



## **Roadway Traffic Noise Feasibility Assessment**

**99 Fifth Avenue**

**Ottawa, Ontario**

REPORT: GWE17-148 – Traffic Noise

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## EXECUTIVE SUMMARY

This document describes a roadway traffic noise feasibility assessment performed for a proposed mixed-use development located at 99 Fifth Avenue, in Ottawa, Ontario. The development comprises an eight-storey building connected by an enclosed atrium to a row of existing heritage buildings oriented along Bank Street. Outdoor amenity space is located on the rooftop and at grade on the west side of the building. Balconies less than 4 m in depth are not considered as outdoor living areas, as per the ENCG. The major sources of transportation noise impacting the development are roadway traffic from Bank Street and Fifth Avenue. 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 received from Minto Communities.

The results of the current analysis indicate that noise levels will range between 51 and 68 dBA during the daytime period (07:00-23:00) and between 43 and 60 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 68 dBA) occur along the development's west façade, which is nearest and most exposed to Bank Street and Fifth Avenue. Noise levels predicted due to roadway traffic sources exceed the criteria listed in Section 4.2 for building components. Therefore, upgraded building components will be required where noise levels exceed 65 dBA. As per City of Ottawa requirements, detailed Sound Transmission Class (STC) calculations will be required to be completed prior to site plan control.

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 upgraded building components and ventilation requirements, warning clauses are likely to be required. A detailed roadway traffic noise assessment will be required at the time of site plan approval to determine specific noise control measures for the development.

Noise levels at the rooftop floor terrace and ground level terrace were found to approach 51 dBA during the daytime period, which is below the ENCG criteria; therefore, no mitigation is required.

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## 1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Minto Communities – Canada to undertake a roadway traffic noise feasibility assessment of a proposed mixed-use development located at 99 Fifth Avenue 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 on the basis of theoretical noise calculation methods conforming to the City of Ottawa<sup>1</sup> and Ministry of the Environment and Climate Change (MOECC)<sup>2</sup> guidelines. Noise calculations were based on architectural drawings received from Minto Communities, 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 feasibility assessment is a proposed mixed-use development to be located at 99 Fifth Avenue in Ottawa, Ontario. The development is located on a parcel of land bounded by Fifth Avenue to the south, Bank Street to the west, Fourth Avenue to the north, and existing residential developments to the east. The site is surrounded by commercial buildings to the west along Bank Street, and mainly residential areas to the east and south. The major sources of transportation noise impacting the development are roadway traffic from Bank Street and Fifth Avenue. Figure 1 illustrates a complete site plan with surrounding context.

The proposed development comprises an eight-storey building connected by an enclosed atrium to a row of existing heritage buildings oriented along Bank Street. Two-storey townhouse units connected to the main building are oriented along both Fourth Avenue and Fifth Avenue. The development includes amenity space in the form of balconies, a rooftop outdoor amenity area and ground level amenity space west of the building. Balconies less than 4 m in depth are not considered as outdoor living areas, as per the ENCG.

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<sup>1</sup> City of Ottawa Environmental Noise Control Guidelines, January 2016

<sup>2</sup> Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

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### 3. OBJECTIVES

The principal objectives of this work are to: (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) explore potential for noise mitigation where required based on the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4 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 ( $2 \times 10^{-5}$  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 impacts on buildings. Table 1 below describes the applicable indoor noise level limits for roadway sources, as specified in the City of Ottawa's ENCG.

**TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD) <sup>3</sup>**

Type of Space	Time Period	L <sub>eq</sub> (dBA)
		Road
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 indoor 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<sup>4</sup>. 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. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, building components will require higher levels of sound attenuation<sup>5</sup>.

The sound level criterion for outdoor living areas is 55 dBA, which applies during the daytime period (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.

#### **4.2.1 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<sup>6</sup> which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes

<sup>3</sup> Adapted from ENCG 2016 – Part 1, Table 2.2c

<sup>4</sup> Burberry, P.B.. (2014). Mitchell's Environment and Services. Routledge, Page 125

<sup>5</sup> MOECC, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3

<sup>6</sup> City of Ottawa Transportation Master Plan, November 2013

*Minto Communities – Canada*

are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 summarizes the AADT values used for each roadway included in this assessment.

**TABLE 2: ROADWAY TRAFFIC DATA**

Segment	Roadway / Transit Class	Speed Limit (km/h)	Traffic Volumes
Bank Street	4-UAU	40	<b>30,000</b>
Fifth Avenue	2-UCU	40	<b>8,000</b>

#### **4.2.2 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 on-site 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
- Reflective ground surface for pavements and roads from source-to-receiver
- Topography considered to be flat or gently sloping
- Existing heritage buildings on-site included in the analysis as a noise barrier with a height of approximately 8 metres
- Noise receptors were strategically identified at six (6) locations around the study area (see Figure 1)

## 5. RESULTS AND DISCUSSION

### 5.1 Roadway Traffic Noise Levels

The results of the roadway traffic 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 ROADWAY TRAFFIC SOURCES**

Receptor Number	Plane of Window Receptor Location	Noise Level (dBA)	
		Day	Night
1	8 <sup>th</sup> Floor – South Façade	67	59
2	8 <sup>th</sup> Floor – East Façade	60	52
3	8 <sup>th</sup> Floor – North Façade	64	56
4	8 <sup>th</sup> Floor – West Façade	68	60
5	Rooftop OLA	51	43
6	Ground Level OLA	51	43

## 6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 51 and 68 dBA during the daytime period (07:00-23:00) and between 43 and 60 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 68 dBA) occur along the development's west façade, which is nearest and most exposed to Bank Street and Fifth Avenue. Noise levels predicted due to roadway traffic sources exceed the criteria listed in Section 4.2 for building components. Therefore, upgraded building components will be required where noise levels exceed 65 dBA. As per City of Ottawa requirements, detailed Sound Transmission Class (STC) calculations will be required to be completed prior to site plan control.

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 upgraded building components and ventilation requirements, warning clauses are likely to be required. A detailed roadway traffic noise assessment will be required at the time of site plan approval to determine specific noise control measures for the development.



Noise levels at the rooftop floor terrace and ground level terrace were found to approach 51 dBA, during the daytime period, which is below the ENCG criteria; therefore, no mitigation would be required.

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,

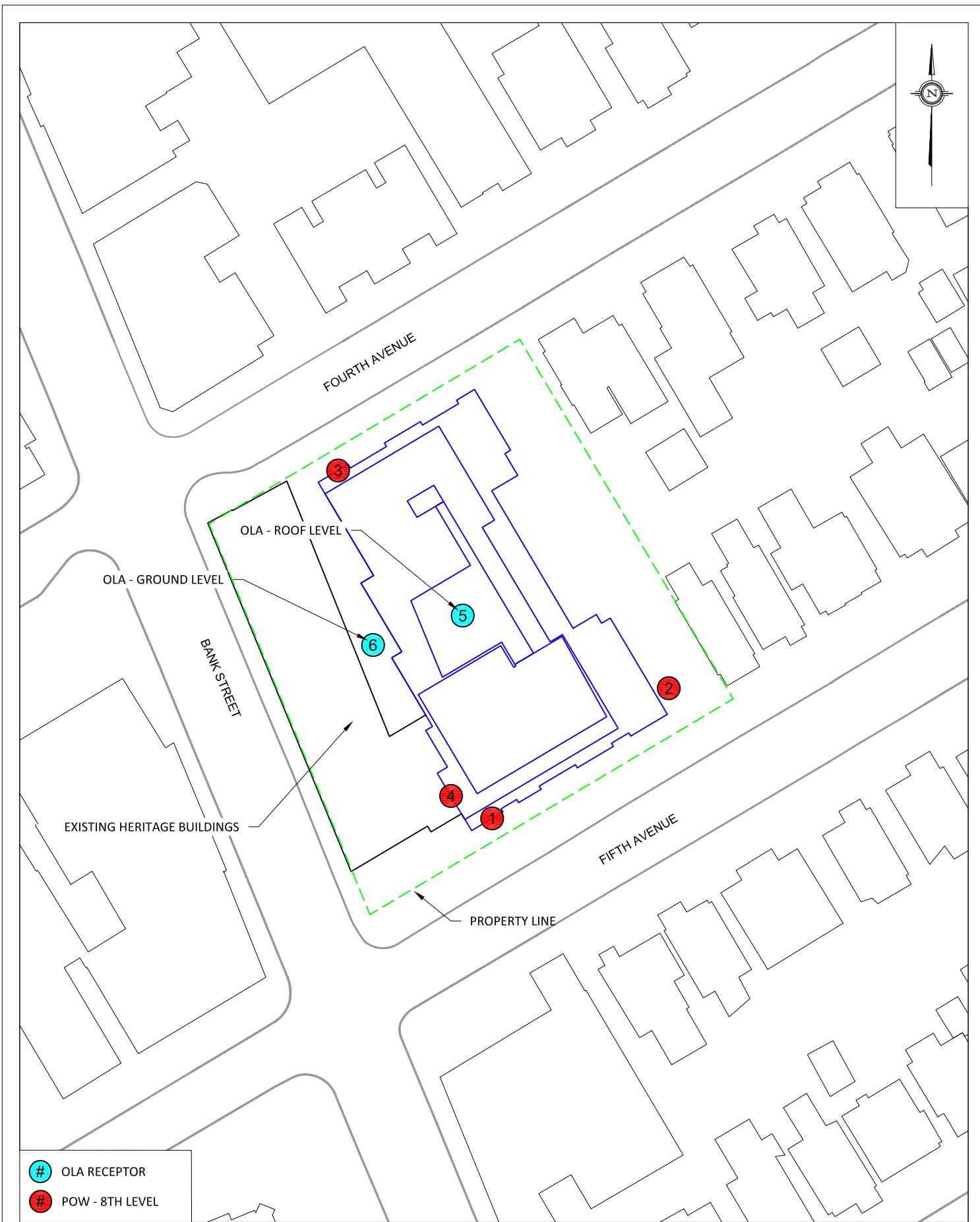
**Gradient Wind Engineering Inc.**




Omar Daher  
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GWE17-148 – Traffic Noise



Joshua Foster, P.Eng.  
Principal



- # OLA RECEPTOR
- # POW - 8TH LEVEL

	PROJECT <b>99 FIFTH AVENUE - TRAFFIC NOISE FEASIBILITY ASSESSMENT</b>	DESCRIPTION <b>FIGURE 1: SITE PLAN, SURROUNDING CONTEXT AND RECEPTOR LOCATIONS</b>
	SCALE <b>1:750 (APPROX.)</b>	DRAWING NO. <b>GWE17-148-1</b>
	DATE <b>NOVEMBER 17, 2017</b>	DRAWN BY <b>O.D.</b>

**APPENDIX A**

**STAMSON 5.04 - INPUT AND OUTPUT DATA**



STAMSON 5.0                      NORMAL REPORT                      Date: 16-11-2017 14:59:45  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

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

-----  
Car traffic volume    :    6477/563    veh/TimePeriod    \*  
Medium truck volume :     515/45     veh/TimePeriod    \*  
Heavy truck volume  :     368/32     veh/TimePeriod    \*  
Posted speed limit  :     40 km/h  
Road gradient        :       0 %  
Road pavement       :       1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT):    8000  
Percentage of Annual Growth            :    0.00  
Number of Years of Growth               :    0.00  
Medium Truck % of Total Volume         :    7.00  
Heavy Truck % of Total Volume          :    5.00  
Day (16 hrs) % of Total Volume         :  92.00

Data for Segment # 1: Fifth Avenue (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                     :  23.25 / 23.25 m  
Topography                         :       1        (Flat/gentle slope; no barrier)  
Reference angle                     :       0.00

Road data, segment # 2: Bank Street (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  :    40 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: Bank Street (day/night)

```

-----
Angle1  Angle2      : -90.00 deg  0.00 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    : 23.25 / 23.25 m
Topography         : 1 (Flat/gentle slope; no barrier)
Reference angle    : 0.00
  
```



Results segment # 1: Fifth Avenue (day)

Source height = 1.50 m

ROAD (0.00 + 63.96 + 0.00) = 63.96 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	63.96	0.00	0.00	0.00	0.00	0.00	0.00	63.96

Segment Leq : 63.96 dBA

Results segment # 2: Bank Street (day)

Source height = 1.50 m

ROAD (0.00 + 63.40 + 0.00) = 63.40 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.00	69.70	0.00	-3.29	-3.01	0.00	0.00	0.00	63.40

Segment Leq : 63.40 dBA

Total Leq All Segments: 66.70 dBA



Results segment # 1: Fifth Avenue (night)

Source height = 1.50 m

ROAD (0.00 + 56.36 + 0.00) = 56.36 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	56.36	0.00	0.00	0.00	0.00	0.00	0.00	56.36

Segment Leq : 56.36 dBA

Results segment # 2: Bank Street (night)

Source height = 1.50 m

ROAD (0.00 + 55.80 + 0.00) = 55.80 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.00	62.10	0.00	-3.29	-3.01	0.00	0.00	0.00	55.80

Segment Leq : 55.80 dBA

Total Leq All Segments: 59.10 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.70  
(NIGHT): 59.10



STAMSON 5.0                      NORMAL REPORT                      Date: 16-11-2017 14:59:57  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

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

-----  
Car traffic volume    : 6477/563    veh/TimePeriod    \*  
Medium truck volume : 515/45     veh/TimePeriod    \*  
Heavy truck volume  : 368/32     veh/TimePeriod    \*  
Posted speed limit  : 40 km/h  
Road gradient        : 0 %  
Road pavement       : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 8000  
Percentage of Annual Growth        : 0.00  
Number of Years of Growth         : 0.00  
Medium Truck % of Total Volume    : 7.00  
Heavy Truck % of Total Volume     : 5.00  
Day (16 hrs) % of Total Volume    : 92.00

Data for Segment # 1: Fifth Avenue (day/night)

-----  
Angle1    Angle2                    : -90.00 deg    0.00 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                : 23.25 / 23.25 m  
Topography                    : 1              (Flat/gentle slope; no barrier)  
Reference angle                : 0.00





Results segment # 1: Fifth Avenue (day)

Source height = 1.50 m

ROAD (0.00 + 59.70 + 0.00) = 59.70 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.00	63.96	0.00	-1.25	-3.01	0.00	0.00	0.00	59.70

Segment Leq : 59.70 dBA

Total Leq All Segments: 59.70 dBA

Results segment # 1: Fifth Avenue (night)

Source height = 1.50 m

ROAD (0.00 + 52.10 + 0.00) = 52.10 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.00	56.36	0.00	-1.25	-3.01	0.00	0.00	0.00	52.10

Segment Leq : 52.10 dBA

Total Leq All Segments: 52.10 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.70  
(NIGHT): 52.10



STAMSON 5.0                      NORMAL REPORT                      Date: 16-11-2017 15:00:19  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Bank Street (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 : 40 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 Street (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 : 30.00 / 30.00 m  
Receiver height : 23.25 / 23.25 m  
Topography : 1 (Flat/gentle slope; no barrier)  
Reference angle : 0.00



Results segment # 1: Bank Street (day)

Source height = 1.50 m

ROAD (0.00 + 63.68 + 0.00) = 63.68 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	69.70	0.00	-3.01	-3.01	0.00	0.00	0.00	63.68

Segment Leq : 63.68 dBA

Total Leq All Segments: 63.68 dBA

Results segment # 1: Bank Street (night)

Source height = 1.50 m

ROAD (0.00 + 56.08 + 0.00) = 56.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	62.10	0.00	-3.01	-3.01	0.00	0.00	0.00	56.08

Segment Leq : 56.08 dBA

Total Leq All Segments: 56.08 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 63.68  
(NIGHT): 56.08



STAMSON 5.0                      NORMAL REPORT                      Date: 16-11-2017 15:00:32  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

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

-----  
Car traffic volume    :    6477/563    veh/TimePeriod    \*  
Medium truck volume :     515/45    veh/TimePeriod    \*  
Heavy truck volume  :     368/32    veh/TimePeriod    \*  
Posted speed limit  :     40 km/h  
Road gradient        :        0 %  
Road pavement       :        1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT):    8000  
Percentage of Annual Growth            :    0.00  
Number of Years of Growth              :    0.00  
Medium Truck % of Total Volume        :    7.00  
Heavy Truck % of Total Volume         :    5.00  
Day (16 hrs) % of Total Volume        :   92.00

Data for Segment # 1: Fifth Avenue (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            :    20.00 / 20.00    m  
Receiver height                     :    23.25 / 23.25    m  
Topography                         :        1        (Flat/gentle slope; no barrier)  
Reference angle                     :        0.00

Road data, segment # 2: Bank Street (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  :    40 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: Bank Street (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 : 27.00 / 27.00 m
Receiver height  : 23.25 / 23.25 m
Topography      : 1 (Flat/gentle slope; no barrier)
Reference angle  : 0.00
  
```



Results segment # 1: Fifth Avenue (day)

Source height = 1.50 m

ROAD (0.00 + 59.70 + 0.00) = 59.70 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	63.96	0.00	-1.25	-3.01	0.00	0.00	0.00	59.70

Segment Leq : 59.70 dBA

Results segment # 2: Bank Street (day)

Source height = 1.50 m

ROAD (0.00 + 67.14 + 0.00) = 67.14 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	69.70	0.00	-2.55	0.00	0.00	0.00	0.00	67.14

Segment Leq : 67.14 dBA

Total Leq All Segments: 67.86 dBA



Results segment # 1: Fifth Avenue (night)

Source height = 1.50 m

ROAD (0.00 + 52.10 + 0.00) = 52.10 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	56.36	0.00	-1.25	-3.01	0.00	0.00	0.00	52.10

Segment Leq : 52.10 dBA

Results segment # 2: Bank Street (night)

Source height = 1.50 m

ROAD (0.00 + 59.55 + 0.00) = 59.55 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	62.10	0.00	-2.55	0.00	0.00	0.00	0.00	59.55

Segment Leq : 59.55 dBA

Total Leq All Segments: 60.27 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.86  
(NIGHT): 60.27





Road data, segment # 2: Bank Street (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  :    40 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: Bank Street (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 : 39.00 / 39.00 m
Receiver height : 1.50 / 1.50 m
Topography     : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg   Angle2 : 90.00 deg
Barrier height  : 25.00 m
Barrier receiver distance : 12.00 / 12.00 m
Source elevation : 0.00 m
Receiver elevation : 25.00 m
Barrier elevation : 0.00 m
Reference angle  : 0.00
  
```



Results segment # 1: Fifth Avenue (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	1.50	10.43	10.43

ROAD (0.00 + 41.31 + 0.00) = 41.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	63.96	0.00	-4.47	0.00	0.00	0.00	-18.17	41.31

Segment Leq : 41.31 dBA

Results segment # 2: Bank Street (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	1.50	18.81	18.81

ROAD (0.00 + 50.41 + 0.00) = 50.41 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	69.70	0.00	-4.15	0.00	0.00	0.00	-15.14	50.41

Segment Leq : 50.41 dBA

Total Leq All Segments: 50.91 dBA



Results segment # 1: Fifth Avenue (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	1.50	10.43	10.43

ROAD (0.00 + 33.72 + 0.00) = 33.72 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	56.36	0.00	-4.47	0.00	0.00	0.00	-18.17	33.72

Segment Leq : 33.72 dBA

Results segment # 2: Bank Street (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	1.50	18.81	18.81

ROAD (0.00 + 42.81 + 0.00) = 42.81 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	62.10	0.00	-4.15	0.00	0.00	0.00	-15.14	42.81

Segment Leq : 42.81 dBA

Total Leq All Segments: 43.31 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 50.91  
(NIGHT): 43.31



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

```

-----
Car traffic volume   : 6477/563   veh/TimePeriod  *
Medium truck volume : 515/45    veh/TimePeriod  *
Heavy truck volume  : 368/32    veh/TimePeriod  *
Posted speed limit  : 40 km/h
Road gradient       : 0 %
Road pavement       : 1 (Typical asphalt or concrete)
  
```

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

```

24 hr Traffic Volume (AADT or SADT): 8000
Percentage of Annual Growth         : 0.00
Number of Years of Growth           : 0.00
Medium Truck % of Total Volume      : 7.00
Heavy Truck % of Total Volume       : 5.00
Day (16 hrs) % of Total Volume      : 92.00
  
```

Data for Segment # 2: Fifth Avenue (day/night)

```

-----
Angle1  Angle2      : -90.00 deg  0.00 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      : 2 (Flat/gentle slope; with barrier)
Barrier angle1  : -90.00 deg  Angle2 : 0.00 deg
Barrier height   : 25.00 m
Barrier receiver distance : 32.00 / 32.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle  : 0.00
  
```

Road data, segment # 3: Fifth Avenu2 (day/night)

```

-----
Car traffic volume   : 6477/563   veh/TimePeriod *
Medium truck volume : 515/45    veh/TimePeriod *
Heavy truck volume  : 368/32    veh/TimePeriod *
Posted speed limit  : 40 km/h
Road gradient       : 0 %
Road pavement      : 1 (Typical asphalt or concrete)
  
```

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

```

24 hr Traffic Volume (AADT or SADT): 8000
Percentage of Annual Growth       : 0.00
Number of Years of Growth         : 0.00
Medium Truck % of Total Volume    : 7.00
Heavy Truck % of Total Volume     : 5.00
Day (16 hrs) % of Total Volume    : 92.00
  
```

Data for Segment # 3: Fifth Avenu2 (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 : 39.00 / 39.00 m
Receiver height  : 1.50 / 1.50 m
Topography      : 2 (Flat/gentle slope; with barrier)
Barrier angle1   : 0.00 deg  Angle2 : 90.00 deg
Barrier height   : 8.00 m
Barrier receiver distance : 30.00 / 30.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle  : 0.00
  
```



Results segment # 1: Bank Street (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	1.50	1.50	1.50

ROAD (0.00 + 50.36 + 0.00) = 50.36 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	69.70	0.00	-2.22	0.00	0.00	0.00	-17.12	50.36

Segment Leq : 50.36 dBA

Results segment # 2: Fifth Avenue (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	1.50	1.50	1.50

ROAD (0.00 + 37.31 + 0.00) = 37.31 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.00	63.96	0.00	-4.15	-3.01	0.00	0.00	-19.49	37.31

Segment Leq : 37.31 dBA



Results segment # 3: Fifth Avenu2 (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	1.50	1.50	1.50

ROAD (0.00 + 40.10 + 0.00) = 40.10 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	63.96	0.00	-4.15	-3.01	0.00	0.00	-16.70	40.10

Segment Leq : 40.10 dBA

Total Leq All Segments: 50.94 dBA

Results segment # 1: Bank Street (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	1.50	1.50	1.50

ROAD (0.00 + 42.76 + 0.00) = 42.76 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	62.10	0.00	-2.22	0.00	0.00	0.00	-17.12	42.76

Segment Leq : 42.76 dBA





Results segment # 2: Fifth Avenue (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	1.50	1.50	1.50

ROAD (0.00 + 29.71 + 0.00) = 29.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.00	56.36	0.00	-4.15	-3.01	0.00	0.00	-19.49	29.71

Segment Leq : 29.71 dBA

Results segment # 3: Fifth Avenu2 (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	1.50	1.50	1.50

ROAD (0.00 + 32.50 + 0.00) = 32.50 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.00	56.36	0.00	-4.15	-3.01	0.00	0.00	-16.70	32.50

Segment Leq : 32.50 dBA

Total Leq All Segments: 43.34 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 50.94  
(NIGHT): 43.34