patersongroup

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Environmental Noise Control And Vibration Study

Proposed Multi-Storey Building
1010 Byron Avenue - Ottawa

Prepared For

Concorde Developments

May 15, 2020

Report: PG5318-1

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

Table of Contents

Page

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Concorde Developments to conduct an environmental noise control and vibration study for the proposed multi-storey building to be located at 1010 Byron Avenue, in the City of Ottawa (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objective of the current study was to:

- ❏ Determine the primary noise sources impacting the site and compare the projected sound levels to guidelines set out by the Ministry of Environment and Climate Change (MOECC) and the City of Ottawa.

- ❏ Review the projected noise levels and offer recommendations regarding warning classes or alternative sound barriers.

- ❏ Review the potential of detrimental vibrations caused by the proposed light rail transit.

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

This study has been conducted according to City of Ottawa Engineering Noise Control Guidelines (ENCG), dated January 2016, and the Ontario Ministry of the Environment Guideline NPC-300. The document - Transit Noise and Vibration Impact Assessment, composed by the Department of Transportation of the United States of America, dated May 2006, was also followed for the vibrational analysis.

2.0 Background

It is understood that the proposed development will consist of a three storey building located in the centre of a residential complex. An amenity area was located to the west of the existing building. This area will be analyzed as an outdoor living area.

3.0 Methodology and Noise Assessment Criteria

The City of Ottawa outlines three (3) sources of environmental noise that must be analyzed separately:

- ❑ Surface Transportation Noise
- ❑ Stationary Noise
  - ❑ new noise-sensitive development applications (noise receptors) in proximity to existing or approved stationary sources of noise, and
  - ❑ new stationary sources of noise (noise generating) in proximity to existing or approved noise-sensitive developments
- ❑ Aircraft noise

Surface Transportation Noise

The City of Ottawa's Official Plan, in addition to the ENCG dictate that the following conditions must be satisfied to classify as a surface transportation noise source for a subject site:

- ❑ Within 100 m of the right-of-way of an existing or proposed arterial, collector or major collector road; a light rail transit corridor; bus rapid transit, or transit priority corridor
- ❑ Within 250 m of the right-of-way for an existing or proposed highway or secondary rail line
- ❑ Within 300 m from the right of way of a proposed or existing rail corridor or a secondary main railway line
- ❑ Within 500 m of an existing 400 series provincial highway, freeway or principle main railway line.

The NPC-300 outlines the limitations of the stationary and environmental noise levels in relation to the location of the receptors. These can be found in the following tables:

Table 1 - Sound Level Limits for Outdoor Living Areas

Time Period	Required $L_{eq(16)}$ (dBA)
16-hour, 7:00-23:00	55

❑ Standards taken from Table 2.2a; Sound Level Limit for Outdoor Living Areas - Road and Rail

Table 2 - Sound Level Limits for Indoor Living Area			
Type of Space	**Time Period**	**Required L_{eq} (dBA)**	
		Road	**Rail**
Living/Dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc	7:00-23:00	45	40
Theaters, place of worship, libraries, individual or semi-private offices, conference rooms, reading rooms	23:00-7:00	45	40
Sleeping quarters	7:00-23:00	45	40
	23:00-7:00	40	35
❑ Standards taken from Table 2.2b; Sound Level Limit for Indoor Living Areas - Road and Rail			

If the sound level limits are exceeded at the window panes for the indoor living areas, the following Warning Clauses may be referenced:

Table 3 - Warning Clauses for Sound Level Exceedances	
Warning Clause	**Description**
Warning Clause Type A	"Purchasers/tenants are advised that sound levels due to increasing road traffic (rail traffic) (air traffic) may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."
Warning Clause Type B	"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road traffic (rail traffic) (air traffic) may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment."
Warning Clause Type C	"This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."
Warning Clause Type D	"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."
❑ Clauses taken from section C8 Warning Clauses; Environmental Noise Guidelines - NPC-300	

Stationary Noise

There are no outdoor living areas specified for this development. However, exposed mechanical equipment is proposed for the development. Noise sensitive land use (i.e. back yards and pane of glass at neighbouring houses) were identified. Therefore, a stationary noise analysis will be required.

Stationary noise sources include sources or facilities that are fixed or mobile and can cause a combination of sound and vibration levels emitted beyond the property line. These sources may include commercial air conditioner units, generators and fans. Facilities that may contribute to stationary noise may include car washes, snow disposal sites, transit stations and manufacturing facilities.

The impact of stationary noise sources are directly related to the location of the subject site within the urban environment. The proposed development can be classified as Class 2 by provincial guidelines and outlined in the ENGC, meaning “a suburban areas of the City outside of the busy core where the urban hum is evident but within the urban boundary.”

Table 4 - Guidelines for Stationary Noise - Class 2		
Time of Day	**Outdoor Point of Reception**	**Pane of Window**
7:00-19:00	50	50
19:00-23:00	45	50
23:00-7:00	-	45
❑ Standards taken from Table 3.2a; Guidelines for Stationary Noise - Steady and Varying Sound		

Due to the nature of the building, a stationary noise source analysis is not required.

Aircraft/Airport Noise

Aircraft noise is distinct, as it is typically low frequency for longer durations. The sound level may also differ between different types of aircraft. Due to the location of the subject site, an analysis aircraft/airport noise is not required.

4.0 Methodology and Vibration Assessment Criteria

Due to the presence of the future Confederation Line, a ground vibration and ground-borne noise review was also performed for this development.

Effects of the Confederation Line on the Proposed Development

The human body can be affected by exposure to vibration, in particular ground-borne vibrations occurring at low frequencies. These can be caused by the surrounding vibration sources previously identified, which include such as wheels on a road or rail system. These ground-borne vibrations can cause the building to shake (ground-borne vibration) and/or rumbling sounds (ground-borne noise).

The methods of defining and measuring vibrations has its own challenges, based on the oscillatory motion identified as a vibration. Due to the nature of the oscillatory motion of the vibration, there is no net movement of the vibration element, and therefore motion descriptors are zero.

There are two (2) main methods of defining the magnitude of the overall vibration. The main one utilized in construction activities is the peak particle velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration signal and is often used when monitoring blasting vibrations and is ideal for evaluating the potential of building damage.

However, human responses require a different method of analysis as the human body required time to respond to vibration signals. The average vibration amplitude would be an applicable method of reporting the ground-borne vibrations that humans would respond to, however with the vibration being represented as a sine wave, the average vibration amplitude would be zero. Therefore, the root mean square (RMS) amplitude, typically calculated over a 1 second interval, is utilized for the analysis. The RMS value is always less than the PPV.

General factors that could affect the magnitude of the created vibrations include, but are not limited to, whether the light rail is above grade or below grade, speed, vehicle suspension, wheel and track condition, track support system, depth of system and soil conditions. It should be noted that vibrations that travel through the bedrock surface should be minimal, but can travel a further distance.

It is anticipated that both the construction of the Confederation Line in addition to the day to day operational frequency of the Confederation line will create vibrations that may be experienced within 1010 Byron Avenue. Vibrations caused by the Confederation Line could propagate through the bedrock surface, and extend to the building foundation at 1010 Byron Avenue, which in turn could extend the vibration through the remainder of the building.

The City of Ottawa has not defined limits as to the amount of vibration caused by the Confederation Line would be acceptable. In a document released to the Council on December 4, 2012, titled “Design, Build, Finance and Maintenance of Ottawa Light Rail Transit (OLRT) Project”, submitted by Ms. Nancy Schepers, it states that:

> That assessment has established a noise and vibration standard that will protect all buildings including highly sensitive receptors like the CBC building on Queen Street and the National Arts Centre on Elgin Street.
>
> Noise levels in these sensitive receptors will be baselined and RTG will work with the institutions to meet performance specifications and coordinate construction activities to minimize impacts on their institution’s operations.
>
> Following the assessment, RTG will develop specific noise and vibration mitigation measures as part of the project’s final design and will maintain the light rail system to ensure that the mitigation measures remain effective in the future during normal operations.
>
> While some construction-related noise will be unavoidable as the Confederation Line is being built, RTG’s construction methods and mitigation strategies will minimize disruption to the best extent possible.

Therefore, the Federal Transit Administration’s Transit Noise and Vibration Impact Assessment Report: FTA-VA-90-1003-06 was utilized as the standard for vibration standards caused by light rail. Upon review of these documents, the following standards were obtained that are applicable to this analysis.

The criteria for the environmental impact from vibrations are based on the RMS vibration levels for repeated events. The proposed development would be classified as a Vibration Category 2 - Residential. This includes all locations where people would sleep. The following table outlines the limits for ground-borne vibrations.

Table 5 - Ground-Borne Vibration (GBV) for General Assessment

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch/sec)		
	Frequent Events	**Occasional Events**	**Infrequent Events**
Category 2	72 VdB	75 VdB	80 VdB

Notes:

- ❏ Frequent events is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
- ❏ Occasional events is define as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
- ❏ Infrequent events is defined as fewer tan 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

The Confederation Line is classified as a light rail transit. According to the DOT - Transit Noise and Vibration Impact Assessment, the description of a light rail transit would be that “the ground-borne vibration characteristics of light rail systems are very similar to those of rapid transit systems. Because the speeds of light rail systems are usually lower, the typical vibration levels usually are lower.” This document also outlines screening radiuses, defined as where there is a potential for disturbing ground-borne vibrations, where additional studies should be completed. For a source of light rail transit within a category 2 classification, the screening distance for vibration assessment is 45 m (150'). The proposed development will be within this radius.

5.0 Analysis

5.1 Noise Attenuation Study - Surface Transportation

The proposed development is bordered to the north by Richmond Road and Byron Avenue. Residential and commercial development surround the proposed development on the remaining boundaries. Honeywell Avenue, Knightsbridge Road and Lockhart Avenue are also located with the 100 m radius around the proposed development. However, none of these additional roads are classified as an arterial or collector road and therefore are not considered in this study.

It is understood that the Ottawa Light Rail Transit (OLRT) is proposing that the Confederation Line will be located between Richmond Road and Byron Avenue. Several attempts were made to contact Ms. Annie Goodchild at the City of Ottawa to obtain additional information regarding the overall layout of the OLRT. For the issuance of this noise and vibration study, it is assumed that the Confederation Line will be located between Richmond Road and Byron Avenue, at an approximate depth of 4 m below the existing ground level.

Noise source locations are presented on Paterson Drawing PG5318-1 - Site Plan, located in Appendix 1.

There are no stationary noise or aircraft noise sources within the influence area.

The noise levels from road traffic are designated by the City of Ottawa, taking into consideration the right-of-way width and the implied roadway class. It is understood that these values represent the maximum allowable capacity of the proposed roadways.

The parameters to be used for sound level predictions can be found below.

Table 6 - Traffic and Road Parameters

Road	Implied Roadway	AADT (Veh/day)	Posted Speed (km/h)	Day/Night Split %	Medium Truck %	Heavy Truck %
Richmond Road	2-UAU	15000	50	92/8	7	5
Byron Avenue	2-UCU	8000	50	92/8	7	5

- Data obtained from the City of Ottawa document ENCG

The projected noise levels from the Confederation Line were provided by the City of Ottawa, taking into consideration the number of trips, the speed of the light rail and the type of engine. This information was provided to Paterson in an e-mail correspondence from Mr. Mike Schmidt at the City of Ottawa and is summarized below.

Table 7 - Light Rail Parameters

Light Rail Line	Engine Type	Maximum Speed (km/hr)	Number of Trips	Length of Train
Confederation Line	Electric	65	488	2

There were several reception points that were considered in our analysis of the proposed multi-storey building. Reception points were selected at the bedroom windows along the different building elevations that are exposed to the identified noise sources. For this analysis, a reception point was taken at the centre of the window pane, at several different floor levels. Reception points are noted on Paterson Drawing PG5318-2 - Receptor Locations, presented in Appendix 1.

Table 9 - Summary of Reception Points and Geometry, presented in Appendix 1, provides a summary of the points of reception and their geometry with respect to the noise sources.

The analysis was completed using STAMSON version 5.04, a computer program which uses the road and rail traffic noise prediction methods using ORNAMENT (Ontario Road Noise Analysis Method for Environment and Transportation) and STEAM (Sound from Trains Environment Analysis Method), publications from the Ontario Ministry of Environment and Energy.

It is understood that the proposed Confederation Line will be located north of the proposed building, located approximately 4 m below ground level. A limitation of the STAMSON software is that a negative elevation can not be inputted. Alternatively, the change in elevation was input using the elevation of the Confederation Line as 0 m and the elevation of the ground floor of the proposed building as 4 m. Additionally, since the design of the Confederation Line includes the wall of the tunnel that will extend from the rail level to ground surface, this was modeled as a 4 m high “barrier”.

5.2 Vibration Assessment - Surface Transportation

At the time of the study, the design details of the Confederation Line are not known. Therefore, all analysis will need to be completed on a projected data basis (i.e. no direct monitoring of the existing conditions). The following assumptions were used for the completion of this study.

It is understood that the Confederation Line will be constructed, at a minimum, of 56 m horizontally from the proposed building perimeter (measured from the proposed building to the centre of the rail line). The following figure is a base curve for ground surface vibration levels, assuming the equipment is in good condition and speeds of 80 km/hr (50 mph) are not exceeded. Due to the nature of the Confederation Line, this table is applicable for the proposed development.

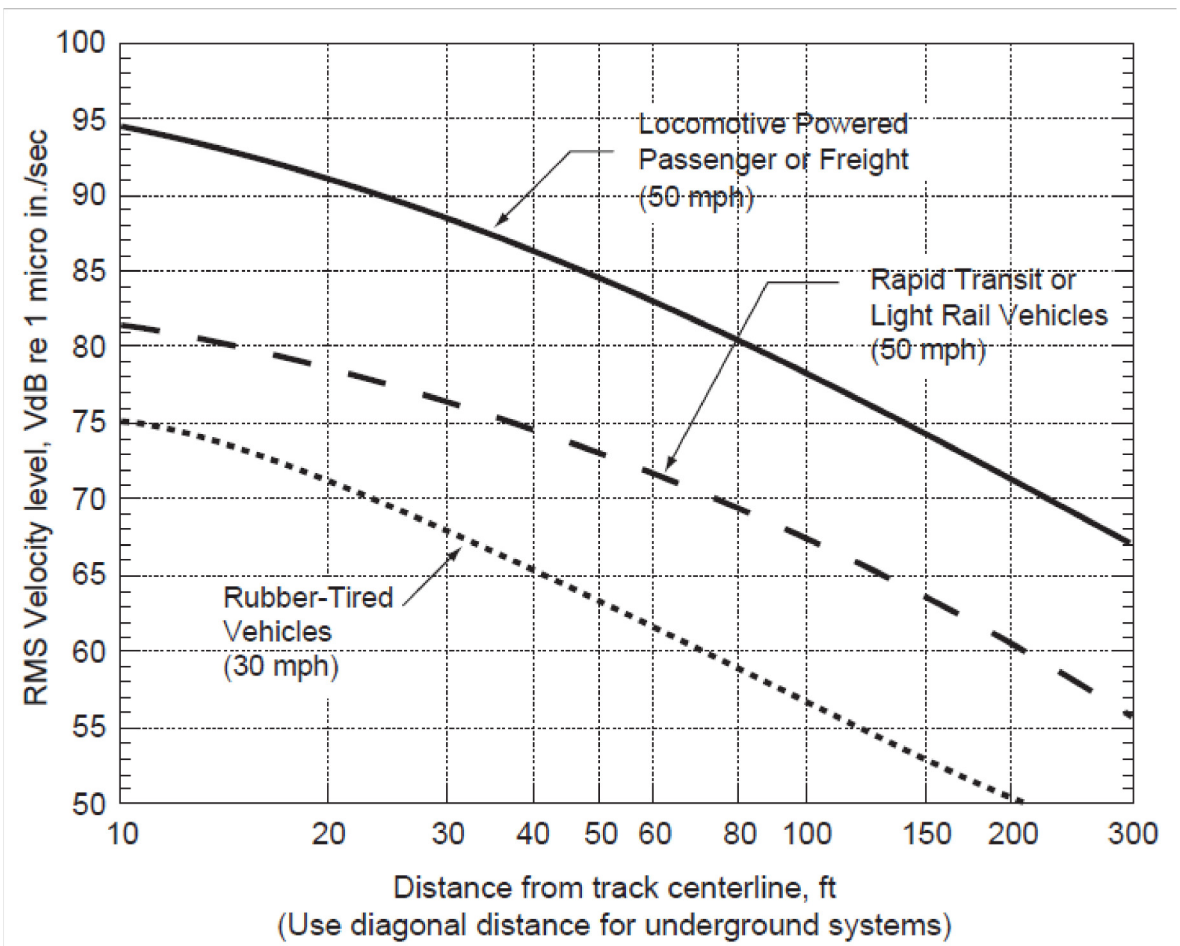


Figure 1 - Generalized Ground Surface Vibration Curve

6.0 Results

6.1 Noise Attenuation Results

The primary descriptors are the 16-hour daytime and the 8-hour night time equivalent sound levels, $L_{eq(16)}$ and the $L_{eq(8)}$ for City roads.

The proposed traffic noise levels were analyzed at all reception points. The results of the STAMSON software can be located in Appendix 2, and the summary of the results can be noted in Table 8.

Table 8 - Proposed Noise Levels

Reception Point	Description	Daytime at Facade $L_{EQ(16)}$ (dBA)	Nighttime at Facade $L_{eq(8)}$ (dBA)	Outdoor Living Area $L_{eq(8)}$ (dBA)
REC 1-1	Northern Elevation, 1st Floor	61.04	53.13	--
REC 1-3	Northern Elevation, 3rd Floor	62.09	54.12	--
REC 2-1	Eastern Elevation, 1st Floor	55.33	47.97	--
REC 2-3	Eastern Elevation, 3rd Floor	57.15	48.25	--
REC 3-1	Western Elevation, 1st Floor	54.98	46.23	--
REC 3-3	Western Elevation, 3rd Floor	56.75	47.54	--
REC 4	Outdoor Amenity Area	--	--	54.95

6.2 Vibration Assessment Results

Based on Figure 1, for a Category 2 structure, the Confederation Line would be located at a minimum of need to be constructed 56 m (184'), measured from the northern edge of Byron Avenue. At this distance, the RMS velocity will be 63 VdB.

7.0 Discussion and Recommendations - Noise Attenuation

7.1 Outdoor Living Areas

An outdoor amenity area was identified on the site plan. This amenity area is located on the ground surface, to the west of the proposed building. The reception point was selected 1.5 m above ground surface. The results of the STAMSON modeling indicates that the daytime $L_{eq(16)}$ is 54.95 dBA. This is lower than the 55 dBA threshhold and is considered acceptable. No futher mitigation measures are required.

7.2 Indoor Living Areas and Ventilation

The results of the STAMSON modelling indicates that the $L_{eq(16)}$ ranges between 54.98 dBA and 62.09 dBA. The ENGC states that the limits for the exterior of the pane of glass is 55 dBA. This value was exceeded on all elevations. Therefore, Warning Clause C is required for all units which must be designed with the provision for adding central air conditioning at the occupant's discretion. The maximum $L_{eq(16)}$ is noted to be below 65 dBA. According to the MOECC guildelines, provided that the $L_{eq(16)}$ is below 65 dBA, standard construction materials are considered acceptable soundproofing and no additional analysis of the building materials will be required.

8.0 Conclusion

The subject site is located at 1010 Byron Avenue. It is understood that the development will consist of a three storey building with an amenity area (identified as an outdoor living area). The noise analysis identified three noise sources: Bryon Avenue, Richmond Road and the future LRT rail (surface transportation noise).

A reception point was located in the centre of the amenity area at an elevation of 1.5 m. Results of this reception point indicate that the noise level will be below 55 dBA. Therefore, no additional mitigation measures will be required.

Pane of glass reception points were selected on the northern, eastern and western elevations, at both 1.5 m (ground floor) and 7.5 m (third floor). These results indicate that the noise levels will be above 55 dBA but below 65 dBA. Therefore all units must be designed with the provision for adding central air conditioning at the occupant's discretion. In addition, Warning Clause C, outlined below, must be added to all deeds of sale.

> "This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning by the occupant in low and medium density developments will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment."

9.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. Our recommendations should be reviewed when the project drawings and specifications are complete.

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 Concorde Developments or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Stephanie A. Boisvenue, P.Eng.

Scott S. Dennis, P.Eng.

Report Distribution:

- ❏ Concorde Developments (3 copies)
- ❏ Paterson Group (1 copy)

APPENDIX 1

TABLE 9 - SUMMARY OF RECEPTION POINTS AND GEOMETRY

DRAWING PG5318-1 - SITE PLAN

DRAWING PG5318-1A - SITE GEOMETRY (REC 1-1 AND REC 1-3)

DRAWING PG5318-1B - SITE GEOMETRY (REC 2-1 AND REC 2-3)

DRAWING PG5318-1C - SITE GEOMETRY (REC 3-1 AND REC 3-3)

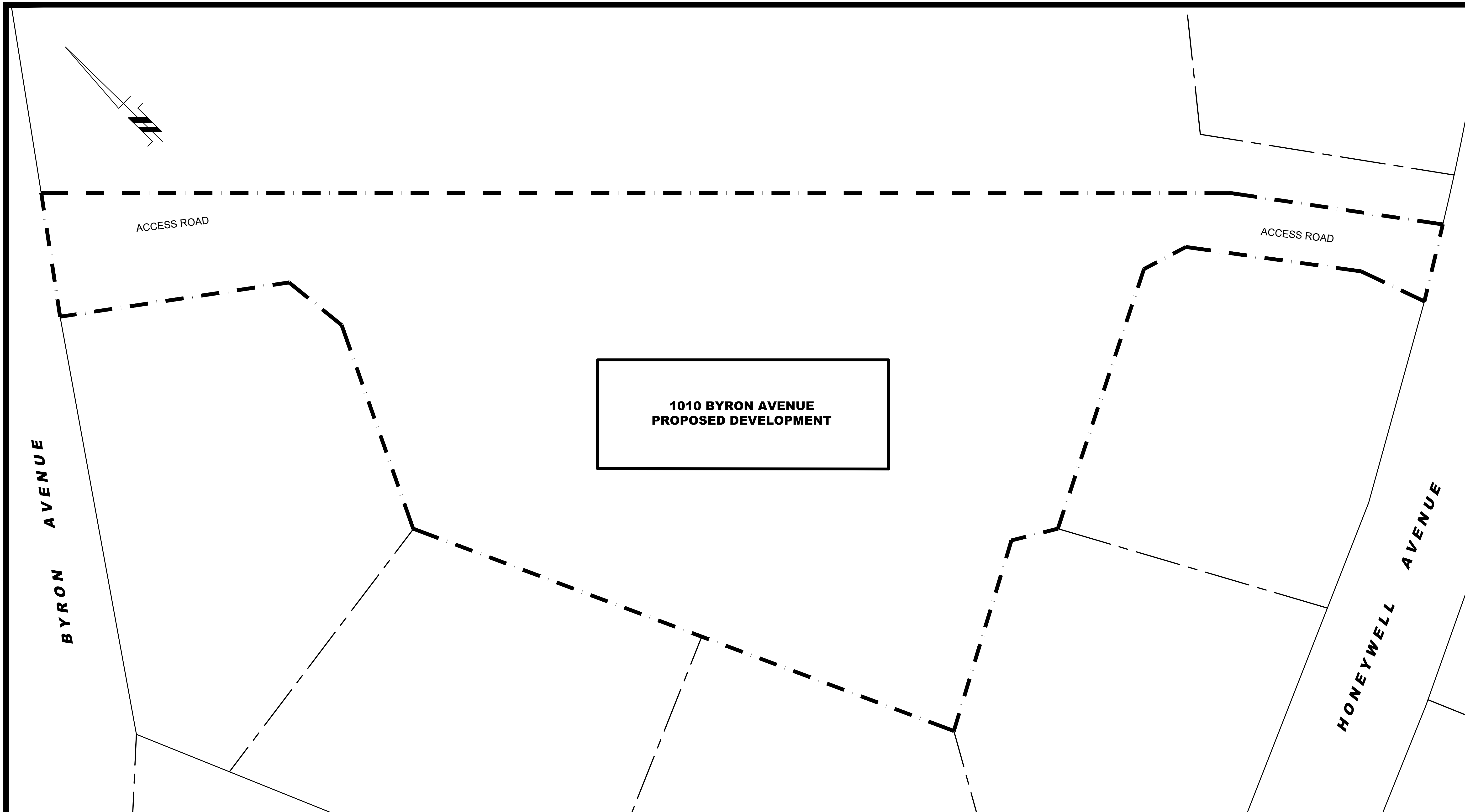
DRAWING PG5318-1D - SITE GEOMETRY (REC 4)

DRAWING PG5318-2 - RECEPTOR LOCATION PLAN

Table 9 - Summary of Reception Points and Geometry
1010 Byron Avenue

Point of Reception	Location	Leq Day (dBA)	Richmond Road						Byron Avenue					
			Horizontal (m)	Vertical (m)	Total (m)	Local Angle (degree)	Row of Houses	Density (%)	Horizontal (m)	Vertical (m)	Total (m)	Local Angle (degree)	Row of Houses	Density (%)
REC 1-1	Northern Elevation, 1st Floor	61.04	65	1.5	65.01731	-55, 45	1	30	30	1.5	30.037477	-75, 60	1	20
REC 1-3	Northern Elevation, 3rd Floor	62.09	65	7.5	65.43126	-55, 45	1	30	30	7.5	30.923292	-75, 60	1	20
REC 2-1	Eastern Elevation, 1st Floor	55.33	87	1.5	87.01293	0, 41	1	30	45	1.5	45.024993	0, 56	1	30
REC 2-3	Eastern Elevation, 3rd Floor	57.15	87	7.5	87.32268	0, 41	1	30	45	7.5	45.620719	0, 56	1	30
REC 3-1	Western Elevation, 1st Floor	54.98	82	1.5	82.01372	-51, 0	1	50	45	1.5	45.024993	-70, 0	1	50
REC 3-3	Western Elevation, 3rd Floor	56.75	82	7.5	82.34227	-51, 0	1	50	45	7.5	45.620719	-70, 0	1	50
REC 4	Outdoor Amenity Area	54.95	85	1.5	85.01323	-51, 0	1	50	47	1.5	47.02393	-74, 0	1	50

Point of Reception	Location	Leq Day (dBA)	Proposed Confederation Line					
			Horizontal (m)	Vertical (m)	Total (m)	Local Angle (degree)	Row of Houses	Density (%)
REC 1-1	Northern Elevation, 1st Floor	61.04	50	1.5	50.02249	-85, 68	1	30
REC 1-3	Northern Elevation, 3rd Floor	62.09	50	7.5	50.55937	-85, 68	1	30
REC 2-1	Eastern Elevation, 1st Floor	55.33	67	1.5	67.01679	0, 65	1	30
REC 2-3	Eastern Elevation, 3rd Floor	57.15	67	7.5	67.41847	0, 65	1	30
REC 3-1	Western Elevation, 1st Floor	54.98	62	1.5	62.01814	-83, 0	1	50
REC 3-3	Western Elevation, 3rd Floor	56.75	62	7.5	62.45198	-83, 0	1	50
REC 4	Outdoor Amenity Area	54.95	64	1.5	64.01758	-83, 0	1	50



patersongroup
consulting engineers

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

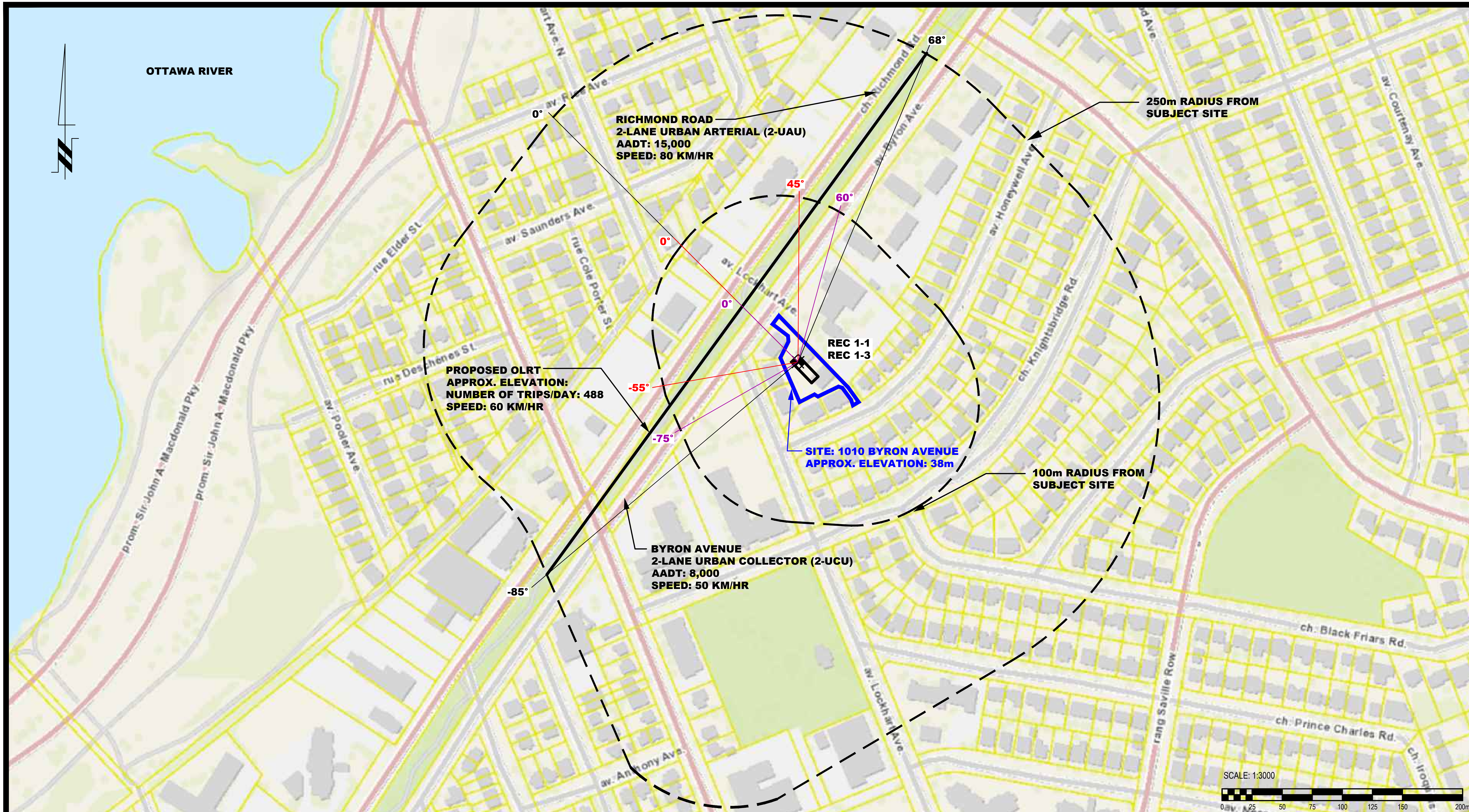
NO.	REVISIONS	DATE	INITIAL

CONCORDE DEVELOPMENTS
NOISE ATTENUATION STUDY
PROPOSED DEVELOPMENT - 1010 BYRON AVENUE
OTTAWA, ONTARIO

Title:
SITE PLAN

Scale: 1:250	Date: 05/2020
Drawn by: YA	Report No.: PG5318-1
Checked by: SB	Dwg. No.: PG5318-1
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg53xx\pg5318\pg5318-1-site plan.dwg



patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

CONCORDE DEVELOPMENTS

NOISE ATTENUATION STUDY
PROPOSED DEVELOPMENT - 1010 BYRON AVENUE

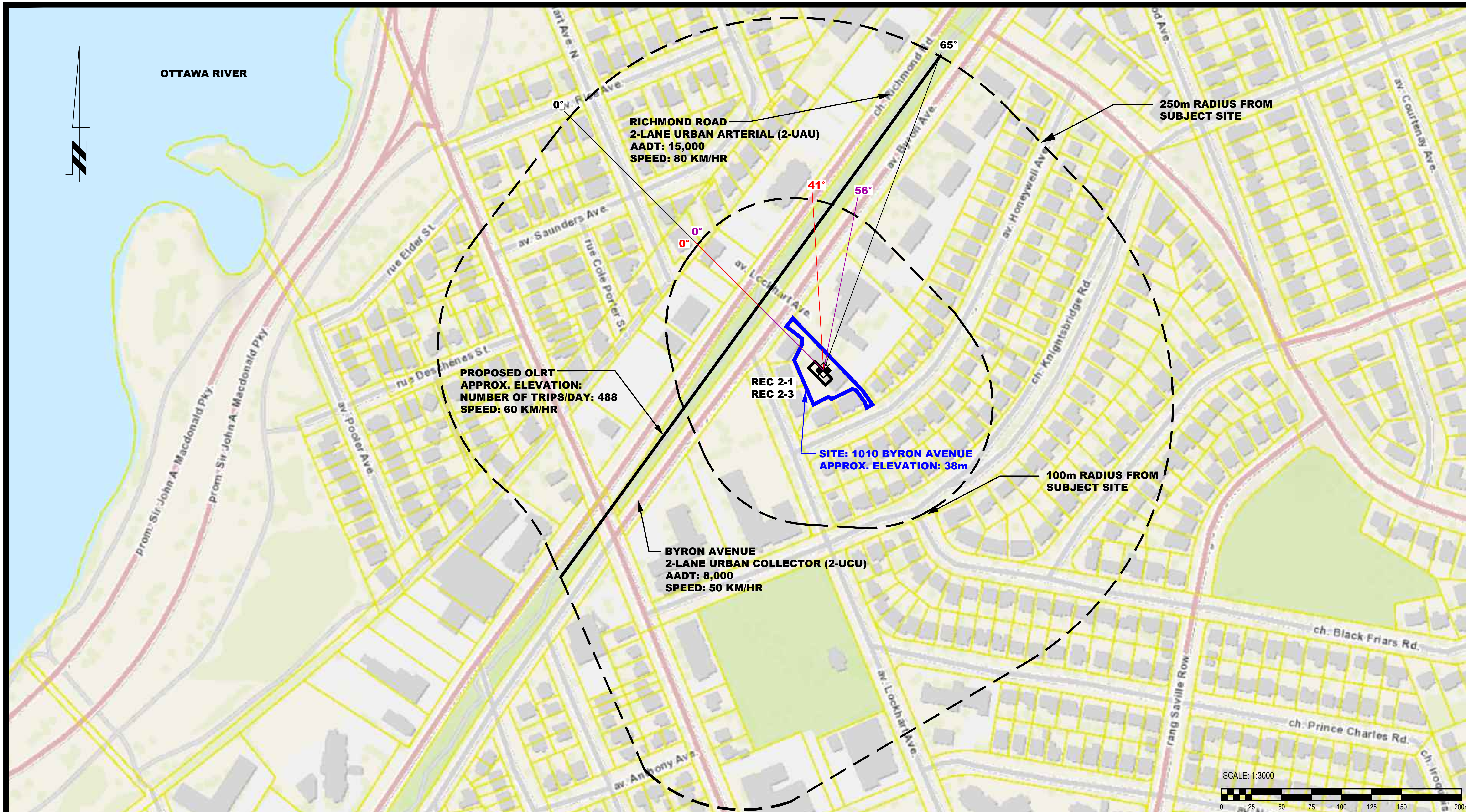
OTTAWA, ONTARIO

Title:

SITE GEOMETRY- REC 1-1 & 1-3

Scale: 1:3000	Date: 05/2020
Drawn by: YA	Report No.: PG5318-1
Checked by: SB	Dwg. No.: PG5318-2B
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg53xx\pg5318\pg5318-2-site geometry.dwg



patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

CONCORDE DEVELOPMENTS

NOISE ATTENUATION STUDY
PROPOSED DEVELOPMENT - 1010 BYRON AVENUE

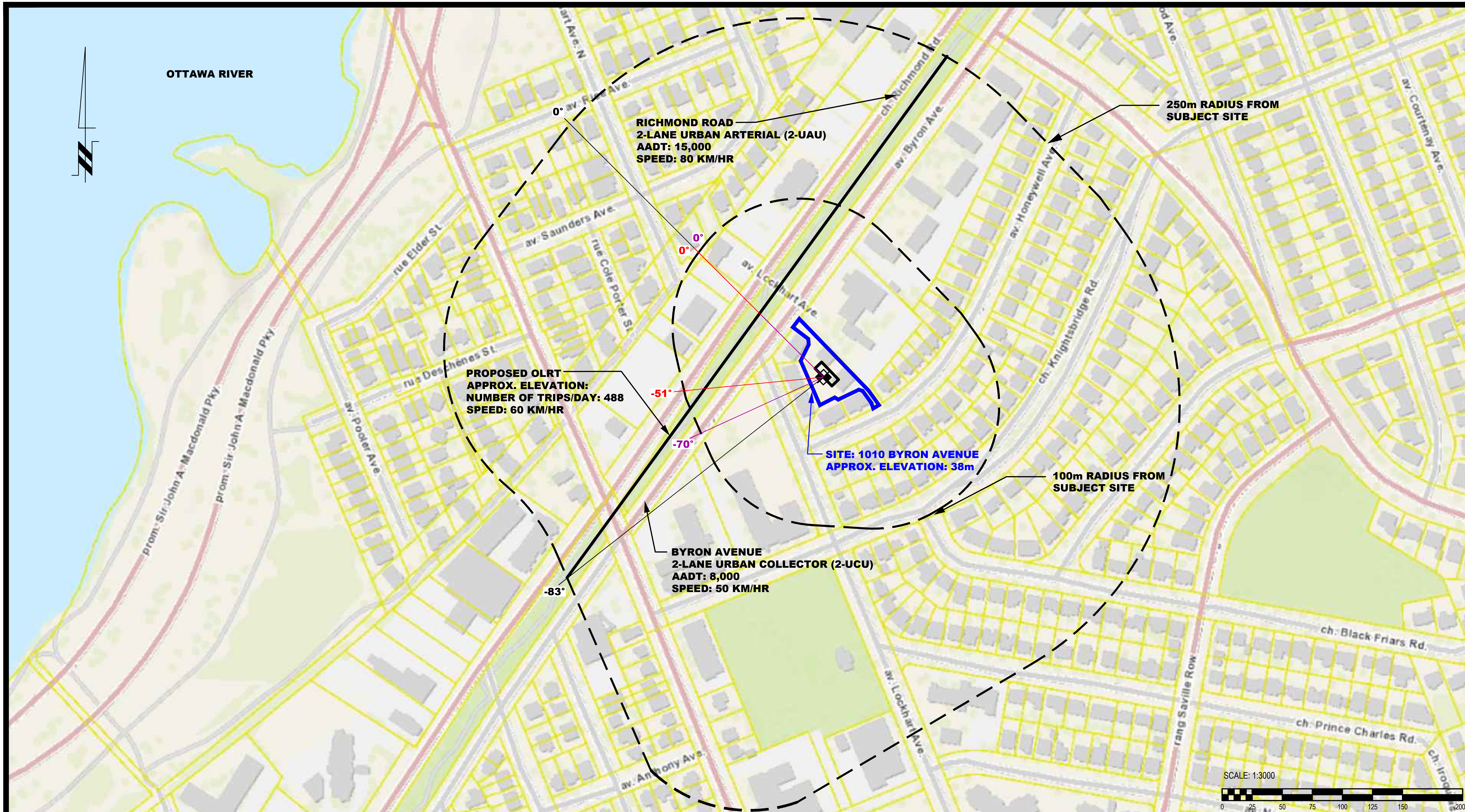
OTTAWA, ONTARIO

Title:

SITE GEOMETRY- REC 2-1 & 2-3

Scale: 1:3000	Date: 05/2020
Drawn by: YA	Report No.: PG5318-1
Checked by: SB	Dwg. No.: PG5318-2C
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg53xx\pg5318\pg5318-2-site geometry.dwg



patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

CONCORDE DEVELOPMENTS

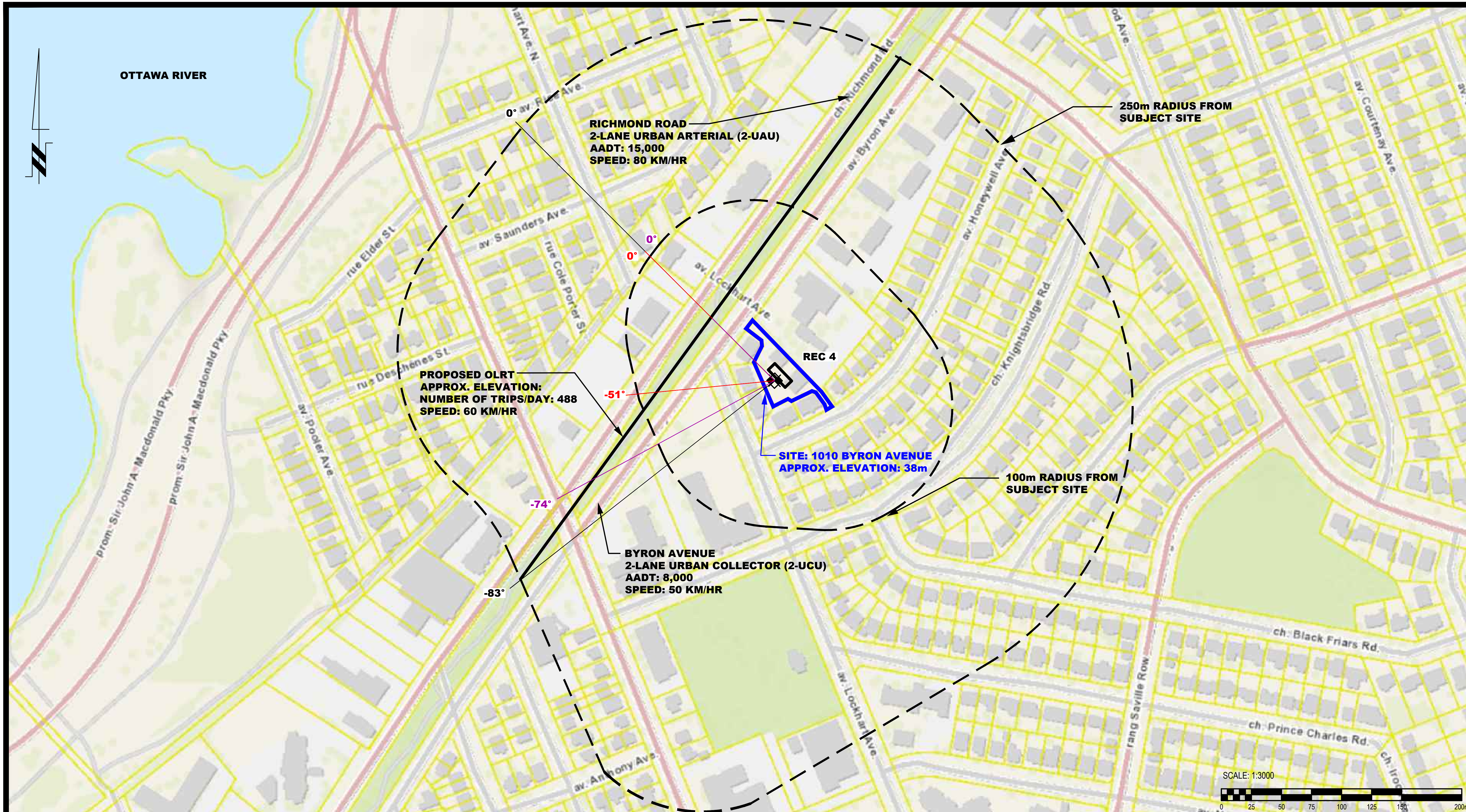
NOISE ATTENUATION STUDY
PROPOSED DEVELOPMENT - 1010 BYRON AVENUE

OTTAWA, ONTARIO

Title:

SITE GEOMETRY- REC 3-1 & 3-3

Scale: 1:3000	Date: 05/2020
Drawn by: YA	Report No.: PG5318-1
Checked by: SB	Dwg. No.: PG5318-2D
Approved by: DJG	Revision No.:



patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

CONCORDE DEVELOPMENTS

NOISE ATTENUATION STUDY
PROPOSED DEVELOPMENT - 1010 BYRON AVENUE

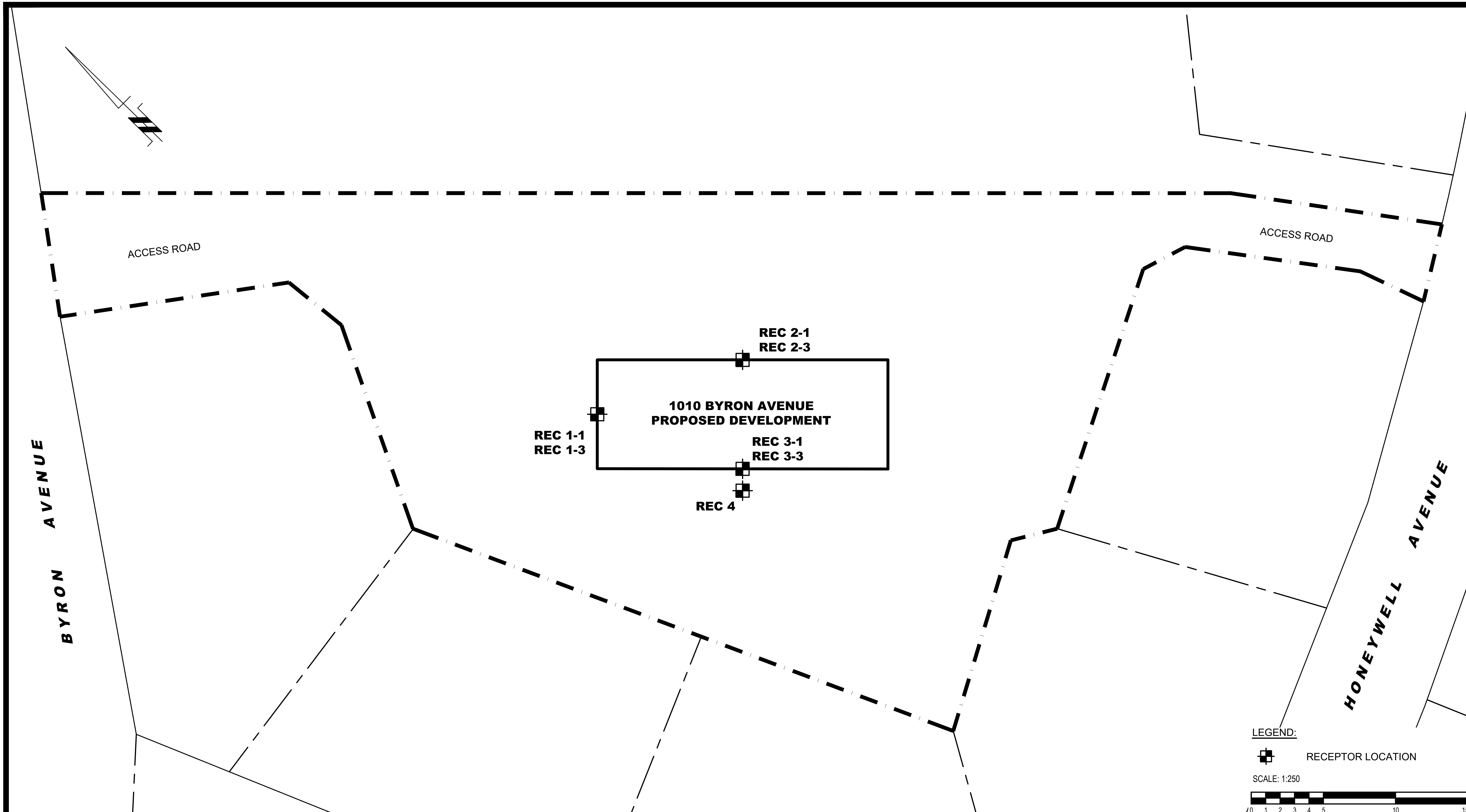
OTTAWA, ONTARIO

Title:

SITE GEOMETRY- REC 4

Scale: 1:3000	Date: 05/2020
Drawn by: YA	Report No.: PG5318-1
Checked by: SB	Dwg. No.: PG5318-2E
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg53xx\pg5318\pg5318-2-site geometry.dwg



patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

CONCORDE DEVELOPMENTS
NOISE ATTENUATION STUDY
PROPOSED DEVELOPMENT - 1010 BYRON AVENUE
OTTAWA, ONTARIO

Title:
RECEPTOR LOCATION PLAN

Scale: 1:250	Date: 05/2020
Drawn by: YA	Report No.: PG5318-1
Checked by: SB	Dwg. No.: PG5318-3
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg53xx\pg5318\pg5318-3-receptor location plan.dwg

APPENDIX 2

STAMSON RESULTS

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2020 03:11:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec11.te             Time Period: Day/Night 16/8 hours
Description: Reception Point 1-1


Rail data, segment # 1: LRT (day/night)
---------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. LRT         ! 422.0/1.0   !  60.0 !  1.0 !  1.0 !  Elec!  No

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -85.00 deg   68.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     30 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  55.00 / 55.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      4       (Elevated; with barrier)
No Whistle
Barrier angle1            : -85.00 deg   Angle2 : 68.00 deg
Barrier height            :   5.00 m
Elevation                 :   5.00 m
Barrier receiver distance :  50.00 / 50.00  m
Source elevation          :   0.00 m
Receiver elevation        :   5.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00


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

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.23 !         4.23
       0.50 !        1.50 !        1.05 !         1.05

LOCOMOTIVE (0.00 + 48.69 + 0.00) = 48.69 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -85     68   0.00  62.03  -5.64  -0.71   0.00  -1.42   0.00  54.27
```

```
   -85     68   0.00  62.03  -5.64  -0.71   0.00   0.00  -6.99  48.69
----------------------------------------------------------------------

WHEEL (0.00 + 41.95 + 0.00) = 41.95 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -85     68   0.00  65.04  -5.64  -0.71   0.00  -1.42   0.00  57.28
   -85     68   0.00  65.04  -5.64  -0.71   0.00   0.00 -16.74  41.95
----------------------------------------------------------------------

Segment Leq : 49.52 dBA

Total Leq All Segments: 49.52 dBA

↑
Results segment # 1: LRT (night)
--------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.23 !         4.23
       0.50 !        1.50 !        1.05 !         1.05

LOCOMOTIVE (0.00 + 25.45 + 0.00) = 25.45 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -85     68   0.00  38.79  -5.64  -0.71   0.00  -1.42   0.00  31.02
   -85     68   0.00  38.79  -5.64  -0.71   0.00   0.00  -6.99  25.45
----------------------------------------------------------------------

WHEEL (0.00 + 18.71 + 0.00) = 18.71 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -85     68   0.00  41.80  -5.64  -0.71   0.00  -1.42   0.00  34.03
   -85     68   0.00  41.80  -5.64  -0.71   0.00   0.00 -16.74  18.71
----------------------------------------------------------------------

Segment Leq : 26.28 dBA

Total Leq All Segments: 26.28 dBA

↑
Road data, segment # 1: Richmond (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  :    80 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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           : -55.00 deg   45.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     30 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  65.00 / 65.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           : -75.00 deg   60.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     20 %
```

```
Surface                     :      1       (Absorptive ground surface)
Receiver source distance  :  30.00 / 30.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Results segment # 1: Richmond (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.57 + 0.00) = 57.57 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -55     45   0.66  72.49   0.00 -10.57  -2.95   0.00  -1.40   0.00  57.57
----------------------------------------------------------------------------

Segment Leq : 57.57 dBA

↑
Results segment # 2: Byron (day)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 57.84 + 0.00) = 57.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -75     60   0.66  65.75   0.00  -5.00  -2.01   0.00  -0.90   0.00  57.84
----------------------------------------------------------------------------

Segment Leq : 57.84 dBA

Total Leq All Segments: 60.72 dBA

↑
Results segment # 1: Richmond (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 49.97 + 0.00) = 49.97 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -55     45   0.66  64.89   0.00 -10.57  -2.95   0.00  -1.40   0.00  49.97
----------------------------------------------------------------------------

Segment Leq : 49.97 dBA
```

↑
Results segment # 2: Byron (night)

Source height = 1.50 m

ROAD (0.00 + 50.25 + 0.00) = 50.25 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-75	60	0.66	58.16	0.00	-5.00	-2.01	0.00	-0.90	0.00	50.25

Segment Leq : 50.25 dBA

Total Leq All Segments: 53.12 dBA

↑

TOTAL Leq FROM ALL SOURCES (DAY): 61.04
(NIGHT): 53.13

↑
↑

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2020 08:29:42
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec13.te              Time Period: Day/Night 16/8 hours
Description: Reception Point 1-3


Rail data, segment # 1: LRT (day/night)
---------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. LRT         ! 422.0/1.0   !  60.0 !  1.0 !  1.0 !  Elec!  No

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -85.00 deg   68.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     30 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  55.00 / 55.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      4       (Elevated; with barrier)
No Whistle
Barrier angle1            : -85.00 deg   Angle2 : 68.00 deg
Barrier height            :   5.00 m
Elevation                 :   5.00 m
Barrier receiver distance :  50.00 / 50.00  m
Source elevation          :   0.00 m
Receiver elevation        :   5.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

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

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        7.50 !        4.77 !         4.77
       0.50 !        7.50 !        1.59 !         1.59

LOCOMOTIVE (0.00 + 50.48 + 0.00) = 50.48 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
------------------------------------------------------------------------
   -85     68   0.00  62.03  -5.64  -0.71   0.00  -1.42   0.00  54.27
```

```
   -85     68   0.00  62.03  -5.64  -0.71   0.00   0.00  -5.20  50.48
----------------------------------------------------------------------

WHEEL (0.00 + 43.44 + 0.00) = 43.44 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -85     68   0.00  65.04  -5.64  -0.71   0.00  -1.42   0.00  57.28
   -85     68   0.00  65.04  -5.64  -0.71   0.00   0.00 -15.26  43.44
----------------------------------------------------------------------

Segment Leq : 51.26 dBA

Total Leq All Segments: 51.26 dBA


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

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        7.50 !        4.77 !         4.77
       0.50 !        7.50 !        1.59 !         1.59

LOCOMOTIVE (0.00 + 27.24 + 0.00) = 27.24 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -85     68   0.00  38.79  -5.64  -0.71   0.00  -1.42   0.00  31.02
   -85     68   0.00  38.79  -5.64  -0.71   0.00   0.00  -5.20  27.24
----------------------------------------------------------------------

WHEEL (0.00 + 20.19 + 0.00) = 20.19 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -85     68   0.00  41.80  -5.64  -0.71   0.00  -1.42   0.00  34.03
   -85     68   0.00  41.80  -5.64  -0.71   0.00   0.00 -15.26  20.19
----------------------------------------------------------------------

Segment Leq : 28.02 dBA

Total Leq All Segments: 28.02 dBA


Road data, segment # 1: Richmond (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  :    80 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: Richmond (day/night)
------------------------------------------
Angle1   Angle2            : -55.00 deg   45.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      1 / 1
House density              :     30 %
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  65.00 / 65.00  m
Receiver height            :   7.50 / 7.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

↑
Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2            : -75.00 deg   60.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      1 / 1
House density              :     20 %
```

```
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  30.00 / 30.00  m
Receiver height            :   7.50 / 7.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00

🡅
Results segment # 1: Richmond (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.82 + 0.00) = 58.82 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -55     45   0.48  72.49   0.00  -9.43  -2.84   0.00  -1.40   0.00  58.82
----------------------------------------------------------------------------

Segment Leq : 58.82 dBA

🡅
Results segment # 2: Byron (day)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.58 + 0.00) = 58.58 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -75     60   0.48  65.75   0.00  -4.46  -1.82   0.00  -0.90   0.00  58.58
----------------------------------------------------------------------------

Segment Leq : 58.58 dBA

Total Leq All Segments: 61.71 dBA

🡅
Results segment # 1: Richmond (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.22 + 0.00) = 51.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -55     45   0.48  64.89   0.00  -9.43  -2.84   0.00  -1.40   0.00  51.22
----------------------------------------------------------------------------

Segment Leq : 51.22 dBA
```

```
Results segment # 2: Byron (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.98 + 0.00) = 50.98 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -75     60   0.48  58.16   0.00  -4.46  -1.82   0.00  -0.90   0.00  50.98
-----------------------------------------------------------------------------

Segment Leq : 50.98 dBA

Total Leq All Segments: 54.11 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 62.09
                         (NIGHT): 54.12
```

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2020 03:12:03
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec21.te             Time Period: Day/Night 16/8 hours
Description: Reception Point 2-1


Rail data, segment # 1: LRT (day/night)
---------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. LRT         ! 422.0/1.0   !  60.0 !  1.0 !  1.0 !  Elec!  No

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   0.00 deg   65.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     30 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  67.00 / 67.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      4       (Elevated; with barrier)
No Whistle
Barrier angle1            :   0.00 deg   Angle2 : 65.00 deg
Barrier height            :   5.00 m
Elevation                 :   5.00 m
Barrier receiver distance :  50.00 / 50.00  m
Source elevation          :   0.00 m
Receiver elevation        :   5.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

🡅
Results segment # 1: LRT (day)
------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.63 !         4.63
       0.50 !        1.50 !        2.02 !         2.02

LOCOMOTIVE (0.00 + 45.89 + 0.00) = 45.89 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  62.03  -6.50  -4.42   0.00  -1.40   0.00  49.71
```

```
     0     65   0.00  62.03  -6.50  -4.42   0.00   0.00  -5.22  45.89
----------------------------------------------------------------------

WHEEL (0.00 + 42.13 + 0.00) = 42.13 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  65.04  -6.50  -4.42   0.00  -1.40   0.00  52.72
     0     65   0.00  65.04  -6.50  -4.42   0.00   0.00 -11.98  42.13
----------------------------------------------------------------------

Segment Leq : 47.42 dBA

Total Leq All Segments: 47.42 dBA

↑
Results segment # 1: LRT (night)
--------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.63 !         4.63
       0.50 !        1.50 !        2.02 !         2.02

LOCOMOTIVE (0.00 + 22.65 + 0.00) = 22.65 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  38.79  -6.50  -4.42   0.00  -1.40   0.00  26.46
     0     65   0.00  38.79  -6.50  -4.42   0.00   0.00  -5.22  22.65
----------------------------------------------------------------------

WHEEL (0.00 + 18.89 + 0.00) = 18.89 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  41.80  -6.50  -4.42   0.00  -1.40   0.00  29.48
     0     65   0.00  41.80  -6.50  -4.42   0.00   0.00 -11.98  18.89
----------------------------------------------------------------------

Segment Leq : 24.18 dBA

Total Leq All Segments: 24.18 dBA

↑
Road data, segment # 1: Richmond (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  :    80 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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           :   0.00 deg   41.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     30 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  87.00 / 87.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           :   0.00 deg   56.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     20 %
```

```
Surface                    :      1       (Absorptive ground surface)
Receiver source distance  :  45.00 / 45.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: Richmond (day)

```
-----------------------------------
```

Source height = 1.50 m

ROAD (0.00 + 51.74 + 0.00) = 51.74 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	41	0.66	72.49	0.00	-12.67	-6.68	0.00	-1.40	0.00	51.74

Segment Leq : 51.74 dBA

Results segment # 2: Byron (day)

```
--------------------------------
```

Source height = 1.50 m

ROAD (0.00 + 51.37 + 0.00) = 51.37 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	56	0.66	65.75	0.00	-7.92	-5.56	0.00	-0.90	0.00	51.37

Segment Leq : 51.37 dBA

Total Leq All Segments: 54.57 dBA

Results segment # 1: Richmond (night)

```
-------------------------------------
```

Source height = 1.50 m

ROAD (0.00 + 44.14 + 0.00) = 44.14 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	41	0.66	64.89	0.00	-12.67	-6.68	0.00	-1.40	0.00	44.14

Segment Leq : 44.14 dBA

```
↑
Results segment # 2: Byron (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 43.78 + 0.00) = 43.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     56   0.66  58.16   0.00  -7.92  -5.56   0.00  -0.90   0.00  43.78
----------------------------------------------------------------------------

Segment Leq : 43.78 dBA

Total Leq All Segments: 46.97 dBA

↑



TOTAL Leq FROM ALL SOURCES (DAY): 55.33
                         (NIGHT): 47.00
↑
↑
```

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2020 08:36:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec21.te             Time Period: Day/Night 16/8 hours
Description: Reception Point 2-3


Rail data, segment # 1: LRT (day/night)
---------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. LRT         ! 422.0/1.0   !  60.0 !  1.0 !  1.0 !  Elec!  No

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   0.00 deg   65.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     30 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  67.00 / 67.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      4       (Elevated; with barrier)
No Whistle
Barrier angle1            :   0.00 deg   Angle2 : 65.00 deg
Barrier height            :   5.00 m
Elevation                 :   5.00 m
Barrier receiver distance :  50.00 / 50.00  m
Source elevation          :   0.00 m
Receiver elevation        :   5.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

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

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        7.50 !        6.16 !         6.16
       0.50 !        7.50 !        3.54 !         3.54

LOCOMOTIVE (0.00 + 49.71 + 0.00) = 49.71 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  62.03  -6.50  -4.42   0.00  -1.40   0.00  49.71
```

```
     0     65   0.00  62.03  -6.50  -4.42   0.00   0.00  -2.22  48.89*
     0     65   0.00  62.03  -6.50  -4.42   0.00   0.00   0.00  51.11
----------------------------------------------------------------------

 * Bright Zone !

WHEEL (0.00 + 46.51 + 0.00) = 46.51 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  65.04  -6.50  -4.42   0.00  -1.40   0.00  52.72
     0     65   0.00  65.04  -6.50  -4.42   0.00   0.00  -7.61  46.51
----------------------------------------------------------------------

Segment Leq : 51.41 dBA

Total Leq All Segments: 51.41 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        7.50 !        6.16 !         6.16
       0.50 !        7.50 !        3.54 !         3.54

LOCOMOTIVE (0.00 + 26.46 + 0.00) = 26.46 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  38.79  -6.50  -4.42   0.00  -1.40   0.00  26.46
     0     65   0.00  38.79  -6.50  -4.42   0.00   0.00  -2.22  25.65*
     0     65   0.00  38.79  -6.50  -4.42   0.00   0.00   0.00  27.86
----------------------------------------------------------------------

 * Bright Zone !

WHEEL (0.00 + 23.27 + 0.00) = 23.27 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     65   0.00  41.80  -6.50  -4.42   0.00  -1.40   0.00  29.48
     0     65   0.00  41.80  -6.50  -4.42   0.00   0.00  -7.61  23.27
----------------------------------------------------------------------

Segment Leq : 28.16 dBA

Total Leq All Segments: 28.16 dBA
```

```
Road data, segment # 1: Richmond (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  :    80 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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           :   0.00 deg   41.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     30 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  87.00 / 87.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           :   0.00 deg   56.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     20 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  45.00 / 45.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 53.18 + 0.00) = 53.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     41   0.48  72.49   0.00 -11.30  -6.61   0.00  -1.40   0.00  53.18
----------------------------------------------------------------------------

Segment Leq : 53.18 dBA

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

Source height = 1.50 m

ROAD (0.00 + 52.36 + 0.00) = 52.36 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     56   0.48  65.75   0.00  -7.06  -5.43   0.00  -0.90   0.00  52.36
----------------------------------------------------------------------------

Segment Leq : 52.36 dBA

Total Leq All Segments: 55.80 dBA

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

Source height = 1.50 m

ROAD (0.00 + 45.58 + 0.00) = 45.58 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
```

```
----------------------------------------------------------------------------
     0     41   0.48  64.89   0.00 -11.30  -6.61   0.00  -1.40   0.00  45.58
----------------------------------------------------------------------------

Segment Leq : 45.58 dBA

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

Source height = 1.50 m

ROAD (0.00 + 44.77 + 0.00) = 44.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
     0     56   0.48  58.16   0.00  -7.06  -5.43   0.00  -0.90   0.00  44.77
----------------------------------------------------------------------------

Segment Leq : 44.77 dBA

Total Leq All Segments: 48.20 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 57.15
                         (NIGHT): 48.25
```

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2020 09:26:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec31.te             Time Period: Day/Night 16/8 hours
Description: Reception Point 3-1


Rail data, segment # 1: LRT (day/night)
---------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. LRT         ! 422.0/1.0   !  60.0 !  1.0 !  1.0 !  Elec!  No

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -83.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  67.00 / 67.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      4       (Elevated; with barrier)
No Whistle
Barrier angle1            : -83.00 deg   Angle2 : 0.00 deg
Barrier height            :   5.00 m
Elevation                 :   5.00 m
Barrier receiver distance :  50.00 / 50.00  m
Source elevation          :   0.00 m
Receiver elevation        :   5.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

↑
Results segment # 1: LRT (day)
-----------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.63 !         4.63
       0.50 !        1.50 !        2.02 !         2.02

LOCOMOTIVE (0.00 + 46.98 + 0.00) = 46.98 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  62.03  -6.50  -3.36   0.00  -2.69   0.00  49.48
```

```
   -83      0   0.00  62.03  -6.50  -3.36   0.00   0.00  -5.19  46.98
----------------------------------------------------------------------

WHEEL (0.00 + 44.24 + 0.00) = 44.24 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  65.04  -6.50  -3.36   0.00  -2.69   0.00  52.49
   -83      0   0.00  65.04  -6.50  -3.36   0.00   0.00 -10.94  44.24
----------------------------------------------------------------------

Segment Leq : 48.83 dBA

Total Leq All Segments: 48.83 dBA
```

🡅
```
Results segment # 1: LRT (night)
--------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.63 !         4.63
       0.50 !        1.50 !        2.02 !         2.02

LOCOMOTIVE (0.00 + 23.74 + 0.00) = 23.74 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  38.79  -6.50  -3.36   0.00  -2.69   0.00  26.24
   -83      0   0.00  38.79  -6.50  -3.36   0.00   0.00  -5.19  23.74
----------------------------------------------------------------------

WHEEL (0.00 + 21.00 + 0.00) = 21.00 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  41.80  -6.50  -3.36   0.00  -2.69   0.00  29.25
   -83      0   0.00  41.80  -6.50  -3.36   0.00   0.00 -10.94  21.00
----------------------------------------------------------------------

Segment Leq : 25.59 dBA

Total Leq All Segments: 25.59 dBA
```

🡅
```
Road data, segment # 1: Richmond (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  :    80 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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           : -51.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  87.00 / 87.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           : -70.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
```

```
Surface                      :      1       (Absorptive ground surface)
Receiver source distance  :  45.00 / 45.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

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

Source height = 1.50 m

ROAD (0.00 + 51.28 + 0.00) = 51.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
---------------------------------------------------------------------------
   -51      0   0.66  72.49   0.00 -12.67  -5.87   0.00  -2.65   0.00  51.28
---------------------------------------------------------------------------

Segment Leq : 51.28 dBA

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

Source height = 1.50 m

ROAD (0.00 + 50.19 + 0.00) = 50.19 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
---------------------------------------------------------------------------
   -70      0   0.66  65.75   0.00  -7.92  -4.89   0.00  -2.75   0.00  50.19
---------------------------------------------------------------------------

Segment Leq : 50.19 dBA

Total Leq All Segments: 53.78 dBA

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

Source height = 1.50 m

ROAD (0.00 + 43.69 + 0.00) = 43.69 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
---------------------------------------------------------------------------
   -51      0   0.66  64.89   0.00 -12.67  -5.87   0.00  -2.65   0.00  43.69
---------------------------------------------------------------------------

Segment Leq : 43.69 dBA
```

```
↑
Results segment # 2: Byron (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 42.60 + 0.00) = 42.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -70      0   0.66  58.16   0.00  -7.92  -4.89   0.00  -2.75   0.00  42.60
----------------------------------------------------------------------------

Segment Leq : 42.60 dBA

Total Leq All Segments: 46.19 dBA

↑



TOTAL Leq FROM ALL SOURCES (DAY): 54.98
                         (NIGHT): 46.23
↑
↑
```

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2020 09:27:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec33.te             Time Period: Day/Night 16/8 hours
Description: Reception Point 3-3


Rail data, segment # 1: LRT (day/night)
---------------------------------------
Train            ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type             !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. LRT         ! 422.0/1.0   !  60.0 !  1.0 !  1.0 !  Elec!  No

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -83.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  67.00 / 67.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      4       (Elevated; with barrier)
No Whistle
Barrier angle1            : -83.00 deg   Angle2 : 0.00 deg
Barrier height            :   5.00 m
Elevation                 :   5.00 m
Barrier receiver distance :  50.00 / 50.00  m
Source elevation          :   0.00 m
Receiver elevation        :   5.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

↑
Results segment # 1: LRT (day)
------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        7.50 !        6.16 !         6.16
       0.50 !        7.50 !        3.54 !         3.54

LOCOMOTIVE (0.00 + 49.48 + 0.00) = 49.48 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  62.03  -6.50  -3.36   0.00  -2.69   0.00  49.48
```

```
   -83      0   0.00  62.03  -6.50  -3.36   0.00   0.00  -2.58  49.59*
   -83      0   0.00  62.03  -6.50  -3.36   0.00   0.00   0.00  52.17
----------------------------------------------------------------------

 * Bright Zone !

WHEEL (0.00 + 47.97 + 0.00) = 47.97 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  65.04  -6.50  -3.36   0.00  -2.69   0.00  52.49
   -83      0   0.00  65.04  -6.50  -3.36   0.00   0.00  -7.21  47.97
----------------------------------------------------------------------

Segment Leq : 51.80 dBA

Total Leq All Segments: 51.80 dBA

↑
Results segment # 1: LRT (night)
--------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        7.50 !        6.16 !         6.16
       0.50 !        7.50 !        3.54 !         3.54

LOCOMOTIVE (0.00 + 26.24 + 0.00) = 26.24 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  38.79  -6.50  -3.36   0.00  -2.69   0.00  26.24
   -83      0   0.00  38.79  -6.50  -3.36   0.00   0.00  -2.58  26.35*
   -83      0   0.00  38.79  -6.50  -3.36   0.00   0.00   0.00  28.93
----------------------------------------------------------------------

 * Bright Zone !

WHEEL (0.00 + 24.72 + 0.00) = 24.72 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  41.80  -6.50  -3.36   0.00  -2.69   0.00  29.25
   -83      0   0.00  41.80  -6.50  -3.36   0.00   0.00  -7.21  24.72
----------------------------------------------------------------------

Segment Leq : 28.56 dBA

Total Leq All Segments: 28.56 dBA
```

```
↑
Road data, segment # 1: Richmond (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  :    80 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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           : -51.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  87.00 / 87.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           : -70.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  45.00 / 45.00  m
Receiver height           :   7.50 / 7.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Richmond (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 52.76 + 0.00) = 52.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -51      0   0.48  72.49   0.00 -11.30  -5.77   0.00  -2.65   0.00  52.76
-----------------------------------------------------------------------------

Segment Leq : 52.76 dBA
```

```
Results segment # 2: Byron (day)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.25 + 0.00) = 51.25 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -70      0   0.48  65.75   0.00  -7.06  -4.69   0.00  -2.75   0.00  51.25
-----------------------------------------------------------------------------

Segment Leq : 51.25 dBA

Total Leq All Segments: 55.08 dBA
```

```
Results segment # 1: Richmond (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 45.17 + 0.00) = 45.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
```

```
-----------------------------------------------------------------------------
   -51      0   0.48  64.89   0.00 -11.30  -5.77   0.00  -2.65   0.00  45.17
-----------------------------------------------------------------------------
```

Segment Leq : 45.17 dBA

Results segment # 2: Byron (night)

```
----------------------------------
```

Source height = 1.50 m

ROAD (0.00 + 43.65 + 0.00) = 43.65 dBA

```
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -70      0   0.48  58.16   0.00  -7.06  -4.69   0.00  -2.75   0.00  43.65
-----------------------------------------------------------------------------
```

Segment Leq : 43.65 dBA

Total Leq All Segments: 47.49 dBA

```
TOTAL Leq FROM ALL SOURCES (DAY): 56.75
                         (NIGHT): 47.54
```

```
STAMSON 5.0        NORMAL REPORT        Date: 15-05-2020 16:09:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rec4.te              Time Period: Day/Night 16/8 hours
Description: Reception Point 4 - Outdoor Living Area


Rail data, segment # 1: LRT (day/night)
---------------------------------------
Train             ! Trains      ! Speed !# loc !# Cars! Eng  !Cont
Type              !             !(km/h) !/Train!/Train! type !weld
-----------------+-------------+-------+------+------+------+----
  1. LRT         ! 422.0/1.0   !  60.0 !  1.0 !  1.0 !  Elec!  No

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -83.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      4       (Elevated; with barrier)
No Whistle
Barrier angle1            : -83.00 deg   Angle2 : 0.00 deg
Barrier height            :   5.00 m
Elevation                 :   5.00 m
Barrier receiver distance :  50.00 / 50.00  m
Source elevation          :   0.00 m
Receiver elevation        :   5.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

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

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.55 !         4.55
       0.50 !        1.50 !        1.81 !         1.81

LOCOMOTIVE (0.00 + 47.04 + 0.00) = 47.04 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  62.03  -6.30  -3.36   0.00  -2.69   0.00  49.67
```

```
   -83      0   0.00  62.03  -6.30  -3.36   0.00   0.00  -5.33  47.04
----------------------------------------------------------------------

WHEEL (0.00 + 43.50 + 0.00) = 43.50 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  65.04  -6.30  -3.36   0.00  -2.69   0.00  52.69
   -83      0   0.00  65.04  -6.30  -3.36   0.00   0.00 -11.88  43.50
----------------------------------------------------------------------

Segment Leq : 48.63 dBA

Total Leq All Segments: 48.63 dBA

↑
Results segment # 1: LRT (night)
--------------------------------

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        4.55 !         4.55
       0.50 !        1.50 !        1.81 !         1.81

LOCOMOTIVE (0.00 + 23.80 + 0.00) = 23.80 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  38.79  -6.30  -3.36   0.00  -2.69   0.00  26.43
   -83      0   0.00  38.79  -6.30  -3.36   0.00   0.00  -5.33  23.80
----------------------------------------------------------------------

WHEEL (0.00 + 20.26 + 0.00) = 20.26 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -83      0   0.00  41.80  -6.30  -3.36   0.00  -2.69   0.00  29.44
   -83      0   0.00  41.80  -6.30  -3.36   0.00   0.00 -11.88  20.26
----------------------------------------------------------------------

Segment Leq : 25.39 dBA

Total Leq All Segments: 25.39 dBA

↑
Road data, segment # 1: Richmond (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  :    80 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: Richmond (day/night)
------------------------------------------
Angle1   Angle2           : -51.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  85.00 / 85.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 2: Byron (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    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):   8000
    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: Byron (day/night)
---------------------------------------
Angle1   Angle2           : -74.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      1 / 1
House density             :     50 %
```

```
Surface                     :      1       (Absorptive ground surface)
Receiver source distance  :  47.00 / 47.00  m
Receiver height             :   1.50 / 1.50   m
Topography                  :      1       (Flat/gentle slope; no barrier)
Reference angle             :   0.00

↟
Results segment # 1: Richmond (day)
-----------------------------------

Source height = 1.50 m

ROAD (0.00 + 51.45 + 0.00) = 51.45 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -51      0   0.66  72.49   0.00 -12.51  -5.87   0.00  -2.66   0.00  51.45
----------------------------------------------------------------------------

Segment Leq : 51.45 dBA

↟
Results segment # 2: Byron (day)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 50.02 + 0.00) = 50.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -74      0   0.66  65.75   0.00  -8.23  -4.76   0.00  -2.74   0.00  50.02
----------------------------------------------------------------------------

Segment Leq : 50.02 dBA

Total Leq All Segments: 53.80 dBA

↟
Results segment # 1: Richmond (night)
-------------------------------------

Source height = 1.50 m

ROAD (0.00 + 43.85 + 0.00) = 43.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -51      0   0.66  64.89   0.00 -12.51  -5.87   0.00  -2.66   0.00  43.85
----------------------------------------------------------------------------

Segment Leq : 43.85 dBA
```

```
Results segment # 2: Byron (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 42.42 + 0.00) = 42.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -74      0   0.66  58.16   0.00  -8.23  -4.76   0.00  -2.74   0.00  42.42
-----------------------------------------------------------------------------

Segment Leq : 42.42 dBA

Total Leq All Segments: 46.20 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 54.96
                         (NIGHT): 46.24
```

APPENDIX 3

CORRESPONDENCE

Stephanie Boisvenue

From: Schmidt, Mike <Mike.Schmidt@ottawa.ca>
Sent: July-24-17 9:55 AM
To: Stephanie Boisvenue
Subject: RE: Proximity Study - 851 Richmond Road
Attachments: 2017_07_20__CIV-0123-CK-CW_profile__851_Richmond_Rd.dwg; 2017_07_20__TRK-0-CK-CW_Align__851_Richmond_Rd.dwg; TRK-2-CK-SHEETS.PDF; TUN-2-S-115to195.pdf; TUN-2-S-115to195 Section.pdf

Hi Stephanie,

Attached is the track horizontal alignment and vertical profile between New Orchard Station and Cleary Station. This shows where the centerline of tracks will physically be located within the Byron Linear Park. In addition, you can see the depth of the track relative to OG (original grade). Furthermore, you may go to GeoOttawa to see the entire Stage 2 LRT alignment by selecting Rail Implementation Office layer http://maps.ottawa.ca/geoottawa/. Attached are (CAD) Alignment files for confederation line limited to the area adjacent to the development. These are stripped down horizontal and vertical alignment but will provide info needed. Attached is also a cross-section showing the typical tunnel box within the Byron Park as well as the Tunnel Alignment.

In terms of the information requested information for the noise and vibration study the following information has been provided to me by our team:

These values are for 2024 (opening year of Confed West):

- On a typical weekday, 244 trips in each direction (488 total)
- Trains are two cars long (2 x 49m = 98 m) and are electric-powered (no locomotives)
- Speeds alongside this parcel range from 45-60 kph. (Speeds in the Cleary Station area are limited to 45kph, though it’s difficult to say exactly what the passing speed will be.)

As previously mentioned the track alignment and station locations cannot be considered finalized until the contract is awarded and final design completed.

Regards,

Mike

Mike Schmidt
Planner II | Urbaniste II
O-Train Planning | Planification de l'O-Train
Transportation Services Department | Direction générale des transports
City of Ottawa | Ville d'Ottawa
613-580-2424 x 13431

From: Schmidt, Mike
Sent: Thursday, July 20, 2017 12:31 PM
To: Stephanie Boisvenue <SBoisvenue@Patersongroup.ca>
Subject: RE: Proximity Study - 851 Richmond Road

Hi Stephanie,

Sorry for the delay in getting you the requested information. I am working with my team to put together what we have available and what we are able to provide at this time. I hope to be able to send something you soon.

Regards,

Mike

Mike Schmidt
Planner II | Urbaniste II
O-Train Planning | Planification de l'O-Train
Transportation Services Department | Direction générale des transports
City of Ottawa | Ville d'Ottawa
613-580-2424 x 13431

From: Schmidt, Mike
Sent: Friday, July 14, 2017 1:24 PM
To: 'Stephanie Boisvenue' <SBoisvenue@Patersongroup.ca>
Subject: RE: Proximity Study - 851 Richmond Road

Hi Stephanie,

I will check if I can get the CAD for these ones.

Mike

From: Stephanie Boisvenue [mailto:SBoisvenue@Patersongroup.ca]
Sent: Thursday, July 13, 2017 1:10 PM
To: Schmidt, Mike <Mike.Schmidt@ottawa.ca>
Subject: RE: Proximity Study - 851 Richmond Road

Thanks Mike. I'll write our response to your e-mail shortly. But in the meantime, I was wondering I could get a copy of those drawings in autoCAD, so that we can add the cross sections to our drawings for the study.

Stephanie

From: Schmidt, Mike [mailto:Mike.Schmidt@ottawa.ca]
Sent: July-13-17 1:00 PM
To: Stephanie Boisvenue
Cc: David Gilbert; Magierowicz, Marc; Dickinson, Mary
Subject: RE: Proximity Study - 851 Richmond Road

Good morning Stephanie,

As discussed, at this stage in the LRT Stage 2 project we cannot confirm definitively if the alignment will be within Richmond Road or Byron Linear Park. At this point we have our recommended alignment which is within Byron Linear Park. The RFP has just recently gone out and since this is a design build project there is the possibility even if unlikely that the final design shifts the alignment back into Richmond Road and therefore at this stage we must protect the entire corridor ion case of that possibility. As the project moves forward we will have more certainty on how the development will proceed and we anticipate that we will have confirmation of the exact alignment location sometime in spring 2018.

In terms of moving things forward for the development application at 851 Richmond Road there are a couple of options in relation to the proximity study, with the understanding that until the alignment is confirmed we need to protect the entire corridor.

At time of site plan application submit:

1. Prepare a proximity study based on the more restrictive Richmond Road alignment.

   Or

2. Prepare a proximity study based on the less restrictive Byron Linear Park alignment. The risk of this approach is if we do not have confirmation on the alignment by the time the 851 Richmond Road development is ready for site plan approval the proximity study would likely need to be updated with the more restrictive Richmond Road alignment. Providing this information at a later date may delay the project and potentially result in changes to the site plan.

In terms of the anticipated construction of the LRT Confederation West Line we anticipate that construction would start in 2021, however construction could start any time after 2018 once the contract is awarded. The construction schedule may vary depending on the proposal that comes in from those biding on the contract. Again as the project moves forward we will have more certainty on timing. We do have conditions which we include in the site plan approval and agreement that discuss access to the site during construction. Worst case scenario if both projects are going to be constructing is the area at the same time the access, servicing, etc. will need to be coordinated and the LRT office will make best efforts to accommodate the development at 851 Richmond Road. In general, once the site plan application is submitted and circulated we will provide further comments on the timing, proximity issues, etc.

Please note that there is also the Richmond Complete Street project that will be occurring in this area and this project will be bundled with the LRT Stage 2 project.

I have attached for now some of the preliminary EA drawings that show the alignment in Richmond Road and cross sections.

I am working on getting the other information requested.

Regards,

Mike

Mike Schmidt
Planner II | Urbaniste II
O-Train Planning | Planification de l'O-Train
Transportation Services Department | Direction générale des transports

City of Ottawa | Ville d'Ottawa
613-580-2424 x 13431

From: Stephanie Boisvenue [mailto:SBoisvenue@Patersongroup.ca]
Sent: Tuesday, July 11, 2017 10:12 AM
To: Schmidt, Mike <Mike.Schmidt@ottawa.ca>
Cc: David Gilbert <DGilbert@Patersongroup.ca>
Subject: Proximity Study - 851 Richmond Road

Mike,

Thank you for taking the time to talk to me this morning, and for looking into all of the necessary information for this application.

I do understand that this segment is still being tendered, and therefore the final alignment has not been finalized. It is understood to be placed either below Richmond Road (directly adjacent to our site) or Byron Avenue (to the south of our site). Based on our phone conversation, the contracts for this portion of the alignment is to be awarded early 2018, with no construction likely occurring before 2021. This would also mean that the final alignment and design drawings may not be available until next year, however it is highly unlikely that the alignment will be placed below Richmond Road.

It is proposed that, due to the likely situation of the Confederation Line being placed below Byron Road, a Proximity Study Phase 1 be completed for the proposed development, with a condition that if the Confederation Line is to be aligned below Richmond Road, that additional studies will be completed at the time of alignment confirmation.

Finally, the discussion of timing of construction between the proposed development of 851 Richmond Road and the Confederation Line was discussed. While construction of the Confederation Line is not likely to commence until at least 2021, it is possible that the development at 851 Richmond Road may already be completed. The proximity study will reflect that the construction of the proposed residential building at 851 Richmond Road may not impact the construction of the Confederation Line due to the building being completed, and therefore will focus on the impact of the completed building on the Confederation Line. Again, we can add a provision that if the construction of 851 Richmond Road is not yet completed by the time construction of the Confederation Line, then additional information will need to be provided, such as shoring information.

In the meantime, I would appreciate if any drawings showing the alignment below Richmond Road or Byron Avenue could be forwarded to be utilized in our proximity study analysis.

Best regards,

Stephanie Boisvenue, P.Eng.

patersongroup
solution oriented engineering

tel:613.226-7381 ext. 219
154 Colonnade Road South
Ottawa, Ontario
K2E 7J5

Le présent courriel a été expédié par le système de courriels de la Ville d'Ottawa. Toute distribution, utilisation ou reproduction du courriel ou des renseignements qui s'y trouvent par une personne autre que son destinataire prévu est interdite. Je vous remercie de votre collaboration.