Final

5707 Hazeldean Road Acoustical Study

City of Ottawa

Prepared for North American Development Group
by IBI Group
September 18, 2019

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1 Introduction

This current study is an update to the previous acoustical study, “Hazeldean/Huntmar Commercial Development Phase 2 Acoustical Study” (IBI Group, January 3, 2012).

The purpose of the study is to examine the required mitigation, if any, to attenuate the noise levels produced by the development of a proposed commercial site expansion in the Kanata/Stittsville area, Ottawa, Ontario.

The subject site is bounded by a residential development to the north, additional commercial lands to the east, Hazeldean Road to the south, and Huntmar Drive to the west. The development comprises a number of buildings; however, this report only applies to Proposed Building D and Building R1 which are adjacent to the existing residential development to the north of the property. Proposed Building B is located 185m from the nearest residential receiver and therefore provides no additional impacts and is within the noise level requirements.

Noise sources within the site will be air conditioners and ventilator units on the building rooftops, a trash compactor, and delivery trucks in the serviceway to the north of the buildings.

Refer to Figure 1 - The Noise Information Plan (Appendix A) showing the layout of the site and the locations of the noise sources and residential receivers.

At the time of writing, some of the proposed conditions of the 2012 acoustical study have been constructed. Accordingly, the noise model has been updated to reflect the existing as-built conditions, and the proposed conditions of the revised development. The proposed building layouts have changed from the 2012 report and have been updated based on the revised Site Plan. The final design for the HVAC equipment for the proposed buildings has not been completed, however the designer has provided the assumed number of units and sizes and this was utilized in the noise modelling.

2 Background and Noise Criteria

The City of Ottawa Environmental Noise Control Guidelines (ENCG), published by the City of Ottawa was utilized as the Noise guideline for this development. This document is based on and references the Ministry of the Environment, Conservation and Parks (MECP) noise guideline NPC-300.

The proposed commercial development is located in a growing community on the southwestern outskirts of Ottawa. The area is predominantly residential and as such is assumed to be classified as a “Class 2” area as defined by the MECP. A “Class 2” area experiences a typical background noise level similar to an urban hum during the day and a background noise level similar to a rural area at night.

The ENCG criteria that applies to this study is Table 3.2a (ENCG page 29). The criteria for a “Class 2” area are summarized in Table 1.

Table 1 – Sound Level Criteria for New Potential Sources of Stationary Noise in Proximity To Existing or City Approved Noise-Sensitive Land Uses

RECEIVER AREA (CLASS #)	NOISE ASSESSMENT LOCATION	TIME OF DAY	HOURLY LEQ (LEQ $_{1HR}$), DBA
Class 2	Outdoor Point of Reception or Plane of Window	07:00 – 19:00	50
	Outdoor Point of Reception	19:00 – 23:00	45
	Plane of Window		50
	Plane of Window	23:00 – 07:00	45

An Outdoor Point of Reception (OPR) is a point on a residential property at which outdoor activities often occur, such as a backyard or patio.

The Plane of Window is the midpoint of a window on the first storey of a residence.

The Plane of Bedroom Window is the midpoint of a window on the second storey of the residence.

Receivers were modelled for the OPR, as well as the living room and bedroom windows of each house backing onto the commercial plaza (see Noise Information Plan, Appendix A).

3 Noise Prediction Methods

The noise levels affecting the residential properties were modelled using Cadna A version 2019 MR1 produced by DataKustik.

3.1 Existing Conditions

The location of rooftop equipment, the trash compactor, truck loading zones, and residence locations were input into the model, and are based on the 2012 Noise Study.

The existing rooftop air conditioners and ventilators were assumed to operate at 100% capacity during the daytime period (07:00 – 19:00), at 75% capacity during the evening (19:00 – 23:00), and at 50% capacity during the night (23:00 – 07:00). The locations and models of the mechanical rooftop equipment was received from the Mechanical Engineering Consultant and were input into the model.

The trash compactor is a Marathon Equipment RJ-100 SC Ultra model. Metro stated that typical trash compaction operations occur over a half-hour period and occur at regular times throughout the day. Noise data were provided by the manufacturer.

The 2012 study assumed that during the daytime, the maximum number of delivery trucks arriving in one hour during the daytime was four (4), and during the evening three (3) trucks. It is assumed that each truck would be idling for 20 minutes. No delivery operations were anticipated during the nighttime hours. The noise produced by an idling truck is assumed to be 75 dBA (Watts et al., 2005; see Appendix B) at a distance of two (2) metres from the engine compartment. This datum was used to calculate the sound power level of the engine.

The City of Ottawa By-law No. 2004-253 prohibits any delivery operations taking place between the hours of 23:00 and 07:00, and thus truck noise was not considered during this time period.

3.2 Proposed Conditions

The proposed conditions include the construction of two new buildings (Proposed Building D and Building R1) adjacent to the residential receivers to the north as shown on the Noise Information Plan in Appendix A. Based on information receiver from the North American Development Group, the proposed rooftops will include 4-ton air conditioning units, with a typical sound power level of 78 dBA. The proposed rooftop air conditioners were assumed to operate at 100% capacity during the daytime period (07:00 – 19:00), at 75% capacity during the evening (19:00 – 23:00), and at 50% capacity during the night (23:00 – 07:00).

4 Results

The Cadna A modelling includes the existing conditions' noise sources and the recommended noise walls proposed in the 2012 Study. The proposed buildings and rooftop equipment was added to the model to determine the resulting noise levels.

The results of the modelling are included in Appendix C and have been summarized in Table 2. Figure 2, Figure 3, and Figure 4 show the results graphically (refer to Appendix C).

Table 2 – Attenuated Sound Levels

LOT NUMBER	OPR DAY 07:00 - 19:00 (MAX 50 DBA)	PLANE OF WINDOW DAY 7:00 - 19:00 (MAX 50 DBA)	OPR EVENING 19:00 - 23:00 (MAX 45 DBA)	PLANE OF WINDOW EVENING 19:00 - 23:00 (MAX 50 DBA)	PLANE OF WINDOW NIGHT 19:00 - 23:00 (MAX 45 DBA)
92	44.8	44.5	43.9	43.5	41.1
93	45.5	45.2	44.5	44.1	41.7
94	46.0	45.7	45.0	44.6	42.0
95	45.8	45.6	44.8	44.6	41.9
96	45.5	45.2	44.4	44.1	41.7
97	44.9	44.8	43.8	43.7	41.4
98	44.6	44.5	43.5	43.3	41.1
99	44.2	44.1	43.1	43.0	40.8
100	43.9	43.8	42.8	42.6	40.5
101	43.5	43.4	42.4	42.3	40.2
102	43.2	43.1	42.1	42.0	39.9
103	42.7	42.6	41.6	41.6	39.6
104	42.7	42.7	41.7	41.7	39.6
105	42.5	42.4	41.6	41.5	39.4
106	42.7	42.6	41.9	41.8	39.5
107	43.6	43.3	43.0	42.6	39.3
108	44.7	44.1	44.3	43.6	39.3
109	44.8	44.2	44.4	43.7	39.4
110	44.6	44.0	44.2	43.6	39.6
111	44.3	43.7	43.9	43.3	39.8
112	43.6	43.1	43.2	42.7	39.8
113	42.1	41.9	41.8	41.5	39.2
114	39.9	40.1	39.4	39.5	38.4

5 Recommendations

This study has shown that no additional physical mitigation is required for the proposed Site Plan to meet ENCG and MECP noise criteria.

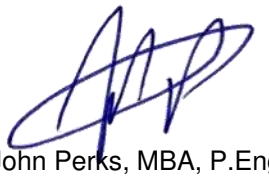
The following recommendations are provided:

1. On the assumption that proposed air conditioning units do not have a sound power level greater than 78 dBA, no attenuation is required to protect the residences from the units. If the actual air conditioning units propose have a sound power level greater than 78 dBA, an updated noise analysis should be completed to confirm the noise impact on the sensitive receivers.

Based on the preceding, we conclude that with the implementation of the above recommendations that the proposed Site Plan will conform to ENCG and MECP standards.

Respectfully submitted.

IBI GROUP



John Perks, MBA, P.Eng
Associate Director

Tiffany Chan, EIT

Appendix A – Noise Information Plan

PLANE OF WINDOW (TYP.)

OUTDOOR POINT OF RECEPTION (TYP.)

PLANE OF WINDOW (TYP.)

OUTDOOR POINT OF RECEPTION (TYP.)

PHASE 5

TRUCK

TRUCK

TRUCK

EXISTING BUILDING

EXISTING BUILDING

PROPOSED BUILDING R1

PROPOSED BUILDING D

EXISTING BUILDING

TERRACE AT 3:1 TO MATCH EXISTING GRADE

CRU B
1346.6 SM
14495 SF

FUTURE DEVELOPMENT

PAD L
434.3 SM
4675 SF

PAD J
608.4 SM
6550 SF

PAD K
556.5 SM
5990 SF

EXTENT OF SITE PLAN APPLICATION REFER TO 2/A101

HUNTMAR ROAD

PAD H
564.9 SM
6080 SF

EXISTING BUILDING

PROPOSED BUILDING B

50 CARS

PAD C
627.0 SM
6750 SF

PAD D
464.5 SM
5000 SF

PAD E
262.0 SM
2820 SF

LANDS OWNED BY OTHERS

PAD A
1567.2 SM
16870 SF

CRU A
1203.2 SM
12950 SF

PAD G
478.4 SM
5150 SF

DEPRESS EXISTING MEDIAN

HAZELDEAN ROAD

True North

LEGEND

RECEIVER LOCATION (TYP.)

CLIENT: NORTH AMERICAN DEVELOPMENT GROUP CITY OF OTTAWA	PROJECT NAME: 5707 HAZELDEAN ROAD KANATA, ONTARIO	IBI GROUP Suite 101 - 410 Albert Street Waterloo ON N2L 3V3 Canada tel 519 585 2255 ibigroup.com	
	SCALE: 1:1250 / DATE: SEPT 2019 PROJECT ENG: J.PERKS / DRAWN BY: TC CHECKED BY: AK / APPROVED BY: JP PROJECT NO: 122445	FIGURE NAME: NOISE INFORMATION PLAN	FIGURE NO.: 1 / REVISION: 0

SCALE CHECK 1 in 10mm

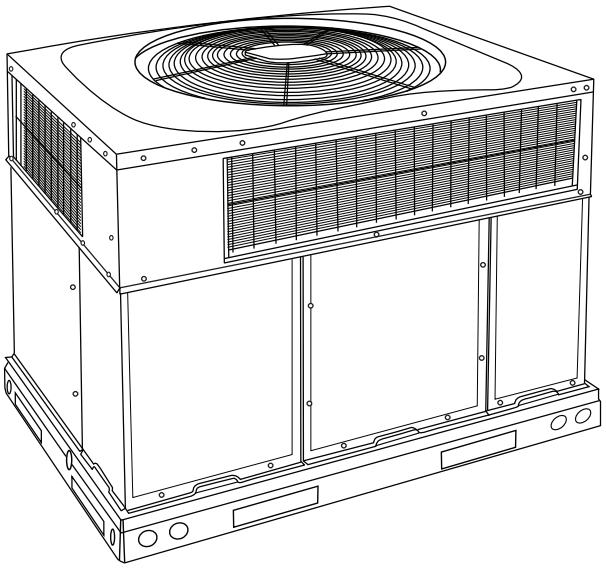
File Location: 122445N_2019-09-13.dwg Last Saved: September 16, 2019, by tiffany.chan Plotted: Monday, September 16, 2019 4:52:07 PM by Tiffany Chan

Appendix B – Noise Level Source Data

48ES−A
Comfort™ 13 SEER Single−Packaged Air Conditioner and Gas Furnace System with Puron® (R−410A) Refrigerant
Single and Three Phase
2 to 5 Nominal Tons (Sizes 24−60)

Carrier®
Turn to the Experts℠

Product Data



A09034

Fig. 1 - Unit 48ES-A

Single-Packaged Products with Energy-Saving Features and Puron® refrigerant.

- Up to 13.5 SEER
- Up to 80.4% AFUE
- Factory-Installed TXV
- Multi-Speed High Efficiency Blower-Standard
- Direct Spark Ignition
- Low Sound Levels
- Dehumidification Feature

FEATURES/BENEFITS

One-piece heating and cooling units with low sound levels, easy installation, low maintenance, and dependable performance.

Puron Environmentally Sound Refrigerant is Carrier's unique refrigerant designed to help protect the environment. Puron is an HFC refrigerant which does not contain chlorine that can harm the ozone layer. Puron refrigerant is in service in millions of systems, proving highly reliable, environmentally sound performance.

Easy Installation

Factory-assembled package is a compact, fully self-contained, combination gas heating/electric cooling unit that is prewired, pre-piped, and pre-charged for minimum installation expense. These units are available in a variety of standard and optional heating/ cooling size combinations with voltage options to meet residential and light commercial requirements. Units are lightweight and install easily on a rooftop or at ground level. The high tech composite base eliminates rust problems associated with ground level applications.

Innovative Unit Base Design

On the inside a high-tech composite material will not rust and incorporates a sloped drain pan which improves drainage and helps inhibit mold, algae and bacterial growth. On the outside metal base rails provide added stability as well as easier handling and rigging.

Convertible duct configuration

Unit is designed for use in either downflow or horizontal applications. Each unit is converted from horizontal to downflow and includes horizontal duct covers. Downflow operation is provided in the field to allow vertical ductwork connections. The basepan seals on the bottom openings to ensure a positive seal in the vertical airflow mode.

Efficient operation High-efficiency design offers SEER (Seasonal Energy Efficiency Ratios) of up to 13.5 and AFUE (Annual Fuel Utilization Efficiency) ratings as high as 80.4%.

Energy-saving, direct spark ignition saves gas by operating only when the room thermostat calls for heating. Standard units are furnished with natural gas controls. A low-cost field installed kit for propane conversion is available for all units.

48ESN units are dedicated Low NOx units designed for California installations. These models meet the California maximum oxides of nitrogen (NOx) emissions requirement of 40 nanograms/joule or less as shipped from the factory and MUST be installed in California Air Quality Management Districts and wherever a Low NOx rule exists.

Durable, dependable components Compressors are designed for high efficiency. Each compressor is hermetically sealed against contamination to help promote longer life and dependable operation. Each compressor also has vibration isolation to provide quieter operation. All compressors have internal high pressure and overcurrent protection.

Monoport inshot burners produce precise air-to-gas mixture, which provides for clean and efficient combustion. The large monoport on the inshot (or injection type) burners seldom, if ever, requires cleaning. All gas furnace components are accessible in one compartment.

Turbo-tubular™ heat exchangers are constructed of aluminized steel for corrosion resistance and optimum heat transfer for improved efficiency. The tubular design permits hot gases to make multiple passes across the path of the supply air.

In addition, dimples located on the heat exchanger walls force the hot gases to stay in close contact with the walls, improving heat transfer.

Direct-drive multi-speed high efficiency brushless DC blower motor is standard on all 48ES-A models.

Direct-drive PSC (Permanent Split Capacitor) condenser-fan motors are designed to help reduce energy consumption and provide for cooing operation down to 40°F (4.4°C) outdoor temperature. Motormaster® II low ambient kit is available as a field-installed accessory.

Thermostatic Expansion Valve - A hard shutoff, balance port TXV maintains a constant superheat at the evaporator exit (cooling cycle) resulting in higher overall system efficiency.

ARI* CAPACITIES

Cooling Capacities and Efficiencies

UNIT 48ES-A	NOMINAL TONS	STANDARD CFM	NET COOLING CAPACITIES (Btuh)	EER**	SEER†
24	2	800	23,000	11.0	13.2
30	2-1/2	1000	28,400	11.2	13.5
36	3	1200	34,400	11.0	13.0
42	3-1/2	1400	40,500	11.2	13.2
48	4	1600	46,500	11.2	13.2
60	5	1750	57,000	11.0	13.4

LEGEND
dB–Sound Levels (decibels)
db—Dry Bulb
SEER—Seasonal Energy Efficiency Ratio
wb—Wet Bulb
COP–Coefficient of Performance
* Air Conditioning & Refrigeration Institute.
**At "A" conditions–80°F (26.7°C) indoor db/67°F (19.4°C) indoor wb & 95°F (35°C) outdoor db.
† Rated in accordance with U.S. Government DOE Department of Energy) test procedures and/or ARI Standards 210/240.

Notes:
1. Ratings are net values, reflecting the effects of circulating fan heat. Ratings are based on:
Cooling Standard: 80°F (26.7°C) db, 67°F wb (19.4°C) indoor entering–air temperature and 95°F db (35°C) outdoor entering–air temperature.
2. Before purchasing this appliance, read important energy cost and efficiency information available from your retailer.

Gas Heating Capacities and Efficiencies

UNIT 48ES-A	HEATING INPUT (Btuh)	OUTPUT CAPACITY (Btuh)	TEMPERATURE RISE RANGE °F (°C)	AFUE (%)
24040 **30040**	40,000	32,000	30-60 (16.7-33.3)	80.0
24060 **30060** **36060** **42060**	60,000	48,000 48,000 48,000 47,000	25-55 (13.9-30.6)	80.0 80.0 80.0 78.5
36090 **42090** **48090** **60090**	90,000	72,000 73,000 73,000 73,000	35-65 (19.4-36.1)	79.3 80.4 80.4 80.4
48115 **60115**	115,000	93,000	30-60 (16.7-33.3)	80.3
48130 **60130**	130,000	103,000	35-65 (19.4-36.1)	78.9

LEGEND
AFUE—Annual Fuel Utilization Efficiency
NOTE: Before purchasing this appliance, read important energy cost and efficiency information available from your retailer.

A-Weighted Sound Power Level (dBA)

UNIT 48ES-A	STANDARD RATING dBA	TYPICAL OCTAVE BAND SPECTRUM (dBA without tone adjustment)						
		125	250	500	1000	2000	4000	8000
24---30	76	66.0	66.0	70.5	71.5	67.5	62.5	58.5
30---30/50	75	66.0	63.5	68.0	68.5	67.5	61.5	55.0
36---30/50/60	75	64.0	63.5	68.0	70.5	64.5	61.0	61.0
42---30/50/60	77	67.0	67.0	69.5	70.5	68.0	65.5	61.0
48---30/50/60	78	71.5	66.5	73.0	71.5	68.0	64.0	57.0
60---30/50/60	78	74.5	66.5	70.0	70.0	66.5	64.0	57.0

* Tested in accordance with ARI Standard 270 (not listed in ARI).

Performance Summary For Untitled1

08/31/2009

01:23PM

Part Number:48TJD024---1A1AA

ARI EER:	**8.60**	
IPLV:	**8.7**	
Base Unit Weight:	**1850**	lb
Base Unit Dimensions		
Unit Length:	**86.1**	in
Unit Width:	**83.5**	in
Unit Height:	**47.3**	in
Unit Voltage-Phase-Hertz:	**575-3-60**	
Air Discharge:	**Vertical**	
Fan Drive Type:	**Belt**	
Actual Airflow:	**8000**	CFM
Site Altitude:	**1125**	ft

Cooling Performance

Condenser Entering Air DB:	**95.0**	F
Evaporator Entering Air DB:	**80.0**	F
Evaporator Entering Air WB:	**67.0**	F
Entering Air Enthalpy:	**32.10**	BTU/lb
Evaporator Leaving Air DB:	**59.5**	F
Evaporator Leaving Air WB:	**57.4**	F
Evaporator Leaving Air Enthalpy:	**25.07**	BTU/lb
Gross Cooling Capacity:	**242.80**	MBH
Gross Sensible Capacity:	**169.66**	MBH
Compressor Power Input:	**19.20**	kW
Coil Bypass Factor:	**0.230**	

Heating Performance

Heating Airflow:	**8000**	CFM
Entering Air Temp:	**70.0**	F
Leaving Air Temp:	**96.9**	F
Gas Input Capacity:	**206.0 / 275.0**	MBH
Gas Heating Capacity:	**223.00**	MBH
Temperature Rise:	**26.9**	F

Supply Fan

External Static Pressure:	**0.50**	in wg
Options / Accessories Static Pressure		
Economiser:	**0.10**	in wg
Total External Static:	**0.60**	in wg
Fan RPM:	**1154**	
Fan Power:	**5.58**	BHP

Electrical Data

Minimum Voltage:	**518**
Maximum Voltage:	**632**
Compressor #1 RLA:	**12.7**
Compressor #1 LRA:	**85**
Compressor #2 RLA:	**11.3**
Compressor #2 LRA:	**85**
Outdoor Fan Motor Qty:	**2**
Outdoor Fan Motor HP (ea):	**1**
Outdoor Fan FLA (ea):	**3.4**
Indoor Fan Motor HP:	**7.5**
Indoor Fan Motor FLA:	**10**
Combustion Fan Motor FLA (ea):	**0.57**
Power Supply MCA:	**44**

Performance Summary For Untitled1

08/31/2009

01:23PM

Power Supply MOCP, Fuse or HACR, U.S.A.: **50**

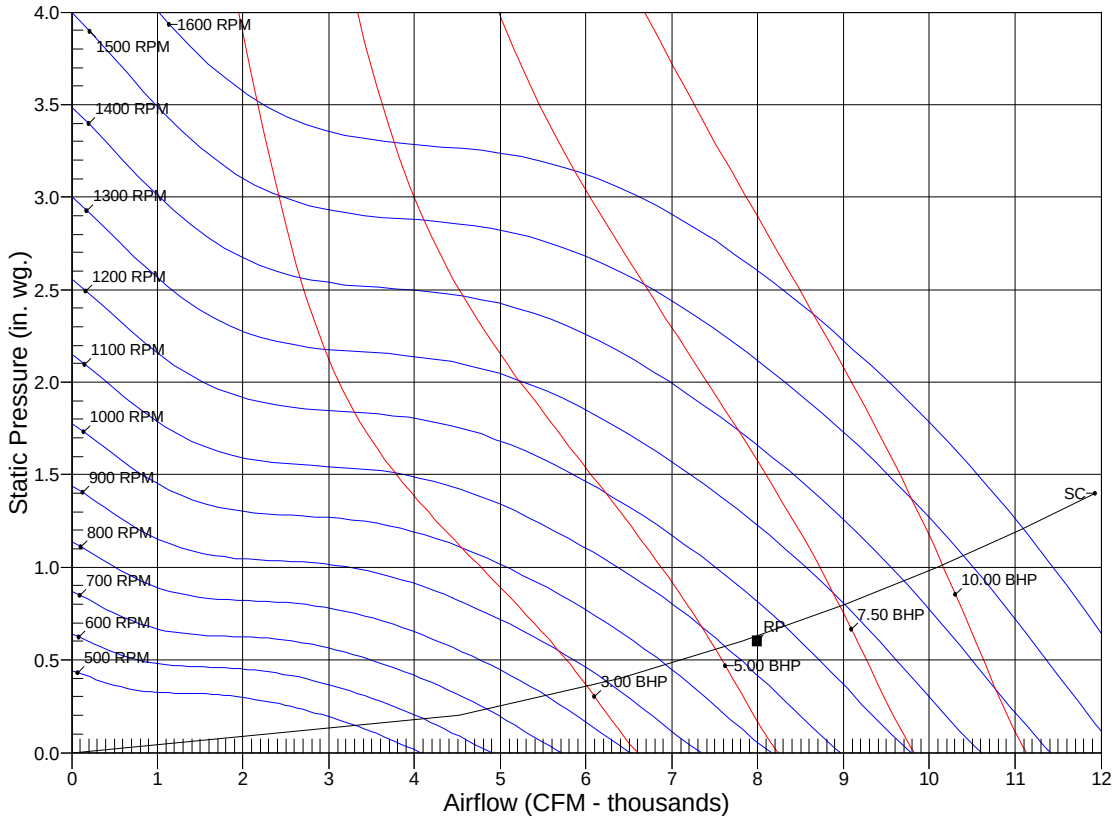
Acoustics

Sound Rating:..... **94.0** db

Sound Power Levels, db re 10E-12 Watts

	Discharge	Inlet	Outdoor
63 Hz	93.9	90.9	98.7
125 Hz	91.1	87.5	92.3
250 Hz	84.0	82.6	93.8
500 Hz	81.9	74.8	90.9
1000 Hz	79.8	78.9	89.6
2000 Hz	76.7	75.9	85.9
4000 Hz	75.4	75.0	80.3
8000 Hz	71.2	69.5	74.3
A-Weighted	85.5	83.7	94.1

Fan Curve



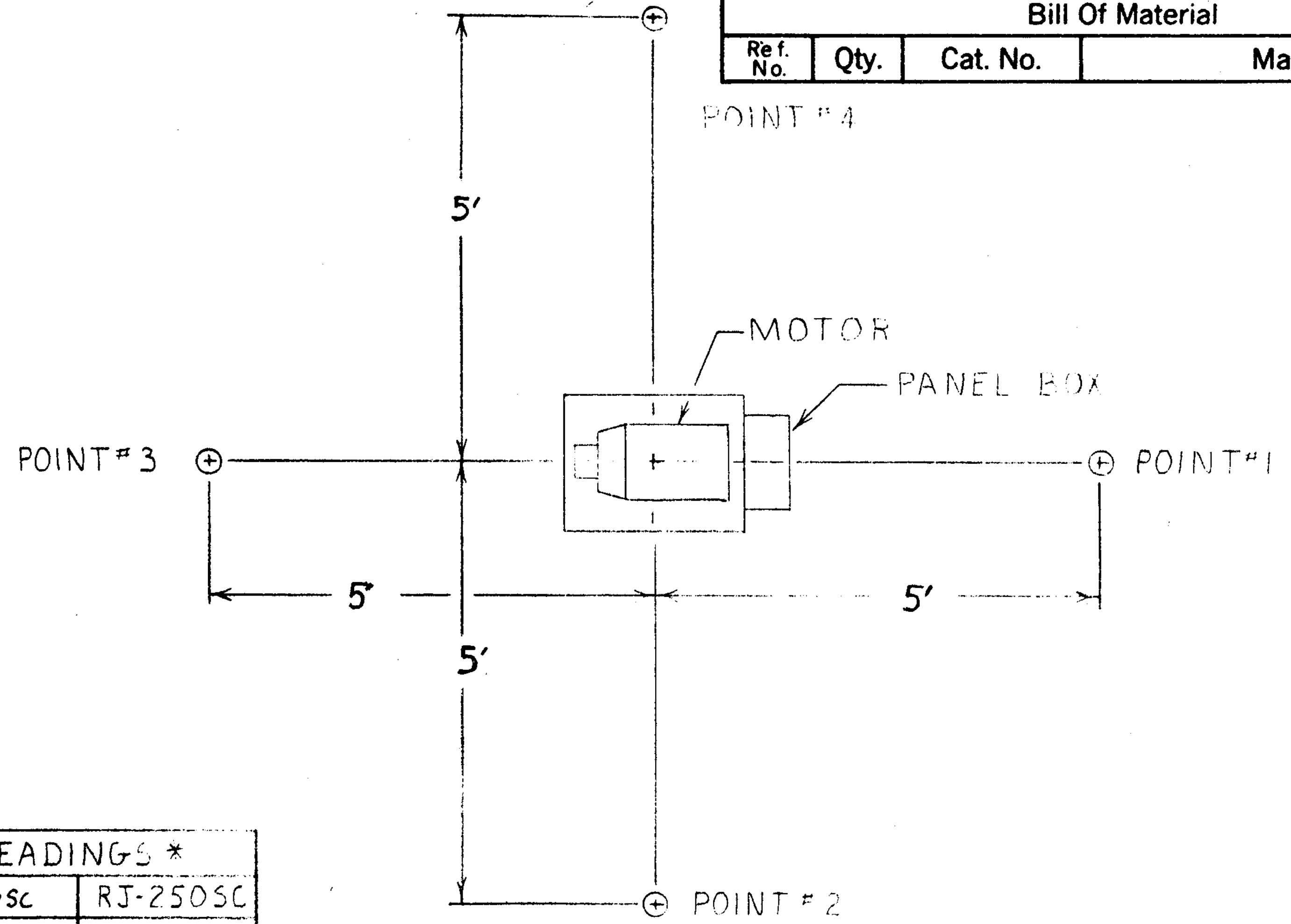
RPM = 1154 BHP = 5.58 Maximum RPM = 1550 Maximum HP = 9.50

SC - System Curve RP - Rated Point

AP 42614

Ref. No.	Qty.	Cat. No.	Material

(Bill Of Material)



DECIBEL READINGS *

POINT	RJ-100SC	RJ-250SC
1	68	68
2	73	73
3	73	73
4	73	73

*ALL READINGS "A" WEIGHTED SLOW RESPONSE

MARATHON RAM JET
Equipment Company,
Vernon, Alabama 35592

Title: DECIBEL READINGS RJ-250SC RJ-100SC POWER UNIT

Routing:

Scale: N.T.S.

Tolerances:

Drawn: RB

Date: 1-5-87

Drawing Number: 51-45711

SHEET: ___ OF ___

REVISED

An examination of vehicle noise test procedures

by G. Watts, P. Nelson, C. Treleven and M. Balsom

PUBLISHED PROJECT REPORT
PPR044

TRL Limited

PUBLISHED PROJECT REPORT PPR044

AN EXAMINATION OF VEHICLE NOISE TEST PROCEDURES

Version: Final Version

by G. Watts, P. Nelson, C. Treleven and M. Balsom

Prepared for: Project Record: Vehicle Noise - Assessment of Test Procedures and New Technologies, S0128/VB

Client: Cleaner Fuels and Vehicles Division, Environmental Standards Branch, Department for Transport (Mr I Turner)

	Approvals
Project Manager	MAg.
Quality Reviewed	P. M. Nelson

Table 4.3: Description of vehicles tested

Vehicle Number	Category	Type	Engine	Unladen Weight (kg)	Load Added (kg)	No. of Axles	Rated Engine Speed (RPM)	Rated Power (kW)	Power to Mass Ratio
1	N3	Rigid	Diesel	8473	4167	2	1720	200	15.8
2	N3	Rigid	CNG	10647	2338	3 *(1)	2100	191	14.7
3	N3	Tractor Unit	CNG	9098	4802	3 *(1)	2100	296	21.3
4	N3	Tractor Unit	Diesel	8037	5513	3 *(1)	1900	313	23.1
5	N2	Rigid	Diesel	4476	1637	2	2700	125	20.4
6	N1 >2500kg	Van	Diesel	1875	814	2	4000	66.2	24.6
7	N1 >2500kg	Van	Diesel	2005	748	2	4000	66.2	24.0
8	N1 <2500kg	Van	Diesel	1183	75*(4)	2	4600	51	40.5
9	N1 <2500kg	Van	Electric	1539	75	2	N/A	28	18.2
10	M3	Bus	Diesel	7446	75	2	2500	107	14.2
11	M3	Bus	CNG	11515	75	2	2100	245	21.1
12	M3 *(2)	Bus	Diesel	15858	75	3	1900	253.5	16.0
13	M3 *(2)	Bus	Diesel	10696	75	2	2200	202	18.9
14	M2	Minibus	Diesel	2164	75	2	4000	66.2	29.6
15	M2	Minibus	LPG	2499	75	2	5000	83	32.2
16	M2 *(3) <3500kg	Minibus	Diesel	2224	75	2	4000	66.2	29.8
17	M2 *(3) <3500kg	Minibus	Diesel	2310	75	2	4000	66.2	27.8
18	M2 *(3) <3500kg	Minibus	Diesel	2023	75	2	3500	74	35.3
19	M1	Car	Diesel	994	75	2	4000	50	46.8
20	M1	Car	LPG	1216	75	2	5650	86	66.6
21	M1	Car	Petrol	1216	75	2	5600	92	71.3
22	M1	4x4	Diesel	2213	75	2	4200	101.5	44.4
23	M1	Car	LPG	1394	75	2	5600	83	59.5
24	M1	Car	Petrol	1394	75	2	6000	90	65.6
25	M1	Sports Car	Petrol	1745	75	2	6100	296	162.6
26	M1	Sports Car	Petrol	875	75	2	7800	140	147.4

(1) The vehicle was equipped with three axles. During the tests the wheels of only two axles were in contact with the ground.

(2) Tested to the new requirements for automatic gearbox M3 vehicle with 30 km/h and 40 km/h exit speeds.

(3) Tested to light vehicle test due to change in weight definitions for M2 vehicles.

(4) In cases where no load is added the mass of an average driver is given for consistency

Appendix A. Results of Vehicle tests

Table A. 1: Results for Vehicle 1 - Vehicle Category N3

Test number	Description	Set 1	Set 2	Set 3	Set 4
1	Current R51.02 (retested)	87.8			
2	Proposed R51.02 (retested)	85.3			
3	Pull away from rest (a=0.5 m/s^2)	82.8			
4	Cruise by on HRA	NA			
5	Cruise by on SMA	NA			
6	Exhaust test proposed R51.02	Max. 88.1			
		Av. 87.9			
7	Exhaust test based on SAE J1492	Max. 88.6			
		Av. 88.2			
8a	Whole vehicle engine sweep	2m 83			
		7m 73.5			
8b	Whole vehicle engine idle	2m 75.2	75.1	74.9	
		7m 66.0	65.9	66.2	
9	Rapid acceleration to maximum engine speed	2m 89.5			
		7m 80.7			
10	Air brake test	2m 74.1			
	Brake Venting	7m 68.5			
	Foot brake operation	2m 68			
		7m 60.4			
	Parking Brake Operation	2m 73.4			
		7m 65.8			
11	Ancillary noise test	N/A			

Table A. 2: Results for Vehicle 2 - Vehicle Category N3

Test number	Description	Set 1	Set 2	Set 3	Set 4
1	Current R51.02	80.9			
2	Proposed R51.02	77.2			
3	Pull away from rest (a=0.5 m/s^2)	85.3			
4	Cruise by on HRA	N/A			
5	Cruise by on SMA	N/A			
6	Exhaust test proposed R51.02	Max. 90.2			
		Av. 90.1			
7	Exhaust test based on SAE J1492	Max. 90.1			
		Av. 90.0			
8a	Whole vehicle engine sweep	2m 80.3			
		7m 73.2			
8b	Whole Vehicle Engine Idle	2m 71.4	71.7	71.4	
		7m 64.8	65.1	64.6	
9	Rapid acceleration to maximum engine speed	2m 87.7			
		7m No Data			
10	Air brake test				
	Brake Venting	2m 82.5			
		7m 76.7 *			
	Foot brake operation	2m 78.9			
		7m 69.8			
	Parking Brake Operation	2m 70.3			
		7m 65.8			

* Exceeds limit value of 72 dB(A)

Table A. 3: Results for Vehicle 3 - Vehicle Category N3

Test number	Description	Set 1		Set 2	Set 3	Set 4
1	Current R51.02		84.7			
2	Proposed R51.02		79.8			
3	Pull away from rest (a=0.5 m/s^2)		81.0			
4	Cruise by on HRA	N/A				
5	Cruise by on SMA	N/A				
6	Exhaust test proposed R51.02	Max.	89.7			
		Av.	89.5			
7	Exhaust test based on SAE J1492	Max.	90			
		Av.	89.7			
8a	Whole vehicle engine sweep	2m	88.7			
		7m	79.1			
8b	Whole Vehicle Engine Idle	2m	82.4	82.5	82.4	
		7m	73.7	72.5	74.3	
9	Rapid acceleration to maximum engine speed	2m	N/A			
		7m	N/A			
10	Air brake test					
	Brake Venting	2m	< 80			
	* Cannot be heard above engine	7m	dB(A)			
	Foot brake operation	2m	76.7			
		7m	69.7			
	Parking Brake Operation	2m	74.8			
		7m	64.4			
11	Ancillary noise test	2m	N/A			
		7m	N/A			

Table A. 4: Results for Vehicle 4 - Vehicle Category N3

Test number	Description	Set 1		Set 2	Set 3	Set 4
1	Current R51.02		83.9			
2	Proposed R51.02		81.9			
3	Pull away from rest (a=0.5 m/s^2)		77.0			
4	Cruise by on HRA	N/A				
5	Cruise by on SMA	N/A				
6	Exhaust test proposed R51.02	Max.	91.9			
		Av.	91.6			
7	Exhaust test based on SAE J1492	Max.	91.9			
		Av.	91.6			
8a	Whole vehicle engine sweep	2m	88.9			
		7m	75.9			
8b	Whole Vehicle Engine Idle	2m	76.1	76.1	76.4	
		7m	67.1	66.8	67.4	
9	Rapid acceleration to maximum engine speed	2m	90.5			
		7m	82.2			
10	Air brake test					
	Brake Venting	2m	79.5			
		7m	71.4			
	Foot brake operation	2m	81.1			
		7m	73.3			
	Parking Brake Operation	2m	74.3			
		7m	65.9			
11	Ancillary noise test	2m	N/A			
		7m	N/A			

Appendix C – Cadna A Output

True North

> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB

CLIENT: NORTH AMERICAN DEVELOPMENT GROUP CITY OF OTTAWA	PROJECT NAME: 5707 HAZELDEAN ROAD KANATA, ONTARIO	IBI GROUP Suite 101 - 410 Albert Street Waterloo ON N2L 3V3 Canada tel 519 585 2255 ibigroup.com	
	SCALE: NTS / DATE: SEPT 2019 PROJECT ENG: J.PERKS / DRAWN BY: TC CHECKED BY: AK / APPROVED BY: JP PROJECT NO: 122445	FIGURE NAME: ATTENUATED STATIONARY NOISE (DAYTIME)	FIGURE NO.: 2 / REVISION: 0

File Location: 117754N_CADNA-Figures.dwg Last Saved: September 16, 2019, by tiffany.chan Plotted: Wednesday, September 18, 2019 3:55:30 PM by Tiffany Chan

SCALE CHECK 1 in 10mm

True North

> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB

CLIENT: NORTH AMERICAN DEVELOPMENT GROUP CITY OF OTTAWA	PROJECT NAME: 5707 HAZELDEAN ROAD KANATA, ONTARIO	IBI GROUP Suite 101 - 410 Albert Street Waterloo ON N2L 3V3 Canada tel 519 585 2255 ibigroup.com	
	SCALE: NTS / DATE: SEPT 2019 PROJECT ENG: J.PERKS / DRAWN BY: TC CHECKED BY: AK / APPROVED BY: JP PROJECT NO: 122445	FIGURE NAME: ATTENUATED STATIONARY NOISE (EVENING)	FIGURE NO.: 3 / REVISION: 0

File Location: 117754N_CADNA-Figures.dwg Last Saved: September 16, 2019, by tiffany.chan Plotted: Wednesday, September 18, 2019 3:55:44 PM by Tiffany Chan

SCALE CHECK 1 in 10mm

True North

> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB

CLIENT: NORTH AMERICAN DEVELOPMENT GROUP CITY OF OTTAWA	PROJECT NAME: 5707 HAZELDEAN ROAD KANATA, ONTARIO	IBI GROUP Suite 101 - 410 Albert Street Waterloo ON N2L 3V3 Canada tel 519 585 2255 ibigroup.com
	SCALE: NTS / DATE: SEPT 2019 PROJECT ENG: J.PERKS / DRAWN BY: TC CHECKED BY: AK / APPROVED BY: JP PROJECT NO: 122445	FIGURE NAME: ATTENUATED STATIONARY NOISE (NIGHT) FIGURE NO.: 4 REVISION: 0

File Location: 117754N_CADNA-Figures.dwg Last Saved: September 16, 2019, by tiffany.chan Plotted: Wednesday, September 18, 2019 3:55:58 PM by Tiffany Chan

SCALE CHECK 1 in 10mm

Name	M.	ID	Level Lr			Limit. Value			Land Use			Height		Co
			Day	Evening	Night	Day	Evening	Night	Type	Auto	Noise Type			X
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)				(m)		(m)
Lot 92 Living Room			44.5	43.5	38.4	0.0	0.0	0.0		x	Total	1.50	r	350785.85
Lot 93 Living Room			45.2	44.1	39.5	0.0	0.0	0.0		x	Total	1.50	r	350793.08
Lot 94 Living Room			45.7	44.6	40.2	0.0	0.0	0.0		x	Total	1.50	r	350800.99
Lot 95 Living Room			45.6	44.6	40.3	0.0	0.0	0.0		x	Total	1.50	r	350809.59
Lot 96 Living Room			45.2	44.1	40.2	0.0	0.0	0.0		x	Total	1.50	r	350817.29
Lot 97 Living Room			44.8	43.7	40.0	0.0	0.0	0.0		x	Total	1.50	r	350825.21
Lot 98 Living Room			44.5	43.3	39.9	0.0	0.0	0.0		x	Total	1.50	r	350832.88
Lot 99 Living Room			44.1	43.0	39.6	0.0	0.0	0.0		x	Total	1.50	r	350841.00
Lot 100 Living Room			43.8	42.6	39.4	0.0	0.0	0.0		x	Total	1.50	r	350848.23
Lot 101 Living Room			43.4	42.3	39.1	0.0	0.0	0.0		x	Total	1.50	r	350856.35
Lot 102 Living Room			43.1	42.0	38.9	0.0	0.0	0.0		x	Total	1.50	r	350863.59
Lot 103 Living Room			42.6	41.6	38.4	0.0	0.0	0.0		x	Total	1.50	r	350876.67
Lot 104 Living Room			42.7	41.7	38.4	0.0	0.0	0.0		x	Total	1.50	r	350884.52
Lot 105 Living Room			42.4	41.5	38.0	0.0	0.0	0.0		x	Total	1.50	r	350894.16
Lot 106 Living Room			42.6	41.8	38.0	0.0	0.0	0.0		x	Total	1.50	r	350901.74
Lot 107 Living Room			43.3	42.6	38.0	0.0	0.0	0.0		x	Total	1.50	r	350909.55
Lot 108 Living Room			44.1	43.6	37.9	0.0	0.0	0.0		x	Total	1.50	r	350918.40
Lot 109 Living Room			44.2	43.7	37.9	0.0	0.0	0.0		x	Total	1.50	r	350925.96
Lot 110 Living Room			44.0	43.6	38.0	0.0	0.0	0.0		x	Total	1.50	r	350933.69
Lot 111 Living Room			43.7	43.3	38.0	0.0	0.0	0.0		x	Total	1.50	r	350941.01
Lot 112 Living Room			43.1	42.7	38.0	0.0	0.0	0.0		x	Total	1.50	r	350949.33
Lot 113 Living Room			41.9	41.5	37.3	0.0	0.0	0.0		x	Total	1.50	r	350957.19
Lot 114 Living Room			40.1	39.5	35.0	0.0	0.0	0.0		x	Total	1.50	r	350965.87
Lot 92 OPR			44.8	43.9	38.4	0.0	0.0	0.0		x	Total	1.50	r	350787.86
Lot 93 OPR			45.5	44.5	39.6	0.0	0.0	0.0		x	Total	1.50	r	350795.09
Lot 94 OPR			46.0	45.0	40.3	0.0	0.0	0.0		x	Total	1.50	r	350803.00
Lot 95 OPR			45.8	44.8	40.4	0.0	0.0	0.0		x	Total	1.50	r	350811.60
Lot 96 OPR			45.5	44.4	40.4	0.0	0.0	0.0		x	Total	1.50	r	350819.30
Lot 97 OPR			44.9	43.8	40.0	0.0	0.0	0.0		x	Total	1.50	r	350827.22
Lot 98 OPR			44.6	43.5	39.9	0.0	0.0	0.0		x	Total	1.50	r	350834.89
Lot 99 OPR			44.2	43.1	39.7	0.0	0.0	0.0		x	Total	1.50	r	350843.01
Lot 100 OPR			43.9	42.8	39.5	0.0	0.0	0.0		x	Total	1.50	r	350850.24
Lot 101 OPR			43.5	42.4	39.2	0.0	0.0	0.0		x	Total	1.50	r	350858.36
Lot 102 OPR			43.2	42.1	39.0	0.0	0.0	0.0		x	Total	1.50	r	350865.60
Lot 103 OPR			42.7	41.6	38.4	0.0	0.0	0.0		x	Total	1.50	r	350878.99
Lot 104 OPR			42.7	41.7	38.4	0.0	0.0	0.0		x	Total	1.50	r	350887.03
Lot 105 OPR			42.5	41.6	37.9	0.0	0.0	0.0		x	Total	1.50	r	350896.67
Lot 106 OPR			42.7	41.9	37.9	0.0	0.0	0.0		x	Total	1.50	r	350904.16
Lot 107 OPR			43.6	43.0	38.0	0.0	0.0	0.0		x	Total	1.50	r	350912.22
Lot 108 OPR			44.7	44.3	37.8	0.0	0.0	0.0		x	Total	1.50	r	350920.29
Lot 109 OPR			44.8	44.4	37.8	0.0	0.0	0.0		x	Total	1.50	r	350927.80
Lot 110 OPR			44.6	44.2	37.9	0.0	0.0	0.0		x	Total	1.50	r	350935.95
Lot 111 OPR			44.3	43.9	37.9	0.0	0.0	0.0		x	Total	1.50	r	350943.27
Lot 112 OPR			43.6	43.2	37.8	0.0	0.0	0.0		x	Total	1.50	r	350951.75
Lot 113 OPR			42.1	41.8	37.0	0.0	0.0	0.0		x	Total	1.50	r	350959.82
Lot 114 OPR			39.9	39.4	34.1	0.0	0.0	0.0		x	Total	1.50	r	350968.82

Name	M.	ID	Level Lr			Limit. Value			Land Use			Height		Coord	
			Day	Evening	Night	Day	Evening	Night	Type	Auto	Noise Type			X	
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)				(m)		(m)	
Lot 92 Bedroom			47.0	46.1	41.1	0.0	0.0	0.0		x	Total	4.50	r	350785.85	50
Lot 93 Bedroom			47.4	46.4	41.7	0.0	0.0	0.0		x	Total	4.50	r	350793.08	50
Lot 94 Bedroom			47.7	46.7	42.0	0.0	0.0	0.0		x	Total	4.50	r	350800.99	50
Lot 95 Bedroom			47.7	46.8	41.9	0.0	0.0	0.0		x	Total	4.50	r	350809.59	50
Lot 96 Bedroom			47.3	46.3	41.7	0.0	0.0	0.0		x	Total	4.50	r	350817.29	50
Lot 97 Bedroom			46.8	45.8	41.4	0.0	0.0	0.0		x	Total	4.50	r	350825.21	50
Lot 98 Bedroom			46.3	45.4	41.1	0.0	0.0	0.0		x	Total	4.50	r	350832.88	50
Lot 99 Bedroom			45.9	44.9	40.8	0.0	0.0	0.0		x	Total	4.50	r	350841.00	50
Lot 100 Bedroom			45.5	44.6	40.5	0.0	0.0	0.0		x	Total	4.50	r	350848.23	50
Lot 101 Bedroom			45.1	44.2	40.2	0.0	0.0	0.0		x	Total	4.50	r	350856.35	50
Lot 102 Bedroom			44.9	43.9	39.9	0.0	0.0	0.0		x	Total	4.50	r	350863.59	50
Lot 103 Bedroom			44.5	43.6	39.6	0.0	0.0	0.0		x	Total	4.50	r	350876.67	50
Lot 104 Bedroom			44.5	43.6	39.6	0.0	0.0	0.0		x	Total	4.50	r	350884.52	50
Lot 105 Bedroom			44.4	43.6	39.4	0.0	0.0	0.0		x	Total	4.50	r	350894.16	50
Lot 106 Bedroom			44.8	44.0	39.5	0.0	0.0	0.0		x	Total	4.50	r	350901.74	50
Lot 107 Bedroom			45.4	44.8	39.3	0.0	0.0	0.0		x	Total	4.50	r	350909.55	50
Lot 108 Bedroom			46.3	45.9	39.3	0.0	0.0	0.0		x	Total	4.50	r	350918.40	50
Lot 109 Bedroom			46.5	46.0	39.4	0.0	0.0	0.0		x	Total	4.50	r	350925.96	50
Lot 110 Bedroom			46.3	45.9	39.6	0.0	0.0	0.0		x	Total	4.50	r	350933.69	50
Lot 111 Bedroom			46.1	45.7	39.8	0.0	0.0	0.0		x	Total	4.50	r	350941.01	50
Lot 112 Bedroom			45.6	45.1	39.8	0.0	0.0	0.0		x	Total	4.50	r	350949.33	50
Lot 113 Bedroom			44.5	44.0	39.2	0.0	0.0	0.0		x	Total	4.50	r	350957.19	50
Lot 114 Bedroom			43.3	42.8	38.4	0.0	0.0	0.0		x	Total	4.50	r	350965.87	50
Lot 92 OPR			44.9	44.0	38.6	0.0	0.0	0.0		x	Total	1.50	r	350787.86	50
Lot 93 OPR			45.6	44.6	39.8	0.0	0.0	0.0		x	Total	1.50	r	350795.09	50
Lot 94 OPR			46.1	45.2	40.5	0.0	0.0	0.0		x	Total	1.50	r	350803.00	50
Lot 95 OPR			46.0	45.0	40.7	0.0	0.0	0.0		x	Total	1.50	r	350811.60	50
Lot 96 OPR			45.6	44.5	40.6	0.0	0.0	0.0		x	Total	1.50	r	350819.30	50
Lot 97 OPR			45.1	44.0	40.3	0.0	0.0	0.0		x	Total	1.50	r	350827.22	50
Lot 98 OPR			44.8	43.7	40.2	0.0	0.0	0.0		x	Total	1.50	r	350834.89	50
Lot 99 OPR			44.4	43.3	40.0	0.0	0.0	0.0		x	Total	1.50	r	350843.01	50
Lot 100 OPR			44.1	43.0	39.8	0.0	0.0	0.0		x	Total	1.50	r	350850.24	50
Lot 101 OPR			43.7	42.5	39.4	0.0	0.0	0.0		x	Total	1.50	r	350858.36	50
Lot 102 OPR			43.3	42.2	39.1	0.0	0.0	0.0		x	Total	1.50	r	350865.60	50
Lot 103 OPR			42.8	41.7	38.5	0.0	0.0	0.0		x	Total	1.50	r	350878.99	50
Lot 104 OPR			42.8	41.8	38.5	0.0	0.0	0.0		x	Total	1.50	r	350887.03	50
Lot 105 OPR			42.5	41.7	38.0	0.0	0.0	0.0		x	Total	1.50	r	350896.67	50
Lot 106 OPR			42.7	41.9	38.0	0.0	0.0	0.0		x	Total	1.50	r	350904.16	50
Lot 107 OPR			43.6	43.0	38.0	0.0	0.0	0.0		x	Total	1.50	r	350912.22	50
Lot 108 OPR			44.7	44.3	37.9	0.0	0.0	0.0		x	Total	1.50	r	350920.29	50
Lot 109 OPR			44.8	44.4	37.8	0.0	0.0	0.0		x	Total	1.50	r	350927.80	50
Lot 110 OPR			44.6	44.2	37.9	0.0	0.0	0.0		x	Total	1.50	r	350935.95	50
Lot 111 OPR			44.3	43.9	37.9	0.0	0.0	0.0		x	Total	1.50	r	350943.27	50
Lot 112 OPR			43.6	43.2	37.8	0.0	0.0	0.0		x	Total	1.50	r	350951.75	50
Lot 113 OPR			42.2	41.8	37.0	0.0	0.0	0.0		x	Total	1.50	r	350959.82	50
Lot 114 OPR			39.9	39.4	34.2	0.0	0.0	0.0		x	Total	1.50	r	350968.82	50