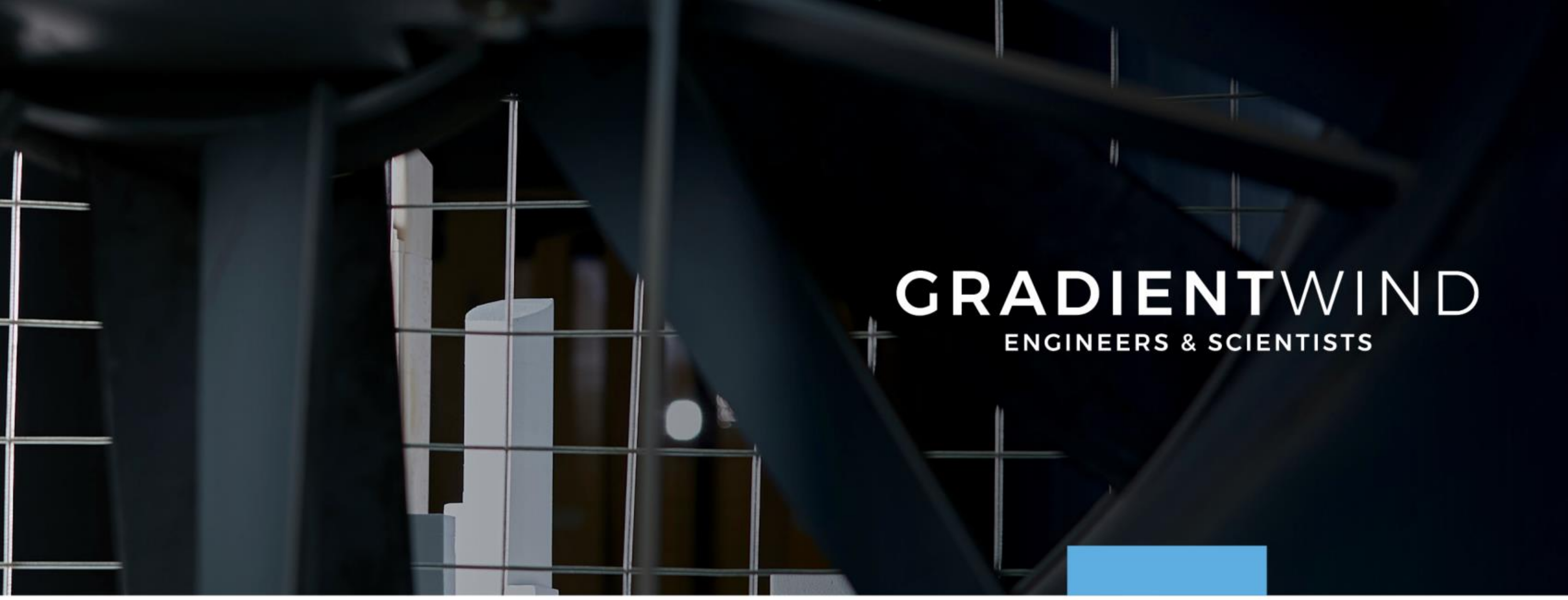
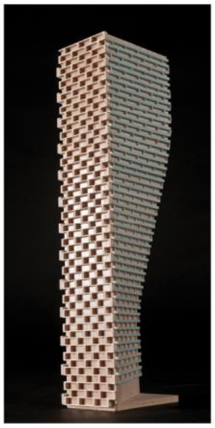


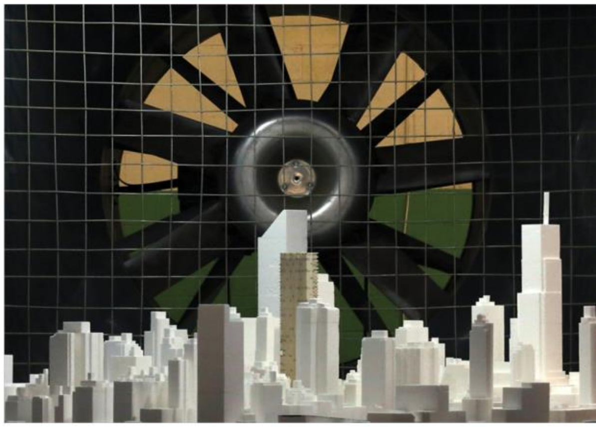
GRADIENTWIND
ENGINEERS & SCIENTISTS

TRANSPORTATION NOISE ASSESSMENT

Mackenzie Building Addition
Carleton University
Ottawa, Ontario

REPORT: GWE19-159 – Traffic Noise





September 12, 2019

PREPARED FOR
Dawn Blackman
Senior Project Manager
Carleton University
1125 Colonel By Drive
Ottawa, ON
K1S 5B6

PREPARED BY
Michael Lafortune, C.E.T., Environmental Scientist
Joshua Foster, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a traffic noise assessment for the proposed Mackenzie Building addition at the Carleton University campus in Ottawa, Ontario. The proposed development comprises a 3-storey rectangular planform Engineering Design Centre, connected to the existing Mackenzie Engineering Building at the northwest corner. The site is surrounded by low and medium-rise institutional and dormitory buildings in all directions. The major source of traffic noise is from Colonel By Drive to the west. The Trillium line LRT is located beyond 100 metres of the study site and has been deemed insignificant as per ENCG Section 2.1. 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) site plan drawings prepared by Diamond Schmitt Architects and KWC Architects Inc.

The results of the current analysis indicate that noise levels will range between 48 and 66 dBA during the daytime period (07:00-23:00) and between 41 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the west façade, which is nearest and most exposed to Colonel By Drive. 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 will also be required to be placed on all Lease, Purchase and Sale Agreements, or Development Agreements, as summarized in Section 6.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Carleton University to undertake a transportation noise assessment for the proposed Mackenzie Building addition at the Carleton University campus 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 and LRT traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on architectural drawings prepared by Diamond Schmitt Architects and KWC Architects Inc., with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this transportation noise assessment is the proposed institutional-use Mackenzie Building addition at the Carleton University Campus located at 1125 Colonel By Drive in Ottawa, Ontario. The proposed development comprises a 3-storey rectangular planform Engineering Design Centre, connected to the existing Mackenzie Engineering Building at the northwest corner. The ground floor, labelled Level 2, comprises a central atrium and bay units situated along the north perimeter of the floor. Level 3 comprises three bay units at the northwest corner, a design room at the northeast corner and breakout areas at the centre of the east and west elevations. Building support facilities occupy the remaining spaces. Level 4 comprises three bay units at the northwest corner, two design rooms at the northeast corner and breakout areas at the centre of the east and west elevations. The centre of Level 3 and 4 is open to the central atrium below, with a staircase providing access to the floors from grade.

The site is surrounded by low and medium-rise institutional and dormitory buildings in all directions. The major source of traffic noise is from Colonel By Drive to the west. The Trillium line LRT is located beyond 100 metres though has been considered as a regular source. Figure 1 illustrates a complete site plan with surrounding context.

---

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

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

3. OBJECTIVES

The principal objectives of this study are to (i) calculate the future noise levels on the study buildings produced by local roadway and LRT 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 Transportation Noise

4.2.1 Criteria for Transportation Noise

For surface transportation 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 45 dBA for library/classroom use, as listed in Table 1.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) [3]

Type of Space	Time Period	Leq (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[4]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[5]. 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 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[6].

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.

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[4] Burberry, P.B. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8
[6] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

4.2.2 Theoretical Transportation 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.

Transportation 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.
- Receptor height was taken to be 10.1 metres at Level 4 for the centre of the window (height to Level 4 floor slab + 1.5 metres) for Receptors 1-3.
- Noise receptors were strategically placed at three locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 4-6.
- The Trillium Line LRT has been modeled using 4-car SRT in STAMSON.

4.2.3 Roadway and LRT 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[7] 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. Future Trillium Line LRT volumes and speed are based on information received from the City of Ottawa for other projects. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

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

TABLE 2: ROADWAY AND LRT TRAFFIC DATA

Segment	Traffic Data	Speed Limit (km/h)	Traffic Volumes
Colonel By Drive	2-Lane Urban Arterial (2-UAU)	60	**15,000**
Trillium Line LRT	LRT	70	**192/24***

* - Daytime/nighttime period

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.

As per Section 4.2, when daytime noise levels (from road and rail 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[8] 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

[8] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985

Based on published research[9], 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, which was prepared for site plan approval, 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 Transportation Noise Levels

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

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD AND LRT TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	10.1	POW – Level 4 – North Façade	64	57
2	10.1	POW – Level 4 – East Façade	48	41
3	10.1	POW – Level 4 – West Façade	66	59

The results of the current analysis indicate that noise levels will range between 48 and 66 dBA during the daytime period (07:00-23:00) and between 41 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the west façade, which is nearest and most exposed to Colonel By Drive.

5.2 Noise Control Measures

The noise levels predicted due to roadway and LRT 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

[9] CMHC, Road & Rail Noise: Effects on Housing

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):

- **Classroom/Lobby Windows**

(i) Facing west will require a minimum STC of 25, which is generally achieved with standard double-glazed windows.

(ii) All other windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Exterior Walls**

(i) Exterior wall components on the 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[10]

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 building are constructed and installed according to the minimum standards of the Ontario Building Code.

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.

---

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

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 48 and 66 dBA during the daytime period (07:00-23:00) and between 41 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (66 dBA) occurs at the west façade, which is nearest and most exposed to Colonel By Drive. 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[11] will also be required to be placed on all Lease, Purchase and Sale Agreements, or Development Agreements, as summarized below:

> *"Tenants and building owners are advised that despite the inclusion of noise control features in the development, sound levels due to increasing roadway and LRT traffic may, on occasion, interfere with some activities of the building occupants as the sound levels exceed the sound level limits of the City and the Ministry of the Environment and Climate Change. To help address the need for sound attenuation, this development includes:*
>
> - *STC rated multi-pane glazing elements and spandrel panels*
>   - *West façade classroom/lobby: STC 25*
> - *STC rated exterior walls*
>   - *West façade: STC 45*
>
> *This development 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 and Climate Change.*
>
> *To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features."*

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

This concludes our 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,

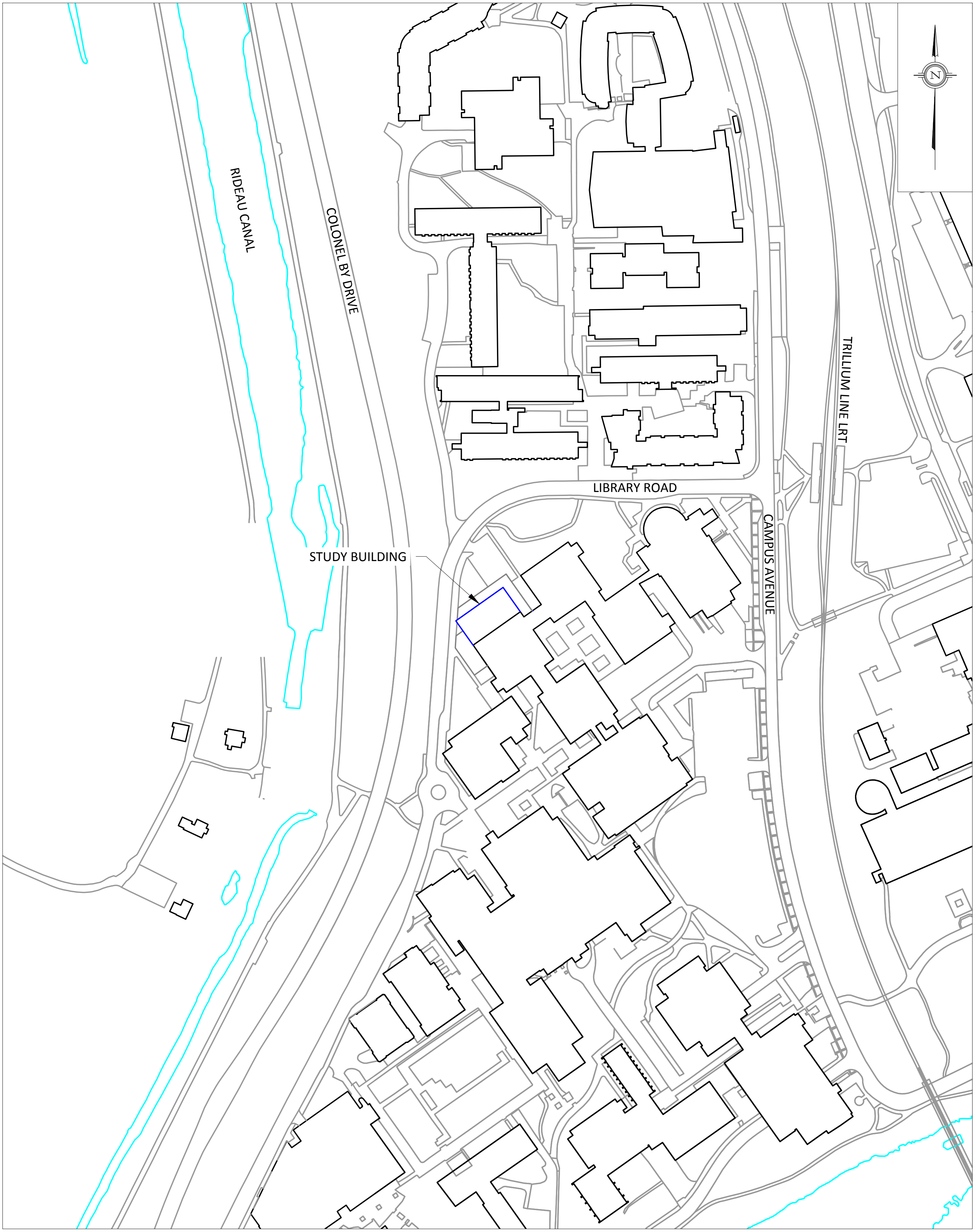
Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
Sep 12, 2019
PROVINCE OF ONTARIO

Michael Lafortune, C.E.T.
Environmental Scientist

Joshua Foster, P.Eng.
Principal

Gradient Wind File #19-159 – Traffic Nosie



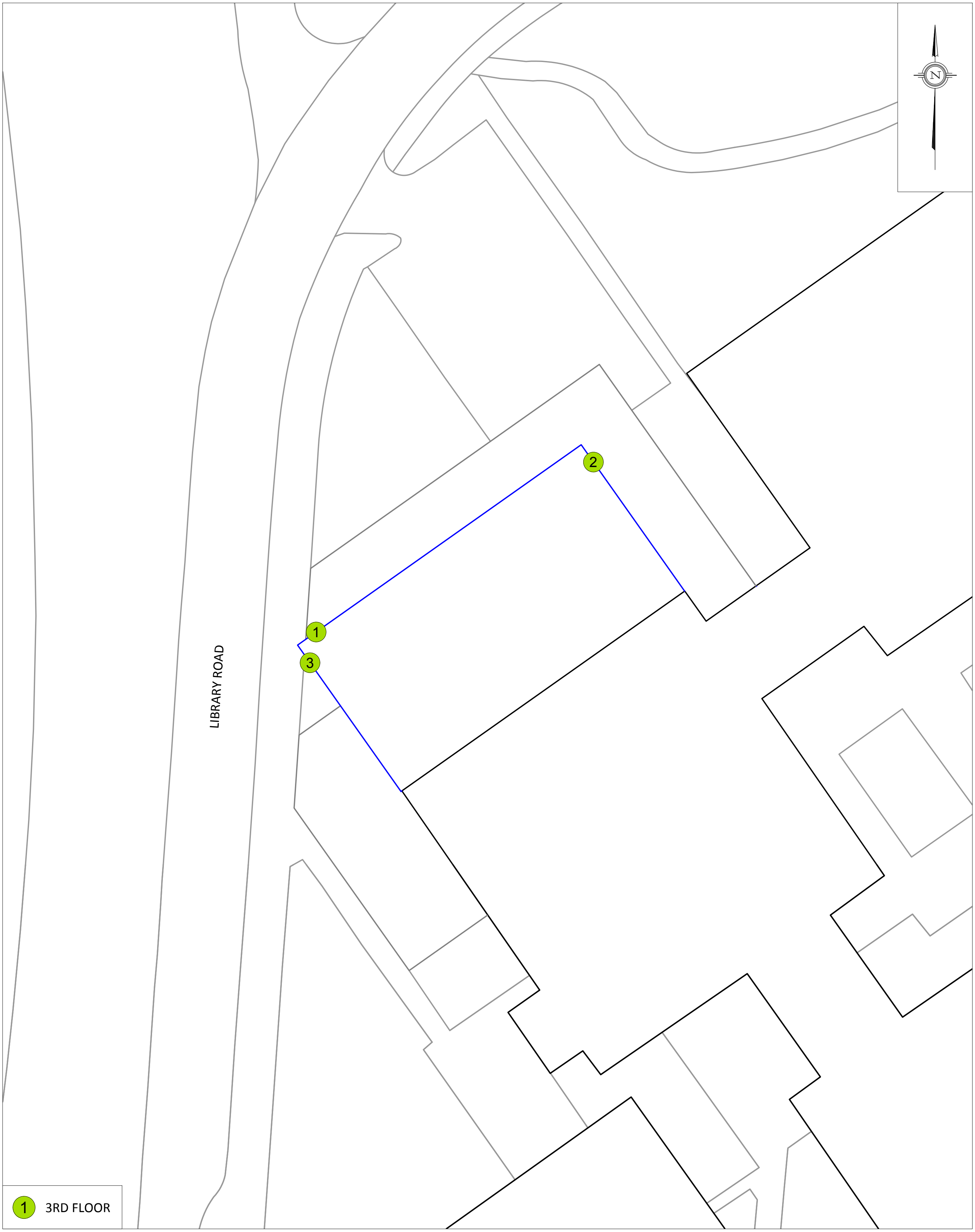
GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	MACKENZIE BUILDING ADDITION, OTTAWA TRANSPORTATION NOISE ASSESSMENT		
SCALE	1:3000 (APPROX.)	DRAWING NO.	GWE19-159-1
DATE	AUGUST 27, 2019	DRAWN BY	M.L.

DESCRIPTION

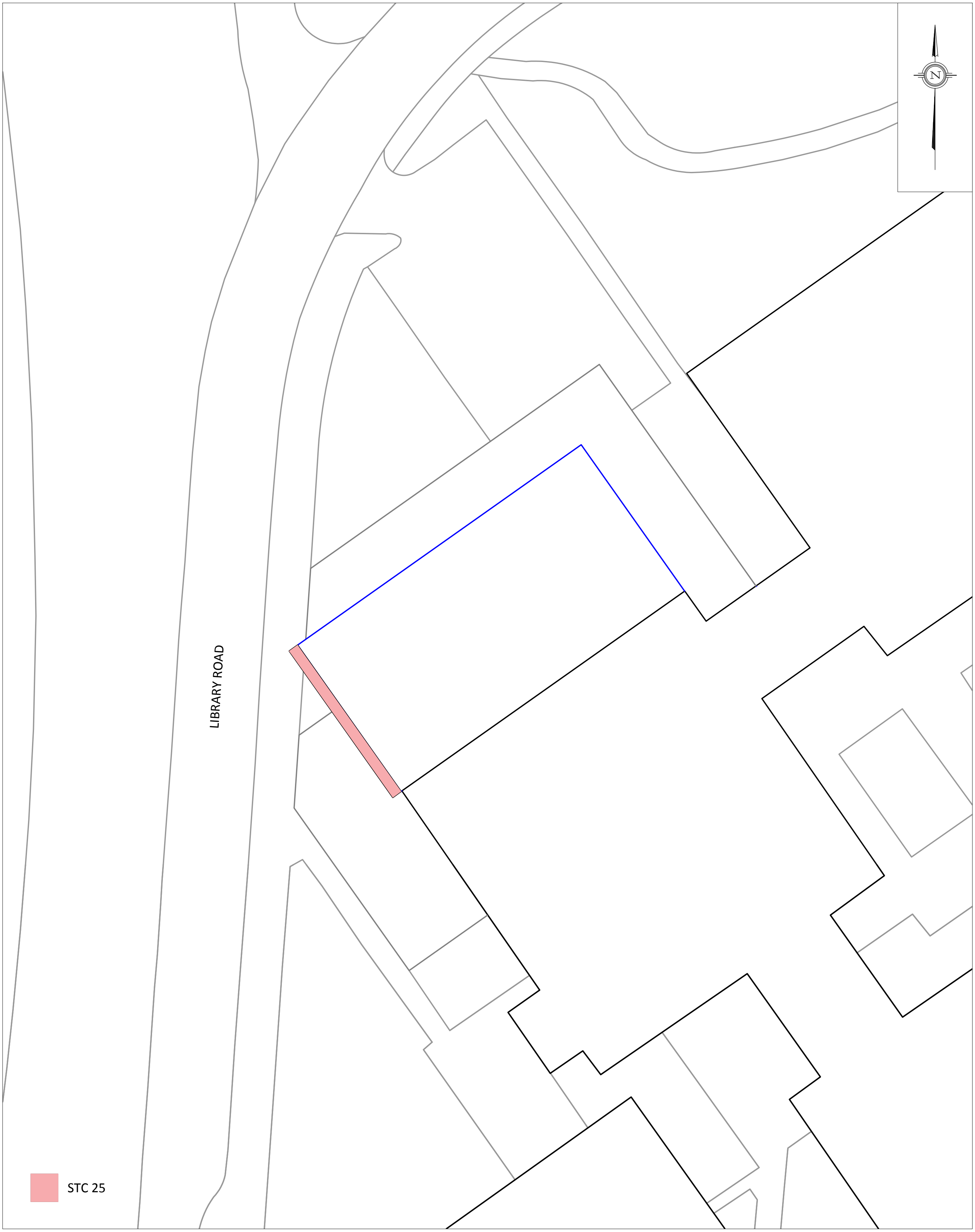
FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT: MACKENZIE BUILDING ADDITION, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION: FIGURE 2: RECEPTOR LOCATIONS
SCALE: 1:500 (APPROX.)	DRAWING NO.: GWE19-159-2	
DATE: AUGUST 27, 2019	DRAWN BY: M.L.	



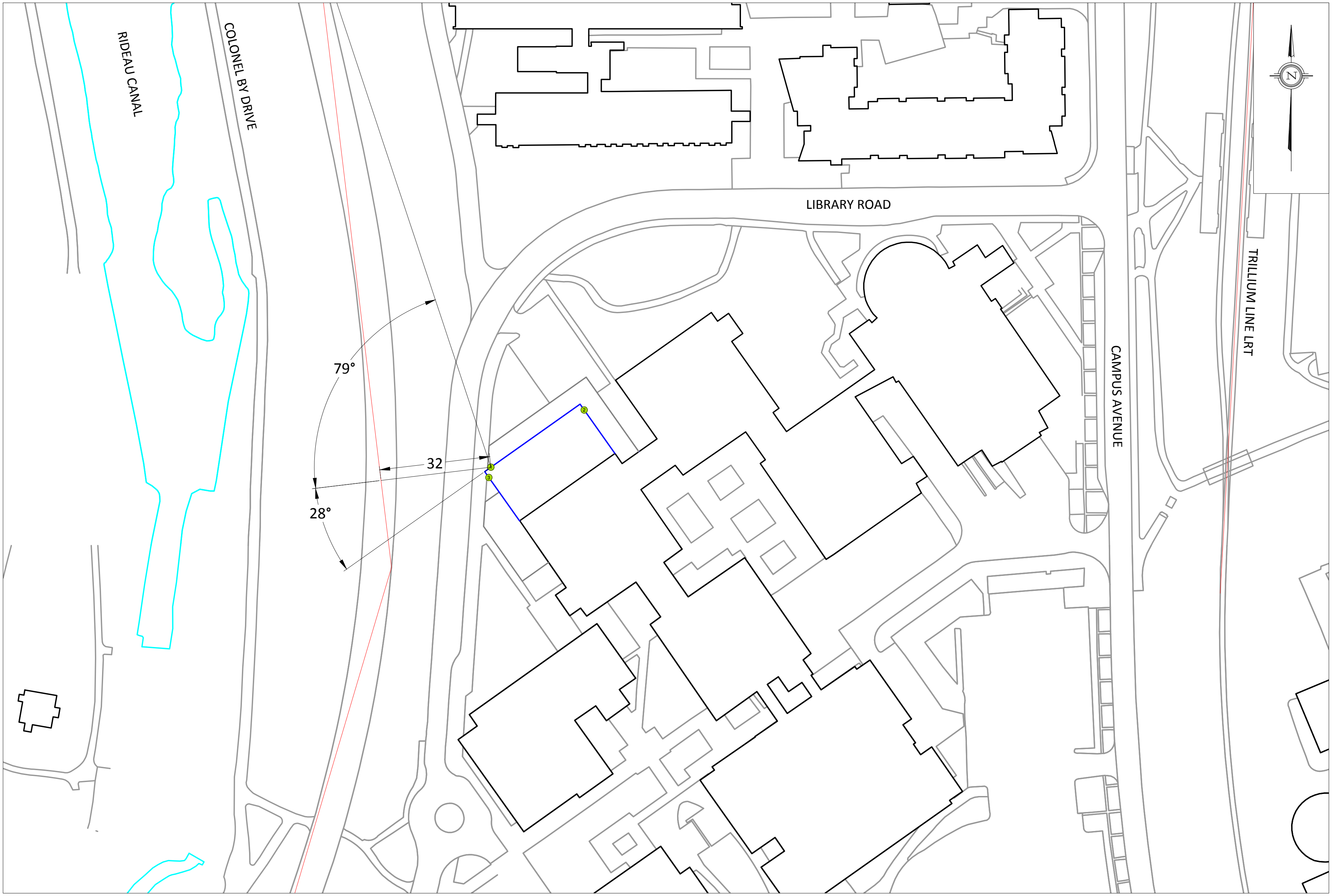
GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	MACKENZIE BUILDING ADDITION, OTTAWA TRANSPORTATION NOISE ASSESSMENT		
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE19-159-3
DATE	AUGUST 27, 2019	DRAWN BY	M.L.

DESCRIPTION

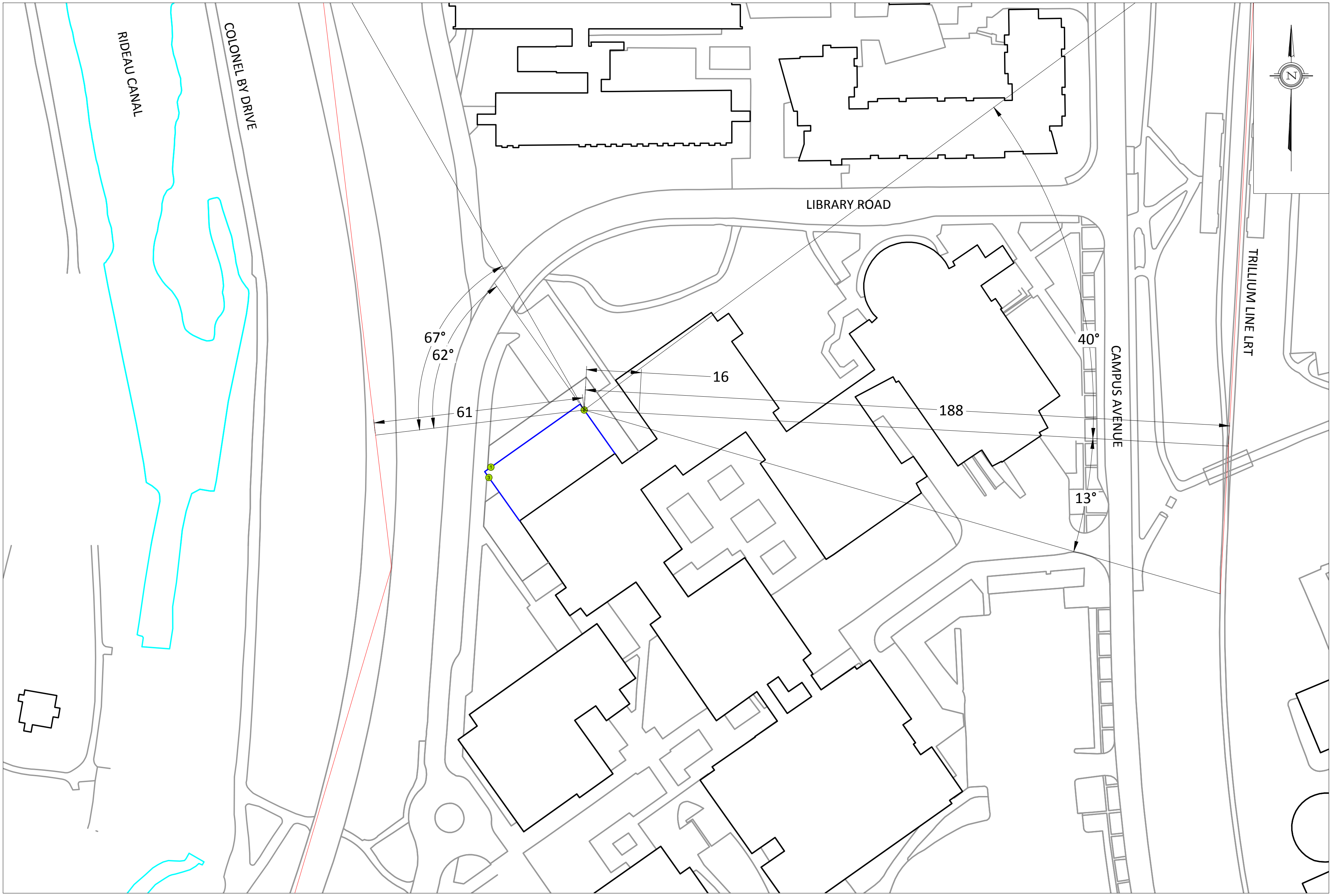
FIGURE 3:
WINDOW STC REQUIREMENTS



GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	MACKENZIE BUILDING ADDITION, OTTAWA TRANSPORTATION NOISE ASSESSMENT
SCALE	1:1500 (APPROX.)
DRAWING NO.	GWE19-159-4
DATE	AUGUST 27, 2019
DRAWN BY	M.L.
DESCRIPTION	FIGURE 4: STAMSON INPUT PARAMETERS - RECEPTOR 1



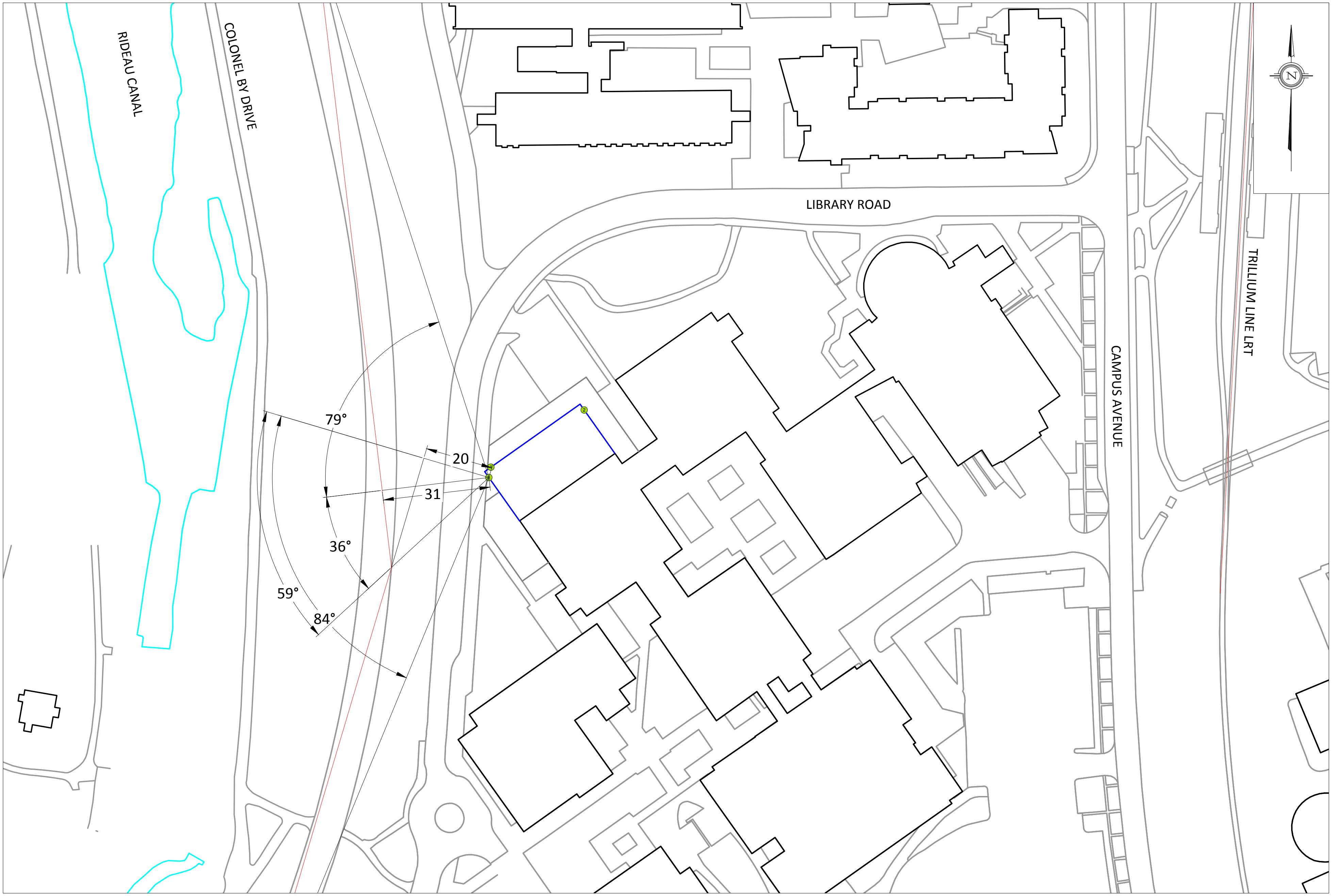
GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD , OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	MACKENZIE BUILDING ADDITION, OTTAWA TRANSPORTATION NOISE ASSESSMENT		
SCALE	1:1500 (APPROX.)	DRAWING NO.	GWE19-159-5
DATE	AUGUST 27, 2019	DRAWN BY	M.L.

DESCRIPTION

FIGURE 5:
STAMSON INPUT PARAMETERS - RECEPTOR 2

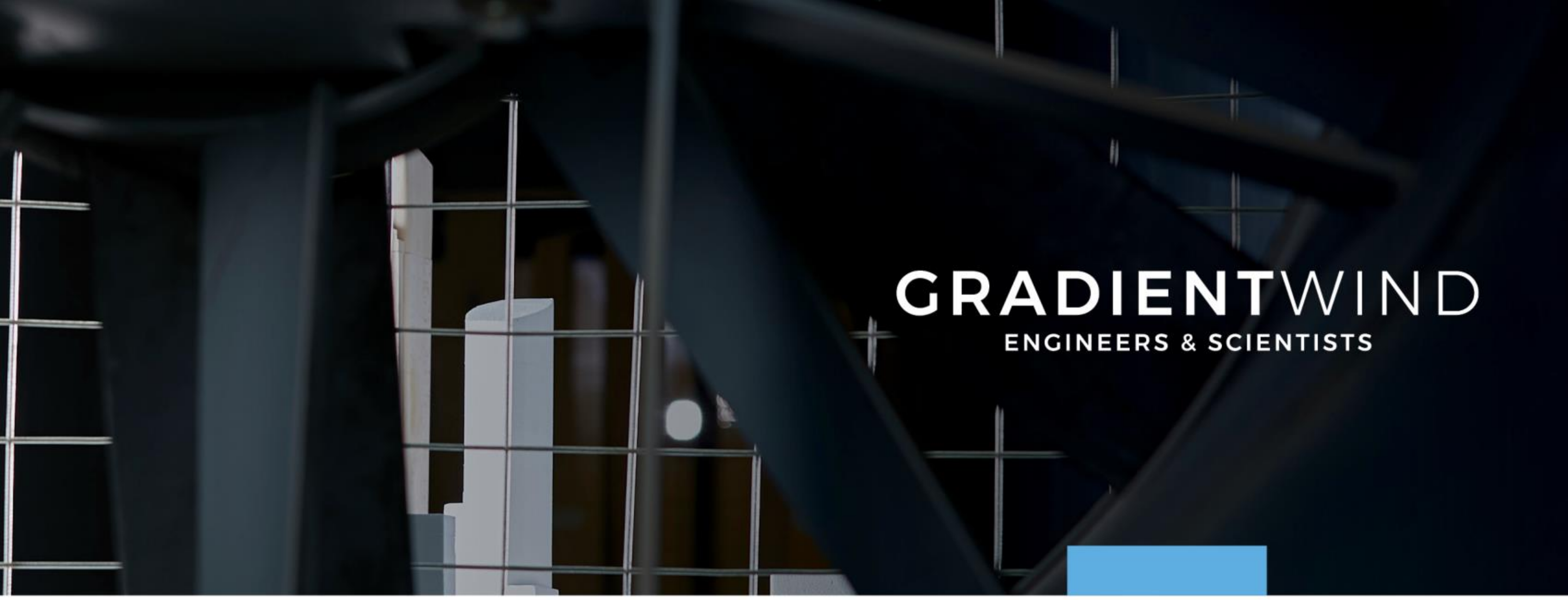


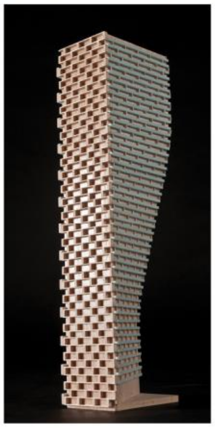
GRADIENTWIND
ENGINEERS & SCIENTISTS
127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

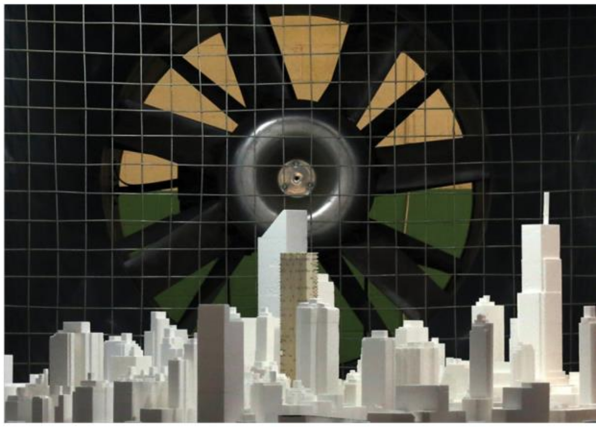
PROJECT	MACKENZIE BUILDING ADDITION, OTTAWA TRANSPORTATION NOISE ASSESSMENT		
SCALE	1:1500 (APPROX.)	DRAWING NO.	GWE19-159-6
DATE	AUGUST 27, 2019	DRAWN BY	M.L.

DESCRIPTION

FIGURE 6:
STAMSON INPUT PARAMETERS - RECEPTOR 3







APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

```
STAMSON 5.0        NORMAL REPORT        Date: 27-08-2019 11:18:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Colonel (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  :    60 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: Colonel (day/night)
-----------------------------------------
Angle1   Angle2           : -28.00 deg   79.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  32.00 / 32.00  m
Receiver height           :  10.10 / 10.10  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 64.45 + 0.00) = 64.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
   -28     79   0.00  70.00   0.00  -3.29  -2.26   0.00   0.00   0.00
64.45
------------------------------------------------------------------------
--

Segment Leq : 64.45 dBA

Total Leq All Segments: 64.45 dBA


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

Source height = 1.50 m

ROAD (0.00 + 56.85 + 0.00) = 56.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
--
   -28     79   0.00  62.40   0.00  -3.29  -2.26   0.00   0.00   0.00
56.85
------------------------------------------------------------------------
--

Segment Leq : 56.85 dBA

Total Leq All Segments: 56.85 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 64.45
                         (NIGHT): 56.85
```

```
STAMSON 5.0        NORMAL REPORT        Date: 27-08-2019 14:56:14
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Colonel (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  :    60 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: Colonel (day/night)
-----------------------------------------
Angle1   Angle2           :  62.00 deg   67.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  61.00 / 61.00  m
Receiver height           :  10.10 / 10.10  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 48.34 + 0.00) = 48.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
    62     67   0.00  70.00   0.00  -6.09 -15.56   0.00   0.00   0.00
48.34
--------------------------------------------------------------------------
--

Segment Leq : 48.34 dBA

Total Leq All Segments: 48.34 dBA


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

Source height = 1.50 m

ROAD (0.00 + 40.74 + 0.00) = 40.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
    62     67   0.00  62.40   0.00  -6.09 -15.56   0.00   0.00   0.00
40.74
--------------------------------------------------------------------------
--

Segment Leq : 40.74 dBA

Total Leq All Segments: 40.74 dBA
```

```
RT/Custom data, segment # 1: Trillium (day/night)
-------------------------------------------------
1 - 4-car SRT:
Traffic volume    :   192/24    veh/TimePeriod
Speed             :    70  km/h

Data for Segment # 1: Trillium (day/night)
------------------------------------------
Angle1   Angle2             : -40.00 deg   13.00 deg
Wood depth                  :      0       (No woods.)
No of house rows            :      0 / 0
Surface                     :      2       (Reflective ground surface)
Receiver source distance    : 188.00 / 188.00 m
Receiver height             :  10.10 / 10.10  m
Topography                  :      2       (Flat/gentle slope; with barrier)
Barrier angle1              : -40.00 deg   Angle2 : 13.00 deg
Barrier height              :  12.00 m
Barrier receiver distance   :  16.00 / 16.00  m
Source elevation            :   0.00 m
Receiver elevation          :   0.00 m
Barrier elevation           :   0.00 m
Reference angle             :   0.00
```

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

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !       10.10 !        9.28 !         9.28

RT/Custom (0.00 + 31.05 + 0.00) = 31.05 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -40     13   0.00  58.95 -10.98  -5.31   0.00   0.00 -11.61  31.05
----------------------------------------------------------------------

Segment Leq : 31.05 dBA

Total Leq All Segments: 31.05 dBA


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

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !       10.10 !        9.28 !         9.28

RT/Custom (0.00 + 25.03 + 0.00) = 25.03 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -40     13   0.00  52.93 -10.98  -5.31   0.00   0.00 -11.61  25.03
----------------------------------------------------------------------

Segment Leq : 25.03 dBA

Total Leq All Segments: 25.03 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 48.42
                         (NIGHT): 40.86
```

```
STAMSON 5.0        NORMAL REPORT        Date: 27-08-2019 11:18:50
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Colonel1 (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  :    60 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: Colonel1 (day/night)
------------------------------------------
Angle1   Angle2            : -84.00 deg   -59.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      2       (Reflective ground surface)
Receiver source distance   :  20.00 / 20.00  m
Receiver height            :  10.10 / 10.10  m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

```
Road data, segment # 2: Colonel2 (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  :    60 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: Colonel2 (day/night)
------------------------------------------
Angle1   Angle2           : -36.00 deg   79.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  31.00 / 31.00  m
Receiver height           :  10.10 / 10.10  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Colonel1 (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.17 + 0.00) = 60.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -84    -59   0.00  70.00   0.00  -1.25  -8.57   0.00   0.00   0.00
60.17
--------------------------------------------------------------------------
--

Segment Leq : 60.17 dBA


Results segment # 2: Colonel2 (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.90 + 0.00) = 64.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -36     79   0.00  70.00   0.00  -3.15  -1.95   0.00   0.00   0.00
64.90
--------------------------------------------------------------------------
--

Segment Leq : 64.90 dBA

Total Leq All Segments: 66.16 dBA
```

```
Results segment # 1: Colonel1 (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 52.58 + 0.00) = 52.58 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -84    -59   0.00  62.40   0.00  -1.25  -8.57   0.00   0.00   0.00
52.58
--------------------------------------------------------------------------
--

Segment Leq : 52.58 dBA


Results segment # 2: Colonel2 (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.30 + 0.00) = 57.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -36     79   0.00  62.40   0.00  -3.15  -1.95   0.00   0.00   0.00
57.30
--------------------------------------------------------------------------
--

Segment Leq : 57.30 dBA

Total Leq All Segments: 58.56 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 66.16
                         (NIGHT): 58.56
```