



Roadway Traffic Noise Feasibility Assessment

1040 Bank Street

Ottawa, Ontario

REPORT: GWE17-064 - Traffic Noise

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May 12, 2017

EXECUTIVE SUMMARY

This document describes a roadway traffic noise feasibility assessment performed for a proposed residential development located at 1040 Bank Street, in Ottawa, Ontario. The development comprises a 6-storey residential building and a 3-storey townhouse. Amenity space is provided as private balconies, however because these are less than 4 m in depth, they are not considered as outdoor living areas (OLA). The major source of transportation noise is Bank Street, Colonel By Drive and Queen Elizabeth Drive. 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 and Climate Change (MOECC) 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 provided by Hobin Architecture Incorporated.

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2.1 for building components on the 6-storey residential building. As per city of Ottawa requirements, the completion of detailed STC calculations will be required prior to building permit application for each unit type.

Results of the calculations also indicate that the 6-storey residential building will require central air conditioning (or similar mechanical system), which will allow occupants to keep windows closed and maintain a comfortable living environment. The townhouse will require forced air heating with provisions for central air condition (or similar mechanical system). In addition to ventilation requirements, Warning Clauses will also be required be placed on all Lease, Purchase and Sale Agreements.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Windmill Developments Group to undertake a roadway traffic noise feasibility assessment of a proposed residential development located at 1040 Bank Street in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to a roadway traffic noise feasibility assessment. GWE's scope of work involved assessing exterior noise levels generated by local roadway traffic. The assessment was performed based on theoretical noise calculation methods conforming to the City of Ottawa¹ and Ministry of the Environment and Climate Change (MOECC)² guidelines. Noise calculations were based on architectural drawings received from Hobin Architecture Incorporated, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this roadway traffic noise assessment is a proposed residential development, comprising a 6-storey residential building and a 3-storey townhouse. The site is located on the northeast corner of the Galt Street & Aylmer Avenue intersection. Surrounding the site is the Rideau Canal to the north, commercial land to the east, along Bank Street, and residential land to the south and west. Amenity space is provided as private balconies, however because these areas are less than 4 m in depth, they are not considered as outdoor living areas (OLA). The major source of transportation noise is Bank Street, Colonel By Drive and Queen Elizabeth Drive. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

The main goals of this work are to: (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) provide preliminary recommendations to 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 of this report.

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

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 vehicle traffic, 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 and 40 dBA for living rooms and sleeping quarters respectively, as listed in Table 1. To account for deficiencies in building construction, these levels should be targeted toward 42 and 37 dBA.

TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD & RAIL)³

Type of Space	Time Period	L _{eq} (dBA)	
		Road	Rail
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50	45
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	40
Sleeping quarters of hotels/motels	23:00 – 07:00	45	40
Sleeping quarters of residences , hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40	35

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 reduction⁴. 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 normally triggers the need for central air conditioning (or similar systems). Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, building components will require higher levels of sound attenuation⁵. Due to the limited information available at the time of the assessment, which was prepared for feasibility purposes, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations have not been performed at this time.

4.2.2 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 Plan⁶ 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.

³ Adapted from ENCG 2016 – Tables 2.2b and 2.2c

⁴ MOECC, Information Session for Noise Specialists – Tuesday November 19, 2013

⁵ MOECC, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

⁶ City of Ottawa Transportation Master Plan, November 2013

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway / Transit Class	Speed Limit (km/h)	Traffic Volumes
Bank Street	4-UAU	50	30,000
Colonel By Drive	2-UAU (Federal Road)	60	15,000
Queen Elizabeth Drive	2-UAU (Federal Road)	60	15,000

4.2.3 Theoretical Transportation Noise Predictions

Noise predictions were performed with the aid of the MOECC computerized noise assessment program, STAMSON 5.04, for road and rail analysis. Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise, and by using existing building locations as noise barriers. 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 was taken to be 92% / 8% respectively for all streets
- Absorptive and reflective intermediate ground surfaces based on specific source-receiver path ground characteristics
- Topography considered in height parameters

Noise receptors were strategically identified at six locations around the study area (see Figure 2).

5. RESULTS AND DISCUSSION

5.1 Roadway Traffic Noise Levels

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

TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROADWAY TRAFFIC SOURCES

Receptor Number	Plane of Window Receptor Location	Noise Level (dBA)	
		Day	Night
1	Residential Building – 6 th Floor – North Façade	67	60
2	Residential Building – 6 th Floor – North Façade	66	58
3	Residential Building – 6 th Floor – North Façade	55	48
4	Residential Building – 6 th Floor – North Façade	60	52
5	Townhouse – 3 rd Floor – West Façade	55	48
6	Townhouse – 3 rd Floor – East Façade	59	51

The results of the current analysis indicate that noise levels will range between 55 and 67 dBA during the daytime period (07:00-23:00) and between 48 and 60 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 67 dBA) occurs along the development's north facing façade, which is nearest and most exposed to Colonel By Drive and Bank Street.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2.1 for building components on the 6-storey residential building. As per city of Ottawa requirements, the completion of a detailed review of building components will be required prior to building permit application for each unit type.

Results of the calculations also indicate that the 6-storey residential building will require central air conditioning (or similar mechanical system), which will allow occupants to keep windows closed and maintain a comfortable living environment. The townhouse will require forced air heating with provisions for central air condition (or similar mechanical system). In addition to ventilation requirements, Warning Clauses will also be required be placed on all Lease, Purchase and Sale Agreements.

Noise control measures will be further refined through more detailed studies at the time of site plan approval.

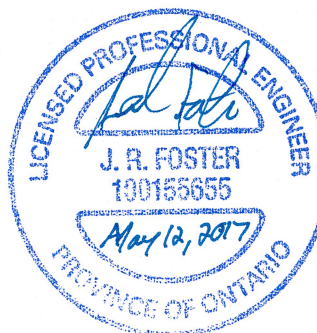
This concludes our assessment and report. If you have any questions or wish to discuss our findings please advise us. In the interim, we thank you for the opportunity to be of service.

Yours truly,

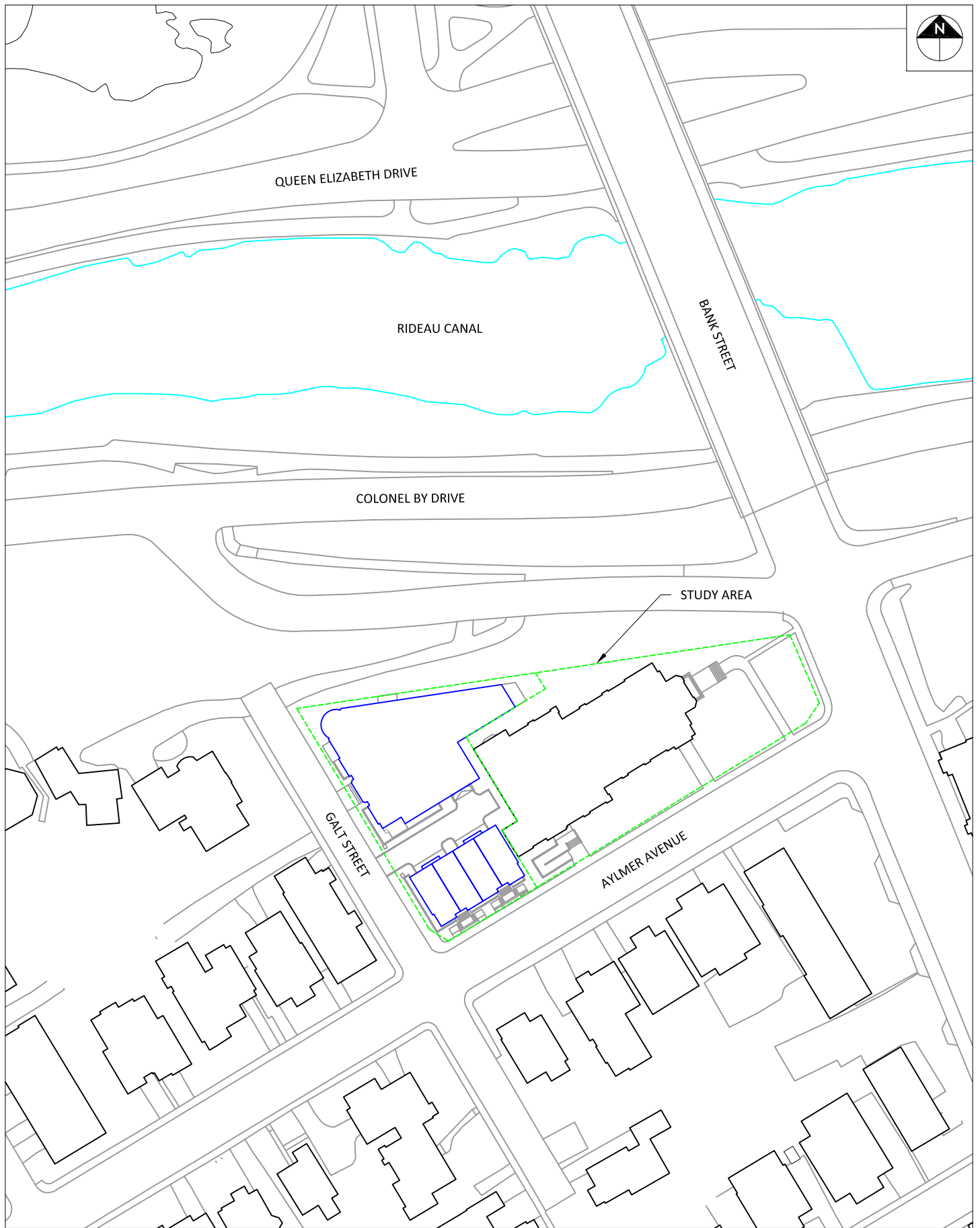
Gradient Wind Engineering Inc.

A blue ink signature of Michael Lafortune, consisting of stylized cursive letters.

Michael Lafortune
Environmental Scientist
GWE17-064 – Traffic Noise



Joshua Foster, P.Eng.
Partner



127 Walgreen Road
Ottawa, Ontario
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GRADIENT WIND
ENGINEERING INC

PROJECT

1064 BANK STREET, OTTAWA
ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT

SCALE

1:1000 (APPROX)

DATE

MAY 8, 2017

DRAWING NO.

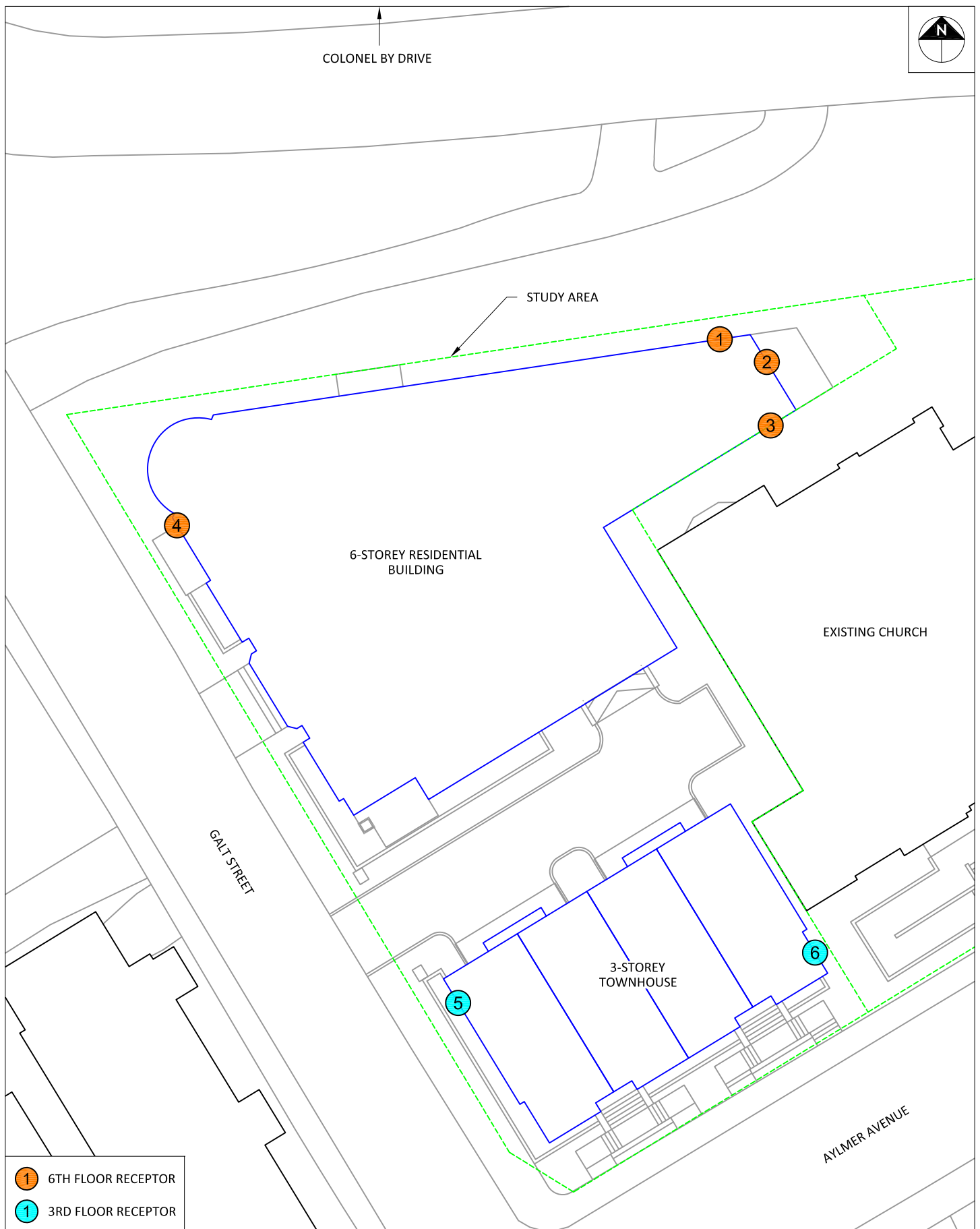
GWE17-064-1

DRAWN BY

M.L.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND
ENGINEERING INC

PROJECT	1064 BANK STREET, OTTAWA ROADWAY TRAFFIC NOISE FEASIBILITY ASSESSMENT	
SCALE	1:300 (APPROX.)	DRAWING NO. GWE17-064-2
DATE	MAY 8, 2017	DRAWN BY M.L.

DESCRIPTION

FIGURE 2:
RECEPTOR LOCATIONS

APPENDIX A

STAMSON 5.04 - INPUT AND OUTPUT DATA

STAMSON 5.0 NORMAL REPORT Date: 08-05-2017 16:08:41
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Bank (day/night)

 Car traffic volume : 24288/2112 veh/TimePeriod *
 Medium truck volume : 1932/168 veh/TimePeriod *
 Heavy truck volume : 1380/120 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): 30000
 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: Bank (day/night)

 Angle1 Angle2 : -77.00 deg 14.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 0 / 0
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 67.00 / 67.00 m
 Receiver height : 16.50 / 16.50 m
 Topography : 1 (Flat/gentle slope; no barrier)
 Reference angle : 0.00

Road data, segment # 2: 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 # 2: Colonel (day/night)

Angle1	Angle2	:	-78.00 deg	70.00 deg
Wood depth	:	0	(No woods.)	
No of house rows	:	0 / 0		
Surface	:	2	(Reflective ground surface)	
Receiver source distance	:	39.00 / 39.00	m	
Receiver height	:	1.50 / 1.50	m	
Topography	:	3	(Elevated; no barrier)	
Elevation	:	22.00	m	
Reference angle	:	0.00		

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

Angle1	Angle2	:	-48.00 deg	22.00 deg
Wood depth	:	0	(No woods.)	
No of house rows	:	0 / 0		
Surface	:	2	(Reflective ground surface)	
Receiver source distance	:	105.00 / 105.00 m		
Receiver height	:	1.50 / 1.50 m		
Topography	:	3	(Elevated; no barrier)	
Elevation	:	22.00 m		
Reference angle	:	0.00		

Results segment # 1: Bank (day)

Source height = 1.50 m

ROAD (0.00 + 62.03 + 0.00) = 62.03 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-77	14	0.00	71.49	0.00	-6.50	-2.96	0.00	0.00	0.00
62.03									

--

Segment Leq : 62.03 dBA



Results segment # 2: Colonel (day)

Source height = 1.50 m

ROAD (0.00 + 65.00 + 0.00) = 65.00 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
-78	70	0.00	70.00	0.00	-4.15	-0.85	0.00	0.00	0.00
65.00									

--

Segment Leq : 65.00 dBA

Results segment # 3: Queen (day)

Source height = 1.50 m

ROAD (0.00 + 57.44 + 0.00) = 57.44 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-48	22	0.00	70.00	0.00	-8.45	-4.10	0.00	0.00	0.00
57.44									

--

Segment Leq : 57.44 dBA

Total Leq All Segments: 67.25 dBA



Results segment # 1: Bank (night)

Source height = 1.50 m

ROAD (0.00 + 54.43 + 0.00) = 54.43 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
-77	14	0.00	63.89	0.00	-6.50	-2.96	0.00	0.00	0.00
54.43									

--

Segment Leq : 54.43 dBA



Results segment # 2: Colonel (night)

Source height = 1.50 m

ROAD (0.00 + 57.40 + 0.00) = 57.40 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
-78	70	0.00	62.40	0.00	-4.15	-0.85	0.00	0.00	0.00
57.40									

--

Segment Leq : 57.40 dBA

Results segment # 3: Queen (night)

Source height = 1.50 m

ROAD (0.00 + 49.85 + 0.00) = 49.85 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
-48	22	0.00	62.40	0.00	-8.45	-4.10	0.00	0.00	0.00
49.85									

Segment Leq : 49.85 dBA

Total Leq All Segments: 59.65 dBA

TOTAL Leq FROM ALL SOURCES (DAY) : 67.25
(NIGHT) : 59.65

STAMSON 5.0 NORMAL REPORT Date: 08-05-2017 16:08:47
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Bank (day/night)

```
-----
Car traffic volume   : 24288/2112   veh/TimePeriod  *
Medium truck volume : 1932/168    veh/TimePeriod  *
Heavy truck volume  : 1380/120    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): 30000
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: Bank (day/night)

```
-----
Angle1   Angle2           : -77.00 deg   90.00 deg
Wood depth           : 0             (No woods.)
No of house rows     : 0 / 0
Surface              : 2             (Reflective ground surface)
Receiver source distance : 65.00 / 65.00 m
Receiver height       : 16.50 / 16.50 m
Topography           : 2             (Flat/gentle slope; with barrier)
Barrier angle1        : 11.00 deg   Angle2 : 90.00 deg
Barrier height        : 14.00 m
Barrier receiver distance : 29.00 / 29.00 m
Source elevation      : 72.00 m
Receiver elevation     : 72.00 m
Barrier elevation      : 72.00 m
Reference angle       : 0.00
```

Road data, segment # 2: 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 # 2: Colonel (day/night)

Angle1	Angle2	:	-25.00 deg	70.00 deg
Wood depth	:	0	(No woods.)	
No of house rows	:	0 / 0		
Surface	:	2	(Reflective ground surface)	
Receiver source distance	:	40.00 / 40.00	m	
Receiver height	:	1.50 / 1.50	m	
Topography	:	3	(Elevated; no barrier)	
Elevation	:	22.00	m	
Reference angle	:	0.00		

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

Angle1	Angle2	:	-22.00 deg	21.00 deg
Wood depth	:	0	(No woods.)	
No of house rows	:	0 / 0		
Surface	:	2	(Reflective ground surface)	
Receiver source distance	:	107.00 / 107.00 m		
Receiver height	:	1.50 / 1.50 m		
Topography	:	3	(Elevated; no barrier)	
Elevation	:	22.00 m		
Reference angle	:	0.00		

Results segment # 1: Bank (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	16.50	9.81	81.81

ROAD (62.01 + 50.42 + 0.00) = 62.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-77	11	0.00	71.49	0.00	-6.37	-3.11	0.00	0.00	0.00
62.01									
11	90	0.00	71.49	0.00	-6.37	-3.58	0.00	0.00	-11.12
50.42									

Segment Leq : 62.31 dBA



Results segment # 2: Colonel (day)

Source height = 1.50 m

ROAD (0.00 + 62.96 + 0.00) = 62.96 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
-25	70	0.00	70.00	0.00	-4.26	-2.78	0.00	0.00	0.00
62.96									

--

Segment Leq : 62.96 dBA

Results segment # 3: Queen (day)

Source height = 1.50 m

ROAD (0.00 + 55.25 + 0.00) = 55.25 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-22	21	0.00	70.00	0.00	-8.53	-6.22	0.00	0.00	0.00
55.25									

--

Segment Leq : 55.25 dBA

Total Leq All Segments: 66.04 dBA

Results segment # 1: Bank (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	16.50	9.81	81.81

ROAD (54.42 + 42.83 + 0.00) = 54.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-77	11	0.00	63.89	0.00	-6.37	-3.11	0.00	0.00	0.00

SubLeq

54.42

42.83

Segment Leq : 54.71 dBA

Results segment # 2: Colonel (night)

Source height = 1.50 m

ROAD (0.00 + 55.36 + 0.00) = 55.36 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-25	70	0.00	62.40	0.00	-4.26	-2.78	0.00	0.00	0.00
55.36									

--

Segment Leq : 55.36 dBA

Results segment # 3: Queen (night)

Source height = 1.50 m

ROAD (0.00 + 47.65 + 0.00) = 47.65 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-22	21	0.00	62.40	0.00	-8.53	-6.22	0.00	0.00	0.00
47.65									

--

Segment Leq : 47.65 dBA

Total Leq All Segments: 58.44 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.04
(NIGHT): 58.44

STAMSON 5.0 NORMAL REPORT Date: 08-05-2017 16:08:53
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Bank (day/night)

```
-----
Car traffic volume   : 24288/2112   veh/TimePeriod  *
Medium truck volume :  1932/168    veh/TimePeriod  *
Heavy truck volume  :  1380/120    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): 30000
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: Bank (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 : 66.00 / 66.00 m
Receiver height     : 16.50 / 16.50 m
Topography          :    2         (Flat/gentle slope; with barrier)
Barrier angle1      :    4.00 deg   Angle2 : 90.00 deg
Barrier height      : 14.00 m
Barrier receiver distance : 30.00 / 30.00 m
Source elevation    : 72.00 m
Receiver elevation   : 72.00 m
Barrier elevation    : 72.00 m
Reference angle     :    0.00
```

Results segment # 1: Bank (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	16.50	9.68	81.68

ROAD (53.64 + 50.40 + 0.00) = 55.33 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-9	4	0.00	71.49	0.00	-6.43	-11.41	0.00	0.00	0.00
53.64									
4	90	0.00	71.49	0.00	-6.43	-3.21	0.00	0.00	-11.45
50.40									

SubLeq

Segment Leq : 55.33 dBA

Total Leq All Segments: 55.33 dBA

Results segment # 1: Bank (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	16.50	9.68	81.68

ROAD (46.05 + 42.80 + 0.00) = 47.73 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-9	4	0.00	63.89	0.00	-6.43	-11.41	0.00	0.00	0.00

SubLeq

46.05

42.80

Segment Leq : 47.73 dBA

Total Leq All Segments: 47.73 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 55.33
(NIGHT): 47.73

STAMSON 5.0 NORMAL REPORT Date: 08-05-2017 16:09:01
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.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 : -74.00 deg -25.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 0 / 0
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 46.00 / 46.00 m
 Receiver height : 1.50 / 1.50 m
 Topography : 3 (Elevated; no barrier)
 Elevation : 22.00 m
 Reference angle : 0.00

Road data, segment # 2: Queen (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: Queen (day/night)

Angle1	Angle2	:	-37.00 deg	-22.00 deg
Wood depth	:	0	(No woods.)	
No of house rows	:	0 / 0		
Surface	:	2	(Reflective ground surface)	
Receiver source distance	:	111.00 / 111.00 m		
Receiver height	:	1.50 / 1.50 m		
Topography	:	3	(Elevated; no barrier)	
Elevation	:	22.00 m		
Reference angle	:	0.00		



Results segment # 1: Colonel (day)

Source height = 1.50 m

ROAD (0.00 + 59.48 + 0.00) = 59.48 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
-74	-25	0.00	70.00	0.00	-4.87	-5.65	0.00	0.00	0.00
59.48									

--

Segment Leq : 59.48 dBA

Results segment # 2: Queen (day)

Source height = 1.50 m

ROAD (0.00 + 50.51 + 0.00) = 50.51 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-37	-22	0.00	70.00	0.00	-8.69	-10.79	0.00	0.00	0.00
50.51									

--

Segment Leq : 50.51 dBA

Total Leq All Segments: 60.00 dBA



Results segment # 1: Colonel (night)

Source height = 1.50 m

ROAD (0.00 + 51.88 + 0.00) = 51.88 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
	-74	-25	0.00	62.40	0.00	-4.87	-5.65	0.00	0.00
	51.88								

--

Segment Leq : 51.88 dBA

Results segment # 2: Queen (night)

Source height = 1.50 m

ROAD (0.00 + 42.92 + 0.00) = 42.92 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-37	-22	0.00	62.40	0.00	-8.69	-10.79	0.00	0.00	0.00
42.92									

--

Segment Leq : 42.92 dBA

Total Leq All Segments: 52.40 dBA

TOTAL Leq FROM ALL SOURCES (DAY) : 60.00
(NIGHT) : 52.40

STAMSON 5.0 NORMAL REPORT Date: 08-05-2017 16:09:06
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.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           : -66.00 deg   -25.00 deg
Wood depth           :      0           (No woods.)
No of house rows     :      0 / 0
Surface              :      2           (Reflective ground surface)
Receiver source distance : 76.00 / 76.00 m
Receiver height       :  7.50 / 7.50 m
Topography           :      2           (Flat/gentle slope; with barrier)
Barrier angle1        : -66.00 deg   Angle2 : -50.00 deg
Barrier height        : 12.00 m
Barrier receiver distance : 30.00 / 30.00 m
Source elevation      : 65.00 m
Receiver elevation    : 72.00 m
Barrier elevation     : 72.00 m
Reference angle       :    0.00
```

Road data, segment # 2: Queen (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: Queen (day/night)

Angle1	Angle2	:	-33.00 deg	-22.00 deg
Wood depth	:	0	(No woods.)	
No of house rows	:	0 / 0		
Surface	:	2	(Reflective ground surface)	
Receiver source distance	:	141.00 / 141.00 m		
Receiver height	:	1.50 / 1.50 m		
Topography	:	3	(Elevated; no barrier)	
Elevation	:	13.00 m		
Reference angle	:	0.00		

Results segment # 1: Colonel (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	7.50	2.37	74.37

ROAD (0.00 + 33.76 + 54.38) = 54.41 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-66	-50	0.00	70.00	0.00	-7.05	-10.51	0.00	0.00	-18.67
33.76									
-50	-25	0.00	70.00	0.00	-7.05	-8.57	0.00	0.00	0.00
54.38									

SubLeq

Segment Leq : 54.41 dBA



Results segment # 2: Queen (day)

Source height = 1.50 m

ROAD (0.00 + 48.13 + 0.00) = 48.13 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
	-33	-22	0.00	70.00	0.00	-9.73	-12.14	0.00	0.00
	48.13								

--

Segment Leq : 48.13 dBA

Total Leq All Segments: 55.33 dBA

Results segment # 1: Colonel (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	7.50	2.37	74.37

ROAD (0.00 + 26.17 + 46.78) = 46.82 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-66	-50	0.00	62.40	0.00	-7.05	-10.51	0.00	0.00	-18.67
26.17									
-50	-25	0.00	62.40	0.00	-7.05	-8.57	0.00	0.00	0.00
46.78									

SubLeq

Segment Leq : 46.82 dBA

Results segment # 2: Queen (night)

Source height = 1.50 m

ROAD (0.00 + 40.53 + 0.00) = 40.53 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--

-33	-22	0.00	62.40	0.00	-9.73	-12.14	0.00	0.00	0.00
40.53									

--

Segment Leq : 40.53 dBA

Total Leq All Segments: 47.74 dBA

TOTAL Leq FROM ALL SOURCES (DAY) : 55.33
(NIGHT) : 47.74

STAMSON 5.0 NORMAL REPORT Date: 08-05-2017 16:09:12
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: BankL (day/night)

```
-----
Car traffic volume   : 24288/2112   veh/TimePeriod  *
Medium truck volume : 1932/168    veh/TimePeriod  *
Heavy truck volume  : 1380/120    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): 30000
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: BankL (day/night)

```
-----
Angle1   Angle2           : -90.00 deg   18.00 deg
Wood depth           : 0               (No woods.)
No of house rows     : 0 / 0
Surface              : 2               (Reflective ground surface)
Receiver source distance : 75.00 / 75.00 m
Receiver height       : 7.50 / 7.50 m
Topography           : 2               (Flat/gentle slope; with barrier)
Barrier angle1        : -90.00 deg   Angle2 : -15.00 deg
Barrier height        : 14.00 m
Barrier receiver distance : 41.00 / 41.00 m
Source elevation      : 72.00 m
Receiver elevation     : 72.00 m
Barrier elevation      : 72.00 m
Reference angle       : 0.00
```

Road data, segment # 2: BankR (day/night)

Car traffic volume	:	24288/2112	veh/TimePeriod	*
Medium truck volume	:	1932/168	veh/TimePeriod	*
Heavy truck volume	:	1380/120	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):	30000
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: BankR (day/night)

Angle1	Angle2	:	18.00 deg	90.00 deg
Wood depth	:	0	(No woods.)	
No of house rows	:	0 / 0		
Surface	:	2	(Reflective ground surface)	
Receiver source distance	:	75.00 / 75.00	m	
Receiver height	:	7.50 / 7.50	m	
Topography	:	2	(Flat/gentle slope; with barrier)	
Barrier angle1	:	18.00 deg	Angle2 :	90.00 deg
Barrier height	:	5.00 m		
Barrier receiver distance	:	49.00 / 49.00	m	
Source elevation	:	72.00 m		
Receiver elevation	:	72.00 m		
Barrier elevation	:	72.00 m		
Reference angle	:	0.00		

Results segment # 1: BankL (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	7.50	4.22	76.22

ROAD (0.00 + 44.74 + 57.13) = 57.38 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	-15	0.00	71.49	0.00	-6.99	-3.80	0.00	0.00	-15.96
-15	18	0.00	71.49	0.00	-6.99	-7.37	0.00	0.00	0.00

SubLeq

44.74

57.13

Segment Leq : 57.38 dBA

Results segment # 2: BankR (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	7.50	3.58	75.58

ROAD (0.00 + 54.11 + 0.00) = 54.11 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
18	90	0.00	71.49	0.00	-6.99	-3.98	0.00	0.00	-6.41

SubLeq

54.11

Segment Leq : 54.11 dBA

Total Leq All Segments: 59.06 dBA

Results segment # 1: BankL (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	7.50	4.22	76.22

ROAD (0.00 + 37.14 + 49.54) = 49.78 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	-15	0.00	63.89	0.00	-6.99	-3.80	0.00	0.00	-15.96
37.14									
-15	18	0.00	63.89	0.00	-6.99	-7.37	0.00	0.00	0.00
49.54									

Segment Leq : 49.78 dBA

Results segment # 2: BankR (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	7.50	3.58	75.58

ROAD (0.00 + 46.51 + 0.00) = 46.51 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
18	90	0.00	63.89	0.00	-6.99	-3.98	0.00	0.00	-6.41

SubLeq

Segment Leq : 46.51 dBA

Total Leq All Segments: 51.46 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.06
(NIGHT): 51.46