



427 Transportation Corridor

Highway 427 Extension
From Highway 7 to Major Mackenzie Drive

Final Preliminary Design Report



A member of
 MMM GROUP

December, 2010

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1. INTRODUCTION

The Ministry of Transportation (MTO) is working to provide for the efficient movement of people and goods within the context of the province's *Growth Plan for the Greater Golden Horseshoe* as released in June 2006. The *Growth Plan* outlines a set of policies for managing growth and development and guiding planning decisions in the Greater Golden Horseshoe over the next 30 years. This broad based plan represents a planning "vision" for the Province of Ontario. As a part of this vision, the plan outlines a strategy for "Where and How to Grow", "Infrastructure to Support Growth", "Protecting What is Valuable", "Sub-Area Growth Strategies" and "Implementation". The *Growth Plan* requires that planning decisions made by the Province, municipalities and other authorities conform to the policies contained in the Plan.

The *Growth Plan* clearly supports improving access to inter-modal facilities to enhance goods movement and provide access to major employment areas. Consistent with this direction, MTO initiated the formal Environmental Assessment process for the 427 Transportation Corridor, within the western part of Vaughan and the eastern part of the City of Brampton.

The purpose of the Environmental Assessment (EA) study was to:

- Address existing and short-term transportation problems related to the current Highway 427 terminus, truck traffic accessibility to and from the CPR Vaughan Intermodal Facility, and their impact on inter-regional traffic in the Peel-York boundary area;
- Identify and protect required property for any proposed transportation corridor and allow planned development to occur outside of the transportation corridor;
- Ensure that alternatives / preferred solution will not preclude or predetermine planning for the other future transportation corridors such as the GTA West corridor or a future extension of the transportation corridor northerly, if ever required.

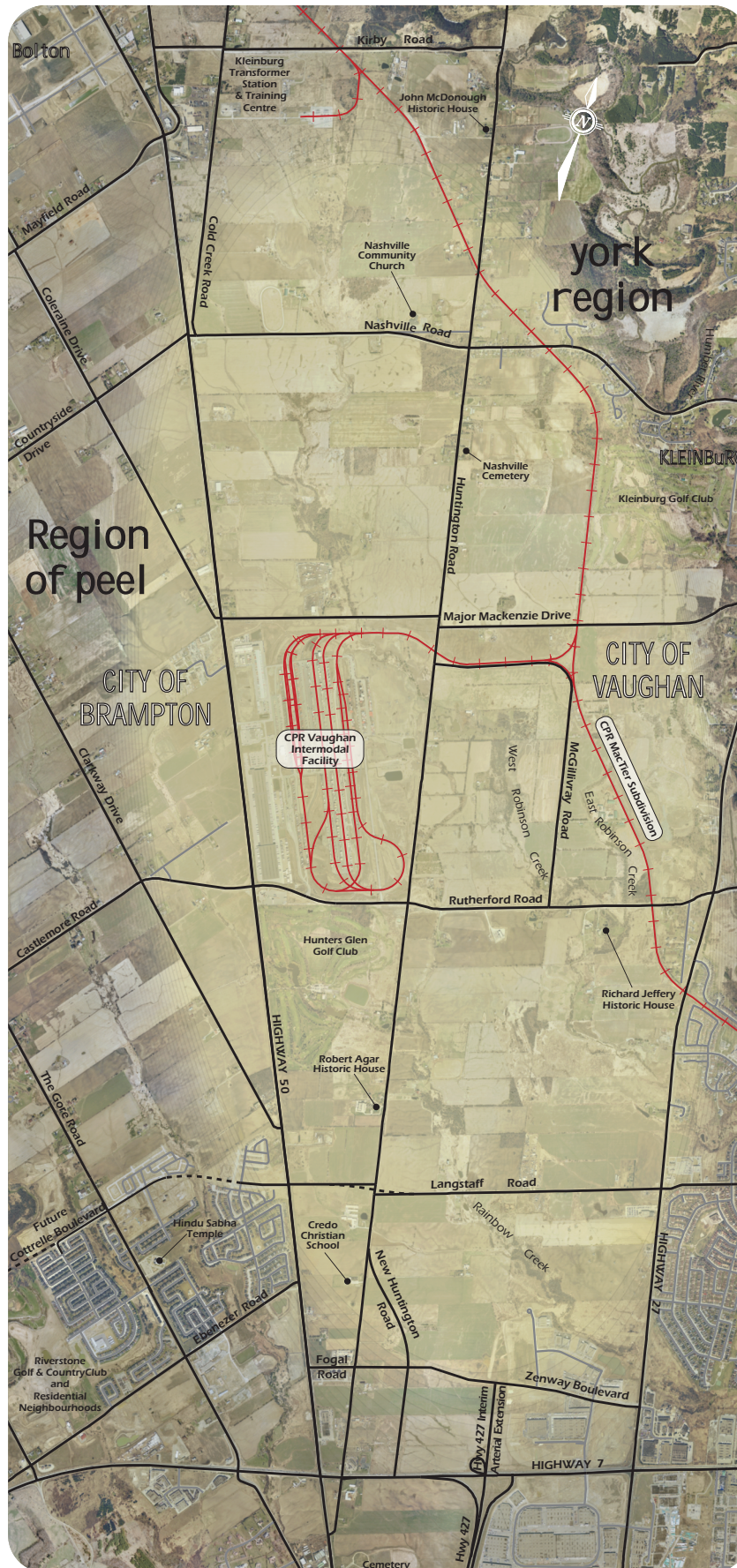
The EA process was completed in a systematic and comprehensive manner, which included public and agency consultation throughout the process.

The EA Report documents the planning process undertaken to identify a preferred alternative. This Preliminary Design Report focuses on the engineering aspect of the report. This report and the EA Report should both be reviewed in order to fully understand the project.

The EA was approved in November 2010.

1.1 Project Location

The project is located within the western part of the City of Vaughan in York Region (Exhibit 1-1).



1.2 Selected Design

The key features of the recommended Highway 427 Extension from Highway 7 to Major Mackenzie Drive include the following:

- Terminates at Major Mackenzie Drive
- 3 interchanges at Langstaff Road, Rutherford Road and Major Mackenzie Drive
- 6 lanes from Highway 7 to Rutherford Road
- 4 lanes from Rutherford Road to Major Mackenzie Drive
- Provision of a median HOV lanes in each direction
- Identification and protection of a 60 m transit right-of-way (ROW) and transit stations to be located along the west side of the 110 m freeway ROW
- Potential transitway stations identified at the interchanges at Langstaff Road, Rutherford Road and Major Mackenzie Drive

1.3 Project Team

The study was administered by the MTO and managed by a project team consisting of senior representatives of the MTO and their consultants, McCormick Rankin Corporation (MRC) in association with Ecoplans Limited. The project team members included:

Lola Vaz-Rafearo	MTO Project Manager
Antonio Di Sabatino	MTO Environmental Planner
Allen Lew	MTO Assistant Project Manager
Michael Chiu	MRC Project Manager
Mike Bricks	Ecoplans Limited Environmental Planner
Leslie Green	MRC Assistant Project Manager
Katie Bright	Ecoplans Limited Environmental Coordinator
Jin Teng	MRC Design Engineer

Various specialist offices within the MTO provided input and advice throughout the study. The MTO offices that were involved included:

Structures	Nick Garland
Traffic	Zaka Uddin
Drainage	John VanVoorst
Corridor Management	Margaret Mikolajczak
Utilities	Mario Panza
Electrical	Howard Sahsuvar
Fisheries	April Marton
Foundations	Betty Bennett
Geotechnical	Ken Zasitko

2. ENVIRONMENTAL APPROVAL

The 427 Transportation Corridor EA Study was undertaken as an Individual Environmental Assessment (IEA) under the Ontario Environmental Assessment Act (OEAA). It was conducted in accordance with the planning process documented in the 427 Transportation Corridor Environmental Assessment Terms of Reference (ToR), which was approved by the Minister of the Environment in November 2005. The main phases of the EA planning process were as follows:

- Purpose and Rationale for the Undertaking
- Alternatives to the Undertaking
- Alternative Methods of Carrying Out the Undertaking
- Preliminary Design of the Preferred Alternative
- EA Report / Documentation

To date, no formal Canadian Environmental Assessment Act (CEAA) triggers have been identified and therefore a Screening under CEAA is not required.

3. CONSULTATION PROCESS

An extensive consultation process was undertaken to assist in the planning and impact assessment for this project. External agencies, interest groups, property owners, utility companies and the general public were consulted regarding specific areas of interest, and kept informed through notices at study commencement, prior to Public Information Centres, and at the completion of the study (filing of the EA Report). The three public information centres were held at key milestones during the study. A detailed discussion of the consultation program and results, copies of relevant correspondence and the Public Information Summary Reports, are included in the EA Report.

Additional consultation was undertaken with several agencies and stakeholder groups, including:

- Toronto and Region Conservation Authority
- Ministry of Natural Resources
- Canadian Pacific Rail (CPR)
- Hydro One
- York Region
- City of Vaughan
- Region of Peel
- City of Brampton
- Town of Caledon

There were no significant issues related to external consultation at the completion of the preliminary design process. However, ongoing consultation during detail design is required with several key agencies and stakeholder groups. Discussions will also be required with affected property owners regarding property impacts. This is discussed in detail in the EA Report.

4. RECOMMENDED DESIGN

The Highway 427 Extension is 6 lanes from Highway 7 to Rutherford Road and 4 lanes from Rutherford Road to Major Mackenzie Drive. It also includes the provision of median HOV lanes in each direction and a carpool lot at the Rutherford Road Interchange, as well as, 5 road structures and 4 creek crossing structures. The total length of the extension is 6.6 km long.

New interchanges will be located at Langstaff Road, Rutherford Road and Major Mackenzie Drive. The existing partial interchange at Highway 7 will also be upgraded to a complete interchange with all moves.

There will be no at-grade intersections and access provided at interchanges. The Recommended Design is illustrated in Exhibit 4-1 (1:5000) of this report.

The Recommended Design also includes various grade separations and side road realignments that are required to maintain access to adjacent lands within the study area.

The Recommended Design was developed through a process that included development of corridor alternatives, a preferred corridor, route and interchange alternatives within the preferred corridor, and the development of the preferred route through consultation with municipalities, agencies and property owners.

In addition, the Recommended Design includes the protection of a future transitway in a 60 m right-of-way and does not preclude a possible future extension of Highway 427.

4.1 Highway Geometrics

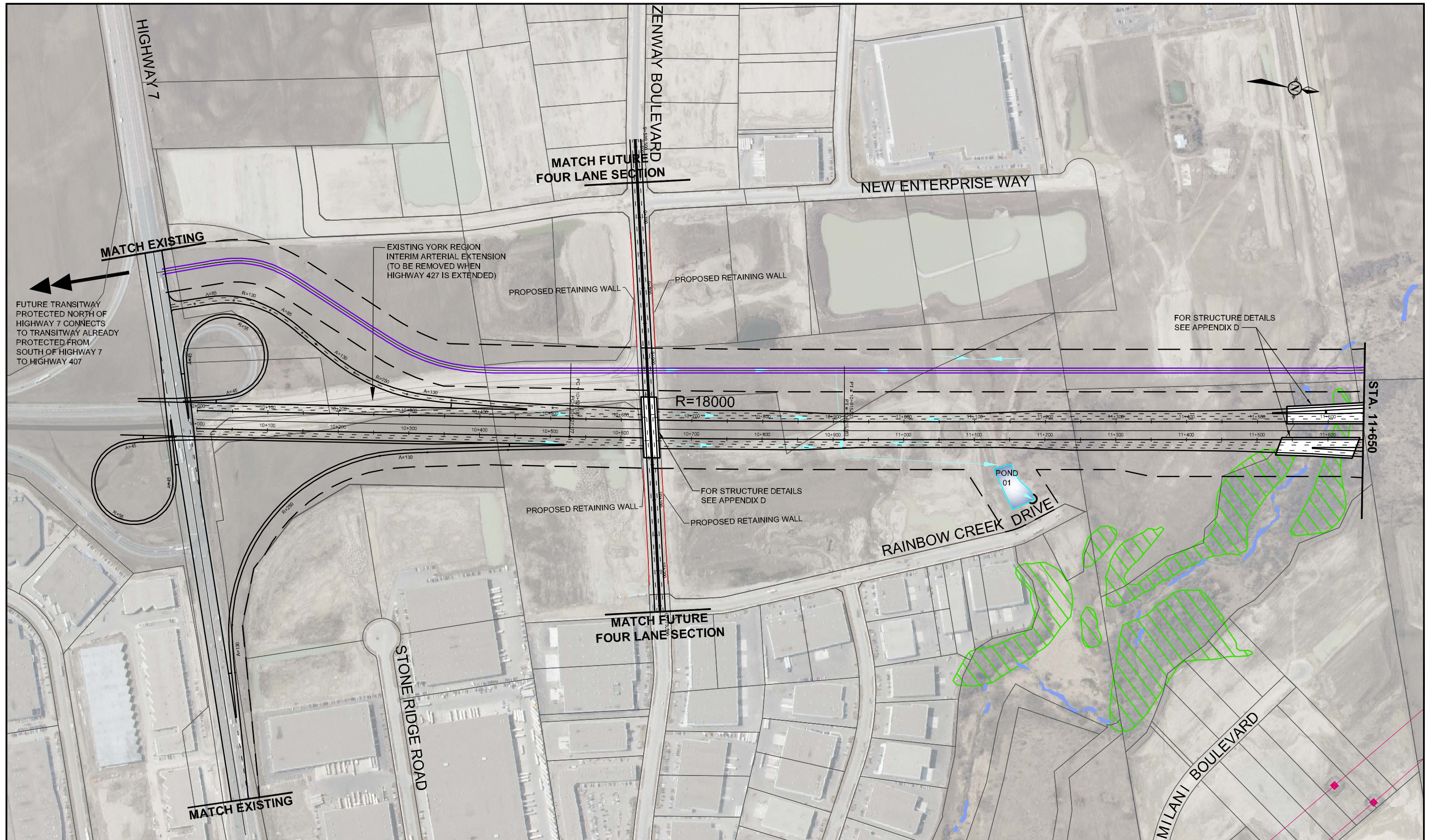
4.1.1 Horizontal Alignment

The horizontal alignment of the highway is curvilinear in nature, consisting of numerous horizontal curves connected by tangent sections. Radii for the horizontal curves range from R=1700 m to R=7000 m. All horizontal alignment elements for Highway 427 meet or exceed the requirements set out in the Geometric Design Standards for Ontario Highways (GDSOH) for the applicable design speed of 120 km/h.

The following is a description of the recommended route:

Highway 7 to Langstaff Road

At the south limit of the project, the alignment matches the existing Highway 427 which is currently only four lanes. The current four lanes terminate at Highway 7 with an interim arterial road extending to Zenway Boulevard which was constructed in 2008 by York Region and will be removed when Highway 427 is extended north. The nature of the widening of Highway 427 south of Highway 7 will be determined through a separate study.



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LEGEND

- PROPOSED HIGHWAY
- PROPOSED TRANSITWAY
- PROPOSED PROPERTY RIGHT-OF-WAY

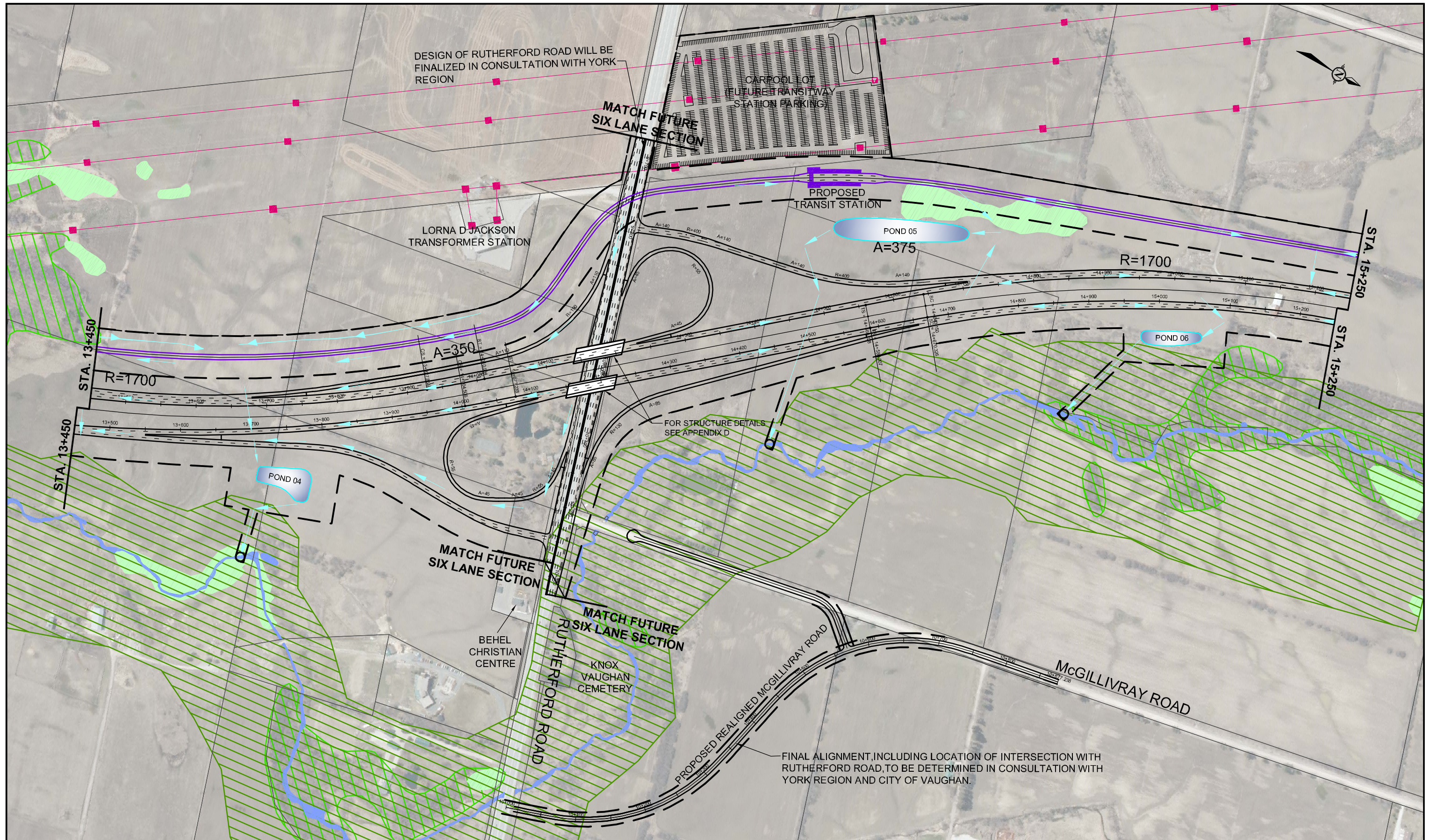
- YORK REGION GREENLANDS
- WOODED AREA
- UNEVALUATED WETLAND

Scale : 1 : 5000

 Date : December 2010

RECOMMENDED PLAN
 STA. 10+000 TO STA. 11+650

EXHIBIT
4-1
 (Plate 1)



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Highway 427 Transportation Corridor
Preliminary Design Report

LEGEND

- — — — — PROPOSED HIGHWAY
- — — — — PROPOSED TRANSITWAY
- — — — — PROPOSED PROPERTY RIGHT-OF-WAY

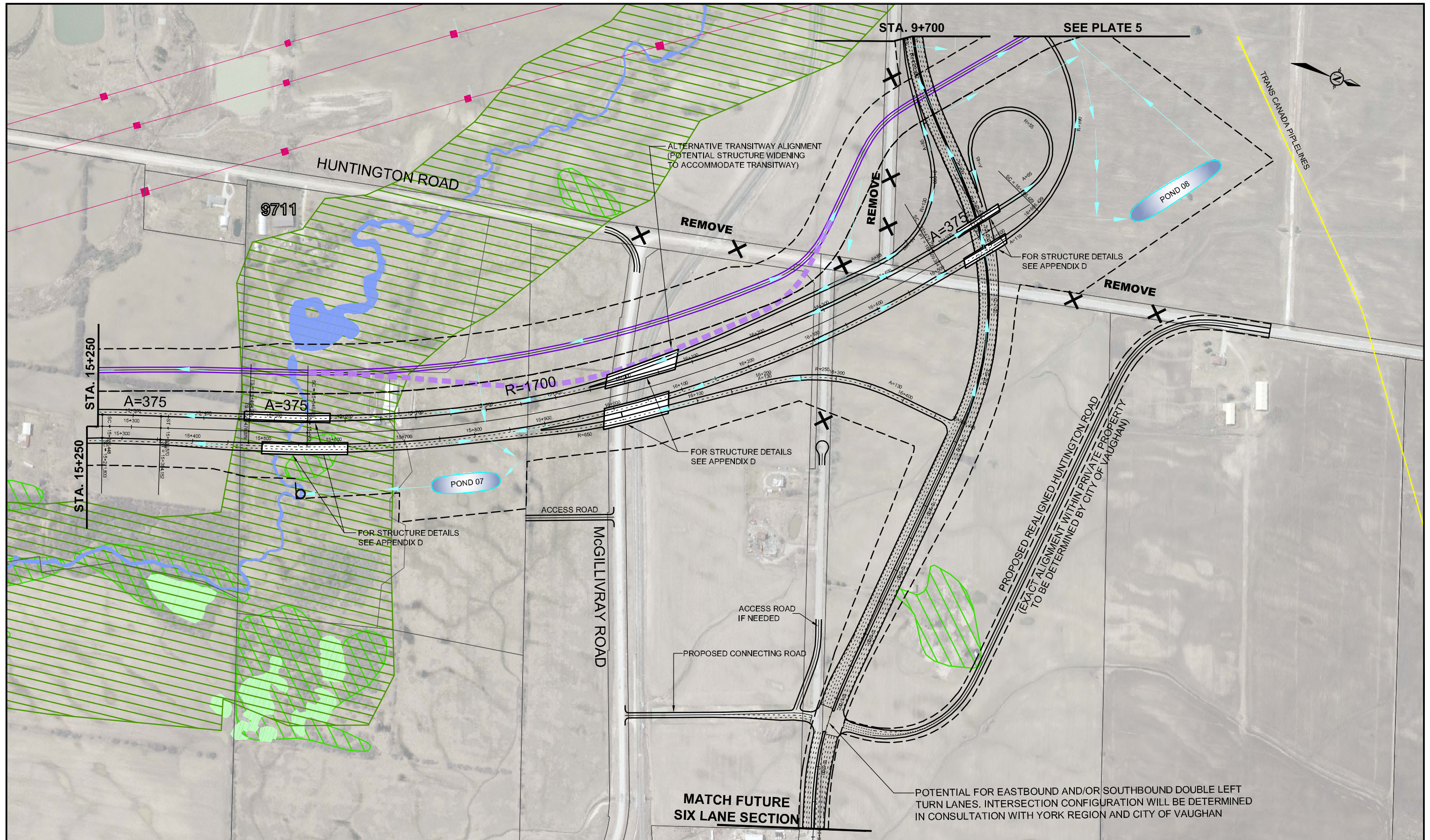
- YORK REGION GREENLANDS
- WOODED AREA
- UNEVALUATED WETLAND

Scale : 1 : 5000
50m 0 100m

Date : December 2010

RECOMMENDED PLAN
STA. 13+450 TO STA. 15+250

EXHIBIT
4-1
(Plate 3)



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LEGEND

- PROPOSED HIGHWAY
- PROPOSED TRANSITWAY
- PROPOSED PROPERTY RIGHT-OF-WAY

- YORK REGION GREENLANDS
- WOODED AREA
- UNEVALUATED WETLAND

Scale :

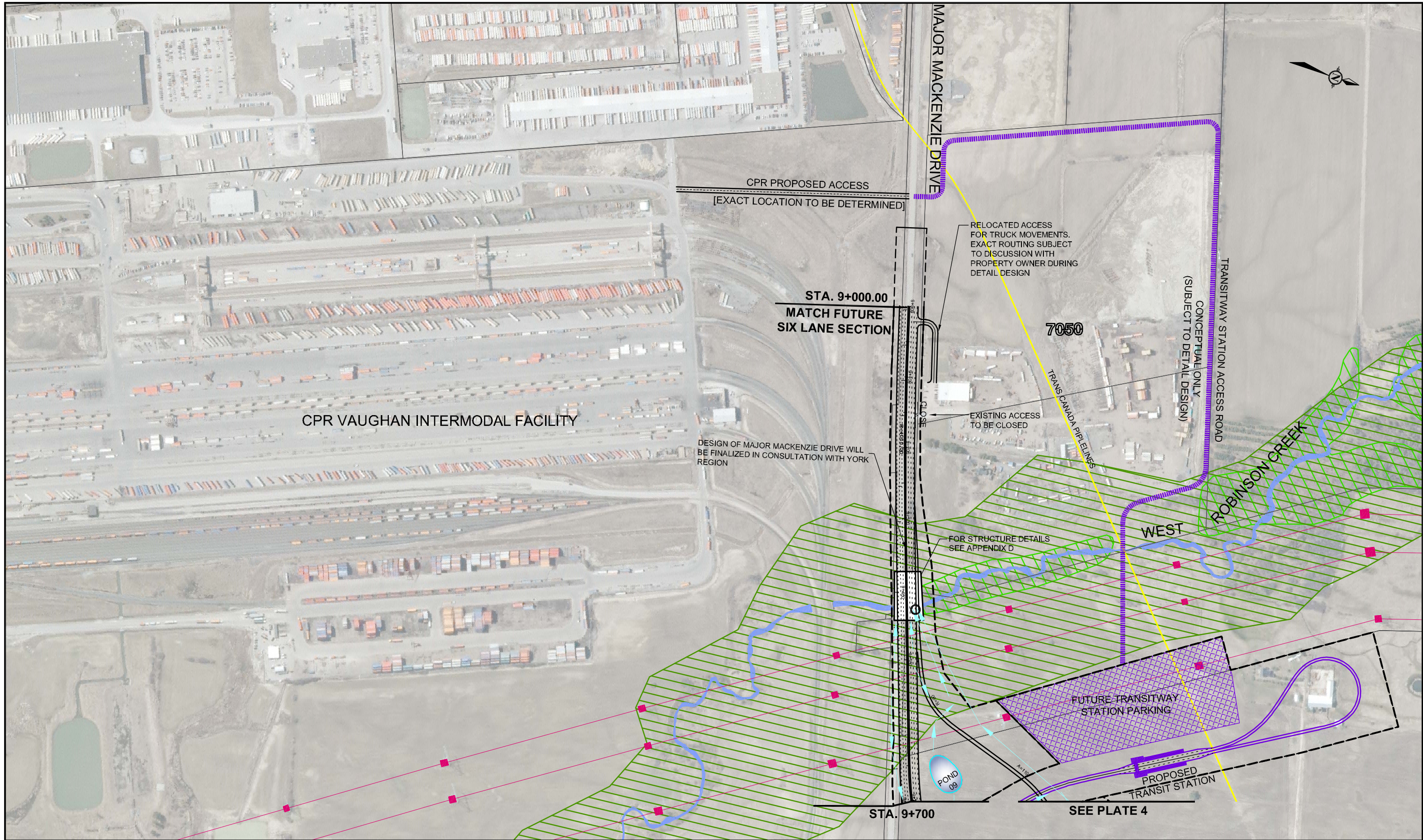
1 : 5000
50m 0 100m

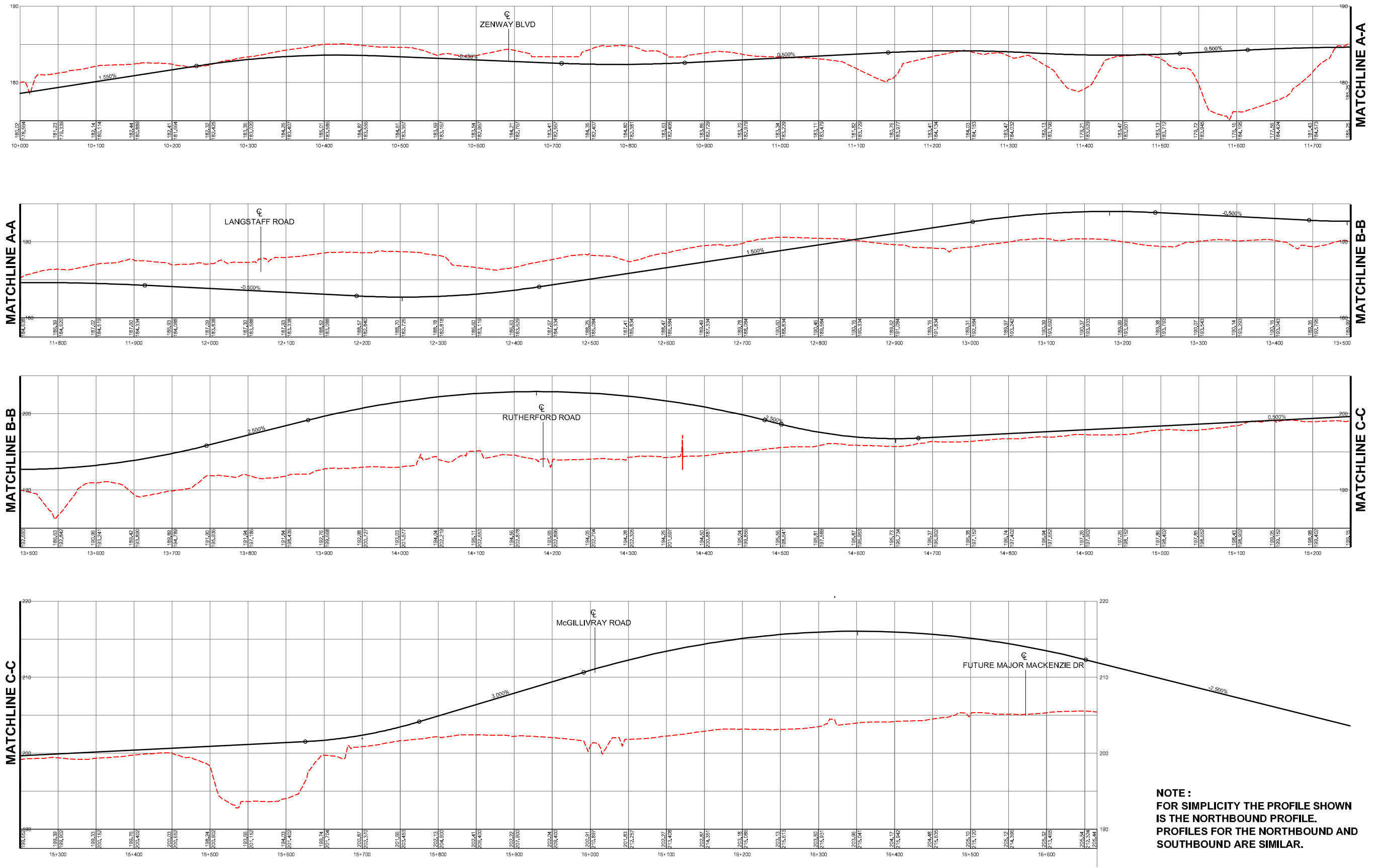
Date :

December 2010

RECOMMENDED PLAN
STA. 15+250 TO STA. 16+638.056

EXHIBIT
4-1
(Plate 4)





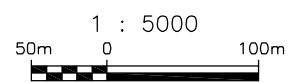
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LEGEND

- — — — — PROPOSED HIGHWAY
- — — — — PROPOSED TRANSITWAY
- — — — — PROPOSED PROPERTY RIGHT-OF-WAY

- YORK REGION GREENLANDS
- WOODED AREA
- UNEVALUATED WETLAND

Scale :



Date :

December 2010

RECOMMENDED PLAN - PROFILE

EXHIBIT
4-1
(Plate 6)

The alignment continues north crossing Zenway Boulevard. The alignment introduces a very large radius of 7000 m to gently take the alignment a few meters east as it approaches Langstaff Road. This shift results in a much better crossing of Rainbow Creek while allowing an interchange to be developed west of the Hydro Corridor as well as avoiding clearance problems with the hydro towers.

Langstaff Road to Rutherford Road (Hydro Corridor Crossing)

Immediately north of Langstaff Road, independent NB and SB alignments are developed to cross the Hydro Corridor. The independent alignments and the corresponding widened median allows for a 500 kV hydro tower to be maintained in the median. As described in the EA Report, Hydro One has determined that no 500 kV hydro towers be removed and a typical 6-lane cross-section with a 22.5 m open median would not be able to achieve that objective. Details regarding hydro towers are documented in Section 7.1.

The NB alignment curves to the east using a radius of 2000 m. The NB alignment then immediately curves back to the west to avoid Robinson Creek and tie into a tangent at Rutherford Road.

The SB alignment while generally behaving as a tangent section through the Hydro Corridor is in fact a series of adjacent curves at a radius of 6000 m. The southernmost radius curves to the east, the middle radius to the west and the northern curve brings the alignment gently back east. This combination, although largely unperceivable to the driver, is necessary to bring the SB alignment directly in the middle of two 500 kV towers. The offset from the edge of pavement to the base of either of these towers is close (10-15 m), but is maximized by the alignment being directly between. It should be noted that in determining the alignment offset to the towers; a 10 lane cross-section was considered and therefore allows flexibility for a potential future widening to an ultimate of 10 lanes without the need to relocate the 500 kV towers.

North of the Hydro Corridor, the SB alignment curves to the west with a 1700 m radius and rejoins the NB alignment at Rutherford Road.

Rutherford Road to Major Mackenzie Drive

The tangent at Rutherford Road is placed to allow the interchange to avoid the hydro towers, the Lorna D. Jackson Transformer Station to the west and the TRCA protected lands along Robinson Creek to the east. Following Rutherford Road, the alignment introduces a 1700 m curve in an easterly direction. This curve both minimizes the undevelopable land between the highway corridor and the TRCA regulated property as well as results in the alignment crossing West Robinson Creek on a tangent in a desirable location.

North of West Robinson Creek, the final 1700 m curve is introduced in a westerly direction. This curve serves a number of functions including minimizing the fragmentation of CPR property and minimizing impact to developable lands to the north. The major rationale for the introduction of this curve is the consideration of the potential further extension of Highway 427 north of Major Mackenzie Drive. The curvature to the west allows the flexibility to either cross the hydro towers to the west or parallel the hydro towers in a northerly direction.

The rationale for all the alignment decisions are explained in much greater detail in the EA Report.

The horizontal alignment for the Highway 427 Extension is summarized in Exhibit 4-2.

Exhibit 4-2 Summary of Highway Horizontal Curves and Spirals

Curve No.	PI Station	Horizontal Curve Parameters			Equivalent Design Speed (km/h)	
		Radius (m)	Spiral In/Out (m)	Length of Curve (m)	Radius	Spirals
1	10+721.5	18000	Spirals Not Required	388.62	>120	Spirals Not Required
2 NB	12+236.4	2000	375	171.2	>120	120
3 NB	13+327.6	2200	400	1413.0	>120	120
2 SB	12+305.5	6000	No Spirals*	166.3	>120	No Spirals*
3 SB	12+554.9	6000	No Spirals*	332.5	>120	No Spirals*
4 SB	12+804.3	6000	No Spirals*	166.3	>120	No Spirals*
5 SB	13+510.4	1700	375	860.0	>120	120
6	14+959.8	1700	375	607.4	>120	120
7	16+034.0	1700	375	938.2	>120	120

Note *: The GDSOH requires a spiral parameter of $A=650$ for an $R=6000$ m curve at a 120 km/h design speed. However at a radius this high, a spiral is mainly for aesthetic purposes, not required for driver comfort or superelevation and a normal crown is used through the curve. Given the constraints in this area, it was determined that a spiral transition was not feasible.

4.1.2 Vertical Alignment

Typically, a vertical alignment is designed considering both a gentle drive in mind and to match as closely as possible the existing terrain to minimize cut/fill quantities. These factors were considered when developing the vertical profile of the alignment, however, due to the existing constraints (e.g. hydro lines, crossing roads, etc.) in the area, achieving an ideal quantity balance was difficult. For the Highway 427 vertical alignment, the key considerations were achieving adequate sight distance to the various interchange ramp bullnoses and achieving vertical clearance to the watercourses, the hydro lines, the CPR crossing and crossing road structures.

The profile of Highway 427 varies throughout its length. In some locations, it is below the existing ground level; while in other locations, it is above the existing ground level. In the north half of the study area, the mainline is mostly above the existing ground due to the need to cross over Rutherford Road, Major Mackenzie Drive and the CPR rail line.

The vertical alignment is summarized in Exhibit 4-3. There are 6 sag curves and 6 crest curves in total. All of the vertical alignment elements for Highway 427 meet or exceed requirements set out in the Geometric Design Standards for Ontario Highways (GDSOH) for the applicable design speed of 120 km/h. The minimum grade is 0.5%, which meets the minimum requirements of the GDSOH for a freeway with an urban drainage system. The maximum grade is 3.0%, which meets the GDSOH requirements for freeways.

In the interchange areas, vertical curves were designed higher than the standard to achieve optimal sight distance to the bullnose and end of acceleration lanes. A minimum sight distance of 470 m to the exit bullnose and the end of the acceleration speed change lane was provided for an object height of 0.0 m.

Vertical curves should generally be designed to follow horizontal curves where possible; avoiding a situation where the horizontal curve is hidden to the driver. This criteria could not be strictly adhered to on this study given that the constraints largely determined the exact placement of both the horizontal and vertical curves.

The existing ground quantity calculations are based on a digital terrain model (DTM) that was established using 2002 aerial photography, which was provided by MTO. Given the high rate of development in the last few years, this information was supplemented by design drawing from developers and York Region in sections where the current DTM is out of date. Further review and a detailed survey should be completed in detail design to confirm the existing conditions and revise the vertical alignment where appropriate.

Exhibit 4-3 Summary of Vertical Curves

Curve No.	VPI Station		Curve Type	K Value	Design Speed (km/h)
	SBL	NBL			
1	10+348.9	10+348.9	Crest	120	120
2	10+793.2	10+793.2	Sag	180	>120
3	10+231.7	10+231.7	Crest	180	>120
4	11+435.0	11+435.0	Sag	180	>120
5	11+764.2	11+764.2	Crest	300	>120
6	12+324.9	12+312.7	Sag	120	>120
7	13+062.0	13+123.0	Crest	120	120
8	13+548.0	13+595.2	Sag	100	>120
9	14+151.1	14+179.1	Crest	120	120
10	14+563.3	14+591.3	Sag	60	120
11	15+715.6	15+744.0	Sag	60	120
12	16+263.3	16+291.3	Crest	120	120

4.1.3 Cross Section

The lane requirements were designed as follows:

- 6 lanes from Highway 7 to Rutherford Road
- 4 lanes from Rutherford Road to Major Mackenzie Drive

The minimum ROW width is 110 m for the Highway corridor and 60 m for the Transitway corridor.

All through lanes are 3.75 m in width. In the median, a minimum 2.5 m fully paved shoulders will be provided. The outside shoulder through the study corridor will be 3.0 m in width and also fully paved. Where speed change lanes are required in the vicinity of interchanges, the width of these auxiliary lanes will be 3.5 m and the adjacent outside shoulder width will be 2.5 m in accordance with the GDSOH.

Exhibit 4-4 further shows the grading requirements and the typical cross sections are shown in Exhibit 4-5.

Exhibit 4-4 Grading Requirements

Grading Height	Requirements
Earth Fills	
< 3.0 m	6:1 foreslope
3.0 m – 4.5 m	5:1 foreslope
4.5 m – 6.0 m	4:1 foreslope
> 6.0 m	2:1 foreslope*
Grading Height	Requirements
Earth Cuts	
< 3.0 m	<ul style="list-style-type: none"> • 6:1 foreslope • Roadside ditch 12.0 m from travelled lane • Min 1.2m flat bottom on ditch • 3:1 backslope
>3.0 m	<ul style="list-style-type: none"> • 6:1 foreslope • Roadside ditch 12.0 m from travelled lane • Min 1.2m flat bottom on ditch • 2:1 backslope

*2 m bench required for high embankments.

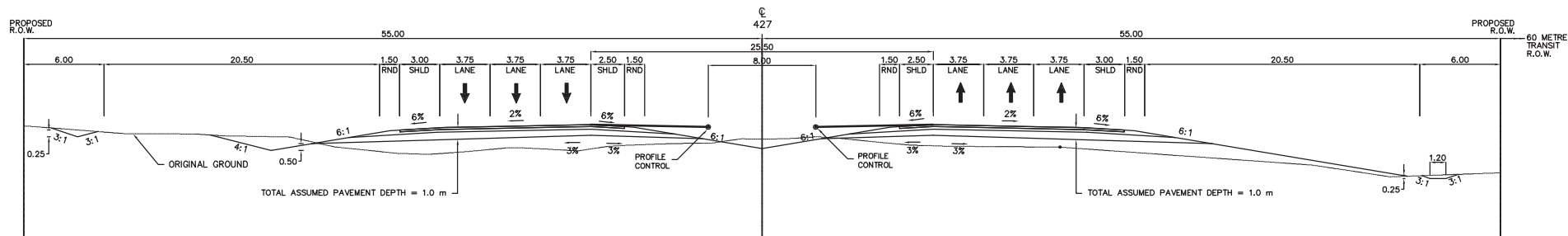
As noted previously, the proposed lane condition for this study is 6 lanes from Highway 7 to Rutherford Road and 4 lanes from Rutherford Road to Major Mackenzie Drive. The resulting cross section would result in an open median. The design of these initial lanes for the EA has taken into consideration a possible future 10 lane closed median cross section to be provided in this corridor, including provision for HOV lanes. The typical cross-section for a future 10 lane Highway 427 Extension is shown in Exhibit 4-6.

4.2 Crossing Roads and Interchanges

The recommended treatment for each crossing road was determined in consultation with local and regional municipal staff and taking into consideration input received from the public. These treatments are supported by detailed traffic analysis for the area.

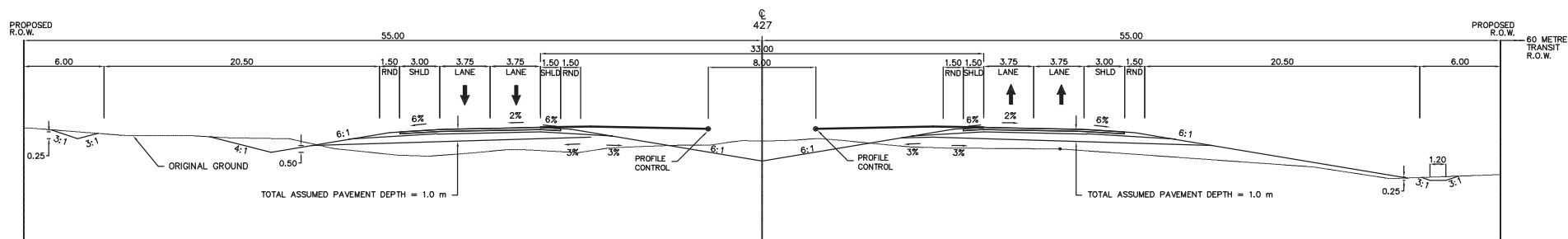
There are 5 crossing roads within the study area limits (Zenway Boulevard, Langstaff Road, Rutherford Road, McGillivray Road and Major Mackenzie Drive). Interchanges are proposed at 3 locations (Langstaff Road, Rutherford Road and Major Mackenzie Drive). They are described in greater detail in the following sub-sections.

The cross sections of the crossing roads are based on York Region's 'Towards Great Regional Streets – A Path to Improvement' and consultation with York Region and City of Vaughan.



6 LANE SECTION HIGHWAY 7 TO RUTHERFORD ROAD

Not to Scale



4 LANE SECTION RUTHERFORD ROAD TO MAJOR MACKENZIE DRIVE

Not to Scale

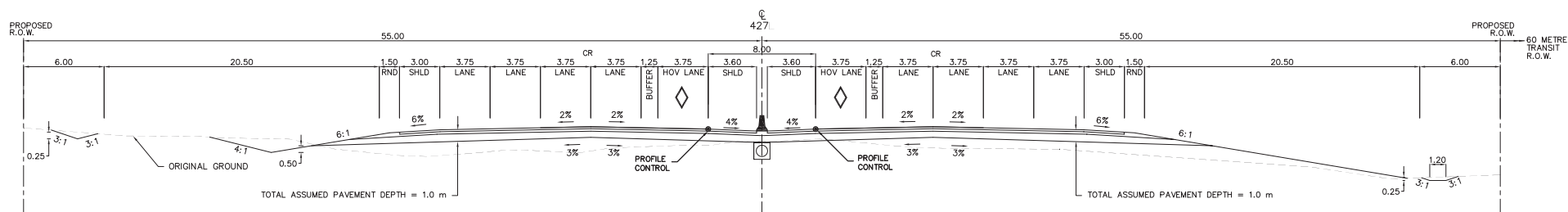


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Highway 427 Extension Typical Cross Sections

EXHIBIT

4-5



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Typical 10-Lane Cross Section

EXHIBIT

4-6

The proposed cross-sections include a 4-lane cross-section at Langstaff Road and Zenway Boulevard and a 6-lane cross-section at Rutherford Road and Major Mackenzie Drive. The 6-lane cross sections include provisions for a Transit/HOV lane. As requested by the municipalities, all cross-sections protect for a 1.5 m sidewalk on both sides. Langstaff Road, Rutherford Road and Major Mackenzie Drive cross-sections protect for a 1.5 m bike lane on either side of the roadway. The cross-sections for the crossing roads are shown in Exhibit 4-7.

The structures of the crossing roads have been designed to accommodate sidewalks, as well as bike lanes on Langstaff Road, Rutherford Road and Major Mackenzie Drive. Details of the bike lane routes in the vicinity of the ramp area will be determined in consultation with the municipality during detail design.

At this time, the City of Vaughan is not considering widening the existing 2-lane McGillivray Road, however, a minimum 20 m right-of-way (ROW) is provided for at the structure to accommodate a future widening to 4 lanes 1.5 m sidewalk on both sides of the road. Details regarding the McGillivray Road cross-section are provided in Section 4.4.

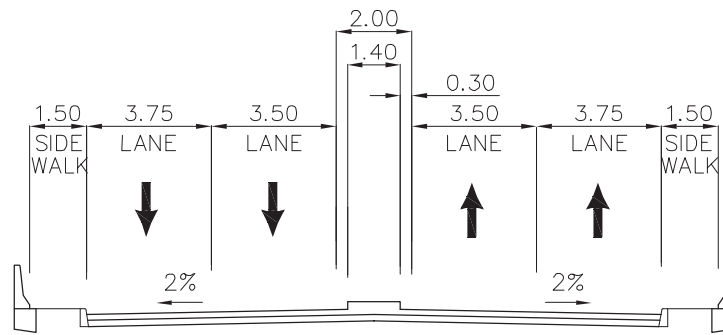
The design of the cross-sections for the crossing roads were based on local and regional Municipal requirements. The cost sharing for all elements of these roadways will be discussed with the local municipalities during detail design.

4.2.1 Interchanges

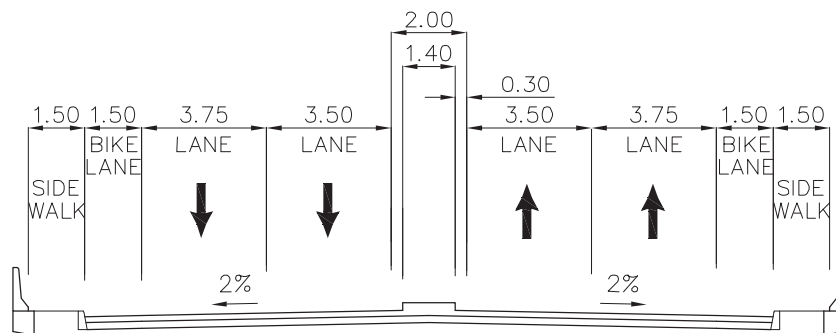
Arterial road interchange locations are proposed on all major arterial crossing roads in the following locations:

- Langstaff Road Underpass
- Rutherford Road Overpass
- Major Mackenzie Drive Overpass

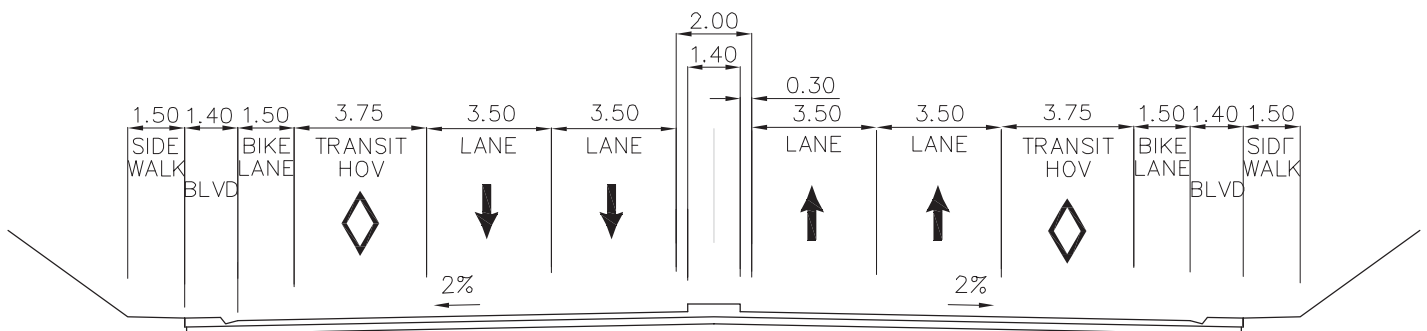
The Highway 7 Interchange will also be modified to include a N-E/W movement, W-N movement and a E-N movement. The existing E-S loop ramp at Highways 7 will be replaced to accommodate the proposed Highway 427 cross-section. The southbound exit ramp will accommodate the proposed E-S loop ramp. In addition, the proposed E-S loop ramp is designed to meet the desirable geometric design standards ($R=55$ m); the existing E-S loop ramp does not meet the design standard ($R=45$ m). Similar to the existing E-S loop ramp, the ramp will be entered using a direct spiral. The direct spiral was maintained to avoid widening the Highway 7 structure. As a result of the desire to maintain the existing Highway 7 structure width, a direct spiral was also used for the proposed W-N loop ramp.



ZENWAY BOULEVARD UNDERPASS



LANGSTAFF ROAD UNDERPASS



RUTHERFORD ROAD AND MAJOR MACKENZIE DRIVE
OVERPASS

It should be noted that as part of York Region's VIVA, the Highway 7 structure would require widening for the implementation of VIVA; however, the widening of the structure to accommodate VIVA is not scheduled. The timing of York Region's implementation of VIVA on Highway 7 should be confirmed during detail design, and the ramp alignments revised accordingly.

The preferred interchange configuration is the Parclo A4 design as it has the best capacity, operational and safety characteristics relative to the other available interchange configurations typically used for urban arterial roads. Parclo A4 is incorporated in all the proposed interchanges with the exception of Major Mackenzie Drive. Given the constraints in the study area, a $R=55$ m inner loop was used in all interchanges.

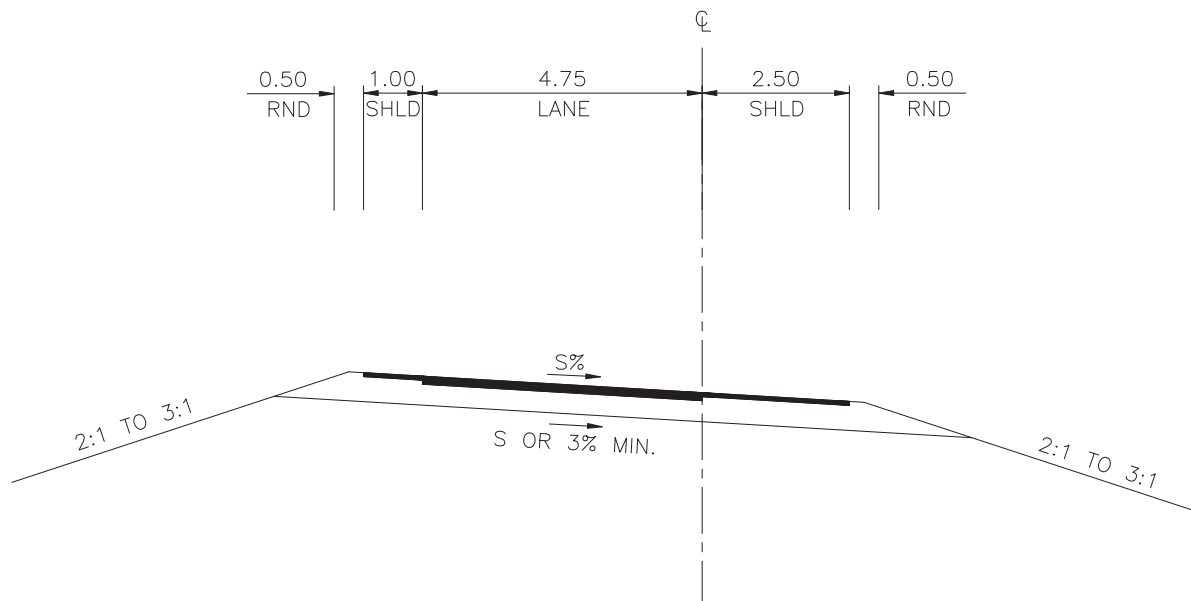
As mentioned above, the modification made to the typical Parclo A4 design is at the Major Mackenzie Drive Interchange which is the terminus of the proposed transportation corridor. High left-turn movements typically associated with freeway terminus are also projected at the Major Mackenzie Drive Interchange; therefore, a direct ramp is included from the northbound lanes to merge with westbound Major Mackenzie Drive. This direct ramp will eliminate the left-turn movements at the northbound exit ramp terminal intersection.

All freeway exit ramps will be two 3.75 m lane ramps, 1.0 m wide fully paved left shoulder, a 2.5 m wide fully paved right shoulder, and 1.0 m rounding. All freeway entrance ramps are single lane ramps with a 4.75 m lane, 1.0 m wide fully paved left shoulder, a 2.5 m wide fully paved right shoulder, and 1.0 m rounding. Typical cross-sections for interchange ramps are shown in Exhibit 4-8.

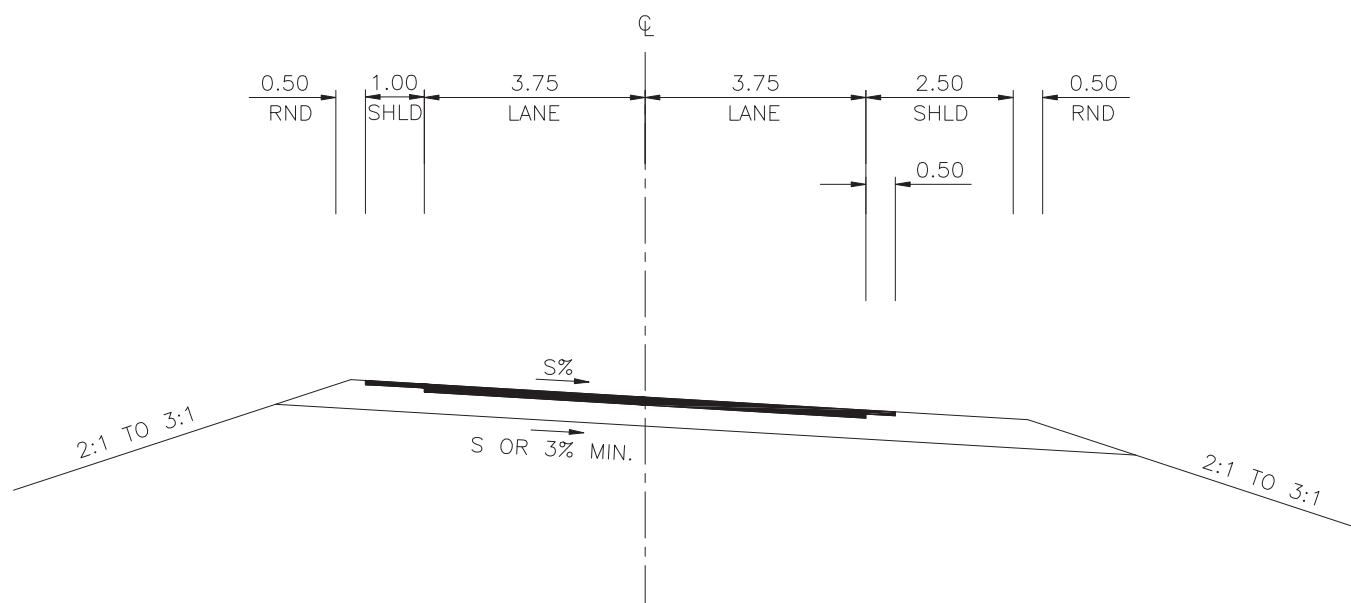
The recommended design of the interchange structures are discussed in Section 4.4.

The grading of the interchange ramps will be designed to provide gentle and traversable slopes to minimize roadside hazards. Exhibit 4-9 summarizes the typical cross-section grading requirements for the interchange ramps.

All interchanges would achieve the desired sight distances to the decision points within the interchange as described in Exhibit 4-10.



**SINGLE - LANE RAMP
(ENTRANCE RAMPS)**
N.T.S.



**TWO - LANE RAMP
(EXIT RAMPS)**
N.T.S.

Exhibit 4-9 Summary of Interchange Ramp Cross-Section Grading Requirements (Earth Fill)

Design Speed	Foreslope
< 80km/h	3:1 or Flatter
< 80km/h (outside of inner loops, between inner and outer loops with drainage ditch)	4:1 or Flatter
80-100 km/h	4:1 or Flatter

Exhibit 4-10 Sight Distances

Design Speed (km/h)	Stopping Sight Distance (m)	Decision Sight Distance (m)		Intersection Sight Distance (m)		
		Minimum	Desirable	Turning Movement Condition B (Crossing roadway)	Turning Movement Condition C (Turning Left Vehicle approaches from left)	Turning Movement Condition D&E (Turning L\R, attain speed before being overtaken)
60	85	170	240	120	140	180
70	110	200	270	135	165	220
80	135	230	310	155	185	270

4.2.1.1 Langstaff Road Interchange

An interchange is proposed at Langstaff Road which is a major arterial roadway.

Langstaff Road was maintained on its current horizontal alignment and the proposed vertical alignment is raised to allow for a 427 underpass.

An 80 km/h design is proposed for the new Langstaff Road vertical alignment; however to achieve the proper sight distance, the vertical curves were flattened to the equivalent of a 100 km/h design speed. As shown on Exhibit 4-7 above, Langstaff Road was designed as a four-lane roadway with 3.5 m wide inner lanes and 3.75 m outer lanes. The cross-section includes a 2 m median and 1.5 m bike lanes in either direction.

The interchange consists of a Parclo A-4 configuration with 55 m inner loops. The outer ramps, with one exception, consist of 250 m curves for an 80 km/h design speed which is the standard ramp design speed recommended by the GDSOH for a 120 km/h freeway.

The minimum ramp design speed is 60 km/h (R=130 m) which was used for the E-N Ramp. The E-N Ramp was tightened in order to accommodate a future intersection of Langstaff Road with both Innovation Drive on the south side and an access road on the north side as proposed by the City of Vaughan. A standard R=250 m curve would introduce functionality issues with the development of this intersection. It should be noted that this tighter curve is introduced for exiting the lower design speed of Langstaff Road and not the freeway. Safety concerns are therefore not considered an issue.

The major modification from a traditional Parclo A-4 interchange is the N-E/W ramp. As shown on the recommended design plans, this ramp is elongated and the freeway exit bullnose is located further north from the crossing road than is typical for a Parclo A-4 interchange. Directly south of this bullnose, the NB alignment crosses between two 500 kV hydro towers. It was determined that the addition of an auxiliary lane in addition to a potential future 5-lane cross section on the SB alignment would not provide adequate clearance to two existing towers, which cannot be relocated. Therefore, the start of the exit ramp terminal was placed in the vicinity of the tower that is to be relocated, which is north of the existing towers that will be maintained, so that additional pavement width would not be necessary between the two existing towers. With proper signage, no operational concerns are noted with this ramp.

To achieve proper sight distance requirements to the ramp terminal intersections for Turning Movement Condition D&E (Exhibit 4-10) at a design speed of 80 km/h, the K value was flattened to $K=80$.

The profile of Langstaff Road was designed to achieve the proper vertical clearance to the hydro lines. It was therefore necessary to develop the flattened crest curve to the west resulting in a longer structure over Rainbow Creek. Alternatively, developing the vertical crest to the east of Highway 427 would require reconstruction of the 500 kV towers. As noted in Section 4.1.1, it was determined by Hydro One that the importance of these 500 kV transmission lines was such that this kind of disruption posed too great a risk to their entire power grid. In addition, the alternative design of maintaining Langstaff Road on its existing profile with a 427 overpass was also considered, however, it was not considered feasible as this would raise the vertical profile of Highway 427 under the hydro towers and the vertical clearance required for the hydro lines in this area would not be achieved.

The final alignment and profiles of the Langstaff Road Interchange will be further refined and confirmed in detail design and will require consultation with York Region and Hydro One. Hydro One requirements are discussed further in Section 7.

4.2.1.2 Rutherford Road Interchange

An interchange is proposed at Rutherford Road which is a major arterial roadway. The interchange consists of a Parclo A-4 configuration with 55 m inner loops. The outer ramps consist of two $R=250$ m freeway exit ramps and two $R=130$ m entrance ramps. The 60 km/h design speed is the standard ramp design speed with a minimum radius of 130 m.

A tighter outer loop ramp design was used to minimize impact to the TRCA regulated area in the northeast quadrant of the interchange and avoid impact to the Lorna D. Jackson Transformer Station located in the southwest quadrant of the interchange.

The inner W-N loop consists of two $R=55$ m curves separated by a short tangent as shown on the Recommended Plan. To fit the curves necessary to achieve the 60 km/h vertical profile for this ramp, a longer roadway was needed than a standard single $R=55$ m ramp would provide. A larger radius would achieve the same effect; however, a larger radius in this area would impact the property of a church and a cemetery directly east of the interchange on Rutherford Road. A “broken-back” curve, although not ideal, is necessary given these constraints and it was determined that no major safety issues would arise with such an alignment.

Given the Lorna D. Jackson Transformer Station, the Hydro Corridor, TRCA regulated lands, a cemetery and a church, this interchange is the most highly constrained within the study. To avoid impacting any of these major constraints, the existing profile of Rutherford Road is maintained and the sight distance requirements for Turning Movement Condition C&D, as shown on Exhibit 4-10, were not achieved for a design speed of 80 km/h at the ramp intersections. The turning movement sight distances are achieved, however, for the posted speed of 60 km/h. It is therefore proposed that this intersection be fully signalized and the sight distance be further reviewed in detail design.

All final alignments and profiles associated with Rutherford Road Interchange will be confirmed in detail design.

4.2.1.3 Major Mackenzie Drive Interchange

An interchange is proposed at Major Mackenzie Drive which is a major arterial roadway.

Highway 427 is proposed as an overpass as it is already at a high elevation to cross over the CPR line. A 2 km realignment of Major Mackenzie Drive to the north is proposed in the area of the Major Mackenzie Drive Interchange as shown in Exhibit 4-1. This northerly shift of 250 m is necessary to achieve separation from the CPR line and allow for the Highway 427 vertical alignment to come to a reasonable elevation to “interchange” with Major Mackenzie Drive.

The alternative of an underpass at Major Mackenzie Drive was also examined. The CPR line is located approximately 300 m south of existing Major Mackenzie Drive and it is proposed that the 427 alignment will cross over the rail line. To achieve the minimum geometric design standards, specifically the required sight distance, to cross over the CPR line and descend to pass under Major Mackenzie Drive, Major Mackenzie Drive would need to be shifted approximately 310 m north.

An 80 km/h design speed is proposed for both the horizontal and vertical alignments of the new Major Mackenzie Drive realignment. Major Mackenzie Drive was designed as a six lane roadway with two 3.5 m wide inner lanes and 3.75 m outer lanes. The cross section includes a 2 m median in the area of the structure and a 6 m median outside of the structure area. In addition, 1.5 m bike lanes and 1.5 m sidewalks are proposed in either direction.

The interchange consists of a Trumpet configuration with a 55 m inner loop. The outer ramps, with one exception, consist of 250 m curves for an 80 km/h design speed, which is the standard ramp design speed recommended by the GDSOH for a 120 km/h freeway.

The minimum ramp design speed is 60 km/h ($R=130$ m) which was used for the W-S Ramp. The W-S Ramp was tightened in this way (as far northeast as possible) to allow the transitway right-of-way to be developed in a way that would minimize impacts to the CPR lands and maximize the offset distance from the existing CPR rail tracks. CPR has indicated that they have plans to expand the tracks in that particular parcel of their property.

Major Mackenzie Drive is the terminus of the proposed transportation corridor; and, high left-turn movements typically associated with freeway terminus are also projected at the Major Mackenzie Drive Interchange. The rationale of the design is to terminate a freeway with a direct ramp both to increase capacity at the interchange and to improve operational

performance on Major Mackenzie Drive. Therefore, a direct ramp (S-W Ramp) is included from the northbound lanes to merge with westbound Major Mackenzie Drive. This direct ramp is to eliminate the left-turn movements at the northbound exit ramp terminal intersection.

Following submission of the Final EA Report, the direct ramp was further reviewed. Based on the review, the last curve of the ramp was tightened from 190 m to 90 m to alleviate concerns brought up by Gusgo Transport Ltd. during the EA Review Period regarding the distance between the end of the ramp terminal and their driveway. As a result, the ramp will taper approximately 50 m east of the original end of taper.

The additional structure required for the direct ramp was designed with consideration of a future extension of Highway 427. In the event of a future extension of Highway 427 beyond Major Mackenzie Drive, the ramp will need to be removed. However, the bridge over Major Mackenzie Drive, which is the most significant cost item in the special ramp design, will remain in place for use. The bridge will be modified/widened to become the Highway 427 northbound mainline.

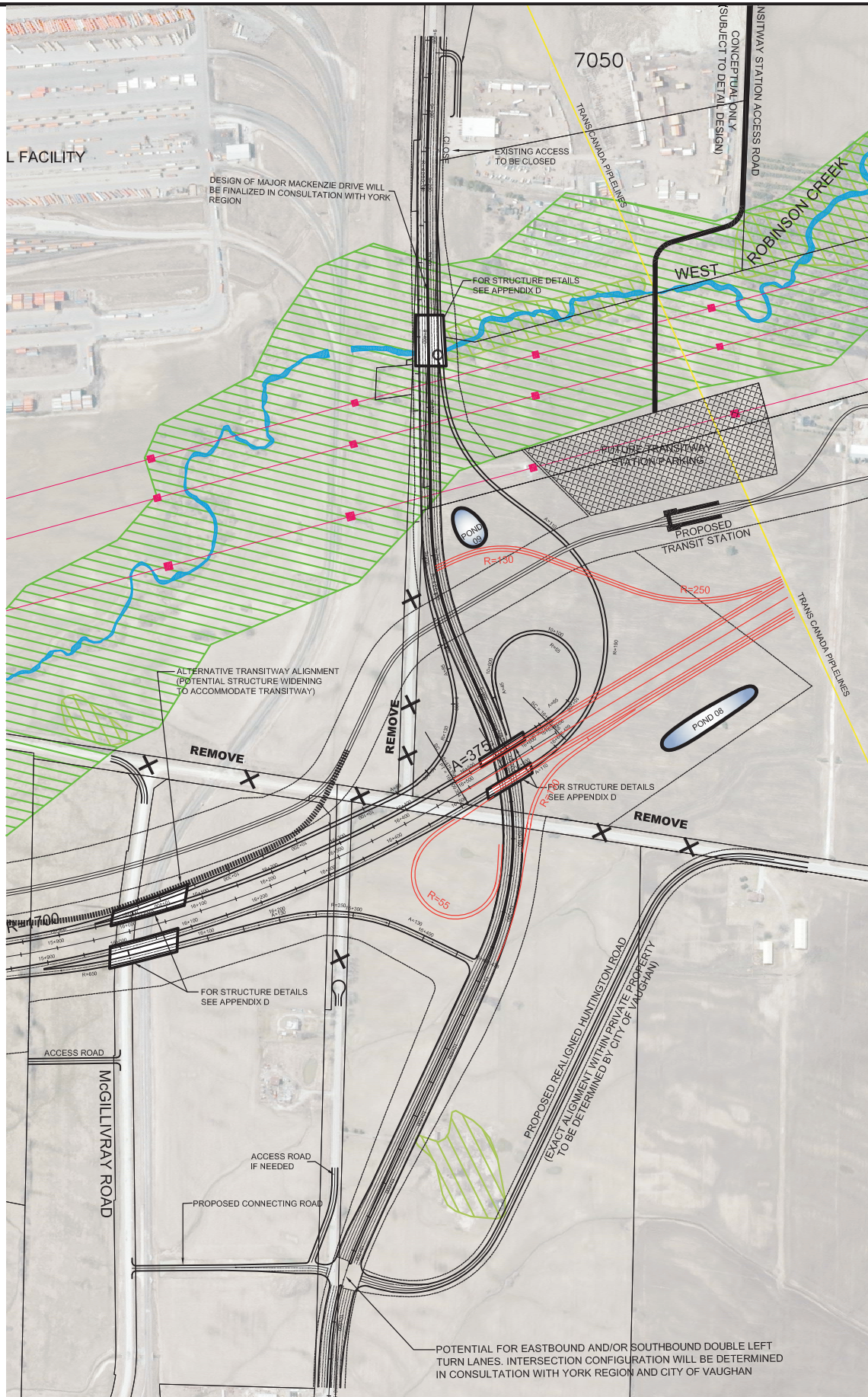
In addition to the direct ramp structure noted above, other aspects of the interchange and right-of-way associated with a potential future extension of Highway 427 north of Major Mackenzie Drive were considered. The long term potential interchange envisioned for Major Mackenzie Drive is a Parclo A-4 and is illustrated in Exhibit 4-11.

As illustrated in Exhibit 4-11, the S-E Ramp has been designed to protect for a R=55 m future W-N inner loop. Both the right-of-way and the northernmost stormwater management pond have also been designed to protect for a future E-N Ramp. A full Parclo A-4 interchange should be designed and referenced in the detail design phase of the study to incorporate protection of a 427 Extension beyond Major Mackenzie Drive in the final design.

In order to protect for the transitway, the future N-E/W Ramp is further separated from the E-S inner loop than typical. The transitway could not be shifted further west due to the constraints of the West Robinson Creek and York Region Greenlands.

In addition, the proposed stormwater management pond located west of the E-S inner loop will be impacted by a future N-E/W Ramp; however, if Highway 427 is extended beyond Major Mackenzie Drive, the S-W Ramp will be eliminated and the stormwater management pond can be reshaped and elongated to the north to make room for the N-E/W Ramp. Given the constraints in this area, it is not possible for the proposed stormwater management pond to accommodate both the interim ramps and the future ramps.

The profile of the realigned Major Mackenzie Drive was designed to achieve proper sight distance for Turning Movement Condition C&D, as shown in Exhibit 4-10, at the ramp terminal intersections for an 80 km/h design speed. All final alignments and profiles associated with the Major Mackenzie Drive Interchange will be confirmed in detail design.



4.2.2 Other Roadway Infrastructure

4.2.2.1 Zenway Boulevard

A 550 m vertical realignment of Zenway Boulevard is proposed to allow for a Highway 427 Extension underpass of Zenway Boulevard.

An overpass alternative, i.e. Highway 427 over Zenway Boulevard, was also examined in this area. Zenway Boulevard has been constructed by the City of Vaughan with the intention of a Highway 427 overpass. During preliminary design of the 427 Extension, an extensive review of the Zenway Boulevard / 427 crossing was conducted, it was determined that a Highway 427 overpass would result in excessive fill south and north of Zenway Boulevard, a high level creek crossing at Rainbow Creek (i.e. longer bridge), additional property requirements north and south of Zenway Boulevard on the east side of the highway alignment, larger noise propagation area, decreased visibility for future commercial properties and an increased visible barrier between the communities on the east and west sides of the Highway 427. The necessary 470 m sight distance (as required by MTO Geometric Standards) to the N-E/W Highway 7 Ramp bullnose (southbound) and the constraint of the Highway 427 profile underneath the existing Highway 7 structure, would require the Highway 427 profile to continue to rise beyond Zenway Boulevard with the crown located approximately 250 m to the north of Zenway Boulevard; and such a profile would result in very excessive fill (of a total of about 900,000 m³ and about 10 m high at its highest point). In addition, due to the height of the Highway 427 fill, it would result in additional right-of-way width (maximum 14 m additional on the east side) based on the need to accommodate the side slopes and the required 2 m bench for high embankments. Additional properties would be required from south to north of Zenway Boulevard. Therefore, a Zenway Boulevard overpass is not preferred. However, the preliminary analysis of this alternative should be confirmed during detailed design.

A technical report is included in Appendix A and provides additional detail on the analysis of the proposed Highway 427 crossing at Zenway Boulevard.

An 80 km/h design is proposed for the new Zenway Boulevard vertical alignment which require K=35 crest curves and K=30 sag curves. The proposed vertical alignment re-joins the existing Zenway Boulevard at the New Enterprise Way intersection and the Rainbow Creek Drive intersection to the east.

It should also be noted that the design of Zenway Boulevard is based on a high transitway profile. The transitway profile is higher than the 427 profile, therefore, the vertical clearance of the structure was based on the transitway profile. During detail design, the profile of the transitway will be developed to investigate if it can be lowered (similar to Highway 427) so to lower the profile of Zenway Boulevard, which would further reduce access impacts on Zenway Boulevard.

As shown on Exhibit 4-7, Zenway Boulevard was designed as a four lane roadway with 3.5 m wide inner lanes and 3.75 m outer lanes. The cross section includes a 2 m median and 1.5 m sidewalks in either direction.

4.2.2.2 McGillivray Road

An easterly realignment of McGillivray Road will be provided for a 800 m section just north of Rutherford Road. The realignment will create a new intersection between McGillivray Road and Rutherford Road.

The realignment is necessary to replace the existing McGillivray Road and Rutherford Road intersection which will be removed in order to accommodate the Rutherford Road Interchange. The existing McGillivray Road in this section will not be abandoned but will end in a cul-du-sac to maintain access to existing properties.

The new intersection will be located 350 m east from the proposed Rutherford Road S-E/W Ramp Intersection. Based on a review of sight distance requirements, it is feasible to locate the intersection of the realigned McGillivray Road between the future Robinson Creek Bridge to the west and the future Rutherford Road/CPR rail grade-separation to the east.

The design speed for this local road will be 80 km/h and consist of two 3.5 m lanes and 1.0 m shoulder with 0.5 m rounding. To minimize the property requirements associated with the realignment of McGillivray Road, the first curve from the existing McGillivray Road was tightened to the minimum radius of 250 m.

Final alignment, including location of the intersection with Rutherford Road, will be determined in consultation with the City of Vaughan and York Region.

4.2.2.3 Huntington Road

A 900 m easterly realignment will be provided for Huntington Road north of Major Mackenzie Drive. The realignment will create a new intersection between Huntington Road and Major Mackenzie Drive.

The Major Mackenzie Drive Interchange displaces the existing Huntington Road and Major Mackenzie Drive intersection. Huntington Road, currently a low volume road under the jurisdiction of the City of Vaughan, could have a cul-de-sac on both sides of Major Mackenzie Drive. However, as a result of the proposed development north of Major Mackenzie Drive east of Huntington Road and the possible future developments west of Huntington Road, there needs to be a connection of Huntington Road (north of Major Mackenzie Drive) with Major Mackenzie Drive.

It was determined that the opportunity to provide a new Huntington Road / Major Mackenzie Drive connection to the west of Highway 427 is very limited. Therefore, a connection would be provided to the east of the proposed interchange. Based on the available distance, only one signalized intersection could be accommodated between the proposed Major Mackenzie Drive Interchange and the CPR rail line.

Through stakeholder consultation with York Region, City of Vaughan and the developer of the proposed development (Nashville West Community) north of Major Mackenzie Drive and east of Huntington Road, concern was expressed regarding the provision of only one access to serve the proposed Nashville West Community, as well as, the possible future developments west of Huntington Road. As a result, York Region and the developer submitted a proposal to MTO in September 2009, which includes in addition to an offset access (between Major Mackenzie Drive and the CPR rail line), a second access

that is directly opposite the proposed Highway 427 NB off-ramp. Prior to any discussions with the MTO, these two accesses were already included in the City of Vaughan adopted Official Plan Amendment (OPA) 699 for the Nashville West Community.

The second access proposed is not preferred by MTO. An access connection directly opposite an interchange off-ramp is undesirable in terms of traffic operations, intersection capacity and interchange ramp operations. As a result, it is MTO's policy to disallow such access connection unless it is the 'last resort'. Therefore, MTO proposes a realigned Huntington Road with its intersection with Major Mackenzie Drive located 650 m east of existing Huntington Road. The Huntington Road / Major Mackenzie Drive intersection will provide full vehicular movements. The intersection will be approximately 450 m east of the S-E Ramp, which is adequate separation between the intersections.

It is expected the municipalities will continue discussions with MTO Corridor Management in achieving a resolution of the proposed second access.

To the south of Major Mackenzie Drive, it is proposed that the existing Huntington Road connection to Major Mackenzie Drive be replaced by a new road, 650 m east of the existing Huntington Road, connecting McGillivray Road and Major Mackenzie Drive. This roadway was identified in the approved Huntington Road Class EA Study from Major Mackenzie Drive to McGillivray Road (May 2004) conducted by City of Vaughan and CPR. The proposed new north-south road will intersect Major Mackenzie Drive directly opposite the realigned Huntington Road to the north.

With this proposed realignment of Huntington Road, it will provide good connectivity in the area by providing direct continuity of the municipal roadways to the north and south of Major Mackenzie Drive. Based on traffic modelling for Year 2021, assuming the proposed development north of Major Mackenzie Drive and east of Huntington Road, double left turn lanes for southbound or/and eastbound traffic may need to be provided for good traffic operation depending upon the future increase in the traffic and development.

The configuration of the intersection will be determined in consultation with York Region and the City of Vaughan. Additional access to the proposed development in the area will be addressed based on MTO's Corridor Management guidelines and practices.

4.2.3 Local Access Roads

4.2.3.1 McGillivray Access Road

The realignment of McGillivray Road will replace a 500 m section of the existing McGillivray Road. This existing alignment will be maintained as an access road to the existing property adjacent to McGillivray Road. The access road will terminate in a cul-du-sac immediately north of West Robinson Creek and will tie into the realigned McGillivray Road at its northern end.

4.2.3.2 Major Mackenzie Road Transitway Access Road

A conceptual 1400 m access road is proposed to provide access to a potential future Major Mackenzie Drive Transitway Station located north of Major Mackenzie Drive. Direct access from Major Mackenzie Drive is not possible due to West Robinson Creek, the hydro lines and the proposed Highway 427 S-W Ramp. The transitway access road

location was determined so as to intersect Major Mackenzie Drive opposite of a proposed CPR access road intersection to the south of Major Mackenzie Drive. The route of the access road was designed to minimize impact to the existing property and business adjacent to Major Mackenzie Drive.

The proposed access road would transverse to a private property west of the Hydro Corridor and may potentially connect to a possible future collector road proposed by the City of Vaughan. Discussions with the property owners were held and key issues are summarized in Section 6.2.2 and details are documented as included in the EA Report.

4.2.4 Road Closures

4.2.4.1 Highway 427 Interim Arterial Extension

In Fall 2008, the Regional Municipality of York opened the 427 Interim Arterial Extension (Regional Road 99), which is a 4-lane arterial road link connecting the existing Highway 427 terminus at Highway 7 and Zenway Boulevard. The arterial road is a municipal initiative to address the immediate-term traffic needs in the Highway 7 area.

This roadway will be removed as part of the 6-lane Highway 427 Extension in this section. The direct access (427 Interim Arterial Extension) from Highway 427 to Zenway Boulevard will be removed and access to Zenway Boulevard will be either from the Highway 7 Interchange or Langstaff Road Interchange.

4.3 Transitway

As part of the Ministry of Transportation's current policy on new freeway facilities, functional design of a transitway facility has played a key role in the preliminary design of the Highway 427 Extension. This has involved a preliminary design of the new freeway that will not preclude such a facility. Preliminary design for the transitway itself is not required as part of the EA Study but rather it is the protection of such a facility for a future undertaking.

The functional design for the transitway and stations will likely be to accommodate either Bus Rapid Transit (BRT) or Light Rail Transit (LRT). The functional design generally followed the design criteria established for the 407 East Extension Preliminary Design.

The vertical alignment of the transitway follows the profile of Highway 427 through most of the study length. The resulting transitway design therefore generally meets the stringent design criteria of the freeway.

4.3.1 Transitway Horizontal Alignment

The horizontal alignment of the transitway is curvilinear in nature. The alignment of the transitway typically parallels the highway alignment except in the vicinity of interchanges and the associated transitway stations. At interchange locations, the transitway alignment typically diverges from the highway alignment to accommodate the ramp infrastructure. The geometric standards of the transitway exceed a design speed of 100 km/h outside of the interchange areas. In the vicinity of the interchange areas, and correspondingly the likely locations of the transitway stations, this standard is typically reduced to a minimum of DS=60 km/h or R=130 m. Attempts were made to maintain a design speed of 100 km/h through the interchange areas but with limited success due to

the constraints at the Rutherford Road Interchange and the Lorna D Jackson Transformer Station, and between the Major Mackenzie Drive Interchange and CPR rail line.

The design criteria were used as representative of the future design only for the purposes of property protection and should not be viewed as a preliminary design of the final transitway.

4.3.2 Transitway Vertical Alignment

The vertical alignment of the transitway typically parallels the highway alignment except in the vicinity of interchanges and the associated transitway stations. The vertical alignment standards of the transitway exceed a design speed of 100 km/h.

The transitway vertical alignment was determined to allow for maximum flexibility for future design. The actual vertical alignment and standards will be determined in a future planning and preliminary design study at which time a transitway mode (LRT/BRT) will also be determined.

The transitway alignment is proposed to underpass Zenway Boulevard and Langstaff Road and overpass Rutherford Road as well as Major Mackenzie Drive. The development of the structures was not an aspect of this study.

4.3.3 Transitway Cross Section

The typical cross section will protect for two 3.5 m lanes with 2.5 m shoulders. The minimum ROW will be 60 m as per MTO standards. Grading requirements matched those of the Highway 427 mainline.

The actual cross section and standards will be determined in a future planning and preliminary design study at which time a transitway mode (LRT/BRT) will also be determined. Additional property requirements may also be needed at that time.

4.3.4 Transitway Station

A total of three transitway stations are protected throughout the study corridor as illustrated on Exhibit 4-1. The transitway stations are situated at the Langstaff Road, Rutherford Road and Major Mackenzie Drive interchanges. The transitway stations are located in the northwest quadrant of the interchanges with an average size of approximately 15 acres.

It was estimated from other studies, such as the Mississauga BRT study, that an area of 6 ha (15 acres) would accommodate the transitway facilities such as the platform as well as a minimum of 500 parking spaces.

The transitway will typically provide a transit interface between inter-regional and local transit services, a kiss and ride area and parking. The transitway station to be located at Rutherford Road will function as a carpool lot prior to implementation of the transitway corridor. A bus loop can be located in the carpool lot to allow for GO Bus service. Following submission of the Final EA Report in January 2010, the Project Team was advised that Hydro One does not permit a bus shelter within the hydro corridor. As a result, the bus shelter can be accommodated outside of the hydro corridor to the east, which is in the area that is being protected for the transitway.

As mentioned, details of the transitway will be developed and assessed in the future prior to implementation. This will be subject to the requirements of MTO's Class EA. The interaction between the transitway and GO Transit services will be considered as part of that assessment.

The Highway 427 Extension does not include a bus by-pass shoulder in preliminary design. However, it does not preclude a bus by-pass shoulder if such a facility is required in the future.

4.3.5 Maintenance Facilities

The location and design of transitway maintenance facilities are beyond the scope of this report and will be the subject of future studies.

This report notes however that the recommended design for the Highway 427 Extension will remove access and create surplus lands of varying degree throughout the study area. The largest of these areas is 9 ha of land south of Rutherford Road to the west of the Highway 427 Extension. This area is bounded by the Highway 427 Extension to the east, the Hydro Corridor to the west and the Lorna B. Jackson Transformer Station to the north. The size of this area combined, as well as being located directly adjacent to the proposed transitway, would make this area a candidate location for a future maintenance facility.

4.4 Structures

4.4.1 General

A total of nine crossings are proposed including two arterial road overpasses, two arterial road underpasses, one rail overpass, two freeway watercourse crossings and two crossing road watercourse crossings. The Structural Planning Report including the preliminary General Arrangements (GAs) for the nine crossings are included in Appendix B.

The nine crossings include fourteen structures at the following locations:

- Highway 427 at Zenway Boulevard Underpass
- Highway 427 NBL over Rainbow Creek
- Highway 427 SBL over Rainbow Creek
- Langstaff Road over Rainbow Creek
- Highway 427 at Langstaff Road Underpass
- Highway 427 NBL at Rutherford Road Overpass
- Highway 427 SBL at Rutherford Road Overpass
- Highway 427 NBL over West Robinson Creek
- Highway 427 SBL over West Robinson Creek
- Highway 427 NBL at CPR / McGillivray Road Overhead Structure
- Highway 427 SBL at CPR / McGillivray Road Overhead Structure

- Highway 427 NBL at Major Mackenzie Drive Overpass
- Highway 427 SBL at Major Mackenzie Drive Overpass
- Major Mackenzie Drive over West Robinson Creek

General Structural Design Criteria

The preliminary planning for all of the structures was generally based on the requirements of the Canadian Highway Bridge Design Code, CAN/CSA-S6-06 (CHBDC). Site specific requirements were assessed on the basis of the CHBDC in conjunction with the MTO Structural Manual. The CHBDC's CL 625-ONT design live load was used for all structures. Development of geometry for the structure types incorporating integral abutment or semi-integral abutment technology was based on the guidelines established in the MTO publications, 'Integral Abutment Bridges', Report S0-96-01, Revision 1, and 'Semi-Integral Abutment Bridges', Report BO-99-03.

As noted in Section 4.1.3, the proposed lane condition for this study is 6 lanes from Highway 7 to Rutherford Road and 4 lanes from Rutherford Road to Major Mackenzie Drive. In addition, the highway cross-section can accommodate a future widening to 10 lanes. The 6-lane configuration consists of through lanes at 3.75 m, as well as, right and left shoulder widths of 3.0 m and 2.5 m, respectively. The 4-lane configuration consists also of through lanes at 3.75 m and right and left shoulder widths of 3.0 m and 1.5 m, respectively.

The width of left shoulder was further examined for bridge spans that exceed 50 m in accordance with Clause D.7.2.2 of Geometric Design Standards for Ontario Highways. Feasibility of reduced left shoulder width was evaluated considering several parameters, including potential future traffic volumes, proximity of bridge structures to interchanges, site distances, etc. For bridge structures in close proximity of interchanges and merging ramp lanes, the standard 2.5 m wide left shoulder is provided including on bridges with a length less than 50 m. For the remaining structures with bridge spans over 50 m, reduced left shoulder widths were considered to reduce the overall bridge cost. As a result, 1.5 m wide left shoulders are proposed for Highway 427 over West Robinson Creek NBL and SBL; and Highway 427 at Major Mackenzie Drive Overpass NBL and SBL.

The minimum vertical clearance over the highway travelled lanes was established as 5.1 m, including 0.1 m for future highway rehabilitation/paving, for steel and precast concrete girder bridges in accordance with Clause C.4.4.3 of the MTO publication, "Geometric Design Standards for Ontario Highways". The minimum vertical clearance over railway tracks was established as 7.010 m in accordance with Railway Authorities standard requirements for overhead bridges. The locations of the critical vertical clearance points for underpass structures reflect the future widening of the Highway 427 Extension.

An 'open-abutment' concept wherein the bridge abutments are perched above and located clear of the under passing roadway has been adopted for all road-road grade separation bridges. The 'open-abutment' configuration is seen as being advantageous in comparison with a 'closed-abutment' configuration in terms of safety, aesthetics, and provision of maximum flexibility for the addition of future lanes/widening the municipal roadway at the overpass structure sites. For consideration of safety and to avoid the requirement for barrier protection between the travelled lanes and the bridge abutments, the minimum

required horizontal clearance between the edge of pavement of the nearest traffic lane and the bridge abutment has been established as the applicable Clear Recovery Zone dimension specified MTO's Roadside Safety Manual. In order to control the span lengths, the abutment fore slopes have been established at a maximum slope of 2:1, transitioning to flatter slopes on the approaching side of the structure in accordance with the MTO Structural Manual. Median piers have typically been positioned in the centre of the median and aligned parallel to the centreline of highway to provide maximum clearance from the edge of pavement and to accommodate the addition of future lanes within the highway median.

The deck cross-sections for the bridge structures within the Highway 427 Extension have been established on the basis of the specified number of through lanes plus allowance for ramp/speed change lane tapers. For precast girder bridges, the superstructure depths have been established based on height of CPCI precast concrete girders corresponding to applicable spans and girders spacing. For steel girder bridges, the structural depths have been established on the basis of span-to-depth ratios.

4.4.2 Watercourse Structures

There are 4 watercourse crossings requiring 6 structures of 2 to 3 bridge spans ranging in lengths from 68 to 120 m:

- Highway 427 NBL over Rainbow Creek
- Highway 427 SBL over Rainbow Creek
- Langstaff Road over Rainbow Creek
- Highway 427 NBL over West Robinson Creek
- Highway 427 SBL over West Robinson Cree
- Major Mackenzie Drive over West Robinson Creek

The required span configurations for the watercourse structures have been established on the basis of several criteria including hydrotechnical requirements, geomorphology, hydrogeology, archaeology, wildlife movement, vertical clearance or openness ratio and environmental sensitivity of both the watercourse/fishery and the valley/terrestrial habitat.

For the multi-span water-crossing bridges, the structure lengths and span configurations shown on the Preliminary GAs (Appendix B) represent the minimum requirements for that specific crossing site. During detail design, the bridge designer shall have the flexibility to adjust abutment and pier locations to suit existing features such as the watercourse alignment; however, the overall structure length and span configuration shown on the Preliminary GAs shall be maintained.

The required vertical clearance of the structure's hydraulic opening is identified by the design storm high water level shown on the GAs and the appropriate additional vertical clearance of 1.0 m in accordance with the CHBDC. Other requirements, such as vertical clearance for wildlife movements, have also been defined where applicable. During

detail design, the bridge designer shall have the flexibility to select the bridge type that will best satisfy the specified geometric requirements.

In order to prevent scour and erosion, rock protection shall be provided on all abutment fore slopes, around piers and roadway embankment slopes within the floodplain of the applicable design storm event. Rock protection shall extend from the toe of slope to 300 mm above the design storm high water level. The gradation and thickness of the rock protection layer shall be determined during the detail design phase. The invert and side slopes/banks of low flow channels shall not be armoured against erosion in order to not impede channel migration. The requirement for rock protection to prevent scour of the structure foundations shall be investigated further during detail design, and appropriate protection provided.

The typical deck cross-section of bridges has been established to suit the interim lane condition for the applicable roadway / highway, with accommodation for future widening to ultimate condition as applicable. The deck cross-sections for the water-crossing bridges have been established on the basis of 3.75 m through lanes plus allowance for ramp/speed change lane tapers where applicable. Right-hand and left-hand side clearances for water-crossing bridges carrying Highway 427 traffic have been provided in conformance with the Geometric Design Standards for Ontario Highways. For the highway crossing of Rainbow Creek, the provided right and left shoulders are 3.0 m and 2.5 m, respectively. For the highway crossing at West Robinson Creek, the right shoulder is 3.0 m and left shoulder is 1.5 m. The 1.5 m shoulder is proposed so to reduce overall structural cost, in accordance with Clause D.7.2.2 of Geometric Design Standards for Ontario Highways. Concrete barrier walls have been provided on either side of the bridge deck.

4.4.3 Underpass Structures

An ‘underpass structure’ is the bridge at the major road (i.e. Highway 427) that passes under the lesser category road (i.e. municipal road). An underpass structure is proposed at Zenway Boulevard and Langstaff Road. The 2 underpass structures consist of 2 spans, with a pier positioned in the centre of the highway median and the abutments and pier aligned parallel to the centreline of the highway.

As noted in Section 4.4.1.1, an ‘open-abutment’ concept has been adopted for the underpass structures. The deck cross-sections for the underpass structures have been established on the basis of the required number of through lanes plus allowances for side clearances, bicycle lanes (Langstaff Road) and sidewalks, as warranted for each specific municipal road. Allowances for raised medians and ramp/speed change lane tapers have also been provided at the interchange underpasses. Side clearance dimensions have been established in accordance with the Geometric Design Standards for Ontario Highways, with consideration to the specific roadway classification and design speed. As mentioned in Section 4.2, 1.5 m wide raised sidewalks were identified on Zenway Boulevard and Langstaff Road, however, the need to provide wider sidewalks should be examined during the detail design. The allowance for the raised medians is in conformance with the Geometric Design Standards for Ontario Highways.

4.4.4 Overpass and Overhead Structures

An ‘overpass structure’ is the bridge at the major road (i.e. Highway 427) that passes over the lesser category road (i.e. municipal road). An ‘overhead structure’ is defined as the road that goes over the railway. Two overpasses are proposed at Rutherford Road and Major Mackenzie Drive requiring 4 structures, as well as, 2 overhead structures at the CP railway/McGillivray Road. The overpass structures require 2 bridge spans and the overhead structure requires 3 bridge spans.

In general the abutments are aligned parallel to the centreline of the underpass road or rail road. As noted in Section 4.4.1.1, an ‘open-abutment’ concept has been adopted for this overpass structures. The typical deck cross-section of the mainline bridges has been established based on the required 4 or 6 lane configuration, with accommodation for future widening to ultimate highway section as applicable. The deck cross-sections for the overpass/overhead bridges on Hwy 427 Extension have been established on the basis of corresponding number of through lanes plus allowance for ramp/speed change lane tapers where applicable. Right-hand and left-hand side clearances of 3.0 m and 2.5 m, respectively, have been provided in conformance with the Geometric Design Standards for Ontario Highways for the Rutherford Road overpass and CPR/McGillivray Road overhead structures. For the Major Mackenzie Drive overpass structures, the right shoulder is 3.0 m and left shoulder is 1.5 m. The 1.5 m shoulder is proposed so to reduce overall structural cost, in accordance with Clause D.7.2.2 of Geometric Design Standards for Ontario Highways. Concrete barrier walls have been provided on either side of the bridge deck.

4.4.5 Description of Structures

4.4.5.1 Highway 427 at Zenway Boulevard Underpass

The recommended structure for the Zenway Boulevard Underpass is a 2-span open-abutment bridge consisting of CPCI 2300 girders composite with a reinforced cast-in-place concrete deck superstructure supported on integral concrete abutments and circular pier columns with rectangular pier cap. The proposed bridge will carry 2 traffic lanes and sidewalk in each westbound and eastbound direction. Structural steel superstructure (steel I girders and steel box girders) and post-tensioned voided concrete slab superstructure were examined during the pre-design; however, CPCI girders were selected as the more economical option. The overall bridge span, height of abutments and skew angle meet the requirements for integral abutments. The maximum length of wingwalls is restricted to 7.0 m for integral abutments, therefore, 2.5 m long retaining walls are proposed on the west approach to the bridge. A west span longer than the proposed 45 m would be required to eliminate retaining walls, however, as 45 m is the upper limit for length of CPCI girders, a more costly bridge option would be required, such as steel girders or post-tensioned concrete slab.

The recommended structure configurations are summarized as follows:

- Two spans open type bridge structure.
- Spans: 45.0 m + 40.0 m
- Skew: 3°53’08”.

- Deck type: CPCI 2300 girders with concrete deck slab.
- Abutments: integral abutments.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments and Pier Foundations: HP 310 x 110 piles.

4.4.5.2 Highway 427 NBL and SBL over Rainbow Creek

The recommended structure configurations for the Highway 427 mainline bridges over the Rainbow Creek have been developed with 4 southbound lanes including a speed-change lane from the on-ramp and 5 northbound lanes including a speed-change lane to the off-ramp. The superstructure consists of CPCI 2300 girders composite with a reinforced cast-in-place concrete deck. Structural steel superstructure was examined during the pre-design; however, CPCI girders were selected as a more economical option. Due to significant variation of deck width for both the NBL and SBL structures, integral abutments are not feasible at this location. The substructure consists of semi-integral concrete abutments and circular pier columns with rectangular pier caps. As the total spans exceed 100 m, expansion joints and sleeper slabs are proposed at ends of approach slabs, in accordance with semi-integral abutments guidelines.

The recommended structure configurations are summarized as follows:

- Three spans open type bridge structures.
- Spans: 32.0 m + 45.0 m + 32.0 m
- Skew: 20°00'00" for NBL and 0°00'00" for SBL.
- Deck type: CPCI 2300 girders with variable width concrete deck slab.
- Abutments: semi-integral abutments with expansion joints and sleeper slabs at ends of approach slabs.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments and Pier Foundations: HP 310 x 110 piles.

4.4.5.3 Langstaff Road over Rainbow Creek

The recommended structure at Langstaff Road crossing over the Robinson Creek is a 2-span bridge. The proposed bridge carries 2 westbound lanes and 3 eastbound lanes including 1 variable width off-ramp lane. It also provides an allowance for 1.5 m bicycle lane and sidewalk on each side of the bridge. The superstructure consists of CPCI 1600 girders composite with a reinforced cast-in-place concrete deck. Structural steel superstructure was examined during the pre-design; however, CPCI girders are selected as a more economical option. Due to variation of deck width between abutments, integral abutments are not feasible at this location. The substructure consists of semi-integral concrete abutments and circular pier columns with rectangular pier cap.

The recommended structure configurations are summarized as follows:

- Two spans open type bridge structure.

- Spans: 2 x 36.0 m.
- Skew: 0°00'00".
- Deck type: CPCI 1600 girders with variable width concrete deck slab.
- Abutments: semi-integral abutments.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments and Pier Foundations: HP 310 x 110 piles.

4.4.5.4 Highway 427 at the Langstaff Road Underpass

The recommended structure for the Langstaff Road Underpass is a 2-span open-abutment bridge consisting of CPCI 2300 girders composite with a reinforced cast-in-place concrete deck superstructure supported on integral concrete abutments and circular pier columns with rectangular pier cap. The proposed bridge carries 2 through lanes, one variable width off-ramp lane, and an allowance for 1.5 m bicycle lane and sidewalk in each westbound and eastbound direction. Structural steel superstructure (steel I girders and steel box girders) and post-tensioned voided concrete slab superstructure were examined during the pre-design; however, CPCI girders are selected as the more economical option. The overall bridge span, height of abutments and skew angle meet the requirements for integral abutments. The maximum length of wingwalls is restricted to 7.0 m for integral abutments; therefore, 2.5 m long retaining walls are proposed on the west approach to the bridge. A west span longer than the proposed 45 m would be required to eliminate retaining walls; however, as 45 m is the upper limit for length of CPCI girders, a more costly bridge option would be required, such as steel girders or post-tensioned concrete slab.

The recommended structure configurations are summarized as follows:

- Two spans open type bridge structure.
- Spans: 2 x 45.0 m.
- Skew: 9°14'36".
- Deck type: CPCI 2300 girders with concrete deck slab.
- Abutments: integral abutments.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments Foundations: HP 310 x 110 piles.
- Pier Foundations: Spread Footings.

4.4.5.5 Highway 427 NBL and SBL at Rutherford Road Overpass

The recommended structures for the Highway 427 NBL and SBL at the Rutherford Road Overpass are 2 2-span bridges. The proposed bridges carry three southbound lanes and three northbound lanes. Open-abutment bridges consist of CPCI 1600 girders composite with a reinforced cast-in-place concrete deck. Structural steel superstructure (steel I girders and steel box girders) and post-tensioned voided concrete slab superstructure

were examined during the pre-design; however, CPCI girders are selected as the more economical option. The overall bridge span, maximum height of abutments and length of wingwalls meet the requirements for integral abutments. According to integral abutment guidelines, if the skew is between 20° and 35°, integral abutments can be considered provided that rigorous analysis is carried out to account for the skew effects. Considering the proposed skew is 23°, the substructure supported on integral concrete abutments and circular pier columns with rectangular pier caps is considered feasible.

The recommended structure configurations are summarized as follows:

- Two spans open type bridge structures.
- Spans: 2 x 34.0 m.
- Skew: 23°18'25" for both NBL and SBL structures.
- Deck type: CPCI 1600 girders with concrete deck slab.
- Abutments: integral abutments.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments Foundations: HP 310 x 110 piles.
- Pier Foundations: Spread Footings.

4.4.5.6 Highway 427 NBL and SBL over West Robinson Creek

The proposed bridges carry three northbound lanes and two southbound lanes. Geomorphology and hydrogeology requirements governed at this crossing resulting in 60 m spans. Steel I girders were proposed as spans exceed maximum spans feasible for CPCI girders. At the pre-design stage, straight girders with variable cantilever lengths are proposed in order to reduce the superstructure cost. Need for curved or kinked girders should be examined during detail design. The superstructure consists of structural steel girders composite with a reinforced cast-in-place concrete deck. The overall spans of bridges meet requirements for integral abutments. As the total spans are between 100 m and 150 m, expansion joints and sleeper slabs are proposed at ends of approach slabs, in accordance with integral abutments guidelines.

The recommended structure configurations are summarized as follows:

- Two spans open type bridge structures.
- Spans: 2 x 60.0 m.
- Skew: 0°00'00".
- Deck type: Welded steel plate girders with concrete deck slab.
- Abutments: integral abutments with expansion joints and sleeper slabs at ends of approach slabs.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments and Pier Foundations: HP 310 x 110 piles.

4.4.5.7 Highway 427 NBL and SBL at CPR / McGillivray Road Overhead

The recommended structures at the CPR/McGillivray Road Overhead are 3-span bridges. The proposed bridges carry 4 northbound lanes including 2 off-ramp lanes and 2 southbound lanes including single variable width on-ramp lane. Open-abutment bridges consist of CPCI 1600 girders composite with a reinforced cast-in-place concrete deck. Structural steel superstructure (steel I girders and steel box girders) and post-tensioned voided concrete slab superstructure were examined during the pre-design; however, CPCI girders were selected as the more economical option. For the NBL structure, the overall bridge span, maximum height of abutments and length of wingwalls, and skew angle meet the requirements for integral abutments. As the variation of the bridge deck width between abutments is relatively small (less than 10%), integral abutments are considered feasible for the NBL bridge. Due to the significant variation of deck width and the 27° skew angle, integral abutments are not feasible for the SBL structure; therefore, the substructure consists of semi-integral concrete abutments. Furthermore, the SBL structure is overbuilt at the southwest side to reduce variation in deck width and facilitate CPCI girders. The piers consist of circular pier columns with rectangular pier caps and concrete crash walls, which is in accordance with requirements for piers constructed adjacent to railways.

The proposed middle spans accommodate 2 existing CPR rail tracks and the provision for future expansion to 4 tracks. As noted in Section 4.2, the south approach spans accommodate the existing McGillivray Road as well as future expansion of McGillivray Road to 4 traffic lanes with a centre median and 1.5 m sidewalks on each side. The north approach spans accommodate the proposed CPR Access Road. In addition, the City of Vaughan will be constructing a sanitary truck sewer along McGillivray Road. There is adequate separation between the abutments and the sanitary truck sewer.

The recommended structure configurations are summarized as follows:

- Three spans open type bridge structures.
- Spans: 33.4 m + 34.2 m + 33.1 m for NBL Bridge and 35.0 m + 34.7 m + 32.6 m for SBL bridge.
- Skew: 18° for NBL bridge and 27° for SBL bridge.
- Deck type: CPCI 1600 girders with variable width concrete deck slab.
- Abutments: semi-integral abutments for southbound lanes and integral abutments for northbound lanes.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments Foundations: HP 310 x 110 piles.
- Pier Foundations: Spread Footings.

4.4.5.8 Highway 427 NBL and SBL at Major Mackenzie Overpass

The recommended structures for the Highway 427 NBL and SBL at the Major Mackenzie Drive Overpass are 2 2-span bridges. The proposed bridges carry 2 northbound lanes and 1 southbound lane. The open-abutment bridges consist of CPCI 1600 girders composite

with a reinforced cast-in-place concrete deck. Structural steel superstructure (steel I girders and steel box girders) and post-tensioned voided concrete slab superstructure were examined during the pre-design; however, CPCI girders were selected as the more economical option. The overall bridge span, maximum height of abutments and length of wingwalls meets requirements for integral abutments. The skew angle for the SBL bridge is less than 20° , and the skew angle of 22° for the NBL bridge is slightly over 20° ; therefore, the substructure supported on integral concrete abutments and circular pier columns with rectangular pier caps is considered feasible.

The recommended structure configurations are summarized as follows:

- Two spans bridge structures.
- Spans: 32.0 m + 36.0 m.
- Skew: $22^\circ 21' 35''$ for NBL bridge and $16^\circ 48' 35''$ for SBL bridge.
- Deck type: CPCI 1600 girders with concrete deck slab.
- Abutments: integral abutments.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments Foundations: HP 310 x 110 piles.
- Pier Foundations: Spread Footings.

4.4.5.9 Major Mackenzie Drive over West Robinson Creek

The recommended structure at Major Mackenzie Drive over the West Robinson Creek is a 2-span bridge. The proposed bridge carries 4 eastbound lanes including 1 ramp lane and 3 westbound lanes. The bridge also includes 1.5 m bicycle lane and sidewalk on each side of the bridge. The superstructure consists of CPCI 1600 girders composite with a reinforced cast-in-place concrete deck. Structural steel superstructure was examined during the pre-design; however, CPCI girders were selected as the more economical option. Due to the significant variation of deck width between the abutments, integral abutments were not feasible at this location. The substructure consists of semi-integral concrete abutments and circular pier columns with rectangular pier cap.

The recommended structure configurations are summarized as follows:

- Two spans bridge structure.
- Spans: 2 x 34.0 m.
- Skew: $0^\circ 00' 00''$.
- Deck type: CPCI 1600 girders with variable width concrete deck slab.
- Abutments: semi-integral abutments.
- Intermediate Piers: Circular pier columns with rectangular pier cap.
- Abutments and Pier Foundations: HP 310 x 110 piles.

In January 2010, the Stage 2 Archaeological Assessment for the Highway 427 Extension was completed. The assessment identified the Coleraine Burying Grounds on the south side of Major Mackenzie Drive east of the proposed bridge at Major Mackenzie Drive over the West Robinson Creek. The current property line for the burying grounds abuts the existing Major Mackenzie Drive right-of-way (ROW). As a result, the preliminary design has been modified to minimize impacts to the Coleraine Burying Grounds. There was a minor shift of the alignment in this section to the north and the proposed Major Mackenzie Drive ROW either matches or is within the existing ROW. In addition, this shift resulted in a slight shift to the proposed structure at Major Mackenzie Drive over the West Robinson Creek. It was determined that the preliminary GA for this structure would not be modified to reflect the above change and will be revised during detail design.

4.4.6 Retaining Walls

Retaining walls may be required at a number of locations including in the vicinity of the hydro towers to maintain a maintenance platform. Retaining wall requirements will be determined through subsequent design phases.

Retaining walls/toe walls are recommended along the existing right-of-way of Zenway Boulevard to minimize the property requirements from adjacent properties. The extent of the retaining walls is shown on Exhibit 4-1. Details regarding the retaining walls/toe walls will be determined during detail design.

4.4.7 Noise Walls

A detailed noise analysis, which followed the MTO Environmental Guide for Noise (October 2006), was conducted. A detailed discussion of the noise analysis is included in the EA Report. Based on the findings of the analysis, the provision of a noise wall is not recommended.

4.5 Drainage and Stormwater Management

This section summarizes the conceptual drainage and stormwater management strategy. Additional details are provided in the Drainage and Stormwater Management Report included in Appendix C.

Following submission of the Final EA Report, the location of Stormwater Management Pond 1 was revised and shifted further north. The location of Pond 1 was revised as a result of correspondence (2001) received during the EA Review Period between the developer of the property, which is the property that Pond 1 will be located on, and TRCA regarding a future stormwater management pond location on their property. Based on the 2001 correspondence, the proposed pond location identified in the ravine feature by the developer was agreed to by TRCA. TRCA was consulted and advised the 427 Project Team in June 2010 that staff would allow the pond location in the ravine feature. TRCA advised that the watercourse located within the ravine feature is a minor water feature (valley depression) and they will allow the pond to be constructed on this feature. Following MTO's review of the revised pond location and TRCA's direction, MTO agreed that the pond can be shifted to the location identified by the developer.

4.5.1 Design Criteria

The drainage within the study area is provided by two watercourses located within the Humber Watershed, including the Rainbow Creek Watershed and the Robinson Creek Watershed, both within the TRCA jurisdiction. Based on discussions with MTO, MOE, MNR and TRCA, the following design criteria were adopted.

4.5.1.1 Hydraulic Criteria

All cross culverts greater than 6m in span are to be designed based on a 100-year design flow without impacting the current flood elevations. Cross culverts less than 6m in span will also be designed based on the 50-year design flow in order to convey all of the flow within the ROW to receiving stormwater management facilities for effective treatment. For areas with a drainage area greater than 125 ha, structures will be sized to convey the Regional Storm (Hurricane Hazel) with no significant increases in flood levels from that of the existing condition.

4.5.1.2 Stormwater Management Criteria

The following stormwater management requirements will be provided in order to achieve the criteria set by the TRCA, MTO, MOE, MNR and DFO.

- Quality Treatment – Enhanced Protection Level (Level 1) quality treatment with special attention given to mitigation of thermal impacts on coldwater streams;
- Extended Detention – Extended detention of 40 m³/ha of the contributing upstream drainage area for all wetponds. The erosion storm values will follow the methodology provided in the report “Low Impact Development Stormwater Management Manual”, dated November 2008. Erosion control will provide controls for the 25 mm storm to be released over a minimum of 48 hours;
- Quantity Treatment – Quantity control will be provided where runoff from the proposed 427 Transportation Corridor is shown to have a negative impact on the downstream peak flows within the receiving watercourse and meet post- to pre-development condition. All outlets from SWM ponds to receiving watercourses will comply with the TRCA’s Storm Outfall and Outfall Channel Design Criteria.

4.5.2 Proposed Conditions

The Stormwater Management Strategy has been developed based on the proposed design, which includes the highway (including the Rutherford Road carpool lot) and the runningway of the transitway. In addition, there is opportunity to provide quality treatment at all transitway stations and quantity treatment at the Langstaff Road transitway station. The stormwater management strategy includes drainage and stormwater management requirements at various locations throughout the study area, including:

- Bridges and cross culverts to convey flows; and
- Stormwater management ponds and flat-bottom swales to treat run-off.

4.5.3 Proposed Drainage Features

There are four major bridge crossings and nine cross culverts required. These crossings are used to convey Rainbow and Robinson Creeks and their tributaries.

In addition, several minor culverts will be required to distribute flow from the median ditch to the left/right ditches, as well as convey flow to proposed stormwater management facilities.

A Fluvial Geomorphology Assessment Report (Appendix D) was completed to evaluate all watercourse crossings and delineate watercourse reaches. This analysis provided recommendations related to sizing and placement of watercourse crossing structures and these recommendations were incorporated into the sizing crossing treatments listed below in Exhibit 4-12.

Exhibit 4-12 Summary of Watercourse Crossing Treatment

Crossing Name	Watercourse	Station	Type
Creek-1	-	10+215 Ramp Hwy 427	Existing Culvert to be extended
Rain-1	Rainbow Creek	11+125 Hwy 427	Twin 2740 mm x 1520 mm Box Culvert
Rain-2 ¹	Rainbow Creek	-	-
Rain-3	Rainbow Creek	11+600 Hwy 427	109 m span Bridge (Middle span of 45 m and 2 spans of 32 m each)
Rain-4	Rainbow Creek	9+7504 Ramp Hwy 427	Ramp Culvert Crossing (Dimensions determined in detail design)
Rain-5	Rainbow Creek	9+508 Langstaff Road	72 m span Bridge (2 spans of 36 m each)
Rob-1	Robinson Creek	13+025 Hwy 427	2440 mm x 1220 mm Box Culvert
Rob-2	Robinson Creek	13+560 Hwy 427	3050 mm x 1220 mm Box Culvert
Rob-3	Robinson Creek	14+480 Hwy 427	2440 mm x 1220 mm Box Culvert
Rob-4	Robinson Creek	10+613 Rutherford Road	Existing Bridge to Stay
Rob-5	Robinson Creek	15+540 Hwy 427	120 m span Bridge (2 spans of 60m)
Rob-6	Robinson Creek	9+422 Major Mackenzie Drive	68 m span Bridge (2 spans of 34 m)

Crossing Name	Watercourse	Station	Type
Rob-7	Robinson Creek	10+250 Major Mackenzie Drive	Twin 3050 mm x 1220 mm Box Culvert

¹ Area diverted to Rain-3

4.5.4 Proposed Stormwater Management Measures

The proposed stormwater management strategy consists of utilizing flat-bottomed grassed swales in all locations and stormwater management facilities to provide quality and quantity control to runoff. The location of these ponds are shown on Exhibit 4-1 and further detailed in the Stormwater Management report in Appendix C.

In addition, vegetative SWMP's such as enhanced ditches, bio-swales and plunge pools will be utilized along critical highway areas where access to a stormwater management pond is limited, and to provide localized erosion control measures.

Specifically, existing drainage patterns are to be maintained as much as possible within the layout of the highway profile. Runoff from areas external to the ROW will be intercepted and conveyed directly to the watercourse. Selection of proposed stormwater management practices was determined based on the drainage area contributing flows to local watercourses. The drainage area considered for stormwater management consisted of the complete ROW including the highway, the proposed transitway and transitway stations. The grassed areas, such as the area between the highway and the transitway ROW, will not contribute to increases in peak flows to receiving watercourses; therefore, quantity controls will not be required. However, the grassed areas will require quality treatment due to clean runoff from the grassed area integrating with pollutants from the highway and the transitway.

For contributing areas of 5.0 ha or greater, Enhanced Protection Level treatment has been provided with quantity and erosion treatment. The primary stormwater management practice for providing treatment for areas of 5.0 ha or greater is stormwater management wetponds. Stormwater management wetponds were specifically chosen by the design team and MTO as opposed to stormwater management wetlands for the following reasons:

- Wetlands have a higher tendency to attract wildlife closer to the highway;
- MTO has experienced higher maintenance issues surrounding wetlands as compared to wetponds;
- MTO has utilized wetponds much more frequently, and have noted that there are no greater stormwater management benefits with wetlands.

In areas where a wetpond is not feasible or the contributing area is less than 5.0 ha, enhanced grass lined swales will be utilized in order to provide some measure of quality treatment, although it is recognized that Enhanced Protection Level treatment will not be feasible. In addition to grass-lined swales, practices outlined in the TRCA report "Low Impact Development Stormwater Management Manual", dated November 2008, can be utilized to provide quality treatment. Quantity control will be provided where the

proposed highway is shown to have a negative impact on the downstream peak flows within the receiving watercourse, using either stormwater management dryponds or enhanced grass-lined swales as storage basins.

Grassed swales that meet the criteria specified earlier will be implemented over the entire study area.

4.5.5 Stormwater Management Methodology

As part of the preliminary design phase, it is important to ensure that adequate property required for the stormwater management ponds are provided. Pond property requirements were sized for the ultimate requirement. A specific design will be developed during detail design.

4.5.5.1 Stormwater Management Wetpond Sizing

The wetpond sizing was undertaken at a basic preliminary design level to determine the ultimate footprint requirements for each pond. Greater detailed hydrologic modeling and detail design of SWM facilities will be undertaken during subsequent design stages to confirm the size and configuration of the proposed stormwater management ponds.

The required volume to provide quantity treatment for the upstream drainage area was computed based on OTTHYMO modelling. The final stormwater management wetpond volume requirements were based on:

- Permanent Pool sized for Enhanced Protection Level (based on Table 3.2 of the MOE “Stormwater Management Planning and Design Manual”);
- Extended detention of 40 m³/ha;
- Erosion storm detention of 25 mm runoff over the catchment area for the proposed condition using OTTHYMO; and
- Active storage computed based on post- to pre-development condition criteria using OTTHYMO.

4.5.5.2 Stormwater Management Wetpond Sizing Requirements

Using the sizes provided, the stormwater management facilities were sited based on several region specific requirements, including:

- Outside of ESA, PSW, ANSI, Greenbelt areas and York Region Greenlands;
- Outside of existing Regional floodlines;
- Outside of adjacent Hydro corridors or minimum 75 m away from tower foundation; and
- On tablelands, avoiding watercourse valleys and regionally specific sensitive areas.

Overall, the stormwater management wetponds were located to have minimal impact on the surrounding environment. In addition, the stormwater management wetpond had to provide clearance for the transitway, as the transitway layout will not be confirmed until subsequent design stages.

4.5.5.3 Stormwater Management Wetpond Property Sizing Requirements

Based on the volumes calculated as part of the wetpond sizing and the wetpond locations, the overall stormwater management property requirements were determined based on the following criteria:

- 4:1 length-to-width ratios (minimum) sized with 4:1 side slopes (including berms if pond requires above grade component);
- Permanent Pool depth between 1.5 and 3 m, where restrictions allow;
- All outlets from SWM ponds to receiving watercourses will comply with the TRCA's Storm Outfall and Outfall Channel Design Criteria;
- Active Storage (extended detention, 25 mm runoff, and 100-year storage from OTTHYMO) depth between 2 and 3 m (preferably 2 m deep);
- Freeboard depth of 0.5 m to allow for overflow weir depth requirements and storage freeboard;
- 5 m width required for access roads around the pond perimeter; and
- 5 m wide buffer around the pond perimeter required to accommodate sundry items such as a drying pad for maintenance/clean-outs, turn-arounds for vehicle access, and as a contingency in case additional volume is required in subsequent design stages.

4.5.5.4 Stormwater Management Wetpond Outlet Structures

Although the stormwater management facilities are only conceptually designed with details of the ultimate layout completed during subsequent design stages, a preliminary evaluation of the proposed outlets required investigation to confirm the feasibility of the pond locations. Outlet types and locations were reviewed for each of the facilities, with the general layout designed based on one of the three following outlet types.

- At-Grade Outlet Swale - the stormwater management facility would outlet to an at-grade ditch or swale, ultimately discharging to a receiving watercourse. In this scenario, the slopes to the receiving watercourse would have to be gentle enough to prevent erosion.
- Pipe Outlet with Headwall - the stormwater management facility would outlet through a pipe, discharging directly to the watercourse. This outlet type would best work where an at-grade swale can not be achieved; however the receiving watercourse is not located in a deep valleyland. In subsequent design stages, outlet pools can be considered at the pipe outlets.
- Valleyland Pipe Outlet with Headwall - the stormwater management facility would outlet through a pipe, discharging at the toe of a defined valleyland slope. This outlet type would be preferred to discharging the flows on the tableland of or the valley slope in order to prevent erosion within the valleylands and the valley slope. Outlet pools with energy dissipaters may be required at the end of the discharge pipe in order to prevent erosion.

For all stormwater management facility outlet locations, it was requested that outlets be located on the straight sections of the watercourse to decrease the occurrence of the channel migrating away from the outlet. In addition, the outlets of the stormwater management facilities should discharge to major watercourses wherever possible, and avoid smaller watercourses and tributaries that are primarily groundwater fed. This will prevent erosion and subsequent negative impacts on the smaller watercourses from the facilities discharged flows, as the groundwater fed watercourses may not be stable enough to handle intense peaks from facility outlets.

4.5.6 Recommended Strategy

In summary, the proposed stormwater management conceptual plan provides adequate property to provide quality treatment and quantity control to runoff from the proposed ROW by means of flat-bottomed grassed swales and stormwater management wetponds for the increase in pavement area. Stormwater management wetponds will provide Enhanced Protection Level treatment to 146.3 ha of proposed ROW, or approximately 88% of the ROW. Of the remaining area, Low-Impact Developments such as flat-bed and vegetative swales will be investigations during subsequent design stages to provide treatment to stormwater that cannot discharge directly to a stormwater management facility. Due to limitation of pond area, the transitway station at Major Mackenzie Drive will only receive quality control treatment through the wet pond whereas the quantity control will be provided at this station. The Langstaff Road and Rutherford Road transitway stations will receive both quality and quantity treatment through the wet ponds.

4.5.7 Summary of Drainage and Stormwater Management Conclusions and Recommendations

The following is a summary of the drainage and stormwater management conclusions and recommendations:

- Flat-bottomed grass-lined swales are recommended throughout the entire study area to provide adequate conveyance capacity of peak flows, while also providing some degree of quality control.
- During subsequent design phases, stormwater management facilities will be designed to provide:
 - Quality Treatment – Enhanced Protection Level (Level 1) quality treatment with special attention given to mitigation of thermal impacts on coldwater watercourses.
 - Extended Detention – Extended detention of 40m³/ha of the upstream drainage area for all wetponds. Within the TRCA jurisdiction, the erosion storm values will follow the methodology provided in the report “Low Impact Development Stormwater Management Manual”, dated November 2008.
 - Quantity Treatment – The quantity treatment is provided to control post-to pre-development flows and the release rates will be confirmed from TRCA.

- An erosion control assessment be conducted using continuous simulation modeling to confirm stormwater management facility requirements for controlling to non-erosive release rates.
- The outlet structure for the 25 mm erosion storm for all stormwater management ponds will utilize a “bottom draw” system, which allows the water discharged from the pond to be taken from the lower (cooler) levels of the pond.
- For the receiving coldwater watercourses, techniques for providing thermal mitigations to discharged stormwater management pond flows will be provided. Thermal practices include, but not limited to: deepening the permanent pool to a minimum of 3 m to facilitate the discharge of cooler water; discharging low flows to an infiltration basin; or providing vegetated shade to outlet channels.
- Areas where stormwater management ponds are not feasible, Low-Impact Developments, such as flat-bottom grass-lined swales, will be utilized. Low Impact Development within the TRCA jurisdiction will be designed using the document “Low Impact Development Stormwater Management Manual”, dated November 2008;
- In the case of accidental spills in areas treated by stormwater management ponds, a shut-off valve should be installed at the pond outlet in order to prevent the spill material from entering a watercourse. In the case of accidental spills in areas not treated by stormwater management ponds, sandbags should be utilized at culvert openings in order to prevent the spill material from entering a watercourse;
- A detailed maintenance plan for all stormwater management facilities, including scheduling, roles, and responsibilities will be provided during Detail Design.
- All Permits to Take Water will be completed as part of the Detail Design stage prior to any construction practices, with input required from MOE Central Region.
- Erosion and sediment control measures and contract specifications are to be developed during subsequent design phases. These documents will be reviewed with the TRCA, MTO, MNR, and MOE prior to construction.
- The location and design of outlets will be carried out at detailed design stage.

4.6 Electrical Systems

4.6.1 Illumination

Full illumination is recommended at the interchange of Highway 7 and Highway 427 due to the existing full illumination along the adjacent Highway 7. Based on the projected volume (AADT) of the highway, which exceeds 30,000, it is recommended that partial illumination be installed at the Langstaff Road, Rutherford Road and Major Mackenzie Drive interchanges. Additional details are provided in the Preliminary Electrical Design Report included in Appendix E.

4.6.2 Traffic Signals

Traffic signals will be installed at all interchange exit ramp terminals. As mentioned in Section 4.2.1.3, a direct ramp is included from the northbound lanes to merge with westbound Major Mackenzie Drive, therefore, no traffic signal is required at this location.

4.7 Pavement Design

A pavement investigation was undertaken as part of the geotechnical component of this study and is summarized in the section below. Additional details are provided in the Preliminary Pavement Design Report included in Appendix F.

4.7.1 Design Considerations

The pavement designs were developed using the “1993 AASHTO Guide for the Design of Pavement Structures”. Traffic load calculations and the AASHTO pavement design parameters were selected from MTO’s Materials Information Report, MI-183 and “Adaptation and Verification of AASHTO Pavement Design Parameters for Ontario Condition” dated March 2008. In addition to the AASHTO method, two other methods – “Thickness Design for Concrete Highways and Street Pavements” published by the Canadian Cement Association and the MTO method outlined in the “Pavement Design and Rehabilitation Manual 1990” were used to design the thickness of the concrete for the rigid pavement.

4.7.2 Preliminary Pavement Design Recommendation

The preliminary pavement design was developed for the Highway 427 Extension, the interchange ramps and the realignment of Major Mackenzie Drive. Both flexible and rigid pavement design were developed for the Highway 427 Extension.

The following 3 pavement designs were analyzed in detail:

- Option 1 – Flexible Pavement: optimum asphalt layer and thick sub-base
- Option 2 – Flexible Pavement: thicker asphalt layer and reduced thickness of sub-base
- Option 3 – Rigid Pavement – concrete

The pavement designs were developed for the 4-lane and 6-lane sections. For each pavement design alternative, Life Cycle Cost Analysis (LCCA) was carried out. Based on the LCCA, Option 1 is preferred to be the preferred flexible pavement strategy for the extension of Highway 427 for both the 4-lane and 6-lane sections.

The recommended pavement designs for the Highway 427 Extension are provided in Exhibit 4-13.

Exhibit 4-13 Recommended Pavement Designs for Highway 427

Parameter	6-Lane Section		4-Lane Section	
	Flexible	Rigid	Flexible	Rigid
Hot Mix Asphalt (mm)	220	-	200	-

Parameter	6-Lane Section		4-Lane Section	
	Flexible	Rigid	Flexible	Rigid
Concrete (mm)	-	260	-	260
Open Graded Drainage Layer (mm)	100	100	100	100
Granular A Base (mm)	150	300	150	300
Granular B Sub-base	700	0	700	0
Total thickness (mm)	1,170	660	1150	660

The recommended pavement design for the interchange ramps and the realignment of Major Mackenzie Drive:

Parameter	Interchange Ramps	Realigned Major Mackenzie Drive
New Asphalt (mm)	180	160
New Granular A Base (mm)	150	150
New Granular Sub-base (mm)	650	550

The preliminary design recommendations should be verified during detail design.

4.8 Foundation Design

A preliminary foundation design investigation was undertaken for the nine structure locations, selected culverts and major embankments. Eleven separate reports were produced, and are on file with MTO:

- Preliminary Foundation Report – Zenway Boulevard Underpass
- Preliminary Foundation Report – Rainbow Creek Bridges
- Preliminary Foundation Report – Rainbow Creek Bridge on Langstaff Road
- Preliminary Foundation Report – Langstaff Road Underpass
- Preliminary Foundation Report – Rutherford Road Overpasses
- Preliminary Foundation Report – West Robinson Creek Bridges
- Preliminary Foundation Report – CPR / McGillivray Road Overhead Structures
- Preliminary Foundation Report – Major Mackenzie Drive Overpasses
- Preliminary Foundation Report – West Robinson Creek Bridge on Major Mackenzie Drive
- Preliminary Foundation Report – Culverts
- Preliminary Foundation Report – High Fill Embankments

The foundation investigations were incorporated into the preliminary design. In general, steel H-piles driven to very dense till material are feasible at all locations. Spread footings “perched” on approach embankments and spread footings on very stiff till were assessed feasible at several abutment and pier locations, respectively. Concrete caisson

foundations were also assessed feasible at most sites, however, due to high construction cost with no benefits to the overall cost or performance to the structures, concrete caissons were considered as less preferred.

The foundation recommendations for the structures are summarized in Section 4.4.

Further borehole investigation and analysis will be required during the detail design phase to confirm the preliminary foundation recommendations.

4.9 Construction Staging

All the portions of the Recommended Alternative can be constructed without impacting existing travel routes except at the Region's 427 Interim Arterial Extension (Regional Road 99) area. The details regarding construction staging and timetable will be developed during detail design. In addition, MTO will work with the municipalities in the development of the construction staging during detail design.

A traffic staging plan will be developed in the subsequent design phases. Where the existing arterial crossing roads need to be reconstructed, a temporary detour roadway will also be constructed to maintain traffic. Staging of the Major Mackenzie Drive Interchange will depend on the timing of the realigned/widened Major Mackenzie Drive.

The 427 Interim Arterial Extension has been built as an interim measure to temporarily relieve the terminus of Highway 427 at Highway 7. During construction of the Highway 427 extension to the north from Highway 7, it is not possible to maintain traffic of the 427 Interim Arterial Extension at all times, MTO will work to mitigate traffic impacts by minimizing the duration of the closure. In addition, the reconstruction of Zenway Boulevard will require a temporary closure of Zenway Boulevard in the vicinity of the intersection with 427 Interim Arterial Extension. Properties on Zenway Boulevard will be accessed from either the east via Highway 27 / Vaughan Valley Boulevard or the west via Highway 50 / Huntington Road. The details regarding construction staging and timetable will be provided during detail design.

Consultation with CP Rail will continue in subsequent design phases to minimize impact to the rail operations in the construction of the CPR overpass.

5. TRAFFIC ENGINEERING

5.1 Network Modelling Link – Needs and Justification

5.1.1 Traffic Operations

5.1.1.1 Future Traffic Projections

The year 2021 a.m. peak hour travel demands for the study area were developed using the EMME model that includes 2021 population and employment forecasts by traffic zone that are applied to a base trip distribution travel pattern. To facilitate the traffic operations analysis for both the mainline traffic forecasts and the ramp terminal traffic forecasts, the EMME model auto assignments were increased by 10% to reflect a system wide truck percentage. This procedure allowed for a system balance of traffic forecasts that were input to the micro-simulation (VISSIM) analysis to assess both mainline and ramp terminal operations and lane geometry required for the 2021 planning horizon.

A summary of the forecast 2021 a.m. peak hour peak direction traffic forecasts and lane requirements for Highway 427 mainline are presented in Exhibit 5-1. The mainline Level of Service (LOS) shown is based on the HCS Freeway Capacity Analysis. It is noted that the mainline forecasts on Highway 427 Extension between Langstaff Road and Highway 7 have been adjusted to reflect the traffic balancing required to accommodate the ramp analysis operations. The traffic balancing adjustments included:

- Reducing the 2021 a.m. peak hour modelled Highway 7 westbound vehicle flows approaching the Highway 427 interchange from approximately 3900 vehicles to approximately 2900 vehicles (more consistent with the arterial capacity anticipated on three (3) arterial lanes).
- Increasing the traffic volumes at the Langstaff Road to Highway 427 southbound on-ramp by approximately 800 vehicles.

Exhibit 5-1 Highway 427 Extension Mainline – 2021 a.m. Peak Hour Peak Direction Vehicle Demands and Lane Requirements

Highway 427 Extension	Southbound (a.m. ph) Vehicle Traffic	Number of Lanes Peak Direction	Total Mainline Lanes	2021 a.m. Peak Hour LOS
South of Major Mackenzie Drive	2,900	2	4	C
South of Rutherford Road	4,650	3	6	D
South of Langstaff Road	5,700	3	6	E

The Transportation Needs Assessment Report, which is included in the 427 Transportation Corridor EA Report, was completed in 2007. There has been continuous consultation throughout the study with York Region's Western Vaughan Individual Environmental Assessment (IEA) Study Project Team with respect to any updated traffic projections to ensure validity of the findings of traffic analyses completed in the earlier phases of the EA.

5.1.1.2 Ramp Operations

An operational analysis was undertaken for each of the ramp terminals at the interchange locations with Highway 7, Langstaff Road, Rutherford Road and Major Mackenzie Drive using the VISSIM micro-simulation model. The 2021 a.m. peak hour balanced traffic flows for Highway 427 Extension and the arterial cross-roads along with the lane geometry at the ramp terminals from the initial preliminary design were key inputs to the VISSIM model. Signal timing plans at each of the Highway 427 ramp terminals were estimated using the Synchro software based on the 2021 a.m. peak hour balanced traffic flows and initial lane geometry.

A summary of the initial ramp terminal lane geometry assumed in the VISSIM Model is presented in Exhibit 5-2 while the assumed lane configuration for the crossroads is as follows:

- Major Mackenzie Drive – 6 lanes
- Rutherford Road – 6 lanes
- Langstaff Road – 4 lanes
- Highway 7 – 6 lanes

Exhibit 5-2 Initial Highway 427 Extension Ramp Terminal Lane Geometry Assumptions – VISSIM Model Analysis

Highway 427 Interchange Location	Number of Off-ramp Lanes	Number of Left Turn Lanes	Shared Left / Right Turn Lane	Open Right Turn Lane
Major Mackenzie Drive				
NB off ramp	1			1
Rutherford Road				
NB off ramp	2	2		1
SB off ramp	2	2		1
Langstaff Road				
NB off ramp	2	2		1
SB off ramp	2	2		1
Highway 7				
NB off ramp	2	1	1	1
SB off ramp	2	1	1	1








The VISSIM analysis indicated that the assumed lane geometry identified in the preliminary design results is reasonable operating conditions as shown in Exhibit 5-3. The VISSIM analysis does indicate that the following enhancements be incorporated into the ramp terminal detailed design to reduce possible congestion / traffic queues backing onto the mainline:

- Provision of an additional right turn lane with a 200 m taper length at the two lane off-ramp terminal locations where there is no channelized right turn;

- Consideration of long taper to on-ramp, where feasible, to reduce the possible queues resulting from short taper / direct opening to access on-ramp.

In addition to the ramp terminal operation analysis presented in Exhibit 5-3, it is important to note that the analysis indicated significant westbound a.m. peak hour traffic flows on Highway 7 approaching the Highway 427 northbound off-ramp terminal. Although these traffic flows will not impact the Highway 427 off-ramp operations, the forecast traffic flows will result in traffic queues extending to the first intersection east of the ramp terminal.

Exhibit 5-3 Highway 427 – 2011 a.m. Peak Hour Ramp Terminal Operation Analysis Summary

Highway 427 Interchange Location	Overall Intersection LOS	Ramp Terminal LOS	Maximum Queue Length (m)	Ramp Terminal Lane Geometry
Major Mackenzie Drive				
NB off ramp	A	A	20m	
Rutherford Road				
NB off ramp	C	C	500m	
SB off ramp	C	C	100m	
Langstaff Road				
NB off ramp	D	D	280m	
SB off ramp	B	C	220m	
Highway 7				
NB off ramp	C	D	240m	
SB off ramp	C	C	210m	

6. RIGHT-OF-WAY REQUIREMENTS AND CORRIDOR CONTROL

6.1 Right-of-Way Requirements

The preliminary right-of-way requirements are shown on the Recommended Plan in Exhibit 4-1. Other than areas of excessive grading requirements and accommodation for the stormwater management ponds, the basic right-of-way is 110 m for the Highway corridor and 60 m for the Transitway corridor.

Property will also be required to construct the interchanges, transitway stations and road re-alignments. As mentioned previously, the proposed realignment of municipal roads will be developed in consultation with local municipalities.

Final right-of-way limits will be confirmed during detail design.

The right-of-way requirements for the 427 Transportation Corridor, including the highway component, the transitway component and the associated support facilities, are presented in Appendix G.

6.2 Corridor Control

6.2.1 Nashville Heights Community

As noted in Section 4.2, the Major Mackenzie Drive Interchange displaces the existing Huntington Road and Major Mackenzie Drive intersection. Huntington Road could have a cul-de-sac on both sides of Major Mackenzie Drive due to existing low volumes, however, as a result of the Nashville Heights Community development north of Major Mackenzie Drive east of Huntington Road and the possible future developments west of Huntington Road, there needs to be a connection of Huntington Road (north of Major Mackenzie Drive) with Major Mackenzie Drive.

The Nashville Heights Community is a residential community expected to include community services such as schools, parks, open space areas and neighbourhood scaled commercial facilities. On June 15, 2009, OPA 699 for Nashville Heights was adopted by City of Vaughan Council, and forwarded to the Region of York, the approval authority. Regional Council approved the Official Plan November 19, 2009: OPA 699 is currently under appeal to the Ontario Municipal Board by a local resident citing primarily density, traffic and servicing issues stemming from the Nashville Heights development.

The OPA includes a proposed road network for the planned Nashville Heights community. In the OPA, Huntington Road is shown realigned in an easterly direction to intersect with Major Mackenzie Drive opposite the proposed Highway 427 NB off-ramp. A second collector road access to Major Mackenzie Drive is proposed approximately 300 metres west of the existing CP tracks.

An access connection directly opposite an interchange off-ramp is undesirable in terms of traffic operations, intersection capacity and interchange ramp operations by MTO. As a result, it is MTO's policy to disallow such access connection unless it is the 'last resort'. Therefore, MTO proposes a realigned Huntington Road with its intersection with Major Mackenzie Drive located 650 m east of existing Huntington Road. The Huntington Road

/ Major Mackenzie Drive intersection will provide full vehicular movements. The intersection will be approximately 450 m east of the S-E Ramp, which is adequate separation between the intersections.

An additional access, including an access directly opposite to the NB off-ramp, to the proposed development in the area will be addressed based on MTO's Corridor Management guidelines and practices. It is expected the municipalities will continue discussions with MTO Corridor Management in achieving a resolution of the proposed second access, which may be required in the future.

6.2.2 Private Accesses

Temporary access to the three properties located on the northside of Langstaff Road just east of the E-N ramp will continue for existing land use. Access for future development will be dealt with through municipal planning process in consultation with MTO Corridor Management Office. The location of the properties are shown on Exhibit 4-1 (Plate 2).

The Lorna D. Jackson Transformer Station access road is located at the end of the taper of the S-E ramp at the Rutherford Road Interchange and will be maintained due to its low usage.

The Behel Christian Centre and Knox Vaughan Cemetery located east of the proposed interchange with Rutherford Road, are not encroached upon, but are in close proximity to the proposed interchange. The access to the Behel Christian Centre will remain at its existing location since its high usage is typically only on a Sunday and does not coincide with the peak use of the proposed interchange. However, if the function of this property changes, the access will require relocation to the east.

The proposed Highway 427 alignment is through the middle of the property located at 9711 Huntington Road. The existing access to the property on Huntington Road will be maintained and provide access to the property on the west side of the alignment. However, an access road will be provided from McGillivray Road to provide access to the eastern section of property. The proposed access is located on McGillivray Road just east of the proposed 427 Extension and is shown on Exhibit 4-1 (Plate 4).

At the north end of the proposed extension, the access to Gusgo Transport Limited (7050 Major Mackenzie Drive) will require relocation to the west side of the property. The relocation is required to minimize potential safety concerns associated with the existing location of the driveway in proximity to the Major Mackenzie Drive Interchange's S-W direct ramp. The proposed access is shown on Exhibit 4-1 (Plate 5). However, the relocation of the access will potentially affect truck movements to the garage and the container area within the property. New internal access route may be required to minimize impacts to business operations. This will be further consulted with the property owner and confirmed during detail design. In addition, a conceptual transitway station access road is proposed along the north end of the property to the west and connects with Major Mackenzie Drive directly opposite the CPR's proposed access road. The exact routing of the transit station access road will be discussed with the owner and confirmed during detail design.

6.2.3 CPR Access

Currently trucks access the CPR Vaughan Intermodal Facility via Rutherford Road. CPR has planned a future additional access for its facility on Major Mackenzie Drive. This access would allow for a pass-through operation with trucks entering at Rutherford Road and exiting at Major Mackenzie Drive. The approximate location of the proposed CPR access road is shown on Exhibit 4-1 (Plate 5).

The proposed highway will compliment the proposed CPR pass-through operation and allow for future expansion of the CPR Vaughan Intermodal Facility by having freeway interchanges at both Rutherford Road and Major Mackenzie Drive.

7. UTILITIES AND SPECIAL CONSIDERATIONS

7.1 Utilities

There are a number of utilities along the corridor that will require protection or relocation as a result of the Recommended Plan. Existing utilities within the corridor include the Hydro One transmission corridor, the Lorna D. Jackson Transformer Station and municipal services including watermains, storm sewers, sanitary sewers and local hydro infrastructure along local roads. In addition, the TransCanada Pipeline's natural gas pipeline that is located north of Major Mackenzie Drive.

7.1.1 Hydro One Transmission Corridor

As described in Section 4.1, it was determined that relocation of the 500 kV towers was not a viable alternative. The highway alignment was developed in consideration of maintaining the existing 500 kV towers in their current locations, adhering to the required vertical and horizontal clearances and provision of maintenance access to all towers.

In the section north of Langstaff Road, it was determined that a 230 kV tower would be relocated to avoid conflicts with the highway alignment. As shown conceptually in Exhibit 4-1, it is proposed that this tower will be replaced by two new towers. One tower will be located within the Highway 427 median area and one tower is anticipated to be located between the Highway 427 and the Transitway Right-of-Way. It was suggested to Hydro One that a monopole tower be used for this second tower as a way of minimizing the tower footprint in anticipation of a future transitway alignment. This will be verified in the next phase of the study with ongoing Hydro One consultation.

The shortest horizontal clearance from a potential retaining wall to the base of the Hydro tower is approximately 10 m under the scenario of a 10 lane cross section. The 10-lane cross-section is described in Section 4.1.3. A minimum platform of 18 m was achieved along the transmission line. In consultation with Hydro One, it was determined that the platform along the lines were critical as the maintenance trucks would likely setup at this location adjacent to the towers. The offset perpendicular from the hydro line to the mainline and shortest offset to the mainline are shown on Exhibit 7-1. The offsets were provided to Hydro One in May 2009.

A survey is required in detail design to determine the exact location and offsets to the towers.

The vertical clearances are based on the Ministry of Transportation 'Minimum Clearances for Arterial Cable Systems' (MTOD-217.030, November 2007). The corresponding clearance for a 500 kV phase-to-phase line is 15.7 m. The current elevations and line sags for the Hydro One lines were provided by and field checked by Hydro One in June 2009. A more detailed survey of the Hydro elevations will need to be completed in detail design.

A conceptual access road plan is also shown on Exhibit 7-1, illustrating access to the existing 500 kV tower and the potential future location of a 230 kV tower. This access road is conceptual only and will be designed in greater detail during detail design in consultation with Hydro One.

Hydro One advised in December 2009 that they have reviewed the preliminary design, as shown on Exhibit 4-1, and agree in principle to the alignment. However, Hydro One will undertake additional studies regarding the impacts to their facilities following MTO's issue of a Memorandum of Understanding (MOU). The MOU should be issued as soon as possible since it will take considerable lead time for Hydro One to relocate the hydro towers.

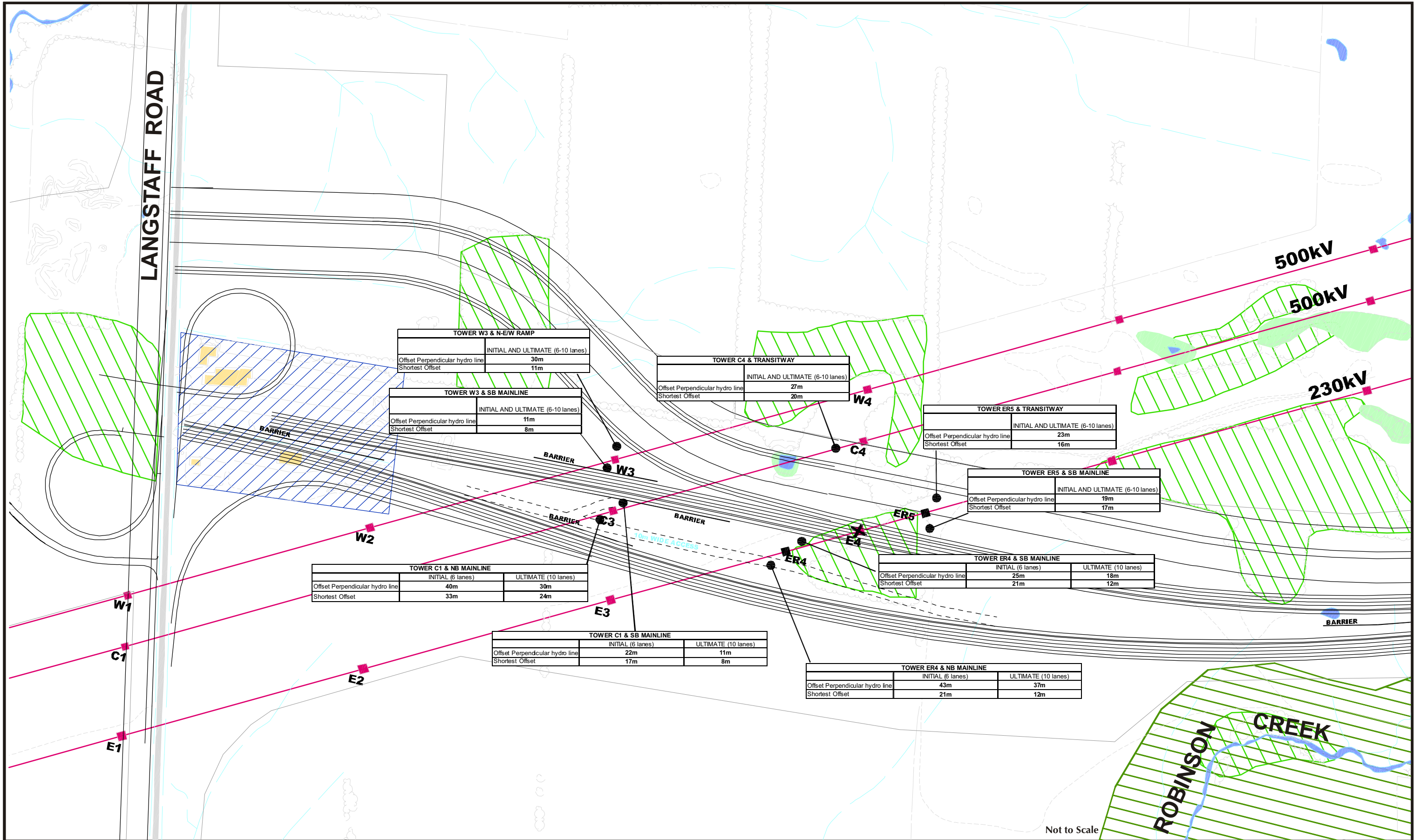
7.1.2 Local Utilities

The existing profiles of Zenway Boulevard and Langstaff Road will be raised significantly. The corresponding municipal services (watermains, storm sewers, sanitary sewers, hydro) will need to be relocated due to the high fills and bridge abutments being proposed. This issue can be addressed by several options including the use of light weight fill; relocation outside the fill area (could be in an easement outside the existing municipal right-of-way); and, construction of a slab/structure on top of the existing pipe to take the load of the fill. Alternative options will be developed / assessed and a preferred solution identified /confirmed during Detail Design. Details of the relocation will be discussed with the municipalities during Detail Design.

York Region is currently constructing a new watermain connection along Huntington Road from Rutherford Road to Nashville Road. Preliminary Highway 427 Extension plans have been provided to the Region for the purpose of the watermain design, particularly the reinforcement of the watermain to accommodate the freeway.

7.1.3 TransCanada Pipeline

The proposed Highway 427 Extension alignment is not anticipated to impact the TransCanada Pipeline's natural gas pipeline that is located north of Major Mackenzie Drive. However, this study also includes the identification and protection of a 60 m right-of-way (ROW) for a future transitway and transitway stations including conceptual transitway station access roads. The proposed transitway ROW north of Major Mackenzie Drive would cross the pipeline, which is shown on Exhibit 4-1 (Plate 5). As noted in Section 4.3, a separate Environmental Assessment (EA) study will need to be undertaken for the proposed transitway and TransCanada Pipelines will be consulted further at that time. It should be noted that, based on correspondence with TransCanada Pipeline to date, NEB approval would not be required for this crossing (approval from the Pipeline Company will).



8. EA COMMITMENT AND MITIGATION MEASURES

Exhibit 8-1 is a summary of the proposed EA commitments and mitigation measures. This table will be expanded during subsequent design and construction phases to include a column explaining how the commitment was addressed in those subsequent stages. The proposed EA commitments and mitigation measures are discussed in detail in the EA Report.

These commitments have been grouped by individual discipline (i.e. Vegetation, Drainage and Stormwater Management etc.) or under the heading of “General” because some of the commitments are not specific to a particular discipline.

Exhibit 8-1 Proposed EA Commitments and Mitigation Measures

ENVIRONMENTAL ISSUE / CONCERN	AGENCIES	PROPOSED MITIGATION / COMMITMENTS TO FUTURE WORK
General		
	MTO All Stakeholder	<ul style="list-style-type: none"> • Implement environmental inspection during construction to ensure that protection measures are implemented, maintained and repaired and remedial measures are initiated where warranted.. • Carry out ongoing consultation with stakeholders during subsequent design phases and construction. • Obtain any necessary approvals or permits during Detail Design
Vegetation		
<p>Intrusion or edge removal of natural vegetation.</p> <p>Release of construction-generated sediment to vegetation areas.</p>	MTO MNR TRCA MOE	<p>General mitigation measures are summarized below and include:</p> <ul style="list-style-type: none"> • Minimize the extent of grading and vegetation removals, wherever feasible. Opportunities to reduce grading limits will be reviewed at Detail Design for all vegetation units. • Ensure a clear delineation of ROW vegetation clearing zones and vegetation retention zones in both the contract documents and in the field to minimize the risk of off-ROW vegetation impacts and avoid incidental impacts as a result of temporary stockpiling, debris disposal and access. • Ensure the use of appropriate vegetation clearing techniques (e.g. trees to be felled away from the retained natural area). • Tree grubbing will be restricted to the required activity zone. Where possible, tree stumps will be cut flush to the ground and grubbing will be avoided to minimize soil disturbance, particularly in erosion prone areas. • Design and install stringent erosion and sediment control measures and maintain throughout construction. This will be particularly important in areas adjacent to wetland communities and watercourses. • Routinely inspect sediment and erosion control structures, including after storms, and repair as required. The structures will be cleaned out when accumulated sediment reaches half the design height. • Re-stabilize and re-vegetate exposed surfaces as soon as possible, using native vegetation seed mixes and plantings in specified areas. • Ensure proper containment and filtering of all construction-generated sediment (whether from dewatering or soil exposure from clearing and grubbing). • Ensure appropriate clearing and disposal of all construction-related debris following construction. • Employ proper handling of potentially toxic construction materials and ensure proper spills management. • Implement environmental inspection during construction to ensure that protection measures are implemented, maintained and repaired and remedial measures are initiated where warranted. • Site specific mitigation measures for vegetation units are recommended, where warranted, as outlined in Table 7 1. The site-specific mitigation measures that are recommended to protect and enhance retained vegetation features include the following: <ul style="list-style-type: none"> • Review details of West Robinson Creek valley crossing and grading at Unit FO-11 to specifically determine if large Bur Oak trees within the ROW can be protected. • Install vegetation protection fencing to protect retained vegetation. This is recommended where vegetation removals will occur within forested communities (i.e. FO-7, FO-15 and FO-21). • Review edge management opportunities at Detail Design for the following units: FO-7, FO-15 and FO-21. Consideration will be given to incorporating narrow ‘no-grubbing’ zones (in order to stimulate suckering and edge creation) and edge plantings to help buffer exposed forest interiors from wind, sun and salt spray.

ENVIRONMENTAL ISSUE / CONCERN	AGENCIES	PROPOSED MITIGATION / COMMITMENTS TO FUTURE WORK
		<ul style="list-style-type: none"> • Develop specific valley restoration (Rainbow Creek, Robinson Creek, West Robinson Creek) and enhancement plans during Detail Design, integrating opportunities to remove invasive species, improve cover and enhance diversity. • Review locations of L-ranked and regionally rare flora at Detail Design to determine if protection is feasible (i.e. species is located beyond the grading limits). This is recommended wherever L-ranked flora has been noted (i.e. within Units FO-7, FO-12, FO-15, FO-17b, FO 21). • Review hedgerows at Detail Design to determine the required removals of hedgerow trees. • The stormwater management facilities were located to avoid or minimize encroachment into vegetation features and specifically the valleys. These areas will be reviewed at Detail Design and their outfalls, particularly those into the main valleys, will be sited and designed during Detail Design in consultation with the ecologists to further minimize effects, and ensure the outfalls are stable (avoid potential erosion and sedimentation effects) and that all areas disturbed during their construction are restored and naturalized. • There are a few cases where site-specific mitigation is not warranted since the majority of the unit will be removed, and/or the units are anthropogenic in origin. For example, there are two small vegetation units that will be completely removed (Units MA-10 and FO-17b). No site-specific mitigation measures are recommended for these features, however opportunities to re-create small seasonal marsh depressions (similar to MA-10) will be explored during Detail Design. In addition, no site-specific mitigation measures are warranted for the cultural meadows affected due to their cultural origin, generally transient persistence, and/or minor natural heritage function. • During Detail Design the location of Pond 2 will be reviewed to determine if the impact to FO-19 can be reduced
Wildlife Habitat		
<p>Localized impacts due to removal of and edge encroachment into common vegetation / habitat.</p> <p>Localized potential impact to migratory birds and their nests.</p> <p>Protection of wildlife during construction.</p> <p>Maintaining wildlife movement opportunities.</p> <p>The breeding habitat for the Western Chorus Frog (and other L-ranked amphibians) potentially exists in the general Study Area.</p>	<p>MTO MNR TRCA MOE</p>	<ul style="list-style-type: none"> • The mitigation measures outlined above to minimize effects to vegetation and protect adjacent vegetation areas will in turn protect the associated wildlife habitat functions. • In order to protect nesting migratory birds, the contractor will: <ul style="list-style-type: none"> • Ensure that no active nests will be removed or disturbed in accordance with the <i>Migratory Birds Convention Act</i>. • Apply timing constraints to avoid vegetation clearing (including grubbing) during the breeding bird season (May 1 to July 31). • If vegetation clearing cannot be scheduled outside the breeding bird season, then an avian biologist will be employed to conduct a nest survey in the area to be cleared. If active nests of migratory birds are located then a mitigation plan will be developed and approved by Environment Canada prior to clearing. This may involve delays to allow for fledging. • Inspect the two large culverts (Langstaff Road and Major Mackenzie Drive) that are proposed for removal for nesting activity during the Detail Design phase. If there is any evidence of or potential for their use for nesting of migratory birds, their removal will be scheduled outside of the migratory bird nesting period. • If the structures cannot be removed outside the identified nesting season, ensure that bird nesting preventative measures (such as wire screens or tarps) will be implemented to prevent new nesting prior to May 1 and maintained until July 31 of the calendar year in which they were installed. At a minimum, the preventative measures will be installed at structures where evidence of past nesting was observed. These measures will be periodically checked, and maintained as required, so as not to entrap birds, and will be removed following construction. • Any wildlife incidentally encountered during construction will not be knowingly harmed. • In the event that wildlife encountered during construction does not move from the construction zone, the Contract Administrator will be notified. • Wildlife movement was a specific consideration in the structure design at the two main valley crossings. Specifically, design criteria for the bridges included maintenance of a minimum height of 3 m and a minimum Openness Ratio (OR) of 0.6 to

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		<p>facilitate movement of the full range of animals using this landscape, including large mammals (e.g. White-tailed Deer). The ultimate design heights and ORs based on the Preliminary Designs for the bridges meet or exceed these minimum criteria (all bridges meet the 3 m minimum height and provide ORs > 3 for the ultimate 10 lane scenario).</p> <ul style="list-style-type: none"> For the smaller watercourse crossings (Rain-1, Rain-2, Rain-4 and Rob-7), a minimum target OR of 0.05 will be implemented in order to facilitate movement of small and medium sized mammals. While preliminary culvert sizing has been developed at some of these crossings, generally the designs will not be finalized until Detail Design and therefore final ORs have not calculated at this time. The valley crossing designs will be further developed at Detail Design, with specific consideration of wildlife movement and habitat opportunities. Other specific design aspects that will be integrated into the Detail Design of the bridges to enhance their function as eco-passages and make them more 'wildlife-friendly' include: <ul style="list-style-type: none"> Avoid use of sharp rock protection and ensure areas on both sides of the watercourse will provide substrate materials conducive to animal movement and footing of ungulates. Incorporate cover elements (e.g., woody cover/masses, brush piles, boulders, vegetation etc.) to provide a natural transition with habitat features on either side of the bridge and provide cover under the bridge. Restore adjacent vegetation areas disturbed for construction access using native species, to replace and enhance the existing vegetation to cover along the valleys. Assess the need for fencing to 'funnel' animals to the bridges will be assessed during Detail Design. At Detail Design, review specific locations of Western Chorus Frog breeding habitat (as well as breeding habitats for Gray Treefrog and Spring Peeper) relative to the highway alignment (e.g. associated with units FO-11, FO-15, FO-17b) and further assess their representation generally. This information will allow a refinement of the impact assessment and will determine whether protection is possible (i.e. habitat is located beyond the grading limits, with consideration of indirect effects of noise). If breeding habitat is directly affected, consider reviewing opportunities for re-creation of habitat features at an adjacent location, if feasible and if surplus property is available.
Fisheries and Aquatic Habitat		
<p>Potential impact on fish habitat</p> <p>One fish species of conservation concern (Redside Dace) has been recorded downstream of the general Study Area.</p>	<p>MTO MNR TRCA DFO</p>	<ul style="list-style-type: none"> The EA Report (Section 7.1.2.3) outlines specific mitigation proposed at each watercourse. The four bridge crossings proposed over Rainbow Creek and West Robinson Creek have been designed to avoid direct encroachment into the bankfull channels and to minimize potential indirect effects to the watercourses by maintaining fluvial geomorphic and hydrotechnical functioning of the channels, which will in turn, maintain fish movement and protect the underlying physical habitat features. Construction related mitigation including: <ul style="list-style-type: none"> All instream or near stream works will be conducted during the appropriate in-water timing window. For the four main crossings (Rain-3, Rain-5, Rob-5, Rob-6) this window will be finalized in further consultation with MNR during Detail Design in relation to the 'potential' presence of Redside Dace. Specifically, the draft mapping provided by MNR (MNR 2008) showing reaches falling under a Redside Dace timing window (July 1-September 15) encompasses the reaches of Rainbow Creek (Langstaff Road crossing), West Robinson Creek at the mainline and Major Mackenzie Drive crossings, and East Robinson Creek at the mainline crossing. However, as is outlined in the EA Report, it is unlikely that this species currently resides in any of these watercourse reaches. The only in-water works proposed at these crossings pertain to removal of the existing culverts at Langstaff Road and Major Mackenzie Drive and re-instatement of the open channel sections; the new bridges will fully span the watercourses. Alternatively, and with agreement from the MNR, a warmwater construction timing (from July 1 to March 31) would be applied to protect the resident warmwater fish communities present at these crossings.

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		<ul style="list-style-type: none"> • A warmwater construction timing window (from July 1 to March 31) will also be applied for installation of the culverts and associated works at the minor watercourses supporting seasonal fish use or draining to a downstream fishery (Creek-1, Rain-1, Rain-3, Rain-4, Rain-5, Rob-6, Rob-7). • Sediment and erosion control measures will be implemented during all phases of construction, clean-up and restoration to prevent sediment laden runoff from entering any of the watercourses directly from the construction zone. At a minimum, the plan will address the following aspects: <ul style="list-style-type: none"> • Perimeter silt fence will be installed between the work areas and all reaches of those watercourses where works are required, including ditch and drainage works that drain to watercourses that support fish habitat. • The fencing will be properly installed and regularly inspected and maintained. It will be left in place and maintained until all surfaces contributing drainage to these watercourses are fully stabilized. • All exposed and newly constructed surfaces will be stabilized using appropriate means in accordance with the characteristics of the soil material and slope conditions. • These surfaces will be fully stabilized and re-vegetated as quickly as possible (and at a maximum within 45 days) following completion of the works. • All near-water construction zones will be isolated using standard perimeter silt fencing of the general construction zone up and downstream. The silt fencing will be heavy duty/re-enforced fencing for all disturbed areas of the embankments that drain to the streams. Silt fencing will be regularly inspected and maintained as required. • Only clean materials free of fine particulate matter will be placed in the water for temporary construction measures (e.g. temporary flow management dams will be constructed of 'pea gravel' bags, geotextile fabric or other clean material, temporary barge access pad, if required, will be constructed or clean rock fill) or permanent works (e.g. culvert and channel substrates, cobble/boulder material). • If any temporary dewatering of the near or instream construction zones is required in order to construct the new culverts or pier footings or remove culverts, appropriate energy dissipation and settling/filtration measures will be used for discharge to ensure no erosion or sediment release occurs in the watercourses. No dewatering discharge will be released directly to the watercourses. If temporary dewatering of the near stream construction zone is required, dewatering will be discharged through a filter bag/splash pad located at least 30 m from the watercourses. • All culvert removal and channel restoration works to be completed 'in the dry' using an appropriate temporary flow bypass system to maintain clean flow around the construction zone. To minimize potential for impacts and facilitate restoration where fish use was identified it is recommended that culvert works on the minor crossings be conducted during low flow periods when these features support no or very small flows. This may be beneficial at West Robinson Creek in particular (i.e. instream works at Major Mackenzie Drive crossing) as this watercourse supports low flows throughout the summer months. • Temporary flow bypass plans for the removal of the existing culverts and natural channel re-instatement works at the Langstaff Road and Major Mackenzie Drive crossings of Rain-4 and Rob-6 will be developed prior to construction. It is anticipated that flows will be diverted through a pipe or flume system. The staging will be planned so that diversion period is minimal. Standard 'dam and pump' techniques will be used at the majority of the new culvert installations and at remainder of the culvert removals (Huntington Road, Major Mackenzie Drive culverts), since flows during the summer should be small, and durations will be relatively short. The withdrawal points will be properly sited and designed to prevent intake of silt or bed materials, and the discharge points sited and designed to prevent erosion and any sediment release. • Where there is no flow on watercourses/drainage features requiring instream works, contingency temporary flow bypass measures will be in place to manage any flow in the event of a storm and associated runoff.

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		<ul style="list-style-type: none"> The reinstated channel sections at the Langstaff Road and Major Mackenzie Drive crossings of Rain-4 and Rob-6 will be constructed 'in the dry', and then opened to flow and transitioned with the up and downstream channel sections. As noted above, construction of the new channel sections, and particularly the flow transition, is recommended during the summer during low flow periods. The new channels will be fully stabilized prior to opening. The transition zones will be carefully constructed to ensure a 'seamless transition' with the upstream channel section. A Scientific Collectors Permit will be obtained in order to conduct a fish salvage prior to any works being conducted for the culvert removals (Rain-4, Rob-6, East Robinson Creek Huntington Road and Major Mackenzie Drive culverts) as well as culvert installations (at Rob-7) using appropriate techniques to capture and transfer unharmed any stranded fish as specified in the permit. All dredged, salvaged or stockpiled materials will be located a safe distance from the watercourses edges and stabilized to prevent migration of any sediment or other material to the watercourse. All work areas or other disturbed surfaces draining to the watercourses and/or in the floodplain will be stabilized and re-vegetated with appropriate native, non-invasive species as soon as feasible following construction. The erosion and sediment control measures will be left in place, monitored and maintained in proper working order until all disturbed areas draining to the watercourses are fully stabilized, including establishment of vegetative cover. No equipment shall cross or otherwise enter the other watercourses except to construct the specified works. All activity will be controlled so as to prevent entry of any petroleum products, debris or other potential contaminants/deleterious substances, in addition to sediment as outlined above, to the watercourses. Storage, maintenance or refueling or maintenance of equipment will be conducted at least 30 m away from the watercourses. The Contractor will have an appropriate spills management/response plan in place throughout construction, including spill control and absorbent materials, instructions regarding their use and notification procedures. Every effort will be made to retain as much of the natural vegetation as reasonably possible to help ensure bank stability and control erosion, and to expedite the re-colonization of native plant species. All riparian vegetation removed to construct the highway works will be replaced with a mix of appropriate native species. Additional riparian plantings may be incorporated to enhance existing conditions along the right-of-way (ROW), and along the re-alignment and pool areas as outlined in the site specific mitigation measures section above. Only native shrub and tree species, compatible with the site conditions will be used. A qualified environmental inspector will be on-site as required throughout construction, responsible for ensuring the sediment and erosion control measures are functioning and all of the mitigation measures are being implemented.
Restoration and Enhancement Opportunities		
Permanent loss of vegetation and associated wildlife habitat.	MTO MNR TRCA DFO	<p>MTO does not have a mandate to secure and manage lands for the purposes of terrestrial habitat restoration/creation/enhancement. MTO's mandate focuses on avoidance and mitigation of impacts to natural features. This objective has been effectively achieved through the process of selecting and refining the technically preferred route.</p> <p>MTO recognizes the value of identifying and integrating opportunities for replacement or enhancement of the existing local features where these efforts can reasonably be expected to persist and provide long term ecological benefit. Given the functions associated with the valley systems, particularly within the transitioning land use patterns, it is logical that these areas be targeted to identify opportunities. This can be considered on lands owned by MTO within or adjacent to the ROW that is surplus to transportation needs, or in some cases, where there are adjacent publicly owned properties.</p> <p><u>Specific Opportunities</u></p> <p>Although the valley systems are re-naturalizing over time, opportunities to enhance this process are evident. For example,</p>

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		<p>opportunities exist generally to remove or control invasive species, improve and diversify cover with native tree and shrub plantings, infill vegetation gaps, enhance slope and bank stability and other riparian functions, enhance botanical diversity with seeding of native riparian grasses and herbs and generally enhance connectivity at the valley crossing areas and on other ROW areas that abut the valleys.</p> <p>As highlighted in the EA Report (Section 7.1.1.3), enhancement opportunities have been incorporated into the Preliminary Design of the replacement structures at the Major Mackenzie Drive and Langstaff Road crossings of the main valleys. Specifically, the existing structures at these road crossings are culverts, which provide only limited opportunities for animal movement. These structures will be replaced with bridges that will meet the same minimum design criteria to pass the full range of wildlife as the two new bridges. The opened valley sections through the new bridges will be rehabilitated, re-instating the valley linkages and significantly improving wildlife movement and habitat opportunities relative to the existing conditions at the culvert crossings.</p> <p>Specific areas where restoration and enhancement opportunities can be explored, on lands owned by MTO within or adjacent to the ROW that is surplus to transportation needs, or in some cases, where there are adjacent publicly owned properties, include:</p> <ul style="list-style-type: none"> • The highway crossing of West Robinson Creek where the landscape is currently pastured and very open. This area would benefit substantially from the restriction of cattle access to the creek and riparian and floodplain areas, and subsequent planting/naturalization to improve cover and habitat opportunities, and enhance diversity and connectivity. • The floodplain and riparian areas on the downstream side of the Major Mackenzie Drive crossing of West Robinson Creek and on the upstream side of the Langstaff Road crossing of Rainbow Creek (north side) are also currently quite open and would benefit from additional tree and shrub plantings to improve cover and enhance diversity and connectivity. • There is a heavy concentration of invasive species noted (including Black Swallow-wort and Buckthorn) at the proposed crossing of Rainbow Creek (in Vegetation Unit FO 21). This area could be enhanced through an invasive species management program targeting these two species and the subsequent planting of native shrubs and seeding of riparian herbs and grasses. Discussions with TRCA in regards to invasive species management will continue during Detail Design. • Opportunities to create small floodplain depressions or enhance existing depressions or abandoned channel areas to provide amphibian breeding habitat that could be used by Western Chorus Frog among other species can be integrated in the enhancement design. • Opportunities to replace vegetation cover exist at the stormwater management facilities. All of the stormwater management facilities are located in primarily agricultural field areas abutting the valleys. The outfalls into the valleys will be sited in disturbed areas or sited to otherwise minimize impacts to existing vegetation. The areas set aside for the stormwater management facilities have been sized conservatively. Therefore, in addition to general naturalization of the stormwater management facilities (recognizing limitations on attracting wildlife to these features), buffer areas and any 'surplus' land areas around the margins that are not required specifically for the facility itself can be planted and naturalized. Where feasible the active pond areas can be sited optimally to maximize the area abutting the valleys available for planting. The outfall areas into the valleys will also be restored and naturalized, incorporating opportunities to enhance existing conditions where these outfalls are located in disturbed and open portions of the valleys. • Other general planting and naturalization opportunities include interchange areas and portions of the highway embankments (provided they do not interfere with visibility and safety requirements). While these plantings may not necessarily contribute directly to natural areas depending on their locations, general functions associated with increased vegetation cover in these headwater areas will accrue. <p><u>Commitments to Future Work</u> MTO's first objective has been and will continue to be to minimize impact to vegetation and associated habitat. This objective will be</p>

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		<p>carried through the Detail Design stage, as the highway plans are refined and finalized. These efforts will focus on reducing the clearing footprint within the ROW and restoring disturbed areas to replace vegetation following construction, where feasible and where this vegetation can be retained in the long term.</p> <p>As well, opportunities for replacement of vegetation will also be identified on lands that MTO own or will own that is surplus to transportation needs. Once the EA is approved and MTO completes the property acquisition process, surplus portions of other properties will be assessed to identify other opportunities for restoration and replacement of vegetation cover. Land areas abutting or close to the valleys will be specifically targeted.</p> <p>Where the adjacent portions of the valleys at the crossings or abutting the ROW are publicly owned, MTO will explore opportunities to extend the vegetation and habitat restoration plans during Detail Design, in consultation with the agencies.</p> <p>These opportunities will be explored and developed further during Detail Design once MTO land ownership and project requirements are finalized. Efforts will target the valley and immediately adjacent lands, focusing on mitigation and restoration, with integration of opportunities to restore and enhance vegetation and habitat conditions that have been generally disturbed through agricultural and other cultural activities. The mitigation, restoration and enhancement plans will be developed in consultation with the agencies. The plans will be incorporated in the Contract Documents.</p>
Drainage and Stormwater Management		
Additional pavement area has the potential to increase the quantity of water into receiving waters and decrease the quality of water	MTO MOE MNR TRCA DFO	<p>The proposed mitigation and commitments to future work includes:</p> <ul style="list-style-type: none"> • Nine stormwater management ponds will be constructed to provide treatment for the increase in pavement. Full detail designs of all stormwater management facilities will be conducted during subsequent design phases using TRCA modeling, watershed reports, and unit release rates, where available; • Areas where stormwater management ponds are not feasible, Low-Impact Developments, such as flat-bottom grass-lined swales, will be utilized. Low-Impact Development within the TRCA jurisdiction will be designed using the document "Low Impact Development Stormwater Management Manual", dated November 2008; • All stormwater management facility designs will incorporate discharge practices in order to mitigate potential negative thermal impacts to receiving watercourses; • The outlet structure for the 25mm erosion storm for all stormwater management ponds will utilize a "bottom draw" system, which allows the water discharged from the pond to be taken from the lower (cooler) levels of the pond; • For the receiving coldwater watercourses, techniques for providing thermal mitigations to discharged stormwater management pond flows will be provided. Thermal practices include, but not limited to: deepening the permanent pool to a minimum of 3 metres to facilitate the discharge of cooler water; discharging low flows to an infiltration basin; or providing vegetated shade to outlet channels; • Outlet structures discharging to a watercourse with sensitive fish habitat or environmental area will be sited during subsequent design phases through a site visit with staff from MTO, MOE, MNR, and the TRCA; • Stormwater management facilities will not be located within sensitive environmental features or regulated floodline areas; • Stormwater management facilities will not discharge to intermittent watercourses that are primarily groundwater fed, as the discharge from the facility may have a negative erosive impact on the receiving watercourse; • Erosion and sediment control measures and contract specifications are to be developed during subsequent design phases. These documents will be reviewed with the TRCA, MTO, MNR, and MOE prior to construction. • Maintenance schedule for the stormwater facilities will be developed during detail design and provided to MOE. <p>For further information on the proposed mitigation, proposed commitments to future work and recommendations, please refer to</p>

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		<p>Appendix C (particularly Sections 9.0, 10.0 and 11.0).</p> <p>In addition, it is noteworthy that MTO employs and recognizes the importance of best salt management practices. MTO follows best management practices for road salt management, which are consistent with the best practices in North America. Best management practices include advanced weather forecasting, electronic spreader equipment, the use of brines in pre-wetted salt, and varying application rates of road maintenance materials to match weather conditions.</p> <p>MTO partners with stakeholders using the latest technology, tools and methods to keep roads safe for winter driving and to minimize salt usage. For example, MTO is a member of a national Road Salt Management working group assigned by the Council of Deputy Ministers responsible for transportation and highway safety. Consisting of both Canadian road maintenance agencies and Environment Canada, this group ensures state-of-the-art salt management practices are identified. MTO will continue to investigate ways to control and reduce salt usage while ensuring highway safety. MTO will continue to explore new and emerging technologies to further enhance road salt management practices.</p> <p>The salt management best management practices employed by MTO will help to minimize salt impacts; however, salt will still be present in highway run-off. The design and mitigation measures identified above and Appendix C are provided in order to mitigate and minimize potential water quality impacts from run-off</p>
Groundwater Resources		
Potential for affecting groundwater quantity and quality	MTO MOE TRCA Property Owner	<p>A groundwater monitoring program will be carried out to document the effects of the proposed construction of Highway 427 Extension on local groundwater resources. The recommended framework for the monitoring program includes the following:</p> <p><u>For Construction</u></p> <ul style="list-style-type: none"> • Prior to the commencement of construction activities, a door to door well survey will be carried out to determine the status of groundwater users within 300 m of the edges of the proposed highway alignment. Based on the survey results, the appropriate site specific individual well monitoring program can be established where a potential interference risk is considered credible. • Installation of one monitoring well (screened in the shallow overburden) near each temporary or permanent groundwater dewatering works. • The monitoring for elevation will include: <ul style="list-style-type: none"> • Pre-construction: weekly 1 month before start of construction. • During construction: dependant upon length of construction; with a minimum frequency of once per month. • Post-construction: weekly for 2 weeks after end of construction. • If there are impacts to the quality and quantity of individual wells, MTO will provide temporary water supply until dewatering operations have been completed and/or replace or restore the water supply by drilling private wells deeper into underlying overburden soils. • The groundwater quality monitoring is as follows: once prior to, once during and once following construction unless contamination is encountered at which point the monitoring will be continued and assessed by a professional geoscientist or engineer. Groundwater quality analysis should include general water chemistry (ions, metals and inorganics), VOCs and polycyclic aromatic hydrocarbons (PAHs). • A spill response program will be developed to minimize the potential for groundwater contamination along the alignment and near the surface water crossings in particular. This will include a procedure for timely notification of the spill, and established procedures for spill contaminant and cleanup.

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		<ul style="list-style-type: none"> For the segments that require a roadway cut (i.e. in the vicinity of Langstaff Road), geotechnical drilling will be conducted during future design phases to determine the subsurface soil and groundwater conditions within the cut section and the degree / extent of potential water table lowering. <p><u>For Highway Operation</u></p> <ul style="list-style-type: none"> Given the low hydraulic conductivity of the overburden soils the potential for long term impacts to groundwater quality is low. These impacts can be further minimized with the application of best management practices for road salting and an appropriate spills response program. MTO employs and recognizes the importance of best salt management practices. MTO follows best management practices for road salt management, which are consistent with the best practices in North America. Best management practices include advanced weather forecasting, electronic spreader equipment, the use of brines in pre-wetted salt, and varying application rates of road maintenance materials to match weather conditions. <p>MTO partners with stakeholders using the latest technology, tools and methods to keep roads safe for winter driving and to minimize salt usage. For example, MTO is a member of a national Road Salt Management working group assigned by the Council of Deputy Ministers responsible for transportation and highway safety. Consisting of both Canadian road maintenance agencies and Environment Canada, this group ensures state-of-the-art salt management practices are identified. MTO will continue to investigate ways to control and reduce salt usage while ensuring highway safety. MTO will continue to explore new and emerging technologies to further enhance road salt management practices</p>
Air Quality		
<ul style="list-style-type: none"> MTO carried out an air quality study and has determined that significant effects are not anticipated during operations. Some minor impacts (construction equipment emissions and dust) are anticipated during construction. 	MTO MOE	<ul style="list-style-type: none"> Construction activities such as the operation of heavy equipment, topsoil removal, excavation and grading will generate dust and exhaust emissions which have the potential to result in temporary decreases in air quality. These activities are therefore anticipated to result in some short-term, localized effects to air quality around the project site. These effects will be controlled by good construction practice, local legislation and manufacturing design. To mitigate potential effects associated with emissions from construction equipment, the Contractor will be required to keep equipment in good operating conditions and will be asked to avoid unnecessary idling of equipment. The use of well-maintained equipment will ensure that combustion emissions are kept to a minimum. To mitigation potential air quality effects resulting from the creation of dust during construction, dust suppressant measures, as identified in Ontario Provincial Standard Specification (OPSS) 506, will be used during construction. OPSS 506 outlines the requirements for dust suppressants and their application. In addition, any disturbed lands will be vegetated (e.g. seeded) as appropriate to reduce the potential for dust to develop from exposed soil. As coniferous trees may provide a more effective barrier to particulates than deciduous trees, the use of coniferous species will be considered in developing the vegetation mitigation, restoration and enhancement plans plan during Detail Design.
Management of Excess Material and Property Contamination		
<ul style="list-style-type: none"> Surplus materials will be generated during construction and require proper management / disposal. An area was identified as having potential for site contamination within the recommended alignment of the Highway 427 extension between Highway 7 and Major Mackenzie Drive. 	MTO MOE	<ul style="list-style-type: none"> Excess materials generated during construction will be managed in accordance with OPSS 180. Opportunities to minimize excess material generation through salvage and reuse (such as earth material for slope flattening) will be identified during the subsequent detail design phase. Phase I and II Environmental Site Assessment will be undertaken for those sites identified in Section 7.1.6 of the EA Report.

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Individual Properties and Access		
<ul style="list-style-type: none"> Impacts on property. Impacts to access 	MTO Property Owner	<ul style="list-style-type: none"> Standard mitigation/compensation measures for property impacts are addressed on an individual property/land owner basis. Mitigation and compensation measures for those properties with direct impacts will include, but are not limited to property acquisition at fair market value in accordance with Ministry policy and directives; and relocation of access. In cases where only part of the property is required, the effect this may have on the balance of the property will be taken into consideration.
Noise		
<ul style="list-style-type: none"> The future absolute noise levels are less than 65 dBA for all receiver locations Eight (8) receiver locations (R1, R5, R7, R9, R10, R11, R12 and R14) are predicted to experience an increase in future noise levels > 5 dBA with the proposed Highway 427 Extension. Construction noise issues. 	MTO MOE	<ul style="list-style-type: none"> Noise mitigation was reviewed for the locations with an increase in sound greater than 5 dBA. It was determined that noise mitigation is not considered to be technically and/or economically feasible at these locations. Further examination will be carried out during the detail design phase if it is determined there are significant changes to the horizontal and vertical profile and/or changes to the traffic projections that warrant additional noise analysis at the existing NSAs. The NSAs in the study area are likely to be displaced in the future due to the anticipated land development adjacent to the future Highway 427 extension. Further examination will be carried out in the subsequent detail design phase to confirm the status of the existing NSAs within the study area. During construction of the proposed improvements, the contractor will be required to abide by the Contract Operational Constraints and municipal noise control by-laws (including any exemptions). The Contractor will be required to keep idling of construction equipment to a minimum and to maintain equipment in good working order to reduce noise from construction activities. Noise emissions from construction equipment will also be subjected to the limits set out in the MOE Publication NPC-115 and the Noise Control Guideline for Class Environmental Assessment of Undertakings. Construction may occur outside of normal working hours and on weekends for certain activities along the Highway 427 extension. Such work will be carried out in compliance with local noise by-laws and any noise by-law exemptions that may be granted. If complaints regarding construction noise arise from construction, they will be investigated according to the provisions of the MTO Noise Guide (October 2006).
Archaeological Resources		
<ul style="list-style-type: none"> Stage 2 Archaeological Assessments were undertaken for all properties where permission to enter was provided. The remaining Archaeological Assessments will be completed once an access agreement can be reached or MTO owns the property. 	MTO MCL	<ul style="list-style-type: none"> The Preliminary Design has been modified to avoid direct impacts to the James Moody site, AkGv-294, located on property 32 on the north side of Major Mackenzie Drive. However, since the corridor lies within the 10 metre buffer zone around the site limits established by the Stage 3 CSP, a Stage 3 test unit excavation within the corridor limits is required. This will involve the excavation of one metre square units placed at five metre intervals across the buffer zone within corridor limits prior to construction. During construction, the James Moody site will be protected to ensure that no construction activities including storage/stockpiling impact the archaeologically sensitive area. This shall include: <ul style="list-style-type: none"> Erect a temporary barrier around the area to be avoided. Issue “no go” instructions to all on site construction crews, engineers, architects or others involved in day-to-day decisions during construction. Show the location of the area to be avoided on all contract drawings, when applicable. Before grading and other soil disturbing activities, inspect to confirm that the placement of barriers conforms to the location and extent of the area to be avoided. During grading and other soil disturbing activities, inspect and monitor the area to be avoided to verify the effectiveness of avoidance strategies. If alteration of the archaeological site is observed at any time during construction, notify the

ENVIRONMENTAL ISSUE / CONCERN	AGENCIES	PROPOSED MITIGATION / COMMITMENTS TO FUTURE WORK
		<p>ministry immediately.</p> <ul style="list-style-type: none"> After completion of the grading and other soil disturbing activities, inspect and report to the Ministry of Culture on the effectiveness of the strategy in ensuring that the area to be avoided remains intact. The Preliminary Design has been modified to minimize impacts to the Coleraine Burying Grounds located on property 34B on the south side of Major Mackenzie Drive. However, in order to ensure no unmarked grave shafts remain between the current Burying Grounds property limits and roadside ditching, Stage 2 monitoring of the mechanical removal of topsoil will be completed within the undisturbed corridor limits. During construction, the Burying Grounds will be protected to ensure that no construction activities including storage/stockpiling impact this archaeologically sensitive area (see above protection standards). The Preliminary Design has been modified to avoid impacts to the Coleraine Schoolhouse located on property 34B on the south side of Major Mackenzie Drive. During construction, the site will be protected to ensure that no construction activities including storage/stockpiling impact the archaeologically sensitive area (see above protection standards). If impacts cannot be avoided, a Stage 3 Archaeological Assessment and possibly Stage 4 excavation will be required. Stage 2 Archaeological Assessment is required for properties as depicted in Exhibit 7-6 of the EA Report. This will be conducted prior to construction. The Stage 2 Reports will be filed with the Ministry of Culture. Construction cannot occur at those sites until the Ministry of Culture has concurred that no further Archaeological Assessment work is required prior to construction. No further archaeological work is required for the 15 isolated, pre-contact findspots including: AkGv-54 (MPA 1989); FS 3 (AMICK 2009) and findspots 1 to 13 including AkGv-297, AkGv-298, AkGv-299, AkGv-300, AkGv-301 and AkGv-302 (NDA 2009). No further archaeological work is required for the remainder of the project based on negative survey results. If human remains are discovered the police or coroner and the Register of Cemeteries, Ministry of Government Services will be notified immediately in accordance with the <i>Cemeteries Act</i>. Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the <i>Ontario Heritage Act</i>. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the <i>Ontario Heritage Act</i>. Further investigation and notifications will be conducted in accordance with the MTO/MCR "Protocol for Dealing with Archaeological Concerns on Ministry of Transportation Undertakings". MTO is committed to sharing the results of future archaeological investigations and continuing discussions with First Nations as appropriate throughout the design and construction process to discuss appropriate mitigation when details are known.
Heritage Resources		
<ul style="list-style-type: none"> There are four (4) direct effects, i.e. displacement or removal, and twelve (12) indirect impacts, i.e. disruption effects, associated with the technically preferred alternative. 	MTO MCL	<ul style="list-style-type: none"> Complete the site specific mitigate measures outlined in the EA Report
Utilities		
<ul style="list-style-type: none"> Utility relocations including existing 230kV towers north of Langstaff Road The existing profiles of Zenway Blvd and Langstaff Road will be raised significantly impacting municipal services. 	MTO HYDRO ONE YORK REGION	<ul style="list-style-type: none"> MTO will further consult with Hydro One during the detail design phase of this study regarding the relocation of the Hydro One 230 kV towers. It is recommended that Hydro One use a monopole tower for the relocated 230 kV tower in the transitway in order to reduce footprint. Municipal services (watermains, storm sewers, sanitary sewers, hydro) may need to be relocated due to the high fills and bridge abutments being proposed. Details of the relocation will be discussed with the municipalities during Detail Design.

ENVIRONMENTAL ISSUE / CONCERN	AGENCIES	PROPOSED MITIGATION / COMMITMENTS TO FUTURE WORK
<ul style="list-style-type: none"> York Region is currently constructing a new watermain connection along Huntington Road from Rutherford Road to Nashville Road. 		<ul style="list-style-type: none"> Preliminary Highway 427 Extension plans have been provided to the Region of York for the purpose of reinforcing the Huntington Road watermain design to accommodate the freeway.
Construction Staging		
<ul style="list-style-type: none"> Motorists may experience delays and disruption during construction. 	<p>MTO YORK REGION CITY OF VAUGHAN CPR</p>	<ul style="list-style-type: none"> All the portions of the recommended alternative can be constructed without impacting existing travel routes except at the Region's 427 Interim Arterial Extension (Regional Road 99) area. The details regarding construction staging and timetable will be provided during detail design. In addition, MTO will work with the municipalities in the development of the construction staging during detail design. A traffic staging plan will be developed in the subsequent design phases. Where the existing arterial crossing roads need to be reconstructed, a temporary detour roadway will also be constructed to maintain traffic. The 427 Interim Arterial Extension has been built as a short term measure to temporarily relieve the terminus of Highway 427 at Highway 7. During construction of the Highway 427 extension to the north from Highway 7, it is not possible to maintain traffic of the 427 Interim Arterial Extension at all times, MTO will work to mitigate traffic impacts by minimizing the duration of the closure. In addition, the reconstruction of Zenway Boulevard will require a temporary closure of Zenway Boulevard in the vicinity of the intersection with 427 Interim Arterial Extension. Properties on Zenway Boulevard will be accessed from either the east via Highway 27 / Vaughan Valley Boulevard or the west via Highway 50 / Huntington Road. The details regarding construction staging and timetable will be provided during detail design. Consultation with CP Rail will continue in subsequent design phases to minimize impact to the rail operations in the construction of the CPR overpass. York Region Emergency Services Branch will be provided with details regarding access routes, egress routes, duration of impediments, and any possible operational impacts resulting from construction. The Peel District School Board will continue to be notified of the project details and provided with information regarding how the proposed works may impact school bus service.
Transportation		
<ul style="list-style-type: none"> The project will impact existing road crossings, which will require future grade separations or closures. 	<p>MTO Municipalities</p>	<ul style="list-style-type: none"> There are 5 crossing roads within the study area limits (Zenway Boulevard, Langstaff Road, Rutherford Road, McGillivray Road and Major Mackenzie Drive). Interchanges are proposed at 3 locations (Langstaff Road, Rutherford Road and Major Mackenzie Drive). The proposed cross-sections include: <ul style="list-style-type: none"> a 4-lane cross-section at Langstaff Road and Zenway Boulevard. In addition, the proposed right-of-way provided for McGillivray Road can accommodate a future widening of 4 lanes and 1.5 m sidewalk on both sides of the road a 6-lane cross-section at Rutherford Road and Major Mackenzie Drive. The 6-lane cross sections include provisions for a Transit/HOV lane. All cross-sections protect for a 1.5 m sidewalk on both sides. Langstaff Road, Rutherford Road and Major Mackenzie Drive cross-sections protect for a 1.5 m bike lane on either side of the roadway. The structures of the crossing roads have been designed to accommodate sidewalks, as well as bike lanes on Langstaff Road, Rutherford Road and Major Mackenzie Drive. Details of the bike lane routes in the vicinity of the ramp area will be determined in consultation with the municipality during detail design. The design of the cross-sections for the crossing roads were per the local and regional municipal requirements. The cost sharing for all elements of these roadways will be discussed with the municipalities during detail design. Local road realignments / connections are required. A brief description of each road realignment / connection is provided below.

ENVIRONMENTAL ISSUE / CONCERN	AGENCIES	PROPOSED MITIGATION / COMMITMENTS TO FUTURE WORK
		<ul style="list-style-type: none"> ○ Major Mackenzie Drive will be realigned northerly for a 1.5 km section in the vicinity of the proposed Major Mackenzie Drive Interchange. This realignment allows for the development of the interchange and also eliminates Major Mackenzie Drive's existing intersection with Huntington Road. ○ Huntington Road will be removed from McGillivray Road northerly to just north of the realigned Major Mackenzie Drive. Huntington Road north will be realigned to connect to Major Mackenzie Drive between Highway 427 and the CPR rail line as discussed in Section 4. Huntington Road south will connect to McGillivray Road. A roadway will connect McGillivray Road and Major Mackenzie Drive. This roadway, which was identified in the approved Huntington Road Class EA Study from Major Mackenzie Drive to McGillivray Road (May 2004) conducted by City of Vaughan and CPR, is located approximately 650 m east of existing Huntington Road. The roadway intersection with McGillivray Road is located close to the existing CPR spur line. As identified in the Huntington Road EA Study, when traffic (road and rail) warrants in the future, the City of Vaughan will determine a long term solution if necessary as part of a future EA study. ○ McGillivray Road will be realigned for a 800 m section approaching Rutherford Road to achieve proper intersection spacing to the Rutherford Road Interchange. Based on a review of sight distance requirements, it is feasible to locate the intersection of the realigned McGillivray Road between the future Robinson Creek Bridge and future Rutherford Road/CPR rail grade-separation. Final alignment, including location of the intersection with Rutherford Road, will be determined in consultation with the City of Vaughan and York Region. The existing McGillivray Road in this section will not be abandoned but will end in a cul-du-sac to maintain access to existing properties.

9. LEGAL AGREEMENTS AND COST SHARING

Legal agreements, cost sharing and recoverable arrangements will need to be negotiated with affected utility companies.

Legal agreements and/or cost sharing will need to be discussed with the York Region and City of Vaughan to address the future municipal road rights-of-way, the reconstruction of the crossing roads and the maintenance of lighting and traffic signal equipment. As noted in Section 4.2, the design of the cross-sections for the crossing roads (Zenway Boulevard, Langstaff Road, Rutherford Road and Major Mackenzie Drive) were per the local and regional Municipal requirements.

Legal agreements will need to be negotiated with affected property owners.

10. DESIGN CRITERIA

The Preliminary Design Criteria for this project is included in Appendix H. The Preliminary Design Criteria was established from MTO's *Geometric Design Standards for Ontario Highways Manual*.

The preliminary design of the highway adheres to the design standards of the manual. However, as noted in Section 4.0, both the proposed E-S and W-N loop ramps are entered using a direct spiral, which is similar to the existing E-S loop ramp. The direct spirals were used to avoid widening the Highway 7 structure. It should be noted that as part of York Region's VIVA, the Highway 7 structure would require widening for the implementation of VIVA; however, the widening of the structure to accommodate VIVA is not scheduled. If York Region widens the structure, the ramp can be adjusted.

11. COST ESTIMATE

The total preliminary construction cost is estimated to be approximately \$300M. The major items include approximately \$170M for new structures, including \$85M for watercourse crossings and \$85M for Roadway/Rail crossings. The next major item is the roadway pavement and grading costs of \$128M, this number also incorporates items such as removals, staging, minor utility relocation, drainage and other minor items. The 230kV hydro tower relocation costs have been included as \$2M. The preliminary cost of major items are summarized in Exhibit 11-1. All costs include 30% for minor items, 25% for contingencies and 10% for Engineering and Contract Administration.

These numbers are at a planning/preliminary design level and subsequent design phases will further refine the design and complete cost estimates in greater detail.

Exhibit 11-1 Preliminary Cost of Major Items

ITEM	COST
Roadway (incl. roadway pavement, grading, removals, staging, minor utility relocation, drainage and other minor items):	
• Highway 427 Mainline	\$88 M
• Interchanges:	
○ Highway 7	\$2.8 M
○ Langstaff Road	\$15.5 M
○ Rutherford Road	\$6 M
○ Major Mackenzie Drive	\$11 M
• Other Crossing Roads:	
○ Zenway Boulevard	\$2.5 M
○ McGillivray Road	\$1.4 M
○ Huntington Road	\$0.8 M
Structures:	
• Zenway Boulevard Underpass	\$11 M
• Highway 427 Rainbow Creek Bridges (NB and SB)	\$34 M
• Rainbow Creek Bridge at Langstaff Road	\$10.5 M
• Langstaff Road Underpass	\$20 M
• Rutherford Road Overpass (NB and SB)	\$15 M
• Highway 427 West Robinson Creek Bridges (NB and SB)	\$22.5 M
• CPR / McGillivray Road Overpass	\$30 M
• Major Mackenzie Drive Overpass (NB and SB)	\$18 M
• West Robinson Creek Bridge at Major Mackenzie Drive	\$9 M
Hydro Tower Relocation	\$2 M
Total Preliminary Construction Cost (2009 figure)	\$300 M

12. INITIATION OF ACTIVITIES REQUIRED FOR DETAILED DESIGN

The following key activities should commence prior to or immediately following the initiation of the Detail Design process:

- Detailed engineering survey – A detailed engineering survey is required to provide an accurate digital terrain model (DTM) and locate precise property lines. The highway design shown in this preliminary design study was based on a DTM provided by MTO based on 2002 aerial photography. Given the high rate of development in the last few years, this information was supplemented by design drawing from developers and York Region in sections where the current DTM was out of date. The accuracy of the information is sufficient only for preliminary design.
- Memorandum of Understanding (MOU) to Hydro One – A MOU should be issued to Hydro One. Hydro One will then commence the planning and design process for the relocation of the hydro towers.

APPENDIX
