alternative would maintain a single crossing of the Rainbow Creek NHS as well as the Area 47 TMP alignment contemplated for Coleraine Drive but would relocate the main arterial road for development Block 47-1 northwest into Block 47-2.	
Alternative 5: Crossing Midway Between Alternatives 2 and 3	Alternative 5 was a compromise configuration requested by adjacent developers. It seeks to find a balance between Alternative 2, which has minimal impact on adjacent development plans but provides minimum queuing length between major intersections, and Alternative 3, which impacts both the industrial and residential developments north and south of Arterial A2. This SPA 2 configuration would require two (2) separate crossings of the Rainbow Creek NHS.	

5.2.2.2 Results of Traffic Analysis

The City's citywide EMME model was updated as a component of the City's TMP 2016 Update. The model output included revised future traffic volumes for the arterial roads within Area 47. Building on the EMME model, CIMA+ developed a Vissim model of the study area, and completed detailed Vissim microsimulation analysis for the main alternative SPA 2 configurations –

- Two (2) separate intersections (using Alternative 1 - Area 47 TMP configuration);
- Single intersection located at Area 47 TMP Coleraine Drive terminus (Alternative 2); and
- A single intersection located at the furthest contemplated distance from Regional Road 50 (using Alternative 3).

Traffic conditions for the remaining alternative configurations were measured relative to these three (3) representative cases, with Alternative 4 providing improved movements on East-West Arterial relative to Alternative 1, and Alternative 5 functioning better than Alternative 2, but not quite as well as Alternative 3. The following subsections provide an overview of the traffic modelling results for the 2041 a.m. peak period, which is the most significant in terms of design of SPA 2.

5.2.2.3 Separate Coleraine Drive and East-West Arterial Intersections (Alternative 1)

The Area 47 TMP configuration for SPA 2 was tested assuming dual left-turn lanes at the intersections of Arterial A2 and Coleraine Drive (EB) as well as Arterial A2 and Regional Road 50 (NB). During the 2041 planning horizon, this configuration results in reduced queuing on Coleraine Drive, but results in queue spillback along Arterial A2 from Regional Road 50 back through the Coleraine Drive intersection during the a.m. peak period. The East-West Arterial / Arterial A2 intersection functions well during all planning horizons / periods. Speed and LOS plots for Alternative 1 are provided in Figure 5-3.

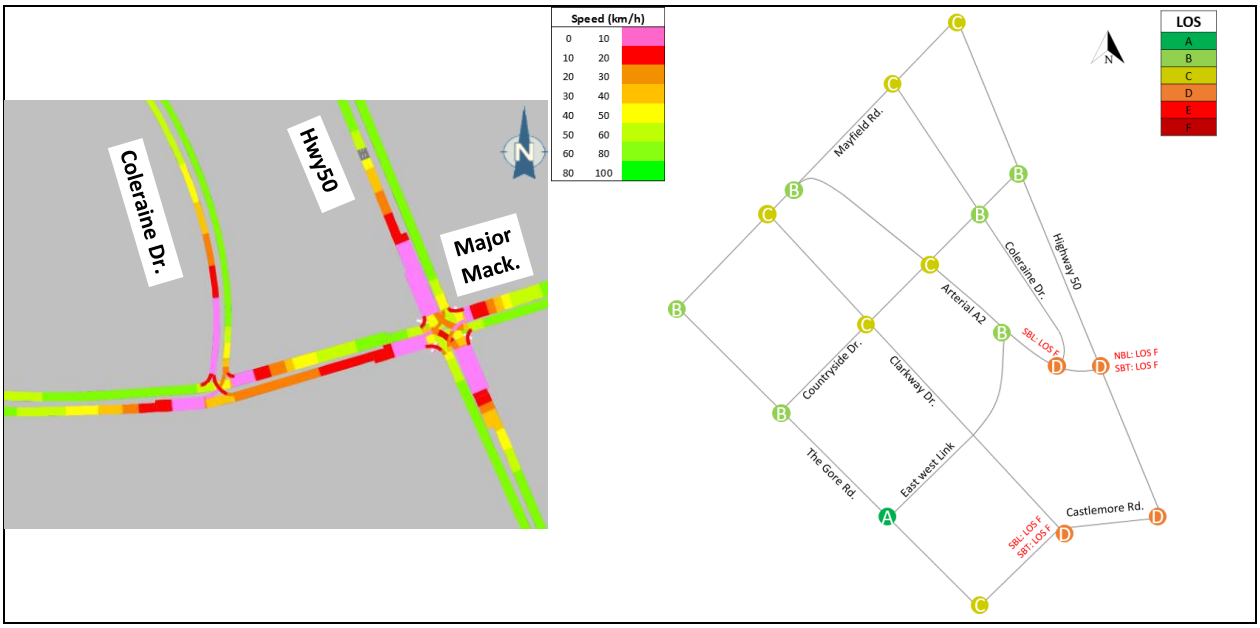


Figure 5-3: 2041 A.M. Peak Period Traffic for SPA 2 Alternative 1

5.2.2.4 Single Intersection at Area 47 TMP Coleraine Drive Alignment (Alternative 2)

The SPA 2 Alternative 2 configuration was also tested assuming dual left-turn lanes at the intersections of Arterial A2 and Coleraine Drive (EB), as well as Arterial A2 and Regional Road 50 (NB). This configuration eliminates the queue spillback from the intersection of Arterial A2 and Regional Road 50, but instead results in longer queues on both the East-West Arterial and Coleraine Drive, with all movements from Coleraine Drive operating at LOS F during the 2041 a.m. peak. Speed and LOS plots for Alternative 2 are provided in Figure 5-4.

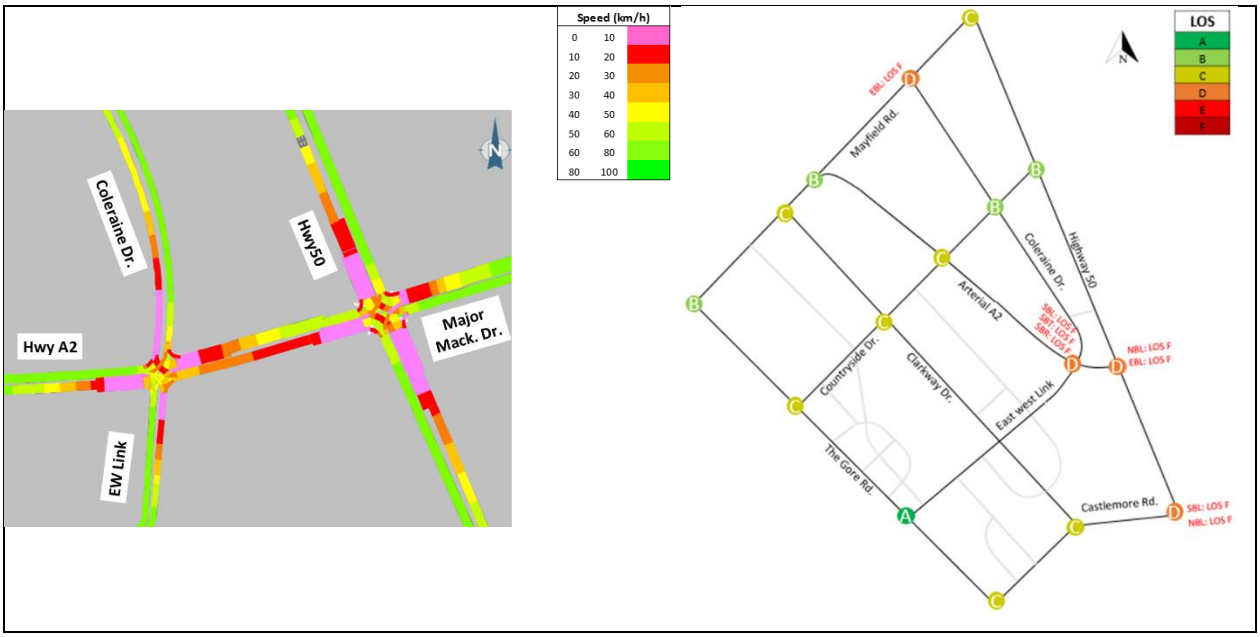


Figure 5-4: 2041 A.M. Peak Period Traffic for SPA 2 Alternative 2

5.2.2.5 Single Intersection at Narrowest Rainbow Creek Crossing (Alternative 3)

The SPA 2 Alternative 3 configuration was also tested assuming dual left-turn lanes at the intersections of Arterial A2 and Coleraine Drive (EB), as well as Arterial A2 and Regional Road 50 (NB). This configuration eliminates the queue spillback from the intersection of Arterial A2 and Regional Road 50 and has significantly reduced queues on the East-West Arterial and Coleraine Drive relative to Alternative 2. Speed and LOS plots for Alternative 3 are provided in Figure 5-5.

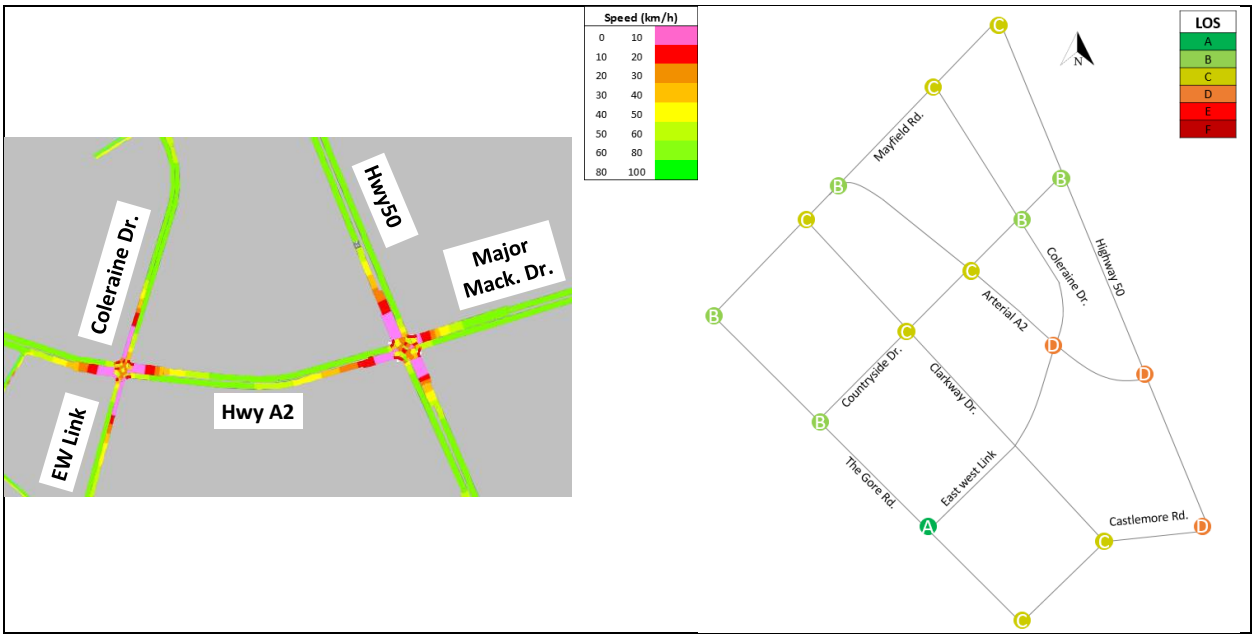


Figure 5-5: 2041 A.M. Peak Period Traffic for SPA 2 Alternative 3

5.2.2.6 Level of Service and Delay Summary for Modelled Alternatives

It should be noted that, while the LOS drawings indicate better function with Alternative 1 relative to Alternative 3, the actual differences in delay times are not significant and rather sit at the cutoff point between LOS levels. This is better communicated through the forecast delays summarized in Table 5-4 and Table 5-5. Additionally, it should be noted that while the overall intersection LOS at Coleraine Drive and East-West Arterial appear better for Alternative 1, drivers will experience delays at two (2) signalized intersections instead of just the one (1; cumulative delay).

Table 5-4: LOS and Delay for Alternative SPA 2 Configurations During the 2041 A.M. Peak

Intersection	Overall LOS / Delay (sec)		
	Alternative 1	Alternative 2	Alternative 3
Regional Road 50 at Arterial A2	D / 51	D / 53	D / 43
Coleraine Drive at Arterial A2	C / 31	D / 42	D / 38

Table 5-5: LOS and Delay for Alternative SPA 2 Configurations During the 2041 P.M. Peak

Intersection	Overall LOS/Delay (sec)		
	Alternative 1	Alternative 2	Alternative 3
Regional Road 50 at Arterial A2	D / 53	E / 58	E / 56
Coleraine Drive at Arterial A2	C / 22	D / 42	D / 42

5.2.2.7 Additional Considerations

It should also be noted that, due to congestion issues at the intersection of Major Mackenzie Drive / Arterial A2 / Regional Road 50, the Region is considering construction of an interchange at this location. Should an interchange be constructed at that location, the intersection of Coleraine Drive and Arterial A2 would need to be relocated further to the northwest to facilitate weaving movements between Coleraine Drive / East-West Arterial and the interchange ramps. This would push Coleraine Drive into the proposed Rainbow Creek NHS.

5.2.2.8 Evaluation of Alternatives

Table 5-6 provides a detailed analysis of the high-level alignment alternatives developed for SPA 2.

Table 5-6: Detailed Evaluation of Intersection Configuration Options for SPA2

Cat.		Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
Engineering	Addresses Problem and Opportunity Statement:	Provide enhanced inter-regional connectivity.		Provides enhanced regional connectivity between York Region to the east and the developing Brampton SP47 to the west.				
								
		Provide access to proposed development.		Arterial A2 provides access to proposed development in SP47, as well as connectivity to the new East-West Arterial and Countryside Drive.				
		Address anticipated capacity issues resulting from extension of Highway 427 to Major Mackenzie Drive, as well as development of the study area.		• Configuration will result in significant queueing along Arterial A2 by the 2041 horizon year and is not compatible with an interchange at Regional Road 50, if required.	• Configuration will result in significant queueing along Coleraine Drive and East-West Arterial by the 2041 horizon year and is not compatible with an interchange at Regional Road 50, if required.	• Configuration addresses issues with queue spillback from Regional Road 50, as well as queue lengths on Coleraine Drive and East-West Arterial. • Compatible with an interchange at Regional Road 50, if required.	• Configuration will result in significant queueing along Arterial A2 by the 2041 horizon year and is not compatible with an interchange at Regional Road 50, if required.	• Configuration addresses issues with queue spillback from Regional Road 50, and partially addresses issues with queue lengths on Coleraine Drive and East-West Arterial. • May be compatible with an interchange at Regional Road 50, if required.
								
		Improve roadway geometrics to meet or exceed City and Regional standards.		• Will improve geometrics at the southern limit of Coleraine Drive. • Both intersections with Arterial A2 and each of East-West Arterial and Coleraine Drive will be located on curves, which is not preferred.	• Will improve geometrics at the southern limit of Coleraine Drive. • Intersection of Arterial A2 with East-West Arterial / Coleraine Drive located on a tangent section, which is preferred.	• Will improve geometrics at the southern limit of Coleraine Drive. • Intersection of Arterial A2 with East-West Arterial / Coleraine Drive located on a curve, which is not preferred – curve radii on Arterial A2 will need to be increased.	• Will improve geometrics at the southern limit of Coleraine Drive. • Intersection of Arterial A2 and Coleraine Drive will be located on a curve, which is not preferred. • Intersection of Arterial A2 and East-West Arterial will be located on a tangent, which is preferred.	• Will improve geometrics at the southern limit of Coleraine Drive. • Intersection of Arterial A2 with East-West Arterial / Coleraine Drive located on a tangent section, which is preferred.
								
		Provide pedestrian and cycling facilities.		MUP will be provided on both sides of the roads within SPA 2.				

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
		Improve intersection safety and operations.	• Alignment of Coleraine Drive / Regional Road 50 intersection will be improved. • T-intersection configuration reduces the number of potential conflict points for left-turning vehicles and improves traffic flow (fewer signal cycles required). • Proximity of Coleraine Drive and Regional Road 50 intersections are anticipated to cause issues with queuing and weaving, increasing potential for collisions.	• Alignment of Coleraine Drive / Regional Road 50 intersection will be improved. • T-intersection configuration reduces the number of potential conflict points for left-turning vehicles and improves traffic flow (fewer signal cycles required). • Proximity of Coleraine Drive and Regional Road 50 intersections are anticipated to cause issues with queuing and weaving, increasing potential for collisions.	• Alignment of Coleraine Drive / Regional Road 50 intersection will be improved. • Coleraine Drive / Arterial A2 will be located on the inside of a curve. Sight distances for vehicles turning right onto Arterial A2 will need to be designed accordingly.	• Alignment of Coleraine Drive / Regional Road 50 intersection will be improved. • T-intersection configuration reduces the number of potential conflict points for left-turning vehicles and improves traffic flow (fewer signal cycles required). • Proximity of Coleraine Drive and Regional Road 50 intersections are anticipated to cause issues with queuing and weaving, increasing potential for collisions.	• Alignment of Coleraine Drive / Regional Road 50 intersection will be improved. • Coleraine Drive / Arterial A2 will be located on the inside of a curve. Sight distances for vehicles turning right onto Arterial A2 will need to be designed accordingly. • Proximity of Coleraine Drive and Regional Road 50 intersections are anticipated to cause issues with queuing and weaving, increasing potential for collisions.
							
		Improve watercourse crossings to enhance hydraulics, stream function and fisheries and wildlife passage.	• New crossing of Rainbow Creek by Arterial A2 will be required. • Crossing will be designed to mitigate flood risks during the Regional storm and will permit passage of both fish and wildlife.	• Two (2) new crossings of Rainbow Creek would be required – one (1) by Arterial A2 and one (1) by the East-West Arterial. • Crossing will be designed to mitigate flood risks during the Regional storm and will permit passage of both fish and wildlife.	• New crossing of Rainbow Creek at the intersection of Arterial A2 / Coleraine Drive / East-West Arterial will be required. • Intersection located over the creek will limit light penetration. Bridge structure to be designed appropriately. • Crossing will be designed to mitigate flood risks during the Regional storm and will permit passage of both fish and wildlife.	• New crossing of Rainbow Creek by Arterial A2 will be required. • Crossing will be designed to mitigate flood risks during the Regional storm and will permit passage of both fish and wildlife.	• Two (2) new crossings of Rainbow Creek would be required – one (1) by Arterial A2 and one (1) by the East-West Arterial. • Crossing will be designed to mitigate flood risks during the Regional storm and will permit passage of both fish and wildlife.
							
		Improve pavement conditions.	Roadways within SPA 2 will be fully reconstructed, providing improved pavement conditions.				
							
	Transportation Network Safety (includes natural hazards)	Safety related factors include roadway geometrics, roadside hazards, intersection design, and control, accommodating pedestrians and cyclists.	• Close spacing of Coleraine Drive and Regional Road 50 intersections with Arterial A2 are anticipated to result in issues with queue spillback, as well as issues with weaving distances if an interchange is constructed at Regional Road 50. • Intersections are located on tangent section or on outside of a curve, which is preferred.	• Close spacing of Coleraine Drive and Regional Road 50 intersections with Arterial A2 are anticipated to result in issues with weaving distances if an interchange is constructed at Regional Road 50. • Intersections are located on tangent section which is preferred. • Additional signal cycle time will be required to accommodate pedestrian and cyclist crossing.	• Intersection is located on a curve, with Coleraine Drive on the inside of the curve on Arterial A2. While the intersection is signalized, adequate sight distance triangles will need to be maintained when developing NHS planting plans and when industrial plans are developed. • Additional signal cycle time will be required to accommodate pedestrian and cyclist crossing.	• Close spacing of Coleraine Drive and Regional Road 50 intersections with Arterial A2 are anticipated to result in issues with queue spillback, as well as issues with weaving distances if an interchange is constructed at Regional Road 50. • Intersections are located on tangent section or on outside of a curve, which is preferred.	• Spacing of Coleraine Drive and Regional Road 50 intersections with Arterial A2 may result in issues with weaving distances if an interchange is constructed at Regional Road 50. • Intersection is located on a curve, with Coleraine Drive on the inside of the curve on Arterial A2. While the intersection is signalized, adequate sight distance triangles will need to be maintained when developing NHS

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
			• Pedestrian and cyclist crossings at Coleraine Drive and East-West Arterial will require dedicated phases.			• Pedestrian and cyclist crossings at Coleraine Drive and East-West Arterial will require dedicated phases.	planting plans and when industrial plans are developed. • Additional signal cycle time will be required to accommodate pedestrian and cyclist crossing.
							
	Transportation Network Connectivity		• Good arterial road connectivity to adjacent development. • East-west to north-south movements between the East-West Arterial and Coleraine Drive requires weaving movement.	• Good arterial road connectivity to adjacent development. • Good connectivity between east-west to north-south movements between the East-West Arterial and Coleraine Drive.	• Good arterial road connectivity to adjacent development. • Good connectivity between east-west to north-south movements between the East-West Arterial and Coleraine Drive.	• Poor arterial road connectivity through residential area planned for south of the TransCanada Pipeline.	• Good arterial road connectivity to adjacent development. • Good connectivity between east-west to north-south movements between the East-West Arterial and Coleraine Drive.
							
	Transportation Network Capacity	Impacts of traffic on local roads and outside the study area. Transportation network improvement and accommodation of goods movement.	• Close spacing of intersections along Arterial A2 are anticipated to result in queue spillback from the Regional Road 50 intersection back through the Coleraine Drive intersection.	• Significant queue lengths are anticipated along Coleraine Drive and the East-West Arterial, which make access to these roadways difficult during peak periods.	• No queue spillback anticipated from Regional Road 50. • Reduced queue lengths anticipated on Coleraine Drive and East-West Arterial.	• Close spacing of intersections along Arterial A2 are anticipated to result in queue spillback from the Regional Road 50 intersection back through the Coleraine Drive intersection.	• Potential for queue spillback from Regional Road 50, as well as increased queue lengths on Coleraine Drive and East-West Arterial.
							
	Impact on Active Transportation	Impact on the safety and usability of planned AT infrastructure, as well as adherence to City AT policy.	• Active transportation facilities will be provided on all roadways within SPA 2. • Queue spill-back through the Regional Road 50 and Coleraine Drive intersections is likely to result in higher risk-taking of drivers trying to enter the intersections, and consequently less attention to pedestrians and cyclists trying to cross the roadway (particularly for right and left-turning vehicles). • Dedicated AT-only signals will be required to enable crossing of Arterial A2 at each of the East-West Arterial and Coleraine Drive.	• Active transportation facilities will be provided on all roadways within SPA 2. • Queue spill-back through the Regional Road 50 and Coleraine Drive / East-West Arterial intersections is likely to result in higher risk-taking of drivers trying to enter the intersection, and consequently less attention to pedestrians and cyclists trying to cross the roadway (particularly for right and left-turning vehicles).	• Active transportation facilities will be provided on all roadways within SPA 2. • Single high-volume intersection with longer crossing distances at Arterial A2 / Coleraine Drive / East-West Arterial will require a design that includes pedestrian refuges. • Higher volume intersection is likely to result in higher risk-taking of drivers trying to enter the intersections, and consequently less attention to pedestrians and cyclists trying to cross the roadway (particularly for right and left-turning vehicles).	• Active transportation facilities will be provided on all roadways within SPA 2. • No arterial roadway access to the Block 47-1 development south of the TransCanada Pipeline corridor will make cycling inconvenient between origins / destinations on either side of Arterial A2.	• Active transportation facilities will be provided on all roadways within SPA 2. • Higher volume intersection is likely to result in higher risk-taking of drivers trying to enter the intersections, and consequently less attention to pedestrians and cyclists trying to cross the roadway (particularly for right and left-turning vehicles).
							

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
	Transit Supportive Development	Potential adverse impact on transit service. Assessment of impact on planned transit service improvements.	• Buses travelling along Arterial A2 between Countryside Drive and Regional Road 50 will be required to pass through two (2) signalized intersections (with associated delay). • Connectivity between Secondary Routes and the Community GO Shuttle on Arterial A2 will require a total of eight (8) stop locations (four (4) at each of East-West Arterial and Coleraine Drive). • Transit riders will be required to cross the intersections to access platforms for transit connections (three (3) conflict points at each intersection for the various connection scenarios). • Depending on routing, transfers for eastbound or westbound travelers may require transfers at both East-West Arterial and Coleraine Drive stops.	• Buses travelling along Arterial A2 between Countryside Drive and Regional Road 50 will be required to pass through only one (1) intersection on route to Regional Road 50. • Connectivity between Secondary Routes and the Community GO Shuttle on Arterial A2 will require a total of four (4) stop locations (one in each quadrant of the intersection). • Transit riders will be required to cross the high-traffic intersection to access platforms for transit connections (eight (8) conflict points for the various connection scenarios).	• Buses travelling along Arterial A2 between Countryside Drive and Regional Road 50 will be required to pass through only one (1) intersection on route to Regional Road 50. • Connectivity between Secondary Routes and the Community GO Shuttle on Arterial A2 will require a total of four (4) stop locations (one in each quadrant of the intersection). • Transit riders will be required to cross the high-traffic intersection to access platforms for transit connections (eight (8) conflict points for the various connection scenarios).	• Buses travelling along Arterial A2 between Countryside Drive and Regional Road 50 will be required to pass through two (2) signalized intersections (with associated delay). • Connectivity between Secondary Routes and the Community GO Shuttle on Arterial A2 will require a total of eight (8) stop locations (four (4) at each of East-West Arterial and Coleraine Drive). • Transit riders will be required to cross the intersections to access platforms for transit connections (three (3) conflict points at each intersection for the various connection scenarios). • Depending on routing, transfers for eastbound or westbound travelers may require transfers at both East-West Arterial and Coleraine Drive stops.	• Buses travelling along Arterial A2 between Countryside Drive and Regional Road 50 will be required to pass through only one (1) intersection on route to Regional Road 50. • Connectivity between Secondary Routes and the Community GO Shuttle on Arterial A2 will require a total of four (4) stop locations (one (1) in each quadrant of the intersection). • Transit riders will be required to cross the high-traffic intersection to access platforms for transit connections (eight (8) conflict points for the various connection scenarios).
							
	Structural Impacts	Potential adverse impact on existing structures.	No existing structures to be impacted.				
							
		Potential impact on proposed structures.	• New crossing of Rainbow Creek by Arterial A2 will be required. • Approximate bridge deck area to be 3,000 m^2.	• To new crossings of Rainbow Creek would be required – one (1) by Arterial A2 and one (1) by the East-West Arterial. • Approximate bridge deck areas would be 2,800 m^2 and 1,750 m^2 respectively.	• New crossing of Rainbow Creek at the intersection of Arterial A2 / Coleraine Drive / East-West Arterial will be required. • Approximate bridge deck area to be 6,100 m^2.	• New crossing of Rainbow Creek by Arterial A2 will be required. • Approximate bridge deck area to be 3,000 m^2.	• To new crossings of Rainbow Creek would be required – one (1) by Arterial A2 and one (1) by the East-West Arterial. • Approximate bridge deck areas would be 2,900 m^2 and 4,000 m^2 respectively.
							
	Hydraulics and Hydrology Impacts (Creeks)	Impact on floodplain, existing flood depths at proposed crossing locations, and existing flood return period.	• 1.0 ha of new linear infrastructure to be constructed within the existing Rainbow Creek floodplain. • Minor impacts to hydraulics and hydrology.	• 2.9 ha of new linear infrastructure to be constructed within the floodplain. • Significant impact to hydraulics and hydrology.	• 1.7 ha of new linear infrastructure to be constructed within the existing Rainbow Creek floodplain. • Moderate impacts to hydraulics and hydrology.	• 1.5 ha of new linear infrastructure to be constructed within the existing Rainbow Creek floodplain. • Moderate impacts to hydraulics and hydrology.	• 1.0 ha of new linear infrastructure to be constructed within the existing Rainbow Creek floodplain. • Minor impacts to hydraulics and hydrology.
							

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
Financial	Utility Relocation	Ability to minimize effects on existing and proposed utilities.	• Approximately 780 m of gas, sanitary sewer and watermain, as well as 1,560 m of overhead utilities will be impacted by this new alignment (along existing Coleraine Drive).	• Approximately 760 m of gas, sanitary sewer and watermain, as well as 1,520 m of overhead utilities will be impacted by this new alignment (along existing Coleraine Drive).	• Approximately 980 m of gas, sanitary sewer and watermain, as well as 1,960 m of overhead utilities will be impacted by this new alignment (along existing Coleraine Drive).	• Approximately 780 m of gas, sanitary sewer and watermain, as well as 1,560 m of overhead utilities will be impacted by this new alignment (along existing Coleraine Drive).	• Approximately 960 m of gas, sanitary sewer and watermain, as well as 1,920 m of overhead utilities will be impacted by this new alignment (along existing Coleraine Drive).
							
	Capital Costs	Function of total road length and width, AT facilities provided, intersection infrastructure, structural area required, and amount of utility relocation.	• Increased cost due to need for two (2) intersections and 1,663 m of auxiliary lane (total of 1,544 m at Regional Road 50 intersection, and 119 m on Coleraine Drive). • Approximate new roadway length within SPA 2 is 3.4 km. • Approximately 2,400 m of utility relocation required. • Lowest structural costs. • Median capital cost.	• Need for 1,492 m of auxiliary lanes due to queuing on Coleraine Drive and East-West arterial (total of 1,028 m at Regional Road 50 intersection and 464 m on Coleraine Drive). • Approximate new roadway length within SPA 2 is 3.5 km. • Approximately 2,300 m of utility relocation required. • Substantial structural costs (two (2) bridges required). • High capital cost.	• Need for 1022 m of auxiliary lanes (total of 922 m at Regional Road 50 intersection and 200 m on Coleraine Drive). • Approximate new roadway length within SPA 2 is 3.2 km. • Approximately 3,000 m of utility relocation required. • Substantial structural costs due to structural requirements associated with placing an intersection over a creek. • High capital cost.	• Increased cost due to need for two (2) intersections and 1,663 m of auxiliary lane (total of 1,544 m at Regional Road 50 intersection, and 119 m on Coleraine Drive). • Approximate new roadway length within SPA 2 is 3.0 km. • Approximately 2,300 m of utility relocation required. • Lowest structural costs. • Median capital cost.	• Need for approximately 1,400 m of auxiliary lanes. • Approximate new roadway length within SPA 2 is 3.4 km. • Approximately 3,000 m of utility relocation required. • Substantial structural costs (two (2) bridges required). • High capital cost.
							
	Operating Costs	Function of road length, area of bridge structures (for maintenance) and number of traffic signals.	• Approximate new roadway length within SPA 2 is 3.4 km. • Approximate bridge deck area to be 3,000 m^2. • Three (3) signalized intersections (Regional Road 50, Coleraine Drive and East-West Arterial). • Median annualized operating cost.	• Approximate new roadway length within SPA 2 is 3.5 km. • Approximate total bridge deck areas would be 4,600 m^2. • Two (2) signalized intersections (Regional Road 50, and Coleraine Drive / East-West Arterial). • Median annualized operating cost.	• Approximate new roadway length within SPA 2 is 3.2 km. • Approximate bridge deck area to be 6,100 m^2. • Two (2) signalized intersections (Regional Road 50, and Coleraine Drive / East-West Arterial). • Median annualized operating cost.	• Approximate new roadway length within SPA 2 is 3.0 km • Approximate bridge deck area to be 3,000 m^2. • Three (3) signalized intersections (Regional Road 50, Coleraine Drive and East-West Arterial). • Median annualized operating cost.	• Approximate new roadway length within SPA 2 is 3.4 km. • Approximate bridge deck areas would be 6,900 m^2. • Two (2) signalized intersections (Regional Road 50, and Coleraine Drive / East-West Arterial). • High annualized operating cost.
							
	Property Acquisition	Approximate area of property required for construction of each alternative.	• Approximately 12.5 ha of property required for new roadways. • Median property acquisition cost.	• Approximately 13.1 ha of property required for new roadways. • Median property acquisition cost.	• Approximately 13.9 ha of property required for new roadways. • High property acquisition cost.	• Approximately 11.5 ha of property required for new roadways. • Low property acquisition cost.	• Approximately 13.3 ha of property required for new roadways. • Median property acquisition cost.
							

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
Social / Cultural Environment	Conformance to Planning Objectives (Growth Plan, Official Plan, Secondary Plan, Area 47 (Area 47 TMP)		• Arterial roads configurations are as assumed during development of the Secondary Plan, Area 47 TMP, and associated active development plans.	• Alignments of Arterial A2 and Coleraine Drive are as assumed during development of the Secondary Plan, Area 47 TMP and associated active development plans. • Some redesign of the residential area along East-West Arterial at Arterial A2 will be required.	• Meets the transportation objectives outlined in the Growth Plan, Official Plan and Area 47 TMP. • Alignments of Coleraine Drive and East-West Arterial are significantly different than were contemplated during creation of the adjacent active development plans.	• Alignments of Arterial A2 and Coleraine Drive are as assumed during development of the Secondary Plan, Area 47 TMP and associated active development plans. • Provision of arterial road connectivity south of the TransCanada Pipeline is not as contemplated during the Area 47 TMP or creation of the active development plans for Blocks 47-1 through 47-3.	• Meets the transportation objectives outlined in the Growth Plan, Official Plan and Area 47 TMP. • Alignments of Coleraine Drive and East-West Arterial are significantly different than were contemplated during creation of the adjacent active development plans.
							
	Residential / Business Access and Displacement	Existing residences and businesses.	• Single existing residential building will require removal. • No anticipated impacts to existing commercial or industrial facilities.	• Single existing residential building will require removal. • Depending on alignment of East-West Arterial, impacts to one (1) or more existing industrial facilities on Cadetta Road could be anticipated.	• No anticipated impacts to existing residential, commercial or industrial facilities.	• Multiple existing residential buildings will require removal – one (1) along Coleraine Drive and two (2) on Clarkway Drive.	• Single existing residential building will require removal. • No anticipated impacts to existing commercial or industrial facilities.
							
		Planned residential, commercial and industrial developments.	• No negative impacts to planned residential, commercial or industrial developments.	• Significant impacts to planned residential development north of the TransCanada Pipeline and east of Clarkway Drive. Property currently designated for residential development may need to be converted for commercial development.	• Impacts to planned industrial, commercial and residential development adjacent to the proposed intersection. • Reconfiguration of building / parking layouts and properties will be required.	• Significant impacts to planned residential and commercial development within Blocks 47-1 and 47-2 due to lack of east-west arterial connection south of the TransCanada Pipeline.	• Impacts to planned industrial, commercial and residential development adjacent to the proposed intersection. • Reconfiguration of building / parking layouts and properties will be required.
							
	Emergency Services (Police, Fire, Ambulance)	Potential to reduce response times.	• Queue spillback through adjacent intersections at Coleraine Drive and Regional Road 50 during peak periods has the potential to cause delays to emergency response vehicles. • Emergency response vehicles will need to travel through two (2) intersections between Countryside Drive and Regional Road 50.	• Queue spillback through adjacent intersections at Coleraine Drive / East-West Arterial and Regional Road 50 during peak periods has the potential to cause delays to emergency response vehicles. • Emergency response vehicles will need to travel through two (2) intersections between Countryside Drive and Regional Road 50.	• Elimination of queue spillback between adjacent intersections has the potential to allow for reduced emergency vehicle response times. • Emergency response vehicles will need to travel through one (1) intersection between Countryside Drive and Regional Road 50.	• Queue spillback through adjacent intersections at Coleraine Drive and Regional Road 50 during peak periods has the potential to cause delays to emergency response vehicles. • Emergency response vehicles will need to travel through two (2) intersections between Countryside Drive and Regional Road 50.	• Elimination of queue spillback between adjacent intersections has the potential to allow for reduced emergency vehicle response times. • Emergency response vehicles will need to travel through one (1) intersection between Countryside Drive and Regional Road 50.
							

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
	Noise Level Impacts	Potential effects of traffic related noise on residences, community facilities, or institutions adjacent to and/or within the study area.	• No significant differences from the majority of other alternatives.	• Increased queuing on East-West Arterial will result in increases in noise levels during the peak periods relative to other alternatives.	• No significant differences from the majority of other alternatives.	• No significant differences from the majority of other alternatives.	• No significant differences from the majority of other alternatives.
							
	Cultural Heritage Impacts	Potential adverse impacts on archaeological resources and built heritage adjacent to and/or within the study area.	No significant difference among alternatives. No built or cultural heritage properties located within SPA 2. Archaeological potential identified for the entirety of SPA 2.				
	Agricultural Impacts	Impact on existing agricultural properties.	• Approximately 12.5 ha of agricultural property required for new roadways. • Three (3) existing agricultural properties that front onto Coleraine Drive and one (1) that fronts onto Clarkway Drive will be significantly segmented. • The back portions of five (5) existing agricultural properties that front onto Clarkway Drive will be significantly impacted. • All impact lands to be redeveloped. • Median impacts to existing agricultural properties.	• Approximately 13.1 ha of agricultural property required for new roadways. • Three (3) existing agricultural properties that front onto Coleraine Drive and one (1) that fronts onto Clarkway Drive will be significantly segmented. • All impact lands to be redeveloped. • Limited impacts to existing agricultural properties.	• Approximately 13.9 ha of agricultural property required for new roadways. • Three (3) existing agricultural properties that front onto Coleraine Drive and one (1) that fronts onto Clarkway Drive will be significantly segmented. • All impact lands to be redeveloped. • Limited impacts to existing agricultural properties.	• Approximately 11.5 ha of agricultural property required for new roadways. • Three (3) existing agricultural properties that front onto Coleraine Drive will be significantly segmented. • Edge impacts to existing agricultural properties that front onto Clarkway Drive. • All impact lands to be redeveloped. • Limited impacts to existing agricultural properties.	• Approximately 13.3 ha of agricultural property required for new roadways. • Four (4) existing agricultural properties that front onto Coleraine Drive and three (3) that front onto Clarkway Drive will be significantly segmented. • The back portions of three (3) existing agricultural properties that front onto Clarkway Drive will be significantly impacted. • All impact lands to be redeveloped. • Significant impacts to existing agricultural properties.
							
Natural Environment	Impact to Designated Natural Heritage Features including wetlands	Proximity to and significance of impact to designated feature.	No existing designated natural heritage feature or wetlands impacted.				
	Impact to Natural Heritage Features such as vegetation and watercourses	Proximity, size, characteristics, and sensitivity of significant rural areas, terrestrial ecosystems, and wetlands. Potential impact or loss of natural areas, terrestrial ecosystems or wetland areas, function or habitat.	• Single crossing of Rainbow Creek NHS. • Least significant impact to this feature due to smallest crossing structure. • Approximate length of NHS crossing is 140 m.	• Two (2) crossings of the Rainbow Creek NHS. • Crossing will be nearly perpendicular to the NHS alignment. • Approximate length of NHS crossing is 380 m (140 m for Arterial A2 and 230 m for East-West Arterial).	• Single, wide crossing of Rainbow Creek NHS. • Intersection footprint to be minimized through the use of retained soil systems. • Approximate length of NHS crossing is 290 m (includes both Arterial A2 and Coleraine Drive / East-West Arterial).	• Single crossing of Rainbow Creek NHS. • Least significant impact to this feature due to smallest crossing structure. • Approximate length of NHS crossing is 140 m.	• Two (2) crossings of the Rainbow Creek NHS. • While northerly crossing will be nearly perpendicular to the NHS alignment, the southerly crossing will run diagonally and have significant impacts. • Approximate length of NHS crossing is 450 m (140 m for Arterial A2 and 340 m for East-West Arterial).
							

Cat.	Criteria	Criteria Indicator	Alternative 1 SP47 TMP Alignment	Alternative 2 Single Intersection with East-West Arterial Realigned to Coleraine Drive	Alternative 3 Single Intersection at Narrow Crossing of Rainbow Creek	Alternative 4 Shift East-West Arterial Further North	Alternative 5 Single Intersection Located Midway Between Alternatives 2 and 3
	Impact to Avian, Wildlife and Plant SAR	Potential effects on avian and wildlife including SAR identified in the study area.	• Approximately 2.1 ha of potential Bobolink habitat will be impacted by Arterial A2 (common to all alternatives). • Approximately 80 m of East-West Arterial will border on potential Bobolink habitat. • Bobolink and Eastern Meadowlark were observed breeding along both Arterial A2 and East-West Arterial alignments.	• Approximately 2.1 ha of potential Bobolink habitat will be impacted by Arterial A2 (common to all alternatives). • Bobolink were observed breeding along proposed Arterial A2 alignment.	• Approximately 2.5 ha of potential Bobolink habitat will be impacted by Arterial A2 (common to all alternatives). • Approximately 80 m of East-West Arterial will border on potential Bobolink habitat. • Bobolink and Eastern Meadowlark were observed breeding along both Arterial A2 and East-West Arterial alignments.	• Approximately 2.1 ha of potential Bobolink habitat will be impacted by Arterial A2 (common to all alternatives). • Alignment runs along the northern limit of approximately 270 m of potential Bobolink and/or Eastern Meadowlark habitat. • Bobolink were observed breeding along proposed Arterial A2 alignment.	• Approximately 2.1 ha of potential Bobolink habitat will be impacted by Arterial A2 (common to all alternatives). • Bobolink were observed breeding along proposed Arterial A2 alignment.
							
	Groundwater Impacts	Potential for adverse effects on existing groundwater resources (water quality and/or quantity).	• 12.5 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods.	• 13.1 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods.	• 13.9 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods.	• 11.5 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods.	• 13.3 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods.
							
OVERALL RANKING (Percentage of Total Available Score)							
PREFERRED ALTERNATIVE	With all evaluation criteria weighted equally, Alternative 1 rates highest overall, followed closely by Alternative 3. As Alternative 1 is not compatible with the future construction of an interchange at Regional Road 50 and Major Mackenzie Drive / Arterial A2 due to insufficient weaving distances between the intersection of Arterial A2 / Coleraine Drive and the future interchange, **Alternative 3 is the Preferred Alternative**						

Legend:	Good	⟷	Poor
			

5.2.2.9 Preferred Alternative

As a result of its ability to eliminate issues with traffic from Regional Road 50 queuing back through the Coleraine Drive intersection, compatibility with a potential future interchange at Regional Road 50 / Major Mackenzie Drive, as well as the potential to limit the number of crossings of Rainbow Creek to one (1; albeit longer) structure, Alternative 3 is the preferred configuration identified for SPA 2.

5.2.2.10 Overview of Refined Alternatives

Identified issues with Alternative 3 specifically relate to impacts to the Rainbow Creek NHS and proposed development plans. A series of refined alternatives to the original Alternative 3 concept were developed and reviewed with impacted developers. Table 5-7 shows the refined designs. Evaluation of the refined Alternative 3 concepts is provided in Table 5-8.

Table 5-7: Refined Alternatives to the Original Alternative 3

Alternatives	Descriptions
Alternative 3A	Alternative 3A is a minor refinement to the original Alternative 3 concept discussed in more detail in previous sections. This alternative located the single crossing structure at the narrowest existing portion of the Rainbow Creek floodplain, requiring realignment of Arterial A2, Coleraine Drive and East-West Arterial. Refinement of the proposed East-West arterial alignment was made adjacent to the proposed community park at Clarkway Drive in order to avoid impacts on that community feature. The design refinement necessitates a reduction in the design speed of East-West Arterial to 70 km/h (originally proposed at 90 km/h).
Alternative 3B	Alternative 3B reverts to the SP47 TMP-proposed alignment of Arterial A2 and relocates the single intersection to the eastern limit of where Arterial A2 crosses into the Rainbow Creek NHS. This alternative was developed in an attempt to reduce impacts to the proposed development and the proposed community park within Block 47-1, while maintaining 90 km/h design speeds on all three (3) impacted arterial roadways. Pursuit of this alternative would require realignment of Rainbow Creek at the crossing location and would result in increased length of the East-West Arterial being located within the Rainbow Creek NHS.
Alternative 3C	Alternative 3C reverts to the SP47 TMP-proposed alignment of Arterial A2 and relocates the single intersection to the mid-point of this Arterial A2 alignment's crossing of the Rainbow Creek NHS. In order to limit impacts to the proposed community park at the intersection of East-West Arterial and Clarkway Drive, the design speed on the East-West Arterial would need to be reduced to 70 km/h.
Alternative 3D	Alternative 3D considers reduced design speeds on both Coleraine Drive and the East-West Arterial in order to mitigate impacts to the proposed community park and residential development along the East-West Arterial, as well as the proposed development proposed along Coleraine Drive. In order to do this and keep the angles of intersection of Arterial A2 with both Coleraine Drive and East-West Arterial within an acceptable range, the alignment of Arterial A2 is modified to include a larger radius curve adjacent to the single intersection.

Table 5-8: Evaluation of the Refined Alternative 3 Concepts

Cat.	Criteria	Criteria Indicator	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 3D
Engineering	Addresses Problem and Opportunity Statement		No significant difference between alternatives.			
	Transportation Network Safety (includes natural hazards)	Safety related factors include roadway geometrics, roadside hazards, intersection design, and control, accommodating pedestrians and cyclists.	• Larger diameter curve on Arterial A2 will improve sight distances from Coleraine Drive. • Minimal area within the NHS will require guiderail and retained soil systems to minimize impact. • Reduced design speed on East-West Arterial improves safety and minimizes speed differentials along collectors.	• Smaller diameter curve on Arterial A2 may necessitate right-turn on red restrictions on Coleraine Drive. • Significant area within the NHS will require guiderail and retained soil systems to minimize impact.	• Smaller diameter curve on Arterial A2 may necessitate right-turn on red restrictions on Coleraine Drive. • Minimal area within the NHS will require guiderail and retained soil systems to minimize impact. • Reduced design speed on East-West Arterial improves safety and minimizes speed differentials along collectors.	• Larger diameter curve on Arterial A2 will improve sight distances from Coleraine Drive. • Minimal area within the NHS will require guiderail and retained soil systems to minimize impact. • Reduced design speeds on Coleraine Drive and East-West Arterial improves safety and minimizes speed differentials between arterials and collectors.
						
	Transportation Network Connectivity		No significant difference between alternatives.			
	Transportation Network Capacity	Impacts of traffic on local roads and outside the study area. Transportation network improvement and accommodation of goods movement.	No significant difference between alternatives.			
	Promotion of Active Transportation	Encourages the use of active transportation.	No significant difference between alternatives.			
	Transit Supportive Development	Potential adverse impact on transit service. Assessment of impact on planned transit service improvements.	No significant difference between alternatives.			
	Structural Impacts	Potential adverse impact on existing structures.	No significant difference between alternatives.			
	Stormwater Management and LID		No significant difference between alternatives.			
	Hydraulics and Hydrology Impacts (Creeks)		• Minimized crossing structure size and floodplain impacts. • All structures will be designed to applicable standards.	• Due to angle of intersection between roadways and creek / NHS, maximum crossing structure size and floodplain impacts to be anticipated. • All structures will be designed to applicable standards.	• Minimal increase in structure sizing and floodplain impacts relative to alternatives 3A and 3D. • All structures will be designed to applicable standards.	• Minimized crossing structure size and floodplain impacts. • All structures will be designed to applicable standards.
						
Financial	Utility Relocation	Ability to minimize effects on existing and proposed utilities.	No significant difference between alternatives.			

Cat.	Criteria	Criteria Indicator	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 3D
Social / Cultural Environment	Capital Costs		• Least significant capital cost due to least amount of roadway being located within the Rainbow Creek NHS (requires least amount of guiderail and retained soil systems).	• Most significant capital cost due to highest amount of roadway being located within the Rainbow Creek NHS (requires highest amount of guiderail and retained soil systems).	• Capital cost minimally increased relative to Alternatives 3A and 3D due to intersection location within portion of Rainbow Creek NHS which is wider than those two (2) intersections.	• Least significant capital cost due to least amount of roadway being located within the Rainbow Creek NHS (requires least amount of guiderail and retained soil systems).
						
	Operating Costs	Function of road length and number of traffic signals.	No significant difference between alternatives.			
	Property Acquisition		No significant difference between alternatives.			
	Conformance to Planning Objectives (Growth Plan, Official Plan, Secondary Plan, Area 47 TMP)		No significant difference between alternatives.			
	Residential / Business Access and Displacement	Existing residences and businesses.	No significant difference between alternatives.			
		Planned residential, commercial and industrial developments.	• Significant impacts to industrial block plan along Coleraine Drive.	• Significant impacts to industrial block plan along Coleraine Drive, as well as residential area planned between Rainbow Creek and the East-West Arterial.	• Significant impacts to industrial block plan along Coleraine Drive, as well as moderate impacts to residential area planned between Rainbow Creek and the East-West Arterial.	• Significant impacts to industrial block plan at southern limit of Coleraine Drive.
						
	Emergency Services (Police, Fire, Ambulance)	Potential to reduce response times. Potential adverse effects include changes to existing entrances and limited access during construction.	No significant difference between alternatives.			
	Noise Level Impacts	Potential effects of traffic related noise on residences, community facilities, or institutions adjacent to and/or within the study area.	No significant difference between alternatives.			
	Cultural Heritage Impacts	Potential adverse impacts on archaeological resources and built heritage adjacent to and/or within the study area.	No significant difference between alternatives.			
	Agricultural Impacts	Impact on existing agricultural properties.	No significant difference between alternatives.			
Natural Environment	Impact to Designated Natural Heritage Features including wetlands	Proximity to and significance of impact to designated feature.	No existing designated natural heritage feature or wetlands impacted.			

Cat.	Criteria	Criteria Indicator	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 3D
	Impact to Natural Heritage Features such as vegetation and watercourses	Proximity, size, characteristics, and sensitivity of significant rural areas, terrestrial ecosystems, and wetlands. Potential impact or loss of natural areas, terrestrial ecosystems or wetland areas, function or habitat.	• Single, wide crossing of Rainbow Creek NHS. • Intersection footprint to be minimized through the use of retained soil systems. • Approximate length of NHS crossing is 320 m (includes both 185 m of Arterial A2 and 135 m of Coleraine Drive / East-West Arterial).	• Two (2) crossings of Rainbow Creek NHS. • Footprints to be minimized through the use of retained soil systems. • Approximate length of NHS crossing is 4,400 m (includes both 140 m of Arterial A2 and 300 m of Coleraine Drive / East-West Arterial).	• Single, wide crossing of Rainbow Creek NHS. • Intersection footprint to be minimized through the use of retained soil systems. • Approximate length of NHS crossing is 300 m (includes both 140 m of Arterial A2 and 160 m of Coleraine Drive / East-West Arterial).	• Single, wide crossing of Rainbow Creek NHS. • Intersection footprint to be minimized through the use of retained soil systems. • Approximate length of NHS crossing is 310 m (includes both 170 m of Arterial A2 and 140 m of Coleraine Drive / East-West Arterial).
						
	Avian and Wildlife Environment Impacts including SAR	Potential effects on avian and wildlife including SAR identified in the study area.	• Proposed alignment of Arterial A2 crosses through identified Bobolink Habitat (all alternatives). • Alignment of East-West Arterial located in close proximity to identified Eastern Meadowlark Habitat.	• Proposed alignment of Arterial A2 crosses through identified Bobolink Habitat (all alternatives).	• Proposed alignment of Arterial A2 crosses through identified Bobolink Habitat (all alternatives).	• Proposed alignment of Arterial A2 crosses through identified Bobolink Habitat (all alternatives). • Alignment of East-West Arterial located in close proximity to identified Eastern Meadowlark Habitat.
						
	Watercourses and Aquatic Environment Impacts	Potential to minimize impact on aquatic features.	• Minimized impact to Rainbow Creek and associated NHS.	• Existing Rainbow Creek would need to be realigned in order for a single crossing to be realized with this alternative.	• Minimal increase to impacts on Rainbow Creek and its associated NHS resulting from southerly shift and less perpendicular intersection with those features.	• Minimized impact to Rainbow Creek and associated NHS.
						
	Groundwater Impacts	Potential for adverse effects on existing groundwater resources (water quality and/or quantity).	No significant difference between alternatives.			
OVERALL RANKING						
PREFERRED ALTERNATIVE			**Alternative 3D is the Preferred Refined Alternative.**			

Legend: Good ⟷ Poor

5.2.2.11 Recommended Arterial Road Configuration Within SPA 2

The recommended intersection configuration for SPA 2 is Alternative 3D. This configuration consists of a single intersection of Arterial A2, Coleraine Drive and East-West Arterial centered on a single Rainbow Creek crossing. In order to reduce impacts to adjacent development, design speeds on Coleraine Drive and East-West Arterial may be reduced to 70 km/h (posted at 60 km/h). The proposed arterial corridor alignments are shown in Figure 5-6, in juxtaposition with the proposed development and Rainbow Creek NHS plans.

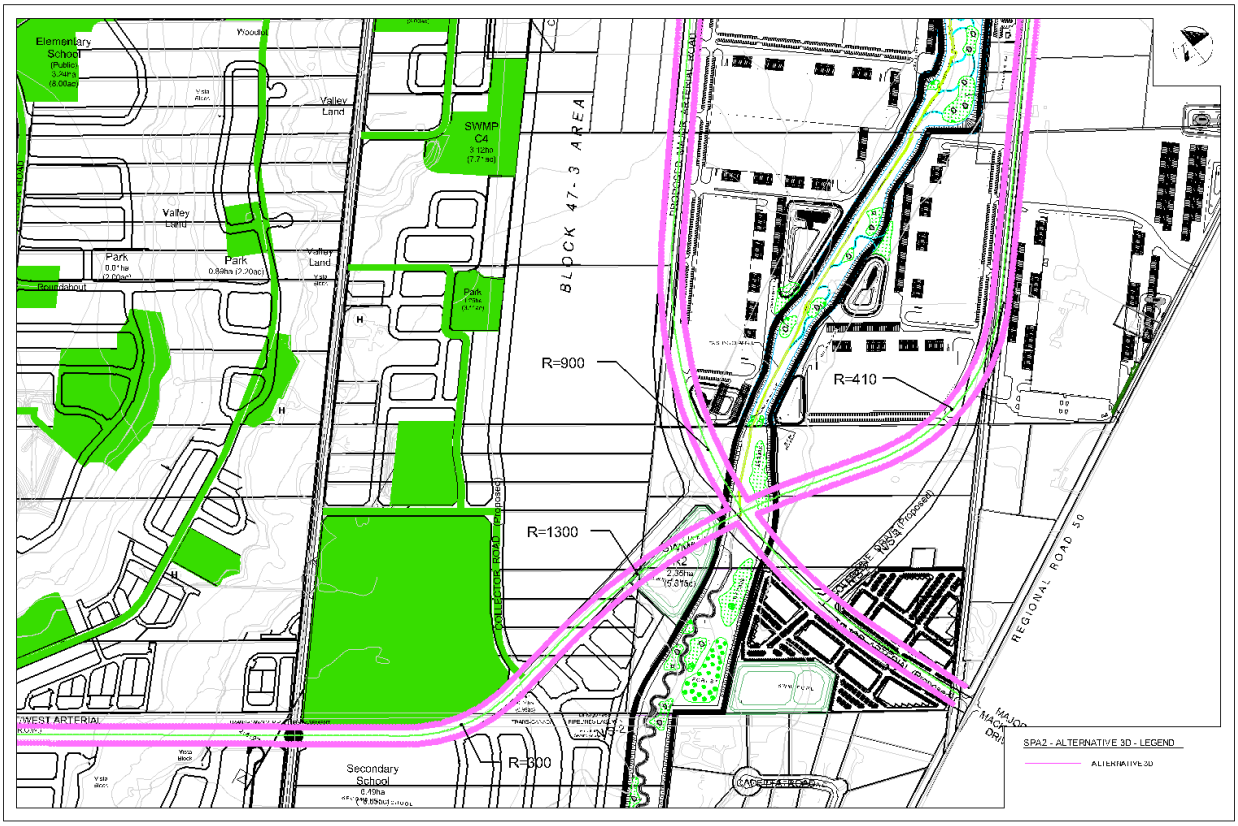


Figure 5-6: Recommended Arterial Road Configuration for SPA 2

5.3 New Arterial Roadways - Arterial A2

This new, six (6) lane, major arterial roadway will run north-south between Mayfield Road and the intersection of Major Mackenzie Drive / Regional Road 50. Its northern extent falls within the limits of SPA 1, while its southern extent is located within SPA 2. As the preferred alternative alignments through these two (2) areas govern the overall alignment of Arterial A2, no further development or evaluation of alternatives is required for this roadway.

5.4 Existing Arterial Roadways

5.4.1 Coleraine Drive

5.4.1.1 Development and Evaluation of Alternative Alignments

Alternative Alignments

Coleraine Drive is an existing arterial roadway, and as such, alignment alternatives are limited based on the desire to make use of the existing ROW (and thereby minimize property impacts). Alternatives considered include widening symmetrically about the existing centreline, widening to the east, widening to the west, or a combination of all three (3) to limit impacts to existing properties, wildlife habitat and structures. Additional alternatives were considered for the southern portion of Coleraine Drive which falls within the limits of SPA 2. These alternatives were previously discussed and are not revisited in this section. Formal evaluation of alignment alternatives for Coleraine Drive are provided in Table 5-9.

Preferred Alignment

Based on the detailed evaluation, the preferred alignment for Coleraine Drive north of SPA 2 is Alternative 1, which keeps the existing ROW centerline and widens evenly to the east and west. This alignment was assumed during development of the Industrial Tertiary Plans.

Table 5-9: Evaluation of Alternative Alignments for Coleraine Drive between Mayfield Road and 700 m South of Countryside Drive (Outside Limits of SPA2)

Category	Criteria		Criteria Indicator	Alternative 1 Widen about existing centerline	Alternative 2 Widen to the east	Alternative 3 Widen to the west
Engineering	Addresses Problem and Opportunity Statement	Provide enhanced inter-regional connectivity.		Widening of Coleraine Drive will provide additional capacity to an existing arterial roadway, indirectly improving inter-regional connectivity.		
						
		Provide access to proposed development.		Planned industrial development adjacent to Coleraine Drive will benefit from increased capacity on existing roadway. No significant difference between alternatives.		
						
		Address anticipated capacity issues resulting from extension of Highway 427 to Major Mackenzie Drive, as well as development of the study area.		Widening of Coleraine Drive will provide additional capacity to the existing arterial roadway network, to accomodate additional north and southbound traffic anticipated from the extension of Highway 427. No difference between alternatives.		
						
		Improve roadway geometrics to meet or exceed City and Regional standards.		• Changes in the alignment of Coleraine Drive at Mayfield Road will improve existing geometrics at that intersection. Introduction of two (2) new, large radii curves will be required.	• Changes in the alignment of Coleraine Drive at Mayfield Road will improve existing geometrics at that intersection.	• Changes in the alignment of Coleraine Drive at Mayfield Road will improve existing geometrics at that intersection. Introduction of two (2) new, large radii curves will be required.
						
		Provide pedestrian and cycling facilities.		New MUP will provide pedestrian and cycling facilities on both sides of Coleraine Drive. No difference between alternatives.		
		Improve traffic, pedestrian and cyclist safety.		Correction to offset approaches to the Coleraine Drive / Mayfield Road intersection will improve vehicular safety. Pedestrain and cyclist safety will be improved through provision of dedicated facilities. No significant difference between alternatives.		
		Improve watercourse crossings to enhance hydraulics, stream function and fisheries and wildlife passage.		Existing crossings of Coleraine Drive over Rainbow Creek will be improved to mitigate identified issues with culvert capacities (flooding).		
		Improve pavement conditions.		Roadway will be reconstructed as part of widening efforts. Pavement conditions will therefore be improved. No significant difference between alternatives.		
	Transportation Network Safety (includes natural hazards)		Safety related factors include roadway geometrics, roadside hazards, intersection design, and control, accommodating pedestrians and cyclists.	Improved intersection alignment at Mayfield Road improves safety along Coleraine Drive.		
	Transportation Network Connectivity			No changes in network connectivity resulting from widening of the roadway. No significant difference between alternatives.		
	Transportation Network Capacity		Impacts on traffic on local roads and outside the study area. Transportation network	Additional through lanes will increase north-south capacity for overall network. No significant difference between alternatives.		

Category	Criteria	Criteria Indicator	Alternative 1 Widen about existing centerline	Alternative 2 Widen to the east	Alternative 3 Widen to the west
		improvement and accommodation of goods movement.			
	Promotion of Active Transportation	Adheres to Region of Peel's Active Transportation Policies and Initiatives as Defined in the TMP.	Provision of MUP on both sides of the roadway will provide a safe environment for active transportation, thereby encouraging use by diverse groups of pedestrians and cyclists. No significant difference between alternatives.		
					
	Transit Supportive Development	Potential adverse impact on transit service. Assessment of impact on planned transit service improvements.	Increased roadway capacity, provision of bus bays, and transit service along the corridor will encourage use of transit services. No significant difference between alternatives.		
					
	Structural Impacts	Potential adverse impact on existing structures.	Existing culvert crossing of Rainbow Creek Tributary will require replacement due to inadequate hydraulic capacity. No difference between alternatives.		
					
		Need for additional bridge structures.	No new crossing anticipated.		
	Stormwater Management and LID		No differences anticipated between alternatives.		
	Hydraulics and Hydrology Impacts (Creeks)	Impact on floodplain, existing flood depths at proposed crossing locations, and existing flood return period.	• Approximately 10,300 m^2 of linear infrastructure will be constructed within the floodplain for existing Rainbow Creek. • Minor impacts anticipated.	• Approximately 10,500 m^2 of linear infrastructure will be constructed within the floodplain for existing Rainbow Creek. • Minor impacts anticipated.	• Approximately 10,200 m^2 of linear infrastructure will be constructed within the floodplain for existing Rainbow Creek. • Minor impacts anticipated.
					
Financial	Utility Relocation	Ability to minimize effects on existing and proposed utilities.	• All hydro and bell will need relocation from approximately 300 m south of Mayfield Road to SPA 2. • Watermain located under the roadway south of Countryside Drive. May need relocation. • Gas located under the roadway for approximately 1,400 m. • Sanitary sewer will not be located per the standard and may require relocation along this entire stretch. • Significant utility impacts.	• All hydro and bell will need relocation from approximately 490 m south of Mayfield Road to SPA 2. • MUP location could be adjusted to minimize impact to Bell pedestals. • No relocation of gas line anticipated. • Watermain would be located under the median. • With exception of 470 m of pipe at the north end of the study area, the sanitary sewer would be located under the median. • Moderate utility impacts.	• All hydro, bell will need relocation from approximately 250 m south of Mayfield Road to SPA 2. • Gas is located under the roadway for approximately 1,600 m. • Watermain is located within the boulevard. • Bell pedestals will require relocation south of Countryside Drive. • Sanitary sewer will not be located per the standard and may require relocation along this entire stretch. • Significant utility impacts.
					
		Measure of anticipated infrastructure impacts (m).	Hydro ~ 1,590 m Bell ~ 690 m Gas ~ 13,900 m Watermain ~ 1,220 m Storm Sewer NA Sanitary Sewer ~ 1,900 m	Hydro ~ 1,400 m Bell ~ 0 m Gas ~ 0 m Watermain ~ 620 m Storm Sewer NA Sanitary Sewer ~ 490 m	Hydro ~ 1,640 m Bell ~ 690 m Gas ~ 1,420 Watermain ~ 600 m Storm Sewer NA Sanitary Sewer ~ 0 m

Category	Criteria	Criteria Indicator	Alternative 1 Widen about existing centerline	Alternative 2 Widen to the east	Alternative 3 Widen to the west
Social / Cultural Environment	Capital Costs	Function of total road length and width, AT facilities provided, intersection infrastructure, structural area required, and amount of utility relocation.	• 1,930 m of four (4) lane roadway and 3,860 m of MUP required. • Two (2) signalized intersections. • Significant cost associated with utilities relocations. • Significant capital cost.	• 1,930 m of four (4) lane roadway and 3,860 m of MUP required. • Two (2) signalized intersections. • Low cost associated with utilities relocations. • Moderate capital cost.	• 1,930 m of four (4) lane roadway and 3,860 m of MUP required. • Two (2) signalized intersections. • Moderate / significant cost associated with utilities relocations. • Significant capital cost.
					
	Operating Costs	Function of road length and number of traffic signals.	No significant difference between alternatives. Same approximate alignment length and identical number of signals.		
	Property Acquisition	Estimated cost of acquiring required property.	• Approximately 0.5 ha of land slated for industrial development. • Approximately 2.3 ha of additional land for potential future redevelopment. • Moderate property acquisition cost.	• Approximately 1.06 ha of land slated for industrial development. • Approximately 1.8 ha of additional land for potential future redevelopment. • Significant property acquisition cost.	• Approximately 2.85 ha of land for potential future redevelopment. • Low / moderate property acquisition cost.
					
	Conformance to Planning Objectives (Growth Plan, Official Plan, Secondary Plan, Area 47 TMP)		• Aligned with planning objectives. • This alignment was assumed during completion of the SP47 TMP and Secondary Plan.	• Aligned with planning objectives. • Alignment located east of, but parallel to, SP47 TMP and Secondary Plan alignment.	• Aligned with planning objectives. • Alignment located west of, but parallel to, SP47 TMP and Secondary Plan alignment
					
	Residential / Business Access and Displacement	Potential adverse effects, including changes to existing entrances.	• No existing residence / business removal required. • Impacts to stone landscaping on two (2) properties north of Countryside Drive.	• No existing residence / business removal required; however, distance between property line and building fronts will be reduced to 10 m for one (1) property.	• No existing residence / business removal required; however, distance between property line and building fronts will be reduced to 10 m for three (3) properties. • Impacts to stone landscaping on two (2) properties north of Countryside Drive.
					
		Impact to planned residential and commercial development, including accesses.	• Aligned with current Tertiary Plan. • Aligned with current development plan.	• Not aligned with current Tertiary Plan. Some reconfigurations of building and parking layouts will be required. • Not aligned with development plan. Some shifting and reconfiguration of landscaped areas will be required.	• Not aligned with current Tertiary Plan. Some reconfigurations of building and parking layouts will be required. • Not aligned with development plan; however, this would provide additional property for this development.
					
	Emergency Services (Police, Fire, Ambulance)	Potential to reduce response times. Potential adverse effects include changes to existing entrances.	No difference between alternatives.		
	Noise Levels Impacts	Potential effects of traffic related noise on residences, community facilities, or institutions adjacent to and/or within the study area.	• Edge of road will move ~ 7 m closer to two (2) residences on east side of road and three (3) residences on west side of road, which may increase noise level heard in these residences.	• Edge of roadway will move ~15 m closer to two (2) residences on east side of road which may increase noise level heard in these residences.	• Edge of roadway will move 15 m closer to six (6) residences on the west side of Coleraine Drive.
					

Category	Criteria	Criteria Indicator	Alternative 1 Widen about existing centerline	Alternative 2 Widen to the east	Alternative 3 Widen to the west
	Cultural Heritage Impacts	Potential adverse effects on archaeological and built heritage resources.	• Would infringe on listed heritage property. ◑	• Would infringe on listed heritage property. ◑	• No impact to heritage properties in the study area. ●
	Agricultural Impacts		• Approximately 2.8 ha of existing agricultural land will be impacted. Moderate agricultural impacts. ◑	• Approximately 2.9 ha of existing agricultural land will be impacted. Moderate agricultural impacts. ◑	• Approximately 2.85 ha of land for potential future redevelopment. Moderate agricultural impacts. ◑
Natural Environment	Impact to Designated Natural Heritage Features including wetlands	Proximity to, and significance of, impact to designated feature.	No designated natural heritage features within the study area. Therefore, no impact from any alternative under consideration.		
	Impact to Natural Heritage Features such as vegetation and watercourses	Proximity, size, characteristics, and sensitivity of significant rural areas, terrestrial ecosystems, and wetlands. Potential impact or loss of natural areas, terrestrial ecosystems or wetland areas, function or habitat.	• Would require widening and upsizing through the existing Rainbow Creek corridor, resulting in loss of approximately 0.80 ha of natural area associated with that creek. • No natural heritage features • Minor impacts to natural areas. ◕	• Would require widening and upsizing through the existing Rainbow Creek corridor, resulting in loss of approximately 0.83 ha of natural area associated with that creek. • No natural heritage features identified. • Minor impacts to natural areas. ◕	• Would require widening and upsizing through the existing Rainbow Creek corridor, resulting in loss of approximately 0.78 ha of natural area associated with that creek. • No natural heritage features identified. • Minor impacts to natural areas. ◕
	Impact to Avian, Wildlife and Plant SAR	Potential effects to SAR habitat.	• Approximately 0.4 ha of potential Bobolink or Eastern Meadowlark habitat impacted. • Minor impact as lands currently undergoes agricultural operations, limiting use of the area for nesting habitat. ◕	• Approximately 0.6 ha of potential Bobolink or Eastern Meadowlark habitat impacted. • Minor impact as lands currently undergoes agricultural operations, limiting use of the area for nesting habitat. ◕	• No impact to identified potential Bobolink or Eastern Meadowlark habitat. ●
	Watercourses and Aquatic Environment Impacts	Potential to minimize impact on aquatic features.	Indirect fish habitat identified at Coleraine Drive crossing of Rainbow Creek Tributary midblock between Countryside and Mayfield. Crossing structure would need to be widened and would impact either / both sides of the tributary depending on direction of widening.		
	Groundwater Impacts	Potential for adverse effects on existing groundwater resources (water quality and/or quantity).	• 5.3 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods. Preferred method to be confirmed based on hydrogeological and geotechnical assessments. ◑	• 5.3 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods. Preferred method to be confirmed based on hydrogeological and geotechnical assessments. ◑	• 5.3 ha reduction in pervious surface area as a result of construction of this alternative. • TRCA requirements for groundwater balance will be met for all alternatives, through provision of off-site recharge or use of on-site LID methods. Preferred method to be confirmed based on hydrogeological and geotechnical assessments. ◑
OVERALL RANKING			●	◑	◕
PREFERRED ALTERNATIVE			**Alternative 1 – Widen Evenly About the Existing Centerline is the Preferred Alternative.**		

Legend:	Good	←	→		Poor
	●	◕	◑	◔	○

5.4.1.2 Preferred Design Concept

Based on the detailed evaluation, the preferred alignment for Coleraine Drive outside of SPA 2 is Alternative 1, which keeps the existing ROW centerline and widens evenly to the east and west. This alignment was assumed during development of the Industrial Tertiary Plans.

5.5 Critical Intersections

Three (3) intersections were identified as requiring particular attention, either due to issues with alignment or as a result of inability to provide at least a LOS of 'D' or better by the 2041 planning horizon regardless of implementation of auxiliary lanes or signal timing. The intersections of Regional Road 50 with each of Coleraine Drive and Countryside Drive were identified as requiring modification to address issues with alignment. Coleraine Drive will no longer intersect Regional Road 50 and so this intersection will no longer be a concern. The third critical intersection is Regional Road 50 at Arterial A2 / Major Mackenzie Drive, where an interchange is being considered to address anticipated poor LOS. Countryside Drive will be assessed under Part B.

5.5.1 Regional Road 50 at Arterial A2 / Major Mackenzie Drive

The grade separation alternatives at the intersection of Regional Road 50 and Major Mackenzie Drive (Arterial A2) have undergone a significant amount of evaluation to determine the preferred alternative. The alternative assessment was completed through a workshop in May 2018 with the City and Region. Table 5-10 provides an overview of the alternative assessment evaluation.

Another evaluation was completed analyzing a high-level 'Vision Zero'- based assessment of the short-listed grade-separation alternative designs. This can be found in Appendix D.

Based on the qualitative assessed number of potential risks and available tools to mitigate those risks, the results of the overall ranking of alternatives were as follows:

Most Preferred Overall Solution: At-Grade Intersection:

- Most significant safety concerns are associated with congestion (potential rear-end collisions) and significant pedestrian crossing distances; and
- Mitigation techniques are available to the City / Region to address these concerns.

Least Preferred Overall Solution: Modified Parclo 'A' Version 3.2:

- Most significant safety concerns are associated with weaving and merging at ramps and bypass lanes at the interchange, as well as the 12 uncontrolled pedestrian crossing locations either at right-turn channels (Coleraine Drive at Regional Road 50) or at the ramps / bypass lanes at the interchange; and
- Mitigation techniques are available to address issues with weaving and merging.
- Limited ability to fully address issues associated with uncontrolled pedestrian / cyclist crossings, particularly as traffic volumes increase.

Further information is provided in Appendix D.

Table 5-10: Detailed Assessment of Alternatives for the Intersection of Arterial A2, Regional Road 50 and Major Mackenzie Drive

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
Addresses Problem and Opportunity Statement		Provide enhanced inter-regional connectivity;	• Maintains east-west connectivity between Brampton and Vaughan. • Additional through and auxiliary lanes will provide improved LOS through the Regional Road 50 / Major Mackenzie Drive intersection, making it a more desirable option for drivers moving between the Regions of Peel and York until such time as congestion becomes intolerable.	• Maintains east-west connectivity between Brampton and Vaughan. • North-south traffic along Regional Road 50 would be unimpeded, making it a more desirable option for drivers moving along the border between the Regions of Peel and York. • Interchange will provide improved east-west traffic flow between the Regions of Peel and York. • Interchange structure provides a visual boundary between the Regions of Peel and York.	• Maintains east-west connectivity between Brampton and Vaughan. • East-west and north-south traffic unimpeded through interchange. • Restrictions in eastbound and westbound lefts will result in vehicles needing to take parallel routes north or south of the interchange in order to make these turns onto Regional Road 50 (approximately 130 vehicles / direction / peak period). • Interchange structure provides a visual boundary between the Regions of Peel and York.
					
		Provide access to proposed development;	• Access between development blocks and major arterial roads is primarily restricted to intersections and limited, approved mid-block median breaks and right-in / right-out direct access points. • Some reconfigurations of the industrial development plan will be required to accommodate westerly shift in the Coleraine Drive / Arterial A2 (Major Mackenzie Drive Extension) intersection.	• Access between development blocks and major arterial roads is primarily restricted to intersections and limited, approved mid-block median breaks and right-in / right-out direct access points. • Planned collector roadway 440 m north of Major Mackenzie Drive would not be feasible due to conflict with the right-turn bypass lanes. If required, collector would need to be moved further to the north. • Some reconfigurations of the industrial development plan will be required to accommodate westerly shift in the Coleraine Drive / Arterial A2 (Major Mackenzie Drive Extension) intersection.	• Access between development blocks and major arterial roads is primarily restricted to intersections and limited, approved mid-block median breaks and right-in / right-out direct access points. • Significant traffic volumes and crossing distances on Coleraine Drive will limit desirability of mid-block access with this alternative. • Some additional internal road networks will be required for larger development areas. • Where access is provided directly to a major arterial road, it is limited to smaller developments or individual dwellings. It is also restricted to right-in / right-out only.
					
		Address anticipated capacity issues resulting from extension of Highway 427 to Major Mackenzie Drive and development of the study area;	• Select movements at the Arterial A2 / Regional Road 50 / Major Mackenzie Drive intersection will reach LOS that exceed what is deemed acceptable by the Region and City by 2041 (Eastbound left and southbound left at LOS F in the p.m. peak, Northbound left at LOS F in the a.m. peak). • Overall, LOS at major intersections will either be at, or better than, minimum acceptable LOS for the 2041 planning horizon (LOS D and E).	• All movements will either be at, or better than, minimum acceptable LOS for the 2041 planning horizon (LOS E or better). • Overall, LOS at major intersections will either be at, or better than, minimum acceptable LOS for the 2041 planning horizon (LOS C and D).	• All movements will either be at, or better than, minimum acceptable LOS for the 2041 planning horizon (LOS E or better). • Overall, LOS at major intersections will either be at, or better than, minimum acceptable LOS for the 2041 planning horizon (LOS B and C).
					
		Improve roadway geometrics to meet or exceed City and Regional standards;	• With a posted speed of 70 km/h, providing the desirable signalized intersection spacing of ~560 m could be accomplished by relocating the proposed collector 440 m north of Major Mackenzie Drive an additional 100 m to the north. • Roadway geometrics will meet City and Regional standards for at-grade intersections:	• With a posted speed of 70 km/h, providing the desirable signalized intersection spacing of ~560 m could be accomplished by relocating the proposed collector 440 m north of Major Mackenzie Drive an additional 100 m to the north. • Roadway geometrics will meet TAC and MTO standards for interchange design:	• Design provides the recommended minimum spacing between Arterial Road intersections. • Roadway geometrics will meet TAC and MTO standards for interchange design: • Reduced four (4) lane cross-section required on Regional Road 50 and Arterial A2.

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
			• Six (6) lane cross-section required on both Major Mackenzie Drive / Arterial A2 and Regional Road 50. • Double left-turn lanes (not desirable) required on Regional Road 50, and single left-turn lanes required on Major Mackenzie Drive / Arterial A2 to accommodate left-turning vehicles. • Right-turn lanes required in all directions.	• Six (6) lane cross-section required on both Major Mackenzie Drive / Arterial A2 and Regional Road 50. • Single left-turn lanes provided on Regional Road 50, Major Mackenzie Drive / Arterial A2 to accommodate left-turning vehicles. • Right-turn ramps will be provided in each direction.	• Right-turn ramps will require signalization or revision to current design (including the addition of merge lanes) to improve level of safety and traffic flow.
					
		Provide pedestrian and cycling facilities;	• Pedestrian and cycling facilities could be provided for all movements, in a similar fashion to all other at-grade signalized intersections with the City / Region.	• Pedestrian and cycling facilities could be provided for all through movements. • Right-turns at the interchange would require travel along the outside of the right / left-turning lanes, which would have a decreased travel distance but would not be intuitive. • Left-turns at the interchange would require movements across an uncontrolled portion of the right-turn lanes. • Potential to provide pedestrian-actuated signals at ramp locations should be investigated further.	• Pedestrian and cycling facilities could be provided for all through movements but would require crossing at several uncontrolled locations. • Right-turns at the interchange would require travel along the outside of the right / left-turning lanes, which would have a decreased travel distance but would not be intuitive. • No ability to provide for left-turning movements at the interchange.
					
		Improve traffic, pedestrian and cyclist safety;	• Controlled crossing in all four (4) directions at all intersections. • Protected left-turn phasing should be provided to minimize safety implications associated with making left-turns across three (3) lanes of on-coming traffic, particularly off of Regional Road 50. • Requires significant pedestrian and cyclist crossing time due to total number of lanes (nine (9) lanes total in north / south direction, eight (8) lanes in total in east / west direction). • Potential vehicular and active transportation conflict points if channelized right-turn lanes are provided. • Right-on-red prohibitions can be used to partially mitigate conflicts with pedestrians and cyclists. • Most significant safety concerns are associated with congestion and significant crossing distances. • Mitigation techniques are available to the City / Region to address these concerns.	• North-south through movements would be unimpeded for vehicular traffic at the interchange. • East-west movements would be controlled in a similar fashion as an at-grade signalized intersection. • All left-turn movements would be completed on a left-turn phase. • Conflict points at uncontrolled locations for pedestrians and cyclists include: • All through movements would require individuals to cross two (2) right-turn ramps / lanes; and • Left-turn movements would require crossing of up to two (2) right-turn ramps / lanes, as well as crossing through the at-grade intersection in two (2) directions. • Potential to provide pedestrian-actuated signals for left-turning cyclists and pedestrians should be investigated further. • Partial mitigation of risk can be provided through provision of enhanced lighting and clear zones, ladder (crosswalk) markings and clear signage indicating pedestrians and cyclists to yield to vehicles. • Most significant safety concerns are associated with congestion, significant crossing distances, and two (2) uncontrolled pedestrian / cyclist crossing locations. • Mitigation techniques are available to the City / Region to address these concerns.	• All through movements would be unimpeded for vehicular traffic. • Left-turn ramps off of Regional Road 50 intersect Major Mackenzie Drive at a 25º angle, which would require signalization or provision of a merge lane. • Right-turn ramps off of Regional Road 50 would require longer merge lanes to improve safety. • All through movements would require active transportation facility users to cross three (3) ramps / merge lanes at uncontrolled locations. • No ability to provide pedestrians and cyclists with a means for making left-turning movements at the interchange. • Routing for active transportation facilities would be significantly longer than with standard signalized intersection. • Limited ability to mitigate risk without signalizing the crossing locations (e.g., pedestrian activated signal), which is not considered financially or operationally feasible given the number of sites. • Most significant safety concerns are associated with weaving and merging at tamps and bypass lanes, as well as the number of uncontrolled pedestrian crossing locations at right-turn channels (Coleraine Drive at Regional Road 50) and at the ramps / bypass lanes at the interchange. • Mitigation techniques are available to the City / Region to address these concerns. • Limited ability to fully address issues associated with uncontrolled pedestrian / cyclist crossings.

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
		Improve watercourse crossings to enhance hydraulics, stream function and fisheries and wildlife passage;	• To maximize intersection spacing along Arterial A2 between Coleraine Drive and Regional Road 50, the intersection with Coleraine Drive will be moved west into the Rainbow Creek NHS. • Potential significant impact to the function of the Rainbow Creek NHS if appropriately sized bridge openings are not provided. • All watercourse crossings will be developed to enhance hydraulics, stream function and both aquatic and terrestrial passage.	• To maximize intersection spacing along Arterial A2 between Coleraine Drive and Regional Road 50, the intersection with Coleraine Drive will be moved west into the Rainbow Creek NHS. • Potential significant impact to the function of the Rainbow Creek NHS if appropriately sized bridge openings are not provided. • All watercourse crossings will be developed to enhance hydraulics, stream function and both aquatic and terrestrial passage.	• Due to elimination of the Regional Road 50 / Major Mackenzie Drive intersection, there are no concerns with intersection spacing to Coleraine Drive. • Four (4) lane bridge structure will be required to cross Arterial A2 over the Rainbow Creek NHS. • Moderate impacts to the function of the Rainbow Creek NHS. • All watercourse crossings will be developed to enhance hydraulics, stream function and both aquatic and terrestrial passage.
	Transportation Network Connectivity	Impacts on traffic on local roads and outside the study area. Transportation network improvement and accommodation of goods movement.	• Network connectivity is provided per the recommendations of the SP47 TMP and earlier Peel Highway 427 Extension Area TMP. • Internal and inter-regional pedestrian and cyclist network connectivity can be provided. • Significant congestion at the Arterial A2 / Regional Road 50 / Major Mackenzie Drive intersection by 2041 will reduce inter-regional vehicular connectivity.	• Network connectivity is provided per the recommendations of the SP47 TMP and earlier Peel Highway 427 Extension Area TMP. • Internal and inter-regional pedestrian and cyclist network connectivity can be provided. • No significant congestion at the Arterial A2 / Regional Road 50 / Major Mackenzie Drive junction by 2041.	• Network connectivity is modified in comparison to the recommendations of the SP47 TMP and earlier Peel Highway 427 Extension Area TMP. • Internal pedestrian and cyclist network connectivity can be provided. Inter-regional connectivity would be difficult to provide through the interchange but would be maintained at intersections to the north. • Improved connectivity between the southern segment of Regional Road 50 and Emil Kolb Parkway (bypass for industrial traffic). Reduced connectivity along Regional Road 50. • No congestion at the Coleraine Drive / Regional Road 50 / Major Mackenzie Drive junction by 2041.
	Transportation Network Capacity	Impacts on traffic on local roads and outside the study area. Transportation network improvement and accommodation of goods movement.	• Traffic volumes could be accommodated on the arterial road network, although the Arterial A2 / Regional Road 50 / Major Mackenzie Drive intersection will be congested by 2041. This will put additional stress on adjacent local roads and cause backup on Major Mackenzie (York Region). • Arterial A2 will provide additional north-south connectivity, including inter-municipal connectivity if extended further north towards Bolton.	• Traffic volumes could be accommodated on the arterial road network, with some congestion of the Arterial A2 / Regional Road 50 / Major Mackenzie Drive intersection by 2041. • Arterial A2 will provide additional north-south connectivity, including inter-municipal connectivity if extended further north towards Bolton.	• Traffic volumes can be accommodated on arterial roads, with some congestion of the Coleraine Drive / Regional Road 50 intersection by 2041. • Network design provides enhanced connectivity to Emil Kolb Parkway (Bolton Bypass), which is an improvement for goods movement.
	Anticipated Impact to Traffic Operations	Indication of LOS for critical intersections.	• Regional Road 50 / Arterial A2 / Major Mackenzie Drive overall PM Peak LOS 'E'. • Individual movements with LOS E or F in PM peak: • Northbound through and left (E); • Eastbound through (E) and left (F); • Southbound left (F); and	• Regional Road 50 / Arterial A2 / Major Mackenzie Drive overall PM peak LOS 'D'. • Individual movements with LOS E in PM peak: • Eastbound left (could be revised to dual left); • Coleraine Drive / Arterial A2 / East-West Arterial overall PM Peak LOS 'C'.	• Regional Road 50 / Coleraine Drive overall PM peak LOS 'C'. • Individual movements with LOS E in PM peak: • Southbound left (could be revised to dual left). • East-West Arterial at Arterial A2 overall PM peak LOS 'B'. • Individual movements with LOS E in PM peak: • Northbound left (could be revised to dual left).

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
			• Westbound through (E). • Coleraine Drive / Arterial A2 / East-West Arterial overall PM Peak LOS 'D'. • Individual movements with LOS E in PM Peak: • Eastbound left; and • Southbound right and left. • Total delay system-wide is 5,020hr/day.	• Individual movements with LOS E in PM Peak: • Westbound left (could be revised to dual left). • Total delay system-wide is 3,759hr/day. •	• No significant delay through the interchange. • Total delay system-wide is 3,526hr/day.
					
	Wayfinding / Human Factor Considerations for Vehicular Traffic	Indication of likely familiarity with proposed approach and clarity of routing for all travel directions.	• Familiar interchange configuration will be easy for drivers to navigate. • Standard intersection signage required.	• Most drivers will not be familiar with this interchange type and wayfinding signage will be required for left-turn movements off of Regional Road 50. • As left-turns from Regional Road 50 must occupy the rightmost lane along with right-turning vehicles, the use of proper advanced signage will be critical.	• Familiar interchange configuration. • Advanced signage will be required to alert vehicles that east and westbound left-turns are not permitted at the interchange. • Signage will be required to differentiate Coleraine Drive and Regional Road 50 at their intersection point.
					
	Promotion of Active Transportation	Adheres to Region of Peel's Active Transportation Policies and Initiatives as Defined in the TMP	• SPA 47 TMP notes that the Major Mackenzie Drive / Regional Road 50 intersection should act as a potential active transportation "Trail Gateway" into the area. • Active transportation facilities could be provided on all impacted roadways. • All active transportation movements could be accommodated at both the Regional Road 50 and Coleraine / East-West arterial intersections with Arterial A2 / Major Mackenzie Drive. • LOS for AT facilities anticipated to be equivalent to the vehicular LOS.	• Ability to use the intersection of Regional Road 50 at Major Mackenzie Drive as a 'Trail Gateway' into SPA 47 is compromised by the complex movements required for pedestrians and cyclists to move through the interchange. • Due to number of uncontrolled crossing locations and complex left-turn movements, the LOS for AT facilities is not equivalent to the vehicular LOS.	• Ability to use the intersection of Regional Road 50 at Major Mackenzie Drive as a 'Trail Gateway' into SPA 47 is compromised by the complex movements required for pedestrians and cyclists to move through the interchange. • Due to lack of ability for pedestrians and cyclists to make left-turn movements at the interchange, as well as the higher priority given to vehicular traffic, the LOS for AT facilities is not equivalent to the vehicular LOS.
					
		Wayfinding / Human Factor Considerations for pedestrians and cyclists.	• Typical intersection configuration, easy for pedestrians and cyclists to navigate.	• Intuitive for through-bound pedestrians and cyclists. • Advanced signage will be required for pedestrians and cyclists making right-turns and north-southbound left-turn movements at the interchange as wayfinding may not be intuitive.	• Intuitive for through-bound pedestrians and cyclists. • Trail maps will be required to assist pedestrians and cyclists with selecting alternative routes when their ultimate destinations would normally require left-turns at the interchange.
					
	Transit Supportive Development	Potential adverse impact on transit service. Assessment of impact on planned transit service improvements.	• Limited impact to existing or future transit routes. • Secondary corridors outlined in SPA 47 TMP unaffected.	• Limited impact to existing or future transit routes. • Secondary corridor north / south to east / west connections at Regional Road 50 / Major Mackenzie Drive will need to be located outside of the interchange footprint.	• GO Bus Route 38 would be redirected to use new Regional Road 50 / Coleraine Drive intersection. Not expected to significantly impact travel time. • New routes would need to consider north and southbound left restrictions at the interchange.

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
					• Secondary corridor north / south to east / west connections at Regional Road 50 / Major Mackenzie Drive will need to be located outside of the interchange footprint.
					
	Structural Impacts	Need for additional bridge structures.	• Estimated area of bridge required over all overpass (assuming all roadway within the NHS is elevated) is 10,500 m^2.	• Approximate area of bridge deck required for the interchange is 2,300 m^2. • Approximate area of retaining walls required is 160 m^2. • Estimated area of bridge required over all overpass (assuming all roadway within the NHS is elevated) is 10,500 m^2.	• Approximate area of bridge deck required for the interchange is 1,400 m^2. • Approximate area of retaining walls required is 320 m^2 (assumed along outside of loop ramps). • Estimated area of bridge required over all overpass (assuming all roadway within the NHS is elevated) is 8,300 m^2.
					
	Constructability	Ability to construct grade separation and/or expand intersections without significant impacts to existing roadways.	• Expansion of the intersection would require standard construction staging, including lane shifting.	• Construction of interchange can be deferred until warranted by traffic volumes. • Staging assumed to progress as follows: – Construct at-grade left and right-turn lanes from Regional Road 50 to/from Arterial A2 / Major Mackenzie Drive as required for the future interchange. – Detour Regional Road 50 traffic onto turn lanes (will require temporary signals). – Construct bridge abutments, retaining walls and new profile along current Regional Road 50 alignment. – Install bridge deck and permanent signals (potential for single weekend installation). – Reroute traffic to permanent configuration.	• No ability to delay construction to a later date. • Significant staging and throw-away detours would be required for construction. • Staging assumed to progress as follows; – Construct collector road between Coleraine Drive and existing Regional Road 50. Detour Coleraine traffic onto collector. – Construct bridge structure. – Construct realigned Regional Road 50 segments and widen Coleraine Drive (off line). – Detour Major Mackenzie Drive to connect to new Regional Road 50 alignment, south of future interchange footprint. – Construct interchange. – Reroute Major Mackenzie Drive along final alignment and decomission detour.
					
Financial	Utility Relocation	Ability to minimize effects on existing and proposed utilities.	Impact to existing utilities would be limited to the future intersection footprint. Anticipated utility impacts include: Overhead hydro, overhead and buried bell, gas, watermain, sanitary sewer. Moderate utility impacts.		
					
	Capital Costs	Function of total road length and width, AT facilities provided, intersection infrastructure, structural area required, and amount of utility relocation.	• Lowest cost.	• Highest cost.	• Moderate cost.
					
	Operating Costs	Function of road length, number of traffic signals, and area of bridge deck.	• Two (2) signalized intersections required (Arterial A2 / Coleraine Drive / East-West Arterial and Regional Road 50 at Major Mackenzie Drive). • Estimated area of bridge required is 10,500 m^2. • Total estimated length of individual lanes within the bounds of the area being evaluated is 28.4 km.	• Two (2) signalized intersections required (Arterial A2 / East-West Arterial and Regional Road 50 at Coleraine Drive). • Approximate area of bridge deck required for the interchange is 2,300 m^2. • Approximate area of retaining walls required is 160 m^2 (assumed along outside of ramps).	• Two (2) signalized intersections required (Arterial A2 / East-West Arterial and Regional Road 50 at Coleraine Drive. • Approximate area of bridge deck required for the interchange is 1,400 m^2. • Approximate area of retaining walls required is 480 m^2 (assumed along outside of ramps).

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
			• Moderate operating cost.	• Estimated area of bridge required is 10,500 m^2. • Total estimated length of individual lanes within the bounds of the area being evaluated is 28.7 km. • Highest operating cost.	• Estimated area of bridge required is 8,300 m^2. • Total estimated length of individual lanes within the bounds of the area being evaluated is 25.6 km. • Lowest operating cost.
					
	Property Acquisition	Estimated area and value of required property	• Estimated property required to accommodate planned interchange and adjacent portions of Arterial A2, Coleraine Drive and East-West Arterial is 8.1 ha.	• Estimated property required to accommodate planned interchange and adjacent portions of Arterial A2, Coleraine Drive and East-West Arterial is 8.8 ha.	• Estimated property required to accommodate planned interchange and associated embankments, as well as the relocation of Regional Road 50, is 8.3 ha. • Estimated property to be made available through abandonment of existing Regional Road 50 ROW is 3.0 ha. Note that new collector road access from York will be required within the area southeast of the future Regional Road 50 / Coleraine Drive intersection, requiring property approximately equal to that being made available.
					
	Congestion Cost	Estimate of annualized congestion cost based on CO_2 emissions, collisions and lost time.	• Moderate congestion cost for 2021 and 2041.	• Lowest congestion cost for 2021 and 2041.	• Highest congestion cost for 2021 and 2041.
					
	Net Present Value Lifecycle Cost (Incl. congestion)	Estimate of annualized lifecycle cost for each intersection alternative, assuming pavement lifecycle of 20 years and structural lifecycle of 50 years.	• Moderate cost. 25% increase relative to Alternative 2.	• Lowest cost.	• Highest cost. 42% increase relative to Alternative 2.
					
	Net Present Value Lifecycle Cost (Excl. congestion)	Estimate of annualized lifecycle cost for each intersection alternative, assuming pavement lifecycle of 20 years and structural lifecycle of 50 years.	• Lowest cost.	• Highest cost. 14% increase relative to Alternative 1.	• Moderate cost. 2% increase relative to Alternative 1.
					
Social / Cultural Environment	Conformance to Planning Objectives (Growth Plan, Official Plan, Secondary Plan, Area 47 TMP)		• Interchange alternative is in line with recommendations of the various applicable planning documents. • Recommended westerly shift of the Arterial A2 / Coleraine Drive intersection does not conform to the recommendations made in the SP47 TMP or the SP47 MESP. • Design coordination with TRCA will be required.	• Interchange alternative is in line with recommendations of the various applicable planning documents. • Recommended westerly shift of the Arterial A2 / Coleraine Drive intersection does not conform to the recommendations made in the SP47 TMP or the SP47 MESP. • Design coordination with TRCA will be required.	• Realignment of Regional Road 50 and change in priority for Coleraine Drive are significantly different conditions than assumed during completion of the SPA47 TMP or Secondary Plans. • Configuration has potentially significant impacts on remainder of the road network due to changes in routing beyond the limits of the SP47 study area.
					
	Residential/Business Access and Displacement	Potential adverse effects, including changes to existing entrances.	• Minimal impact to existing development.	• Westbound right ramp will cut off access to four (4) properties in the northeast quadrant of the Regional Road 50 / Major Mackenzie Drive intersection and necessitate buyout of the one (1) property located immediately at the existing intersection.	• Realignment of Regional Road 50 and provision of the westbound right ramp will cut off access to four (4) properties in the northeast quadrant of the Regional Road 50 / Major Mackenzie Drive intersection.

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
				• Access will be cut off for one (1) existing industrial complex in the southwest quadrant of the intersection. • Access to Cadetta Road will become right-in / right-out only, eliminating access from this development to Highway 427.	• Access and parking will be removed for one (1) existing industrial complex in the southwest quadrant of the intersection. • Access to Cadetta Road will become right-in / right-out only, eliminating access from this development to Highway 427.
					
		Impact to planned residential and commercial development, including accesses.	• Reconfiguration of the proposed industrial development along Coleraine Drive will be required to accommodate westerly relocation of the Coleraine Drive / Arterial A2 intersection (no change in area of available developable land). • Minor property impacts resulting from expansion of the Regional Road 50 / Major Mackenzie Drive intersection anticipated. • Will have edge impacts on two (2) parcels, require buyout of one (1) industrial property, and have access implications for one (1) parcel.	• Reconfiguration of the proposed industrial development along Coleraine Drive will be required to accommodate westerly relocation of the Coleraine Drive / Arterial A2 intersection (no change in area of available developable land). • Property will be required in the northwest quadrant of the Regional Road 50 / Major Mackenzie Drive intersection to accommodate proposed southbound ramps/lanes. This will require changes to the proposed office development at this intersection. • Will have edge impacts on four (4) parcels, require buyout of three (3) industrial properties, and have access implications for three (3) parcels.	• Reconfiguration of the proposed industrial and office developments along Coleraine Drive will be required to accommodate realignment of Regional Road 50 and construction of the interchange west of the current Regional Road 50 / Coleraine Drive intersection. • Maintenance of road access along the existing Regional Road 50 alignment will be required to provide access to property east of Coleraine Drive, which would otherwise become land locked. • Will have edge impacts on six (6) parcels, require buyout of six (6) parcels (including three (3) existing residential properties), and have access implications for three (3) parcels.
					
	Emergency Services (Police, Fire, Ambulance)	Potential to reduce response times. Potential adverse effects include changes to existing entrances.	• No anticipated changes in response times as a result of implementation of this alternative.	• Grade separation of Regional Road 50 will reduce north-south travel times in comparison to an at-grade signalized intersection.	• East-west and north-south travel times through the interchange will be reduced compared to that of an at-grade signalized intersection. • Continuous north-south travel along Regional Road 50 requires a turn movement through the new intersection with Coleraine Drive. As this intersection is anticipated to be significantly congested, reductions in travel time through the interchange are anticipated to be offset by this intersection.
					
	Cultural Heritage Impacts	Potential adverse effects on archaeological and built heritage resources.	No impacts to cultural heritage features.		
					
	Impact to Natural Heritage Features such as vegetation and watercourses	Proximity, size, characteristics, and sensitivity of significant rural areas, terrestrial ecosystems, and wetlands. Potential impact or loss of natural areas, terrestrial ecosystems or wetland areas, function or habitat.	• 1.3 ha of transportation infrastructure associated with the future intersection of Arterial A2 / East-West Arterial and Coleraine Drive will be located within the proposed Rainbow Creek NHS. • 10.7 ha of existing agricultural land will be impacted to construct portions of Arterial A2, Coleraine Drive, East-West Arterial and their associated intersections.	• 1.3 ha of transportation infrastructure associated with the future intersection of Arterial A2 / East-West Arterial and Coleraine Drive will be located within the proposed Rainbow Creek NHS. • 10.8 ha of existing agricultural land will be impacted to construct portions of Arterial A2, Coleraine Drive, East-West Arterial and their associated intersections. • The interchange will primarily be constructed on existing industrial land and/or within existing road ROW.	• 0.8 ha of transportation infrastructure associated with Arterial A2 will be located within the proposed Rainbow Creek NHS. • 13.5 ha of existing agricultural land will be required to construct the interchange and adjacent intersections.
					

Cat.	Criteria	Criteria Indicator	Alternative 1 At-Grade Intersection	Alternative 2 Single Point Urban Interchange	Alternative 3 Modified Parclo 'A' Version 3.2
OVERALL RANKING, ALL CRITERIA WEIGHTED EVENLY					
OVERALL RANKING (LIFECYCLE COST WITHOUT CONGESTION, COST WEIGHTED AT 50% OF TOTAL SCORING)					
OVERALL RANKING (LIFECYCLE COST WITH CONGESTION, COST WEIGHTED AT 50% OF TOTAL SCORING)					
PREFERRED ALTERNATIVE			With lifecycle cost (construction, operations, maintenance) valued at 50% of the overall scoring, the preferred alternative for reconfiguration of the transportation network within SPA 2 is Alternative 1 (At-Grade) if congestion is not considered, and Alternative 2 (Single Point Urban Interchange) if congestion is considered. As Alternative 1 ranks highest overall (all criteria even), and when congestion is not considered, it is recommended that **Alternative 1 be implemented** until such time as congestion becomes a significant concern. For this reason, sufficient property to construct the Single Point Urban Interchange (Alternative 2) should be secured at the time of development.		

Legend: Good ⟷ Poor

5.6 Rainbow Creek Crossing

5.6.1 SP47 Transportation Master Plan Crossing Design (Alternative 0 - Base Case)

The following section provides information on the 'base case' single structure crossing design that was originally contemplated as part of the SP47 TMP and assumed during completion of the MESP Addendum. Note that the roadway configuration associated with this alternative is not considered acceptable due to the unacceptable queuing that results from insufficient intersection spacing.

5.6.1.1 Roadway Design

The arterial network assumed during completion of the SP47 TMP, Block Planning, and MESP Addendum studies included separate intersections for Arterial A2 / East-West Arterial and Arterial A2 / Coleraine Drive, respectively located west and east of the Rainbow Creek corridor. This network configuration is illustrated in Figure 5-7. Estimated horizontal design components are summarized in Table 5-11.

It should be noted that the final alignment for the reconstruction of Major Mackenzie Drive was incorrectly assumed during development of the original concept, and that the Arterial A2 ROW was therefore incorrectly illustrated as being shifted to the southwest of its true location. This will have implications for development parcels in Block 47-3. As the curve radius on Arterial A2 sits at the absolute minimum, no further reduction can be contemplated to adjust for this error.

For grading and NHS impact assessment purposes, the vertical alignment of Arterial A2 was assumed to be the same as that used for Alternative 2. With a 15 m single span crossing structure in place, this crossing would impact approximately 8,600 m^2 of the proposed NHS.

Table 5-11: Approximate Horizontal Design Components for Transportation Network

	Roadway	
Design Requirement	**Arterial A2**	**Coleraine Drive**
Min. Radius (m)	530	640
Min. Tangent at Intersections (m)	160 (Coleraine Dr.) 0 (East-West Arterial)	180
Meets Design Requirements?	No	Yes
Required Design Modifications	Minimum tangent not provided at East-West, but intersection located on outside of curve is considered acceptable.	n/a

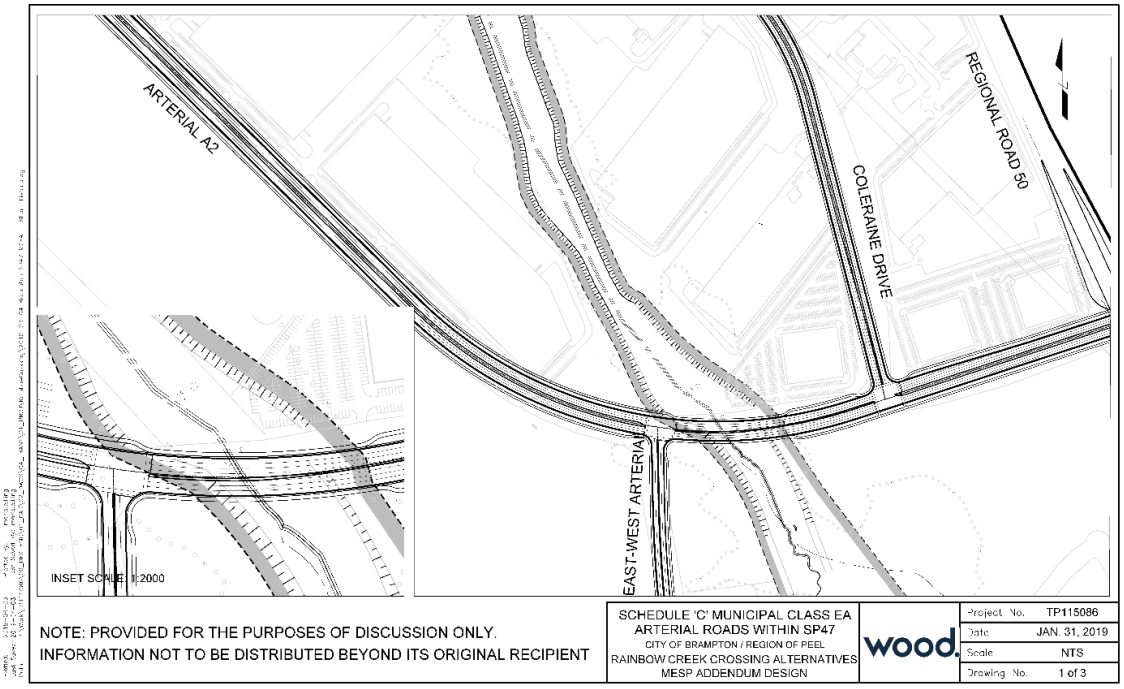


Figure 5-7: SP47 Transportation Master Plan Arterial Network Within SPA 2

5.6.1.2 Structural Design of Rainbow Creek Crossing

Based on calculated hydraulic, road flood, and estimated grading requirements, a 2.25 m H x 15 m W x 75 m L rigid frame, single span structure would be required for the Arterial A2 crossing of Rainbow Creek. A schematic of this crossing is provided in Figure 5-8.

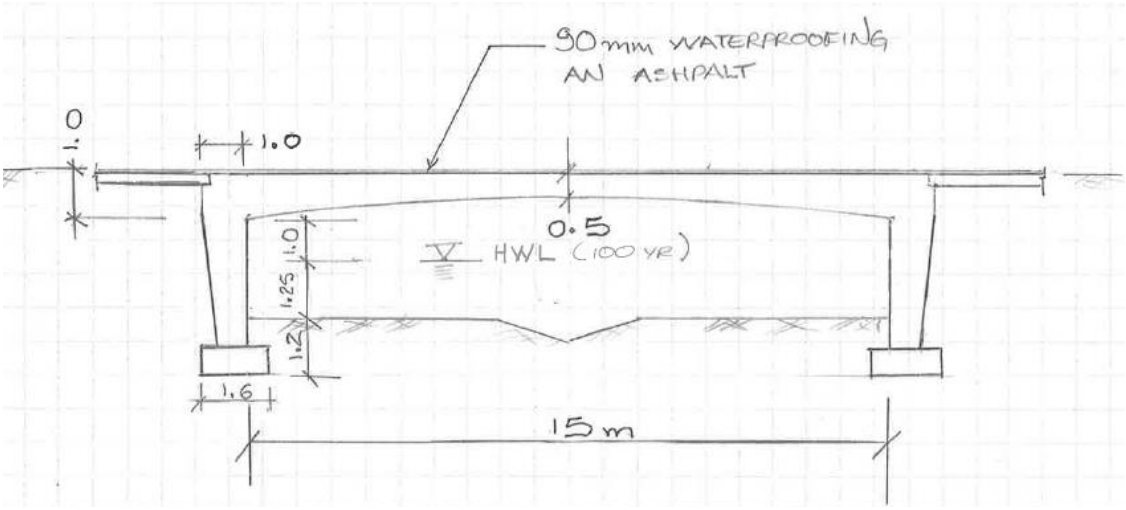


Figure 5-8: Rigid frame, single span crossing of Arterial A2 over Rainbow Creek

5.6.1.3 Environmental Impacts

Social / Cultural
No anticipated impacts to social or cultural environments – either existing or planned. The planned environment was designed around this road network scenario.

Natural
The openness ratio was calculated for Alternative 0 – Base Case as identified in Table 5-12 below. Based on the proposed dimensions for the single span structure, the minimum openness ratio requirement to facilitate the wildlife groups identified in the MESP Addendum (Savanta, 2019) is achieved, along with accommodating larger mammals (e.g., coyotes). This single span structure will facilitate movement between habitat types defined in proximity to Arterial A2 (Forest and Meadow). Determination of open bottom vs. closed bottom boxes will be confirmed during detailed design.

Table 5-12: Wildlife Crossing Design Parameters – Alternative 0 – Base Case

Design Option	Dimensions	Openness Ratio	Wildlife Group Accommodated
Single Span	2.25 (H) x 15.0 (W) x 75.0 (L)	0.45	All wildlife sizes with the exception of deer (e.g., coyotes, small and medium size mammals; amphibians and reptiles).

As for impacts to the NHS, a summary is provided in Table below.

Based on the overall vegetative cover of each vegetation community, Alternative 0 – Base Case will impact the following:

- Grassland Temporary: Grassland overall (51,400 m^2) – Alternative 0 (723.83 m^2) = 1.4%
- Grassland Permanent: Grassland overall (51,400 m^2) – Alternative 0 (2364.25 m^2) = 4.6%
- Thicket Temporary: Thicket overall (49,400 m^2) – Alternative 0 (642.29 m^2) = 1.3%
- Thicket Permanent: Thicket overall (49,400 m^2) – Alternative 0 (0 m^2) = 0%

Table 5-13: Natural Heritage Impact – Alternative 0 – Base Case

Design Option	Landcover Type	Temporary Impact (Earthworks) m^2	Permanent Impact (Hard Surface) m^2	Total Impact per land cover m^2
Alternative 0	Grassland	723.83	2,364.25	3,088.08
	Wildlife Best Management Practices	1,822.64	3,082.99	4,905.63
	Thicket	642.29	0	642.29
Total Impact (Exclusive of Wildlife Best Management Practice)		1,366.12	2,364.25	3,730.37

The grassland habitat proposed (25 m width) along Arterial A2 was designed to account for the road alignment and road widening design, whereby it was implemented as a buffer between adjacent communities so as to avoid creating suitable habitat for wildlife in close proximity to the roadways and roadway maintenance requirements (Savanta, 2019).

Based on the high-level review of impacts for hard surface, those associated with the grassland vegetative cover (4.6%) is relatively small given the amount of overall vegetative cover to be implemented within the

Rainbow Creek corridor. The overall design of vegetative types can be re-visited during detailed design to accommodate for the loss of grassland habitat, should it be warranted. This can be facilitated through the reduction in woodland cover in proximity to large structures such as that proposed for Arterial A2, which may assist with sight lines and visibility in the future and prevent future unwarranted wildlife-vehicle interactions.

From a habitat connectivity perspective, a single span at this size will allow for connectivity between the north and south sides of the structure. This single span, given the openness ratio may also allow for light penetration underneath the structure which can help with plant growth and help aid in recovery of loss of vegetative coverage as a whole. Based on the sizing, connectivity and loss, Alternative 0 would be a favourable design option.

Economic Impact
Estimated construction costs associated with implementation of Alternative 0 (SP47 TMP design) are summarized in 5-14.

Table 5-14: Estimated Economic Impacts of Alternative 0 - Base Case

Design Element	Units	Unit Cost	# of Units	Total Cost
Structure (Construction)	m^2	$4,500	1,125	$5,060,000
Roadway (Construction)	N/A	N/A	N/A	$9,300,000
Total Construction Cost	N/A	N/A	N/A	$14,400,000
Annual Maintenance and Operations Cost	$/yr	N/A	N/A	$86,740
Total Lifecycle Cost	$	N/A	N/A	$35,690,000

5.6.2 Intersection within NHS (Alternative 1)

5.6.2.1 Roadway Design

Horizontal Alignment
This roadway alignment alternative locates the single Arterial A2 / Coleraine Drive / East-West Arterial intersection within the Rainbow Creek NHS, with the north-south axis of the intersection approximately aligned with existing Rainbow Creek. Arterial A2 approximately follows the alignment set out in the SP47 TMP, with the tie-in to Major Mackenzie Drive appropriately adjusted, and the curve radius increased to 900 m to move the intersection to a suitable location. East-West Arterial approximately follows the alignment set out in Block 47-2, while Coleraine Drive is aligned to minimize impacts to industrial development blocks. Horizontal design details for the arterial road segments located within SPA 2 are summarized in Table 5-15.

Some flexibility exists in the alignments of both Arterial A2 and Coleraine Drive, although changes to the Arterial A2 design will impact the location of the creek crossing.

Table 5-15: Horizontal Design Details for Transportation Network Alternative 1

Design Requirement	Arterial A2	Coleraine Drive	East-West Arterial
Min. Radius (m)	900	400	300
Min. Tangent at Intersections (m)	No tangent segment. 900 m curve at intersection.	No tangent segment. 1,300 m curve at intersection.	No tangent segment.

			1,300 m curve at intersection.
Meets Design Requirements?	No	Yes	Yes
Required Design Modifications	Curve radius has been increased to straighten approach. No further modification required.	Large radius curve is sufficiently long to approximate tangent.	Large radius curve is sufficiently long to approximate tangent.

Vertical Alignment

Through the study area the natural topography is relatively flat, with a natural slope rising from the south to the north of the project extents. The vertical alignments of East-West Arterial / Coleraine Drive and Arterial A2 have been designed to follow this natural slope while maintaining minimum grade requirements. This results in East-West Arterial and Coleraine Drive rising at a constant 0.5% grade from the south to the north through the NHS area. Arterial A2 also rises at a constant 0.5% grade from the west to the east through the intersection area to suit its overall horizontal north-west alignment. As this follows the natural topography it allows the intersection to be lower comparatively to Arterial Road Network Alternative 2 options.

Due to the location of the intersection, following the natural topography vertically provides adequate cover to the structures and clearance to the regional Water Service Elevation Level (WSEL) flood event. For preliminary grading it has been assumed that fill embankments be graded at 3:1 slope. The resultant area of impact on the NHS is approximately 15,316 m^2 with a fill volume of 34,780 m^3 (within NHS only). Further steepening of the embankments could be contemplated to reduce impacts to the NHS to an estimated minimum of 13,100 m^2.

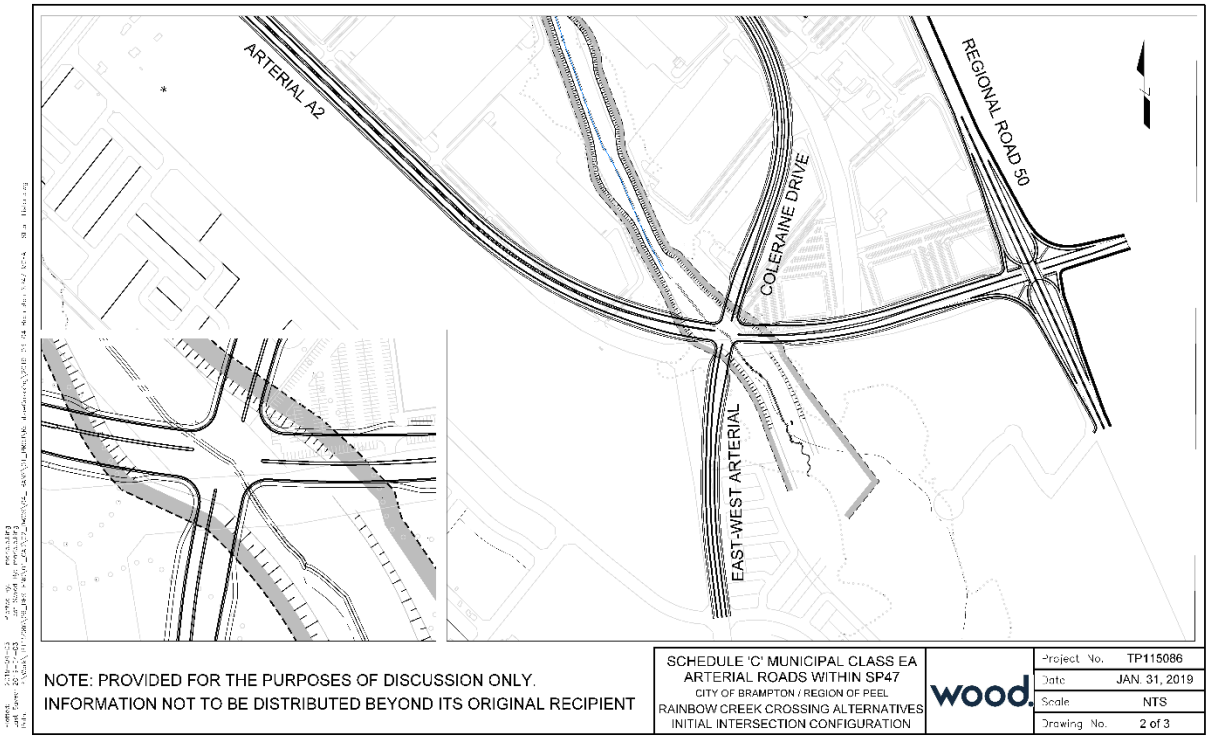


Figure 5-9: Roadway Design Alternative 1 - Intersection Within the NHS

5.6.3 Structural Design Alternatives

5.6.3.1 Alternative 1A – Parallel Box Culverts

Structural Design Details

The most economically feasible and constructable design for the Rainbow Creek crossing that meets calculated hydraulic, road flood, and estimated grading requirements would be to provide a series of parallel box culverts. The conceptual typical section for this design is illustrated in Figure 5-10.

These designs employs prefabricated box culvert segments, with the central culvert servicing creek flows and the side culverts generally providing dry passage for mammals.

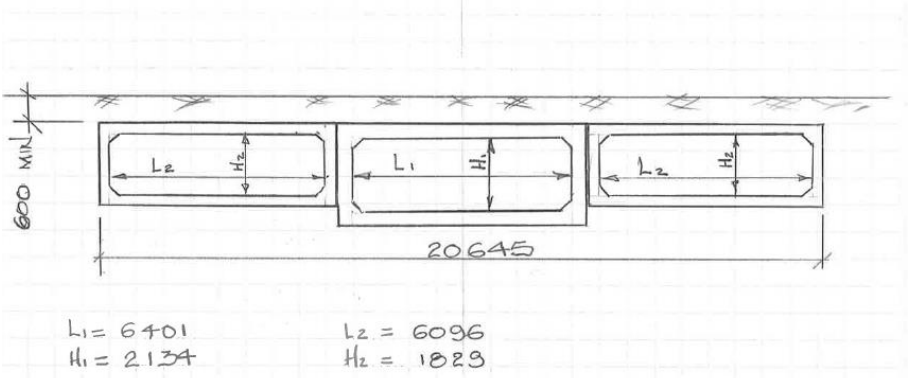


Figure 5-10: Conceptual cross-section for Structural Alternative 1A

Environmental Impacts

Social / Cultural

This alternative has no impact on existing social or cultural resources. There are impacts, however, to planned industrial properties along both Arterial A2 and Coleraine Drive. West of the NHS, approximately 18,700 m^2 of property will be required from the planned industrial complex located north of Arterial A2. The Coleraine Drive alignment runs through the center of one (1) planned industrial complex and would require approximately 3,500 m^2 of property from another. Reconfiguration of planned development will be required.

Natural Environment

The openness ratio was calculated for Alternative 1A as identified in Table 5-16 below. Based on the proposed dimensions for both the outside boxes, and inside box, the minimum openness ratio requirement to facilitate the wildlife groups identified in the MESP Addendum (Savanta, 2019) is achieved. More specifically, the wildlife groups associated with preferred habitat movement corridors around Arterial A2 (forest to meadow and meadow to meadow) will be accommodated. Determination of open bottom vs. closed bottom boxes will be confirmed during detailed design.

Table 5-16: Wildlife Crossing Design Parameters – Alternative 1A

Design Option	Dimensions	Openness Ratio	Wildlife Group Accommodated
Parallel Boxes: Two (2) Outside; One Centre	Outside: 1.829 (H) x 6.096 (W) x 75.0 (L)	0.15	Mid-sized mammals (e.g., fox, raccoon, skunk); Small mammals (e.g., mouse, vole, squirrel); Amphibian and Reptiles
	Centre: 2.134 (H) x 6.401 (W) x 75.0 (L)	0.18	Mid-sized mammals (e.g., fox, raccoon, skunk); Small mammals (e.g., mouse, vole, squirrel); Amphibian and Reptiles

As for impacts to the NHS, a summary is provided in the table below.

Based on the overall vegetative cover of each vegetation community Alternative 1A will impact the following:

- Woodland Temporary: Woodland overall (371,100 m^2) – Alternative 1A (1,987.40 m^2) = 0.5%
- Woodland Permanent: Woodland overall (371,100 m^2) – Alternative 1A (3,665.25 m^2) = 0.9%
- Grassland Temporary: Grassland overall (51,400 m^2) – Alternative 1A (501.51 m^2) = 0.9%
- Grassland Permanent: Grassland overall (51,400 m^2) – Alternative 1A (3,881.11 m^2) = 7.55%

Table 5-17: Natural Heritage Impact – Alternative 1A

Design Option	Landcover Type	Temporary Impact (Earthworks) m^2	Permanent Impact (Hard Surface) m^2	Total Impact per land cover m^2
Alternative 1A	Woodland	1,987.40	3,665.25	5,652.65
	Grassland	501.51	3,881.11	4,382.62
	Wildlife Best Management Practices	1,793.60	3,092.36	4,885.96
Total Impact (Exclusive of Wildlife Best Management Practice)		2,488.91	7,546.36	10,035.27

The grassland habitat proposed (25 m width) along Arterial A2 was designed to account for the road alignment and road widening design, whereby it was implemented as a buffer between adjacent communities so as to avoid creating suitable habitat for wildlife in close proximity to the roadways and roadway maintenance requirements (Savanta, 2019).

Based on the high-level review of impacts for hard surface, those associated with the woodland vegetative cover (>1%) and grassland cover (7.5%) are relatively small given the amount of overall vegetative cover to be implemented within the Rainbow Creek corridor. The multiple box scenario will segment the crossing into three (3) different structures. This results in smaller structures with smaller openness ratios, and light penetration. This may limit vegetative growth within the culverts, which in turn will not allow for any vegetative recovery within the culvert systems to account for the loss of each community within the overall Rainbow Creek corridor. With that said, the overall design of vegetative types can be re-visited during detailed design to accommodate for the loss of grassland habitat, should it be warranted. This can be facilitated through the reduction in woodland cover in proximity to large structures (e.g., such as that proposed for Arterial Road A2), which may assist with sight lines and visibility in the future and prevent future unwarranted wildlife-vehicle interactions.

Compared to a single span design, the inclusion of multiple structures may allow for the design to implement measures targeted to specific wildlife groups. For example, the center culvert would maintain the flow of Rainbow Creek and serve as fish habitat and passage, and the two (2) outside culverts can be designed to facilitate passage by amphibians and reptiles in one, and small to medium sized mammals in another, taking into consideration design criteria such as substrate type, refuge materials (e.g., brush piles and leaf litter). The two (2) outside culverts could also be designed to facilitate passage by all wildlife groups (small and medium size mammals, reptiles and amphibians) in both culverts, and each can be designed to implement additional means to facilitate passage (e.g., inclusion of a shelf).

Given the above, and the overall impact to the NHS, this Alternative (1A) would be a favourable design option if proper measures were implemented to ensure measures for substrate, dimensions and approaches are considered.

Economic Impact

The following table provides an estimate of the anticipated economic impacts of the proposed crossing design.

Table 5-18: Estimated Economic Impacts of Alternative 1A

Design Element	Units	Unit Cost	# of Units	Total Cost
Structure (Construction)	m^2	$3,000	2,270	$6,800,000
Roadway (Construction)	N/A	N/A	N/A	$8,970,000
Total Construction Cost	N/A	N/A	N/A	$15,770,000
Annual Maintenance and Operations Cost	$/yr	N/A	N/A	$97,300
Total Lifecycle Cost	$	N/A	N/A	$37,670,000

5.6.3.2 Alternative 1B - 15 m Rigid Frame, Single Span Structure

Structural Design Details

Based on calculated hydraulic, road flood, and estimated grading requirements and the instruction from the Authority having jurisdiction, 2.5 m H x 25 m W x 75 m L rigid frame, single span structure would be required for the Arterial A2 crossing of Rainbow Creek. A schematic of this crossing is provided in Figure 5-11.

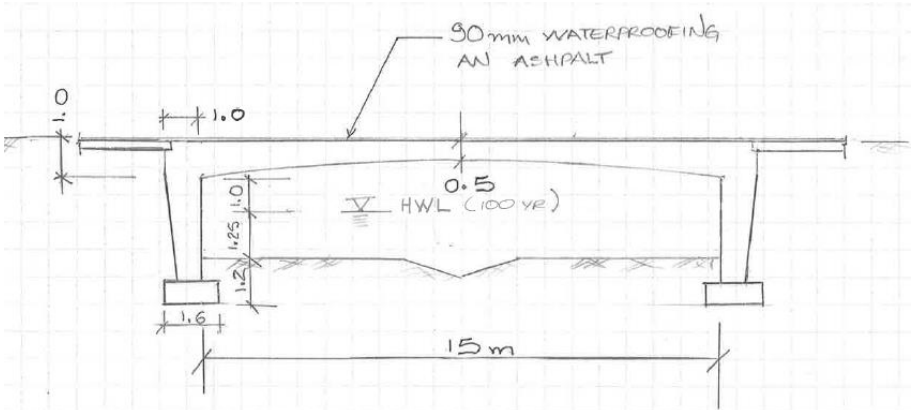


Figure 5-11: Rigid Frame, Single Span Crossing Arterial A2 Over Rainbow Creek

Environmental Impacts

Social / Cultural
Same impacts as for Alternative 1A.

Natural
The openness ratio was calculated for Alternative 1B as identified in Table 5-19 below. Based on the proposed dimensions for the single span structure, it meets minimum openness ratio requirement to facilitate the wildlife groups identified in the MESP Addendum (Savanta, 2019), in addition to some large mammals (e.g., coyotes). Similar to 1A, the single span structure will facilitate movement between habitat types defined in proximity to Arterial A2 (Forest and Meadow). Determination of open bottom vs. closed bottom boxes will be confirmed during detailed design.

Table 5-19: Wildlife Crossing Design Parameters – Alternative 1B

Design Option	Dimensions	Openness Ratio	Wildlife Group Accommodated
Single Span	2.5 (H) x 25.0 (W) x 75.0 (L)	0.30	All wildlife sizes with the exception of deer (e.g., coyotes, small and medium size mammals; amphibians and reptiles).

As for impacts to the NHS, a summary is provided in Table 5-20 below.

Based on the overall vegetative cover of each vegetation community Alternative 1B will impact the following:

- Woodland Temporary: Woodland overall (371,100 m^2) – Alternative 1B (1,987.40 m^2) = 0.5%
- Woodland Permanent: Woodland overall (371,100 m^2) – Alternative 1B (3,665.25 m^2) = 0.9%
- Grassland Temporary: Grassland overall (51,400 m^2) – Alternative 1B (501.51 m^2) = 0.9%
- Grassland Permanent: Grassland overall (51, 400 m^2) – Alternative 1B (3,881.11 m^2) = 7.55%

Table 5-20: Natural Heritage Impact – Alternative 1B

Design	Landcover Type	Temporary Impact (Earthworks) m^2	Permanent Impact (Hard Surface) m^2	Total Impact per land cover m^2
Alternative 1B	Woodland	1,987.40	3,665.25	5,652.65
	Grassland	501.51	3,881.11	4,382.62
	Wildlife Best Management Practices	1,793.60	3,092.36	4,885.96
Total Impact (Exclusive of Wildlife Best Management Practice)		2,488.91	7,546.36	10,035.27

Similar to 1A, the overall impact on the communities and vegetative cover is the same, as it will require similar impacts in terms of grading and overall constructability. As noted, the overall design of vegetative types can be re-visited during detailed design to accommodate for the loss of grassland habitat, should it be warranted. This can be facilitated through the reduction in woodland cover in proximity to large structures such as that proposed for Arterial A2, which may assist with sight lines and visibility in the future and prevent future unwarranted wildlife-vehicle interactions.

From a habitat connectivity perspective, a single span at this size will allow for connectivity between the north and south sides of the structure. This single span, given the openness ratio may also allow for light penetration underneath the structure which can help with plant growth and help aid in recovery of loss of vegetative coverage as a whole. Based on the sizing, connectivity and loss, Alternative (1B) would be the preferred design option.

Economic Impact

The following table provides an estimate of the anticipated economic impacts of the proposed crossing design.

Table 5-21: Estimated Economic Impacts of Alternative 1B

Design Element	Units	Unit Cost	# of Units	Total Cost
Structure (Construction)	m^2	$4,500	2,100	$9,450,000
Roadway (Construction)	N/A	N/A	N/A	$8,970,000
Total Construction Cost	N/A	N/A	N/A	$18,420,000
Annual Maintenance and Operations Cost	$/yr	N/A	N/A	$103,600
Total Lifecycle Cost	$	N/A	N/A	$41,840,000

5.6.4 Intersection West of NHS (Alternative 2)

5.6.4.1 Roadway Design

Horizontal Alignment

This roadway alignment alternative locates the single Arterial A2 / Coleraine Drive / East-West Arterial intersection immediately west of the Rainbow Creek NHS and will require two (2) creek crossings – one (1) for Arterial A2 and one (1) for Coleraine Drive. Consideration of a network alternative that removed the intersection from the NHS was previously requested by TRCA.

Arterial A2 approximately follows the alignment set out in the SP47 TMP, with the tie-in to Major Mackenzie Drive appropriately adjusted. There are significant modifications relative to the originally contemplated horizontal alignments for both the East-West Arterial and Coleraine Drive in order to limit both intersection skew and impacts to planned industrial properties. A significant number of alternative alignments for both Coleraine Drive and East-West Arterial were contemplated for this alternative, with this particular option brought forward due to the reduced impacts on the proposed industrial developments. Creek crossing designs and impacts are not considered to be significantly different between alternatives. Horizontal design details for the arterial road segments located within SPA 2 are summarized in Table 5-22.

As previously discussed, some flexibility exists in the alignments of all roadways under this design configuration, although changes will result in greater impacts to the planned industrial complexes.

Table 5-22: Horizontal Design Details

Design Requirement	Arterial A2	Coleraine Drive	East-West Arterial
Min. Radius (m)	600	330	330
Min. Tangent at Intersections (m)	n/a	75	75
Meets Design Requirements?	No	Yes	Yes
Required Design Modifications	Minimum tangent not provided at East-West, but intersection located on outside of curve is considered acceptable.	n/a	n/a

Vertical Alignment

As noted for Alternative 1, the natural topography of the study area is relatively flat, with a natural slope rising from the south to the north of the project extents. The vertical alignments of East-West Arterial / Coleraine Drive and Arterial A2 have been designed to follow this natural slope while maintaining minimum 0.5% grade requirements. Arterial A2 rises at a constant 0.5% grade from the west to the east through the intersection area to suit its overall horizontal north-west alignment. Due to the horizontal alignment shifting the location of the intersection further west relative to Arterial Road Network Alternative 1, East-West Arterial / Coleraine Drive alignment has been raised to suit the intersection grade with Arterial A2. This has been achieved by introducing a crest curve 100m south of the intersection and a sag curve 200 m to the north of the intersection. This ties the vertical alignment back with the natural

topography while maintaining a minimum grade of 0.5% as not to increase the grading footprint through the NHS area along the Coleraine Drive intersection leg.

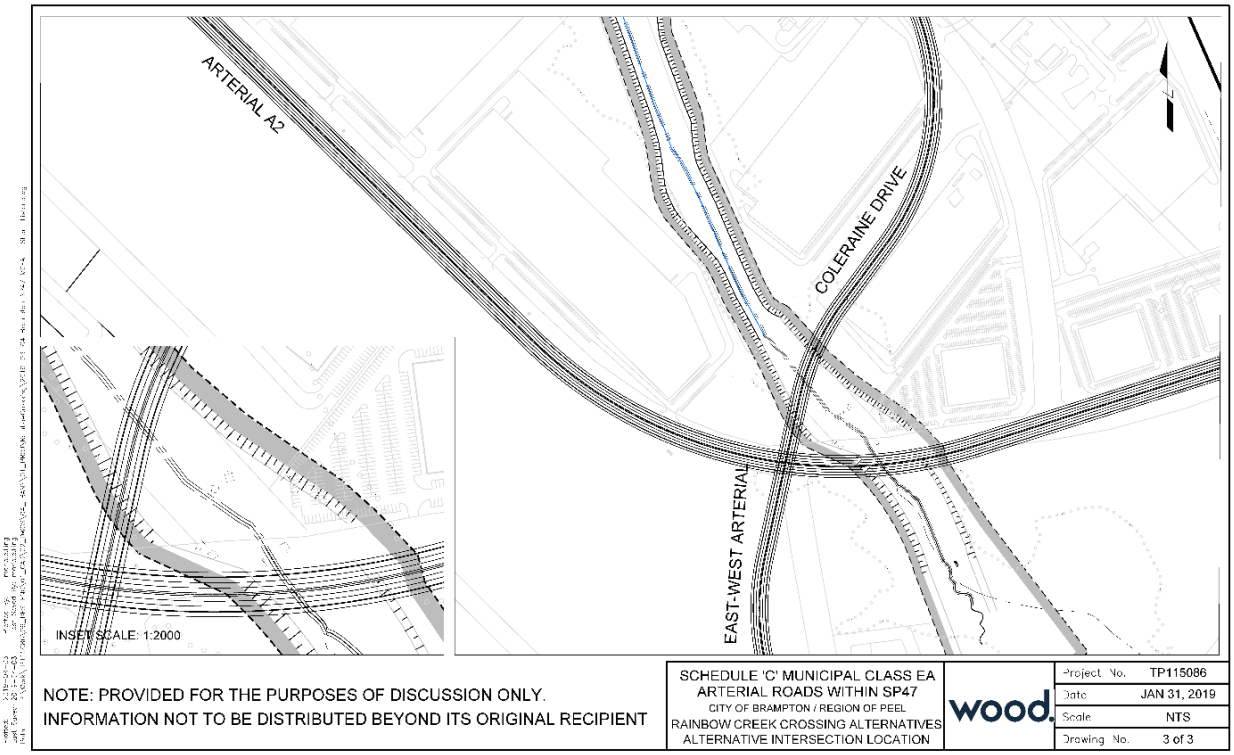


Figure 5-12: Roadway Design Alternative 2 - Intersection West of the NHS

Arterial A2 follows the natural topography which vertically provides adequate cover to suitable structures and clearance to the regional WSEL flood event. The vertical alignment of East-West Arterial and Coleraine Drive alignment have been minimized to reduce impact in the NHS. However, due to the intersection location the road surface follows a higher road elevation than Alternative 1, resulting in greater impact area and fill volume within the NHS. For preliminary grading it has been assumed that fill embankments be graded at 3:1 slope to reduce impact on the NHS area. The resultant area of impact on the NHS is approximately 15,800 m^2 with a fill volume of 43,050 m^3 (within NHS only). Further steepening of the embankments (e.g., through the use of green walls or similar) could reduce the impacted area to approximately 11,200 m^2.

5.6.5 Alternative 2A – Parallel Box Culverts

Structural Design Details

The most economically feasible and constructible design for the Rainbow Creek crossing that meets calculated hydraulic, road flood, and estimated grading requirements would be to provide a series of parallel box culverts. The conceptual typical section for this design is illustrated in Figure 5-13 (north crossing) and Figure 5-14 (south crossing).

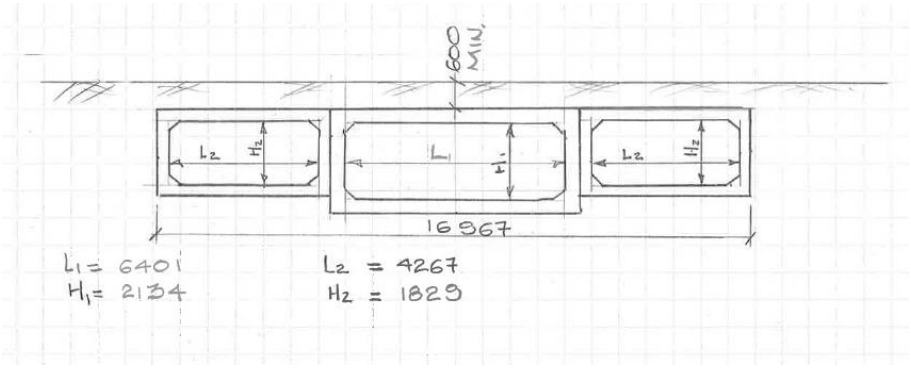


Figure 5-13: Conceptual Cross-Section for Structural Alternative 2A - North Structure

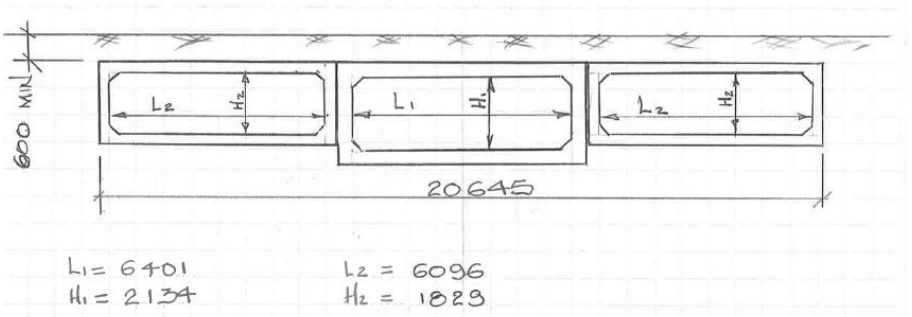


Figure 5-14: Conceptual Cross-Section for Structural Alternative 2A - South Structure

5.6.5.1 Environmental Impacts

Social / Cultural

This alternative has no impact on existing social or cultural resources. There are impacts, however, to planned industrial properties. Coleraine Drive is approximately aligned between two (2) planned industrial complexes, with reconfiguration / relocation of the same building footprints anticipated to be feasible once the previously contemplated Coleraine Drive ROW is made available. Some reconfigurations of planned developments will be required, but overall impacts are anticipated to be minor.

Natural

The openness ratio was calculated for Alternative 2A as identified in Table 5-23 below. Based on the proposed dimensions for both the north and south crossings, each of the proposed box culverts meet the minimum openness ratio requirement to facilitate the wildlife groups identified in the MESP Addendum (Savanta, 2019). Similar to 1A and 1B, the structures associated with both crossings will facilitate movement between habitat types defined in proximity to Arterial A2 (Forest and Meadow). Determination of open bottom vs. closed bottom boxes will be confirmed during detailed design.

Table 5-23: Wildlife Crossing Design Parameters – Alternative 2A

Design Option	Criteria	Dimensions	Openness Ratio	Wildlife Group Accommodated
Parallel Boxes: Two (2) Outside;	North Crossing	Outside: 1.829 (H) x 4.267 (W) x 70.0 (L)	0.11	Mid-sized mammals (e.g., fox, raccoon, skunk); Small mammals (e.g., mouse, vole, squirrel); Amphibian and Reptiles

Design Option	Criteria	Dimensions	Openness Ratio	Wildlife Group Accommodated
One Centre		Centre: 2.134 (H) x 6.401 (W) x 70.0 (L)	0.20	Mid-sized mammals (e.g., fox, raccoon, skunk); Small mammals (e.g., mouse, vole, squirrel); Amphibian and Reptiles
	South Crossing	Outside: 1.829 (H) x 6.096 (W) x 75.0 (L)	0.15	Mid-sized mammals (e.g., fox, raccoon, skunk); Small mammals (e.g., mouse, vole, squirrel); Amphibian and Reptiles
		Centre: 2.134 (H) x 6.401 (W) x 75.0 (L)	0.18	Mid-sized mammals (e.g., fox, raccoon, skunk); Small mammals (e.g., mouse, vole, squirrel); Amphibian and Reptiles

As for impacts to the NHS, a summary is provided in Table 5-24 below. Based on the overall vegetative cover of each vegetation community Alternative 2A will impact the following:

- Woodland Temporary: Woodland overall (371,100 m^2) – Alternative 2A (2,048.85 m^2) = 0.55%
- Woodland Permanent: Woodland overall (371,100 m^2) – Alternative 2A (4,442.90 m^2) = 1.2%
- Grassland Temporary: Grassland overall (51,400 m^2) – Alternative 2A (1,034.09 m^2) = 2%
- Grassland Permanent: Grassland overall (51,400 m^2) – Alternative 2A (2,720.37 m^2) = 5.3%
- Thicket Temporary: Thicket overall (49,400 m^2) – Alternative 2A (642.29 m^2) = 1.3%
- Thicket Permanent: Thicket overall (49,400 m^2) – Alternative 2A (0 m^2) = 0%

Table 5-24: Natural Heritage Impact – Alternative 2A

Design	Landcover Type	Temporary Impact (Earthworks) m^2	Permanent Impact (Hard Surface) m^2	Total Impact per land cover m^2
Alternative 2A	Woodland	2,048.95	4,442.90	6,491.85
	Grassland	1,034.09	2,720.37	3,754.46
	Wildlife Best Management Practices	1,822.64	3082.99	4,905.63
	Thicket	642.29	0	642.29
Total Impact (Exclusive of Wildlife Best Management Practice)		3,725.33	7,163.27	10,888.60

Similar to the previous alternatives 1A and 1B, the greatest loss is to the grassland community (5.3%), which was the dominant community identified for those areas around road crossings within the MESP Addendum (Savanta, 2019).

The loss of grassland habitat can be revisited during detailed design should it be warranted, whereby additional grassland space can be implemented on the north side of the crossing, with a decrease in woodland cover. This may be beneficial to include over the long term so as to avoid wildlife interactions typical of forest communities and coverage (e.g., larger mammals) near the intersections.

Again, as noted with Alternative 2A, the inclusion of multiple structures may allow for the design to implement measures targeted to specific wildlife groups. For example, the centre culvert would maintain the flow of Rainbow Creek and serve as fish habitat and passage, and the two (2) outside culverts can be designed to facilitate passage by amphibians and reptiles and small to medium sized mammals in various ways.

When considering habitat movement and connectivity for the two (2) Rainbow Creek crossing alternatives, an important characteristic is the distance between crossing structures. In review of both the Conservation Halton and Credit Valley Conservation wildlife passage guidance documents (2018 and 2017 respectively), each note that small, medium and large mammals tend to prefer when structures are separated by more than 150 m at a minimum: with the greater distance requirements, the larger the species. In this Alternative, the distance between the north and south crossing is approximately 80 m. Given background information, this would not support those small, medium and larger mammals to move within the corridor as one would anticipate in instances where crossings are greater spaced. Due to the limitations posed within the corridor (due to future land development), there is not much movement for where the crossings can be moved. Therefore, from an impact perspective, and end goal of the Rainbow Creek corridor as per the MESP and MESP Addendum, this Alternative (2A) would be less preferred for the preferred design.

Economic Impact

The following table provides an estimate of the anticipated economic impacts of the proposed crossing design.

Table 5-25: Estimated Economic Impacts of Alternative 2A

Design Element	Units	Unit Cost	# of Units	Total Cost
Structure (Construction)	m^2	$4,500	1,650	$8,200,000
Roadway (Construction)	N/A	N/A	N/A	$9,330,000
Total Construction Cost	N/A	N/A	N/A	$17,530,000
Annual Maintenance and Operations Cost	$/yr	N/A	N/A	$112,200
Total Lifecycle Cost	$	N/A	N/A	$41,800,000

5.6.6 Alternative 2B – 12 and 15 m Rigid Frame, Single Span Structures

5.6.6.1 Structural Design Details

Based on calculated hydraulic, road flood, and estimated grading requirements, 2.25 m H x 12 m W x 70 m L (north) and 2.25 m H x 15 m W x 75 m L (south) rigid frame, single span structures would be required for the Coleraine Drive and Arterial A2 crossings of Rainbow Creek, respectively. A schematic of this crossing is provided in Figure 5-15 and Figure 5-16.

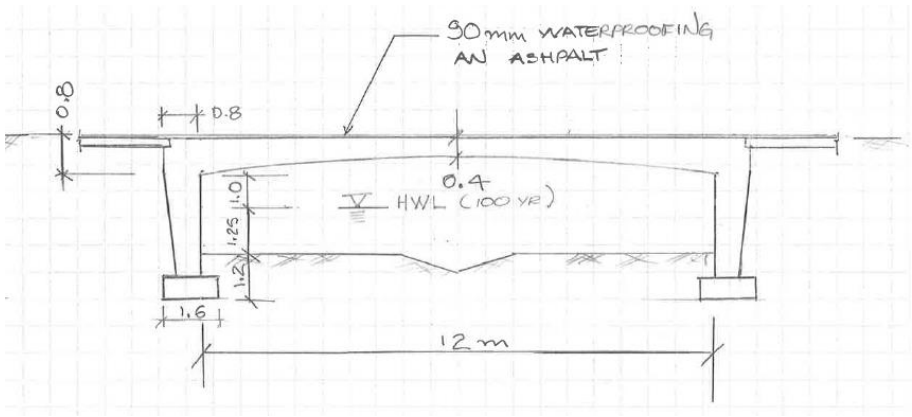


Figure 5-15: Conceptual Cross-Section for Structural Alternative 2B - North Structure

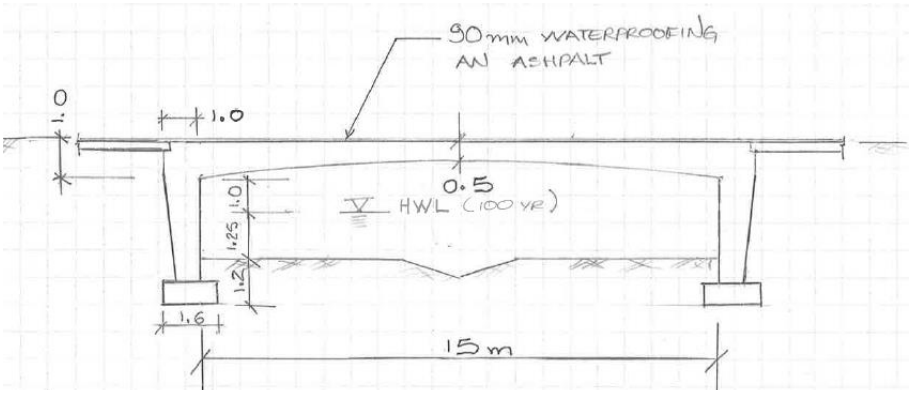


Figure 5-16: Conceptual Cross-Section for Structural Alternative 2B - South Structure

5.6.6.2 Environmental Impacts

Social / Cultural
Refer to previous section.

Natural
The openness ratio was calculated for Alternative 2B as identified in Table 5-26 below. Based on the proposed dimensions for both the north and south crossings, each of the single span structures meets the minimum openness ratio requirement to facilitate the wildlife groups identified in the MESP Addendum (Savanta, 2019), in addition to larger mammals (e.g., coyotes). Similar to the other alternatives discussed herein, the structures associated with both crossings will facilitate movement between habitat types defined in proximity to Arterial A2 (Forest and Meadow). Determination of open bottom vs. closed bottom boxes will be confirmed during detailed design.

Table 5-26: Wildlife Crossing Design Parameters – Alternative 2B

Design Option	Criteria	Dimensions	Openness Ratio	Wildlife Group Accommodated
Single Span	North Crossing	2.25 (H) x 12.0 (W) x 70.0 (L)	0.39	All wildlife sizes with the exception of deer (e.g., coyotes, small and medium size mammals; amphibians and reptiles).
	South Crossing	2.25 (H) x 15.0 (W) x 75.0 (L)	0.45	All wildlife sizes with the exception of deer (e.g., coyotes, small and medium size mammals; amphibians and reptiles).

As for impacts to the NHS, a summary is provided in Table 5-27 below. Based on the overall vegetative cover of each vegetation community Alternative 2B will impact the following:

- Woodland Temporary: Woodland overall (371,100 m^2) – Alternative 2B (2,048.85 m^2) = 0.55%
- Woodland Permanent: Woodland overall (371,100 m^2) – Alternative 2B (4,442.90 m^2) = 1.2%
- Grassland Temporary: Grassland overall (51,400 m^2) – Alternative 2B (1,034.09 m^2) = 2%
- Grassland Permanent: Grassland overall (51,400 m^2) – Alternative 2B (2,720.37 m^2) = 5.3%
- Thicket Temporary: Thicket overall (49,400 m^2) – Alternative 2B (642.29 m^2) = 1.3%
- Thicket Permanent: Thicket overall (49,400 m^2) – Alternative 2B (0 m^2) = 0%

Table 5-27: Natural Heritage Impact – Alternative 2B

Design	Landcover Type	Temporary Impact (Earthworks) m^2	Permanent Impact (Hard Surface) m^2	Total Impact per land cover m^2
Alternative 2B	Woodland	2,048.95	4,442.9	6,491.85
	Grassland	1,034.09	2,720.37	3,754.46
	Wildlife Best Management Practices	1,822.64	3082.99	4,905.63
	Thicket	642.29	0	642.29
Total Impact (Exclusive of Wildlife Best Management Practice)		3,725.33	7,163.27	10,888.60

Similar to Alternative 1A and 1B, the footprint associated with 2A and 2B is essentially the same from a construction impact perspective. The loss of vegetative cover at this time would be the same relative to a single span structure versus a multiple box culvert scenario. Using a single span structure may allow for greater light penetration given the higher openness ratio, which may be able to facilitate some plant life underneath, thereby reducing the overall loss to the coverage identified (e.g., 5.3% for grassland). Again, as noted herein there is an option to revise the vegetative coverage within the corridor to accommodate for loss of one (1) coverage over another particularly around specific features and hardscapes that will be better fine-tuned during detailed design.

Similar to 2A, the habitat and connectivity issues for small, medium and larger mammals would also apply to this Alternative. The only difference between 2A and 2B, would be that this is a single span structure which may appear "more" inviting to wildlife compared to three (3) boxes at the north crossing, and then another three (3) boxes within 80 m at the south crossing. Therefore, from an impact perspective, and end goal of the Rainbow Creek corridor as per the MESP and MESP Addendum, this Alternative (2B) would be less preferred for the preferred design, but a bit better overall than 2A simply because of the openness factor, and potential for vegetative cover to exist within / underneath the structure.

Economic Impact

The following table provides an estimate of the anticipated economic impacts of the proposed crossing design.

Table 5-28: Estimated Economic Impacts of Alternative 2B

Design Element	Units	Unit Cost	# of Units	Total Cost
Structure (Construction)	m^2	$4,500	1,650	$9,100,000
Roadway (Construction)	N/A	N/A	N/A	$9,330,000
Total Construction Cost	N/A	N/A	N/A	$18,430,000
Annual Maintenance and Operations Cost	$/yr	N/A	N/A	$121,200
Total Lifecycle Cost	$	N/A	N/A	$43,700,000

5.6.7 Alternative 2C – 60 m Rigid Frame, Dual Span, Parallel Structures

5.6.7.1 Structural Design Details

Without the design constraints associated with having an intersection located on top of the creek crossing structure, it is technically feasible to provide a multi-span structure that would elevate much of the transportation infrastructure out of the NHS. This design alternative would provide a set of dual-span, parallel structures (one structure for each travel direction) for each crossing location, with the bridges ideally separated to provide both structural independence and additional light penetration. The conceptual sketches for this alternative are provided in Figure 5-17.

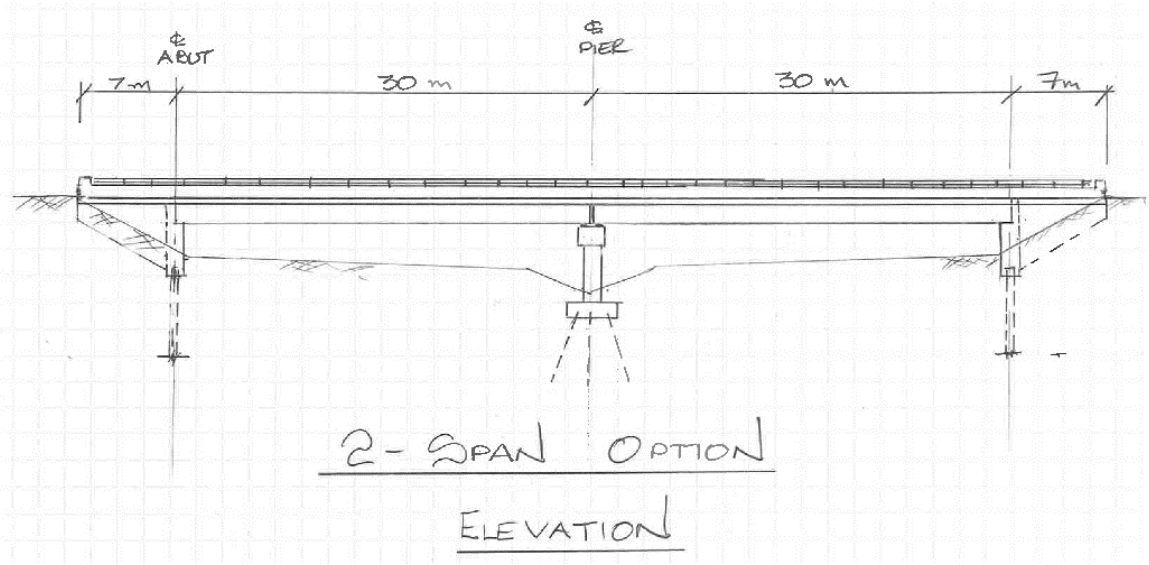


Figure 5-17: Conceptual Cross-Section for Structural Alternative 2C

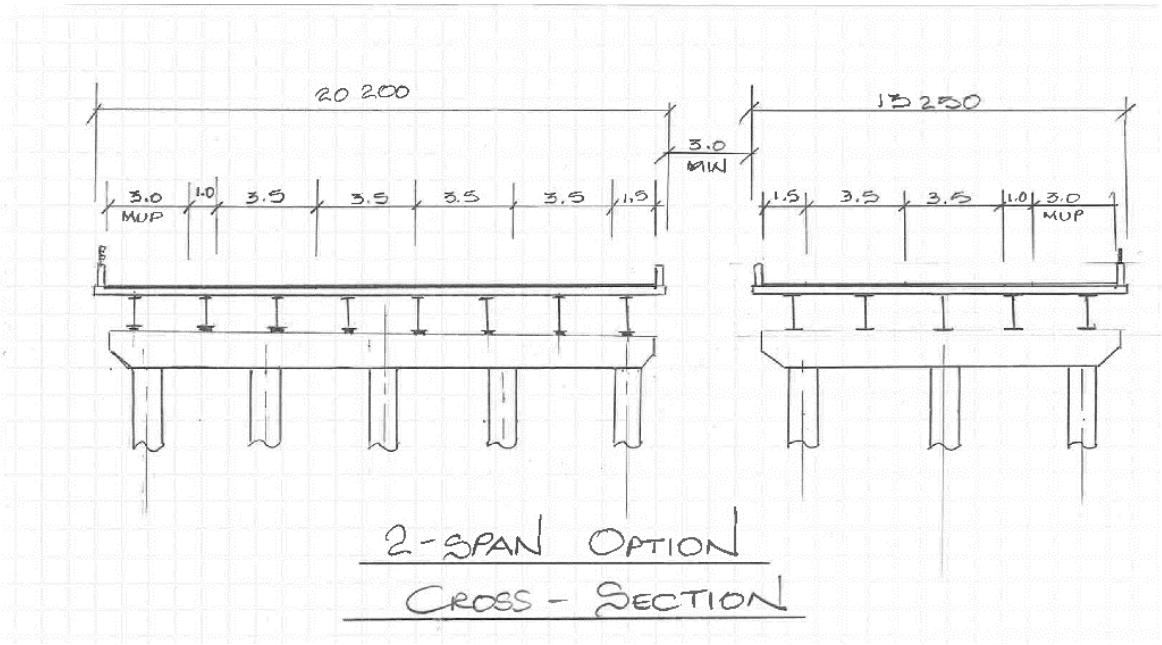


Figure 5-18: Dual Span Structural Alternative 2C

5.6.7.2 Environmental Impacts

Social / Cultural
Same impacts as Alternative 2A.

Natural
The openness ratio was calculated for Alternative 2C as identified in Table 5-29. Based on the proposed dimensions these dual span structures would more than meet the minimum openness ratio requirement to facilitate the wildlife groups identified in the MESP Addendum (Savanta, 2019), in addition to larger mammals (inclusive of deer). Similar to the other alternatives discussed herein, the structures associated with both crossings will facilitate movement between habitat types defined in proximity to Arterial A2 (Forest and Meadow). Determination of open bottom vs. closed bottom boxes will be confirmed during detailed design.

Table 5-29: Wildlife Crossing Design Parameters – Alternative 2C

Design Option	Criteria	Dimensions	Openness Ratio	Wildlife Group Accommodated
Single Span	North Crossing	2.25 (H) x 60 (W) x 36.45 (L)	3.7	All wildlife sizes (e.g., large, small and medium size mammals; amphibians and reptiles).
	South Crossing	2.25 (H) x 60 (W) x 36.45 (L)	3.7	All wildlife sizes (e.g., large, small and medium size mammals; amphibians and reptiles).

An assessment of impacts relative to vegetative cover has not been completed at this time, however this size structure and clear span across the entire NHS will likely result in limited to no impacts to the NHS. The large openness ratio will facilitate all wildlife types inclusive of deer and will likely provide enough light penetration to facilitate vegetative growth underneath the structures, thus allowing for complete connectivity. The only downside to this Alternative, is that like Alternative 2A and 2B, both the north and south crossing structures are within 80 m of one (1) another, which is not always preferred for larger, medium and small mammals.

From an impact perspective, this Alternative does provide an abundant amount of positives, with the exception of the distance between the two (2) structures. It is for this reason and uncertainty of usage by multiple wildlife groups that this would not be the preferred solution.

Economic Impact

The following table provides an estimate of the anticipated economic impacts of the proposed crossing design.

Table 5-30: Estimated Economic Impacts of Alternative 2C

Design Element	Units	Unit Cost	# of Units	Total Cost
Structure (Construction)	m^2	$4,500	1,650	$17,600,000
Roadway (Construction)	N/A	N/A	N/A	$9,330,000
Total Construction Cost	N/A	N/A	N/A	$26,930,000
Annual Maintenance and Operations Cost	$/yr	N/A	N/A	$206,200
Total Lifecycle Cost	$	N/A	N/A	$61,120,000

5.6.8 Overall Evaluation of Alternatives

Table 5-31 provides an overview of the design alternatives as they relate to the evaluation criteria established for the Arterial Roads Class EA.

It should be noted that Peel Region will continue to work together with TRCA to identify appropriate compensation opportunities. Peel Region understands that ecosystem compensation will follow in principle the TRCA's Guideline for Determining Ecosystem Compensation, dated June 2018. Compensation will be approved by TRCA and Peel Region in advance of TRCA permit approvals.

Table 5-31: Evaluation of Rainbow Creek Crossing Design Alternatives

Cat.	Criteria	Criteria Indicator	Alternative 0 TMP Road Network Configuration (Base Case for Comparison Only)	Alternative 1 – Single Intersection Within the NHS		Alternative 2 – Two (2) Separate Crossings, Intersection West of NHS		
				1A Parallel Box Culverts	1B 25 m Structural Culvert	2A Parallel Box Culverts	2B 12 m and 15 m Structural Culverts	2C Structures That Span the Meander Belt
Engineering	Provide enhanced inter-regional connectivity		• Significant operational issues are anticipated due to the close proximity of the Coleraine Drive and Regional Road 50 intersections. Travel between Regions through this network will be difficult.	• Improved traffic flow associated with increased intersection spacing. • Movement between Regions will be improved.		• Improved traffic flow associated with increased intersection spacing. • Movement between Regions will be improved.		
								
	Provide access to proposed development		• Access to Arterial A2 from Coleraine Drive will be significantly impacted by traffic queue spillback from Regional Road 50 during peak periods. • Alternative does provide for separated access to the industrial and residential developments.	• Access will be provided to proposed development as envisioned during completion of the SP47 TMP and Secondary Plan.		• Access will be provided to proposed development as envisioned during completion of the SP47 TMP and Secondary Plan.		
								
	Improve roadway geometrics to meet or exceed City and Regional standards		Arterial roadway design acceptably meets applicable design standards.					
								
	Transportation Network Safety (includes natural hazards)	Safety related factors include roadway geometrics, roadside hazards, intersection design and control, accommodating pedestrians and cyclists.	• Anticipated significant traffic congestion will result in increased risk of rear-end and side-swipe collisions. • Lack of through movement traffic signal phase on Coleraine Drive and East-West Arterial at Arterial A2 will impact safety of pedestrians and cyclists making this movement.	• Single at-grade intersection ranked most preferred through Vision Zero Assessment. • Most significant safety concerns are associated with intersection crossing distances.		• Single at-grade intersection ranked most preferred through Vision Zero Assessment. • Most significant safety concerns are associated with intersection crossing distances. • Collector roadway planned for east side of Community Park will need to be significantly realigned to address intersection skew and visibility associated with increased sinuosity of East-West Arterial.		
								
	Transportation Network Connectivity		• Improved east-west connectivity provided along Arterial A2 relative to existing condition.	• Improved east-west connectivity provided along Arterial A2 relative to existing condition. • Connection of Coleraine Drive and East-West Arterial at a single intersection enhances north-south and east-west connectivity.		• Improved east-west connectivity provided along Arterial A2 relative to existing condition. • Connection of Coleraine Drive and East-West Arterial at a single intersection enhances north-south and east-west connectivity.		

Cat.	Criteria	Criteria Indicator	Alternative 0 TMP Road Network Configuration (Base Case for Comparison Only)	Alternative 1 – Single Intersection Within the NHS		Alternative 2 – Two (2) Separate Crossings, Intersection West of NHS		
				1A Parallel Box Culverts	1B 25 m Structural Culvert	2A Parallel Box Culverts	2B 12 m and 15 m Structural Culverts	2C Structures That Span the Meander Belt
			• No continuous easterly connection for East-West Arterial or westerly connection for Coleraine Drive.					
								
	Transportation Network Capacity	Impacts on traffic on local roads and outside the study area. Transportation network improvement and accommodation of goods movement.	• Traffic queuing from Regional Road 50 extends back beyond Coleraine Drive during peak periods (design horizon), impacting access from the industrial area to Major Mackenzie Drive / Highway 427 Extension.	• Increased separation between intersections on Arterial A2 improve traffic operations along the main corridor. • Option exists to grade-separate Arterial A2 / Regional Road 50 intersection if congestion becomes significantly worse by design horizon. • Improved network operation accommodates goods movement.		• Increased separation between intersections on Arterial A2 improve traffic operations along the main corridor. • Option exists to grade-separate Arterial A2 / Regional Road 50 intersection if congestion becomes significantly worse by design horizon. • Improved network operation accommodates goods movement.		
								
	Promotion of Active Transportation	Adheres to Brampton's Active Transportation Policies and Initiatives as Defined in the TMP.	Pedestrian and cycling facilities to be similarly provided for all alternatives.					
	Transit Supportive Development	Potential adverse impact on transit service. Assessment of impact on planned transit service improvements.	• Transit service will be impacted by anticipated congestion. • Additional transfer anticipated for travel between East-West Arterial to Coleraine Drive.	• No anticipated adverse impact on transit services.		• Increased westerly shift of Coleraine Drive at Arterial A2 will increase travel times for southbound to eastbound routes.		
								
	Structural Impacts	Potential adverse impact on existing structures.	No existing bridge structure to be impacted. No difference between alternatives.					
								

Cat.	Criteria	Criteria Indicator	Alternative 0 TMP Road Network Configuration (Base Case for Comparison Only)	Alternative 1 – Single Intersection Within the NHS		Alternative 2 – Two (2) Separate Crossings, Intersection West of NHS		
				1A Parallel Box Culverts	1B 25 m Structural Culvert	2A Parallel Box Culverts	2B 12 m and 15 m Structural Culverts	2C Structures That Span the Meander Belt
		Need for additional bridge structures.	• Estimated structural dimensions of 2.25 H x 15.0 W x 75.0 L. • Estimated construction cost of $5,060,000.	• Estimated structural dimensions of 1.829 H x 6.096 W x 110.0 L (Outside Culverts) and 2.134 H x 6.401 W x 110.0 L (Centre Culvert). • Estimated construction cost of $6,800,000. • Outside culverts will require additional maintenance to minimize the amount of debris that is accumulated.	• Estimated structural dimensions of 2.5 H x 25.0 W x 75.0 L. • Estimated construction cost of $9,450,000.	• Estimated dimensions of north culverts: 0.829 H x 4.267 W x 70.0 L and 2.134 H x 6.401 W x 70.0 L. • Estimated dimensions of south culverts: 1.829 H x 6.096 W x 75.0 L and 1.829 H x 6.096 W x 75.0 L. • Estimated construction cost of $8,200,000. • Outside culverts will require additional maintenance to minimize the amount of debris that is accumulated.	• Estimated structural dimensions of 2.25 H x 12.0 W x 70.0 L (North Structure). • 2.25 H x 15.0 W x 75.0 L (South Structure). • Estimated construction cost of $9,100,000.	• Estimated dimensions for each of the two (2) structures is 2.25 H x 60 W x 36.45 L. • Estimated construction cost of $17,600,000.
								
	Hydraulics and Hydrology Impacts (Creeks)	Impact on floodplain, existing flood depths at proposed crossing locations, and existing flood return period.	• Regional Flood Depth = 2.70 m at upstream side of Arterial A2 crossing. • Note: flood depths to remain in channel so as to not impact adjacent properties.	• Regional Flood Depth = 2.76 m at upstream side of crossing. • Note: flood depths to remain in channel so as to not impact adjacent properties.	• Regional Flood Depth = 2.80 m at upstream side of crossing. • Note: flood depths to remain in channel so as to not impact adjacent properties.	• Regional Flood Depth = 2.81 m at upstream side of Coleraine Drive crossing. • Regional Flood Depth = 2.67 m at upstream side of Arterial A2 crossing. • Note: flood depths to remain in channel so as to not impact adjacent properties.	• Regional Flood Depth = 2.81 m at upstream side of Coleraine Drive crossing. • Regional Flood Depth = 2.70 m at upstream side of Arterial A2 crossing. • Note: flood depths to remain in channel so as to not impact adjacent properties.	• Structural spans are great enough not to have any impact on flood depths or floodplain.
								
Financial	Utility Relocation	Anticipated impacts to existing and proposed utilities.	• No difference in impact to existing utilities between alternatives. • Total road length of 2,200 m within focused study area, with proportional length of storm sewer, sanitary sewer, watermain and hydro required.	• No difference in impact to existing utilities between alternatives. • Total road length of 2,230 m within focused study area, with proportional length of storm sewer, sanitary sewer, watermain and hydro required.		• No difference in impact to existing utilities between alternatives. • Total road length of 2,300 m within focused study area, with proportional length of storm sewer, sanitary sewer, watermain and hydro required.		
								
	Capital Costs	Function of total road length and width, AT	• Lowest cost	• Low cost.	• Low cost.	Moderate cost.	• Moderate cost.	• Highest cost.

Cat.	Criteria	Criteria Indicator	Alternative 0 TMP Road Network Configuration (Base Case for Comparison Only)	Alternative 1 – Single Intersection Within the NHS		Alternative 2 – Two (2) Separate Crossings, Intersection West of NHS		
				1A Parallel Box Culverts	1B 25 m Structural Culvert	2A Parallel Box Culverts	2B 12 m and 15 m Structural Culverts	2C Structures That Span the Meander Belt
		facilities provided, intersection infrastructure, structural area required, and amount of utility relocation.						
	Operating Costs	Function of road length and number of traffic signals.	• Lowest cost 	• Low cost. 	• Low cost. 	• Moderate cost. 	• Moderate cost. 	• Highest cost. 
	Property Acquisition	Estimated cost of acquiring required property.	• Approximately 9.38 ha will be required to construct roadways within the focused study area. • Moderate cost. 	• Approximately 9.43 ha will be required to construct roadways within the focused study area. • Moderate cost. 	• Approximately 9.43 ha will be required to construct roadways within the focused study area. • Moderate cost. 	• Approximately 9.94 ha will be required to construct roadways within the focused study area. • High cost. 	• Approximately 9.94 ha will be required to construct roadways within the focused study area. • High cost. 	• Approximately 9.94 ha will be required to construct roadways within the focused study area. • High cost.
Social / Cultural Environment	Conformance to Planning Objectives (Growth Plan, Official Plan, Secondary Plan, Area 47 TMP)		• Roadway alignments and Rainbow Creek crossing structure are in accordance with all previous planning studies. • Anticipated traffic congestion has the potential to impact growth potential. 	• Intersection location and roadway alignments vary from what was presented in the SP47 TMP, although design of SPA 2 was to be deferred to EA phase. • Provides improved traffic operations and network connectivity relative to SP47 TMP design, supporting increased growth potential. • Design will have impact to currently on-going block planning processes. 		• Intersection location and roadway alignments vary from what was presented in the SP47 TMP, although design of SPA 2 was to be deferred to EA phase. • Provides improved traffic operations and network connectivity relative to SP47 TMP design, supporting increased growth potential. • Ability to provide planned collector road network southwest of Arterial A2, along East-West Arterial, will be significantly limited and will impact Secondary Plan land uses. • Design will have impact to currently on-going block planning processes. 		
	Residential/ Business Access and Displacement	Potential adverse effects including limited access and changes to existing entrances.	No anticipated impact to existing accesses associated with any of the contemplated alternatives.					
		Potential adverse effects including limited access and changes to planned entrances.	• Block Plans were developed based on this road network alternative. No adverse impacts anticipated. 	• Access points will need to be revised for two (2) planned industrial complexes – one (1) fronting on Coleraine Drive and one (1) fronting on Arterial A2. • Planned office blocks will no longer have direct access to Coleraine Drive / Arterial A2. • Reconfiguration of the planned road network southeast of the proposed main intersection will be required. 		• Access points will need to be revised for two (2) planned industrial complexes – one (1) fronting on Coleraine Drive and one (1) fronting on Arterial A2. • Planned office blocks will no longer have direct access to Coleraine Drive / Arterial A2. Location of access will be further limited by the sinuous alignment of Coleraine Drive. • Reconfiguration of the planned road network southwest of the proposed main intersection will be required. 		

Cat.	Criteria	Criteria Indicator	Alternative 0 TMP Road Network Configuration (Base Case for Comparison Only)	Alternative 1 – Single Intersection Within the NHS		Alternative 2 – Two (2) Separate Crossings, Intersection West of NHS		
				1A Parallel Box Culverts	1B 25 m Structural Culvert	2A Parallel Box Culverts	2B 12 m and 15 m Structural Culverts	2C Structures That Span the Meander Belt
Natural Environment	Cultural Heritage Impacts	Potential adverse impacts on archaeological resources and built heritage adjacent to and/or within the study area.	• No difference between anticipated archaeological impacts between alternatives. • No impact to built heritage resources and cultural heritage landscapes. • Minimal intrusion into planned Rainbow Creek NHS.	• No difference between anticipated archaeological impacts between alternatives. • No impact to built heritage resources and cultural heritage landscapes. • Only the NHS will be visible north and south of the intersection. • Landscaping to be designed to blend into the NHS.		• No difference between anticipated archaeological impacts between alternatives. • No impact to built heritage resources and cultural heritage landscapes. • Crossings are close enough that they will be visible to each other, reducing visibility of NHS. • Landscaping to be designed to blend into NHS.		
								
	Impact to Designated Natural Heritage Features including wetlands	Proximity to, and significance of, impact to designated feature.	• There are no designated features identified within the area proposed for temporary (earthworks) or hard surface. Two (2) table wetland features that appear to provide a connection to future stormwater management ponds are within 40 m from the limit of disturbance. The influence or impacts associated with this crossing is not expected to have negative implications on this feature.	• There are no designated features identified within the area proposed for temporary (earthworks) or hard surface. Two (2) table wetland features that appear to provide a connection to future stormwater management ponds are roughly 140 m away from the disturbance area.		• There are no designated features identified within the area proposed for temporary (earthworks) or hard surface. Two (2) table wetland features that appear to provide a connection to future stormwater management ponds are within 40 m from the limit of disturbance. The influence or impacts associated with this crossing is not expected to have negative implications on this feature.		
								

	Impact to Natural Heritage Features such as vegetation and watercourses	Proximity, size, characteristics, and sensitivity of significant rural areas, terrestrial ecosystems, and wetlands. Potential impact or loss of natural areas, terrestrial ecosystems or wetland areas, function or habitat.	• N/A	• No anticipated impact to fish or fish passage. • There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Permanent impacts (hard surface) contribute to a loss of >1% of forest cover and approximately 7.55% of grassland coverage. • The installation of multiple boxes decreases the openness ratio compared to a single span by roughly half. This will still allow the wildlife group known to this area to move through the corridor, but may limit larger mammals (e.g., coyotes). • The multiple boxes may also limit the light availability within the culverts to facilitate plant growth, therefore maintaining the loss of vegetative cover as a whole within the Rainbow Creek Corridor.	• No anticipated impact to fish or fish passage. • There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Permanent impacts (hard surface) contribute to a loss of >1% of forest cover and approximately 7.55% of grassland coverage. • The installation of a single span structure may still allow for vegetation to grow underneath which will help limit the overall loss of vegetative coverage within the Rainbow Creek Corridor. • In terms of wildlife passage and connectivity, the openness ratio calculated for this meets the wildlife group known to this area, and identified for future use in this area, in addition to facilitating movement of larger mammals (e.g., coyotes).	• No anticipated impact to fish or fish passage. • There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Permanent impacts (hard surface) contribute to a loss of 1.2% of forest cover, approximately 5.3% of grassland coverage, and 0% thicket coverage (only impacts to thicket cover is earthworks which can be restored through seeding and planting). • The installation of a multiple boxes, at multiple locations has a similar loss of vegetation cover in comparison to construction of a single crossing, as the floodplain condenses to account for industrial land use. Again, multiple boxes provide a smaller openness ratio which may cause lower light penetration and plant survivability, thereby maintain the overall vegetative loss. • In terms of wildlife passage and connectivity, the openness ratio calculated for this alternative meets the criteria necessary to facilitate movement by the wildlife group known to this area / identified for future use in this area. The inclusion of multiple boxes combined with two (2) crossings approximately 80 m apart may deter some wildlife from passage and they tend to prefer greater distances between crossings.	• No anticipated impact to fish or fish passage. • There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Permanent impacts (hard surface) contribute to a loss of 1.2% of forest cover, approximately 5.3% of grassland coverage, and 0% thicket coverage (only impacts to thicket cover is earthworks which can be restored through seeding and planting). • The installation of a single span structure may still allow for vegetation to grow underneath which will help limit the overall loss of vegetative coverage within the Rainbow Creek Corridor. • In terms of wildlife passage and connectivity, the openness ratio calculated for this meets the wildlife group known to this area, and identified for future use in this area, in addition to facilitating movement of larger mammals (e.g., coyotes), however, the distance between the north and south crossing may be a deterrent for large and medium sized mammals as they are only 80 m apart, and these species tend to prefer greater distances.	• No anticipated impact to fish or fish passage. • There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Permanent impacts (hard surface) contribute to a loss of 1.2% of forest cover, approximately 5.3% of grassland coverage, and 0% thicket coverage (only impacts to thicket cover is earthworks which can be restored through seeding and planting). • The installation of a single span structure may still allow for vegetation to grow underneath which will help limit the overall loss of vegetative coverage within the Rainbow Creek Corridor. • In terms of wildlife passage and connectivity, the openness ratio calculated for this meets the wildlife group known to this area, and identified for future use in this area, in addition to facilitating movement of larger mammals (e.g., coyotes), however, the distance between the north and south crossing may be a deterrent for large and medium sized mammals as they are only 80 m apart, and these species tend to prefer greater distances.
								

	Improve watercourse crossings to enhance hydraulics, stream function and fisheries and wildlife passage		• There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Watercourse crossing and fish passage will be maintained. • Permanent impacts (hard surface) contribute to a loss of >1% of forest cover and approximately 7.55% of grassland coverage. • The installation of a single span structure may still allow for vegetation to grow underneath which will help limit the overall loss of vegetative coverage within the Rainbow Creek Corridor. • In terms of wildlife passage and connectivity, the openness ratio calculated for this meets the wildlife group known to this area, and identified for future use in this area, in addition to facilitating movement of larger mammals (e.g., coyotes).	• There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Watercourse crossing and fish passage will be maintained. • Permanent impacts (hard surface) contribute to a loss of >1% of forest cover and approximately 7.55% of grassland coverage. • The installation of multiple boxes decreases the openness ratio compared to a single span by roughly half. This will still allow the wildlife group known to this area to move through the corridor, but may limit larger mammals (e.g., coyotes). • The multiple boxes may also limit the light availability within the culverts to facilitate plant growth, therefore maintaining the loss of vegetative cover within the Rainbow Creek Corridor.	• There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Watercourse crossing and fish passage will be maintained. • Permanent impacts (hard surface) contribute to a loss of >1% of forest cover and approximately 7.55% of grassland coverage. • The installation of a single span structure may still allow for vegetation to grow underneath which will help limit the overall loss of vegetative coverage within the Rainbow Creek Corridor. • In terms of wildlife passage and connectivity, the openness ratio calculated for this meets the wildlife group known to this area, and identified for future use in this area, in addition to facilitating movement of larger mammals (e.g., coyotes).	• There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Watercourse crossing and fish passage will be maintained. • Permanent impacts (hard surface) contribute to a loss of 1.2% of forest cover, approximately 5.3% of grassland coverage, and 0% thicket coverage (only impacts to thicket cover is earthworks which can be restored through seeding and planting). • The installation of a multiple boxes, at multiple locations (north and south) has a similar loss of vegetation cover in comparison to construction of a single crossing, as the floodplain condenses to account for industrial land use. Again, multiple boxes provide a smaller openness ratio which may cause lower light penetration and plant survivability, thereby maintain the overall vegetative loss. • The openness ratio calculated for this alternative meets the criteria necessary to facilitate movement by the wildlife group known to this area / identified for future use in this area. The inclusion of multiple boxes combined with two (2) crossings approximately 80 m apart may deter some wildlife from passage and they tend to prefer greater distances between crossings.	• There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Watercourse crossing and fish passage will be maintained. • Permanent impacts (hard surface) contribute to a loss of 1.2% of forest cover, approximately 5.3% of grassland coverage, and 0% thicket coverage (only impacts to thicket cover is earthworks which can be restored through seeding and planting). • The installation of a single span structure may still allow for vegetation to grow underneath which will help limit the overall loss of vegetative coverage within the Rainbow Creek Corridor. • In terms of wildlife passage and connectivity, the openness ratio calculated for this meets the wildlife group known to this area, and identified for future use in this area, in addition to facilitating movement of larger mammals (e.g., coyotes), however, the distance between the north and south crossing may be a deterrent for large and medium sized mammals as they are only 80 m apart, and these species tend to prefer greater distances.	• There will be a small marginal loss in vegetative cover planned for this section of the Rainbow Creek Corridor. • Watercourse crossing and fish passage will be maintained. • Permanent impacts (hard surface) contribute to a loss of 1.2% of forest cover, approximately 5.3% of grassland coverage, and 0% thicket coverage (only impacts to thicket cover is earthworks which can be restored through seeding and planting). • The installation of a single span structure may still allow for vegetation to grow underneath which will help limit the overall loss of vegetative coverage within the Rainbow Creek Corridor. • In terms of wildlife passage and connectivity, the openness ratio calculated for this meets the wildlife group known to this area, and identified for future use in this area, in addition to facilitating movement of larger mammals (e.g., coyotes), however, the distance between the north and south crossing may be a deterrent for large and medium sized mammals as they are only 80 m apart, and these species tend to prefer greater distances.

Cat.	Criteria	Criteria Indicator	Alternative 0 TMP Road Network Configuration (Base Case for Comparison Only)	Alternative 1 – Single Intersection Within the NHS		Alternative 2 – Two (2) Separate Crossings, Intersection West of NHS		
				1A Parallel Box Culverts	1B 25 m Structural Culvert	2A Parallel Box Culverts	2B 12 m and 15 m Structural Culverts	2C Structures That Span the Meander Belt
	Impact to Avian, Wildlife and Plant SAR	Potential effects to SAR habitat.	There are no anticipated impacts to SAR or their habitat, as none have been documented in proximity to Arterial Road A2.					
OVERALL RANKING			Not Ranked. Alternative is not functional from a transportation perspective.					
PREFERRED ALTERNATIVE			With all factors weighted equally, the single intersection within the NHS is the preferred alternative, with no significant indication of preference for structural alternative. However, given the fact that hydraulic function of the multi-culvert alternative could be impacted by build up of debris, the single openning alternative is considered to be the preliminary preferred solution.					

Legend: Good ⟷ Poor

6.0 Description of Preferred Design

6.1 Major Features of the Recommended Plan

The following sections outline the development and evaluation process applied during selection of the preferred alternatives for the arterial roads within SPA 47.

6.1.1 Roadway Design

Two (2) new arterial road segments will be constructed within SPA 2 for Part A:

- Arterial A2 (new, six (6) lane cross-section, Region of Peel); and
- Coleraine Drive (realignment, 4-lane cross-section, Region of Peel).

All roadways are to be designed in accordance with TAC's *Geometric Design Guide for Canadian Roads* (2017), along with the applicable owner's *Design, Specifications and Procedures Manuals*. Roadway design criteria that govern the horizontal and vertical designs for these roadways is summarized in Table 6-1.

Within the urban environment, horizontal roadway design curves are generally constrained so that super-elevation (commonly referred to as 'banking') is not required. Superelevation, particularly for wider road cross-sections, causes issues with drainage and tie-ins to driveways and at intersections due to the difference in elevation between curbs on either side of the roadway. Superelevation is also undesirable where vehicles may slow, stop or change lanes, particularly when ice or snow may be present. The lowest limit of curve radii that can therefore be used within the urban environment is that associated with what is termed 'reverse crown', with the preference being for 'normal crown'.

Table 6-1: Horizontal and Vertical Design Criteria for Arterial Roads within SPA2

Design Criteria	Arterial A2	Coleraine Drive
General		
Jurisdiction	Region of Peel	Region of Peel
Posted Speed (km/h)	70	70
Design Speed (km/h)	90	90
Horizontal Constraints		
Normal Crown (-0.02 m/m) R_{min} (m)	2,620	2,620
Reverse Crown (+0.02 m/m) R_{min} for e = 0.04 (m) – 0.06 m	530 - 600	530 - 600
Min. Tangent Length at Intersections (m)	75.0	75.0
Vertical Constraints		
Maximum Grade	3.0%	3.0%
Minimum Grade	0.5%	0.5%
Sag Vertical Curve K_{min}	38	38
Crest Vertical Curve K_{min}	39	39
Intersection Design		
Min. Radius of Curbs at Intersections (m)	15.0	15.0

Note: Region of Peel's standard ROW for four (4) lane roadways is 36.0 m.

6.1.2 Cross-Sections

Alternative cross-sections were developed for each roadway and presented to the public at PIC #1 for review and comment. They were developed using Region of Peel standards, recommendations for active transportation facilities provided through the SP47 Secondary Plan, as well as input from internal and Technical Advisory Committee stakeholders. Details related to the cross-section alternatives considered are provided below. No comments were received related to cross-section alternatives.

6.1.3 Active Transportation Facilities

The form that active transportation facilities take plays an important role in determining a preferred cross-section alternative. Consideration must be given to the preferred width of pedestrian facilities based on anticipated / desired volumes, while user type, roadway design speed, and anticipated traffic volumes (among other things) must be considered when determining what type of cycling facility is most appropriate for a given roadway. Connectivity to planned active transportation networks and community amenities is another important consideration. Evaluation of appropriate active transportation facilities (pedestrian and cyclist) is provided in each of the following sections, on a roadway-by-roadway basis.

6.1.3.1 Transit Facilities

Compatibility of cross-section elements with anticipated transit facilities is also a key consideration when evaluating alternatives. Secondary transit routes are anticipated on all roadways considered under this Class EA, with GO Shuttles and Local Routes also operating on portions of Arterial A2.

Transit-compatible cross-sections consider the frequency and interaction of buses and other road users (cyclists and other motorized vehicles). Roadways where anticipated transit volumes exceed 30 vehicles per hour may not be suitable for on-street cycling facilities and should consider potential delay to other lane users.

6.1.4 Horizontal Alignments

For existing roadways, minor changes in horizontal alignment are generally considered to limit impact to existing and planned properties and infrastructure resulting from widening of the road and ROW, as well as to correct issues with alignment at intersections. These minor changes would include consideration for widening about, left or right of the existing centreline. For intersections where approaches are offset or not perpendicular, shifts in alignment may be made outside of the intersection to correct the issue.

6.1.4.1 Rainbow Creek Crossing

This roadway alignment alternative locates the single Arterial A2 / Coleraine Drive / East-West Arterial intersection within the Rainbow Creek NHS, with the north-south axis of the intersection approximately aligned with existing Rainbow Creek. Arterial A2 approximately follows the alignment set out in the SP47 TMP, with the tie-in to Major Mackenzie Drive appropriately adjusted, and the curve radius increased to 900 m to move the intersection to a suitable location. East-West Arterial approximately follows the alignment set out in Block 47-2, while Coleraine Drive is aligned to minimize impacts to industrial development blocks. Horizontal design details for the arterial road segments located within SPA 2 are summarized in Table 6-2.

Some flexibility exists in the alignments of both Arterial A2 and Coleraine Drive, although changes to the Arterial A2 design will impact the location of the creek crossing.

Table 6-2: Horizontal Design Details for Transportation Network Alternative 1

	Roadway		
Design Requirement	**Arterial A2**	**Coleraine Drive**	**East-West Arterial**
Min. Radius (m)	900	400	300
Min. Tangent at Intersections (m)	No tangent segments. 900 m curve at intersection.	No tangent segments. 1,300 m curve at intersection.	No tangent segments. 1,300 m curve at intersection.
Meets Design Requirements?	No	Yes	Yes
Required Design Modifications	Curve radius has been increased to straighten approach. No further modification required.	Large radius curve is sufficiently long to approximate tangent.	Large radius curve is sufficiently long to approximate tangent.

6.1.5 Vertical Alignment

6.1.5.1 Rainbow Creek Crossing

Through the study area the natural topography is relatively flat, with a natural slope rising from the south to the north of the project extents. The vertical alignments of East-West Arterial / Coleraine Drive and Arterial A2 have been designed to follow this natural slope while maintaining minimum grade requirements. This results in East-West Arterial and Coleraine Drive rising at a constant 0.5% grade from the south to the north through the NHS area. Arterial A2 also rises at a constant 0.5% grade from the west to the east through the intersection area to suit its overall horizontal north-west alignment. As this follows the natural topography it allows the intersection to be lower comparatively to Arterial Road Network Alternative 2 options.

Due to the location of the intersection, following the natural topography vertically provides adequate cover to the structures and clearance to the regional WSEL flood event. For preliminary grading it has been assumed that fill embankments be graded at 3:1 slope. The resultant area of impact on the NHS is approximately 15,316 m^2 with a fill volume of 34,780 m^3 (within NHS only). Further steepening of the embankments could be contemplated to reduce impacts to the NHS to an estimated minimum of 13,100 m^2.

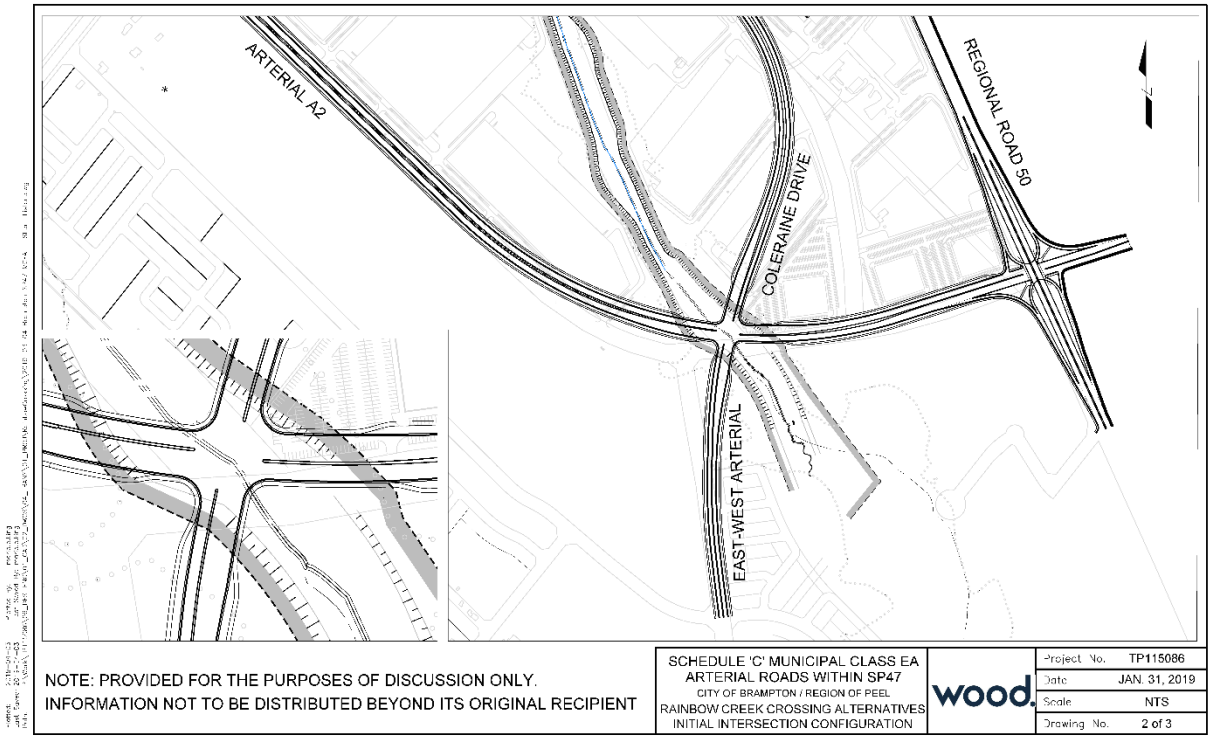


Figure 6-1: Roadway Design Alternative 1 - Intersection Within the NHS

6.2 Arterial A2

Arterial A2 is a major east-west arterial that connects areas west of The Gore Road (via Mayfield Road) with those east of Regional Road 50, including access to Highway 427. It is to be designed as an inter-regional route for goods movement, in line with the recommendations made in the Region of Peel's Strategic Goods Movement Network Study (2013). The Region's standard design speed for major arterial roadways is 90 km/h, with a posted speed of 70 km/h. All other relevant design criteria for Arterial A2 are provided in the Recommended Design portion of this ESR.

6.2.1 Development and Evaluation of Alternative Cross-Sections

6.2.1.1 Infrastructure Requirements

Clear Zone

Based on design speed and anticipated annual average daily traffic (AADT), clear zone width for Arterial A2 is calculated to be 7.5 m. Additional details are provided in Table 6-3.

Table 6-3: Clear Zone Width Determination Based on Table 2-2 of the MTO Roadside Design Manual

Design Speed	PM Peak Hour Traffic Volumes (2041)	# of Lanes per Direction	AADT (Calculated as PHT/K, K=0.9)	Clear Zone (CZ) Width
90 km/h	1,269 (NB) 489 (SB)	3	14,100 (NB) 5,440 (SB)	AADT>= 6000, CZ = 7.5 m

SB - Southbound
NB – Northbound
PHT: Peak Hour Traffic
K: Proportion of AADT on a roadway segment or link during the Design Hour, e.g., the hour in which the 30th highest hourly traffic flow of the year takes place.

Vehicular Lanes
Based on traffic analysis completed as part of this study, a six (6) lane cross-section will be required for this roadway by 2041. Regional standards dictate auxiliary lanes should be 3.50 m wide.

Active Transportation: Pedestrian Facilities
Pedestrian facilities are provided either in the form of a sidewalk or as a shared MUP facility that can also be used by cyclists. The Regional standard for active transportation facilities along arterial roadways is to provide a 3.0 m MUP; however, the need for this type of facility is dependent on the outcome of the cycling facility assessment.

Active Transportation: Cycling Facilities
Determination of cycling facility need is based on the recommendations made in the SP47 Secondary Plan; while the recommended form of those facilities is determined through the evaluation process set out in Section 3 of *Ontario Traffic Manual (OTM) Book 18: Cycling Facilities*. Table 6-4 provides an overview of the evaluation process used to determine the preferred form of cycling facility on Arterial A2.

Table 6-4: Evaluation of Suitable Cycling Facility Types for Arterial A2

<table>
<tr><th colspan="2" rowspan="2">Evaluation Criteria</th><th colspan="4">Suitable Cycling Facility Type(s)</th></tr>
<tr><th>Shared Lanes</th><th>Exclusive Cycle Lanes</th><th>Buffered Cycle Lanes</th><th>Physically Separated / MUP</th></tr>
<tr><td colspan="6">Secondary Plan Recommendation: Physically Separated / MUP</td></tr>
<tr><td colspan="6">OTM Book 18 Recommendation Based On:</td></tr>
<tr><td rowspan="2">Figure 3.3</td><td>Estimated AADT: 14,100</td><td rowspan="3">Shared facility dangerous due to AADT & design speed.</td><td rowspan="2">On-road facility dangerous due to AADT & design speed.</td><td rowspan="2">Although buffered, facility is still on-road.</td><td rowspan="2">Separated facility recommended.</td></tr>
<tr><td>Design Speed: 90 km/h</td></tr>
<tr><td>Roadway Function</td><td>Mobility (Arterial)</td><td colspan="3">Table 3.3 recommends cycle lane or separated facility.</td></tr>
<tr><td>Vehicle Mix</td><td>Buses</td><td>Cyclist discomfort due to bus interaction.</td><td>Cyclists may still feel uncomfortable.</td><td>Cyclists may still feel uncomfortable despite buffer.</td><td>Separated facility creates comfort for cyclists.</td></tr>
<tr><td>Anticipated Users</td><td>Experienced</td><td>May be comfortable with shared roadways but separate facilities preferred.</td><td colspan="3">Exclusive cycle lanes / separated facilities preferred.</td></tr>
<tr><td>Anticipated Cycle Volumes</td><td>Low</td><td>Wide curb lane may be appropriate, though may</td><td colspan="3">Could foster increase in cyclist volumes.</td></tr>
</table>

		discourage volume growth.		
On-Street Parking	**Not permitted**	Only appropriate if cycle lanes are not feasible.	Opportunities to provide cycle lane.	Opportunities to provide separate facility.
Recommended Cycling Facility Type(s)		**MUP**		

6.2.1.2 Alternative Cross-Sections

A set of three (3) alternative cross-sections were developed and evaluated based on the recommended ROW width and lane configuration. These are summarized in Table 6-5 and evaluated in Table 6-6.

Table 6-5: Alternative Cross-Sections for Arterial A2

Cross-Section Details	Alternative #		
	1	2	3
ROW Width (m)	45.0		
# of Lanes	6	6	6
Median Width, including curb (m)	5.50	2.00	5.50
Through-Lane Width (m)	3.65	3.65	3.65
Curb Lane Width (m)	3.75	3.75	3.75
Cycle Lane Width, Including Buffers (m)	N/A	N/A	1.5 (Track)
Parking Lane Width (m)	N/A	N/A	N/A
Boulevard Width, Including Splash Strip (m)	4.00	4.45	3.0
Distance Between Cycle Track and Sidewalk (m)	N/A	N/A	1.00
Sidewalk Width (m)	N/A	N/A	1.50
MUP Width (m)	3.00	3.00	N/A
Utility Corridor Width, Beyond AT Facilities (m)	1.20	2.50	1.20
Available ROW Width Beyond Clear Zone (m)	1.20	2.95	1.20

Table 6-6: Arterial A2 Evaluation of Alternatives

	Objective Met by Cross-Section		
Design Objectives	**Alt. 1**	**Alt. 2**	**Alt. 3**
City/Region Standard	Boulevard width (3.20 m) does not meet Regional standard (5.0 m)	Boulevard width (4.45 m) does not meet Regional standard (5.0 m)	Boulevard width (2.65 m) does not meet Regional standard (5.0 m)
Meets Pedestrian Needs	MUP	MUP	Sidewalk
Meets Cyclist Needs	MUP	MUP	Cycle Track
Transit Compatible	Adequate width for transit shelters.	Adequate width for transit shelters.	Limited space for transit shelters
Compatible with Adjacent Land Uses (Current and Future)	Compatible	Compatible	Cycle lanes not compatible with industrial land uses.
Provides adequate width for utilities outside of	Insufficient width for utilities outside of clear	Approximately 3.95 m of ROW width located	Insufficient width for utilities outside of clear

clear zone (2.5 m required for overhead pole lines)	zone. Additional 1.3 m would be required outside of clear zone.	outside of clear zone on either side of roadway. Sufficient space for utilities.	zone. Additional 1.3 m would be required outside of clear zone.
Recommended Cross-Section	**Alternative 2**		

6.2.1.3 Preferred Cross-Section

The preferred cross-section is Alternative 2, which is illustrated in Figure 6-2 and Figure 6-3, and includes a 2.0 m raised median (including curbs), 3.65 m vehicular lanes, 4.45 m boulevards (including 1.0 m splash strips), 3.0 m MUP and 2.5 m space between the ROW limit and MUP for aboveground utilities.

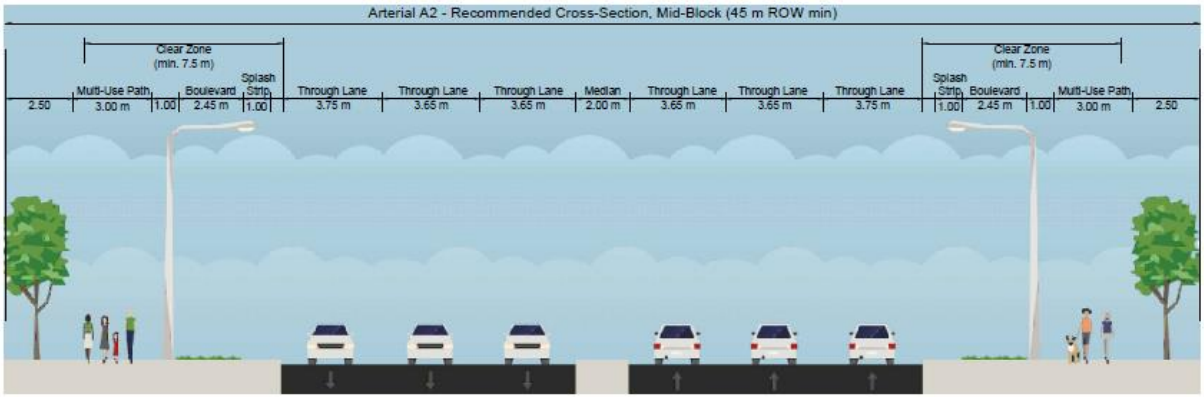


Figure 6-2: Arterial A2 – Recommended Cross-Section, Midblock

Figure 6-3: Arterial A2 – Recommended Cross-Section, Intersection

Development and evaluation of alternative alignments for Arterial A2 was discussed in Section 5.3. Based on the detailed evaluation, the preferred alignment for Arterial A2 is Alternative 3, and the preferred cross section is Alternative 2.

6.3 Coleraine Drive

6.3.1 Development and Evaluation of Alternative Cross-Sections

Coleraine Drive is a major north-south arterial that connects areas north of Mayfield Road to those south of Arterial A2 / Major Mackenzie Drive, providing traffic relief for Regional Road 50. It is to be designed as a truck route, in line with the recommendations made in the Region of Peel's Strategic Goods

Movement Network Study (2013). The Region's standard design speed for major arterial roadways is 90 km/h, with a posted speed of 70 km/h.

6.3.1.1 Infrastructure Requirements

Clear Zone
Based on design speed and anticipated AADT, clear zone width for Coleraine Drive is calculated to be 7.5 m. Additional details are provided in Table 6-7.

Table 6-7: Clear Zone Width for Coleraine Drive Based on Table 2-2 of the MTO Roadside Design Manual

Design Speed	PM Peak Hour Traffic Volumes (2041)	# of Lanes per Direction	AADT (Calculated as PHT/K, K=0.9)	Clear Zone (CZ) Width
90 km/h	1,151 (NB) 548 (SB)	2	12,790 6,090	AADT>= 6000, CZ = 7.5 m

Vehicular Lanes
Based on traffic analysis completed as part of this study, a four (4) lane cross-section will be required for this roadway by 2041. Regional standards dictate auxiliary lanes should be 3.50 m wide.

Active Transportation: Pedestrian Facilities
Pedestrian facilities are provided either in the form of a sidewalk or as a shared MUP facility that can also be used by cyclists. The Regional standard for active transportation facilities along arterial roadways is to provide a 3.0 m MUP; however, the need for this type of facility is dependent on the outcome of the cycling facility assessment.

Active Transportation: Cycling Facilities
Determination of cycling facility need is based on the recommendations made in the SP47 Secondary Plan; while the recommended form of those facilities is determined through the evaluation process set out in Section 3 of OTM Book 18: Cycling Facilities. Table 6-8 provides an overview of the evaluation process used to determine the preferred form of cycling facility on Coleraine Drive.

Table 6-8: Evaluation of Suitable Cycling Facility Types for Coleraine Drive

			Suitable Cycling Facility Type(s)			
Evaluation Criteria			**Shared Lanes**	**Exclusive Cycle Lanes**	**Buffered Cycle Lanes**	**Physically Separated/ MUP**
Secondary Plan Recommendation: **Physically Separated / MUP** OTM Book 18 Recommendation Based On:						
Figure 3.3	**Estimated AADT**	**12,800**	Shared facility dangerous due to AADT & design speed	On-road facility dangerous due to AADT & design speed	Although buffered, facility is still on-road	Separated facility recommended
	Design Speed	**90**				
Roadway Function		**Mobility (Arterial)**		Table 3.3 of OTM recommends cycle lane or separated facility		
Vehicle Mix		**Buses & Trucks**	Cyclist discomfort due	Cyclist discomfort due	Cyclists may still feel	Separated facility creates

		to bus & truck interaction	to bus & truck interaction	uncomfortable despite buffer	comfort for cyclists
Anticipated Users	**Experienced**	May be comfortable with shared roadways but separate facilities preferred	Exclusive cycle lanes / separated facilities preferred	Exclusive cycle lanes / separated facilities preferred	Exclusive cycle lanes / separated facilities preferred
Anticipated Cycle Volumes	**Low**	Wide curb lane may be appropriate, though may discourage volume growth	Could foster increase in cyclist volumes	Could foster increase in cyclist volumes	Could foster increase in cyclist volumes
On-Street Parking	**Not permitted**	Only appropriate if cycle lanes are not feasible	Opportunities to provide cycle lane	Opportunities to provide cycle lane	Opportunities to provide separate facility
Recommended Cycling Facility Type(s)		**MUP**			

6.3.1.2 Alternative Cross-Sections

Three (3) alternative cross-sections were developed and evaluated for Coleraine Drive, based on the recommended ROW width and lane configuration. These are summarized in Table 6-9 and evaluated in Table 6-10.

Table 6-9: Alternative Cross-Sections for Coleraine Drive

Cross-Section Details	Alternative #		
	1	2	3
ROW Width (m)	36.0 m (Region of Peel's standard ROW for four (4) lane roadways)		
# of Lanes	4	4	4
Median Width, including curb (m)	5.50	2.0	5.50
Through-Lane Width (m)	3.65	3.50	3.65
Curb Lane Width (m)	3.75	3.50	3.75
Cycle Lane Width, Including Buffers (m)	N/A	N/A	N/A
Parking Lane Width (m)	N/A	N/A	N/A
Boulevard Width, Including Splash Strip (m)	3.35	4.45	2.35
Cycle Track Width (m)	N/A	N/A	1.50
Sidewalk Width (m)	N/A	N/A	1.50
Distance Between Cycle Track and Sidewalk (m)	N/A	N/A	1.00
MUP Width (m)	3.00	3.00	N/A
Utility Corridor Width, Beyond AT Facilities (m)	1.00	2.05	1.00
Available ROW Width Beyond Clear Zone (m)	0.35	2.50	0.35

Table 6-10: Evaluation of Cross-Section Alternatives for Coleraine Drive

	Objective Met by Cross-Section		
Design Objectives	**Alt. 1**	**Alt. 2**	**Alt. 3**
City/Region Standard	Boulevard width (3.70 m) does not meet Regional standard (5.0 m)	Boulevard width (3.45 m) does not meet Regional standard (5.0 m)	Boulevard width (2.40 m) does not meet Regional standard (5.0 m)
Meets Pedestrian Needs	MUP	MUP	Sidewalk
Meets Cyclist Needs	MUP	MUP	Cycle Track
Transit Compatible	Limited space for transit shelters	Adequate width for transit shelters.	Limited space for transit shelters
Compatible with Adjacent Land Uses (Current and Future)	Compatible	Compatible	Compatible
Provides adequate width for utilities outside of clear zone (2.5 m preferred for swing in overhead lines).	Insufficient width for utilities outside of clear zone. Additional 2.15 m required.	Approximately 2.50 m of ROW width located outside of clear zone on either side of roadway. Boulevard could be further reduced to ensure swing in overhead lines does not pass over MUP.	Insufficient width for utilities outside of clear zone. Additional 2.15 m required.
Other considerations	Transit connections to be provided at intersections, where ROW would be widened. Maintenance for separate sidewalk and cycle track not preferred.		
Recommended Cross-Section	**Alternative 2**		

6.3.1.3 Preferred Cross-Section

The development and evaluation of alternative alignments for Coleraine Drive was discussed in Section 5.4.

The preferred cross-section for Coleraine Drive is Alternative 2, which provides a 2.0 m median (including curbs), 3.5 m vehicular lanes, 4.45 m boulevards (including 1.0 m splash strips), 3.0 m MUP, and a 2.05 m space between the ROW limit and MUP for aboveground utilities.

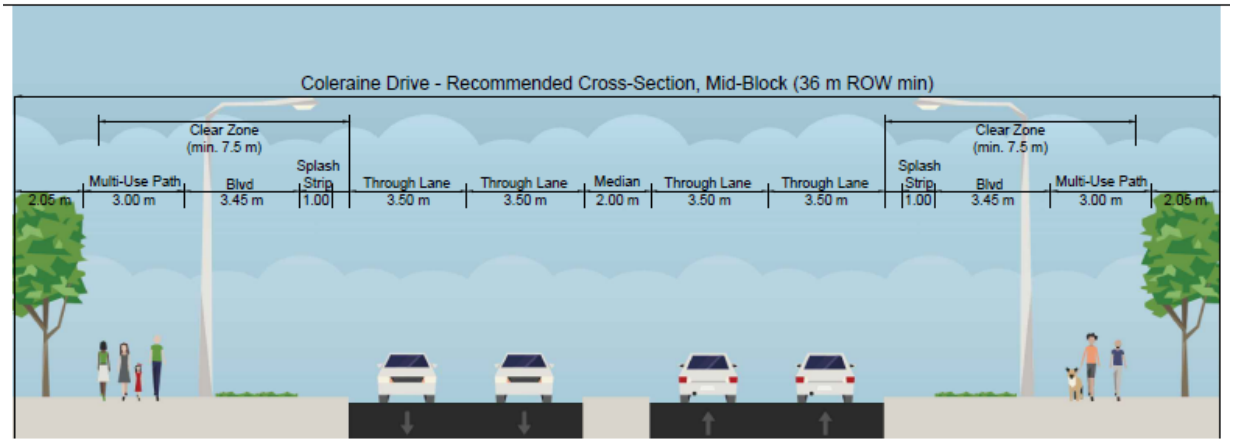


Figure 6-4: Coleraine Drive – Recommended Cross-Section, Mid-Block

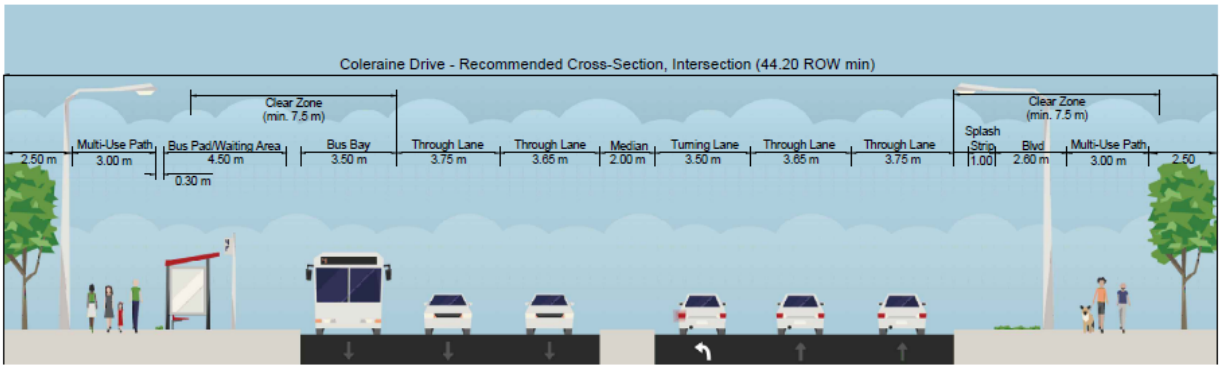


Figure 6-5: Coleraine Drive – Recommended Cross-Section, Intersection

6.4 Cadetta Road

Cadetta Road is a minor east-west industrial dead-end road that connects to Regional Road 50, providing truck access to industrial businesses. Due to the impact at the Regional Road 50 and Arterial A2 / Major Mackenzie Drive intersection, modifications will need to be made at the Cadetta Road and Regional Road 50 Intersection. The intersection will be realigned to intersect further south on Regional Road 50, reducing the intersection skew, providing better access for transport trucks.

Also, a bus maintenance facility is proposed at southwest quadrant of Cadetta Road and Highway 50 intersection. In consultation with City, Region, IBI and Brampton Transit staff, modification were made to proposed SPUI at Highway 50 / Arterial A2 and Major Mackenzie Drive as discussed in earlier section under Stakeholder Consultation.

6.5 Future Conditions Hydraulics for Rainbow Creek Crossing

6.5.1 Performance Criteria

Structure dimensions for each crossing alternative will be determined based on their performance with respect to current MTO guidelines for conveyance and freeboard (Highway Deign Standards, MTO, January 2008), and City and Region requirements for conveyance.

MTO guidelines for culvert and bridge hydraulic design are based on providing a set freeboard and clearance. Freeboard is measured from the design event water surface elevation to the edge of travelled way. Clearance is measured from the design event water surface elevation to the obvert of the crossing. The design event, freeboard and clearance required consider the road classification and the total structure span. MTO guidelines are summarized in Table 6-11.

Table 6-11: Hydraulic Performance Requirements Criteria

Functional Road Classification	MTO Design Flow Return Period[1]		Freeboard Criteria (m) [1]	Clearance Criteria for Bridges (m) [1]	Clearance Criteria for Open-Footing Culverts (m) [1,2]
	Total Span less than or equal to 6.0 m	Total Span greater than 6.0 m			
Freeway, Urban Arterial	50	100	1.0	1.0	0.3
Rural Arterial, Collector	25	50	1.0	1.0	0.3
Local	10	25	0.3	0.3	0.3

Note: [1] *Highway Drainage Design Standard (MTO, January 2008)*

[2] *It is noted that there is no clearance criteria for closed-footing culverts.*

The City and Region requirements for conveyance require at least one (1) lane in each direction be maintained as flood-free during the Regional Storm Event. This is an emergency management requirement. It should be noted that this conveyance requirement is greater than the Design Flow Return Period.

Furthermore, the City and Region requirements for conveyance eliminate overtopping of the ROW during the Region Storm Event and effectively satisfy the MNRF guidelines for safe ingress and egress (Technical Guide – River and Stream Systems: Flooding Hazard Limit, MNR, 2002) of pedestrians and passenger and emergency vehicles.

In addition to the conveyance requirements, there is a requirement to accommodate mammalian passage beneath the proposed crossing alternatives. As per Conservation Halton's "Road Ecology Best Management Practices: Quick Reference Guide", (September 2018), and Credit Valley Conservation's "Fish and Wildlife Crossing Guideline" (April 2017), mammalian passage is accommodated when the proposed crossing structure provides an openness ratio of 0.2. As per the MESP Addendum, the largest mammalian species noted within Area 47 is a coyote. As such, the minimum opening height of the proposed crossing alternatives is 2.0 m (Conservation Halton, 2018 and Credit Valley Conservation, April 2017).

6.5.2 Geomorphological Recommendations

Geomorphological condition of creeks is a design consideration for crossing structures, although the extent to which it is considered is dependent on a number of issues, including creek stability and structural cost. Geomorphological studies of Rainbow Creek were completed both as part of the MESP Addendum and Class EA works, each with different approaches to determining the Meander Belt Width. These studies provide estimated 100-year erosion rates and meander belt widths for the creek, with structures ideally, but not necessarily, sized to accommodate these widths. Both the MESP Addendum and Class EA studies considered design requirements of the Arterial A2 crossing location, as indicated in Table 6-12. As the northerly Coleraine Drive crossing was not contemplated during completion of the geomorphological assessment, no site-specific information is available. If crossing design Alternative 2 is identified as the preferred option, consideration should be given to completing an assessment at the Coleraine crossing location.

Table 6-12: Fluvial Geomorphological Existing Conditions and Design Requirements

Fluvial Geomorphological Characteristics	Applicable Study	
	MESP Addendum Assessment (6)	Class EA Assessment
Consultant Team	GEO Morphix Ltd.	Matrix
Rapid Geomorphic Assessment Classification Score	0.04 (Stable)	0.14 (Stable / In Regime)
Rapid Stream Assessment Technique Score	28 (Good)	28 (Moderate)
Average Bankfull Width (m)	0.8	1.0
Average Bankfull Depth (m)	0.3	0.3
Meander Belt Width Methodology	William's Method	Risk-Based
Preliminary Meander Belt Width (m)		60
100 Yr Erosion Rate (m)		9
Final Meander Belt Width (m)	24	78
Meander Amplitude (m)		18
Recommended Structure Sizing (m)		Existing bankfull plus 100 year erosion rate both sides (19.5 m)

6.5.3 Natural Heritage

In addition to the design requirements noted below, timelines for construction should follow the warmwater fisheries timing window based on available information to date but shall be confirmed with TRCA during detailed design. Additionally, timing for construction shall follow guidance with respect to vegetation removal, which shall not take place during the local breeding bird season which is established from April 1 to August 31 in any given year, to comply with the Migratory Birds Convention Act (MBCA).

6.5.3.1 Animal Passage

Based on the MESP Addendum (Savanta, 2019), Section 4.5.1, wildlife habitats, and existing wildlife movement corridors were reviewed when preparing the terrestrial concept plan and specifications for each structure within the corridor. For the most part, targeted wildlife with home ranges include frogs and toads, snakes, turtles and Red-tailed Hawk *(Buteo jamaicensis*). Habitat for each of the above species have been proposed along the Rainbow Creek corridor (inclusive of overwinter, breeding and foraging habitats). To support safe passage under the roadway, the MESP addendum (Savanta, 2019) has identified that each crossing within the Rainbow Creek corridor (four (4) total) should be designed to support movement for amphibians, reptiles and small and medium sized mammals.

More specifically as it pertains to Arterial Road A2, the MESP Addendum recommended a clear span culvert type, with dimensions of 2.25m (H) X 12m (W) X 45m (L).

6.5.3.2 Ambient Conditions

The MESP Addendum (Savanta, 2019) conducted a literature review on ambient condition criteria for wildlife passages which included criteria for light, moisture and temperature. Based on the findings found within several studies, some species of amphibians and reptiles exhibited a preference for a given condition, whereby, some had reduced times in entering and passing through tunnels with artificial light, whereas others preferred lighted tunnels (Savanta, 2019). Unlike culvert sizing, criteria with respect to light and ambient conditions was not clearly specified in the MESP Addendum. For the most part, large, medium and small sized mammals tend to prefer dark lighting conditions, whereby, amphibians and reptiles tend to prefer ambient light, moisture and temperature conditions (Conservation Halton, 2018). Ensuring the proper openness ratio for each wildlife group should allow for proper lighting conditions within the structure. Where additional artificial lighting requirements may be needed to help encourage passage, (depending on preferred design) this can be identified during detailed design.

6.5.3.3 NHS Function and Connectivity

The urban natural corridor design objectives for the Rainbow Creek corridor are identified in the MESP Addendum (Savanta, 2019). As existing conditions reveal a natural system with low function and connectivity, the goal of the proposed alignment and restoration aims to:

- Improve aquatic and semi-aquatic habitat by increasing the number of riffle pool sequences within the creek system, as well as offline wetlands;
- Create a system that will naturalize overtime;
- Provide additional plantings and vegetative cover;
- Increase forest canopy coverage by 29% with focus on areas where light and noise are expected to be high;

- Increase species diversity for both flora and fauna;
- Create a series of habitat types and enhancements inclusive of foraging, overwintering and breeding;
- Improve habitat for odonata, lepidoptera and other insects;
- Provide protection for locally rare species;
- Identify culvert crossing specifications in order to facilitate movement for amphibians, reptiles and small and medium sized animals; and
- Create a vegetative buffer and create a means for passive recreational usage within the corridor through a trail system.

Habitat structures such as brush piles, and/or snake hibernacula have been prescribed within the Rainbow Creek corridor, but none are within proximity to Arterial A2 (Savanta, 2019). Therefore, none of these structures will be impacted by the proposed crossing, and do not need to be considered in the design of the crossings moving forward.

In terms of vegetative cover, there are three (3) main vegetation communities proposed throughout the Rainbow Creek corridor, woodland, thicket and grassland (Savanta, 2019). Within the full corridor the following has been proposed:

- Woodland 37.11 ha (371,100 m^2);
- Thicket 5.14 ha (51,400 m^2); and
- Grassland 4.94 ha (49,400 m^2).

Each community has been designed in accordance with each Segment (1, 2, or 3) and will consist of both upland and lowland communities depending on the hydraulics of the area (Savanta, 2019). The vegetation communities have been further broken down by Segments. However, since Arterial A2 is split between both Segment 1 and Segment 2, the full coverage along the entire corridor was considered when evaluating overall impacts to the NHS as noted herein.

A high-level conceptual design was provided within the MESP Addendum with requirements to follow the design to the extent possible, with the understanding that site level conditions during detailed design may require some slight modifications (Savanta, 2019). For the purposes of this assessment, the conceptual designs for vegetative cover were used to assess impacts of the alternative design concepts, whereby impacts were split based on vegetative cover type. It is important to note that the designs did include an area identified as Wildlife Best Management Practices. The definition of this feature was not provided in the MESP Addendum and has been assumed to reflect that area associated with a structure and/or culvert crossing and therefore does not necessarily represent pervious 'soft surface'.

6.5.4 Hydraulic Requirements for Single Intersection Road Network Designs

Hydraulic assessments have been completed for the Arterial Road Network Alternatives 1 and 2 to determine the crossing structure dimensions required to satisfy the applicable hydraulic performance requirements. The approved Rainbow Creek HEC-RAS model (Version 5.0.1) was provided by TRCA for WSP's use in completing the hydraulic assessments (ref. email correspondence Chekol-Parajuli, King, dated March 11, 2019). It is understood that the proposed conditions geometry file contained within the approved Rainbow Creek HEC-RAS model defines the approved proposed Rainbow Creek realignment geometry, and as such was used as the basis for each alternative assessment. Crossing configurations were determined for the following alternatives:

- Arterial Network Alternative 1 – Crossing Alternative 1A – Multiple Spans (Parallel Box Culverts)
- Arterial Network Alternative 1 – Crossing Alternative 1B – Single Span Structure (Bridge)
- Arterial Network Alternative 2 – Crossing Alternative 2A North & 2A South - Multiple Spans (Parallel Box Culverts)
- Arterial Network Alternative 2 – Crossing Alternative 2B North & 2B South - Single Span Structures (Bridge)

6.5.5 Hydraulic Structure Performance Assessment

Coleraine Drive and Arterial Road A2 are proposed to be classified as Urban Arterial and have been assessed on this basis. The assessments have been completed utilizing existing conditions peak flows for the 2 – 100 year storm events, and future conditions uncontrolled peak flows for the Regional Storm Event. Peak flows were provided within the flow files contained within the approved Rainbow Creek HEC-RAS model.

The results of the hydraulic structure performance assessments are summarized in Table 6-13. The results in Table 6-13 indicate that the noted configurations achieve the applicable City, Region and MTO performance criteria, with the exception of crossing scenarios 1A, 2A South and 2B South whose provided clearance has been determined to be marginally less than the guideline minimum 1.0 m. While crossing scenarios 1A and 2B South do not explicitly meet the cited clearance criteria, the provided clearance narrowly falls short of achieving the criteria, and as such performance is considered satisfactory. Crossing scenario 2A South falls short of the cited clearance criteria by 0.11 m. An assessment has been completed for this crossing where the span of the outside boxes were upsized to provide additional conveyance capacity. The results of the test run did not alter the provided clearance of 0.89 m, indicating that the cited clearance criteria can only be achieved by increasing the opening height of the crossing. Understanding that Regional Storm conveyance is being provided by this crossing, and the provided clearance of 0.89 m is greater than MTO's minimum of 0.30 m, increasing the opening height to achieve the cited clearance criteria does not justify the economic requirements to do so. As such, the performance of crossing scenario 2A South is also considered satisfactory.

Table 6-13: Crossing Alternative Performance Assessments

Scenario Identification Number	Crossing Alternative	Arrangement	Road(s)	Structure		City / Region Conveyance Capacity Requirement	Conveyance Capacity Provided	MTO Design Flow Return Period Criteria	Required Freeboard (m)	Provided Freeboard (m)	Required Clearance (m)	Provided Clearance (m)
				Type	Size (m)							
1A	1	Multiple Spans (Parallel Box Culverts)	Arterial A2 & Coleraine Drive	Concrete Box Culverts - Open Bottom	Outside Boxes: 1.829 (H) x 6.096 (W) x 110.74 (L) Centre Box: 2.134 (H) x 6.401 (W) x 110.74 (L)	Regional Storm	Regional Storm	100 Year	1.00	1.84	1.00	0.97
1B	1	Single Span Structure (Bridge)	Arterial A2 & Coleraine Drive	Concrete Slab Bridge	2.5 (H) x 25.0 (W) x 75.0 (L)	Regional Storm	Regional Storm	100 Year	1.00	2.84	1.00	1.39
2A North	2	Multiple Spans (Parallel Box Culverts)	Coleraine Drive	Concrete Box Culverts - Open Bottom	Outside Boxes: 1.829 (H) x 4.267 (W) x 70.0 (L) Centre Box: 2.134 (H) x 6.401 (W) x 70.0 (L)	Regional Storm	Regional Storm	100 Year	1.00	2.06	1.00	1.19
2A South			Arterial A2	Concrete Box Culverts - Open Bottom	Outside Boxes: 1.829 (H) x 6.096 (W) x 75.0 (L) Centre Box: 2.134 (H) x 6.401 (W) x 75.0 (L)	Regional Storm	Regional Storm	100 Year	1.00	1.78	1.00	0.89
2B North	2	Single Span Structure (Bridge)	Coleraine Drive	Concrete Slab Bridge	2.25 (H) x 12.0 (W) x 70.0 (L)	Regional Storm	Regional Storm	100 Year	1.00	2.01	1.00	1.26
2B South			Arterial A2	Concrete Slab Bridge	2.25 (H) x 15.0 (W) x 75.0 (L)	Regional Storm	Regional Storm	100 Year	1.00	1.76	1.00	0.99

Each crossing alternative was modelled in HEC-RAS as an open bottom structure, as it is WSP's understanding that TRCA requires all new crossings to facilitate a naturalized channel through the length of the crossing. It should be noted that the preliminary crossing contained within the approved Rainbow Creek HEC-RAS model was modelled as a closed-bottom culvert which does not represent a naturalized channel through the length of the culvert. Furthermore, it should be noted that the length of the preliminary crossing contained within the approved Rainbow Creek HEC-RAS model is significantly shorter than the length of a realistic crossing alternative.

6.6 Access Management

An Access Management Report was completed, focusing on access management along Arterial A2, Coleraine Drive, Clarkway Drive, Countryside Drive, the new East-West Arterial and Mayfield Road. The Access Management Report discussed the existing properties with accesses that will be impacted, the existing standards, and future mitigation procedures as well as suggested intersection and accessway locations as per the TAC and Region of Peel Guidelines. It is proposed that proper measures are taken in regards of the proposed locations of future intersections and accesses. Following the Region of Peel's new access bylaw and standards should be adhered to improve transitions between regional and municipal roads.

There are a few points of concern that will need to be addressed in the detailed design of the new proposed intersections at Arterial A2 and Countryside Drive as well as Coleraine Drive and Countryside Drive. It is suggested that the accessways that exist near those intersections should be converted to right-in right-out accesses to minimize the disruption to the traffic flow.

The existing driveways 450 m south of Countryside Drive on Coleraine Drive will also need to be redesigned. Due to the proximity of the driveways, it may also be feasible to design an access road that connects to the four (4) properties and provide an intersection or left-in access to the access road.

Proposed intersections on the curved sections raise safety concerns due to obstruction of sightlines and reduced decision stopping distances. Therefore, these intersections should be designed with extra care for left-turning vehicles to make them as safe as possible due to the high speeds and potential heavy vehicle traffic.

In conclusion, due to the proposed roads having median blocks, adjustments to the existing accesses need to be made to adhere to the Region of Peel's new access standards. Future full movement intersections should have a spacing of 450 m wide. For new left-in accesses to be built, it would be necessary for the through lane widths to be reduced to provide adequate width for a left-turning lane in the median space and construct them with 225 m spacing. The Access Management Report can be found in Appendix D.

6.7 Property Requirements

The preliminary design in Appendix P shows the proposed alignment of the new Arterial Road A2, and the proposed widening and realignment of Coleraine Drive within the Study Area. Table 6-14 lists the properties impacted by the preferred design as shown in Appendix P. The details of property requirements will be confirmed and refined during detailed design, with the potential for two (2) full buyouts.

Table 6-14: Properties Impacted

Road	Address
Arterial A2	7300 Major Mackenzie Drive
Arterial A2	10021 Highway 50
Arterial A2	8211 Mayfield Road
Arterial A2	0 Clarkway Drive
Arterial A2	11411 Clarkway Drive
Arterial A2	5232 Countryside Drive
Arterial A2	5252 Countryside Drive
Arterial A2	5253 Countryside Drive
Arterial A2	6 Cadetta Road (For Interchange)
Arterial A2	4 Cadetta Road (For Interchange)
Arterial A2	10410 Coleraine Drive – (For Interchange)
Arterial A2	0 Clarkway Drive
Coleraine Drive	10490 Coleraine Drive
Coleraine Drive	10500 Coleraine Drive
Coleraine Drive	10514 Coleraine Drive
Coleraine Drive	10568 Coleraine Drive
Coleraine Drive	0 Coleraine Drive
Coleraine Drive	10810 Coleraine Drive
Coleraine Drive	10826 Coleraine Drive
Coleraine Drive	10854 Coleraine Drive
Coleraine Drive	5482 Countryside Drive
Coleraine Drive	0 Countryside Drive
Coleraine Drive	11462 Coleraine Drive
Coleraine Drive	11189 Coleraine Drive
Coleraine Drive	0 Countryside Drive
Coleraine Drive	5620 Countryside Drive
Coleraine Drive	5556 Countryside Drive
Coleraine Drive	10815 Coleraine Drive
Coleraine Drive	10461 Coleraine Drive
Coleraine Drive	Unassigned
Coleraine Drive	10700 Highway 50
Coleraine Drive	10900 Coleraine Drive
Coleraine Drive	10671 Clarkway Drive

6.8 Utilities

The utility information was provided to WSP by the City and Region and various different utility companies. This includes location of existing infrastructure such as watermain, wastewater (sanitary), gas, hydro and cables within the study area. WSP has shown these utilities on the design drawings and identified if relocation is required due to the proposed road elevations or potential utility conflicts. The

information for future watermain and wastewater was extracted from the master plans provided by the Region and depicted on the plan and profile drawings.

For the provision of future hydro along Coleraine Drive and Arterial A2, a meeting with Alectra was arranged to discuss potential locations of hydro poles and/or underground services. Alectra noted that an overhead hydro facility is planned north of Countryside Drive, whereas underground facility is proposed south of Countryside Drive for which the cost will be borne by the adjacent development. This arrangement is reflected on typical cross sections as well as on the design drawings. In the event that an overhead hydro facility is planned south of Countryside Drive, the typical cross-sections shown for north of Countryside Drive (with overhead hydro requirements) will apply.

Consultation was also undertaken with TransCanada Pipeline as a pipeline currently crosses Highway 50 at Major Mackenzie Drive. TransCanada Pipeline noted the following to be considered during detailed design and construction:

- Written consent is required from TransCanada Pipeline for any work within 30 m of the pipeline(s).
- The City of Brampton / Region of Peel shall engage with TransCanada Pipeline for an evaluation of the road widening / reconstruction across TransCanada Pipeline's facilities.
- It is recommended that overburden / additional grading within the TransCanada Pipeline easement and within 7 m of either edge of it be reduced as much as possible. Significant overburden over TransCanada Pipeline's assets may have an impact on TransCanada Pipeline's evaluation of the widening and reconstruction.

6.9 Agency Approvals

Agency approvals are required before construction can begin. Approval requirements are summarized in Table 6-15.

Table 6-15: Required Agency Approvals / Permitting Requirements

Agency	Approval / Permit Required	Comments
Required Permits		
Department of Fisheries and Oceans	Fisheries Act	Request for Review during detailed design
Toronto and Region Conservation Authority	Permit under O. Reg. 166/06	Required to construct in areas within regulated limit
Ministry of the Environment, Conservation and Parks	Ontario Water Resources Act, 1990	Where construction dewatering volumes are expected to exceed 400,000 L/day, a PTTW will be required.
Potentially Required (To be determined in the Detailed Design Stage)		
Ministry of the Environment, Conservation and Parks	License to Collect Fish for Scientific Purposes Fish and Wildlife Conservation Act, 1997	Required if wildlife is collected or relocated. However, it is expected that any wildlife present on site will be able to leave the area under their own power and relocation will not be required.
Ministry of the Environment, Conservation and Parks	Endangered Species Act, 2007	Required if threatened and/or endangered species are encountered during detailed design (e.g., Barn Swallow)

6.10 GTA West Connection

GTA West Study focuses on a new multi-modal transportation corridor that will extend from Highway 400 in the east, to the Highway 401 / 407 interchange in the west, with provisions for a 400 series highway, transitway and potential goods movement priority features. The MTO is currently undertaking the Stage 2 GTA West Study which will identify the route, determine interchange locations, and complete the preliminary design and environmental assessment. More information can be found on the project's website: www.gta-west.com.

Traffic studies for the arterial roads within Area 47 were completed under two conditions: (1) with GTA West built by 2041, and (2) GTA West built beyond 2041. The decision was made to design the road network with flexibility to connect to the future GTA West, but under the assumption that it would not be built within the next 20 years. This is considered a 'conservative' approach, that considers worst case traffic within Area 47. Alignment of A2 north of Mayfield Road is subject to final location of the GTA West Interchange.

The GTA West Stage 2 Study planning, and preliminary design phase will culminate in Environmental Assessment Report. It is anticipated that the Final Environmental Assessment Report will be submitted to the MECP by the end of 2022.

Due to proximity of GTA West Corridor with future Arterial A2 at Mayfield Road, WSP has developed alignment options for future Arterial A2 to determine impacts to adjacent lands and natural features, property acquisitions, geometric feasibility and potential cost as follows:

- Option 1 - Proposed Alignment (originally proposed and displayed at PIC #2)
- Option 2 - Proposed Alignment shift to the East
- Option 3 - Proposed Alignment shift to the West

WSP has arranged meetings with MTO staff on August 27, 2020, January 22, 2021 and February 5, ,2021 to present and obtain feedback for these options. The alignment options and corresponding evaluation were discussed in detail with MTO staff. The alignment for Arterial A2 presented as Option 1 originally proposed and displayed at PIC # 2 was selected as preferred.

Following the review and approval of the GTA West EA report, the corridor will be protected. Currently there is no commitment to a timeline for additional design and construction phases of the project.

It is noted that additional median width will be required on Mayfield Road in the area of GTA West / Highway 413. This additional width will be required to accommodate median bridge piers that will be required for the GTA West / Highway 413 and transitway overpasses. Given the proximity of the GTA West / Highway 413 and transitway bridges to the Arterial A2 / Mayfield Road intersection, the intersection geometry may require modification to accommodate the median widening. Furthermore, based on the current preferred route for the proposed Highway 413 corridor, the GTA West EA has identified the potential to consider a change to the vertical profile of Coleraine Drive. The section of Coleraine Drive potentially affected by this change would be subject to vertical grade assessment and refinements by the GTA West EA

6.11 Preliminary Cost Estimate

A summary of the preliminary cost is provided in Table 6-16 and the detailed cost estimate can be found in Appendix Q. The cost estimate does not include the design and construction of the stormwater pond at Coleraine Drive and Arterial A2. This will be confirmed during detailed design.

Table 6-16: Preliminary Cost Estimate

Summary (rounded)	Coleraine Drive	Arterial A2
General	$620,000	$620,000
Roadwork	$11,860,000	$12,160,000
Storm Sewer	$650,000	$30,000
Traffic Signals	$1,650,000	$2,310,000
Street Lighting	$2,192,000	$2,102,000
Utility Relocations (Estimated) ***If required, additional cost to mitigate potential impacts to TransCanada pipeline will be determined during detailed design.**	$6,754,000	$484,000
Structural	$2,270,000	$23,550,000
30% Contingency	$7,800,000	$12,380,000
Property (m^2)	$110,900,000	$84,200,000
Total Tender	**$144,700,000**	**$137,800,000**

7.0 Environmental Issues and Commitments

7.1 Natural Environment

Further details can be found in Appendix E.

7.1.1 Terrestrial Resources

The vegetation communities within the study area have been created by human disturbance and are classified as cultural vegetation types, residential areas, and predominately agricultural fields. These are the land uses which will be primarily impacted by the planned development. Species of conservation concern should be considered as they may be present. However, the severe agricultural landscape limits the candidacy of Significant Wildlife Habitat (SWH), as habitat required to delineate the Significant Wildlife Habitat is not available. The most substantial impact on terrestrial wildlife will be the change from a relatively penetrable landscape to an impenetrable landscape due to the increase in roads. The following potential impacts relate primarily to the impacts associated with road infrastructure:

- Direct loss of floral and faunal habitat and soil compaction resulting from vehicle and machinery operations to be calculated in detailed design;
- Reduced stability of landforms composed of unconsolidated material;
- Tree / shrub root stress and possible decline as a result of re-grading / fill placement along natural area edges and the removal of 293 trees (based on preliminary design); and
- Changes in drainage which may affect aquatic and wetland habitats.

Many of the usual impacts associated with a direct loss of flora and fauna are not the case for this study area as the severe agricultural landscape limits the amount of natural area and inherent resiliency.

7.1.1.1 Tree Inventory

Impacts on trees within the study area will be largely associated with construction and grading activities. To meet the requirements for the construction footprint provided in the preferred alternative design, a total of 293 trees will need to be removed, and 15 trees may potentially be injured. While the nature of the work to be completed is generally understood, the sites specific locations / extent of the work has not been determined. The Design Builder is responsible to confirm the limits of the work and tree removals.

Potential impacts to trees could be avoided during construction with appropriate protection measures and practices. The location and type of protection is to be confirmed during detailed design and are not illustrated at this time. Compensation for trees needs to be discussed between the City, the Region of Peel, and the TRCA. However, using the City and TRCA guidelines, 1,932 compensation trees is likely required. As it is preferred that compensation plantings occur on-site, and the Rainbow Creek Corridor is subject to an extensive restoration plan, compensation plantings required as part of the arterial road network could be included within the Rainbow Creek Restoration plan, if accepted by the City, Region, and TRCA.

Peel Region will continue to work together with TRCA to identify appropriate compensation opportunities. Peel Region understands that ecosystem compensation will follow in principle the TRCA's Guideline for Determining Ecosystem Compensation, dated June 2018. Compensation will be approved by TRCA and Peel Region in advance of TRCA permit approvals.

7.1.1.2 Erosion and Sediment Control Mitigation

Design and implement standard Erosion and Sediment Control (ESC) measures, consistent with Ontario Provincial Standards and Specifications (OPSS), to contain / isolate the construction zone, manage site drainage / runoff and prevent erosion of exposed soils and migration of sediment. ESC measures should be implemented before the commencement of works, and maintained through all phases of the project, until vegetation is re-established, or erosion protection materials stabilize all disturbed ground. The ESC plan should include regular inspection and maintenance, and removal of non-biodegradable ESC materials once the site is stabilized. Furthermore:

- Operate, store, handle, and dispose of all materials used or generated (e.g., organics, soils, construction waste and debris, etc.) and maintain equipment in a manner that prevents the entry of any deleterious substance from entering the watercourse or contaminating the natural environment. Store and stockpile materials at a safe distance from the watercourse and ensure they are stabilized and contained as necessary.
- Prohibit or limit access to banks or areas adjacent to waterbodies, to the extent required to protect the structural integrity of the banks or shorelines. Whenever possible, operate machinery on land above the high-water mark in a manner that minimizes disturbance to the bed and banks of the waterbody.
- Ensure any part of equipment entering the watercourse, or operating from the bank, shall be free of fluid leaks, invasive species and noxious weeds and externally cleaned / degreased to prevent any deleterious substances from entering the watercourse and contamination of the natural environment. Design and implement a containment plan to isolate all work above water and keep airborne contaminants and all deleterious substances from entering the watercourse (Adherence to the Region of Peel's Salt Management Plan and the City of Brampton's Salt Management Guidelines). The containment plan should include regular inspection, removal and disposal of materials generated and use in-water scaffolding where appropriate.
- Ensure a Spill Management Plan (including spill kit materials, instructions regarding their use, education of contract personnel, and emergency contact numbers) is always present on site for implementation in the event of an accidental spill.
- Minimize the removal and clearing of natural materials such as herbaceous plants, woody debris, and rocks from the banks or the shoreline of the watercourse. Where vegetation is removed, incorporate temporary measures (e.g., biodegradable materials, nurse-crop vegetation) to provide interim stabilization until vegetation is fully established. Stabilize and reinforce banks to pre-disturbance condition (or better) using properly designed and installed stabilization measures. Restore vegetation according to a vegetation rehabilitation plan.
- Design and implement a vegetation rehabilitation plan to restore riparian vegetation to pre-construction state or better. Considerations:
- Plant with site-appropriate native species and where possible, use commercial seed mats, perforated soil cloth, etc.;
- Plant trees and shrubs for shade to cool water and provide overhead cover;
- Design and install riparian plantings to avoid or minimize encroachment into and/or alteration of bank and bed profile;
- Re-instate native soils or replace them with topsoil / suitable planting medium and use only clean material free of particulates;
- Incorporate soil / seed bank salvage, vegetation transplant or bio-engineering (e.g., live stakes, cuttings) techniques;

- Reinstate and re-stabilize any portion of the waterbody bed / substrates disturbed during construction to pre-construction (or better) condition including morphological elements (e.g., pools and riffles) and substrates (salvage and reinstatement of native materials); and
- Integrate the provision of fish cover where feasible. Design and install in-stream cover habitat elements (e.g., woody debris structures, boulders, overhanging vegetation on banks) to replace or reinstate fish cover removed, altered or disturbed during construction.

7.1.1.3 Terrestrial Environment Mitigation

Removal of woody vegetation is recommended to occur outside of the migratory bird nesting period (April 1 to August 31) and activities will occur in accordance with the MBCA and *Migratory Bird Regulations*. These timing constraints should not be perceived as absolutes. This period represents the core breeding period, although some species may nest in March and September. Ultimately, the objective from a compliance perspective is to not circumvent the MBCA. As such, due diligence measures should be implemented and documented for any nest searching efforts, including record control, to ensure compliance with the MBCA.

For activities, including vegetation removal, which may occur during bird nesting season, surveys to identify nesting activity will be completed by an Avian Biologist within 24 hours of scheduled work activities. The Avian Biologist conducting the surveys must be able to identify birds by species and be knowledgeable of nesting seasons and activities for appropriate species. It is important to note, that depending on the time of clearing activities, nest sweeps during the breeding season may not be a viable option. More specifically in the event vegetation becomes too dense and a clear confirmation / due diligence cannot be provided through nest sweeps, clearing activities may not be able to move forward until a timing where credible due diligence can be implemented (e.g., following the nesting season).

If a species listed under the ESA as extirpated, endangered or threatened is identified, Section 9 of the Act prohibits killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, leasing, trading or offering to buy, sell, lease or trade a member of the species. Some of these prohibitions also apply to body parts of a member of the species and to things derived from a member of the species. Similarly, if a species is listed under the ESA as endangered or threatened, Section 10 of the Act prohibits damaging or destroying the habitat of the species. Species listed as special concern are not afforded protection under Sections 9 and 10 of the ESA; however, due diligence should be enforced if a special concern species or their habitat is present. More specifically;

- Should any SAR be encountered on site during Project implementation, the MECP should be contacted immediately;
- Construction personnel should watch for wildlife attempting to nest in and around construction areas, and as possible avoid nesting areas. Construction personnel should avoid preventing wildlife from reaching other sensitive areas beyond the work area, and;
- The effects of construction activities in areas where terrestrial crayfish chimneys were found should be considered. The current hydrology should be maintained through the appropriate design of roadside ditches and stormwater management systems. Minimize the footprint of the road and the construction area to the greatest extent practicable to avoid damaging colonies.

Other mitigation measures to consider are fencing to direct wildlife movement through wildlife crossings but also to prevent uncontrolled access and encroachment from pedestrians into adjacent natural areas. Should impenetrable barriers be considered, opportunities for wildlife passage should be incorporated. It is recommended that buffer widths be increased from the minimum 10 m to 15 m near areas of ecological

sensitivity. Additionally, all crossing structures should be clear-span structures with abutments located outside any significant valleylands and natural heritage systems to reduce impacts as recommended by Savanta (2019). These clear-span structures will also act as passages to reduce crossing hazards for wildlife.

Lastly, keeping with similar recommendation as identified within the MESP, it is recommended that low mast lighting is implemented and directed downward and shielded (often referred to as directional lighting systems) to minimize light projection into the NHS and lightening at wildlife crossings should be limited, where feasible.

7.1.1.4 Habitat Compensation

The proposed removal of natural features to facilitate the proposed project (that are deemed acceptable to the City / Region and TRCA) is to be totaled, and further consultation with TRCA is to occur during detail design. Peel Region will continue to work together with TRCA to identify appropriate compensation opportunities. Peel Region understands that ecosystem compensation will follow in principle the TRCA's Guideline for Determining Ecosystem Compensation, dated June 2018. Compensation will be approved by TRCA and Peel Region in advance of TRCA permit approvals.

Additionally, the removal of trees from hedgerows and other areas will require compensation. Compensation is currently estimated to be 1,900 compensation trees which will be further refined in detailed design.

7.1.2 Aquatic Resources

Possible impacts from the proposed construction and improvements may include the alteration of water levels and the change in the pattern of surface water flow and shallow groundwater movement. Surface water runoff from the proposed roadways may also introduce contaminants (e.g., salts or sediments). Potential impacts to fish and fish habitat are anticipated to be limited but may include the following:

- Removal of riparian vegetation could result in increased water temperatures and instability in channel banks;
- The project works associated with new culvert installation or installation of culvert extensions within permanent fish habitat will require temporary in-water works and associated timing restrictions;
- Introduction of pollutants, concrete outwash and other deleterious substances (e.g., sediment, salt, paint, solvents, oil and grease) into the watercourse;
- Changes in stream channel structure and water clarity;
- Roadside drainage could increase the input of pollutants; and
- Removal of rocks, woody debris, and/or riparian vegetation from the banks may alter natural habitat features and bank stability.

The MESP acknowledged that urban development can alter or eliminate headwater drainage features (HDFs) and, as a result, have broad implications for water quality and quantity, recharge / infiltration, and overall health of downstream habitats and the aquatic and terrestrial integrity within watersheds. All HDF's in Part "A" Study Corridor are classified as "Mitigation 1", "Mitigation 2", or "No Mitigation". HDFs classified as "Mitigation 1" or "Mitigation 2" could either remain as open watercourses provided that flows can be maintained (via stormwater pond outlets, LID swales or other techniques), or be replicated using well-vegetated urban swales or wetlands (Mitigation 1), or lot-level and conveyance stormwater techniques such as LID measures. Those HDFs with "No Management" classification could be eliminated

and replaced with a traditional urban major-minor drainage system. Refer to Appendix F for the location of HDF's and respective mitigation category.

Development opportunities and constraints, including stormwater management, will have to be assessed as development proceeds through future Block or Tertiary Planning and associated environmental studies. The Savanta 2019 Environmental Impact Statement (refer to MESP Addendum) discusses impacts in relation to Stormwater Management Facility locations, removal of HDFs, and encroachment of residential lots, roadways, and trails in the NHS. The Savanta Environmental Impact Statement (2019) should be considered in conjunction with the information below during detailed design.

7.1.2.1 Aquatic Environment Mitigation

To mitigate damages specific to the aquatic environment, design and install culverts to prevent the creation of barriers to fish movement and maintain bankfull channel and habitat functions to the extent possible. This includes embedment of the culvert, or installing open bottom structures, reinstatement of the low flow channel and native substrates, proper sizing of the culvert, and maintaining channel slope. Additionally, conducting in-stream work during periods of low flow to allow work to be conducted during dry conditions or isolated from flows. If in-water works are required beyond the timing constraints, a Request For Review (RF) from Department of Fisheries and Oceans Canada (DFO) is required. The duration of in-water work should be minimized and scheduled to avoid wet, windy and rainy periods that may increase erosion and sedimentation.

If in-water work is to occur, always design and implement an isolation / containment plan to isolate temporary in-water work zones and maintain clean flow downstream / around the work zone. The design should:

- Use only clean materials free of particulate matter for temporary cofferdams;
- Situate or otherwise manage flow withdrawal and discharge (e.g., see dewatering discharge) to prevent erosion and sediment release into a waterbody; and
- Ensure the work zone is stabilized against the impacts of high flow events during the work period.

Reinstate and re-stabilize any portion of the waterbody bed / substrates disturbed during construction to pre-construction (or better) condition, including:

- Morphological elements, e.g., pools and riffles; and
- Substrates, which may include salvage and reinstatement of native materials.
- Identify local regulatory authorities and have contact information available while on site.

Significant impacts to aquatic habitat as a result of the proposed works are not anticipated. There is potential for localized changes in hydrology and water quality due to the increase in impervious surfaces; however, mitigation measures and best management practices are expected to prevent these changes from impacting aquatic habitat.

Other considerations are the management of flows (e.g., minimum flows, seasonal flow augmentation, flushing flows) for specific aquatic habitat management goals and to mitigate other effects of flow management (e.g., fish passage, fish stranding). To avoid impacts to fishes:

- Exclude or move fish from the work area. Retain a qualified environmental professional to ensure applicable permits for relocating fish are obtained. Fish trapped within an isolated work area should

be captured and relocated to adjacent channels sections outside the work area using appropriate capture, handling and release techniques to prevent harm and minimize stress.
  - A License to Collect Fish for Scientific Purposes (LCFSP) as part of the *Fish and Wildlife Conservation Act* will be required to rescue and relocate fish. The LCFSP will need to be obtained by the contractor that will be undertaking the fish rescue and relocation work.
- Pumps utilized for dewatering activities should be fitted with screens or barriers to avoid entrainment and impingement of fish at water intakes during dewatering processes.
- Discharge water from dewatering activities will be directed to an area located a minimum of 30 m from a watercourse and within a vegetated area and/or onto a scour pad.

Lastly, to mitigate damages specific to the aquatic environment, avoid hard engineering (sheet pile or other vertical walls) if possible. If rock reinforcement / armouring is required, ensure that appropriately sized, clean rock is used, and that rock is installed at a similar slope to maintain a uniform bank / shoreline and natural stream / shoreline alignment.

Based on the information collected, the in-water construction timing to be considered for this project would follow that associated with timing restrictions for warmwater fish habitat where appropriate, e.g., in-water works must be conducted between July 1 and March 31. This timing is to be confirmed during future phases of the project through consultation with TRCA / MNRF / DFO.

7.2 Vegetation and Aesthetic Assessment

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

Table 7-1: Streetscape Treatment

Opportunity / Issue	Streetscape Treatment
New Arterial A2	
Boulevard Trees	Diverse species to be planted on 10.0 m centres on both sides of Streets where possible. Trees should provide shade to MUP.
Wetland / Riparian Zone Restoration	Repair or restore existing wetland plant communities, relocated wetlands, ponds, riparian zones, creek channels, and improve drainage areas.
ROW Planting	Consider using low growing meadow species in place of sod for beautification, reduction of ROW maintenance costs, and improvement of adjacent habitat.
Low Impact Development	Consider setting aside space to accommodate LID Strategies to improve water quality, ground water recharge, and reduce non-point source pollution; Bioretention Structures, Bioswales, etc.
Coleraine Drive	
Boulevard Trees	Diverse species to be planted on 10.0 m centres on both sides of Streets where possible. Trees should provide shade to MUP.
Wetland / Riparian Zone Restoration	Repair or restore existing wetland plant communities, relocated wetlands, ponds, riparian zones, creek channels, and improve drainage areas.
ROW Planting	Consider using low growing meadow species in place of sod for beautification, reduction of ROW maintenance costs, and improvement of adjacent habitat.
Low Impact Development	Consider setting aside space to accommodate LID Strategies to improve water quality, ground water recharge, and reduce non-point source pollution; Bioretention Structures, Bioswales, etc.

The following recommendations relate to the streetscape improvements that are to be implemented along this portion of the Highway 427 Industrial Secondary Plan Area.

- A Vegetation Assessment will be required, prepared by a certified International Society of Arboriculture arborist. All existing vegetation removed as part of this project should be inventoried.

Mitigation During Construction:

- Construction activities are to avoid damaging existing, healthy, trees located close to the ROW wherever possible. This is to be accomplished by installing suitable tree protection fencing, extending to the 'dripline' of trees designated for protection. This tree protection zone is to remain undisturbed by excavation, storage of materials and equipment, and other construction related activities. The fencing is to remain in place through the duration of construction activities.
- Existing trees scheduled for removal are to be inspected to determine if transplanting is a feasible option (depending on size, species and health of tree).

Street Tree Planting and Planting / Streetscape Design:

- Tree planting / streetscape plans are to be prepared for the corridor by a registered landscape architect, as part of the detailed design of the roadway. These plans are to address:
    - Compensation for vegetation requiring removal on or near private property.
    - Planting of new street trees to improve the aesthetics of the streetscape, to be planted on 10.0 m centres or as required by the City / Region.
    - Restoration of disturbed boulevard landscaped areas and drainage infrastructure.
    - Restoration of Riparian Zones, Stream Channels, and Wetlands.
- All trees to be planted are to be selected from the Region of Peel approved street tree plant list.
- The planting of new trees along the corridor is to be coordinated with existing and proposed utility corridors, and light standards.
- Construction impacts at stream crossings are to be mitigated with the planting of riparian vegetation. This vegetation should be native, non-invasive, riparian vegetation, as approved by the local Conservation Authority.
- Trees to be planted near overhead utilities to be selected to conform to mature height limitations (Hydro approved species).

Further details can be found in Appendix F.

7.3 Stage 1 Archeological Assessment

7.3.1 2018 Stage 1 Archaeological Assessment

The 2018 Stage 1 Archaeological Assessment recommended the following:

Due to the assortment of property types within the identified areas of archaeological potential, Stage 2 assessment should be carried out by means of a combination of pedestrian survey and test pit survey. All open sections greater than 10 m by 10 m should be freshly ploughed, disked if necessary, and allowed to weather sufficiently before being subjected to pedestrian survey at 5 m intervals. Stage 2 assessment elsewhere should be conducted by means of hand shovel test pits at 5 m intervals. All test pit soils should be examined for intact cultural deposits and should be passed through 6 mm mesh screens to facilitate the recovery of artifacts. Although the identified areas of potential are ostensibly undisturbed, if unforeseen areas of disturbance and archaeological potential removal are encountered, the documentation of these areas should include their exact spatial limits. Undisturbed portions of the study area have archaeological potential and warrant Stage 2 property assessment given:

1. The proximity of numerous nearby watercourses;
2. The proximity of several early historic transportation routes; and
3. The presence of 180 registered archaeological sites within a 1 km radius.

7.3.2 2020 Stage 1 Archaeological Assessment

In light of the findings of the 2018 Stage 1 Archaeological Assessment of the study area, the 2020 Stage 1 Archaeological Assessment recommended the following:

1. 0.3 ha (18%) of the study area has low archaeological potential due to disturbance and requires no further archaeological assessment.
2. Approximately 1.4 ha (82%) of the study area has archaeological potential and requires a Stage 2 archaeological assessment.
3. All areas that have archaeological potential and are accessible by plough should be subjected to Stage 2 property assessment by means of pedestrian survey. This technique involves walking across the entire field in parallel rows at 5 m intervals and surveying the ground surface for artifacts. The agricultural land should be prepared for the pedestrian survey by disk harrowing to the depth of previous ploughing. The fields must be allowed to weather through one (1) heavy rainfall to improve surface visibility.
4. All areas that have archaeological potential but cannot be accessed by plough should be assessed by means of hand-shovel test pitting at 5 m grid intervals. All test pits should be a minimum of 30 cm in diameter and dug to a minimum of 5 cm into the subsoil. Soil fills should be screened through 6 mm mesh screens in order to facilitate artifact recovery. Test pit profiles should be examined for cultural deposits prior to being backfilled. Test pitting should be conducted to within 1 m of all disturbances. All test pits should be backfilled to level grade, and any sod caps replaced and tamped down by foot.
5. There may also be a possibility of previously undocumented archaeological resources being unexpectedly encountered during construction, in spite of prior assessments. MTCS should be notified (at archaeology@ontario.ca) if this occurs and all activities impacting archaeological resources must cease immediately. A licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists. If human remains are encountered, all activities must cease immediately, and the local police and coroner must be contacted.

The 2020 Stage 1 Archaeological Assessment was completed due to a change in alignment, which resulted in areas not investigated during the 2018 Stage 1 Archaeological Assessment. For detailed design, all necessary further stages of archaeological assessment should be completed as early as possible. It is recommended to not commence ground-disturbing activities until all required archaeological reports have been entered into the Ontario Public Register of Archaeological Reports. Further details can be found in Appendix G.

7.4 Built Heritage Resources and Cultural Heritage Landscapes

The impact assessment determined that no indirect impacts are anticipated to Part A roadways. Direct impacts are anticipated to one (1) road, Coleraine Drive, since the proposed road widening will result in the permanent alteration of this historical rural roadscape.

The following recommendations are made regarding built heritage resources and cultural heritage landscapes:

1. The locations of built heritage resources and cultural heritage landscapes should be identified on construction mapping so that project personnel are aware of the presence of heritage properties within, and adjacent to, the proposed work.
2. Direct impacts are anticipated to Coleraine Drive due to proposed road widening that will permanently alter the historical character of this rural road. A Heritage Impact Assessment (HIA) should be completed for this roadscape to determine whether this road has heritage value when evaluated against the criteria contained in O. Reg. 9 / 06 of *the Ontario Heritage Act*. If the roadscape is found to have Cultural Heritage Value or Interest, then an impact assessment should be complete and mitigation measures prepared. The HIA should be completed at the outset of the detailed design phase of the project. One (1) HIA may be completed for all potential heritage roadscapes impacted by Part A and Part B Roadways of the project.
3. Direct impacts are anticipated to one heritage property, Cultural Heritage Resource 3 (5556 Countryside Drive) as a result of minor acquisition along property frontages to accommodate the widened roadway. This property is listed on the City of Brampton Municipal Register of Cultural Heritage. Therefore, impacts to this property should be evaluated in an HIA and where impacts are anticipated, a conservation strategy and mitigation measures should be prepared. The HIA should be completed at the outset of the detailed design phase of the project. The HIA once completed, will require presentation to the Brampton Heritage Board.
4. This report should be submitted to the City of Brampton, City of Vaughan, and Ministry of Tourism, Culture and Sport for review and comment.

Further details can be found in Appendix H.

7.5 Contamination Overview Study

Further environmental studies of the high and medium ranked properties directly impacted by project activities are recommended to confirm the environmental conditions in support of property acquisitions, environmental due diligence, and management of excess soils and materials. These investigations may include Phase One and Phase Two Environmental Site Assessments. If any properties within the study area require change in property use, a Record of Site Condition would be required. If contamination is identified, mitigation measures may need to be developed and implemented, which may include environmental remediation or a risk assessment. Further details can be found in Appendix I.

7.6 Stormwater Management

The following conclusions and recommendations stem from the foregoing hydrologic and hydraulic assessments for the Part A ROW.

Conclusions:

- Stormwater management planning for this study area is based on the stormwater facilities proposed within the Area 47 development blocks being designed to service the City of Brampton and Region of Peel owned ROW for the water quantity, water quality, and erosion control stormwater requirements.
- Notwithstanding, two (2) alternate stormwater management options for Coleraine Drive have been advanced, namely:
    - Alternative #1 - Redirecting ROW drainage from Subcatchments CR4, CR5, CR6, CS6 and A7, away from stormwater management facility R7b and R4b, to stormwater management facility R4a.

    - Alternative #2 - Redirecting ROW drainage to a new stormwater facility to be located in the north-west quadrant of the intersection of Coleraine Drive and Arterial A2.
- The ROWs are required to control the runoff from the 90th percentile storm event, as per the Region of Peel road reconstruction criteria. Based on available borehole logs and groundwater information, the runoff from the 90th percentile storm event can be controlled via on-site retention by implementing LID Best Management Practices within the ROW.
- The existing crossing of Coleraine Drive does not meet the applicable MTO criteria for freeboard and conveyance, and the applicable Region of Peel criteria for conveyance.
- The proposed crossings of Coleraine Drive and Arterial A2 have been sized to meet the applicable MTO criteria for freeboard, clearance, and conveyance, and the applicable Region of Peel criteria for conveyance.
- A comparison of computed water surface elevations and computed channel velocities under existing and proposed conditions, indicates that changes are expected, within Area 47. HEC-RAS results at the upstream boundary, at Mayfield Road, indicate a small increase in computed water surface elevations of 20 cm and 15 cm, respectively, for the Regional and 100-year Flood events.
- Increases in computed water surface elevations along the study reach are limited in spatial extend and are considered easily addressed with limited re-grading and/or landscaped flood proofing measures to ensure no impacts to the adjacent developable lands.
- Computed channel velocities in some reaches may necessitate implementation of erosion controls.

<u>Recommendations</u>

- The stormwater facilities proposed within the Area 47 development blocks are to be designed to service the City of Brampton and Region of Peel owned ROW for the water quantity, water quality, and erosion control stormwater requirements. Information pertaining to the manner in which the major and minor systems of the City of Brampton and Region of Peel owned ROW would be connected to the systems servicing the development blocks has not been made available for the current study. As such, the road reconstruction retention volume requirements, as well as the short-listed LID Best Management Practices, should be further reviewed and refined when this information becomes available.
- The developer group has agreed to locate the proposed storm water management pond near the intersection of Coleraine Drive and future Arterial Road A2 that will accommodate storm run-off from the realigned Coleraine Drive (ref. agreement in Appendix J). Further, the exact pond location, dimensions and design details will be determined during future phases of work. Further to the Stormwater Drainage Assessment Report in Appendix J, the Region of Peel will arrange for the design and construction of the stormwater management pond and the City of Brampton will accept conveyance and maintenance of the pond after the maintenance / warranty period.
- It is recommended that the proposed crossings of Coleraine Drive and Arterial A2 be advanced to the detailed design stage.
- It is recommended that the Region's four (4) step process for considering climate change resiliency in the design of stormwater infrastructure should be implemented at the detailed design stage.
- It is recommended that Rainbow Creek alterations or floodproofing measures associated with adjacent developable lands for the reach from Coleraine Drive to Mayfield Road be designed / implemented to achieve a near zero change in computed results between existing and proposed conditions or to accommodate minor changes in computed water surface elevations.

7.7 Fluvial Geomorphology

The Fluvial Geomorphology Investigation revealed the need to realign channels due to road widening and construction works. Specifically, it is recommended that new crossing structures accommodate a minimum span of three (3) times the bankfull width of the channel or the maximum existing meander amplitude. These recommendations will reasonably minimize the risk due to natural erosion hazards within the watercourse corridors, but all recommended structures will still be within the recommended meander belt widths.

At new culvert crossings, it is recommended that the structure be placed at an optimal skew perpendicular (90 degrees) to the meander axis to ensure long term channel and bank stability. At bridge crossings, the channel will have to be realigned to pass through the axis of the intersection. At all crossing locations, natural channel design principles will need to be implemented when considering upstream and downstream tie-in points as well as bed and bank treatments.

The proposed road widening works also provide opportunity for channel enhancement and restoration in a variety of locations where watercourses may be impacted by the construction. Reaches currently serving as roadside ditches or that flow parallel to the existing roads can be realigned to achieve a more sinuous planform within the recommended meander belt width corridor, while reducing erosion on the banks and minimizing the risk to new infrastructure. Further details can be found in Appendix K.

7.8 Geotechnical Investigation

The purpose of the geotechnical investigation was to assess the existing pavement condition and obtain subsurface and groundwater information by means of a limited number of boreholes within the investigated areas. 33 boreholes were drilled along Coleraine Drive and 31 boreholes drilled along the alignment of new Arterial A2 so far. This information was used to provide recommendations for pavement design alternatives for the new roads / road widening, foundation design for culverts, slope stability analysis for embankments (where required), roadway cut and fill operations, dewatering requirements, and chemical analyses and disposal requirements of surplus materials in conformance to the MOE Clean-up guidelines for this project. Based on the results and recommendations of the geotechnical investigation in Appendix L, the following considerations for design and construction are provided:

- All topsoil and loose soil or soil mixed with organic matter should be stripped from pavement areas, manhole / catch basin founding areas, and base of underground utility services.
- Any loose, soft or unstable areas in the exposed subgrade should be subexcavated and replaced with approved fill and compacted.
- Lean concrete may be used to backfill sub-excavated areas.
- Excavation should be carried out with a temporary slope of 1H:1V or flatter above the groundwater level.
- Roadway shoring protection systems may be required during construction of the culverts.
- The embankment required for road widening should be constructed with compacted engineered fill at 2H:1V (or flatter) side slopes. If a side slope steeper than 2H:1V slope is required or if the height of the embankment / cut slope is greater than 2 m, slope stability analysis should be carried out to assess stability of the planned slope, depending on the subsurface conditions.
- Where existing embankments are to be widened, the side slopes should be benched in accordance with OPSD 208.010 prior to placement of the widening fills.

- Final (permanent) embankment side slopes in granular fills should be established to match the existing slopes or as per OPSD 200.010.
- Final slopes should be treated with a seed and mulch to prevent ravelling.
- Backfilling, if required, for site grading (e.g., for subgrade raise, replacement of soft soil) should be placed as engineered fill.
- The fill soils used for embankment widening should consist of approved clean fill (e.g., Select Subgrade Materials - OPSS 1010).
- Engineered fill per OPSS.MUNI 1010, where required, may be used to backfill excavated areas, backfill around manholes, replace soft / incompetent soils, and/or raise grades.
- Engineered fill for backfill of excavated areas should be placed after stripping existing fill soils, any soils containing excessive organic matters and otherwise unsuitable soils.
- Based on observations at the borehole locations and planned excavation depth, normal excavation equipment should be suitable for excavation.
- Hard till soils may require additional effort for excavation (e.g., heavy excavator, rippers, impact hammer, etc.).
- Cobbles / boulders can be encountered in the till and in fill soils, and removal of the cobbles / boulders should be considered and planned for.
- During the construction, temporary runoff controls such as sediment trap, interceptor drain, dyke and/or silt fence should be installed to prevent uncontrolled water / sediment flow into existing water courses.
- The effluent from dewatering operations should also be filtered or passed through sediment traps to prevent turbidity.
- Based on the soil and groundwater conditions at the borehole locations, groundwater control within the excavated area should not be significant.
- Use of a lean concrete mud mat or granular layer may be warranted where founding surfaces are to be exposed for extended period, especially if the work is carried out during wet weather. Care should also be exercised to minimize disturbance to the final subgrade during excavation.
- Temporary shoring can be accomplished using soldier piles with lagging (or similar) in order to support the sides of the excavation, for vertical excavation during construction of culvert, installation of underground utilities or roadway protection, and bracings should be installed within the shoring system to minimize movements of the soils.
- Most of the excavated soils (e.g., granular fills, clayey fill and till soils) can be suitable for being reused for backfill, provided they can be separately stored, properly compacted and are environmentally acceptable.
- Fill soils containing construction debris (or similar) and organic matter should not be reused. Soils that are too wet to compact will require additional processing (e.g., drying). Cobbles and boulders (larger than 100 mm in size), if any, should be discarded by mechanical means (e.g., sieving) or manual removal.
- Soil Corrosivity Tests indicate that, in accordance with Table 1 of CSA A23.1-14 and based on "structurally reinforced concrete exposed to chloride, with or without freezing and thawing" and based on project location, exposure class "C-1" can be used.
- In accordance with Table 6 of the CSA Series A23.1-14, Type GU Portland cement can be used based on the water-soluble sulphate content measured in soil.
- Protection against steel corrosion, where required, could include one (1) or a combination of: adequate concrete cover, low-permeability concrete, corrosion inhibitors; coated reinforcing steel; clad reinforcing steel; and corrosion-resistant alloy reinforcement.

Further details can be found in Appendix L. As per recommendations from the MECP, the assessment of possible contaminated sites along the road alignments and the risk of entrainment of contaminated groundwater during construction dewatering will be reviewing during detailed design stage. Additionally, the MECP also recommends completing investigations within 0.5 km of the proposed Arterial A2 which was not accessible during the geotechnical investigations during detailed design.

7.9 Hydrogeology Investigation

Based on the results of the hydrogeological assessment in Appendix M, the following recommendations are provided::

- While a PTTW for groundwater extraction from excavations is not anticipated to be needed, permitting may be required if dewatering rates exceed the thresholds for EASR registration and a PTTW because of surface water, storm water and wetland water influx into excavations.
- Record the amount of water taking during each day of dewatering to ensure the maximum water taking does not exceed the thresholds for EASR registration or a PTTW.
- To be diligent, it is recommended that a private well survey be completed to confirm the location of depth of and water level in water supply wells 4907185 and 4904154 near Coleraine Drive and water supply wells 4902856, 4902866 and 4905894 near Clarkway Drive.
- In addition to groundwater extraction, stream diversion may be necessary to install the culverts. Any dewatering system should be designed by a dewatering contractor and should take the stream surface water flow into consideration.
- Use standard ESC measures that meet or exceed OPSS to discharge the abstracted water into the adjacent wetlands, streams or other natural surface water body. The measures should be implemented prior to work and be maintained during construction until disturbed areas have been effectively stabilized and restored. Removing sediment from the abstracted water could be achieved by filter bags or for higher amounts by collecting the abstracted water in a weir tank to allow sediment to settle out of the water first.
- The quality of the water discharged into the adjacent wetlands, streams or other natural surface water body should meet upstream (e.g., background) water quality and/or the Ontario Provincial Water Quality Objectives.

Further details can be found in Appendix M. Additionally, the MECP recommends completing investigations within 0.5 km of the proposed Arterial A2 which was not accessible during hydrogeological assessment during detailed design. MECP also recommends performing the door-to-door survey to all properties on private wells as water supply and invite property owners to participate on the monitoring program for the project during detailed design. A private well survey should also be completed to confirm the location of, depth of, and water level in water supply wells 4907185 and 4904154 near Coleraine Drive, and water supply wells 4902856, 4902866 and 4905894 near Clarkway Drive during detailed design. Lastly, groundwater levels will be monitored on an ongoing basis to determine seasonal water level fluctuations during detailed design.

7.10 Road Traffic Noise Impact Study

A Road Traffic Noise Impact Study was undertaken for both Part A and Part B roadways in accordance with the provincial guidelines (MOE / MTO Protocol) and the Region and City's Noise Policies. As per the MOE / MTO Protocol, the objective sound level is 55 dBA (16-hour Leq (Equivalent continuous sound pressure level) and consideration of noise attention is only required if the noise impact is greater than 5

dB and the overall sound level is greater than 55 dBA. Noise impact is defined as the difference between the future "build" noise level (future noise level with the proposed improvements) and the future "no-build" noise level (future noise level without the proposed improvements).

In addition to the MOE / MTO Protocol, the Region of Peel corporate policy W30-04 and the City of Brampton document "Noise Attenuation – Retrofit Policy and Road Widenings" were also considered in the Noise Impact Study. According to these documents, noise attenuation should be considered when the noise levels are predicted to be 60 dBA or higher (16-hour Leq) and only if a reduction of 5 dB or more can be achieved for the 16-hour period between 07:00 and 23:00.

The focus of this assessment was to predict the noise levels at properties within the study area and adjacent to the assessed roadways. 90 representative receptors were selected to predict the future noise levels as a result of the Project. These locations are expected to be the most affected by the noise associated with the road network improvements. Roadways within the study area, as well as the encompassing roads (e.g., Mayfield Road, Regional Road 50, Castlemore Road and The Gore Road) were the dominant source of noise considered in the traffic noise impact study.

Both the MOE / MTO Protocol and Region / City policies were used for the assessment. With respect to the MOE / MTO Protocol, the results indicate that the noise impacts within the study area are predicted to be more than 5 decibels (dB) for a total of 12 receptors when comparing the Future "build" 2041 and Future "no-build" 2041 scenarios. However, the overall sound levels of the Future "build" scenario at eight (8) of the identified receptors are less than or equal to the 55 dBA (16-hour Leq) criterion. Therefore, in accordance with the MOE / MTO protocol, consideration of noise mitigation is not required for those receptors. For the other four (4) receptors, consideration of noise mitigation is required in accordance with the MOE / MTO protocol.

The Peel Region and the City of Brampton Noise Attenuation Policies identify a 60 dBA (16-hour Leq) criterion for consideration for noise mitigation. The Future "build" levels are at or above the 60 dBA criterion at six (6) reverse frontage or side exposure locations. Therefore, these locations were considered for possible noise mitigation in accordance with the Peel Region and City of Brampton Noise Attenuation Polices.

Based on the noise modelling results, a noise barrier/mitigation investigation was completed for eight (8) receptors: mitigation consideration was warranted for two (2) receptors in accordance with the MOE / MTO Protocol, two (2) receptors with both the MOE / MTO Protocol and the Region and City's Noise Policies, and four (4) receptors with Region/City Policies only. Three (3) barrier heights were considered in this investigation: 2.4 m, 3 m and 4 m. As per the noise policies, in order to be warranted, the barrier must achieve a minimum 5 dB reduction at a targeted receptor. An objective level of 55 dBA (16-hour Leq) was also considered as per the MOE / MTO Protocol. The investigation results indicated that none of the barriers with lower heights (e.g., 3 m and 2.4 m) can achieve the 5 dB minimum reduction requirement at the target receptors, except Barrier 7 which is expected to provide 7 dB and 5 dB reductions at receptor RD08 with heights of 3 m and 2.4 m, respectively (Refer to Appendix N for figure of the location of receptors). However, the mitigated future "build" levels at RD08 under both cases would remain above the MOE / MTO Protocol objective level of 55 dBA by at least 3 dBA. As a result, 5 barriers (each 4 m high) were considered feasible and recommended for implementation. The proposed barrier height may be achieved via a combination of earth berm and barrier. The use of earth berm may also require other considerations such as slope requirement and potential effects on nearby properties and/or development lands. Further investigations to verify the noise wall locations and heights are recommended during the detailed design stage. In addition, as the assessed receptors were identified based on existing conditions

(e.g., land uses), should land uses be updated in the future, the mitigation recommendation may require a re-evaluation. Further details on the Noise Impact Study including the barrier investigation can be found in Appendix N.

7.11 Summary of Mitigation and Commitments to Further Investigation

Table 7-2 provides a summary of the mitigation and commitments to further investigation for all technical studies completed for this Study.

Table 7-2: Summary of Mitigation and Commitments to Further Investigation

Category	Details
Natural Environment	Design and implement standard ESC measures, consistent with OPSS, to contain / isolate the construction zone, manage site drainage / runoff and prevent erosion of exposed soils and migration of sediment. ESC measures should be implemented before the commencement of works, and maintained through all phases of the project, until vegetation is re-established, or erosion protection materials stabilize all disturbed ground. The ESC plan should include regular inspection and maintenance, and removal of non-biodegradable ESC materials once the site is stabilized.
	Operate, store, handle, and dispose of all materials used or generated and maintain equipment in a manner that prevents the entry of any deleterious substance from entering the watercourse or contaminating the natural environment. Store and stockpile materials at a safe distance from the watercourse and ensure they are stabilized and contained as necessary.
	Prohibit or limit access to banks or areas adjacent to waterbodies, to the extent required to protect the structural integrity of the banks or shorelines. Whenever possible, operate machinery on land above the high-water mark in a manner that minimizes disturbance to the bed and banks of the waterbody.
	Ensure any part of equipment entering the watercourse, or operating from the bank, shall be free of fluid leaks, invasive species and noxious weeds and externally cleaned / degreased to prevent any deleterious substances from entering the watercourse and contamination of the natural environment. Design and implement a containment plan to isolate all work above water and keep airborne contaminants and all deleterious substances from entering the watercourse. The containment plan should include regular inspection, removal and disposal of materials generated and use in-water scaffolding where appropriate.
	Ensure a Spill Management Plan is always present on site for implementation in the event of an accidental spill.
	Minimize the removal and clearing of natural materials such as herbaceous plants, woody debris, and rocks from the banks or the shoreline of the watercourse. Where vegetation is removed, incorporate temporary measures to provide interim stabilization until vegetation is fully established. Stabilize and reinforce banks to pre-disturbance condition (or better) using properly designed and installed stabilization measures. Restore vegetation according to a vegetation rehabilitation plan.
	Design and implement a vegetation rehabilitation plan to restore riparian vegetation to pre-construction state or better.
	To mitigate damages specific to the aquatic environment, design and install culverts to prevent the creation of barriers to fish movement and maintain bankfull channel and habitat functions to the extent possible. This includes embedment of the culvert, or installing open bottom structures, reinstatement of the low flow channel and native substrates, proper sizing of the culvert, and maintaining channel slope. Additionally, conducting in-stream work during periods of low flow to allow work to be conducted during dry conditions or isolated from flows. If in-water works are required beyond the timing constraints, a Request For Review from DFO is required. The duration of in-water work should be minimized and scheduled to avoid wet, windy and rainy periods that may increase erosion and sedimentation.
	If in-water work is to occur, always design and implement an isolation / containment plan to isolate temporary in-water work zones and maintain clean flow downstream / around the work zone.
	Reinstate and re-stabilize any portion of the waterbody bed / substrates disturbed during construction to pre-construction (or better) condition.
	Exclude or move fish from the work area. Retain a qualified environmental professional to ensure applicable permits for relocating fish are obtained. Fish trapped within an isolated work area should be captured and relocated to adjacent channels sections outside the work area using appropriate capture, handling and release techniques to prevent harm and minimize stress. A LCFSP as part of the Fish and Wildlife

Category	Details
	Conservation Act will be required to rescue and relocate fish. The LCFSP will need to be obtained by the contractor that will be undertaking the fish rescue and relocation work,
	Pumps utilized for dewatering activities should be fitted with screens or barriers to avoid entrainment and impingement of fish at water intakes during dewatering processes.
	Discharge water from dewatering activities will be directed to an area located a minimum of 30 m from a watercourse and within a vegetated area and/or onto a scour pad.
	To mitigate damages specific to the aquatic environment, avoid hard engineering (sheet pile or other vertical walls) if possible. If rock reinforcement / armouring is required, ensure that appropriately sized, clean rock is used, and that rock is installed at a similar slope to maintain a uniform bank / shoreline and natural stream / shoreline alignment.
	The in-water construction timing to be considered for this project would follow that associated with timing restrictions for warmwater fish habitat where appropriate, e.g., in-water works must be conducted between July 1 and March 31. This timing is to be confirmed during future phases of the project through consultation with TRCA / MNRF / DFO.
	Removal of woody vegetation is recommended to occur outside of the migratory bird nesting period (April 1 to August 31) and activities will occur in accordance with the MBCA and Migratory Bird Regulations. These timing constraints should not be perceived as absolutes. This period represents the core breeding period, although some species may nest in March and September. Ultimately, the objective from a compliance perspective is to not circumvent the MBCA. As such, due diligence measures should be implemented and documented for any nest searching efforts, including record control, to ensure compliance with the MBCA.
	For activities, including vegetation removal, which may occur during bird nesting season, surveys to identify nesting activity will be completed by an Avian Biologist within 24 hours of scheduled work activities. The Avian Biologist conducting the surveys must be able to identify birds by species and be knowledgeable of nesting seasons and activities for appropriate species. It is important to note that, depending on the time of clearing activities, nest sweeps during the breeding season may not be a viable option. More specifically in the event vegetation becomes too dense and a clear confirmation / due diligence cannot be provided through nest sweeps, clearing activities may not be able to move forward until a timing where credible due diligence can be implemented.
	If a species listed under the ESA as extirpated, endangered or threatened is identified, Section 9 of the Act prohibits killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, leasing, trading or offering to buy, sell, lease or trade a member of the species. Some of these prohibitions also apply to body parts of a member of the species and to things derived from a member of the species. Similarly, if a species is listed under the ESA as endangered or threatened, Section 10 of the Act prohibits damaging or destroying the habitat of the species. Species listed as special concern are not afforded protection under Sections 9 and 10 of the ESA; however, due diligence should be enforced if a special concern species or their habitat is present.
	Other mitigation measures to consider are fencing to direct wildlife movement through wildlife crossings but also to prevent uncontrolled access and encroachment from pedestrians into adjacent natural areas. Should impenetrable barriers be considered, opportunities for wildlife passage should be incorporated. It is recommended that buffer widths be increased from the minimum 10 m to 15 m near areas of ecological sensitivity. Additionally, all crossing structures should be clear-span structures with abutments located outside any significant valleylands and natural heritage systems to reduce impacts. These clear-span structures will also act as passages to reduce crossing hazards for wildlife.

Category	Details
	It is recommended that low mast lighting is implemented and directed downward and shielded to minimize light projection into the NHS and lightening at wildlife crossings should be limited, where feasible.
	Peel Region will continue to work together with TRCA to identify appropriate compensation opportunities. Peel Region understands that ecosystem compensation will follow in principle the TRCA's Guideline for Determining Ecosystem Compensation, dated June 2018. Compensation will be approved by TRCA and Peel Region in advance of TRCA permit approvals.
	Additionally, the removal of trees from hedgerows and other areas will require compensation. Compensation is currently estimated to be 1,900 compensation trees which will be further refined in detailed design.
Vegetation / Aesthetic	Existing hydrological patterns should be maintained or replicated.
	Consider LID strategies to treat non-point source pollution from roadways, such as bioswales, bioretention areas, treatment trains, etc. and improve water quality, groundwater recharge.
	For minor seasonal flow areas, culverts size should be adequate for passage of appropriate wildlife species. Wildlife underpasses should also be considered where appropriate based on the Ecological Study.
	Ponds and wetlands removed should be replaced following regional guidelines for mitigation.
	Street Tree plantings should follow Region of Peel and City of Brampton standards and prioritize diverse, appropriate species with a focus on salt tolerance and ecological value. Trees must have adequate volume of high quality, or remediated soils.
	Ensure species diversity. The Peel Urban Forest Strategy recommends no single streetscaping species represents more than 5% of the tree population, no genus represents more than 10% of the tree population, and no family represents more than 20% of the tree population.
	Improved plantings for beautification, reduction of ROW maintenance costs, and improvement of adjacent habitat. Sod / turf strips should be reconsidered, replaced by a diverse and native low growing meadow mix requiring a single seasonal mowing.
	Intersections should enhance pedestrian and cycling visibility and crossing as appropriate for the context (e.g., reducing crossing distance, cross-ride treatments, providing a pedestrian crossing island, removing right-turn channels or moving to smart channels).
	Tree cover for active transportation infrastructure (including sidewalks) to provide shade (trees that will grow greater than or equal to 15 m tall at maturity). Diverse species to be planted on 10.0 m centres on both sides of Streets where possible.
	Consider planting more shrubs and perennials for increased vegetation densities suited to the growing conditions and constraints.
	A Landscape Plan will be developed at the detailed design stage providing opportunities to enhance the streetscape with doubled staggered rows, accent plantings and spacing that will be in accordance to current City of Brampton and Region of Peel standards and recommendations. This will also include features such as Region of Peel approved rest areas in appropriate locations in consultation with and consideration of public transit.
	Repair or restore existing wetland plant communities, relocated wetlands, ponds, riparian zones, creek channels, and improve drainage areas.
	Consider using low growing meadow species in place of sod for beautification, reduction of ROW maintenance costs, and improvement of adjacent habitat.
	A Landscape Plan will be developed at the detailed design stage providing opportunities to enhance the Streetscape and include features such as Region of Peel approved rest areas in appropriate locations in consultation with and consideration of public transit.
	A Vegetation Assessment will be required, prepared by a certified International Society of Arboriculture arborist. All existing vegetation removed as part of this project should be inventoried.

Category	Details
	Construction activities are to avoid damaging existing, healthy, trees located close to the ROW wherever possible. This is to be accomplished by installing suitable tree protection fencing, extending to the 'dripline' of trees designated for protection. This tree protection zone is to remain undisturbed by excavation, storage of materials and equipment, and other construction related activities. The fencing is to remain in place through the duration of construction activities.
	Existing trees scheduled for removal are to be inspected to determine if transplanting is a feasible option (depending on size, species, and health of tree).
	Tree planting / streetscape plans are to be prepared for the corridor by a registered landscape architect, as part of the detailed design of the roadway. These plans are to address: - Compensation for vegetation requiring removal on or near private property. - A Landscape Plan will provide opportunities to enhance the streetscape with doubled staggered rows, accent plantings and spacing that will be in accordance to current City of Brampton and Region of Peel standards and recommendations. - Restoration of Riparian Zones, Stream Channels, and Wetlands.
	All trees to be planted are to be selected from the City of Brampton and Region of Peel Approved Street Tree List.
	The planting of new trees along the corridor is to be coordinated with existing and proposed utility corridors, and light standards.
	Construction impacts at stream crossings are to be mitigated with the planting of riparian vegetation. This vegetation should be native, non-invasive, riparian vegetation, as approved by the local Conservation Authority.
	Trees to be planted near overhead utilities to be selected to conform to mature height limitations (Hydro approved species).
	During detailed design: - Full tree inventory is required to help produce a total number of trees expected to be removed, and an estimate of those able to be retained. - Tree clearing must not be conducted during the MBCA breeding season, unless under appropriate permitting. - Retention of as many mature trees as possible. As many are fully mature, transplant is not a reasonable option and they are of high value to the Region and the environment. - Possible new plantings (planted to Peel Urban Forest Standards and Specifications), amongst more established trees would offer more diversity to the area, as well as aesthetics. - Increased root zone around driveways. - Including species from the Region of Peel and City of Brampton Approved Street Tree Lists such as salt-tolerant deciduous street tree species (Pin Oak, Privacy Pine, Austrian Pine, Thornless Honey Locust, Silver Maple) or shrub species for riparian areas (Heart-leaved Willow, Common Elderberry, Eastern White Cedar and Balsam Fir). - Invasive species should be kept in check as construction activities can greatly increase their numbers. - Proper mulching of new trees and those retained trees that may be impacted by construction. - Ensuring minimal compaction of soils in the root zone and no change in grade surrounding retained trees.
Archaeology	Prior to any land altering activities, the portions of the study area deemed to have archaeological potential require Stage 2 assessment by means of shovel test pit survey or pedestrian survey, as appropriate, in accordance with the Standards and Guidelines for Consultant Archaeologists. All necessary further stages of archaeological assessment required should be completed as early as possible during detailed design. It is recommended to not commence ground-disturbing activities until all required archaeological reports have been entered into the Ontario Public Register of Archaeological Reports.

Category	Details
	Where ploughing is viable, all open land greater than 10 m by 10 m in area must be freshly ploughed (and disked if necessary) and then allowed to weather sufficiently before being subjected to pedestrian survey at 5 m intervals.
	For lands measuring less than 10 m by 10 m in area, or where ploughing is not viable, a test pit survey must be executed. Such lands may include woodlots, pasture with high rock content, abandoned farmland with heavy brush and weed growth, orchards and vineyards that cannot be strip ploughed, parkland, residential lawns that will remain as lawns for an extended length of time, and properties with existing landscaping or infrastructure.
	There may also be a possibility of previously undocumented archaeological resources being unexpectedly encountered during construction, in spite of prior assessments. MHSTCI should be notified (at archaeology@ontario.ca) if this occurs and all activities impacting archaeological resources must cease immediately. A licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists. If human remains are encountered, all activities must cease immediately, and the local police and coroner must be contacted.
Built Heritage Resources and Cultural Heritage Landscapes	The locations of built heritage resources and cultural heritage landscapes should be identified on construction mapping so that project personnel are aware of the presence of heritage properties within, and adjacent to, the proposed work.
	Direct impacts are anticipated to Cultural Heritage Resource 6 (Coleraine Drive) due to proposed road widening that will permanently alter the historical character of this rural road. An HIA should be completed for this roadscape to determine whether this road has heritage value when evaluated against the criteria contained in O. Reg. 9 / 06 of the Ontario Heritage Act. If the roadscape is found to have Cultural Heritage Value, then an impact assessment should be complete and mitigation measures prepared. The HIA should be completed at the outset of the detailed design phase of the project. The HIA once completed, will require presentation to the Brampton Heritage Board.
	Direct impacts are anticipated to one heritage property, Cultural Heritage Resource 3 (5556 Countryside Drive) as a result of minor acquisition along property frontages to accommodate the widened roadway. This property is listed on the City of Brampton Municipal Register of Cultural Heritage. Therefore, impacts to this property should be evaluated in an HIA and where impacts are anticipated, a conservation strategy and mitigation measures should be prepared. The HIA should be completed at the outset of the detailed design phase of the project. The HIA once completed, will require presentation to the Brampton Heritage Board.
	This report should be submitted to the City of Brampton, City of Vaughan, and Ministry of Tourism, Culture and Sport for review and comment.
Contamination	Further environmental studies of the high and medium ranked properties directly impacted by project activities would be recommended to confirm the environmental conditions in support of property acquisitions, environmental due diligence, and management of excess soils and materials. These investigations may include Phase One and Phase Two Environmental Site Assessment.
	If any properties within the study area require change in property use, a Record of Site Condition would be required. If contamination is identified, mitigation measures may need to be developed and implemented, which may include environmental remediation or a risk assessment.
	Further investigation is required during the Cadetta Road detailed design, as this area of the Site was not assessed during this investigation.
Stormwater Management	The stormwater facilities proposed within the Area 47 development blocks are to be designed to service the City of Brampton and Region of Peel owned ROW for the water quantity, water quality, and erosion control stormwater requirements. Information pertaining to the manner in which the major and minor systems of the City of Brampton and Region of Peel owned ROW would be connected to the systems servicing the development blocks has not been made available for the current study. As such, the road reconstruction retention volume

Category	Details
	requirements, as well as the short-listed LID Best Management Practices, should be further reviewed and refined when this information becomes available.
	The developer group has agreed to locate the proposed stormwater management pond near the intersection of Coleraine Drive and future Arterial Road A2 that will accommodate storm run-off from the realigned Coleraine Drive (ref. agreement in Appendix J). Further, the exact pond location, dimensions and design details will be determined during future phases of work. Further to the Stormwater Drainage Assessment Report in Appendix J, the Region of Peel will arrange for the design and construction of the stormwater management pond and the City of Brampton will accept conveyance and maintenance of the pond after the maintenance / warranty period.
	It is recommended that the proposed crossings of Coleraine Drive and Arterial A2 be advanced to the detailed design stage.
	It is recommended that the Region's four (4) step process for considering climate change resiliency in the design of stormwater infrastructure should be implemented at the detailed design stage.
	The MECP is in the process of issuing a Stormwater Consolidated Linear Infrastructure (CLI) Environmental Compliance Approval (ECA) to the Region of Peel. The Stormwater CLI ECA covers storm assets servicing regional roads, namely storm sewers, ditches, stormwater management facilities and LID, and Stormwater Pumping Stations. The Stormwater CLI ECA sets forth conditions for alterations to the stormwater system as well as ongoing operation of the system. The ECA comes with criteria for design of alterations to the Region's existing stormwater system. At the time of completion of the Class EA study, the CLI ECA template and criteria were not available, therefore the Class EA recommendations do not guarantee compliance with the CLI ECA conditions and criteria. It is recommended that at the detailed design stage, the Engineering Consultant re-assess the Class EA recommendations against the CLI ECA criteria and make the necessary adjustments and changes to the stormwater recommendations to be in compliance, where feasible.
	It is recommended that Rainbow Creek alterations or floodproofing measures associated with adjacent developable lands for the reach from Coleraine Drive to Mayfield Road be designed / implemented to achieve a near zero change in computed results between existing and proposed conditions or to accommodate minor changes in computed water surface elevations.
Fluvial Geomorphology	From a fluvial geomorphic perspective, it is recommended that new crossing structures accommodate a minimum span of three (3) times the bankfull width of the channel or the maximum existing meander amplitude.
	The crossing recommendations will reasonably minimize the risk due to natural erosion hazards within the watercourse corridors, but all recommended structures will still be within the recommended meander belt widths.
	At new bridge crossings, it is recommended that the structure be placed at an optimal skew perpendicular (90^{O}) to the meander axis to ensure long term channel and bank stability and the channel will have to be realigned to pass through the axis of the intersection.
	At all crossing locations, natural channel design principles will need to be implemented when considering upstream and downstream tie-in points as well as bed and bank treatments.
Geotechnical	All topsoil and loose soil or soil mixed with organic matter should be stripped from pavement areas, manhole / catch basin founding areas, and base of underground utility services.
	Any loose, soft or unstable areas in the exposed subgrade should be sub-excavated and replaced with approved fill and compacted.
	Lean concrete may be used to backfill sub-excavated areas. Excavation should be carried out with a temporary slope of 1H:1V or flatter above the groundwater level.
	Roadway shoring protection systems may be required during construction of the culverts.

Category	Details
	The embankment required for road widening should be constructed with compacted engineered fill at two (2) Horizontal: one (1) Vertical (or flatter) side slopes. If a side slope steeper than two (2) Horizontal: one (1) Vertical slope is required or if the height of the embankment / cut slope is greater than 2 m, slope stability analysis should be carried out to assess stability of the planned slope, depending on the subsurface conditions. Where existing embankments are to be widened, the side slopes should be benched in accordance with Ontario Provincial Standard Drawing 208.010 prior to placement of the widening fills. Final (permanent) embankment side slopes in granular fills should be established to match the existing slopes or as per Ontario Provincial Standard Drawing 200.010. Final slopes should be treated with a seed and mulch to prevent ravelling.
	Widening of the road will require, as a minimum, stripping the existing ground surface cover from the area required for road widening. The planned widening will generally be constructed to the same elevation as the existing road surface. Grading, backfilling and compacting should follow OPSS.MUNI 206, OPSS.MUNI 401, OPSS 501.MUNI, and/or the City / Region's requirements. Backfilling, if required, for site grading should be placed as engineered fill. Engineered fill per OPSS.MUNI 1010 should be used to replace soft / incompetent soils and/or raising grade. Engineered fill should be prepared according to the City's standards / contract specifications. The fill soils used for embankment widening should consist of approved clean fill.
	Engineered fill per OPSS.MUNI 1010, where required, may be used to backfill excavated areas, backfill around manholes, replace soft / incompetent soils, and/or raise grades. Engineered fill for backfill of excavated areas should be placed after stripping existing fill soils, any soils containing excessive organic matters and otherwise unsuitable soils. Engineered fill can be prepared by placing fill soil and compacted as per OPSS.MUNI 501 and/or applicable City Standard. Alternatively, engineered fill should be placed in loose layers not exceeding 200 mm. The water content of the fill should be within ± 2 % of its optimum moisture content at the time of its placement, and it should be thoroughly compacted to a minimum of 98% of Standard Proctor Maximum Dry Density in general. The fill soils should consist of inorganic soils and should not be frozen during backfilling and compaction. Full-time geotechnical inspection and quality control are necessary for the construction of a certifiable engineered fill. The compaction procedures and quality control should be overseen by a geotechnical engineer.
	All excavations should be carried out in accordance with the latest Ontario's Occupational Health and Safety Act and Regulations for Construction Projects (O. Reg. 213 / 91).
	In accordance with the OHSA, a maximum short-term slope of 1H:1V is required to within 1.2 m of the trench bottom for temporary excavations in Type 1 and 2 cohesive till and native silty sand that is above the groundwater level, or properly dewatered. For Type 1 and 2 soils, a maximum depth of 1.2 m high vertical cut at the bottom of excavation may generally be constructed. However, under the groundwater table a 1.2 m high vertical cut may not be stable and flatter slopes may be required. Type 3 soils above the groundwater level may be inclined at 1H:1V or flatter from the bottom. In the case of saturated Type 3 fills or native granular deposits below the prevailing groundwater, if adequate dewatering is not implemented, slopes of open excavations will have to be reduced to 2H: 1V or flatter. In the absence of proper dewatering or groundwater control of Type 3 soils, slope flattening may be insufficient to prevent particularly saturated granular soils from becoming unstable and devolving to Type 4 materials. Near the ground surface, occasional 3H:1V or flatter slopes may be required due to loose / soft surficial soils. If open cut cannot be carried out, a temporary shoring system may be used to limit the extent of excavation. Trenching should be carried out in accordance with OPSS.MUNI 401. Stockpiles, materials or any heavy equipment should be kept at least the same horizontal distance as the depth of the excavation from the upper edge of the excavation to prevent slope instability. All surface drainage should be directed away from any open excavations and trenches.

Category	Details
	During the construction, temporary runoff controls such as sediment trap, interceptor drain, dyke and/or silt fence should be installed to prevent uncontrolled water / sediment flow into existing water courses. The effluent from dewatering operations should also be filtered or passed through sediment traps to prevent turbidity.
	Based on the soil and groundwater conditions at the borehole locations, groundwater control within the excavated area should not be significant. In the clayey soils, groundwater seepage into the excavation, if encountered, is likely to be slow and a properly filtered sump and pump system or gravity drainage may be used for dewatering the excavation. High water flow rates may be encountered during construction and the dewatering effort could require an increased number of sumps and pumps.
	Use of lean concrete mud mat or granular layer may be warranted where founding surfaces are to be exposed for extended period, especially if the work is carried out during wet weather. Care should also be exercised to minimize disturbance to the final subgrade during excavation.
	It is recommended that qualified geotechnical personnel be present during the foundation excavation to review the conditions of the foundation subgrade.
	Based on observations at the borehole locations and planned excavation depth, normal excavation equipment should be suitable for excavation. Hard till soils may require additional effort for excavation. The terms describing the compactness or consistency of soil strata give an indication of the effort needed for excavation. It should be noted that cobbles / boulders can be encountered in the till and in fill soils. Therefore, removal of the cobbles / boulders should be considered and planned for.
	Temporary shoring may be required for vertical excavation during construction of culverts, installation of underground utilities or roadway protection. This can be accomplished using soldier piles with lagging (or similar) in order to support the sides of the excavation. Temporary shoring design and construction should comply with OPSS.MUNI 539, or applicable City / Region Standard. The temporary shoring system should be designed to resist the lateral earth, surcharge and hydrostatic pressures which could occur during construction. Bracings should be installed within the shoring system to minimize movements of the soils. The temporary shoring system should be designed in accordance with the latest editions of Canadian Foundation Engineering Manual's and Canadian Highway Bridge Design Code, together with the requirements of the Ontario Health and Safety Regulations, as applicable. The shoring system should be designed and approved by a professional engineer.
	As per recommendations from the MECP, the assessment of possible contaminated sites along the road alignments and the risk of entrainment of contaminated groundwater during construction dewatering will be reviewing during detailed design stage.
	MECP recommends completing investigations within 0.5 km of the proposed Arterial A2 which was not accessible during the geotechnical investigations during detailed design.
	Most of the excavated soils can be suitable for being reused for backfill, provided they can be separately stored, properly compacted and are environmentally acceptable. Fill soils containing construction debris (or similar) and organic matter should not be reused. Soils that are too wet to compact will require additional processing (e.g., drying). Cobbles and boulders (larger than 100 mm in size), if any, should be discarded by mechanical means or manual removal.
Hydrogeology	While a permit to take water for groundwater extraction from excavations is not anticipated to be needed, permitting may be required if dewatering rates exceed the thresholds for EASR registration and a PTTW because of surface water, storm water and wetland water influx into excavations.
	Record the amount of water taking during each day of dewatering to ensure the maximum water taking does not exceed the thresholds for EASR registration or a PTTW.

Category	Details
	It is recommended that a private well survey be completed to confirm the location of, depth of and water level in water supply wells 4907185 and 4904154 near Coleraine Drive.
	In addition to groundwater extraction, stream diversion may be necessary to install the culverts. Any dewatering system should be designed by a dewatering contractor and should take the stream surface water flow into consideration.
	Use standard ESC measures that meet or exceed OPSS to discharge the abstracted water into the adjacent wetlands, streams or other natural surface water body. The measures should be implemented prior to work and be maintained during construction until disturbed areas have been effectively stabilized and restored. Removing sediment from the abstracted water could be achieved by filter bags or for higher amounts by collecting the abstracted water in a weir tank to allow sediment to settle out of the water first.
	The MECP recommends completing investigations within 0.5 km of the proposed Arterial A2 which was not accessible during hydrogeological assessment during detailed design.
	MECP also recommends performing the door-to-door survey to all properties on private wells as water supply and invite property owners to participate on the monitoring program for the project during detailed design.
	A private well survey should also be completed to confirm the location of, depth of, and water level in water supply wells 4907185 and 4904154 near Coleraine Drive, and water supply wells 4902856, 4902866 and 4905894 near Clarkway Drive during detailed design.
	Lastly, groundwater levels will be monitored on an ongoing basis to determine seasonal water level fluctuations during detailed design.
	The quality of the water discharged into the adjacent wetlands, streams or other natural surface water body should meet upstream (e.g., background) water quality and/or the Ontario Provincial Water Quality Objectives.
Noise	The contract documents should identify the contractor's responsibilities with respect to controlling noise, as well as recording, investigating and, if possible, addressing complaints.
	Noise wall locations and heights to be verified during detailed design.
	The contract documents should also explicitly state that compliance with all applicable law is an expectation of the contract including adherence to the City of Brampton By-Law 93-84 and MECP Publication NPC-115.
Consultation	Additional consultation will be carried out with York Region during detailed design. Major Mackenzie Drive, which forms the east leg of the Highway 50 and Arterial Road A2 intersection, is under York Region's jurisdiction. To address the issues identified at the intersection of Highway 50 and Arterial Road A2, a single-point urban interchange (SPUI) has been proposed as the preferred ultimate configuration. This intersection will continue to be monitored through future studies, in consultation with York Region, to determine when the preferred ultimate configuration will be warranted. For the interim condition, Arterial A2 should be designed in conjunction with the future Highway 50 / Major Mackenzie Drive intersection proposed design.
	The Region will confirm the A2 and Mayfield Road intersection LOS for 2051 through the upcoming TMP and will continue, through subsequent stages of this project, to consult with the Town of Caledon to ensure best outcomes. The upcoming TMP will assess the traffic operations for 2051 at the intersections of Mayfield Road with Humber Station Road, Coleraine Drive, and Arterial Road A2.
	Further consultation to occur with HDI during detailed design and construction. HDI will be involved in weekly inspection visits to observe ESC measures, vegetation removal, work near watercourses, and any wildlife sweeps that may occur.
TransCanada Pipeline	Written consent is required from TransCanada Pipeline for any work within 30 m of the pipeline(s).
	The Region of Peel and City of Brampton shall engage with TransCanada Pipeline for an evaluation of the road widening / reconstruction across TransCanada Pipeline's facilities.

Category	Details
	It is recommended that overburden / additional grading within the TransCanada Pipeline easement and within 7 m of either edge of it be reduced as much as possible. Significant overburden over TransCanada Pipeline's assets may have an impact on TransCanada Pipeline's evaluation of the widening and reconstruction.
Design	Transit stops will be reviewed and incorporated where feasible during detailed design with consideration for the City's comments in Appendix C.
	The cost estimate does not include the design and construction of the stormwater pond at Coleraine Drive and Arterial A2. This will be confirmed during detailed design.
	Streetlighting design will be reviewed with the City and Region. Comments received from the City and Region during the Class EA Study are included in Appendix C. It is noted that the use of Aluminium poles may be an option in areas where clearance requirements are not met. Further, photometrics will need to be completed for the road and intersections, including calculation for the sidewalk/MUP.

7.12 Monitoring

A monitoring program will be established to ensure that the mitigation measures specified in Table 7-2 are undertaken. The key impacts to the environment are the short-term impacts that require monitoring during construction. The construction of this project will be monitored on site by the Region to ensure that the Contractor is implementing standard construction practices. This will include erosion and sedimentation control, dust and noise control, protection of existing vegetation, assurance of traffic safety and maintenance of traffic flow without causing unnecessary delays, etc. The overall performance and effectiveness of the environmental mitigating measures specified are to be monitored and assessed during and subsequent to the construction of the project.

The environmental impacts outlined in this section are considered as normal impacts associated with roads construction. The established standard construction practices outlined as the mitigating measures will be incorporated in the contract documents. The Contract Administrator is to ensure that these mitigating measures are undertaken during construction. Should unforeseen environmental concerns and/or issues arise during the construction period, the appropriate ministry and agencies will be contacted, and appropriate measures will be taken to mitigate the environmental concerns / issues.

7.13 Commitments to Further Investigations

Commitments to further investigation during the detailed design stage are:

- Utilities coordination and possible sub-surface utility engineering (SUE) to determine types, location, and depths of the existing and any new facilities;
- Detailed stormwater management design and coordination with agencies;
- Landscape design;
- Property acquisition;
- Detailed cost estimate;
- Construction phases / implementation;
- Construction staging & detour;
- Consultation with York Region will be required for matching into existing and/or proposed road geometrics of Highway 50 and Major Mackenzie Drive during detailed design.
- Proposed road design of Highway 50 (from a separate EA Study) to considered for the at-grade and interchange design of Arterial A2 / Highway 50 / Major Mackenzie intersection.
- Mitigation Measures for potential relocation of utilities and municipal services (water, wastewater, storm, etc.) due to conflicts/in-adequate cover to be investigated in detailed during detailed design stage.

Additional investigations identified by agencies (Refer to **Appendix C** 'Agency Consultation' for details).

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