# Appendix D
# Noise Assessment Report

# Environmental Noise Assessment
# Bryne Drive, Harvie Road and Essa Road Class Environmental Assessment
# City of Barrie

Novus Reference No. 16-0254 Version 2.0 (Final) September 27, 2017


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## Table of Contents



## List of Tables

## List of Figures



## List of Appendices

# 1.0 INTRODUCTION

Novus Environmental Inc. (Novus) was retained by Hatch Infrastructure to conduct an environmental noise impact assessment for the proposed Bryne Drive, Harvie Road and Essa Road in the City of Barrie, Ontario.

The objectives of this study are as follows:

- to assess future "build" and "no-build" sound levels from road traffic noise sources in the area (i.e., noise levels with and without the proposed project taking place);
- to use these predictions to assess potential impacts according to the applicable guidelines;
- to specify mitigation measures where required; and
- to assess the potential for construction noise and provide a Code of Practice to minimize potential impacts.

A glossary of common terms and a description of transportation sound basics can be found in **Appendix A**.

## 1.1 Project Description (Nature of the Undertaking)

The proposed roadway improvements are located in the City of Barrie. The Study Area includes the following improvements to accommodate future growth to 2031:

- Harvie Road, from Essa Road to the future Bryne Drive;
- Essa Road, from Mapleview Drive West to Coughlin Road; and
- Bryne Drive, from Caplan Avenue to Essa Road.

The Study Areas for the three projects are found in **Appendix E**. **Figure E.1** to **E.3** illustrates the project study area.

## 1.2 Future Road Improvements Outside of This Study

A Harvie Road/Big Bay Point Road crossing over Highway 400 received environmental approval in 2015. It connects existing Harvie Road to Big Bay Point Road and protects property for a possible future interchange at Highway 400.

# 2.0 ROAD TRAFFIC NOISE IMPACTS (OPERATIONAL NOISE)

For roadway projects, operational noise is of primary importance. This section of the report provides an analysis of operational noise impacts from road traffic noise related to this undertaking.

## 2.1 Applicable Guidelines

There are several transportation noise guidelines that are applicable to this project. Ontario Provincial policies and guidelines from the Ontario Ministry of Transportation (MTO) and the Ontario Ministry of the Environmental and Climate Change (MOECC) are directly applicable under the Municipal Class EA process for transportation projects, and are discussed in detail in this report.

### 2.1.1 Ontario Provincial Guidelines and Policies

Ontario has a number of guidelines and documents related to assessing road traffic noise impacts. The document most applicable to municipal roadway projects is:

- Ontario MOECC/MTO, "Joint Protocol", *A Protocol for Dealing with Noise concerns during the Preparation, Review and Evaluation of Provincial Highway's Environmental Assessments* (MTO & MOECC, 1986)

In May 2007, the MTO released the *Environmental Guide for Noise* (MTO, 2006) which supersedes the Joint Protocol and previous MTO *Quality and Standards Directive QST-A1 Noise Policy and Acoustic Standards for Provincial Highways* (MTO 1992). Currently the *Environmental Guide for Noise* (the Guide) has not been adopted by the MOECC for municipal projects. Therefore, the Joint Protocol has been used for this study. A summary of the effort required under the Joint Protocol is shown in **Table 1.**

The Joint Protocol sets out an Outdoor Objective sound level of 55 dBA $L_{eq}$, or the existing ambient. For sound levels less than 65 dBA either the Guide or the Joint Protocol assesses noise impacts in a similar manner. Only in the case where sound levels exceed 65 dBA, is the Guide more stringent. The evaluation of noise impacts is determined by the change in cumulative sound levels from the 2031 "no-build" scenario to the future "build" scenario. Assessments are based on a minimum 10-year future horizon year (i.e., traffic volumes 10 years after the completion of the project). Accordingly, a design year of 2031 applies to this project, corresponding to the traffic forecasts provided by Hatch Infrastructure.

Noise mitigation is warranted when increases in sound level over the "no-build" ambient are greater than 5 dBA. Mitigation measures can include changes in vertical profiles and horizontal alignments, noise barriers, and noise reducing asphalts. Noise mitigation, where

applied, must be administratively, economically, and technically feasible, and must provide at least 5 dBA of reduction averaged over the first row of noise-sensitive receivers. Mitigation measures are restricted to within the roadway right-of-way. Off right-of-way noise mitigation, such as window upgrades and air conditioning, is not considered.

Table 1: Summary of Mitigation Efforts Under the MOECC/MTO Joint Protocol

| Future Sound Levels | Change in Noise Level Above Future "No-Build" Ambient (dBA) | Mitigation Effort Required |
|---|---|---|
| < 55 dBA | 0 to 5 | None |
| | > 5 | |
| > 55 dBA | 0 to 5 | |
| | > 5 | • Investigate noise control measures within right-of-way<br>• Noise control measures where used must provide a minimum of 5 dBA of attenuation, averaged over the first row of receivers<br>• Mitigated to as close to ambient as possible, where technically, economically and administratively feasible |

Notes: Values are $L_{eq}$ (16h) levels for municipal roads

## 2.2 Location of Noise Sensitive Areas Within the Study Area

### 2.2.1 Definition of Noise Sensitive Areas

Noise impacts from transportation projects are evaluated at noise sensitive receptors commonly referred to as Noise Sensitive Areas (NSAs). Under the Joint Protocol, NSAs include the following land uses, provided they have an Outdoor Living Area (OLA) associated with them:

- Private homes (single family units and townhouses)
- Multiple unit buildings such as apartments, provided they have a communal OLA associated with them
- Hospitals and nursing homes for the aged, provided they have an OLA for use by patients
- Schools, educational facilities, and daycare centres where there are OLAs for students
- Campgrounds that provide overnight accommodation
- Hotels and motels with outdoor communal OLAs for visitors
- Churches and places of worship

The following land uses are generally not considered to qualify as NSAs:

- Apartment balconies
- Cemeteries
- Parks and picnic areas not part of a defined OLA
- All commercial
- All industrial

Land use zoning maps are included in **Appendix B**.

### 2.2.2 Representative NSAs for Analysis

A number of NSAs have been used in the analysis to represent worst-case potential noise impacts at all nearby noise sensitive land uses within the study area. NSAs were picked to assess areas with similar overall noise levels and similar changes in noise ("build" versus "no-build"). These NSA and modelled receptor locations are shown in **Figure 1** and **Figure 2** and described in **Table 2**.

Table 2: Representative NSAs Considered in Analysis

| Receptor Location | Description |
|---|---|
| Harvie R1 | 8 Thrushwood Dr. |
| Harvie R2 | 2 Thrushwood Dr. |
| Harvie R3 | 116 Harvie Rd. |
| Harvie R4 | 126 Harvie Rd. |
| Harvie R5 | 202 Harvie Rd. |
| Harvie R6 | 214 Harvie Rd. |
| Harvie R7 | 404 Southwoods Cres. |
| Harvie R8 | 219 Southwoods Cres. |
| Harvie R9 | 229 Southwoods Cres. |
| Bryne R1 | 62 Megan Cres. |
| Bryne R2 | 50 Megan Cres. |
| Bryne R3 | 40-12 Megan Cres. |
| Bryne R4 | 26 Megan Cres. |
| Essa R1 | 570 Essa Rd. |
| Essa R2 | 29 Huitema Ct. |
| Essa R3 | 1 Huitema Ct. |
| Essa R4 | 63 Brucker Rd. |
| Essa R5 | 13 Brucker Rd. |
| Essa R6 | 392 Emms Dr. |
| Essa R7 | Proposed Residential Apartment Unit North of Mapleview Dr. W |
| Essa R8 | Proposed Residential Apartment Unit North of Mapleview Dr. W |
| Essa R9 | 21 Cityview Cir. |
| Essa R10 | 339 Essa Rd. |
| Essa R11 | 17 Sawmill Rd. |
| Essa R12 | 21 Mayfair Dr. |
| Harvie R10 | 4 Thrushwood Dr. |
| Harvie R11 | 6 Thrushwood Dr. |

The OLA may be situated on any side of the receptor, but is generally taken to be in the back yard. For assessment purposes, the OLA is taken as a point 3 m from the façade of the receptor, and 1.5 m (approximate head-height) above the ground surface to be consistent with MOECC policy. The locations of the representative noise receivers used in the analysis are shown in **Figure 1** and **Figure 2**.

## 2.3 Study Horizons

Under the Joint Protocol a "noise impact" is defined as the difference in projected noise levels changes comparing the noise levels a minimum of 10 years after construction between the "no build" and "build" scenarios. The year 2031 is the best available traffic volume to model the future "no build" scenario and for the future "build" condition and to model the noise impact calculations.

## 2.4 Study Scenarios

As mentioned above, the "noise impact" for the study area is defined as the difference in projected noise levels between the "no build" and "build" scenarios. It should be noted that the future road improvements identified in **Section 1.2** and their corresponding projected traffic volumes are included in the "build" scenarios as these improvements have been approved by the applicable agencies and will be implemented regardless of the outcome of this assessment.

## 2.5 Road Traffic Data

Traffic volumes for the 2031 "no-build" and "build" scenarios for multiple roadways were provided by Hatch Infrastructure and are shown in **Table 3** and **Table 4**, respectively. Traffic data was provided in the form of Annual Average Daily Traffic (AADT) as well as the percentage of commercial trucks was also provided for sections along both roadways as well as for significant crossing roadways. A conservative Medium Truck / Heavy truck split of 50/50 was used in this study and is based on historical information for these types of roadways.

Traffic volumes and the percentage trucks on Highway 400 came from the Ministry of Transportation Systems Analysis and Forecasting Office (SAFO) Provincial Planning Forecasting Tool on MTO Internet Site.

Table 3: Road Traffic Data for 2031 Future **"No-Build"** Scenario

| Road and Section | AADT | Day / Night Split [1] | Overall % Commercial Vehicles | Medium / Heavy Truck Split [2], [3] | Posted Speed Limit (km/h) |
|---|---|---|---|---|---|
| Essa Road | | | | | |
| Mapleview Dr. West to Coughlin Rd. | 20,075 | 90/10 | 2.0 | 1.0/1.0 | 60 |

| Road and Section | AADT | Day / Night Split [1] | Overall % Commercial Vehicles | Medium / Heavy Truck Split [2], [3] | Posted Speed Limit (km/h) |
|---|---|---|---|---|---|
| Coughlin Rd. to Veterans Dr. | 17,345 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Veterans Dr. to Ardagh Rd. | 29,555 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Ardagh Rd. to Highway 400 SB Off Ramp | 40,890 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Harvie Road | | | | | |
| Essa Rd. to Veterans Dr. | 1,250 | 90/10 | 2.0 | 1.0/1.0 | 50 |
| Veterans Dr. to Thrushwood Dr. | 1,963 | 90/10 | 2.0 | 1.0/1.0 | 50 |
| Thrushwood Dr. to Dead End | 863 | 90/10 | 2.0 | 1.0/1.0 | 50 |
| Bryne Drive | | | | | |
| Dead End to Essa Rd. | 7,290 | 90/10 | 4.0 | 2.0/2.0 | 50 |
| Veterans Drive | | | | | |
| Essa Rd. to Harvie Rd. | 19,275 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Harvie Rd. to Touchette Dr. | 18,938 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Mapleview Drive | | | | | |
| Veterans Rd. to Essa Rd. | 22,175 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Highway 400 | | | | | |
| Essa Rd. to Mapleview Dr. | 151,700 | 67/33 | 12.0 | 2.2/9.8 | 100 |
| Thrushwood Drive | | | | | |
| South of Harvie Rd. | 1,400 | 90/10 | 2.0 | 1.0/1.0 | 50 |

Notes: [1] XX / YY is the percentage of vehicle traffic in the 16 hour daytime and 8 hour night-time respectively.
[2] MM / HH is the percentage of medium trucks and heavy trucks used in the analysis, respectively.
[3] Medium / Heavy Truck Split of 50/50 based on historical information for this class of roadway except for Highway 400.

Table 4: Road Traffic **Data for 2031 Future "Build"** Scenario

| Road and Section | AADT | Day / Night Split [1] | Overall % Commercial Vehicles | Medium / Heavy Truck Split [2], [3] | Posted Speed Limit (km/h) |
|---|---|---|---|---|---|
| Essa Road | | | | | |
| Mapleview Dr. West to Coughlin Rd. | 20,075 | 90/10 | 2.0 | 1.0/1.0 | 70 |
| Coughlin Rd. to Veterans Dr. | 17,345 | 90/10 | 2.0 | 1.0/1.0 | 70 |
| Veterans Dr. to Ardagh Rd. | 39,390 | 90/10 | 2.0 | 1.0/1.0 | 70 |
| Ardagh Rd. to Highway 400 SB Off Ramp | 53,445 | 90/10 | 2.0 | 1.0/1.0 | 70 |
| Harvie Road | | | | | |
| Essa Rd. to Veterans Dr. | 14,488 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Veterans Dr. to Thrushwood Dr. | 30,963 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Thrushwood Dr. to 200 m E. of Thrushwood Dr. | 29,800 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| 200 m E. of Thrushwood Dr. to Bryne Dr. | 29,800 | 90/10 | 2.0 | 1.0/1.0 | 70 |
| Bryne Drive | | | | | |
| Essa Rd. to Harvie Rd. | 14,745 | 90/10 | 2.0 | 1.0/1.0 | 50 |
| Harvie Rd. to Caplan Ave. | 14,190 | 90/10 | 2.0 | 1.0/1.0 | 50 |

| Road and Section | AADT | Day / Night Split [1] | Overall % Commercial Vehicles | Medium / Heavy Truck Split [2], [3] | Posted Speed Limit (km/h) |
|---|---|---|---|---|---|
| Veterans Drive | | | | | |
| Essa Rd. to Harvie Rd. | 15,750 | 90/10 | 4.0 | 2.0/2.0 | 60 |
| Harvie Rd. to Touchette Dr. | 24,638 | 90/10 | 4.0 | 2.0/2.0 | 60 |
| Mapleview Drive | | | | | |
| Veterans Dr. to Essa Rd. | 32,340 | 90/10 | 2.0 | 1.0/1.0 | 60 |
| Highway 400 | | | | | |
| Essa Rd. to Mapleview Dr. | 151,700 | 67/33 | 12.0 | 2.2/9.8 | 100 |
| Thrushwood Drive | | | | | |
| South of Harvie Rd. | 1,400 | 90/10 | 2.0 | 1.0/1.0 | 50 |

Notes: [1] XX / YY is the percentage of vehicle traffic in the 16 hour daytime and 8 hour night-time respectively.
[2] MM / HH is the percentage of medium trucks and heavy trucks used in the analysis, respectively.
[3] Medium / Heavy Truck Split of 50/50 based on historical information for this class of roadway except for Highway 400.

## 2.6 Noise Model Used

The highway noise prediction model used is the United States Federal Highway Administration Method. The STAMINA 2.0 highway noise prediction model is a computerized version of this method. This model is jointly approved by the MTO and the MOECC.

The noise prediction model relies on the use of vehicle noise emission levels to generate a noise source that can then be assessed at the noise receptors based on the following factors:

- posted speeds for the roadways in the area used in the noise analysis. (In the case of roadways with a posted speed of less than 50 km/h a more conservative speed of 50 km/h is used as the approved models will not predict sound levels below that speed);
- pavement surface used for construction of the roadway (i.e. hot mix asphaltic pavement);
- elevations, contours and locations of all of the NSA's near the right-of-way;
- roadway grades;
- intervening rows of homes and barriers;
- type of ground cover, soft or hard ground;
- percentage of commercial traffic; and
- distance from the roadway.

The model uses the following vehicle classifications:

Automobiles - Two axles and four wheels designed primarily for the transportation of nine or fewer passengers, or transportation of cargo (light trucks). This classification includes motorcycles. Generally, the gross vehicle weight is less than 4,500 kilograms.

Medium trucks - Two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 4,500 kilograms but less than 12,000 kilograms.

Heavy trucks - Three or more axles and designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 12,000 kilograms.

Distances, roadway heights and receptor locations were obtained from plan drawings supplied by Hatch Infrastructure and aerial photographs.

## 2.7 Detailed Modelling

**Table 5** presents a comparison of "no build" versus future "build" sound levels at receptors in the study area during the 16 hour day. The STAMINA 2.0 results can be found in **Appendix C**.

Table 5: 2031 **"No Build"** and **"Build"** Noise Levels

| Receptor Location | "No Build" Leq (16h) | "Build" Leq (16h) | Change ("Build" minus "No-Build") | Increase Above 5 dBA |
|---|---|---|---|---|
| Harvie R1 | 49.2 | 54.8 | 5.6 | Yes |
| Harvie R2 | 49.5 | 57.8 | 8.3 | Yes |
| Harvie R3 | 53.2 | 61.5 | 8.3 | Yes |
| Harvie R4 | 53.4 | 60.6 | 7.2 | Yes |
| Harvie R5 | 58.9 | 61.3 | 2.4 | No |
| Harvie R6 | 54.4 | 59.8 | 5.4 | Yes |
| Harvie R7 | 60.5 | 64.4 | 3.9 | No |
| Harvie R8 | 52.3 | 55.2 | 2.9 | No |
| Harvie R9 | 51.8 | 55.8 | 4.0 | No |
| Bryne R1 | 53.9 | 54.6 | 0.7 | No |
| Bryne R2 | 54.8 | 55.7 | 0.9 | No |
| Bryne R3 | 55.5 | 56.5 | 1.0 | No |
| Bryne R4 | 53.8 | 55.5 | 1.7 | No |
| Essa R1 | 55.9 | 57.4 | 1.5 | No |
| Essa R2 | 55.7 | 57.3 | 1.6 | No |
| Essa R3 | 57.4 | 59.1 | 1.7 | No |
| Essa R4 | 56.2 | 57.7 | 1.5 | No |
| Essa R5 | 58.0 | 59.8 | 1.8 | No |
| Essa R6 | 58.1 | 60.0 | 1.9 | No |
| Essa R7 | 60.3 | 61.6 | 1.3 | No |
| Essa R8 | 59.2 | 60.4 | 1.2 | No |
| Essa R9 | 58.7 | 60.1 | 1.4 | No |
| Essa R10 | 64.8 | 66.3 | 1.5 | No |

| Receptor Location | "No Build" Leq (16h) | "Build" Leq (16h) | Change ("Build" minus "No-Build") | Increase Above 5 dBA |
|---|---|---|---|---|
| Essa R11 | 65.8 | 67.1 | 1.3 | No |
| Essa R12 | 58.9 | 59.8 | 0.9 | No |
| Harvie R10 | 48.6 | 56.7 | 8.1 | Yes |
| Harvie R11 | 48.4 | 55.5 | 7.1 | Yes |

## 2.8 Discussion of Impacts and Investigation of Noise Mitigation

The results show that changes in sound levels resulting from the proposed project are expected to be upwards of 8.3 dBA. A number of other homes will experience increases over 5.0 dBA. All of the impacted homes are near existing Harvie Road. The primary cause of this impact is the large increase in road traffic volumes, increases in posted speed limits and to a lesser degree the road widening. The road traffic volumes are increasing from approximately 2,000 to over 30,000 vehicles per day on Harvie Rd.

A noise sensitive area, including receptors Bryne R1 – R4, was identified to the west of the proposed Bryne Drive extension. The predicted noise levels at these receptors are dominated by transportation noise from Highway 400. Therefore, construction of the proposed Bryne Drive extension does not have a significant impact on homes in its vicinity.

Homes in the Essa Road area will experience slight noise level increases because of increases in road traffic volumes in the area caused by the construction of both Harvie Road and Bryne Drive.

All of the homes on Harvie Road that experience noise impacts have private driveways that enter Harvie Road. The exception to this are the homes in the southwest quadrant of Harvie Road and Thrushwood Drive. These homes are currently protected by an approximately 2.5 metre high wooden noise barrier wall. If this wall is removed, and a higher and longer wall constructed in its place, the noise impacting the homes could be reduced.

**Table 6** shows the results of an investigation on the effectiveness of a new noise barrier as is shown in **Figure 3.**

Table 6: Noise Levels and Improvement with Proposed Noise Barrier

| Receptor Location | "No Build" Leq (16h) | "Build" Leq (16h) | Change ("Build" minus "No-Build") | Future "Build" with New Noise Barrier | Improvement with New Barrier |
|---|---|---|---|---|---|
| Harvie R1 | 49.2 | 54.8 | 5.6 | 52.6 | -2.2 |
| Harvie R2 | 49.5 | 57.8 | 8.3 | 53.3 | -4.5 |
| Harvie R10 | 53.2 | 56.7 | 8.1 | 52.6 | -4.1 |
| Harvie R11 | 53.4 | 55.5 | 7.1 | 52.3 | -3.2 |

The reduction in sound levels with the construction of this noise barrier is not as high as would be the case if there were not a 2.5 m high noise barrier already providing some protection. The approximate lengths and heights of the new proposed noise barrier are shown in **Table 7.** To minimize the visual intrusion of the noise barrier the height was reduced to be that same as the current barrier as much as possible at the east end of the recommended noise barrier. Details of the proposed design are shown in **Figure 4**. The house itself acts as an effective noise barrier in combination with the recommended new noise barrier. The estimated noise barrier costs are based upon experience in construction of walls of similar height and length and they are an 'as constructed' cost.

Table 7: Proposed Noise Barrier Heights, Lengths and Costs

| Barrier Height | Recommended Approximate Barrier Length in Metres | Estimated Cost at $500/m2 |
|---|---|---|
| 2.5 | 9 | $11,250 |
| 3.0 | 4 | $6,000 |
| 3.5 | 4 | $7,000 |
| 4.0 | 77 | $154,000 |
| Total = | 94 | $178,250 |

# 3.0 CONSTRUCTION NOISE IMPACTS

Construction noise impacts are temporary in nature, and largely unavoidable. Although for some periods and types of work, construction noise will be noticeable, with adequate controls, impacts can be minimized. This section of the report provides an examination of the City of Barrie noise bylaw and recommends a Code of Practice to minimize impacts.

## 3.1 Construction Noise Guidelines

### 3.1.1 Local Noise Control Bylaws

The proposed project lies within the local jurisdiction of the City of Barrie. A bylaw restricting noise from construction activity exists within the City. The City of Barrie has a permanent exemption under this by-law as outlined in the third section of Schedule 2 of the by-law as summarized below in **Table 8**. A copy of the bylaw can be found in **Appendix D**.

Table 8: City of Barrie Noise Control Bylaw

| Jurisdiction | Bylaw Number | Bylaw Provision |
|---|---|---|
| City of Barrie | By-law 2006-140 | **SCHEDULE 2 to BY-LAW 2006- 140**<br><br>**PERMANENT EXEMPTIONS**<br><br>1. The use of bells or chimes normally associated with church activities.<br><br>2. The operation of bells and other signalling devices utilized as traffic control devices at:<br><br>• intersections with traffic signalling devices; and<br><br>• railway crossings.<br><br>3. The operation of equipment in conjunction with City projects or reconstruction projects, general maintenance and emergency maintenance projects.<br><br>4. All activities approved by the Barrie Agricultural Society and conducted at the Barrie Fairgrounds provided that the midway electronically produced sounds and amplified sounds from other fair related activities be reduced to two thirds normal operation by volume by 11:00 p.m. of one day to 9:00 a.m. of the next day during the operation of the Barrie Fair.<br><br>5. All activities directly associated with the conduct of City sanctioned Special Events including but not limited to the detonation of fireworks. Such exemption shall only be applicable between the hours of 10:00 a.m. of one day and 11:00 p.m. of the same day.<br><br>6. All activities directly associate with the conduct of the City of Barrie New Year's Eve celebration including but not limited the detonation of fireworks. Such exemption shall only be applicable between the hours of 10:00 a.m. of one day and 12:30 a.m. of the next day.<br><br>7. The operation of authorized emergency vehicles and related signalling devices.<br><br>8. The operation of vehicles and equipment utilized for the clearing and removal of snow from public and private property.<br><br>9. The operation of any rail car including but not limited to refrigeration cars, locomotives or self-propelled passenger cars, operated under the Railway Act of Canada. |

### 3.1.2 MOECC Model Municipal Noise Control Bylaw

The MOECC stipulates limits on noise emissions from individual items of equipment, rather than for overall construction noise. In the presence of persistent noise complaints, sound emission standards for the various types of construction equipment used on the project should be checked to ensure that they meet the specified limits contained in MOE Publication NPC-115 – "Construction Equipment", as shown in **Table 9.**

Table 9: NPC-115 Maximum Noise Emission Levels for Typical Construction Equipment

| Type of Unit | Maximum Sound Level [1] (dBA) | Distance (m) | Power Rating (kW) |
|---|---|---|---|
| Excavation Equipment [2] | 83 | 15 | < 75 |
| | 85 | 15 | > 75 |
| Pneumatic Equipment [3] | 85 | 7 | - |

| Type of Unit | Maximum Sound Level [1] (dBA) | Distance (m) | Power Rating (kW) |
|---|---|---|---|
| Portable Compressors | 76 | 7 | - |

Notes: [1] Maximum permissible sound levels presented here are for equipment manufactured after Jan. 1, 1981.
[2] Excavation equipment includes bulldozers, backhoes, front end loaders, graders, excavators, steam rollers and other equipment capable of being used for similar applications.
[3] Pneumatic equipment includes pavement breakers.

## 3.2 Anticipated Construction Activities

The following construction activities are anticipated as part of this project:

- Removing existing surface pavements
- Earth grading
- Construction and rehabilitation of the base course
- Paving (and repaving) of the roadway surfaces
- Culvert construction or extensions
- Construction of new roadway including removal of overburden

## 3.3 Construction Code of Practice Requirements (Mitigation)

To minimize the potential for construction noise impacts, it is recommended that provisions be written into the contract documentation for the contractor, as outlined below:

- Where possible construction should be carried out during the daytime. If construction activities are required outside of these hours, the Contractor should try and minimize the amount of noise being generated.
- There should be explicit indication that Contractors are expected to comply with all applicable requirements of the contract.
- All equipment should be properly maintained to limit noise emissions. As such, all construction equipment should be operated with effective muffling devices that are in good working order.
- The Contract documents should contain a provision that any initial noise complaint will trigger verification that the general noise control measures agreed to be in effect.
- In the presence of persistent noise complaints, all construction equipment should be verified to comply with MOECC NPC-115 guidelines, as outlined in Section 3.1.2.
- In the presence of persistent complaints and subject to the results of a field investigation, alternative noise control measured may be required, where reasonably available. In selecting appropriate noise control and mitigation measures, consideration should be given to the technical, administrative and economic feasibility of the various alternatives.

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

The potential environmental noise impacts of the proposed Bryne Drive, Harvie Road and Essa Road construction or reconstruction has been assessed. Both operational and construction noise impacts have been considered. The following conclusions and recommendations result:

- Changes in sound levels resulting from the proposed project are expected to be upwards of 8.3 dBA. A number of other homes will experience increases over 5.0 dBA. All of the impacted homes are near existing Harvie Road. The primary cause of this change is the large increase in road traffic volumes, posted speed limits and to a lesser degree the Harvie Road widening.
- The noise barrier as is shown described in **Table 7** should be constructed to minimize noise impacts at the southwest corner of Thrushwood Dr. and Harvie Rd.
- All of the homes on Harvie Road that experience noise impacts have private driveways that enter Harvie Road. No mitigation is possible because any recommended noise barrier would need to run through the driveway and would prevent assess to the homes.
- Construction noise impacts are temporary in nature but will be noticeable at times at residential NSAs. Methods to minimize construction noise impacts should be included in the Construction Code of Practice, as outlined above.

## 5.0 REFERENCES

Ontario Ministry of the Environment and Climate Change (MOECC), 1977b, *Model Municipal Noise Control Bylaw,* which includes Publication NPC-115 – Construction Equipment

Barry, T.M. and Reagan, J.A., "FHWA Highway Noise Prediction Model", U.S. Federal Highway Administration, Report FHWA RD-77 108, December 1978

Ontario Ministry of the Environment and Climate Change (MOECC), 1977c, *Model Municipal Noise Control Bylaw,* which includes Publication NPC-119 – Noise From Blasting

Ontario Ministry of the Environment and Climate Change (MOECC) / Ontario Ministry of Transportation (MTO), 1986, "Joint Protocol", *A Protocol for Dealing with Noise Concerns During the Preparation, Review and Evaluation of Provincial Highway's Environmental Assessments*

Ontario Ministry of the Environment and Climate Change (MOECC), 2013, *Environmental Noise Guideline*: *Stationary and Transportation Sources – Approval and Planning, Publication NPC-300*

Ontario Ministry of Transportation (MTO), 1992a, Quality and Standards Directive QST-A1, Noise Policy and Acoustic Standards for Provincial Highways

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# Figures

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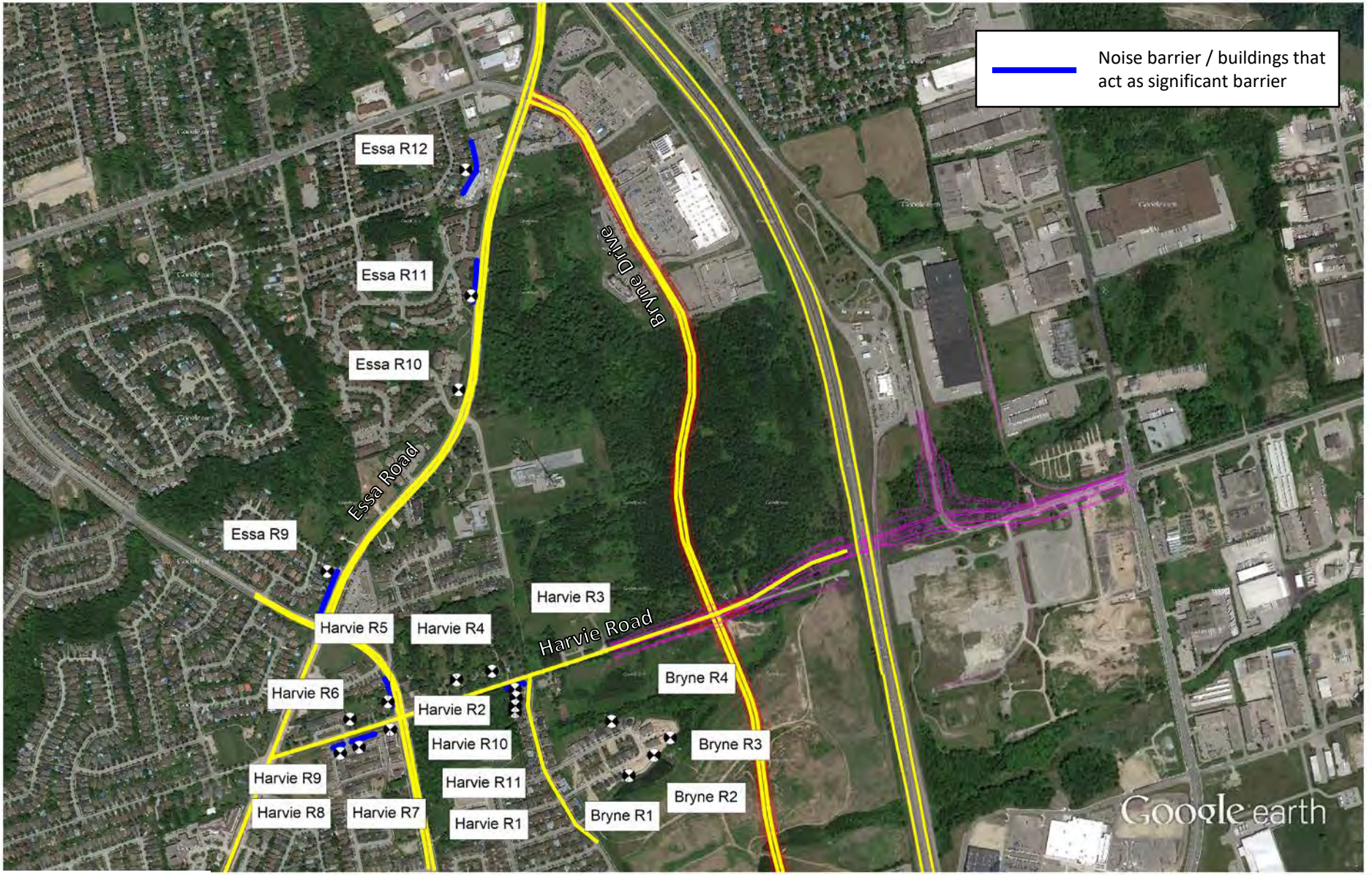




Figure No. 1

Location of Representative Noise Sensitive Receptors

Bryne Drive, Harvie Road and Essa Road Environmental Noise Assessment
Barrie, Ontario

True North

Scale: 1: 13,000
Date: 17/08/11
File No.: 16-254
Drawn By: SS

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Figure No. 2

Location of Representative Noise Sensitive Receptors

Bryne Drive, Harvie Road and Essa Road Environmental Noise Assessment
Barrie, Ontario

True North

Scale: 1: 9,000
Date: 17/08/11
File No.: 16-254
Drawn By: SS

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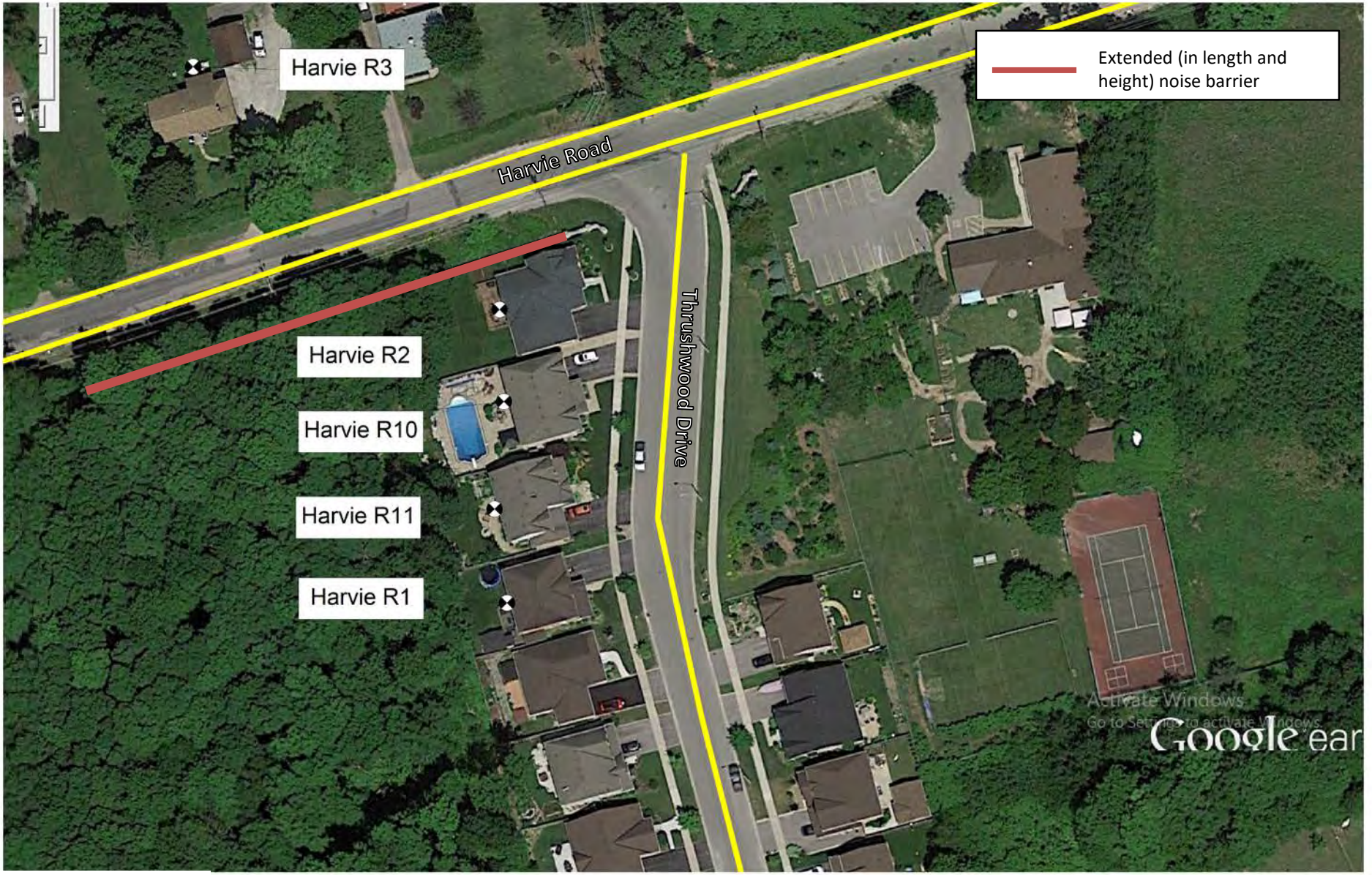




Figure No. 3

**Recommended** Noise Barrier Location

Bryne Drive, Harvie Road and Essa Road Environmental Noise Assessment
Barrie, Ontario

True North

| | |
|---|---|
| Scale: | 1: 1,000 |
| Date: | 17/09/26 |
| File No.: | 16-254 |
| Drawn By: | SS |

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Figure No. 4

Design Concept for **Recommended** Noise Barrier

Bryne Drive, Harvie Road and Essa Road Environmental Noise Assessment
Barrie, Ontario

True North

| | |
|---|---|
| Scale: | N/A |
| Date: | 17/09/26 |
| File No.: | 16-254 |
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# Appendix A

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# Glossary of Commonly Used Noise Terminology

**Airborne Sound*:** Sound that reaches the point of interest by propagation through air.

**Ambient or Background Noise:** The ambient noise from all sources other than the sound of interest (i.e. sound other than that being measured). Under most MOE guidelines, aircraft overflights and train noise, due to their transient nature, are normally excluded from measurements of background noise.

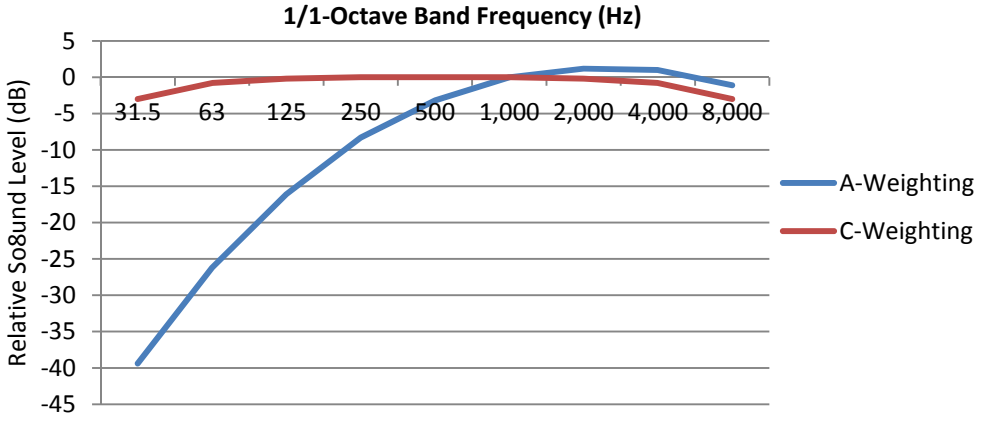
**Articulation Index (AI)*:** A numerically calculated measure of the intelligibility of transmitted or processed speech. It takes into account the limitations of the transmission path and the background noise. The articulation index can range in magnitude between 0 and 1.0. If the AI is less than 0.1, speech intelligibility is generally low. If it is above 0.6, speech intelligibility is generally high.

**Attenuation*:** The reduction of sound intensity by various means (e.g., air, humidity, porous materials, etc.).

**dB -Decibel:** The logarithmic units associated with sound pressure level, sound power level, or acceleration level. See sound pressure level, for example.

**dBA -Decibel, A-Weighted:** The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to quiet sound levels. The resultant sound pressure level is therefore representative of the subjective response of the human ear. A-weighted sound pressure levels are denoted by the suffix 'A' (ie. dBA), and the term pressure is normally omitted from the description (i.e., sound level or noise level).

**dBC -Decibel, C-Weighted:** The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to loud sound levels. C-weighted sound pressure levels are denoted by the suffix 'C' (ie dBC). C-weighted levels are often used in low-frequency noise analysis, as the filtering effect is nearly flat at lower frequencies.




**dBL or dBLin -Decibel, Linear:** The logarithmic units associated with a sound pressure level, where the sound pressure signal is unfiltered, and represents the full spectrum of incoming noise.

**Calibrator (Acoustical)*:** A device which produces a known sound pressure on the microphone of a sound level measurement system, and is used to adjust the system to standard specifications.

---

Definitions with a "*" marker originally from "Noise Control Terms Made Somewhat Easier", by David Kelso (Minnesota Pollution Control Agency), and Al Perez (Northern Sound), Minneapolis, Minnesota May, 1983, as modified on the Noise Pollution Clearinghouse website www.nonoise.org.

**Directivity Factor (Q)** (also, **Directional** or **Directionality Factor):** A factor mathematically related to Directivity Index, used in calculating propagated sound levels to account for the effect of reflecting surfaces near to the source. For example, for a source in free space where the sound is radiating spherically, Q = 1. For a source located on or very near to a surface (such as the ground, a wall, rooftop, etc.), where the sound is radiating hemispherically, Q = 2. This accounts for the additional sound energy reflecting off the surface, and translates into a +3 dB add.

**Directivity Index*:** In a given direction from a sound source, the difference in decibels between (a) the sound pressure level produced by the source in that direction, and (b) the space-average sound pressure level of that source, measured at the same distance.

**Energy Equivalent Sound Level ($L_{eq}$):** An energy-average sound level taken over a specified period of time. It represents the average sound pressure encountered for the period. The time period is often added as a suffix to the label (i.e., Leq(24) for the 24-hour equivalent sound level). Leq is usually A-weighted. An Leq value expressed in dBA is a good, single value descriptor of the annoyance of noise.

**Exceedance Noise Level ($L_N$):** The noise level exceeded N% of the time. It is a statistical measure of the noise level. For highly varying sounds, the L90 represents the background noise level, L50 represents the median or typical noise level, and L10 represents the short term peak noise levels, such as those due to occasional traffic or a barking dog.

**Far Field***: Describes a region in free space where the sound pressure level from a source obeys the inverse-square law (the sound pressure level decreases 6 dB with each doubling of distance from the source). Also, in this region the sound particle velocity is in phase with the sound pressure. Closer to the source where these two conditions do not hold constitutes the "near field" region.

**Free Sound Field (Free Field)*:** A sound field in which the effects of obstacles or boundaries on sound propagated in that field are negligible.

**Frequency*:** The number of times per second that the sine wave of sound or of a vibrating object repeats itself. Now expressed in hertz (Hz), formerly in cycles per second (cps).

**Hertz (Hz)*:** Unit of measurement of frequency, numerically equal to cycles per second.

**Human Perception of Sound:** The human perception of noise impact is an important consideration in qualifying the noise effects caused by projects. The following table presents a general guideline.

***Subjective Human Perception of Changes in Sound Levels***

| Change in Broadband Sound Level (dB) | Human Perception of Change |
|---|---|
| <3 | Imperceptible change |
| 3 | Just-perceptible change |
| 4 to 5 | Clearly noticeable change |
| 6 to 9 | Substantial change |
| >10 and more | Very substantial change (half or twice as loud) |
| >20 and more | Very substantial change ( much quieter or louder) |

Notes:
Adapted from Bies and Hansen, p53, and MOE Noise Guidelines for Landfill Sites, 1998. Applies to changes in broadband noise sources only (i.e., increases or decreases in the same noise or same type of noise only). Changes in frequency content or the addition of tonal or temporal changes would affect the perception of the change.

**Impact Insulation Class (IC)*:** A single-figure rating that compares the impact sound insulating capabilities of floor-ceiling assemblies to a reference contour.

**Impact Sound*:** The sound produced by the collision of two solid objects, e.g., footsteps, dropped objects, etc., on an interior surface (wall, floor, or ceiling) of a building. Typical industrial sources include punch presses, forging hammers, etc.

**Impulsive Noise*:** a) Single or multiple sound pressure peak(s) (with either a rise time less than 200 milliseconds or total duration less than 200 milliseconds) spaced at least by 500 millisecond pauses, b) A sharp sound pressure peak occurring in a short interval of time.

**Infrasonic*:** Sounds of a frequency lower than 20 hertz.

**Insertion Loss (IL):** The arithmetic difference between the sound level from a source before and after the installation of a noise mitigation measure, at the same location. Insertion loss is typically presented as a positive number, i.e., the post-mitigation sound level is lower than the pre-mitigation level. Insertion loss is expressed in dB and is usually specified per 1/1 octave band, per 1/3 octave band, or overall.

**Intensity*:** The sound energy flow through a unit area in a unit time.

**Low Frequency Noise (LFN):** Noise in the low frequency range, from infrasonic sounds (<20 Hz) up to 100 Hz.

**Masking*:** a) The process by which the threshold of audibility for a sound is raised by the presence of another (masking) sound, or b) The amount by which the threshold of audibility of a sound is raised by the presence of another (masking) sound.

**Near Field*:** The sound field very near to a source, where sound pressure does not obey the inverse-square law and the particle velocity is not in phase with the sound pressure.

**Noise:** Unwanted sound.

**Noise Criteria (NC) Curves:** A single number rating for noise in 1/1-octave frequency bands which is sensitive to the relative loudness and speech interference properties of a given sound spectrum. The method consists of a family of criteria curves extending from 63 Hz to 8000 Hz, and a tangency rating procedure. Oringinally proposed by Bernanek in 1957. While other more modern criteria curve rating schemes exist (NCB, RC, RC Mark II, RNC, etc.), NC curves are still widely used in determining acceptability of noise levels within spaces. Level of NC 25 to NC 35 are usually considered acceptable for residences, private offices, and schools.

**Noise Isolation Class (NIC)*:** A single number rating derived in a prescribed manner from the measured values of noise reduction between two areas or rooms. It provides an evaluation of the sound isolation between two enclosed spaces that are acoustically connected by one or more paths.

**Noise Reduction (NR)*:** The numerical difference, in decibels, of the average sound pressure levels in two areas or rooms. A measurement of "noise reduction" combines the effect of the sound transmission loss performance of structures separating the two areas or rooms, plus the effect of acoustic absorption present in the receiving room.

**Noise Reduction Coefficient (NRC)*:** A measure of the acoustical absorption performance of a material, calculated by averaging its sound absorption coefficients at 250, 500, 1000 and 2000 Hz, expressed to the nearest multiple of 0.05.

**Noise Level:** Same as Sound Level, except applied to unwanted sounds.

**Noise Exposure Forecast (NEF):** A calculated measure of aircraft noise based on the type of aircraft in use, the take-off and landing patterns of the aircraft, and times of operation. It represents the noise exposure over a typical 24 hour period. A penalty is applied to nighttime operation.

**Peak Sound Pressure Level:** Same as Sound Pressure Level except that peak (not peak-to-peak) sound pressure values are used in place of RMS pressures.

**Quasi-Steady Impulsive Noise:** Noise composed of a series of short, discrete events, characterized by rapid rise times, but with less than 0.5 seconds elapsing between events.

**RMS Sound Pressure:** The square-root of the mean-squared pressure of a sound (usually the result of an RMS detector on a microphone signal).

**Reverberant Field*:** The region in a room where the reflected sound dominates, as opposed to the region close to the noise source where the direct sound dominates.

**Reverberation*:** The persistence of sound in an enclosed space, as a result of multiple reflections, after the sound source has stopped.

**Reverberation Time (RT)*:** The reverberation time of a room is the time taken for the sound pressure level to decrease 60 dB from its steady-state value when the source of sound energy is suddenly interrupted. It is a measure of the persistence of an impulsive sound in a room as well as of the amount of acoustical absorption present inside the room. Rooms with long reverberation times are called live rooms.

**Sabin*:** A measure of the sound absorption of a surface; it is the equivalent of one square metre of a perfectly absorptive surface (or one square foot in imperial units).

**Sound:** a dynamic (fluctuating) pressure.

**Sound Exposure Level (SEL):** An $L_{eq}$ referenced to a one second duration. Also known as the Single Event Level. It is a measure of the cumulative noise exposure for a single event. It provides a measure of the accumulation of sound energy over the duration of the event.

**Sound Level (SL):** The A-weighted Sound Pressure Level expressed in dBA.

**Sound Level Meter*:** An instrument comprised of a microphone, amplifier, output meter, and frequency-weighting networks which is used for the measurement of noise and sound levels.

**Sound Pressure Level (SPL):** The logarithmic ratio of the RMS sound pressure to the sound pressure at the threshold of hearing. The sound pressure level is defined by equation (1) where P is the RMS pressure due to a sound and P0 is the reference pressure. P0 is usually taken as $2.0 \times 10^{-6}$ Pascals.

$$\textbf{(1)}\ \text{SPL (dB)} = 20 \log(P_{RMS}/P_0)$$

**Sound Power Level (PWL):** The logarithmic ratio of the instantaneous sound power (energy) of a noise source to that of an international standard reference power. The sound power level is defined by equation (2) where W is the sound power of the source in watts, and W0 is the reference power of $10^{-12}$ watts.

$$\textbf{(2)}\ \text{PWL (dB)} = 10 \log(W/W_0)$$

Interrelationships between sound pressure level (SPL) and sound power level (PWL) depend on the location and type of source.

**Sound Transmission Class (STC)*:** The preferred single figure rating system designed to give an estimate of the sound insulation properties of a structure or a rank ordering of a series of structures.

**Sound Transmission Loss (STL)*:** A measure of sound insulation provided by a structural configuration. Expressed in decibels, it is 10 times the logarithm to the base 10 of the reciprocal of the sound transmission coefficient of the configuration.

**Spectrum*:** The description of a sound wave's resolution into its components of frequency and amplitude.

**Speech Interference Level (SIL)*:** A calculated quantity providing a guide to the interference of a noise with the reception of speech. The speech-interference level is the arithmetic average of the octave band levels of the interfering noise in the most important part of the speech frequency range. The levels in octave bands centered at 500, 1000, and 2000 Hz are commonly averaged to determine the speech-interference level.

**Speed (Velocity) of Sound in Air*:** 344 m/s (1128 ft/s) at 70°F (21°C) in air at sea level.

**Threshold of Audibility (Threshold of Detectability)*:** The minimum sound pressure level at which a person can hear a specified frequency of sound over a specified number of trials.

**Transmission Loss:** A measure of the reduction in sound energy resulting from incident sound waves striking a wall, partition or enclosure, and radiating through to the other side. Mathematically, the transmission coefficient t is the ratio of transmitted acoustic power to the incident acoustic power, and in decibels, the Transmission Loss (TL) of the wall is:

$$\textbf{(3)}\ TL = 10\log(1 / t)$$

The TL of a wall varies by frequency. The associated noise reduction (NR) due to the TL of the wall is a function of the TL and the acoustical parameters of the receiving space. For noise radiating from an enclosure into the outdoors, NR = (TL + 6).

# TRANSPORTATION SOUND BASICS

## Sound Levels

Sound is, in its simplest form, a dynamic, fluctuating pressure, in a fluid medium. That medium can be air, other gases, or liquids such as water. These fluctuations are transmitted by pressure waves through the medium from the source to the receiver. For the majority of transportation engineering purposes, the primary interest is with sound waves in air, with human beings as the receptor. Noise is defined as unwanted sound. The standard practice within the acoustical industry is to use these two terms interchangeably.

## Decibels

A decibel (dB) is a logarithmic ratio of a value to a reference level. The general mathematical format is:

$$\text{Level in dB} = 10 \log (\text{Value} / \text{Reference})$$

Any value can be expressed in decibels. Decibels are very, very useful in performing comparisons where there are huge ranges in levels. For example, an acoustical engineer can expect to deal with acoustical energy values ranging from 0.00001 W to 100 W (sound power), and pressures ranging from 0.002 Pa to 200 Pa (sound pressure).1[1] For completeness, decibels should always be stated with their reference level (e.g., 20 dB re: 20 µPa). However, in practice the reference level is often left out.

## Sound Pressure Level

Sound pressure level is what humans experience as sound. Sound waves create small fluctuations around the normal atmospheric pressure. These pressure fluctuations come into contact with eardrums and create the sensation of sound. Sound pressure is measured in decibels, according to the following equation:

$$\text{Sound Pressure Level, dB} = 10 \log (p^2/p_0^2))$$

Where: p = root mean square (r.m.s.) sound pressure, in Pa po = reference sound pressure, 20 µPa

The reference pressure represents the faintest sound that a "typical" human being can hear. The typical abbreviation for sound pressure level is SPL, although Lp is also often used in equations. "Sound level" or "noise level" are also sometimes used.

## Octave Bands

Sounds are composed of varying frequencies or pitches. Human sensitivity to noise varies by frequency, with a greater sensitivity to higher frequency sounds. The propagation of sound also varies by frequency. The unit of frequency is Hertz (Hz), which refers the number of cycles per second (number of wave peaks per second of the propagating sound wave). The typical human hearing response runs from 20 Hz to 20,000 Hz. Frequencies below 20 Hz are generally inaudible, although response is variable, and some individuals may be able to hear or perceive them.

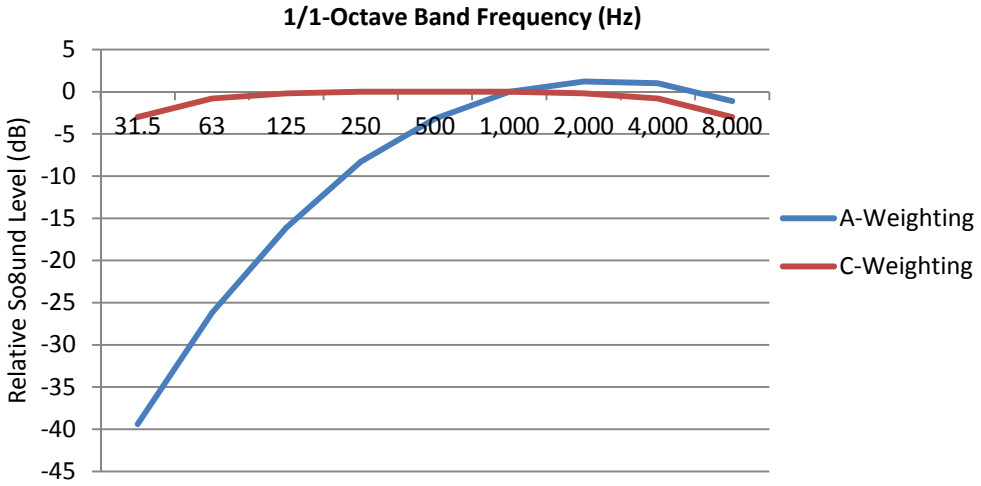
[1] Equivalent to Sound Power Levels ranging from 70 to 140 dB and Sound Pressure Levels ranging from 20 dB to 140 dB

Sound is typically analysed in octave bands or 1/3-octave bands. An octave band is defined as a band or range of sound frequencies where the frequency range doubles for succeeding octave (alternately, the highest frequency in the range is twice the value of the lowest frequency).

## A-Weighting

When the overall sound pressure level is expressed as a single value (i.e., not expressed in frequency band levels) the variation in human frequency response must be accounted for. People do not hear low frequency noise as well as noise in mid or high frequencies. To account for this, frequency-weighting networks have been developed to better account for human hearing response. The most frequently used networks are the A-Weighting and C-Weighting.

The A-Weighting network was developed to correspond to how humans hear low to medium levels of noise. The A-Weighting is the most frequently used scheme, and the majority of noise guidelines are expressed in A-Weighted decibel values, denoted as "dBA" levels. C-Weighted "dBC" values are sometimes used in assessing low-frequency noise impacts, which are generally not of concern in transportation noise impact assessment. The A-Weighting and C-Weighting values are shown in the following figure.




***A-Weighting and C-Weighting Networks***

## Ranges of Sound Levels

People experience a wide range of sound levels in their daily activities. The table below presents a graphical comparison of "typical" noise levels which might be encountered, and the general human perception of the level. Sound levels from 40 to 65 dBA are in the faint to moderate range. The vast majority of the outdoor noise environment, even within the busiest city cores, will lie within this area. Sound levels from 65 to 90 are perceived as loud. This area includes very noisy commercial and industrial spaces. Sound levels greater than 90 dB are very loud to deafening, and may result in hearing damage.

***Ranges of Sound Levels***

| Sound Levels | | Sources of Noise |
|---|---|---|
| **Human Perception** | **SPL in dBA** | |
| Deafening | 125 | Sonic booms |
| | 120 | Threshold of Feeling / Pain |
| | 115 | Maximum level, hard rock band concert |
| | 110 | Accelerating Motorcycle at a few feet away |
| Very Loud | 105 | Loud auto horn at 3 m (10 ft) away |
| | 100 | Dance club / maximum human vocal output at 1 m (3 ft) distance |
| | 95 | Jack hammer at 15 m (50 ft) distance |
| | 90 | Indoors in a noisy factory |
| Loud | 85 | Heavy truck pass-by at 15 m (50 ft) distance |
| | 80 | School cafeteria / noisy bar; Vacuum cleaner at 1.5 m (5 ft) |
| | 75 | Near edge of major highway |
| | 70 | Inside automobile at 60 km/h |
| | 65 | Normal human speech (unraised voice) at 1 m (3 ft) distance |
| Moderate | 60 | Typical background noise levels in a large department store |
| | 55 | General objective for outdoor sound levels; typical urban sound level (24h) |
| | 50 | Typical suburban / semi-rural sound level (24h) |
| | 45 | Typical noise levels in an office due to HVAC; typical rural levels (24h) |
| Faint | 40 | Typical background noise levels in a library |
| | 35 | |
| | 30 | Broadcast Studio |
| | 25 | Average whisper |
| Very Faint | 20 | Deep woods on a very calm day |
| | 15 | |
| | 10 | |
| | 5 | Human breathing |
| | 0 | Quietest sound that can be heard |

Transportation noise events, which vary with time, can also be considered in terms of their maximum noise level ($L_{max}$) during a vehicle pass-by, as shown in the following table:

**Typical Pass-By Noise Level at 15 m from Noise Source**

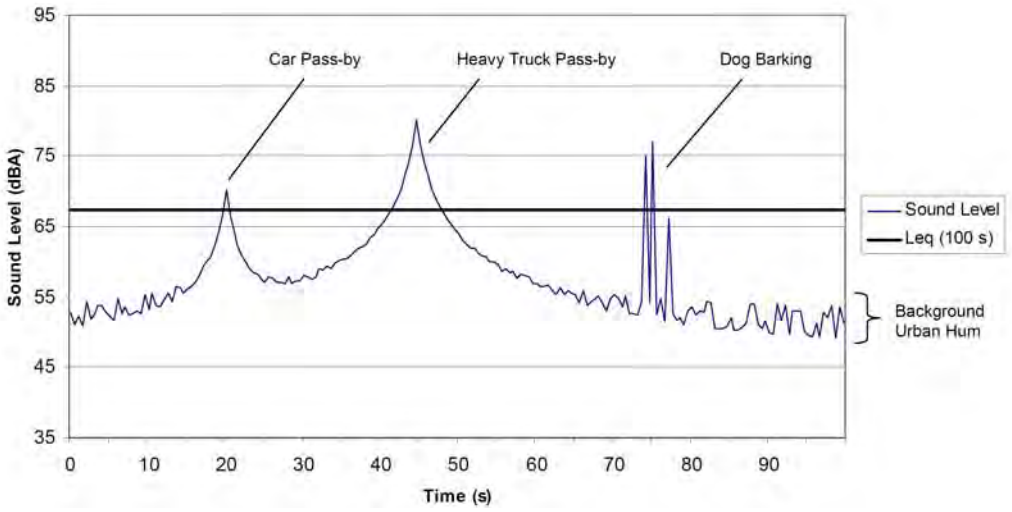
| Event | Range of Noise Levels (dBA) at 15 m |
|---|---|
| Semi-Trailer Trucks | 75 - 85 |
| Aircraft | 69 - 85 [1] |
| Conventional Light Rapid Transit (Streetcars) | 72 - 80 [2] |
| Large Trucks | 71 - 78 |
| Street Motorcycle | 76 |
| Diesel or Natural Gas Bus | 70 - 78 |
| Trolley Bus | 69 - 73 |
| Small Motorcycle | 67 |
| General Busy Auto Traffic | 66 – 70 |
| Individual Automobiles | 63 - 69 |

Notes: Source: BKL Consultants Ltd.
[1] Aircraft flyover not at 15 m distance
[2] Based on data provided for the Calgary, Edmonton and Portland LRT systems.

## Noise Descriptors – $L_{eq}$ Values

At this time, the best available research indicates that long-term human responses to noise are best evaluated using energy equivalent sound exposure levels (Leq values), in A-Weighted decibels ($L_{eq}$ values in dBA)[2,3] including adjustments to account for particularly annoying characteristics of the sounds being analyzed.

Sound levels in the ambient environment vary each instant. In a downtown urban environment, the background noise is formed by an "urban hum", composed of noise from distant road traffic and from commercial sources. As traffic passes near a noise receptor, the instantaneous sound level may increase as a vehicle approaches, and then decrease as it passes and travels farther away. The energy equivalent sound exposure level $L_{eq}$ is the average sound level over the same period of time with same acoustical energy as the actual environment (i.e., it is the average of the sound energy measured over a time period T). As a time-average, all $L_{eq}$ values must have a time period associated with them. This is typically placed in brackets beside the $L_{eq}$ tag. For example, a thirty-minute Leq measurement would be reported as an $L_{eq}$ (30 min) value. The $L_{eq}$ concept is illustrated in Figure 3, showing noise levels beside a small roadway, over a 100 second time period, with two vehicle pass-bys:




***The $L_{eq}$ Concept***

In this example, the background "urban hum" is between 47 and 53 dBA. A car passes by at 20 seconds. As it approaches, the noise level increases to a maximum, and then decreases as it speeds away. At 45 seconds, a heavy truck passes by. Near 75 seconds, a dog barks three times. The maximum sound level (Lmax) over the period is 80 dBA and the minimum is 47 dBA. For almost 50 % of the time, the sound level is lower than 55 dBA.

The $L_{eq}$ (100s) for the example is 67 dBA, which is much higher than the statistical mean sound level of 55 dBA. This illustrates that the Leq value is very sensitive to loud noise events, which contain much more sound energy (as sound is ranked on a logarithmic scale) than the normal background. It is also sensitive to the number of events during the time period, and the duration of those events. If only the truck had passed by during the measurement (no car and no dog barks), the $L_{eq}$ (100s) would be 66 dBA. If only the car and dog barks had occurred, the $L_{eq}$ (100s) would be 61 dBA. This shows that the truck pass-by is the dominant event in our example, due to its level and duration.

[2] Berglund and Lindvall, Community Noise, 1995.

[3] ISO 1996:2003(E), Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures.

The ability of the $L_{eq}$ metric to account for the three factors of level, duration and frequency of events makes it a robust predictor of human response to noise. It is for this reason that the vast majority of noise standards are based on $L_{eq}$ values.

## Typical Durations for $L_{eq}$ Analyses

For transportation noise impact analyses, the following durations are typically used:

| | | |
|---|---|---|
| $L_{eq}$ (24h) | – | The sound exposure level over then entire 24-hour day |
| $L_{eq}$ Day | – | Either: Leq (15h), from 7am to 10 pm;<br>or Leq (16h), from 7am to 11 am |
| $L_{eq}$ Night | – | Either: Leq (9h), from 10 pm to 7 am; or<br>Leq (8h), from 11 pm to 7 am |
| $L_{dn}$ | – | A special Leq (24h) value with a 10 dB night-time penalty applied to overnight sound levels (10pm to 7am) |
| $L_{eq}$ (1-h) | – | The sound exposure over a 1-hour time period |

$L_{eq}$ (24h) values are appropriate for examining impacts of transportation noise sources with small changes in sound exposure levels over the 24-hour day. For example, freeway noise levels are generally consistent over the 24-hour day. Therefore, for freeways, there is little difference between $L_{eq}$ (24h) values and the corresponding $L_{eq}$ Day and $L_{eq}$ Night values.

$L_{eq}$ Day values, covering off the AM-peak and PM-peak travel periods, are generally appropriate for examining the impacts of non-freeway highways and municipal arterial roadways. The vast majority of noise associated with these sources is concentrated in the daytime hours, where typically, 85% to 90% of the daily road traffic will occur.[4] Thus, if reasonable sound levels occur during the daytime (and appropriate guideline limits are met), they will also occur (and be met) at night.

To account for increased annoyance with noise overnight in a single value, the U.S. Environmental Protection Agency (U.S. EPA) developed the $L_{dn}$ metric (also known as DNL). It is a special form of the $L_{eq}$ (24h) with a +10 dB night-time penalty. $L_{dn}$ values and a related metric, the day-evening-night level (Lden) are also used in some European guidelines. $L_{dn}$ values are not used in Canadian Provincial jurisdictions in evaluating transportation noise. Instead, guideline limits for separate Leq Day and Leq Night periods are generally used.

$L_{eq}$ (1-h) values are the average sound levels over a one-hour time period. These tend to fluctuate more over the day, as traffic levels can fluctuate significantly hour to hour. $L_{eq}$ (1-h) values are useful in assessing the impact of transportation sources which also vary hourly, and which may vary in a different manner than the background traffic. These values are often used to assess haul route noise impacts, for example.

[4] Based on research conducted by Ontario Ministry of Transportation, and provided in the *MTO Environmental Office Manual Technical Areas – Noise.* Daytime refers to a 16 hour day from 7am to 11 pm.

Some transportation noise sources may have significant traffic levels occurring overnight. For example, freight rail traffic in heavily used corridors can be shifted to over-night periods, with daytime track use being reserved for freight switcher traffic and passenger traffic. In situations such as this, an assessment of both daytime and night-time noise impacts may be appropriate.

## Decibel Addition

Decibels are logarithmic numbers, and therefore have special properties of addition. Decibel values must be added logarithmically. If two sources, each emitting the same amount of sound energy, are placed side-by-side, then the total increase in sound level will only be 3 dB. If the difference in sound energy emitted is greater than 10 dB, then effectively the sound level will be the same as for the loudest unit (i.e., the increase in noise will be less than a decibel).

***Decibel Addition Chart***

| dB Difference Of | dB Value to Add to Highest Number |
|---|---|
| 0 | 3.0 |
| 1 | 2.5 |
| 2 | 2.1 |
| 3 | 1.8 |
| 4 | 1.5 |
| 5 | 1.2 |
| 6 | 1.0 |
| 7 | 0.8 |
| 8 | 0.6 |
| 9 | 0.5 |
| 10 | 0.4 |

This affects transportation noise from projects, as noise emission is logarithmically related to traffic volume. Doubling the traffic volume (essentially the same as adding a source with the same sound emission) will only result in a 3 dB increase over the original levels. The decibel increase in noise due to the increase in traffic volume, assuming all other factors remain the same, can be estimated by:

$$\text{dB increase} = 10 \log (\text{new volume} / \text{original volume}).$$

## Human Response to Changes in Sound Levels

The human ear does not interpret changes in sound level in a linear manner. The general subjective human perception of changes in sound level is shown in the following table.

***Subjective Human Perception of Changes in Sound Levels***[5,6]

| Change in Broadband Sound Level (dB) | Human Perception of Change |
|---|---|
| <3 | Imperceptible change |
| 3 | Just-perceptible change |
| 4 to 5 | Clearly noticeable change |
| 6 to 9 | Substantial change |
| >10 and more | Very substantial change (half or twice as loud) |
| >20 and more | Very substantial change ( much quieter or louder) |

Notes:

Adapted from Bies and Hansen, p53, and MOE Noise Guidelines for Landfill Sites, 1998. Applies to changes in broadband noise sources only (i.e., increases or decreases in the same noise or same type of noise only). Changes in frequency content or the addition of tonal or temporal changes would affect the perception of the change.

The above table is directly applicable to changes in sound level where the noise sources are of the same general character. For example, existing road traffic noise levels can be directly compared to future road traffic noise levels, using the above relationships. In comparing road traffic noise to road plus rail traffic noise, the different frequency and temporal nature of the noise means that the rail noise may be more noticeable. Adjustments for the nature of the new sound can be applied to better account for temporal and frequency differences.

For transportation noise sources, research conducted by the U.S. Environmental Protection Agency indicates that a 5 dB change in sound levels is required to trigger a change in large-scale community response to noise. This correlates to a clearly noticeable increase in noise levels.

## Decay of Noise with Distance

Noise levels decrease with increasing distance from a source of noise. The rate of decay is partially dependent on the nature of the ground between the source: whether it is hard (acoustically reflective) or soft (acoustically absorptive). Transportation noise sources in general act as *line sources* of sound. For line sources, the rate of decay is approximately:

- Hard ground: 3 dB for each doubling of distance from the source
- Soft ground: 5 dB for each doubling of distance from the source

[5] Bies, D.A., and C.H Hansen 1988. Engineering Noise – Theory and Practice, 2nd Ed. E & E & FN Spon, London, p 53.

[6] Ontario Ministry of the Environment 1998. Noise Guidelines for Landfill Sites. Queen's Printer for Ontario.

# Appendix B

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The City of BARRIE

# ZONING BY-LAW 2009-141
# SOUTH SECTION

## Office Consolidation
## December 31, 2016

1:7,500

0 0.25 0.5 1 km

N



GIS Branch 3/6/2017

Kempenfelt Bay

Town Of Innisfil

Township Of Essa

PLEASE REFER TO TOWN OF INNISFIL ZONING BY-LAW 054-04, AS AMENDED.

PLEASE REFER TO TOWN OF INNISFIL ZONING BY-LAW 054-04, AS AMENDED.

- Central Area Commercial (C1, C1-1, C1-2)
- Transation Centre Commercial (C2, C2-1, C2-2)
- Shopping Centre Commercial (C3)
- General Commercial (C4)
- Convenience Commercial (C5)
- Residential Single Detached Dwelling First Density (R1)
- Residential Single Detached Dwelling Second Density (R2, R2-WS)
- Residential Single Detached Dwelling Third Density (R3, R3-WS)
- Residential Single Detached Dwelling Four Density (R4, R4-WS)
- Residential Apartment Dwelling First Density (RA1, RA1-1, RA1-2, RA1-3)
- Residential Apartment Dwelling Second Density(RA2, RA2-1, RA2-2)
- Residential Hold (RH)
- Residential Multiple Dwelling First Density (RM1; RM1-SS, RM1-WS)
- Residential Multiple Dwelling Second Density (RM2)
- Residential Multiple Dwelling Second Density (RM2-TH, RM2-TH WS)
- Institutional (I)
- Educational Institutional (I-E)
- Major Institutional (I-M, I-M-1)
- Environmental Protection Area (EP)
- Open Space (OS)
- Agriculture (A)
- Business Park (BP)
- Highway Industrial (HI)
- Light Industrial (LI)
- General Industrial (GI)
- Restrictive Industrial (RI)
- Municipal Services and Utilities (MSU)
- City Centre Revitalization Area
- Application Currently Before the Ontario Municipal Board
- City Boundary
- Parcels
- Water

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# Appendix C

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STAMINA 2.0/BCR
FHWA VERSION 3 (MARCH 1983)
TRAFFIC NOISE PREDICTION MODEL

(INPUT UNITS- METRIC , OUTPUT UNITS- METRIC )

Bryne Dr, Harvie Rd,Essa Rd Class EA, 2031 Traffic 16 hr day, Ext.Cond, Sept 26,2017

PROGRAM INITIALIZATION PARAMETERS

| HEIGHT | CODE | DESCRIPTION |
|---|---|---|
| 0.00 | 1 | RECEIVER HEIGHT ADJUSTMENT |
| 1.00 | 2 | A-WEIGHTED SOUND LEVEL ONLY |
| 0.00 | 3 | HEIGHT ADJUSTMENT FOR PASSENGER CARS (CARS) |
| 2.44 | 4 | HEIGHT ADJUSTMENT FOR HEAVY TRUCKS (HT) |
| 0.70 | 5 | HEIGHT ADJUSTMENT FOR MEDIUM TRUCKS (MT) |

ROADWAY 1 RDWY 1 Highway 400 NB North of Mapleview Dr Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604882. | 4909851. | 304. | |
| Seg 2 | 604848. | 4910050. | 304. | |
| Seg 3 | 604810. | 4910250. | 304. | |
| Seg 4 | 604770. | 4910440. | 300. | |
| Seg 5 | 604736. | 4910630. | 301. | 1 |
| Seg 6 | 604698. | 4910824. | 298. | |
| Seg 7 | 604663. | 4911007. | 293. | |
| Seg 8 | 604625. | 4911187. | 288. | |
| Seg 9 | 604591. | 4911372. | 283. | |
| Seg 10 | 604554. | 4911618. | 286. | 1 |
| Seg 11 | 604510. | 4911813. | 278. | |
| Seg 12 | 604459. | 4912002. | 273. | |
| Seg 13 | 604335. | 4912268. | 250. | |
| Seg 14 | 604206. | 4912466. | 238. | |

ROADWAY 2 RDWY 2 Highway 400 NB at Essa Rd Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604206. | 4912466. | 238. | |
| Seg 2 | 604149. | 4912542. | 232. | |
| Seg 3 | 604086. | 4912617. | 227. | |
| Seg 4 | 604019. | 4912691. | 221. | |
| Seg 5 | 603955. | 4912763. | 216. | |
| Seg 6 | 603889. | 4912839. | 210. | |
| Seg 7 | 603823. | 4912913. | 205. | |
| Seg 8 | 603758. | 4912986. | 199. | |
| Seg 9 | 603697. | 4913060. | 194. | |
| Seg 10 | 603634. | 4913132. | 189. | |
| Seg 11 | 603571. | 4913206. | 183. | |
| Seg 12 | 603504. | 4913280. | 178. | |
| Seg 13 | 603441. | 4913352. | 173. | |
| Seg 14 | 603375. | 4913430. | 167. | |
| Seg 15 | 603307. | 4913509. | 161. | |

ROADWAY 3 RDWY 3 Highway 400 SB at Essa Rd Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603285. | 4913489. | 305. | 1 |
| Seg 2 | 603347. | 4913416. | 305. | 1 |
| Seg 3 | 603411. | 4913344. | 305. | 1 |
| Seg 4 | 603480. | 4913265. | 305. | 1 |
| Seg 5 | 603538. | 4913196. | 305. | 1 |
| Seg 6 | 603608. | 4913118. | 305. | 1 |
| Seg 7 | 603673. | 4913041. | 306. | 1 |
| Seg 8 | 603737. | 4912970. | 306. | 1 |
| Seg 9 | 603801. | 4912896. | 306. | 1 |
| Seg 10 | 603865. | 4912822. | 306. | 1 |
| Seg 11 | 603932. | 4912739. | 306. | 1 |
| Seg 12 | 603999. | 4912670. | 306. | 1 |
| Seg 13 | 604065. | 4912591. | 307. | 1 |
| Seg 14 | 604130. | 4912512. | 307. | 1 |

| | | | | |
|---|---|---|---|---|
| Seg 15 | 604192. | 4912438. | 307. | 1 |

ROADWAY 4 RDWY 4 Highway 400 SB North of Mapleview Dr Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604195. | 4912436. | 240. | |
| Seg 2 | 604328. | 4912198. | 260. | 1 |
| Seg 3 | 604376. | 4912112. | 267. | 1 |
| Seg 4 | 604417. | 4912010. | 273. | 1 |
| Seg 5 | 604497. | 4911700. | 282. | 1 |
| Seg 6 | 604532. | 4911531. | 287. | 1 |
| Seg 7 | 604566. | 4911331. | 281. | |
| Seg 8 | 604616. | 4911102. | 283. | 1 |
| Seg 9 | 604671. | 4910825. | 285. | 1 |
| Seg 10 | 604710. | 4910626. | 284. | |
| Seg 11 | 604746. | 4910430. | 282. | |
| Seg 12 | 604789. | 4910234. | 276. | |
| Seg 13 | 604825. | 4910040. | 266. | |
| Seg 14 | 604861. | 4909851. | 257. | |

ROADWAY 5 RDWY 5 Essa Road NB at Mapleview Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 553. | 60. |
| HT | 6. | 60. |
| MT | 6. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602431. | 4909074. | 305. | 1 |
| Seg 2 | 602466. | 4909165. | 307. | 1 |
| Seg 3 | 602501. | 4909258. | 306. | |
| Seg 4 | 602538. | 4909348. | 305. | |
| Seg 5 | 602571. | 4909438. | 306. | 1 |
| Seg 6 | 602607. | 4909528. | 307. | 1 |
| Seg 7 | 602645. | 4909621. | 308. | 1 |
| Seg 8 | 602681. | 4909713. | 309. | 1 |
| Seg 9 | 602719. | 4909804. | 312. | 1 |
| Seg 10 | 602755. | 4909897. | 313. | 1 |
| Seg 11 | 602791. | 4909990. | 314. | 1 |
| Seg 12 | 602822. | 4910069. | 314. | |

ROADWAY 6 RDWY 6 Essa Road NB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 60. |
| HT | 11. | 60. |
| MT | 11. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603279. | 4911212. | 312. | |
| Seg 2 | 603312. | 4911300. | 313. | 1 |
| Seg 3 | 603326. | 4911333. | 313. | |
| Seg 4 | 603348. | 4911372. | 314. | 1 |
| Seg 5 | 603365. | 4911399. | 313. | |
| Seg 6 | 603385. | 4911428. | 313. | |
| Seg 7 | 603413. | 4911460. | 313. | |
| Seg 8 | 603453. | 4911504. | 312. | |
| Seg 9 | 603519. | 4911574. | 311. | |
| Seg 10 | 603540. | 4911598. | 310. | |
| Seg 11 | 603561. | 4911626. | 308. | |
| Seg 12 | 603593. | 4911676. | 308. | |
| Seg 13 | 603606. | 4911707. | 309. | 1 |
| Seg 14 | 603615. | 4911726. | 309. | |
| Seg 15 | 603627. | 4911771. | 309. | |

ROADWAY 7 RDWY 7 Essa Road NB at Loggers Run

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 60. |
| HT | 11. | 60. |
| MT | 11. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603627. | 4911771. | 309. | |
| Seg 2 | 603637. | 4911810. | 309. | |
| Seg 3 | 603642. | 4911869. | 305. | |
| Seg 4 | 603644. | 4911901. | 302. | |
| Seg 5 | 603651. | 4911968. | 297. | |
| Seg 6 | 603657. | 4912024. | 290. | |
| Seg 7 | 603661. | 4912068. | 290. | |
| Seg 8 | 603667. | 4912122. | 287. | |
| Seg 9 | 603671. | 4912174. | 281. | |

| | | | | |
|---|---|---|---|---|
| Seg 10 | 603693. | 4912267. | 274. | |
| Seg 11 | 603714. | 4912329. | 271. | |
| Seg 12 | 603732. | 4912381. | 268. | |
| Seg 13 | 603764. | 4912474. | 264. | |

ROADWAY 8 RDWY 8 Essa Rd NB at Ardagh Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1473. | 60. |
| HT | 15. | 60. |
| MT | 15. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603764. | 4912474. | 263. | |
| Seg 2 | 603782. | 4912541. | 262. | |
| Seg 3 | 603793. | 4912587. | 259. | |
| Seg 4 | 603797. | 4912620. | 258. | |
| Seg 5 | 603799. | 4912664. | 257. | |
| Seg 6 | 603801. | 4912716. | 254. | |
| Seg 7 | 603802. | 4912778. | 252. | |

ROADWAY 9 RDWY 9 Essa Road SB at Ardagh Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1473. | 60. |
| HT | 15. | 60. |
| MT | 15. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603790. | 4912778. | 252. | 1 |
| Seg 2 | 603790. | 4912716. | 254. | 1 |
| Seg 3 | 603789. | 4912659. | 257. | 1 |
| Seg 4 | 603786. | 4912619. | 258. | 1 |
| Seg 5 | 603780. | 4912586. | 259. | 1 |
| Seg 6 | 603769. | 4912546. | 262. | 1 |
| Seg 7 | 603749. | 4912482. | 263. | 1 |

ROADWAY 10 RDWY 10 Essa Rd SB at Loggers Run

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 60. |
| HT | 11. | 60. |
| MT | 11. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603749. | 4912482. | 264. | |
| Seg 2 | 603718. | 4912385. | 264. | |
| Seg 3 | 603698. | 4912320. | 272. | 1 |
| Seg 4 | 603684. | 4912274. | 273. | 1 |
| Seg 5 | 603670. | 4912216. | 277. | 1 |
| Seg 6 | 603662. | 4912173. | 282. | 1 |
| Seg 7 | 603655. | 4912118. | 288. | 1 |
| Seg 8 | 603650. | 4912059. | 290. | 1 |
| Seg 9 | 603643. | 4911986. | 296. | 1 |
| Seg 10 | 603639. | 4911925. | 300. | 1 |
| Seg 11 | 603631. | 4911847. | 308. | 1 |
| Seg 12 | 603622. | 4911784. | 309. | 1 |

ROADWAY 11 RDWY 11 Essa Road SB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 60. |
| HT | 11. | 60. |
| MT | 11. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603622. | 4911784. | 309. | 1 |
| Seg 2 | 603611. | 4911752. | 310. | 1 |
| Seg 3 | 603596. | 4911710. | 309. | 1 |
| Seg 4 | 603577. | 4911671. | 309. | |
| Seg 5 | 603552. | 4911630. | 308. | |
| Seg 6 | 603508. | 4911578. | 309. | 1 |
| Seg 7 | 603467. | 4911534. | 310. | 1 |
| Seg 8 | 603412. | 4911474. | 311. | 1 |
| Seg 9 | 603381. | 4911436. | 312. | 1 |
| Seg 10 | 603352. | 4911394. | 312. | |
| Seg 11 | 603323. | 4911347. | 313. | 1 |
| Seg 12 | 603305. | 4911307. | 314. | 1 |
| Seg 13 | 603269. | 4911219. | 312. | |

ROADWAY 12 RDWY 12 Essa Road SB at Mapleview Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 553. | 60. |
| HT | 6. | 60. |
| MT | 6. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602816. | 4910072. | 314. | 1 |

| | | | | |
|---|---|---|---|---|
| Seg 2 | 602789. | 4910007. | 314. | |
| Seg 3 | 602755. | 4909916. | 314. | |
| Seg 4 | 602718. | 4909822. | 312. | |
| Seg 5 | 602680. | 4909732. | 310. | |
| Seg 6 | 602644. | 4909638. | 308. | |
| Seg 7 | 602608. | 4909545. | 307. | |
| Seg 8 | 602570. | 4909452. | 306. | |
| Seg 9 | 602534. | 4909359. | 305. | |
| Seg 10 | 602498. | 4909269. | 306. | 1 |
| Seg 11 | 602462. | 4909175. | 307. | 1 |
| Seg 12 | 602425. | 4909080. | 305. | |

ROADWAY 13 RDWY 13 Harvie Rd EB/WB at Essa

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 69. | 50. |
| HT | 1. | 50. |
| MT | 1. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603143. | 4910898. | 314. | |
| Seg 2 | 603234. | 4910928. | 314. | |
| Seg 3 | 603330. | 4910959. | 313. | |
| Seg 4 | 603422. | 4910989. | 311. | |
| Seg 5 | 603461. | 4911002. | 311. | |

ROADWAY 14 RDWY 14 Harvie Rd EB/WB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 108. | 50. |
| HT | 1. | 50. |
| MT | 1. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603462. | 4911002. | 313. | 1 |
| Seg 2 | 603557. | 4911034. | 308. | |
| Seg 3 | 603649. | 4911063. | 307. | |
| Seg 4 | 603708. | 4911081. | 307. | |
| Seg 5 | 603768. | 4911101. | 304. | |

ROADWAY 15 RDWY 15 Harvie Rd EB/WB at Thrushwood Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 48. | 50. |
| HT | 0. | 50. |
| MT | 0. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603768. | 4911101. | 304. | |
| Seg 2 | 603852. | 4911125. | 303. | |
| Seg 3 | 603964. | 4911160. | 302. | |

ROADWAY 16 RDWY 16 Veterans Rd S of Harvie NB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 522. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603538. | 4910635. | 311. | 1 |
| Seg 2 | 603532. | 4910673. | 311. | 1 |
| Seg 3 | 603524. | 4910716. | 311. | 1 |
| Seg 4 | 603515. | 4910757. | 312. | 1 |
| Seg 5 | 603508. | 4910791. | 311. | |
| Seg 6 | 603500. | 4910830. | 311. | 1 |
| Seg 7 | 603490. | 4910877. | 311. | |
| Seg 8 | 603482. | 4910923. | 311. | |
| Seg 9 | 603470. | 4910982. | 311. | 1 |
| Seg 10 | 603465. | 4911003. | 311. | |

ROADWAY 17 RDWY 17 Veterans Rd N of Harvie NB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 531. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603465. | 4911003. | 311. | 1 |
| Seg 2 | 603455. | 4911055. | 312. | 1 |
| Seg 3 | 603441. | 4911095. | 312. | 1 |
| Seg 4 | 603408. | 4911145. | 313. | 1 |
| Seg 5 | 603365. | 4911180. | 312. | |
| Seg 6 | 603292. | 4911206. | 311. | |
| Seg 7 | 603243. | 4911226. | 312. | 1 |
| Seg 8 | 603208. | 4911241. | 311. | |
| Seg 9 | 603140. | 4911278. | 310. | |
| Seg 10 | 603114. | 4911295. | 310. | |

ROADWAY 18 RDWY 18 Veterans Rd N of Harvie SB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 531. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603111. | 4911289. | 310. | |
| Seg 2 | 603133. | 4911276. | 310. | |
| Seg 3 | 603195. | 4911241. | 311. | 1 |
| Seg 4 | 603249. | 4911217. | 312. | 1 |
| Seg 5 | 603299. | 4911196. | 312. | |
| Seg 6 | 603310. | 4911192. | 312. | |
| Seg 7 | 603358. | 4911173. | 312. | 1 |
| Seg 8 | 603385. | 4911151. | 313. | 1 |
| Seg 9 | 603405. | 4911132. | 313. | |
| Seg 10 | 603435. | 4911092. | 312. | |
| Seg 11 | 603444. | 4911051. | 312. | |
| Seg 12 | 603456. | 4911001. | 311. | |

ROADWAY 19 RDWY 19 Veterans Rd S of Harvie SB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 522. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603456. | 4911001. | 311. | |
| Seg 2 | 603462. | 4910970. | 311. | |
| Seg 3 | 603471. | 4910924. | 311. | |
| Seg 4 | 603482. | 4910868. | 311. | 1 |
| Seg 5 | 603491. | 4910828. | 311. | |
| Seg 6 | 603500. | 4910781. | 312. | 1 |
| Seg 7 | 603513. | 4910707. | 311. | |
| Seg 8 | 603525. | 4910639. | 311. | |

ROADWAY 20 RDWY 20 Bryne Drive NB Dead end to Essa

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 197. | 50. |
| HT | 4. | 50. |
| MT | 4. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604137. | 4911972. | 292. | |
| Seg 2 | 604100. | 4912034. | 288. | |
| Seg 3 | 604067. | 4912087. | 284. | |
| Seg 4 | 604017. | 4912162. | 279. | |
| Seg 5 | 603970. | 4912262. | 278. | |
| Seg 6 | 603903. | 4912400. | 269. | |
| Seg 7 | 603856. | 4912453. | 267. | |
| Seg 8 | 603770. | 4912494. | 263. | |

ROADWAY 21 RDWY 21 Bryne Drive SB Deadend to Essa

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 197. | 60. |
| HT | 4. | 60. |
| MT | 4. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603766. | 4912478. | 263. | 1 |
| Seg 2 | 603848. | 4912444. | 267. | 1 |
| Seg 3 | 603895. | 4912392. | 269. | 1 |
| Seg 4 | 603957. | 4912262. | 278. | 1 |
| Seg 5 | 604009. | 4912159. | 279. | 1 |
| Seg 6 | 604056. | 4912084. | 284. | 1 |
| Seg 7 | 604090. | 4912031. | 288. | 1 |
| Seg 8 | 604132. | 4911970. | 292. | 1 |

ROADWAY 22 RDWY 22 Thrushwood Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 77. | 50. |
| HT | 1. | 50. |
| MT | 1. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603929. | 4910702. | 304. | |
| Seg 2 | 603878. | 4910742. | 303. | |
| Seg 3 | 603846. | 4910799. | 304. | 1 |
| Seg 4 | 603820. | 4910840. | 305. | 1 |
| Seg 5 | 603799. | 4910881. | 306. | 1 |
| Seg 6 | 603785. | 4910938. | 306. | 1 |
| Seg 7 | 603771. | 4910991. | 307. | 1 |
| Seg 8 | 603763. | 4911028. | 307. | |
| Seg 9 | 603764. | 4911047. | 307. | |

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Seg 10                  603768.    4911095.        307.       1

ROADWAY 23     RDWY 23 Essa Rd from Coughlin to Veterans
                    VEHICLE TYPE   VEHICLES/HOUR     SPEED
                         CARS            1107.         60.
                         HT                11.         60.
                         MT                11.         60.
                     -----------COORDINATES-------------
                           X            Y            Z       GRADE
Seg 1                   602818.    4910067.        314.
Seg 2                   602854.    4910162.        314.
Seg 3                   602885.    4910241.        314.
Seg 4                   602936.    4910365.        314.
Seg 5                   603039.    4910633.        314.       1
Seg 6                   603131.    4910864.        314.
Seg 7                   603219.    4911087.        313.
Seg 8                   603245.    4911148.        313.
Seg 9                   603271.    4911210.        312.

ROADWAY 24     RDWY 24 Mapleview EB/WB Ginger to Veterans Dr
                    VEHICLE TYPE   VEHICLES/HOUR     SPEED
                         CARS            1222.         60.
                         HT                12.         60.
                         MT                12.         60.
                     -----------COORDINATES-------------
                           X            Y            Z       GRADE
Seg 1                   601437.    4908845.        305.       1
Seg 2                   601643.    4908913.        305.       1
Seg 3                   602001.    4909031.        306.       1
Seg 4                   602244.    4909113.        304.
Seg 5                   602467.    4909189.        307.       1
Seg 6                   602899.    4909326.        306.
Seg 7                   603339.    4909462.        308.       1
Seg 8                   603726.    4909594.        309.       1

BARRIER   1   TYPE(A)     Barrier 1 Barrier on Essa Rd at Clovergate and Fairfield Hotel
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603627.  4912381.      275.      271.        0.
Bar 2       603632.  4912365.      275.      271.
Bar 3       603636.  4912344.      275.      271.
Bar 4       603641.  4912322.      277.      272.
Bar 5       603640.  4912317.      272.      272.
Bar 6       603640.  4912312.      284.      273.
Bar 7       603628.  4912294.      284.      273.
Bar 8       603618.  4912276.      284.      273.
Bar 9       603608.  4912257.      286.      275.

BARRIER   2   TYPE(A)     Barrier 2 Barrier on Essa Rd at Loggers Run N
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603634.  4911997.      297.      295.        0.
Bar 2       603636.  4912021.      292.      290.
Bar 3       603638.  4912045.      292.      290.
Bar 4       603639.  4912066.      292.      290.
Bar 5       603640.  4912086.      291.      289.
Bar 6       603641.  4912096.      290.      288.

BARRIER   3   TYPE(A)     Barrier 3 Barrier on Essa Rd at Ferndale Dr S
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603307.  4911351.      315.      313.        0.
Bar 2       603303.  4911341.      315.      313.
Bar 3       603295.  4911323.      315.      313.
Bar 4       603289.  4911310.      315.      313.
Bar 5       603285.  4911300.      315.      313.
Bar 6       603281.  4911289.      315.      313.
Bar 7       603278.  4911281.      315.      313.
Bar 8       603273.  4911268.      315.      313.
Bar 9       603268.  4911256.      315.      313.
Bar 10      603265.  4911248.      315.      313.

BARRIER   4   TYPE(A)     Barrier 4 Barrier on Essa S of Coughlin Rd
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602787.  4910034.      316.      314.        0.
Bar 2       602782.  4910025.      316.      314.
Bar 3       602769.  4909989.      316.      314.
Bar 4       602756.  4909956.      316.      314.
Bar 5       602754.  4909957.      316.      314.
Bar 6       602745.  4909932.      316.      314.
Bar 7       602740.  4909920.      316.      314.
Bar 8       602741.  4909919.      316.      314.
Bar 9       602734.  4909902.      316.      314.
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Bar 10      602728.  4909886.      316.      314.

BARRIER   5   TYPE(A)     Barrier 5 Barrier on Essa S of Coughlin Rd (continued)
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602728.  4909886.      315.      313.        0.
Bar 2       602726.  4909880.      315.      313.
Bar 3       602723.  4909874.      315.      313.
Bar 4       602719.  4909864.      315.      313.
Bar 5       602718.  4909864.      315.      313.
Bar 6       602715.  4909857.      315.      313.
Bar 7       602712.  4909851.      315.      313.
Bar 8       602710.  4909846.      315.      313.
Bar 9       602703.  4909827.      315.      313.

BARRIER   6   TYPE(A)     Barrier 6 Barrier on Essa at Coughlin Rd (continued)
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602697.  4909808.      314.      312.        0.
Bar 2       602685.  4909779.      314.      312.
Bar 3       602684.  4909779.      314.      312.
Bar 4       602665.  4909731.      313.      311.
Bar 5       602666.  4909731.      312.      310.
Bar 6       602647.  4909682.      312.      310.
Bar 7       602646.  4909683.      312.      310.
Bar 8       602627.  4909635.      312.      310.

BARRIER   7   TYPE(A)     Barrier 7 Barrier on Essa across from Messa dev
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602571.  4909498.      309.      307.        0.
Bar 2       602580.  4909521.      309.      307.
Bar 3       602588.  4909541.      309.      307.
Bar 4       602586.  4909541.      309.      307.
Bar 5       602595.  4909563.      309.      307.
Bar 6       602603.  4909582.      309.      307.
Bar 7       602604.  4909583.      309.      307.
Bar 8       602628.  4909634.      309.      307.

BARRIER   8   TYPE(A)     Barrier 8 Barrier on Veterans Road N of Harvie
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603437.  4911029.      314.      312.        0.
Bar 2       603441.  4911030.      314.      312.
Bar 3       603435.  4911053.      314.      312.
Bar 4       603427.  4911079.      314.      312.
Bar 5       603420.  4911093.      314.      312.

BARRIER   9   TYPE(A)     Barrier 9 Barrier on Harvie Road Mid Rise Barrier 1
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603396.  4910960.      321.      311.        0.
Bar 2       603372.  4910952.      322.      312.

BARRIER  10   TYPE(A)     Barrier 10 Barrier on Harvie Road Mid Rise Barrier 2
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603369.  4910952.      322.      312.        0.
Bar 2       603340.  4910942.      323.      313.

BARRIER  11   TYPE(A)     Barrier 11 Barrier on Harvie Road Mid Rise Barrier 3
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603320.  4910936.      323.      313.        0.
Bar 2       603295.  4910927.      324.      314.

BARRIER  12   TYPE(A)     Barrier 12 Barrier on Harvie Road at Thrushwood Dr
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603754.  4911082.      308.      306.        0.
Bar 2       603752.  4911083.      308.      306.
Bar 3       603747.  4911081.      308.      306.
Bar 4       603742.  4911079.      309.      306.
Bar 5       603733.  4911077.      309.      306.
Bar 6       603725.  4911074.      309.      307.
Bar 7       603718.  4911072.      309.      307.
Bar 8       603711.  4911070.      309.      307.

BARRIER  13   TYPE(A)     Barrier 13 Thrushwood Homes at Harvie Rd.
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603748.  4911078.      311.      306.        0.
Bar 2       603734.  4911073.      311.      306.
Bar 3       603738.  4911058.      311.      306.
```

| | | | | |
|---|---|---|---|---|
| Bar 4 | 603734. | 4911056. | 312. | 307. |
| Bar 5 | 603739. | 4911040. | 311. | 306. |
| Bar 6 | 603733. | 4911038. | 311. | 306. |
| Bar 7 | 603738. | 4911019. | 311. | 306. |
| Bar 8 | 603736. | 4911018. | 311. | 306. |
| Bar 9 | 603739. | 4911006. | 311. | 306. |

Receivers

| | COORDINATES | | |
|---|---|---|---|
| | X | Y | Z |
| Rec 1 | 603732. | 4911014. | 308. |
| Rec 2 | 603732. | 4911067. | 308. |
| Rec 3 | 603677. | 4911111. | 309. |
| Rec 4 | 603592. | 4911090. | 310. |
| Rec 5 | 603428. | 4911037. | 313. |
| Rec 6 | 603337. | 4910996. | 314. |
| Rec 7 | 603433. | 4910971. | 312. |
| Rec 8 | 603364. | 4910929. | 313. |
| Rec 9 | 603315. | 4910911. | 314. |
| Rec 10 | 604005. | 4910861. | 301. |
| Rec 11 | 604066. | 4910909. | 301. |
| Rec 12 | 604104. | 4910952. | 301. |
| Rec 13 | 603964. | 4910991. | 301. |
| Rec 14 | 602920. | 4910169. | 315. |
| Rec 15 | 602744. | 4909990. | 315. |
| Rec 16 | 602710. | 4909874. | 315. |
| Rec 17 | 602662. | 4909763. | 313. |
| Rec 18 | 602602. | 4909610. | 309. |
| Rec 19 | 602575. | 4909518. | 308. |
| Rec 20 | 602551. | 4909289. | 307. |
| Rec 21 | 602625. | 4909480. | 308. |
| Rec 22 | 603282. | 4911351. | 313. |
| Rec 23 | 603598. | 4911786. | 310. |
| Rec 24 | 603627. | 4912011. | 309. |
| Rec 25 | 603619. | 4912315. | 309. |
| Rec 26 | 603735. | 4911050. | 308. |
| Rec 27 | 603733. | 4911030. | 308. |

ALPHA FACTORS - RECEIVER ACROSS,ROADWAY DOWN

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 2 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 3 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 4 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 5 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 6 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 7 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 8 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 9 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 10 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 11 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 12 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 13 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 14 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 15 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 16 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 17 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 18 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 19 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 20 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 21 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 22 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 23 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| 24 * | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |

SHIELDING FACTORS - RECEIVER ACROSS,ROADWAY DOWN

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 14 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 * | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

```
18 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
19 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
20 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
21 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
22 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
23 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
24 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

RECEIVER    LEQ(H)   L10
Rec 1        49.2   52.4
NO ROADWAY SEGMENTS EXCEED   40.0 DBA

RECEIVER    LEQ(H)   L10
Rec 2        49.5   52.8
NO ROADWAY SEGMENTS EXCEED   40.0 DBA

RECEIVER    LEQ(H)   L10
Rec 3        53.2   56.7
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        3    4
          44.1 40.1

RECEIVER    LEQ(H)   L10
Rec 4        53.4   56.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2
          44.1

RECEIVER    LEQ(H)   L10
Rec 5        58.9   62.4
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  13        4
          40.4
  14        1
          40.2
  16        8    9
          43.6 44.0
  17        1    2    3
          50.1 47.7 44.3
  18        9   10   11
          44.4 49.0 52.5
  19        1    2
          46.1 42.2
  23        6
          40.9

RECEIVER    LEQ(H)   L10
Rec 6        54.4   57.9
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  13        2    3
          40.7 44.7
  23        6    7
          46.1 40.8

RECEIVER    LEQ(H)   L10
Rec 7        60.5   64.0
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  13        3    4
          45.8 47.1
  14        1
          41.1
  16        7    8    9
          43.3 51.6 48.5
  17        1    2
          47.9 40.5
  18       11
          49.4
  19        1    2    3
          53.6 52.7 44.8
  23        6
          40.5

RECEIVER    LEQ(H)   L10
Rec 8        52.3   55.6
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  16        8
          40.9
  19        2    3
```

```
         41.0 40.5
  23       6
         40.9

RECEIVER    LEQ(H)   L10
Rec 9        51.8   55.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  23       5    6
         40.8 44.7

RECEIVER    LEQ(H)   L10
Rec 10       53.9   55.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       5    6    7    8    9
         41.3 41.8 41.8 41.0 40.4
   4       6    7    8    9   10
         41.4 42.8 44.2 41.9 40.2

RECEIVER    LEQ(H)   L10
Rec 11       54.8   56.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       4    5    6    7    8    9
         40.3 42.2 43.1 43.2 42.4 41.6
   4       6    7    8    9   10
         42.7 44.2 45.5 42.8 40.8

RECEIVER    LEQ(H)   L10
Rec 12       55.5   56.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       4    5    6    7    8    9   10
         40.5 42.7 43.9 44.2 43.5 42.6 40.7
   4       4    5    6    7    8    9   10
         40.5 40.6 43.8 45.4 46.5 43.3 41.0

RECEIVER    LEQ(H)   L10
Rec 13       53.8   55.0
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       5    6    7    8    9
         40.1 41.1 41.6 41.4 41.3
   4       4    6    7    8    9
         40.1 42.3 43.0 43.6 40.6

RECEIVER    LEQ(H)   L10
Rec 14       55.9   59.4
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  23       1    2    3
         49.3 52.9 47.4

RECEIVER    LEQ(H)   L10
Rec 15       55.7   59.2
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5       9   10   11
         41.2 49.1 46.8
  12       1    2    3
         45.5 50.4 43.0
  23       1
         43.9

RECEIVER    LEQ(H)   L10
Rec 16       57.4   60.9
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5       8    9   10
         44.3 52.1 45.6
  12       2    3    4
         44.2 53.3 45.4

RECEIVER    LEQ(H)   L10
Rec 17       56.2   59.6
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5       7    8    9
         45.1 50.7 43.5
  12       3    4    5
         42.6 50.9 47.1

RECEIVER    LEQ(H)   L10
```

```
Rec 18       58.0   61.5
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        5    6    7
          43.1 52.6 47.9
  12        5    6    7
          45.7 53.9 44.8

RECEIVER    LEQ(H)   L10
Rec 19       58.1   61.5
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        4    5    6
          42.7 52.1 48.5
  12        6    7    8
          47.0 53.8 43.8
  24        5
          41.9

RECEIVER    LEQ(H)   L10
Rec 20       60.3   63.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        2    3    4
          46.4 55.3 46.1
  12        8    9   10
          44.7 53.5 47.0
  24        4    5
          43.8 54.2

RECEIVER    LEQ(H)   L10
Rec 21       59.2   62.7
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        4    5    6
          45.0 55.2 47.8
  12        6    7    8
          45.3 53.9 46.2
  24        5
          44.0

RECEIVER    LEQ(H)   L10
Rec 22       58.7   62.3
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   6        1    2    3    4    5
          46.2 46.1 49.2 45.7 42.5
  11        8    9   10   11   12
          40.4 44.9 51.7 49.5 48.2

RECEIVER    LEQ(H)   L10
Rec 23       64.8   68.3
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       12
          40.5
   4        1    2    4
          40.6 40.2 41.7
   6       11   12   13   14
          42.6 44.3 45.6 54.8
   7        1    2    3    4
          56.2 51.1 42.4 41.4
  10        9   10   11
          41.5 49.3 58.3
  11        1    2    3    4
          59.0 52.6 45.4 41.3

RECEIVER    LEQ(H)   L10
Rec 24       65.8   69.0
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       12   13
          42.1 41.8
   4        1    2    3    4
          43.0 41.9 40.7 42.0
   7        3    4    5    6    7    8
          40.6 50.1 57.3 52.8 46.8 41.2
  10        6    7    8    9   10
          44.2 49.0 63.1 55.8 47.3

RECEIVER    LEQ(H)   L10
Rec 25       58.9   61.7
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
```

```
   1       12   13
          41.9 43.4
   2        1    2    3    4    5    6
          40.6 41.3 41.6 41.4 41.2 40.4
   3        9   10   11   12   13   14
          41.0 42.2 42.3 42.6 42.3 41.3
   4        1    2    4
          44.2 41.8 40.6
   7        9   10   11   12
          46.3 46.8 43.6 41.8
  10        1    2    3    4    5    6
          42.4 46.0 47.0 48.2 43.5 41.3

RECEIVER    LEQ(H)   L10
Rec 26       48.6   52.1
NO ROADWAY SEGMENTS EXCEED   40.0 DBA

RECEIVER    LEQ(H)   L10
Rec 27       48.4   51.9
NO ROADWAY SEGMENTS EXCEED   40.0 DBA
```

STAMINA 2.0/BCR
FHWA VERSION 3 (MARCH 1983)
TRAFFIC NOISE PREDICTION MODEL
(INPUT UNITS- METRIC , OUTPUT UNITS- METRIC )

Bryne Dr,Harvie Rd,Essa Rd Class EA, 2031 Traff., 16 hr day, Future Cond, Sept 2

PROGRAM INITIALIZATION PARAMETERS

| HEIGHT | CODE | DESCRIPTION |
|---|---|---|
| 0.00 | 1 | RECEIVER HEIGHT ADJUSTMENT |
| 1.00 | 2 | A-WEIGHTED SOUND LEVEL ONLY |
| 0.00 | 3 | HEIGHT ADJUSTMENT FOR PASSENGER CARS (CARS) |
| 2.44 | 4 | HEIGHT ADJUSTMENT FOR HEAVY TRUCKS (HT) |
| 0.70 | 5 | HEIGHT ADJUSTMENT FOR MEDIUM TRUCKS (MT) |

ROADWAY 1 RDWY 1 Highway 400 NB North of Mapleview Dr Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604882. | 4909851. | 304. | |
| Seg 2 | 604848. | 4910050. | 304. | |
| Seg 3 | 604810. | 4910250. | 304. | |
| Seg 4 | 604770. | 4910440. | 300. | |
| Seg 5 | 604736. | 4910630. | 301. | 1 |
| Seg 6 | 604698. | 4910824. | 298. | |
| Seg 7 | 604663. | 4911007. | 293. | |
| Seg 8 | 604625. | 4911187. | 288. | |
| Seg 9 | 604591. | 4911372. | 283. | |
| Seg 10 | 604554. | 4911618. | 286. | 1 |
| Seg 11 | 604510. | 4911813. | 278. | |
| Seg 12 | 604459. | 4912002. | 273. | |
| Seg 13 | 604335. | 4912268. | 250. | |
| Seg 14 | 604206. | 4912466. | 238. | |

ROADWAY 2 RDWY 2 Highway 400 NB at Essa Rd Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604206. | 4912466. | 238. | |
| Seg 2 | 604149. | 4912542. | 232. | |
| Seg 3 | 604086. | 4912617. | 227. | |
| Seg 4 | 604019. | 4912691. | 221. | |
| Seg 5 | 603955. | 4912763. | 216. | |
| Seg 6 | 603889. | 4912839. | 210. | |
| Seg 7 | 603823. | 4912913. | 205. | |
| Seg 8 | 603758. | 4912986. | 199. | |
| Seg 9 | 603697. | 4913060. | 194. | |
| Seg 10 | 603634. | 4913132. | 189. | |
| Seg 11 | 603571. | 4913206. | 183. | |
| Seg 12 | 603504. | 4913280. | 178. | |
| Seg 13 | 603441. | 4913352. | 173. | |
| Seg 14 | 603375. | 4913430. | 167. | |
| Seg 15 | 603307. | 4913509. | 161. | |

ROADWAY 3 RDWY 3 Highway 400 SB at Essa Rd Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603285. | 4913489. | 305. | 1 |
| Seg 2 | 603347. | 4913416. | 305. | 1 |
| Seg 3 | 603411. | 4913344. | 305. | 1 |
| Seg 4 | 603480. | 4913265. | 305. | 1 |
| Seg 5 | 603538. | 4913196. | 305. | 1 |
| Seg 6 | 603608. | 4913118. | 305. | 1 |
| Seg 7 | 603673. | 4913041. | 306. | 1 |
| Seg 8 | 603737. | 4912970. | 306. | 1 |
| Seg 9 | 603801. | 4912896. | 306. | 1 |
| Seg 10 | 603865. | 4912822. | 306. | 1 |
| Seg 11 | 603932. | 4912739. | 306. | 1 |
| Seg 12 | 603999. | 4912670. | 306. | 1 |
| Seg 13 | 604065. | 4912591. | 307. | 1 |
| Seg 14 | 604130. | 4912512. | 307. | 1 |
| Seg 15 | 604192. | 4912438. | 307. | 1 |

ROADWAY 4 RDWY 4 Highway 400 SB North of Mapleview Dr Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604195. | 4912436. | 240. | |
| Seg 2 | 604328. | 4912198. | 260. | 1 |
| Seg 3 | 604376. | 4912112. | 267. | 1 |
| Seg 4 | 604417. | 4912010. | 273. | 1 |
| Seg 5 | 604497. | 4911700. | 282. | 1 |
| Seg 6 | 604532. | 4911531. | 287. | 1 |
| Seg 7 | 604566. | 4911331. | 281. | |
| Seg 8 | 604616. | 4911102. | 283. | 1 |
| Seg 9 | 604671. | 4910825. | 285. | 1 |
| Seg 10 | 604710. | 4910626. | 284. | |
| Seg 11 | 604746. | 4910430. | 282. | |
| Seg 12 | 604789. | 4910234. | 276. | |
| Seg 13 | 604825. | 4910040. | 266. | |
| Seg 14 | 604861. | 4909851. | 257. | |

ROADWAY 5 RDWY 5 Essa Road NB at Mapleview Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 553. | 70. |
| HT | 6. | 70. |
| MT | 6. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602429. | 4909075. | 305. | 1 |
| Seg 2 | 602464. | 4909166. | 307. | 1 |
| Seg 3 | 602499. | 4909259. | 306. | |
| Seg 4 | 602536. | 4909349. | 305. | |
| Seg 5 | 602570. | 4909438. | 306. | 1 |
| Seg 6 | 602605. | 4909528. | 307. | 1 |
| Seg 7 | 602643. | 4909622. | 308. | 1 |
| Seg 8 | 602680. | 4909713. | 309. | 1 |
| Seg 9 | 602718. | 4909804. | 312. | 1 |
| Seg 10 | 602754. | 4909897. | 313. | 1 |
| Seg 11 | 602790. | 4909990. | 314. | 1 |
| Seg 12 | 602821. | 4910070. | 314. | |

ROADWAY 6 RDWY 6 Essa Road NB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603279. | 4911212. | 312. | |
| Seg 2 | 603312. | 4911300. | 313. | 1 |
| Seg 3 | 603326. | 4911333. | 313. | |
| Seg 4 | 603348. | 4911372. | 314. | 1 |
| Seg 5 | 603365. | 4911399. | 313. | |
| Seg 6 | 603385. | 4911428. | 313. | |
| Seg 7 | 603413. | 4911460. | 313. | |
| Seg 8 | 603453. | 4911504. | 312. | |
| Seg 9 | 603519. | 4911574. | 311. | |
| Seg 10 | 603540. | 4911598. | 310. | |
| Seg 11 | 603561. | 4911626. | 308. | |
| Seg 12 | 603593. | 4911676. | 308. | |
| Seg 13 | 603606. | 4911707. | 309. | 1 |
| Seg 14 | 603615. | 4911726. | 309. | |
| Seg 15 | 603627. | 4911771. | 309. | |

ROADWAY 7 RDWY 7 Essa Road NB at Loggers Run

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603627. | 4911771. | 309. | |
| Seg 2 | 603637. | 4911810. | 309. | |
| Seg 3 | 603642. | 4911869. | 305. | |
| Seg 4 | 603644. | 4911901. | 302. | |
| Seg 5 | 603651. | 4911968. | 297. | |
| Seg 6 | 603657. | 4912024. | 290. | |
| Seg 7 | 603661. | 4912068. | 290. | |
| Seg 8 | 603667. | 4912122. | 287. | |
| Seg 9 | 603671. | 4912174. | 281. | |
| Seg 10 | 603693. | 4912267. | 274. | |
| Seg 11 | 603714. | 4912329. | 271. | |
| Seg 12 | 603732. | 4912381. | 268. | |
| Seg 13 | 603764. | 4912474. | 264. | |

ROADWAY 8 RDWY 8 Essa Rd NB at Ardagh Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1473. | 70. |
| HT | 15. | 70. |
| MT | 15. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603764. | 4912474. | 263. | |
| Seg 2 | 603782. | 4912541. | 262. | |
| Seg 3 | 603793. | 4912587. | 259. | |
| Seg 4 | 603797. | 4912620. | 258. | |
| Seg 5 | 603799. | 4912664. | 257. | |
| Seg 6 | 603801. | 4912716. | 254. | |
| Seg 7 | 603802. | 4912778. | 252. | |

ROADWAY 9 RDWY 9 Essa Road SB at Ardagh Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1473. | 70. |
| HT | 15. | 70. |
| MT | 15. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603790. | 4912778. | 252. | 1 |
| Seg 2 | 603790. | 4912716. | 254. | 1 |
| Seg 3 | 603789. | 4912659. | 257. | 1 |
| Seg 4 | 603786. | 4912619. | 258. | 1 |
| Seg 5 | 603780. | 4912586. | 259. | 1 |
| Seg 6 | 603769. | 4912546. | 262. | 1 |
| Seg 7 | 603749. | 4912482. | 263. | 1 |

ROADWAY 10 RDWY 10 Essa Rd SB at Loggers Run

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603749. | 4912482. | 264. | |
| Seg 2 | 603718. | 4912385. | 264. | |
| Seg 3 | 603698. | 4912320. | 272. | 1 |
| Seg 4 | 603684. | 4912274. | 273. | 1 |
| Seg 5 | 603670. | 4912216. | 277. | 1 |
| Seg 6 | 603662. | 4912173. | 282. | 1 |
| Seg 7 | 603655. | 4912118. | 288. | 1 |
| Seg 8 | 603650. | 4912059. | 290. | 1 |
| Seg 9 | 603643. | 4911986. | 296. | 1 |
| Seg 10 | 603639. | 4911925. | 300. | 1 |
| Seg 11 | 603631. | 4911847. | 308. | 1 |
| Seg 12 | 603622. | 4911784. | 309. | 1 |

ROADWAY 11 RDWY 11 Essa Road SB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603622. | 4911784. | 309. | 1 |
| Seg 2 | 603611. | 4911752. | 310. | 1 |
| Seg 3 | 603596. | 4911710. | 309. | 1 |
| Seg 4 | 603577. | 4911671. | 309. | |
| Seg 5 | 603552. | 4911630. | 308. | |
| Seg 6 | 603508. | 4911578. | 309. | 1 |
| Seg 7 | 603467. | 4911534. | 310. | 1 |
| Seg 8 | 603412. | 4911474. | 311. | 1 |
| Seg 9 | 603381. | 4911436. | 312. | 1 |
| Seg 10 | 603352. | 4911394. | 312. | |
| Seg 11 | 603323. | 4911347. | 313. | 1 |
| Seg 12 | 603305. | 4911307. | 314. | 1 |
| Seg 13 | 603269. | 4911219. | 312. | |

ROADWAY 12 RDWY 12 Essa Road SB at Mapleview Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 553. | 70. |
| HT | 6. | 70. |
| MT | 6. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602812. | 4910073. | 314. | 1 |
| Seg 2 | 602787. | 4910008. | 314. | |
| Seg 3 | 602753. | 4909917. | 314. | |
| Seg 4 | 602716. | 4909823. | 312. | |
| Seg 5 | 602680. | 4909732. | 310. | |
| Seg 6 | 602642. | 4909639. | 308. | |

| | | | | |
|---|---|---|---|---|
| Seg 7 | 602605. | 4909546. | 307. | |
| Seg 8 | 602567. | 4909453. | 306. | |
| Seg 9 | 602532. | 4909360. | 305. | |
| Seg 10 | 602495. | 4909270. | 306. | 1 |
| Seg 11 | 602460. | 4909176. | 307. | 1 |
| Seg 12 | 602422. | 4909081. | 305. | |

ROADWAY 13 RDWY 13 Harvie Rd EB/WB at Essa

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 799. | 60. |
| HT | 8. | 60. |
| MT | 8. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603143. | 4910898. | 314. | |
| Seg 2 | 603234. | 4910928. | 314. | |
| Seg 3 | 603330. | 4910959. | 313. | |
| Seg 4 | 603422. | 4910989. | 311. | |
| Seg 5 | 603461. | 4911002. | 311. | |

ROADWAY 14 RDWY 14 Harvie Rd EB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 853. | 60. |
| HT | 9. | 60. |
| MT | 9. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603460. | 4910998. | 313. | 1 |
| Seg 2 | 603556. | 4911030. | 308. | |
| Seg 3 | 603648. | 4911059. | 307. | |
| Seg 4 | 603707. | 4911078. | 307. | |
| Seg 5 | 603765. | 4911097. | 304. | |
| Seg 6 | 603819. | 4911113. | 304. | |
| Seg 7 | 603940. | 4911152. | 303. | |
| Seg 8 | 603959. | 4911159. | 302. | |

ROADWAY 15 RDWY 15 Harvie Rd EB at Thrushwood Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 821. | 70. |
| HT | 8. | 70. |
| MT | 8. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603959. | 4911159. | 302. | |
| Seg 2 | 603967. | 4911161. | 302. | |
| Seg 3 | 604051. | 4911189. | 298. | |
| Seg 4 | 604127. | 4911213. | 296. | |
| Seg 5 | 604217. | 4911242. | 293. | |

ROADWAY 16 RDWY 16 Harvie Rd EB at Bryne Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1078. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604217. | 4911242. | 293. | |
| Seg 2 | 604269. | 4911259. | 292. | |
| Seg 3 | 604306. | 4911277. | 292. | 1 |
| Seg 4 | 604335. | 4911294. | 292. | |
| Seg 5 | 604370. | 4911318. | 290. | |
| Seg 6 | 604403. | 4911339. | 292. | 1 |
| Seg 7 | 604436. | 4911356. | 288. | |
| Seg 8 | 604478. | 4911372. | 285. | |
| Seg 9 | 604530. | 4911389. | 288. | 1 |

ROADWAY 17 RDWY 17 Harvie Rd WB at Bryne Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1078. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604527. | 4911405. | 288. | 1 |
| Seg 2 | 604476. | 4911387. | 290. | 1 |
| Seg 3 | 604441. | 4911372. | 291. | 1 |
| Seg 4 | 604410. | 4911359. | 291. | |
| Seg 5 | 604376. | 4911336. | 293. | 1 |
| Seg 6 | 604324. | 4911302. | 294. | 1 |
| Seg 7 | 604294. | 4911285. | 294. | |
| Seg 8 | 604267. | 4911271. | 293. | |
| Seg 9 | 604215. | 4911251. | 292. | |

ROADWAY 18 RDWY 18 Harvie Rd WB at Thrushwood

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 821. | 60. |
| HT | 8. | 60. |
| MT | 8. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604215. | 4911251. | 293. | 1 |
| Seg 2 | 604168. | 4911235. | 294. | 1 |
| Seg 3 | 604113. | 4911217. | 296. | 1 |
| Seg 4 | 604079. | 4911207. | 297. | 1 |
| Seg 5 | 603963. | 4911169. | 303. | 1 |
| Seg 6 | 603957. | 4911166. | 302. | |

ROADWAY 19 RDWY 19 Harvie Rd WB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 853. | 60. |
| HT | 9. | 60. |
| MT | 9. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603957. | 4911166. | 302. | 1 |
| Seg 2 | 603896. | 4911147. | 303. | 1 |
| Seg 3 | 603848. | 4911131. | 304. | 1 |
| Seg 4 | 603819. | 4911121. | 304. | |
| Seg 5 | 603779. | 4911108. | 305. | 1 |
| Seg 6 | 603763. | 4911103. | 304. | |
| Seg 7 | 603711. | 4911087. | 307. | 1 |
| Seg 8 | 603660. | 4911070. | 308. | 1 |
| Seg 9 | 603609. | 4911053. | 308. | 1 |
| Seg 10 | 603554. | 4911036. | 308. | |
| Seg 11 | 603458. | 4911005. | 313. | 1 |

ROADWAY 20 RDWY 20 Veterans Rd S of Harvie NB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 522. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603538. | 4910635. | 311. | 1 |
| Seg 2 | 603532. | 4910673. | 311. | 1 |
| Seg 3 | 603524. | 4910716. | 311. | 1 |
| Seg 4 | 603515. | 4910757. | 312. | 1 |
| Seg 5 | 603508. | 4910791. | 311. | |
| Seg 6 | 603500. | 4910830. | 311. | 1 |
| Seg 7 | 603490. | 4910877. | 311. | |
| Seg 8 | 603482. | 4910923. | 311. | |
| Seg 9 | 603470. | 4910982. | 311. | 1 |
| Seg 10 | 603465. | 4911003. | 311. | |

ROADWAY 21 RDWY 21 Veterans Rd N of Harvie NB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 531. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603465. | 4911003. | 311. | 1 |
| Seg 2 | 603455. | 4911055. | 312. | 1 |
| Seg 3 | 603441. | 4911095. | 312. | 1 |
| Seg 4 | 603408. | 4911145. | 313. | 1 |
| Seg 5 | 603365. | 4911180. | 312. | |
| Seg 6 | 603292. | 4911206. | 311. | |
| Seg 7 | 603243. | 4911226. | 312. | 1 |
| Seg 8 | 603208. | 4911241. | 311. | |
| Seg 9 | 603140. | 4911278. | 310. | |
| Seg 10 | 603114. | 4911295. | 310. | |

ROADWAY 22 RDWY 22 Veterans Rd N of Harvie SB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 531. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603111. | 4911289. | 310. | |
| Seg 2 | 603133. | 4911276. | 310. | |
| Seg 3 | 603195. | 4911241. | 311. | 1 |
| Seg 4 | 603249. | 4911217. | 312. | 1 |
| Seg 5 | 603299. | 4911196. | 312. | |
| Seg 6 | 603310. | 4911192. | 312. | |
| Seg 7 | 603358. | 4911173. | 312. | 1 |
| Seg 8 | 603385. | 4911151. | 313. | 1 |

| | | | | |
|---|---|---|---|---|
| Seg 9 | 603405. | 4911132. | 313. | |
| Seg 10 | 603435. | 4911092. | 312. | |
| Seg 11 | 603444. | 4911051. | 312. | |
| Seg 12 | 603456. | 4911001. | 311. | |

ROADWAY 23 RDWY 23 Veterans Rd S of Harvie SB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 522. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603456. | 4911001. | 311. | |
| Seg 2 | 603462. | 4910970. | 311. | |
| Seg 3 | 603471. | 4910924. | 311. | |
| Seg 4 | 603482. | 4910868. | 311. | 1 |
| Seg 5 | 603491. | 4910828. | 311. | |
| Seg 6 | 603500. | 4910781. | 312. | 1 |
| Seg 7 | 603513. | 4910707. | 311. | |
| Seg 8 | 603525. | 4910639. | 311. | |

ROADWAY 24 RDWY 24 Bryne Drive NB at Caplan Ave

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 383. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604385. | 4910454. | 304. | |
| Seg 2 | 604395. | 4910486. | 304. | |
| Seg 3 | 604399. | 4910514. | 303. | |
| Seg 4 | 604398. | 4910536. | 303. | |
| Seg 5 | 604396. | 4910550. | 303. | |
| Seg 6 | 604368. | 4910655. | 301. | |
| Seg 7 | 604351. | 4910722. | 301. | |
| Seg 8 | 604341. | 4910776. | 302. | 1 |
| Seg 9 | 604334. | 4910833. | 302. | |
| Seg 10 | 604320. | 4910939. | 298. | |
| Seg 11 | 604314. | 4910989. | 297. | |
| Seg 12 | 604309. | 4911012. | 296. | |
| Seg 13 | 604299. | 4911045. | 297. | 1 |
| Seg 14 | 604267. | 4911125. | 291. | |
| Seg 15 | 604224. | 4911227. | 293. | 1 |

ROADWAY 25 RDWY 25 Bryne Drive NB at Harvie Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 398. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604214. | 4911251. | 292. | |
| Seg 2 | 604147. | 4911417. | 300. | 1 |
| Seg 3 | 604129. | 4911537. | 302. | 1 |
| Seg 4 | 604136. | 4911642. | 307. | 1 |
| Seg 5 | 604162. | 4911771. | 299. | |
| Seg 6 | 604162. | 4911866. | 299. | |
| Seg 7 | 604136. | 4911969. | 290. | |
| Seg 8 | 604021. | 4912158. | 280. | |
| Seg 9 | 603903. | 4912400. | 269. | |
| Seg 10 | 603857. | 4912454. | 267. | 1 |
| Seg 11 | 603775. | 4912495. | 263. | |

ROADWAY 26 RDWY 26 Bryne Drive SB at Harvie Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 398. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603766. | 4912478. | 263. | 1 |
| Seg 2 | 603847. | 4912445. | 267. | 1 |
| Seg 3 | 603896. | 4912391. | 269. | 1 |
| Seg 4 | 604013. | 4912153. | 280. | 1 |
| Seg 5 | 604073. | 4912060. | 285. | 1 |
| Seg 6 | 604125. | 4911967. | 290. | 1 |
| Seg 7 | 604150. | 4911870. | 299. | 1 |
| Seg 8 | 604152. | 4911782. | 299. | 1 |
| Seg 9 | 604123. | 4911631. | 307. | 1 |
| Seg 10 | 604118. | 4911528. | 302. | 1 |
| Seg 11 | 604134. | 4911427. | 300. | 1 |
| Seg 12 | 604203. | 4911248. | 292. | 1 |

ROADWAY 27  RDWY 27 Bryne Drive SB at Caplan Ave

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 383. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604203. | 4911248. | 294. | 1 |
| Seg 2 | 604252. | 4911131. | 293. | |
| Seg 3 | 604289. | 4911042. | 296. | 1 |
| Seg 4 | 604300. | 4911004. | 296. | 1 |
| Seg 5 | 604306. | 4910962. | 298. | 1 |
| Seg 6 | 604320. | 4910849. | 302. | 1 |
| Seg 7 | 604331. | 4910765. | 303. | 1 |
| Seg 8 | 604349. | 4910683. | 300. | |
| Seg 9 | 604373. | 4910591. | 302. | 1 |
| Seg 10 | 604385. | 4910546. | 303. | 1 |
| Seg 11 | 604388. | 4910522. | 304. | 1 |
| Seg 12 | 604386. | 4910499. | 303. | |
| Seg 13 | 604381. | 4910477. | 304. | 1 |
| Seg 14 | 604375. | 4910458. | 304. | 1 |

ROADWAY 28  RDWY 28 Thrushwood Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 77. | 50. |
| HT | 1. | 50. |
| MT | 1. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603929. | 4910702. | 304. | |
| Seg 2 | 603878. | 4910742. | 303. | |
| Seg 3 | 603846. | 4910799. | 304. | 1 |
| Seg 4 | 603820. | 4910840. | 305. | 1 |
| Seg 5 | 603799. | 4910881. | 306. | 1 |
| Seg 6 | 603785. | 4910938. | 306. | 1 |
| Seg 7 | 603771. | 4910991. | 307. | 1 |
| Seg 8 | 603763. | 4911028. | 307. | |
| Seg 9 | 603764. | 4911047. | 307. | |
| Seg 10 | 603768. | 4911095. | 307. | 1 |

ROADWAY 29  RDWY 29 Essa Rd from Coughlin to Veterans

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1107. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602818. | 4910067. | 314. | |
| Seg 2 | 602854. | 4910162. | 314. | |
| Seg 3 | 602885. | 4910241. | 314. | |
| Seg 4 | 602936. | 4910365. | 314. | |
| Seg 5 | 603039. | 4910633. | 314. | 1 |
| Seg 6 | 603131. | 4910864. | 314. | |
| Seg 7 | 603219. | 4911087. | 313. | |
| Seg 8 | 603245. | 4911148. | 313. | |
| Seg 9 | 603271. | 4911210. | 312. | |

ROADWAY 30  RDWY 30 Mapleview EB/WB Ginger to Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1783. | 60. |
| HT | 18. | 60. |
| MT | 18. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 601437. | 4908845. | 305. | 1 |
| Seg 2 | 601643. | 4908913. | 305. | 1 |
| Seg 3 | 602001. | 4909031. | 306. | 1 |
| Seg 4 | 602244. | 4909113. | 304. | |
| Seg 5 | 602467. | 4909189. | 307. | 1 |
| Seg 6 | 602899. | 4909326. | 306. | |
| Seg 7 | 603339. | 4909462. | 308. | 1 |
| Seg 8 | 603726. | 4909594. | 309. | 1 |

BARRIER  1  TYPE(A)  Barrier 1 Barrier on Essa Rd at Clovergate and Fairfield Hotel

| | X | Y | Z | Z0 | DELZ | P |
|---|---|---|---|---|---|---|
| Bar 1 | 603627. | 4912381. | 275. | 271. | 0. | |
| Bar 2 | 603632. | 4912365. | 275. | 271. | | |
| Bar 3 | 603636. | 4912344. | 275. | 271. | | |
| Bar 4 | 603641. | 4912322. | 277. | 272. | | |
| Bar 5 | 603640. | 4912317. | 272. | 272. | | |
| Bar 6 | 603640. | 4912312. | 284. | 273. | | |
| Bar 7 | 603628. | 4912294. | 284. | 273. | | |
| Bar 8 | 603618. | 4912276. | 284. | 273. | | |

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Bar 9       603608.  4912257.      286.      275.

BARRIER   2   TYPE(A)     Barrier 2 Barrier on Essa Rd at Loggers Run N
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603634.  4911997.      297.      295.        0.
Bar 2       603636.  4912021.      292.      290.
Bar 3       603638.  4912045.      292.      290.
Bar 4       603639.  4912066.      292.      290.
Bar 5       603640.  4912086.      291.      289.
Bar 6       603641.  4912096.      290.      288.

BARRIER   3   TYPE(A)     Barrier 3 Barrier on Essa Rd at Ferndale Dr S
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603307.  4911351.      315.      313.        0.
Bar 2       603303.  4911341.      315.      313.
Bar 3       603295.  4911323.      315.      313.
Bar 4       603289.  4911310.      315.      313.
Bar 5       603285.  4911300.      315.      313.
Bar 6       603281.  4911289.      315.      313.
Bar 7       603278.  4911281.      315.      313.
Bar 8       603273.  4911268.      315.      313.
Bar 9       603268.  4911256.      315.      313.
Bar 10      603265.  4911248.      315.      313.

BARRIER   4   TYPE(A)     Barrier 4 Barrier on Essa S of Coughlin Rd
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602787.  4910034.      316.      314.        0.
Bar 2       602782.  4910025.      316.      314.
Bar 3       602769.  4909989.      316.      314.
Bar 4       602756.  4909956.      316.      314.
Bar 5       602754.  4909957.      316.      314.
Bar 6       602745.  4909932.      316.      314.
Bar 7       602740.  4909920.      316.      314.
Bar 8       602741.  4909919.      316.      314.
Bar 9       602734.  4909902.      316.      314.
Bar 10      602728.  4909886.      316.      314.

BARRIER   5   TYPE(A)     Barrier 5 Barrier on Essa S of Coughlin Rd (continued)
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602728.  4909886.      315.      313.        0.
Bar 2       602726.  4909880.      315.      313.
Bar 3       602723.  4909874.      315.      313.
Bar 4       602719.  4909864.      315.      313.
Bar 5       602718.  4909864.      315.      313.
Bar 6       602715.  4909857.      315.      313.
Bar 7       602712.  4909851.      315.      313.
Bar 8       602710.  4909846.      315.      313.
Bar 9       602703.  4909827.      315.      313.

BARRIER   6   TYPE(A)     Barrier 6 Barrier on Essa at Coughlin Rd (continued)
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602697.  4909808.      314.      312.        0.
Bar 2       602685.  4909779.      314.      312.
Bar 3       602684.  4909779.      314.      312.
Bar 4       602665.  4909731.      313.      311.
Bar 5       602666.  4909731.      312.      310.
Bar 6       602647.  4909682.      312.      310.
Bar 7       602646.  4909683.      312.      310.
Bar 8       602627.  4909635.      312.      310.

BARRIER   7   TYPE(A)     Barrier 7 Barrier on Essa across from Messa dev
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602571.  4909498.      309.      307.        0.
Bar 2       602580.  4909521.      309.      307.
Bar 3       602588.  4909541.      309.      307.
Bar 4       602586.  4909541.      309.      307.
Bar 5       602595.  4909563.      309.      307.
Bar 6       602603.  4909582.      309.      307.
Bar 7       602604.  4909583.      309.      307.
Bar 8       602628.  4909634.      309.      307.

BARRIER   8   TYPE(A)     Barrier 8 Barrier on Veterans Road N of Harvie
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603437.  4911029.      314.      312.        0.
Bar 2       603441.  4911030.      314.      312.
Bar 3       603435.  4911053.      314.      312.
Bar 4       603427.  4911079.      314.      312.
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Bar 5       603420.  4911093.      314.      312.

BARRIER   9   TYPE(A)     Barrier 9 Barrier on Harvie Road Mid Rise Barrier 1
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603396.  4910960.      321.      311.        0.
Bar 2       603372.  4910952.      322.      312.

BARRIER  10   TYPE(A)     Barrier 10 Barrier on Harvie Road Mid Rise Barrier 2
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603369.  4910952.      322.      312.        0.
Bar 2       603340.  4910942.      323.      313.

BARRIER  11   TYPE(A)     Barrier 11 Barrier on Harvie Road Mid Rise Barrier 3
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603320.  4910936.      323.      313.        0.
Bar 2       603295.  4910927.      324.      314.

BARRIER  12   TYPE(A)     Barrier 12 Barrier on Harvie Road at Thrushwood Dr
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603754.  4911082.      308.      306.        0.
Bar 2       603752.  4911083.      308.      306.
Bar 3       603747.  4911081.      308.      306.
Bar 4       603742.  4911079.      309.      306.
Bar 5       603733.  4911077.      309.      306.
Bar 6       603725.  4911074.      309.      307.
Bar 7       603718.  4911072.      309.      307.
Bar 8       603711.  4911070.      309.      307.

BARRIER  13   TYPE(A)     Barrier 13 Thrushwood Homes at Harvie Rd.
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603748.  4911078.      311.      306.        0.
Bar 2       603734.  4911073.      311.      306.
Bar 3       603738.  4911058.      311.      306.
Bar 4       603734.  4911056.      312.      307.
Bar 5       603739.  4911040.      311.      306.
Bar 6       603733.  4911038.      311.      306.
Bar 7       603738.  4911019.      311.      306.
Bar 8       603736.  4911018.      311.      306.
Bar 9       603739.  4911006.      311.      306.

Receivers
                    ------------COORDINATES-------------
                           X           Y           Z
Rec 1                   603732.     4911014.        308.
Rec 2                   603732.     4911067.        308.
Rec 3                   603677.     4911111.        309.
Rec 4                   603592.     4911090.        310.
Rec 5                   603428.     4911037.        313.
Rec 6                   603337.     4910996.        314.
Rec 7                   603433.     4910971.        312.
Rec 8                   603364.     4910929.        313.
Rec 9                   603315.     4910911.        314.
Rec 10                  604005.     4910861.        301.
Rec 11                  604066.     4910909.        301.
Rec 12                  604104.     4910952.        301.
Rec 13                  603964.     4910991.        301.
Rec 14                  602920.     4910169.        315.
Rec 15                  602744.     4909990.        315.
Rec 16                  602710.     4909874.        315.
Rec 17                  602662.     4909763.        313.
Rec 18                  602602.     4909610.        309.
Rec 19                  602575.     4909518.        308.
Rec 20                  602551.     4909289.        307.
Rec 21                  602625.     4909480.        308.
Rec 22                  603282.     4911351.        313.
Rec 23                  603598.     4911786.        310.
Rec 24                  603627.     4912011.        309.
Rec 25                  603619.     4912315.        309.
Rec 26                  603735.     4911050.        308.
Rec 27                  603733.     4911030.        308.

 ALPHA FACTORS - RECEIVER ACROSS,ROADWAY DOWN

 1 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
 2 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
 3 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
 4 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
 5 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
 6 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
```

```
 7 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
 8 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
 9 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
10 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
11 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
12 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
13 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
14 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
15 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
16 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
17 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
18 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
19 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
20 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
21 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
22 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
23 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
24 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
25 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
26 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
27 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
28 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
29 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7
30 * 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7

 SHIELDING FACTORS - RECEIVER ACROSS,ROADWAY DOWN

 1 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 2 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 3 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 4 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 5 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 6 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 7 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 8 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 9 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
10 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
11 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
12 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
13 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
14 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
15 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
16 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
17 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
18 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
19 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
20 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
21 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
22 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
23 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
24 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
25 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
26 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
27 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
28 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
29 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
30 * 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

RECEIVER    LEQ(H)   L10
Rec 1        54.8   58.3
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2    3    4
          44.2 48.0 41.5
  19        6    7    8
          40.7 46.6 43.7

RECEIVER    LEQ(H)   L10
Rec 2        57.8   61.3
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2    3    4
          44.7 51.0 51.1
  19        6    7    8    9
          49.7 49.4 45.3 40.1

RECEIVER    LEQ(H)   L10
Rec 3        61.5   65.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        1    2    3    4    5    6
          41.0 48.2 54.4 51.1 43.4 40.6
  19        4    5    6    7    8    9
          41.3 41.8 51.0 56.0 50.3 43.3
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RECEIVER    LEQ(H)   L10
Rec 4        60.6   64.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        1    2    3    4
          48.1 54.4 47.2 41.1
  19        6    7    8    9   10
          40.5 45.5 52.6 53.5 47.3

RECEIVER    LEQ(H)   L10
Rec 5        61.3   64.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  13        2    3    4
          41.0 50.4 52.1
  14        1    2
          51.1 41.0
  19       10
          50.3
  20        8    9
          43.6 44.0
  21        1    2    3
          50.1 47.7 44.3
  22        9   10   11
          44.4 49.0 52.5
  23        1    2
          46.1 42.2
  29        6
          42.5

RECEIVER    LEQ(H)   L10
Rec 6        59.8   63.4
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  13        1    2    3    4
          41.0 52.4 56.4 42.6
  14        1
          42.7
  19       10
          41.5
  29        6    7    8
          47.7 42.4 40.1

RECEIVER    LEQ(H)   L10
Rec 7        64.4   67.9
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  13        2    3    4
          42.7 57.5 58.8
  14        1    2
          52.8 40.3
  19       10
          51.0
  20        7    8    9
          43.3 51.6 48.5
  21        1    2
          47.9 40.5
  22       11
          49.4
  23        1    2    3
          53.6 52.7 44.8
  29        6
          42.1

RECEIVER    LEQ(H)   L10
Rec 8        55.2   58.7
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  13        2    3    4
          47.5 44.7 41.6
  14        1
          43.0
  19       10
          41.6
  20        8
          40.9
  23        2    3
          41.0 40.5
  29        5    6
          40.2 42.5

RECEIVER    LEQ(H)   L10
Rec 9        55.8   59.3
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
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ROADWAY  SEGMENT
  13        1    2    3
          44.8 50.1 48.0
  29        5    6
          42.5 46.3

RECEIVER    LEQ(H)   L10
Rec 10       54.6   55.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1        5    6    7    8    9
          41.3 41.8 41.8 41.0 40.4
   4        6    7    8    9   10
          41.4 42.8 44.2 41.9 40.2

RECEIVER    LEQ(H)   L10
Rec 11       55.7   56.9
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1        4    5    6    7    8    9
          40.3 42.2 43.1 43.2 42.4 41.6
   4        6    7    8    9   10
          42.7 44.2 45.5 42.8 40.8

RECEIVER    LEQ(H)   L10
Rec 12       56.5   57.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1        4    5    6    7    8    9   10
          40.5 42.7 43.9 44.2 43.5 42.6 40.7
   4        4    5    6    7    8    9   10
          40.5 40.6 43.8 45.4 46.5 43.3 41.0

RECEIVER    LEQ(H)   L10
Rec 13       55.5   57.2
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1        5    6    7    8    9
          40.1 41.1 41.6 41.4 41.3
   4        4    6    7    8    9
          40.1 42.3 43.0 43.6 40.6
  14        6
          42.1
  15        2
          40.4
  18        4
          40.4

RECEIVER    LEQ(H)   L10
Rec 14       57.4   61.0
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  29        1    2    3    4
          50.9 54.5 49.0 41.5

RECEIVER    LEQ(H)   L10
Rec 15       57.3   60.7
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        9   10   11
          42.7 50.6 48.4
  12        1    2    3
          47.1 52.0 44.3
  29        1
          45.5

RECEIVER    LEQ(H)   L10
Rec 16       59.1   62.5
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        8    9   10
          45.8 53.8 47.1
  12        2    3    4
          45.7 55.1 46.8

RECEIVER    LEQ(H)   L10
Rec 17       57.7   61.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        7    8    9
          46.6 52.3 45.1
  12        3    4    5    6
          44.3 52.2 48.5 40.5
```

```
RECEIVER    LEQ(H)   L10
Rec 18       59.8   63.2
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        5    6    7
          44.8 54.4 49.5
  12        5    6    7
          47.0 55.8 46.4
  30        5
          40.9

RECEIVER    LEQ(H)   L10
Rec 19       60.0   63.3
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        4    5    6    7
          44.3 54.0 50.2 41.1
  12        5    6    7    8
          40.1 48.8 55.9 45.5
  30        5
          43.6

RECEIVER    LEQ(H)   L10
Rec 20       61.6   65.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        2    3    4
          47.9 56.5 47.6
  12        8    9   10
          46.1 54.5 48.3
  30        4    5
          45.5 55.9


RECEIVER    LEQ(H)   L10
Rec 21       60.4   63.9
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   5        4    5    6
          46.5 56.4 49.2
  12        6    7    8
          46.7 54.9 47.5
  30        5
          45.7

RECEIVER    LEQ(H)   L10
Rec 22       60.1   63.6
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   6        1    2    3    4    5    6
          47.7 47.5 50.7 47.3 44.1 41.4
  11        8    9   10   11   12
          42.0 46.5 53.3 50.8 49.7
  29        8
          41.0

RECEIVER    LEQ(H)   L10
Rec 23       66.3   69.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       12
          40.5
   4        1    2    4
          40.6 40.2 41.7
   6       11   12   13   14
          44.2 45.9 47.3 56.4
   7        1    2    3    4
          57.8 52.7 44.0 43.0
  10        8    9   10   11
          40.1 42.9 50.7 59.9
  11        1    2    3    4    5
          60.6 54.2 47.0 42.9 40.5

RECEIVER    LEQ(H)   L10
Rec 24       67.1   70.4
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       12   13
          42.1 41.8
   4        1    2    3    4
          43.0 41.9 40.7 42.0
   7        2    3    4    5    6    7    8    9
          41.2 42.2 51.7 58.9 54.4 48.4 42.8 40.7
  10        5    6    7    8    9   10   11
```

```
          40.6 45.5 50.5 64.5 57.2 48.7 40.2

RECEIVER    LEQ(H)   L10
Rec 25       59.8   62.7
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
   1       12   13
          41.9 43.4
   2        1    2    3    4    5    6
          40.6 41.3 41.6 41.4 41.2 40.4
   3        9   10   11   12   13   14
          41.0 42.2 42.3 42.6 42.3 41.3
   4        1    2    4
          44.2 41.8 40.6
   7        8    9   10   11   12
          40.4 47.9 48.4 45.2 43.4
  10        1    2    3    4    5    6
          44.0 47.6 48.6 49.6 44.8 42.7

RECEIVER    LEQ(H)   L10
Rec 26       56.7   60.2
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2    3    4
          44.6 51.3 46.2
  19        6    7    8
          45.2 49.8 44.8

RECEIVER    LEQ(H)   L10
Rec 27       55.5   59.0
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2    3    4
          44.5 49.8 43.0
  19        6    7    8    9
          42.2 48.3 44.4 40.0
```

STAMINA 2.0/BCR
FHWA VERSION 3 (MARCH 1983)
TRAFFIC NOISE PREDICTION MODEL

(INPUT UNITS- METRIC, OUTPUT UNITS- METRIC)
Bryne Dr, Harvie Rd, Essa Rd Class EA, 2031 Traffic 16 hr day, Future Cond, Sept 26, 2017
PROGRAM INITIALIZATION PARAMETERS

| HEIGHT | CODE | DESCRIPTION |
|---|---|---|
| 0.00 | 1 | RECEIVER HEIGHT ADJUSTMENT |
| 1.00 | 2 | A-WEIGHTED SOUND LEVEL ONLY |
| 0.00 | 3 | HEIGHT ADJUSTMENT FOR PASSENGER CARS (CARS) |
| 2.44 | 4 | HEIGHT ADJUSTMENT FOR HEAVY TRUCKS (HT) |
| 0.70 | 5 | HEIGHT ADJUSTMENT FOR MEDIUM TRUCKS (MT) |

ROADWAY 1 RDWY 1 Highway 400 NB North of Mapleview Dr Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604882. | 4909851. | 304. | |
| Seg 2 | 604848. | 4910050. | 304. | |
| Seg 3 | 604810. | 4910250. | 304. | |
| Seg 4 | 604770. | 4910440. | 300. | |
| Seg 5 | 604736. | 4910630. | 301. | 1 |
| Seg 6 | 604698. | 4910824. | 298. | |
| Seg 7 | 604663. | 4911007. | 293. | |
| Seg 8 | 604625. | 4911187. | 288. | |
| Seg 9 | 604591. | 4911372. | 283. | |
| Seg 10 | 604554. | 4911618. | 286. | 1 |
| Seg 11 | 604510. | 4911813. | 278. | |
| Seg 12 | 604459. | 4912002. | 273. | |
| Seg 13 | 604335. | 4912268. | 250. | |
| Seg 14 | 604206. | 4912466. | 238. | |

ROADWAY 2 RDWY 2 Highway 400 NB at Essa Rd Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604206. | 4912466. | 238. | |
| Seg 2 | 604149. | 4912542. | 232. | |
| Seg 3 | 604086. | 4912617. | 227. | |
| Seg 4 | 604019. | 4912691. | 221. | |
| Seg 5 | 603955. | 4912763. | 216. | |
| Seg 6 | 603889. | 4912839. | 210. | |
| Seg 7 | 603823. | 4912913. | 205. | |
| Seg 8 | 603758. | 4912986. | 199. | |
| Seg 9 | 603697. | 4913060. | 194. | |
| Seg 10 | 603634. | 4913132. | 189. | |
| Seg 11 | 603571. | 4913206. | 183. | |
| Seg 12 | 603504. | 4913280. | 178. | |
| Seg 13 | 603441. | 4913352. | 173. | |
| Seg 14 | 603375. | 4913430. | 167. | |
| Seg 15 | 603307. | 4913509. | 161. | |

ROADWAY 3 RDWY 3 Highway 400 SB at Essa Rd Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 2781. | 100. |
| HT | 311. | 100. |
| MT | 69. | 100. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603285. | 4913489. | 305. | 1 |
| Seg 2 | 603347. | 4913416. | 305. | 1 |
| Seg 3 | 603411. | 4913344. | 305. | 1 |
| Seg 4 | 603480. | 4913265. | 305. | 1 |
| Seg 5 | 603538. | 4913196. | 305. | 1 |
| Seg 6 | 603608. | 4913118. | 305. | 1 |
| Seg 7 | 603673. | 4913041. | 306. | 1 |
| Seg 8 | 603737. | 4912970. | 306. | 1 |
| Seg 9 | 603801. | 4912896. | 306. | 1 |
| Seg 10 | 603865. | 4912822. | 306. | 1 |
| Seg 11 | 603932. | 4912739. | 306. | 1 |
| Seg 12 | 603999. | 4912670. | 306. | 1 |
| Seg 13 | 604065. | 4912591. | 307. | 1 |
| Seg 14 | 604130. | 4912512. | 307. | 1 |
| Seg 15 | 604192. | 4912438. | 307. | 1 |

ROADWAY 4 RDWY 4 Highway 400 SB North of Mapleview Dr Off Ramp

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|

| | | | |
|---|---|---|---|
| CARS | 2781. | 100. | |
| HT | 311. | 100. | |
| MT | 69. | 100. | |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604195. | 4912436. | 240. | |
| Seg 2 | 604328. | 4912198. | 260. | 1 |
| Seg 3 | 604376. | 4912112. | 267. | 1 |
| Seg 4 | 604417. | 4912010. | 273. | 1 |
| Seg 5 | 604497. | 4911700. | 282. | 1 |
| Seg 6 | 604532. | 4911531. | 287. | 1 |
| Seg 7 | 604566. | 4911331. | 281. | |
| Seg 8 | 604616. | 4911102. | 283. | 1 |
| Seg 9 | 604671. | 4910825. | 285. | 1 |
| Seg 10 | 604710. | 4910626. | 284. | |
| Seg 11 | 604746. | 4910430. | 282. | |
| Seg 12 | 604789. | 4910234. | 276. | |
| Seg 13 | 604825. | 4910040. | 266. | |
| Seg 14 | 604861. | 4909851. | 257. | |

ROADWAY 5 RDWY 5 Essa Road NB at Mapleview Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 553. | 70. |
| HT | 6. | 70. |
| MT | 6. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602429. | 4909075. | 305. | 1 |
| Seg 2 | 602464. | 4909166. | 307. | 1 |
| Seg 3 | 602499. | 4909259. | 306. | |
| Seg 4 | 602536. | 4909349. | 305. | |
| Seg 5 | 602570. | 4909438. | 306. | 1 |
| Seg 6 | 602605. | 4909528. | 307. | 1 |
| Seg 7 | 602643. | 4909622. | 308. | 1 |
| Seg 8 | 602680. | 4909713. | 309. | 1 |
| Seg 9 | 602718. | 4909804. | 312. | 1 |
| Seg 10 | 602754. | 4909897. | 313. | 1 |
| Seg 11 | 602790. | 4909990. | 314. | 1 |
| Seg 12 | 602821. | 4910070. | 314. | |

ROADWAY 6 RDWY 6 Essa Road NB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603279. | 4911212. | 312. | |
| Seg 2 | 603312. | 4911300. | 313. | 1 |
| Seg 3 | 603326. | 4911333. | 313. | |
| Seg 4 | 603348. | 4911372. | 314. | 1 |
| Seg 5 | 603365. | 4911399. | 313. | |
| Seg 6 | 603385. | 4911428. | 313. | |
| Seg 7 | 603413. | 4911460. | 313. | |
| Seg 8 | 603453. | 4911504. | 312. | |
| Seg 9 | 603519. | 4911574. | 311. | |
| Seg 10 | 603540. | 4911598. | 310. | |
| Seg 11 | 603561. | 4911626. | 308. | |
| Seg 12 | 603593. | 4911676. | 308. | |
| Seg 13 | 603606. | 4911707. | 309. | 1 |
| Seg 14 | 603615. | 4911726. | 309. | |
| Seg 15 | 603627. | 4911771. | 309. | |

ROADWAY 7 RDWY 7 Essa Road NB at Loggers Run

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603627. | 4911771. | 309. | |
| Seg 2 | 603637. | 4911810. | 309. | |
| Seg 3 | 603642. | 4911869. | 305. | |
| Seg 4 | 603644. | 4911901. | 302. | |
| Seg 5 | 603651. | 4911968. | 297. | |
| Seg 6 | 603657. | 4912024. | 290. | |
| Seg 7 | 603661. | 4912068. | 290. | |
| Seg 8 | 603667. | 4912122. | 287. | |
| Seg 9 | 603671. | 4912174. | 281. | |
| Seg 10 | 603693. | 4912267. | 274. | |
| Seg 11 | 603714. | 4912329. | 271. | |
| Seg 12 | 603732. | 4912381. | 268. | |
| Seg 13 | 603764. | 4912474. | 264. | |

ROADWAY 8 RDWY 8 Essa Rd NB at Ardagh Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1473. | 70. |
| HT | 15. | 70. |
| MT | 15. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603764. | 4912474. | 263. | |
| Seg 2 | 603782. | 4912541. | 262. | |
| Seg 3 | 603793. | 4912587. | 259. | |
| Seg 4 | 603797. | 4912620. | 258. | |
| Seg 5 | 603799. | 4912664. | 257. | |
| Seg 6 | 603801. | 4912716. | 254. | |
| Seg 7 | 603802. | 4912778. | 252. | |

ROADWAY 9 RDWY 9 Essa Road SB at Ardagh Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1473. | 70. |
| HT | 15. | 70. |
| MT | 15. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603790. | 4912778. | 252. | 1 |
| Seg 2 | 603790. | 4912716. | 254. | 1 |
| Seg 3 | 603789. | 4912659. | 257. | 1 |
| Seg 4 | 603786. | 4912619. | 258. | 1 |
| Seg 5 | 603780. | 4912586. | 259. | 1 |
| Seg 6 | 603769. | 4912546. | 262. | 1 |
| Seg 7 | 603749. | 4912482. | 263. | 1 |

ROADWAY 10 RDWY 10 Essa Rd SB at Loggers Run

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603749. | 4912482. | 264. | |
| Seg 2 | 603718. | 4912385. | 264. | |
| Seg 3 | 603698. | 4912320. | 272. | 1 |
| Seg 4 | 603684. | 4912274. | 273. | 1 |
| Seg 5 | 603670. | 4912216. | 277. | 1 |
| Seg 6 | 603662. | 4912173. | 282. | 1 |
| Seg 7 | 603655. | 4912118. | 288. | 1 |
| Seg 8 | 603650. | 4912059. | 290. | 1 |
| Seg 9 | 603643. | 4911986. | 296. | 1 |
| Seg 10 | 603639. | 4911925. | 300. | 1 |
| Seg 11 | 603631. | 4911847. | 308. | 1 |
| Seg 12 | 603622. | 4911784. | 309. | 1 |

ROADWAY 11 RDWY 11 Essa Road SB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1086. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603622. | 4911784. | 309. | 1 |
| Seg 2 | 603611. | 4911752. | 310. | 1 |
| Seg 3 | 603596. | 4911710. | 309. | 1 |
| Seg 4 | 603577. | 4911671. | 309. | |
| Seg 5 | 603552. | 4911630. | 308. | |
| Seg 6 | 603508. | 4911578. | 309. | 1 |
| Seg 7 | 603467. | 4911534. | 310. | 1 |
| Seg 8 | 603412. | 4911474. | 311. | 1 |
| Seg 9 | 603381. | 4911436. | 312. | 1 |
| Seg 10 | 603352. | 4911394. | 312. | |
| Seg 11 | 603323. | 4911347. | 313. | 1 |
| Seg 12 | 603305. | 4911307. | 314. | 1 |
| Seg 13 | 603269. | 4911219. | 312. | |

ROADWAY 12 RDWY 12 Essa Road SB at Mapleview Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 553. | 70. |
| HT | 6. | 70. |
| MT | 6. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602812. | 4910073. | 314. | 1 |
| Seg 2 | 602787. | 4910008. | 314. | |
| Seg 3 | 602753. | 4909917. | 314. | |
| Seg 4 | 602716. | 4909823. | 312. | |
| Seg 5 | 602680. | 4909732. | 310. | |
| Seg 6 | 602642. | 4909639. | 308. | |

| | | | | |
|---|---|---|---|---|
| Seg 7 | 602605. | 4909546. | 307. | |
| Seg 8 | 602567. | 4909453. | 306. | |
| Seg 9 | 602532. | 4909360. | 305. | |
| Seg 10 | 602495. | 4909270. | 306. | 1 |
| Seg 11 | 602460. | 4909176. | 307. | 1 |
| Seg 12 | 602422. | 4909081. | 305. | |

ROADWAY 13 RDWY 13 Harvie Rd EB/WB at Essa

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 799. | 60. |
| HT | 8. | 60. |
| MT | 8. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603143. | 4910898. | 314. | |
| Seg 2 | 603234. | 4910928. | 314. | |
| Seg 3 | 603330. | 4910959. | 313. | |
| Seg 4 | 603422. | 4910989. | 311. | |
| Seg 5 | 603461. | 4911002. | 311. | |

ROADWAY 14 RDWY 14 Harvie Rd EB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 853. | 60. |
| HT | 9. | 60. |
| MT | 9. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603460. | 4910998. | 313. | 1 |
| Seg 2 | 603556. | 4911030. | 308. | |
| Seg 3 | 603648. | 4911059. | 307. | |
| Seg 4 | 603707. | 4911078. | 307. | |
| Seg 5 | 603765. | 4911097. | 304. | |
| Seg 6 | 603819. | 4911113. | 304. | |
| Seg 7 | 603940. | 4911152. | 303. | |
| Seg 8 | 603959. | 4911159. | 302. | |

ROADWAY 15 RDWY 15 Harvie Rd EB at Thrushwood Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 821. | 70. |
| HT | 8. | 70. |
| MT | 8. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603959. | 4911159. | 302. | |
| Seg 2 | 603967. | 4911161. | 302. | |
| Seg 3 | 604051. | 4911189. | 298. | |
| Seg 4 | 604127. | 4911213. | 296. | |
| Seg 5 | 604217. | 4911242. | 293. | |

ROADWAY 16 RDWY 16 Harvie Rd EB at Bryne Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1078. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604217. | 4911242. | 293. | |
| Seg 2 | 604269. | 4911259. | 292. | |
| Seg 3 | 604306. | 4911277. | 292. | 1 |
| Seg 4 | 604335. | 4911294. | 292. | |
| Seg 5 | 604370. | 4911318. | 290. | |
| Seg 6 | 604403. | 4911339. | 292. | 1 |
| Seg 7 | 604436. | 4911356. | 288. | |
| Seg 8 | 604478. | 4911372. | 285. | |
| Seg 9 | 604530. | 4911389. | 288. | 1 |

ROADWAY 17 RDWY 17 Harvie Rd WB at Bryne Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1078. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604527. | 4911405. | 288. | 1 |
| Seg 2 | 604476. | 4911387. | 290. | 1 |
| Seg 3 | 604441. | 4911372. | 291. | 1 |
| Seg 4 | 604410. | 4911359. | 291. | |
| Seg 5 | 604376. | 4911336. | 293. | 1 |
| Seg 6 | 604324. | 4911302. | 294. | 1 |
| Seg 7 | 604294. | 4911285. | 294. | |
| Seg 8 | 604267. | 4911271. | 293. | |
| Seg 9 | 604215. | 4911251. | 292. | |

ROADWAY 18 RDWY 18 Harvie Rd WB at Thrushwood

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 821. | 60. |
| HT | 8. | 60. |
| MT | 8. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604215. | 4911251. | 293. | 1 |
| Seg 2 | 604168. | 4911235. | 294. | 1 |
| Seg 3 | 604113. | 4911217. | 296. | 1 |
| Seg 4 | 604079. | 4911207. | 297. | 1 |
| Seg 5 | 603963. | 4911169. | 303. | 1 |
| Seg 6 | 603957. | 4911166. | 302. | |

ROADWAY 19 RDWY 19 Harvie Rd WB at Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 853. | 60. |
| HT | 9. | 60. |
| MT | 9. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603957. | 4911166. | 302. | 1 |
| Seg 2 | 603896. | 4911147. | 303. | 1 |
| Seg 3 | 603848. | 4911131. | 304. | 1 |
| Seg 4 | 603819. | 4911121. | 304. | |
| Seg 5 | 603779. | 4911108. | 305. | 1 |
| Seg 6 | 603763. | 4911103. | 304. | |
| Seg 7 | 603711. | 4911087. | 307. | 1 |
| Seg 8 | 603660. | 4911070. | 308. | 1 |
| Seg 9 | 603609. | 4911053. | 308. | 1 |
| Seg 10 | 603554. | 4911036. | 308. | |
| Seg 11 | 603458. | 4911005. | 313. | 1 |

ROADWAY 20 RDWY 20 Veterans Rd S of Harvie NB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 522. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603538. | 4910635. | 311. | 1 |
| Seg 2 | 603532. | 4910673. | 311. | 1 |
| Seg 3 | 603524. | 4910716. | 311. | 1 |
| Seg 4 | 603515. | 4910757. | 312. | 1 |
| Seg 5 | 603508. | 4910791. | 311. | |
| Seg 6 | 603500. | 4910830. | 311. | 1 |
| Seg 7 | 603490. | 4910877. | 311. | |
| Seg 8 | 603482. | 4910923. | 311. | |
| Seg 9 | 603470. | 4910982. | 311. | 1 |
| Seg 10 | 603465. | 4911003. | 311. | |

ROADWAY 21 RDWY 21 Veterans Rd N of Harvie NB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 531. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603465. | 4911003. | 311. | 1 |
| Seg 2 | 603455. | 4911055. | 312. | 1 |
| Seg 3 | 603441. | 4911095. | 312. | 1 |
| Seg 4 | 603408. | 4911145. | 313. | 1 |
| Seg 5 | 603365. | 4911180. | 312. | |
| Seg 6 | 603292. | 4911206. | 311. | |
| Seg 7 | 603243. | 4911226. | 312. | 1 |
| Seg 8 | 603208. | 4911241. | 311. | |
| Seg 9 | 603140. | 4911278. | 310. | |
| Seg 10 | 603114. | 4911295. | 310. | |

ROADWAY 22 RDWY 22 Veterans Rd N of Harvie SB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 531. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603111. | 4911289. | 310. | |
| Seg 2 | 603133. | 4911276. | 310. | |
| Seg 3 | 603195. | 4911241. | 311. | 1 |
| Seg 4 | 603249. | 4911217. | 312. | 1 |
| Seg 5 | 603299. | 4911196. | 312. | |
| Seg 6 | 603310. | 4911192. | 312. | |
| Seg 7 | 603358. | 4911173. | 312. | 1 |
| Seg 8 | 603385. | 4911151. | 313. | 1 |

| | | | | |
|---|---|---|---|---|
| Seg 9 | 603405. | 4911132. | 313. | |
| Seg 10 | 603435. | 4911092. | 312. | |
| Seg 11 | 603444. | 4911051. | 312. | |
| Seg 12 | 603456. | 4911001. | 311. | |

ROADWAY 23 RDWY 23 Veterans Rd S of Harvie SB

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 522. | 60. |
| HT | 5. | 60. |
| MT | 5. | 60. |

| | COORDINATES | | | |
|---|---|---|---|---|
| | X | Y | Z | GRADE |
| Seg 1 | 603456. | 4911001. | 311. | |
| Seg 2 | 603462. | 4910970. | 311. | |
| Seg 3 | 603471. | 4910924. | 311. | |
| Seg 4 | 603482. | 4910868. | 311. | 1 |
| Seg 5 | 603491. | 4910828. | 311. | |
| Seg 6 | 603500. | 4910781. | 312. | 1 |
| Seg 7 | 603513. | 4910707. | 311. | |
| Seg 8 | 603525. | 4910639. | 311. | |

ROADWAY 24 RDWY 24 Bryne Drive NB at Caplan Ave

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 383. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | COORDINATES | | | |
|---|---|---|---|---|
| | X | Y | Z | GRADE |
| Seg 1 | 604385. | 4910454. | 304. | |
| Seg 2 | 604395. | 4910486. | 304. | |
| Seg 3 | 604399. | 4910514. | 303. | |
| Seg 4 | 604398. | 4910536. | 303. | |
| Seg 5 | 604396. | 4910550. | 303. | |
| Seg 6 | 604368. | 4910655. | 301. | |
| Seg 7 | 604351. | 4910722. | 301. | |
| Seg 8 | 604341. | 4910776. | 302. | 1 |
| Seg 9 | 604334. | 4910833. | 302. | |
| Seg 10 | 604320. | 4910939. | 298. | |
| Seg 11 | 604314. | 4910989. | 297. | |
| Seg 12 | 604309. | 4911012. | 296. | |
| Seg 13 | 604299. | 4911045. | 297. | 1 |
| Seg 14 | 604267. | 4911125. | 291. | |
| Seg 15 | 604224. | 4911227. | 293. | 1 |

ROADWAY 25 RDWY 25 Bryne Drive NB at Harvie Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 398. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | COORDINATES | | | |
|---|---|---|---|---|
| | X | Y | Z | GRADE |
| Seg 1 | 604214. | 4911251. | 292. | |
| Seg 2 | 604147. | 4911417. | 300. | 1 |
| Seg 3 | 604129. | 4911537. | 302. | 1 |
| Seg 4 | 604136. | 4911642. | 307. | 1 |
| Seg 5 | 604162. | 4911771. | 299. | |
| Seg 6 | 604162. | 4911866. | 299. | |
| Seg 7 | 604136. | 4911969. | 290. | |
| Seg 8 | 604021. | 4912158. | 280. | |
| Seg 9 | 603903. | 4912400. | 269. | |
| Seg 10 | 603857. | 4912454. | 267. | 1 |
| Seg 11 | 603775. | 4912495. | 263. | |

ROADWAY 26 RDWY 26 Bryne Drive SB at Harvie Rd

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 398. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | COORDINATES | | | |
|---|---|---|---|---|
| | X | Y | Z | GRADE |
| Seg 1 | 603766. | 4912478. | 263. | 1 |
| Seg 2 | 603847. | 4912445. | 267. | 1 |
| Seg 3 | 603896. | 4912391. | 269. | 1 |
| Seg 4 | 604013. | 4912153. | 280. | 1 |
| Seg 5 | 604073. | 4912060. | 285. | 1 |
| Seg 6 | 604125. | 4911967. | 290. | 1 |
| Seg 7 | 604150. | 4911870. | 299. | 1 |
| Seg 8 | 604152. | 4911782. | 299. | 1 |
| Seg 9 | 604123. | 4911631. | 307. | 1 |
| Seg 10 | 604118. | 4911528. | 302. | 1 |
| Seg 11 | 604134. | 4911427. | 300. | 1 |
| Seg 12 | 604203. | 4911248. | 292. | 1 |

ROADWAY 27  RDWY 27 Bryne Drive SB at Caplan Ave

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 383. | 50. |
| HT | 8. | 50. |
| MT | 8. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 604203. | 4911248. | 294. | 1 |
| Seg 2 | 604252. | 4911131. | 293. | |
| Seg 3 | 604289. | 4911042. | 296. | 1 |
| Seg 4 | 604300. | 4911004. | 296. | 1 |
| Seg 5 | 604306. | 4910962. | 298. | 1 |
| Seg 6 | 604320. | 4910849. | 302. | 1 |
| Seg 7 | 604331. | 4910765. | 303. | 1 |
| Seg 8 | 604349. | 4910683. | 300. | |
| Seg 9 | 604373. | 4910591. | 302. | 1 |
| Seg 10 | 604385. | 4910546. | 303. | 1 |
| Seg 11 | 604388. | 4910522. | 304. | 1 |
| Seg 12 | 604386. | 4910499. | 303. | |
| Seg 13 | 604381. | 4910477. | 304. | 1 |
| Seg 14 | 604375. | 4910458. | 304. | 1 |

ROADWAY 28  RDWY 28 Thrushwood Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 77. | 50. |
| HT | 1. | 50. |
| MT | 1. | 50. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 603929. | 4910702. | 304. | |
| Seg 2 | 603878. | 4910742. | 303. | |
| Seg 3 | 603846. | 4910799. | 304. | 1 |
| Seg 4 | 603820. | 4910840. | 305. | 1 |
| Seg 5 | 603799. | 4910881. | 306. | 1 |
| Seg 6 | 603785. | 4910938. | 306. | 1 |
| Seg 7 | 603771. | 4910991. | 307. | 1 |
| Seg 8 | 603763. | 4911028. | 307. | |
| Seg 9 | 603764. | 4911047. | 307. | |
| Seg 10 | 603768. | 4911095. | 307. | 1 |

ROADWAY 29  RDWY 29 Essa Rd from Coughlin to Veterans

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1107. | 70. |
| HT | 11. | 70. |
| MT | 11. | 70. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 602818. | 4910067. | 314. | |
| Seg 2 | 602854. | 4910162. | 314. | |
| Seg 3 | 602885. | 4910241. | 314. | |
| Seg 4 | 602936. | 4910365. | 314. | |
| Seg 5 | 603039. | 4910633. | 314. | 1 |
| Seg 6 | 603131. | 4910864. | 314. | |
| Seg 7 | 603219. | 4911087. | 313. | |
| Seg 8 | 603245. | 4911148. | 313. | |
| Seg 9 | 603271. | 4911210. | 312. | |

ROADWAY 30  RDWY 30 Mapleview EB/WB Ginger to Veterans Dr

| VEHICLE TYPE | VEHICLES/HOUR | SPEED |
|---|---|---|
| CARS | 1783. | 60. |
| HT | 18. | 60. |
| MT | 18. | 60. |

| | X | Y | Z | GRADE |
|---|---|---|---|---|
| Seg 1 | 601437. | 4908845. | 305. | 1 |
| Seg 2 | 601643. | 4908913. | 305. | 1 |
| Seg 3 | 602001. | 4909031. | 306. | 1 |
| Seg 4 | 602244. | 4909113. | 304. | |
| Seg 5 | 602467. | 4909189. | 307. | 1 |
| Seg 6 | 602899. | 4909326. | 306. | |
| Seg 7 | 603339. | 4909462. | 308. | 1 |
| Seg 8 | 603726. | 4909594. | 309. | 1 |

BARRIER  1  TYPE(A)  Barrier 1 Barrier on Essa Rd at Clovergate and Fairfield Hotel

| | X | Y | Z | Z0 | DELZ | P |
|---|---|---|---|---|---|---|
| Bar 1 | 603627. | 4912381. | 275. | 271. | 0. | |
| Bar 2 | 603632. | 4912365. | 275. | 271. | | |
| Bar 3 | 603636. | 4912344. | 275. | 271. | | |
| Bar 4 | 603641. | 4912322. | 277. | 272. | | |
| Bar 5 | 603640. | 4912317. | 272. | 272. | | |
| Bar 6 | 603640. | 4912312. | 284. | 273. | | |
| Bar 7 | 603628. | 4912294. | 284. | 273. | | |
| Bar 8 | 603618. | 4912276. | 284. | 273. | | |

```
Bar 9       603608.  4912257.      286.      275.

BARRIER   2   TYPE(A)     Barrier 2 Barrier on Essa Rd at Loggers Run N
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603634.  4911997.      297.      295.        0.
Bar 2       603636.  4912021.      292.      290.
Bar 3       603638.  4912045.      292.      290.
Bar 4       603639.  4912066.      292.      290.
Bar 5       603640.  4912086.      291.      289.
Bar 6       603641.  4912096.      290.      288.

BARRIER   3   TYPE(A)     Barrier 3 Barrier on Essa Rd at Ferndale Dr S
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603307.  4911351.      315.      313.        0.
Bar 2       603303.  4911341.      315.      313.
Bar 3       603295.  4911323.      315.      313.
Bar 4       603289.  4911310.      315.      313.
Bar 5       603285.  4911300.      315.      313.
Bar 6       603281.  4911289.      315.      313.
Bar 7       603278.  4911281.      315.      313.
Bar 8       603273.  4911268.      315.      313.
Bar 9       603268.  4911256.      315.      313.
Bar 10      603265.  4911248.      315.      313.

BARRIER   4   TYPE(A)     Barrier 4 Barrier on Essa S of Coughlin Rd
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602787.  4910034.      316.      314.        0.
Bar 2       602782.  4910025.      316.      314.
Bar 3       602769.  4909989.      316.      314.
Bar 4       602756.  4909956.      316.      314.
Bar 5       602754.  4909957.      316.      314.
Bar 6       602745.  4909932.      316.      314.
Bar 7       602740.  4909920.      316.      314.
Bar 8       602741.  4909919.      316.      314.
Bar 9       602734.  4909902.      316.      314.
Bar 10      602728.  4909886.      316.      314.

BARRIER   5   TYPE(A)     Barrier 5 Barrier on Essa S of Coughlin Rd (continued)
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602728.  4909886.      315.      313.        0.
Bar 2       602726.  4909880.      315.      313.
Bar 3       602723.  4909874.      315.      313.
Bar 4       602719.  4909864.      315.      313.
Bar 5       602718.  4909864.      315.      313.
Bar 6       602715.  4909857.      315.      313.
Bar 7       602712.  4909851.      315.      313.
Bar 8       602710.  4909846.      315.      313.
Bar 9       602703.  4909827.      315.      313.

BARRIER   6   TYPE(A)     Barrier 6 Barrier on Essa at Coughlin Rd (continued)
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602697.  4909808.      314.      312.        0.
Bar 2       602685.  4909779.      314.      312.
Bar 3       602684.  4909779.      314.      312.
Bar 4       602665.  4909731.      313.      311.
Bar 5       602666.  4909731.      312.      310.
Bar 6       602647.  4909682.      312.      310.
Bar 7       602646.  4909683.      312.      310.
Bar 8       602627.  4909635.      312.      310.

BARRIER   7   TYPE(A)     Barrier 7 Barrier on Essa across from Messa dev
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       602571.  4909498.      309.      307.        0.
Bar 2       602580.  4909521.      309.      307.
Bar 3       602588.  4909541.      309.      307.
Bar 4       602586.  4909541.      309.      307.
Bar 5       602595.  4909563.      309.      307.
Bar 6       602603.  4909582.      309.      307.
Bar 7       602604.  4909583.      309.      307.
Bar 8       602628.  4909634.      309.      307.

BARRIER   8   TYPE(A)     Barrier 8 Barrier on Veterans Road N of Harvie
          ---------COORDINATES----------
                X         Y         Z          Z0       DELZ       P
Bar 1       603437.  4911029.      314.      312.        0.
Bar 2       603441.  4911030.      314.      312.
Bar 3       603435.  4911053.      314.      312.
Bar 4       603427.  4911079.      314.      312.
```

Bar 5 603420. 4911093. 314. 312.

BARRIER 9 TYPE(A) Barrier 9 Barrier on Harvie Road Mid Rise Barrier 1

| | ---------COORDINATES---------- | | | | | |
|---|---|---|---|---|---|---|
| | X | Y | Z | Z0 | DELZ | P |
| Bar 1 | 603396. | 4910960. | 321. | 311. | 0. | |
| Bar 2 | 603372. | 4910952. | 322. | 312. | | |

BARRIER 10 TYPE(A) Barrier 10 Barrier on Harvie Road Mid Rise Barrier 2

| | ---------COORDINATES---------- | | | | | |
|---|---|---|---|---|---|---|
| | X | Y | Z | Z0 | DELZ | P |
| Bar 1 | 603369. | 4910952. | 322. | 312. | 0. | |
| Bar 2 | 603340. | 4910942. | 323. | 313. | | |

BARRIER 11 TYPE(A) Barrier 11 Barrier on Harvie Road Mid Rise Barrier 3

| | ---------COORDINATES---------- | | | | | |
|---|---|---|---|---|---|---|
| | X | Y | Z | Z0 | DELZ | P |
| Bar 1 | 603320. | 4910936. | 323. | 313. | 0. | |
| Bar 2 | 603295. | 4910927. | 324. | 314. | | |

BARRIER 12 TYPE(A) Barrier 12 Thrushwood Homes at Harvie Rd.

| | ---------COORDINATES---------- | | | | | |
|---|---|---|---|---|---|---|
| | X | Y | Z | Z0 | DELZ | P |
| Bar 1 | 603748. | 4911078. | 311. | 306. | 0. | |
| Bar 2 | 603734. | 4911073. | 311. | 306. | | |
| Bar 3 | 603738. | 4911058. | 311. | 306. | | |
| Bar 4 | 603734. | 4911056. | 312. | 307. | | |
| Bar 5 | 603739. | 4911040. | 311. | 306. | | |
| Bar 6 | 603733. | 4911038. | 311. | 306. | | |
| Bar 7 | 603738. | 4911019. | 311. | 306. | | |
| Bar 8 | 603736. | 4911018. | 311. | 306. | | |
| Bar 9 | 603739. | 4911006. | 311. | 306. | | |

BARRIER 13 TYPE(A) Barrier 13 New Barrier on Harvie Road at Thrushwood Dr

| | ---------COORDINATES---------- | | | | | |
|---|---|---|---|---|---|---|
| | X | Y | Z | Z0 | DELZ | P |
| Bar 1 | 603657. | 4911053. | 311. | 307. | 0. | |
| Bar 2 | 603667. | 4911056. | 311. | 307. | | |
| Bar 3 | 603677. | 4911059. | 311. | 307. | | |
| Bar 4 | 603685. | 4911061. | 311. | 307. | | |
| Bar 5 | 603696. | 4911065. | 311. | 307. | | |
| Bar 6 | 603705. | 4911068. | 311. | 307. | | |
| Bar 7 | 603715. | 4911071. | 311. | 307. | | |
| Bar 8 | 603719. | 4911072. | 311. | 307. | | |
| Bar 9 | 603725. | 4911074. | 311. | 307. | | |
| Bar 10 | 603731. | 4911076. | 310. | 306. | | |

BARRIER 14 TYPE(A) Barrier 14 New Barrier on Harvie Road at Thrushwood Dr (continued)

| | ---------COORDINATES---------- | | | | | |
|---|---|---|---|---|---|---|
| | X | Y | Z | Z0 | DELZ | P |
| Bar 1 | 603731. | 4911076. | 310. | 306. | 0. | |
| Bar 2 | 603733. | 4911077. | 310. | 306. | | |
| Bar 3 | 603735. | 4911078. | 310. | 306. | | |
| Bar 4 | 603737. | 4911079. | 309. | 306. | | |
| Bar 5 | 603739. | 4911079. | 309. | 306. | | |
| Bar 6 | 603742. | 4911080. | 309. | 306. | | |
| Bar 7 | 603745. | 4911081. | 308. | 306. | | |
| Bar 8 | 603748. | 4911082. | 308. | 306. | | |
| Bar 9 | 603752. | 4911083. | 308. | 306. | | |
| Bar 10 | 603755. | 4911082. | 308. | 306. | | |

Receivers

| | ----------COORDINATES---------- | | |
|---|---|---|---|
| | X | Y | Z |
| Rec 1 | 603732. | 4911014. | 308. |
| Rec 2 | 603732. | 4911067. | 308. |
| Rec 26 | 603735. | 4911050. | 308. |
| Rec 27 | 603733. | 4911030. | 308. |

ALPHA FACTORS - RECEIVER ACROSS,ROADWAY DOWN
1 * 0.7 0.7 0.7 0.7
2 * 0.7 0.7 0.7 0.7
3 * 0.7 0.7 0.7 0.7
4 * 0.7 0.7 0.7 0.7
5 * 0.7 0.7 0.7 0.7
6 * 0.7 0.7 0.7 0.7
7 * 0.7 0.7 0.7 0.7
8 * 0.7 0.7 0.7 0.7
9 * 0.7 0.7 0.7 0.7
10 * 0.7 0.7 0.7 0.7
11 * 0.7 0.7 0.7 0.7
12 * 0.7 0.7 0.7 0.7
13 * 0.7 0.7 0.7 0.7
14 * 0.7 0.7 0.7 0.7

15 * 0.7 0.7 0.7 0.7
16 * 0.7 0.7 0.7 0.7
17 * 0.7 0.7 0.7 0.7
18 * 0.7 0.7 0.7 0.7
19 * 0.7 0.7 0.7 0.7
20 * 0.7 0.7 0.7 0.7
21 * 0.7 0.7 0.7 0.7
22 * 0.7 0.7 0.7 0.7
23 * 0.7 0.7 0.7 0.7
24 * 0.7 0.7 0.7 0.7
25 * 0.7 0.7 0.7 0.7
26 * 0.7 0.7 0.7 0.7
27 * 0.7 0.7 0.7 0.7
28 * 0.7 0.7 0.7 0.7
29 * 0.7 0.7 0.7 0.7
30 * 0.7 0.7 0.7 0.7

 SHIELDING FACTORS - RECEIVER ACROSS,ROADWAY DOWN
 1 * 0.0 0.0 0.0 0.0
 2 * 0.0 0.0 0.0 0.0
 3 * 0.0 0.0 0.0 0.0
 4 * 0.0 0.0 0.0 0.0
 5 * 0.0 0.0 0.0 0.0
 6 * 0.0 0.0 0.0 0.0
 7 * 0.0 0.0 0.0 0.0
 8 * 0.0 0.0 0.0 0.0
 9 * 0.0 0.0 0.0 0.0
10 * 0.0 0.0 0.0 0.0
11 * 0.0 0.0 0.0 0.0
12 * 0.0 0.0 0.0 0.0
13 * 0.0 0.0 0.0 0.0
14 * 0.0 0.0 0.0 0.0
15 * 0.0 0.0 0.0 0.0
16 * 0.0 0.0 0.0 0.0
17 * 0.0 0.0 0.0 0.0
18 * 0.0 0.0 0.0 0.0
19 * 0.0 0.0 0.0 0.0
20 * 0.0 0.0 0.0 0.0
21 * 0.0 0.0 0.0 0.0
22 * 0.0 0.0 0.0 0.0
23 * 0.0 0.0 0.0 0.0
24 * 0.0 0.0 0.0 0.0
25 * 0.0 0.0 0.0 0.0
26 * 0.0 0.0 0.0 0.0
27 * 0.0 0.0 0.0 0.0
28 * 0.0 0.0 0.0 0.0
29 * 0.0 0.0 0.0 0.0
30 * 0.0 0.0 0.0 0.0

RECEIVER    LEQ(H)   L10
Rec 1        52.6   55.8
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2
          44.1
  19        8
          41.3

RECEIVER    LEQ(H)   L10
Rec 2        53.3   56.9
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2    3    4
          40.8 43.3 45.2
  19        6    7
          43.8 43.0

RECEIVER    LEQ(H)   L10
Rec 26       52.6   56.1
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2    3    4
          43.2 41.9 41.0
  19        6    7
          40.6 42.2

RECEIVER    LEQ(H)   L10
Rec 27       52.3   55.7
ROADWAY SEGMENT SOUND LEVEL CONTRIBUTIONS EXCEEDING   40.0 DBA
ROADWAY  SEGMENT
  14        2    3
          44.1 40.1
  19        7    8    9
          40.7 41.1 40.0

# Appendix **D**

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By-law 2006-140 – As Amended

This By-law printed under and by the authority of the Council of the City of Barrie

# A By-law of The Corporation of the City of Barrie to prohibit and regulate noise and to repeal By-law 76-140 and all amendments thereto.

**BY-LAW NUMBER 2006-140**

**A By-law of The Corporation of the City of Barrie to prohibit and regulate noise and to repeal By-law 76-140 and all amendments thereto.**

**WHEREAS** Section 8 of the Municipal Act, R.S.O. 2001, S.O. 2001, c. 25 ("the Municipal Act, 2001"), provides that a municipality has the capacity, rights, powers and privileges of a natural person for the purpose of exercising its authority under the Act;

**AND WHEREAS** Section 9 of the Municipal Act, 2001, provides that Sections 8 and 11 shall be interpreted broadly so as to confer broad authority on municipalities to (a) enable municipalities to govern their affairs as they consider appropriate and, (b) enhance their ability to respond to municipal issues;

**AND WHEREAS** Section 11 of the Municipal Act, 2001, provides that a single-tier municipality may pass by-laws respecting matters within the spheres of jurisdiction set out therein;

**AND WHEREAS** By-law 76-140 was passed by the Council of The Corporation of the City of Barrie on the 25th day of July 1977 and approved by the Ministry of Environment pursuant to the provisions of the Environmental Protection Act, 1971, as amended on the 18th day of August 1977;

**AND WHEREAS** by motion 06-G-243 it is deemed expedient that the Council of The Corporation of the City of Barrie repeal and replace By-law 76-140 to regulate and control noise;

**NOW THEREFORE** the Council of The Corporation of the City of Barrie enacts the following:

1.0.0 **TITLE**

1.1.0 This By-law shall be referred to as "The Noise Control By-Law".

2.0.0 **TECHNICAL TERMS**

2.1.0 In this By-Law all words and definitions that are of technical nature and are related to sound and vibration shall have the meanings specified by the Ministry of the Environment in Publication NPC-101 – Technical Definitions.

3.0.0 **DEFINITIONS**

3.1.0 For the purpose of this By-Law,

3.1.1 "Applicant" means a person or persons seeking an exemption of either a temporary or permanent nature from the provisions and requirements of this By-law;

3.1.2 "Authorized Emergency Vehicle" means an ambulance, vehicle of the fire service, vehicle of the municipal, provincial or federal police, armoured cars while carrying cash or securities, equipment, facilities or vehicles operated by or for a public utility company while actively engaged in the construction, maintenance or repair of any highway, and any equipment, facilities or vehicles operated by or for the City, Bell Canada, Canada Post or the Ministry of Transportation;

3.1.3 "Certificate" means a certificate of Competency in Environmental Acoustics, Technology of a specified class issued by an accredited program of an Ontario Community College or other approved agency;

3.1.4 "City Clerk" means the Clerk of The Corporation of the City of Barrie or his designate;

3.1.5 "City" means The Corporation of the City of Barrie;

3.1.6 "Construction" means the erection, alteration, repair, dismantling, demolition, structural maintenance, painting, moving, land clearing, earth moving, grading, excavating, the laying of pipe and conduit whether above or below ground level, street and highway building, concreting, equipment installation and alteration and the structural installation of construction components and materials in any form or for any purpose, and includes any work in connection therewith;

3.1.7 "Construction Equipment" means any equipment or device designed and intended for use in construction, or material handling, including but not limited to, air compressors, pile drivers, pneumatic or hydraulic tools, bulldozers, tractors, excavators, trenchers, cranes, derricks, loaders, scrapers, pavers, generators, off highway haulers or trucks, ditchers, compactors and rollers, pumps, concrete mixers, graders, or other material handling equipment;

3.1.8 "Construction Site" means the area or portion of land used for or under construction or any other area used for any purpose related to the construction or for any related purpose;

3.1.9 "Conveyance" means a vehicle and any other device used to transport a person or persons or goods from place to place but does not include any vehicle or device operated only within the premises of a person;

3.1.10 "Council" means the Council of The Corporation of the City of Barrie;

3.1.11 "Domestic Animal" means an animal that is housed and fed by a person and which actually lives in physical proximity to humans, including but not limited to pets such as dogs, cats and birds, guard animals, food species such as chickens, etc.;

3.1.12 "Downtown Business Improvement Area" means the Downtown Business Improvement Area as defined by the City of Barrie from time to time

3.1.13 "Highway" includes a common and public highway, street, avenue, parkway, driveway, square, place, bridge, viaduct or trestle designed and intended for or used by, the general public for the passage of vehicles;

3.1.14 "Minister" means the Minister of the Environment;

3.1.15 "Ministry" means the Ministry of the Environment;

3.1.16 "Motor Vehicle" means any motorized conveyance and includes any automobile, motorcycle and any other vehicle propelled or driven otherwise than by muscular power, but does not include the cars of electric or steam railways, or other motor vehicle running only upon rails, or a motorized snow vehicle, traction engine, farm tractor, self-propelled implement of husbandry or road building machine;

3.1.17 "Motorized Conveyance" means a conveyance propelled or driven otherwise than by muscular, gravitational or wind power;

3.1.18 "Municipality" means the land within the geographic boundaries of the City of Barrie;

3.1.19 "Noise" means unwanted sound;

3.1.20 "Officer" means a person appointed by Council as a Municipal Law Enforcement Officer, a Police Officer, or other individual duly appointed to enforce this by-law;

3.1.21 "Permit" means a permit or written authorization of a temporary or permanent nature, issued by the City Clerk or Council of the City of Barrie, which provides an exemption(s) to the requirements and provisions of this by-law;

3.1.22 "Person" means any individual, corporation, partnership, company, association or party and the heirs, executors, administrators of other legal representative of such person to whom the context can apply according to law; shall include any group of persons comprising a society or other organization and shall include the plural wherein the context requires. Wherever the word "he" or "him" is used, it shall mean and include the feminine or neuter gender wherever the context so requires.

3.1.23 "Point of Reception" means any point on a premise of a person where sound or vibration originating from other than those premises is received;

3.1.24 "Publication - NPC" means a specified publication of Ministry of the Environment as set out in Schedule 3 of this By-Law;

3.1.25 "Quiet Zone" means an area within a distance of 500 meters of Royal Victoria Hospital, or other hospital, long term care facility as regulated by the Ministry of Health, City Hall, or any Provincial or Federal Courthouse.

3.1.26 "Residential Area" means any area of the municipality where residential use is permitted under the provisions of the City of Barrie Zoning By-Law, as amended from time to time.

3.1.27 "Residential Renovations" means construction that does not require any building permits and renovations are constructed without operation of heavy equipment;

3.1.28 "Shall" is mandatory and not directory;

3.1.29 "Source" or "Source of Sound or Vibration" means an activity, matter, thing, or tangible personal property or real property, from which sound or vibration is emitted;

3.1.30 "Sound" is a sensation caused in the ear due to a vibration of surrounding air or other medium;

3.1.31 "Stationary Source" means a source of sound, which does not normally move from place to place and includes the premises of a person as one stationary source unless the dominant source on the premises is construction equipment or a conveyance;

4.0.0 **PROHIBITIONS**

4.1.0 No person shall emit or cause or permit the emission of sound resulting in noise from an act listed in Schedule 1 - Prohibitions by Time and Place, if the sound is clearly audible at a point of reception.

4.2.0 Notwithstanding any other provision of this by-law, no person shall emit or cause or permit the emission of sound such that the level of resultant sound at a point of reception located in a residential area, or quiet zone exceeds the applicable sound level limit as established and prescribed by the Ministry of the Environment in the following Publications, as may be applicable:

a) Publication NPC – 101 Technical Definitions;
b) Publication NPC – 102 Instrumentation;
c) Publication NPC – 103 Procedures;
d) Publication NPC – 104 Sound Level Adjustments;
e) Publication NPC – 115 Construction Equipment;
f) Publication NPC – 117 Domestic Outdoor Power Tools;
g) Publication NPC – 118 Motorized Conveyances;
h) Publication NPC – 119 Blasting;
i) Publication NPC – 205 Stationary Source;
j) Publication NPC – 206 Road Traffic; and
k) Publication NPC – 216 Residential Air Conditioners

5.0.0 **GENERAL PROHIBITION**

5.1.0 Notwithstanding any other provision of this by-law, no person shall emit or cause or permit the emission of sound likely to disturb another person in a residential area between 9:00 p.m. of one day and 7:00 a.m. of the following day where the noise is clearly audible at the point of reception.

6.0.0 **EXEMPTIONS AND PERMITS**

6.1.0 Notwithstanding any other provision of this By-law, the provisions and requirements of this By-law shall not apply to any person who emits or causes or permits the emission of sound in connection with any activities listed in Schedule 2, Permanent Exemptions, or to impulsive sound, or blasting, or to any person or activity for which a permit has been issued under the authority of this by-law.

6.2.0 Every application for exemption shall be made to the City Clerk in writing and shall contain:

a) the name and address of the applicant;
b) a description of the source of sound or vibration and resulting noise in respect of which exemption is sought;
c) a statement of the particular requirement or provision of the By-Law from which exemption is sought;
d) the reasons for which, in the applicant's opinion, the exemption should be granted;
e) in the case of a temporary exemption, a statement of the actions, steps or other such measures, if any, planned or presently being taken, by the applicant, intended to bring about compliance with the By-Law;
f) any additional information deemed necessary by the City Clerk or Council to consider an application made under this section.

6.3.0 The applicant shall, upon application to the City Clerk, submit all fees as set out in accordance with the City of Barrie Fee's By-law. The application fee is non-refundable.

6.4.0 No application shall be deemed complete until the applicant has provided any and all information as required by the City Clerk or Council and has paid the application fee as set out in the City of Barrie Fee's By-law. Where additional costs may be incurred by the applicant, such costs shall be borne by the applicant.

6.5.0 The City Clerk may, upon written application by any person, issue a permit of a Temporary Exemption to the applicant from any provision or requirement of this by-law as the City Clerk deems appropriate.

6.6.0 Where the application is for a permanent exemption, the City Clerk will make appropriate public notification of any duly completed application on behalf of the applicant prior to recommendations for consideration of such application by Council.

6.7.0 Where deemed appropriate by Council, the City Clerk may issue a Permit of a Permanent Exemption to exempt the applicant from any provision or requirement of this by-law.

6.8.0 Any permit issued in accordance with the provisions of Section 6.5.0 or Section 6.7.0 of this By-law may specify any terms and conditions under which the permit is issued.

6.9.0 Where an application is not approved or approved upon terms and conditions or to a lesser extent than the exemption applied for, the City Clerk shall set out in writing the reasons therefore and shall serve a copy of the decision upon the applicant.

6.10.0 Notwithstanding any other provision of this By-law, it shall be lawful during an emergency to emit or cause or permit the emission of sound or vibration in connection with emergency measures undertaken for:

a) the immediate health, safety or welfare of the inhabitants or any of them; or
b) the preservation or restoration of property;
c) unless such sound or vibration is clearly audible for a longer duration or of a nature more disturbing than is reasonably necessary for the accomplishment of such emergency purpose.

7.0.0 **SEVERABILITY**

7.1.0 Should any section of this By-law be declared by a Court of competent jurisdiction to be invalid for any reason, the provision shall be deemed conclusively to be severed from the by-law, and the remaining parts shall nevertheless remain valid and binding, and shall be read as if the offending section or part had been struck out.

8.0.0 **ADMINISTRATION and ENFORCEMENT**

8.1.0 The City Clerk or his designate shall administer the provisions of this By-Law.

8.2.0 The provisions of this By-law shall be enforced by an officer, as defined within this By-law.

9.0.0 **PENALTIES**

9.1.0 Every person who contravenes any provision of this By-law is guilty of an offence and upon conviction, is liable to the penalty specified by the Provincial Offences Act, R.S.O. 1990, Chapter P.33, as amended.

10.0.0 **REPEAL**

10.1.0 Upon the passage of this By-law, that By-law 76-140 and all amendments thereto be repealed.

11.0.0 **ENACTMENT**

11.1.0 This By-Law shall have effect immediately upon the final passing thereof.

**READ** a first and second time this 12th day of June, 2006.

**READ** a third time and finally passed this 12th day of June, 2006.

**THE CORPORATION OF THE CITY OF BARRIE**

**"R.J. HAMILTON"**

**MAYOR – R. J. HAMILTON**

**"JOHN R. SISSON"**

**CLERK - JOHN R. SISSON**

**SCHEDULE 1 to BY-LAW 2006-140**

**PROHIBITIONS BY TIME AND PLACE**

| **Particulars of Noise** | **Prohibited Period by Time and Place** | |
|---|---|---|
| | **Quiet Zone** | **Residential Area** |
| The operation of any auditory signalling device, including but not limited to the ringing of bells or gongs and the blowing of horns or sirens or whistles, or the production, reproduction or amplification of any similar sounds except where required or authorized in accordance with good safety practices. | At any time | 7:00 p.m. of one day to 7:00 a.m. of the next day, and<br><br>All day Sundays and Statutory Holidays |
| The operation of any electronic device or group of connected electronic devices incorporating one or more loudspeakers or other electro mechanical transducers, and intended for the production, reproduction or amplification of sound except within the geographic boundaries of the Downtown Business Improvement Area. | At any time | At any time |
| The operation of any electronic device or group of connected electronic devices incorporating one or more loudspeakers or other electro mechanical transducers, and intended for the production, reproduction or amplification of sound within the geographic boundaries of the Downtown Business Improvement Area | Not applicable | 11:00 p.m. of one day to 7:00 a.m. of the next day;<br><br>And at any time when the business operating within the Downtown Business Improvement Area is closed for business |
| Loading, unloading, delivering, packing, unpacking, or otherwise handling any containers, produce, materials, or refuse unless necessary for the maintenance of essential services or the preservation of perishable goods | 7:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) | 11:00 p.m. of one day to 7:00 a.m. of the next day;<br><br>On Sundays, from 12:00 midnight to 10:00 a.m. and from 2:00 p.m. to 12:00 midnight; and<br><br>On Statutory Holidays, from 12:00 midnight to 10:00 a.m. and from 2:00 p.m. to 12:00 midnight. |

| Particulars of Noise | Prohibited Period by Time and Place | |
|---|---|---|
| | **Quiet Zone** | **Residential Area** |
| The operation of any construction equipment in connection with construction, unless otherwise exempt under the provisions of this by-law | 5:00 p.m. of one day to 7:00 a.m. of the next day<br>All day Sundays and Statutory Holidays | 7:00 p.m. of one day to 7:00 a.m. of the next day, and<br>All day Sundays and Statutory Holidays |
| The operation of any construction equipment without effective muffling devices in good working order and in constant operation | At any time | At any time |
| The detonation of fireworks or explosive devices. | At any time | 11:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| The operation of a combustion engine which, is, or is used in, or is intended for use in, a toy or a model or replica of a larger device, which model or replica has no function other than amusement and which is not a conveyance. | At any time | 7:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| The operation of any motorized conveyance other than on a highway or other place intended for its operation. | At any time | 7:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| The venting, release or pressure relief of air, steam or other gaseous material, product or compound from any autoclave, boiler, pressure vessel, pipe, valve, machine, device or system. | At any time | 11:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| Persistent barking, calling or whining or other similar persistent noise making by any domestic pet. | At any time | At any time |
| The operation of any powered or non-powered tool for domestic purposes other than snow removal. | 5:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) | 11:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| The operation of solid waste bulk lift or refuse compacting equipment | 5:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) | 11:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| The operation of commercial car wash. | 5:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) | 11:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| Yelling, shouting, hooting, whistling or singing or similar sounds | At any time | 11:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| The operation of a sound emitting pest control device | At any time | 11:00 p.m. of one day to 7:00 a.m. of the next day (9:00 a.m. Sundays) |
| Racing of any motorized conveyance other than in a racing event regulated by law | At any time | At any time |
| The operation of a motor vehicle in such a way that the tires squeal | At any time | At any time |
| The operation of any combustion engine without an effective exhaust muffling device in good working order and in constant operation | At any time | At any time |

| Particulars of Noise | Prohibited Period by Time and Place | |
|---|---|---|
| | **Quiet Zone** | **Residential Area** |
| The operation of a vehicle or a vehicle with a trailer resulting in banging, clanking, squealing or other like sounds due to improperly secured load or equipment | At any time | At any time |
| The operation of a motor vehicle horn or other warning device except where required or authorized by law in accordance with good safety practices | At any time | At any time |
| The idling of an engine or motor in, or on, any motor vehicle or item of attached auxiliary equipment for a continuous period exceeding five minutes, while such vehicle is stationary in a Residential Area or, unless,<br>• the vehicle is in an enclosed structure constructed so as to effectively prevent excessive noise emission;<br>• the original equipment manufacturer specifically recommends a longer idling period for normal and efficient operation of the motor vehicle in which case such recommended period shall not be exceeded;<br>• such operation of the engine or motor is essential to a basic function of the vehicle or equipment, including but not limited to, operation of ready mixed concrete trucks, lift platforms or refuse compactors and heat exchange systems;<br>• weather conditions justify the use of heating or refrigerating systems powered by the motor or engine for the safety and welfare of the operator, passengers or animals, or preservation of perishable cargo;<br>• prevailing low temperatures make longer idling periods necessary, immediately after starting the motor or engine; or,<br>• the idling is for the purpose of cleaning and flushing the radiator and associated circulation system for seasonal change of antifreeze, cleaning of the fuel system, carburetor or the like, when such work is performed other than for profit. | At any time | At any time |

**SCHEDULE 2 to BY-LAW 2006- 140**

**PERMANENT EXEMPTIONS**

1. The use of bells or chimes normally associated with church activities.

2. The operation of bells and other signalling devices utilized as traffic control devices at:

   - intersections with traffic signalling devices; and

   - railway crossings.

3. The operation of equipment in conjunction with City projects or reconstruction projects, general maintenance and emergency maintenance projects.

4. All activities approved by the Barrie Agricultural Society and conducted at the Barrie Fairgrounds provided that the midway electronically produced sounds and amplified sounds from other fair related activities be reduced to two thirds normal operation by volume by 11:00 p.m. of one day to 9:00 a.m. of the next day during the operation of the Barrie Fair.

5. All activities directly associated with the conduct of City sanctioned Special Events including but not limited to the detonation of fireworks. Such exemption shall only be applicable between the hours of 10:00 a.m. of one day and 11:00 p.m. of the same day.

6. All activities directly associate with the conduct of the City of Barrie New Year's Eve celebration including but not limited the detonation of fireworks. Such exemption shall only be applicable between the hours of 10:00 a.m. of one day and 12:30 a.m. of the next day.

7. The operation of authorized emergency vehicles and related signalling devices.

8. The operation of vehicles and equipment utilized for the clearing and removal of snow from public and private property.

9. The operation of any rail car including but not limited to refrigeration cars, locomotives or self-propelled passenger cars, operated under the Railway Act of Canada.

## SCHEDULE 3 TO BY-LAW 2006-140

## NOISE CONTROL - TECHNICAL PUBLICATIONS

**THESE TECHNICAL PUBLCATIONS ARE THE MINISTRY OF ENVIRONMENT NPC'S WHICH FORM PART OF THE RECOMMENDED NOISE CONTROL BY-LAW.**

### INDEX OF PUBLICATIONS

1. Publication - N.P.C. 101 – Technical Definitions
2. Publication – N.P.C. 102 – Instrumentation
3. Publication - N.P.C. 103 – Procedures
4. Publication – N.P.C. 104 – Sound Level Adjustments
5. Publication – N.P.C. 117 – Domestic Outdoor Power Tools
6. Publication – N.P.C. 115 – Construction Equipment
7. Publication - N.P.C. 118 – Motorized Conveyances
8. Publication – N.P.C.119 – Blasting
9. Publication – N.P.C. 205 – Stationary Sources (Urban) – Classes I and II
10. Publication – N.P.C. 206 – Sound Levels of Road Traffic
(method to establish "urban hum")
11. Publication – N.P.C. 216 – Residential Air Conditioners

## PUBLICATION NPC – 101 TECHNICAL DEFINITIONS

## TABLE OF CONTENTS

1. Technical Terminology and Standards

The following terminology and standards shall be used for the purposes of any Noise Control By-Law enacted pursuant to The Environmental Protection Act and all Publications of the Noise Pollution Control Section of the Pollution Control Branch of the Ministry of the Environment. The definition of any technical word used in such By-Law or this or any such Publication and not herein defined shall be the definition appearing in the applicable Publication of the Canadian Standards Association (CSA), the American National Standards Institute (ANSI), the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), the Society of Automotive Engineers (SAE), or the Machinery and Equipment Manufacturers Association of Canada (MEMAC):

(1) Acoustic Calibrator

An “Acoustic Calibrator” is an electro-mechanical or mechanical device intended for the calibration of sound level meters and meeting the specifications of Publication NPC-102 - Instrumentation, for Acoustic Calibrators.

(2) A-weighting

The “A-weighting” is the frequency weighting characteristic as specified in IEC 123 or IEC 179 and intended to approximate the relative sensitivity of the normal human ear to different frequencies (pitches) of sound.

(3) A-weighted Sound Pressure Level

The “A-weighted sound pressure level” is the sound pressure level modified by application of the A-weighting. It is measured in decibels, A-weighted, and denoted dBA.

(4) Beating

“Beating” is the characteristic of a sound which has an audible cyclically varying sound level, caused by the interaction of two sounds of almost the same frequency.

(5) Buzzing Sounds

A “buzzing sound” is a sound which is characterized by the presence of a large number of related discrete harmonics in its frequency spectrum. These harmonics together with the fundamental frequency produce a sound which subjectively is termed a “buzz”. Examples are sounds from a buzzer or a chain saw.

(6) Decibel

The “decibel” is a dimensionless measure of sound level or sound pressure level; see sound pressure level.

(7) Effective Sound Pressure

The “effective sound pressures” at a point is the root-mean square value of the instantaneous sound pressure, over a time interval, at the point under consideration as detected with a sound level meter meeting the requirements of Publication NPC-102 - Instrumentation.

(8) Equivalent Sound Level

The "equivalent sound level" sometimes denoted $L_{eq}$, is the value of the constant sound level which would result in exposure to the same total A-weighted energy as would the specified time-varying sound, if the constant sound level persisted over an equal time interval. It is measured in dBA.

The mathematical definition of equivalent sound level ($L_{eq}$) for an interval defined as occupying the period between two points in time $t_1$ and $t_2$ is:

$$L_{eq} = 10 \log_{10} \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p^2(t)}{p_r^2} \, dt$$

where p(t) is the time varying A-weighted sound pressure and $p_r$ is the reference pressure of 20 uPa.

(9) Fast Response

"Fast response" is a dynamic characteristic setting of a sound level meter meeting the applicable specifications of Publication NPC-102 - Instrumentation.

(10) Frequency

The "frequency" of a periodic quantity is the number of times that the quantity repeats itself in a unit interval of time. The unit of measurement is hertz (Hz) which is the same as cycles per second.

(11) General Purpose Sound Level Meter

A "General Purpose Sound Level Meter" is a sound level meter which meets the specifications of Publication NPC-102 - Instrumentation, for General Purpose Sound Level Meters.

(12) Impulse Response

"Impulse response" is a dynamic characteristic setting of a sound level meter meeting the specifications of Publication NPC-IO2 - Instrumentation, for Impulse Sound Level Meters.

(13) Impulsive Sound

An "impulsive sound" is a single pressure pulse or a single burst of pressure pulses, as defined by IEC 179A, First supplement to IEC 179, Sections 3.1 and 3.2.

(14) Impulse Sound Level

The "impulse sound level" is the sound level of an impulsive sound as measured with an Impulse Sound Level Meter set to impulse response. It is measured in A-weighted decibels, denoted dBAI.

(15) Impulse Sound Level Meter

An "Impulse Sound Level Meter" is a sound level meter which meets the specifications of Publication NPC-102 - Instrumentation, for Impulse Sound Level Meters.

(16) Integrating Sound Level Meter

An "Integrating Sound Level Meter" is a sound level meter which is capable of being used to derive the equivalent sound level ($L_{eq}$) and which meets the specifications of Publication NPC-102 - Instrumentation, for Type B Integrating Sound Level Meters.

(17) Logarithmic Mean Impulse Sound Level

The "Logarithmic Mean Impulse Sound Level", sometimes denoted $L_{LM}$ of N impulsive sounds, is ten times the logarithm to the base 10 of the arithmetic mean of ten to the power of one tenth the impulse sound level of each impulsive sound.

Algebraically, it can be written as:

$$L_{LM} = 10 \log_{10} [\frac{1}{N}(10^{dBAI_1/10} + 10^{dBAI_2/10} \ldots + 10^{dBAI_N/10})]$$

where, $dBAI_1$, dBAl2, ….$dBAI_N$, are the N impulse sound levels.

(18) Overpressure

The "overpressure" at a point due to an acoustic disturbance is the instantaneous difference at that point between the peak pressure during the disturbance and the ambient atmospheric pressure. The unit of measurement is the pascal. One pascal, abbreviated Pa, is the same as one newton per square meter, abbreviated $N/m^2$.

(19) Overpressure Level

The "overpressure level" is twenty times the logarithm to the base 10 of the ratio of the peak pressure to the reference pressure of 20 uPa.

(20) Peak Particle Velocity

The "peak particle velocity" is the maximum instantaneous velocity experienced by the particles of a medium when set into transient vibratory motion. This can be derived as the magnitude of the vector sum of three orthogonal components and is measured in cm/s.

(21) Peak Pressure Level Detector

A "Peak Pressure Level Detector" is a device capable of measuring peak pressure or pressure level perturbations in air and which meets the specifications of Publication NPC-102 - Instrumentation, for Peak Pressure Level Detectors.

(22) Percentile Sound Level

The "x percentile sound level", designated $L_x$, is the sound level exceeded x percent of a specified time period. It is measured in dBA.

(23) Quasi-Steady Impulsive Sound

"Quasi-Steady Impulsive Sound" is a sequence of impulsive sounds emitted from the same source, having a time interval of less than 0.5 s between successive impulsive sounds.

(24) Slow Response

"Slow response" is a dynamic characteristic setting of a sound level meter meeting the applicable specifications of Publication NPC-102 - Instrumentation.

(25) Sound

"Sound" is an oscillation in pressure, stress, particle displacement or particle velocity, in a medium with internal forces (e.g. elastic, viscous), or the superposition of such propagated oscillations, which may cause an auditory sensation.

(26) Sound Level

"Sound level" is the A-weighted sound pressure level.

(27) Sound Level Meter

A "sound level meter" is an instrument which is sensitive to and calibrated for the measurement of sound.

(28) Sound Pressure

The "sound pressure" is the instantaneous difference between the actual pressure and the average or barometric pressure at a given location. The unit of measurement is the micropascal (uPa) which is the same as a micronewton per square meter ($uN/m^2$).

(29) Sound Pressure Level

The "sound pressure level" is twenty times the logarithm to the base 10 of the ratio of the effective pressure (p) of a sound to the reference pressure ($p_r$) of 20 uPa. Thus the sound pressure level in $dB=20 \log_{10} \frac{p}{p_r}$.

(30) Tonality

A "tone" or a "tonal sound" is any sound which can be distinctly identified through the sensation of pitch.

(31) Vibration

"Vibration" is a temporal and spatial oscillation of displacement, velocity or acceleration in a solid medium.

(32) Vibration Velocity Detector

A "Vibration Velocity Detector" is a device which is capable of measuring vibration velocity and which meets the specifications of Publication NPC-102 - Instrumentation, for Vibration Velocity Detectors.

**PUBLICATION NPC-102 INSTRUMENTATION**
**TABLE OF CONTENTS**

1. Scope

This Publication sets out minimum specifications for equipment used for the measurement of sound and vibration. For most of the specifications the International Electrotechnical Commission (IEC) recommended standards 123 (First edition 1961), 179 (Second edition 1973) and 179A (First supplement to IEC 179, published 1973) have been adopted. In some cases, these standards are amended or augmented for greater precision.

TABLE 102-1

| NPC-102 Section | Type of Instrument | Application |
|---|---|---|
| 3 | General Purpose Sound Level Meter | Non-impulsive sounds |
| 4 | Impulse Sound Level Meter | Impulsive sounds |
| 5 | Peak Pressure Level Detector | Peak pressure perturbations |
| 6 | Type B Integrating Sound Level Meter | Varying sounds of low crest factor |
| 7 | Type A Integrating Sound Level Meter | Varying sounds of high crest factor |
| 8 | Vibration Velocity Detector | Peak vibration velocity in solids |
| 9 | Acoustic Calibrator | Calibration of sound level meters |

2. Technical Definitions

The technical terms used in this Publication are defined in the specifications themselves or in Publication NPC-101 - Technical Definitions.

3. General Purpose Sound Level Meter

(1) Purpose

A General Purpose Sound Level Meter is a sound level meter which is intended to be used for the measurement of non-impulsive sounds, without significant A-weighted acoustic energy above 2000 Hz.

(2) Specifications

A sound level meter which meets the following specifications is a General Purpose Sound Level Meter:

(a) the sound level meter, including a microphone equipped with a windscreen shall meet the specifications of IEC 123, except that, in addition to meeting the specifications of subclause 5.2 thereof, the microphone of the sound level meter shall also meet the specifications of subclause 5.2 amended by the substitution therein of an angle of incidence of $\pm 30^0$ instead of $\pm 90^0$, as it therein appears, and by the substitution of Table 102-2 hereof instead of Table 1, as it therein appears;

(b) the sound level meter shall incorporate A-weighting, which is specified in IEC 123 as optional;

(c) the sound level meter shall have a minimum usable range of sensitivity of from 40 dBA to 100 dBA and it shall read to an accuracy of ±1.0 dB over that range;

(d) a windscreen shall be installed on the microphone and shall not affect by more than 1 dB the tolerance prescribed in clauses (a) and (c);

(e) the sound level meter, including a microphone equipped with a windscreen, shall, when operated in the presence of wind, indicate a wind-induced sound level not in excess of the relevant value listed in Table 102-3.

4. Impulse Sound Level Meter

(1) Purpose

An Impulse Sound Level Meter is a sound level meter which is intended to be used for the measurement of any sounds, including sounds for which a General Purpose Sound Level Meter may be used.

(2) Specifications

A sound level meter which meets the following specifications is an Impulse Sound Level Meter:

(a) the sound level meter, including a microphone equipped with a windscreen, shall meet the specifications of a General Purpose Sound Level Meter;
(b) the sound level meter, including a microphone equipped with a windscreen, shall meet the specifications of IEC 179 and IEC 179A, supplement to IEC 179, including the optional characteristics mentioned in subclause 4.5 of IEC 179A;
(c) the sound level meter shall incorporate A-weighting as specified in IEC 179.

5. Peak Pressure Level Detector

(1) Purpose

A Peak Pressure Level Detector is a sound level meter which is intended to be used for the measurement of peak pressure perturbations in air. The value indicated by this device is not an average of the pressure level perturbations.

(2) Specifications

A sound level meter which meets the following specifications is a Peak Pressure Level Detector (the features of this device are incorporated in an Impulse Sound Level Meter as specified in section 4 above):

(a) the microphone of the sound level meter, when equipped with a windscreen, shall perform within a tolerance of ±1 dB throughout the frequency range of from 5 Hz to 31.5 Hz in the circumstances and conditions for use set out in Table 1 of IEC 179;
(b) the sound level meter without the microphone shall be capable of providing linear response as specified in subclause 4.5 of IEC 179, within a tolerance of ±1 dB throughout the frequency range of from 5 Hz to 15 kHz;
(c) the sound level meter shall incorporate the optional characteristics specified in subclause 4.5 of IEC 179A;
(d) the sound level meter shall meet the specifications set out in IEC 179 clause 3, subclauses 4.1, 4.2, 4.4, 4.5, 4.7, 4.8, clause 5, subclauses 6.2, 6.3, 6.4, 6.5, 6.8, 6.9, 7.1 through 7.9, 7.11, 8.1, 8.2, 8.3, 8.6 through 8.9 and the appropriate specifications of clause 10.

6. Type B Integrating Sound Level Meter

(1) Purpose

(a) An Integrating Sound Level Meter is a sound level meter which is intended to be used for the measurement of sound over a period of time, such that the equivalent sound level ($L_{eq}$) of the sound may be obtained.

(b) The Type B Integrating Sound Level Meter is specified with sufficient dynamic range and measurement precision to measure equivalent sound levels of general sounds that exceed limitations set out in this by-law.

(c) Either a Type A or Type B Integrating Sound Level Meter may be used for most such applications, but a Type A Integrating Sound Level Meter must be used when the sound under study is Quasi-Steady Impulsive Sound (see NPC-103 - Procedures, sections 3 and 4) or when the operational dynamic range greatly exceeds 40 dB.

(2) General Description

The tolerances specified for the microphone, weighting and amplifier of a Type B integrating Sound Level Meter are the same as those specified for a General Purpose Sound Level Meter in section 3 of this Publication. The computational portions of the instrument mist operate within a net accuracy of ±1 dB for time periods of 20 minutes to one hour over a dynamic range of at least 40 dB with test signals having a crest factor (as defined in IEC 179A) up to 3. An operator-activated switch is included to inhibit the integration function alone and, if the system includes an elapsed-time clock, to inhibit both the integration and time summation functions.

(3) Specifications

A sound level meter which meets the following specifications is a Type B Integrating Sound Level Meter:

(a) the instrument will generally be a combination of microphone, amplifier, A-weighting network, computation circuit to obtain the integral of the mean square A-weighted pressure, display and a means of inhibiting the integration, but may vary from the above provided that it performs the same functions within the tolerances set out below;

(b) the instrument may include computational circuitry to calculate and display the equivalent sound level directly;

(c) the microphone of the instrument shall meet the specifications of clause 5 of IEC 123, except that, in addition to meeting the specifications of subclause 5.2 thereof, the microphone shall also meet the specifications of subclause 5.2 amended by the substitution therein of an angle of incidence of ± $30^0$ instead of ± $90^0$, as it therein appears, and by the substitution of Table 102-2 hereof instead of Table 1, as it therein appears;

(d) a windscreen shall be installed on the microphone during operation and shall not affect by more than 1 dB the tolerance prescribed in clause (c);

(e) the sound level meter, including a microphone equipped with a windscreen, shall, when operated in the presence of wind, indicate a wind-induced sound level not in excess of the relevant value listed in Table 102-3;

(f) the A-weighting network shall meet the specifications of Table II and Figure 1 of IEC 123;

(g) the amplifier shall meet the specifications of subclauses 7.2, 7.3 and 7.11 of IEC 123;

(h) for each sensitivity setting of the instrument the amplifier shall have a power handling capacity at least 10 dB greater than the maximum sound level specified for that sensitivity setting;

(i) if the computation circuit is of the sampling (digital) type, when operating in conjunction with the microphone, windscreen, A-weighting network and amplifier. It shall generate a signal proportional to the mean square A-weighted pressure with a 1 ±0.25 s exponential averaging time constant;

(j) the computation circuit shall Integrate the mean square A-weighted pressure and shall be capable of doing so on each sensitivity setting for a minimum of 6 minutes at the maximum sound level specified for that sensitivity setting;

(k) if the computation circuit is not capable of meeting the specification of clause (j) with the reference therein to “6 minutes” changed to “60 minutes”, then the device shall be provided with a means to indicate to the operator when the integration capability has been exceeded;

(1) if the computational circuit is of the sampling (digital) type, sampling shall take place at least twice per second;

(m) the computation circuit shall operate over the usable dynamic range of the instrument with a linearity of ±1 dB for any sound with a ratio of peak pressure to root mean square pressure up to 3 (crest factor up to 3);

(n) an operator-activated switch shall be provided to inhibit integration or, if the instrument has an internal elapsed time clock, to inhibit both integration and accumulation of time;

(o) the combination of windscreen, microphone, A-weighting network, amplifier and computation circuit shall have a usable dynamic range extending at least from 50 dBA to 90 dBA and the manufacturer shall specify the usable dynamic range;

(p) the instrument may be provided with more than one sensitivity setting and the manufacturer shall specify the minimum and maximum input sound level for each sensitivity setting;

(q) if the maximum sound level specified for any sensitivity setting is less than 100 dBA, the system shall include a means of indicating to the operator that the maximum input sound level for that sensitivity setting has been exceeded and such indication shall be maintained until cancelled by the operator;

(r) the display shall indicate either,

  (i) an output proportional to the integrated mean square A-weighted pressure, or

  (ii) the integrated mean square A-weighted pressure divided by the duration of the period of time for which the equivalent sound level is to be determined, or

  (iii) the equivalent sound level for the period of time for which the equivalent sound level is to be determined;

(s) It shall be possible to read from the display or to calculate from the reading of the display, the equivalent sound level to a resolution of ±1 dB over the usable dynamic range of the instrument for integration times from 20 minutes to 60 minutes;

(t) if the indication of the display is as described in subclause (ii) or (iii) of clause (r), the instrument shall include an elapsed-time clock;

(u) the complete instrument shall follow the recommendations and meet the specifications of subclauses 7.4, 7.5, 7.6, 7.7, 7.8 and 7.9 of IEC 123; and

(v) the Instrument shall include a means of determining whether the battery of the instrument if any, has sufficient life to permit proper operation for a period of at least one hour.

7. Type A Integrating Sound Level Meter

(1) Purpose

(a) An Integrating Sound Level Meter is a sound level meter which is intended to be used for the measurement of sound over a period of time, such that the equivalent sound level ($L_{eq}$ ) of the sound may be obtained.

(b) The Type B Integrating Sound Level Meter is specified with sufficient dynamic range and measurement precision to measure equivalent sound levels of general sounds that exceed limitations set out in this by-law.

(c) Either a Type A or a Type B Integrating Sound Level Meter may be used for most such applications, but a Type A Integrating Sound Level Meter must be used when the sound under study is Quasi-Steady Impulsive Sound (see NPC-103 - Procedures, Sections 3 and 4) or when the operational dynamic range greatly exceeds 40 dB.

(2) General Description

The tolerances specified for the microphone, weighting and amplifier of a Type A Integrating Sound Level Meter are the same as those specified for a General Purpose Sound Level Meter in section 3 of this Publication. The computational portions of the instrument must operate within a net accuracy of ±1 dB for time periods of 20 minutes to one hour over a dynamic range of at least 80 dB with test signals having a crest factor (as defined in IEC 179A) up to 5. An operator activated switch is included to inhibit both the integration and time summation functions.

(3) Specifications

A sound level meter which meets the following specifications is a Type A Integrating Sound Level Meter:

(a) the sound level meter shall meet the specifications of a Type B Integrating Sound Level Meter;

(b) the instrument shall be provided with an Internal elapsed-time clock;

(c) for each sensitivity setting of the instrument, the amplifier shall have a power handling capacity at least 14 dB greater than the maximum sound level specified for that sensitivity setting;

(d) the computation circuit shall operate over the usable dynamic range of the instrument with a linearity of ±1 dB for any sound with a ratio of peak pressure to root mean square pressure up to 5 (Crest Factor up to 5); and

(e) the combination of windscreen, microphone, A-weighting network, amplifier and computation circuit shall have a usable dynamic range extending at least from 40 dBA to 120 dBA.

8. Vibration Velocity Detector

(1) Purpose

A Vibration Velocity Detector is a device intended to be used for the measurement of the peak particle velocity of a solid surface.

(2) Specifications

A device which meets the following specifications is a Vibration Velocity Detector:

(a) the device shall include either a transducer which responds to the total vibration vector or three transducers which have their axes of maximum sensitivity mutually orthogonal $\pm 1^0$;

(b) where three transducers are used to measure three mutually orthogonal components of vibration, the response of any one of the transducers to vibration in the plane normal to its axis of maximum sensitivity shall be less than 10% of its response to the same vibration along its axis of maximum sensitivity;

(c) the output of the device shall be proportional to the velocity of the surface on which the transducer is, or the transducers are, mounted and the output of the device shall be in such form that the device indicates, or can be used to calculate, the peak particle velocity in the frequency range of from 5 Hz to 500 Hz over a range of peak particle velocity of from 0.25 cm/s to 10 cm/s with a tolerance of ±10%; and

(d) It shall be possible to field-calibrate the device with an accuracy of ±5% using either a reference electrical signal in series with the equivalent transducer impedance or a reference vibration source.

9. Acoustic Calibrator

(1) Purpose

An Acoustic Calibrator is an electro-mechanical or mechanical device which produces sound of a known frequency and which, when coupled to a sound level meter, produces a predictable response in the sound level meter if the sound level meter is operating properly at the calibration frequency.

(2) Specifications

A device, capable of producing sound, which meets the following specifications, is an Acoustic Calibrator:

(a) the device shall be capable of being physically attached to a sound level meter in such a way that the device and the sound level meter are “acoustically coupled”, that is, sound from the device is transmitted through the air by way of a chanter formed by the attachment of the device to the microphone of the sound level meter;

(b) the device shall produce sound of a stated frequency, within a frequency tolerance of ±5%;

(c) the manufacturer of the device shall provide with the device, any data required in order to determine the sound level reading which should be indicated on the sound level meter when calibrated for those microphone and sound level meter types with which the manufacturer recommends the device be used. Where additional accessories must be used to provide this sound level reading, the manufacturer shall state that they must be used;

(d) the maximum tolerance in the sound pressure level generated by the device when coupled to the microphone shall apply over an atmospheric pressure range of 87 kPa to 107 kPa, and shall be ±0.5 dB over the temperature range of from $0^0$C to $40^0$C and ±1.0 dB over the temperature range of from -l$0^0$C to $50^0$C;

(e) if the device is battery powered, means for checking the battery condition shall be included with the device;

(f) the following data shall be provided with the device by the manufacturer,

(i) the nominal sound pressure level produced,

(ii) the nominal frequency at which the device operates,

(iii) the ranges of temperature and atmospheric pressure over which the device is intended to operate, and the applicable overall sound pressure level tolerance for these ranges.

TABLE 102-2

Permissible Tolerances on Microphone Sensitivity
Over an Angle of ± $30^0$

| Frequency Hz | Permissible Tolerances dB | |
|---|---|---|
| | A* | B** |
| 31.5 - 500 | ±1 | ±1 |
| 1000 | ±1 | ±1 |
| 2000 | ±2 | +1-2 |
| 4000 | ±4 | +1-4 |
| 8000 | ±10 | +1-10 |

* COLUMN A: The microphone is mounted on the sound level meter.

** COLUMN B: The microphone is physically separated from the sound level meter but electrically connected thereto.

TABLE 102-3

Maximum Wind Induced Sound Level Indication Using A-weighting and
Slow Response (where available)

| Wind Speed | dBA |
|---|---|
| 15 km/h | 41 |
| 20 km/h | 48 |
| 25 km/h | 53 |

## PUBLICATION NPC-103 PROCEDURES

## TABLE OF CONTENTS

1. Scope

This Publication comprises the various measurement procedures to be used in connection with other Publications which provide limits or standards for sound or vibration. Several of the procedures adopted are those of nationally or internationally recognized agencies. Table 103-1 lists the measurement procedures which are included in this Publication.

TABLE 103-1

| NPC-103 Section | Type of Measurement | Procedure |
|---|---|---|
| 3 | Steady or impulsive sound | Ministry |
| 4 | Varying sound | Ministry |
| 5 | Sound and vibration from blasting | Ministry |
| 6 | Powered mobile construction equipment | SAE J88a |
| 7 | Pneumatic equipment | MEMAC |
| 8 | Small engines | SAE J1046 |
| 9 | Truck with governed diesel engines | CSA Z107.22-M |

2. Technical Definitions

The technical terms used in a procedure shall have the meaning given either in that procedure or in Publication NPC-l0l - Technical Definitions.

3. Procedure for Measurement of Steady or Impulsive Sound

(1) (a) Classification

For the purposes of this procedure sounds can conveniently be placed in four mutually exclusive categories as follows:

(i) impulsive sounds, other than Quasi-Steady Impulsive Sounds, such as, but not limited to, the sound from gunshots, certain explosive pest control devices and certain industrial metal working operations (e.g. forging, hammering. punching, stamping, cutting, forming and moulding);

(ii) Quasi-Steady Impulsive Sounds, such as, but not limited to, the sound from pavement breakers, riveting guns, ineffectively muffled internal combustion engines or ineffectively muffled air compressors;

(iii) buzzing sounds, such as, but not limited to, the sounds from positive displacement blowers, chain saws, small combustion engines and concrete finishers;

(iv) all other sounds.

(b) Application

This procedure applies to measurements at a point of reception of:

(i) sound of a type mentioned in category (i) or (ii) of clause (a); and

(ii) sound of a type mentioned in categories (iii) or (iv) of clause (a), which is always higher than the permissible level or which, when the sound is present, does not vary in level over a range of more than 6 dB during the period of observation.

(2) Instrumentation

(a) Sound Level Meter

(i) An Impulse Sound Level Meter shall be used for the measurement of sound in category (i), (ii) or (iii) of clause 3(1) (a).

(ii) A General Purpose Sound Level Meter shall be used for the measurement of sound in category (iv) of clause 3(1) (a).

NOTE: An Integrating Sound Level Meter may be used for the measurement of sound in category (iv) of clause 3(1) (a), but the procedure set out in section 4 - Procedure for Measurement of Varying Sound most be used.

(b) Calibrator
An Acoustic Calibrator shall be used.

(c) Windscreen
A windscreen shall be used in all outdoor measurements.

(3) Measurement Location

For sound transmitted solely through air, the measurement location shall be one or more of the following points of reception:

(a) a location out-of-doors where a person may be exposed to the sound; or

(b) the plane of an exterior door or window of a room in which a person may be exposed to the sound, where the door or window is open.

(4) Use of Instrumentation

(a) Battery Check
If the sound level meter is battery powered the condition of the battery shall be checked after the meter has been allowed to warm up and stabilize. The battery condition shall be rechecked at least once per hour during a series of measurements and at the conclusion of such measurements. The meter shall not be used unless the battery condition is confirmed to be within the range recommended by the manufacturer for proper operation.

(b) Calibration
The sound level meter shall be calibrated after the meter has been allowed to warm up and stabilize, at least once per hour during a series of measurements and at the conclusion of such measurements.

(c) Sound Level Meter Settings
Measurements shall be taken using the following response settings:

(i) Impulse Response (dBAI)
The impulse response and A-weighting shall be used for impulsive sound in category (i) of clause 3 (1)(a). An ‘impulse hold’ facility may be used if available on the meter.

(ii) Slow Response (dBA)
The slow response and A-weighting shall be used for sound in categories (ii), (iii) or (iv) of clause 3 (l)(a).

(d) Instrument Configuration

(i) Reflective Surfaces
The microphone shall be located not less than 1 m above the ground, not less than 1 m from any sound reflective surface except for the purposes of clause 3(3)(b) and not less than arm’s length from the body, of the person operating the meter. Not more than one person, other than the operator of the meter, shall be within 7 m of the microphone and that person shall be behind the operator of the meter.

For the case of clause 3(3)(b) the microphone shall be in the middle of the aperture located not less than 15 cm from the window frame or door frame.

(ii) Microphone Orientation

The microphone shall be oriented such that the sound to be measured is incident at an angle recommended by the microphone manufacturer for flattest frequency response in a free field.

(e) Measurement - Slow Response

(i) Readings Taken

For sound in categories (ii), (iii) or (iv) of clause 3 (1)(a), a minimum of three observations with a minimum observation time of 15 s each shall be made. The observed average reading for each of the observations shall be noted as well as the minimum and the maximum of the range of sound levels during each observation period. If the difference between any two observed average readings is greater than 3 dB, a minimum of six observations shall be made. For the purpose of adjustments for intermittency the duration of the sound in any one hour shall be noted.

(ii) Readings Reported

The arithmetic mean of the observed average readings shall be reported, rounded to the nearest decibel. Adjustments for intermittence and quality of sound shall be made in accordance with Publication NPC-104 - Sound Level Adjustments, and the result shall be reported. The result is the one hour equivalent sound level ($L_{eq}$) of the sound under study for any one hour period during which the readings were taken pursuant to subclause (i).

(iii) Wide Variation of Sound Levels

If, in making observations pursuant to subclause (i), there is a difference of more than 6 dB between the lowest and highest values of the observed ranges of sound levels, this procedure shall not be used unless the lower limit of each such range is above the maximum permissible level. Instead, the procedure set out in Section 4 - Procedure for Measurement of Varying Sound at a point of reception, shall be used.

(f) Measurement – Impulse Response - Frequent Impulses

(i) Readings Taken

For sound in category (i) of clause 3 (i)(a) not less than 20 impulses shall be measured within a continuous period of 20 minutes and each measurement taken shall be reported.

(ii) Extension of Time

Where a minimum of 20 impulses cannot be measured within a continuous period of 20 minutes pursuant to subclause (i) the time period may be extended to 2 hours if an impulse occurred in each of the four consecutive periods of five minutes each during the Initial 20 minute measurement period.

(iii) Level Reported

The Logarithmic Mean Impulse Sound Level ($L_{LM}$) of the 20 or more measurements shall be calculated and reported to the nearest decibel. This Logarithmic Mean Impulse Sound Level is a valid and effective sound level or any one hour period during which readings were taken pursuant to subclauses (i) and (ii).

(g) Measurement - Impulse Response - Single Event Readings Taken and Reported

For impulsive sounds in category (i) of clause 3(1)(a), that occur as single, seemingly independent events not normally measurable using the procedure set out in clause (f) for frequent impulses, each impulse shall be independently measured and each impulse sound level reported to the nearest decibel.

(h) Variation in Calibration

Measurements shall not be reported if the sound level meter calibration has changed more than 0.5 dB from the previous calibration.

(i) Weather Conditions

(i) Wind
Measurements shall not be taken unless the wind-induced sound level is more than 10 dB below the measured levels. Reference should be made to Publication NPC-102 - Instrumentation, particularly Table 102-3.

(ii) Humidity
Measurements shall not be taken if the relative humidity is above the maximum for which the meter specification is guaranteed by the manufacturer (normally 90%).

(iii) Precipitation
Measurements shall not be taken during precipitation.

(iv) Temperature
Measurements shall not be taken when the air temperature is outside the range for which the specification of the instrument is guaranteed by the manufacturer. (Normally, only the lower temperature limit is significant.)

(5) Documentation

The following represents the minimum information which shall be contained in a report of an investigation where the above procedure was used. (Adapted from CSA Z107.2-1973 Methods for the Measurement of Sound Pressure Levels.)

(a) Acoustic Environment

(i) Location and description of sound sources.

(ii) Dimensioned sketch including photographs, if possible, of the location of the sound source and the point of reception, showing all buildings, trees, structures and any other sound reflective surfaces.

(iii) Physical and topographical description of the ground surface.

(iv) Meteorological conditions prevailing at the time of the investigation including approximate local wind speed in km/h, wind direction, air temperature in $^{0}$C, approximate relative humidity and extent of cloud cover.

(b) Instrumentation

All the equipment used for making sound level measurements shall be listed, including:

(i) type, model and serial number of sound level meter;

(ii) type, model and serial number of microphone;

(iii) type, model and serial number of Acoustic Calibrator;

(iv) extension cables and additional amplifier, if used.

(c) Acoustical Data

The measurement details shall be described, including:

(i) the location of the microphone, using a sketch if necessary;

(ii) measurements or readings obtained, preferably listed in tabular form, referencing location on a sketch or map, time periods involved, and relevant data required for making calculations;

(iii) adjustments made for quality of sound or intermittence;

(iv) details of any calculations;

(v) comparison with applicable sound level limits, standards or guidelines.

4. Procedure for Measurement of Varying Sound

(1) (a) Classification

For the purposes of this procedure sounds can conveniently be placed in four mutually exclusive categories as follows:

(i) impulsive sounds, other than Quasi-Steady Impulsive Sounds, such as, but not limited to, the sound from gunshots, certain explosive pest control devices and certain industrial metal working operations (e.g. forging, hammering, punching, stamping, cutting, forming and moulding);

(ii) Quasi-Steady Impulsive Sounds, such as, but not limited, to, the sound from pavement breakers, riveting guns, ineffectively muffled internal combustion engines or ineffectively muffled air compressors;

(iii) buzzing sounds, such as, but not limited to the sound from positive displacement blowers, chain saws, small combustion engines and concrete finishers;

(iv) all other sounds.

(b) Application

This procedure applies to measurements at a point of reception of continuous or intermittent sound mentioned in category (ii), (iii) or (iv) of clause (a).

(2) Instrumentation

(a) Integrating Sound Level Meter

An Integrating Sound Level Meter shall be used which is appropriate for the sound to be measured:

(i) Either a Type A or Type B Integrating Sound Level Meter may be used for the measurement of sound in category (iv) of clause 4(1)(a);

(ii) A Type A Integrating Sound Level Meter shall be used for the measurement of sound in categories (ii) or (iii) of clause 4(1)(a).

(b) Calibrator

An Acoustic Calibrator shall be used.

(c) Windscreen

A windscreen shall be used in all outdoor measurements.

(3) Measurement Location

(a) Air-Borne Sound

For sound transmitted solely through air, the measurement location shall be one or more of the following points of reception:

(i) a location out-of-doors where a person may be exposed to the sound; or

(ii) the plane of an exterior door or window of a room in which a person may be exposed to the sound, where the door or window is open.

(4) Use of Instrumentation

(a) Battery Check

If the Integrating Sound Level Meter uses a battery, the condition of the battery shall be checked before each measurement, and measurement shall not commence unless the battery has sufficient life remaining to permit proper operation for a period of at least one hour.

(b) Calibration

The Integrating Sound Level Meter shall be calibrated before and after each measurement period.

(c) Instrument Configuration

(i) Reflective Surfaces

The microphone shall be located not less than 1 m above the ground, not less than 1 m from any sound reflective surface except for the purposes of subclause 4(3)(a)(ii) and not less than arm's length from the body of the person operating the meter. Not more than one person, other than the operator of the meter, shall be within 7 m of the microphone and that person shall be behind the operator of the meter. For the case of subclause 4(3)(a)(ii) the microphone shall be in the middle of the aperture located not less than 15 cm from the window frame or door frame.

(ii) Microphone Orientation

The microphone shall be oriented such that the sound to be measured is incident at an angle recommended by the microphone manufacturer for flattest frequency response in a free field.

(d) Extraneous Sources

When measuring the sound from a source, integration shall from time to time be inhibited by the operator immediately when the received sound is dominated by sound from a source other than the source under study and it shall remain inhibited while such a condition persists and for at least 10 seconds thereafter. While integration is inhibited the elapsed time used to calculate the equivalent sound level shall not be allowed to accumulate.

(e) Timing

If the Integrating Sound Level Meter is not provided with an internal elapsed-time clock, the operator shall accumulate the elapsed time during the measurement period by means of a stop-watch or other time measuring device.

(f) Readings

(i) Stationary Source

When measuring the sound from a stationary source, measurements to be used in calculating results shall be taken during a continuous period not in excess of one hour and, for purposes of calculation and reporting of results, the accumulated elapsed time of measurement as obtained in accordance with clause (d) is deemed to be one hour if the accumulated time is 20 minutes or more.

Measurements containing information from an accumulated time period of less than 20 minutes are insufficient for purposes of calculating the equivalent sound level ($L_{eq}$) of a stationary source.

(ii) Road Traffic Noise Sources

When measuring the sound from road traffic the accumulated elapsed time obtained in accordance with clause (d) shall not be less than twenty minutes and the actual accumulated elapsed time of measurement shall be used for purposes of calculation.

(g) Adjustments

Adjustments for quality of sound shall be made in accordance with Publication NPC-104 - Sound Level Adjustments and the result reported. No adjustment shall be made for intermittence.

(h) Variation in Calibration

A measurement shall not be reported if the Integrating Sound Level Meter calibration after the measurement period is more than 0.5 dB different from that before the measurement commenced.

(i) Weather Conditions

(i) Wind

Measurements shall not be made unless the wind-induced sound level is more than 10 dB below the measured levels. Reference should be made to Publication NPC-102-Instrumentation and particularly Table 102-3.

(ii) Humidity

Measurements shall not be taken if the relative humidity is above the maximum for which the meter specification is guaranteed by the manufacturer (normally 90%).

(iii ) Precipitation

Measurements shall not be taken during precipitation.

(iv) Temperature

Measurements shall not be taken when the air temperature is outside the range for which the specification of the instrument is guaranteed by the manufacturer. (Normally, only the lower temperature limit is significant.)

(j) Readings Reported

(i) For sound from a stationary source, the value to be reported based on measurements made during the accumulated elapsed time of 20 minutes or more and the time period for calculation which is one hour is, after adjustment in accordance with clause (g), the one hour equivalent sound level ($L_{eq}$) of the sound under study for any one hour period during which measurements were taken pursuant to subclause 4(4)(f)(i).

(ii) For sound from road traffic, the value to be reported based on measurements made during the accumulated elapsed time of 20 minutes or more and the time period for calculation which is the actual accumulated elapsed time, is the one hour equivalent sound level ($L_{eq}$) of the sound under study for any one hour period during which measurements were taken pursuant to subclause 4(4)(f)(ii).

(iii) The one hour equivalent sound level ($L_{eq}$) shall be reported to the nearest decibel.

(5) Documentation

The following represents the minimum information which shall be contained in a report of an investigation where the above procedure was used. (Adapted from CSA Z107.2-1973 Methods for the Measurement of Sound Pressure Levels.)

(a) Acoustic Environment

(i) Location and description of sound sources.

(ii) A list of the types of extraneous noise sources which caused integration to be inhibited during measurement.

(iii) Dimensioned sketch including photographs, if possible, of the location of the sound source and the point of reception. showing all buildings, trees, structures and any other sound reflective surfaces.

(iv) Physical and topographical description of the ground surface.

(v) Meteorological conditions prevailing at the time of the investigation including approximate local wind speed in km/h, wind direction, air temperature in $^{0}$C, approximate relative humidity and extent of cloud cover.

(b) Instrumentation

All the equipment used for making sound level measurements shall be listed, including:

(i) type, model and serial number of Integrating Sound Level Meter;

(ii) type, model and serial number of microphone;

(iii) type, model and serial number of Acoustic Calibrator;

(iv) extension cables and additional amplifier, if used.

(c) Acoustical Data

The measurement details shall be described, including:

(i) the location of the microphone, using a sketch if necessary;

(ii) the continuous time period of observation;

(iii) the accumulated elapsed time of measurement following the procedure of clauses 4(4)(d) and (e);

(iv) the Integrating Sound Level Meter reading or output and any other relevant data required for calculations;

(v) adjustments made for quality of sound;

(vi) details of all calculations;

(vii) the equivalent sound levels obtained, preferably listed in tabular form, referencing location on a sketch or map;

(viii) comparison with applicable sound level limits, standards or guidelines.

5. Procedure for Measurement of Sound and Vibration Due to Blasting Operations

(1) Application

This procedure applies to the measurement of sound (concussion) and vibration due to blasting operations.

(2) Sound

(a) Instrumentation

(i) Measuring Device

A Peak Pressure Level Detector shall be used.

(ii) Calibrator

An Acoustic Calibrator shall be used.

(iii) Windscreen

A windscreen shall be used in all outdoor measurements.

(b) Measurement Location

The measurement location shall be at a point of reception out-of-doors within 7 m of a building.

(c) Use of Instrumentation

(i) Battery Check

If the measuring device is battery powered, the condition of the battery shall be checked after the device has been allowed to warm up and stabilize and after each measurement has been made. The device shall not be used unless the battery condition is confirmed to be within the range recommended by the manufacturer for proper operation.

(ii) Calibration

The measuring device shall be calibrated after it has been allowed to warm up and stabilize and after each measurement has been made.

(iii) Meter Setting

The measuring device shall be set to read the peak pressure level using linear response and a ‘hold’ facility, if available.

(d) Instrument Configuration

(i) Reflective Surfaces

The microphone shall be located not less than 1 m above the ground, not less than 1 m from any sound reflective surface and not less than arm’s length from the body of the person operating the device. Not more than one person, other than the operator of the meter, shall be within 7 m of the microphone and that person shall be behind the operator of the meter.

(ii) Microphone Orientation

The microphone shall be oriented such that the concussion wave to be measured is incident at an angle recommended by the microphone manufacturer for flattest frequency response in a free field.

(e) Readings

(i) Peak Pressure Level

The value of peak pressure level reported shall be given to the nearest decibel.

(ii) Variation in Calibration

A measurement shall not be reported if the meter calibration after the measurement is more than 0.5 dB different from that before the measurement.

(iii) Battery Deterioration

A measurement shall not be reported if the battery condition after the measurement is not within the range recommended by the manufacturer for proper operation.

(f) Weather Conditions

(i) Wind Measurements shall not be reported unless the wind-induced sound pressure level is more than 10 dB below the measured peak pressure level. Reference should be made to Publication NPC-102 - Instrumentation.

(ii) Humidity

Measurements shall not be taken if the relative humidity is above the maximum for which the meter specification is guaranteed by the manufacturer (normally 90%).

(iii) Precipitation

Measurements shall not be taken during precipitation.

(iv) Temperature

Measurements shall not be taken when the air temperature is outside the range for which the meter specification is guaranteed by the manufacturer. (Normally only the lower temperature limit is significant.)

(3) Vibration

(a) Instrumentation

(i) Measuring Device

A Vibration Velocity Detector shall be used.

(ii) Calibrator

An electrical reference signal of known voltage and frequency shall be used in the field for calibration of the Vibration Velocity Detector excluding the transducer. A reference vibration source shall be used for laboratory calibration of the complete Vibration Velocity Detector.

(b) Measurement Location

Vibration measurements shall be made at a point of reception inside a building below grade or less than 1 m above grade, preferably on a basement floor close to an outside corner.

(c) Use of Instrumentation

(i) Battery Check

If the measuring device is battery powered, the condition of the battery shall be checked after the device has been allowed to warm up and stabilize and after each measurement has been made. The device shall not be used unless the battery condition is confirmed to be within the range recommended by the manufacturer for proper operation.

(ii) Calibration

Field calibration shall be carried out before and after each measurement. Laboratory calibration of the complete Vibration Velocity Detector as used in the field, including the transducer, shall be carried out not less than once per calendar year and the results certified

(d) Instrument Configuration

(i) Mounting

The transducer shall be affixed to a part of the structure so as to prevent movement of the transducer relative to the structure. The preferred structural element is the basement floor as indicated in clause (b).

(ii) Transducer Orientation

If three vector components of vibration velocity are recorded individually, it is preferable to orient the transducers such that the three axes of measurement are (a) vertical, (b) radial (along a horizontal line joining the location of the blast to the location of measurement) and. (c) transverse (along a horizontal line at right angles to the line joining the location of the blast to the location of measurement).

(e) Readings

(i) Peak Particle Velocity

The peak particle velocity in cm/s shall be reported.

(ii) Variation in Calibration

A measurement shall not be reported if calibration after the measurement is more than 5% different from that before the measurement.

(iii) Battery Deterioration

A measurement shall not be reported if the battery condition after the measurement is not within the range recommended by the manufacturer for proper operation.

(4) Documentation

The following represents the minimum information which shall be contained in a report of an investigation where the above procedure was used.

(a) Description of Area

(i) Location and description of the blasting operation.

(ii) Dimensioned sketch including photographs, if possible, of the location of the blasting operation, the nearest premises and the measurement location.

(iii) Description of the measurement location.

(iv) Physical and topographical description of the ground surface.

(v) Meteorological conditions at the time of the investigation, including approximate wind speed in km/h, wind direction, air temperature in degrees Celsius, approximate relative humidity, degree of cloud cover and whether or not a condition of thermal inversion prevailed.

(b) Instrumentation

All the equipment used for making sound and vibration measurements shall be listed, including:

(i) type, model and serial number of Peak Pressure Level Detector;

(ii) type, model and serial number of microphone;

(iii) type. model and serial number of Acoustic Calibrator;

(iv) windscreen;

(v) extension cables and additional amplifiers, if used;

(vi) type, model and serial number of Vibration Velocity Detector;

(vii) type, model and serial number of transducers.

(viii) type, model and serial number of vibration calibrator.

(c) Sound and Vibration Data

The measurement details shall be described, including:

(i) the location where measurements were taken, the time period involved and the orientation of instrumentation using a sketch, if necessary;

(ii) details of all calculations;

(iii) the peak pressure level in dB and/or peak particle velocity in cm/s;

(iv) comparison with applicable peak pressure limits and/or peak particle velocity limits.

6. Exterior Sound Level Measurement Procedure For Powered Mobile Construction Equipment - SAE J88a

SAE J88a Recommended Practice is adopted by the Ministry with the following change:

Where ANSI Type 1 sound level meter specification is referred to, reference shall be made instead to Publication IEC-179 (1973) for Precision sound level meters. (General Purpose Sound Level Meter)

7. MEMAC Test Code For the Measurement of Sound From Pneumatic Equipment

The MEMAC Test Code For The Measurement Of Sound From Pneumatic Equipment is adopted by the Ministry with the following additional requirement:

For measurement of percussive machines the sound level meter used shall meet the specifications of IEC Publications 179 and 179A (1973). (Impulse Sound Level Meter)

8. Exterior Sound Level Measurement Procedure For Small Engine Powered Equipment - SAE J 1046

SAE J 1046 — Recommended Practice, is adopted by the Ministry with the following changes:

(1) Where ANSI Type 1 sound level meter specification is referred to, reference shall be made instead to IEC Publications 179 and 179A (1973). (Impulse Sound Level Meter)

(2) Replace clause 3.1.1 with the following:

The minimum dimensions of the measurement zone are defined as a path of travel 1.2 m wide by 14 m long plus an adjacent area having the base along the edge of the path of travel and the apex 7 m from the midpoint of the base.

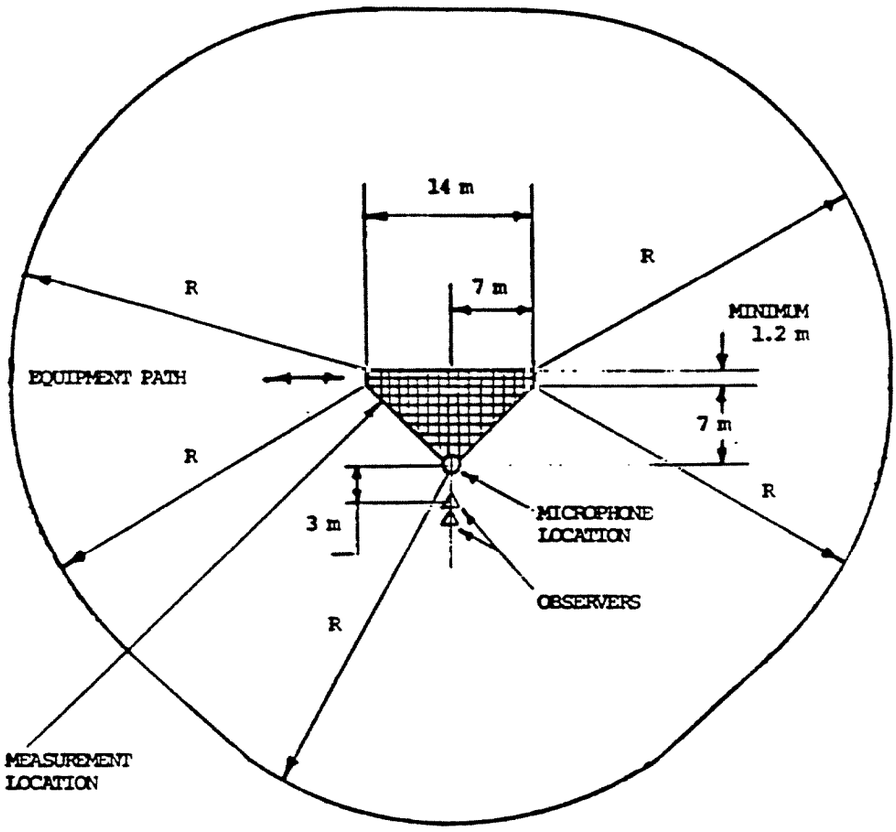
(3) Replace Fig. 1 with Fig. 103-1, hereof.

(4) In section 3.3 Measurements, all references to 25 ft. shall be changed to 7 m.

9. Procedure for Measurement of the Maximum Exterior Sound Level of Stationary Trucks with Governed Diesel Engines - CSA Z107.22-M1977

(1) CSA Z107.22-M1977 standard is adopted by the Ministry with the following change:

A General Purpose Sound Level Meter shall be used.




REF. US EPA 550-9-74-011 R = 30 M MINIMUM RADIUS

TEST SITE CONFIGURATION FOR EXTERIOR SOUND LEVEL MEASUREMENT

PROCEDURE FOR SMALL ENGINE POWERED EQUIPMENT – SAE J 1046

FIG. 103-1

## PUBLICATION NPC-104 SOUND LEVEL ADJUSTMENTS

## TABLE OF CONTENTS

1. Scope

This Publication refers to the adjustment of a sound level obtained following the procedures set out in either section 3 or 4 of NPC-103 – Procedures.

2. Technical Definitions

The technical terms used in this Publication are defined In Publication NPC-l0l - Technical Definitions.

3. Intermittence

If a sound is intermittent, the following adjustment shall be subtracted from the observed value:
Adjustment - 10 $\log_{10} \frac{1}{x}$ where x is the fraction of an hour for which the sound persists.

Such sound level adjustments are approximated in Table 104-1.

4. Adjustment for Special Quality of Sound

(1) Tonality
If a sound has a pronounced audible tonal quality such as a whine, screech, buzz, or hum then the observed value shall be increased by 5.

(2) Cyclic Variations
If a sound has an audible cyclic variation in sound level such as beating or other amplitude modulation then the observed value shall be increased by 5.

(3) Quasi-Steady Impulsive Sound
If a sound is Quasi-Steady Impulsive Sound then the observed value shall be increased by 10.

(4) One Adjustment Only
An adjustment may be made under one only of subsections (1), (2) and (3), providing that, if subsection (3) applies, it shall be used in preference to subsection (1) or subsection (2).

TABLE 104-1
Adjustment for Intermittence

| Duration of Sound In One Hour (Minutes) | Adjustment |
|---|---|
| 40 - 60 | 0 |
| 20 - 39 | 3 |
| 10 - 19 | 6 |
| 5 - 9 | 9 |
| 3 - 4 | 12 |
| 1—2 | 15 |
| less than 1 | 20 |

**PUBLICATION NPC-115**

**CONSTRUCTION EQUIPMENT**

**TABLE OF CONTENTS**

1. Scope

This Publication sets sound emission standards for various items of new construction equipment according to the date of manufacture of the equipment.

2. Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-l01 - Technical Definitions.

3. Sound Emission Standards

Tables 115-1 to 115-4 inclusive list Residential Area sound emission standards and Quiet Zone sound emission standards for specific items of new construction equipment measured in accordance with the procedures indicated.

TABLE 115-1

Quiet Zone and Residential Area Sound Emission Standards for Excavation Equipment, Dozers, Loaders, Backhoes or Other Equipment Capable of Being Used for Similar Application

| | Maximum Sound Level as determined using Publication NPC-103 - Procedures, section 6 dBA | |
|---|---|---|
| Date of Manufacture | Power Rating Less than 75 kW | Power Rating 75 kW and larger |
| January 1, 1979 to December 31, 1980 | 85 | 88 |
| January 1, 1981 and after | 83 | 85 |

TABLE 115-2

Sound Emission Standards for Pneumatic Pavement Breakers

| Standard | Date of Manufacture | Maximum Sound Level as measured using Publication NPC-103 - Procedures, section 7 dBA |
|---|---|---|
| Quiet Zone Sound Emission Standard | Jan. 1, 1979 and after | 85 |
| Residential Area Sound Emission Standard | Jan. 1, 1979 to Dec. 31 1980 | 90 |
| | Jan. 1, 1981 and after | 85 |

TABLE 115-3

Sound Emission Standards for Portable Air Compressors

| Standard | Date of Manufacture | Maximum Sound Level as measured using Publication NPC-103 – Procedures, section 7 |
|---|---|---|
| Quiet Zone Sound Emission Standard | Jan. 1, 1979 to Dec. 31, 1980 | 76 |
| | Jan. 1, 1981 and after | 70 |
| Residential Area Sound Emission Standard | Jan. 1, 1979 and after | 76 |

TABLE 115-4

Sound Emission Standard for Tracked Drills

| Standard | Date of Manufacture | Maximum Sound Level as measured using Publication NPC-103 – Procedures, section 6<br><br>dBA |
|---|---|---|
| Quiet Zone and Residential Area Sound Emission Standard | Jan. 1, 1981 and after | 100 |

**PUBLICATION NPC-117**

**DOMESTIC OUTDOOR POWER TOOLS**

**TABLE OF CONTENTS**

1. Scope

This Publication sets sound emission standards for various domestic outdoor power tools.

2. Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-101 - Technical Definitions.

3. Sound Emission Standards

Table 117-1 lists sound emission standards for walk-behind powered lawn mowers measured according to the procedure indicated in the Table.

TABLE 117-1

Sound Emission Standards for Walk-Behind Powered Lawn Mowers

| Date of Manufacture | Maximum Sound Level as Measured using Publication NPC-103 – Procedures section 8<br><br>DBA |
|---|---|
| Jan. 1, 1979 to Dec. 31, 1980 | 73 |
| Jan. 1, 1981 and after | 69 |

**PUBLICATION NPC-118**

**MOTORIZED CONVEYANCES**

**TABLE OF CONTENTS**

1. Scope

This Publication sets sound emission standards for motorized conveyances of various types.

2. Technical Definitions

(1) The technical terms used in this Publication are defined in Publication NPC—101 - Technical Definitions.

(2) Definitions Specific to this Publication Heavy Vehicle
"Heavy vehicle" means a motorized conveyance having a registered gross weight of more than 4,500 kg.

3. Sound Emission Standards — Governed Diesel Engines

Table 118-1 lists for various years of manufacture, the sound emission standard for a heavy vehicle powered by a governed diesel engine when measured in accordance with the procedure set out in the Table.

TABLE 118-1
Sound Emission Standards for Heavy Vehicles
with Governed Diesel Engines

| Date of Manufacture | Maximum Sound Level as Measured Using Publication NPC-103 – Procedures, section 9 |
|---|---|
| Prior to Jan. 1, 1979 | 100 |
| Jan. 1, 1979 and after | 95 |

4. Sound Emission Standards — Gasoline Engines

Table 118-2 lists, for various years of manufacture, the sound emission standard for a heavy vehicle powered by an ungoverned gasoline engine, when measured in accordance with the procedure set out in the Table.

TABLE 118-2

UNDER PREPARATION

| Date of Manufacture | Maximum Sound Level as Measured Using Publication NPC-103 – Procedures, section 9 |
|---|---|
| Jan. 1, 1979 | 100 |
| Jan. 1, 1979 and after | 95 |

## PUBLICATION NPC-119

## BLASTING

**TABLE OF CONTENTS**

1. Scope

This Publication refers to limits on sound (concussion) and vibration due to blasting operations.

2. Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-101 - Technical Definitions.

3. Measurement Procedures

All measurements of peak pressure level and vibration velocity shall be made in accordance with the “Procedure for Measurement of Sound and Vibration due to Blasting Operations” set out in Publication NPC-103 - Procedures, section 5.

4. Concussion - Cautionary Limit

Subject to section 5 the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 120 dB.

5. Concussion - Peak Pressure Level Limit

If the person in charge of a blasting operation carries out routine monitoring of the peak pressure level, the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 128 dB.

6. Vibration - Cautionary Limit

Subject to section 7 the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.00 cm/s.

7. Vibration - Peak Particle Velocity Limit

If the person in charge, of a blasting operation carries out routine monitoring of the vibration the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.25 cm/s.

**PUBLICATION NPC-205**

**SOUND LEVEL LIMITS FOR STATIONARY SOURCES IN**

**CLASS 1 & 2 AREAS (URBAN)**

**TABLE OF CONTENTS**

1. Scope

This Publication establishes sound level limits for stationary sources such as industrial and commercial establishments or ancillary transportation facilities, affecting points of reception in Class 1 and 2 Areas (Urban). The limits apply to noise complaint investigations carried out in order to determine potential violation of section 14 of the Environmental Protection Act. The limits also apply to the assessment of planned stationary sources of sound in compliance with Section 9 of the Environmental Protection Act and under the provisions of the Aggregate Resources Act and the Environmental Assessment Act.

This Publication does not address sound and vibration produced by blasting: blasting in quarries and surface mines are considered in Reference [7].

This Publication includes an Annex, which provides additional details, definitions and rationale for the sound level limits.

2. References

Reference is made to the following publications:

[1] NPC-101 - Technical Definitions

[2] NPC-102 - Instrumentation

[3] NPC-103 - Procedures

[4] NPC-104 - Sound Level Adjustments

[6] NPC-206 - Sound Levels due to Road Traffic

[7] NPC-119 – Blasting

[8] NPC-216 - Residential Air Conditioning Devices

[9] NPC-232 - Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)

[10] NPC-233 - Information to be Submitted for Approval of Stationary Sources of Sound

[12] ORNAMENT, Ontario Road Noise Analysis Method for Environment and Transportation. Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376, 1989

References [1] to [4] and [7] can be found in the Mode1 Municipal Noise Control By-Law, Ontario Ministry of the Environment, Final Report, August, 1978.

3. Technical Definitions

“Ambient sound level” means Background sound level.

“Background sound level” is the sound level that is present in the environment, produced by noise sources other than the source under impact assessment. Highly intrusive short duration noise caused by a source such as an aircraft fly-over or a train pass-by is excluded from the determination of the background sound level.

“Class 1 Area” means an area with an acoustical environment typical of a major population center, where the background noise is dominated by the urban hum.

“Class 2 Area” means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours.

Other characteristics which may indicate the presence of a Class 2 Area include:

- absence of urban hum between 19:00 and 23:00 hours;
- evening background sound level defined by natural environment and infrequent human activity; and
- no clearly audible sound from stationary sources other than from those under impact assessment.

"Class 3 Area" means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as the following:

- a small community with less than 1000 population:
- agricultural area;
- a rural recreational area such as a cottage or a resort area; or
- a wilderness area.

Other technical terms are defined in Reference [1] and in the Annex to Publication NPC-205.

4. Establishment of Limits - Objective

The sound level limit at a point of reception must be established based on the principle of "predictable worst case" noise impact. In general, the limit is given by the background sound level at the point of reception. The sound level limit must represent the minimum background sound level that occurs or is likely to occur during the operation of the stationary source under impact assessment.

5. Background Sound Levels

The time interval between the background sound level measurement and the measurement of the sound level produced by the stationary source under impact assessment should be minimized as much as possible. Preferably, the two measurements should be carried out within one hour of each other.

6. Sound Levels due to Stationary Sources

(1) Complaint Investigation of Stationary Sources

The One Hour Equivalent Sound Level ($L_{eq}$) and/or the Logarithmic Mean Impulse Sound Level ($L_{LM}$) produced by the stationary sources shall be obtained by measurement performed in accordance with Section 7.

(2) Approval of Stationary Sources

The One Hour Equivalent Sound Level ($L_{eq}$) and/or the Logarithmic Mean impulse Sound Level ($L_{LM}$) produced by the stationary sources shall be obtained by measurement or prediction. The estimation of the $L_{eq}$ and/or $L_{LM}$ of the stationary source under impact assessment shall reflect the principle of "predictable worst case" noise impact. The "predictable worst case" noise impact occurs during the hour when the difference between the predicted sound level produced by the stationary source and the background sound level of the natural environment is at a maximum.

7. Procedures

All sound level measurements and calculations shall be made in accordance with References [3] [6] and [12].

Sound from existing adjacent stationary sources may be included in the determination of the background One Hour Equivalent Sound Level ($L_{eq}$) it such stationary sources of sound are not under consideration for noise abatement by the Municipality or the Ministry of Environment and Energy.

8. Sound Level Limits - General

(1) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a stationary source, the sound level limit expressed in terms of the Logarithmic Mean Impulse Sound Level ($L_{LM}$) is the background One Hour Equivalent Sound Level ($L_{eq}$) typically caused by road traffic as obtained pursuant to Section 6 for that point of reception.

(2) For sound from a stationary source, including Quasi-Steady Impulsive Sound but not including other impulsive sound the sound level limit expressed in terms of the One Hour Equivalent Sound Level ($L_{eq}$) is the background One Hour Equivalent Sound Level ($L_{eq}$) typically caused by road traffic as obtained pursuant to Section 6 for that point of reception.

9. Sound Level Limits – Specific Impulsive Sounds

(1) For impulsive sound other than Quasi-Steady Impulsive Sound, from a stationary source which is an industrial metal working operation (including but not limited to forging, hammering. punching, stamping, cutting, forming and moulding), the sound level limit at a point of reception expressed in terms of the Logarithmic Mean Impulse Sound Level ($L_{LM}$) is 60 dBAI, if the stationary source were operating before January 1, 1980, and otherwise is 50 dBAI.

(2) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a stationary source which is the discharge of firearms on the premises of a licensed gun club, the sound level limit at a point of reception expressed in terms of the Logarithmic Mean impulse Sound Level ($L_{LM}$) is:

- 70 dBAI if the gun club were operating before January 1, 1980;

or

- 50 dBAI if the gun club began to operate after January 1, 1980;

or

- the $L_{LM}$ prior to expansion, alteration or conversion.

(3) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a stationary source which is not a blasting operation in a surface mine or quarry, characterized by impulses which are so infrequent that they cannot normally be measured using the procedure for frequent impulses of Reference [3] the sound level limit at a point of reception expressed in terms of the impulse sound level is 100 dBAI.

10. Sound Level Limits - Pest Control Devices

(1) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a pest control device employed solely to protect growing crops, the sound level limit at a point of reception expressed in terms of the Logarithmic Mean Impulse Sound Level ($L_{LM}$) is 70 dBAI.

(2) For sound including Quasi-Steady Impulsive Sound but not including other impulsive sound from a pest control device employed solely to protect growing crops, the sound level limit at a point of reception expressed in terms of the One Hour Equivalent Sound Level ($L_{eq}$) is 60 dBA.

11. Prohibition - Pest Control Devices

The operation of a pest control device employed solely to protect growing crops outdoors during the hours of darkness, sunset to sunrise, is prohibited.

12. Pre-emption

The least restrictive sound level limit of Sections 8, 9 and 10 applies.

13. Exclusion

No restrictions apply to a stationary source resulting in a One Hour Equivalent Sound Level ($L_{eq}$) or a Logarithmic Mean Impulse Sound Level ($L_{LM}$) lower than the minimum values for that time period as specified in Table 205-1.

**TABLE 205-1**

Minimum Values for One Hour
$L_{eq}$ or $L_{LM}$ by Time of Day

| | One Hour $L_{eq}$ or $L_{LM}$ (dBAI) | |
|---|---|---|
| Time of Day | Class 1 Area | Class 2 Area |
| 0700 - 1900 | 50 | 50 |
| 1900 – 2300 | 47 | 45 |
| 2300 – 0700 | 45 | 45 |

**ANNEX**
**SOUND LEVEL LIMITS FOR STATIONARY SOURCES**
**IN CLASS 1 & 2 AREAS (URBAN)**

A.1. General

In general, noises are annoying because they are heard over and above the level of the so-called “background” or surrounding environmental noise climate at a particular location. The standard for environmental noise acceptability of stationary sources is therefore expressed as the difference between noise from the source and the background noise.

The background noise is essentially made up of the road traffic noise, which creates an “urban hum”. It may also include contributions from existing industry or commercial activity adjacent to the stationary source under investigation. Contributions of these secondary noise sources are considered to be a part of urban hum and may be included in the measurements or calculation of the background sound levels provided that they are not under consideration for noise abatement by the Municipality or the Ministry of Environment and Energy.

The sound level limits specified in Section 8 of Publication NPC-205 represent the general limitation on noise produced by stationary sources. Some noises, however, are annoying no matter where or in what kind of environment they exist. High level impulsive noises represent a special category and consequently, are restricted by an absolute limitation. Sections 9 and 10 of this Publication provide criteria of acceptability for specific impulsive noise sources.

A.2. Application

The limits presented in Publication NPC-2O5 are designed for the control of noise from sources located in industrial, commercial or residential areas. The limits apply to points of reception located in Class 1 and Class 2 Areas.

Sound level limits contained in Publication NPC-205 do not apply to the excluded noise sources listed in Section A.3.(2) and neither do they apply to any equipment, apparatus or device used in agriculture for food crop seeding, chemical spraying or harvesting. In addition, several specific noise sources have been addressed in separate Publications. Limits for residential air conditioners are contained in Publication NPC-216 - Residential Air Conditioning Devices, Reference [8] and the limits for blasting operations in quarries and surface mines are contained in Publication NPC-l 19 - Blasting, Reference [7].

A.3. Stationary Sources

The objective of the definition of a stationary source of sound is to address sources such as industrial and commercial establishments or ancillary transportation facilities. In order to further clarify the scope of the definition, the following list identifies examples of installations, equipment, activities or facilities that are included and those that are excluded as stationary sources.

(1) Included Sources

Individual stationary sources such as:

Heating, ventilating and air conditioning (HVAC) equipment;
Rotating machinery;
Impacting mechanical sources;
Generators;
Burners;
Grain dryers.

Facilities usually comprising many sources of sound. In this case, the stationary source is understood to encompass all its activities taking place within the property boundary of the facility. The following are examples of such facilities:

Industrial facilities;
Commercial facilities;
Ancillary transportation facilities;
Aggregate extraction facilities;
Warehousing facilities;

Maintenance and repair facilities;
Snow disposal sites;
Routine loading and unloading facilities (supermarkets, assembly plants, etc.).

Other sources such as:
Car washes;
Race tracks;
Firearm Ranges.

(2) Excluded Sources

Specific sources or facilities:
Construction activities;
Transportation corridors, i.e. roadways and railways;
Residential air conditioning devices including air conditioners and hear pumps; Gas stations;
Auditory warning devices required or authorized by law or in accordance with goods safety practices;
Occasional movement of vehicles on the property such as infrequent delivery of goods to convenience stores, fast food restaurants, etc.

Other noise sources, normally addressed in a qualitative manner in municipal noise by-laws:

The operation of auditory signaling devices, including but not limited so the ringing of bells or gongs and the blowing of horns or sirens or whistles, or the production, reproduction or amplification of any similar sounds by electronic means;

Noise produced by animals kept as domestic pets such as dogs barking;

Tools and devices used by occupants for domestic purposes such as domestic power tools, radios and televisions, etc., or activities associated with domestic situations such as domestic quarrels, noisy parties etc;

Noise resulting from gathering of people at facilities such as restaurants and parks.

Activities related go essential service and maintenance of public facilities such as but not limited to roadways, parks and sewers, including snow removal, road cleaning, road repair and maintenance, lawn mowing and maintenance, sewage removal, garbage collection, etc.

A.4 Predictable Worst Case Impact

The assessment of noise impact requires the determination of the “predictable worst case” impact. The “predictable worst case” impact assessment should establish the largest noise excess produced by the source over the applicable limit. The assessment should reflect a planned and predictable mode of operation of the stationary source.

It is important to emphasize that the “predictable worst case” impact does not necessarily mean that the sound level of the source is highest; it means that the excess over the limit is largest. For example, the excess over the applicable limit at night may be larger even if the day-time sound level produced by the source is higher.

A.5 Definitions

In the interpretation of Publication NPC-205, the following definitions are of particular relevance:

- Ancillary Transportation Facilities

  "Ancillary transportation facilities" mean subsidiary locations where operations and activities associated with the housing of transportation equipment (or personnel) take place. Examples of ancillary transportation facilities include, but are not limited to, substations, vehicle storage arid maintenance facilities, fans, fan and vent shafts, mechanical equipment plants, emergency services buildings, etc.

- Construction

  "Construction" includes erection, alteration, repair, dismantling, demolition, structural maintenance, painting, moving, land clearing, earth moving, grading, excavating, the laying of pipe and conduit whether above or below ground level, street and highway building, concreting, equipment installation and alteration and the structural installation of construction components and materials in any form or for any purpose, and includes any work in connection therewith; "construction" excludes activities associated with the operation at waste and snow disposal sites;

- Construction Equipment

  Construction equipment means any equipment or device designed and intended for use in construction, or material handling including but not limited to, air compressors, pile drivers, pneumatic or hydraulic tools, bulldozers, tractors, excavators, trenchers, cranes, derricks, loaders, scrapers, payers, generators, off-highway haulers or trucks, ditchers, compactors and rollers, pumps, concrete mixers, graders, or other material handling equipment;

- Conveyance

  "Conveyance" includes a vehicle and any other device employed to transport a person or persons or goods from place to place but does not include any such device or vehicle if operated only within the premises of a person;

- Highway

  "Highway" includes a common and public highway, street, avenue, parkway, driveway, square, place, bridge, viaduct or trestle designed and intended for, or used by the general public for the passage of vehicles;

- Motor Vehicle

  "Motor vehicle" includes an automobile, motorcycle and any other vehicle propelled or driven otherwise than by muscular power, but does not include the cars of diesel, electric or steam railways, or other motor vehicles running only upon rails, or a motorized snow vehicle, traction engine, farm tractor, self-propelled implement of husbandry or road-building machine within the meaning of the Highway Traffic Act;

- Motorized Conveyance

  "Motorized conveyance" means a conveyance propelled or driven otherwise than by muscular, gravitational or wind power:

- Noise

  "Noise" means unwanted sound;

- Point of Reception

  "Point of reception" means any point on the premises of a person where sound or vibration originating from other than those premises as received.

  For the purpose of approval of new sources, including verifying compliance with Section 9 of the Environmental Protection Act, the point of reception may be located on any of the following existing or zoned for future use premises: permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, camp grounds, and noise sensitive buildings such as schools and places of worship.

  For equipment/facilities proposed on premises such as nursing/retirement homes, rental residences, hospitals, and schools, the point of reception may be located on the same premises.

- Stationary Source

  "Stationary source" and a source of sound which does not normally move from place to place and includes the premises of a person as one stationary source, unless the dominant source of sound on those premises is construction or a conveyance.

- Urban Hum

  Means aggregate sound of many unidentifiable, mostly road traffic related noise sources.

**PUBLICATION NPC-206**

**SOUND LEVELS DUE TO ROAD TRAFFIC**

**TABLE OF CONTENTS**

1. Scope

This Publication describes the methods to determine the One Hour Equivalent Sound Level ($L_{eq}$) of sound caused by road traffic. The road traffic sound level is used to define sound level limits for the purposes of complaint investigation or approval of stationary sources of sound.

The methods apply at a point of reception in any community where the background sound level is dominated by the sound of road traffic, referred to as "urban hum". Highly intrusive short duration noise caused by a source such as an aircraft fly-over or a train pass-by is excluded from the determination of this background sound level.

2. References

Reference is made to the following publications:

[1] NPC-101 - Technical Definitions

[2] NPC-102 - Instrumentation

[3] NPC-103 - Procedures

[5] NPC-205 - Sound Level Limits for Stationary Sources in Class I & 2 Areas (Urban)

[11] ORNAMENT, Ontario Road Noise Analysis Method for Environment and Transportation, Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376, 1989

References [1] to [3] can be found in the Model Municipal Noise Control By-Law, Ontario Ministry of the Environment, Final Report, August 1978.

3. Technical Definitions

"Ambient sound level" means Background sound level;

"Background sound level" is the sound level that is present in the environment, produced by noise sources other than the source under impact assessment. Highly intrusive short duration noise caused by a source such as an aircraft fly-over or a train pass-by is excluded from the determination of the background sound level;

Other technical terms are defined in Reference [1].

4. Sound Levels due to Road Traffic

Depending on the application, the One Hour Equivalent Sound Level ($L_{eq}$) of road traffic shall be obtained either by measurement or by calculation. The following procedures shall be used for complaint investigation and for the approval of stationary sources:

(1) Complaint Investigation of Stationary Sources

The One Hour Equivalent Sound Level ($L_{eq}$) of road traffic may be measured or calculated. Measurements of the One Hour Equivalent Sound Level ($L_{eq}$) of road traffic shall be carried out using instrumentation described in Reference [2], following procedures for the measurement of varying sound described in Reference [3].

The results of the road traffic $L_{eq}$ measurements must not be affected by the sound due to other noise sources; the measurements should be performed when the stationary source under impact assessment is not operating. The time interval between the road traffic $L_{eq}$ measurements and the measurement of the sound level produced by the stationary source under impact assessment should be minimized as much as possible. Preferably, the two measurements should be carried out within one hour of each other.

The calculation of the One Hour Equivalent Sound Level ($L_{eq}$) of road traffic shall be based on the traffic flows observed on the contributing road(s), from which traffic noise is audible at the point of reception, within one hour of the period when the sound from the stationary source is measured. The calculation procedure is described in Reference [11].

(2) Approval of Stationary Sources

Measurements of the One Hour Equivalent Sound Level ($L_{eq}$) of road traffic shall be carried out following procedures for the measurement of varying sound described in Reference [3].

Results of the measurement of the One Hour Equivalent Sound Level ($L_{eq}$) of road traffic shall reflect the principle of “predictable worst case” noise impact. The “predictable worse case” noise impact occurs during the hour when the difference between the sound level produced by the stationary source under impact assessment and the sound level due to road traffic is largest.

The One Hour Equivalent Sound Level ($L_{eq}$) of road traffic may be calculated on the basis of traffic flows observed on the contributing road(s), from which traffic noise is audible at the point of reception. The results of calculation of the One Hour Equivalent Sound Level ($L_{eq}$) of road traffic shall reflect the principle of “predictable worse case” noise impact. The calculation procedure is described in Reference [11].

**PUBLICATION NPC-216**

**RESIDENTIAL AIR CONDITIONING DEVICES**

**TABLE OF CONTENTS**



**ANNEX**

1. Scope

This Publication sets sound level limits and sound emission standards for residential air conditioning devices including heat pumps installed in urban areas of Ontario.

2. References

Reference is made to the following publications, or revisions thereof:

[1] NPC-101 - Technical Definitions

[2] NPC-102 - Instrumentation

[3] NPC-103 - Procedures

[4] NPC-104 - Sound Level Adjustments

[6] NPC-206 - Sound Levels due to Road Traffic

[10] ORNAMENT, Ontario Road Noise Analysis Method for Environment and Transportation Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376 (1989).

[12] Survey of Outdoor Air Conditioner Noise, Final Report, RAC Report #458G, Ontario Ministry of the Environment, ISBN 0-7729-9094-8 (1991).

[13] Environmental Noise Guidelines for the Installation of Residential Air Conditioning Devices, Ontario Ministry of Environment and Energy, ISBN 0-7778-1616-4 (1994).

[14] ARI* Standard 270-84. Sound Rating of Outdoor Unitary Equipment.

[15] ARI*1 Standard 275-84. Application of Sound Rated Outdoor Unitary Equipment.

[16] ANSI Standard S12.32 - 1990, Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms, Precision Methods for the Determination of Sound Power Levels.

References [1] to [6] are also part of the Model Municipal Noise Control By-Law, Ontario Ministry of the Environment.

3. Technical Definitions

“Ambient sound level” is the sound level that is present in the environment, produced by noise sources other than the source under impact assessment. See Background sound level;

“Background sound level” means Ambient sound level;

“Class 1 Area” means an area with an acoustical environment typical of a major population centre, where the background noise is dominated by the urban hum.

“Class 2 Area” means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours.

Other characteristics which may indicate the presence of a Class 2 Area include:

- absence of urban hum between 19:00 and 23:00 hours;
- ambient sound level is defined by natural environment and infrequent human activity; and
- no clearly audible sound from stationary sources* other than from those under consideration.

"Class 3 Area" means an area with an acoustical environment that is dominated by natural sounds typical of agricultural or wilderness areas and having little or no road traffic, such as the following:

- a small community with less than 1000 population;
- farm land or land zoned rural or agricultural;
- a rural recreational area such as a cottage or a resort area; or
- a wilderness area.

4. Sound Level Limits for Air Conditioning Devices

Either the general sound level limit in Section 4.(l) or the specific sound level limit in Section 4.(3) shall apply to an air conditioning device. The less restrictive of these two limits shall prevail.

(1) General Sound Level Limit

The general sound level limit (shown in Table 216-1 and determined in accordance with Section 4.(2)) is 5 dBA greater than a one hour equivalent sound level ($L_{eq}$) caused by road traffic at the point of reception during the period of 07:00 to 21:00 hours. The specific hour is to be determined by the noise control officer based on the assessment of annoyance by the complainant.

TABLE 216-1

**GENERAL SOUND LEVEL LIMIT**

| All Air Conditioning Devices | |
|---|---|
| Area Type | $L_{eq}$ (dBA) |
| Class 1 and Class 2 | One Hour Equivalent Sound Level ($L_{eq}$) of road traffic plus 5 dBA measured during the period of 07:00 to 21:00 hours |

(2) Establishment of the General Sound Level Limit

The general sound level limit shall be established through measurements or calculation of the One Hour Equivalent Sound Level ($L_{eq}$) caused by road traffic as obtained pursuant to Reference (6) at the point of reception.

(3) Specific Sound Level Limits

Specific sound level limits are identified in Table 216-2 for two types of residential air conditioning devices as minimum limits of compliance.

**SPECIFIC SOUND LEVEL LIMITS**

| Central Air Conditioning Devices | |
|---|---|
| Area Type | One Hour $L_{eq}$ (dBA) |
| Class 2 | 45 |
| Class 1 | 50* |
| Window or Through-the-Wall Air Conditioning Devices | |
| Area Type | One Hour $L_{eq}$ (dBA) |
| Class 2 | 45 |
| Class 1 | 50 |

* when the devices are mandatory requirements for noise control in the interior living spaces of new land use developments, the specific sound level limit is one hour $L_{eq}$ = 55 dBA.

5. Sound Levels from Installed Air Conditioning Devices

To determine if an installed air conditioning device complies with the sound level limits, the sound level due to the device must be measured following the procedure described in Reference (3).

The procedure assumes that the measured sound is dominated by the source under investigation (air conditioning device). To ensure that the measured sound is dominated by the air conditioning device, sound level measurements must be carried out separately with, and without the device in operation.

The measurement of the background sound level, i.e. without the air conditioning device operating, is carried out in accordance with the procedure described in Reference (3).

If the change in sound level measured separately with, and without the air conditioning device operating is less than 10 dBA, a correction shall be made to determine the contribution of the existing background sound levels to the overall measured sound level. Table 216-3 provides correction values and an example of the calculation.

**TABLE 216-3**
**PROCEDURE RECOMMENDED TO SEPARATE THE SOUND LEVEL OF AN AIR CONDITIONING DEVICE FROM THE BACKGROUND SOUND LEVEL**

| Change in dBA of Sound Level With and Without Unit in Operation | Correction in dBA to be Subtracted from Higher Sound Level to Obtain Sound Level from Device |
|---|---|
| 10 or more | 0 |
| 7 to 9 | 1 |
| 4 to 6 | 2 |
| 3 | 3 |
| 2 | 4 |
| 1 | 6 |
| 0 | 10 |

**Example:** **Sound Level without unit in operation = 45 dBA**

**Sound Level with unit in operation = 50 dBA**

**Change = 5 dBA**

**Correction from Table = 2 dBA**

**Unit Sound Level = 50 – 2 = 48 dBA**

**TABLE 216-4**
**SOUND EMISION STANDARDS FOR**
**RESIDENTIAL CENTRAL AIR CONDITIONING DEVICES**

| Date of Manufacture | Size (BTUH) | Maximum ARI Standard* Sound Rating (bels) |
|---|---|---|
| After 1990-12-31 and Before 1992-01-01 | 38,900 or less | 8.0 |
| After 1991-12-31 and Before 1995-01-01 | 38,900 or less | 7.6 |
| After 1994-12-31 | 38,900 or less | (under discussion with the industry to assess the feasibility or reduction.) |

**BTUH = British Thermal Unit for an Hour**

*Measurement procedure as per Reference (14).

## ANNEX

## EXPLANATORY NOTES TO PUBLICATION NPC-216

## RESIDENTIAL AIR CONDITIONING DEVICES

A.I. Sound Level Measurements - Summary

Verification of compliance of the air conditioner and heat pump units with the sound level limits can be accomplished through measurements using a properly calibrated sound level meter, which meets the required standard specifications.

Details of the instrument specifications are included in Reference [2].

The measurements shall be performed outdoors at a sensitive location on neighbouring residential property in the vicinity of the air conditioning device, where the sound of the device may cause annoyance. Typically this would be a patio or a window.

The measurements may also be required at a point of reception in the plane of an open window facing the unit to ensure that the sound level at noise sensitive indoor spaces in a neighbouring residence is not in excess of the guideline limits. Details of the measurement procedure are included in Reference [3].

A.2. Sound Level Limits

People's response to noise varies depending upon the community, as well as the individual's economic and social relationship to the source. The sound level limits for air conditioner and heat pump noise were established based on the results of sociological surveys of large numbers of people and represent what is considered to be the onset of significant degradation of the noise environment relative to the expectations of the general population.

The sound level limits are receptor oriented, i.e. they apply at any noise sensitive location within a Class 2 or Class 1 Area (as defined in NPC-216) at which sound from the air conditioning device may cause annoyance.

The specific limits shown in Table 216-2 are expressed in terms of the one hour equivalent sound level $L_{eq}$, and apply to receptor locations in Class 1 and Class 2 Area.

A separate limit applies to those receptor locations in Class 1 Area where the unit was a mandatory requirement for noise control of the interior living space in new land use developments.

A pre-emption in the form of a general limit applies in an area of a relatively high background noise caused by road traffic as shown in Table 216-1. In accordance with this pre-emption, the existing background sound level, if higher than the limits in Table 216-2, represents the criterion of acceptability for the air conditioning device operation. In addition, the general limits are increased by 5 dBA for any hour from 07:00 to 21:00 hours. The period of assessment was chosen in accordance with the findings of a sociological survey conducted in 1990, Reference [12].

A.3. Complaint Investigation

Investigators of a complaint against installed air conditioning devices must carry out sound level measurements at the receptor location(s). The measurements are to be made in accordance with methods identified in Section A.1. The operating sound of the air conditioning device and the background sound consisting of the road traffic noise must be measured at the same location, separately. While the background sound level is measured the air conditioning device must be turned off. Contributions from aircraft and rail noise sources must be inhibited at all times. Unattended measurements are not recommended. Atmospheric conditions may have significant influence on the ambient sound levels, for details see Reference [3].

The sound level of an installed air conditioning device may be calculated from the sound levels measured with the device operating (device plus background noise) and without it operating (background only). The procedure is described in Section 5. A correction value is determined between these two sound levels. Subtracting this correction from the higher sound level (measured with the device in operation) gives the sound level due to the air conditioning device itself. See Table 216-3.

Determination of the road traffic sound level is to be made by the noise control officer based on the assessment of the annoyance by the complainant(s). The time of highest annoyance within the time period of 07:00 to 21:00 is to fall in the selected one hour of the road traffic noise.

A.4. Installation of Air Conditioning Devices

Purchasers and installers of air conditioning devices have to be cognizant of the MOEE guideline on the Sound Emission Standards listed in Table 216-4. Further explanation of the standards is provided in Section A.5. Only units meeting the requirements of Table 216-4 may be installed in Ontario.

For guidance on the selection, location or sound rating of the air conditioning devices or for the method to estimate the sound levels, installers should refer to Reference [13].

Installation of units that are in compliance with the sound emission standard must also be in compliance with the point of reception sound level limits, i.e. complying with the least restrictive sound level limit of Tables 216-1 and 216-2.

If the calculated sound level of the unit is in excess of the specific sound level limit (Table 216-2), the general sound level limit is to be determined. If both limits are exceeded by the calculated levels then alteration is needed in one or more of the following: the size or make of unit, its location or the type of noise reducing installation treatment (use of barrier or enclosure).

Owners of installed units producing a sound level in excess of the sound level limits will be required to reduce the noise of the unit, when faced with complaints.

Noise abatement is more expensive and less cost effective than a proper installation.

A.5. Sound Emission Standards

In contrast to the sound level limits which apply at the point of reception, sound emission standards are source oriented, and are based on the concept of sound power level which is a basic measure of the acoustic output of a noise source.

The sound level of the air conditioner or heat pump at a receptor location depends on many factors such as distance separation, unit's orientation with respect to the receptor, presence of shielding objects or structures, intervening terrain, topography and ground cover between the unit and receptor, as well as on atmospheric conditions, all of which are independent of the actual sound emission of the unit.

Sound power on the other hand is a fundamental property of the acoustic source alone and is, therefore, an important absolute parameter which is widely used for rating and comparing sound sources.

The rating of air conditioner and heat pump equipment is designated as the ARI Sound Rating ($SR^*$) and is provided by the manufacturer of the device.

The Sound Rating is based on laboratory tests performed at Standard Rating conditions in accordance with References (14) and (16). The SR is an indicator of the sound power level of the equipment; the lower the SR, the lower the sound power of the air conditioner or heat pump.

Sound Emission Standards in Table 216-4 apply to central air conditioning devices only and not for window or through-the-wall units.

The maximum acceptable ARI Standard Sound Ratings shown in Table 216-4 are set in accordance with the date of manufacture. Two Sound Emission Standards, 8.0 and 7.6 bels are specified for air conditioner and heat pump units manufactured during 1991, and during 1992 through 1994 respectively. The Sound Emission Standard applies to units that are sized at 38,900 BTUH capacity or less. The emission limits projected after 1994 are under discussion with the industry to assess the feasibility of reduction.

**AMENDMENTS TO BY-LAW 2006-140**

| Amending By-law | | Date of By-law |
|---|---|---|
| By-law 2012-038 | Section 6.3.0 and 6.4.0 | February 13, 2012 |

# Appendix E

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*Figure E.1 – Bryne Drive Study Area*


*Figure E.2 – Harvie Road Study Area*


*Figure E.1 – Essa Road Study Area*