

NOISE IMPACT ASSESSMENT STUDY

Development Address:

16 and 20 Champagne Avenue South
Ottawa, Ontario

Client:

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22 August 2018

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Champagne Apartments
16 and 20 Champagne Avenue South
Ottawa, Ontario

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EXECUTIVE SUMMARY

In accordance with the City of Ottawa's Environmental Noise Control Guidelines, this report and associated study present an assessment of the environmental noise impacting on the property identified as Champagne Apartments, located at 16 and 20 Champagne Avenue South in Ottawa, Ontario. This development proposal is made by JLG Developments Inc.

With respect to the residential intention of the development, the assessment indicates that indoor noise level limits due to transportation sources in some of the units will only be met when windows are closed. These units require central air conditioning and building envelope components designed to ensure indoor sound level limits are met.

An assessment of building envelope components (windows, doors, and exterior walls) has been completed in order to identify construction requirements to ensure indoor sound level limits are met. The results are included in this report.

The assessment also indicate that the outdoor amenity area (rear yard) will be exposed to noise in excess of the requirements. However, there are no practical measures that can be implemented by the proponents to mitigate this noise. Deletion of the rear yard is not recommended.

The results indicate that the noise emissions for the site will, with respect to background levels of noise, comply with City of Ottawa Environmental Noise Control Guidelines and therefore, do not constrain the proposed property development.

1.0 INTRODUCTION / BACKGROUND INFORMATION

In accordance with the City of Ottawa's Environmental Noise Guidelines (ENCG), this report provides a detailed study of the environmental noise impact upon the development proposed by JLG Developments Inc. and located at 16 and 20 Champagne Avenue South in Ottawa, Ontario.

The proposed development involves the removal of two existing two-storey dwellings, and the construction of a new three-storey apartment building. The development will include 19 new apartment units (total for all floors, including three basement units), and an Outdoor Living Area (OLA) identified as the rear yard.

In accordance with City and Provincial Guidelines, ambient noise levels due to significant sources of road traffic are assessed and compared with applicable sound levels limits. Noise levels are assessed at living/dining and bedroom windows on the north and east façades of the proposed building, as well as at the rear yard.

Site plans are provided in Appendix A, with the assessment locations marked.

1.1 REFERENCES

This study is based on information presented in the following drawings:

- 1809 16&20 Champagne 180704.pdf (received 04 July 2018 by email)
- Preliminary unit layouts and façade designs, received 12 July 2018 by email.

Reference is made to the following documents:

- 1) Ontario Ministry of the Environment and Climate Change (MOECC) Environmental Noise Guideline publication NPC-300: Stationary and Transportation Sources - Approval and Planning, dated August 2013
- 2) City of Ottawa Environmental Noise Control Guidelines updated January 2016 (ENCG)
- 3) City of Ottawa Transportation Master Plan, November 2013 (TMP)

- 4) City of Ottawa Noise By-law No. 2017-255
- 5) Ontario Ministry of the Environment and Climate Change (MOECC) modelling tool STAMSON, version 5.02
- 6) DBR/NRC Building Research Note BRN148: Acoustic Insulation Factor, dated June 1980 (BRN 148)

In this report:

- Unless otherwise indicated, noise levels are reported in terms of sound pressure levels ("SPL") in decibels, referenced to 2×10^{-5} pascals.

1.2 PURPOSE

The purpose of this report is to demonstrate that Champagne Apartments can be developed in a manner that meets all applicable requirements with respect to environmental noise.

1.3 SCOPE

This Noise Impact Assessment Study presents a detailed study of the issues, as defined by the ENCG. No further study is required or proposed.

The scope of this report is limited to the issues described above, and makes no claim as to the validity of the noise level criteria or their ability to satisfy the expectations of all persons.

2.0 SOUND LEVEL CRITERIA

2.1 TRANSPORTATION NOISE

The applicable outdoor and indoor sound level limits due to road noise per the ENCG and NPC-300 are summarized in Table 1 and Table 2. There are no significant sources of rail or aircraft noise in the vicinity of the project.

Table 1: Sound Level Limit for Outdoor Living Areas

Time Period	$L_{eq}(16)$ dBA
16 hours between 07:00-23:00	55*

*Where it can be demonstrated to the satisfaction of the City of Ottawa that achieving the outdoor 55 dBA L_{eq} is not technically or economically feasible, a tolerance of not more than 5 dB above the stated limit may be acceptable.

Table 2: Sound Level Limits for Indoor Living Areas

Type of Space	Time Period	Road L_{eq} dBA
Living/dining, den areas of residences, hospitals, nursing homes schools, daycare centres, etc. rooms and dens of residences	16 hours between 07:00-23:00	45
Living/dining, den areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	8 hours between 23:00-07:00	45
Sleeping quarters	16 hours between 07:00-23:00	45
	8 hours between 23:00-07:00	40

The indoor sound level analysis is based on sound levels calculated at the façades or Planes Of Windows (POW) to noise-sensitive indoor spaces. Depending on POW noise levels, noise control measures affecting ventilation systems for residential units (to allow windows to remain closed) may be required. The ventilation requirements are summarized in Table 3, per NPC-300.

Table 3: Ventilation Requirements

Assessment Location	Daytime Noise Level (L_{eq} 16 hr)	Nighttime Noise Level (L_{eq} 8 hr)	Ventilation Requirements
Plane of a bedroom or living/dining room window	Up to 55 dBA	Up to 50 dBA	None
	Up to 65 dBA	Up to 60 dBA	Provision for the installation of central air conditioning in the future, at occupant's discretion
	Above 65 dBA	Above 60 dBA	Central air conditioning

Depending on noise levels calculated at POWs, an analysis may be required in order to identify façade components (exterior walls, windows, and doors as applicable) that will ensure that indoor noise level limits are met. The requirements are summarized in Table 4.

Table 4: Building Component Requirements (Road Noise)

Assessment Location	Daytime Noise Level (L_{eq} 16 hr)	Nighttime Noise Level (L_{eq} 8 hr)	Building Component Requirements
Plane of a bedroom or living/dining room window	Up to 65 dBA	Up to 60 dBA	Per the Ontario Building Code
	Above 65 dBA	Above 60 dBA	Must be designed to ensure indoor criteria are met*

* Per the ENCG (Section 5.2, page 14), the preferred assessment method is the Acoustic Insulation Factor (AIF) method.

2.2 STATIONARY SOURCE NOISE

This project is located within a Class 1 area, which is the acoustical environment typical of a major population centre. The surrounding environment can be characterized as primarily residential and adjacent to major transportation arteries. In the following table, sound level exclusion limits are extracted from the MOECC Guideline.

Table 5: Exclusion Limits for Class 1 Area

Receiver Area (Class #)	Time Period	Exclusion Limit Value, 1-hour L_{eq} , dBA	
		<i>Outdoor Point of Reception</i>	<i>Plane of Window of Noise Sensitive Space</i>
Class 1 (Ref: MOECC NPC-300)	07:00 – 19:00	50	50
	19:00 - 23:00	50	50
	23:00 - 07:00	(n/a)	45

Per NPC-300, unless it can be demonstrated that background sound levels consistently exceed the exclusion limits in a given time period, the exclusion limits set the sound level limit for noise from a stationary source.

3.0 TRANSPORTATION NOISE ASSESSMENT

3.1 ROAD TRAFFIC INFORMATION

The City of Ottawa Transportation Master Plan has been used to identify significant roadways within the vicinity of the project that must be included in noise level calculations. The significant roadways are the eastbound and westbound segments of Highway 417 (see Area Plan, Figure A.2). Average Annual Daily Traffic (AADT) volumes have been assigned and divided by time-of-day and vehicle categories per ENCG requirements (ENCG, Appendix B). The traffic data used for noise level calculations are summarized in Table 6. In order to account for changes in direction and varying heights of noise barriers along Highway 417, the northbound and eastbound segments have been further sub-divided into segments labelled A, B, and C, each with identical AADT values (refer to Figure A.3 for details).

Table 6: Roadway Traffic Flow Data

Roadway Segment	Roadway Class	Speed Limit	Total AADT	AADT by Vehicle Type and Time of Day (Daytime / Nighttime)		
				Cars	Medium Trucks	Heavy Trucks
Highway 417 eastbound	8-lane Highway	100 km/h	146664	59370/5163	4723/411	3373/293
Highway 417 westbound				59370/5163	4723/411	3373/293

Traffic flow was presumed to be at the centre of each roadway segment, as is normal practice.

3.2 POINTS OF ASSESSMENT

The following Points of Assessment (POA) form part of this Noise Study. These locations have been selected due to their potential to be worst-case locations in terms of noise levels or building component requirements. The assessment locations are shown on the Site Plan included in Appendix A.

- POA 1 is located on the north façade of the building at a height of 2.5 m above ground, corresponding to approximately the centre of the ground floor. The assessment location has significant exposure to Highway 417.
- POA 2 is located on the north façade of the building at a height of 9.5 m above ground, corresponding to approximately the centre of the top floor. The assessment location represents the worst-case in terms of exposure to Highway 417.
- POA 3 is located on the east façade, near the north-east corner of the building, at a height of 2.5 m above ground. The assessment location is representative of the worst-case noise level on the west and east façades at ground level.
- POA 4 is located on the east façade, near the north-east corner of the building, at a height of 9.5 m above ground. The assessment location is representative of the worst-case noise level on the west and east façades for the second and third floors.
- POA 5 is located in the rear yard at 3 m from the centre of the west façade. The assessment height is 1.5 m above ground.

Highway 417 is elevated in relation to the grade at 16 and 20 Champagne Avenue South by approximately 6 m relative to the east façade of the building, which has been accounted for in our calculations (POA 1, POA 2, POA 3 and POA 4). To account for the higher grade at the rear yard compared to the east façade, our calculations account for a 4 m height difference between POA 5 and Highway 417.

3.3 TRAFFIC NOISE CALCULATION DETAILS AND RESULTS

Noise level calculations were made at each POA using the MOECC tool STAMSON, version 5.02. Table 7 summarizes distances and angles used for calculations at each POA. To account for low-rise buildings located between the proposed development and Highway 417, the calculations include 3 rows of houses with 30% density for the first row. A reflective ground surface has been assumed in all cases. The detailed calculation results are included as Appendix B, and the results are summarized in Table 8.

Table 7: STAMSON Calculation Details

POA			Roadway Segments				Barriers				
ID	Height (m)	Gnd Elev (m)	Name	Angles (deg)	D to POA (m)	Gnd Elev (m)	Description (refer to Figure A.3)	Angles (deg)	D to POA (m)	Height (m)	Gnd Elev (m)
1	2.5	0.0	HW417AE	-90 to -39	122.2	6.0	417 (tall)	-90 to -39	111.8	4.0	6.0
			HW417AW	-90 to -39	139.6	6.0	417 (tall)	-90 to -39	111.8	4.0	6.0
			HW417BE	-39 to 21	122.2	6.0	417 (short)	-39 to 21	111.8	1.5	6.0
			HW417BW	-39 to 21	139.6	6.0	417 (short)	-39 to 21	111.8	1.5	6.0
			HW417CE	16 to 90	120.4	6.0	417 (short)	16 to 56	111.8	1.5	6.0
			HW417CW	16 to 90	141.8	6.0	417 (short)	16 to 56	111.8	1.5	6.0
2	9.5	0.0	HW417AE	-90 to -39	122.2	6.0	417 (tall)	-90 to -39	111.8	4.0	6.0
			HW417AW	-90 to -39	139.6	6.0	417 (tall)	-90 to -39	111.8	4.0	6.0
			HW417BE	-39 to 21	122.2	6.0	417 (short)	-39 to 21	111.8	1.5	6.0
			HW417BW	-39 to 21	139.6	6.0	417 (short)	-39 to 21	111.8	1.5	6.0
			HW417CE	16 to 90	120.4	6.0	417 (short)	16 to 56	111.8	1.5	6.0
			HW417CW	16 to 90	141.8	6.0	417 (short)	16 to 56	111.8	1.5	6.0
3	2.5	0.0	HW417BE	0 to 17	123.1	6.0	417 (short)	0 to 17	114.0	1.5	6.0
			HW417BW	0 to 17	140.5	6.0	417 (short)	0 to 17	114.0	1.5	6.0
			HW417CE	12 to 90	127.1	6.0	417 (short)	12 to 49	114.0	1.5	6.0
			HW417CW	12 to 90	143.2	6.0	417 (short)	12 to 49	114.0	1.5	6.0
4	9.5	0.0	HW417BE	0 to 17	123.1	6.0	417 (short)	0 to 17	114.0	1.5	6.0
			HW417BW	0 to 17	140.5	6.0	417 (short)	0 to 17	114.0	1.5	6.0
			HW417CE	12 to 90	127.1	6.0	417 (short)	12 to 49	114.0	1.5	6.0
			HW417CW	12 to 90	143.2	6.0	417 (short)	12 to 49	114.0	1.5	6.0
5	1.5	0.0	HW417AE	-90 to -30	130.2	4.0	417 (tall)	-90 to -30	121.5	4.0	4.0
			HW417AW	-90 to -30	147.6	4.0	417 (tall)	-90 to -30	121.5	4.0	4.0
			HW417BE	-30 to 28	130.2	4.0	417 (short)	-30 to 28	121.5	1.5	4.0
			HW417BW	-30 to 28	147.6	4.0	417 (short)	-30 to 28	121.5	1.5	4.0
			HW417CE	23 to 90	138.8	4.0	Proposed building	23 to 90	3.0	9.5	0.0
			HW417CW	23 to 90	147.8	4.0	Proposed building	23 to 90	3.0	9.5	0.0

Table 8: Summary of Traffic Noise Level Calculation Results

Location	Calculated Noise Level Daytime (OLA or plane of window)	Calculated Noise Level Nighttime (plane of bedroom window)
POA 1 North façade, ground floor	69 dBA L_{eq}	61 dBA L_{eq}
POA 2 North façade, top floor	70 dBA L_{eq}	62 dBA L_{eq}
POA 3 East façade, ground floor	67 dBA L_{eq}	59 dBA L_{eq}
POA 4 East façade, top floor	68 dBA L_{eq}	60 dBA L_{eq}
POA 5 OLA: rear yard	66 dBA L_{eq}	N/A

3.4 INDOOR NOISE CONTROL MEASURES: APARTMENTS

The calculation results confirm that indoor noise control measures are required for units with line-of-sight to the highway. The south façade is shielded by the building and is therefore exposed to a significantly lower noise level. The ventilation and building component requirements are summarized below.

Table 9: Summary of Noise Control Requirements

Units	Ventilation Requirements	Building Component Requirements
All units with windows on north, east, or west façades (all heights)	Central air conditioning	Components must be designed to ensure indoor noise level limits are met
Units with south-facing windows only	No ventilation requirements	Per OBC (no special requirements for noise)

In addition, Notices-on-Title are required with respect to noise for units that include noise control measures. Recommended wording per the ENCG and NPC-300 is included in Appendix D.

As noted in Table 9, components must be designed to ensure that indoor noise level limits are met in some areas. Details are provided in Section 3.6 and Appendix C.

3.5 NOISE CONTROL MEASURES: OUTDOOR AMENITY AREA

The noise level calculation at POA '5' exceeds the 55 dBA limit for transportation noise. Given the size and location of the development, and the elevation of the rear yard relative to the noise source (Highway 417), there are no practical measures that can be implemented as part of the proposed development to reduce noise levels at the rear yard. Noise levels could be effectively reduced via an enhancement of the noise barrier along the south of Highway 417. There are many existing residential OLAs in the area that will be subject to similar noise levels. Should the Province upgrade the barriers along Highway 417 in the future, noise levels from road traffic will be reduced throughout the neighbourhood.

No noise control measures are recommended for the rear yard. A Notice-on-Title is required to alert tenants of the potential for disturbance. Recommended wording is included in Appendix D.

3.6 ACOUSTIC INSULATION FACTOR ANALYSIS

An Acoustic Insulation Factor (AIF) analysis was performed according to BRN148 in order to confirm façade component construction requirements that will ensure indoor sound level limits are met within the proposed apartments. The façade components include the exterior wall, windows that are fixed and sealed to the frame, and operable windows. Glass patio doors are treated as operable windows.

Intermediate calculation results for the AIF analysis are provided in Appendix C.

3.6.1 Exterior Wall Construction

Exterior wall constructions have not been developed for the project at the time of preparation of this report. Our calculations have assumed construction equivalent to NRC exterior wall type EW1 (per BRN148). The construction details for EW1 are provided below.

- 12.7 mm gypsum board
- vapour barrier
- 38 by 89 mm studs
- 50 mm (or thicker) mineral wool or glass fibre batts
- sheathing

- wood siding, or metal siding and fibre backer board

Exterior wall assemblies which include heavier or additional layers of sheet material (drywall or sheathing), additional insulation or cavity thickness, and/or thicker or heavier cladding materials compared to EW1 will generally provide equivalent or superior performance in terms of noise transmission loss.

3.6.2 Fixed and Operable Windows

The window requirements have been determined based on the calculated outdoor sound levels at the building façades, and dimensions derived from preliminary drawings of the building façades and unit layouts. Based on our analysis, we propose the following minimum construction for all fixed and operable windows on the north, east, and west façades:

- double-glazed units, each pane 3mm thick, with 6mm interpane spacing.

Based on our understanding that façade component areas and room dimensions may change compared to the preliminary design, we have determined upper limits of Area Ratios for each façade component, included in Table 10. The Area Ratio is defined as the surface area of a façade component (exterior wall, operable window, or fixed window) divided by the floor area, for a given room. Therefore, larger windows and/or smaller room dimensions compared to the preliminary design can be accommodated, provided that the resulting Area Ratios do not exceed the applicable upper-limit values in Table 10.

Table 10: Upper Limit of Area Ratios for Window AIF Analysis

Space Type	Façade	Maximum Area Ratios (wall or window area relative to floor area)		
		Exterior Wall	Operable Windows	Fixed Windows
Living/Kitchen areas with windows on one or two façades	North	56%	11%	14%
	East or west	35%	17%	28%
Bedrooms with two exterior walls, windows on one façade only	North	142%	14%	28%
	East or west	142%	28%	35%
Studies with exterior walls and windows on one façade only	North	89%	28%	17%
	East or west	142%	35%	44%

Should a revised design result in the above Area Ratios being exceeded, additional calculations would be required to determine suitable component constructions to meet indoor noise level limits.

4.0 STATIONARY NOISE IMPACT ASSESSMENT

4.1 ON-SITE STATIONARY NOISE SOURCE EMISSIONS

With reference to the ENCG and NPC-300, operation of Champagne Apartments, in its entirety, is considered a “Stationary Source”. Therefore, as part of the mechanical design, all new exterior equipment serving multiple dwellings or common areas must be selected such that total emissions from the site comply with NPC-300 limits for a stationary noise source. Note that this excludes equipment serving individual dwellings (e.g. air conditioning equipment), which are instead subject to limits found in City of Ottawa By-law No. 2017-255.

4.2 OFF-SITE STATIONARY NOISE SOURCE EMISSIONS

A site visit was conducted on 09 July 2018 to review the site and its surroundings. It was confirmed that all of the surrounding properties are low-rise residential. We therefore conclude that there are no concerns regarding the impact of existing off-site stationary noise sources upon the proposed development.

5.0 RECOMMENDATIONS

The following noise control measures are recommended:

- Central air conditioning for all units with windows on the north, south, or east façades;
- Exterior wall construction with performance equivalent to or exceeding EW1 construction (see Section 3.6.1), in terms of noise transmission loss;
- The following minimum construction for operable and fixed windows on the north, east, and west façade (provided that the Area Ratios shown in Table 10 are not exceeded – otherwise, additional calculations will be necessary):
 - double-glazed units, each pane 3mm thick, with 6mm interpane spacing;
- Notices-on-Title respecting noise (recommended wording is attached as Appendix D).

While the calculated noise level at the outdoor amenity area (rear yard) is above the published requirements, there is nothing practical that can be done by the developers to lower it other than deletion of the rear yard (not recommended).

In addition to the above, any new on-site mechanical equipment for the proposed development shall be designed to meet ENCG and NPC-300 requirements for noise emissions from a stationary source, as applicable.

We conclude that the project can be developed such that all environmental noise requirements are met.

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22 August 2018

This Noise Impact Assessment Study was prepared by Integral DX Engineering for the account of JLG Developments Inc.. The material in it reflects Integral DX Engineering's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibilities of such third parties. Integral DX Engineering accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Attachments:

- Appendix A: Figures
- Appendix B: Stamson 5.02 outputs dated 02 August 2018
- Appendix C: Results of AIF Analysis
- Appendix D: Recommended Wording for Notices-on-Title

APPENDIX A: FIGURES

(attachment to Integral DX Engineering Ltd. report dated 22 August 2018)

INCLUDED FIGURES

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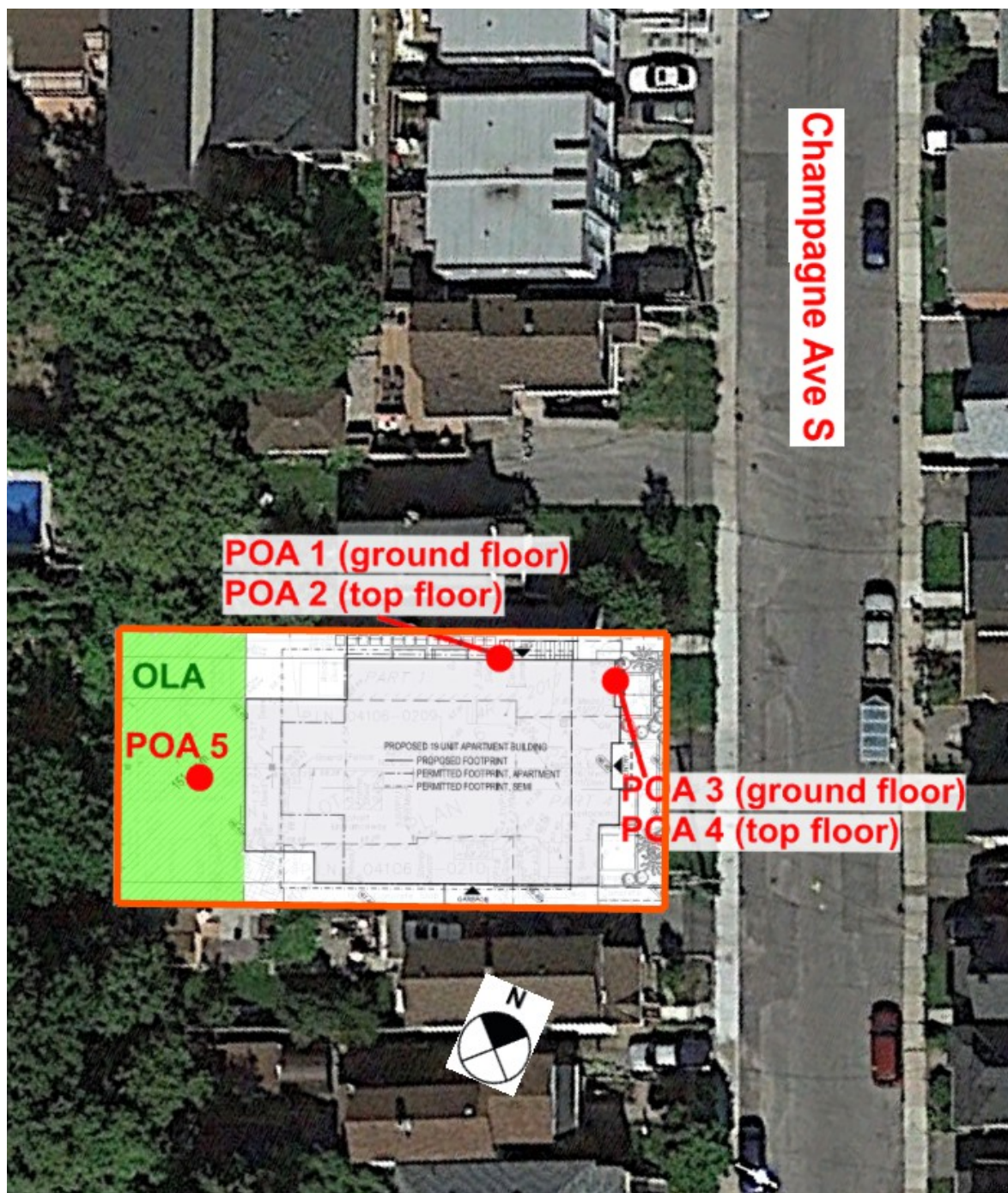


Figure A.1: Site Plan with Points of Assessment Marked



Figure A.2: Area Plan showing Proposed Development in Context

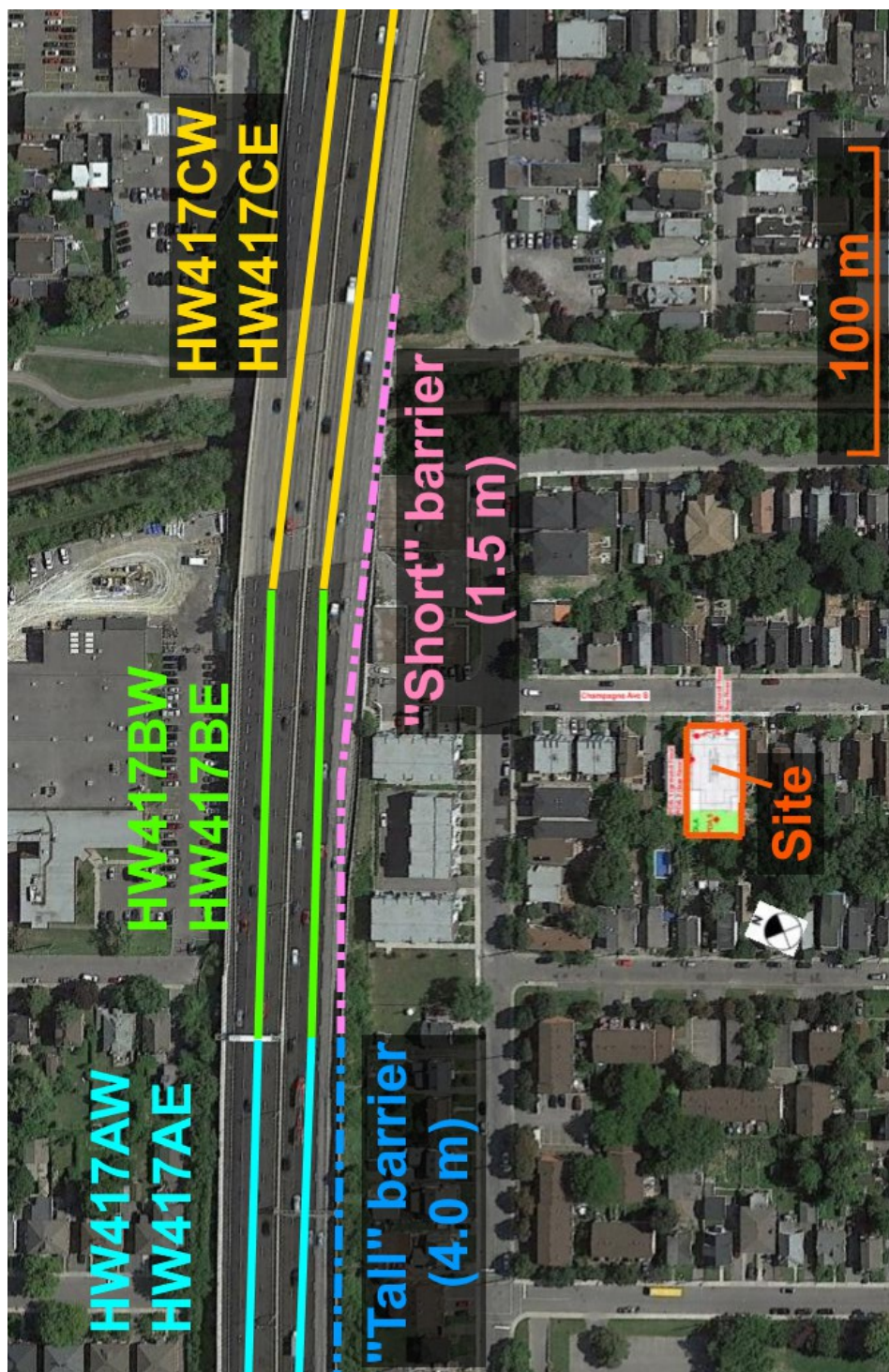


Figure A.3: Roadway Segments and Barriers for STAMSON Calculations

APPENDIX B: STAMSON 5.02 OUTPUTS DATED 02 AUGUST 2018

(attachment to Integral DX Engineering Ltd. report dated 22 August 2018)

STAMSON 5.0 SUMMARY REPORT Date: 02-08-2018 13:50:31
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: POA1.te Time Period: Day/Night 16/8 hours
 Description: North Facade, Ground Floor

Road data, segment # 1: HW417AE (day/night)

```
-----
Car traffic volume   : 59370/5163   veh/TimePeriod  *
Medium truck volume : 4723/411    veh/TimePeriod  *
Heavy truck volume  : 3373/293    veh/TimePeriod  *
Posted speed limit  : 100 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): 73332
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: HW417AE (day/night)

```
-----
Angle1   Angle2       : -90.00 deg   -39.00 deg
Wood depth      : 0 (No woods.)
No of house rows : 3 / 3
House density   : 30 %
Surface        : 2 (Reflective ground surface)
Receiver source distance : 122.20 / 122.20 m
Receiver height : 2.50 / 2.50 m
Topography     : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg   Angle2 : -39.00 deg
Barrier height  : 4.00 m
Elevation      : 6.00 m
Barrier receiver distance : 111.80 / 111.80 m
Source elevation : 6.00 m
Receiver elevation : 0.00 m
Barrier elevation : 6.00 m
Reference angle : 0.00
```

Road data, segment # 2: HW417AW (day/night)

```

-----
Car traffic volume   : 59370/5163   veh/TimePeriod  *
Medium truck volume : 4723/411    veh/TimePeriod  *
Heavy truck volume  : 3373/293    veh/TimePeriod  *
Posted speed limit  : 100 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): 73332
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: HW417AW (day/night)

```

-----
Angle1   Angle2       : -90.00 deg   -39.00 deg
Wood depth          : 0             (No woods.)
No of house rows    : 3 / 3
House density       : 30 %
Surface             : 2             (Reflective ground surface)
Receiver source distance : 139.60 / 139.60 m
Receiver height     : 2.50 / 2.50 m
Topography          : 4             (Elevated; with barrier)
Barrier angle1      : -90.00 deg   Angle2 : -39.00 deg
Barrier height      : 4.00 m
Elevation           : 6.00 m
Barrier receiver distance : 111.80 / 111.80 m
Source elevation    : 6.00 m
Receiver elevation  : 0.00 m
Barrier elevation    : 6.00 m
Reference angle     : 0.00

```

Road data, segment # 3: HW417BE (day/night)

```

-----
Car traffic volume   : 59370/5163   veh/TimePeriod  *
Medium truck volume : 4723/411    veh/TimePeriod  *
Heavy truck volume  : 3373/293    veh/TimePeriod  *
Posted speed limit  : 100 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): 73332
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: HW417BE (day/night)

 Angle1 Angle2 : -39.00 deg 21.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 122.20 / 122.20 m
 Receiver height : 2.50 / 2.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : -39.00 deg Angle2 : 21.00 deg
 Barrier height : 1.50 m
 Elevation : 6.00 m
 Barrier receiver distance : 111.80 / 111.80 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Road data, segment # 4: HW417BW (day/night)

 Car traffic volume : 59370/5163 veh/TimePeriod *
 Medium truck volume : 4723/411 veh/TimePeriod *
 Heavy truck volume : 3373/293 veh/TimePeriod *
 Posted speed limit : 100 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): 73332
 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 # 4: HW417BW (day/night)

 Angle1 Angle2 : -39.00 deg 21.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 139.60 / 139.60 m
 Receiver height : 2.50 / 2.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : -39.00 deg Angle2 : 21.00 deg

Barrier height : 1.50 m
 Elevation : 6.00 m
 Barrier receiver distance : 111.80 / 111.80 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Road data, segment # 5: HW417CE (day/night)

 Car traffic volume : 59370/5163 veh/TimePeriod *
 Medium truck volume : 4723/411 veh/TimePeriod *
 Heavy truck volume : 3373/293 veh/TimePeriod *
 Posted speed limit : 100 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): 73332
 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 # 5: HW417CE (day/night)

 Angle1 Angle2 : 16.00 deg 90.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 120.40 / 120.40 m
 Receiver height : 2.50 / 2.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : 16.00 deg Angle2 : 56.00 deg
 Barrier height : 1.50 m
 Elevation : 6.00 m
 Barrier receiver distance : 111.80 / 111.80 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Road data, segment # 6: HW417CW (day/night)

 Car traffic volume : 59370/5163 veh/TimePeriod *
 Medium truck volume : 4723/411 veh/TimePeriod *

Heavy truck volume : 3373/293 veh/TimePeriod *
 Posted speed limit : 100 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): 73332
 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 # 6: HW417CW (day/night)

 Angle1 Angle2 : 16.00 deg 90.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 141.80 / 141.80 m
 Receiver height : 2.50 / 2.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : 16.00 deg Angle2 : 56.00 deg
 Barrier height : 1.50 m
 Elevation : 6.00 m
 Barrier receiver distance : 111.80 / 111.80 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Result summary (day)

	! source !	Road !	Total !
	! height !	Leq !	Leq !
	! (m) !	(dBA) !	(dBA) !
	+	+	+
1.HW417AE	! 1.50 !	57.11 !	57.11
2.HW417AW	! 1.50 !	57.70 !	57.70
3.HW417BE	! 1.50 !	62.05 !	62.05
4.HW417BW	! 1.50 !	60.91 !	60.91
5.HW417CE	! 1.50 !	63.61 !	63.61
6.HW417CW	! 1.50 !	62.63 !	62.63
	+	+	+
Total			69.07 dBA

Result summary (night)

	!	source	!	Road	!	Total
	!	height	!	Leq	!	Leq
	!	(m)	!	(dBA)	!	(dBA)
1.HW417AE	!	1.49	!	49.51	!	49.51
2.HW417AW	!	1.49	!	50.10	!	50.10
3.HW417BE	!	1.49	!	54.45	!	54.45
4.HW417BW	!	1.49	!	53.31	!	53.31
5.HW417CE	!	1.49	!	56.01	!	56.01
6.HW417CW	!	1.49	!	55.04	!	55.04
Total						61.47 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 69.07
 (NIGHT): 61.47

STAMSON 5.0 SUMMARY REPORT Date: 02-08-2018 13:50:47
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: POA2.te Time Period: Day/Night 16/8 hours
 Description: North Facade, Top Floor

Road data, segment # 1: HW417AE (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
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: HW417AE (day/night)

```
-----
Angle1 Angle2 : -90.00 deg -39.00 deg
Wood depth : 0 (No woods.)
No of house rows : 3 / 3
House density : 30 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 122.20 / 122.20 m
Receiver height : 9.50 / 9.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -39.00 deg
Barrier height : 4.00 m
Elevation : 6.00 m
Barrier receiver distance : 111.80 / 111.80 m
Source elevation : 6.00 m
Receiver elevation : 0.00 m
Barrier elevation : 6.00 m
Reference angle : 0.00
```

Road data, segment # 2: HW417AW (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
 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: HW417AW (day/night)

 Angle1 Angle2 : -90.00 deg -39.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 139.60 / 139.60 m
 Receiver height : 9.50 / 9.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : -90.00 deg Angle2 : -39.00 deg
 Barrier height : 4.00 m
 Elevation : 6.00 m
 Barrier receiver distance : 111.80 / 111.80 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Road data, segment # 3: HW417BE (day/night)

 Car traffic volume : 59370/5163 veh/TimePeriod *
 Medium truck volume : 4723/411 veh/TimePeriod *
 Heavy truck volume : 3373/293 veh/TimePeriod *
 Posted speed limit : 100 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): 73332
 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: HW417BE (day/night)

 Angle1 Angle2 : -39.00 deg 21.00 deg


```

Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 122.20 / 122.20 m
Receiver height      :      9.50 / 9.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       : -39.00 deg   Angle2 : 21.00 deg
Barrier height       :      1.50 m
Elevation            :      6.00 m
Barrier receiver distance : 111.80 / 111.80 m
Source elevation     :      6.00 m
Receiver elevation   :      0.00 m
Barrier elevation    :      6.00 m
Reference angle      :      0.00

```

Road data, segment # 4: HW417BW (day/night)

```

Car traffic volume   : 59370/5163   veh/TimePeriod *
Medium truck volume  : 4723/411     veh/TimePeriod *
Heavy truck volume   : 3373/293     veh/TimePeriod *
Posted speed limit   : 100 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): 73332
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 # 4: HW417BW (day/night)

```

Angle1   Angle2       : -39.00 deg   21.00 deg
Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 139.60 / 139.60 m
Receiver height      :      9.50 / 9.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       : -39.00 deg   Angle2 : 21.00 deg
Barrier height       :      1.50 m
Elevation            :      6.00 m
Barrier receiver distance : 111.80 / 111.80 m
Source elevation     :      6.00 m
Receiver elevation   :      0.00 m
Barrier elevation    :      6.00 m

```

Reference angle : 0.00

Road data, segment # 5: HW417CE (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
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 # 5: HW417CE (day/night)

```
-----
Angle1 Angle2 : 16.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 3 / 3
House density : 30 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 120.40 / 120.40 m
Receiver height : 9.50 / 9.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : 16.00 deg Angle2 : 56.00 deg
Barrier height : 1.50 m
Elevation : 6.00 m
Barrier receiver distance : 111.80 / 111.80 m
Source elevation : 6.00 m
Receiver elevation : 0.00 m
Barrier elevation : 6.00 m
Reference angle : 0.00
```

Road data, segment # 6: HW417CW (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
 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 # 6: HW417CW (day/night)

 Angle1 Angle2 : 16.00 deg 90.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 141.80 / 141.80 m
 Receiver height : 9.50 / 9.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : 16.00 deg Angle2 : 56.00 deg
 Barrier height : 1.50 m
 Elevation : 6.00 m
 Barrier receiver distance : 111.80 / 111.80 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Result summary (day)

	! source !	Road !	Total
	! height !	Leq !	Leq
	! (m) !	(dBA) !	(dBA)
1.HW417AE	! 1.50 !	58.22 !	58.22
2.HW417AW	! 1.50 !	59.52 !	59.52
3.HW417BE	! 1.50 !	63.12 !	63.12 *
4.HW417BW	! 1.50 !	62.55 !	62.55 *
5.HW417CE	! 1.50 !	64.09 !	64.09 *
6.HW417CW	! 1.50 !	63.40 !	63.40 *
Total			70.07 dBA

* Bright Zone !

Result summary (night)

! source ! Road ! Total

	!	height	!	Leq	!	Leq
	!	(m)	!	(dBA)	!	(dBA)
1.HW417AE	!	1.49	!	50.62	!	50.62
2.HW417AW	!	1.49	!	51.92	!	51.92
3.HW417BE	!	1.49	!	55.52	!	55.52 *
4.HW417BW	!	1.49	!	54.96	!	54.96 *
5.HW417CE	!	1.49	!	56.49	!	56.49 *
6.HW417CW	!	1.49	!	55.80	!	55.80 *
Total						62.47 dBA

* Bright Zone !

TOTAL Leq FROM ALL SOURCES (DAY): 70.07
(NIGHT): 62.47

STAMSON 5.0 SUMMARY REPORT Date: 02-08-2018 13:50:59
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: POA3.te Time Period: Day/Night 16/8 hours
 Description: East Facade, Ground Floor

Road data, segment # 1: HW417BE (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
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: HW417BE (day/night)

```
-----
Angle1 Angle2 : 0.00 deg 17.00 deg
Wood depth : 0 (No woods.)
No of house rows : 3 / 3
House density : 30 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 123.10 / 123.10 m
Receiver height : 2.50 / 2.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : 0.00 deg Angle2 : 17.00 deg
Barrier height : 1.50 m
Elevation : 6.00 m
Barrier receiver distance : 114.00 / 114.00 m
Source elevation : 6.00 m
Receiver elevation : 0.00 m
Barrier elevation : 6.00 m
Reference angle : 0.00
```

Road data, segment # 2: HW417BW (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
 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: HW417BW (day/night)

 Angle1 Angle2 : 0.00 deg 17.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 140.50 / 140.50 m
 Receiver height : 2.50 / 2.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : 0.00 deg Angle2 : 17.00 deg
 Barrier height : 1.50 m
 Elevation : 6.00 m
 Barrier receiver distance : 114.00 / 114.00 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Road data, segment # 3: HW417CE (day/night)

 Car traffic volume : 59370/5163 veh/TimePeriod *
 Medium truck volume : 4723/411 veh/TimePeriod *
 Heavy truck volume : 3373/293 veh/TimePeriod *
 Posted speed limit : 100 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): 73332
 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: HW417CE (day/night)

 Angle1 Angle2 : 12.00 deg 90.00 deg

```

Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 127.10 / 127.10 m
Receiver height       :      2.50 / 2.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       :      12.00 deg   Angle2 : 49.00 deg
Barrier height        :      1.50 m
Elevation            :      6.00 m
Barrier receiver distance : 114.00 / 114.00 m
Source elevation      :      6.00 m
Receiver elevation    :      0.00 m
Barrier elevation     :      6.00 m
Reference angle       :      0.00

```

Road data, segment # 4: HW417CW (day/night)

```

-----
Car traffic volume   : 59370/5163   veh/TimePeriod *
Medium truck volume  : 4723/411    veh/TimePeriod *
Heavy truck volume   : 3373/293    veh/TimePeriod *
Posted speed limit   : 100 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): 73332
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 # 4: HW417CW (day/night)

```

-----
Angle1   Angle2       : 12.00 deg   90.00 deg
Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 143.20 / 143.20 m
Receiver height       :      2.50 / 2.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       :      12.00 deg   Angle2 : 49.00 deg
Barrier height        :      1.50 m
Elevation            :      6.00 m
Barrier receiver distance : 114.00 / 114.00 m
Source elevation      :      6.00 m
Receiver elevation    :      0.00 m
Barrier elevation     :      6.00 m

```

Reference angle : 0.00

Result summary (day)

	!	source	!	Road	!	Total
	!	height	!	Leq	!	Leq
	!	(m)	!	(dBA)	!	(dBA)
1.HW417BE	!	1.50	!	56.59	!	56.59
2.HW417BW	!	1.50	!	55.43	!	55.43
3.HW417CE	!	1.50	!	63.60	!	63.60
4.HW417CW	!	1.50	!	62.92	!	62.92
Total						67.04 dBA

Result summary (night)

	!	source	!	Road	!	Total
	!	height	!	Leq	!	Leq
	!	(m)	!	(dBA)	!	(dBA)
1.HW417BE	!	1.49	!	48.99	!	48.99
2.HW417BW	!	1.49	!	47.83	!	47.83
3.HW417CE	!	1.49	!	56.00	!	56.00
4.HW417CW	!	1.49	!	55.32	!	55.32
Total						59.44 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.04
(NIGHT): 59.44

STAMSON 5.0 SUMMARY REPORT Date: 02-08-2018 13:51:11
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: POA4.te Time Period: Day/Night 16/8 hours
 Description: East Facade, Top Floor

Road data, segment # 1: HW417BE (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
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: HW417BE (day/night)

```
-----
Angle1 Angle2 : 0.00 deg 17.00 deg
Wood depth : 0 (No woods.)
No of house rows : 3 / 3
House density : 30 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 123.10 / 123.10 m
Receiver height : 9.50 / 9.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : 0.00 deg Angle2 : 17.00 deg
Barrier height : 1.50 m
Elevation : 6.00 m
Barrier receiver distance : 114.00 / 114.00 m
Source elevation : 6.00 m
Receiver elevation : 0.00 m
Barrier elevation : 6.00 m
Reference angle : 0.00
```

Road data, segment # 2: HW417BW (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
 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: HW417BW (day/night)

 Angle1 Angle2 : 0.00 deg 17.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 140.50 / 140.50 m
 Receiver height : 9.50 / 9.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : 0.00 deg Angle2 : 17.00 deg
 Barrier height : 1.50 m
 Elevation : 6.00 m
 Barrier receiver distance : 114.00 / 114.00 m
 Source elevation : 6.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 6.00 m
 Reference angle : 0.00

Road data, segment # 3: HW417CE (day/night)

 Car traffic volume : 59370/5163 veh/TimePeriod *
 Medium truck volume : 4723/411 veh/TimePeriod *
 Heavy truck volume : 3373/293 veh/TimePeriod *
 Posted speed limit : 100 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): 73332
 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: HW417CE (day/night)

 Angle1 Angle2 : 12.00 deg 90.00 deg

```

Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 127.10 / 127.10 m
Receiver height       :      9.50 / 9.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       :      12.00 deg   Angle2 : 49.00 deg
Barrier height       :      1.50 m
Elevation            :      6.00 m
Barrier receiver distance : 114.00 / 114.00 m
Source elevation      :      6.00 m
Receiver elevation    :      0.00 m
Barrier elevation     :      6.00 m
Reference angle      :      0.00

```

Road data, segment # 4: HW417CW (day/night)

```

-----
Car traffic volume   : 59370/5163   veh/TimePeriod  *
Medium truck volume  : 4723/411    veh/TimePeriod  *
Heavy truck volume   : 3373/293    veh/TimePeriod  *
Posted speed limit   : 100 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): 73332
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 # 4: HW417CW (day/night)

```

-----
Angle1   Angle2      : 12.00 deg   90.00 deg
Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 143.20 / 143.20 m
Receiver height       :      9.50 / 9.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       :      12.00 deg   Angle2 : 49.00 deg
Barrier height       :      1.50 m
Elevation            :      6.00 m
Barrier receiver distance : 114.00 / 114.00 m
Source elevation      :      6.00 m
Receiver elevation    :      0.00 m
Barrier elevation     :      6.00 m

```

Reference angle : 0.00

Result summary (day)

	!	source	!	Road	!	Total
	!	height	!	Leq	!	Leq
	!	(m)	!	(dBA)	!	(dBA)
1.HW417BE	!	1.50	!	57.61	!	57.61 *
2.HW417BW	!	1.50	!	57.05	!	57.05 *
3.HW417CE	!	1.50	!	64.09	!	64.09 *
4.HW417CW	!	1.50	!	63.59	!	63.59 *
Total						67.73 dBA

* Bright Zone !

Result summary (night)

	!	source	!	Road	!	Total
	!	height	!	Leq	!	Leq
	!	(m)	!	(dBA)	!	(dBA)
1.HW417BE	!	1.49	!	50.01	!	50.01 *
2.HW417BW	!	1.49	!	49.45	!	49.45 *
3.HW417CE	!	1.49	!	56.49	!	56.49 *
4.HW417CW	!	1.49	!	55.99	!	55.99 *
Total						60.13 dBA

* Bright Zone !

TOTAL Leq FROM ALL SOURCES (DAY) : 67.73
(NIGHT) : 60.13

STAMSON 5.0 SUMMARY REPORT Date: 02-08-2018 14:25:39
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: POA5.te Time Period: Day/Night 16/8 hours
Description: OLA at rear yard, no barrier

Road data, segment # 1: HW417AE (day/night)

Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
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: HW417AE (day/night)

Angle1 Angle2 : -90.00 deg -30.00 deg
Wood depth : 0 (No woods.)
No of house rows : 3 / 3
House density : 30 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 130.20 / 130.20 m
Receiver height : 1.50 / 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : -90.00 deg Angle2 : -30.00 deg
Barrier height : 4.00 m
Elevation : 4.00 m
Barrier receiver distance : 121.50 / 121.50 m
Source elevation : 4.00 m
Receiver elevation : 0.00 m
Barrier elevation : 4.00 m
Reference angle : 0.00

Road data, segment # 2: HW417AW (day/night)

Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
 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: HW417AW (day/night)

 Angle1 Angle2 : -90.00 deg -30.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 147.60 / 147.60 m
 Receiver height : 1.50 / 1.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : -90.00 deg Angle2 : -30.00 deg
 Barrier height : 4.00 m
 Elevation : 4.00 m
 Barrier receiver distance : 121.50 / 121.50 m
 Source elevation : 4.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 4.00 m
 Reference angle : 0.00

Road data, segment # 3: HW417BE (day/night)

 Car traffic volume : 59370/5163 veh/TimePeriod *
 Medium truck volume : 4723/411 veh/TimePeriod *
 Heavy truck volume : 3373/293 veh/TimePeriod *
 Posted speed limit : 100 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): 73332
 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: HW417BE (day/night)

 Angle1 Angle2 : -30.00 deg 28.00 deg

```

Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 130.20 / 130.20 m
Receiver height       :      1.50 / 1.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       : -30.00 deg   Angle2 : 28.00 deg
Barrier height       :      1.50 m
Elevation            :      4.00 m
Barrier receiver distance : 121.50 / 121.50 m
Source elevation      :      4.00 m
Receiver elevation    :      0.00 m
Barrier elevation     :      4.00 m
Reference angle      :      0.00

```

Road data, segment # 4: HW417BW (day/night)

```

Car traffic volume   : 59370/5163   veh/TimePeriod *
Medium truck volume  : 4723/411     veh/TimePeriod *
Heavy truck volume   : 3373/293     veh/TimePeriod *
Posted speed limit   : 100 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): 73332
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 # 4: HW417BW (day/night)

```

Angle1   Angle2       : -30.00 deg   28.00 deg
Wood depth           :      0      (No woods.)
No of house rows     :      3 / 3
House density        :      30 %
Surface              :      2      (Reflective ground surface)
Receiver source distance : 147.60 / 147.60 m
Receiver height       :      1.50 / 1.50 m
Topography           :      4      (Elevated; with barrier)
Barrier angle1       : -30.00 deg   Angle2 : 28.00 deg
Barrier height       :      1.50 m
Elevation            :      4.00 m
Barrier receiver distance : 121.50 / 121.50 m
Source elevation      :      4.00 m
Receiver elevation    :      0.00 m
Barrier elevation     :      4.00 m

```

Reference angle : 0.00

Road data, segment # 5: HW417CE (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
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 # 5: HW417CE (day/night)

```
-----
Angle1 Angle2 : 23.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 3 / 3
House density : 30 %
Surface : 2 (Reflective ground surface)
Receiver source distance : 138.80 / 138.80 m
Receiver height : 1.50 / 1.50 m
Topography : 4 (Elevated; with barrier)
Barrier angle1 : 23.00 deg Angle2 : 90.00 deg
Barrier height : 9.50 m
Elevation : 4.00 m
Barrier receiver distance : 3.00 / 3.00 m
Source elevation : 4.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00
```

Road data, segment # 6: HW417CW (day/night)

```
-----
Car traffic volume : 59370/5163 veh/TimePeriod *
Medium truck volume : 4723/411 veh/TimePeriod *
Heavy truck volume : 3373/293 veh/TimePeriod *
Posted speed limit : 100 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): 73332
 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 # 6: HW417CW (day/night)

 Angle1 Angle2 : 23.00 deg 90.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 3 / 3
 House density : 30 %
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 147.80 / 147.80 m
 Receiver height : 1.50 / 1.50 m
 Topography : 4 (Elevated; with barrier)
 Barrier angle1 : 23.00 deg Angle2 : 90.00 deg
 Barrier height : 9.50 m
 Elevation : 4.00 m
 Barrier receiver distance : 3.00 / 3.00 m
 Source elevation : 4.00 m
 Receiver elevation : 0.00 m
 Barrier elevation : 0.00 m
 Reference angle : 0.00

Result summary (day)

	! source !	Road !	Total !
	! height !	Leq !	Leq !
	! (m) !	(dBA) !	(dBA) !
1.HW417AE	! 1.50 !	57.03 !	57.03
2.HW417AW	! 1.50 !	58.14 !	58.14
3.HW417BE	! 1.50 !	61.87 !	61.87
4.HW417BW	! 1.50 !	60.98 !	60.98
5.HW417CE	! 1.50 !	49.91 !	49.91
6.HW417CW	! 1.50 !	49.64 !	49.64
	-----+-----+-----+-----		
	Total		66.17 dBA

Result summary (night)

! source ! Road ! Total
 ! height ! Leq ! Leq
 ! (m) ! (dBA) ! (dBA)

1.HW417AE	!	1.49	!	49.44	!	49.44
2.HW417AW	!	1.49	!	50.55	!	50.55
3.HW417BE	!	1.49	!	54.27	!	54.27
4.HW417BW	!	1.49	!	53.38	!	53.38
5.HW417CE	!	1.49	!	42.31	!	42.31
6.HW417CW	!	1.49	!	42.04	!	42.04
Total						58.57 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.17
(NIGHT): 58.57

APPENDIX C: RESULTS OF AIF ANALYSIS

(attachment to Integral DX Engineering Ltd. report dated 22 August 2018)

The table below shows intermediate calculation results for the AIF analysis, assuming the recommended exterior wall and window constructions (see Sections 3.6.1 and 3.6.2). The calculations were completed per BRN148 based on the information provided in the preliminary floor plans and façade drawings. Worst-case noise sensitive indoor locations were considered, factoring in façade noise levels, applicable indoor noise level limits, floor areas, façade component areas, and the number of façade components.

Table C.1: AIF Calculation Results

Indoor Location	Road Noise (dBA)				N (1)	Average AIF Needed	Floor Area (m²)	Components				
	Indoor Limit		Facade Level					Type (2)	Area (m²)	AR (3)	Actual Performance	
	Day	Night	Day	Night							AIF	▲PWL (4)
Unit 1 Bedroom	45	40	69.1	61.5	2	29	11.5	EW	2.9	25.1	43	-45
								F-W	0.9	7.8	37	-42
								Total				-129
Unit 1 Living and Kitchen	45	45	67.0	59.4	4	30	21.4	EW	4.6	21.3	44	-22
								OP-W	2.0	9.4	33	-12
								F-W	1.9	8.7	37	-20
								Total				-54
Unit 4 Bedroom	45	40	70.1	62.5	3	32	12.7	EW	8.5	66.5	39	-27
								OP-W	1.1	9.0	34	-12
								F-W	0.7	5.4	39	-27
								Total				-66
Unit 4 Liv/Din (north façade)	45	45	70.1	62.5	6	35	22.9	EW	11.6	50.6	40	-10
								OP-W	2.3	9.9	33	10
								F-W	1.4	6.0	38	-8
								Total				-8
Unit 4 Liv/Din (west façade)	45	45	67.7	60.1	6	33	22.9	EW	4.7	20.7	44	-15
								OP-W	0.6	2.7	37	-11
								F-W	2.1	9.0	37	-11
								Total				-37
Unit 10 Liv/Din/Kit (east6 façade)	45	45	67.7	60.1	4	31	38.3	EW	10.0	26.2	43	-22
								OP-W	6.3	16.4	31	0
								F-W	5.7	14.8	34	-12
								Total				-34
Unit 10 small bedroom	45	40	67.7	60.1	3	30	9.7	EW	6.8	70.0	39	-29
								OP-W	1.1	11.8	32	-12
								F-W	0.7	7.1	37	-27
								Total				-68
Unit 5 study	45	45	67.0	59.4	3	29	4.3	EW	3.2	75.0	38	-29
								OP-W	1.1	26.4	29	0
								F-W	0.7	15.9	34	-23
								Total				-52
Unit 5 bedroom	45	40	67.0	59.4	4	30	9.4	EW	5.5	58.7	39	-22
								OP-W	0.6	6.7	35	-17
								F-W	2.1	22.0	33	-12
								Total				-51

Notes:

(1) N refers to the number of different types of components.

(2) Component Types:

EW = Exterior Wall

OP-W = Operable Window

F-W = Fixed Window

(3) AR refers to the ratio of the component area and floor area, expressed as a percentage value.

(4) ▲PWL refers to the change in transmitted sound power for the specified component, compared to a component with an AIF rating equal to the average required rating. The room total value is provided, and must be less than or equal to 0 to meet the indoor sound level limit.

Additional calculations were completed to determine upper limits of Area Ratio (AR). The indoor noise level limits will be met with the recommended window and exterior wall constructions, provided that the Area Ratios shown in Table C.2 are not exceeded.

Table C.2: AIF Calculation Results with Area Ratio Upper Limits

Indoor Location	Road Noise (dBA)				N (1)	Average AIF Needed	Components			
	Indoor Limit		Facade Level				Type (2)	AR (3)	Actual Performance	
	Day	Night	Day	Night					AIF	▲PWL (4)
Worst-case for living/kitchen areas with windows on two façades. North façade requirements.	45	45	70.1	62.5	6	35	EW	56.0	40	-10
							OP-W	11.0	33	10
							F-W	14.0	35	0
							Total		0	
Worst-case for living/kitchen areas with windows on two façades. West façade requirements.	45	45	67.7	60.1	6	33	EW	35.0	42	-15
							OP-W	17.0	31	10
							F-W	28.0	32	4
							Total		-1	
Worst-case for bedrooms with windows on the north façade only, up to two exterior walls.	45	40	70.1	62.5	4	33	EW	142.0	36	-12
							OP-W	14.0	32	6
							F-W	28.0	32	6
							Total		0	
Worst-case for bedrooms with windows on the east or west façade only. Up to two exterior walls.	45	40	67.7	60.1	4	31	EW	142.0	36	-17
							OP-W	28.0	29	15
							F-W	35.0	31	0
							Total		-2	
Worst-case for study room with north façade exterior wall and windows (only).	45	45	70.1	62.5	3	32	EW	89.0	38	-25
							OP-W	28.0	29	33
							F-W	17.0	34	-12
							Total		-4	
Worst-case for study room with east or west façade exterior wall and windows (only).	45	45	67.7	60.1	3	30	EW	142.0	36	-25
							OP-W	35.0	28	20
							F-W	44.0	30	0
							Total		-5	

Notes:

(1) N refers to the number of different types of components.

(2) Component Types:

EW = Exterior Wall

OP-W = Operable Window

F-W = Fixed Window

(3) AR refers to the ratio of the component area and floor area, expressed as a percentage value.

(4) ▲PWL refers to the change in transmitted sound power for the specified component, compared to a component with an AIF rating equal to the average required rating. The room total value is provided, and must be less than or equal to 0 to meet the indoor sound level limit.

APPENDIX D: RECOMMENDED WORDING FOR NOTICES-ON-TITLE

(attachment to Integral DX Engineering Ltd. report dated 22 August 2018)

For all units:

"Purchasers/tenants are advised that sound levels due to increasing road traffic will interfere with outdoor activities as the sound levels exceed the sound level limits of the City and the Ministry of the Environment and Climate Change."

For all units with north, west, and/or east façade windows:

"To help address the need for sound attenuation this development includes multi-pane glass. To ensure that provincial sound level limits are not exceeded it is important to maintain these sound attenuation features."

"This dwelling unit has been supplied with a central air conditioning system and other measures which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment and Climate Change."

For all units:

"The Transferee covenants with the Transferor that the above clause, verbatim, shall be included in all subsequent Agreements of Purchase and Sale and Deeds conveying the lands described herein, which covenant shall run with the said lands and is for the benefit of the subsequent owners of the said lands and the owner of the adjacent road."