

Geotechnical
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Noise and Vibration Studies

Trillium Line Level 2 Proximity Study

Proposed Mixed-Use Development

933 Gladstone Avenue

Ottawa, Ontario

Prepared For

Ottawa Community Housing

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Report: PG5929-1

1.0 Introduction

Paterson Group (Paterson) was commissioned by Ottawa Community Housing (OCH) to conduct a Trillium Line Level 2 Proximity Study for the proposed mixed-use development, and for the proposed first building in the subject development, Gladstone Village Phase 1 (GVP1), to be located at 933 Gladstone Avenue, in the City of Ottawa.

The objectives of the current study were to:

- ❑ Review all current information provided by the City of Ottawa with regards to the details of the Trillium Line.
- ❑ Liaison between the City of Ottawa and the OCH consultant team involved with the aforementioned project.

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

2.0 Development Details

Based on available plans and discussion with the client, it is understood that the proposed mixed-use development at 933 Gladstone Avenue will consist of 3 high-rise buildings coupled with mid-rise buildings upon shared podiums with one to two levels of underground parking, 1 high-rise building with 3 levels of underground parking, and 4 low-rise townhouse blocks. The development will also include associated access lanes, local roadways, and landscaped areas.

For purposes of this study, only the 4 mid to high-rise buildings bordering the rail line will be considered to be within the zone of influence of the Trillium Line. The 4 proposed mid to high-rise buildings, Buildings C (GVP1), D, E, and F, will be located along the Trillium Line Railway setback approximately 3 to 8 m from the property boundary. The design underside of footing elevations for the proposed underground parking structures located along the rail are anticipated to be approximately 48.6 to 54.1 m, and the buildings will be founded upon sound bedrock. Detailed architectural (prepared by Diamond Schmitt) and civil drawings (prepared by Morrison Hershfield), and structural (prepared by RJC) and mechanical (prepared by Smith + Anderson) design briefs were only available for Building C (GVP1) at the time of preparation of this report.

It is also understood that the Trillium Line within the vicinity of the subject site is located above ground and is founded upon bedrock. It is further understood City of Ottawa proposes that the Corso Italia Rail Station be constructed in close proximity to the proposed development.

For purposes of top of rail elevations, rail station underside of footing elevations, and rail station and rail line footprint locations, available City of Ottawa Corso Italia Station drawings dated March 29, 2021 were used in conjunction with Google Earth, and the rail implementation O-Train layer on GeoOttawa . It should be noted that Paterson had to make several assumptions in preparation of this report based on the available information.

At the time of preparation of this report, the following is known about the Trillium Line in the vicinity of the subject site:

- ❑ The Trillium Line rail runs parallel to the south-west boundary of the site, with a multi-use pathway located between the subject site and the Trillium Line rail corridor.
- ❑ The existing Trillium Line rail is located at the ground surface at an approximate geodetic elevation of 56 m, while the 933 Gladstone Avenue site is located up the slope to the north-east at an approximate geodetic elevation ranging from 60 to 62 m.
- ❑ Based on the subsurface profile encountered at the borehole locations at the subject site within the vicinity of the Trillium Line, bedrock is expected at depths of about 3.0 to 7.4 m below the existing ground surface, corresponding to approximate geodetic elevations of 52.8 to 58.6 m.
- ❑ Corso Italia Station is proposed to be located approximately 19 m south-west of the proposed development within the vicinity of Buildings D and E.

3.0 Construction Methodology and Impact Review

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

3.1 Vibration Monitoring and Control Program

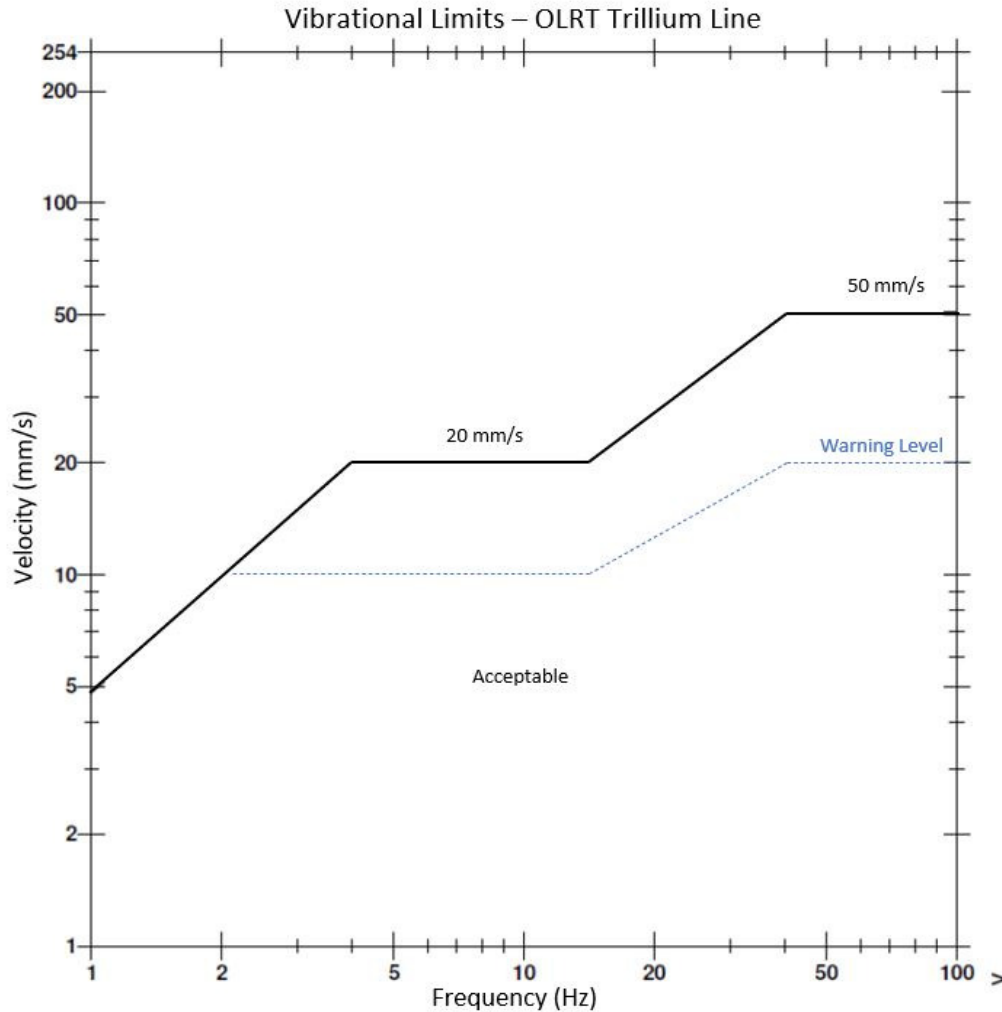
Due to the presence of the Trillium Line and proposed Corso Italia Station, which is understood to be currently under construction, the contractor should take extra precaution to minimize vibrations. The vibration monitoring program will be required for the full construction duration for blasting operations,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

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

The location should be reviewed periodically throughout construction to ensure that the monitoring equipment remains at the closest radius to the construction activities. The vibration monitor locations should be approved by the project manager prior to installation. During construction, the vibration monitor will be relocated for the 'worst case' location for each construction activity. When an event is triggered, Paterson will review the results and provide any necessary feedback. Otherwise, the vibration results will be summarized in the weekly report.

Proposed Vibration Limits

The following figure outlines the recommended vibration limits for the Trillium Line railway and associated infrastructure:



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

Monitoring Data

The monitoring protocol should include the following information:

Warning Level Event

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

Exceedance Level Event

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

The data collected should include the following:

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

Monitoring should be compliant with all related regulations.

3.2 Incident/Exceedance Reporting

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

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

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

4.0 Proximity Study Requirement Responses

Paterson was informed by the City of Ottawa that a Level 2 Trillium Line Proximity Study should be completed for the proposed development. A Level 2 Trillium Line Proximity Study is required where the proposed development is located within the City of Ottawa’s Development Zone of Influence.

The following table lists the applicable requirements for Level 1 and Level 2 study and the response location for each item:

Table 1 - List of Trillium Line Proximity Study Requirements	
Level 1 Projects	Response
A site plan of the development with the centreline or reference line of the Trillium Line structure and/or right-of-way location and the relevant distances between the Trillium Line and developer’s structure shown clearly;	See Trillium Line Proximity Plan (Drawing No. PG5929-1 dated August 2021) presented in Appendix A.
Plan and cross-sections of the development locating the Trillium Line structure/right-of-way and founding elevations relative to the development, including any underground storage tanks and associated piping;	Refer to the Trillium Line Proximity Plan (Drawing No. PG5929-1 dated August 2021) and Cross-Sections A-A’, B-B’, C-C’, and D-D’ (Drawing No. PG5929-2 to PG5929-5 dated August 2021) presented in Appendix A.
A geotechnical investigation report showing up-to-date geotechnical conditions at the site of the development. The geotechnical investigation shall be prepared in accordance with the Geotechnical Investigation and Reporting Guidelines for Development Applications in the City;	Refer to the Preliminary Geotechnical Investigation report prepared by Golder Associates: Proposed Development, Gladstone Village, 933 Gladstone Avenue, Ottawa, Ontario dated June, 2018 presented in Appendix B.
Structural, foundation, excavation and shoring drawings;	A structural design brief, and civil and architectural drawings, prepared by others, were available for Phase 1 at the time of preparation of this report and are presented in Appendix 1. Further structural, foundation, excavation and shoring drawings will be provided prior to the Site Plan Agreement. Based on available design details, the proposed building foundations will consist of conventional footings placed directly over a clean, bedrock surface. No negative impacts are anticipated for the Trillium Line or proposed Corso Italia Station due to the proposed building locations.

<p>Acknowledgment that the potential for noise, vibration, electro-magnetic interference and stray current from Confederation Line operations have been considered in the design of the project, and appropriate mitigation measures applied.</p>	<p>Refer to the draft Transportation Noise Assessment prepared by Gradient Wind Engineers & Scientists dated August 31, 2021 which is presented in Appendix C.</p>
<p>Level 2 Projects</p>	<p>Response</p>
<p>A structural analysis or calculations of the effects of loadings, including construction loading, on the Trillium Line structure, and demonstrating that the Trillium Line will not be adversely affected by the development, including solutions to mitigate any impact on the Trillium Line structure.</p>	<p>No building loads will be imposed on the subject alignment of the Trillium Line due to the presence of sound bedrock at founding level of the proposed buildings, and the setback of the Trillium Line and Corso Italia Station, which are located a minimum of 28 m and 22 m, respectively, away from the building foundations. Refer to Cross-Sections A-A', B-B', C-C', and D-D' (Drawing No. PG5929-2 to PG5929-5 dated August 2021) and the Proximity Assessment Report PG5929-LET.01 dated September 22, 2021 presented in Appendix D.</p>
<p>Documentation showing that the excavation support system and permanent structure adjacent to the Trillium Line property are designated for at-rest earth pressures.</p>	<p>The temporary shoring system will be designed for at-rest earth pressures as required by the site Preliminary Geotechnical Investigation report by others.</p> <p>Temporary shoring drawings will be submitted once they are finalized.</p>
<p>Structural drawings, including foundation plans, sections and details, floor plans, column and wall schedules and loads on foundation for the development. The relationship of the development to the Trillium Line structure should be depicted in both plan and section;</p>	<p>A structural design brief was available for Phase 1 at the time of preparation of this report and is presented in Appendix 1. Structural drawings will be provided, once available. Refer to the Trillium Line Proximity Plan (Drawing No. PG5929-1 dated August 2021) and Cross-Sections A-A', B-B', C-C', and D-D' (Drawing No. PG5929-2 to PG5929-5 dated August 2021), which illustrate the relative depths and locations of the proposed buildings to the Trillium Line and Corso Italia Station structures.</p>
<p>Shoring design criteria and description of excavation and shoring method;</p>	<p>The temporary shoring system for the proposed development is anticipated to consist of soldier piling and lagging. Additional shoring design criteria are provided in the aforementioned Preliminary Geotechnical Investigation report. The temporary shoring drawings will be submitted once they are finalized.</p>

<p>Groundwater control plan, including the determination of the short-term (during construction) and long-term effects of dewatering on the Trillium Line structure, and provision of assurances that the influences of dewatering will have no impact on the Trillium Line structure;</p>	<p>Due to the relatively shallow bedrock in the vicinity of the subject site, it is anticipated that the rail line and proposed station are bearing on bedrock. Therefore, should groundwater lowering occur, no negative impacts are expected for the Trillium Line or proposed station. Refer to Proximity Assessment Report PG5929-LET.01 dated September 22, 2021 presented in Appendix D.</p>
<p>Proposal to replace/repair waterproofing system of the affected Trillium Line structure, including the Trillium Line expansion joint;</p>	<p>As noted above, there will be at least a 22 m buffer between the proposed rail line and station and the proposed buildings at 933 Gladstone Avenue. Therefore, the replace/repair of the waterproofing system is not applicable.</p>
<p>Identification of utility installations proposed through or adjacent to Trillium Line property.</p>	<p>At the time of writing this report, civil drawings for Phase 1 were available and are presented in Appendix 1. Further detailed plans will be forwarded once they are completed. Based on the current available information, no negative impacts to the Trillium Line are anticipated due to utilities associated with Phase 1 of the proposed development.</p>
<p>Identification of the exhaust air quality and relationship of air in-take/discharge to the Trillium Line at-grade vent shaft openings and station entrance openings.</p>	<p>At the time of writing this report, the mechanical design report for Phase 1 was available and is presented in Appendix 1. Detailed plans will be forwarded once they are completed. Based on the current available information, no negative impacts to the Trillium Line are anticipated due to mechanical features associated with the Phase 1 of the proposed development.</p>
<p>Proposal for a pre-construction condition survey of the Trillium Line structure, including a survey to confirm locations of existing walls and foundations;</p>	<p>A thorough pre-construction condition survey of the Trillium Line and associated infrastructure will be completed prior to the start of construction at 933 Gladstone Avenue.</p>
<p>Monitoring plan for movement of the shoring and Trillium Line structure prior to and during construction of the development, including an Action Protocol.</p>	<p>A monitoring plan for the movement of the temporary shoring system adjacent of the Trillium Line will be completed prior to construction and will be included with the temporary shoring drawing submission.</p>

We trust that this information satisfies your immediate request.

Paterson Group Inc.



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