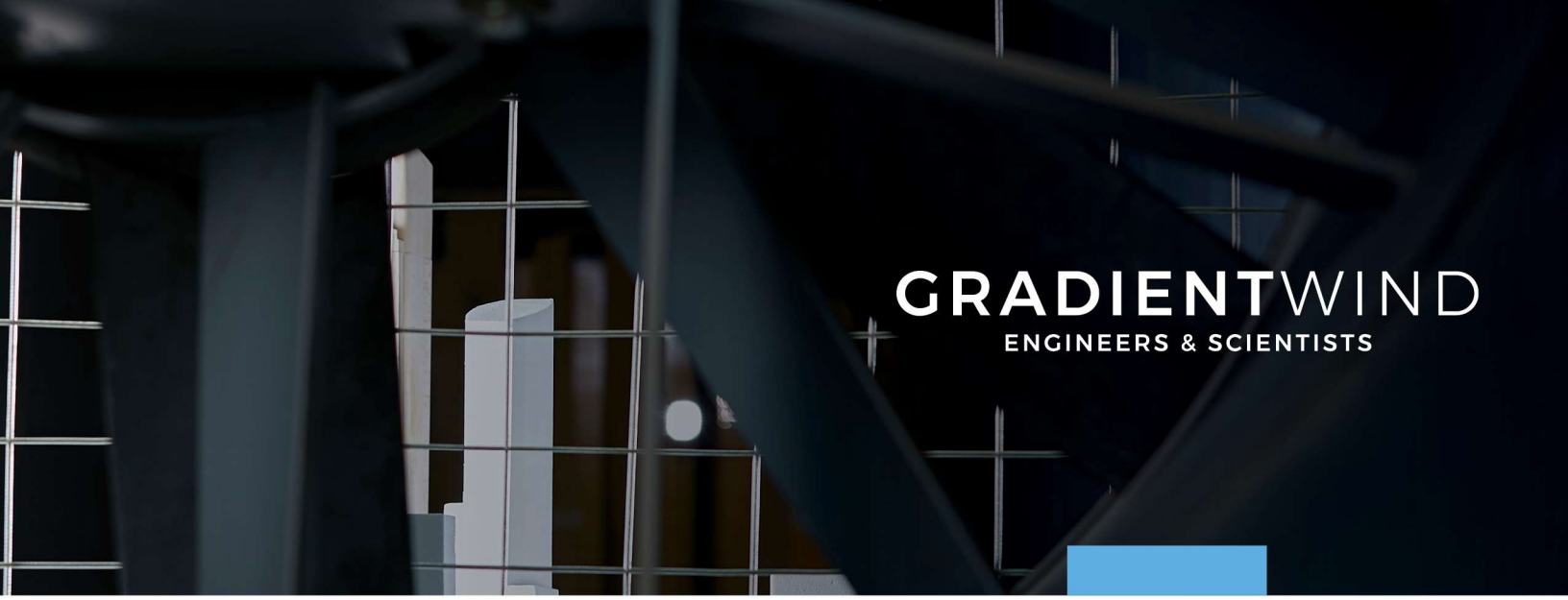

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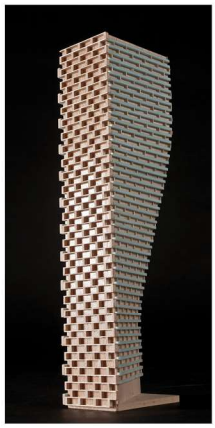
ROADWAY TRAFFIC NOISE ASSESSMENT

327 Richmond Road
Ottawa, Ontario

Report: 20-053 – Traffic Noise



May 14, 2020

PREPARED FOR
Richmond Churchill Limited Partnership
485 Bank Street, Suite 207
Ottawa, ON K2P 1Z2

PREPARED BY
Samantha Phillips, B.Eng., Environmental Scientist
Joshua Foster, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a detailed roadway traffic noise assessment undertaken to satisfy the requirements for a joint zoning by-law amendment and site plan control application submission for a proposed mixed-use development located at 327 Richmond Road in Ottawa, Ontario. The development is a nine-storey building with retail units at grade and residential units in the remaining floors above. Outdoor amenity areas are provided on the building rooftop. The major sources of traffic noise are Richmond Road and Churchill Avenue North to the south and west of the site, respectively. 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; and (iv) architectural drawings prepared by Hobin Architecture Inc. dated March 2020.

The results of the current analysis indicate that noise levels will range between 69 and 59 dBA during the daytime period (07:00-23:00) and between 62 and 51 dBA during the nighttime period (23:00-07:00). The highest noise level (69 dBA) occurs at the south and west façades, which are nearest and most exposed to Richmond Road and Churchill Avenue North. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. A Warning Clause[1] will also be required in all Lease, Purchase and Sale Agreements.

The noise levels at the rooftop OLAs are expected to approach 49 dBA and 48 dBA during the daytime period. As the noise levels are below the daytime criteria of 55 dBA, no noise control measures are required.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016

With regard to stationary noise impacts, a stationary noise study will be performed for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise-sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment. Where necessary noise screens and silencers can be incorporated into the design.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Richmond Churchill Limited Partnership to undertake a roadway traffic noise assessment to satisfy the requirements for a joint zoning by-law amendment and site plan control application submission for a proposed mixed-use development at 327 Richmond Road in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[2] and Ministry of the Environment, Conservation and Parks (MECP)[3] guidelines. Noise calculations were based on architectural drawings prepared by Hobin Architecture Inc. dated March 2020, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this traffic noise assessment is a proposed mixed-use development at 327 Richmond Road in Ottawa, Ontario. The subject site is located at 327 Richmond Road in Ottawa on a parcel of land bordered by Richmond Road to the south, Churchill Avenue North to the west, Winona Avenue to the east, and Whitby Avenue to the north.

The proposed development comprises a 9-storey (plus mechanical penthouse) building, with a 'C'-shaped planform at grade encircling a courtyard at the north end of the subject site. At grade, the entrance at the southwest corner is recessed, creating an overhang. A patio is located at the southwest corner. The ground floor comprises a mixed-use lobby, access to the underground parking from the northwest corner, a loading/move-in bay, a mailroom, and retail space. Levels 2 and above comprise residential units. At the second level, the building steps back from the west elevation, as well as from the south wall of the courtyard, revealing private terraces. The building steps back again from the south and east elevations at Level 4, and from the east side of the north elevation at Levels 5, 6, and 7. At Level 8 the building steps

[2] City of Ottawa Environmental Noise Control Guidelines, January 2016
[3] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

back from all sides. Common outdoor amenity terraces are located on Level 10. Except for the terrace at the north side of Level 2, the terraces and balconies extend less than 4 metres from the façade, they do not require consideration as outdoor living areas (OLA) in this study. A receptor was not included at the Level 2 terrace since the study building itself provides blockage from the surrounding roadways.

The site borders low-rise residential buildings to the north and roadways; Winona Avenue, Churchill Avenue North and Richmond Road at the east, west and south sides, respectively. Beyond the roadways, the site is surrounded by low-rise residential and commercial buildings in all directions.

The major sources of traffic noise are Richmond Road and Churchill Avenue North to the south and west of the site, respectively. Although Byron Avenue, located south of the site, is a nearby collector roadway, it is located just beyond 100 metres of the study site and therefore are not included as sources influencing the study site as per ENCG Section 2.1. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4.2 of this report.

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 indoor noise limit range (that is relevant to this study) is 50, 45 and 40 dBA for retail spaces, living rooms and sleeping quarters respectively for roadway transportation sources as listed in Table 1.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [4]

Type of Space	Time Period	L_{eq} (dBA)
General offices, reception areas, **retail stores**, etc.	07:00 – 23:00	50
Living/dining/den areas of **residences**, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45
Sleeping quarters of hotels/motels	23:00 – 07:00	45
Sleeping quarters of **residences**, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[5]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[6]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need

[4] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[5] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[6] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8

for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[7].

The sound level criterion for outdoor living areas is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation must be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion.

4.2.2 Theoretical Roadway Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road analysis. Appendix A includes the STAMSON 5.04 input and output data.

Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 2, 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 for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building, except for the segment of Churchill Avenue North to the south of Richmond Road which was considered to have a gradient of 6%.
- Receptor height was taken to be 16.5 metres at Level 5 for the centre of the window (height to 5th floor slab + 1.5 metres) for Receptors 1-6, and 31.5 m for rooftop Receptor 7 and 8.
- For the rooftop receptors, the study building itself was considered as a noise barrier with a height of 30-metres.
- Noise receptors were strategically placed at eight locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 4-6.

[7] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.3 Roadway 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[8] 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. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Richmond Road	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Churchill Avenue North – North of Richmond Road	2-Lane Urban Arterial (2-UAU)	50	**15,000**
Churchill Avenue North – South of Richmond Road	2-Lane Major Collector (2-UMCU)	50	**12,000**

4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, brick veneer walls can achieve STC 50 or more. Standard commercially sided exterior metal stud walls have around STC 45. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

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

As per Section 4.2, when daytime noise levels (from road sources) at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[9] considers:

- Window type and total area as a percentage of total room floor area
- Exterior wall type and total area as a percentage of the total room floor area
- Acoustic absorption characteristics of the room
- Outdoor noise source type and approach geometry
- Indoor sound level criteria, which varies according to the intended use of a space

Based on published research[10], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

5. RESULTS AND DISCUSSION

5.1 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 3. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

[9] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985
[10] CMHC, Road & Rail Noise: Effects on Housing

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	16.5	POW – Level 5, North Façade at Northeast Corner	59	51
2	16.5	POW – Level 5, North Façade at Northwest Corner	65	58
3	16.5	POW – Level 5, East Façade	66	58
4	16.5	POW – Level 5, South Façade at Southeast Corner	69	61
5	16.5	POW – Level 5, South Façade at Southwest Corner	69	62
6	16.5	POW – Level 5, West Façade	69	62
7	31.5	OLA – Rooftop at Northwest Corner	49	-
8	31.5	OLA – East Side of Rooftop	48	-

The results of the current analysis indicate that noise levels will range between 69 and 59 dBA during the daytime period (07:00-23:00) and between 62 and 51 dBA during the nighttime period (23:00-07:00). The highest noise level (69 dBA) occurs at the south and west façades, which are nearest and most exposed to Richmond Road and Churchill Avenue North. The noise levels at the rooftop OLAs are expected to approach 49 dBA and 48 dBA during the daytime period. As the noise levels are below the daytime criteria of 55 dBA, no noise control measures are required.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per city of Ottawa requirements, detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized below for various units within the development (see Figure 3):

- **Bedroom Windows**

(i) Bedroom windows facing south as well as those at the west façade overlooking Churchill Avenue North will require a minimum STC of 32.

(ii) Bedroom windows facing north at the northwest corner of the building as well as those at the east façade overlooking Winona Avenue will require a minimum STC of 29.

(iii) All other bedroom windows are to satisfy Ontario Building Code (OBC 2012) requirements.

- **Living Room Windows**

(i) Living room windows facing south as well as those at the west façade overlooking Churchill Avenue North will require a minimum STC of 27.

(ii) Living room windows facing north at the northwest corner of the building as well as those at the east façade overlooking Winona Avenue will require a minimum STC of 24.

(iii) All other living room windows are to satisfy Ontario Building Code (OBC 2012) requirements.

- **Exterior Walls**

(i) Exterior wall components on the north, east, south and west façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data[11].

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a window/wall system is used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the

[11] J.S. Bradley and J.A. Birta. Laboratory Measurements of the Sound Insulation of Building Façade Elements, National Research Council October 2000.

building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, Warning Clauses will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 69 and 59 dBA during the daytime period (07:00-23:00) and between 62 and 51 dBA during the nighttime period (23:00-07:00). The highest noise level (69 dBA) occurs at the south and west façades, which are nearest and most exposed to Richmond Road and Churchill Avenue North. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. The following Warning Clause[12] will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized below:

> *"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing roadway traffic may, on occasion, interfere with some activities of the dwelling occupants, as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*
>
> - *STC rated multi-pane glazing elements and spandrel panels*
> - *South façade and west façade overlooking Churchill Avenue North bedroom/living room: STC 32/27*

[12] City of Ottawa Environmental Noise Control Guidelines, January 2016

- *North façade at northwest corner of the building and east façade overlooking Winona Avenue bedroom/living room: STC 29/24*

- *STC rated exterior walls*
  - *North, east, south and west façade: STC 45*

This dwelling unit has also been designed with air conditioning. Air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment, Conservation and Parks.

To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features."

The noise levels at the rooftop OLAs are expected to approach 49 dBA and 48 dBA during the daytime period. As the noise levels are below the daytime criteria of 55 dBA, no noise control measures are required.

With regard to stationary noise impacts, a stationary noise study will be performed for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise-sensitive areas. This study will include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. Noise impacts can generally be minimized by judicious selection and placement of the equipment. Where necessary noise screens and silencers can be incorporated into the design.

This concludes our roadway traffic noise 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,

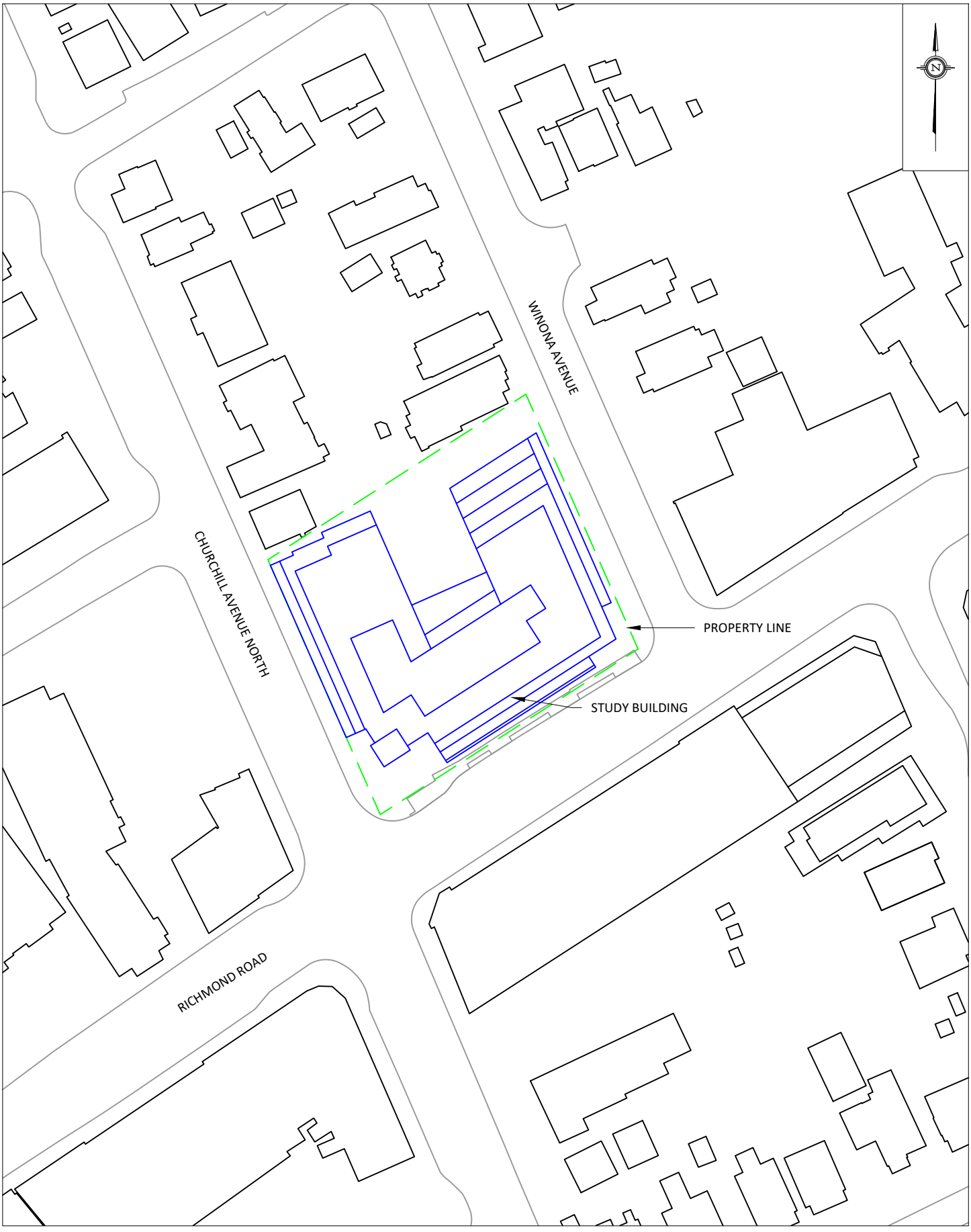
Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
May 14, 2020
PROVINCE OF ONTARIO

Samantha Phillips, B.Eng.
Environmental Scientist

Joshua Foster, P.Eng.
Principal

GW20-053 – Traffic Noise



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PROJECT	327 RICHMOND ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	GW20-053-1
DATE	APRIL 23, 2020	DRAWN BY	S.P.

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT

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DRAWING NO.	GW20-053-2
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DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS

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SCALE	1:500 (APPROX.)	DRAWING NO.	GW20-053-3
DATE	APRIL 23, 2020	DRAWN BY	S.P.

FIGURE 3:
WINDOW STC REQUIREMENTS

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SCALE	1:1000 (APPROX.)
DRAWING NO.	GW20-053-4
DATE	APRIL 23, 2020
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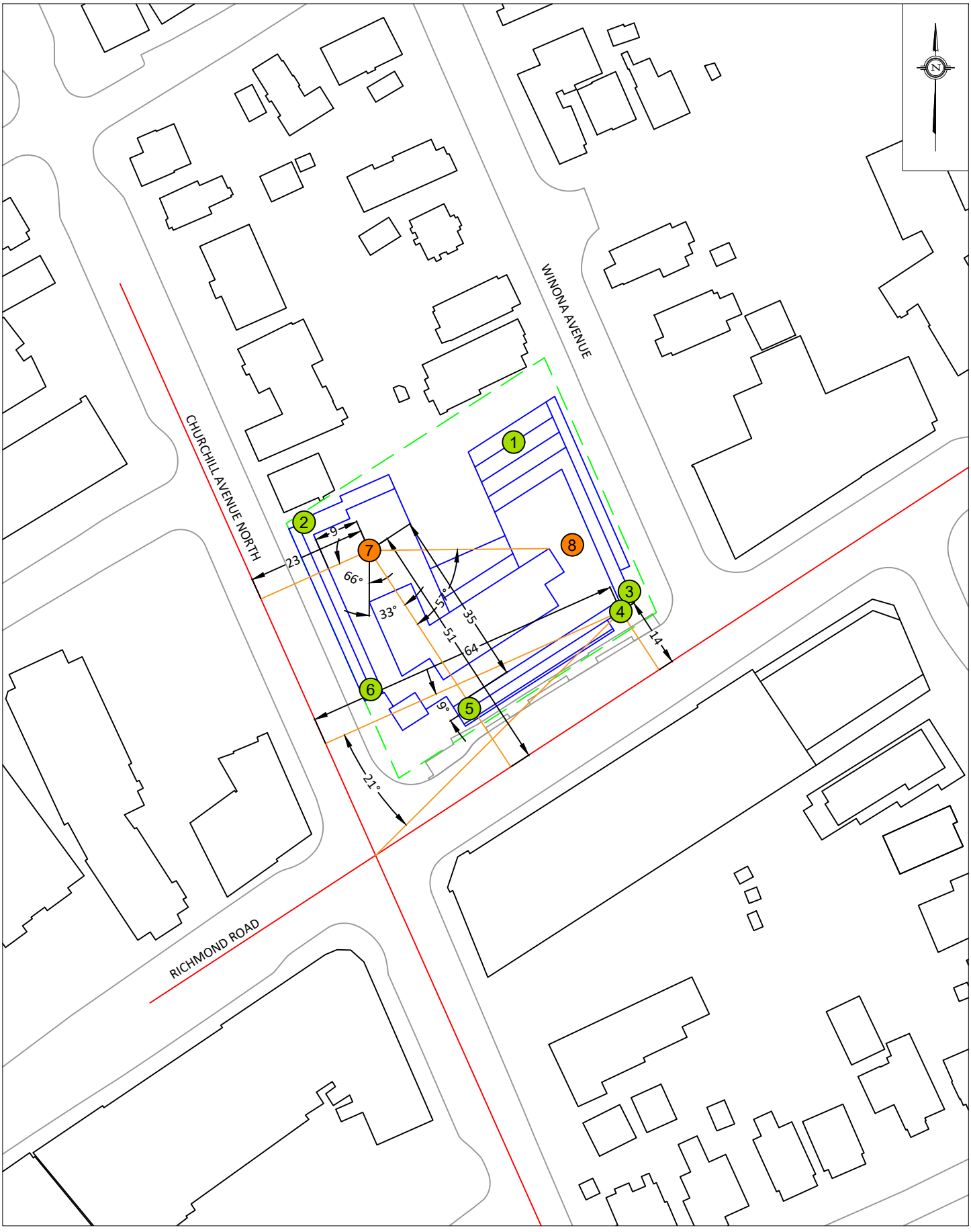
DESCRIPTION

FIGURE 4:
STAMSON INPUT PARAMETERS - RECEPTORS 1, 2, 3, 5



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PROJECT	327 RICHMOND ROAD, OTTAWA ROADWAY TRAFFIC NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW20-053-5
DATE	APRIL 23, 2020
DRAWN BY	S.P.

DESCRIPTION

FIGURE 5:
STAMSON INPUT PARAMETERS - RECEPTORS 4, 7

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SCALE	1:1000 (APPROX.)	DRAWING NO.	GW20-053-6
DATE	APRIL 23, 2020	DRAWN BY	S.P.

FIGURE 6:
STAMSON INPUT PARAMETERS - RECEPTORS 6, 8

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APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA AND SUPPORTING INFORMATION

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```
STAMSON 5.0        NORMAL REPORT        Date: 13-04-2020 15:30:20
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R1.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Churchill N (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Churchill N (day/night)
---------------------------------------------
Angle1   Angle2           :  10.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  58.00 / 58.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Churchill N (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.08 + 0.00) = 59.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    10     90   0.00  68.48   0.00  -5.87  -3.52   0.00   0.00   0.00
59.08
-------------------------------------------------------------------------
--

Segment Leq : 59.08 dBA

Total Leq All Segments: 59.08 dBA


Results segment # 1: Churchill N (night)
-----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.49 + 0.00) = 51.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    10     90   0.00  60.88   0.00  -5.87  -3.52   0.00   0.00   0.00
51.49
-------------------------------------------------------------------------
--

Segment Leq : 51.49 dBA

Total Leq All Segments: 51.49 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 59.08
                           (NIGHT): 51.49
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-04-2020 15:36:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R2.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Churchill N (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Churchill N (day/night)
---------------------------------------------
Angle1   Angle2           :   0.00 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           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Churchill N (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.47 + 0.00) = 65.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     90   0.00  68.48   0.00   0.00  -3.01   0.00   0.00   0.00
65.47
-------------------------------------------------------------------------
--

Segment Leq : 65.47 dBA

Total Leq All Segments: 65.47 dBA


Results segment # 1: Churchill N (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.87 + 0.00) = 57.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     90   0.00  60.88   0.00   0.00  -3.01   0.00   0.00   0.00
57.87
-------------------------------------------------------------------------
--

Segment Leq : 57.87 dBA

Total Leq All Segments: 57.87 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 65.47
                           (NIGHT): 57.87
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-04-2020 15:42:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename:                       Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Richmond (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   9.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  16.00 / 16.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Richmond (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.60 + 0.00) = 65.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      9   0.00  68.48   0.00  -0.28  -2.60   0.00   0.00   0.00
65.60
-------------------------------------------------------------------------
--

Segment Leq : 65.60 dBA

Total Leq All Segments: 65.60 dBA


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

Source height = 1.50 m

ROAD (0.00 + 58.01 + 0.00) = 58.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90      9   0.00  60.88   0.00  -0.28  -2.60   0.00   0.00   0.00
58.01
-------------------------------------------------------------------------
--

Segment Leq : 58.01 dBA

Total Leq All Segments: 58.01 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 65.60
                           (NIGHT): 58.01
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-04-2020 16:07:09
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R4.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Richmond (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond (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           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Churchill N (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Churchill N (day/night)
-----------------------------------------------
Angle1   Angle2           : -21.00 deg   -9.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 3: Churchill S (day/night)
-----------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     6 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Churchill S (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   -21.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Richmond (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.48 + 0.00) = 68.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  68.48   0.00   0.00   0.00   0.00   0.00   0.00
68.48
-------------------------------------------------------------------------
--

Segment Leq : 68.48 dBA


Results segment # 2: Churchill N (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.42 + 0.00) = 50.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -21     -9   0.00  68.48   0.00  -6.30 -11.76   0.00   0.00   0.00
50.42
-------------------------------------------------------------------------
--

Segment Leq : 50.42 dBA
```

```
Results segment # 3: Churchill S (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.22 + 0.00) = 58.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -21   0.00  68.69   0.00  -6.30  -4.16   0.00   0.00   0.00
58.22
-------------------------------------------------------------------------
--

Segment Leq : 58.22 dBA

Total Leq All Segments: 68.93 dBA


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

Source height = 1.50 m

ROAD (0.00 + 60.88 + 0.00) = 60.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  60.88   0.00   0.00   0.00   0.00   0.00   0.00
60.88
-------------------------------------------------------------------------
--

Segment Leq : 60.88 dBA
```

```
Results segment # 2: Churchill N (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 42.82 + 0.00) = 42.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -21     -9   0.00  60.88   0.00  -6.30 -11.76   0.00   0.00   0.00
42.82
-------------------------------------------------------------------------
--

Segment Leq : 42.82 dBA


Results segment # 3: Churchill S (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.62 + 0.00) = 50.62 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -21   0.00  61.09   0.00  -6.30  -4.16   0.00   0.00   0.00
50.62
-------------------------------------------------------------------------
--

Segment Leq : 50.62 dBA

Total Leq All Segments: 61.33 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 68.93
                           (NIGHT): 61.33
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-04-2020 16:20:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R5.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Richmond (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond (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           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Churchill N (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Churchill N (day/night)
-----------------------------------------------
Angle1   Angle2           : -33.00 deg   -9.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 3: Churchill S (day/night)
------------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     6 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Churchill S (day/night)
------------------------------------------------
Angle1   Angle2           : -90.00 deg   -33.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 68.48 + 0.00) = 68.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90    0.00  68.48   0.00   0.00   0.00   0.00   0.00   0.00
68.48
-------------------------------------------------------------------------------
--

Segment Leq : 68.48 dBA
```

```
Results segment # 2: Churchill N (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.87 + 0.00) = 56.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -33     -9   0.00  68.48   0.00  -2.86  -8.75   0.00   0.00   0.00
56.87
-------------------------------------------------------------------------
--

Segment Leq : 56.87 dBA


Results segment # 3: Churchill S (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.83 + 0.00) = 60.83 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -33   0.00  68.69   0.00  -2.86  -4.99   0.00   0.00   0.00
60.83
-------------------------------------------------------------------------
--

Segment Leq : 60.83 dBA

Total Leq All Segments: 69.42 dBA
```

```
Results segment # 1: Richmond (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.88 + 0.00) = 60.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90   0.00  60.88   0.00   0.00   0.00   0.00   0.00   0.00
60.88
-------------------------------------------------------------------------------
--

Segment Leq : 60.88 dBA


Results segment # 2: Churchill N (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.27 + 0.00) = 49.27 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -33     -9   0.00  60.88   0.00  -2.86  -8.75   0.00   0.00   0.00
49.27
-------------------------------------------------------------------------------
--

Segment Leq : 49.27 dBA
```

```
Results segment # 3: Churchill S (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 53.23 + 0.00) = 53.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -33   0.00  61.09   0.00  -2.86  -4.99   0.00   0.00   0.00
53.23
-------------------------------------------------------------------------
--

Segment Leq : 53.23 dBA

Total Leq All Segments: 61.82 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 69.42
                           (NIGHT): 61.82
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-04-2020 08:07:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R6.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Richmond (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond (day/night)
-------------------------------------------
Angle1   Angle2           :   9.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  28.00 / 28.00  m
Receiver height           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Churchill N (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Churchill N (day/night)
-----------------------------------------------
Angle1   Angle2           : -68.00 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           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 3: Churchill S (day/night)
-----------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     6 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Churchill S (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   -68.00 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           :  16.50 / 16.50  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Richmond (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.30 + 0.00) = 62.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     9     90   0.00  68.48   0.00  -2.71  -3.47   0.00   0.00   0.00
62.30
-------------------------------------------------------------------------
--

Segment Leq : 62.30 dBA


Results segment # 2: Churchill N (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.91 + 0.00) = 67.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -68     90   0.00  68.48   0.00   0.00  -0.57   0.00   0.00   0.00
67.91
-------------------------------------------------------------------------
--

Segment Leq : 67.91 dBA
```

```
Results segment # 3: Churchill S (day)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.56 + 0.00) = 59.56 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90    -68   0.00  68.69   0.00   0.00  -9.13   0.00   0.00   0.00
59.56
-------------------------------------------------------------------------
--

Segment Leq : 59.56 dBA

Total Leq All Segments: 69.44 dBA


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

Source height = 1.50 m

ROAD (0.00 + 54.70 + 0.00) = 54.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     9     90   0.00  60.88   0.00  -2.71  -3.47   0.00   0.00   0.00
54.70
-------------------------------------------------------------------------
--

Segment Leq : 54.70 dBA
```

```
Results segment # 2: Churchill N (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.32 + 0.00) = 60.32 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -68     90   0.00  60.88   0.00   0.00  -0.57   0.00   0.00   0.00
60.32
-------------------------------------------------------------------------------
--

Segment Leq : 60.32 dBA


Results segment # 3: Churchill S (night)
----------------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.96 + 0.00) = 51.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -68   0.00  61.09   0.00   0.00  -9.13   0.00   0.00   0.00
51.96
-------------------------------------------------------------------------------
--

Segment Leq : 51.96 dBA

Total Leq All Segments: 61.84 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 69.44
                           (NIGHT): 61.84
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-04-2020 16:56:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R7.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Churchill N (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Churchill N (day/night)
---------------------------------------------
Angle1   Angle2           : -66.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  23.00 / 23.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -66.00 deg   Angle2 : 90.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :   9.00 / 9.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Richmond 1 (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond 1 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -57.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  51.00 / 51.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -57.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :  35.00 / 35.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Richmond 2 (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond 2 (day/night)
-----------------------------------------------
Angle1   Angle2           :  33.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  51.00 / 51.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  33.00 deg   Angle2 : 90.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :  35.00 / 35.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Churchill N (day)
-----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       19.76 !        19.76

ROAD (0.00 + 48.06 + 0.00) = 48.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -66     90   0.00  68.48   0.00  -1.86  -0.62   0.00   0.00 -17.94
48.06
-------------------------------------------------------------------------------
--

Segment Leq : 48.06 dBA


Results segment # 2: Richmond 1 (day)
-----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       10.91 !        10.91

ROAD (0.00 + 38.82 + 0.00) = 38.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -57   0.00  68.48   0.00  -5.31  -7.37   0.00   0.00 -16.97
38.82
-------------------------------------------------------------------------------
--

Segment Leq : 38.82 dBA
```

```
Results segment # 3: Richmond 2 (day)
-----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       10.91 !        10.91

ROAD (0.00 + 40.17 + 0.00) = 40.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    33     90   0.00  68.48   0.00  -5.31  -4.99   0.00   0.00 -18.00
40.17
-------------------------------------------------------------------------------
--

Segment Leq : 40.17 dBA

Total Leq All Segments: 49.14 dBA


Results segment # 1: Churchill N (night)
----------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       19.76 !        19.76

ROAD (0.00 + 40.47 + 0.00) = 40.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -66     90   0.00  60.88   0.00  -1.86  -0.62   0.00   0.00 -17.94
40.47
-------------------------------------------------------------------------------
--

Segment Leq : 40.47 dBA
Results segment # 2: Richmond 1 (night)
```

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

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       10.91 !        10.91

ROAD (0.00 + 31.23 + 0.00) = 31.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -57   0.00  60.88   0.00  -5.31  -7.37   0.00   0.00 -16.97
31.23
-------------------------------------------------------------------------------
--

Segment Leq : 31.23 dBA


Results segment # 3: Richmond 2 (night)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       10.91 !        10.91

ROAD (0.00 + 32.57 + 0.00) = 32.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    33     90   0.00  60.88   0.00  -5.31  -4.99   0.00   0.00 -18.00
32.57
-------------------------------------------------------------------------------
--

Segment Leq : 32.57 dBA

Total Leq All Segments: 41.55 dBA
```

```
TOTAL Leq FROM ALL SOURCES (DAY): 49.14
                           (NIGHT): 41.55
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-04-2020 17:12:34
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: R8.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Richmond (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Richmond (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   46.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 46.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Churchill N (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    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):  15000
    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: Churchill N (day/night)
---------------------------------------------
Angle1   Angle2           :  11.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  60.00 / 60.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  11.00 deg   Angle2 : 90.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :  46.00 / 46.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: Churchill S (day/night)
-----------------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     6 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  12000
    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: Churchill S (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   -53.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  60.00 / 60.00  m
Receiver height           :  31.50 / 31.50  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -53.00 deg
Barrier height            :  30.00 m
Barrier receiver distance :  46.00 / 46.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Richmond (day)
-----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       17.50 !        17.50

ROAD (0.00 + 45.96 + 0.00) = 45.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     46   0.00  68.48   0.00  -3.01  -1.22   0.00   0.00 -18.29
45.96
-------------------------------------------------------------------------------
--

Segment Leq : 45.96 dBA


Results segment # 2: Churchill N (day)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        8.50 !         8.50

ROAD (0.00 + 40.14 + 0.00) = 40.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    11     90   0.00  68.48   0.00  -6.02  -3.58   0.00   0.00 -18.74
40.14
-------------------------------------------------------------------------------
--

Segment Leq : 40.14 dBA
```

```
Results segment # 3: Churchill S (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        8.50 !         8.50

ROAD (0.00 + 38.14 + 0.00) = 38.14 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -53   0.00  68.69   0.00  -6.02  -6.87   0.00   0.00 -17.65
38.14
-------------------------------------------------------------------------------
--

Segment Leq : 38.14 dBA

Total Leq All Segments: 47.50 dBA


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

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !       17.50 !        17.50

ROAD (0.00 + 38.37 + 0.00) = 38.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     46   0.00  60.88   0.00  -3.01  -1.22   0.00   0.00 -18.29
38.37
-------------------------------------------------------------------------------
--

Segment Leq : 38.37 dBA
Results segment # 2: Churchill N (night)
```

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

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        8.50 !         8.50

ROAD (0.00 + 32.54 + 0.00) = 32.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    11     90   0.00  60.88   0.00  -6.02  -3.58   0.00   0.00 -18.74
32.54
-------------------------------------------------------------------------------
--

Segment Leq : 32.54 dBA


Results segment # 3: Churchill S (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       31.50 !        8.50 !         8.50

ROAD (0.00 + 30.55 + 0.00) = 30.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -53   0.00  61.09   0.00  -6.02  -6.87   0.00   0.00 -17.65
30.55
-------------------------------------------------------------------------------
--

Segment Leq : 30.55 dBA

Total Leq All Segments: 39.91 dBA
```

```
TOTAL Leq FROM ALL SOURCES (DAY): 47.50
                           (NIGHT): 39.91
```