Roadway Traffic Noise Assessment

349 Olmstead Street

Ottawa, Ontario

REPORT: GWE16-047 – Roadway Traffic Noise

Prepared For:

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EXECUTIVE SUMMARY

This document describes a roadway traffic noise assessment performed for a proposed redevelopment of the École Horizon-Jeunesse located at 349 Olmstead Street in Ottawa, Ontario. Upon completion, the school will rise approximately 11 meters above local grade. Figure 1 illustrates a site plan with surrounding context. The major source of roadway noise affecting the development is traffic along McArthur Avenue and Olmstead Street.

The assessment is based on: (i) theoretical noise prediction methods that conform to the Ontario 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 Edward J. Cuhaci & Associates Architects Inc.

The results of the current study indicate that noise levels will range between 48 and 66 dBA during the daytime period (07:00-23:00) and between 40 and 58 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 66 dBA) occurs on the south façade of the new west wing (Receptor 4), which is nearest and most exposed to McArthur Avenue. Minimum building construction in all areas is required to satisfy the Ontario Building Code (2012). In addition, upgraded building component Sound Transmission Class (STC) ratings are required where noise levels exceed 65 dBA (see Figure 3).

Results of the calculations also indicate that the main school building, with the exception of the portables, will require central air conditioning (or similar mechanical system), which will allow occupants to keep windows closed and maintain a comfortable living environment. As the building is for an institutional purpose, Warning Clauses do not apply.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Conseils des Écoles Catholique du Centre – Est (CECCE) to undertake a roadway traffic noise study of a proposed redevelopment to the École Horizon-Jeunesse located at 349 Olmstead Street in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to a roadway traffic noise assessment. GWE's scope of work involved assessing exterior and interior 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[1] and Ontario Ministry of the Environment and Climate Change[2] guidelines. Noise calculations were based on architectural drawings received from Edward J. Cuhaci & Associates Architects Inc., with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this environmental noise assessment is a proposed redevelopment of École Horizon-Jeunesse. The project will see the partial demolition of the existing school building with a new wing planned for the west side of the site. The work is planned over three phases and the assessment considers the ultimate build-out of Phase 3. The development is located on the northeast corner of the McArthur Avenue & Olmstead Street intersection. The major sources of roadway noise are McArthur Avenue and Olmstead Street. The site is surrounded on all sides with mixed-use land, specifically commercial and residential. Figure 1 illustrates a complete site plan with surrounding context. Upon completion, the development will rise approximately 11 meters above local grade.

[1] City of Ottawa Environmental Noise Control Guidelines, January, 2016
[2] Ministry of the Environment – Publication NPC-300

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, (ii) ensure that interior 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.

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 dBA for schools and conference rooms, as listed in Table 1. Based on GWE's experience, more comfortable indoor noise levels should be targeted toward 42 dBA to control peak noise, and deficiencies in building envelope construction.

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) and outdoor living area (OLA) dictate the action required to achieve the recommended sound levels. When noise levels at these areas exceed the criteria outlined in Table 2, specific outdoor, ventilation and Warning Clause requirements may apply. In addition, when noise levels exceed the criteria outlined in Table 3, upgraded building components must be designed.

[3] Adapted from ENCG 2006 – Table 1.6

TABLE 2: ROAD & RAIL NOISE COMBINED – OUTDOOR NOISE, VENTILATION AND WARNING CLAUSE REQUIREMENTS[4]

Time Period	L_{EQ} (dBA)	Ventilation Requirements	Outdoor Noise Control Measures	Warning Clause
Outdoor Living Area (OLA)				
Daytime (07:00 – 23:00)	$L_{EQ(16hr)} < 55$	N/A	Not required	Not required
	$55 < L_{EQ(16hr)} \leq 60$	N/A	May not be required but should be considered	Generic†
	$L_{EQ(16hr)} > 60$	N/A	Required to reduce the L_{EQ} to below 60 dBA and as close to 55 dBA where feasible	Extensive Mitigation ††
Plane of Window (POW)				
Daytime (07:00 – 23:00)	$L_{EQ(16hr)} < 55$	Not required	N/A	Not required
	$55 < L_{EQ(16hr)} \leq 65$	Forced air heating with provision for central air conditioning	N/A	Generic
	$L_{EQ(16hr)} > 65$	Central air conditioning	N/A	Extensive Mitigation
Nighttime (23:00 – 07:00)	$L_{EQ(8hr)} < 50$	Not required	N/A	Not required
	$50 < L_{EQ(8hr)} \leq 60$	Forced air heating with provision for central air conditioning	N/A	Generic
	$L_{EQ(8hr)} > 60$	Central air conditioning	N/A	Extensive Mitigation

† - Required if resultant L_{EQ} exceeds 55 dBA

†† - Required if resultant L_{EQ} exceeds 55 dBA and if it is administratively, economically and/or technically feasible

[4] Adapted from ENCG 2006 – Table 1.10

TABLE 3: ROAD & RAIL NOISE BUILDING COMPONENT REQUIREMENTS[5]

Source	L_{EQ} (dBA)	Building Component Requirements
Road	$L_{EQ(16hr)}$ > 65 (Daytime)	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria
	$L_{EQ(8hr)}$ > 60 (Nighttime)	
Rail	$L_{EQ(16hr)}$ > 60 (Daytime)	
	$L_{EQ(8hr)}$ > 55(Nighttime)	

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 Plan[6] which provides 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 4 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 4: ROADWAY TRAFFIC DATA

Roadway	Roadway Class	Speed Limit (km/h)	Official Plan AADT
McArthur Avenue	4-UAU	40	**30,000**
Olmstead Street	2-UCU	40	**8,000**

[5] Adapted from ENCG 2006 – Table 1.8

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

4.2.3 Theoretical Roadway Noise Predictions

Noise predictions were performed with the aid of the Ministry of the Environment (MOE) computerized noise assessment program, STAMSON 5.04, for road and rail analysis. Appendix A includes the STAMSON 5.04 input and output data.

Roadway noise calculations were performed by treating each road 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 4, 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
- The study site was treated as having flat topography

Noise receptors were strategically placed at 8 locations around the study area (see Figure 2).

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 veneered walls can achieve STC 55. 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.

According to the ENCG, when daytime noise levels (from road and rail sources) at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure[7] considers:

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

Based on published research[8], exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows / curtainwalls in the same partition. Due to site conditions, 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).

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 not specified any particular window configurations, as there are several manufacturers and various combinations of window components that will offer the necessary sound attenuation rating. However, it is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors. All specified building components will require review by a qualified acoustical engineer for conformance to the recommendations of this report prior to building permit application.

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

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

5. RESULTS AND DISCUSSION

5.1 Roadway Noise Levels

Appendix A contains the complete set of input and output data from all STAMSON 5.04 calculations. The results of the roadway noise calculations are summarized in Table 5 below.

TABLE 5: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC

Receptor Number	Plane of Window Receptor Location	Noise Level (dBA)	
		Day	Night
1	POW – Ground Level – North Façade	58	51
2	POW – 2nd Floor – East Façade	48	40
3	POW – 2nd Floor – South Façade	63	55
4	POW – 2nd Floor – South Façade	66	58
5	POW – 2nd Floor – West Façade	64	56
6	POW – 2nd Floor – West Façade	62	55
7	POW – Ground Level – South Façade	63	55
8	POW – Ground Level – Portables	55	48

The results of the current analysis indicate that noise levels will range between 48 and 66 dBA during the daytime period (07:00-23:00) and between 40 and 58 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 66 dBA) occurs on the south façade of the new west wing (Receptor 4), which is nearest and most exposed to McArthur Avenue.

5.2 STC Requirements

The noise levels predicted due to roadway traffic exceed the criteria listed in ENCG for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been determined by calculation and GWE Experience. The STC requirements for the windows are summarized below (see Figure 3):

- **Classroom, Meeting Rooms, Office and Library Windows / Curtainwalls**

(i) Windows / curtainwalls on the fully glazed portion of the new west wing, as well as ground level windows in this area will require a minimum STC of 25

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

Results of the calculations also indicate that the main school building, with the exception of the portables, will require central air conditioning (or similar mechanical system), which will allow occupants to keep windows closed and maintain a comfortable living environment.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current study indicate that noise levels will range between 48 and 66 dBA during the daytime period (07:00-23:00) and between 40 and 58 dBA during the nighttime period (23:00-07:00). The highest noise level (i.e. 66 dBA) occurs on the south façade of the new west wing (Receptor 4), which is nearest and most exposed to McArthur Avenue. Minimum building construction in all areas is required to satisfy the Ontario Building Code (2012). In addition, Sound Transmission Class (STC) ratings are required for building components where noise levels exceed 65 dBA (see Figure 3).

Results of the calculations also indicate that the main school building, with the exception of the portables, will require central air conditioning (or similar mechanical system), which will allow occupants to keep windows closed and maintain a comfortable living environment. As the building is for institutional purposes, Warning Clauses typically do not apply.

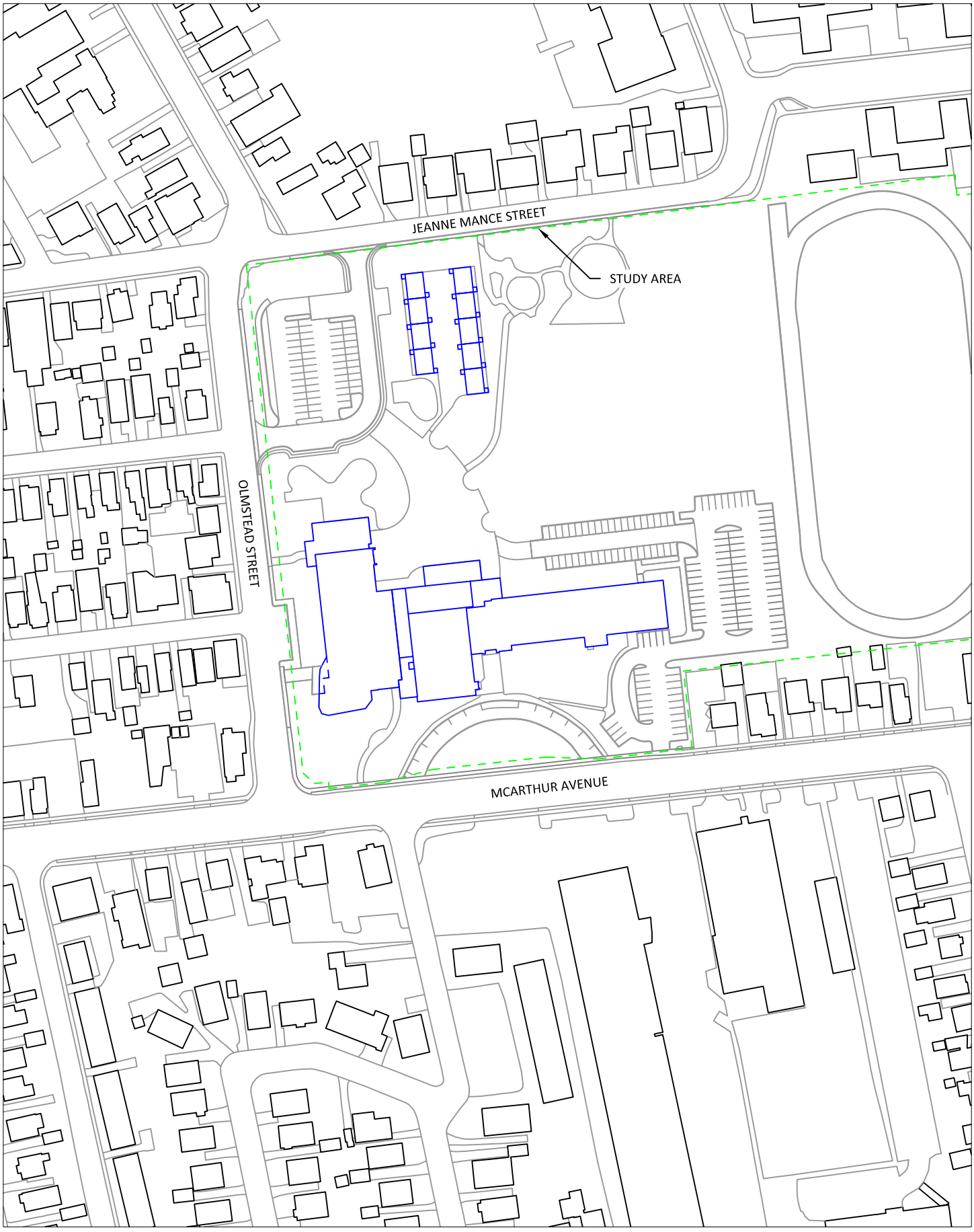
This concludes our assessment and report. If you have any questions or wish to discuss our findings please advise us. In the interim, we thank you for the opportunity to be of service.

Yours truly,

Gradient Wind Engineering Inc.

Michael Lafortune
Environmental Technologist
GWE1-047 – Roadway Traffic Noise

Joshua Foster, P.Eng.
Partner



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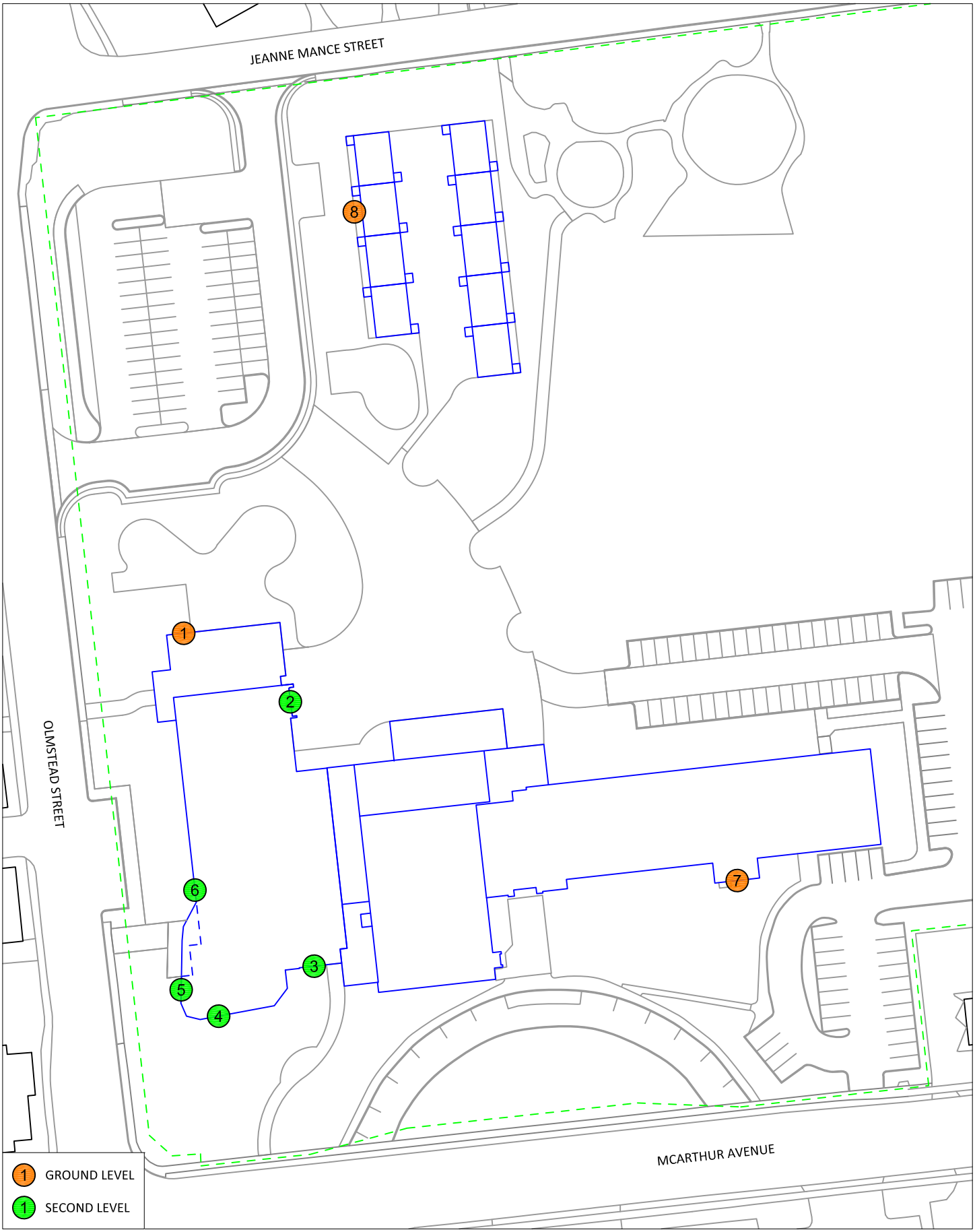
PROJECT	ECOLE HORIZON-JEUNESSE - ROADWAY TRAFFIC NOISE STUDY
SCALE	1:2000 (APPROX.)
DRAWING NO.	GWE16-047-1
DATE	MAY 16, 2016
DRAWN BY	M.L
DESCRIPTION	FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT



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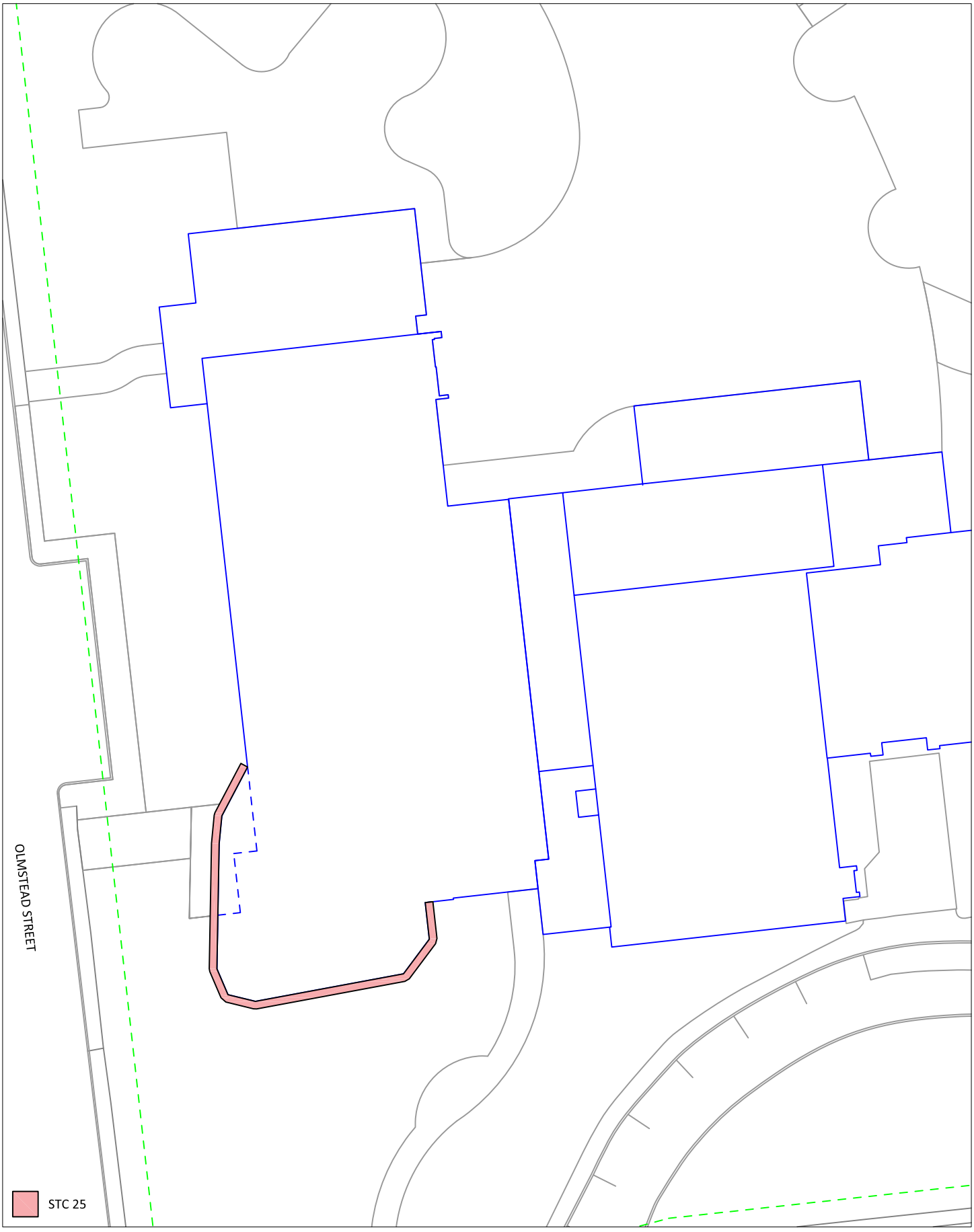
PROJECT	ECOLE HORIZON-JEUNESSE - ROADWAY TRAFFIC NOISE STUDY
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE16-047-2
DATE	MAY 16, 2016
DRAWN BY	M.L
DESCRIPTION	FIGURE 2: RECEPTOR LOCATIONS



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PROJECT	ECOLE HORIZON-JEUNESSE - ROADWAY TRAFFIC NOISE STUDY
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE16-047-3
DATE	MAY 16, 2016
DRAWN BY	M.L
DESCRIPTION	FIGURE 3: WINDOW STC REQUIREMENTS

APPENDIX A

STAMSON 5.04 - INPUT AND OUTPUT DATA

STAMSON 5.0 NORMAL REPORT Date: 13-05-2016 15:22:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: Olmstead (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: Olmstead (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	: 28.00 / 28.00	m
Receiver height	: 1.50 / 1.50	m
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

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

Source height = 1.50 m

ROAD (0.00 + 58.23 + 0.00) = 58.23 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  -2.71  -3.01   0.00   0.00   0.00
58.23
-------------------------------------------------------------------------
--

Segment Leq : 58.23 dBA

Total Leq All Segments: 58.23 dBA


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

Source height = 1.50 m

ROAD (0.00 + 50.64 + 0.00) = 50.64 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  -2.71  -3.01   0.00   0.00   0.00
50.64
-------------------------------------------------------------------------
--

Segment Leq : 50.64 dBA

Total Leq All Segments: 50.64 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 58.23
                           (NIGHT): 50.64
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-05-2016 15:22:11
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Olmstead (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: Olmstead (day/night)
----------------------------------------------
Angle1   Angle2           : -64.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  48.00 / 48.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -64.00 deg   Angle2 : 90.00 deg
Barrier height            :   8.60 m
Barrier receiver distance :   1.00 / 1.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: McArthur (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: McArthur (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  :  98.00 / 98.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 0.00 deg
Barrier height            :   8.60 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Olmstead (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 !        5.50 !        5.42 !         5.42

ROAD (0.00 + 40.61 + 0.00) = 40.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -64     90   0.00  63.96   0.00  -5.05  -0.68   0.00   0.00 -17.61
40.61
-------------------------------------------------------------------------------
--

Segment Leq : 40.61 dBA
```

```
Results segment # 2: McArthur (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 !        5.50 !        4.93 !         4.93

ROAD (0.00 + 46.83 + 0.00) = 46.83 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  -8.15  -3.01   0.00   0.00 -11.71
46.83
-------------------------------------------------------------------------------
--

Segment Leq : 46.83 dBA

Total Leq All Segments: 47.76 dBA
```

```
Results segment # 1: Olmstead (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 !        5.50 !        5.42 !         5.42

ROAD (0.00 + 33.02 + 0.00) = 33.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -64     90   0.00  56.36   0.00  -5.05  -0.68   0.00   0.00 -17.61
33.02
-------------------------------------------------------------------------------
--

Segment Leq : 33.02 dBA
```

```
Results segment # 2: McArthur (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 !        5.50 !        4.93 !         4.93

ROAD (0.00 + 39.23 + 0.00) = 39.23 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  -8.15  -3.01   0.00   0.00 -11.71
39.23
-------------------------------------------------------------------------------
--

Segment Leq : 39.23 dBA

Total Leq All Segments: 40.16 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 47.76
                           (NIGHT): 40.16
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-05-2016 15:22:17
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Olmstead (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: Olmstead (day/night)
----------------------------------------------
Angle1   Angle2           : -44.00 deg   0.00 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           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -38.00 deg   Angle2 : 0.00 deg
Barrier height            :   8.60 m
Barrier receiver distance :   6.00 / 6.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: McArthurL (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: McArthurL (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   51.00 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           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -50.00 deg
Barrier height            :   7.70 m
Barrier receiver distance :   5.00 / 5.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 3: McArthurR (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 # 3: McArthurR (day/night)
-------------------------------------------
Angle1   Angle2           :  51.00 deg   90.00 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           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  51.00 deg   Angle2 : 90.00 deg
Barrier height            :   8.60 m
Barrier receiver distance :   7.00 / 7.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Olmstead (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 !        5.50 !        4.98 !         4.98

ROAD (44.32 + 34.24 + 0.00) = 44.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -44    -38   0.00  63.96   0.00  -4.87 -14.77   0.00   0.00   0.00
44.32
-------------------------------------------------------------------------------
--
   -38      0   0.00  63.96   0.00  -4.87  -6.75   0.00   0.00 -18.10
34.24
-------------------------------------------------------------------------------
--

Segment Leq : 44.72 dBA
```

```
Results segment # 2: McArthurL (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 !        5.50 !        5.06 !         5.06

ROAD (0.00 + 47.80 + 62.32) = 62.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -50   0.00  69.70   0.00  -4.87  -6.53   0.00   0.00 -10.50
47.80
-------------------------------------------------------------------------------
--
   -50     51   0.00  69.70   0.00  -4.87  -2.51   0.00   0.00   0.00
62.32
-------------------------------------------------------------------------------
--

Segment Leq : 62.47 dBA
```

```
Results segment # 3: McArthurR (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 !        5.50 !        4.89 !         4.89

ROAD (0.00 + 46.63 + 0.00) = 46.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    51     90   0.00  69.70   0.00  -4.87  -6.64   0.00   0.00 -11.56
46.63
-------------------------------------------------------------------------------
--

Segment Leq : 46.63 dBA

Total Leq All Segments: 62.65 dBA
```

```
Results segment # 1: Olmstead (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 !        5.50 !        4.98 !         4.98

ROAD (36.72 + 26.64 + 0.00) = 37.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -44    -38   0.00  56.36   0.00  -4.87 -14.77   0.00   0.00   0.00
36.72
-------------------------------------------------------------------------------
--
   -38      0   0.00  56.36   0.00  -4.87  -6.75   0.00   0.00 -18.10
26.64
-------------------------------------------------------------------------------
--

Segment Leq : 37.13 dBA
```

```
Results segment # 2: McArthurL (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 !        5.50 !        5.06 !         5.06

ROAD (0.00 + 40.21 + 54.72) = 54.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -50   0.00  62.10   0.00  -4.87  -6.53   0.00   0.00 -10.50
40.21
-------------------------------------------------------------------------------
--
   -50     51   0.00  62.10   0.00  -4.87  -2.51   0.00   0.00   0.00
54.72
-------------------------------------------------------------------------------
--

Segment Leq : 54.87 dBA
```

```
Results segment # 3: McArthurR (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 !        5.50 !        4.89 !         4.89

ROAD (0.00 + 39.03 + 0.00) = 39.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    51     90   0.00  62.10   0.00  -4.87  -6.64   0.00   0.00 -11.56
39.03
-------------------------------------------------------------------------------
--

Segment Leq : 39.03 dBA

Total Leq All Segments: 55.05 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 62.65
                           (NIGHT): 55.05
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-05-2016 15:22:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Olmstead (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: Olmstead (day/night)
----------------------------------------------
Angle1   Angle2           : -55.00 deg   -4.00 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           :   5.50 / 5.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: McArthur (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: McArthur (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  :  38.00 / 38.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  63.00 deg   Angle2 : 90.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  22.00 / 22.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 55.93 + 0.00) = 55.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -55     -4   0.00  63.96   0.00  -2.55  -5.48   0.00   0.00   0.00
55.93
-------------------------------------------------------------------------
--

Segment Leq : 55.93 dBA


Results segment # 2: McArthur (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 !        5.50 !        3.18 !         3.18

ROAD (64.95 + 47.91 + 0.00) = 65.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     63   0.00  69.70   0.00  -4.04  -0.71   0.00   0.00   0.00
64.95
-------------------------------------------------------------------------
--
    63     90   0.00  69.70   0.00  -4.04  -8.24   0.00   0.00  -9.51
47.91
-------------------------------------------------------------------------
--

Segment Leq : 65.04 dBA

Total Leq All Segments: 65.54 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 48.33 + 0.00) = 48.33 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -55     -4   0.00  56.36   0.00  -2.55  -5.48   0.00   0.00   0.00
48.33
-------------------------------------------------------------------------
--

Segment Leq : 48.33 dBA


Results segment # 2: McArthur (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 !        5.50 !        3.18 !         3.18

ROAD (57.36 + 40.31 + 0.00) = 57.44 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -90     63   0.00  62.10   0.00  -4.04  -0.71   0.00   0.00   0.00
57.36
-------------------------------------------------------------------------
--
    63     90   0.00  62.10   0.00  -4.04  -8.24   0.00   0.00  -9.51
40.31
-------------------------------------------------------------------------
--

Segment Leq : 57.44 dBA

Total Leq All Segments: 57.94 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 65.54
                           (NIGHT): 57.94
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-05-2016 15:22:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Olmstead (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: Olmstead (day/night)
----------------------------------------------
Angle1   Angle2           : -66.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  20.00 / 20.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: McArthur (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: McArthur (day/night)
------------------------------------------
Angle1   Angle2           :   7.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  44.00 / 44.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  51.00 deg   Angle2 : 90.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  26.00 / 26.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 62.08 + 0.00) = 62.08 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -66     90   0.00  63.96   0.00  -1.25  -0.62   0.00   0.00   0.00
62.08
-------------------------------------------------------------------------
--

Segment Leq : 62.08 dBA


Results segment # 2: McArthur (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 !        5.50 !        3.13 !         3.13

ROAD (58.90 + 48.22 + 0.00) = 59.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     7     51   0.00  69.70   0.00  -4.67  -6.12   0.00   0.00   0.00
58.90
-------------------------------------------------------------------------
--
    51     90   0.00  69.70   0.00  -4.67  -6.64   0.00   0.00 -10.16
48.22
-------------------------------------------------------------------------
--

Segment Leq : 59.26 dBA

Total Leq All Segments: 63.91 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 54.49 + 0.00) = 54.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -66     90   0.00  56.36   0.00  -1.25  -0.62   0.00   0.00   0.00
54.49
-------------------------------------------------------------------------------
--

Segment Leq : 54.49 dBA


Results segment # 2: McArthur (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 !        5.50 !        3.13 !         3.13

ROAD (51.31 + 40.62 + 0.00) = 51.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     7     51   0.00  62.10   0.00  -4.67  -6.12   0.00   0.00   0.00
51.31
-------------------------------------------------------------------------------
--
    51     90   0.00  62.10   0.00  -4.67  -6.64   0.00   0.00 -10.16
40.62
-------------------------------------------------------------------------------
--

Segment Leq : 51.66 dBA

Total Leq All Segments: 56.31 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 63.91
                           (NIGHT): 56.31
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-05-2016 15:22:37
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Olmstead (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: Olmstead (day/night)
----------------------------------------------
Angle1   Angle2           : -69.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  25.00 / 25.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: McArthurL (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: McArthurL (day/night)
-------------------------------------------
Angle1   Angle2           :   0.00 deg   39.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  63.00 / 63.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 15.00 deg
Barrier height            :   8.60 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 # 3: McArthurR (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 # 3: McArthurR (day/night)
-------------------------------------------
Angle1   Angle2           :  39.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  63.00 / 63.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  39.00 deg   Angle2 : 90.00 deg
Barrier height            :   7.00 m
Barrier receiver distance :  45.00 / 45.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 61.20 + 0.00) = 61.20 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -69     90   0.00  63.96   0.00  -2.22  -0.54   0.00   0.00   0.00
61.20
-------------------------------------------------------------------------
--

Segment Leq : 61.20 dBA


Results segment # 2: McArthurL (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 !        5.50 !        4.80 !         4.80

ROAD (0.00 + 36.14 + 54.71) = 54.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     15   0.00  69.70   0.00  -6.23 -10.79   0.00   0.00 -16.53
36.14
-------------------------------------------------------------------------
--
    15     39   0.00  69.70   0.00  -6.23  -8.75   0.00   0.00   0.00
54.71
-------------------------------------------------------------------------
--

Segment Leq : 54.77 dBA
```

```
Results segment # 3: McArthurR (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 !        5.50 !        2.64 !         2.64

ROAD (0.00 + 46.98 + 0.00) = 46.98 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    39     90   0.00  69.70   0.00  -6.23  -5.48   0.00   0.00 -11.01
46.98
-------------------------------------------------------------------------
--

Segment Leq : 46.98 dBA

Total Leq All Segments: 62.22 dBA


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

Source height = 1.50 m

ROAD (0.00 + 53.61 + 0.00) = 53.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -69     90   0.00  56.36   0.00  -2.22  -0.54   0.00   0.00   0.00
53.61
-------------------------------------------------------------------------
--

Segment Leq : 53.61 dBA
```

```
Results segment # 2: McArthurL (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 !        5.50 !        4.80 !         4.80

ROAD (0.00 + 28.54 + 47.12) = 47.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
     0     15   0.00  62.10   0.00  -6.23 -10.79   0.00   0.00 -16.53
28.54
-------------------------------------------------------------------------------
--
    15     39   0.00  62.10   0.00  -6.23  -8.75   0.00   0.00   0.00
47.12
-------------------------------------------------------------------------------
--

Segment Leq : 47.18 dBA
```

```
Results segment # 3: McArthurR (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 !        5.50 !        2.64 !         2.64

ROAD (0.00 + 39.38 + 0.00) = 39.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    39     90   0.00  62.10   0.00  -6.23  -5.48   0.00   0.00 -11.01
39.38
-------------------------------------------------------------------------------
--

Segment Leq : 39.38 dBA

Total Leq All Segments: 54.63 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 62.22
                           (NIGHT): 54.63
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-05-2016 15:22:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r7.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: McArthur (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: McArthur (day/night)
----------------------------------------------
Angle1   Angle2           : -90.00 deg   74.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  54.00 / 54.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -48.00 deg
Barrier height            :   8.00 m
Barrier receiver distance :  37.00 / 37.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: McArthur (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 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 44.66 + 62.44) = 62.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -48   0.00  69.70   0.00  -5.56  -6.32   0.00   0.00 -13.16
44.66
-------------------------------------------------------------------------------
--
   -48     74   0.00  69.70   0.00  -5.56  -1.69   0.00   0.00   0.00
62.44
-------------------------------------------------------------------------------
--

Segment Leq : 62.52 dBA

Total Leq All Segments: 62.52 dBA
```

```
Results segment # 1: McArthur (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 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 37.06 + 54.85) = 54.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -90    -48   0.00  62.10   0.00  -5.56  -6.32   0.00   0.00 -13.16
37.06
-------------------------------------------------------------------------------
--
   -48     74   0.00  62.10   0.00  -5.56  -1.69   0.00   0.00   0.00
54.85
-------------------------------------------------------------------------------
--

Segment Leq : 54.92 dBA

Total Leq All Segments: 54.92 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 62.52
                           (NIGHT): 54.92
```

```
STAMSON 5.0        NORMAL REPORT        Date: 13-05-2016 15:22:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: OlmsteadL (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: OlmsteadL (day/night)
----------------------------------------------
Angle1   Angle2           : -59.00 deg   24.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  71.00 / 71.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: OlmsteadR (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: OlmsteadR (day/night)
-------------------------------------------
Angle1   Angle2           :  56.00 deg   73.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  33.00 / 33.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 1.50 m

ROAD (0.00 + 53.84 + 0.00) = 53.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -59     24   0.00  63.96   0.00  -6.75  -3.36   0.00   0.00   0.00
53.84
-------------------------------------------------------------------------------
--

Segment Leq : 53.84 dBA
```

```
Results segment # 2: OlmsteadR (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.28 + 0.00) = 50.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
    56     73   0.00  63.96   0.00  -3.42 -10.25   0.00   0.00   0.00
50.28
-------------------------------------------------------------------------
--

Segment Leq : 50.28 dBA

Total Leq All Segments: 55.43 dBA


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

Source height = 1.50 m

ROAD (0.00 + 46.25 + 0.00) = 46.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -59     24   0.00  56.36   0.00  -6.75  -3.36   0.00   0.00   0.00
46.25
-------------------------------------------------------------------------
--

Segment Leq : 46.25 dBA
```

```
Results segment # 2: OlmsteadR (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 42.69 + 0.00) = 42.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
    56     73   0.00  56.36   0.00  -3.42 -10.25   0.00   0.00   0.00
42.69
-------------------------------------------------------------------------------
--

Segment Leq : 42.69 dBA

Total Leq All Segments: 47.84 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 55.43
                           (NIGHT): 47.84
```