environmental noise and vibration feasibility study
project number: 12366

Cumberland Terrace
2 Bloor Street West
City of Toronto

Prepared for:

Architects Alliance

Prepared by:

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executive summary

Aercoustics Engineering Limited has prepared this report in support of an application to the City of Toronto for Site Plan Approval for the proposed development is located near the corner of Bloor Street West and Yonge Street. This development consists of a proposed 54-storey residential tower with the lower 5 storeys containing amenity and service space, a proposed 5-storey podium containing retail, parking, and amenities, and a proposed 2-storey podium with retail and amenity space.

The impact of vibration from the TTC Bloor-Danforth subway line has been analysed by measurement and assessed against the MOE guidelines and the City of Toronto By-Laws.

- A conservative analysis indicates that over time, subway vibration levels in the proposed development may exceed the criteria of perceptible vibration;
- Ground-bourne noise levels from the subway are predicted to cause a very significant intrusion in the range of 60 to 65 dBA.
- It is recommended that the development include vibration mitigation.

The dominant road traffic sources in the subject study area include Bloor Street West, Bay Street, Yonge Street, and Cumberland Street. The following conclusions are made in respect to road traffic noise.

- Standard OBC window and wall construction will be sufficient for compliance with the MOE criteria for indoor sound levels (STC 35 or higher);
- 1.8m high rooftop barriers are recommended to protect outdoor amenity areas on the West Podium rooftop;
- The provision for adding central air conditioning is required for residential units with no AC.

This site is not affected by aircraft traffic or freight/above-grade rail traffic. Mechanical equipment on neighbouring rooftops may require moderate amounts of mitigation and it is recommended that a detailed study be completed to assess this. This will require the cooperation from the owners/operators of other adjacent properties.

As indicated in the City of Toronto and MOE implementation guidelines where mitigation is required or noise may be a concern, future occupants will be advised through warning clauses. At some locations, audible noise below the MOE criteria levels may be a concern and therefore warning clauses are recommended. Section 7 of the report provides notes and sample wording of the warning clauses.

This report has also identified high level noise/vibration controls to ensure that the self-noise impact of the proposed development is minimized.
With the incorporation of the noise and vibration controls discussed in this report, the sound levels at the sensitive receptors of the proposed mixed-use residential and commercial high-rise development will comply with the noise guidelines of the MOE.

When detailed plans are available, they should be reviewed by an acoustical consultant to confirm the architectural sound isolation requirements to ensure compliance with the City of Toronto noise by-laws and MOE Guidelines.
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1 Introduction

Aercoustics Engineering Limited has been retained by Architects Alliance to prepare an Environmental Noise and Vibration Feasibility Study. The proposed development is a mixed-use residential and commercial development. It is located near the southeast corner of Bay St and Cumberland St.

Figure 1 provides a key plan showing the proposed development location at 2 Bloor Street West. Figure 2 shows a site plan of the proposed development.

The purpose of this study is to examine the existing and future noise environment in the development area and to evaluate its impact potential on the future residential and commercial receptors. This report also investigates the noise control features that are required for the development in order to meet the noise guidelines of the Ontario Ministry of the Environment (MOE) and to satisfy the requirements of the City of Toronto.

The development consists of a proposed 54-storey residential tower with the lower 5 storeys containing amenity and service space, a proposed 5-storey podium containing retail, parking, and amenities, and a proposed 2-storey podium with retail and amenity space.

Existing buildings at the site of the proposed development will be demolished prior to construction.

The subject site is surrounded in all directions by commercial-residential zoned properties and the existing TTC Bloor-Danforth subway line lies immediately below. The noise impact potential of the surrounding land uses on the proposed project has been examined and is further discussed in this document in accordance with the MOE noise guidelines outlined in the MOE publication NPC-300 and LU-131.

This report is based on the Architectural Plans prepared by Architects Alliance dated May 30, 2014, Mechanical and Electrical design briefs prepared by Smith and Anderson dated April 23, 2014, and City of Toronto Peak Traffic Data provided by BA Group.

The dominant road traffic sources in the subject study area include Bloor Street West, Bay Street, Yonge Street, and Cumberland Street. The impact of vibration from the TTC Bloor-Danforth subway line has been assessed by measurement against the MOE guidelines.
2 Guidelines and Criteria

2.1 Vibration Requirements
Vibration can be measured in terms of velocity or acceleration. The City of Toronto follows the vibration study guidelines of CN Rail. The CN guidelines pertaining to vibration propose a limit to vibration levels in terms of an RMS velocity with an 1-second averaging time constant, which is 0.14 mm/s within a frequency range of 4 Hz and 200 Hz. A vibration velocity level of 0.10 mm/s is generally considered to be the on-set of human perception to vibration. The guidelines also require that the foundation of any development within 75 m of a principal mainline right of way undertake vibration measurements to ensure feasibility.

2.2 Outdoor Living Area (OLA)
MOE Guidelines recommend that equivalent noise levels (Leq) in outdoor living areas should not exceed 55 dBA. Predicted noise levels between 55 dBA and 60 dBA may be acceptable, provided that the future occupants of the buildings are made aware of the potential noise problems through appropriate warning clauses. Noise levels above 60 dBA are generally not acceptable.

All unenclosed balconies that are less than 4 m in depth and outside the exterior of the building façade are exempt from meeting the MOE outdoor noise criteria with regards to transportation noise sources. Should the depth of the future balconies and terraces be greater than 4 m, they will be subject to the MOE noise level limit of 55 dBA.

2.3 Indoor Living Spaces
Indoor noise levels due to road traffic were examined with respect to the MOE Guidelines. Bedrooms are normally required to meet an indoor Leq of 40 dBA from road traffic noise sources. The recommended indoor sound limit for living or dining rooms is an Leq of 45 dBA. Retail or general office spaces should meet the indoor noise level of 50 dBA as a general good design practice.

To achieve these levels, the MOE Guidelines provide a basis for the type of windows and exterior walls that will be required based on projected outdoor noise levels.

It is also an MOE requirement that a central air conditioning system be installed for the dwelling(s) when the nighttime or daytime outdoor noise levels at the façade of the dwelling are above 60 dBA and 65 dBA, respectively. The provision for adding central air conditioning must be made if the nighttime sound level is greater than 50 dBA and less than or equal to 60 dBA on the outside face of a bedroom window or greater than 55 dBA and less than or equal to 65 dBA on the outside face of a living/dining room window. This provision involves a ducted heating system sized to accommodate the addition of central air conditioning by the occupant at a later date.

The required limits are summarized in Table 2-1 below.

Table 2-1: Noise Limits – Road Traffic

<table>
<thead>
<tr>
<th>Type of Space</th>
<th>Required Leq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrooms (Indoor)</td>
<td>40 dBA</td>
</tr>
<tr>
<td>Living/Dining Rooms (Indoor)</td>
<td>45 dBA</td>
</tr>
<tr>
<td>Outdoor Living Areas (OLA)</td>
<td>55 dBA</td>
</tr>
</tbody>
</table>
2.4 Stationary Noise sources

The noise level limits pertaining to stationary noise sources have been established based on MOE Publication NPC-300. The MOE defines a Class 1 area as an area with an acoustical environment typical of a major population centre, where the background noise is dominated by the urban hum. Due to frequent road activity and an urban environment, all receptors in this study are considered to be in a Class 1 area.

The appropriate stationary source exclusion limits are summarized in Table 2-2.

Table 2-2: Noise Exclusion Limits – Stationary Noise Sources – Class 1

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Sound Level Exclusion Limit* Class 1 Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (07:00 to 19:00)</td>
<td>50 dBA</td>
</tr>
<tr>
<td>Evening (19:00 to 23:00)</td>
<td>47 dBA</td>
</tr>
<tr>
<td>Night (23:00 to 07:00)</td>
<td>45 dBA</td>
</tr>
</tbody>
</table>

* - or the minimum existing hourly background sound level Leq, whichever is higher

Long term RIOM NL-32 ambient sound level monitors, configured to record statistical data on an hourly basis, were installed on the rooftop of the 34 storey commercial tower located at 2 Bloor Street West. One monitor faced the west direction and one faced the north direction, as indicated on Figure 1. Both monitors recorded data from June 9th, 2014 to June 12, 2014 and were positioned such that they were shielded from penthouse mechanical equipment operating at 2 Bloor Street West.

The long term community sound monitoring data confirmed that the characteristic noise environment at the proposed site is that of an urban population centre with relatively high ambient sound levels throughout the day and night. The lowest 1-hour Leq recorded by the noise monitors was 55 dBA. This sound level during night-time hours is very typical for downtown Toronto and is similar to other areas measured previously by Aercoustics for other developments.

The MOE exclusion limit listed in Table 2-2 should not apply and the lowest 1-hour L eq at future proposed residential receptors should be applied as the applicable sound level limit. A reduction of 3 dB to the monitor data has been taken to account for the proximity of the microphone to the building façade during the monitoring period. This is common practice that represents the removal of a sound reflection from the building itself.

Appendix D displays the hourly A-weighted Leq versus the monitoring time period, as well as pertinent weather data. Sound level limits for each receptor have been established using the lowest one-hour Leq measured during the day-time, evening, and night-time periods, as summarized in Table 2-3 below:
Table 2-3: Noise Limits – Stationary Noise Sources

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Sound Level Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (07:00 to 19:00)</td>
<td>60 dBA</td>
</tr>
<tr>
<td>Evening (19:00 to 23:00)</td>
<td>59 dBA</td>
</tr>
<tr>
<td>Night (23:00 to 07:00)</td>
<td>55 dBA</td>
</tr>
</tbody>
</table>

The above listed sound level limits apply to plane of window and outdoor living area points of reception.

3 Details of Prediction Methods and Site Measurements

3.1 Vibration Measurements

The proposed development complex is located directly above the existing TTC Bloor-Danforth subway line. Therefore, a vibration study is required to determine feasibility based on the CN Rail Guidelines and Procedures which are followed by the City of Toronto. Vibration measurements were performed on October 28, 2009 and June 9th, 2014.

Vibration measurements were performed at three locations within the food court of the existing Cumberland Terrace development. The 2008 measurements were performed directly on the top of the subway structure in the location indicated as position 1 on Figure 3 via a hole excavated in the floor of the food court. The 2014 measurements were performed above the subway structure directly on the finished tile floor of the food court in the two locations indicated as 2 and 3 on Figure 3. We have included the data collected previously at this location in 2008 for the purposes of assessing vibration at the top of the TTC tunnel. Preliminary building plans indicate that building structure is planned to be partially supported directly on the top of the subway tunnel.

Over the course of the 2014 recording period, more than 10 trains were captured. The vibration data was analysed with a 1 second time constant from 4 Hz to 200 Hz as per the applicable guidelines. For the 2009 measurements, more than 10 trains were captured, and the data was analysed from 4 Hz to 200Hz using a 1 second Leq. In both cases, the maximum level recorded was determined from all train pass-bys.

3.2 Road Noise Predictions

Sound level calculations were performed in accordance with the Ministry of the Environment Guidelines outlined in Reference 1, and by the Guidelines of the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT). Sample copies of the traffic noise predictions from MOE’s Road and Rail Traffic Noise Prediction Model STAMSON (Version 5.02) are included in Appendix A.

The equivalent sound levels (Leq’s) due to road traffic were calculated at worst case residential receptors in the proposed development. The calculations were performed for both daytime and nighttime conditions at worst case receiver heights and locations. Noise levels were also predicted at the critical outdoor living areas throughout the development.
3.3 Road Traffic Data

Predictions of road traffic noise were based on the road traffic data outlined in Table 3-1 below. City of Toronto Peak Traffic Counts were provided via BA Group. This data was predicted for the year 2024 at an assumed 2% increase per year.

Copies of the road traffic data are included in Appendix A.

Table 3-1: Road Traffic Volumes

<table>
<thead>
<tr>
<th></th>
<th>Bloor Street West</th>
<th>Bay Street</th>
<th>Yonge Street</th>
<th>Cumberland Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>24hr Volumes</td>
<td>15,430</td>
<td>15,450</td>
<td>11,810</td>
<td>2110</td>
</tr>
<tr>
<td>No. of Lanes</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Day/Night Split (%)</td>
<td>90/10*</td>
<td>90/10*</td>
<td>90/10*</td>
<td>90/10*</td>
</tr>
<tr>
<td>Percentage of Trucks (%)</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Heavy/Medium Ratio (%)</td>
<td>0/1</td>
<td>1/2*</td>
<td>3/4*</td>
<td>1/0</td>
</tr>
<tr>
<td>Posted Speed (km/hr)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

* Assumed.

3.4 Stationary Noise Sources

The potential impact of the surrounding land uses on the proposed project has been examined. As noted in Section 1, the adjacent properties are mixed commercial and residential uses. Most of the adjacent buildings have comfort heating/cooling and ventilation mechanical equipment located on rooftops. Some of these are partially enclosed by large parapets.

The closest off-site stationary sources to the proposed subject development are on the rooftop of the retail building immediately to the south, followed by those on the rooftop of the buildings immediately north-east. Some of this equipment may need to be mitigated as discussed later.

The potential impact of the proposed project on the surrounding community has been assessed. Rooftop cooling towers, chillers, emergency backup generator, pumps, and ancillary equipment is proposed in the tower. Cooling towers and an emergency backup generator are proposed on the West podium and a dry cooler is proposed on the East podium. Depending on the final equipment selection, layout, and supplied silencing, a minimal impact from stationary equipment on the surrounding environment is expected.

Mitigation requirements will be determined as part of the development’s detailed design to ensure compliance with the MOE noise guidelines.
4 Results of Noise Predictions & Measurements

4.1 Results of TTC Subway Vibration Measurements
The maximum recorded vibration levels on the top of the TTC subway structure was 0.4mm/s, whereas the maximum level recorded on the food court floor was 0.08mm/s. These are summarized in Appendix C.

The levels recorded on the food court floor are likely lower due to coupling losses between the subway tunnel, the soil and the base concrete slab at concourse level. The current structural design of the building has a caisson wall on either side of the subway tunnel which will support the proposed development. These caisson’s will tie into the earth near the base of the subway (the origin of vibration excitation) and hence will likely be subjected to higher vibration levels than the measured 0.08mm/s on the concourse floor.

The Cumberland Terrace development structure is proposed to be partially supported on top of the subway structure as well. As a result, the overall vibration experienced by the proposed development structure will likely be some quantity between the caisson vibration level and TTC structure vibration level.

The measurements do not account for the possibility that rail joints located along another section of subway track may cause higher levels in parts of the structure than those locations where measurements have been performed. Also, rolling contact fatigue, rail corrugation, fleet variation and wheel defects are effects at both the track and vehicle level which in time can increase vibration levels beyond what was measured by as much as 5-15 dB.

The vibration level experienced by the future residents is largely dependent on the response of the proposed building, which is difficult to model at this stage of the project. Depending on the foundation type and structure of the building the coupling loss factors and amplification effects could be different. Therefore, it is reasonable to predict that for unmitigated building construction, particularly considering the factors above, some trains may exceed the vibration criteria. As such, vibration mitigation is recommended for the tower.

4.2 Predicted Structure-Borne Noise
Before the vibration is felt, significant levels of vibration induced noise will be generated. This was investigated further to determine the levels of noise intrusion into future residential spaces. The vibration measurement data was used to predict the vibration-induced noise levels in the proposed residential units. The predicted unmitigated A-weighted sound levels for residences are shown in Table 4-1. These calculations are approximate and are meant to give a range of expected sound levels from subway train pass-bys.

Table 4-1: Predicted Unmitigated Sound Levels

<table>
<thead>
<tr>
<th>Residential Tower, Retail, and Amenity Spaces</th>
<th>Predicted sound level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60-65dBA</td>
</tr>
</tbody>
</table>

These predictions indicate that an objectionable noise intrusion is likely to occur without mitigation. This noise is characterized by a low frequency rumble sound in the 40 to 50 Hz range and subsequent harmonics at 100 to 125 Hz radiating from the walls, floor and ceiling. The MOE criteria
for rail noise in a bedroom and retail space is 35dBA and 45dBA respectively. The levels predicted from unmitigated structure borne noise exceed this by 15 to 30 dB. This is considered a very significant intrusion.

4.3 Road Noise Prediction Results

Table 4-2 below lists the daytime and nighttime $L_{eq}$'s due to road traffic as predicted at critical locations within the development, labelled as 1-4 in blue on the site plan in Figure 2. Sample calculations are provided in Appendix A.

Table 4-2: Calculated Unmitigated Noise Levels Due to Road Traffic

<table>
<thead>
<tr>
<th>Calculation Location</th>
<th>Floor Number/Receptor Height</th>
<th>Description</th>
<th>Source</th>
<th>Distance (m)</th>
<th>$L_{eq}$ (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23.5m</td>
<td>West Podium Rooftop terrace (OLA)</td>
<td>Bay Street</td>
<td>14</td>
<td>67</td>
</tr>
<tr>
<td>2</td>
<td>14.5m</td>
<td>East Podium Rooftop terrace (OLA)</td>
<td>Yonge Street</td>
<td>60</td>
<td>56</td>
</tr>
<tr>
<td>3</td>
<td>All floors</td>
<td>Tower South Face</td>
<td>Bloor Street West</td>
<td>70</td>
<td>56</td>
</tr>
<tr>
<td>4</td>
<td>All floors</td>
<td>Tower North Face</td>
<td>Cumberland Street</td>
<td>7</td>
<td>57</td>
</tr>
<tr>
<td>5</td>
<td>All floors</td>
<td>Tower East Face</td>
<td>Yonge Street, Bloor Street West Cumberland</td>
<td>105</td>
<td>70</td>
</tr>
<tr>
<td>6</td>
<td>All floors</td>
<td>Tower West Face</td>
<td>Bloor Street West, Bay Street Cumberland</td>
<td>70</td>
<td>58</td>
</tr>
</tbody>
</table>

The outdoor living area (OLA) receptors on the East and West podiums were chosen to be at the worst case location of the useable area nearest to Yonge Street and Bay Street, respectively.

The noise levels listed in the table above were used to determine the window glazing as well as exterior wall requirements for each designated point of reception. These requirements consist of assumed window to room floor area percentages based on similar projects in the GTA and a corner bedroom or living room with two faces exposed to the noise sources. Glazing requirements should be verified once floor plans and architectural drawings are finalized.

4.4 Stationary Source Impact

Using a likely conservative assumption that rooftop equipment on all surrounding buildings has a sound power level of 100dBA to 105dBA, the worst-case predicted impact on the residential tower was 60-65dBA. Based on this analysis the dominant noise sources are those located immediately to the south of the facility, and this worst case impact occurs at the lower levels of the residential portion of the tower. The predicted impact of 60-65dBA is greater than the established sound level limit of 55dBA by up to 10dB; as such source-side mitigation and barriers around rooftop amenity...
areas may be necessary but should not affect the feasibility of the proposed development.

5 Noise & Vibration Control Recommendations

5.1 Vibration Controls
Based on the results of the vibration measurements and predictions, it is recommended that the development include vibration mitigation. Although the vibration predictions at the most sensitive residential units are within applicable vibration limits, further wear and tear from the subway train, and variables related to the building foundation and structure may result in higher vibration levels. Also, the vibration level from subway pass-bys will likely be perceptible. Due to the high vibration-induced noise levels predicted which would likely cause objectionable noise intrusions into the dwellings, vibration mitigation is strongly recommended.

With mitigation, vibration levels can be limited in the proposed residential towers to within the acceptable criteria outlined by the MOE and the City of Toronto. In addition, predicted noise levels can be significantly reduced to within typical levels of that of bedrooms and living rooms. Note that this analysis should be revised if the planned locations of the residential units in the architectural plans are changed.

A warning clause is recommended to warn future residents that some vibration induced noise may be audible. Sample wording is provided in Section 7.

5.2 Outdoor Living Areas
The unmitigated noise level calculations due to road traffic, as listed in Table 4-2 above, indicate that the sound levels at the rooftop terraces on the west podium is predicted to be up to 67 dBA. This is much higher than the MOE guideline sound level limit of 55 dBA. It is recommended to provide a barrier around the perimeter of these amenity areas to a height of 1.8m. The barrier should have a minimum surface density 10kg per square meter and should be continuous with no gaps or penetrations.

All unenclosed balconies that are less than 4 m in depth and outside the exterior of the building façade are exempt from meeting the MOE outdoor noise criteria with regards to transportation noise sources.

5.3 Indoor Living Spaces
Indoor sound levels have been examined with respect to MOE Guidelines as summarized in Section 2.2 of this report. The dimensions of a typical upper floor northwest corner unit were used based on the typical floor plans. The recommendations discussed below are based on these floor plans and must be verified upon the review of the final architectural design of the proposed development.
Table 5-1: Recommended Window Glazing

<table>
<thead>
<tr>
<th>Façade</th>
<th>Floor Number</th>
<th>Daytime Window STC</th>
<th>Nighttime Window STC</th>
</tr>
</thead>
<tbody>
<tr>
<td>All façades</td>
<td>All</td>
<td>STC 35</td>
<td>STC 35</td>
</tr>
</tbody>
</table>

Note: The above listed STC rating should be reviewed/confirmed once the final suite layouts/architectural drawings are available.

The worst case impact of the daytime road traffic predicts a level of 59 dBA at the north face of the proposed tower. For the proposed residential units shown on the typical floor plan, calculations were performed with the noise insulation modelling software IBANA v1.2 for a standard high-rise window (assuming floor to ceiling glazing 6 mm / 13 mm / 6 mm, STC 35). Based on the floor plans provided, the indoor sound level was predicted to be less than the 45 dBA sound level limit using standard high-rise window glazing.

No upgraded building construction is required. The building envelope components meeting the requirements of the Ontario Building Code will provide adequate acoustical protection for the future indoor daytime living spaces. Similarly, the bedroom windows and walls meeting the Ontario Building Code requirement will also suffice for noise control purposes.

If central air conditioning is not already proposed to be included, the provision for adding central air conditioning is required for the tower. Sample warning clause wording is provided in Section 7 of this document and should be included in the purchase/lease agreements.

5.4 Stationary Noise Sources

The stationary noise sources on the rooftops of the adjacent residential and commercial developments may be audible in the residential units and associated amenity spaces.

During the design stage of the project, more detailed measurement and analysis of the mechanical equipment on the rooftops of buildings to the north and south of the proposed development is recommended. This is to determine if any additional noise controls are needed. Regardless, the impact from this equipment can be practically mitigated and does not affect the feasibility of the proposed residential buildings.

A warning clause should be included in all purchase and sale agreements for all units to warn of potential noise from commercial stationary sources. Sample warning clause wording is provided in Section 7.
5.5 Self-impact of the proposed development

As part of the City of Toronto Noise By-law requirements, it is important to mention the self-impact of the development on itself.

The proposed residential development is required to satisfy the general requirements of the Ontario Building Code. The construction of partitions within a residential building should meet the following STC (Sound Transmission Class) requirements:

- Suite/Suite – Wall or Floor - STC 50
- Suite/Elevator or Hoistway or Refuse Chute – STC 55

The noise associated with mechanical/electrical equipment operation should satisfy the NC (Noise Criteria) recommended by ASHRAE (American Society of Heating and Air-conditioning Engineers HVAC Handbook). The criteria is as follows:

- Living Rooms, Dining Rooms – NC-30 to NC-35
- Bedroom NC-25 to NC-30

The following additional recommendations are made at this point to minimize the self-impact of the building at this point. Further details will be provided throughout the design of the building.

- A suspended drywall ceiling or floating floor will likely be required for the mechanical spaces located above dwelling units (e.g. mechanical rooms located at the penthouse level)
- Noise propagation from the mechanical equipment, particularly supply fans, pumps, and air conditioning equipment should be verified to ensure acceptable interior noise levels.
- All mechanical equipment should be installed with adequate vibration isolation
- The outdoor mechanical equipment noise levels should not exceed sound pressure levels outlined in Section 2.4; noise controls such as silencers/enclosures should be recommended upon review of the proposed mechanical equipment. This sound level limit applies to both off-property and on-property sensitive receptors
- The walls between garbage rooms and adjacent suites should have minimum STC rating of 60. Also, the entire run of the garbage chute should be straight with at least 2” insulation around its perimeter.
- The walls between elevator shafts and adjacent suites should have minimum STC rating of 60.
- The proposed standby generator should be acoustically treated (i.e. silencers, mufflers, etc.) and reviewed to ensure MOE noise guidelines are satisfied.
• Pipe risers should be separated from suites with a wall construction providing a minimum STC of 50.

• All pipes greater than 3” in diameter should be vibration isolated from all walls and floors. These pipes should be supported on resilient hangers with a neoprene element in series with a spring isolator having static deflection of at least 1”.

• All pipes penetrating through the wall of floors should do so through enlarged sleeve penetration. There should be no mechanical contact between the two, thus avoiding the transfer of vibration to the structure. All sleeve penetrations should also be stuffed with insulation and sealed on both sides with non-hardening caulking. Wherever pipes pass through sleeved floor penetrations at anchor points, neoprene-metal-neoprene pad should be inserted between the floor/sleeving and the pipe clamps.

6 Conclusions

The results of this study indicate that standard window and wall construction will be sufficient for compliance with the MOE criteria for indoor sound levels. It was assumed that standard high-rise construction which meets the requirements of the Ontario Building Code (OBC) will be used. 1.8m high rooftop barriers are recommended to protect outdoor amenity areas on the East and West Podium rooftops.

Due to the vibration and vibration-induced noise from the nearby TTC Bloor-Danforth subway line, it is recommended that the residential tower include vibration mitigation.

With the incorporation of the noise controls discussed in this report, the sound levels at the sensitive receptors of the proposed mixed-use residential and commercial high-rise development will comply with the noise guidelines of the MOE. As indicated in the City of Toronto and MOE implementation guidelines where mitigation is required or noise may be a concern, future occupants will be advised through warning clauses. Section 7 of the report provides notes and sample wording of the warning clauses. At some locations, audible noise below the MOE criteria levels may be a concern and therefore warning clauses are recommended.

When detailed plans are available, they should be reviewed by an acoustical consultant to confirm the architectural sound isolation requirements to ensure compliance with the City of Toronto noise by-laws and MOE Guidelines.
7 Notes and Warning Clauses

1. Purchase and lease agreements and the condominium agreement for all units in the proposed development shall include the following warning clauses:

   **Warning Clause 1:**
   "Purchasers/tenants are advised that sound levels due to increasing road traffic may be audible and may occasionally interfere with some activities of the dwelling occupants."

   **Warning Clause 2:**
   "Purchasers/tenants are advised that this development is in proximity to commercial developments and that sound levels may at times be audible."

   **Warning Clause 3:**
   "Purchasers/tenants are advised that this development is in proximity to a Toronto Transit Commission (TTC) subway line and that vibration induced noise may at times be audible and may occasionally interfere with some activities of the dwelling occupants."

2. Purchase and lease agreements and the condominium agreement for all units in the proposed tower shall include the following warning clause:

   **Warning Clause 5:**
   "Purchasers/tenants are advised that this dwelling unit has been fitted with a forced air heating system and the ducting was sized to accommodate central air conditioning. Installation of central air conditioning by the occupant will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the noise criteria of the City of Toronto and the MOE."

3. Purchase and lease agreements and the condominium agreement for units associated with the west podium rooftop amenity area shall include the following warning clause:

   **Warning Clause 5:**
   "Purchasers/tenants are advised that sound levels due to increasing road traffic may occasionally interfere with some activities of the dwelling occupants as the sound level may exceed the sound level criteria of the municipality and the Ministry of the Environment."

4. The general architectural plans, configuration/layout and grading of the site are integral parts of the noise control system. Any major deviations will require further analysis for verification purposes.
8 References


The scope of the work outlined in this document is limited to the acoustic, noise and/or vibration control aspects of the design. Contractor to verify all dimensions.

NOT FOR CONSTRUCTION

Noise Monitor Locations

Project Name:
Cumberland Terrace Vibration Study

Drawing Title:
Key Plan
The scope of the work outlined in this document is limited to the acoustic, noise and/or vibration control aspects of the design. Contractor to verify all dimensions.

Project Name: Cumberland Terrace Vibration Study

Drawing Tile: Site Plan

Scale: NTS

Drawn: MH

Eng: DG

Date: June 16, 2014

NOT FOR CONSTRUCTION
The scope of the work outlined in this document is limited to the acoustic, noise and/or vibration control aspects of the design. Contractor to verify all dimensions.

Project Name:
Cumberland Terrace Vibration Study

Location of Performed Vibration Measurements

NOT FOR CONSTRUCTION
Appendix A

Road Traffic Data, and
Sample of Road Noise Predictions
Road data, segment # 1: Bloor (day/night)

Car traffic volume : 15743/1749 veh/TimePeriod *
Medium truck volume : 1185/132 veh/TimePeriod *
Heavy truck volume : 0/0 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 15430
Percentage of Annual Growth : 2.00
Number of Years of Growth : 10.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 0.00
Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 1: Bloor (day/night)

Angle1 Angle2 : -45.00 deg  60.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 70.00 / 70.00 m
Receiver height : 40.00 / 9.00 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -45.00 deg  Angle2 : 60.00 deg
Barrier height : 9.00 m
Barrier receiver distance : 5.70 / 5.70 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00
Road data, segment # 2: Bay (day/night)

Car traffic volume : 15912/1768 veh/TimePeriod *
Medium truck volume : 677/75 veh/TimePeriod *
Heavy truck volume : 339/38 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 15430
Percentage of Annual Growth : 2.00
Number of Years of Growth : 10.00
Medium Truck % of Total Volume : 4.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 2: Bay (day/night)

Angle1 Angle2 : -85.00 deg -84.90 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 15.00 / 15.00 m
Receiver height : 1.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 3: Yonge (day/night)

Car traffic volume : 12050/1339 veh/TimePeriod *
Medium truck volume : 518/58 veh/TimePeriod *
Heavy truck volume : 389/43 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 11810
Percentage of Annual Growth : 2.00
Number of Years of Growth : 10.00
Medium Truck % of Total Volume : 4.00
Heavy Truck % of Total Volume : 3.00
Day (16 hrs) % of Total Volume : 90.00
Data for Segment # 3: Yonge (day/night)

---------------------------------------
Angle1   Angle2           : -85.00 deg   -84.99 deg
Wood depth                : 0       (No woods.)
No of house rows          : 0 / 0
Surface                   : 1       (Absorptive ground surface)
Receiver source distance  : 15.00 / 15.00  m
Receiver height           : 1.50 / 4.50   m
Topography                : 1       (Flat/gentle slope; no barrier)
Reference angle           : 0.00

Road data, segment # 4: Cumberland (day/night)

----------------------------------------------
Car traffic volume  : 2815/313 veh/TimePeriod *
Medium truck volume : 0/0    veh/TimePeriod *
Heavy truck volume  : 278/31    veh/TimePeriod *
Posted speed limit  : 50 km/h
Road gradient       : 0 %
Road pavement       : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 2110
Percentage of Annual Growth : 5.00
Number of Years of Growth : 10.00
Medium Truck % of Total Volume : 0.00
Heavy Truck % of Total Volume : 9.00
Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 4: Cumberland (day/night)

--------------------------------------------
Angle1   Angle2           : -85.00 deg   -84.99 deg
Wood depth                : 0       (No woods.)
No of house rows          : 0 / 0
Surface                   : 1       (Absorptive ground surface)
Receiver source distance  : 15.00 / 15.00  m
Receiver height           : 1.50 / 4.50   m
Topography                : 1       (Flat/gentle slope; no barrier)
Reference angle           : 0.00
Results segment # 1: Bloor (day)

Source height = 0.50 m

Barrier height for grazing incidence

<table>
<thead>
<tr>
<th>Source Height (m)</th>
<th>Receiver Height (m)</th>
<th>Barrier Height (m)</th>
<th>Elevation of Barrier Top (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>40.00</td>
<td>36.78</td>
<td>36.78</td>
</tr>
</tbody>
</table>

ROAD (0.00 + 56.23 + 0.00) = 56.23 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
</thead>
<tbody>
<tr>
<td>-45</td>
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<td>0.00</td>
<td>65.26</td>
<td>0.00</td>
<td>-6.69</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>56.23*</td>
</tr>
<tr>
<td>-45</td>
<td>60</td>
<td>0.00</td>
<td>65.26</td>
<td>0.00</td>
<td>-6.69</td>
<td>-2.34</td>
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<td>0.00</td>
<td>56.23</td>
</tr>
</tbody>
</table>

* Bright Zone!

Segment Leq : 56.23 dBA

Results segment # 2: Bay (day)

Source height = 1.19 m

ROAD (0.00 + 27.27 + 0.00) = 27.27 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
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<tbody>
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<td>-85</td>
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<td>66.79</td>
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<td>0.00</td>
<td>-39.52</td>
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<td>0.00</td>
<td>0.00</td>
<td>27.27</td>
</tr>
</tbody>
</table>

Segment Leq : 27.27 dBA
Results segment # 3: Yonge (day)

Source height = 1.32 m

ROAD (0.00 + 16.95 + 0.00) = 16.95 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
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<tbody>
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<td>0.00</td>
<td>16.95</td>
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Segment Leq : 16.95 dBA

Results segment # 4: Cumberland (day)

Source height = 1.73 m

ROAD (0.00 + 13.65 + 0.00) = 13.65 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
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</thead>
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<td>0.00</td>
<td>0.00</td>
<td>13.65</td>
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</table>

Segment Leq : 13.65 dBA

Total Leq All Segments: 56.24 dBA
Results segment # 1: Bloor (night)
----------------------------------
Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source Height (m) ! Receiver Height (m) ! Barrier Height (m) ! Elevation of Barrier Top (m)
------------------------------------------
0.50 ! 9.00 ! 8.31 ! 8.31

ROAD (0.00 + 42.94 + 0.00) = 42.94 dBA

Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
-----------------------------------------------------------------------------
-45     60   0.00  58.74   0.00  -6.69  -2.34   0.00   0.00  -6.76  42.94
-----------------------------------------------------------------------------
Segment Leq : 42.94 dBA

Results segment # 2: Bay (night)
--------------------------------
Source height = 1.19 m

ROAD (0.00 + 21.60 + 0.00) = 21.60 dBA

Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
-----------------------------------------------------------------------------
-85    -85   0.58  60.27   0.00   0.00 -38.67   0.00   0.00   0.00  21.60
-----------------------------------------------------------------------------
Segment Leq : 21.60 dBA

Results segment # 3: Yonge (night)
----------------------------------
Source height = 1.31 m

ROAD (0.00 + 11.31 + 0.00) = 11.31 dBA

Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
-----------------------------------------------------------------------------
-85    -85   0.58  59.96   0.00   0.00 -48.65   0.00   0.00   0.00  11.31
-----------------------------------------------------------------------------
Segment Leq : 11.31 dBA
Results segment # 4: Cumberland (night)

Source height = 1.73 m

ROAD (0.00 + 8.08 + 0.00) = 8.08 dBA

<table>
<thead>
<tr>
<th>Angle1</th>
<th>Angle2</th>
<th>Alpha</th>
<th>RefLeq</th>
<th>P.Adj</th>
<th>D.Adj</th>
<th>F.Adj</th>
<th>W.Adj</th>
<th>H.Adj</th>
<th>B.Adj</th>
<th>SubLeq</th>
</tr>
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<tbody>
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<td>0.56</td>
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<td>-48.52</td>
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<td>0.00</td>
<td>8.08</td>
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</table>

Segment Leq : 8.08 dBA

Total Leq All Segments: 42.98 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 56.24
(NIGHT): 42.98
Appendix B

Noise Monitoring Data
Monitor Location: 2 Bloor Street, Toronto, ON
Monitoring Period: Monday, June 09, 2014 To Thursday, June 12, 2014
AEL Monitor ID: CTRFWEST
Project: Cumberland Terrace Vibration
Project Number: 14176

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Minimum Leq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (07:00 - 19:00)</td>
<td>64.5 dBA</td>
</tr>
<tr>
<td>Evening (19:00 - 23:00)</td>
<td>62.5 dBA</td>
</tr>
<tr>
<td>Night (23:00 - 07:00)</td>
<td>61.5 dBA</td>
</tr>
</tbody>
</table>

Monitoring Equipment
Manufacturer: Larson-Davis
Model Number: 700
Serial Number: B2187

Date / Time
Leq  L90  Rain  Snow  Wind

aercoustics.com
## Ambient Monitor Data

**Monitor Location:** Toronto, ON  
**Monitoring Period:** Monday, June 09, 2014 To Thursday, June 12, 2014  
**AEL Monitor ID:** CTRFWEST  
**Project:** Cumberland Terrace Vibration  
**Project Number:** 14176

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Minimum Leq</th>
<th>Lvc</th>
<th>Uav</th>
<th>Lmv</th>
<th>Lvp</th>
<th>Lnp</th>
<th>Tavg</th>
<th>Savg</th>
<th>Vavg</th>
<th>Wind Speed kph</th>
<th>Weather</th>
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<tbody>
<tr>
<td>Day (23:00 - 07:00)</td>
<td>65 dB</td>
<td>59.5</td>
<td>60.5</td>
<td>59.5</td>
<td>61.5</td>
<td>60.5</td>
<td>61.5</td>
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<td>19</td>
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<tr>
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<td>60</td>
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<td>61.5</td>
<td>18.9</td>
<td>19</td>
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<td>NA</td>
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<tr>
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<td>17.8</td>
<td>17</td>
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</tr>
<tr>
<td>Tuesday, June 10, 2014</td>
<td>61.5</td>
<td>59.5</td>
<td>60.5</td>
<td>59.5</td>
<td>61</td>
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<td>10:00</td>
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<td>59.5</td>
<td>60.5</td>
<td>59.5</td>
<td>61</td>
<td>60</td>
<td>61</td>
<td>17.7</td>
<td>17</td>
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<tr>
<td>Wednesday, June 11, 2014</td>
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<td>59.5</td>
<td>60.5</td>
<td>59.5</td>
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<td>61.5</td>
<td>18.5</td>
<td>18</td>
<td>0</td>
<td>NA</td>
</tr>
</tbody>
</table>

---

**GPS Location (UTM):**
- **Zone:** Eastern  
- **Northing:** Nothing

---

**Monitoring Equipment:**
- **Manufacturer:** Larson-Davis  
- **Model Number:** 700  
- **Serial Number:** B2187

---

**Temperature °C, Wind Speed kph, Weather:**
- **Temperature:** NA  
- **Wind Speed:** NA  
- **Weather:** NA

---

**Project Number:** 14176

---

**Contact:** acoustic.com

---

**Note:**
- The data provided is a snapshot of ambient noise levels measured over a period of four days. The measurements include both day and nighttime periods, with detailed records of temperature, wind speed, and weather conditions. The data is recorded in decibels (dB) and includes minimum Leq values for each hour. The location information is provided in UTM (Universal Transverse Mercator) coordinates, and the monitoring equipment details are included for reference.
Monitor Location: Toronto, ON
Monitoring Period: Monday, June 09, 2014 To Thursday, June 12, 2014
AEL Monitor ID: CTRFWEST
Project: Cumberland Terrace Vibration
Project Number: 14176

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Minimum Leq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (07:00 - 19:00)</td>
<td>64.5 dBA</td>
</tr>
<tr>
<td>Evening (19:00 - 23:00)</td>
<td>62.5 dBA</td>
</tr>
<tr>
<td>Night (23:00 - 07:00)</td>
<td>61.5 dBA</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Date/Time</th>
<th>LVL</th>
<th>SEL</th>
<th>Lmin</th>
<th>Lmax</th>
<th>Lpk</th>
<th>L01</th>
<th>L05</th>
<th>L10</th>
<th>L90</th>
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<th>Wind Speed kph</th>
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<td>94</td>
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<td>14:00</td>
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<td>81</td>
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Monitor Location: 2 Bloor Street, Toronto, ON
Monitoring Period: Monday, June 09, 2014 To Thursday, June 12, 2014
AEL Monitor ID: CTRFNORTH
Project: Cumberland Terrace Vibration
Project Number: 14176

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Minimum Leq</th>
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<tbody>
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<td>Day (07:00 - 19:00)</td>
<td>62.5 dBA</td>
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<tr>
<td>Evening (19:00 - 23:00)</td>
<td>61.5 dBA</td>
</tr>
<tr>
<td>Night (23:00 - 07:00)</td>
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Monitoring Equipment
- Manufacturer: Larson-Davis
- Model Number: 700
- Serial Number: B3479

![Graph of Leq, L90, Rain, Snow, and Wind over time]

aercoustics.com
## Ambient Monitor Data

**Monitor Location:** Toronto, ON  
**Monitoring Period:** Monday, June 09, 2014 To Thursday, June 12, 2014  
**AEL Monitor ID:** CTRFN  
**Project:** Cumberland Terrace Vibration  
**Project Number:** 14176  
**Manufacturer:** Larson Davis  
**Model Number:** 700  
**Serial Number:** B3479  
**Project Number:** 14176  
** aller Number:** B3479

### Ambient Monitor Data

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<thead>
<tr>
<th>Time</th>
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<th>L10</th>
<th>L90</th>
<th>Temperature °C</th>
<th>Wind Speed kph</th>
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### Notes
- **L01**, **L05**, **L10**, and **L90** are the 10th, 50th, and 90th percentiles of the noise levels, respectively.
- **Temperature °C** and **Wind Speed kph** are the outdoor temperature and wind speed, respectively.
- **Weather** indicates the current weather conditions.

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**AEL Monitors Limited**  
**aercoustics engineering limited**

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**aercoustics.com**
## Ambient Monitor Data

**Monitor Location:** Toronto, ON  
**Monitoring Period:** Monday, June 09, 2014 To Thursday, June 12, 2014  
**AEL Monitor ID:** CTRFN  
**Project:** Cumberland Terrace Vibration  
**Project Number:** 14176

### Time Periods and Data

<table>
<thead>
<tr>
<th>Time Period</th>
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### Date/Time

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### Monitoring Equipment

- **Manufacturer:** LarsonDavis  
- **Model Number:** 700  
- **Serial Number:** 83476

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*aercoustics.com*
Vibration Measurements of TTC Subway Passbys

- **TTC Structure**
- **Food Court Floor**
- **ISO Vibration Limit**

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<tr>
<th>Velocity (dB re 10nm/s)</th>
<th>Frequency (Hz)</th>
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- ISO Vibration Limit