Executive Summary

This document provides an overview of the noise and vibration impact analyses completed for five preferred alternatives 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 all access road alternatives, except for the Parkway alternative, for which three additional receptor were exclusively applicable.
3. Since each access road alternative, except for Alternative 3 and the Parkway alternative, 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, 2B, and Parkway alternative) and tunnel (3) seem to generate lower noise levels at the receptor locations. Only below-grade alternatives (1B, 2B), the tunnel alternative (3) and Parkway alternative show no predicted noise impact in all route segments between Pulford Street and the existing Highway 401. For all alternatives, some exceedances were observed between Malden Road and Pulford Street, with at least one receptor experiencing a high noise impact (greater than 10 dB exceedances above the no-build sound levels) for all three scenario years (2015, 2025, and 2035), either daytime or nighttime.
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 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 from the edge of the roadway 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 from the edge of the roadway were counted as potential locations where vibration levels could potentially reach the threshold value of 0.14 mm/sec.

MITIGATION MEASURES

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

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

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.

MITIGATION RESULTS

1. In all cases for receptor located in areas between Malden Road and North Talbot Road (the existing Highway 401) along the proposed access road, the proposed 5 m high 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 (2-S and 2A-S) on Spring Garden Road along the proposed access road for Alternatives 1A and 1B. It should be noted that 2A-S is a vacant residential lot.
2. Silencers can be installed to mitigate noise from the ventilation building fans associated with the tunnel alternative.
3. 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.
4. Of all of the crossing and plaza combinations, the approach roadways that connect crossings 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 itself is minimal. The highest noise impact was predicted when the Plaza A and Crossing C via Brighton Beach combination is used. With mitigation in place, the modelling results show that for all but two receptor locations (near Ojibway Parkway (R26&R27), with all crossings that connect to Plaza A options) the proposed 5 m (16 ft) high acoustic barrier on the proposed approach roadways to the crossings in combination with the 4 m (13 ft) high acoustic barrier on the proposed crossings are effective in reducing sound levels to within 5 dB of the no-build sound levels. The sound levels after mitigation for receptor location R26 and R27 are predicted to be at maximum 7 dB above the no-build sound levels for the different crossings that connect to Plaza A.

   One receptor in the Brighton Beach area (R25) is also predicted to experience a high noise impact as a result of the crossings connecting to 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.

5. 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.
6. 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. 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.

CONCLUSIONS

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

1. Without mitigation, based on noise modelling results for the access road alternatives connecting to the proposed Plaza A, the proposed alternatives 2B, 3 (tunnel) and the Parkway will result in the least occurrences of project sound levels that are greater than 5 dB above the no-build scenarios. For route alignment connecting to Plazas B and C (i.e., not Plaza A), both Alternative 3 (tunnel) and the Parkway alternative will result in the least occurrences of project sound levels exceeding the no-build sound level by greater than 5 dB. The counts are presented below:

Alternative:	1A	1B	2A	2B	3	Parkway
Number of receptor locations where exceedances occur (without mitigation) – connection to Plaza A, option 1 at segment Cousineau Road to Howard Avenue:	3	3	4	2	2	2
Number of receptor locations where exceedances occur (without mitigation) – connection to Plaza A, option 2 at segment Cousineau Road to Howard Avenue:	4	3	5	2	2	2
Number of receptor locations where exceedances occur (without mitigation) – connection to Plaza B and C, option 1 at segment Cousineau Road to Howard Avenue:	3	2	4	2	1	1
Number of receptor locations where exceedances occur (without mitigation) – connection to Plaza B and C, option 2 at segment Cousineau Road to Howard Avenue:	4	2	5	2	1	1

2. With a 5 m high barrier in place, the proposed project will result in no to marginal noise impact for all access road alternatives, except for two locations with the Alternatives 1A and 1B scenarios. The two receptors (2A-S and 2A) are located in the route segment between Malden Road and Pulford Street. The noise level after mitigation at these two receptor locations range from 5 to 7 dB above the no-build sound levels for the different access road alternatives in the worst-case year 2035. For Alternatives 2A and 2B scenarios, Receptor 2A-S is approximately 5 dB above the no-build sound levels. However, it should be noted that Receptor 2A-S is currently a vacant lot, but is zoned residential. It should also be noted that for several receptors, a decrease in noise levels compared to future no-build noise levels was predicted.
3. The Crossing C option shows the highest potential for noise impact in the southern portion of Sandwich Towne. 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).
4. 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, even after mitigation, a potential 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.
5. 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.
6. There are several route segments with receptors within 25 m from the edge of the roadway. 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.