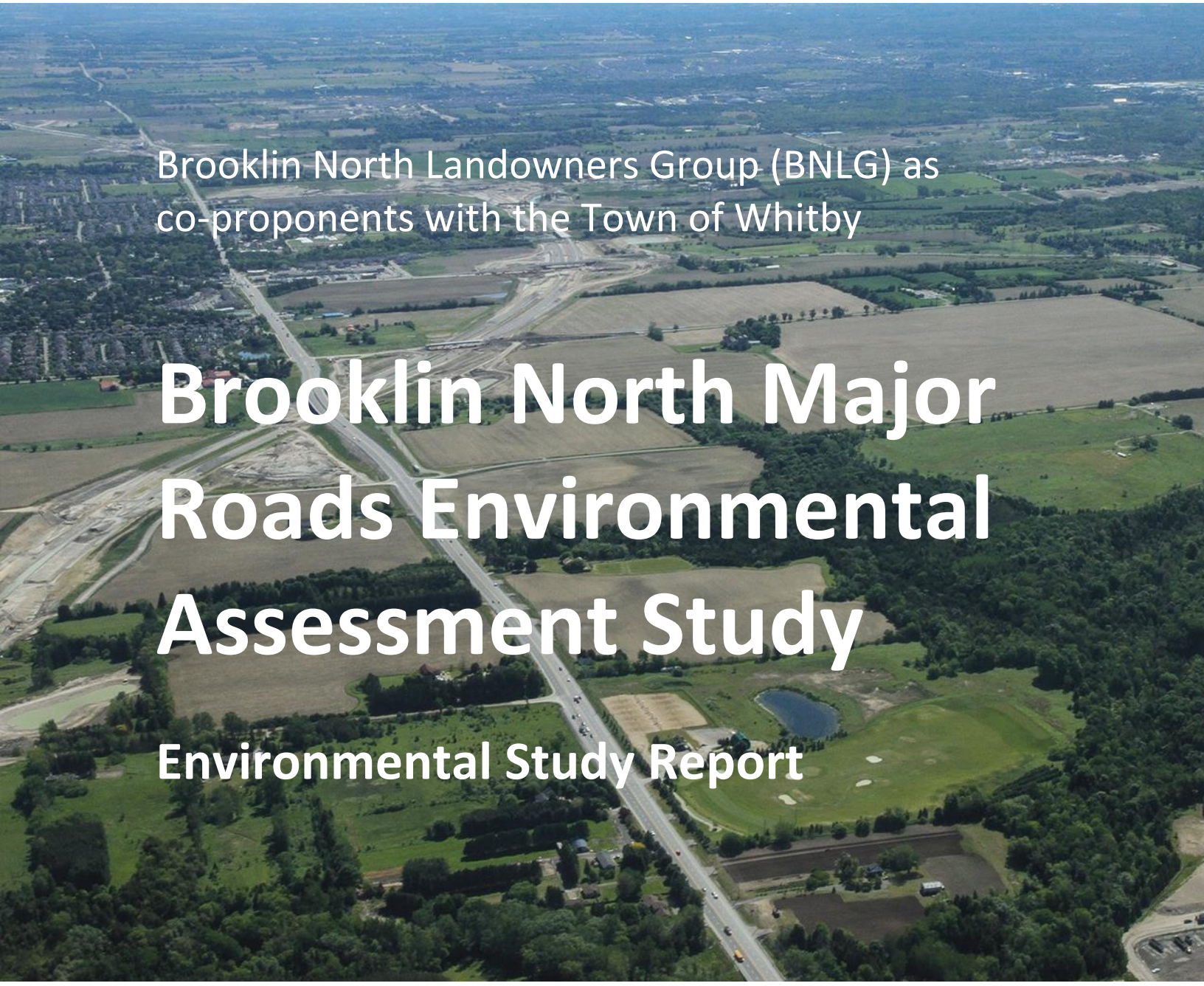

Brooklin North Landowners Group (BNLG) as co-proponents with the Town of Whitby

Brooklin North Major Roads Environmental Assessment Study

Environmental Study Report

February 2021 (Revised November 2021)
19382

BROOKLIN NORTH LANDOWNERS GROUP
MALONE GIVEN PARSONS

Whitby

Disclaimer

This Report represents the work of LEA Consulting Ltd ("LEA"). This Report may not be relied upon for detailed implementation or any other purpose not specifically identified within this Report. This Document is confidential and prepared solely for the use of the Town of Whitby and the Brooklin North Landowners Group. Neither LEA, its sub-consultants nor their respective employees assume any liability for any reason, including, but not limited to, negligence, to any party other than the Town of Whitby and the Brooklin North Landowners Group for any information or representation herein.

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1 Introduction

The Brooklin North Major Roads Environmental Assessment (BNMREA) Study has been conducted to evaluate and recommend a preferred arterial and collector road network that can support sustainable long-term growth and the efficient and safe movement of people and goods in the community of Brooklin, located within the Town of Whitby, Ontario. The study focuses on the development of major road designs for the Brooklin North neighbourhood, a planned expansion area that is expected to accommodate a population of 45,202 and 11,437 jobs by the horizon year of 2031.

The purpose of this Environmental Study Report (ESR) is to document the results of Phases 1 to 4 of the Municipal Class Environmental Assessment (MCEA) process. Phases 1 and 2 of the MCEA process were previously completed as part of the Brooklin Secondary Plan and Brooklin Transportation Master Plan (Brooklin TMP), collectively known as the Brooklin Study, and its findings have been reviewed and confirmed as part of the BNMREA. This report outlines the need and justification for additional transportation infrastructure within the study area, the process used to select a preferred alternative solution, and the method used to develop and identify the preferred alternative design of the recommended road network.

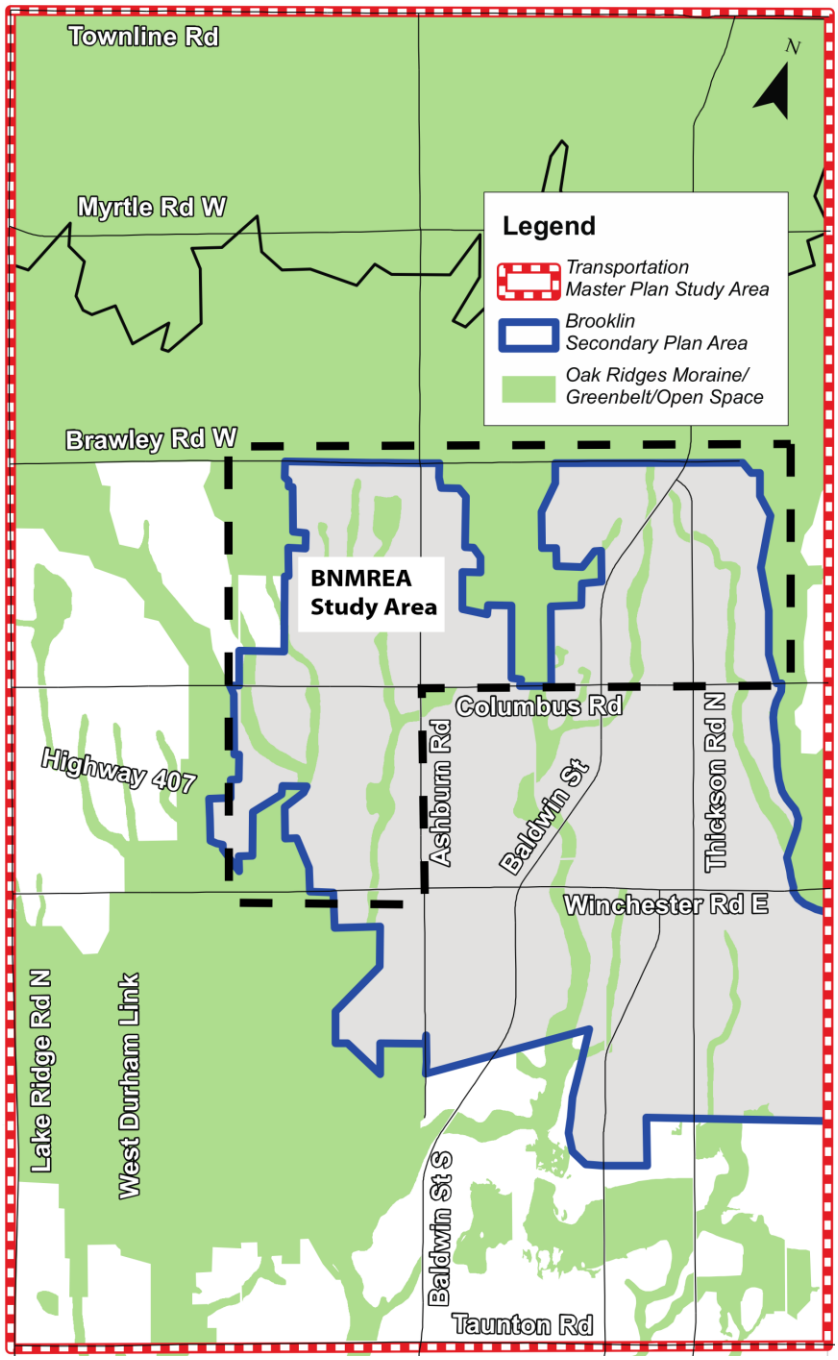
1.1 Background

In 2014, the Town of Whitby (Town) began preparing the Brooklin Study to develop a future vision for the Brooklin community. The Brooklin Study was motivated by the need for a cohesive land use and transportation strategy to guide population and employment growth in the Brooklin area, while reflecting the preferences of existing residents and community stakeholders.

The Brooklin Study was prepared through an integrated approach that satisfies the requirements of the Planning Act and Phases 1 and 2 of the MCEA process, as permitted under Section A.2.9 of the MCEA document. The study boundaries of the Brooklin Secondary Plan encompassed the existing Brooklin settlement and future expansion areas. The Brooklin TMP adopted a larger study area, containing the Brooklin Secondary Plan boundaries along with the surrounding rural area (see **Figure 1-1**). The Brooklin Study was completed in 2017 and approved by the Town and the Region of Durham in 2018.

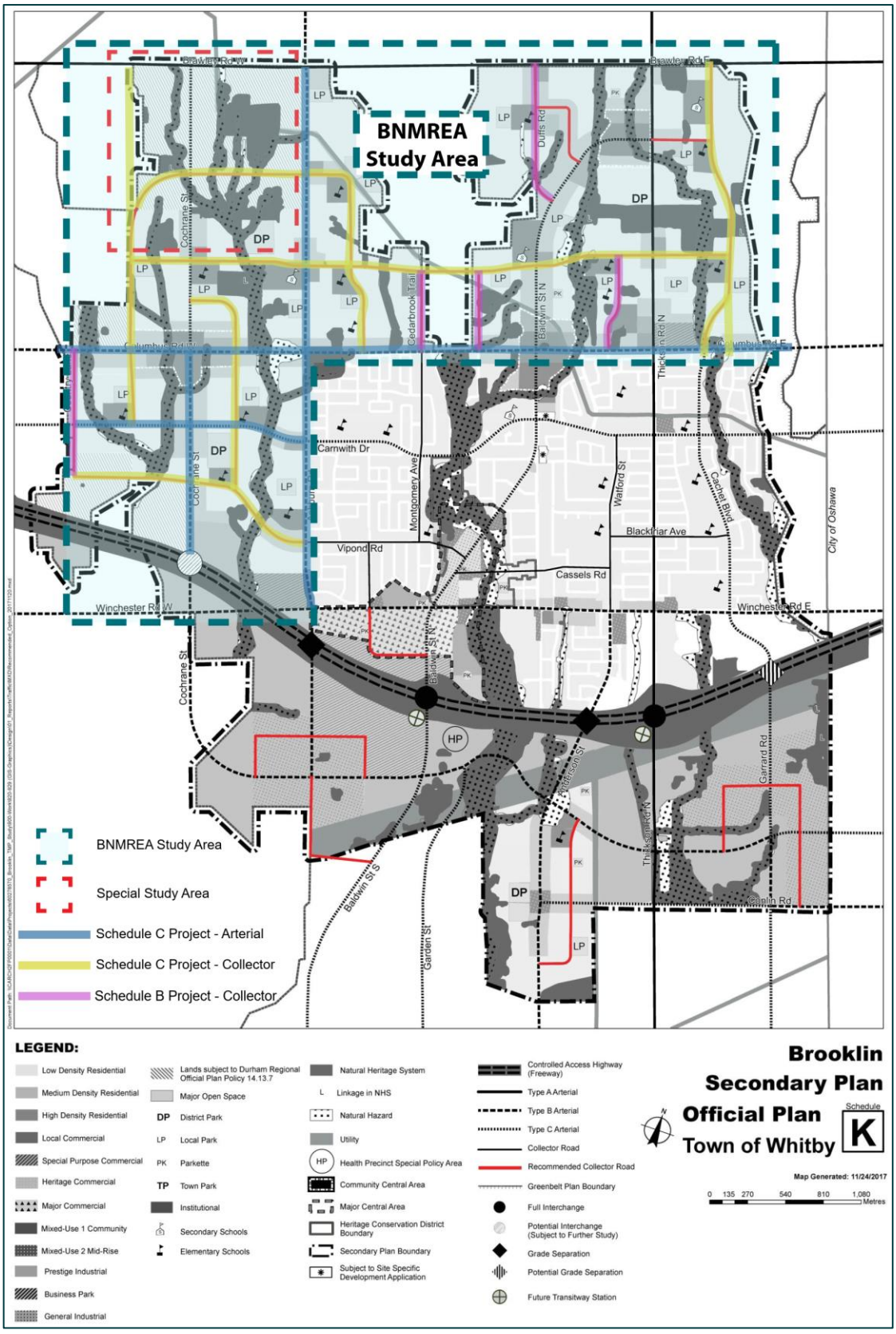
Subsequently, the Brooklin North Landowners Group (BNLG) drafted a Comprehensive Block Plan (CBP) in 2018 to further refine the land use scenarios for Brooklin North, the planned expansion area located to the north and west of the existing Brooklin community. The CBP is a conceptual land use plan that provides a framework for landowners to coordinate the development of individual subdivisions.

Figure 1-1: Brooklin Secondary Plan and Brooklin TMP Study Areas (Image: Town of Whitby)



The Brooklin TMP identified a preferred transportation network for the Brooklin North expansion area to address existing deficiencies and support future population and employment growth. The recommended road network includes several projects identified as Schedule C due to their potential environmental impacts. These projects are required to complete Phases 3 and 4 of the MCEA process; Schedule A or B projects can be satisfied through the draft plan approval process. **Figure 1-2** illustrates the recommended arterial and collector road network in Brooklin North.

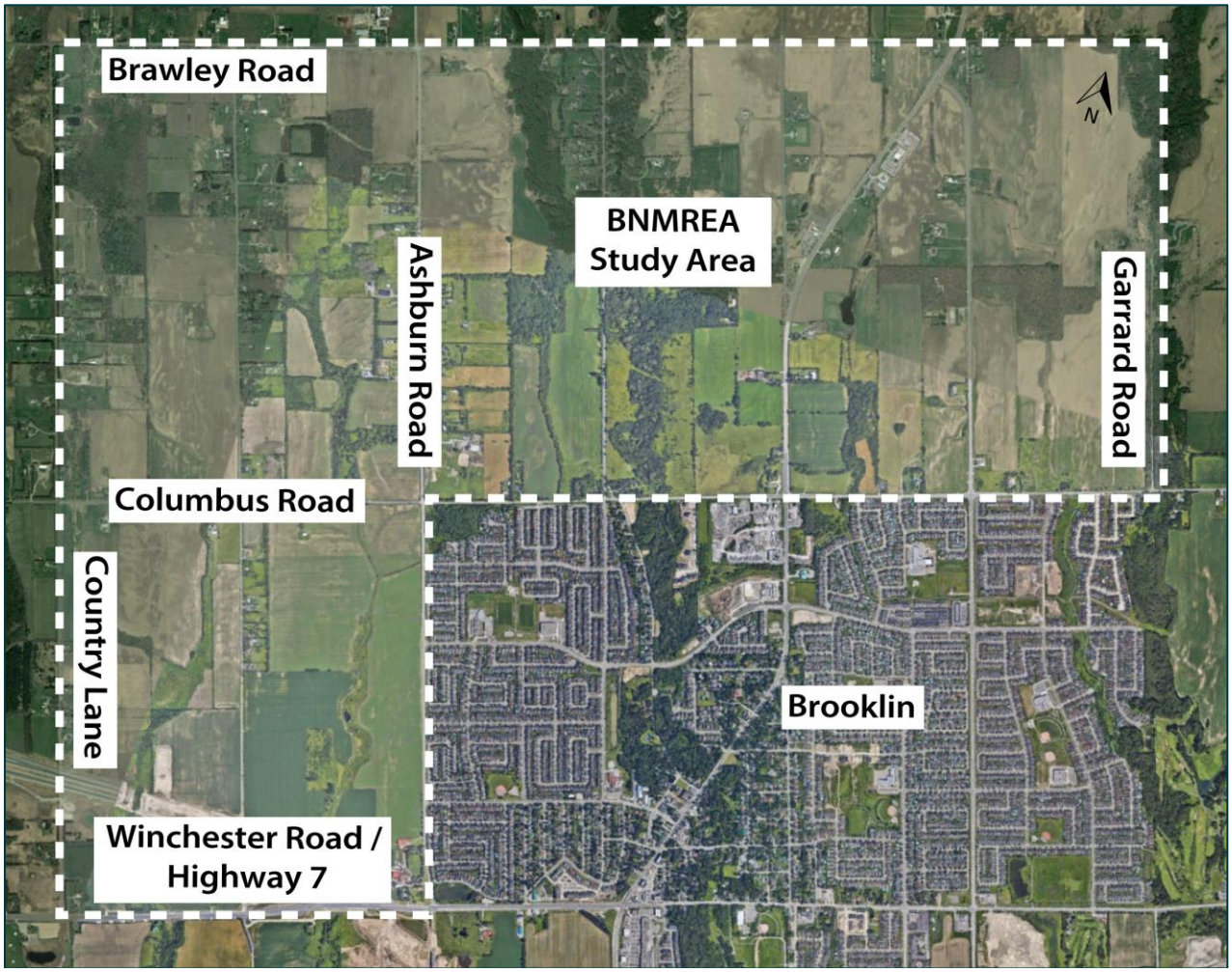
Figure 1-2: Brooklin TMP Recommended Road Network (Image: Town of Whitby)



The Town, as co-proponents with the BNLG, have initiated the BNMREA to complete the environmental assessment of several Schedule C projects identified by the Brooklin TMP. The study has further developed the road network recommended by the Brooklin TMP, evaluating and selecting design alternatives for arterial and collector roads within the study area. Re-routing Highway 7/12 and the widening of Thickson Road were not included in the project scope of the BNMREA and will be addressed through separate studies.

The BNMREA study area is bounded by Brawley Road to the north, Garrard Road to the east, the existing Brooklin settlement to the southeast (bounded by Columbus Road and Ashburn Road), Winchester Road / Highway 7 to the south, and Country Lane to the west. The study area is illustrated in **Figure 1-3**.

Figure 1-3: BNMREA Study Area (Image: Google Earth)



1.2 Process

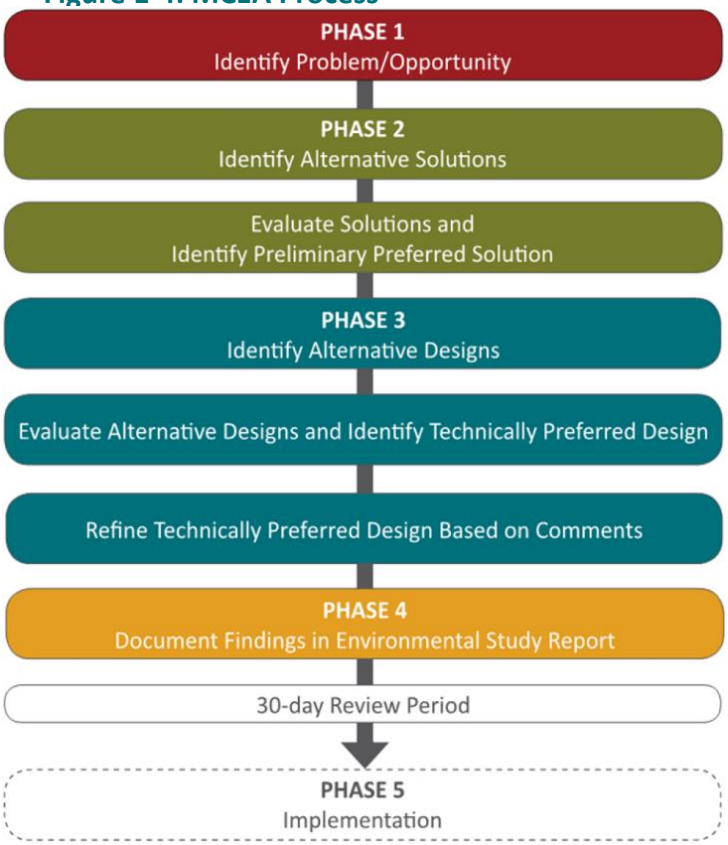
LEA Consulting Ltd. (LEA) has been retained by the BNLG, as co-proponents with the Town, to provide environmental assessment planning and design services to complete the BNMREA. The MCEA process is illustrated in **Figure 1-4**.

While the focus of this study was on Phase 3 of the MCEA process, LEA first needed to conduct a comprehensive review of the Brooklin TMP methodology and findings, including technical background studies. This review reaffirmed that the Brooklin TMP had satisfied Phases 1 and 2 of the MCEA process.

As part of Phase 3, the alternative design concepts of the arterial and collector road alignments have been developed. Alternative designs were examined using a set of evaluation criteria, and a preliminary preferred design was identified for each road. After consultation with review agencies, stakeholders, and members of the public, the preferred designs were further refined.

This ESR summarizes the findings of Phases 1 to 3, satisfying the requirements of Phase 4. After public and agency review and comment, the study will be finalized and received by the Town.

Figure 1-4: MCEA Process



1.3 Study team

The study was initiated by Malone Given Parsons on behalf of the BNLG and the Town. The Town and BNLG are acting as co-proponents for the study. LEA is the lead consultant undertaking this study, along with a multi-disciplinary team of sub-consultants:

- LEA Consulting Ltd. – EA Process Specialization, Engineering (Transportation, Structural and Civil), Noise, and Planning;
- LGL Ltd. – Natural Environment;
- Archeoworks Inc. – Archaeology;
- Unterman McPhail Associates – Built and Cultural Heritage; and
- RWDI Consulting Engineers – Air Quality.

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2 Consultation and Engagement

Throughout the study, the public has been given opportunity to engage with and shape the study process by making comments, identifying problems, and providing additional information. The comments provided have broadened the information base and facilitated decision making in the process. At its conclusion, the project mailing list included over 1,000 contacts comprised of stakeholders, associations, businesses and members of the public. A summary of the public correspondence and input received during the study is provided in **Appendix A**. The consultation program summarized in the following sections has been designed to comply with MCEA requirements (dated 2000, most recent approved amendments in 2015) for a Schedule C project.

2.1 Public Notices

The first step the public and agency consultation process was the publication and circulation of the Notice of Study Commencement, a copy of which is provided in **Appendix Ai**. The notice was issued in August 2019, and published on the Town's website on August 1, 2019 at https://www.whitby.ca/en/news/commencement-of-brooklin-north-major-roads-environmental-assessment-study.aspx. The notice was also sent to residents and businesses in the study area via email if available and otherwise through mail. A total of 593 email notices and 523 mailed notices were sent out.

2.2 Online Community Open House #1

The Community Open House notice was published on the Town's website on April 9th, 2020 as well as local newspapers, including Whitby This Week on April 23rd, 2020 and The Brooklin Town Crier on April 24th, 2020. In addition, the notice was circulated to the project mailing list. Following recommendations of health officials during the COVID-19 pandemic shutdown, the Community Open House materials were made available online beginning April 15th, 2020 at https://www.lea.ca/BrooklinNorthCOH.

The open house provided information on the study process, including information on:

- Summary of findings of Phase 1 and 2 of the MCEA process
- Project background
- Study purpose
- Preliminary alignments
- Preliminary cross sections

Members of the public were encouraged to review the materials online and were provided the opportunity to submit questions and comments throughout the period of April 15th to May 6th, 2020. Submissions were available through comment boxes on the website, through email or by phone.

Throughout the online open house, the website was visited 2,703 times and the presentation was downloaded 90 times over the course of the consultation period. From these reviews, the study team was provided a total of 16 comments. The information presented on the open house web page is provided in **Appendix Aii**.

Discussion of feedback received through the open house can be found in **Section 6.4**.

2.3 Stakeholder Consultation

Several stakeholders were consulted with over the duration of the BNMREA. Their input informed the direction and recommendations in the study.

2.3.1 Indigenous Community and Organizations Engagement

In accordance with the Ontario governments process for Indigenous and First Nations engagement, Indigenous communities were contacted at multiple points throughout the study process. Specifically, the study team contacted the Indigenous and First Nations communities at the point of the Notice of Commencement, the online Community Open House, completion of the Stage 1 Archaeological Assessment (AA), and completion of the ESR.

The communities contacted are listed below with group consultation guidelines where applicable:

- Anishinabek Nation/Union of Ontario Indians Nipissing First Nation
- Alderville First Nation
- Hiawatha First Nation
- Curve Lake First Nation (specific consultation guidelines provided and followed)
- Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)
- Assistant Deputy Minister's Office - Negotiations and Reconciliation Division
- Mississaugas of Scugog Island
- Mississaugas of the Credit First Nation
- Williams Treaties First Nations Process Coordinator
- Chippewas Of Mnjikaning (Rama)
- Métis Nation of Ontario Oshawa and Durham Region Metis Council
- Chippewas of Georgina Island
- Kawartha Nishnawbe First Nation
- Huron-Wendat First Nation

The following Indigenous Communities and agencies were sent a copy of the draft Stage 1 Archaeological Assessment Report for comment on August 12, 2020:

- Anishinabek Nation
- Alderville First Nation
- Hiawatha First Nation
- Mississaugas of the New Credit First Nation
- Chippewas of Mnjikaning (Rama)
- Williams Treaties First Nations Process Coordinator
- Curve Lake First Nation
- Chippewas of Georgina Island
- Ministry of Indigenous Affairs
- Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)

A summary of agency comments is provided in Table 2-2, while details of the letters of notification, comment tracking and responses provided can be found in Appendix Aiii.

Table 2-1: Summary of Indigenous Community and Organization Correspondence

Indigenous Community / Organization	Comment	Project Team Response / Action
Oshawa and Durham Region Métis Council	Comment received on March 25, 2021: • Expressed concerns with project impacts to wildlife	Response sent on March 26, 2021 indicated: • The natural environment was assessed and considered in a comprehensive evaluation

Indigenous Community / Organization	Comment	Project Team Response / Action
		process that resulted in the selection of preferred roadway solutions. Residual impacts of the preferred alignments have been addressed through the preliminary design process, and will continue to be addressed as the projects proceed through the next detailed design and construction phases of work beyond the Roads EA.

The Project Team is not aware of outstanding Indigenous Community comments or concerns with the Stage 1 Archaeological Assessment Report, and the report was finalized and has been included in **Appendix E**.

2.3.2 Internal and External Agencies

There are several agencies who have jurisdiction in the area of the study and whose feedback is vital in guiding the study's direction. Throughout the BNMREA, the study team corresponded with representatives of the following internal agencies:

- Town of Whitby (Town)
- Regional Municipality of Durham (Region)

The following external agencies were engaged throughout the study process:

- Ministry of the Environment, Conservation and Parks (MECP)
- Central Lake Ontario Conservation Authority (CLOCA)
- TransCanada Pipeline

The following external agencies were provided notification of the project start and online community house and provided opportunities to provide comment on the project:

- Ministry of Natural Resources and Forestry (MNRF)
- Ministry of Heritage, Sport, Tourism and Culture Industries
- Ministry of Transportation (MTO)
- Ministry of Indigenous Affairs (formerly Ministry of Aboriginal Affairs)
- Durham District School Board and Durham District Separate School Board
- Utility Companies including:
  - Bell
  - Rogers
  - Elexicon
  - Enbridge

These agencies will continue to provide comments during the development phases within the Brooklin Secondary Plan area after the conclusion of the BNMREA and will be stakeholders for the development

of the detailed design of the roads analyzed in the BNMREA. Other agencies including Department of Fisheries and Oceans will be engaged as part of the permit process for the water crossings.

A summary of agency comments are provided in **Table 2-2** and a copy of the letters of notification, comment tracking and responses are provided in **Appendix Aiii**.

Table 2-2: Summary of Agency Correspondence

Stakeholder	Comment	Project Team Response / Action
Ministry of Environment, Conservation and Parks (MECP)	Comments received on August 26, 2019: • Confirmed receipt of the Notice of Commencement • Provided guidance on the Ministry's interest with respect to the Class EA process • Noted a quantitative air quality assessment is likely required • Legal duty to consult with Aboriginal communities, and provided a list of communities identified to be potentially affected by the project Comments received on April 21, 2021 on the ESR: • Requested additional details on the stakeholder engagement • Requested clarification on the air quality assessment methodology • Suggested completion of additional geotechnical, contamination, and hydrogeological studies be completed	Comments were noted by the Project Team. A virtual meeting between the Project Team and MECP was held on May 26, 2021 to discuss the qualitative approach for the air quality assessment. A response letter was sent to MECP in November 2021 providing a response detailed how all MECP's comments were addressed in the revised ESR.
Central Lake Ontario Conservation Authority (CLOCA)	Comment received on October 20, 2019: • Requested an update on the study Comment received on November 21, 2019: Requested clarification on the MCEA schedule Comments were received on May 3, 2020 on the draft Stormwater Management Report. Comments received on May 5, 2021 on the ESR: • Requested clarification text be added to the ESR regarding wildlife	Response sent on November 13, 2020: • Provided a list of contacts the notice of study commencement was sent to • Confirmed CLOCA would be included on all consultation milestones throughout the study Response sent on November 22, 2019: • The study is being completed as a Schedule C project • Scope of study includes confirming Phase 1 and 2 work completed as part of the TMP, while this study will complete Phase 3 and 4 of the study

Stakeholder	Comment	Project Team Response / Action
	linkages, thermal regimes within the study area, and mitigation measures / commitments to future work	A response letter was sent to CLOCA in November 2021 providing a response detailed how all CLOCA's comments were addressed in the final Stormwater Management Report, Natural Heritage Report, and revised ESR
TC Energy	Comment received on January 13, 2020: • Provided contact information for communication throughout the study	Contact list was updated as requested.
Regional Municipality of Durham	Comments received on May 6, 2021 on the ESR: • Questions about why some roads were sub-standard	A response letter was sent to Durham Region in November 2021 providing a response to how the Region's comments were addressed in the revised ESR or explanation for the sub-standard design.

2.3.2.1 Agency Meetings

The Project Team met with external government agencies during the study to present an overview of the project and discuss agency comments and interests. A summary of the key stakeholder meetings are provided in **Table 2-3**.

Table 2-3: Summary of Key Stakeholder Meetings

Agency	Meeting Date	Topics Discussed
Ministry of Environment, Conservation and Parks	June 11, 2019	Project Team met with MECP to present and discuss the following: • Introduce the Project Team • Study Background • Key Areas of Provincial Interest and Policy Direction
Town of Whitby Council	December 9, 2020	Project Team presented the following to the Town of Whitby Council: • Study Background • Scope of Work •
CLOCA	March 6, 2020	Project Team met with CLOCA to present and discuss the following: • Project overview • Existing natural environmental and hydraulic conditions • Proposed stormwater management

Agency	Meeting Date	Topics Discussed
		• Other comments and requirements CLOCA would like considered / reviewed as part of the EA
CLOCA	October 20, 2020	Project Team met with CLOCA virtually to present and discuss the following: • Preferred alternative impacts • Proposed mitigation Environmental compensation requirements
Town of Whitby Council	February 22, 2021	Project Team presented the following to the Town of Whitby Council: • Study update • Study findings and recommendations
MECP	May 26, 2021	Project Team met with MECP to discuss MECP's April 29, 2021 comments on the ESR. Based on the discussions, MECP accepted the rationale to use a qualitative air quality assessment for the Brooklin North Major Roads EA.

2.3.3 Area Landowners

Similarly, there were many opportunities for private property owners to become involved and provide feedback during the project. Through their feedback preferred designs were refined and potential mitigation of impacts to adjacent properties, including property requirements and access, were discussed. Throughout the BNMREA, the study team corresponded with the representatives of the following groups and properties:

- Conlin Employment Area Landowners Group
- Brookfield Homes Limited
- Brookvalley Project Management Inc.
- Mattamy Homes Canada
- Sorbara Group
- Mykinder Holding Corporation
- Valerie Cranmer & Associates
- Fieldgate Development
- Abacus Equity Infusion Inc.
- Greenworld Investment Inc.
- Madison Properties Inc.
- Luvian Homes
- Nideva Properties Inc.
- H.A. Homung Investments Ltd.
- Highmark Homes
- CTE Management Inc.
- 24 Princess Street

- 360 Columbus Road West
- 7152 Ashburn Road
- 1628755 Ontario Ltd.

Details of the letters of notification, comment tracking and responses provided are detailed in **Appendix Aiii**.

3 Existing and Planned Conditions

The MCEA process requires an assessment of the existing socio-economic, natural, and cultural environment to evaluate potential impacts associated with the proposed design solutions. Background studies were conducted during the preparation of the Brooklin Study, including socio-economic, natural environment, transportation, archaeological and cultural heritage, and stormwater management studies. Their findings were reviewed and confirmed as part of the BNMREA. As previously noted, the BNMREA study area is a subset of the study boundaries used in the Brooklin Study, and this review therefore highlights applicable sections of each related technical report.

3.1 Socio-Economic Environment and Planning Policy

3.1.1 Population, Housing and Employment

Hemson Consulting Ltd. completed a Population, Housing and Employment Analysis report in 2015 in support of the Brooklin Study. The report reviewed historical development patterns in the region, conducted a housing needs assessment, examined residential and employment capacity, and assessed intensification potential in the Brooklin area. The analysis was guided by provincial, regional, and local policy, including the Growth Plan for the Greater Golden Horseshoe (Growth Plan), Region of Durham Official Plan, and Town of Whitby Official Plan. Municipal and regional policy is required to conform with the basic planning parameters articulated in the provincial Growth Plan, including a minimum greenfield density of 50 people and jobs per hectare and a region-wide intensification target of 40%[1]. Brooklin North is a designated greenfield area and is therefore subject to the provincial minimum density requirement.

Building upon the Growth Plan, the Region prepared the Growing Durham report in 2008 to examine how the region can shift towards an appropriate housing mix and meet the density and intensification targets prescribed by provincial policy. Within the Brooklin community, the existing housing stock is 84% low density, 12% medium density, and 4% high density units; these figures are broadly consistent with the regional average. As an outcome of the Growing Durham report, the Region is targeting a shift in the proportion of low-density units to 50% region-wide by 2031, and to 68% within designated greenfield areas, to meet the Growth Plan targets and achieve a more compact urban form.

Population and employment capacity within the Brooklin Secondary Plan boundaries were studied to determine the growth potential of the existing Brooklin settlement and future expansion areas. The report examines full build-out of available greenfield land in the Brooklin Secondary Plan area, which is expected to take place after 2031. The analysis assumes that future development will adhere to the direction provided by provincial, regional, and local planning policies, including the minimum density, intensification and housing mix targets described above. The analysis results indicate that the Brooklin Secondary Plan study area can support a population of up to 45,202 and 11,437 jobs by 2031. The majority of new growth will be accommodated within the planned expansion areas, including Brooklin North.

The report prepared by Hemson Consulting Ltd. provided key inputs for the development of the Brooklin Study, as its population and employment forecasts informed the land use and transportation strategy

[1] The Population, Housing and Employment Analysis report was developed based on the 2006 Growth Plan. The Growth Plan has subsequently been revised in 2017 and 2019, and the region-wide intensification target for Durham has been increased from 40% to 50%. The minimum greenfield density target remains unchanged.

for the existing Brooklin settlement and designated greenfield areas. Future road network requirements for the study area were identified based on traffic forecasts linked to the full build-out scenario (post-2031).

3.1.2 Relevant Provincial Plans, Policies, and Guidelines

Provincial plans, policies, and guidelines considered as part of the development of the Brooklin Study and the BNMREA are briefly outlined below:

- **Provincial Policy Statement (2014)** guides land use planning and development in Ontario. It contains a set of policies that outline a municipality's responsibilities regarding transportation infrastructure and corridors to align with land use patterns and support multimodal travel for the efficient movement of people and goods.
- **Places to Grow: Growth Plan for the Greater Golden Horseshoe (2019)** provides population and employment growth forecasts for the Region that are required to be used for regional and local planning purposes. It also sets minimum intensification targets for delineated built-up areas and designated greenfield areas in the Region (discussed in **Section 3.1.1**).
- **Greenbelt Plan (2017)** identifies where urbanization should be avoided to permanently protect agricultural land use and the ecological function of the area. The north section of the Brooklin TMP study area is located within the Oak Ridges Moraine Area of the Greenbelt Plan. Development applications that began after 2004 under the Ontario Planning and Development Act, the Planning Act or the Condominium Act must conform to the Greenbelt Plan.
- **Oak Ridges Moraine Conservation Plan (2017)**, under Ontario Regulation 140/02, protects the functions of the Oak Ridges Moraine by directing land use planning, development, and site alterations that fall within the Oak Ridges Moraine. As noted above, this plan would apply to the Brooklin TMP study area.

Regional plans, policies, and guidelines considered as part of the development of the Brooklin Study and the BNMREA are briefly outlined below:

- **Region of Durham Official Plan (2017)** sets out parameters for growth in the Region to establish a transportation system that is well-connected, safe, efficient, reliable, and integrated with land use. It identifies Columbus Road and Winchester Road as Regional Corridors, where high-density mixed-use developments supportive of transit and pedestrians are to be located with efficient connections to Regional Centres. Downtown Brooklin (around the intersection of Baldwin Street and Winchester Road) is one such recognized Regional Centre that is to support a concentration of urban activities.
- **Region of Durham Transportation Master Plan (2017)** sets out policies, programs, and infrastructure required to address transportation needs associated with expected growth in the Region up to and beyond a horizon year of 2031. Along with road network expansions, it provides a variety of recommendations to improve the Region's transportation network with enhanced transit and active transportation opportunities that meet multi-modal needs while considering numerous factors, including safety, sustainability, and economic growth. These recommendations are reflected in the planning policies as they relate to the Town.
- **Durham Region Towards Resilience, Durham Community Climate Adaptation Plan (2016)** identifies areas for projects to consider opportunities for climate change mitigation and adaption. Areas specific to roads include resilient asphalt programs, road embankment program and adaptive culverts and bridges.

3.1.3 Relevant Local (Town) Plans, Policies, and Guidelines

Local (Town) plans, policies, and guidelines considered as part of the development of the BNMREA are briefly outlined below:

- **Town of Whitby Official Plan (2018)** provides guiding principles for the revitalization of Downtown Brooklin and identifies intensification corridors along Baldwin Street, Winchester Road, and Columbus Road. As discussed below, Official Plan Amendment 108 (modified in 2020) is now in effect and implements the Brooklin Secondary Plan.
- **Town of Whitby Transportation Master Plan (2010)** outlines several deficiencies, including congestion issues along Baldwin Street due to heavy commuter traffic travelling through Downtown Brooklin and a lack of high capacity east-west roads or access to them. Several changes to the transportation network within the study area were proposed, which provided a basis for the development of the Brooklin Study for the urban expansion areas north and west of the existing Brooklin settlement.
- **Town of Whitby Active Transportation Plan (March 2019)**[2] expands on the Town's TMP (2010) described above and the Town's Cycling and Leisure Trails Plan (2010) to set out short, medium, and long-term commitments to providing active transportation options for the public. Several key objectives include establishing a continuous network; considering a variety of accessibility needs for safety and comfort; and integrating active transportation into daily community services. The outcomes of this plan would be used to inform the detailed design of active transportation infrastructure for road network improvements recommended by the BNMREA.
- **Whitby Sustainable Development Guidelines (2019)** were developed to support the Town's commitment to incorporating sustainability practices in development, adhering to policies related to sustainability, climate change, and energy management from the Town of Whitby Official Plan. As Whitby experiences significant growth in the near future, the Town must ensure proposed developments are sustainable and resilient for the community to continue supporting future generations. Upon implementation, these guidelines can be used to encourage sustainable development for site plan and subdivision applications on private property through minimum and voluntary tiered standards.
- **Whitby Green Standard (2020)** is a set of criteria that improve the planning and construction of new developments in the Town to meet the Town's goal of creating healthy, sustainable, and complete communities as well as to meet the target of 80% reduction in greenhouse gas emissions by 2050. The Whitby Green Standard is meant to guide developers and the Town in ensuring new developments meet and exceed, where possible, minimum sustainability criteria. Once Whitby Council approves the final version, the Whitby Green Standard will apply to all new development subject to the Town's Site Plan Control Bylaw & Plan of Subdivision Agreement. Thus, it will help to inform the Draft Plan review/approval process of the BNMREA as well as future developments in the study area.

Key foundation documents of the BNMREA, including the Brooklin Study and the Brooklin Community Secondary Plan Area Community Block Plan (CBP), are discussed in detail in the sections below.

- **Brooklin Study (2017)** As noted above, the Brooklin Study (which includes the Brooklin Secondary Plan and Brooklin TMP) were completed in tandem as part of the integrated approach permitted by the MCEA process. The first step was the preparation of background studies to document existing conditions and a visioning exercise with community and stakeholder participation. Three land use

[2] Note that the Town of Whitby Active Transportation Plan has recently been updated in October 2020.

and transportation options were developed, and a preferred strategy was then selected based on evaluation criteria and consultation feedback. The preferred strategy provides the basis for the Brooklin Secondary Plan policies and recommended transportation network.

Four public information centres (PICs) were held throughout the study to provide information and solicit feedback on the study scope and objectives, land use and transportation options, and the draft secondary plan policies. These public events were supplemented with online engagement, including MetroQuest surveys. Stakeholder feedback was received through a Community Advisory Committee (CAC) with representation from local businesses and landowners. In addition, the Brooklin TMP received technical input and guidance from a Technical Advisory Committee (TAC) comprising relevant provincial and municipal government agencies.

The studies were initiated in 2014 and completed in 2017. Official Plan Amendment #108 to the Town of Whitby Official Plan, which implements the Brooklin Secondary Plan, was approved by the Town and the Region in 2018 but was subsequently appealed.

The Brooklin Secondary Plan was developed to articulate and implement a vision for the future growth of the Brooklin community. The policies contained within the Brooklin Secondary Plan aim to retain the small-town character of the settlement while permitting growth and allowing Brooklin to evolve into a complete community. For expansion areas such as Brooklin North, the Brooklin Secondary Plan envisions that "Brooklin's new neighbourhoods will be walkable with higher density located along the arterial road spines and parks, schools and commercial areas distributed to promote a walkable destination". The Brooklin Secondary Plan outlines several strategic objectives for Brooklin pertaining to transportation that have been reflected in the Brooklin TMP's recommended transportation network, and subsequently, in the road designs prepared as part of the BNMREA:

- To reduce traffic congestion by providing a balanced road network for local residents, businesses and visitors.
- To eliminate heavy vehicle and through traffic from Baldwin Street through Downtown Brooklin
- To provide a range of transportation choices including transit, cycling, walking and a diverse transportation network so that all ages and levels of mobility can comfortably and conveniently access all parts of the Municipality.
- To create an active transportation network linking destinations such as natural areas, parks, recreation areas, stores, employment areas and connections to southern Whitby.
- To create an integrated multi-use trail system.

The Brooklin Secondary Plan includes a preferred land use plan for the existing Brooklin settlement and planned expansion areas. Within Brooklin North, the majority of land is designated for low density residential or as a natural heritage area. The plan focuses higher density residential, commercial, and mixed uses along major corridors, such as Baldwin Street and Columbus Road, while providing smaller medium density and commercial pockets at key intersections within the residential area. The preferred land use plan is provided in **Figure 3-1**.

The preferred transportation network developed through the Brooklin TMP enables the direction and allocation of growth envisioned by the Brooklin Secondary Plan. The Brooklin TMP examined the full build-out of the Brooklin Secondary Plan to determine required modifications to the existing road network and propose a collector road network for expansion areas such as Brooklin North. In addition, the study included recommendations pertaining to active transportation, transit, and transportation demand management that will be incorporated as part of subsequent studies or network planning. The development and evaluation of the Brooklin TMP preferred road network is further discussed in **Section 4.2**. The preferred road network is illustrated in **Figure 3-2**.

A recommendation of the Brooklin TMP is the relocation of Highway 7/12 outside of the Brooklin settlement to reduce road congestion and improve the public realm. This project is not included as part of the BNMREA scope of work. In 2020, The Town initiated a provincial Class Environmental Assessment (Highway 7/12 Alternative Route Environmental Assessment) as discussed in **Section 3.4.4** to further the alignment and design of an alternative route for Highway 7/12 that is expected to be completed in late 2021.

Figure 3-1: Preferred Brooklin Land Use Plan (Image: Town of Whitby)

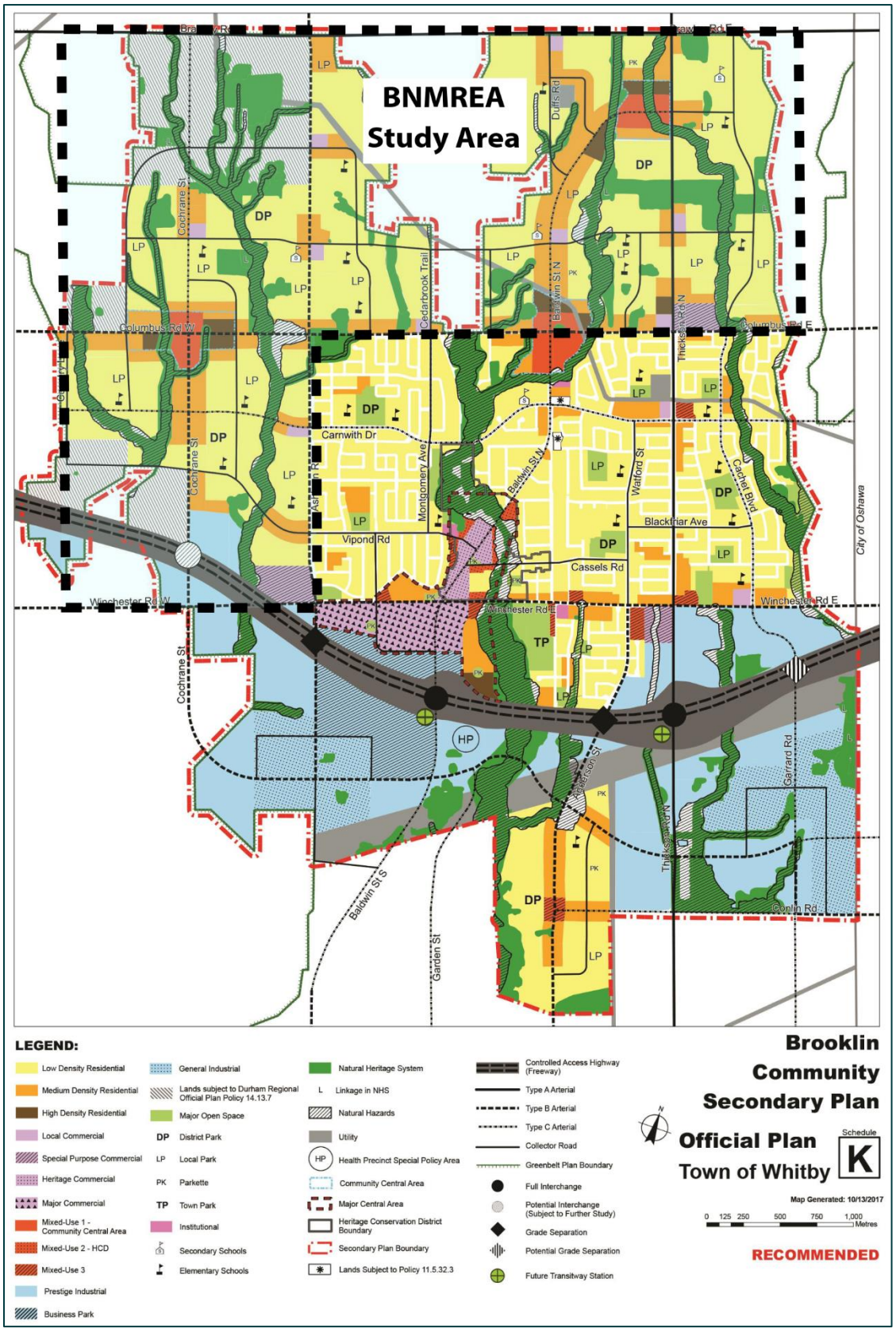
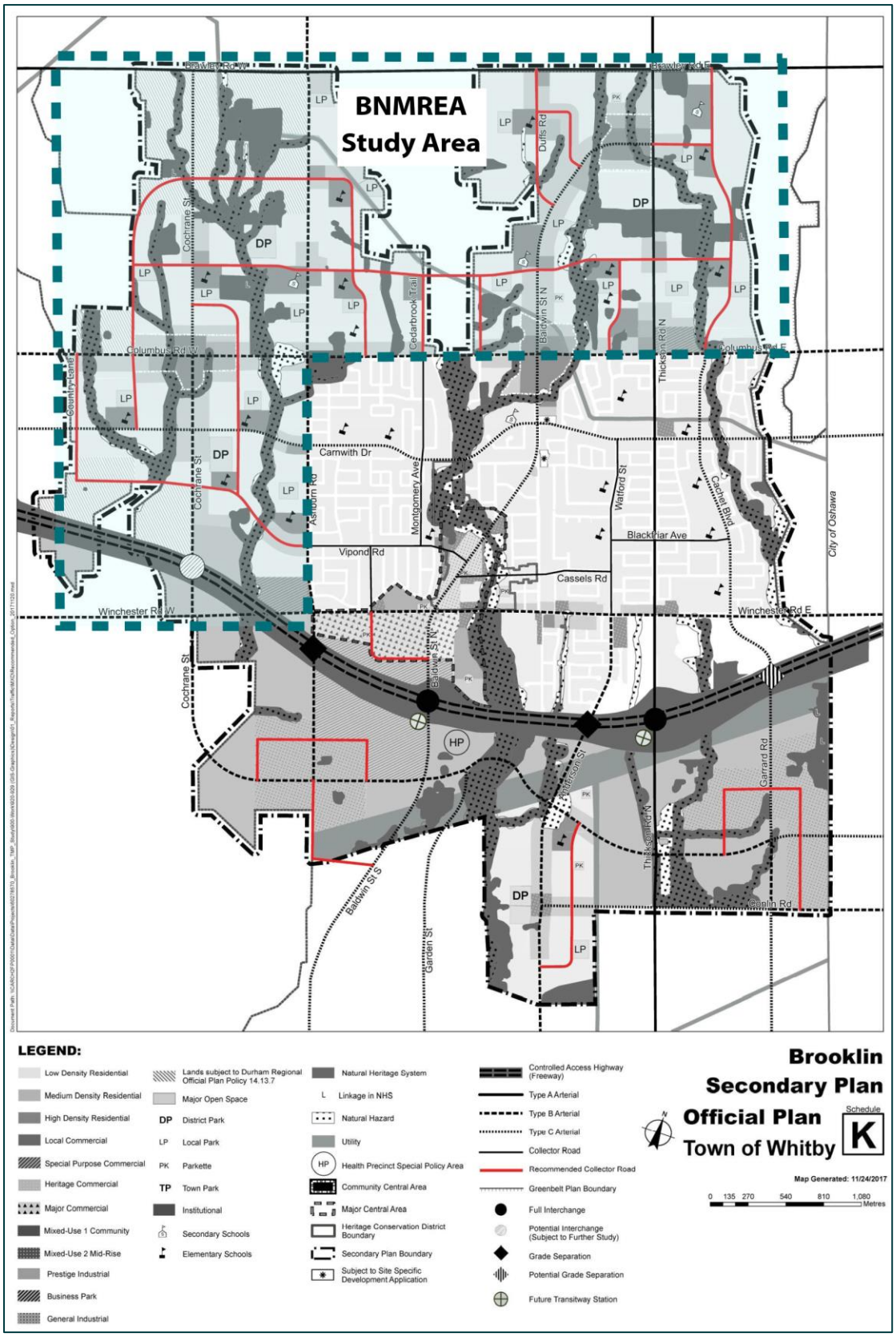


Figure 3-2: Preferred Brooklin Road Network (Image: Town of Whitby)



Brooklin Community Secondary Plan Area CBP (April 2019)

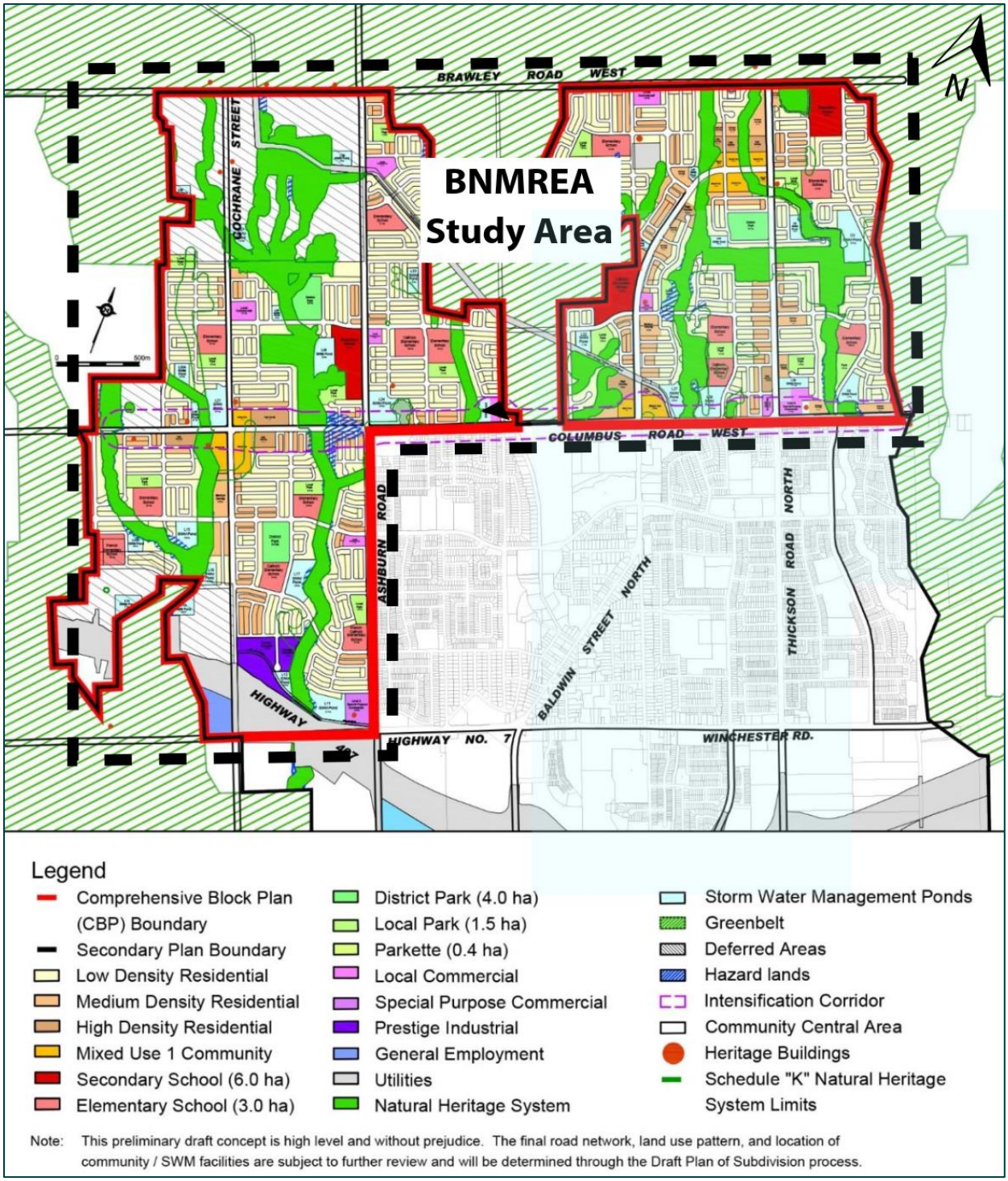
After the Brooklin Study was completed in 2018, the BNLG initiated the development of a CBP for the Brooklin North expansion area. The CBP is a composite development plan that further refines and details the Brooklin North community, including the provision of supporting infrastructure and development phasing. The CBP will enable effective coordination between adjacent landowners as they implement draft plans for individual developments in Brooklin North. While a draft of the CBP was completed in 2019, it is intended to be a living document that will evolve through the detailed planning process. The preliminary phasing plan for Brooklin North is illustrated in **Figure 3-3**.

In support of the CBP, BA Group conducted traffic modelling to update the traffic forecasts established through the Brooklin TMP based on the detailed land use plan and development phasing proposed in the CBP. The analysis results indicate that the Phase 1 lands of participating landowners can be supported by the existing road network, prior to the completion of scheduled road widenings. Individual traffic impact assessments will be required for each draft plan to confirm required intersection improvements and traffic control within the draft plan area and in their surrounding area.

The CBP was used as a reference document during the preparation of the BNMREA, but it does not have official standing as it is not a regulatory planning document. It was referred to as it provides a comprehensive framework for the coordination of the specific Plans of Subdivision. However, it is recognized that the specific Plans of Subdivision may in fact differ in their implementation from the CBP. Finally, the CBP was also considered as it outlines an initial phasing plan for the allocation of development. This was utilized in order to inform the infrastructure timing requirements.

Furthermore, the **Brooklin Urban Design and Sustainable Development Guidelines (2018)** were developed to provide a framework of design and built form policies and standards to implement principles set out in the Brooklin Secondary Plan. These guidelines can be used to evaluate development applications within the Brooklin Secondary Plan area, such as to demonstrate how a proposed development would support sustainability goals.

Figure 3-3: Brooklin North CBP (Image: BNLG)



3.2 Natural Environment

As part of the BNMREA, a natural heritage investigation was completed by LGL Limited in August 2020 to support the development, evaluation, and selection of preferred road designs in Phase 3. The results of this investigation are documented in the Natural Heritage Report provided in **Appendix D**.

The Natural Heritage Report documents the data collection, field investigations, and analysis undertaken to establish the existing conditions of the key natural heritage features within the BNMREA study area, a summary of which is provided below.

3.2.1 Physiography, Bedrock and Surface Geology and Soils

The study area is located within the South Slope physiographic region, which is made up of areas of thin aeolian sand deposits underlain by glacial till and is topographically lower and flatter than the moraine to the north. The slope is characterized by north-south trending drainage with sharp valley cuts and numerous gullies. Bedrock geology is comprised of black and grey shale.

Surface geology consists of glaciolacustrine-derived silty to clayey till and stone poor carbonate-derived silty to sandy till located north and south of Columbus Road, respectively. There are numerous pockets of course textured glaciolacustrine deposits north and south of Columbus Road and modern alluvium deposits consisting mostly of sandy soils located along the stream valleys of Lynde and Oshawa creeks. One pocket of fine-textured glaciolacustrine deposits is located between Ashburn Road and Cedarbrook Trail north of Columbus Road.

The soils are primarily Darlington loam, which is undulating to rolling and slightly stony found mostly east of Highway 12 and Bond head loam, which is rolling and slightly to moderately stony found mostly west of Highway 12. The loam soils typically range from imperfect to good drainage.

3.2.2 Aquatic Habitats and Communities

The study area spans three watersheds; however, all 24 existing and proposed watercourse crossings are located within the Lynde Creek and the Oshawa Creek watersheds, under the jurisdiction of CLOCA and the MNRF Aurora District.

Lynde Creek Watershed

Water quality testing results indicated that as water flows from northern rural areas to southern urban areas, the water quality degrades in addition to increased temperature. On the other hand, naturalized areas generally have higher water quality. It is recognized that groundwater contributes year-round flow to multiple watercourses within this watershed, helping to moderate water temperatures during peak summer months. Most species present within the watershed are generally tolerant of all thermal regimes, such as Rainbow Trout and Eastern Blacknose Dace.

One aquatic Species at Risk (SAR), Redside Dace, was identified within this watershed based on a review of the MNRF Natural Heritage Information Centre (NHIC) database, Minister of Fisheries and Oceans Canada (DFO) SAR mapping, and correspondence with the MECP and CLOCA. Redside Dace is provincially regulated as 'Endangered' under the Ontario Endangered Species Act, 2007 (Ontario ESA) and federally regulated as 'Schedule 1 – Endangered' under the Species at Risk Act (SARA). In adherence to the Ontario ESA, any occupied or recovery habitat of Redside Dace (current or within the past 20 years) is subject to Ontario Regulation 242/08, which enforces protection to the meander belt plus a 30 m protection zone of the occupied or recovery habitat. This also applies to any habitat that contributes baseflow to the occupied or recovery watercourse, such as a wetland. Thus, watercourse crossings

located within the Lynde Creek subwatersheds with occupied and/or recovery Redside Dace habitat are subject to regulations under the Ontario ESA, the SARA, and Ontario Regulation 242/08 as well as general regulation limits of CLOCA and permitting under Ontario Regulation 42/06.

As a protective measure, the MNRF has prescribed a cold-water in-water works timing window of July 1 to September 15 to all watercourses within the Lynde Creek watershed.

Oshawa Creek Watershed

Despite intensive agricultural practices, land development, and lack of stormwater management which contributes to impaired water quality in urban areas, the watershed continues to provide a productive fishery and support sensitive cold-water species. High groundwater content is found within the watershed, which contributes to the cold-water thermal regime of the mid to upper reaches and the mid to lower reaches within this watershed. Common fish species identified from the watershed include Chinook Salmon, Brook Trout, Brown Trout and Rainbow Trout, as well as Slimy Sculpin and Mottled Sculpin. There are no known aquatic SAR found within this watershed for the study area.

The watercourses within the Brooklin Secondary Plan Area that belong to the Oshawa Creek Watershed have been prescribed as a cold-water thermal regime by the MNRF and CLOCA, and an in-water works timing window between July 1 and September 15 will be applied during construction.

3.2.3 Vegetation and Vegetation Communities

Vegetation communities identified primarily consist of cultural communities where regular or past disturbances have occurred due to land use practices as well as maintained and/or retained areas. These typically contain a high proportion of invasive and/or non-native plant species that are disturbance tolerant. Several meadow marsh and shallow marsh communities are bisected by existing watercourse crossings along roads. Also, forest and wetland communities are typically part of larger vegetation communities that extend beyond the study area associated with watercourses. Several are located within the Greenbelt Plan, including those associated with tributaries of West Lynde Creek, Lynde Creek and Oshawa Creek. Overall, the identified vegetation communities are considered widespread and common in Ontario and are secure globally.

Element occurrences of red mulberry, a provincially tracked (S2) species, also regulated as ‘Endangered’ under the Ontario ESA, were identified within the study area. However, this species was not observed within the study area during botanical surveys undertaken. Furthermore, Butternut trees are regulated as ‘Endangered’ under the Ontario ESA. During LGL’s botanical surveys, nine Butternut trees were identified throughout several parts of the study area. No other plant species regulated as ‘Endangered’, ‘Threatened’, or ‘Special Concern’ under the Ontario ESA or the SARA were found.

3.2.4 Wildlife and Wildlife Habitat

The majority of the landscape is comprised of active agricultural fields, which constitutes poor quality wildlife habitat, with narrow, linear patches of natural habitat associated with watercourses. Much of the remainder is comprised of rural residences/farm buildings, roads, and denser residential subdivisions. The transitions between the forest and wetland communities and the agricultural and rural residential lands provide habitats for species that utilize edge habitats. The larger, forested valleys form north-south corridors for wildlife movement. During the next detailed design phase, new crossings will be designed based on the openness ratios outlined in the Natural Heritage Report (Appendix D), and constructed and maintained so that wildlife corridors associated with these valleylands will be preserved and no new barriers are created. In general, the study area supports a modest assemblage of wildlife

species tolerant of anthropogenic features and disturbance and those more dependent upon larger natural habitats.

Based on field observations by LGL Limited, 58 species of wildlife and 49 species of birds were recorded within the study area. Of these, Barn Swallow and Bobolink are regulated as 'Threatened' under the Ontario ESA and the SARA. Eastern Wood Pewee, listed as 'Special Concern' both provincially and federally, was also observed during breeding bird surveys; however, this is not a regulated species under the Ontario ESA or the SARA.

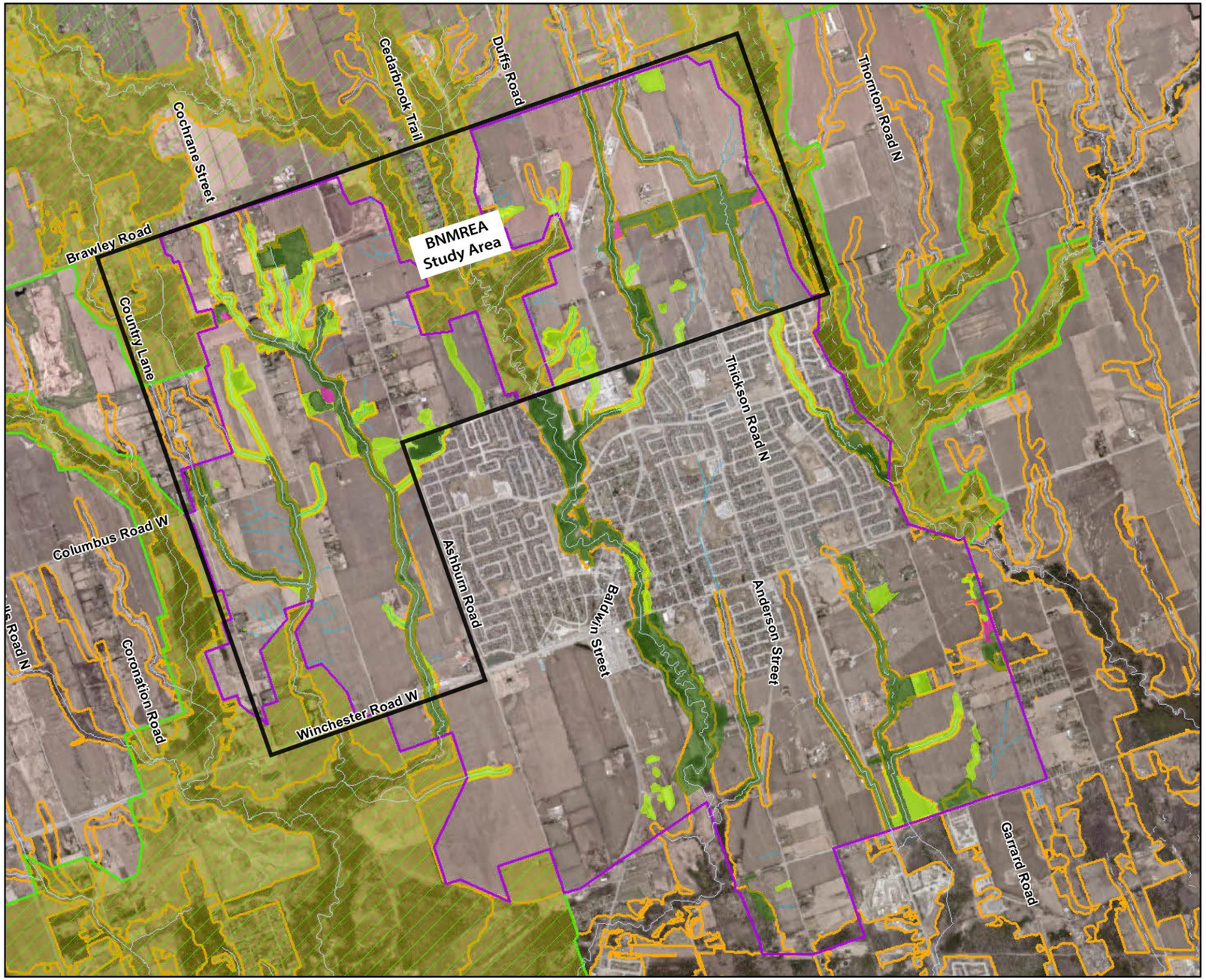
The NHIC search also showed recent records of occurrence in or adjacent to the study area for Wood Thrush (listed as 'Special Concern' both provincially and federally) and Eastern Meadowlark (regulated as 'Threatened' under the Ontario ESA and the SARA). No Wood Thrush or Eastern Meadowlark were observed during LGL Limited's surveys and habitat within the study area was absent for Wood Thrush and limited for Eastern Meadowlark.

3.2.5 Environmental Constraints

In addition to the above detailed investigations the overall environmental constraints are identified in **Figure 3-4**, as per the supporting Natural Heritage Assessment Report prepared by Beacon and R.J. Burnside for the Brooklin TMP. The Natural Heritage System is differentiated across two levels: constrained features (Level 1) and areas requiring additional study (Level 2):

- **Level 1**: Areas which have significance or sensitivity that should be protected from development. Adjacent development will require an Environmental Impact Study (EIS) demonstrating that it will not create negative impacts on these natural features or functions.
- **Level 1 Linkage**: Functioning or potential corridors that enable wildlife movement within and among watersheds.
- **Level 2**: Further study is required to assess whether the feature exists or is worth preserving. In the case of removal, investigations are required to determine necessary mitigation measures.

Figure 3-4: Natural Heritage System (Image: Beacon Environmental)



Natural Heritage System

Brooklin
Secondary Plan

Brooklin Landowners Group

Legend

- Brooklin Secondary Plan Area
- CLOCA Natural Heritage System
- Greenbelt
- Greenbelt Natural Heritage System

Beacon NHS

- Level 1
- Level 1 Linkage
- Level 2 - Further Study

Watercourses (MNR, 2012)

- Permanent
- Intermittent
- Drainage Features to be removed - Subject to confirmation with CLOCA

Note: Lands that occur between the shaded Beacon NHS and the hollow CLOCA NHS are also effectively areas that require further study.

Note: Redside Dace occupied and recovery habitat boundaries include a meander belt plus 30 m except in the built-up area of Brooklin where the natural heritage system was delineated based on the natural heritage features.

First Base Solutions
Web Mapping Service 2013

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BEACON ENVIRONMENTAL

Project 211017
December 2014

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3.3 Source Water Protection

In accordance with the Clean Water Act (Section A.2.10.6), the BNMREA considered the potential impact of the proposed project to impact sources of driving water. Specifically, the project reviewed the Source Protection Authority documentation produced by the **C**redit Valley, **T**oronto and **R**egion and **C**entral Lake Ontario (**CTC**) Source Protection Committee. This documentation is applicable as the subject site is located within the CLOCA Watershed.

Overall, 95% of the population within the Central Lake Ontario Source Protection Area (CLOSPA) receives its drinking water from municipal plants that use Lake Ontario as a source. The remainder use private wells as a source for drinking water.

Highly Vulnerable Aquifer areas are areas susceptible to contamination moving from the surface into the groundwater. In the CLOSPA jurisdiction, there are large areas covered by saturated sand deposits that support many shallow wells. These aquifers are considered vulnerable to contamination that may cause deterioration of the water quality in water wells that use this source. Areas of high vulnerability, as illustrated in **Figure 3-5**, are those with a score of 6 per the Technical Rules.

Source Groundwater Recharge Areas are areas where the highest volume of recharge to the aquifers occurs and are delineated as part of the water budget process. Source Groundwater Recharge Areas are important water quantity areas—replenishing the aquifers that serve as a source of drinking water (including both municipal and other drinking water uses, such as private wells). The vulnerability of the Source Groundwater Recharge Areas in the CLOSPA were scored based on the final output of the aquifer vulnerability analysis show in **Figure 3-5** (high=6, medium=4, and low=2). As illustrated in **Figure 3-6**, there are no municipal groundwater supplies within the CLOSPA jurisdiction. A WHPA Q1/Q2, which was delineated as a result of a York Region Tier 3 Water Budget study, extends into a small area in the northwest area of CLOSPA.

The Province has identified 21 activities that, if they are present in vulnerable areas, now or in the future, could pose a threat (listed in Section 1.1 of O. Reg. 287/07). Nineteen of these activities are relevant to drinking water quality threats while two are relevant to drinking water quantity threats. Based on these activities and the Threats Assessment Process, the development of a new collector road network does not trigger a potential threat to the CLOSPA.

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Figure 3-5: Highly Vulnerable Aquifers and Vulnerability Scoring (Image: CTC Source Protection)

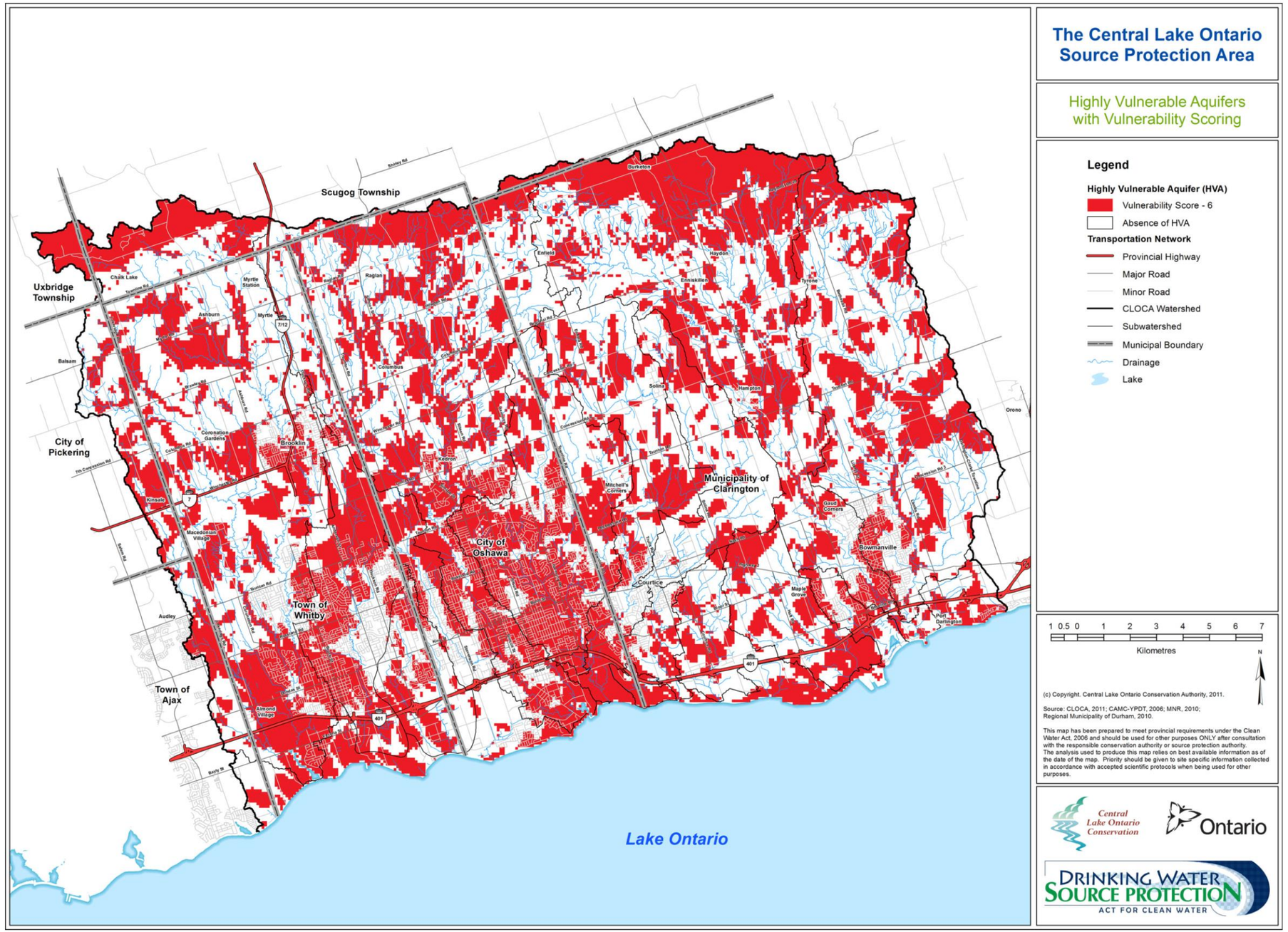
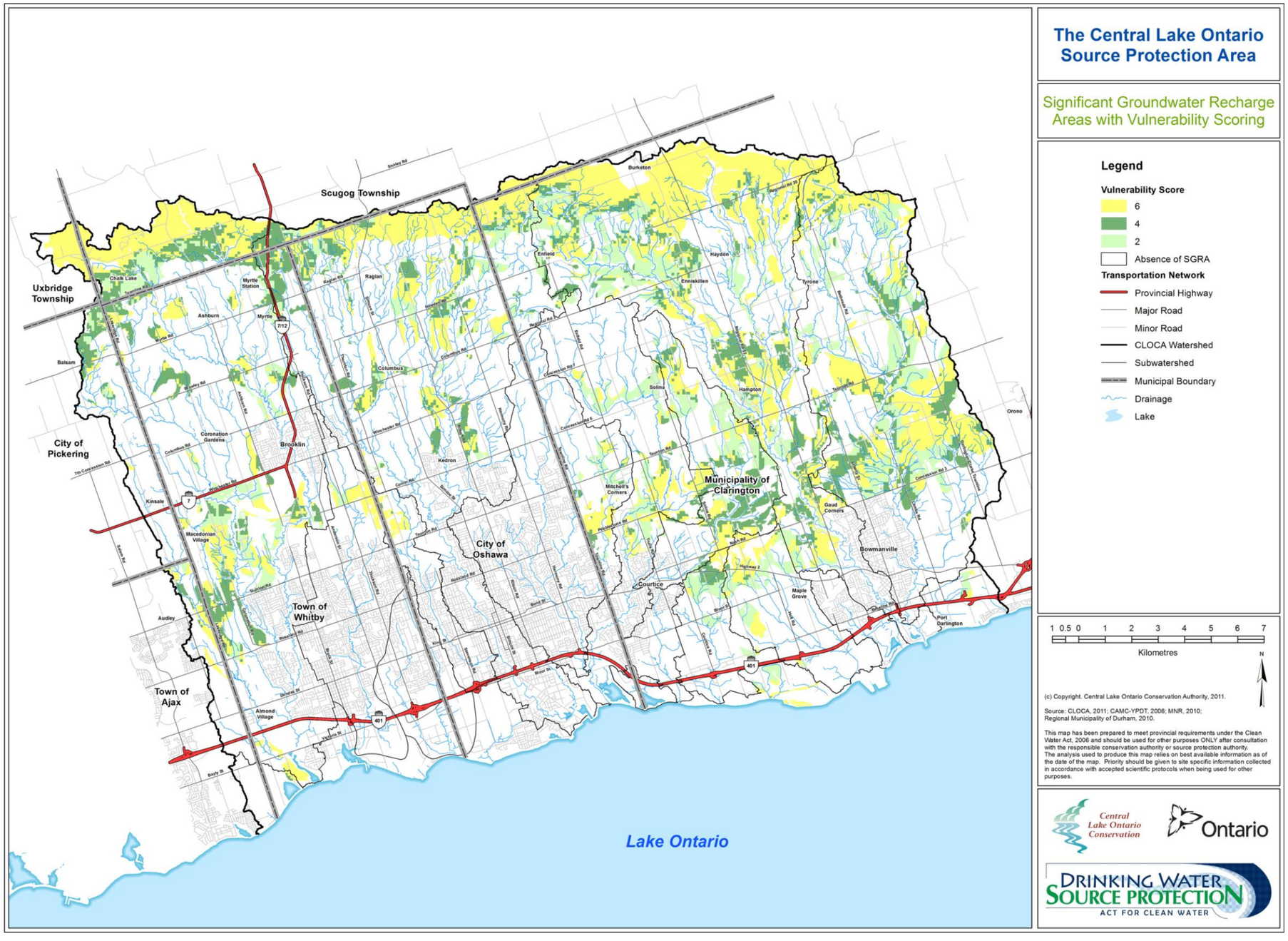


Figure 3-6: SGRAs with Vulnerability Scoring (Image: CTC Source Protection)



It should be noted however with the construction of the road improvements there will be an increase in the amount of impervious surface within the study area. Generally, the degree of imperviousness applied a threat level based on its density within a 1km^2 grid. Since the overall percentage of density of impervious road area proposed would be less than 8% of the total study area, the threat level was determined to be low or not applicable with respect to the application of road salt.

3.4 Transportation

As part of the Brooklin TMP, AECOM established the existing transportation conditions in the BNMREA study area. A review of the existing transportation conditions and modeling done for the Brooklin TMP is included in Technical Memorandum 1 (included in **Appendix B**). The review and summary are provided in the following sections.

3.4.1 Active Transportation Network

Outside of the existing Brooklin community, the majority of the road network consists of rural cross-sections with limited provision of pedestrian or cycling facilities. A bike lane is provided on Ashburn Road within the study area, along with a sidewalk on the east side of the roadway between Winchester Road and Joshua Boulevard.

3.4.2 Transit Network

In the existing Brooklin community, two Durham Region Transit (DRT) bus routes connect the community to destinations within the Town and the City of Oshawa. Route 302 operates through eastern, central, and western Brooklin and connects to Whitby GO station via Baldwin Street and Brock Street. Route 310 operates through Brooklin, serving the eastern and central areas. In addition to service to Oshawa, service also operates to Whitby GO station via Anderson Street.

In addition, GO transit service is available in Brooklin. Route 81 connects Beaverton and Port Perry to Downtown Whitby and the Whitby GO station via Brooklin. Route 52 provides an east-west connection between Brooklin and York University to the west, along with UOIT / Durham College and Downtown Oshawa to the east. Residents in Brooklin can access the Lakeshore East GO rail corridor directly by utilizing park-n-ride facilities available at Whitby GO and other stations. Furthermore, VIA Rail service along the Ontario-Quebec route is available at the Oshawa GO station, connecting to both Toronto and beyond the east and west.

3.4.3 Road Network

Provincial Road Network

Highway 7 (Winchester Road West) and Highway 12 (Baldwin Street North) are provincial highways utilized by provincial, regional, and local traffic. In addition, the tolled Highway 407 (provincially owned section) and Highway 412 are located to the south and southwest of the study area.

Regional Road Network

Regional arterial roadways include Regional Road 3 (Winchester Road East) and Regional Road 26 (Thickson Road).

Municipal Road Network

Collector and local roadways are under the jurisdiction of the Town. Arterial roadways under Town jurisdiction within the study area are detailed below:

- **Brawley Road** is an east-west Type A arterial roadway with a right-of-way (ROW) width that varies from 20-30m. It has a two-lane rural cross-section and a posted speed of 50km/hr in the study area. The roadway is located north of the existing Brooklin community.
- **Ashburn Road** is a north-south Type B arterial roadway with a ROW width that varies from 20-28m. It has a two-lane rural cross-section between Robmar Street and Highway 7 (Winchester Road); a two-lane urban cross-section between Highway 7 and just south of Columbus Road with a sidewalk on the east side and bike lanes on both sides of the roadway; and a two-lane rural cross-section north of Columbus Road West. The roadway has a posted speed of 60km/hr. Ashburn Road lies along the west boundary of the existing Brooklin community. Marked on-street bike lanes are provided to connect to the Greenbelt Route to the north and also to connect to Iroquois Trail to the south.
- **Cochrane Street** is a north-south rural arterial roadway, classified as a Type B arterial roadway between Winchester Road West and Columbus Road West and a Type C arterial roadway north of Columbus Road West to Brawley Road, with a ROW width of 20m. The roadway has a two-lane rural cross-section and a posted speed of 60km/hr. Cochrane Street is located west of the existing Brooklin community.
- **Columbus Road** is an east-west Type B arterial roadway with a ROW width that varies from 20-25m for most of the study area, with some sections that have a ROW width greater than 25m. The roadway has a two-lane rural cross-section. Active transportation facilities were only located on the south side between Croxall Boulevard and Selkirk Drive (sidewalk), between Thickson Road and Cachet Boulevard (multi-use path), and between west of Wycombe Street and west of Garrard Street (multi-use path). The roadway has a posted speed of 50km/hr. Columbus Road is located to the north of the existing Brooklin community.
- **Carnwith Drive** is an east-west Type C arterial roadway with a ROW width that varies from 26-30m. The road consists of varying urban cross-sections (three to four-lanes with an additional turning lane at some intersections) with sidewalks along both sides of the roadway and marked on-street bike lanes on both sides of the roadway between east of Downey Drive to west of Thickson Road. The road has a posted speed of 50km/hr, with the exception of sections adjacent to an elementary school where the posted speed is 40km/hr during school peak periods. Carnwith Drive is located between Ashburn Road and Rockland Crescent in the existing Brooklin community.
- **Cachet Boulevard** is a north-south Type C arterial roadway with a ROW width of 26m. The road has a two-lane urban cross-section (with an additional left turn lane provided at the intersection with Columbus Road West) with sidewalks on both sides of the roadway. Cachet Boulevard has a posted speed of 50km/hr. The road is located between Winchester Road and Columbus Road in the existing Brooklin community.

The study area road network is provided in **Figure 3-7**, including provincial, regional, and main municipal facilities.

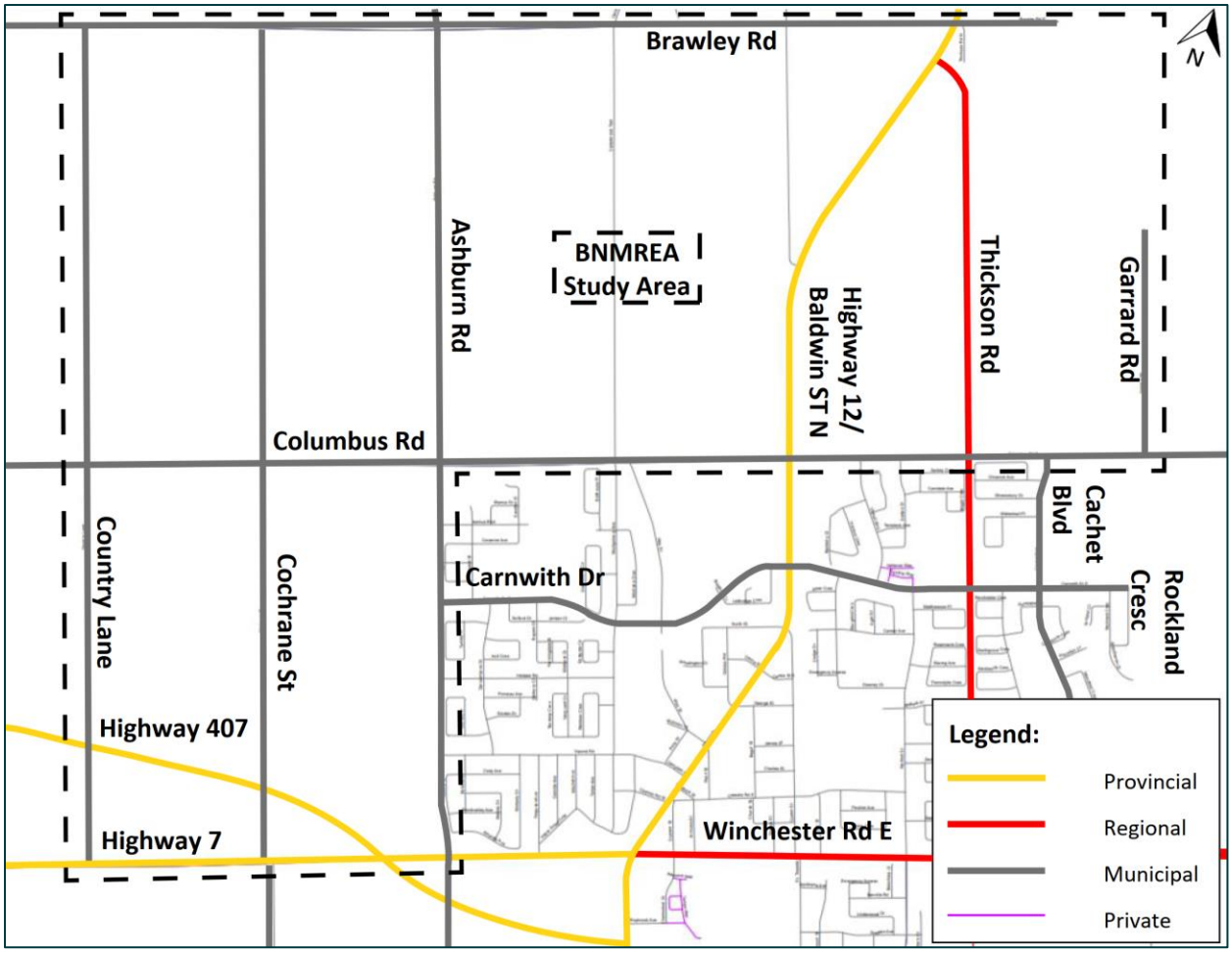
3.4.4 Ongoing Studies Within and Adjacent to Study Area

Highway 7/12 Alternative Route, Brooklin Area Environmental Assessment Study (Highway 7/12 Alternative Route EA)

The Brooklin TMP identified the need to divert through traffic, heavy trucks, and commuter traffic not destined to Downtown Brooklin from Highway 7/12 to suitable alternatives in order to support expected growth and the social environment within Downtown Brooklin. In June 2018, a Feasibility Study for Highway 7/12 was prepared to identify feasible alternate routes to allow the Town to proceed with an environmental assessment.

The Highway 7/12 Alternative Route EA was initiated by the Town (using MTO's Class Environmental Assessment for Provincial Transportation Facilities) to determine an alternative route(s) for provincial traffic that currently uses Highway 7/12 through Downtown Brooklin. The Final Study Design Report, dated July 2020, outlines the study background, process, alternatives, and the public consultation plan.

Figure 3-7: Existing Road Network (Image: Town of Whitby)



As part of the preliminarily design stage (Winter to Fall 2021), alternative corridors will be evaluated and a preferred plan to meet local and provincial traffic needs will be recommended. Once a technically preferred corridor alternative is chosen, through trips not destined for the Downtown Brooklin will be discouraged by potentially re-aligning the intersection of Baldwin Street and Thickson Road to create a terminal point.

As illustrated in **Figure 3-8**, the preliminary conceptual corridor alternatives that were carried forward for the Highway 7/12 Alternative Route EA fall within the BNMREA study area. As the BNMREA progresses to the next stage of the Draft Plan review/approval process, it is important to review preliminary work to ensure the recommendations of the two studies align and can be used to effectively address the needs of Brooklin. The main implications are expected to be related to the transportation aspect of the environment, including, but not limited, to the horizontal and vertical road alignments; cross-section elements; intersection location and control; watercourse crossing structures; and future traffic patterns with the diversion of north-south traffic.

Mid-Block Arterial Road Class Environmental Assessment Study (Mid-Block EA)

The Mid-Block EA was initiated by the Town in partnership with the BNLG as a Schedule C MCEA for a new east-west arterial road south of Highway 407 between Cochrane Street at Highway 7 and Thornton Road in Oshawa. The purpose of this new road is to facilitate east-west traffic and support expected growth in central and north Whitby. The need for this Mid-Block Arterial Road was identified in the Town's TMP (2010) and its alignment was refined in the Brooklin TMP (2017).

The Mid-Block EA reconfirmed the need for this road and carried out Phases 3 and 4 of the MCEA Process for the study area illustrated in **Figure 3-9**, which were completed in Summer 2020. Based on the Online Community Open House #2 material, the preliminary recommended intersection control for the Mid-Block Arterial Road includes signalization at Highway 7 and Cochrane Street and at Thickson Road (or roundabout) and roundabouts at the remaining intersections. In addition, a multi-use path and a sidewalk are proposed on the north and south sides of the Mid-Block Arterial Road, respectively.

The BNMREA study area is located just north of the Mid-Block Arterial Road. Just as for the Highway 7/12 Alternative Route EA, it is important to ensure that the preliminary recommendations of the BNMREA and the Mid-Block EA align with consistent corridor improvements to meet the changing travel needs of Brooklin. Careful consideration should be given to aspects, such as continuous active transportation routes, compatible intersection control, impacts and mitigation measures associated with the implementation of infrastructure improvements, and future travel patterns.

Figure 3-8: Preliminary Highway 7/12 Corridor Alternatives (Highway 7/12 EA, BT Engineering)

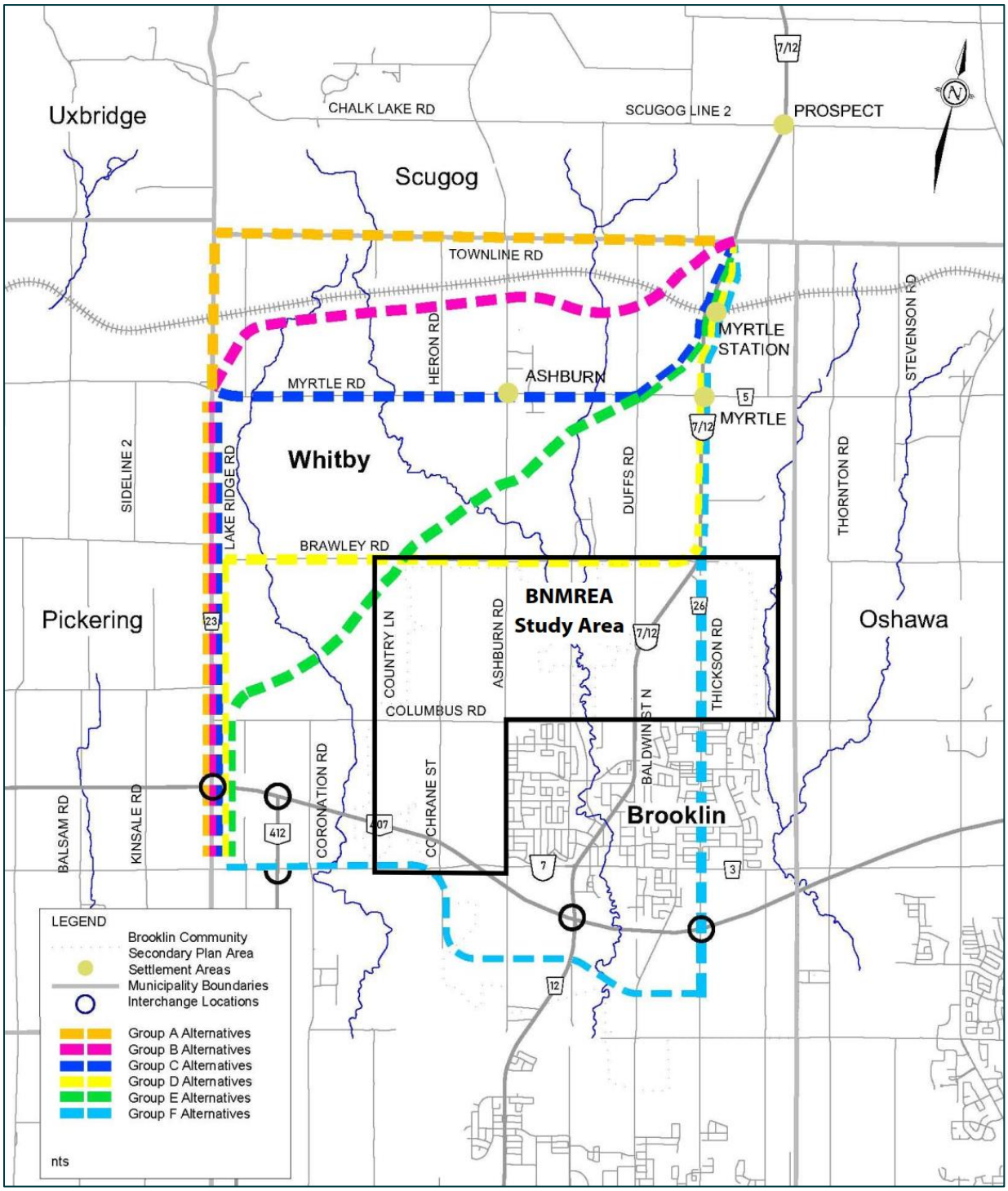
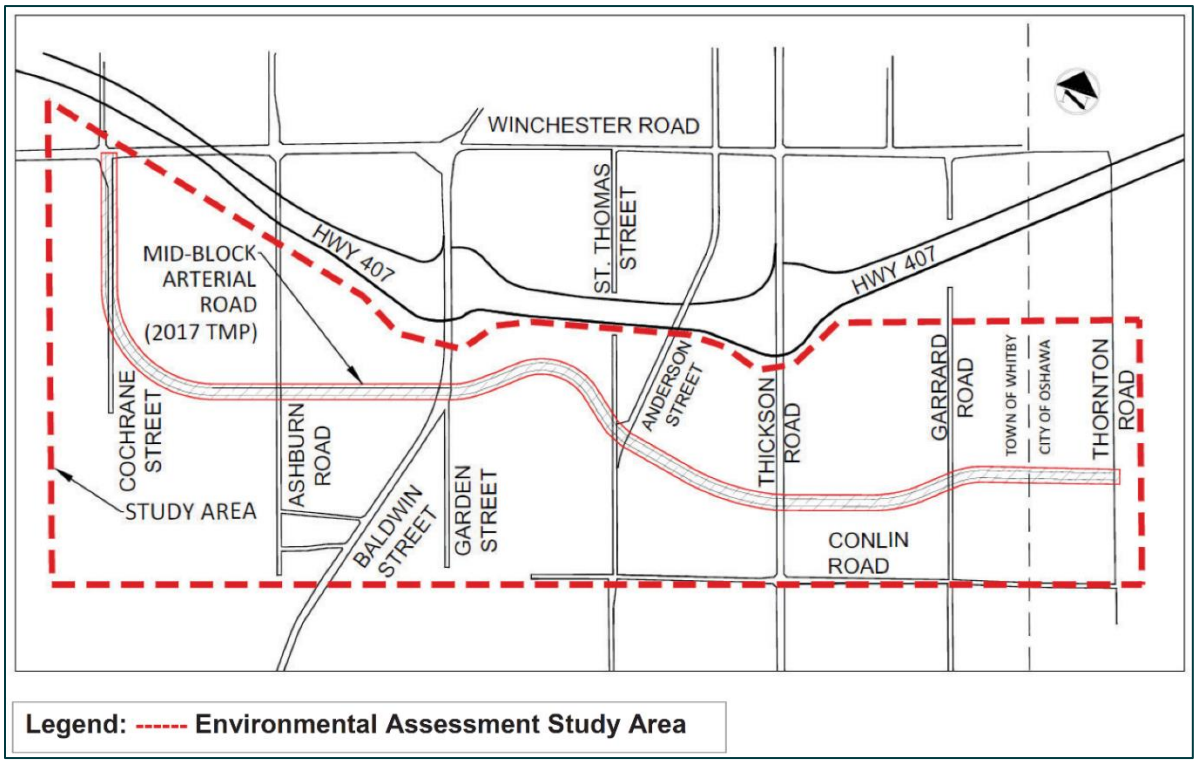


Figure 3-9: Study Area for the Mid-Block EA (Image: TMIG, Town of Whitby)



3.5 Archaeological and Cultural Heritage

3.5.1 Stage 1 Archaeological Assessment (Stage 1 AA)

Archeoworks Inc. was retained by the BNLG as part of the Brooklin Study to conduct a Stage 1 AA in 2014 examining the potential for recovering undisturbed Indigenous and Euro-Canadian archeological resources within the study area. Areas of obvious disturbance, such as the Brooklin settlement area, and road network, along with areas that have previously been cleared of archeological concern through previous AAs were excluded from the review. Archeological potential was identified based on the proximate location of watercourses and historical travel corridors, archival evidence indicating the presence of historical structures in or near the study area, along with identified archaeological sites within 300m of the study boundaries. A significant portion of the study area has retained its rural character, with lands remaining largely undisturbed, based on on-site property inspections and a review of aerial and satellite imagery.

The presence of the Pioneer Baptist Cemetery at the intersection of Columbus Road and Garrard Road, immediately outside of the study boundary, was identified as a site of interest given the potential for unmarked remains in the surrounding area.

Archeoworks Inc. completed a follow-up Stage 1 AA in May 2020 to support Phases 3 and 4 of the BNMREA. Areas retaining archeological potential have been delineated for further study as part of a Stage 2 AA. In addition, several sites within the study area will be subject to a Stage 3 AA or Stage 4 mitigation. In particular, the Dryden Site (AIGr-495), a registered archeological site that has been subject to a Stage 3 AA, falls within the road alignment of Columbus Road and will require Stage 4

archaeological assessment and cleared of archaeological potential prior to start of construction. The full Stage 1 AA is available in **Appendix E**.

Figure 3-10 illustrates areas identified as having archaeological potential and requiring Stage 2AA mitigation measures in the BNMREA study area.

3.5.2 Cultural Heritage

In support of the Brooklin Study, a Cultural Heritage Resource Survey report was prepared by Wayne Morgan in 2014 and peer reviewed by Unterman McPhail Associates (Unterman McPhail). Unterman McPhail also conducted a desktop review of historical maps to determine whether cultural heritage resources exist within the Brooklin Secondary Plan area. The Cultural Heritage Resource Survey is available in **Appendix F**.

In addition, the Stage 1 AA report conducted by Archeoworks Inc. documented the heritage properties that were listed and/or designated within the study area. These studies identified various cultural heritage resources in the Brooklin Secondary Plan study area, which were broadly categorized as:

- The Downtown Brooklin Heritage Conservation District (HCD);
- Culturally Sensitive Areas; and
- Listed and/or Designated Heritage Properties.

A review of properties listed on the Town's register and/or designated under Parts I or IV of the Ontario Heritage Act was carried out. A map showing the location of these properties is included in the May 2020 Stage 1 AA report and depicted in **Figure 3-11**.

The location of cultural heritage properties was considered in the development of the Brooklin Study road network. The detailed designs prepared as part of Phase 3 were developed to avoid impacting identified cultural heritage features within the BNMREA study area.

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Figure 3-10: Archaeological Assessment Requirements in the BNMREA Study Area (Archeoworks Inc.)

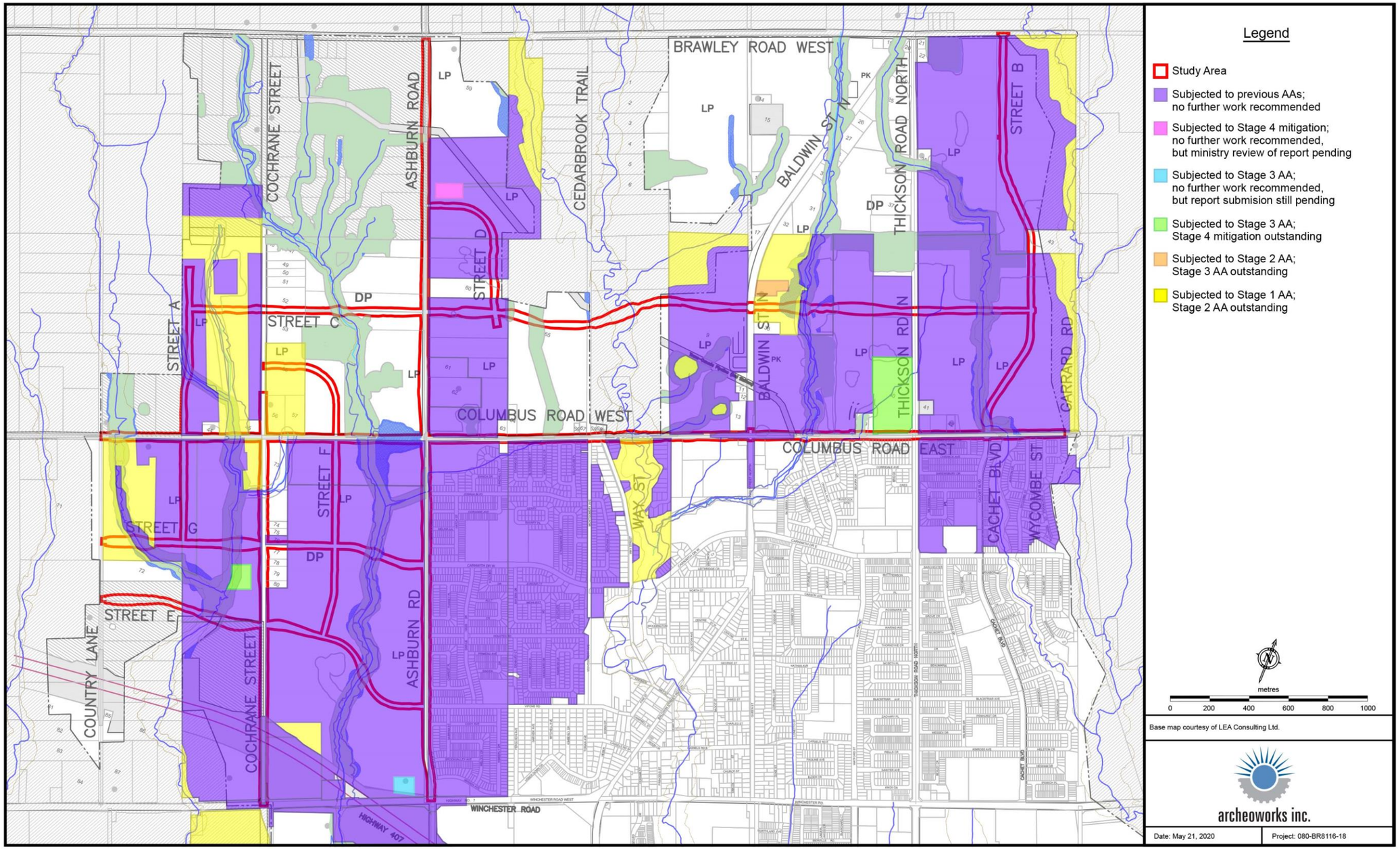
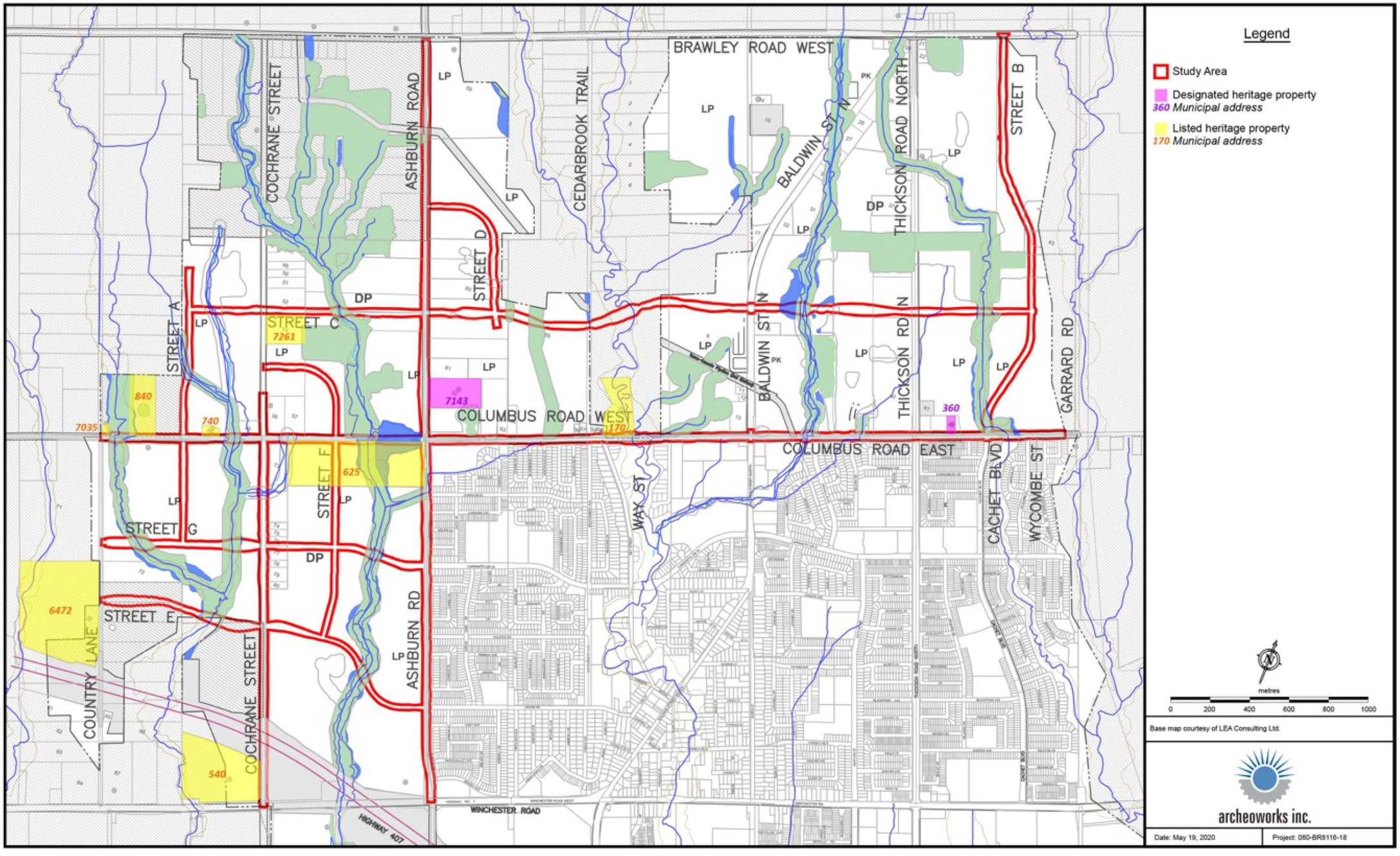


Figure 3-11: Designated and Listed Cultural Heritage Properties in the BNMREA Study Area (Archeoworks Inc.)



3.6 Stormwater Management

The study area spans across various watersheds including Lynde Creek, Pringle Creek, and Oshawa Creek Watersheds, under the jurisdiction of CLOCA. There are 24 existing and proposed watercourse crossings located throughout the study area, which come in contact with one of the study area roadways. A map of the existing and proposed watercourse crossings is included in **Figure 3-12**.

A brief description of the drainage system for each roadway is provided in the following section. The full study for drainage and stormwater management is available in **Appendix G.**

Ashburn Road is a two-lane arterial road that was identified in the Brooklin TMP to be widened to four lanes between Winchester Road and Brawley Road post 2031 (and protected in the meantime). There is one watercourse crossing and five outlet points along this stretch of roadway. The existing drainage system along Ashburn Road consists of a combination of storm sewers, culverts, and roadside ditches. There are two outlets between Winchester Road and Columbus Road and flow is conveyed through catch basins to the storm sewer system or the adjacent watercourse. There are ditches along the road between Columbus Road and Brawley Road to convey the runoff generated from the road. In addition, there are two stormwater management ponds in the vicinity of the project limits which may serve as an outlet for the roadway runoff. The general direction of drainage is from north to south with the major overland flow route on the road from the northern limit (Brawley Road) to the south (Columbus Road).

Columbus Road is a two-lane arterial road that is proposed as part of the Brooklin TMP to be widened to four lanes between Lake Ridge Road and Garrard Road. There are nine outlet points and ten watercourse crossings along the entire length of this road. The existing drainage system along Columbus Road consists of roadside ditches on both sides between Coronation Road and Croxall Boulevard and between approximately 175m east of Thickson Road and Garrard Road. For a length of approximately 700m, the south side of the road is composed of curb and gutter and catch basins; the north side of the road is comprised of roadside ditches conveying the overland flows to the nearby creeks. Based on the topography of the area, the road is draining from east of Thickson Road to the watercourse crossing west of Croxall Boulevard. Additionally, there are two existing stormwater management ponds located on the north and south side of Columbus Road and watercourse crossing (WC) #1 that potentially serve as outlets for road runoff. WC #4 and WC #8 are identified as having undersized culverts.

Cochrane Street is a two-lane arterial road proposed to be widened to four lanes between Winchester Road and Columbus Road. There are three outlet ponds and one watercourse crossing (WC #11) along the entire length of this road. The existing drainage system along Cochrane Street consists of a combination of centerline culverts and roadside ditches. The general direction of drainage is from north to south with the major overland flow route on the road from the northern limit (Columbus Road) to the south (Winchester Road).

There are two existing ponds encroaching into the proposed roads. The first pond is located at the north-east corner of the proposed intersection of Street G and Cochrane Street. This existing pond is encroaching into the proposed Street G ROW. The second existing pond is located at the east side of Ashburn Road and the proposed Street C, with the existing pond encroaching into the proposed Street C ROW. These existing ponds will be removed or relocated due to the proposed development planned in this area. A strategy for pond relocations will be developed during the Draft Plan review/approval process.

The modelling results for the existing conditions are summarized in **Table 3-1**. The table provides insight into the structure types and sizes as well as their compliance with design standards. Additional details are available in **Appendix G**.

There are a number of undersized culverts for handling any storm events throughout the study area. These undersized crossings include WC #3, #4, #8, #10, and #11.

A hydrologic model was created for the existing condition in Visual OTTHYMO (VH 6.0) to determine peak flows within the proposed road ROW for each of the roads. Based on available Town standards and geographic information, existing land uses were determined for each of the areas and they were further used to determine composite runoff coefficients and percentages of imperviousness for each of the drainage areas.

Figure 3-12: Existing and Proposed Watercourse Crossing Locations (LEA)

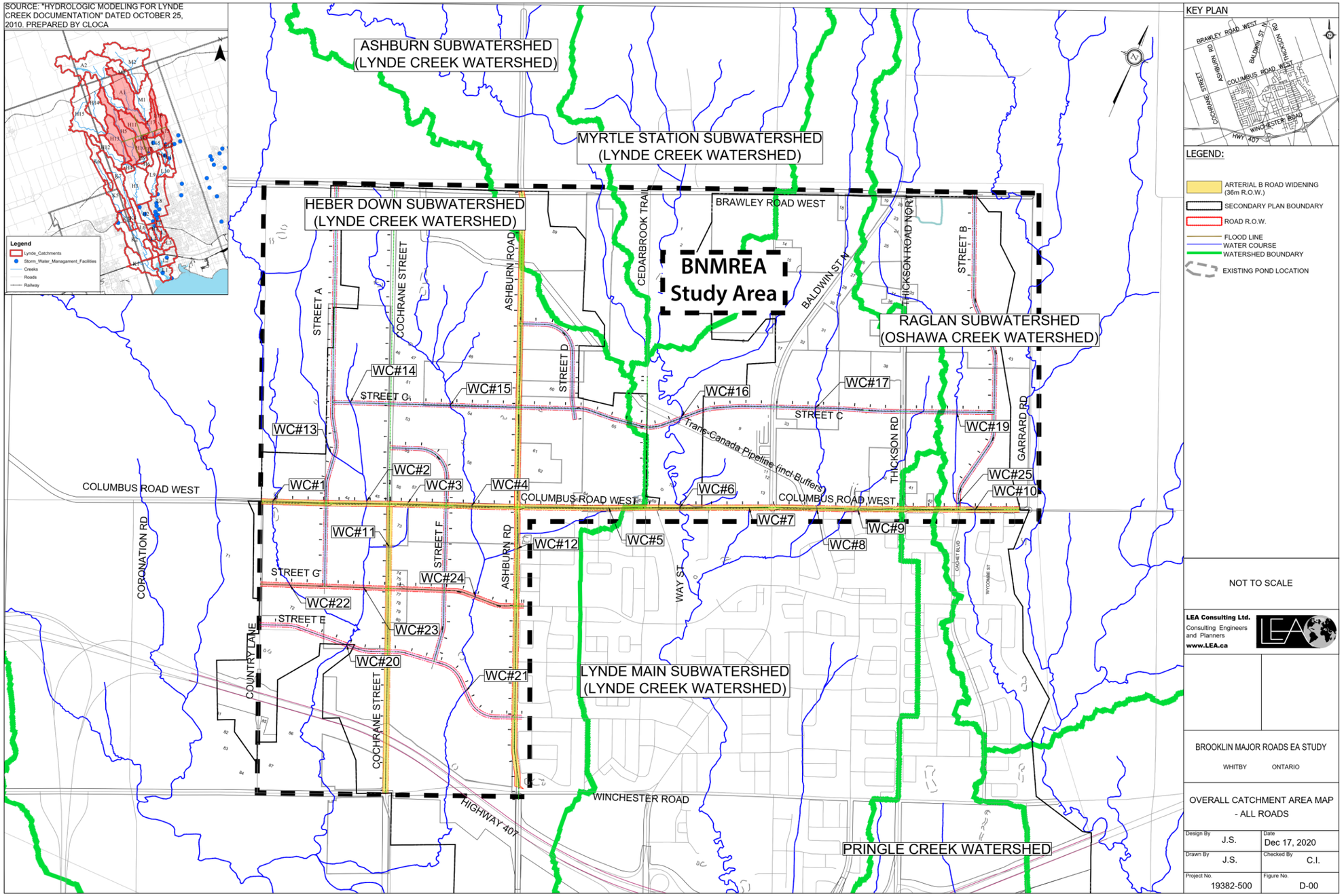


Table 3-1: North Brooklin EA Watercourse Crossings (Culvert/Bridges) Lynde Creek and Oshawa Creek Watersheds (Existing Design Parameters and Structure Performance)

GENERAL INFO		ROADWAY DATA	EXISTING STRUCTURE DESIGN PARAMETERS								HYDRAULICS		EXISTING CULVERT / BRIDGE PERFORMANCE	
WC#	Street	Road Station	Type	Inverts Upstr (m)	Inverts Downstr (m)	Length (m)	Slope (%)	Span x Rise (m)	Diameter (m)	Material	Computed HW Elevation (m)		Freeboard (m)	HW/D (m)
											50 yr WS US	100yr WS US		
WC1	Columbus Road	10+277.93	ARCH Culvert	176.40	176.24	13.9	1.2	3x1.7	-	Corrugated Metal	-	179.53	0.17	1.84
WC#2	Columbus Road	10+883.83	Circular Culvert	172.00	171.55	16	2.8	-	1.1	Corrugated Metal	-	173.6	-0.28	1.45
WC#3*	Columbus Road	10+950.6	Circular Culvert	174.91	174.82	9.00	1.00	-	0.5	Corrugated Metal	-	192.89	-16.48	35.95
WC#4	Columbus Road	11+558.79	Box Culvert	171.39	171.26	16.4	0.8	3.6x1.33	-	Unavailable	-	173.41	0.21	1.52
WC#5*	Columbus Road	12+238.3	Box Culvert	176.27	176.11	16.80	1.00	0.91x0.73	-	Corrugated Metal	177.6	-	0.60	1.82
WC#6	Columbus Road	12+692.32	Box Culvert	167.917	167.651	16.6	1.6	6.1x3	-	Unavailable	-	170.77	1.97	0.95
		12+692.32	Box Culvert	167.917	167.651	16.6	1.6	6.1x3	-	Unavailable	-	170.77	1.97	0.95
WC#7*	Columbus Road	13+142.8	Circular Culvert	177.66	177.42	23.15	1.00	-	0.88	Corrugated Metal	178.29	-	1.15	0.72
WC#8	Columbus Road	13+575.73	Box Culvert	180.37	180.35	16.9	0.1	1.85x1.85		Unavailable	-	182.42	1.13	1.11
WC#9*	Columbus Road	13+844.8	Circular Culvert	184.00	183.95	5.10		-	0.67	Corrugated Metal	185.9	-	-0.23	2.84
		13+844.9	Circular Culvert	184.00	183.95	5.10	1.00	-	0.67	Corrugated Metal				
WC#10	Columbus Road	14+802.04	Box Culvert	185.88	186.29	15.22	-2.7	1.82x1.98	-	Concrete	-	189.55	-0.64	1.85
WC#11*	Cochrane Street	10+589.9	Circular Culvert	170.50	170.42	8.00	1.00	-	0.5	Corrugated Metal	-	195.88	-23.93	50.77
WC#12*	Ashburn Road	1+564	Box Culvert	170.59	170.40	18.70	1.00	2.48x1.10	-	Corrugated Metal	171.27	-	1.12	1.37

3.7 Air and Noise Quality

As part of the BNMREA, air and noise quality studies were conducted to support the evaluation and selection of a preferred road design in Phase 3. The results of these studies are summarized below.

3.7.1 Air Quality

RWDI completed a Qualitative Air Quality Impact Assessment in May 2020 to examine the potential impact on air quality associated with increasing vehicle volumes due to the development of the BNMREA study area. The assessment focused on existing residences located south of Columbus Road West and east of Ashburn Road. The study can be found in **Appendix H**.

A qualitative assessment was performed to assess the existing air quality conditions within the study area, using surrogate studies in the Town to establish background concentrations in air contaminants, include the Garden Street EA and the Dryden Boulevard EA, in the Town of Whitby which are both located approximately 10 km south of the North Brooklin study area. The surrogate studies involved similar roadway improvements (i.e., expansion from 2 to 4 lanes or extension of an existing arterial roadway) with similar vehicle traffic volumes and speed limits, and both assessed air quality impacts to receptors immediately adjacent to the roadways, similar to the section of the North Brooklin area that was the focus of this study. The surrogate studies were located in areas that are somewhat more densely developed than the North Brooklin study area; background concentrations for air contaminants would be expected to be a little higher for the surrogate study areas than for the North Brooklin study area, and therefore predicted impacts also slightly higher. This suggests that the use of the results of the surrogate studies would be conservative as applied to the North Brooklin study.

The key factors affecting air quality impacts on nearby receptors from roadway emissions are: traffic volume and speed, proximity to the receptors, and background air quality. As a majority of the existing land for the study area consists of agricultural land uses with no existing receptors, detailed road studies were used as a proxy for the potential impact on residential receptors adjacent to the subject new roadways. The location of residential receptors is provided in **Figure 3-13**. This forms a base to compare the 2031 forecasted volume data for the future conditions, further discussed in **Section 8**.

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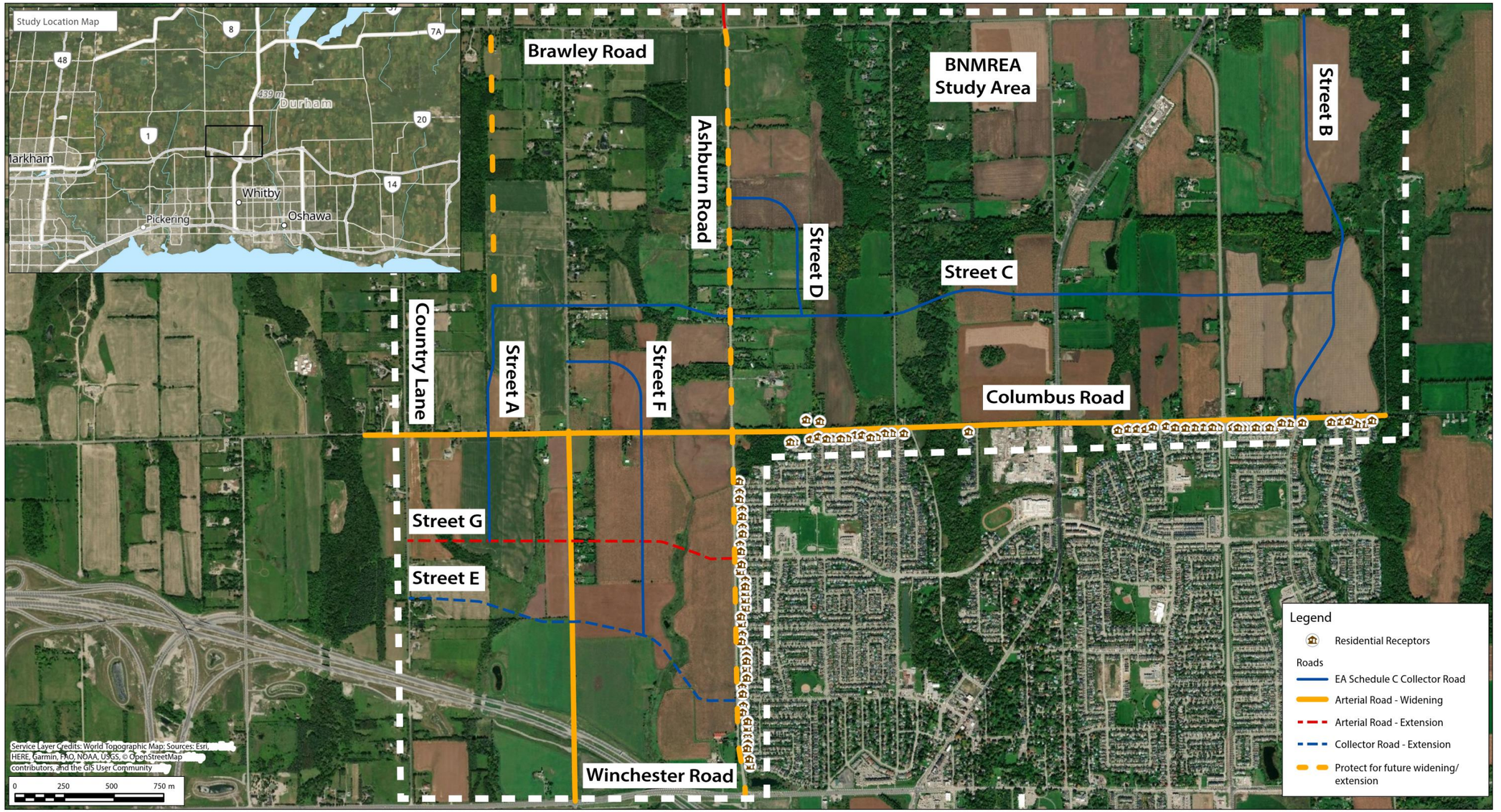
Figure 3-13: Air Quality Residential Receptors in the Brooklin Area (RWDI)



Study Area

Map Projection:
North Brooklin EA - Brooklin, ON

True North

Project #: 1901296

Drawn by:	DJH	Figure:	1
Approx. Scale:	1:19,000		
Date Revised:	May 28, 2020		

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A comparison of the existing air contaminants to the air quality thresholds set by the MECP shows that the existing values for PM2.5, NO2, and acrolein are less than their relevant thresholds. Specifically, the relevant contaminants have generally continued to exhibit declining trends over the past ten years in Southern Ontario, mainly due to declining tailpipe emissions from motor vehicles. The declining trends in these emissions are expected to continue as older vehicles are replaced with vehicles with lower tailpipe emissions. The proposed North Brooklin Roads project is expected to increase local air contaminant levels, however, based on detailed in-house studies for projects of similar size and traffic volumes, air quality impacts on any nearby receptors for the Future Build scenario are expected to remain below all applicable air quality thresholds.

3.7.2 Noise Assessment Study

LEA completed a Noise Assessment Study in May 2020 to identify existing conditions and potential areas of sensitive land uses within the BNMREA study area. The study considered 105 receptors locations. The report is included in **Appendix I**.

Existing background levels of noise in the study area are anticipated to be predominantly due to transportation sources, including the existing regional roads. MTO noise guidelines (Environmental Guide for Noise, 2006) indicate that daytime ambient sound levels for suburban and rural areas are around the fifty (50) and forty-five (45) dBA ranges, respectively, depending on traffic. Should proposed projects increase noise levels 5 dBA above observed existing levels or over 65 dBA, mitigation measures are required. The Region's guidelines for noise attenuation barriers near Regional Road expansion projects have similar recommendations for mitigation thresholds. The sensitive receptors are shown identified in **Table 3-2.** Existing conditions demonstrate that no receptors currently exceed the MTO guideline ambient sound levels for suburban conditions.

Table 3-2: Existing Conditions and Receptors on Key Existing Roads

Road Name	Number of Segments (As per the Key Plan)	Number of Receptors	Number of Receptors Exceeding Threshold
Columbus Road	10	34	0
Ashburn Road	7	25	0
Cochrane Street	8	19	0
Total:	**25**	**78**	**0**

The study concludes that current acoustic barriers are generally in good condition and designed with adequate density for proper sound insulation. In multiple locations, holes were observed in the existing barriers which likely require repair to correctly attenuate sound. Locations of the existing barriers and condition summaries can be found in the Appendices of the Noise Assessment Study, included in **Appendix I**.

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4 Confirmation of Phases 1 and 2

Phase 1 of the MCEA process requires the identification of problems and opportunities within the study area that can be addressed through an environmental assessment process. As part of the Brooklin Study, the review of existing conditions and input from the community and stakeholders provided the basis for the study problem and opportunity statement. Subsequently, the integrated study proceeded to Phase 2 through the preparation of three land use and transportation options representing different scenarios for the future growth of Brooklin. The preferred option was selected based on evaluation criteria and consultation feedback. Phases 1 and 2 were reviewed and confirmed as part of the BNMREA before proceeding to Phase 3 (refer to Technical Memorandum 1, included in **Appendix B**).

It should be noted that the development of the Brooklin Study relied on population and employment forecasts which have since been refined through the CBP. The CBP further details the units and Ground Floor Area (GFA) for commercial and employment land associated with full build out of Brooklin North, and therefore represents a refined assessment of future road network performance. The BNMREA relies upon the CBP statistics for traffic modelling and analysis. However, the problem and opportunity statement and alternative solutions prepared as part of the Brooklin TMP are still considered to be valid, and the work conducted satisfies the Phase 1 and 2 requirements.

4.1 Problem and Opportunity Statement

The following key problems were identified in the Brooklin TMP (November 2017):

- Brooklin will experience significant population growth through intensification and greenfield expansion;
- Planned transportation improvements will influence travel behaviour within the study area;
- The existing road network in Brooklin has capacity constraints. In Downtown Brooklin, Baldwin Street is approaching capacity during peak periods. Additional capacity issues are anticipated on other major north-south roadways across Brooklin. These problems are expected to be exacerbated by growth in the Brooklin area;
- Baldwin Street is utilized as a long-distance corridor for through traffic, including truck traffic, which conflicts with the “main street” character and public realm of Downtown Brooklin;
- Neighbourhood streets will experience increasing traffic volumes; and
- A lack of active transportation and transit infrastructure and services.

Recognizing the need to address the problems highlighted above, the Brooklin TMP was developed based on the following problem and opportunity statement:

“With impending significant population growth, and to support a community-focused, pedestrian-oriented, business friendly, and sustainable downtown, the longer-distance through traffic, heavy-truck traffic, and some commuter traffic is no longer suited to travel through Downtown Brooklin. Diversion of Provincial Highway 7 /12 to a suitable alternative has the potential to alleviate congestion and improve the social environment of the downtown core. Transportation policies and infrastructure improvements are required to encourage alternative sustainable modes of travel throughout Brooklin (transit, walking, and cycling) and to accommodate the transportation infrastructure needs associated with growth identified in the Brooklin Secondary Plan Area.”

The problem and opportunity statement identified that realizing the growth potential of Brooklin will require the implementation of transportation and infrastructure improvements to support additional population and employment. To guide the development of a preferred transportation network that

responds to the problems and opportunities highlighted above, the Brooklin TMP identified three guiding principles for the development of alternative solutions:

- Traffic congestion will be improved by providing a balanced road network for local residents, businesses and visitors. Heavy trucks and through traffic will be diverted from Baldwin Street in Downtown Brooklin. Roundabouts will be incorporated into new and existing intersections whenever practical;
- A range of transportation choices will be provided, including transit, walking, and cycling, enabling comfortable and convenient access to all parts of the community regardless of age or level of mobility; and
- Connections to southern Whitby, surrounding rural and natural areas, trails and parks, recreational areas, retail and services, and employment areas within Brooklin will be maintained and improved. An integrated multi-use trail system will connect local nodes while providing access to transit services and the regional and provincial road network.

4.2 Alternative Solutions from Brooklin TMP (2017)

4.2.1 Arterial Road Network

The development of alternative solutions in the Brooklin TMP was based on a horizon period of 2031 and full build-out of the study area. The traffic analysis was confined to the AM peak period. A Do-Nothing scenario, wherein future population and employment growth is included but no road network improvements are implemented beyond existing or committed projects, served as the baseline for the preparation of alternative solutions. Three broad strategies were evaluated as part of the development of the preferred transportation network:

- **Transportation Demand Management (TDM)**: Provide capacity relief through the implementation of commuter parking lots, promotion of transit and active transportation, flexible work arrangements, and an improved active transportation network;
- **Enhanced Transit**: Increase the transit mode share from 5% to 9-10% in the AM peak period through an increase in the number and frequency of bus routes within the Brooklin study area; and
- **Network Alternatives**: Four network alternatives were considered during the development of a "long list" solutions that can address existing or future capacity constraints:
  - Revise the existing road network;
  - Add new arterial roadways;
  - Retain the Highway 7/12 designation on Baldwin Street; and
  - Remove the Highway 7/12 designation on Baldwin Street and transfer ownership from the Province to the Town.

The TDM strategy and enhanced transit were both included as part of each alternative solution, as they are predominantly recommendations for other implementing agencies. Through an initial screening process involving a screenline analysis and other considerations, the long list of network alternatives was refined to a short list of four alternatives for the arterial road network:

- Alternative #1 - Do Nothing;
- Alternative #2 - Widen Lake Ridge Road (between Highway 7 and Brawley Road) and Thickson Road (between Winchester Road and Brawley Road);
- Alternative #3 - Widen Cochrane Street (between Highway 7 and Carnwith Drive); and
- Alternative #4 - Widen Cochrane Street (between Highway 7 and Carnwith Drive) and Widen Ashburn Road (between Highway 7 and Carnwith Drive)

All arterial road network alternatives widen an existing two-lane cross-section to a four-lane cross-section. The arterial road network alternatives were examined based on predefined evaluation criteria consistent with the MCEA process, including transportation/technical, natural environment, socio-economic, cultural, and cost indicators. Traffic modelling of the arterial road network alternatives was based on Land Use Option 2 (discussed in the section below) because it generates the highest volume of traffic, and therefore represents the most conservative estimate of future network conditions.

The results of the evaluation recommend Alternative #2 (widen Lake Ridge Road and Thickson Road) and Alternative #3 (widen Cochrane Street) be implemented to support future growth in Brooklin, as illustrated in **Figure 4-1**. In addition, the report recommends protecting the Ashburn Road ROW for post-2031 implementation of Alternative #4. Removing the Highway 7/12 designation on Baldwin Street is also recommended and will be addressed as part of a separate provincial class EA.

The widening of Columbus Road from two-lanes to four-lanes, between Lake Ridge Road and the Whitby/Oshawa Boundary, was identified by the Town's TMP (2010) as a priority project for future implementation. This widening was included as part of all four alternatives in the Brooklin TMP as a base case project to occur in all scenarios.

4.2.2 Collector Road Network

While the Brooklin TMP evaluated alternative solutions pertaining to the arterial road network of the broader study area, a collector road network was prepared for each land use option through the Brooklin Secondary Plan process. The collector road network alternatives were developed to support the location and magnitude of population and employment growth being considered in each land use option. New collector roads were only required in the planned expansion areas, such as Brooklin North. The development of the collector roads was guided by the following key principles:

- Collector (and local roads) should be designed in a grid system, wherever possible, to disperse traffic and lower volumes on each road. A grid system also improves pedestrian connectivity and enhances access to services and transit. Designs should be consistent with the Durham Region intersection spacing criteria and Arterial Corridor Guidelines.
- Collector road ROWs should include sidewalks on both sides. However, a multi-use path on one side may also be considered, rather than a sidewalk.

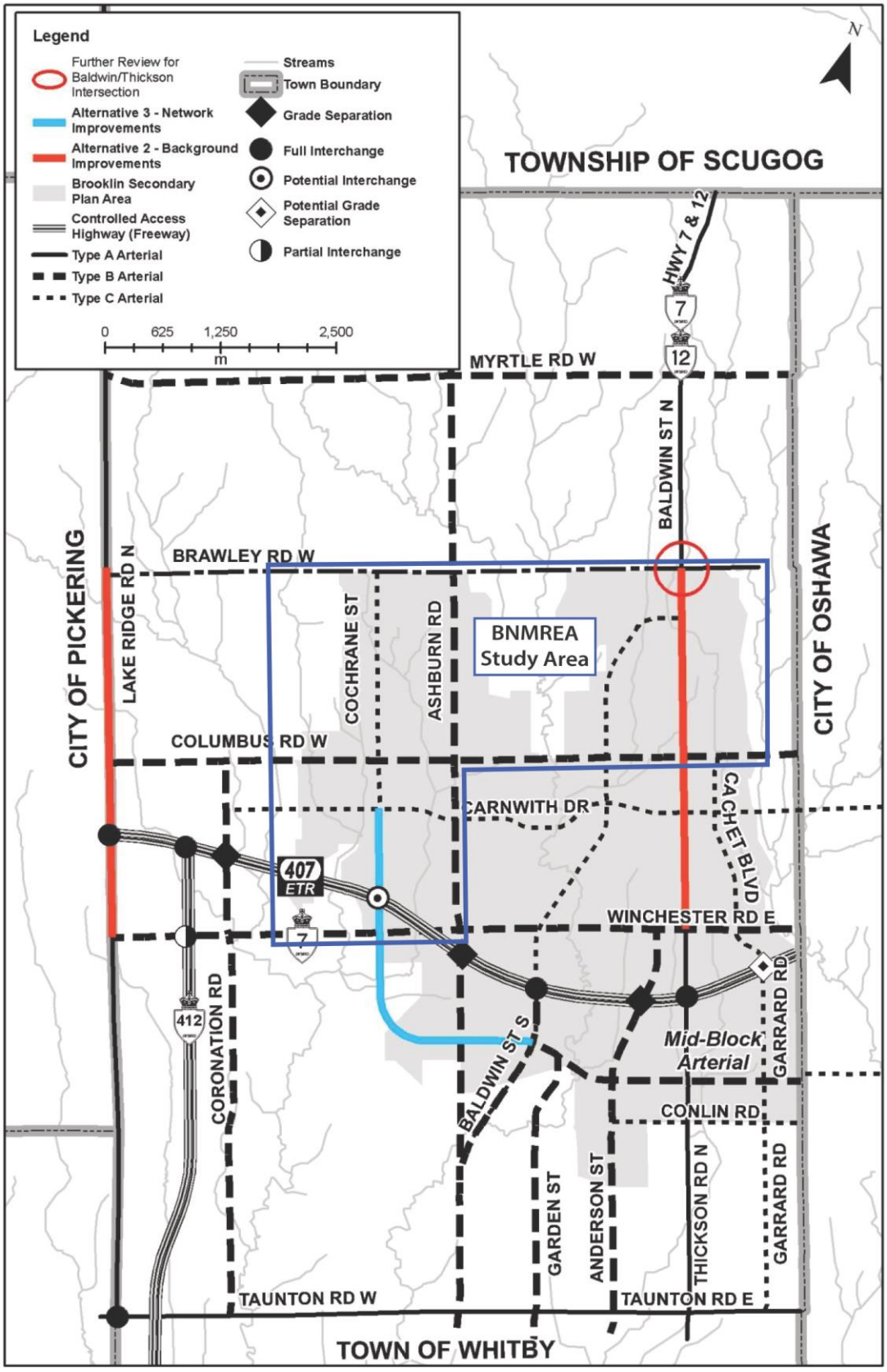
The three-land use and transportation options are detailed below:

Option 1: East-West Corridors and Five Nodes

Option 1 involves the development of higher density residential uses along the east-west collector and arterial roads, which will primarily be medium density ground-related housing with higher density residential located at major intersections. The recommended road network changes include:

- **Vipond Road and Carnwith Drive**: These roads are both extended westerly to connect with Country Lane.
- **New east-west collector road:** This is located north of Columbus Road, crossing the Greenbelt area and extending beyond Cochrane Street to the west and Thickson Road to the east.

Figure 4-1: Arterial Road Network Alternatives from Brooklin TMP (Town of Whitby)



- **New collector roads in the northwest quadrant:** A grid of two east-west and three north-south collector roads are located in the northwest quadrant. Not all north-south collector roads are continuous in this option.
- **New collector roads in the northeast quadrant:** In the northeast quadrant, two new collector roads are proposed to connect Duffs Road and Thickson Road, crossing Baldwin Street. East of Thickson Road, a north-south collector road is proposed between Brawley Road and Columbus Road.
- **The intersection of Baldwin Street and Thickson Road**: The north end of Baldwin Street is to be modified to form a T-intersection with Thickson Road as the major through road. This realignment is to allow for improved development access and intersection operations and to discourage longer distance travel through Downtown Brooklin.

During public consultation, comments received on Option 1 indicated that the Vipond extension connection to Cochrane Street is preferred, but the road crossings in the north-west quadrant should be removed due to their potential impacts on the natural environment.

Option 2: North-South Corridors and Four Nodes

Option 2 has higher density residential land uses planned mostly along the north-south corridors, with medium density ground-related housing and higher density residential areas clustered at key intersections. The recommended road network changes include:

- **Vipond Road and Carnwith Drive with a new east-west collector road**: Both Vipond Road and Carnwith Drive would be extended to the west. Vipond Road connects to Cochrane Street, and Carnwith Drive extends further to connect with Country Lane. A new east-west collector road connects Cochrane Street and Country Lane south of Carnwith Drive.
- **New collector roads in the northwest quadrant**: The new east-west collector road parallel and north of Columbus Road West does not cross the Greenbelt area. Three additional east-west collector roads are provided in the northwest quadrant, connected by a new north-south collector road between Cochrane Street and Ashburn Road. A north-south connection is also provided from Carnwith Drive to one of the east-west collector roads. In addition, a north-south collector road is proposed west of Cochrane Street, providing connections between Brawley Road and Carnwith Drive.
- **New collector roads in the northeast quadrant**: A new collector road is proposed to connect Thickson Road and Brawley Road via Duffs Road. A north-south collector road is also proposed east of Thickson Road.
- **The intersection of Baldwin Street and Thickson Road**: The alignment of the intersection at Baldwin Street and Thickson Road is the same as it is in Option 1, with Baldwin Street ending at Thickson Road in a T-intersection.

During public consultation, the comments received on Option 2 indicated that the continuous Vipond extension across Cochrane Street is preferred (similar to Option 1), but the road crossings in the north-west quadrant should be removed due to their potential natural environment impacts. In addition, the east-west road parallel to Columbus Road is expected to significantly improve east-west connectivity and should preferably be continuous, as in Option 1.

Option 3: Three Community Central Area Nodes

Option 3 prioritizes nodes of higher density development, unlike the corridor approach adopted by Options 1 and 2. The recommended road network changes include:

- **Vipond Road and Carnwith Drive**: These roads are both extended to the west to connect with Country Lane.

- **New east-west collector road:** This is proposed north of Columbus Road, providing a continuous connection from west of Cochrane Street to east of Thickson Road.
- **New collector roads in the northwest quadrant:** Around the higher density residential and commercial node at the intersection of Columbus Road and Cochrane Street, a north-south collector road is proposed on the east and west sides of the higher density area. In the northwest quadrant, two additional east-west collector roads are proposed south of Brawley Road, and two north-south collector roads are proposed.
- **New collector roads in the northeast quadrant**: A new collector road is proposed to connect Brawley Road and Thickson Road. The new road crosses the north end of Baldwin Street, where a higher density residential and commercial node is proposed. A new north-south collector is also located east of Thickson Road. The existing intersection alignment at Baldwin Street and Thickson Road is maintained.

During public consultation, comments received on Option 3 indicated that the Vipond Road extension to Cochrane Street was preferred, but the road crossings in the north-west quadrant are not desired due to their potential impacts on the natural environment.

4.2.3 Preferred Arterial and Collector Road Network

New Collector Roads

The land use options, and associated collector road networks were presented to the Town Council in November 2015, and to the general public at the PIC #3 held on March 9, 2016. Numerous comments were received from the public and government agencies which aided in developing the preferred land use and collector road network. The following changes were incorporated:

- Intersection spacing of collector and arterial roadways was further refined so that the proposed network better aligns with the Durham Region intersection spacing guidelines. However, there are some exceptions where road alignments are limited by natural environment constraints;
- Collector roads were proposed south of Winchester Road to service industrial lands; and
- School locations were modified to allow access to/from collector roads. Secondary schools are proposed to be located closer to arterial roads to increase use of transit and active transportation.

The following new collector roads were identified as MCEA Schedule C projects:

- Street B: New north-south collector road east of Thickson Road which connects Columbus Road to Brawley Road;
- Mid-block north-south collector roads west of the Greenbelt area, including a road east of Ashburn Road (Street D), a road between Ashburn Road and Cochrane Street (Street F), and a road between Cochrane Street and Country Lane (Street A);
- Street G: Carnwith Road extension west of Country Lane;
- Street E: Vipond Road extension west of Country Lane; and
- Street C: New east-west collector road located north of Columbus Road.

Widening of Arterial Roads

The following arterial widening projects were identified as MCEA Schedule C projects:

- Columbus Road (existing two-lane to four-lane cross-sections)3
- Cochrane Street (existing two-lane to four-lane cross-sections)

[3] As previously noted, this widening project was identified by the Town of Whitby TMP (2010).

- Ashburn Road (existing two-lane to four-lane cross-sections) – post-2031

In addition, Lake Ridge Road and Thickson Road have been identified as Schedule C projects, but they will be addressed as part of separate studies.

Preferred Road Network

The preferred road network is depicted in **Figure 4-2**. Road segments identified as Schedule C projects require completion of Phases 3 and 4 of the MCEA process. The remaining local road network will be implemented through individual Planning Act applications.

As part of the BNMREA, the development and evaluation of arterial and collector roads within the study area was reviewed to confirm that it satisfied Phase 2 of the MCEA process. Of the ten (10) of the Schedule C projects, seven (7) were identified as justified and were taken forward to Phase 3 without any modifications. Three (3) of the projects were identified as special study areas, which require additional review considering new information as discussed in **Section 4.3**. The list of projects is identified as below and are numerically labelled per **Figure 4-2**:

- Type B arterial Roadway
  1. Columbus Road widening (between Country Lane and Garrard Road)
  2. Cochrane Street widening (between Winchester Road and Columbus Road)
  3. Protection for Ashburn Road widening (between Winchester Road and Brawley Road)
- Type C Arterial Roadway
  4. Street G (Extension of Carnwith Drive)
- Collector Roadway
  5. **(Special Study Area B)** Street A (protection for extension between Street C and Brawley Road)
  6. (Special Study Area A) Street B
  7. Street C
  8. Street D
  9. Street E (Extension of Vipond Road)
  10. Street F

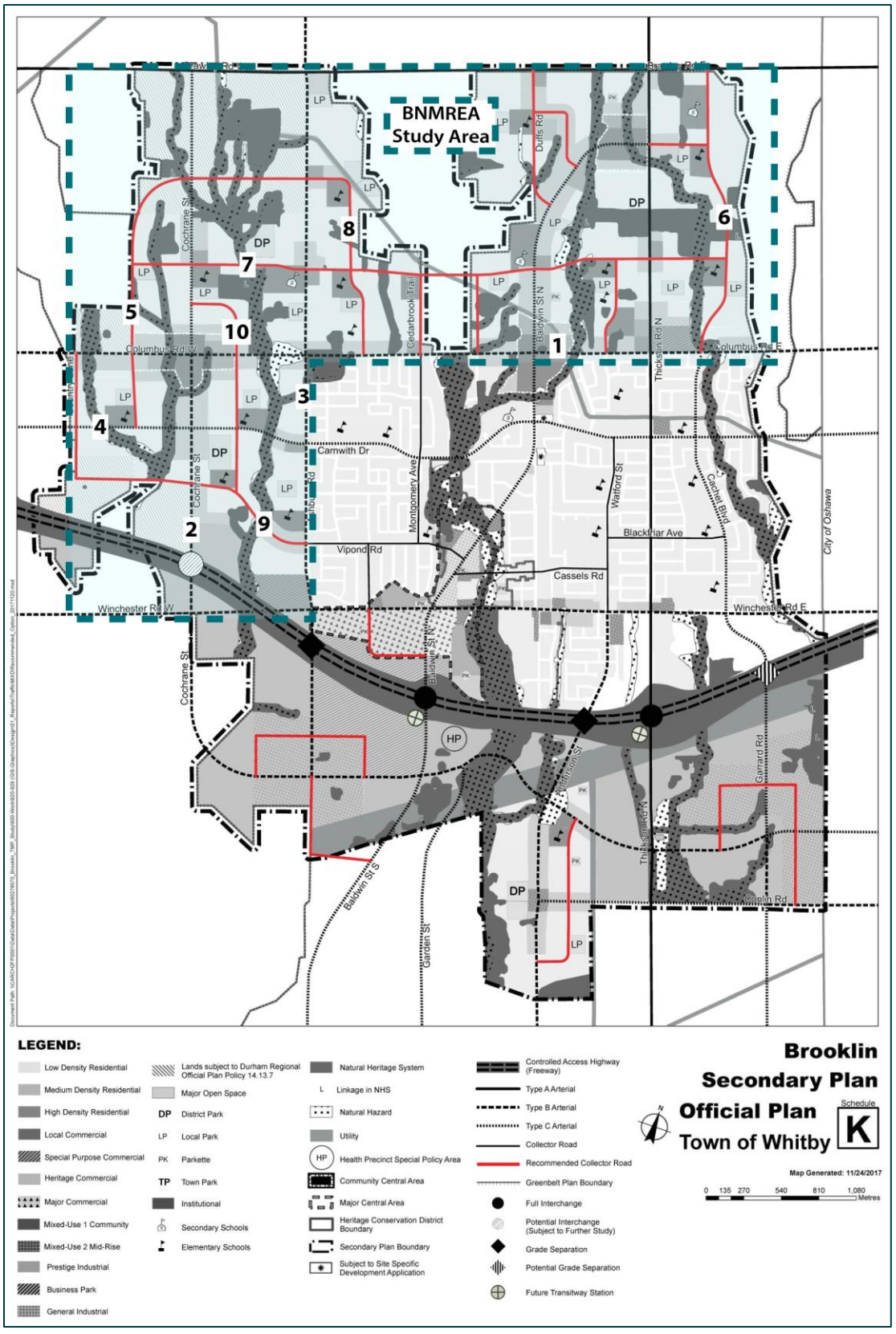
4.3 Special Study Areas A and B and Ashburn Road

Special Study Areas A and B identified in Schedule K of the Brooklin Secondary Plan as well as Ashburn Road were further considered before proceeding with Phase 3 of the MCEA process. The following sections outline the review of the two Special Study Areas as well as Ashburn Road.

4.3.1 Special Study Area A

Special Study Area A incorporates the segment of Street B just north of Columbus Road (labeled as Road 6 in **Figure 4-2**). The alignment identified in the Brooklin Secondary Plan Schedule K requires a crossing of the natural heritage system to provide a connection at Columbus Road and Cachet Boulevard. Previous iterations of the Brooklin TMP road network plan shown in the early PICs of the Brooklin TMP study showed a connection of Street B which aligned the road at Wycombe Road.

Figure 4-2: Preferred Road Network Per Brooklin Secondary Plan (Town of Whitby)



Traffic Demand

Based on the 2031 Traffic Demand forecasts prepared by BA Group for the Brooklin Secondary Plan, this collector road was expected to accommodate a total two-way traffic volume of 1039 trips in the AM peak hour and 1055 trips in the PM peak hour. This is considered to be sufficient demand and need for a north-south collector road at the east end of the study area Given this, both the recommended Brooklin TMP alignment (connecting at Cachet Boulevard) and the alternative alignment avoiding the natural heritage system (connecting at Wycombe Road).

Special Study Area A – Recommendation

Special Study Area A was recommended to be carried forward to consider alternative alignments as part of Phase 3 in the BNMREA.

4.3.2 Special Study Area B

Special Study Area B incorporates the area in the northwest area of the BMNREA study area, within a portion of the CBP consisting primarily of lands which were deferred for future consideration. The remaining land uses include a local park and significant natural heritage system that surrounds several tributaries. Aside from Cochrane Street extending through Special Study Area B, Schedule K depicts a collector road located mid-block between Country Lane and Cochrane Street, which travels north from the main east-west collector in Brooklin North before turning east, crossing the natural heritage system, and intersecting with Cochrane Street and Ashburn Road. This collector road is labelled in **Figure 4-2** as Road 5 (Street A).

As part of the Brooklin TMP recommendations, it was identified that a "mid-block north-south collector road between Cochrane Street and Country lane" was to be provided. However, as described above, the depiction of this collector road starts off north-south but turns east-west to cross the natural heritage system. Based on the above, the following items were identified for further consideration with respect to the proposed collector road within Special Study Area B:

- The collector road crosses several sensitive natural heritage system linkages;
- The collector road does not appear to service a typical level of traffic demand; and
- The collector road is located within deferred lands as designated in the Brooklin Secondary Plan.

Natural Environment

As the collector road travels east-west from the mid-block location between Country Lane and Cochrane Drive, it is proposed to traverse four watercourses. These watercourses form a headwater system of the Lynde Creek and have been identified as contributing habitat for Redside Dace and at a minimum, are considered indirect fish habitat supporting Redside Dace. The area around Special Study Area B's tributaries have been identified as being ecologically significant groundwater recharge areas and a part of a highly vulnerable aquifer system. That said, the watercourses are considered to be of the first order in the hierarchical classification of dendritic streams. Indicating that they contribute to ephemeral streams unless groundwater inputs provide intermittent or permanent flows. As part of a first order stream, the natural environment investigation indicated the stream would not support fish habitat. The area Ecological Land Classification are generally cultural thicket and meadow types, while there is a presence of a meadow marsh community series in the area. Considering this, a road crossing of this area would need to be sensitive to the presence of the watercourses and their role as contributing Redside Dace habitat, incorporating measures related to hydraulic, thermostatic, and ecological considerations.

Traffic Demand

Based on the 2031 Traffic Demand forecasts prepared by BA Group for the Brooklin Secondary Plan, this collector road was expected to accommodate a total two-way traffic volume of 72 trips in the AM peak hour and 90 trips in the PM peak hour. Further, it would appear that the traffic forecasted to use this collector road, is using it as an alternative route to Cochrane Street. Considering the assessed traffic operations along Cochrane Street, it was determined that the section north of Columbus operates well with little constraint. Specifically, the reported volume-to-capacity ratios are expected to be highest only for the southbound traffic at 0.6 and 0.53 for the AM and PM peak hours, respectively. With an overall capacity of 500 vehicles per hour per direction, this would indicate that there is sufficient capacity to accommodate the traffic which is currently diverting across the collector road within Special Study Area B.

Deferred Planning Designation

As noted, the land uses on either side of the proposed collector road are noted in the Brooklin Secondary Plan as being deferred. As a result, population and employment density has neither been assumed for, nor allocated to these lands. The future development of these lands would need to be considered at a later time and likely to follow the build out of much of the existing planned Brooklin Secondary Plan. Considering the unknowns with respect to the proposed land uses and their requirements for an associated road network, would be premature to assume that the proposed road network would satisfy the requirements of this area.

Special Study Area B – Recommendation

Based on the above considerations with respect to the anticipated impact to the ecological communities, the current forecasted traffic demands, and the current planning designation, it is recommended that the collector road within Special Study Area B be deferred for future consideration. As a result, the recommendations as part of this BNMREA will neither predetermine, nor preclude, the future extension of this collector road. Furthermore, as the planning policy in this area develops, so too can the alignment of this collector road be considered. As the alignment is considered, based on the significant ecological impacts, consideration should be given to its potential extension directly north between Street C and Brawley Road.

4.3.3 Ashburn Road

Ashburn Road is identified as to be protected for widening between Winchester Road and Brawley Road (labeled as Road 3 in **Figure 4-2**). The widening is indicated as protected for as the horizon of the widening is recommended in the TMP to occur post-2031.

It was noted that in the 2031 volume to capacity ratio forecasts prepared by BA Group for the Brooklin Secondary Plan identified similar operational constraints for both the Ashburn Road corridor as well as the Cochrane Street corridor in the base conditions. However, only Cochrane Street has been considered for widening within the study horizon.

Further review demonstrated that while base conditions for both corridors showed similar capacity constraints in the future horizon of 2031, a widening of one of the corridors was needed to improve north-south network capacity. Between the two, Cochrane Street was identified as the preferred option for widening by the horizon year, given the future connectivity to the Highway 407 interchange.

4.4 Areas Outside of the BNMREA Subject to Further Study

In addition to the road network within the deferred lands, several projects have been identified as being New and Unfinished Business since the completion of the Brooklin TMP. These projects have been identified to be outside of the scope of the BNMREA. The projects include improvements to Brawley Road, Columbus Road (west of Country Lane) and Cedarbrook Trail (north of Street C). The following section outlines the scope of what is required and the potential impact to the BNMREA.

4.4.1 Brawley Road

Brawley Road is currently a two-lane road with a rural cross-section. East of Baldwin Street, Brawley Road comes to a dead-end. Brawley Road is planned to accommodate several collector and arterial road connections that are related to the development within the Brooklin North area. However, the function of Brawley Road would need to be assessed in combination with the planning for a potential route for Highway 7/12. It is understood that the current recommendations are to protect for a ROW that would accommodate a four-lane arterial road within a 45-50m ROW.

A review of the forecasted demand for these intersections identified that interim improvements are not required to support the CBP. Specifically, this was concluded as the volumes forecasted under future conditions do not warrant the inclusion of exclusive left or right turn lanes at these intersections. The design of Brawley Road would be subject to a future environmental assessment.

4.4.2 Columbus Road – West of Country Lane

The westerly limit of the BNMREA study area is Country Lane. However, from a travel demand perspective, the role and function of Columbus Road between Country Lane and Lake Ridge Road is significant. It is recognized that the level of improvement planned on Columbus Road does impact the function on other roads planned within the primary study area of the BNMREA. In the Brooklin TMP, it was recommended that major arterial road network be developed to alleviate the identified deficiencies in the Town an included a widening from two to four lanes of Columbus Road between Lake Ridge Road and the Whitby-Oshawa boundary by 2031. The actual cross section, alignment (Region of Durham Official Plan identifies connection to 7th Concession), and connectivity of the section between Country Lane and Lake Ridge Road is dependent on the outcome of the pending Highway 7/12 Alternative Route EA. Given the travel demand assessment identified in the Brooklin TMP, the design for Columbus Road east of Country Lane should be sensitive to this potential for Columbus Road to be improved to the west. This section of Columbus Road is identified as being subject to future commitment and further study to develop its design.

4.4.3 Cedarbrook Trail at Street C

The intersection of Cedarbrook Trail with Street C was identified as “New and Unfinished Business” by Town Council on December 9, 2019 (Item MD – 4149):

That the 2017 Brooklin Transportation Master Plan, as outlined in Report PW 35-17 and Attachment 1, be approved subject to the following amendments: c. That staff report back on options for the east-west collector road crossing Cedarbrook Trail as an active transportation and transit route only; and, d. That staff investigate options for incorporating a dead-end at Cedarbrook Trail, north and south of the new collector road, between Brawley and Columbus Roads and report back to Council with the findings.

Cedarbrook Trail north of Street C is not part of the BNMREA study area. Volume forecasts for the future condition show that volumes on Cedarbrook Trail will remain very low, increasing from a peak hour,

peak direction of less than 50 in the present to less than 150 in the future. Cedarbrook Trail is not considered to have a strategic role in the network and therefore no improvements are expected to be required. Any future treatment of Cedarbrook Trail north of Street C, including a potential closure, would be the subject of a future more detailed traffic analysis to address the local impacts of such a closure. Strategically, there is no significance to area community wide traffic with or without closure. Street C and Cedarbrook Trail intersection control will examine various measures, such as stop control or roundabouts.

4.4.4 Cochrane Street – North of Columbus Road

Cochrane Street between Winchester Road and Columbus Road was examined as part of the BNMREA. North of Columbus Road, the CBP identifies developments on the east and west sides of Cochrane Street for approximately 1km before entering deferred lands and Natural Heritage System areas. The future need and timing for improvements and widening and associated design for this section of Cochrane Street will be driven by adjacent development. The future improvements and associated timing will therefore be subject to future studies prepared in support of the Development Application and Draft Plan review/approval process.

4.4.5 Highway 407/Cochrane Street Interchange

The Highway 407 East Environmental Assessment, which was approved on May 26, 2010 stated: "A Future interchange at Cochrane Street is not precluded and would be subject to approval of an independent EA, and review and approval by MTO".

The 2017 Brooklin TMP recommended the protection of a future Highway 407 Interchange at Cochrane Street to service future development lands. Appendix B of that report included an assessment of potential interchange configurations at Highway 407 and Cochrane Street as well as at Ashburn Road, concluding that Cochrane Street was the preferred location.

The Cochrane Street Interchange review provided an overview of the key design principles and guidelines that were considered in the development of the conceptual design alternatives for the Cochrane Street and Ashburn Road interchange locations, and the identification of key advantages and disadvantages for each alternative design from a design, transportation operations and land use perspective. The study also identified additional work which is expected to be required by MTO for their review and approval of an additional interchange on the Highway 407 mainline between Highway 412 and Baldwin Street.

The TMP recommended as part of the additional work to obtain MTO approval of an additional interchange on Highway 407 between Highway 412 and Baldwin Street that a Class Environmental Assessment Study be prepared. The study would examine, at a minimum, the need and justification for a new interchange and the impacts of the proposed changes on the footprint, capacity, and operation of the Highway 407 mainline and the adjacent interchanges. The study would also include mitigation measures acceptable to MTO that would address any of the identified impacts. The technically preferred alternative and associated design will require MTO endorsement as part of the study process.

It is noted that the initiation and timing of the recommended environmental assessment exercise for the future interchange will be contingent on the findings of the broader Highway 7/12 Alternative Route EA. The future route and alignment of Highway 7/12 alternative route will have a significant impact of the future need and role of the potential Cochrane Street interchange.

5 Development of Alternative Design Concepts

Phase 3 Alternative Design Concepts for Preferred Solution(s) of the MCEA process, as specified in Municipal Engineers Association's (MEA) MCEA Manual, focuses on the identification and evaluation of alternative design concepts to implement the preferred solution. The Brooklin TMP recommendations, with minor refinements discussed in **Section 4.2.3**, form the preferred solution. According to the MEA's MCEA Manual, there are usually a number of ways in which a project can be developed and designed to implement a preferred solution, and the role of Phase 3 is to describe reasonable designs, provide an evaluation of potential impacts, and confirm a preferred design.

It should be noted that alternative design concepts were developed only for ten (10) Schedule C projects identified in the Brooklin TMP recommendations. These projects were separated into the three functional road classifications applied in this BNMREA, which have been provided in the following roadway list with corresponding numerical labels shown in **Figure 5-1**:

Type B arterial Roadway

- Columbus Road widening (between Country Lane and Garrard Road)
- Cochrane Street widening (between Winchester Road and Columbus Road)
- Protection for Ashburn Road widening (between Winchester Road and Brawley Road)

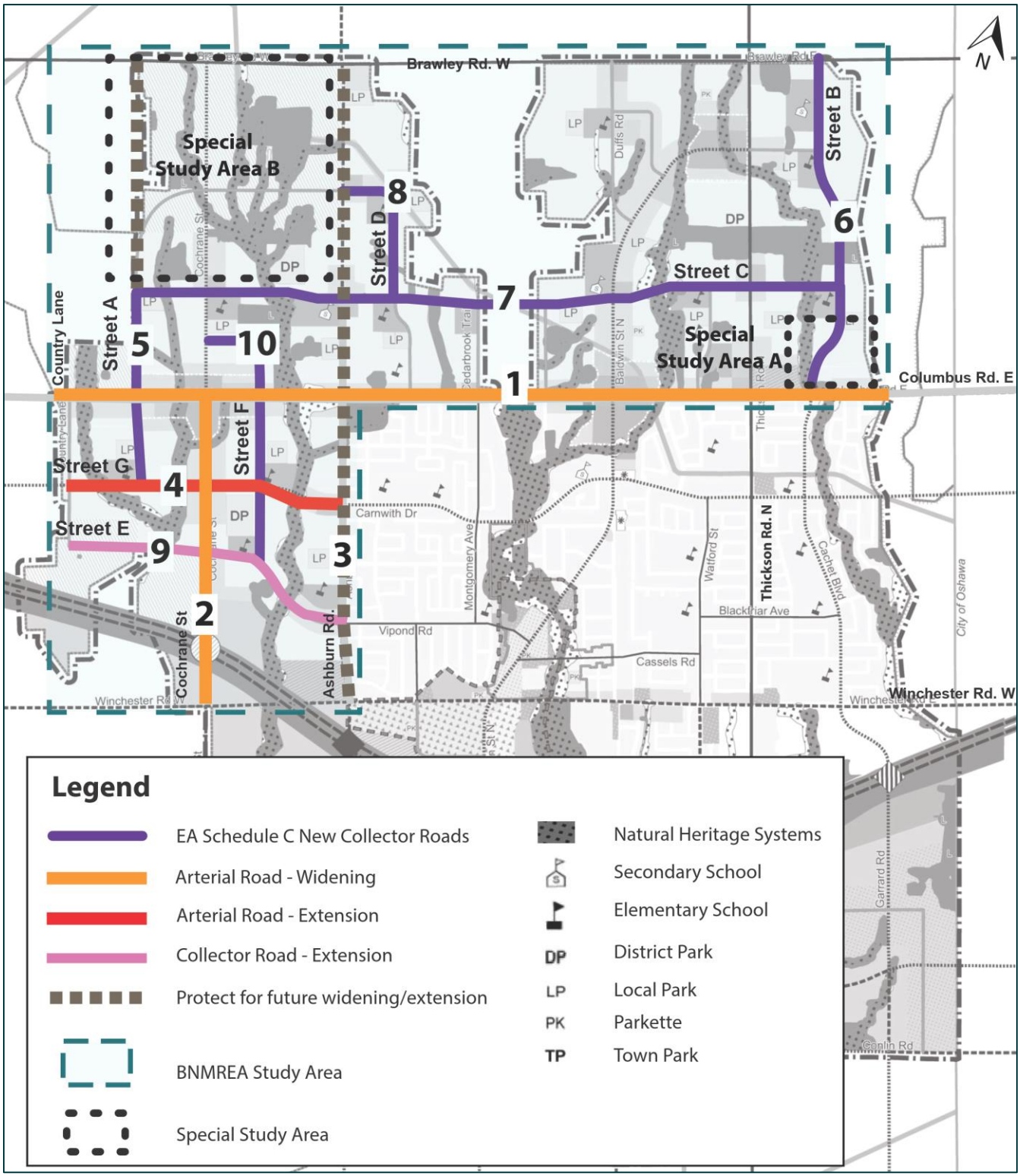
Type C Arterial Roadway

- Street G (Extension of Carnwith Drive)

Collector Roadway

- Street A (protection for extension between Street C and Brawley Road)
- Street B
- Street C
- Street D
- Street E (Extension of Vipond Road)
- Street F

Figure 5-1: Proposed Road Improvements Key Map



It is recognized through the work undertaken as part of the Brooklin TMP that general corridors for the roads have been identified. As part of the development of the alternative design concepts, this BNMREA will identify preferred road alignments, potential watercourse crossing locations, and intersection locations in order to document the impact of each alternative design and identify appropriate mitigation measures. For the purpose of this BNMREA, the designs will be developed with respect to the proposed alignments. Each proposed alignment considered how it relates to existing and future needs as well as the overall goals of the BNMREA to achieve network connectivity and accessibility. Following the determination of the preferred alignments, the roads would be subject to the Town's applicable standards with adjustments and modifications considering adjacent land use:

- It should be noted that although Columbus Road is under the jurisdiction of the Town, for the purposes of this BNMREA, the Region's road design standards were applied as there may be a potential for this road to be part of future road rationalization discussions with the Region;
- It should also be noted that in reviewing the Town's arterial road design standards, the Town's Type C arterial roadway has a design speed standard of 70 km/hr. As Street G (the extension of Carnwith Drive) west of Ashburn Road will be abutted by schools, the design criteria have been adjusted to consider a lower design speed consistent with the adjacent land uses; and
- Where a Town road intersects with a Regional or Provincial road, such as at Thickson Road and Street C, it was considered that the Region's standards will govern for all approaches of the intersection that are to be designed as part of the BNMREA. Note that Thickson Road is identified for widening to a 40 m ROW in the Region's Official Plan, which is to be addressed through separate studies.

The details of how the cross-sections have been rationalized by the Town are detailed in **Section 7**.

5.1 Development of Road Alignments

Several factors were important to consider in the development of the alignments, including conformity with the Brooklin Study and the CBP, adherence to design guidelines (as outlined in **Section 5.1.1**), impacts to natural and cultural environments, and implementation feasibility and cost.

As part of the Brooklin Study, approximate alignments for each of the corridors were outlined, which were used as the foundation for the roads shown in the CBP. As part of the Phase 1 and 2 review in the BNMREA, it was noted that these alignments need to be refined and evaluated based on additional natural environment information, updated traffic modelling forecasts, and revised planning context.

Allowing for the above factors, a corridor envelope was formed for each of the proposed roads, based on the preliminary alignment shown in the CBP. These corridors provided a guide within which the alignments would minimize impacts to natural environment features and would comply with geometric design constraints described in **Section 5.1.1**.

For some of the proposed roads, the preliminary CBP alignment fell within all of the constraints and were not observed to have any impact to natural or cultural features, and therefore the base alignment was deemed to be the preferred alignment.

Where the base alignment from the CBP needed to be adjusted due to design constraints (updated design criteria and new information on natural heritage features), three alignments were selected from within the corridor envelope. These alignments typically featured the extremes (furthest north/south or east/west) of the corridor and a centered alignment. Through the evaluation, the preferred alignment was typically identified as a combination of these alignments.

5.1.1 Design Criteria

After consultation with the study team and key stakeholders, the following design criteria were determined to be applicable for the BNMREA. The main design criteria and constraints to the designs applied in the development of the alternative alignments were:

- Geometric constraints as outlined in **Table 5-1** based on standards from the Town (Public Works Design Criteria and Engineering Standards. 2019) and the Region (Design Specifications for Roads and Entranceways, 2020);
- Design speeds are outlined in Table 5-2;
- Natural heritage features (as shown in **Figure 3-4**). Mapping of these features was confirmed with the CLOCA and identified new and widened roads should maintain a minimum buffer of 10m from sensitive natural features. Where impacts are unavoidable, the alignment should seek to reduce the crossing to as small an area as possible;
- Wildlife passage based on openness ratio will be incorporated into the design in the next Detailed Design phase as determined appropriate (or where determined appropriate) in consultation with the Town and CLOCA;
- Avoid impacts to existing structures;
- The TransCanada Pipeline to their corridor requires that any road crossing have a minimum of 45-degree angle, and any bridge abutments be located at minimum of 7m from the edge of the ROW;
- Maintain connectivity to existing transportation network; and
- Maintain access for existing and proposed land uses.

Table 5-1: Geometric Design Constraints for Alignments (Whitby and Durham)

Classification	Minimum Curved Radius	Minimum Straight Length	Posted Speed	Design Speed	Minimum Intersection Angle	Minimum Intersection Spacing
Type B Arterial (Regional Standards)	190 m (TAC)	85 m	60 km/h	70 km/h (TAC)	70°	525 m N/S 300/500 m E/W
Type C Arterial (Regional Standards)	100 m (TAC)	85 m	50 km/h; 40 km/h in school zones	50 km/h	70°	300 m
Collector (Town Standards)	185 m	60 m	50 km/h; 40 km/h in school zones	50 km/h	80°-100°	60 m

Table 5-2: Road Design Speeds

Road Name	Road Classification	Design Speed	Design Standard
Columbus Road	Type B Arterial	*70 km/hr	TAC
Cochrane Street	Type B Arterial	**70 km/hr	TAC
Ashburn Road	Type B Arterial	70 km/hr	TAC
Street G	Type C Arterial	50 km/hr	TAC
Street A	Collector	50 km/hr	TAC
Street B	Collector	50 km/hr	TAC
Street C	Collector	***50 km/hr	TAC
Street D	Collector	50 km/hr	TAC
Street E	Collector	50 km/hr	TAC
Street F	Collector	50 km/hr	TAC

* *For Columbus Road and Street C, at the intersections with Thickson Road, the right and left turning lanes are designed per Regional Municipality of Durham standards (for design exceptions refer to **Section 7.1**)*

5.1.2 Alignment Alternatives

This section outlines the alignment alternatives for each of the proposed road improvements developed through consultation with the study team and key stakeholders.

As illustrated in **Figure 5-2**, alignment alternatives were developed for the corridor envelopes along Street B, C, E (Extension of Vipond Road), and G (Extension of Carnwith Drive). For these proposed roads, the base alignment from the CBP needed to be adjusted due to constraints including natural heritage features, cultural heritage features, proximity to other streets, proposed land use plans, and geometric design constraints.

Where the design criteria and constraints of the study area identified in **Section 5.1.1** were met by a proposed road, the base alignment proposed in the CBP or no alternative alignments could be developed, a single alternative was developed and determined to be preferred. It is noted that adjustments to the ultimately preferred alignments and

Street B

The two alignment alternatives for Street B are shown in **Figure 5-3**. Note that in Alternative 2, unlike in Alternative 1, Street B crosses a floodplain to connect with Cachet Boulevard. This would provide a vital north-south connection for the study area; however, it poses challenges with the construction of a bridge in an Environmentally Sensitive Area (ESA). Alternative 1 does not involve a water-crossing and is preferred from a fish and fish habitat perspective.

Street C

The three alignment alternatives for Street C are shown in **Figure 5-4**. These were developed based on several constraints, such as providing separation from the nearest intersection at Columbus Road, establishing a minimum 45-degree angle when crossing the TransCanada Pipeline, and minimizing the impact on ESAs as well as the crossing distance. All three alternatives have a ROW width of 26m. When crossing the TransCanada Pipeline, Street C forms an angle of 45.4 degrees for alternatives 1 and 2 and 45.7 degrees for alternative 3 with the pipeline. The width of the required watercourse crossing slightly increases between each alternative, being 142m for alternative 1, 144m for alternative 2, and 145m for alternative 3.

Street E (Extension of Vipond Road)

The three alignment alternatives for Street E (Extension of Vipond Road) are shown in **Figure 5-5**. Some of the main constraints for this corridor included providing separation from the nearest intersections at Columbus Road West and at Carnwith Drive and minimizing the impact on ESAs. All three alternatives have a ROW width of 26m. The width of the required watercourse is 69m for alternative 1, 73.5m for alternative 2, and 67m for alternative 3. Note that with alternative 1, Street E (Extension of Vipond Road) forms a skewed intersection with Cochrane Street, which does not satisfy minimum intersection design requirements.

Figure 5-2: Overall Plan of Corridor Envelopes

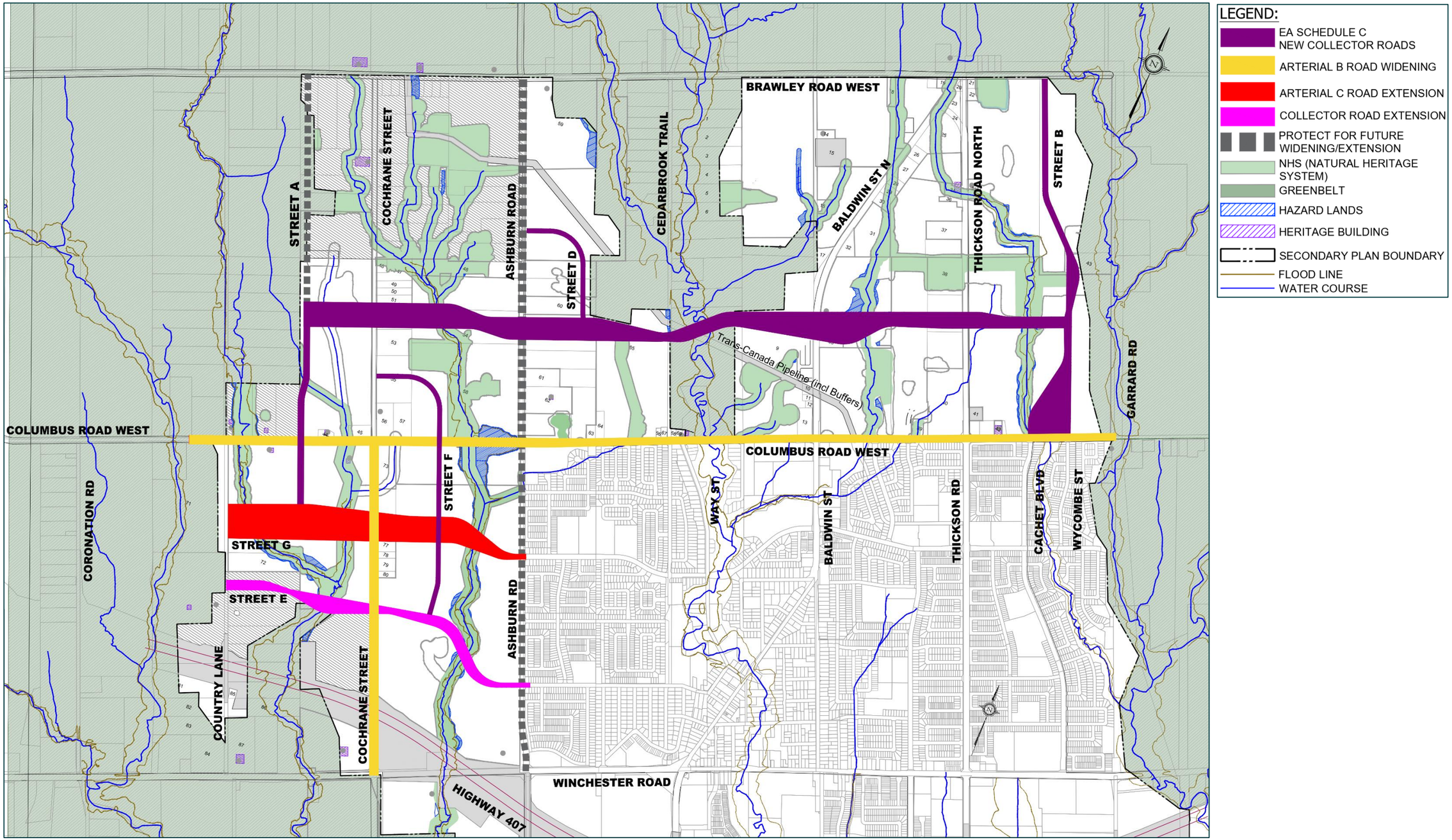


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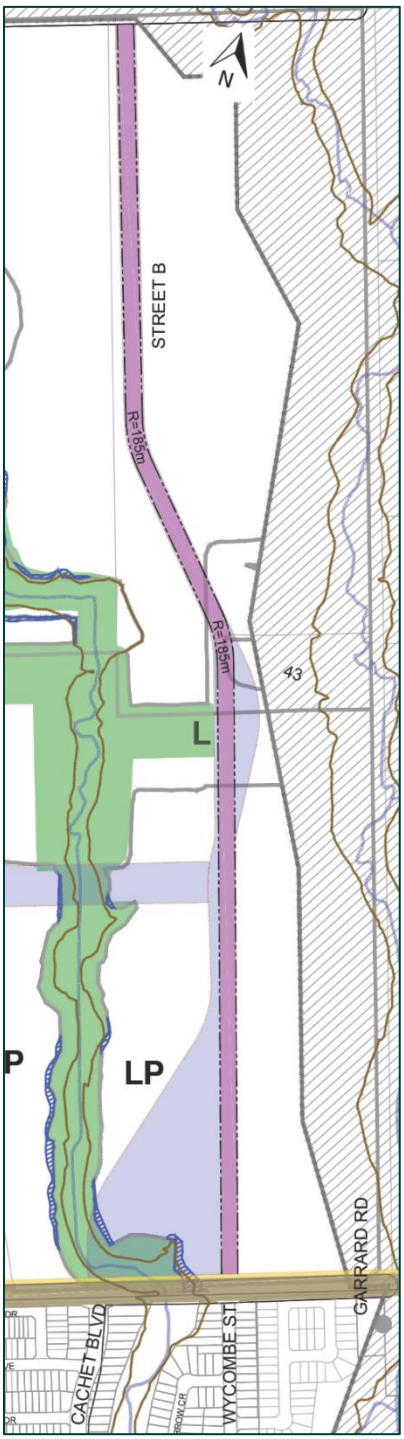
Figure 5-3: Street B Alignment Alternatives

Street B Alignment Alternative 1



Street B Alignment Alternative 2

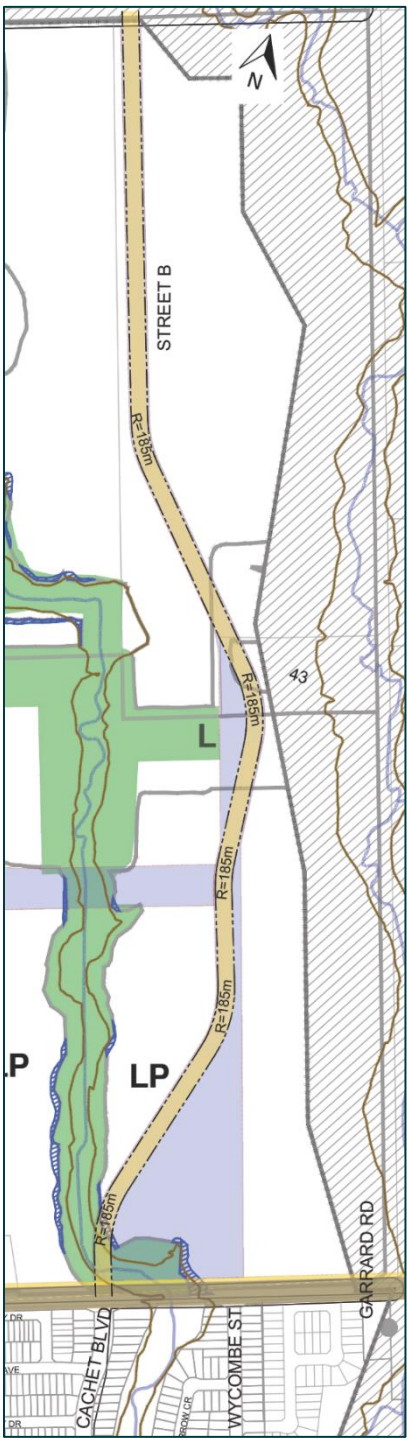
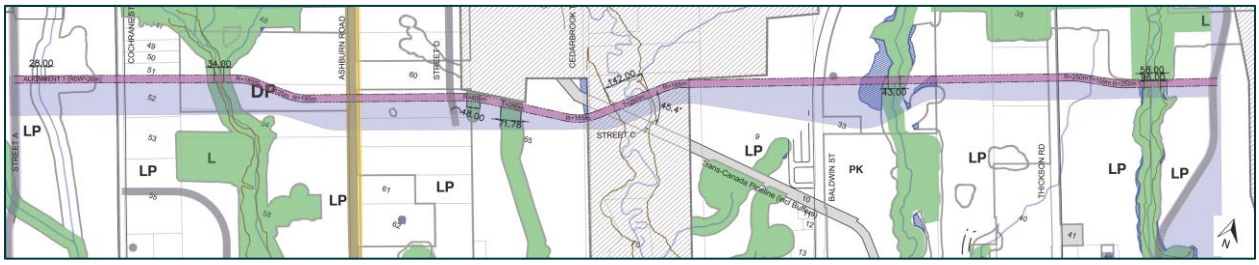
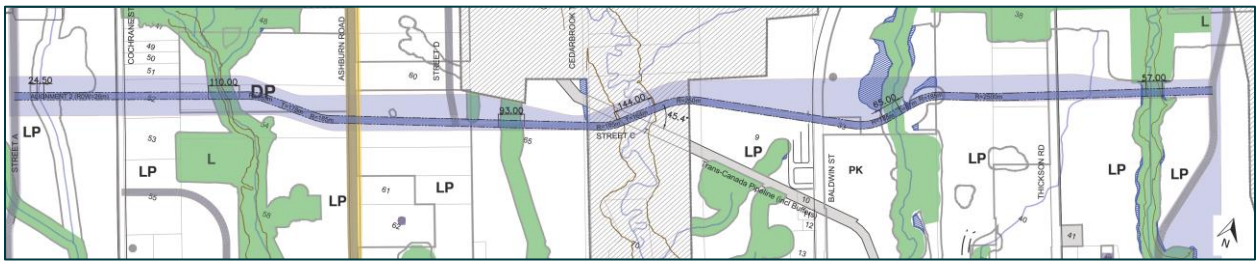


Figure 5-4: Street C Alignment Alternatives

Street C Alignment Alternative 1



Street C Alignment Alternative 2



Street C Alignment Alternative 3

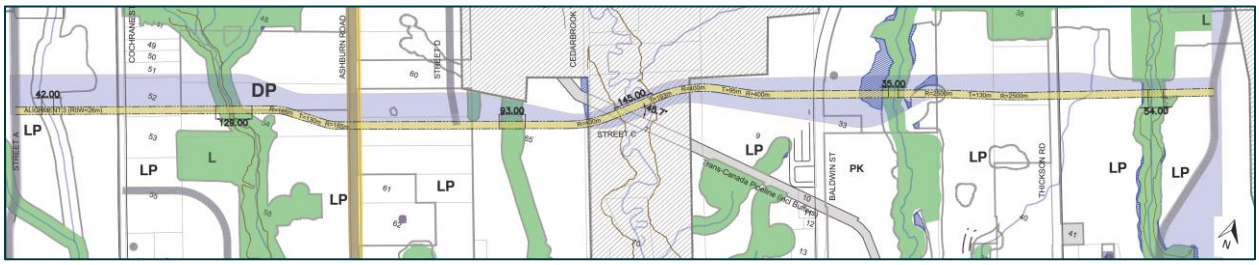
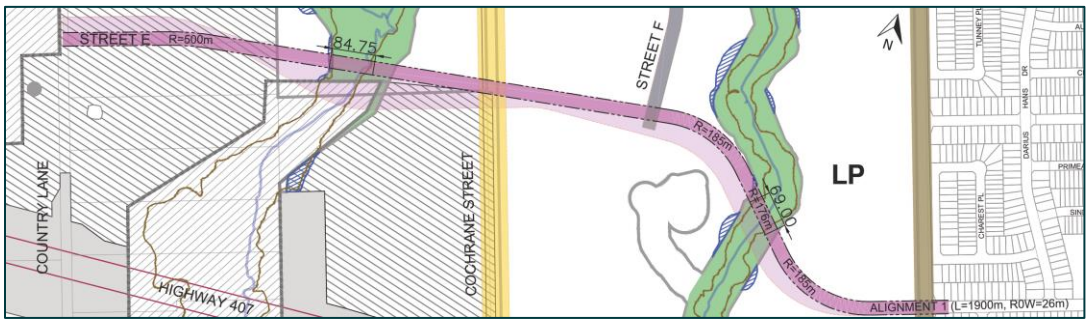


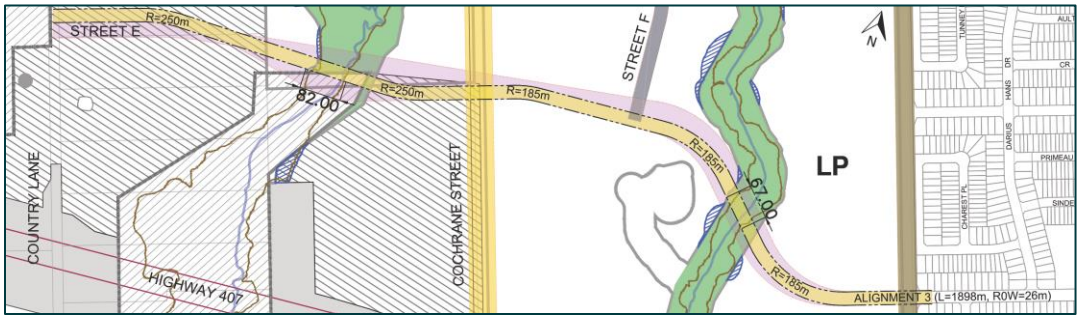
Figure 5-5: Street E (Extension of Vipond Road) Alignment Alternatives

Street E (Extension of Vipond Road) Alignment Alternative 1



Street E (Extension of Vipond Road) Alignment Alternative 2

Street E (Extension of Vipond Road) Alignment Alternative 3

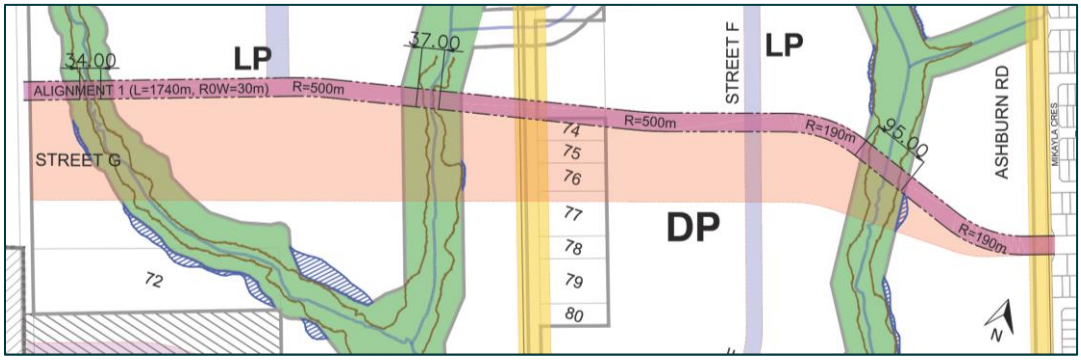


Street G (Extension of Carnwith Drive)

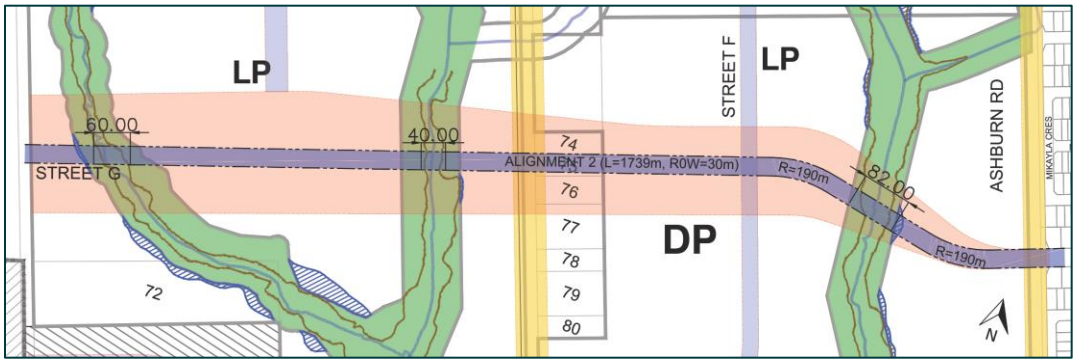
The three alignment alternatives for Street G (Extension of Carnwith Drive) are shown in Error! Not a valid bookmark self-reference.. The major constraints for this corridor included providing separation from the nearest intersections at Vipond Road and minimizing the impact on ESAs. All three alternatives have a ROW width of 30m. The width of the required watercourse is 95m for alternative 1, 82m for alternative 2, and 60m for alternative 3. With alternative 1, Street G (Extension of Carnwith Drive) forms a skewed intersection with Cochrane Street, which does not satisfy minimum intersection design requirements.

Figure 5-6: Street G (Extension of Carnwith Drive) Alignment Alternatives

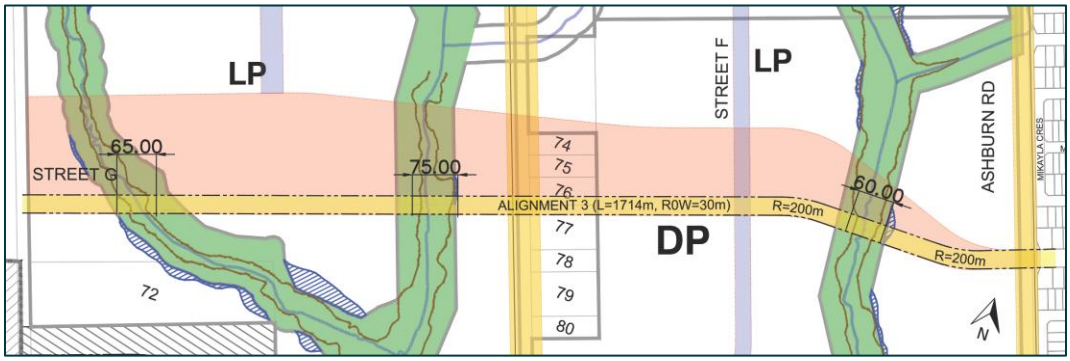
Street G (Extension of Carnwith Drive) Alignment Alternative 1



Street G (Extension of Carnwith Drive) Alignment Alternative 2



Street G (Extension of Carnwith Drive) Alignment Alternative 3



6 Evaluation and Selection of Recommended Alternative Design Concept

Based on the review of the background studies undertaken as part of the existing conditions review, consideration of the CBP and proposed alignments, and discussions with landowners and other stakeholders (including municipal and provincial agencies, CLOCA staff, Indigenous and First Nations communities, and the public), a comparison of alternatives has been undertaken. As identified in the Brooklin TMP, through traffic modelling and in close coordination with the CBP, the following roads were identified as needing improvements which include:

- Cochrane Street (widening from two to four lanes between Winchester Road and Columbus Road);
- Columbus Road (widening from two to four lanes between Country Lane and the Oshawa boundary just west of Garrard Road); and
- Ashburn Road (protection for widening from two to four lanes between Winchester Road and Brawley Road)

For the widening of these roadways from two lanes to four lanes, proposed preferred design solutions were developed to minimize property impacts. Where existing development was located, the design was shifted to avoid impacts to these residences and businesses, but in areas where both sides of the road were undeveloped, the widening was proposed to occur symmetrically about the centreline.

In addition, three new collector roadways (Street A, Street D, and Street F) were determined to have no notable differences in alternative alignment, and therefore the alignment from the Brooklin TMP and the CBP was adopted for these roadways. In the refinement of these roads, however, the BNMREA has applied the Town's road design standards. This has resulted in more gradual horizontal curves being proposed, particularly with respect to Street D and Street F.

6.1 Evaluation Criteria

To identify the preferred alternative of the recommended alternative design concepts, a series of evaluation criteria were developed based on the following broad categories:

- Transportation;
- Natural Environment;
- Socio-Economic Environment;
- Cultural Environment; and
- Constructability.

These evaluation criteria were developed considering the requirements of the MCEA planning and design process, stakeholder feedback, and the professional experience of the study team. The five categories of the evaluation criteria, detailed in **Table 6-1**, were chosen to assist with the differentiation of the benefits and impacts of each of the alternative designs being evaluated. A list and description of the selected evaluation criteria and respective measures for each category are provided in **Table 6-2**.

Table 6-1: Description of Categories of Evaluation Criteria

Evaluation Criteria	Details on Considerations
Transportation	• Considerations included: road safety; supporting transit, active transportation, and road capacity; compliance with design standards; community connectivity; and enhancing public realm • Foundation for designing safe, functional, and well-connected roadways that provide multiple mode choices to serve travel needs of future community
Natural Environment	• Data sources: field research (where permission was granted), aerial photographs, secondary sources, and input from environmental agencies (such as CLOCA, MNRF, and MECP) • Consolidated data guided where to locate roadways to minimize impacts to natural environment and to determine where there are acceptable mitigation measures for ESAs
Socio-Economic Environment	• Considerations included: property requirements; policy compliance; aesthetics (including existing and proposed land uses); and potential noise and air quality impacts • Largely based on examining current municipal and provincial land use policy, urban design policy, the Brooklin Study, the CBP, and the Town of Whitby Official Plan, in addition to conducting a noise and air quality impact assessment on sensitive noise receptors
Cultural Environment	• Considerations included: cultural heritage landscape (including built heritage structures) and areas with potential for archaeological resources requiring additional assessment • Data sources: secondary sources, field research
Constructability	• Considerations included: engineering feasibility and construction costs, capital costs, property acquisition, and operation and maintenance costs • Focused on determining if the implementation of alternatives would be financially feasible

Table 6-2: Description of Evaluation Criteria and Measures

Evaluation Criteria		Description of Criterion	Measure of Criterion
Transportation	Road Safety	Priority of road safety (pedestrian, cyclist and motor vehicle)	Does the alternative achieve/provide complete street principles and Vision Zero objectives considering all ages and abilities?
	Transit Serviceability	Ability to accommodate future transit infrastructure	Does the alternative facilitate transit services, including alternative adaptable options for changing options in transit service provision, such as automated vehicles or Mobility-as-a-service (MaaS)?
	Potential to Support Active Transportation Modes	Ability to provide/accommodate active transportation facilities	Does the alternative facilitate active transportation? Does the alternative provide comfortable and convenient active transportation facilities for all purposes?
	Road Capacity	Ability to accommodate expected traffic needs within acceptable levels of service	Does the alternative provide sufficient road capacity for the projected traffic needs?
	Design Standard Compliance	Ability to meet design standard (Town and Regional Standards)	Does the alternative comply to Town and Region design standards? Does the alternative maintain the flexibility (for future implementation) to accommodate emerging technologies and climate change initiatives?
	Community Connectivity	Ability to provide infrastructure needed for all users to connect to all desired areas within the community	Does the alternative better connect the area for all users and services? Does the alternative provide enhanced connections to major destinations for all modes? Does the alternative contribute to flexibility of the network to allow for better access/service? Does the alternative align with fine-grained network of streets (local, collector, and arterial)?
	Develop/Promote High Quality and Sustainable Public Realm	Ability to adequately provide space for active transportation users	Does the alternative provide for safe and continuous active transportation (walk, cycling) routes? Does the alternative provide opportunities for place-making or creating unique opportunities? Does the alternative consider sufficient space to allow for carbon and stormwater storage to mitigate climate change?
Natural Environment	Fish/ Fish Habitat	Avoidance of identified fish habitat	Does the alternative have impact to fish or fish habitat? Can the impacts be mitigated?
	Wetlands	Effects on identified wetlands	Does the alternative have impact to wetland habitats? Can the impacts be mitigated?
	Significant Woodlands	Effects on significant woodlands	Does the alternative have impact to significant woodlots? Can the impacts be mitigated?

Evaluation Criteria		Description of Criterion	Measure of Criterion
	Areas of Natural & Significant Interest (ANSI)	Effects on Areas of Natural and Scientific Interest	Does the alternative have impact to ANSIs? Can the impacts be mitigated?
	Species at Risk/Habitat Area	Effects on Species at Risk/Habitat Area	Does the alternative have impact to at risk or habitat areas? Can the impacts be mitigated?
	Floodplain	Effects on designated floodplains	How many metres of the floodplain is crossed by the alternative? Can the impacts be mitigated?
Socio Economic Environment	Aesthetics	Adherence to urban design principles	Does the alternative encourage aesthetic and urban design principles?
	Property Impacts	Effects on existing property	What are the property requirements of the alternative?
	Policy Compliance	Conformity with relevant Planning Policy	Does the alternative meet The Town's and Regional policy objectives?
	Existing and Proposed Land Uses	Ability to accommodate existing and proposed future development	Does the alternative properly service existing and proposed land uses?
	Noise Impact	Effect on noise and vibration sensitive receptors	Are there noise impacts of the alternative? Can they be mitigated?
Cultural Environment	Impact to Cultural Heritage Landscapes	Potential for disruption cultural landscape features	Does the alternative have impact to cultural heritage features or landscapes? Can the impacts be mitigated? Are there opportunities to frame and celebrate heritage resources?
	Built Heritage Resources	Potential for disruption to built heritage resources	Does the alternative have impact to built heritage resources? Can the impacts be mitigated?
	Archaeological Resources	Potential for impact to archaeological resources	Does the alternative have impact to archeological resources? Can the impacts be mitigated?
Implementation	Engineering Feasibility and Construction Cost	Feasibility of alternative to construct; including preliminary construction costs	Is the alternative cost effective to build? Can the alternative be phased to offset initial costs and provide infrastructure in lock-step with development? Is it possible to protect for future expansion and extension?
	Existing municipal infrastructure and utilities	Potential impacts on existing utilities and municipal infrastructure	Are there potential conflicts with existing utilities or challenges in re-location (temporary or permanent)? Would the alternative have an impact on existing municipal infrastructure to remain?
	Capital	Potential capital costs	What are the capital costs associated with the proposed alternative? (relative scale – preferred to least preferred)

Evaluation Criteria		Description of Criterion	Measure of Criterion
	Property Acquisition	Amount and type of property required	What are the property costs associated with the proposed alternative? (relative scale - preferred to least preferred) How many private properties will be impacted or need to be acquired to support the alternative?
	Operating Costs	Estimated cost of operations	What are operating costs of the proposed alternative? (relative scale)
	Maintenance Costs	Estimated cost of maintenance	What are maintenance costs of the proposed alternative? (relative scale) How much effort is required for maintaining and operating the alternative?

6.2 Assessment of the Alternatives

Alternative design concepts for each alignment were evaluated against the criteria listed in Table 6-2. The evaluation process consisted of both qualitative and quantitative evaluation for each of the alignments under consideration. The evaluation considered feedback from stakeholders (including the Town, BNLG, members of the public, and environmental agencies) and was completed using professional judgement and the results of various environmental and technical studies conducted as part of the environmental assessment process. Quantitative results from the studies were also used to substantiate the evaluation rationale where appropriate.

As discussed in **Section 5**, corridor envelopes were developed for each of the recommended Schedule C projects. Alignment alternatives were developed within these envelopes, which were determined based on constraints of the study area, such as:

- Natural heritage features;
- Cultural heritage features;
- Proximity to other streets;
- Proposed Land Use Plans; and
- Geometric Design Constraints.

Where the constraints did not impact a road proposed within the Brooklin Study and the CBP, the preliminary alignment proposed was deemed to be preferred. This was the case for the three Type B arterial road improvements and for three proposed collector roads (Street A, D, and F). It is noted that adjustments to the ultimately preferred alignments and preliminary designs may be considered in response to changes in development plans or in consideration of more detailed field investigations during the Draft Plan review/approval process. **Section 9** of this ESR identifies those elements of the design that may be adjusted during the Draft Plan review/approval process.

Table 6-3 to **Table 6-6** provide an overview of the evaluation for each of the alignment alternatives developed for the remaining proposed roads, which include Street B, C, E (Extension of Vipond Road), and G (Extension of Carnwith Drive). The evaluation was conducted using a scale of 1 to 5, with 1 being the least preferred and 5 being the most preferred given the criterion measure. A criterion which involved a quantitative value (such as cost, areas of impact to natural, property, habitats, road capacity) was assigned scores based comparatively against the other alternatives. A qualitative criterion was assigned scores based on how well it met the measures. High level preliminary cost estimates of the alternatives were done for a comparative scoring and are subject to further refinement. At this stage of

the project development, high level preliminary cost estimates do not include utility relocations, cut and fill requirements, or detailed structure costs.

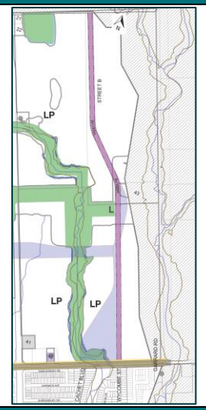
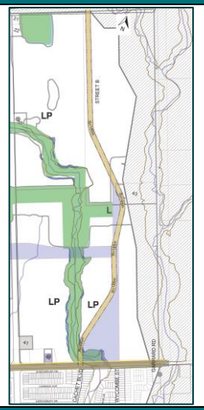
At the end of each evaluation table, the preliminary preferred alternative for each proposed road is identified. A summary of the evaluation of each alignment alternative is provided in **Table 6-7**.

Table 6-3: Evaluation of Street B Alignment Alternatives

Legend:

5	4	3	2	1

Most Preferred / Least Impacts → **Least Preferred / Greatest Impacts**

Evaluation Criteria	Street B-1		Street B-2	
				
Transportation				
Road Safety	5	The alternative is designed to meet the road safety principles and Vision Zero objectives.	5	The alternative is designed to meet the road safety principles and Vision Zero objectives
Transit Serviceability	1	Offset alignment of collector roads does not facilitate transit connection north and south of Columbus.	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated
Potential to Support Active Transportation Modes	5	Active transportation is incorporated into the roadway design; and meets the requirements for a safe recreation and community experience.	5	Active transportation is incorporated into the roadway design and meets the requirements for a safe recreation and community experience
Road Capacity	1	Offset alignment of B1 does not provide a continuous north south collector road connection, as the leg south of Columbus Road is a local road (Wycombe Road) ends at Carnwith Drive.	5	The alternative provides sufficient road capacity to meet the projected traffic needs and provides a continuous north-south connection as the leg south of Columbus Road is a minor arterial road (Cachet Blvd) continues all the way to Winchester Road.
Design Standard Compliance	5	Complies with Town and Regional design standards	5	Complies with Town and Regional design standards
Community Connectivity	1	Offset intersection would require only one of two links being able to be signalized; does not allow for community connectivity	5	Alternative provides connection to designated future land uses
Develop/Promote High Quality and Sustainable Public Realm	5	Route provides sufficient ROW to include active transportation	5	Route provides sufficient ROW to include active transportation

Natural Environment				
Fish/Fish Habitat	5	No aquatic habitat area impacted	5	No aquatic habitat area impacted
Wetlands	5	No wetland areas impacted	4	Bisects 8m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System
Significant Woodlands	5	No woodlots impacted	5	No woodlots impacted
Areas of Natural & Significant Interest (ANSI)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)
Species at Risk/Habitat Area	5	No potential habitat areas are at risk	5	No potential habitat areas are at risk
Floodplain	5	No floodplain area is crossed	1	Impacts stream order #3; riparian buffer 60 m (i.e. 30m on both side of creek); minimal length of culvert and amount of fill into valley/floodplain to mitigate for impacts; mitigation considered includes alternative slope stabilization methods (i.e. retaining walls) to narrow grading limit
Socio-Economic Environment				
Aesthetics	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network
Property Impacts	3	Medium density residential development will be impacted by this alignment	4	No developable land will be impacted; minor impacts to development blocks
Policy Compliance	5	Meets planning objectives	5	Meets planning objectives
Existing and Proposed Land Uses	4	Alignment properly services existing and proposed land uses; with the exception of a small portion near Columbus Road	5	Alignment properly services existing and proposed land uses
Noise Impact	2	Two existing residential receptors impacted; there is a predicted noise increase of 5 dBA; mitigation will be required. Connection to local road (Wycombe Road as with B-1) may lead to increase in traffic noise on existing road south of Columbus Road.	3	Two receptors impacted; there is a predicted noise increase of 5 dBA; mitigation will be required. From noise impact perspective, prefer to connect traffic to Type C arterial road (Cachet Boulevard).
Cultural Environment				
Impact to Cultural Heritage Landscapes	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns
Built Heritage Resources	4	Indirect impacts to farmstead due to introduction of new infrastructure	4	Indirect impacts to farmstead due to introduction to new infrastructure
Archaeological Resources	4	Majority of the alignment has been assessed; portion of alignment requires Stage 2 Archaeological Assessment	4	Majority of the alignment has been assessed; portion of alignment requires Stage 2 Archaeological Assessment
Constructability				
Engineering Feasibility and Construction Cost	3	Estimated cost $8.2 million; construction can be phased; will be determined through the draft plan process	3	Estimated cost $8.7 million; construction can be phased; will be determined through the draft plan process
Existing Municipal Infrastructure and Utilities	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process
Capital	3	Although roadway length is similar to B-2, capital costs are estimated to be lower than B-2 as no watercourse crossing is required	2	Capital costs are estimated to higher since there will be a watercourse crossing required at Columbus Road East
Property Acquisition	3	Minimal additional property will be needed	3	Minimal additional property will be needed
Operating Costs	3	Moderate operating costs	3	Moderate operating costs
Maintenance Costs	3	Low-moderate maintenance costs	2	Moderate maintenance costs due to bridge across the floodplain
Overall	**102**	**B-1 is the preliminary preferred alternative north of Street C**	**110**	**B-2 is the preliminary preferred alternative south of Street C**

Table 6-4: Evaluation of Street C Alignment Alternatives

Legend:

5	4	3	2	1

Most Preferred / Least Impacts → **Least Preferred / Greatest Impacts**

Evaluation Criteria	Street C-1		Street C-2		Street C-3	
						
Transportation						
Road Safety	5	The alternative is designed to meet the road safety principles and Vision Zero objectives	5	The alternative is designed to meet the road safety principles and Vision Zero objectives	5	The alternative is designed to meet the road safety principles and Vision Zero objectives
Transit Serviceability	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated
Potential to Support Active Transportation Modes	5	Active transportation is incorporated into the roadway design	5	Active transportation is incorporated into the roadway design	5	Active transportation is incorporated into the roadway design
Road Capacity	5	The alternative provides sufficient road capacity to meet the projected traffic needs	5	The alternative provides sufficient road capacity to meet the projected traffic needs	5	The alternative provides sufficient road capacity to meet the projected traffic needs
Design Standard Compliance	5	Complies with Town and Regional design standards	5	Complies with Town and Regional design standards	5	Complies with Town and Regional design standards
Community Connectivity	5	Alternative provides connection to designated future land uses	5	Alternative provides connection to designated future land uses	5	Alternative provides connection to designated future land uses
Develop/Promote High Quality and Sustainable Public Realm	5	Route provides sufficient ROW to including active transportation	5	Route provides sufficient ROW to including active transportation	5	Route provides sufficient ROW to include active transportation
Natural Environment						
Fish/Fish Habitat	1	Crosses 11m of Redside Dace habitat	1	Crosses 14m of Redside Dace habitat	1	Crosses 11m of Redside Dace habitat
Wetlands	1	Bisecting 341m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System	1	Bisects 317m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System	2	Bisects 260m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System
Significant Woodlands	1	Crosses 397m of woodlots	1	Crosses 415m of woodlots	1	Crosses 444m of woodlots

Areas of Natural & Significant Interest (ANSI)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)
Species at Risk/Habitat Area	3	Habitat areas are at risk for Bobolink and Redside Dace; mitigation measures involve using ecological data combined with engineering design for permanent mitigation (crossing fences and structures)	3	Habitat areas are at risk for Bobolink and Redside Dace; mitigation measures involve using ecological data combined with engineering design for permanent mitigation (crossing fences and structures)	3	Habitat areas for Bobolink and Redside Dace are at risk; mitigation measures involve using ecological data combined with engineering design for permanent mitigation (crossing fences and structures)
Floodplain[4]	1	Impacts stream orders 1, 2 and 3; riparian buffer meander belt + 30m	1	Impacts stream orders 1, 2 and 3; riparian buffer meander belt + 30m	1	Impacts stream orders 1, 2 and 3; riparian buffer meander belt + 30m
Socio-Economic Environment						
Aesthetics	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network
Property Impacts	1	Major impact on developable property by this alignment, including a secondary school and commercial and residential land uses	1	Major impact on developable property by this alignment, including medium density and low density residential development	5	No impact on developable property by this alignment
Policy Compliance	5	Meets planning objectives	5	Meets planning objectives	5	Meets planning objectives
Existing and Proposed Land Use	5	Alignment services proposed land uses	5	Alignment services proposed land uses	5	Alignment services proposed land uses
Noise Impact	2	Two receptors impacted; there is a predicted noise increase of 5 dBA; mitigation will be required	2	Two receptors impacted; there is a predicted noise increase of 5 dBA; mitigation will be required	2	Two receptors impacted; there is a predicted noise increase of 5 dBA; mitigation will be required
Cultural Environment						
Impact to Cultural Heritage Landscapes	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns
Built Heritage Resources	5	No direct impacts to built heritage features are anticipated	5	No direct impacts to built heritage features are anticipated	5	No direct impacts to built heritage features are anticipated
Archaeological Resources	3	Half of the alignment has been assessed; portion of the alignment requires Stage 2 Archaeological Assessment	3	Half of the alignment has been assessed; portion of the alignment requires Stage 2 Archaeological Assessment	3	Half of the alignment has been assessed; portion of the alignment requires Stage 2 Archaeological Assessment
Constructability						
Engineering Feasibility and Construction Cost	3	Estimated cost $16.9 million; construction can be phased; will be determined through the draft plan process	3	Estimated cost $16.9 million; construction can be phased; will be determined through the draft plan process	3	Estimated cost $16.9 million; construction can be phased; will be determined through the draft plan process

[4] Minimal length of structure and amount of fill into valley/floodplain to mitigate for impacts; minimize culvert size to accommodate wildlife passage; mitigation considered includes alternative slope stabilization methods (i.e. retaining walls) to narrow grading limit

Existing Municipal Infrastructure and Utilities	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process
Capital	3	Moderate capital costs	3	Moderate capital costs	3	Moderate capital costs
Property Acquisition	3	Minimal additional property will be needed	3	Minimal additional property will be needed	3	Minimal additional property will be needed
Operating Costs	3	Moderate operating costs	3	Moderate operating costs	3	Moderate operating costs
Maintenance Costs	3	Moderate maintenance costs	3	Moderate maintenance costs	3	Moderate maintenance costs
Overall	**95**		**95**		**100**	**C-3 is the preliminary preferred alternative[5]**

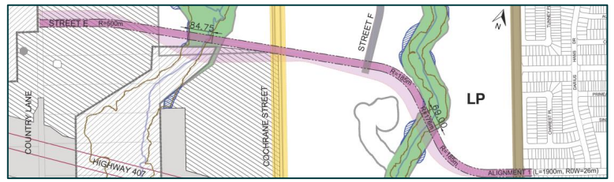
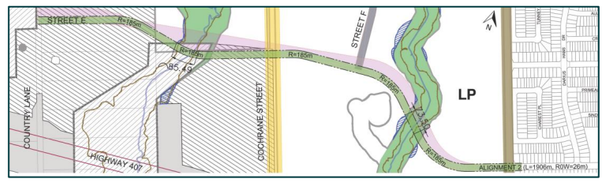
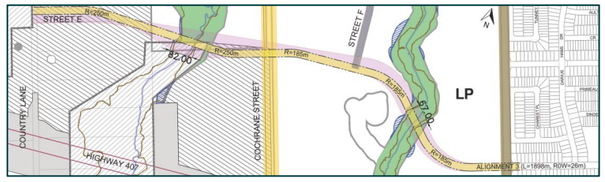
[5] After public consultation and stakeholder feedback, additional field investigations along the Street C corridor was required and conducted in September 2020. The new information resulted in minor refinements to the preliminary preferred alternative (C-3), which is presented in the recommended design.

Table 6-5: Evaluation of Street E Alignment Alternatives

Legend:

5	4	3	2	1

Most Preferred / Least Impacts → **Least Preferred / Greatest Impacts**

Evaluation Criteria	Street E-1		Street E-2		Street E-3	
						
Transportation						
Road Safety	4	The alternative meets the majority of Vision Zero objectives and road safety principles but maintains a skewed alignment at Cochrane Street, which is less preferred	5	The alternative is designed to meet the road safety principles and Vision Zero objectives	5	The alternative is designed to meet the road safety principles and Vision Zero objectives
Transit Serviceability	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS. can be accommodated	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS can be accommodated
Potential to Support Active Transportation Modes	5	Active transportation is incorporated into the roadway design	5	Active transportation is incorporated into the roadway design	5	Active transportation is incorporated into the roadway design
Road Capacity	5	The alternative provides sufficient road capacity to meet the projected traffic needs	5	The alternative provides sufficient road capacity to meet the projected traffic needs	5	The alternative provides sufficient road capacity to meet the projected traffic needs
Design Standard Compliance	5	Complies with Town and Regional design standards	5	Complies with Town and Regional design standards	5	Complies with Town and Regional design standards
Community Connectivity	5	Alternative provides connection to designated future land uses	5	Alternative provides connection to designated future land uses	5	Alternative provides connection to designated future land uses
Develop/Promote High Quality and Sustainable Public Realm	5	Route provides sufficient ROW to include active transportation	5	Route provides sufficient ROW to include active transportation	5	Route provides sufficient ROW to include active transportation
Natural Environment						
Fish/Fish Habitat	1	Crosses 19m of Redside Dace habitat	1	Crosses 17m of Redside Dace habitat	1	Crosses 11m of Redside Dace habitat
Wetlands	4	Bisects 85m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System	3	Bisects 123m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System	4	Bisects 63m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System

Evaluation Criteria	Street E-1		Street E-2		Street E-3	
Significant Woodlands	5	No impacts to woodlots	4	Crosses 44m of woodlots	5	No impacts to woodlots
Areas of Natural & Significant Interest (ANSI)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)
Species at Risk/Habitat Area	3	Habitat areas are at risk for Redside Dace	3	Habitat areas for Redside Dace are at risk	3	Habitat areas for Redside Dace are at risk
Floodplain[6]	2	Impacts stream orders 2 and 3; riparian buffer meander belt + 30m	2	Impacts stream orders 2 and 3; riparian buffer meander belt + 30m	2	Impacts stream orders 2 and 3; riparian buffer meander belt + 30m
Socio-Economic Environment						
Aesthetics	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network
Property Impacts	4	Minor impact on developable property by this alignment	4	Minor impact on developable property by this alignment	4	Minor impact on developable property by this alignment
Policy Compliance	5	Meets planning objectives	5	Meets planning objectives	5	Meets planning objectives
Existing and Proposed Land Uses	5	Alignment services all proposed land uses	5	Alignment services all proposed land uses	5	Alignment services all proposed land uses
Noise Impact	5	No receptors are impacted	5	No receptors are impacted	5	No receptors are impacted
Cultural Environment						
Impact to Cultural Heritage Landscapes	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns	4	Indirect impacts due to the removal of heritage attributes. such as tree lines, hedgerows, and field patterns	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns
Built Heritage Resources	5	No direct impacts to built heritage features are anticipated	5	No direct impacts to built heritage features are anticipated	5	No direct impacts to built heritage features are anticipated
Archaeological Resources	4	Majority of the alignment has been assessed; small portion requires Stage 2 Archaeological Assessment	4	Majority of the alignment has been assessed; small portion requires Stage 2 Archaeological Assessment	4	Majority of alignment has been assessed: small portion requires Stage 2 Archaeological Assessment
Constructability						
Engineering Feasibility and Construction Cost	3	Estimated cost $7.8 million; construction can be phased; will be determined through the draft plan process	3	Estimated cost $7.8 million; construction can be phased; will be determined through the draft plan process	3	Estimated cost $7.8 million; construction can be phased; will be determined through the draft plan process
Existing Municipal Infrastructure and Utilities	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process
Capital	2	High capital costs due to length of crossing required	2	High capital costs due to length of crossing required	3	Moderate capital costs

[6] Minimal length of structure and amount of fill into valley/floodplain; minimal impacts to naturalized areas within meander belt width plus 30m; mitigation measures include alternative slope stabilization methods (i.e. retaining walls) to narrow grading limit

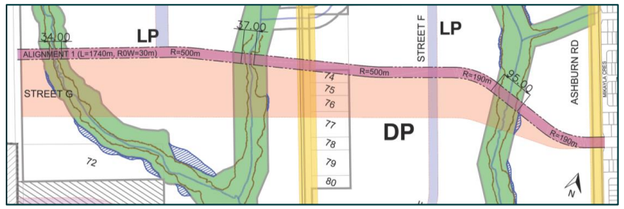
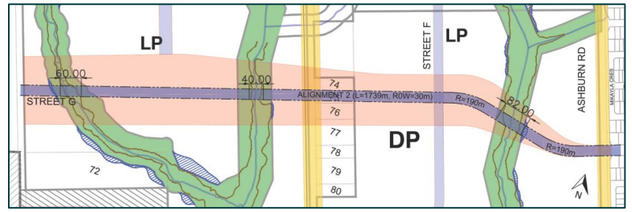
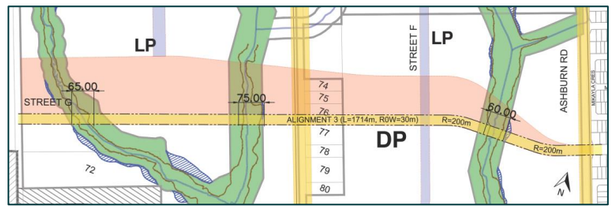
Evaluation Criteria	Street E-1		Street E-2		Street E-3	
Property Acquisition	2	Encroaches on stormwater pond and future elementary school site	2	Clips two future elementary school sites	5	No additional property will be required
Operating Costs	3	Moderate operating costs	3	Moderate operating costs	3	Moderate operating costs
Maintenance Costs	3	Moderate maintenance costs	3	Moderate maintenance costs	3	Moderate maintenance costs
Overall	**107**		**106**		**112**	**E-3 is the preliminary preferred alternative**

Table 6-6: Evaluation of Street G Alignment Alternatives

Legend:

5	4	3	2	1

Most Preferred / Least Impacts → **Least Preferred / Greatest Impacts**

Evaluation Criteria	Street G-1		Street G-2		Street G-3	
					
Transportation						
Road Safety	4	The alternative meets the majority of Vision Zero objectives and road safety principles but maintains a skewed alignment at Cochrane Street, which is less preferred	5	The alternative is designed to meet the road safety principles and Vision Zero objectives	5	The alternative is designed to meet the road safety principles and Vision Zero objectives
Transit Serviceability	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated	5	All types of alternative modes of transportation, including transit/automated vehicles or MaaS, can be accommodated
Potential to Support Active Transportation Modes	5	Active transportation is incorporated into the roadway design	5	Active transportation is incorporated into the roadway design	5	Active transportation is incorporated into the roadway design
Road Capacity	5	The alternative provides sufficient road capacity to meet the projected traffic needs	5	The alternative provides sufficient road capacity to meet the projected traffic needs	5	The alternative provides sufficient road capacity to meet the projected traffic needs
Design Standard Compliance	5	Complies with Town and Regional design standards	5	Complies with Town and Regional design standards	5	Complies with Town and Regional design standards
Community Connectivity	5	Alternative provides connection to designated future land uses	5	Alternative provides connection to designated future land uses	5	Alternative provides connection to designated future land uses
Develop/Promote High Quality and Sustainable Public Realm	5	Route provides sufficient ROW to include active transportation	5	Route provides sufficient ROW to include active transportation	5	Route provides sufficient ROW to include active transportation
Natural Environment						
Fish/Fish Habitat	1	Crosses 11m of Redside Dace habitat	1	Crosses 10m of Redside Dace habitat	1	Crosses 11m of Redside Dace habitat
Wetlands	3	Bisects 103m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System	3	Bisects 156m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System	2	Bisects 194m of wetlands, which were not formally evaluated per Ontario Wetland Evaluation System
Significant Woodlands	4	Crosses 15m of woodlots	4	Crosses 36m of woodlots	3	Crosses 85m of woodlots

Evaluation Criteria	Street G-1		Street G-2		Street G-3	
Areas of Natural & Significant Interest (ANSI)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)	5	No identified ANSIs in the study area (Brooklin Secondary Plan Area NHA report)
Species at Risk/Habitat Area	3	Habitat area for Bobolink and Redside Dace are at risk	3	Habitat area for Bobolink and Redside Dace are at risk	3	Habitat area for Bobolink and Redside Dace are at risk
Floodplain[7]	3	Impacts stream order 2; riparian buffer 30m; minimal length of structure and amount of fill into valley/floodplain	3	Impacts stream order 2; riparian buffer 30m; minimal length of structure and amount of fill into valley/floodplain	3	Impacts stream order 2; riparian buffer 30m; minimal length of structure and amount of fill into valley/floodplain
Socio-Economic Environment						
Aesthetics	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network	5	Adheres to the Brooklin Urban Design and Sustainability Development Guidelines by providing a balanced multi-modal transportation network
Property Impacts	4	Minor impact on developable property by this alignment	1	Major impact on developable property by this alignment, including bisecting two schools	5	No developable property is impacted by this alignment
Policy Compliance	5	Meets planning objectives	5	Meets planning objectives	5	Meets planning objectives
Existing/Proposed Land Uses	5	Alignment services all proposed land uses	5	Alignment services all proposed land uses	5	Alignment services all proposed land uses
Noise Impact	3	One receptor impacted; there is a predicted noise increase of 5 dBA; mitigation is required	3	One receptor impacted; there is a predicted noise increase of 5 dBA; mitigation is required	3	One receptor impacted; there is a predicted noise increase of 5 dBA; mitigation is required
Cultural Environment						
Impact to Cultural Heritage Landscapes	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns	4	Indirect impacts due to the removal of heritage attributes, such as tree lines, hedgerows, and field patterns
Built Heritage Resources	5	No direct impact to built heritage features are anticipated	5	No direct impact to built heritage features are anticipated	5	No direct impact to built heritage features are anticipated
Archaeological Resources	4	Majority of the alignment has been assessed; small portion requires Stage 2 Archaeological Assessment	4	Majority of the alignment has been assessed; small portion requires Stage 2 Archaeological Assessment	4	Majority of the alignment has been assessed; small portion requires Stage 2 Archaeological Assessment
Constructability						
Engineering Feasibility and Construction Cost	3	Estimated cost $7.6 million; construction can be phased; will be determined through the draft plan process	3	Estimated cost $7.5 million; construction can be phased; will be determined through the draft plan process	3	Estimated cost $7.5 million; construction can be phased; will be determined through the draft plan process
Existing Municipal Infrastructure and Utilities	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process	3	Some conflicts are predicted; will be considered during the Draft Plan review/approval process
Capital	3	Moderate capital costs	3	Moderate capital costs	3	Moderate capital costs

[7] Minimal impacts to naturalized areas within meander belt width plus 30m; mitigation measures includes alternative slope stabilization methods (i.e. retaining walls) to narrow grading limit

Evaluation Criteria	Street G-1		Street G-2		Street G-3	
Property Acquisition	1	Less property available for development; encroaches on low and medium density residential property and future elementary school	1	Less property available for development; encroaches on low and medium density residential property and future elementary school	5	No additional property will be required; no impacts to future property
Operating Costs	3	Moderate operating costs	3	Moderate operating costs	3	Moderate operating costs
Maintenance Costs	3	Moderate maintenance costs	3	Moderate maintenance costs	3	Moderate maintenance costs
Overall	**104**		**102**		**108**	**G-3 is the preliminary preferred alternative**

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Table 6-7: Summary of Evaluation

Alternative	Summary of Evaluation
Street B Alternatives	
Street B-1	• Meets road safety principles, provides sufficient ROW, and has minimal environmental impacts where possible • Does not provide continuous north-south connection or provide for community connectivity
Street B-2	• Provides sufficient road capacity to meet projected traffic needs • Similar socioeconomic, and cultural impacts as Street B-1 • Higher environmental impacts than Street B-1 because of the potential impact associated with the bridge crossing over the natural heritage corridor • Provides continuous north-south connection all the way to Winchester Road, allowing for more efficient community connectivity • Projected to be costlier than Street B-1 due to the need to construct bridge
Street C Alternatives	
Street C-1	• Similar impacts as other two Street C alternatives (i.e. provides sufficient road capacity to meet projected traffic needs, impacts to natural environment and cultural heritage) • Impacts developable property, including a secondary school and commercial and residential land uses
Street C-2	• Similar impacts as other two Street C alternatives ((refer to Street C-1 summary) • Impacts developable property, including low and medium density residential
Street C-3	• Similar impacts as other two Street C alternatives (refer to Street C-1 summary) • Less hazard lands located along the alignment and therefore less impacts to natural environment • Does not impact any developable property along the alignment
Street E (Extension of Vipond Road) Alternatives	
Street E-1	• Meets majority of Vision Zero objectives and road safety principles but maintains skewed alignment at Cochrane Street, which is less preferred • Bisects 85m of wetlands and 19m of Redside Dace habitat
Street E-2	• Minor property impacts, including encroaching on two future elementary schools • Bisects 123m of wetlands, which represents the most significant impact on wetlands out of the Street E alternatives • Impacts 44m of woodlots, while the other two Street E alignments do not impact any woodlots
Street E-3	• Least amount of environmental impacts (to Redside Dace habitat and wetlands) out of the Street E alternatives • No additional property will be required
Street G (Extension of Carnwith Drive) Alternatives	
Street G-1	• Meets majority of Vision Zero objectives and road safety principles but maintains skewed alignment at Cochrane Street, which is less preferred • Bisects the least amount of wetlands out of the Street G alternatives • Encroaches on low and medium density residential property and a future elementary school
Street G-2	• Supports all modes of transportation • Bisects 156m of wetlands and crosses 36m of woodlots

Alternative	Summary of Evaluation
	• Most impact to developable property out of the Street G alternatives, including the bisection two elementary schools
Street G-3	• Provides sufficient road capacity to meet the projected traffic needs • Minimizes impact on ESAs and has the least impact to hazard lands throughout study area out of the Street G alternatives • No impact to developable property

6.3 Selection of the Preliminary Preferred Alternative

The alternative alignments for Street B, C, E (Extension of Vipond Road), and G (Extension of Carnwith Drive) were evaluated based on the five criteria described in **Table 6-1** . The evaluation was conducted using a scale of 1 to 5, with 1 being the least preferred and 5 being the most preferred given the measure of each criterion. The evaluation of each alignment was conducted to minimize impacts to the natural environment and to developable property, while providing well designed, safe connections to future residential and commercial lands.

The evaluation identified B-1/B-2, C-3[5], E-3, and G-3 as the preliminary preferred alternatives for the collector road alternatives under consideration. These alignments provided the least amount of impact to the natural, cultural, and socio-economic environments, while providing the most efficient connections to development lands in the future community of Brooklin North. A summary of the selection of the preliminary preferred alternatives is provided in **Table 6-8**.

As discussed in **Section 5.1.2**, for the remaining collector roads (Street A, D, and F), the base alignments proposed in the Brooklin Study and CBP were deemed to be the preferred as they met the design criteria and constraints of the study area. It is noted that adjustments to the ultimately preferred alignments and preliminary designs may be considered in response to changes in development plans or in consideration of more detailed field investigations during the Draft Plan review/approval process. **Section 9** of this ESR identifies those elements of the design that may be adjusted during the Draft Plan review/approval process.

Table 6-8: Summary of the Selection of the Preliminary Preferred Alternative

Preliminary Preferred Alternative	Summary of Selection
Street B-1 (north of Street C) and Street B-2 (south of Street C)	• Similar impacts between alternatives, except for natural environment • Street B-2 impacts wetland and floodplain areas due to its connection to Cachet Boulevard (Type C arterial connecting to Winchester Road) to provide a continuous north-south link vital to community • Proposed crossing of natural heritage feature north of Columbus Road may require creek realignment, which would be subject to CLOCA and DFO permits • Alternative options that include intersections further east would be required to have right-in/right-out configurations at Columbus Road
Street C-3	• Constraints: create separation from nearest intersection (Columbus Road), create a minimum 45-degree angle when crossing the TransCanada Pipeline, and minimize crossing distance and impact on ESAs • Street C-3 has least impact out of Street C alternatives on natural features and hazard lands through the study area

Preliminary Preferred Alternative	Summary of Selection
	• Street C-3 alignment maintains required 45-degree tangent through the TransCanada Pipeline and a straight tangent through floodplain and creek meander, reducing structural difficulty in crossing this corridor • Street C-3's impact on floodplain and creek meander slightly longer than other Street C alternatives due to crossing structure
Street E-3 (Extension of Vipond Road)	• Constraints: create separation from nearest intersections (Columbus Road and Street G), and minimize crossing distance and impact on ESAs • Street E-3 has the smallest footprint within ESAs and reduced crossing distances out of Street E alternatives • Intersection alignment for Street E-3 preferred out of the Street E alternatives (i.e. closest to 90-degree angle at Country Lane, Cochrane Street and Ashburn Road)
Street G-3 (Extension of Carnwith Drive)	• Constraints: create separation from nearest intersections (Vipond Road), and minimize crossing distance and impact on ESAs • Street G-3 has the least impact to natural areas and hazard lands than the other two Street G alternatives • Street E-3 maintains preferred intersection alignment at Country Lane, Cochrane Street, and Ashburn Road

6.4 Feedback from the Community Open House

As discussed in **Section 2**, members of the public have provided feedback on the design of the proposed roadways, and in turn the study team has taken the following feedback and modified or revised the design of the roadway as a result of this feedback. **Table 6-9** provides the comment(s) made by the public and the study team's responses.

Table 6-9: Feedback from Community Open House

Public Comment	Study Team Responses
Avoid the natural heritage features along Street B. Line up Street B with Wycombe to create a legible intersection. The adjustment will have the benefit of slowing through traffic by requiring drivers to turn corners to navigate fully north and south.	The intersection of Street B and Columbus Road was reviewed in detail as part of this BNMREA. This included: • Reviewing previous public and agency commentary on the intersection as part of the Brooklin TMP, in which the alignment with Cachet Boulevard was preferred to create a preferred signalized intersection spacing along Columbus Road • Alignment of Street B with Wycombe Street would have resulted in an increased level of traffic along the local roads south of Columbus Road • The environmental conditions were also reviewed and noted that the watercourse was not noted to be a habitat, or contributing habitat, for Species at Risk. The area surrounding the watercourse is defined as a cultural meadow and is not considered a significant ecological community.

Public Comment	Study Team Responses
	Based on the above, the intersection alignment of Street B and Cachet Boulevard was recommended to be maintained. Later during the study, CLOCA provided the following additional information to the Project Team: The fish community downstream of the subject area includes sensitive coldwater species such as Rainbow Trout (OC05). Young-of-the-year Rainbow Trout have been captured in this tributary during CLOCA sampling in 2007, 2012 and 2017. This indicates that this tributary provides important habitat for various life stages including (but not limited to) nursery and rearing. Where the subject tributary joins the Oshawa Creek at the Winchester Golf Course, migratory adult Rainbow Trout and Pacific Salmon have been observed annually during the respective spring and fall spawning runs. During the summer of 2010 as part of the development process, approximately 140 m of creek channel immediately downstream/south of Columbus Road East was re-aligned through natural channel design. This re-alignment addressed erosion problems along with removing fish passage issues (e.g., piping/tile drains) both of which were created through historical agricultural practices. Given that there are no barriers downstream, this watercourse would be better described currently as seasonal direct fish habitat.
The below comments are paraphrased: • Alignment of Street C does not match the alignment that was presented in the TMP and the need for Street C does not appear to be justified. The crossing of the Greenbelt and alignment of the road to the east are both too far north. The crossing is in an area that is full of wildlife that will be disrupted. Has the study team completed any on-site investigations of the crossing or just desktop reviews? Further, the development plans to the east of the Greenbelt would be disrupted by this proposal. • Generally, comments received through these processes are ignored, but if the study team would like a tour of the area one can be arranged. Other information that is	The need for Street C was identified as part of the Brooklin Study. • Based on feedback received from stakeholders, additional field investigations were conducted in September 2020 (further discussed in **Section 7.1.4**). • The alignment of Street C has been revised to reflect the additional field investigations and stakeholder discussions with the TransCanada Pipelines. The intent is for Street C to cross the Greenbelt at the location where the Greenbelt has been previously disturbed by the pipeline. • For the purposes of the BNMREA, the study team has utilized digital terrain mapping that was developed for the study area. It is acknowledged that through the Draft Plan review/approval process a detailed topographic survey would be required.

Public Comment	Study Team Responses
available includes a 0.5m topographic survey.	
Alignment of Street C differs from the alignment of the mid-block collector road proposed in the Brooklin North CBP.	The arterial and collector roads are generally in the locations shown in the Brooklin Secondary Plan. The CBP further states that the new/expanded roads in the BNMREA may result in further revisions without the need for revision to the CBP.
Columbus Road west of Baldwin Street: I believe that the bridge on Columbus will need to be replaced. Columbus Road West is used heavily by those coming into Brooklin from the west. Vehicles are moving at high speeds along this road currently. There is a lot of pedestrian traffic along this road (walking), along with cyclists. Can there be a dedicated bike lane installed or sidewalk?	Columbus Road west of Baldwin Street is proposed to be widened and reconstructed as part of the BNMREA. It is proposed to include: • Two 3.5m travel lanes in each direction; • A 2m emerging technology lane on the south side; • A 2m in-boulevard cycling facility in each direction; and • A 3m multi-use path on the north side and a 2m sidewalk on the south side.

While all comments and suggestions cannot be accommodated due to technical incompatibility, or requests made that are outside of the scope of the BNMREA, the study team has taken into consideration all suggestions, comments and requests made by the public as part of the environmental assessment process, and as part of the design exercise undertaken for this BNMREA.

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7 Recommended Design

The preferred design concepts for the recommended transportation network in the Brooklin TMP evolved over the course of this BNMREA. The recommended design was ultimately selected based on a comparative evaluation process, public and stakeholder agency input, and extensive discussions by the study team and key stakeholders. This section describes the engineering features of the recommended design concepts for transportation network improvements in the study area. This includes alignments, cross-sections, watercourse crossings, intersection control measures, preliminary cost estimates, and anticipated implementation process. A full set of plan and profile drawings, has been included in **Appendix J,** with typical section drawings included in **Appendix K**. Note that these designs are preliminary and are planned to be flexible to accommodate to specific site conditions identified through the Draft Plan review/approval process, as discussed in **Section 9**.

As explained in **Section 5**, design concepts were produced only for select Schedule C projects identified in the Brooklin TMP recommendations (refer to **Figure 5-1**). The proposed roads, separated into the three functional road classifications applied in this BNMREA and numbered based on **Figure 5-1**, include:

- Type B arterial Roadway
  1. Columbus Road widening (between Country Lane and Garrard Road)
  2. Cochrane Street widening (between Winchester Road and Columbus Road)
  3. Protection for Ashburn Road widening (between Winchester Road and Brawley Road)
- Type C Arterial Roadway
  4. Street G (Extension of Carnwith Drive)
- Collector Roadway
  5. Street A (protection for extension between Street C and Brawley Road)
  6. Street B
  7. Street C
  8. Street D
  9. Street E (Extension of Vipond Road)
  10. Street F

7.1 Alignments

7.1.1 Horizontal Alignment

The recommended road alignments for each proposed road improvement is illustrated in **Figure 7-1** and described below.

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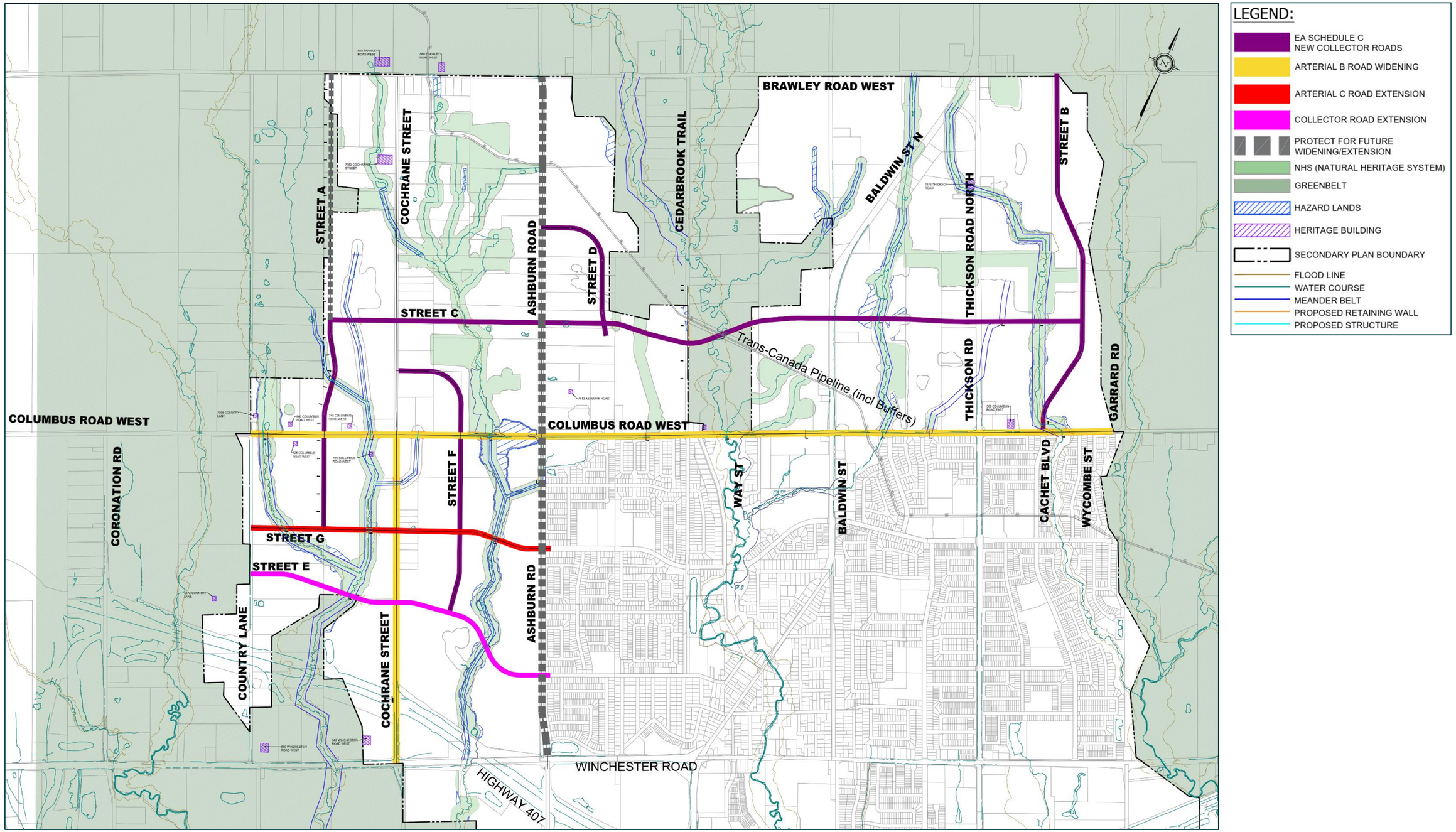
Figure 7-1: BNMREA Study Preferred Alignments of Proposed Road Improvements



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Columbus Road

Columbus Road between Country Lane and Garrard Road is proposed to be widened to a 36 m arterial road ROW with the existing alignment. West of Ashburn Road, the widening is planned to generally be balanced between the north and south sides. East of Ashburn Road, widening transitions to be solely to the north of the existing ROW as there are property constraints on the south side with existing properties and parallel public ROW.

This portion of Columbus Road includes ten watercourse crossings. In addition, the TransCanada pipeline crosses underneath Columbus Road, just east of Baldwin Street.

Of note, the left turn lanes at Columbus Road and Thickson Road intersection were not fully designed to Regional Municipality of Durham's road design standards due to spacing constraints as described below (Please refer to Appendix J, Sheet 07 to 09):

- Due to space constraints, left-turn deceleration lengths were not applied for the eastbound and westbound approaches at Thickson road intersection. For the midblock segment approaching Thickson Road, two-way left turn lanes are introduced. At the Thickson Road and Columbus Road intersection, the eastbound left-turn lane's taper length is designed per Region standard and the westbound left turn lane's taper is designed per TAC standards.
- The eastbound left turn lane on Columbus Road at Thickson Road is shorter than the length specified in the Regional Municipality of Durham's road design standards (i.e. the deceleration length was not incorporated into the design). The left turn lane taper was designed per TAC standards to allow the inclusion of the westbound left turn lane taper at the Selkrik Drive and Columbus Road intersection
- The westbound left turn lane on Columbus Road at Thickson Road was designed to TAC standards and the tapers designed to TAC to accommodate the Cachet Boulevard turning lanes to the east. The left turn lane taper was designed per TAC standards

Cochrane Street

Cochrane Street between Winchester Road and Columbus Road is proposed to be widened to a 36 m arterial road ROW. This corridor was developed to match the existing road alignment, maintaining existing intersections and bridges. As both sides of Cochrane Street are subject to future development, the widening is proposed equally on either side. Note that this BNMREA does not include a design of an interchange between Cochrane Street and the Highway 407 but does not preclude for its potential inclusion and design through a separate study.

This portion of Cochrane Street contains one watercourse crossing south of Columbus Road West.

Ashburn Road

Ashburn Road between Winchester Road and Brawley Road is to be protected for widening to a 36 m arterial road ROW with interim conditions recommended as part of the BNMREA, which were developed to match the existing road alignment, maintaining existing intersections and bridges. Between Winchester Road and Columbus Road, the protection for widening is to the west of Ashburn Road in order to protect existing properties and ROWs. Between Columbus Road and Brawley Road, both sides of Ashburn Road are subject to future development, so the protection for widening is proposed equally on either side.

This portion of Ashburn Road has one watercourse crossing north of Street G. In addition, the TransCanada pipeline crosses underneath Ashburn Road north of Street D.

Street A

Street A is a proposed north-south collector road between Street G (Extension of Carnwith Drive) and Street C. The preferred alignment alternative for Street A extends north along the western edge of the study limit. A minor curve just north of Columbus Road allows Street A to avoid a natural heritage feature. The alignment supports the proposed CBP land uses. Between Street C and Brawley Road, Street A is recommended to be protected for future extension as the land is currently deferred and subject to further planning processes. As the development in the area is determined, the alignment of Street A can be confirmed. Currently, the alignment of Street A does not plan for, nor preclude, further extension to the north.

Street A would have one watercourse crossing north of Columbus Road.

Street B

Street B is a proposed north-south collector road between Columbus Road and Brawley Road. The recommended alignment is a combination of the B-1 (north of Street C) and B-2 (south of Street C) alternatives due to the following:

- The crossing of the natural heritage feature just north of Columbus Road allows for an extension of Cachet Boulevard, a Type C arterial road which connects to Winchester Road;
- The new crossing of the natural heritage feature shall be designed, constructed, and maintained so that wildlife corridors associated with these valleylands will be preserved and no new barriers to wildlife are created;
- Should the proposed crossing require a realignment of the creek, it would be feasible subject to CLOCA and DFO permits;
- Alternative options that include intersections further east would have resulted in undesirable outcomes from a transportation planning perspective, including increasing the traffic experienced by the local street (Wycombe Street) and resulting in a situation where the intersection of Street B and Columbus Road West would not be signalized; and
- The curve north of Street C would allow the road to avoid the identified natural feature.

Street B would have one water course crossing at Columbus Road.

Street C

Street C is a proposed east-west collector road between Street A and Street B. The Street C-3 alternative was selected as the preliminary preferred alignment because it would have the least impact to natural features and hazard lands through the study area. Minor refinements were made to the C-3 preliminary preferred alignment based on findings from the additional field investigations conducted in September 2020. The street has been designed to incorporate the minimum crossing angle of 45° with the TransCanada Pipeline and maintain a straight tangent through the floodplain and creek meander, reducing the structural difficulty in crossing the corridor.

Street C would have five watercourse crossings.

With respect to the structure crossing the Trans Canada Pipeline, the Street C (East-West Collector) was identified as “New and Unfinished Business” by Town Council on December 9, 2019 (Item MD – 4149):

> That the 2017 Brooklin Transportation Master Plan, as outlined in Report PW 35-17 and Attachment 1, be approved subject to the following amendments: **c. That staff report back on options for the east-west collector road crossing Cedarbrook Trail as an active transportation and transit route only**; and d. That staff investigate options for incorporating a dead-end at Cedarbrook Trail, north

and south of the new collector road, between Brawley and Columbus Roads and report back to Council with the findings.

The need for a continuous east-west collector road (from the west Secondary Plan Boundary to east of Thickson Road) running north of, and parallel to, Columbus Road was identified in the 2017 Brooklin TMP as a Schedule C project, the timing of which was dependent on development. As part of the scope of the BNMREA, Phase 1 and 2 of the Environmental Assessment process (Need and Justification and Alternatives) were revisited in consideration of update land use forecasts. This analysis confirmed the need for Street C as a continuous road, serving the initial and second phases of development. Eliminating the crossing of the greenbelt east of Cedarbrook Trail will, in the long-term, result in capacity constraints on Columbus Road between Cedarbrook Trail and Baldwin Street, as well as increased demands on Cedarbrook Trail between Street C and Columbus Road and the future north-south collector road east of the greenbelt and west of Baldwin Street. In addition, operational issues will arise in the long term at the intersections of Cedarbrook Trail and the north-south collector road with Columbus Road.

However, it is acknowledged that dependent on the pace of development and the growth in travel and depending on the timing of the future widening of Columbus Road, Street C could be phased in such a manner that the crossing of the greenbelt is the last section of the road to be implemented. Traffic conditions on Columbus Road and the north-south collectors should be monitored as development along the Street C corridor proceeds to identify any emerging issues or capacity constraints that would necessitate the construction of the crossing. Should the Street C connection through the Greenbelt be deferred to a later phase of development, an active mode / transit connection could be considered to connect the communities as an interim condition.

The detailed assessment and monitoring plan would be the subject of future studies. The recommendation of the BNMREA is that ultimately, to support development and to ensure the efficiency and safety of the Brooklin Transportation Network, the east-west collector road should be a continuous facility crossing the greenbelt. The preliminary designs and costing for this facility protect for this potential.

Of note, the Selkirk Drive extension roundabout will result in a sub-standard eastbound left-turn lane due to the spacing constraint between the Selkirk roundabout and the Street C and Thickson Road intersection. The eastbound left turn and right turn lane tapers are designed to the Regional Municipality of Durham's road design standards. While the Regional Municipality of Durham's road design standards for the left turn deceleration length could not be incorporated into the design due to spacing constraints, the left-turn deceleration lengths meet the TAC standards. Please refer to Appendix J, Sheet 37 to 38.

Street D

Street D is a proposed north-south collector road between Ashburn Road and Street C. The preferred alternative for Street D is aligned with that shown in the CBP. A minor adjustment was made at the north extension of Street D to provide a geometric curve consistent with the Town's design standards for collector roads.

Street E (Extension of Vipond Road)

Street E (Extension of Vipond Road) is a proposed east-west collector road extension of Vipond Road between Ashburn Road and Country Lane. The Street E-3 alternative was selected as the preferred alignment due to the following:

- This alignment would have the smallest footprint within ESAs and reduced crossing distances; and

- The intersection alignments for this alternative are preferred as they are the closest to 90° angle at Country Lane, Cochrane Street, and Ashburn Road.

At the intersection of Country Lane, the Street E alignment was shifted approximately 30m north of the originally planned location to avoid a currently occupied residential property.

Street E (Extension of Vipond Road) would contain two watercourse crossings.

Street F

Street F is a proposed north-south collector road between Cochrane Street and Street E (Extension of Vipond Road). The preferred alignment of Street F in the Brooklin TMP and the CMP avoided the identified sensitive natural environment areas. No modifications were needed to the original corridor alignment, except for the curve at the north end of Street F, which was changed to comply with the Town's standards.

Street G (Extension of Carnwith Drive)

Street G (Extension of Carnwith Drive) is a proposed east-west arterial road extension of Carnwith Drive between Ashburn Road and Country Lane. The Street G-3 alternative was selected as the preferred alignment because it had the least impact to natural features and hazard lands through the study area. Also, this alignment maintains a preferred intersection alignment at the intersections of Country Lane, Cochrane Street, and Ashburn Road.

Street G (Extension of Carnwith Drive) would contain three watercourse crossings.

7.1.2 Vertical Alignment (Cut-Fill Requirements)

The vertical alignments of the existing roads were designed to follow the existing profiles as closely as possible, while reconciling the need to maintain standard curvature and slopes as defined by the design criteria discussed in **Section 5.1.1**.

There are some locations within the study roads where the new profile significantly differs from existing conditions to satisfy design standards and ensure appropriate crossfall through existing and new intersections. The summary of total cut and fill for each of the roadways is identified in **Table 7-1**. Specific cut and fill details for each of the roadways are included in **Appendix J**.

Table 7-1: Vertical Alignment Cut-Fill Summary Table

Street	Cut (cubic metres)	Fill (cubic metres)
Columbus Road	11,013	99,441
Ashburn Road	40,192	57,329
Cochrane Street	17,348	23,402
Street A	10,031	19,433
Street B	56,856	12,779
Street C	173,724	219,612
Street D	9,217	11,405
Street E	9,521	112,215
Street F	39,833	3,886
Street G	27,959	77,118
Total	**395,693**	**636,619**

7.1.3 Intersection of Street B with Columbus Road

The intersection of Street B and Columbus Road was identified through the evaluation of the alternative design concepts to be preferred to align with the existing intersection of Cachet Boulevard and Columbus Road. As noted in **Section 6.3**, the intersection aligning with Cachet Boulevard was preferred based on network connectivity of the collector and arterial road network and reducing impacts to existing local roadways. That said, it was recognized that in order to do so the alignment of Street B would need to traverse the adjacent Oshawa Creek. This impact was determined to be manageable as the Oshawa Creek is not currently a habitat to any Species at Risk, however, fish community downstream of the study area include sensitive coldwater species and given that there are no barriers downstream, this watercourse is considered seasonal direct fish habitat. This watercourse is identified as a Stream Order 3, which necessitated careful consideration of the proposed alternatives from a hydraulic design perspective. At the same time, the proximity of the intersection to the watercourse limited the available vertical clearance.

Based on the above constraints, the recommended design has been developed to meet the geometric design standards from the Town that incorporate a 1% crossfall from the centreline of Columbus Street E north before transitioning to a sag curve with a k-value of 13 to transition into a slope of 3%. At the watercourse, an arch culvert is being proposed that will have a width of 15m. A soffit elevation of 190.10 has been achieved, which provides a 0.24m clearance during the 50-year storm events. Although this does not meet the 0.3m required clearance based on MTO requirements the difference has been identified to be minor and manageable given the location and constraints. It should be noted that the elevation of the soffit is fixed due to the pre-cast nature of the culvert product proposed to be used and cannot be adjusted to accommodate the additional 0.06m clearance. It should be noted that bridge structures were also considered to be used for this implementation but due to the limitations in accommodating overtopping and the constraints imposed by the road geometry, the pre-cast culvert was the preferred option. Furthermore, through detailed design for this section of Street B, it is recommended that consideration be given to implementing a rigid pavement structure and incorporating a concrete base layer to reduce the final elevation of the roadway. Confirmation of pavement structure should be determined and recommend by a geotechnical engineer through the Draft Plan review/approval process. The Town's typical flexible pavement structure for this classification of roadway would have required a reduction in the crossfall of Columbus Road from 1% to 0.5%. As a result, in order to maintain the design consistency of the intersection the rigid pavement structure is recommended.

7.1.4 TransCanada Pipeline Crossing at Street C

The intersection of Street C and the TransCanada Pipeline occurs within the Greenbelt area of the study area, which is a major part of the ecological system for the BNMREA study area. As a result, how and where the crossing occurs was of particular importance. It was recognized that the presence of the pipeline has created an opportunity to locate the crossing where the ecological communities have been previously disturbed and ensure that any impact to vegetation would not be significant as it would represent edge conditions to broader system. That being said, it should be recognized that the pipeline is adjacent to a watercourse that was identified to be Redside Dace habitat, an endangered and protected species. To this end, the study team engaged TransCanada about the parameters required for the road to cross the pipeline. In response, the following items were identified:

- Minimum crossing angle of the street and pipeline is to be 45 degrees
- No infrastructure should be within a 7m buffer on either side of the pipeline ROW

- Should the pipeline be bridged sufficient clearance would be required to facilitate construction/maintenance activities

Cross-section details for Street C are included in **Section 7.2**.

Crossing Design

Considering the design parameters discussed with TransCanada, LEA developed several crossing options for the crossing between Street C and the pipeline. The first round included three alternative alignment options considered that included different crossing locations. The preferred alignment was determined based on the environmental assessment evaluation process including a consideration of the overall impact on ecological, socio-economical, historical environment as well as the overall feasibility. Additional field work was conducted in September 2020, after the preferred alignment was selected, to confirm the exact location of the watercourse and pipeline crossing. The second round of options included the consideration of 3 different structure types and 1 sub-option which was a derivative of one of the original structure types considered. Of the structural options developed, LEA short-listed two options which were presented and discussed with TransCanada on June 18, 2020. These options were short-listed based on their constructability, impact to the surrounding ecology, and cost. The options included:

- Bridge Spanning the Pipeline and Watercourse
  1. To clear the required buffers and existing floodplain, the structure would be over 170m in length
  2. Structure depth would be approximately 4-8m deep
  3. Would likely require a two-span structure with to help reduce structure depth
  4. Would result in minimal clearance below the structure to the existing ground elevation over the TransCanada Pipeline
- Bridge Spanning the Watercourse with Grading Over the Pipeline
  1. Structure would span from the edge of the floodplain to the 7.0m buffer east of the TransCanada pipeline ROW, approximately 77m
  2. Structure depth would be approximately 4m deep
  3. Would be a single-span structure
  4. Area over the TransCanada Pipeline ROW and adjacent buffers would be graded to tie into the bridge approach and proposed road elevation (3-6.5m of fill)

Based on the above options, it was concluded that a bridge with a 130m length and single-span spanning both the watercourse and pipeline would have the least impacts. Specifically, it would facilitate maintenance and construction requirements of the pipeline through typical construction methods as a 5m clearance would be maintained. No infrastructure, such as retaining or abutment walls, will be within 7m of the pipeline ROW, and met the minimum 45-degree crossing of the pipeline. From an ecological perspective, it crossed the Greenbelt at an area that was previously disturbed, the vegetation communities impacted are edge communities, and structural span would accommodate hydraulic flows of the watercourse with minimal changes to the overall flow and floodplain.

Future Commitments

Based on the study team's discussion with TransCanada on June 18, 2020, it was recognized that TransCanada would require a number of future commitments which will need to be undertaken during the Draft Plan review/approval process. Specifically, these include a reimbursable agreement between the party undertaking the construction and TransCanada Pipelines to allow for TransCanada to undertake the following:

- An engineering analysis of the crossing to determine if permanent protective measures may be required to carry the design loads and mitigate risks of the crossing;
- An inspection of the pipeline to provide additional required data for the final design solution
- The preliminary design and cost estimate; and
- Construction of the project to install the crossing solution.

It was also recommended that as part of the Draft Plan review/approval process that when a topographic survey is undertaken that the surveyor also coordinate with Ontario OneCall to confirm the location of the pipeline.

7.2 Cross-Sections

This section outlines how cross-sections were determined for both the arterial roads and the collector roads under consideration for this BNMREA. The process used to determine the framework of the recommended cross-sections for each of the corridors considered in the BNMREA is described below.

Step 1: Review of ROW with respect to Transportation, Operations and Maintenance

- Direct and frequent driveway access on current 20m and 23m ROW collectors not consistent with role and function of collector;
- On-street parking;
- Limited driveway apron;
- Sight distances (curvilinear alignments, side street intersections, and traffic control visibility);
- Minimal buffer separation in areas of high pedestrian activity and cycling;
- Transit and transit furniture (sight distance impedance); and
- Inconsistency in corridor widths and provisions.
- Snow storage;
- Tree health;
- Sidewalk and multi-use path maintenance;
- Conflicts;
- Trees and above/below ground utilities; and
- Above ground utilities with cross section elements.

Step 2: Review Objectives for Road Network

- Complete Streets principles to ensure streets are designed to be safe for everyone;
- Understand role and relationships of street with surrounding context (such as land use);
- Mobility versus access versus placemaking;
- Function of street with respect to each mode transportation; and
- Given transportation functions of street, features required to provide safe mobility for all users and whether available ROW allows for these features to be provided

Step 3: Road Classification and ROW Framework

- Determine function and role of roadway classifications considered for BNMREA, refined consultation with the Town in consideration of the Town and Regional guidelines

Step 4: Cross-Section Elements Design Criteria Framework

- Determine minimum and desired widths for the cross-section elements based on Town and Regional standards as well as municipal guidelines for engineering, landscaping, and maintenance requirements.

Step 5: Application of Classification, ROW and Design Elements Framework

- Section by section review of cross-section elements in consideration of the role and function, adjacent land use, mobility characteristics, roadway needs, and preferred design elements.

7.2.1 Road Classification and ROW Framework

Table 7-2 outlines the summary of the function and role of the roadway classifications being applied within Brooklin North. Based on the role and functions confirmed through consultation with the Town and Region, each of the subject roadways were reviewed to confirm a classification and develop a rationale for the preferred ROW. This is summarized in **Table 7-3** and illustrated in **Figure 7-2**.

Table 7-2: Summary of Function and Role of Road Classifications

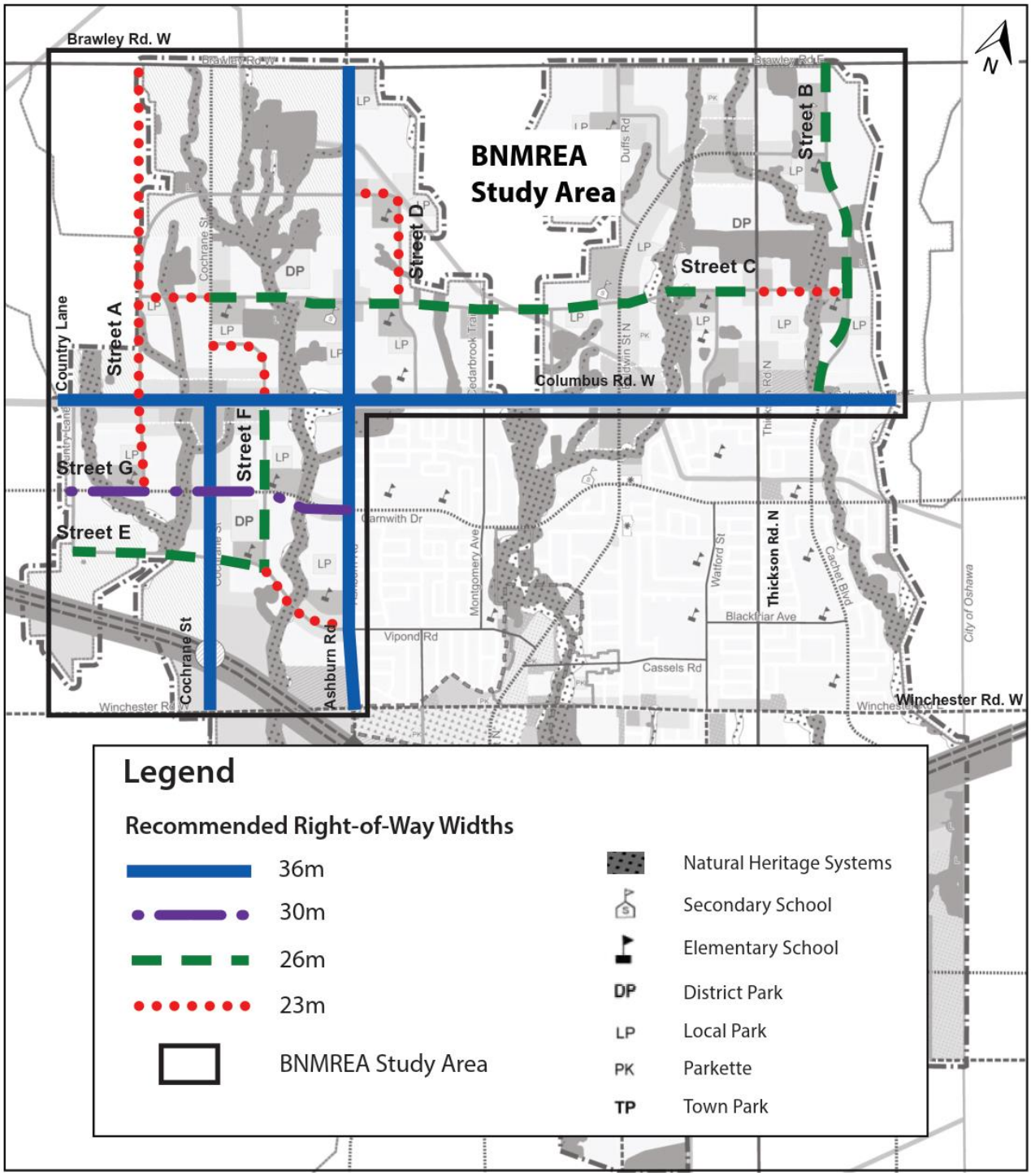
Criterion	Minor Collector	Major Collector	Type C Arterial	Type B Arterial
Source	Town of Whitby	Town of Whitby	Region of Durham	Region of Durham
ROW Width from Official Plan [m]	20 - 26	20 - 26	26 - 30	30 - 36
Recommended ROW Width [m]	23	26	30	36
Traffic Volumes [AADT]	3,500	3,500	4,000 - 20,000	5,000 - 40,000
Emerging Technology Potential	No	Yes	Yes	Yes
Desirable Connector	Locals, Collectors, Arterials	Locals, Collectors, Arterials	Collectors, Arterials	Collectors, Arterials
Transit Service	Limited	Yes	Yes	Yes
Accommodation for Cyclists	MUP on one side or on-street bike lanes	MUP and/or on-street bike lanes or cycle track	MUP and/or on-street bike lanes or cycle track	MUP and/or on-street bike lanes or cycle track
Accommodation for Pedestrians	Both sides (via MUP and/or sidewalks)	Both sides (via MUP and/or sidewalks)	Both sides (via MUP and/or sidewalks)	Both sides (via MUP and/or sidewalks)
Parking	One side of the street, if no street bike lanes	Some restrictions near schools and if on-street cycling is provided	Restrictions during peak hour and if on-street cycling is provided	Prohibited

Table 7-3: Rationale for Preferred Right-of-Way (ROW) Widths

Road	ROW	Rationale
Type B Arterial (30m - 36m ROW)		
Cochrane Street	36m	• Potential for interchange at Hwy 407; • Anticipated commuter corridor; • Connection to the Mid-Block Arterial and transit; • Industrial uses north of Hwy 407; and • Heavy vehicle route.
Ashburn Road	36m	• Potential for Active Transportation Corridor and Emerging Technology Corridor

Road	ROW	Rationale
		• Potential for transit (future connection to the Transitway, proximity/connection to MTO carpool lot) • Connection to Mid Block Arterial, Iroquois Trail, and Heber Down Conservation Area; and • Access to Recreation Complex and to Hospital/Health Precinct site.
Columbus Road	36m	• Transportation spine for North Brooklin with higher density uses (high density residential, mixed use, commercial); • Transit potential; • Potential roundabout corridor; and • Road for potential future road rationalization discussion between the Town and the Region – Schedule E, Table E7 of the Regional Official Plan (as amended by ROPA 171 in 2018) requires a 36m ROW for a 4-lane Type B Arterial.
Type C Arterial (26m – 30m ROW)		
Carnwith Drive	30m	• Major corridor connecting out of existing Brooklin residential to connect between Ashburn and Cochrane; • Transit potential; and • High vulnerable user activity with potential two schools on north side.
Collector Roads		
Residential / School Frontage, such as: Street B, Street C (Cochrane to Thickson), Street E (Extension of Vipond Road), and Street F (south of Columbus)	26m	• Higher vehicle activity (auto and larger vehicles, like school buses); • High level of vulnerable users (high pedestrian activity, children); • Increased side friction (direct driveway access, higher density development, smaller lot size); • Maintain safe sight lines for access, especially along curvilinear alignments; • Current residential collectors with 23m ROW problematic; • Need to learn from current visibility/sight line issues in residential areas that have required post construction mitigation (i.e. unwarranted stop control); and • 26m ROW allows for larger property setbacks.
Non-residential frontage such as: Street A, Street C (west of Cochrane and east of Thickson), Street D, and Street F (north of Columbus)	23m	• Consistent, relatively straight alignment; • Little side friction (direct driveway access limited, density of development low, larger lot size); and • Lower activity level (vehicle and non-auto).

Figure 7-2: Preferred Rights-of-Way for BNMREA



7.2.2 Cross-Section Elements Design Criteria Framework

After consultation with the study team and key stakeholders, the design criteria and guiding principles applied to the development of alternative cross-sections were determined. For all road types, the minimum and desired (and maximums when appropriate) widths for specific cross-section elements are outlined in **Table 7-4**. These widths are based on standards and guidelines from the Region, the Town (including the Landscape Plan Guidelines for Site Plan and Subdivision Developments to determine boulevard widths), the Transportation Association of Canada, Ontario Provincial Standard Drawings (OPSD), the Ontario Traffic Manual, and best practices considering various factors, including user safety.

Table 7-4: Design Criteria for Cross-Section Elements

Element	Minimum [m]	Desired [m]	Maximum [m]	Source
Pavement Width	8.50	-	-	Town of Whitby
Basic Travel Lane	3.50	3.50	4.25	Town of Whitby/Durham Region
On Street Parking	2.00	2.50	2.80	Town of Whitby
Emerging Technology Lane[8]	2.00	2.50	-	In consideration of Best Practices
Cycling Facility (lane or track)	1.50	1.80	-	Town of Whitby
Cycling Buffer to Travel/Parking Lane	0.50	1.00	-	Town of Whitby
Boulevard Width[9]	4.00	5.00	5.00	Town of Whitby
Curb and Gutter	0.50	-	-	OPSD 600.040
Sidewalk	1.50	2.00	-	Town of Whitby
MUP	3.00	4.00	-	Town of Whitby
Side Clearance	0.50	0.50 - 1.00	1.00	Town of Whitby

Utility locations were considered based on The Town's design standards with offset from the property line (Design Standard 400.10, October 2018).

[8] In the interim condition, prior to approval of a formal emerging technology lane program (specifying vehicle type and restrictions), it is intended for the emerging technology lane to be marked as a hazard area and signed accordingly.

[9] Within areas of sensitive natural features or constrained areas, such as at bridge and culvert structures, a reduced right-of-way will be applied, and the boulevards will be reduced to become a 1m buffer/snow storage space between the travel lanes and curb. If on-street parking is included in a cross-section, the on-street parking will be dropped through the constrained area.

7.2.3 Feedback on Cross-Sections

Preliminary cross-section options were shown during the public consultation online Community Open House and have since been refined to capture additional feedback from internal and external stakeholders. The incorporation of this feedback required additional cross-sections to be developed. Key public feedback included:

- Boulevard widths are to be maximized when possible to provide additional soil volume to ensure tree canopy health and viability. For both collector and arterial roadways, a boulevard of 5m is preferred.
- Cross-sections for arterial roads should include cycling facilities to encourage and facilitate cycling within the community.
- Adjacent to industrial and institutional/school land uses, it is expected and noted that higher vehicular volumes and heavy vehicle volumes are expected. A boulevard width of 5m is preferred in these locations to provide additional separation of active transportation uses from vehicles.
- The collector road cross-section option with emerging technology shown in the COH boards was modified to accommodate wider boulevard requirements.

7.2.4 Cross-Section Designs

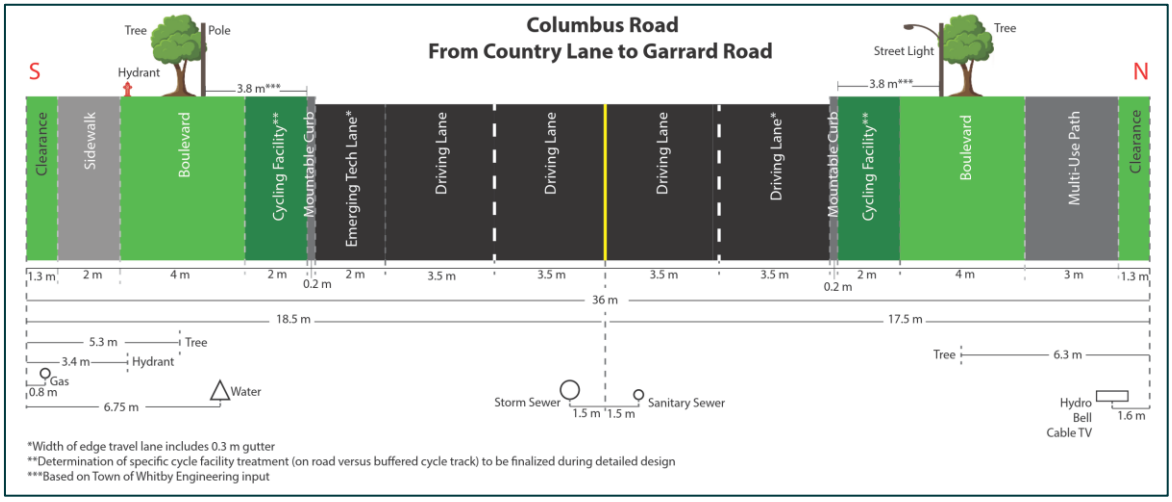
Given the proposed role and function of the arterial roads and new collector roads, cross-section types were finalized. The cross-section type(s) proposed for each corridor is outlined and illustrated in **Table 7-5**. Formal cross-section drawings are included in **Appendix K**. As the role of the roadways are dependent on the adjacent land use, forecasted traffic volumes and desired routes, the cross-section varies across the corridors.

Note that active transportation infrastructure was provided along each corridor based on the April 2019 version of the Town's Preliminary Draft Active Transportation Plan. It is acknowledged that an updated draft was developed in October 2020 that includes revised provisions for active transportation; however, there is the potential for this draft to be revised again before being finalized in 2021. Thus, any inconsistencies between the recommendations of this BNMREA and the Final Active Transportation Plan will be addressed during the Draft Plan review/approval process.

Table 7-5: Recommended Typical Cross-Sections Types for the BNMREA Roads

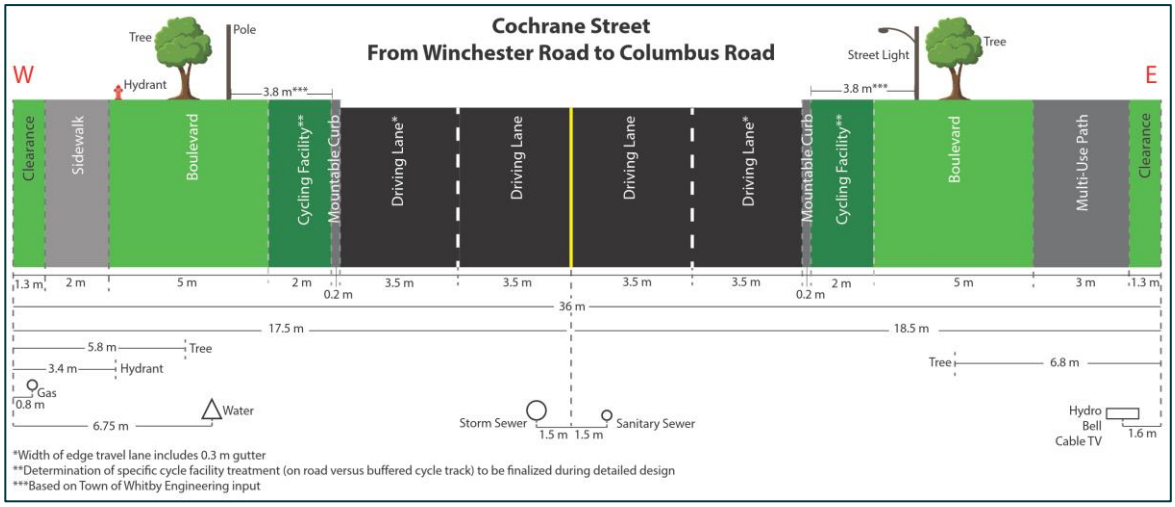
Columbus Road (Between Country Lane and Garrard Road):

- 36m wide right-of-way
- 2m wide sidewalk on south side and 3m wide multi-use path on north side
- 4m wide boulevards
- 2m wide cycling facility in each direction
- 2m emerging technology lane (eastbound)
- Two 3.5m wide driving lanes in either direction



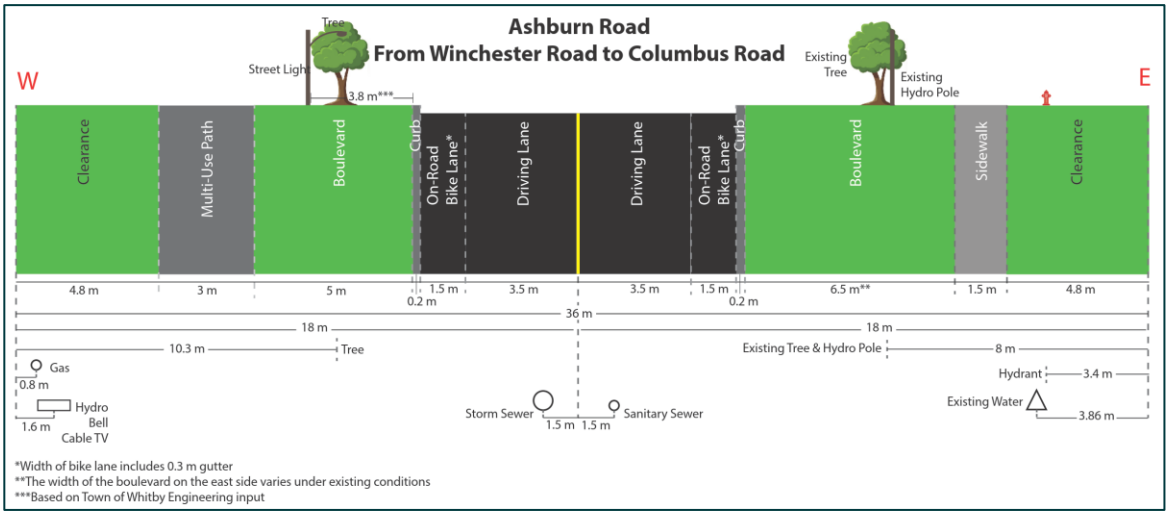
Cochrane Street (Between Winchester Road and Columbus Road):

- 36m wide right-of-way
- 2m wide sidewalk on west side and 3m wide multi-use path on east side
- 5m wide boulevards
- 2m wide cycling facility in each direction
- Two 3.5m wide driving lanes in either direction



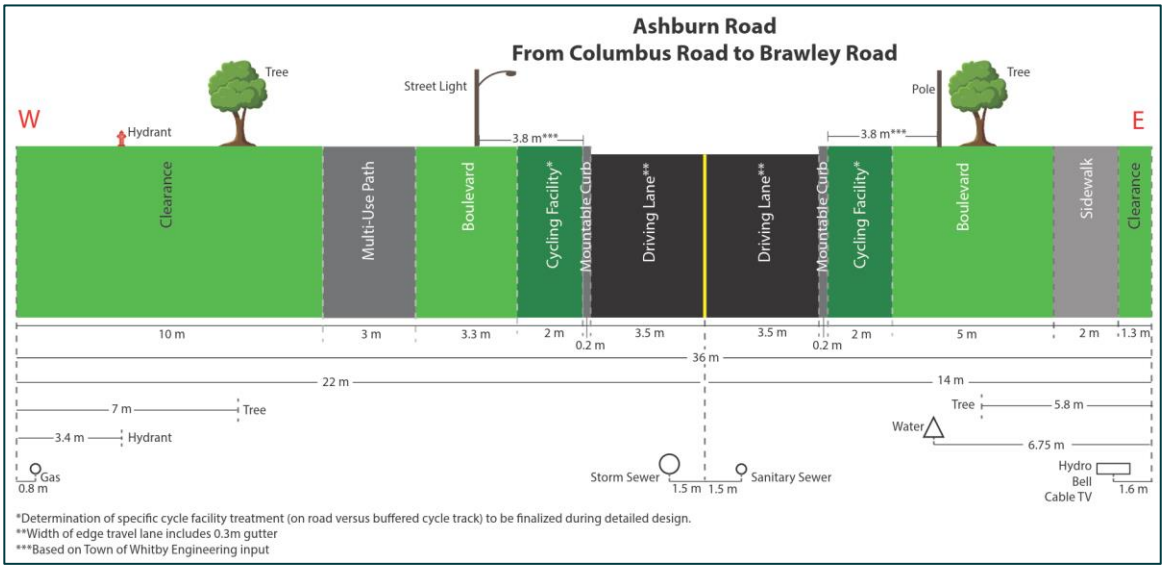
Ashburn Road (Between Winchester Road and Columbus Road):

- 36m wide right-of-way
- 3m wide multi-use path on west side and existing 1.5m wide sidewalk on east side
- 5m wide boulevard on west side and existing 6.5m wide boulevard on east side
- Existing 1.5m on-street bike lane in each direction
- One existing 3.5m wide driving lane in either direction



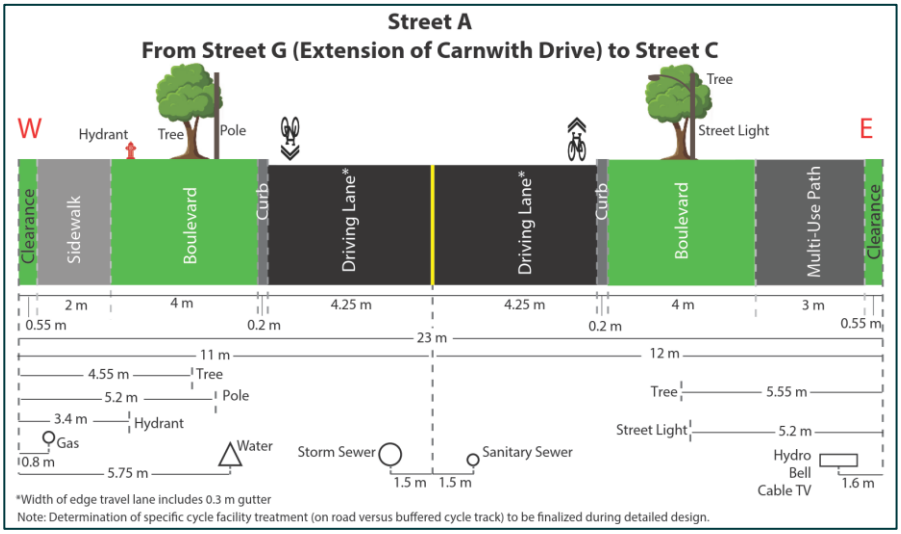
Ashburn Road (Between Columbus Road and Brawley Road):

- 36m wide right-of-way
- 3m wide multi-use path on west side and 2m wide sidewalk on east side
- 5m wide boulevard on east side and 3.3m wide boulevard on west side
- 2m wide cycling facility in each direction
- One 3.5m wide driving lane in either direction



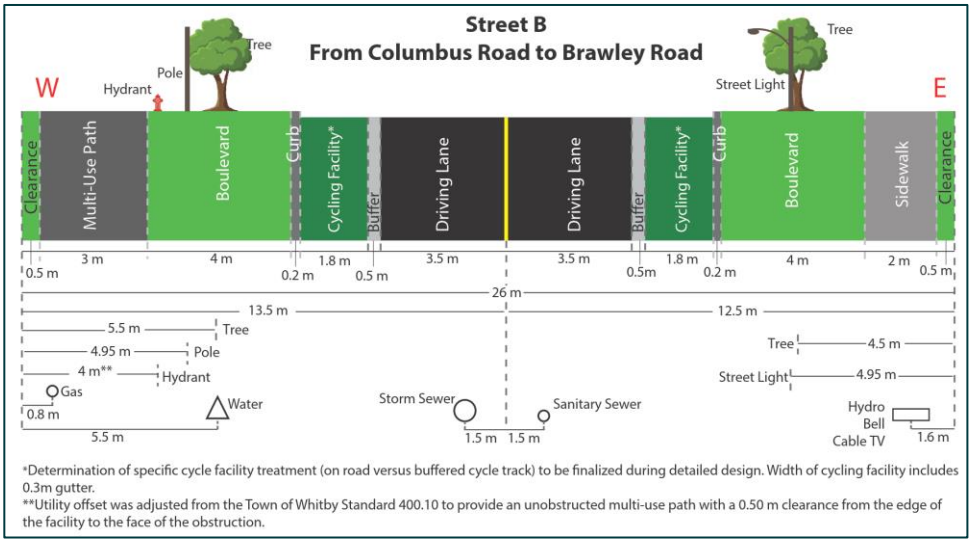
Street A (Between Street G and Street C):

- 23m wide right-of-way
- 2m wide sidewalk on west side and 3m wide multi-use path on east side
- 4m wide boulevard
- One 4.25m wide driving lane with signed bike route/shared roadway in either direction



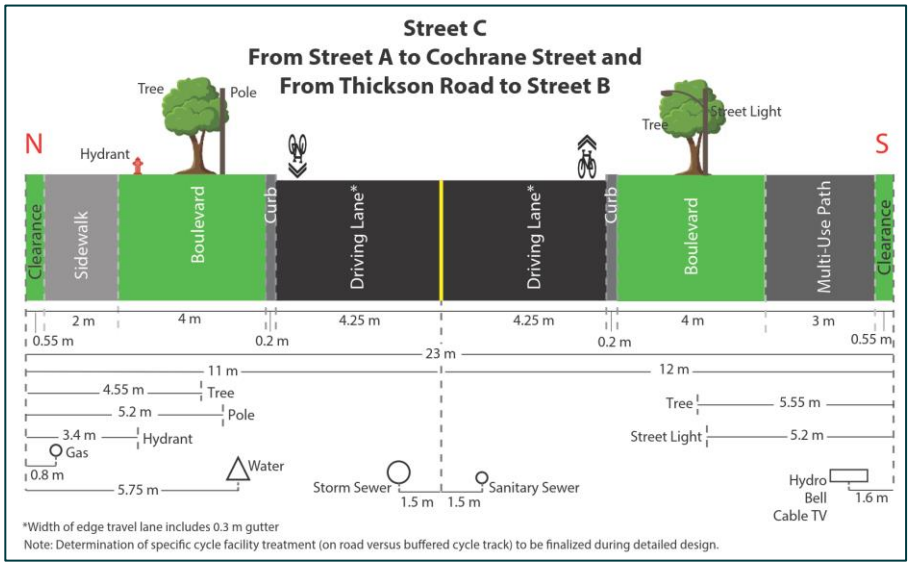
Street B (Between Columbus Road and Brawley Road):

- 26m wide right-of-way
- 3m wide multi-use path on west side and 2m wide sidewalk on east side
- 4m wide boulevard
- 1.8m on-street cycling facility with 0.5m buffer in each direction
- One 3.5m wide driving lane in either direction



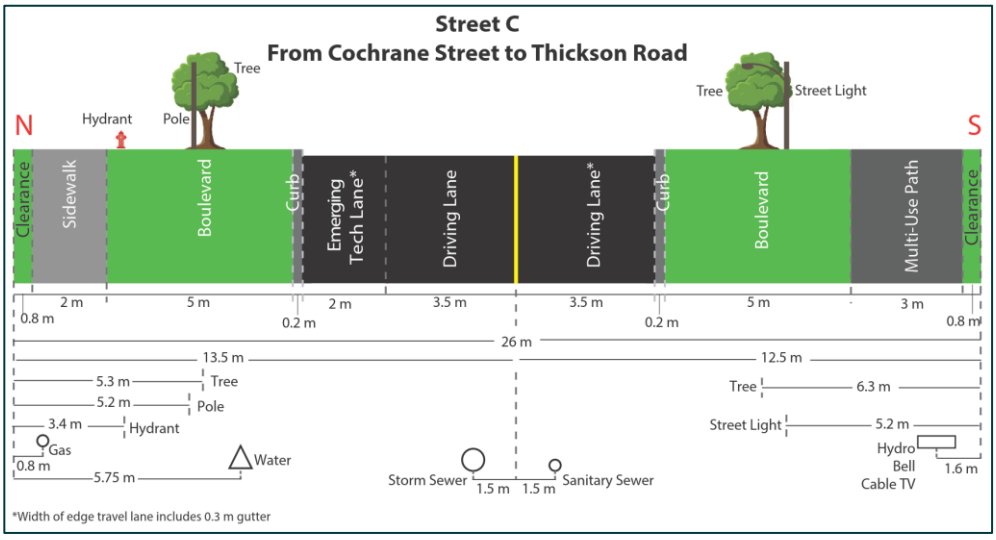
Street C (Between Street A and Cochrane Street, Between Thickson Road and Street B):

- 23m wide right-of-way
- 2m wide sidewalk on north side and 3m wide multi-use path on south side
- 4m wide boulevard
- One 4.25m wide driving lane with signed bike route in either direction



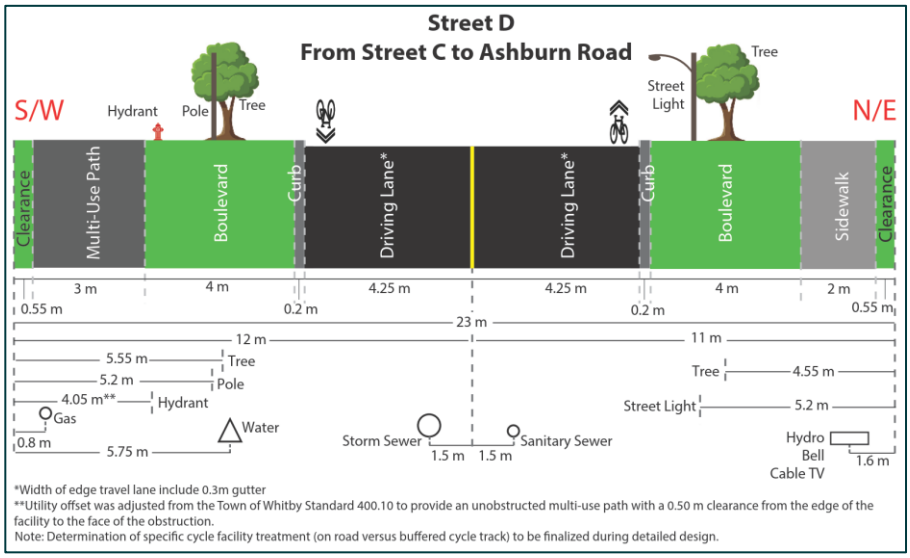
Street C (Between Cochrane Street and Thickson Road):

- 26m wide right-of-way
- 2m wide sidewalk on north side and 3m wide multi-use path on south side
- 5m wide boulevard
- 2m emerging technology lane (westbound)
- One 3.5m wide driving lane in either direction



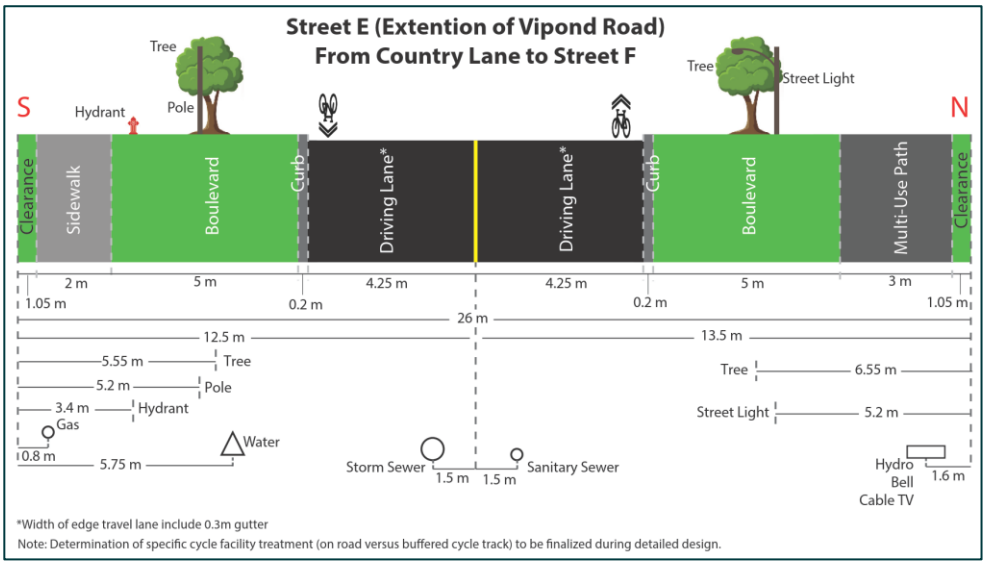
Street D (Between Street C and Ashburn Road):

- 23m wide right-of-way
- 3m wide multi-use path on south/west side and 2m wide sidewalk on north/east side
- 4m wide boulevard
- One 4.25m wide driving lane with signed bike route in either direction



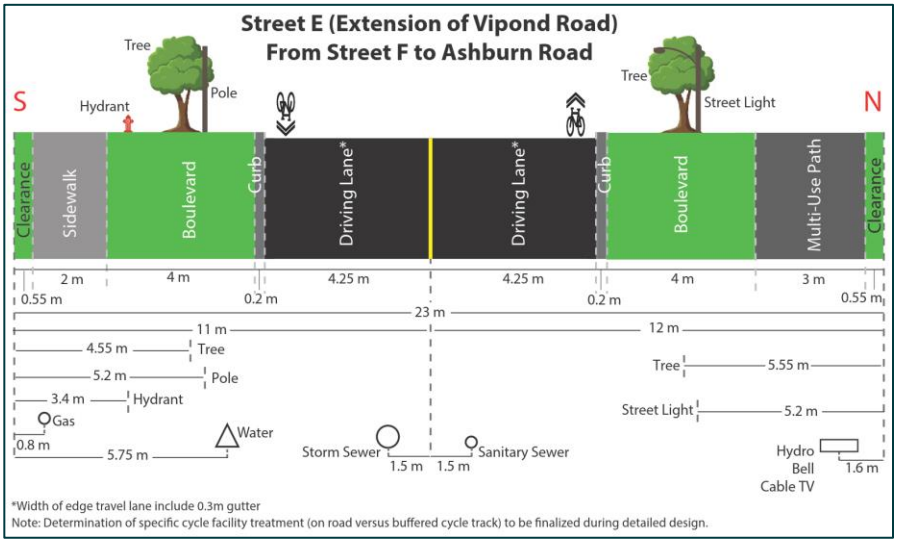
Street E (Extension of Vipond Road) (Between Country Lane and Street F):

- 26m wide right-of-way
- 2m wide sidewalk on south side and 3m wide multi-use path on north side
- 5m wide boulevard
- One 4.25m wide driving lane with signed bike route in either direction



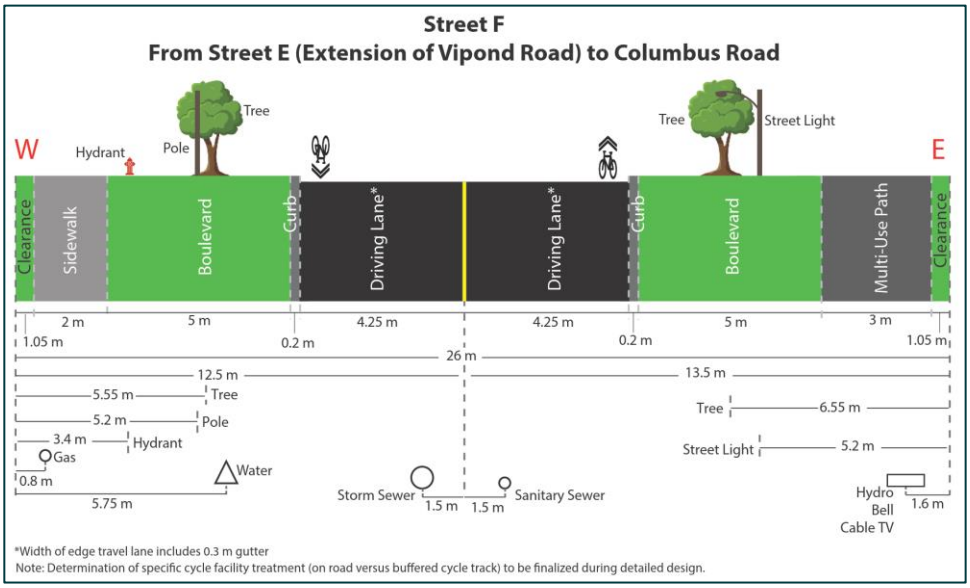
Street E (Extension of Vipond Road) (Between Street F and Ashburn Road):

- 23m wide right-of-way
- 2m wide sidewalk on south side and 3m wide multi-use path on north side
- 4m wide boulevard
- One 4.25m wide driving lane with signed bike route in either direction



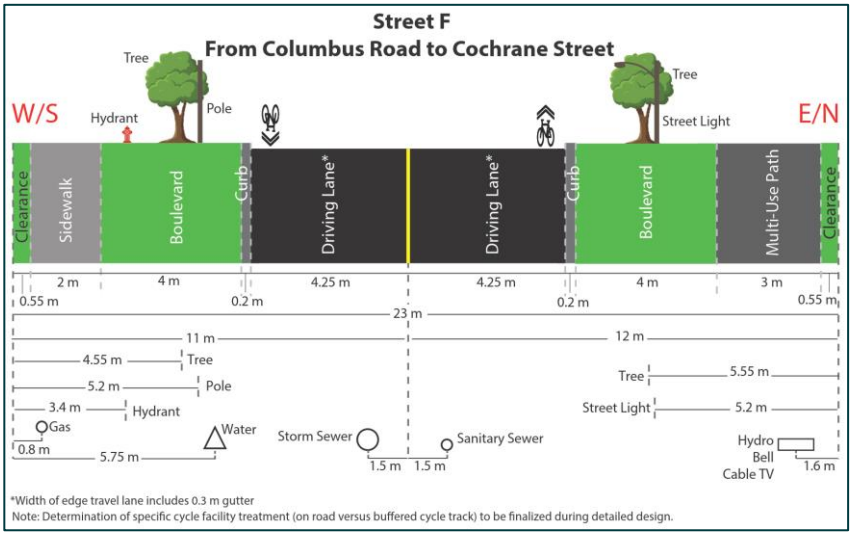
Street F (Between Street E and Columbus Road):

- 26m wide right-of-way
- 2m wide sidewalk on west side and 3m wide multi-use path on east side
- 5m wide boulevard
- One 4.25m wide driving lane with signed bike route/shared roadway in either direction



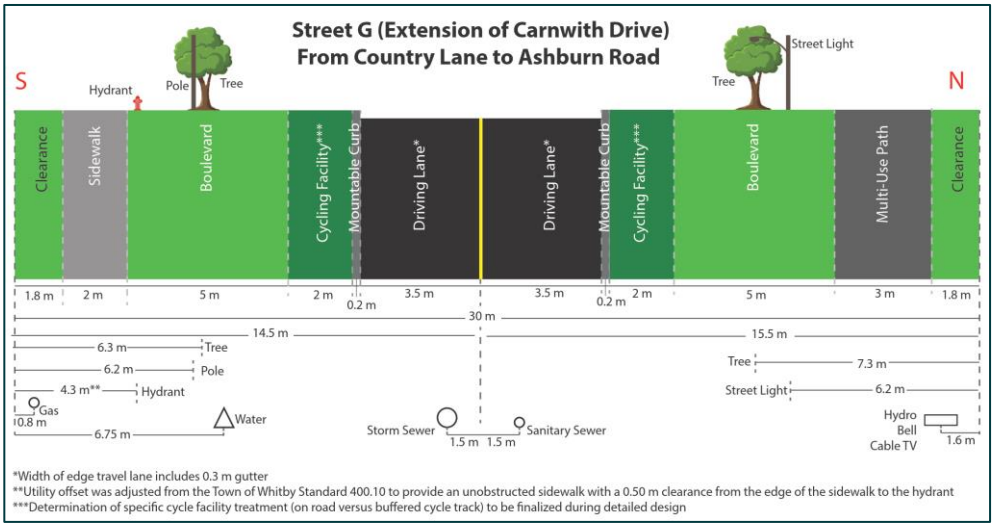
Street F (Between Columbus Road and Cochrane Street):

- 23m wide right-of-way
- 2m wide sidewalk on west/south side and 3m wide multi-use path on east/north side
- 4m wide boulevard
- One 4.25m wide driving lane with signed bike route/shared roadway in either direction



Street G (Extension of Carnwith Drive) (Between Country Lane to Ashburn Road):

- 30m wide right-of-way
- 2m wide sidewalk on south side and 3m wide multi-use path on north side
- 5m wide boulevard
- 2m wide cycling facility in each direction
- One 3.5m wide driving lane in either direction



7.3 Watercourse Crossings

7.3.1 Design Criteria

The streets that comprise this Environmental Assessment study are located within the Town and CLOCA jurisdiction. As per the analysis completed by AECOM on the Lynde Creek Master Drainage Plan Update – Municipal Class Environmental Assessment Master Plan Project File Report (working draft), and correspondence with CLOCA, Candevcon East Limited, and LEA, the design flows were determined based on the road classification as outlined in the MTO Highway Drainage Design Standards (January 2008).

For all watercourse crossings, the MTO's Design Standard WC-1 was applied based on the road classification. Columbus Road, Ashburn Road, Cochrane Street, and Street G (Extension of Carnwith Drive) are classified as arterial roads for which structures were designed for the 100-year storm event for a span greater than 6m or for the 50-year storm event for a span less than or equal to 6m. Streets A to F are classified as collector roads for which structures were designed for the 50-year storm event for a span greater than 6m or for the 25-year storm event for a span less than or equal to 6m.

In cases where design flow information was currently available, MTO's Design Standards WC-2 and WC-7 were used to determine the appropriate freeboard and clearance (for bridges) based on road classification as well as flood depth (HW/D) as described below:

1. The freeboard shall be greater than or equal to 1.0m as per WC-2 for bridges and WC-7 for culverts. Freeboard will be measured from the water level to the edge of the travelled lane.
2. The clearance for bridges shall be greater than or equal to 1.0m as per WC-2 and clearance will be measured to the lowest point on the soffit.
3. For open footing culvert, the minimum clearance for culverts with a straight soffit shall be 0.3m measured from the soffit to the design flow water level established with WC-1. The minimum clearance for culverts with irregular cross sections shall be measured 0.3 m below the Effective Rise of the culvert.
4. As per WC-7, the flood depth at culverts shall be:
   - For culverts with diameter or rise less than 3m: HW/D less than or equal to 1.5;
   - For culverts with diameter or rise between 3m to 4.5m: HW/D less than or equal to 4.5; and
   - For culverts with diameter or rise greater than 4.5m: HW/D less than or equal to 1.

As previously communicated to CLOCA and Candevcon East Limited, if there is a lack of information on the 25-year or 50-year storm event design flow in the HEC-RAS model, the 100-year storm event design flow with a 0.3m freeboard was used.

7.3.2 Summary of Methodology and Structure Types and Sizes

There are 24 watercourse crossings identified within the limits of the study area, a majority of which are located within the Lynde Creek Watershed and a few located within the Oshawa Creek Watershed. The Existing Floodplain Map shows the BNMREA study area and includes the location of all watercourse crossings and floodplain limits in relation to the relevant subwatersheds.

The HEC-RAS model for the Lynde Creek watershed used the 100-year flow to help determine the proposed structures needed at each crossing. The HEC-RAS model for Lynde Creek for the 25-year and 50-year will be completed as a separate exercise completed by CLOCA in post environmental assessment submission. The HEC-RAS model for the Oshawa Creek watershed provided by CLOCA included the 25-

year, 50-year, 100-year, and Regional storm events. As such, design flows for each crossing in this watershed were based on road classifications.

All structures were sized in consultation with the study team, considering creek flow regime/stream order and Redside Dace habitat or other environmental constraints related to wildlife passage/openness ratio (See Appendix D). The following classifications for the watercourse crossings are listed by each stream order:

- Stream order 1 and 2
  - Minimize length of culverts and amount of fill into valley/floodplain;
  - Explore alternative slope stabilization methods (i.e. retaining walls) to narrow grading limit; and
  - Some creeks that are classified as stream order 2 are Redside Dace habitat, therefore in these cases a bridge or open bottom span culvert is recommended.
- Stream order 3
  - Only open bottom span culverts or bridges were to be considered to address the needs of species including Redside Dace that may inhabit these creeks as well as to maintain natural interaction with groundwater;
  - Minimize impacts to naturalized areas within the meander belt width plus 30m; and
  - Minimize structure size to provide wildlife passage as needed.

The existing and proposed streets that are part of this BNMREA were overlaid on top of two existing floodplain maps that were exported from the Lynde Creek and Oshawa Creek HEC-RAS models to determine existing cross-section information that needed to be updated due to the proposed new roads and improvements to existing roads.

The cross sections in the existing HEC-RAS model were updated per the latest road design and survey data. The proposed culverts and bridges were added to the model based on the existing flows, channel elevations, stream orders (as identified by the Environmental team), considering the available cover for each structure. Based on the existing and proposed water levels and road geometry, preliminary structure configuration at each watercourse crossing has been determined. Additionally, MTO design criteria were checked to ensure compliance for each crossing.

The proposed design was determined from an environmental perspective, whereby fish habitat dictated the type of structure. A stream order 1 allowed any type of structure while a stream order 2 and 3 required an open footing culvert or bridge as it is located on a Redside Dace habitat. Additionally, the wildlife passage assessment provided an openness ratio to be maintained in crossings with culverts (Appendix D). These two criteria created constraints which further refined the details of each structure.

In summary, the proposed structure types for the BNMREA study area are as follows:

- Four open footing culverts (at WC #1, #2, #13, and #17);
- Four box culverts (at WC #3, #8, #11, and #14);
- Nine bridges (at WC #4, #6, #15, #16, and #20 to #24);
- One circular culvert (at WC #7);
- Three wide span culverts (at WC #10, #19, and #25); and
- One twin barrel circular culvert (at WC #12).

Flows under future conditions will be conveyed by proposed minor and major storm systems (at WC #5 and #9).

There is a total of nine watercourse crossings that are located on Redside Dace habitat (WC #2, #4, #6, #15, #16, #20, #21, #23, #24) and environmental considerations have been included in the design, which

shows larger spans at these locations. All clearance criteria have been met at all crossings except for WC#6; freeboard criteria have been met at all crossings except for WC #9 and #12 due to site constraints since culverts are located on existing roads; and HW/D criteria has been met in all culvert crossings.

Table 7-6 summarizes the structure types and sizes of the watercourse crossings. The rows highlighted in blue indicate that the watercourse crossings required will be bridges, while the other crossing types are either open footing culvert, box culvert, circular culvert, twin circular culverts or wide span culverts.

Note that the current design is based on hydraulic design standards and environmental considerations. Structural details for each crossing are to be provided during the Draft Plan review/approval process.

Table 7-6: Summary of Proposed Design Parameters and Structure Performances (Lynde Creek and Oshawa Creek Watersheds)

General Info			Proposed Structure Design Parameters						Lowest Soffit Elevation	Design Flow Storm	Proposed Culvert/Bridge Performance				
											Computed HW Elevation (m)				
WC#	Street	Type	Inverts Upstr (m)	Inverts Downstr (m)	Length (m)	Slope (%)	Span/Width (m)	Diameter/Rise (m)			50yr	100yr[5]	Regional	Freeboard (m)	HW/D (m)
WC#1	Columbus	Open Footing Culvert	176.43	176.12	36.2	0.9%	5	2	-	50yr	-	178.37	180.08	1.68	0.97
WC#2	Columbus	Open Footing Culvert	172.08	171.25	36.0	2.3%	3.5	1.25	-	50yr	-	172.88	172.43	1.54	0.64
WC#3	Columbus	Box Culvert	175.07	174.89	36.0	0.5%	1.8	0.9	-	50yr	-	175.93	-	1.14	0.96
WC#4	Columbus	Bridge	-	-	27.1	-	20m span	-	174.1	100yr	-	173	173.12	2.02	-
WC#5*	Columbus	Box Culvert	Flow under future conditions will be conveyed by proposed minor and major storm systems												
WC#6	Columbus	Bridge	-	-	29	-	26m span	-	170.52	100yr	-	170.35	173.89	2.10	-
WC#7	Columbus	Circular Culvert	177.66	177.48	36	0.50%	-	0.9	-	50yr	178.22	-		1.30	0.63
WC#8	Columbus	Box Culvert	180.8	180.51	35.7	0.8	4.5	2	-	50yr	-	181.82	183.11	2.23	0.51
WC#9*	Columbus	Box Culvert	Flow under future conditions will be conveyed by proposed minor and major storm systems												
WC#10	Columbus	Wide Span Culvert	186.96	186.5	29.93	1.5%	16.2	1.83	189.06	100yr	-	188.57		1.53	0.88
WC#11	Cochrane	Box Culvert	170.64	170.46	36.0	0.5%	1.8	0.9	-	50yr	-	171.61	-	1.11	1.08
WC#12*	Ashburn	Twin circular culvert	170.5852	170.4952	36	0.25%		0.9	-	50yr	171.51	-		0.97	1.03
WC#13	Street A	Open Footing Culvert	177.39	177.02	27.2	1.4%	6	2	-	25yr	-	177.91	177.48	2.87	0.26
WC#14	Street C	Box Culvert	183.44	182.09	29.2	4.6%	1.8	0.9	-	25yr	-	183.67	183.72	1.77	0.26
WC#15	Street C	Bridge	-	-	16.085	-	12	-	187.85	50yr	-	186.93	186.95	2.58	-
WC#16	Street C	Bridge	-	-	25.835	-	130	-	178.84	50yr	-	174.99	176.51	10.03	-
WC#17	Street C	Open Footing Culvert	-	-	26.12		6	2	198.68	25yr	-	197.66	197.84	2.76	
WC#18	Street C	Circular	196.1	195.985	23	0.50%	-	0.675	-	25yr	-	196.8	-	1.11	1.04
WC#19	Street C	Wide Span Culvert	-	-	26	-	16.159	1.83	196.11	50yr	195.69	-		1.56	
WC#20	Street E	Bridge	-	-	14.4	-	30		159.64	50yr	-	158.26	158.46	1.75	-
WC#21	Street E	Bridge	-	-	14.31	-	24	-	163.63	50yr	-	162.08	162.29	3.10	-
WC#22	Street G	Bridge	-	-	23.8	-	25		174.49	100yr	-	169.27	169.4	5.06	-
WC#23	Street G	Bridge	-	-	17.0	-	30		163.81	100yr	-	162.815	162.89	2.28	-
WC#24	Street G	Bridge	-	-	17.0	-	20	-	168.71	100 yr	-	167.72	167.87	2.25	-
WC#25	Street B	Wide Span Culvert	-	-	26	-	14.94	1.44	190.1	50yr	189.83			1.38	-

1. Culverts/bridges with a total span less than or equal to 6.0m on urban arterial roads are designed for 50yr storm (MTO Standard WC-1)
2. Culverts/bridges with a total span less than or equal to 6.0m on collector roads are designed for 25yr storm (MTO Standard WC-1)
3. Culverts/bridges with a total span greater than 6.0 on urban arterial roads are to be designed for the 100yr storm (MTO Standard WC-1)
4. Culverts/bridges with a total span greater than 6.0 on collector roads are to be designed for the 50yr storm (MTO Standard WC-1). As the 50yr storm design flow was not available in the model, 100 year storm flow data was used
5. Freeboard is calculated as the difference between the WL generated by the design flow and the Edge of Travel Lane
6. Clearance is calculated as the difference between the lowest point on the soffit and the design flow
7. The invert for open footing culverts corresponds to the bottom of creek elevations

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7.4 Intersection Control and Network Performance

Technical transportation assessments were completed as part of the BMNREA to forecast future operations of the recommended road network and to identify auxiliary lane requirements and intersection controls. This analysis built upon earlier transportation assessments conducted by BA Group for the CBP, which identified future traffic demands and base lane requirements. The analysis was conducted for the horizon year of 2031, by which the expansion area of Brooklin North is expected to accommodate a population of 45,202 and 11,437 jobs. The details of the analysis are provided in Technical Memorandum 2 found in **Appendix C**.

The transportation analysis developed the preferred intersection controls by undertaking an Intersection Control Study (ICS) for the appropriate control types based on the classifications of the intersecting roads. The ICS provided an evaluation of the operational capacity analysis, intersection geometry, transit needs, active transportation priorities, and land use contexts for each of the classifications.

Based on the results of the ICS, capacity analysis was conducted for the recommended control types using Synchro software based on HCM 2010 methodologies. The preferred control types were recommended for the study area and used to inform the preliminary design process.

7.4.1 Intersection Control Study Process

The Intersection Control Study process was developed and provided by the Town. Key criteria included:

- The role and function of the intersecting roadways;
- The geometry of the road;
- The need for access control;
- The character of the adjacent land use; and
- The location of the intersection relative to the transition between rural and urban areas.

LEA conducted an evaluation of the following types of intersections in the study area to inform the recommended control:

- Arterial to Arterial – with and without emerging technology, each with options of signalized/unsignalized versus roundabout;
- Arterial to Collector – with and without emerging technology and within the natural environment, each with options of signalized/unsignalized versus roundabout; and
- Collector to Collector – with and without emerging technology, each with options of two-way stop control (TWSC) versus roundabout.

The evaluation criteria are discussed in **Table 7-7**. Please note that while these evaluation criteria were used to provide a framework for intersection control recommendations, there were other considerations for each intersection, including consistency along corridors, strategies for traffic calming, and operational impacts.

Roundabout Implementation Strategy

Roundabouts were not included in the initial network developed for the CBP and the BA Group 2031 Meso and Micro Traffic Forecast Output Summary Report (BA Group Report). The Town's Road Design Criteria (2019) identify roundabouts to be considered:

- at any new intersection;

- when an all-way stop controlled intersection is warranted; or
- when a signal is warranted

Polices, strategic directions, and design guidelines identified in the Town's TMP (2010), the Brooklin TMP, and the Town's Design Criteria and Engineering Guidelines were considered for the preferred roundabout implementation strategy. This strategy reflects the following objectives for roundabout implementation:

- Traffic Calming: Roundabouts reduce speeds while maintaining the function of the road for vehicles and other users (such as pedestrians and cyclists). This additionally mitigates requests from the public for unwarranted traffic control, such as traffic signals or all-way stop control;
- Improved Safety: Roundabouts can improve safety for all road users, mainly by reducing conflict points; and
- Gateway: Roundabouts provide a visual cue to indicate a change in local context, such as the transition between rural and urban areas or a change in road classification and land uses.

Intersection Control Study Evaluation

Evaluation criteria aligning with the Town's ICS were used to score and recommend control for arterial-arterial, arterial-collector, and collector-collector intersections. An overview of the scoring rationale and outcomes for each type of intersection are provided in **Table 7-7**. Details on the scoring for each type of intersection that were used to arrive at the scoring outcome can be found in the Technical Memorandum 2 provided in **Appendix C**.

Table 7-7: Overview of Intersection Control Study Evaluation

Criteria	Scoring Rationale
Traffic safety	• Roundabouts reduce number of conflict points, speeds, and collision severity
Vehicular Capacity	• Roundabouts provide benefit to minor movements and typically operate with lower delay in comparison to stop-controlled intersections. • Signalized intersections have more benefit to major movements but have lower efficiency in off peak hours than at roundabouts.
Impacts to pedestrians and cyclists	• Signalized intersections accommodate pedestrians with a dedicated phase and reduce horizontal deflection for cyclists • Roundabouts provide refuges and shorter crossings for pedestrians
Impacts to the environment	• Roundabouts are expected to have reduced emissions due to decreased delays, controlled speeds, and fewer stop/starts
Access management	• Allows for easy U-turn along major corridor if minor intersections are restricted to Right-in/Right-out.
Impacts to transit	• Transit assumed to use major legs of an intersection • Roundabouts require transit stops to be located further from the intersection and are more difficult for large transit vehicles to navigate
Property impacts	• Signalized or TWSC has smaller footprint than roundabouts
Emerging technology	• Signalized or TWSC intersections require less horizontal deflection of the emerging technology lanes than roundabouts
Construction costs[10]	• Initial capital cost is higher for roundabouts
Scoring Outcome (Details on Scoring Provided in Appendix C)	
Arterial to Arterial	• With or without emerging technology: Signalized/unsignalized
Arterial to Collector	• With emerging technology and within natural environment: signalized/unsignalized • Without emerging technology: either signalized or roundabout, subject to corridor priorities
Collector to Collector	• With or without emerging technology: roundabout

It should be noted that while these scoring outcomes were used to provide a framework for intersection control recommendations, there were other considerations for each intersection, including consistency along corridors, strategies for traffic calming, and operational impacts, which could have changed the overall recommendation.

[10] Note that this depends on local conditions and assumptions on the capital costs of roundabouts versus the signalized alternative.

7.4.2 Intersection Capacity Analysis Results

Signalized, Two-Way Stop Control or All-Way Stop Control Intersections

Synchro software was used to conduct the capacity analysis for the study area intersections during the AM and PM peak hours for the horizon year 2031. The majority of intersections are expected to perform with acceptable levels of service and residual capacity in the AM and PM peak hours. For the horizon year of 2031, a few signalized intersections are expected to approach capacity or experience capacity constraints, including the intersection of Columbus Road and Thickson Road in the PM peak hour. To mitigate some of these constraints, signal timing optimization and/or a corridor signal coordination study has been identified as an appropriate mitigation option. Signal timings incorporated in the study are preliminary and are recommended to be further optimized as part of the Development Application or Draft Plan review/approval process.

Signal Warrant Analysis

A number of existing unsignalized intersections were upgraded to signalized intersections in the BA Group Report. In reviewing the added traffic volumes and the proposed road network, LEA concurred and included these signalized intersections for the base case scenario with traffic signal warrant analysis, which was based on the MTO minimum requirements for the installation of traffic signals.

Signal warrant analysis was performed for unsignalized intersections that were upgraded to signalized intersections, based on the MTO minimum requirements for the installation of traffic signals. Detailed results are provided in the Technical Memorandum 2 (**Appendix C**). Future intersection signalization was recommended for intersections that either met the MTO traffic volume warrants or required protection for signalization due to delay at minor movements, active transportation needs (frequent protected crossings) and/or access needs (for development parcels/blocks). Further consideration should be made during detailed site-specific studies along major arterial road corridors, such as Columbus Road, on a case by case basis. These additional locations will need to conform with design and intersection spacing guidelines.

Roundabout Analysis

The Town's preferred roundabout implementation builds on the polices, strategic directions, and design guidelines identified in the Town's TMP (2010), the Brooklin TMP, and the Town's Design Criteria and Engineering Guidelines. Locations identified as potential roundabouts have been assessed for feasibility and consideration for roundabout designs.

In the capacity analysis conducted for all potential roundabout locations results indicated that all analyzed intersections are expected to perform well with low delays and acceptable V/C ratios. It should be noted that although a capacity analysis for Garrard Road and Columbus Road and for Country Lane and Columbus Road were included, the design of these intersections is not within the scope of the BNMREA.

7.4.3 Recommended Intersection Control Summary

The recommendations for intersection control for the study area are summarized below, based on the traffic assessment as well as the Town's Intersection Control Study Process, MTO Signal Warrants for all new intersections, and discussions with the Town and the BNLG.

The proposed controls for main intersections are listed in **Table 7-8** and illustrated in **Figure 7-3**.

Table 7-8: Recommended Intersection Control for Main Study Area Intersections

Location of Intersection	Intersection with	Recommended Control
Columbus Road	All intersections between and including Street A and Street B	Signalized
	Country Lane[11], Garrard Road[11]	Roundabout
Cochrane Street	Street A, Street E (Extension of Vipond Road), Street G (Extension of Carnwith Drive), Winchester Road	Signalized
	Street F	Two-way Stop Control
Ashburn Road	Brawley Road, Street D	Roundabout
	All intersections of Ashburn Road between and including Street C and Winchester Road	Signalized
Street A	Street C, Street G (Extension of Carnwith Drive)	Roundabout
Street B	Brawley Road, Road II	Two-way Stop Control
	Street C	Roundabout
Street C	Street D, Cedarbrook Trail, Future Local Road (Road V), Selkirk Drive	Roundabout
	Baldwin Street, Thickson Road	Signalized
Street E (Extension of Vipond Road)	Country Lane, Street F	Roundabout
Street G (Extension of Carnwith Drive)	Country Lane, Street F	Roundabout

Based on the overall performance of the recommended network, auxiliary lane requirements were identified based on capacity results, access needs and road classification. Adjustments to the intersection control may be considered as development plans are received or in consideration of more detailed data during the Draft Plan review/approval process. **Section 9.9** of this ESR identifies those elements of the design that may be adjusted during the Draft Plan review/approval process.

[11] While this table includes a recommendation for a roundabout along Columbus Road at Country Lane and at Garrard Road, the design of these intersections is not in the scope of this BNMREA.

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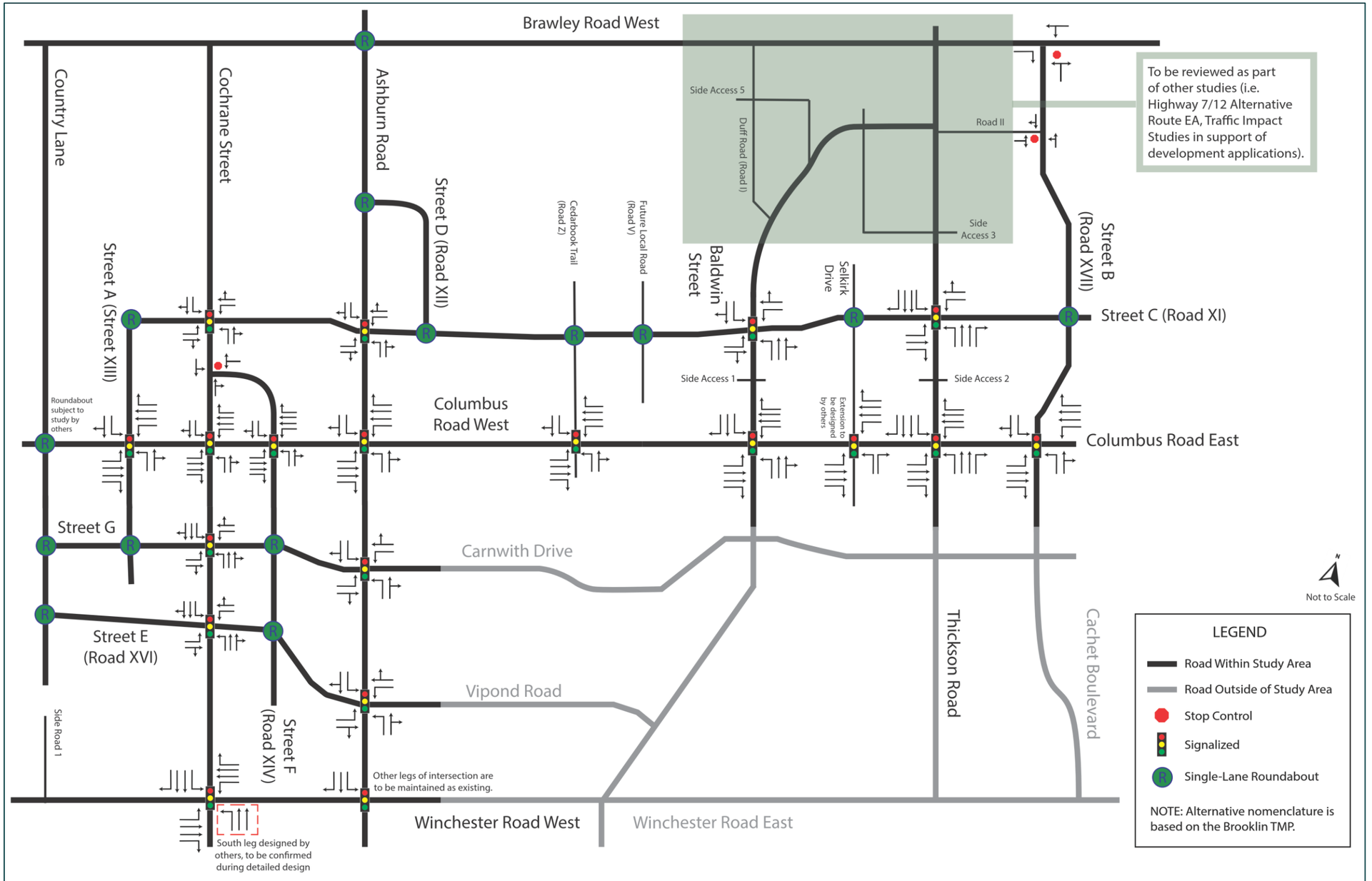
Figure 7-3: Recommended Intersection Control for BNMREA Study Area



NOTE: Where a minor roadway (not in scope) intersects with a major roadway (in scope), lane geometry was assumed for the minor roadway for the purposes of assessing the performance of the intersection and to determine traffic control needs. Refer to Section 9 for more details on the future flexibility of the lane configurations and intersection control.

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7.5 Phasing and Implementation

Development within the Brooklin Secondary Plan is anticipated to occur over the horizon period up to the year 2031. This BNMREA has identified the required road network improvements to support the needs of this community. The phasing and implementation of the proposed road improvements have been identified based on the proposed phasing of the CBP which was prepared by the BNLG and approved by the Town.

The majority of the road network improvements identified are expected to be subject to the timing of the individual developments adjacent or dependent on the new or improved facility. Roads that are anticipated to be detailed designed and constructed through the course of the development process by the landowners include:

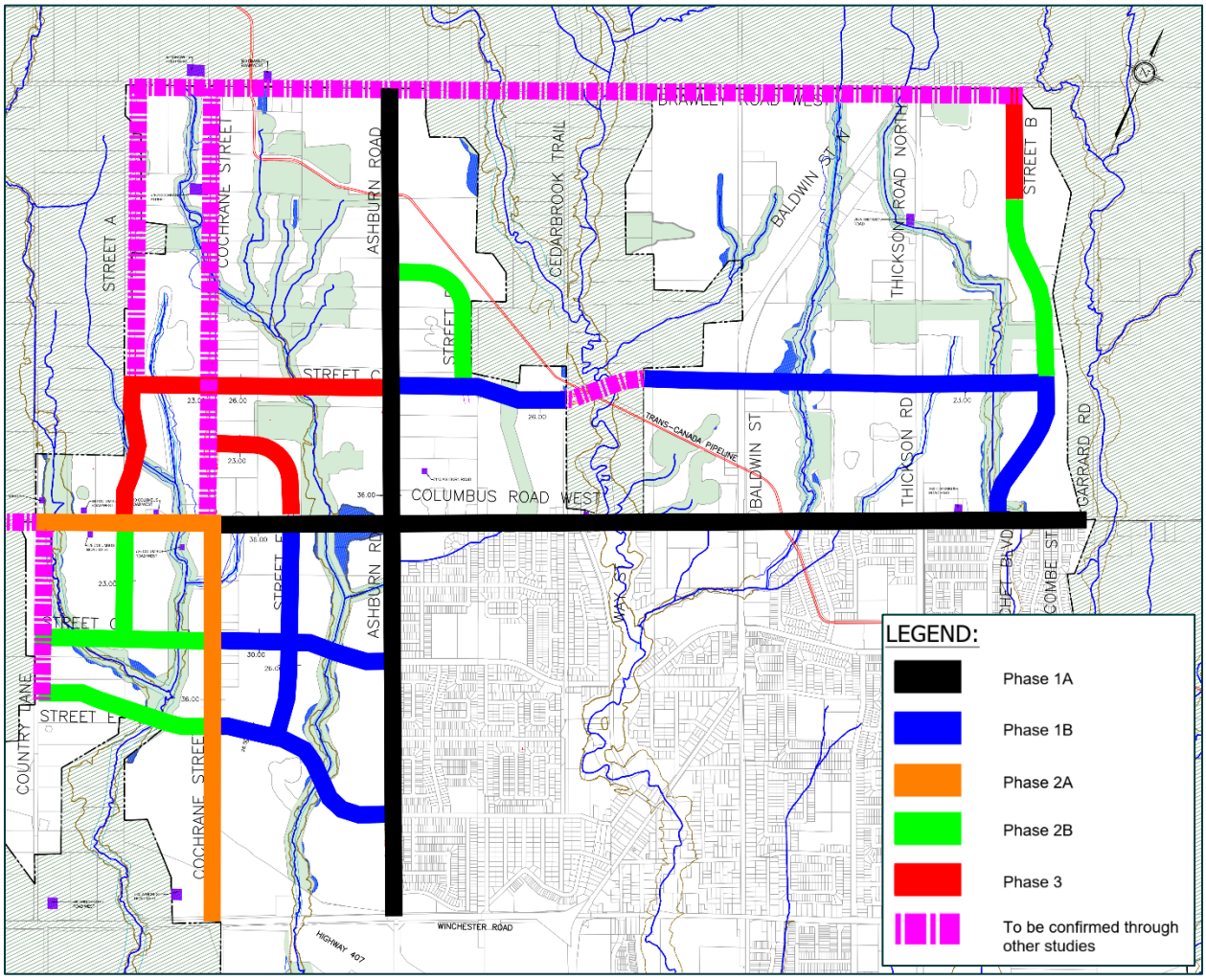
- Type C Arterial Roadway
  1. Street G (Extension of Carnwith Drive)
- Collector Roadway
  2. Street A (protection for extension between Street C and Brawley Road)
  3. Street B
  4. Street C
  5. Street D
  6. Street E (Extension of Vipond Road)
  7. Street F

In phasing roads that extend beyond a single property owner, maintaining the identified boundary location and road geometry is critical to not result in increased impacts for later implementation of the road. It is expected that the Town will enforce the adherence to the road geometry at the time of approval of the individual Plans of Subdivision.

It is proposed that the proposed road improvements be undertaken as capital projects by the Town and implemented in two-time horizons: 1 – 5 years and 5 – 10 years. It should be noted that this BNMREA has identified timing based on the proposed phasing of the CBP which was prepared by the BNLG and approved by the Town. It is understood that the timing of the implementation of the development is limited by the allotment of new greenfield residential units. That being said, should the allotment allocated to the Brooklin Secondary Plan change and the construction timing of the phases be adjusted, so too should the timing of the proposed capital works be re-evaluated.

The phasing and implementation plan is presented in **Figure 7-4**. In addition to the above discussed phasing, future improvements to Ashburn Road and the extension of Street A to Brawley Road have been identified. As noted through the Brooklin Secondary Plan and subsequent Transportation Assessment prepared for by BA Group, these sections do not warrant improvement given the projected volumes. Should additional density be targeted to the deferred lands within the Brooklin Secondary Plan, it is recommended that the justification for, and timing of, these sections be reconsidered.

Figure 7-4: Phasing Plan for the BNMREA



7.6 Preliminary Cost Estimates

Preliminary roadworks cost estimates are presented in **Table 7-9** with a detailed breakdown in **Appendix M**. The proposed road improvements for the BNMREA are estimated to cost about **$294,260,000**. Note that this estimate was determined based on the following assumptions:

- No additional costs for land acquisition;
- Grading has been assumed to existing (does not incorporate future development plans);
- Municipal services and utilities are not included;
- Street trees are not included;
- Engineering and approvals are not included; and
- Includes an assumed contingency of 20%.

Table 7-9: Summary of Preliminary Cost Estimates for BNMREA

Existing Roads				
Road	**Number of Lanes**	**Improvement**	**Approx. Length [m]**	**Cost**
Ashburn Road (Interim)	2	Arterial Road Urbanization	3,868	$19,350,000
Cochrane Street	4	Arterial Road Widening	866	$10,380,000
Columbus Road	4	Arterial Road Widening	4,884	$79,500,000
Proposed Roads				
Road	**Number of Lanes**	**Proposed**	**Approx. Length (m)**	**Cost**
Street A	2	New Collector Road	1,400	$10,050,000
Street B	2	New Collector Road	2,118	$17,540,000
Street C	2	New Collector Road	4,301	$69,640,000
Street D	2	New Collector Road	872	$5,300,000
Street E (Extension of Vipond Road)	2	Collector Road Extension	1,898	$30,920,000
Street F	2	New Collector Road	1,665	$15,460,000
Street G (Extension of Carnwith Drive)	2	Arterial Road Extension	1,714	$36,120,000
			Total Cost	**$294,260,000**

7.7 Future Commitments and Draft Plan Review and Approval Process

In accordance with the Schedule C MCEA requirements of the study, impacts to the environment, as defined by the EA act, were minimized, where possible, through the evaluation process that was undertake in identifying the preferred design. Potential impacts and proposed mitigation measures associated with implementing the preferred designs for each road have been identified.

Additional works that are required to be completed during the Draft Plan review/approval process of the project, prior to construction, are identified as follows:

Transportation/Technical Requirements

- Confirm/refine alignments based on more detailed topographic and field surveys;
- Undertake traffic studies in support of the development process, including traffic analysis and intersection control reviews;
- Confirm intersection configurations of minor streets with costs associated with such improvements over those identified in this BNMREA will be borne by the specific development(s) contributing to the need for the minor street access and improvement;

- Undertake a roundabout operational analysis to verify performance, geometry, and suitability;
- Further discussion is required with Durham Region Transit (DRT) in Detailed Design to determine appropriate transit stop locations; and
- The Town is open to discussing design modifications with adjacent developers along Ashburn Road within the vicinity of Street C affected by the retaining wall in the next approvals phase to minimize or remove the impacts associated with the installation of the retaining walls
- Develop a traffic management plan to maintain vehicular access during construction.

Drainage/Stormwater Management

- Finalize proposed stormwater outlet locations and servicing;
- Undertake the necessary property acquisitions for the proposed stormwater management facilities (SWMF) in conjunction with proposed development plans;
- Complete the environmental assessment and design of the proposed SWMFs;
- Detailed design of the trunk storm sewers should be coordinated with the SWMF design; and
- Confirm outlets, trunk storm sewer, low-impact developments (LID) and oil and grit separator design, and location based on SWMFs.

Socio-Economic Requirements

- Complete detailed property requirements and begin negotiations with affected property owners to purchase property required to implement the preferred design.

Natural Environment Requirements

- Clearly define the vegetation removal areas and conduct a floral inventory;
- Prepare a tree preservation plan to ensure the health of retained vegetation;
- Prepare a post-construction restoration/landscaping plan to compensate for removed vegetation and enhance buffer areas using native species;
- Wildlife crossing features shall be included in the culvert designs during the next design phase as appropriate as confirmed in consultation with the Town and CLOCA; and
- Ensure that construction impact mitigation measures as described in the ESR are incorporated into construction contract documents.

Cultural Heritage Requirements

- Complete a Cultural Heritage Evaluation/Impact Assessment; and
- Complete AAs to the stages required.

Permits and Monitoring

- Permits anticipated, but may not be limited to, the regulations that are set forth by the below legislation:
  - Department of Fisheries and Oceans
    - Species-at-Risk Act
    - Fisheries Act
  - MECP
    - Ontario Environmental Assessment Act
    - Ontario Water Resources Act
    - Environmental Protection Act
    - Endangered Species Act
  - MNRF
    - Fish and Wildlife Conservation Act

- CLOCA
  - Ontario Regulation 42/06
- Town
  - Noise Control By-Law
  - Traffic By-Law

- Monitoring will be required in accordance with the above legislation, and others as identified through the Draft Plan review/approval process, during both the construction and post-construction periods:
  - Contractors must be aware of all environmental considerations to ensure that all environmental standards and commitments are met.
  - Contractors should carefully review **Section 8** of this ESR to ensure they are aware of the potential impacts of the proposed projects and employ appropriate mitigation measures.
  - During design and construction, reports and plans should be based on a best management approach that centres around the prevention of impacts, protection of the existing environment and capitalizing on opportunities for rehabilitation and enhancement of any impacted areas.
  - The proponent is also to engage in post-construction monitoring to ensure all mitigation measures have been effective and are functioning properly. At this time, additional measures that may be required will be identified and reviewed.

8 Anticipated Mitigation Measures

Table 8-1 summarizes the potential impacts of the preferred alternative design and proposed mitigation measures, while the following sections provide greater detail of the anticipated impacts and recommended future commitments and monitoring activities as part of the construction process.

Table 8-1: Anticipated Impacts and Proposed Mitigation Measures

Anticipated Impact	Response Mitigation Measure and Commitment to Future Work
Traffic • Re-routing of traffic patterns during construction • Increase in traffic volumes beyond anticipated forecasts, leading to capacity constraints	• A traffic management plan will be developed to maintain a lane of traffic in either direction at all times and to maintain access to adjacent businesses during construction. In the event that closures are required in both directions of travel (i.e. for the removal of an existing structure), a traffic management plan during construction will be developed and coordinated with adjacent construction activities to maintain reasonable connectivity and level of service for existing residents. • The Town of Whitby and Region of Durham will monitor the operations of the study intersections and make the necessary changes to the signal timings to optimize traffic movements in the area, potentially undertaking signal coordination studies for corridors. • The Town will require all future development applications to demonstrate integration with the proposed design through transportation impact studies, intersection control reviews, and other related studies. • The Town will require all future developments to consider the implications of the proposed infrastructure phasing to ensure adequate capacity and connectivity is provided in the network prior to proceeding with development.
Property Impacts Nearby properties and business affected by construction activities	• Nearby businesses will be considered in the development of a construction plan and the duration of the impact of construction activities will be reduced/mitigated as much as possible. • Compensation to private property owners will be provided as part of property acquisition process.
Air Quality • Impacts to air quality during construction	• An air quality management plan be required as part of the construction tendering process so that operational practices are implemented to limit the off-site impacts and include industry best management practices as well as any measures required by local by-laws or regulations. • Application of water, or chemical dust suppressant, to unpaved areas when visible dust plumes are present or during periods of high winds. • Cleaning of paved surfaces to reduce track out and dust deposits on paved areas. • Limiting the speed of vehicles on unpaved surfaces. • Covering loads when hauling fine-grained materials.

Anticipated Impact	Response Mitigation Measure and Commitment to Future Work
	• Truck and tire washes, or other methods, to prevent vehicles from tracking dust from the construction area. • Implementation of a site inspection plan to ensure site conditions are regularly monitored. • Implementation of a complaint response procedure to ensure any reported impacts are promptly investigated and timely corrective actions are implemented.
Natural Environment • Soil erosion and sedimentation during construction • Loss/displacement of vegetation, wildlife, fish, and habitat	• Site-specific erosion and sedimentation control plan should be developed and implemented at each phase of the development of the area, following the Erosion and Sediment Control Guidelines for Urban Construction (2019). • Construction work will be carefully planned and monitored to minimize disruption to the existing natural environment (including soil, fish/fish habitats, vegetation, wildlife/wildlife habitats, and designated natural areas), such as by using cofferdams to isolate work, restoring vegetation, and salvaging wildlife. This is to be done by the contractors with close consultation with the Town. • During the next detailed design phase, new crossings will be designed in consultation with the Town and CLOCA based on the openness ratio outlined in the Natural Heritage Report (Appendix D) and constructed and maintained so that wildlife corridors associated with these valleylands will be preserved and no new barriers are created. A cold-water in-water works timing window of July 1 to September 15 to all watercourses within the Lynde Creek and Oshawa Creek watersheds. • Migratory birds were confirmed within the study area. The contractor shall comply all requirements under the Migratory Bird Convention Act (MCBA), and construction works and clearing that would disrupt birds projected under the MBCA must be completed outside the breeding bird season (i.e. April 1 to August 31) of any given year. • Prior to the construction of the infrastructure within the natural heritage system or for the watercourses, the proponent will be responsible for acquiring all appropriate permits and permissions with associated review agencies including CLOCA, DFO, MNRF, and MECP. This will include but is not limited to the assessment of impacts to Species at Risk habitats and the requirements within the Endangered Species Act.
Groundwater • Water-taking permit	• A Hydrogeological Assessment will be completed during the next step, Detailed Design phase and a commitment this future assessment will be added in the ESR. The Hydrogeological Assessment will document the hydrogeology and stratigraphy, confirm water-taking permit requirements (i.e. EASR or PTTW), identify potential impacts, and recommend mitigation measures.

Anticipated Impact	Response Mitigation Measure and Commitment to Future Work
	• All recommended mitigation measures from the Hydrogeological Assessment will be incorporated into the Contract Package in the next design phase, • Should a registration under MECP's EASR or a PTTW be required, the Hydrogeological Assessment Report will be completed to the level of detail required for a PTTW or EASR, and all recommended mitigation measures will be incorporated into the contract package. Any EASR registration / PTTW will be completed/obtained prior to start of dewatering, if required.
Stormwater Management • Increase in run-off volume and peak flow rates • Need for stormwater quantity and quality control	• Storage requirements were developed for several roads, which will be allocated in either underground storage facilities within road ROW or stormwater management ponds. • Implement end of pipe stormwater facilities and appropriate low impact development measures, such as enhanced grass swale and vegetated filter strips, to improve the quality of and discharge flow rate for stormwater entering downstream conveyance systems. • The MNRF's Thermal Mitigation Checklist for Stormwater Management Ponds Discharging into Redside Dace Habitat (July 2014) will be considered during preliminary stormwater management facility block sizing. Thermal mitigation of stormwater management ponds is also an important component to ensuring that Redside Dace habitat is not impacted long-term and will be considered and incorporated into the design where feasible. • All mitigation measures recommended in the Stormwater Management Report (Appendix G) will be incorporated into the contract package and implemented during construction.
Contamination • Potential to encounter contamination soils / groundwater during construction	• A Phase 1 ESA will be completed on any impacted properties during detailed design will has been added as a commitment to future work to the ESR. Further Phase 2 ESA will be completed if required, based on the recommendations of the Phase 1 ESA. • Any required mitigation measures to address contaminated soils / groundwater will be incorporated into the contract package, if required. • Ministry's new excess soil management regulations will be incorporated into the contract package and applied during construction.
Utilities and Infrastructure • Update utilities and legal land surveys	• In preparation of the Draft Plan review/approval process, updated utilities and legal land surveys within the expected construction limits will be required. • Separate study is required to determine detailed design and construction details of utilities relocation plan.

Anticipated Impact	Response Mitigation Measure and Commitment to Future Work
Archaeology • Unanticipated discovery of archaeological and or human remains	• Areas with archaeological potential requiring further Stage 2 and 4 archaeological assessments were identified within the study area (**Figure 3-10**). All areas shall be cleared of archaeological potential prior to an area being impacted. • Potentially interested Indigenous Communities shall be engaged prior to the completion of further Stage 2-4 archaeological assessment, including providing opportunities for attendance by field liaisons during the archaeological assessment field work. • If there is an unanticipated discovery of archaeological and or human remains, the Town will immediately contact the Ontario Ministry of Heritage, Sport, Tourism, and Culture Industries and the Registrar or Deputy Registrar of the Cemeteries Regulation Unit of the Ontario Ministry of Government and Consumer Services.
Cultural Heritage	• Listed and designated cultural heritage resources were identified within the study are. Impacts to listed and designated cultural heritage resources shall be avoided as designs are refined and impacts to these cultural heritage resources must be avoided during construction must be avoided (e.g. vibrations, etc.).

8.1 Transportation Impacts

The traffic assessment for the study area demonstrated that this design can accommodate 2031 future traffic volumes and incorporate the full build-out of the Brooklin Secondary Plan. **Figure 8-1** and **Figure 8-2** indicate intersections for which critical volume-to-capacity ratios and movements (as defined in the figures) were identified for the future morning and afternoon peak hour, respectively. Note that these figures only show the portion of the BNMREA study area where capacity constraints were identified, which was along and north of Columbus Road. For each respective peak hour, no capacity constraints were identified at intersections that are shown without a symbol in the figure.

As indicated in **Figure 8-1** and **Figure 8-2**, a few signalized intersections are expected to approach capacity or experience capacity constraints, including Columbus Road and Thickson Road. It is recommended that as part of the Development Application or Draft Plan review/approval process, the signal timings in the area be reviewed and/or a corridor signal coordination study be further optimized to reflect up to date traffic flow within the study area.

The future traffic conditions are expected to be reviewed with individual development proposals. These proposals should be required to confirm their integration with the proposed design to the Town through transportation impact studies and other related studies, thus assessing and confirming the intersection control and geometry recommended through this BNMREA.

A construction staging plan should also be completed during the Draft Plan review/approval process to ensure access to adjacent properties are maintained through the construction process.

Figure 8-1: Future Weekday Morning Peak Hour Critical Volume-to-Capacity (V/C) Ratios and Critical Movements

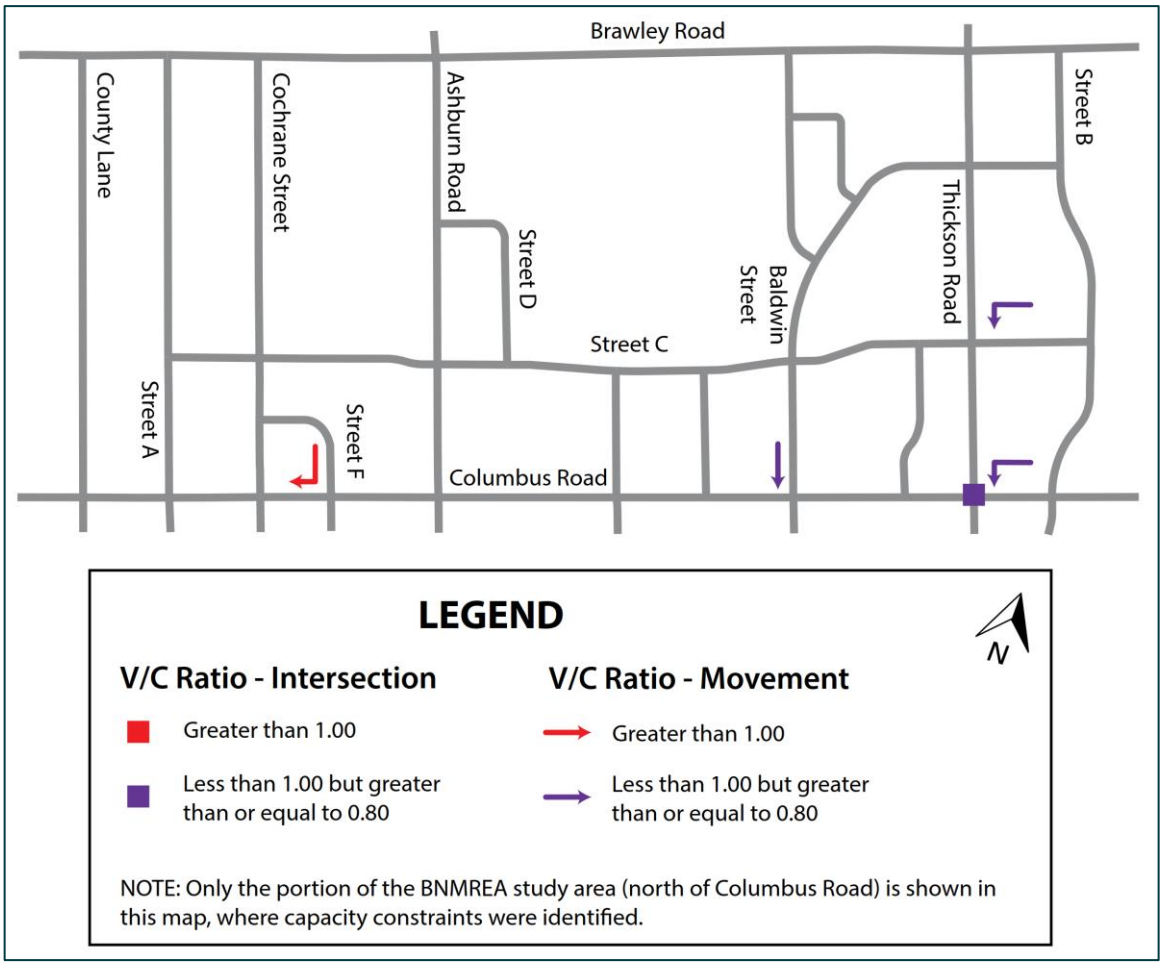
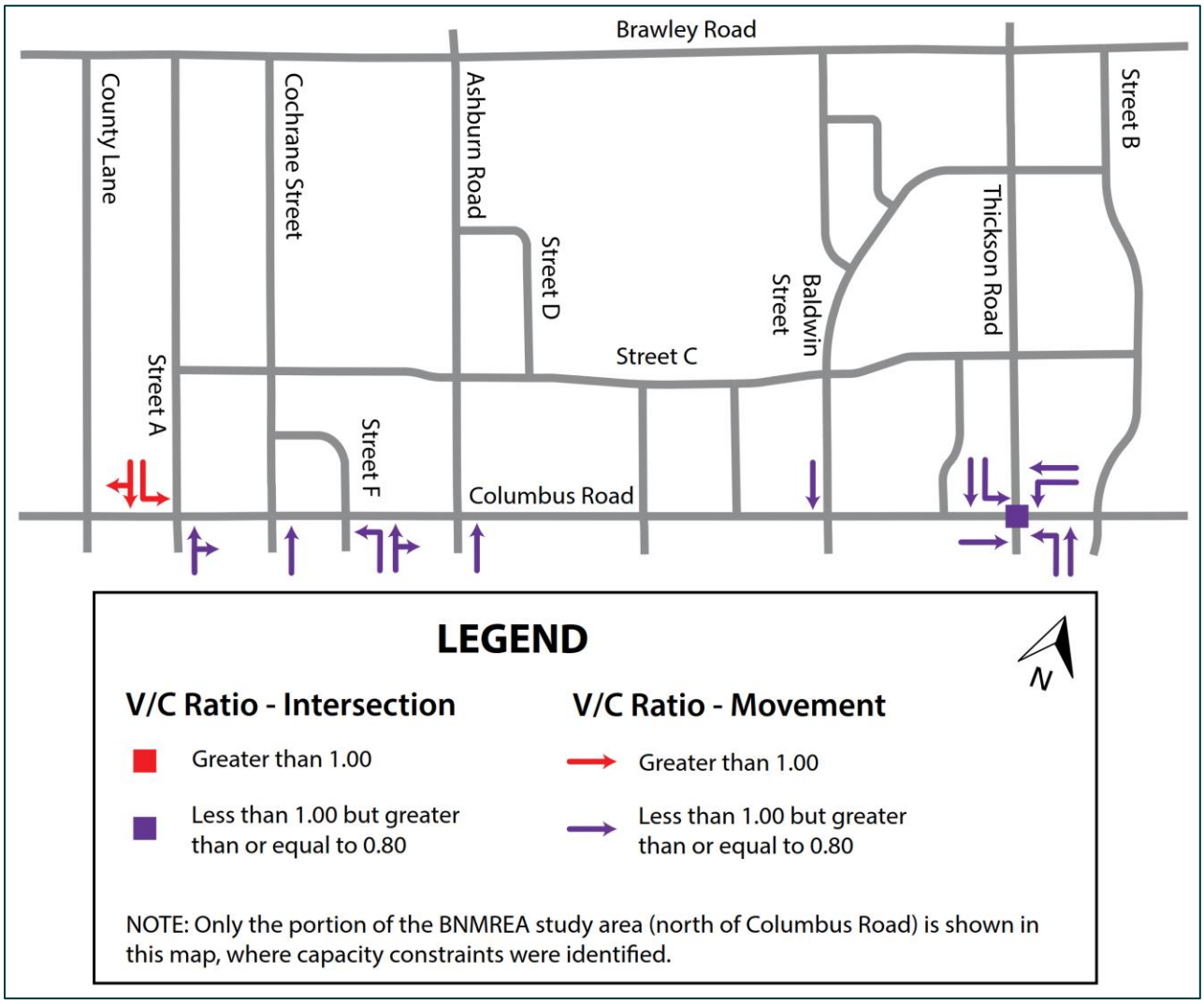


Figure 8-2: Future Weekday Afternoon Peak Hour Critical Volume-to-Capacity (V/C) Ratios and Critical Movements



8.2 Stormwater

As described in **Section 3.6**, the BNMREA study area spans across the Lynde Creek, Pringle Creek, and Oshawa Creek Watersheds, under the jurisdiction of CLOCA. There are 24 existing and proposed watercourse crossings located throughout the study area, with design details summarized in **Section 7.3**.

The Drainage, Hydrology, Stormwater Management and Hydraulics Report provided in **Appendix G** presents a preliminary drainage and stormwater management plan for the proposed road improvements with strategies and recommendations for stormwater quantity and quality control, LIDs, water balance, and stormwater management facilities (SWMF) design in Redside Dace habitat. The following is a summary of these measures that aim to minimize the impact on the existing watercourses and downstream storm sewer systems.

8.2.1 Watercourse Crossing Design

Every effort has been made to size the watercourse crossing structures such that any structures located downstream on a reach impacted by multiple roads would not create a bottle neck for upstream flows. As well, a significant improvement in structure sizes is proposed for all crossings within the study limits to ensure the drainage strategy includes an adequate conveyance system of creek flows that prevents future road overtopping and meets MTO's criteria based on the respective road classification, while maintaining existing overland flow routes. Several watercourse crossings outside of the scope of the BNMREA were also identified for future studies as they require replacement to prevent future road overtopping.

8.2.2 Storm Sewer System Design

This report does not cover the proposed storm sewer system design for all roads within the scope of this BNMREA. This will need to be completed in more advanced stages of the project once additional details and grading plans are available for all proposed developments around these roads. Outlet locations and constraints due to water levels in the receiving creeks will need to be considered to ensure storm sewers will have a free flow outfall and creek flows would not back up into the proposed storm sewer system. All storm sewer systems will need to follow the Town's design criteria.

Further field investigations, including topographic survey, Subsurface Utility Investigations (SUE) and CCTV survey, is recommended during the Draft Plan review/approval process to refine the drainage strategy along Columbus Road in the vicinity of WC #5 and #9. At both of these locations, the external catchment area, which is currently intercepted by the existing storm sewer system, needs to be accounted for in the proposed storm sewer design to maintain existing drainage patterns and outlets.

8.2.3 Water Quantity Control

Based on CLOCA's Technical Guidelines for Stormwater Management Submissions, it was established that post-development peak flows need to be controlled to match pre-development peak flows for the 2-year to 100-year storm event. Following this criterion, storage requirements, as summarized in **Table 8-2**, were developed. During the Draft Plan review/approval process, additional analysis is required to allocate these volumes in either underground storage facilities within the road ROW or stormwater management ponds as well as a combination of LIDs.

It should be noted that the preference is to include these controls in the surrounding SWMF for the proposed subdivisions. The approximate volume allocation for each road to accommodate quality and quantity control as well as maps illustrating the proposed stormwater management pond locations as shown in the CBP are provided in **Appendix G**.

Table 8-2: Water Quantity Control Storage Requirements for Lynde and Oshawa Creeks

Road	Lynde Creek - 100 year Required Storage (m^3)	Oshawa Creek - 100 year Required Storage (m^3)
Columbus Road	4,070	470
Cochrane Street	2,070	-
Ashburn Road	3,300	-
Street A	2,400	-
Street B	-	2,800
Street C	3,700	330
Street D	800	-
Street E	1,600	-
Street F	1,400	-
Street G	1,600	-

8.2.4 Water Quality Control

The widening of the existing roads and addition of new roads is expected to increase the imperviousness within the road ROW and the runoff discharged to outlets, which poses both water quantity and water quality concerns. Thus, future mitigation measures that may be most effective are proposed, based on applicable standards and guidelines, particularly the Stormwater Management Planning and Design Manual (March 2003) by the MECP as well as the Low Impact Development Stormwater Management Planning and Design Guide (2010) by Credit Valley Conservation.

The main two approaches to dealing with the increased flows and water quality concerns are end of pipe stormwater facilities and LIDs. Examples of LIDs include bottomless catch basins, vegetable buffer strips, tree soil cells, and oil and grit separators. The feasibility of these LIDs should be further investigated during the Draft Plan review/approval process once soil condition, groundwater levels and space constraints are more defined. To follow a treatment train approach, these main two measures will need to be combined in further stages of the project to promote good infiltration rates within the watersheds and meet the regulatory guidelines of 80% removal of total suspended solids.

8.2.5 Stormwater Management Facility Design in Redside Dace Habitat

A total of nine watercourse crossings (WC #2, #4, #6, #15, #16, #20, #21, #23, #24) and a number of SWMFs representing ultimate outlets of roadway runoff are located within Redside Dace habitat. Following the MNRF's Guidance for Development Activities in Redside Dace Protected Habitat (March 2016), various methods such as LIDs and end of pipe stormwater management methods will be implemented to address water quantity and quality concerns.

Furthermore, criteria outlined by the MECP's Stormwater Management Planning and Design Manual (March 2003) will be implemented for the design of the proposed stormwater ponds to mitigate the increased temperatures. The criteria focus on pond configuration, riparian planting strategy, bottom-draw outlet, subsurface trench outlet, nighttime release, and outlet channel design.

In addition, the MNRF's Thermal Mitigation Checklist for Stormwater Management Ponds Discharging into Redside Dace Habitat (July 2014) will be considered during preliminary stormwater management facility block sizing. Thermal mitigation of stormwater management ponds is also an important component to ensuring that Redside Dace habitat is not impacted long-term and will be considered and incorporated into the design where feasible.

8.3 Utilities

The design of the utilities within the road ROW shall be considered in relation to the Town's typical cross-sections and standard separation requirements. Generally, utilities within the road allowance shall be designed to avoid potential encroachment or conflict with surface features such as street trees or street lighting.

The construction of the widenings will require the relocation of all existing utilities to their ultimate locations as per the designated ROW. Most notably affected is the Elexicon network which will require relocations along Columbus Road, Cochrane Street, and Ashburn Road. Through the Draft Plan review/approval process, the utility companies will be engaged to determine the proposed relocations. All utilities affected are illustrated in **Appendix L**.

In addition to the relocations, it is expected that in order to service the proposed development new utility connections will need to be made to the Brooklin North area. These will be made in consideration of the proposed Phasing and Implementation Plan and should be done in order to minimize construction activity along the ROW.

8.4 Archaeological

There are a number of areas identified for archaeological potential, given the largely undisturbed nature of the study area. The areas with archaeological potential where the proposed alignments of the recommended design are impacted must subjected to further Stage 2-4 archaeological assessment (AA) as shown in Figure 3-10 and **Appendix E**, and cleared of archaeological potential prior to the start of construction. Indigenous Community involvement during further Stage 2-4 archaeological assessment is recommended.

8.5 Climate Change

In June 2019, the Town declared that climate change is an emergency and efforts to drastically reduce greenhouse gas emissions should be considered in all Town initiatives. The BNMREA focuses on a large study area which is mainly in a natural, semi-natural or agricultural state. Modifying and introducing new infrastructure to the area required significant consideration to integrate more resilient and sustainable infrastructure. Climate change trends across Ontario and more locally across the Greater Toronto Hamilton Area, including Durham Region, show that temperatures are increasing across all seasons, precipitation patterns are changing, and extreme weather events are becoming more intense and frequent. Planning to account for these changes in historical averages as well as short-term, more extreme events is challenging, but essential.

The Region's TMP provides some guidance to address climate change impacts on transportation projects. Potential climate change effects to consider during construction include the greenhouse gas

emissions associated with the construction period including the physical machinery and equipment, travel distance and time for construction workers to get to and from the site, and the sourcing of building materials. To minimize potential effects during construction, the idling of construction equipment will be minimized, and equipment will be in good working order to reduce inefficiencies in the operation of the equipment.

The provision of enhanced ditches will improve storm water collection and reduce potential flooding impacts on area lands. The provision of paved shoulders/bike lanes will encourage active transportation and, therefore, may decrease the use of motor vehicles along the corridor. If motor vehicle trips are reduced, this will decrease the release of one of the biggest contributors to carbon dioxide, a key greenhouse gas.

Significant and/or sensitive flora and fauna were identified within the study area, and road designs were modified to avoid all conflicts when possible. Mitigation measures to reduce impacts to these communities are further discussed in **Section 8.7**. To replace or increase vegetation along the preferred road options, additional width was provided within the boulevard space to accommodate trees for additional carbon storage and water retention during storm events.

A number of bridge and culvert structures were identified through the development of the alternatives. Since the preliminary design of these watercourse crossings were based on significant storm events (100-year), additional freeboard is currently provided for some culverts in Lynde Creek, which can address climate change concerns. The preliminary watercourse crossing designs also considered adaptive design options, consistent with both the MECP, the Region of Durham Community Climate Adaption Plan, and the Town's Official Plan. During the Draft Plan review/approval process, a commitment shall be made to review, address, and reconfirm as necessary considerations for climate change, including adaptive capacity for both existing and future structures and implementing sustainable measures to reduce the severity of storm event impacts on the infrastructure.

8.6 Air Quality, Dust and Noise

More detailed studies regarding the air quality and noise impacts associated with the recommended design are included in **Appendix H** and **Appendix I**, respectively.

RWDI completed a Qualitative Air Quality Impact Assessment in May 2020 to examine the potential impact on air quality associated with increasing vehicle volumes in the study area due to the development of the Brooklin North community. The assessment focused on the impact on existing residences located south of Columbus Road and east of Ashburn Road.

The study concluded that the resulting contaminant concentrations associated with full build-out of the study area will be only slightly higher than the existing scenario and will remain below provincial air quality thresholds. No additional mitigation measures were noted.

Construction phase impacts were not included in the modelling analysis but were addressed qualitatively in the assessments. It is recommended that in order to minimize potential air quality impacts during construction, the construction tendering process should include strict requirements for implementation of an emissions management plan. This plan is recommended to refer to the Cheminfo Services Inc. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities (report prepared for Environment Canada in March 2005, which can be found at http://www.bv.transports.gouv.qc.ca/mono/1173259.pdf).

Overall, it is expected that the proposed projects will not cause any air quality criteria thresholds to be exceeded. That being said, all construction activities should utilize methods to minimize construction noise as included in the Construction Code of Practice. As well, it is expected that due to existing roads

being widened, the design will improve the air quality slightly at sensitive uses in the area due to reductions in traffic idling and general improvement in tailpipe emissions technologies. In addition, all roadways are proposed to incorporate sufficient boulevard space to encourage healthy tree canopies, which provide localized improvements to air quality.

LEA completed a Noise Assessment Study in May 2020 to identify potential noise impacts on noise sensitive land uses within the BNMREA study area. The study considered 105 receptors locations to evaluate the impact of transportation noise emission from the existing roads, as well as the future development of Brooklin North.

The study concludes that current acoustic barriers are generally in good condition and designed with adequate density for proper sound insulation. In a few locations, holes were observed in barriers and repairs are recommended to ensure proper sound insulation. In addition, sound barriers are recommended in several locations on Columbus Road West, Ashburn Road, Cochrane Road, and Street A, B, and C of the BNMREA collector road network to mitigate the noise impact associated with the Brooklin North development.

The road traffic noise levels are anticipated to be typical of suburban areas, and no change is expected in the sound levels from existing to the proposed design. There are multiple locations where daytime ambient levels of traffic are expected around and above the 60 dBA range. Mitigation measures including sound barriers are identified in **Table 8-3**.

Table 8-3: Mitigation Measures within the BNMREA Study Area

Roadway	Receptor Location (Outdoor Living Area)	Mitigation Measure
Columbus Road	Current OLAs located at R3, R5, R6, R9, R16, and R19.	Sound Barrier of 2.0m
	Current OLA located at R1 and Future OLAs represented by R8	Sound Barrier of 2.2m
	Future OLAs represented by R18	Sound Barrier of 2.4m
	Current OLA located at R28	Sound Barrier of 3.0m
Cochrane Street	current OLAs located at receptor R9, R13 and R14 and the future OLAs represented by R2 and R11	Sound Barrier of 2.0m
	future OLAs represented by R1 and R7.	Sound Barrier of 2.4m
Street A	Future OLAs represented by R2	Sound Barrier of 2.2m
Street B	future OLAs represented by R1	Sound Barrier of 2.4m
	Future OLAs represented by R2	Sound Barrier of 2.0m
Street C	future OLAs represented by R5	Sound Barrier of 2.0m
	Future OLAs represented by R7	Sound Barrier of 2.6m
Street G	Future OLAs represented by R3	Sound Barrier of 2.0m

8.7 Natural Environment

As explained in **Section 3.2**, the Natural Heritage Report, prepared by LGL Limited in August 2020, identified potential environmental effects related to the preliminary road design and grading as well as protection or mitigation measures to manage adverse effects.

Overall, the BNMREA carried out the design, evaluation, and selection of the proposed roads in a manner that minimizes encroachment onto and potential impacts on natural heritage features. As the project moves on to the Draft Plan review/approval process, the following tasks need to be conducted:

- Creating environmental management plans, such as for erosion and sediment control;
- Continuous consultation with the MECP to discuss matters related to Species at Risk including field investigations;
- Continuous consultation with DFO to discuss the Fisheries Act requirements, self-assessment of harmful impacts, and Species at Risk; and
- Site-specific Environment Impact Studies as identified by the CLOCA and the Town.

The proposed protection and mitigation measures outlined in the Natural Heritage Report will need to be reviewed and updated as needed during the later stages of this project.

8.8 Ecosystem Protection and Restoration

Given the current natural, semi-natural or agricultural state of the lands, the recommended designs focused on reducing impacts and avoided sensitive natural features as much as possible. However, impacts to some ecosystems were unavoidable and several mitigation and remediation measures were identified for the recommended design, described in the sections below. The proposed environmental protection/mitigation measures will need to be reviewed and updated as necessary during the Draft Plan review/approval process. These recommendations are taken from the LGL Natural Heritage Report and further details can be found in **Appendix D.**

8.8.1 Soils, Erosion and Sediment Control, and Surface Water

Road construction activities (mainly excavation, grading, and cuts/fills) could potentially disturb soil particles, leading to soil erosion and sedimentation in bodies of water. This reduces water quality and could indirectly harm vegetation, wildlife, and aquatic habitat. To reduce soil erosion and its associated harmful impacts, site-specific erosion and sedimentation control plans, in accordance with the Erosion and Sediment Control Guidelines for Urban Construction (2019), must be developed and implemented during and after construction until the soils have re-stabilized. The plan should identify details on the installation, maintenance, and removal of short-term measures to control erosion and sedimentation, such as straw bale flow checks.

It is also possible for contaminants to enter surface water from other sources, such as spills or construction equipment. It is recommended to implement best practices and control for all construction operations to reduce the potential of these additional contaminants entering bodies of water and impairing water quality. Some identified measures include inspecting operation and storage areas prior to construction based on the Erosion and Sediment Control Guidelines for Urban Construction (2019) and developing a Spill Prevention and Response Contingency Plan to effectively report, contain, and clean up in case of a spill.

During construction, the following control measures may minimize construction-related impacts:

- Placing straw bale flow checks at regular intervals in roadside ditches down-gradient from areas of soil disturbance to trap suspended sediments and reduce the erosive force of runoff;

- Placing silt fence along watercourses, ditches, wetlands and forest/woodland edges in areas of soil disturbance;
- Limiting the extent and duration that soils are exposed to the elements to the minimum area and time necessary to perform the work;
- Managing stormwater during construction to prevent contact with exposed soils;
- Applying seed and mulch, tackifier and/or erosion control blanket in areas of soil disturbance to provide adequate slope protection and long-term slope stabilization;
- Monitoring and maintenance of erosion and sedimentation control measures during construction to ensure their effectiveness;
- Any dewatering will have discharge directed to a sediment containment system (sediment basin, sediment bag, etc.) prior to release to the watercourse;
- Storage, stockpiling and staging areas will be delineated prior to construction and inspected in accordance with the Erosion and Sediment Control Guideline for Urban Construction (GGHA 2006);
- Construction material, excess material, construction debris, and empty containers will be stored at least 30 m distance from watercourses and watercourse banks to prevent their entry into watercourses;
- Equipment refueling, maintenance and washing activities will be conducted at a pre-determined site located at an adequate distance (minimum 30 m) from the watercourses and their banks located within the study area to prevent the entry of petroleum, oil or lubricants (POL) or other deleterious substances (including any debris, waste, rubble or concrete material) into watercourses within the study area, or their release to the environment. Any material which inadvertently enters the watercourses will be removed by the Contractor in a manner satisfactory to the Contract Administrator; and
- All spills that could potentially cause damage to the environment will be reported to the Spills Action Centre of the MECP. In the event of a spill, containment and clean-up will be completed quickly and effectively. In addition, an NSSP (Spill Prevention and Response Contingency Plan) must be included in the contract package to ensure a Spill Prevention and Response Contingency Plan and the appropriate contingency materials to absorb or contain any petroleum products/spills that may be accidentally discharged will be on site at all times.

8.8.2 Aquatic Habitats and Communities

There are 24 existing and proposed watercourse crossings in the study area, 12 of which support fish habitat. For each of the existing or proposed watercourse crossings, the report identifies fish habitats, existing and/or proposed crossing structures, the net environmental effects of all proposed work, and site-specific mitigation measures.

The proposed work at several crossings does not meet the self-assessment criteria for serious harm to fish or fish habitat outlined in the Fisheries Act. Thus, a request should be submitted to DFO during the Draft Plan review/approval process to review this project for authorization. In addition, since a majority of the construction work is proposed to occur in Redside Dace habitat, the work should be reviewed by the MNRF and follow the Ontario ESA.

The proposed construction of culverts, bridges, wing walls, and retaining walls could potentially result in adverse impacts to fish habitat and thus fish, including:

- Temporary disruption or permanent loss of localized fish habitat;
- Changes to water quality and quantity due to erosion and downstream sedimentation;
- Changes in water temperature due to storm runoff or destruction of riparian vegetation; and
- Changes to floodplain and riparian vegetation.

A number of measures were identified to minimize or eliminate these potential adverse impacts. Some of these include:

- Minimizing the length of the proposed culvert or width of bridge;
- Maintaining, to the extent possible, the extent of the floodplain post-development;
- Using temporary flow bypass systems and cofferdams to isolate construction works; and
- Using best management practices to treat water before entering the watercourse.

During construction, the following control measures may minimize construction-related impacts:

- All works to be conducted within the Redside Dace timing window (July 1- September 15);
- Work will be done “in the dry”;
- Vegetation removals will require replacement;
- Substrate should be restored under bridge to provide a low flow channel and suitable habitat for Redside Dace;
- Cofferdams will be constructed using pea gravel bags or equivalent to isolate the work area and maintain flow;
- Where cofferdams are to be employed, unwatering effluent will be treated prior to discharge to receiving watercourse;
- Fish isolated by construction activities will be captured and safely released to the watercourse;
- Good housekeeping practices related to materials storage/stockpiling, equipment fueling/ maintenance, etc. will be implemented during construction; and
- Disturbed riparian areas will be vegetated and/or covered with an erosion control blanket as quickly as possible to stabilize the banks and minimize the potential for erosion and sedimentation.

The goal of the restoration and enhancement plan is to provide an overall benefit to the watercourse at these locations through restoration of riparian habitat. Placement of natural substrates that can form a low flow channel and facilitate fish passage will be required at WC #2, #4, #6, #15, #16, #20, #21, #23 and #24. Restoration of disturbed riparian areas associated with culvert/bridge and retaining wall works should focus on the replacement and enhancement of the riparian vegetation that will be affected by the proposed works. These restoration and enhancement works will increase the diversity of habitat in relation to what is present by increasing riparian cover, increase habitat diversity, and provide good floodplain connectivity as well as provide shade to the watercourses, particularly important in occupied/recovery Redside Dace habitat.

At a minimum, the following should be employed as restoration/enhancement during the Draft Plan review/approval process of the project for all crossings where works (in-water or riparian) are proposed. Banks and riparian areas should be planted with native grasses and shrubs to provide increased shading and allochthonous inputs to the watercourse. Where restoration and enhancement will not suffice to offset/mitigate impacts, compensation should be employed. Compensation plans, if necessary, will be completed during the Draft Plan review/approval process in consultation with regulatory agencies.

8.8.3 Vegetation and Vegetation Communities

The proposed road widening, and construction is expected to displace and/or disturb a total of 81.62 hectares of vegetation communities, including forest, wetland, cultural, and human influenced lands. ESAs in the vicinity of the study area are not expected to be impacted, but it is recommended that provisions be in place to avoid and protect these areas. In addition, some Species at Risk and rare species were identified in the study area. Several measures are outlined in the report to mitigate the impacts of construction to vegetation and vegetation communities as much as possible, including minimizing the removal of vegetation, preventing soil migration, protecting exposed surfaces with native vegetation cover, and restoring vegetation.

Overall, impacts to most wetland communities will result with removals along existing community edges, adjacent to roads where community edges are already in a disturbed state. Most of these communities are identified as Low Sensitivity within CLOCA's ESA system. Thus, impacts to these communities are expected to be of minor significance. At a minimum, the following protection/mitigation measures will be implemented during construction to ensure the protection of vegetation and vegetation communities to the extent possible:

- Wherever possible during the Draft Plan review/approval process, efforts will be made to minimize the removal of vegetation/vegetation communities, to the extent possible;
- The Natural Heritage System shall be retained and enhanced wherever possible;
- Within the Urban Area boundary, the following minimum vegetation protection zones shall be required for protection of natural heritage or hydrologic features and their ecological functions:
  - 30 metres from the centre line of a cold or cool water watercourse
- The contractor shall ensure that soil migration from the construction area is prevented, and that exposed soils are stabilized as soon as is possible;
- Special care will be taken when construction vehicles are operating in the vicinity of the more sensitive wetland and forest features and riparian habitat associated with various watercourses across the study area. Provisions should be included in the contract package to ensure that these more sensitive features are avoided and to prohibit/limit impacts onto these sensitive areas;
- Native and non-invasive vegetation cover will be used to protect any exposed surfaces;
- Old field seed mix and mulching or erosion control blanket will be placed in areas of soil disturbance to provide adequate slope protection and long-term slope stabilization in areas where sensitive features and watercourses are to be protected;
- Appropriate tree protection will be installed to protect trees and natural areas to be retained, including safeguarding trees and natural areas from construction operations, equipment and vehicles. Prior to construction, trees and natural areas to be protected will be clearly identified in the field by the Contract Administrator and a protective barrier will be installed. Repairing or replacing trees/shrubs identified to remain outside of grading limits, which become damaged by construction activities, should be undertaken; and, restoration of disturbed natural areas should use a native species seed mix and woody species plantings similar to the character of the surrounding area, or similar native woody species;
- Restoration and edge management planning will be undertaken and implemented to mitigate impacts related to vegetation removals and/or impacts near to existing edges of natural areas. Restoration and edge management planning shall be undertaken by experienced, qualified professionals;
- Maintenance and warranty should be in place for restoration works undertaken;
- Landscape planning and planting will be undertaken and implemented to mitigate removals within landscaped/manicured areas, to beautify areas within the new ROW, provide shading, provide wildlife habitat for local, urban species, and to promote carbon capture. Landscaping planning and implementation shall be undertaken by experienced, qualified professionals;
- Maintenance and warranty for Landscaping should be in place for landscaping works undertaken;
- Minimize vegetation disturbance using the following recommended mitigation measures:
- Prior to site preparation (clearing, grubbing, grading), fence work limits with temporary tree protection hoarding and sediment and erosion control fencing to prevent encroachments into the surrounding woodlands during construction;
- Fell trees into the ROW to the extent possible to avoid damaging non-target vegetation. Chip fallen trees and brush on site;
- Remove, transport and dispose Ash (Fraxinus spp.) trees in compliance with the Canadian Food Inspection Agency (CFIA) guidelines and directives to prevent the spread of Emerald Ash Borer;

- Engage a qualified arborist to inspect trees along the edges of the work area after construction is completed. If necessary, remediate or remove any trees damaged as a result of clearing or construction;
- Implement an edge management plan along the road allowance following construction to protect the newly created forest edges. Place buffer plantings along the forest edge to mitigate disturbances, increase shade, and reduce wind. Spread wood chips from the cleared vegetation in the planting areas; and
- Develop a vegetation salvage plan to help retain native biodiversity and implement the plan prior to site preparation and construction. Consider soil seed bank salvage and/or transplanting individuals or populations of native species from the road alignment to suitable areas on the site. Avoid areas with significant numbers of invasive species, such as Dog-strangling Vine and Common Buckthorn, for plant salvage unless appropriate measures can be taken to ensure that native species are transplanted without spreading invasive species to other areas of the site.

Vegetation Compensation

- Where significant vegetation communities (specifically Cultural Woodland, Cultural Plantation, Forest and Wetlands) are irreparably damaged or lost, offsets will be provided to compensate for this habitat loss. The offsets will be provided at a 1:1 ratio on a like-for-like basis to the extent possible. The offsets will also be located within the sub-watersheds where the vegetation loses will occur, where feasible, with the transfer of a comparable area of land
- from the Greenbelt buffer area (outside of the Greenbelt and Minimum Vegetation Protection Zone (MVPZ), not within the CLOCA system, and not within 30 m of a significant feature). The current assessment of the lost natural environment, based on the recommended preliminary design for the new infrastructure, indicates that 0.23 ha of cultural woodland, 0.03 ha of cultural plantation, 0.91 ha of forest, and 1.65 ha of wetland communities for a total of 2.82 ha will be removed due to new transportation infrastructure. The final quantification of lost area will be determined during the Draft Plan review/approval process.
- A preliminary review of suitable lands on which to provide compensation has been largely determined, and confirmation will be provided to CLOCA prior to the Draft Plan review/approval process, along with a commitment to undertake restoration for all impacted lands within five years of environmental clearance of the Environmental Study Report. Lands identified for compensation will be parcels of adequate size to restore habitat within fewer parcels by creating larger habitat segments that ultimately serve to enhance existing natural heritage features. Where lands for suitable wetland restoration are limited, increased forest habitat will be planted in lieu, to be determined in discussion with CLOCA.

8.8.4 Wildlife and Wildlife Habitat

The construction and operation of the proposed roads have the potential to impact wildlife and wildlife habitat through:

- Displacement of wildlife and wildlife habitat;
- Barrier effects on wildlife passage;
- Wildlife/vehicle conflicts;
- Disturbance to wildlife from noise, light and visual intrusion;
- Potential impacts to migratory birds; and
- Displacement of rare, threatened or endangered wildlife or significant wildlife habitat.

To minimize disturbance to wildlife and wildlife habitat, several measures were recommended such as:

- Locating crossings where historic crossings remain to avoid new disturbances;
- Implementing new crossings in a manner that avoids barriers to wildlife passage;
- Relocating species with limited mobility before construction begins; and
- Conducting construction outside of bird breeding months.

Since the wildlife in the study area is adapted to existing human-made infrastructure, any increase in noise, light, or visual intrusion from the proposed project is not expected to have significant effects. Construction activities will comply with the Town noise control by-law. Should exemptions to the noise by-law be required, the appropriate application should be made to Town Council.

Also, the proposed roads have minimal encroachment into and impacts on the habitats of Species at Risk identified in the study area; nevertheless, it is necessary to consult with the MECP during the Draft Plan review/approval process with the potential need for further field studies.

The modification and widening of the existing road network are not expected to have any significant impact on wildlife and/or wildlife. The construction and operation of the new roadway network proposed through this project has the potential to result in impacts to wildlife and wildlife habitat. The majority of the land area that will potentially be occupied by these new roads will be areas already disturbed by agriculture, especially those that traverse the landscape in a north-south direction, as they will run parallel to watercourses and their associated natural habitats. Greater impacts may occur in areas where the roads cross these natural habitats in an east-west direction. Efforts have been taken and should continue to locate these crossings where existing crossings occur. Any new area crossings should seek to restore/relocate disturbed habitats.

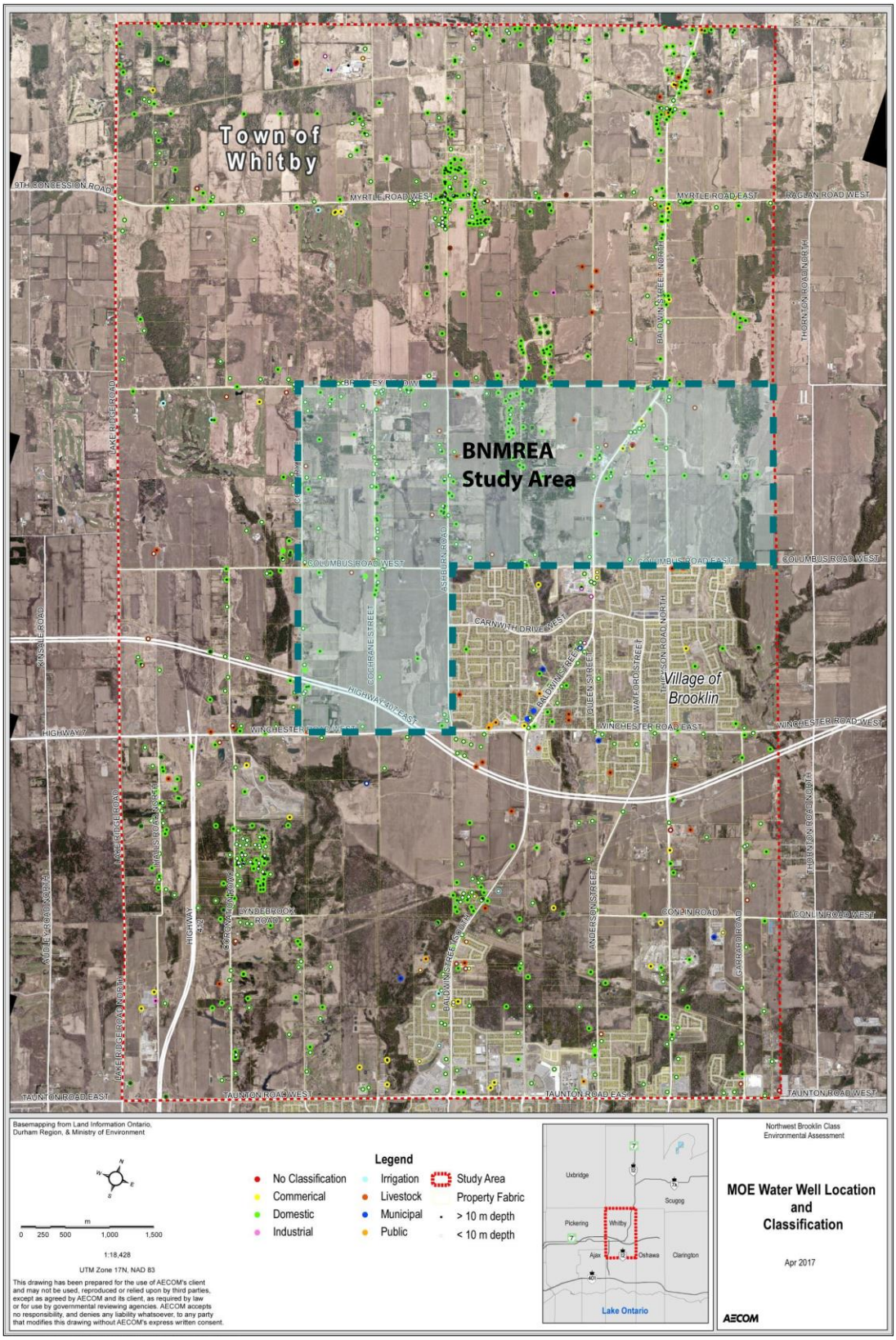
At a minimum, the following protection/mitigation measures will be implemented before and during construction to ensure the protection of communities to the extent possible:

- A wildlife linkage will be provided for Street B within the Level 1 linkage area (shown in Figure 3-4).
- During the next Detailed Design phase, new crossings will be designed in consultation with the Town and CLOCA based on the openness ratio outlined in the Natural Heritage Report (Appendix D), and constructed and maintained so that wildlife corridors associated with these valleylands will be preserved to avoid creating barriers.
- Migratory birds were confirmed within the study area. The contractor shall comply all requirements under the Migratory Bird Convention Act (MCBA), and construction works and clearing that would disrupt birds projected under the MBCA must be completed outside the breeding bird season (i.e. April 1 to August 31) of any given year.
- Prior to construction activities, a wildlife salvage will be performed to remove species with limited mobility (amphibians and reptiles) from harm. A Scientific Collector's Permit in accordance with the Fish and Wildlife Conservation Act will be obtained from MNRF prior to the wildlife salvage. Wildlife will be moved to the closest available suitable habitat located outside of the area of disturbance.
- Consult MECP during the Draft Plan review/approval process and construction to confirm permitting requirements for any disturbances to wildlife habitats.

8.9 Groundwater

As noted in **Section 3.3**, the majority of the CLOSPA receives its drinking water from Lake Ontario with only 5% relying on private wells. It is recognized that as a result of existing land uses in the BNMREA study area, the existing residents do rely on private wells to supply drinking water. These were mapped as part of the Brooklin Study and are illustrated in **Figure 8-3**. Generally, the wells in the study area range in depth from approximately 3m to 223m. Based on the profile of the preferred design the maximum cuts to the existing elevation have been minimized and limited to approximately 2.5m. Based on this, and the understanding that the residential wells will be removed as a result residential intensification that triggers the proposed roadways, the impact of the roads will be minor.

Figure 8-3: MECP Water Well Records (AECOM Natural Environment Report, 2017)



Outside of the changes to the elevation of the existing ground, it is expected that there may be localized impacts to the water table as a result of the dewatering required to construct the proposed bridges and culverts at the watercourse crossings. To account for this impact, the construction of the bridges and culverts should be timed seasonally to mitigate the anticipated impacts.

8.10 Property Requirements and Grading Implications

Given that the study area is largely undeveloped, property will need to be acquired in order to facilitate the implementation of the BNMREA road network. In total the preferred design will require the acquisition of 49ha of property for the road ROWs and require easements to facilitate grading on another 14ha. The property identified is expected to be acquired through two main processes. With much of the area subject to redevelopment, it is understood that the property required for the improvements could be obtained through future development applications or may need to be expropriated. Generally, the properties required do not impact any structures that would not have otherwise been redeveloped as part of an overall Plan of Subdivision.

A summary of the affected properties is provided by **Table 8-4** to **Table 8-14**. Detailed plan and profile drawings are available in **Appendix J**, which identify the limits for impacts on property and grading.

Table 8-4: Property Impact Summary for Columbus Road

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
7035 County Lane	Columbus Road West	0.10	-
835 Columbus Rd W	Columbus Road West	0.35	0.07
840 Columbus Rd W	Columbus Road West	0.10	0.01
810 Columbus Rd W	Columbus Road West	0.13	0.01
7300 Cochrane St	Columbus Road West	0.16	0.02
740 Columbus Rd W	Columbus Road West	0.07	0.01
710 Columbus Rd W	Columbus Road West	0.13	0.02
835 Columbus Rd W	Columbus Road West	0.35	0.08
7081 Cochrane St	Columbus Road West	0.12	0.01
7201 Cochrane St	Columbus Road West	0.08	0.03
7152 Ashburn Rd	Columbus Road West	0.53	0.07
6783 Cochrane St	Columbus Road West	0.11	-
625 Columbus Rd W	Columbus Road West	0.68	0.19
7053 Ashburn Rd	Columbus Road West	0.26	0.06
Columbus Road Open Space	Columbus Road West	0.01	0.04
7053 Ashburn Rd	Columbus Road West	0.03	0.02
410 Columbus Rd W	Columbus Road West	0.07	0.02
390 Columbus Rd W	Columbus Road West	0.04	0.004
405 Columbus Rd W	Columbus Road West	0.003	0.004
35 Bellhouse Pl	Columbus Road West	0.004	0.002
302 Montgomery Ave	Columbus Road West	0.01	0.002
360 Columbus Rd W	Columbus Road West	0.25	0.03
320 Columbus Rd W	Columbus Road West	0.02	-
310 Columbus Rd W	Columbus Road West	0.04	-
190 Columbus Rd W	Columbus Road West	0.02	0.003
188 Way St	Columbus Road West	0.04	0.001

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
180 Columbus Rd W	Columbus Road West	0.01	0.02
187 Way St	Columbus Road West	0.04	-
170 Columbus Rd W	Columbus Road West	0.14	0.01
7245 Cedarbrook Trail	Columbus Road West	0.15	-
Lynde Creek Open Space	Columbus Road West	-	0.15
2 Camber Ct	Columbus Road West	-	0.03
7260 Baldwin St N	Columbus Road West	0.14	0.04
360 Columbus Rd W	Columbus Road West	0.02	0.02
6900 Baldwin St N	Columbus Road West	0.10	0.1
7030 Baldwin St N	Columbus Road West	0.05	0.01
37 Northcastle Cres	Columbus Road West	-	0.01
43 Bellhouse PI	Columbus Road West	-	0.004
[nil] Baldwin St N	Columbus Road East	0.34	-
100 Columbus Rd E	Columbus Road East	0.19	-
160 Columbus Rd E	Columbus Road East	0.14	-
6875 Baldwin St N	Columbus Road East	-	0.02
91 Columbus Rd E	Columbus Road East	-	0.04
91 Columbus Rd E	Columbus Road East	-	0.004
7150 Thickson Rd N	Columbus Road East	0.21	-
400 Columbus Rd E	Columbus Road East	0.04	-
[nil] Columbus Rd E	Columbus Road East	0.06	0.01
360 Columbus Rd E	Columbus Road East	0.05	0.01
[nil] Columbus Rd E	Columbus Road East	0.02	0.004
400 Columbus Rd E	Columbus Road East	0.59	0.06
Total		**6.00**	**1.25**

Table 8-5: Property Impact Summary for Cochrane Street

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
[nil] Cochrane St	Cochrane Street	0.39	0.08
835 Columbus Rd W	Cochrane Street	0.74	0.46
6783 Cochrane St	Cochrane Street	0.19	0.04
6743 Cochrane St	Cochrane Street	0.13	0.04
6675 Cochrane St	Cochrane Street	0.03	0.01
6663 Cochrane St	Cochrane Street	0.03	0.01
6643 Cochrane St	Cochrane Street	0.03	0.01
6605 Cochrane St	Cochrane Street	0.05	0.02
6583 Cochrane St	Cochrane Street	0.03	0.01
6573 Cochrane St	Cochrane Street	0.06	0.01
6543 Cochrane St	Cochrane Street	0.03	0.005
330 Winchester Rd W	Cochrane Street	0.53	0.17
Total		**2.24**	**0.87**

Table 8-6: Property Impact Summary for Ashburn Road

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
330 Winchester Rd W	Ashburn Road	1.10	0.30
625 Columbus Rd W	Ashburn Road	0.18	0.09
Columbus Road Open Space	Ashburn Road	-	0.02
7053 Columbus Rd W	Ashburn Road	0.11	0.04
7143 Ashburn Rd	Ashburn Road	0.12	0.01
7183 Ashburn Rd	Ashburn Road	0.08	0.02
7233 Ashburn Rd	Ashburn Road	0.08	0.02
7293 Ashburn Rd	Ashburn Road	0.07	0.04
7343 Ashburn Rd	Ashburn Road	0.07	0.03
7383 Ashburn Rd	Ashburn Road	0.07	0.04
7413 Ashburn Rd	Ashburn Road	0.08	0.02
7463 Ashburn Rd	Ashburn Road	0.08	0.03
7613 Ashburn Rd	Ashburn Road	0.42	0.17
7963 Ashburn Rd	Ashburn Road	0.43	-
765 Brawley Rd	Ashburn Road	0.39	-
7742 Ashburn Rd	Ashburn Road	0.02	-
7692 Ashburn Rd	Ashburn Road	0.02	0.05
7632 Ashburn Rd	Ashburn Road	0.02	0.03
7602 Ashburn Rd	Ashburn Road	0.06	0.04
7492 Ashburn Rd	Ashburn Road	0.03	0.03
7472 Ashburn Rd	Ashburn Road	0.02	0.02
7432 Ashburn Rd	Ashburn Road	0.06	0.05
7362 Ashburn Rd	Ashburn Road	0.03	0.02
7302 Ashburn Rd	Ashburn Road	0.03	0.07
7152 Ashburn Rd	Ashburn Road	0.42	0.25
8195 Ashburn Road	Ashburn Road	0.023	-
760 Brawley Road	Ashburn Road	0.006	-
Total		**4.02**	**1.39**

Table 8-7: Property Impact Summary for Thickson Road

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
42 Apsley Cres	Thickson Road	0.02	-
400 Columbus Rd E	Thickson Road	0.01	-
7055 Thickson Rd N	Thickson Road	0.01	-
400 Columbus Rd E	Thickson Road	0.36	-
7470 Thickson Rd N	Thickson Road	0.08	-
7400 Thickson Rd N	Thickson Road	0.08	-
7240 Thickson Rd N	Thickson Road	0.1	-
7150 Thickson Rd N	Thickson Road	0.15	-
24 Briggs Cres	Thickson Road	0.01	-
69041 Ashburn Road	Thickson Road	0.01	-
Total		**0.83**	**-**

Table 8-8: Property Impact Summary for Street A

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
975 Brawley Rd W	Street A	0.98	-
7762 Cochrane St	Street A	0.34	-
7712 Cochrane St	Street A	0.23	-
7632 Cochrane St	Street A	0.23	-
7300 Cochrane St	Street A	3.18	0.28
810 Columbus Rd W	Street A	0.04	0.03
835 Columbus Rd W	Street A	1.12	0.32
370 Brawley Road	Street A	0.06	-
Total		**6.18**	**0.63**

Table 8-9: Property Impact Summary for Street B

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
400 Columbus Rd E	Street B	2.71	0.38
7480 Garrard Rd	Street B	0.32	0.13
7590 Garrard Rd	Street B	2.65	0.84
Total		**5.68**	**1.35**

Table 8-10: Property Impact Summary for Street C

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
7300 Cochrane St	Street C	0.74	0.43
7321 Cochrane St	Street C	0.53	0.18
7362 Ashburn Rd	Street C	0.66	0.26
7302 Ashburn Rd	Street C	0.89	0.46
7343 Ashburn Rd	Street C	0.85	0.69
360 Columbus Rd W	Street C	1.15	0.19
7245 Cedarbrook Trail	Street C	1.29	0.07
7260 Baldwin St N	Street C	1.19	0.71
7365 Baldwin St N	Street C	1.06	0.33
100 Columbus Rd E	Street C	0.82	0.63
7400 Thickson Rd N	Street C	0.57	0.33
400 Columbus Rd E	Street C	1.26	0.36
Total		**11.01**	**4.64**

Table 8-11: Property Impact Summary for Street D

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
7613 Ashburn Rd	Street D	0.97	0.20
7463 Ashburn Rd	Street D	0.23	0.10
7413 Ashburn Rd	Street D	0.23	0.10
7283 Ashburn Rd	Street D	0.23	0.11
7343 Ashburn Rd	Street D	0.50	0.02
7293 Ashburn Rd	Street D	0.11	0.05
Total		**2.27**	**0.58**

Table 8-12: Property Impact Summary for Street E (Extension of Vipond Road)

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
6523 Country Lane	Street E	0.91	0.78
6483 Country Lane	Street E	0.23	0.05
835 Columbus Rd W	Street E	0.60	0.21
[nil] Cochrane St	Street E	0.47	0.29
330 Winchester Rd W	Street E	2.51	0.61
6472 Country Lane	Street E	0.10	0.17
Total		**4.82**	**2.11**

Table 8-13: Property Impact Summary for Street F

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
330 Winchester Rd W	Street F	2.09	0.57
625 Columbus Rd W	Street F	0.55	0.09
7152 Ashburn Rd	Street F	0.96	0.16
7201 Cochrane St	Street F	0.47	0.13
Total		**4.07**	**0.95**

Table 8-14: Property Impact Summary for Street G (Extension of Carnwith Drive)

Address	Proposed Street Alignment	Est. Property Required for ROW (Ha)	Est. Property Required for Grading (Ha)
835 Columbus Rd W	Street G	2.56	0.50
6605 Cochrane St	Street G	0.18	0.04
6643 Cochrane St	Street G	0.16	0.06
330 Winchester Rd W	Street G	2.00	0.44
6800 Country Lane	Street G	0.09	0.10
Total		**4.99**	**1.14**

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9 Revisions and Addenda to the Environmental Study Report

This section will delineate minor adjustments that have been contemplated in the proposed design and major changes that would necessitate a formal addendum to the ESR. Any addenda required shall be led with the ESR and the Notice of Filing of Addendum shall be given immediately to all potentially affected members of the public and review agencies, as well as those who were notified in the preparation of the original ESR. The ESR addendum will be placed on the public record with the Town for a 60-day review period. A person or party with concern regarding the addendum may make a written request to the Minister of the Environment for a "Part II Order" within this 60-day period. In accordance with the Environmental Assessment Act R.S.O 1990, E. 18 (as amended July 21, 2020):

- "A person may request the Minister to make an order under this section only on the grounds that the order may prevent, mitigate or remedy adverse impacts on the existing aboriginal and treaty rights of the aboriginal peoples of Canada as recognized and affirmed in section 35 of the Constitution Act, 1982. 2020, c. 18, Sched. 6, s. 25 (1)."

Provided that no Part II Orders are received, the Town may proceed to Phase 5 of the MCEA process, design and construction.

9.1 Lapse of Time

According to the MCEA process, "if the period of time from the filing of the Notice of Completion of Environmental Study Report in the public record or the MOE's denial of a Part II Order request(s), to the proposed commencement of construction for the project exceeds ten (10) years, the proponent shall review the planning and design process and the current environmental setting to ensure that the project and the mitigation measures are still valid given the current planning context. The review shall be recorded in an addendum to the Environmental Study Report which shall be placed on the public record."

It should be noted that the above noted expiration of the approval is subject to further extensions offered by the Minister in accordance with Environmental Assessment Act R.S.O 1990, E. 18, s. 11.5 (as amended July 21, 2020). The extension offered by the Minister can be issued at any time including after the 10th anniversary of the approval and the Minister can through the extension set a date in which the approval would expire.

9.2 Change in Planning Context or Background Conditions

Subsequent to the filing of the ESR, any modification to the project or change in the environmental setting for the project shall be reviewed by the proponent. Should the change be considered significant, it should be documented as an addendum to the ESR detailing the circumstances necessitating the change, the environmental implications of the change, and the mitigating measures. A minor change to the undertaking can proceed without an addendum as long as there are in line with the intent of the environmental assessment.

9.3 Changes in Adjacent Plans of Subdivision or Site Plans

It has been acknowledged that there are number of Schedule 'B' roads that were identified by the Brooklin Study but are not included in the recommended design as part of this BNMREA. These roads and intersections have been incorporated as part of this BNMREA as a means to assess the performance of the intersection and constructability constraints. It is noted that the specific future geometry of the minor street, area required, proposed lane configurations, and applicable sightlines will be determined

and reviewed through the Development Application and Draft Plan review/approval process. During the Development Application process, the Town may request studies including, but not limited to, Transportation Impact Studies, Functional and Preliminary Designs, Safety Assessments, and Sightline Analyses. Through the Development Application process, it is expected that these roads will be secured as a Specific Condition of Approval.

It is also acknowledged that at the time of the completion of the BNMREA, the grading plans for the adjacent developments had not yet been finalized. As a result, it was the intent of this BNMREA to minimize cut- and fill of the properties adjacent to the proposed ROWs. That said, it is recognized that as the development process proceeds, and the specific soil management plans are developed there may be opportunities to develop vertical and horizontal profiles that minimize the anticipated impacts. Any proposed modification to the vertical and horizontal profiles would be subject to approval by the Town and are to be proposed in accordance with the Town's design standards. The anticipated variation in the vertical and horizontal alignments is expected to be minor and occur within the development block. That is to say, the intersection locations between existing and proposed roads, as well as proposed and proposed roads, is not expected to deviate significantly. Further, the locations of the watercourse crossings, while subject to approval by the CLOCA and further investigation (i.e. geotechnical investigations, environmental impact statement, or more detailed hydraulic assessments), are also not anticipated to deviate.

9.4 Land Acquisition

It is anticipated that most of the property required to develop the proposed road network will be acquired through the planning process as part of either the plans of subdivision or site plans. That being said, it is expected that some property is affected that is not subject to development. The recommended design as part of this BNMREA, for the most part, incorporates a grading solution for any difference in elevation between the proposed road and existing ground. Should through the Draft Plan review/approval process, however, should it be determined that grading permissions will not be sought across some properties and the Town would opt to implement a retaining wall instead, this would be deemed to be a minor alteration to the recommended design and not require an addendum to be filed.

9.5 Archaeological

The Stage 1 archaeological assessment (AA) done as part of the BNMREA which identified several areas with archeological potential require further assessment. As part of the Draft Plan review/approval process, the proposed road alignments shall be subjected to further Stage 2, 3 and 4 AA as recommended in the Stage 1 AA in advance of construction. Results of these investigations are not expected to trigger an addendum to this ESR.

9.6 Geotechnical Investigation

As part of this BNMREA, geotechnical investigations were not conducted. Rather, it is understood that through the course of the Development Application process a soil management and soil excavation plans will be prepared for the subject sites. Through this process it is expected that additional information regarding the soil composition will be obtained. Soil management provisions will be undertaken in accordance with Ontario Regulation 153/04 and are expected to include a Record of Site Condition. Should through the course of the geotechnical investigations, it may be identified that the soil conditions within the proposed ROWs are unsuitable. In such cases a qualified person (as outlined in Ontario Regulation 153/04) will be engaged to develop either a soil treatment or disposal program. It is also understood and anticipated that the qualified person may make recommendations to the alignment

of the road ROW to minimize overall impact to soil management requirements. Provided the intersection location and watercourse crossing locations do not change, these changes would be considered to be minor in nature and not require an addendum to the ESR.

It is also expected that, and as a result of the geotechnical investigations, undertaken through the Draft Plan review/approval process, the foundation and pavement structure design will be finalized. The geotechnical engineer engaged during the Draft Plan review/approval process will identify the necessary soil bearing requirements and make a recommendation with respect to the proposed foundation type for the bridge structures and culverts. While the anticipated foundation and structure type may change as a result of these investigations, provided that the crossing locations are maintained, these changes would be considered to be minor in nature and not require an addendum to the ESR.

9.7 Watercourse Span

9.7.1 Supplementary Natural Environmental Survey

Following the filing of this ESR, it is acknowledged that the project team will undertake a summer season natural heritage field investigation. This additional field survey will be considered in combination with the fall and spring season of surveys undertaken for the Brooklin North Major Roads EA, existing secondary sources, and other background Environmental Impact Studies. Further, the findings from the summer field survey will be summarized in a Supplemental Report to be filed with the ESR and included in the project file. Based on the Natural Environment review conducted to date, it is not expected that the findings of the summer field survey will result in changes to the overall recommendations of the Brooklin North Major Roads EA. That being said, should the findings result in changes being required to the recommended alternative design concepts, an addendum to the ESR will be required before the undertaking can proceed to implementation.

9.7.2 Ecological Considerations

Changes to the watercourse spans would increase the footprint within the environment and may require the collection of further environment data and analysis. However, this is not expected to trigger an addendum to this ESR. As identified in **Section 8.7**, it is important to consult with relevant agencies (including the MECP, CLOCA, and DFO) to discuss matters related to Species at Risk and further field investigation.

9.7.3 Hydraulic Considerations

As discussed in previous chapters and in detail in the report in **Appendix G**, there are various watercourse crossings that have been identified due to the widening of the existing roads or addition of new roads. All structures were designed to meet MTO criteria, environmental constraints and limit fluctuations in water levels.

The proposed structure types are as follows:

- Four open footing culverts (at WC #1, #2, #13, and #17);
- Four box culverts (at WC #3, #8, #11, and #14);
- Nine bridges (at WC #4, #6, #15, #16, and #20 to #24);
- One circular culvert (at WC #7);
- Three wide span culverts (at WC #10, #19, and #25); and
- One twin barrel circular culvert (at WC #12).

Flows under future conditions will be conveyed by proposed minor and major storm systems (at WC #5 and #9).

All clearance criteria have been met at all crossings except for WC#6; freeboard criteria have been met at all crossings except for WC #9 and #12 due to site constraints since culverts are located on existing roads; and HW/D criteria has been met in all culvert crossings.

In order to avoid any bottle necks in the system, considerations for culvert replacements located upstream were provided, however these existing culverts are located outside of the scope of work of this BNMREA. The following is a summary of culverts upstream or downstream of the proposed culverts that require upgrades and should be recommended for improvements in further studies:

- Existing culvert upstream of WC#1 is a 1.7m x 0.78m arch corrugated metal culvert (HEC-RAS ST 4497 – HeberT2 Reach 3) that is at full capacity (100yr);
- Existing bridge downstream of WC#6 is a 12.2m span bridge (HEC-RAS ST 5082 – Lynde 5) is at full capacity (100yr);
- Existing Culvert at WC#8 is a 1.55m diameter circular culvert (HEC-RAS ST 787 – Lynde T3 Reach 1) is at full capacity (100yr);
- Existing culverts downstream of WC#10 is a 2.38x1.19m box culvert (HEC-RAS ST 1254.65 – Ranglan T4) is at full capacity (100yr);
- Existing culvert upstream of WC#15 is 0.5m diameter CSP culvert (HEC-RAS RS 5246 – Heber T2a Reach 2) is at full capacity (100yr & Regional);
- Existing bridge upstream of WC#16 is a 10m span bridge (HEC-RAS ST 8 – Ashburn 1) is at full capacity (100yr);
- Existing culvert upstream of WC#17 is a 0.91x0.91 box culvert (HEC-RAS ST 2970 – LyndeT3) is at full capacity (100yr); and
- Existing culvert downstream of WC#20 is a 6.1m x 1.56 concrete box culvert (HEC-RAS ST 1064 - HeberT2 Reach 2) is at full capacity (100yr & Regional).

As part of the Draft Plan review/approval process, a complete HEC-RAS model needs to be further developed for Lynde Creek Watershed to include all return periods analyzed (currently only 100-year and Regional event were updated in the model). Once this hydraulic model is available, the structure sizing presented in this report needs to be revisited to ensure compliance to standards; it is expected that changes in flow data may impact the structure sizes. If structure sizes need to be changed, this would require an update to the hydraulic analysis and drainage and stormwater management plan. This is expected to proceed without needing an addendum to this ESR.

9.7.4 Upstream/Downstream Impacts

The watercourse crossings modelled in HEC-RAS were analyzed for differences in water levels at multiple cross sections upstream and downstream of a culvert. Due to the absence of an existing structure, most watercourse crossing locations indicated an increase in water levels compared to existing conditions as the previously unobstructed stream was replaced with a structure that acted as a potential restriction in flow area within the reach. Through an iterative process, the structures were designed such that minimal fluctuation was observed in water levels upstream and downstream of the structures while complying with the design criteria.

There were two watercourse crossings with overall decreases, fifteen watercourse crossings with both an increase and a decrease, and five watercourse crossings with no change in water levels in upstream and downstream sections. The changes in upstream and downstream water levels varied between a 1.4 decrease and a 0.51 increase. Most fluctuations are localized to the crossing. In cases where new crossings are located in close proximity to each other, the fluctuations are more evident.

During the Draft Plan review/approval process, as part of the update to the hydraulic analysis and drainage and stormwater management plan, upstream and downstream impacts will be considered. This could include analyzing watercourse crossings upstream and downstream of those within the scope of this BNMREA for potential replacement to prevent future road overtopping; storm sewer system design with detailed grading plans for the area; and incorporating best practices for drainage and stormwater management to minimize impacts on existing watercourses and downstream storm sewer systems.

9.8 Review and Adjustment of Recommend ROW

The recommended ROW identified for each street within this BNMREA represent the preferred design to accommodate safety, traffic operations, street connectivity, active transportation, utility and maintenance needs, and optimal soil planting zones for street trees. They were selected based on the polices and strategic directions as related to Complete Streets practices, the roles and function of the roadway identified in the Town's TMP (2010) and the Brooklin TMP, and Municipal guideline documents (e.g. The Town's Design Criteria and Engineering Guidelines, Landscape Plan Guidelines, etc.). The preferred ROW's were then used to establish the relevant design criteria and cross section elements for the subject arterial and collector roads.

It is acknowledged that opportunities to adjust the ROW width, and associated cross section elements, and minor changes to property requirements may be considered during the Development Application process; Draft Plan review/approval process; and in response to changes in development plans, municipal servicing requirements, or if a physical/road design constraint is identified. All Draft Plan ROWs shall be finalized prior to the Draft Plan approval.

Any consideration of modified ROW width would be conditional on the completion of supporting technical studies and designs (e.g. Transportation Impact Studies, servicing plans, alternative cross sections, etc.) that provide a rationale and justification for the proposed adjustment. The technical studies must demonstrate that the proposed modification is appropriate and is consistent with the intent of the preferred solution as identified in this BNMREA and would be subject to approval by the Town.

9.9 Intersection Control Measures

The intersection control measures recommended in Technical Memorandum 2, and the subsequent preliminary designs for intersections provided in this BNMREA may be revised or require modifications based on refinements to the individual design elements brought forward through the Plan of Subdivision and detailed design and processes (e.g. lane widths, queue storage requirements, roundabout diameter, etc.). This would require the provision of updated design drawings and relevant transportation analysis with appropriate traffic modelling to demonstrate that the proposed intersection control / geometry appropriately accommodates forecasted traffic demand, active transportation, safety, natural environment impacts. Changes with respect to the recommended intersection control, or the preliminary design plates provided in this BNMREA would be subject to approval by the Town and be consistent with the Town's approved guidelines. Any such updates are not expected to trigger an addendum to this ESR.

Despite the above, intersection locations shown in the ESR, and the recommended intersection control, does not preclude the Town from approving access to individual development blocks as development occurs in North Brooklin. Furthermore, this BNMREA does not preclude the Town from approving intersections along the corridors within the scope of the BNMREA (signalized, unsignalized, or roundabout), subject to appropriate rationale and analysis provided, and a design being provided that is

acceptable to the Town. Any additional intersections or driveways would be considered as part of the Development Application process for individual development sites which may be proposed as the area builds out.

9.10 Geomorphological Investigations

This BNMREA has relied on the geomorphological investigations prepared to date as part of either the Brooklin Secondary Plan or the CBP. It is recognized that as part of the Draft Plan review/approval process additional geomorphological investigations will be required to develop the footing designs, ensure slope stability and mitigate potential erosion. Incorporating the findings of this studies are not expected to result in significant changes to the recommended design and would not trigger an addendum to the ESR.

9.11 Other Changes

In addition to the items outlined above, it is expected that through the course of the Draft Plan review/approval process minor alterations to the recommended design may be required. The determination of whether a change is deemed minor and is accordance with the environmental assessment, is noted to be at the discretion of the Town. Changes deemed minor can occur within the Draft Plan review/approval process and do not require a public notification. It is anticipated that through this the Town will work with its partner agencies, including CLOCA, to notify if changes to the design have been made.

BROOKLIN NORTH LANDOWNERS GROUP
MALONE GIVEN PARSONS