Canada-United States-Ontario-Michigan
Border Transportation Partnership

Practical Alternatives Evaluation Working Paper

Air Quality Impact Assessment

DRAFT May 2008

PREFACE

The Detroit River International Crossing (DRIC) Environmental Assessment Study is being conducted by a partnership of the federal, state and provincial governments in Canada and the United States in accordance with the requirements of the Canadian Environmental Assessment Act (CEAA), the Ontario Environmental Assessment Act (OEAA), and the U.S. National Environmental Policy Act (NEPA). In 2006, the Canadian and U.S. Study Teams completed an assessment of illustrative crossing, plaza and access road alternatives. This assessment is documented in two reports: *Generation and Assessment of Illustrative Alternatives Report - Draft November 2006)* (Canadian side) and *Evaluation of Illustrative Alternatives Report (December 2006)* (U.S. side). The results of this assessment led to the identification of an Area of Continued Analysis (ACA) as shown in Exhibit 1.

Within the ACA, practical alternatives were developed for the crossings, plazas and access routes alternatives. The evaluation of practical crossing, plaza and access road alternatives is based on the following seven factors:

- Changes to Air Quality;
- Protection of Community and Neighbourhood Characteristics;
- Consistency with Existing and Planned Land Use;
- Protection of Cultural Resources;
- Protection of the Natural Environment;
- Improvements to Regional Mobility;
- Cost and Constructability.

This report pertains to the *Changes to Air Quality* factor and is one of several reports used in support of the evaluation of practical alternatives and the selection of the technically and environmentally preferred alternative. This report will form a part of the environmental assessment documentation for this study.

Additional documentation pertaining to the evaluation of practical alternatives is available for viewing/downloading at the study website (www.partnershipborderstudy.com).

EXECUTIVE SUMMARY

Identifying how the Detroit River International Crossing (DRIC) study alternatives may change air quality is an important consideration in the DRIC Environmental Assessment.

Air quality effects of the Practical Alternatives have been assessed using a combination of existing air monitoring data and air dispersion modelling. Air dispersion modelling must be used to assess the impacts of future changes, such as implementation of the alternatives, and changes in fuels, vehicle technologies and traffic volumes. The predictive air quality model being used is specifically designed to assess impacts from roads and highways. The model incorporates the differences between moving vehicles, and queued vehicles that are idling, as well as differences in roads that are at-grade, below-grade, end-to-end tunneled or elevated on bridges.

Existing concentrations of gaseous pollutants in Windsor such as sulphur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOCs) (such as acrolein) and others were examined earlier in this study as part of the assessment of Illustrative Alternatives and found to be well below Ontario Ministry of the Environment (MOE) Ambient Air Quality Criteria (AAQCs). Due to the number of alternatives and combinations being assessed, two indicator pollutants were selected for this phase of the analysis. Those chosen to represent one gaseous compound and one particulate compound are nitrogen oxides (NO_x) and particulate matter less than 2.5 microns ($PM_{2.5}$). These pollutants are generally the typical air pollutant indicator compounds with respect to transportation vehicle emissions. Changes in the total predicted concentrations of these two air pollutants were examined for each alternative in relation to the future no-build alternative.

How the Analysis was Done

The analysis was completed using the following approach:

- Compile data on existing $PM_{2.5}$ and NO_x concentrations
- Determine background concentrations
- Input traffic data for future conditions, including access road, plaza and crossing alternatives
- Calculate pollutant emissions from the highway corridor for existing and future conditions
- Use air dispersion model (CAL3QHCR) with meteorological data from Windsor Airport to determine future air pollutant concentrations in the vicinity of the corridor (essentially all of west Windsor) and at sensitive receptor locations (such as schools and residences).

Data on the existing air pollutant concentrations in the Windsor area was obtained from the two MOE air monitoring stations located on College Avenue and on University Avenue. Data from the two DRIC air monitoring stations, established in 2006, were also used to refine the background concentrations.

Traffic projections were developed for the DRIC study for all main roads in the corridor for each year considered in the assessment, which were 2015, 2025 and 2035. This included the future "do nothing" cases (i.e. expected traffic volumes if no new access road/crossing is built), as well as each of the Practical Alternatives for the access road, plaza and crossing.

Emission rates from these vehicles were input into the CalTrans CAL3QHCR roadway dispersion model, which is accepted for use in Ontario by the MOE and is supported by Environment Canada. Improvements in fuels and technologies legislated to occur over the next several years and historical fleet turnover rates were considered in these emission rates. The model incorporated meteorological data from Windsor Airport, to determine predicted air pollutant concentrations at various locations in west Windsor in addition to specific sensitive receptor locations and receptors as discussed in the *Practical Alternative Work Paper - Social Impact Assessment (April 2008)*. The uncertainties and inevitable variability associated with predicting future traffic flows, weather conditions and emission rates place some limitations on the accuracy of model results; however, the results are useful and acceptable for comparing among various alternatives.

Findings

Although this phase of the study focused on $PM_{2.5}$ and NO_x specifically, additional pollutants will be examined when assessing the technically and environmentally preferred alternative.

Presently, approximately 45 percent of the total NO_x emissions in the Windsor airshed come from trucks and cars on the local road network. Emissions from the vehicles using the Huron Church Road corridor contribute approximately two percent of the total NOx emissions to the Windsor airshed. Recent and on-going improvements in emission control technologies and fuels will combine to substantially reduce the emissions from transportation sources. As of June 2006, the maximum amount of sulphur in on-road diesel fuel was reduced from 500 mg/kg to 15 mg/kg. These reductions were necessary for Canadian sulphur levels in on-road fuels to be consistent with U.S. levels, and to ensure that advanced emission control technologies on newer engines would be effective. In January 2007, additional engine standards for heavy-duty vehicles came into effect. These standards reduce NO_x and particulate matter emissions by 60 percent and 90 percent respectively over existing levels, and require the incorporation of additional emission control technologies on these newer engines to effect these reductions.

Based on these and other anticipated changes in both Canada and the U.S., preliminary estimates are that annual emissions of NO_x from road related transportation sources in Windsor will be reduced from approximately 4,000 tonnes in 2004 to 500 tonnes in 2035. These changes will occur over time as the vehicle fleet is replaced. Based on these projected decreases, cars and trucks will likely contribute less than 10 percent of the total regional NO_x emissions.

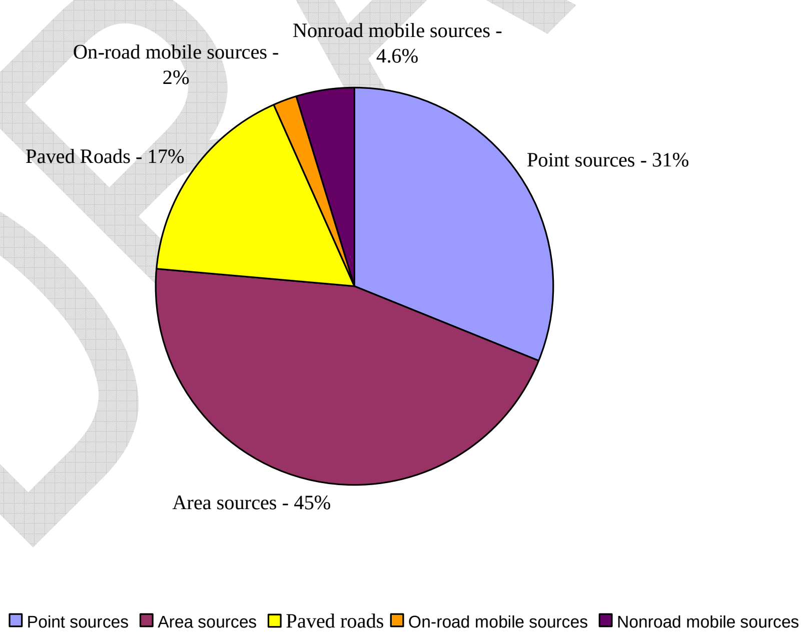
$PM_{2.5}$ emissions from road based transportation sources are comprised of two contributing fractions. The first is tailpipe emissions resulting from fuel combustion. The second, and higher fraction, is from road dust, which is generated from the re-suspension of surface material and debris, tire and brake wear, and roadway abrasion.

The figure below presents the breakdown of $PM_{2.5}$ emissions in southwestern Ontario. It is divided into:

- Point Sources (i.e. factory smoke stacks)
- Area Sources (farms, construction sites, unpaved roadways)
- Non-road Mobile Sources (rail transportation, marine transportation, construction equipment)
- Paved Roads
- On-road Mobile Sources (tailpipe emissions from cars and trucks on roads and highways).

As can be seen in the chart, cars and trucks on paved roads and highways contribute 19 percent (17 percent + 2 percent) of the total $PM_{2.5}$ emissions, and only two percent of this is from tailpipes. Improvements in fuels and vehicle engine technologies will result in further decreases in the tailpipe portion of $PM_{2.5}$ emissions from road-based transportation.

$PM_{2.5}$ Emissions for Southwest Ontario (Year 2000)



Since total road emissions of $PM_{2.5}$ are predominantly comprised of road dust, $PM_{2.5}$ emissions will increase as traffic increases in the Highway 3/Huron Church Road corridor. However, the tailpipe fraction of $PM_{2.5}$ emissions is currently a maximum of 30 percent of the total road based $PM_{2.5}$ emissions from the corridor. By 2015, this fraction will be reduced to less than 10 percent of the total $PM_{2.5}$ emissions, because of the combined effect of cleaner fuels and provision of a freeway for international traffic. (Free flow conditions on a freeway avoid braking, idling and acceleration at traffic signals).

By 2025, the tailpipe fraction of $PM_{2.5}$ will be further reduced to four percent of the total roadway contribution from the corridor, as the vehicle fleet is fully replaced with vehicles that incorporate the new engine technologies.

Another important consideration is the role of contributions from upwind sources and transboundary (air pollution that originates outside of the local region) air flow on total $PM_{2.5}$ concentrations in Windsor. During typical conditions, these sources comprise approximately 56 percent of the total concentration of particulate matter in the Windsor area. During a smog event, this contribution increases to over 80 percent, as polluted air flows into the region from upwind sources in the U.S.

Practical Alternatives

At-grade, below-grade and end-to-end tunnel alternatives were modelled to determine impacts of:

- Changes in alignment from the existing corridor
- Changes in grade (i.e. at grade vs. below grade)
- The effects of short tunnels on local air quality
- Tunnel ventilation requirements
- Changes in service road configuration

Implementation of any of the alternatives that were assessed in this phase of the study generally result in decreased $PM_{2.5}$ and NO_x concentrations, and an improvement in air quality compared to the no-build alternative. No one alternative consistently stands out as a preferred alternative for all segments of the proposed freeway extension and the differences between the alternatives could be considered marginal.

All predicted NO_x concentrations in the vicinity of the corridor are predicted to be below relevant standards and guidelines. Or stated more simply, there were no instances of predicted increases in concentrations that would cause a change in the MOE AQI∗ rating in the corridor.

∗ - The Ontario Ministry of the Environment (MOE) publishes results annually on the air quality in different locations in Ontario as part of their Air Quality program. The Air Quality Index (AQI) is an indicator of air quality, based on hourly pollutant measurements of some or all of the six most common air pollutants: sulphur dioxide, ozone, nitrogen dioxide, total reduced sulphur compounds, carbon monoxide and fine particulate matter.

Tunnel Ventilation Options

Four different options for ventilation of the cut and cover end-to-end tunnel option were assessed. Options 1A, 1B, and 1C represented differing configurations and locations of ventilation buildings, while Option 2 included jet fans placed on the tunnel ceiling throughout the tunnel with pollutants being exhausted out through the portals instead of through ventilation buildings.

The results of the atmospheric dispersion modelling assessment indicate that of the four tunnel ventilation options studied, Option 2 (i.e. using jet fans to ventilate the tunnel through the portals instead of a vent building) results in unacceptably high concentrations of $PM_{2.5}$ and NO_x at the receptors compared to the other three ventilation options.

The results also indicate that there is little to no difference in the maximum predicted concentrations between the three ventilation building options assessed. For the purposes of comparison to at-grade and below-grade alternatives, Option 1A was used for the ventilation configuration for the end-to-end cut and cover tunnel. The two locations along the access road corridor developed in consultation with the public for the two ventilation buildings were in the vacant field in the northwest corner of the Todd Lane/Huron Church Road intersection, and the vacant field opposite St. Clair College.

At-grade vs. Below-grade vs. Cut and Cover End-to-End Tunnel

Air dispersion modelling of air quality impacts of the Practical Alternatives indicates that there are slight differences between these alternatives within 50 – 100 m (164 – 328 ft) from the right-of-way (ROW) under certain conditions. Below-grade alternatives including the Parkway result in a reduction in maximum predicted $PM_{2.5}$ and NO_x concentrations in the vicinity of the ROW, in comparison to at-grade alternatives. For example, within 50 m (164 ft) from the ROW, below-grade sections show slightly lower predicted concentrations of $PM_{2.5}$ and NO_x than at-grade sections. By 100 m (328 ft) and beyond from ROW, there is no discernible difference between at-grade and below-grade alternatives.

Within 50 m (164 ft) of the ROW, the end-to-end tunnel alternative results in lower maximum predicted concentrations of $PM_{2.5}$ compared to at-grade and below-grade alternatives under certain conditions. At 100 m (328 ft) from the ROW, there is little difference between the alternatives in terms of maximum predicted $PM_{2.5}$ concentrations. At 250 m (820 ft) from the ROW there is no difference between any of the alternatives in terms of $PM_{2.5}$ concentrations.

The end-to-end tunnel alternative results in increases in the maximum predicted 1-hour and 24-hour NO_x concentrations in the vicinity of the ROW near the tunnel portals under certain conditions, compared to at-grade and below-grade options. This reflects the effect of the tunnel entrance and exit portals, in addition to the dispersion characteristics of the exhaust stacks at the ventilation buildings.

Service Road Configurations

Air dispersion modelling of air quality impacts of the Practical Alternatives indicates that between Alternatives 1 (one-way service roads) and 2 (parallel two-way service roads), there is little difference in the predicted changes to $PM_{2.5}$ and NO_x concentrations. Maximum predicted $PM_{2.5}$ and NO_x concentrations are slightly higher with the one-way service road options compared to the two-way service road options. However, air quality conditions are the same on average for each option.

Route Alignments between St. Clair College and Howard Avenue

Two route alignment options were studied for the area between St. Clair College and Howard Avenue. Option 1 considers a widening of the present roadway corridor more to the north (Windsor) side of Highway 3, whereas Option 2 considers a widening of the corridor more to the south (LaSalle) side of Highway 3.

The air dispersion modelling results indicate that there is little difference in the change in $PM_{2.5}$ and NO_x concentrations between Option 1 and Option 2 at receptors located within 50 m (164 ft) of the ROW between St. Clair College and Howard Avenue. Receptors within 50 m (164 ft) of the proposed ROW experience slightly lower maximum predicted NO_x and $PM_{2.5}$ concentrations with the Option 2 alignment versus the Option 1 alignment under certain conditions. This difference is primarily due to the change in the proximity of these receptors to the proposed ROW. However, on average, there is little to no difference in air quality conditions between Option 1 and Option 2 alignments.

Plaza Alternatives

Four plaza alternatives were studied (Plazas A, B, B1 & C) in this phase of the assessment. The results indicate that each of the four plaza alternatives studied results in increases in the predicted maximum $PM_{2.5}$ and NO_x concentrations in the vicinity of the plaza. These increases are experienced up to 250 m (820 ft) away from the property boundaries of each plaza under certain conditions. The effects of Plazas B, B1 and C are predominantly seen in the area to the west of Ojibway Parkway/E.C. Row Expressway interchange at non-sensitive receptors. None of the plaza options would result in a discernible difference in the maximum predicted concentrations for Sandwich Towne.

Crossing Alternatives

Three bridge crossing alternatives have been studied. The results of the atmospheric dispersion modelling indicate that each of the three crossing alternatives results in increases in the predicted $PM_{2.5}$ and NO_x concentrations within 250 m (820 ft) of the crossings and the approach roadways between each plaza and bridge under certain conditions. The area to the west of Ojibway Parkway/E.C. Row Expressway interchange will be impacted by changes in the predicted concentrations of $PM_{2.5}$ and NO_x resulting from Crossings A and B are primarily seen in the area to the west of Ojibway Parkway/E.C. Row Expressway interchange. In Sandwich Towne, there is no discernible difference in the predicted maximum $PM_{2.5}$ and NO_x concentrations from these crossing alternatives.

However, Crossing C (including the approach roadway to the crossing from the plaza sites) results in slight increases in the predicted maximum $PM_{2.5}$ and NO_x concentrations in the portion of Sandwich Towne within 250 m (820 ft) of this crossing compared to the no-build alternative. This occurs during certain worst-case meteorological conditions (light or no winds).

Next Steps

The following work will be undertaken as part of the assessment of the technically and environmentally preferred alternative.

- Model additional air pollutants and compare MOE criteria and guidelines
- Assess construction impacts
- Assess the need for mitigation measures.

Practical Alternatives Evaluation Working Paper

Air Quality Impact Assessment

Table of Contents

Page No.

Preface P-1
Executive Summary E-1
1.0 Introduction 1
1.1 Practical Alternatives Under Assessment 1
1.2 Area of Investigation 10
2.0 Existing Environmental Conditions 11
2.1 Climate and Meteorological Data 11
2.1.1 Near-Surface Temperature 12
2.1.2 Precipitation 12
2.1.3 Atmospheric Stability 13
2.1.4 Wind Direction 13
2.1.5 Wind Speed 14
2.1.6 Mixing Height 15
2.2 Assessment Criteria 15
2.3 Existing Air Pollutant Concentrations 17
2.3.1 Ambient Monitoring Data 18
2.3.1.1 Existing Air Pollutant Concentrations in the Huron Church Rd/Hwy 3 Corridor 20
2.3.2 Contribution from Upwind / Background Sources 23
3.0 Air Dispersion Modelling 25
3.1 Assessment Methodology 25
3.2 Model Inputs and Set-up 27
3.2.1 Meteorological Data 27
3.2.2 Receptors 29
3.2.3 Source Characteristics and Emissions 31
3.2.3.1 Traffic Volumes 31
3.2.3.2 Vehicle Emissions Estimates 32
3.2.3.3 Customs / Inspections Plazas 35
3.2.3.4 Tunnel Ventilation Buildings and Portal Emissions 36
3.2.3.5 The Parkway Tunnel Emissions 37
3.2.4 Model combinations 37
4.0 Overview of Model Results 39
4.1 Access Road Segment Assessments 40
4.1.1 Malden Road to Labelle Street 42
4.1.2 Labelle Street to Pulford Street 46
4.1.3 Pulford Street to North of Lennon Drain 50
4.1.4 North of Lennon Drain to Cousineau Road 54

4.1.5 Cousineau Road to Howard Avenue 58
4.1.6 Howard Avenue to Highway 401 62
4.1.7 Overall Access Road Assessment 65
4.2 Customs / Inspection Plaza Alternatives 66
4.2.1 Plaza A 68
4.2.2 Plaza B 68
4.2.2.1 Plaza B1 68
4.2.2.2 Plaza B 69
4.2.3 Plaza C 69
4.3 Crossing Alternatives 71
4.3.1 Crossing A 73
4.3.2 Crossing B 73
4.3.3 Crossing C 73
5.0 Evaluation of Alternatives 75
5.1 Access Road Alternatives 75
5.1.1 Comparison of At Grade, Below Grade, Cut & Cover Tunnel and Parkway Alternatives 75
5.1.1.1 At Grade versus Below Grade Alternatives 76
5.1.1.2 At Grade versus Tunnel Alternatives 76
5.1.1.3 Below Grade (including Parkway) Alternatives versus Tunnel 77
5.1.2 Service Road Configurations 78
5.1.3 Route Alignments Between St. Clair College & Howard Avenue 78
5.1.3.1 At Grade Alternatives 78
5.1.3.2 Below Grade Alternatives 79
5.2 Evaluation of Plaza/Crossing Alternatives 79
5.2.1 $PM_{2.5}$ Concentrations 79
5.2.2 NO_X Concentrations 80
5.3 Final Conclusions 81
6.0 References 84
APPENDICES 86
Appendix A: Roadway Segments Considered in Analysis and Traffic Data 87
Appendix B: MOBILE 6.2 Modelling Results 93
Appendix C: Sample Calculations 150

List of Figures

Figure 1.1 - Key Plan of the Area of Continued Analysis 3
Figure 1.2 - Summary of Alternative configurations 4
Figure 1.3 - Parkway Tunnel Configurations 5
Figure 1.4 - Right of Way for Option 1 and Option 2 Alignments 6
Figure 1.5 - Tunnel Ventilation Building Options 8
Figure 1.6 - Practical Canadian Plaza and Crossing Alternative Combinations 9
Figure 2.1 - Wind Rose - Windsor Airport (2000-2004) 14
Figure 2.2 - $PM_{2.5}$ Emissions In Southwestern Ontario (2000) 18
Figure 2.3 - MOE Monitoring Station Locations and DRIC Monitoring Station Locations 21
Figure 3.1 - 2003 Windsor Wind rose 28
Figure 3.2 - Receptor Grid 30
Figure A.1 – Modelled Road Network – Existing Roadways 92

List of Tables

Table 2.1 - Windsor Airport Climate Normals (1971-2000) 12
Table 2.2 - Stability Class Distribution - Windsor Airport (2000-2004) 13
Table 2.3 - Air Quality Criteria for $PM_{2.5}$ and NOx 17
Table 2.4 - Five Year Summary of MOE Monitoring Results – NO2 19
Table 2.5 - Five Year Summary of MOE Monitoring Results – $PM_{2.5}$ 19
Table 2.6 - Summary of DRIC 1st Quarter Monitoring Results (Oct 07 – Dec 07) 22
Table 2.7 - Summary of DRIC Monitoring Results (November 2006 – October 2007) 23
Table 2.8 - Summary of Background Concentrations Used in DRIC AQ Assessment 24
Table 3.1 - Summary of Traffic Volumes on Main Roads 32
Table 3.2 - Summary of Emission Factors used in the Assessment 34
Table 4.1 - Change in maximum NO_x concentrations relative to no-build, Malden Road to Labelle Street 43
Table 4.2 - Change in maximum $PM_{2.5}$ concentrations relative to no-build, Malden Road to Labelle Street 45
Table 4.3 - Change in maximum NO_x concentrations relative to no-build, Labelle Street to Pulford Street 47
Table 4.4 - Change in maximum $PM_{2.5}$ concentrations relative to no-build, Labelle Street to Pulford Street 49
Table 4.5 - Change in maximum NO_x concentrations relative to no-build, Pulford Street to North of Lennon Drain 51
Table 4.6 - Change in maximum $PM_{2.5}$ concentrations relative to no-build, Pulford Street to North of Lennon Drain 53
Table 4.7 - Change in maximum NO_x concentrations relative to no-build, North of Lennon Drain to Cousineau 55
Table 4.8 - Change in maximum $PM_{2.5}$ concentrations relative to no-build, North of Lennon Drain to Cousineau 57
Table 4.9 - Change in maximum NO_x concentrations relative to no-build, Cousineau Road to Howard Avenue 59
Table 4.10 - Change in maximum $PM_{2.5}$ concentrations relative to no-build, Cousineau Road to Howard Avenue 61
Table 4.11 - Change in maximum NO_x concentrations relative to no-build, Howard Ave to Highway 401 63

List of Tables (Cont'd)

Table 4.12 - Change in maximum $PM_{2.5}$ concentrations relative to no-build, Howard Ave to Highway 401. 64
Table 4.13 – Change in maximum $PM_{2.5}$ concentrations and exceedances relative to no build for each Plaza crossing 67
Table 4.14 – Change in NO_x concentrations and exceedances relative to no build for each Plaza crossing 67
Table 4.15 – Change in maximum $PM_{2.5}$ concentrations and exceedances relative to no-build for Plazas and Crossings 72
Table 4.16 – Change in maximum NO_x concentrations and exceedances relative to no-build for Plazas and Crossings 72

1.0 Introduction

Changes to Air Quality is one of the seven factors being used to assess the potential effects of the various transportation improvement alternatives currently being studied by the Detroit River International Crossing (DRIC) study team.

Due to the proximity to the Canada-U.S. border and the resulting high rate of traffic through the City of Windsor, vehicular emissions and their effect on existing air quality are of concern in the Windsor-Essex area. The City of Windsor also has a relatively high fraction of diesel powered transport trucks that are used to move goods into and out of Canada. Diesel exhaust is highly visible, and there is increasing evidence that there are health effects associated with it. Thus, a primary objective of the Air Quality Assessment is to have a transportation solution that not only improves transportation in the Windsor-Essex area, but also improves the overall air quality relative to existing conditions or "No Build" in the local area, if possible.

This report outlines the methodology and tools used to conduct the Air Quality Assessment and presents the results and evaluation of each of the alternatives studied. The methodology follows that outlined in the Air Quality Work Plan (*February 2006*) which was circulated to various authorities for review and comment.

The focus of this report is to determine the relative impacts of each modelled scenario when compared to the No Build and to determine if any of the alternatives offer appreciable deterioration to air quality relative to each other and to No Build The uncertainties and inevitable variability associated with predicting future traffic flows, weather conditions and emission rates place some limitations on the accuracy of model results; however, the results are useful and acceptable for comparing among various alternatives as any uncertainties will be consistent from alternative to alternative.

This report will support the choice of the Technically and Environmentally Preferred Alternative (TEPA). As per the Air Quality Work Plan (February 2006), analysis of the TEPA will include additional contaminants, refinements of the modelling parameters, if required, and other more detailed information.

This assessment identifies predicted changes in particulate and gaseous pollutant concentrations. The effects of these changes on adjacent sensitive receptors (e.g. homes and schools) are discussed in the *Practical Alternative Work Paper - Social Impact Assessment (April 2008)*.

1.1 Practical Alternatives Under Assessment

Five practical alternatives for the Access Road were presented in the public in March 2006 at the second round of DRIC Public Information Open Houses (PIOH). The alternatives are all located within the Area of Continued Analysis (ACA) as shown in Figure 1.1. Figure 1.2 summarizes the differences in road configurations of the alternatives.

Following the PIOH in December 2006, a Parkway alternative was developed for the access road based on the below-grade and tunnel alternatives (Alternatives 1B, 2B and 3) and reflecting the study goals and the community input received. With the Parkway, the access road for international traffic would be below-grade from Howard Avenue to E.C. Row Expressway, with a number of tunnels. The Right of Way is also expanded in sections with the Parkway to provide additional buffer.

The six practical alternatives for the Access Road are as follows:

- Alternative 1A – At grade freeway with one-way local access service roads located along each side;
- Alternative 1B – Below grade freeway with one-way local access service drives located at grade along each side;
- Alternative 2A – At grade freeway with two-way local access service roads located along the approximate existing Huron Church Road / Highway 3 corridor;
- Alternative 2B – Below grade freeway with two-way local access service roads located at grade along the approximate Huron Church Road / Highway 3 corridor;
- Alternative 3 – Tunneled freeway with two-way local access service roads located at-grade along the approximate Huron Church Road / Highway 3 corridor; and
- Parkway Alternative - A below grade six-lane freeway with a series of tunnels ranging in length from 120 m to 240 m. Service roads include both two-way and one-way segments located adjacent to the freeway. The tunnel locations are shown in Figure 1.3.

In addition to these six alternatives, Alternatives 1A – 2B have two different alignment options (Option 1 & Option 2) between St. Clair College and Howard Avenue. Option 1 and Option 2 were included in the assessment. The Right of Way (ROW) for each of these alignment options is shown below in Figure 1.4.

FIGURE 1.1 - KEY PLAN OF THE AREA OF CONTINUED ANALYSIS

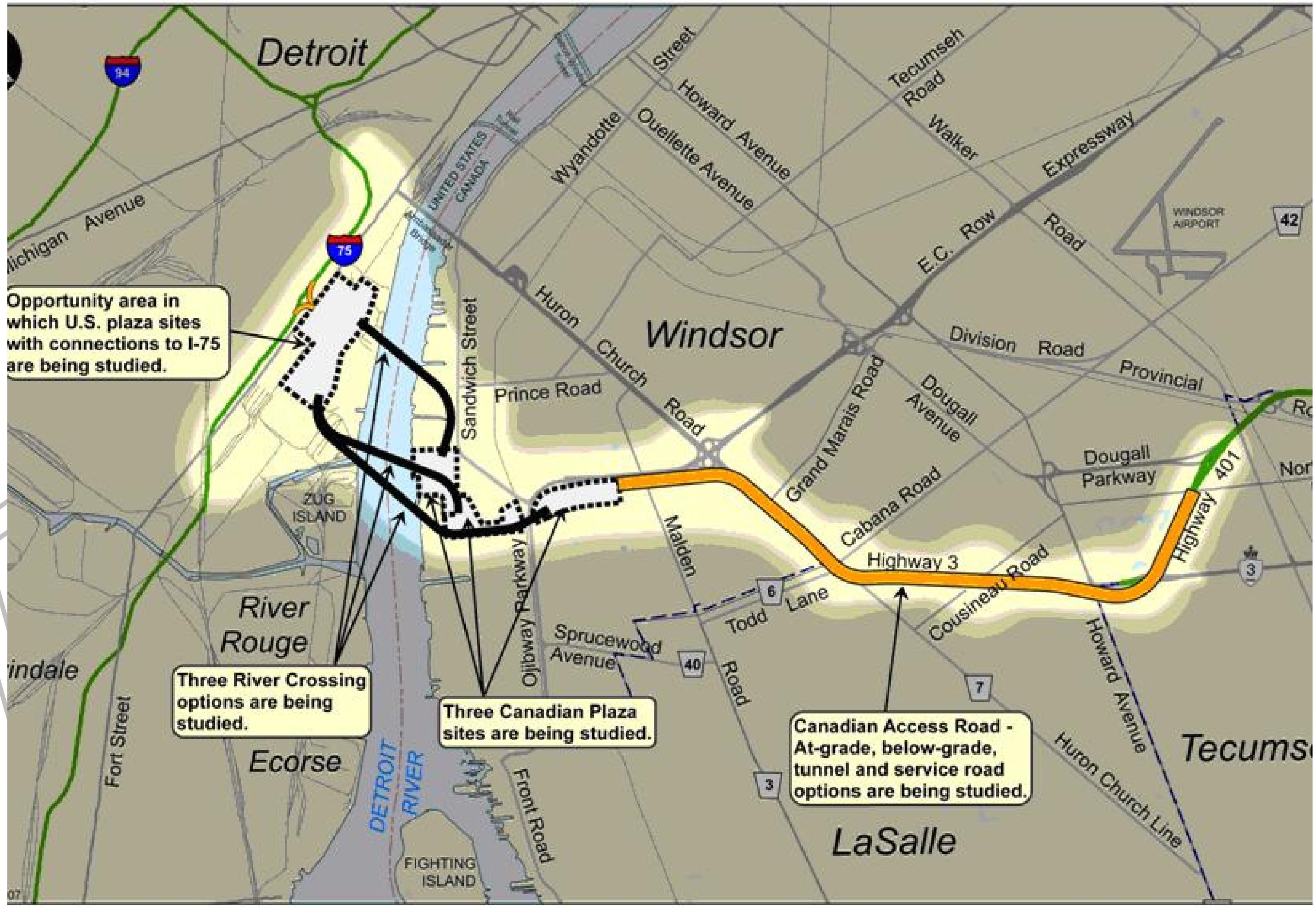


FIGURE 1.2 - SUMMARY OF ALTERNATIVE CONFIGURATIONS

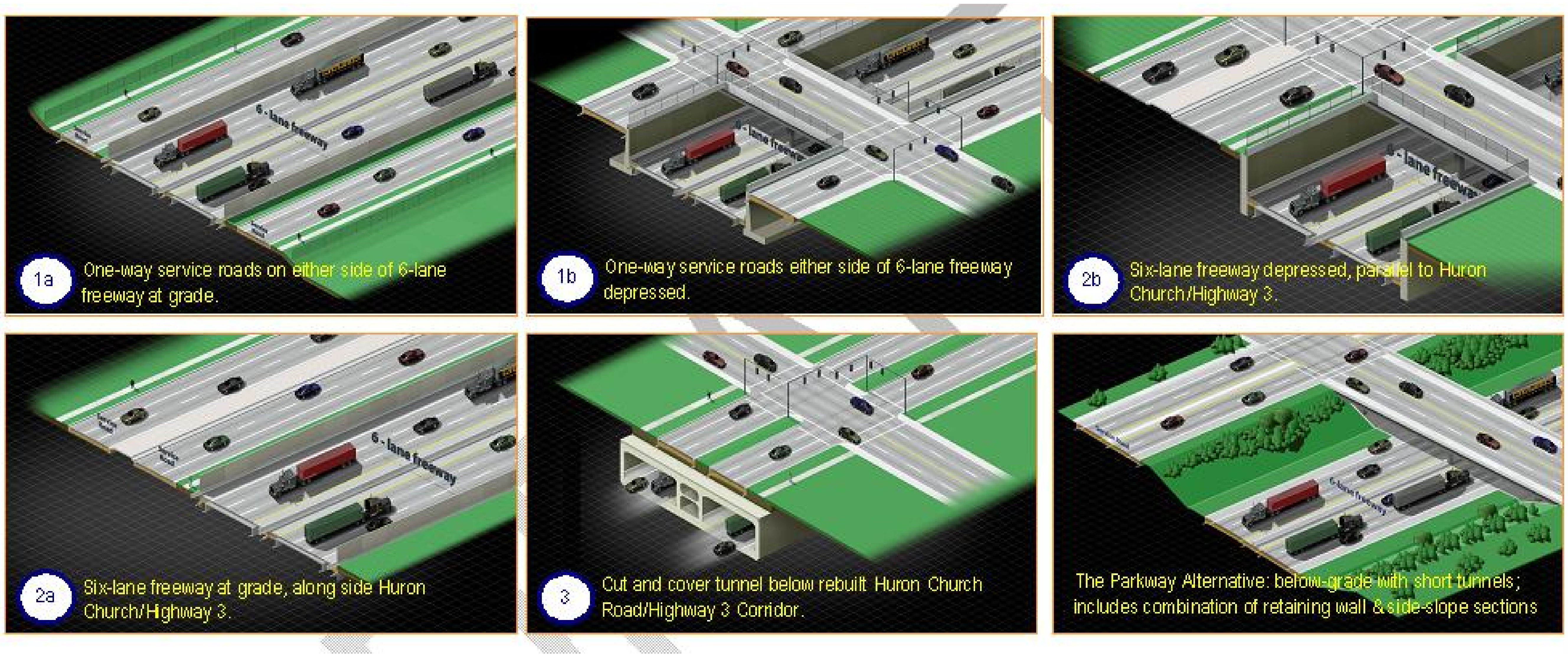
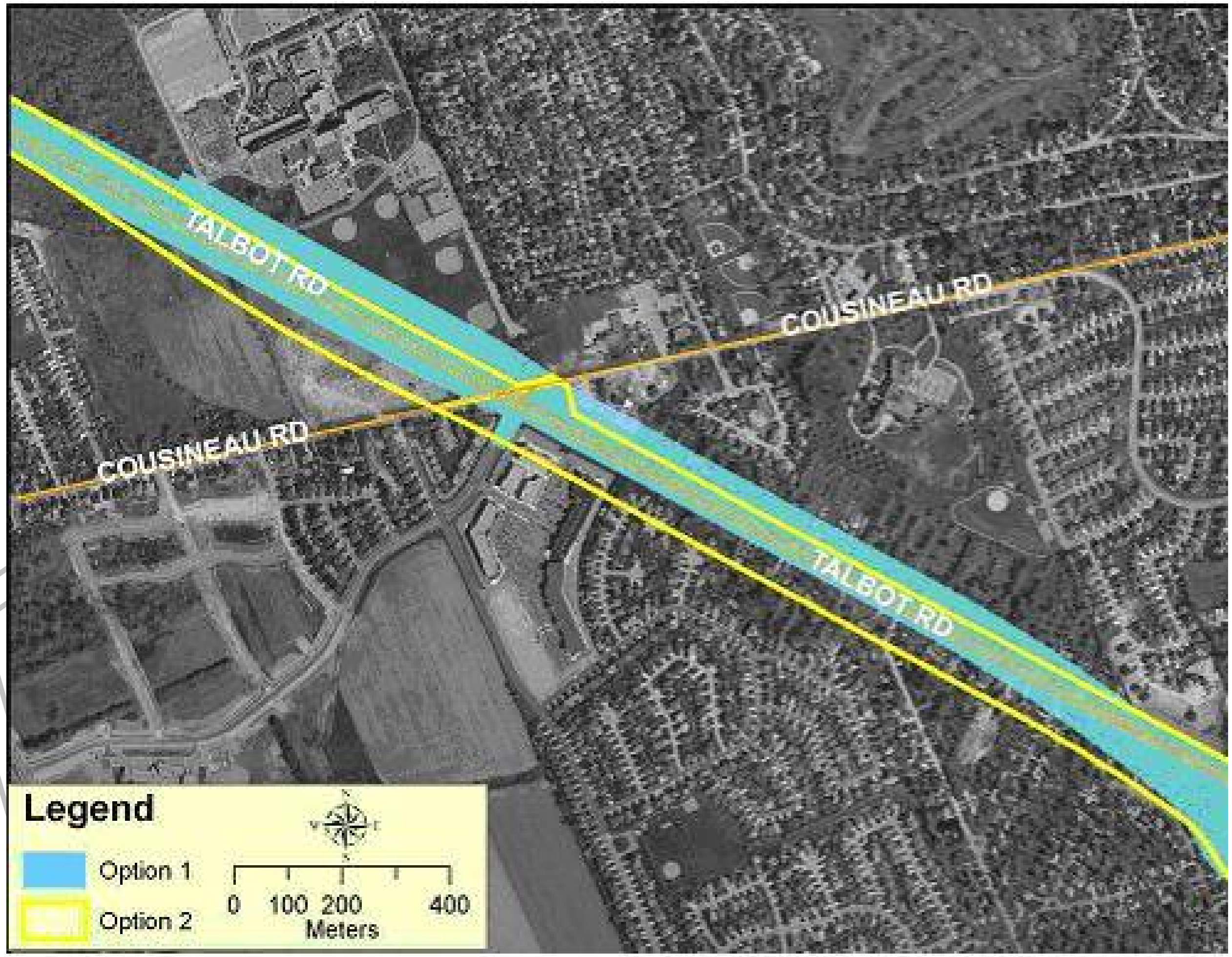


FIGURE 1.3 - PARKWAY TUNNEL CONFIGURATIONS

I.D.	Location of Tunnel	Tunnel Length (M)	Roof Area (Sq M)	I.D.	Location of Tunnel	Tunnel Length (M)	Roof Area (Sq M)
1	Spring Garden	200	9,000	7	Cabana Road West	120	8,300
2	Ramp N-E and Labelle Street	240	10,810	8	Huron Church Line	240	14,400
4	Grand Marais Road West	120	9,550	11	St. Clair College	120	7,225
5	Pulford Street	120	9,705	12	Cousineau Road	120	7,225
6	Reddock St	120	15,320	13	Hearthwood Place	220	19,250
				15	Oliver Estates Area	240	13,200

Structures 3 9 10 14 16 17 18 are proposed as roadway overpasses

FIGURE 1.4 - RIGHT OF WAY FOR OPTION 1 AND OPTION 2 ALIGNMENTS

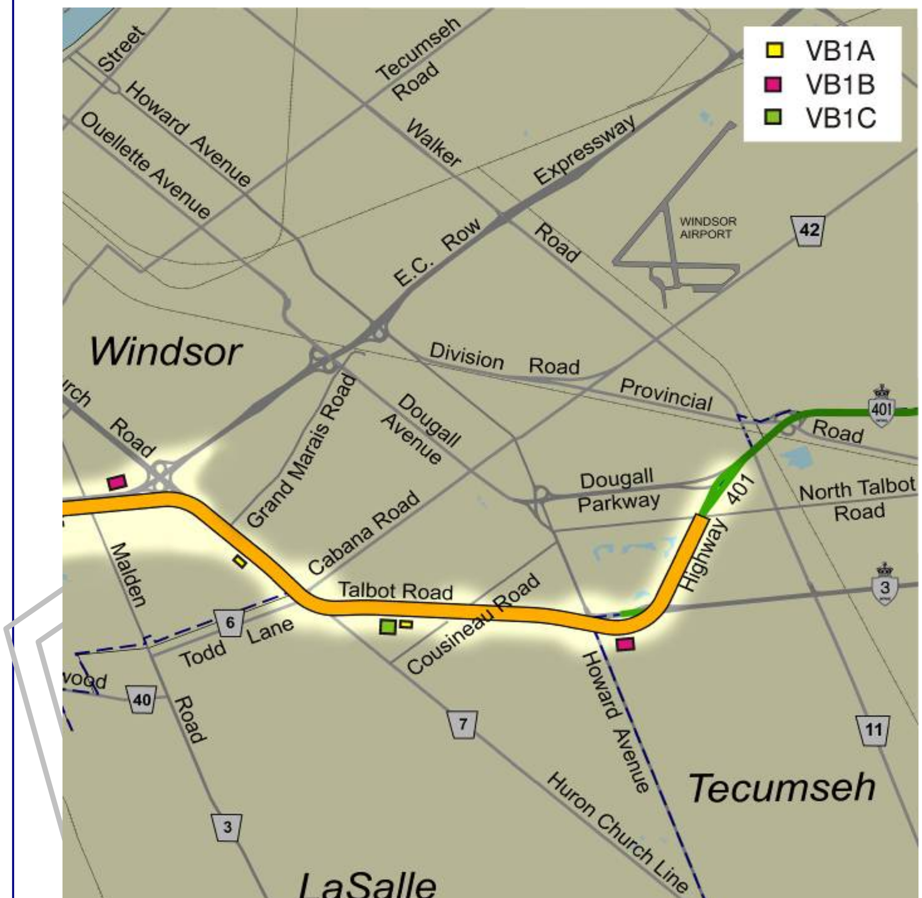


Also, four separate ventilation options were studied for Alternative 3. These are as follows:

- VB1A – use of two separate ventilation buildings to circulate and remove air from the tunnel. One vent building located approximately 1/3rd of the distance from the south tunnel entrance/exit at the present Highway 401 terminus at Highway 3; the second vent building located approximately 1/3rd of the distance from the north tunnel entrance and exit, which is half way between Malden Rd. and Huron Church Road.
- VB1B – use of two separate ventilation buildings at the main tunnel entrances/exits to circulate and remove air from the tunnel. One vent building located approximately at the present Highway 401 terminus at Highway 3; the second vent building located approximately half way between Malden Rd. and Huron Church Road.
- VB1C – use of a single ventilation building at the approximate half way point of the tunnel to circulate and remove air from the tunnel. One vent building located in the vicinity of Todd Lane/Cabana Rd.
- Jet Fans – use of multiple jet fans located in the tunnel interior to continuously circulate the tunnel air; assumes no vent buildings required.

The locations of the three vent building options are shown on Figure 1.5 below.

FIGURE 1.5 - TUNNEL VENTILATION BUILDING OPTIONS

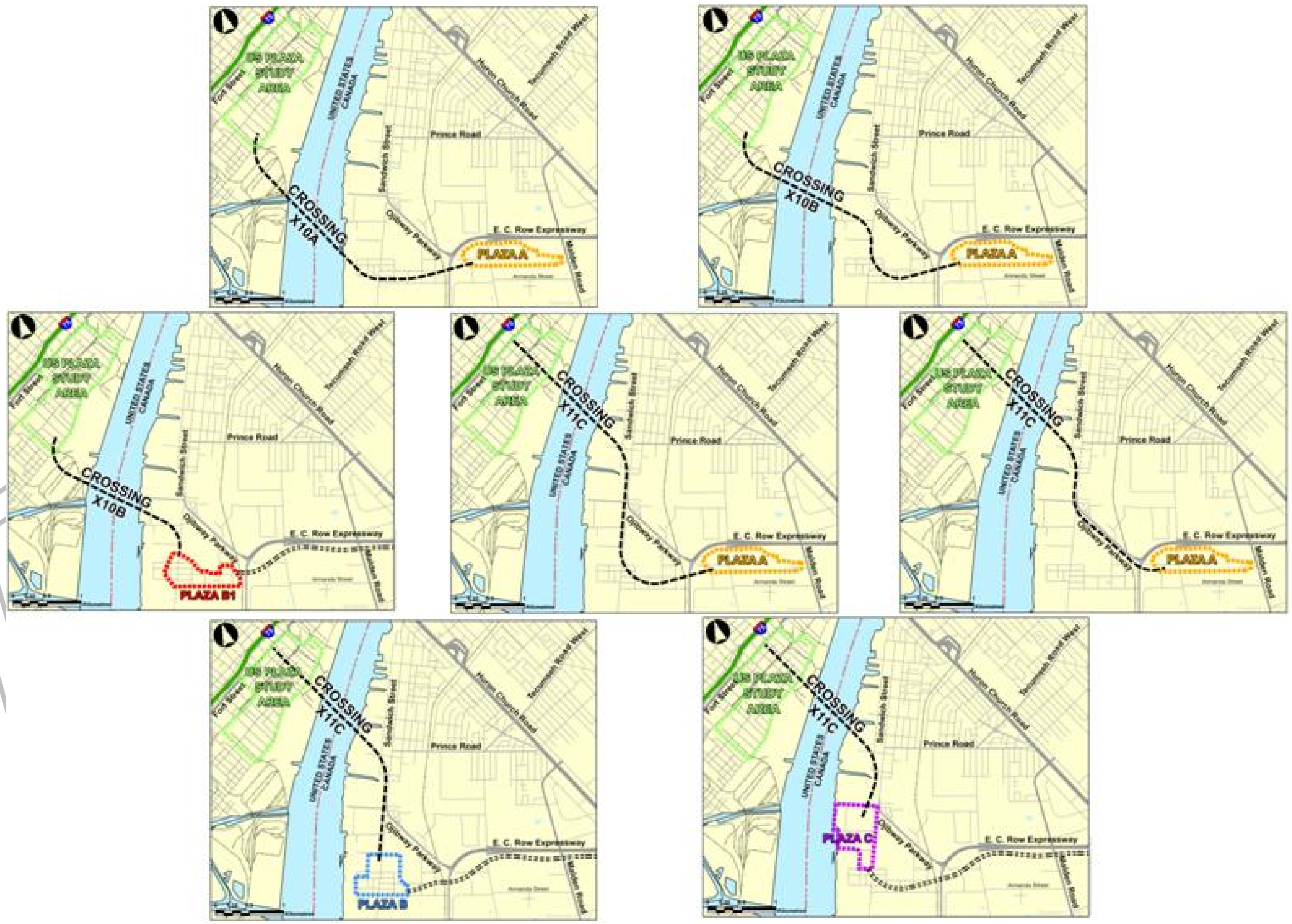


Four Plaza Alternatives and three river Crossing Alternatives were also examined, in various combinations. Each Plaza Alternative typically had several potential Crossing Alternatives, as follows:

- Plaza A
  - to Crossing A
  - to Crossing B
  - to Crossing C
- Plaza B
  - to Crossing C
- Plaza B1
  - to Crossing B
- Plaza C
  - to Crossing C

The different Canadian plaza and crossing Alternative combinations are presented in Figure 1.6 below.

FIGURE 1.6 - PRACTICAL CANADIAN PLAZA AND CROSSING ALTERNATIVE COMBINATIONS



Potential air quality effects of the six practical alternatives for the access road, four Tunnel Ventilation Alternatives and seven combinations of Plaza/Crossing Alternatives were assessed in accordance with the Air Quality Impact Assessment Work Plan developed for the DRIC Study, using a combination of existing air monitoring data in combination with air dispersion modelling. Air dispersion modelling was used to assess the impacts of future changes, such as implementation of the alternatives and, in addition, changes in fuels, vehicle technologies and traffic volumes. The model choice for most of the alternatives is CAL3QHCR with the exception of the end-to-end tunnel alternatives which used ISCST3 for the tunnels. CAL3QHCR is specifically designed to assess impacts from roads and highways. The model incorporates the differences between moving vehicles, and queued vehicles that are idling, as well as differences in roads that are "at grade", below grade and bridges.

Two indicator pollutants were selected for this phase of the analysis to represent one gaseous compound and one particulate compound. These are Particulate Matter less than 2.5 microns ($PM_{2.5}$) and Nitrogen Oxides (NO_x). Changes in the total predicted concentrations of these two air pollutants were compared for each alternative, as well as to existing conditions and a future "do nothing" condition.

1.2 Area of Investigation

Since air quality is not limited by local political boundaries, a relatively broad area was included in the Air Quality Assessment. This comprised an approximate 10 km x 10 km area in West Windsor, from just south of the present Highway 401 terminus at Highway 3, 10 km north and 10 km west to the Detroit River. This is approximately the area depicted in Figure 1.1 that was presented earlier.

Potential air quality effects from roadways decrease with increasing distance from the roadway. Therefore, the greatest effects will occur immediately adjacent to the roadway. For assessment of the potential affects on air quality of the Access Road Alternatives and Crossing Alternatives, an area located within 250 m on either side of the Right of Way (ROW) of each proposed Alternative was studied. Similar to the connecting route alternatives, the Plaza Alternatives were assessed within 250 m of the proposed facility property lines.

2.0 Existing Environmental Conditions

Assessment of the existing environmental conditions in the Windsor area is an important first step in the analysis of the various alternatives being studied. The existing conditions represent the benchmark to which future changes must be added (such as future traffic growth without implementation of any project related Alternatives). The benchmark and future changes form the baseline conditions, and are also known as the No Build Alternatives (one for each horizon year). All future changes related to the project are added to the existing conditions and evaluated against the baseline condition.

2.1 Climate and Meteorological Data

Characterization of the existing climate and meteorological conditions in the vicinity of the Huron Church Road / Highway 3 corridor is important because these are the main forces driving contaminant transport (dispersion) in the atmosphere. The direction and speed of the wind dictates the location and distance from the source that the pollutants may travel. The factors that influence the contaminant mixing in the atmosphere are described below.

The Windsor-Essex area has a middle latitude humid continental climate affected by Lake Erie and Lake St. Clair. The region is characterized by pronounced seasonal differences of weather and by a highly variable day-to-day weather pattern. Some periods in summer are essentially humid tropical (high temperatures, high humidity, afternoon thunderstorms, etc.). Some periods in winter are effectively polar (very cold, clear, dry). Precipitation occurs throughout the year.

The surface meteorological data used in the air dispersion modelling was obtained from the Windsor Airport meteorological station (2000 – 2004) which is approximately 5 – 7 km east of the Huron Church Road / Highway 3 corridor. It is well exposed and represents the general wind flow pattern in the vicinity of the corridor since the area is generally flat. The upper air measurements used are from the closest upper air station in Pontiac, Michigan, which is located approximately 30 km northwest of the DRIC study area. In order to be considered representative, the wind and temperature data should be obtained from within 100 km of the study area, and the upper air data (which is a regional parameter) should be within 300 km. The stations used for this study are well within these parameters.

2.1.1 Near-Surface Temperature

Temperature and precipitation normals for the Windsor Airport (1971-2000) are presented in Table 2.1. “Normals” is the term commonly used for values of climatic elements averaged over a fixed standard period of years (usually 30 years).

Temperature near the surface of the earth controls the buoyant component of turbulence (vertical motion). Heat from the earth's surface heats the air near the ground causing it to rise. This mechanism reaches a maximum in early afternoon and is at a minimum near sunrise. This affects the dispersion of air pollutants through the influence of “thermal mixing” as the air mass rises.

Table 2.1 indicates that the mean (averaged over 30 years) daily minimum temperature is –8.1°C in January and daily maximum temperature is 28°C in July at the Windsor Airport site. The annual mean temperature is 9.4°C.

TABLE 2.1 - WINDSOR AIRPORT CLIMATE NORMALS (1971-2000)

Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-4.5	-3.2	2	8.2	14.9	20	23	21.6	17	11	4.6	-1.5	9.4
Standard Deviation	2.9	2.7	2.1	1.6	2.1	1.3	1.1	1.2	1.3	1.7	1.7	2.7	0.8
Daily Maximum (°C)	-0.9	0.6	6.4	13	20.5	25	28	26.6	23	16	8.3	1.9	14
Daily Minimum (°C)	-8.1	-7	-2.4	3	9.3	15	17	16.6	12	6.2	0.9	-4.8	4.9
Precipitation													
Rainfall (mm)	29	33	55.6	81	80.7	90	82	79.7	96	64	67	47	805.2
Snowfall (cm)	35	28	20.6	4.3	0	0	0	0	0	0.7	8.3	30	126.6
Precipitation (mm)	58	57	75	85	80.8	90	82	79.7	96	65	76	75	918.3
Days with Rainfall													
>= 0.2 mm	5.7	5.6	9.4	12	11.8	11	10	10	11	11	11	7.9	115.7
Days With Snowfall													
>= 0.2 cm	13	9.1	6.7	2.3	0.03	0	0	0	0	0.3	3.8	10	45
Days with Precipitation													
>= 0.2 mm	15	12	13.9	13	11.8	11	10	10	11	11	13	15	146.7
Wind													
Days with Winds >= 52 km/hr	1.9	1.4	2.5	1.8	1.1	0.9	0.7	0.3	0.4	0.5	1.2	1.2	14
Days with Winds >= 63 km/hr	0.6	0.4	0.7	0.7	0.5	0.3	0.4	0.2	0.1	0.2	0.3	0.3	4.7

Source: Environment Canada website, http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html

The meteorological file used in the air dispersion modeling for this project requires hourly temperatures for each day in the year.

2.1.2 Precipitation

Precipitation acts as an atmospheric cleansing mechanism, as contaminants in the air are generally washed out by precipitation. More precipitation produces more washout. For this study, the role of precipitation in the removal of pollutants from the air was not considered, thereby generally providing conservatively high ground level concentrations.

As shown in Table 2.1 above, the Windsor area normally receives a total of 918.3 mm of precipitation per year, including 805.2 mm of rainfall and 126.6 cm of snowfall. The maximum mean monthly rainfall is 96.2 mm, which occurs in September.

2.1.3 Atmospheric Stability

Normally, temperature decreases with increasing height above sea level. The relationship of the actual vertical temperature to the near-surface temperature determines the atmosphere's ability to resist or enhance vertical motion. The amount of vertical motion is a measure of the stability of the atmosphere.

The atmosphere can have three general stability states - unstable, neutral and stable. The stability scale normally used for air quality simulations varies from very unstable (A) through neutral (D) to very stable (F). The stability class distribution for the Windsor Airport station for the period 2000 - 2004 is presented in Table 2.2. At this station, neutral stability conditions {D (neutral) + C (near neutral)} occur approximately 67% of the time and stable conditions (E, F) about 28% of the time. Stable conditions can produce higher concentrations of contaminants because of reduced turbulent mixing.

TABLE 2.2 - STABILITY CLASS DISTRIBUTION - WINDSOR AIRPORT (2000-2004)

Stability Class	% Frequency						Descriptor
	2000-2004	2000	2001	2002	2003	2004	
A	0.5	0.4	0.8	0.6	0.4	0.4	Unstable
B	4.2	3.6	4.6	4.4	4.4	3.9	
C	10.1	10.6	10.3	9.8	9.9	9.9	Neutral
D	57.0	56.0	56.2	57.1	57.0	58.6	
E	13.3	13.6	14.0	13.2	12.8	13.1	Stable
F	14.9	15.8	14.2	15.0	15.5	14.1	

The meteorological file used in the air dispersion modeling for this project requires hourly stability classes for each day in the year.

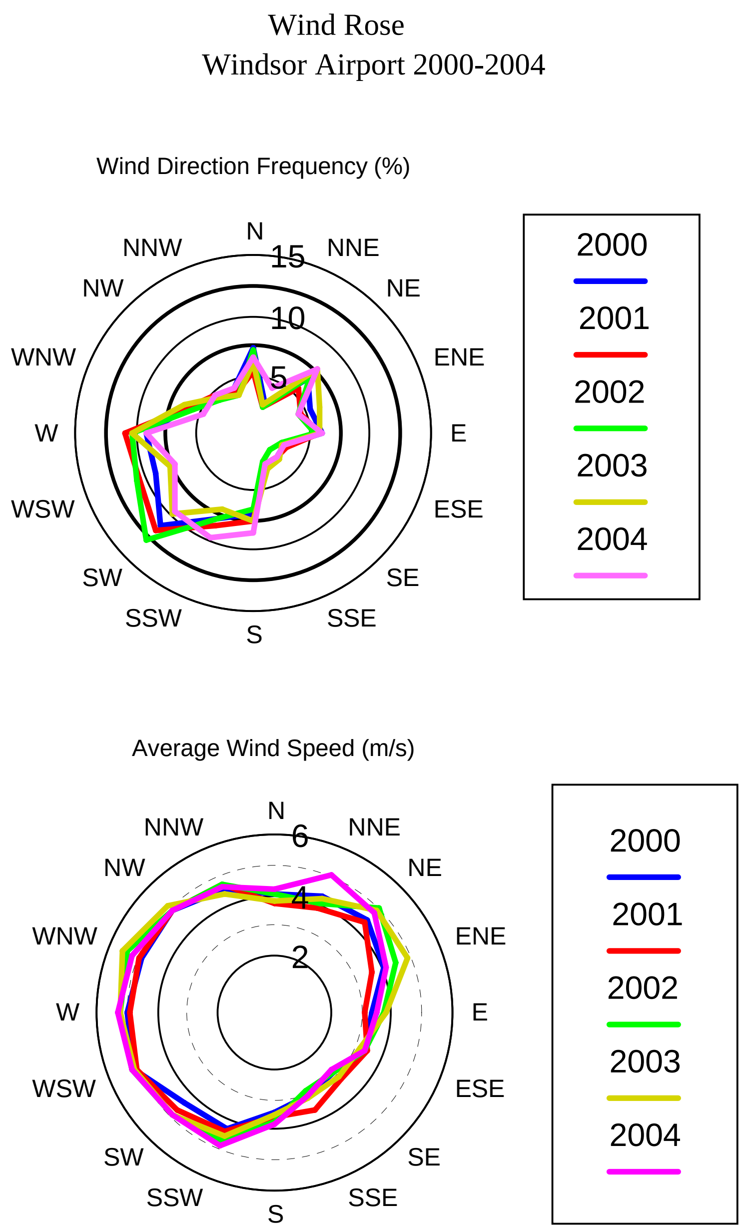
2.1.4 Wind Direction

Wind direction is reported as the direction from which the wind blows and is based on surface (10 meter) observations. In general terms, if the wind does not blow toward a receptor, there will be no impact from an upwind emission source. The wind blows in all directions with varying frequencies. Certain directions occur more frequently than others. These are known as the prevailing wind directions.

Figure 2.1 presents a wind rose for the Windsor Airport for the years 2000 - 2004. The prevailing wind is from the southwest, primarily during the summer months, with winds blowing from the west through southwest directions (i.e., from Southeast Michigan) approximately 32% of the time.

The dispersion modelling for this study uses the hourly wind directions of each day in the year.

FIGURE 2.1 - WIND ROSE - WINDSOR AIRPORT (2000 - 2004)



2.1.5 Wind Speed

Contaminant concentrations decrease with increasing wind speed as a result of atmospheric mixing. The wind speed used in the air quality modelling is based on surface observations from the Windsor Airport. Wind speed increases with height as surface friction is reduced. Variation of wind speed with height is built into the dispersion model used in this assessment. When wind speeds are high, there is good dispersion of gases and particles, but more potential for re-suspension of surface dust. When wind speeds are near zero, the primary mechanism of pollutant transport away from a source is via diffusion, which can lead to very high pollutant concentrations near the ground. Calms were recorded 4.3% of the time at the Windsor Airport meteorological station (Figure 2.1) during 2003 compared with 3.6% for the 2000 – 2004 period.

The meteorological file used in the air dispersion modeling for this project requires hourly wind speed and directions for each day.

2.1.6 Mixing Height

Another very important parameter in the dispersion of contaminants from a source is the "mixing height". This is the vertical extent through which the plume can be mixed. With a higher mixing height, there is a larger volume of air available within which the pollutants can mix, which results in lower concentrations. With a lower mixing height, the plume may become trapped resulting in higher concentrations.

The concept of mixing height is founded on the principle that heat transferred to the atmosphere at the earth's surface results in convection, vigorous vertical mixing and the establishment of a dry-adiabatic lapse rate [Holzworth 1967]. For annual and 24-hour average concentrations, the mixing height does not have much effect on the modelled ground level concentrations [Young & Radonjic 1993]. For 1 hour average concentrations, however, mixing height is very important. The use of variable mixing heights, that are as close to the actual conditions as possible, improves the ability of the model to accurately predict downwind concentrations. For the sources that are close to the ground, the mixing heights do not play a major role.

The closest station having the upper air data necessary for this study is the Pontiac, Michigan. The mixing height data for each day in the 5-year meteorological period (2000 - 2004) was developed using the Holzworth methodology. The surface values and the mean monthly minimum (morning) and maximum (afternoon) mixing heights were then pre-processed through the U.S. EPA meteorological pre-processor (PCRAMMET) [U.S. EPA 1998] which combines surface and upper air measurements to create the hourly mixing heights which are required by the dispersion model. Missing data was filled in by interpolation. There were no significant blocks of data missing from this meteorological data set.

2.2 Assessment Criteria

Environment Canada and the Ontario Ministry of the Environment (MOE) have set air quality objectives, and air quality standards and criteria, respectively for various air pollutants.

Ontario Regulation 419/05 (O.Reg. 419/05) made under the *Ontario Environmental Protection Act* (EPA) defines maximum concentration levels for various air contaminants at a Point of Impingement (POI), arising from an industrial facility or similar operation. The POI is generally defined as the off property location where the maximum concentration resulting from a facility emission occurs. However, if there is a child care facility, health care facility, senior citizens' residence or long-term care facility or educational facility on the property in question these locations become the designated POI location.

Facility property boundaries are most often used as the POI. With the exception of the ventilation buildings assessed for Alternative 3, the emissions in this assessment are from open, public sources, and thus are not subject to MOE POI standards and criteria (ventilation buildings are assessed against POI criteria to determine the necessary property footprint).

In addition, Section 14 of the *Ontario Environmental Protection Act* (*EPA*) prohibits a facility or operation to cause an adverse effect. The definition of "adverse effect" in the *EPA* includes, but is not limited to:

1. impairment of the quality of the natural environment for any use that can be made of it; and,

2. loss of enjoyment of normal use of property.

The Ontario Ministry of the Environment (MOE) as a component of the MOE standard setting process has developed a list of the Ambient Air Quality Criteria (AAQCs). The AAQCs are effect-based levels in air, with variable averaging time (e.g., 24-hour, 1 hour and 10 minutes) appropriate for the effect that it is intended to protect against. The AAQCs, which represent desirable levels in ambient air, are used for assessing general air quality and the potential for causing an adverse effect. The Standards Development Branch of the MOE publishes a set of guideline limits in *Ontario's Ambient Air Quality Criteria* [MOE, 2008].

Federal Air Quality Objectives encompass three levels of air quality objectives: maximum desirable level (MDL), maximum acceptable level (MAL) and maximum tolerable level (MTL). The MAL is intended to provide adequate protection against effects on soil, water, vegetation, materials, visibility, personal comfort and well-being. The MAL is considered to be a realistic objective. When the MAL is exceeded, the need for control action by a regulatory agency is indicated. Table 2.3 summarizes the applicable available criteria from the MOE and Environment Canada.

TABLE 2.3 - AIR QUALITY CRITERIA FOR $PM_{2.5}$ AND NO_X

Contaminant	Averaging Time	MOE AAQC µg/m³ (ppb)	Federal AQ Objective or Maximum Acceptable Level (MAL) (µg/m³)
NO_x (as NO_2)	1 h	400 (200)	-
	24 h	200 (100)	-
	Annual	-	100[1]
$PM_{2.5}$	24 h	-	30 *

Notes
NO_x – nitrogen oxides – sum of nitrogen dioxide (NO_2) and nitric oxide (NO)
$PM_{2.5}$ includes all particulate matter with an aerodynamic diameter less than 2.5 µm – considered respirable
[1] MAL is for NO_2
- Indicates no criterion available
* comes into force in 2010

Emissions of NO_x and $PM_{2.5}$ from the vehicles traveling on the freeway and the local service roads, other local arterial roadways, local industry and transboundary pollution from the southeastern United States have the greatest potential to impact local air quality. NO_x is the sum of nitrogen dioxide (NO_2) plus nitric oxide (NO). At present, there is no provincial annual AAQC for NO_x, but there is a federal MAL for NO_2. The assessment was conservatively completed assuming that 100% of the NO_x is NO_2. Typically, NO_2 comprises approximately 60% of total NO_x. With respect to $PM_{2.5}$, the MOE does not currently have an AAQC for $PM_{2.5}$. Instead, they have adopted the Canada Wide Standard (CWS) for $PM_{2.5}$, which is a Federal air quality objective that comes into force in 2010. Unlike the POI criteria in Ontario Regulation 419, it is not a legally enforceable standard that can be applied to specific sources. However, non-attainment of the CWS may indicate that regional action is required to reduce emissions.

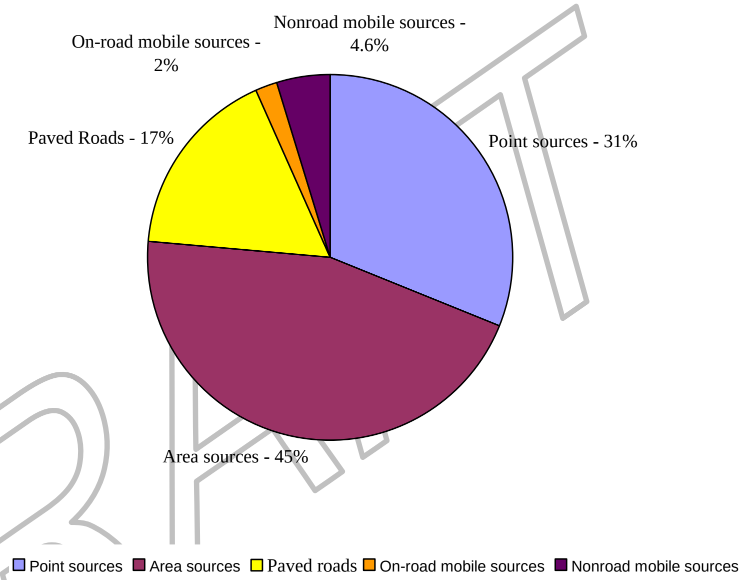
2.3 Existing Air Pollutant Concentrations

The Ontario Ministry of the Environment (MOE) measures air contaminants at various locations throughout Ontario, and reports on the state of Ontario's air quality on an annual basis. These reports are known as "Air Quality in Ontario" reports.

The existing air quality is greatly influenced by local and long range (cross-border) contaminants generated in upwind urban and industrial areas. The predominant wind directions in Windsor are from the west to southwest, which bring contaminants from the heavily industrialized areas of Detroit, nearby communities and beyond. Air quality impacts in the area are dominated by the substances that combine to produce smog or acid rain. This includes both NO_x and $PM_{2.5}$.

Figure 2.2 presents a breakdown of $PM_{2.5}$ emissions in Southwestern Ontario in 2000 (adapted from Environment Canada Great Lakes Basin Airshed Management Framework Pilot Project).

FIGURE 2.2 - $PM_{2.5}$ EMISSIONS IN SOUTHWESTERN ONTARIO (2000)



2.3.1 Ambient Monitoring Data

The MOE has historically operated a number of ambient air monitoring stations in Windsor. However, in recent years the number of fully operational stations has been reduced to two. These stations are located at:

1) 467 University Ave. (Station #060204 C);
2) College / South St. (Station #060211R);

The locations of these monitoring stations in relation to the DRIC Area of Continued Analysis are presented in Figure 2.3.

To assess the existing air pollutant concentrations in the area, monitoring data from these two stations were obtained from the MOE [MOE 2000 - 2005]. The MOE AAQCs are based on Nitrogen Dioxide (NO_2) measurements rather than total NO_x, thus the NO_2 data has been presented. Tables 2.4 and 2.5 present a summary of the measurements for NO_2 and $PM_{2.5}$ respectively.

TABLE 2.4 - FIVE YEAR SUMMARY OF MOE MONITORING RESULTS – NO_2

Station ID	Station Location	Averaging Period	Nitrogen Dioxide (µg/m³)						
			AAQC	Year					Ave
				2001	2002	2003	2004	2005	
#060211-R	College / South St.	Average	-	39	37	INS+	33	32	35
		90th Percentile	-	66	62	69	62	62	64
		1-Hour Maximum	400	130	175	182	176	133	159
		24-Hour Maximum	200	83	116	92	79	109	96
#060204-C	467 University Ave.	Average	-	36	36	INS	34	32	35
		90th Percentile	-	62	60	73	68	62	65
		1-Hour Maximum	400	163	130	150	182	124	150
		24-Hour Maximum	200	77	86	94	90	100	89

+ INS = Insufficient data available to compute a representative average

TABLE 2.5 - FIVE YEAR SUMMARY OF MOE MONITORING RESULTS – $PM_{2.5}$

Station ID	Station Location	Averaging Period	$PM_{2.5}$ (µg/m³)						
			AAQC	Year					Ave
				2001	2002	2003	2004	2005	
#060211-R	College / South St.	Average	-	-	11.8	9.6	9.5	10.5	10
		90th Percentile	-	-	26	20	21	24	23
		1-Hour Maximum	-	-	74	64	56	74	67
		24-Hour Maximum	30**	-	56	41	38	52	47
		No. of Times above Benchmark	-	-	18	7	9	9	11
#060204-C	467 University Ave.	Average	-	9.4	9.8	8.5	8.6	10.4	9
		90th Percentile	-	20	21	19	19	24	21
		1-Hour Maximum	-	72	75	64	54	72	67
		24-Hour Maximum	30**	40	56	43	39	48	45
		No. of Times above Benchmark (30 µg/m³)	-	7	10	5	8	12	8

** Canada Wide Standard, NOT AAQC

2.3.1.1 Existing Air Pollutant Concentrations in the Huron Church Rd/Hwy 3 Corridor

As part of the Environmental Assessment, the DRIC team established two ambient air monitoring stations in the study ACA, along the existing Huron Church/Talbot Rd. corridor. The stations were located at the Ontario Public Health Laboratory and to the south of St. Clair College. The location of both the DRIC monitoring stations and the MOE stations are shown in Figure 2.3.

Detailed results from the DRIC monitoring program are included separately in the Air Quality Monitoring Report.

The main purpose of the monitoring program was to collect data on the total pollutant concentrations of various pollutants that are routinely observed in the corridor. The monitoring program commenced in September 2006 and continued to October 2007.

The data are being used to:

- Establish current conditions within the corridor;
- Assist in determining background air concentrations of the pollutants being measured; and,
- Benchmark the air dispersion modelling.

In addition to $PM_{2.5}$ and NO_2 which are discussed in this assessment, additional contaminants were included in the monitoring program and will be considered in the analysis of the TEPA.

FIGURE 2.3 - MOE MONITORING STATION LOCATIONS AND DRIC MONITORING STATION LOCATIONS

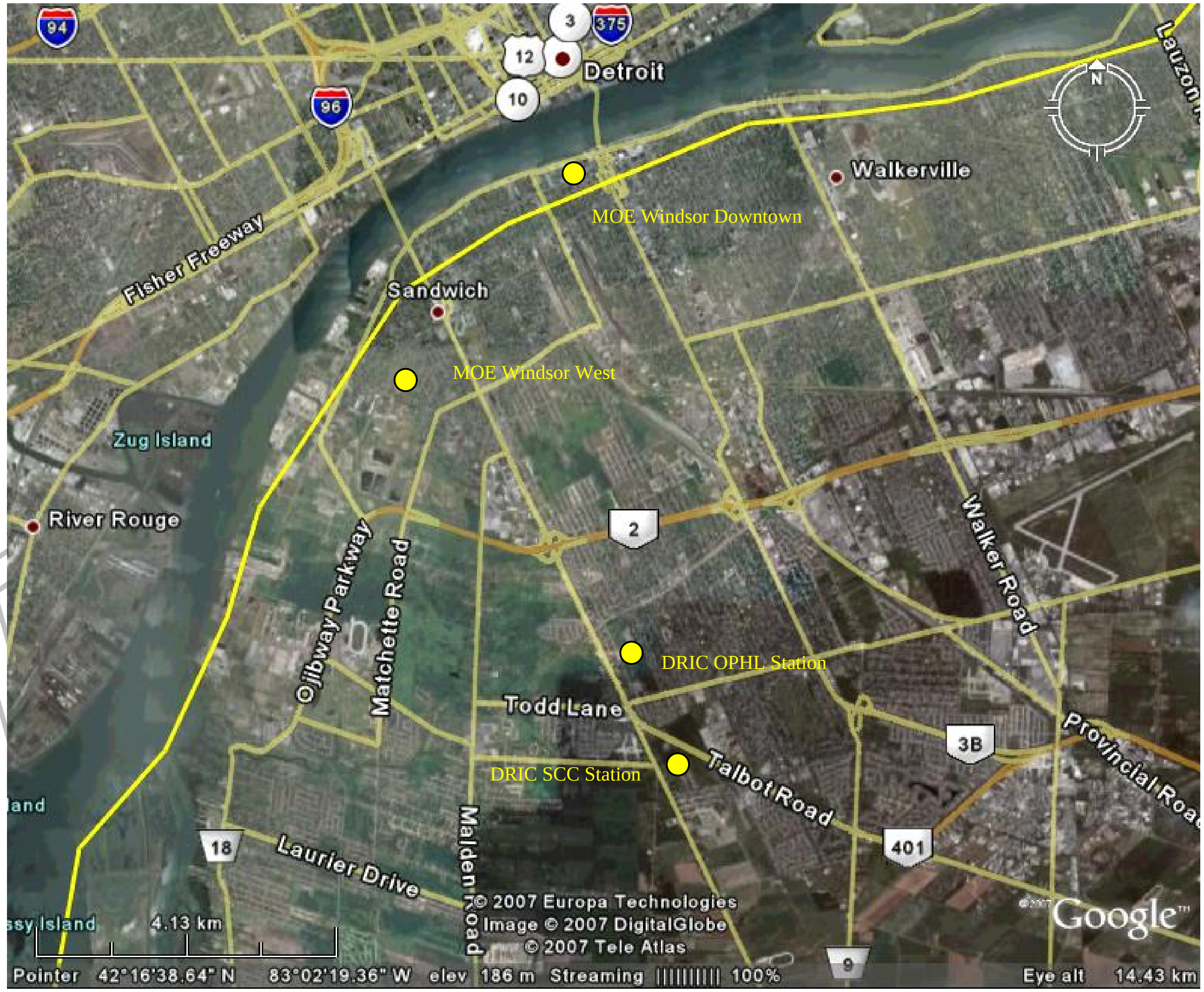


Table 2.6 presents a summary of the $PM_{2.5}$ and NO_2 measurements collected from the two DRIC stations from October 2006 to December 2006. These first quarter results were used to assist in establishing background concentrations for the modeling of the alternatives. While data are currently available for more than just the first quarter, the initial model runs were performed when only limited data was available. To keep the comparisons consistent between alternatives, the first quarter results were used for all alternatives.

Table 2.7 presents a summary of the $PM_{2.5}$ and NO_2 measurements collected from the two DRIC stations from November 2006 through October 2007. After being fully evaluated, these data will be used as part of the final analysis of the preferred alternative.

TABLE 2.6 - SUMMARY OF DRIC 1ST QUARTER MONITORING RESULTS (OCT 07 – DEC 07)

Pollutant	Averaging Time	OPHL	SCC	Average of 2 Stations
NO_2 (1-hr), µg/m³	Max	85	85	85
	Min	0	0	0
	Average	27	21	24
	90th Percentile	47	39	43
NO_2 (24-hr), µg/m³	Max	52	50	51
	Min	2	2	2
	Average	26	21	24
	90th Percentile	43	32	38
$PM_{2.5}$ (24-hr), µg/m³	Max	48	46	47
	Min	8	8	8
	Average	21	20	21
	90th Percentile	32	29	31

TABLE 2.7 - SUMMARY OF DRIC MONITORING RESULTS (NOVEMBER 2006 – OCTOBER 2007)

Pollutant	Averaging Time	OPHL	SCC	Average of 2 Stations
NO_2 (1-hr), µg/m^3	Max	104	110	107
	Min	0	0	0
	Average	27	23	25
	90th Percentile	50	44	47
NO_2 (24-hr), µg/m^3	Max	68	52	60
	Min	3	3	3
	Average	27	23	25
	90th Percentile	43	36	40
$PM_{2.5}$ (24-hr), µg/m^3	Max	48	46	47
	Min	8	7	8
	Average	20	21	21
	90th Percentile	32	33	33

2.3.2 Contribution from Upwind / Background Sources

Air dispersion models provide an estimate of the air pollutant concentrations resulting from emission sources that are specifically included in the model set-up and inputs. Concentrations resulting from other, upwind (areas to the south and west of Windsor) sources are not included, but must be considered when assessing total expected air pollutant concentrations against relevant standards and guidelines. This is typically done by adding a "background component" to all model predicted results. The Ontario Ministry of the Environment (MOE) generally advocates the use of 90th percentile air pollutant concentrations obtained from ambient air monitoring stations for this purpose (i.e., background concentrations are lower 90% of the time). This approach is considered to provide a conservative estimate of background concentrations.

Data on the existing air pollutant concentrations in the Windsor area were obtained from the two MOE air monitoring stations. Given their locations in an urban setting, data from the MOE stations reflect local traffic. The MOE data therefore provide somewhat higher background concentrations of pollutants such as NO_x and $PM_{2.5}$ than might otherwise be observed at stations further from traffic but upwind (i.e. south and west) of the study area. However, for the DRIC Study, the two MOE stations were considered to be far enough away from the Huron Church/Highway 3 corridor that existing traffic conditions from this corridor would not be impacting the MOE monitors to any notable degree.

Tables 2.4 and 2.5 indicate that the average 90th percentile measured concentrations at each of the MOE stations are 23 and 21 ug/m^3 for 1-hour $PM_{2.5}$ and 64 and 65 ug/m^3 for 1-hour NO_2. The first quarter data from the two DRIC air monitoring stations were used in conjunction with the MOE monitoring data in determining the appropriate background concentrations.

As shown in Table 2.6, the average measured concentration at the DRIC stations for the first quarter of monitoring data (Oct 1 – Dec 31st, 2006) was 21 µg/m^3 for $PM_{2.5}$. This corresponds to the 22 ug/m3 of the 90th percentile for the MOE monitoring stations. Therefore, for the purposes of background, a rounded value of 20 µg/m3 was chosen. This value allows for a conservative approach to determining the possible combined effects of the roadway and other contributions to $PM_{2.5}$.

For NO_2 the average value from the DRIC monitoring stations is 24 µg/m3. The 90th percentile value for the MOE monitoring stations is 65 µg/m3. Because of the large discrepancy between the MOE and DRIC monitoring stations and the general acceptance by the MOE for 90th percentile values, a conservative rounded value of 70 µg/m3 was chosen for background for NO_x.

Established background levels will be re-evaluated in greater detail to reflect the full year of monitoring in the Huron Church/Highway 3 Corridor, as appropriate, in assessing the TEPA.

Table 2.8 presents the selected background concentrations used in the DRIC AQ assessment.

TABLE 2.8 - SUMMARY OF BACKGROUND CONCENTRATIONS USED IN DRIC AQ ASSESSMENT

Pollutant	Averaging Time		
	1-hour	24-hour	Annual
NO_x	70 µg/m^3	70 µg/m^3	-
$PM_{2.5}$	-	20 µg/m^3	9 µg/m^3

3.0 AIR DISPERSION MODELLING

Atmospheric dispersion modelling is an essential step in the air quality assessment process as it is the only way to evaluate the impact of future changes in air pollutant emission sources. With respect to the Detroit River International Crossing Study, these changes include implementation of a new access road, plaza and crossing, changes in fuels, vehicle technologies and traffic volumes.

Dispersion modelling is used to predict atmospheric concentrations of pollutants at specific receptors downwind of the source of pollutants over specific averaging times (i.e., annual, daily, hourly). The process involves using a computer model to mimic the way pollutants are emitted from sources, and how the atmosphere disperses them. The model takes emissions from a source, estimates how high into the atmosphere they will go, how widely they will spread and how far they will travel based on hourly meteorological data. The model then outputs the pattern of concentrations that will occur at receptors located downwind of the source for various averaging times.

In general, the maximum air pollutant concentrations (rather than average concentrations) predicted to occur over specific time periods at each receptor are typically used to assess the impact of 'worst case' meteorological conditions. For air quality impact assessment, 'worst case' conditions are usually periods with light wind speeds, when atmospheric dispersion is poor.

3.1 Assessment Methodology

A large amount of data was required to complete the Air Quality Assessment in support of the evaluation of practical alternatives. This included data on existing air pollutant concentrations in the Windsor area, existing and future traffic volumes on the Huron Church Rd./Highway 3 corridor for each connecting route Alternative and Future No-Build scenarios, meteorological conditions in the Windsor area, and geographic information such as the location co-ordinates of roadways and sensitive receptors.

The necessary data was obtained from various sources, including other DRIC team members (i.e., traffic consultant, survey/mapping consultant), Environment Canada and the Ontario Ministry of the Environment (MOE).

The analysis was completed using the following approach:

1. Characterize Existing Environmental Conditions
    a. Acquire Meteorological Data
    b. Compile data on existing $PM_{2.5}$ and NO_x concentration
    c. Determine background concentrations
2. Acquire data on current and future car and truck traffic volumes
    a. Input to model - traffic data for existing and future conditions, including access road, plaza and crossing alternatives

3. Calculate pollutant emission factors for the highway corridor for existing and future conditions
    a. Input to model - vehicle emissions for each road considered in the assessment, for both $PM_{2.5}$ and NO_x with emission factors specific to each horizon year
4. Use air dispersion modelling (primarily CAL3QHCR, with ISCST3 used for tunnel ventilation) with meteorological data from Windsor Airport to determine future air pollutant concentrations in the vicinity of the corridor (essentially all of west Windsor) and at sensitive receptor locations (such as schools).

For the analysis of practical alternatives, an air dispersion model was set up for each of the alternative connecting routes, plazas, and crossings. The selected dispersion model was the CAL3QHCR model, which is specifically designed for roads and highways, and is approved for use in Ontario by the MOE. The model calculates emissions from moving vehicles differently from those that are queued and idling at intersections and inspection plazas. The model also differentiates between at-grade, below-grade and elevated sources.

The evaluation of practical alternative 3 required the assessment of tunnel ventilation buildings and emissions from the tunnel entrance and exit portals. The CAL3QHCR model is not appropriate for these emission sources, and thus another model was required. SENES evaluated both the AERMOD and ISCST3 models for this purpose. While both models are appropriate to use in this assessment, the ISCST3 model was preferred since the same meteorological data file could be used for both ISCST3 and CAL3QHCR models. Use of the AERMOD dispersion model would have required a different meteorological data file, which potentially could have introduced some inconsistencies since the outputs from both the CAL3QHCR and AERMOD/ISCST3 models were being combined. In order to avoid this potential problem, the ISCST3 air dispersion model was selected.

For The Parkway alternative, emissions calculation methodology had to be modified to reflect the use of tunnels and to assess emissions at the portals of these tunnels. The CAL3QHCR model was used for the assessment as it was deemed to be most applicable conventional model for a preliminary assessment.

3.2 Model Inputs and Set-up

Air dispersion models typically require the following inputs: hourly meteorological data, receptor locations, source characteristics, and emission rates.

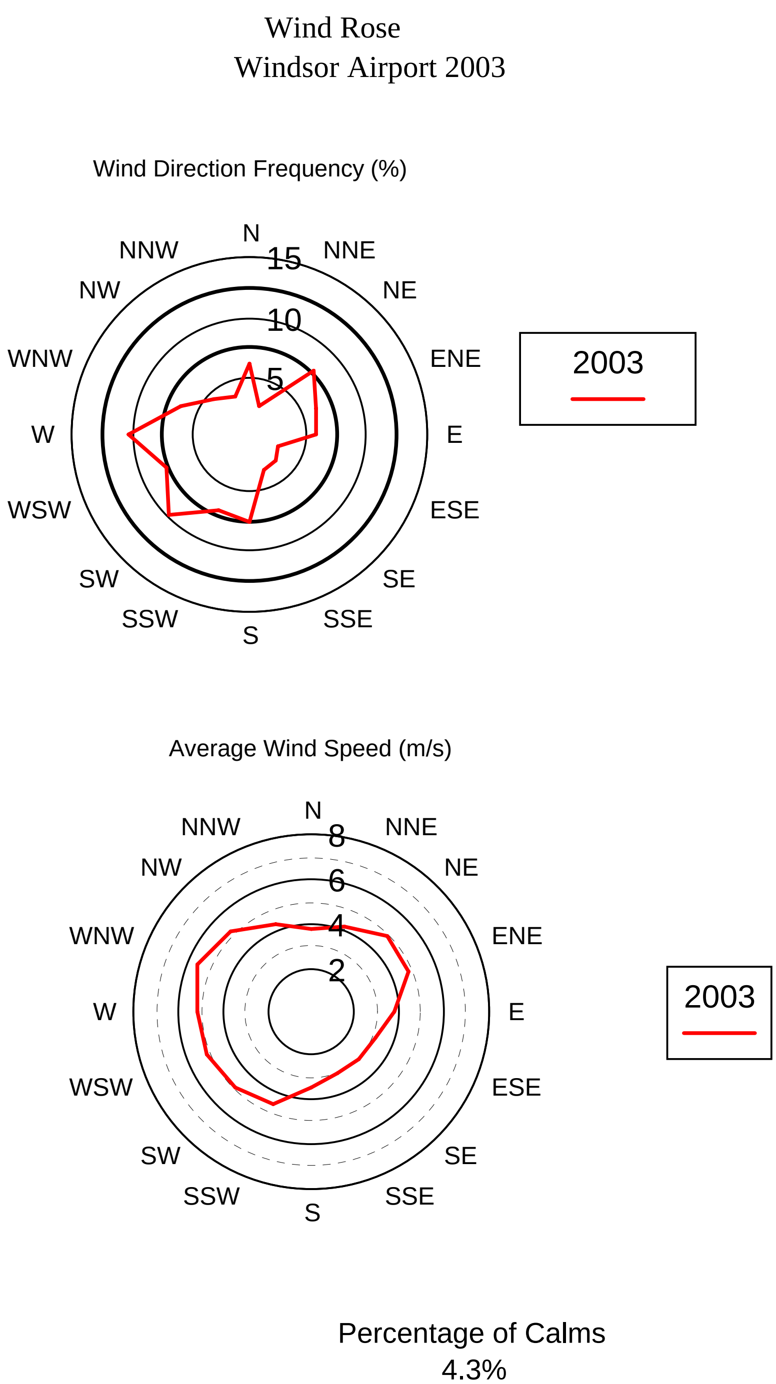
3.2.1 Meteorological Data

In order to simulate how air pollutants will disperse as they move away from a source, air dispersion models use hourly meteorological data to simulate the possible meteorological conditions that are routinely experienced in a specific area. The data typically includes mixing height, temperature, cloud cover, cloud opacity, wind speed and wind direction. These were described in detail in Section 2.1.

For the assessment of practical alternatives, one set of model runs were conducted at the sensitive receptor locations using meteorological data from 2000 through 2004. A maximum year was selected for use in all subsequent analyses. This was done by modeling a test case with the five years of meteorological data, and comparing the results.

The model results indicated that the meteorological data from 2003 generally resulted in the highest atmospheric concentrations for both contaminants evaluated (NO_x and $PM_{2.5}$). Thus, the analysis for all alternatives was completed using this single year of data. The 2003 wind rose is presented in Figure 3.1. As can be seen in the figure, the 2003 wind rose is similar to the 5-year average, except that the 2003 wind speeds are lower in the quadrants from WSW to SSW, and slightly higher in the ENE quadrant. This is consistent with the model results (i.e., slightly higher predicted concentrations) since lower wind speeds results in poorer dispersion conditions.

FIGURE 3.1 - 2003 WINDSOR WIND ROSE

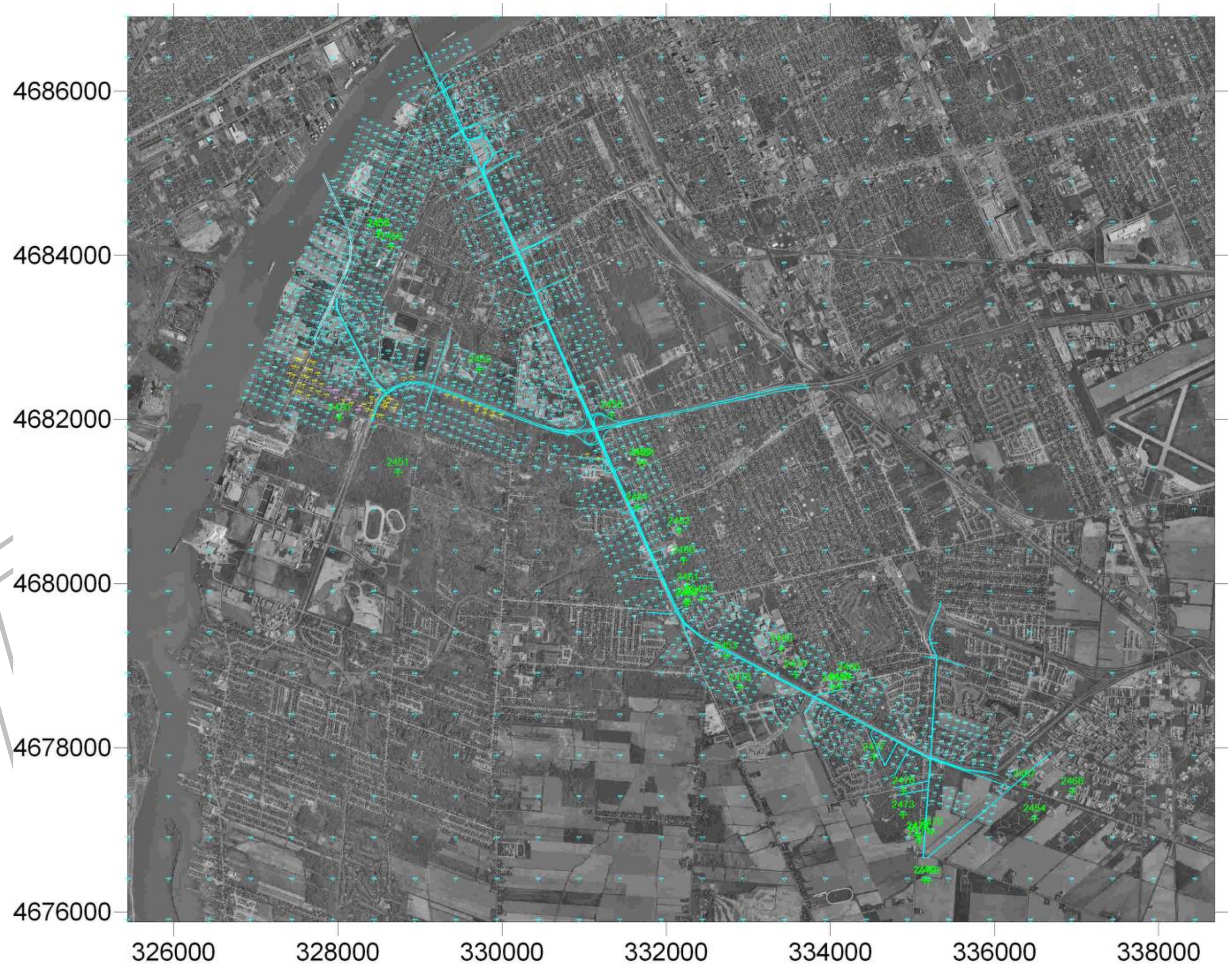


3.2.2 Receptors

A gridded network of receptors was created along the corridor at 100 m intervals that covered an area of 500 meters from the access road on each side. In order to ensure that the worst-case effects were captured in the model results, several grids with different receptor spacing were used within this area. The first two rows of receptors were placed at 50 m intervals from each side of the ROW, followed by 100 m intervals up to 500 m away. Another grid with 500 m x 500 m spacing was then overlaid to cover the rest of the modelling domain, which was essentially all of west Windsor. Any receptors that fell within the proposed ROW were removed to prevent erroneous model results, as the models do not accurately predict air pollutant concentrations at locations on a source (i.e., on the roadway). Sensitive receptors (schools, churches, parks, etc.) were also identified and included in the model runs. A total of 2484 receptors were used in each model run completed for the analysis as shown in Figure 3.2.

For a discussion on how predicted changes in pollutant concentrations will affect sensitive receptors and neighbourhoods, refer to the *Practical Alternative Work Paper - Social Impact Assessment (April 2008).*

FIGURE 3.2 - RECEPTOR GRID



3.2.3 Source Characteristics and Emissions

Each emission source included in an air dispersion model is described and input separately. Source characteristics required for input to the CAL3QHCR model include road segment identification with geographic coordinates, segment width, traffic volumes for free-flowing and idling traffic, and emission factors, which represent vehicle emissions in grams per vehicle kilometer travelled. Additional information on signal timing and intersection capacity was required for road segments where vehicles queue, such as intersections. The Universal Transverse Mercator (UTM) (geographic) coordinates of all road segments and intersections were determined from digital orthographic aerial photographs combined with AutoCAD drawings of the proposed connecting route, plaza and crossing alternatives. All elements were combined in a Geographic Information System (GIS) for data maintenance. Over 700 free-flowing roadway sources (i.e., Highway 401, sections of Huron Church Road) and almost 150 queue sources (i.e., signalized intersections where vehicles wait for a green light) were included in each model run for the assessment of the connecting route alternatives.

Details on the roadway segments considered in the assessment are included in Appendix A.

3.2.3.1 Traffic Volumes

Annual Average Daily Traffic (AADT) volumes for the roadway segments, plazas and crossings for existing conditions (2006) and the future build and no build cases for 2015, 2025 & 2035 were provided by IBI Group and URS Canada. For details on how the traffic predictions were developed, refer to the *Level 2 Traffic Operations Report (February 2008).*

A selection of traffic volumes from the main routes considered in this assessment is presented below in Table 3.1 to illustrate the relative magnitude of the volumes. The full record of traffic data used in the assessment is presented in Appendix A. These data form the basis of the emission calculations used in the dispersion modeling analysis.

TABLE 3.1 - SUMMARY OF TRAFFIC VOLUMES ON MAIN ROADS

LOCATION	SECTION	SCENARIO	24-HOUR AADT							
			2006		2015		2025		2035	
			CARS	TRUCKS	CARS	TRUCKS	CARS	TRUCKS	CARS	TRUCKS
Huron Church Rd / Talbot Road	North of ECR (Malden)	No Build	46619	10495	51466	15109	50865	19582	50178	23384
		Alternatives	0	0	58313	3352	60655	3876	63147	4592
	Grand Marais	No Build	38142	10685	40771	15164	43485	18702	44116	22369
		Alternatives	0	0	16732	245	18689	323	19884	351
	Todd/Cabbana	No Build	33454	8049	35160	11484	37285	13728	38494	16010
		Alternatives	0	0	15378	203	17269	227	18615	246
	Howard	No Build	24217	6349	24229	9039	23549	11054	23159	13246
		Alternatives	0	0	15282	21	16601	49	16979	73
Hwy 401 Mainline	Todd/Cabbana to Grand Marais	Alternatives	0	0	39481	11976	45994	16720	49632	20509

Hourly profiles for typical daily use of car and truck traffic on different roadway types (i.e., highway, major arterial, local roads) were also provided, which were used to convert the AADTs into hourly volumes. These hourly volumes of domestic and international cars and trucks on each roadway segment were used to estimate emissions of $PM_{2.5}$ and NOx from each source. Separate weekday and weekend traffic patterns were provided to SENES and used to represent actual expected traffic conditions. Idling traffic volumes and queue lengths were calculated by the CAL3QHCR air dispersion model based on the number of vehicles that approach an intersection, the signal timing and the capacity of each intersection. The vehicles approaching an intersection queue were conservatively assumed to be same as the free-flowing traffic volume.

3.2.3.2 Vehicle Emissions Estimates

Emissions from vehicles traveling on public roadways account for a significant portion of the smog producing air pollutants in North America. Although tailpipe emissions are the major source of gaseous pollutants (such as NO_x), they are not the major source of particulate emissions. In most cases, tailpipe emissions are a small fraction (<5%) of the total particulate emissions from roadways during free-flow traffic conditions. As cars and trucks travel over the surface of a roadway, there are other sources in addition to tailpipe emissions that contribute to overall particulate emissions. These other sources include road abrasion and degradation, tire & brake wear, and soil/mud/debris that are deposited on the surface. Particulate from these other (non-tailpipe) sources is collectively known as surface resuspended particulate. When vehicles queue and idle, the particulate emissions are 100% from the tailpipe, as there are no emissions from the roadway surface if the vehicles are not moving.

For tail pipe emissions, idling cars emit approximately 4 times more particulate than free-flowing cars, and idling diesel trucks emit over 25 times more particulate than free-flowing diesel trucks. However, vehicles generally spend less time idling, unless the roadways are completely congested. Because of the significant difference between particulate emissions from idling and moving vehicles, the inclusion of queuing in the analysis is an important and necessary consideration. The freeway extension is expected to divert most of the traffic currently following the existing corridor (which requires periodic idling at intersections) to a free-flowing state which would reduce tailpipe emissions from idling.

Emission factors were developed separately for vehicle exhaust and surface roadway emissions (i.e., road dust) using Environment Canada's MOBILE 6.2C model and USEPA emission factor methodologies (i.e., AP-42). Separate emission factors were developed for cars and trucks, and incorporate:

- regulatory changes in fuels and engine technologies;
- differences in Canadian and U.S. fuels and vehicles; and
- Canadian and U.S. fleet turnover rates.

Recent and on-going improvements in emission control technologies and fuels will combine to substantially reduce the emissions from transportation sources. As of June 2006, the maximum amount of sulphur in on-road diesel fuel was reduced from 500 mg/kg to 15 mg/kg. This reduction was necessary for sulphur levels in Canadian on-road fuels to be consistent with U.S. levels, and to ensure that advanced emission control technologies on newer engines would be effective. In January 2007, additional engine standards for heavy-duty vehicles came into effect in the US that will also impact the Canadian fleet. These standards reduce NO_x and particulate matter tail-pipe emissions by 60% and 90% respectively over existing levels, and require the incorporation of additional emission control technologies on these newer engines to effect these reductions.

Since the area considered in the assessment includes a number of different types of roads, the development of the emission factors considered appropriate vehicle speeds for each road type. Different emission factors were applied to each road based on the current or future assumed posted speed limits. The assessment also spans a long period of time, over which several regulated changes to fuel characteristics and vehicle engine technologies will occur. Although the effect of fuel changes on emissions starts to occur immediately following the implementation of the changes, technological changes require several years before the effects of the changes are fully observed. As such, the historical vehicle fleet turnover rates from the Detroit and Windsor areas were obtained from Air Improved Resource, Inc. and used to reflect the impacts of technological changes on vehicle emissions.

Table 3.2 presents a summary of the emission factors used in this assessment. Cars and trucks entering Canada from the U.S. were assumed to have U.S. vehicle and fuel characteristics, whereas cars and trucks exiting Canada were assumed to have Canadian vehicle and fuel characteristics. These assumptions are expected to adequately represent the fleet characteristics and emissions in the Windsor area, particularly on a daily basis, as some vehicles will both exit and enter on the same day. The complete database of emission factors, fleet turnover information and other assumptions used in the MOBILE6.2C model can be found in Appendix B. Sample calculations are presented in Appendix C.

TABLE 3.2 - SUMMARY OF EMISSION FACTORS USED IN THE ASSESSMENT

Pollutant	Speed (km/h)	Surface Emissions (g/VKT)	Tailpipe Emission Factors (g/VKT)											
			Canadian Cars			Canadian Trucks			U.S. Cars			U.S. Trucks		
			2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
NO_x	Idle*		1.32	0.63	0.58	113.68	115.42	115.42	1.20	0.59	0.52	111.9	115.65	115.65
	25		0.44	0.20	0.18	2.35	0.46	0.34	0.40	0.19	0.16	1.9	0.50	0.34
	50		0.40	0.18	0.17	2.02	0.39	0.29	0.36	0.17	0.15	1.7	0.43	0.29
	75		0.49	0.21	0.19	2.91	0.57	0.43	0.44	0.20	0.17	2.4	0.63	0.43
	100		0.49	0.21	0.19	2.91	0.57	0.43	0.44	0.20	0.17	2.4	0.63	0.43
$PM_{2.5}$	Idle*	0	0.0086	0.0066	0.0065	1.0684	0.3140	0.1554	0.0086	0.0067	0.0065	1.1543	0.4342	0.1557
	25	1.3-2.3**	0.0021	0.0016	0.0016	0.0129	0.0062	0.0058	0.0021	0.0016	0.0016	0.0119	0.0063	0.0058
	50		0.0021	0.0016	0.0016	0.0129	0.0062	0.0058	0.0021	0.0016	0.0016	0.0119	0.0063	0.0058
	75		0.0021	0.0016	0.0016	0.0129	0.0062	0.0058	0.0021	0.0016	0.0016	0.0119	0.0063	0.0058
	100		0.0021	0.0016	0.0016	0.0129	0.0062	0.0058	0.0021	0.0016	0.0016	0.0119	0.0063	0.0058

* Idle emission rates expressed as g/hr

** $PM_{2.5}$ surface emissions based on modeled conditions and are dependent on average combined vehicle weight

In regards to traffic movements, the following additional assumptions were made:

- Vehicles on Highway 401 will be moving in a free-flowing state;
- Vehicles on service roads (and north of EC Row) will generally move in free-flow, but will queue at signalized intersections;
- Inbound vehicles at the customs plaza will queue at booths; and
- Outbound vehicles at the customs plaza will not queue.

3.2.3.3 Customs / Inspections Plazas

The traffic conditions at the customs plazas were modeled using the same queuing algorithm that was used for the intersections. Volumes of cars and trucks entering Canada from the U.S. as well those leaving Canada were provided to SENES by IBI and URS Canada for the years 2015, 2025, and 2035.

The amount of queuing at the plazas was estimated using the hourly traffic volume and the number of booths that are open during each hour, in addition to the average duration of each vehicle at a booth. The number of booths open in each hour was assumed to be a function of the traffic volume entering the plaza. Queues of cars and trucks form at car and truck booths respectively, and thus were modelled separately. Design information regarding plaza operations and vehicle timings were provided by Stantec.

With respect to plaza queuing, the following assumptions were used:

- Each truck requires 60 seconds at the primary inspection booth.
- Each car requires 45 seconds at the primary inspection booth.
- There is always queuing (idling) at the booth due to the one vehicle in the booth being inspected.
- Number of open booths assumed to be slightly less than capacity, such that some minimal queuing (2 or 3 cars or trucks) is always occurring at open booths.
- During periods where the capacity of the plaza is exceeded, longer queues form back towards the plaza entrance.

Groups of queue links were set up for each plaza car and truck lane based on an equal hourly distribution of free flow traffic through each booth that is open during a given hour. The groups extended back away from the booths to accommodate longer and longer queue lengths, as necessary. Each queue link was then manually “turned on” or “off” by calculating the number of vehicles queued at the open booths.

Based on the methodology and assumptions outlined above, and the inbound traffic volumes through the plaza provided by IBI, the maximum number of plaza booths open at any given time was 17 truck booths and 9 car booths at any of the new Customs/Inspection Plaza Alternatives.

The same methodology was applied to the Ambassador Bridge plaza for the future no-build scenarios and all of the connecting route alternatives. Using this approach, the queue lengths at the Ambassador Bridge often extended back across the Ambassador Bridge and onto Huron Church Road for the future no-build scenarios, which is what would be expected.

3.2.3.4 Tunnel Ventilation Buildings and Portal Emissions

The tunnel ventilation buildings are not a roadway source, and thus require the use of a different model. The ISCST3 model, which is used for assessing the impact of stationary emission sources such as industrial stacks, was used to model emissions from the tunnel entrance / exit portals and ventilation buildings. The conceptual design of the tunnel is based on the premise that emissions should not escape from the portals (i.e., exhaust flow is always greater than supply flow, such that air is continually drawn into the tunnel through the ramps and portals). However, there is a "piston effect" as cars drive out of the tunnel, which will result in some emissions from these areas. A total of 5% of the emissions were assumed to escape from the tunnel at these portal locations.

Based on the tunnel configuration, there are 10 locations where emissions may exit the tunnel. These are entrance/exit portals at on and off ramps, as well as two main entrance and egress locations (one at the approximate present terminus of Highway 401 [which is combined with an entrance portal] and one immediately west of the intersection of Huron Church Rd and EC Row Expressway). The main entrance and egress locations were assumed to be comprised of two separate tunnel "tubes". The 5% of the emissions that were assumed to escape from the portals were assumed to be evenly apportioned over these 10 locations. For the "Jet Fans" option, 100% of tunnel emissions were assumed to be emitted from these openings, and the emissions were evenly apportioned over the 10 locations.

As outlined earlier, there are three options for tunnel ventilation buildings (VBIA, VBIB, VBIC). Each of these has a slightly different conceptual design and thus each option was modelled to assess whether there are any differences in the potential affects to air quality. Mitigation options were not considered in this phase of the assessment.

The basic assumptions were as follows:

- The ventilation systems collect 95% of the total emissions from the tunnel:
    - All collected emissions were discharged from the vent stacks;
    - Vent building height is 18 m;
    - Stack height is 45 m (from the ground surface).
- Options VBIA & VBIA have two ventilation buildings:
    - Emissions were apportioned equally between the two buildings.
- Option VBIC has one ventilation building.

The locations of each of the ventilation building options were presented earlier in Figure 1.3.

The ISCST3 model input files were completed and run for each of the tunnel ventilation scenarios. The hourly predicted concentrations from the vent buildings and portals were then added to the hourly predicted concentrations from the surface roadway sources (i.e., re-build Huron Church Road / Highway 3 corridor from the CAL3QHCR model) plus ambient background concentrations to determine the total model predicted concentrations.

3.2.3.5 The Parkway Tunnel Emissions

For the Parkway option, emissions for the tunnels were considered to be emitted from the ends of the tunnels and dispersed over a short distance (generally varying by tunnel length) from the ends of the tunnels. The tunnel structures are typical of most overpass structures and are open between opposing traffic directions such that air can flow freely between the opposing traffic thus the piston effect previously described for longer tunnels is minimized. In addition, the amount of turbulence from the tunnel egress points could be expected to impact both traffic flow directions. Both NO_x and $PM_{2.5}$ were considered to be fully emitted from the tunnels and there was no allowance for deposition of $PM_{2.5}$ within the tunnels.

The emissions at each portal were modeled using CAL3QHCR, and included both tailpipe and resuspended emissions from within the tunnels. Appendix C has more information on the emissions calculations.

3.2.4 Model combinations

The work undertaken for this project required an assessment of local impacts, as well as an assessment of end-to-end solutions. The length of the model run times (i.e., computer time) and the number of possible combinations of connecting route, plaza and crossing alternatives would require an extraordinary amount of time effort to model each possible end-to-end combination. In addition, separate model runs are required for each pollutant ($PM_{2.5}$ and NO_x).

In order to complete all of the necessary model runs, the models were run in blocks of roadway/facility type. For each pollutant, separate runs were set up for each connecting route alternative, each plaza/crossing combination, and separate connections to the plazas from Highway 401. In addition, there are two alignment alternatives (Option 1 & Option 2) for four of the connecting routes, and four tunnel ventilation options. Also, all model runs had to be completed for three horizon years (2015, 2025 & 2035).

These model runs were completed on the same receptor network, and the results were output as hourly and/or daily values for the entire year of meteorology, at each receptor. The model results for each necessary combination of blocks were then added together to provide the hourly or daily maximum concentrations. A computer program was developed using the Linux operating system to overlay the necessary files. The combinations considered in this assessment are outlined below.

Connecting Routes

- Future No-Build, Alternatives 1A (Opt 1 & 2) , 1B (Opt 1 & 2), 2A (Opt 1 & 2), 2B (Opt 1 & 2), 3 (VB1A), 3 (VB1B), 3 (VB1C), 3 (jet fans), The Parkway = 14 connecting route alternatives x 2 pollutants x 3 years = 84 model runs

Plazas & Crossings

- Alternatives PA-A, PA-B, PA-C, PB-C, PB1-B, PB1-C, PC-C = 7 combinations x 2 pollutants x 3 years = 42 model runs

`

Connections to Plazas

- Alternatives 1A – PA, 1A – PB/C, 1B-PA, 1B-PB/C, 2A/2B-PA, 2A/2B-PB/C, 3-PA, 3-PB/C, The Parkway-PA, The Parkway-PB/C = 10 alternatives x 2 pollutants x 3 years = 60 model runs

It should be noted that Huron Church Road north of EC Row Expressway and the Ambassador Bridge/Plaza were included in each model run for all of the connecting route alternatives.

A model input file was prepared for each necessary run, as outlined above and run using one year of meteorological data (2003). The models were run on the Linux operating system, which offers more flexibility and memory in terms of processor use, file storage and manipulation of large data files.

Once the model runs were complete, the data was post-processed by adding the necessary data component results together (i.e., connecting route + connection to plazas + plaza/crossing) to form complete end-to-end results. The summed results were then imported into a GIS system for each combination such that the data could be interpreted in different areas along the connecting route, at various distances away from the ROW of each alternative.

4.0 OVERVIEW OF MODEL RESULTS

As discussed earlier, air dispersion models calculate air pollutant concentrations at the receptor locations specified by the user in the model inputs. For this study, two gridded networks of receptors were used along the roadway, as well as specific sensitive receptor locations (see Section 3.2.2). This chapter presents the results of the air dispersion modeling that was undertaken for each alternative.

The results from the No Build Alternative represent the predicted air quality conditions that will occur if no transportation improvements are undertaken in the corridor but assume a projected traffic growth for each of the horizon years. Thus, all results have been presented in relation to this condition, such that the expected change in air quality due to the project (i.e., air pollutant concentrations) is apparent.

It is important to note that the values presented are not indicative of typical conditions as the background levels that are added to the modeled concentrations occur only 10% of the time. In addition, the maximum conditions that are being used for comparison purposes represent the highest concentration at any receptor within the roadway segment within a modelled 1 year period and are not the average or more typical of the concentrations across all of the receptors within the roadway segment.

For each pollutant and averaging time being evaluated, the magnitude of the maximum model predicted concentrations for each alternative and year are presented as percentages of the predicted concentrations for the No Build Alternative for the respective horizon year.

Since the edges of the proposed right-of-way (ROW) limits differ for many of the access road alternatives, the results have been presented at defined distance intervals of 50 m, 100 m and 250 m from the edge of ROW for comparative purposes. In many cases, this occurred at different model receptors for different Alternatives, since a receptor that was located 50 m from the ROW for one Alternative could have been within the ROW for another Alternative.

For the purposes of this report, differences of less than +/- 10% (nominally 2 to 3 $\mu g/m^3$ for $PM_{2.5}$ and 15 to 30 $\mu g/m^3$ for NO_x) were deemed to be within model tolerances given the variability in road alignment, interpolation of results to receptor location and traffic volumes and thus were considered to represent "no appreciable" difference. Differences within an additional 10% (i.e., between 80-89% and 111-120% or 4-6 $\mu g/m^3$ for $PM_{2.5}$ and 15-30 $\mu g/m^3$ for NOx) were considered to represent "marginal" change. Any other differences were considered as "notable" or "appreciable" changes. In addition, when comparing the alternatives to each other, a 10% difference between the alternatives would be required prior to saying that one alternative shows improvements over another. For example, Alternative 1A may be at 92% of No Build, and Alternative 2B may be at 88% of No Build. Under the conventions listed above, Alternative 2B would be considered to show a marginal improvement over No Build, but Alternative 2B is only 4% lower than Alternative 1A, and therefore is not appreciably different from Alternative 1A.

By comparison, the Ministry of the Environment (MOE) publishes air quality conditions in different locations, including Windsor, in Ontario through their Air Quality Index (AQI). This information is available to the public on an hourly basis. The AQI is an indicator of air quality based on the highest pro-rated hourly pollutant measurements of common air contaminants. The range of concentration of the contaminants determines the Air Quality Index. When $PM_{2.5}$ is the driver for air quality, a change of about 6 $\mu g/m^3$ is required to move the Index from one rating to another.

At 50 m from ROW, any changes predicted by the modelling for any of the practical alternatives (i.e., at-grade, below-grade, tunnel, the Parkway) were within this six $\mu g/m^3$ range and would typically not alter the Air Quality Index.

In addition, where the concentrations (including background) were predicted to exceed Federal or Provincial standards, objectives or guidelines, the change in the number of times the concentration was predicted to exceed (i.e., number of exceedances) was also reported, relative to the No Build Alternative. These measures were used to assess the potential impacts of any predicted changes to air quality.

Achievement of the Canada Wide Standard (CWS) for $PM_{2.5}$ is based on achieving an exceedances frequency of no more than eight 24-hour periods with concentrations greater than 30 $\mu g/m^3$ in any given year over a three year period. Thus, only results with greater than eight exceedances were deemed to be in exceedance of the Standard. In addition, the eight day threshold was used to assess the significance of any changes in the number days predicted to be greater than 30 $\mu g/m^3$ in comparison to No Build (i.e., if an Alternative had 9 exceedances less (or more) than No Build, this difference was deemed to be significant, regardless of the total number of exceedance days). In addition, any exceedance of the annual criteria of 15 $\mu g/m^3$ was deemed to be significant for the purpose of this assessment.

The results are presented separately for the Access Road alternatives, Customs/Inspection Plazas and Crossings.

4.1 Access Road Segment Assessments

Tables 4.1 through 4.12 present the results of the air dispersion modelling for each of the Access Road alternatives by road segment. In order to compare microscale differences between the alternatives, the results of each Access Road Alternative will be presented and discussed in relation to specific road segments along the route, starting near the three potential river crossing locations and ending east of the present Highway 401 terminus. These road segments are as follows:

- Malden Road to Labelle Street
- Labelle Street to Pulford Street
- Pulford Street to Lennon Drain
- Lennon Drain to Cousineau Road
- Howard Avenue to Cousineau Road
- Highway 401/Highway 3 to Howard Avenue

The limits of the Access Road Alternatives assessment are between the existing Highway 401 terminus and Malden Road south of EC Row Expressway. The section from Malden Road to the river is covered under the Crossings and Plazas discussion (Section 4.2.4)

The results are presented as a percentile comparison to No Build at increasing distances/offsets at 50 m, 100 m and 250 m from the ROW.

This assessment identifies the maximum changes in concentrations at any location within the corridor segments regardless of the location of sensitive receptors. For details on the effects of the changes in concentration on sensitive receptors in specific neighbourhoods within these roadway segments, refer to the *Practical Alternative Work Paper - Social Impact Assessment (April 2008)*.

The results presented below generally follow the expected trends based on the changes in vehicle emission factors (see Appendix B) and increases in traffic volumes (see Appendix A) over time. In summary, results of the modelling indicate that:

- the concentrations for NO_x and $PM_{2.5}$ decrease as the distance from the roadway increases;
- the $PM_{2.5}$ concentrations increase with time, as traffic volumes are predicted to increase from 2015 through 2035; and
- NO_x concentrations decrease over time as the emission factors for cars and non-idling trucks are going to be significantly reduced in the future to the extent that emissions are lower than 2015, regardless of predicted traffic growth in this study. For trucks, free flow emissions are expected to decrease by approximately 75 to 80% by 2025 and by approximately 85% by 2035 (see Table 3.2), with idling emissions not expected to be appreciably different. As a result, alternatives which improve free flow are better able to leverage improvements in emission levels than the No Build option.

It should be noted that the roadway and ramp alignments are essentially identical between Highway 401 and Howard Avenue for all variations of Alternatives 1 and 2. As a result, the maximum predicted concentrations and the changes in relation to No Build are the same for these Alternatives, and thus any variations in the model predicted concentrations are likely due to slight differences in the forecasted traffic volumes for each alternative, in addition to some residual effect of emissions that occur in the previous segment.

As outlined previously, four separate tunnel ventilation options were examined. The results indicate that the location of the ventilation buildings does not have a notable affect; the locations of the entrance and exit portals have a higher impact on the results. The results of the "Jet Fans" tunnel ventilation option indicated that this option produced unacceptably high $PM_{2.5}$ and NO_x concentrations, and thus will not be discussed in detail in this report. Thus, the results will be discussed in the context of only one of the ventilation options (VB1A).

The Parkway follows similar patterns to Alternatives 1 and 2. These will be discussed in detail in the applicable sections.

4.1.1 Malden Road to Labelle Street

In this road segment the 401 veers away from Huron Church, crosses Spring Garden and follows the EC Row Expressway. The Plaza A configuration crosses Spring Garden slightly to the west of the Plaza B configuration. Both the at-grade and below-grade options are at approximately the same elevations for this section of the road with the freeway at below grade where local arterial roads cross over it, such that these arterial roads are at-grade, rather than elevated. The Alternative 3 tunnel ends near Spring Garden. The ramp configuration for Plaza A is considerably different than for Plaza B. There are two tunnels with the Parkway alternative in this location and the ROW is wider in areas relative to the other options.

NO_x

NO_x concentrations in this area are well below criteria for No Build and all alternatives in all horizon years. In general, with isolated exceptions, all alternatives result in lower NO_x hourly and 24-hour concentrations than No Build over all horizon years as shown in Table 4.1. With the exception of Alternative 3 (VBIA), appreciable decreases in NO_x hourly concentrations are noted for all Alternatives at 50 m, with appreciable decreases extending to 100 m in 2035 for all Alternatives. Most other NO_x hourly concentrations at or beyond 100 m are not appreciably different to only marginally better than No Build.

For all alternatives and all horizon years, NO_x 24-hour concentrations show no appreciable to only marginally improvements over No Build.

While differences exist between Plaza alignments for each alternative, with few exceptions, these differences were not appreciable.

Table 4.1 - Change in Maximum NOx Concentrations Relative to No-Build, Malden Road to Labelle Street

Alternative	Distance from ROW (m)	Malden Rd to Labelle											
		2015				2025				2035			
		Plaza A Alignment		Plaza B/C Alignment		Plaza A Alignment		Plaza B/C Alignment		Plaza A Alignment		Plaza B/C Alignment	
		1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour
Alternative 1A	**50**	63%	82%	84%	89%	77%	87%	82%	90%	59%	85%	69%	95%
	100	73%	98%	90%	101%	83%	90%	89%	94%	69%	89%	78%	93%
	250	89%	86%	95%	93%	89%	94%	92%	95%	82%	91%	86%	94%
Alternative 1B	**50**	78%	88%	88%	91%	69%	87%	76%	90%	64%	85%	70%	88%
	100	82%	102%	94%	102%	79%	90%	83%	93%	75%	90%	79%	93%
	250	89%	93%	95%	93%	86%	93%	91%	95%	83%	93%	84%	94%
Alternative 2A	**50**	65%	83%	68%	81%	68%	87%	66%	87%	65%	85%	63%	85%
	100	82%	100%	75%	97%	83%	93%	76%	93%	78%	92%	71%	92%
	250	89%	93%	93%	92%	97%	96%	90%	95%	93%	95%	86%	94%
Alternative 2B	**50**	65%	83%	64%	81%	67%	87%	66%	87%	64%	85%	62%	85%
	100	82%	100%	75%	97%	78%	90%	74%	90%	75%	90%	71%	90%
	250	88%	93%	91%	92%	91%	93%	88%	94%	88%	94%	85%	94%
Alternative 3 (VBIA)	**50**	86%	84%	91%	87%	84%	89%	83%	90%	72%	88%	70%	89%
	100	88%	100%	92%	101%	90%	94%	87%	94%	76%	93%	73%	93%
	250	98%	92%	99%	94%	97%	96%	96%	95%	89%	95%	85%	95%
The Parkway 2015	**50**	71%	82%	71%	82%	69%	87%	75%	89%	65%	85%	66%	85%
	100	86%	100%	86%	101%	81%	93%	88%	95%	77%	93%	79%	93%
	250	87%	91%	89%	91%	85%	95%	94%	96%	89%	95%	89%	95%

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

$PM_{2.5}$

With the exception of the Parkway, there is largely no appreciable to isolated marginal differences between No Build and any of the alternatives for $PM_{2.5}$ 24-hour and annual maximum concentrations for all distances and all scenarios as shown in Table 4.2. The Parkway generally shows marginal to notable decreases in maximum 24-hour and annual maximum concentrations at 50 m from ROW, with differences beyond 50 m being similar to other scenarios. For each Plaza alignment the maximum concentrations for all alternatives are located in the same location and are not impacted by the Tunnel or the tunnels of the Parkway.

While differences in $PM_{2.5}$ 24-hour and annual maximum concentrations exist between Plaza alignments for each alternative, with isolated exceptions, these differences were not appreciable.

With isolated exceptions, primarily for Plaza A Alignments in 2015, all alternatives are expected to reduce the number of exceedances of the CWS $PM_{2.5}$ 24-hour standard, with exceedances generally predicted to occur only within 50 - 100 m of ROW for all alternatives (including No Build). There are no exceedances of the CWS $PM_{2.5}$ 24-hour standard by 250 m from ROW.

TABLE 4.2 - CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS RELATIVE TO NO-BUILD, MALDEN ROAD TO LABELLE STREET

Alternative	Distance from ROW (m)	Malden Rd to Labelle																	
		2015						2025						2035					
		Plaza A Alignment			Plaza B / C			Plaza A Alignment			Plaza B / C			G-H - Plaza A			G-H - Plaza B / C		
		24 Hour	Annual	> CWS	24 Hour	Annual	> CWS	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances
Alternative 1A	50	106%	93%	15	94%	100%	-3	92%	93%	-20	95%	93%	-7	88%	100%	-52	93%	94%	-31
	100	97%	92%	0	100%	92%	0	100%	100%	-1	103%	100%	3	100%	100%	-13	103%	100%	-7
	250	100%	100%	0	96%	100%	0	96%	100%	0	93%	100%	0	97%	100%	0	93%	100%	0
Alternative 1B	50	94%	93%	10	97%	100%	3	103%	100%	7	97%	100%	-2	102%	100%	-4	98%	94%	-23
	100	100%	92%	0	103%	100%	2	103%	108%	7	103%	100%	2	103%	100%	6	100%	100%	-5
	250	100%	109%	0	100%	100%	0	96%	100%	0	100%	100%	0	100%	108%	0	97%	100%	0
Alternative 2A	50	92%	92%	9.5	88%	92%	-3	87%	91%	-23	87%	92%	-26	85%	91%	-42	85%	91%	-44
	100	94%	88%	0	95%	88%	0	99%	93%	-4	101%	94%	-4	100%	91%	-17	101%	91%	-17
	250	95%	99%	0	95%	99%	0	95%	93%	0	95%	94%	0	95%	98%	0	96%	98%	0
Alternative 2B	50	92%	93%	5	96%	94%	-3	97%	93%	-20	97%	93%	-22	97%	93%	-36	97%	93%	-38
	100	89%	86%	0	90%	87%	0	93%	92%	-5	94%	92%	-6	92%	88%	-21	94%	89%	-19
	250	94%	98%	0	95%	98%	0	94%	93%	0	94%	93%	0	93%	97%	0	94%	98%	0
Alternative 3 (VBIA)	50	94%	93%	-6	94%	93%	-10	100%	93%	-12	97%	93%	-13	95%	94%	-44	100%	94%	-25
	100	100%	92%	0	103%	92%	2	103%	100%	-1	109%	100%	5	103%	93%	-16	115%	100%	-3
	250	104%	100%	0	104%	100%	0	104%	100%	0	111%	100%	1	100%	100%	0	107%	100%	2
The Parkway	50	86%	79%	2	78%	79%	-20	85%	80%	-13	77%	80%	-41	81%	75%	-47	81%	75%	-51
	100	100%	85%	0	93%	85%	0	94%	85%	-6	88%	85%	-6	88%	86%	-23	100%	86%	-19
	250	100%	91%	0	100%	91%	0	100%	83%	0	86%	83%	0	97%	92%	0	100%	92%	0

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

Roadway Section Summary

The Parkway offers notable to marginal improvement for $PM_{2.5}$ concentrations relative to No Build, primarily due to an expanded ROW which provides additional buffer space for $PM_{2.5}$ maximum concentrations. Plaza B/C alignment shows the greatest decrease in predicted exceedances of $PM_{2.5}$ 24-hour concentrations, with these reductions generally occurring within 50 - 100 m of ROW. All other alternatives show no appreciable to isolated marginal changes in $PM_{2.5}$ concentrations. NO_x concentrations are generally lower with all alternatives than for the No Build scenario, however, even the No Build scenario concentrations are lower than the applicable criteria.

4.1.2 Labelle Street to Pulford Street

This roadway section generally follows the existing Huron Church corridor. The connections to Plaza A and Plaza B differ slightly (less than 100 m difference in location) between Labelle St and Grand Marais Road West. Beyond Grand Marais there is no difference in Plaza Alignments and the Plaza alignment options will not be discussed further. The At Grade options (1A and 2A) are below grade between Labelle Street and Grand Marais and transition to at grade beyond Grand Marais. The Below Grade options (1B, 2B, and Parkway) are below grade for the entire route section. The freeway is located slightly to the west of Huron Church for Alternatives 2A, 2B, and the Parkway. Alternative 3, the tunnel option, is completely tunneled in this section. There are Parkway tunnels located at Labelle Street, Grand Marais West, and Pulford Street.

NO_x

NO_x concentrations in this area are well below criteria for No Build and all alternatives in all horizon years. In general, with isolated exceptions, all alternatives result in lower NO_x hourly and 24-hour concentrations than No Build over all horizon years as shown in Table 4.3. All alternatives show marginal to notable reductions in NO_x hourly concentrations at 50 – 100 m with no appreciable to marginal reductions at 100 m and beyond.

With two exceptions, for all alternatives and all horizon years, NO_x 24-hour concentrations show no appreciable to only marginally improvements over No Build.

While differences exist between Plaza alignments for each alternative, these differences were not appreciable for NO_x 24-hour concentrations. In general, for Alternatives 1A, 1B, 2A and 2B the Plaza B alignment NO_x 1 hour concentrations were marginally to notably lower than for the Plaza A alignment.

TABLE 4.3 - CHANGE IN MAXIMUM NOX CONCENTRATIONS RELATIVE TO NO-BUILD, LABELLE STREET TO PULFORD STREET

Alternative	Distance from Roadway (m)	Labelle to Pulford											
		2015				2025				2035			
		Plaza A Alignment		Plaza B/C Alignment		Plaza A Alignment		Plaza B/C Alignment		Plaza A Alignment		Plaza B/C Alignment	
		1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour
Alternative 1A	**50**	81%	86%	74%	89%	71%	85%	72%	89%	84%	84%	69%	91%
	100	96%	91%	81%	92%	79%	92%	76%	93%	85%	93%	69%	90%
	250	112%	99%	83%	95%	93%	96%	83%	95%	107%	99%	81%	95%
Alternative 1B	**50**	80%	85%	73%	85%	86%	89%	70%	86%	83%	84%	68%	81%
	100	93%	90%	70%	87%	90%	94%	69%	89%	84%	93%	64%	88%
	250	106%	96%	84%	94%	103%	99%	86%	95%	106%	99%	81%	94%
Alternative 2A	**50**	86%	85%	74%	85%	81%	85%	70%	86%	76%	80%	66%	81%
	100	98%	96%	70%	88%	87%	95%	70%	90%	79%	89%	64%	89%
	250	100%	95%	87%	94%	98%	96%	86%	95%	99%	96%	83%	95%
Alternative 2B	**50**	86%	84%	74%	84%	81%	85%	70%	85%	73%	80%	65%	81%
	100	98%	87%	70%	87%	86%	92%	70%	90%	77%	89%	64%	89%
	250	101%	95%	87%	94%	100%	96%	85%	95%	97%	95%	83%	95%
Alternative 3 (VBIA)	**50**	87%	90%	87%	90%	74%	87%	74%	87%	70%	83%	70%	83%
	100	88%	95%	88%	95%	75%	93%	75%	93%	68%	90%	68%	90%
	250	94%	98%	94%	98%	88%	96%	88%	96%	87%	96%	87%	96%
The Parkway	**50**	72%	82%	68%	82%	70%	84%	83%	89%	68%	79%	66%	79%
	100	83%	88%	80%	89%	75%	90%	89%	95%	70%	89%	70%	89%
	250	80%	93%	83%	93%	82%	94%	96%	97%	81%	94%	81%	94%

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

$PM_{2.5}$

There is generally no appreciable difference to isolated marginally differences between No Build and Alternatives 1A, 1B, and 2B for $PM_{2.5}$ 24-hour and annual maximum concentrations for all distances beyond ROW in all horizon years for either Plaza A or Plaza B alignment. The Parkway and Alternative 3, the Tunnel, show marginal to notable decreases in maximum $PM_{2.5}$ 24-hour and annual concentrations at 50 m from ROW, with differences from No Build diminishing at greater distances. Reductions for Alternative 3, the Tunnel, are attributable to emission sources being covered and vented at tunnel portals, with this effect generally limited to within 50 -100 m of the ROW.

While differences in $PM_{2.5}$ 24-hour and annual maximum concentrations exist between Plaza alignments for each alternative, with isolated exceptions, these differences were not appreciable.

Exceedances of the CWS $PM_{2.5}$ 24-hour standard are generally predicted to occur under certain conditions within 50 m of ROW for all alternatives in all horizon years, except for Alternative 3 which is not predicted to have exceedances. Plaza B alignment generally shows fewer exceedances than Plaza A alignment within 100 m of ROW. Exceedances will also be predicted for all alternatives other than Alternative 3 within 100 m by 2035. Increases in exceedances of the CWS $PM_{2.5}$ 24-hour standard are predicted for Alternatives 1A, 1B, 2A and 2B for at least one Plaza Alignment in at least one horizon year.

TABLE 4.4 - CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS RELATIVE TO NO-BUILD, LABELLE STREET TO PULFORD STREET

	Distance from ROW (m)	Labelle to Pulford																	
		2015						2025						2035					
		Plaza A Alignment			Plaza B / C			Plaza A Alignment			Plaza B / C			Plaza A Alignment			Plaza B / C		
		24 Hour	Annual	> CWS	24 Hour	Annual	> CWS	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances
Alternative 1A	50	97%	100%	6	97%	100%	-5	95%	100%	18	93%	100%	10	95%	>100%	-1	93%	94%	-4
	100	97%	100%	-3	97%	100%	-3	103%	108%	11	103%	100%	-1	103%	100%	7	103%	93%	7
	250	96%	100%	0	96%	100%	0	104%	100%	0	104%	92%	0	104%	100%	0	104%	100%	0
Alternative 1B	50	94%	100%	3	89%	93%	-5	93%	100%	-7	85%	93%	-7	95%	>100%	2	84%	88%	-22
	100	94%	100%	-3	87%	100%	-3	97%	108%	6	91%	92%	-4	94%	100%	10	89%	93%	-6
	250	104%	100%	0	92%	100%	0	108%	100%	0	100%	92%	0	107%	100%	0	96%	92%	0
Alternative 2A	50	89%	93%	-15	89%	93%	-14	85%	93%	-22	85%	93%	-25	86%	94%	-31	86%	94%	-33
	100	94%	108%	-3	97%	100%	-3	100%	108%	10	100%	100%	1	94%	107%	-10	100%	100%	1
	250	96%	100%	0	96%	100%	0	104%	92%	0	100%	100%	0	100%	100%	0	104%	100%	0
Alternative 2B	50	97%	93%	-13	97%	93%	-13	95%	93%	-19	95%	93%	-21	98%	94%	-25	98%	94%	-27
	100	94%	100%	-3	90%	100%	-3	100%	100%	7	94%	100%	-4	97%	100%	6	91%	93%	-6
	250	96%	100%	0	96%	100%	0	104%	92%	0	104%	100%	0	104%	92%	0	104%	100%	0
Alternative 3 (VBIA)	50	75%	79%	-18	78%	86%	-18	70%	80%	-40	73%	87%	-40	67%	75%	-74	70%	81%	-74
	100	81%	92%	-3	84%	92%	-3	81%	85%	-4	81%	92%	-4	77%	79%	-15	77%	86%	-15
	250	88%	91%	0	92%	91%	0	88%	83%	0	92%	92%	0	89%	92%	0	93%	92%	0
The Parkway	50	83%	79%	-18	83%	79%	-18	88%	80%	-22	75%	73%	-40	88%	75%	-51	86%	81%	-54
	100	90%	83%	-3	90%	92%	-3	94%	85%	-4	88%	85%	-4	94%	79%	-9	94%	86%	-12
	250	92%	91%	0	92%	91%	0	92%	83%	0	92%	83%	0	93%	83%	0	93%	83%	0

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

Roadway Section Summary

Alternative 3 with a Plaza A alignment offers a notable improvement in maximum $PM_{2.5}$ 24-hour concentrations relative to No Build within 50 - 100 m of the ROW, primarily due to emission sources being covered and vented at tunnel ventilation buildings which, while not reducing the overall pollutant burden, do provide for better dispersion. Plaza B alignment for the Parkway also shows notable improvements relative to No Build. All other alternatives generally show no appreciable to only marginal change in $PM_{2.5}$ 24-hour concentrations. Exceedances of the CWS $PM_{2.5}$ 24-hour standard are generally reduced or eliminated with Alternative 3 and the Parkway within 50 - 100 m of ROW for all horizon years. There are no exceedances of the CWS $PM_{2.5}$ 24-hour standard at 250 m. NO_x concentrations are lower with all alternatives than for No Build, however, even No Build concentrations are lower than the applicable criteria.

4.1.3 Pulford Street to North of Lennon Drain

This roadway section generally follows the existing Huron Church corridor and transitions to following Talbot Road where Huron Church intersects Talbot Road. The At Grade options (1A and 2A) are generally at grade with a dip below grade at Todd Lane/Cabana Road West. The Below Grade options (1B, 2B, and Parkway) are below grade for the entire route section. The freeway is located more to the west of Huron Church for Alternatives 2A, 2B, and the Parkway relative to Alternatives 1A and 1B, particularly at the Todd Lane/Cabana Road interchange. Alternative 3, the tunnel option, is completely tunneled in this section. There are four Parkway tunnels located in this section at Pulford Street, Reddock, Todd Lane/Cabana Road West, and at the Lennon Drain.

NO_x

NO_x concentrations in this area are well below criteria for No Build and all alternatives in all horizon years. In general, with isolated exceptions at 250 m, all alternatives result in appreciably lower NO_x hourly concentrations than No Build over all horizon years. All alternatives show marginal to notable reductions in NO_x 24-hour concentrations at 50 and 100 m, with no appreciable reductions noted at 250 m.

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TABLE 4.5 - CHANGE IN MAXIMUM NOx CONCENTRATIONS RELATIVE TO NO-BUILD, PULFORD STREET TO NORTH OF LENNON DRAIN

Alternative	Distance from Roadway (m)	Pulford to North of Lennon Drain					
		2015		2025		2035	
		1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour
Alternative 1A	50	57%	82%	43%	76%	36%	70%
	100	66%	85%	54%	81%	42%	76%
	250	85%	95%	69%	94%	57%	90%
Alternative 1B	50	50%	77%	39%	75%	34%	69%
	100	61%	83%	53%	80%	41%	76%
	250	85%	95%	67%	94%	55%	90%
Alternative 2A	50	45%	75%	38%	74%	33%	69%
	100	53%	82%	50%	80%	40%	76%
	250	79%	94%	63%	92%	53%	90%
Alternative 2B	50	43%	75%	37%	75%	33%	71%
	100	52%	82%	47%	80%	41%	76%
	250	72%	93%	62%	92%	53%	90%
Alternative 3 (VBIA)	50	49%	71%	40%	73%	35%	68%
	100	64%	79%	54%	78%	43%	74%
	250	99%	93%	69%	92%	57%	90%
The Parkway	50	60%	76%	43%	74%	38%	69%
	100	74%	83%	58%	80%	45%	76%
	250	91%	93%	69%	92%	57%	90%

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

$PM_{2.5}$

Generally all alternatives show notable to marginal improvements for $PM_{2.5}$ 24-hour maximum concentrations within 50 m of ROW for all horizon years as shown in Table 4.6. Beyond 50 m, these concentrations are largely not appreciably different from No Build, except for both the Parkway and Alternative 3 which consistently show marginal to appreciable improvements at 100 m.

Both the Parkway and Alternative 3 show notable to marginal decreases in the annual $PM_{2.5}$ concentrations within 100 m of ROW. All other alternatives generally show no appreciable differences in annual $PM_{2.5}$ concentrations from ROW.

While No Build is predicted to be above the CWS $PM_{2.5}$ 24-hour standard for all horizon years, no exceedances of the CWS are predicted for all alternatives in 2015. By 2035 all alternatives other than Alternatives 2B and 3 are predicted to exceed the allowable CWS standard at 50 m from ROW; however, a substantial reduction in the number of exceedances relative to No Builds is predicted. Alternatives 2B and 3 are not predicted to have any exceedances of the CWS.

TABLE 4.6 - CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS RELATIVE TO NO-BUILD, PULFORD STREET TO NORTH OF LENNON DRAIN

Alternative	Distance from ROW (m)	Pulford North of Lennon Drain								
		2015			2025			2035		
		24 Hour	Annual	> CWS	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances
Alternative 1A	50	89%	100%	-11	85%	100%	-22	90%	100%	-21
	100	90%	100%	0	97%	100%	-5	100%	100%	-3
	250	100%	100%	0	100%	100%	0	108%	109%	0
Alternative 1B	50	86%	92%	-17	79%	93%	-33	80%	93%	-42
	100	87%	100%	0	87%	92%	-5	94%	100%	-10
	250	100%	100%	0	96%	100%	0	100%	100%	0
Alternative 2A	50	80%	92%	-17	82%	93%	-29	88%	93%	-37
	100	83%	92%	0	94%	92%	-5	100%	100%	-5
	250	96%	100%	0	104%	100%	0	104%	109%	0
Alternative 2B	50	77%	92%	-17	79%	93%	-33	76%	87%	-54
	100	83%	92%	0	90%	92%	-5	91%	92%	-10
	250	96%	100%	0	104%	100%	0	100%	100%	0
Alternative 3 (VBIA)	50	63%	77%	-17	56%	71%	-38	56%	67%	-58
	100	73%	83%	0	71%	77%	-5	72%	77%	-10
	250	92%	91%	0	88%	91%	0	85%	91%	0
The Parkway	50	83%	85%	-17	77%	79%	-38	76%	80%	-44
	100	87%	83%	0	84%	77%	-5	84%	85%	-10
	250	96%	82%	0	92%	91%	0	92%	91%	0

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

Roadway Section Summary

Alternative 3 generally offers a notable improvement in $PM_{2.5}$ 24-hour concentrations relative to No Build within 100 m of ROW, primarily due to the emissions being vented through vent buildings which allows for better dispersion. All other alternatives generally show a marginal reduction in maximum $PM_{2.5}$ 24-hour concentrations relative to No Build within 50 m from ROW and are similar to each other in overall reduction with the Parkway and Alternative 2B showing slightly greater reductions. Exceedances of the CWS $PM_{2.5}$ 24-hour standard are predicted to be reduced or eliminated for all alternatives. Both the Parkway and Alternative 3 show notable to marginal reductions of annual $PM_{2.5}$ concentrations. NO_x concentrations are lower with all alternatives than for the No Build scenario, however, even the No Build scenario concentrations are lower than the applicable criteria.

4.1.4 North of Lennon Drain to Cousineau Road

This roadway section generally follows Talbot Road. The At Grade options (1A and 2A) are at grade and transition to below grade near St. Clair College and remain below grade beyond Cousineau. The Below Grade options (1B, 2B, and Parkway) are below grade for the entire route section. The freeway is located more to the west of Talbot Road for Alternatives 2A, 2B, and the Parkway relative to Alternatives 1A and 1B. Alternative 3, the tunnel option, is completely tunneled in this section.

This section of the road involves Option 1 and Option 2 Service Road configurations. Option 1 realigns the existing Talbot Road corridor slightly to the northeast. This realignment begins approximately at St. Clair College and continues past Cousineau Road to Howard Avenue. The Option 2 alignment uses the existing Talbot Road corridor as local access service roads without any realignment and aligns the freeway to the southeast.

NO_x

NO_x concentrations in this area are well below criteria for No Build and all alternatives in all horizon years. In general, with isolated exceptions for Option 1 in 2015, all alternatives result in appreciably lower NO_x hourly concentrations than No Build over all horizon years as shown in Table 4.7.

With isolated exceptions, all alternatives generally show no appreciable to marginal reductions over No Build in NO_x 24-hour concentrations.

While differences exist between Option 1 and 2 alignments, these differences were generally not appreciable, except for Alternatives 1A and 1B for which Option 1 had appreciably lower NO_x hourly concentrations in 2015 and 2025 and marginally lower concentrations in 2035.

TABLE 4.7 - CHANGE IN MAXIMUM NOX CONCENTRATIONS RELATIVE TO NO-BUILD, NORTH OF LENNON DRAIN TO COUSINEAU

Alternative	Distance from Roadway (m)	North of Lennon Drain to Cousineau Rd											
		2015				2025				2035			
		Option 1 Alignment		Option 2 Alignment		Option 1 Alignment		Option 2 Alignment		Option 1 Alignment		Option 2 Alignment	
		1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour
Alternative 1A	**50**	89%	95%	58%	92%	78%	91%	61%	91%	65%	87%	55%	86%
	100	79%	87%	55%	87%	73%	83%	59%	83%	66%	80%	54%	80%
	250	84%	98%	56%	94%	77%	94%	61%	92%	66%	91%	58%	91%
Alternative 1B	**50**	83%	91%	55%	88%	74%	88%	59%	88%	63%	86%	53%	86%
	100	77%	84%	53%	84%	69%	82%	57%	82%	62%	80%	53%	80%
	250	81%	96%	56%	93%	75%	92%	61%	92%	64%	91%	57%	91%
Alternative 2A	**50**	59%	92%	53%	88%	62%	91%	58%	88%	54%	87%	51%	85%
	100	54%	86%	52%	84%	60%	83%	56%	82%	53%	80%	52%	78%
	250	60%	95%	58%	94%	63%	94%	62%	92%	58%	92%	57%	91%
Alternative 2B	**50**	56%	88%	54%	88%	58%	88%	57%	86%	53%	85%	51%	85%
	100	51%	83%	53%	84%	56%	81%	54%	78%	52%	78%	52%	78%
	250	58%	94%	58%	94%	61%	92%	59%	88%	57%	91%	57%	91%
Alternative 3 (VBIA)	**50**	92%	110%			77%	96%			66%	93%		
	100	86%	98%			73%	88%			66%	84%		
	250	85%	95%			78%	95%			69%	92%		
The Parkway	**50**			76%	89%			72%	88%			64%	85%
	100			73%	84%			69%	82%			63%	78%
	250			70%	94%			72%	92%			66%	91%

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

$PM_{2.5}$

There is generally no appreciable difference between No Build and any of the alternatives for $PM_{2.5}$ 24-hour and annual maximum concentrations for all distances beyond ROW in all horizon years as shown in Table 4.8. Alternative 3, the Tunnel, generally shows a marginal reduction in concentrations within 100 m of ROW due to emission sources being covered and vented at tunnel portals.

With two isolated exceptions, there were no appreciable differences in $PM_{2.5}$ 24-hour and annual maximum concentrations between Option 1 and 2 alignments.

While the Option 2 alignment shows a greater reduction in exceedances of the CWS $PM_{2.5}$ 24-hour standard than the Option 1 alignment, exceedances of the CWS $PM_{2.5}$ 24-hour standard are still predicted, primarily within 50 -100 m of ROW for in 2025 and 2035. For Option 2, only Alternative 1A has any exceedance of the CWS $PM_{2.5}$ 24-hour standard. The frequency of exceedances is greater for at grade versus below grade alternatives.

TABLE 4.8 - CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS RELATIVE TO NO-BUILD, NORTH OF LENNON DRAIN TO COUSINEAU ROAD

Highest $PM_{2.5}$ Concentration Relative to No Build at Intervals from Right of Way ($\mu g/m^3$)																			
	Distance from ROW (m)	North of Lennon Drain to Cousineau Rd																	
		2015						2025						2035					
		Option 1 Alignment			Option 2 Alignment			Option 1 Alignment			Option 2 Alignment			Option 1 Alignment			Option 2 Alignment		
		24 Hour	Annual	> CWS	24 Hour	Annual	> CWS	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances
Alternative 1A	50	103%	100%	-1	100%	100%	-3	103%	100%	0	100%	100%	-10	105%	100%	0	103%	93%	-19
	100	111%	100%	0	104%	100%	1	107%	100%	8	107%	100%	4	113%	100%	15	109%	100%	6
	250	100%	100%	0	104%	91%	0	104%	100%	0	108%	100%	0	104%	100%	0	111%	100%	0
Alternative 1B	50	91%	100%	-5	91%	100%	-5	91%	100%	-12	91%	92%	-15	89%	107%	-27	89%	93%	-33
	100	104%	100%	0	100%	100%	0	100%	100%	0	97%	92%	1	97%	100%	2	100%	100%	0
	250	96%	100%	0	100%	91%	0	96%	100%	2	104%	100%	0	100%	100%	0	104%	100%	0
Alternative 2A	50	97%	100%	-4	88%	100%	-5	100%	100%	-7	91%	92%	-14	100%	100%	-15	89%	93%	-33
	100	104%	100%	0	96%	100%	0	103%	100%	1	97%	92%	1	103%	108%	1	94%	100%	-5
	250	100%	100%	0	96%	91%	0	104%	100%	0	100%	100%	0	107%	109%	0	100%	100%	0
Alternative 2B	50	88%	100%	-5	91%	100%	-4	86%	100%	-17	86%	92%	-17	87%	93%	-31	84%	93%	-35
	100	96%	100%	0	96%	100%	0	90%	100%	0	93%	92%	1	94%	100%	-5	91%	100%	-4
	250	96%	100%	0	100%	91%	0	96%	100%	0	100%	100%	0	100%	100%	0	100%	100%	0
Alternative 3 (VBIA)	50	84%	92%	-5				80%	85%	-17				79%	79%	-40			
	100	93%	91%	0				87%	83%	0				84%	83%	-5			
	250	92%	91%	0				88%	91%	0				89%	91%	0			
The Parkway	50				91%	92%	-5				91%	92%	-15				92%	86%	-37
	100				100%	91%	0				100%	92%	0				97%	92%	-1
	250				96%	91%	0				96%	91%	0				96%	91%	0

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

Roadway Section Summary

All alternatives generally show no appreciable change in $PM_{2.5}$ concentrations. Option 2 alignment generally shows a greater reduction in exceedances of the CWS $PM_{2.5}$ 24-hour standard than Option 1 alignment. NO_x concentrations are lower with all alternatives than for the No Build scenario, however, even the No Build scenario is lower than the applicable criteria.

4.1.5 Cousineau Road to Howard Avenue

This roadway section continues to follow Talbot Road. The At Grade options (1A and 2A) are at grade and for most of the route with transitions to below grade at Cousineau Road and Howard Avenue. The Below Grade options (1B, 2B, and Parkway) are below grade for the entire route section. The freeway is located more to the west of Talbot Road for Alternatives 2A, 2B, and the Parkway relative to Alternatives 1A and 1B. Alternative 3, the tunnel option, is completely tunneled in this section.

This section of the road involves Option 1 and Option 2 Service Road configurations. Option 1 realigns the existing Talbot Road corridor slightly to the northeast. This realignment begins approximately at St. Clair College and continues past Cousineau Road to Howard Avenue. The Option 2 alignment uses the existing Talbot Road corridor as local access service roads without any realignment and aligns the freeway to the southeast.

NO_x

NO_x concentrations in this area are well below criteria for No Build and all alternatives in all horizon years. In general, with isolated exceptions, all alternatives result in notably to marginally lower NO_x hourly concentration and marginally to not appreciably lower 24-hour concentrations than No Build over all horizon years as shown in Table 4.9. All alternatives generally show notable reductions in NO_x hourly concentrations up to 100 m from ROW.

With one exception, for all alternatives and all horizon years, NO_x 24-hour concentrations show no appreciable to only marginally improvements over No Build.

While differences exist between Option 1 and 2 Alignments, these differences were not appreciable for NO_x 24-hour concentrations and were not appreciable to only marginally different for NO_x 1 hour concentrations, with Option 2 generally showing lower concentrations.

TABLE 4.9 - CHANGE IN MAXIMUM NOX CONCENTRATIONS RELATIVE TO NO-BUILD, COUSINEAU ROAD TO HOWARD AVENUE

Alternative	Distance from Roadway (m)	Cousineau Rd to Howard Ave											
		2015				2025				2035			
		Option 1 Alignment		Option 2 Alignment		Option 1 Alignment		Option 2 Alignment		Option 1 Alignment		Option 2 Alignment	
		1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour
Alternative 1A	50	75%	89%	65%	86%	63%	84%	58%	84%	58%	81%	53%	80%
	100	72%	88%	69%	88%	61%	86%	58%	85%	57%	84%	55%	83%
	250	91%	98%	78%	96%	83%	95%	76%	94%	77%	95%	73%	94%
Alternative 1B	50	73%	86%	63%	84%	61%	82%	56%	82%	57%	80%	52%	79%
	100	68%	87%	63%	87%	59%	85%	58%	85%	56%	83%	55%	82%
	250	91%	96%	77%	95%	81%	95%	76%	95%	75%	94%	73%	94%
Alternative 2A	50	73%	87%	64%	84%	65%	86%	60%	82%	59%	82%	56%	80%
	100	74%	88%	69%	87%	69%	89%	58%	85%	62%	85%	55%	83%
	250	85%	98%	85%	96%	88%	97%	78%	94%	82%	96%	75%	94%
Alternative 2B	50	65%	85%	63%	83%	63%	84%	58%	82%	59%	82%	54%	79%
	100	69%	88%	63%	85%	66%	86%	57%	85%	62%	85%	54%	82%
	250	85%	98%	77%	95%	86%	94%	77%	94%	83%	97%	75%	94%
Alternative 3 (VBIA)	50	82%	80%			64%	80%			59%	78%		
	100	90%	85%			68%	84%			64%	82%		
	250	115%	94%			93%	94%			87%	94%		
The Parkway	50			85%	85%			65%	84%			60%	80%
	100			84%	87%			66%	86%			61%	83%
	250			95%	95%			84%	95%			82%	95%

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

$PM_{2.5}$

There are generally no appreciable to marginal differences between No Build and all alternatives, other than Alternative 3, for $PM_{2.5}$ 24-hour and annual maximum concentrations for all distances beyond ROW in all horizon years for either Option 1 or Option 2 Alignment as shown in Table 4.10. Alternative 3, the Tunnel, shows notable reductions in $PM_{2.5}$ 24-hour concentrations up to 100 m due to emission sources being covered and vented at tunnel ventilation buildings which, while not reducing the overall pollutant burden, do provide for better dispersion. Alternative 3 also shows notable reductions in $PM_{2.5}$ annual concentrations in 2025 and 2035 at 50 m, with only marginal to no appreciable differences noted for other horizons and distances.

Exceedances of $PM_{2.5}$ 24-hour average concentrations greater than the CWS $PM_{2.5}$ 24-hour standard allowable frequency are generally predicted to occur for the No Build Scenario within 50 -100 m of ROW for all horizon years. Alternative 3 is not predicted to have any exceedances due to the design of the vent buildings. The rest of the alternatives may exceed the CWS frequency within 50 -100 m of ROW by 2035; however, the exceedances are reduced with all alternatives relative to No Build. The Option 2 alignment is predicted to have fewer exceedances than the Option 1 alignment.

TABLE 4.10 - CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS RELATIVE TO NO-BUILD, COUSINEAU ROAD TO HOWARD AVENUE

Highest $PM_{2.5}$ Concentration Relative to No Build at Intervals from Right of Way ($\mu g/m^3$)																			
	Distance from ROW (m)	Cousineau Rd to Howard Ave																	
		2015						2025						2035					
		Option 1 Alignment			Option 2 Alignment			Option 1 Alignment			Option 2 Alignment			Option 1 Alignment			Option 2 Alignment		
		24 Hour	Annual	> CWS	24 Hour	Annual	> CWS	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances
Alternative 1A	50	94%	100%	-4	94%	100%	-3	97%	100%	-5	100%	100%	-12	93%	100%	-19	93%	100%	-29
	100	100%	100%	0	104%	100%	0	103%	100%	1	103%	100%	4	100%	100%	-1	110%	108%	4
	250	100%	110%	0	100%	110%	0	104%	100%	0	104%	100%	0	117%	100%	0	117%	100%	1
Alternative 1B	50	91%	100%	-8	85%	100%	-7	92%	100%	-9	86%	100%	-18	85%	100%	-39	83%	100%	-41
	100	100%	100%	0	96%	100%	0	100%	100%	0	97%	100%	1	100%	100%	-1	100%	108%	-1
	250	100%	110%	0	100%	110%	0	100%	100%	0	100%	100%	0	113%	100%	0	113%	100%	0
Alternative 2A	50	91%	100%	-8	82%	100%	-8	92%	100%	-12	86%	100%	-18	93%	100%	-21	80%	93%	-44
	100	96%	100%	0	93%	100%	0	100%	100%	0	93%	100%	1	103%	100%	-2	97%	100%	-4
	250	96%	110%	0	96%	110%	0	100%	100%	0	100%	100%	0	113%	100%	0	113%	100%	0
Alternative 2B	50	85%	100%	-8	85%	100%	-8	89%	100%	-16	86%	100%	-17	85%	100%	-39	80%	93%	-44
	100	93%	100%	0	96%	100%	0	93%	100%	0	93%	100%	1	97%	100%	-4	97%	100%	-4
	250	96%	110%	0	100%	110%	0	100%	100%	0	100%	100%	0	113%	100%	0	113%	100%	0
Alternative 3 (VBIA)	50	67%	83%	-8				64%	77%	-20				58%	71%	-50			
	100	79%	91%	0				73%	83%	0				74%	83%	-4			
	250	88%	100%	0				85%	91%	0				92%	91%	0			
The Parkway	50				82%	92%	-8				81%	92%	-20				78%	86%	-38
	100				89%	100%	0				87%	92%	0				87%	92%	-4
	250				92%	100%	0				88%	91%	0				104%	91%	0

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

Roadway Section Summary

Alternative 3 offers a notable improvement relative to No Build for $PM_{2.5}$ 24-hour average concentrations within 100 m of ROW, primarily due to emissions being exhausted through vent buildings. All other alternatives show no appreciable to marginal changes in $PM_{2.5}$ concentrations. Option 2 alignment reduces the frequency of exceedances of the CWS $PM_{2.5}$ 24-hour standard relative to Option 1 and all alternatives show a reduction in the frequency of exceedances. NO_x concentrations are lower with all alternatives than for the No Build scenario, however, even the No Build scenario is lower than the applicable criteria.

4.1.6 Howard Avenue to Highway 401

The proposed freeway is situated approximately 200 m to the west of the Talbot Road/Highway 3 corridor for all alternatives. There are slight differences in ramp configurations for The Parkway but essentially there is no difference in predicted traffic or alignment for the alternatives. All alternatives are at grade in this section of the roadway and Alternative 3 is not tunneled in this section. As a result, the maximum predicted concentrations and the changes in relation to No Build are the same for these Alternatives, and thus any variations in the model predicted concentrations are likely due to slight differences in the forecasted traffic volumes for each alternative, in addition to some residual effect of emissions that occur in the previous segment.

NO_x

NO_x concentrations in this area are well below criteria for No Build and all alternatives in all horizon years as shown in Table 4.11. In 2015, NO_x hourly concentration reductions are variable relative to No Build. In 2025 and 2035, NO_x hourly concentrations are notably lower than No Build out to 100 m, after which they are generally marginally lower.

For all alternatives and all horizon years, NO_x 24-hour concentrations show no appreciable to only marginally improvements over No Build.

TABLE 4.11 - CHANGE IN MAXIMUM NOX CONCENTRATIONS RELATIVE TO NO-BUILD, HOWARD AVE TO HIGHWAY 401

Alternative	Distance from Roadway (m)	Howard Ave to Highway 401					
		2015		2025		2035	
		1 Hour	24 Hour	1 Hour	24 Hour	1 Hour	24 Hour
Alternative 1A	50	84%	90%	67%	84%	64%	83%
	100	80%	98%	68%	91%	64%	90%
	250	94%	99%	83%	97%	80%	96%
Alternative 1B	50	79%	92%	66%	84%	63%	83%
	100	77%	98%	68%	91%	64%	90%
	250	92%	100%	82%	96%	80%	96%
Alternative 2A	50	80%	92%	65%	85%	66%	86%
	100	77%	98%	68%	91%	65%	90%
	250	89%	99%	82%	97%	80%	96%
Alternative 2B	50	80%	92%	64%	85%	66%	84%
	100	77%	99%	67%	91%	64%	90%
	250	90%	99%	81%	96%	79%	96%
Alternative 3 (VBIA)	50	101%	97%	75%	88%	71%	86%
	100	111%	102%	78%	95%	73%	93%
	250	122%	103%	95%	99%	89%	97%
The Parkway	50	86%	91%	68%	85%	66%	83%
	100	87%	96%	71%	93%	66%	90%
	250	97%	100%	84%	97%	81%	96%

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

$PM_{2.5}$

There is generally no appreciable difference between the alternatives and No Build in this roadway segment as shown in Table 4.12. Some $PM_{2.5}$ maximum hourly concentrations are predicted to marginally increase over No Build at 250 m from ROW; however no exceedances of the CWS $PM_{2.5}$ 24-hour standard are predicted.

TABLE 4.12 - CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS RELATIVE TO NO-BUILD, HOWARD AVE TO HIGHWAY 401

	Distance from ROW (m)	Howard Ave to Highway 401								
		2015			2025			2035		
		24 Hour	Annual	> CWS	24 Hour	Annual	> CWS	24 Hour	Annual	> CWS
Alternative 1A	50	100%	92%	0	97%	100%	0	97%	92%	-5
	100	104%	91%	0	108%	100%	0	104%	100%	0
	250	109%	100%	0	109%	100%	0	108%	100%	0
Alternative 1B	50	100%	92%	0	97%	100%	0	97%	92%	-5
	100	104%	91%	0	108%	100%	0	104%	100%	0
	250	109%	100%	0	113%	100%	0	108%	100%	0
Alternative 2A	50	100%	100%	0	97%	100%	0	100%	92%	-5
	100	100%	100%	0	108%	100%	0	104%	92%	0
	250	109%	100%	0	109%	100%	0	113%	100%	0
Alternative 2B	50	104%	100%	0	97%	100%	0	100%	92%	-5
	100	104%	100%	0	108%	100%	0	104%	92%	0
	250	114%	100%	0	109%	100%	0	113%	100%	0
Alternative 3 (VBIA)	50	104%	100%	0	100%	100%	0	100%	100%	1
	100	104%	100%	0	108%	100%	0	107%	100%	0
	250	114%	110%	0	113%	100%	0	113%	100%	0
The Parkway	50	104%	92%	0	103%	100%	3	100%	92%	2
	100	104%	100%	0	108%	100%	0	104%	92%	0
	250	109%	100%	0	109%	91%	0	100%	91%	0

Note: Values less than 100% indicate that the alternative has lower concentrations than the No Build Scenario. Cells highlighted in green indicate appreciable differences.

Roadway Section Summary

For $PM_{2.5}$ there is generally no appreciable difference between the alternatives and No Build in this area, nor is there an appreciable difference between the alternatives to each other. NO_x concentrations are lower with all alternatives than for the No Build scenario, however, even the No Build scenario is lower than the applicable criteria.

4.1.7 Overall Access Road Assessment

NO_x concentrations do not exceed any applicable standards for all horizon years, averaging periods, and distances to ROW for No Build and any of the alternatives. Generally any of the alternatives will show decreases in NO_x relative to No Build. This could be due to the alternatives having decreased idling due to the reduction of signalized intersections for international traffic. Air quality related to NO_x is expected to improve relative to No Build; however, the impacts are most notable within 100 m of ROW.

$PM_{2.5}$ concentrations generally do not show the same improvements as NO_x concentrations, primarily due to the large road dust component and increased traffic. However, in general, from 50 - 100 m from ROW there is a marginal to not appreciable reduction in concentrations relative to No Build for all alternatives other than Alternative 3 and the Parkway which can show appreciable differences in the relative maximum concentrations. The reductions shown for Alternative 3 are dependent on proper ventilation building design.

As mentioned previously in Section 4.0, none of the alternatives result in a sufficient enough change to impact the Air Quality Index.

Within 100 m of ROW, $PM_{2.5}$ exceedances are consistently predicted to be fewer relative to No Build for all alternatives and this effect is more pronounced by 2035. There are no exceedances predicted for any of the alternatives and No Build beyond 100 m of ROW.

With all alternatives showing a reduction in NO_x concentrations and $PM_{2.5}$ exceedances and with generally only marginal differences in $PM_{2.5}$ concentrations, no one alternative consistently stands out as a preferred alternative for all segments of the proposed freeway extension. Therefore all alternatives were considered to have the same impacts to air quality. It is important to consider that this assessment was performed using the maximum concentrations and the 90^{th} percentile background (i.e., 90% of the time the background concentration would be lower) and that typical conditions would be expected to show even less variation between the alternatives.

4.2 Customs / Inspection Plaza Alternatives

As discussed previously, three separate alternatives were studied for Customs / Inspection Plaza alternatives. These are Plaza A, Plaza B / B1 and Plaza C. Tables 4.13 and 4.14 present the results of the air dispersion modelling ($PM_{2.5}$ and NO_x) for each of these Alternatives. In order to compare the location specific differences between the different alternatives, the results of each plaza alternative will be presented and discussed in relation to specific areas in the vicinity of each facility.

The plaza results show that the maximum predicted concentrations of $PM_{2.5}$ and NO_x are generally much higher than those predicted for the access road alternatives. This is due to the longer idling time near the plazas as vehicles queue in line at the booths. Although the traffic data is similar for all Plaza alternatives, the footprints of the plaza properties, alignment of the plazas and proximity of nearby roads plays an important role in the maximum predicted concentrations, which is reflected in differences in the modelling results.

TABLE 4.13 – CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS AND EXCEEDANCES RELATIVE TO NO BUILD FOR EACH PLAZA CROSSING

	Year	Distance from	Plaza A			Plaza B			Plaza B1			Plaza C		
			24 Hour	Annual	>CWS	24 Hour	Annual	>CWS	24 Hour	Annual	>CWS	24 Hour	Annual	>CWS
% Difference	2015	50	204%	200%	134	250%	145%	127	317%	200%	148	209%	136%	84
		100	167%	140%	15	173%	130%	20	165%	140%	54	177%	140%	28
		250	129%	120%	0	141%	110%	0	132%	110%	0	145%	120%	2
% Difference	2025	50	204%	200%	156	284%	155%	167	348%	220%	177	208%	145%	97
		100	159%	150%	36	209%	140%	35	239%	150%	77	200%	140%	59
		250	136%	130%	1	159%	120%	3	152%	110%	8	164%	120%	6
% Difference	2035	50	221%	209%	168	288%	164%	175	413%	240%	193	217%	155%	109
		100	191%	150%	56	218%	150%	48	250%	160%	87	214%	140%	77
		250	136%	130%	3	164%	120%	8	152%	120%	11	173%	120%	17

Note: Because the impacts are greater than 20% for all configurations, coloured highlighting has not been applied

TABLE 4.14 – CHANGE IN NO_X CONCENTRATIONS AND EXCEEDANCES RELATIVE TO NO BUILD FOR EACH PLAZA CROSSING

Year	Distance from Property	Plaza A		Plaza B		Plaza B1		Plaza C	
		1-Hour	Exceedances	1-Hour	Exceedances	1-Hour	Exceedances	1-Hour	Exceedances
2015	50	344%	8	429%	6	522%	2	123%	0
	100	194%	0	376%	2	368%	1	128%	0
	250	181%	0	199%	0	223%	0	116%	0
2025	50	805%	14	750%	18	790%	7	213%	0
	100	458%	1	623%	7	590%	1	208%	0
	250	393%	0	258%	0	310%	0	173%	0
2035	50	886%	16	774%	17	691%	6	222%	0
	100	533%	1	587%	6	655%	3	216%	0
	250	448%	0	233%	0	306%	0	176%	0

Note: Because the impacts are greater than 20% for all configurations, coloured highlighting has not been applied

4.2.1 Plaza A

The Plaza A Alternative is located adjacent to E.C. Row Expressway in the vicinity of Spring Garden Road / Armanda Street in an area with residential uses present. Plaza A provides potential access to all of the Crossing Alternatives (A, B or C) that are included in the study.

As can be seen in the Table 4.13, the maximum predicted $PM_{2.5}$ 24-hour concentrations increase appreciably to significantly out to 250 m from the Plaza A boundary, in comparison to the No Build Alternative. In addition, the number of days exceeding the CWS 24-hour standard are also predicted to increase significantly at distances up to 100 m from the plaza boundary in 2035. At distances of 250 m or more, only isolated exceedances of the CWS 24-hour standard are predicted.

The annual $PM_{2.5}$ average concentrations also increase in comparison to No Build, but are below the 15 $\mu g/m^3$ criterion by 100 m away from the plaza boundary in 2035.

Similar to the $PM_{2.5}$ results, the maximum predicted 1-hour NO_x concentrations shown in Table 4.14 also increase significantly within 250 m of the plaza boundary; however, the change in number of times that the MOE AAQC is predicted to be exceeded is not appreciable (i.e. 1 hour or less) beyond 100 m away.

Based on the results presented above, air quality is predicted to be generally impacted within approximately 100 m of the Plaza A boundary.

4.2.2 Plaza B

The Plaza B alternatives are located in an industrial area immediately north of Broadway Street, west of Ojibway Parkway, near the Detroit River.

Plazas B and B1 are only slight variants of one another, and thus will be discussed in the same section. Due to the required elevation of the Crossing Alternatives and maximum grade allowances on the approach to the crossing, Plaza B could not provide access to Crossing B. Thus, the Plaza B1 variant was created to permit access to Crossing Alternative B.

4.2.2.1 Plaza B1

Plaza B1 is located immediately to the west of Ojibway Parkway, and leads to Crossing Alternative B. The results shown in the Tables indicate a general decline in air quality in the immediate vicinity of the Plaza. In addition, the nearby concentrations are affected by traffic on the E.C. Row interchange.

Within 250 m of the property boundary, the maximum predicted $PM_{2.5}$ concentrations increase significantly in comparison to the No Build Alternative. In addition, the change in the number of days predicted to exceed the CWS 24-hour standard is significant within 250 m of the plaza boundary in 2025 and 2035. At distances of 250 m or more, the number of exceedances of the CWS 24-hour standard is appreciably reduced.

Annual average $PM_{2.5}$ concentrations are also higher compared to No Build, but are below the 15 ug/m^3 criterion beyond 50 m away from the plaza boundary in 2015 and 2025, and beyond 100 m in 2035.

Table 4.14 presents the maximum predicted 1-hour NO_x concentrations. The Table shows that the predicted concentrations are significantly greater than No Build within 250 m of the Plaza boundary; however, the maximum predicted concentrations only incrementally exceeds the MOE 1-hour NO_x criterion on an infrequent (i.e. 7 hours or less per year) out to 100 m, with no exceedances noted by 250 m.

Based on the results presented above, a general decrease in air quality is expected within approximately 250 m of the Plaza B1 boundary. However, the highest impacts will likely occur within 50 - 100 m of the boundary.

If Plaza A is not built, there will still be impacts as the freeway will be extended through this area to allow for connections to Plaza B, B1, or C. See Section 4.2.4 for more discussion.

4.2.2.2 Plaza B

Plaza B is located adjacent to Plaza B1, slightly farther to the west and closer to the Detroit River. Only Crossing Alternative C can be accessed from this Plaza Alternative.

Table 4.13 shows that the maximum predicted $PM_{2.5}$ concentrations are significantly higher than the No Build Alternative within 250 m of the Plaza B property boundary. In addition, the number of days predicted to exceed the CWS 24-hour standard increases significantly over the No Build Alternative within 100 m of the plaza boundary in 2035, with the number of exceedances significantly reduced by 250 m.

Annual average $PM_{2.5}$ concentrations are higher compared to No Build, but are below the 15 µg/m^3 criterion beyond 100 m from the Plaza B boundary in all three horizon years.

The maximum predicted 1-hour NO_x concentrations shown in Table 4.14 are also significantly higher in comparison to the No Build Alternative within 250 m of the plaza boundary. The maximum predicted concentrations exceed the MOE 1-hour NO_x criterion on occasion at distances up to 100 m from the Plaza in all years, but the change in number of exceedances is only significant at 50 m away in 2025 and 2035.

These results indicate that air quality is predicted to decrease within approximately 250 m from the Plaza B property boundary by 2035. The highest impacts will likely occur within 50 to 100 m of the boundary.

4.2.3 Plaza C

The Plaza C Alternative is located in an industrial area in the vicinity of the Brighton Beach Generating Station, on the approximate footprint of the transformer station. Plaza C provides access to Crossing Alternative C only.

Similar to the $PM_{2.5}$ results for the other Plaza alternatives, the maximum predicted $PM_{2.5}$ concentrations increase significantly over No Build at distances up to 250 m from the Plaza C boundary. Also, the change in the number of times that the CWS 24-hour standard is predicted to be exceeded (relative to No Build) is significant at distances up to

250 m away by 2035, with the number of exceedances significantly reduced by 250 m relative to the number of exceedances at 50 and 100 m.

The annual average $PM_{2.5}$ concentration only exceeds the 15 ug/m^3 criterion at 50 m from the boundary in all horizon years.

The predicted maximum 1-hour NO_x concentrations shown in Table 4.14 are also significantly higher in comparison to the No Build Alternative within 250 m of the plaza boundary; however, the MOE AAQC is not exceeded at any distance interval, in any of the horizon years.

As can be seen in the Tables, the overall magnitude of the changes in maximum NO_x and exceedances of the CWS 24-hour standard is generally less for the Plaza C Alternative than for any of the other Plaza Alternatives evaluated. This is due to the Plaza alignment and arrangement of roadways within the property. There is a larger buffer between the traveled portion of the roadways within Plaza C and the property boundary. As a result, the emissions have dispersed more by the time they reach the property boundary.

These results indicate a decrease in air quality within approximately 250 m from the Plaza C property boundary. However, the most significant affects will likely occur within 50 – 100 m away.

4.2.4 Access Road Connections to Plazas B, B1, and C

For Plazas B, B1, and C, the 401 section between Ojibway Parkway and Malden Road runs parallel and to the south of EC Row. Both the 401 extension and EC Row are in free-flow state in this section of the road. There are minor differences in traffic predicted for all alternatives and crossings in this segment and any differences in concentrations amongst the alternatives are due to these minor differences. Therefore the key comparison is between the alternatives and the No Build scenario.

NO_x concentrations in this area are well below criteria for No Build and all alternatives in all horizon years and there is no appreciable difference between No Build and alternatives at any distance from ROW. NO_x concentrations are reduced for both No Build and the alternatives by 2025 due to technology changes previously described.

$PM_{2.5}$ 24-hour concentrations for both No Build and the alternatives are predicted to be below the CWS 24-hour standard until 2035. In 2035 exceedances are predicted under certain conditions within 50-100 m for the alternatives.

4.3 Crossing Alternatives

As outlined earlier in the report, three separate bridge crossing alternatives were studied and evaluated as part of this project. These are:

- Crossing A
- Crossing B
- Crossing C

Also, there is a connecting roadway between the exit of each plaza and the entrance to the Crossings.

The air dispersion modeling results for all Crossing Alternatives are presented in Tables 4.15 through 4.16. In order to compare the location specific differences between the different alternatives, the results of each crossing alternative will be presented and discussed in relation to specific areas in the vicinity of each bridge and connecting roadway.

The results for the crossings indicate that the maximum predicted concentrations of $PM_{2.5}$ and NO_x are generally similar to those of the access road alternatives. However, for some Plaza / Crossing combinations there is some “spillover” of idle emissions from the Plaza, due to the proximity of the Plaza to the Crossing. This is the case for the Plaza B / Crossing B and Plaza C / Crossing C combinations.

TABLE 4.15 – CHANGE IN MAXIMUM $PM_{2.5}$ CONCENTRATIONS AND EXCEEDANCES RELATIVE TO NO-BUILD FOR PLAZAS AND CROSSINGS

Year	Distance from ROW (m)	Crossing A From Plaza A			Crossing B From Plaza A			Crossing B From Plaza B1			Crossing C From Plaza A			Crossing C From Plaza B			Crossing C From Plaza C		
		24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances	24 Hour	Annual	Exceedances
2015	50	204%	200%	134	204%	200%	134	317%	200%	148	192%	200%	100	250%	145%	127	200%	115%	84
	100	167%	140%	15	167%	140%	15	165%	140%	54	195%	140%	15	173%	130%	20	177%	108%	28
	250	129%	120%	0	129%	120%	0	132%	110%	0	138%	120%	0	141%	110%	1	145%	109%	2
2025	50	204%	200%	156	204%	200%	156	348%	220%	177	192%	200%	122	284%	155%	167	208%	145%	97
	100	159%	150%	36	159%	150%	36	250%	150%	77	191%	150%	36	209%	140%	35	200%	140%	59
	250	136%	130%	1	136%	130%	1	152%	110%	8	141%	130%	2	159%	120%	3	164%	120%	6
2035	50	212%	209%	168	212%	209%	168	413%	240%	193	204%	209%	134	300%	164%	175	217%	155%	109
	100	150%	127%	44	150%	127%	44	250%	160%	87	196%	150%	56	209%	150%	48	214%	140%	77
	250	135%	120%	5	135%	120%	5	152%	120%	11	164%	130%	3	164%	120%	8	173%	120%	6

Note: Because the impacts are greater than 20% for all configurations, coloured highlighting has not been applied

TABLE 4.16 – CHANGE IN MAXIMUM NO_X CONCENTRATIONS AND EXCEEDANCES RELATIVE TO NO-BUILD FOR PLAZAS AND CROSSINGS

Year	Distance from ROW (m)	Crossing A From Plaza A		Crossing B From Plaza A		Crossing B From Plaza B1		Crossing C From Plaza A		Crossing C From Plaza B		Crossing C From Plaza C	
		1-Hour	Exceedances	1-Hour	Exceedances	1-Hour	Exceedances	1-Hour	Exceedances	1-Hour	Exceedances	1-Hour	Exceedances
2015	50	344%	0	344%	0	429%	0	344%	0	429%	0	123%	0
	100	194%	0	194%	0	376%	0	194%	0	376%	0	128%	0
	250	181%	0	181%	0	199%	0	181%	0	199%	0	116%	0
2025	50	805%	0	805%	0	750%	0	805%	0	750%	0	213%	0
	100	458%	0	458%	0	623%	0	458%	0	623%	0	208%	0
	250	393%	0	393%	0	258%	0	393%	0	258%	0	173%	0
2035	50	886%	0	886%	0	774%	0	886%	0	774%	0	222%	0
	100	533%	0	533%	0	587%	0	533%	0	587%	0	216%	0
	250	448%	0	448%	0	233%	0	448%	0	233%	0	176%	0

Note: Because the impacts are greater than 20% for all configurations, coloured highlighting has not been applied

4.3.1 Crossing A

Crossing Alternative A can be accessed from Plaza A only, and is located in the vicinity of Wright and Water Streets. It has the longest span of the three Alternatives studied, at 1.1 km.

Table 4.15 shows that the maximum predicted $PM_{2.5}$ concentrations are significantly higher than the No Build Alternative within 100 m of the Crossing and marginally to significantly higher at 250 m. In addition, the number of days predicted to exceed the CWS 24-hour standard increases significantly over the No Build Alternative within 50 m of the Crossing, with the number of exceedances reduced by approximately 70 to 85% by 100 m, with no or few exceedances predicted by 250 m.

The annual average $PM_{2.5}$ concentrations are predicted to appreciably increase in the vicinity of the crossing, and will only exceed the 15 ug/m^3 criterion within 50 m in 2025 and 2035 and d1 00 m in 2025.

The changes in the maximum predicted 1-hour NO_x concentrations shown in Table 4.16 are significantly higher than No Build; however, there are no exceedances of the MOE 1-hour NO_x criterion in the vicinity of the crossing and connecting roadway.

Based on these results, a decrease in air quality is predicted to occur at distance up to 250 m away from Crossing A and the associated connecting roadway, with impacts being most apparent within the first 100 m.

4.3.2 Crossing B

Crossing Alternative B can be accessed from Plaza A or Plaza B1. Crossing B is located adjacent to the Brighton Beach Power Station and has a span of approximately 800 m.

As shown in Table 4.15, the Crossing B from both Plazas show notable increases in $PM_{2.5}$ concentrations within 100 m – 250 m of the Plaza. Exceedances are appreciably increased within 50 m of the crossing/plaza configurations. Crossings are influenced by the Plaza configurations with the highest concentrations found in close proximity to the plazas.

The changes in the maximum predicted 1-hour NO_x concentrations shown in Table 4.16 are significantly higher than No Build; however, there are no exceedances of the MOE 1-hour NO_x criterion in the vicinity of the crossing and connecting roadway.

Based on the above, air quality is predicted to decrease within 250 m of Crossing B and or the associated connecting roadway, with impacts being most apparent within the first 100 m.

4.3.3 Crossing C

Crossing Alternative C can be accessed from Plaza A, Plaza B or Plaza C. It is located near Stirling Marine Fuels, and has the shortest span of the three Crossing Alternatives, at approximately 700 m.

Table 4.15 shows that the maximum predicted $PM_{2.5}$ 24-hour concentrations are generally appreciably to significantly higher than the No Build Alternative within 250 m of all Crossing C combinations. In addition, the number of days predicted to exceed the CWS 24-hour standard increases significantly over the No Build Alternative within 50 m of the Crossing, with fewer exceedances by 100 m, with no notable (i.e., >8) increases in exceedances by 250 m.

In general, the annual average $PM_{2.5}$ concentrations are predicted to marginally to significantly increase in the vicinity of the crossing, for all Plaza combinations, but will only exceed the 15 ug/m^3 criterion within 50 m for Plaza C in all horizon years and Plazas A and B out to 100 m by 2035.

The changes in the maximum predicted 1-hour NO_x concentrations shown in Table 4.16 are significantly higher than the No Build; however, there are no exceedances of the MOE 1-hour NO_x criterion at any of the Crossing/Plaza configurations. The lowest increases in concentrations are consistently seen in the vicinity of Crossing C from Plaza C.

Based on these results, a decrease in air quality is expected within 100 m of the connecting roadway of Crossing C with either Plaza A, Plaza B, or Plaza C, with impacts being most apparent within the first 100 m.

5.0 EVALUATION OF ALTERNATIVES

The previous chapter presented the air dispersion modeling results for each Access Road, Plaza, and Crossing Alternative studied, and examined the potential changes to air quality in comparison to the No Build Option (i.e., doing nothing at all). This section of the report presents a comparative evaluation of the different options and discusses the potential benefits and effects in comparison to one another. Once again, this is completed separately for the Access Road Alternatives. The changes in air quality for the Crossings are linked to the Plaza configurations and this chapter combines the assessment of the Crossings and the Plazas together.

5.1 Access Road Alternatives

In order to evaluate the potential benefit and effects of each Access Road Alternative and compare these to one another, the maximum predicted $PM_{2.5}$ and NO_x concentrations for each segment at each distance interval were averaged along the entire route between Labelle Street and Howard Avenue. In this manner, the average change in the maximum concentrations compared to No Build could be assessed. These results are presented in Table 5.1 for both $PM_{2.5}$ and NO_x.

The key finding is that implementation of almost any of the Alternatives results in improved air quality on average in comparison to the No-Build option. Some Alternatives and alignments result in more dramatic improvements than others. In general, below grade Alternatives (1B & 2B, the Parkway) result in lower concentrations and slightly fewer exceedances of $PM_{2.5}$ criteria on average than the at-grade Alternative 1A. Differences in Alternative 2A and 2B are not appreciable, except for the number of CWS $PM_{2.5}$ 24-hour exceedances in 2035. A tunneled Alternative with a properly designed vent building (Alternative 3) results in the greatest reduction in $PM_{2.5}$ concentrations and generally comparable reductions in NO_x concentrations. As mentioned previously, the Jet Fans tunnel ventilation option typically resulted in unacceptable concentrations of $PM_{2.5}$ and NO_x, and frequently exceeded the relevant criteria by a significant amount, and thus was not considered further in this assessment.

Table 5.1 shows that all alternatives result in lower maximum concentrations and number of exceedances on average in comparison with the No Build scenario. The below grade options consistently result in slightly lower $PM_{2.5}$ and NO_x annual and 24-hr concentrations relative to Alternative 1A. Also, the reduction in number of exceedances of the $PM_{2.5}$ criterion is greater for the below grade options than for the at-grade Alternative 1A. These results are discussed in further detail in the following sections.

5.1.1 Comparison of At Grade, Below Grade, Cut & Cover Tunnel and Parkway Alternatives

This section discusses the differences between the alternatives relative to each other.

5.1.1.1 At Grade versus Below Grade Alternatives

The effect of depressing the roadway is discussed and examined in this section, through the comparison of Alternative 1A to 1B, of 2A to 2B and the Parkway (which most closely follows Alternative 2B. As can be seen in Table 5.1, comparing the relative $PM_{2.5}$ concentrations between 1A and 1B, Alternative 1A concentrations are predicted to be very close to the No Build option. Alternative 1B (below grade) results in marginally lower concentrations (relative to No Build) at 50 m from the roadway. Similarly, Alternative 1B results in a greater reduction in the number of days predicted to be greater than the CWS $PM_{2.5}$ 24-hour standard. However, this effect is limited primarily to approximately 50 m from the ROW. At 100 m from the ROW, there is no appreciable difference between Alternative 1A and 1B, and no difference between implementation of either Alternative 1A or 1B and No Build, except for the number of exceedances of the CWS $PM_{2.5}$ 24-hour standard in 2035.

A similar trend is seen in the comparison of Alternative 2A versus 2B. In comparison to No Build, the $PM_{2.5}$ concentrations at 50 m away are marginally lower over all horizon years for Alternative 2B Option 2 and generally not appreciably different for all other scenarios. There is no appreciable difference in $PM_{2.5}$ concentrations at 50 m between Alternative 2A and 2B. Also, until 2035 when Alternative 2B shows a greater reduction, there is no real difference between Alternative 2A and 2B in terms of the number of days predicted to exceed the CWS $PM_{2.5}$ 24-hour standard at 50 m away from the roadway. .

The Parkway option shows similar trends to the other Below Grade alternatives with a greater reduction in predicted exceedances of the CWS $PM_{2.5}$ 24-hour standard than either at grade alternative.

The annual average concentrations do not exceed the criterion on average for any of the alternatives examined, in any of the horizon years.

In terms of NO_x concentrations, there are no predicted exceedances of the MOE 1-hour NO_x criterion for any of Alternatives 1A, 1B, 2A, 2B, or the Parkway at any of the distance intervals studied. As mentioned previously, implementation of any of these alternatives result in notable (i.e. > 20%) decreases in the maximum predicted concentrations, relative to No Build. There are no appreciable differences between the alternatives for NO_x concentrations.

5.1.1.2 At Grade versus Tunnel Alternatives

In this section of the report, the effect of end to end tunneling of the roadway is examined in comparison to an at grade roadway. This will be done via a comparison of the results along the route between Alternative 1A and 3, as well as 2A to 3.

Comparing the results presented in Table 5.1 for Alternatives 1A and 3 show that a tunneled alternative would result in appreciable reductions in the maximum $PM_{2.5}$ concentrations at 50 m from the ROW in all horizon years examined. This is true for comparisons of Alternative 3 to both Alternative 1A and 2A. Also, in comparison to Alternative 1A and 2A there is a significant reduction (i.e., >8) in the number of days predicted to exceed the CWS $PM_{2.5}$ 24-hour standard at 50 m away for a tunneled access road in comparison to an at-grade roadway in 2025 and 2035.

The annual average concentrations do not exceed the criterion on average for any of the alternatives examined, in any of the horizon years.

With respect to the maximum predicted 1-hour NO_x concentrations, there are no predicted exceedances of the MOE 1-hour NO_x criterion for any of the at-grade or tunneled Alternatives examined. Comparing the relative magnitude of the maximum predicted concentrations between 1A and 3 shows that there is no difference at any of the distance intervals, in any of the horizon years. However, a comparison between Alternative 2A and 3 indicates that a tunneled alternative increases the maximum predicted concentrations over an at-grade access road with 2-way service roads at 50 m from the ROW. However, this difference is marginal only in the year 2015 for the 1-hour NO_x concentration. All other differences are not appreciable.

Based on these results, the effect of tunneling the roadway (either positive or negative) does not extend beyond a maximum of 100 m away in comparison to at grade Alternatives.

5.1.1.3 Below Grade (including Parkway) Alternatives versus Tunnel

This evaluation examines differences between below grade alternatives and the tunneled alternative (Alternative 3). This will be done through a comparison of Alternative 1B to 3, Alternative 2B to 3, and The Parkway to Alternative 3.

The results presented in Table 5.1 show that there are generally appreciable or close to appreciable differences (i.e. > 20%) in the relative maximum $PM_{2.5}$ concentrations between the below grade alternatives (1B, 2B and the Parkway) in comparison to the tunneled alternative (3).

When compared to both Alternatives 1B and 2B, a tunneled alternative would result in reductions in the number of days predicted to exceed the CWS $PM_{2.5}$ 24-hour standard. However, the reductions are only notable (i.e. > 8) at 50 m from the ROW in 2035 for both Alternatives in 2025.

Both the Parkway and the Tunnel alternative show similar exceedances of the CWS $PM_{2.5}$ 24-hour standard with fewer exceedances predicted for these alternatives than the other below grade alternatives.

The NO_x results are similar to what was observed when the at-grade alternatives were compared to a tunneled alternative. There are no predicted exceedances of the MOE 1-hour NO_x or 24-hour criteria for any of the below grade or tunneled alternatives. The only Below Grade Alternative that shows any marginal to notable improvement over Alternative 3 is Alternative 2B for 2015 and 2025 1-hour NO_x concentrations. The Parkway option does not appear to be appreciably different from Alternative 3.

Based on the above comparisons, the effect of tunneling the roadway (either positive or negative) is limited to within 50 - 100 m from the roadway in comparison to below grade alternatives; however, the Parkway option results in a greater reduction in the frequency of the CWS $PM_{2.5}$ 24-hour standard compared to Alternative 3.

5.1.2 Service Road Configurations

As part of the assessment, two separate configurations (Alternative 1 and Alternative 2) of freeway service roads were studied. These included one-way service roads on either side of the freeway, and two way service roads located approximately on the existing Highway 3 / Huron Church Road alignment. The differences between these configurations will be evaluated through comparisons between Alternatives 1A and 2A, as well as 1B and 2B.

The Parkway Alternative follows a similar configuration to Alternative 2B.

Comparison of the $PM_{2.5}$ concentration data between all service road configurations indicates that there are no appreciably differences between one way and two way traffic flow; however, Alternative 2B Option 1 consistently shows marginal improvements in maximum $PM_{2.5}$ concentrations across all horizon years. Also, the two-way service road alignments consistently result in reductions in the number of days predicted to be greater than the CWS $PM_{2.5}$ 24-hour standard. These differences are notable (i.e., > 8) at 50 m from the ROW in 2025 and 2035 for Alternative 2A versus Alternative 1A.

There is generally no appreciable difference in any of the alternatives for NO_x concentrations.

The results indicate that the two-way service road configurations result in similar maximum $PM_{2.5}$ concentrations and fewer days that are predicted to exceed the CWS, with reductions in frequencies limited to less than 100 m away from the ROW. Thus, differences in service road configuration can be considered to have no appreciable impact on overall air quality.

5.1.3 Route Alignments Between St. Clair College & Howard Avenue

As outlined previously, two separate route alignment options were studied in the area between St. Clair College and Howard Avenue. The first route alignment (Option 1) realigns the existing Talbot Road / Highway 3 corridor slightly to the northeast. This realignment begins at approximately at Howard Avenue and continues approximately to the entrance to St. Clair College.

The Option 2 alignment utilizes the existing Talbot Road / Highway 3 corridor as local access service roads without any realignment and aligns the freeway to the southeast.

In order to evaluate whether there are any differences between the two alignments, the Option 1 and Option 2 results will be compared to one another for each alternative. This will be done separately for the at-grade and below grade alternatives.

5.1.3.1 At Grade Alternatives

The $PM_{2.5}$ results from Alternative 1A and 2A show that the maximum predicted concentrations are similar for both Option 1 and Option 2 at 50 m away in all horizon years. The number of days predicted to exceed the CWS $PM_{2.5}$ 24-hour standard is reduced for the Option 2 alignment at 50 m away by 2025. However, this difference is not appreciable (i.e., > 8) until 2035, and then only for Alternative 2B.

The Option 1 and 2 alignments show no appreciable differences in maximum predicted 1-hour NO_x concentrations, with the exception of a marginal reduction for Alternative 1A Option 2 at 50 m from the ROW in 2015.

Differences in route alignments for the at-grade service road configuration can be considered to have generally no appreciable impact on overall air quality.

5.1.3.2 Below Grade Alternatives

There is no appreciable differences between the Option 1 and Option 2 alignments for the below grade alternatives for either $PM_{2.5}$ concentrations, predicted CWS $PM_{2.5}$ 24-hour standard exceedance days and 1-hour NO_x concentrations.

The Below Grade alternatives do not appear to be impacted by the Option 1 and Option 2 alignments.

5.2 Evaluation of Plaza/Crossing Alternatives

The dispersion model results presented previously for each of the four plaza alternatives were used to complete a comparative evaluation of the different plaza and crossing configuration options. This evaluation is presented in Table 5.2.

The property footprints and layouts for each Plaza Alternative are slightly different, and thus the results will also differ somewhat.

The crossings are impacted by the plaza configurations and therefore the results are presented concurrently in Table 5.2.

5.2.1 $PM_{2.5}$ Concentrations

As can be seen in Table 5.2, the maximum predicted $PM_{2.5}$ concentrations at 50 m away from the property boundary increase by a factor of around 2 to over 3 versus No Build concentrations in each of the horizon years for all of the Plaza/Crossing configurations. The changes at all distance intervals from the boundary were shown earlier in Table 4.15, and are significant at 250 m for all Plaza Alternatives and all horizon years. Similarly, all of the Plaza Alternatives result in a significant increase the number of days predicted to exceed the CWS $PM_{2.5}$ 24-hour standard at 100 m away, in comparison to No Build.

The largest difference of any alternatives (i.e., highest increase) is seen in the vicinity of Plaza B1/Crossing B in 2035. Plaza B1/Crossing B also has the largest increase in number of days predicted to exceed the CWS within 100 m of the Plaza boundary. This can be attributed to the limited buffer area around the toll/inspection plaza with this option and the low levels of traffic in the vicinity that currently exists (i.e., the impacts are greatest when traffic extremes are greatest).

The lowest concentrations and lowest change in the number of days predicted to exceed the CWS $PM_{2.5}$ 24-hour standard is seen in the vicinity of the Plaza A configurations with Crossing C via Ojibway Park and Plaza C/Crossing C. These two configurations provide greater buffer around the tolling/inspection areas than Plaza B or B1 Crossing configurations.

5.2.2 NO_X Concentrations

The plaza/crossing alternatives have a significant impact on the air quality in the immediate vicinity of the property boundaries. The maximum predicted 1-hour NO_x concentrations at 50 m away from the property boundary increase by as much as approximately a factor of 5 in 2015, 8 in 2025 and 9 in 2035, in comparison to the No Build concentrations for all plaza/crossing alternatives. The increases in concentration are significant at distances up to 250 m from the property boundary, for all alternatives, and all horizon years with the Crossing C options showing the lowest increase in concentrations.

The NO_x criterion is not exceeded at Plaza A from Crossing C via Brighton Beach or Plaza C at any of the distance intervals in any of the horizon years.

Plaza A (except for the Crossing C via Brighton Beach) and Plaza B results in the largest increases in maximum predicted concentrations and the largest increases in the number of exceedances of the NO_x criterion at distances up to 100 m from the property boundary.

The lowest concentrations and lowest change in the number of days predicted to exceed the NO_x criterion is seen in the vicinity of Plaza A from Crossing C via Brighton Beach and Plaza C. For Plaza C, this is likely due to an additional buffer between the vehicles and the property boundary, because of the facility layout.

5.3 Final Conclusions

Access Road Alternatives

All alternatives offer benefits due to the decrease in traffic idling, particularly from diesel trucks.

For the Access Road Alternatives Alternative 3 and the Parkway are slightly preferred over the other options as they have the greatest potential for reduction of exceedances of the $PM_{2.5}$ standard and $PM_{2.5}$ concentrations. However, the impacts are limited to within 50 m from ROW and beyond 50 m from ROW the differences between any of the alternatives become less notable. NO_x concentrations for all alternatives are reduced relative to No Build, however, even the No Build concentrations are below acceptable standards and less weight is given to the reduction in NO_x concentrations than the $PM_{2.5}$ exceedances.

In general, with all alternatives:

- the concentrations for NO_x and $PM_{2.5}$ decrease as the distance from the roadway increases;
- exceedances of the $PM_{2.5}$ 24-hour CWS criteria are reduced relative to No Build
- the $PM_{2.5}$ concentrations increase with time (though are still lower than No Build), as traffic volumes are predicted to increase from 2015 through 2035; and
- NO_x concentrations decrease over time as the emission factors for cars and non-idling trucks are going to be significantly reduced in the future to the extent that emissions are lower than 2015, regardless of predicted traffic growth in this study.

Plazas and Crossings

The effects of the plazas and crossings are primarily related to the plazas with the potentially larger volumes of idling traffic. The crossings are predicted to be free-flow and have a minor impact relative to the plazas. As with the access roads, the impacts are reduced at greater distances from the plazas. Plaza C has the greatest buffer zone between the area of queuing vehicles and the property line of the plaza; therefore the impacts are reduced with Plaza C. Plaza B1 queuing occurs closest to the property line of the Plaza and the negative impacts on air quality is the highest with this option.

All Plaza and Crossing Configurations are predicted to have an increased number of days of exceedances of the $PM_{2.5}$ 24-hourly concentrations and more than a doubling in $PM_{2.5}$ concentrations.

Crossing C/Plaza C is slightly preferred to the other crossing/plaza alternatives as this combination results in fewest days of CWS exceedances for particulate. Crossing B/Plaza B1 results in greatest increase in $PM_{2.5}$ exceedances. All options will result in a decreased air quality within 250 m of the plazas.

TABLE 5.1 - ACCESS ROAD EVALUATION TABLE

PRACTICAL ALTERNATIVES EVALUATION	Factor: Changes in Air Quality

Performance Measure	Criteria/Indicator	Measurement/Units	Alternative 1A	Alternative 1A	Alternative 1B	Alternative 1B	Alternative 2A	Alternative 2A	Alternative 2B	Alternative 2B	Alternative 3	The Parkway
			Option 1	Option 2	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2		
	Change in the number of 24 hr periods where concentrations of $PM_{2.5}$ is > 30 µg/m^3 versus do nothing in 2015	Distance from Roadway, 50 m	-4	-4	-7	-7	-9	-9	-9	-8	-10	-12
		Distance from Roadway, 100 m	-1	0	-1	-1	-1	-1	-1	-1	-1	-1
		Distance from Roadway, 250 m	0	0	0	0	0	0	0	0	0	0
		Maximum concentration relative to Do Nothing (at 50 m)	96%	98%	89%	91%	89%	90%	87%	91%	73%	86%
	Change in the number of 24 hr periods where concentrations of $PM_{2.5}$ is > 30 µg/m^3 versus Do Nothing in 2025	Distance from Roadway, 50 m	-3	-7	-12	-15	-15	-17	-17	-18	-23	-28
		Distance from Roadway, 100 m	1	0	-2	-1	-1	0	-2	-1	-2	-3
		Distance from Roadway, 250 m	0	0	0	0	0	0	0	0	0	0
		Maximum concentration relative to Do Nothing (at 50 m)	94%	97%	87%	90%	90%	90%	87%	91%	68%	82%
	Change in the number of 24 hr periods where concentrations of $PM_{2.5}$ is > 30 µg/m^3 versus Do Nothing in 2035	Distance from Roadway, 50 m	-10	-16	-27	-29	-22	-30	-31	-33	-44	-43
		Distance from Roadway, 100 m	4	3	-3	-3	-1	-3	-5	-5	-7	-8
		Distance from Roadway, 250 m	0	0	0	0	0	0	0	0	0	0
		Maximum concentration relative to Do Nothing (at 50 m)	95%	97%	85%	88%	92%	90%	86%	88%	66%	86%
	Does the average annual concentration of $PM_{2.5}$ exceed 15 µg/m^3 in 2015, 2025, or 2035	Yes/No	N	N	N	N	N	N	N	N	N	N
	Does the average annual concentration of $PM_{2.5}$	Yes/No	N	N	N	N	N	N	N	N	N	N
	Summary of effect on concentration of particulate matter	Subjective assessment	The Tunnel (Alternative 3) and the Parkway are slightly preferred within the first 50 m from the Right of Way, primarily due to a greater reduction in exceedances. However, all Alternatives result in similar AQ conditions at 100 m and beyond from the right of way. The Below Grade options result in fewer exceedances and lower maximum concentrations than the At Grade alternatives within 50 m from the Right of Way. There is no notable difference between Option 1 and Option 2. Exceedances are reduced with all Alternatives relative to No Build. Changes relative to each alternative are typically limited to within 20% and therefore none of the alternatives are considered significantly different from each other.									
	Relative change in maximum concentrations, 2015	Maximum 1 - hour concentration relative to Do Nothing (at 50 m)	74%	63%	70%	60%	63%	59%	60%	59%	77%	72%
		Maximum 24 hour concentration relative to do Nothing at 50 m	88%	87%	85%	83%	85%	83%	83%	82%	88%	83%
	Relative change in maximum concentrations, 2025	Maximum 1 - hour concentration relative to Do Nothing (at 50 m)	64%	58%	61%	56%	59%	57%	57%	55%	64%	66%
		Maximum 24 hour concentration relative to do Nothing at 50 m	85%	85%	83%	83%	84%	83%	83%	82%	84%	84%
	Relative change in maximum concentrations, 2035	Maximum 1 - hour concentration relative to Do Nothing (at 50 m)	57%	53%	55%	52%	53%	52%	53%	51%	57%	57%
		Maximum 24 hour concentration relative to do Nothing at 50 m	82%	82%	79%	79%	80%	79%	80%	79%	80%	78%
	Summary of effect on concentration of gaseous pollutant	Subjective assessment	There are no exceedances of the NOx criteria for any of the alternatives and No Build in any of the horizon years. All alternatives as well as No Build are well below the NOx standards for 1 hour and 24 hour time periods. All alternatives show similar reductions relative to No Build.									
Overall Assessment			**Any impacts are generally limited to 50 m from ROW. All alternatives predict fewer exceedances relative to No Build and thus are preferred to No Build. NOx maximum concentrations are lowered significantly than No Build, however, the No Build option is also below the criteria. Differences between the alternatives are typically less than 10% even at 50 m from ROW and the difference is decreased by 100 m. There is therefore no significant differences between the alternatives.**									
1-High Impact 2-Medium Impact 3-Low Impact 4-Neutral/No Impact 5-Low Benefit 6-Medium Benefit 7-High Benefit			3	3	3	3	3	3	3	3	3	3

1. Do Nothing defined as no transportation improvements other than those already identified/approved
2. Year 2015 reflects effects upon opening of facility
3. Provinicial guideline for acceptable maximum 24-hr
4. Year 2025 reflects effects 10 years post construction
5. Year 2035 reflects effects at 30 year planning
6. Federal objective for acceptable average annual concentration of PM2.5 is < 15µg/m3

TABLE 5.2 - PLAZA AND CROSSINGS EVALUATION TABLE

PRACTICAL ALTERNATIVES EVALUATION

Factor: Changes in Air Quality

Segment = Crossing to Malden Rd

Performance Measure	Criteria/Indicator	Measurement/Units	Plaza A: From Crossing A	Plaza A: From Crossing B	Plaza A: From Crossing C via Ojibway Parkway	Plaza A: From Crossing C via Brighton Beach	Plaza B: From Crossing C	Plaza B1: From Crossing B	Plaza C: From Crossing C
Effect on changes in concentration of particulate matter	Change in concentration of $PM_{2.5}$ versus Do Nothing	Subjective assessment at identified receptors versus Do Nothing	In Armanda St. area, future No Build results in the lowest concentrations of all Alternatives, and Plaza A results in marginally higher PM2.5 concentrations than Plaza B due to proximity of Plaza A to Armanda St. Implementation of any Plaza Alternative results in increased concentrations over No Build. Crossing Alternatives have no impact on this area. In Sandwich, future No Build results in the lowest concentrations of all Alternatives, but there is essentially no difference between No Build and Plaza A/Plaza B/Plaza C Alternatives. Thus, Plaza alternatives have no impact in Sandwich. Crossing C results in the highest concentrations in Sandwich relative to all other Alternatives, but the increase is marginal.						
	Change in the number of 24 hr periods where in concentrations of $PM_{2.5}$ is > 30 µg/m^3 versus do nothing in 2015	Number expressed in terms of 50m from future property line	134	134	100	134	127	148	84
		100m	15	15	15	15	20	54	28
		250m	0	0	0	0	1	0	2
		Maximum concentration under Do Nothing at 50 m	204%	204%	192%	171%	250%	317%	200%
		Assessment of Results	Implementation of any of the Alternatives has a negative impact on Air Quality within 100 m of the Plaza and Crossing boundaries. Significant increases in maximum concentrations are predicted to occur within 100 m of the Plaza and Crossing boundaries versus No Build for all Plaza/Crossing combinations. Maximum concentrations are approximately two times higher than No Build within 50 m of the Plaza boundary. Maximum Plaza A concentrations and exceedances occur in the area bounded by Sandwich, EC Row, Healey, and Broadway. The differences between the Crossing alternatives for Plaza B are marginal. Maximum Plaza B and C concentrations and exceedances occur northwest of the exits of the Plazas in the industrial areas.						
	Change in the number of 24 hr periods where in concentrations of $PM_{2.5}$ is > 30 µg/m^3 versus Do Nothing in 2025	Number expressed in terms of distance intervals/offsets from roadway at 50m	156	156	122	156	167	177	97
		100m	36	36	36	35	35	77	59
		250m	1	1	2	2	3	8	6
		Maximum concentration under Do Nothing at 50 m	204%	204%	192%	184%	284%	348%	208%
		Assessment of Results	Implementation of any of the Alternatives has a negative impact on Air Quality within 100 m of the Plaza and Crossing boundaries. Significant increases in maximum concentrations are predicted to occur within 100 m of the Plaza and Crossing boundaries versus No Build for all Plaza/Crossing combinations. Maximum concentrations are approximately two times higher than No Build within 50 m of the Plaza boundary. Maximum Plaza A concentrations and exceedances occur in the area bounded by Sandwich, EC Row, Healey, and Broadway. The differences between the Crossing alternatives for Plaza B are marginal. Maximum Plaza B and C concentrations and exceedances occur northwest of the exits of the Plazas in the industrial areas.						
	Change in the number of 24 hr periods where in concentrations of $PM_{2.5}$ is > 30 µg/m^3 versus Do Nothing in 2035	Number expressed in terms of distance intervals/offsets from roadway at 50m	168	168	134	168	175	193	109
		100m	56	56	56	56	48	87	77
		250m	3	3	3	3	8	11	6
		Maximum concentration under Do Nothing at 50 m	221%	229%	204%	192%	300%	413%	217%
		Assessment of Results	Implementation of any of the Alternatives has a negative impact on Air Quality within 100 m of the Plaza and Crossing boundaries. Significant increases in maximum concentrations are predicted to occur within 100 m of the Plaza and Crossing boundaries versus No Build for all Plaza/Crossing combinations. Maximum concentrations are approximately two times higher than No Build within 50 m of the Plaza boundary. Maximum Plaza A concentrations and exceedances occur in the area bounded by Sandwich, EC Row, Healey, and Broadway. The differences between the Crossing alternatives for Plaza B are marginal. Maximum Plaza B and C concentrations and exceedances occur northwest of the exits of the Plazas in the industrial areas.						
	Does the average annual concentration of $PM_{2.5}$ exceeds 15 µg/m^3 in 2015	Yes/No 50m	Yes	Yes	Yes	Yes	Yes	Yes	No
		100m	No	No	No	No	No	No	No
		250m	No	No	No	No	No	No	No
		Assessment of Results	Average (typical) concentrations are predicted to be greater than the Reference Level at 50 m away from the Plaza Boundary for all Alternatives in 2015. Concentrations are less than the reference level at greater than 50 m from the property boundary.						
	Does the average annual concentration of $PM_{2.5}$ exceeds 15 µg/m^3 in 2025	Yes/No 50m	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		100m	No	No	No	No	No	No	No
		250m	No	No	No	No	No	No	No
		Assessment of Results	Average (typical) concentrations are predicted to be greater than the Reference Level at 50 m away from the Plaza Boundary for all Alternatives in 2025. Concentrations are less than the reference level at greater than 50 m from the property boundary.						
	Does the average annual concentration of $PM_{2.5}$ exceeds 15 µg/m^3 in 2035	Yes/No 50m	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		100m	No	No	No	No	Yes	Yes	No
		250m	No	No	No	No	No	No	No
		Assessment of Results	Average (typical) concentrations are predicted to be greater than the Reference Level at 50 m away from the Plaza Boundary for all Alternatives in 2035.						
	Summary of effect on concentration of particulate matter	Subjective assessment	Plaza A has more receptors in closer proximity to the Plaza boundary than other Alternatives, and the highest effects are seen within 50 - 100 m of the boundary. Crossing C may, under some circumstances, have an impact on the Sandwich area, however, model results do not predict notable differences between the Crossing and No Build scenarios.						
Effect on changes in concentration of gaseous pollutants	Change in concentration of NOx versus Do Nothing	Subjective Assessment based on changes at identified receptors versus Do Nothing	NOx concentrations in the vicinity of Armanda street are increased relative to No Build for all Plaza alternatives. Implementation of Plaza A results in higher NOx concentrations than other Plaza alternatives. Crossing Alternatives have no impact on Armanda St area. In Sandwich, future No Build results in the lowest NOx concentrations of all Alternatives. However, there is little to no difference between No Build and Plaza A/B Alternatives. Crossing A/B have little impact on NOx concentrations in Sandwich. Crossing C results in marginally higher NOx concentrations in Sandwich relative to other crossing Alternatives.						
	Change in the number of 24 hr periods where concentrations of NOx >400 µg/m^3 versus Do Nothing in 2015	Number expressed in terms of distance intervals/offsets from roadway at 50m	8	8	8	0	2	6	0
		100m	0	0	0	0	1	2	0
		250m	0	0	0	0	0	0	0
		Maximum concentration under Do Nothing at 50 m	344%	344%	344%	101%	522%	429%	123%
		Assessment of Results	Maximum predicted 1-hour NOx concentrations increase by 1 - 5X over future No Build within 50 m of the Plaza boundary for all Alternatives. There is an increase in the number of hours greater than the MOE AAQC for NOx relative to No Build at 50 m away from the Plaza boundary. Plaza A and Plaza B1 have the highest increases due to the combined effect of the Plaza and local roads. NOx concentrations are higher relative to No Build within 50 - 250 m of the roadway for all crossings. The impact of the crossings is limited to within 250 m of the bridge/roadway.						
	Change in the number of 24 hr periods where concentrations of NOx > 400 µg/m^3 versus Do Nothing in 2025	Number expressed in terms of distance intervals/offsets from roadway at 50m	14	14	14	0	7	18	0
		100m	1	1	1	0	1	7	0
		250m	0	0	0	0	0	0	0
		Maximum concentration under Do Nothing at 50 m	805%	805%	805%	131%	790%	750%	213%
		Assessment of Results	Maximum predicted 1-hour NOx concentrations increase by 1 - 8X over future No Build within 50 m of the Plaza boundary for all Alternatives. There is an increase in the number of hours greater than the MOE AAQC for NOx relative to No Build at 50 m away from the Plaza boundary. Plaza A and Plaza B1 have the highest increases due to the combined effect of the Plaza and local roads. NOx concentrations are higher relative to No Build within 50 - 250 m of the roadway for all crossings. The impact of the crossings is limited to within 250 m of the bridge/roadway.						
	Change in the number of 24 hr periods where concentrations of NOx > 400 µg/m^3 versus Do Nothing in 2035	Number expressed in terms of distance intervals/offsets from roadway at 50m	16	16	16	0	6	16	0
		100m	16	16	16	0	6	16	0
		250m	1	1	1	0	3	6	0
		Maximum concentration relative to Do Nothing at 50m	886%	886%	886%	136%	691%	774%	222%
		Assessment of Results	Maximum predicted 1-hour NOx concentrations increase by 1 - 8X over future No Build within 50 m of the Plaza boundary for all Alternatives. There is an increase in the number of hours greater than the MOE AAQC for NOx relative to No Build at 50 m away from the Plaza boundary. Plaza A and Plaza B1 have the highest increases due to the combined effect of the Plaza and local roads. NOx concentrations are higher relative to No Build within 50 - 250 m of the roadway for all crossings. The impact of the crossings is limited to within 250 m of the bridge/roadway.						
	Summary of effect on concentration of gaseous pollutant	Subjective assessment	Implementation of Plaza A or Plaza B1 Alternatives results in increases of short term NOx concentrations in close proximity (50 m) to the Plaza boundary, due to combined effect of the Plaza and nearby major roads such as EC Row and Ojibway Pkwy.						
Factor Summary:									
Factor Score:			2	2	2	2	2	2	2

1-High Impact   2-Medium Impact   3-Low Impact   4-Neutral/No Impact   5-Low Benefit   6-Medium Benefit   7-High Benefit

Notes:
1. Do Nothing defined as no transportation improvements other than those already identified/approved
2. Year 2015 reflects effects upon opening of facility
3. Provincial guideline for acceptable maximum 24-hr average PM2.5 concentration is <30µg/m3
4. Year 2025 reflects effects 10 years post construction
5. Year 2035 reflects effects at 30 year planning horizon
6. Health Canada objective for acceptable average annual concentration of PM2.5 is < 15µg/m3

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