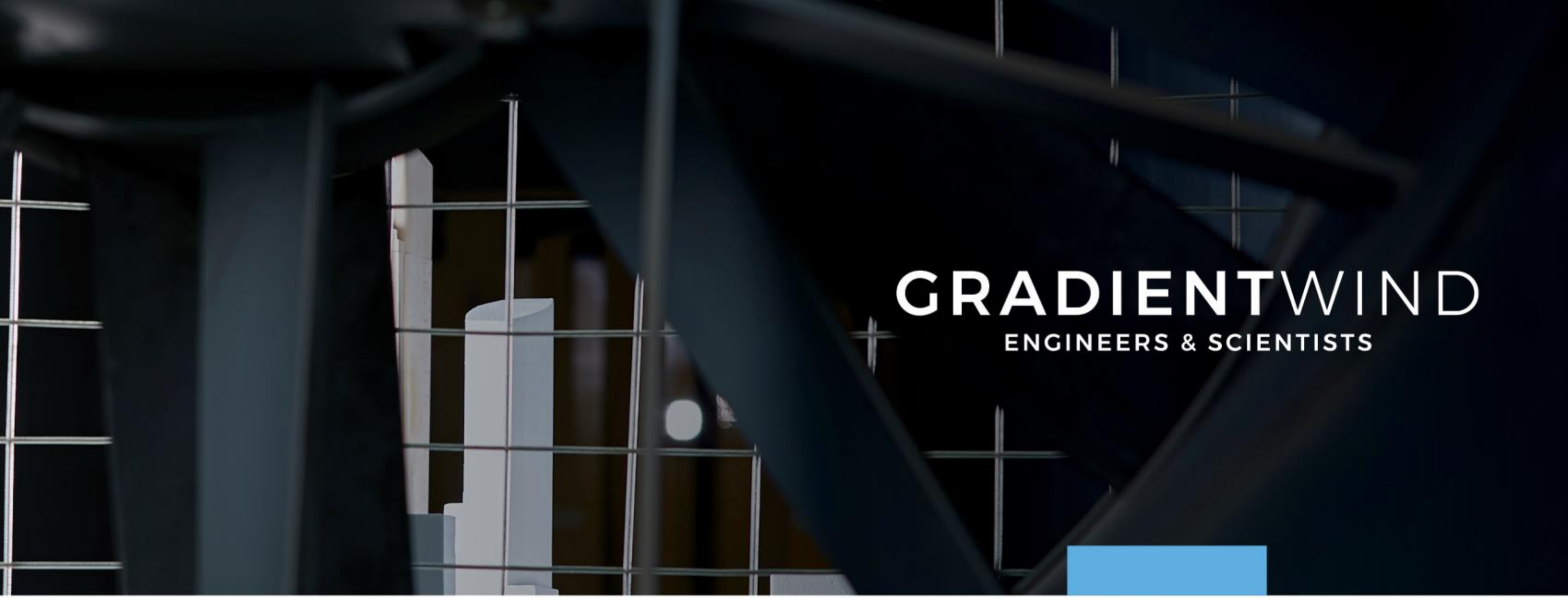
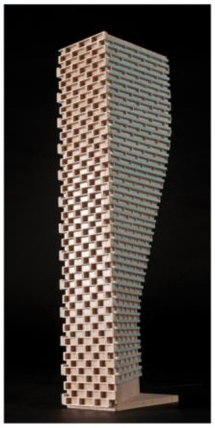
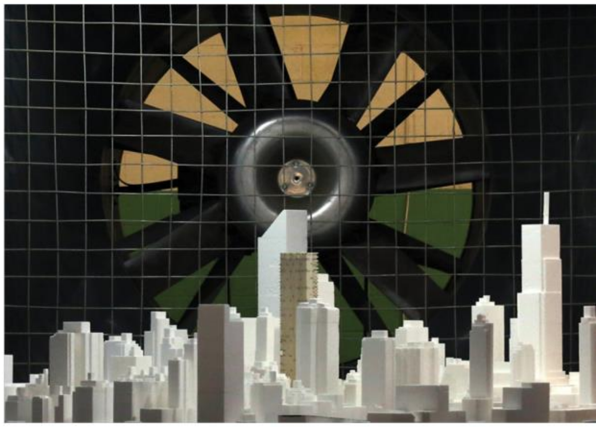


ROADWAY TRAFFIC NOISE AND VIBRATION FEASIBILITY ASSESSMENT

Conservancy Subdivision (Phase 3)
Ottawa, Ontario

REPORT: GW17-151 – Traffic Noise





October 20, 2021

PREPARED FOR
Caivan Communities
2934 Baseline Road, Suite 302
Ottawa, Ontario
K2H 1B2

PREPARED BY
Giuseppe Garro, MASc., Junior Environmental Scientist
Joshua Foster, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a roadway traffic noise feasibility assessment in support of a rezoning and draft plan of subdivision application for a proposed residential subdivision, referred to as Barrhaven Conservancy Subdivision, located at 3288 Borrisokane Road and 4305, 4345, and 4375 McKenna Casey Drive in Ottawa, Ontario. The study site is situated in the southwest area of Barrhaven in Ottawa, Ontario. This report provides an analysis focused on the Phase 3 draft plan which incorporates lands situated between Phase 2 to the east and Highway 416 to the west. The initial concept plan being considered for application comprises residential developments (single, town homes, and back-to-back town homes), two parks, as well as potential open spaces along the north, west, and south boarders.

The major sources of transportation noise affecting the development include roadway traffic along the proposed minor collectors near the southeast portion of the site, Highway 416 to the west, and the VIA Rail railway corridor to the northwest. However, the road network and arrangement of land uses may be subject to change through the development approval process. In addition, this report also provides an analysis of the vibration impacts from the VIA Rail. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on: (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; (iv) architectural drawings provided by Caivan Communities in October 2021; and (v) ground-borne vibration criteria as specified by the Federal Transit Authority (FTA) Protocol. As the site plan may be subject to change, Gradient Wind took the approach to establish noise contours around the site. The contours, based on the City of Ottawa noise criteria, were used to determine what level of noise control for various areas on site would likely be required.

The results of the current study indicate that noise levels due to roadway and railway traffic over the site will range between approximately 61 and 68 dBA during the daytime period (07:00-23:00). The highest transportation noise levels will occur nearest to the intersection of the two proposed minor collectors. Results of the roadway traffic noise calculations also indicate that lots with rear yards having partial or direct exposure to the minor collector, VIA Rail corridor, or Highway 416 may require noise control

measures. Mitigation measures are described in Section 5.2, with the aim to reduce the L_{eq} to as close to 55 dBA as technically, economically and administratively feasible. A detailed roadway traffic noise study will be required at the time of site plan approval to determine specific noise control measures for the development.

Estimated vibration levels from the VIA Rail Line are expected to exceed the criterion of 0.1mm/s, based on the FTA protocol and an offset distance of 32 m from the nearest property line to the railway track centerline. Details of the calculation are provided in Appendix B. However, this is conservative estimation based on railway information.

It should be noted that Gradient Wind conducted on-site vibration measurements of the VIA Rail Line for a nearby property located at 3058 Jockvale Road (ref. *Gradient Wind report GW16-136 - 3058 Jockvale Road, dated December 8, 2016*). As actual vibration levels were measured below the criterion of 0.1 mm/s, it is expected that actual vibration levels at the study site will also fall below the criterion, and thus vibration mitigation is not expected. With that notion, it is suggested that an on-site vibration measurement analysis for the study site be conducted at a future stage of development.

GRADIENTWIND
ENGINEERS & SCIENTISTS

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Caivan Communities to undertake a roadway traffic noise and vibration feasibility assessment in support of a rezoning and draft plan of subdivision application for a proposed residential subdivision. The subdivision, referred to as Barrhaven Conservancy Subdivision Phase 3, is located at 3288 Borrisokane Road and 4305, 4345, and 4375 McKenna Casey Drive in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to a roadway traffic noise feasibility assessment. Gradient Wind's scope of work involved assessing exterior noise levels throughout the site generated from nearby transportation sources, as well as vibration levels generated by the railway corridor to the north.

The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks[2] guidelines, and vibration calculations conforming to the U.S. Federal Transit Authority (FTA) Transit Noise and Vibration Assessment Protocol. Noise calculations were based on an initial concept plan provided by Caivan Communities in October 2021, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications, and railway traffic volumes based on correspondence with VIA Rail Canada Inc. on a previous noise assessment (ref. *Gradient Wind report GW16-136 - 3058 Jockvale Road, dated December 8, 2016*).

2. TERMS OF REFERENCE

The focus of this roadway traffic noise and vibration feasibility assessment is Phase 3 of a proposed subdivision concept plan located at 3288 Borrisokane Road and 4305, 4345, and 4375 McKenna Casey Drive in Ottawa, Ontario. The study site is situated in the southwest area of Barrhaven in Ottawa, Ontario. The draft plan incorporates lands situated between Phase 2 to the east and Highway 416 to the west. The initial concept plan being considered for application comprises residential developments (single, town homes, and back-to-back town homes), two parks, as well as potential open spaces along the north, west, and south boarders. The town house units proposed include rear lane and traditional front lane town homes. The rear lane town homes are located adjacent to the central proposed collector roadway near

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ontario Ministry of the Environment and Climate Change – Publication NPC-300

the southeast quadrant, as well as a portion on the lands to the north. There is a proposed parkland to the northwest of the site (2.9 Ha) as well as to the northeast (0.63 Ha). The remaining space is dedicated to single detached homes and traditional townhomes. The development is expected to contain outdoor living areas in the rear yards of each single detached dwelling unit. As existing storm water retention pond is situated to the northeast of the site with a drainage channel running north-south and bisects Phase 2 and Phase 3.

The study area is bordered on the north by a railway corridor running east-west, Highway 416 to the west, vacant open space to the south, and Phase 2 to the east. The major sources of transportation noise affecting the development include roadway traffic along the proposed minor collectors near the southeast portion of the site, Highway 416 to the west, and the VIA Rail railway corridor to the northwest.

Due to the current state of development, the final site configuration is uncertain and may be subject to change. Therefore, Gradient Wind took the approach to establish noise contours around the site ignoring the proposed site massing. The contours were combined with the City of Ottawa noise criteria, to determine what level of noise control for various areas on site would be required. This report also provides an analysis of vibration impacts from the rail traffic along the VIA Rail Line. Figure 1 illustrates the site plan and surrounding context.

3. OBJECTIVES

The principal objective of this work is to calculate the future noise and vibration levels on the study site produced by local transportation traffic and explore potential for noise mitigation where required. Noise calculations are based on initial concept plan provided by Caivan Communities in October 2021, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{eq}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specifies that the recommended Outdoor Living Area (OLA) noise limit is 55 dBA during the daytime period. OLA do not need to be considered during the nighttime period.

Predicted noise levels at the OLA dictate the action required to achieve the recommended sound levels. According to the ENCG, if an area is to be used as an OLA, noise control measures are required to reduce the L_{eq} to 55 dBA. This is typically done with noise control measures outlined in Section 5.2. When noise levels at these areas exceed the criteria, specific Warning Clause requirements may apply. As this is a preliminary assessment, noise control recommendations are of a general nature. Specific mitigation requirements would be the work of a future study.

4.2.2 Theoretical Roadway Noise Predictions

Noise predictions were determined by computer modelling using two programs. To provide a general sense of noise across the site, the employed software program was Predictor-Lima (TNM calculation), which incorporates the United States Federal Highway Administration's (FHWA) Transportation Noise Model (TNM) 2.5. This computer program is capable of representing three-dimensional surface and first reflections of sound waves over a suitable spectrum for human hearing. A receptor grid with 5 × 5 m spacing was placed across the study site, along with a number of discrete receptors at key sensitive areas. Although this program outputs noise contours, it is not the approved model for roadway predictions by the City of Ottawa. Therefore, the results were confirmed by performing discrete noise calculations with the Ministry of the Environment, Conservations and Parks (MECP) computerized noise assessment program, STAMSON 5.04, at key receptor locations coinciding with receptor locations in Predictor as shown in Figure 2. Receptor distances and exposure angles are depicted in Figure 3-5. Appendix A includes the STAMSON 5.04 input and output data.

Roadway noise calculations were performed by treating each road segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 1, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split was taken to be 92% / 8% respectively for all streets.
- Receptor heights taken to be 1.5 m above grade.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground. For select receptors, the ground surface was taken to be absorptive due to the presence of soft (lawn) ground.
- Topography was assumed to be flat/gentle for receptors influenced by collector roadways, as well as the VIA Rail line.
- Highway 416 to the west was modelled as having a 2% grade with a maximum elevation difference of 10 meters from grade.
- No massing considered as potential noise screening elements.
- Noise receptors were strategically placed at 6 locations throughout the development.
- Receptor distances and exposure angles illustrated in Figure 3-5.
- The VIA Rail lined was modeled as a diesel train with 1 locomotive and an average of 4 cars per train.

4.2.3 Roadway and Railway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[3] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. For railway volumes, the data was projected to 2031 at an annual rate of 2.5% per year. Table 1 (below) summarizes the AADT values used for each roadway and VIA Rail line included in this assessment.

TABLE 1: ROADWAY AND RAILWAY TRAFFIC DATA

Roadway	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Proposed Minor Collector	2-Lane Urban Collector (2-UCU)	50	**8,000**
Highway 416	Freeway	100	**18,333/lane**
VIA Rail	Passenger Rail	150	**18/4***

* Projected 2031 AADT daytime/nighttime rail traffic volumes based on information received from VIA Rail

4.3 Ground Vibration and Ground-borne Noise

Rail systems and heavy vehicles on roadways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods or vibration-sensitive buildings. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through a medium, and intercepted by a receiver. In the case of ground vibrations, the medium can be uniform, or more often, a complex layering of soils and rock strata. Also, similar to sound waves in air, ground vibrations produce perceptible motions and regenerated noise known as 'ground-borne noise' when the vibrations encounter a hollow structure such as a building. Ground-borne noise and vibrations are generated when there is excitation of the ground, such as from a train. Repetitive motion of the wheels on the track or rubber tires passing over an uneven surface causes vibrations to propagate through the soil. When they

[3] City of Ottawa Transportation Master Plan, November 2013

encounter a building, vibrations pass along the structure of the building beginning at the foundation and propagating to all floors. Air inside the building excited by the vibrating walls and floors represents regenerated airborne noise. Characteristics of the soil and the building are imparted to the noise, thereby creating a unique noise signature.

Human response to ground vibrations is dependent on the magnitude of the vibrations, which is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical units of ground vibration measures are millimeters per second (mm/s), or inch per second (in/s). Since vibrations can vary over a wide range, it is also convenient to represent them in decibel units, or dBV. In North America, it is common practice to use the reference value of one micro-inch per second (µin/s) to represent vibration levels for this purpose. The threshold level of human perception to vibrations is about 0.10 mm/s RMS or about 72 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations is 0.5 mm/s RMS (or 85 dBV), five times higher than the perception threshold, whereas the threshold for significant structural damage is 10 mm/s RMS (or 112 dBV), at least one hundred times higher than the perception threshold level.

4.3.1 Ground Vibration Criteria

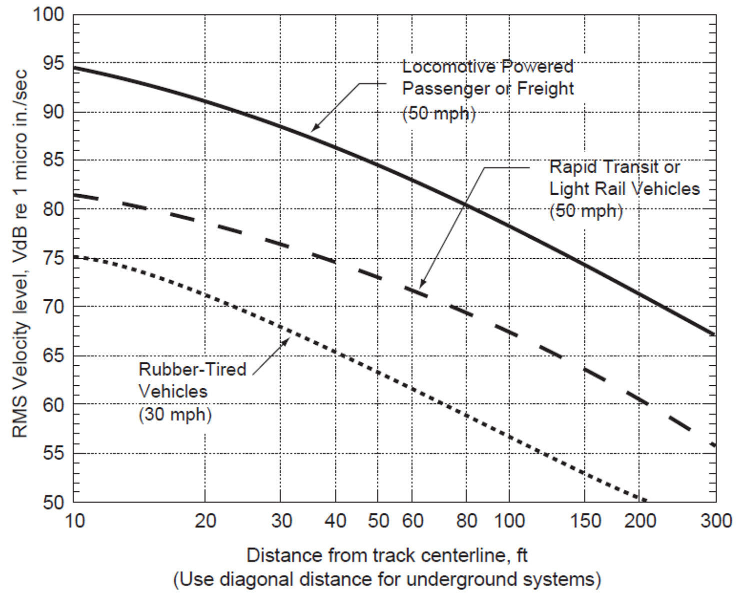
In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land uses next to transit corridors. Similar standards have been developed by the MECP. These standards indicate that the appropriate criteria for residences is 0.10 mm/s RMS for vibrations. For main line railways, a document titled Guidelines for New Development in Proximity to Railway Operations, indicates that vibration conditions should not exceed 0.14 mm/s RMS averaged over a one second time-period at the first floor and above of the proposed building. The Federal Transportation Authority (FTA) criterion was adopted as the appropriate standard for this study. As the main vibration source is due to the VIA Rail line which has frequent events, the 0.10 mm/s RMS (72 dBV) vibration criteria and 35 dBA ground borne noise criteria were adopted for this study.

4.3.2 Theoretical Ground Vibration Prediction Procedure

Potential vibration impacts of the trains were predicted using the Federal Transit Authority's (FTA) *Transit Noise and Vibration Impact Assessment*[4] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure below, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed, such as operating speed of vehicle, conditions of the track, construction of the track and geology, as well as the structural type of the impacted building structures. The vibration impact on the building was determined using a set of curves for Locomotive Powered Passenger train at a speed of 50 mph. As this is feasibility study, general assumptions were made for the building construction of the residential homes based on experience with similar developments. Adjustment factors were considered based on the following information:

- The maximum operating speed of the VIA Rail assumed to be 90 mph (150 km/h) at peak
- The offset distance between the development and the closest track is 32 m
- The vehicles are assumed to have soft primary suspensions
- Tracks are not welded, though in otherwise good condition
- Soil conditions do not efficiently propagate vibrations
- The building's foundation coupling is 1-2 storey wood frame

[4] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006



FTA GENERALIZED CURVES OF VIBRATION LEVELS VERSUS DISTANCE

(ADOPTED FROM FIGURE 10-1, FTA TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT)

5. RESULTS AND DISCUSSION

5.1 Transportation Noise Levels

The results of the roadway traffic noise contour calculations for the daytime period, covering the entire study site, are shown in Figure 8. Discrete receptors were also placed at ground level at key locations throughout the site. The noise contours were generated using TNM and verified with discrete receptors using STAMSON 5.04, as shown in Figure 2, and summarized in Table 2 below. Appendix A contains the complete set of input and output data from all STAMSON 5.04 calculations.

TABLE 2: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	Predictor-Lima Noise Level (dBA)
			Day	Day
1	1.5	OLA – Grade Level – Rear of Town Home	61	63
2	1.5	OLA – Grade Level –Open Space	64	65
3	1.5	OLA – Grade Level – Rear of Single Home	67	67
4	1.5	OLA – Grade Level – Rear of Single Home	63	66
5	1.5	OLA – Grade Level – Front of Town Home	66	63
6	1.5	OLA – Grade Level – Front of Town Home	68	65

As shown above, the results calculated from TNM have good correlation with calculations performed in STAMSON 5.04. A tolerance of 3 dBA between models is generally considered acceptable given human hearing cannot detect a change in sound level of less than 3 dBA. As stated in Section 4.2.2, massing elements, such as buildings, were conservatively ignored as potential screening elements. These measures are briefly described in Section 5.2, with the aim to reduce the L_{eq} to as close to 55 dBA as technically, economically and administratively feasible.

According to Table 2, homes fronting the proposed minor collectors will require noise control measures as outlined in Section 5.2. Lots with rear yards having partial or direct exposure to the minor collector, VIA Rail corridor, or Highway 416 may require mitigation in the form of a noise barrier as outlined in Figure 7. Massing elements along the edge of the development are expected block direct line of sight of the roadways and railway and act as sound barriers, reducing the sound experienced at the inner blocks within the subdivision. A detailed roadway traffic noise study will be required at the time of subdivision registration to determine specific noise control measures for the development.

5.2 Noise Control Measures

The noise levels predicted due to roadway and railway traffic, at a number of receptors, exceed the criteria listed in the ENCG for outdoor living areas, as discussed in Section 4.2.3. Therefore, noise control measures as described below, subscribing to Table 2.3a in the ENCG and listed in order of preference, will be required to reduce the L_{eq} to 55 dBA:

- Distance setback with soft ground
- Insertion of noise insensitive land uses between the source and sensitive points of reception
- Orientation of buildings to provide sheltered zones in rear yards
- Shared outdoor amenity areas
- Earth berms (sound barriers)
- Acoustic barriers

Based on expected noise levels, blocks in the dark red to purple regions in Figure 8 will likely require upgraded building components and central air conditioning. These blocks are outlined in Figure 6 by the red hatched area. Blocks in the dark orange and red regions in Figure 8 will require forced air heating with provisions for central air conditioning. These blocks are highlighted in Figure 6 by the green hatched area. Warning Clauses will also be required on purchase, sale, and lease agreements. Specific mitigation will be determined during the detailed design assessment.

5.3 Ground Vibrations and Ground-borne Noise Levels

Estimated vibration levels are expected to be 0.407 mm/s RMS (84 dBV), based on the FTA protocol and an offset distance of 32 m from the nearest property line to the railway track centerline. Details of the calculation are provided in Appendix B. However, this is conservative estimation based on railway information.

As previously mentioned, Gradient Wind conducted on-site vibration measurements of the VIA Rail Line for a nearby property located at 3058 Jockvale Road (ref. *Gradient Wind report GW16-136 - 3058 Jockvale Road*, dated December 8, 2016). Measurements were conducted using seismographs placed at 15m and 30m from the railway corridor ROW. The average on-site vibration measurements conducted at 15m and 30m were determined to be 0.1 mm/s and 0.01mm/s, respectively. As actual vibration levels fall below the criterion of 0.1 mm/s, it is expected that actual vibration levels at the study site will also fall below the criterion, and thus vibration mitigation is not expected. With that notion, it is suggested that an on-site vibration measurement analysis for the study site be conducted at a future stage of development.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current study indicate that noise levels due to roadway and railway traffic over the site will range between approximately 61 and 68 dBA during the daytime period (07:00-23:00). The highest transportation noise levels will occur nearest to the intersection of the two proposed minor collectors. Results of the roadway traffic noise calculations also indicate that lots with rear yards having partial or direct exposure to the minor collector, VIA Rail corridor, or Highway 416 may require noise control measures. Mitigation measures are described in Section 5.2, with the aim to reduce the L_{eq} to as close to 55 dBA as technically, economically and administratively feasible. A detailed roadway traffic noise study will be required at the time of site plan approval to determine specific noise control measures for the development.

Estimated vibration levels are expected to be 0.407 mm/s RMS (84 dBV), based on the FTA protocol and an offset distance of 32 m from the nearest property line to the railway track centerline. Details of the calculation are provided in Appendix B. However, this is conservative estimation based on railway information.

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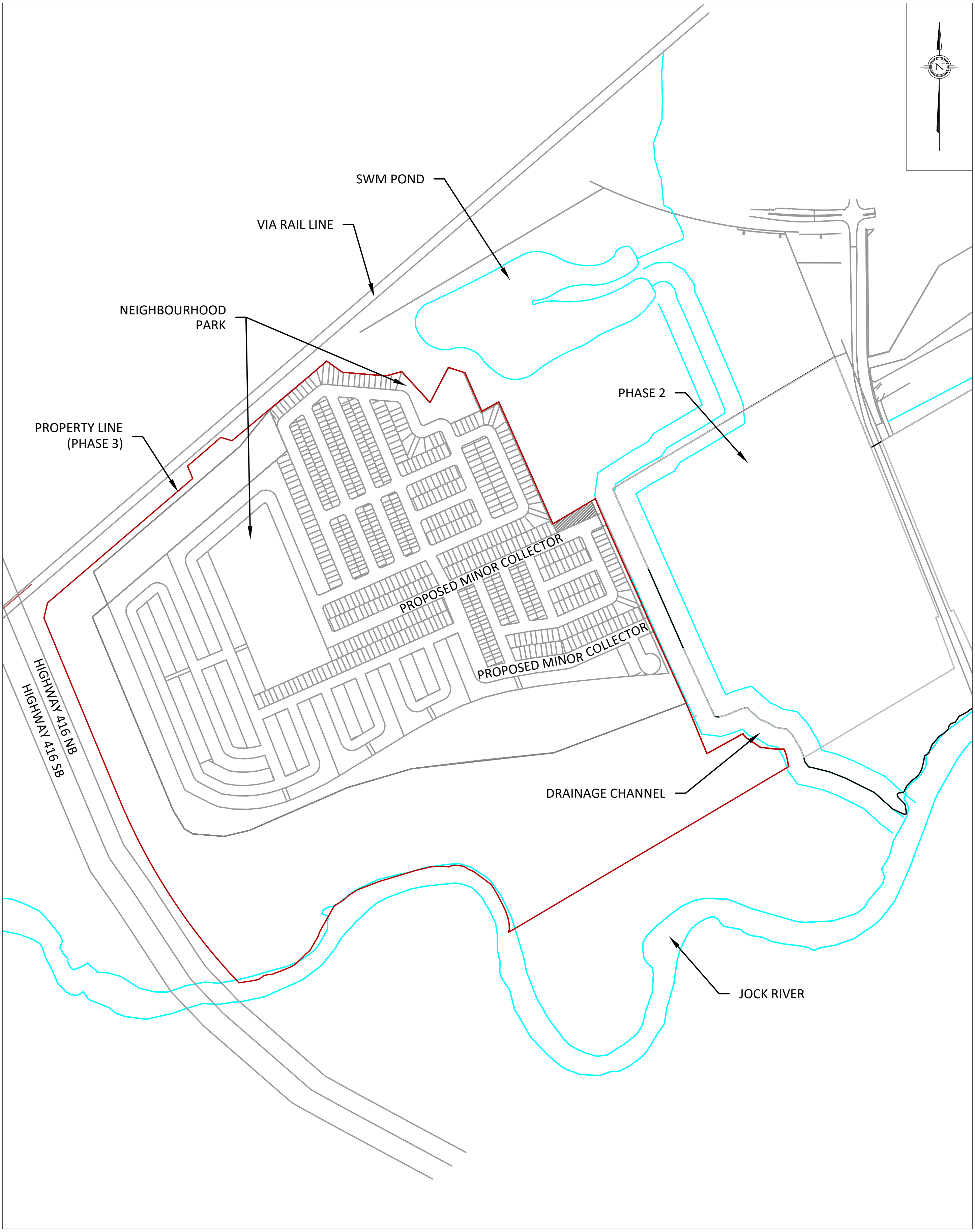
This concludes our roadway traffic noise and vibration feasibility assessment and report. If you have any questions or wish to discuss our findings please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

Gradient Wind Engineering Inc.

Giuseppe Garro, MASc.
Junior Environmental Scientist
GW17-151

Joshua Foster, P.Eng.
Principal



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PROJECT: CONSERVANCY SUBDIVISION (PHASE 3), OTTAWA ROADWAY TRAFFIC NOISE AND VIBRATION FEASIBILITY STUDY		DESCRIPTION: FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:8000 (APPROX.)	DRAWING NO.: GW17-151-1	
DATE: OCTOBER 18, 2021	DRAWN BY: G.G.	

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SCALE	1:8000 (APPROX.)	DRAWING NO.	GW17-151-2
DATE	OCTOBER 18, 2021	DRAWN BY	G.G.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS

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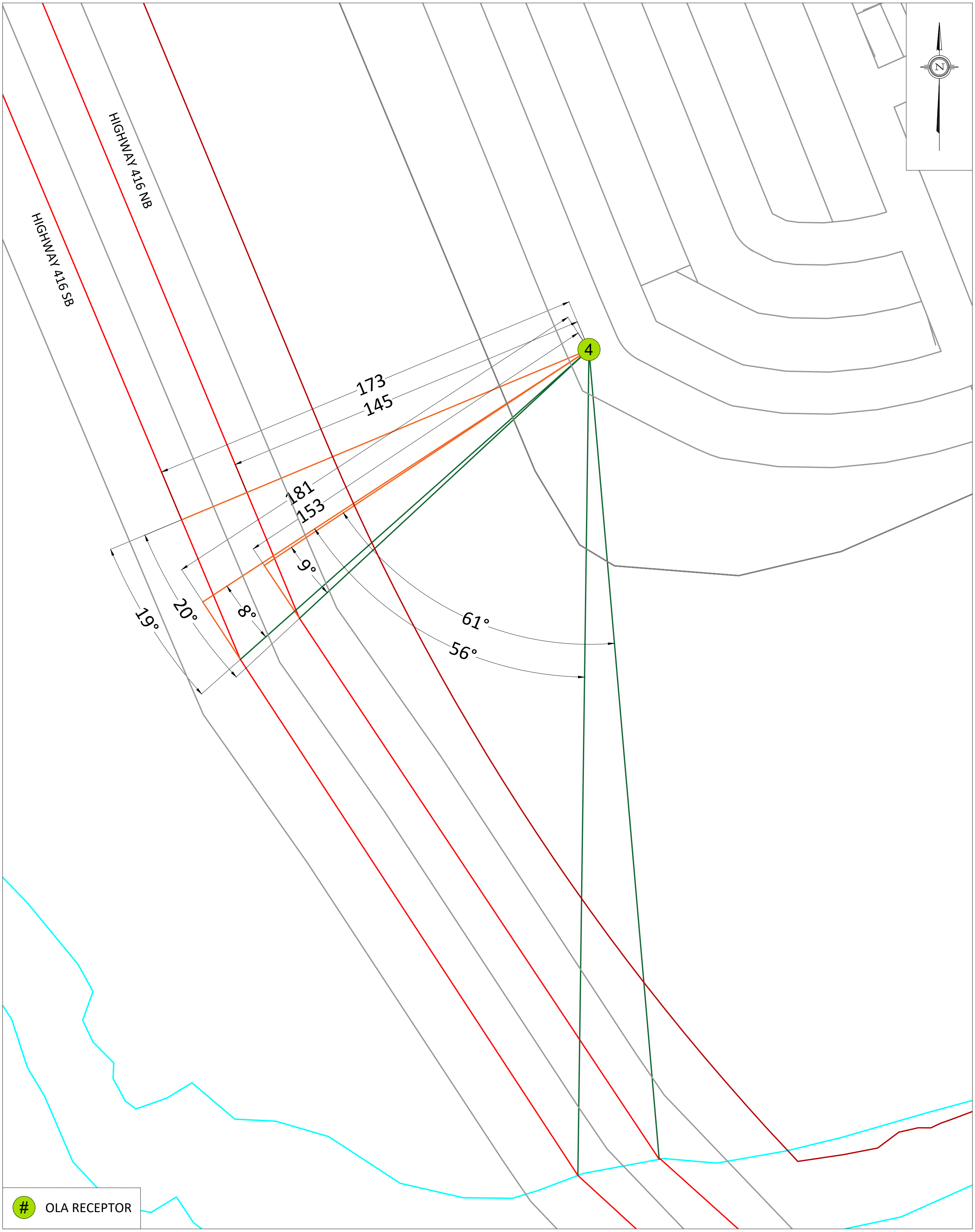
SCALE: 1:4000 (APPROX.)

DRAWING NO.: GW17-151-3

DATE: OCTOBER 18, 2021

DRAWN BY: G.G.

DESCRIPTION: FIGURE 3: RECEPTOR 1-3 STAMSON INPUT PARAMETERS



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PROJECT	CONSERVANCY SUBDIVISION (PHASE 3), OTTAWA ROADWAY TRAFFIC NOISE AND VIBRATION FEASIBILITY STUDY	
SCALE	1:2000 (APPROX.)	DRAWING NO. GW17-151-4
DATE	OCTOBER 18, 2021	DRAWN BY G.G.

DESCRIPTION

FIGURE 4:
RECEPTOR 4 STAMSON INPUT PARAMETERS

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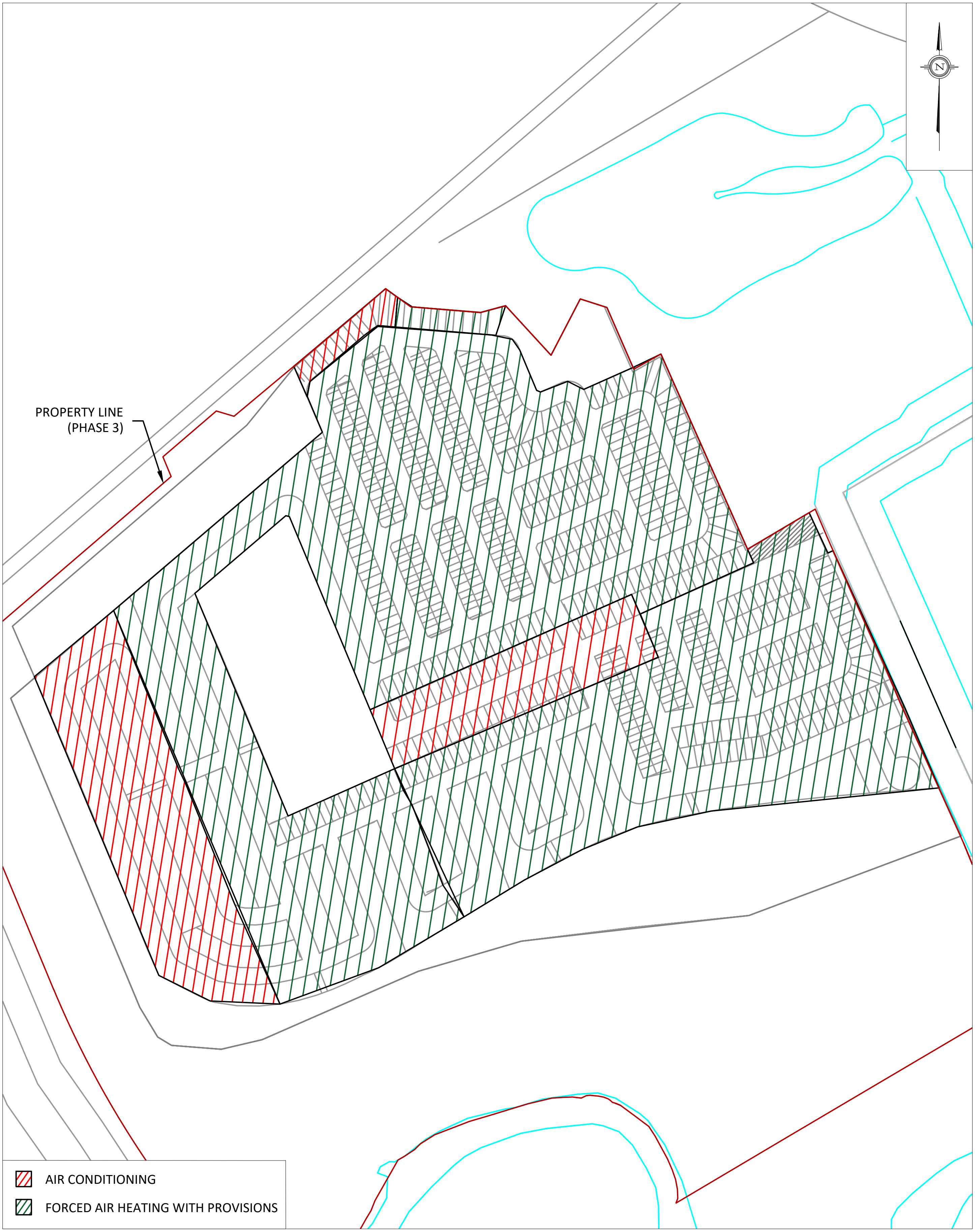
SCALE	1:2000 (APPROX.)	DRAWING NO.	GW17-151-5
DATE	OCTOBER 18, 2021	DRAWN BY	G.G.
DESCRIPTION	FIGURE 5: RECEPTOR 5 AND 6 STAMSON INPUT PARAMETERS		



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD , OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: CONSERVANCY SUBDIVISION (PHASE 3), OTTAWA ROADWAY TRAFFIC NOISE AND VIBRATION FEASIBILITY STUDY		DESCRIPTION: FIGURE 6: POTENTIAL VENTILATION REQUIREMENTS
	SCALE: 1:2000 (APPROX.)	DRAWING NO.: GW17-151-6	
	DATE: OCTOBER 18, 2021	DRAWN BY: G.G.	

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SCALE	1:2000 (APPROX.)	DRAWING NO.	GW17-151-7
DATE	OCTOBER 18, 2021	DRAWN BY	G.G.

DESCRIPTION

FIGURE 7:
POTENTIAL NOISE BARRIER LOCATIONS

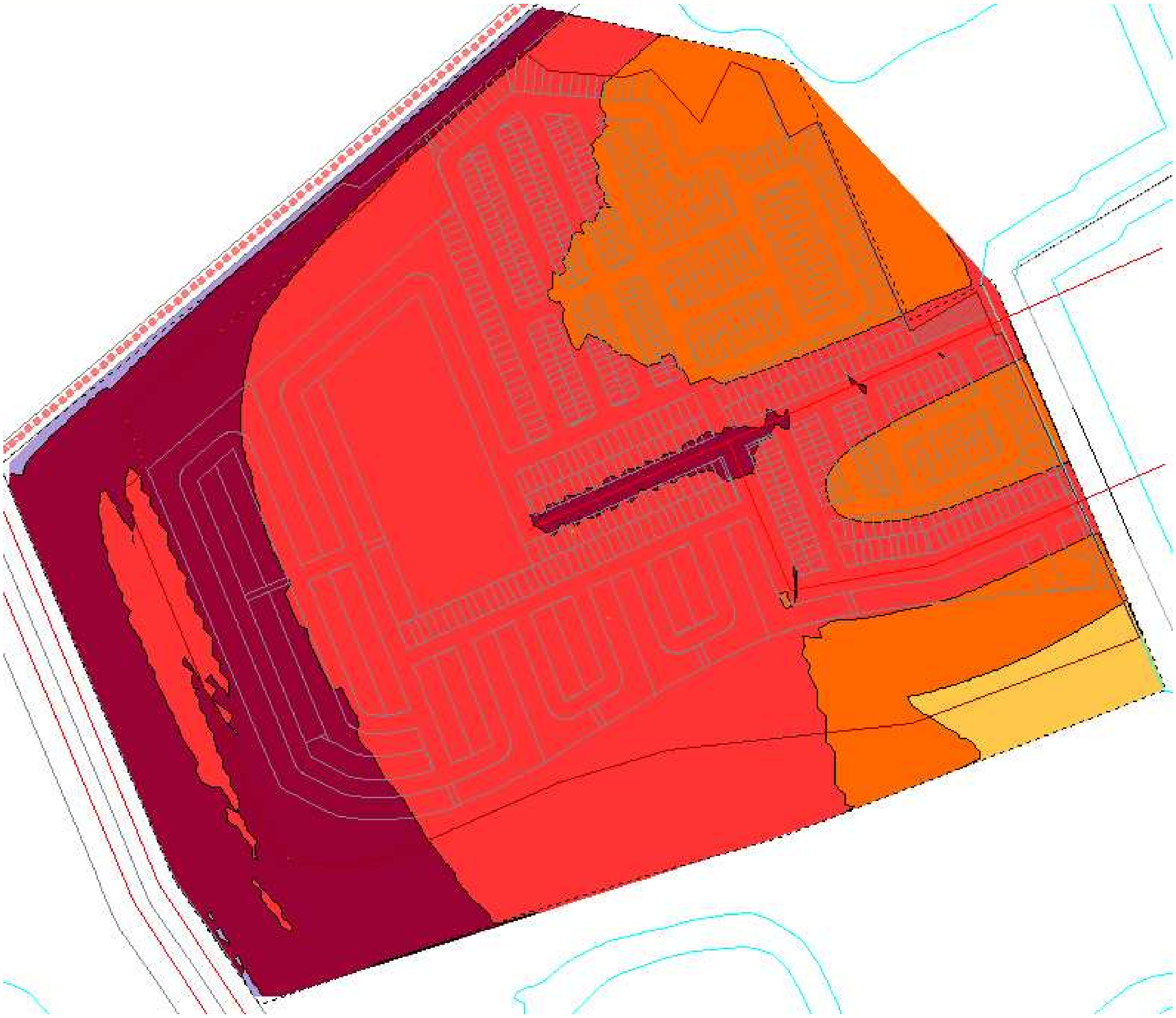
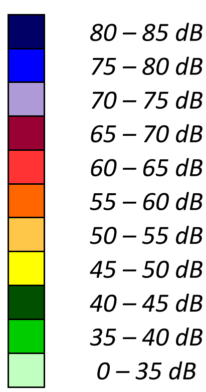
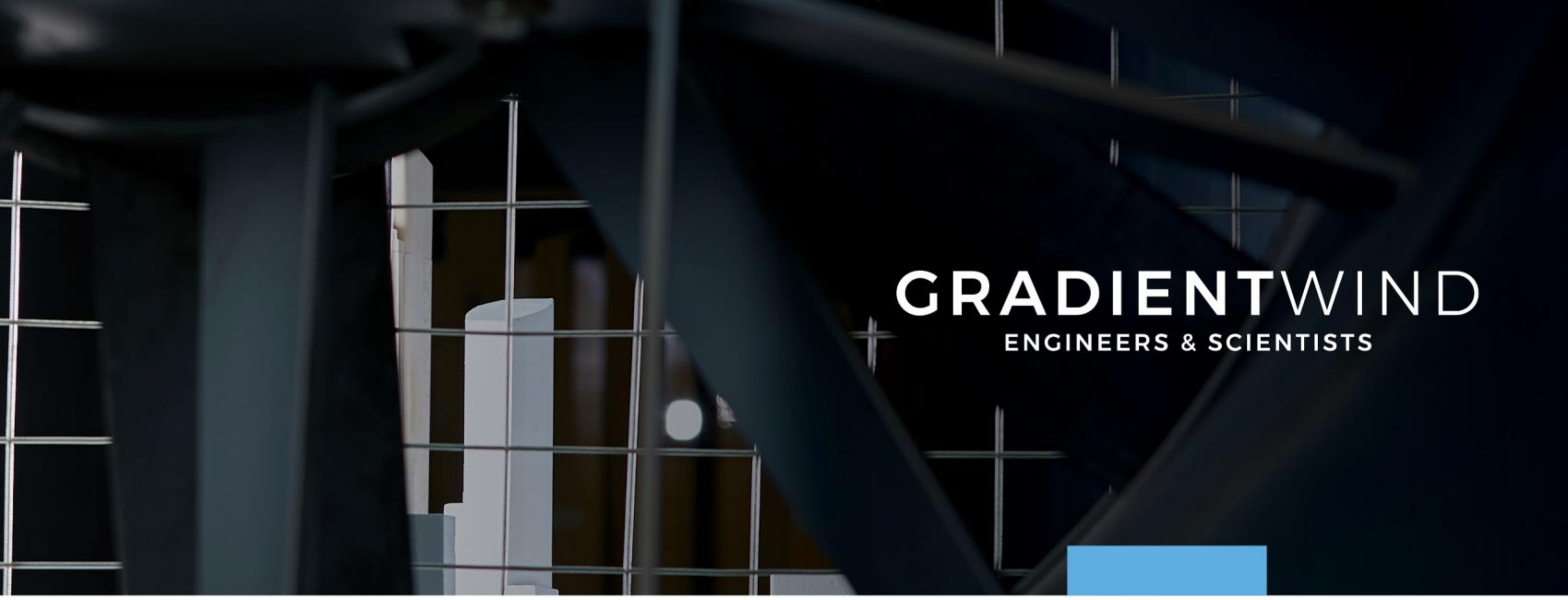
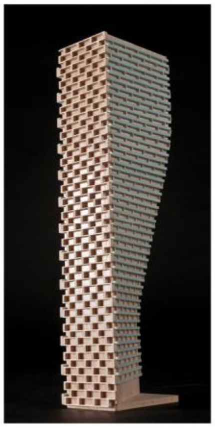
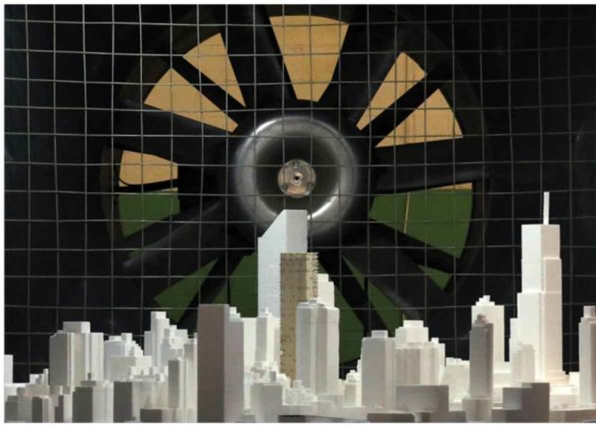


FIGURE 8: GROUND LEVEL NOISE CONTOURS FOR THE SITE (DAYTIME PERIOD)









APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

```
 STAMSON 5.0        NORMAL REPORT        Date: 18-10-2021 14:14:03
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1.te               Time Period: Day/Night 16/8 hours
Description:


Rail data, segment # 1: Via (day/night)
---------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. VIA         !  18.0/4.0   ! 150.0 !  1.0 !  4.0 !Diesel!  No

Data for Segment # 1: Via (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  43.00 / 43.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle           :   0.00

Results segment # 1: Via (day)
------------------------------

LOCOMOTIVE (0.00 + 59.91 + 0.00) = 59.91 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.58  68.49  -7.25  -1.33   0.00   0.00   0.00  59.91
----------------------------------------------------------------------

WHEEL (0.00 + 52.52 + 0.00) = 52.52 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.66  61.57  -7.59  -1.46   0.00   0.00   0.00  52.52
----------------------------------------------------------------------

Segment Leq : 60.64 dBA

Total Leq All Segments: 60.64 dBA

Results segment # 1: Via (night)
--------------------------------

LOCOMOTIVE (0.00 + 56.39 + 0.00) = 56.39 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
```

```
   -90      90    0.58   64.97   -7.25   -1.33    0.00    0.00    0.00   56.39
----------------------------------------------------------------------

WHEEL (0.00 + 49.00 + 0.00) = 49.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      90    0.66   58.05   -7.59   -1.46    0.00    0.00    0.00   49.00
----------------------------------------------------------------------

Segment Leq : 57.12 dBA

Total Leq All Segments: 57.12 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 60.64
                         (NIGHT): 57.12
```

```
STAMSON 5.0        NORMAL REPORT        Date: 18-10-2021 14:14:11
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2.te                 Time Period: Day/Night 16/8 hours
Description:


Rail data, segment # 1: Via (day/night)
---------------------------------------
Train            ! Trains       ! Speed !# loc !# Cars! Eng  !Cont
Type             !              !(km/h) !/Train!/Train! type !weld
-----------------+--------------+-------+------+------+------+----
  1. VIA         !  18.0/4.0    ! 150.0 !  1.0 !  4.0 !Diesel!  No

Data for Segment # 1: Via (day/night)
-------------------------------------
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  50.00 / 50.00  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle            :   0.00

Results segment # 1: Via (day)
------------------------------

LOCOMOTIVE (0.00 + 58.87 + 0.00) = 58.87 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.58  68.49  -8.29  -1.33   0.00   0.00   0.00  58.87
----------------------------------------------------------------------

WHEEL (0.00 + 51.43 + 0.00) = 51.43 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.66  61.57  -8.68  -1.46   0.00   0.00   0.00  51.43
----------------------------------------------------------------------

Segment Leq : 59.59 dBA

Total Leq All Segments: 59.59 dBA

Results segment # 1: Via (night)
--------------------------------

LOCOMOTIVE (0.00 + 55.35 + 0.00) = 55.35 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
```

```
   -90      90   0.58  64.97  -8.29  -1.33   0.00   0.00   0.00  55.35
----------------------------------------------------------------------

WHEEL (0.00 + 47.91 + 0.00) = 47.91 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      90   0.66  58.05  -8.68  -1.46   0.00   0.00   0.00  47.91
----------------------------------------------------------------------

Segment Leq : 56.07 dBA

Total Leq All Segments: 56.07 dBA

Road data, segment # 1: HWY 416 NB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  36666
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 416 NB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 374.00 / 374.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      3       (Elevated; no barrier)
Elevation                 :  10.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 416 SB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)
```

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

    24 hr Traffic Volume (AADT or SADT):  36666
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 416 SB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 403.00 / 403.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      3       (Elevated; no barrier)
Elevation                 :  10.00 m
Reference angle           :   0.00

Results segment # 1: HWY 416 NB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.93 + 0.00) = 58.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  78.83   0.00 -19.00  -0.90   0.00   0.00   0.00
58.93
--------------------------------------------------------------------------
--

Segment Leq : 58.93 dBA

Results segment # 2: HWY 416 SB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.49 + 0.00) = 58.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  78.83   0.00 -19.44  -0.90   0.00   0.00   0.00
58.49
```

```
--------------------------------------------------------------------------
--

Segment Leq : 58.49 dBA

Total Leq All Segments: 61.73 dBA

Results segment # 1: HWY 416 NB (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.34 + 0.00) = 51.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  71.23   0.00 -19.00  -0.90   0.00   0.00   0.00
51.34
--------------------------------------------------------------------------
--

Segment Leq : 51.34 dBA

Results segment # 2: HWY 416 SB (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.90 + 0.00) = 50.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  71.23   0.00 -19.44  -0.90   0.00   0.00   0.00
50.90
--------------------------------------------------------------------------
--

Segment Leq : 50.90 dBA

Total Leq All Segments: 54.14 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 63.80
                         (NIGHT): 58.22
```

```
STAMSON 5.0        NORMAL REPORT        Date: 18-10-2021 14:14:18
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3.te                Time Period: Day/Night 16/8 hours
Description:


Rail data, segment # 1: Via (day/night)
---------------------------------------
Train            ! Trains       ! Speed !# loc !# Cars! Eng  !Cont
Type             !              !(km/h) !/Train!/Train! type !weld
-----------------+--------------+-------+------+------+------+----
  1. VIA         !  18.0/4.0    ! 150.0 !  1.0 !  4.0 !Diesel!  No

Data for Segment # 1: Via (day/night)
-------------------------------------
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 104.00 / 104.00 m
Receiver height            :   1.50 / 1.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
No Whistle
Reference angle            :   0.00

Results segment # 1: Via (day)
------------------------------

LOCOMOTIVE (0.00 + 53.83 + 0.00) = 53.83 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.58  68.49 -13.33  -1.33   0.00   0.00   0.00  53.83
----------------------------------------------------------------------

WHEEL (0.00 + 46.15 + 0.00) = 46.15 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.66  61.57 -13.96  -1.46   0.00   0.00   0.00  46.15
----------------------------------------------------------------------

Segment Leq : 54.51 dBA

Total Leq All Segments: 54.51 dBA

Results segment # 1: Via (night)
--------------------------------

LOCOMOTIVE (0.00 + 50.31 + 0.00) = 50.31 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
```

```
   -90      90   0.58  64.97 -13.33  -1.33   0.00   0.00   0.00  50.31
----------------------------------------------------------------------

WHEEL (0.00 + 42.63 + 0.00) = 42.63 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90      90   0.66  58.05 -13.96  -1.46   0.00   0.00   0.00  42.63
----------------------------------------------------------------------

Segment Leq : 50.99 dBA

Total Leq All Segments: 50.99 dBA

Road data, segment # 1: HWY 416 NB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  36666
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 416 NB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 143.00 / 143.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      3       (Elevated; no barrier)
Elevation                 :  10.00 m
Reference angle           :   0.00

Road data, segment # 2: HWY 416 SB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)
```

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

    24 hr Traffic Volume (AADT or SADT):  36666
    Percentage of Annual Growth         :   0.00
    Number of Years of Growth           :   0.00
    Medium Truck % of Total Volume      :   7.00
    Heavy Truck  % of Total Volume      :   5.00
    Day (16 hrs) % of Total Volume      :  92.00

Data for Segment # 2: HWY 416 SB (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 171.00 / 171.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      3       (Elevated; no barrier)
Elevation                 :  10.00 m
Reference angle           :   0.00

Results segment # 1: HWY 416 NB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.61 + 0.00) = 64.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  78.83   0.00 -13.32  -0.90   0.00   0.00   0.00
64.61
--------------------------------------------------------------------------
--

Segment Leq : 64.61 dBA

Results segment # 2: HWY 416 SB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.55 + 0.00) = 63.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  78.83   0.00 -14.38  -0.90   0.00   0.00   0.00
63.55
```

```
--------------------------------------------------------------------------
--

Segment Leq : 63.55 dBA

Total Leq All Segments: 67.12 dBA

Results segment # 1: HWY 416 NB (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.02 + 0.00) = 57.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  71.23   0.00 -13.32  -0.90   0.00   0.00   0.00
57.02
--------------------------------------------------------------------------
--

Segment Leq : 57.02 dBA

Results segment # 2: HWY 416 SB (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.96 + 0.00) = 55.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.36  71.23   0.00 -14.38  -0.90   0.00   0.00   0.00
55.96
--------------------------------------------------------------------------
--

Segment Leq : 55.96 dBA

Total Leq All Segments: 59.53 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 67.35
                         (NIGHT): 60.10
```

```
STAMSON 5.0        NORMAL REPORT        Date: 18-10-2021 14:14:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: HWY 416 NB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  36666
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: HWY 416 NB (day/night)
--------------------------------------------
Angle1   Angle2          : -20.00 deg   90.00 deg
Wood depth               :      0       (No woods.)
No of house rows         :      0 / 0
Surface                  :      1       (Absorptive ground surface)
Receiver source distance : 145.00 / 145.00 m
Receiver height          :   1.50 / 1.50   m
Topography               :      1       (Flat/gentle slope; no barrier)
Reference angle          :   0.00

Road data, segment # 2: HWY 416 NB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 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):  36666
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
```

```
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: HWY 416 NB (day/night)
--------------------------------------------
Angle1   Angle2            : -61.00 deg   -9.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 153.00 / 153.00 m
Receiver height            :   1.50 / 1.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

Road data, segment # 3: HWY 416 SB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  36666
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: HWY 416 SB (day/night)
--------------------------------------------
Angle1   Angle2            : -19.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 173.00 / 173.00 m
Receiver height            :   1.50 / 1.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

Road data, segment # 4: HWY 416 SB (day/night)
----------------------------------------------
Car traffic volume  : 29685/2581  veh/TimePeriod  *
Medium truck volume :  2361/205   veh/TimePeriod  *
Heavy truck volume  :  1687/147   veh/TimePeriod  *
Posted speed limit  :   100 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):  36666
    Percentage of Annual Growth         :   0.00
    Number of Years of Growth           :   0.00
    Medium Truck % of Total Volume      :   7.00
    Heavy Truck  % of Total Volume      :   5.00
    Day (16 hrs) % of Total Volume      :  92.00

Data for Segment # 4: HWY 416 SB (day/night)
--------------------------------------------
Angle1   Angle2           : -56.00 deg   -8.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 181.00 / 181.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: HWY 416 NB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.17 + 0.00) = 59.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -20     90   0.66  78.83   0.00 -16.36  -3.31   0.00   0.00   0.00
59.17
--------------------------------------------------------------------------
--

Segment Leq : 59.17 dBA

Results segment # 2: HWY 416 NB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.56 + 0.00) = 55.56 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -61     -9   0.66  78.39   0.00 -16.74  -6.08   0.00   0.00   0.00
55.56
```

```
--------------------------------------------------------------------------
--

Segment Leq : 55.56 dBA

Results segment # 3: HWY 416 SB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.84 + 0.00) = 57.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -19     90   0.66  78.83   0.00 -17.63  -3.36   0.00   0.00   0.00
57.84
--------------------------------------------------------------------------
--

Segment Leq : 57.84 dBA

Results segment # 4: HWY 416 SB (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.12 + 0.00) = 54.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -56     -8   0.66  78.39   0.00 -17.95  -6.31   0.00   0.00   0.00
54.12
--------------------------------------------------------------------------
--

Segment Leq : 54.12 dBA

Total Leq All Segments: 63.12 dBA

Results segment # 1: HWY 416 NB (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.57 + 0.00) = 51.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
```

```
   -20      90    0.66   71.23    0.00 -16.36   -3.31    0.00    0.00    0.00
51.57
----------------------------------------------------------------------------
--

Segment Leq : 51.57 dBA

Results segment # 2: HWY 416 NB (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 47.97 + 0.00) = 47.97 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -61      -9    0.66   70.79    0.00 -16.74   -6.08    0.00    0.00    0.00
47.97
----------------------------------------------------------------------------
--

Segment Leq : 47.97 dBA

Results segment # 3: HWY 416 SB (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.25 + 0.00) = 50.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -19      90    0.66   71.23    0.00 -17.63   -3.36    0.00    0.00    0.00
50.25
----------------------------------------------------------------------------
--

Segment Leq : 50.25 dBA

Results segment # 4: HWY 416 SB (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 46.53 + 0.00) = 46.53 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
```

```
   -56     -8   0.66  70.79   0.00 -17.95  -6.31   0.00   0.00   0.00
46.53
--------------------------------------------------------------------------
--

Segment Leq : 46.53 dBA

Total Leq All Segments: 55.53 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 63.12
                         (NIGHT): 55.53
```

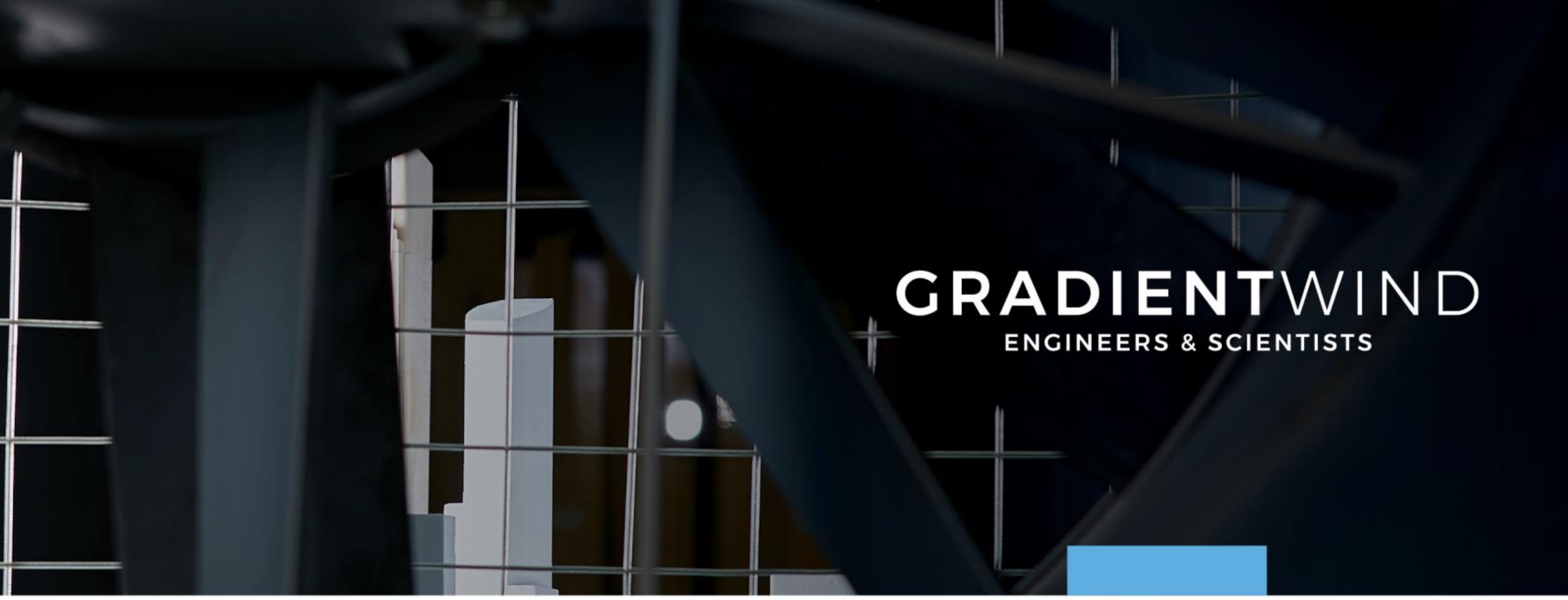
```
STAMSON 5.0        NORMAL REPORT        Date: 18-10-2021 14:14:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.te                  Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Prop Min Col (day/night)
------------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Prop Min Col (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1: Prop Min Col (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.75 + 0.00) = 65.75 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  65.75   0.00   0.00   0.00   0.00   0.00   0.00
65.75
-------------------------------------------------------------------------
--
```

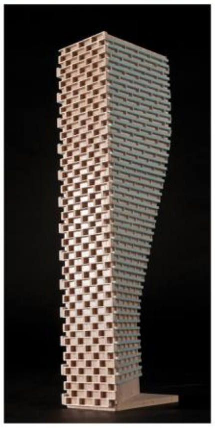
```
Segment Leq : 65.75 dBA

Total Leq All Segments: 65.75 dBA

Results segment # 1: Prop Min Col (night)
-----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.16 + 0.00) = 58.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  58.16   0.00   0.00   0.00   0.00   0.00   0.00
58.16
--------------------------------------------------------------------------
--

Segment Leq : 58.16 dBA

Total Leq All Segments: 58.16 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.75
                         (NIGHT): 58.16
```

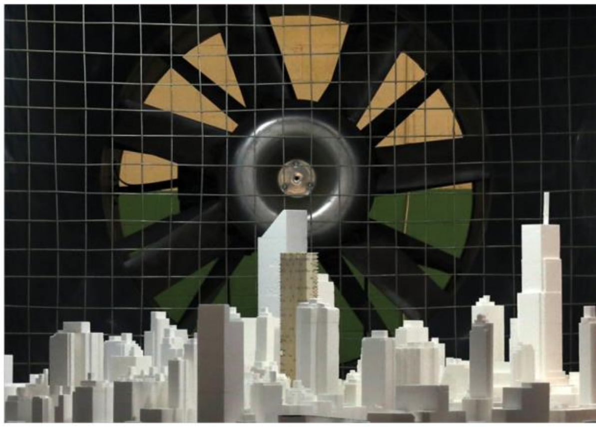
```
STAMSON 5.0        NORMAL REPORT        Date: 18-10-2021 14:14:37
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r6.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Prop Min Col (day/night)
------------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Prop Min Col (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  15.00 / 15.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: Prop Min Col (day/night)
------------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
```

```
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Prop Min Col (day/night)
----------------------------------------------
Angle1   Angle2            : -90.00 deg   42.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  17.00 / 17.00  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

Results segment # 1: Prop Min Col (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.75 + 0.00) = 65.75 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  65.75   0.00   0.00   0.00   0.00   0.00   0.00
65.75
--------------------------------------------------------------------------
--

Segment Leq : 65.75 dBA

Results segment # 2: Prop Min Col (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.86 + 0.00) = 63.86 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     42   0.00  65.75   0.00  -0.54  -1.35   0.00   0.00   0.00
63.86
--------------------------------------------------------------------------
--

Segment Leq : 63.86 dBA

Total Leq All Segments: 67.92 dBA
```

```
Results segment # 1: Prop Min Col (night)
-----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.16 + 0.00) = 58.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  58.16   0.00   0.00   0.00   0.00   0.00   0.00
58.16
--------------------------------------------------------------------------
--

Segment Leq : 58.16 dBA

Results segment # 2: Prop Min Col (night)
-----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.27 + 0.00) = 56.27 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     42   0.00  58.16   0.00  -0.54  -1.35   0.00   0.00   0.00
56.27
--------------------------------------------------------------------------
--

Segment Leq : 56.27 dBA

Total Leq All Segments: 60.33 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.92
                         (NIGHT): 60.33
```





APPENDIX B

FTA VIBRATION CALCULATIONS

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

GWE17-151 18-Oct-21

Possible Vibration Impacts on Conservancy Subdivision
Predicted using FTA General Assesment

Train Speed 150 km/h 90 mph

	Distance from C/L	
	(m)	(ft)
VIA Rail	32.0	105.0

	Vibration	
From FTA Manual Fig 10-1		
Vibration Levels at distance from track	78	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1		
Speed reference 50 mph	5	Speed Limit of 150 km/h (90 mph)
Vehicle Parameters	0	Assume Soft primary suspension, Wheels run true
Track Condition	0	None
Track Treatments	0	None
Type of Transit Structure	0	None
Efficient vibration Propagation	0	Propagation through rock
Vibration Levels at Fdn	83	0.363
Coupling to Building Foundation	-5	1-2 Storey Wood Frame
Floor to Floor Attenuation	0.0	Ground Floor Ocupied
Amplification of Floor and Walls	6	
Total Vibration Level	84.10545	dBV or 0.407 mm/s
Noise Level in dBA	49.10545	dBA

Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise				
Factors Affecting Vibration Source				
Source Factor	**Adjustment to Propagation Curve**			**Comment**
		Reference Speed		
Speed	Vehicle Speed	50 mph	30 mph	Vibration level is approximately proportional to $20*\log(speed/speed_{ref})$. Sometimes the variation with speed has been observed to be as low as 10 to 15 $\log(speed/speed_{ref})$.
	60 mph	+1.6 dB	+6.0 dB	
	50 mph	0.0 dB	+4.4 dB	
	40 mph	-1.9 dB	+2.5 dB	
	30 mph	-4.4 dB	0.0 dB	
	20 mph	-8.0 dB	-3.5 dB	
Vehicle Parameters (not additive, apply greatest value only)				
Vehicle with stiff primary suspension	+8 dB			Transit vehicles with stiff primary suspensions have been shown to create high vibration levels. Include this adjustment when the primary suspension has a vertical resonance frequency greater than 15 Hz.
Resilient Wheels	0 dB			Resilient wheels do not generally affect ground-borne vibration except at frequencies greater than about 80 Hz.
Worn Wheels or Wheels with Flats	+10 dB			Wheel flats or wheels that are unevenly worn can cause high vibration levels. This can be prevented with wheel truing and slip-slide detectors to prevent the wheels from sliding on the track.
Track Conditions (not additive, apply greatest value only)				
Worn or Corrugated Track	+10 dB			If both the wheels and the track are worn, only one adjustment should be used. Corrugated track is a common problem. Mill scale on new rail can cause higher vibration levels until the rail has been in use for some time.
Special Trackwork	+10 dB			Wheel impacts at special trackwork will significantly increase vibration levels. The increase will be less at greater distances from the track.
Jointed Track or Uneven Road Surfaces	+5 dB			Jointed track can cause higher vibration levels than welded track. Rough roads or expansion joints are sources of increased vibration for rubber-tire transit.
Track Treatments (not additive, apply greatest value only)				
Floating Slab Trackbed	-15 dB			The reduction achieved with a floating slab trackbed is strongly dependent on the frequency characteristics of the vibration.
Ballast Mats	-10 dB			Actual reduction is strongly dependent on frequency of vibration.
High-Resilience Fasteners	-5 dB			Slab track with track fasteners that are very compliant in the vertical direction can reduce vibration at frequencies greater than 40 Hz.

Table 10-1. Adjustment Factors for Generalized Predictions of Ground-Borne Vibration and Noise (Continued)

Path Factor	Adjustment to Propagation Curve	Comment
Factors Affecting Vibration Path		
Resiliently Supported Ties	-10 dB	Resiliently supported tie systems have been found to provide very effective control of low-frequency vibration.
Track Configuration (not additive, apply greatest value only)		
Type of Transit Structure	Relative to at-grade tie & ballast: Elevated structure -10 dB Open cut 0 dB	The general rule is the heavier the structure, the lower the vibration levels. Putting the track in cut may reduce the vibration levels slightly. Rock-based subways generate higher-frequency vibration.
	Relative to bored subway tunnel in soil: Station -5 dB Cut and cover -3 dB Rock-based - 15 dB	
Ground-borne Propagation Effects		
Geologic conditions that promote efficient vibration propagation	Efficient propagation in soil +10 dB	Refer to the text for guidance on identifying areas where efficient propagation is possible.
	Propagation in rock layer — **Dist.** / **Adjust.**: 50 ft +2 dB 100 ft +4 dB 150 ft +6 dB 200 ft +9 dB	The positive adjustment accounts for the lower attenuation of vibration in rock compared to soil. It is generally more difficult to excite vibrations in rock than in soil at the source.
Coupling to building foundation	Wood Frame Houses -5 dB 1-2 Story Masonry -7 dB 3-4 Story Masonry -10 dB Large Masonry on Piles -10 dB Large Masonry on Spread Footings -13 dB Foundation in Rock 0 dB	The general rule is the heavier the building construction, the greater the coupling loss.
Factors Affecting Vibration Receiver		
Receiver Factor	**Adjustment to Propagation Curve**	**Comment**
Floor-to-floor attenuation	1 to 5 floors above grade: -2 dB/floor 5 to 10 floors above grade: -1 dB/floor	This factor accounts for dispersion and attenuation of the vibration energy as it propagates through a building.
Amplification due to resonances of floors, walls, and ceilings	+6 dB	The actual amplification will vary greatly depending on the type of construction. The amplification is lower near the wall/floor and wall/ceiling intersections.
Conversion to Ground-borne Noise		
Noise Level in dBA	Peak frequency of ground vibration: Low frequency (<30 Hz): -50 dB Typical (peak 30 to 60 Hz): -35 dB High frequency (>60 Hz): -20 dB	Use these adjustments to estimate the A-weighted sound level given the average vibration velocity level of the room surfaces. See text for guidelines for selecting low, typical or high frequency characteristics. Use the high-frequency adjustment for subway tunnels in rock or if the dominant frequencies of the vibration spectrum are known to be 60 Hz or greater.