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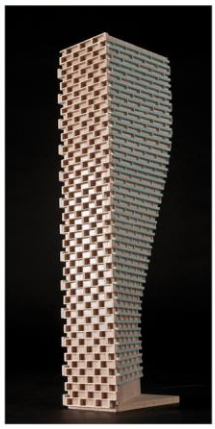
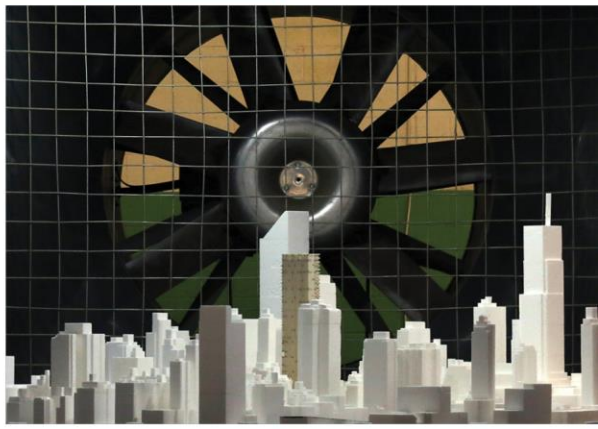
TRAFFIC NOISE ASSESSMENT

1110 Fisher Avenue
Ottawa, Ontario

GRADIENT WIND REPORT: 12-089 – Traffic Noise





May 21, 2019

PREPARED FOR

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EXECUTIVE SUMMARY

This report describes a traffic noise assessment undertaken in support of Zoning By-law Amendment (ZBA) application for a proposed residential development located at 1110 Fisher Avenue in Ottawa, Ontario. Gradient Wind previously completed traffic noise assessments for this site in January of 2013 and July of 2015. The previous designs included a seven-storey condominium building and four, four-storey townhomes, respectively.

The current development is a nine-storey building with three levels of underground parking accessed by a driveway from Fisher Avenue. There are residential units and a gym/amenity space at grade, with the remaining floorplates occupied by residential units. A mechanical penthouse is situated on the roof of the building with potential for a roof top terrace. Communal terraces are considered to be noise sensitive outdoor living areas (OLA) if they are greater than or equal to 4-meters in depth. The primary source of traffic noise is Fisher Avenue to the east of the site. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) architectural drawings prepared by ARC Associates Inc. dated May 8, 2019.

The results of the current analysis indicate that noise levels will range between 48 and 67 dBA during the daytime period (07:00-23:00) and between 40 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (67 dBA) occurs at the east façade, which is nearest and most exposed to Fisher Avenue. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

Results of the calculations also indicate that the development will require central air conditioning, or similar mechanical systems, which will allow occupants to keep windows closed and maintain a

comfortable living environment. A Warning Clause[1] will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized in Section 6. Noise levels at the rooftop receptor (Receptor 5) are not expected to exceed 55 dBA during the daytime period. Therefore, no acoustic mitigation is required.

Proposed Heating Ventilation and Air Conditioning (HVAC) equipment is not expected to be of a concern provided judicious selection and placement of the equipment. Generally the equipment will be located in a mechanical penthouse or on the building roof which will shield the equipment from the low rise noise sensitive surrounding land uses. Prior to building permit a review of the mechanical equipment and drawings should be conducted by a qualified acoustic engineer to ensure compliance with the stationary sound level limits outlined in the ENCG.

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

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Prestige Design and Construction Ltd. to undertake a traffic noise assessment in support of Zoning By-Law Amendment (ZBA) application for a proposed residential development located at 1110 Fisher Avenue in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa[2] and Ministry of the Environment, Conservation and Parks (MECP)[3] guidelines. Noise calculations were based on architectural drawings prepared by ARC Associates Inc. dated May 8, 2019, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this traffic noise assessment is a proposed residential development located at 1110 Fisher Avenue in Ottawa, Ontario. The study site is located on a nearly rectangular parcel of land adjacent to Fisher avenue to the east.

The proposed development is a nine-storey, nearly square planform building with three levels of underground parking accessed by a driveway from Fisher Avenue. The building will rise to a total height of approximately 31 meters from grade to the top of the mechanical penthouse. There are residential units and a gym/amenity space at grade, with the remaining floorplates occupied by residential dwellings. Floorplates set back from the north side at Level 2 to create roof decks; however, as the roof decks extend less than 4-metres from the façade, they do not require consideration as outdoor living areas (OLA) in this study. Private and semi-private balconies located on all façades are not considered OLA as they are less than 4-mteres in depth. A mechanical penthouse is situated on the roof of the building with the potential for a noise sensitive roof top terrace.

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

The site is surrounded by low-rise residential buildings to the north, a school site to the west and south, and Fisher Avenue to the east. Beyond the school site to the south reside medium to high-rise residential buildings. Beyond Fisher Avenue lies the Ottawa Civic Hospital Experimental Farm. The primary source of traffic noise is Fisher Avenue to the east. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

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

4. METHODOLOGY

4.1 Background

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

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{eq}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's

Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 45 and 40 dBA for living rooms and sleeping quarters respectively for roadway as listed in Table 1. Based on Gradient Wind's experience, more comfortable indoor noise levels should be targeted toward 42 and 37 dBA respectively, to control peak noise and deficiencies in building envelope construction.

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

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[5]. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment[6]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation[7].

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

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

4.2.2 Theoretical Roadway Noise Predictions

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

Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground for all receptors excluding Receptor 2 and 3 which assumed soft ground (lawn).
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- Receptor height was taken to be 25.9 metres above grade at the 9th Floor for the centre of the plane of window (POW) and 28.9 meters at the roof top surface for the potential roof top terrace (OLA).
- Receptor distances and exposure angles are illustrated in Figure 3 and 4.
- Receptor 3 and 5 considered the proposed building as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures 3 and 4.
- Noise receptors were strategically placed at five (5) locations around the study building (see Figure 2).

4.2.3 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway

classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[8] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Fisher Avenue	2-Lane Urban Arterial Undivided (2-UAU)	50	**15,000**

4.3 Indoor Noise Calculations

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

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

- Window type and total area as a percentage of total room floor area
- Exterior wall type and total area as a percentage of the total room floor area
- Acoustic absorption characteristics of the room

[8] City of Ottawa Transportation Master Plan, November 2013
[9] Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985

- Outdoor noise source type and approach geometry
- Indoor sound level criteria, which varies according to the intended use of a space

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

5. RESULTS AND DISCUSSION

5.1 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 3 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 TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	25.9	POW – 9th Floor – East Façade	67	59
2	25.9	POW – 9th Floor – South Façade	62	55
3	25.9	POW – 9th Floor – West Façade	48	40
4	25.9	POW – 9th Floor – North Façade	62	55
5	28.9	OLA – Potential Roof Top Terrace	55	-

The results of the current analysis indicate that noise levels will range between 48 and 67 dBA during the daytime period (07:00-23:00) and between 40 and 59 dBA during the nighttime period (23:00-

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

07:00). The highest noise level (67 dBA) occurs at the east façade, which is nearest and most exposed to Fisher Avenue.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per city of Ottawa requirements, detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized below for various units within the development (see Figure 5):

- **Bedroom/Living Room Windows**

(i) Bedroom/living room windows facing east will require a minimum STC of 30

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

- **Exterior Walls**

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

The STC requirements apply to window and door 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

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

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

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

Noise levels at the roof top receptor (Receptor 5) are not expected to exceed 55 dBA during the daytime period. Therefore, no acoustic mitigation is required.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that noise levels will range between 48 and 67 dBA during the daytime period (07:00-23:00) and between 40 and 59 dBA during the nighttime period (23:00-07:00). The highest noise level (67 dBA) occurs at the east façade, which is nearest and most exposed to Fisher Avenue. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 5.

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

> *"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing roadway traffic may, on occasion, interfere with some activities of the dwelling occupants, as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*

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

- *STC rated multi-pane glazing elements*
    - *East façade bedroom/living room: STC 30*
- *STC rated exterior walls*
    - *East façade: STC 45*

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

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

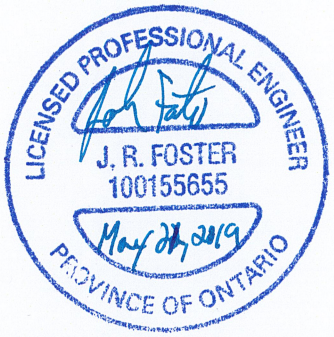
Noise levels at the rooftop receptor (Receptor 5) are not expected to exceed 55 dBA during the daytime period. Therefore, no acoustic mitigation is required.

Proposed Heating Ventilation and Air Conditioning (HVAC) equipment is not expected to be of a concern provided judicious selection and placement of the equipment. Generally the equipment will be located in a mechanical penthouse or on the building roof which will shield the equipment from the low rise noise sensitive surrounding land uses. Prior to building permit a review of the mechanical equipment and drawings should be conducted by a qualified acoustic engineer to ensure compliance with the stationary sound level limits outlined in the ENCG.

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.



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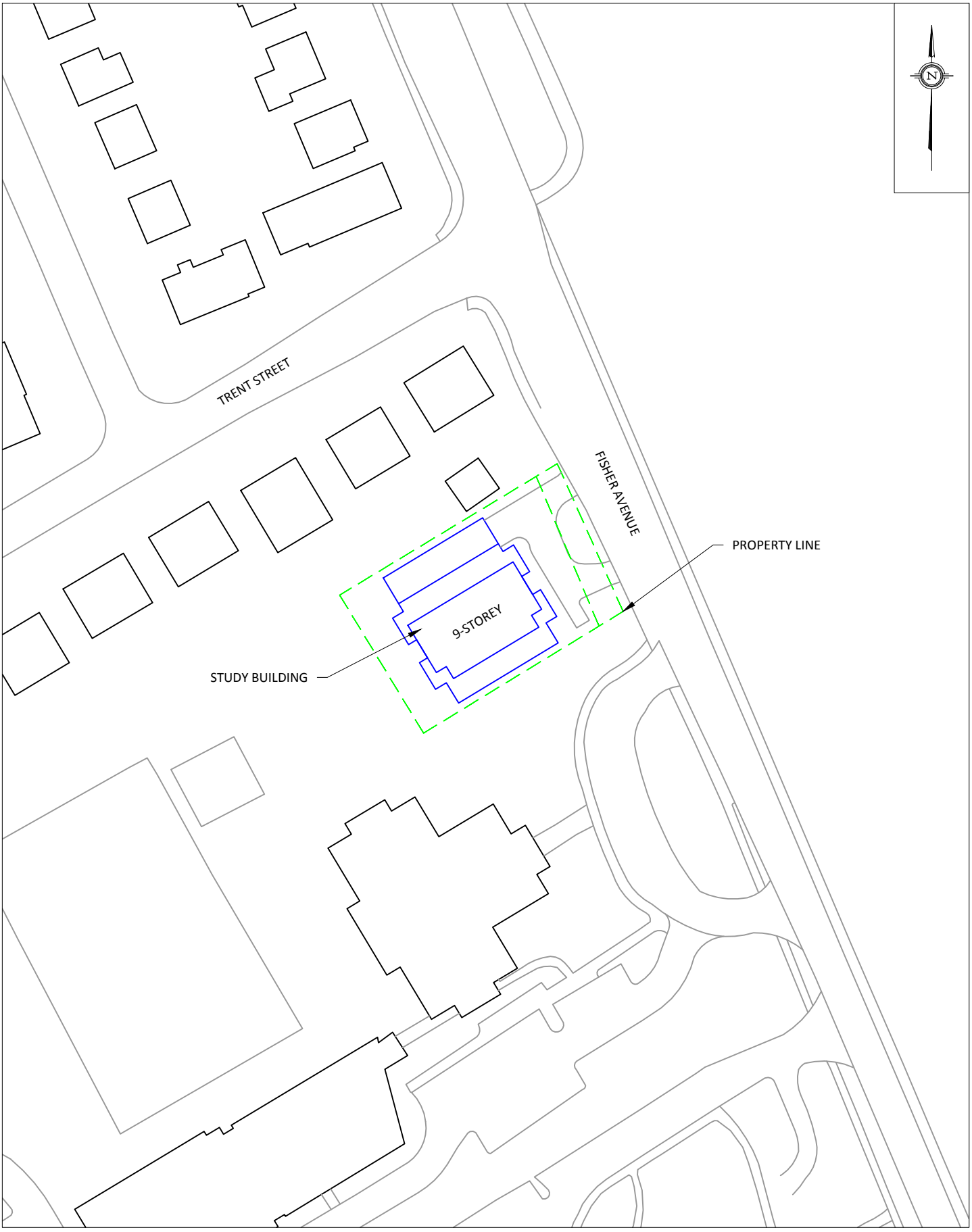

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PROJECT	1110 FISHER AVENUE - TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:1000 (APPROX.)	DRAWING NO.	GWE12-089-1
DATE	MAY 15, 2019	DRAWN BY	G.G.

FIGURE 1:
SITE PLAN & SURROUNDING CONTEXT

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SCALE	1:500 (APPROX.)	DRAWING NO.	GWE12-089-2
DATE	MAY 15, 2019	DRAWN BY	G.G.

FIGURE 2:
RECEPTOR LOCATIONS

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SCALE	1:500 (APPROX.)	DRAWING NO.	GWE12-089-3
DATE	MAY 15, 2019	DRAWN BY	G.G.

FIGURE 3:
RECEPTOR 1-3 STAMSON INPUT PARAMETERS

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PROJECT	1110 FISHER AVENUE - TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE12-089-4
DATE	MAY 15, 2019	DRAWN BY	G.G.

FIGURE 4:
RECEPTOR 4 AND 5 STAMSON INPUT PARAMETERS

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PROJECT	1110 FISHER AVENUE - TRAFFIC NOISE ASSESSMENT		DESCRIPTION
SCALE	1:500 (APPROX.)	DRAWING NO.	GWE12-089-5
DATE	MAY 15, 2019	DRAWN BY	G.G.

FIGURE 5:
BEDROOM AND LIVING ROOM STC REQUIREMENTS

APPENDIX A

STAMSON 5.04 – INPUT AND OUTPUT DATA

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
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```
STAMSON 5.0        NORMAL REPORT        Date: 14-05-2019 16:17:12
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Fisher Ave (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Fisher Ave (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  :  21.00 / 21.00  m
Receiver height           :  25.90 / 25.90  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Fisher Ave (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 67.02 + 0.00) = 67.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  68.48   0.00  -1.46   0.00   0.00   0.00   0.00
67.02
-------------------------------------------------------------------------
--

Segment Leq : 67.02 dBA

Total Leq All Segments: 67.02 dBA


Results segment # 1: Fisher Ave (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.42 + 0.00) = 59.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     90   0.00  60.88   0.00  -1.46   0.00   0.00   0.00   0.00
59.42
-------------------------------------------------------------------------
--

Segment Leq : 59.42 dBA

Total Leq All Segments: 59.42 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 67.02
                           (NIGHT): 59.42
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-05-2019 16:17:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Fisher Ave (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Fisher Ave (day/night)
--------------------------------------------
Angle1   Angle2           : -10.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  34.00 / 34.00  m
Receiver height           :  25.90 / 25.90  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Fisher Ave (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.37 + 0.00) = 62.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -10     90   0.00  68.48   0.00  -3.55  -2.55   0.00   0.00   0.00
62.37
-------------------------------------------------------------------------
--

Segment Leq : 62.37 dBA

Total Leq All Segments: 62.37 dBA


Results segment # 1: Fisher Ave (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.78 + 0.00) = 54.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -10     90   0.00  60.88   0.00  -3.55  -2.55   0.00   0.00   0.00
54.78
-------------------------------------------------------------------------
--

Segment Leq : 54.78 dBA

Total Leq All Segments: 54.78 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 62.37
                           (NIGHT): 54.78
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-05-2019 16:17:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Fisher Ave (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Fisher Ave (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  46.00 / 46.00  m
Receiver height           :  25.90 / 25.90  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :  27.41 m
Barrier receiver distance :   0.10 / 0.10   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Fisher Ave (day)
-------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
-------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       25.90 !       25.85 !        25.85

ROAD (0.00 + 47.59 + 0.00) = 47.59 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90   0.00  68.48   0.00  -4.87   0.00   0.00   0.00 -16.03
47.59
-------------------------------------------------------------------------------
--

Segment Leq : 47.59 dBA

Total Leq All Segments: 47.59 dBA
```

```
Results segment # 1: Fisher Ave (night)
---------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       25.90 !       25.85 !        25.85

ROAD (0.00 + 39.99 + 0.00) = 39.99 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     90    0.00  60.88   0.00  -4.87   0.00   0.00   0.00 -16.03
39.99
-------------------------------------------------------------------------------
--

Segment Leq : 39.99 dBA

Total Leq All Segments: 39.99 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 47.59
                           (NIGHT): 39.99
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-05-2019 16:18:04
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Fisher Ave (day/night)
----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Fisher Ave (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   -6.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :  25.90 / 25.90  m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Fisher Ave (day)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.31 + 0.00) = 62.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -6   0.00  68.48   0.00  -2.86  -3.31   0.00   0.00   0.00
62.31
-------------------------------------------------------------------------------
--

Segment Leq : 62.31 dBA

Total Leq All Segments: 62.31 dBA

Results segment # 1: Fisher Ave (night)
---------------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.71 + 0.00) = 54.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90     -6   0.00  60.88   0.00  -2.86  -3.31   0.00   0.00   0.00
54.71
-------------------------------------------------------------------------------
--

Segment Leq : 54.71 dBA

Total Leq All Segments: 54.71 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 62.31
                           (NIGHT): 54.71
```

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2019 09:28:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Fisher Ave1 (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Fisher Ave1 (day/night)
-----------------------------------------------
Angle1   Angle2           : -25.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  35.00 / 35.00  m
Receiver height           :  28.90 / 25.90  m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -25.00 deg   Angle2 : 0.00 deg
Barrier height            :  27.40 m
Barrier receiver distance :  11.00 / 11.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Fisher Ave2 (day/night)
-----------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Fisher Ave2 (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  :  35.00 / 35.00  m
Receiver height           :  28.90 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :  27.40 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Fisher Ave1 (day)
-----------------------------------
Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       28.90 !       20.29 !        20.29

ROAD (0.00 + 36.23 + 0.00) = 36.23 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -25      0   0.00  68.48   0.00  -3.68  -8.57   0.00   0.00 -20.00
36.23
-------------------------------------------------------------------------------
Segment Leq : 36.23 dBA

Results segment # 2: Fisher Ave2 (day)
-----------------------------------
Source height = 1.50 m

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       28.90 !       26.55 !        26.55

ROAD (0.00 + 54.89 + 0.00) = 54.89 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     90   0.00  68.48   0.00  -3.68  -3.01   0.00   0.00  -6.90
54.89
-------------------------------------------------------------------------------
--

Segment Leq : 54.89 dBA

Total Leq All Segments: 54.95 dBA
```

```
Results segment # 1: Fisher Ave1 (night)
----------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !       25.90 !       18.23 !        18.23

ROAD (0.00 + 28.63 + 0.00) = 28.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -25      0   0.00  60.88   0.00  -3.68  -8.57   0.00   0.00 -20.00
28.63
-------------------------------------------------------------------------------
--

Segment Leq : 28.63 dBA

Results segment # 2: Fisher Ave2 (night)
----------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        4.50 !        4.24 !         4.24

ROAD (0.00 + 34.64 + 0.00) = 34.64 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     90   0.00  60.88   0.00  -3.68  -3.01   0.00   0.00 -19.55
34.64
-------------------------------------------------------------------------------
--

Segment Leq : 34.64 dBA
Total Leq All Segments: 35.61 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 54.95
                           (NIGHT): 35.61
```