Canada-United States-Ontario-Michigan
Border Transportation Partnership

Practical Alternatives Evaluation Working Paper - DRAFT

Noise and Vibration Assessment

July 2007

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 Protection of Community and Neighbourhood Characteristics factor and is one of several reports that will be 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).

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Executive Summary

This document provides an overview of the noise and vibration impact analyses completed to date as part of the Detroit River International Crossing (DRIC) Environmental Assessment.

Noise is generally described as unwanted sound. However, noise and sound are often used interchangeably. The unit used for measuring sound is the decibel (dB). To better reflect the response of human receptors to sounds measured by instruments, "*weighting scales*" are used. The "*A weighted scale*" is used to duplicate the human response to the audible frequency range. Sound levels so adjusted are referred to as "*A weighted decibels*" and assigned the unit abbreviation dBA.

Vibration is the movement of particles in time and space. Any moving disturbance produces vibration. Like sound, vibration travels in the form of waves from the source to the receiver. However, unlike sound, vibration requires the presence of a solid medium for its existence, transmission and perception. The vibration levels from a given source are established either through prediction or through measurements at a sensitive receptor location.

ASSESSING NOISE AND VIBRATION IMAPCTS

The Ontario Ministries of Transportation (MTO) and Environment (MOE) have developed a specific protocol for assessing noise impacts from transportation projects which must be applied to all transportation projects in the province. In general terms, the noise impact is determined by comparing the noise specifically caused by the project with the existing noise experienced by sensitive receptors in the vicinity of the project. Typically, where the project noise exceeds the background/existing noise levels by five or more decibels (dB), mitigation measures including sound barriers are to be considered for the project. However, additional mitigation may also be required in specific circumstances.

Vibration impact is usually evaluated in terms of human response to building vibration. It is generally accepted that 0.14 mm/sec is the threshold of vibration perception for the average person. As the vibration level increases from this threshold, the average person will become increasingly uncomfortable. At 50 mm/sec, vibrations are likely to cause structural damage to buildings.

HOW THE ANALYSIS WAS PERFORMED

The methodology for estimating noise levels consisted of the following key steps for evaluation of the proposed access roads, and plazas and crossings.

1. Traffic data were established for the base year (2006), as well as for future years (2015, 2025 and 2035), representing baseline conditions and conditions for each access road alternative. For each alternative, certain key information was determined, including Annual Average Daily Traffic (AADT), percentage of automobiles, percentage of heavy and medium trucks, speed limit, road elevation, local topography, surrounding ground conditions, etc.

2. Sensitive noise receptors along each access road alternative were identified. The receptors selected for assessment were those that were most potentially impacted (i.e. subject to frontline exposure) by the various alternatives. Multiple receptors were selected to capture the anticipated variations in exposure to noise from traffic based on the alignment of existing roads, the alignment of the Practical Alternatives, and variations in traffic volumes. On this basis, a total of 31 receptors were selected for access road alternatives.
3. Since each access road alternative, except for Alternative 3, has a total of two alignment options between St. Clair College and Howard Avenue, it should be noted that the noise impact on some receptors are assessed for both alignment options, depending on the receptor location, while other receptors are assessed for only a single alignment option. This two-route alignment was also considered when assessing the portion of the access road from Malden Road to Pulford Street along the proposed access road.
4. Baseline ("no-build") and project noise levels were estimated at each of the receptors identified for each access road alternative, using the MOE's STAMSON traffic noise model. This was performed for 2015, 2025, and 2035. The key inputs to the STAMSON noise model are: traffic volume, percentage of automobiles, percentage of heavy and medium trucks, posted speed limit, road gradient, road surface type, local topography, surrounding ground surface cover, noise source height, receptor height and source to receptor distance.
5. The impact of the plaza/crossing alternatives was assessed based on two groups of receptors; a total of 21 and 13 receptors were identified in Sandwich Towne (close to Crossing C) and areas between Ojibway Parkway to Malden Road (close to Plaza A), respectively.
6. The CADNA-A noise model was used to estimate receptor noise levels for each of the four plazas and corresponding crossing alternatives. This model can be used to predict noise levels from both stationary and mobile noise sources. The modelling approach considered vehicle queuing, idling and acceleration. The key inputs to this model included maximum hourly vehicular traffic (cars and trucks), plaza layout, vehicle sound levels, locations of vehicles at plaza sites.
7. For Alternative 3 (the Tunnel Option), sound levels emanating from surface roads, the tunnel portals and ventilation buildings were assessed. The sound levels from the surface roads were estimated using the MOE's STAMSON model. Noise from the ventilation building was assessed using the CADNA-A model.

The methodology used for estimating vibration from the DRIC project consisted of the following key steps:

1. Through consultations with other disciplines, an effort was made to identify areas and facilities in proximity to the practical crossing, plaza and access road alternatives that were potentially vulnerable to ground vibrations.
2. Receptors within the potentially vulnerable areas were identified for vibration monitoring.
3. Ground vibration levels were measured at two locations (side by side) at each of eight receptors. The traffic at each location was monitored over a period of 30 minutes. The monitoring was conducted over two different days to identify any differences in the vibration patterns. (Note: If traffic is busy, truck speed reduces considerably, thereby reducing the vibration signal).

PREDICTED NOISE AND VIBRATION IMPACTS

The following points summarize the noise and vibration impacts predicted at receptors locations along the DRIC project ROW:

1. In general, in comparison with at-grade alternatives (1A and 2A), the below-grade alternatives (1B and 2B) and tunnel (3) seem to generate lower noise levels at the receptor locations. Only alternatives 2B and 3 show no predicted noise impact in all route segments between Pulford Street to the existing highway 401. For all alternatives, some exceedances were observed between Malden Road to Pulford Street, with two receptors experiencing a high noise impact (> 10 dB exceedances above the no-build sound levels) for all three scenario years (2015, 2025, and 2035).
2. The minimum separation distances between the ventilation building and a sensitive noise receptor for Alternative 3 were based on the MOE sound level exclusion limits of 45 and 50 dBA for nighttime and daytime, respectively for urban areas. The ventilation noise is determined to be directional and, when unmitigated, the maximum separation distance estimated to meet the most stringent 45 dBA noise limit is 760 m.
3. The noise generated solely from the plaza locations is not expected to cause a high noise impact at the receptors closest to the plazas. In most cases, the receptors are more than 50 m (164 ft) away from the plazas. However, the noise modeling results show that a high noise impact (greater than 10 dB above no-build receptor sound levels) is predicted for some of the receptors in closest proximity to the and crossings and approach roadways to the crossings. The potentially affected receptors are located in the Ojibway Parkway to Malden Road area and are most affected with Plaza A in place and in Sandwich Towne with the Crossing C option. Noise mitigation for the crossing was considered using acoustic barriers.
4. Baseline vibration levels were measured in 2006 at eight locations, including areas close to a church and houses. All access road alternatives were reviewed to identify residences, hospitals and other potentially vulnerable receptors, within 25 m of the right-of-way (ROW) of all access road alternatives. The results showed for the most part that, the levels measured were within the threshold of perception limit of 0.14 mm/sec. These levels do not decay very much with distance at close proximities to the road edges and should the roadway contain an expansion joint, etc., these levels may increase to the threshold level of perception. Hence, as a precautionary measure, receptors within 25 m of the ROW were counted as potential locations where vibration levels could potentially reach the threshold value of 0.14 mm/sec.

MITIGATION MEASURES AND RESULTS

Mitigation measures were investigated for areas impacted by excessive changes in noise levels following the procedures outlined below:

1. <u>Analysis Procedures for Access Road:</u> Additional assessment was undertaken for noise sensitive receptors that showed more than 5 dB increase in project sound levels above the no-build sound levels. For each access road segment where such exceedances were predicted, the effect of a 5 m (16 ft) high noise barrier was used to estimate sound level reductions. In cases where multiple receptors exceeded no-build sound levels by more than 5 dB within a prescribed road segment (e.g., Mulden Road to Pulford Street), the mitigation calculation was only performed for the receptor with the highest estimated noise

exceedance in that road segment , or for a receptor in the area within the segment with the highest cluster of homes.

2. In all cases for receptor located in areas between Malden Road and North Talbot Road along the proposed access road, the proposed 5 m noise barrier on the proposed access road was effective in reducing the predicted project noise to within 5 dB of the estimated baseline noise levels, except for two receptors on Spring Garden Road along the proposed access road.
3. Silencers can be installed to mitigate noise from the ventilation building fans associated with the tunnel alternative.
4. Analysis procedures for Plazas/Crossings: For access road alternatives with connection to Plaza A, a 4 m high acoustic barrier was placed beginning at the exit of the plaza, and continuing along the crossing route. For alternatives involving Plazas B, B1, and C, a 5 m high acoustic barrier was modeled along the proposed access road leading to each of the plazas. The height of the acoustic barrier was limited to 4 m on all crossings.
5. The Plaza A to Crossing C Via Ojibway Parkway combination, is closest to the receptors in Sandwich Towne. This combination shows the highest potential for noise impact in the southern portion of Sandwich Towne. The area impacted is generally bound by Watkin Street and Essex Terminal Railway. The modelling results show that a 4 m high acoustic barrier in place on Crossing C is effective in reducing the project noise levels to within 5 dB of the no-build noise levels in the impacted area of Sandwich Towne.
6. Of all of the crossing and plaza combinations, crossings that connect to Plaza A produce the highest noise impact to receptors in the Ojibway Parkway to Malden Road area. The noise impact from traffic in Plaza A is minimal. The highest noise impact was predicted when the Plaza A and Crossing C via Brighton Beach combination is used. The project sound levels from crossings connected to Plaza A cannot sufficiently be reduced to within 5 dB of the no-build noise levels for the remnant residential properties in the Brighton Beach Industrial Park.
7. The installation of a 5 m high acoustic barrier along the segment of the proposed access road that leads to Plazas B, B1 and C is sufficient to mitigate noise levels for receptors in the Ojibway Parkway to Malden Road area for all access road alternatives involving these plazas.
8. The vibration measurements, for the most part, were within the threshold of perception limit of 0.14 mm/sec for all locations measured in the area of continued analysis.

Vibration

9. It is determined that vibration mitigation measures are not required for the crossings, plazas and access roads since vibration levels are not expected to approach 50 mm/sec which is the threshold for structural damage.

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CONCLUSIONS

Based on the noise and vibration analyses completed, the following key conclusions can be drawn:

1. Based on noise modelling results for the access road alternatives, both Alternatives 2B and 3 will result in the least occurrences of sound level exceedances greater than 5 dB above the no-build scenarios. After mitigation, the proposed project will result in no to marginal noise impact for all access road alternatives, except for the two receptor locations mentioned above. The noise level after mitigation at theses two receptor locations ranged from 5 to 7 dB above the no-build sound levels for the different access road alternatives in the worst-case year 2035.
2. The results show that with a 4 m high acoustic barrier installed on Crossing C the receptors in the south end of Sandwich Towne are likely to experience little to no noise impacts (less than 5 dB above the no-build sound level).
3. For crossing options connecting to Plaza B, B1 or C, a potential noise impact was identified for receptors in the Ojibway Parkway to Malden Road areas that are in the vicinity of the proposed access road. However, the receptor sound levels can be reduced to within 5 dB above the no-build sound levels with a 5 m high acoustic barrier installed on the proposed access road. However, for crossing options connection to Plaza A option, after mitigation, none to marginal noise impact was identified for two receptors in the Ojibway Parkway to Malden Road area that are in the vicinity of the proposed approach roadway leaving Plaza A to crossings.
4. None of the access road alternatives are expected to cause vibrations in the 50 mm/sec range; therefore, no structural damage is anticipated from vehicular traffic.
5. There are several route segments with receptors within 25 m of the ROW. As noted above, at this distance, there is a potential for receptors along the route to experience vibration levels near the threshold value of 0.14 mm/sec. The area with the highest number of receptors within 25 m is between Malden Road and Pulford Street. The area with the least number of receptors within 25 m is between North of Lennon Drain to Cousineau Road.

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Practical Alternatives

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1. DEFINE STUDY AREA OF INVESTIGATION

For the noise and vibration assessment, it is assumed that all houses located within the proposed right-of-way (ROW) of any alternative will be displaced by the project. Therefore, noise sensitive areas were only identified outside of the ROW for each access road alternative. For the areas outside of the proposed ROW, a minimum of one representative receptor location closest to the proposed ROW were selected for analysis. The receptors are located between 50 m and 300 m from the proposed access road, with several located within 15 m of the access roads

For the vibration assessment, areas within 25 m of the ROW and 50 m of the crossing and plaza options were defined as the area of investigation.

2. DATA COLLECTION

Data pertinent to noise and vibration included aerial photographs, GIS/AutoCad drawings of access road and crossings/plazas alternatives, traffic data, and road elevation and width. These data were collected from other project consultants. The traffic data collected included existing (year 2006) and future "build" and "no build" scenarios. The traffic data were used to estimate existing and future noise levels at receptors along practical access road alternatives. For the vibration assessment, measurements were carried out to provide baseline condition in 2006.

Noise sensitive areas/receptors were determined according to the Ontario Ministry of the Environment (MOE) definition of "noise sensitive land uses in publication LU-131 (Noise Assessment Criteria in Land Use Planning). The definition for noise sensitive land uses is as follows:

- Residential developments.
- Seasonal residential development.
- Hospitals, nursing/retirement homes, schools, day-care centers, etc.

The noise sensitive areas include both existing use, and lands zoned for future use. The above definition was further expanded to include three potential areas of religious significance for local First Nations.

Based on the current property fabric (tax roll data), site reconnaissance, and orthographic image, no sensitive receptors were identified near crossing A.

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3. DATA ANALYSIS

3.1 Overall Noise Assessment Methodology

The following outlines the key steps of the methodology used for estimating sound levels for the surface route alternatives (1A, 2A, 1B and 2B), as well as the surface roads (e.g., Howard Avenue) for Alternative 3 (tunnel option) and the plaza/crossing combinations.

1) Obtained traffic data from the traffic consultant to prepare traffic volume profiles for the base year (2006), as well as for future scenario years (2015, 2025 and 2035). The traffic data obtained for the future scenario years include data representing “no build”/baseline conditions and “build” conditions for each access road alternatives (i.e., 1A, 1B, 2A and 2B), plaza and crossing options. For each alternative, certain key information was determined, including Annual Average Daily Traffic (AADT), percentage of automobiles, percentage of heavy and medium trucks, posted speed limit, road elevation, local topography, surrounding ground conditions, etc.

2) Obtained information concerning roadway characteristics such as road/crossing elevation, road width, number of lanes, plaza layout and AutoCAD/GIS drawings of each crossing, plaza and access road alternatives from the lead engineering consultant. The distances from representative receptors to the closest roads were determined based on the review of aerial photographs and GIS drawings provided by the lead engineering consultant.

3) Identified closest sensitive noise receptors. The receptors selected for assessment were those determined to be potentially most likely to be impacted (i.e., subject to frontline exposure) by the various alternatives. Multiple receptors were selected to capture the anticipated variations in exposure to noise from traffic based on the alignment of existing roads, the alignment of the proposed alternatives, and variations in traffic volumes. As was stated previously, receptors within the ROW were not considered as it was determined that these receptors will be displaced by the project.

In some road segments, multiple receptors were selected to capture the anticipated variations in exposure to noise from traffic based on the alignment of existing roads, the alignment of the proposed access road alternatives, and potential variations in traffic volumes. On this basis, a total of 31 receptors closest to the access road alternative were selected (see Table 3.1 and Figures 3.1-1 to 3.1-6). The letter “A” shown on the figures denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas. Receptors 1A-S, 3A-S and 4A-S are the same locations as 1-S, 3-S and 4-S, respectively. Since each access road alternative, except for Alternative 3, has a total of two alignment options between St. Clair

College and Howard Avenue, it should be noted that the noise impact on some receptors are assessed for both alignment options, depending on the receptor location, while other receptors are assessed for only a single alignment option. This two-route alignment also occurs when assessing route segment G-H, from Malden Road to Pulford Street along the proposed access road: (1) connection to Plaza A, and (2) connection to other plazas. Overall, a total of 45 assessments were carried out for Alternative 1A and 1B, a total of 43 assessments were conducted for Alternative 2A and 2B, and a total of 36 assessments were conducted for Alternative 3. Therefore, the sound level exceedances discussed in Section 5 of this report pertain to the number of exceedance occurrences rather than the actual number of receptors.

TABLE 3.1 RECEPTOR SELECTIONS

Route Segment	Description	No. of Receptors South Side	No. of Receptors North Side
G – H	Malden Road to Pulford Street	7*	3
H – I	Pulford Street to North of Lennon Drain	4	3
I – J	North of Lennon Drain to Cousineau Road	2	1
J – K	Cousineau Road to Howard Avenue	3	3
K – L	Howard Avenue to Highway 401/Highway 3	1	2
L – M	Highway 401/Highway 3 to North Talbot Road	1	1
	Total	18	13

* In this segment, the same receptor locations are used for connections to Plaza A and other plazas; except for Receptor location 2. Receptor Locations G-H 2A and G-H 2 are separate locations and are therefore counted separately (see Figure 3.1-1).

4) Estimated sound levels for future "no build" and future "build" (i.e., with the proposed access road alternatives) scenarios for each alternative at each of the receptor locations identified for the three scenario years. Traffic sound levels for all access road alternatives were estimated using the Ontario Ministry of the Environment (MOE) approved computer modelling program, STAMSON noise model version 5.0. This model is receptor specific and estimates noise emissions from roadways based on traffic parameters.

In general, the policy of a 24-hr L_{eq} sound level is used for representing freeway noise because of the usual lack of traffic data to differentiate between daytime and nighttime noise conditions. This study is unique in that there is ample traffic data available which allows for differentiation in traffic volumes and composition (light, medium and heavy vehicles) for both daytime and nighttime. Further, through the public consultation process, the public has emphasized that there are recognizable differences between daytime and nighttime noise conditions. Based on these factors, it was determined that it would be prudent to differentiate between the daytime L_{eq} (16 hours) and nighttime L_{eq} (8 hours) noise conditions.

5) Estimated future "no build" and future "build" sound levels for each crossing and plaza alternatives. The CADNA_A noise model was used to estimate receptor sound levels from crossing traffic as well as from traffic at each of the four plaza

options. The outdoor noise propagation model is based on ISO 9613, Part 1: Calculation of the absorption of sound by the atmosphere, 1993 and Part 2: General method of calculation (ISO 9613-2:1996).

Given the complexity in modelling sound levels from the crossing/plaza alternatives as part of the DRIC Study, the preferred noise prediction method is to use a comprehensive model, in which, among other things, road curvature, road elevation and variable ground adsorption can be appropriately incorporated. Following are the key reasons for the use of the CADNA_A model, instead of the STAMSON model, in this special circumstance:

i. The crossing locations are greater than 500 m from some of the receptors of concern. STAMSON cannot be used for estimating noise levels beyond 500 m.

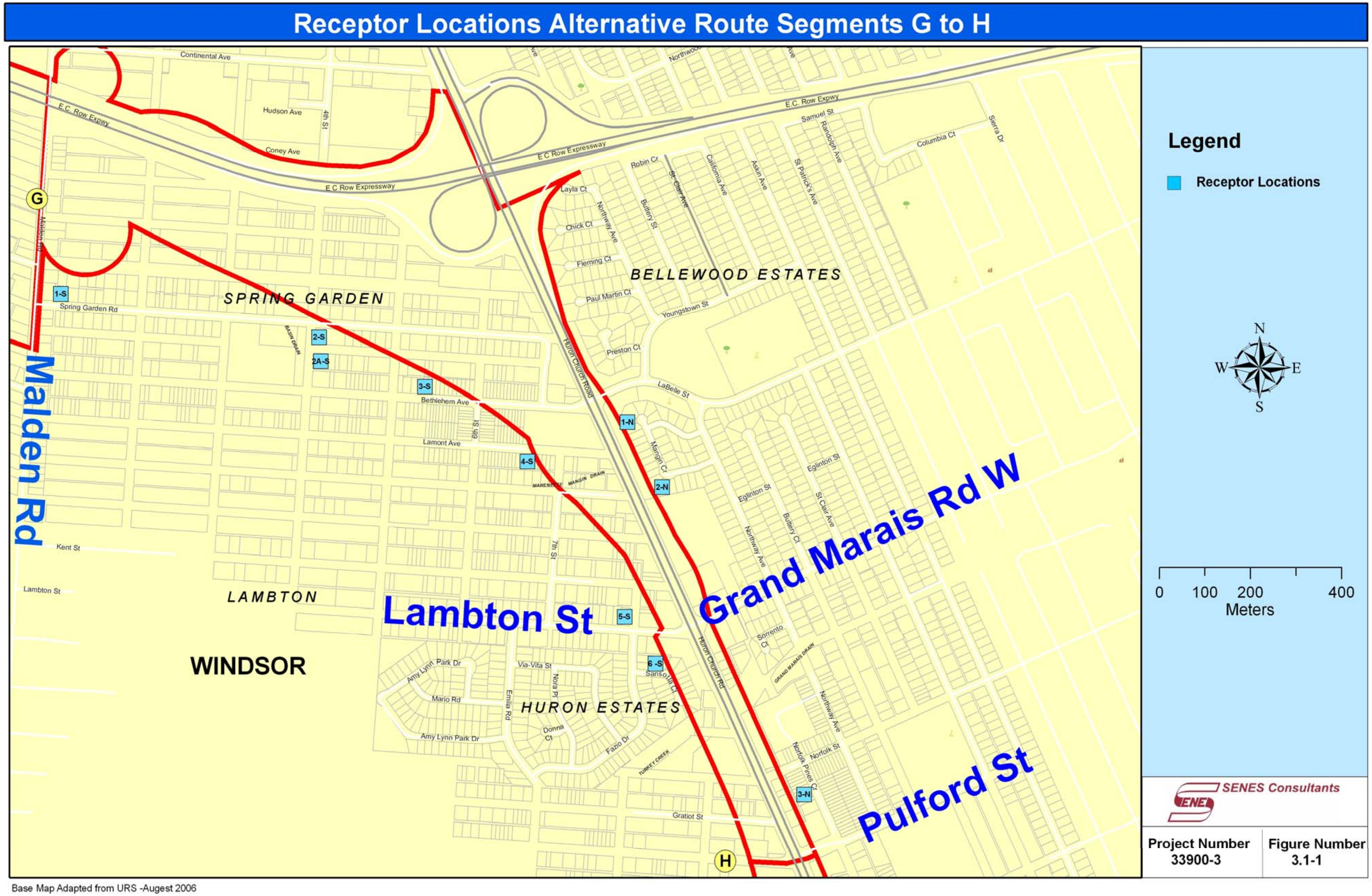
ii. The CADNA_A model is able to integrate the geometry and elevation of each crossing over its entire length, thus allowing for a predication of noise from the entire roadway. This is important in this instance, as the road profile varies from at grade elevation to 50 m at its maximum height. It also curves. The STAMSON model is best suited for estimating noise from a point source of traffic, along a straight line.

iii. The CADNA_A model could handle traffic queuing that occurs at the plaza locations, STAMSON is not well suited for this.

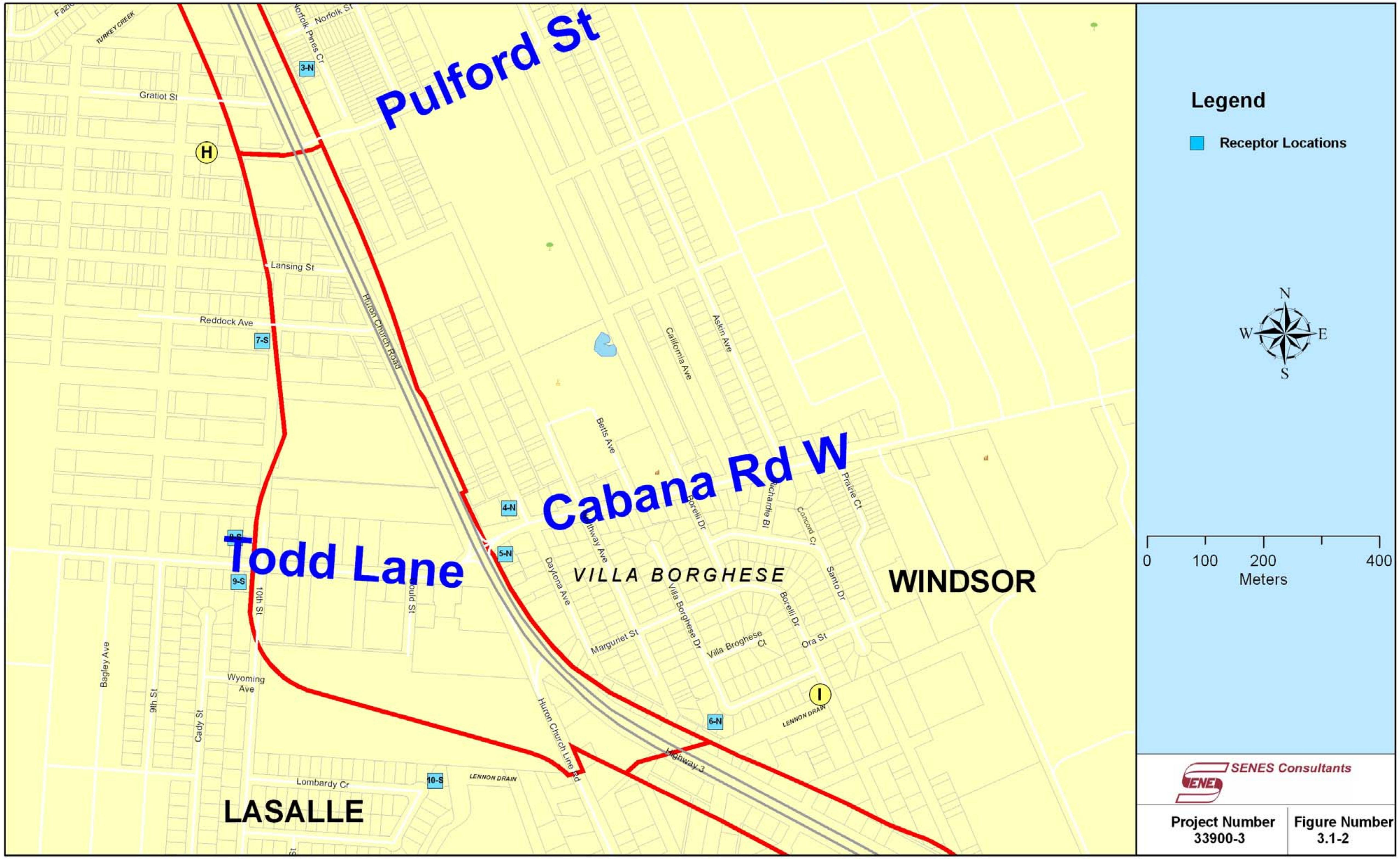
iv. The CADNA_A model could handle stop and go traffic noise, a situation that will occur at the plazas. STAMSON does not reasonably account for stop and go traffic.

v. The CADNA_A model can be used to model the road network of interest in the Sandwich Towne community, in the Ojibway Parkway to Malden Road area, the plazas and the crossings, simultaneously. This allows for a direct comparison of changes (or no changes) in the receptor sound levels.

6) Identified potential noise mitigation requirements. Noise mitigation is to be considered, where feasible, whenever the project sound levels exceed the receptor “no-build”/baseline sound levels by greater than 5 dB. For the present purpose, a maximum 5 m high noise barrier was used as the mitigating approach on the proposed access road in instances where receptor sound levels due to the project exceed the predicted “no-build” receptor sound levels by > 5dB.

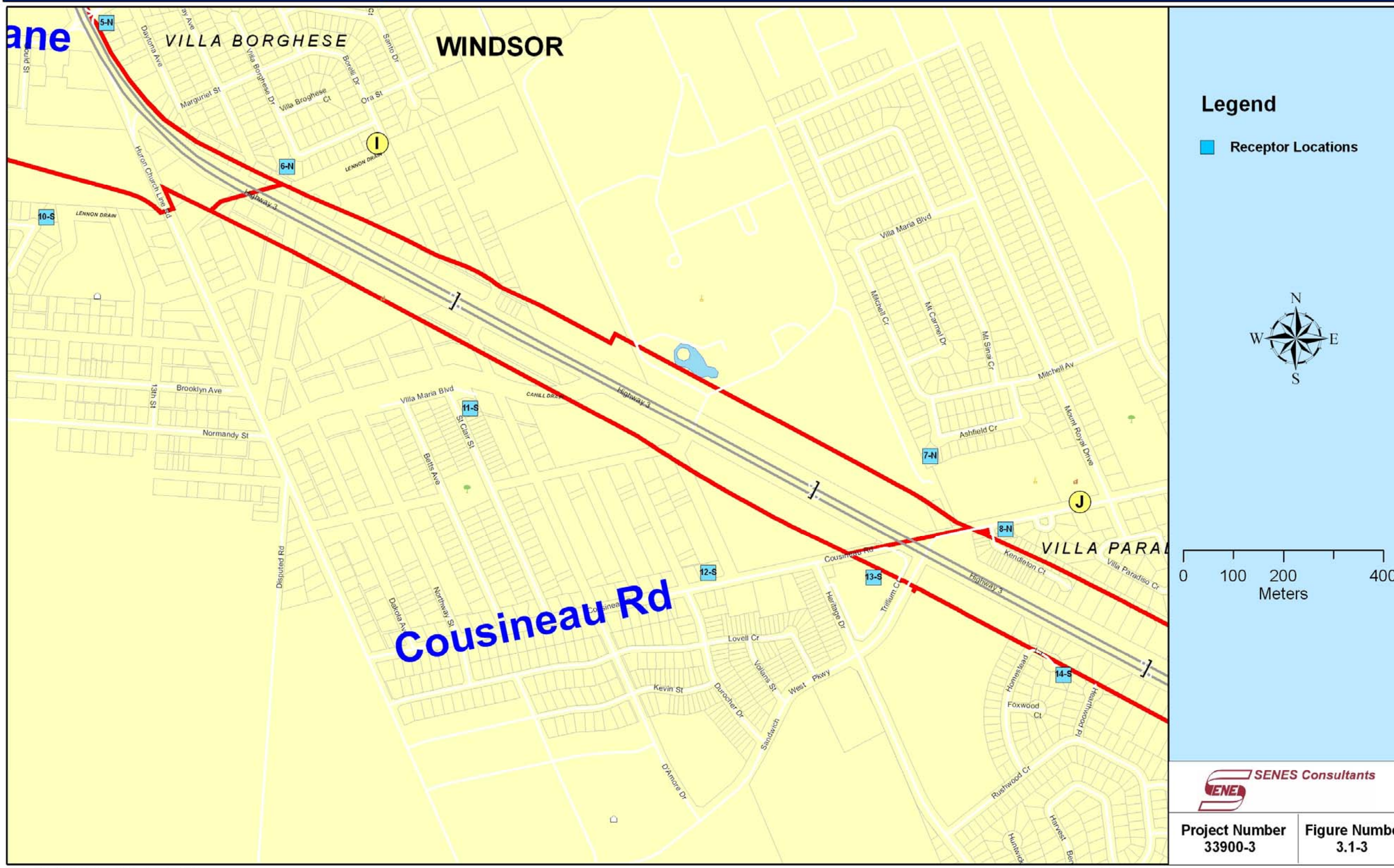

Receptor Locations Alternative Route Segments G to H
Legend
Receptor Locations
N
S
W
E
0
100
200
400
Meters
SENES Consultants
Project Number
33900-3
Figure Number
3.1-1
Malden Rd
Lambton St
Grand Marais Rd W
Pulford St
WINDSOR
SPRING GARDEN
BELLEWOOD ESTATES
LAMBTON
HURON ESTATES
G
H
1-S
2-S
2A-S
3-S
4-S
5-S
6 -S
1-N
2-N
3-N
E C Row Expressway
Continental Ave
Hudson Ave
Coney Ave
Spring Garden Rd
Bethlehem Ave
Lamont Ave
Kent St
Lambton St
Huron Church Road
Gratiot St
Base Map Adapted from URS -Augest 2006

Receptor Locations Alternative Route Segments H to I

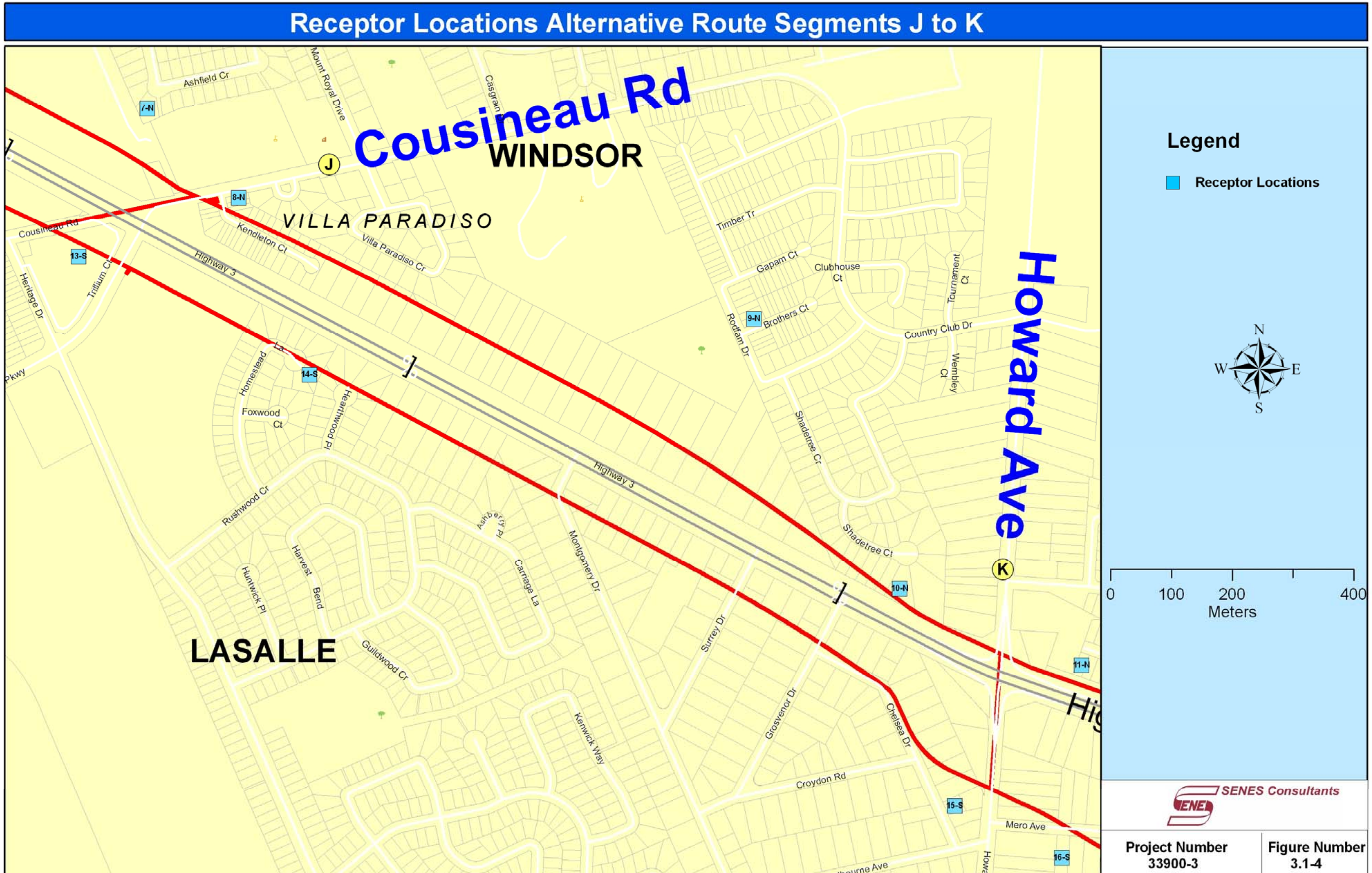


Base Map Adapted from URS -Augest 2006

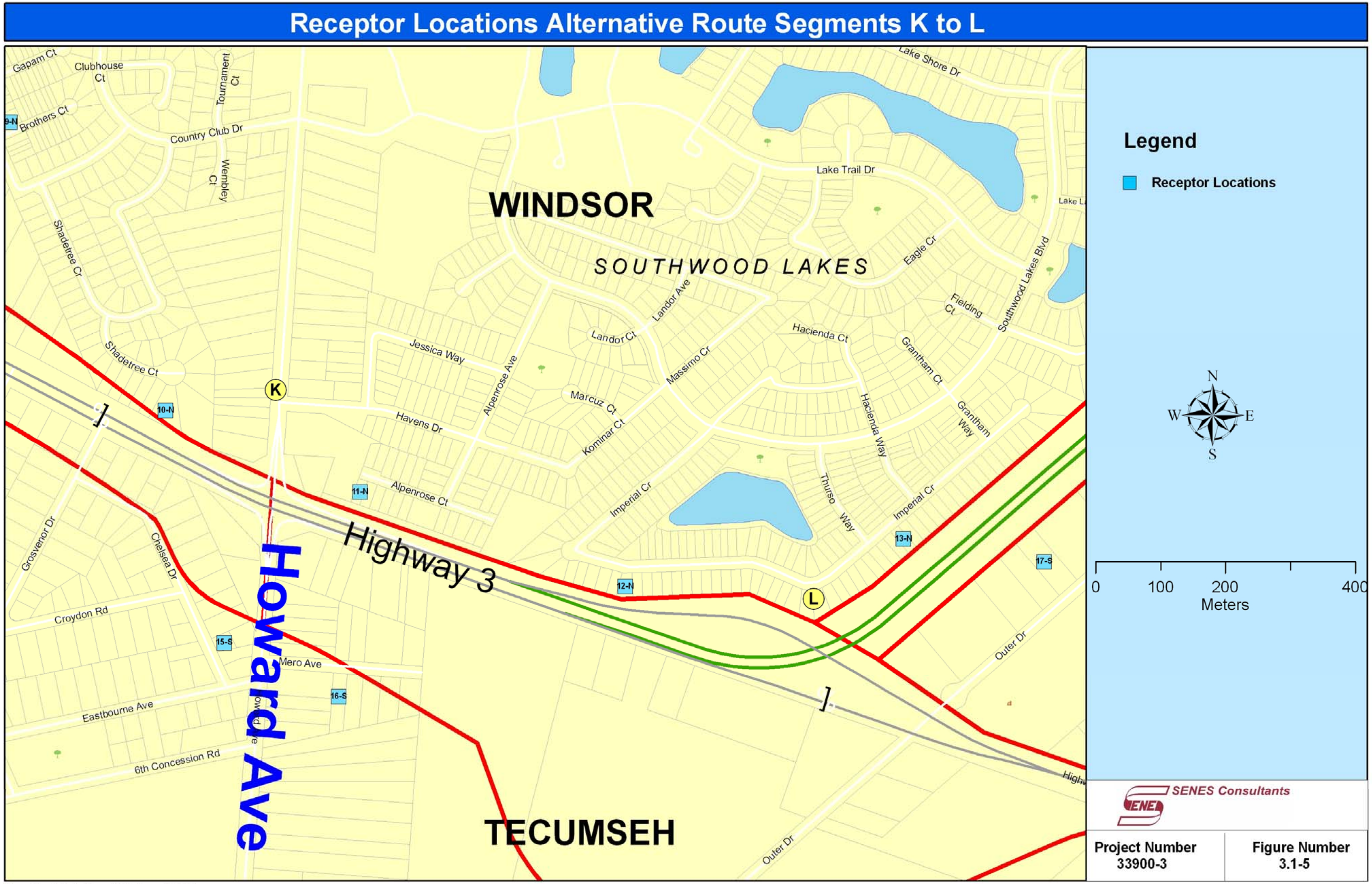
Receptor Locations Alternative Route Segments I to J



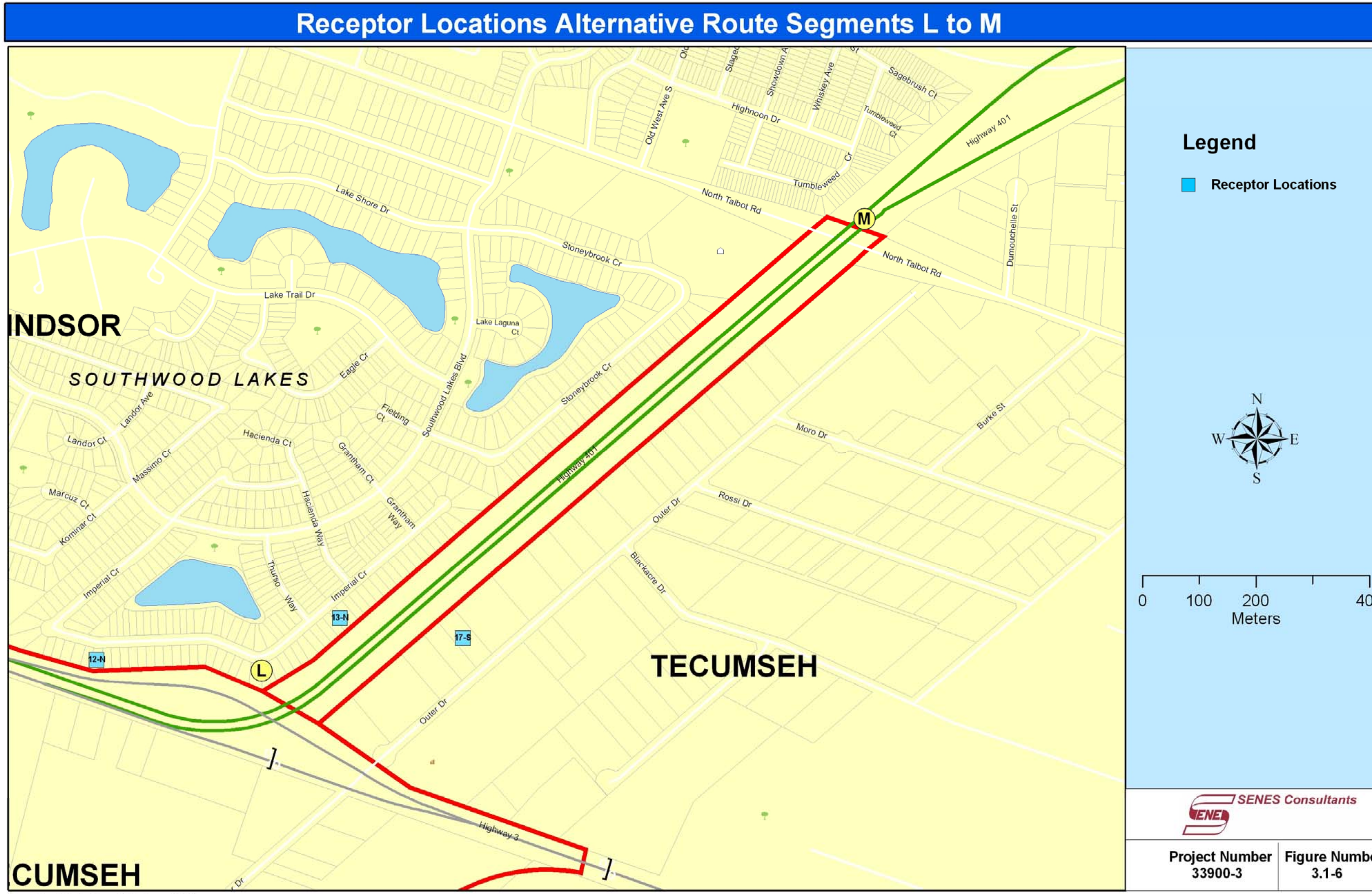
Base Map Adapted from URS -Augest 2006



Base Map Adapted from URS -Augest 2006



Base Map Adapted from URS -Augest 2006



Base Map Adapted from URS -Augest 2006

3.2 Vibration Assessment Methodology

The vibration assessment includes both field measurements to establish baseline vibration levels and an assessment of vibration impacts associated with the proposed practical routes.

The methodology for estimating vibration impacts consisted of the following key steps:

- Through consultations with other disciplines, locations potentially vulnerable to ground borne vibration were identified
- Receptors within the potentially vulnerable areas were identified for vibration monitoring.
- Ground vibration levels were measured at two locations (side by side) at each of eight representative receptors (see Figure 3.2-1). The traffic at each location was monitored over a period of 30 minutes. The monitoring was conducted over two different days to identify any differences in the vibration patterns. (Note: Under busy traffic conditions, truck speeds are reduced considerably, thereby reducing vibration levels).

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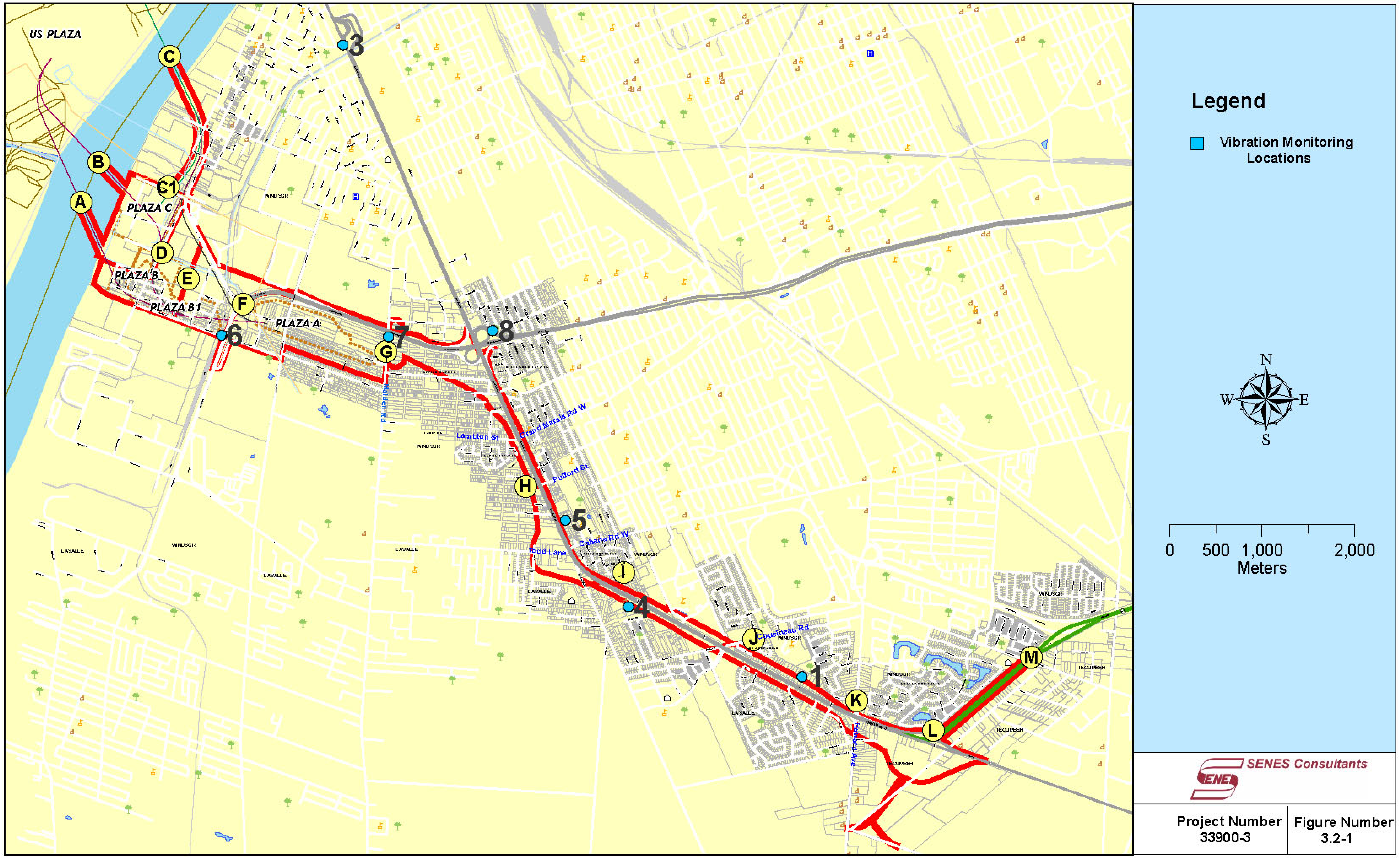
Vibration Monitoring Locations



Base Map Adapted from URS -Augest 2006

3.3 Traffic Noise Modelling Parameters for Surface Alternatives

STAMSON Model

The key inputs to the STAMSON noise model are noise source height, receptor height, source to receptor distance, road pavement (e.g., asphalt), surrounding ground conditions (e.g., reflective surface), and traffic parameters such as Annual Average Daily Traffic (AADT), percentage of heavy and medium trucks of total AADT volume, percentage of daytime (07:00 – 23:00) traffic volume, and posted speed limit. The model outputs the daytime and nighttime (23:00 – 07:00) sound levels in 16-hour L_{eq} and 8-hr L_{eq}, respectively. This definition of daytime and nighttime applies to all tables provided in this report.

The key traffic parameters used for modelling receptor noise levels for each access road alternative for the three scenario years are provided in Appendix A.

3.4 Traffic Noise Modelling Assumptions

The following key modelling assumptions were used in the prediction of noise levels for the practical access road alternatives:

- All source-to-receptor distances less than 15 m were assumed to be 15 m due to the limitations of the STAMSON model. This only occurred in a very few instances.
- A daytime receptor height of 1.5 m was used for all receptors. A nighttime receptor height of 1.5 m was used for bungalows and 4.5 m for two-storey dwellings (second story window).
- All major roads that intersect or run parallel to the proposed access roads and Highway 401 were considered in the traffic noise modelling.
- The outdoor living area (OLA) as defined in LU-131 was used for determining the daytime source-to-receptor distances. In all cases, the OLA was assumed to be located in the backyard of residences, 3 m from the building façade. To estimate nighttime sound levels, the receptor was assumed to be located at the main floor and a second storey window of the house for single storey homes and two-storey houses, respectively.
- Existing backyard fences at receptor locations that were identified by aerial photographs and confirmed by on-site surveillance were included in the noise

modelling as having a noise attenuating effect. However, the actual acoustic quality of these existing fences was not verified.

- The intermediate ground surface (i.e., the surface between the road and receptor) was considered absorptive in cases where the OLA is situated on deep grass-covered lots and/or when more than 50% of the surface between the road and receptor location is grass-covered.

3.5 Noise Assessment Methodology for Tunnel Portal and Ventilation Buildings

The noise associated with surface access road alternatives for the tunnel option was modelled using the methodology for surface alternatives as described in Section 3.1.1. Thus, the key remaining noise sources associated with the tunnel option are the tunnel portals and ventilation buildings.

The sound levels generated from traffic entering and exiting both ends of a tunnel are amplified by what is known as a "reverberation effect" or "portal effect". To develop an appropriate methodology to determine the increase in traffic noise at the tunnel portal due to reverberation, a literature review was conducted. One such study recently completed for the Eastlink – Mitcham Frankston Project in Australia by Graeme E. Harding & Associates indicated that the tunnel structure reduces traffic noise. In other words, the noise reverberation due to the tunnel was not considered to have a noticeable impact on the receptor noise levels, when compared to the reduction in traffic noise due to the tunnel.

In another study, the U.S. Transportation Research Board (TRB) undertook field research to determine the increase in noise levels immediately outside of a tunnel portal. The abstract of this study, pointing out its key findings, is provided below:

> *"The purpose of the study was to determine how the increase in noise due to reverberations in a tunnel affects noise levels immediately outside a tunnel. An array of sound-level meters measured the traffic noise simultaneously at various locations near a tunnel portal. The results are given in terms of the statistical noise descriptors L10, L50, and L90. Graphic plots of distance from the tunnel portal versus decibel level are presented. Measurements were taken on top and in front of the tunnel portal. The results indicate that for measurement sites on top of the tunnel, the drop-off in sound level is very abrupt and at 30 to 40 ft (9 to 12 m) behind the portal the traffic noise has diminished to the ambient noise levels of the surrounding area. For sites in front of the tunnel portal, the drop-off rate is less abrupt than that for the sites on top but was still rapid*

> *and reaches normal free-field traffic noise levels at 60 to 70 ft (18 to 21 m) from the portal." (O'Connor, 1989).*

This study clearly indicates that although the reverberation effect exists, however, this effect is localized and diminishes rapidly with distance.

In order to estimate the increase in traffic noise in areas immediately outside of the tunnel portal, SENES conducted its own study. The methodology applied for the study is summarized below:

- SENES conducted noise monitoring at the Welland Canal in Thorold, Ontario.
- The traffic noise was measured for a period of 1.5 hours (part of which was during the morning rush hour) by setting up noise meters near the portal of the tunnel, at approximately 15m from the edge of the roadway. The data logging interval was set at 1 minute.
- Traffic counts were conducted simultaneously with the noise measurements and the percentage of truck traffic was noted.
- The STAMSON traffic noise model was used to estimate the noise levels associated with the traffic count. Two road segments were assumed (i.e., northbound and southbound), with the receptor location being the measurement point (~15m from the edge of the road). Based on site observations, a 50/50 split was applied for medium and heavy trucks. The traffic data was extrapolated for the 16-hour daytime for use in the STAMSON noise model. This modelling predicted the traffic noise excluding the tunnel effect.
- The model predicted sound levels were compared against the arithmetic mean of the measured sound pressure levels. The differences observed were considered to be the "tunnel effect".

3.6 Noise Assessment Methodology for Plazas and Crossings using CADNA_A

As was noted earlier, the CADNA_A noise model was used to estimate receptor noise levels for each of the four plaza and corresponding crossing alternatives. This model is capable of incorporating source and receptor elevations, ground topography, ground adsorption, reflection order, as well as calculating cumulative impact from multiple noise sources.

For the purposes of this study, the following approaches were taken for modelling the four plazas and the corresponding crossing alternatives:

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- Geo-referenced AutoCAD drawings of the proposed plazas and corresponding crossing alternative were used in the noise modelling.
- Dominant noise sources associated with the plaza locations consisted of idling cars, idling trucks and accelerating trucks. The change in sound power levels between an idling car and a car gradually accelerating was considered to be negligible.
- To estimate conservatively high noise levels for the "build" alternatives, the maximum hourly vehicle traffic to and from the plazas were considered in the assessment.
- The maximum numbers of cars entering the plaza from the U.S., and the maximum number of vehicles that can be processed through the inspection booths were used to estimate traffic queuing inside the plaza areas.
- A logical network of roadways within the plaza were considered for the vehicle queuing. Where required, the queued traffic extended onto the crossing to accommodate calculated maximum number of vehicles in the queue.
- Queued traffic was modelled as stationary point sources, considering a continuous in-flow of vehicles to the plaza, at the maximum hourly rate.
- For trucks leaving the inspection booths (i.e., entering Canada), two noise sources were modelled: one to represent idling conditions; and the other to represent truck acceleration noise.
- Crossings were modelled based on the 24-hour traffic split (day/night) for vehicles leaving the inspection plazas and those entering the inspection plazas.
- The height of the crossings was incorporated into the noise modelling (i.e., elevated noise source). The elevations were based on the conceptual designs of the bridges, with the maximum elevation being at the mid-point of the Detroit River, at a height of 50m above the ground/water surface.
- For the crossings, a posted speed of 60 km/h was applied for both cars and trucks.
- The road surface of the crossings was assumed to be concrete.
- To ensure that the ambient no build sound levels were accurately predicted for comparison with the project sound levels, only traffic volumes from roads in the immediate vicinity of the receptors were used in the modelling. On this basis, two main groups of receptors were selected, 21 in Sandwich Towne and up to 13 in the Ojibway Parkway to Malden Road area. The number of receptors in the Ojibway Parkway to Malden Road area varies depending on the plaza/crossing combination, as some receptors are expected to be displaced by the proposed project.
- Sound levels were predicted at the selected receptors, by incorporating traffic parameters for relevant local roads along with those for the crossings and plazas.
- The CADNA_A modelling yields conservatively high receptor noise levels for the plaza/crossing alternatives as it does not include the potential noise attenuation

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provided by existing buildings between the plaza/crossing and the closest receptors.

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4. Predicted Sound Levels

The sound levels predicted using the MOE STAMSON model are presented in this section. The noise impact of the proposed project is discussed in Section 5.

4.1 Baseline Noise Level in Year 2006

Table 4.1 shows the predicted base year (2006) and future "no-build"/baseline sound levels for the three scenario years of 2015, 2025 and 2035. The results show that the sound levels predicted at the receptors for the base year are generally high, >55 dBA, during both daytime and nighttime hours. In fact, the model predicted daytime sound levels of 55 dBA, or higher, at all 32 receptors. The daytime sound levels are predicted to range from a low of approximately 55 dBA to a high of approximately 79 dBA. The nighttime sound levels are predicted to range from a low of approximately 51 dBA to a high of approximately 74 dBA. These sound levels reflect the predicted high traffic volume on the major roads within the study area and the relatively high percentage of truck traffic on a number of these roads.

Overall, sound levels for the base year and future baseline years are predicted to be lowest at receptor 9-S on the south side of the route segment extending along the proposed access road from Malden Road to Pulford Street. The corresponding highest sound levels are predicted for receptor 5-N on the north side of the route segment extending along the proposed access road from Pulford Street to North Lennon Drain.

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TABLE 4.1 PREDICTED BASELINE SOUND LEVELS (dBA) AND WITH "NO-BUILD" SCENARIOS FOR ALL THREE SCENARIO YEARS

Route Segment	Receptor No.	Map ID	2006		2015		2025		2035	
			Day	Night	Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road										
GH	R1	1-S	63.0	55.8	64.3	57.2	64.9	57.9	67.0	60.1
GH	R2	2-S	56.2	52.2	57.2	53.5	57.8	54.4	58.4	55.2
GH	R3	3-S	56.6	53.4	57.9	55.1	58.7	56.0	59.4	56.9
GH	R4	4-S	59.3	56.7	60.8	58.4	61.6	59.4	62.4	60.3
G-H	R5	5-S	63.2	60.9	64.5	62.3	65.3	63.1	66.0	63.9
G-H	R6	6-S	60.6	66.8	61.9	68.2	62.6	69.1	63.3	70.0
H-I	R1	7-S	59.4	56.7	60.7	58.2	61.5	59.1	62.2	59.9
H-I	R2	8-S	59.1	54.9	60.0	56.0	60.5	56.7	61.0	57.3
H-I	R3	9-S	56.5	52.5	57.5	53.8	58.1	54.5	58.6	55.1
H-I	R4	10-S	56.9	54.4	58.5	56.5	59.5	57.6	60.3	58.7
I-J	R1	11-S	60.4	57.7	62.0	59.7	62.9	60.8	63.7	61.9
I-J	R2	12-S	61.2	57.7	62.4	59.4	63.1	60.4	63.6	61.3
J-K	R1	13-S	71.5	67.5	73.0	69.5	73.8	70.6	74.5	71.5
J-K	R2	14-S	65.2	61.9	66.8	63.9	67.7	65.0	68.5	66.0
J-K	R3	15-S	59.2	55.4	60.3	57.1	61.0	58.0	61.7	58.9
K-L	R1	16-S	66.3	62.5	67.2	63.6	68.0	64.6	68.6	65.3
L-M	R1	17-S	62.5	62.1	63.3	63.1	64.4	63.9	65.0	64.6
F-G	R1	1	58.6	51.1	59.2	51.9	59.6	52.4	60.0	52.8
F-G	R2	2	60.3	55.1	61.5	56.6	62.2	57.4	64.2	59.6
Receptors on the North Side of the Proposed Access Road										
GH	R1	1-N	55.5	63.4	57.0	65.0	57.9	66.1	58.7	67.0
GH	R2	2-N	55.5	60.7	57.0	64.4	57.9	65.4	58.6	66.3
GH	R3	3-N	72.8	68.8	74.1	70.2	74.9	71.1	75.5	72.0
H-I	R1	4-N	66.4	63.4	67.5	64.9	68.3	65.7	68.9	66.5
H-I	R2	5-N	75.8	71.0	77.2	72.7	78.0	73.5	78.7	74.3
H-I	R3	6-N	71.9	68.0	73.5	70.0	74.4	71.2	75.2	72.2
I-J	R1	7-N	60.5	57.6	62.2	59.8	63.1	61.0	64.0	62.1
J-K	R1	8-N	69.9	66.4	71.4	68.4	72.3	69.5	73.0	70.4
J-K	R2	9-N	54.8	52.7	56.4	54.8	57.3	55.9	58.0	56.8
J-K	R3	10-N	61.7	61.2	63.2	63.1	64.0	64.1	64.7	65.0
K-L	R1	11-N	65.4	68.5	66.3	69.7	67.1	70.6	67.8	71.4
K-L	R2	12-N	64.2	67.8	65.2	69.0	66.0	70.0	66.7	70.7
L-M	R1	13-N	60.7	65.6	61.4	66.5	62.5	67.3	63.1	68.0

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4.2 Alternative 1A

Table 4.2 shows the predicted receptor sound levels associated with Alternative 1A for the three scenario years. The table shows that the predicted daytime sound levels for this alternative range from a low of approximately 54 dBA at receptor 7-N located on the north side of the I-J route segment along the proposed access road from north of Lennon Drain to Cousineau Road, to a high of approximately 79 dBA at receptor 1 on the south side of the F-G route segment extending along the proposed access road from Matchette Road to Malden Road. Nighttime sound levels range from a low of approximately 50 dBA at receptor 7-N located on the north side of the I-J route segment along the proposed access road from north of Lennon Drain to Cousineau Road to a high of approximately 77 dBA at receptor 1 on the south side of the F-G route segment extending along the proposed access road from Matchette Road to Malden Road.

TABLE 4.2 PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 1A

Route Segment	Map ID	Stamson ID	Alternative 1A - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	67.9	64.9	69.6	67.1	69.7	67.7
GH	1-S	R1	65.7	63.7	67.0	65.3	67.9	66.6
GH	2A-S	R2-A	72.7	71.2	73.8	72.8	74.9	74.1
GH	2-S	R2	63.5	61.5	64.7	63.3	65.7	64.4
GH	3A-S	R3-A	60.7	58.1	61.9	59.6	62.8	60.7
GH	3-S	R3	57.6	54.5	58.8	55.8	59.3	56.7
GH	4A-S	R4-A	64.3	61.2	64.7	61.2	65.5	62.1
GH	4-S	R4	64.1	60.8	64.5	60.7	65.2	61.6
G-H	5-S	R5	67.1	64.1	68.3	65.7	69.2	66.6
G-H	6-S	R6	65.0	70.5	66.3	72.1	67.1	73.1
H-I	7-S	R1	64.4	60.3	65.7	61.9	66.6	62.9
H-I	8-S	R2	58.1	53.4	58.5	54.1	58.9	54.6
H-I	9-S	R3	55.7	51.2	56.2	52.1	56.7	52.7
H-I	10-S	R4	56.1	51.2	55.7	52.6	58.5	54.0
I-J Option 1	11-S	R1_1	62.7	59.3	64.2	61.2	65.1	62.3
I-J Option 2	11-S	R1_2	62.9	59.5	64.4	61.4	65.3	62.4
I-J Option 1	12-S	R2_1	57.3	53.2	58.0	54.0	58.7	54.9
I-J Option 2	12-S	R2_2	57.7	53.7	58.2	54.5	59.2	55.5

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TABLE 4.2(CONT'D) PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 1A

Route Segment	Map ID	Stamson ID	Alternative 1A - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
J-K Option 1	13-S	R1_1	63.3	57.2	64.0	58.4	64.7	59.3
J-K Option 2	13-S	R1_2	66.1	60.2	66.8	61.4	67.5	62.3
J-K Option 1	14-S	R2_1	68.1	64.9	69.4	66.4	70.3	67.4
J-K Option 2	14-S	R2_2	72.5	68.9	73.8	70.4	74.7	71.3
J-K Option 1	15-S	R3_1	60.1	53.8	60.9	55.0	61.5	55.7
J-K Option 2	15-S	R3_2	60.7	54.2	61.0	55.1	61.6	55.9
K-L	16-S	R1	66.7	63.6	67.8	65.2	68.6	66.0
L-M	17-S	R1	67.2	64.2	68.4	65.4	68.6	68.2
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	57.4	58.0	59.1	64.2	59.5	59.6
GH	1-N	R1	57.5	58.2	58.6	58.8	59.5	59.8
GH	2A-N	R2-A	60.0	57.1	61.0	58.5	62.0	59.6
GH	2-N	R2	60.3	57.5	61.4	59.0	62.4	60.1
GH	3-N	R3	76.3	71.8	77.4	73.5	78.3	74.5
H-I	4-N	R1	62.0	55.7	62.7	56.9	63.4	57.7
H-I	5-N	R2	62.8	57.7	63.5	58.9	64.8	60.1
H-I	6-N	R3	75.5	71.0	76.7	72.6	77.6	73.6
I-J	7-N	R1_1	55.1	51.1	56.2	52.9	57.0	53.9
I-J	7-N	R1_2	53.5	49.7	54.7	51.5	55.6	52.5
J-K Option 1	8-N	R1_1	63.7	58.3	64.2	59.4	64.8	60.2
J-K Option 2	8-N	R1_2	62.8	56.8	63.2	57.8	63.7	58.6
J-K Option 1	9-N	R2_1	59.4	57.3	60.7	58.8	61.5	59.7
J-K Option 2	9-N	R2_2	58.6	56.5	60.2	58.3	60.7	58.9
J-K Option 1	10-N	R3_1	68.5	65.0	70.0	66.7	70.9	67.6

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TABLE 4.2 (CONT'D) PREDICTED SOUND LEVELS (DBA) FOR ALTERNATIVE 1A

Route Segment	Map ID	Stamson ID	Alternative 1A - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
J-K Option 2	10-N	R3_2	68.1	64.6	69.5	66.2	70.4	67.2
K-L Option 1	11-N	R1_1	63.1	60.1	64.6	61.8	65.4	62.7
K-L Option 2	12-N	R2	62.6	66.3	64.1	68.2	65.1	69.2
L-M	13-N	R1	65.5	67.7	66.7	68.9	67.5	69.8

Note: The letter "A" shown on the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas.

4.3 Alternative 1B

Table 4.3 shows the predicted receptor sound levels associated with Alternative 1B for the three scenario years. The table shows that the predicted daytime sound levels for this alternative range from a low of approximately 51 dBA at receptor 9-N located on the north side of the J-K route segment along the proposed access road between Cousineau Road and Howard Avenue, to a high of approximately 77 dBA at receptor 1 on the south side of the F-G route segment extending along the proposed access road from Matchette Road to Malden Road. Nighttime sound levels range from a low of approximately 48 dBA at receptor 9-N located on the north side of the J-K route segment along the proposed access road between Cousineau Road and Howard Avenue, to a high of approximately 74 dBA at receptor 1 on the south side of the F-G route segment extending along the proposed access road from Matchette Road to Malden Road.

TABLE 4.3 PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 1B

Route Segment	Map ID	Stamson ID	Alternative 1B - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	67.1	63.5	67.9	65.1	68.6	66.3
GH	1-S	R1	64.2	61.8	65.4	63.7	66.3	65.0
GH	2A-S	R2-A	69.8	68.4	71.1	70.3	72.2	71.6
GH	2-S	R2	63.5	61.4	64.7	63.3	65.7	64.6
GH	3A-S	R3-A	60.9	58.1	62.0	59.8	62.9	60.9

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TABLE 4.3(CONT'D) PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 1B

Route Segment	Map ID	Stamson ID	Alternative 1B - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	3-S	R3	57.7	54.7	58.7	56.0	59.4	56.9
GH	4A-S	R4-A	66.8	64.8	67.4	65.4	67.8	65.6
GH	4-S	R4	64.8	61.8	65.4	62.4	65.8	62.7
G-H	5-S	R5	56.9	53.4	58.5	55.8	59.3	56.4
G-H	6-S	R6	57.4	54.3	58.6	55.6	59.4	56.3
H-I	7-S	R1	56.0	51.7	57.0	53.0	57.8	53.8
H-I	8-S	R2	58.6	53.4	59.4	54.4	60.0	55.1
H-I	9-S	R3	56.1	51.3	57.0	52.4	57.6	53.1
H-I	10-S	R4	52.8	48.7	53.7	50.0	54.4	50.8
I-J Option 1	11-S	R1_1	54.5	51.1	55.7	52.6	56.5	53.5
I-J Option 2	11-S	R1_2	54.6	51.2	55.8	52.7	56.6	53.6
I-J Option 1	12-S	R2_1	57.5	53.1	57.6	53.5	58.3	54.3
I-J Option 2	12-S	R2_2	57.3	53.2	58.1	54.2	58.8	55.0
J-K Option 1	13-S	R1_1	63.2	57.4	64.1	58.6	64.8	59.4
J-K Option 2	13-S	R1_2	66.3	60.6	67.1	61.8	67.9	62.7
J-K Option 1	14-S	R2_1	59.1	56.1	60.3	57.5	61.2	58.3
J-K Option 2	14-S	R2_2	63.7	60.6	64.8	61.4	65.6	62.2
J-K Option 1	15-S	R3_1	60.6	54.6	61.4	55.8	62.1	56.6
J-K Option 2	15-S	R3_2	60.8	54.8	61.6	56.0	62.2	56.7
K-L	16-S	R1	66.7	63.9	67.8	65.2	68.6	66.1
L-M	17-S	R1	67.1	64.1	68.3	65.4	69.2	66.3

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TABLE 4.3(CONT'D) PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 1B

Route Segment	Map ID	Stamson ID	Alternative 1B - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	57.9	58.9	59.2	60.0	60.1	60.7
GH	1-N	R1	58.0	59.1	59.2	60.2	60.2	60.9
GH	2A-N	R2-A	60.4	57.5	61.6	59.2	62.5	60.3
GH	2-N	R2	60.9	57.9	62.0	59.7	63.0	60.8
GH	3-N	R3	59.6	55.9	60.6	57.1	61.4	57.9
H-I	4-N	R1	61.7	56.0	62.5	57.2	63.2	58.0
H-I	5-N	R2	63.6	59.0	64.3	60.1	64.9	60.8
H-I	6-N	R3	62.8	57.6	63.8	58.9	64.5	59.8
I-J	7-N	R1_1	55.2	51.5	56.4	53.1	57.2	54.0
I-J	7-N	R1_2	53.7	50.1	54.9	51.8	55.7	52.7
J-K Option 1	8-N	R1_1	64.4	59.6	65.0	60.7	65.6	61.5
J-K Option 2	8-N	R1_2	63.4	58.0	63.9	59.0	64.5	59.8
J-K Option 1	9-N	R2_1	51.2	55.5	52.4	50.3	53.2	57.8
J-K Option 2	9-N	R2_2	50.6	48.4	51.8	49.8	52.6	50.6
J-K Option 1	10-N	R3_1	59.8	56.4	61.1	57.7	61.9	58.5
J-K Option 2	10-N	R3_2	59.4	55.9	60.6	57.3	61.5	58.1
K-L Option 1	11-N	R1_1	63.2	60.5	64.6	61.8	65.5	62.7
K-L Option 2	12-N	R2	62.8	66.7	64.1	68.2	65.1	69.2
L-M	13-N	R1	65.5	67.6	66.7	68.9	67.5	69.8

Note: The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas.

4.4 Alternative 2A

Table 4.4 shows the predicted receptor sound levels associated with Alternative 2A for the three scenario years. The table shows that the predicted daytime sound levels for this alternative range from a low of approximately 53 dBA at receptor 10-S located on the south side of the H-I route segment extending along the proposed access road from Pulford Street to North of Lenon Drain, to a high of approximately 79 dBA at receptor 6-S located on the south side of the G-H route segment along the proposed access road from Malden Road to Pulford Street. Nighttime sound levels range from a low of approximately 48 dBA at receptor 10-S located on the south side of the H-I route segment extending along the proposed access road from Pulford Street to North of Lenon Drain, to a high of approximately 75 dBA at receptor 6-S south side of the G-H route segment along the proposed access road from Malden Road to Pulford Street.

TABLE 4.4 PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 2A

Route Segment	Map ID	Stamson ID	Alternative 2A - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	66.9	63.3	67.9	65.3	68.6	66.4
GH	1-S	R1	64.2	61.7	65.6	64.0	66.4	65.1
GH	2A-S	R2-A	67.8	64.8	69.2	67.1	70.1	68.3
GH	2-S	R2	63.5	61.3	64.9	63.5	65.8	64.6
GH	3A-S	R3-A	61.0	58.1	62.3	60.1	63.1	61.1
GH	3-S	R3	58.4	55.1	59.5	56.7	60.1	57.5
GH	4A-S	R4-A	58.7	56.2	59.8	58.1	60.5	59.0
GH	4-S	R4	57.9	55.0	59.0	56.8	59.6	57.7
G-H	5-S	R5	62.6	60.2	64.1	62.0	65.1	63.1
G-H	6-S	R6	76.9	72.7	78.3	74.3	79.1	75.4
H-I	7-S	R1	67.5	62.1	69.2	64.5	70.2	66.0
H-I	8-S	R2	59.3	54.5	59.9	55.4	60.2	56.0
H-I	9-S	R3	56.9	52.3	57.7	53.5	58.2	59.7
H-I	10-S	R4	52.6	48.0	54.2	50.4	55.1	51.9
I-J Option 1	11-S	R1_1	66.1	62.5	67.6	64.3	68.4	65.4
I-J Option 2	11-S	R1_2	na	na	na	na	na	na
I-J Option 1	12-S	R2_1	63.2	59.9	64.5	61.6	65.3	62.7
I-J Option 2	12-S	R2_2	63.7	60.4	65.1	62.1	65.9	63.2
J-K Option 1	13-S	R1_1	62.5	57.4	63.6	59.0	64.3	60.0
J-K Option 2	13-S	R1_2	65.0	61.3	66.3	63.0	67.1	64.1
J-K Option 1	14-S	R2_1	67.5	63.7	68.9	65.4	69.8	66.6

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TABLE 4.4(CONT'D) PREDICTED SOUND LEVELS (DBA) FOR ALTERNATIVE 2A

Route Segment	Map ID	Stamson ID	Alternative 2A - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
J-K Option 2	14-S	R2_2	74.7	70.3	76.2	72.0	77.0	73.2
J-K Option 1	15-S	R3_1	59.6	53.0	60.5	54.3	61.1	55.2
J-K Option 2	15-S	R3_2	na	na	na	na	na	na
K-L	16-S	R1	66.2	62.4	67.6	64.3	68.4	65.5
L-M	17-S	R1	67.2	64.2	68.4	65.5	69.2	66.4
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	55.9	53.7	57.4	55.8	58.3	56.8
GH	1-N	R1	56.6	54.3	58.1	56.3	58.9	57.4
GH	2A-N	R2-A	57.2	53.5	58.6	55.6	59.4	56.6
GH	2-N	R2	57.3	53.7	58.7	55.7	59.5	56.8
GH	3-N	R3	74.5	69.8	75.8	71.4	76.6	72.5
H-I	4-N	R1	60.5	53.7	61.1	54.7	61.6	55.5
H-I	5-N	R2	66.8	59.6	67.5	60.5	68.2	61.3
H-I	6-N	R3	65.1	60.7	66.5	62.5	67.3	63.7
I-J	7-N	R1_1	55.9	52.3	57.3	54.1	58.1	55.4
I-J	7-N	R1_2	54.7	51.2	56.1	53.0	57.0	54.2
J-K Option 1	8-N	R1_1	65.0	60.0	66.0	61.5	66.6	62.6
J-K Option 2	8-N	R1_2	63.7	58.0	64.6	59.4	60.4	65.2
J-K Option 1	9-N	R2_1	59.1	56.3	60.5	58.1	61.3	59.2
J-K Option 2	9-N	R2_2	57.9	55.2	59.3	56.9	60.2	58.1
J-K Option 1	10-N	R3_1	66.4	62.4	68.0	64.3	68.9	65.5
J-K Option 2	10-N	R3_2	65.8	61.8	67.4	63.7	68.3	64.9
K-L Option 1	11-N	R1_1	63.5	62.1	65.1	63.5	65.9	64.5
K-L Option 2	12-N	R2	62.1	64.1	63.9	66.9	64.7	68.3
L-M	13-N	R1	65.5	67.7	66.7	69.0	67.5	69.9

Note: The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connectionto Plaza A in order to distinguish it from the access road alternative with connection to other plazas. "na" = not applicable.

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4.5 Alternative 2B

Table 4.5 shows the predicted receptor sound levels associated with Alternative 2B for the three scenario years. The table shows that the predicted daytime sound levels for this alternative range from a low of approximately 50 dBA at receptor 9-N located on the north side of the J-K route segment along the proposed access road from Cousineau Road to Howard Avenue, to a high of approximately 77 dBA at receptor receptor 1 on the south side of the F-G route segment extending along the proposed access road from Matchette Road to Malden Road. Nighttime sound levels range from a low of approximately 47 dBA at receptor 9-N located on the north side of the J-K route segment along the proposed access road from Cousineau Road to Howard Avenue, to a high of approximately 74 dBA at receptor 1 on the south side of the F-G route segment extending along the proposed access road from Matchette Road to Malden Road.

TABLE 4.5 PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 2B

Route Segment	Map ID	Stamson ID	Alternative 2B - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	66.9	63.3	67.9	65.3	68.6	66.4
GH	1-S	R1	64.2	61.7	65.6	64.0	66.4	65.1
GH	2A-S	R2-A	67.8	64.8	69.2	67.1	70.1	68.3
GH	2-S	R2	63.5	61.3	64.9	63.5	65.8	64.6
GH	3A-S	R3-A	61.0	58.1	62.3	60.1	63.1	61.1
GH	3-S	R3	58.4	55.1	59.5	56.7	60.1	57.5
GH	4A-S	R4-A	58.6	56.6	59.7	58.5	60.4	59.5
GH	4-S	R4	57.8	55.3	58.8	57.1	59.5	58.1
G-H	5-S	R5	58.5	55.3	59.7	56.6	60.5	57.4
G-H	6-S	R6	59.4	56.3	60.7	57.7	61.5	58.6
H-I	7-S	R1	58.2	53.4	59.5	55.1	60.3	56.2
H-I	8-S	R2	59.2	54.4	59.7	55.1	60.0	55.7
H-I	9-S	R3	56.7	52.1	57.4	53.2	57.9	54.0
H-I	10-S	R4	52.6	48.0	54.2	50.4	55.1	51.9
I-J Option 1	11-S	R1_1	55.8	52.4	57.3	62.8	58.2	65.4
I-J Option 2	11-S	R1_2	na	na	na	na	na	na

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TABLE 4.5(CONT'D) PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 2B

Route Segment	Map ID	Stamson ID	Alternative 2B - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
I-J Option 1	12-S	R2_1	56.6	52.6	57.7	53.9	64.0	61.4
I-J Option 2	12-S	R2_2	56.8	52.8	57.9	54.2	58.5	55.1
J-K Option 1	13-S	R1_1	62.5	57.4	63.6	59.0	64.3	60.0
J-K Option 2	13-S	R1_2	65.0	61.3	66.3	63.0	67.1	64.1
J-K Option 1	14-S	R2_1	57.7	54.2	59.2	64.1	60.1	57.3
J-K Option 2	14-S	R2_2	64.1	60.8	65.6	62.7	66.5	63.9
J-K Option 1	15-S	R3_1	59.9	53.5	60.8	54.8	61.5	55.8
J-K Option 2	15-S	R3_2	na	na	na	na	na	na
K-L	16-S	R1	66.2	62.4	67.6	64.3	68.4	65.5
L-M	17-S	R1	67.2	64.2	68.4	65.5	69.2	66.4
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	56.4	54.1	57.8	56.2	58.7	57.2
GH	1-N	R1	57.0	54.7	58.5	56.6	59.4	57.8
GH	2A-N	R2-A	57.6	54.0	59.0	56.1	59.9	57.1
GH	2-N	R2	57.7	54.1	59.2	56.2	60.0	57.2
GH	3-N	R3	58.4	54.8	59.5	56.0	60.1	56.6
H-I	4-N	R1	60.4	53.5	61.0	54.5	61.5	55.3
H-I	5-N	R2	66.6	59.4	67.3	60.2	68.0	61.0
H-I	6-N	R3	61.0	56.0	62.0	57.4	62.6	58.3
I-J	7-N	R1_1	54.4	50.7	55.7	52.4	56.5	53.5
I-J	7-N	R1_2	53.3	49.6	54.6	51.3	55.4	52.5
J-K Option 1	8-N	R1_1	64.1	58.7	65.0	60.0	65.6	60.9
J-K Option 2	8-N	R1_2	62.9	56.8	63.7	58.0	64.3	58.9
J-K Option 1	9-N	R2_1	50.6	54.7	52.0	49.4	52.8	57.6
J-K Option 2	9-N	R2_2	49.6	46.8	51.1	48.5	51.9	49.7
J-K Option 1	10-N	R3_1	59.3	55.1	60.7	56.8	61.5	57.9
J-K Option 2	10-N	R3_2	58.7	54.6	60.1	56.2	60.9	57.3

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TABLE 4.5(CONT'D) PREDICTED SOUND LEVELS (DBA) FOR ALTERNATIVE 2B

Route Segment	Map ID	Stamson ID	Alternative 2B - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
K-L Option 1	11-N	R1_1	63.5	62.1	65.1	63.5	65.9	64.5
K-L Option 2	12-N	R2	62.1	64.1	63.9	66.9	64.7	68.3
L-M	13-N	R1	65.5	67.7	66.7	69.0	67.5	69.9

Note: The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas. "na" = not applicable.

4.6 Alternative 3 - sound levels from surface roads

Although the tunnel portals and ventilation buildings are the key noise sources associated with Alternative 3 (tunnel option), the surface roads including the access roads and other local roads are to be considered as noise sources.

Table 4.6 shows the predicted receptor sound levels associated with Alternative 3 for the three scenario years. The table shows that the predicted daytime and nighttime sound levels for this alternative range from lower than 50 dBA to higher than 70 dBA.

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TABLE 4.6 PREDICTED SOUND LEVELS (dBA) FOR ALTERNATIVE 3 – SURFACE ROUTES ONLY

Route Segment	Map ID	Stamson ID	Alternative 3 - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	67.0	63.4	68.0	65.4	68.6	66.5
GH	1-S	R1	64.5	61.9	65.7	64.1	66.5	65.3
GH	2A-S	R2-A	56.6	51.0	57.3	51.5	57.8	52.3
GH	2-S	R2	56.9	51.4	57.6	52.0	58.1	52.6
GH	3A-S	R3-A	55.2	50.3	55.9	51.0	56.4	51.4
GH	3-S	R3	55.2	50.3	55.9	51.0	56.4	51.4
GH	4A-S	R4-A	66.4	63.7	66.6	63.3	67.2	63.8
GH	4-S	R4	59.9	55.6	60.1	55.2	60.7	55.6
G-H	5-S	R5	53.6	51.7	53.2	51.5	53.4	51.5
G-H	6-S	R6	49.8	51.9	49.0	50.8	49.6	51.6
H-I	7-S	R1	48.6	40.7	48.3	40.2	47.6	39.5
H-I	8-S	R2	60.8	50.8	60.8	50.8	61.0	51.1
H-I	9-S	R3	59.9	48.4	59.9	48.6	60.1	48.8
H-I	10-S	R4	44.5	37.5	45.2	38.2	45.5	38.7
I-J Option 1	11-S	R1_1	49.3	44.7	49.6	45.3	50.1	45.9
I-J Option 2	11-S	R1_2	na	na	na	na	na	na
I-J Option 1	12-S	R2_1	56.3	51.3	57.0	51.9	57.4	52.4
I-J Option 2	12-S	R2_2	na	na	na	na	na	na
J-K Option 1	13-S	R1_1	63.4	56.6	63.8	57.1	64.2	57.7
J-K Option 2	13-S	R1_2	na	na	na	na	na	na
J-K Option 1	14-S	R2_1	54.4	47.8	54.6	48.1	54.9	48.6
J-K Option 2	14-S	R2_2	na	na	na	na	na	na
J-K Option 1	15-S	R3_1	57.8	49.1	57.4	48.7	56.9	48.2
J-K Option 2	15-S	R3_2	na	na	na	na	na	na
K-L	16-S	R1	66.5	63.5	67.7	64.8	68.5	66.0
L-M	17-S	R1	67.2	64.1	68.3	65.3	69.1	66.2

TABLE 4.6(CONT'D) PREDICTED SOUND LEVELS (DBA) FOR ALTERNATIVE 3 – SURFACE ROUTES ONLY

Route Segment	Map ID	Stamson ID	Alternative 3 - Sound Level (dBA)					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	46.7	47.1	47.3	47.9	47.6	48.1
GH	1-N	R1	46.7	47.1	47.3	47.9	47.6	48.1
GH	2A-N	R2-A	52.1	55.5	52.3	54.7	53.0	55.4
GH	2-N	R2	47.5	49.9	48.1	51.0	48.5	51.4
GH	3-N	R3	55.6	51.9	56.3	52.6	56.6	53.0
H-I	4-N	R1	60.6	52.1	60.6	52.1	60.9	52.5
H-I	5-N	R2	62.1	54.6	62.4	54.8	62.7	55.2
H-I	6-N	R3	58.8	50.6	59.0	50.7	59.4	51.3
I-J	7-N	R1_1	48.4	42.3	48.6	42.6	48.9	42.9
I-J	7-N	R1_2	na	na	na	na	na	na
J-K Option 1	8-N	R1_1	62.3	54.1	62.3	54.3	62.6	54.6
J-K Option 2	8-N	R1_2	na	na	na	na	na	na
J-K Option 1	9-N	R2_1	41.3	35.5	41.5	35.8	41.8	36.3
J-K Option 2	9-N	R2_2	na	na	na	na	na	na
J-K Option 1	10-N	R3_1	49.5	46.0	49.8	46.3	50.1	46.7
J-K Option 2	10-N	R3_2	na	na	na	na	na	na
K-L Option 1	11-N	R1_1	64.2	62.2	65.4	63.3	66.3	64.3
K-L Option 2	12-N	R2	64.1	68.1	65.2	69.3	66.1	70.5
L-M	13-N	R1	65.2	67.4	66.3	68.5	67.1	69.4

Note: The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas. "na" = not applicable.

The results for all alternatives show that, in general, daytime sound levels are predicted to be higher than nighttime sound levels mainly due to the higher traffic volume during the daytime hours. There are; however, some instances where the nighttime sound levels are predicted to be higher than the daytime sound levels. These situations occur where the daytime and nighttime traffic volumes are similar and:

1) the location of the road traffic is closer to the second storey window of the receptor, which is used for predicting the nighttime sound levels, than the outdoor

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living area (OLA)/backyard, which is used for predicting the daytime sound levels; and

2) the distances from the road traffic to the OLA and second storey window of the receptor are similar. Sound attenuating features, such as soft ground and acoustic fences, which help to mitigate daytime sound levels in the OLA, do not mitigate sound levels at the height of the second storey window.

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5. TRAFFIC NOISE IMPACT ASSESSMENT

5.1 Assessment Protocol

For this study, the following protocol was established in consultation with the Ministry of Environment in May 2006 for assessing noise impact of the proposed alternatives:

- The objective for outdoor noise levels will be the higher of the Leq 55 dBA or existing ambient, determined by traffic noise predictions.
- Stationary noise sources such as the plaza location will be assessed in accordance with publication NPC-205 of the MOE Model Municipal Noise Control By-law.
- No noise mitigation measures will be considered where the noise increase above the ambient does not exceed 5 dBA.
- Noise mitigation measures will be investigated if the existing established sound levels at the closest receptor are exceeded by > 5 dBA

In addition to the quantitative limits outlined in the protocol above, traffic noise impact may be described qualitatively using the scale shown in Table 5.1 below. In general, the scale rates the impact of background sound level exceedances.

TABLE 5.1 QUALITATIVE CRITERIA* FOR ASSESSING TRAFFIC NOISE

Increase in Background Noise Level	Loudness	Impact Rating
up to 3 dBA	hardly perceptible	marginal to none
4 to 5 dBA	noticeable	Low
6 to 10 dBA	almost twice as loud	Moderate
11 plus dBA	more than twice as loud	High

*adapted from Table 6.9 in MOE 1990.

5.1.1 Alternative 1A

When compared to the predicted baseline sound levels, the results show that for the most part, Alternative 1A is likely to cause a no to marginal noise impact (i.e., <3 dB increase above baseline receptor sound levels) at most receptors, during both daytime and nighttime hours. In fact, several receptors are predicted to experience a reduction in noise levels when compared to the "no build" situation. This is primarily due to the decreasing traffic volume based on the proposed project. The

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resulting sound levels above the predicted "no-build" scenario sound levels are listed in Table 5.1-1. Table 5.1-2 below shows the daytime and nighttime exceedances for each scenario year.

TABLE 5.1-1 RESULTING SOUND LEVELS (dBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 1A (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	Alternative 1A					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	3.6	7.7	4.7	9.2	2.7	7.6
GH	1-S	R1	1.4	6.5	2.1	7.3	1.0	6.5
GH	2A-S	R2-A	15.5	17.6	16.0	18.4	16.5	18.9
GH	2-S	R2	6.3	8.0	6.9	8.9	7.3	9.3
GH	3A-S	R3-A	2.8	3.0	3.2	3.6	3.4	3.8
GH	3-S	R3	-0.3	-0.5	0.1	-0.2	-0.1	-0.3
GH	4A-S	R4-A	3.6	2.8	3.1	1.8	3.1	1.8
GH	4-S	R4	3.4	2.5	2.8	1.3	2.8	1.3
G-H	5-S	R5	2.6	1.8	3.0	2.5	3.2	2.7
G-H	6-S	R6	3.1	2.3	3.6	3.0	3.8	3.1
H-I	7-S	R1	3.7	2.1	4.3	2.8	4.4	3.0
H-I	8-S	R2	-1.8	-2.5	-2.0	-2.6	-2.1	-2.7
H-I	9-S	R3	-1.8	-2.6	-1.9	-2.5	-1.9	-2.4
H-I	10-S	R4	-2.4	-5.2	-3.8	-5.0	-1.8	-4.7
I-J Option 1	11-S	R1_1	0.8	-0.4	1.3	0.4	1.4	0.4
I-J Option 2	11-S	R1_2	0.9	-0.2	1.5	0.5	1.5	0.5
I-J Option 1	12-S	R2_1	-5.1	-6.3	-5.1	-6.4	-4.9	-6.4
I-J Option 2	12-S	R2_2	-4.7	-5.8	-4.9	-5.9	-4.4	-5.8
J-K Option 1	13-S	R1_1	-9.7	-12.3	-9.8	-12.2	-9.8	-12.2
J-K Option 2	13-S	R1_2	-6.9	-9.3	-7.0	-9.1	-7.0	-9.1
J-K Option 1	14-S	R2_1	1.3	1.0	1.7	1.4	1.8	1.4
J-K Option 2	14-S	R2_2	5.7	4.9	6.0	5.3	6.2	5.3
J-K Option 1	15-S	R3_1	-0.2	-3.3	-0.2	-3.1	-0.3	-3.2
J-K Option 2	15-S	R3_2	0.3	-2.9	-0.1	-2.9	-0.1	-3.0

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TABLE 5.1-1(CONT'D) RESULTING SOUND LEVELS (dBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 1A (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	Alternative 1A					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
K-L	16-S	R1	-0.5	-0.1	-0.2	0.6	0.0	0.7
L-M	17-S	R1	3.8	1.1	4.0	1.5	3.6	3.6
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	0.4	-7.1	1.2	-1.9	0.9	-7.4
GH	1-N	R1	0.5	-6.8	0.6	-7.3	0.9	-7.2
GH	2A-N	R2-A	3.0	-7.3	3.2	-6.9	3.4	-6.7
GH	2-N	R2	3.4	-6.9	3.5	-6.5	3.7	-6.2
GH	3-N	R3	2.3	1.6	2.6	2.4	2.8	2.5
H-I	4-N	R1	-5.6	-9.1	-5.6	-8.8	-5.6	-8.8
H-I	5-N	R2	-14.4	-14.9	-14.6	-14.7	-14.0	-14.1
H-I	6-N	R3	2.0	0.9	2.4	1.5	2.4	1.4
I-J	7-N	R1_1	-7.1	-8.7	-6.9	-8.1	-6.9	-8.2
I-J	7-N	R1_2	-8.6	-10.1	-8.4	-9.5	-8.4	-9.5
J-K Option 1	8-N	R1_1	-7.7	-10.1	-8.1	-10.1	-8.2	-10.2
J-K Option 2	8-N	R1_2	-8.7	-11.6	-9.1	-11.6	-9.3	-11.8
J-K Option 1	9-N	R2_1	3.0	2.5	3.3	2.9	3.5	2.9
J-K Option 2	9-N	R2_2	2.2	1.7	2.9	2.5	2.7	2.1
J-K Option 1	10-N	R3_1	5.4	2.0	6.0	2.6	6.1	2.6
J-K Option 2	10-N	R3_2	5.0	1.5	5.5	2.1	5.7	2.1
K-L Option 1	11-N	R1_1	-3.1	-9.5	-2.6	-8.8	-2.3	-8.7
K-L Option 2	12-N	R2	-2.5	-2.7	-1.9	-1.7	-1.6	-1.5
L-M	13-N	R1	4.1	1.1	4.2	1.6	4.4	1.9

Note: Bolded values indicating the sound levels exceeded 5 dB above the "no-build" scenario sound levels. The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas.

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TABLE 5.1-2 PREDICTED RECEPTOR NOISE IMPACT OF ALTERNATIVE 1A - NUMBER OF OCCURRENCES (WITHOUT MITIGATION)

Scenario Year	No. of Exceedances <0 dB		No. of Exceedances 0-3 dB		No. of Exceedances 4-5 dB		No. of Exceedances 6-10 dB		No. of Exceedances > 10 dB	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
2015	18	25	17	15	7	1	2	3	1	1
2025	18	22	16	17	6	2	4	3	1	1
2035	18	22	17	16	5	3	4	3	1	1

Note: the sound levels are rounded off to the nearest integer for the preparation of this table (e.g., 3.49 dBA ≈ 3 dBA and 3.5 dBA ≈ 4 dBA).

Most of the exceedances >5 dB are predicted to occur in the route segments from F to H along the proposed access road between Matchette Road and Pulford Street. The only other receptor predicted to experience a >5 dB exceedance in its baseline noise level is located along the proposed access road between Cousineau Road and Howard Avenue. Noise mitigation measures are to be considered in all instances where the "no-build" sound levels are exceeded by more than 5 dB due to the project. As discussed later in Section 7, the proposed mitigation measures are found to effectively reduce sound levels in most instances to within 5 dB above the no-build sound levels.

5.1.2 Alternative 1B

When compared to the predicted baseline sound levels, the results show that for the most part, Alternative 1B is likely to cause a no to marginal noise impact (i.e., <3 dB increase above baseline receptor sound levels) at most receptors, during both daytime and nighttime hours. The resulting sound levels above the predicted "no-build" scenario sound levels are listed in Table 5.1-3. Table 5.1-4 below shows the daytime and nighttime exceedances for each scenario year.

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TABLE 5.1-3 RESULTING SOUND LEVELS (dBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 1B (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	2.8	6.3	2.9	7.2	1.6	6.3
GH	1-S	R1	-0.1	4.7	0.4	5.8	-0.7	4.9
GH	2A-S	R2-A	12.6	14.8	13.3	15.9	13.8	16.5
GH	2-S	R2	6.3	7.9	6.9	8.9	7.3	9.4
GH	3A-S	R3-A	2.9	3.1	3.3	3.7	3.5	4.0
GH	3-S	R3	-0.2	-0.4	0.0	-0.1	0.0	0.0
GH	4A-S	R4-A	6.0	6.4	5.7	6.0	5.4	5.3
GH	4-S	R4	4.0	3.4	3.7	3.1	3.4	2.4
G-H	5-S	R5	-7.6	-8.9	-6.8	-7.4	-6.7	-7.5
G-H	6-S	R6	-4.4	-13.9	-4.0	-13.6	-4.0	-13.7
H-I	7-S	R1	-4.7	-6.5	-4.4	-6.1	-4.4	-6.1
H-I	8-S	R2	-1.3	-2.5	-1.1	-2.3	-1.0	-2.2
H-I	9-S	R3	-1.4	-2.5	-1.1	-2.2	-1.0	-2.0
H-I	10-S	R4	-5.7	-7.7	-5.8	-7.6	-5.9	-7.9
I-J Option 1	11-S	R1_1	-7.4	-8.6	-7.2	-8.2	-7.2	-8.4
I-J Option 2	11-S	R1_2	-7.4	-8.5	-7.1	-8.1	-7.1	-8.3
I-J Option 1	12-S	R2_1	-5.0	-6.3	-5.5	-6.9	-5.3	-7.0
I-J Option 2	12-S	R2_2	-5.1	-6.2	-5.0	-6.3	-4.8	-6.3
J-K Option 1	13-S	R1_1	-9.8	-12.1	-9.8	-12.0	-9.8	-12.1
J-K Option 2	13-S	R1_2	-6.7	-8.9	-6.7	-8.7	-6.6	-8.8
J-K Option 1	14-S	R2_1	-7.7	-7.9	-7.4	-7.6	-7.3	-7.7
J-K Option 2	14-S	R2_2	-3.2	-3.3	-3.0	-3.7	-2.9	-3.7
J-K Option 1	15-S	R3_1	0.3	-2.5	0.4	-2.2	0.4	-2.4
J-K Option 2	15-S	R3_2	0.4	-2.3	0.5	-2.1	0.5	-2.2
K-L	16-S	R1	-0.5	0.3	-0.1	0.7	0.0	0.8
L-M	17-S	R1	3.8	1.0	4.0	1.5	4.2	1.7

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Table 5.1-3(Cont'd) Resulting Sound Levels (dBA) Above the "no-build" Scenario – Alternative 1B (without mitigation)

Route Segment	Map ID	Stamson ID	2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	0.9	-6.2	1.3	-6.1	1.5	-6.3
GH	1-N	R1	1.0	-5.9	1.3	-5.9	1.5	-6.1
GH	2A-N	R2-A	3.4	-6.9	3.7	-6.3	3.9	-6.0
GH	2-N	R2	3.9	-6.5	4.2	-5.8	4.4	-5.5
GH	3-N	R3	-14.4	-14.4	-14.2	-14.1	-14.2	-14.1
H-I	4-N	R1	-5.9	-8.9	-5.8	-8.6	-5.8	-8.6
H-I	5-N	R2	-13.7	-13.7	-13.8	-13.5	-13.8	-13.5
H-I	6-N	R3	-10.6	-12.5	-10.6	-12.2	-10.7	-12.5
I-J	7-N	R1_1	-7.0	-8.3	-6.8	-7.9	-6.8	-8.1
I-J	7-N	R1_2	-8.5	-9.7	-8.3	-9.3	-8.3	-9.4
J-K Option 1	8-N	R1_1	-7.1	-8.8	-7.3	-8.7	-7.4	-8.9
J-K Option 2	8-N	R1_2	-8.1	-10.4	-8.4	-10.4	-8.6	-10.6
J-K Option 1	9-N	R2_1	-5.3	0.7	-5.0	-5.5	-4.9	0.9
J-K Option 2	9-N	R2_2	-5.8	-6.4	-5.6	-6.1	-5.4	-6.2
J-K Option 1	10-N	R3_1	-3.3	-6.7	-2.9	-6.4	-2.8	-6.5
J-K Option 2	10-N	R3_2	-3.7	-7.1	-3.4	-6.8	-3.2	-6.9
K-L Option 1	11-N	R1_1	-3.0	-9.2	-2.6	-8.8	-2.3	-8.7
K-L Option 2	12-N	R2	-2.4	-2.3	-1.9	-1.7	-1.6	-1.5
L-M	13-N	R1	4.1	1.1	4.2	1.6	4.5	1.9

Note: Bolded values indicating the sound levels exceeded 5 dB above the "no-build" scenario sound levels. The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas.

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TABLE 5.1-4 PREDICTED RECEPTOR NOISE IMPACT OF ALTERNATIVE 1B - NUMBER OF OCCURRENCE (WITHOUT MITIGATION)

Scenario Year	No. of Exceedances <0 dB		No. of Exceedances 0-3 dB		No. of Exceedances 4-5 dB		No. of Exceedances 6-10 dB		No. of Exceedances > 10 dB	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
2015	31	34	7	6	4	1	2	3	1	1
2025	30	35	7	4	5	1	2	4	1	1
2035	30	34	8	5	5	3	1	2	1	1

Note: the sound levels are round off to the nearest integer for the preparation of this table (e.g., 3.49 dBA ≈ 3 dBA and 3.5 dBA ≈ 4 dBA).

Most of the exceedances >5 dB are predicted to occur in the in the route segments from F to H along the proposed access road between Matchette Road and Pulford Street. Noise mitigation measures are to be considered in all instances where the “no-build” sound levels are exceeded by more than 5 dB due to the project. As discussed later in Section 7, the proposed mitigation measures are found to effectively reduce sound levels in most instances to within 5 dB above the no-build sound levels.

5.1.3 Alternative 2A

When compared to the predicted baseline sound levels, the results show that for the most part, Alternative 2A is likely to cause a no to marginal noise impact (i.e., <3 dB increase above baseline receptor sound levels) at most receptors, during both daytime and nighttime hours. The resulting sound levels above the predicted “no-build” scenario sound levels are listed in Table 5.1-5. Table 5.1-6 below shows the daytime and nighttime exceedances for each scenario year.

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TABLE 5.1-5 RESULTING SOUND LEVELS (dBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 2A (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	Alternative 2A					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	2.7	6.1	3.0	7.4	1.6	6.3
GH	1-S	R1	-0.1	4.6	0.6	6.1	-0.6	5.1
GH	2A-S	R2-A	10.6	11.3	11.4	12.7	11.7	13.1
GH	2-S	R2	6.4	7.7	7.1	9.1	7.4	9.5
GH	3A-S	R3-A	3.1	3.0	3.6	4.0	3.7	4.2
GH	3-S	R3	0.5	0.0	0.8	0.6	0.7	0.6
GH	4A-S	R4-A	-2.1	-2.2	-1.8	-1.3	-1.9	-1.2
GH	4-S	R4	-2.8	-3.3	-2.7	-2.6	-2.8	-2.6
G-H	5-S	R5	-1.9	-2.1	-1.2	-1.1	-0.9	-0.7
G-H	6-S	R6	15.1	4.5	15.6	5.2	15.7	5.4
H-I	7-S	R1	6.8	4.0	7.8	5.4	8.0	6.1
H-I	8-S	R2	-0.6	-1.4	-0.6	-1.3	-0.8	-1.3
H-I	9-S	R3	-0.6	-1.5	-0.4	-1.0	-0.4	4.6
H-I	10-S	R4	-5.9	-8.5	-5.3	-7.3	-5.1	-6.8
I-J Option 1	11-S	R1_1	4.2	2.8	4.7	3.4	4.7	3.5
I-J Option 2	11-S	R1_2	na	na	na	na	na	na
I-J Option 1	12-S	R2_1	0.8	0.5	1.4	1.2	1.7	1.5
I-J Option 2	12-S	R2_2	1.3	1.0	2.0	1.7	2.3	2.0
J-K Option 1	13-S	R1_1	-10.5	-12.1	-10.2	-11.6	-10.2	-11.5
J-K Option 2	13-S	R1_2	-8.0	-8.2	-7.5	-7.6	-7.5	-7.4
J-K Option 1	14-S	R2_1	0.6	-0.2	1.2	0.4	1.3	0.6
J-K Option 2	14-S	R2_2	7.9	6.4	8.4	7.0	8.5	7.2
J-K Option 1	15-S	R3_1	-0.7	-4.1	-0.5	-3.8	-0.6	-3.7
J-K Option 2	15-S	R3_2	na	na	na	na	na	na
K-L	16-S	R1	-1.0	-1.3	-0.4	-0.3	-0.2	0.2
L-M	17-S	R1	3.9	1.1	4.0	1.5	4.3	1.8

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Table 5.1-5(Cont'd) Resulting Sound Levels (dBA) Above the "no-build" Scenario – Alternative 2A (without mitigation)

Route Segment	Map ID	Stamson ID	Alternative 2A					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	-1.1	-11.3	-0.5	-10.3	-0.4	-10.2
GH	1-N	R1	-0.4	-10.8	0.1	-9.7	0.3	-9.6
GH	2A-N	R2-A	0.2	-10.9	0.7	-9.8	0.8	-9.7
GH	2-N	R2	0.3	-10.7	0.8	-9.7	0.9	-9.6
GH	3-N	R3	0.4	-0.5	0.9	0.3	1.0	0.5
H-I	4-N	R1	-7.1	-11.2	-7.2	-11.0	-7.3	-11.0
H-I	5-N	R2	-10.5	-13.1	-10.6	-13.1	-10.6	-13.0
H-I	6-N	R3	-8.4	-9.4	-7.9	-8.7	-7.8	-8.6
I-J	7-N	R1_1	-6.3	-7.4	-5.9	-6.9	-5.8	-6.7
I-J	7-N	R1_2	-7.5	-8.6	-7.1	-8.0	-7.0	-7.8
J-K Option 1	8-N	R1_1	-6.5	-8.4	-6.3	-8.0	-6.4	-7.8
J-K Option 2	8-N	R1_2	-7.8	-10.4	-7.8	-10.1	-12.6	-5.2
J-K Option 1	9-N	R2_1	2.7	1.6	3.2	2.2	3.3	2.4
J-K Option 2	9-N	R2_2	1.5	0.4	2.0	1.1	2.1	1.3
J-K Option 1	10-N	R3_1	3.3	-0.6	4.0	0.3	4.1	0.5
J-K Option 2	10-N	R3_2	2.7	-1.2	3.4	-0.3	3.6	-0.1
K-L Option 1	11-N	R1_1	-2.7	-7.6	-2.1	-7.1	-1.9	-6.9
K-L Option 2	12-N	R2	-3.0	-4.9	-2.1	-3.1	-1.9	-2.4
L-M	13-N	R1	4.1	1.1	4.2	1.7	4.5	1.9

Note: Bolded values indicating the sound levels exceeded 5 dB above the "no-build" scenario sound levels. The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas. "na" = not applicable.

TABLE 5.1-6 PREDICTED RECEPTOR NOISE IMPACT OF ALTERNATIVE 2A - NUMBER OF OCCURRENCE (WITHOUT MITIGATION)

Scenario Year	No. of Exceedances <0 dB		No. of Exceedances 0-3 dB		No. of Exceedances 4-5 dB		No. of Exceedances 6-10 dB		No. of Exceedances > 10 dB	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
2015	22	27	13	9	3	3	3	3	2	1
2025	20	24	13	11	5	3	3	4	2	1
2035	21	22	11	11	6	5	3	4	2	1

Note: the sound levels are round off to the nearest integer for the preparation of this table (e.g., 3.49 dBA ≈ 3 dBA and 3.5 dBA ≈ 4 dBA).

Most of the exceedances >5 dB are predicted to occur in the route segments from F to H along the proposed access road between Matchette Road and Pulford Street. The only other receptor predicted to experience a >5 dB exceedance in its baseline noise level is located in the H-I route segment along the proposed access road between Pulford Street and North of Lennon Drain. Noise mitigation measures are to be considered in all instances where the "no-build" sound levels are exceeded by more than 5 dB due to the project. As discussed later in Section 7, the proposed mitigation measures are found to effectively reduce sound levels in most instances to within 5 dB above the no-build sound levels.

5.1.4 Alternative 2B

When compared to the predicted baseline sound levels, the results show that for the most part, Alternative 2B is likely to cause a no to marginal noise impact (i.e., <3 dB increase above baseline receptor sound levels) at most receptors, during both daytime and nighttime hours. The resulting sound levels above the predicted "no-build" scenario sound levels are listed in Table 5.1-7. Table 5.1-8 below shows the daytime and nighttime exceedances for each scenario year.

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TABLE 5.1-7 RESULTING SOUND LEVELS (dBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 2B (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	Alternative 2B					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	2.6	6.1	3.0	7.4	1.6	6.3
GH	1-S	R1	-0.1	4.6	0.6	6.1	-0.6	5.1
GH	2A-S	R2-A	10.6	11.3	11.4	12.7	11.7	13.1
GH	2-S	R2	6.4	7.7	7.1	9.1	7.4	9.5
GH	3A-S	R3-A	3.1	3.0	3.6	4.0	3.7	4.2
GH	3-S	R3	0.5	0.0	0.8	0.6	0.7	0.6
GH	4A-S	R4-A	-2.1	-1.8	-1.9	-0.9	-2.0	-0.8
GH	4-S	R4	-3.0	-3.0	-2.8	-2.2	-2.9	-2.2
G-H	5-S	R5	-6.0	-7.0	-5.6	-6.5	-5.5	-6.4
G-H	6-S	R6	-2.4	-12.0	-1.9	-11.4	-1.8	-11.4
H-I	7-S	R1	-2.5	-4.8	-2.0	-4.0	-1.9	-3.7
H-I	8-S	R2	-0.8	-1.6	-0.8	-1.5	-1.0	-1.6
H-I	9-S	R3	-0.8	-1.7	-0.7	-1.4	-0.7	-1.1
H-I	10-S	R4	-5.9	-8.5	-5.3	-7.3	-5.2	-6.8
I-J Option 1	11-S	R1_1	-6.2	-7.3	-5.6	2.0	-5.6	3.5
I-J Option 2	11-S	R1_2	na	na	na	na	na	na
I-J Option 1	12-S	R2_1	-5.8	-6.9	-5.5	-6.5	0.4	0.1
I-J Option 2	12-S	R2_2	-5.6	-6.6	-5.2	-6.2	-5.1	-6.1
J-K Option 1	13-S	R1_1	-10.5	-12.1	-10.2	-11.6	-10.2	-11.5
J-K Option 2	13-S	R1_2	-8.0	-8.2	-7.5	-7.6	-7.5	-7.4
J-K Option 1	14-S	R2_1	-9.1	-9.7	-8.5	-0.9	-8.4	-8.7
J-K Option 2	14-S	R2_2	-2.8	-3.1	-2.1	-2.4	-1.9	-2.1
J-K Option 1	15-S	R3_1	-0.4	-3.6	-0.2	-3.2	-0.2	-3.1
J-K Option 2	15-S	R3_2	na	na	na	na	na	na
K-L	16-S	R1	-1.0	-1.3	-0.4	-0.3	-0.2	0.2
L-M	17-S	R1	3.9	1.1	4.0	1.5	4.3	1.8

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TABLE 5.1-7(CONT'D) RESULTING SOUND LEVELS (DBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 2B (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	Alternative 2B					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	-0.6	-10.9	-0.1	-9.9	0.1	-9.7
GH	1-N	R1	0.0	-10.3	0.6	-9.5	0.7	-9.1
GH	2A-N	R2-A	0.6	-10.4	1.2	-9.4	1.2	-9.2
GH	2-N	R2	0.8	-10.3	1.3	-9.3	1.4	-9.1
GH	3-N	R3	-15.6	-15.4	-15.4	-15.2	-15.5	-15.4
H-I	4-N	R1	-7.2	-11.3	-7.3	-11.2	-7.4	-11.3
H-I	5-N	R2	-10.6	-13.3	-10.7	-13.4	-10.7	-13.3
H-I	6-N	R3	-12.5	-14.0	-12.4	-13.8	-12.6	-13.9
I-J	7-N	R1_1	-7.8	-9.1	-7.5	-8.6	-7.5	-8.6
I-J	7-N	R1_2	-8.9	-10.1	-8.6	-9.7	-8.6	-9.6
J-K Option 1	8-N	R1_1	-7.3	-9.7	-7.3	-9.5	-7.4	-9.5
J-K Option 2	8-N	R1_2	-8.5	-11.5	-8.6	-11.5	-8.7	-11.5
J-K Option 1	9-N	R2_1	-5.8	0.0	-5.3	-6.5	-5.2	0.7
J-K Option 2	9-N	R2_2	-6.8	-8.0	-6.2	-7.4	-6.2	-7.1
J-K Option 1	10-N	R3_1	-3.9	-8.0	-3.3	-7.3	-3.3	-7.1
J-K Option 2	10-N	R3_2	-4.4	-8.5	-3.9	-7.8	-3.8	-7.7
K-L Option 1	11-N	R1_1	-2.7	-7.6	-2.1	-7.1	-1.9	-6.9
K-L Option 2	12-N	R2	-3.0	-4.9	-2.1	-3.1	-1.9	-2.4
L-M	13-N	R1	4.1	1.1	4.2	1.7	4.5	1.9

Note: Bolded values indicating the sound levels exceeded 5 dB above the "no-build" scenario sound levels. The letter "A" shown in the Map and Stamson ID columns in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas. "na" = not applicable

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TABLE 5.1-8 PREDICTED RECEPTOR NOISE IMPACT OF ALTERNATIVE 2B - NUMBER OF OCCURRENCE (WITHOUT MITIGATION)

Scenario Year	No. of Exceedances <0 dB		No. of Exceedances 0-3 dB		No. of Exceedances 4-5 dB		No. of Exceedances 6-10 dB		No. of Exceedances > 10 dB	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
2015	33	35	6	4	2	1	1	2	1	1
2025	32	34	6	4	3	1	1	3	1	1
2035	31	31	7	6	3	3	1	2	1	1

Note: the sound levels are round off to the nearest integer for the preparation of this table (e.g., 3.49 dBA ≈ 3 dBA and 3.5 dBA ≈ 4 dBA).

Most of the exceedances >5 dB are predicted to occur in the route segments from F to H route segment along the proposed access road between Matchette Road and Pulford Street. Noise mitigation measures are to be considered in all instances where the "no-build" sound levels are exceeded by more than 5 dB due to the project. As discussed later in Section 7, the proposed mitigation measures are found to effectively reduce sound levels in most instances to within 5 dB above the no-build sound levels.

5.1.5 Alternative 3 - Sound Levels from Surface Roads

When compared to the predicted baseline sound levels, the results show that for the most part, Alternative 3 is likely to cause a no to marginal noise impact (i.e., <3 dB increase above baseline receptor sound levels) at most receptors, during both daytime and nighttime hours. The sound levels presented here are only based on noise from vehicle traveling on the access roads and local roads. The sound levels from the tunnel portal and ventilation building are discussed in Section 5.2. The resulting sound levels above the predicted "no-build" scenario sound levels are listed in Table 5.1-9. Table 5.1-10 below shows the daytime and nighttime exceedances for each scenario year.

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TABLE 5.1-9 RESULTING SOUND LEVELS (dBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 3 SURFACE ROADS ONLY (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	Alternative 3					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the South Side of the Proposed Access Road								
GH	1A-S	R1-A	2.7	6.2	3.1	7.5	1.7	6.4
GH	1-S	R1	0.2	4.7	0.8	6.2	-0.5	5.2
GH	2A-S	R2-A	-0.6	-2.6	-0.6	-2.9	-0.6	-2.9
GH	2-S	R2	-0.3	-2.1	-0.2	-2.4	-0.3	-2.6
GH	3A-S	R3-A	-2.7	-4.8	-2.8	-5.1	-3.0	-5.6
GH	3-S	R3	-2.7	-4.8	-2.8	-5.1	-3.0	-5.6
GH	4A-S	R4-A	5.7	5.4	5.0	3.9	4.8	3.6
GH	4-S	R4	-0.9	-2.8	-1.6	-4.2	-1.7	-4.7
G-H	5-S	R5	-10.9	-10.6	-12.1	-11.6	-12.6	-12.3
G-H	6-S	R6	-12.1	-16.3	-13.6	-18.3	-13.8	-18.3
H-I	7-S	R1	-12.1	-17.5	-13.2	-18.9	-14.6	-20.5
H-I	8-S	R2	0.8	-5.2	0.3	-5.8	0.0	-6.2
H-I	9-S	R3	2.3	-5.4	1.8	-5.9	1.5	-6.3
H-I	10-S	R4	-14.0	-19.0	-14.3	-19.4	-14.8	-20.0
I-J Option 1	11-S	R1_1	-12.7	-15.0	-13.3	-15.5	-13.7	-16.0
I-J Option 2	11-S	R1_2	na	na	na	na	na	na
I-J Option 1	12-S	R2_1	-6.1	-8.1	-6.1	-8.5	-6.2	-8.8
I-J Option 2	12-S	R2_2	na	na	na	na	na	na
J-K Option 1	13-S	R1_1	-9.6	-12.9	-10.0	-13.5	-10.3	-13.8
J-K Option 2	13-S	R1_2	na	na	na	na	na	na
J-K Option 1	14-S	R2_1	-12.4	-16.2	-13.2	-17.0	-13.6	-17.4
J-K Option 2	14-S	R2_2	na	na	na	na	na	na
J-K Option 1	15-S	R3_1	-2.5	-8.0	-3.6	-9.3	-4.8	-10.7
J-K Option 2	15-S	R3_2	na	na	na	na	na	na
K-L	16-S	R1	-0.7	-0.1	-0.3	0.3	-0.1	0.7
L-M	17-S	R1	3.8	1.0	3.9	1.4	4.2	1.6

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TABLE 5.1-9(CONT'D) RESULTING SOUND LEVELS (dBA) ABOVE THE "NO-BUILD" SCENARIO – ALTERNATIVE 3 SURFACE ROADS ONLY (WITHOUT MITIGATION)

Route Segment	Map ID	Stamson ID	Alternative 3					
			2015		2025		2035	
			Day	Night	Day	Night	Day	Night
Receptors on the North Side of the Proposed Access Road								
GH	1A-N	R1-A	-10.3	-17.9	-10.6	-18.2	-11.1	-18.8
GH	1-N	R1	-10.3	-17.9	-10.6	-18.2	-11.1	-18.8
GH	2A-N	R2-A	-4.9	-8.9	-5.6	-10.7	-5.6	-11.0
GH	2-N	R2	-9.5	-14.5	-9.7	-14.5	-10.1	-14.9
GH	3-N	R3	-18.4	-18.4	-18.5	-18.5	-18.9	-19.0
H-I	4-N	R1	-7.0	-12.8	-7.7	-13.6	-8.0	-14.1
H-I	5-N	R2	-15.2	-18.1	-15.6	-18.7	-16.0	-19.1
H-I	6-N	R3	-14.7	-19.4	-15.4	-20.5	-15.8	-20.9
I-J	7-N	R1_1	-13.8	-17.5	-14.6	-18.4	-15.0	-19.2
I-J	7-N	R1_2	na	na	na	na	na	na
J-K Option 1	8-N	R1_1	-9.2	-14.3	-10.0	-15.2	-10.4	-15.8
J-K Option 2	8-N	R1_2	na	na	na	na	na	na
J-K Option 1	9-N	R2_1	-15.1	-19.2	-15.8	-20.1	-16.2	-20.6
J-K Option 2	9-N	R2_2	na	na	na	na	na	na
J-K Option 1	10-N	R3_1	-13.7	-17.0	-14.2	-17.8	-14.6	-18.3
J-K Option 2	10-N	R3_2	na	na	na	na	na	na
K-L Option 1	11-N	R1_1	-2.1	-7.5	-1.7	-7.3	-1.5	-7.1
K-L Option 2	12-N	R2	-1.1	-0.9	-0.8	-0.6	-0.6	-0.2
L-M	13-N	R1	3.8	0.8	3.8	1.3	4.1	1.5

Note: Bolded values indicating the sound levels exceeded 5 dB above the "no-build" scenario sound levels. The letter "A" shown in the Map and Stamson ID column in the above table denotes evaluation for the access road alternative with connection to Plaza A in order to distinguish it from the access road alternative with connection to other plazas. "na" = not applicable

TABLE 5.1-10 PREDICTED RECEPTOR NOISE IMPACT OF ALTERNATIVE 3 - NUMBER OF OCCURRENCE (WITHOUT MITIGATION)

Scenario Year	No. of Exceedances <0 dB		No. of Exceedances 0-3 dB		No. of Exceedances 4-5 dB		No. of Exceedances 6-10 dB		No. of Exceedances > 10 dB	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
2015	29	31	4	2	2	2	1	1	0	0
2025	29	30	4	3	3	1	0	2	0	0
2035	31	30	2	3	3	2	0	1	0	0

Note: the sound levels are round off to the nearest integer for the preparation of this table (e.g., 3.49 dBA ≈ 3 dBA and 3.5 dBA ≈ 4 dBA).

Most of the exceedances >5 dB are predicted to occur in the route segments from F to H along the proposed access road between Matchette Road and Pulford Street. Noise mitigation measures are to be considered in all instances where the "no-build" sound levels are exceeded by more than 5 dB due to the project. As discussed later in Section 7, the proposed mitigation measures are found to effectively reduce sound levels in most instances to within 5 dB above the no-build sound levels.

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5.1.6 Overall Comparison of Access Road Alternatives

In comparison with at-grade alternatives, the tables presented in Sections 4 and 5 have demonstrated that the below grade alternatives (1B and 2B) and tunnel alternative generate lower noise levels at the receptor locations. Of all the alternatives, Alternatives 2B and 3 had the least occurrences where the predicted project sound levels exceeded the no-build sound levels by greater than 5 dB.

When Alternative 2B is compared to Alternative 3 (not including noise from the ventilation buildings), some exceedances were observed (see Tables 5.1-7 and 5.1-9) between Malden Road to Pulford Street for both alternatives. In this same road segment, some areas of the proposed access road are at grade for Alternative 2B; whereas for Alternative 3 the shielding is provided by the tunnel which results in lower predicted overall sound levels at the receptors and less incidences of exceedances. Noise mitigation measures were considered whenever the project sound levels exceed the receptor no-build sound levels by greater than 5 dB (see Section 7 for details).

Also, receptors located on the south side of G-H segment between Malden Road to Pulford Street along the proposed access road are predicted to experience a high noise impact compared to those located on the other road segments along the proposed access road.

5.2 Noise Impact from Tunnel Portal Effect and Ventilation Building (Alternative 3)

The major noise sources associated with the tunnel option consist of the tunnel ventilation building(s) and the tunnel portals. The proposed tunnel starts at Highway 401 as it enters the City of Windsor and ends near the custom plaza, with a total length of approximately 6 km. The proposed tunnel is to be constructed such that six traffic lanes (three in each direction) can be accommodated. The following tunnel ventilation options were proposed in the RWDI document (August 2006):

- Option 1: Two ventilation buildings, each located between the portal and midpoint of the tunnel.
- Option 2: Jet fans inside the tunnel.

The noise impact associated with Option 2 (internal jet fans) is considered to be localized near the portal areas and would mainly result from the fans located near the portals. The portal noise for this option will be similar to option 1. For the purposes of this report, option 2 was not investigated further.

Therefore, only noise impacts associated with option 1 was investigated, incorporating both predicted noise from the portals as well as the ventilation buildings. Details of the noise estimation from the portals as well as the noise modelling of the ventilation buildings are summarized below.

5.2.1 Noise Results from Tunnel Portal

A key component with tunnel noise is the reverberation noise observed at tunnel portals. Previous studies undertaken to determine the increase in traffic noise levels at tunnel portals have indicated that although there is an increase in noise levels due to reverberation caused by the tunnel walls, the increase is quite localized and diminishes rapidly with distance from the portal.

The methodology summarized in Section 3.5 was carried out to determine the increase in traffic noise near tunnel portals. The traffic data used for the modelling of traffic noise at the Welland Canal is summarized in Table 5.2-1. The predicted and measured values are compared in Table 5.2-2. It should be noted that two measurements, one at each end of the Welland Canal, were collected. The arithmetic averages of the 1 minute Leq values at the two monitoring stations are 92 dBA and 86 dBA. These sound levels were measured in the close vicinity of the tunnel portal (15 m from the portal).

As was noted earlier in Section 3.3, the U.S. TRB study confirmed higher sound levels in the immediate vicinity of tunnel portals due to the reverberation effect. The results obtained by SENES, based on the traffic volumes through the Welland Canal Tunnel indicate increases of 12 and 18 dB at the two tunnel portals. For the purposes of this report, as a conservative measure the higher of the two sound levels was used in acoustic modelling of the portal, in CADNA_A.

Therefore, an increase in sound level of approximately 18 dB was added to the model predicted free-field traffic noise for the reverberation or “tunnel effect” as shown in Table 5.2-3.

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TABLE 5.2-1 PARAMETERS USED IN TRAFFIC NOISE MODELLING FOR THE PROPOSED ACCESS ROAD FOR YEAR 2035

Location	Time	HWY 401	Road Segment	Source to Receptor Distance (m)	Vehicle Count for 2035				Road Gradient	Posted Speed Limit (km/h)
					Total	Car	Truck			
							Med	Heavy		
Portal Entrance (Near HWY 3)	Day	NB	1	15	21,096	14,287	826	5,983	n/a	80
		SB	2	30	24,832	14,221	1,115	9,496	3%	
	Night	NB	1	15	4,814	3,260	188	1,365	n/a	
		SB	2	30	5,444	3,118	244	2,082	3%	
Portal Exit (Near Malden Road)	Day	NB	1	15	8,230	3,000	504	4,726	3.25%	80
		SB	2	30	17,115	5,665	1,082	10,368	n/a	
	Night	NB	1	15	3,085	1,124	189	1,771	3.25%	
		SB	2	30	4,919	1,628	311	2,980	n/a	

TABLE 5.2-2 COMPARISON OF STAMSON MODEL RESULTS AND MEASURED SOUND LEVELS AT THE WELLAND CANAL TUNNEL

Description	Start – End Time	Duration (hr)	Traffic Data		Measured Distance (m)	STAMSON Predicted (dBA)	Measured (dBA)	Tunnel Effect (dBA)
			Car	Truck				
Total Segment 1 (Northbound)	8:50 – 10:20 am	1.5	1200	120	15	N/A	N/A	N/A
Total Segment 2 (Southbound)	8:50 – 10:20 am	1.5	1061	123	30			
Total Segment 1 (Northbound)	Daytime	Hourly	800	80	15			
Total Segment 2 (Southbound)	Daytime	Hourly	707	82	30			
Total Segment 1 (Northbound)	Daytime	16 hrs	12800	1280	15	74.3	92	17.9
Total Segment 2 (Southbound)	Daytime	16 hrs	11317	1312	30		86	12

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TABLE 5.2-3 CORRECTED SPL AND PWL LEVELS FOR WINDSOR TUNNEL PORTALS

Location	Time	Model Predicted L_{eq}* (dBA)	Tunnel Effect (dB)	Calculated SPL ** (dBA)	Calculated PWL*** (dBA)
Portal Entrance (Near HWY 3)	Daytime	80	17.9	98	129.4
	Nighttime	77	17.9	95	126.2
Portal Exit (Near Malden Road)	Daytime	79	17.9	97	129.0
	Nighttime	78	17.9	96	127.6

Note:

*Leq: Sound level equivalent based on STAMSON model, for a receptor at 15 m from the center of the roadway

**SPL: Sound Pressure Level in dBA, corrected for the noise caused by the "tunnel effect"

***PWL: Sound Power Level in dBA, independent of distance, calculated based on 15 m separation distance between the source and an arbitrary receptor; as well as assuming hemi-spherical spreading

To incorporate the “tunnel effect” in the noise modelling for the tunnel option in this assessment, the proposed access road traffic for 2035 was first modelled using the STAMSON model. The traffic values used included both local and international traffic. Since the traffic data are different at each portal (entering tunnel from Highway 401 versus exiting to custom plaza) two separate model runs were completed, one for each portal. The STAMSON model runs are presented in Appendix C.

Based on the SENES’ field observations of tunnel portal noise dissipation, as well as other related published documents, including the research work completed by the U.S. TRB and the Australia East Link studies, it is determined that the noise reverberation at the tunnel portals is quite localized and does not extend beyond a short distance from the portals. The U.S. TRB study confirmed that the reverberation effect decreases rapidly to the point where the effect is completely neutralizes by ambient traffic at a distance of about 20 to 23 m (60 to 70 ft).

Therefore, for the purposes of this assessment, given that there are no receptors within the areas of potential noise impact from the tunnel portal, the reverberation effect was considered negligible and thus was not included in the impact assessment.

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It should be noted that the following figures provided in Section 5.2 of the report pertain to noise emitted from the ventilation buildings only.

5.2.2 Noise from Tunnel Ventilation Building

There are two separate ventilation buildings. For option 1, the dimension of the two proposed buildings have footprint of 75 m x 30 m. The building height is 18m and stack height is 2.5 times the building height or 45 m (for good dispersion of pollutants). All the inlets and exhausts were modelled as point sources. The ventilation buildings are two storey structures, with inlet (supply fans) and exhausts located on both floors. For each inlet, two point sources, one with an elevation of 4.5 m and the other with an elevation of 15.3 m were used (one for each floor). In order to incorporate directivity for the stack to comply with the CADNA_A modelling procedures, the source was placed at the top point of the stack and was assigned an elevation of 0.01 m less than top of the stack (44.99 m).

The inlet and exhaust noise levels were assumed to be the same as shown in Table 5.2-4.

TABLE 5.2-4 SOUND POWER LEVEL (PWL) SPECTRUM FOR VENT FANS

	Frequency (Hz)								A-weighted	Lin
	31.5	63	125	250	500	1000	2000	4000	8000		
PWL (dB)	112	112	108	105	101	95	88	82	76	102.2	116.3

To assess the impact of the tunnel ventilation noise, modelling was conducted to determine the separation distances needed from the tunnel building to achieve sound levels of 45, 50 and 55 dBA. The sound levels of 45 and 50 dBA represent the minimum MOE nighttime and daytime sound level limits for a stationary source; in this case the ventilation building, in an urban area, as stipulated in NPC-205. The sound level of 55 dBA represents the minimum noise criterion for receptors associated with the DRIC project.

Figures 5.2-1 provide predicted separation distances from the ventilation building to achieve sound levels of 45, 50 and 55 dBA, for Option 1A and 1B, respectively. As expected, the figures show that the greatest separation distance is required for achieving the 45 dBA limit.

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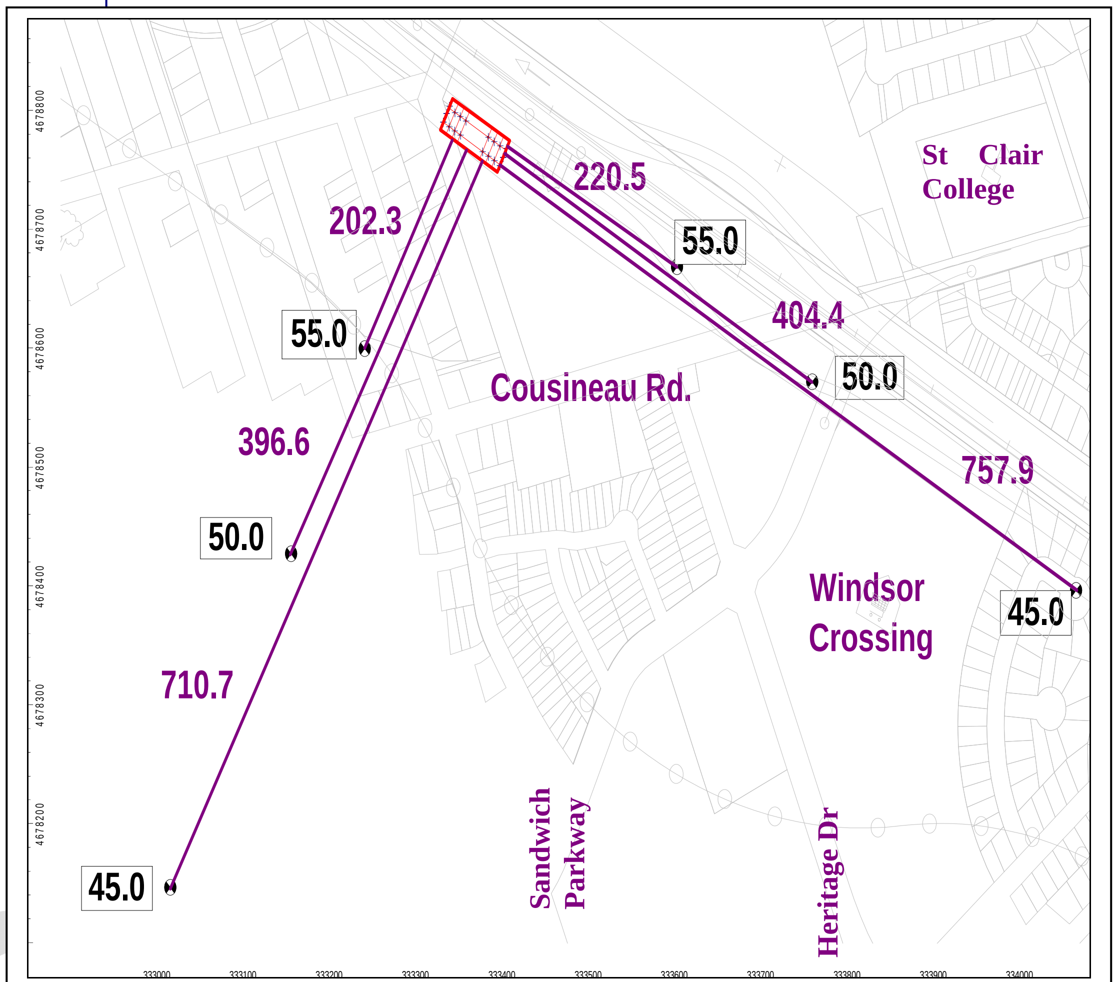
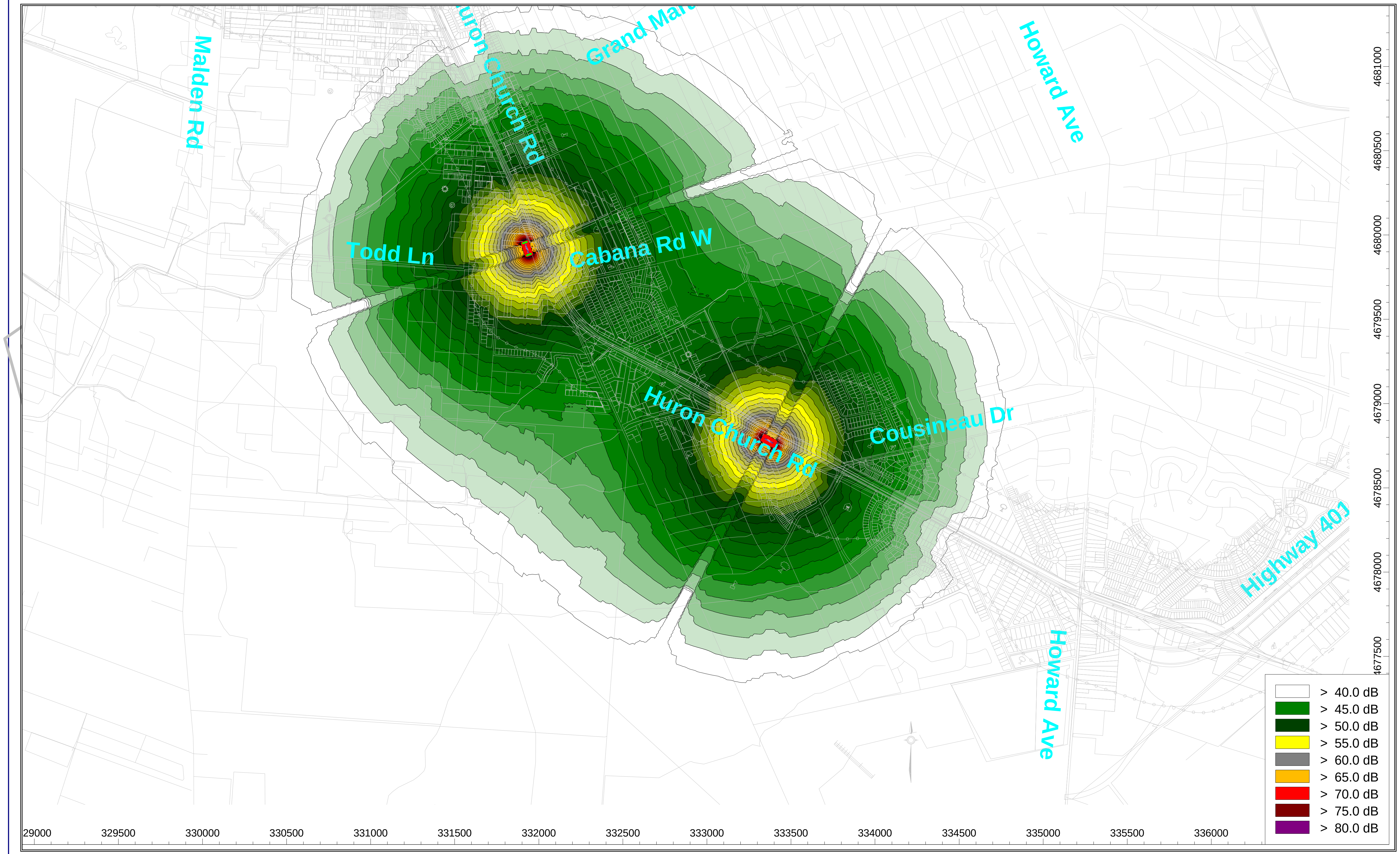
FIGURE 5.2-1 SEPARATION DISTANCES (M) FOR OPTION 1A – VENTILATION BUILDING – NO MITIGATION



Note: The purple coloured values are the separation distances (m), the values shown in boxes are the L_{eq} sound levels (dBA).

The un-mitigated daytime noise level contours for tunnel ventilation are presented graphically in Figure 5.2-2. It should be noted that the reason for the appearance of more colour gradations in the noise contour figure is that each contour line in the figures represents 1 dB interval whereas the colour in the legend represents every 5 dB interval. The colour of each 1 dB interval within a 5 dB interval have colour in shades that are between the first and the next 5 dB interval.

FIGURE 5.2-2 NOISE LEVEL CONTOURS FOR THE TUNNEL OPTION 1A – INCLUDING VENTILATION BUILDINGS AND PORTALS - DAYTIME



Note: Each contour line represents 1 dB interval

5.3 Noise Assessment for Plazas and Crossings

Noise modelling was undertaken for the plaza/crossing alternatives based on traffic volumes projected for the years 2015, 2025, and 2035. The modelling exercise was performed in two stages.

1. First, the future no-build noise levels were established for receptors in Sandwich Towne and in the Ojibway Parkway to Malden Road area for each of the years 2015, 2025, and 2035 using the CADNA_A noise model. These runs provided the no-build sound levels to which the project noise levels were compared.
2. Once the future no-build levels were established, the traffic sources associated with the project were added to the model for each plaza and crossing alternative.

In cases where the project sound levels were found to exceed the no-build sound level by greater than 5 dB, a 4 m high acoustic barrier was modelled on the crossings for noise attenuation. A 5 m acoustic barrier was modelled on relevant segments of the proposed access road where similar exceedances were observed. Mitigation measures are discussed in Section 7 of this report.

As was mentioned in Section 3.6, the impact of all the plaza/crossing alternatives were assessed for two groups of receptors, 21 in Sandwich Towne and 13 in the area between Ojibway Parkway and Malden Road. The combination of receptors identified in the Ojibway Parkway to Malden Road area and Brighton Beach communities that are used in the evaluation of plaza/crossing option is shown in Table 5.3-1.

TABLE 5.3-1 RECEPTOR LOCATIONS EVALUATED FOR EACH OF THE PLAZA/CROSSING COMBINATION

	Plaza A Crossing A	Plaza A Crossing B	Plaza A Crossing C1	Plaza A Crossing C2	Plaza B Crossing C	Plaza B1 Crossing B	Plaza C Crossing C
R22	√	√	√	√	√	√	√
R23	√	√	√	√	√	√	√
R24	√	√	√	√	√	√	√
R25	√	displaced	√	√	displaced	displaced	displaced
R26	√	√	√	√	displaced	displaced	displaced
R27	√	√	√	√	√	√	√
R28	√	√	√	√	na	na	na
R29	√	√	√	√	na	na	na
R30	√	√	√	√	√	√	√
R31	displaced	displaced	displaced	displaced	√	√	√
R32	displaced	displaced	displaced	displaced	√	√	√
R33	displaced	displaced	displaced	displaced	√	√	√
R34	displaced	displaced	displaced	displaced	√	√	√

Note: √ - Receptor assessed
Displaced – Receptor is likely to be displaced by the proposed option
na – Receptor is too distant to be impacted by the proposed option

Of all the crossing and plaza combinations, the modelling results indicate that most Sandwich Towne receptors are unlikely to be impacted by the project, except for some of the residential receptors closes to Crossing C, in particular R1 to R8 (see Figure 5.3-1). The impacted area in the Sandwich Towne is generally bound by Watkin Street and Essex Terminal Railway. The Plaza A to Crossing C combination, using Approach C2 (Via Ojibway Parkway) is closest to the receptors in Sandwich Towne. This combination showed the highest potential for noise impact in Sandwich Towne. The data show that there is a likelihood that some of the residents in Sandwich Towne could potentially be exposed to traffic noise levels from Plaza A to Crossing C that would exceed the future no-build sound levels by 10 dB or higher, as shown in Tables 5.3-2 to 5.3-7.

FIGURE 5.3-1 NOISE RECEPTORS SELECTED FOR MODELLING IN SANDWICH TOWNE

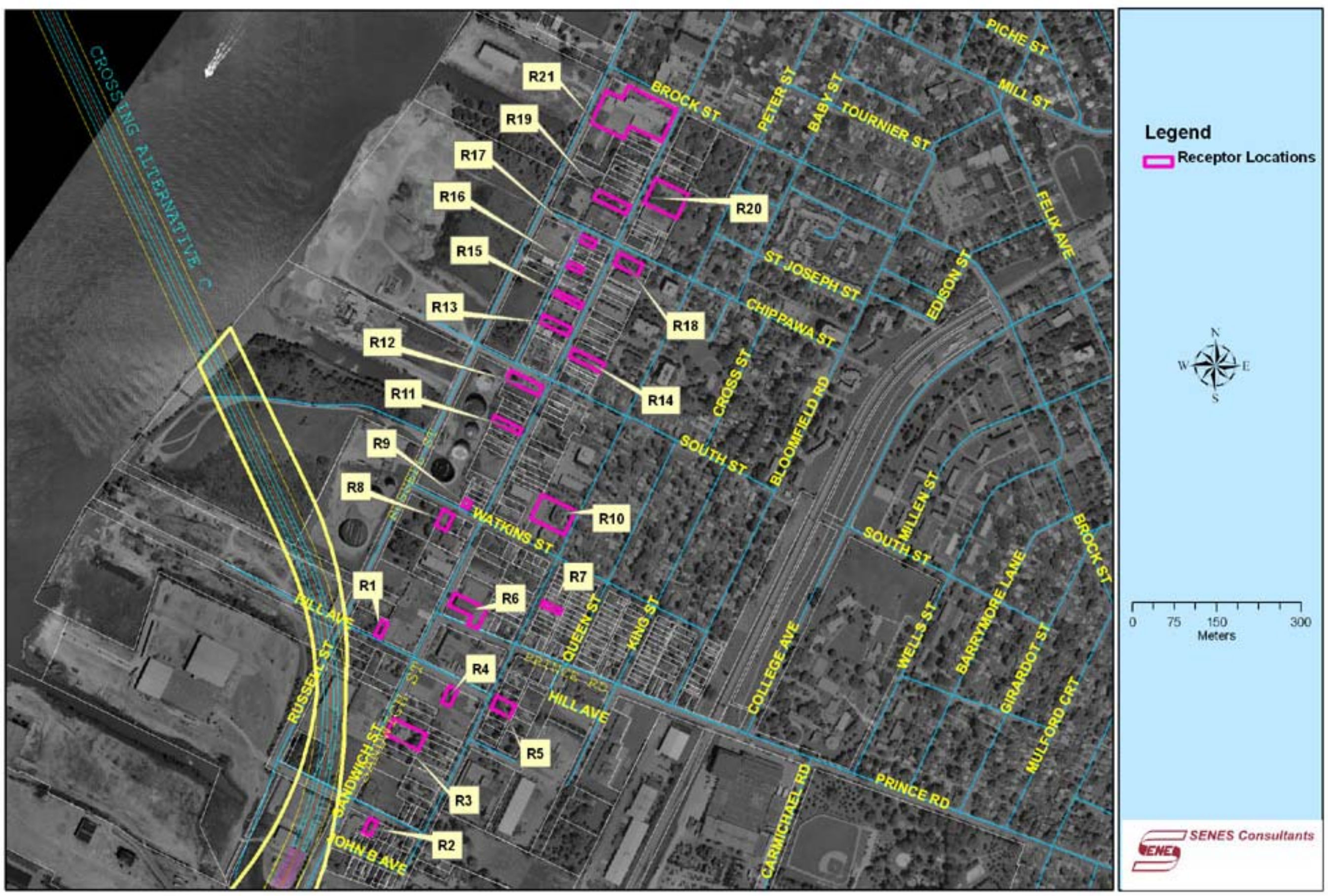


TABLE 5.3-2 DAYTIME NOISE LEVELS AT RECEPTORS R1-R21 (2015) (PLAZA A TO CROSSING C VIA OJIBWAY PARKWAY) – NO MITIGATION

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)
R1	58.1	68.6	**10.5**
R2	58.9	68.5	**9.6**
R3	59	66.7	**7.7**
R4	57.3	63.2	**5.9**
R5	53.9	59.9	**6**
R6	60	62.9	2.9
R7	54.1	58.2	4.1
R8	58.6	63	4.4
R9	60.6	63.2	2.6
R10	55.9	59.1	3.2
R11	59.1	61.3	2.2
R12	61.1	62.3	1.2
R13	62.8	63.7	0.9
R14	60.5	61.5	1
R15	59.9	61	1.1
R16	60.7	61.6	0.9
R17	60.5	61.3	0.8
R18	60.9	61.6	0.7
R19	59.7	60.6	0.9
R20	68	68.4	0.4
R21	58.1	58.9	0.8

TABLE 5.3-3 NIGHTTIME NOISE LEVELS AT RECEPTORS R1-R21 (2015) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY) – NO MITIGATION

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)
R1	52.9	66.1	**13.2**
R2	54.9	66.6	**11.7**
R3	60.8	67.2	**6.4**
R4	52.9	60.8	**7.9**
R5	48.6	57.4	**8.8**
R6	63.3	65.2	1.9
R7	49	55.8	**6.8**
R8	53.1	60	**6.9**
R9	55.8	59.8	4
R10	53.7	57.4	3.7
R11	59.5	61.1	1.6
R12	59.6	60.8	1.2
R13	54.3	56.6	2.3
R14	62.4	63.1	0.7
R15	61.8	62.6	0.8
R16	54.3	56.1	1.8
R17	55.1	56.5	1.4
R18	62.1	62.7	0.6
R19	59.7	60.5	0.8
R20	62.2	62.8	0.6
R21	61.9	62.6	0.7

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TABLE 5.3-4 DAYTIME NOISE LEVELS AT RECEPTORS R1-R21 (2025) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY) – NO MITIGATION

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)
R1	58.3	69.6	**11.3**
R2	59.1	69.4	**10.3**
R3	59.2	67.6	**8.4**
R4	57.6	64.1	**6.5**
R5	54.3	60.8	**6.5**
R6	60.4	63.6	3.2
R7	54.5	59	4.5
R8	58.8	63.7	4.9
R9	60.9	63.8	2.9
R10	56.2	59.7	3.5
R11	59.3	61.8	2.5
R12	61.3	62.7	1.4
R13	63.1	64.1	1
R14	60.7	61.8	1.1
R15	60.1	61.4	1.3
R16	60.9	62	1.1
R17	60.6	61.6	1
R18	61	61.8	0.8
R19	59.9	60.9	1
R20	68	68.2	0.2
R21	58.3	59.2	0.9

TABLE 5.3-5 NIGHTTIME NOISE LEVELS AT RECEPTORS R1-R21 (2025) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY) – NO MITIGATION

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)
R1	53.1	67.1	**14**
R2	55.2	67.5	**12.3**
R3	61.1	68	**6.9**
R4	53.2	61.7	**8.5**
R5	48.8	58.4	**9.6**
R6	63.6	65.7	2.1
R7	49.2	56.7	**7.5**
R8	53.3	60.9	**7.6**
R9	56	60.5	4.5
R10	53.9	58.1	4.2
R11	59.8	61.4	1.6
R12	59.8	61.1	1.3
R13	54.5	57	2.5
R14	62.6	63.5	0.9
R15	62.1	62.8	0.7
R16	54.6	56.5	1.9
R17	55.4	56.9	1.5
R18	62.3	63.1	0.8
R19	60	60.7	0.7
R20	62.4	63.1	0.7
R21	62.2	62.7	0.5

TABLE 5.3-6 DAYTIME NOISE LEVELS AT RECEPTORS R1-R21 (2035) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY) – NO MITIGATION

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dbA)
R1	57.7	71.2	**13.5**
R2	58.2	71	**12.8**
R3	58.4	69.1	**10.7**
R4	56.8	65.4	**8.6**
R5	53.8	62.2	**8.4**
R6	60	64.6	4.6
R7	54.1	60.2	**6.1**
R8	58.2	64.9	**6.7**
R9	60.1	64.7	4.6
R10	55.4	60.7	**5.3**
R11	58.7	62.6	3.9
R12	60.8	63.2	2.4
R13	62.3	64.4	2.1
R14	59.9	62.3	2.4
R15	59.4	61.9	2.5
R16	60.2	62.4	2.2
R17	60	62	2
R18	60.3	62.2	1.9
R19	59.2	61.3	2.1
R20	67	68.8	1.8
R21	57.7	59.5	1.8

TABLE 5.3-7 NIGHTTIME NOISE LEVELS AT RECEPTORS R1-R21 (2035) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY) – NO MITIGATION

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dbA)
R1	53.3	69	**15.7**
R2	55.4	69.3	**13.9**
R3	61.4	69.6	**8.2**
R4	53.4	63.4	**10**
R5	49	60.1	**11.1**
R6	63.9	66.5	2.6
R7	49.4	58.3	**8.9**
R8	53.5	62.5	**9**
R9	56.2	61.8	**5.6**
R10	54.2	59.4	**5.2**
R11	59.9	62.1	2.2
R12	59.9	61.7	1.8
R13	54.7	58	3.3
R14	63	63.9	0.9
R15	62.1	63.2	1.1
R16	54.7	57.3	2.6
R17	55.5	57.5	2
R18	62.8	63.4	0.6
R19	60	61.1	1.1
R20	62.8	63.5	0.7
R21	62.2	63	0.8

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The tables summarize the model outputs for each of the receptor locations shown on Figure 5.3-1 for the 'worst-case scenario' (Plaza A Crossing C, via Ojibway Parkway), including the future no-build (background) noise levels, and the noise levels with no barrier. The full complement of model results is included in Appendix D.

As was the case in Sandwich Towne, in most cases the project is expected to have little to no impact on residents in the Ojibway Parkway to Malden Road area; however, the data also indicate that there are receptor locations where the project noise levels exceed the no-build noise levels by > 5dB, to a maximum of approximately 30 dB. In such cases, mitigation measures are to be considered. These mitigation measures are discussed in Section 7 of this report.

Tables 5.3-8 to 5.3-13 below summarize the model outputs for the 'worst-case scenario' (Plaza A, Crossing C, via Brighton Beach) for each of the receptor locations in the Ojibway Parkway to Malden Road area shown on Figure 5.3-2. This Plaza/Crossing combination is closest to receptors in the Ojibway Parkway to Malden Road areas and Brighton Beach areas. The tables show the future no-build (background) noise levels, and the noise levels due to the plaza and crossing with no barrier in place (i.e., before mitigation). Results associated with other plaza and crossing combinations are provided in Appendix D.

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FIGURE 5.3-2 NOISE RECEPTORS SELECTED FOR MODELLING IN OJIBWAY PARKWAY TO MALDEN ROAD AREA

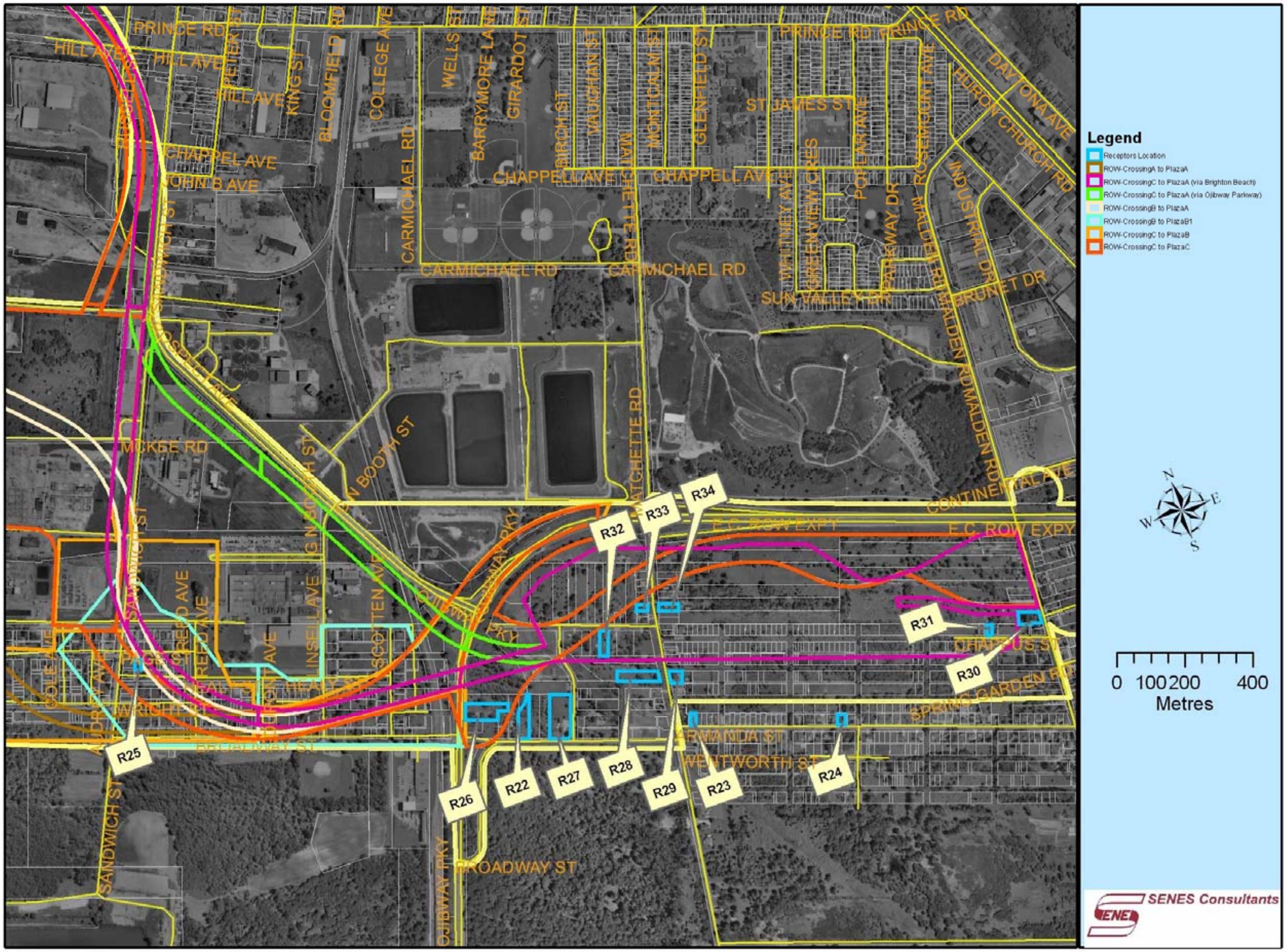

Table 5.3-8 Daytime Noise Levels at Receptors in the Ojibway Parkway to Malden Road Area (2015) -Plaza A to Crossing C Via Brighton Beach – No Mitigation

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)
R22	55.6	61.2	5.6
R23	59.1	58.5	-0.6
R24	56.7	58.1	1.4
R25	45.6	71.5	25.9
R26	60	67.3	7.3
R27	54.7	60	5.3
R28	59	57	-2
R29	59.5	56.8	-2.7
R30	61.3	65.7	4.4

Table 5.3-9 Nighttime Noise Levels at Receptors in the Ojibway Parkway to Malden Road Area (2015) - Plaza A to Crossing C Via Brighton Beach – No Mitigation

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)
R22	49	58.3	9.3
R23	52.8	54	1.2
R24	50.6	53.4	2.8
R25	39.9	69.6	29.7
R26	53.7	62.8	9.1
R27	48.1	56.7	8.6
R28	52.7	55	2.3
R29	53.7	54.9	1.2
R30	57.6	62.3	4.7

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TABLE 5.3-10 DAYTIME NOISE LEVELS AT RECEPTORS IN THE OJIBWAY PARKWAY TO MALDEN ROAD AREA (2025) - PLAZA A TO CROSSING C VIA BRIGHTON BEACH – NO MITIGATION

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)
R22	56	62	6
R23	59.6	59.1	-0.5
R24	57.1	58.8	1.7
R25	45.9	72.5	26.6
R26	60.5	67.9	7.4
R27	55.1	60.9	5.8
R28	59.3	57.8	-1.5
R29	60	57.6	-2.4
R30	61.8	66.6	4.8

TABLE 5.3-11 NIGHTTIME NOISE LEVELS AT RECEPTORS IN THE OJIBWAY PARKWAY TO MALDEN ROAD AREA (2025) - PLAZA A TO CROSSING C VIA BRIGHTON BEACH– NO MITIGATION

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dbA)
R22	49.5	59.3	9.8
R23	53.4	54.7	1.3
R24	51.1	54.4	3.3
R25	40.3	70.7	30.4
R26	54.2	63.6	9.4
R27	48.6	57.5	8.9
R28	53.1	55.6	2.5
R29	54.3	55.5	1.2
R30	58.3	63.8	5.5

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Table 5.3-12 Daytime Noise Levels at Receptors in the Ojibway Parkway To Malden Road Area (2035) - Plaza A to Crossing C via Brighton Beach – No Mitigation

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)
R22	56.3	62.7	6.4
R23	59.9	59.5	-0.4
R24	57.5	59.3	1.8
R25	46.2	73.3	27.1
R26	60.8	68.4	7.6
R27	55.4	61.6	6.2
R28	59.8	58.3	-1.5
R29	60.2	58.1	-2.1
R30	63.3	67.3	4

Table 5.3-13 Nighttime Noise Levels at Receptors in the Ojibway Parkway to Malden Road Area (2035) - Plaza A to Crossing C via Brighton Beach – No Mitigation

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)
R22	50.1	60	9.9
R23	53.7	55.1	1.4
R24	51.6	55.1	3.5
R25	40.7	71.4	30.7
R26	54.9	64.2	9.3
R27	49.2	58.1	8.9
R28	53.6	56	2.4
R29	54.5	55.9	1.4
R30	59.5	64.8	5.3

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6. Vibration Impact Assessment

6.1 Baseline Vibration Monitoring

Existing (2006) ground vibration levels were measured at two locations (side by side) in each of the eight receptor sites (see Figure 3.2-1 in Section 3.2). Receptors for vibration monitoring were selected to reflect areas of potentially elevated vibration levels such as locations in close proximity to heavy traveled roads, near overpasses, bridges, curved roads, with accelerating traffic, as well as locations where free flowing traffic travel at higher speeds. The two measurement locations were separated by a distance of 6 inches. Two stakes were driven to a depth of 12 inches into the ground and the transducers were attached through magnet to the stakes. The vibration levels are reported in terms of velocity in mm/sec from 5 Hz to 200 Hz in one-third octave band intervals. The vibration level is the rms (root mean square) maximum level in each frequency band measured during the traffic pass-by. The traffic was traveling at varying speeds during each event.

The vibration measurements were taken using two Bruel & Kjaer (B&K) 4370 accelerometers which were the main transducers. One of the transducers was connected to a Hewlett-Packard two-channel real time analyzer through a B & K 2635 charge amplifier. The second transducer was connected to a B & K type 2306 chart recorder through a B & K vibration meter to measure the time history plot. Both the meters were set to read vibration velocity from 1 Hz to 1 KHz.

The traffic events at each location were monitored over a period of 30 minutes. About 15 minutes were recorded by the chart recorder. Two twelve minute periods were measured by the analyzer to produce two spectrum plots. The traffic events are identified in Table 6.1 below. The events were monitored on two different days to identify any differences in the vibration patterns. (Note: If traffic is busy, the truck speed reduces considerably, thereby reducing the vibration signal).

TABLE 6.1 TRAFFIC DESCRIPTION

Location	Date & Time	
	2006/06/28	2006/06/29
Location 1	8 am to 8.30 am	11.25 to 11.55 am
Location 2	9.15 am to 10 am	1.45 to 2.15 pm
Location 3	10.15 am to 10.45 am	2.30 to 3 pm
Location 4	11.15 am to 11.45 am	10.45 to 11.15 am
Location 5	12 to 12.30 pm	9.45 to 10.15 am

Location	Date & Time	
	2006/06/28	2006/06/29
Location 6	1.15 to 1.45 pm	9 to 9.30 am
Location 7	2 to 2.30 pm	8 to 8.30 am
Location 8	2.30 to 3 pm	7.15 to 7.45 am

<u>Receptor Locations</u>

Eight Receptor Locations were chosen to measure pre-modification vibration levels. The eight locations are:

1) The grassy area adjacent to the roadway at the house, between 1140 and 1202 Talbot Street.
2) Adjacent to the West sidewalk opposite to the church (at the foundation block of the Ambassador Bridge – the 5th Block south of Riverside Avenue).
3) Adjacent to the sidewalk of the cul-de-sac at the end of Mill Street.
4) The grassy area adjacent to the roadway (east side of Huron Church Road) outside the Heritage Park Alliance Church.
5) In the park near the cul-de-sac at the end of Northway Avenue.
6) Just south of the Railway tracks at the intersection of Ojibway Parkway and Broadway).
7) Just north of the EC Row Expressway (west side) at 4340 Malden Road.
8) Near the sidewalk of the turn-around-loop on Huron Church Road – opposite to 3495 Huron Church Road.

6.2 Key Results

All access road alternatives were reviewed to identify residences, hospitals and other potentially vulnerable receptors, within 25 m of the right-of-way (ROW). The vibration measurements were conducted within 5 m of the edge of the roadway and for the most part, the levels measured were within the threshold of perception limit of 0.14 mm/sec for all locations tested in the area of continued analysis (ACA). The monitoring results are illustrated graphically and are provided in Appendix E in graphical format. These levels do not decay very much with distance at close proximities to the road edges and should the roadway contain an expansion joint, etc., these levels may increase to the threshold level of perception. Hence, as a precautionary measure, receptors within 25 m of the ROW were counted as potential locations where vibration levels could potentially reach the threshold value of 0.14 mm/sec. The number of houses that might potentially experience vibration

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level exceeding 0.14 mm/sec vibration frequency is presented in Tables 6.2-1 and 6.2-2 for the combination of plaza and crossing and access road alternatives.

There are several route segments with receptors within 25 m of the ROW. As noted above, at this distance, there is a potential for receptors along the proposed access road alternative to experience vibration levels near the threshold value of 0.14 mm/sec. The area along Highway 401 from Malden Road to Pulford Street potentially has the highest number of receptors within 25 m of the ROW. The area along the proposed access road from north of Lennon Drain to Cousineau Road potentially has the least number of receptors within 25 m of the ROW.

Overall, none of the access road alternatives are expected to cause vibrations in the 50 mm/sec range for all locations tested in the ACA; therefore, no structural damage is anticipated from vehicular traffic.

TABLE 6.2-1 NUMBER OF HOUSES WITH POTENTIAL TO EXPERIENCE VIBRATION EXCEEDING 0.14 mm/sec NEAR THE PROPOSED PLAZAS AND CROSSINGS

Alternatives	Segment	No. of Houses
	Plaza A	
From Crossing A	Crossing A to Malden Road	4
From Crossing B	Crossing B to Malden Road	12
From Crossing (via Brighton Beach)	Crossing C to Malden Road	13
From Crossing (via Ojibway Parkway)	Crossing C to Malden Road	11
	Plaza B	
From Crossing C	Crossing C to GN Booth	3
From Crossing C	GN Booth to Ojibway Parkway	0
From Crossing C	Ojibway Parkway to Malden Road	23
	Plaza B1	
From Crossing B	Crossing B to Ojibway Parkway	3
From Crossing B	Ojibway Parkway to Malden Road	23
	Plaza C	
From Crossing C	Crossing C to Sandwich Street	1
From Crossing C	Sandwich Street to GN Booth	3
From Crossing C	GN Booth to Ojibway Parkway	0
From Crossing C	Ojibway Parkway to Malden Road	23

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Table 6.2-2 Number of Houses with Potential to Experience Vibration Exceeding 0.14 mm/sec Near Access Road Alternatives

Alternatives	Criteria/Indicator	No. of Houses on the Proposed Hwy 401	Malden Rd to Pulford		Pulford North of Lennon Drain	North of Lennon Drain to Cousineau Rd		Cousineau Road to Howard Ave		Howard Ave to Highway 401	Highway 3 to North Talbot Rd
			G-H		H-I	I-J		J-K		K-L	L-M
			Connection to Plaza A	Connection to Other Plazas		Option 1	Option 2	Option 1	Option 2		
Alt 1A	# of sensitive receptors with vibration exceeding 0.14 mm/sec vibration frequency	North Side of the Proposed Hwy 401	26	22	10	8 + 1 church	7 + 1 church	1	12	3	2
		South Side of the Proposed Hwy 401	40	31	11	3	4	17	39	38	65
Alt 1B	# of sensitive receptors with vibration exceeding 0.14 mm/sec vibration frequency	North Side of the Proposed Hwy 401	36	21	10	8 + 1 church	7 + 1 church	na	12	3	2
		South Side of the Proposed Hwy 401	35	32	10	3	3	17	36	38	65
Alt 2A	# of sensitive receptors with vibration exceeding 0.14 mm/sec vibration frequency	North Side of the Proposed Hwy 401	23	21	8	1 church	5 + 1 church	22	13	3	2
		South Side of the Proposed Hwy 401	7	3	4	3	0	15	0	38	65
Alt 2B	# of sensitive receptors with vibration exceeding 0.14 mm/sec vibration frequency	North Side of the Proposed Hwy 401	25	18	4	1 church	5 + 1 church	22	13	3	2
		South Side of the Proposed Hwy 401	7	3	4	3	0	15	0	38	65
Alt 3	# of sensitive receptors with vibration exceeding 0.14 mm/sec vibration frequency	North Side of the Proposed Hwy 401	36	30	9	2	na	40	na	3	2
		South Side of the Proposed Hwy 401	30	16	4	1 church	na	21	na	38	65

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7. Noise Mitigation Assessment

Noise mitigation measures were investigated and additional assessment were undertaken for cases where the predicted project noise levels at the closest receptor exceeded the "no-build" scenario by > 5 dB.

7.1 Noise Mitigation Measures for Non-tunnelled Access Road Alternatives

For each route segment where exceedances of greater than 5 dB above the no-build noise levels was predicted, the effect of a 5 m high noise barrier was estimated for either the receptor with the highest estimated exceedance, or the area within the segment with the highest cluster of homes. Based on the predicted sound levels, acoustic barriers will be needed for several route segments as outlined in Table 7.1-1. The affected receptors are listed in Table 7.1-2.

TABLE 7.1-1 ACCESS ROAD SEGMENTS REQUIRING ACOUSTIC BARRIERS

Access Road Alternatives	1A		1B	2A			2B	3
Route Segment	Malden Road to Pulford Street (G-H)	Cousineau Road to Howard Avenue (J-K, Options 1 & 2)	Malden Road to Pulford Street (G-H)	Malden Road to Pulford Street (G-H)	Pulford Street to North of Lennon Drain (H-I)	Cousineau Road to Howard Avenue (J-K, Option 2)	Malden Road to Pulford Street (G-H)	Malden Road to Pulford Street (G-H)

Most of the receptors located on the south side of the proposed access road in the G-H segment (between Malden Road and Pulford Street) had sound level exceedances greater than 5 dB above the no-build scenarios for all alternatives for all three scenario years. For receptors located on the north side of the proposed access road, no noise exceedances were greater than 5 dB above the no-build scenarios. The resulting sound levels with mitigation are provided in Table 7.1-2.

In all cases, the 5 m high noise barrier was effective in reducing the predicted project noise to within 5 dB of the estimated baseline noise levels (see Table 7.3), except for Alternative 1A Receptor 2A-S, and Alternative 1B Receptor 2A-S, due to its close proximity to the proposed access road. In these cases, higher noise barriers were used and the results are also provided in Tables 7.1-.2 and 7.1-3 (see grey-shaded values).

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TABLE 7.1-2 MITIGATED SOUND LEVELS WITH A 5 M HIGH BARRIER[1]

	Route Segment	Map ID	Stamson ID	Un-mitigated Sound Levels (dBA) 2015 Day	2015 Night	2025 Day	2025 Night	2035 Day	2035 Night	Mitigated Sound Levels (dBA) 2015 Day	2015 Night	2025 Day	2025 Night	2035 Day	2035 Night
Alternative 1A	GH	2A-S	R2-A	72.7	71.2	73.8	72.8	74.9	74.1	60.3	58.0	61.2	59.4	62.9 62.6*	60.9 60.5*
	J-K Option 2	14-S	R2_2	72.5	68.9	73.8	70.4	74.7	71.3	63.4	63.6	64.5	63.9	65.3	66.0
	J-K Option 1	10-N	R3_1	68.5	65.0	70.0	66.7	70.9	67.6	58.7	54.9	59.9	56.3	60.7	57.2
	J-K Option 2	10-N	R3_2	68.1	64.6	69.5	66.2	70.4	67.2	58.3	54.5	59.5	55.9	60.3	56.8
Alternative 1B	GH	2A-S	R2-A	69.8	68.4	71.1	70.3	72.2	71.6	61.1 60.6*	59.1 58.5*	62.2 61.3**	60.9 59.7**	63.1 61.8***	62.1 60.4***
Alternative 2A	GH	2A-S	R2-A	67.8	64.8	69.2	67.1	70.1	68.3	61.5	57.5	62.4	59.4	63.1	60.5
	H-I	7-S	R1	67.5	62.9	69.2	65.3	70.2	66.8	59.3	55.5	60.8	57.5	61.7	58.8
	J-K Option 2	14-S	R2_2	74.7	70.3	76.2	72.0	77.0	73.2	63.5	60.4	65.1	62.2	66.0	63.4
Alternative 2B	GH	2A-S	R2-A	67.8	64.8	69.2	67.1	70.1	68.3	61.5	57.5	62.4	59.4	63.1	60.5
Alternative 3	GH	1A-S	R1-A	67.0	63.4	68.0	65.4	68.6	66.5	64.4	59.0	65.0	60.3	65.4	61.1

Note: [1] 5 m high barrier unless otherwise specified (see grey-shaded values). * Mitigation with 5.5 m high barrier; ** Mitigation with 6.0 m high barrier.
*** Mitigation with 6.5m high barrier

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TABLE 7.1-3 RESULTING EXCEEDANCES (dB) ABOVE THE "NO-BUILD" SCENARIO SOUND LEVELS WITH A 5 M HIGH BARRIER[1]

				Incremental Sound Level above baseline (dB)					
	Route Segment	Map ID	Stam-son ID	2015		2025		2035	
				Day	Night	Day	Night	Day	Night
Alternative 1A	GH	2A-S	R2-A	3	4	3	5.0	4.5 4.2*	5.8 5.3*
	J-K Option 2	14-S	R2_2	0	0	0	0	0	0.1
	J-K Option 1	10-N	R3_1	-5	-8	-4	-8	-4	-8
	J-K Option 2	10-N	R3_2	-5	-9	-5	-8	-4	-8
Alternative 1B	GH	2A-S	R2-A	4 3*	5.6 5.0*	4.4 3.5**	6.5 5.3**	4.7 3.5***	7.0 5.3***
Alternative 2A	GH	2A-S	R2-A	4	4	5	5	5	5
	H-I	7-S	R1	0	0	0	0	0	0
	J-K Option 2	14-S	R2_2	0	0	0	0	0	0
Alternative 2B	GH	2A-S	R2-A	4	4	5	5	5	5
Alternative 3	GH	1A-S	R1-A	0.1	2	0	2	-2	1

Note: [1] unless otherwise specified (see grey-shaded values).
* Mitigation with 5.5 m high barrier
** Mitigation with 6.0 m high barrier
*** Mitigation with 6.5 m high barrier
Bolded values indicating values exceeded 5 dB above the corresponding "no-build" scenarios

For comparison purposes, the predicted incremental sound levels for all alternatives are shown in Table 7.1-4. Results for the worst-case traffic noise year, 2035, is used for this comparison. The negative values indicate occurrences when the project sound levels are predicted to be lower than those without the proposed project, or the no-build option. As can be seen in Table 7.1-4 below, Alternative 3 has the most occurrences where receptor sound levels are predicted to improve (i.e., < 0 increase in sound levels) and the least occurrences of exceedances that are greater than 5 dB above the 2035 baseline levels.

TABLE 7.1-4 PREDICTED INCREMENTAL SOUND LEVELS (dB) FOR ALL ALTERNATIVES IN HORIZON YEAR 2035 -WITH MITIGATION

Route Segment	Map ID	Baseline Sound Level (dBA)		Incremental Sound Level (dB)									
				1A		1B		2A		2B		Alt 3	
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Receptors on the South Side													
GH	1A-S	67.0	60.1	-2.7	-1.7	-2.3	-1.2	<5*	<5*	<5*	<5*	-1.6	1.1
GH	1-S	67.0	60.1	<5*	<5*	-0.7	4.9	<5*	<5*	<5*	<5*	<5*	<5*
GH	2A-S	58.4	55.2	4.5	5.8	4.7	7.0	4.7	5.3	4.7	5.3	-0.6	-2.9
GH	2-S	58.4	55.2	1.7	2.5	1.8	6.2	2.0	2.8	2.0	2.8	-0.3	-2.6
GH	3A-S	59.4	56.9	3.4	3.8	3.5	4.0	3.7	4.2	3.7	4.2	-3.0	-5.6
GH	3-S	59.4	56.9	-0.1	-0.3	0.0	0.0	0.7	0.6	0.7	0.6	-3.0	-5.6
GH	4A-S	62.4	60.3	3.1	1.8	<5*	<5*	-1.9	-1.2	-2.0	-0.8	4.8	3.6
GH	4-S	62.4	60.3	2.8	1.3	3.4	2.4	-2.8	-2.6	-2.9	-2.2	-1.7	-4.7
G-H	5-S	66.0	63.9	3.2	2.7	-6.7	-7.5	-0.9	-0.7	-5.5	-6.4	-12.6	-12.3
G-H	6-S	63.3	70.0	3.8	3.1	-4.0	-13.7	<5*	<5*	-1.8	-11.4	-13.8	-18.3
H-I	7-S	62.2	59.9	4.4	3.0	-4.4	-6.1	-0.5	-1.1	-1.9	-3.7	-14.6	-20.5
H-I	8-S	61.0	57.3	-2.1	-2.7	-1.0	-2.2	-0.8	-1.3	-1.0	-1.6	0.0	-6.2
H-I	9-S	58.6	55.1	-1.9	-2.4	-1.0	-2.0	-0.4	4.6	-0.7	-1.1	1.5	-6.3
H-I	10-S	60.3	58.7	-1.8	-4.7	-5.9	-7.9	-5.1	-6.8	-5.2	-6.8	-14.8	-20.0
I-J Option 1	11-S	63.7	61.9	1.4	0.4	-7.2	-8.4	4.7	3.5	-5.6	3.5	-13.7	-16.0
I-J Option 2	11-S	63.7	61.9	1.5	0.5	-7.1	-8.3	0.0	0.0	0.0	0.0	na	na
I-J Option 1	12-S	63.6	61.3	-4.9	-6.4	-5.3	-7.0	1.7	1.5	0.4	0.1	-6.2	-8.8
I-J Option 2	12-S	63.6	61.3	-4.4	-5.8	-4.8	-6.3	2.3	2.0	-5.1	-6.1	na	na
J-K Option 1	13-S	74.5	71.5	-9.8	-12.2	-9.8	-12.1	-10.2	-11.5	-10.2	-11.5	-10.3	-13.8
J-K Option 2	13-S	74.5	71.5	-7.0	-9.1	-6.6	-8.8	-7.5	-7.4	-7.5	-7.4	na	na
J-K Option 1	14-S	68.5	66.0	1.8	1.4	-7.3	-7.7	1.3	0.6	-8.4	-8.7	-13.6	-17.4
J-K Option 2	14-S	68.5	66.0	-3.2	0.1	-2.9	-3.7	-2.5	-2.6	-1.9	-2.1	na	na
J-K Option 1	15-S	61.7	58.9	-0.3	-3.2	0.4	-2.4	-0.6	-3.7	-0.2	-3.1	-4.8	-10.7
J-K Option 2	15-S	61.7	58.9	-0.1	-3.0	0.5	-2.2	0.0	0.0	0.0	0.0	na	na
K-L	16-S	68.6	65.3	0.0	0.7	0.0	0.8	-0.2	0.2	-0.2	0.2	-0.1	0.7
L-M	17-S	65.0	64.6	3.6	3.6	4.2	1.7	4.3	1.8	4.3	1.8	4.2	1.6

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TABLE 7.1-4 (CONT'D) PREDICTED INCREMENTAL SOUND LEVELS (dB) FOR ALL ALTERNATIVES IN HORIZON YEAR 2035 -WITH MITIGATION

Route Segment	Map ID	Baseline Sound Level (dBA)		Incremental Sound Level (dB)									
				1A		1B		2A		2B		Alt 3	
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Receptors on the North Side													
GH	1A-N	58.7	67.0	0.9	-7.4	1.5	-6.3	-0.4	-10.2	0.1	-9.7	-11.1	-18.8
GH	1-N	58.7	67.0	0.9	-7.2	1.5	-6.1	0.3	-9.6	0.7	-9.1	-11.1	-18.8
GH	2A-N	58.6	66.3	3.4	-6.7	3.9	-6.0	0.8	-9.7	1.2	-9.2	-5.6	-11.0
GH	2-N	58.6	66.3	3.7	-6.2	4.4	-5.5	0.9	-9.6	1.4	-9.1	-10.1	-14.9
GH	3-N	75.5	72.0	2.8	2.5	-14.2	-14.1	1.0	0.5	-15.5	-15.4	-18.9	-19.0
H-I	4-N	68.9	66.5	-5.6	-8.8	-5.8	-8.6	-7.3	-11.0	-7.4	-11.3	-8.0	-14.1
H-I	5-N	78.7	74.3	-14.0	-14.1	-13.8	-13.5	-10.6	-13.0	-10.7	-13.3	-16.0	-19.1
H-I	6-N	75.2	72.2	2.4	1.4	-10.7	-12.5	-7.8	-8.6	-12.6	-13.9	-15.8	-20.9
I-J	7-N	64.0	62.1	-6.9	-8.2	-6.8	-8.1	-5.8	-6.7	-7.5	-8.6	-15.0	-19.2
I-J	7-N	64.0	62.1	-8.4	-9.5	-8.3	-9.4	-7.0	-7.8	-8.6	-9.6	na	na
J-K Option 1	8-N	73.0	70.4	-8.2	-10.2	-7.4	-8.9	-6.4	-7.8	-7.4	-9.5	-10.4	-15.8
J-K Option 2	8-N	73.0	70.4	-9.3	-11.8	-8.6	-10.6	-12.6	-5.2	-8.7	-11.5	na	na
J-K Option 1	9-N	58.0	56.8	3.5	2.9	-4.9	0.9	3.3	2.4	-5.2	0.7	-16.2	-20.6
J-K Option 2	9-N	58.0	56.8	2.7	2.1	-5.4	-6.2	2.1	1.3	-6.2	-7.1	na	na
J-K Option 1	10-N	64.7	65.0	-4.0	-8.0	-2.8	-6.5	4.1	0.5	-3.3	-7.1	-14.6	-18.3
J-K Option 2	10-N	64.7	65.0	-4.0	-8.0	-3.2	-6.9	3.6	-0.1	-3.8	-7.7	na	na
K-L Option 1	11-N	67.8	71.4	-2.3	-8.7	-2.3	-8.7	-1.9	-6.9	-1.9	-6.9	-1.5	-7.1
K-L Option 2	12-N	66.7	70.7	-1.6	-1.5	-1.6	-1.5	-1.9	-2.4	-1.9	-2.4	-0.6	-0.2
L-M	13-N	63.1	68.0	4.4	1.9	4.5	1.9	4.5	1.9	4.5	1.9	4.1	1.5

Note: *mitigation modelling was conducted for the worst case receptor, 2A-S (or 1A-S in the case of Alternative 3 option), and therefore no actual values are available here. Since the mitigation is effective for the worst case, therefore, it is reasonable to assume that the incremental sound level for other receptors in the G-H segment will be below 5 dB above the baseline sound level.

na – not applicable

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7.2 Noise Mitigation Measures for Plaza/Crossing Alternatives

As was discussed earlier in Section 5.3, noise levels from certain plaza/crossing alternatives are predicted to cause a high noise impact in Sandwich Towne and the area between Ojibway Parkway to Malden Road. Therefore, noise mitigation measures are to be considered.

A 4 m high acoustic barrier was modeled as a mitigation measure for all crossings that have predicted noise impact greater than 5 dB above the future no-build scenarios. It should be noted that the crossings are elevated and some portions of the approach roadways are elevated. To add an acoustic barrier to the elevated approach roadway and crossing is a complicated and expensive measure and the cost effectiveness of this type of mitigation will need to be assessed. This type of mitigation is more complicated than installing an acoustic barrier on flat terrain or at grade as is the case for the access road alternatives. The modelling results show that with the acoustic barrier in place, the project noise levels can be reduced to within 5 dB of the no-build noise levels at all of the receptors in Sandwich Towne (see Tables 7.2-1 to 7.2-6). The full complement of model results are included in Appendix D.

TABLE 7.2-1 DAYTIME NOISE LEVELS AT RECEPTORS R1-R21 (2015)
(PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY)

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dbA)
R1	58.1	68.6	**10.5**	59.1	1
R2	58.9	68.5	**9.6**	60.3	1.4
R3	59	66.7	**7.7**	60.1	1.1
R4	57.3	63.2	**5.9**	58.7	1.4
R5	53.9	59.9	**6**	55.9	2
R6	60	62.9	2.9	60.8	0.8
R7	54.1	58.2	4.1	55.8	1.7
R8	58.6	63	4.4	60.1	1.5
R9	60.6	63.2	2.6	61.8	1.2
R10	55.9	59.1	3.2	57.4	1.5
R11	59.1	61.3	2.2	60.4	1.3
R12	61.1	62.3	1.2	61.9	0.8
R13	62.8	63.7	0.9	63.5	0.7
R14	60.5	61.5	1	61.2	0.7
R15	59.9	61	1.1	60.8	0.9
R16	60.7	61.6	0.9	61.5	0.8
R17	60.5	61.3	0.8	61.2	0.7
R18	60.9	61.6	0.7	61.5	0.6
R19	59.7	60.6	0.9	60.5	0.8
R20	68	68.4	0.4	68.3	0.3
R21	58.1	58.9	0.8	58.8	0.7

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TABLE 7.2-2 NIGHTTIME NOISE LEVELS AT RECEPTORS R1-R21 (2015) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY)

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dbA)
R1	52.9	66.1	**13.2**	55.2	2.3
R2	54.9	66.6	**11.7**	57	2.1
R3	60.8	67.2	**6.4**	61.6	0.8
R4	52.9	60.8	**7.9**	55.1	2.2
R5	48.6	57.4	**8.8**	52.1	3.5
R6	63.3	65.2	1.9	64	0.7
R7	49	55.8	**6.8**	52.1	3.1
R8	53.1	60	**6.9**	55.8	2.7
R9	55.8	59.8	4	57.5	1.7
R10	53.7	57.4	3.7	55.6	1.9
R11	59.5	61.1	1.6	60.5	1
R12	59.6	60.8	1.2	60.5	0.9
R13	54.3	56.6	2.3	55.9	1.6
R14	62.4	63.1	0.7	63	0.6
R15	61.8	62.6	0.8	62.5	0.7
R16	54.3	56.1	1.8	55.7	1.4
R17	55.1	56.5	1.4	56.3	1.2
R18	62.1	62.7	0.6	62.6	0.5
R19	59.7	60.5	0.8	60.5	0.8
R20	62.2	62.8	0.6	62.7	0.5
R21	61.9	62.6	0.7	62.6	0.7

TABLE 7.2-3 DAYTIME NOISE LEVELS AT RECEPTORS R1-R21 (2025) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY)

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dbA)
R1	58.3	69.6	**11.3**	59.4	1.1
R2	59.1	69.4	**10.3**	60.7	1.6
R3	59.2	67.6	**8.4**	60.4	1.2
R4	57.6	64.1	**6.5**	59	1.4
R5	54.3	60.8	**6.5**	56.4	2.1
R6	60.4	63.6	3.2	61.3	0.9
R7	54.5	59	4.5	56.3	1.8
R8	58.8	63.7	4.9	60.5	1.7
R9	60.9	63.8	2.9	62.1	1.2
R10	56.2	59.7	3.5	57.8	1.6
R11	59.3	61.8	2.5	60.8	1.5
R12	61.3	62.7	1.4	62.2	0.9
R13	63.1	64.1	1	64	0.9
R14	60.7	61.8	1.1	61.4	0.7
R15	60.1	61.4	1.3	61.1	1
R16	60.9	62	1.1	61.8	0.9
R17	60.6	61.6	1	61.5	0.9
R18	61	61.8	0.8	61.7	0.7
R19	59.9	60.9	1	60.8	0.9
R20	68	68.2	0.2	68.2	0.2
R21	58.3	59.2	0.9	59	0.7

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TABLE 7.2-4 NIGHTTIME NOISE LEVELS AT RECEPTORS R1-R21 (2025) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY)

Receptor	No Build (dBA)	With Crossing (dBA)	Difference (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dbA)
R1	53.1	67.1	**14**	55.6	2.5
R2	55.2	67.5	**12.3**	57.4	2.2
R3	61.1	68	**6.9**	62	0.9
R4	53.2	61.7	**8.5**	55.5	2.3
R5	48.8	58.4	**9.6**	52.6	3.8
R6	63.6	65.7	2.1	64.3	0.7
R7	49.2	56.7	**7.5**	52.6	3.4
R8	53.3	60.9	**7.6**	56.4	3.1
R9	56	60.5	4.5	57.9	1.9
R10	53.9	58.1	4.2	56	2.1
R11	59.8	61.4	1.6	60.8	1
R12	59.8	61.1	1.3	60.7	0.9
R13	54.5	57	2.5	56.3	1.8
R14	62.6	63.5	0.9	63.3	0.7
R15	62.1	62.8	0.7	62.7	0.6
R16	54.6	56.5	1.9	56.1	1.5
R17	55.4	56.9	1.5	56.6	1.2
R18	62.3	63.1	0.8	63	0.7
R19	60	60.7	0.7	60.7	0.7
R20	62.4	63.1	0.7	63.1	0.7
R21	62.2	62.7	0.5	62.7	0.5

TABLE 7.2-5 DAYTIME NOISE LEVELS AT RECEPTORS R1-R21 (2035) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dbA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dbA)
R1	57.7	71.2	**13.5**	60	2.3
R2	58.2	71	**12.8**	61.3	3.1
R3	58.4	69.1	**10.7**	61	2.6
R4	56.8	65.4	**8.6**	59.6	2.8
R5	53.8	62.2	**8.4**	57.1	3.3
R6	60	64.6	4.6	61.8	1.8
R7	54.1	60.2	**6.1**	57	2.9
R8	58.2	64.9	**6.7**	61.1	2.9
R9	60.1	64.7	4.6	62.6	2.5
R10	55.4	60.7	**5.3**	58.4	3
R11	58.7	62.6	3.9	61.3	2.6
R12	60.8	63.2	2.4	62.5	1.7
R13	62.3	64.4	2.1	64.2	1.9
R14	59.9	62.3	2.4	61.9	2
R15	59.4	61.9	2.5	61.5	2.1
R16	60.2	62.4	2.2	62.1	1.9
R17	60	62	2	61.7	1.7
R18	60.3	62.2	1.9	62.1	1.8
R19	59.2	61.3	2.1	61.1	1.9
R20	67	68.8	1.8	68.8	1.8
R21	57.7	59.5	1.8	59.3	1.6

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TABLE 7.2-6 NIGHTTIME NOISE LEVELS AT RECEPTORS R1-R21 (2035) (PLAZA A TO CROSSING C – VIA OJIBWAY PARKWAY)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dbA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dbA)
R1	53.3	69	**15.7**	56.6	3.3
R2	55.4	69.3	**13.9**	58.3	2.9
R3	61.4	69.6	**8.2**	62.4	1
R4	53.4	63.4	**10**	56.3	2.9
R5	49	60.1	**11.1**	53.7	4.7
R6	63.9	66.5	2.6	64.7	0.8
R7	49.4	58.3	**8.9**	53.6	4.2
R8	53.5	62.5	**9**	57.4	3.9
R9	56.2	61.8	**5.6**	58.7	2.5
R10	54.2	59.4	**5.2**	56.7	2.5
R11	59.9	62.1	2.2	61.2	1.3
R12	59.9	61.7	1.8	61.1	1.2
R13	54.7	58	3.3	57	2.3
R14	63	63.9	0.9	63.7	0.7
R15	62.1	63.2	1.1	63	0.9
R16	54.7	57.3	2.6	56.7	2
R17	55.5	57.5	2	57.1	1.6
R18	62.8	63.4	0.6	63.3	0.5
R19	60	61.1	1.1	61	1
R20	62.8	63.5	0.7	63.4	0.6
R21	62.2	63	0.8	62.9	0.7

In addition to the above tables, sound level contour plots are provided for the Plaza A to Crossing C alternative in Figures 7.2-1 to 7.2-3 for scenario year 2035 (daytime), and Figures 7.2-4 to 7.2-6 for scenario year 2035 (nighttime). These sound level contour plots represent the worst-case sound levels. It should be noted that the reason for the appearance of more colour gradations in the noise contour figures presented in this section is that each contour line in the figures represents 1 dB interval whereas the colour in the legend represents every 5 dB interval. The colour of each 1 dB interval within a 5 dB interval have colour in shades that are between the first and the next 5 dB interval.

These plots show the predicted noise levels at the receptors in Sandwich Towne for the 2035 no-build scenario, the scenario with no barrier, and the scenario with a 4 m high barrier in place. The sound level contour plots are useful for comparison purposes (i.e., showing the effect of Crossing C, via Ojibway Parkway, on the receptors compared to the no-build scenario, and the effect of the barrier on noise propagation compared to the scenario with no barrier). However, it should be noted that the contours do not reflect the attenuation provided by existing buildings (such as homes or industrial plants). As a result, noise levels appear to propagate uninhibited throughout the populated area and thus appear to be more far-reaching than they would be in reality.

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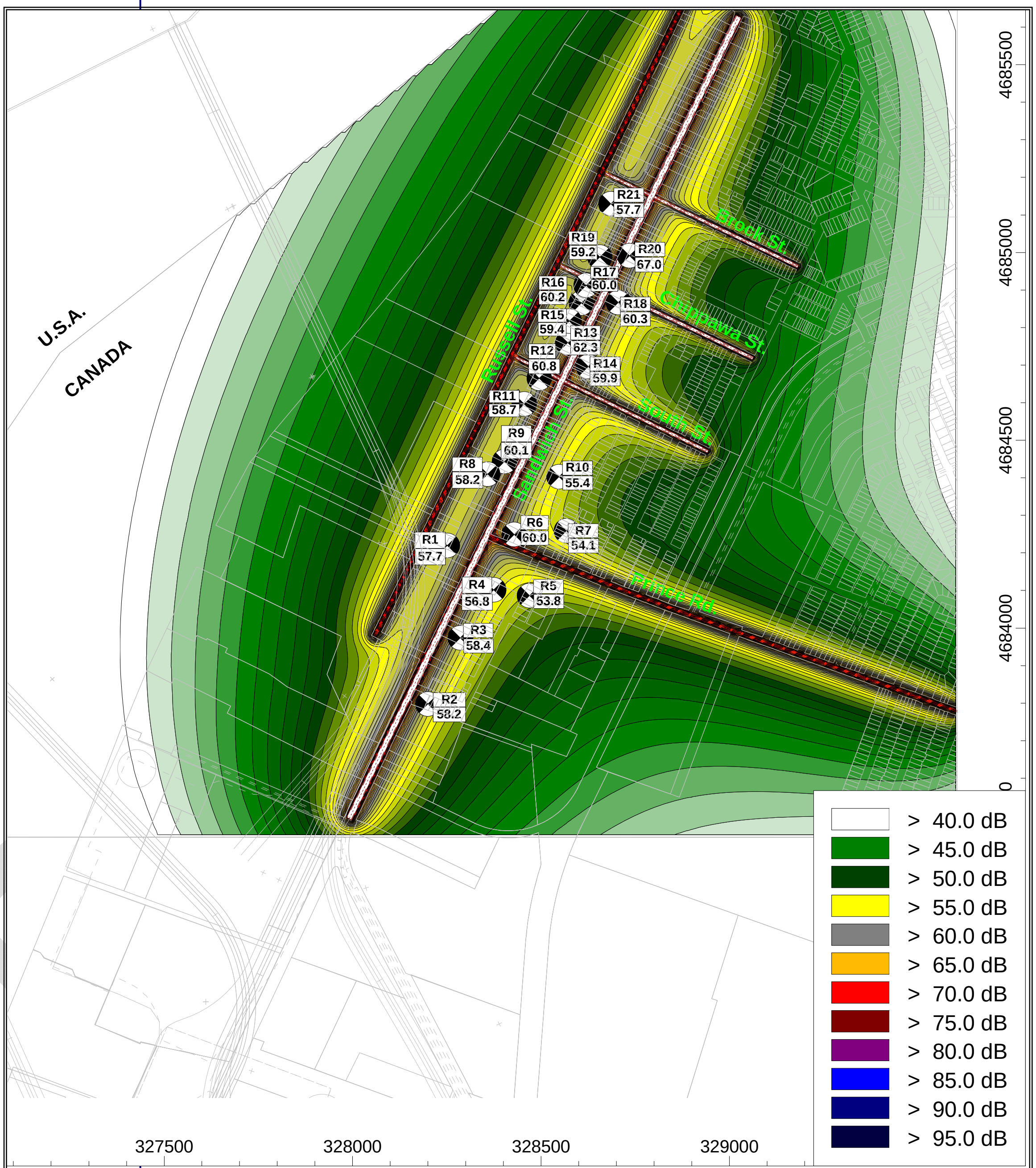
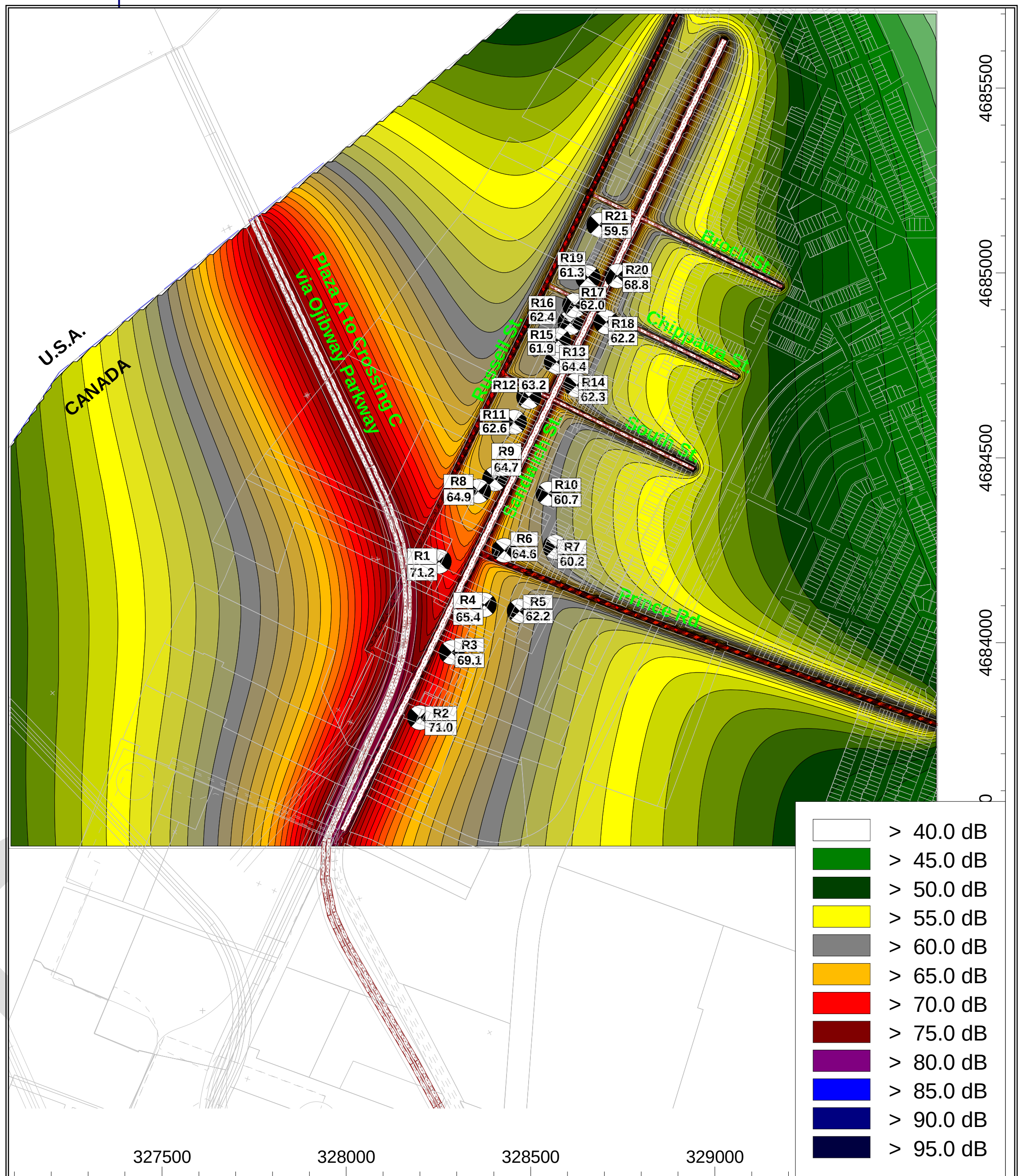
FIGURE 7.2-1 PLAZA A – CROSSING C: FUTURE NO-BUILD (2035) – DAYTIME (VIA OJIBWAY PARKWAY)



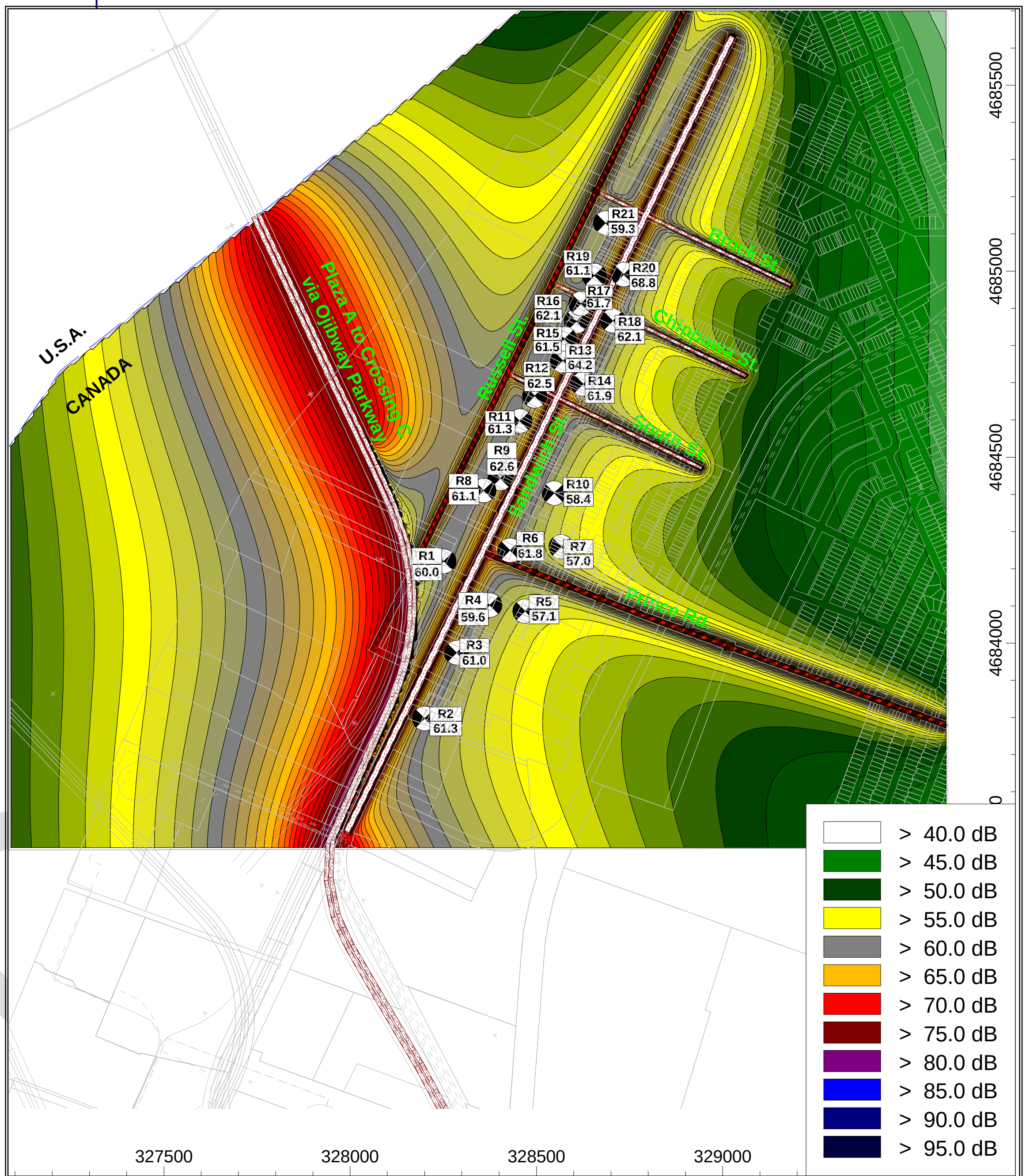
Note: Each contour line represents 1 dB interval

FIGURE 7.2-2 PLAZA A – CROSSING C: NO MITIGATION (2035) – DAYTIME (VIA OJIBWAY PARKWAY)



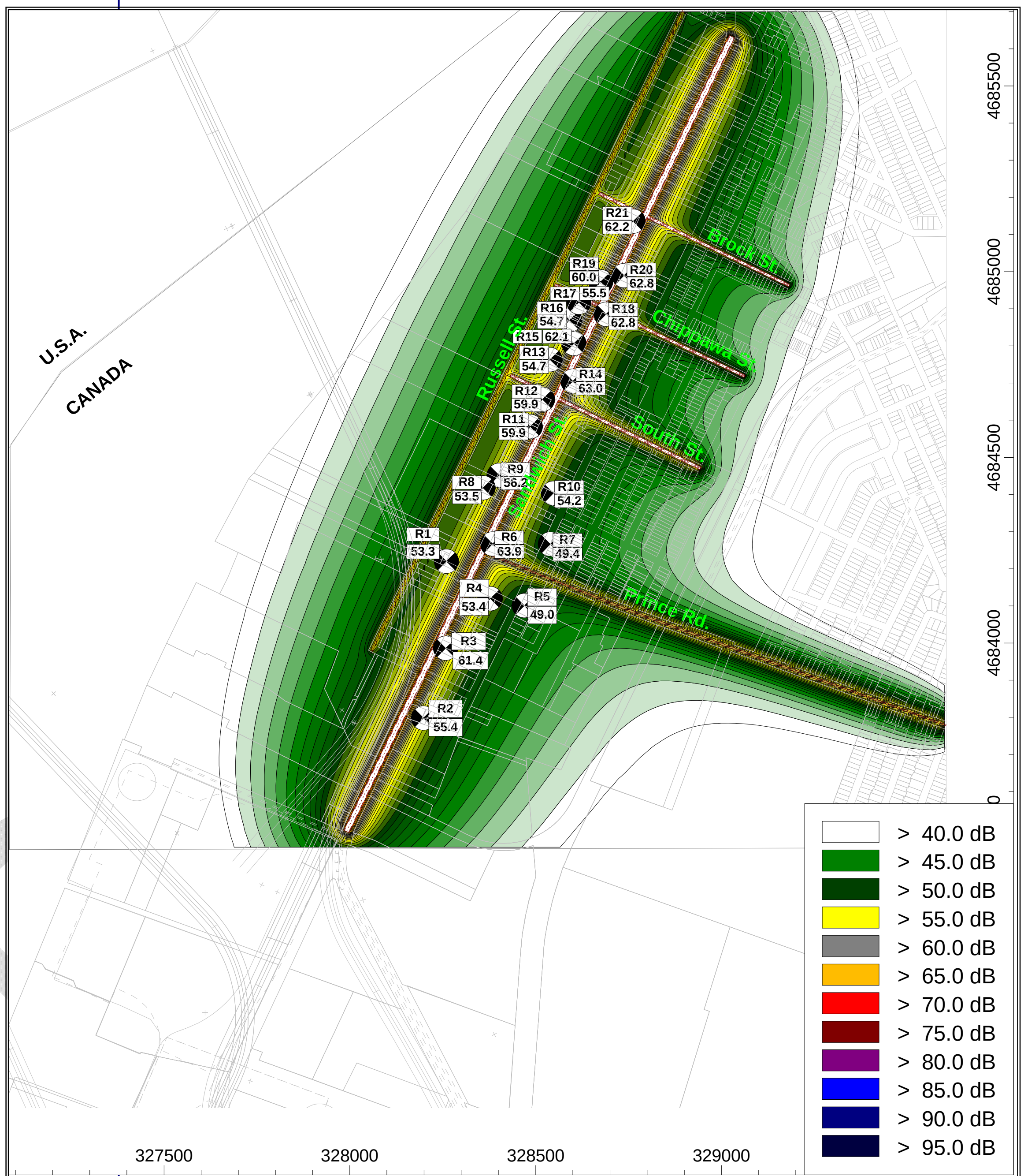
Note: Each contour line represents 1 dB interval

FIGURE 7.2-3 PLAZA A – CROSSING C: 4 M BARRIER (2035) – DAYTIME (VIA OJIBWAY PARKWAY)



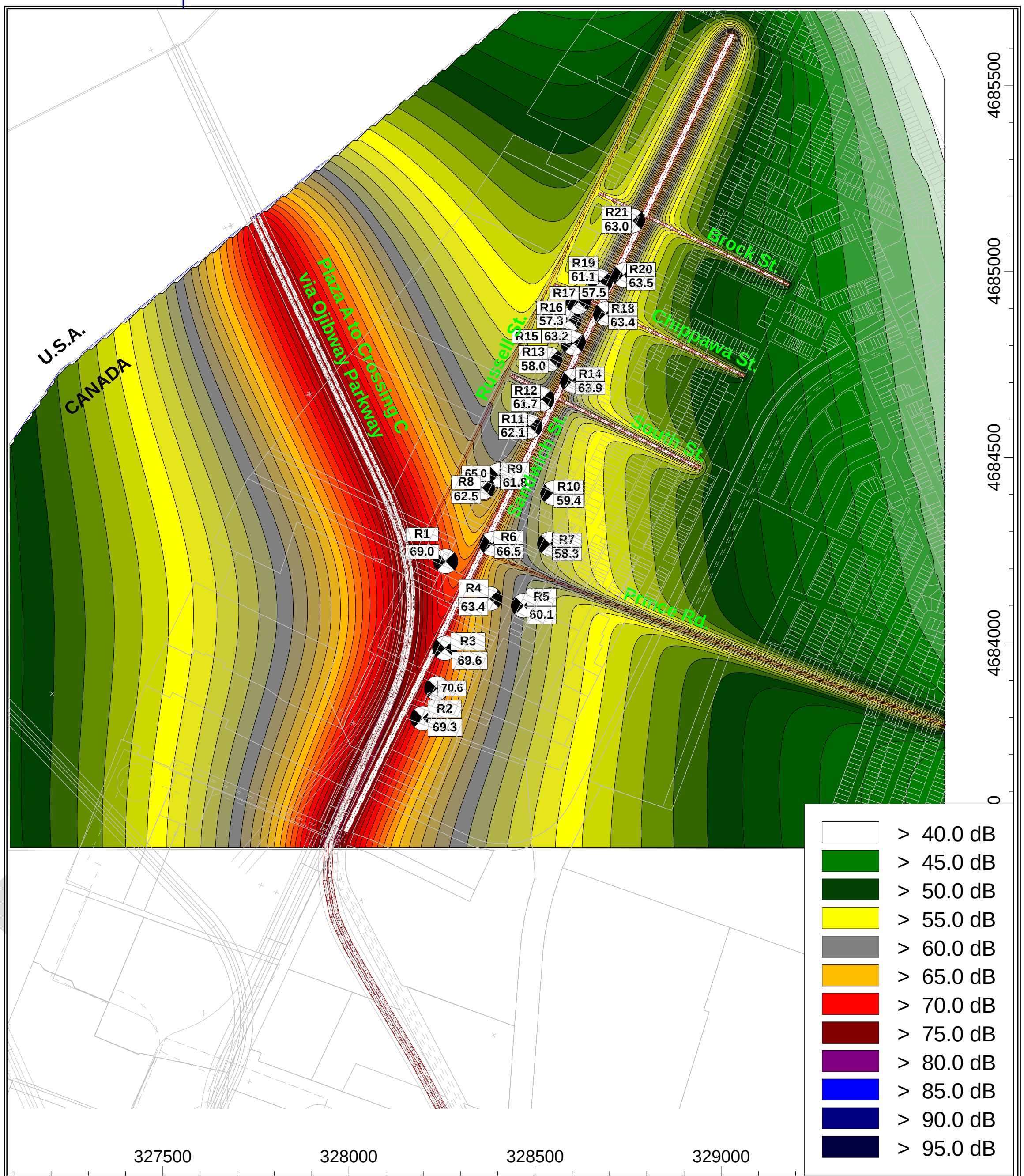
Note: Each contour line represents 1 dB interval

FIGURE 7.2-4 PLAZA A – CROSSING C: FUTURE NO-BUILD (2035) – NIGHTTIME (VIA OJIBWAY PARKWAY)



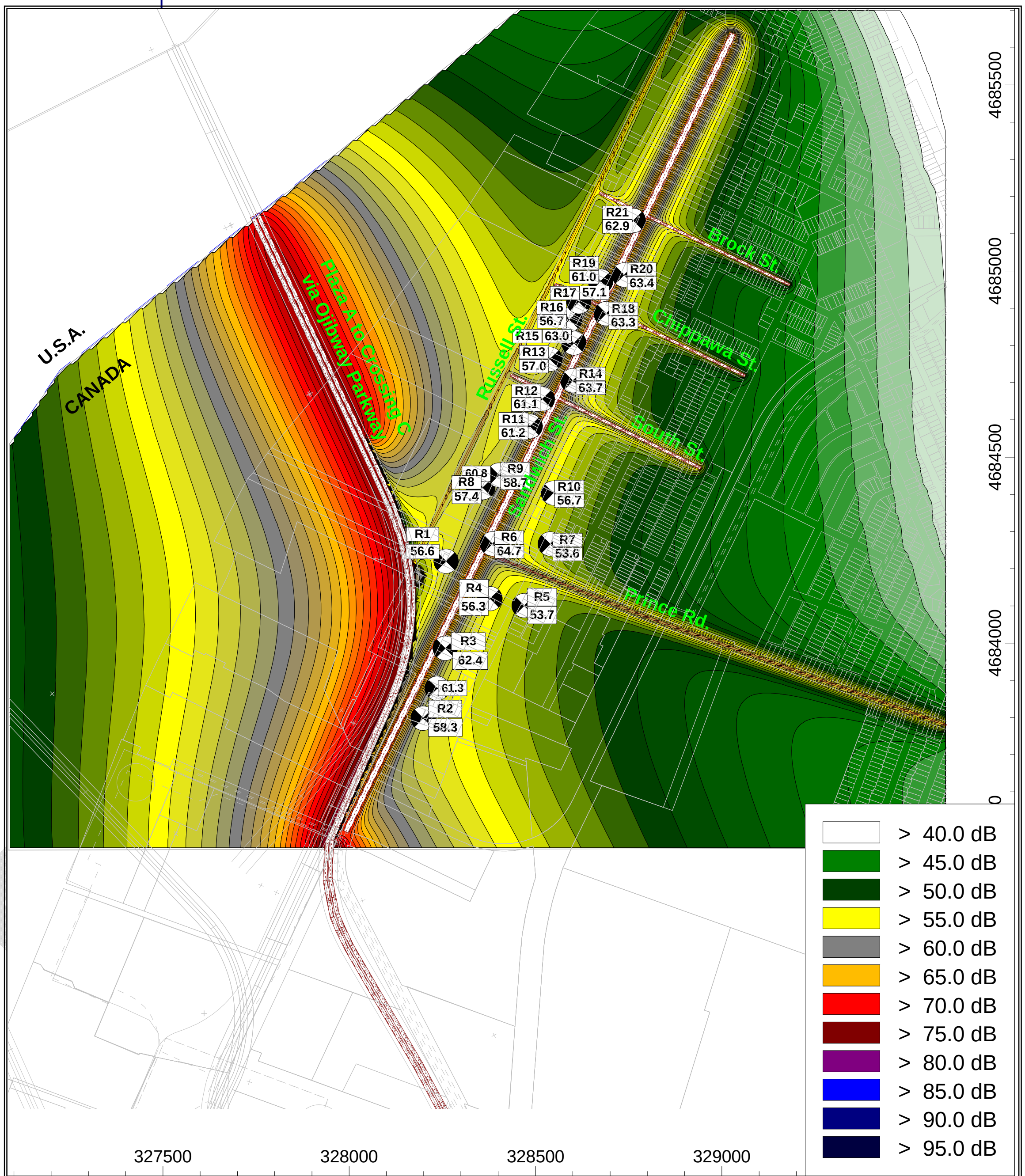
Note: Each contour line represents 1 dB interval

FIGURE 7.2-5 PLAZA A – CROSSING C2: NO MITIGATION (2035) – NIGHTTIME (VIA OJIBWAY PARKWAY)



Note: Each contour line represents 1 dB interval

FIGURE 7.2-6 PLAZA A – CROSSING C: 4 M BARRIER (2035) – NIGHTTIME (VIA OJIBWAY PARKWAY)



Note: Each contour line represents 1 dB interval

The noise modeling conducted for the receptors in the area between Ojibway Parkway to Malden Road show that, due to the proximity of receptors in this area to the plaza and crossing locations, unmitigated project noise levels at various receptor locations exceed the no-build sound levels by > 5 dB. At some receptor locations, noise levels due to the project are predicted to exceed the no-build levels by > 30 dB. Noise mitigation was considered for each alternative in the form of an acoustic barrier.

For alternatives involving Plaza A, a 4 m high acoustic barrier was placed beginning at the exit of the plaza to the US border, and continuing along the crossing route. For alternatives involving Plazas B, B1, and C, a 5 m high acoustic barrier was modeled along the proposed access road leading to each of the plazas. The height of the acoustic barrier was limited to 4 m on all crossings. The effect of the acoustic barrier is shown in Tables 7.2-7 to 7.2-12.

Table 7.2-7 Daytime Noise Levels at Receptors in the Ojibway Parkway to Malden Road Area (2015) - Plaza A to Crossing C (via Brighton Beach)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dBA)
R22	55.6	61.2	5.6	57.7	2.1
R23	59.1	58.5	-0.6	58.1	-1
R24	56.7	58.1	1.4	57.3	0.6
R25	45.6	71.5	25.9	52.1	6.5
R26	60	67.3	7.3	65.6	5.6
R27	54.7	60	5.3	56.3	1.6
R28	59	57	-2	56.5	-2.5
R29	59.5	56.8	-2.7	56.4	-3.1
R30	61.3	65.7	4.4	62	0.7

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TABLE 7.2-8 NIGHTTIME NOISE LEVELS AT RECEPTORS (2015) IN THE OJIBWAY PARKWAY TO MALDEN ROAD AREA - PLAZA A TO CROSSING C (VIA BRIGHTON BEACH)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dBA)
R22	49	58.3	9.3	52.9	3.9
R23	52.8	54	1.2	53.4	0.6
R24	50.6	53.4	2.8	51.9	1.3
R25	39.9	69.6	29.7	51.4	11.5
R26	53.7	62.8	9.1	58.6	4.9
R27	48.1	56.7	8.6	53.7	5.6
R28	52.7	55	2.3	54.5	1.8
R29	53.7	54.9	1.2	54.5	0.8
R30	57.6	62.3	4.7	56.9	-0.7

TABLE 7.2-9 DAYTIME NOISE LEVELS AT RECEPTORS (2025) IN THE OJIBWAY PARKWAY TO MALDEN ROAD AREA - PLAZA A TO CROSSING C (VIA BRIGHTON BEACH)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dBA)
R22	56	62	6	58.2	2.2
R23	59.6	59.1	-0.5	58.7	-0.9
R24	57.1	58.8	1.7	57.9	0.8
R25	45.9	72.5	26.6	53.2	7.3
R26	60.5	67.9	7.4	65.8	5.3
R27	55.1	60.9	5.8	57	1.9
R28	59.3	57.8	-1.5	57.2	-2.1
R29	60	57.6	-2.4	57.1	-2.9
R30	61.8	66.6	4.8	62.6	0.8

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TABLE 7.2-10 NIGHTTIME NOISE LEVELS AT RECEPTORS (2025) IN THE OJIBWAY PARKWAY TO MALDEN ROAD AREA- PLAZA A TO CROSSING C (VIA BRIGHTON BEACH)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dBA)
R22	49.5	59.3	9.8	53.6	4.1
R23	53.4	54.7	1.3	54	0.6
R24	51.1	54.4	3.3	52.7	1.6
R25	40.3	70.7	30.4	52.4	12.1
R26	54.2	63.6	9.4	59.1	4.9
R27	48.6	57.5	8.9	54.3	5.7
R28	53.1	55.6	2.5	55	1.9
R29	54.3	55.5	1.2	55	0.7
R30	58.3	63.8	5.5	57.8	-0.5

TABLE 7.2-11 DAYTIME NOISE LEVELS AT RECEPTORS IN THE OJIBWAY PARKWAY TO MALDEN ROAD AREA (2035) - PLAZA A TO CROSSING C (VIA BRIGHTON BEACH)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dBA)
R22	56.3	62.7	6.4	58.8	2.5
R23	59.9	59.5	-0.4	59.1	-0.8
R24	57.5	59.3	1.8	58.3	0.8
R25	46.2	73.3	27.1	53.9	7.7
R26	60.8	68.4	7.6	66.3	5.5
R27	55.4	61.6	6.2	57.6	2.2
R28	59.8	58.3	-1.5	57.6	-2.2
R29	60.2	58.1	-2.1	57.5	-2.7
R30	63.3	67.3	4	63.1	-0.2

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TABLE 7.2-12 NIGHTTIME NOISE LEVELS AT RECEPTORS IN THE OJIBWAY PARKWAY TO MALDEN ROAD AREA (2035) - PLAZA A TO CROSSING C (VIA BRIGHTON BEACH)

Receptor	No Build (dBA)	With Crossing NO BARRIER (dBA)	Difference NO BARRIER (dBA)	With Crossing 4m BARRIER (dBA)	Difference 4m BARRIER (dBA)
R22	50.1	60	9.9	54.2	4.1
R23	53.7	55.1	1.4	54.4	0.7
R24	51.6	55.1	3.5	53.3	1.7
R25	40.7	71.4	30.7	53.2	12.5
R26	54.9	64.2	9.3	59.5	4.6
R27	49.2	58.1	8.9	54.7	5.5
R28	53.6	56	2.4	55.4	1.8
R29	54.5	55.9	1.4	55.3	0.8
R30	59.5	64.8	5.3	58.6	-0.9

In addition to the above tables, contour plots are provided for the Plaza A to Crossing C alternative in Figures 7.2-7 to 7.2-9 for 2035 daytime, and Figures 7.2-10 to 7.2-12 for 2035 nighttime. These plots show the predicted noise levels from the Plaza A to Crossing C alternative in the Ojibway Parkway to Malden Road area for the 2035 no-build scenario, 2035 with no acoustic barrier, and 2035 with a 4 m acoustic barrier in place. These contour plots are useful for comparison purposes (i.e., showing the effect of Plaza A to Crossing C on the receptors in the Ojibway Parkway to Malden Road area compared to the no-build scenario, and the effect of the barrier on noise propagation compared to the scenario with no barrier), however, it should be noted that the attenuating effect of buildings (such as homes or industrial plants) have not been taken into account. It should also be noted that the noise modeling did not take into account the elevated topography in Malden Park on the north side of E.C. Row between Matchette Road and Malden Road. As a result, noise levels appear to propagate uninhibited through the populated area and appear to be more far-reaching than they would be in reality. There is a large fill area that has significantly changed the topography in Malden Park which could potentially provide sound attenuating for the lands north of E.C. Row.

In summary, the installation of a 5 m high acoustic barrier along the segment of the proposed access road that leads to Plazas A, B, B1 and C is sufficient to mitigate receptor noise levels in the Ojibway Parkway to Malden Road area for all access road alternatives involving these plazas. However, the 4 m high acoustic barrier on crossings connected to Plaza A is not always sufficient to reduce noise levels to within 5 dB of the no-build noise levels at receptors in the Ojibway Parkway to Malden Road area. The potentially affected receptors in the Ojibway Parkway to Malden Road area are in close proximity to the approach roadway leaving Plaza A to the crossings). These receptors are summarized below:

- One receptor in the Brighton Beach area (R25 on Figure 5.3-2) is predicted to experience a high noise impact as a result of the crossings from Plaza A. This receptor; however, represent remnant residential properties in the Brighton Beach Industrial Park located on lands zoned industrial and are legal non-conforming uses.
- Two receptors in the Ojibway Parkway to Malden Road area (R26 and R27on Figure 5.3-2) are predicted to experience a marginal to none noise impact as a result of the approach roadway leaving from Plaza A to crossings.

It should be noted that the noise impact due to traffic in Plaza A is minimal. Also, as noted earlier, the highest noise impact is predicted when the Plaza A and Crossing C via Brighton Beach combination is used.

For comparison purposes, the predicted incremental sound levels for all crossings and plaza options are shown in Tables 7.2-13 and 7.2-14. Results for the worst-case traffic noise year, 2035, is used for this comparison. The negative values indicate occurrences when the project sound levels are predicted to be lower than those without the proposed project, or the no-build option.

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TABLE 7.2-13 INCREMENTAL RECEPTOR SOUND LEVELS AT SANDWICH TOWNE FOR ALL PLAZA AND CROSSING OPTIONS (HORIZON YEAR 2035) – WITH MITIGATION

Receptor ID	Baseline Sound Level (dBA)		Incremental Sound Level (dB)							
			Plaza A – Crossing C (via Brighton Beach)		Plaza A – Crossing C (via Ojibway Parkway)		Plaza B – Crossing C		Plaza C – Crossing C	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
R1	57.7	53.3	1.9	2.5	2.3	3.3	2	2.9	2.7	3.6
R2	58.2	55.4	2.3	1.7	3.1	2.9	3	3.1	2.9	2.6
R3	58.4	61.4	2.2	0.7	2.6	1	2.7	1.1	2.6	1
R4	56.8	53.4	2.5	2.3	2.8	2.9	2.6	2.7	2.5	2.3
R5	53.8	49	2.8	3.7	3.3	4.7	2.8	4	2.6	3.5
R6	60	63.9	1.5	0.7	1.8	0.8	1.5	0.7	1.5	0.6
R7	54.1	49.4	2.4	3.4	2.9	4.2	2.3	3.4	2.2	3.1
R8	58.2	53.5	2.6	3.3	2.9	3.9	2.3	2.8	2.5	3.1
R9	60.1	56.2	2.3	2.1	2.5	2.5	2.1	1.8	2.2	1.9
R10	55.4	54.2	2.7	2	3	2.5	2.5	1.9	2.5	1.9
R11	58.7	59.9	2.3	1.2	2.6	1.3	2	1	2.2	1.2
R12	60.8	59.9	1.6	1.1	1.7	1.2	1.4	0.9	1.5	1.1
R13	62.3	54.7	1.7	2	1.9	2.3	1.8	1.7	1.9	1.9
R14	59.9	63	1.9	0.6	2	0.7	1.7	0.6	1.7	0.5
R15	59.4	62.1	1.9	0.9	2.1	0.9	1.9	0.8	1.9	0.9
R16	60.2	54.7	1.8	1.7	1.9	2	1.8	1.5	1.9	1.7
R17	60	55.5	1.6	1.4	1.7	1.6	1.6	1.2	1.7	1.3
R18	60.3	62.8	1.7	0.4	1.8	0.5	1.6	0.5	1.6	0.3
R19	59.2	60	1.8	0.9	1.9	1	1.8	0.9	1.8	1
R20	67	62.8	2	0.5	1.8	0.6	1.6	0.6	1.5	0.4
R21	57.7	62.2	1.5	0.8	1.6	0.7	1.5	0.7	1.5	0.8

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TABLE 7.2-14 INCREMENTAL RECEPTOR SOUND LEVELS AT OJIBWAY PARKWAY TO MALDEN ROAD AREA FOR ALL PLAZA AND CROSSING OPTIONS (HORIZON YEAR 2035) – WITH MITIGATION

Receptor ID	Baseline Sound Level (dBA)		Incremental Sound Level (dBA)													
			Plaza A – Crossing A		Plaza A – Crossing B		Plaza A – Crossing C (via Brighton Beach)		Plaza A – Crossing C (via Ojibway Parkway)		Plaza B – Crossing C		Plaza B1 – Crossing B		Plaza C – Crossing C	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
R22	56.3	50.1	1.7	3.3	2.3	3.9	2.5	4.1	2.9	4.9	-0.6	3.4	-0.9	2.8	-0.5	3.6
R23	59.9	53.7	-1.6	0.1	-0.9	0.7	-0.8	0.7	-0.6	1.2	0.6	1.2	0.5	1.1	0.6	1.2
R24	57.5	51.6	0.1	1.1	0.8	1.6	0.8	1.7	0.9	1.8	1	1.9	1	1.8	1	1.9
R25	46.2	40.7	6.1	9.3	na	na	7.7	12.5	4.6	8.3	na	na	na	na	na	na
R26	60.8	54.9	4.4	3.6	5.4	4.5	5.5	4.6	5.5	4.6	na	na	na	na	na	na
R27	55.4	49.2	1.6	4.6	2.1	5.4	2.2	5.5	3.4	6.4	0.2	3.5	-0.1	3	0.3	3.7
R28	59.8	53.6	-2.4	1.6	-2.2	1.8	-2.2	1.8	-1.5	2.5	na	na	na	na	na	na
R29	60.2	54.5	-2.9	0.7	-2.7	0.8	-2.7	0.8	-2.2	1.4	na	na	na	na	na	na
R30	63.3	59.5	-0.2	-0.9	-0.2	-0.9	-0.2	-0.9	-0.2	-0.9	-0.6	-1.8	-0.6	-1.7	-0.6	-1.8
R31	58.7	53.4	na	na	na	na	na	na	na	na	1.3	2.4	1.3	2.4	1.3	2.3
R32	57.5	51.6	na	na	na	na	na	na	na	na	0.4	4.3	0.4	4.3	0.5	4.4
R33	61.4	55.5	na	na	na	na	na	na	na	na	0.3	2.4	0.3	2.4	0.3	2.4
R34	61.3	55.5	na	na	na	na	na	na	na	na	0.4	2.2	0.4	2.2	0.4	2.2

Note: na - not applicable (the receptors are likely to be displaced by the proposed project)

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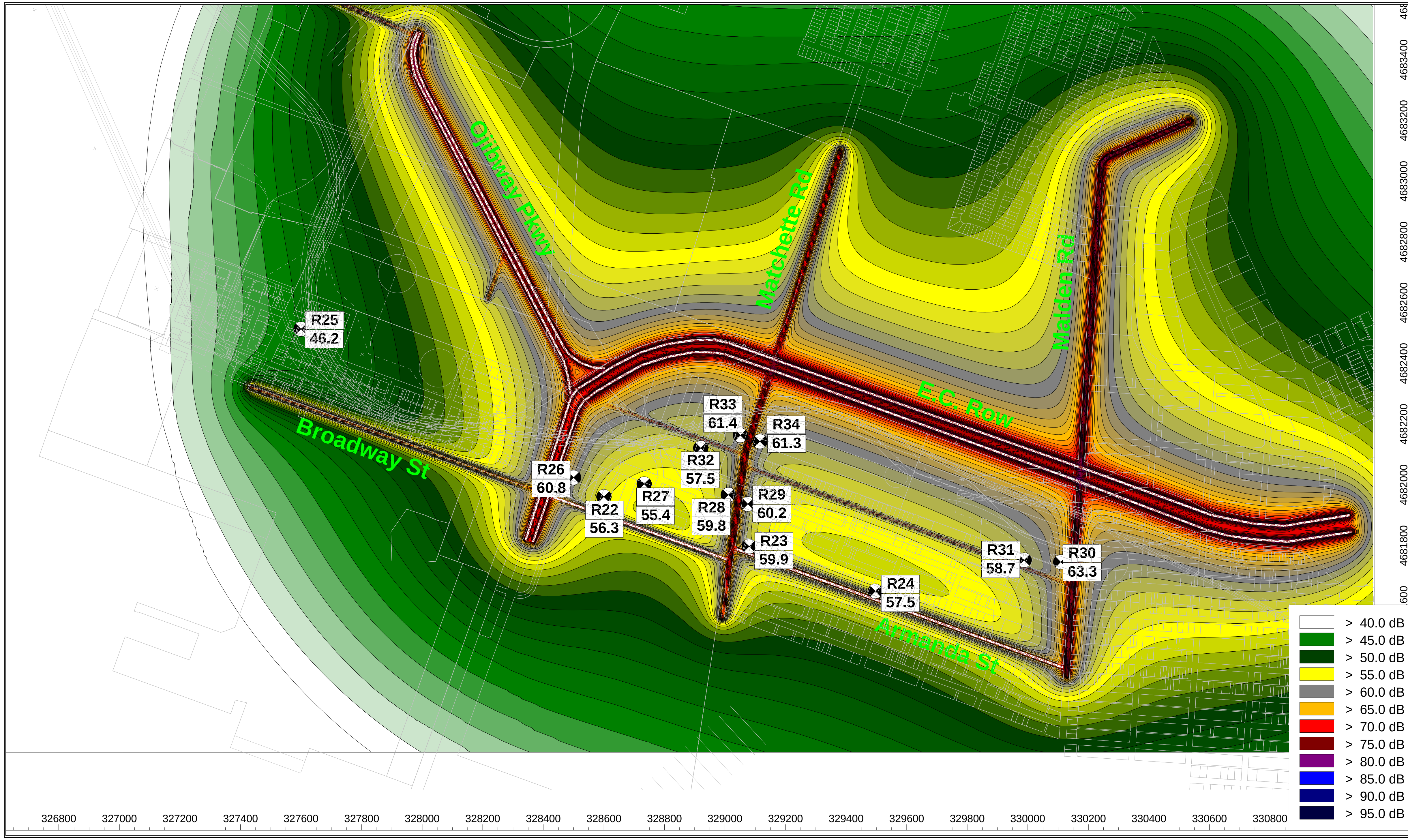
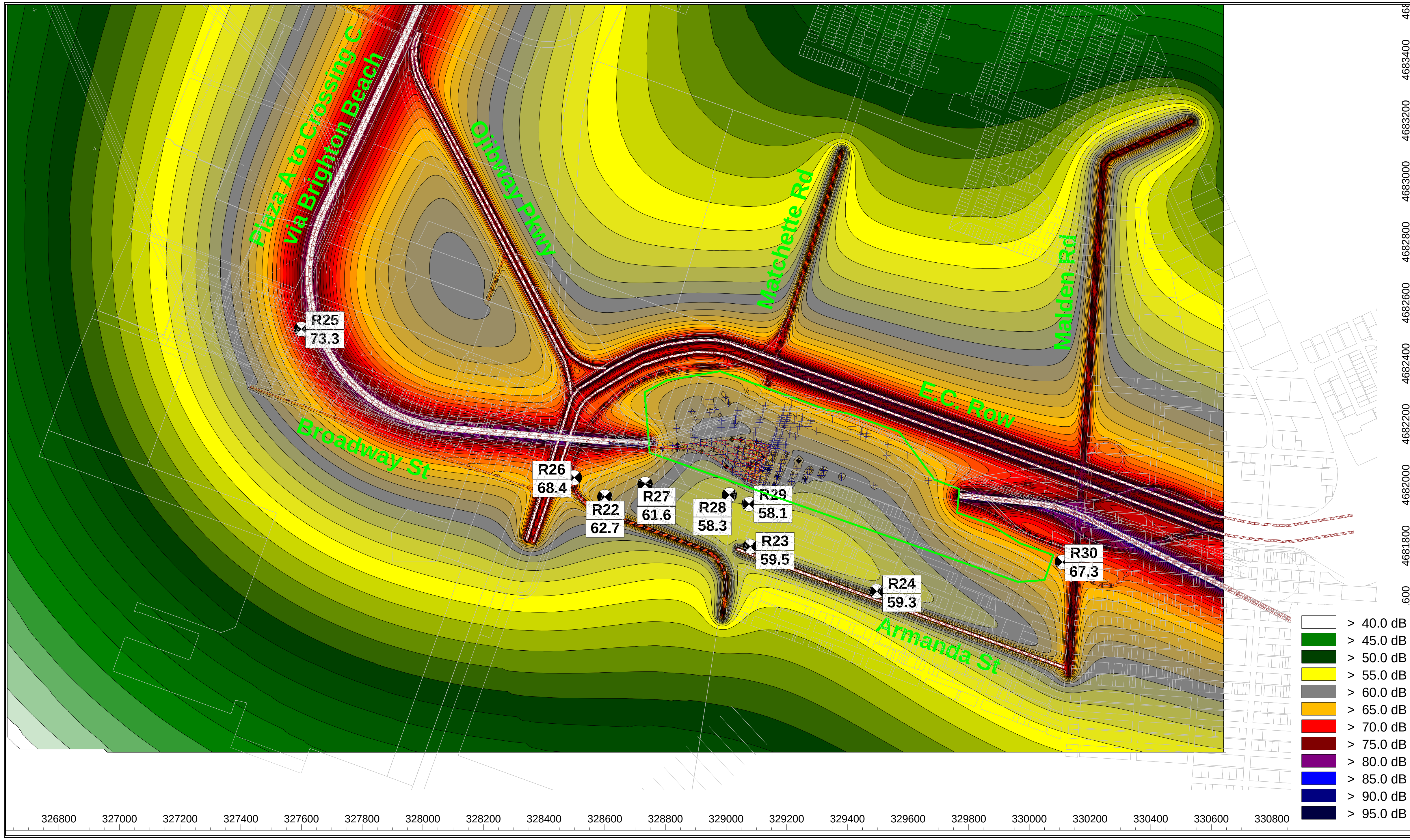
FIGURE 7.2-7 PLAZA A – CROSSING C (VIA BRIGHTON BEACH): FUTURE NO-BUILD (2035) – DAYTIME



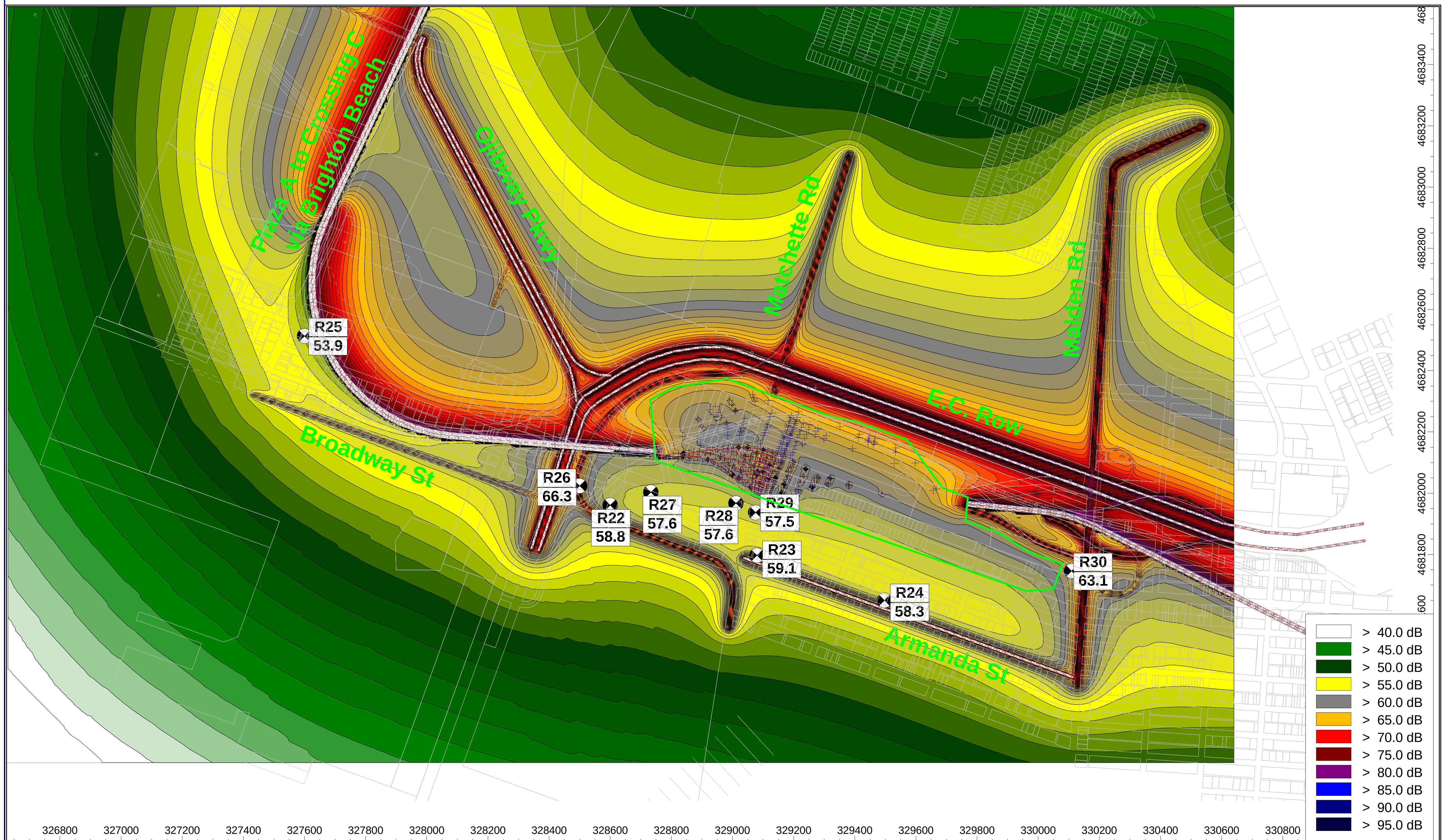
Note: Each contour line represents 1 dB interval

FIGURE 7.2-8 PLAZA A – CROSSING C (VIA BRIGHTON BEACH): NO MITIGATION (2035) – DAYTIME



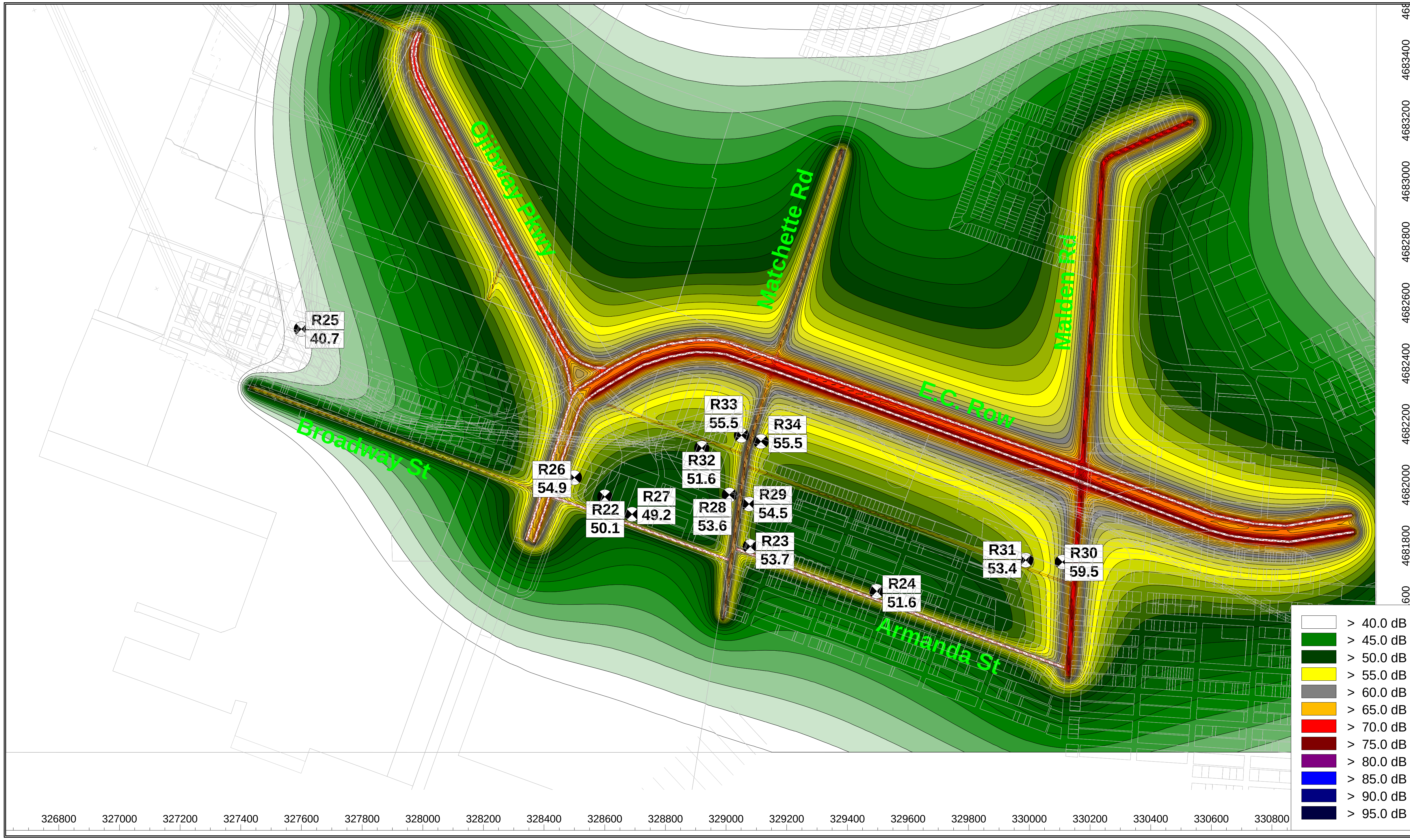
Note: Each contour line represents 1 dB interval

FIGURE 7.2-9 PLAZA A – CROSSING C (VIA BRIGHTON BEACH): 4 M BARRIER (2035) – DAYTIME



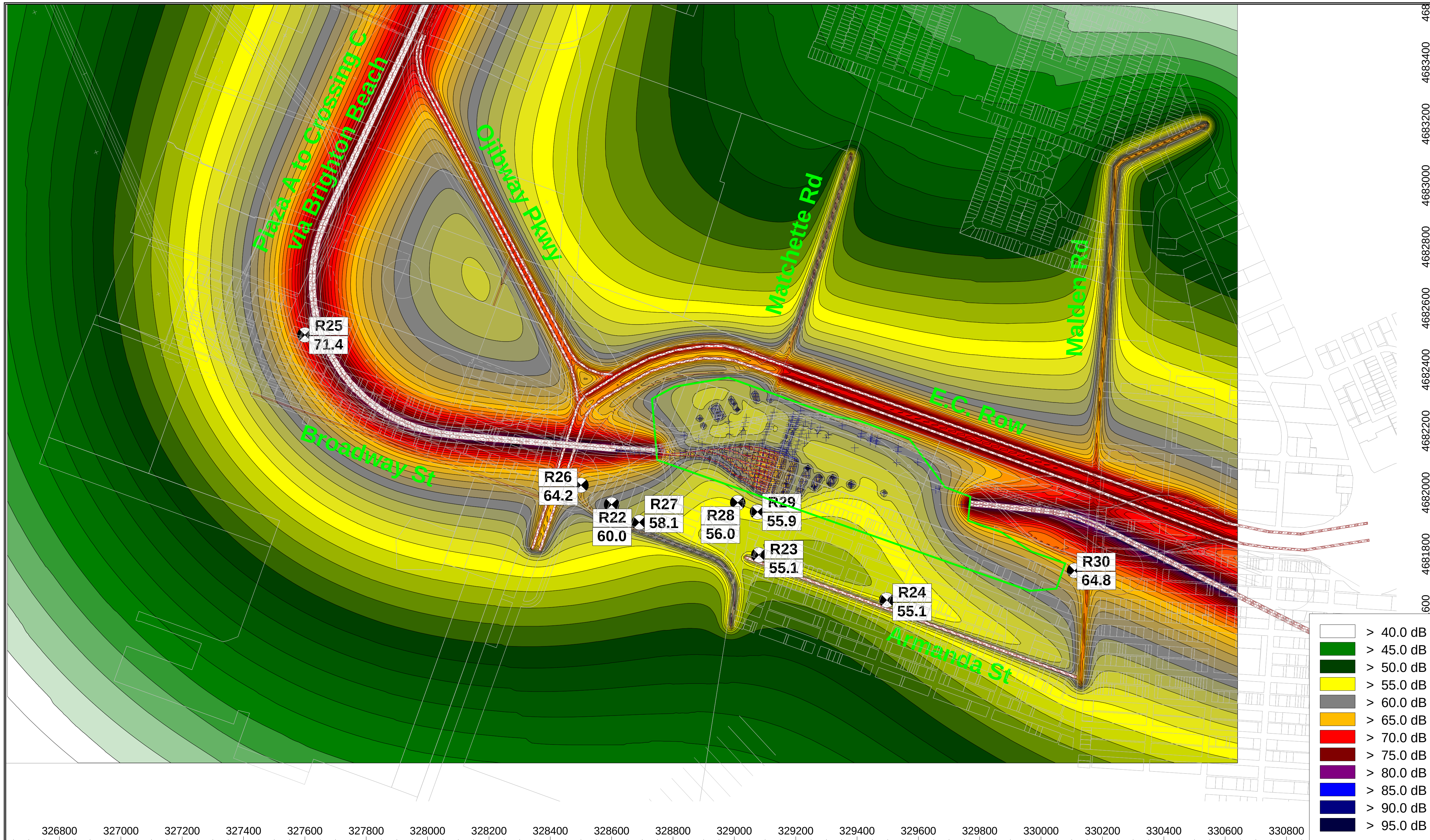
Note: Each contour line represents 1 dB interval

FIGURE 7.2-10 PLAZA A – CROSSING C (VIA BRIGHTON BEACH): FUTURE NO-BUILD (2035) – NIGHTTIME



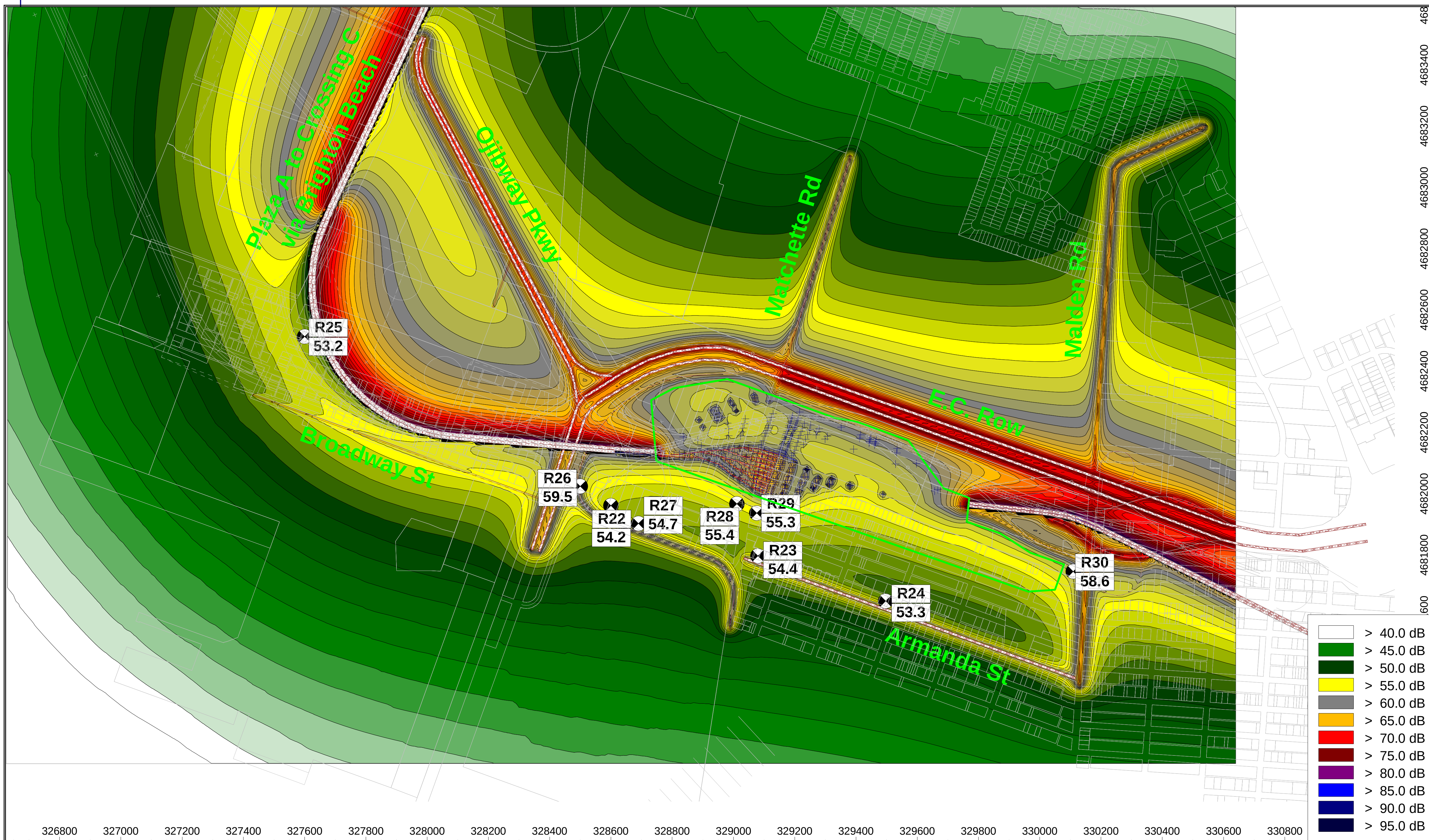
Note: Each contour line represents 1 dB interval

FIGURE 7.2-11 PLAZA A – CROSSING C (VIA BRIGHTON BEACH): NO MITIGATION (2035) – NIGHTTIME



Note: Each contour line represents 1 dB interval

FIGURE 7.2-12 PLAZA A – CROSSING C (VIA BRIGHTON BEACH): 4 M BARRIER (2035) – NIGHTTIME



Note: Each contour line represents 1 dB interval

7.3 Noise Mitigation Measures for Tunnel Alternative

The tunnel portals and ventilation buildings are the key noise sources associated with the tunnel alternative.

Given the low frequency characteristics of the vent fans, acoustic louvers may not be as effective as silencers. Table 7.3-1 shows the noise attenuation that can be expected with the installation of a silencer. The values in the table are sound level reductions that can be achieved for noise emitted by the ventilation fans at the respective sound frequencies should a silencer be installed.

TABLE 7.3-1 SILENCER NOISE ATTENUATION

	Silencer								
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
Attenuation (dB)	-12	-15	-20	-24	-25	-25	-25	-25	-25

The modeling results show that with the silencer specified above for option 1 the noise from the ventilation building can be effectively controlled. The fan noise is directional. The following summarizes the *minimum* separation distances required to achieve 45 dBA (which represents the minimum nighttime sound level limit for a stationary source in an urban area), 50 dBA (which represents the minimum daytime sound level limit for a stationary source in an urban area), and 55 dBA (which represents the minimum sound level limit for the DRIC project).

Option 1

Nighttime

- ≈ 16.5 m from the south façade of the ventilation building to achieve 45 dBA;
- ≈ 50 m from the west façade of the ventilation building to achieve 45 dBA;

Daytime

- ≈ 24 m from the west façade of the ventilation building to achieve 50 dBA;
- ≈ 9.5 m from the west façade of the ventilation building to achieve 55 dBA.

It should be noted that due to the directivity of the fan noise and building shielding effect, the highest predicted noise levels at the side of the building with no fans is predicted to be approximately 41 dBA for option 1.

Further, the ventilation buildings can be located to maximize the separation distances between the buildings and any receptors. Thus, it is expected that the ventilation building noise could be localized through mitigation. The modeling

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results provide the minimum separation distances between the ventilation building and a sensitive receptor in order to meet the sound level limits of 45 dBA, 50 dBA, and 55 dBA. With the mitigation in place, the minimum separation distance to achieve 45 dBA in option 1 has been reduced from almost 760 m (see Figure 5.2-1) to only approximately 50 m.

The reverberation noise from the portal is also expected to be localized in the immediate vicinity of the portal. Existing studies, as well as the SENES' investigation, indicate that within a short distance from the tunnel, between 18 to 21 m, the reverberation effect (or the portal effect) will be largely unnoticed.

7.4 Vibration Mitigation Measures

Based on the field monitoring results, it is expected that the vibration levels caused by the proposed project will comply with MOE criteria. For this reason, no measures to migrate vibration are being proposed.

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