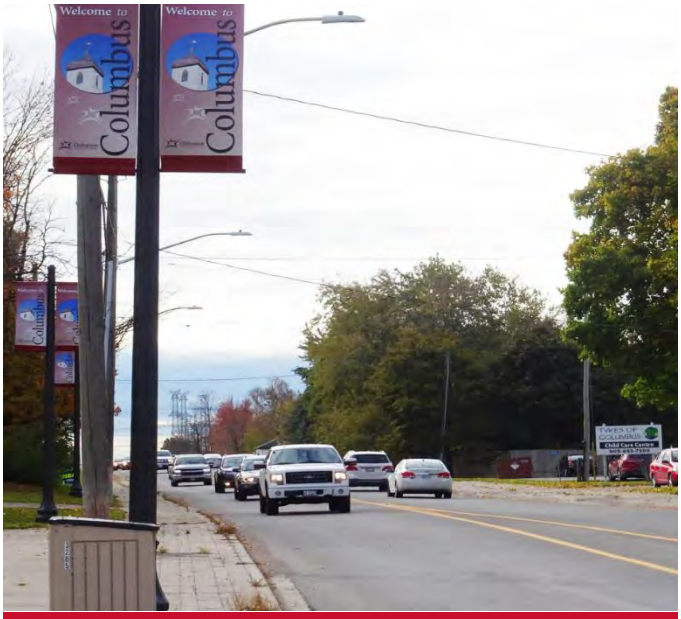

Integrated Columbus Part II Planning Act and Municipal Class Environmental Assessment Act Study

Phase 2 Transportation Report

City of Oshawa
November 13, 2019

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1 Introduction

The City of Oshawa has initiated an integrated Study that will satisfy the requirements of the Planning Act and Master Plan requirements of the Municipal Class Environmental Assessment Act, for the Columbus Community, focusing on the Columbus Part II Planning area. The Columbus Part II Planning Area is identified in Schedule "E" of the Oshawa Official Plan and shown on **Exhibit 1-1**. The Study aims to achieve the City's objectives for future growth while considering the historical context, cultural heritage, scale of development, transportation and servicing infrastructure, and the protection and enhancement of environmental and natural features in the area. The Study's objectives focus on advancing development which is consistent with the Provincial, Regional and City policy framework.

This Phase 2 Transportation Report documents:

1. Transportation assessment of preliminary alternative transportation networks, completed to inform the development of three Land Use and Road Alternatives
2. Transportation assessment of Land Use and Road Alternatives including traffic analysis and preliminary cost estimates for major transportation infrastructure
3. Design feasibility of the draft preferred alternative
4. Refinements and recommendations for further study

It should be noted that the development of land use and road alternatives followed the assessment of preliminary transportation network alternatives. As such refinements to the network were undertaken in parallel to the identification of land uses within the Columbus Part II Planning area.

1.1 Study Area

The Study Area is located in the City of Oshawa, within the Regional Municipality of Durham. The Study Area extends beyond the Columbus Part II Planning Area, and is generally bounded by Howden Road to the north, the Oshawa-Whitby boundary to the west, Winchester Road to the south and the east branch of the Oshawa Creek to the east. The Study Area extends beyond the Part II Planning Area in order to provide a broader assessment of all the requirements for development including transportation and infrastructure requirements. **Exhibit 1-1** illustrates the Study Area as well as the Columbus Part II Planning Area.

1.2 Study Process

This integrated Study seeks to advance development in a manner that is consistent with both the Planning Act and Municipal Class Environmental Assessment Act requirements. The Study will follow the Master Planning process (Approach 4 – Integration with the Planning Act) as described in the Municipal Engineers Association Municipal Class Environmental Assessment (October 2000, as amended in 2007, 2011 and 2015).

The Master Plan will examine transportation, water and wastewater infrastructure requirements for the Study Area. At this time, the Study is planning to address Schedule B and C requirements within the completed Notice of Study Completion. It is noted however that upon confirmation of the road network and in consultation with review agencies, the project schedule will be reviewed to re-confirm if Schedule B and C project requirements are addressed within the level of investigations undertaken. If not then the Notice of Completion may serve to fulfill Schedule B requirements only.

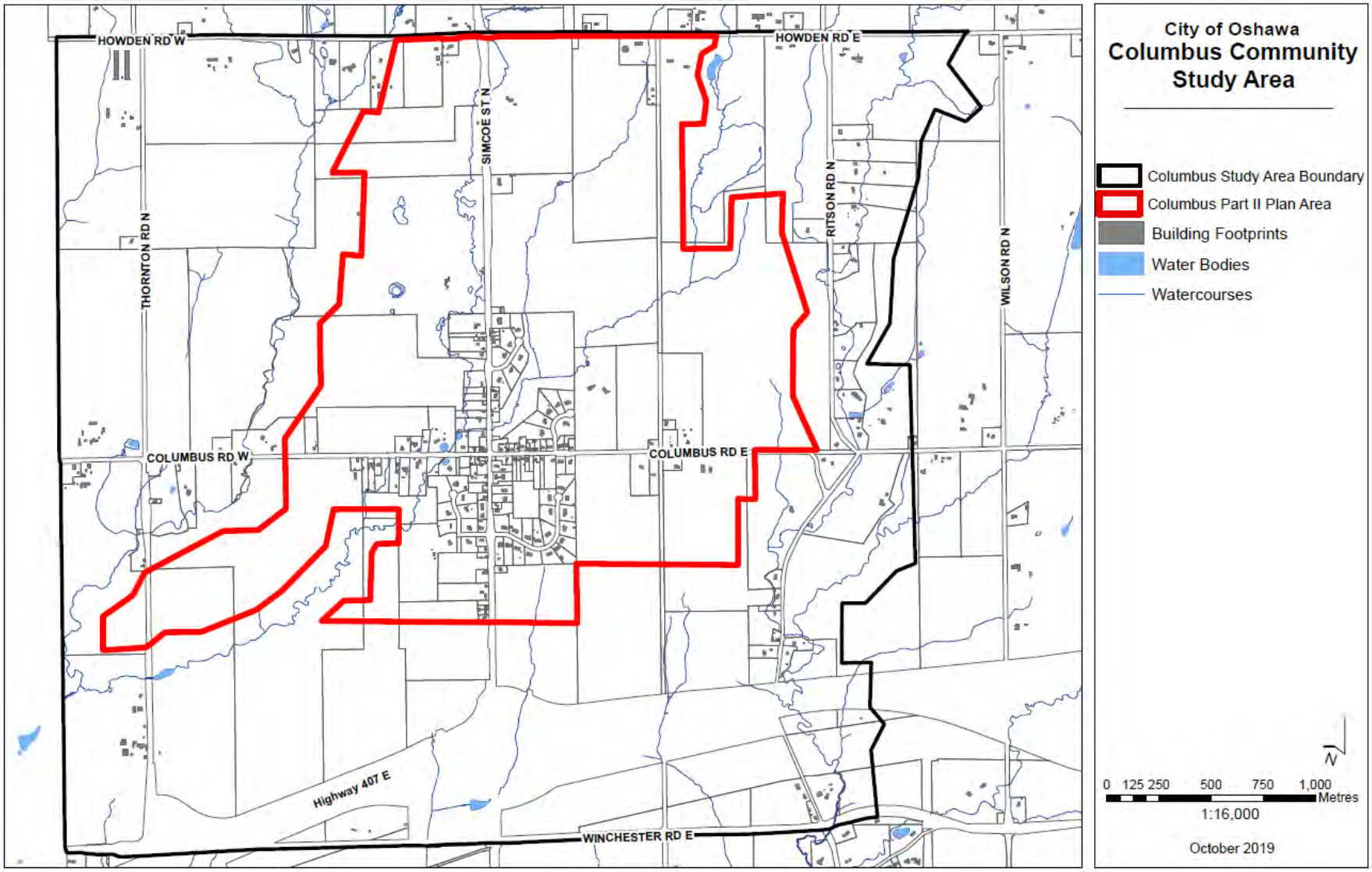


Exhibit 1-1: Study Area

2 Development of Preliminary Transportation Network Alternatives

Preliminary transportation network alternatives were developed prior to the development of land use and road alternatives building upon the Phase 1 Problem and Opportunity Statement which identifies the existing transportation issues, and recognizes the opportunity to improve the Study Area transportation network for all modes.

2.1 Land Use Assumptions

Population and employment assumptions for the traffic zones within and around the study area in **Exhibit 2-1** were based on the Region of Durham's Emme model. These assumptions forecasted significant population and employment growth in the Columbus area – 6,400 people and 660 jobs, which are summarized by traffic zone in **Table 2-1**.

Relative to the City of Oshawa as a total, the Region's Emme model assumes 159,400 people and 50,700 jobs in 2011 and 199,700 people and 86,300 jobs by 2031.

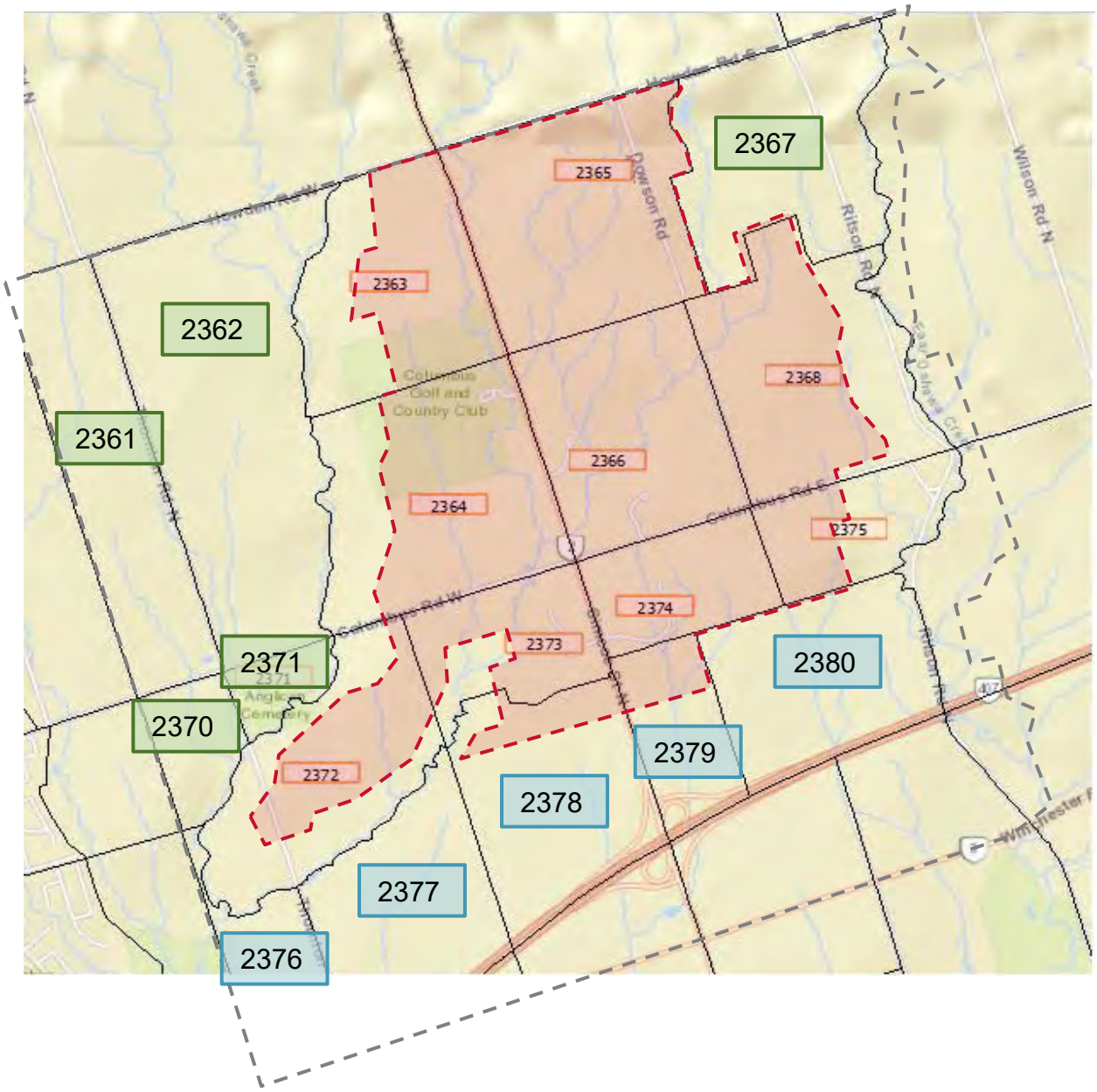


Exhibit 2-1. Durham Region Emme Model Traffic Zones

Table 2-1. Land use assumptions for 2011 and 2031 Durham Emme model

2363	21	-	775	95
2364	69	1	880	85
2365	9	-	1,259	123
2366	117	2	945	95
2368	27	1	866	95
2372	9	-	509	60
2373	87	5	375	30
2374	93	2	541	50
2375	6	-	261	25
2361	9	-	8	-
2362	12	-	17	-
2367	9	-	-	-
2370	6	-	8	-
2371	12	-	12	-
2376	9	-	5	-
2377	-	-	9	-
2378	18	-	4	40
2379	18	-	30	45
2380	27	1	-	-

These land use assumptions were used to develop and assess four preliminary transportation network alternatives. Refinements to these alternatives may be made during the consideration of land use forecasting and development of the Land Use and Road Alternatives (**Section 4**).

2.2 Preferred Natural Heritage System Crossing Locations

As input to the development of transportation network alternatives, the parallel Columbus Subwatershed Study identified preferred Natural Heritage System Crossing Locations which minimize overall impacts. The locations are illustrated in **Exhibit 2-2**.

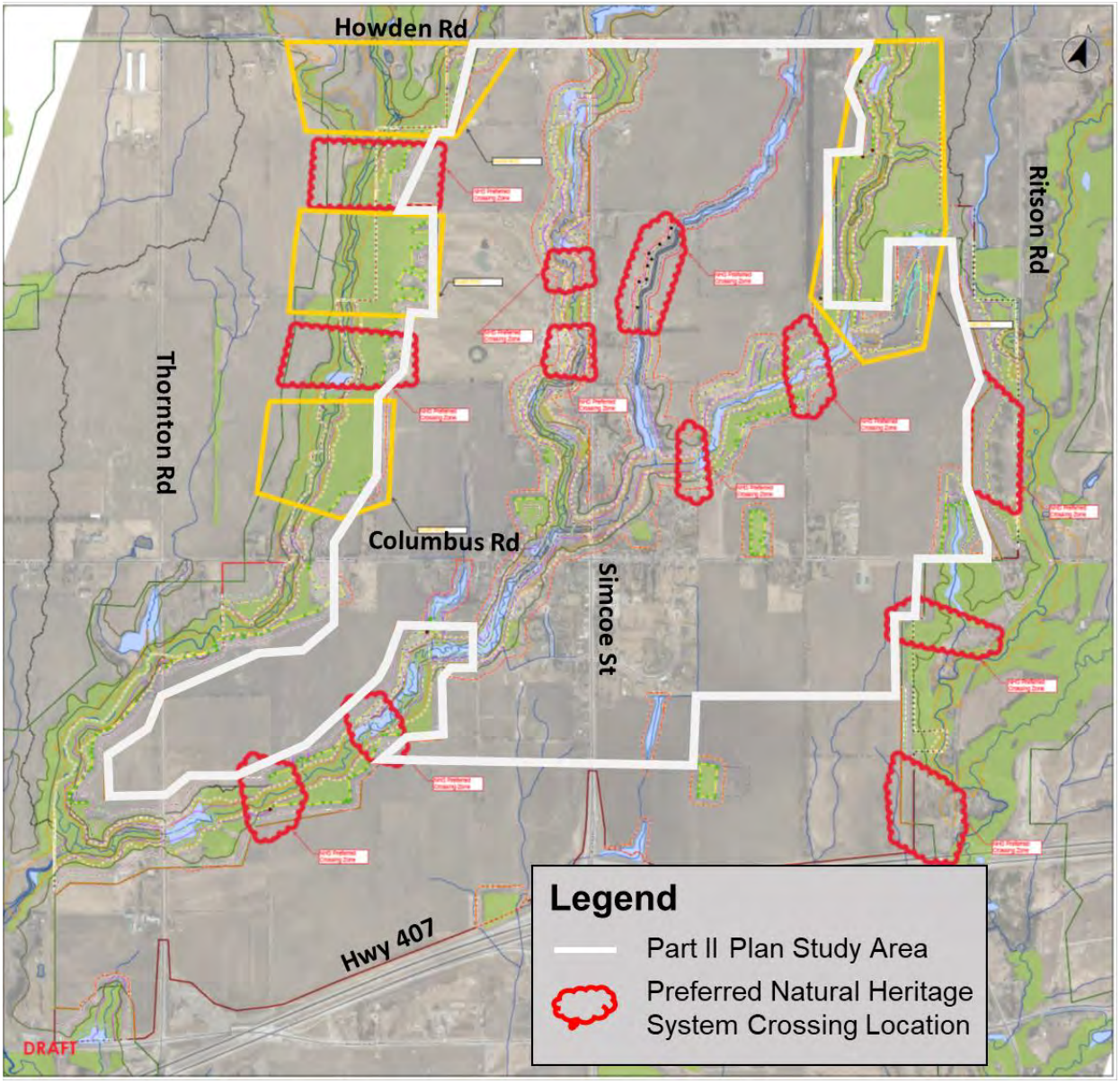


Exhibit 2-2: Preferred Natural Heritage System Crossing Locations

2.3 Preliminary Transportation Network Alternatives

Four preliminary transportation network alternatives are identified for consideration in this analysis as follows:

1. Alternative 1 - Minimal Connectivity is illustrated in **Exhibit 2-3**, and offers a collector road system which does not require any major watercourse crossings, generally minimizing costs at the expense of connectivity.
2. Alternative 2 - Connected Collector Road Network supports development through a new collector road system which requires new watercourse

crossings to improve connectivity. Two sub-options are identified as follows:

a. A collector network with high connectivity shown in **Exhibit 2-4**

b. A collector network with partial connectivity to minimize impact on NHS, as shown in **Exhibit 2-5**

3. Alternative 3 - Simcoe Street Bypass proposes a re-routing of the existing Simcoe Street North through Columbus, and a downgrading of the existing street to serve a more local purpose. Two sub options are identified as follows:

   a. West bypass shown in **Exhibit 2-6**

   b. East bypass shown in **Exhibit 2-7**

4. Alternative 4 - Oshawa Transportation Master Plan (T.M.P.) Network considers the recommendations of the Oshawa T.M.P, shown in **Exhibit 2-8.**

It should be noted that the classification of new roads identified in the alternatives above is consistent with Table 5 in the City of Oshawa Official Plan (Classification of Roads). Furthermore, it is clarified that these networks are preliminary and are intended to inform the development of Land Use and Road Alternatives.

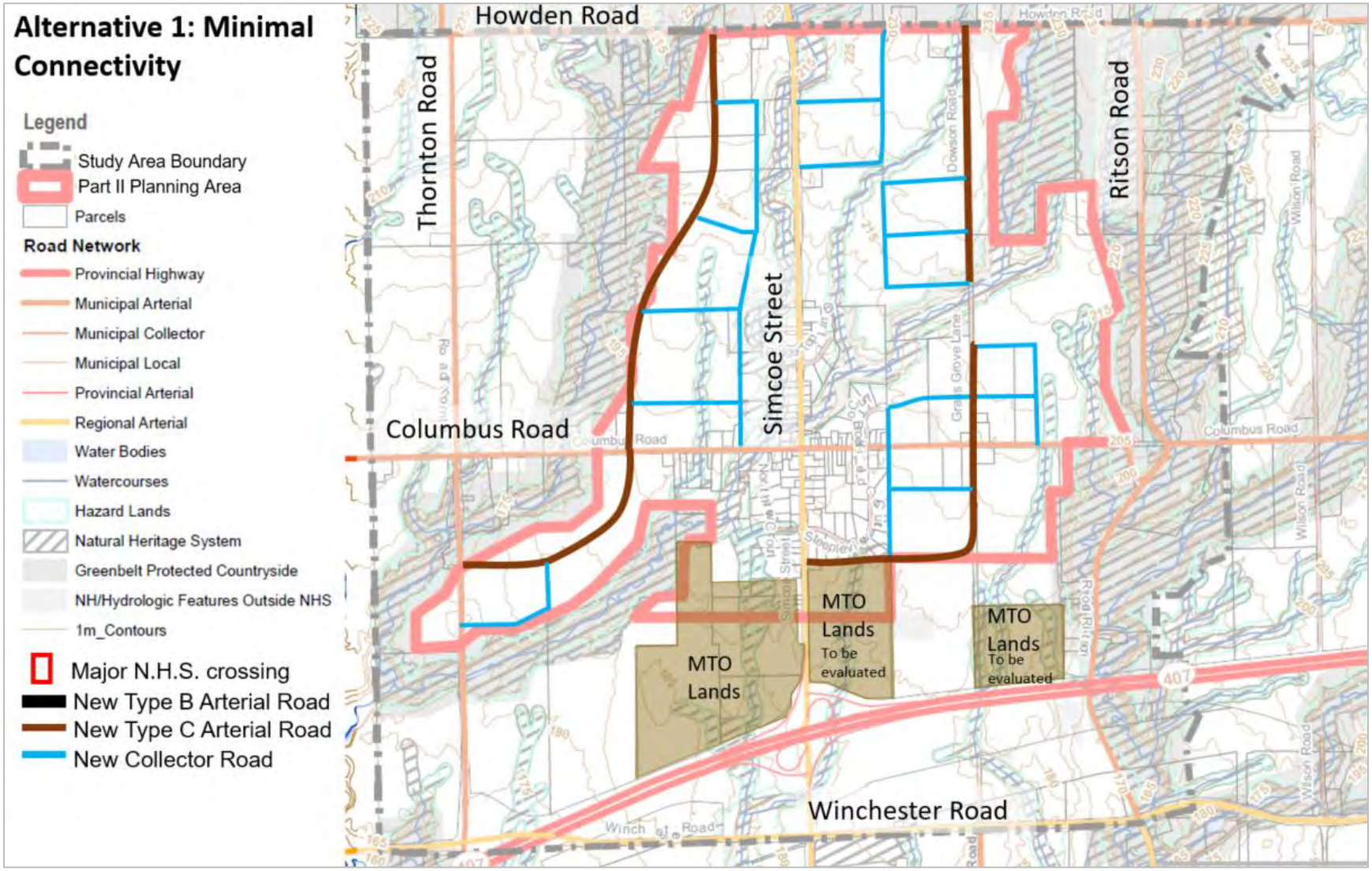


Exhibit 2-3: 2031 Alternative 1 – Minimal Connectivity

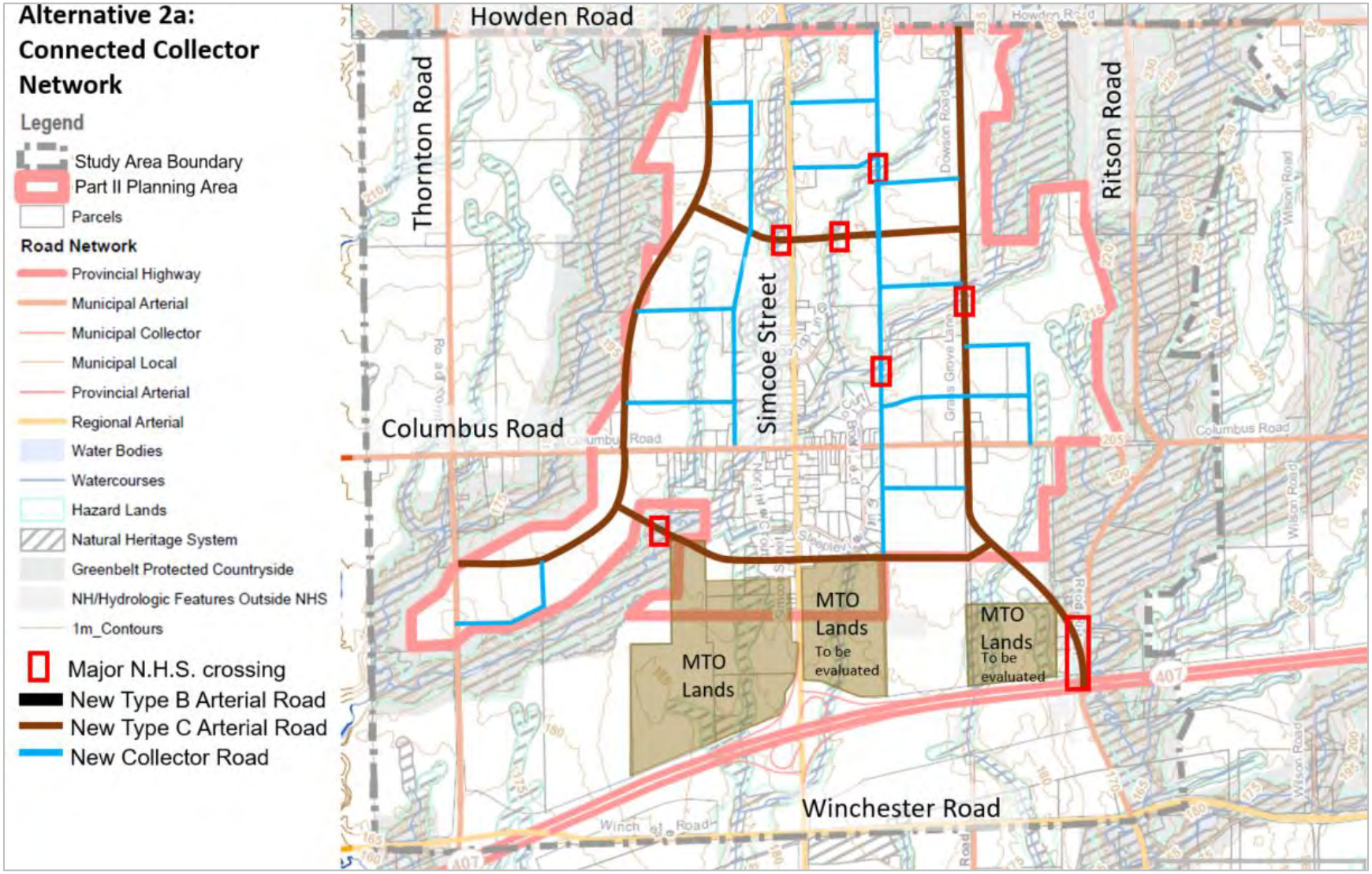


Exhibit 2-4: 2031 Alternative 2-a – Connected Collector Network

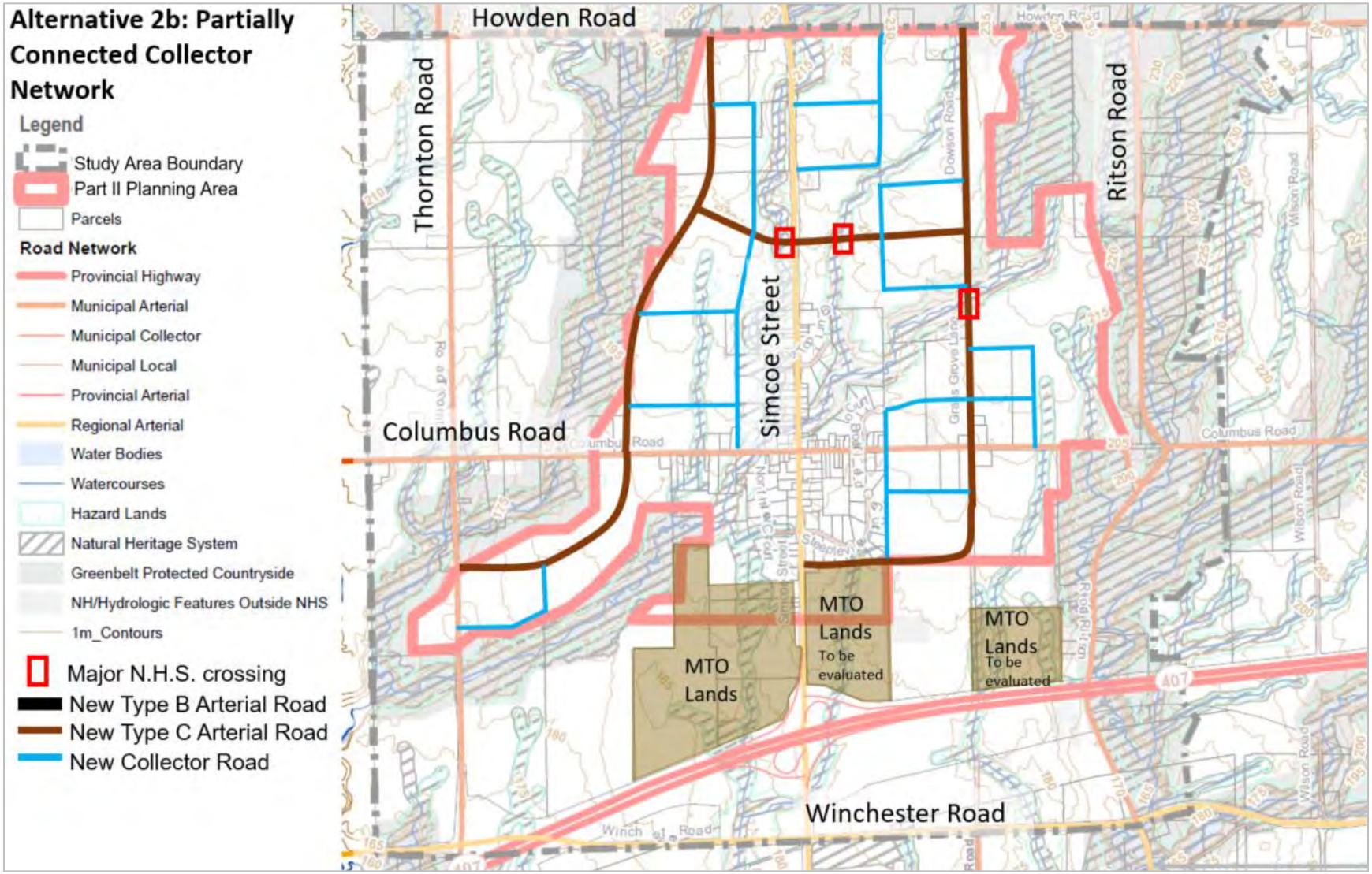


Exhibit 2-5: 2031 Alternative 2-b – Partially Connected Collector Network

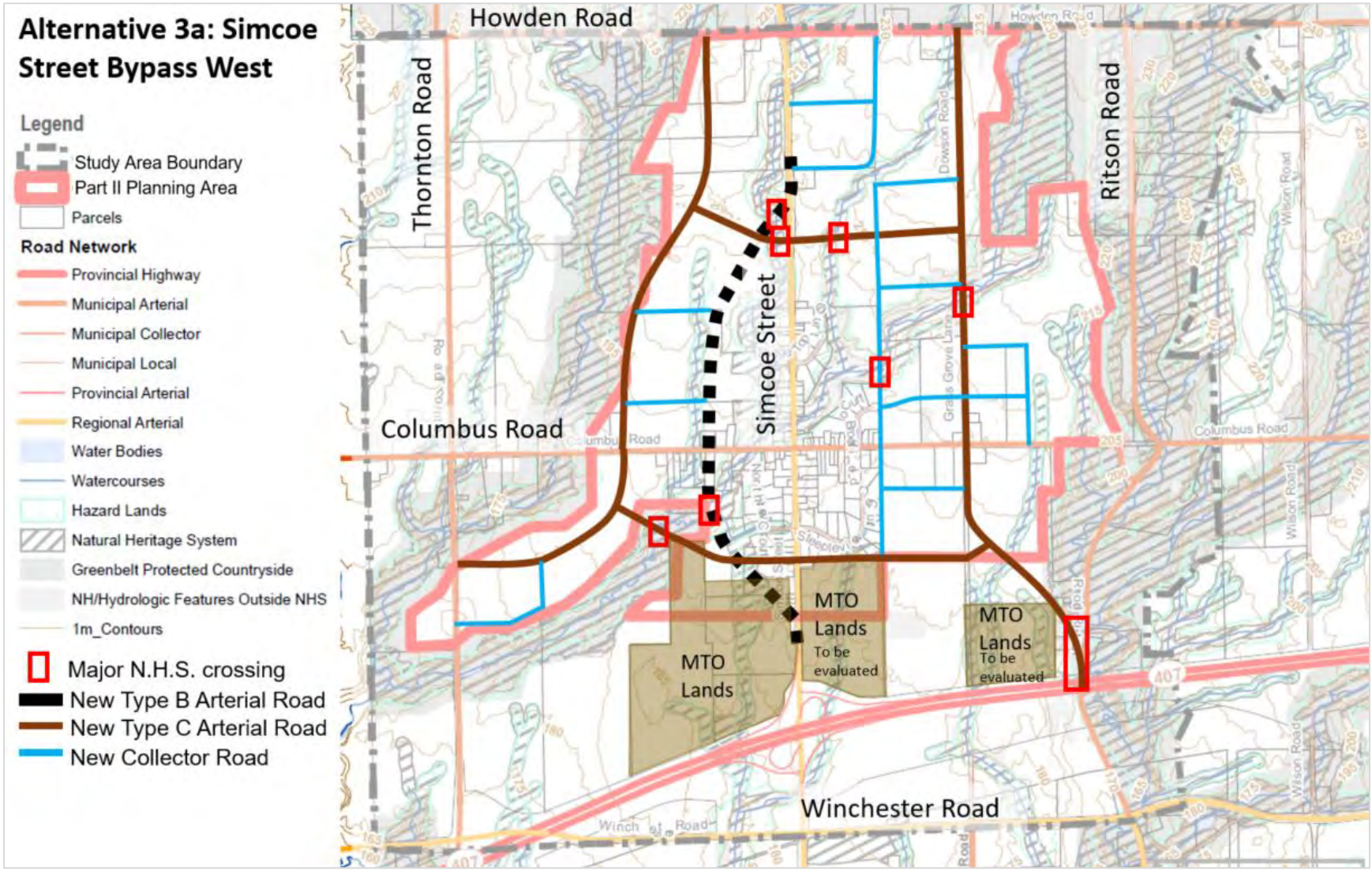


Exhibit 2-6: 2031 Alternative 3-a – Simcoe Street Bypass West

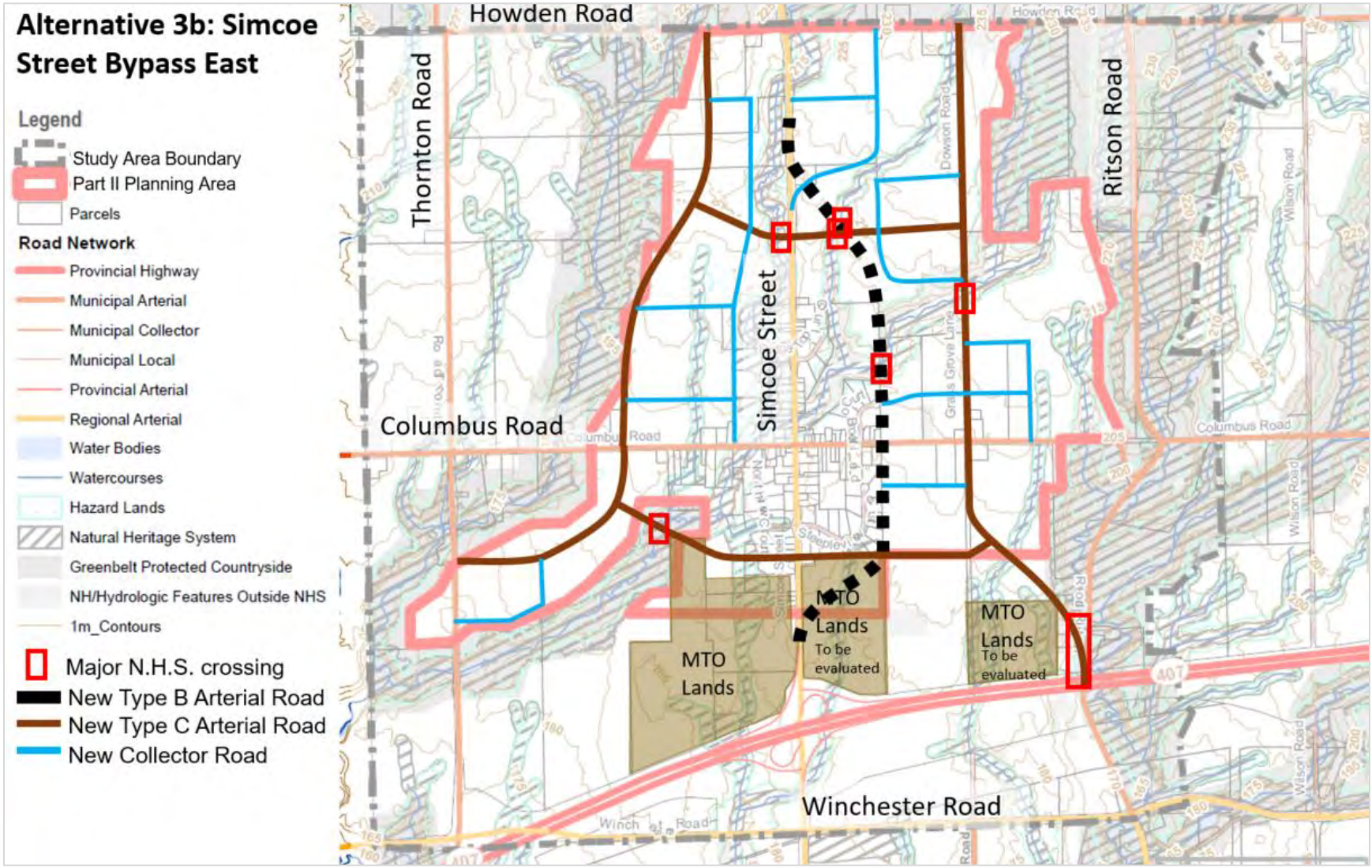


Exhibit 2-7: 2031 Alternative 3-b – Simcoe Street Bypass East

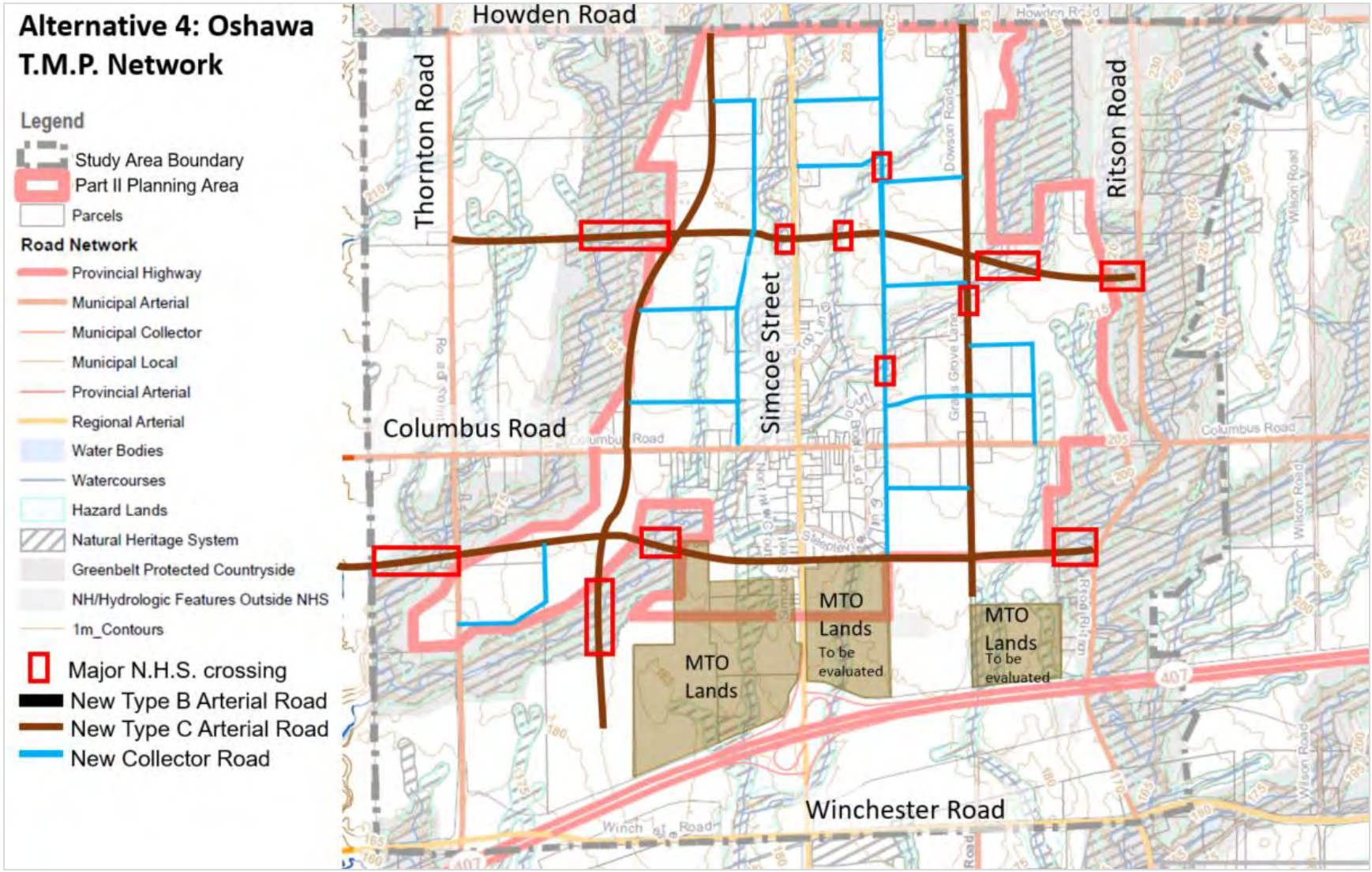


Exhibit 2-8: 2031 Alternative 4 – Oshawa T.M.P. Network

3 Assessment of Preliminary Alternatives

The preliminary transportation alternatives presented are assessed through a multiple account evaluation to determine a preliminary transportation Preferred Alternative to be carried forward for input to land use and road alternative development. The following sections identifies the evaluation criteria used, supporting analysis, evaluation and selection of the preliminary transportation Preferred Alternative.

3.1 Evaluation Criteria

The preliminary transportation network alternatives were evaluated against the following major criteria:

- Transportation
- Natural Environment
- Socio-Economic Environment
- Cost

The indicators used in the evaluation of the alternatives are documented and described in **Table 3-1**, with methodology presented in **Section 3.2**.

Each of the performance indicators identified within the major criteria category are evaluated individually, and provided equal weighting in the overall evaluation. The performance indicators are identified based upon key issues identified in the Problem Statement:

> *Columbus is a small, tight knit community in north Oshawa. Because of its distance to the core of the City, travel in the area is dominated by the personal automobile. As a result, there are existing concerns about high traffic volumes and speeding through the community.*
>
> *The development of Columbus through the Study presents an opportunity to address these concerns while also improving the Study Area transportation network for all travel modes – including pedestrians, cyclists, transit and vehicles. The Study will seek to address these opportunities by building upon the recommendations of the Durham Region T.M.P. and the City of Oshawa Integrated T.M.P. to identify a transportation network that supports anticipated growth and that is safe, accessible and comfortable for users of all ages and abilities.*

Table 3-1: Evaluation Criteria

Major Criteria	Performance Indicators
Transportation	• Provides vehicular traffic and potential future transit services with multiple, direct route options based on connectivity index analysis[1] • Diverts traffic away from locations with high average collision rates (Ritson Road at Columbus Road and Simcoe Street North between Columbus Road and Ridge Top Court) • Provides opportunities for a well-connected on-street pedestrian and cycling network • Provides opportunities for future Regional improvements to Simcoe Street North, north of Highway 407 East, including transit services and a future road expansion beyond 2031
Natural Environment	• Minimize impacts to the Greenbelt, particularly the Natural Heritage System and Water Resource System traversed and/or occupied
Socio-Economic Environment	• Minimize impacts to Cultural Heritage Resources and Archaeological Features • Minimize impacts to Study Area lands owned by the Ministry of Transportation which are under further assessment and/or are designated for compensation. • Minimize noise impacts on existing communities • Minimize tailpipe emissions by providing direct routes and reducing auto reliance.
Capital Costs	• Minimizes capital construction costs

3.2 Criteria Methodology and Results

The following section outlines the methodology used to evaluate quantitative performance indicators and its resulting outcome.

3.2.1 Future Traffic Conditions

Future traffic volumes considered in the analysis of preliminary transportation network alternatives are based on the 2031 Background Traffic volumes documented in the Columbus Part II Plan *Phase 1 Transportation Report, Exhibit 5-7.*

[1] Based on link-node ratio calculations as per The City of Calgary Transportation Plan Connectivity Handbook, Draft, 2010. Desirable block connectivity is equal or greater than 1.4.

3.2.2 Connectivity Index

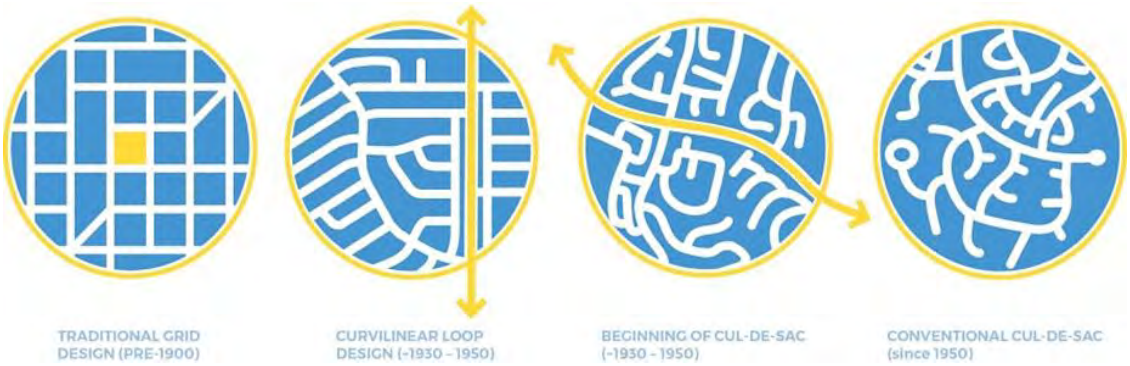
A well connected transportation network provides multiple options for different modes of transportation, such as; walking, cycling, transit or car. According to the Victoria Transport Policy Institute, "connectivity refers to the directness of links and the density of connections in path or road network". A well-connected road or path network has many short links, numerous intersections, and minimal dead ends (cul-de-sacs). As connectivity increases, travel distances decrease and route options increase, allowing more direct travel between destinations, creating a more accessible and resilient system. Based on the City of Calgary Transportation Plan (CTP) Draft Connectivity Handbook, increased connectivity has numerous benefits including[2]:

- Improving public health by providing walking and cycling as a sustainable transportation option.
- Enhancing accessibility to arterial and collector streets and reducing delays for motorists.
- Reducing walking distances to and from transit stops.

In urban areas, street network concepts are traditionally hierarchical with local, collector and arterial streets. Local streets provide access to land uses while collector streets provide access to local streets, increasing vehicular mobility by increasing distances between access points. Arterial streets are generally found on the outskirts of neighbourhoods and are designed to maximize vehicular mobility while minimizing access points. Many post-World War 2 neighbourhoods were designed with the primary purpose of funneling automobile traffic, minimizing access points (intersections) while including unfriendly elements to walking or cycling in cul-de-sacs and dead ends. **Figure 3-1** illustrates the types of street network design which ranges from the most to least connected neighbourhoods.

[2] The City of Calgary Transportation Plan Connectivity Handbook, Draft, 2010

Figure 3-1: Types of Street Network Design and Connectivity



Source: Neighbourhood Street Design Guidelines: A Recommended Practice of the Institute of Transportation Engineers, 2010.

It is possible to quantify the degree of connectivity of a neighborhood street network. Better connectivity is a key component of good neighborhood design to provide more direct access for transit and active transportation users. In this TMP, connectivity is measured through the Connectivity Index method developed by the City of Calgary.

The Connectivity Index (CI) uses the "Links and Nodes" method and measures "street connectivity" for vehicles and an "active mode" index for active transportation users. In this study, the Calgary Connectivity Handbook methodology is used to measure CI, as the same methodology/ approach has been recently utilized for two major mobility hub secondary plan studies in City of Toronto: the Keele-Finch Plus and Don Mills Crossing Phase 1 Reports.

The "Links and Nodes" methodology for the street connectivity calculates the ratio between the streets (links) and intersection (nodes) and crossing the CI analysis area. To calculate the number of links for the CI analysis, all links inside the boundary and crossing the boundary, with the exclusion of alleys and private driveways, are summed. Links crossing the boundary are included as they provide direct access into the boundary. To calculate the number of nodes for the CI analysis, all intersections within the boundary and any intersections just outside of the boundary are summed, as long as intersections outside of the boundary include a link that provides access into the boundary. The lowest possible ratio is 1.00 which indicates no connectivity in the study area while the maximum ratio of 2.00 indicates complete connectivity. Based on the paper *Roadway Connectivity: Creating More Connected Roadway and Pathway Networks (2017)* by the Victoria Transportation Policy Institute, a ratio of 1.4 to 1.7 indicates a desirable index zone for connectivity.

Table 3-2 summarizes the connectivity index for each alternative.

Table 3-2: Connectivity Index Analysis

Alternative	Nodes	Links	Connectivity Index
1	60	77	1.28
2a	65	89	1.37
2b	62	82	1.32
3a	67	93	1.39
3b	67	92	1.37
4	68	94	1.38

Although none of the alternatives achieve the desired ratio of 1.4 for connectivity, it is noted that Alternative 3a has the highest connectivity index at 1.39, where Alternative 1 has the lowest at 1.28. It must also be recognized that the analysis conducted at this time considers only the arterial and collector street network. Local street connectivity and pedestrian / cyclist only connections are not yet considered in the analysis.

3.2.3 Noise Impacts

Noise impacts on the existing community were assessed by considering the projected growth in traffic volumes comparatively across the preliminary network alternatives. Based on Emme network modelling of each of the preliminary network alternatives, the total intersection approach volumes for the 2031 AM peak hour at the Simcoe Street and Columbus Road intersection were summed to inform the analysis. The resulting total volumes are summarized in **Table 3-3**. The existing approach volume is provided to validate the results. It is further noted that this preliminary analysis is based upon Durham Region Emme model policy forecasts for population and employment documented in **Table 2-1**.

Based on the analysis, the both bypass options successfully divert traffic away from the existing Hamlet of Columbus centered on the Simcoe Street and Columbus Road intersection.

Table 3-3: Total Intersection Approach 2031 AM Peak Hour Volumes

Alternative	Estimated 2031 AM Peak Hour Approach Volume
Existing	1,275
1	1,760
2a	1,688
2b	1,662
3a	220
3b	256
4	1,590

3.2.4 Tailpipe Emissions

Tailpipe emissions were evaluated using vehicle kilometres travelled (V.K.T.) within the Columbus study area for each alternative. Alternatives that provide more direct routing within the road network would have reduced auto reliance and more efficient auto usage for trips travelled, resulting in overall reduced tailpipe emissions.

V.K.T. was calculated through consideration of the vehicle volume on each link within the study area in the 2031 AM EMME model, in addition to the length of the link:

$$V.K.T. = \sum Volume\ per\ Link * Length\ of\ Link$$

Total V.K.T. per alternative is provided in **Table 3-4**. It is noted that Alternative 3a has the lowest total V.K.T. while Alternative 2b has the highest total V.K.T. While the difference between alternatives appears minor, the intent of the analysis is comparative in nature and intended to inform preliminary network analysis. Overall, it appears that a western Simcoe bypass option maximizes efficiency in vehicular movements relative to other options.

Table 3-4. Total V.K.T. per Alternative

Alternative	Total V.K.T.
1	8,560
2a	8,460
2b	8,600
3a	8,440
3b	8,530
4	8,500

3.2.5 Analysis of Alternatives

Table 3-5 documents the detailed assessment of the alternatives based on the performance indicators identified in **Table 3-1**. The indicators are rated on a 4-point scale from least supportive to most supportive as shown in the following diagram:

Least Supportive ○ ◔ ◑ ◕ ● Most Supportive

Table 3-5: Assessment of Preliminary Transportation Network Alternatives

Criteria	Alternative 1	Alternative 2-a	Alternative 2-b	Alternative 3-a	Alternative 3-b	Alternative 4
Transportation						
Provides vehicular traffic and potential future transit services with multiple, direct route options based on connectivity index analysis	○ Connectivity Index = 1.28.	◕ Connectivity Index = 1.37.	◔ Connectivity Index = 1.32.	● Connectivity Index = 1.39.	◑ Connectivity Index = 1.37.	◕ Connectivity Index = 1.38.
Diverts traffic away from locations with high average collision rates (Ritson Road at Columbus Road and Simcoe Street North between Columbus Road and Ridge Top Court)	○ High traffic volumes at both Ritson and Simcoe.	◔ High traffic volumes at Simcoe, new Type C Arterial connection to Ritson reduces traffic at Ritson and Columbus intersection.	○ High traffic volumes at both Ritson and Simcoe.	◕ Bypass reduces traffic volumes at Simcoe, new Type C Arterial connection to Ritson reduces traffic at Ritson and Columbus intersection.	● East Bypass most effectively reduces traffic volumes at Simcoe, new Type C Arterial connection to Ritson reduces traffic at Ritson and Columbus intersection.	○ High traffic volumes at both Ritson and Simcoe.
Provides opportunities for a well-connected on-street pedestrian and cycling network	○ Lowest degree of connectivity for pedestrians and cyclists.	◑ Moderate connectivity for pedestrians and cyclists.	◔ Low degree of connectivity for pedestrians and cyclists.	◕ High connectivity for pedestrians and cyclists.	◕ High connectivity for pedestrians and cyclists.	● Highest connectivity for pedestrians and cyclists.

Criteria	Alternative 1	Alternative 2-a	Alternative 2-b	Alternative 3-a	Alternative 3-b	Alternative 4
Supports Regional improvements to Simcoe Street North, north of Highway 407 East, including transit services and a future road expansion beyond 2031	○ Limited supporting collector road network will put highest strain on Simcoe Street's limited Right-of-Way through Columbus.	◑ Well connected supporting collector road network will put moderate strain on Simcoe Street's limited Right-of-Way through Columbus.	◔ Partially connected supporting collector road network will put high strain on Simcoe Street's limited Right-of-Way through Columbus.	● Bypass options support regional right-of-way requirements to accommodate road expansion and transit services.	● Bypass options support regional right-of-way requirements to accommodate road expansion and transit services.	◕ Improving connections to Thornton Road and Ritson Road will reduce strain on Simcoe Street's limited Right-of-Way through Columbus.
Natural Environment						
Minimize impacts to the Greenbelt, particularly the Natural Heritage System and Water Resource System traversed and/or occupied	● No major N.H.S./watercourse crossings required.	◑ 6 major N.H.S./watercourse crossings required, including ~120m crossing of Greenbelt.	◕ 3 major N.H.S./watercourse crossings required.	◔ 7 major N.H.S./watercourse crossings required, including ~120m crossing of Greenbelt and Type B Arterial adjacent to Greenbelt.	◑ 6 major watercourse crossings required, including ~120m crossing of Greenbelt.	○ 12 watercourse crossings, including four major crossings of Greenbelt.
Socio-Economic Environment						

Criteria	Alternative 1	Alternative 2-a	Alternative 2-b	Alternative 3-a	Alternative 3-b	Alternative 4
Minimize impacts to Cultural Heritage Resources and Archaeological Features	Minimizes impact to potential cultural heritage resources. No impact to archaeological features requiring further study.	Moderate impact to potential cultural heritage resources. No impact to archaeological features requiring further study.	Low impact to potential cultural heritage resources. No impact to archaeological features requiring further study.	High impact to potential cultural heritage resources. No impact to archaeological features requiring further study.	High impact to potential cultural heritage resources. No impact to archaeological features requiring further study.	Maximum impact to potential cultural heritage resources. Potential impact to archaeological features requiring further study at Ritson Road.
Minimize impacts to Study Area lands owned by the Ministry of Transportation (M.T.O.) which are under further assessment and/or are designated for compensation	Very minor impacts to northern boundary of M.T.O. lands east of Simcoe Street.	Very minor impacts to northern boundary of lands east of Simcoe Street; minor impacts to lands west of Simcoe Street; minor impact to lands west of Ritson Road.	Very minor impacts to northern boundary of M.T.O. lands east of Simcoe Street.	Major impact to M.T.O. lands west of Simcoe Street; minor impact to lands west of Ritson Road.	Major impact to lands east of Simcoe Street; minor impacts to lands west of Simcoe Street; minor impact to lands west of Ritson Road.	Very minor impacts to northern boundary of M.T.O. lands east of Simcoe Street; minor impacts to M.T.O. lands west of Simcoe Street.
Minimize noise impacts on existing communities	Total estimated 2031 AM peak hour vehicles entering the Simcoe/Columbus intersection: 1,800.	Total estimated 2031 AM peak hour vehicles entering the Simcoe/Columbus intersection: 1,700.	Total estimated 2031 AM peak hour vehicles entering the Simcoe/Columbus intersection: 1,700.	Total estimated 2031 AM peak hour vehicles entering the Simcoe/Columbus intersection: 220.	Total estimated 2031 AM peak hour vehicles entering the Simcoe/Columbus intersection: 260.	Total estimated 2031 AM peak hour vehicles entering the Simcoe/Columbus intersection: 1,700.

Criteria	Alternative 1	Alternative 2-a	Alternative 2-b	Alternative 3-a	Alternative 3-b	Alternative 4
Minimize tailpipe emissions by providing direct routes and reducing auto reliance.	○ Study Area V.K.T.: 8,560.	◕ Study Area V.K.T.: 8,460.	○ Study Area V.K.T.: 8,600.	● Study Area V.K.T.: 8,440.	◑ Study Area V.K.T.: 8,530.	◑ Study Area V.K.T.: 8,500.
Capital Costs						
Minimizes capital construction costs	● No major watercourse crossings required.	◑ 6 major watercourse crossings required.	◕ 3 major watercourse crossings required.	◔ 7 major watercourse crossings required + construction of Type B Arterial Road bypass.	◔ 6 major watercourse crossings required + construction of Type B Arterial Road bypass.	○ 12 watercourse crossings including 4 major bridge structures.

3.3 Preliminary Transportation Recommendations

As mentioned previously, the performance indicators are equally weighted. In order to provide an objective evaluation, a total score is calculated and assigned in order to provide input to the Study team with respect to a preliminary preferred transportation network. Points are assigned to each major criteria based upon the performance indicators illustrated in **Table 3-1**, where zero points are assigned for the empty circle, and four points assigned to the full circle.

Table 3-6 summarizes the scoring by major criteria.

Table 3-6: Overall Evaluation of Preliminary Alternatives

Criteria	Alternative 1	Alternative 2-a	Alternative 2-b	Alternative 3-a	Alternative 3-b	Alternative 4
Transportation	0	8	3	14	14	10
Natural Environment	4	2	3	1	2	0
Socio-Economic Environment	8	8	8	10	6	6
Capital Costs	4	2	3	1	1	0
Overall Score	**16**	**20**	**17**	**26**	**22**	**16**

Based on this evaluation, the ***preliminary transportation network Preferred Alternative is 3-a – Simcoe Street Bypass West***. It is recognized that this analysis is intended to provide technical input to the development of land use and road alternatives, and these alternatives may continue to consider transportation network options which did not score as highly as there may be benefits from a land use and built form perspective not considered in this evaluation.

4 Transportation Assessment of Land Use and Road Alternatives

Three land use and road alternatives for the development of the Study Area were developed by the Study team. A transportation assessment of the alternatives is conducted and documented within this chapter to provide input to a broader evaluation of these alternatives.

4.1 Land Use and Road Alternatives

It is noted firstly that the development of land use and road alternatives followed the assessment of preliminary transportation network alternatives presented previously in this report. As such refinements to the network were undertaken in parallel to the identification of land uses within the Columbus Part II Planning Area.

In total, three land use and road alternatives were identified, and these are illustrated in **Exhibit 4-1**, **Exhibit 4-2**, and **Exhibit 4-3**.

In relation to the transportation networks, the land use and road alternatives are directly related to the transportation network alternatives assessed previously:

- Alternative 1 is similar to transportation network Alternative 2 with elements of both Alternative 2-a and Alternative 2-b.
- Alternative 2 is similar to transportation network Alternative 3-b, with a key change in the Bypass alignment extending further west than initially envisioned. This change however also serves to consolidate and minimize new crossings of the Natural Heritage System.
- Alternative 3 is similar to transportation network Alternative 4.

It is to be noted that all alternatives are subject to the recommended realignment at Columbus Road and Ritson Road as part of the Ritson Road North and Columbus Road East Intersection Improvements Class EA Study.

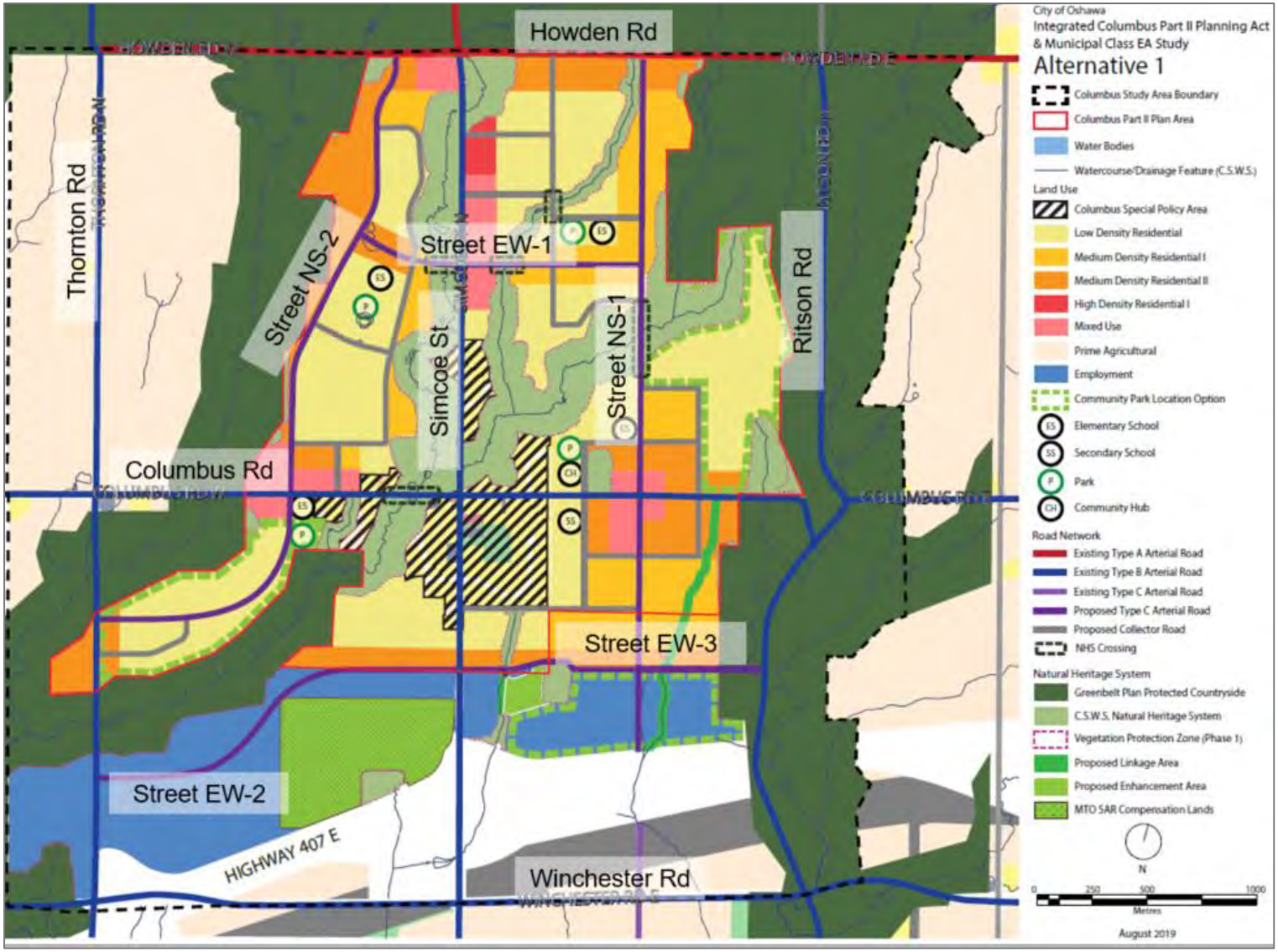


Exhibit 4-1: Alternative 1

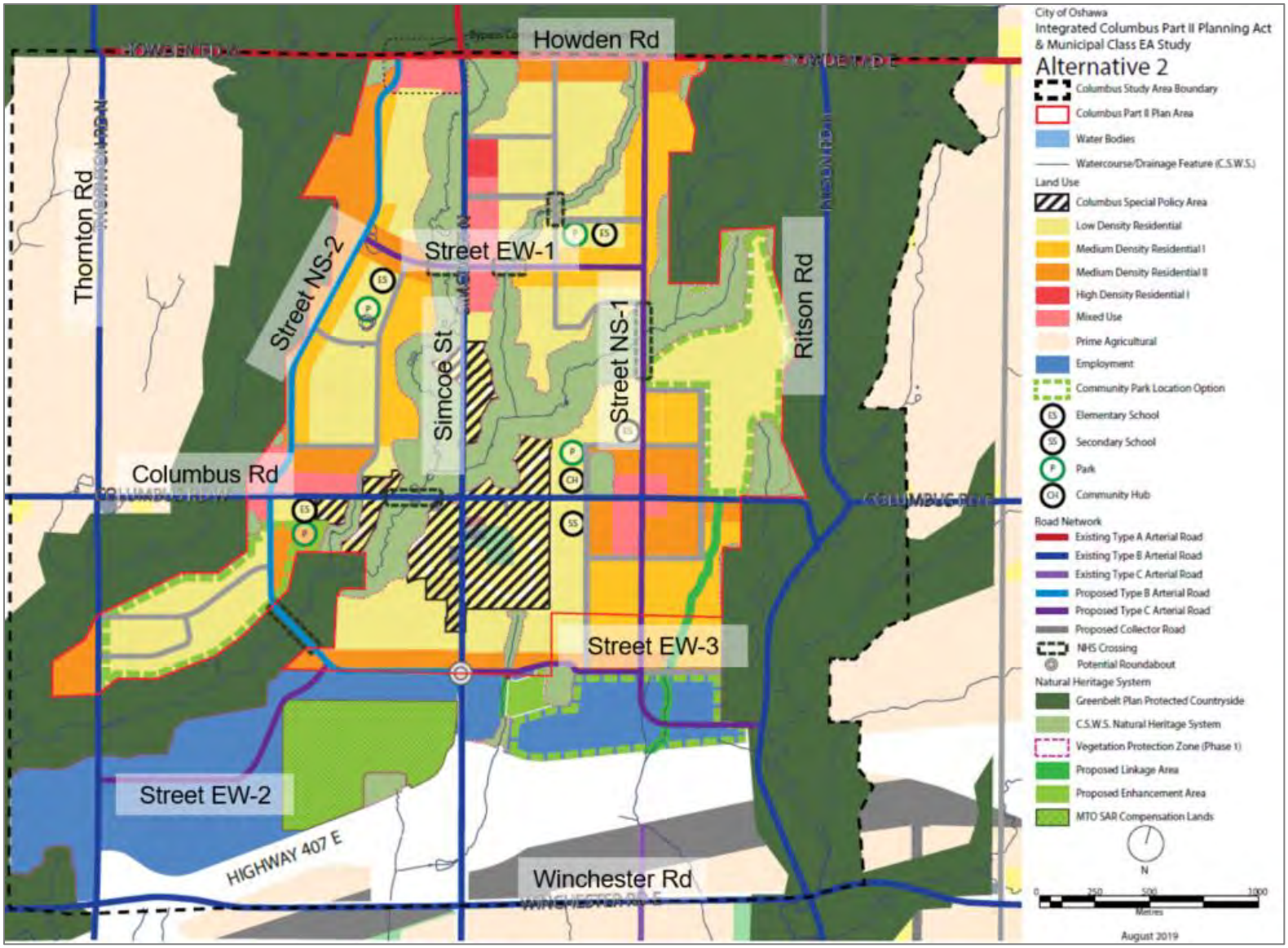


Exhibit 4-2: Alternative 2

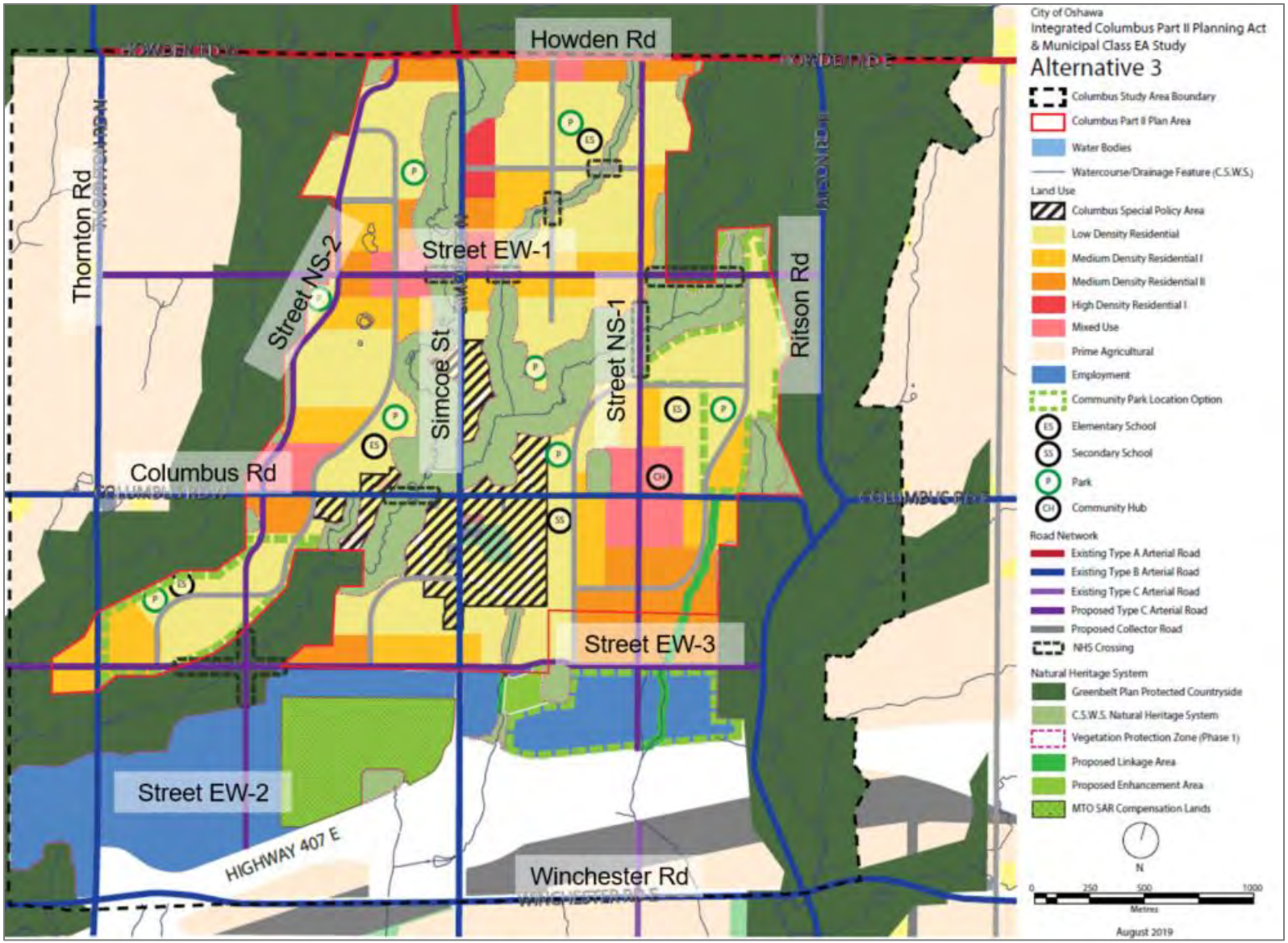


Exhibit 4-3: Alternative 3

4.2 Population and Employment Projections

For the three land use and road alternatives, population and employment projections were developed by the Study team, including a minimum and maximum population range and projected jobs. Study Area total projections for 2031, including both the Part II Planning Area and the Employment lands south of the Part II Planning Area and north of Highway 407 East, are summarized in **Table 4-1** for each land use and road alternative as well as for the 2031 Base Case (consistent with the Durham Region Transportation Master Plan or T.M.P. Study).

Table 4-1: Study Area 2031 Population and Employment Projections

Scenario		Part II Planning Area	Employment Lands	Total
2031 Base	Pop.	6,400	50	6,450
	Emp.	660	90	750
2031 Alt. 1	Min. Pop.	19,200	3,300	22,500
	Max. Pop.	27,300	5,000	32,300
	Emp.	500	5,000	5,500
2031 Alt. 2	Min. Pop.	19,000	3,200	22,200
	Max. Pop.	27,300	4,800	32,100
	Emp.	500	4,800	5,300
2031 Alt. 3	Min. Pop.	17,300	3,500	20,800
	Max. Pop.	25,400	5,000	30,400
	Emp.	500	4,900	5,400

The breakdown of population and employment by Traffic Zone across each of the three alternatives, based on the maximum population projection, is provided in **Table 4-2**.

Table 4-2: 2031 Population and Employment Projections by Traffic Zone

	Base Case	Base Case	Alt. 1	Alt. 1	Alt. 2	Alt. 2	Alt. 3	Alt. 3
Traffic Zone	Pop.	Emp.	Max. Pop.	Emp.	Max. Pop.	Emp.	Max. Pop.	Emp.
2363	780	100	4,020	30	4,030	30	3,060	20
2364	880	90	3,880	100	4,110	90	3,680	120
2365	1,260	120	6,520	100	6,430	100	7,000	60
2366	950	100	2,090	120	2,110	120	2,370	20
2368	870	100	4,330	10	4,220	10	3,170	120
2372	510	60	3,240	10	3,080	10	2,410	50
2373	380	30	340	50	480	40	860	-
2374	540	50	1,160	70	1,160	70	1,230	70
2375	260	30	1,770	10	1,710	10	1,630	40
2376	10	-	-	830	-	830	-	830
2377	10	-	-	2,270	-	2,090	-	2,140
2378	-	40	1,750	400	1,600	400	1,490	450
2379	30	50	890	390	860	390	730	400
2380	-	-	2,360	1,100	2,290	1,070	2,780	1,120
TOTAL	**6,460**	**740**	**32,340**	**5,500**	**32,070**	**5,270**	**30,410**	**5,440**

Relative to the Durham T.M.P. Study and thus the preliminary transportation assessment conducted and documented in **Section 3** of this report, a significantly higher level of growth is anticipated within the Study Area.

4.3 Traffic Conditions

To inform the assessment of land use and road alternatives, a comparative analysis of travel demand generated by each alternative is conducted to inform infrastructure needs in addition to assessing the connectivity of the network. It is noted that a more detailed transportation analysis will be carried out in later stages of the study on the preferred alternative to identify specific number of traffic lanes and intersection lane configuration requirements.

A four stage travel demand forecasting process was undertaken for this analysis, including trip generation using the ITE Trip Generation Informational

Report (10th Edition), trip distribution based upon patterns identified by the Durham Region Emme model, mode share assumptions, and manual assignment of background and site or study area traffic.

Trip generation is based upon the "maximum" population projections identified in **Table 4-2.** Additional details on the four stage travel demand analysis and key assumptions are provided in **Appendix A**.

Screenline analysis considers the total travel demand crossing an imaginary line to understand transportation infrastructure requirements for a specified area. Four screenlines are assessed in this analysis, generally bounding the study area, and these are illustrated in **Exhibit 4-4**.

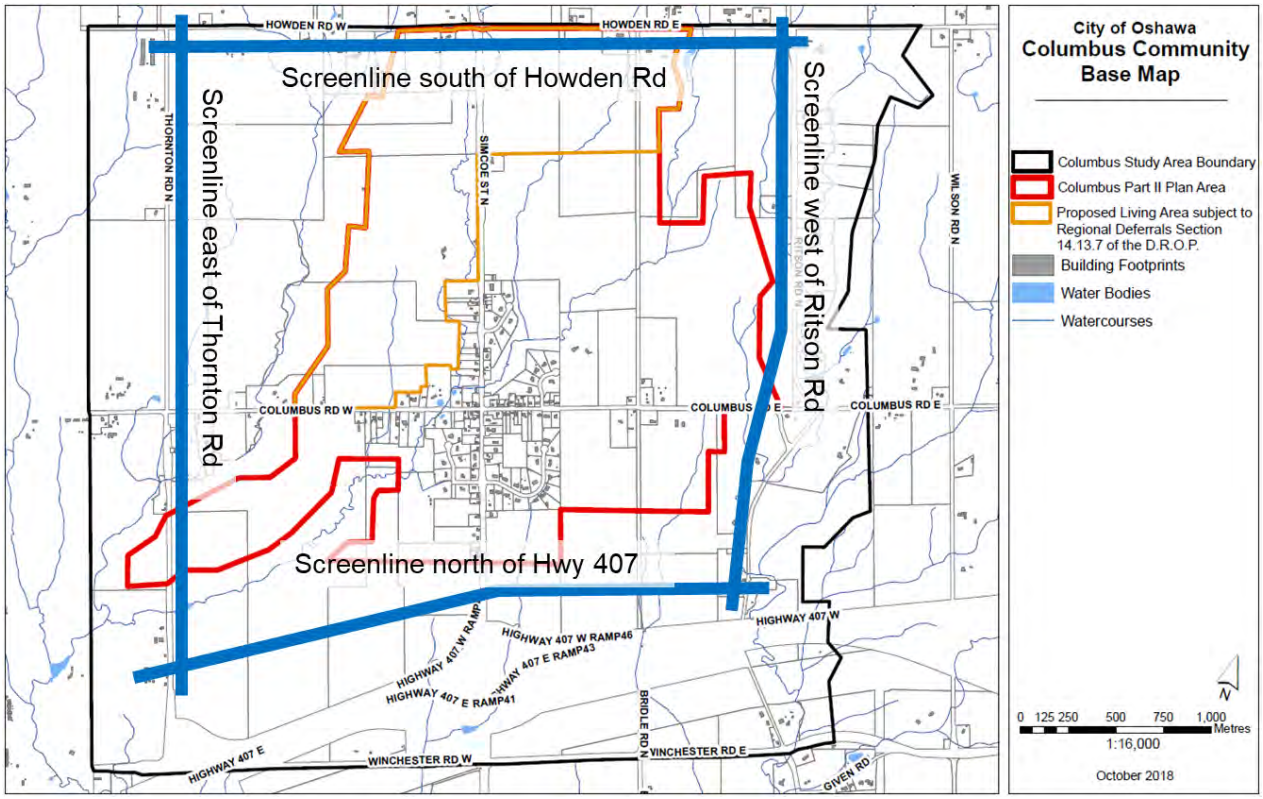


Exhibit 4-4: Traffic Screenline Locations

Predicted traffic crossing each of the four screenlines is summarized in **Table 4-3**. To identify infrastructure needs, the predicted peak hour traffic demands are compared against theoretical roadway capacity per hour, consistent with the G.T.A Network Coding Standard and the Durham Region Emme model. The capacity assumptions are as follows:

- Type A Arterial Road: 900-1000 vehicles per hour per lane.
    - Howden Road is the only Type A arterial road in the study area, however it is noted that the Durham Emme model assumes a

capacity of 500 due to the existing of the roadway which includes residential accesses with a narrow rural road platform (i.e. no shoulders).

- Type B Arterial Road: 800-900 vehicles per hour per lane.
    - Columbus Road, Winchester Road, Simcoe Street and Ritson Road. It is noted that the Durham Emme model assumes a 400-500 capacity for Columbus Road and Ritson Road due to existing conditions.
- Type C Arterial Road: 700 vehicles per hour per lane
- Collector Road: 500 vehicles per hour per lane

Based on the anticipated demand considering the full build out of the study area relative to the current condition of existing roadways in the study area, roadway improvements are required through the study area, which are reflected in **Table 4-3**. This includes the following improvements:

- Operational improvements to Thornton Road through the study area, including intersection lane configuration improvements to increase capacity
- Widening of Simcoe Street from 2 to 4 lanes through the study area (aligned with the Durham Region T.M.P. recommendation for a road widening beyond 2031)
- Operational improvements to Ritson Road from Street E.W.-3 to the southern limits of the study area
- Operational improvements to Columbus Road west of Street N.S.-2 or Simcoe Street Bypass to western limits of the study area

Table 4-3: 2031 AM Peak Hour Peak Direction Screenline Traffic

	2031 Total Traffic Volume			Capacity			Volume to Capacity Ratio		
Screenline	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**
North of Hwy 407 (Southbound – Trips Out)									
Thornton	854	762	814	900	900	900	0.95	0.85	0.90
Simcoe	1,786	1,952	1,936	1,800	1,800	1,800	0.99	1.08	1.08
Ritson	378	250	186	900	900	900	0.42	0.28	0.21
Total	**3,018**	**2,964**	**2,936**	**3,600**	**3,600**	**3,600**	**0.84**	**0.82**	**0.82**
South of Howden (Southbound – Trips In)									
Thornton	467	250	559	900	900	900	0.52	0.28	0.62
Simcoe St Bypass or Street NS-2	73	1,662	70	700	1,800	700	0.10	0.92	0.10
Simcoe	1,536	102	1,423	1,800	700	1,800	0.85	0.15	0.79
Street NS-1	48	68	46	700	700	700	0.07	0.10	0.07
Ritson	58	63	52	400	400	400	0.15	0.16	0.13
Total	**2,182**	**2,145**	**2,150**	**4,500**	**4,500**	**4,500**	**0.48**	**0.48**	**0.48**
East of Thornton (Westbound – Trips Out)									
Howden	112	147	145	500	500	500	0.22	0.29	0.29
Street EW-1	0	0	50			700			0.07
Columbus Rd	706	770	704	900	900	900	0.78	0.86	0.78
Collector Rd	183	368	0	500	500		0.37	0.74	
Street EW-2	0	43	178	700	700	700	0.00	0.06	0.25
Total	**1,001**	**1,328**	**1,077**	**2,600**	**2,600**	**2,800**	**0.39**	**0.51**	**0.38**
West of Ritson (Westbound – Trips In)									
Howden	186	192	70	500	500	500	0.37	0.38	0.14
Street EW-1	0	0	70			700			0.10
Columbus Rd	281	268	319	500	500	500	0.56	0.54	0.64
Street EW-3	36	46	22	700	700	700	0.05	0.07	0.03
Total	**503**	**506**	**481**	**1,700**	**1,700**	**2,400**	**0.30**	**0.30**	**0.20**
Legend:									
Volume to capacity ratio	< 0.85	0.85 to 1.00	> 1.00						

Based on this analysis, screenlines at the west, north and east boundaries of the study area are not anticipated to be congested with sufficient capacity to meet demand across all alternatives. While the screenline at the southern boundary is just under the threshold of 0.85 in all scenarios, there are high traffic demands anticipated on Thornton Road and Simcoe Street.

This analysis informs the specific infrastructure needs identified in previous studies. This includes:

- Deferred Highway 407 midblock crossings D.5., east and west of Simcoe Street, Official Plan Schedule 'B'
- Proposed Type C Arterial Road west of Thornton Road (Whitby connection to Carnwith Drive) Official Plan Schedule 'B'

With spare capacity on Ritson Road in all scenarios, it is anticipated that congestion on Simcoe Street will divert traffic to Ritson Road during peak times. Based on this finding, the deferred midblock crossings (D.5.) of Highway 407 identified in the Oshawa Official Plan Schedule 'B' are not required based on the projected build-out of the study area by the year 2031, especially when considering the anticipated costs associated with providing grade separated crossings.

Similarly, the Type C Arterial Road is not required to serve east-west traffic demands between Whitby and Oshawa based on this analysis. The east of Thornton Road screenline has spare capacity and a new crossing of the Natural Heritage System is unlikely to be justified based on the projected build-out of the study area by 2031.

4.4 Costing Methodology and Estimates

High-level capital cost estimates are identified based upon the networks identified for the three land use and road alternatives to provide input to the selection of a Preferred Alternative. The capital cost estimates are based upon the unit costs utilized in the City of Oshawa's 2019 Development Charges Background Study (2019 D.C. Study), applied to typical cross-sections for the roadway types identified in the Alternative drawings.

4.4.1 Right-of-Way Widths and Benchmark Costs

Recommended right-of-way (R.O.W.) widths are based upon the anticipated role and function of each roadway identified for each alternative and are based upon the cross-section elements identified in the City's Standard Engineering Drawings. The assumptions for the benchmark costs used for this Study are summarized in **Table 4-4**.

Table 4-4: Right-of-Way Widths and Benchmark Costs ($2019)

Street Type* (Standard Drawing #)	Recommended R.O.W. Width* (Pavement width)*	Vehicular Travel Lanes	Boulevards	Benchmark Capital Cost ($/km)**
Type B Arterial (OS-209)	36m (14.5m)	Four	1.5m sidewalks and trees on both sides	$4,790,000
Type C Arterial (OS-208)	30m (14.5m)	Two	1.5m sidewalks and trees on both sides	$4,790,000
Collector Road (OS-204)	20m (10m)	Two	1.5m sidewalks and trees on both sides	$4,220,000

*Source: City of Oshawa Official Plan Table 5

**Source: City of Oshawa 2019 Development Charges Update ($2019), including 15% General Items, 15% Contingency, 30% Engineering.

Major bridge structures are also factored into the cost estimates, also based on the City's 2019 D.C. Study. Type B and C arterial road structures are based upon 2019 D.C. Study estimated costs for a 14.5m pavement width while collector road bridge structure costs are based upon the proportional cost of a 10m width structure to a 14.5m width structure.

For the purposes of this analysis, only major bridge structures are included and it is assumed that all crossings of either the Greenbelt Protected Countryside Area or the City's Natural Heritage System (N.H.S.) will require bridges to minimize environmental impacts. The benchmark costs for structures are summarized in **Table 4-5**.

Table 4-5: Major Structure Capital Unit Costs ($2019)

Structure Type	Type B Arterial*	Type C Arterial*	Collector Road**
Greenbelt Crossing Structure	$ 23,200,000	$ 23,200,000	$ 16,000,000
N.H.S. Crossing Structure	$ 23,200,000	$ 23,200,000	$ 16,000,000

*Source: City of Oshawa 2019 Development Charges Update ($2019), new construction structure at 14.5m pavement width, including 15% General Items, 15% Contingency, 30% Engineering.

**Source: Approximated cost based 2019 D.C. Update and ratio of 10m pavement width to 14.5m pavement width new construction structure.

4.4.2 Capital Cost Estimates

Based on the benchmark and unit costs identified, preliminary engineering cost estimates are identified for each of the land use and road alternatives. The lengths of road assumed for each classification and capital cost estimate for linear roadways are provided in **Table 4-6**, structures in **Table 4-7**, and the total estimate is provided in **Table 4-8**.

Table 4-6: Linear Roadway Capital Cost Estimates ($2019)

	Benchmark Cost ($/km)	Alternative 1	Alternative 2	Alternative 3
Total Estimated Kilometres of Roadway				
Type B Arterial		**-**	**3.5 km**	**-**
NS-2		-	3.5 km	-
Type C Arterial		**11 km**	**7.5 km**	**13 km**
EW-1		1.4 km	1.4 km	3.3 km
EW-2		1.7 km	1.3 km	-
EW-3		1.4 km	0.9 km	3.0 km
NS-1		3.0 km	3.6 km	3.2 km
NS-2		3.5 km	-	3.5 km
Collector Road		**9.5 km**	**10.5 km**	**9.5 km**
Cost Estimate				
Type B Arterial	$ 4,790,000	$ -	$ 16,770,000	$ -
Type C Arterial	$ 4,790,000	$ 52,700,000	$ 35,920,000	$ 62,260,000
Collector Road	$ 4,220,000	$ 40,100,000	$ 44,310,000	$ 40,100,000
Total Cost Estimate - Roads		**$ 92,800,000**	**$ 97,000,000**	**$ 102,360,000**

Table 4-7: Structure Capital Cost Estimates ($2019)

	Benchmark Cost ($/Crossing)	Alternative 1	Alternative 2	Alternative 3
Total Estimated Number of Crossings				
Greenbelt Crossing-Type B Arterial		0	1	0
Greenbelt Crossing-Type C Arterial		0	0	5
N.H.S. Crossing-Type C Arterial		4	4	3
N.H.S. Crossing-Collector Road		1	1	2
Cost Estimate				
Greenbelt Crossing-Type B Arterial	$ 23,200,000	$ -	$ 23,200,000	$ -
Greenbelt Crossing-Type C Arterial	$ 23,200,000	$ -	$ -	$ 116,000,000
N.H.S. Crossing-Type C Arterial	$ 23,200,000	$ 92,800,000	$ 92,800,000	$ 69,600,000
N.H.S. Crossing-Collector Road	$ 16,000,000	$ 16,000,000	$ 16,000,000	$ 32,000,000
Total Cost Estimate - Structures		**$ 108,800,000**	**$ 132,000,000**	**$ 217,600,000**

Table 4-8: Total Capital Cost Estimates ($2019)

	Alternative 1	Alternative 2	Alternative 3
Total Capital Cost Estimate	**$ 201,600,000**	**$ 229,000,000**	**$ 319,960,000**

4.5 Transportation Evaluation of Land Use and Road Alternatives

Table 4-9 summarizes the transportation evaluation of land use and road alternatives which builds largely upon the assessment of preliminary transportation alternatives based upon the performance indicators identified in **Table 3-1**. The indicators are rated comparatively between the three alternatives on a 3-point scale from least supportive (○) to neutral (◑) to most supportive (●).

It is noted that the transportation analysis relies largely upon the findings of the preliminary transportation analysis conducted in **Section 3**, with the addition of a screenline traffic analysis considering the full build-out of the Part II Plan area. As documented in **Section 4.3**, this analysis determined that traffic conditions and infrastructure requirements are similar across each of the three alternatives, including a four lane widening of Simcoe Street or the Simcoe Street Bypass.

Table 4-9: Transportation Evaluation of Land Use Alternatives

Criteria	Alternative 1	Alternative 2	Alternative 3
Transportation	○ Based on preliminary transportation network analysis (Alternative 2-a), this option scores 8/16.	● Based on preliminary transportation network analysis (Alternative 3-a), this option scores 14/16.	◑ Based on preliminary transportation network analysis (Alternative 4), this option scores 10/16.
Natural Environment	● Minimizes number of new crossings of N.H.S. No new crossings of Protected Greenbelt.	◑ Minimizes number of new crossings of N.H.S. One new crossing of Protected Greenbelt.	○ Major impacts to N.H.S. and Protected Greenbelt.
Socio-Economic Environment	◑ Minimizes potential impacts to cultural and archaeological heritage resources and M.T.O. compensation lands.	● Minimizes noise impacts and tailpipe emissions impacts on existing communities.	○ High potential impact to cultural and archaeological resources, does not mitigate impacts to existing communities.
Capital Costs	● $197M	◑ $229M	○ $320M
Recommendation	Less Preferred Transportation Option	Preferred Transportation Option	Less Preferred Transportation Option

Based on the transportation analysis presented, Alternative 2 is preferred from a transportation perspective. This analysis shall provide input a broader evaluation of alternatives. Further technical assessments are carried out in subsequent sections of this report to aid in further public, agency and stakeholder consultation.

5 Design Feasibility of Draft Preferred Alternative

A functional design exercise is carried out on the Draft Preferred Alternative 2 to confirm the design feasibility of the road network and to identify any potential challenges. The analysis is carried out at a high level because the land in the Study Area will undergo significant modifications due to development. At this stage only arterial roads presented in Alternative 2 were reviewed; collector roads are not included at this stage.

5.1 Scope

Five new arterial roads have been proposed within Alternative 2 for the Columbus Community, including 1 Type B arterial and 4 Type C arterials. Generally, the City of Oshawa classifies Type B arterials as serving moderate volumes of traffic whereas Type C arterials service lower volumes of traffic[3]. The methodology for the design of these roads is as follows:

- Development of design criteria per City of Oshawa and Transportation Association of Canada (T.A.C.) guidelines
- Creation of preliminary horizontal alignments
- Identification of vertical alignment challenges based on the horizontal alignments

The description of the five roads are as follows (for numbering refer to **Exhibit 4-2**):

- Type B
  - Simcoe Street Bypass from existing Simcoe Street North, westerly and northerly to Howden Road
- Type C
  - East-West-1 (E.W.-1): From Simcoe Street Bypass easterly to NS-1
  - East-West-2 (E.W.-2): From Thornton Road easterly to the Simcoe Street Bypass
  - East-West-3 (E.W.-3): From Simcoe Street Bypass and existing Simcoe Street North intersection easterly to NS-1
  - North-South-1 (N.S.-1): From Howden Road to Ritson Road (uses Grass Grove Lane north of Columbus, and Dowson Road south of Howden)

[3] https://www.oshawa.ca/business-and-investment/resources/Engineering-Design-Criteria-Manual.pdf

5.2 Methodology

5.2.1 Design Criteria

The design criteria for the horizontal and vertical alignments for the Columbus Plan was developed referencing T.A.C. guidelines (June 2017) and City of Oshawa guidelines. The functional design criteria is summarized in **Table 5-1**.

Table 5-1: Functional Design Criteria

Classification	Type B – Arterial		Type C – Arterial	
	Design Standards	**Reference**	**Design Standards**	**Reference**
Jurisdiction	Region		Region	
Posted Speed (km/h)	60	City of Oshawa	50	City of Oshawa
Design Speed (km/h)	80	City of Oshawa	70	City of Oshawa
Min Radius (m) @ 4% Super-elevation	280	Region of Durham	200	Region of Durham
Minimum radius tangent	65	T.A.C. 2017	60	T.A.C. 2017
Sag Vertical Curve K_{min}	12-16	Region of Durham / T.A.C. 2017	10-12	Region of Durham / T.A.C. 2017
Crest Vertical Curve K_{max}	26	Region of Durham / T.A.C. 2017	17	Region of Durham / T.A.C. 2017
Right-of-Way (R.O.W.) width (m)	36	Region of Durham	30	Region of Durham

5.2.2 Horizontal Alignments

The horizontal alignment for each road was created to satisfy the minimum radius requirement identified in the design criteria of 280m and 200m for Type B and Type C arterials, respectively. A minimum tangent of 65m and 60m for Type B and Type C arterials between curves were also ensured, respectively. Proposed roads were designed to perpendicularly intersect all other proposed and existing roads where possible. A R.O.W. offset to the alignment was also used to avoid any lands designated as part of the Natural Heritage System (N.H.S.).

A drawing of the functional horizontal alignments developed for this exercise is provided in **Appendix B**.

5.2.3 Vertical Alignments

Surface profiles were created for the horizontal alignments based on 1 metre topographic contour information provided by the City of Oshawa. The contour data was transformed into a Digital Terrain Model (D.T.M.); however, the level

of accuracy is limited due to the lack of break-lines available. As a result, only steep vertical grades (>6%) are identified.

It is important to consider safe smooth transitions between adjacent grades when designing vertical alignments. This is captured within a K factor, a coefficient that considers the horizontal length of the vertical curve with respect to the change in vertical grade experienced. It also considers safe stopping distances along vertical curves. K factors were considered where possible. Crest K factors used are outlined in the design criteria. A conservative sag K factor of 16 and 12 was used for Type B and Type C arterials, respectively.

5.2.4 Limitations and Further Study Required

The intent of this analysis is to identify feasible horizontal and vertical roadway alignments to inform the land use plan. Any particularly challenging vertical alignments are investigated further to understand potential implications, however further design work is required to inform the Preferred Alternative and ultimately, a Part II Plan which shall incorporate a more detailed land survey. Intersection locations will also need to be confirmed to ensure compliance with the minimum intersection spacing indicated in the Region of Durham's Official Plan.

5.3 Findings

Significant grades greater than 6% for each road are identified in the section below. In addition to the individual steep grades identified, it is noted that the design speed for all roads may need to be reduced to minimize earthworks required for appropriate crest and sag K factors.

In all following images, the horizontal alignment is shown with its curves (blue), tangents (red) and offsets (yellow).

5.3.1 Simcoe Street Bypass

The proposed Simcoe Street Bypass will require some refinements to the proposed horizontal alignment. This includes:

1. Straightening of the roadway south of Howden Road
2. Straightening of the roadway north of Columbus Road to provide a longer tangent section to improve vehicle sightlines and storage at the southbound approach to the Columbus Road intersection

The vertical grades are acceptable with the exception of the Greenbelt Protected Countryside Area crossing just south of Columbus Road. A

significant valley with 7% to 20% slopes will require a major bridge structure to span the valley and minimize impacts to the Greenbelt lands.

An illustration of the length and depth of the valley lands at the proposed crossing location is provided in **Exhibit 5-1**, while the proposed horizontal alignment is provided in **Exhibit 5-2**.

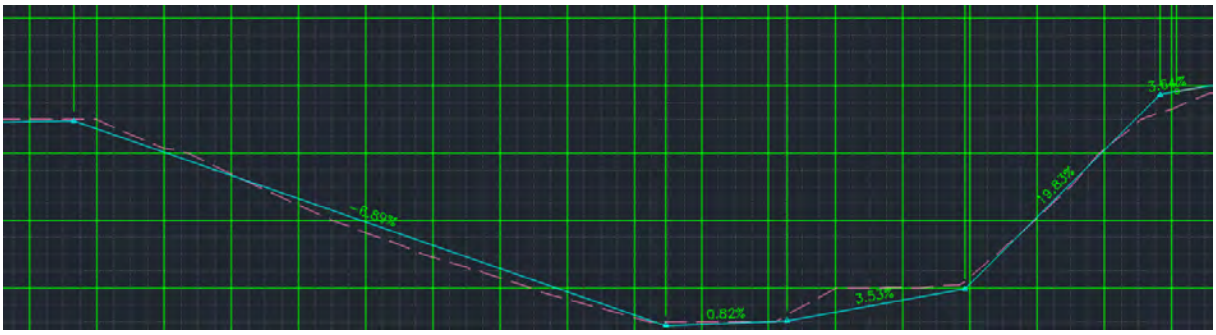


Exhibit 5-1: Simcoe Street Bypass – Vertical Profile at Proposed Greenbelt Crossing Location

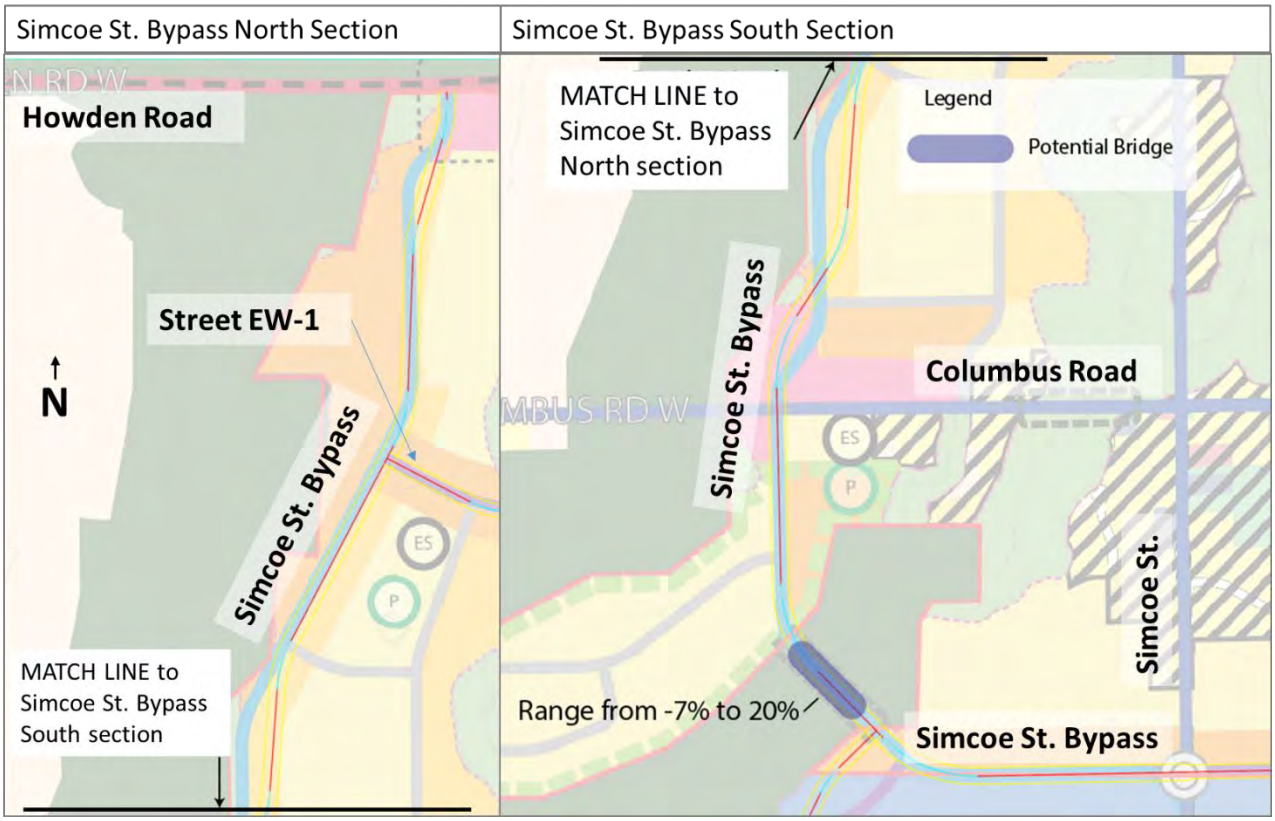


Exhibit 5-2: Simcoe Street Bypass Functional Design

5.3.2 Street E.W.-1

The horizontal alignment of Street E.W.-1 as illustrated in Alternative 2 does not require significant modification (**Exhibit 5-3**). There are however some major constraints with respect to vertical grades, including a valley west of the existing Simcoe Street North which will require a bridge structure (**Exhibit 5-4**), and an 8% uphill grade east of existing Simcoe Street North, on the east side of a N.H.S. corridor, which will require some earthworks to minimize slopes either to the roadway itself or the surrounding developable land (**Exhibit 5-5**).

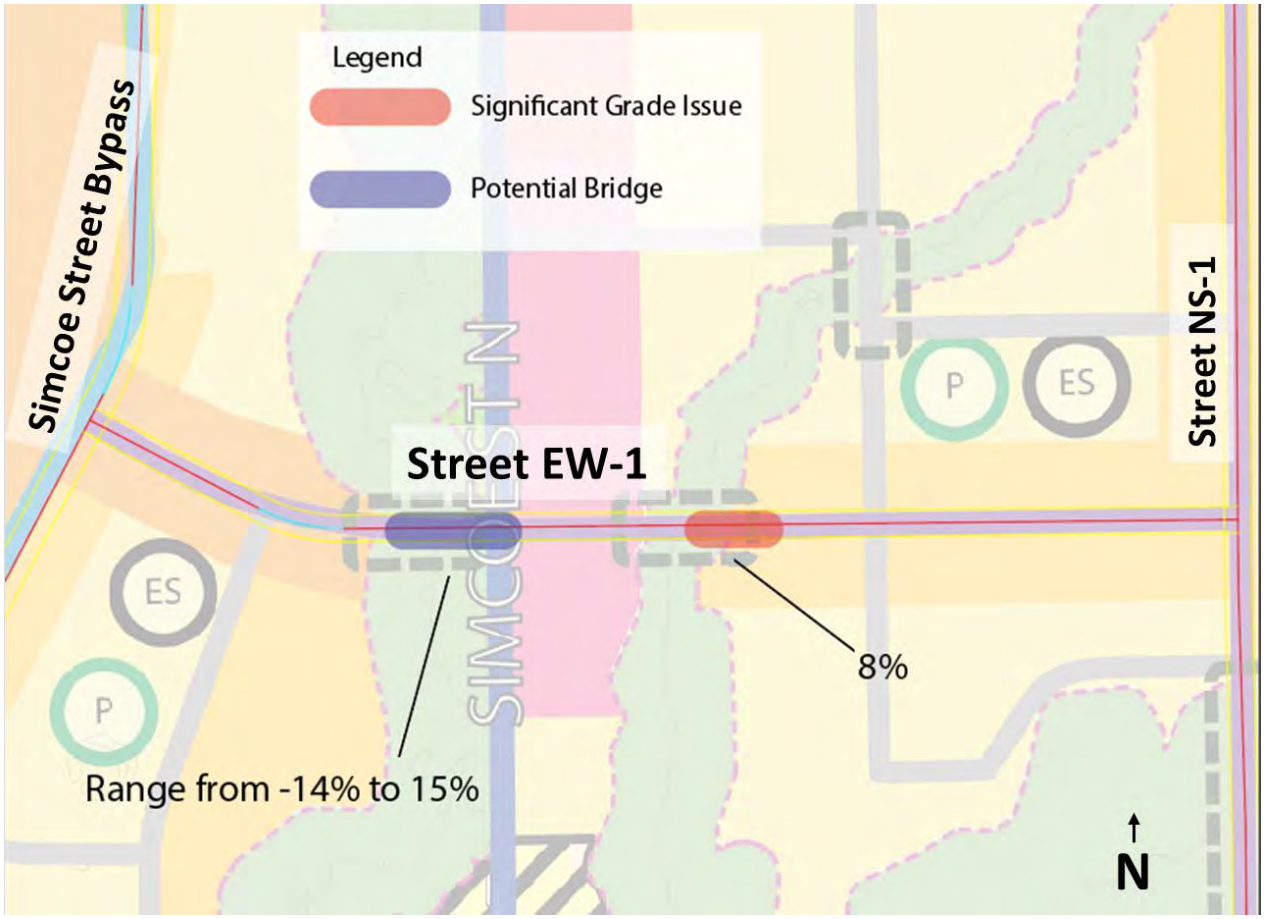


Exhibit 5-3: Street E.W.-1 Functional Design

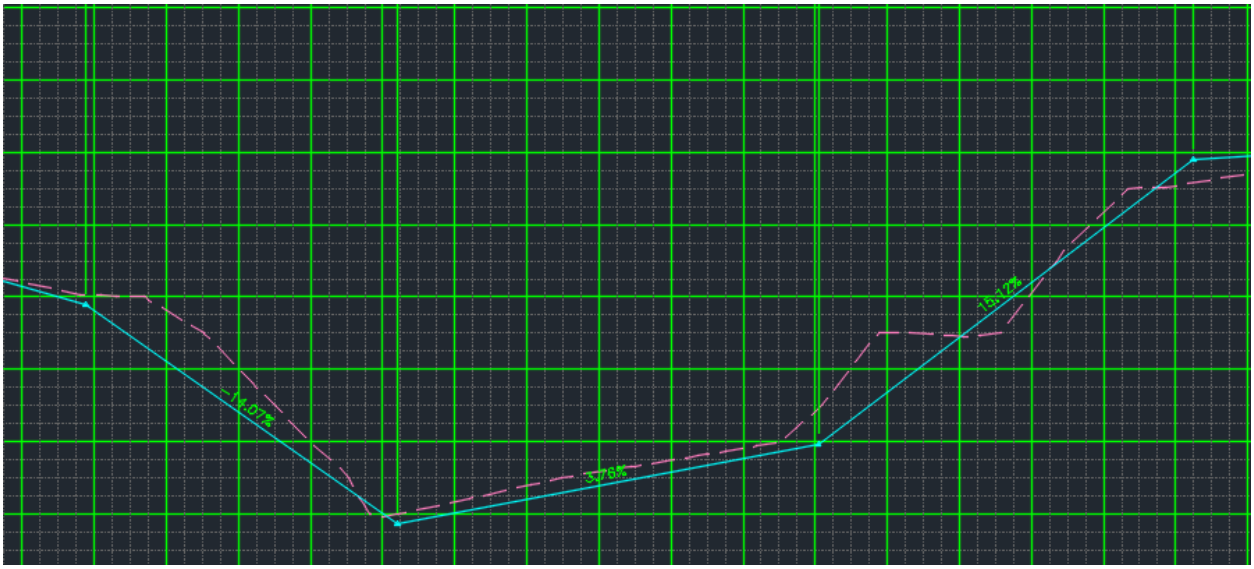


Exhibit 5-4: Street E.W.-1 – Vertical Profile at Proposed N.H.S. Crossing Location west of existing Simcoe Street North

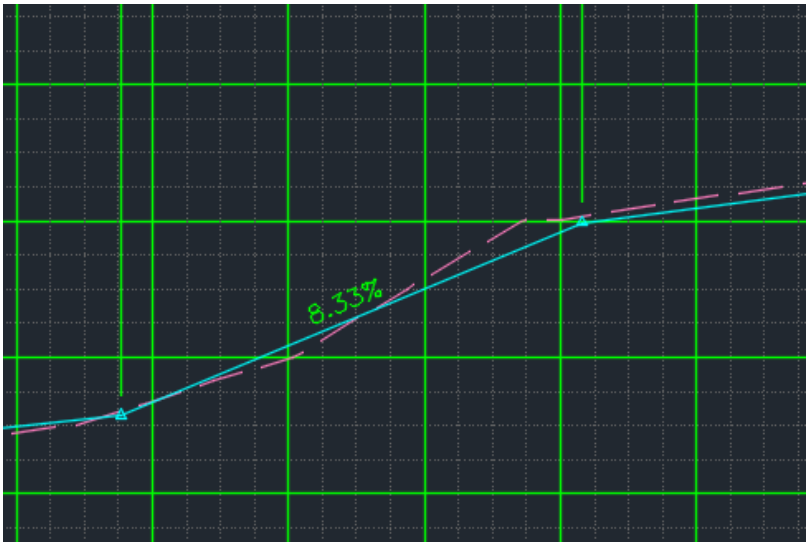


Exhibit 5-5: Street E.W.-1 – Vertical Profile at Proposed N.H.S. Crossing Location east of existing Simcoe Street North

5.3.3 Street E.W.-2

Relative to Alternative 2, Street E.W.-2's horizontal alignment is modified slightly as it approaches the Simcoe Street Bypass. In order to accommodate the design speed, the curve radius was increased. With respect to vertical grades no issues were identified. The functional design of Street E.W.-2 is illustrated in **Exhibit 5-6**.

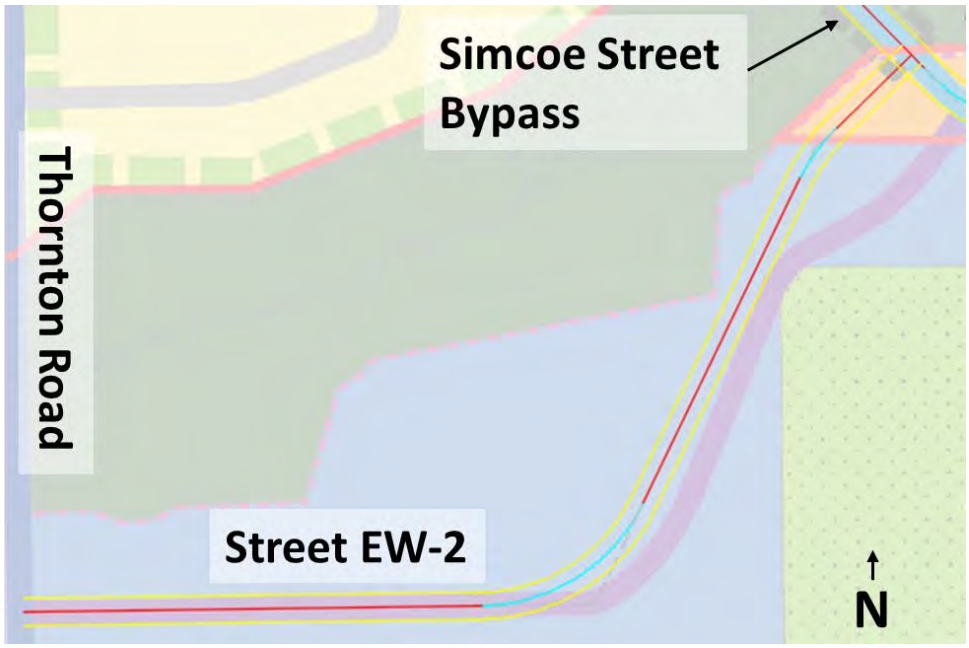


Exhibit 5-6: Street E.W.-2 Functional Design

5.3.4 Street E.W.-3

Relative to Alternative 2, Street E.W.-3's horizontal alignment is modified slightly as it approaches Street N.S.-1. Based on the design speed, flatter curves are required for this street as it curves around a natural feature. With respect to vertical grades no issues were identified. The functional design of Street E.W.-3 is illustrated in **Exhibit 5-7**.

Exhibit 5-7: Street E.W.-3 Functional Design

5.3.5 Street N.S.-1

Relative to Alternative 2, Street E.W.-3's horizontal alignment is modified slightly as it curves towards Ritson Road to the south end. Based on the design a larger radius is required. The functional design of Street N.S.-1 is illustrated in **Exhibit 5-8**.

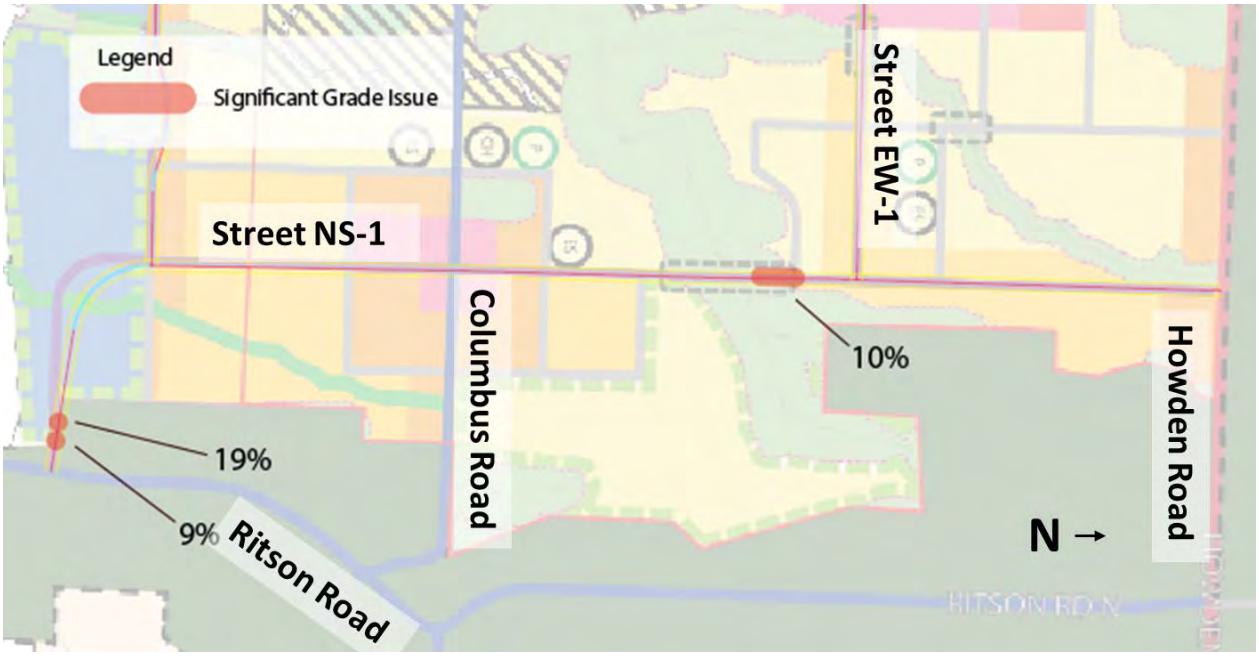


Exhibit 5-8: Street N.S.-1 Functional Design

With respect to vertical grades two issues are noted – firstly at the approach to Ritson Road, and secondly across the N.H.S. just south of Street E.W.-1. Just west of Ritson Road, there is relatively steep terrain, elevating westerly from Ritson Road in first a 5% grade then a 9% grade, and then a 19% grade. Earthworks are required to level these lands to accommodate the proposed connection to Ritson road. The vertical grades just west of Ritson Road are illustrated in **Exhibit 5-9**.

For the location north of Columbus Road and just south of Street E.W.-1, a 10% grade is observed at the northern end of the N.H.S. system. A bridge crossing should be considered to minimize the grades at this location. The vertical grade at this location is illustrated in **Exhibit 5-10**.

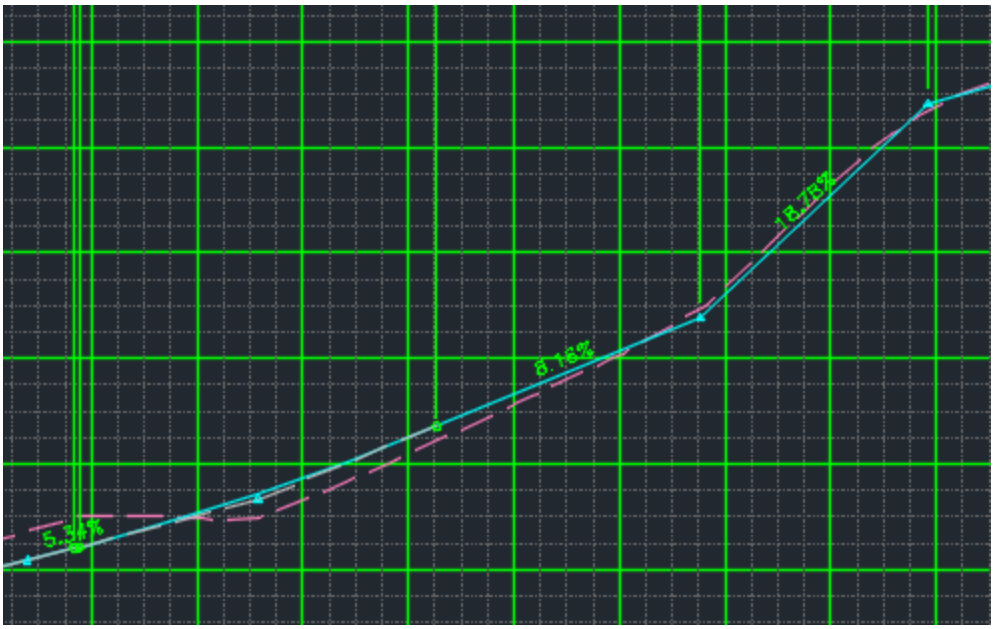


Exhibit 5-9: Street N.S.-1 Vertical Alignment West of Ritson Road

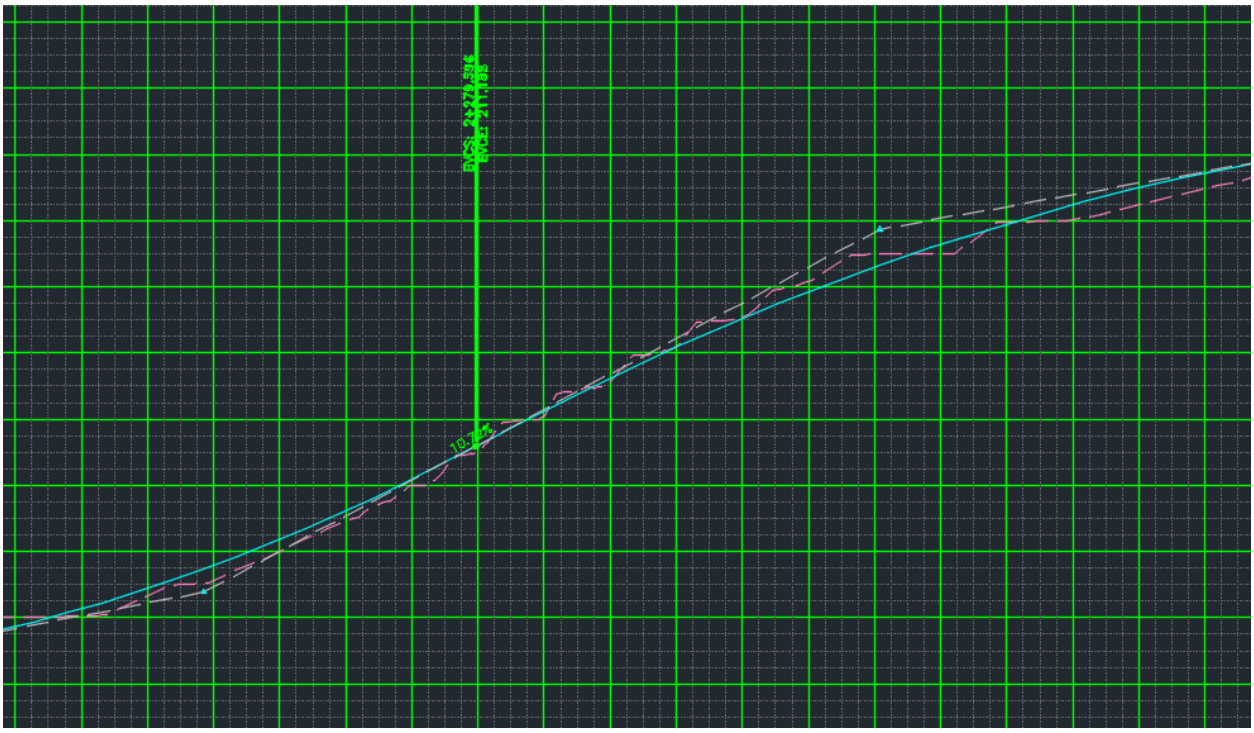


Exhibit 5-10: Street N.S.-1 Vertical Alignment south of Street E.W.-1

5.4 Conclusions

Based on the functional design work, some tweaks to the recommended network should be carried out following the Part II Plan. Furthermore,

problematic locations with respect to vertical grades have been identified and will require further study to minimize steep road grades. These locations are summarized in **Exhibit 5-11**, in the red circles.

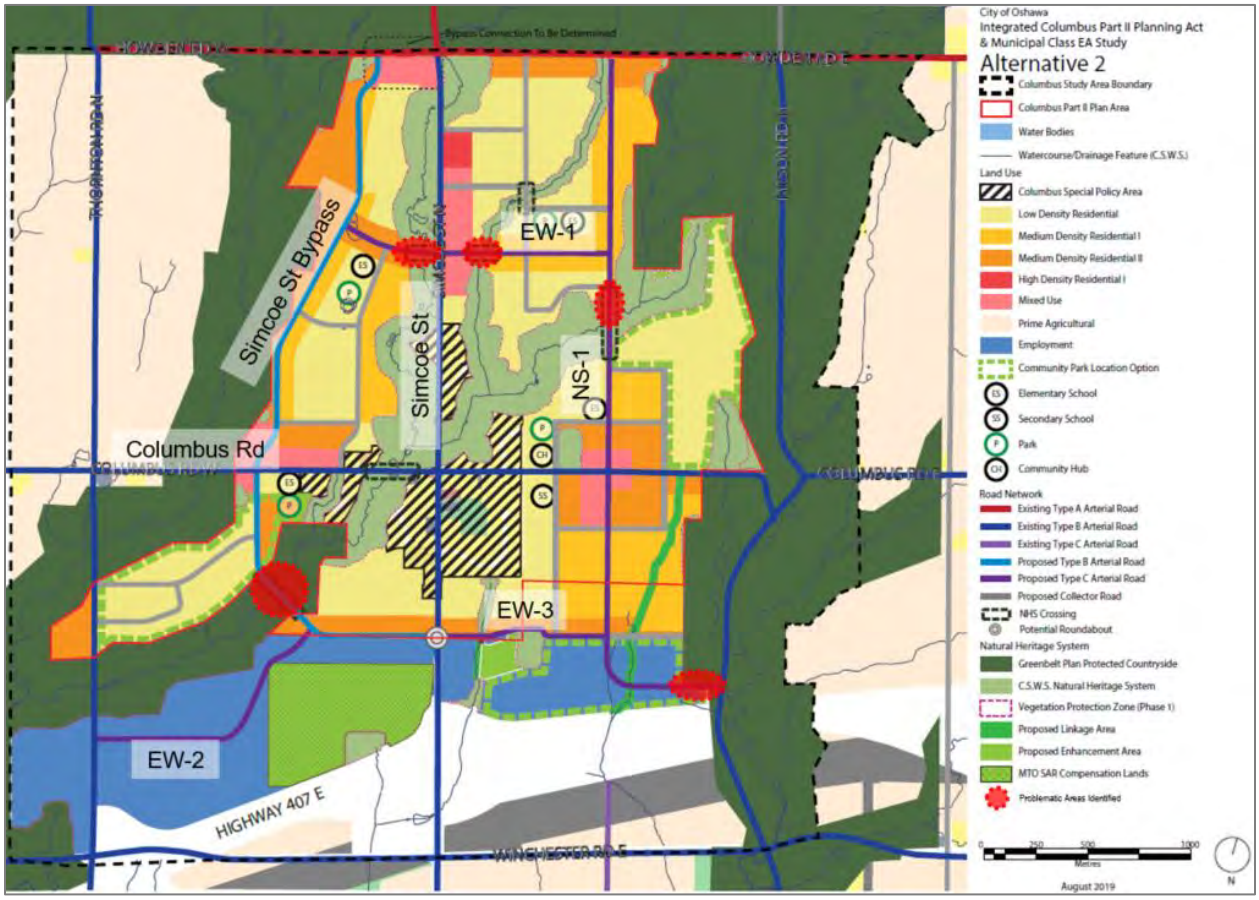


Exhibit 5-11: Summary of locations with challenging vertical grades

6 Refinements and Recommendations

Modifications to the alternatives presented are required to better inform the ultimate selection of a preferred alternatives. These modifications are summarized in the following sections.

6.1 Simcoe Street Bypass South Intersection

Through consultation with the Technical Advisory Committee, the feasibility of the proposed roundabout identified in Alternative 2 (at the Simcoe Street Bypass intersection with the existing Simcoe Street North and Street E.W.-3) in effectively diverting Regional through traffic appears limited. As such a conceptual design of a continuous Simcoe Street Bypass has been undertaken to inform the analysis to ensure that this option is feasible. This design is provided in **Exhibit 6-1**.

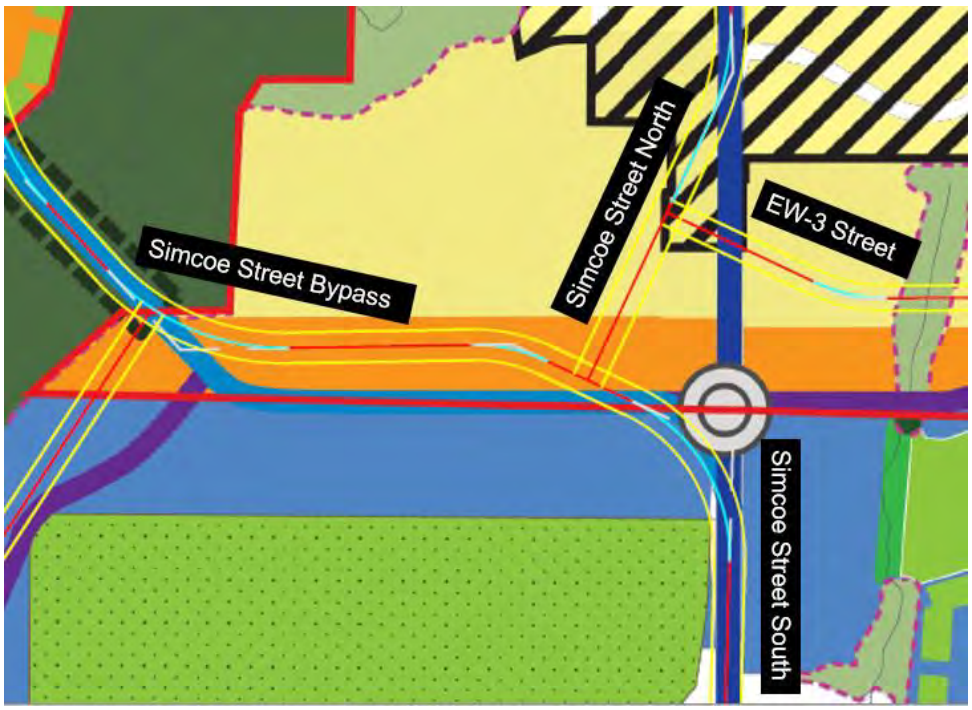


Exhibit 6-1: Functional Design of a Continuous Simcoe Street Bypass

The horizontal alignment of the continuous Bypass option appears to be feasible maintaining a tangent section towards the Highway 407 ramps while still crossing the Greenbelt lands at the preferred crossing location.

6.2 Simcoe Street North Role and Function

With the conceptual alignment of the Simcoe Street Bypass, it is recommended that Simcoe Street North through Columbus be downgraded to a Type C Arterial Road, a classification which is better aligned with the number of private accesses along the street, limited right-of-way width, and projected traffic volumes with the Bypass.

6.3 Brooklin By-pass Provincial Class E.A. Study

In addition to the deferred midblock crossings of Highway 407 (D.5) and the Carnwith Drive connection assessed in **Section 4.3**, it is noted that this analysis has not yet considered the proposed Type 'A' arterial connecting Howden Road and Brawley Road which is subject to the outcome of Brooklin By-pass Provincial Class EA Study.

6.4 Proposed Roundabout at Ritson Road and Columbus Road

The City of Oshawa in 2011 completed a Municipal Class E.A. study for Ritson Road North at Columbus Road East Intersection Improvements. The study recommended a roundabout solution and this improvement will be incorporated into the final transportation analysis and design in the next phase of this study.

6.5 Summary of Recommendations and Findings

Other recommendations to be carried forward for the preferred alternative, as documented in this report, include:

1. Carry forward Alternative 2 from a transportation perspective to a broader evaluation of Land Use and Road Alternatives.
2. As the intent of this analysis is to identify feasible horizontal and vertical roadway alignments to inform the land use plan, only Phases 1 and 2 of the Municipal Class E.A. process will be satisfied. Further design work is required to inform the Phases 3 and 4 of the Municipal Class E.A. process which will consider a more detailed land survey and undertake geotechnical and fluvial geomorphological and other engineering studies to identify a preferred design solution.
3. Challenging vertical grades have been identified which will need to be addressed during a future Phase 3 and 4 E.A. study. It is further noted that land development adjacent to the proposed roadways may support the

required roadway grading and vertical profiles. As such this future E.A. study may need to be completed in parallel to landowner site design.

4. Intersection locations will also need to be confirmed to ensure compliance with the minimum intersection spacing indicated in the Region of Durham's Official Plan.
5. Based on the findings of the traffic analysis:
    a. The deferred midblock crossings (D.5.) of Highway 407 identified in the Oshawa Official Plan Schedule 'B' are not required based on the projected build-out of the study area by the year 2031, especially when considering the anticipated costs associated with providing grade separated crossings.
    b. Similarly, the Type C Arterial Road is not required to serve east-west traffic demands between Whitby and Oshawa based on this analysis. The east of Thornton Road screenline has spare capacity and a new crossing of the Natural Heritage System is unlikely to be justified based on the projected build-out of the study area by 2031.
    c. Operational improvements to Thornton Road through the study area, including intersection lane configuration improvements to increase capacity
    d. Widening of Simcoe Street from 2 to 4 lanes through the study area (aligned with the Durham Region T.M.P. recommendation for a road widening beyond 2031)
    e. Operational improvements to Ritson Road from Street E.W.-3 to the southern limits of the study area
    f. Operational improvements to Columbus Road west of Street N.S.-2 or Simcoe Street Bypass to western limits of the study area