Environmental Noise Assessments

4005 Strandherd Drive High School

Ottawa, Ontario

REPORT: GWE18-012 – Environmental Noise R2

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EXECUTIVE SUMMARY

This document describes an environmental noise assessment performed for a proposed high school development located at 4005 Strandherd Drive in Ottawa, Ontario. The development comprises a new three-storey building as well as provisions for future expansion with a west wing as well as 12 portable classroom units. The site is located southwest of the Strandherd Drive & Chapman Mills Drive intersection. The site is surrounded by a mixture of commercial and residential land uses. The major sources of transportation noise are Strandherd Drive, Chapman Mills Drive, the proposed OC Transpo Bus Rapid Transit (BRT) corridor to the south, as well as a OC Transpo layby along Chapman Mills Drive. The major sources of stationary noise are from rooftop mechanical equipment atop the proposed building. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on: (i) theoretical noise prediction methods that conform to the Ministry of the Environment , Conservation, and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) architectural drawings and mechanical information received from GRC Architects.

The results of the current analysis indicate that transportation noise levels will range between 53 and 72 dBA during the daytime period (07:00-23:00) and between 46 and 65 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 72 dBA) occurs along the development's north façade, which are nearest and most exposed to Strandherd Drive. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated on Figure 3. Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable indoor environment. A Warning Clause will also be required to be placed on all Lease, Purchase and Sale Agreements, or Development Agreements, as summarized in Section 6.

Based on the assumptions in this report stationary noise levels from the school's HVAC equipment is expected to fall below ENCG criteria during all hours of the day. Since the noise levels fall below ENCG criteria, the proposed development is expected to be compatible with the existing and future noise

sensitive land uses. A review of final equipment selection and locations by a qualified acoustical engineer will be required prior to installation of the equipment.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by GRC Architects on behalf of Conseil des École Publiques de L'Est de L'Ontario to undertake an environmental noise assessment of a proposed high school development located at 4005 Strandherd Drive in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to an environmental noise assessment. GWE's scope of work involved assessing exterior and interior noise levels generated by local transportation sources, as well as consideration of stationary impacts from proposed mechanical equipment. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on preliminary architectural drawings and mechanical information received from GRC Architects, and 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 and vibration assessment is a proposed high school development, comprising a new three-storey building as well as provisions for future expansion with a west wing as well as 12 portable classroom units. The site is located southwest of the Strandherd Drive & Chapman Mills Drive intersection. The site is surrounded by mixed-use land, including commercial and residential. The major sources of transportation noise are Strandherd Drive, Chapman Mills Drive, the proposed OC Transpo Bus Rapid Transit (BRT) corridor to the south, as well as a OC Transpo bus layby along Chapman Mills Drive. The major sources of stationary noise are from rooftop mechanical equipment atop the proposed building. Figure 1 illustrates a complete site plan with surrounding context.

3. OBJECTIVES

The main goals of this work are to: (i) calculate the future noise levels on the study building produced by local transportation sources, (ii) calculate the future noise levels on surrounding noise-sensitive properties, as well as the study building, produced by stationary noise sources associated with the development, and (iii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa's Environmental Noise Control Guidelines as outlined in Section 4 of this report.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] MECP – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

4. METHODOLOGY

4.1 Background

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

4.2 Transportation Noise

4.2.1 Criteria for Transportation 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 (that is relevant to this study) is 45 dBA for schools, as listed in Table 1. To account for deficiencies in building construction, theses levels should be targeted toward 42 dBA.

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

Type of Space	Time Period	L_{eq} (dBA)	
		Road	Rail
General offices, reception areas, retail stores, etc.	07:00 – 23:00	50	45
Living/dining/den areas of residences, hospitals, **schools**, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc.	07:00 – 23:00	45	40
Sleeping quarters of hotels/motels	23:00 – 07:00	45	40
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40	35

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction[4]. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which normally triggers the need for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, building components will require higher levels of sound attenuation[5].

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

4.2.1 Transportation Source 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, roadway traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[6] which provide additional details on future roadway expansions. Transitway volumes have been based on

[3] Adapted from ENCG 2016 – Tables 2.2b and 2.2c
[4] Burberry, P.B.. (2014). Mitchell's Environment and Services. Routledge, Page 125
[5] MECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3
[6] City of Ottawa Transportation Master Plan, November 2013

information received through correspondence with the City of Ottawa. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

TABLE 2: ROADWAY TRAFFIC DATA

Segment	Roadway / Transit Class	Speed Limit (km/h)	Traffic Volumes
Strandherd Drive	4-UAD	80	**35,000**
Chapman Mills Drive	2-UMCU	40	**12,000**
Bus Rapid Transit	(BRT)	80	***191/67**

* - Daytime and Nighttime volumes based on correspondence with the City of Ottawa

4.2.2 Theoretical Transportation Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road and rail analysis. Roadway traffic noise calculations were performed by treating each roadway segment as separate line sources of noise, and by using existing building locations as noise barriers. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split was taken to be 92% / 8% respectively for all streets.
- Reflective and absorptive intermediate ground surfaces based on specific source-receiver path ground characteristics. Pavement, such as roads and parking lots, is considered as reflective ground, while vegetated space is considered as absorptive ground.
- Site is considered to be flat or gently sloping.

Noise receptors were strategically identified at ten (10) locations around the proposed high school building, (see Figure 2). A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A, and a sample of STAMSON input parameters is available in Figure 4-7.

The impact of the bus layby on the development was determined by computer modelling based on the software program Predictor-Lima developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2. This computer program is capable of representing three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. The methodology has been used on numerous assignments, and has been accepted by the Ministry of the Environment, Conservation and Parks (MECP) as part of Environmental Compliance Approvals applications. Five idling buses were considered in the layby, during the daytime and evening periods, for 30 minutes every hour. A sound power rating of 98 dBA is based on GWE's past experience with similar sources.

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 commercial 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, 6" metal stud walls with gypsum board sheathing can achieve STC 45 or more. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

As per Section 4.2, when daytime noise levels from roadway 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

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

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 in the same partition. Due to the limited information, available at the time of the study, which was prepared for site plan approval, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

4.4 Stationary Noise

4.4.1 Assumptions

Preliminary mechanical information for the development has been provided by LRL Associates Ltd. A review of final equipment selection and locations by a qualified acoustical engineer will be required prior to installation of the equipment. The following assumptions have been included in the analysis:

(i) The locations, quantity and tonnage of rooftop units have been assumed based on direction from LRL Associates Ltd. and GWE's experience with similar developments.

(ii) The sound data of rooftop units is based on manufacture's data.

(iii) During the daytime and evening period (07:00 – 23:00), the rooftop mechanical units (RTU and MUA) on the building are in full operation.

(iv) During the nighttime period (23:00 – 07:00), the rooftop mechanical units on the building are in operation 50% of the time.

(v) Screening effects of buildings and parapets have been considered in the modelling. Parapet heights are assumed to be a minimum of 1 m above the roof deck.

4.4.2 Stationary Noise Source Assessment and Criteria

For stationary sources, the L_{eq} is calculated on an hourly interval, while for roadways, the L_{eq} is calculated on the basis of a 16-hour daytime / 8-hour nighttime split. Noise criteria taken from the ENCG apply to points of reception (POR). A POR is defined under ENCG as "any location on a noise sensitive land use where noise from a stationary source is received", this can be an outdoor point of reception or at the plane of window. A POR can be located on an existing or zoned for future use premises of permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, camp

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

grounds, and noise sensitive buildings such as schools, places of worship and daycare facilities. According to the ENCG, the recommended maximum noise level for a suburban (Class 2) environment at a POR is either the lowest one-hour background noise level due to other sources, or the exclusionary limits outlined in Table 3, whichever is higher. The site is considered to be in a Class 2 because it is in the suburban community of Barrhaven and daytime noise levels are dominated by roadway traffic along Strand herd.

TABLE 3: EXCLUSIONARY LIMITS FOR CLASS 2 AREA

Time of Day	Outdoor Points of Reception	Plane of Window
07:00 – 19:00	50	50
19:00 – 23:00	45	50
23:00 – 07:00	N/A	45

4.4.3 Determination of Noise Source Power Levels

Table 4 summarizes the sound power levels of each source assumed in our analysis. Source locations are illustrated in Figure 8. Rooftop equipment sound power data is from manufacture's test data. The proposed equipment is assumed to comprise of:

- Three make-up air units (MUA)– HTS Model ERU-OU-WH-13100 (S1 to S3)
- Four roof top units (RTU) – Lennox Model 036 (S4 to S7)
- One kitchen exhaust fan (EF) – Greenheck (S8)
- One fluid cooler (FC) – Ref Plus 1X4 Fans (S9)

TABLE 4: EQUIPMENT SOUND POWER LEVELS (dBA)

Source ID	Height above roof/grade (m)	Description	Frequency (Hz)								
			63	125	250	500	1000	2000	4000	8000	Total
S1-3	2	MUA	65	75	80	85	88	85	82	75	92
S4-7	1.5	RTU	41	51	63	74	76	74	69	60	80
S8	1.5	EF	43	66	62	62	62	62	55	50	70
S9	2.5	FC	-	-	-	-	87	-	-	-	87

4.4.4 Stationary Source Noise Predictions

The impact of the stationary noise sources on the nearby residential areas was determined by an acoustic software Predictor-Lima. A total of sixteen (16) receptor locations were chosen around the site to measure the noise impact at points of reception (POR) during the daytime and evening period (07:00 – 23:00), as well as the nighttime period (23:00 – 07:00). POR locations included outdoor points of reception (OPOR) and the plane of windows (POW) of the adjacent residential properties, as well as on-site locations. Sensor locations are described in Table 5 and illustrated in Figure 9. All units were represented as point sources in the Predictor model. Table 6 below contains Predictor-Lima calculation settings. These settings are typical and have been based on ISO 9613 standards and guidance from the MECP.

Ground absorption over the study area was determined based on topographical features (such as water, concrete, grassland, etc.). An absorption value of 0 is representative of hard ground, while a value of 1 represents grass, and similar soft surface conditions. Existing and proposed buildings were added to the model to account for screening and reflection effects from building façades. A Predictor-Lima sample output is available in Appendix B, further modelling data are available upon request.

TABLE 5: RECEPTOR LOCATIONS

Receptor Number	Location	Height Above Grade (m)
R1	POW – 269 Broxburn Crescent	4.5
R2	OPOR – 269 Broxburn Crescent	1.5
R3	POW – 326 Broxburn Crescent	4.5
R4	POW – 325 Broxburn Crescent	4.5
R5	OPOR – 325 Broxburn Crescent	1.5
R6	POW – 219 Broxburn Crescent	4.5
R7	POW – 220 Broxburn Crescent	4.5
R8	OPOR – 220 Broxburn Crescent	1.5
R9	POW – 100 Fraser Fields Way	4.5
R10	OPOR – 100 Fraser Fields Way	1.5
R11	POW – 135 Harthill Way	7.5
R12	POW – 2007 Madrid Ave	7.5
R13	POW – 4025 Strandherd Drive	4.5
R14	POW – 4025 Strandherd Drive	4.5
R15	South Building Façade	9.5
R16	Outdoor Classroom	1.5

TABLE 6: CALCULATION SETTINGS

Parameter	Setting
Meteorological correction method	Single value for C0
Value C0	0
Default ground attenuation factor	1
Ground attenuation factor for roadways and paved areas	0
Temperature (K)	283
Pressure (kPa)	101.33
Air humidity (%)	70

5. RESULTS AND DISCUSSION

5.1 Transportation Noise Levels

The results of the roadway traffic noise calculations are summarized in Table 7 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

TABLE 7: EXTERIOR NOISE LEVELS DUE TO TRANSPORTATION SOURCES

Receptor Number	Plane of Window Receptor Location	Roadway Noise Level (dBA)		Bus Layby Noise Level (dBA)		Combined Noise Level (dBA)	
		Day	Night	Day	Night	Day	Night
1	POW – Ground Floor South Façade	59	52	62	N/A	64	52
2	POW – Ground Floor Portables North Façade	72	64	24	N/A	72	64
3	POW – Ground Floor Portables West Façade	60	53	24	N/A	60	53
4	POW – 3rd Floor North Façade	72	65	26	N/A	72	65
5	POW – 3rd Floor North Façade	71	64	41	N/A	71	64
6	POW – 3rd Floor East Façade	69	62	58	N/A	69	62
7	POW – 3rd Floor South Façade	59	52	60	N/A	63	52
8	POW – 3rd Floor South Façade	56	50	36	N/A	56	50
9	POW – 3rd Floor West Façade	68	61	26	N/A	68	61
10	OPOR – Ground Floor Outdoor Classroom	52	46	31	N/A	52	46

The results of the current analysis indicate that combined noise levels will range between 53 and 72 dBA during the daytime period (07:00-23:00) and between 46 and 65 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 72 dBA) occurs along the development's north façade, which are nearest and most exposed to Strandherd Drive. Bus layby noise contours at 1.5 m above grade can be seen in Figure 10 for daytime conditions.

5.1.1 Noise Control Measures

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

requirements for the windows are summarized below for various units within the development (see Figure 3):

- **Classroom, Office and Lobby Windows**

(i) Classroom, office and lobby windows facing north will require a minimum STC of 30

(ii) Classroom, office and lobby windows facing east will require a minimum STC of 28

(iii) Classroom, office and lobby windows facing west will require a minimum STC of 26

(iv) Classroom, office and lobby windows facing south will require a minimum STC of 24

(v) All other classroom, office and lobby windows are to satisfy Ontario Building Code (OBC 2012) requirements

- **Exterior Walls**

(i) Exterior wall components on all façades will require a minimum STC of 45 which will be achieved with 6" metal studs and gypsum board sheathing and an interior layer of drywall or an acoustical equivalent according to NRC test data[9].

The STC requirements would apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a window / wall system is used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors. Results of the calculations also indicate that Building B will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment.

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

5.2 Stationary Noise Levels

As Table 8 (below) summarizes, noise levels fall below ENCG criteria during all hours of the day. Noise contours at 1.5 m above grade can be seen in Figure 11 and 12 for daytime/evening and nighttime conditions. Since the noise levels fall below ENCG criteria, the proposed development is expected to be compatible with the existing and future noise sensitive land uses.

TABLE 8: NOISE LEVELS FROM STATIONARY SOURCES

Receptor Number	Receptor Location	1-HR L_{EQ} (dBA)		ENCG Criteria (dBA)		Meets ENCG
		Daytime/ Evening	Night	Daytime/ Evening	Night	
R1	POW – 269 Broxburn Crescent	37	35	50	45	Yes
R2	OPOR – 269 Broxburn Crescent	37	35	45	-	Yes
R3	POW – 326 Broxburn Crescent	42	39	50	45	Yes
R4	POW – 325 Broxburn Crescent	41	39	50	45	Yes
R5	OPOR – 325 Broxburn Crescent	41	39	45	-	Yes
R6	POW – 219 Broxburn Crescent	43	41	50	45	Yes
R7	POW – 220 Broxburn Crescent	45	43	50	45	Yes
R8	OPOR – 220 Broxburn Crescent	43	40	45	-	Yes
R9	POW – 100 Fraser Fields Way	45	44	50	45	Yes
R10	OPOR – 100 Fraser Fields Way	42	40	45	-	Yes
R11	POW – 135 Harthill Way	48	45	50	45	Yes
R12	POW – 2007 Madrid Ave	40	37	50	45	Yes
R13	POW – 4025 Strandherd Drive	41	39	50	45	Yes
R14	POW – 4025 Strandherd Drive	37	34	50	45	Yes
R15	South Building Façade	47	44	50	-*	Yes
R16	Outdoor Classroom	43	40	50	-*	Yes

* - On-site receptors are not applicable during the nighttime period, as the school will not be occupied

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current analysis indicate that transportation noise levels will range between 53 and 72 dBA during the daytime period (07:00-23:00) and between 46 and 65 dBA during the nighttime period (23:00-07:00). The highest noise levels (i.e. 72 dBA) occurs along the development's north façade, which are nearest and most exposed to Strandherd Drive. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated on Figure 3. Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable indoor environment. The following Warning Clause[10] will also be required to be placed on all Lease, Purchase and Sale Agreements, or Development Agreements, as summarized below:

> *"Owners/operators are advised that despite the inclusion of noise control features in the development, sound levels due to increasing roadway traffic may, on occasion, interfere with some activities of the building occupants as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*
>
> - *STC rated multi-pane glazing elements and spandrel panels*
> - *North façade classroom, office and lobby windows: STC 30*
> - *East façade classroom, office and lobby windows: STC 28*
> - *West façade classroom, office and lobby windows: STC 26*
> - *South façade classroom, office and lobby windows: STC 24*
> - *STC rated exterior walls*
> - *North, east, west and south façade: STC 45*
>
> *This dwelling unit has also been designed with air conditioning. Air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment, Conservation and Parks.*

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

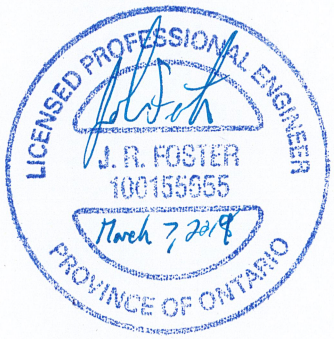
To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features."

Based on the assumptions of this report it is expected stationary noise levels from the buildings proposed mechanical equipment will fall below ENCG criteria during all hours of the day. Since the noise levels fall below ENCG criteria, the proposed development is expected to be compatible with the existing and future noise sensitive land uses. A review of final equipment selection and locations by a qualified acoustical engineer will be required prior to installation of the equipment.

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.



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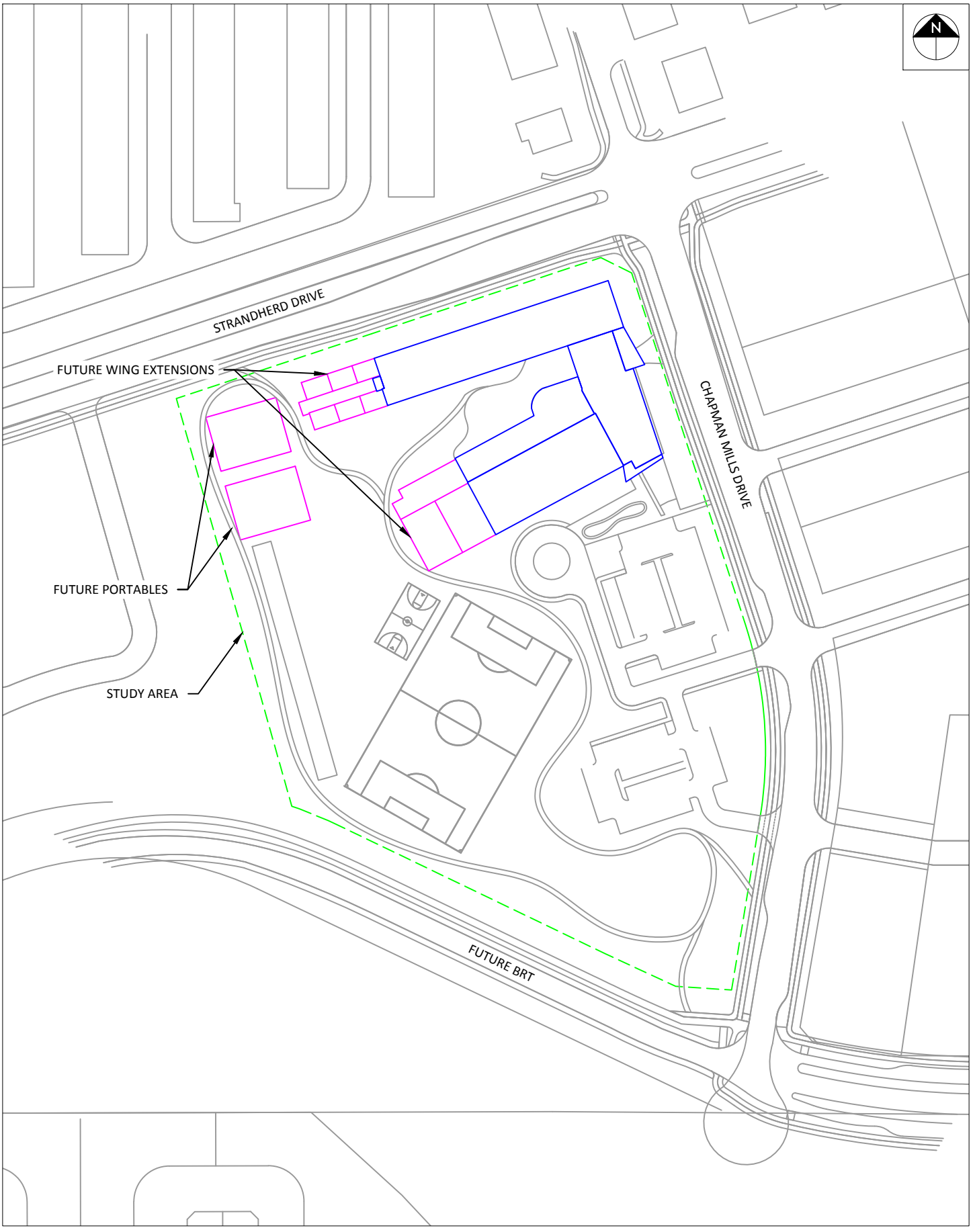

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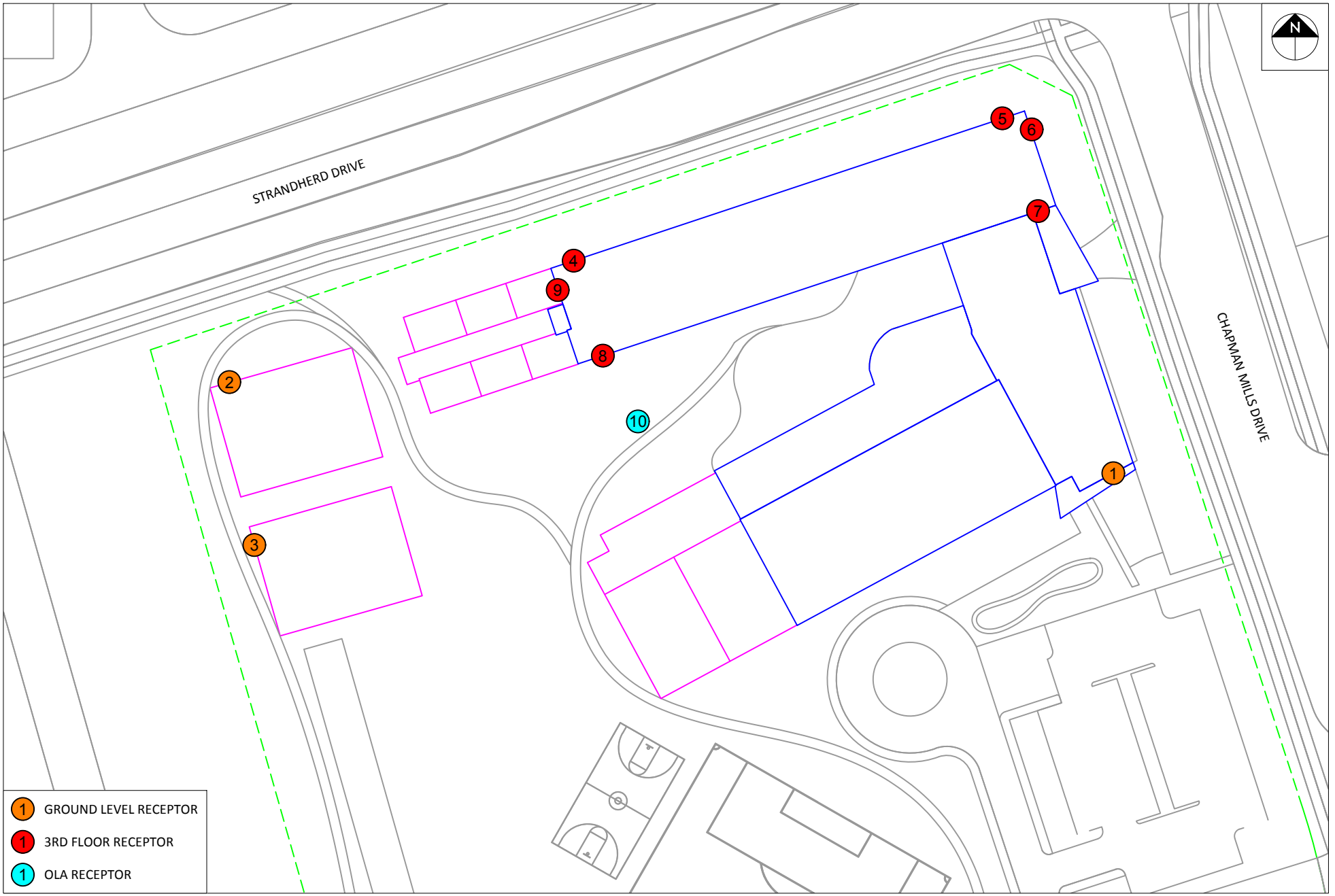
GRADIENT WIND ENGINEERING INC

PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GWE18-012-1
DATE	MARCH 7, 2019
DRAWN BY	M.L.
DESCRIPTION	FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT



127 Walgreen Road
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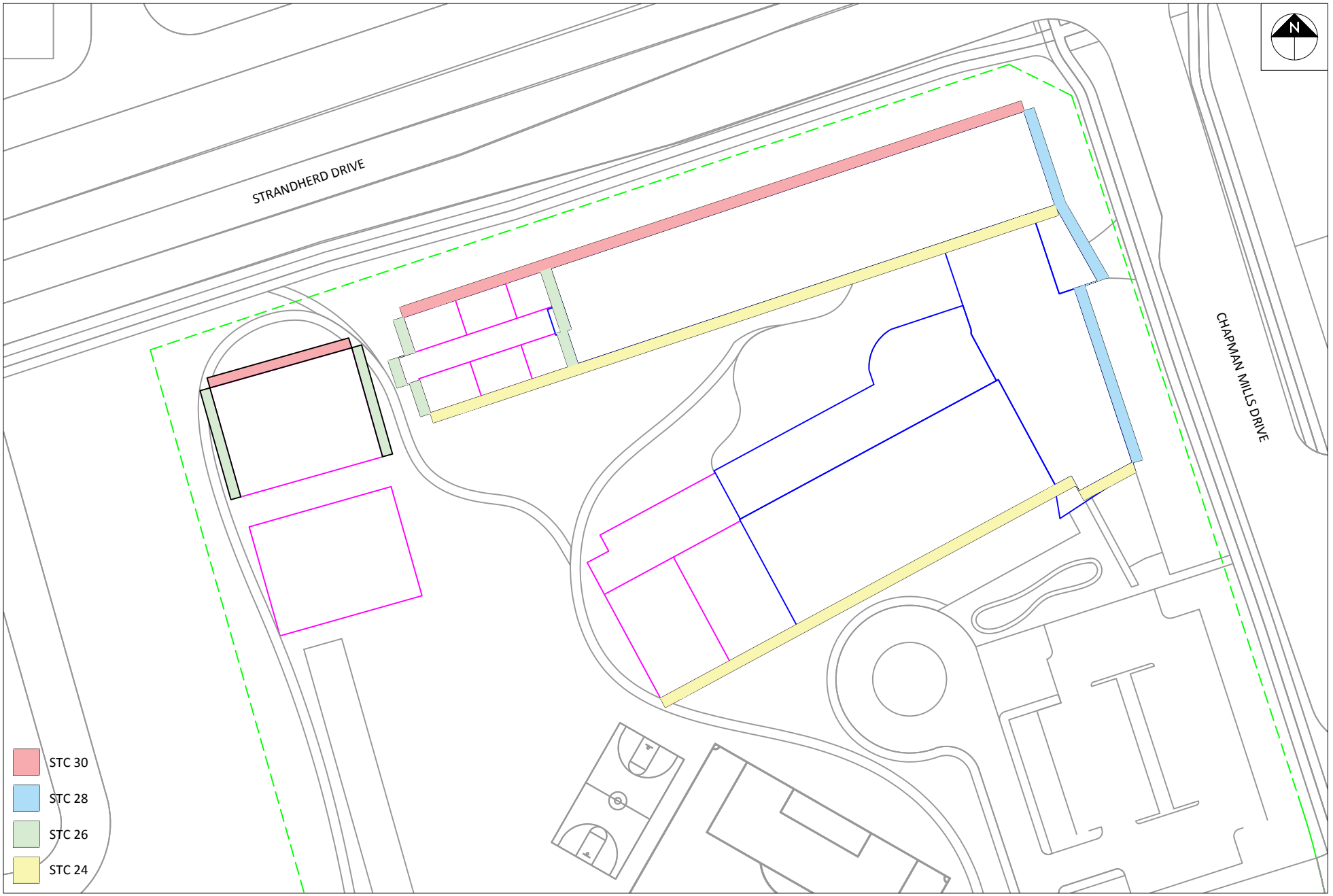
GRADIENT WIND ENGINEERING INC

PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE18-012-2
DATE	MARCH 7, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 2:
ROADWAY TRAFFIC NOISE RECEPTOR LOCATIONS



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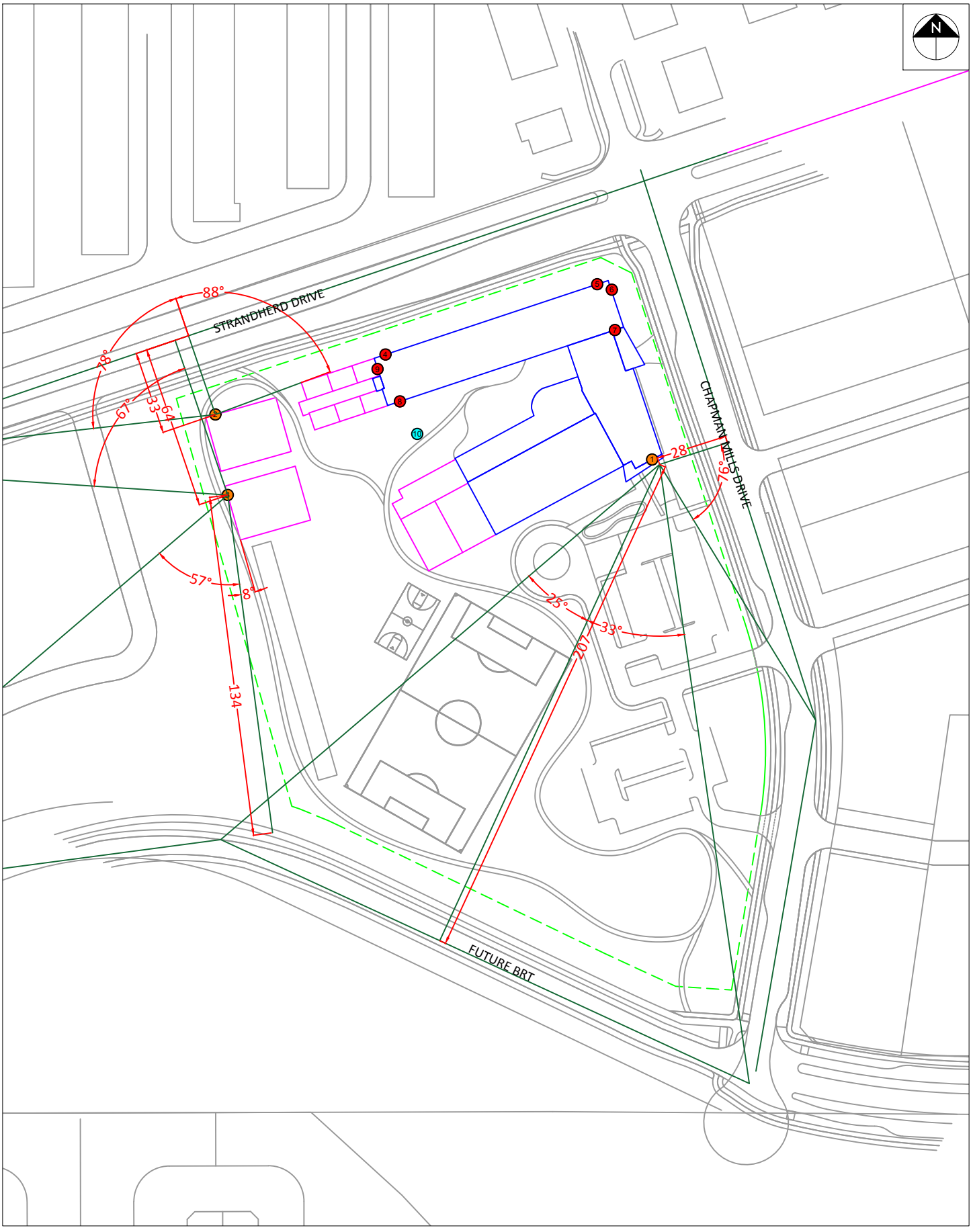
PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE18-012-3
DATE	MARCH 7, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 3:
WINDOW STC REQUIREMENTS

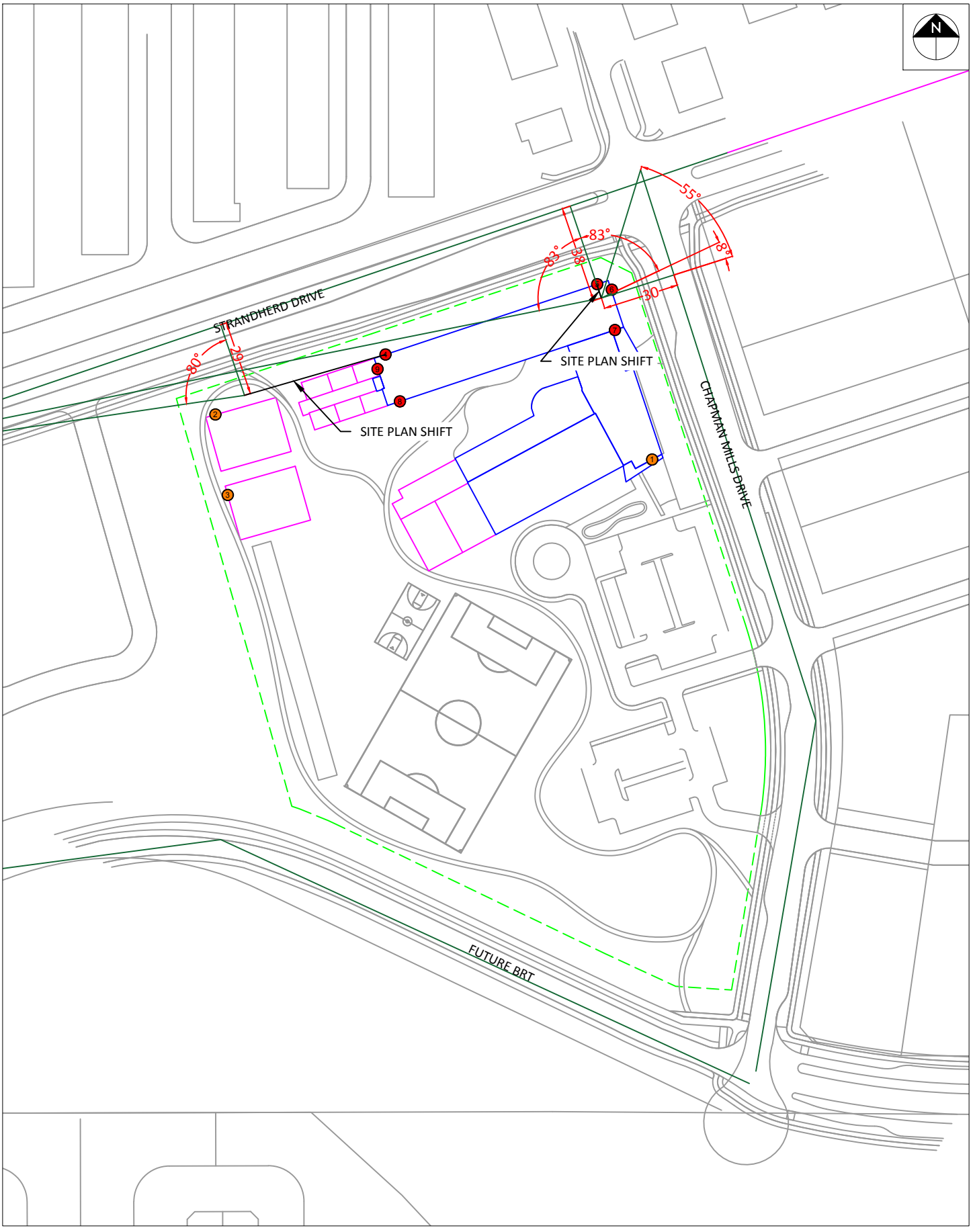


GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GWE18-012-4
DATE	MARCH 7, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 4:
STAMSON INPUT PARAMETERS - RECEPTOR 1-3



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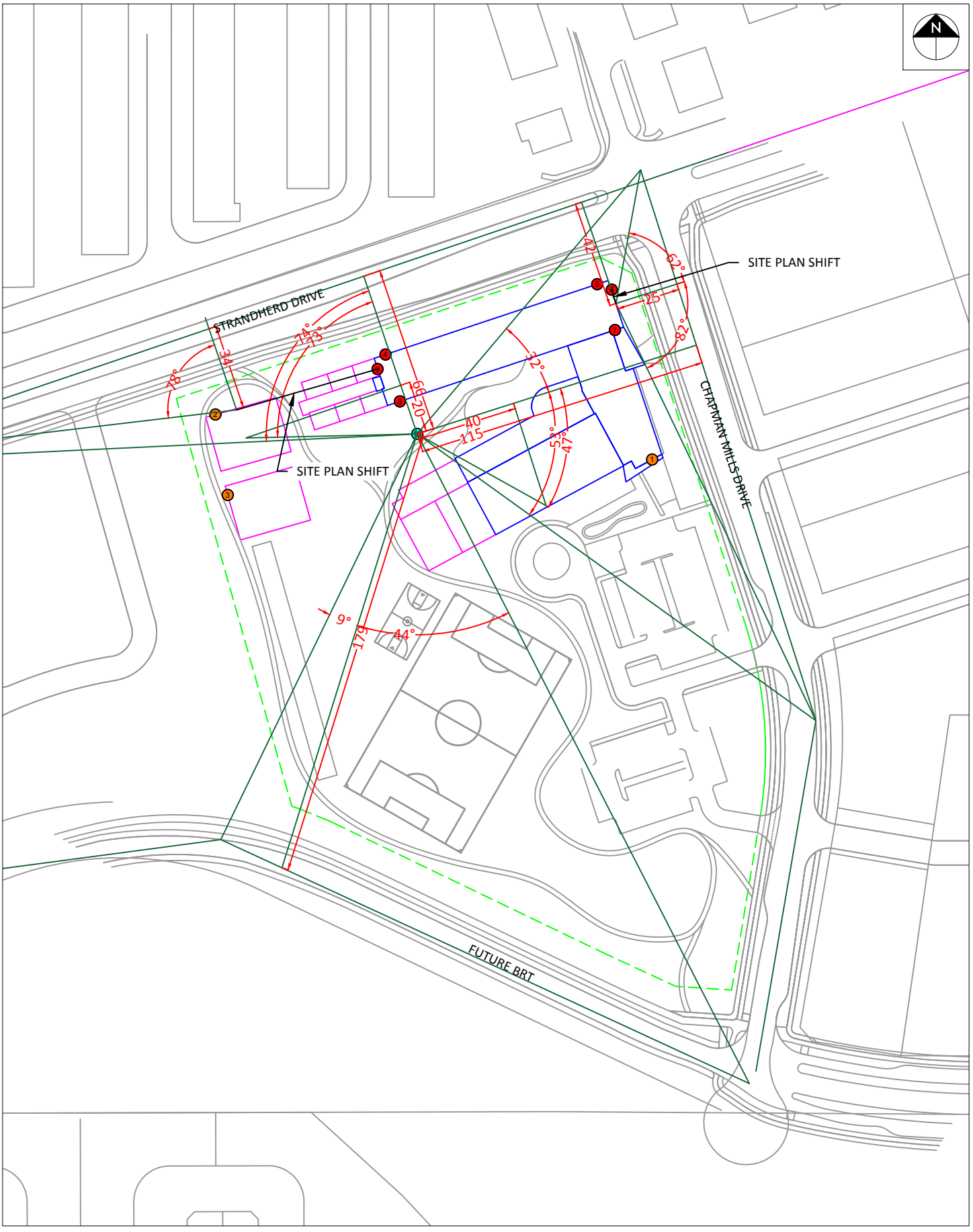
(613) 836 0934

GRADIENT WIND ENGINEERING INC

PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT		DESCRIPTION
SCALE	1:2000 (APPROX.)	DRAWING NO. GWE18-012-4	FIGURE 5: STAMSON INPUT PARAMETERS - RECEPTOR 4 AND 5
DATE	MARCH 7, 2019	DRAWN BY M.L.	



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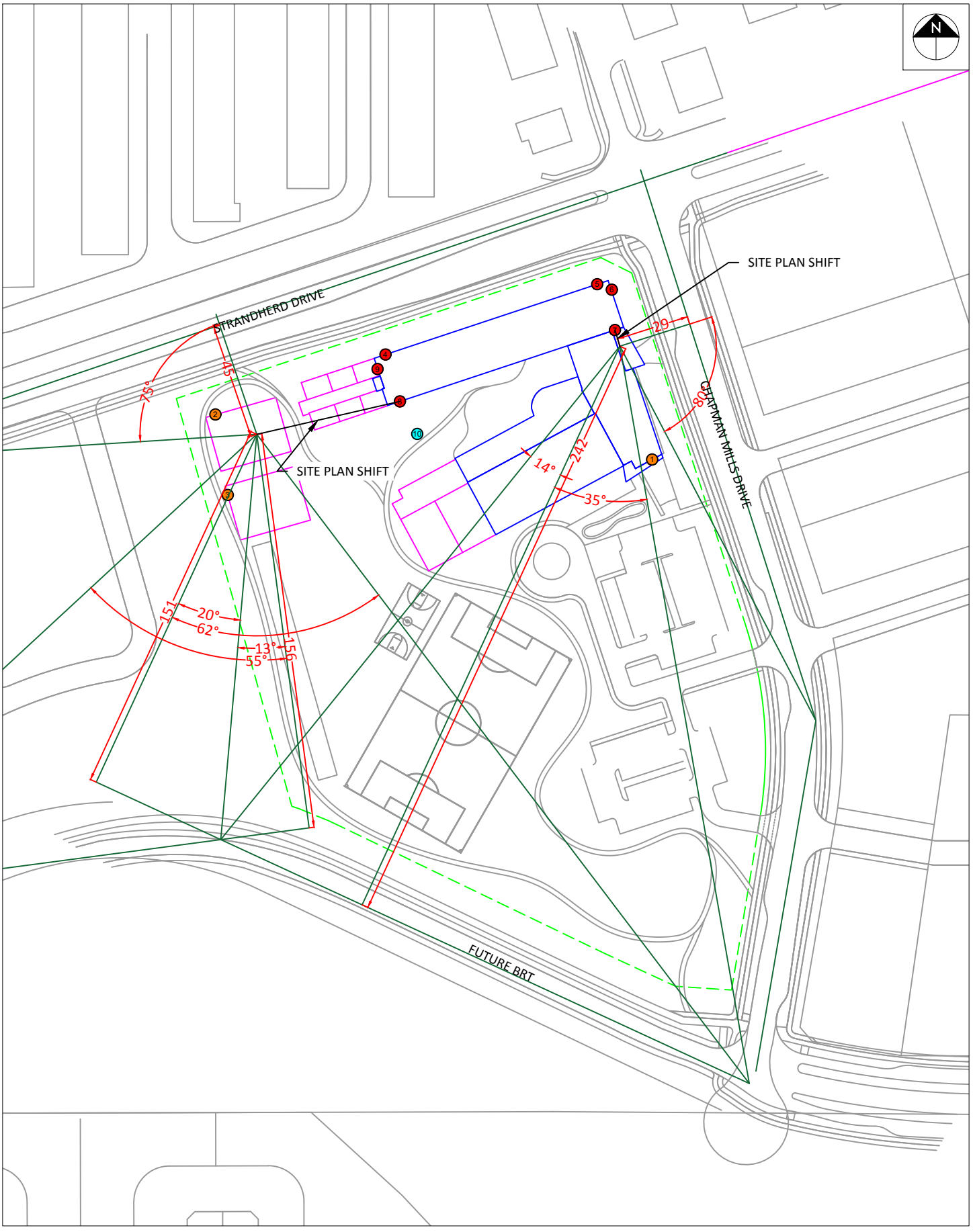
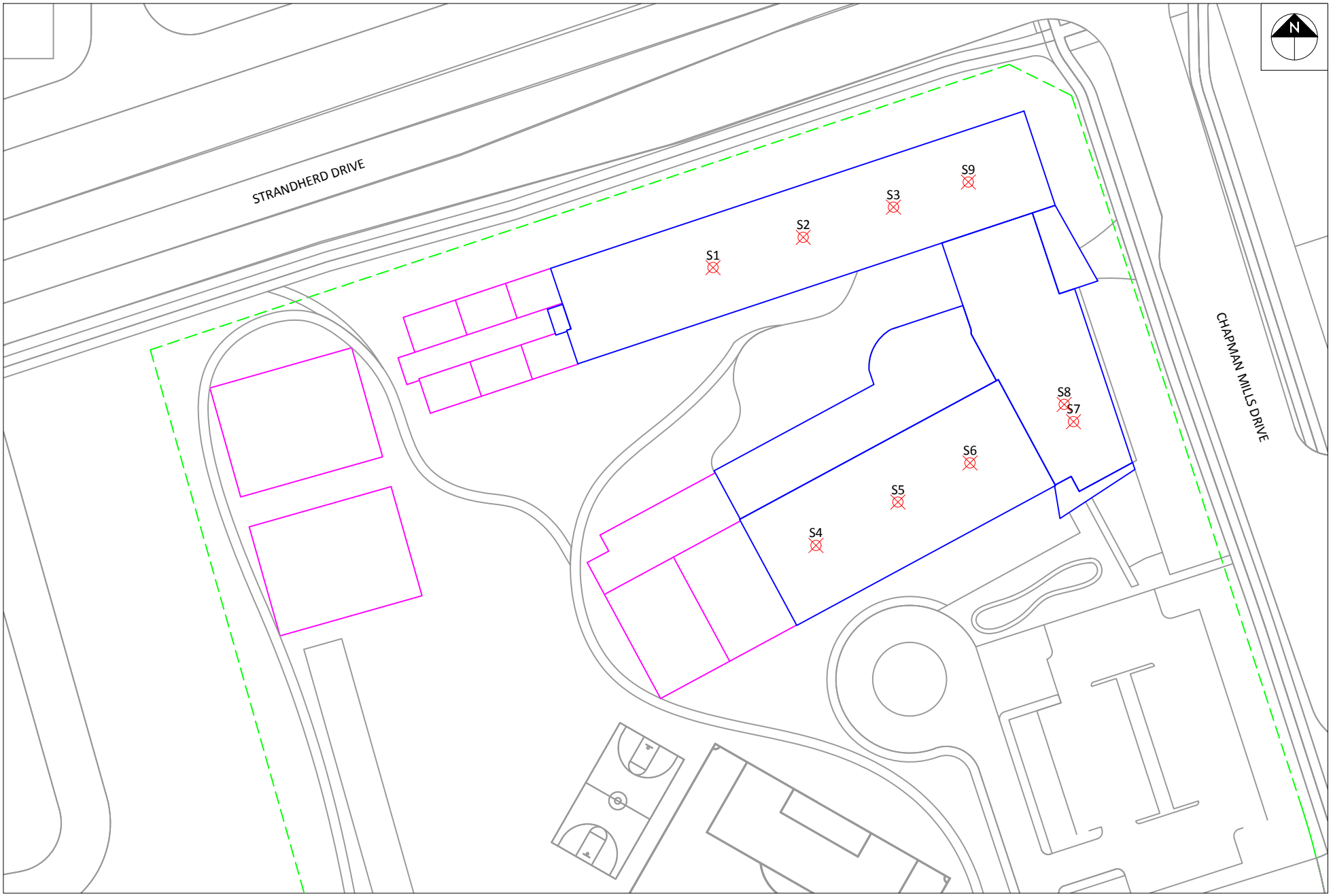
PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT
SCALE	1:2000 (APPROX.)
DRAWING NO.	GWE18-012-6
DATE	MARCH 7, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 6:
STAMSON INPUT PARAMETERS - RECEPTOR 6,9,10



GRADIENT WIND ENGINEERING INC 127 Walgreen Road Ottawa, Ontario (613) 836 0934	PROJECT: 4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT		DESCRIPTION: FIGURE 7: STAMSON INPUT PARAMETERS - RECEPTOR 7 AND 8
	SCALE: 1:2000 (APPROX.)	DRAWING NO.: GWE18-012-7	
	DATE: MARCH 7, 2019	DRAWN BY: M.L.	



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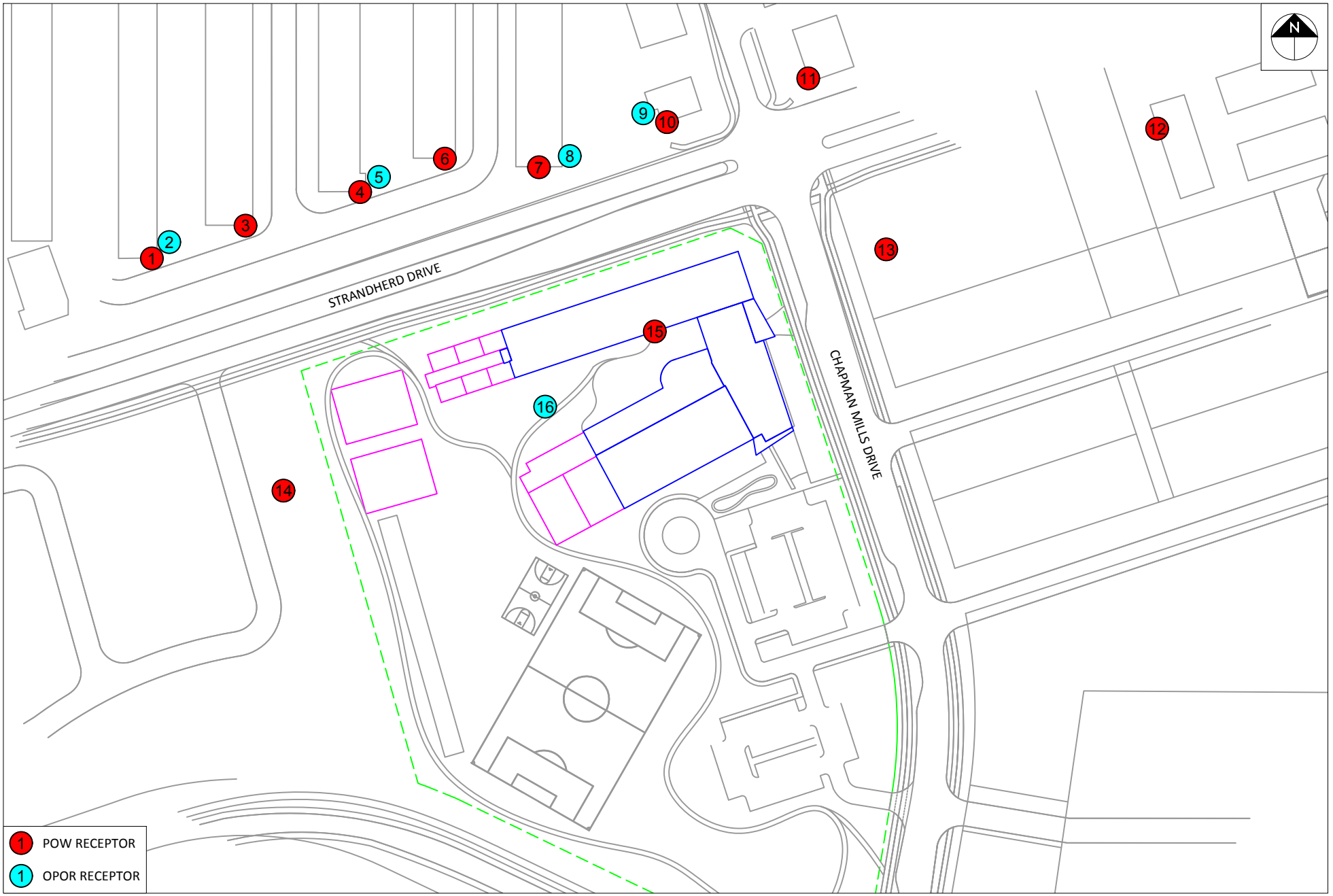
PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT
SCALE	1:1000 (APPROX.)
DRAWING NO.	GWE18-012-8
DATE	MARCH 7, 2019
DRAWN BY	M.L.

DESCRIPTION

FIGURE 8:
STATIONARY NOISE SOURCE LOCATIONS



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PROJECT	4005 STRANDHERD DRIVE ENVIRONMENTAL NOISE ASSESSMENT		
SCALE	1:2000 (APPROX.)	DRAWING NO.	GWE18-012-9
DATE	MARCH 7, 2019	DRAWN BY	M.L.

DESCRIPTION

FIGURE 9:
STATIONARY NOISE RECEPTOR LOCATIONS

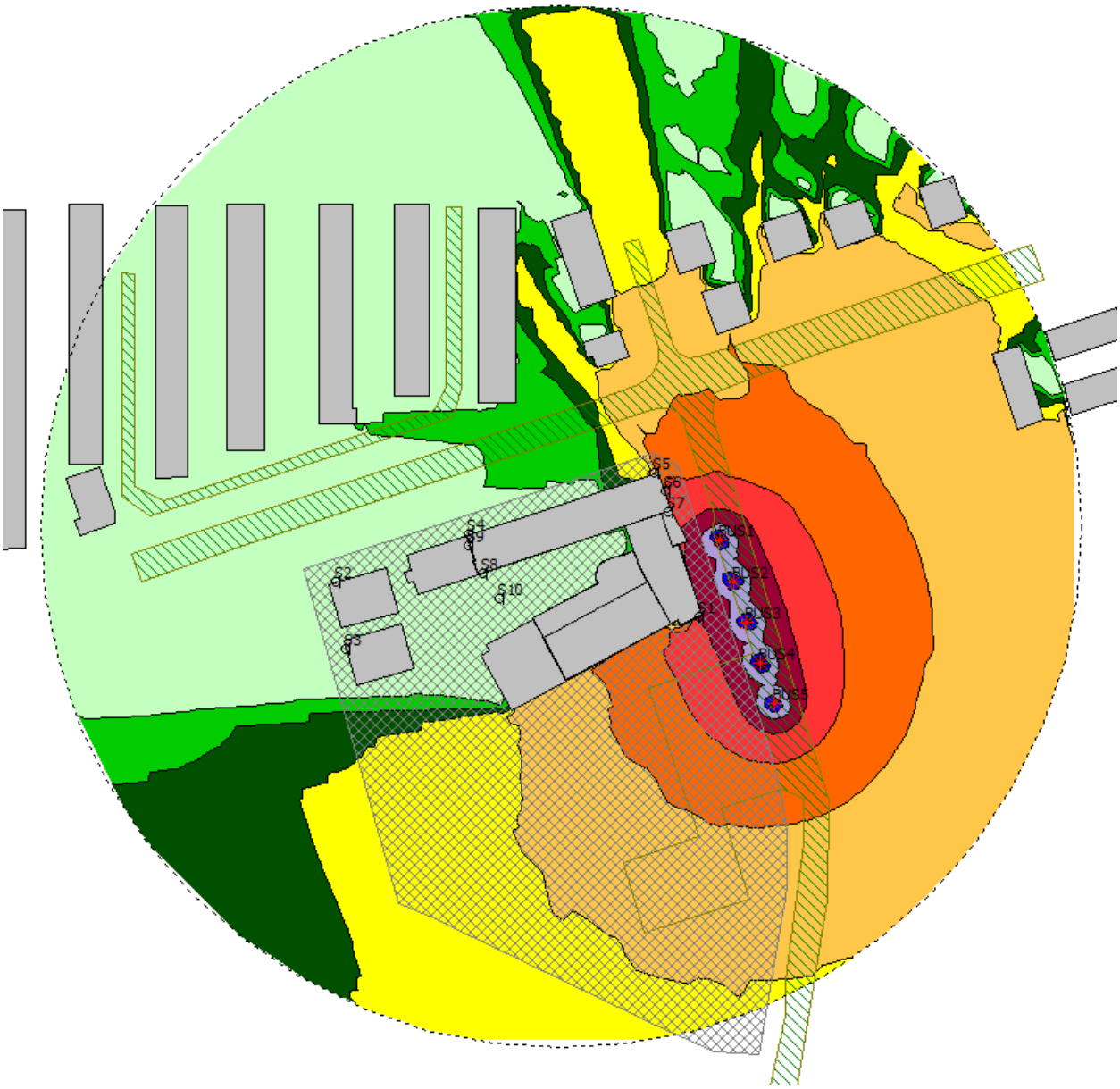


FIGURE 10: DAYTIME/EVENING BUS LAYBY NOISE CONTOURS (1.5 METERS ABOVE GRADE)

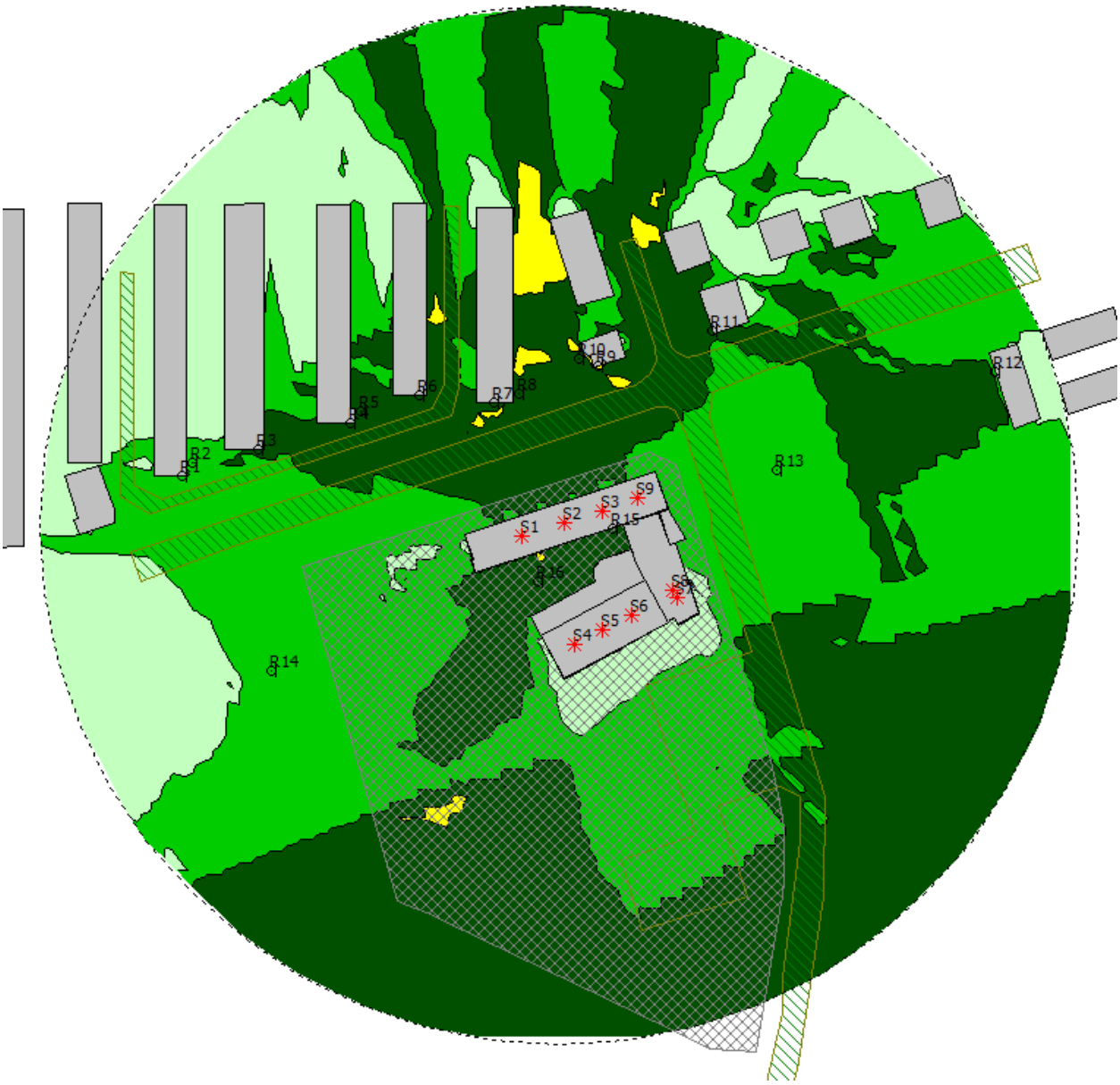
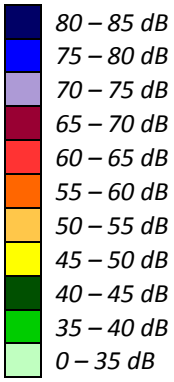


FIGURE 11: DAYTIME/EVENING STATIONARY NOISE CONTOURS (1.5 METERS ABOVE GRADE)



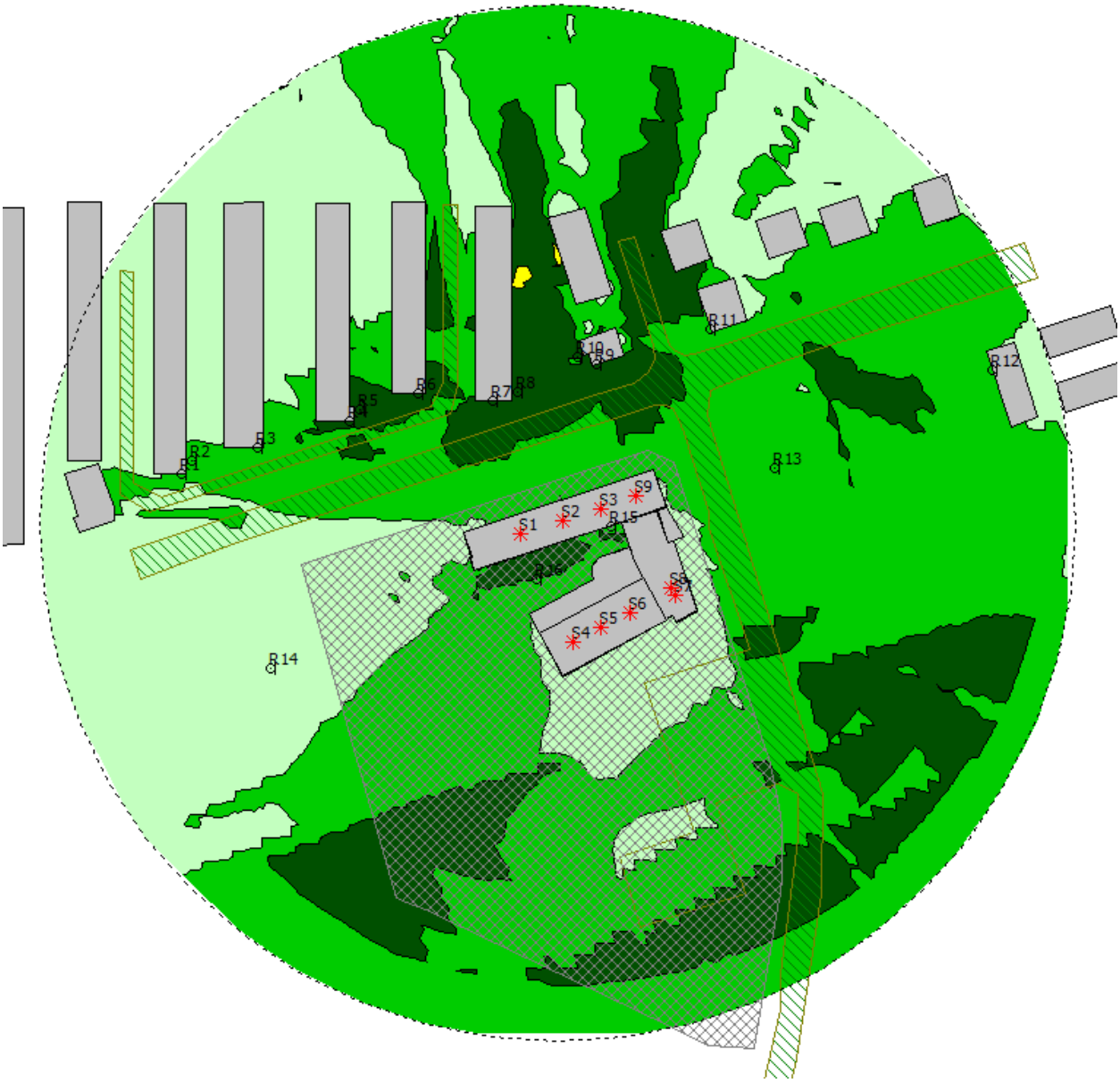


FIGURE 12: NIGHTTIME STATIONARY NOISE CONTOURS (1.5 METERS ABOVE GRADE)

80 – 85 dB
75 – 80 dB
70 – 75 dB
65 – 70 dB
60 – 65 dB
55 – 60 dB
50 – 55 dB
45 – 50 dB
40 – 45 dB
35 – 40 dB
0 – 35 dB

APPENDIX A

STAMSON 5.04 - INPUT AND OUTPUT DATA

```
STAMSON 5.0        NORMAL REPORT        Date: 14-09-2018 10:35:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Chap (day/night)
----------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Chap (day/night)
--------------------------------------
Angle1   Angle2           :   0.00 deg   76.00 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: Chap (day)
-------------------------------

Source height = 1.50 m

ROAD (0.00 + 59.26 + 0.00) = 59.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     76   0.00  65.72   0.00  -2.71  -3.74   0.00   0.00   0.00
59.26
-------------------------------------------------------------------------
--

Segment Leq : 59.26 dBA

Total Leq All Segments: 59.26 dBA


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

Source height = 1.50 m

ROAD (0.00 + 51.66 + 0.00) = 51.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     76   0.00  58.12   0.00  -2.71  -3.74   0.00   0.00   0.00
51.66
-------------------------------------------------------------------------
--

Segment Leq : 51.66 dBA

Total Leq All Segments: 51.66 dBA
```

```
RT/Custom data, segment # 1: OC (day/night)
-------------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: OC (day/night)
------------------------------------
Angle1   Angle2           : -33.00 deg   25.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 207.00 / 207.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 43.10 + 0.00) = 43.10 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -33     25   0.00  59.41 -11.40  -4.92   0.00   0.00   0.00  43.10
-------------------------------------------------------------------------

Segment Leq : 43.10 dBA

Total Leq All Segments: 43.10 dBA
```

Results segment # 1: OC (night)

Source height = 0.50 m

RT/Custom (0.00 + 41.56 + 0.00) = 41.56 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-33	25	0.00	57.87	-11.40	-4.92	0.00	0.00	0.00	41.56

Segment Leq : 41.56 dBA

Total Leq All Segments: 41.56 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.36
(NIGHT): 52.06

```
STAMSON 5.0        NORMAL REPORT        Date: 10-09-2018 36:06:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2n.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Strand (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  :    80 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: Strand (day/night)
----------------------------------------
Angle1   Angle2           : -78.00 deg   88.00 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: Strand (day)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 71.72 + 0.00) = 71.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -78     88   0.00  75.50   0.00  -3.42  -0.35   0.00   0.00   0.00
71.72
-------------------------------------------------------------------------
--

Segment Leq : 71.72 dBA

Total Leq All Segments: 71.72 dBA


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

Source height = 1.50 m

ROAD (0.00 + 64.12 + 0.00) = 64.12 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -78     88   0.00  67.90   0.00  -3.42  -0.35   0.00   0.00   0.00
64.12
-------------------------------------------------------------------------
--

Segment Leq : 64.12 dBA

Total Leq All Segments: 64.12 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 71.72
                           (NIGHT): 64.12
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-09-2018 10:37:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3n.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Strand (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  :    80 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: Strand (day/night)
-----------------------------------------
Angle1   Angle2           : -67.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 60.03 + 0.00) = 60.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -67      0   0.66  75.50   0.00 -10.46  -5.01   0.00   0.00   0.00
60.03
-------------------------------------------------------------------------
--

Segment Leq : 60.03 dBA

Total Leq All Segments: 60.03 dBA


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

Source height = 1.50 m

ROAD (0.00 + 52.43 + 0.00) = 52.43 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -67      0   0.66  67.90   0.00 -10.46  -5.01   0.00   0.00   0.00
52.43
-------------------------------------------------------------------------
--

Segment Leq : 52.43 dBA

Total Leq All Segments: 52.43 dBA
```

```
RT/Custom data, segment # 1: OC (day/night)
-------------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: OC (day/night)
------------------------------------
Angle1   Angle2           :  -8.00 deg   57.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 134.00 / 134.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


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

Source height = 0.50 m

RT/Custom (0.00 + 38.76 + 0.00) = 38.76 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
    -8     57   0.66  59.41 -15.79  -4.86   0.00   0.00   0.00  38.76
-------------------------------------------------------------------------

Segment Leq : 38.76 dBA

Total Leq All Segments: 38.76 dBA
```

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

Source height = 0.50 m

RT/Custom (0.00 + 37.22 + 0.00) = 37.22 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
    -8     57   0.66  57.87 -15.79  -4.86   0.00   0.00   0.00  37.22
-------------------------------------------------------------------------

Segment Leq : 37.22 dBA

Total Leq All Segments: 37.22 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 60.06
                           (NIGHT): 52.56
```

```
STAMSON 5.0        NORMAL REPORT        Date: 06-02-2018 86:29:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Strand (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  :    80 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: Strand (day/night)
----------------------------------------
Angle1   Angle2           : -80.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 72.39 + 0.00) = 72.39 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -80     90   0.00  75.50   0.00  -2.86  -0.25   0.00   0.00   0.00
72.39
-------------------------------------------------------------------------
--

Segment Leq : 72.39 dBA

Total Leq All Segments: 72.39 dBA


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

Source height = 1.50 m

ROAD (0.00 + 64.79 + 0.00) = 64.79 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -80     90   0.00  67.90   0.00  -2.86  -0.25   0.00   0.00   0.00
64.79
-------------------------------------------------------------------------
--

Segment Leq : 64.79 dBA

Total Leq All Segments: 64.79 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 72.39
                           (NIGHT): 64.79
```

```
STAMSON 5.0        NORMAL REPORT        Date: 06-02-2018 86:29:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Strand (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  :    80 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: Strand (day/night)
----------------------------------------
Angle1   Angle2           : -83.00 deg   83.00 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           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Chap (day/night)
---------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Chap (day/night)
--------------------------------------
Angle1   Angle2           : -55.00 deg   -8.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 71.11 + 0.00) = 71.11 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -83     83   0.00  75.50   0.00  -4.04  -0.35   0.00   0.00   0.00
71.11
-------------------------------------------------------------------------
--

Segment Leq : 71.11 dBA


Results segment # 2: Chap (day)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.87 + 0.00) = 56.87 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -55     -8   0.00  65.72   0.00  -3.01  -5.83   0.00   0.00   0.00
56.87
-------------------------------------------------------------------------
--

Segment Leq : 56.87 dBA

Total Leq All Segments: 71.27 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 63.51 + 0.00) = 63.51 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -83     83   0.00  67.90   0.00  -4.04  -0.35   0.00   0.00   0.00
63.51
-------------------------------------------------------------------------
--

Segment Leq : 63.51 dBA


Results segment # 2: Chap (night)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.28 + 0.00) = 49.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -55     -8   0.00  58.12   0.00  -3.01  -5.83   0.00   0.00   0.00
49.28
-------------------------------------------------------------------------
--

Segment Leq : 49.28 dBA

Total Leq All Segments: 63.67 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 71.27
                           (NIGHT): 63.67
```

```
STAMSON 5.0        NORMAL REPORT        Date: 06-02-2018 86:29:41
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Strand (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  :    80 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: Strand (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  :  42.00 / 42.00  m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Chap (day/night)
---------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Chap (day/night)
--------------------------------------
Angle1   Angle2           : -62.00 deg   82.00 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           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 68.02 + 0.00) = 68.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     90   0.00  75.50   0.00  -4.47  -3.01   0.00   0.00   0.00
68.02
-------------------------------------------------------------------------
--

Segment Leq : 68.02 dBA


Results segment # 2: Chap (day)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.53 + 0.00) = 62.53 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -62     82   0.00  65.72   0.00  -2.22  -0.97   0.00   0.00   0.00
62.53
-------------------------------------------------------------------------
--

Segment Leq : 62.53 dBA

Total Leq All Segments: 69.10 dBA
```

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

Source height = 1.50 m

ROAD (0.00 + 60.42 + 0.00) = 60.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     90   0.00  67.90   0.00  -4.47  -3.01   0.00   0.00   0.00
60.42
-------------------------------------------------------------------------
--

Segment Leq : 60.42 dBA


Results segment # 2: Chap (night)
---------------------------------

Source height = 1.50 m

ROAD (0.00 + 54.93 + 0.00) = 54.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -62     82   0.00  58.12   0.00  -2.22  -0.97   0.00   0.00   0.00
54.93
-------------------------------------------------------------------------
--

Segment Leq : 54.93 dBA

Total Leq All Segments: 61.50 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 69.10
                           (NIGHT): 61.50
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-09-2018 10:38:14
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Chap (day/night)
----------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Chap (day/night)
--------------------------------------
Angle1   Angle2           :   0.00 deg   80.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  29.00 / 29.00  m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 59.33 + 0.00) = 59.33 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     80   0.00  65.72   0.00  -2.86  -3.52   0.00   0.00   0.00
59.33
-------------------------------------------------------------------------
--

Segment Leq : 59.33 dBA

Total Leq All Segments: 59.33 dBA


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

Source height = 1.50 m

ROAD (0.00 + 51.73 + 0.00) = 51.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
     0     80   0.00  58.12   0.00  -2.86  -3.52   0.00   0.00   0.00
51.73
-------------------------------------------------------------------------
--

Segment Leq : 51.73 dBA

Total Leq All Segments: 51.73 dBA
```

```
RT/Custom data, segment # 1: OC (day/night)
-------------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: OC (day/night)
------------------------------------
Angle1   Angle2           : -35.00 deg   14.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 242.00 / 242.00 m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: OC (day)

Source height = 0.50 m

RT/Custom (0.00 + 41.69 + 0.00) = 41.69 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-35	14	0.00	59.41	-12.08	-5.65	0.00	0.00	0.00	41.69

Segment Leq : 41.69 dBA

Total Leq All Segments: 41.69 dBA

Results segment # 1: OC (night)

Source height = 0.50 m

RT/Custom (0.00 + 40.15 + 0.00) = 40.15 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-35	14	0.00	57.87	-12.08	-5.65	0.00	0.00	0.00	40.15

Segment Leq : 40.15 dBA

Total Leq All Segments: 40.15 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 59.40
(NIGHT): 52.02

```
STAMSON 5.0        NORMAL REPORT        Date: 14-09-2018 10:40:03
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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


Road data, segment # 1: Strand (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  :    80 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: Strand (day/night)
-----------------------------------------
Angle1   Angle2           : -75.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  45.00 / 45.00  m
Receiver height           :   9.50 / 9.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -75.00 deg   Angle2 : 90.00 deg
Barrier height            :  11.00 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
```

```
Results segment # 1: Strand (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 !        9.50 !        9.32 !         9.32

ROAD (0.00 + 55.52 + 0.00) = 55.52 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -75     90   0.00  75.50   0.00  -4.77  -0.38   0.00   0.00 -14.83
55.52
-------------------------------------------------------------------------------
--

Segment Leq : 55.52 dBA

Total Leq All Segments: 55.52 dBA


Results segment # 1: Strand (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 !        9.50 !        9.32 !         9.32

ROAD (0.00 + 47.92 + 0.00) = 47.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -75     90   0.00  67.90   0.00  -4.77  -0.38   0.00   0.00 -14.83
47.92
-------------------------------------------------------------------------------
--

Segment Leq : 47.92 dBA

Total Leq All Segments: 47.92 dBA
```

```
RT/Custom data, segment # 1: OC1 (day/night)
-----------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: OC1 (day/night)
-------------------------------------
Angle1   Angle2           : -62.00 deg   -20.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 151.00 / 151.00 m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
RT/Custom data, segment # 2: OC2 (day/night)
-----------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 2: OC2 (day/night)
-------------------------------------
Angle1   Angle2           :  13.00 deg   55.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 156.00 / 156.00 m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: OC1 (day)

Source height = 0.50 m

RT/Custom (0.00 + 43.06 + 0.00) = 43.06 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-62	-20	0.00	59.41	-10.03	-6.32	0.00	0.00	0.00	43.06

Segment Leq : 43.06 dBA

Results segment # 2: OC2 (day)

Source height = 0.50 m

RT/Custom (0.00 + 42.92 + 0.00) = 42.92 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
13	55	0.00	59.41	-10.17	-6.32	0.00	0.00	0.00	42.92

Segment Leq : 42.92 dBA

Total Leq All Segments: 46.00 dBA

Results segment # 1: OC1 (night)

Source height = 0.50 m

RT/Custom (0.00 + 41.53 + 0.00) = 41.53 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-62	-20	0.00	57.87	-10.03	-6.32	0.00	0.00	0.00	41.53

Segment Leq : 41.53 dBA

```
Results segment # 2: OC2 (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 41.38 + 0.00) = 41.38 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
    13     55   0.00  57.87 -10.17  -6.32   0.00   0.00   0.00  41.38
-------------------------------------------------------------------------

Segment Leq : 41.38 dBA

Total Leq All Segments: 44.47 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 55.98
                           (NIGHT): 49.54
```

```
STAMSON 5.0        NORMAL REPORT        Date: 06-02-2018 86:29:55
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Strand (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  :    80 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: Strand (day/night)
----------------------------------------
Angle1   Angle2           : -78.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  34.00 / 34.00  m
Receiver height           :   9.50 / 9.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

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

Source height = 1.50 m

ROAD (0.00 + 68.31 + 0.00) = 68.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -78      0   0.00  75.50   0.00  -3.55  -3.63   0.00   0.00   0.00
68.31
-------------------------------------------------------------------------
--

Segment Leq : 68.31 dBA

Total Leq All Segments: 68.31 dBA


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

Source height = 1.50 m

ROAD (0.00 + 60.71 + 0.00) = 60.71 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------
--
   -78      0   0.00  67.90   0.00  -3.55  -3.63   0.00   0.00   0.00
60.71
-------------------------------------------------------------------------
--

Segment Leq : 60.71 dBA

Total Leq All Segments: 60.71 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 68.31
                           (NIGHT): 60.71
```

```
STAMSON 5.0        NORMAL REPORT        Date: 14-09-2018 10:41:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r10.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Strand (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  :    80 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: Strand (day/night)
----------------------------------------
Angle1   Angle2           : -74.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  66.00 / 66.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -73.00 deg   Angle2 : 90.00 deg
Barrier height            :  11.00 m
Barrier receiver distance :  20.00 / 20.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Chap (day/night)
---------------------------------------
Car traffic volume  :  9715/845   veh/TimePeriod  *
Medium truck volume :   773/67    veh/TimePeriod  *
Heavy truck volume  :   552/48    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):  12000
    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: Chap (day/night)
--------------------------------------
Angle1   Angle2           : -32.00 deg   53.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 115.00 / 115.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -32.00 deg   Angle2 : 47.00 deg
Barrier height            :   5.00 m
Barrier receiver distance :  40.00 / 40.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Strand (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 (38.65 + 50.67 + 0.00) = 50.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -74    -73   0.66  75.50   0.00 -10.68 -26.16   0.00   0.00   0.00
38.65
-------------------------------------------------------------------------------
--
   -73     90   0.00  75.50   0.00  -6.44  -0.43   0.00   0.00 -17.96
50.67
-------------------------------------------------------------------------------
--

Segment Leq : 50.94 dBA
```

```
Results segment # 2: Chap (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 + 38.72 + 34.99) = 40.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -32     47   0.36  65.72   0.00 -12.03  -3.72   0.00   0.00 -11.25
38.72
-------------------------------------------------------------------------------
--
    47     53   0.66  65.72   0.00 -14.68 -16.04   0.00   0.00   0.00
34.99
-------------------------------------------------------------------------------
--

Segment Leq : 40.25 dBA

Total Leq All Segments: 51.30 dBA
```

```
Results segment # 1: Strand (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 (31.06 + 43.07 + 0.00) = 43.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -74    -73   0.66  67.90   0.00 -10.68 -26.16   0.00   0.00   0.00
31.06
-------------------------------------------------------------------------------
--
   -73     90   0.00  67.90   0.00  -6.44  -0.43   0.00   0.00 -17.96
43.07
-------------------------------------------------------------------------------
--

Segment Leq : 43.34 dBA
```

```
Results segment # 2: Chap (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 + 31.12 + 27.39) = 32.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-------------------------------------------------------------------------------
--
   -32     47   0.36  58.12   0.00 -12.03  -3.72   0.00   0.00 -11.25
31.12
-------------------------------------------------------------------------------
--
    47     53   0.66  58.12   0.00 -14.68 -16.04   0.00   0.00   0.00
27.39
-------------------------------------------------------------------------------
--

Segment Leq : 32.65 dBA

Total Leq All Segments: 43.70 dBA
```

```
RT/Custom data, segment # 1: OC (day/night)
-----------------------------------------
1 - Bus:
Traffic volume    :   191/67    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: OC (day/night)
-----------------------------------
Angle1   Angle2           : -44.00 deg   9.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  : 179.00 / 179.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: OC (day)

Source height = 0.50 m

RT/Custom (0.00 + 43.34 + 0.00) = 43.34 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-44	9	0.00	59.41	-10.77	-5.31	0.00	0.00	0.00	43.34

Segment Leq : 43.34 dBA

Total Leq All Segments: 43.34 dBA

Results segment # 1: OC (night)

Source height = 0.50 m

RT/Custom (0.00 + 41.80 + 0.00) = 41.80 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-44	9	0.00	57.87	-10.77	-5.31	0.00	0.00	0.00	41.80

Segment Leq : 41.80 dBA

Total Leq All Segments: 41.80 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 51.94
(NIGHT): 45.86

APPENDIX B

PREDICTOR LIMA - OUTPUT DATA

```
================================================================================
Testfile      openend:   ########    12:48:09 PM
================================================================================


--------------------------------------------------------------------------------
Cross      section      for          receiver    R11         (Id=-61)    and          source      S2          (Id=251)

ItemType   Id           Distance     X           Y           Hgrnd       Height       GrndFact    Cluster
Receiver   R11                 0     2171593     1425689         0          7.5              0
Ground     LWPOLYLIN       15.278    2171584     1425677         0            0              0
Ground     LWPOLYLIN       46.862    2171564     1425652         0            0              0
Building   LWPOLYLIN       99.153    2171532     1425611         0           11              0         19
Barrier    LWPOLYLIN       99.512    2171532     1425611        11            1              0         19
Pointsourc S2             116.599    2171522     1425597        11            2              0
--------------------------------------------------------------------------------
L(wr)              65          65          75          80          85          88          85          82          75
A(ground)          -3          -3          -3          -3          -3          -3          -3          -3          -3

A(barrier)          0           0           0           0           0           0           0           0           0
A(veg)              0           0           0           0           0           0           0           0           0
A(sit)              0           0           0           0           0           0           0           0           0
A(bld)              0           0           0           0           0           0           0           0           0
A(air)              0        0.01        0.05        0.12        0.23        0.43        1.13        3.83       13.64
A(geo)          52.34       52.34       52.34       52.34       52.34       52.34       52.34       52.34       52.34
C(meteo)            0           0           0           0           0           0           0           0           0
--------------------------------------------------------------------------------
L(p)            15.66       15.65       25.62       30.54       35.44       38.24       34.54       28.84       12.02 |              41.86

================================================================================

          Height      Source      Per          LAeq              32          63         125         250         500        1000        2000        4000        8000
               7.5 S2                   1        41.86          15.66       15.65       25.62       30.54       35.44       38.24       34.54       28.84       12.02
               7.5 S2                   2 --           --          --          --          --          --          --          --          --          --
               7.5 S2                   3        38.85          12.65       12.64       22.61       27.53       32.43       35.23       31.53       25.83        9.01
               7.5 S2                   4 --           --          --          --          --          --          --          --          --          --

================================================================================

          Height      Per          LAeq              32          63         125         250         500        1000        2000        4000        8000
               7.5            1        41.86          15.66       15.65       25.62       30.54       35.44       38.24       34.54       28.84       12.02
               7.5            2 --           --          --          --          --          --          --          --          --          --
               7.5            3        38.85          12.65       12.64       22.61       27.53       32.43       35.23       31.53       25.83        9.01
               7.5            4 --           --          --          --          --          --          --          --          --          --

--------------------------------------------------------------------------------
          0.0002;      96;          0.0000021; TTimerSet - overhead
          0.0012;      48;          0.0000255; WriteTestString
--------------------------------------------------------------------------------


================================================================================
Testfile      closed:    ########    12:48:09 PM
================================================================================
```