REPORT

Fernbank Public School – 480 Cope Drive

Ottawa, Ontario

Noise Impact Study

SACL #SW19541

Oct 29, 2019

Submitted to:

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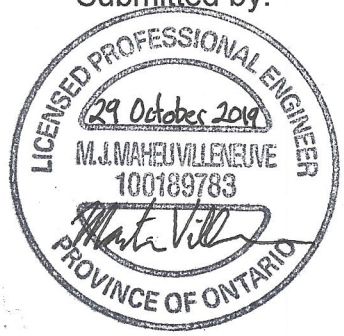

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1. Introduction

At the request of N45 Architecture Inc. (N45), Swallow Acoustic Consultants Ltd. / Thornton Tomasetti (SACL / TT) is pleased to present this Noise Impact Study (NIS) for the proposed 2-storey Fernbank Public School (the Project) to be located at 480 Cope Drive in Ottawa, Ontario (the Site). This NIS assesses noise impacts from nearby surface transportation sources, as well as noise impacts from the Project onto nearby noise-sensitive points of reception (residences). Based on observations made at the site and surrounding area, there are no significant off-site stationary noise sources that may exceed the applicable sound level criteria for the Project.

The Project is a public school consisting of new construction. Therefore, the playground associated with the project is not considered for assessment for stationary noise sources, consistent with the City of Ottawa Environmental Noise Control Guidelines (ENCG) [1]. The playground is considered as part of the assessment for noise due to transportation noise sources.

Adjacent properties consist of one- and two-storey residential buildings to the east, north and west. A park is proposed south of the Project.

The main surface transportation corridors impacting on the Project are Cope Drive and Rouncey Road, based on their roadway classifications per the City of Ottawa, and their proximity to the development.

An aerial photo of the area is presented in Figure 1 and a site plan of the proposed Project is shown in Figure 2, which has also been marked-up to show the Point of Reception (POR) locations.

2. Noise Assessment Criteria

The City of Ottawa requirements for environmental noise impact assessments are outlined in the ENCG, which in turn reference the Environmental Noise Guideline, NPC-300 [2], prepared by the Ontario Ministry of the Environment, Conservation and Parks (MECP). The Project is located in a Class 1 area, which is defined as an area with an acoustical environment typical of a major population centre.

The sections below describe the applicable noise assessment criteria for surface transportation noise sources and stationary noise sources.

2.1. Surface Transportation Noise Assessment Criteria

Sound level limits values outlined in ENCG for road traffic noise impacting on noise-sensitive areas applicable to the Project are summarized in Table 1.

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Table 1: Sound Level Limits for Noise-Sensitive Areas

Type of Point of Reception	Time Period	Sound Level Limit for Road Traffic Noise L_{eq} [dBA]
Schools (Indoor Living Areas)	Daytime (07:00 to 23:00)	45
	Nighttime (23:00 to 07:00)	N/A
Schools (Outdoor Amenity Areas)	Daytime (07:00 to 23:00)	55

Furthermore, based on the plane-of-window calculations for indoor spaces, upgraded building components, ventilation systems and warning clauses may be required. The ENCG building component and ventilation requirements for road noise are shown in Tables 2 and 3, below.

Table 2: ENCG Building Component Requirements (Road Noise – Daytime Only)

Assessment Location	Sound Level (time as noted)	Building Component Requirements
Plane of Window	Daytime $L_{EQ-16HR}$ Less than or equal to 65 dBA	Building compliant with the Ontario Building Code
	Daytime $L_{EQ-16HR}$ Greater than 65 dBA	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria

(Reference: MECP NPC-300, Section C7.1.3 – Indoor Living Areas: Building Components)

Table 3: ENCG Ventilation and Warning Clause Requirements (Road noise - Daytime Only)

Assessment Location	Sound Level (time as noted)	Ventilation Requirement	Warning Clause Requirement
Plane of Window	Daytime $L_{EQ-16HR}$ Less than or equal to 55 dBA	None required	Not required
	Daytime $L_{EQ-16HR}$ Greater than 55 dBA to less than or equal to 65 dBA	Forced air heating with provision for central air conditioning	Required Type C
	Daytime $L_{EQ-16HR}$ Greater than 65 dBA	Central air conditioning	Required Type D

(Reference: MECP NPC-300, Section C7.1.2 – Plane of a Window: Ventilation Requirements)

2.2. Stationary Source Noise Assessment Criteria

Stationary sources of noise include all sources of sound and vibration that exist or operate on nearby premises, excluding construction noise sources. The noise level criterion for noise from stationary sources in a given time period is the higher value between (1) the time period exclusion limit value prescribed by the MECP, and (2) the corresponding minimum hourly background/ambient sound level ($L_{eq,1hr}$) due to traffic during the time period. Exclusion limit

values outlined in the ENCG for new noise-sensitive land uses in proximity to existing stationary noise sources have been summarized in Table 4 for Class 1 areas.

Table 4: ENCG Exclusion Limit Values for Class 1 Areas (New Noise-Sensitive Land Uses in Proximity to Existing Stationary Sources)

Type of Point of Reception	Time Period (Description)	Exclusion Limit - $L_{eq,1hr}$ [dBA]
Outdoor Living Area (OLA)	07:00 to 23:00 (Daytime)	50
Plane of Window (Living Quarters)	07:00 to 23:00 (Daytime)	50
Plane of Window (Sleeping Quarters)	23:00 to 07:00 (Night-time)	45

The exclusion limits outlined in Table 4 apply to both neighbouring "off-site" stationary noise sources which may impact the Project, as well as "on-site" stationary noise sources associated with the Project which may impact neighbouring noise sensitive land uses (in this case, the neighbouring residences).

3. Surface Transportation Noise

3.1. Surface Transportation Noise – Road Noise Levels

The surface transportation corridors impacting on the Project are Cope Drive and Rouncey Road, which are under construction and classified as proposed "Major Collector" roadways as per the City of Ottawa Transportation Master Plan (TMP) [3]. Both Cope Drive and Rouncey Road are located within 100 m of the Project's limits. Other major transportation routes in the area such as Fernbank Road and Defence Street are beyond the distance limits required for assessment, per the ENCG.

The "ultimate" road and traffic data information, including the Annual Average Daily Traffic (AADT), for Cope Drive and Rouncey Road was obtained from the ENCG based on their roadway classifications and are summarized in Table 5. These parameters were used to predict the traffic noise levels following the prediction method outlined in the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT) [4], developed by the MECP. Software developed by the MECP to perform ORNAMENT calculations, STAMSON Version 5.04, was used to predict the noise levels. Calculation results from STAMSON are available in Appendix A.

Table 5: ENCG Traffic and Road Parameters for STAMSON Modelling

Road	Implied Roadway Class	Speed Limit [km/h]	Ultimate AADT [Vehicles/day]	Day/Night Split [%]	Medium Trucks [%]	Heavy Trucks [%]
Cope Drive	2-Lane Major Collector (2-UMCU)	50	12,000	92/8	7	5
Rouncey Road	2-Lane Major Collector (2-UMCU)	50	12,000	92/8	7	5

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Separation distances were taken from the centreline of the road segment to the POR.

3.2. Surface Transportation Noise - Points of Reception

PORs were chosen to represent worst-case scenarios at the Plane of Window (PoW) of occupied spaces and Outdoor Amenity Areas (OAA). Only one PoW POR was considered, which represents the worst-case location due to exposure to both road segments. Similarly, one OAA POR was considered for the playground, in a location consistent with the ENCG's definition of 'Outdoor Amenity Area'. Table 6 contains a description of the location of the PORs, and their locations are shown in Figure 2. An aerial photo with receptor locations and distance measurements between source and receivers is given in Figures 3 and 4.

Table 6: Points of Reception (POR) Locations

Point of Reception (POR)	Height (ref. Grade) [m]	Storey	Building Facade	Notes/Comments
POR 1	4.5	2nd	Northeast	PoW: Library (considered equivalent to a classroom).
POR 2	1.5	Grade	South	OAA: Playground

For POR 2, noise from Rouncey Road is partially obstructed by the proposed school itself.

The ground surface between both transportation corridors and the Project includes many backyards, front yards and a playground, and is therefore modelled as sound-absorptive in our analysis.

3.3. Surface Transportation Noise - Calculations

STAMSON transportation noise calculations can be found in Appendix A. Table 7 shows the daytime noise level prediction results at each POR, along with a comparison to the daytime criteria for noise control measures outlined in Section 2.

Table 7: Daytime Calculated Noise Levels Due to Surface Transportation Noise

Point of Reception (POR)	Transportation Noise Level Calculation [dBA] (Daytime)	Building Component Requirement	Minimum Ventilation Requirement	Noise Mitigation Measures	Warning Clause
POR 1	65	OBC-compliant	Forced air heating with provision for central air conditioning	N/A	Type C
POR 2	51	N/A	N/A	None	None

The criteria limit for noise control measures are exceeded at the POR due to noise from Cope Drive and Rouncey Road. Therefore, noise control measures are required for all occupied learning spaces in the school.

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4. Noise Control – Surface Transportation Noise

4.1. Indoor Noise Control Measures

4.1.1. Ventilation Requirements

The results shown in Table 7 indicate that the calculated surface transportation noise levels exceed the applicable sound level limits at the plane of windows for the Project, which represents occupied learning areas (library) on the north and east facades (worst-case location, due to full exposure to both Cope Drive and Rouncey Road) during the daytime. Therefore, as per Table 3, forced air heating with provisions for central air conditioning must be provided to all occupied spaces inside the proposed school.

4.1.2. Building Component Requirements

As indicated in Table 7, the sound levels at the north and east façades (worst-case locations) do not exceed 65 dBA during the daytime due to road traffic. Therefore, as indicated in Table 2, the building envelope components (exterior walls and windows) of all façades must be designed to meet Ontario Building Code specifications.

4.2. Warning Clause Requirements

Per the ENCG, warning clause Type 'C' must be included in agreements of offers of purchase and sale, as well as any lease/rental agreements associated with the school. Sample wording from the ENCG have been adapted below for the Project.

WARNING CLAUSE TYPE 'C':

> "This school has been designed with the provision for adding central air conditioning at the owner's discretion. Installation of central air conditioning by the owner will allow windows to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment and Climate Change."

5. Neighbouring Stationary Source Noise

As noted during a site visit undertaken on October 23rd 2019, there are no significant stationary noise sources neighbouring the Project that were identified to cause noise levels in excess of MOECC and City of Ottawa requirements.

6. The Project as Stationary Noise Source

The Project may also be considered a Stationary Source for adjacent land uses, which include two-storey residences in all directions. The nearest residences are located to the north and east of the project, as shown in Figure 1.

6.1. Stationary Noise Sources

Mechanical equipment associated with the new school is limited to 12 rooftop air handling units (RTU), which are expected to run 24 hours a day, seven days a week. The RTUs have been sized for the Project such that they may operate at 75% speed during worst-case predictable conditions. Other small rooftop exhaust fans for bathrooms, etc. are considered insignificant noise sources in the context of this study. The 12 RTU units are listed in Table 8, for which radiated noise levels were obtained from the manufacturer (see Appendix B). All of the RTU noise sources are considered to be running in steady-state conditions. The RTU locations are shown in Figure 5.

Table 8: Mechanical Noise Sources Associated With School

Source No.	Location	Description (make / model)	Sound Power Level Data Used (see Appendix B)	Overall Sound Power Level [dBA]
RTU-1	Rooftop	20 Ton RTU (AAON / RN-020)	"RN 13-20 Ton (75%)"	84
RTU-2	Rooftop	5 Ton RTU (AAON / RQ-005)	"RQ 4-6 RN 6 & 7 Ton (75%)"	74
RTU-3, 4	Rooftop	11 Ton RTU (AAON / RN-011)	"RN 9 & 11 Ton (75%)"	77
RTU-5	Rooftop	6 Ton RTU (AAON / RQ-006)	"RQ 4-6 RN 6 & 7 Ton (75%)"	74
RTU-6	Rooftop	10 Ton RTU (AAON / RN-010)	"RN 8 & 10 Ton (75%)"	81
RTU-7	Rooftop	7 Ton RTU (AAON / RN-007)	"RQ 4-6 RN 6 & 7 Ton (75%)"	74
RTU-8	Rooftop	18 Ton RTU (AAON / RN-018)	"RN 13-20 Ton (75%)"	84
RTU-9	Rooftop	16 Ton RTU (AAON / RN-016)	"RN 13-20 Ton (75%)"	84
RTU-10	Rooftop	11 Ton RTU (AAON / RN-011)	"RN 9 & 11 Ton (75%)"	77
RTU-11	Rooftop	9 Ton RTU (AAON / RN-009)	"RN 9 & 11 Ton (75%)"	77
RTU-12	Rooftop	7 Ton RTU (AAON / RN-007)	"RQ 4-6 RN 6 & 7 Ton (75%)"	74

6.2. Receptor Locations

A critical plane-of-window receptor location was chosen for each of the nearest residential buildings to the north and east, labelled POR 'A' and POR 'B'. These critical noise receptors represent the locations that are most exposed to the nearest proposed stationary noise sources, at a height representing a third-floor window (worst-case due to line-of-sight to noise sources). These receptor locations are shown in Figure 6.

6.3. Stationary Source Noise Level Prediction

Sound levels at the PORs due to the stationary sources associated with the school were calculated using the software CadnaA, version 2019, in accordance with the methods described in ISO 9613-2, and the results are presented below. Calculated noise level contours are also presented in Figure 7.

Table 9: Predicted Stationary Noise Source Levels at the Receptors

Receptor	Time Period	Predicted Stationary Sound Levels $L_{EQ\text{-}1hr}$ (dBA)	Stationary Source Sound Level Limit $L_{EQ\text{-}1hr}$ (dBA)	Compliance?
POR 'A'	Night-time (0700 – 1900)	42	45	Yes
POR 'B'	Night-time (0700 – 1900)	37	45	Yes

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The predicted stationary sound levels are not exceeded at POR 'A' and 'B' and no noise mitigation will be required.

7. Concluding Comments

With the incorporation of the noise control measures and warning clauses as presented in Section 4 of this report, the impact of transportation noise on the proposed residential development will meet ENCG requirements. In summary, these noise control measures include:

- forced air heating with provisions for central air conditioning provided to all occupied spaces;

The proposed Fernbank Public School, to be located at 480 Cope Drive in Ottawa, should therefore be approved from a noise aspect.

------ End ------

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References

1. City of Ottawa Environmental Noise Control Guidelines (ENCG), approved by Ottawa City Council in January 2016.
2. Ministry of the Environment, Conservation and Parks (MOECP) Publication NPC-300: Stationary and Transportation Sources - Approval and Planning, published in October 2013.
3. City of Ottawa Transportation Master Plan (TMP), published by the City of Ottawa on November 2013.
4. Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT), Technical document published by the MOECC in October 1989.

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Figures

Figure 1. Site Aerial

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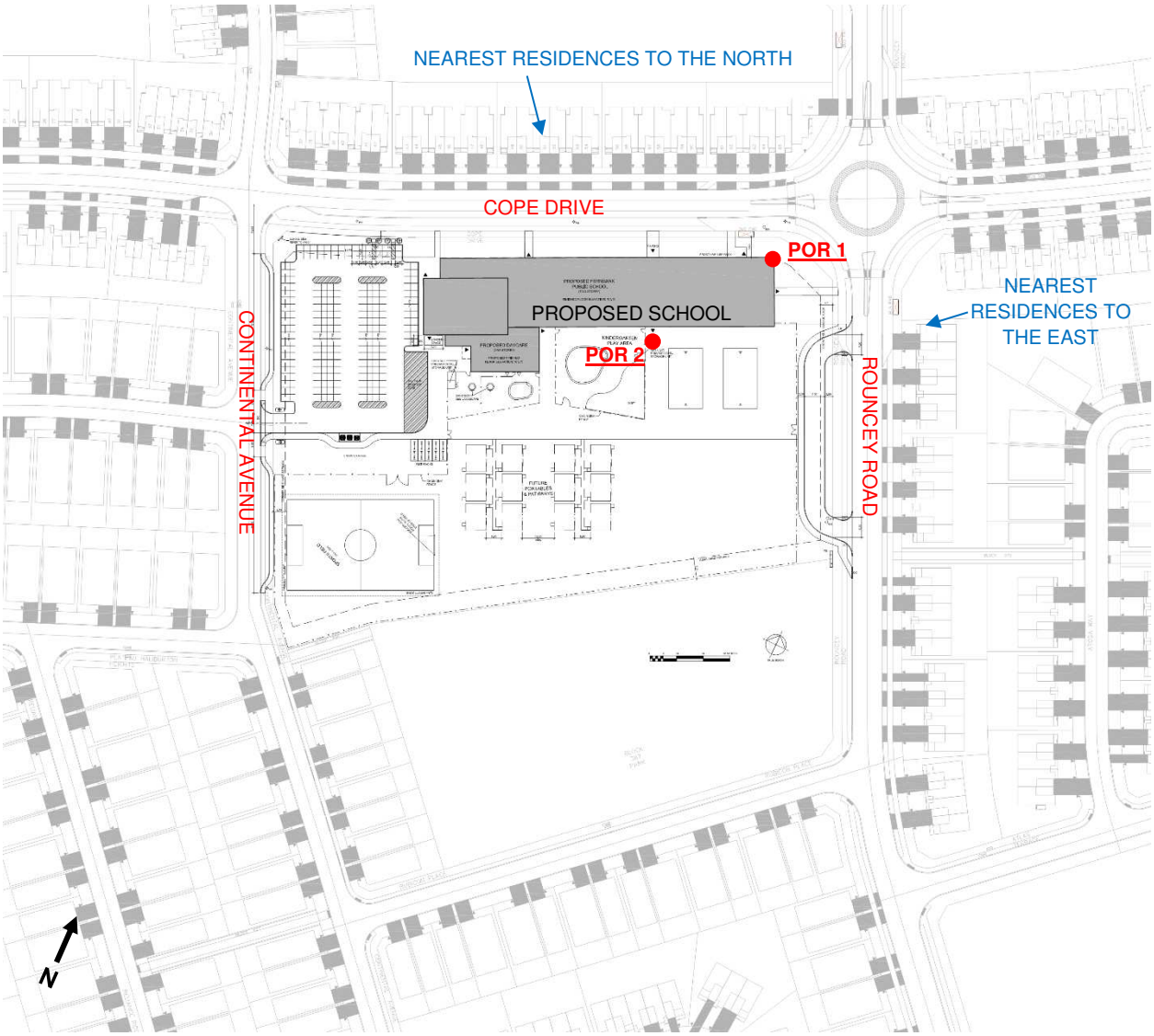

Figure 2. Site Plan with POR Locations and Proximity of Nearest Residences

Figure 3. POR 1 Location, with Distances from Source to Receptors.

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Figure 4. POR 2 Location, with Distances from Source to Receptors.

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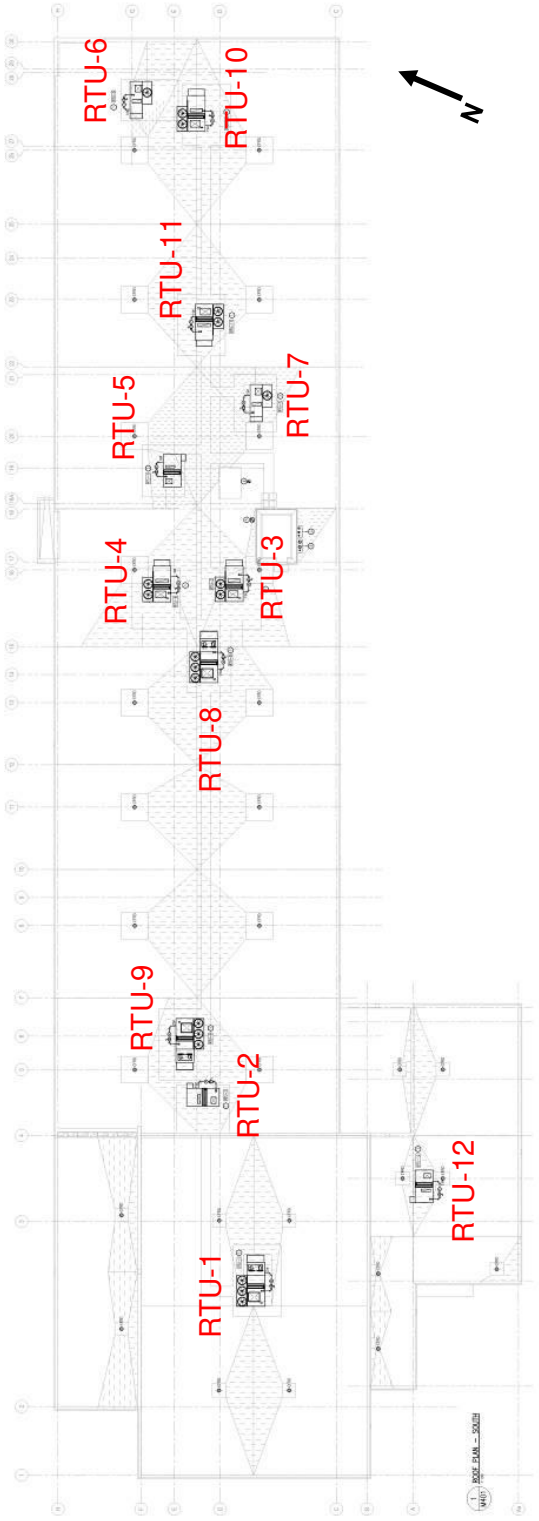

Figure 5: Location of Significant Rooftop Noise Sources

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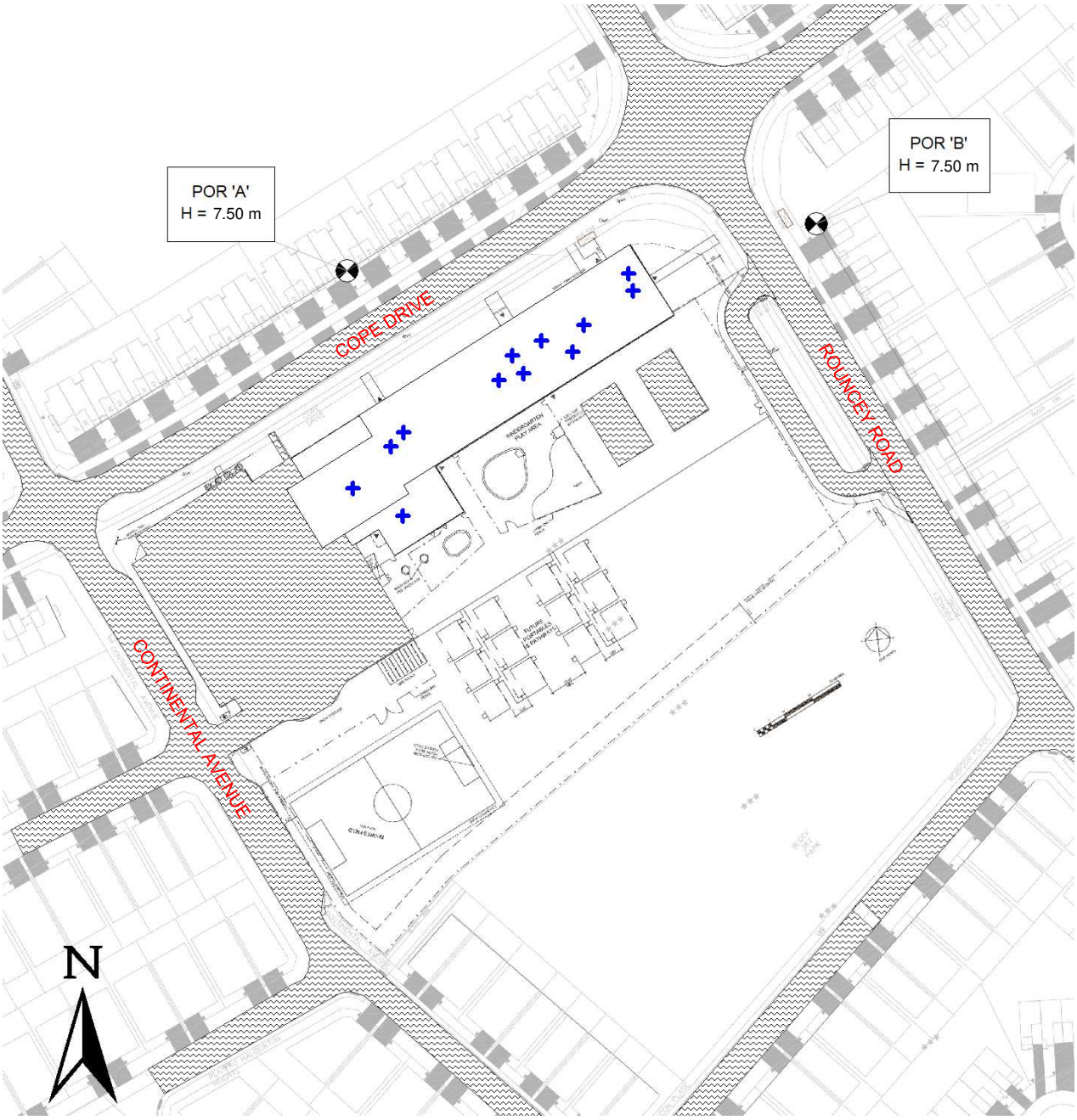

Figure 6: Location of Worst-Case Points of Reception for Stationary Noise Sources

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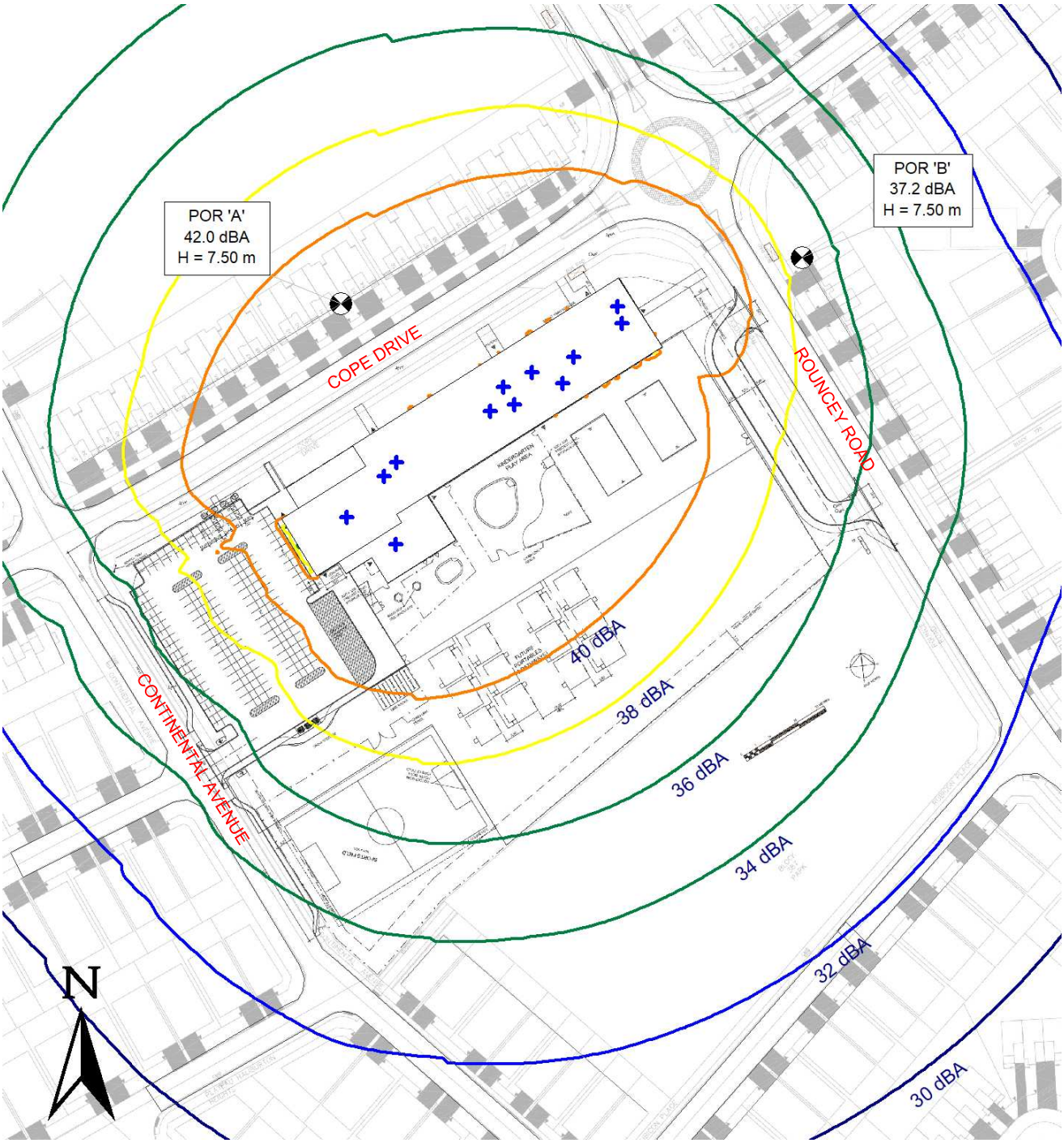

Figure 7: Noise Contour Map for Stationary Noise Sources (Grid Height: 7.5m)

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Appendices

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APPENDIX A: Transportation Noise Results from STAMSON

```
STAMSON 5.0         SUMMARY REPORT         Date: 28-10-2019 10:41:20
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 480cope1.te           Time Period: Day/Night 16/8 hours
Description: POR1 at 480 Cope Drive (2nd Floor).


Road data, segment # 1: Cope Drive (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: Cope Drive (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  22.00 / 22.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: Rouncey Road (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: Rouncey Road (day/night)
-----------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.00 / 35.00  m
Receiver height           :   5.50 / 5.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Cope Drive       !     1.50 !    63.70 !    63.70
 2.Rouncey Road     !     1.50 !    60.60 !    60.60
--------------------+----------+----------+----------
                      Total                  65.43 dBA


Result summary (night)
----------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Cope Drive       !     1.50 !    56.10 !    56.10
 2.Rouncey Road     !     1.50 !    53.00 !    53.00
--------------------+----------+----------+----------
                      Total                  57.83 dBA


TOTAL Leq FROM ALL SOURCES (DAY): 65.43
                           (NIGHT): 57.83
```


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```
STAMSON 5.0        SUMMARY REPORT        Date: 28-10-2019 10:35:43
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 480cope2.te          Time Period: Day/Night 16/8 hours
Description: POR2 at 480 Cope Drive (playground).


Road data, segment # 1: Rouncey Road (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  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  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: Rouncey Road (day/night)
-----------------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  80.00 / 80.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Rouncey Road     !     1.50 !    50.98 !    50.98
--------------------+----------+----------+----------
                      Total                   50.98 dBA


Result summary (night)
----------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
```

	! (m)	! (dBA)	! (dBA)
1.Rouncey Road	! 1.50	! 43.38	! 43.38
	Total		43.38 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 50.98
(NIGHT): 43.38

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APPENDIX B: Manufacturer Noise Level Data - AAON

The noise level data below was obtained from AAON for the rooftop air handling units associated with the school. AAON indicated that the 75% capacity values should be used in this case, which represents the expected operating range given the local climate.

Speed %			Fans	Dia	RPM	Sound Power Level 63	125	250	500	1000	2000	4000	8000	LwA
100%	RQ 2 & 3 Ton	Inlet	1	30	850	79	74	72	70	66	62	59	59	72
		Outlet				81	77	71	71	67	62	59	58	73
		Total				83	79	74	73	69	65	62	61	75
75%	RQ 2 & 3 Ton	Inlet	1	30	638	73	68	66	63	59	56	53	52	65
		Outlet				75	71	64	65	60	56	53	52	66
		Total				77	73	68	67	63	59	56	55	69
50%	RQ 2 & 3 Ton	Inlet	1	30	425	64	59	57	54	51	47	44	44	57
		Outlet				66	62	56	56	52	47	44	43	57
		Total				68	64	59	58	54	50	47	46	60
25%	RQ 2 & 3 Ton	Inlet	1	30	213	49	44	42	39	36	32	29	29	42
		Outlet				51	47	40	41	37	32	29	28	42
		Total				53	49	44	43	39	35	32	31	45
100%	RQ 4-6 RN 6 & 7 Ton	Inlet	1	30	1085	85	79	77	75	71	68	65	64	77
		Outlet				86	83	76	76	72	68	65	63	78
		Total				89	84	80	79	75	71	68	67	80
75%	RQ 4-6 RN 6 & 7 Ton	Inlet	1	30	814	78	73	71	69	65	61	58	58	71
		Outlet				80	77	70	70	66	61	58	57	72
		Total				82	78	73	72	68	64	61	61	74
50%	RQ 4-6 RN 6 & 7 Ton	Inlet	1	30	543	70	64	62	60	56	53	50	49	
		Outlet				71	68	61	61	57	53	50	48	63
		Total				74	69	65	64	59	56	53	52	65
25%	RQ 4-6 RN 6 & 7 Ton	Inlet	1	30	271	54	49	47	45	41	37	35	34	47
		Outlet				56	53	46	46	42	38	35	33	48
		Total				59	54	50	48	44	41	38	37	50
100%	RN 8 & 10 Ton	Inlet	1	30	1085	92	86	85	82	78	75	72	71	84
		Outlet				94	90	83	83	79	75	72	71	85
		Total				96	91	87	86	82	78	75	74	88
75%	RN 8 & 10 Ton	Inlet	1	30	814	86	80	78	76	72	68	66	65	78
		Outlet				87	84	77	77	73	69	66	64	79
		Total				90	85	81	80	75	72	69	68	81
50%	RN 8 & 10 Ton	Inlet	1	30	543	77	71	69	67	63	60	57	56	69
		Outlet				79	75	68	68	64	60	57	56	70
		Total				81	76	72	71	67	63	60	59	73
25%	RN 8 & 10 Ton	Inlet	1	30	271	62	56	54	52	48	45	42	41	54
		Outlet				64	60	53	53	49	45	42	41	55
		Total				66	61	57	56	52	48	45	44	58
100%	RN 9 & 11 Ton	Inlet	2	30	1085	88	82	80	78	74	71	68	67	80
		Outlet				89	86	79	79	75	71	68	66	81
		Total				92	87	83	82	78	74	71	70	83
75%	RN 9 & 11 Ton	Inlet	2	30	814	81	76	74	72	68	64	61	61	74
		Outlet				83	80	73	73	69	64	61	60	75
		Total				85	81	76	75	71	67	64	64	77
50%	RN 9 & 11 Ton	Inlet	2	30	407	66	61	59	57	53	49	46	46	59
		Outlet				68	64	58	58	54	49	46	45	60
		Total				70	66	61	60	56	52	49	48	62
25%	RN 9 & 11 Ton	Inlet	2	30	271	57	52	50	48	44	40	38	37	50
		Outlet				59	56	49	49	45	41	38	36	51
		Total				62	57	53	51	47	44	41	40	53
100%	RN 13-20 Ton	Inlet	2	30	1085	95	89	88	85	81	78	75	74	87
		Outlet				97	93	86	86	82	78	75	74	88
		Total				99	94	90	89	85	81	78	77	91
75%	RN 13-20 Ton	Inlet	2	30	814	89	83	81	79	75	71	69	68	81
		Outlet				90	87	80	80	76	72	69	67	82
		Total				93	88	84	83	78	75	72	71	84
50%	RN 13-20 Ton	Inlet	2	30	543	80	74	72	70	66	63	60	59	72
		Outlet				82	78	71	71	67	63	60	59	73
		Total				84	79	75	74	70	66	63	62	76
25%	RN 13-20 Ton	Inlet	2	30	271	65	59	57	55	51	48	45	44	57
		Outlet				67	63	56	56	52	48	45	44	58
		Total				69	64	60	59	55	51	48	47	61
100%	RN 25 & 30 Ton	Inlet	3	30	1085	97	91	89	87	83	80	77	76	89
		Outlet				98	95	88	88	84	80	77	75	90
		Total				101	96	92	91	86	83	80	79	92
75%	RN 25 & 30 Ton	Inlet	3	30	814	90	85	83	81	77	73	70	70	83
		Outlet				92	88	82	82	78	73	70	69	83
		Total				94	90	85	84	80	76	73	72	86
50%	RN 25 & 30 Ton	Inlet	3	30	543	81	76	74	72	68	64	62	61	74
		Outlet				83	80	73	73	69	65	62	60	75
		Total				86	81	77	75	71	67	65	64	77
25%	RN 25 & 30 Ton	Inlet	3	30	271	66	61	59	57	53	49	47	46	59
		Outlet				68	65	58	58	54	49	47	45	60
		Total				70	66	62	60	56	52	50	49	62

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