

Geotechnical  
Engineering

Environmental  
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Hydrogeology

Geological  
Engineering

Materials Testing

Building Science

Noise and Vibration Studies

## Trillium Line Level 1 Proximity Study

Proposed High-Rise Building  
829 Carling Avenue  
Ottawa, Ontario

Prepared For

Claridge Homes

### Paterson Group Inc.

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May 12, 2021

Report: PG5744-2

## 1.0 Introduction

Paterson Group (Paterson) was commissioned by Claridge Homes to conduct a Level 1 Trillium Line proximity study for the proposed high-rise building to be located at 829 Carling Avenue in the City of Ottawa.

The objective of the current study was to:

- ❑ Review all current information provided by the City of Ottawa with regards to the infrastructure of the Trillium Line and Carling Rail Station.
- ❑ Liaise between the City of Ottawa and Claridge Homes consultant team involved with the aforementioned project.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains a collaboration of architectural, civil, structural, geotechnical, and shoring design information as they pertain to the aforementioned project.

## 2.0 Development Details

Based on available drawings, it is understood that the proposed development consists of a high-rise building with 6 underground levels. The underground parking structure is expected to occupy the majority of the site.

The following is known about the Trillium Line in the vicinity of the subject site:

- ❑ The Trillium Line rail runs in a north-south alignment at an approximate distance of 85 m from the western boundary of the subject site.
- ❑ Carling Station is located adjacent to the east side of the rail at an approximate distance of 75 m from the western boundary of the site. The rail station structure extends to the level of the rail line.
- ❑ The existing Trillium Line rail is located at the ground surface in a recessed trench at an approximate geodetic elevation of 56 m, while the 829 Carling Avenue site is located up the slope to the east at an approximate geodetic elevation of 62.4 m.
- ❑ Based on the subsurface profile encountered at the borehole locations at the subject site, bedrock is expected at depths of approximately 0.9 to 1.5 m, corresponding to approximate geodetic elevations of 60.7 to 61.6 m.

## **3.0 Construction Methodology and Impact Review**

Paterson has prepared a construction methodology summary along with possible impacts on the adjacent segment of the Trillium Line and Carling Rail Station based on the current building design details. The Construction Methodology and Impact Review is provided in Appendix 1 and presents the anticipated construction items, impact review and mitigation program recommended for the existing Trillium Line railway and Carling Rail Station. One of the main issues will be vibrations associated with the bedrock blasting removal program. It is recommended that a vibration monitoring program be implemented to ensure vibration levels remain below recommended tolerances. Details of a recommended vibration monitoring program are presented below.

### **3.1 Vibration Monitoring and Control Program**

Due to the presence of the existing Trillium Line railway and Carling Station, the contractor should take extra precaution to minimize vibrations. The vibration monitoring program will be required for the full construction duration for blasting operations, dewatering, backfilling and compaction, construction traffic and other construction activities. The purpose of the Vibration Monitoring and Control Program (VMCP) is to provide a description of the measures to be implemented by the contractor to manage excavation operations and any other vibration sources during the construction for the proposed development. The VMCP will also provide a guideline for assessing results against the relevant vibration impact assessment criteria and recommendations to meet the required limits.

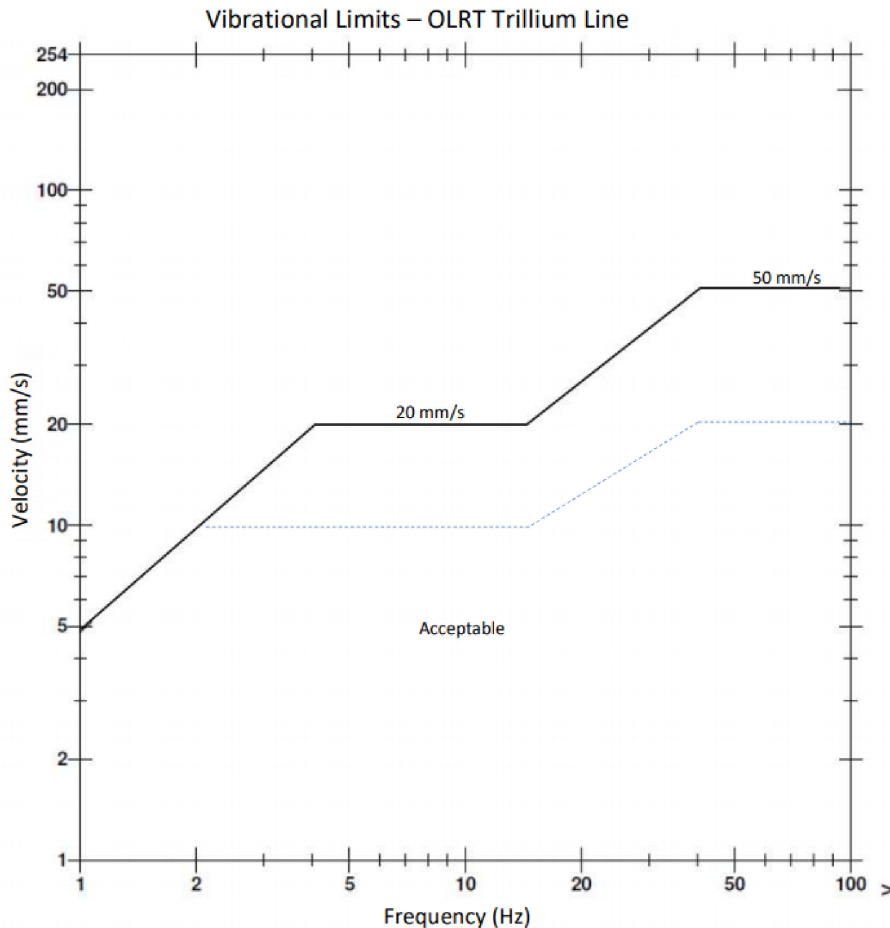
The monitoring program will incorporate real time results at the Trillium Line corridor structure and Carling Station, which are located in the general vicinity of the subject site. The monitoring equipment should consist of a tri-axial seismograph, capable of measuring vibration intensities up to 254 mm/s at a frequency response of 2 to 250 Hz. The monitoring equipment should be placed in Carling Station.

The location should be reviewed periodically throughout construction to ensure that the monitoring equipment remains at the closest radius to the construction activities. The vibration monitor locations should be approved by the project manager prior to installation.

During construction, the vibration monitor will be relocated for the 'worst case' location for each construction activity. When an event is triggered, Paterson will review the results and provide any necessary feedback. Otherwise, the vibration results will be summarized in the weekly report.

## Proposed Vibration Limits

The excavation operations should be planned and conducted under the supervision of a licensed professional engineer who is an experienced bedrock excavation consultant. The following figure outlines the recommended vibration limits for the Trillium Line railway:



## Monitoring Data

The monitoring protocol should include the following information:

## Trigger Level Event

- Paterson will review all vibrations over the established warning level, illustrated by the blue line in the above figure, and;
- Paterson will notify the contractor if any vibrations occur due to construction activities and are close to exceedance level.

### **Exceedance Level Event**

- Paterson will notify all the relevant stakeholders via email if any vibrations surpass the exceedance level, illustrated by the black line in the above figure.
- Ensure monitors are functioning
- Issue the vibration exceedance result

The data collected should include the following:

- Measured vibration levels
- Distance from the construction activity to monitoring location
- Vibration type

Monitoring should be compliant with all related regulations.

## **3.2 Incident/Exceedance Reporting**

In case an incident/exceedance occurs from construction activities, the Senior Project Management and any relevant personnel should be notified immediately. A report should be completed which contains the following:

- Identify the location of vibration exceedance
- The date, time and nature of the exceedance/incident
- Purpose of the exceeded monitor and current vibration criteria
- Identify the likely cause of the exceedance/incident
- Describe the response action that has been completed to date
- Describe the proposed measures to address the exceedance/incident.

The contractor should implement mitigation measures for future excavation or any construction activities as necessary and provide updates on the effectiveness of the improvement. Response actions should be pre-determined prior to excavation, depending on the approach provided to protect elements. Processes and procedures should be in-place prior to completing any vibrations to identify issues and react in a quick manner in the event of an exceedance.

## **4.0 Proximity Study Requirement Responses**

Paterson was informed by the City of Ottawa that a Level 1 Trillium Line Proximity Study should be completed for the proposed development. A Level 1 Trillium Line Proximity Study is required where the proposed development is located within the City of Ottawa's Development Zone of Influence.

The following table lists the applicable requirements for Level 1 studies and the response for each item:

<b>Table 1 List of Trillium Line Level 1 Proximity Study Requirements</b>	
<b>Level 1 Projects</b>	<b>Response</b>
A site plan of the development with the centreline or reference line of the Trillium Line structure and/or right-of-way and Carling Station located and the relevant distances between the Trillium Line and developer's structure shown clearly;	See Trillium Line Proximity Plan (Drawing No. PG5744-2 dated April 2021) presented in Appendix A.
Plan and cross-sections of the development locating the Trillium Line structure/right-of-way and Carling Station and founding elevations relative to the development, including any underground storage tanks and associated piping;	Refer to the Trillium Line Proximity Plan (Drawing No. PG5744-2 dated April 2021) and Cross-Section A-A' (Drawing No. PG5744-3 dated April 2021) presented in Appendix A.
A geotechnical investigation report showing up-to-date geotechnical conditions at the site of the development. The geotechnical investigation shall be prepared in accordance with the Geotechnical Investigation and Reporting Guidelines for Development Applications in the City;	Refer to Geotechnical Investigation: Paterson Group Report PG5744-1 dated May 12, 2021 presented in Appendix B.
Structural, foundation, excavation and shoring drawings;	Structural, foundation, excavation and shoring drawings will be provided prior to the Site Plan Agreement. Based on available design details, the proposed building foundation will consist of conventional footings placed directly over a clean, bedrock surface. No negative impacts are anticipated for the Trillium Line or Carling Station due to the proposed building location.
Acknowledgment that the potential for noise, vibration, electro-magnetic interference and stray current from Trillium Line operations have been considered in the design of the project, and appropriate mitigation measures applied.	Refer to the Transportation Noise Assessment prepared by Gradient Wind Engineers & Scientists dated April 14, 2021 which is presented in Appendix C.

We trust that this information satisfies your immediate request.

Best Regards,

**Paterson Group Inc.**



Scott S. Dennis, P.Eng.



David J. Gilbert, P.Eng.

**Report Distribution**

- Claridge Homes (e-mail copy)
- Paterson Group (1 copy)

# **APPENDIX A**

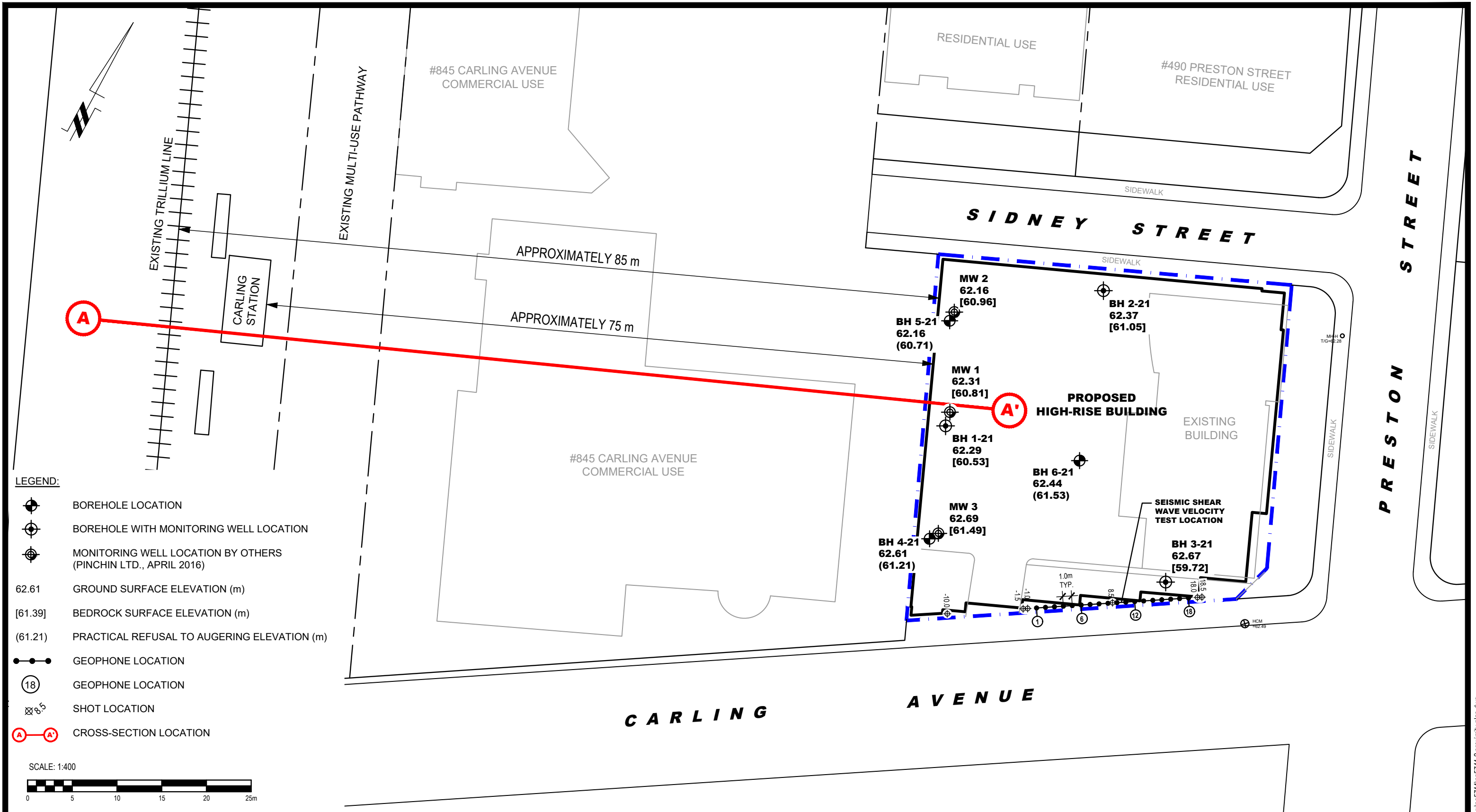
**Trillium Line Proximity Plan**

**Cross Section A-A'**

**Topographic Plan of Survey**

**Construction Methodology and Impact Review**





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NO.	REVISIONS	DATE	INITIAL

CLARIDGE HOMES  
TRILLIUM LINE PROXIMITY STUDY  
PROPOSED HIGH-RISE BUILDING - 829 CARLING AVENUE

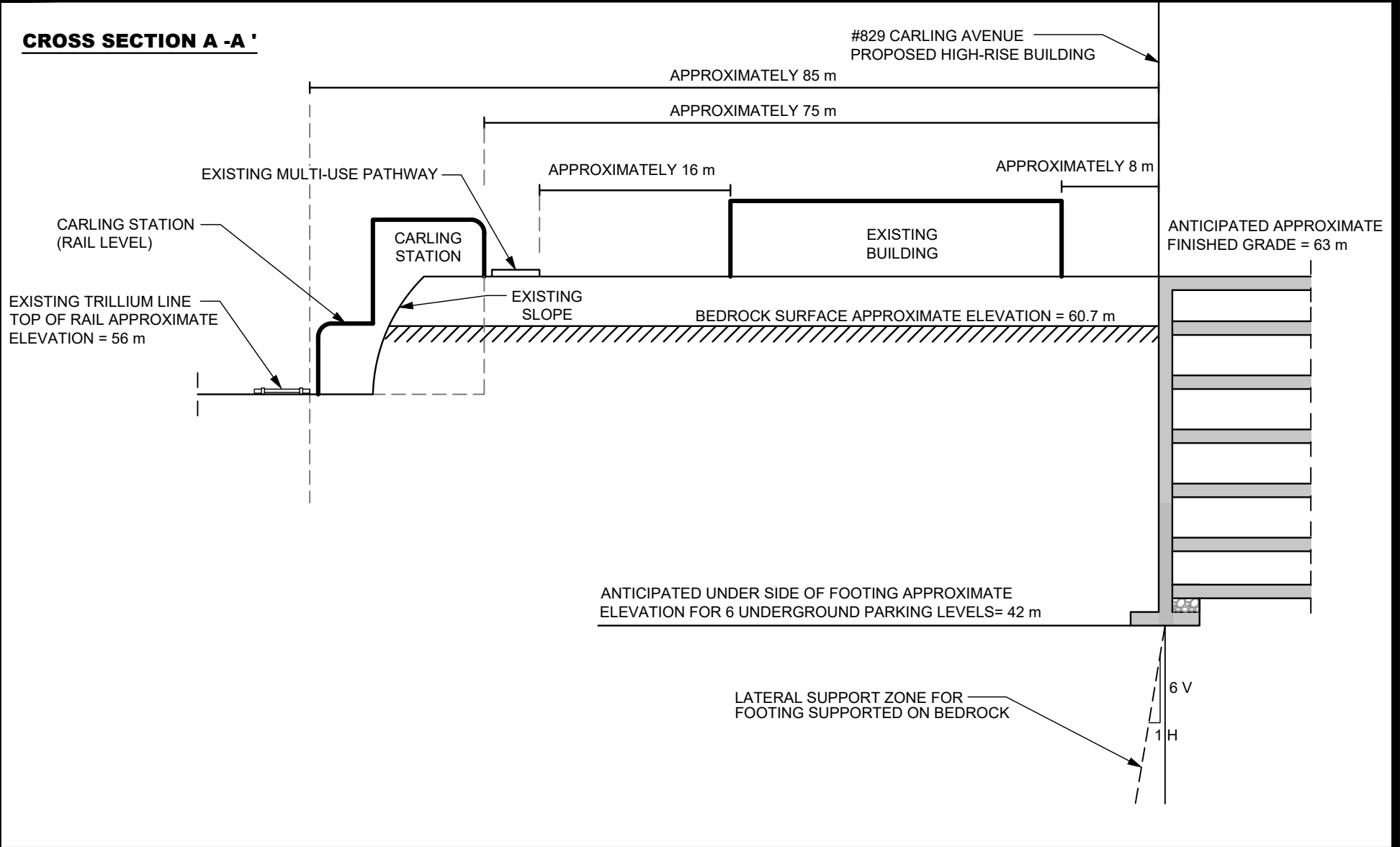
OTTAWA, ONTARIO

Title: **TRILLIUM LINE PROXIMITY PLAN**

Scale: 1:400  
Drawn by: NFRV  
Checked by: NP  
Approved by: SD

Date: 04/2021  
Report No.: PG5744-2  
Dwg. No.: **PG5744-2**  
Revision No.:

**CROSS SECTION A - A '**



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**CLARIDGE HOMES**  
**TRILLIUM LINE PROXIMITY STUDY**  
**829 CARLING AVENUE**

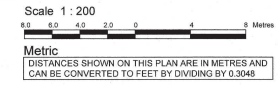
**OTTAWA, ONTARIO**

**CROSS SECTION A-A'**

Scale:	N.T.S.	Date:	04/2021
Drawn by:	NFRV	Report No.:	PG5744-2
Checked by:	NP	Drawing No.:	<b>PG5744-3</b>
Approved by:	SD	Revision No.:	

TOPOGRAPHICAL PLAN OF SURVEY OF

PART OF LOTS 1554, 1555, 1556, 1557  
 REGISTERED PLAN 38  
 CITY OF OTTAWA  
 Surveyed by Annis, O'Sullivan, Vollebek Ltd.



Surveyor's Certificate  
 I CERTIFY THAT:  
 1. This survey and plan are correct and in accordance with the Surveys Act and the Surveyors Act and the regulations made under them.  
 2. The survey was completed on the 29th day of July 2010.  
 July 29, 2010  
 Ontario Land Surveyor

Notes & Legend

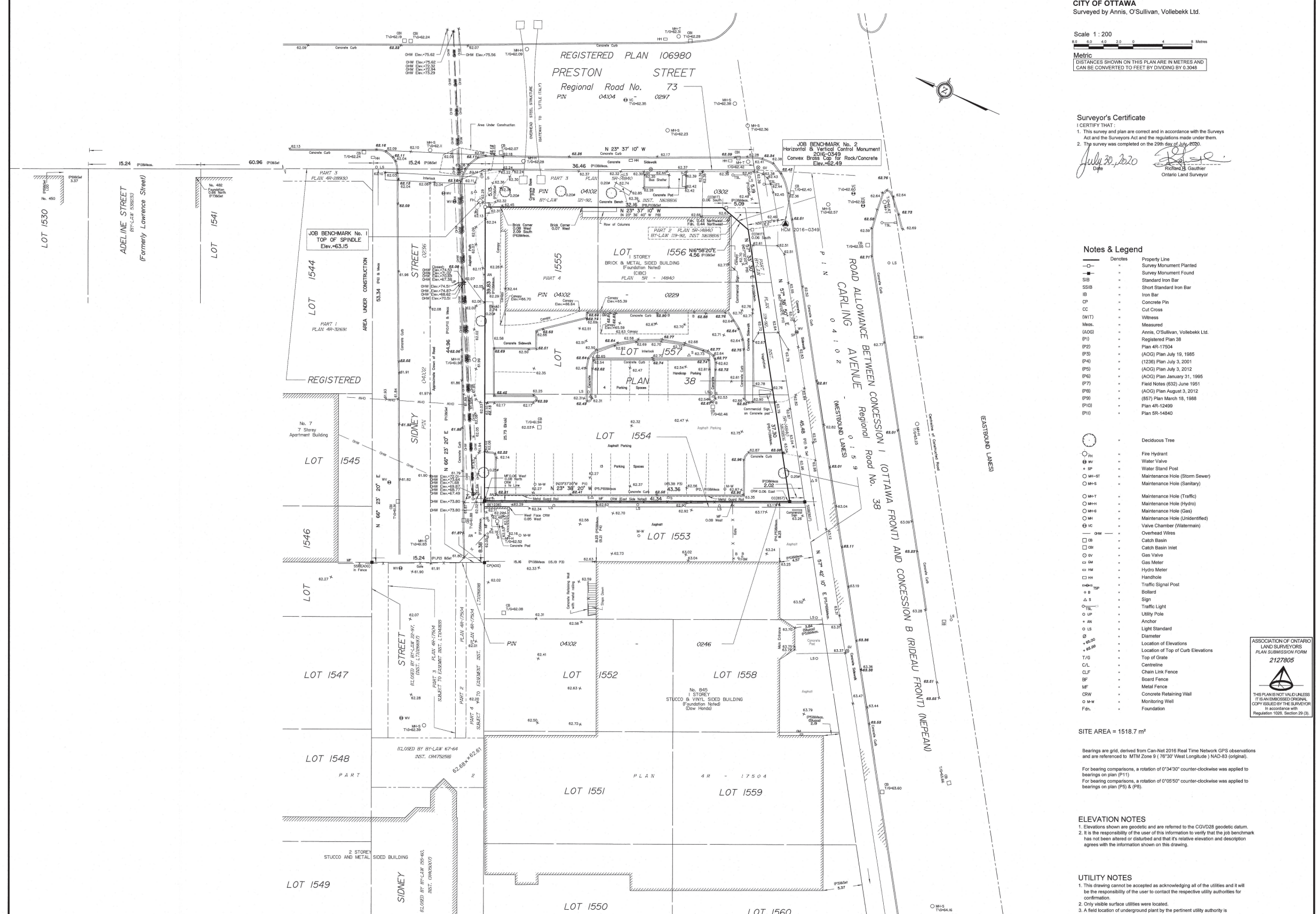
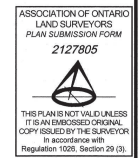
Symbol	Description
—	Property Line
—	Survey Monument Planted
—	Survey Monument Found
SIB	Standard Iron Bar
SSIB	Short Standard Iron Bar
IB	Iron Bar
CP	Concrete Pin
CC	Cut Cross
(WIT)	Witness
Mes.	Measured
(AOG)	Annis, O'Sullivan, Vollebek Ltd.
(P1)	Registered Plan 38
(P2)	Plan 4R-17504
(P3)	(AOG) Plan July 19, 1985
(P4)	(1238) Plan July 3, 2001
(P5)	(AOG) Plan July 3, 2012
(P6)	(AOG) Plan January 31, 1995
(P7)	Field Notes (632) June 1951
(P8)	(AOG) Plan August 3, 2012
(P9)	(557) Plan March 18, 1988
(P10)	Plan 4R-12499
(P11)	Plan 5R-14840
○	Deciduous Tree
○ HW	Fire Hydrant
○ W	Water Valve
○ SP	Water Stand Post
○ MH-ST	Maintenance Hole (Storm Sewer)
○ MH-S	Maintenance Hole (Sanitary)
○ MH-T	Maintenance Hole (Traffic)
○ MH-H	Maintenance Hole (Hydro)
○ MH-G	Maintenance Hole (Gas)
○ MH	Maintenance Hole (Unidentified)
○ VC	Valve Chamber (Watermain)
— HW	Overhead Wires
□ CB	Catch Basin
□ CB	Catch Basin Inlet
□ GV	Gas Valve
□ GM	Gas Meter
□ HM	Hydro Meter
□ HH	Handhole
□ TSP	Traffic Signal Post
○ B	Bollard
○ S	Sign
○ TL	Traffic Light
○ UP	Utility Pole
○ AN	Anchor
○ LS	Light Standard
○ D	Diameter
○ EL	Location of Elevations
○ EL	Location of Top of Curb Elevations
T/G	Top of Grate
C/L	Centreline
CLF	Chain Link Fence
BF	Board Fence
MF	Metal Fence
CRW	Concrete Retaining Wall
○ MW	Monitoring Well
Fdn.	Foundation

SITE AREA = 1518.7 m<sup>2</sup>

Bearings are grid, derived from Can-Net 2016 Real Time Network GPS observations and are referenced to MTM Zone 9 (76°30' West Longitude) NAD-83 (original).  
 For bearing comparisons, a rotation of 0°34'30" counter-clockwise was applied to bearings on plan (P11).  
 For bearing comparisons, a rotation of 0°05'50" counter-clockwise was applied to bearings on plan (P9) & (P6).

ELEVATION NOTES  
 1. Elevations shown are geodetic and are referred to the CGVD28 geodetic datum.  
 2. It is the responsibility of the user of this information to verify that the job benchmark has not been altered or disturbed and that its relative elevation and description agrees with the information shown on this drawing.

UTILITY NOTES  
 1. This drawing cannot be accepted as acknowledging all of the utilities and it will be the responsibility of the user to contact the respective utility authorities for confirmation.  
 2. Only visible surface utilities were located.  
 3. A field location of underground plant by the pertinent utility authority is mandatory before any work involving breaking ground, probing, excavating etc.



### Construction Methodology and Impact Review

Construction Item	Potential Impact	Mitigation Program
<p><b>Item A - Installation of Temporary Shoring System</b> - Where adequate space is not available for the overburden to be sloped, the overburden along the perimeter of the proposed building footprint will need to be shored in order to complete the construction of the underground parking levels. The shoring system is anticipated to consist of a soldier pile and lagging or interlocking sheet pile system along the west side, which is nearest to the Trillium Line.</p>	<p>Vibration issues during shoring system installation</p>	<p>Design of the temporary shoring system, in particular vibrations during installation, will take into consideration the presence of the Trillium Line and Carling Station.</p> <p>Installation of the shoring system is not anticipated to have an adverse impact on the Trillium Line or Carling Station, nonetheless, a vibration monitoring device is recommended to be installed to monitor vibrations. The vibration monitor would be remotely connected to permit real time monitoring and a vibration monitoring program would be implemented as detailed in Subsection 3.1 - Vibration Monitoring and Control Program of Paterson Group Report PG5744-2 dated May 12, 2021.</p>
<p><b>Item B - Bedrock Blasting and Removal Program</b> - Blasting of the bedrock will be required for the proposed building and parking garage structure construction. It is expected that up to approximately 20 m of bedrock removal is required based on the current design concepts for the proposed development.</p>	<p>Structural damage of Trillium Line and Carling Station due to vibrations from blasting program.</p>	<p>Structural damage to the Trillium Line or Carling Station during bedrock blasting and removal is not anticipated, nonetheless, a vibration monitoring device is recommended to be installed in Carling Station in order to monitor vibrations. The vibration monitor would be remotely connected to permit real time monitoring and a vibration monitoring program would be implemented as detailed in Subsection 3.1 - Vibration Monitoring and Control Program of Paterson Group Report PG5744-2 dated May 12, 2021.</p>
<p><b>Item C - Construction of Footings and Foundation Walls</b> - The proposed building will include 6 levels of underground parking. Therefore, the footings will be placed over a clean, surface sounded limestone bedrock bearing surface or lean concrete filled trench extending to the bedrock surface.</p>	<p>Building footing loading on adjacent Trillium Line and Carling Station, and excavation within the lateral support zone of the Trillium Line and Carling Station.</p>	<p>Due to the distance between the proposed building and the Trillium Line and Carling Station, the zone of influence from the proposed footings will not intersect the rail line structure and associated infrastructure. Further, although the underground parking levels for the proposed building will extend approximately 21 m below existing ground surface, due to the approximate 75 to 85 m distance between the proposed building and rail line structure and station, the building excavation will not impact the lateral support zone of the Trillium Line or Carling Station.</p>

# **APPENDIX B**

**Geotechnical Investigation:**

**Report PG5744-1**

**dated May 12, 2021**

Geotechnical  
Engineering

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## Geotechnical Investigation

Proposed High-Rise Building  
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Report: PG5744-1

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### **Appendix 1**

Soil Profile and Test Data Sheets  
Symbols and Terms  
Stratigraphic and Instrumentation Logs by Others  
Unconfined Compressive Strength Testing Results  
Hydraulic Conductivity Analysis  
Analytical Testing Results

### **Appendix 2**

Figure 1 - Key Plan  
Figures 2 to 3 - Shear Wave Velocity Profiles  
Drawing PG5744-1 - Test Hole Location Plan



## 1.0 Introduction

Paterson Group (Paterson) was commissioned by Claridge Homes to complete a geotechnical investigation for the proposed high-rise building to be located at 829 Carling Avenue, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan presented in Appendix 2 of this report).

The objectives of the geotechnical investigation were to:

- determine the subsoil and groundwater conditions at this site by means of test holes.
- provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

## 2.0 Proposed Development

Based on the available drawings, it is understood that the proposed development will consist of a high-rise building with 6 levels of underground parking. Further, it is understood the footprint of the underground parking levels will occupy the majority of the subject site. The proposed building will be surrounded by landscaped margins.

Construction of the proposed development will involve demolition of the existing commercial structure on-site.

## **3.0 Method of Investigation**

### **3.1 Field Investigation**

#### **Field Program**

The field program for the current investigation was carried out from April 20 to 22, 2021 and consisted of advancing 6 boreholes to a maximum depth of 23.9 m below the existing ground surface. A previous investigation was also completed at the subject site by others in April of 2016. At that time, 4 boreholes were advanced to a maximum depth of 7.6 m. The borehole locations for the current investigation were determined in the field by Paterson personnel taking into consideration site features and underground services. The locations of the boreholes are shown on Drawing PG5744-1 - Test Hole Location Plan in Appendix 2.

The boreholes were completed with a truck-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer. The test hole procedure consisted of augering and rock coring to the required depths at the selected locations, and sampling and testing the overburden.

#### **Sampling and In-Situ Testing**

Soil samples were collected from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sampler. Rock cores (RC) were obtained using 47.6 mm inside diameter coring equipment. All samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags, and rock cores were placed in cardboard boxes. All samples were transported to our laboratory for further examination and classification. The depths at which the auger, split spoon and rock core samples were recovered from the boreholes are shown as AU, SS and RC, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Bedrock samples were recovered using a core barrel and diamond drilling techniques. The depths at which rock core samples were recovered from the boreholes are shown as RC on the Soil Profile and Test Data sheets in Appendix 1.

A recovery value and a Rock Quality Designation (RQD) value were calculated for each drilled section (core run) of bedrock and are shown on the borehole logs. The recovery value is the ratio, in percentage, of the length of the bedrock sample recovered over the length of the drilled section (core run). The RQD value is the ratio, in percentage, of the total length of intact rock pieces longer than 100 mm in one core run over the length of the core run. These values are indicative of the quality of the bedrock.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

### **Groundwater**

Monitoring wells were installed in the boreholes to permit monitoring of the groundwater levels subsequent to the completion of the current sampling program. All groundwater observations are noted on the Soil Profile and Test Data sheets presented in Appendix 1.

All monitoring wells should be decommissioned in accordance with Ontario Regulations O.Reg 903 by a qualified licensed well technician and prior to construction.

### **Sample Storage**

All samples from the current investigation will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

## **3.2 Field Survey**

The test hole locations were selected by Paterson to provide general coverage of the proposed development taking into consideration the existing site features and underground utilities. The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a GPS unit with respect to a geodetic datum. The location of the test holes and ground surface elevation at each test hole location are presented on Drawing PG5744-1 - Test Hole Location Plan in Appendix 2.

### **3.3 Laboratory Testing**

Soil and bedrock samples recovered from the subject site were visually examined in our laboratory to review the field logs. Unconfined compressive strength testing of recovered rock cores was carried out on select bedrock core samples. The results of the unconfined compressive strength testing are discussed in Subsection 4.2.

### **3.4 Analytical Testing**

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed in Subsection 6.7.

## **4.0 Observations**

### **4.1 Surface Conditions**

The subject site is currently occupied by an existing single-storey commercial building, which is located on the eastern end of the site. The western half of the site generally consists of asphalt paved access lanes and parking areas with landscaped margins. The subject site is bordered to the north by Sidney Street, to the east by Preston Street, to the south by Carling Avenue, and to the west by a low-rise commercial building.

The ground surface across the subject site is relatively flat at approximate geodetic elevation 62 m, and is generally at-grade with the surrounding roadways.

### **4.2 Subsurface Profile**

#### **Overburden**

Generally, the subsurface profile encountered at the test hole locations consists of an approximate 50 to 80 mm thick asphalt surface underlain by fill. The fill extended to the bedrock surface at approximate depths of 0.9 to 1.5 m below the existing ground surface, and was generally observed to consist of silty sand with clay, gravel, topsoil, and crushed stone. Construction debris including wood, brick and concrete were also observed within the fill at borehole BH 3-21.

#### **Bedrock**

Practical refusal to augering on the bedrock surface was encountered at approximate depths ranging from 0.9 to 1.5 m. The bedrock was observed to consist of grey limestone, and based on the RQDs of the recovered bedrock core, was generally weathered and of poor quality to approximate depths of 3 m, becoming good to excellent in quality with depth. At boreholes BH 1-21 to BH 3-21, the bedrock was cored to depths ranging from 22.6 to 23.9 m below the existing ground surface.

Unconfined compressive strength (UCS) was carried out on a total of 3 bedrock core samples. The results of the testing are presented in Table 1 on the next page.

<b>Table 1 - Unconfined Compressive Strength Testing Results</b>			
<b>Borehole Number</b>	<b>Sample No.</b>	<b>Sample Depth (m)</b>	<b>Unconfined Compressive Strength (MPa)</b>
BH 1-21	RC14	21.2 - 21.3	15.7
BH 2-21	RC14	20.6 - 20.7	11.4
BH 3-21	RC14	20.7 - 20.8	11.6

Based on available geological mapping, the bedrock in this area consists of interbedded limestone and shale of the Verulam formation with a drift thickness of 1 to 10 m.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil and bedrock profiles encountered at each test hole location.

### 4.3 Groundwater

Groundwater levels were measured in the monitoring wells on April 28, 2021. The monitoring wells installed by others (MW-1 through MW-3) were also measured on April 18, 2016. The results are presented in Table 2 below.

<b>Table 2 - Summary of Groundwater Levels</b>			
<b>Borehole Number</b>	<b>Measured Groundwater Level</b>		<b>Recording Date</b>
	<b>Depth (m)</b>	<b>Elevation (m)</b>	
BH 1-21	10.35	51.94	April 28, 2021
BH 2-21	23.24	39.13	April 28, 2021
BH 3-21	3.59	59.08	April 28, 2021
MW-1	3.45	-	April 18, 2016
	2.03	-	April 28, 2021
MW-2	4.75	-	April 18, 2016
	2.10	-	April 28, 2021
MW-3	Dry	-	April 18, 2016
	Dry	-	April 28, 2021

It should be noted that groundwater levels could be influenced by surface water infiltrating the backfilled boreholes. Long-term groundwater levels can also be estimated based on the observed color, moisture content and consistency of the recovered soil samples.

Based on these observations, the long-term groundwater level is expected between a 3 to 4 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations, therefore, the groundwater levels could vary at the time of construction.

## **5.0 Discussion**

### **5.1 Geotechnical Assessment**

From a geotechnical perspective, the subject site is suitable for the proposed development. The proposed high-rise building is recommended to be founded on conventional spread footings placed on clean, surface sounded bedrock.

Bedrock removal will be required to complete the underground parking levels. Hoe ramming is an option where the bedrock is weathered and/or where only small quantities of bedrock need to be removed. Line drilling and controlled blasting is recommended where large quantities of bedrock need to be removed. The blasting operations should be planned and completed under the guidance of a professional engineer with experience in blasting operations.

The above and other considerations are discussed in the following sections.

### **5.2 Site Grading and Preparation**

#### **Stripping Depth**

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding, and other settlement sensitive structures.

Existing foundation walls and other construction debris should be entirely removed from within the building perimeter. Under paved areas, existing construction remnants, such as foundation walls, should be excavated to a minimum of 1 m below final grade.

Due to the relatively shallow depth of the bedrock surface and the anticipated founding level for the proposed building, all existing overburden material should be excavated from within the proposed building footprint.

#### **Bedrock Removal**

Bedrock removal can be accomplished by hoe ramming where the bedrock is weathered and/or where only small quantities of the bedrock need to be removed. Sound bedrock may be removed by line drilling in conjunction with controlled blasting and/or hoe ramming.



Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be completed prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocity (measured at the structures) should not exceed 25 mm/s during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is an experienced blasting consultant.

### **Vibration Considerations**

Construction operations are the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipment could be the source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the nearby buildings and structures. Therefore, all vibrations are recommended to be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). The guidelines are for current construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended be completed to minimize the risks of claims during or following the construction of the proposed building.

## **Fill Placement**

Fill used for grading beneath the proposed building should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the buildings and paved areas should be compacted to at least 98% of the material's standard Proctor maximum dry density (SPMDD).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. This material should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a composite drainage membrane.

## **5.3 Foundation Design**

### **Bearing Resistance Values**

Footings placed on clean, surface sounded limestone bedrock can be designed using a factored bearing resistance value at ultimate limit states (ULS) of **5,000 kPa**, incorporating a geotechnical resistance factor of 0.5.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings placed on clean, surface-sounded bedrock will be subjected to negligible post-construction total and differential settlements.

Footings placed on a sound limestone bedrock bearing surface at depth can also be designed using a higher factored bearing resistance value at ultimate limit states (ULS) of **6,000 kPa**, incorporating a geotechnical resistance factor of 0.5, if founded on limestone bedrock and the bedrock is free of seams, fractures and voids within 1.5 m below the founding level.

This could be verified by completing and probing 50 mm diameter drill holes to a depth of 1.5 m below the founding level within the footprint of the footings. At least one drill hole should be completed per major footing. The drill hole inspection should be carried out by the geotechnical consultant. Also, the above probing program can be omitted if the bedrock side profile in the excavation demonstrates and confirms that the limestone bedrock is sound.

### **Lateral Support**

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1H:6V (or shallower) passes only through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A heavily fractured, weathered bedrock bearing medium will require a lateral support zone of 1H:1V (or shallower).

## **5.4 Design for Earthquakes**

Shear wave velocity testing was completed for the subject site to accurately determine the applicable seismic site classification for the proposed building in accordance with Table 4.1.8.4.A of the Ontario Building Code 2012. The shear wave velocity testing was completed by Paterson personnel. The results of the shear wave velocity test are provided in Figures 2 and 3 in Appendix 2.

### **Field Program**

The seismic array testing location was placed on the southeast corner of the site in an approximate southwest-northeast direction as presented in Drawing PG5744-1, attached to the present report. Paterson field personnel placed 18 horizontal 4.5 Hz. geophones mounted to the surface by means of two 75 mm ground spikes attached to the geophone land case. The geophones were spaced at 1 m intervals and connected by a geophone spread cable to a Geode 24 Channel seismograph.

The seismograph was also connected to a computer laptop and a hammer trigger switch attached to a 12-pound dead blow hammer. The hammer trigger switch sends a start signal to the seismograph. The hammer is used to strike an I-Beam seated into the ground surface, which creates a polarized shear wave. The hammer shots are repeated between 4 to 8 times at each shot location to improve signal to noise ratio.

The shot locations are also completed in forward and reverse directions (i.e.- striking both sides of the I-Beam seated parallel to the geophone array). The shot locations were 10, 1.5, and 1 m away from the first geophone, 18 and 18.5 m away from the last geophone, and at the centre of the seismic array.

## Data Processing and Interpretation

Interpretation for the shear wave velocity results were completed by Paterson personnel. Shear wave velocity measurement was made using reflection/refraction methods. The interpretation is performed by recovering arrival times from direct and refracted waves.

The interpretation is repeated at each shot location to provide an average shear wave velocity,  $V_{s30}$ , of the upper 30 m profile, immediately below the proposed building foundation. The layer intercept times, velocities from different layers and critical distances are interpreted from the shear wave records to compute the bedrock depth at each location.

The bedrock velocity was interpreted using the main refractor wave velocity, which is considered a conservative estimate of the bedrock velocity due to the increasing quality of the bedrock with depth. It should be noted that as bedrock quality increases, the bedrock shear wave velocity also increases.

The  $V_{s30}$  was calculated using the standard equation for average shear wave velocity provided in the OBC 2012, and as presented below.

$$V_{s30} = \frac{Depth_{OfInterest} (m)}{\sum \left( \frac{Depth_{Layer1} (m)}{Vs_{Layer1} (m / s)} + \frac{Depth_{Layer2} (m)}{Vs_{Layer2} (m / s)} \right)}$$

$$V_{s30} = \frac{30m}{\left( \frac{30m}{2,439m / s} \right)}$$

$$V_{s30} = 2,439m / s$$

Based on the result, the average seismic shear wave velocity,  $V_{s30}$ , for foundations at the subject site is **2,439 m/s**. Therefore, a **Site Class A** is applicable for seismic design of the proposed building as per Table 4.1.8.4.A of the OBC 2012. The soils underlying the subject site are not susceptible to liquefaction.

## 5.5 Basement Slab

For the proposed development, all overburden soil will be removed from the building footprint, leaving the bedrock as the founding medium for the basement floor slab. It is anticipated that the basement area for the proposed building will be mostly parking and the recommended pavement structures noted in Subsection 5.8 will be applicable. However, if storage or other uses of the lower level will involve the construction of a concrete floor slab, the upper 200 mm of sub-slab fill is recommended to consist of 19 mm clear crushed stone.

Any soft areas in the basement slab subgrade should be removed and backfilled with appropriate backfill material prior to placing fill. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

In consideration of the groundwater conditions at the site, a sub-slab drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should be provided in the subfloor fill under the lower basement floor. This is discussed further in Subsection 6.1.

## 5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the proposed building. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a drained unit weight of 20 kN/m<sup>3</sup> (effective unit weight 13 kN/m<sup>3</sup>).

However, the majority of the basement walls are to be poured against a composite drainage blanket which will be placed against the exposed bedrock face. A nominal coefficient of at-rest earth pressure of 0.05 is recommended in conjunction with a bulk unit weight of 23.5 kN/m<sup>3</sup> (effective 15.5 kN/m<sup>3</sup>) where this condition occurs. Further, a seismic earth pressure component will not be applicable for the foundation wall which is poured against the bedrock face. It is expected that the seismic earth pressure will be transferred to the underground floor slabs, which should be designed to accommodate these pressures. A hydrostatic groundwater pressure should be added for the portion below the groundwater level.

Undrained conditions are anticipated (i.e. below the groundwater level). Therefore, the applicable effective unit weight of the retained soil or bedrock should be utilized, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

### **Lateral Earth Pressures**

The static horizontal earth pressure ( $P_o$ ) can be calculated using a triangular earth pressure distribution equal to  $K_o \cdot \gamma \cdot H$  where:

- $K_o$  = at-rest earth pressure coefficient of the applicable retained material
- $\gamma$  = unit weight of fill of the applicable retained material ( $\text{kN/m}^3$ )
- $H$  = height of the wall (m)

An additional pressure having a magnitude equal to  $K_o \cdot q$  and acting on the entire height of the wall should be added to the above diagram for any surcharge loading,  $q$  (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

### **Seismic Earth Pressures**

The total seismic force ( $P_{AE}$ ) includes both the earth force component ( $P_o$ ) and the seismic component ( $\Delta P_{AE}$ ).

The seismic earth force ( $\Delta P_{AE}$ ) can be calculated using  $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$  where:

- $a_c$  =  $(1.45 - a_{\max}/g)a_{\max}$
- $\gamma$  = unit weight of fill of the applicable retained soil ( $\text{kN/m}^3$ )
- $H$  = height of the wall (m)
- $g$  = gravity,  $9.81 \text{ m/s}^2$

The peak ground acceleration, ( $a_{\max}$ ), for the Ottawa area is  $0.32g$  according to OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component ( $P_o$ ) under seismic conditions can be calculated using  $P_o = 0.5 K_o \gamma H^2$ , where  $K_o = 0.5$  for the soil conditions noted above.

The total earth force ( $P_{AE}$ ) is considered to act at a height,  $h$  (m), from the base of the wall, where:

$$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\} / P_{AE}$$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

## 5.7 Rock Anchor Design

### Overview of Anchor Features

The geotechnical design of grouted rock anchors in sedimentary bedrock is based upon two possible failure modes. The anchor can fail either by shear failure along the grout/rock interface or a 60 to 90 degree pullout of rock cone with the apex of the cone near the middle of the bonded length of the anchor. Interaction may develop between the failure cones of anchors that are relatively close to one another resulting in a total group capacity smaller than the sum of the load capacity of each individual anchor.

A third failure mode of shear failure along the grout/steel interface should be reviewed by the structural engineer to ensure all typical failure modes have been reviewed.

The anchor should be provided with a bonded length at the base of the anchor which will provide the anchor capacity, as well an unbonded length between the rock surface and the top of the bonded length.

Permanent anchors should be provided with corrosion protection. As a minimum, the entire drill hole should be filled with cementitious grout. The free anchor length is provided by installing a plastic sleeve to act as a bond break, with the sleeve filled with grout or a corrosion inhibiting mastic. Double corrosion protection can be provided with factory assembled systems, such as those available from Dywidag Systems or Williams Form Engineering Corp. Recognizing the importance of the anchors for the long term performance of the foundation of the proposed building, the rock anchors for this project are recommended to be provided with double corrosion protection.

## Grout to Rock Bond

The Canadian Foundation Engineering Manual recommends a maximum allowable grout to rock bond stress (for sound rock) of 1/30 of the unconfined compressive strength (UCS) of either the grout or rock (but less than 1.3 MPa) for an anchor of minimum length (depth) of 3 m. Generally, the UCS of limestone ranges between about 50 and 80 MPa, which is stronger than most routine grouts. A factored tensile grout to rock bond resistance value at ULS of **1.0 MPa**, incorporating a resistance factor of 0.4, can be calculated. A minimum grout strength of 40 MPa is recommended.

## Rock Cone Uplift

As discussed previously, the geotechnical capacity of the rock anchors depends on the dimensions of the rock anchors and the configuration of the anchorage system. Based on existing bedrock information, a **Rock Mass Rating (RMR) of 65** was assigned to the bedrock, and Hoek and Brown parameters (**m and s**) were taken as **0.575 and 0.00293**, respectively.

## Recommended Rock Anchor Lengths

Parameters used to calculate rock anchor lengths are provided in Table 3 below:

<b>Table 3 - Parameters used in Rock Anchor Review</b>	
Grout to Rock Bond Strength - Factored at ULS	1.0 MPa
Compressive Strength - Grout	40 MPa
Rock Mass Rating (RMR) - Good quality Limestone Hoek and Brown parameters	65 m=0.575 and s=0.00293
Unconfined compressive strength - Limestone bedrock	50 MPa
Unit weight - Submerged Bedrock	15.5 kN/m <sup>3</sup>
Apex angle of failure cone	60°
Apex of failure cone	mid-point of fixed anchor length

The fixed anchor length will depend on the diameter of the drill holes. Recommended anchor lengths for a 75 mm and 125 mm diameter hole are provided in Table 4 on the next page. The factored tensile resistance values given in Table 3 are based on a single anchor with no group influence effects. A detailed analysis of the anchorage system, including potential group influence effects, could be provided once the details of the loading for the proposed building are determined.



<b>Table 4 - Recommended Rock Anchor Lengths - Grouted Rock Anchor</b>				
<b>Diameter of Drill Hole (mm)</b>	<b>Anchor Lengths (m)</b>			<b>Factored Tensile Resistance (kN)</b>
	<b>Bonded Length</b>	<b>Unbonded Length</b>	<b>Total Length</b>	
75	2.0	0.8	2.8	450
	2.6	1.0	3.6	600
	3.2	1.3	4.5	750
	4.5	2.0	6.5	1000
125	1.6	1.0	2.6	600
	2.0	1.2	3.2	750
	2.6	1.4	4.0	1000
	3.2	1.8	5.0	1250

### **Other considerations**

The anchor drill holes should be within 1.5 to 2 times the rock anchor tendon diameter, inspected by geotechnical personnel and should be flushed clean prior to grouting. A tremie tube is recommended to place grout from the bottom of the anchor holes. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day that grout is prepared.

The geotechnical capacity of each rock anchor should be proof tested at the time of construction. More information on testing can be provided upon request. Compressive strength testing is recommended to be completed for the rock anchor grout.

## **5.8 Pavement Design**

For design purposes, it is recommended that the rigid pavement structure for the underground parking level consist of Category C2, 32 MPa concrete at 28 days with air entrainment of 5 to 8%. The recommended rigid pavement structure is further presented in Table 5 on the next page. The flexible pavement structure presented in Table 6 should be used for at grade access lanes and heavy loading parking areas.

<b>Table 5 - Recommended Rigid Pavement Structure - Lower Parking Level</b>	
<b>Thickness (mm)</b>	<b>Material Description</b>
150	<b>Exposure Class C2 - 32 MPa Concrete</b> (5 to 8% Air Entrainment)
300	<b>BASE</b> - OPSS Granular A Crushed Stone
<b>SUBGRADE</b> - Existing imported fill, or OPSS Granular B Type I or II material placed over bedrock.	

To control cracking due to shrinking of the concrete floor slab, it is recommended that strategically located saw cuts be used to create control joints within the concrete floor slab of the underground parking level. The control joints are generally recommended to be located at the center of the column lines and spaced at approximately 24 to 36 times the slab thickness (for example; a 0.15 m thick slab should have control joints spaced between 3.6 and 5.4 m). The joints should be cut between 25 and 30% of the thickness of the concrete floor slab and completed as early as 4 hour after the concrete has been poured during warm temperatures and up to 12 hours during cooler temperatures.

<b>Table 6 - Recommended Asphalt Pavement Structure - Access Lanes and Heavy Loading Parking Areas</b>	
<b>Thickness (mm)</b>	<b>Material Description</b>
40	<b>Wear Course</b> - HL-3 or Superpave 12.5 Asphaltic Concrete
50	<b>Binder Course</b> - HL-8 or Superpave 19.0 Asphaltic Concrete
150	<b>BASE</b> - OPSS Granular A Crushed Stone
450	<b>SUBBASE</b> - OPSS Granular B Type II
<b>SUBGRADE</b> - OPSS Granular B Type II overlying the Concrete Podium Deck.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable vibratory equipment.

## 5.9 Hydraulic Conductivity Testing

Hydraulic conductivity testing was completed at boreholes BH 3-21 and MW-1 which were outfitted with monitoring wells and screened within the bedrock. Rising head and falling head testing (“slug testing”) was completed within the limestone bedrock in accordance with ASTM Standard Test Method D4404 - Field Procedure for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers.

Following the completion of the slug testing, the test data was analyzed as per the method set out by Hvorslev (1951). Assumptions inherent in the Hvorslev method include a homogeneous and isotropic aquifer of infinite extent with zero-storage assumption, and a screen length significantly greater than the monitoring well diameter. The assumption regarding aquifer storage is considered to be appropriate for groundwater flow through the bedrock aquifer. The assumption regarding screen length and well diameter is considered to be met based on the screen lengths of 3 and 2.1 m and the well diameters of 0.032 and 0.038 m at boreholes BH 3-21 and MW-1, respectively.

While the idealized assumptions regarding aquifer extent, homogeneity, and isotropy are not strictly met in this case (or in any real-world situation), it has been our experience that the Hvorslev method produces effective point estimates of hydraulic conductivity in conditions similar to those encountered at the subject site.

The Hvorslev analysis is based on the line of best fit through the field data (hydraulic head recovery vs. time), plotted on a semi-logarithmic scale. In cases where the initial hydraulic head displacement is known with relative certainty, such as in this case where a physical slug has been introduced/removed, the line of best fit is considered to pass through the origin.

Based on the above test methods, the monitoring wells screened in the bedrock displayed a hydraulic conductivity value ranging from  **$9.96 \times 10^{-8}$  to  $6.02 \times 10^{-7}$  m/sec**. The values measured within the monitoring wells are generally consistent with similar material Paterson has encountered on other sites and typical published values for good to excellent quality limestone bedrock. These values typically range from  $1 \times 10^{-6}$  to  $1 \times 10^{-10}$  m/sec. The range in hydraulic conductivity values is due to the variability of the bedrock quality. The results from the hydraulic conductivity testing are attached to the current report.

## 6.0 Design and Construction Precautions

### 6.1 Foundation Drainage and Backfill

It is anticipated that the portion of the proposed building foundation walls located below the long-term groundwater table will be blind poured and placed against a groundwater infiltration control system. Also, a perimeter foundation drainage system will be required as a secondary system to account for any groundwater which comes in contact with the proposed building's foundation walls.

For the groundwater infiltration control system for the foundation walls, the following is recommended:

- Line drill the excavation perimeter (usually at 150 to 200 mm spacing).
- Mechanical bedrock removal along the foundation walls can be undertaken up to 150 mm from the finished vertical excavation face.
- Grind the bedrock surface up to the outer face of the line drill holes to ensure a satisfactory surface for the below grade foundation drainage system.
- If bedrock overbreaks occur, shotcrete these areas to fill in cavities and to smooth out angular features at the bedrock surface, as required based on site inspection by Paterson.
- Place a suitable waterproofing membrane (such as Tremco Paraseal or approved equivalent) against the prepared bedrock surface. The membrane liner should extend from 4 m below existing grade down to footing level.
- Place a composite drainage layer, such as Delta Drain 6000 or equivalent, over the membrane (as a secondary system). The composite drainage layer should extend from finished grade to underside of footing level.
- Pour foundation wall against the composite drainage system.

It is recommended that 100 mm diameter sleeves at 3 m centres be cast in the footing or at the foundation wall/footing interface to allow the infiltration of any water that breaches the waterproofing system to flow to an interior perimeter drainage pipe. The perimeter drainage pipe should direct water to sump pit(s) within the lower basement area.

A waterproofing system should also be provided for the elevator pits (pit bottom and walls).

## **Sub-slab Drainage System**

Sub-slab drainage will be required to control water infiltration for the underground parking levels. For preliminary design purposes, we recommend that 100 or 150 mm perforated pipes be placed at approximate 6 m centres underlying the lowest level floor slab. The spacing of the sub-slab drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

## **6.2 Protection of Footings Against Frost Action**

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a minimum of 0.6 m of soil cover in conjunction with adequate foundation insulation, should be provided.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the heated structure and require additional protection, such as soil cover of 2.1 m or an equivalent combination of soil cover and foundation insulation.

However, the footings are generally not expected to require protection against frost action due to the founding depth. Unheated structures such as the access ramp may require insulation for protection against the deleterious effects of frost action.

## **6.3 Excavation Side Slopes**

The side slopes of excavations in the overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled.

### **Unsupported Excavations**

The excavation side slopes in the overburden and above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soils are considered to be a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

A trench box is recommended to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not remain open for extended periods of time.

### **Bedrock Stabilization**

Excavation side slopes in sound bedrock can be carried out using almost vertical side walls. A minimum 1 m horizontal ledge should be left between the bottom of the overburden excavation and the top of the bedrock surface to provide an area to allow for potential sloughing or to provide a stable base for the overburden shoring system.

Horizontal rock anchors may be required at specific locations to prevent pop-outs of the bedrock, especially in areas where bedrock fractures are conducive to the failure of the bedrock surface.

The requirement for horizontal rock anchors should be evaluated during the excavation operations and should be discussed with the structural engineer during the design stage.

Further, due to the depth of excavation at this site, groundwater infiltration through the vertical bedrock face is anticipated. During the winter season, ice may start to form along the excavation sidewalls at various locations. The following recommendations are suggested to manage the ice accumulation, where encountered. Ultimately, it is the responsibility of the excavation contractor to ensure that excavation remains a worker safe area.

- ❑ Ice build up on the excavation sidewalls, should it occur, would present a hazard for workers working below these areas. At the locations where ice is observed above head level, worker access should be restricted using approved barriers and signage for hazard areas, until such time that the ice has been removed
- ❑ At the locations where construction personnel will be working, any overhanging ice should be removed at the beginning of each day using either the excavator bucket, hoe-ram or rock grinder where the excavator can reach the ice. Once this equipment is no longer present on-site, a hydraulic lift may be required to remove the overhanging ice.

## Temporary Shoring

Temporary shoring may be required for the overburden soil to complete the required excavations where insufficient room is available for open cut methods. The design and approval of the temporary shoring system will be the responsibility of the shoring contractor and the shoring designer who is a licensed professional engineer and is hired by the shoring contractor. It is the responsibility of the shoring contractor to ensure that the temporary shoring is in compliance with safety requirements, designed to avoid any damage to adjacent structures, and include dewatering control measures. In the event that subsurface conditions differ from the approved design during the actual installation, it is the responsibility of the shoring contractor to commission the required experts to re-assess the design and implement the required changes.

The designer should also take into account the impact of a significant precipitation event and designate design measures to ensure that a precipitation will not negatively impact the shoring system or soils supported by the system.

The temporary shoring system may consist of a soldier pile and lagging system. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be added to the earth pressures described below. These systems can be cantilevered, anchored or braced. Generally, the shoring systems should be provided with tie-back rock anchors to ensure the stability.

The toe of the shoring is recommended to be adequately supported to resist toe failure by means of rock bolts or extending the piles into the bedrock through pre-augered holes if a soldier pile and lagging system is used.

The earth pressures acting on the shoring system may be calculated using the following parameters.

<b>Table 7 - Soil Parameters</b>	
<b>Parameters</b>	<b>Values</b>
Active Earth Pressure Coefficient ( $K_a$ )	0.33
Passive Earth Pressure Coefficient ( $K_p$ )	3
At-Rest Earth Pressure Coefficient ( $K_o$ )	0.5
Dry Unit Weight ( $\gamma$ ), kN/m <sup>3</sup>	21
Effective Unit Weight ( $\gamma'$ ), kN/m <sup>3</sup>	13

The active earth pressure should be calculated where wall movements are permissible while the at-rest pressure should be calculated if no movement is permissible.

The dry unit weight should be calculated above the groundwater level while the effective unit weight should be calculated below the groundwater level.

The hydrostatic groundwater pressure should be included to the earth pressure distribution wherever the effective unit weight are calculated for earth pressures. If the groundwater level is lowered, the dry unit weight for the soil/bedrock should be calculated full weight, with no hydrostatic groundwater pressure component.

For design purposes, the minimum factor of safety of 1.5 should be calculated.

## **6.4 Pipe Bedding and Backfill**

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on soil subgrade. If the bedding is placed on bedrock, the thickness of the bedding should be increased to 300 mm for sewer pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 95% of the SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce the potential differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD.

## **6.5 Groundwater Control**

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.



## **Groundwater Control for Building Construction**

A temporary Ministry of Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16.

If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

## **Impacts to Neighbouring Properties**

It is understood that 6 levels of underground parking are planned for the proposed building with the lower portion of the foundation walls having a groundwater infiltration control system in place. Due to the presence of a groundwater infiltration control system in place against the bedrock face, long-term groundwater lowering is anticipated to be negligible for the area. Therefore, no adverse effects to neighbouring properties are expected.

## **6.6 Winter Construction**

Precautions must be taken if winter construction is considered for this project.

The subsoil conditions at this site mostly consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters, tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be carried out in a manner to avoid the introduction of frozen materials, snow or ice into the trenches.

## **6.7 Corrosion Potential and Sulphate**

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of an aggressive to very aggressive corrosive environment.

## 7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- Review of the geotechnical aspects of the excavating contractor's shoring design, prior to construction.
- Review the bedrock stabilization and excavation requirements.
- Review proposed waterproofing and foundation drainage design and requirements.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials used.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

## 8.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A geotechnical investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine its suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Claridge Homes or their agents is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

### Paterson Group Inc.



Scott S. Dennis, P.Eng.



David J. Gilbert, P.Eng.

### Report Distribution

- Claridge Homes (1 digital copy)
- Paterson Group (1 copy)

# **APPENDIX 1**

**SOIL PROFILE & TEST DATA SHEETS**

**SYMBOLS AND TERMS**

**STRATIGRAPHIC AND INSTRUMENTATION LOGS BY OTHERS**

**UNCONFINED COMPRESSIVE STRENGTH TESTING RESULTS**

**HYDRAULIC CONDUCTIVITY ANALYSIS**

**ANALYTICAL TESTING RESULTS**

DATUM Geodetic

FILE NO. **PG5744**

REMARKS

HOLE NO. **BH 1-21**

BORINGS BY Track-Mount Power Auger

DATE April 20, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
								20	40	60	80		
<b>GROUND SURFACE</b>													
Asphaltic concrete	0.05	AU	1			0	62.29						
<b>FILL:</b> Brown silty sand with crushed stone	0.36	AU	2										
	0.76												
<b>FILL:</b> Topsoil with silty clay	1.17	SS	3	50	28	1	61.29						
<b>FILL:</b> Brown silty sand with clay and gravel, trace topsoil													
<b>BEDROCK:</b> Poor quality, grey limestone		RC	1	100	62	2	60.29						
	3.00					3	59.29						
		RC	2	100	88	4	58.29						
		RC	3	100	100	5	57.29						
		RC	4	100	100	6	56.29						
		RC	5	100	100	7	55.29						
<b>BEDROCK:</b> Good to excellent quality, grey limestone		RC	6	100	100	8	54.29						
		RC	7	100	100	9	53.29						
						10	52.29						
						11	51.29						
						12	50.29						
						13	49.29						

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

DATUM Geodetic

FILE NO. **PG5744**

REMARKS

HOLE NO. **BH 1-21**

BORINGS BY Track-Mount Power Auger

DATE April 20, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction		
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %						
								20	40	60	80			
GROUND SURFACE														
BEDROCK: Good to excellent quality, grey limestone		RC	8	100	100	13	49.29							
		RC	9	100	100	14	48.29							
		RC	10	100	100	15	47.29							
		RC	11	100	100	16	46.29							
		RC	12	100	95	17	45.29							
		RC	13	100	90	18	44.29							
		RC	14	100	100	19	43.29							
							20	42.29						
							21	41.29						
							22	40.29						
		End of Borehole (GWL @ 10.35m - April 28, 2021)												

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE April 21, 2021

FILE NO. **PG5744**

HOLE NO. **BH 2-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
								20	40	60	80		
<b>GROUND SURFACE</b>													
Asphaltic concrete	0.08	AU	1			0	62.37						
<b>FILL:</b> Brown silty sand with crushed stone, trace clay		AU	2										
	1.22	SS	3	54	20	1	61.37						
		RC	1	100	100	2	60.37						
		RC	2	100	95	3	59.37						
		RC	3	100	100	4	58.37						
		RC	4	100	100	5	57.37						
		RC	5	100	100	6	56.37						
<b>BEDROCK:</b> Excellent quality, grey limestone		RC	6	100	100	7	55.37						
		RC	7	100	100	8	54.37						
		RC	8	100	100	9	53.37						
		RC	7	100	100	10	52.37						
		RC	8	100	100	11	51.37						
		RC	8	100	100	12	50.37						
						13	49.37						
								20	40	60	80	100	
								<b>Shear Strength (kPa)</b>					
								▲ Undisturbed    △ Remoulded					



DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE April 21, 2021

FILE NO. **PG5744**

HOLE NO. **BH 2-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction		
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %						
								20	40	60	80			
GROUND SURFACE						13	49.37							
BEDROCK: Excellent quality, grey limestone		RC	9	100	100	14	48.37							
		RC	10	100	100	15	47.37							
		RC	11	100	100	16	46.37							
		RC	12	100	97	17	45.37							
		RC	13	100	100	18	44.37							
		RC	14	100	90	19	43.37							
		RC	15	100	100	20	42.37							
							21	41.37						
							22	40.37						
							23	39.37						
End of Borehole (GWL @ 23.24m - April 28, 2021)	23.55													

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

DATUM Geodetic

FILE NO. **PG5744**

REMARKS

HOLE NO. **BH 3-21**

BORINGS BY Track-Mount Power Auger

DATE April 22, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
								20	40	60	80	
<b>GROUND SURFACE</b>												
Concrete	0.08	AU	1			0	62.67					
<b>FILL:</b> Brown silty sand, trace crushed stone	0.91	SS	2	100	5	1	61.67					
<b>FILL:</b> Brown silty sand with gravel, some topsoil, trace wood, brick, mortar and concrete	1.09											
<b>BEDROCK:</b> Poor quality, grey limestone - vertical seam from 1.45 to 1.9m depth	2.95	RC	1	100	47	2	60.67					
		RC	2	100	93	3	59.67					
		RC	3	100	98	4	58.67					
		RC	4	100	100	5	57.67					
		RC	5	100	95	6	56.67					
<b>BEDROCK:</b> Excellent quality, grey limestone		RC	6	100	10	7	55.67					
		RC	7	100	100	8	54.67					
		RC	8	100	100	9	53.67					
						10	52.67					
						11	51.67					
						12	50.67					
						13	49.67					

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

DATUM Geodetic

FILE NO. **PG5744**

REMARKS

HOLE NO. **BH 3-21**

BORINGS BY Track-Mount Power Auger

DATE April 22, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction			
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %							
GROUND SURFACE								20	40	60	80				
<b>BEDROCK:</b> Excellent quality, grey limestone		RC	9	100	100	13	49.67								
							14	48.67							
							15	47.67							
							16	46.67							
							17	45.67							
							18	44.67							
							19	43.67							
							20	42.67							
							21	41.67							
							22	40.67							
							23	39.67							
							23.93								
		End of Borehole													
		(GWL @ 3.59m - April 28, 2021)													

20 40 60 80 100  
**Shear Strength (kPa)**  
 ▲ Undisturbed    △ Remoulded

DATUM Geodetic

FILE NO. **PG5744**

REMARKS

HOLE NO. **BH 4-21**

BORINGS BY Track-Mount Power Auger

DATE April 20, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
								20	40	60	80		
<b>GROUND SURFACE</b>													
Asphaltic concrete	0.05	AU	1			0	62.61						
FILL: Crushed stone with topsoil, some sand		AU	2										
	1.22	SS	3	33	14	1	61.61						
BEDROCK: Weathered grey limestone	1.40												
End of Borehole													
Practical refusal to augering at 1.40m depth.													

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

DATUM Geodetic

FILE NO. **PG5744**

REMARKS

HOLE NO. **BH 5-21**

BORINGS BY Track-Mount Power Auger

DATE April 20, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
								20	40	60	80		
<b>GROUND SURFACE</b>													
Asphaltic concrete	0.08	AU	1			0	62.16						
<b>FILL:</b> Brown silty sand with crushed stone		AU	2										
- some topsoil, trace clay and rock fragments by 0.8m depth	1.14	SS	3	25	31	1	61.16						
<b>BEDROCK:</b> Weathered grey limestone	1.45												
End of Borehole													
Practical refusal to augering at 1.45m depth.													

20 40 60 80 100  
**Shear Strength (kPa)**  
▲ Undisturbed    △ Remoulded

DATUM Geodetic




FILE NO. **PG5744**

REMARKS

HOLE NO. **BH 6-21**

BORINGS BY Track-Mount Power Auger

DATE April 21, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Monitoring Well Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
GROUND SURFACE								20	40	60	80	
Asphaltic concrete 0.08		AU	1			0	62.44					
FILL: Brown silty sand with crushed stone 0.84		SS	2	8	50+							
BEDROCK: Weathered, grey limestone 0.91												
End of Borehole												
Practical refusal to augering at 0.91m depth.												

20 40 60 80 100  
Shear Strength (kPa)  
▲ Undisturbed    △ Remoulded

# SYMBOLS AND TERMS

## SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)
Very Soft	<12
Soft	12-25
Firm	25-50
Stiff	50-100
Very Stiff	100-200
Hard	>200

## SYMBOLS AND TERMS (continued)

### SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their "sensitivity". The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

### ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called "mechanical breaks") are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

### SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.



## SYMBOLS AND TERMS (continued)

### GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D_{30})^2 / (D_{10} \times D_{60})$
Cu	-	Uniformity coefficient = $D_{60} / D_{10}$

Cc and Cu are used to assess the grading of sands and gravels:

Well-graded gravels have:  $1 < Cc < 3$  and  $Cu > 4$

Well-graded sands have:  $1 < Cc < 3$  and  $Cu > 6$

Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.

Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

### CONSOLIDATION TEST

$p'_o$	-	Present effective overburden pressure at sample depth
$p'_c$	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below $p'_c$ )
Cc	-	Compression index (in effect at pressures above $p'_c$ )
OC Ratio		Overconsolidation ratio = $p'_c / p'_o$
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

### PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.
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## SYMBOLS AND TERMS (continued)

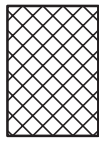
### STRATA PLOT



Topsoil



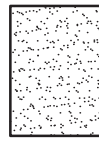
Asphalt



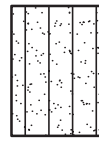
Fill



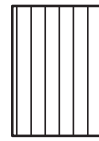
Peat



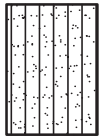
Sand



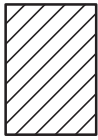
Silty Sand



Silt



Sandy Silt



Clay



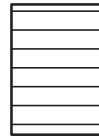
Silty Clay



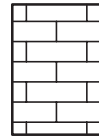
Clayey Silty Sand



Glacial Till



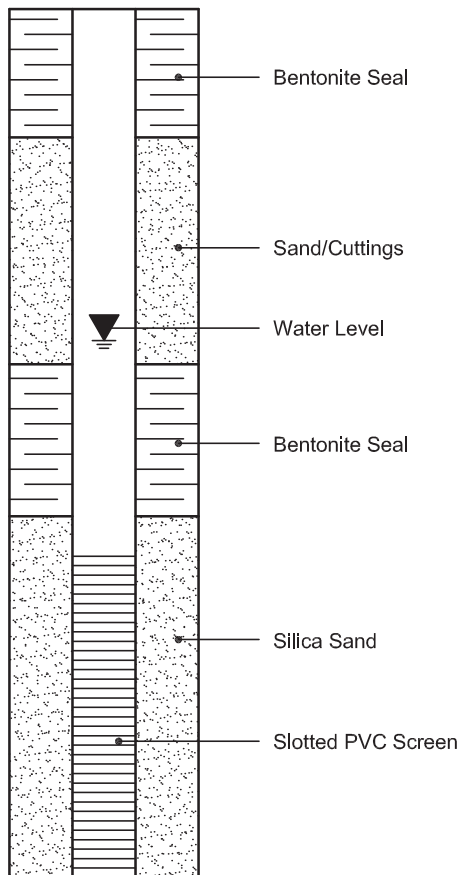
Shale



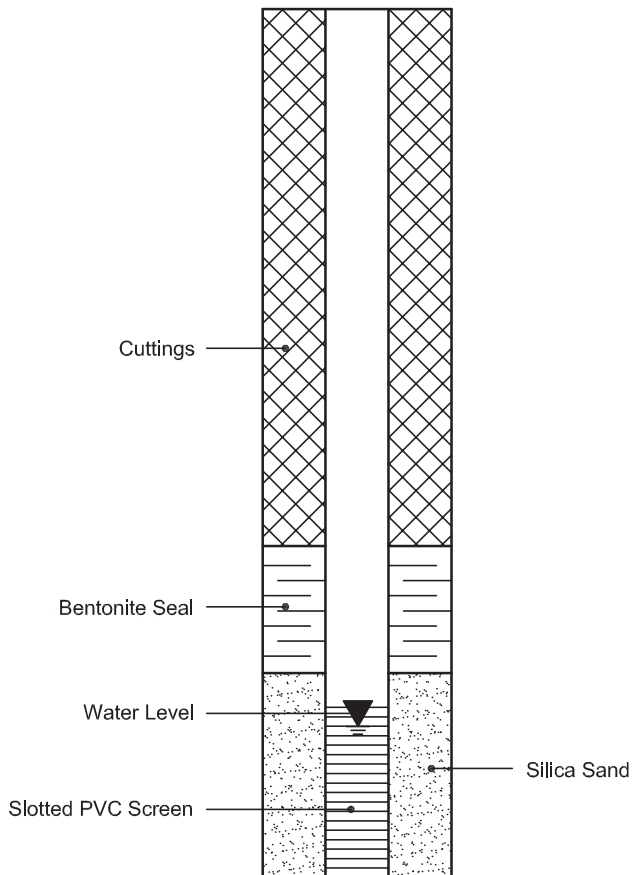
Bedrock

### MONITORING WELL AND PIEZOMETER CONSTRUCTION

#### MONITORING WELL CONSTRUCTION



#### PIEZOMETER CONSTRUCTION





**Pinchin Ltd.**  
555 Legget Drive, Suite 1001  
Kanata, Ontario

## Stratigraphic and Instrumentation Log: MW-1

<b>Project No.:</b> 111021.002	<b>Logged By:</b> RML
<b>Project:</b> Phase II ESA	<b>Entered By:</b> RML
<b>Client:</b> CIBC Corporate Real Estate	<b>Project Manager:</b> FD
<b>Location:</b> 829 Carling Ave, Ottawa, ON	<b>Drill Date:</b> April 15, 2016

SUBSURFACE PROFILE				SAMPLE					Well Completion Details	Vapour Data	
Depth	Symbol	Description	Depth (m)	Number	Type	Sample	N-Value	Recovery (%)		( % LEL )	( ppm )
ft m										■ 20 40 60 80 ■	● 250 750 1250 ●
0		Ground Surface	0.0								
1		<b>ASPHALT</b>									
2		<b>SANDY GRAVEL FILL</b> Brown, moist, no odour		1	SS		NA	50			
3											
4				2	SS		NA	50		Sample submitted for analysis of PHC, VOC and PH.	
5		<b>LIMESTONE BEDROCK</b>	4.5								
6											
7											
8											
9											
10											
11											
12											
13											
14											
15		End of Borehole	4.6							Water level measured at 3.45 mbgs on April 18, 2016.	
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
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9/8/2016 4:11:22 PM

**Drilled By:** Strata Drilling Group  
**Drill Method:** Geo-Machine  
**Vapour Instrument:** Photoionization Detector  
**Well Casing Size:** 38mm

**Datum:** NA  
**Casing Elevation:** NM  
**Ground Elevation:** NM  
**Sheet:** 1 of 1



**Pinchin Ltd.**  
555 Legget Drive, Suite 1001  
Kanata, Ontario

## Stratigraphic and Instrumentation Log: MW-2

<b>Project No.:</b> 111021.002	<b>Logged By:</b> RML
<b>Project:</b> Phase II ESA	<b>Entered By:</b> RML
<b>Client:</b> CIBC Corporate Real Estate	<b>Project Manager:</b> FD
<b>Location:</b> 829 Carling Ave, Ottawa, ON	<b>Drill Date:</b> April 15, 2016

SUBSURFACE PROFILE				SAMPLE					Well Completion Details	Vapour Data		
Depth	Symbol	Description	Depth (m)	Number	Type	Sample	N-Value	Recovery (%)		( % LEL )	(ppm)	(ppm)
ft m										20 40 60 80	250 750 1250	250 750 1250
0		Ground Surface	0.0									
1	[Symbol]	<b>ASPHALT</b>										
2	[Symbol]	<b>SANDY GRAVEL FILL</b> Brown, moist, no odour		1	SS	[Symbol]	NA	50				
3	[Symbol]			2	SS	[Symbol]	NA	50				
4	[Symbol]	<b>LIMESTONE BEDROCK</b>	1.2									
5	[Symbol]											
6	[Symbol]											
7	[Symbol]											
8	[Symbol]											
9	[Symbol]											
10	[Symbol]											
11	[Symbol]											
12	[Symbol]											
13	[Symbol]											
14	[Symbol]											
15	[Symbol]											
16	[Symbol]											
17	[Symbol]											
18	[Symbol]											
19	[Symbol]											
20	[Symbol]											
21	[Symbol]	End of Borehole	6.1									
22	[Symbol]											
23	[Symbol]											
24	[Symbol]											
25	[Symbol]											
26	[Symbol]											
27	[Symbol]											
28	[Symbol]											
29	[Symbol]											
30	[Symbol]											

Sample submitted for analysis of PHC and VOC.

Water level measured at 4.75 mbgs on April 18, 2016.

CONFIDENTIAL  
 Downloaded by:  
 Joanne Panno  
 Metrus Properties Limited  
 CIBC National Banking Centre Portfolio  
 9/8/2016 4:11:22 PM

**Drilled By:** Strata Drilling Group  
**Drill Method:** Geo-Machine  
**Vapour Instrument:** Photoionization Detector  
**Well Casing Size:** 38mm

**Datum:** NA  
**Casing Elevation:** NM  
**Ground Elevation:** NM  
**Sheet:** 1 of 1



**Pinchin Ltd.**  
555 Legget Drive, Suite 1001  
Kanata, Ontario

### Stratigraphic and Instrumentation Log: MW-3

<b>Project No.:</b> 111021.002	<b>Logged By:</b> RML
<b>Project:</b> Phase II ESA	<b>Entered By:</b> RML
<b>Client:</b> CIBC Corporate Real Estate	<b>Project Manager:</b> FD
<b>Location:</b> 829 Carling Ave, Ottawa, ON	<b>Drill Date:</b> April 15, 2016

SUBSURFACE PROFILE				SAMPLE					Well Completion Details	Vapour Data	
Depth	Symbol	Description	Depth (m)	Number	Type	Sample	N-Value	Recovery (%)		(% LEL)	(ppm)
0		Ground Surface	0.0								
0	■	<b>ASPHALT</b>									
1	●	<b>SANDY GRAVEL FILL</b> Brown, moist, no odour		1	SS		NA	50			
2											
3	■			2	SS		NA	50			
4	■	<b>LIMESTONE BEDROCK</b>	1.2								
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
		End of Borehole	7.6								

CONFIDENTIAL  
 Downloaded by:  
 Joanne Panno  
 Metrus Properties Limited  
 CIBC National Banking Centre Portfolio  
 9/8/2016 4:11:22 PM

Sample submitted for analysis of PHC, VOC and PH.

Note: Monitoring well dry on April 18, 2016

**Drilled By:** Strata Drilling Group  
**Drill Method:** Geo-Machine  
**Vapour Instrument:** Photoionization Detector  
**Well Casing Size:** 38mm

**Datum:** NA  
**Casing Elevation:** NM  
**Ground Elevation:** NM  
**Sheet:** 1 of 1

CLIENT:	<b>Claridge Homes</b>	FILE No.:	<b>PG5744</b>
PROJECT:	829 Carling Ave.	REPORT No.:	1
SITE ADDRESS	<b>Proposed High-Rise Building</b>	DATE REPT'D:	27-Apr-21
STRUCTURE TYPE & LOCATION:	Bedrock		

**SAMPLE INFORAMTION**

LAB NO.:	24013	24014	24015
SAMPLE NO.:	BH1-21 RC14	BH2-21 RC14	BH3-21 RC14
DEPTH:	69'-5" to 69'-9"	67'-5" to 67'-9"	67'-10" to 68'-2"

**SAMPLE DATES**

DATE CORED	April 21st - 22nd	April 21st - 22nd	April 21st - 22nd
DATE RECEIVED	22-Apr-21	22-Apr-21	22-Apr-21
DATE TESTED	27-Apr-21	27-Apr-21	27-Apr-21

**SAMPLE DIMENSIONS**



AVERAGE DIAMETER (mm)	48.00	48.00	48.00
HEIGHT (mm)	95.00	95.00	95.00
WEIGHT (g)	460	460	440
AREA (mm <sup>2</sup> )	1810	1810	1810
VOLUME (cm <sup>3</sup> )	172	172	172
<b>UNIT WEIGHT (kg/m<sup>3</sup>)</b>	<b>2676</b>	<b>2676</b>	<b>2560</b>

**TEST RESULTS**

H / D RATIO	1.98	1.98	1.98
CORRECTION FACTOR	0.997	0.997	0.997
LOAD (lbs)	6402	4663	4713
GROSS Mpa	15.7	11.5	11.6
<b>MPa CORRECTED</b>	<b>15.7</b>	<b>11.4</b>	<b>11.6</b>
FORM OF BREAK	<b>TYPE A</b>	<b>TYPE A</b>	<b>TYPE A</b>
DIRECTION OF LOADING	PARALLEL	PARALLEL	PARALLEL

**REMARKS**


**TECHNICAL PERSONNEL**

TECHNICIAN:	VERIFIED BY:	<b>C. Beadow</b>	APPROVED BY:	<b>Joe Forsyth, P. Eng.</b>
				

**CERTIFIED LAB**

John D. Paterson & Associates Ltd., 28 Concourse Gate, Nepean, ON

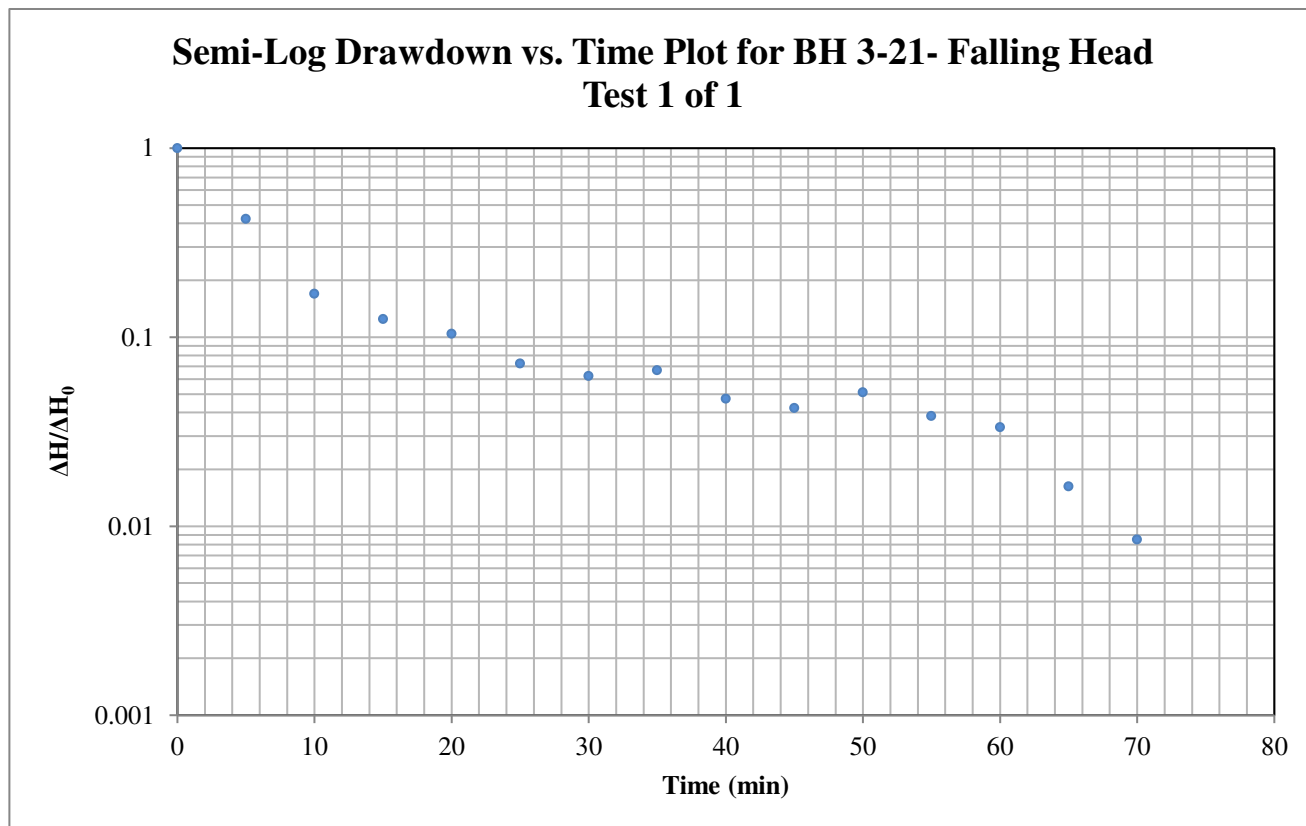
**Hvorslev Hydraulic Conductivity Analysis**

Project: Claridge Homes - 829 Carling Avenue

Test Location: BH 3-21

Test: 1 of 1 Rising Head

Date: April 28, 2021



Hvorslev Horizontal Hydraulic Conductivity

Hvorslev Shape Factor

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L >> D

Hvorslev Shape Factor F: 3.59613

Well Parameters:

L	3 m	Saturated length of screen or open hole
D	0.03175 m	Diameter of well
r <sub>c</sub>	0.01588 m	Radius of well

Data Points (from plot):

t*:	6.057 minutes	ΔH*/ΔH <sub>0</sub> :	0.37
-----	---------------	-----------------------	------

<b>Horizontal Hydraulic Conductivity</b>
<b>K = 6.02E-07 m/sec</b>

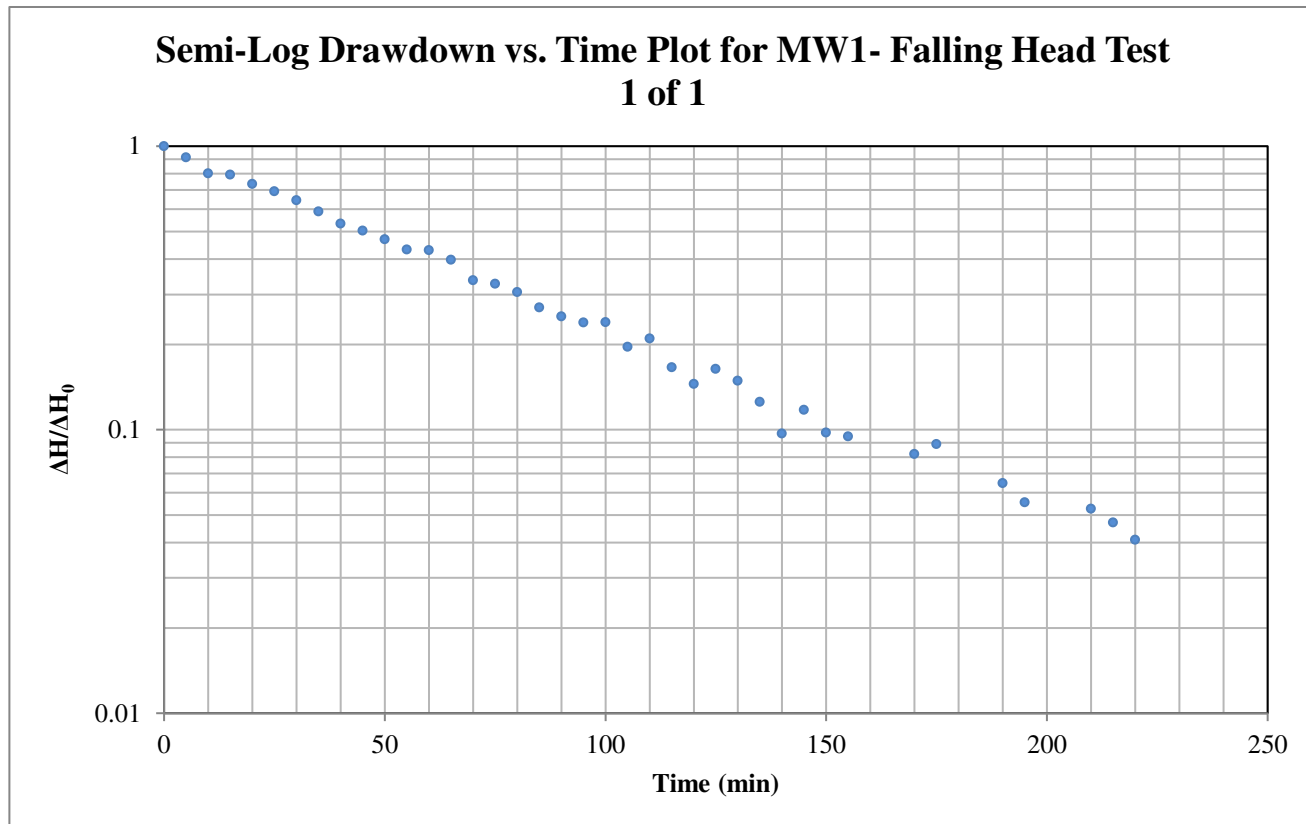
**Hvorslev Hydraulic Conductivity Analysis**

Project: Claridge Homes - 829 Carling Avenue

Test Location: MW1

Test: 1 of 1 Falling Head Test

Date: April 27, 2021



Hvorslev Horizontal Hydraulic Conductivity

Hvorslev Shape Factor

$$K = \frac{\pi r_c^2}{F t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for  $L \gg D$

Hvorslev Shape Factor F: 2.80425

Well Parameters:

L	2.1 m	Saturated length of screen or open hole
D	0.038 m	Diameter of well
r <sub>c</sub>	0.019 m	Radius of well

Data Points (from plot):

t\*: 67.273 minutes      ΔH\*/ΔH₀: 0.37

<b>Horizontal Hydraulic Conductivity</b>
<b>K = 9.96E-08 m/sec</b>



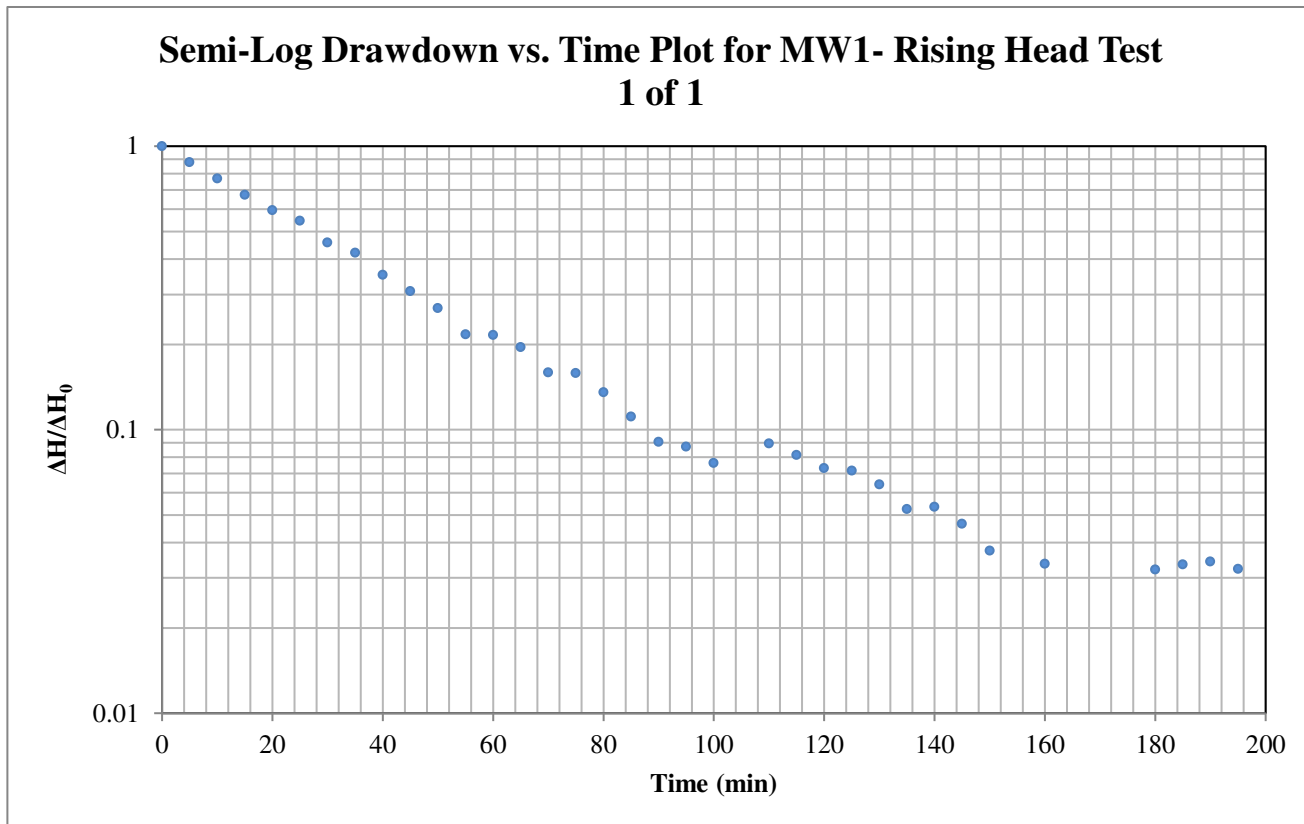
**Hvorslev Hydraulic Conductivity Analysis**

Project: Claridge Homes - 829 Carling Avenue

Test Location: MW1

Test: 1 of 1 Rising Head

Date: April 28, 2021



Hvorslev Horizontal Hydraulic Conductivity

Hvorslev Shape Factor

$$K = \frac{\pi r_c^2}{F t^*} \frac{1}{\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)}$$

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L >> D

Hvorslev Shape Factor F: 2.80425

Well Parameters:

L	2.1 m	Saturated length of screen or open hole
D	0.038 m	Diameter of well
r <sub>c</sub>	0.019 m	Radius of well

Data Points (from plot):

t\*: 38.700 minutes                      ΔH\*/ΔH₀: 0.37

<b>Horizontal Hydraulic Conductivity</b>
<b>K = 1.73E-07 m/sec</b>

Certificate of Analysis

Report Date: 27-Apr-2021

Client: Paterson Group Consulting Engineers

Order Date: 22-Apr-2021

Client PO: 29754

Project Description: PG5744

<b>Client ID:</b>	BH2-21 SS3	-	-	-
<b>Sample Date:</b>	21-Apr-21 09:00	-	-	-
<b>Sample ID:</b>	2117544-01	-	-	-
<b>MDL/Units</b>	Soil	-	-	-

**Physical Characteristics**

% Solids	0.1 % by Wt.	90.4	-	-	-
----------	--------------	------	---	---	---

**General Inorganics**

pH	0.05 pH Units	10.09	-	-	-
Resistivity	0.10 Ohm.m	13.5	-	-	-

**Anions**

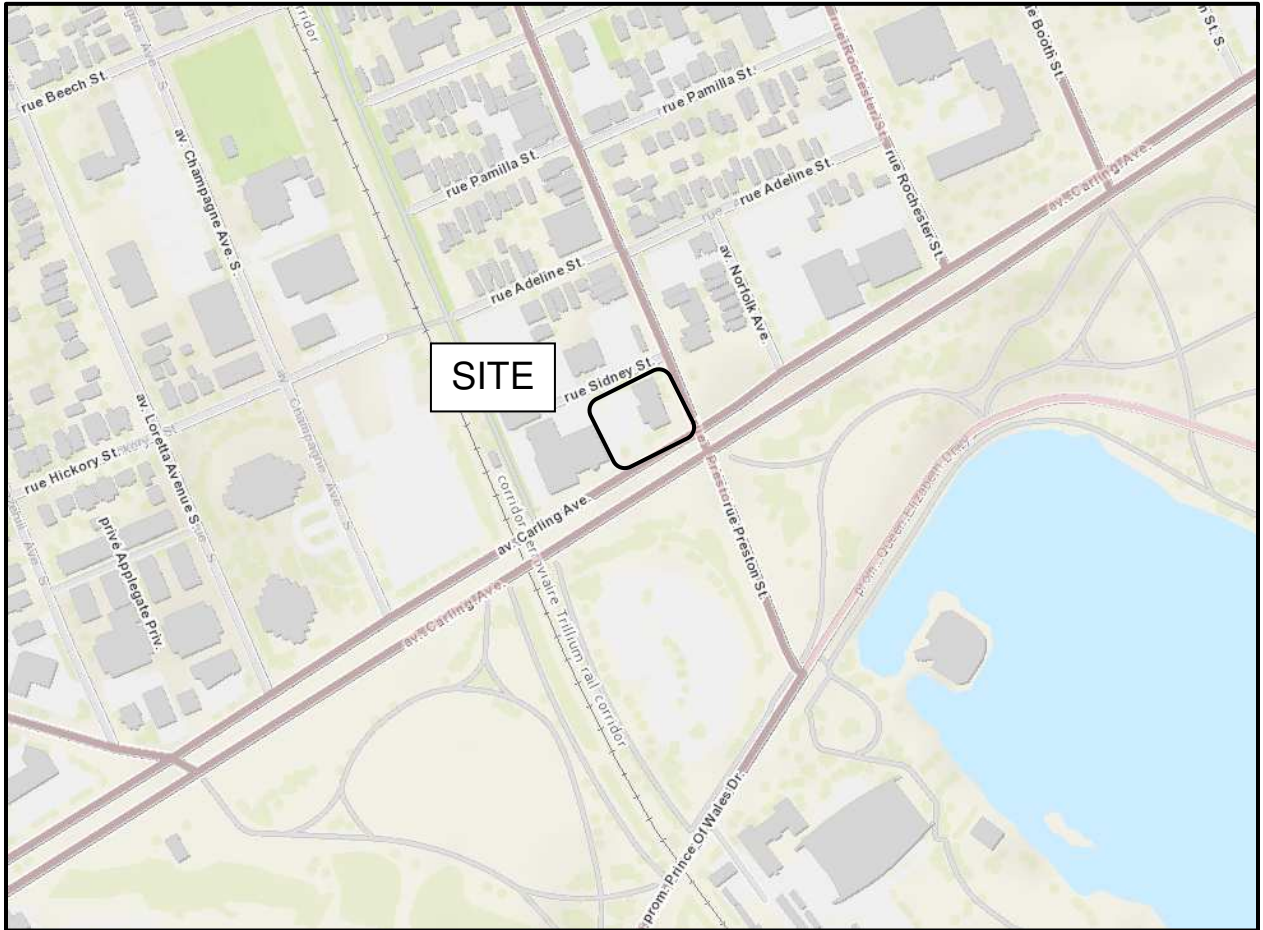
Chloride	5 ug/g dry	133	-	-	-
Sulphate	5 ug/g dry	433	-	-	-

# **APPENDIX 2**

**FIGURE 1 - KEY PLAN**

**FIGURES 2 TO 3 - SHEAR WAVE VELOCITY PROFILES**

**DRAWING PG5744-1 - TEST HOLE LOCATION PLAN**



# FIGURE 1

## KEY PLAN

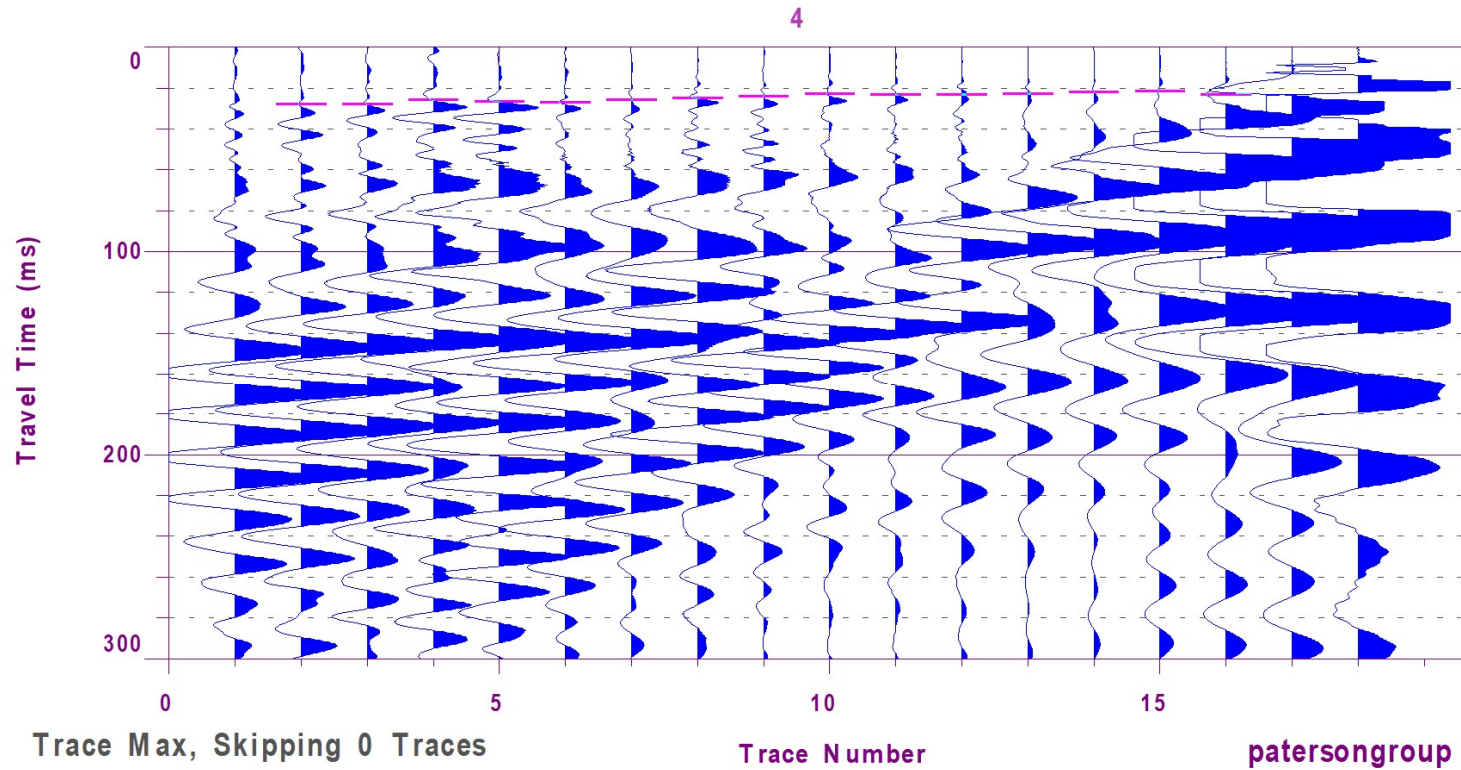


Figure 2 – Shear Wave Velocity Profile at Shot Location 18 m

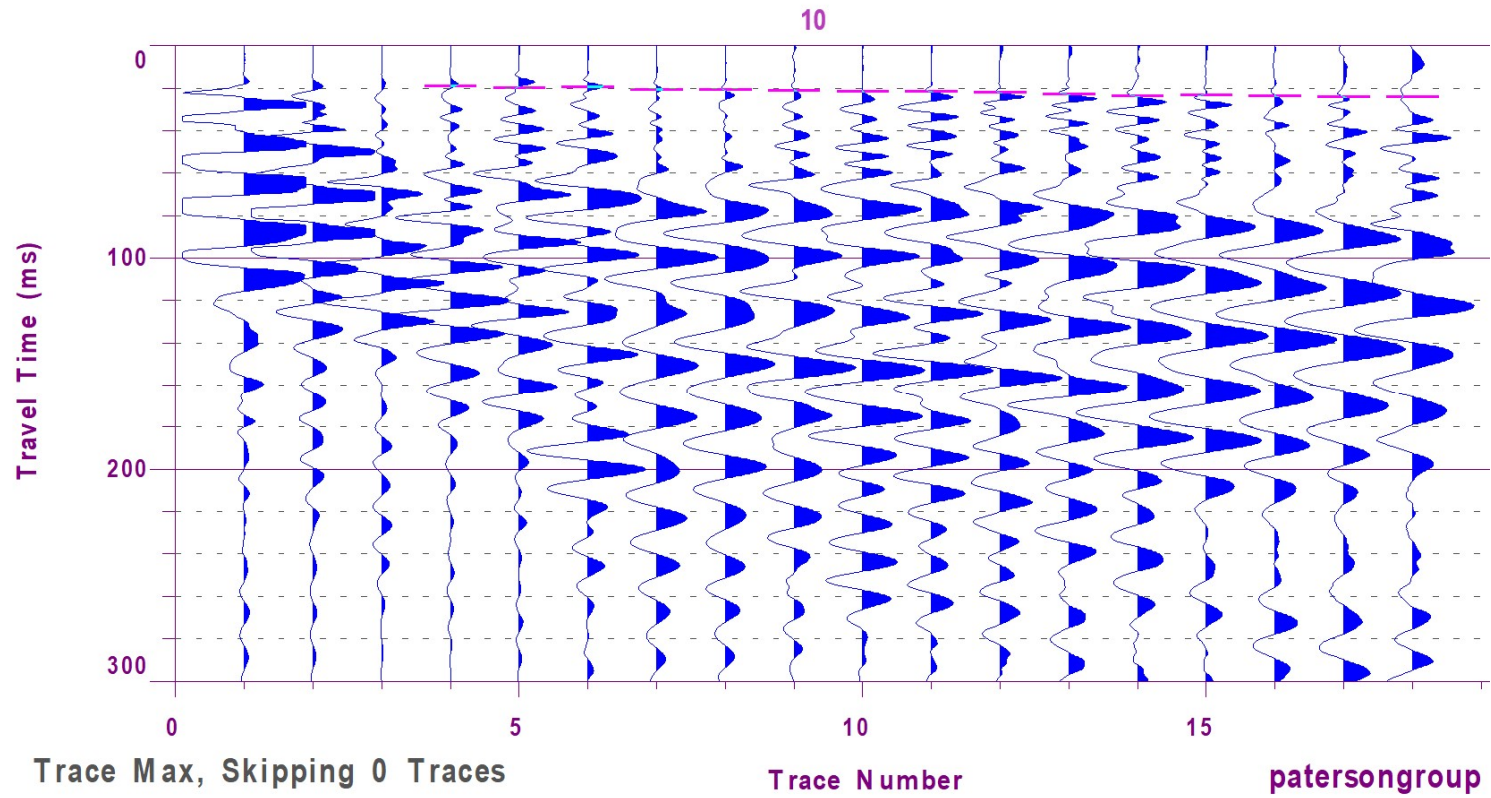
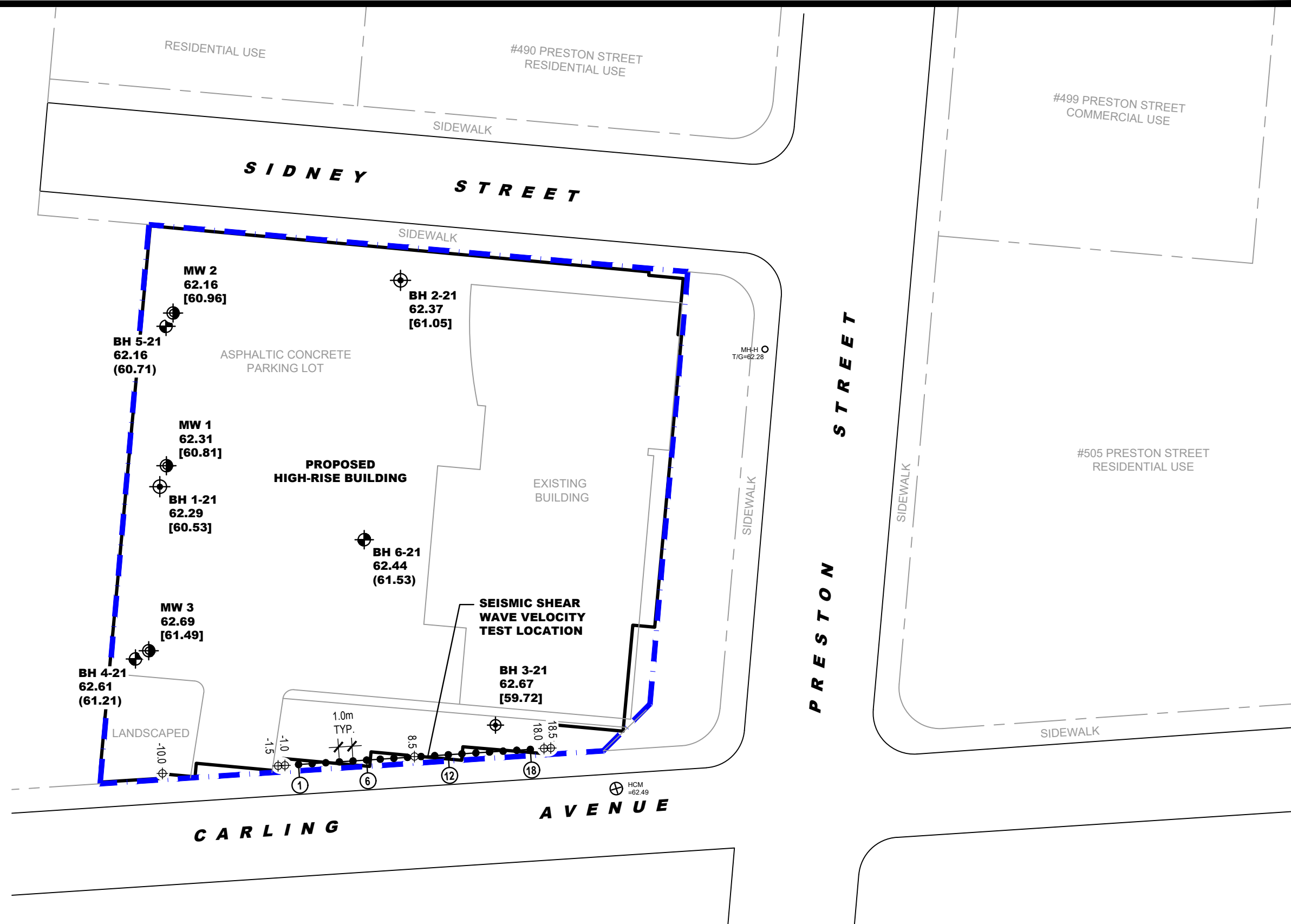
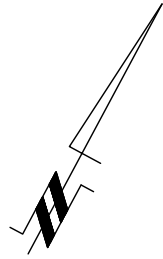


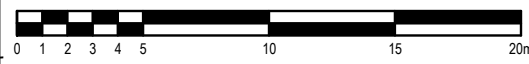
Figure 3 – Shear Wave Velocity Profile at Shot Location -1.5 m



**LEGEND:**

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- MONITORING WELL LOCATION BY OTHERS (PINCHIN LTD., APRIL 2016)
- 62.61 GROUND SURFACE ELEVATION (m)
- [61.39] BEDROCK SURFACE ELEVATION (m)
- (61.21) PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
- GEOPHONE LOCATION
- GEOPHONE LOCATION
- SHOT LOCATION

SCALE: 1:300



**patersongroup**  
consulting engineers

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Ottawa, Ontario K2E 7J5  
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

**CLARIDGE HOMES**  
**GEOTECHNICAL INVESTIGATION**  
**PROPOSED HIGH-RISE BUILDING - 829 CARLING AVENUE**

OTTAWA, ONTARIO

**TEST HOLE LOCATION PLAN**

Scale:	1:300	Date:	04/2021
Drawn by:	JM	Report No.:	PG5744-1
Checked by:	SD	Dwg. No.:	<b>PG5744-1</b>
Approved by:	DJG	Revision No.:	

# **APPENDIX C**

**Transportation Noise Assessment  
prepared by Gradient Wind Engineers & Scientists  
dated April 14, 2021**



**TRANSPORTATION NOISE  
ASSESSMENT**

829 Carling Avenue  
Ottawa, Ontario

REPORT: 21-086 – Transportation Noise



April 14, 2021

PREPARED FOR  
Claridge Homes  
210 Gladstone Avenue  
Ottawa, ON K2P 0Y6

PREPARED BY  
Giuseppe Garro, M.A.Sc., Junior Environmental Scientist  
Joshua Foster, P.Eng., Principal

## EXECUTIVE SUMMARY

This report describes a transportation noise assessment undertaken to satisfy the requirements for concurrent Zoning By-law Amendment (ZBA) and Site Plan Control (SPC) application submissions for the proposed mixed-use tall building development located at 829 Carling Avenue in Ottawa, Ontario. The proposed development comprises 61-stories, including a mechanical level, situated on a nearly square parcel of land at the northwest corner of the Preston Street and Carling Avenue intersection. The primary sources of transportation noise include Carling Avenue, Preston Street, and the O-Train Line 2 (Trillium Line) light rail. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) architectural drawings provided by Hariri Pontarini Architects in March 2021.

The results of the current analysis indicate that noise levels will range between 49 and 74 dBA during the daytime period (07:00-23:00) and between 57 and 66 dBA during the nighttime period (23:00-07:00). The highest noise level (74 dBA) occurs at the south façade, which is nearest and most exposed to Carling Avenue. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. Warning Clauses will also be required on all Lease, Purchase and Sale Agreements, as summarized in Section 6 of this report.

Noise levels at the Level 8 amenity terrace areas (Receptors 10 and 11) are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise mitigating impact of raising the perimeter guards to 1.8 m above the walking surface. Results of the investigation proved that noise levels



can be reduced to 54 dBA. Therefore, it is advised that the barrier be raised 1.8 m above the walking surface.

With regard to stationary noise impacts, noise levels on the surrounding noise sensitive properties are expected to be negligible as the mechanical equipment will primarily reside in the mechanical level located on the high roof. A stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise sensitive areas. The assessment will also include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. In the event that noise levels exceed ENCG criteria, noise impacts can generally be minimized by judicious selection and placement of the equipment.



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**Appendix A – STAMSON 5.04 Input and Output Data and Supporting Information**



## 1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Claridge Homes to undertake a transportation noise assessment to satisfy the requirements for concurrent Zoning By-law Amendment (ZBA) and Site Plan Control (SPC) application submissions for the proposed mixed-use tall building development located at 829 Carling Avenue in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to the assessment of exterior and interior noise levels generated by local roadway traffic.

Our work is based on theoretical noise calculation methods conforming to the City of Ottawa<sup>1</sup> and Ministry of the Environment, Conservation and Parks (MECP)<sup>2</sup> guidelines. Noise calculations were based on architectural drawings provided by Hariri Pontarini Architects in March 2021, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

## 2. TERMS OF REFERENCE

The focus of this transportation noise assessment is a proposed mixed-use building development located at 829 Carling Avenue in Ottawa, Ontario. The proposed development comprises a 61-storey mixed-use residential building situated on a nearly square parcel of land at the northwest corner of the Preston Street and Carling Avenue intersection. The site is bounded by Sidney Street to the north, Preston Street to the east, Carling Avenue to the south, and a low-rise commercial building to the west.



*Architectural Rendering, Southeast Perspective  
(Courtesy of Hariri Pontarini Architects)*

At Level 1, the floorplan includes retail spaces at the northeast corner with access from Preston Street and the southwest corner from Carling Avenue. The main residential entrance is located at the southeast

---

<sup>1</sup> City of Ottawa Environmental Noise Control Guidelines, January 2016

<sup>2</sup> Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013



corner of the building fronting Preston Street. Access to six levels of below-grade parking and six levels of above-grade parking (Levels 2-7, inclusive) is provided at the northwest corner of the floorplan from Sidney Street.

At Level 8, the tall building steps back from west and north perimeters to accommodate an outdoor common amenity terrace. Indoor amenities at Level 8 include a movie theatre, party rooms, a game room, exercise areas, and a swimming pool. The swimming pool resides in a building along the west elevation of the podium that rises approximately 1.5 storeys above Level 8 and includes an outdoor common amenity terrace on the roof deck. The tower rises from Levels 9-21 with a common floorplate. At Level 21, the tower steps back from the west elevation to accommodate a terrace area and continues to Level 47 with a common floorplate. At Level 47, the tower again steps back from the west elevation to accommodate a terrace area and continues to the upper roof with a common floorplate.

Balconies/terraces extending less than 4 metres (m) in depth from the façade do not require consideration as Outdoor Living Areas (OLA) as mentioned in the ENCG. The primary sources of transportation noise include Carling Avenue, Preston Street, and the O-Train Line 2 (Trillium Line) light rail transit (LRT) system. Figure 1 illustrates a complete site plan with surrounding context.

The development is surrounded by low-rise buildings from the southwest clockwise to north-northeast, mid- and high-rise buildings to the east-northeast, and open land for the remaining compass azimuth. An existing condominium building is located to the immediate northwest (7 Sidney Street), a 31-storey mixed-use residential building under construction to the immediate north (SoHo Italia at 500 Preston Street), and an existing 45-storey residential building to the immediate east-northeast (ICON I at 505 Preston Street). The existing/proposed buildings are serviced by standard HVAC equipment primarily located in a mechanical penthouse/level. Therefore, these buildings are expected to be in compliance with ENCG noise guidelines as they would have required their own stationary noise assessment prior to construction. With that notion, in addition to the set-back distance from the existing nearby HVAC equipment and the proposed development, stationary noise impacts from nearby existing properties are expected to be negligible.

### **3. OBJECTIVES**

The principal objectives of this study are to (i) calculate the future noise levels on the study building produced by local roadway traffic, and (ii) ensure that interior and exterior noise levels do not exceed the allowable limits specified by the City of Ottawa’s Environmental Noise Control Guidelines as outlined in Section 4.2 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 ( $2 \times 10^{-5}$  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 Transportation Noise**

##### **4.2.1 Criteria for Transportation Noise**

For surface roadway traffic noise, 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 roadways, 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 residential buildings. The City of Ottawa’s Environmental Noise Control Guidelines (ENCG) specifies that the recommended indoor noise limit range (that is relevant to this study) is 50, 45 and 40 dBA for office and reception areas, living rooms, and sleeping quarters, respectively, as listed in Table 1.

**TABLE 1: INDOOR SOUND LEVEL CRITERIA (ROAD)<sup>3</sup>**

Type of Space	Time Period	L <sub>eq</sub> (dBA)
General <b>offices, reception areas</b> , retail stores, etc.	07:00 – 23:00	50
Living/dining/den areas of <b>residences</b> , 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
Sleeping quarters of hotels/motels	23:00 – 07:00	45
Sleeping quarters of <b>residences</b> , hospitals, nursing/retirement homes, etc.	23:00 – 07:00	40

Predicted noise levels at the plane of window (POW) dictate the action required to achieve the recommended sound levels. An open window is considered to provide a 10 dBA reduction in noise, while a standard closed window is capable of providing a minimum 20 dBA noise reduction<sup>4</sup>. A closed window due to a ventilation requirement will bring noise levels down to achieve an acceptable indoor environment<sup>5</sup>. Therefore, where noise levels exceed 55 dBA daytime and 50 dBA nighttime, the ventilation for the building should consider the need for having windows and doors closed, which triggers the need for forced air heating with provision for central air conditioning. Where noise levels exceed 65 dBA daytime and 60 dBA nighttime, air conditioning will be required and building components will require higher levels of sound attenuation<sup>6</sup>.

The sound level criterion for outdoor living areas (OLA) is 55 dBA, which applies during the daytime (07:00 to 23:00). When noise levels exceed 55 dBA, mitigation should be provided to reduce noise levels where technically and administratively feasible to acceptable levels at or below the criterion. Furthermore, noise levels at the OLA must not exceed 60 dBA if mitigation can be technically and administratively achieved.

<sup>3</sup> Adapted from ENCG 2016 – Tables 2.2b and 2.2c

<sup>4</sup> Burberry, P.B. (2014). Mitchell’s Environment and Services. Routledge, Page 125

<sup>5</sup> MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.8

<sup>6</sup> MOECP, Environmental Noise Guidelines, NPC 300 – Part C, Section 7.1.3





## 4.2.2 Theoretical Transportation Noise Predictions

Noise predictions were performed with the aid of the MECP computerized noise assessment program, STAMSON 5.04, for road analysis. Appendix A includes the STAMSON 5.04 input and output data.

Roadway and LRT traffic noise calculations were performed by treating each roadway segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 2, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions.
- The day/night split for all streets was taken to be 92%/8%, respectively.
- Ground surfaces were taken to be reflective due to the presence of hard (paved) ground.
- Topography was assumed to be a flat/gentle slope surrounding the study building.
- A difference in elevation for the LRT was measured to be approximately 7 meters below grade.
- For select sources where appropriate, receptors considered the existing and the proposed buildings as a barrier partially or fully obstructing exposure to the source as illustrated by exposure angles in Figures 4-7.
- Noise receptors were strategically placed at 13 locations around the study area (see Figure 2).
- Receptor distances and exposure angles are illustrated in Figures 4-7.

## 4.2.3 Transportation Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan<sup>7</sup> which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. Table 2 (below) summarizes the AADT values used for each roadway included in this assessment.

---

<sup>7</sup> City of Ottawa Transportation Master Plan, November 2013

**TABLE 2: TRANSPORTATION TRAFFIC DATA**

Segment	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes
Carling Avenue	6-Lane Urban Arterial Divided	60	<b>50,000</b>
Preston Street	2-Lane Urban Arterial Undivided	50	<b>15,000</b>
O-Train Line 2	Light Rail Transit	50	<b>192/24*</b>

\*Daytime/Nighttime volumes based on the City of Ottawa’s Environmental Assessment for the LRT Project

### 4.3 Indoor Noise Calculations

The difference between outdoor and indoor noise levels is the noise attenuation provided by the building envelope. According to common industry practice, complete walls and individual wall elements are rated according to the Sound Transmission Class (STC). The STC ratings of common residential walls built in conformance with the Ontario Building Code (2012) typically exceed STC 35, depending on exterior cladding, thickness and interior finish details. For example, brick veneer walls can achieve STC 50 or more. Standard commercially sided exterior metal stud walls have around STC 45. Standard good quality double-glazed non-operable windows can have STC ratings ranging from 25 to 40, depending on the window manufacturer, pane thickness and inter-pane spacing. As previously mentioned, the windows are the known weak point in a partition.

As per Section 4.2, when daytime noise levels from road sources at the plane of the window exceed 65 dBA, calculations must be performed to evaluate the sound transmission quality of the building components to ensure acceptable indoor noise levels. The calculation procedure<sup>8</sup> considers:

- Window type and total area as a percentage of total room floor area
- Exterior wall type and total area as a percentage of the total room floor area
- Acoustic absorption characteristics of the room
- Outdoor noise source type and approach geometry
- Indoor sound level criteria, which varies according to the intended use of a space

<sup>8</sup> Building Practice Note: Controlling Sound Transmission into Buildings by J.D. Quirt, National Research Council of Canada, September 1985

Based on published research<sup>9</sup>, exterior walls possess specific sound attenuation characteristics that are used as a basis for calculating the required STC ratings of windows in the same partition. Due to the limited information available at the time of the study, which was prepared for a Site Plan Control (SPC) application, detailed floor layouts and building elevations have not been finalized; therefore, detailed STC calculations could not be performed at this time. As a guideline, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels).

## 5. RESULTS AND DISCUSSION

### 5.1 Transportation Traffic Noise Levels

The results of the transportation noise calculations are summarized in Table 3 below. A complete set of input and output data from all STAMSON 5.04 calculations are available in Appendix A.

**TABLE 3: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC**

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	
			Day	Night
1	95.6	POW – 30 <sup>th</sup> Floor – East Façade	72	65
2	186.5	POW – 60 <sup>th</sup> Floor – East Façade	72	65
3	95.6	POW – 30 <sup>th</sup> Floor – South Façade	74	66
4	186.5	POW – 60 <sup>th</sup> Floor – South Façade	74	66
5	95.6	POW – 30 <sup>th</sup> Floor – North Façade	65	57
6	186.5	POW – 60 <sup>th</sup> Floor – North Façade	65	57
7	20	POW – 7 <sup>th</sup> Floor – West Façade	70	62
8	95.6	POW – 30 <sup>th</sup> Floor – West Façade	70	62
9	186.5	POW – 60 <sup>th</sup> Floor – West Façade	69	62
10	25.8	OLA – 8 <sup>th</sup> Floor Southwest Amenity Area	58	N/A*
11	25.8	OLA – 8 <sup>th</sup> Floor Northwest Amenity Area	57	N/A*
12	31.1	OLA – 9 <sup>th</sup> Floor West Amenity Area	55	N/A*
13	147.2	OLA – 47 <sup>th</sup> Floor West Amenity Area	49	N/A*

\*Noise levels at an OLA during the nighttime period are not considered as per ENCG

<sup>9</sup> CMHC, Road & Rail Noise: Effects on Housing



The results of the current analysis indicate that noise levels will range between 49 and 74 dBA during the daytime period (07:00-23:00) and between 57 and 66 dBA during the nighttime period (23:00-07:00). The highest noise level (74 dBA) occurs at the south façade, which is nearest and most exposed to Carling Avenue. As noise levels at the Level 8 amenity terrace areas exceed 55 dBA, noise mitigation is required.

## 5.2 Noise Control Measures

The noise levels predicted due to roadway and LRT traffic exceed the criteria listed in Section 4.2 for building components. As discussed in Section 4.3, the anticipated STC requirements for windows have been estimated based on the overall noise reduction required for each intended use of space (STC = outdoor noise level – targeted indoor noise levels). As per city of Ottawa requirements, detailed STC calculations will be required to be completed prior to building permit application for each unit type. The STC requirements for the windows are summarized below for various units within the development (see Figure 3):

- **Bedroom Windows**
  - (i) Bedroom windows facing east and south will require a minimum STC of 37.
  - (ii) Bedroom windows facing west will require a minimum STC of 33.
  - (iii) All other bedroom windows are to satisfy Ontario Building Code (OBC 2012) requirements.
  
- **Living Room Windows**
  - (i) Living room windows facing east and south will require a minimum STC of 32.
  - (ii) Living room windows facing west will require a minimum STC of 28.
  - (iii) All other living room windows are to satisfy Ontario Building Code (OBC 2012) requirements.
  
- **Office/Amenity/Reception Area Windows**
  - (i) Office/amenity/reception area windows facing east and south will require a minimum STC of 27.
  - (ii) Office/amenity/reception area windows facing west will require a minimum STC of 23.
  - (iii) All other office/amenity/reception area windows are to satisfy Ontario Building Code (OBC 2012) requirements.

- **Exterior Walls**

- (i) Exterior wall components on the south, west, and east façades will require a minimum STC of 45, which will be achieved with brick cladding or an acoustical equivalent according to NRC test data<sup>10</sup>.

The STC requirements apply to windows, doors, spandrel panels and curtainwall elements. Exterior wall components on these façades are recommended to have a minimum STC of 45, where a punch window and wall system may be used. A review of window supplier literature indicates that the specified STC ratings can be achieved by a variety of window systems having a combination of glass thickness and inter-pane spacing. We have specified an example window configuration, however several manufacturers and various combinations of window components, such as those proposed, will offer the necessary sound attenuation rating. It is the responsibility of the manufacturer to ensure that the specified window achieves the required STC. This can only be assured by using window configurations that have been certified by laboratory testing. The requirements for STC ratings assume that the remaining components of the building are constructed and installed according to the minimum standards of the Ontario Building Code. The specified STC requirements also apply to swinging and/or sliding patio doors.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. In addition to ventilation requirements, Warning Clauses will also be required in all Lease, Purchase and Sale Agreements, as summarized in Section 6.

### 5.3 Noise Barrier Calculation

Noise levels at the Level 8 amenity terrace areas (Receptors 10 and 11) are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise mitigating impact of raising the perimeter guards to 1.8 m above the walking surface. Results of the investigation proved that noise levels can be reduced to 54 dBA. Therefore, it is advised that the barrier be raised 1.8 m above the walking surface (see Figure 3).

---

<sup>10</sup> J.S. Bradley and J.A. Birta. Laboratory Measurements of the Sound Insulation of Building Façade Elements, National Research Council October 2000.



**TABLE 4: RESULTS OF NOISE BARRIER INVESTIGATION**

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	Daytime L <sub>eq</sub> Noise Levels (dBA)	
			No Barrier	With 1.8 m Barrier
10	25.8	OLA – 8 <sup>th</sup> Floor Southwest Amenity Area	58	54
11	25.8	OLA – 8 <sup>th</sup> Floor Northwest Amenity Area	57	54

## 6. CONCLUSIONS AND RECOMMENDATIONS

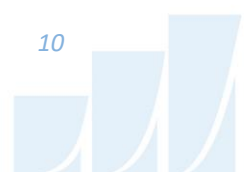
The results of the current analysis indicate that noise levels will range between 49 and 74 dBA during the daytime period (07:00-23:00) and between 57 and 66 dBA during the nighttime period (23:00-07:00). The highest noise level (74 dBA) occurs at the south façade, which is nearest and most exposed to Carling Avenue. Building components with a higher Sound Transmission Class (STC) rating will be required where exterior noise levels exceed 65 dBA, as indicated in Figure 3.

Results of the calculations also indicate that the development will require central air conditioning, which will allow occupants to keep windows closed and maintain a comfortable living environment. The following Warning Clause<sup>11</sup> will also be required be placed on all Lease, Purchase and Sale Agreements, as summarized below:

*“Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing roadway traffic may, on occasion, interfere with some activities of the dwelling occupants, as the sound levels exceed the sound level limits of the City and the Ministry of the Environment, Conservation and Parks. To help address the need for sound attenuation, this development includes:*

- *STC rated multi-pane glazing elements*
- *STC rated exterior walls*

<sup>11</sup> City of Ottawa Environmental Noise Control Guidelines, January 2016

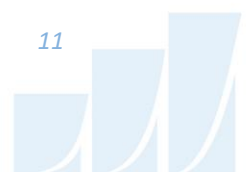


*This dwelling unit has also been designed with air conditioning. Air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment, Conservation and Parks.*

*To ensure that provincial sound level limits are not exceeded, it is important to maintain these sound attenuation features.”*

Noise levels at the Level 8 amenity terrace areas (Receptors 10 and 11) are expected to exceed 55 dBA during the daytime period without a noise barrier. If these areas are to be used as outdoor living areas, noise control measures are required to reduce noise levels as close as possible to 55 dBA where technically and administratively feasible. Further analysis investigated the noise mitigating impact of raising the perimeter guards to 1.8 m above the walking surface. Results of the investigation proved that noise levels can be reduced to 54 dBA. Therefore, it is advised that the barrier be raised 1.8 m above the walking surface.

With regard to stationary noise impacts, noise levels on the surrounding noise sensitive properties are expected to be negligible as the mechanical equipment will primarily reside in the mechanical level located on the high roof. A stationary noise study is recommended for the site during the detailed design once mechanical plans for the proposed building become available. This study would assess impacts of stationary noise from rooftop mechanical units serving the proposed building on surrounding noise sensitive areas. The assessment will also include recommendations for any noise control measures that may be necessary to ensure noise levels fall below ENCG limits. In the event that noise levels exceed ENCG criteria, noise impacts can generally be minimized by judicious selection and placement of the equipment.



This concludes our transportation noise 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.

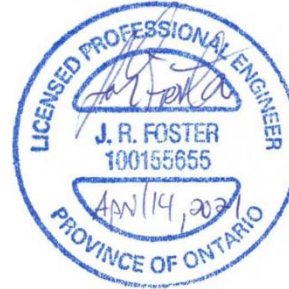
Sincerely,

**Gradient Wind Engineering Inc.**



Giuseppe Garro, M.A.Sc.  
Junior Environmental Scientist

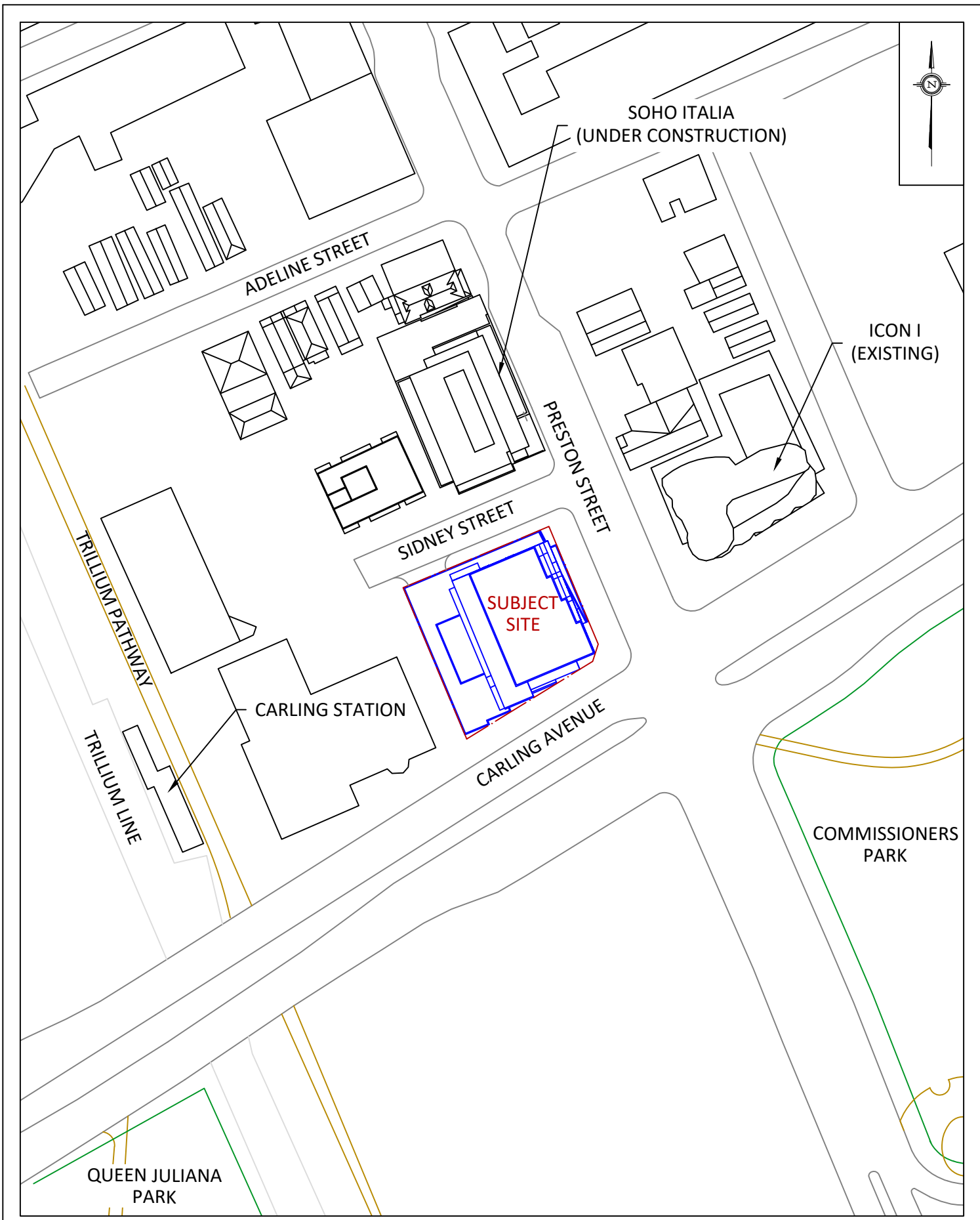
*Gradient Wind File #21-086 - Transportation Noise*



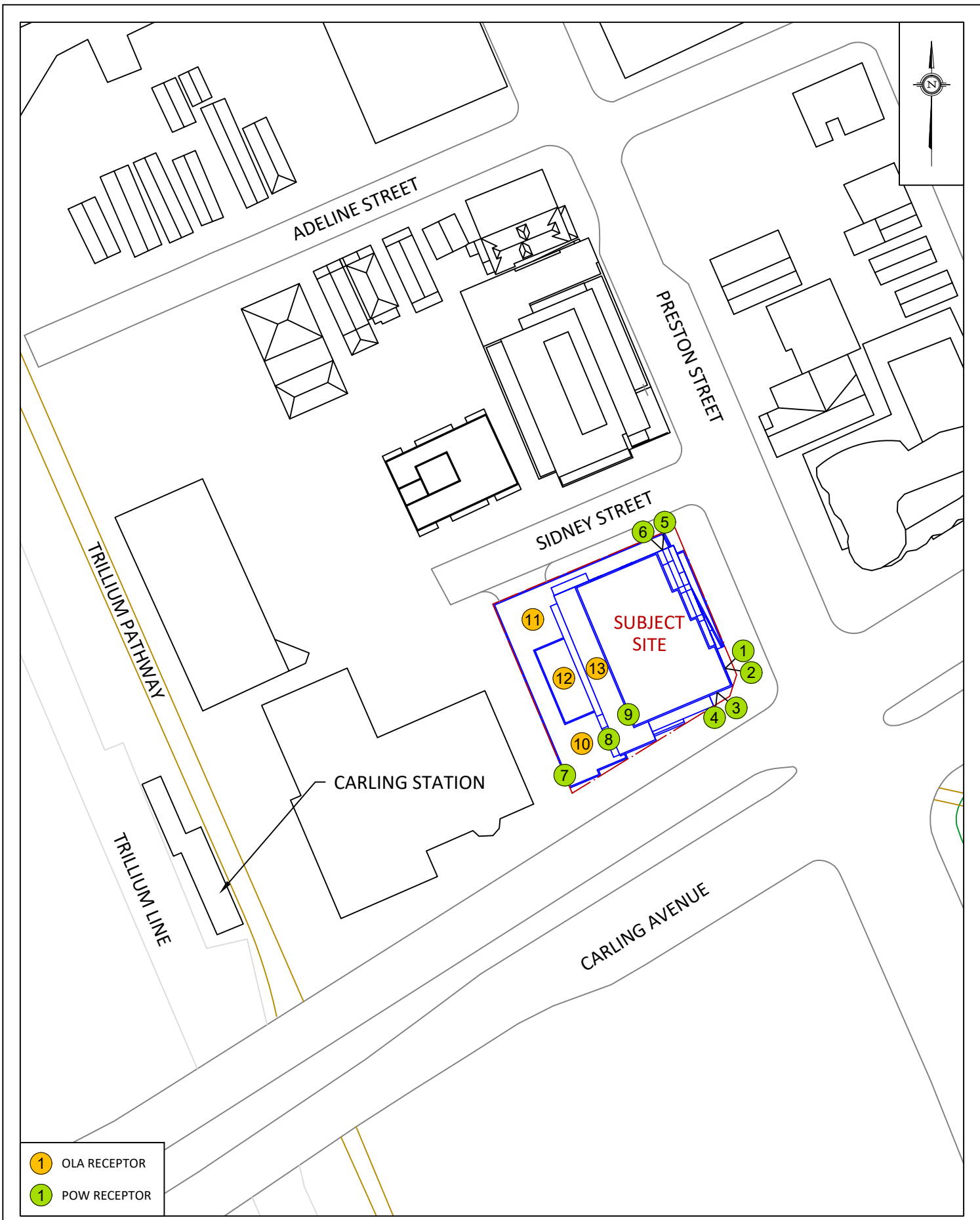
Joshua Foster, P.Eng.  
Principal





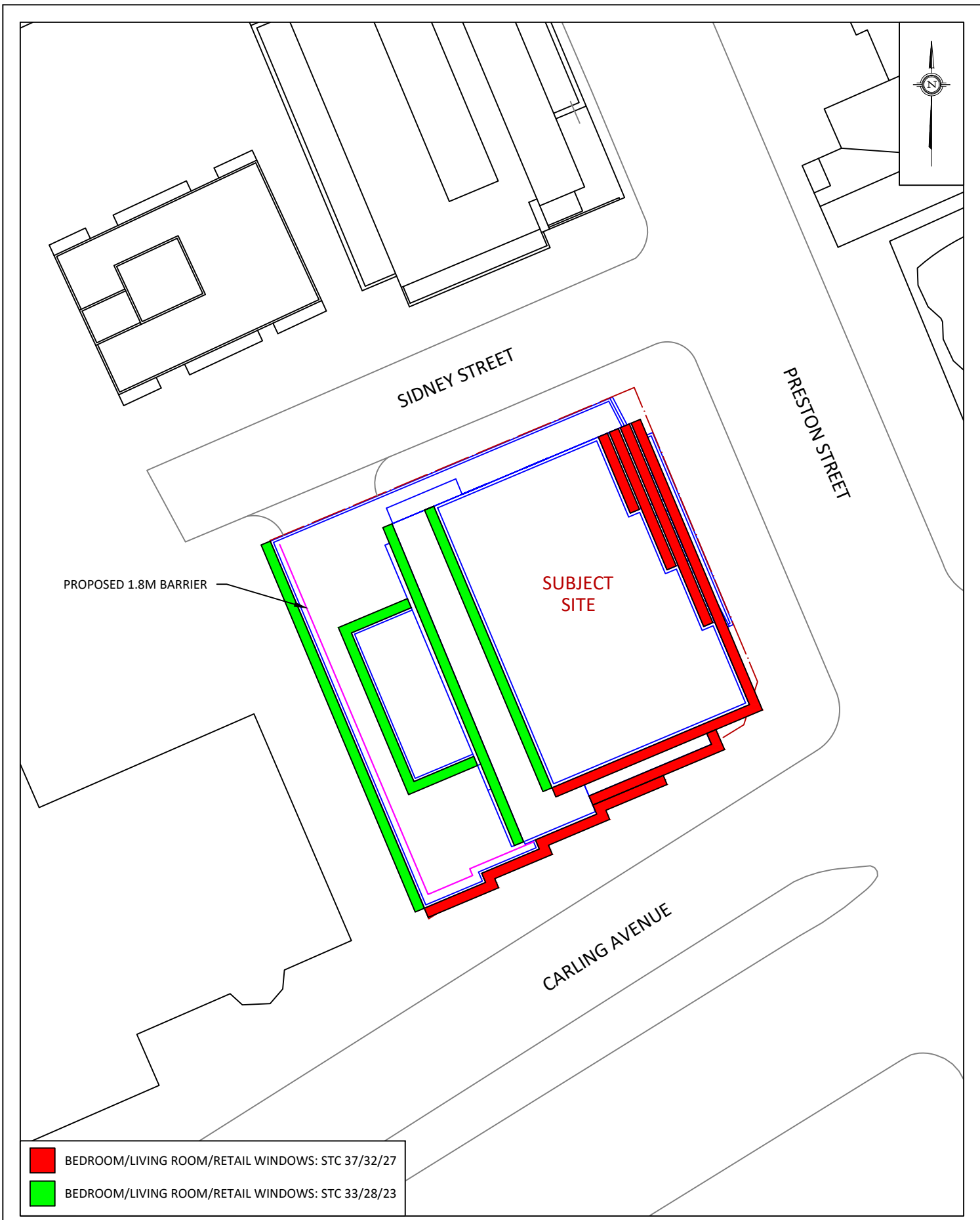


<b>GRADIENTWIND</b> ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 829 CARLING AVENUE, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION  <b>FIGURE 1:</b> PROPOSED SITE PLAN AND SURROUNDING CONTEXT
	SCALE 1:1250	DRAWING NO. 21-086-1	
	DATE APRIL 13, 2021	DRAWN BY G.G.	



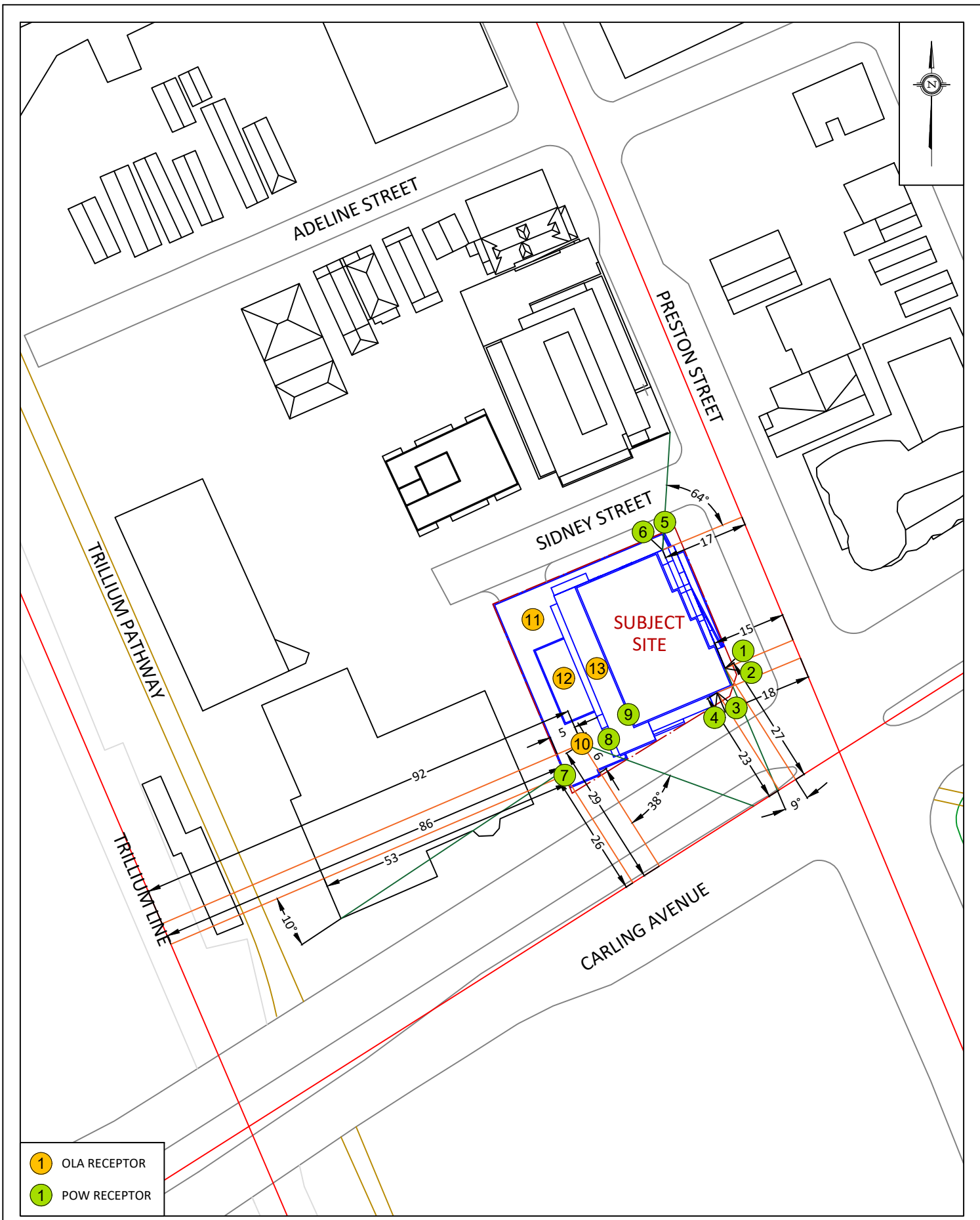
- 1 OLA RECEPTOR
- 1 POW RECEPTOR

<b>GRADIENTWIND</b> ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 829 CARLING AVENUE, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION  <b>FIGURE 2:          RECEPTOR LOCATION</b>
	SCALE 1:1000	DRAWING NO. 21-086-2	
	DATE APRIL 13, 2021	DRAWN BY G.G.	



- BEDROOM/LIVING ROOM/RETAIL WINDOWS: STC 37/32/27
- BEDROOM/LIVING ROOM/RETAIL WINDOWS: STC 33/28/23

<b>GRADIENTWIND</b> ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT	829 CARLING AVNEUE, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION	FIGURE 3: WINDOW STC REQUIREMENTS
	SCALE	1:500	DRAWING NO.	21-086-3	
	DATE	APRIL 13, 2021	DRAWN BY	G.G.	



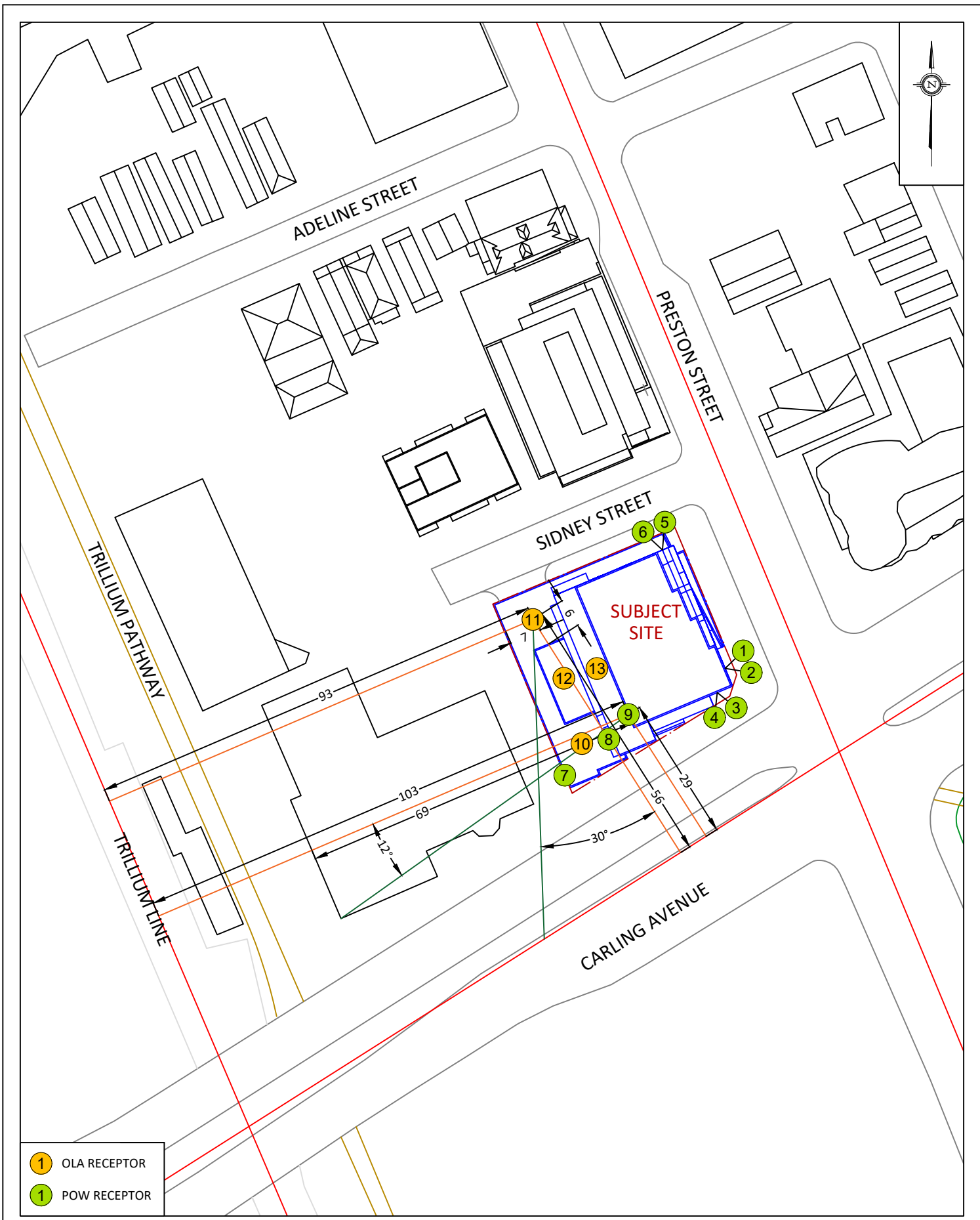
- 1 OLA RECEPTOR
- 1 POW RECEPTOR

<b>GRADIENTWIND</b> ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 829 CARLING AVENUE, OTTAWA TRANSPORTATION NOISE ASSESSMENT	DESCRIPTION:	
	SCALE: 1:1000	DRAWING NO.: 21-086-4	<b>FIGURE 4:</b> STAMSON INPUT PARAMETERS
	DATE: APRIL 13, 2021	DRAWN BY: G.G.	



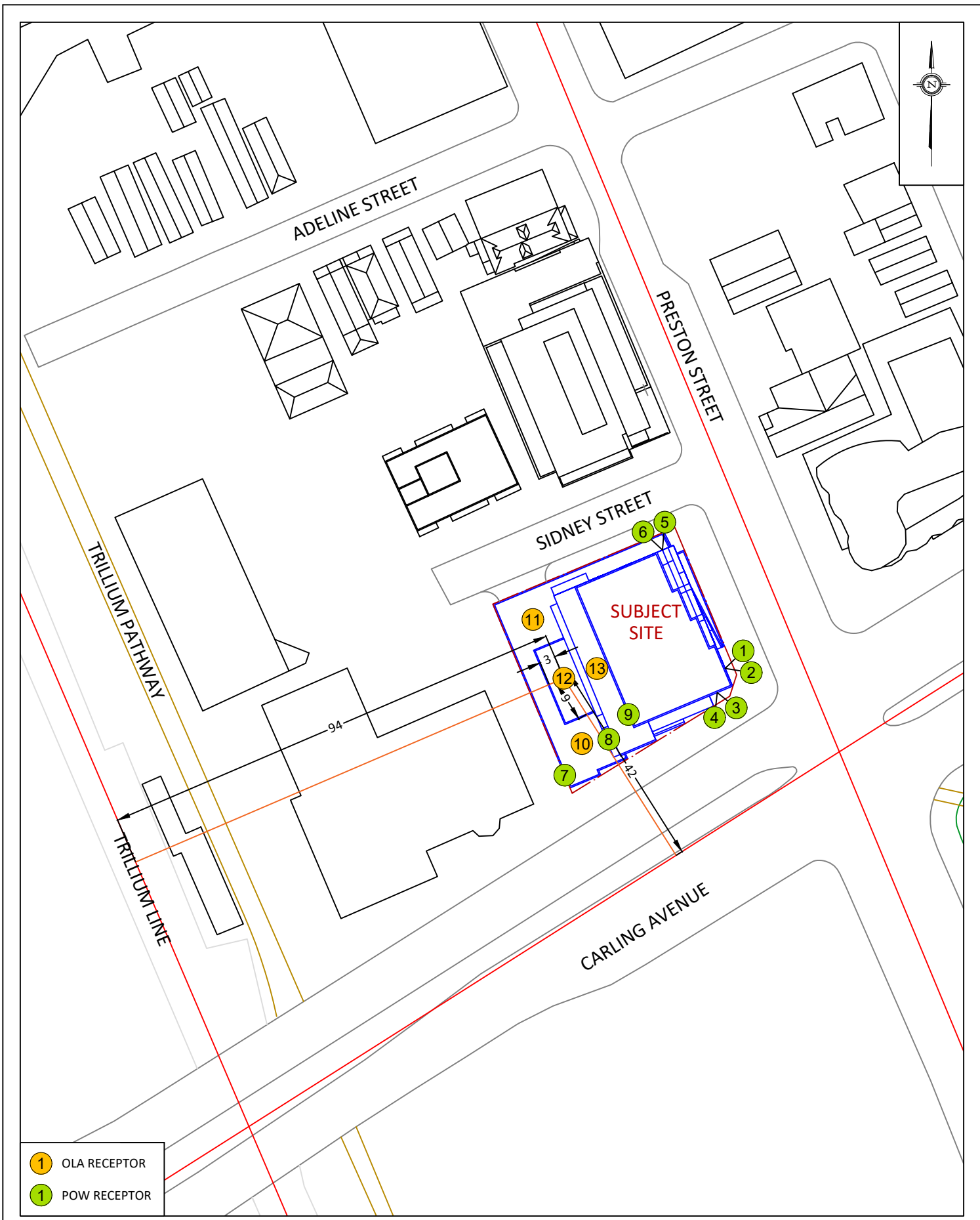
- 1 OLA RECEPTOR
- 1 POW RECEPTOR

<b>GRADIENTWIND</b> ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 829 CARLING AVNEUE, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION  FIGURE 5: STAMSON INPUT PARAMETERS
	SCALE 1:1000	DRAWING NO. 21-086-5	
	DATE APRIL 13, 2021	DRAWN BY G.G.	



- 1 OLA RECEPTOR
- 1 POW RECEPTOR

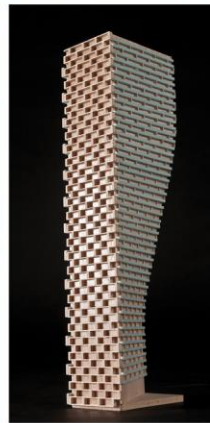
<b>GRADIENTWIND</b> ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT 829 CARLING AVENUE, OTTAWA TRANSPORTATION NOISE ASSESSMENT		DESCRIPTION  FIGURE 6: STAMSON INPUT PARAMETERS
	SCALE 1:1000	DRAWING NO. 21-086-6	
	DATE APRIL 13, 2021	DRAWN BY G.G.	



PROJECT	829 CARLING AVENUE, OTTAWA TRANSPORTATION NOISE ASSESSMENT	
SCALE	1:1000	DRAWING NO. 21-086-7
DATE	APRIL 13, 2021	DRAWN BY G.G.

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## APPENDIX A

### STAMSON 5.04 – INPUT AND OUTPUT DATA



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STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:38:41  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

## Road data, segment # 1: PRESTON ST (day/night)

-----

Car traffic volume : 12144/1056    veh/TimePeriod    \*  
Medium truck volume : 966/84    veh/TimePeriod    \*  
Heavy truck volume : 690/60    veh/TimePeriod    \*  
Posted speed limit : 50 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 15000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

## Data for Segment # 1: PRESTON ST (day/night)

-----

Angle1    Angle2                      : -90.00 deg    90.00 deg  
Wood depth : 0                      (No woods.)  
No of house rows : 0 / 0  
Surface : 2                      (Reflective ground surface)  
Receiver source distance : 15.00 / 15.00 m  
Receiver height : 95.60 / 95.60 m  
Topography : 1                      (Flat/gentle slope; no barrier)  
Reference angle : 0.00

## Road data, segment # 2: CARLING AV (day/night)

-----

Car traffic volume : 40480/3520    veh/TimePeriod    \*  
Medium truck volume : 3220/280    veh/TimePeriod    \*  
Heavy truck volume : 2300/200    veh/TimePeriod    \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00



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Heavy Truck % of Total Volume : 5.00  
 Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 2: CARLING AV (day/night)

```
-----
Angle1  Angle2      : -90.00 deg   9.00 deg
Wood depth      :      0      (No woods.)
No of house rows :      0 / 0
Surface         :      2      (Reflective ground surface)
Receiver source distance : 27.00 / 27.00 m
Receiver height : 95.60 / 95.60 m
Topography      :      1      (Flat/gentle slope; no barrier)
Reference angle :      0.00
-----
```

Results segment # 1: PRESTON ST (day)

Source height = 1.50 m

ROAD (0.00 + 68.48 + 0.00) = 68.48 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	90	0.00	68.48	0.00	0.00	0.00	0.00	0.00	0.00

```
-----
--
-90    90    0.00  68.48  0.00  0.00  0.00  0.00  0.00  0.00
68.48
-----
--
```

Segment Leq : 68.48 dBA

Results segment # 2: CARLING AV (day)

Source height = 1.50 m

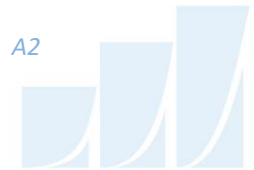
ROAD (0.00 + 70.08 + 0.00) = 70.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	9	0.00	75.22	0.00	-2.55	-2.60	0.00	0.00	0.00

```
-----
--
-90    9    0.00  75.22  0.00  -2.55  -2.60  0.00  0.00  0.00
70.08
-----
--
```

Segment Leq : 70.08 dBA

Total Leq All Segments: 72.36 dBA



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Results segment # 1: PRESTON ST (night)

Source height = 1.50 m

ROAD (0.00 + 60.88 + 0.00) = 60.88 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
-90	90	0.00	60.88	0.00	0.00	0.00	0.00	0.00	0.00
60.88									

Segment Leq : 60.88 dBA

Results segment # 2: CARLING AV (night)

Source height = 1.50 m

ROAD (0.00 + 62.48 + 0.00) = 62.48 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

--									
-90	9	0.00	67.63	0.00	-2.55	-2.60	0.00	0.00	0.00
62.48									

Segment Leq : 62.48 dBA

Total Leq All Segments: 64.76 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 72.36  
(NIGHT): 64.76



# GRADIENTWIND

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STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:38:58  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2.te                      Time Period: Day/Night 16/8 hours  
Description:

## Road data, segment # 1: PRESTON ST (day/night)

-----

Car traffic volume : 12144/1056 veh/TimePeriod \*  
Medium truck volume : 966/84 veh/TimePeriod \*  
Heavy truck volume : 690/60 veh/TimePeriod \*  
Posted speed limit : 50 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 15000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

## Data for Segment # 1: PRESTON ST (day/night)

-----

Angle1 Angle2 : -90.00 deg 90.00 deg  
Wood depth : 0 (No woods.)  
No of house rows : 0 / 0  
Surface : 2 (Reflective ground surface)  
Receiver source distance : 15.00 / 15.00 m  
Receiver height : 186.50 / 186.50 m  
Topography : 1 (Flat/gentle slope; no barrier)  
Reference angle : 0.00

## Road data, segment # 2: CARLING AV (day/night)

-----

Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00



# GRADIENTWIND

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Heavy Truck % of Total Volume : 5.00  
 Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 2: CARLING AV (day/night)

```
-----
Angle1  Angle2      : -90.00 deg   9.00 deg
Wood depth      :      0      (No woods.)
No of house rows :      0 / 0
Surface         :      2      (Reflective ground surface)
Receiver source distance : 27.00 / 27.00 m
Receiver height : 186.50 / 186.50 m
Topography      :      1      (Flat/gentle slope; no barrier)
Reference angle :      0.00
-----
```

Results segment # 1: PRESTON ST (day)

Source height = 1.50 m

ROAD (0.00 + 68.48 + 0.00) = 68.48 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	90	0.00	68.48	0.00	0.00	0.00	0.00	0.00	0.00

```
-----
SubLeq
-----
--
-90      90      0.00  68.48   0.00   0.00   0.00   0.00   0.00   0.00
68.48
-----
--
```

Segment Leq : 68.48 dBA

Results segment # 2: CARLING AV (day)

Source height = 1.50 m

ROAD (0.00 + 70.08 + 0.00) = 70.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	9	0.00	75.22	0.00	-2.55	-2.60	0.00	0.00	0.00

```
-----
SubLeq
-----
--
-90      9      0.00  75.22   0.00  -2.55  -2.60   0.00   0.00   0.00
70.08
-----
--
```

Segment Leq : 70.08 dBA

Total Leq All Segments: 72.36 dBA



Results segment # 1: PRESTON ST (night)

Source height = 1.50 m

ROAD (0.00 + 60.88 + 0.00) = 60.88 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
-90	90	0.00	60.88	0.00	0.00	0.00	0.00	0.00	0.00
60.88									

Segment Leq : 60.88 dBA

Results segment # 2: CARLING AV (night)

Source height = 1.50 m

ROAD (0.00 + 62.48 + 0.00) = 62.48 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
-90	9	0.00	67.63	0.00	-2.55	-2.60	0.00	0.00	0.00
62.48									

Segment Leq : 62.48 dBA

Total Leq All Segments: 64.76 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 72.36  
(NIGHT): 64.76



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:39:06  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3.te                      Time Period: Day/Night 16/8 hours  
Description:

## Road data, segment # 1: PRESTON ST (day/night)

-----

Car traffic volume : 12144/1056 veh/TimePeriod \*  
Medium truck volume : 966/84 veh/TimePeriod \*  
Heavy truck volume : 690/60 veh/TimePeriod \*  
Posted speed limit : 50 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 15000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

## Data for Segment # 1: PRESTON ST (day/night)

-----

Angle1 Angle2 : 0.00 deg 90.00 deg  
Wood depth : 0 (No woods.)  
No of house rows : 0 / 0  
Surface : 2 (Reflective ground surface)  
Receiver source distance : 18.00 / 18.00 m  
Receiver height : 95.60 / 95.60 m  
Topography : 1 (Flat/gentle slope; no barrier)  
Reference angle : 0.00

## Road data, segment # 2: CARLING AV (day/night)

-----

Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00







# GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: PRESTON ST (night)

Source height = 1.50 m

ROAD (0.00 + 57.08 + 0.00) = 57.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
0	90	0.00	60.88	0.00	-0.79	-3.01	0.00	0.00	0.00
57.08									

Segment Leq : 57.08 dBA

Results segment # 2: CARLING AV (night)

Source height = 1.50 m

ROAD (0.00 + 65.77 + 0.00) = 65.77 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
-90	90	0.00	67.63	0.00	-1.86	0.00	0.00	0.00	0.00
65.77									

Segment Leq : 65.77 dBA

Total Leq All Segments: 66.32 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 73.92  
(NIGHT): 66.32



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:39:15  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.te                      Time Period: Day/Night 16/8 hours  
Description:

## Road data, segment # 1: PRESTON ST (day/night)

-----

Car traffic volume : 12144/1056 veh/TimePeriod \*  
Medium truck volume : 966/84 veh/TimePeriod \*  
Heavy truck volume : 690/60 veh/TimePeriod \*  
Posted speed limit : 50 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 15000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

## Data for Segment # 1: PRESTON ST (day/night)

-----

Angle1 Angle2 : 0.00 deg 90.00 deg  
Wood depth : 0 (No woods.)  
No of house rows : 0 / 0  
Surface : 2 (Reflective ground surface)  
Receiver source distance : 18.00 / 18.00 m  
Receiver height : 186.50 / 186.50 m  
Topography : 1 (Flat/gentle slope; no barrier)  
Reference angle : 0.00

## Road data, segment # 2: CARLING AV (day/night)

-----

Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00





# GRADIENTWIND

ENGINEERS & SCIENTISTS

Results segment # 1: PRESTON ST (night)

Source height = 1.50 m

ROAD (0.00 + 57.08 + 0.00) = 57.08 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
0	90	0.00	60.88	0.00	-0.79	-3.01	0.00	0.00	0.00
57.08									

Segment Leq : 57.08 dBA

Results segment # 2: CARLING AV (night)

Source height = 1.50 m

ROAD (0.00 + 65.77 + 0.00) = 65.77 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
-90	90	0.00	67.63	0.00	-1.86	0.00	0.00	0.00	0.00
65.77									

Segment Leq : 65.77 dBA

Total Leq All Segments: 66.32 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 73.92  
(NIGHT): 66.32



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:39:22  
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.te    Time Period: Day/Night 16/8 hours  
 Description:

Road data, segment # 1: PRESTON ST (day/night)

```
-----
Car traffic volume   : 12144/1056   veh/TimePeriod  *
Medium truck volume :    966/84    veh/TimePeriod  *
Heavy truck volume  :    690/60    veh/TimePeriod  *
Posted speed limit  :     50 km/h
Road gradient       :      0 %
Road pavement      :      1 (Typical asphalt or concrete)
```

\* Refers to calculated road volumes based on the following input:

```
24 hr Traffic Volume (AADT or SADT): 15000
Percentage of Annual Growth         : 0.00
Number of Years of Growth           : 0.00
Medium Truck % of Total Volume      : 7.00
Heavy Truck % of Total Volume       : 5.00
Day (16 hrs) % of Total Volume      : 92.00
```

Data for Segment # 1: PRESTON ST (day/night)

```
-----
Angle1  Angle2           : -90.00 deg   0.00 deg
Wood depth           :      0      (No woods.)
No of house rows    :      0 / 0
Surface              :      2      (Reflective ground surface)
Receiver source distance : 17.00 / 17.00 m
Receiver height      : 95.60 / 95.60 m
Topography           :      1      (Flat/gentle slope; no barrier)
Reference angle      :      0.00
```

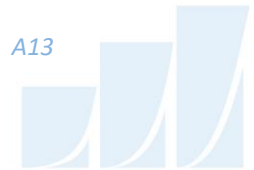
Results segment # 1: PRESTON ST (day)

Source height = 1.50 m

ROAD (0.00 + 64.93 + 0.00) = 64.93 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq									
-----									
--	-90	0	0.00	68.48	0.00	-0.54	-3.01	0.00	0.00
64.93									
-----									
--									



Segment Leq : 64.93 dBA

Total Leq All Segments: 64.93 dBA

Results segment # 1: PRESTON ST (night)

-----  
Source height = 1.50 m

ROAD (0.00 + 57.33 + 0.00) = 57.33 dBA

Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj  
SubLeq

-----

--										
--	-90	0	0.00	60.88	0.00	-0.54	-3.01	0.00	0.00	0.00

57.33

-----

--

Segment Leq : 57.33 dBA

Total Leq All Segments: 57.33 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 64.93  
(NIGHT): 57.33

# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:39:29  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r6.te    Time Period: Day/Night 16/8 hours  
Description:

Road data, segment # 1: PRESTON ST (day/night)

-----  
Car traffic volume : 12144/1056 veh/TimePeriod \*  
Medium truck volume : 966/84 veh/TimePeriod \*  
Heavy truck volume : 690/60 veh/TimePeriod \*  
Posted speed limit : 50 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 15000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: PRESTON ST (day/night)

-----  
Angle1 Angle2 : -90.00 deg 0.00 deg  
Wood depth : 0 (No woods.)  
No of house rows : 0 / 0  
Surface : 2 (Reflective ground surface)  
Receiver source distance : 17.00 / 17.00 m  
Receiver height : 186.50 / 186.50 m  
Topography : 1 (Flat/gentle slope; no barrier)  
Reference angle : 0.00

Results segment # 1: PRESTON ST (day)

-----  
Source height = 1.50 m

ROAD (0.00 + 64.93 + 0.00) = 64.93 dBA

Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj  
SubLeq

-----  
--  
-90 0 0.00 68.48 0.00 -0.54 -3.01 0.00 0.00 0.00  
64.93  
-----  
--



Segment Leq : 64.93 dBA

Total Leq All Segments: 64.93 dBA

Results segment # 1: PRESTON ST (night)

-----  
Source height = 1.50 m

ROAD (0.00 + 57.33 + 0.00) = 57.33 dBA

Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj  
SubLeq

-----  
--  
-90 0 0.00 60.88 0.00 -0.54 -3.01 0.00 0.00 0.00  
57.33  
-----  
--

Segment Leq : 57.33 dBA

Total Leq All Segments: 57.33 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 64.93  
(NIGHT): 57.33





# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:39:38  
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r7.te    Time Period: Day/Night 16/8 hours  
 Description:

Road data, segment # 1: CARLING AV (day/night)

```
-----
Car traffic volume   : 40480/3520   veh/TimePeriod  *
Medium truck volume : 3220/280    veh/TimePeriod  *
Heavy truck volume  : 2300/200    veh/TimePeriod  *
Posted speed limit  : 60 km/h
Road gradient       : 0 %
Road pavement      : 1 (Typical asphalt or concrete)
```

\* Refers to calculated road volumes based on the following input:

```
24 hr Traffic Volume (AADT or SADT): 50000
Percentage of Annual Growth         : 0.00
Number of Years of Growth           : 0.00
Medium Truck % of Total Volume      : 7.00
Heavy Truck % of Total Volume       : 5.00
Day (16 hrs) % of Total Volume      : 92.00
```

Data for Segment # 1: CARLING AV (day/night)

```
-----
Angle1  Angle2      : 0.00 deg  90.00 deg
Wood depth      : 0 (No woods.)
No of house rows : 0 / 0
Surface         : 2 (Reflective ground surface)
Receiver source distance : 26.00 / 26.00 m
Receiver height  : 20.00 / 20.00 m
Topography      : 1 (Flat/gentle slope; no barrier)
Reference angle  : 0.00
```

Results segment # 1: CARLING AV (day)

Source height = 1.50 m

ROAD (0.00 + 69.83 + 0.00) = 69.83 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq									
69.83	0	90	0.00	75.22	0.00	-2.39	-3.01	0.00	0.00



# GRADIENTWIND

ENGINEERS & SCIENTISTS

Segment Leq : 69.83 dBA

Total Leq All Segments: 69.83 dBA

Results segment # 1: CARLING AV (night)

-----  
Source height = 1.50 m

ROAD (0.00 + 62.23 + 0.00) = 62.23 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

-----  
--  

0	90	0.00	67.63	0.00	-2.39	-3.01	0.00	0.00	0.00
---	----	------	-------	------	-------	-------	------	------	------

  
62.23  
-----  
--

Segment Leq : 62.23 dBA

Total Leq All Segments: 62.23 dBA

RT/Custom data, segment # 1: LRT (day/night)

-----  
1 - 4-car SRT:

Traffic volume : 192/24 veh/TimePeriod

Speed : 50 km/h

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

-----  
Angle1 Angle2 : -90.00 deg 90.00 deg  
Wood depth : 0 (No woods.)  
No of house rows : 0 / 0  
Surface : 2 (Reflective ground surface)  
Receiver source distance : 86.00 / 86.00 m  
Receiver height : 20.00 / 20.00 m  
Topography : 4 (Elevated; with barrier)  
Barrier angle1 : -10.00 deg Angle2 : 90.00 deg  
Barrier height : 6.00 m  
Elevation : 7.00 m  
Barrier receiver distance : 53.00 / 53.00 m  
Source elevation : 0.00 m  
Receiver elevation : 0.00 m  
Barrier elevation : 0.00 m  
Reference angle : 0.00



# GRADIENTWIND

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Results segment # 1: LRT (day)

-----  
 Source height = 0.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
0.50	20.00	7.98	7.98

RT/Custom (44.92 + 45.89 + 0.00) = 48.44 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-10	0.00	56.02	-7.58	-3.52	0.00	0.00	0.00	44.92
-10	90	0.00	56.02	-7.58	-2.55	0.00	0.00	-0.97	44.92*
-10	90	0.00	56.02	-7.58	-2.55	0.00	0.00	0.00	45.89

\* Bright Zone !

Segment Leq : 48.44 dBA

Total Leq All Segments: 48.44 dBA

Results segment # 1: LRT (night)

-----  
 Source height = 0.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
0.50	20.00	7.98	7.98

RT/Custom (38.90 + 39.87 + 0.00) = 42.42 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-10	0.00	50.00	-7.58	-3.52	0.00	0.00	0.00	38.90
-10	90	0.00	50.00	-7.58	-2.55	0.00	0.00	-0.97	38.90*
-10	90	0.00	50.00	-7.58	-2.55	0.00	0.00	0.00	39.87

\* Bright Zone !

Segment Leq : 42.42 dBA

Total Leq All Segments: 42.42 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 69.86  
 (NIGHT): 62.28



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:39:54  
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8.te    Time Period: Day/Night 16/8 hours  
 Description:

Road data, segment # 1: CARLING AV (day/night)

```
-----
Car traffic volume   : 40480/3520   veh/TimePeriod   *
Medium truck volume : 3220/280    veh/TimePeriod   *
Heavy truck volume  : 2300/200    veh/TimePeriod   *
Posted speed limit  : 60 km/h
Road gradient       : 0 %
Road pavement      : 1 (Typical asphalt or concrete)
```

\* Refers to calculated road volumes based on the following input:

```
24 hr Traffic Volume (AADT or SADT): 50000
Percentage of Annual Growth         : 0.00
Number of Years of Growth           : 0.00
Medium Truck % of Total Volume      : 7.00
Heavy Truck % of Total Volume       : 5.00
Day (16 hrs) % of Total Volume      : 92.00
```

Data for Segment # 1: CARLING AV (day/night)

```
-----
Angle1  Angle2      : 0.00 deg  90.00 deg
Wood depth      : 0 (No woods.)
No of house rows : 0 / 0
Surface         : 2 (Reflective ground surface)
Receiver source distance : 27.00 / 27.00 m
Receiver height  : 95.60 / 95.60 m
Topography      : 1 (Flat/gentle slope; no barrier)
Reference angle  : 0.00
```

Results segment # 1: CARLING AV (day)

Source height = 1.50 m

ROAD (0.00 + 69.66 + 0.00) = 69.66 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq	-----									
69.66	0	90	0.00	75.22	0.00	-2.55	-3.01	0.00	0.00	0.00
	-----									
	--									



# GRADIENTWIND

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Segment Leq : 69.66 dBA

Total Leq All Segments: 69.66 dBA

Results segment # 1: CARLING AV (night)

-----  
Source height = 1.50 m

ROAD (0.00 + 62.07 + 0.00) = 62.07 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

-----  
--  
0      90      0.00    67.63    0.00    -2.55    -3.01    0.00    0.00    0.00  
62.07  
-----  
--

Segment Leq : 62.07 dBA

Total Leq All Segments: 62.07 dBA

RT/Custom data, segment # 1: LRT (day/night)

-----  
1 - 4-car SRT:

Traffic volume       :   192/24       veh/TimePeriod

Speed                :     50 km/h

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

-----  
Angle1   Angle2               : -90.00 deg   90.00 deg  
Wood depth               :       0       (No woods.)  
No of house rows         :       0 / 0  
Surface                  :       2       (Reflective ground surface)  
Receiver source distance :   97.00 / 97.00 m  
Receiver height          :   95.60 / 95.60 m  
Topography               :       4       (Elevated; with barrier)  
Barrier angle1           : -11.00 deg   Angle2 : 90.00 deg  
Barrier height           :     6.00 m  
Elevation                :     7.00 m  
Barrier receiver distance:   64.00 / 64.00 m  
Source elevation         :     0.00 m  
Receiver elevation       :     0.00 m  
Barrier elevation        :     0.00 m  
Reference angle          :     0.00

Results segment # 1: LRT (day)

-----  
Source height = 0.50 m



# GRADIENTWIND

ENGINEERS & SCIENTISTS

Barrier height for grazing incidence

Source Height (m)	! Receiver ! Height (m)	! Barrier ! Height (m)	! Elevation of ! Barrier Top (m)
0.50	95.60	32.85	32.85

RT/Custom (44.34 + 45.41 + 0.00) = 47.92 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-11	0.00	56.02	-8.11	-3.58	0.00	0.00	0.00	44.34
-11	90	0.00	56.02	-8.11	-2.51	0.00	0.00	-0.01	45.40*
-11	90	0.00	56.02	-8.11	-2.51	0.00	0.00	0.00	45.41

\* Bright Zone !

Segment Leq : 47.92 dBA

Total Leq All Segments: 47.92 dBA

Results segment # 1: LRT (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source Height (m)	! Receiver ! Height (m)	! Barrier ! Height (m)	! Elevation of ! Barrier Top (m)
0.50	95.60	32.85	32.85

RT/Custom (38.32 + 39.39 + 0.00) = 41.90 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-11	0.00	50.00	-8.11	-3.58	0.00	0.00	0.00	38.32
-11	90	0.00	50.00	-8.11	-2.51	0.00	0.00	-0.01	39.38*
-11	90	0.00	50.00	-8.11	-2.51	0.00	0.00	0.00	39.39

\* Bright Zone !

Segment Leq : 41.90 dBA

Total Leq All Segments: 41.90 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 69.69  
(NIGHT): 62.11



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:40:02  
 MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9.te                                      Time Period: Day/Night 16/8 hours  
 Description:

Road data, segment # 1: CARLING AV (day/night)

```
-----
Car traffic volume   : 40480/3520   veh/TimePeriod  *
Medium truck volume : 3220/280    veh/TimePeriod  *
Heavy truck volume  : 2300/200    veh/TimePeriod  *
Posted speed limit  : 60 km/h
Road gradient       : 0 %
Road pavement      : 1 (Typical asphalt or concrete)
```

\* Refers to calculated road volumes based on the following input:

```
24 hr Traffic Volume (AADT or SADT): 50000
Percentage of Annual Growth         : 0.00
Number of Years of Growth           : 0.00
Medium Truck % of Total Volume      : 7.00
Heavy Truck % of Total Volume       : 5.00
Day (16 hrs) % of Total Volume      : 92.00
```

Data for Segment # 1: CARLING AV (day/night)

```
-----
Angle1  Angle2      : 0.00 deg  90.00 deg
Wood depth      : 0 (No woods.)
No of house rows : 0 / 0
Surface         : 2 (Reflective ground surface)
Receiver source distance : 29.00 / 29.00 m
Receiver height : 186.50 / 186.50 m
Topography      : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00
```

Results segment # 1: CARLING AV (day)

Source height = 1.50 m

ROAD (0.00 + 69.35 + 0.00) = 69.35 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq	-----									
69.35	0	90	0.00	75.22	0.00	-2.86	-3.01	0.00	0.00	0.00
	-----									
	--									



# GRADIENTWIND

ENGINEERS & SCIENTISTS

Segment Leq : 69.35 dBA

Total Leq All Segments: 69.35 dBA

Results segment # 1: CARLING AV (night)

-----  
Source height = 1.50 m

ROAD (0.00 + 61.75 + 0.00) = 61.75 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------

SubLeq

-----  
--  
0      90      0.00    67.63    0.00    -2.86    -3.01    0.00    0.00    0.00  
61.75  
-----  
--

Segment Leq : 61.75 dBA

Total Leq All Segments: 61.75 dBA

RT/Custom data, segment # 1: LRT (day/night)

-----  
1 - 4-car SRT:

Traffic volume       :   192/24       veh/TimePeriod

Speed                :     50 km/h

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

-----  
Angle1   Angle2               : -90.00 deg   90.00 deg  
Wood depth               :       0       (No woods.)  
No of house rows         :       0 / 0  
Surface                  :       2       (Reflective ground surface)  
Receiver source distance : 103.00 / 103.00 m  
Receiver height          : 186.50 / 186.50 m  
Topography               :       4       (Elevated; with barrier)  
Barrier angle1           : -12.00 deg   Angle2 : 90.00 deg  
Barrier height           :     6.00 m  
Elevation                :     7.00 m  
Barrier receiver distance : 69.00 / 69.00 m  
Source elevation         :     0.00 m  
Receiver elevation       :     0.00 m  
Barrier elevation        :     0.00 m  
Reference angle          :     0.00

Results segment # 1: LRT (day)

-----  
Source height = 0.50 m





# GRADIENTWIND

ENGINEERS & SCIENTISTS

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !      186.50 !      61.90 !      61.90
  
```

RT/Custom (44.02 + 45.19 + 0.00) = 47.66 dBA

```

-----
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
   -90   -12   0.00  56.02  -8.37  -3.63   0.00   0.00   0.00  44.02
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
   -12    90   0.00  56.02  -8.37  -2.47   0.00   0.00  -0.00  45.18*
   -12    90   0.00  56.02  -8.37  -2.47   0.00   0.00   0.00  45.19
-----
  
```

\* Bright Zone !

Segment Leq : 47.66 dBA

Total Leq All Segments: 47.66 dBA

Results segment # 1: LRT (night)

-----

Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !      186.50 !      61.90 !      61.90
  
```

RT/Custom (38.00 + 39.17 + 0.00) = 41.64 dBA

```

-----
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
   -90   -12   0.00  50.00  -8.37  -3.63   0.00   0.00   0.00  38.00
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
   -12    90   0.00  50.00  -8.37  -2.47   0.00   0.00  -0.00  39.16*
   -12    90   0.00  50.00  -8.37  -2.47   0.00   0.00   0.00  39.17
-----
  
```

\* Bright Zone !

Segment Leq : 41.64 dBA

Total Leq All Segments: 41.64 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 69.38  
(NIGHT): 61.79



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 13-04-2021 13:25:32  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r10.te                      Time Period: Day/Night 16/8 hours  
Description:

Road data, segment # 1: CARLING AV (day/night)

-----  
Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: CARLING AV (day/night)

-----  
Angle1    Angle2                      : -38.00 deg    90.00 deg  
Wood depth                      : 0                      (No woods.)  
No of house rows                : 0 / 0  
Surface                            : 2                      (Reflective ground surface)  
Receiver source distance        : 29.00 / 29.00 m  
Receiver height                 : 25.80 / 25.80 m  
Topography                        : 2                      (Flat/gentle slope; with barrier)  
Barrier angle1                    : -38.00 deg    Angle2 : 90.00 deg  
Barrier height                    : 24.30 m  
Barrier receiver distance        : 6.00 / 6.00 m  
Source elevation                 : 0.00 m  
Receiver elevation                : 0.00 m  
Barrier elevation                 : 0.00 m  
Reference angle                  : 0.00

Results segment # 1: CARLING AV (day)

-----  
Source height = 1.50 m

Barrier height for grazing incidence

-----  
Source            ! Receiver            ! Barrier            ! Elevation of  
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)



# GRADIENTWIND

ENGINEERS & SCIENTISTS

```

-----+-----+-----+-----
          1.50 !          25.80 !          20.77 !          20.77
ROAD (0.00 + 57.55 + 0.00) = 57.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----

```

```

--
-38      90      0.00  75.22   0.00  -2.86  -1.48   0.00   0.00 -13.34
57.55
-----
--

```

Segment Leq : 57.55 dBA

Total Leq All Segments: 57.55 dBA

Results segment # 1: CARLING AV (night)

Source height = 1.50 m

Barrier height for grazing incidence

```

-----+-----+-----+-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.50 !          25.80 !          20.77 !          20.77

```

```

ROAD (0.00 + 49.95 + 0.00) = 49.95 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----
--
-38      90      0.00  67.63   0.00  -2.86  -1.48   0.00   0.00 -13.34
49.95
-----
--

```

Segment Leq : 49.95 dBA

Total Leq All Segments: 49.95 dBA

RT/Custom data, segment # 1: LRT (day/night)

```

-----
1 - 4-car SRT:
Traffic volume   :   192/24   veh/TimePeriod
Speed            :     50 km/h

```

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



# GRADIENTWIND

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```

Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth      :           0   (No woods.)
No of house rows :           0 / 0
Surface         :           2   (Reflective ground surface)
Receiver source distance : 92.00 / 92.00 m
Receiver height  : 25.80 / 25.80 m
Topography      :           4   (Elevated; with barrier)
Barrier angle1   : -90.00 deg   Angle2 : 90.00 deg
Barrier height   : 24.30 m
Elevation       : 7.00 m
Barrier receiver distance : 5.00 / 5.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle  : 0.00
  
```

Results segment # 1: LRT (day)

-----

Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !      25.80 !      24.42 !      24.42
  
```

RT/Custom (0.00 + 48.15 + 0.00) = 48.15 dBA

```

-----
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
   -90    90    0.00  56.02  -7.88   0.00   0.00   0.00  -4.95  43.20*
   -90    90    0.00  56.02  -7.88   0.00   0.00   0.00   0.00  48.15
-----
  
```

\* Bright Zone !

Segment Leq : 48.15 dBA

Total Leq All Segments: 48.15 dBA

Results segment # 1: LRT (night)

-----

Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
  
```



# GRADIENTWIND

ENGINEERS & SCIENTISTS

0.50 !            25.80 !            24.42 !            24.42

RT/Custom (0.00 + 42.13 + 0.00) = 42.13 dBA

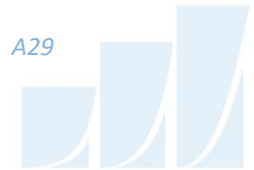
Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	50.00	-7.88	0.00	0.00	0.00	-4.95	37.18*
-90	90	0.00	50.00	-7.88	0.00	0.00	0.00	0.00	42.13

\* Bright Zone !

Segment Leq : 42.13 dBA

Total Leq All Segments: 42.13 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 58.02  
 (NIGHT): 50.61



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 13-04-2021 13:25:48  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r10b.te                      Time Period: Day/Night 16/8 hours  
Description:

Road data, segment # 1: CARLING AV (day/night)

-----  
Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: CARLING AV (day/night)

-----  
Angle1    Angle2                      : -38.00 deg    90.00 deg  
Wood depth                      : 0                      (No woods.)  
No of house rows                : 0 / 0  
Surface                            : 2                      (Reflective ground surface)  
Receiver source distance        : 29.00 / 29.00 m  
Receiver height                 : 25.80 / 25.80 m  
Topography                        : 2                      (Flat/gentle slope; with barrier)  
Barrier angle1                    : -38.00 deg    Angle2 : 90.00 deg  
Barrier height                    : 26.10 m  
Barrier receiver distance        : 6.00 / 6.00 m  
Source elevation                 : 0.00 m  
Receiver elevation                : 0.00 m  
Barrier elevation                 : 0.00 m  
Reference angle                  : 0.00

Results segment # 1: CARLING AV (day)

-----  
Source height = 1.50 m

Barrier height for grazing incidence

-----  
Source            ! Receiver            ! Barrier            ! Elevation of  
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)



# GRADIENTWIND

ENGINEERS & SCIENTISTS

```

-----+-----+-----+-----
          1.50 !          25.80 !          20.77 !          20.77
ROAD (0.00 + 54.40 + 0.00) = 54.40 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----

```

```

--
-38      90      0.00  75.22   0.00  -2.86  -1.48   0.00   0.00 -16.49
54.40
-----
--

```

Segment Leq : 54.40 dBA

Total Leq All Segments: 54.40 dBA

Results segment # 1: CARLING AV (night)

Source height = 1.50 m

Barrier height for grazing incidence

```

-----+-----+-----+-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.50 !          25.80 !          20.77 !          20.77

```

```

ROAD (0.00 + 46.80 + 0.00) = 46.80 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----
--
-38      90      0.00  67.63   0.00  -2.86  -1.48   0.00   0.00 -16.49
46.80
-----
--

```

Segment Leq : 46.80 dBA

Total Leq All Segments: 46.80 dBA

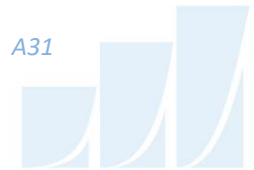
RT/Custom data, segment # 1: LRT (day/night)

```

-----
1 - 4-car SRT:
Traffic volume      :   192/24      veh/TimePeriod
Speed               :     50 km/h

```

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



# GRADIENTWIND

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```

Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth      :           0   (No woods.)
No of house rows :           0 / 0
Surface         :           2   (Reflective ground surface)
Receiver source distance : 92.00 / 92.00 m
Receiver height : 25.80 / 25.80 m
Topography     :           4   (Elevated; with barrier)
Barrier angle1 : -90.00 deg   Angle2 : 90.00 deg
Barrier height : 26.10 m
Elevation     : 7.00 m
Barrier receiver distance : 5.00 / 5.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00
    
```

Results segment # 1: LRT (day)

-----  
 Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !       25.80 !       24.42 !       24.42
    
```

RT/Custom (0.00 + 38.39 + 0.00) = 38.39 dBA

```

-----
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj  SubLeq
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
   -90    90   0.00  56.02  -7.88   0.00   0.00   0.00  -9.76  38.39
-----
    
```

Segment Leq : 38.39 dBA

Total Leq All Segments: 38.39 dBA

Results segment # 1: LRT (night)

-----  
 Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !       25.80 !       24.42 !       24.42
    
```

RT/Custom (0.00 + 32.37 + 0.00) = 32.37 dBA





# GRADIENTWIND

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Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	50.00	-7.88	0.00	0.00	0.00	-9.76	32.37

Segment Leq : 32.37 dBA

Total Leq All Segments: 32.37 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 54.51  
(NIGHT): 46.95



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 13-04-2021 13:33:30  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r11.te                      Time Period: Day/Night 16/8 hours  
Description:

## Road data, segment # 1: CARLING AV1 (day/night)

-----  
Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

## Data for Segment # 1: CARLING AV1 (day/night)

-----  
Angle1    Angle2                      : 0.00 deg    30.00 deg  
Wood depth                      : 0            (No woods.)  
No of house rows                : 0 / 0  
Surface                          : 2            (Reflective ground surface)  
Receiver source distance        : 56.00 / 56.00 m  
Receiver height                 : 25.80 / 25.80 m  
Topography                      : 2            (Flat/gentle slope; with barrier)  
Barrier angle1                  : 0.00 deg    Angle2 : 30.00 deg  
Barrier height                  : 29.60 m  
Barrier receiver distance       : 6.00 / 6.00 m  
Source elevation                : 0.00 m  
Receiver elevation               : 0.00 m  
Barrier elevation                : 0.00 m  
Reference angle                 : 0.00

## Road data, segment # 2: CARLING AV2 (day/night)

-----  
Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)



# GRADIENTWIND

ENGINEERS & SCIENTISTS

\* Refers to calculated road volumes based on the following input:

```

24 hr Traffic Volume (AADT or SADT): 50000
Percentage of Annual Growth      : 0.00
Number of Years of Growth       : 0.00
Medium Truck % of Total Volume  : 7.00
Heavy Truck % of Total Volume   : 5.00
Day (16 hrs) % of Total Volume  : 92.00
    
```

Data for Segment # 2: CARLING AV2 (day/night)

```

-----
Angle1  Angle2      : 30.00 deg  90.00 deg
Wood depth      : 0 (No woods.)
No of house rows : 0 / 0
Surface         : 2 (Reflective ground surface)
Receiver source distance : 56.00 / 56.00 m
Receiver height  : 25.80 / 25.80 m
Topography      : 2 (Flat/gentle slope; with barrier)
Barrier angle1  : 30.00 deg  Angle2 : 90.00 deg
Barrier height   : 24.30 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle  : 0.00
    
```

Results segment # 1: CARLING AV1 (day)

Source height = 1.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.50 !      25.80 !      23.20 !      23.20
    
```

ROAD (0.00 + 41.72 + 0.00) = 41.72 dBA

```

Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----
--
    0    30    0.00  75.22   0.00  -5.72  -7.78   0.00   0.00 -20.00
41.72
-----
--
    
```

Segment Leq : 41.72 dBA



# GRADIENTWIND

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Results segment # 2: CARLING AV2 (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	25.80	22.76	22.76

ROAD (0.00 + 57.03 + 0.00) = 57.03 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

30	90	0.00	75.22	0.00	-5.72	-4.77	0.00	0.00	-7.70
57.03									

Segment Leq : 57.03 dBA

Total Leq All Segments: 57.16 dBA

Results segment # 1: CARLING AV1 (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	25.80	23.20	23.20

ROAD (0.00 + 34.13 + 0.00) = 34.13 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

0	30	0.00	67.63	0.00	-5.72	-7.78	0.00	0.00	-20.00
34.13									

Segment Leq : 34.13 dBA



# GRADIENTWIND

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Results segment # 2: CARLING AV2 (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	25.80	22.76	22.76

ROAD (0.00 + 49.44 + 0.00) = 49.44 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
30	90	0.00	67.63	0.00	-5.72	-4.77	0.00	0.00	-7.70

SubLeq

49.44

Segment Leq : 49.44 dBA

Total Leq All Segments: 49.57 dBA

RT/Custom data, segment # 1: LRT (day/night)

1 - 4-car SRT:

Traffic volume : 192/24 veh/TimePeriod  
 Speed : 50 km/h

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

Angle1	Angle2	: -90.00 deg	90.00 deg
Wood depth		: 0	(No woods.)
No of house rows		: 0 / 0	
Surface		: 2	(Reflective ground surface)
Receiver source distance		: 93.00 / 93.00	m
Receiver height		: 25.80 / 25.80	m
Topography		: 4	(Elevated; with barrier)
Barrier angle1		: -90.00 deg	Angle2 : 90.00 deg
Barrier height		: 24.30	m
Elevation		: 7.00	m
Barrier receiver distance		: 7.00 / 7.00	m
Source elevation		: 0.00	m
Receiver elevation		: 0.00	m
Barrier elevation		: 0.00	m
Reference angle		: 0.00	



# GRADIENTWIND

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Results segment # 1: LRT (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
0.50	25.80	23.90	23.90

RT/Custom (0.00 + 42.73 + 0.00) = 42.73 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	56.02	-7.92	0.00	0.00	0.00	-5.37	42.73

Segment Leq : 42.73 dBA

Total Leq All Segments: 42.73 dBA

Results segment # 1: LRT (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
0.50	25.80	23.90	23.90

RT/Custom (0.00 + 36.71 + 0.00) = 36.71 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	50.00	-7.92	0.00	0.00	0.00	-5.37	36.71

Segment Leq : 36.71 dBA

Total Leq All Segments: 36.71 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 57.31  
(NIGHT): 49.79



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 13-04-2021 13:33:44  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r11b.te                      Time Period: Day/Night 16/8 hours  
Description:

## Road data, segment # 1: CARLING AV1 (day/night)

-----

Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

## Data for Segment # 1: CARLING AV1 (day/night)

-----

Angle1 Angle2 : 0.00 deg 30.00 deg  
Wood depth : 0 (No woods.)  
No of house rows : 0 / 0  
Surface : 2 (Reflective ground surface)  
Receiver source distance : 56.00 / 56.00 m  
Receiver height : 25.80 / 25.80 m  
Topography : 2 (Flat/gentle slope; with barrier)  
Barrier angle1 : 0.00 deg Angle2 : 30.00 deg  
Barrier height : 29.60 m  
Barrier receiver distance : 6.00 / 6.00 m  
Source elevation : 0.00 m  
Receiver elevation : 0.00 m  
Barrier elevation : 0.00 m  
Reference angle : 0.00

## Road data, segment # 2: CARLING AV2 (day/night)

-----

Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)



# GRADIENTWIND

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\* Refers to calculated road volumes based on the following input:

```

24 hr Traffic Volume (AADT or SADT): 50000
Percentage of Annual Growth          : 0.00
Number of Years of Growth            : 0.00
Medium Truck % of Total Volume       : 7.00
Heavy Truck % of Total Volume        : 5.00
Day (16 hrs) % of Total Volume       : 92.00
    
```

Data for Segment # 2: CARLING AV2 (day/night)

```

-----
Angle1   Angle2           : 30.00 deg   90.00 deg
Wood depth           : 0           (No woods.)
No of house rows     : 0 / 0
Surface              : 2           (Reflective ground surface)
Receiver source distance : 56.00 / 56.00 m
Receiver height       : 25.80 / 25.80 m
Topography           : 2           (Flat/gentle slope; with barrier)
Barrier angle1       : 30.00 deg   Angle2 : 90.00 deg
Barrier height        : 26.10 m
Barrier receiver distance : 7.00 / 7.00 m
Source elevation      : 0.00 m
Receiver elevation    : 0.00 m
Barrier elevation     : 0.00 m
Reference angle       : 0.00
    
```

Results segment # 1: CARLING AV1 (day)

Source height = 1.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.50 !      25.80 !      23.20 !      23.20
    
```

ROAD (0.00 + 41.72 + 0.00) = 41.72 dBA

```

Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj
SubLeq
-----
--
    0    30    0.00  75.22  0.00  -5.72  -7.78  0.00  0.00 -20.00
41.72
-----
--
    
```

Segment Leq : 41.72 dBA





# GRADIENTWIND

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Results segment # 2: CARLING AV2 (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	25.80	22.76	22.76

ROAD (0.00 + 53.02 + 0.00) = 53.02 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

30	90	0.00	75.22	0.00	-5.72	-4.77	0.00	0.00	-11.71
53.02									

Segment Leq : 53.02 dBA

Total Leq All Segments: 53.33 dBA

Results segment # 1: CARLING AV1 (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	25.80	23.20	23.20

ROAD (0.00 + 34.13 + 0.00) = 34.13 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

0	30	0.00	67.63	0.00	-5.72	-7.78	0.00	0.00	-20.00
34.13									

Segment Leq : 34.13 dBA



# GRADIENTWIND

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Results segment # 2: CARLING AV2 (night)

-----  
 Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	! Receiver ! Height (m)	! Barrier ! Height (m)	! Elevation of ! Barrier Top (m)
1.50	!	25.80	!
		22.76	!
			22.76

ROAD (0.00 + 45.42 + 0.00) = 45.42 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

-----  
 --  
 30      90      0.00    67.63    0.00    -5.72    -4.77    0.00    0.00    -11.71  
 45.42  
 -----  
 --

Segment Leq : 45.42 dBA

Total Leq All Segments: 45.73 dBA

RT/Custom data, segment # 1: LRT (day/night)

-----  
 1 - 4-car SRT:  
 Traffic volume       :   192/24       veh/TimePeriod  
 Speed                :     50 km/h

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

-----  
 Angle1   Angle2               : -90.00 deg   90.00 deg  
 Wood depth                :       0       (No woods.)  
 No of house rows         :       0 / 0  
 Surface                    :       2       (Reflective ground surface)  
 Receiver source distance :  93.00 / 93.00 m  
 Receiver height           :  25.80 / 25.80 m  
 Topography                :       4       (Elevated; with barrier)  
 Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg  
 Barrier height            :  24.30 m  
 Elevation                 :     7.00 m  
 Barrier receiver distance:  7.00 / 6.00 m  
 Source elevation         :     0.00 m  
 Receiver elevation        :     0.00 m  
 Barrier elevation         :     0.00 m  
 Reference angle          :     0.00



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Results segment # 1: LRT (day)

Source height = 0.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
0.50	25.80	23.90	23.90

RT/Custom (0.00 + 42.73 + 0.00) = 42.73 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	56.02	-7.92	0.00	0.00	0.00	-5.37	42.73

Segment Leq : 42.73 dBA

Total Leq All Segments: 42.73 dBA

Results segment # 1: LRT (night)

Source height = 0.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
0.50	25.80	24.17	24.17

RT/Custom (0.00 + 37.03 + 0.00) = 37.03 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	50.00	-7.92	0.00	0.00	0.00	-5.05	37.03

Segment Leq : 37.03 dBA

Total Leq All Segments: 37.03 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 53.69  
(NIGHT): 46.28



# GRADIENTWIND

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STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:40:41  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r12.te                      Time Period: Day/Night 16/8 hours  
Description:

Road data, segment # 1: CARLING AV (day/night)

-----  
Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: CARLING AV (day/night)

-----  
Angle1    Angle2                      :    0.00 deg    90.00 deg  
Wood depth                            :            0            (No woods.)  
No of house rows                      :            0 / 0  
Surface                                :            2            (Reflective ground surface)  
Receiver source distance               :    42.00 / 42.00 m  
Receiver height                        :    31.10 / 31.10 m  
Topography                            :            2            (Flat/gentle slope; with barrier)  
Barrier angle1                         :    0.00 deg    Angle2 : 90.00 deg  
Barrier height                         :    29.60 m  
Barrier receiver distance               :    9.00 / 9.00 m  
Source elevation                       :    0.00 m  
Receiver elevation                      :    0.00 m  
Barrier elevation                       :    0.00 m  
Reference angle                        :    0.00

Results segment # 1: CARLING AV (day)

-----  
Source height = 1.50 m

Barrier height for grazing incidence

-----  
Source            ! Receiver            ! Barrier            ! Elevation of  
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)



# GRADIENTWIND

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```

-----+-----+-----+-----
          1.50 !          31.10 !          24.76 !          24.76
ROAD (0.00 + 53.92 + 0.00) = 53.92 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----

```

```

--
    0      90      0.00  75.22   0.00  -4.47  -3.01   0.00   0.00 -13.82
53.92
-----
--

```

Segment Leq : 53.92 dBA

Total Leq All Segments: 53.92 dBA

Results segment # 1: CARLING AV (night)

-----

Source height = 1.50 m

Barrier height for grazing incidence

```

-----+-----+-----+-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.50 !          31.10 !          24.76 !          24.76

```

```

ROAD (0.00 + 46.32 + 0.00) = 46.32 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----

```

```

--
    0      90      0.00  67.63   0.00  -4.47  -3.01   0.00   0.00 -13.82
46.32
-----
--

```

Segment Leq : 46.32 dBA

Total Leq All Segments: 46.32 dBA

RT/Custom data, segment # 1: LRT (day/night)

-----

```

1 - 4-car SRT:
Traffic volume      :   192/24      veh/TimePeriod
Speed                :    50 km/h

```

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

-----



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```

Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth      :           0   (No woods.)
No of house rows :           0 / 0
Surface         :           2   (Reflective ground surface)
Receiver source distance : 94.00 / 94.00 m
Receiver height  : 31.10 / 29.60 m
Topography      :           4   (Elevated; with barrier)
Barrier angle1   : -90.00 deg   Angle2 : 90.00 deg
Barrier height   : 29.60 m
Elevation       : 7.00 m
Barrier receiver distance : 3.00 / 3.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle  : 0.00
  
```

Results segment # 1: LRT (day)

-----

Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !      31.10 !      30.12 !      30.12
  
```

RT/Custom (0.00 + 48.05 + 0.00) = 48.05 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	56.02	-7.97	0.00	0.00	0.00	-3.43	44.62*
-90	90	0.00	56.02	-7.97	0.00	0.00	0.00	0.00	48.05

\* Bright Zone !

Segment Leq : 48.05 dBA

Total Leq All Segments: 48.05 dBA

Results segment # 1: LRT (night)

-----

Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
  
```



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0.50 !            29.60 !            28.67 !            28.67

RT/Custom (0.00 + 33.98 + 0.00) = 33.98 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	50.00	-7.97	0.00	0.00	0.00	-8.06	33.98

Segment Leq : 33.98 dBA

Total Leq All Segments: 33.98 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 54.92  
 (NIGHT): 46.57



# GRADIENTWIND

ENGINEERS & SCIENTISTS

STAMSON 5.0                      NORMAL REPORT                      Date: 12-04-2021 17:40:49  
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r13.te                      Time Period: Day/Night 16/8 hours  
Description:

Road data, segment # 1: CARLING AV (day/night)

-----  
Car traffic volume : 40480/3520 veh/TimePeriod \*  
Medium truck volume : 3220/280 veh/TimePeriod \*  
Heavy truck volume : 2300/200 veh/TimePeriod \*  
Posted speed limit : 60 km/h  
Road gradient : 0 %  
Road pavement : 1 (Typical asphalt or concrete)

\* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 50000  
Percentage of Annual Growth : 0.00  
Number of Years of Growth : 0.00  
Medium Truck % of Total Volume : 7.00  
Heavy Truck % of Total Volume : 5.00  
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: CARLING AV (day/night)

-----  
Angle1    Angle2                      :    0.00 deg    90.00 deg  
Wood depth                            :            0            (No woods.)  
No of house rows                      :            0 / 0  
Surface                                :            2            (Reflective ground surface)  
Receiver source distance               : 40.00 / 40.00 m  
Receiver height                        : 147.20 / 147.20 m  
Topography                            :            2            (Flat/gentle slope; with barrier)  
Barrier angle1                         :    0.00 deg    Angle2 : 90.00 deg  
Barrier height                         : 145.70 m  
Barrier receiver distance               : 18.00 / 18.00 m  
Source elevation                        :    0.00 m  
Receiver elevation                      :    0.00 m  
Barrier elevation                        :    0.00 m  
Reference angle                        :    0.00

Results segment # 1: CARLING AV (day)

-----  
Source height = 1.50 m

Barrier height for grazing incidence

-----  
Source            ! Receiver            ! Barrier            ! Elevation of  
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)





# GRADIENTWIND

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```

-----+-----+-----+-----
          1.50 !          147.20 !          81.63 !          81.63
ROAD (0.00 + 48.91 + 0.00) = 48.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----

```

```

--
    0      90      0.00  75.22   0.00  -4.26  -3.01   0.00   0.00 -19.05
48.91
-----
--

```

Segment Leq : 48.91 dBA

Total Leq All Segments: 48.91 dBA

Results segment # 1: CARLING AV (night)

Source height = 1.50 m

Barrier height for grazing incidence

```

-----+-----+-----+-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.50 !          147.20 !          81.63 !          81.63

```

```

ROAD (0.00 + 41.31 + 0.00) = 41.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
-----
--
    0      90      0.00  67.63   0.00  -4.26  -3.01   0.00   0.00 -19.05
41.31
-----
--

```

Segment Leq : 41.31 dBA

Total Leq All Segments: 41.31 dBA

RT/Custom data, segment # 1: LRT (day/night)

```

-----
1 - 4-car SRT:
Traffic volume   :   192/24   veh/TimePeriod
Speed            :     50 km/h

```

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



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```

Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth      :           0   (No woods.)
No of house rows :           0 / 0
Surface         :           2   (Reflective ground surface)
Receiver source distance : 101.00 / 101.00 m
Receiver height : 147.20 / 147.20 m
Topography      :           4   (Elevated; with barrier)
Barrier angle1  : -90.00 deg   Angle2 : 90.00 deg
Barrier height  : 145.70 m
Elevation       :           7.00 m
Barrier receiver distance : 2.00 / 2.00 m
Source elevation :           0.00 m
Receiver elevation :           0.00 m
Barrier elevation :           0.00 m
Reference angle :           0.00
    
```

Results segment # 1: LRT (day)

-----

Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !      147.20 !      144.30 !      144.30
    
```

RT/Custom (0.00 + 39.78 + 0.00) = 39.78 dBA

```

-----
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
   -90    90    0.00  56.02  -8.28   0.00   0.00   0.00  -7.96  39.78
-----
    
```

Segment Leq : 39.78 dBA

Total Leq All Segments: 39.78 dBA

Results segment # 1: LRT (night)

-----

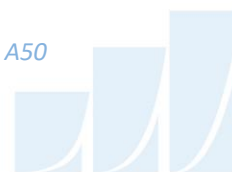
Source height = 0.50 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          0.50 !      147.20 !      144.30 !      144.30
    
```

RT/Custom (0.00 + 33.76 + 0.00) = 33.76 dBA



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Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	50.00	-8.28	0.00	0.00	0.00	-7.96	33.76

Segment Leq : 33.76 dBA

Total Leq All Segments: 33.76 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 49.41  
(NIGHT): 42.01

# **APPENDIX D**

**Proximity Assessment:**

**PG5744-LET.01 dated May 12, 2021**

154 Colonnade Road South  
Ottawa, Ontario  
Canada, K2E 7J5  
**Tel: (613) 226-7381**  
**Fax: (613) 226-6344**

May 12, 2021  
Report: PG5744-LET.01

**Claridge Homes**  
210 Gladstone Avenue  
Ottawa, Ontario  
K2P 0Y6

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Attention: **Mr. Vincent Denomme**

Subject: **Proximity Assessment  
Proposed High-Rise Building  
829 Carling Avenue - Ottawa**

Dear Sir,

Further to your request and authorization, Paterson Group (Paterson) prepared the current letter report to summarize construction issues which could occur due to the proximity of the proposed development with respect to the subject alignment of the Trillium Line and associated infrastructure located approximately 75 m west of the site boundary. The following letter should be read in conjunction with the Paterson Group Report PG5744-2 dated May 12, 2021.

## 1.0 Background Information

Based on current plans, it is understood that the proposed development will consist of a high-rise building. The proposed building will have 6 levels of underground parking which will occupy the majority of the site.

The following sections summarize our existing soils information and construction precautions for the proposed development, which may impact the subject alignment of the Trillium Line and Carling Station.

It should be noted that the information submitted as part of the current Proximity Study will be supplemented with construction plans issued for construction, such as dewatering and discharge plans.

## 2.0 Subsurface Conditions

Based on existing geotechnical information, the subsurface conditions in the immediate area of the subject site and subject Trillium Line alignment consist of the following:

- ❑ Existing surface grade is at an elevation of approximately 62.4 m in the location of the proposed building, where as the rail for the Trillium Line is located in a recessed trench at approximate geodetic elevation 56 m.
- ❑ The overburden thickness is approximately 0.9 to 1.5 m.
- ❑ Bedrock surface elevation is at an approximate geodetic elevation of 60.7 to 61.6 m.
- ❑ The bedrock underlying the site consists of limestone which is generally of good to excellent quality. Unconfined compressive strengths of similar limestone bedrock formations typically exceed 80 MPa.

### Trillium Line Location

Available information indicates that the Trillium Line is located approximately 85 m from the west property line of the subject site. Carling Station is located along the east side of the rail line approximately 75 m from the west property line of the subject site. The top of rail (TOR) is anticipated to be located at approximate elevation 56 m (geodetic) in this area. The founding elevation of the proposed building adjacent to the rail line and station will extend below the elevation of the rail and station. However, the Trillium Line railway and Carling Station is not located within the building's lateral support zone, and will not be adversely affected. Further, the proposed building is not located within the rail line's lateral support zone, and will therefore not impact the founding support of the Trillium Rail line or Carling Station.

## 3.0 Construction Precautions and Recommendations

### Influence of Proposed Development on Trillium Line

Based on existing soils information and building design details, the footings of the proposed building will be founded on good quality bedrock. Further, based on the approximate distances of 85 m between the proposed building and the Trillium Line railway and 75 m between the proposed building and Carling Station, no lateral loads from the proposed building will be transferred to the railway and the Trillium Line and Carling Station will not be undermined.

## **Excavation and Temporary Shoring**

The overburden along the perimeter of the proposed building footprint will need to be sloped or shored in order to complete the construction of the underground parking levels. Bedrock removal is also anticipated, which will be completed by line drilling, blasting and/or hoe ramming. The blasting and hoe ramming will be carried out by a contractor specializing in bedrock removal.

Where required, it is anticipated that the temporary shoring system will consist of soldier piles and lagging or steel sheet piles designed for at-rest earth pressures, using a pressure coefficient of  $K_0=0.5$  as per the geotechnical design recommendations outlined in the Geotechnical Investigation Report (Paterson Group Report PG5744-1 dated May 12, 2021).

The geotechnical engineer will review the stability of the rock face underlying the overburden. Following the review of the rock face, the geotechnical engineer will determine if rock reinforcement is required, and if so, the extent to which rock reinforcement is required. This determination will include consideration for the Trillium Line.

A seismograph would be installed in Carling Station to monitor vibrations during the bedrock removal program. A program detailing trigger levels and action levels is provided in Section 3.1 of the Paterson Group Report PG5744-2 dated May 12, 2021.

## **Pre-Construction Survey**

A pre-construction survey will be required for the Trillium Line and Carling Station. Any existing structures in the immediate area of the proposed building will also undergo a pre-construction survey as per standard construction practices, where bedrock blasting will be required.

## **Groundwater Control**

Groundwater observations during the recent geotechnical investigation indicated groundwater levels at an approximate depth of 3 to 4 m below the existing ground surface and within the bedrock. The design of the temporary shoring system and dewatering plans for the site will take into consideration the adjacent Trillium Line railway infrastructure. These plans will be forwarded once they are available.

## 4.0 Conclusions and Recommendations

Based on the currently available information for the subject alignment of the proposed building and the existing subsurface information, the proposed building will not negatively impact the existing Trillium Line or Carling Station. It should be noted that the information submitted as part of the current Proximity Study will be supplemented with construction plans issued for construction, dewatering and discharge plans, and field monitoring program as described in the application conditions.

We trust that this information satisfies your immediate request.

Best Regards,

**Paterson Group Inc.**



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