Highway 400 - Highway 404 Link (Bradford Bypass) County Road 4 Early Works (GWP 2008-21-00)

County Road 4 Qualitative Climate Change Assessment

Ontario Ministry of Transportation

Project number: 60636190

January 21 2022

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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1 Introduction

The Ontario Ministry of Transportation (MTO) has retained AECOM Canada Ltd. (AECOM) to undertake the Early Works study for the grade separated bridge crossing at County Road 4 for the future Bradford Bypass (Highway 400 – Highway 404 Link), in accordance with the provisions of the Ontario Regulation (O. Reg.) 697/21 (herein referred to as "the Project"). The limits of construction work are located along County Road 4 from 8th Line to the intersection with 9th Line within in the Town of Bradford West Gwillimbury and that area is referred to as the Study Area. This study will advance as an early works project for the Bradford Bypass. The new bridge will be designed to include the widening and underpass of County Road 4 approved by Simcoe County.

AECOM is pleased to provide this memorandum discussing the qualitative impacts of climate change related to the preliminary design of the County Road 4 Early Works.

A review of the project documents shows that the main components of the project include the following:

Table 1: List of project components and elements

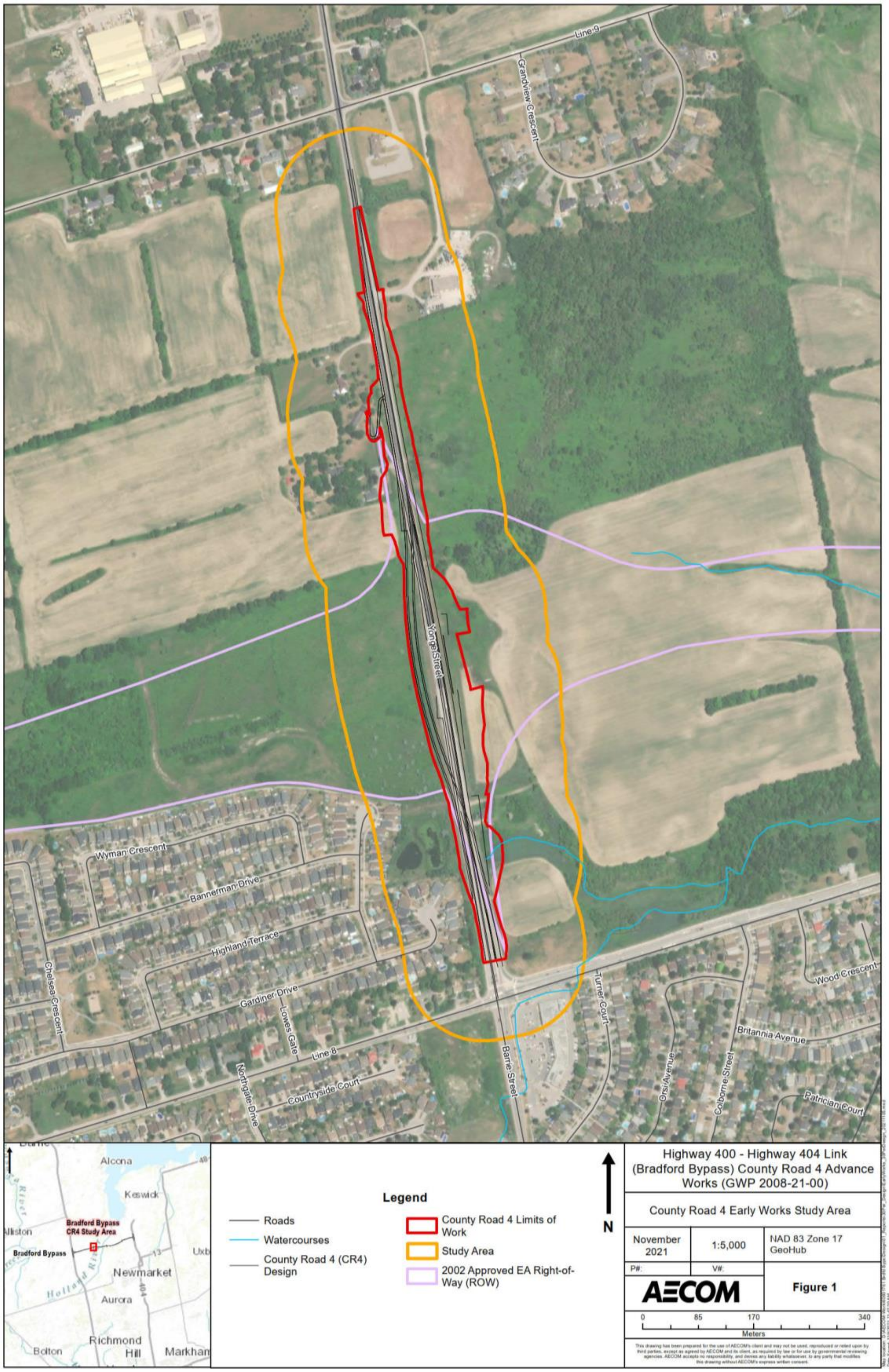
Components	Elements
Construction site	• Shoulder strengthening and temporary roadway widening • A temporary detour road • Temporary aerial traffic signal spans, traffic island removals, and lane shifts • Reprofiling and realigning County Road 4 • Pavement markings, signage, traffic safety and control devices, barriers, and attenuators • Driveway and entrance access modifications, realignment, and reconstruction
Plant and equipment	• Fencing • Drainage and watercourse • Lighting
Materials	• Illumination poles • Duct crossings and manholes for future lighting • Electrical embedded ducts for the County Road 4 structure • Aerial traffic signal spans
People	• Construction/operation Workers • Users of the bypass
Operation of the overpass infrastructure	• Bypass structure • Pavement • Road users
Surrounding natural environment	• The Unnamed Tributary north of 8th Line and the Holland River • The surrounding terrestrial ecosystems • Agricultural lands • Residential subdivision
Indigenous communities	This refers to Indigenous communities that have or may have existing aboriginal or treaty rights, as recognized and affirmed in section3 5 of the *Constitution Act, 1982,* that may be impacted by the Early Works, and Indigenous communities that may otherwise be interested in the Early Works

1.1 Study Area

As shown in Figure 1, the study area is located in the Town of Bradford West Gwillimbury and County of Simcoe and falls within the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA). The limits of the study area are summarized below:

- North Limit is 200 m south of 9th Line (Sta. 9_300), and
- South Limit is 100 m north of 8th Line (Sta. 10_350).

Figure 1: Study Area



The land use consists of a residential subdivision, located in the south-west quadrant of the intersection of County Road 4 and 8th Line, and agricultural lands with some rural residential properties located along the north portion of the study area. The topography of the site generally slopes to the east towards the Holland River, which conveys flow north to Cook's Bay (Lake Simcoe). The study area itself is quite steep across County Road 4, with most of the roadway at a 3% slope with one section sloped at 6%.

The project encompasses the area marked in red within Figure 1 which shows how the MTO County Road 4 Advanced Works GWP 2008-21-00 project will tie into the County of Simcoe County Road 4 Widening Phase 1 design, as approved under the June 2012 Environmental Study Report "County Road 4: Phase 1 widening from 11th Line to 8th Line."

1.2 Climate Change Assessment & the Environmental Assessment Process

In 2017 the Ministry of Environment, Conservation and Parks (MECP) released a new guide "Considering Climate Change in the Environmental Assessment Process" (Climate Change guide) released under the *Environmental Assessment Act*, R.S.O. 1990, chapter E.18. This guidance demonstrates both quantitatively and qualitatively how proponents should address climate change impacts and mitigation considerations for new projects undergoing the environmental assessment process. In a letter dated September 28, 2020, the MECP requested this guidance be employed for the Highway 400 – Highway 404 Link (Bradford Bypass) No. 2019-E-0048, and therefore is also being considered as part of the County Road 4 Early Works GWP 2008-21-00.

The directions implemented within the MECP's Climate Change guide were developed to support the climate-focused policies of the Provincial Policy Statement (section 3 of the Planning Act).

The Provincial Policy Statement was updated in 2020 to align with other changes to land use planning changes to the *Planning Act* through *More Homes, More Choice Act, 2019,* and *A Place to Grow: Growth Plan for the Greater Golden Horseshoe*. A partial listing of applicable policies in the 2020 Provincial Policy Statement include (Ontario Government, 2021):

- Policy 1.1.3.2 – Land use patterns within settlement areas shall be based on densities and a mix of land uses which:
    - Minimize negative impacts to air quality and climate change, and promote energy efficiency
- Policy 1.6.6.7 – Planning for stormwater management by minimizing erosion and changes in water balance, and prepare for the impacts of a changing climate through effective management of stormwater, including the use of green infrastructure
- Policy 1.8 - Planning authorities shall support energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions, and preparing for the impacts of a changing climate through land use and development patterns.
- Policy 3.1.3 Planning authorities shall prepare for the impacts of a changing climate that may increase the risk associated with natural hazards.

As part of the assessment of climate change, the MECP expects proponents to evaluate and assess the following key items during the assessment of alternatives and alternative methods of implementing the project undergoing environmental assessment:

1. the project's expected production of greenhouse gas emissions and impacts on carbon sinks (climate change mitigation), and
2. the resilience or vulnerability of the undertaking to changing climatic conditions (climate change adaptation).

This memorandum will focus on both these key areas of assessment for the Project and describe possible mitigation options available for reducing the Project's effects on climate change (Climate Change Mitigation), and the effects of climate change on the Project (Climate Change Adaption).

2 Climate Change Mitigation

In assessing potential impacts the Project may have on the local area and impacts on climate change; the following key questions must be considered within the planning and design stages.

1. How might the project/alternatives generate greenhouse gas emissions or affect carbon storage or the removal of carbon dioxide from the atmosphere?
2. To what extent have the project/alternatives already taken into account impacts on climate change in project planning?
3. Are there alternative methods to implement the project that would reduce any adverse contributions to a changing climate?
4. How might the project/alternatives give rise to climate change impacts, positive or negative, on Indigenous people and/or communities?
5. What commitments can be made to reduce the impacts on climate change from the project over time, i.e. when the project is implemented?

Each of these questions was addressed in the following sub-sections of this assessment, with suggested mitigation included where appropriate.

2.1 Greenhouse Gas Background

Greenhouse gases emitted from vehicular traffic, construction, and other sources of carbon emission and sinks identified within this report are limited to carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These may be emitted from sources such as tailpipe exhausts, diesel vehicular combustion, on-site generator combustion, decomposition of natural materials within existing naturalized areas, created upstream through material sourcing (e.g. concrete and steel production), and removed from the atmosphere as part of natural biosynthesis of vegetation within the project study area. The balance of creation and absorption of greenhouse gases from a project's construction, operation, and maintenance phases contributes to the overall climate change impact a project may have on the surrounding environment and regional climate.

Individual greenhouse gases have differing abilities to absorb heat in the atmosphere. These varying heat absorption properties are quantified by an individual global warming potential (GWP) factor for each contaminant which converts the mass of a greenhouse gas to the representative equivalent mass of CO_2 ($CO_{2\ eq}$). The Global Warming Potentials are calculated based on the amount of heat trapping potential that would result from the emission of 1 kg of a given greenhouse gas to the emission of 1 kg of CO_2. Global Warming Potentials for various greenhouse gas compounds are defined by Environment Canada in their most recently published article in the Canadian Gazette Par I, Volume 155 (February 13, 2021)[1]. These GWP values are identified in Table 2 below.

Table 2: Greenhouse Gas 100-year Global Warming Potentials

Greenhouse Gas	100-year GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous Oxide (N_2O)	298

[1] Canadian Department of the Environment, *Canadian Environmental Protection Act, 1999: Notice with respect to reporting of greenhouse gases (GHGs) for 2020*, Canada Gazette, Volume 155, Part I, February 13, 2021. Accessed January 6, 2022: https://gazette.gc.ca/rp-pr/p1/2021/2021-02-13/html/sup1-eng.html

2.2 Net Greenhouse Gas Emissions

To promote design efficiencies between the Bradford Bypass Project and the County of Simcoe's widening of County Road 4 (2012 approved Municipal Class Environmental Assessment), MTO will incorporate the widening elements for this section of County Road 4 and include the construction of a multi-use path on behalf of the County of Simcoe. The benefit of the Early Works is that it reduces the requirement to perform construction activities twice within one region, once for the widening of County Road 4, and a second time for the construction of the grade separated bridge crossing of the Bradford Bypass. This significantly reduces requirements for additional removal of natural features and associated carbon sinks/reservoirs and increased upstream cost from construction materials required for the second phase of construction. Combining the County of Simcoe's widening into MTO's Early Works contract also allows the vegetation along the slopes of County Road 4 to begin to mature and contribute to the local carbon sink, rather than be completely removed a second time as would be the case if the widening were performed as a separate contract by the County of Simcoe. Completing this project will allow ease of construction on future Bradford Bypass interchange works, limiting required feature construction to interchange ramps, intersection ramp terminals, lighting and traffic systems, ultimate drainage systems, and pavement markings, signage and traffic control devices.
The impacts of greenhouse gas emissions from the Project are contributed during three primary phases: construction, operation, and maintenance. Construction emissions may be categorized as both direct and indirect emissions which includes emissions from construction vehicle operation, land use change, and upstream material production for concrete, asphalt, steel, and other materials required for road construction. The upstream emissions of greenhouse gas are typically referred to as 'embodied carbon' within the buildings industry and can account for a vast majority of the emission on new construction projects as global production of concrete alone accounting for 26% of all industrial carbon dioxide emissions in 2019[2].

Construction of new projects can impact the lands surrounding the construction site, reducing the percentage of local carbon sinks and reservoirs within the area. Carbon sinks are generally defined as areas which work to remove carbon from the atmosphere, typically including agricultural lands, forests, and large bodies of water. Carbon reservoirs perform a similar function, but also have the capacity to hold carbon within their systems which may be released later within the life cycle. These can include wetlands, vegetation and soils, reservoirs of fossil fuels, and permafrost land. The Project is anticipated to affect the local lands surrounding construction area through both expansion of road footprint for the final design and for construction of temporary bypass/detour roadways during the construction phases of the Project, both of which will impact existing agricultural land surrounding the roadway footprint. This would have a minor impact on the ability of the land within the study area to act as carbon sinks and/or reservoirs, which could slightly increase the Project's potential impact to climate change. The relative impact of this change of land use in relation to other key aspects of the Project's construction, such as embodied carbon and upstream greenhouse gas production in material production, would be considered insignificant and may be decreased through specific targeted mitigation within the final design. Based on the area of vegetated land use which would be impacted by construction and project development, and the low-biomass per square-foot ratio of the type of vegetation found within this Project staging zones (i.e. grasses vs. densely forested land), the loss of carbon sink potential is significantly outweighed by the volume of GHGs associated with upstream creation of concrete, steel, asphalt, and other construction materials required for the road. Nevertheless, the impacts from loss of vegetated carbon sink land can be mitigated by swiftly re-instating greenspace with biomass dense vegetation (e.g. shrubs, etc.) as construction progresses where feasible, as an example.

The operation life cycle of new road or road alteration projects, such as the County Road 4 Early Works, are typically anticipated to have the greatest impact on greenhouse gas emissions from the anticipated adjustment to road traffic and traffic behaviour patterns within the study area resulting from the new project implementation. A traffic analysis was performed on the Project, including a comparison to existing conditions assessed during 2019, the County Road 4 Early Works (without the construction of the Bradford Bypass) assessed at the 2041 project horizon, and the County Road 4 Early Works including the projected Bradford Bypass intersection. Table 3 below shows the results of these three scenario comparisons.

[2] Joint statement: Canada's Cement Industry and the Government of Canada announce a partnership to establish Canada as a global leader in low-carbon cement and to achieve net-zero carbon concrete (https://www.ic.gc.ca/eic/site/icgc.nsf/eng/07730.html)

Table 3: Traffic Analysis Results for County Road 4 (AECOM, 2021)

	2019 (Latest Available Year)	2041 (Design Year) Only Widening	2041 (Design Year) With the Bradford Bypass
AADT	18,763	25,200	29,800
SADT	17,483	23,481	27,767
DHV	1,989	2,671	3,159
AM Peak Hour Volume	1,261	2,190	2,974
PM Peak Hour Volume	1,596	2,082	2,079
% Commercial vehicles	4% (2017)	6%	6%

6. AADT: Annual average daily traffic defined as the average twenty four hour, two way traffic for the period January 1st to December 31st.
7. SADT: Summer Average Daily Traffic; defined as the average twenty four hour, two way traffic for the period July 1st to August 1st including weekends.
8. DHV: Design Hourly Volume

As shown in this comparison, the traffic along County Road 4 is anticipated to increase in a future scenario. It is unclear from this analysis whether the traffic increase is a direct result of the Project, both from a road widening perspective without the Bradford Bypass and from a wholistic perspective including the addition of the proposed Bradford Bypass intersection. It is reasonable to assume that the projected population increase within the Greater Toronto Area (GTA) and surrounding areas would increase the traffic flow along the north-south routes to and from the County of Simcoe and lower regions and major traffic routes intersecting with the GTA . Regardless, the projected impacts of the Project with and without a Bradford Bypass inclusion show marked increase in daily traffic travel along the County Road 4 route within the study area, which may coincide with a similar increase in vehicular emissions from those operated by gasoline and diesel fuel. This would affect the direct emissions from the Project's operation within the year of 2041 and beyond. There is possible mitigation of the direct affects of the Project's increase in traffic through incorporation of higher percentages of electric and low-emission vehicles through programs like the Government of Canada's proposed Zero Emission Vehicle Infrastructure Program[3].

Maintenance activities would have a temporary increase on greenhouse gas emissions resulting from the operation of construction vehicles operated by gasoline or diesel fuel. In addition, the downstream greenhouse gas impacts may be increased from material disposal or recycling programs.

2.3 Impacts on Climate during Assessment Process

There were no key features of the Project identified as having the potential to reduce greenhouse gas emissions within the community, barring any proposed mitigation measures which may be implemented in the final design. As the project involves widening and detour routing for the County Road 4 Early Works, the reduction of local agricultural land acting as carbon sinks/reservoirs is a necessary component of the construction phase. Steps may be taken to reduce disturbance to natural lands within construction by remaining efficient with use of space, and re-sodding exposed soil as soon as feasibly possible following construction completion. The construction is proposed in stages, which may be conducive to retaining minimal local impact and replacing vegetation in completed segments of road construction once a given construction stage has been completed.

[3] Zero Emission Vehicle Infrastructure Program (https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876)

2.4 Alternative Designs for Project

This Project included an alternative assessment for three bridge options an NU Girder design, a Steel Box Girder design and a Cast-in-place Post-Tensioned Deck. While there would be an alteration in material requirements for each design which would affect upstream greenhouse gas emissions and embodied carbon within the bridge structures, this was not included as predominate decision factor in the selection of the preferred design. Rather, the design selection process was focused on structural requirements which best fit the overall geography and design requirements for the underpass structure.

2.5 Indigenous Community Impacts

There are several Indigenous communities that have or may have existing aboriginal or treaty rights, as recognized and affirmed in section3 5 of the *Constitution Act, 1982,* that may be impacted by the Early Works, and Indigenous communities that may otherwise be interested in the Early Works, including:

- The Alderville First Nation,
- Beausoleil First Nation,
- Chippewas of Georgina Island First Nation,
- Chippewas of Rama First Nation,
- Curve Lake First Nation,
- Hiawatha First Nation,
- Mississaugas of Scugog Island First Nation,
- Métis Nation of Ontario, and
- The MNO Georgian Bay Métis Council

Care must be taken not to inadvertently harm natural lands which act as a source of carbon sink and reservoir and may also act as a source of resource for communities.

2.6 Greenhouse Gas Mitigation

There are several options and technologies available at this time which can serve to mitigate a project's impact on greenhouse gas release (both direct and indirect).Projected increase in access to new technologies over time is anticipated as provincial and federal governments implement new focused actions related to climate change mitigation development. Preliminary mitigation options for this Project can include the use of best practices and technologies that target greenhouse gas emissions and climate change impacts during all project phases (i.e. construction, operation and maintenance).

Table 4 details project impacts to greenhouse gas releases and climate change resulting from construction, operation, and decommissioning phases of the project and potential mitigation measures which may be employed to reduce project impacts.

Table 4: Greenhouse Gas Emission & Climate Change Mitigation Options

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
Construction: Reduction of natural or agricultural land acting as carbon sink and/or reservoir within the project Study Area	Corresponding percentage of land use reduction in available carbon sink and reservoir capacity for removing carbon from the atmosphere.	• Limiting the requirement of naturalized land to only that which is required to construct the Project, including that which is required to appropriately stage construction. • Re-naturalizing (e.g. re-sodding, vegetation, and tree planting, etc.) of staging areas immediately following construction phase end.

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
Construction: Operation of gasoline or diesel fuel powered construction vehicles a**nd equipment** during construction activities	Emissions from diesel or gasoline powered vehicles and equipment cause an increase in greenhouse gas emissions during construction operations.	• Properly maintaining vehicles and other internal combustion engines used on site (pumps, generators, etc.) to ensure engines are operating as designed with optimal emissions. Minimizing on-site vehicle idling during construction activities and implementing a vehicle maximum idling policy while on site.
Construction: Paving techniques	Approach to paving on-site during construction has a direct impact on greenhouse gases released.	• Use of reclaimed materials in the roadway - aggregate for use in new hot mix asphalt and road base, subase or shoulders
Construction: Structural work	Structural design and material component selection has an impact on both indirect upstream greenhouse gas emissions and embodied carbon of structural materials for the project.	• Use of prefabricated Bridge Elements to improve the efficiency and duration of construction is an option open to the Contractor • Precast concrete pavement and rapid set concrete for concrete repairs to minimize congestion • Extended life-cycle materials (ASTM 1010 or Corrosion Resistant Steel) to minimize rehabilitation requirements
Construction: Traffic management	Approaches for traffic management on road construction projects has an impact on the indirect emissions from vehicles passing through the construction zone.	• Design-Build Reference Concept drawings includes a construction detour to reduce congestion.
Construction: Earth management	Approaches to earth management on-site during construction has an impact on direct emissions from vehicles operating onsite, and embodied carbon of the project infrastructure during its lifespan.	• Where property availability allows, using excess materials on site through slope flattening is an option that can be considered by the Design Build Contractor in order to minimize the need to truck excess materials away from the Site. • Minimizing double handling of materials and the associated trucks required for hauling is typically desired by contractors to reduce costs, this also has the benefit of reducing fuel requirements and emissions. • Retained soil system (RSS) walls or mechanically stabilized earth (MSE) rather than concrete retaining walls
Operations: Electrical systems design	Design of electrical systems for the project has the capacity to affect the indirect emissions of greenhouse	• LED Traffic Signal Heads and LED Lighting at the intersection of County Road 4 and 8th Line, if specified by the Town of Bradford

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
	gases related to energy production for the ongoing operation of the project infrastructure during its lifespan.	West Gwillimbury which has jurisdiction over this intersection,
Operations: Increased impact from gasoline and diesel fueled passenger and commercial vehicles travelling within the Study Area	Increased vehicle kilometers travelled along the project corridor, projected through traffic modelling for the various project scenarios and/or alternatives, will increase greenhouse gas emissions from vehicle tailpipe exhaust. Anticipated improvement to vehicle emission efficiencies (via new manufacturer standards, low-carbon fuels and electric vehicles) can effectively decrease emissions from travelling vehicles within the study area; however, these efficiencies may be offset by traffic increases if significant enough.	• The Town of Bradford West Gwillimbury had jurisdiction over the signalized intersection at County Road 4 and 8th Line; however, signal timing plans are typically designed to reduce overall vehicle delay either at an individual intersection or on a network wide basis, this in turn leads to reduced idling time.

Additional considerations on climate change may be carried forward into development of the Bradford Bypass project design. These additional considerations are summarized in Table 5 below.

Table 5: Greenhouse Gas Emission & Climate Change Mitigation Options to be Carried Forward to Bradford Bypass

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
Construction: Increased upstream greenhouse gas emissions (embodied carbon) from material production, including concrete, asphalt, steel, and other necessary materials.	Required materials for construction, including concrete, steel, asphalt, and other materials have an indirect upstream greenhouse gas cost associated with production, typically linearly correlated with tonnes (mass) of material produced for the project. This is typically one of the largest sources of greenhouse gas impact for construction projects due to the high-carbon intensive processes of creating both concrete, steel and asphalt.	• Prioritizing use of low-carbon materials where feasible for the project budget and schedule (e.g. low-carbon concrete as an alternative to Portland cement) • Prioritizing sourcing materials from companies and suppliers with good standing track records for emissions reduction and emission efficient production methods to reduce up-stream carbon costs of material purchase. • Prioritizing transportation of materials via. low-carbon, carbon neutral or carbon free shipping (e.g. local suppliers, electric powered shipping, Tier 4 locomotive rail shipping where feasible, etc.)
Maintenance: downstream emissions from material waste practices or recycling practices resulting from road maintenance activities may provide a one-time increase in corresponding project emissions.	Emissions from landfilling of any project organic materials, incineration of project materials, or recycling/reuse of project materials may result in temporary increase in associated greenhouse gas releases.	• Employing a plan for carbon neutral modes of material disposal and/or recycling programs where possible and feasible. Encouraging reuse of available material for future projects to reduce future material production emissions (e.g. recycling of concrete components into new

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
		concrete construction)
Operations: Electrical systems design	Design of electrical systems for the project has the capacity to affect the indirect emissions of greenhouse gases related to energy production for the ongoing operation of the project infrastructure during its lifespan.	• Permanent solar/wind powered variable message signs, where applicable within the design • Solar powered traffic count stations, where applicable within the design • Solar Powered Cathodic Protection system for bridges, where applicable within the design • Vehicle charging facilities to encourage and facilitate use of electric vehicles, where applicable within the design.

3 Climate Change Adaption

The Climate Change Resilience Assessment (CCRA) is performed in the context of a preliminary screening to provide input and direction for the design, construction, operation and maintenance of the Project. A CCRA typically involves adopting a risk management approach to a) anticipate climate change related risks that may have an impact on the assets or activities under study, and b) identify potential design features or actions to help prevent, withstand, respond to, recover from and adapt to these risks.

3.1 Methodology

The CCRA was undertaken following the five key steps described the ISO 31000 Risk Management Standard (i.e., establishing the context, risk identification, risk analysis, risk evaluation, risk treatment and adaptation measures), as well as the Ministry of the Environment, Conservation and Parks (MECP) guidance for Considering Climate Change in the Environmental Assessment Process. The CCRA was based on review of Project documents.

3.2 Establishing the Context

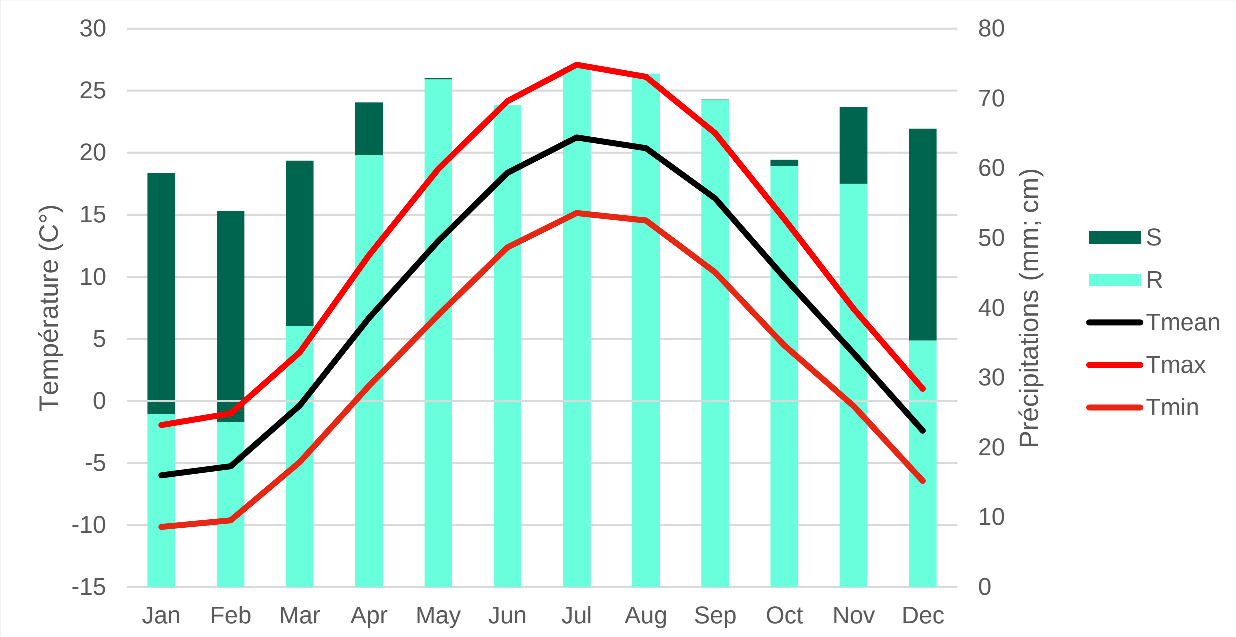
The scope and boundaries of the assessment encompass time periods and areas during and within which the Project components are likely to interact with or be influenced by climate risks. The scope of the assessment for this Project considers climate change impacts on the construction (design) as well as future operation and maintenance phases of the Project.

This project will be staged in approximately three to four years for the construction phase, and it will be operational for approximately 75 years (the life span of the infrastructure). Therefore, the assessment will be carried out using the projections for time periods 2021-2040, 2041-2060, 2061-2080, and 2081-2100.

3.3 Climate Data Analysis

Climate data was analyzed based on temperature and precipitation data measured at the Toronto Pearson International Airport's weather station from 1981 to 2010 from the Canadian Centre for Climate Services (CCCS). Figure 2 below presents climate norms over the 1981-2010 period for temperature (mean, minimum and maximum) and for overall precipitation and snow and rain separately.

Figure 2: Climate Normal from the Weather Station at Toronto Pearson International Airport (1981-2010)



[4]

3.4 Climate Projections

Climate projections are based on assumptions regarding the evolution of GHG emissions. These are referred to as Representative Concentration Pathways (RCP). For this Report, we select the high carbon future (RCP 8.5) scenario as it represents the worst-case scenario, which would bring the highest climate change impacts on the Project. The high carbon future scenario is a very high GHG emission scenario that is consistent with no policy changes and substantial international efforts to reduce emissions. Climate change projections were also retrieved from the CCCS.

3.4.1 Identification of Climate Indicators

A climate indicator represents a certain climate condition or a type of event (e.g., number of hot days with + 30°C), defined by a threshold above which the evaluated infrastructure would trigger a reaction resulting in a loss of productivity, damage to the infrastructure or more intensive maintenance plan. The likelihood or probability associated with an indicator is calculated from data recorded at a weather station and applies to a historical dataset or climate prediction.

The analysis of climate data from the Toronto airport weather station highlights eleven (11) climate variables with a high probability of occurrence in the future. These indicators were selected based on the following criteria:

- Climate indicators identified in past extreme weather events: past extreme weather events were researched and provided insights on which climate indicators are relevant to the future infrastructure.
- Historical and future annual and seasonal variation for both temperature and precipitation were reviewed and provided insights on future trends
- Relevant climate indicators showing significant increases in probability during the project's timeframe
- Relevance of climate indicators to local reality
- Potential interactions of a certain climate condition with the Project component

[4] S = Snow, R = Rain, Tmean= Mean temperature; Tmax= maximum temperature, Tmin= Minimum temperature

Considering climate normal and projected changes for the 2081-2100 timeframe, the calculated probabilities of occurrence for each climate indicator were then converted into a score as shown in Table 6 below.

Table 6: Climate indicators probability scoring (climate data from the Weather Station at Toronto Pearson International Airport)

	Code	Climate Indicators	Definition	1981-2010	2081-2100
Temperature	T1	Hot temperature	Days with Tmax ≥ 30°C	5	5
Temperature	T3	Heat wave	Instances of 3 days with Tmin ≥ 20°C and Tmax ≥ 33°C	4	5
Temperature	T5	Diurnal variation	Days with Tmax-Tmin ≥ 20°C	4	5
Precipitation	P2	Heavy rainfall	Days with P ≥ 25mm	5	5
Precipitation	P5	Winter rain or snow	Instances of P ≥ 25mm within Jan-Feb-Mar	2	3
Precipitation	P9	Drought	Instance of P < 0.2mm for 10 days	5	5
Wind	W1	Heavy wind	Days with W ≥ 65km/h	5	5
Wind	PW1	Blowing rain	Instances of (P ≥ 5mm) and (W ≥ 65km/h)	5	5
Wind	PW2	Blowing snow	Instances of ((S ≥ 5cm) or (SD ≥ 5cm)) and (W ≥ 65km/h)	5	5
Other	H1	Relative humidity	Days with Hmd ≥ 90%	3	3
Other	H5	Fog	Days with fog	4	4

Likelihood Scoring description

Very high	Once every year or more	More than 70% (100%)	5
High	Once every 2 years	40%-70% (50%)	4
Moderate	Once every 5 years	20%-40% (20%)	3
Low	Once every 10 years	4%-20% (10%)	2
Very low	Once every 30 years	4% or less (4%)	1

The probability of occurrence of hot temperatures, heat waves, diurnal variation, heavy rainfall, drought, heavy wind, blowing rain and blowing snow to happen once every year or more in the 2081-2100 timeframe is higher than 70%.

3.4.2 Future Projections

The Project is located within the Town of Bradford West Gwillimbury, which is characterized as having a warm-summer humid continental climate. The climate is cold and temperate, and rainfall is significant, with precipitation occurring even during the driest month.

The modelled climate conditions for the time periods of 2021-2040, 2041-2060, 2061-2080, and 2081-2100 were used over the construction phase and life of the proposed overpass

- The construction phase will have a maximum duration of approximately three (3) years. Thus, the anticipated climate conditions in the 2021-2040 projection time period are considered
- The proposed County Road 4 Underpass Structure will have a minimum design life of 75 years. Thus, anticipated climate conditions in the 2081-2100 projection time period are considered.

Precipitation

The predicted effects of climate change will cause wetter winter and almost drier summer although natural variation, including extreme events such as storms and heat waves (Table 7), will continue to punctuate these trends. The projected changes of total precipitation (snow + rain) for the periods 2021-2041, 2041-2060, 2061-2080 and, 2081-2100 relative to the 1986-2005 average are summarized in table 5.

Table 7: Projected Seasonal Change in Total Precipitation (%) for the town of Bradford West Gwillimbury, ON using RCP 8.5 emission scenario

Season	Time period, Total Precipitation Change (%)			
	2021-2040	2041-2060	2061-2080	2081-2100
Winter	+9.4%	+11.2%	+16.7%	+21.0%
Summer	+2.0%	+0.2%	+0.3%	-0.7%
Spring	+5.9%	+10.9%	+17.9%	+19.7%
Autumn	+5.3%	+5.3%	+1.7%	+5.3%

Source: Canadian Centre for Climate Services (website consulted on November 25, 2021)

The CCCS predicts that there will be an increase in precipitations for all the season for all the time periods except a decrease of 0.7% in the summer in the 2081-2100 period. Thus, the frequency of heavy rainfall (Days with P ≥ 25mm) is expected to continue and even increase during the winter period in the Town of Bradford West Gwillimbury. In this report the term “heavy rainfall” shall mean daily rainfalls of greater than 25mm.

Snow Depth

With regards to future changes, rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter. CCCS projections indicate the Town of Bradford West Gwillimbury will experience a substantial reduction in snow depth as low as -83.2% for the period 2081-2100 (Table 8). The projected change is relative to the 1986-2005 average.

Table 8: Projected Seasonal Change in snow depth (%) for the Town of Bradford West Gwillimbury, ON using RCP 8.5 emission scenario

Season	Time period, change in Snow Depth (%)			
	2021-2040	2041-2060	2061-2080	2081-2100
Winter	-34.5%	-57.3%	-70.5%	-82.3%
Summer	-100.0%	-100.0%	-100.0%	-100.0%
Spring	-97.4%	-97.4%	-94.6%	-97.4%
Autumn	-73.5%	-91.2%	-95.1%	-99.4%

Source: Canadian Centre for Climate Services (website consulted on November 25, 2021)

Temperature

In general, it is anticipated that climate change will cause hotter summers and warmers winters in the Town of Bradford West Gwillimbury (Table 9).

Table 9: Projected Change in Seasonal Mean temperature(ºC) for the Town of Bradford West Gwillimbury, ON using RCP 8.5 emission scenario

Season	Time period , Mean Temperature change ºC			
	2021-2040	2041-2060	2061-2080	2081-2100
Winter	+6.2 ºC	+6.2 ºC	+5.0 ºC	+6.2 ºC
Summer	+1.5 ºC	+2.9 ºC	+4.3 ºC	+5.6 ºC
Spring	+4.9%	+4.9%	+3.6%	+4.9%
Autumn	+5.4%	+5.4%	+4.1%	+5.4%

Source: Canadian Centre for Climate Services (website consulted on November 25, 2021)

There will be an increase in summer mean temperature relative to the 1986-2005 average by approximately 1.5 ºC in the 2021-2040 period up to a rise of +5.6 ºC for the time horizon 2081-2100 under RCP 8.5. The temperature rise will be greater during the winter period, with increases of up to 6.2 ºC (table 5) in comparison to the 1986-2005 average.

Wind

For all seasons, the projected averages of wind speed for all the time periods are smaller than the 1986-2005 averages (Table 10).

Table 10: Projected Change in Seasonal surface wind speed for the Town of Bradford West Gwillimbury, ON using RCP 8.5 emission scenario

Season	Time period , Surface wind speed change (%)			
	2021-2040	2041-2060	2061-2080	2081-2100
Winter	-0.3%	-0.3%	-0.5%	-0.6%
Summer	-1.2%	-2.7%	-4.9%	-6.8%
Spring	-0.7%	-0.6%	+0.2%	-1.1%
Autumn	-6.2%	-6.2%	-4.0%	-6.2%

Source: Canadian Centre for Climate Services (website consulted on November 26, 2021)

3.4.3 Estimate of Likelihood of Climatic Events to Occur

Based on the climate norms and projected changes for the different timeframe, the likelihood rating assigned for the climate indicators varies from low (L), moderate (M) and high (H) (see Table 11).

Table 11: Likelihood rating for climate indicators considered for the assessment

		Construction phase (2021-2040)	Operation phase (2081-2100)
Precipitation	Heavy rainfall	High (H)	High (H)
	Winter rain on snow		
	Drought	Low (L)	Low (L)
Temp.	Hot temperature & Heat wave	– Moderate (M)	Moderate (M)
	Diurnal variation		
Wind –	Heavy wind	Moderate (M)	Moderate (M)
	Blowing rain		
	Blowing snow		
Other	Relative humidity	Low (L)	Low (L)
	Fog		

3.4.4 Risk Evaluation

A project's risk to climate change is determined by:

- A typical severity of consequence on the assets. To estimate the level of consequences, three impact categories were identified based on what is considered most relevant when managing risks for the project. These are impacts on health and safety (include occupational illness and injury to staff or public inconvenience), infrastructure integrity (include damages or deterioration of essential component materials) and operational impacts (include operational inefficiencies and potential facility shut down)
- The probability or likelihood of relevant climate variables in the context of changing climate.

To assess and evaluate the risk of each interaction between the Project components and climate variables, severity levels were given by using relevant literature.

This qualitative risk analysis is determined from the combination of the severity and likelihood ratings, using the matrix shown in Table 12.

Table 12: Risk matrix

Likelihood \ Severity of Consequence	Low	Medium	High
Low	Low risk	Low risk	Low risk
Moderate	Low risk	Moderate risk	Moderate risk
High	Low risk	Moderate risk	High risk

L = Low; M = Moderate; and H = High

Adaptation measures are only suggested to interactions with moderate and high risks.

An environmental management plan (EMP) will be developed prior to construction for the Project and will reflect commitments made under Ontario Regulation 697/21 Bradford Bypass Project. This assessment examines the impacts of adverse climate events within the Study Area of the Project and assess high-level risk mitigation. Therefore, in order to prevent any significant adverse environmental impacts during the construction of the Project and as possible solutions that should be discussed with engineers, the adaptation measures listed in Table 13 can be integrated as part of the EMP for the County Road 4 Early Works. The potential impacts and proposed adaptation measures outlined in Table and Table below will be considered as part of the overall Bradford Bypass Project design, construction, operations and maintenance.

Table 13: Climate Change Adaptation Risk Assessment and Proposed Adaptation Measures Specific for County Road 4 Early Works

Potential Impact	Risk	Proposed Adaptation Measures
Construction: Heavy rainfall event would pose a risk to the construction site. Waterlogging and flash floods may occur on the construction site due to heavy rain. This can compromise any materials contained there.	Moderate	• Design the construction site drainage system to be able to withstand heavy rainfall
Site and Equipment: Potential impacts to equipment and structures associated with changes in winds: • Storms and heavy winds could damage fences and lighting poles. Construction could be delayed by such climate events. • Risk to the safety of site workers and the surrounding environment • Loss of materials • Increase in dust	Moderate	• If any height work will be undertaken, the schedule of activities should be adjusted, and the wind speed reviewed beforehand. • Ensure all site fences and structures are properly secured • Cover spoil and material heaps during periods of high winds • Implement measures to control dust
Surrounding Natural Environment: Potential impacts to the surrounding natural environment as a result of increased precipitation: • During construction, heavy rainfall may result in soil erosion on surrounding agricultural lands and nearby residential subdivision. • Heavy rainfall can also result in accidental spills of hydraulic oil or fuel into the Unnamed Tributary north of 8th Line that can damage terrestrial and aquatic ecosystems	Moderate	• To prevent the risk of erosion and the potential for runoff from the construction site into the Unnamed Tributary north of 8th Line, consider installing sediment barriers and redirecting water to a vegetated area

Table 14: Risk assessment for 2021–2040-time frame for the overall Bradford Bypass Project

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures
Construction site						
Precipitation	Heavy rainfall	M	H	**Moderate**	Heavy rainfall event would pose a risk to the construction site. Waterlogging and flash floods may occur on the construction site due to heavy rain. This can compromise any materials contained there.	The construction site drainage system should be able to withstand heavy rainfall
	Winter rain on snow					
	Drought	L	L	**Low**	The climate change resilience assessment during the construction phase for the construction site elements is rated as low risk, given that the duration of this phase is short and that potential mitigation measures will be integrated into the environmental management plan.	Not applicable
Temperature	Hot temperature & Heat wave		M			
	Diurnal variation		M			
Wind	Heavy wind		M			
	Blowing rain					
	Blowing snow					
Other	Relative humidity		L			
	Fog					
Plant and equipment						
Precipitation	Heavy rainfall	H	H	**High**	Heavy precipitation and increased runoff can cause damage to fences and lighting. Site drainage may become overwhelmed due to heavy precipitation.	Consider making drainage systems more capable to account for climate change
	Winter rain on snow	M		**Moderate**		
	Drought	L	L			

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures
Temperature	Hot temperature & Heat wave	L	M	**Low**	The climate change resilience assessment during the construction phase for some elements of this component is rated as low risk, given that the duration of this phase is short and that potential mitigation measures will be integrated into the environmental management plan	Not applicable
	Diurnal variation	L				
Wind	Heavy wind	M	M	**Moderate**	• Storms and heavy winds could damage fences and lighting poles. Construction could be delayed by such climate events. • Risk to the safety of site workers and the surrounding environment • Loss of materials • Increase in dust	• Consider adjusting the schedule of activities if height work is to be undertaken, and reviewing the wind speed beforehand. • Ensuring all site fences and structures are properly secured • Covering spoil and material heaps during periods of high winds • Taking measures to control dust
	Blowing rain					
	Blowing snow					
Other	Relative humidity		L	**Low**	The climate change resilience assessment during the construction phase for some elements of this component is rated as low risk, given that the duration of this phase is short and that potential mitigation measures will be integrated into the environmental management plan	Not applicable
	Fog					
People						
Precipitation	Heavy rainfall	L	H	**Low**	These climate variables will not affect this component	Not applicable
	Winter rain on snow					
	Drought					
Temperature	Hot temperature & Heat wave	M	M	**Moderate**	• There may be health risks associated with heat waves for workers on construction sites	Consider moving construction work schedules to cooler times in anticipation of hot weather, and incorporating appropriate breaks.
	Diurnal variation					

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures
Wind	Heavy wind				• There's a risk factor for construction workers health when temperatures change rapidly within a day. This is particularly relevant to cardiovascular and respiratory diseases	
	Blowing rain					
	Blowing snow					
Other	Relative humidity	L	L	Low	The climate change resilience assessment during the construction phase for some elements of this component is rated as low risk, given that the duration of this phase is short and that potential mitigation measures will be integrated into the environmental management plan	Not applicable
	Fog					
Materials						
Precipitation	Heavy rainfall	L	H	Low	The climate change resilience assessment during the construction phase for some elements of this component is rated as low risk, given that the duration of this phase is short and that potential mitigation measures will be integrated into the environmental management plan	Not applicable
	Winter rain on snow					
	Drought		L			
Temperature	Hot temperature & Heat wave		M			
	Diurnal variation					
Wind	Heavy wind	M	M	Moderate	Storms and heavy winds could damage aerial traffic signal spans and illumination poles	Consider installing traffic signal spans and illumination poles that withstand heavy winds (W ≥ 65km/h
	Blowing rain	L	M	Low	The climate change resilience assessment during the construction phase for some elements of this component is rated as low risk, given that the duration of this phase is short and that potential mitigation	Not applicable
	Blowing snow					
Other	Relative humidity		L			
	Fog					

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures
					measures will be integrated into the environmental management plan	
Surrounding natural environment						
Precipitation	Heavy rainfall	M	H	**Moderate**	• During construction, heavy rainfall may result in soil erosion on surrounding agricultural lands and nearby residential subdivision. • Heavy rainfall can also result in accidental spills of hydraulic oil or fuel into the Unnamed Tributary north of 8th Line that can damage terrestrial and aquatic ecosystems	• Consider installing sediment barriers and redirecting water to a vegetated area to prevent the risk of erosion and the potential for runoff from the construction site into watercourses • It is suggested using temporary retention basins, geotextile membranes, surface drainage ditches to direct runoff in order to prevent accidental spills into the Unnamed Tributary north of 8th Line or surrounding agricultural lands.
	Winter rain on snow	M				
	Drought	L	M	**Low**	The climate change resilience assessment during the construction phase for some elements of this component is rated as low risk, given that the duration of this phase is short and that potential mitigation measures will be integrated into the environmental management plan	Not applicable
Temperature	Hot temperature & Heat wave					
	Diurnal variation					
Wind	Heavy wind					
	Blowing rain					
	Blowing snow		L			
Other	Relative humidity					
	Fog					
Indigenous communities						
Precipitation	Heavy rainfall	M	H	**Moderate**	• During construction, heavy rainfall may result in soil erosion on surrounding agricultural lands	• Consider installing sediment barriers and redirecting water to a vegetated area to prevent the risk of erosion and the potential for runoff from the construction site into watercourses
	Winter rain on snow					

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures
					• Heavy rainfall can also result in accidental spills of hydraulic oil or fuel into the Unnamed Tributary north of 8th Line that can damage terrestrial and aquatic ecosystems	• It is suggested using temporary retention basins, geotextile membranes, surface drainage ditches to direct runoff in order to prevent accidental spills into the Unnamed Tributary north of 8th Line or surrounding agricultural lands.
	Drought	L	L	**Low**	The impact on indigenous communities for these climate variables during the construction phase for is rated as low risk, given that the duration of this phase is short and that potential mitigation measures will be integrated into the environmental management plan	Not applicable
Temperature	Hot temperature & Heat wave		M			
	Diurnal variation					
Wind	Heavy wind					
	Blowing rain					
	Blowing snow					
Other	Relative humidity		L			
	Fog					

Table 15: Risk assessment for operations and maintenance, 2081–2100-time frame for the overall Bradford Bypass Project

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures to be integrated to the EIA
Operation of the overpass infrastructure						
Precipitation	Heavy rainfall Winter rain on snow	M	H	**Moderate**	Increased precipitation could lead to more weather-related accidents, delays, and traffic disruptions (loss of life and property, increased safety risks, increased risks of hazardous cargo accidents). Increased precipitations could also accelerate degradation of the overpass structure	• To prevent degradation of the overpass structure, consider enhancing the grade of concrete and the quality of protective surface coatings and barriers, or using stainless steel, or galvanized reinforcement. • Think about controlling speed to prevent vehicle accident during heavy rainfall events.
	Drought	L	L	**Low**	Drought will not affect this component	Not applicable
Temperature	Hot temperature & Heat wave	M	M	**Moderate**	Hot temperature and heat waves could result in expansion of bridge joints, resulting in reduced bridge operations and higher maintenance costs. Higher temperatures may also cause premature deterioration to road pavements asphalt (e.g., potholes, rutting, cracking), particularly in high-traffic areas, which could result in increased maintenance costs. Also, heat waves may exacerbate urban heat island due to increased surface temperatures of the pavement.	• Consider using paving materials with greater expansion resistance in extreme heat • Consider using heat-resistant paving materials • Consider tracking the impacts of extreme heat to identify "hot-spots" that may require an increased rate of inspection • Consider conducting frequent inspections of pavement surfaces to ensure cracks are properly sealed
	Diurnal variation	L		**Low**	Diurnal variation will not affect this component	Not applicable
Wind	Heavy wind Blowing rain	M	M	**Moderate**		

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures to be integrated to the EIA
	Blowing snow				Storms and heavy winds would pose threats to structure, as well as to road users	The structure may be adequately designed to allow for future worst-case wind conditions
Other	Relative humidity	L	L	Low	Relative humidity and fog will not affect this component	Not applicable
	Fog					
Construction site						
Precipitation	Heavy rainfall	Not applicable				
	Winter rain on snow					
	Drought					
Temperature	Hot temperature & Heat wave					
	Diurnal variation					
Wind	Heavy wind					
	Blowing rain					
	Blowing snow					
Other	Relative humidity					
	Fog					
Plant and equipment						
Precipitation	Heavy rainfall	M	H	Moderate	Heavy precipitation and increased runoff can cause damage to tunnels, culverts. The drainage system may become overwhelmed due to heavy precipitation	Consider designing the drainage systems with greater capacity that take climate change into account
	Winter rain on snow					
	Drought	L	L	Low		Not applicable

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures to be integrated to the EIA
Temperature	Hot temperature & Heat wave		M		These climate variables will not affect this component	
	Diurnal variation					
Wind	Heavy wind	M	M	Moderate	Storms and heavy winds could damage lighting poles	Consider installing traffic signal light poles that withstand heavy winds (W ≥ 65km/h).
	Blowing rain					
	Blowing snow					
Other	Relative humidity	L	L	Low	These climate variables will not affect this component	Not applicable
	Fog					
People						
Precipitation	Heavy rainfall	L	H	Low	These climate variables will not affect this component	Not applicable
	Winter rain on snow					
	Drought		L			
Temperature	Hot temperature & Heat wave		M			
	Diurnal variation					
Wind	Heavy wind					
	Blowing rain					
	Blowing snow					
Other	Relative humidity					
	Fog					
Materials						

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures to be integrated to the EIA
Precipitation	Heavy rainfall	L	H	Low	These climate variables will not affect this component	Not applicable
	Winter rain on snow					
	Drought		L			
Temperature	Hot temperature & Heat wave		M			
	Diurnal variation					
Wind	Heavy wind	M	M	Moderate	Storms and heavy winds could damage aerial traffic signal spans and illumination poles	Consider installing traffic signal spans and illumination poles that withstand heavy winds (W ≥ 65km/h
	Blowing rain	L	M	Low	These climate variables will not affect this component	Not applicable
	Blowing snow					
Other	Relative humidity					
	Fog					
Surrounding natural environment						
Precipitation	Heavy rainfall	L	H	Low	These climate variables will not affect this component	Not applicable
	Winter rain on snow					
	Drought		L			
Temperature	Hot temperature & Heat wave		M			
	Diurnal variation					
Wind	Heavy wind					

Climate variable		Severity	Likelihood	RISK	Potential impacts	Proposed adaptation measures to be integrated to the EIA
	Blowing rain					
	Blowing snow					
Other	Relative humidity		L			
	Fog					
Indigenous communities						
Precipitation	Heavy rainfall	L	H	Low	These climate variables will not affect this component	Not applicable
	Winter rain on snow					
	Drought		L			
Temperature	Hot temperature & Heat wave		M			
	Diurnal variation					
Wind	Heavy wind					
	Blowing rain					
	Blowing snow					
Other	Relative humidity		L			
	Fog					

4 Sensitive Receptors & Resources

Populations nearest to transportation related emissions are at a disproportionate risk of exposure to traffic related air pollution. The climate resilience assessment considers all project components listed in Table 16 to be potential sensitive receptors because they are siting residences within 115 m from the project (i.e., potentially impacted by climate change and air pollution related to traffic activities). Therefore, they should all be considered in the impact assessment.

Table 16: Local Sensitive Receptors

Receptor ID	Sensitive vs. Critical Receptor	Receptor Description	Address	UTM Coordinates (17 T Region)
SR1	Sensitive	Local Residence	2 Turner Crescent, Bradford West Gwillimbury, Ontario	614686.29 m E 4886945.38 m N
SR2	Sensitive	Local Residence	2496 8th Line, Bradford West Gwillimbury, Ontario	614533.47 m E 4886938.14 m N
SR3	Sensitive	Local Residence	27 Gardiner Drive, Bradford West Gwillimbury, Ontario	614507.51 m E 4886991.30 m N
SR4	Sensitive	Local Residence	23 Gardiner Drive, Bradford West Gwillimbury, Ontario	614513.00 m E 4887039.00 m N
SR5	Sensitive	Local Residence	17 Gardiner Drive, Bradford West Gwillimbury, Ontario	614498.00 m E 4887098.00 m N
SR6	Sensitive	Local Residence	2942 Simcoe County Rd 4, Bradford West Gwillimbury, Ontario	614373.00 m E 4887697.00 m N
SR7	Sensitive	Local Residence	2948 Simcoe County Rd 4, Bradford West Gwillimbury, Ontario	614322.91 m E 4887735.41 m N
SR8	Sensitive	Local Residence	2964 Simcoe County Rd 4, Bradford West Gwillimbury, Ontario	614349.59 m E 4887822.90 m N
SR9	Sensitive	Local Residence	2980 Simcoe County Rd 4, Bradford West Gwillimbury, Ontario	614322.68 m E 4887863.47 m N
SR10	Sensitive	Local Residence	2488 9th Line, Bradford West Gwillimbury, Ontario	614283.08 m E 4888229.67 m N

5 Conclusion

The MECP guidance for considering climate change in the environmental assessment process outlines that the scoping stage should identify the potential impact of the project on the receiving environment, the sensitivity of this environment, and taking into account how this will be affected by a changing climate.

From the qualitative climate change mitigation assessment undertaken for the County Road 4 Early Works, there are several mitigation options which may be employed during the construction, operation, and maintenance phases of the project's life span which could reduce the project's impact on climate change, as per Table 4.

From the qualitative climate change resilience assessment undertaken for the County Road 4 Early Works, climate variables to which the proposed project receptors are likely to have a low risk to climate change should be scoped out of further assessment and those with a moderate or high risk should be taken forward for further assessment in the environmental impact assessment process, as per Table 14 and Table .

It is suggested this document be referenced by the contractor, construction, and design teams to provide recommended guidance on best practices for climate change mitigation and adaptation for all phases of the project. Potential impacts, proposed mitigation and proposed adaptation measures are outlined in Sections 2.6 and 3.4.4 of this Report, which include recommended measures to be implemented for the County Road 4 Early Works as well as measures to be considered as part of the overall Bradford Bypass.

6 References

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