# Environmental Noise Feasibility Assessment

## 3095 Albion Road North

## Ottawa, Ontario

REPORT: GWE15-119 - Noise

**Prepared For:**

Akram Farhat
**Ahlul-Bayt Centre Ottawa**
200 Baribeau Street
Ottawa, Ontario
K1L 7R6

**Prepared By:**

Michael Lafortune, Environmental Technologist
Joshua Foster, P.Eng., Partner

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127 Walgreen Road, Ottawa, Ontario K0A 1L0
T (613) 836-0934 ● www.gradientwind.com

## EXECUTIVE SUMMARY

This document describes an environmental noise feasibility assessment performed for a proposed place of worship, school and community centre to be located at 3095 Albion Road North in Ottawa, Ontario. The building will rise two-storeys above local grade. The major sources of noise in the area are from the Walkley Yard maintenance and storage facility to the southeast.

The assessment is based on: (i) theoretical noise prediction methods that conform to the Ministry of the Environment and Climate Change (MOE) and City of Ottawa requirements; (ii) noise level criteria as specified by the MOE's Environmental Noise Guidelines (NPC-300) and (iii) architectural drawings received from SJL Architects Incorporated, and base mapping information provided by the City of Ottawa.

The results of the stationary noise calculations indicate that noise levels will marginally exceed NPC-300 criteria for a Class 1 area, but will, however, fall below criteria for a Class 4 area. We would therefore recommend the new development be considered as a Class 4 area. In order to be designated as a Class 4 area, it is required that the installation of central air conditioning (or similar mechanical system) is incorporated into the design, which will allow building occupants to keep exterior windows and doors closed and maintain a comfortable living environment. The Warning Clause (Type F[1]) will also be required.

Upon approval of this development being designated as a Class 4 area, a copy of this report and the notice of approval from the land-use planning authority (City of Ottawa) will be forwarded to the surrounding stationary noise source owners as per the requirements in NPC-300.

The results of the railway traffic noise analysis indicate that noise levels will reach 56 dBA during the daytime period (07:00-23:00). The highest noise levels occur along the south façade which is nearest and most exposed to Walkley Yard. Minimum building construction in all areas is required to satisfy the Ontario Building Code (2012).

[1] Ministry of the Environment – Publication NPC-300

Noise levels at the playground are expected to approach 56 dBA during the daytime period. According to NPC-300, if this is to be used as an outdoor living area, noise control measures should be considered, but may not be required. Investigation into the application of a 2.2-meter noise barrier (minimum allowable barrier height) along the southwest property line proved that noise levels can be reduced to 53 dBA, as illustrated in Figure 2. The inclusion of a noise barrier along the south property line will also have an added benefit of reducing stationary noise levels at the playground. The barrier should be constructed in accordance with the requirements in Appendix C of the ENCG, and have a minimum surface density of 20 kg/$m^3$.

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# 1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Ahlul-Bayt Centre Ottawa to undertake an environmental noise feasibility assessment for a proposed place of worship, school and community centre to be located at 3095 Albion Road in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to a noise feasibility assessment. GWE's scope of work involved assessing exterior noise levels generated by stationary and transportation sources associated with Walkley Yard. The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[2] and Ontario Ministry of the Environment (MOE)[3] guidelines. Noise calculations were based on architectural drawings received from SJL Architects Incorporated, and base mapping information provided by the City of Ottawa.

# 2. TERMS OF REFERENCE

The focus of this environmental noise feasibility assessment is a proposed Mosque and Community / Recreational Centre. The proposed building will comprise a total floor area of 3,325 square meters ($m^2$) and rise two-storeys above grade. The development is located near the intersection of Kitchener Avenue and Albion Road North. To the southeast of the development is the Walkley Yard maintenance and storage facility. To the west is open space, with commercial and industrial facilities to the north. The major sources of noise in the area are from the rail line and yards. The Walkley Yard includes maintenance and storage facilities for both Canadian National Rail and OC Transpo. Figure 1 illustrates a complete site plan with surrounding context.

[2] City of Ottawa Environmental Noise Control Guidelines, SS Wilson Associates, May 10, 2006
[3] Ontario Ministry of the Environment – Publication NPC-300

# 3. OBJECTIVES

The main goals of this work are to: (i) calculate the future noise levels on the study building produced by local railway traffic, (ii) determine outdoor noise impacts from existing surrounding stationary noise sources, and (iii) ensure that noise levels do not exceed the allowable limits specified by the MOE's Environmental Noise Control Guidelines (NPC-300) as outlined in Section 4.2 and 4.3 of this report.

# 4. METHODOLOGY

## 4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level ($2\times10^{-5}$ Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

## 4.2 Stationary Noise

Stationary sources are defined in the City of Ottawa's ENCG as: "all sources of sound and vibration, whether fixed or mobile, that exist or operate on a premises, property or facility. The combined sound and vibration levels of which are emitted beyond the property boundary of the premises, property or facility, unless the source(s) is (are) due to construction". The significant stationary sources in operation in the study area are an OC Transpo Trillium Line (O-Train) maintenance and storage facility and a Canadian National Railway (CN) rail yard.

GWE tried several times to contact each of the rail authorities, but were, however, unsuccessful. The assessment of stationary noise was therefore based upon a screen level exercise which was developed by the United States Federal Transit Authority. Using a number of test facilities similar to the OC Transpo and CN and rail yards, appropriate reference sound levels are provided with procedures of determining impacts at various set back distances from the facility. The full methodology is described in section 4.2.3.

### 4.2.1 Stationary Noise Criteria

The equivalent sound energy level, $L_{EQ}$, provides a weighted measure of the time varying noise levels (including quasi-impulsive), which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a selected period of time. For stationary sources, the $L_{EQ}$ is commonly calculated on an hourly interval, while for roadways, the $L_{EQ}$ is calculated on the basis of a 16-hour daytime / 8-hour nighttime split.

Noise criteria taken from the NPC-300 apply to outdoor points of reception (POR) on the property; for daytime operations it is considered 30 meters from a dwelling, and for nighttime operations the plane of window (POW). According to this document, the recommended maximum noise levels in an urban environment (Class 1 Area) are the higher of the limits set out in Table 1, or the noise produced by roadway traffic, whichever is greater[4]. Generally, the site is considered to be in a Class 1 area as it is within the urban boundary and background noise levels are expected to be dominated by transportation and other sources.

The NPC-300 also allows for the consideration of a Class 4 area for new proposed noise sensitive land uses where central air conditioning will form an integral part of the design. For a development to be considered a Class 4 area, the planning authority must agree to the condition. Once the development has been approved as a Class 4 area, the surrounding source owners will be notified and can then use the Class 4 designation for their approval process with the MOE. Table 1 also summarizes the Class 4 sound level limits.

**TABLE 1: MOE EXCLUSIONARY SOUND LEVEL LIMITS**

| Time of Day | Noise Level Limits (dBA) Class 1 | | Noise Level Limits (dBA) Class 4 | |
|---|---|---|---|---|
| | Outdoor Point of Reception | Plane of Window | Outdoor Point of Reception | Plane of Window |
| 07:00 – 19:00 | 50 | 50 | 55 | 60 |
| 19:00 – 23:00 | 50 | 50 | 55 | 60 |
| 23:00 – 07:00 | N/A | 45 | N/A | 55 |

[4] City of Ottawa Environmental Noise Control Guidelines, SS Wilson Associates, May 10, 2006

### 4.2.2 Site Inspection

GWE conducted a visit to the site on December 8, 2015. During the site visit, it was observed that the dominant source of noise was the CN Rail Yard, as well as some noise originating from the OC Transpo facility. Noise originating from the commercial and industrial site to the north was found to be insignificant in comparison. Common sources of noise included the movement of diesel equipment and locomotives, shunting of cars and brake squeal on rail cars. All noises typically associated with a rail yard and storage and maintenance facility.

During the site visit, limited noise measurements were conducted using a Brüel and Kjær Type 2250 integrating sound level meter equipped with a Type 4189 microphone (Type 1). Measurements were conducted in the centre of the site and on the east side of the development. Measurements were conducted for a period of 20 minutes, which is considered to represent a one-hour $L_{EQ}$ as per MOE Procedures document NPC-103.

### 4.2.3 FTA Stationary Noise Calculations

Stationary noise source information was requested several times from the rail authorities at Walkley Yard; however, GWE received no response. Therefore, stationary noise prediction methods were adopted in the absence of available information. In the United States of America, the Federal Transit Administration (FTA) has produced a document entitled: 'Transit Noise and Vibration Impact Assessment[5]'. This document provides a general assessment and screening procedures for the computation of stationary noise impacts from rail yards. The general assessment has been based on noise source and land-use information discussed in Sections 4.2.1 and 4.2.2.

The general assessment for stationary noise begins with determining a reference sound exposure level (SEL) at 50 feet from the center of the site. A value of 118 dBA is provided for Yards and Shops similar to that of the OC Transpo and CN facilities at Walkley Yard. A reference SEL of 109 dBA is provided for layover tracks. After reference SEL's have been determined for each defined noise source, an hourly $L_{EQ}$ can be calculated based on the train volumes associated with each noise source. It was assumed that both OC Transpo and CN Yards and Shops sources have 20 train activities per hour. The layover track source considers one diesel locomotive idling for a total of one-hour at the CN facility.

[5] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006

The following equation was used to extrapolate hourly $L_{EQ}$'s at 50 feet to points of reception on the study building. Where a barrier breaks the line of sight between the receiver and the source, an attenuation value of 5 dBA can be applied.

$L_2=L_1-20\log(R_2/R_1)$

Where:

$L_1$ is the calculate $L_{EQ}$ sound level

$L_2$ is the extrapolated sound level

$R_1$ is equal to 50 feet

$R_2$ is the distance from source to point of reception

## 4.3 Railway Traffic Noise

### 4.3.1 Railway Traffic Noise Criteria

For railway traffic, the equivalent sound energy level, $L_{EQ}$, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For railways, the $L_{EQ}$ is commonly calculated on the basis of a 16-hour ($L_{EQ16}$) daytime (07:00-23:00) / 8-hour ($L_{EQ8}$) nighttime (23:00-07:00) split to assess its impact on noise sensitive buildings.

For rail traffic, NPC-300 specifies that the recommended indoor noise limit range (that is relevant to this study) is 45 dBA for places for worship, schools and community centres, as outlined in Table 2 below. Based on GWE's experience, more comfortable indoor noise levels should be targeted toward 42 dBA to control peak noise and deficiencies in building envelope construction.

**TABLE 2: INDOOR SOUND LEVEL CRITERIA (ROAD & RAIL)[6]**

| Type of Space | Time Period | $L_{EQ}$ (dBA) | |
|---|---|---|---|
| | | Road | Rail |
| General offices, reception areas, retail stores, etc. | 07:00 – 23:00 | 50 | 45 |
| Living/dining/den areas of residences, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, etc. | 07:00 – 23:00 | 45 | 40 |
| Sleeping quarters of hotels/motels | 23:00 – 07:00 | 45 | 40 |

Due to the characteristics of rail noise which occur over short periods (i.e. whistles, brake squealing), and a significant low frequency component produced by the movement of the locomotive along the track, road and rail traffic noise require separate analyses, particularly when assessing indoor sound levels. In order to account for the special character of railway sound, the indoor sound level criteria are more stringent by 5 dB as compared to the road traffic criteria. This difference typically results in requirements for upgraded glazing elements to provide better noise attenuation by the building envelope. Interior noise level criteria include the influence from rail crossings and warning whistle bursts.

Predicted noise levels at the plane of window (POW) and outdoor living area (OLA) dictate the action required to achieve the recommended sound levels. When noise levels at these areas exceed the criteria outlined in Table 3, specific outdoor, ventilation and Warning Clause requirements may apply. In addition, when noise levels exceed the criteria outlined in Table 4, upgraded building components must be designed.

[6] Adapted from ENCG – Table 1.6

**TABLE 3: ROAD & RAIL NOISE COMBINED – OUTDOOR NOISE, VENTILATION AND WARNING CLAUSE REQUIREMENTS[7]**

| Time Period | $L_{EQ}$ (dBA) | Ventilation Requirements | Outdoor Noise Control Measures | Warning Clause |
|---|---|---|---|---|
| **Outdoor Living Area (OLA)** | | | | |
| Daytime (07:00 – 23:00) | $L_{EQ(16hr)} < 55$ | N/A | Not required | Not required |
| | $55 < L_{EQ(16hr)} \leq 60$ | N/A | May not be required but should be considered | Type A† |
| | $L_{EQ(16hr)} > 60$ | N/A | Required to reduce the $L_{EQ}$ to below 60 dBA and as close to 55 dBA where feasible | Type B†† |
| **Plane of Window (POW)** | | | | |
| Daytime (07:00 – 23:00) | $L_{EQ(16hr)} < 55$ | Not required | N/A | Not required |
| | $55 < L_{EQ(16hr)} \leq 65$ | Forced air heating with provision for central air conditioning | N/A | Type C |
| | $L_{EQ(16hr)} > 65$ | Central air conditioning | N/A | Type D |
| Nighttime (23:00 – 07:00) | $L_{EQ(8hr)} < 50$ | Not required | N/A | Not required |
| | $50 < L_{EQ(8hr)} \leq 60$ | Forced air heating with provision for central air conditioning | N/A | Type C |
| | $L_{EQ(8hr)} > 60$ | Central air conditioning | N/A | Type D |

† - Required if resultant $L_{EQ}$ exceeds 55 dBA

†† - Required if resultant $L_{EQ}$ exceeds 55 dBA and if it is administratively, economically and/or technically feasible

**TABLE 4: ROAD & RAIL NOISE BUILDING COMPONENT REQUIREMENTS[8]**

| Source | $L_{EQ}$ (dBA) | Building Component Requirements |
|---|---|---|
| Road | $L_{EQ(16hr)} > 65$ (Daytime) | Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria |
| | $L_{EQ(8hr)} > 60$ (Nighttime) | |
| Rail | $L_{EQ(16hr)} > 60$ (Daytime) | |
| | $L_{EQ(8hr)} > 55$(Nighttime) | |

[7] Adapted from ENCG – Table 1.10

[8] Adapted from ENCG – Table 1.8

In addition, the exterior walls of the first row of dwellings next to railway tracks are to be built to a minimum of brick veneer or masonry equivalent construction, from the foundation to the rafters when the rail traffic $L_{EQ}$ (24-hour), estimated at a location of a nighttime receptor, is greater than 60 dBA, and when the first row of dwellings is within 100 metres of the tracks, as outlined in Table 5 below.

**TABLE 5: PLANE OF BEDROOM WINDOW FAÇADE MATERIAL REQUIREMENTS (RAIL NOISE ONLY)[9]**

| Distance to Railway | $L_{EQ}$ (dBA) | Façade Material Requirement |
|---|---|---|
| < 100 meters | $L_{EQ(24hr)} \leq 60$ | Not required |
| | $L_{EQ(24hr)} > 60$ | Brick veneer or masonry equivalent |
| > 100 meters | Not required | |

### 4.3.2 Railway Traffic Volumes

The NPC-300 recommends the use of future rail traffic volumes obtained from the applicable rail authority. In the absence of future rail traffic volumes, the existing data should be increased at an annual rate of 2.5% per year for a minimum of 15 years after the expected construction completion date. Projected daily rail traffic data are based on previous projects related to the Trillium O-Train line. Table 6 below summarizes the rail traffic volumes considered in the assessment. As a conservative measure, these volumes were assumed to be worst-case heavy rail diesel locomotive CN trains with 10 cars. Compared to the CN trains, the light rail transit vehicles would be considered insignificant.

**TABLE 6: RAILWAY TRAFFIC DATA**

| Railway | Train Class | Speed Limit (km/h) | Projected 2030 Rail Volume |
|---|---|---|---|
| CN Rail | Diesel (Freight) | 40 | 216/Day |

### 4.3.3 Theoretical Railway Noise Predictions

Calculations were performed for receptors in close proximity to the CN freight railway with the assistance of the (MOE) rail and road noise analysis program STAMSON 5.04 which incorporates the calculation model '*Sound from Trains Environment Analysis Method*' (STEAM). The impact from railway noise is then

[9] Adapted from ENCG – Table 1.9

combined with roadway predictions using a logarithmic addition at each point of reception and compared to the relevant criteria.

The CN railway lines were treated as single line sources of noise which use existing building locations as noise barriers. In addition to the railway volumes summarized in Table 6, theoretical noise predictions were also based on the following parameters:

- All trains operating in the area are diesel trains
- One locomotive was modelled per train, with an average of 10 cars per train
- Trains entering the yard are traveling at 40 km/h
- As no crossings are near the development, whistles are not used
- Rail lines are not welded

# 5. RESULTS AND DISCUSSION

## 5.1 Stationary Noise Levels

The results of the FTA stationary noise calculations indicate that noise levels will marginally exceed NPC-300 criteria for a Class 1 area, however fall below criteria for a Class 4 area which assumes the study building has exterior windows and doors closed. Noise levels at the nearest façade to the Walkley Yard facilities (Receptor 1) are presented in Table 7. As the playground (Receptor 2) is on the west side of the building and a masonry wall is proposed along the south property line, the noise levels expected at the playground are 53 dBA.

**TABLE 7: FTA EXTERIOR NOISE LEVELS DUE TO STATIONARY NOISE**

| Source | Distance to Receptor (m) | Noise Level (dBA) | NPC-300 Class 4 Criteria (dBA) | Meets NPC-300 Class 4 Criteria |
|---|---|---|---|---|
| OC Transpo Yard | 319 | 56 | 60 | YES |
| CN Yard | 430 | 53 | | YES |
| CN Layover Track | 312 | 47 | | YES |
| Total | N/A | 58 | | YES |

As the building is being considered as a place of worship, school and community centre where central air conditioning (or similar mechanical system) will be provided as part of the design, we would recommend the development be considered as a Class 4 area which will allow building occupants to keep exterior windows and doors closed and maintain a comfortable living environment. The Warning Clause (Type F) will be required to be placed on title.

## 5.2 Railway Traffic Noise Levels

Appendix A contains the complete set of input and output data from all STAMSON 5.04 calculations. The results of the roadway noise calculations are summarized in Table 8 below.

**TABLE 8: EXTERIOR NOISE LEVELS DUE TO RAILWAY TRAFFIC**

| Receptor Number | Plane of Window Receptor Location | Noise Level (dBA) |
|---|---|---|
| | | Day |
| 2 | OLA / POW – Ground Level – South Façade | 56 |

The results of the current analysis indicate that noise levels will reach 56 dBA during the daytime period (07:00-23:00). The highest noise levels occur along the west façade which is closest to Walkley Yard.

The noise levels predicted due to railway traffic do not exceed the criteria listed in NPC-300 for building components. Therefore, upgrading building components will not be required. Minimum building construction in all areas is required to satisfy the Ontario Building Code (2012).

In addition, as noise levels are greater than 55 dBA the installation of forced air heating with provision for central air conditioning (or similar mechanical systems) will be required for the development, along with the Warning Clause (Type C). However, because the development will incorporate the installation of central air conditioning (or similar mechanical system) as part of compliance for stationary noise, the Warning Clause (Type C) does not apply.

Noise levels at the playground are expected to approach 56 dBA during the daytime period. According to NPC-300, if this area is to be used as an outdoor living area, noise control measures should be considered, but may not be required. Investigation into the application of a 2.2-meter noise barrier (minimum allowable barrier height) along the southwest property line, proved that noise levels can be reduced to 53 dBA, as illustrated in Figure 2. The inclusion of a noise barrier along the south property line will also have an added benefit of reducing stationary noise levels at the playground. The barrier should be constructed in accordance with the requirements in Appendix C of the ENCG, and have a minimum surface density of 20 kg/m$^3$. Table 9 summarizes the results of the barrier investigations at the playground.

**TABLE 9: RESULTS OF BARRIER INVESTIGATION**

| Location | Reference Receptors | Barrier Height (m) | Daytime $L_{EQ}$ Noise Levels (dBA) | |
|---|---|---|---|---|
| | | | Without Barrier | With Barrier |
| Playground | 2 | 2.2 | 56 | 53 |

## 6. CONCLUSIONS AND RECOMMENDATIONS

The results of the stationary noise calculations indicate that noise levels will marginally exceed NPC-300 criteria for a Class 1 area, but do, however, fall below criteria for a Class 4 area. We would therefore recommend the new development be considered as a Class 4 area. In order to designate as a Class 4 area it is required that the installation of central air conditioning (or similar mechanical system) is incorporated into the design which will allow building occupants to keep exterior windows and doors closed and maintain a comfortable living environment. The following Warning Clause (Type F[10]) will also be required:

> *"Purchasers/occupants are advised that sound levels due to the adjacent industry (facility) (utility) are required to comply with sound level limits that are protective of indoor areas and are based on the assumption that windows and exterior doors are closed. This facility has been supplied with a ventilation/air conditioning system which will allow windows and exterior doors to remain closed."*

[10] Ministry of the Environment – Publication NPC-300

Upon approval of this development being designated as a Class 4 area, a copy of this report and the notice of approval from the land-use planning authority (City of Ottawa) will be forwarded to the surrounding stationary noise source owners as per the requirements in NPC-300.

The results of the railway traffic noise analysis indicate that noise levels will reach 56 dBA during the daytime period (07:00-23:00). The highest noise levels occur along the south façade, which is nearest and most exposed to Walkley Yard. Minimum building construction in all areas is required to satisfy the Ontario Building Code (2012).

Noise levels at the playground are expected to approach 56 dBA during the daytime period. According to NPC-300, if this is to be used as an outdoor living area, noise control measures should be considered, but may not be required. Investigation into the application of a 2.2-meter noise barrier (minimum allowable barrier height) along the southwest property line proved that noise levels can be reduced to 53 dBA, as illustrated in Figure 2. The inclusion of a noise barrier along the south property line will also have an added benefit of reducing stationary noise levels at the playground. The barrier should be constructed in accordance with the requirements in Appendix C of the ENCG, and have a minimum surface density of 20 kg/m$^3$.

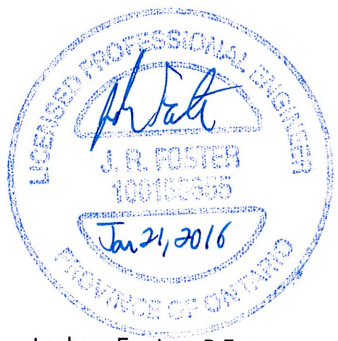
Additionally, the following restrictive covenant shall also be included in all Agreements of Lease, Purchase and Sale:

> *"The Transferee covenants with the Transferor that the above clause, verbatim, shall be included in all subsequent Agreements of Purchase and Sale and deeds conveying the lands described herein, which shall run with the said lands and is for the benefit of the subsequent owners of the said lands and the owner of the adjacent road."*

This concludes our assessment and report. If you have any questions or wish to discuss our findings please advise us. In the interim, we thank you for the opportunity to be of service.

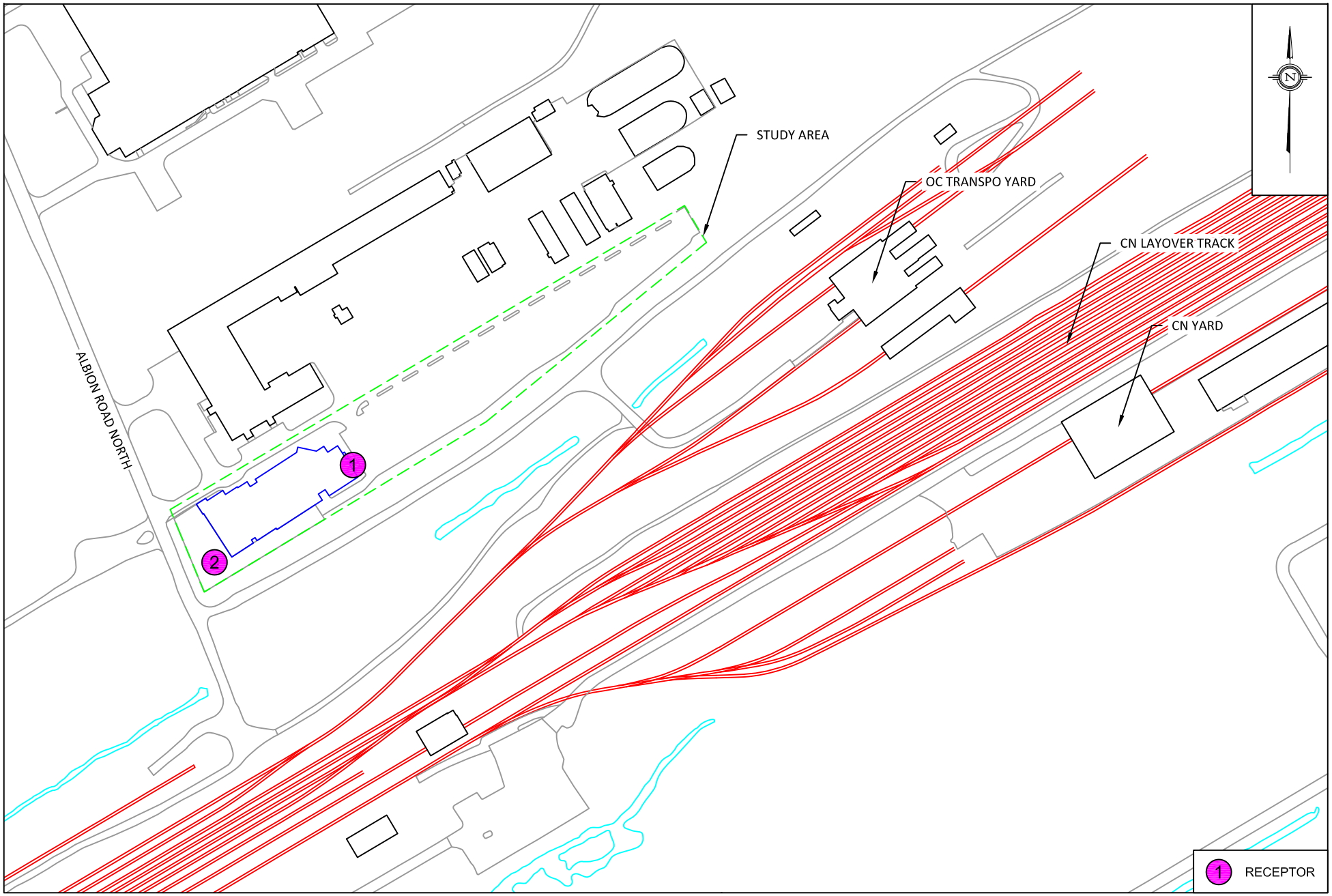
Yours truly,

***Gradient Wind Engineering Inc.***




Michael Lafortune
Environmental Technologist
*GWE15-119 - Noise*

Joshua Foster, P.Eng.
Partner



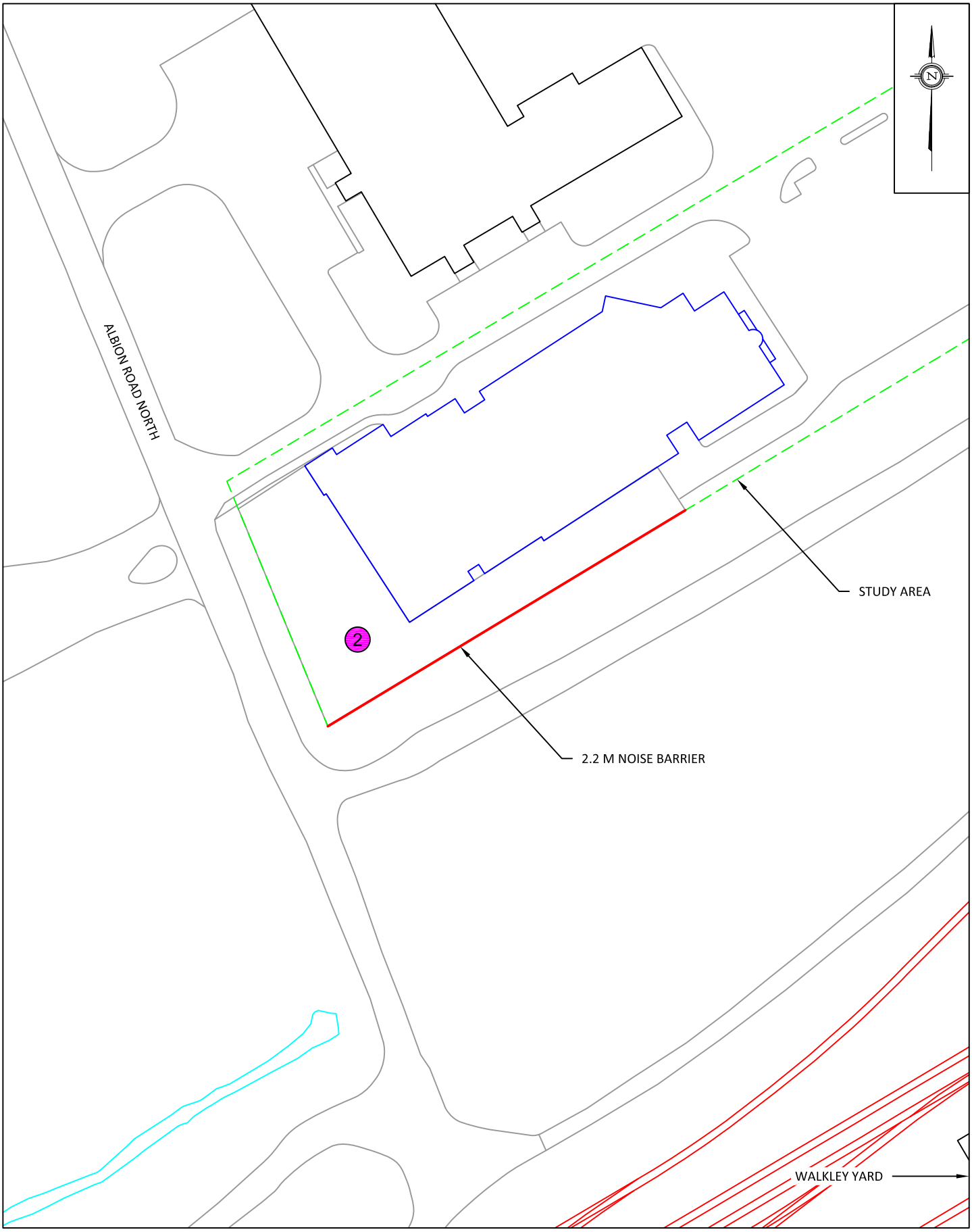

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND ENGINEERING INC

| | |
|---|---|
| PROJECT | 3095 ALBION ROAD NORTH - FEASIBILITY NOISE STUDY |
| SCALE | 1:3000 (APPROX.) |
| DRAWING NO. | GWE15-119-1 |
| DATE | DECEMBER 14, 2015 |
| DRAWN BY | M.L |

DESCRIPTION

FIGURE 1:
RECEPTOR AND NOISE SOURCE LOCATIONS




127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND ENGINEERING INC

| | | | |
|---|---|---|---|
| PROJECT | 3095 ALBION ROAD NORTH - FEASIBILITY NOISE STUDY | | DESCRIPTION |
| SCALE | 1:1000 (APPROX.) | DRAWING NO. GWE15-119-2 | FIGURE 2: PROPOSED NOISE BARRIER LOCATION |
| DATE | DECEMBER 14, 2015 | DRAWN BY M.L | |

# APPENDIX A

## STAMSON 5.04 - INPUT AND OUTPUT DATA (RAILWAY TRAFFIC NOISE)

STAMSON 5.0 NORMAL REPORT Date: 11-12-2015 16:29:51
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1.te Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CNL (day/night)

| Train Type | Trains | Speed (km/h) | # loc /Train | # Cars /Train | Eng type | Cont weld |
|---|---|---|---|---|---|---|
| 1. | 216.0/0.0 | 40.0 | 1.0 | 10.0 | Diesel | No |

Data for Segment # 1: CNL (day/night)

Angle1 Angle2 : -90.00 deg -45.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 141.00 / 141.00 m
Receiver height : 1.50 / 4.50 m
Topography : 2 (Flat/gentle slope; with barrier)
No Whistle
Barrier angle1 : -90.00 deg Angle2 : -45.00 deg
Barrier height : 9.00 m
Barrier receiver distance : 10.00 / 10.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Rail data, segment # 2: CNR (day/night)

| Train Type | Trains ! | Speed (km/h) | # loc /Train | # Cars /Train | Eng type | Cont weld |
|---|---|---|---|---|---|---|
| 1. | 216.0/0.0 | 40.0 | 1.0 | 10.0 | Diesel | No |

Data for Segment # 2: CNR (day/night)

Angle1 Angle2 : -45.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 141.00 / 141.00 m
Receiver height : 1.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
No Whistle
Reference angle : 0.00

Results segment # 1: CNL (day)
---

Barrier height for grazing incidence
---
Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
4.00 ! 1.50 ! 1.68 ! 1.68
0.50 ! 1.50 ! 1.43 ! 1.43

LOCOMOTIVE (0.00 + 41.42 + 0.00) = 41.42 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.05 72.43 -10.17 -6.27 0.00 0.00 -14.58 41.42
---

WHEEL (0.00 + 33.96 + 0.00) = 33.96 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.15 66.77 -11.19 -6.81 0.00 0.00 -14.81 33.96
---

Segment Leq : 42.14 dBA

Results segment # 2: CNR (day)
---

LOCOMOTIVE (0.00 + 54.81 + 0.00) = 54.81 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 90 0.58 72.43 -15.42 -2.20 0.00 0.00 0.00 54.81
---

WHEEL (0.00 + 48.33 + 0.00) = 48.33 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 90 0.66 66.77 -16.15 -2.29 0.00 0.00 0.00 48.33
---

Segment Leq : 55.69 dBA

Total Leq All Segments: 55.88 dBA

Results segment # 1: CNL (night)
---

Barrier height for grazing incidence
---
Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---
4.00 ! 4.50 ! 4.46 ! 4.46
0.50 ! 4.50 ! 4.22 ! 4.22

LOCOMOTIVE (0.00 + -27.54 + 0.00) = 0.00 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.00 0.00 -9.73 -6.02 0.00 0.00 -11.79 -27.54
---

WHEEL (0.00 + -28.78 + 0.00) = 0.00 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.06 0.00 -10.32 -6.35 0.00 0.00 -12.12 -28.78
---

Segment Leq : 0.00 dBA

Results segment # 2: CNR (night)
---

LOCOMOTIVE (0.00 + -16.63 + 0.00) = 0.00 dBA

| Angle1 | Angle2 | Alpha | RefLeq | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj | SubLeq |
|---|---|---|---|---|---|---|---|---|---|
| -45 | 90 | 0.50 | 0.00 | -14.55 | -2.08 | 0.00 | 0.00 | 0.00 | -16.63 |

WHEEL (0.00 + -17.79 + 0.00) = 0.00 dBA

| Angle1 | Angle2 | Alpha | RefLeq | D.Adj | F.Adj | W.Adj | H.Adj | B.Adj | SubLeq |
|---|---|---|---|---|---|---|---|---|---|
| -45 | 90 | 0.60 | 0.00 | -15.57 | -2.22 | 0.00 | 0.00 | 0.00 | -17.79 |

Segment Leq : 0.00 dBA

Total Leq All Segments: 0.00 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 55.88
(NIGHT): 0.00

STAMSON 5.0 NORMAL REPORT Date: 11-12-2015 16:29:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1b.te Time Period: Day/Night 16/8 hours
Description: Considers 2.2 m noise barrier

Rail data, segment # 1: CNL (day/night)

| Train Type | Trains ! | Speed !(km/h) | # loc !/Train | # Cars !/Train | Eng type | Cont !weld |
|---|---|---|---|---|---|---|
| 1. | 216.0/0.0 | 40.0 | 1.0 | 10.0 | Diesel | No |

Data for Segment # 1: CNL (day/night)

Angle1 Angle2 : -90.00 deg -45.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 141.00 / 141.00 m
Receiver height : 1.50 / 4.50 m
Topography : 2 (Flat/gentle slope; with barrier)
No Whistle
Barrier angle1 : -90.00 deg Angle2 : -45.00 deg
Barrier height : 9.00 m
Barrier receiver distance : 10.00 / 10.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Rail data, segment # 2: CNR (day/night)

| Train Type | Trains ! | Speed (km/h) | # loc /Train | # Cars /Train | Eng type | Cont weld |
|---|---|---|---|---|---|---|
| 1. | 216.0/0.0 | 40.0 | 1.0 | 10.0 | Diesel | No |

Data for Segment # 2: CNR (day/night)

Angle1 Angle2 : -45.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 141.00 / 141.00 m
Receiver height : 1.50 / 4.50 m
Topography : 2 (Flat/gentle slope; with barrier)
No Whistle
Barrier angle1 : -45.00 deg Angle2 : 37.00 deg
Barrier height : 2.20 m
Barrier receiver distance : 19.00 / 19.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00

Results segment # 1: CNL (day)
---

Barrier height for grazing incidence
---
Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
4.00 ! 1.50 ! 1.68 ! 1.68
0.50 ! 1.50 ! 1.43 ! 1.43

LOCOMOTIVE (0.00 + 41.42 + 0.00) = 41.42 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.05 72.43 -10.17 -6.27 0.00 0.00 -14.58 41.42
---

WHEEL (0.00 + 33.96 + 0.00) = 33.96 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.15 66.77 -11.19 -6.81 0.00 0.00 -14.81 33.96
---

Segment Leq : 42.14 dBA

Results segment # 2: CNR (day)
---

Barrier height for grazing incidence
---
Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
4.00 ! 1.50 ! 1.84 ! 1.84
0.50 ! 1.50 ! 1.37 ! 1.37

LOCOMOTIVE (0.00 + 49.51 + 49.34) = 52.43 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 37 0.45 72.43 -14.14 -3.59 0.00 0.00 -5.19 49.51
---
37 90 0.58 72.43 -15.42 -7.67 0.00 0.00 0.00 49.34
---

WHEEL (0.00 + 42.03 + 42.70) = 45.38 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 37 0.56 66.77 -15.16 -3.64 0.00 0.00 -5.95 42.03
---
37 90 0.66 66.77 -16.15 -7.92 0.00 0.00 0.00 42.70
---

Segment Leq : 53.21 dBA

Total Leq All Segments: 53.54 dBA

Results segment # 1: CNL (night)
---

Barrier height for grazing incidence
---
Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
4.00 ! 4.50 ! 4.46 ! 4.46
0.50 ! 4.50 ! 4.22 ! 4.22

LOCOMOTIVE (0.00 + -27.54 + 0.00) = 0.00 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.00 0.00 -9.73 -6.02 0.00 0.00 -11.79 -27.54
---

WHEEL (0.00 + -28.78 + 0.00) = 0.00 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-90 -45 0.06 0.00 -10.32 -6.35 0.00 0.00 -12.12 -28.78
---

Segment Leq : 0.00 dBA

Results segment # 2: CNR (night)
---

Barrier height for grazing incidence
---
Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
---+---+---+---
4.00 ! 4.50 ! 4.43 ! 4.43
0.50 ! 4.50 ! 3.96 ! 3.96

LOCOMOTIVE (0.00 + -18.16 + -21.90) = 0.00 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 37 0.36 0.00 -13.26 -3.56 0.00 0.00 0.00 -16.82*
-45 37 0.50 0.00 -14.55 -3.61 0.00 0.00 0.00 -18.16
---
37 90 0.50 0.00 -14.55 -7.36 0.00 0.00 0.00 -21.90
---

* Bright Zone !

WHEEL (0.00 + -19.22 + -23.29) = 0.00 dBA
Angle1 Angle2 Alpha RefLeq D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
---
-45 37 0.47 0.00 -14.29 -3.60 0.00 0.00 0.00 -17.89*
-45 37 0.60 0.00 -15.57 -3.65 0.00 0.00 0.00 -19.22
---
37 90 0.60 0.00 -15.57 -7.72 0.00 0.00 0.00 -23.29
---

* Bright Zone !

Segment Leq : 0.00 dBA

Total Leq All Segments: 0.00 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 53.54
(NIGHT): 0.00