

# **Noise Impact Study**

## **Proposed Residential Development**

### **3958 Cardinal Drive**


### **Niagara Falls, Ontario**

Prepared for:

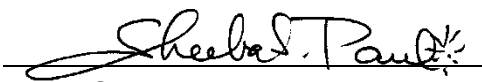
12604515 Canada Corporation  
88 Dunn Street, Unit 402  
Oakville, Ontario, L6J 3C7



Prepared by

  
Victor Garcia, PEng

Reviewed by

  
Sheeba Paul, MEng, PEng

July 26, 2023

HGC Project No. 02300481

# Table of Contents

1	Introduction and Summary .....	1
2	Site Description and Sources of Sound.....	2
3	Criteria for Acceptable Sound Levels.....	2
3.1	Road Traffic Noise Criteria .....	2
4	Traffic Sound Level Assessment .....	3
4.1	Road Traffic Data .....	3
4.2	Road Traffic Noise Predictions .....	4
5	Traffic Noise Recommendations .....	5
5.1	Outdoor Living Areas.....	5
5.2	Indoor Living Areas.....	5
5.3	Building Facade Constructions.....	6
5.4	Warning Clauses.....	7
6	Summary and Recommendations .....	8
6.1	Implementation.....	9

**Figure 1: Key Plan**

**Figure 2: Proposed Site Plan Showing Prediction Locations**

**Figure 3: Proposed Site Plan Showing Barrier and Ventilation Requirements**

**Appendix A: Supporting Drawings**

**Appendix B: Road Traffic Data**

**Appendix C: Sample STAMSON 5.04 Output**

# 1 Introduction and Summary

HGC Engineering was retained by 12604515 Canada Corporation to conduct a noise impact study for a proposed residential development to be located at 3958 Cardinal Drive in the City of Niagara Falls, Regional Municipality of Niagara, Ontario. The study has been prepared for submission as part of the approval process by the municipality.

Road traffic data for Thorold Stone Road and Cardinal Drive were obtained from the Region of Niagara. The data was used to predict future traffic sound levels at various facades of the proposed development. The predicted sound levels were compared to the guidelines of the Ministry of Environment, Conservation, and Parks (MECP) and the Region of Niagara.

The sound level predictions indicate that future road traffic sound levels will exceed MECP guidelines at the proposed development. Acoustic barriers are required for dwellings closest to Thorold Stone Road. Air conditioning is also required for dwelling units with flanking exposure to Thorold Stone Road. Forced air ventilation with ducts sized for the future installation of air conditioning by the occupant is required for dwelling units with some exposure to the roadway. Building and glazing constructions meeting the minimum requirements of the Ontario Building Code will be sufficient for the development. The MECP guidelines recommend that warning clauses be used to inform future residents of the traffic noise impacts.



## 2 Site Description and Sources of Sound

A key plan showing the location of the proposed site is indicated in Figure 1. The development is located at 3958 Cardinal Drive, in the City of Niagara Falls, Ontario. A site plan prepared by Concept Lines Inc. dated June 2023 is attached as Figure 2. The development is proposed to include 3-storey townhouse blocks. Prediction locations are provided on Figure 2 for reference. Appendix A includes preliminary floor plans and building elevations.

The primary source of noise is road traffic on Thorold Stone Road. Lands surrounding the proposed site are residential. There are no significant sources of stationary sound within 500 m of the subject site.

## 3 Criteria for Acceptable Sound Levels

### 3.1 Road Traffic Noise Criteria

Guidelines for acceptable levels of road traffic noise impacting residential developments are given in the MECP publication NPC-300, “Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning”, Part C release date October 21, 2013 and are listed in Table 1 below. The values in Table 1 are energy equivalent (average) sound levels [LEQ] in units of A weighted decibels [dBA]. These criteria have generally been adopted by the Regional Municipality of Niagara.

**Table 1: Road Traffic Noise Criteria**

	<b>Daytime LEQ(16 hour) Road</b>	<b>Nighttime LEQ(8 hour) Road</b>
Outdoor Living Areas	55 dBA	--
Inside Living/Dining Rooms	45 dBA	45 dBA
Inside Bedrooms	45 dBA	40 dBA

Daytime refers to the period between 07:00 and 23:00, while nighttime refers to the period between 23:00 and 07:00. The term "Outdoor Living Area" (OLA) is used in reference to an outdoor patio, a

backyard, a terrace or other area where passive recreation is expected to occur. Balconies that are less than 4 m in depth are not considered to be outdoor living areas under MECP guidelines.

The guidelines in the MECP publication allow the sound level in an Outdoor Living Area to be exceeded by up to 5 dBA, without mitigation, if warning clauses are placed in the purchase and rental agreements and offers of purchase and sale for the property. When OLA sound levels exceed 60 dBA, physical mitigation is required to reduce the OLA sound level to below 60 dBA and as close to 55 dBA as technically, economically and administratively feasible.

A central air conditioning system as an alternative means of ventilation to open windows is required for dwellings where nighttime sound levels outside bedroom/living/dining room windows exceed 60 dBA or daytime sound levels exceed 65 dBA outside bedroom/living/dining room windows. A forced air ventilation system with ducts sized for the future provision of air conditioning by the occupant, or some other alternative form of mechanical ventilation, is required where nighttime sound levels at bedroom/living/dining room windows are in the range of 51 – 60 dBA or daytime sound levels are in the range of 56 – 65 dBA.

Building components such as walls, windows and doors must be designed to achieve indoor sound level criteria when the plane of bedroom/living/dining room window sound level is greater than 60 dBA or the daytime sound level is greater than 65 dBA due to road traffic noise.

Warning clauses are required to notify future residents of possible excesses when nighttime sound levels exceed 50 dBA at the plane of the bedroom/living/dining room window and daytime sound levels exceed 55 dBA in the outdoor living area and at the plane of the bedroom/living/dining room window due to road traffic.

## 4 Traffic Sound Level Assessment

### 4.1 Road Traffic Data

Road traffic data for Thorold Stone Road was provided by the Region of Niagara form of annual average daily traffic (AADT) for the year 2018 and is included in Appendix B. The data was projected to the year 2043 using a 2.5%/year growth rate. A commercial vehicle percentage of 1.4%



ACOUSTICS



NOISE



VIBRATION

was split into 0.4% heavy trucks and 1.0% medium trucks. A day/night split of 90%/10% was used in the analysis. A posted speed limit of 50 km/h was used in the analysis.

Cardinal Drive is a low volume roadway and is not included in the analysis.

**Table 2: Projected Road Traffic Data to 2043**

Road Name		Cars	Medium Trucks	Heavy Trucks	Total
Thorold Stone Road	Daytime	36 678	372	149	37 199
	Nighttime	4 075	41	17	4 133
	<b>Total</b>	<b>40 753</b>	<b>413</b>	<b>166</b>	<b>41 332</b>

## 4.2 Road Traffic Noise Predictions

To assess the levels of road traffic noise which would impact the site in the future, road traffic predictions were made using STAMSON version 5.04, a computer algorithm developed by the MECP. Sample STAMSON output is included in Appendix C.

Predictions of the traffic sound levels were made at the various façades with exposure to Thorold Stone Road. The predictions were performed at the top storey of the building during the daytime hours and nighttime hours to investigate ventilation requirements. The results of these predictions are summarized in Table 3. The acoustic requirements may be subject to modifications if the site plan is changed significantly.

**Table 3: Future Road Traffic Sound Levels, [dBA], Without Mitigation**

Prediction Location	Description	Daytime in OLA LEQ-16 hr	Daytime at Façade LEQ-16 hr	Nighttime at Façade LEQ-8 hr
[A]	Southern unit with flanking exposure to Thorold Stone Road	62	66	59
[B]	Dwellings with some exposure to Thorold Stone Road	<55	<55	<50

## 5 Traffic Noise Recommendations

The predictions indicate that the future traffic sound levels will exceed MECP guidelines at the proposed residential development. Recommendations to address these excesses are discussed below.

### 5.1 Outdoor Living Areas

The predicted sound level in the OLAs of the dwellings closest to Thorold Stone Road (prediction location [A]) will be 62 dBA, 7 dBA in excess of the MECP limit of 55 dBA. Physical mitigation in the form of an acoustic barrier is required. With a 2.0 m acoustic barrier the predicted sound level in the amenity space will be reduced to 55 dBA.

For the rear yards of the remaining dwellings units further from the roadway are less than 55 dBA. No further mitigation is required.

### 5.2 Indoor Living Areas

#### Air Conditioning

The predicted future nighttime sound levels of residential buildings closest to Thorold Stone Road (prediction location [A]) are greater than 65 dBA during the day. Central air conditioning systems are required so that windows may remain closed.

#### Provision for the Future Installation of Air Conditioning

The predicted sound levels at the plane of the windows further from Thorold Stone Road will be between 51 and 60 dBA during the nighttime hours and between 56 to 65 dBA during the daytime hours. To address these excesses, the MECP guidelines recommend that these dwelling units be equipped with forced air ventilation systems with ducts sized to accommodate the future installation of air conditioning by the occupant.

Window or through-the-wall air conditioning units are not recommended for any residential units because of the noise they produce and because the units penetrate through the exterior wall which degrades the overall noise insulating properties of the envelope. Acceptable units are those housed in their own closet with an access door for maintenance. The location, installation and sound ratings of



the outdoor air conditioning devices should minimize noise impacts and comply with the criteria of MECP publication NPC-300, as applicable. Ventilation requirements are shown in Figure 3.

### 5.3 Building Facade Constructions

Future sound levels at the southern façades of the townhouses closest to Thorold Stone Road will exceed 65 dBA during the daytime hours. MECP guidelines recommend that the windows, walls and doors be designed so that the indoor sound levels comply with MECP noise criteria.

The required building components are selected based on the Acoustical Insulation Factor (AIF) value for road traffic. To do so, calculations were performed to determine the acoustical insulation factors to maintain indoor sound levels within MECP guidelines. The calculation methods were developed by the National Research Council (NRC). They are based on the predicted future sound levels at the building facades, and the anticipated area ratios of the facade components (windows and walls) and the floor area of the adjacent room.

The minimum necessary specification for the building envelope is AIF-26 for living/dining/family rooms and OBC for bedrooms, based on the possibility of sound entering the buildings through windows and walls.

Detailed floor plans and building elevations were reviewed for the proposed townhouses and are included in Appendix A. The window to floor area ratios for living rooms were calculated to be up to 15% and up to 11% for bedrooms. Based on the calculated window to floor area ratios, any window glazing constructions meeting the minimum requirements of the OBC will be sufficient for the proposed dwellings.

The townhouse blocks are proposed to consist of siding with portions of brick, which will provide sufficient mitigation for the indoor spaces of the proposed dwellings. Any insulated metal exterior door meeting OBC requirements will be sufficient to provide noise insulation. If sliding patio doors are to be used in the dwellings, they must be included in the window area.





## 5.4 Warning Clauses

The MECP guidelines recommend that warning clauses be included in the property and tenancy agreements and offers of purchase and sale for all units with anticipated traffic sound level excesses. Examples are provided below.

Suggested wording for dwelling units which have sound level excesses but do not require mitigation measures is given below.

Type A:

Purchasers/tenants are advised that sound levels due to increasing road traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the Municipality's and the Ministry of Environment, Conservation, and Parks' noise criteria.

Suggested wording for future dwellings with daytime OLA sound levels exceeding the MECP criteria by 6 dB or more, for which physical mitigation has been provided is given below.

Type B:

Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the City's and the Ministry of the Environment, Conservation and Parks' noise criteria. The acoustical barrier as installed shall be maintained, repaired or replaced by the owner. Any maintenance, repair or replacement shall be with the same material, to the same standards and having the same colour and appearance of the original.

Suitable wording for the dwellings requiring an alternative means of ventilation to open windows is given below.

Type C:

This dwelling unit has been fitted with a forced air heating system and the ducting etc., was sized to accommodate central air conditioning. Installation of central air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the criteria of the Municipality and the Ministry of Environment, Conservation, and Parks. (Note: The location and installation of the outdoor air conditioning device should be done so as to minimize the noise impacts and comply with criteria of MECP publication NPC-300, as applicable.)



ACOUSTICS



NOISE



VIBRATION

A suggested wording for future dwellings requiring central air conditioning systems is given below.

Type D:

This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors 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, Conservation and Parks.

These sample clauses are provided by the MECP as examples and can be modified by the Municipality as required.

## 6 Summary and Recommendations

The following list and Table 4 summarize the recommendations made in this report.

1. Acoustic barriers are required for dwelling units with flanking exposure to Thorold Stone Road.
2. Central air conditioning is required for the townhouse units closest to Thorold Stone Road. Forced air ventilation with ducts sized for the future installation of air conditioning by the occupant is required for the townhouse dwellings with some exposure to Thorold Stone Road.
3. Any building and glazing construction meeting the minimum requirements of the Ontario Building Code will provide sufficient acoustical insulation for the indoor spaces.
4. Warning clauses should be used to inform future residents of the traffic noise issues.

**Table 4: Summary of Noise Control Requirements and Noise Warning Clauses**

Unit No.	Acoustic Barrier	Ventilation Requirements	Type of Warning Clause	Building Façade Constructions
1, 24	✓	Air Conditioning	A, B, D	OBC
2 – 8, 25 – 33	--	Forced Air	A, C	OBC
Remaining Units	--	--	--	OBC

Notes:

-- no specific requirement

OBC – meeting the minimum requirements of the Ontario Building Code

## 6.1 Implementation

To ensure that the noise control recommendations outlined above are fully implemented, it is recommended that:

- 1) Prior to the issuance of building permits and occupancy permits, the building inspector or a Professional Engineer qualified to perform acoustical engineering services in the Province of Ontario should certify that the noise control measures have been properly incorporated, installed and constructed.



ACOUSTICS



NOISE



VIBRATION

## Limitations

This document was prepared solely for the addressed party and titled project or named part thereof, and should not be relied upon or used for any other project without obtaining prior written authorization from HGC Engineering. HGC Engineering accepts no responsibility or liability for any consequence of this document being used for a purpose other than for which it was commissioned. Any person or party using or relying on the document for such other purpose agrees, and will by such use or reliance be taken to confirm their agreement to indemnify HGC Engineering for all loss or damage resulting therefrom. HGC Engineering accepts no responsibility or liability for this document to any person or party other than the party by whom it was commissioned.

Any conclusions and/or recommendations herein reflect the judgment of HGC Engineering based on information available at the time of preparation, and were developed in good faith on information provided by others, as noted in the report, which has been assumed to be factual and accurate. Changed conditions or information occurring or becoming known after the date of this report could affect the results and conclusions presented.



ACOUSTICS



NOISE



VIBRATION



Figure 1 - Key Plan



ACOUSTICS



NOISE



VIBRATION





# APPENDIX A

## Supporting Drawings



ACOUSTICS



NOISE



VIBRATION











# APPENDIX B

## Road Traffic Data



ACOUSTICS



NOISE



VIBRATION

**MH Corbin Traffic Analyzer Study  
 Computer Generated Summary Report  
 City: Niagara Region  
 Street: 610590 - EB  
 Location: 7540**

A study of vehicle traffic was conducted with the device having serial number 135571. The study was done in the EB lane at 610590 - EB in Niagara Region, ON in county. The study began on 2019-03-26 at 12:00 AM and concluded on 2019-03-27 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 11,306 vehicles passed through the location with a peak volume of 259 on 2019-03-26 at [04:45 PM-05:00 PM] and a minimum volume of 4 on 2019-03-26 at [03:30 AM-03:45 AM]. The AADT count for this study was 11,306.

**SPEED**

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 50 - 55 KM/H range or lower. The average speed for all classified vehicles was 50 KM/H with 62.44% vehicles exceeding the posted speed of 50 KM/H. 0.00% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 50KM/H and the 85th percentile was 59.17 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
867	1166	2124	3710	1846	854	322	104	42	33	0	0	0	0	0

CHART 1

**CLASSIFICATION**

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin. Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 10868 which represents 98 percent of the total classified vehicles. The number of Small Trucks in the study was 92 which represents 1 percent of the total classified vehicles. The number of Trucks/Buses in the study was 80 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 28 which represents 0 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
8300	2568	92	80	9	12	7	0							

CHART 2

**HEADWAY**

During the peak traffic period, on 2019-03-26 at [04:45 PM-05:00 PM] the average headway between vehicles was 3.462 seconds. During the slowest traffic period, on 2019-03-26 at [03:30 AM-03:45 AM] the average headway between vehicles was 180 seconds.

**WEATHER**

The roadway surface temperature over the period of the study varied between 0.00 and 23.50 degrees C.

**MH Corbin Traffic Analyzer Study  
 Computer Generated Summary Report  
 City: Niagara Region  
 Street: 610590 - WB  
 Location: 7540**

A study of vehicle traffic was conducted with the device having serial number 130995. The study was done in the WB lane at 610590 - WB in Niagara Region, ON in county. The study began on 2019-03-26 at 12:00 AM and concluded on 2019-03-27 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 10,988 vehicles passed through the location with a peak volume of 289 on 2019-03-26 at [04:45 PM-05:00 PM] and a minimum volume of 2 on 2019-03-26 at [03:00 AM-03:15 AM]. The AADT count for this study was 10,988.

**SPEED**

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 55 - 60 KM/H range or lower. The average speed for all classified vehicles was 57 KM/H with 88.63% vehicles exceeding the posted speed of 50 KM/H. 0.00% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 55KM/H and the 85th percentile was 65.32 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
242	269	717	2765	2959	2164	1053	422	152	62	0	0	0	0	0

CHART 1

**CLASSIFICATION**

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin. Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 10486 which represents 97 percent of the total classified vehicles. The number of Small Trucks in the study was 106 which represents 1 percent of the total classified vehicles. The number of Trucks/Buses in the study was 154 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 59 which represents 1 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
5294	5192	106	154	25	7	20	7							

CHART 2

**HEADWAY**

During the peak traffic period, on 2019-03-26 at [04:45 PM-05:00 PM] the average headway between vehicles was 3.103 seconds. During the slowest traffic period, on 2019-03-26 at [03:00 AM-03:15 AM] the average headway between vehicles was 300 seconds.

**WEATHER**

The roadway surface temperature over the period of the study varied between 2.00 and 28.00 degrees C.

## Time/Class Report

<b>Device ID:</b> 135571 <b>Operator:</b> MD <b>Begin:</b> 03-26-2019 12:00 AM <b>End:</b> 03-27-2019 12:00 AM <b>Hours:</b> 24.00 <b>Period (min):</b> 15	<b>Location:</b> 7540 <b>Lane:</b> EB <b>Street:</b> 610590 - EB <b>City:</b> Niagara Region <b>County:</b> <b>State:</b> ON	<b>Raw Count:</b> 11,306 <b>AADT Count:</b> 11,306 <b>AADT Factor:</b> 1 <b>Speed Limit:</b> 50
---	---	--

Date And Time Range	< to 15	16 to 25	26 to 32	33 to 42	43 to 51	52 to 61	62 to 71	72 to >	Total
Tue,03-26-2019									
[00:00-00:15]	10	5	0	0	0	0	0	0	15
[00:15-00:30]	20	3	0	0	0	0	0	0	23
[00:30-00:45]	5	4	0	0	0	0	0	0	9
[00:45-01:00]	7	4	0	0	0	0	0	0	11
	42	16	0	0	0	0	0	0	58
[01:00-01:15]	3	2	0	0	0	0	0	0	5
[01:15-01:30]	4	4	0	0	0	0	0	0	8
[01:30-01:45]	12	0	0	0	0	0	0	0	12
[01:45-02:00]	6	1	0	0	0	0	0	0	7
	25	7	0	0	0	0	0	0	32
[02:00-02:15]	8	1	0	0	0	0	0	0	9
[02:15-02:30]	9	2	0	0	0	0	0	0	11
[02:30-02:45]	5	0	0	0	0	0	0	0	5
[02:45-03:00]	3	3	0	0	0	0	1	0	7
	25	6	0	0	0	0	1	0	32
[03:00-03:15]	1	3	0	0	0	0	0	0	4
[03:15-03:30]	9	2	0	0	0	0	0	0	11
[03:30-03:45]	2	2	0	0	0	0	0	0	4
[03:45-04:00]	4	2	1	0	0	0	0	0	7
	16	9	1	0	0	0	0	0	26
[04:00-04:15]	2	2	0	0	0	0	0	0	4
[04:15-04:30]	5	3	0	0	0	0	0	0	8
[04:30-04:45]	6	5	0	1	0	0	0	0	12
[04:45-05:00]	10	4	0	0	0	0	0	0	14
	23	14	0	1	0	0	0	0	38
[05:00-05:15]	14	5	0	0	0	0	0	0	19
[05:15-05:30]	12	7	0	0	0	0	0	0	19
[05:30-05:45]	25	10	0	0	0	0	0	0	35
[05:45-06:00]	31	10	1	0	0	0	0	0	42
	82	32	1	0	0	0	0	0	115
[06:00-06:15]	27	8	1	1	0	0	0	0	37
[06:15-06:30]	55	20	0	0	0	0	0	0	75
[06:30-06:45]	66	26	0	0	0	0	0	0	92
[06:45-07:00]	68	30	0	0	0	0	0	0	98
	216	84	1	1	0	0	0	0	302
[07:00-07:15]	63	24	2	0	0	0	0	0	89
[07:15-07:30]	77	30	2	2	0	0	0	0	111
[07:30-07:45]	120	33	1	2	0	0	0	0	156



## Time/Class Report

<b>Device ID:</b> 135571 <b>Operator:</b> MD <b>Begin:</b> 03-26-2019 12:00 AM <b>End:</b> 03-27-2019 12:00 AM <b>Hours:</b> 24.00 <b>Period (min):</b> 15	<b>Location:</b> 7540 <b>Lane:</b> EB <b>Street:</b> 610590 - EB <b>City:</b> Niagara Region <b>County:</b> <b>State:</b> ON	<b>Raw Count:</b> 11,306 <b>AADT Count:</b> 11,306 <b>AADT Factor:</b> 1 <b>Speed Limit:</b> 50
---	---	--

Date And Time Range	< to 15	16 to 25	26 to 32	33 to 42	43 to 51	52 to 61	62 to 71	72 to >	Total
Tue,03-26-2019									
[07:45-08:00]	140	56	1	2	0	0	0	0	199
	400	143	6	6	0	0	0	0	555
[08:00-08:15]	147	41	2	3	0	1	0	0	194
[08:15-08:30]	174	65	3	4	0	0	0	0	246
[08:30-08:45]	154	47	1	2	1	0	0	0	205
[08:45-09:00]	181	56	1	1	0	1	0	0	240
	656	209	7	10	1	2	0	0	885
[09:00-09:15]	123	46	1	1	3	0	0	0	174
[09:15-09:30]	138	41	5	2	0	0	1	0	187
[09:30-09:45]	110	54	4	1	0	1	0	0	170
[09:45-10:00]	102	43	2	2	0	0	0	0	149
	473	184	12	6	3	1	1	0	680
[10:00-10:15]	91	30	2	1	0	0	1	0	125
[10:15-10:30]	115	33	2	0	0	0	0	0	150
[10:30-10:45]	105	47	2	3	0	0	0	0	157
[10:45-11:00]	112	32	3	1	0	0	0	0	148
	423	142	9	5	0	0	1	0	580
[11:00-11:15]	108	32	1	3	0	0	0	0	144
[11:15-11:30]	119	35	0	0	0	0	0	0	154
[11:30-11:45]	107	45	1	1	1	0	0	0	155
[11:45-12:00]	117	37	1	2	0	0	0	0	157
	451	149	3	6	1	0	0	0	610
[12:00-12:15]	101	38	1	1	0	0	0	0	141
[12:15-12:30]	155	41	1	1	0	0	0	0	198
[12:30-12:45]	128	55	2	2	0	1	0	0	188
[12:45-13:00]	133	40	0	2	0	1	0	0	176
	517	174	4	6	0	2	0	0	703
[13:00-13:15]	109	44	4	3	0	0	1	0	161
[13:15-13:30]	109	44	5	0	1	0	0	0	159
[13:30-13:45]	129	39	4	1	0	0	0	0	173
[13:45-14:00]	163	47	0	1	0	1	0	0	212
	510	174	13	5	1	1	1	0	705
[14:00-14:15]	128	41	2	1	0	1	1	0	174
[14:15-14:30]	122	41	1	0	0	0	0	0	164
[14:30-14:45]	154	37	3	2	0	0	0	0	196
[14:45-15:00]	160	43	1	1	0	0	0	0	205
	564	162	7	4	0	1	1	0	739

## Time/Class Report

<b>Device ID:</b> 135571 <b>Operator:</b> MD <b>Begin:</b> 03-26-2019 12:00 AM <b>End:</b> 03-27-2019 12:00 AM <b>Hours:</b> 24.00 <b>Period (min):</b> 15	<b>Location:</b> 7540 <b>Lane:</b> EB <b>Street:</b> 610590 - EB <b>City:</b> Niagara Region <b>County:</b> <b>State:</b> ON	<b>Raw Count:</b> 11,306 <b>AADT Count:</b> 11,306 <b>AADT Factor:</b> 1 <b>Speed Limit:</b> 50
---	---	--

Date And Time Range	< to 15	16 to 25	26 to 32	33 to 42	43 to 51	52 to 61	62 to 71	72 to >	Total
Tue,03-26-2019									
[15:00-15:15]	167	57	2	0	0	1	0	0	227
[15:15-15:30]	158	41	2	0	0	0	0	0	201
[15:30-15:45]	155	56	1	1	0	0	1	0	214
[15:45-16:00]	161	41	0	3	0	0	0	0	205
	641	195	5	4	0	1	1	0	847
[16:00-16:15]	150	35	1	4	0	1	0	0	191
[16:15-16:30]	183	58	4	0	0	1	0	0	246
[16:30-16:45]	162	43	2	2	0	1	0	0	210
[16:45-17:00]	186	45	4	4	1	0	1	0	241
	681	181	11	10	1	3	1	0	888
[17:00-17:15]	173	63	2	1	0	0	0	0	239
[17:15-17:30]	195	52	1	0	0	0	0	0	248
[17:30-17:45]	145	37	0	1	0	0	0	0	183
[17:45-18:00]	147	41	0	3	1	0	0	0	192
	660	193	3	5	1	0	0	0	862
[18:00-18:15]	138	45	0	1	0	0	0	0	184
[18:15-18:30]	162	38	1	0	0	0	0	0	201
[18:30-18:45]	110	31	0	1	0	0	0	0	142
[18:45-19:00]	121	30	2	2	0	0	0	0	155
	531	144	3	4	0	0	0	0	682
[19:00-19:15]	120	26	1	0	0	0	0	0	147
[19:15-19:30]	124	31	2	0	0	0	0	0	157
[19:30-19:45]	87	21	0	0	0	0	0	0	108
[19:45-20:00]	96	22	0	1	0	0	0	0	119
	427	100	3	1	0	0	0	0	531
[20:00-20:15]	82	26	1	0	0	0	0	0	109
[20:15-20:30]	124	21	0	0	1	0	0	0	146
[20:30-20:45]	81	17	1	0	0	1	0	0	100
[20:45-21:00]	64	19	0	1	0	0	0	0	84
	351	83	2	1	1	1	0	0	439
[21:00-21:15]	72	23	1	2	0	0	0	0	98
[21:15-21:30]	83	20	0	0	0	0	0	0	103
[21:30-21:45]	69	18	0	1	0	0	0	0	88
[21:45-22:00]	65	18	0	1	0	0	0	0	84
	289	79	1	4	0	0	0	0	373
[22:00-22:15]	57	17	0	1	0	0	0	0	75
[22:15-22:30]	56	16	0	0	0	0	0	0	72
[22:30-22:45]	30	9	0	0	0	0	0	0	39

## Time/Class Report

<b>Device ID:</b> 135571 <b>Operator:</b> MD <b>Begin:</b> 03-26-2019 12:00 AM <b>End:</b> 03-27-2019 12:00 AM <b>Hours:</b> 24.00 <b>Period (min):</b> 15	<b>Location:</b> 7540 <b>Lane:</b> EB <b>Street:</b> 610590 - EB <b>City:</b> Niagara Region <b>County:</b> <b>State:</b> ON	<b>Raw Count:</b> 11,306 <b>AADT Count:</b> 11,306 <b>AADT Factor:</b> 1 <b>Speed Limit:</b> 50							
Date And Time Range	< to 15	16 to 25	26 to 32	33 to 42	43 to 51	52 to 61	62 to 71	72 to >	Total
Tue, 03-26-2019									
[22:45-23:00]	62	14	0	0	0	0	0	0	76
	205	56	0	1	0	0	0	0	262
[23:00-23:15]	29	8	0	0	0	0	0	0	37
[23:15-23:30]	25	11	0	0	0	0	0	0	36
[23:30-23:45]	12	6	0	0	0	0	0	0	18
[23:45-00:00]	26	7	0	0	0	0	0	0	33
	92	32	0	0	0	0	0	0	124
03-26-2019 12:00 AM									
03-27-2019 12:00 AM									
	8300	2568	92	80	9	12	7	0	11068

## Time/Class Report

<b>Device ID:</b> 130995 <b>Operator:</b> MD <b>Begin:</b> 03-26-2019 12:00 AM <b>End:</b> 03-27-2019 12:00 AM <b>Hours:</b> 24.00 <b>Period (min):</b> 15	<b>Location:</b> 7540 <b>Lane:</b> WB <b>Street:</b> 610590 - WB <b>City:</b> Niagara Region <b>County:</b> <b>State:</b> ON	<b>Raw Count:</b> 10,988 <b>AADT Count:</b> 10,988 <b>AADT Factor:</b> 1 <b>Speed Limit:</b> 50
---	---	--

Date And Time Range	< to 15	16 to 25	26 to 32	33 to 42	43 to 51	52 to 61	62 to 71	72 to >	Total
Tue,03-26-2019									
[00:00-00:15]	14	13	0	0	0	0	1	0	28
[00:15-00:30]	10	10	1	0	0	0	0	0	21
[00:30-00:45]	18	8	0	0	0	0	0	0	26
[00:45-01:00]	6	5	0	1	0	0	0	0	12
	48	36	1	1	0	0	1	0	87
[01:00-01:15]	3	9	0	0	0	0	0	0	12
[01:15-01:30]	6	1	0	0	0	0	0	0	7
[01:30-01:45]	7	6	1	0	0	0	0	0	14
[01:45-02:00]	9	4	0	1	0	0	0	0	14
	25	20	1	1	0	0	0	0	47
[02:00-02:15]	3	4	0	0	0	0	0	0	7
[02:15-02:30]	3	6	0	0	0	0	0	0	9
[02:30-02:45]	3	1	0	0	0	0	0	0	4
[02:45-03:00]	0	5	0	0	0	0	0	0	5
	9	16	0	0	0	0	0	0	25
[03:00-03:15]	1	1	0	0	0	0	0	0	2
[03:15-03:30]	4	5	0	0	0	0	0	0	9
[03:30-03:45]	6	5	0	0	0	0	0	0	11
[03:45-04:00]	5	3	0	0	0	1	0	0	9
	16	14	0	0	0	1	0	0	31
[04:00-04:15]	2	1	0	0	0	0	0	0	3
[04:15-04:30]	2	6	0	0	0	0	0	0	8
[04:30-04:45]	3	7	0	0	0	0	0	0	10
[04:45-05:00]	2	5	1	1	0	0	0	0	9
	9	19	1	1	0	0	0	0	30
[05:00-05:15]	4	3	0	0	0	0	0	0	7
[05:15-05:30]	11	5	0	1	0	0	0	0	17
[05:30-05:45]	14	5	0	0	0	0	0	0	19
[05:45-06:00]	16	14	0	0	0	0	0	0	30
	45	27	0	1	0	0	0	0	73
[06:00-06:15]	11	20	0	1	0	0	0	0	32
[06:15-06:30]	19	19	1	2	0	0	0	0	41
[06:30-06:45]	28	40	0	0	0	0	1	0	69
[06:45-07:00]	21	40	0	0	0	0	0	0	61
	79	119	1	3	0	0	1	0	203
[07:00-07:15]	50	62	1	2	0	0	0	1	116
[07:15-07:30]	48	47	2	1	0	0	0	0	98
[07:30-07:45]	61	86	1	4	1	0	0	0	153

## Time/Class Report

<b>Device ID:</b> 130995 <b>Operator:</b> MD <b>Begin:</b> 03-26-2019 12:00 AM <b>End:</b> 03-27-2019 12:00 AM <b>Hours:</b> 24.00 <b>Period (min):</b> 15	<b>Location:</b> 7540 <b>Lane:</b> WB <b>Street:</b> 610590 - WB <b>City:</b> Niagara Region <b>County:</b> <b>State:</b> ON	<b>Raw Count:</b> 10,988 <b>AADT Count:</b> 10,988 <b>AADT Factor:</b> 1 <b>Speed Limit:</b> 50
---	---	--

Date And Time Range	< to 15	16 to 25	26 to 32	33 to 42	43 to 51	52 to 61	62 to 71	72 to >	Total
Tue,03-26-2019									
[07:45-08:00]	68	70	4	4	2	0	1	0	149
	227	265	8	11	3	0	1	1	516
[08:00-08:15]	67	78	3	3	1	0	1	0	153
[08:15-08:30]	85	88	2	6	1	0	2	0	184
[08:30-08:45]	95	80	5	2	1	0	0	0	183
[08:45-09:00]	67	74	3	4	1	0	1	0	150
	314	320	13	15	4	0	4	0	670
[09:00-09:15]	52	60	2	3	1	0	0	0	118
[09:15-09:30]	54	70	3	3	0	0	0	0	130
[09:30-09:45]	78	92	6	1	0	0	0	0	177
[09:45-10:00]	60	45	3	4	0	0	1	0	113
	244	267	14	11	1	0	1	0	538
[10:00-10:15]	75	77	2	4	0	0	1	0	159
[10:15-10:30]	62	74	1	0	1	0	0	0	138
[10:30-10:45]	64	91	2	1	0	1	0	0	159
[10:45-11:00]	65	75	2	1	1	0	1	0	145
	266	317	7	6	2	1	2	0	601
[11:00-11:15]	74	70	1	2	0	0	0	0	147
[11:15-11:30]	74	81	2	4	0	1	0	0	162
[11:30-11:45]	75	72	1	3	0	0	1	0	152
[11:45-12:00]	93	83	3	4	0	0	0	0	183
	316	306	7	13	0	1	1	0	644
[12:00-12:15]	71	86	3	2	0	0	0	0	162
[12:15-12:30]	91	74	1	5	0	0	0	2	173
[12:30-12:45]	94	89	1	1	0	0	0	0	185
[12:45-13:00]	78	67	1	2	0	1	1	1	151
	334	316	6	10	0	1	1	3	671
[13:00-13:15]	88	80	1	4	0	0	0	0	173
[13:15-13:30]	87	70	4	2	0	0	0	0	163
[13:30-13:45]	83	81	4	3	1	0	2	0	174
[13:45-14:00]	80	79	6	6	1	1	0	0	173
	338	310	15	15	2	1	2	0	683
[14:00-14:15]	83	81	3	4	0	0	0	0	171
[14:15-14:30]	78	86	2	4	0	0	0	0	170
[14:30-14:45]	97	110	4	3	0	0	0	0	214
[14:45-15:00]	116	98	1	1	0	0	0	0	216
	374	375	10	12	0	0	0	0	771

## Time/Class Report

<b>Device ID:</b> 130995		<b>Location:</b> 7540				<b>Raw Count:</b> 10,988				
<b>Operator:</b> MD		<b>Lane:</b> WB				<b>AADT Count:</b> 10,988				
<b>Begin:</b> 03-26-2019 12:00 AM		<b>Street:</b> 610590 - WB				<b>AADT Factor:</b> 1				
<b>End:</b> 03-27-2019 12:00 AM		<b>City:</b> Niagara Region				<b>Speed Limit:</b> 50				
<b>Hours:</b> 24.00		<b>County:</b>								
<b>Period (min):</b> 15		<b>State:</b> ON								
<b>Date</b>	<b>&lt;</b>	<b>16</b>	<b>26</b>	<b>33</b>	<b>43</b>	<b>52</b>	<b>62</b>	<b>72</b>		
<b>And</b>	<b>to</b>	<b>to</b>	<b>to</b>	<b>to</b>	<b>to</b>	<b>to</b>	<b>to</b>	<b>to</b>		
<b>Time Range</b>	<b>15</b>	<b>25</b>	<b>32</b>	<b>42</b>	<b>51</b>	<b>61</b>	<b>71</b>	<b>&gt;</b>		<b>Total</b>
Tue,03-26-2019										
[15:00-15:15]	94	115	2	4	4	0	1	0		220
[15:15-15:30]	99	102	0	4	3	0	0	0		208
[15:30-15:45]	110	91	0	6	1	0	1	0		209
[15:45-16:00]	109	105	2	3	1	1	0	0		221
	<u>412</u>	<u>413</u>	<u>4</u>	<u>17</u>	<u>9</u>	<u>1</u>	<u>2</u>	<u>0</u>		<u>858</u>
[16:00-16:15]	114	102	2	4	0	0	1	0		223
[16:15-16:30]	128	118	1	3	0	0	0	1		251
[16:30-16:45]	114	124	0	3	0	0	0	0		241
[16:45-17:00]	134	145	2	5	1	0	0	0		287
	<u>490</u>	<u>489</u>	<u>5</u>	<u>15</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>1</u>		<u>1002</u>
[17:00-17:15]	124	129	1	2	0	0	0	0		256
[17:15-17:30]	137	124	3	2	0	0	0	0		266
[17:30-17:45]	96	95	0	2	0	1	0	0		194
[17:45-18:00]	99	83	1	3	0	0	1	0		187
	<u>456</u>	<u>431</u>	<u>5</u>	<u>9</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>		<u>903</u>
[18:00-18:15]	101	73	0	1	0	0	0	0		175
[18:15-18:30]	103	89	1	3	0	0	0	0		196
[18:30-18:45]	88	91	0	1	0	0	0	0		180
[18:45-19:00]	89	81	3	0	0	0	1	0		174
	<u>381</u>	<u>334</u>	<u>4</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>		<u>725</u>
[19:00-19:15]	79	69	0	1	0	0	0	0		149
[19:15-19:30]	70	62	1	2	0	0	1	0		136
[19:30-19:45]	52	64	0	1	0	0	0	1		118
[19:45-20:00]	63	57	0	0	0	0	0	1		121
	<u>264</u>	<u>252</u>	<u>1</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>2</u>		<u>524</u>
[20:00-20:15]	72	51	0	1	1	0	0	0		125
[20:15-20:30]	61	43	2	0	0	0	0	0		106
[20:30-20:45]	48	47	0	0	0	0	0	0		95
[20:45-21:00]	66	52	0	0	1	0	0	0		119
	<u>247</u>	<u>193</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>		<u>445</u>
[21:00-21:15]	58	46	1	0	0	0	0	0		105
[21:15-21:30]	55	45	0	0	0	0	0	0		100
[21:30-21:45]	36	38	0	0	0	0	0	0		74
[21:45-22:00]	35	30	0	0	0	0	0	0		65
	<u>184</u>	<u>159</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>		<u>344</u>
[22:00-22:15]	36	34	0	2	0	0	0	0		72
[22:15-22:30]	36	27	0	0	1	0	0	0		64
[22:30-22:45]	28	27	0	0	0	0	0	0		55

## Time/Class Report

<b>Device ID:</b> 130995 <b>Operator:</b> MD <b>Begin:</b> 03-26-2019 12:00 AM <b>End:</b> 03-27-2019 12:00 AM <b>Hours:</b> 24.00 <b>Period (min):</b> 15	<b>Location:</b> 7540 <b>Lane:</b> WB <b>Street:</b> 610590 - WB <b>City:</b> Niagara Region <b>County:</b> <b>State:</b> ON	<b>Raw Count:</b> 10,988 <b>AADT Count:</b> 10,988 <b>AADT Factor:</b> 1 <b>Speed Limit:</b> 50							
Date And Time Range	< to 15	16 to 25	26 to 32	33 to 42	43 to 51	52 to 61	62 to 71	72 to >	Total
Tue, 03-26-2019									
[22:45-23:00]	18	23	0	0	0	0	0	0	41
	118	111	0	2	1	0	0	0	232
[23:00-23:15]	33	21	0	0	0	0	0	0	54
[23:15-23:30]	34	26	0	0	0	0	0	0	60
[23:30-23:45]	14	19	0	1	0	0	0	0	34
[23:45-00:00]	17	17	0	0	0	0	0	0	34
	98	83	0	1	0	0	0	0	182
03-26-2019 12:00 AM									
03-27-2019 12:00 AM									
	5294	5192	106	154	25	7	20	7	10805

# APPENDIX C

Sample STAMSON 5.04 Output



ACOUSTICS



NOISE



VIBRATION





Total Leq All Segments: 65.93 dBA  
Results segment # 1: Thorold (night)

-----  
Source height = 0.80 m

ROAD (0.00 + 59.41 + 0.00) = 59.41 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	60.66	0.00	-1.25	0.00	0.00	0.00	0.00	59.41

-----

Segment Leq : 59.41 dBA

Total Leq All Segments: 59.41 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.93 dBA  
(NIGHT): 59.41 dBA