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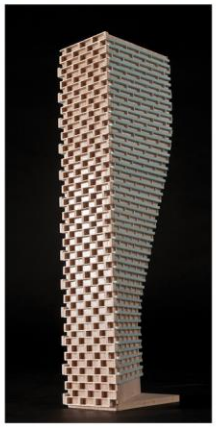
STATIOANRY NOISE FEASIBILITY ASSESSMENT

841 Grenon Avenue
Ottawa, Ontario

REPORT: GWE19-009 - Stationary Noise



January 18, 2019

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EXECUTIVE SUMMARY

This report describes a stationary noise feasibility assessment performed for a proposed residential development located at 841 Grenon Avenue in Ottawa, Ontario. The development comprises a single four-storey building. Surface parking is located at the southwest corner on the development site. Sources of stationary noise include rooftop mechanical equipment. Figure 1 illustrates a 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 (MOECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG), and; (iii) site plan drawings prepared by Project1 Studio Inc., dated December 20, 2018.

The results of the current study indicate that noise levels at nearby points of reception are expected to fall below the ENCG noise criteria, provided that the assumptions for noise control as outlined in Section 2.1 are adhered to during the detailed design process. As such, the proposed development is expected to be compatible with the existing noise sensitive land uses and will satisfy all site plan conditions. A review of the final equipment selections 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. (Gradient Wind) was retained by Building Investments to undertake a stationary noise feasibility assessment for the proposed residential development at 841 Grenon Avenue in Ottawa, Ontario. This report summarizes the methodology, results and recommendations related to a stationary noise feasibility assessment.

The present scope of work involves assessing exterior noise levels generated by rooftop mechanical equipment. The assessment was performed based on theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MOECP) NPC-300[2] guidelines, site plan drawings prepared by Project1 Studio Inc., dated December 20, 2018, mechanical information provided by Building Investments based on experience with similar projects, surrounding street layouts obtained from the City of Ottawa, and recent site imagery.

2. TERMS OF REFERENCE

The focus of this stationary noise feasibility assessment is the proposed residential development at 841 Grenon Avenue in Ottawa, Ontario. The development is located east of Grenon Avenue, between Carling Avenue and Michele Drive.

The development comprises a single four-storey building. Surface parking is located at the southwest corner on the development site. The development site borders existing residential properties along Grenon Avenue, which are the nearest points of reception. Figure 1 illustrates the site plan and surrounding context. Sources of stationary noise include rooftop mechanical equipment. Figure 2 illustrates the location of all noise sources included in this study.

The study building is located more than 100 m from an arterial, collector or major collector roadway, therefore a transportation noise assessment is not required.

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ministry of the Environment, Conservation and Parks (MOECP), Environmental Noise Guideline – Publication NPC-300, August 2013

2.1 Assumptions

Gradient Wind has assumed the preliminary mechanical information of the development based on information received from Building Investments and experience with similar developments. A review of the final equipment selections and locations by a qualified acoustical engineer will be required prior to installation of the equipment. The following assumptions have been made in the analysis:

(i) The locations, quantity and tonnage of rooftop equipment has been based on information provided from Building Investments based on experience with similar developments.

(ii) Sound data for the makeup air unit is based on manufacturer's data for an Allied Commercial Model KGB024.

(iii) Sound data for the dry cooler is based on manufacturer's data for an Airedale Model DR50.

(iv) The makeup air unit is assumed to operate continuously over a 1-hour period during the daytime/evening period, and at 50% operation during the nighttime period.

(v) The dry cooler is assumed to operate continuously over a 1-hour period during the daytime/evening and nighttime period.

(vi) Screening effects of the parapets have been conservatively excluded in the modelling.

3. OBJECTIVES

The main goals of this work are to (i) calculate the future noise levels on the surrounding dwellings produced by stationary sources and (ii) ensure that exterior noise levels do not exceed the allowable limits specified by the ENCG, as outlined in Section 4 of this report.

4. METHODOLOGY

The impact of the external stationary noise sources on the nearby residential areas was determined by computer modelling. Stationary noise source modelling is based on the software program *Predictor-Lima* developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2. This computer program simulates three-dimensional surfaces and first reflections of sound waves over a suitable spectrum for human hearing. This methodology has been used on numerous assignments and has been accepted by the MOECP as part of Environmental Compliance Approvals applications. Twelve receptor locations were selected for the study site, as illustrated in Figure 3.

4.1 Perception of Noise

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 source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Its measurement 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 represents the noise perceived by the human ear. With this scale, a doubling of sound power at the source results in a 3 dBA increase in measured noise levels at the receiver and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

Stationary sources are defined in NPC-300 as "a source of sound or combination of sources of sound that are included and normally operated within the property lines of a facility and includes the premises of a person as one stationary source, unless the dominant source of sound on those premises is construction"[3].

4.2 Stationary Noise Criteria

The equivalent sound energy level, L_{eq}, provides a weighted 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 selected period of time. For stationary sources, the L_{eq} is commonly 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 and NPC-300 apply to outdoor points of reception (POR). A POR is defined under NPC-300 as "any location on a noise sensitive land use where noise from a stationary source is received"[4]. 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 grounds, and noise sensitive buildings such as schools and places of worship. The recommended maximum noise levels for a Class 2 area in a suburban environment at a POR are outlined in Table 1 below.

[3] NPC – 300, page 16
[4] NPC – 300, page 14

TABLE 1: EXCLUSIONARY LIMITS FOR CLASS 1 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

4.3 Determination of Noise Source Power Levels

Preliminary mechanical information for the development has been based on information received from Building Investments and experience with similar developments. Table 2 summarizes the sound power of each source used in the analysis.

TABLE 2: EQUIPMENT SOUND POWER LEVELS (dBA)

Source ID	Description	Height Above Grade (m)	Frequency (Hz)								
			63	125	250	500	1000	2000	4000	8000	Total
S1	Makeup Air Unit	1.2	0	63	66	70	71	68	62	53	86
S2	Dry Cooler	1	57	70	76	79	82	77	72	62	85

4.4 Stationary Source Noise Predictions

The impact of stationary noise sources on nearby residential areas was determined by computer modelling using the software program Predictor-Lima. This program was developed from the International Standards Organization (ISO) standard 9613 Parts 1 and 2 and 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 (MOECP) as part of Environmental Compliance Approval applications.

A total of 8 receptor locations were chosen around the site to measure the noise impact at points of reception (POR) during the daytime/evening period (07:00 – 23:00), as well as during the nighttime period (23:00 – 07:00). POR locations include outdoor points of reception (OPOR) and the plane of windows (POW) of the adjacent residential properties. Sensor locations, which are based on worst-case dwellings,

are described in Table 3 and illustrated in Figure 3. Worst-case dwellings were determined with a receptor grid over the site, with a spacing of 5X5 m. All receptors were represented as point sources in the Predictor model. Table 4 below contains Predictor-Lima calculation settings. These are typical settings that 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 A. Further modelling data is available upon request.

TABLE 3: RECEPTOR LOCATIONS

Receptor Number	Receptor Location	Height Above Grade (m)
R1	POW – 825 Grenon Avenue	7.5
R2	OPOR – 825 Grenon Avenue	1.5
R3	POW – 2881 Richmond Road	35
R4	POW – 856 Grenon Avenue	4.5
R5	OPOR – 856 Grenon Avenue	1.5
R6	POW – 855 Grenon Avenue	4.5
R7	POW – 855 Grenon Avenue	4.5
R8	OPOR – 855 Grenon Avenue	1.5

TABLE 4: CALCULATION SETTINGS

Parameter	Setting
Meteorological correction method	Single value for C0
Value C0	0
Ground attenuation factor for soft surfaces (grass / open areas)	1
Ground attenuation factor for roadways and paved areas	0
Temperature (K)	283.15
Pressure (kPa)	101.33
Air humidity (%)	70

5. RESULTS AND DISCUSSION

Noise levels at nearby sensitive receptors fall below ENCG criteria for stationary noise, as summarized in Table 5 below. The sound levels listed in Table 5 are based on the assumptions outlined in Section 2.1.

TABLE 5: NOISE LEVELS FROM STATIONARY SOURCES

Receptor Number	Plane of Window Receptor Location	Noise Level (dBA)		Sound Level Limits		Meets ENCG Class 4 Criteria	
		Day/ Evening	Night	Day/ Evening	Night	Day/ Evening	Night
R1	POW – 825 Grenon Avenue	37	37	50	45	Yes	Yes
R2	OPOR – 825 Grenon Avenue	31	30	45	-	Yes	Yes
R3	POW – 2881 Richmond Road	35	35	50	45	Yes	Yes
R4	POW – 856 Grenon Avenue	34	33	50	45	Yes	Yes
R5	OPOR – 856 Grenon Avenue	28	28	45	-	Yes	Yes
R6	POW – 855 Grenon Avenue	37	37	50	45	Yes	Yes
R7	POW – 855 Grenon Avenue	39	39	50	45	Yes	Yes
R8	OPOR – 855 Grenon Avenue	34	33	45	-	Yes	Yes

As Table 5 summarizes, noise levels fall below ENCG criteria at all receptors. Noise contours at 4.5 m above grade can be seen in Figure 4 and 5 for daytime and nighttime conditions, respectively. The rooftop equipment should be located toward the centre of the rooftop, avoiding direct line of sight with sensitive areas if possible. With consideration of Gradient Wind's recommendations, the proposed development is expected to be compatible with the existing land uses.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current study indicate that noise levels at nearby points of reception are expected to fall below the ENCG noise criteria, provided that the assumptions for noise control as outlined in Section 2.1 are adhered to during the detailed design process. As such, the proposed development is expected to be compatible with the existing noise sensitive land uses and will satisfy all site plan conditions. A review of the final equipment selections 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.

Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. R. FOSTER
100155655
Jan 18, 2019
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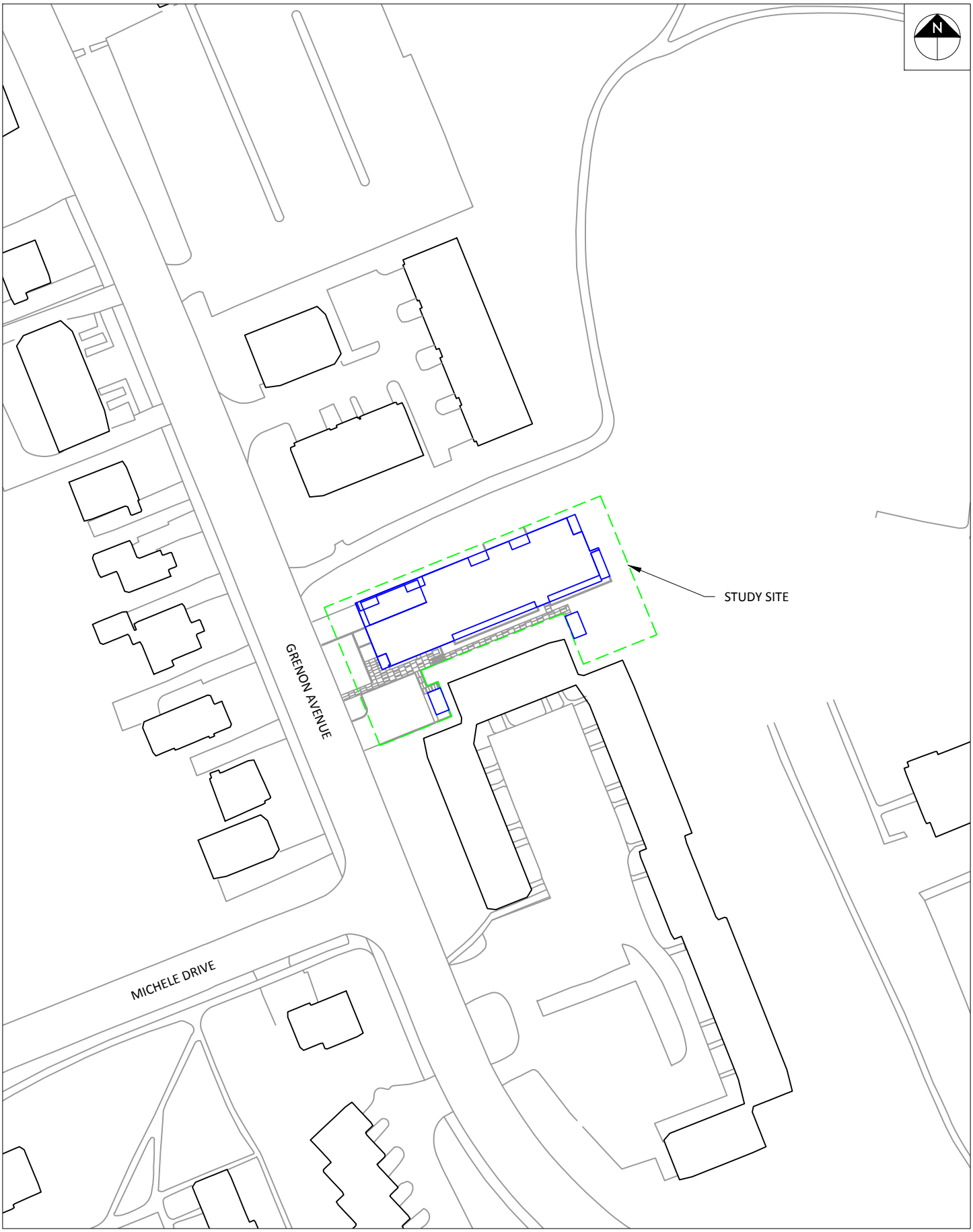

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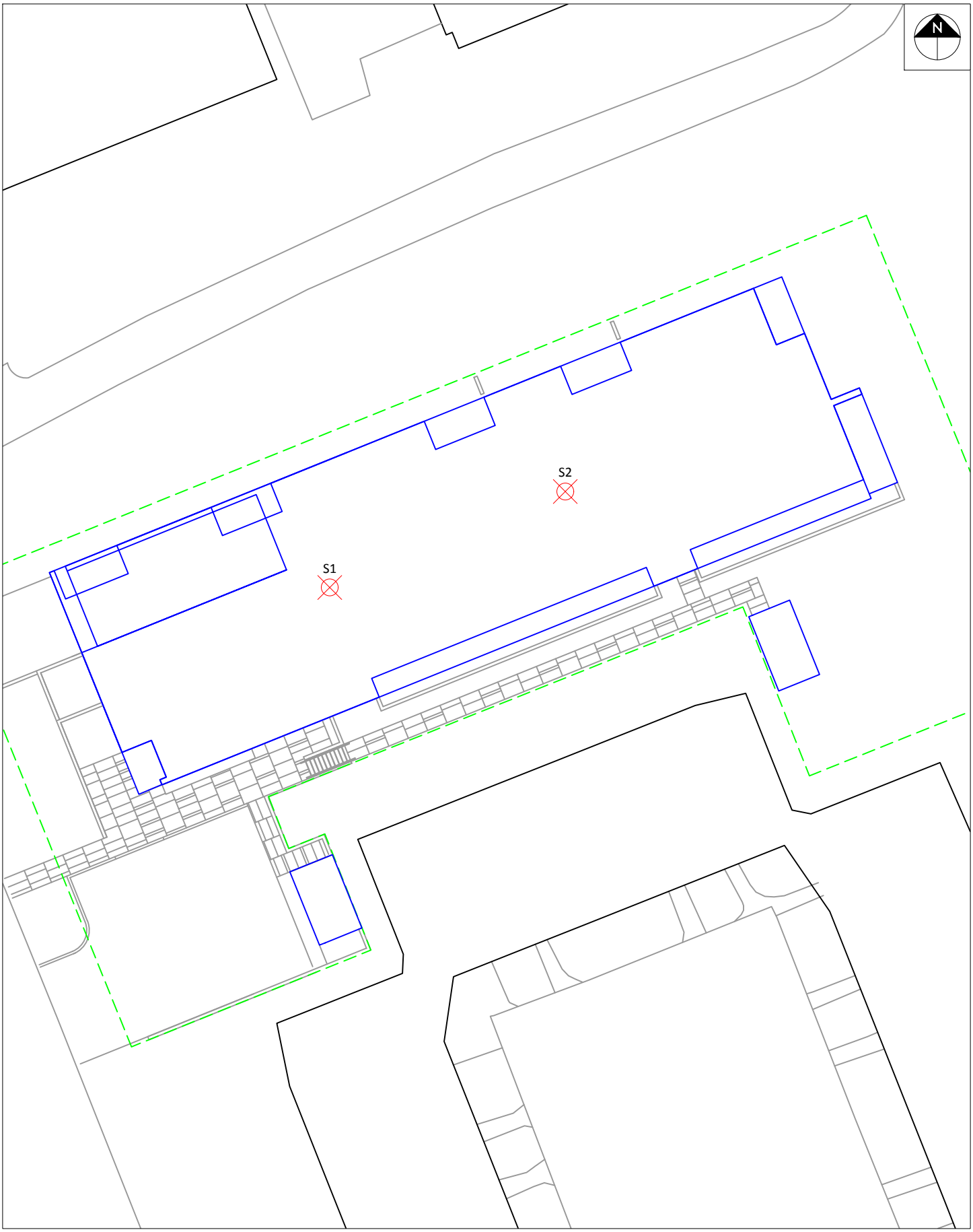
PROJECT	841 GRENON AVENUE, OTTAWA STATIONARY NOISE FEASIBILITY ASSESSMENT		DESCRIPTION
SCALE	1:2000 (APPROX.)	DRAWING NO. GWE19-009-1	FIGURE 1: SITE PLAN AND SURROUNDING CONTEXT
DATE	JANUARY 17, 2019	DRAWN BY M.L.	



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PROJECT	841 GRENON AVENUE, OTTAWA STATIONARY NOISE FEASIBILITY ASSESSMENT		DESCRIPTION
SCALE	1:300 (APPROX.)	DRAWING NO. GWE19-009-2	FIGURE 2: SOURCE LOCATIONS
DATE	JANUARY 17, 2019	DRAWN BY M.L.	

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PROJECT	841 GRENON AVENUE, OTTAWA STATIONARY NOISE FEASIBILITY ASSESSMENT		DESCRIPTION
SCALE	1:2000 (APPROX.)	DRAWING NO. GWE19-009-3	FIGURE 3: RECEPTOR LOCATIONS
DATE	JANUARY 17, 2019	DRAWN BY M.L.	

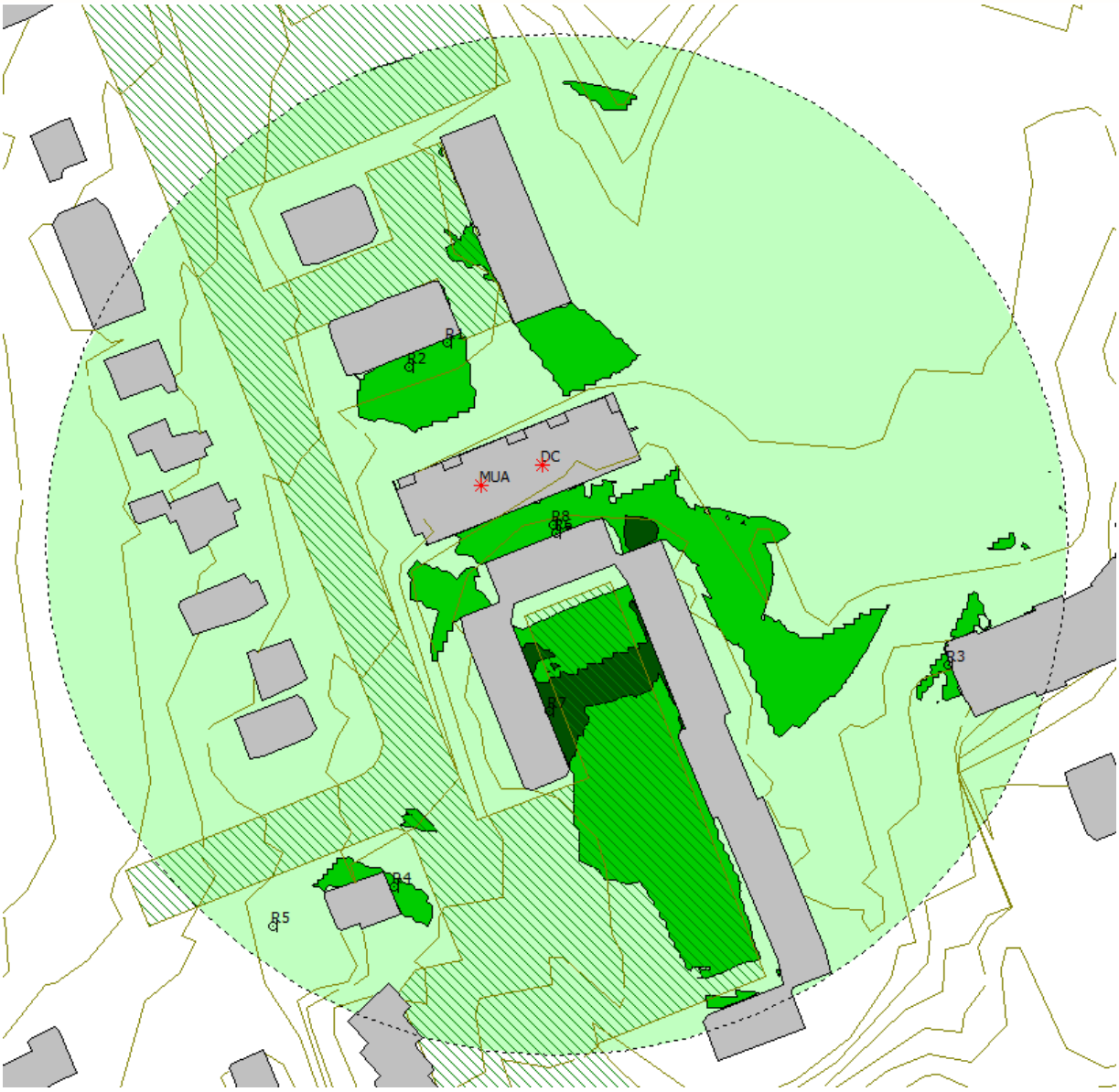

FIGURE 4: DAYTIME/EVENING NOISE CONTOURS (4.5 METERS ABOVE GRADE)

- *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*

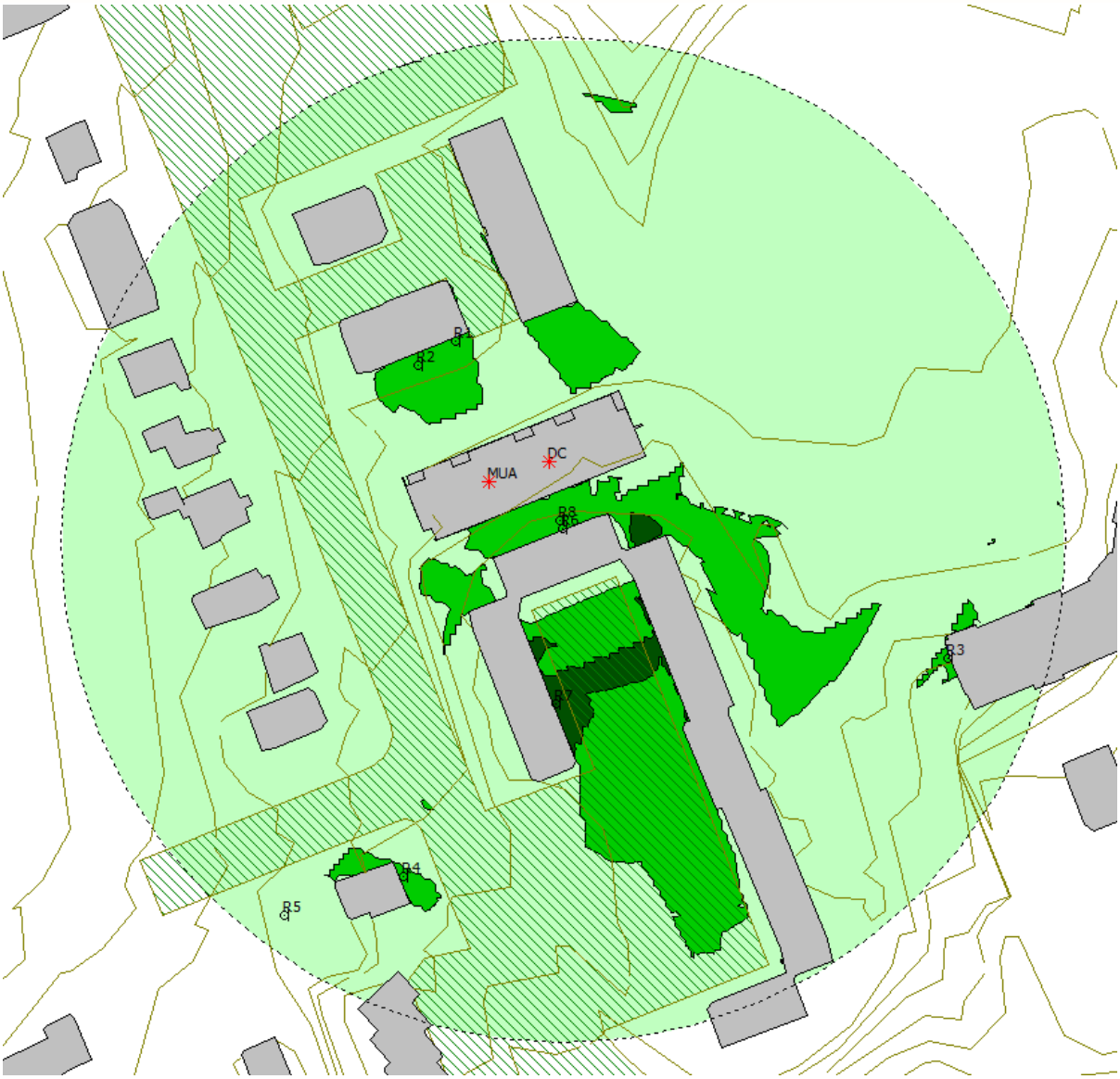

FIGURE 5: NIGHTTIME NOISE CONTOURS (4.5 METERS ABOVE GRADE)

- *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

SAMPLE CALCULATION INPUT/OUTPUT

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==========
Testfile openend: ######## 1:05:18 PM
==========

Cross section for receiver R3 (Id=-13) and source DC (Id=358)

ItemType	Id	Distance	X	Y	Hgrnd	Height	GrndFact	Cluster
Receiver	R3	0	359776	5024180	76.8	35	1	
Heightline	Tri	2315.2	2.423	359773.8	5024181	76.49	0	1
Heightline	Tri	2361.1	2.423	359773.8	5024181	76.49	0	1
Heightline	Tri	2279.3	8.497	359768.4	5024184	76	0	1
Heightline	Tri	2315.3	8.497	359768.4	5024184	76	0	1
Heightline	Tri	2246.2	12.488	359764.8	5024186	75.82	0	1
Heightline	Tri	2279.2	12.488	359764.8	5024186	75.82	0	1
Heightline	Tri	2201.1	16.237	359761.4	5024188	75.57	0	1
Heightline	Tri	2246.1	16.237	359761.4	5024188	75.57	0	1
Heightline	Tri	2165.1	23.533	359754.9	5024191	75	0	1
Heightline	Tri	2201.2	23.533	359754.9	5024191	75	0	1
Heightline	Tri	2146.3	25.799	359752.9	5024192	75	0	1
Heightline	Tri	2165.2	25.799	359752.9	5024192	75	0	1
Heightline	Tri	2127.2	33.061	359746.4	5024195	75	0	1
Heightline	Tri	2146.2	33.061	359746.4	5024195	75	0	1
Heightline	Tri	2097.3	39.171	359740.9	5024198	75	0	1
Heightline	Tri	2127.3	39.171	359740.9	5024198	75	0	1
Heightline	Tri	1420.1	41.391	359738.9	5024199	75	0	1
Heightline	Tri	2097.2	41.391	359738.9	5024199	75	0	1
Heightline	Tri	1420.3	41.947	359738.4	5024199	75	0	1
Heightline	Tri	1598.2	41.947	359738.4	5024199	75	0	1
Heightline	Tri	1417.3	45.522	359735.2	5024200	75	0	1
Heightline	Tri	1598.3	45.522	359735.2	5024200	75	0	1
Heightline	Tri	1417.2	57.198	359724.7	5024206	75.92	0	1
Heightline	Tri	1970.2	57.198	359724.7	5024206	75.92	0	1
Heightline	Tri	1960.3	64.078	359718.5	5024209	76	0	1
Heightline	Tri	1970.1	64.078	359718.5	5024209	76	0	1
Heightline	Tri	1847.3	64.198	359718.4	5024209	76	0	1
Heightline	Tri	1960.1	64.198	359718.4	5024209	76	0	1
Heightline	Tri	1847.1	64.276	359718.4	5024209	76	0	1
Heightline	Tri	1857.3	64.276	359718.4	5024209	76	0	1
Heightline	Tri	1795.2	79.047	359705.1	5024215	75.33	0	1
Heightline	Tri	1857.2	79.047	359705.1	5024215	75.33	0	1
Building	LWPOLYLIN	79.984	359704.3	5024216	73.77	13	1	18
Building	LWPOLYLIN	79.985	359704.3	5024216	73.62	13	1	18
Heightline	Tri	1762.2	83.295	359701.3	5024217	75	0	1
Heightline	Tri	1795.3	83.295	359701.3	5024217	75	0	1
Heightline	Tri	1155.2	83.479	359701.1	5024217	75	0	1
Heightline	Tri	1762.1	83.479	359701.1	5024217	75	0	1
Heightline	Tri	1155.3	83.535	359701.1	5024217	74.99	0	1
Heightline	Tri	1164.1	83.535	359701.1	5024217	74.99	0	1
Pointsourc	DC	88.448	359696.7	5024219	86.77	1	1	

L(wr)	--	57	70	76	79	82	77	72	62
A(ground)	-3	-3	0.48	6.52	7.33	1.69	0	0	0
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	0.04	0.1	0.18	0.34	0.89	3	10.71
A(geo)	50.24	50.24	50.24	50.24	50.24	50.24	50.24	50.24	50.24
C(meteo)	0	0	0	0	0	0	0	0	0

L(p)	--	9.75	19.25	19.15	21.26	29.74	25.88	18.76	1.05	32.34

Cross section for receiver R3 (Id=-13) and source DC (Id=358)

[Reflection in facade POLYLINE (Id=45)]

ItemType	Id	Distance	X	Y	Hgrnd	Height	GrndFact	Cluster
Receiver	R3	0	359776	5024180	76.8	35	1	
Heightline	Tri	2315.2	2.468	359774.4	5024182	76.38	0	1
Heightline	Tri	2361.1	2.468	359774.4	5024182	76.38	0	1
Heightline	Tri	2279.3	5.533	359772.5	5024185	76	0	1
Heightline	Tri	2315.3	5.533	359772.5	5024185	76	0	1
Heightline	Tri	2279.1	16.42	359765.5	5024193	75.24	0	1
Heightline	Tri	2359.1	16.42	359765.5	5024193	75.24	0	1
Heightline	Tri	2249.1	19.972	359763.2	5024196	75	0	1
Heightline	Tri	2359.3	19.972	359763.2	5024196	75	0	1
Heightline	Tri	2249.3	21.789	359762.1	5024197	74.94	0	1
Heightline	Tri	2265.3	21.789	359762.1	5024197	74.94	0	1
Heightline	Tri	2204.1	22.439	359761.7	5024198	74.92	0	1
Heightline	Tri	2265.2	22.439	359761.7	5024198	74.92	0	1
Heightline	Tri	2104.3	43.29	359748.3	5024214	74.56	0	1
Heightline	Tri	2204.2	43.29	359748.3	5024214	74.56	0	1
Heightline	Tri	2104.1	56.633	359739.8	5024224	74	0	1
Heightline	Tri	2153.1	56.633	359739.8	5024224	74	0	1
Heightline	Tri	2153.2	61.747	359736.5	5024228	74	0	1
Heightline	Tri	2184.2	61.747	359736.5	5024228	74	0	1
Heightline	Tri	2184.1	63.54	359735.4	5024229	74	0	1
Heightline	Tri	2206.3	63.54	359735.4	5024229	74	0	1
Heightline	Tri	2064.1	63.794	359735.2	5024229	74	0	1
Heightline	Tri	2206.2	63.794	359735.2	5024229	74	0	1
Heightline	Tri	1972.1	70.278	359731.1	5024234	74	0	1
Heightline	Tri	2064.2	70.278	359731.1	5024234	74	0	1
Heightline	Tri	1921.2	85.437	359721.4	5024246	74	0	1
Heightline	Tri	1972.3	85.437	359721.4	5024246	74	0	1
Heightline	Tri	1908.3	94.116	359715.8	5024253	74	0	1
Heightline	Tri	1921.3	94.116	359715.8	5024253	74	0	1
Heightline	Tri	1790.3	99.197	359712.6	5024257	74	0	1
Heightline	Tri	1908.1	99.197	359712.6	5024257	74	0	1
Heightline	Tri	1790.1	107.211	359707.5	5024263	73.71	0	1
Heightline	Tri	1851.3	107.211	359707.5	5024263	73.71	0	1
Heightline	Tri	1512.2	111.735	359704.6	5024266	73.74	0	1
Heightline	Tri	1851.2	111.735	359704.6	5024266	73.74	0	1
Heightline	Tri	1441.3	111.739	359704.6	5024266	73.74	0	1
Heightline	Tri	1512.3	111.739	359704.6	5024266	73.74	0	1
Heightline	Tri	1441.1	112.534	359704.1	5024267	73.74	0	1
Heightline	Tri	1840.2	112.534	359704.1	5024267	73.74	0	1
Heightline	Tri	1436.3	121.779	359698.2	5024274	73.68	0	1
Heightline	Tri	1840.1	121.779	359698.2	5024274	73.68	0	1
Heightline	Tri	1408.1	125.261	359695.9	5024277	73.7	0	1
Heightline	Tri	1436.2	125.261	359695.9	5024277	73.7	0	1
Heightline	Tri	1308.1	127.68	359694.4	5024279	73.73	0	1
Heightline	Tri	1408.2	127.68	359694.4	5024279	73.73	0	1
Heightline	Tri	1308.2	133.579	359690.6	5024283	73.62	0	1
Heightline	Tri	1405.3	133.579	359690.6	5024283	73.62	0	1
Building	LWPOLYLIN	137.817	359687.9	5024286	73.23	8.83	1	17
Building	LWPOLYLIN	139.484	359686.9	5024288	73.23	8.83	1	17
Heightline	Tri	1244.2	142.702	359684.8	5024290	73	0	1
Heightline	Tri	1405.2	142.702	359684.8	5024290	73	0	1
Heightline	Tri	1244.3	143.665	359684.2	5024291	73	0	1
Heightline	Tri	1332.2	143.665	359684.2	5024291	73	0	1
Ground	LWPOLYLIN	144.704	359683.5	5024292	38.76	0	0	
Heightline	Tri	1219.3	147.502	359681.7	5024294	73	0	0
Heightline	Tri	1332.1	147.502	359681.7	5024294	73	0	0
Heightline	Tri	1084.3	173.55	359665.1	5024314	72.01	0	0
Heightline	Tri	1219.2	173.55	359665.1	5024314	72.01	0	0
Heightline	Tri	1084.1	173.747	359665	5024314	72	0	0
Heightline	Tri	1085.3	173.747	359665	5024314	72	0	0
Heightline	Tri	1082.3	178.491	359661.9	5024318	72	0	0
Heightline	Tri	1085.2	178.491	359661.9	5024318	72	0	0
Heightline	Tri	1082.1	179.802	359661.1	5024319	72	0	0
Heightline	Tri	1129.2	179.802	359661.1	5024319	72	0	0

Heightline	Tri	1073.3	180.586	359660.6	5024319	72	0	0
Heightline	Tri	1129.1	180.586	359660.6	5024319	72	0	0
Heightline	Tri	757.1	207.652	359643.3	5024340	71.55	0	0
Heightline	Tri	1073.1	207.652	359643.3	5024340	71.55	0	0
Building(R)	POLYLINE	208.192	359642.9	5024340	71.03	38.41	0	
Heightline	Tri	757.1	208.621	359643.1	5024340	71.55	0	0
Heightline	Tri	1073.1	208.621	359643.1	5024340	71.55	0	0
Heightline	Tri	969.3	226.235	359650.3	5024324	71.79	0	0
Heightline	Tri	1073.2	226.235	359650.3	5024324	71.79	0	0
Heightline	Tri	965.2	235.752	359654.1	5024315	72	0	0
Heightline	Tri	969.2	235.752	359654.1	5024315	72	0	0
Heightline	Tri	958.3	238.914	359655.4	5024312	72	0	0
Heightline	Tri	965.3	238.914	359655.4	5024312	72	0	0
Heightline	Tri	949.1	241.166	359656.3	5024310	72	0	0
Heightline	Tri	958.2	241.166	359656.3	5024310	72	0	0
Heightline	Tri	949.3	242.202	359656.7	5024309	72	0	0
Heightline	Tri	1101.3	242.202	359656.7	5024309	72	0	0
Heightline	Tri	963.2	268.396	359667.4	5024285	72.83	0	0
Heightline	Tri	1101.1	268.396	359667.4	5024285	72.83	0	0
Ground	LWPOLYLIN	268.825	359667.6	5024285	38.76	0	1	
Heightline	Tri	957.1	270.476	359668.2	5024284	72.88	0	1
Heightline	Tri	963.1	270.476	359668.2	5024284	72.88	0	1
Heightline	Tri	942.3	272.678	359669.1	5024282	72.92	0	1
Heightline	Tri	957.3	272.678	359669.1	5024282	72.92	0	1
Heightline	Tri	942.2	273.717	359669.5	5024281	72.93	0	1
Heightline	Tri	979.2	273.717	359669.5	5024281	72.93	0	1
Heightline	Tri	979.1	274.099	359669.7	5024280	72.93	0	1
Heightline	Tri	1060.1	274.099	359669.7	5024280	72.93	0	1
Ground	LWPOLYLIN	274.611	359669.9	5024280	38.76	0	0	
Heightline	Tri	1060.2	295.417	359678.4	5024261	72.97	0	0
Heightline	Tri	1083.3	295.417	359678.4	5024261	72.97	0	0
Heightline	Tri	1083.2	295.623	359678.4	5024261	72.97	0	0
Heightline	Tri	1312.3	295.623	359678.4	5024261	72.97	0	0
Heightline	Tri	1312.2	297.966	359679.4	5024258	73	0	0
Heightline	Tri	1351.1	297.966	359679.4	5024258	73	0	0
Ground	LWPOLYLIN	312.247	359685.2	5024245	38.76	0	1	
Heightline	Tri	1351.2	314.806	359686.2	5024243	73	0	1
Heightline	Tri	1376.2	314.806	359686.2	5024243	73	0	1
Heightline	Tri	1255.2	321.479	359688.9	5024237	73.34	0	1
Heightline	Tri	1376.3	321.479	359688.9	5024237	73.34	0	1
Heightline	Tri	1164.3	331.274	359692.9	5024228	74	0	1
Heightline	Tri	1255.3	331.274	359692.9	5024228	74	0	1
Building	LWPOLYLIN	332.783	359693.5	5024227	73.77	13	1	18
Building	LWPOLYLIN	332.783	359693.5	5024227	73.62	13	1	18
Pointsourc	DC	340.561	359696.7	5024219	86.77	1	1	

L(wr)	--	57	70	76	79	82	77	72	62
A(ground)	-3	-3	0.98	6.61	7.54	1.12	-0.8	-0.8	-0.8
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)	0.01	0.04	0.14	0.36	0.66	1.25	3.3	11.19	39.9
A(geo)	61.66	61.66	61.66	61.66	61.66	61.66	61.66	61.66	61.66
A(refl)	--	--	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97
C(meteo)	0	0	0	0	0	0	0	0	0

L(p)	--	--	6.25	6.4	8.18	17	11.87	-1.02	-39.73 |	19.11

Cross section for receiver R3 (Id=-13) and source DC (Id=358)
[Reflection in facade POLYLINE (Id=61)]

ItemType	Id	Distance	X	Y	Hgrnd	Height	GrndFact	Cluster
Receiver	R3	0	359776	5024180	76.8	35	1	
Building(R)	POLYLINE	0.59	359776.3	5024181	76.2	40.05	1	

Heightline	Tri	2315.2	3.009	359774.2	5024182	76.42	0	1
Heightline	Tri	2361.1	3.009	359774.2	5024182	76.42	0	1
Heightline	Tri	2279.3	8.363	359769.4	5024184	76	0	1
Heightline	Tri	2315.3	8.363	359769.4	5024184	76	0	1
Heightline	Tri	2246.2	13.626	359764.6	5024187	75.76	0	1
Heightline	Tri	2279.2	13.626	359764.6	5024187	75.76	0	1
Heightline	Tri	2201.1	18.416	359760.3	5024189	75.44	0	1
Heightline	Tri	2246.1	18.416	359760.3	5024189	75.44	0	1
Heightline	Tri	2165.1	24.127	359755.2	5024191	75	0	1
Heightline	Tri	2201.2	24.127	359755.2	5024191	75	0	1
Heightline	Tri	2146.3	25.953	359753.5	5024192	75	0	1
Heightline	Tri	2165.2	25.953	359753.5	5024192	75	0	1
Heightline	Tri	2127.2	34.177	359746.1	5024195	75	0	1
Heightline	Tri	2146.2	34.177	359746.1	5024195	75	0	1
Heightline	Tri	2097.3	40	359740.9	5024198	75	0	1
Heightline	Tri	2127.3	40	359740.9	5024198	75	0	1
Heightline	Tri	1420.1	42.429	359738.7	5024199	75	0	1
Heightline	Tri	2097.2	42.429	359738.7	5024199	75	0	1
Heightline	Tri	1420.3	42.926	359738.3	5024199	75	0	1
Heightline	Tri	1598.2	42.926	359738.3	5024199	75	0	1
Heightline	Tri	1417.3	46.678	359734.9	5024201	75	0	1
Heightline	Tri	1598.3	46.678	359734.9	5024201	75	0	1
Heightline	Tri	1417.2	58.048	359724.7	5024206	75.9	0	1
Heightline	Tri	1970.2	58.048	359724.7	5024206	75.9	0	1
Heightline	Tri	1933.3	64.946	359718.5	5024209	75.99	0	1
Heightline	Tri	1970.3	64.946	359718.5	5024209	75.99	0	1
Heightline	Tri	1897.2	65.033	359718.4	5024209	75.99	0	1
Heightline	Tri	1933.2	65.033	359718.4	5024209	75.99	0	1
Heightline	Tri	1857.1	65.473	359718	5024209	75.96	0	1
Heightline	Tri	1897.1	65.473	359718	5024209	75.96	0	1
Heightline	Tri	1795.2	79.722	359705.2	5024215	75.33	0	1
Heightline	Tri	1857.2	79.722	359705.2	5024215	75.33	0	1
Building	LWPOLYLIN	80.616	359704.4	5024216	73.77	13	1	18
Building	LWPOLYLIN	80.617	359704.4	5024216	73.62	13	1	18
Heightline	Tri	1762.2	83.931	359701.4	5024217	75	0	1
Heightline	Tri	1795.3	83.931	359701.4	5024217	75	0	1
Heightline	Tri	1155.2	84.156	359701.2	5024217	75	0	1
Heightline	Tri	1762.1	84.156	359701.2	5024217	75	0	1
Heightline	Tri	1155.3	84.224	359701.1	5024217	74.99	0	1
Heightline	Tri	1164.1	84.224	359701.1	5024217	74.99	0	1
Pointsourc	DC	89.131	359696.7	5024219	86.77	1	1	

L(wr)	--	57	70	76	79	82	77	72	62
A(ground)	-3	-3	0.48	6.54	7.35	1.69	0	0	0
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	0.04	0.1	0.18	0.34	0.89	3.03	10.79
A(geo)	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3
A(refl)	--	--	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97	-0.97
C(meteo)	0	0	0	0	0	0	0	0	0

L(p)	--	--	18.22	18.1	20.2	28.71	24.84	17.71	-0.06	| 31.28

Cross section for receiver R3 (Id=-13) and source DC (Id=358)
[Reflection in facade POLYLINE (Id=64)]

ItemType	Id	Distance	X	Y	Hgrnd	Height	GrndFact	Cluster
Receiver	R3	0	359776	5024180	76.8	35	1	
Building	POLYLINE	0.759	359776.3	5024181	76.2	40.05	1	42
Heightline	Tri	2361.3	1.819	359776.7	5024182	76.54	0	1
Heightline	Tri	2363.3	1.819	359776.7	5024182	76.54	0	1
Heightline	Tri	2363.2	3.717	359777.4	5024184	76.29	0	1
Heightline	Tri	2485.2	3.717	359777.4	5024184	76.29	0	1

Building	POLYLINE	5.522	359778.1	5024185	76.2	40.05	1	42
Heightline	Tri	2359.2	8.134	359779	5024188	75.82	0	1
Heightline	Tri	2485.1	8.134	359779	5024188	75.82	0	1
Heightline	Tri	2249.1	20.275	359783.5	5024199	75	0	1
Heightline	Tri	2359.3	20.275	359783.5	5024199	75	0	1
Heightline	Tri	2249.2	25.991	359785.7	5024204	74.83	0	1
Heightline	Tri	2456.3	25.991	359785.7	5024204	74.83	0	1
Heightline	Tri	2456.1	32.772	359788.2	5024211	74.72	0	1
Heightline	Tri	2519.2	32.772	359788.2	5024211	74.72	0	1
Heightline	Tri	2519.1	52.099	359795.4	5024229	74.72	0	1
Heightline	Tri	2548.3	52.099	359795.4	5024229	74.72	0	1
Heightline	Tri	2548.1	59.259	359798	5024235	75	0	1
Heightline	Tri	2598.2	59.259	359798	5024235	75	0	1
Heightline	Tri	2598.1	62.995	359799.4	5024239	75.22	0	1
Heightline	Tri	2639.1	62.995	359799.4	5024239	75.22	0	1
Heightline	Tri	2639.3	64.389	359799.9	5024240	75.3	0	1
Heightline	Tri	2843.2	64.389	359799.9	5024240	75.3	0	1
Heightline	Tri	2823.3	69.93	359802	5024245	75.33	0	1
Heightline	Tri	2843.3	69.93	359802	5024245	75.33	0	1
Heightline	Tri	2788.1	89.345	359809.2	5024263	75.28	0	1
Heightline	Tri	2823.2	89.345	359809.2	5024263	75.28	0	1
Heightline	Tri	2788.3	91.113	359809.9	5024265	75.18	0	1
Heightline	Tri	3092.2	91.113	359809.9	5024265	75.18	0	1
Heightline	Tri	3063.1	91.444	359810	5024265	75	0	1
Heightline	Tri	3092.3	91.444	359810	5024265	75	0	1
Heightline	Tri	2742.1	93.971	359810.9	5024268	74.55	0	1
Heightline	Tri	3063.2	93.971	359810.9	5024268	74.55	0	1
Heightline	Tri	2742.2	98.702	359812.7	5024272	74	0	1
Heightline	Tri	2821.3	98.702	359812.7	5024272	74	0	1
Heightline	Tri	2761.2	103.181	359814.4	5024276	74	0	1
Heightline	Tri	2821.2	103.181	359814.4	5024276	74	0	1
Heightline	Tri	2761.3	114.459	359818.6	5024287	74	0	1
Heightline	Tri	3021.2	114.459	359818.6	5024287	74	0	1
Heightline	Tri	3005.1	114.574	359818.6	5024287	74	0	1
Heightline	Tri	3021.1	114.574	359818.6	5024287	74	0	1
Heightline	Tri	3002.2	114.689	359818.6	5024287	74	0	1
Heightline	Tri	3005.3	114.689	359818.6	5024287	74	0	1
Heightline	Tri	3002.1	114.806	359818.7	5024287	74	0	1
Heightline	Tri	3007.2	114.806	359818.7	5024287	74	0	1
Heightline	Tri	3007.1	116.566	359819.3	5024289	74	0	1
Heightline	Tri	3009.1	116.566	359819.3	5024289	74	0	1
Heightline	Tri	2735.1	122.759	359821.6	5024294	74	0	1
Heightline	Tri	3009.3	122.759	359821.6	5024294	74	0	1
Heightline	Tri	2735.2	124.007	359822.1	5024295	74	0	1
Heightline	Tri	2837.2	124.007	359822.1	5024295	74	0	1
Heightline	Tri	2837.3	136.403	359826.7	5024307	74	0	1
Heightline	Tri	3019.1	136.403	359826.7	5024307	74	0	1
Building(R)	POLYLINE	137.439	359827.1	5024308	80.85	36.32	1	
Heightline	Tri	2837.3	138.407	359826.3	5024307	74	0	1
Heightline	Tri	3019.1	138.407	359826.3	5024307	74	0	1
Heightline	Tri	2650.2	157.547	359810.5	5024297	74	0	1
Heightline	Tri	2837.1	157.547	359810.5	5024297	74	0	1
Heightline	Tri	2625.1	163.996	359805.1	5024293	74	0	1
Heightline	Tri	2650.1	163.996	359805.1	5024293	74	0	1
Heightline	Tri	2610.3	166.025	359803.4	5024292	74	0	1
Heightline	Tri	2625.2	166.025	359803.4	5024292	74	0	1
Heightline	Tri	2570.2	166.552	359803	5024292	74	0	1
Heightline	Tri	2610.2	166.552	359803	5024292	74	0	1
Heightline	Tri	2570.1	172.34	359798.2	5024288	74	0	1
Heightline	Tri	2635.3	172.34	359798.2	5024288	74	0	1
Heightline	Tri	2564.1	173.37	359797.4	5024288	74	0	1
Heightline	Tri	2635.1	173.37	359797.4	5024288	74	0	1
Heightline	Tri	2550.1	174.844	359796.1	5024287	74	0	1
Heightline	Tri	2564.2	174.844	359796.1	5024287	74	0	1
Heightline	Tri	2541.3	180.889	359791.1	5024284	74	0	1
Heightline	Tri	2550.3	180.889	359791.1	5024284	74	0	1
Heightline	Tri	2280.1	194.888	359779.5	5024276	74	0	1

Heightline	Tri	2541.2	194.888	359779.5	5024276	74	0	1
Heightline	Tri	1915.2	231.326	359749.4	5024255	74	0	1
Heightline	Tri	2280.2	231.326	359749.4	5024255	74	0	1
Heightline	Tri	1915.1	238.037	359743.8	5024251	74	0	1
Heightline	Tri	1972.2	238.037	359743.8	5024251	74	0	1
Heightline	Tri	1921.2	262.23	359723.8	5024238	74	0	1
Heightline	Tri	1972.3	262.23	359723.8	5024238	74	0	1
Heightline	Tri	1921.1	267.481	359719.5	5024235	74	0	1
Heightline	Tri	1934.2	267.481	359719.5	5024235	74	0	1
Heightline	Tri	1924.2	270.949	359716.6	5024233	74.21	0	1
Heightline	Tri	1934.3	270.949	359716.6	5024233	74.21	0	1
Building	LWPOLYLIN	276.494	359712	5024230	73.77	13	1	18
Building	LWPOLYLIN	276.494	359712	5024230	73.62	13	1	18
Heightline	Tri	1892.3	277.414	359711.2	5024229	74.46	0	1
Heightline	Tri	1924.1	277.414	359711.2	5024229	74.46	0	1
Heightline	Tri	1868.2	279.059	359709.9	5024228	74.44	0	1
Heightline	Tri	1892.1	279.059	359709.9	5024228	74.44	0	1
Heightline	Tri	1155.1	285.927	359704.2	5024225	74.69	0	1
Heightline	Tri	1868.3	285.927	359704.2	5024225	74.69	0	1
Heightline	Tri	1155.3	287.396	359703	5024224	74.62	0	1
Heightline	Tri	1164.1	287.396	359703	5024224	74.62	0	1
Pointsourc	DC	294.999	359696.7	5024219	86.77	1	1	

L(wr)	--	57	70	76	79	82	77	72	62
A(ground)	-3	-3	1.57	7.84	8.81	2.03	0	0	0
A(barrier)	13.02	15.38	13.62	10.88	14.26	22.97	25	25	25
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)	0.01	0.04	0.12	0.31	0.57	1.08	2.86	9.7	34.59
A(geo)	60.42	60.42	60.42	60.42	60.42	60.42	60.42	60.42	60.42
A(refl)	--	--	--	--	--	--	--	--	-0.97
C(meteo)	0	0	0	0	0	0	0	0	0

L(p)	--	--	--	--	--	--	--	--	-58.98 |	-58.98

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Height	Source	Per	LAeq	32	63	125	250	500	1000	2000	4000	8000
35	DC	1	34.97	--	9.75	21.89	21.79	23.89	32.39	28.5	21.3	3.54
35	DC	2	--	--	--	--	--	--	--	--	--	--
35	DC	3	34.97	--	9.75	21.89	21.79	23.89	32.39	28.5	21.3	3.54
35	DC	4	--	--	--	--	--	--	--	--	--	--

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Height	Per	LAeq	32	63	125	250	500	1000	2000	4000	8000
35	1	34.97	--	9.75	21.89	21.79	23.89	32.39	28.5	21.3	3.54
35	2	--	--	--	--	--	--	--	--	--	--
35	3	34.97	--	9.75	21.89	21.79	23.89	32.39	28.5	21.3	3.54
35	4	--	--	--	--	--	--	--	--	--	--

0.0001;	782;	0.0000001; TTimerSet - overhead
0.0019;	391;	0.0000049; WriteTestString

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Testfile closed: ######## 1:05:18 PM

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