REPORT

1555 18TH STREET EAST

OWEN SOUND, ONTARIO

NOISE IMPACT STUDY

RWDI #2204035

January 16, 2023

SUBMITTED TO

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VERSION HISTORY

Index	Date	Description	Prepared by	Reviewed by
1	October 13, 2022	Draft	Lorenzo Carboni	Slavi Grozev
2	October 14, 2022	Final	Natalie Firth	Scott Bell
3	November 10, 2022	Updated with new site plan	Lorenzo Carboni	Slavi Grozev
4	January 13, 2023	Updated with new site plan	Colin Jakubec	Slavi Grozev

EXECUTIVE SUMMARY

RWDI was retained to prepare a Noise Impact Study (NIS) for the proposed development 1555 18th Street East in Owen Sound, Ontario. The proposed development site is a green field between the SmartCenters' plaza and the Grey Bruce Health Services Center. This assessment was completed per requirements in the pre-consultation review.

Due to the transportation sound levels at the plane of the façade, central air conditioning is recommended for Building A to allow for windows and doors to remain closed as a noise mitigation measure. Further, prospective purchasers or tenants should be informed by a warning clause "Type D".

Due to the non-permitted stationary source sound levels at the façade being elevated is checked that the levels indoors with closed windows will not be a nuisance, per the local by-law. As such it is advisable to install or make an allowance for the residents to a ventilation system that will allow for windows to be closed.

The potential noise levels from stationary sources of sound were evaluated. Based on the noise modeling results with the noted ventilation requirements, the proposed development is not anticipated to infringe on the compliance of any commercial or industrial operations with environmental noise permits (ECA or EASR), nor cause infractions against the local noise by-law.

At this stage in design the noise levels produced by the development on itself, and its surroundings could not be quantitatively assessed. However, the effect on both the building itself and its surroundings is expected to be feasible to meet the applicable criteria. We recommend that the building design is evaluated prior to building permit to ensure that the acoustical design is adequately implemented in order to meet the applicable criteria.

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1 INTRODUCTION

RWDI was retained to prepare a Noise Impact Study (NIS) for the proposed development 1555 18th Street East in Owen Sound, Ontario. The proposed development site is a green field between the SmartCenters' plaza and the Grey Bruce Health Services Center.

The proposed development will consist of multiple low rise residential buildings, with a mix of apartment buildings and townhouse blocks. The context site plan is shown in **Figure 1**.

The site is minimally exposed to noise from road traffic from 10th Street East and 18th Avenue East to the west.

Surrounding stationary sources of noise include commercial buildings in the SmartCenters' plaza to the north and the health care facility to the south.

This assessment was completed per requirements in the pre-consultation review from the City of Owen Sound. This assessment was based on design drawings dated December 7, 2022. Drawings are included in **Appendix A**.

2 APPLICABLE CRITERIA

Applicable criteria for transportation noise sources (road and rail), stationary noise sources and rail vibration are adopted from the Ontario Ministry of the Environment, Conservation and Parks (MECP) NPC-300 Environmental Noise Guideline (MOE, 2013), with a summary of the applicable criteria included with **Appendix B**. The Grey County Development Application Guidelines were also referenced to ensure the necessary supporting information is provided.

The proposed development site would be characterized as a "Class 1 Area", which is defined according to NPC-300 as an area with an acoustical environment typical of a major population centre, where the background sound level is dominated by the activities of people, usually road traffic, often referred to as "urban hum."

In addition to the applicable provincial guidance the City of Owen Sound By-law (OS, 2014) is applicable.

3 THE EFFECTS OF THE ENVIRONMENT ON THE PROPOSED DEVELOPMENT

3.1 Transportation Source Assessment

3.1.1 Road Traffic Volume Data

The 10th Street East annual average daily traffic volumes, and percentage of trucks were obtained from publicly available City of Owen Sound data. A 90%/10% daytime/nighttime local road split was applied. The traffic volumes for each of the respective roadways were grown at a rate of 2% per year to represent the predicted 10-year horizon volumes.

A summary of the traffic data used is included in **Table 1** below with more detailed information included in **Appendix C**.

Table 1: Road Traffic Volumes

Roadway	2032 Future Traffic (AADT)	% Day/Night	Speed Limit (km/hr)	% Trucks Day/Night
10th Street East and 18th Avenue East	6544	90% / 10%	50	17.2% / 10.8%

3.1.2 Representative Receptors

The selection of receptors affected by transportation noise sources was based on the drawings reviewed for this assessment. Using the "building evaluation" feature of Cadna/A, each façade of the residential buildings was assessed.

Outdoor Living Areas (OLAs) would include outdoor areas intended and designed for the quiet enjoyment of the outdoor environment and which are readily accessible from the building. OLAs may include any common outdoor amenity spaces associated with a multi-unit residential development (e.g., courtyards, roof-top terraces), and/or private backyards and terraces with a minimum depth of 4m provided they are the only outdoor living area for the occupant. For this development no OLAs were associated with the apartment buildings, daytime sound levels from transportation sources were assessed in the backyards associated with the townhouse blocks, one representative receptor is assessed for each block. The OLA locations are indicated in **Figure 2**.

3.1.3 Transportation Source Assessment - Analysis and Results

Sound levels due to the adjacent transportation (road) sources were predicted using the RLS-90 standard (RLS,1990) as implemented in the Cadna/A software package.

To assess the effect of transportation noise on the development, the maximum sound level on each façade and the qualifying OLAs was determined with the results summarized in **Table 2**, note that only the worst-case façade for each block is shown here.

Table 2: Predicted Transportation Source Sound Levels

Building	Plane of Window			Outdoor Living Area
	Façade	Day L_{EQ}, 16hr	Night L_{EQ}, 8hr	Day L_{EQ}, 16hr
Building A	Northwest	63	56	-
Building B	North	47	40	-
Block 01	West	52	46	47
Block 02	West	51	43	48
Block 03	West	50	43	47
Block 04	West	48	41	47
Block 05	West	47	41	45
Block 06	West	46	39	45
Block 07	North	47	40	44
Block 08	North	44	38	38
Block 09	North	43	37	37
Block 10	North	43	36	36
Building C	West	45	38	-
Building D	North	43	37	-
Building E	North	42	35	-

With the exception of Building A, facades have sound levels below the provincial criteria. Recommendations for building A are made in **Section 3.3.1**, for the rest of the development no mitigation or noise warning clauses are required.

A sample calculation output file of the CadnaA RLS-90 calculation is provided in **Appendix D**.

3.2 Stationary Source Assessment

Stationary sources could be grouped into two categories: Those that have a permit with the Ontario Ministry of the Environment, Conservation and Parks (MECP) through an Environmental Compliance Approval (ECA) or Environmental Activity and Sector Registry (EASR); and those that are exempt from ECA or EASR permit requirements.

In the case where a stationary source has an ECA or EASR permit with the MECP, and would be put in a position where it is no longer in compliance with the applicable sound level criteria due to the encroachment of the proposed new development, source specific mitigation and/or formal classification of the proposed development

lands as a "Class 4 Area" (refer to C.4.4.2 "Class 4 Area" in NPC-300) would be required. In this case, coordination and agreements between the stationary source owner, proposed new development owner, the land-use planning authority and potentially the MECP would be needed.

In the case where a stationary source is exempt from ECA or EASR permit requirements with the MECP, the noise provisions of the applicable Municipal Code and guidance from NPC-300 would be applicable. In this case, mitigation of sound levels due to stationary sources would be from a due diligence perspective to avoid nuisance complaints from future occupants of the proposed new development. Mitigation could be in the form of mitigation at the source (with agreement from the stationary source owner) and/or mitigation at the receptor through site and building element design (building orientation, acoustical barriers, façade sound insulation design).

3.2.1 Stationary Source Modeling

In this case, sources associated with the SmartCenters are assessed as due diligence against the local noise By-law and the Grey Bruce Health Services Center with its ECA (#8948-A4SR26) is assessed strictly per NPC-300.

RWDI conducted a screening level assessment to determine stationary sources of noise surrounding the proposed development using a combination publicly available aerial imagery, street-level imagery, business listings and MECP's Access Environment database.

The stationary source is assessment is split into three scenarios.

1. Sources associated with the SmartCenters assessed as due diligence (non-Permitted);
2. Standard sources associated with the Grey Bruce Health Services Center (Permitted); and
3. Emergency sources associated with the Grey Bruce Health Services Center (Emergency Permitted).

3.2.1.1 Representative Receptors

Using the "building evaluation" feature of Cadna/A, each façade of the residential buildings was assessed. The worst-case outdoor points of reception (ORP) locations were assessed to evaluate the potential stationary source noise effects on the proposed development. The OPRs mirror the OLA locations, adjusted to capture the worst-case stationary source noise scenarios. The OPR locations are indicated in **Figure 3**.

3.2.1.2 Assumed Sources and Sound Power Levels

The Grey Bruce Health Services Center was identified to have a noise abatement action plan to address certain louvers on the side of the building. The facility was modeled to include the louver mitigation outlined in its ECA and with the understanding that it should be compliant at a height of 4.5 above grade at the development site given its existing residential zoning category. Additionally, it is expected that the facility will be compliant at the existing Chapman House, Hospice of Grey Bruce. No significant sources of noise were identified at Chapman House. Sound power levels for general emissions from the facilities louvers and emergency generator exhaust stacks were selected to model this facility as such.

RWDI proxy data was used for the sound power levels of the HVAC units, chillers, auto shop, idling trucks including refrigerated trucks, included in the model. The assumed sound power levels included in the stationary source

assessment are presented in **Table 3**. The locations of the sources and sound power levels used for each scenario of the stationary source assessment illustrated in **Figure 4.1, 4.2** and **4.3** respectively.

Table 3: Stationary Source Sound Power Level Assumptions

Source	Proxy Data / Calculation	Sound Power Level (dBA)	Duty Cycle	
			Daytime and Evening (07:00h – 23:00h)	Nighttime (23:00h – 07:00h)
Non-Permitted Stationary Sources				
HVAC_1F	Proxy Data	82	Continuous	30 min/hour
HVAC_2F	Proxy Data	85	Continuous	30 min/hour
HVAC_3F	Proxy Data	87	Continuous	30 min/hour
HVAC_4F	Proxy Data	88	Continuous	30 min/hour
HVAC_6F	Proxy Data	90	Continuous	30 min/hour
Chiller	Proxy Data	92	Continuous	Continuous
Idling Truck	Proxy Data	92	10 min/hour	10 min/hour
Refrigerated Truck	Proxy Data	102	Continuous	Continuous
Auto Shop	Proxy Data	90	Continuous[1]	Off Duty
Permitted Stationary Sources				
Hospital Louver	Calculation	92[2], 83[3], 80[3], 79[3]	Continuous	Continuous
Hospital Generator	Calculation	92	Continuous	Continuous

Note(s):
1. Sound level measurement accounts for typical on-off and sporadic use of tools at a typical auto shop.
2. Base sound level used for louvers on hospital
3. Mitigated per Grey Bruce Health Services Center noise abetment action plan applied to select louvers.

The assumed sound power level values and duty-cycles for the stationary sources are based on reasonable assumptions for the source type. Continuous operation of the HVAC units during the daytime and 50% duty cycle during the nighttime when operations are reduced, chillers are assumed to operate continuously as it is expected that these units service the refrigerated sections within Walmart. Idling trucks are to account for up to 2 deliveries per hour abiding by the City of Owen sounds 5-minute idling bylaw, refrigerated trucks are modeled operating continuously as the refrigeration unit is not subject to the idling bylaw. The auto shop is modeled as operating continuously during its posted business hours. Continuous operation of all sources at the Grey Bruce Health Services Center is the worst-case scenario and representative of typical healthcare facility operations.

3.2.1.3 Analysis and Results

Stationary source noise modelling was carried out using the Cadna/A software package, a commercially available implementation of the ISO 9613 (ISO, 1994 and ISO, 1996) algorithms. The predicted sound levels are assessed against both the Class 1 Area limits, 50 dBA for the daytime and 45 dBA for the nighttime (refer to **Appendix B** for additional details).

The predicted sound levels at the plane of window during the worst-case 1-hour from each stationary source scenario are presented in **Table 4**. Only the worst case for each façade in each scenario are presented.

Table 4: Predicted Sound Levels at Worst-case Facades – Stationary Sources

Building	Non-Permitted			Permitted			Emergency Permitted		
	Façade	Day L_{EQ}, 1hr	Night L_{EQ}, 1hr	Façade	Day L_{EQ}, 1hr	Night L_{EQ}, 1hr	Façade	Day L_{EQ}, 1hr	Night L_{EQ}, 1hr
Building A	NE	53	52	SW	41	41	SE	45	45
Building B	N	47	45	S	45	45	S	50	50
Block 01	N	57	56	W	42	42	W	46	46
Block 02	N	57	57	W	42	42	S	40	40
Block 03	W	57	56	W	42	42	W	38	38
Block 04	N	56	55	W	41	41	W	37	37
Block 05	N	55	54	W	41	41	S	37	37
Block 06	N	54	53	W	40	40	S	36	36
Block 07	N	47	46	S	45	45	S	48	48
Block 08	N	47	45	S	44	44	S	46	46
Block 09	N	47	45	S	43	43	S	44	44
Block 10	N	44	42	S	42	42	S	43	43
Building C	N	52	51	W	40	40	S	41	41
Building D	N	51	49	W	38	38	W	38	38
Building E	N	49	47	W	37	37	S	36	36

Note(s):
1. Worst-case daytime and nighttime occur on different façades.

As shown in **Table 4**, the daytime and nighttime permitted sources continuous sound levels at the façades are predicted to meet the applicable Class 1 sound level criteria. The non-permitted sources exceed the NPC-300 Class 1 limits at the plane-of-window; however, these sources are subject to the local bylaw and are assessed as due diligence. To ensure that residences are provided comfortable interior environment the sound levels from the worst-case areas in the development (Block 02) were evaluated inside the residence with a closed window. It is expected that the Ontario Building Code minimums will provide comfortable interior sound levels with approximately 20 dB reduction. Furthermore, given that the subject lands are already zoned for a noise sensitive use, the nearby industries effects will have already been considered.

The predicted sound levels at the plane of window during the worst-case 1-hour from each stationary source scenario are presented in **Table 5.**

Table 5: Predicted Sound Levels at Outdoor Points of Reception – Stationary Sources

Building	Day L_{EQ}, 1hr		
	Non-Permitted	Permitted	Emergency Permitted
Block 01	50	35	30
Block 02	50	36	32
Block 03	50	34	29
Block 04	50	34	29
Block 05	48	32	27
Block 06	50	32	27
Block 07	30	46	47
Block 08	32	46	46
Block 09	28	45	44
Block 10	27	43	44

As shown in **Table 5**, the daytime permitted continuous sound levels at the OPRs are predicted to meet the applicable Class 1 sound level criteria. As such the non-permitted sources assed for due diligence are not expected to be an annoyance.

A sample calculation output file of the CadnaA ISO-9613 calculation is provided in **Appendix D**.

3.3 Recommendations

Based on the noise and vibration assessment results, the following recommendations were determined for the project. Recommendations are provided for both transportation sources and stationary sources.

3.3.1 Transportation Sources

Due to the transportation sound levels at the plane of the façade, central air conditioning is recommended for Building A to allow for windows and doors to remain closed as a noise mitigation measure. Further, prospective purchasers or tenants should be informed by a warning clause "Type D".

There is no required mitigation to address noise levels from transportation sources of noise for other parts of the proposed development.

3.3.2 Stationary Sources

Due to the non-permitted stationary source sound levels at the façade being elevated is checked that the levels indoors with closed windows will not be a nuisance, per the local by-law. As such it is advisable to install or make an allowance for the residents to a ventilation system that will allow for windows to be closed.

Based on the noise modeling results with the noted ventilation requirements, the proposed development is not anticipated to infringe on the compliance of any commercial or industrial operations with environmental noise permits (ECA or EASR), nor cause infractions against the local noise by-law (OS, 2014). As such, the land use compatibility of the proposed development with respect to the nearby industries is considered acceptable from the noise assessment perspective.

4 THE EFFECTS OF THE PROPOSED DEVELOPMENT ON ITS SURROUNDINGS AND ON ITSELF

On-site stationary sources for the dwellings are expected to mainly consist of HVAC related equipment. Consideration should be given to control airborne and structure-borne noise generated within the proposed development.

Provided that best practices for the acoustical design of the building and guidelines from NPC-216 (MOE, 1993) are followed, noise from the development are expected to be feasible to meet the applicable sound level criteria due to the residential nature of the proposed dwellings.

We recommend that the potential noise effect of the proposed development is reviewed during detailed design to ensure the applicable sound level criteria will be achieved.

5 CONCLUSIONS

RWDI was retained to prepare a Noise Impact Study (NIS) for the proposed development 1555 18th Street East in Owen Sound, Ontario.

Due to the transportation sound levels at the plane of the façade, central air conditioning is recommended for Building A to allow for windows and doors to remain closed as a noise mitigation measure. Further, prospective purchasers or tenants should be informed by a warning clause "Type D".

Due to the non-permitted stationary source sound levels at the façade being elevated is checked that the levels indoors with closed windows will not be a nuisance, per the local by-law. As such it is advisable to install or make an allowance for the residents to a ventilation system that will allow for windows to be closed.

The potential noise levels from stationary sources of sound were evaluated. Based on the noise modeling results with the noted ventilation requirements, the proposed development is not anticipated to infringe on the compliance of any commercial or industrial operations with environmental noise permits (ECA or EASR), nor cause infractions against the local noise by-law.

At this stage in design the noise levels produced by the development on itself, and its surroundings could not be quantitatively assessed. However, the effect on both the building itself and its surroundings is expected to be feasible to meet the applicable criteria. We recommend that the building design is evaluated prior to building permit to ensure that the acoustical design is adequately implemented in order to meet the applicable criteria.

Based on the results of the analysis including implementation of the recommendations included with this assessment, the proposed development is considered feasible from an environmental noise perspective.

6 REFERENCES

1. Ontario Ministry of the Environment (MOE), August 2013, Publication NPC-300, Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning (MOE, 2013).
2. Ontario Ministry of the Environment and Energy (MOE), 1993, Publication NPC-216, Residential Air Conditioning Devices (MOE, 1993).
3. Richtlinien für den Lärmschutz an Strassen (RLS). BM für Verkehr, Bonn, 1990 (RLS, 1990).
4. Controlling Sound Transmission into Buildings (BPN-56), National Research Council Canada (NRCC, 1985).
5. Institute of Transportation Engineers (ITE), 2010, *Traffic Engineering Handbook, 6th Edition* (ITE, 2010)
6. International Organization for Standardization (ISO), 1994b, International Standard ISO 9613-1:1994, Acoustics – Attenuation of Sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere. (ISO, 1994)
7. International Organization for Standardization (ISO), 1996, International Standard ISO 9613-2:1996, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (ISO, 1996)
8. Bies, H. and Hanson, C. H. (2009), Engineering Noise Control: Theory and Practice. Spon Press, New York, USA.
9. Crocker, M. (2007), Handbook of Noise and Vibration Control. John Wiley & Sons, Inc.
10. The Corporation of the City of Owen Sound, Consolidated Version April 23, 2014, *By-law No. 2001-034 "A By-law to Prohibit and Regulate Unusual Noises or Noises Likely to Disturb the Inhabitants of the City of Owen Sound"*. (OS, 2014)

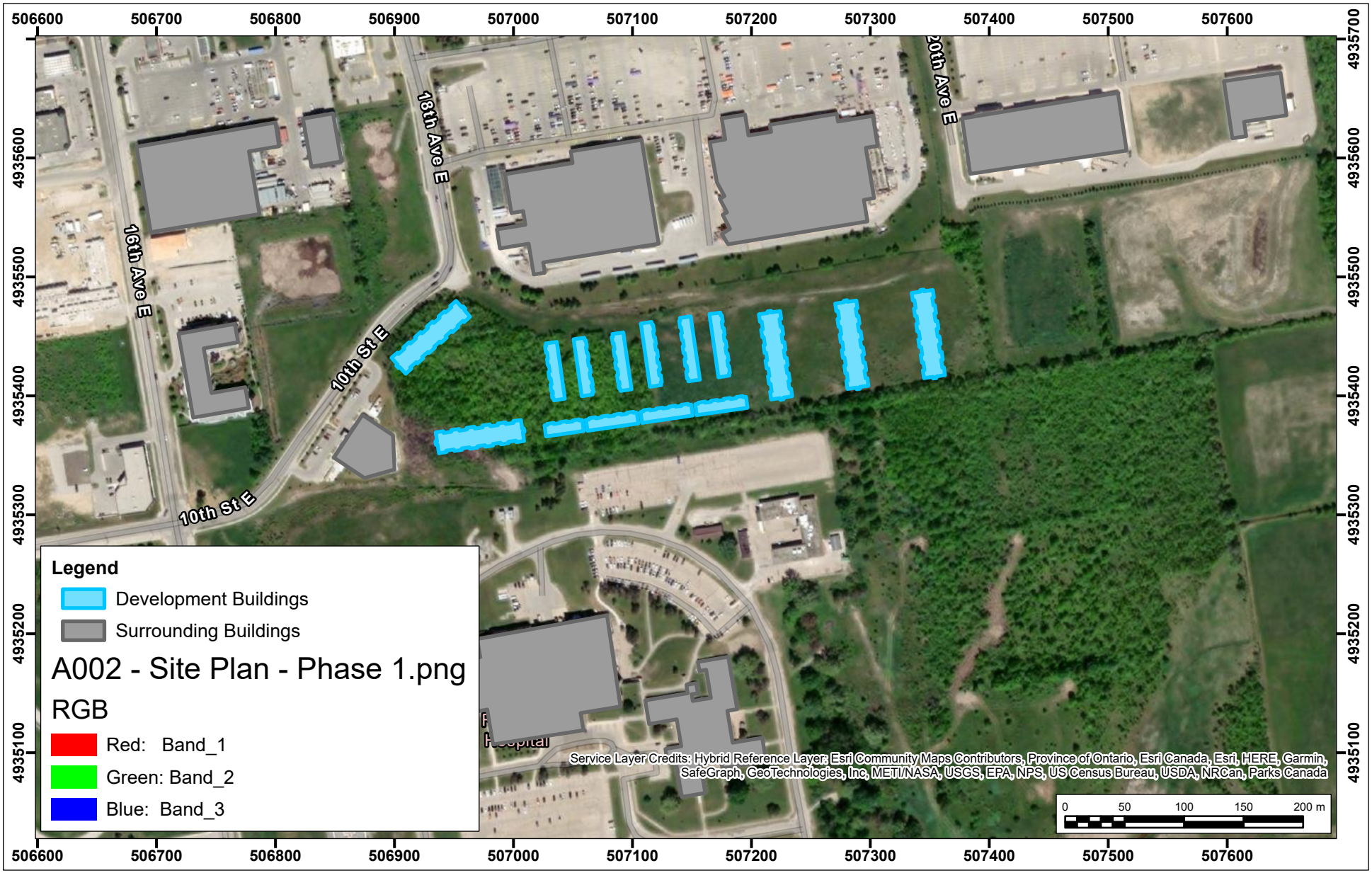
7 STATEMENT OF LIMITATIONS

This report entitled "1555 18th Street East Noise Impact Study" dated November 10, 2022, was prepared by Rowan Williams Davies & Irwin Inc. ("RWDI") for SmartCenters ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

FIGURES



Site Context Plan

True North

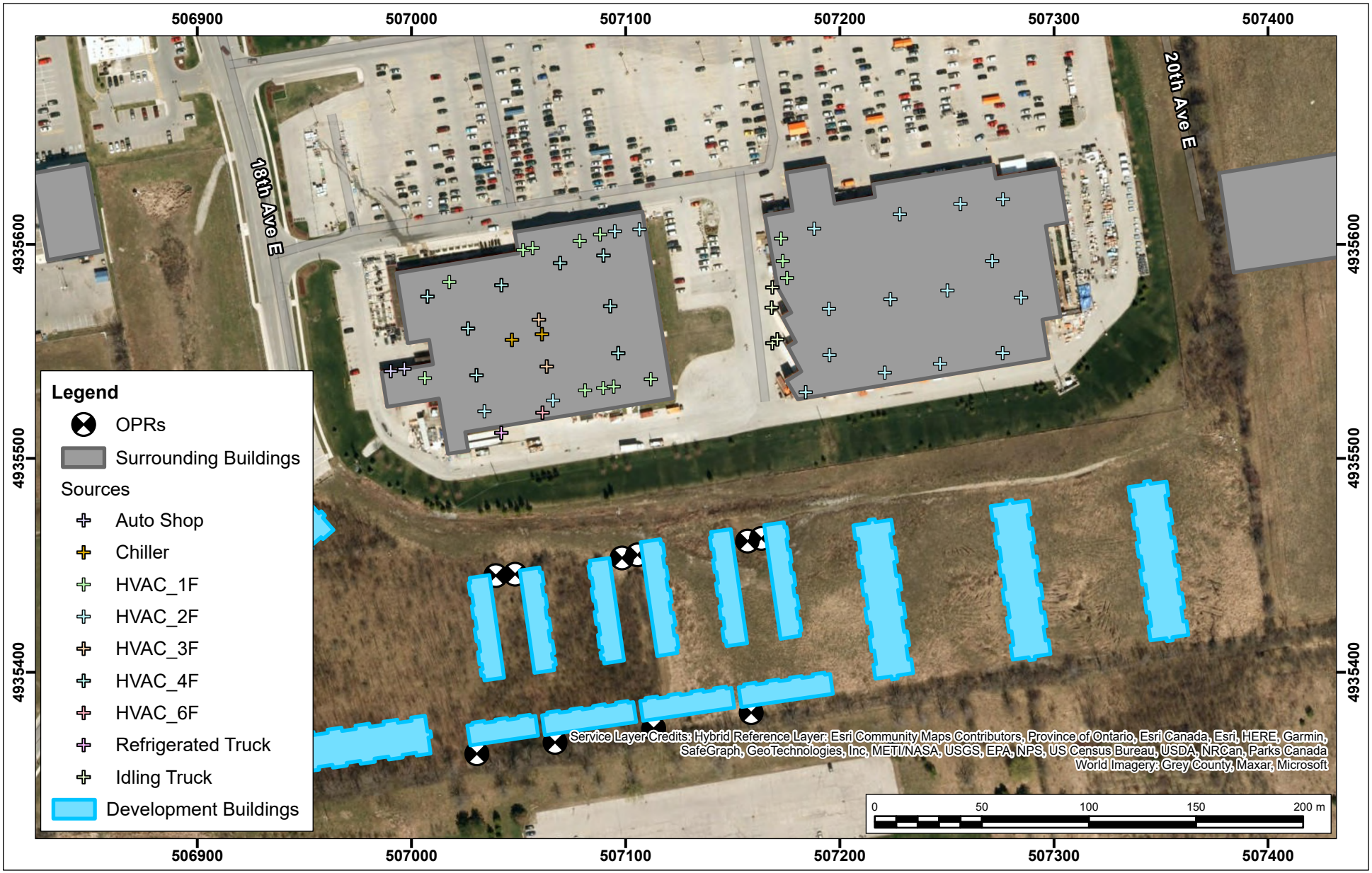
Map Projection: NAD 1983 UTM Zone 17N

1555 18th Street East - Owen Sound, Ontario

Project #: 2204035

Drawn by: LRC	Figure: 1
Approx. Scale:	1:4,500
Date Revised:	Jan 16, 2023

Map Document: \\rwdgroup\guelph\Jobs_3\2204035\03\Workitem\20Environmental\Noise\Analysis\GIS\1555_18th_Ave_E\1555_18th_Ave_E.aprx



Stationary Source Locations
Standard Non-Permitted

Map Projection: NAD 1983 UTM Zone 17N
1555 18th Street East - Owen Sound, Ontario

True North

Project #: 2204035

Drawn by: LRC	Figure: 4.1
Approx. Scale:	1:2,500
Date Revised:	Jan 16, 2023

Map Document: \\rwdgroup\guelph\Jobs_3\2204035\03\Workitem\20EnvironmentalNoise\Analysis\GIS\1555_18th_Ave_E\1555_18th_Ave_E.aprx

Outdoor Point of Reception Locations

True North

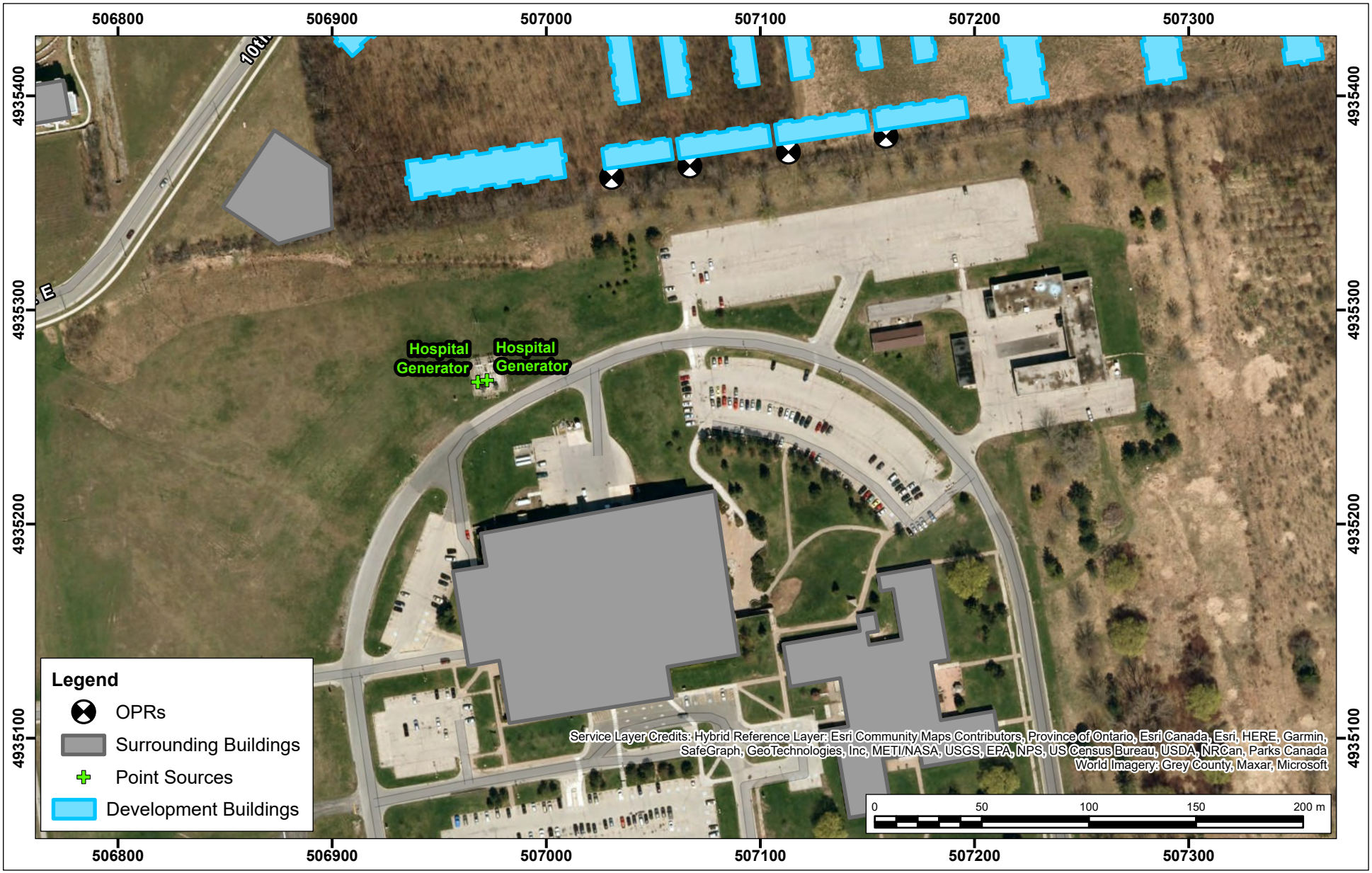
Map Projection: NAD 1983 UTM Zone 17N

1555 18th Street East - Owen Sound, Ontario

Project #: 2204035

Drawn by: LRC	Figure: 3
Approx. Scale:	1:1,000
Date Revised:	Jan 16, 2023

Map Document: \\rwdgroup\guelph\Jobs_3\2204035\03\Workitem\20Environmental\Noise\Analysis\GIS\1555_18th_Ave_E\1555_18th_Ave_E.aprx



Stationary Source Locations
Emergency Permitted

Map Projection: NAD 1983 UTM Zone 17N

1555 18th Street East - Owen Sound, Ontario

True North

Project #: 2204035

Drawn by: LRC	Figure: 4.3
Approx. Scale:	1:2,500
Date Revised:	Jan 16, 2023

Map Document: \\rwdgroup\guelph\Jobs_3\2204035\03\Workitems\20Environmental\Noise\Analysis\GIS\1555_18th_Ave_E\1555_18th_Ave_E.aprx

APPENDIX A

1 A002 Site Plan - PHASE 1
1 : 400

PARKING REQUIREMENTS

APARTMENTS - 1.25/UNIT

BUILDING A:	78 units
BUILDING B:	78 units
	156 units x 1.25 = 195 spaces
Total Apartment Unit Parking:	**195 spaces**

Portion to be Accessible:
"1, plus 3% of the total required"
3% of 195 = 5.85 (6) + 1 = 7
1 + 6 = 7 spaces accessible (3 Type A, 4 Type B)

TYPE A = 6m x 3.4m + 1.5m transfer space
TYPE B = 6m x 2.4m + 1.5m transfer space

DWELLING UNITS (TOWNHOUSE) - 1.0/DWELLING

BLOCKS 1, 2, 3	9 dwelling units each (27 units)
BLOCKS 4,5,6,	10 dwelling units each (30 units)
BLOCK 7	6 dwelling units (6 units)
BLOCK 8,9,10,	8 dwelling units (24 units)
TOTAL UNITS:	87 Dwelling Units
Total Dwelling Unit Parking:	**87 spaces**

TOTAL PARKING REQUIRED: 195 + 87 = **282 spaces**

PHASE 1 - PARKING SCHEDULE

DESCRIPTION	COUNT
BUILDING A	
ACCESSIBLE TYPE A - 6.00m x 3.40m	1
ACCESSIBLE TYPE B - 6.00m x 2.40m	2
TYPICAL PARKING - 6.00m x 2.65m	94
	97
BUILDING B	
ACCESSIBLE TYPE A - 6.00m x 3.40m	2
ACCESSIBLE TYPE B - 6.00m x 2.40m	2
TYPICAL PARKING - 6.00m x 2.65m	94
	98
TOWNHOUSE	
TYPICAL PARKING - 6.00m x 2.65m	87
	87
	282

PHASE 1 - SITE STATISTICS

DESCRIPTION	AREA (SM)	AREA (SF)	PERCENTAGE
BUILDING FOOTPRINT			
APARTMENT	2,592.87 m²	27,909 ft²	7.1%
TOWNHOUSE	3,495.82 m²	37,629 ft²	9.6%
	6,088.69 m²	65,538 ft²	16.7%
HARD LANDSCAPE			
ASPHALT	12,176.46 m²	131,066 ft²	33.5%
CURB	411.30 m²	4,427 ft²	1.1%
DRIVEWAY	1,352.18 m²	14,555 ft²	3.7%
PAVER	239.78 m²	2,581 ft²	0.7%
SIDEWALK	2,875.64 m²	30,953 ft²	7.9%
	17,055.37 m²	183,582 ft²	46.9%
SOFT LANDSCAPE			
LANDSCAPE	10,151.90 m²	109,274 ft²	27.9%
TOWNHOUSE BACKYARD	2,208.47 m²	23,772 ft²	6.1%
PARKLAND	872.99 m²	9,397 ft²	2.4%
	13,233.36 m²	142,443 ft²	36.4%
	36,377.42 m²	391,563 ft²	100.0%
OVERALL SITE	39,774.72 m²	428,132 ft²	100.0%

Chamberlain Architects Constructors Managers

Chamberlain Architect Services Limited

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CANADA

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NO.	ISSUED	DATE
1	ISSUED TO CLIENT	2022-09-12
2	ISSUED TO CLIENT	2022-10-26
3	ISSUED TO CLIENT	2022-10-27
4	CLIENT REVIEW	2022-11-17
5	FOR CO-ORDINATION	2022-12-07

SEAL

CONSTRUCTION NORTH TRUE NORTH

OWEN SOUND SMART CENTRES

10th STREET EAST &
18th AVENUE EAST
OWEN SOUND, ON

SHEET NAME

SITE PLAN
PHASE 1

START DATE	2022.09.12
DRAWN BY	MMW/ SS
CHECKED BY	CC
SCALE	1 : 400
PROJECT NO.	122038
DRAWING	A002

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APPENDIX B

CRITERIA

Transportation Sources

Guidance from the Ontario Ministry of the Environment, Conservation and Parks (MECP) NPC-300 Environmental Noise Guideline was used to assess environmental noise generated by transportation-related sources. There are three aspects to consider, which include the following:

i. Transportation source sound levels in indoor living areas (living rooms and sleeping quarters), which determines building façade elements (windows, exterior walls, doors) sound insulation design recommendations.
ii. Transportation source sound levels at the plane of the window, which determines air-conditioning and ventilation system recommendations and associated warning clauses which inform the future occupants that windows and doors must be closed in order to meet the indoor sound level criteria.
iii. Transportation source sound levels in Outdoor Living Areas (OLAs), which determines OLA noise mitigation and related warning clause recommendations.

Road and Rail

Indoor Sound Level Criteria

For assessing sound originating from transportation sources, NPC-300 defines sound level criteria as summarized in **Table 1** for indoor areas of sensitive uses. The specified values are maximum sound levels and apply to the indicated indoor spaces with the windows and doors closed.

Table 1: Indoor Sound Level Criteria for Road and Rail Sources

Type of Space	Source	Sound Level Criteria (Indoors)	
		Daytime $L_{eq,16\text{-}hr}$ 07:00h – 23:00h	Nighttime $L_{eq,8\text{-}hr}$ 23:00h – 07:00h
Living Quarters Examples: Living, dining and den areas of residences, hospitals, nursing homes, schools and daycare centres	**Road**	45 dBA	
	Rail	40 dBA	
Sleeping Quarters	**Road**	45 dBA	40 dBA
	Rail	40 dBA	35 dBA

NPC-300 also provides guidelines for acceptable indoor sound levels that are extended to land uses and developments which are not normally considered noise sensitive. The guideline sound level criteria presented in **Table 2** are provided to inform good-practice design objectives.

Table 2: Supplementary Indoor Sound Level Criteria for Road and Rail Sources

Type of Space	Source	Sound Level Criteria (Indoors)	
		Daytime $L_{eq,16\text{-}hr}$ 07:00h – 23:00h	Nighttime $L_{eq,8\text{-}hr}$ 23:00h – 07:00h
General offices, reception areas, retail stores, etc.	**Road**	50 dBA	-
	Rail	45 dBA	-
Theatres, places of worship, libraries, individual or semi-private offices, conference rooms, reading rooms, etc.	**Road**	45 dBA	-
	Rail	40 dBA	-
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	**Road**	-	40 dBA
	Rail	-	35 dBA
Sleeping quarters of hotels/motels	**Road**	-	45 dBA
	Rail	-	40 dBA

Outdoor Living Areas (OLAs)

Outdoor Living Areas (OLAs) would include outdoor areas intended and designed for the quiet enjoyment of the outdoor environment and which are readily accessible from the building.

OLAs may include any common outdoor amenity spaces associated with a multi-unit residential development (e.g. courtyards, roof-top terraces), and/or private backyards and terraces with a minimum depth of 4m provided they are the only outdoor living area for the occupant. The sound level criteria for outdoor living areas is summarized in **Table 3**.

Table 3: Sound Level Criteria – Outdoor Living Area

Assessment Location	Sound Level Criteria (Outdoors)	
	Daytime $L_{eq,16\text{-}hr}$ 07:00h – 23:00h	Nighttime $L_{eq,8\text{-}hr}$ 23:00h – 07:00h
Outdoor Living Area (OLA) (Combined Road and Rail)	55 dBA	-

Outdoor and Plane of Window Sound Levels

In addition to the sound level criteria, noise control measures and requirements for ventilation and warning clauses requirements are recommended for residential land-uses based on predicted transportation source sound levels incident in the plane of window at bedrooms and living/dining rooms, and/or at outdoor living areas. These recommendations are summarized in **Table 4** below.

Table 4: Ventilation, Building Component, and Warning Clauses Recommendations for Road/Rail Sources

Assessment Location	Transportation Sound Level (Outdoors)		Recommendations
	Daytime $L_{eq,16\text{-}hr}$ 07:00h – 23:00h	Nighttime $L_{eq,8\text{-}hr}$ 23:00h – 07:00h	
Plane of Window (Road)	> 65 dBA	> 60 dBA	Installation of air conditioning to allow windows to remained closed. The sound insulation performance of building components must be specified and designed to meet the indoor sound level criteria. Warning clause "Type D" is recommended.
	> 55 dBA	> 50 dBA	Applicable for low and medium density development: Forced-air ventilation system to allow for the future installation of air-conditioning. Warning clause "Type C" is recommended. Applicable for high density development: Air conditioning to allow windows to remained closed. Warning clause "Type D" is recommended.
Plane of Window (Rail [1, 2])	> 60 dBA	> 55 dBA	The acoustical performance of building façade components should be specified such that the indoor sound level limits are predicted to be achieved. Warning clause "Type D" is recommended.
	> 60 dBA ($L_{eq,\ 24hr}$) and < 100m from tracks		Exterior walls consisting of a brick veneer or masonry equivalent for the first row of dwellings. Warning clause "Type D" is recommended.
Outdoor Living Area (Combined Road and Rail [3])	≤ 60 dBA > 55 dBA	-	If sound levels are predicted to exceed 55 dBA, but are less than 60 dBA, noise controls may be applied to reduce the sound level to 55 dBA. If noise control measures are not provided, a warning clause "Type A" is recommended.
	> 60 dBA	-	Noise controls (barriers) should be implemented to meet the 55 dBA criterion. If mitigation is not feasible to meet the 55 dBA criterion for technical, economic or administrative reasons, an exceedance of 5 dB may be acceptable (to a maximum sound level of 60 dBA). In this case a warning clause "Type B" would be recommended.

Note(s):

1. Whistle noise is included (if applicable) in the determination of the sound level at the plane of window.
2. Some railway companies (e.g. CN, CP) may require that the exterior walls include a brick veneer or masonry equivalent for the façade facing the railway line, regardless of the sound level.
3. Whistle noise is not included in the determination of the sound level at the OLA.

Rail Layover Sites

NPC-300 provides a sound level limit for rail layover sites to be the higher of the background sound level or 55 dBA $L_{eq,1\text{-}hr,}$ for any one-hour period.

Rail Vibration Criteria

An assessment of rail vibration is generally recommended for developments within 75m of a rail corridor or rail yard, and adjacent to or within a setback of 15m of a transit (subway or light-rail) rail line.

The generally accepted vibration criterion for sensitive land-uses is the threshold of perception for human exposure to vibration, being a vibration velocity level of 0.14 mm/s RMS in any one-third octave band centre frequency in the range of 4 Hz to 200 Hz.

This vibration criterion is based on a one-second exponential time-averaged maximum hold root-mean-square (RMS) vibration velocity level and is consistent with the Railway Associations of Canada (RAC, 2013) guideline, the U.S. Federal Transit Authority (FTA, 2018) criterion for residential land-uses, the Toronto Transit Commission (TTC) guidelines for the assessment of potential vibration impact of future expansion (MOEE/TTC, 1993).

Aircraft

Land-use compatibility in the vicinity of airports is addressed in Ministry of the Environment, Conservation, and Parks (MECP) Guideline NPC-300 (MOE, 2013). The guideline provides recommendations for ventilation, and noise control for different Noise Exposure Forecast (NEF) values, which would be based on NEF contour maps available from the airport authority. The NEF values can be expressed as $L_{A,eq,24hr}$ sound levels by using the expression NEF = $L_{Aeq,24hr}$ -32 dBA.

Table 5: Indoor Sound Level Criteria for Aircraft Sources

Assessment Location	Indoor Sound Level Criteria NEF ($L_{eq,\ 24hr}$) [1]
Living/dining/den areas of residences, hospitals, schools, nursing/retirement homes, daycare centres, etc.	NEF- 5 (37 dBA)
Sleeping quarters	NEF-0 (32 dBA)

NPC-300 also provides guidelines for acceptable indoor sound levels that are extended to land uses and developments which are not normally considered noise sensitive. The guideline sound level criteria presented in **Table 6** are provided to inform good-practice design objectives.

Table 6: Supplementary Indoor Sound Level Criteria for Aircraft Sources

Assessment Location	Indoor Sound Level Criteria[1]
General offices, reception areas, retail stores, etc.	NEF-15 (47 dBA)
Individual or semi-private offices, conference rooms, etc.	NEF-10 (42 dBA)
Sleeping quarters of hotels/motels, theatres, libraries, places of worship, etc.	NEF-5 (37 dBA)

Table 7: NPC-300 Sound Level Criteria for Aircraft (Outdoors)

Assessment Location	Outdoor Sound Level Criteria[1]
Outdoor areas, including OLA	NEF-30 (62 dBA)

Table 8: Ventilation, Building Component, and Warning Clauses Recommendations for Aircraft Sources

Assessment Location	Aircraft Sound Level	NPC-300 Requirements
	NEF ($L_{EQ,24\text{-}hr}$)	
Outdoors	≥NEF 30	Air conditioning to allow windows to remained closed. The sound insulation performance of building components must be specified and designed to meet the indoor sound level criteria. Warning clauses "Type D" and "Type B" are recommended.
	< NEF 30 ≥ NEF 25	The sound insulation performance of building components must be specified and designed to meet the indoor sound level criteria. Applicable for low and medium density development: Forced-air ventilation system to allow for the future installation of air-conditioning. Warning clause "Type C" is recommended. Applicable for high density development: Air conditioning to allow windows to remained closed. Warning clause "Type D" is recommended.
	< NEF 25	Further assessment not required

Stationary Sources

NPC-300 Sound Level Criteria – Stationary Sources

Guidance from the MECP NPC-300 Environmental Noise Guideline is used to assess environmental noise generated by stationary sources, for example industrial and commercial facilities.

Noise from stationary sources is treated differently from transportation sources and requires sound levels be assessed for the predictable worst-case one-hour average sound level (L_{eq}) for each period of the day. For assessing sound originating from stationary sources, NPC-300 defines sound level criteria for two types of Points of Reception (PORs): outdoor and plane of window.

The assessment criteria for all PORs is the higher of either the exclusion limit per NPC-300 or the minimum background sound level that occurs or is likely to occur at a POR. The applicable exclusion limit is determined based on the level of urbanization or "Class" of the area. The NPC-300 exclusion limits for continuously operating stationary sources are summarized in **Table 9**.

Table 9: NPC-300 Exclusion Limits – Continuous and Quasi-Steady Impulsive Stationary Sources (LAeq-1hr)

Time Period	Class 1 Area		Class 2 Area		Class 3 Area		Class 4 Area	
	Outdoor	Plane of Window	Outdoor	Plane of Window	Outdoor	Plane of Window	Outdoor	Plane of Window
Daytime 0700-1900h	50 dBA	50 dBA	50 dBA	50 dBA	45 dBA	45 dBA	55 dBA	60 dBA
Evening 1900-2300h	50 dBA	50 dBA	45 dBA	50 dBA	40 dBA	40 dBA	55 dBA	60 dBA
Nighttime 2300-0700h	--	45 dBA	--	45 dBA	--	40 dBA	--	55 dBA

Note(s):

1. The applicable sound level criterion is the background sound level or the exclusion limit, whichever is higher.
2. Class 1, 2 and 3 sound level criteria apply to a window that is assumed to be open.
3. Class 4 area criteria apply to a window that is assumed closed. Class 4 area requires formal designation by the land-use planning authority.
4. Sound level criteria for emergency backup equipment (e.g. generators) operating in non-emergency situations such as testing or maintenance are 5 dB greater than the applicable sound level criteria for stationary sources.

For impulsive sound, other than quasi-steady impulsive sound, from a stationary source, the sound level criteria at a POR is expressed in terms of the Logarithmic Mean Impulse Sound Level (L_{LM}), and is summarized in **Table 10**.

Table 10: NPC-300 Exclusion Limits – Impulsive Stationary Sources (L_{LM})

Time Period	Number of Impulses in Period of One-Hour	Class 1 and 2 Areas		Class 3 Areas		Class 4 Areas	
		Outdoor	Plane of Window	Outdoor	Plane of Window	Outdoor	Plane of Window
Daytime (0700-2300h)	9 or more	50 dBAI	50 dBAI	45 dBAI	45 dBAI	55 dBAI	60 dBAI
Nighttime (2300–0700h)		-	45 dBAI	-	40 dBAI	-	55 dBAI
Daytime (0700-2300h)	7 to 8	55 dBAI	55 dBAI	50 dBAI	50 dBAI	60dBAI	65 dBAI
Nighttime (2300–0700h)		-	50 dBAI	-	45 dBAI	-	60 dBAI
Daytime (0700-2300h)	5 to 6	60 dBAI	60 dBAI	55 dBAI	55 dBAI	65 dBAI	70 dBAI
Nighttime (2300–0700h)		-	55 dBAI	-	50 dBAI	-	65 dBAI
Daytime (0700-2300h)	4	65 dBAI	65 dBAI	60 dBAI	60 dBAI	70 dBAI	75 dBAI
Nighttime (2300–0700h)		-	60 dBAI	-	55 dBAI	-	70 dBAI
Daytime (0700-2300h)	3	70 dBAI	70 dBAI	65 dBAI	65 dBAI	75 dBAI	80 dBAI
Nighttime (2300–0700h)		-	65 dBAI	-	60 dBAI	-	75 dBAI
Daytime (0700-2300h)	2	75 dBAI	75 dBAI	70 dBAI	70 dBAI	80 dBAI	85 dBAI
Nighttime (2300–0700h)		-	70 dBAI	-	65 dBAI	-	80 dBAI
Daytime (0700-2300h)	1	80 dBAI	80 dBAI	75 dBAI	75 dBAI	85 dBAI	90 dBAI
Nighttime (2300–0700h)		-	75 dBAI	-	70 dBAI	-	85 dBAI

Note(s):

1. The applicable sound level criterion is the background sound level or the exclusion limit, whichever is higher.

D-Series Guidelines

The MECP D-series guidelines (MOE, 1995) provide direction for land use planning to maximize compatibility of industrial uses with adjacent land uses. The goal of Guideline D-6 is to minimize encroachment of sensitive land uses on industrial facilities and vice versa, in order to address potential incompatibility due to adverse effects such as noise, odour and dust.

For each class of industry, the guideline provides an estimate of potential influence area and states that this influence area shall be used in the absence of the recommended technical studies. Guideline D-6 also recommends a minimum separation distance between each class of industry and sensitive land uses (see **Table 11**). Section 4.10 of D-6 identifies exceptional circumstances with respect to redevelopment, infill and mixed-use areas. In these cases, the guideline suggests that separation distances at, or less than, the recommended minimum separation distance may be acceptable if a justifying impact assessment is provided.

Table 11: Summary of Guideline D-6

Industry Class	Definition	Potential Influence Area	Recommended Minimum Separation Distance (property line to property line)
Class I	Small scale, self-contained, daytime only, infrequent heavy vehicle movements, no outside storage.	70 m	20 m
Class II	Medium scale, outdoor storage of wastes or materials, shift operations and frequent heavy equipment movement during the daytime.	300 m	70 m
Class III	Large scale, outdoor storage of raw and finished products, large production volume, continuous movement of products and employees during daily shift operations.	1000 m	300 m

Guideline D-6 provides criteria for classifying industrial land uses, based on their outputs, scale of operations, processes, schedule and intensity of operations. **Table 12** provides the classification criteria and examples.

Table 12: Guideline D-6 Industrial Categorization Criteria

Criteria	Class I	Class II	Class III
Outputs	• Sound not audible off property • Infrequent dust and/ or odour emissions and not intense • No ground-borne vibration	• Sound occasionally audible off property • Frequent dust and/ or odour emissions and occasionally intense • Possible ground-borne vibration	• Sound frequently audible off property • Persistent and intense dust and/ or odour emissions • Frequent ground-borne vibration
Scale	• No outside storage • Small scale plant or scale is irrelevant in relation to all other criteria	• Outside storage permitted • Medium level of production	• Outside storage of raw and finished products • Large production levels
Process	• Self-contained plant or building which produces / stores a packaged product • Low probability of fugitive emissions	• Open process • Periodic outputs of minor annoyance • Low probability of fugitive emissions	• Open process • Frequent outputs of major annoyances • High probability of fugitive emissions
Operation / Intensity	• Daytime operations only • Infrequent movement of products and/or heavy trucks	• Shift operations permitted • Frequent movements of products and/or heavy trucks with majority of movements during daytime hours	• Continuous movement of products and employees • Daily shift operations permitted
Examples	• Electronics Manufacturing • Furniture refinishing • Beverage bottling • Auto parts • Packaging services • Dairy distribution • Laundry and linen supply	• Magazine printing • Paint spray booths • Metal command • Electrical production • Dairy product manufacturing • Feed packing plant	• Paint and varnish manufacturing • Organic chemicals manufacturing • Breweries • Solvent recovery plant • Soap manufacturing • Metal manufacturing

APPENDIX C

Street 1	Column1	Street 2	Location	2016 Total	2006 Volume	Change	% Change	% Trucks
1st St SW	&	4th Ave W	East Leg	1,625	1,548	77	5%	22%
1st St SW	&	4th Ave W	North Leg	1,769	1,692	77	5%	20%
1st St SW	&	Deviation Rd	North Leg	3,079	2,923	156	5%	26%
10th St E	&	10 Ave E	West Leg	6,948	17,132	-10,184	-59%	24%
10th St E	&	10th Ave E	East Leg	6,628	2,658	3,970	149%	26%
10th St E	&	10th Ave E	South Leg	9,020	11,379	-2,359	-21%	26%
10th St E	&	16th Ave E	East Leg	4,767	3,406	1,361	40%	28%
10th St E	&	2nd Ave E	North Leg	9,402	13,207	-3,805	-29%	37%
10th St E	&	2nd Ave E	South Leg	4,200	6,604	-2,404	-36%	34%
10th St E	&	2nd Ave E	East Leg	14,923	19,504	-4,581	-23%	32%
10th St E	&	3rd Ave E	North Leg	4,871	7,562	-2,691	-36%	28%
10th St E	&	3rd Ave E	South Leg	4,959	8,503	-3,544	-42%	31%
10th St E	&	4th Ave E	North Leg	1,935	2,482	-547	-22%	26%
10th St E	&	4th Ave E	South Leg	2,914	2,971	-57	-2%	19%
10th St E	&	7th Ave E	South Leg	1,918	1,960	-42	-2%	20%
10th St E	&	8th Ave E	South Leg	1,920	3,373	-1,453	-43%	27%
10th St W	&	1st Ave W	North Leg	8,264	9,939	-1,675	-17%	27%
10th St W	&	1st Ave W	South Leg	2,489	2,756	-267	-10%	25%
10th St W	&	1st Ave W	East Leg	17,142	25,361	-8,219	-32%	32%
10th St W	&	2nd Ave W	North Leg	5,107	7,998	-2,891	-36%	29%
10th St W	&	2nd Ave W	South Leg	5,778	7,825	-2,047	-26%	25%
10th St W	&	3rd Ave W	North Leg	1,291	1,584	-293	-18%	25%
10th St W	&	3rd Ave W	South Leg	2,243	2,750	-507	-18%	n/a
10th St W	&	3rd Ave W	East Leg	12,936	19,621	-6,685	-34%	38%
10th St W	&	4th Ave W	North Leg	2,445	2,508	-63	-3%	20%
10th St W	&	6th Ave W	South Leg	1,279	1,588	-309	-19%	30%
10th St W	&	6th Ave W	East Leg	14,640	18,542	-3,902	-21%	33%
10th St W	&	8th Ave W	South Leg	4,074	5,249	-1,175	-22%	24%

APPENDIX D

Cadna/A RLS-90 Calculation Protocol - Definitions

Parameter	Unit	Definition
Nr		Ray Number
X	**(m)**	X-axis Cartesian Coordinate
Y	**(m)**	Y-axis Cartesian Coordinate
Z	**(m)**	Z-axis Cartesian Coordinate
Refl.	**order**	Order of Reflection
DEN	**D/E/N**	Time of Day (Day, Evening, or Night)
LmE	**(dBA)**	Emission level 25 m perpendicular from the road's axis
Dl	**(dB)**	10 log (length)
Dstg	**(dB)**	Gradient correction
Drefl	**(dB)**	Level increase due to multiple reflection
K	**(dB)**	Model correction
Ds	**(dB)**	Attenuation due to divergence
Dbm	**(dB)**	Attenuation due to meteorology and ground
Dz	**(dB)**	Screening attenuation of a barrier

Receiver
Name: OLA Block 01
ID: !0F00!OLA_Block01
X: 507040.99 m
Y: 4935444.93 m
Z: 12.50 m

Road, RLS-90, Name: "", ID: "!00!"																
Nr.	X	Y	Z	Refl.	DEN	LmE	DI	Dstg	Drefl	K	Ds	Dbm	Dz	RL	Lr
	(m)	(m)	(m)			dB(A)	dB	dB	dB	dB	(dB)	(dB)	(dB)	(dB)	dB(A)
1	506942.11	4935550.94	0.50	0	D	64.9	16.4	0.0	0.0	0.0	-32.8	0.0	7.4	0.0	41.2
1	506942.11	4935550.94	0.50	0	N	58.4	16.4	0.0	0.0	0.0	-32.8	0.0	7.4	0.0	34.7
1	506942.11	4935550.94	0.50	0	E	-6.6	16.4	0.0	0.0	0.0	-32.8	0.0	7.4	0.0	-30.3
2	506932.90	4935593.85	0.50	0	D	64.9	16.4	0.0	0.0	0.0	-35.0	0.0	4.9	0.0	41.4
2	506932.90	4935593.85	0.50	0	N	58.4	16.4	0.0	0.0	0.0	-35.0	0.0	4.9	0.0	34.9
2	506932.90	4935593.85	0.50	0	E	-6.6	16.4	0.0	0.0	0.0	-35.0	0.0	4.9	0.0	-30.1
4	506920.47	4935651.79	0.50	0	D	64.9	18.7	0.0	0.0	0.0	-37.6	0.0	4.8	0.0	41.3
4	506920.47	4935651.79	0.50	0	N	58.4	18.7	0.0	0.0	0.0	-37.6	0.0	4.8	0.0	34.8
4	506920.47	4935651.79	0.50	0	E	-6.6	18.7	0.0	0.0	0.0	-37.6	0.0	4.8	0.0	-30.2
9	506904.81	4935724.75	0.50	0	D	64.9	18.7	0.0	0.0	0.0	-40.2	-4.2	0.0	0.0	39.2
9	506904.81	4935724.75	0.50	0	N	58.4	18.7	0.0	0.0	0.0	-40.2	-4.2	0.0	0.0	32.7
9	506904.81	4935724.75	0.50	0	E	-6.6	18.7	0.0	0.0	0.0	-40.2	-4.2	0.0	0.0	-32.3
16	506905.80	4935720.15	0.50	1	D	64.9	17.6	0.0	0.0	0.0	-42.1	0.0	4.8	1.0	34.6
16	506905.80	4935720.15	0.50	1	N	58.4	17.6	0.0	0.0	0.0	-42.1	0.0	4.8	1.0	28.1
16	506905.80	4935720.15	0.50	1	E	-6.6	17.6	0.0	0.0	0.0	-42.1	0.0	4.8	1.0	-36.9
23	506810.52	4935347.55	7.49	0	D	64.9	16.1	0.0	0.0	0.0	-38.0	0.0	26.4	0.0	16.6
23	506810.52	4935347.55	7.49	0	N	58.4	16.1	0.0	0.0	0.0	-38.0	0.0	26.4	0.0	10.1
23	506810.52	4935347.55	7.49	0	E	-6.6	16.1	0.0	0.0	0.0	-38.0	0.0	26.4	0.0	-54.9
30	506833.85	4935378.98	5.29	0	D	64.9	15.8	0.0	0.0	0.0	-36.6	0.0	26.5	0.0	17.6
30	506833.85	4935378.98	5.29	0	N	58.4	15.8	0.0	0.0	0.0	-36.6	0.0	26.5	0.0	11.0
30	506833.85	4935378.98	5.29	0	E	-6.6	15.8	0.0	0.0	0.0	-36.6	0.0	26.5	0.0	-53.9
32	506845.81	4935395.11	4.16	0	D	64.9	3.7	0.0	0.0	0.0	-35.9	0.0	26.9	0.0	5.8
32	506845.81	4935395.11	4.16	0	N	58.4	3.7	0.0	0.0	0.0	-35.9	0.0	26.9	0.0	-0.7
32	506845.81	4935395.11	4.16	0	E	-6.6	3.7	0.0	0.0	0.0	-35.9	0.0	26.9	0.0	-65.7
33	506850.21	4935401.04	3.75	0	D	64.9	11.0	0.0	0.0	0.0	-35.6	0.0	27.1	0.0	13.2
33	506850.21	4935401.04	3.75	0	N	58.4	11.0	0.0	0.0	0.0	-35.6	0.0	27.1	0.0	6.7
33	506850.21	4935401.04	3.75	0	E	-6.6	11.0	0.0	0.0	0.0	-35.6	0.0	27.1	0.0	-58.3
40	506864.38	4935420.13	2.41	0	D	64.9	15.5	0.0	0.0	0.0	-34.7	0.0	28.7	0.0	16.9
40	506864.38	4935420.13	2.41	0	N	58.4	15.5	0.0	0.0	0.0	-34.7	0.0	28.7	0.0	10.4
40	506864.38	4935420.13	2.41	0	E	-6.6	15.5	0.0	0.0	0.0	-34.7	0.0	28.7	0.0	-54.6
51	506879.76	4935440.86	0.96	0	D	64.9	12.2	0.0	0.0	0.0	-33.8	0.0	29.5	0.0	13.8
51	506879.76	4935440.86	0.96	0	N	58.4	12.2	0.0	0.0	0.0	-33.8	0.0	29.5	0.0	7.3
51	506879.76	4935440.86	0.96	0	E	-6.6	12.2	0.0	0.0	0.0	-33.8	0.0	29.5	0.0	-57.7
65	506861.05	4935415.65	2.73	1	D	64.9	15.4	0.0	0.0	0.0	-41.6	0.0	25.9	1.0	11.8
65	506861.05	4935415.65	2.73	1	N	58.4	15.4	0.0	0.0	0.0	-41.6	0.0	25.9	1.0	5.3
65	506861.05	4935415.65	2.73	1	E	-6.6	15.4	0.0	0.0	0.0	-41.6	0.0	25.9	1.0	-59.7
70	506892.57	4935455.01	0.50	0	D	64.9	13.4	0.0	0.0	0.0	-33.0	0.0	29.6	0.0	15.7
70	506892.57	4935455.01	0.50	0	N	58.4	13.4	0.0	0.0	0.0	-33.0	0.0	29.6	0.0	9.2
70	506892.57	4935455.01	0.50	0	E	-6.6	13.4	0.0	0.0	0.0	-33.0	0.0	29.6	0.0	-55.8
90	506906.73	4935468.51	0.50	0	D	64.9	12.4	0.0	0.0	0.0	-32.2	0.0	27.7	0.0	17.4
90	506906.73	4935468.51	0.50	0	N	58.4	12.4	0.0	0.0	0.0	-32.2	0.0	27.7	0.0	10.9
90	506906.73	4935468.51	0.50	0	E	-6.6	12.4	0.0	0.0	0.0	-32.2	0.0	27.7	0.0	-54.1
98	506921.57	4935480.98	0.50	0	D	64.9	13.3	0.0	0.0	0.0	-31.4	0.0	28.0	0.0	18.9
98	506921.57	4935480.98	0.50	0	N	58.4	13.3	0.0	0.0	0.0	-31.4	0.0	28.0	0.0	12.4
98	506921.57	4935480.98	0.50	0	E	-6.6	13.3	0.0	0.0	0.0	-31.4	0.0	28.0	0.0	-52.6
100	506932.65	4935489.35	0.50	0	D	64.9	8.0	0.0	0.0	0.0	-30.8	0.0	24.5	0.0	17.6
100	506932.65	4935489.35	0.50	0	N	58.4	8.0	0.0	0.0	0.0	-30.8	0.0	24.5	0.0	11.1
100	506932.65	4935489.35	0.50	0	E	-6.6	8.0	0.0	0.0	0.0	-30.8	0.0	24.5	0.0	-53.9
106	506940.62	4935500.07	0.50	0	D	64.9	13.2	0.0	0.0	0.0	-30.6	0.0	22.5	0.0	24.9
106	506940.62	4935500.07	0.50	0	N	58.4	13.2	0.0	0.0	0.0	-30.6	0.0	22.5	0.0	18.4
106	506940.62	4935500.07	0.50	0	E	-6.6	13.2	0.0	0.0	0.0	-30.6	0.0	22.5	0.0	-46.6
114	506946.39	4935519.19	0.50	0	D	64.9	13.1	0.0	0.0	0.0	-31.0	0.0	13.6	0.0	33.4

Road, RLS-90, Name: "", ID: "!00!"															
Nr.	X	Y	Z	Refl.	DEN	LmE	Dl	Dstg	Drefl	K	Ds	Dbm	Dz	RL	Lr
	(m)	(m)	(m)			dB(A)	dB	dB	dB	dB	(dB)	(dB)	(dB)	(dB)	dB(A)
114	506946.39	4935519.19	0.50	0	N	58.4	13.1	0.0	0.0	0.0	-31.0	0.0	13.6	0.0	26.9
114	506946.39	4935519.19	0.50	0	E	-6.6	13.1	0.0	0.0	0.0	-31.0	0.0	13.6	0.0	-38.1
123	506788.28	4935321.32	9.38	0	D	64.9	14.6	0.0	0.0	0.0	-39.2	0.0	25.9	0.0	14.4
123	506788.28	4935321.32	9.38	0	N	58.4	14.6	0.0	0.0	0.0	-39.2	0.0	25.9	0.0	7.9
123	506788.28	4935321.32	9.38	0	E	-6.6	14.6	0.0	0.0	0.0	-39.2	0.0	25.9	0.0	-57.1
128	506763.70	4935304.94	10.41	0	D	64.9	15.0	0.0	0.0	0.0	-40.2	0.0	25.5	0.0	14.2
128	506763.70	4935304.94	10.41	0	N	58.4	15.0	0.0	0.0	0.0	-40.2	0.0	25.5	0.0	7.6
128	506763.70	4935304.94	10.41	0	E	-6.6	15.0	0.0	0.0	0.0	-40.2	0.0	25.5	0.0	-57.3
140	506735.75	4935296.27	11.05	0	D	64.9	14.4	0.0	0.0	0.0	-41.1	0.0	25.3	0.0	12.8
140	506735.75	4935296.27	11.05	0	N	58.4	14.4	0.0	0.0	0.0	-41.1	0.0	25.3	0.0	6.3
140	506735.75	4935296.27	11.05	0	E	-6.6	14.4	0.0	0.0	0.0	-41.1	0.0	25.3	0.0	-58.7

Cadna/A ISO-9613 Calculation Protocol - Definitions

Parameter	Unit	Definition
Nr		Ray Number
X	**(m)**	X-axis Cartesian Coordinate
Y	**(m)**	Y-axis Cartesian Coordinate
Z	**(m)**	Z-axis Cartesian Coordinate
Refl.	**order**	Order of Reflection
DEN	**D/E/N**	Time of Day (Day, Evening, or Night)
Freq.	**(Hz)**	1/1 Octave Band Dominant Frequency or Frequency Type ("A" for A-weighted)
Lw	**(dBA)**	Overall Sound Power Level
I/a	**dB**	Line/Area Source Correction
Optime	**dB**	Operating Time Correction
K0	**(dB)**	D_omega in ISO 9613-2 (correction for radiation into solid angles less than 4 Pi)
Di	**(dB)**	Directivity Index
Adiv	**(dB)**	Attenuation Due to Divergence
Aatm	**(dB)**	Atmospheric Attenuation
Agr	**(dB)**	Ground Attenuation
Afol	**(dB)**	Attenuation Due to Foliage
Ahous	**(dB)**	Attenuation from Houses
Abar	**(dB)**	Barrier Attenuation
Cmet	**(dB)**	Meteorological Correction
RL	**(dB)**	Reflection Loss
Lr	**(dBA)**	Resulting Noise Impact at Receptor - Leq (1-Hr)

Receiver
Name: OPR Block 07
ID: !0F02!OPR_Block07
X: 507030.52 m
Y: 4935361.97 m
Z: 12.50 m

Point Source, ISO 9613, Name: "Hospital", ID: "!0502!"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
6	507059.94	4935212.06	29.00	0	DEN	A	91.5	0.0	0.0	3.0	0.0	54.7	0.8	-0.4	0.0	0.0	0.0	0.0	0.0	39.4
10	507059.94	4935212.06	29.00	1	DEN	A	91.5	0.0	0.0	3.0	0.0	55.2	0.9	-0.4	0.0	0.0	0.0	0.0	1.0	37.9

Point Source, ISO 9613, Name: "Hospital", ID: "!0502!"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
17	507017.12	4935204.28	29.00	0	DEN	A	91.5	0.0	0.0	3.0	0.0	55.0	0.9	-0.4	0.0	0.0	0.0	0.0	0.0	39.1
19	507017.12	4935204.28	29.00	1	DEN	A	91.5	0.0	0.0	3.0	0.0	55.4	0.9	-0.4	0.0	0.0	0.0	0.0	1.0	37.6

Point Source, ISO 9613, Name: "Hospital", ID: "!0502!"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
26	506974.09	4935196.46	29.00	0	DEN	A	91.5	0.0	0.0	3.0	0.0	55.9	0.9	-0.4	0.0	0.0	0.0	0.0	0.0	38.1

Point Source, ISO 9613, Name: "Hospital", ID: "!0502!"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
33	507080.38	4935203.88	29.00	0	DEN	A	83.0	0.0	0.0	3.0	0.0	55.4	2.0	-0.6	0.0	0.0	9.9	0.0	0.0	19.3
39	507080.38	4935203.88	29.00	1	DEN	A	83.0	0.0	0.0	3.0	0.0	55.8	2.0	-0.6	0.0	0.0	21.5	0.0	1.1	6.1

Point Source, ISO 9613, Name: "Hospital", ID: "!0502!"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
49	507083.34	4935183.80	29.00	0	DEN	A	80.2	0.0	0.0	3.0	0.0	56.4	2.6	-0.5	0.0	0.0	11.9	0.0	0.0	12.8
53	507083.34	4935183.80	29.00	1	DEN	A	80.2	0.0	0.0	3.0	0.0	56.8	2.6	-0.5	0.0	0.0	21.8	0.0	1.1	1.4

Point Source, ISO 9613, Name: "Hospital", ID: "!0502!"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
63	507086.18	4935164.49	29.00	0	DEN	A	79.1	0.0	0.0	3.0	0.0	57.3	3.7	-0.5	0.0	0.0	13.0	0.0	0.0	8.6
68	507086.18	4935164.49	29.00	1	DEN	A	79.1	0.0	0.0	3.0	0.0	57.6	3.8	-0.5	0.0	0.0	21.9	0.0	1.2	-2.0