Final Geotechnical Reference Document

Proposed Industrial Development - Intersection of Rideau Street and Somme Street
Ottawa, Ontario

Consolidated FastFrate (Ottawa) Holdings Inc.

October 20, 2022

→ **The Power of Commitment**

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1. Introduction

GHD Limited (GHD) has been retained by Consolidated FastFrate (Ottawa) Holdings Inc. (FastFrate), represented by Mr. Keefe Primett of CBRE Limited, to complete a number of geotechnical investigations and analyses for the construction of a new warehouse and office building located southeast of the intersection of Rideau Street and Somme Street in Ottawa, Ontario, hereafter referred to as the 'Site'.

This Final Geotechnical Reference Document, hereby referred to as Final Geotechnical Report, is prepared in accordance with the CBRE Change of Order sent by email to GHD by Mr. Keefe Primett on October 11, 2022.

The purpose of this Final Geotechnical Report is to present the subsurface soil and groundwater conditions within the site development footprint as interpreted from the previous geotechnical investigations as well as taking into considerations questions and comments presented by the City of Ottawa during the Site Plan Control approval process. This Final Geotechnical Report supersedes any previously emitted geotechnical document.

This report provides recommendations with respect to the proposed development, including but not limited to:

– Foundation design and general recommendations with respect to deep dynamic compaction ground improvement technique.
– Subgrade preparation for the proposed building slabs and exterior pavement areas, including exterior pavement design.
– General excavation recommendations.
– Site seismic classification in accordance with the National Building Code of Canada (NBCC).
– Control of groundwater.
– General Construction recommendations.
– Slope Stability Analyses

In addition, this report is accompanied by a series of three appendices:

– Appendix A Soundings Reports
– Appendix B Geotechnical Lab Results
– Appendix C Analytical Lab Results
– Appendix D Water Well Record from the Ministry of the Environment and Parks
– Appendix E Slope Stability Analysis Results Under Dynamic Compaction Conditions
– Appendix F Slope Stability Analysis Results Following the Final Slope Projected Geometry
– Appendix G Maccaferri Retaining Structure Drawings

It should be noted that no field investigations were completed in order to prepare this Final Geotechnical Report. This report aims to summarize different geotechnical investigation reports and recommendations given by GHD for this development into one final document. However, all previous field investigations and geotechnical laboratory analysis methods and results are described.

Although GHD recognizes that some works have been recently completed on the site, namely grading and Dynamic Compaction, this Final Geotechnical Report only includes information and recommendations based on previously completed site investigations and comments from the City of Ottawa presented as part of the Site Plan Control approval process.

The Site location map is provided in **Figure 3** at the end of this report.

The factual data, interpretations, and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. This report should be read in

conjunction with the Statement of Limitations appended to this report. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2. Previous investigations

GHD previously completed the following geotechnical investigations on this site:

1. "Geotechnical Study Subdivision Plan Hawthorne Industrial Park Lots 26 and 27, Concession 6 Southeast of Hawthorne and Rideau Roads", dated May 4th, 2009, ref no.: T020556-A1.
2. "Geotechnical Investigation – Warehouse and Offices, Intersection of Rideau Street and Somme Street", dated October 27th, 2021, ref no.: 11215612.
3. "Supplementary Geotechnical Investigation, Proposed Industrial Development – Intersection of Rideau Street and Somme Street, Ottawa, Ontario", dated January 24th, 2022, ref no.: 11231101.

In addition to these geotechnical investigations, GHD also submitted an Addendum letter in response to the City of Ottawa comments, which is dated June 7th, 2022, ref no. 12576381.

As previously stated, this Final Geotechnical Report supersedes all other geotechnical documents submitted by GHD for this project.

3. Site and project description

The proposed new building will consist of an approximately 50,000 square feet (sf) warehouse on the eastern portion of the Site, connected to an approximately 20,000 sf cross dock on the western portion, with approximately 1,500 sf of associated office space.

The Site topography is relatively flat with various small mounds of fill material sloping down to the surrounding streets. The surrounding topography slopes up from south to north by approximately 3.5 meters (m) from Rideau Street to the section of Somme Street south of the Site. The Site elevation is higher compared to the surrounding streets varying from approximately 0.2 m higher on the south side (Somme Street) to 4.0 m higher on the north side (Rideau Street). There is also a ditch along the south, west, and north perimeters of the Site.

The historic fill placement at the Site has created sloping of approximately 2H:1V around the south, west, and north perimeters of the Site.

GHD's understanding of the proposed building, is based on a sketch provided by the client, which is illustrated in the Borehole Location Plan provided in Figure 4.

The location of the Site is shown on the Site Location Plan attached as **Figure 3**.

4. Methodology

The field investigation and geotechnical laboratory testing protocols and methodologies for the previous investigations are presented in the following sections.

4.1 Field investigation

The drilling program for each investigation is summarized in **Table 1**.

Table 1 Soundings of Previously Completed Geotechnical Investigation

Investigation	Soundings	Approx. depth (m)
1. 2009 - T020556-A1(1)	B5-1, B5-2, B5-3, MW7-08, TP5-01	3.9 to 10.0
2. 2021 - 11215612	BH1, BH2, BH3, BH4, DCPT5	11.3 to 14.9
3. 2022 - 11231101	BH-1-21, BH-2-21, BH-3-21, BH-4-21, BH-5-21	8.0 to 18.9

Notes:
(1) Only the soundings completed in the proposed development footprint are presented.

The drilling program associated with the 2022 geotechnical investigation was conducted between July 26 and July 28, 2021, and consisted of advancing a total of five boreholes identified as BH1-21 to BH5-21. Three of the boreholes were located within the proposed building footprints and extended to 9.1 to 18.9 metres below ground surface (mbgs), and two of the boreholes were located in the proposed retaining structure footprint located on the northern extremity of the site extended from 8.0 to 12.0 mbgs.

Drilling for the 2021 geotechnical investigation was conducted between August 6 and August 7, 2020, and consisted of advancing a total of four boreholes and one dynamic cone penetration test identified as BH1 to BH4 and DCPT5. The boreholes were advanced to depths ranging between 11.1 and 14.9 mbgs, and the dynamic cone penetration test was terminated at 5.9 mbgs.

For the 2009 investigation, four boreholes and one test pit identified as B5-1 to B5-3, MW7-08, and TP5-01 were advanced in the proposed development footprint. The boreholes were advanced between 3.9 and 10.0 mbgs. The test pit was terminated at 3 mbgs.

The drilling work was carried out by a track-mounted power auger drilling rig, under the full-time supervision of a GHD's experienced technical representative.

The boreholes were advanced using hollow stem augers, and soil samples were collected every 0.75 m intervals to the termination depth of the boreholes. All samplings were conducted using a 50-millimetre (mm) outside diameter split spoon sampler in general accordance with the specifications of the Standard Penetration Test Method (ASTM D1587-8). In addition, at each borehole location, the relative density or consistency of the subsurface soil layers was measured using the Standard Penetration Test (SPT) method, by counting the number of blows ('N') required to drive a conventional split-barrel soil sampler 0.30 m depth. Soil samples were retrieved from each borehole location to verify strata boundaries and soil properties.

In each investigation phase, GHD's technical representatives logged the overburdened material encountered in the boreholes and examined the samples as they were obtained. The recovered samples were sealed in clean and transferred to the GHD laboratory, where they were reviewed by a senior geotechnical engineer. The detailed results of the individual boreholes are recorded on the accompanying borehole logs presented in Appendix A.

Monitoring wells were installed in boreholes nos BH1 and MW7-08 in order to measure groundwater levels. Details of the monitoring well construction are presented on the attached borehole logs.

The boreholes in which monitoring wells were not installed were backfilled upon completion and sealed in accordance with Ontario Regulation 903 (O. Reg. 903). Excess soil cuttings were distributed evenly on the ground surface in the area of the location of the boreholes.

4.2 Surveying

Geodetic ground surface elevations were collected by GHD field staff with a Leica 1200+ Real-Time-Kinematic (RTK) GPS survey system. The elevations of the boreholes are for use within the context of this report only.

4.3 Laboratory testing

Prior to the geotechnical laboratory testing, the soil samples extracted from the Site were subjected to tactile examination by an experienced GHD geotechnical engineer who confirmed the field descriptions and selected representative samples for detailed testing. Soil classification has been conducted in accordance with the Unified Soil Classification System (ASTM D2487).

Geotechnical laboratory testing included moisture content determination on 127 recovered samples. The results for moisture content determination are presented in Appendix B.

A total of 11 particle size distribution tests (gradation analysis) using sieve analysis (ASTM D6913) and hydrometer testing (MTO LS-702) were completed. The results of the grain size analysis (sieve and hydrometer) are summarized in the following sections and the grain-size distribution curves are presented in Appendix B.

Uniaxial Compressive Strength of Intact Rock Core Specimens tests (ASTM D7012 – Method C) were conducted on two representative rock core samples. The results are presented in Appendix B. A summary of the obtained results is tabulated in the following sections.

Table 2 presents the number and type of geotechnical laboratory testing completed within the previous investigations.

Table 2 Geotechnical Laboratory Testing Completed

Laboratory test	2022 investigation (11231101)	2021 investigation (11215612)
Hydrometer grain size analyses	7	4
Atterberg limit tests	5	1
Moisture content determination	79 (on all collected samples)	48 (on all collected samples)
Unconfined compressive strength test (UCS)	1	1

Analytical testing was also carried out on one soil sample collected during the 2021 investigation to determine the corrosion potential of the subsurface soils at the Site. The certificates of analysis of the corrosion testing are presented in Appendix C.

4.4 Subsurface conditions

Error! Reference source not found. presents a summary of the depth (elevation) or thickness of each subsoil stratum encountered at the sounding locations completed by GHD. The corresponding borehole logs are presented in Appendix A of this report. The subsections below briefly summarize the encountered stratigraphy.

It should be noted that the subsurface conditions are confirmed at the borehole locations only and may vary at other locations (between and beyond the borehole locations). The boundaries between the various strata, as shown on the borehole logs, are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geological change.

The general stratigraphy at the Site consists of topsoil overlying a thick layer of fill material, underlain by a native silty sand to sandy silt deposit. Locally, a silty clay till is encountered under this deposit. Limestone bedrock with interbedded sandstone was encountered at depths ranging from 8.2 mbgs (BH1) to 14.8 mbgs (BH2-21). A brief description of each soil stratum is summarized in **Table 3** and in the sections below.

Table 3 Subsoil Stratigraphy Depth and Elevation (m)

Sounding no. (Surface elevation)	Topsoil thickness (m)	Fill thickness (m)	Silty sand to sandy silt depth (Elevation)	Sandy clay depth (Elevation)	Silty clay depth (Elevation)	Bedrock depth (Elevation)	End of sounding depth (Elevation)
2022 Investigation							
BH1-21 (91.07)	0.075	4.50	4.58 (86.49)	--	--	9.86 (81.21)	13.82 (77.25)
BH2-21 (90.79)	0.075	5.26(1)	5.34 (85.45)	--	11.56 (79.23)	14.78 (76.01)	18.87 (71.92)
BH3-21 (90.55)	0.075	3.33(1)	3.81 (86.74)	--	--	--	9.14(2) (81.11)
BH4-21 (90.23)	0.075	6.48(1)	6.55 (83.68)	--	11.43 (78.80)	--	12.04(2) (78.19)
BH5-21 (90.39)	0.075	4.50	4.57 (85.82)	--	--	--	8.00(2) (82.39)
2021 Investigation							
BH1 (90.21)	0.075	5.84	5.91 (84.30)	--	--	8.21 (82.00)	11.30 (78.91)
BH2 (89.80)	0.075	6.03	6.10 (83.70)	--	--	9.30 (80.50)	12.20 (77.60)
BH3 (90.88)	0.125	5.96	6.08 (84.80)	--	--	11.88 (79.00)	14.90 (75.98)
BH4 (90.44)	0.125	6.02(1)	6.14 (84.30)	--	--	--	11.14(2) (79.30)
2008 Study							
B5-1 (90.48)	--	5.33((1)	5.33 (85.15)	6.86 (83.62)	7.32 (83.16)	--	10.03(2) 80.45
B5-2 (90.78)	--	4.57(1)	--	--	4.57 (86.21)	--	6.71 (84.07)
B5-3 (90.51)	--	6.10(1)	--	--	6.10 (84.41)		7.62 (82.89)
MW7-08 (93.81)	--	5.49	5.49 (88.32)	--	--	--	3.92 (89.83)
TP5-01 (91.08)	--	3.00	--	--	--	--	3.00 (88.08)

Notes:
(1) Presence of organic materials encountered in the fill
(2) Borehole terminated on auger refusal
-- Not encountered

4.4.1 Topsoil layer

A surficial layer of topsoil with rootlets and organic matter was encountered at the ground surface of all 2022 and 2021 boreholes drilled at the Site. The thickness of the topsoil layer ranged from 75 mm to 125 mm at the borehole locations. It should be noted that the thickness of topsoil may vary between borehole locations. Classification of this material was based solely on visual and textural evidence.

4.4.2 Fill layer

Fill was encountered below the ground cover in all soundings. The fill materials generally extended to approximate depths ranging between 3.3 to 6.0 mbgs. Its composition is in general heterogeneous, consisting of a mixture of sand, silt, clay, and gravel. Cobbles and possible boulders were encountered in the boreholes at varying depths. Trace amount of organic matter and/or rootlets were also observed within the fill in boreholes nos BH2-21 through BH4-21, BH4, and B5-1 through B5-3. Fragments of buried asphalt were noted in boreholes nos. BH3, BH4, BH3-21, B5-1, through B5-3, and MW7-08.

Standard Penetration (SPT) 'N' values obtained within the fill layer varied between 2 to 46 blows per 300 mm, indicating a soft to stiff consistency of the fine-grained fill materials or very loose to dense relative density of the granular materials. One shear vane test was performed within the clay fill material at the location of borehole no. BH2 location that recorded a shear strength of 50 kilopascals (kPa).

Samples of this material were visually described to be in a generally moist condition transitioning to wet at around 3 to 4 mbgs depth. The measured moisture content of the fill samples extracted from the borings generally ranged between 10 and 20 percent by weight. Occasionally elevated moisture content values obtained from the fill material indicate the presence of organic matter.

Five fill samples were submitted to particle size distribution tests and one to an Atterberg Limit test. The results are summarized in **Table 4** and **Table 5**.

Table 4 Summary of the Particle Size Distribution Tests Results on Fill Layer Samples

Borehole ID	Sample number	Depth (mbgs)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Fines silt & clay (%)
BH1	SS3	1.5 – 2.1	51	43	5	1	6
BH2	SS4	2.3 – 3.0	1	2	36	61	97
BH2	SS7	4.5 – 6.1	25	38	29	8	37
BH1-21	SS2B	0.9 – 1.4	17	60	19	4	23
BH5-21	SS3	1.5 – 2.1	25	38	29	8	37

Table 5 Summary of Atterberg Limit Tests Results on Fill Layer Samples

Borehole ID	Sample Number	Depth (mbgs)	WL (%)	WP (%)	IP (%)	W (%)
BH2	SS4	2.3 – 3.0	69	21	48	56.0
Notes: W – Natural Water Content WL – Liquid Limit WP – Plastic Limit IP – Plasticity Index						

These results confirm that the fill layer is generally heterogeneous with mainly sand and gravel with varying proportions of silt and clay.

4.4.3 Silty sand to sandy silt deposit

The prominent native soil at the Site consists of granular deposits of silty sand to sandy silt that was encountered beneath the earth fill layer in all the drilled boreholes. The granular soils contained varying amounts of gravel and clay. Cobbles and possible boulders are expected within this deposit becoming more frequent with depth.

SPT 'N' values within the silty sand or sandy silt stratum varied between 5/300 mm and greater than 100/300 mm, indicating a loose to very dense relative density. The deposit is generally in a compact to very dense condition except in borehole no. BH3-21, where the silty sand soils were locally observed to be loose between 4.8 to 5.2 mbgs.

Water content measurements obtained from extracted samples of the granular soils varied between 7 and 30 percent indicating a moist to wet condition.

Five samples were submitted to particle size distribution tests and four to Atterberg Limit test. The results are summarized in **Table 6** and **Table 7**.

Table 6 Summary of the Particle Size Distribution Tests Results on Silty Sand to Sandy Silt Deposit Samples

Borehole ID	Sample number	Depth (mbgs)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Fines silt & clay (%)
BH3	SS10	6.9 – 7.5	8	47	37	8	45
BH1-21	SS13	9.1 – 9.8	16	32	36	16	52
BH2-21	SS12	8.4 – 9.0	20	38	33	9	42
BH3-21	SS8	5.3 – 5.9	19	49	26	6	32
BH5-21	SS7	4.6 – 5.2	10	38	41	11	52

Table 7 Summary of Atterberg Limit Tests Results on Silty Sand to Sandy Silt Deposit Samples

Borehole ID	Sample number	Depth (mbgs)	WL (%)	WP (%)	IP (%)	W (%)
BH1-21	SS13	9.1 – 9.8	26	18	8	8.0
BH2-21	SS12	8.4 – 9.0	25	17	8	8.9
BH3-21	SS8	5.3 – 5.9	17	13	4	9.7
BH5-21	SS7	4.6 – 5.2	20	13	7	15.0

Notes:
W – Natural Water Content
WL – Liquid Limit
WP – Plastic Limit
IP – Plasticity Index

4.4.4 Sandy clay layer

A sandy clay layer was encountered below the silty sand to sandy silt at the location of borehole no. B5-1. The material was very soft and in a moist condition. Refusal, with SPT 'N' values over 50 for 300 mm, was encountered in this material, which indicates that it is in a very dense state.

4.4.5 Silty clay till

Below the fill material and the native sandy clay (in borehole no. B5-1) a silty clay layer was encountered at depths ranging from 4.6 to 11.4 mbgs in borehole nos. BH-2-21, BH-4-21, B5-1, B5-2, and B5-3. With the exception of localized sections in boreholes nos B5-2 and B5-3, the silty clay layer stiffness can be described as hard. An SPT 'N' value between 39 and 59 and refusal was encountered in this deposit. In borehole no. B5-2, between 4.57 and

6.12 mbgs, the silty clay layer is firm to stiff with an SPT 'N' values of 2 and 7. In borehole no. B5-3, between 6.1 and 6.71 mbgs, the deposit is firm with an SPT 'N' value of 25. It then becomes very stiff with an SPT 'N' value of 39.

Water content measurements obtained from extracted samples of the fine-grained soils varied between 11 and 14 percent, indicating a moist condition.

One sample of this layer was submitted to a particle size distribution test and an Atterberg Limit test. The results are summarized in **Table 8** and **Table 9**.

Table 8 Summary of the Particle Size Distribution Test Results on Silty Clay Till Layer Sample

Borehole ID	Sample number	Depth (mbgs)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Fines silt & clay (%)
BH2-21	SS18 (Silty Clay)	13.0 – 13.6	6	29	42	23	65

Table 9 Summary of Atterberg Limit Test Results on Silty Clay Till Layer Sample

Borehole ID	Sample Number	Depth (mbgs)	WL (%)	WP (%)	IP (%)	W (%)
BH2-21	SS18 (Silty Clay)	13.0 – 13.6	28	14	14	11.9
Notes: W – Natural Water Content WL – Liquid Limit WP – Plastic Limit IP – Plasticity Index						

The geotechnical tests conducted in this layer, which show water content values lower than the plasticity limit as well as the SPT 'N' values obtained during the advancement of the boreholes and the visual observations of the retrieved samples, allow us to conclude that this deposit is associated with a fluvioglacial till and not a glaciomarine clay. This deposit is not considered sensitive.

4.4.6 Bedrock

Limestone bedrock with interbedded sandstone was encountered at depths of 8.2 mbgs (BH1), 9.3 mbgs (BH2), 11.9 m (BH3), 9.9 mbgs (BH1-21), and 14.8 mbgs (BH2-21). Boreholes nos BH4, BH3-21 to BH5-21, and B5-1 were terminated upon refusal at depths ranging from 8.0 to 12.0 mbgs in inferred bedrock or boulders. The bedrock quality varied with depth and location; the recorded rock quality designation (RQD) ranged between 37 to 95 percent.

Table 10 Summary of Uniaxial Compressive Strength of Intact Rock Core Specimens

Borehole ID	Rock type	Depth (mbgs)	Compressive strength (MPa)
BH2	Limestone	9.4 – 9.6	125.2
BH2-21	Limestone	15.7 – 15.8	139.1

Based on the results of the unconfined compressive strength test, the tested rock core samples may be generally classified in accordance with ISRM (International Society of Rock Mechanics) guidelines as very strong.

4.5 Groundwater conditions

Four wells are present on the site. Two of them, wells nos MW7-08 and BH1 were installed by GHD. The details of the other two wells are unknown, however, based on the logs of the historical water wells installed at the Site or in its immediate vicinity obtained from the Ministry of Environment and Parks (MECP) website, these wells could be wells nos 1527383 and 1527384. The well logs retrieved from the MECP website are presented in Appendix D.

Table 11 shows measured groundwater levels.

Table 11 Groundwater Readings

Monitoring well ID	Installation date	Ground surface elevation (2) (m)	Well installation depth (mbgs)	Water level readings depths mbgs(1)/Elev. (m) August 18, 2020	Water level readings depths mbgs(1)/Elev. (m)June 3, 2022	Water level readings depths mbgs(1)/Elev. (m) August 9, 2022
BH1 (GHD)	August 6, 2020	90.2	7.1	4.0/86.2	2.95/87.5	Abandoned
MW7 (CRA)	2008	90.8	6.0	3.3/87.5	2.70/88.3	Abandoned
Northwest Well	Unknown	90.9	5.3	3.3/87.6	3.30/87.6	Abandoned
Northeast Well	Unknown	90.3	5.4	3.5/86.8	2.90/87.6	Abandoned
Notes: (1) Metres below ground surface						

The measured groundwater levels in the installed monitoring wells ranged between 2.70 and 4.0 mbgs, at elevations ranging between 86.2 and 88.3 m. These levels indicate the water is within the fill material. It should be noted that the groundwater table is subject to seasonal fluctuations and in response to precipitation and snowmelt events. Also, it would be expected that water may be perched within the fill materials, especially during and following periods of precipitation and in the spring and fall or other wet seasonal periods.

4.6 Corrosivity testing results

One soil sample was submitted for analysis of parameters used to assess the potential corrosivity of the site soils to steel and concrete during the 2021 investigation. The Certificates of Analysis are provided in Appendix C and summarized in **Table 12**.

Table 12 Corrosion Parameter Results

Sample ID	BH3 SS3
pH	8.66
Resistivity (ohm-cm)	1920
Sulphate (%)	0.08
Chloride (%)	0.008
REDOX Potential (mV)	205
Sulphide (ug/g)	<0.20

5. Discussion and recommendations

The recommendations in this report are based on GHD's understanding of the most recent proposed development, which is outlined below:

– An approximate 50,000 sf warehouse on the west portion of the Site.
– An approximate 20,000 sf cross-dock connected to the east face of the warehouse.
– Approximately 1,500 sf of office space connected to the south face of the cross-dock.
– No underground levels are planned for the proposed structure.

At the time of preparation of this report, it is understood that the finished floor elevation is at 92.0 m. Structural details, specifically column loads, were not known.

Based on the proposed development, the subsurface conditions encountered in the boreholes, and assuming the boreholes to be representative of the subsurface conditions across the Site, the following recommendations are provided for the design of the proposed building.

Fill material:

An approximate 3.3 m to 6.0 m thick layer of fill is present throughout the Site. The composition of the fill material is not consistent with depth or from borehole to borehole. Buried asphalt was noted in the fill material at various locations. Traces of organic matter and layers up to 3.51 m bgs were also locally encountered in the fill material. This uncontrolled fill material is unsuitable to accommodate the use of conventional shallow foundations and slab-on grades in its current state.

***Ground improvement methods, such as deep dynamic compaction, can be used to render the existing fill suitable to support the shallow foundation for the proposed structure. Although deep dynamic compaction is generally considered suitable for deep, loose, low-plasticity mineral fills, it is not effective in adequately compact, high organic layers. It is, therefore, recommended that prior to commencing the deep dynamic compaction detailed design, the specialty soil improvement contractor conducts a supplementary test pit investigation to determine the nature and extent of organics within the fill layer or at the fill/native deposit interface to confirm that the deep dynamic compaction method is the most viable and feasible soil improvement method for this project*. Over excavation of organics/clayey lens and addition of sand and gravel layer during the compacting process could be locally required**.

Alternatively, other soil improvement techniques, such as the installation of rigid inclusions or deep foundations, such as steel piles driven to refusal, could be used to support both the building structure and slabs may be considered. GHD can provide recommendations for other foundation support systems (including other soil improvement techniques) at FastFrate's request and if required.

However, considering that the Client has opted for the use of deep dynamic compaction on the site to improve the existing ground conditions, GHD is only presenting recommendations regarding this option.

Presence of cobbles and boulders:

Obstructions to SPT were encountered within the fill material as well as within the native deposit overlying the bedrock. The obstructions are assumed to be possible cobbles or boulders. The specialty soil improvement contractor should review the presence of cobbles and boulders in the fill layer and native deposits and determine if their presence would affect the preferred methodology and its effectiveness.

Dewatering:

Considering the groundwater level, which is approximately 2.7 mbgs, the general excavations are expected to be above the groundwater level. Surface water and perched water lenses may, however, be encountered.

Slope stability:

The historic fill placement at the Site has created sloping of approximately 2:1 (H:V) around the south, west, and north perimeters of the Site. Slope stability analysis for the construction sequence, under dynamic compaction conditions and the geometry of the final slopes, has been completed by GHD and is presented in the following sections.

5.1 Site preparation and grading

5.1.1 Building footprints (foundations and slabs)

As previously stated, the initial site conditions consist of a 3.3 to 6.5 m thick uncontrolled fill layer. This fill layer was randomly placed (i.e., it is not an engineered fill), therefore, not suitable to support conventional shallow foundations. Ground improvement methods, such as deep dynamic compaction, can be used to densify the existing fill layer and accommodate such structures founded directly on the subgrade. These soil improvement works must be completed and certified by a contractor specialized in this field.

The deep dynamic compaction method would compact the existing fill material using a crane that repeatedly drops a weight in a closely spaced grid pattern across the site, creating a uniformly compacted subgrade.

This would result in consolidation and thus lower the existing grades. Additional fill could be required to achieve the design grades.

Following the end of the dynamic compaction work, the soil improvement contractor will have to certify his work for the desired bearing capacity. For this project, the desired serviceability limit state the bearing capacity is 150 kPa and the ultimate limit states bearing capacity is 225 kPa. In order to certify these capacities, the contractor will have to conduct a number of Pressure Meter Testing (PMT) in accordance with ASTM D4719. An acceptable lower limit of the pressure limit result from the PMT would be 600 kPa over a depth of 1.5 B, where B is the footing width. However, the confirmation of the bearing capacity of the improved soils is the responsibility of the specialty contractor.

Although the existing fill is generally suitable for densification with deep dynamic compaction, it should be noted that the presence of organics within this uncontrolled fill may require the excavation and replacement of some materials. This will be determined by the soil improvement contractor while completing the deep dynamic compaction work, as deep craters may appear in zones with increased organic materials. In which case, the existing fill will have to be excavated and replaced with granular material.

Prior to Site grading activity, the exposed dynamically compacted subgrade soils should be visually inspected and probed. Any soft, organic, or unacceptable areas should be removed as directed by the Geotechnical Engineer and replaced with suitable engineered materials.

The fill required to achieve the design grades must comprise clean granular materials free of organics, frozen soils, construction debris, particle sizes larger than 100 mm, and any other deleterious materials. This material, approved by the geotechnical engineer, should be placed in loose lifts of up to 200 mm thick and compacted to 98 percent SPMDD in the building footprint.

Fill in the building footprint must be placed under full-time geotechnical supervision to be certified as engineered fill.

5.1.2 Exterior pavement and underground servicing

Similarly, as stated above the presence of a 3.3 m to 6.0 m thick layer of uncontrolled fill would require site soil improvement for the pavement and servicing subgrade.

Ideally, this improvement would involve similar dynamic compaction methods as discussed in the building subgrade preparation section above.

Should these operations not be economically justified, the client must be aware that deflections and cracking and potential movement of underground servicing should be anticipated where parking areas and underground services are constructed over the existing fill. A pavement and servicing maintenance program should be considered for this development.

Should the client forgo dynamic compaction within the pavement and exterior servicing areas, alternate less significant improvement methods would involve additional compaction of the subgrade as well as placement of thicker base and sub-base layers.

Prior to Site grading activity, the exposed subgrade soils should be visually inspected, compacted, and proof-rolled using large axially loaded equipment. Any soft, organic, or unacceptable areas should be removed as directed by the Geotechnical Engineer and replaced with suitable engineered materials.

The fill required to achieve the design grades must comprise clean granular materials free of organics, frozen soils, construction debris, particle sizes larger than 100 mm, and any other deleterious materials. The material, approved by the geotechnical engineer, should be placed in loose lifts up to 200 mm thick and compacted to 98 percent SPMDD in the pavement footprint areas and 92 percent SPMDD in the proposed landscaped areas. The pavement sub-base and base layers must be compacted to 100 percent SPMDD.

Perimeter drainage must be designed so as to prevent lateral infiltration beneath the asphalt surfaces from adjacent grassed or landscaped areas.

Sanitary sewer and watermain bedding should comply with the City of Ottawa Standard S6 and S7, and W17, respectively, and Class B bedding consisting of OPSS Granular “A” 300 mm thick below the invert of the pipe and extending to 300 mm above the crown of the pipe. The bedding material should be compacted to 95 percent SPMDD.

5.2 Excavation and dewatering

Considering the final floor elevation of 92.0 m and the projected final grade surrounding the proposed building, which varies between 90.8 m and 91.99, the depth of the general excavation is not expected to be under the groundwater level, which was measured at a maximum elevation of 88.3 m. Surface water management and perched water lenses may, however, be encountered during excavation work.

Roadway construction debris, including concrete and asphalt, are expected within the fill material. This debris was also observed on the surface at the time of GHD's Site visit. For excavations less than two (2) m of depth, the walls of the excavations must be sloped at a minimum of 1H:1V as per the Occupational Health and Safety Act (OHSA) requirements for Type 3 soils (fill) or supported by temporary shoring. For excavations more than two (2) m deep, the walls of the excavation must be sloped at a minimum of 2H: 1V.

Unsupported side slopes should be adjusted depending on the true subsoil and groundwater conditions encountered during excavation work, and flatter side slopes than those mentioned above may be required locally.

During the excavation, no excavated material should be piled, nor machinery or equipment placed closer than the distance equivalent to the depth of the excavations. Furthermore, no vertical un-braced excavations should be performed in the soil. In addition, the exposed subsoils should be protected against erosion from water runoff or rain.

The stability and safety of unsupported excavation slopes remain the responsibility of the contractor at all times.

It is recommended that the FastFrate design team include in the specification package requirements for the successful contractor to submit written Plans for Excavation as well as Soil and Groundwater Management for review by the FastFrate design team.

5.3 Shallow foundation

Once the building footprint is prepared as discussed in section 5.1.1 and certified by the soil improvement contractor, the Site would be suitable to support conventional shallow foundations.

The soil improvement works must be completed by a contractor specialized in this field. As the resulting serviceability and ultimate bearing capacity values are an integral part of the eventual foundation design, these values must be determined and confirmed by the soil improvement contractor. The degree of densification must be confirmed by in-situ testing by the specialty soil improvement contractor following the dynamic compaction operations following the recommendations and thresholds presented in section 5.1.1. The dynamic compaction work and pad preparation must be certified by the soil improvement contractor prior to the construction of the proposed building.

For footings design, footings placed on at least 1.0 m thick engineered fill underlain by improved ground can be sized for Serviceability Limit State (SLS) soil bearing resistance of 150 kPa and factored (Φ=0.5) Ultimate Limit State soil

bearing resistance of 225 kPa. As previously mentioned, the bearing capacity design values must be confirmed by the soil improvement designer following the completion of the soil improvement works.

5.4 Seismic site classification

The 2012 Ontario Building Code (OBC) requires the assignment of a Seismic Site Class for calculations of earthquake design forces and the structural design based on a two percent probability of exceedance in 50 years. According to the 2012 OBC, the Seismic Site Class is a function of soil profile and is based on the average properties of the subsoil strata to a depth of 30 m below the ground surface. The 2012 OBC provides the following three methods to obtain the average properties for the top 30 m of the subsoil strata:

– Average shear wave velocity.

– Average Standard Penetration Test (SPT) values (uncorrected for overburden).

– Average undrained shear strength.

During the geotechnical investigations, the depths of boreholes extended to a maximum depth of approximately 14 m bgs and the subsurface profile below this depth is inferred. Based on the borehole information for the Site and using site classification criteria provided in Table 4.1.8.4.A, of the 2012 OBC, a Seismic Site Class 'D' can be used for preliminary design purposes if the proposed building is supported on certified improved ground.

A Seismic Site Class ‘C’ may potentially be obtained following the soil improvement work should shear wave velocity testing confirm this improved classification.

5.5 Frost protection

All of the exterior building foundations (footings, etc.) for heated structures should be placed at least 1.5 m beneath the final exterior grade in order to provide adequate frost protection.

Building foundations for unheated structures or isolated exterior foundations (retaining walls, signs, lamp posts, etc.) should be placed at least 1.8 m beneath the final exterior grade in order to provide adequate frost protection.

Note that exterior building foundation sections (even for a heated structure) with exposed foundation walls, such as foundation walls at dock areas, must be considered unheated for frost protection design purposes.

Should construction take place during winter, the exposed surfaces to support foundations must be protected by Contractors against freezing assuming unheated conditions.

5.6 Interior floor slabs

Once the building footprint is prepared as discussed in section 5.1.1 and certified by the soil improvement contractor, the site would be suitable to support conventional slab-on-grades.

The slab-on-grade foundation should incorporate a final granular base layer, consisting of at least 300 mm of Granular ‘A’ material as per Ontario Provincial Standard Specifications (OPSS form 1010), compacted to at least 100 percent of the material's SPMDD. Depending on the final floor's finish, the architect may require the use of a vapour barrier to be installed, to limit vapour emission through the concrete slab.

The slab-on-grade must be set at least 200 mm above the exterior grades, which should be sloping away from the building footprint at 5 percent in landscaped areas and 2 percent in paved areas.

The specialty contractor should be providing the modulus of subgrade reaction for design of the slab-on-grade if required.

5.7 Exterior slabs

Once the building footprint is prepared as discussed in section 5.1.1 and certified by the soil improvement contractor, the site would be suitable to support conventional slab-on-grades.

In order to avoid the potentially detrimental effects of freeze-thaw cycles on the good behaviour of exterior concrete slabs around the proposed building, GHD recommends that a non-frost susceptible base layer, such as a Granular 'A' as per Ontario Provincial Standard Specifications (OPSS Form 1010), be used under the exterior slabs down to a depth of 1.8 m below the top of the slabs.

This base layer should be placed in thin lifts not exceeding 300 mm and compacted to a minimum of 98 percent SPMDD.

The base layer should also be properly drained by means of a French drain in order to prevent water accumulation under the slabs. Note that this requirement also applies to the exterior concrete aprons.

Transition slopes of 3.0 H / 1.0 V should be provided at the edges of the various slabs, between the non-frost susceptible granular foundation and the surrounding soils (silty clay/clayey silt deposit), over the entire frost depth of 1.8 m.

A possible alternative to the placement of non-frost susceptible base material to a depth of 1.8 m below exterior slab grades could include the use of sufficient insulation material under the slab to replace the equivalent amount of granular base backfill omitted to frost depth. As a general rule of thumb, one (1.0) inch 25 mm of insulation is equivalent to 300 mm of non-frost susceptible material.

In any case, the slabs should incorporate a granular base layer consisting of at least 300 mm of OPSS Granular 'A' compacted to at least 100 percent of the material's SPMDD.

5.8 Pavement recommendations

Once the exterior pavement footprint is adequately prepared, as discussed in section 5.1.2, the following pavement structures are suggested. This design load is based on a proposed warehouse and office structure that will be serviced by eleven loading docks, sixty parking spaces for light-duty vehicles, and eight parking spaces for heavy-duty vehicles.

The following input parameters for the pavement design have been provided by the Transportation Impact Study, dated May 18, 2021, prepared by Castleglenn Consultants:

– The facility will be staffed by 30 employees.
– The daily truck volume could range from 60 to 120 two-way trips, with an average of 90 two-way truck trips.
– The trucks would be loaded on the way in and empty on the way out.

Assuming that the facility will be operated on weekdays only, and will be closed on the weekend and statutory holidays, 250 days per year are used to calculate the Equivalent Single Axle Load (ESAL) of 9.92 x 105. A heavy-duty pavement with a structural number of 123 mm is required for supporting the design ESAL. The structural number of the proposed pavement is 171 mm, which exceeds the required 123 mm.

Table 13 Pavement Design (Flexible Pavement Structure) for a Design Life of 20 years

Pavement structure element	Compaction requirement	Layer thickness (mm)	
		Light duty	Heavy duty
Surface course OPSS 1150 HL1 Hot Mix, PG70-34	OPSS 310, Table 8	40	40
Base course OPSS 1150 HL8 HS Hot Mix Asphalt, PG64-34	OPSS 310, Table 8	50	100 (in two lifts)
Granular A base (19 mm crusher run limestone)	100 % SPMDD	300	300
Granular B Type II sub-base (50 mm crusher run limestone)	100 % SPMDD	400	500

Table 14 Pavement Design (Rigid Pavement Structure)

Pavement structure element	Compaction requirement	Layer thickness (mm)
Rolled compacted concrete	N/A	180
Base course: Granular A (19 mm crusher run limestone)	100 percent of SPMDD ASTM D698	300
Granular B Type II sub-base (50 mm crusher run limestone)	100 percent of SPMDD ASTM D698	300

The pavement contractor is responsible for ensuring adequate compaction of the asphalt and base layers, as per OPSS.

It is noted that the pavement granular base and sub-base layers can consist of gravel or crushed limestone, as specified above. The material gradation and durability requirements of the selected granular courses should meet OPSS 1010 specifications.

The pavement design considers that construction will be carried out during dry periods of the year and that the subgrade is competent, as discussed in section 5.1.2 of this report. If the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material may be required. The need for additional sub-base material is best determined during construction.

Joint design and construction should be carried out in accordance with the OPSS/OPSD requirements.

The installation of a geotextile membrane at the subgrade level is required to prevent contamination of the sub-base layers with fine particles.

To maintain the integrity of the pavement at the Site, subdrains should be installed at all catch basins and along the perimeter of the parking lot.

Grading adjacent to pavement areas should be designed so that water is not allowed to pond adjacent to the outside edges of the pavement.

5.9 Underground service trenches

Underground service lines, if any, should be founded on a prepared fill subgrade, as discussed in section 5.1.2. The suitability of the foundation soils to provide adequate support for buried services must be verified and confirmed on the Site at the time of construction/installation by qualified geotechnical personnel experienced in such work. For subgrade consisting of the existing uncontrolled fill, which is outside the projected footprint of the soil amelioration work, some settlements may occur, and a servicing maintenance program should be considered.

The frost penetration depth for the region of Ottawa is considered as 1.8 m in accordance with Ontario Provincial Standard Drawing (OPSD) 3090.101. Accordingly, underground services should be located below the depth of frost penetration and in accordance with the City of Ottawa specifications.

Note that the City of Ottawa specifies that watermains and sewer require respective minimum soil cover above of 2.4 and 2.0 m. Where the available cover is less than required, thermal rigid insulation should be used as specified in the City of Ottawa specifications.

The bedding and sand cover materials should be adequately compacted to provide support and protection to the service pipes. Provided the base area of the underground service line is free of all soft/loose and deleterious materials, the pipe bedding should comply with a Class B bedding configuration as per the requirements of OPSD 802.031 and OPSD 802.032 (rigid pipe) and/or OPSD 802.010 (flexible pipe). Where disturbance of the trench base has occurred because of surface water or groundwater seepage and the like, the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill.

Backfilling of trenches can be accomplished by reusing the excavated soils or similar fill material or imported granular soil, provided the moisture content of the material is maintained within ±2 percent of optimum, and the fill is free of topsoil, organics, and any deleterious material. The fill placed in excavated trenches should be in loose lifts not exceeding 200 mm thick and compacted to not less than 95 percent of its SPMDD.

Due to the relatively low permeability of the existing fill and depth of excavation, no major groundwater problems are foreseen at this time for such excavations. Infiltration into the excavations should be readily handled with ordinary sumps and pumps.

5.10 Permanent drainage

5.10.1 Underfloor drainage slab-on-grade – No basement

Under-floor drains are not considered necessary for a structure without a basement and a floor slab set above the surrounding grades.

5.10.2 Perimeter drainage

For the proposed building with no basement or underground level, and based on the Site's subsurface condition, perimeter drainage around the exterior of the walls of the proposed building is not considered necessary.

5.11 Corrosion potential of soils

Analytical testing was carried out on a soil sample collected (BH3 SS3) to determine the corrosion potential of the subsurface soils at the Site. The certificates of analysis for the sample tested are presented in Appendix C and are summarized in **Table 12**.

The American Water Works Association (AWWA) publication 'Polyethylene Encasement for Ductile-Iron Pipe Systems' ANSI/AWWA C105/A21.5-10, dated October 1, 2010, assigns points based on the results of the above tests. Soil that has a total point score of 10 or more is considered to be potentially corrosive to ductile iron pipe. A score of less than 10 was obtained for the soil sample submitted.

Table 15 of the Canadian Standards Association (CSA) document A23.1-04/A23.2-04 'Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete divides the degree of exposure into the following three classes:

Table 15 Classes of Exposure

Degrees (Class) of Exposure	Water Soluble (SO_4) in Soil Samples (%)
Very Severe (S-1)	>2.0
Severe (S-2)	0.20 – 2.0
Moderate (S-3)	0.10 – 0.20

A review of the analytical test results shows the sulphate content in the tested samples was found to be less than 0.08 percent.

Although both test samples suggest a low degree of corrosivity, GHD recommends that further tests be carried out through the entire site in order to obtain a broader representation of corrosivity potential as a result of the variability and uncontrolled nature of the existing fill on-Site.

5.12 Backfill

The placement and compaction of the materials that will support pavement, floor slab, or footings must be treated as engineered fill.

The fill operations for engineered fill must satisfy the following criteria:

– Engineered fill must be placed under the continuous supervision of the geotechnical engineer.
– Prior to placing any engineered fill, all unsuitable fill materials must be removed, and the subgrade proof rolled and approved. Any deficient areas should be repaired.
– Prior to the placement of engineered fill, the source or borrow areas for the engineered fill must be evaluated for their suitability. Samples of proposed fill material must be provided to the geotechnical engineer and tested in the geotechnical laboratory for standard proctor maximum dry density (SPMDD) and grain size prior to approval of the material for use as engineered fill. The engineered fill must consist of environmentally suitable soils (as per industry standard procedures of federal or provincial guidelines/regulations), free of organics and other deleterious material (building debris such as wood, bricks, metal, and the like), compactable, and of suitable moisture content so that it is within -2 percent to +0.5 percent of the optimum moisture as determined by the standard proctor test. Imported granular soils meeting the requirements of Granular 'A' or Type II OPSS 1010 criteria would be suitable.
– The engineered fill must be placed in maximum loose lift thicknesses of 0.2 m. Each lift of engineered fill must be compacted with a heavy roller to 100 percent SPMDD.
– Field density tests must be taken by the geotechnical engineer on each lift of engineered fill. Any engineered fill, which is tested and found to not meet the specifications, shall be either removed or re-compacted and retested.

5.13 Slope stability

The historic fill placement at the Site has created sloping of approximately 2H:1V around the south, west, and north perimeters of the Site.

Slope stability analysis was performed for the slopes under loads induced by dynamic compaction works and following the final slopes geometry. This final slope geometry includes the construction of a retaining structure in the north sector.

5.13.1 Slope stability under dynamic compaction loads

The stability assessment has been completed in alignment with the cross-sections received by GHD from CIVITAS on July 28, 2021 and July 22, 2021, for the north and west slopes, respectively. The locations of the cross-sections are shown on the site plan provided in **Figure 1**.

Based on the subsurface conditions described in section 4, GHD determined geotechnical parameters to be used in the slope stability analysis.

Table 16 Geotechnical Parameters for the Slope Stability Analysis

Material	Unit weight (kN.m^3)	Cohesion (kPa)	Internal friction angle (°)
Existing fill	18	4	25
Native sandy silt	17	2	34
Bedrock	N/A (considered impenetrable)		

These parameters were calculated based on SPT correlations as presented in “Foundation Analysis and Design”, fifth edition, by Joseph E. Bowles and on engineering judgment.

Dynamic compaction works consist in repeatedly dropping a 5 to 40 tons mass freely from a height of 10 to 40 m on a grid pattern. For this project, a 12.5 tons (12 500 kg) hammer dropped from a height of 12 m is considered.

Due to the dropping of the heavy mass, vibrations are generated in the surrounding soil. Vibration then propagates through the surrounding soil until the vibration wave attenuates completely. If the vibrations exceed certain threshold limits for level or sloping ground conditions, ground displacements may occur. In addition, vibrations can cause a reduction in the shear strength of soils. As such, construction vibrations such as dynamic compaction need to be considered in the stability analyses.

Vibrations are a function of the amount of energy that gets dissipated with increase in distance from the source of energy. The established energy versus distance relationship is exponential in nature, meaning that an exponential reduction in vibration is realized with increasing distances. Vibration energy, measured as Peak Particle Velocity (PPV), gets dissipated with time as soil conditions have a damping effect on vibration. PPV follows a reverse log curve on an exponential scale, therefore, values begin very high near the source of vibrations and drop off rapidly farther from the source. A slope can experience movements if ground acceleration 'a' due to gravity exceeds yield acceleration (Ky) values[1].

[1] Matasovic' N., (1991): Selection of Method for Seismic Slope Stability Analysis. Proceedings: Second International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, March 11-15, 1991, St. Louis, Missouri, Paper No. 7.20

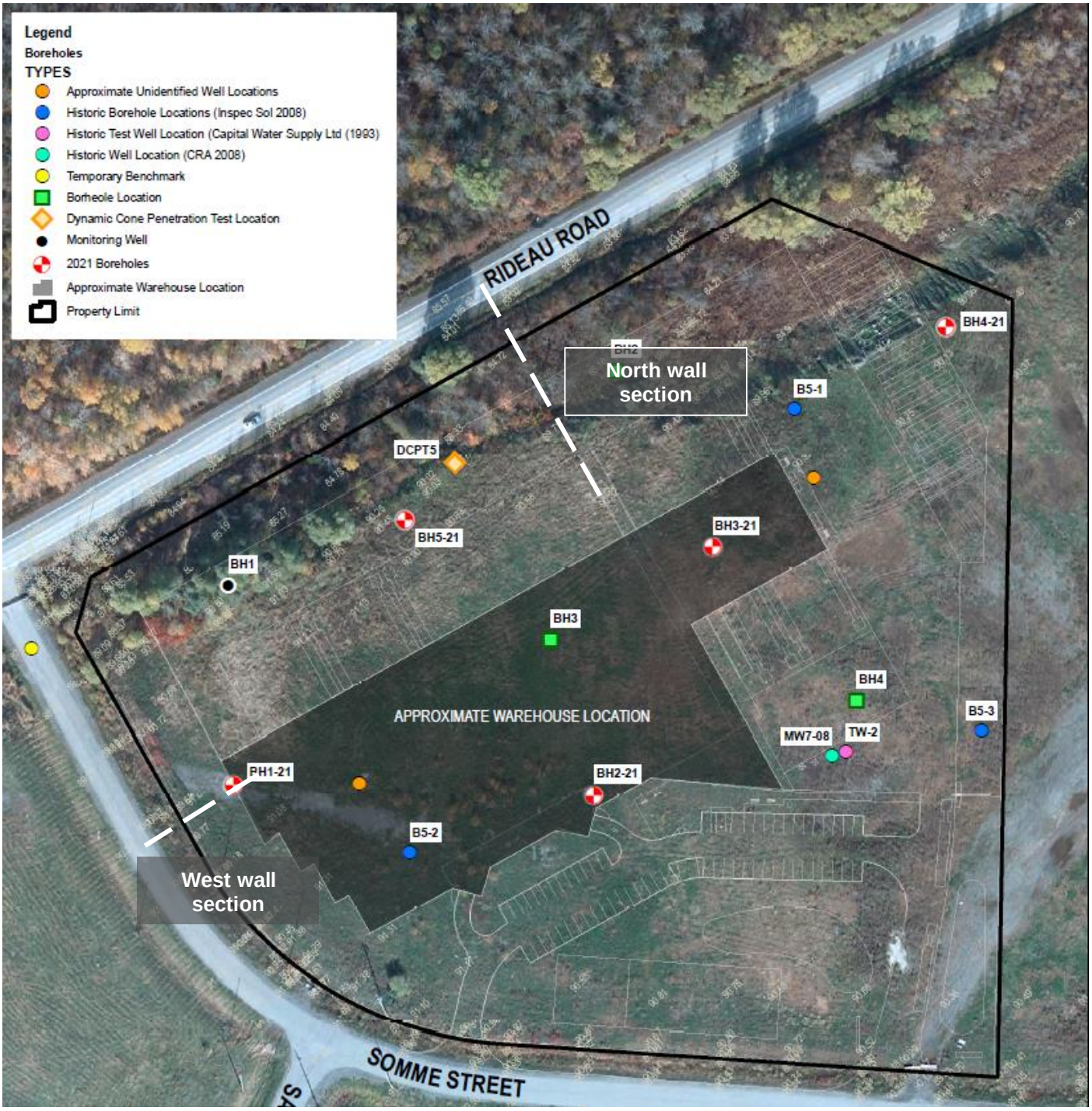

Figure 1 *Site Layout showing the location of the analyzed cross sections and the proposed building footprint*

Ground acceleration 'a' is related to PPV through the frequency of motion 'F', assuming sinusoidal motion, using the following equation:

$$a = 2 * \pi * PPV * F \qquad \text{Eq. (1)}$$

Where:

- PPV = Peak Particle Velocity in mm/sec
- F = Frequency in Hz

One way to estimate the PPV value occurring from the dynamic compaction is presented by Hamidi & al., 2011[2], which proposes a number of equations between the pounder weight (w), the distance (d), and the pounder drop height (H). An upper PPV value can be calculated using the following equation:

$$PPV \leq 25 * \left(\frac{\sqrt{WH}}{d}\right)^{1.1} \qquad \text{Eq. (2)}$$

For the west slope, GHD recommends the construction of a platform extending 4 m from the building footprint with a 5.7H:1V slope. For the north slope, the dynamic compaction works will be at approximatively 35 m from the crest of the existing slope.

Using the abovementioned equations and assuming a maximum frequency of motion for the machinery of 10 Hz for construction operations[3], a ground acceleration value of 0.35g and 0.05g will be used for the west and north slope, respectively. These ground acceleration values will be incorporated in the slope stability analysis as horizontal seismic loads in order to account for the impact of the vibrations occurring due to dynamic compaction works.

The slope stability analysis was carried out using the SLOPE/W 2019 software package produced by GEO-SLOPE International Ltd. Each trial was modelled using the Morgenstern-Price method, and the optimized critical slip surface was selected. This approach calculates a factor of safety that represents the ratio of forces resisting a failure (i.e., shear strength, friction, etc.) to those favouring failure (weight, external loading, etc.). Theoretically, a factor of safety of 1.0 would represent an equilibrium condition (i.e., a marginally stable slope). The City of Ottawa recommends a minimum factor of safety of 1.5 under static conditions and 1.1 under pseudo-static conditions to account for uncertainty in soil parameters used and slope geometry. Due to the thickness of the fill layer and generally horizontally layered stratigraphy, only circular slip failures were considered.

A distributed load of 100 kPa located 3 m away from the building edge was calculated to represent the crane load used during dynamic compaction. The crane load considered is a Liebherr HS855HD.

A summary of the slope stability analysis results is shown in **Table 17**, with the graphical output for the analysis for each condition provided in Appendix E.

Table 17 Results of the Slope Stability Analyses During Dynamic Compaction Works

	Factor of safety	
	Static loading	**Pseud-static loading (considering vibrations impact from the pounder drop)**
West slope	1.60	1.1
North slope	2.06	1.71

[2] Babak Hamidi, Hamid Nikraz and Serge Varaksin, (2011) : Dynamic Compaction Vibration Monitoring in a Saturated Site, International Conference on Advances in Geotechnical Engineering, Perth, Australia.
[3] OSM Blasting Performance Standards 30 Code of Federal Regulations

Based on the slope stability analysis, the factor of safety for the slope is above or equal to the recommended values of 1.5 for static conditions and 1.1 for pseudo-static conditions. The west and north slope are considered stable under static and pseudo-static conditions during the deep dynamic compaction works. Some sloughing and bulging-type movements at the west slope could be expected during the dynamic compaction. The slope will need to be restored to its design grades under-engineered controls after dynamic compaction is complete and before the proposed building is constructed.

5.13.2 Slope stability for the final slope configurations

The stability assessment of the final north slopes has been completed in alignment with the cross-sections received by GHD from Maccaferi which are presented in the reinforced structure drawings attached in Appendix G. The stability assessment of the final west slope has been completed in alignment with the cross-section provided by CIVITAS on July 22, 2021. The locations of the cross-sections are shown on the site plan provided in Figure 2.

For the final slope configuration, static and pseudo-static analyses were completed. The pseudo-static analysis takes into account an earthquake's Peak Ground Acceleration (PGA) with a 2 percent probability of exceedance in 50 years, which is 0.308 g, where 'g' is the acceleration due to gravity. The PGA occurs only for a fraction of a second in a given earthquake. A use of PGA may therefore result in a very conservative design. Hynes-Griffin and Franklin[4] concluded that slopes and embankments with a yield acceleration equal to half the peak ground acceleration would experience permanent seismic deformations of less than 1 m in any earthquake, even for embankments where amplification of acceleration by a factor of three occurs. In the absence of amplification, or if amplification is taken into account in determining the peak acceleration, the Hynes and Franklin data suggest that deformations will remain less than 0.3 m for yield accelerations less than or equal to one-half the peak acceleration. In this case, the amplification is only by a factor of 1.05, therefore an earthquake-induced deformation of less than 0.3 m is expected. The seismic coefficient used in the pseudo-static analyses was 50 percent of the PGA value of 0.308, i.e., 0.154.

Along the Site's north boundary, a retaining structure up to approximately 6.5 m in height and a face slope of 45 to 60 degrees from the vertical, will be constructed due to vehicle circulation constraints and to redirect the stormwater drainage to the south. This retaining structure design was completed by Maccaferri and reviewed by GHD. The reinforcement will be obtained by the use of geogrids between each 560 mm soil lift.

In order to build this reinforced structure, the fill available on site can be used as long as it is comprised of compactable mineral soils only, i.e. SM and/or SC soils only. Note that some organic materials and buried asphalt have been noted within the existing on-site fill layer as described in section 4. These materials will need to be sorted out before the fill is used for the new reinforced structure. It is recommended that compaction of the fill be completed using layers with a thickness of 200 millimetres (mm) to achieve a 95 percent of the standard proctor. Please note that this recommendation does not consider environmental considerations if any.

The slope stability analyses for the north slope were completed on three different cross sections each under static and pseudo-static conditions. The geometry of each cross-section is based on the drawings provided by Maccaferri.

In order to complete the slope stability analysis, geotechnical parameters for the reinforced soil were determined based on our engineering judgment and experience. These parameters are presented in **Table 18**.

Table 18 Additional Geotechnical Parameters for the Soil Stability Analysis

Material	Unit weight (kN.m^3)	Cohesion (kPa)	Internal friction angle (°)
Reinforced fill	18	4	25

Additionally, in order to account for the possibility of a truck impact load on the safety barriers installed on top of the retaining structure, GHD completed a slope stability analysis using a horizontal impact force of 564 kN corresponding to a truck travelling a distance of 1 m at a speed of 5 km/hr creating an impact force of approximately 100 kN. This force was conservatively applied as a point load horizontally at the top of the retaining structure.

[4] Hynes-Griffin, M.E., Franklin A.G., (1984): Rationalizing the Seismic Coefficient Method, Miscellaneous Paper GL-84-13, Corps of Engineers

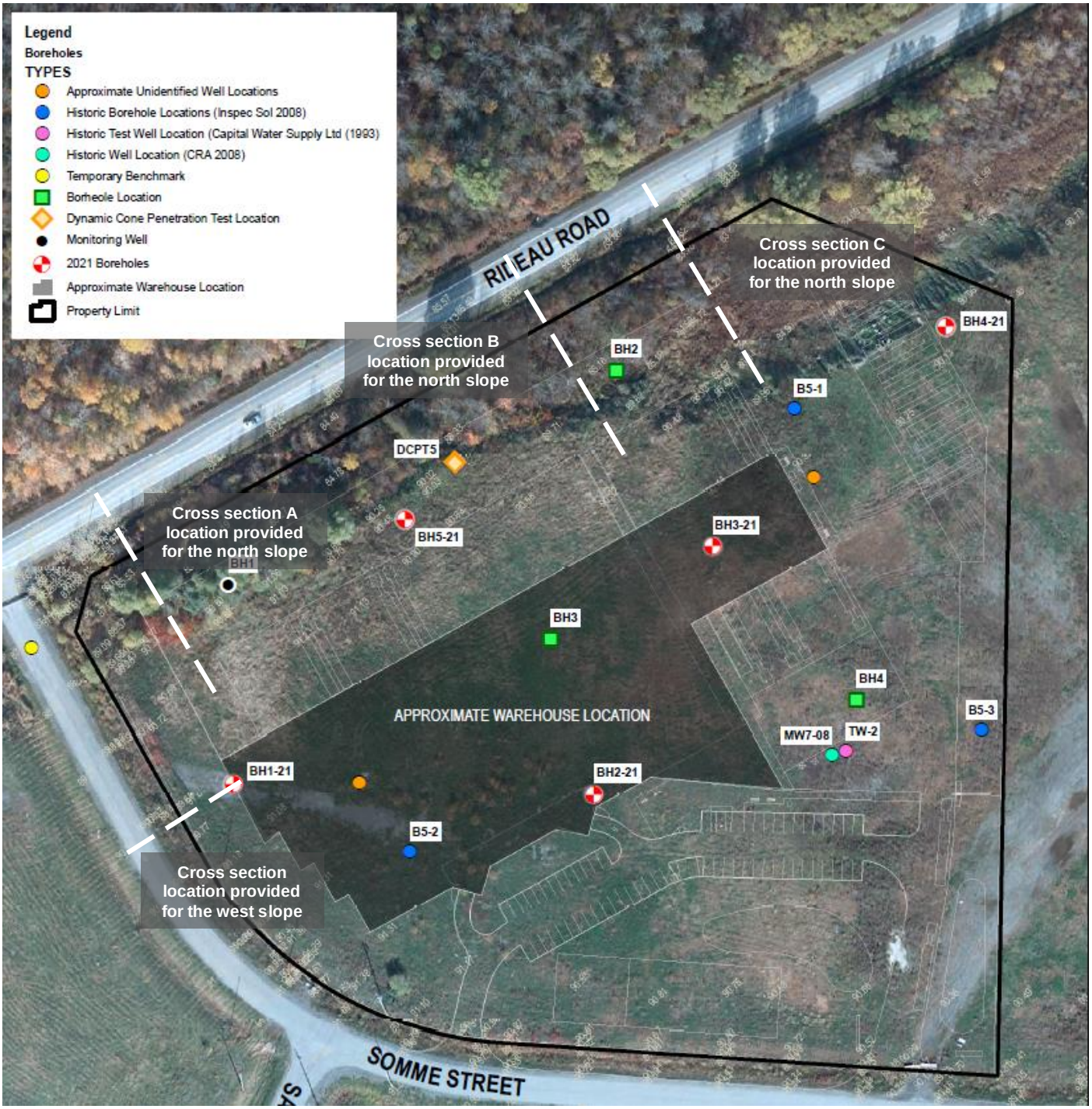

Figure 2 *Site layout showing the location of the analyzed cross-sections and the proposed building footprint*

A summary of the slope stability analysis results is presented in **Table 19**. The graphical output for each analysis is provided in Appendix F.

Table 19 Results of the Slope Stability analyses for the Final Slope Configuration

	Factor of safety		
	Static loading	**Pseud-static loading**	**Considering truck impact load on safety barrier**
West slope	2.49	1.66	Not applicable
North slope – Cross section A	1.74	1.29	1.49
North Slope – Cross section B	1.63	1.21	1.51
North Slope – Cross section C	1.63	1.23	1.56

Based on the slope stability analysis, the factor of safety for the slopes is above or equal to the recommended values of 1.5 for static conditions and 1.1 for pseudo-static conditions. The west and north slope are considered stable under static and pseudo-static conditions.

5.14 Vibration monitoring and contingency plans

During the dynamic compaction vibration works, monitoring must be carried out using approved seismographs/ accelerometers. Continuous readings must be recorded for one week prior to the start of construction. Continuous readings comprised of PPV and construction frequency in all directions must be recorded throughout construction at Site boundaries and any nearby structures. The recording must be checked at least once per day to ensure that the vibration levels are not exceeding the specified limits.

Should the recorded vibrations exceed the allowable limits, the ground improvement contractor should review and modify the ground improvement methodology. The modifications may include reductions in the drop weight, drop height, or both while increasing the number of drops per impact point.

The vibration limits within habited areas are set to avoid disturbance to inhabitants and to avoid damage to any existing structures. The criteria presented in **Table 20** are, typically, set for a construction site.

Table 20 Prohibited construction vibrations

Frequency of vibration (Hz)	**Vibration PPV (mm/sec)**
Less than 4	8
4 to 10	15
More than 10	25

6. Limitations of the investigation

This report: has been prepared by GHD for Consolidated FastFrate (Ottawa) Holdings Inc. and may only be used and relied on by Consolidated FastFrate (Ottawa) Holdings Inc. for the purpose agreed between GHD and Consolidated FastFrate (Ottawa) Holdings Inc. as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Consolidated FastFrate (Ottawa) Holdings Inc. arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions, and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to sections 1 and 5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The recommendations made in this report are in accordance with our present understanding of the project, the current Site use, ground surface elevations and conditions, and are based on the work scope approved by the Client and described in the report. The services were performed in a manner consistent with that level of care and skill ordinarily exercised by members of geotechnical engineering professions currently practicing under similar conditions in the same locality.

No other representations, and no warranties or representations of any kind, either expressed or implied, are made. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

All details of design and construction are rarely known at the time of completion of a geotechnical study. The recommendations and comments made in this report are based on our subsurface investigation and resulting understanding of the project, as defined at the time of the study. We should be retained to review our recommendations when the drawings and specifications are complete. Without this review, GHD will not be liable for any misunderstanding of our recommendations or their application and adaptation into the final design. By issuing this report, GHD is the geotechnical engineer of record. It is recommended that GHD be retained during construction of all foundations and during earth-work operations to confirm the conditions of the subsoil are actually similar to those observed during our study. The intent of this requirement is to verify that conditions encountered during construction are consistent with the findings in the report and that inherent knowledge developed as part of our study is correctly carried forward to the construction phases.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments included in this report are based on the results obtained at the test locations only. The subsurface conditions confirmed at the test locations may vary at other locations. The subsurface conditions can also be significantly modified by the construction activities on Site (ex., excavation, dewatering and drainage, blasting, pile driving, etc.). These conditions can also be modified by exposure of soils or bedrock to humidity, dry periods, or frost. Soil and groundwater conditions between and beyond the test locations may differ both horizontally and vertically from those encountered at the test locations and conditions may become apparent during construction which could not be detected or anticipated at the time of our investigation. Should any conditions at the Site be encountered which differ from those found at the test locations, we request that we be notified immediately in order to permit a reassessment of our recommendations. If changed conditions are identified during construction, no matter how minor, the recommendations in this report shall be considered invalid until sufficient review and written assessment of said conditions by GHD are completed.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

Data Disclaimer

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Paper Size ANSI A

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 18N

N

CONSOLIDATED FASTRATE
RIDEAU ROAD & SOMME STREET, OTTAWA, ON
PT LOT 26, CON 6 FROM RIDEAU RIVER
GEOGRAPHIC TOWNSHIP OF GLOUCESTER
CITY OF OTTAWA

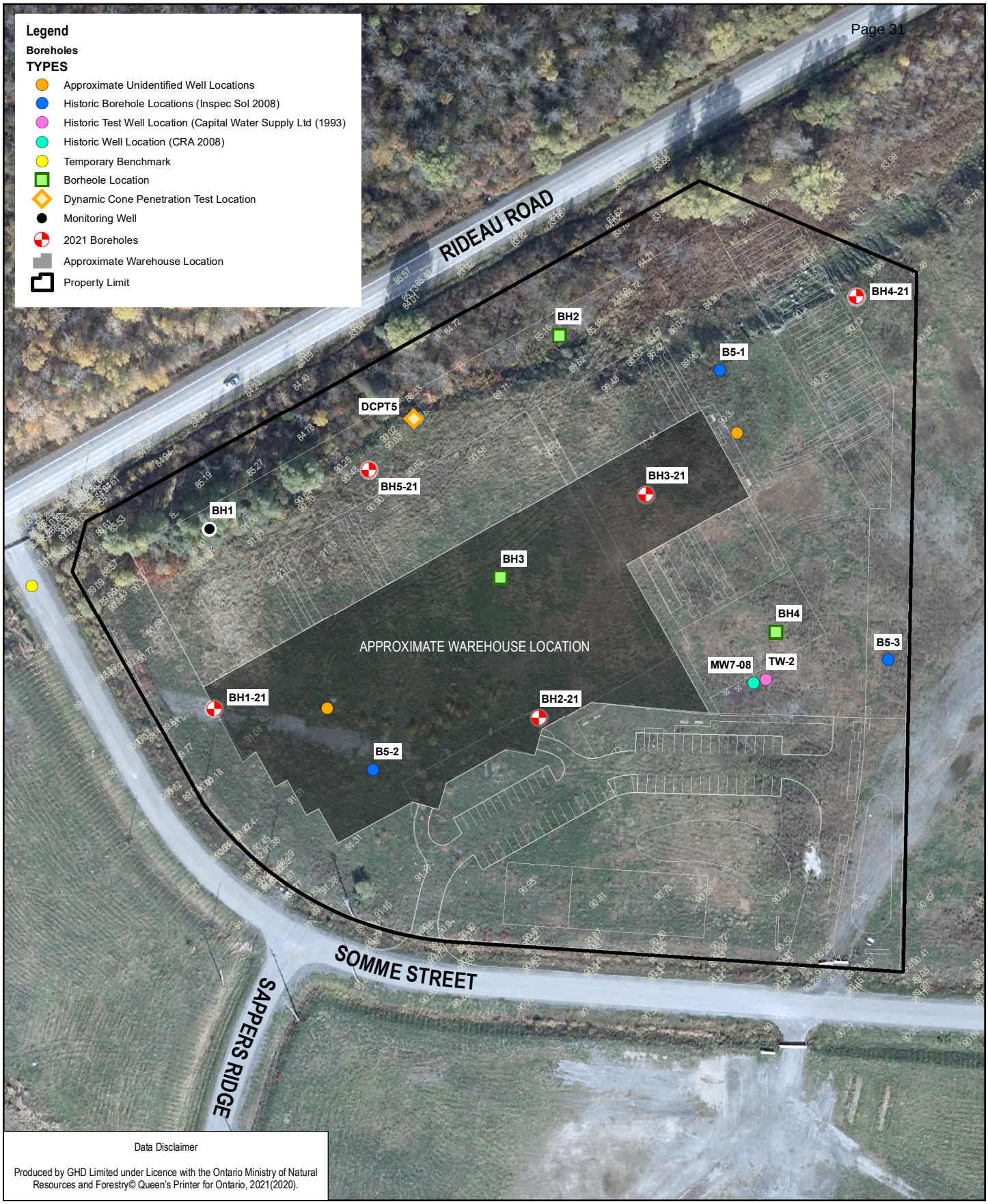
GEOTECHNICAL INVESTIGATION
SITE LOCATION PLAN

Project No. **11231101**
Revision No.
Date **Sep 3, 2021**

FIGURE 3

Q:\gis2\GIS\PROJECTS\11231000s\11231101\Layouts\202109_RPT001\11231101_202109_RPT001_GIS001 - Site Location Plan.mxd
Print date: 03 Sep 2021 - 13:55

Imagery source: © City of Ottawa, 2019.



Data Disclaimer

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Paper Size ANSI A

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 18N

N

GHD

CONSOLIDATED FASTRATE
RIDEAU ROAD & SOMME STREET, OTTAWA, ON
PT LOT 26, CON 6 FROM RIDEAU RIVER
GEOGRAPHIC TOWNSHIP OF GLOUCESTER
CITY OF OTTAWA

GEOTECHNICAL INVESTIGATION
BOREHOLE LOCATION PLAN

Project No. **11231101**
Revision No.
Date **Sep 3, 2021**

FIGURE 4

Q:\gis2\GIS\PROJECTS\11231000s\11231101\Layouts\202109_RPT001\11231101_202109_RPT001_GIS002 - Borehole Location Plan.mxd
Print date: 03 Sep 2021 - 13:52

Imagery source: © City of Ottawa, 2019; CAD Data: 1128236a1-dessin1.dwg

Appendices

Appendix A

Soundings Reports

Notes on Borehole and Test Pit Reports

Soil description :

Each subsurface stratum is described using the following terminology. The relative density of granular soils is determined by the Standard Penetration Index ("N" value), while the consistency of clayey sols is measured by the value of undrained shear strength (Cu).

Classification (Unified system)

Clay	< 0.002 mm		
Silt	0.002 to 0.075 mm		
Sand	0.075 to 4.75 mm	fine	0.075 to 4.25 mm
		medium	0.425 to 2.0 mm
		coarse	2.0 to 4.75 mm
Gravel	4.75 to 75 mm	fine	4.75 to 19 mm
		coarse	19 to 75 mm
Cobbles	75 to 300 mm		
Boulders	>300 mm		

Terminology

"trace"	1-10%
"some"	10-20%
adjective (silty, sandy)	20-35%
"and"	35-50%

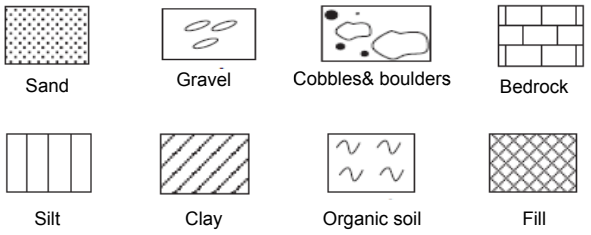
Relative density of granular soils	Standard penetration index "N" value (BLOWS/ft – 300 mm)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Consistency of cohesive soils	Undrained shear strength (Cu) (P.S.F)	(kPa)
Very soft	<250	<12
Soft	250-500	12-25
Firm	500-1000	25-50
Stiff	1000-2000	50-100
Very stiff	2000-4000	100-200
Hard	>4000	>200

Rock quality designation

"RQD" (%) Value	Quality
<25	Very poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

STRATIGRAPHIC LEGEND



Samples:

Type and Number

The type of sample recovered is shown on the log by the abbreviation listed hereafter. The numbering of samples is sequential for each type of sample.

SS: Split spoon
SSE, GSE, AGE: Environmental sampling
ST: Shelby tube
PS: Piston sample (Osterberg)
AG: Auger
RC: Rock core
GS: Grab sample

Recovery

The recovery, shown as a percentage, is the ratio of length of the sample obtained to the distance the sampler was driven/pushed into the soil

RQD

The "Rock Quality Designation" or "RQD" value, expressed as percentage, is the ratio of the total length of all core fragments of 4 inches (10 cm) or more to the total length of the run.

IN-SITU TESTS:

N: Standard penetration index
R: Refusal to penetration
N_c: Dynamic cone penetration index
Cu: Undrained shear strength
Pr: Pressure meter
k: Permeability
ABS: Absorption (Packer test)

LABORATORY TESTS:

I_p: Plasticity index
W_l: Liquid limit
Wp: Plastic limit
H: Hydrometer analysis
GSA: Grain size analysis
A: Atterberg limits
w: Water content
γ: Unit weight
C: Consolidation
CS: Swedish fall cone
CHEM: Chemical analysis
O.V.: Organic vapor

REFERENCE No.: 11231101 ENCLOSURE No.:

BOREHOLE No.: BH1-21

ELEVATION: 91.07 m

BOREHOLE LOG

Page: 1 of 2

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.

PROJECT: ConFastfrate, New Warehouse & Offices

LOCATION: Somme Street, Ottawa, ON

DESCRIBED BY: J. Scott CHECKED BY: Leandro Ramos

DATE (START): 26 July 2021 DATE (FINISH): 27 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa
metres	91.07		GROUND SURFACE			%		N	10 20 30 40 50 60 70 80 90
	90.99		**TOPSOIL** (75 mm)						
			FILL - SILTY SAND, trace gravel, trace clay, dark grey, moist, compact		SS1	96	7-15-10-9	25	
					SS2A	71	9-6-3-4	9	
1.0	90.20		**FILL** - SAND, trace silt, trace gravel, brown, moist, loose Gravel - 17%, Sand - 60%, Silt - 19%, Clay - 4%		SS2B		--		
	89.54		**FILL** - SILTY SAND, with clay, trace gravel, dark grey, moist, dense cobble encountered at 1.83 mbgs		SS3	71	7-13-33-40	46	
2.0					SS4	42	5-2-3-50/76 mm	5	
3.0					SS5A	67	8-8-5-3	13	
			with organics and wood fragments		SS5B		--		>>
					SS6	0	50/51 mm	50/51 mm	
4.0			augers grinding at 3.96 mbgs, inferred boulders or construction debri						
	86.49		**SILTY SAND** - trace gravel, trace clay, brown, moist, dense to very dense		SS7	83	10-21-37 -50/127 mm	58	
5.0					SS8A	100	43-31-36-47	67	
6.0	85.27		grey, very moist, augers grinding at 9.85 mbgs, inferred boulder		SS8B		--		
					SS9	83	24-23-18-26	41	
7.0			cobble encoutered at 6.86 mbgs		SS10	75	13-11-15-12	26	
					SS11	71	6-4-12-23	16	
8.0					SS12	67	50-15-15-18	30	
9.0					SS13	67	13-17-19-17	36	
			Gravel - 16%, Sand - 32%, Silt - 36%, Clay - 16%						
10.0	81.21		**LIMESTONE** - interbedded sandstone, grey, poor to excellent quality based on RQD - highly weatherd from 9.86 mbgs to 9.93 mbgs		RC1	58	38	38	
11.0			silty sand seam at 10.92 mbgs						

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

File: \\GHDNET\GHD\CA\PETERBOROUGH\PROJECTS\662\11231101\WORKSHARE\FIELD\GINT LOG\11231101 LOGS.GPJ Library File: 11231101 GHD_GEOTECH_V10.GLB Report: 11231101 BOREHOLE LOG Date: 12/8/21

BOREHOLE No.: BH1-21
ELEVATION: 91.07 m

BOREHOLE LOG

Page: 2 of 2

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.
PROJECT: ConFastfrate, New Warehouse & Offices
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: J. Scott CHECKED BY: Leandro Ramos
DATE (START): 26 July 2021 DATE (FINISH): 27 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
metres	91.07		GROUND SURFACE			%		N	
			vertical fracture at 11.58 mbgs		RC2	98	95	95	
12.0									
13.0					RC3	95	58	58	
14.0	77.25		Borehole terminated at 13.82 mbgs Note: Borehole Coordinate - UTM Zone 18 - Northing: 5017223.9 - Easting: 456487.2						
15.0									
16.0									
17.0									
18.0									
19.0									
20.0									
21.0									
22.0									

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

REFERENCE No.: 11231101 ENCLOSURE No.:

BOREHOLE No.: BH2-21

ELEVATION: 90.79 m

BOREHOLE LOG

Page: 1 of 2

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.

PROJECT: ConFastfrate, New Warehouse & Offices

LOCATION: Somme Street, Ottawa, ON

DESCRIBED BY: J. Scott CHECKED BY: Leandro Ramos

DATE (START): 27 July 2021 DATE (FINISH): 27 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
metres	90.79		GROUND SURFACE			%		N	
	90.71		**TOPSOIL** (75 mm)		SS1A	92	3-12-11-15	23	
			FILL - SILTY SAND, trace clay, trace bricks, trace asphalt, brown to black, moist, compact		SS1B		--		
	90.33		**FILL** - SAND AND GRAVEL, trace silt, brown, moist, compact		SS2	88	6-14-17-15	31	
1.0	90.03		**FILL** - SILTY SAND, with gravel, trace clay, brown to grey, moist, dense		SS3A	46	7-9-6-6	15	
			with clay at 1.65 mbgs		SS3B		--		
2.0			trace clay at 2.89 mbgs		SS4	67	28-13-12-38	25	
3.0			asphalt at 3.35 mbgs		SS5	63	8-7-5-12	12	
					SS6A	67	3-1-1-1	2	
4.0	86.93		**ORGANIC**		SS6B		--		
			FILL - SILTY SAND, trace gravel, trace clay, brown, wet, loose		SS6C		--		
	86.88		with topsoil at 4.57 mbgs		SS7A	88	2-3-7-8	10	
5.0			with clay, bricks fragments at 4.72 mbgs		SS7B		--		
	85.45		**SILTY SAND** - with clay, trace gravel, brown, moist to wet, compact to dense		SS8	83	8-19-22-40	41	
6.0			grey at 6.10 mbgs		SS9	54	9-14-12-13	26	
7.0					SS10	79	5-3-5-6	8	
8.0					SS11	75	5-7-8-10	15	
			Gravel - 20%, Sand - 38%, Silt - 33%, Clay - 9%		SS12	63	6-10-11-17	21	
9.0			wet at 9.14 mbgs		SS13	71	11-18-18-21	36	
10.0			augers grinding at 10.08 mbgs, inferred boulder		SS14	71	19-50/25 mm	50/25 mm	
11.0					SS15	25	11-14-15-21	29	

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

File: \\GHDNET\GHD\CA\PETERBOROUGH\PROJECTS\662\11231101\WORKSHARE\FIELD\GINT LOG\11231101 LOGS.GPJ Library File: 11231101 GHD_GEOTECH_V10.GLB Report: 11231101 BOREHOLE LOG Date: 12/8/21

BOREHOLE No.: BH2-21
ELEVATION: 90.79 m

BOREHOLE LOG

Page: 2 of 2

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.
PROJECT: ConFastfrate, New Warehouse & Offices
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: J. Scott CHECKED BY: L. Ramos
DATE (START): 27 July 2021 DATE (FINISH): 27 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
metres	90.79		GROUND SURFACE			%		N	
	79.36		**SAND** - trace silt, grey, wet, dense		SS16A	92	11-15-18-31	23	
12.0	79.23		**SILTY CLAY** - with sand, trace gravel reddish brown, moist, hard		SS16B		–		
					SS17	0	21-31-31-40	62	
13.0					SS18	100	9-21-38-50/127 mm	59	
14.0					SS19	100	17-26-48-50/127 mm	59	
15.0	76.01		**LIMESTONE** - interbedded sandstone, grey, good quality based on RQD		RC1	100	78	78	
			UCS = 139.1 MPa						
16.0									
					RC2	98	76	76	
17.0									
18.0					RC3	100	89	89	
19.0	71.92		Borehole terminated at 18.87 mbgs						
20.0			Note: Borehole Coordinates - UTM Zone 18N - Northing: 5017221.2 - Easting: 456581.5						
21.0									
22.0									

NOTES:
m bgs: meters below ground surface
RQD: Rock Quality Designation

REFERENCE No.: 11231101 ENCLOSURE No.:

BOREHOLE No.: BH3-21
ELEVATION: 90.55 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.
PROJECT: ConFastfrate, New Warehouse & Offices
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: J. Scott CHECKED BY: L. Ramos
DATE (START): 26 July 2021 DATE (FINISH): 26 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA				
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %
metres	90.55		GROUND SURFACE			%		N
	90.48		**TOPSOIL** (75 mm)					
			FILL - SILTY SAND, with gravel, trace clay, brown, moist, compact		SS1	71	2-6-4-10	10
					SS2A	42	5-5-7-14	12
1.0	89.64		with presence of organics/topsoil		SS2B		–	
2.0					SS3	33	5-5-6-15	11
			with to trace clay at 2.5 m bgs		SS4	42	7-6-4-3	10
3.0			grey at 3.0 m bgs		SS5	86	2-2-8-27	10
			moist					
	87.20		**ASPHALT**					
4.0	87.15		**FILL** - SANDY GRAVEL, dark grey, wet, compact		SS6	46	12-12-5-7	17
	86.74		**SILTY SAND** - trace gravel, some clay, brown, moist, compact					
5.0			loose at 4.75 m bgs		SS7	0	3-2-3-4	5
			compact to very dense at 5.5 m bgs Gravel - 19%, Sand - 49%, Silt - 26%, Clay - 6%		SS8	73	10-16-21-46	37
6.0	WL6.2 2021-07-26				SS9	100	13-26-27-41	53
7.0					SS10A	100	9-11-11-15	22
	83.54		with clay, trace gravel, trace cobbles, grey, moist, compact		SS10B		–	
8.0					SS11	71	8-13-20-28	33
					SS12	79	5-10-16-36	26
9.0			wet at 9.14 m bgs		SS13	80	18-50/102 mm	100+
	81.11		Borehole terminated due to auger refusal at 9.45 mbgs. Bedrock or boulder inferred					
10.0			Noted: Borehole Location - UTM Zone 18N - Northing: 5017286.1 - Easting: 456612.6					
11.0								

SCALE FOR TEST RESULTS
50kPa 100kPa 150kPa 200kPa
10 20 30 40 50 60 70 80 90

NOTES:
m bgs: meters below ground surface
RQD: Rock Quality Designation

File: G:\11231101\WORKSHARE\FIELD\GINT LOG\11231101 LOGS - COPY.GPJ Library File: 11231101 GHD_GEOTECH_V10.GLB Report: 11231101 BOREHOLE LOG Date: 24/1/22

BOREHOLE No.: BH4-21
ELEVATION: 90.23 m

BOREHOLE LOG

Page: 1 of 2

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.
PROJECT: ConFastfrate, New Warehouse & Offices
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: J. Scott CHECKED BY: L. Ramos
DATE (START): 8 July 2021 DATE (FINISH): 28 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa
metres	90.23		GROUND SURFACE			%		N	10 20 30 40 50 60 70 80 90
	90.16		**TOPSOIL** (75 mm)						
			FILL - SILTY SAND, with clay, trace rootlets, brown to grey, moist, stiff		SS1	43	1-2-7-4	9	
1.0			asphalt at 0.8 m bgs cobble at 0.9 m bgs		SS2	54	7-8-4-9	12	
			cobble at 1.5 m bgs		SS3	21	9-10-7-5	17	
2.0					SS4	0	4-2-1-2	3	
3.0	87.19		**FILL** - very loose fill mixed with organics/top soil and wood fragments - dark brown, moist		SS5	67	2-1-1-4	2	
4.0					SS6	13	5-1-0-1	1	
5.0					SS7	17	2-1-1-2	2	
					SS8	42	2-1-2-2	3	
6.0 ▼	WL6.1 2021-07-26				SS9A	83	1-3-2-3	5	
	83.68		**SILTY SAND** - with clay, trace rootlets, brown, moist		SS9B		–		
7.0			wet at 6.86 mbgs trace gravel, rootlets stopped at 7.01 mbgs		SS10	42	4-11-11-15	22	
8.0			brown with grey mottling, moist at 7.62 m bgs		SS11	83	5-10-12-11	22	
			wet at 8.69 mbgs		SS12	100	21-27-31-30	58	
9.0					SS13	0	22-22-19-36	41	
10.0					SS14	71	8-21-20-31	41	
11.0			moist at 10.82 mbgs		SS15	67	20-16-25-25	41	

NOTES:
m bgs: meters below ground surface
RQD: Rock Quality Designation

REFERENCE No.: 11231101 ENCLOSURE No.:

BOREHOLE No.: BH4-21

ELEVATION: 90.23 m

BOREHOLE LOG

Page: 2 of 2

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.

PROJECT: ConFastfrate, New Warehouse & Offices

LOCATION: Somme Street, Ottawa, ON

DESCRIBED BY: J. Scott CHECKED BY: Leandro Ramos

DATE (START): 8 July 2021 DATE (FINISH): 28 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
metres	90.23		GROUND SURFACE			%		N	
	78.80		**SILTY CLAY** - with sand, trace gravel, reddish brown, moist, hard		SS16	100	13-24-26-22	50	○ ●
12.0	78.19		Borehole terminated due to auger refusal at 12.04 mbgs. Bedrock or boulder inferred						
			Note: Borehole Coordinate - UTM 18 Zone - Northing: 5017343.6 - Easting: 456673.6						
13.0									
14.0									
15.0									
16.0									
17.0									
18.0									
19.0									
20.0									
21.0									
22.0									

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH5-21
ELEVATION: 90.39 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: Consolidated Fastfrate (Ottawa) Holdings Ltd.
PROJECT: ConFastfrate, New Warehouse & Offices
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: J. Scott CHECKED BY: Leandro Ramos
DATE (START): 26 July 2021 DATE (FINISH): 26 July 2021

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Blows per 6 in. / 15 cm	Penetration Index / RQD %	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa
metres	90.39		GROUND SURFACE			%		N	10 20 30 40 50 60 70 80 90
	90.32		**TOPSOIL** (75 mm)						
			FILL - SILTY CLAY, trace sand, grey, moist, very soft		SS1	21	1-0-0-1	0	
					SS2A	24	2-5-6-7	11	
1.0	89.48		**FILL** - SANDY SILT, trace clay, trace gravel, dark brown, moist, compact		SS2B		--		
			loose at 1.52 mbgs		SS3	24	12-5-4-6	9	
2.0			Gravel - 25%, Sand - 38%, Silt - 29%, Clay - 8%						
			with clay, some gravel at 2.29 mbgs		SS4	24	5-4-2-5-6	6	
3.0					SS5	24	4-3-6-7	9	
			shale cobble at 3.2 mbgs						
4.0					SS6	24	4-3-3-5	6	
	85.82		**SILTY SAND** - trace clay, trace gravel, brown, moist, compact to very dense		SS7	24	3-5-8-9	13	
5.0			Gravel - 10%, Sand - 38%, Silt - 41%, Clay - 11% wet at 5.03 mbgs						
			moist, containing cobbles at 5.33 mbgs		SS8	24	14-20-42-42	62	
6.0			grey at 6.1 mbgs		SS9	24	8-16-20-20	36	
7.0			wet, with clay at 6.86 mbgs		SS10	16	15-34-50/102 mm	84/254 mm	
			moist at 7.62		SS11A	15	23-40-50/76 mm	90/229 mm	
8.0	82.52		**SANDY SILT** - trace clay, grey, moist, very loose		SS11B		--		
	82.39		Borehole terminated due to auger refusal at 8.0 mbgs. Bedrock or boulder inferred						
9.0			Note: Borehole Coordinate - UTM 18 Zone - Northing: 5017293.2 - Easting: 456532.1						
10.0									
11.0									

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH1
ELEVATION: 90.21 m

BOREHOLE LOG

Page: 1 of 2

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 6 August 2020 DATE (FINISH): 6 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	MONITOR WELL	State	Type and Number	Recovery	OVC	Penetration Index / RQD
meters	90.21		GROUND SURFACE	1.01			%	ppm	N
	90.1		**TOPSOIL**(75 mm thickness)						
0.5			**FILL** - Silty sand, trace gravel, loose, brown, damp			SS1	50		5
	89.4								
1.0			**FILL** - Gravel, trace sand, possible cobble/boulder, compact to dense, grey, damp			SS2	50		47
1.5	88.7			Riser					
			FILL - Silty sand, some clay, trace gravel, compact, brown and grey, damp			SS3	42		20
2.0				Cuttings					
2.5						SS4	58		19
3.0	87.2								
			FILL - Silty clay, some sand, trace gravel, very stiff, brown and grey, damp			SS5	33		10
3.5			becoming sandy at 3.8 mbgs						
4.0	86.3		**FILL** - Clayey silty sand, compact, grey and brown, moist	WL 3.99		SS6	58		14
4.5				4.57					
				Bentonite		SS7	21		14
5.0				5.18					
5.5				5.49		SS8	46		12
	84.3								
6.0			**SILTY SAND**- some clay, trace to some gravel, compact, brown and grey, moist	Sand					
				Screen		SS9	54		12
6.5									

SCALE FOR TEST RESULTS
50kPa 100kPa 150kPa 200kPa
10 20 30 40 50 60 70 80 90

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH1
ELEVATION: 90.21 m

BOREHOLE LOG

Page: 2 of 2

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 6 August 2020 DATE (FINISH): 6 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		MONITOR WELL	SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK		State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.21		GROUND SURFACE				%	ppm	N	
			Refusal encountered at 7.2 mbgs Cobbles and boulders encountered from 7.3 to 8.2 mbgs	7.01		SS10	71		50+	
7.5										
8.0						RC1	49			
	82.0		**LIMESTONE**- interbedded sandstone, grey, fair becoming good quality with depth based on RQD							
8.5										
						RC2	94		73	
9.0										
9.5										
10.0						RC3	100		82	
10.5										
11.0						RC4	100		90	
	78.9		Borehole terminated at 11.3 mbgs							
11.5										
12.0										
12.5										
13.0										
13.5										

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH2
ELEVATION: 89.80 m

BOREHOLE LOG

Page: 1 of 2

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 6 August 2020 DATE (FINISH): 6 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	89.80		GROUND SURFACE			%	ppm	N	
	89.7		**TOPSOIL**(75 mm thickness)						
			FILL - Silty clay, firm to stiff, grey, moist		SS1	58		2	●
0.5									
1.0					SS2	100		2	●
1.5									
2.0					SS3	100		1	●
2.5					SS4	100		WH	
3.0									
3.5					FV5				△
	86.0								
4.0			**FILL** - Clayey sand, some gravel, organics, loose, grey and brown, moist		SS6	75		5	●
4.5									
	85.2		**FILL** - Gravelly sandy silt, compact to very dense, brown and grey, saturated		SS7	83		33	●
5.0									
5.5					SS8	63		70	●
6.0									
	83.7		**SILTY SAND**- some gravel, compact to very dense, grey, moist to saturated		SS9	100		27	●
6.5									

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH2
ELEVATION: 89.80 m

BOREHOLE LOG

Page: 2 of 2

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 6 August 2020 DATE (FINISH): 6 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	89.80		GROUND SURFACE			%	ppm	N	
					SS10	83		57	
7.5									
					SS11	91		70	
8.0									
			Cobbles and boulders encountered from 8.4 to 9.3 mbgs		SS12	100		50+	
8.5									
9.0			Refusal encountered at 9.3 mbgs		SS13	100		50+	
	80.5		**LIMESTONE**- interbedded sandstone, grey, fair to good quality based on RQD						
9.5					RC1	100		85	
10.0									
10.5									
					RC2	100		83	
11.0									
11.5									
					RC3	100		52	
12.0									
	77.6		Borehole terminated at 12.2 mbgs						
12.5									
13.0									
13.5									

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH3

ELEVATION: 90.88 m

BOREHOLE LOG

Page: 1 of 3

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.

PROJECT: New Warehouse

LOCATION: Somme Street, Ottawa, ON

DESCRIBED BY: RVT CHECKED BY: BV

DATE (START): 7 August 2020 DATE (FINISH): 7 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.88		GROUND SURFACE			%	ppm	N	
	90.8		**TOPSOIL**(125 mm thickness)						
0.5			**FILL** - Clayey silty sand, trace to some gravel, compact, brown and grey, damp		SS1	63		11	
	90.0								
1.0			**FILL** - Crushed limestone, asphalt, compact, grey and black, damp		SS2	58		42	
1.5	89.4		**FILL** - Sand, trace gravel, clay pockets, asphalt, compact, grey and black, damp to moist		SS3	38		15	
2.0									
	88.6								
2.5			**FILL** - Silty sand, some gravel, trace clay, possible cobbles/boulders, compact , grey, moist		SS4	33		54	
3.0	87.8								
3.5			**FILL** - Clayey sand, asphalt, loose to compact, grey and brown, moist		SS5	33		22	
4.0					SS6	4		8	
4.5	86.3								
5.0			**FILL** - Silty sand, trace gravel, trace to some clay, dense to very dense, brown and grey, damp to moist, possible cobbles/boulders		SS7	50		54	
5.5					SS8	33		44	
6.0	84.8								
6.5			**SANDY SILT**- some gravel, compact to very dense, grey, damp		SS9	83		31	

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH3
ELEVATION: 90.88 m

BOREHOLE LOG

Page: 2 of 3

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 7 August 2020 DATE (FINISH): 7 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.88		GROUND SURFACE			%	ppm	N	
					SS10	83		28	
7.5			Possible cobbles/boulders encountered from 7.6 to 9.1 mbgs						
8.0					SS11	83		24	
8.5					SS12	25		80	
9.0									
9.5					SS13	100		42	
			Refusal encountered at 10 mbgs						
10.0			Cobbles and boulders encountered from 10.0 to 11.9 mbgs						
10.5									
11.0					RC1	32			
11.5									
	79.0								
12.0			**LIMESTONE**- interbedded sandstone, grey, poor to fair quality based on RQD						
12.5					RC2	100		57	
13.0									
13.5			Rock core mechanical breaks during coring from 13.4 to 14.9 mbgs						

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH3
ELEVATION: 90.88 m

BOREHOLE LOG

Page: 3 of 3

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 7 August 2020 DATE (FINISH): 7 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.88		GROUND SURFACE			%	ppm	N	
					RC3	92		37	
14.5									
15.0	75.9		Borehole terminated at 14.9 mbgs						
15.5									
16.0									
16.5									
17.0									
17.5									
18.0									
18.5									
19.0									
19.5									
20.0									
20.5									

NOTES:
mbgs: meters below ground surface
RQD: Rock Quality Designation

BOREHOLE No.: BH4
ELEVATION: 90.44 m

BOREHOLE LOG

Page: 1 of 2

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 7 August 2020 DATE (FINISH): 7 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.44		GROUND SURFACE			%	ppm	N	
	90.3		**TOPSOIL**(125 mm thickness)						
0.5			**FILL** - Gravelly sand, compact, grey, damp		SS1	63		33	
	89.7		**FILL** - Sand and gravel, compact, grey, damp						
1.0					SS2	50		17	
1.5			Asphalt encountered at 1.5 mbgs						
					SS3	54		27	
2.0									
2.5					SS4	58		28	
3.0	87.4		**FILL** - Silty sand, trace clay, trace to some gravel, possible cobbles/boulders, brown and grey, damp to moist		SS5	100		50+	
3.5									
			Wood encountered at 3.8 mbgs						
4.0					SS6	17		19	
4.5									
					SS7	0		4	
5.0									
5.5					SS8	75		29	
6.0	84.3		**SILTY SAND**- trace to some gravel, trace clay, compact to dense, grey and brown, moist						
6.5					SS9	79		49	

NOTES:
mbgs: meters below ground surface

BOREHOLE No.: BH4
ELEVATION: 90.44 m

BOREHOLE LOG

Page: 2 of 2

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 7 August 2020 DATE (FINISH): 7 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.44		GROUND SURFACE			%	ppm	N	
					SS10	4		32	
7.5									
					SS11	58		18	
8.0									
8.5					SS12	58		44	
9.0									
					SS13	67		50	
9.5									
10.0									
10.5									
					SS14	88		50+	
11.0	79.3		Borehole terminated at refusal at 11.1 mbgs						
11.5									
12.0									
12.5									
13.0									
13.5									

NOTES:
mbgs: meters below ground surface

BOREHOLE No.: DCPT5
ELEVATION: 90.76 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: Consolidated Fastrate (Ottawa) Holdings Ltd.
PROJECT: New Warehouse
LOCATION: Somme Street, Ottawa, ON
DESCRIBED BY: RVT CHECKED BY: BV
DATE (START): 7 August 2020 DATE (FINISH): 7 August 2020

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS
meters	90.76		GROUND SURFACE			%	ppm	N	50kPa 100kPa 150kPa 200kPa
			Dynamic Cone Penetration test from surface to refusal encountered at 5.9 mbgs						10 20 30 40 50 60 70 80 90
0.5									
1.0									
1.5									
2.0									
2.5									
3.0									
3.5									
4.0									
4.5									
5.0									
5.5									
6.0	84.8								
6.5									

NOTES:
mbgs: meters below ground surface

INSPEC-SOL

BOREHOLE No.: B5-1
ELEVATION: 90.48 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: R.W.Tomlinson Ltd.
PROJECT: Geotechnical Investigation
LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario
DESCRIBED BY: B.Beveridge CHECKED BY: J.Bennett
DATE (START): October 30, 2008 DATE (FINISH): October 30, 2008

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- o Water content (%)
- Atterberg limits (%)
- • N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		MONITOR WELL	SAMPLE DATA				
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK		State	Type and Number	Recovery	Organic Vapour ppm or %LEL	Penetration Index / RQD
meters	90.48		GROUND SURFACE	91.70 91.60			%	ppm	N
1.0			FILL - silty clay, some sand, gravel, concrete, asphalt and organics, loose to dense, green/brown/grey, moist			SS1	46		6
2.0						SS2	25		10
3.0						SS3	50		4
4.0						SS4	50		9
5.0						SS5	75		50+
6.0	85.15		SANDY SILT- some sand, gravel, trace oxidation, very stiff, greenish brown, moist			SS6	59		10
7.0	83.62		SANDY CLAY- some gravel, trace oxidation, very soft, red / green / grey, moist	6.98 7.29		SS7	67		50+
8.0	83.16		SILTY CLAY- some gravel, very stiff, grey, moist	WL 7.63		SS8	25		50+
9.0				8.81		SS9	42		50+
10.0	80.45		End of Borehole Auger Refusal Assumed Bedrock	10.03		SS10	0		R
11.0						SS11	50		R
12.0						SS12	46		R
13.0						SS13	17		R

SCALE FOR TEST RESULTS
50kPa 100kPa 150kPa 200kPa
10 20 30 40 50 60 70 80 90

NOTES:

BOREHOLE LOG T020556-A1-BH(OCT-31-08).GPJ INSPEC_SOL.GDT 5/12/09

INSPEC-SOL

BOREHOLE No.: B5-2
ELEVATION: 90.78 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: R.W.Tomlinson Ltd.
PROJECT: Geotechnical Investigation
LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario
DESCRIBED BY: B.Beveridge CHECKED BY: J.Bennett
DATE (START): October 23, 2008 DATE (FINISH): October 23, 2008

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Organic Vapour ppm or %LEL	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa 10 20 30 40 50 60 70 80 90
meters	90.78		GROUND SURFACE			%	ppm	N	
			FILL - silty clay, some asphalt, sand and gravel, trace organics, compact to dense, brown/black, moist						
1.0					SS1	92		49	
2.0					SS2	55		12	
					SS3	75		50+	
3.0					SS4	63		17	
4.0					SS5	71		32	
	86.21		SILTY CLAY - some gravel, trace oxidation, firm to stiff, brown/grey, moist to wet		SS6	38		2	
5.0					SS7	100		7	
6.0					SS8	84		R	
	84.07		End of Borehole						
7.0									
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									

NOTES:

BOREHOLE LOG T020556-A1-BH(OCT-31-08).GPJ INSPEC_SOL.GDT 5/12/09

INSPEC•SOL

BOREHOLE No.: B5-3

ELEVATION: 90.51 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: R.W.Tomlinson Ltd.

PROJECT: Geotechnical Investigation

LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario

DESCRIBED BY: B.Beveridge CHECKED BY: J.Bennett

DATE (START): October 23, 2008 DATE (FINISH): October 23, 2008

LEGEND

- SS Split Spoon
- ST Shelby Tube
- RC Rock Core
- Water Level
- o Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	Organic Vapour ppm or %LEL	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa
meters	90.51		GROUND SURFACE			%	ppm	N	10 20 30 40 50 60 70 80 90
			FILL- concrete and asphalt fragments, some sand, trace organics						
1.0	89.75		FILL- silty clay, some gravel, trace oxidation, stiff, brown, moist		SS1	42		50+	
2.0	88.99		FILL- sandy silt, some gravel, trace clay, organics, very stiff, brownish green, moist		SS2	58		15	
3.0	88.22		FILL- silty clay, some asphalt, gravel and sand, trace organics, hard, brown, moist		SS3	50		38	
					SS4	59		13	
4.0	86.70		FILL- silty clay, trace organics, oxidation, gravel, sand, hard, moist		SS5	21		17	
5.0			-becoming trace to some gravel		SS6	84		32	
6.0			-becoming more asphalt fragments, hard to very stiff		SS7	71		22	
	84.41		SILTY CLAY- some sand, trace organics, firm, grey, moist		SS8	25		7	
7.0			-becoming very stiff		SS9	59		39	
	82.89		End of Borehole						
8.0									
9.0									
10.0									
11.0									
12.0									
13.0									

NOTES:

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Orgaworld
PROJECT NUMBER: 45804
CLIENT: Orgaworld Canada Real Estate Ltd.
LOCATION: Hawthorne and Rideau Road, Ottawa, Ontario

HOLE DESIGNATION: MW7-08
DATE COMPLETED: July 14, 2008
DRILLING METHOD: HSA
FIELD PERSONNEL: T. Saunders

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	TOP OF RISER	94.82						
	GROUND SURFACE	93.81						
0	FILL - silty sand with some gravel, trace asphalt, trace concrete, trace clay, compact to dense, grey to brown, moist		Bentonite Hole Plug	SS1		50	38	0.0
1				SS2		35		4.6
2				SS3		50	13	0.0
3				SS4		25	15	4.3
4	- becoming wet at 3.65m BGS		Filter Sand / Well Screen	SS5		100		
5				SS6		42	54	0.0
	SM - TILL - silty sand with some gravel, brown, moist to wet	88.32		SS7		50	15	0.0
6				SS8		100		1.5
7	END OF BOREHOLE @ 6.98m BGS	86.83		SS9		100		0.0
8								
9								
10								
11								

WELL DETAILS
Screened interval:
90.76 to 87.72m
3.05 to 6.10m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 10
Material: PVC
Seal:
93.20 to 91.37m
0.61 to 2.44m BGS
Material: Bentonite
Sand Pack:
91.37 to 87.72m
2.44 to 6.10m BGS
Material: Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STATIC WATER LEVEL ▼ July 17, 2008

CHEMICAL ANALYSIS (SS4)

OVERBURDEN LOG 45804-00(JULY-2008)MW-OT003.GPJ CRA_CORP.GDT 1/30/09

REFERENCE No.: T020556-A1 ENCLOSURE No.: 40

INSPEC-SOL

TEST PIT No.: TP5-01
ELEVATION: 298.82 ft

TEST PIT REPORT

CLIENT: R.W.Tomlinson Ltd.
PROJECT: Geotechnical Investigation
LOCATION: Lot 26 and 27, concession 6, Ottawa, Ontario
DESCRIBED BY: B.Beveridge DATE: November 10, 2008
CHECKED BY: J.Bennett DATE:

LEGEND

GSE - GRAB SAMPLE (environmental)
GS - GRAB SAMPLE (geotechnical)
Cu - SHEAR TEST
CHEM - CHEMICAL ANALYSIS
OVC - ORGANIC VAPOR CONCENTRATION
INF - INFILTRATION
▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (ft) 298.82	Symbol	STRATIGRAPHY	Sample Type & Number	OVC ppm	Tests Type	▼ INF
1	0.5			FILL-silty clay, some brick, asphalt, concrete, gravel, cobbles, trace organics, brownish black, moist				
2								
3	1.0							
4								
5	1.5							
6								
7	2.0							
8	2.5			-Water infiltration observed at 2.5m BGS				
9								
9.8	3.0	288.99		End of Test Pit				
10								
11	3.5							
12								
13	4.0							
14								
15	4.5							
16								
17	5.0							
18	5.5							
19								
	6.0							

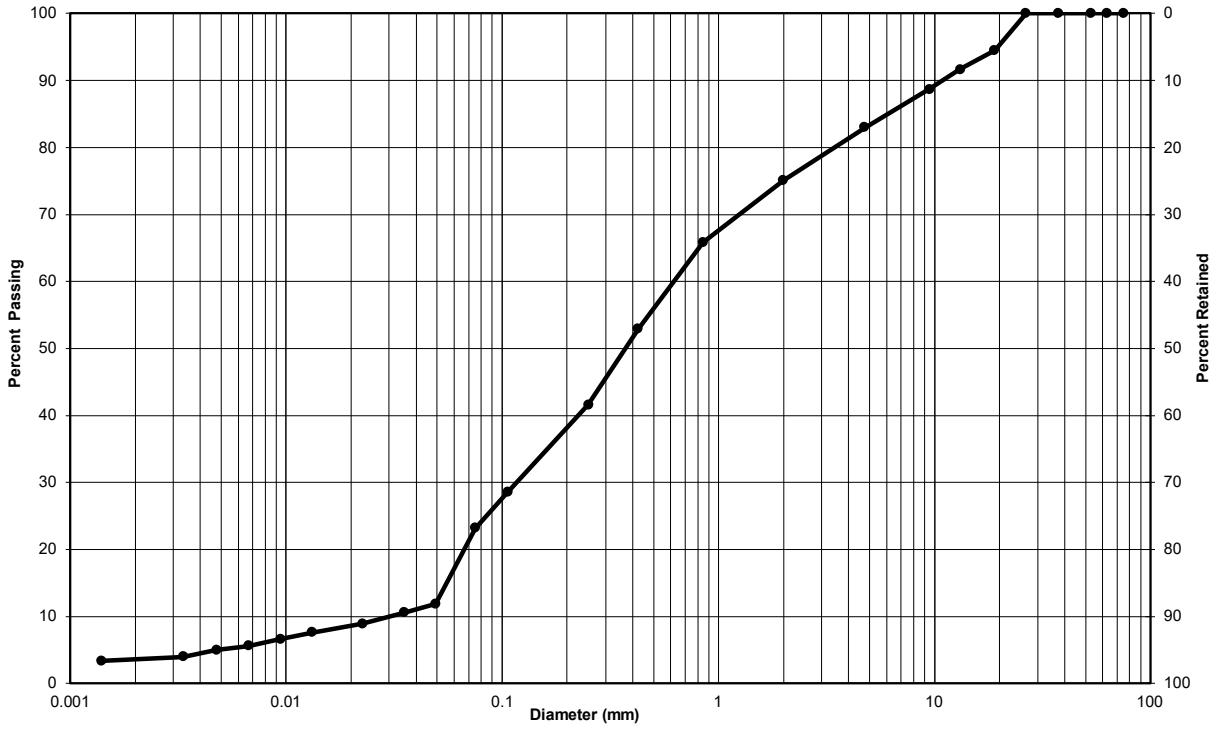
Appendix B

Geotechnical Lab Results

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101

Borehole no.:	BH1-21	Sample no.:	SS2B
Depth:	0.9 to 1.4m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

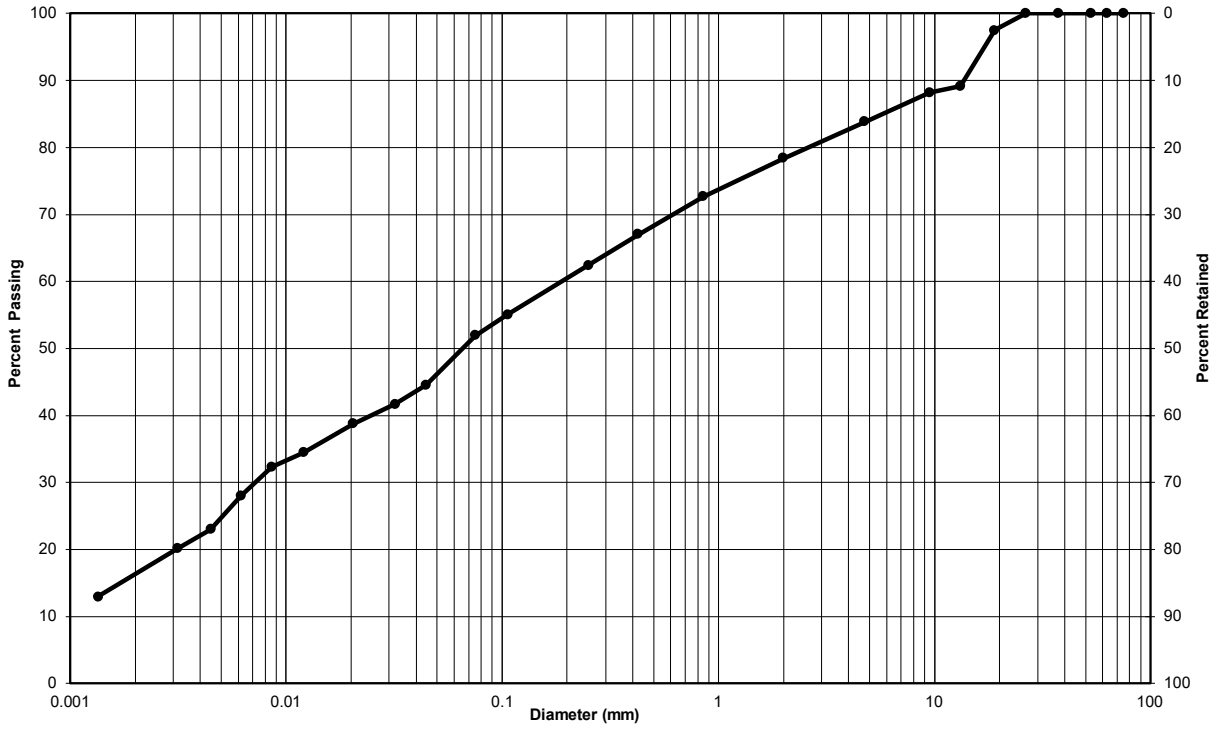
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty sand with gravel (SM)	17	60	23
Silt-size particles (%):	19		
Clay-size particles (%) (<0.002mm):	4		

Remarks:

Performed by:	Jade Gorman	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101
Borehole no.:	BH1-21	Sample no.:	SS13
Depth:	9.1 to 9.8m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy lean clay with gravel (CL)	16	32	52
Silt-size particles (%):	36		
Clay-size particles (%) (<0.002mm):	16		

Remarks:

Performed by:	Jade Gorman	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project no.:**	11231101

Borehole no.:	BH1-21	Sample no.:	SS13	Depth:	9.1 to 9.8m
Soil Description:	Lean Clay (CL)			Date sampled:	

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B33-02667	Spatula no.:	1
Sieve no.:	n/a	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	32	23	15
Water Content:			
Tare no.	1	8	43A
Wet soil+tare, g	26.69	30.76	28.34
Dry soil+tare, g	25.62	28.79	26.84
Mass of water, g	1.07	1.97	1.50
Tare, g	21.32	21.19	21.22
Mass of soil, g	4.30	7.60	5.62
Water content %	24.9%	25.9%	26.7%

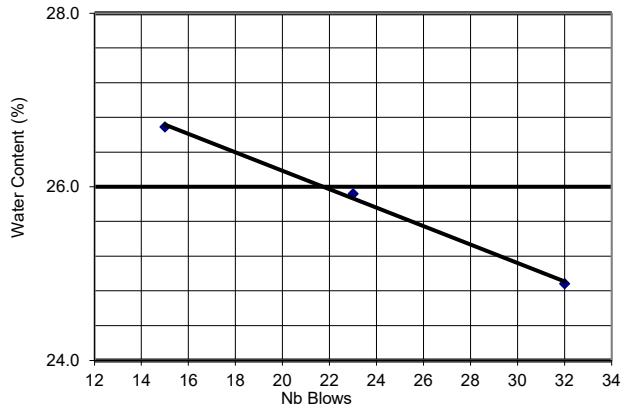
Plastic Limit (PL) - Water Content:		
Tare no.	20	22
Wet soil+tare, g	28.02	27.70
Dry soil+tare, g	26.99	26.75
Mass of water, g	1.03	0.95
Tare, g	21.36	21.56
Mass of soil, g	5.63	5.19
Water content %	18.3%	18.3%
Average water content %	18.3%	

Natural Water Content (W^n):		
Tare no.	N7	
Wet soil+tare, g	203.55	
Dry soil+tare, g	191.76	
Mass of water, g	11.79	
Tare, g	45.09	
Mass of soil, g	146.67	
Water content %	8.0%	

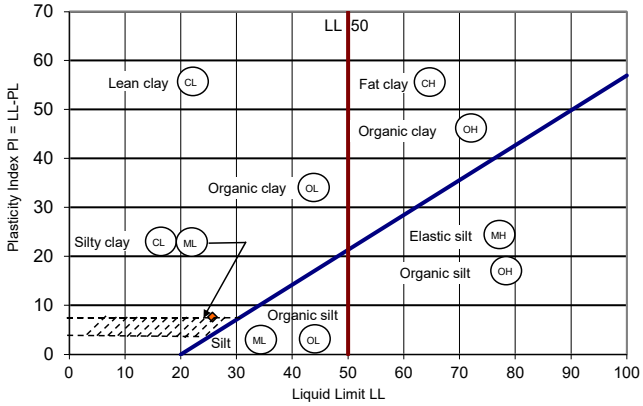
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content W^n
26	18	8	8.0

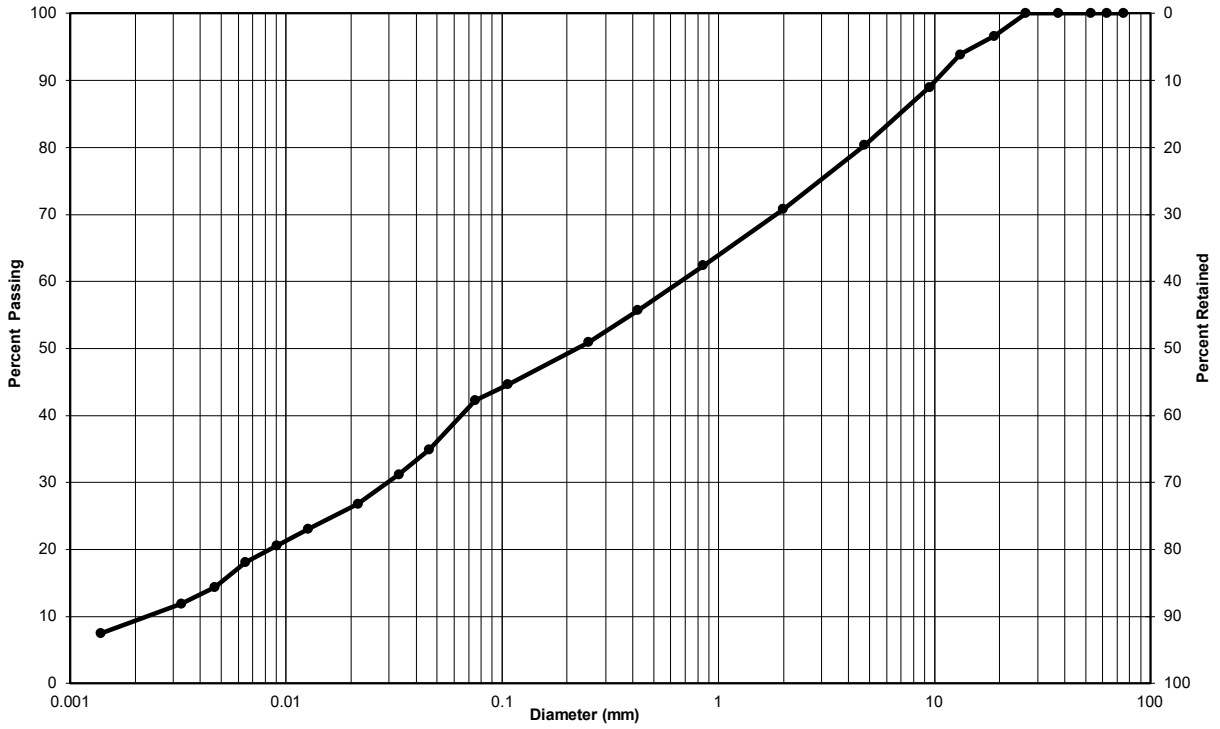
Remarks:

Performed by:	Josh Sullivan	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101

Borehole no.:	BH2-21	Sample no.:	SS12
Depth:	8.4 to 9.0m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy lean clay with gravel (CL)	20	38	42
Silt-size particles (%):	33		
Clay-size particles (%) (<0.002mm):	9		

Remarks:

Performed by:	Jade Gorman	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project no.:**	11231101

Borehole no.:	BH2-21	Sample no.:	SS12	Depth:	8.4 to 9.0m
Soil Description:	Lean Clay (CL)			Date sampled:	

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B33-02667	Spatula no.:	1
Sieve no.:	n/a	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	27	21	15
Water Content:			
Tare no.	1	8	43A
Wet soil+tare, g	29.51	29.53	29.71
Dry soil+tare, g	27.86	27.82	27.93
Mass of water, g	1.65	1.71	1.78
Tare, g	21.30	21.26	21.32
Mass of soil, g	6.56	6.56	6.61
Water content %	25.2%	26.1%	26.9%

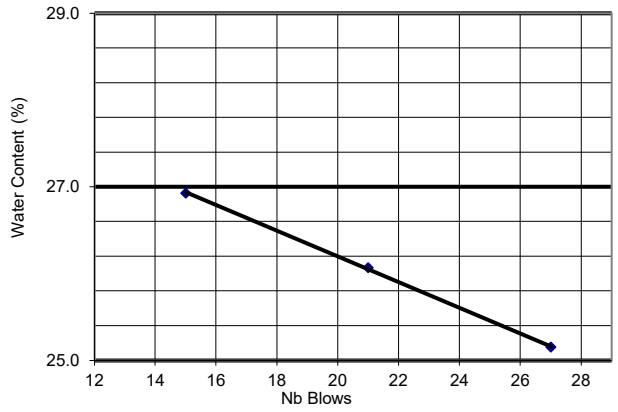
Plastic Limit (PL) - Water Content:		
Tare no.	20	22
Wet soil+tare, g	28.59	28.68
Dry soil+tare, g	27.57	27.62
Mass of water, g	1.02	1.06
Tare, g	21.57	21.36
Mass of soil, g	6.00	6.26
Water content %	17.0%	16.9%
Average water content %	17.0%	

Natural Water Content (W^n):		
Tare no.	Z57	
Wet soil+tare, g	194.57	
Dry soil+tare, g	182.50	
Mass of water, g	12.07	
Tare, g	47.10	
Mass of soil, g	135.40	
Water content %	8.9%	

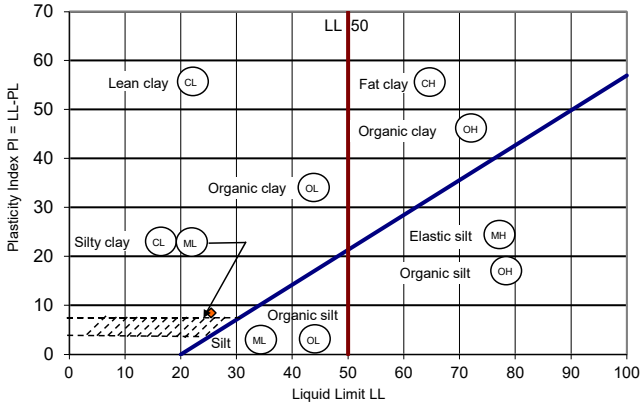
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content W^n
25	17	8	8.9

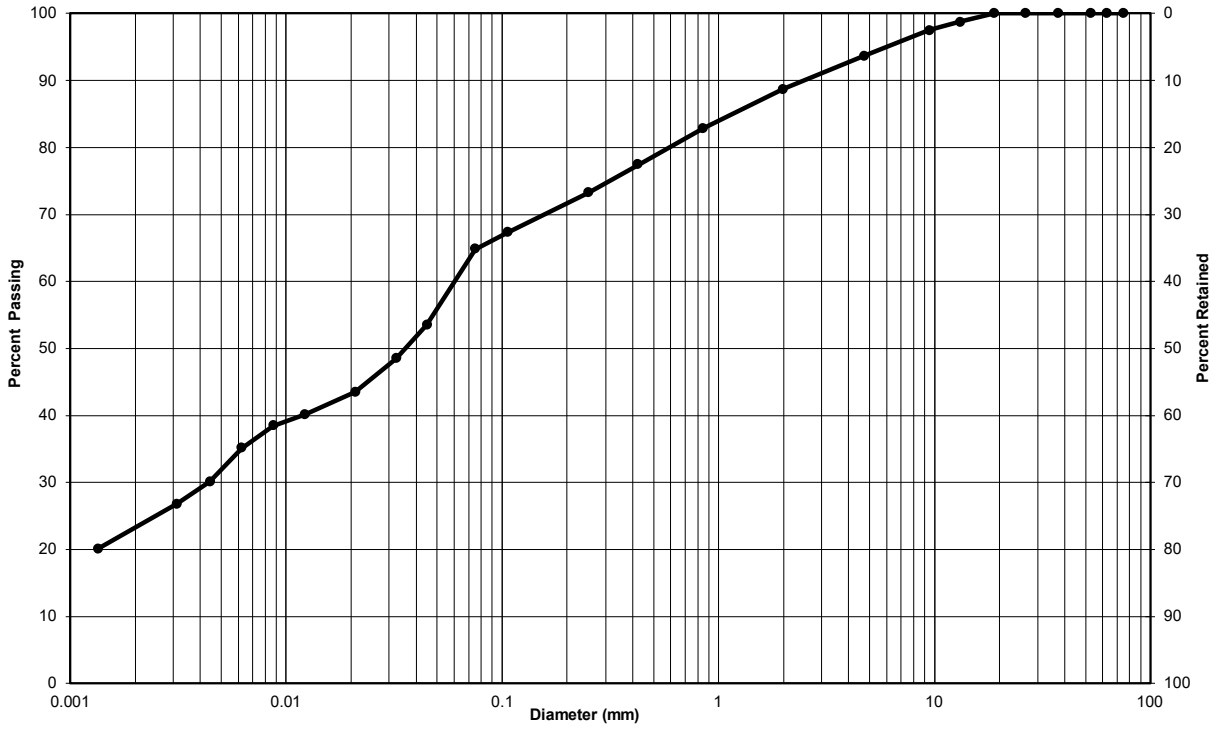
Remarks:

Performed by:	Josh Sullivan	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101

Borehole no.:	BH2-21	Sample no.:	SS18
Depth:	13.0 to 13.6m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy lean clay (CL)	6	29	65
Silt-size particles (%):	42		
Clay-size particles (%) (<0.002mm):	23		

Remarks:

Performed by:	Josh Sullivan	**Date:**	September 9, 2021
Verified by:	Joe Sullivan	**Date:**	September 13, 2021

Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project no.:**	11231101

Borehole no.:	BH2	Sample no.:	SS18	Depth:	13.0 to 13.6m
Soil Description:	Lean Clay (CL)			Date sampled:	

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B33-02667	Spatula no.:	1
Sieve no.:	n/a	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	34	23	15
Water Content:			
Tare no.	116	117	118
Wet soil+tare, g	30.86	30.40	29.04
Dry soil+tare, g	28.88	28.46	27.37
Mass of water, g	1.98	1.94	1.67
Tare, g	21.48	21.50	21.60
Mass of soil, g	7.40	6.96	5.77
Water content %	26.8%	27.9%	28.9%

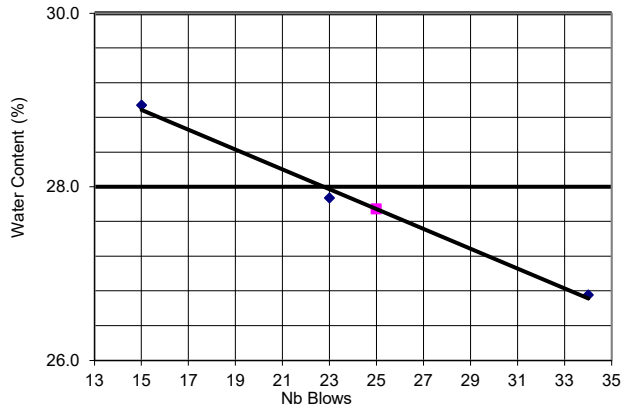
Plastic Limit (PL) - Water Content:		
Tare no.	20	21
Wet soil+tare, g	27.84	27.84
Dry soil+tare, g	27.06	27.09
Mass of water, g	0.78	0.75
Tare, g	21.41	21.54
Mass of soil, g	5.65	5.55
Water content %	13.8%	13.5%
Average water content %	13.7%	

Natural Water Content (W^n):		
Tare no.	S19	
Wet soil+tare, g	167.57	
Dry soil+tare, g	154.66	
Mass of water, g	12.91	
Tare, g	45.95	
Mass of soil, g	108.71	
Water content %	11.9%	

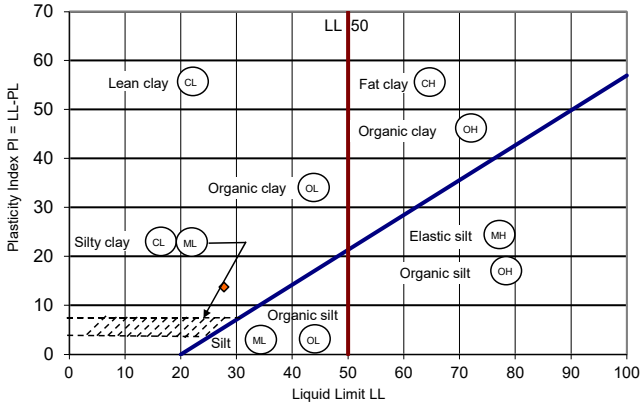
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content W^n
28	14	14	11.9

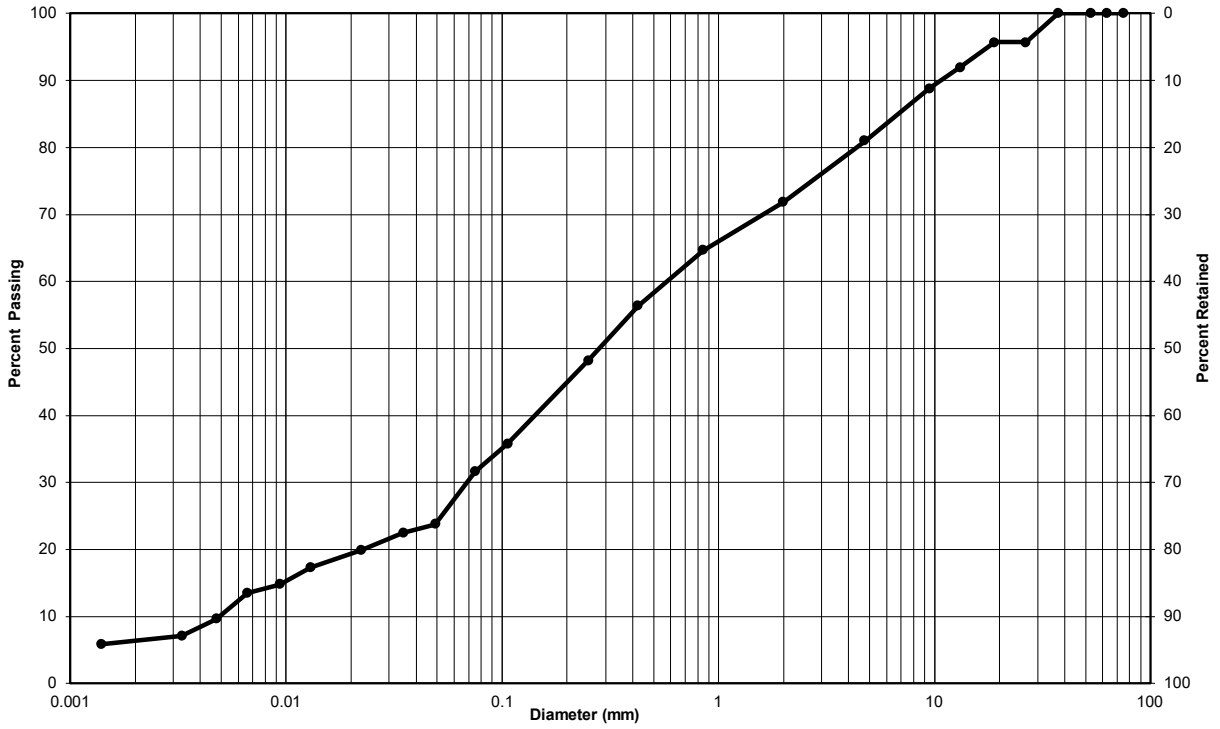
Remarks:

Performed by:	Josh Sullivan	**Date:**	September 10, 2021
Verified by:	Joe Sullivan	**Date:**	September 13, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101

Borehole no.:	BH3-21	Sample no.:	SS8
Depth:	5.3 to 5.9m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy silty clay with gravel (CL-ML)	19	49	32
Silt-size particles (%):	26		
Clay-size particles (%) (<0.002mm):	6		

Remarks:

Performed by:	Jade Gorman	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project no.:**	11231101

Borehole no.:	BH3-21	Sample no.:	SS8	Depth:	5.3 to 5.9m
Soil Description:	Silty Clay (CL-ML)			Date sampled:	

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B33-026667	Spatula no.:	1
Sieve no.:	n/a	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	25	21	15
Water Content:			
Tare no.	116	9	7
Wet soil+tare, g	32.73	31.64	30.02
Dry soil+tare, g	31.13	30.20	28.77
Mass of water, g	1.60	1.44	1.25
Tare, g	21.46	21.75	21.67
Mass of soil, g	9.67	8.45	7.10
Water content %	16.5%	17.0%	17.6%

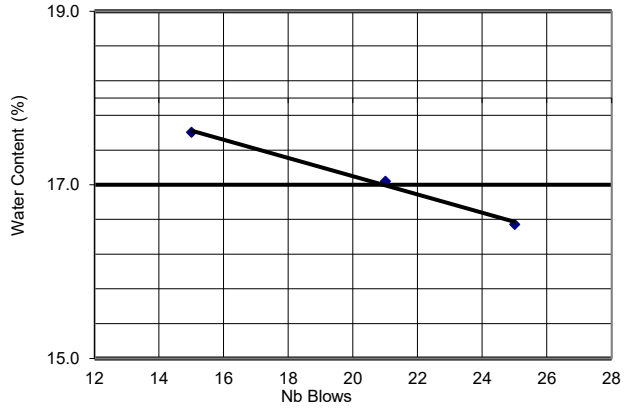
Plastic Limit (PL) - Water Content:		
Tare no.	100	117
Wet soil+tare, g	27.92	28.13
Dry soil+tare, g	27.17	27.33
Mass of water, g	0.75	0.80
Tare, g	21.53	21.48
Mass of soil, g	5.64	5.85
Water content %	13.3%	13.7%
Average water content %	13.5%	

Natural Water Content (W^n):		
Tare no.	T3	
Wet soil+tare, g	313.52	
Dry soil+tare, g	289.92	
Mass of water, g	23.60	
Tare, g	46.54	
Mass of soil, g	243.38	
Water content %	9.7%	

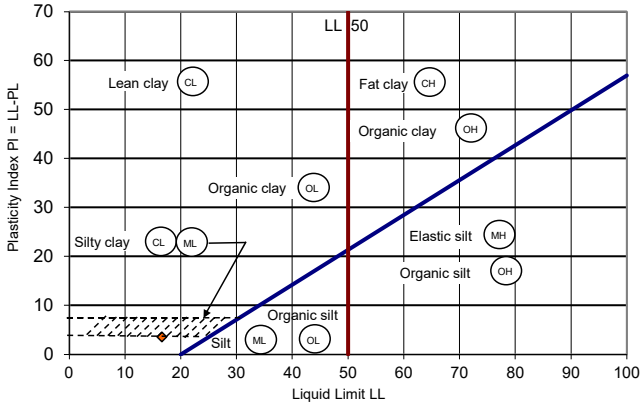
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



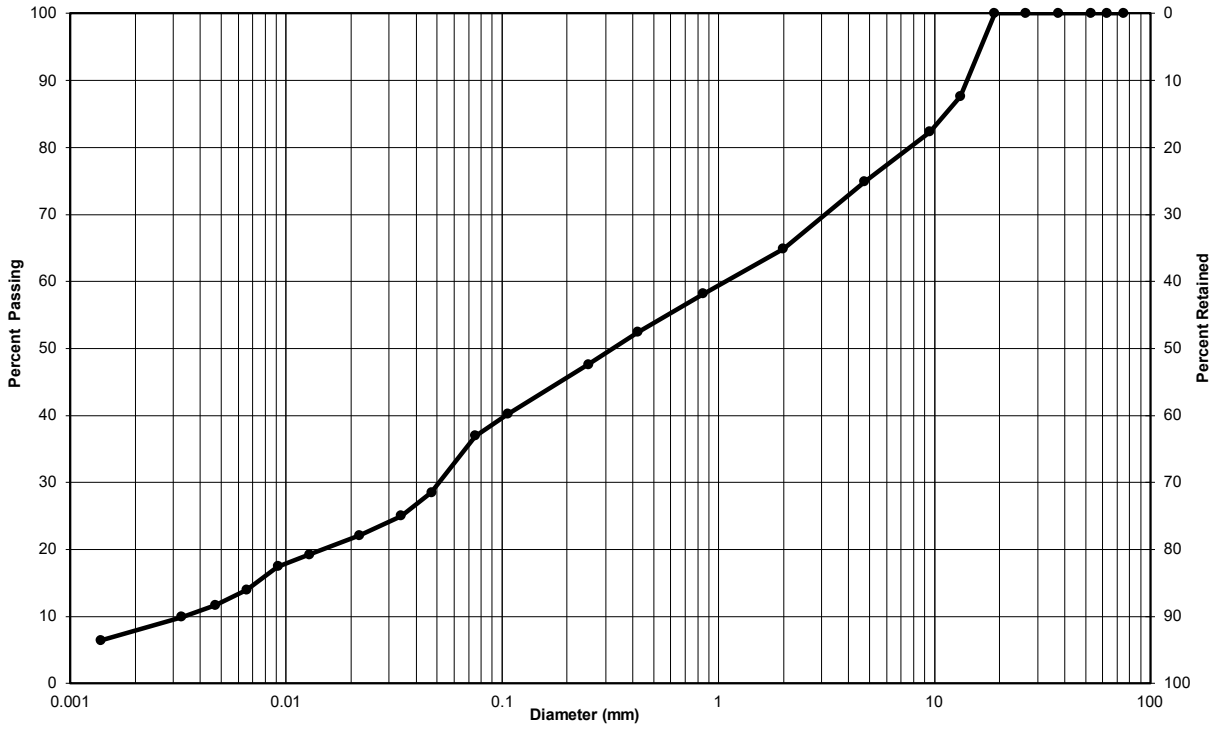
Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content W^n
17	13	4	9.7

Remarks:

Performed by:	Josh Sullivan	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101
Borehole no.:	BH5-21	Sample no.:	SS3
Depth:	1.5 to 2.1m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty sand with gravel (SM)	25	38	37
Silt-size particles (%):	29		
Clay-size particles (%) (<0.002mm):	8		

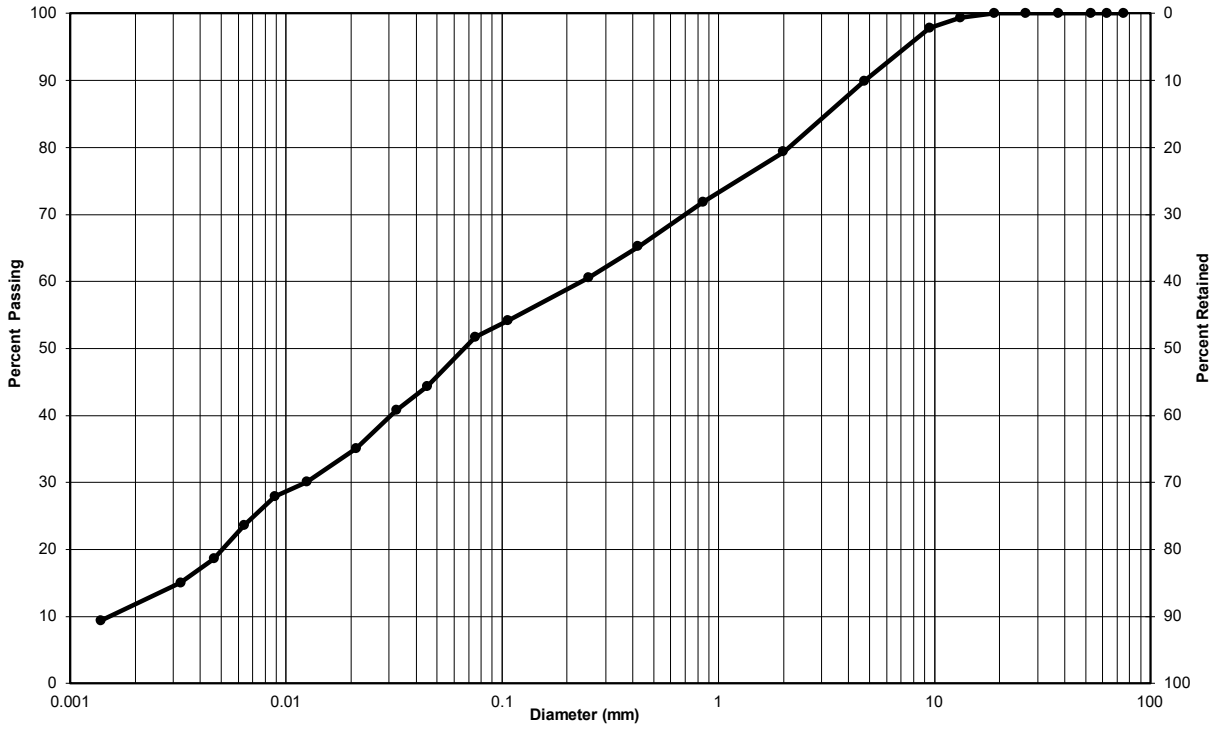
Remarks:

Performed by:	Jade Gorman	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101

Borehole no.:	BH5-21	Sample no.:	SS7
Depth:	4.6 to 5.2m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sandy silty clay with gravel (CL-ML)	10	38	52
Silt-size particles (%):	41		
Clay-size particles (%) (<0.002mm):	11		

Remarks:

Performed by:	Jade Gorman	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project no.:**	11231101

Borehole no.:	BH5-21	Sample no.:	SS7	Depth:	4.6 to 5.2m
Soil Description:	Silty Clay (CL-ML)			Date sampled:	

Apparatus:	Hand Crank	Balance no.:	10	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	B33-02667	Spatula no.:	1
Sieve no.:	n/a	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	25	20	15
Water Content:			
Tare no.	2	5	142
Wet soil+tare, g	28.96	28.31	27.50
Dry soil+tare, g	27.69	27.09	26.38
Mass of water, g	1.27	1.22	1.12
Tare, g	21.44	21.39	21.40
Mass of soil, g	6.25	5.70	4.98
Water content %	20.3%	21.4%	22.5%

Plastic Limit (PL) - Water Content:

Tare no.	19	21
Wet soil+tare, g	28.76	28.58
Dry soil+tare, g	27.93	27.75
Mass of water, g	0.83	0.83
Tare, g	21.58	21.39
Mass of soil, g	6.35	6.36
Water content %	13.1%	13.1%
Average water content %	13.1%	

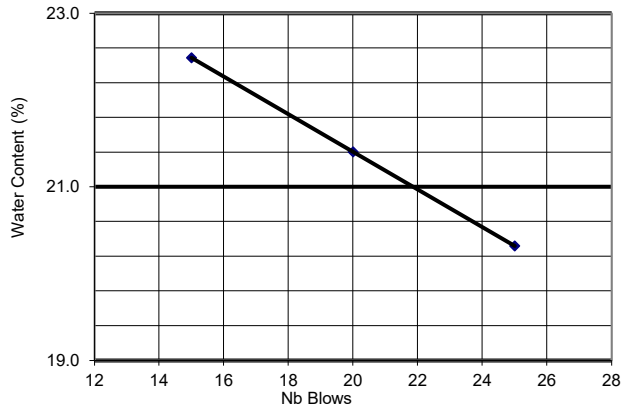
Natural Water Content (W^n):

Tare no.	N30	
Wet soil+tare, g	240.14	
Dry soil+tare, g	214.80	
Mass of water, g	25.34	
Tare, g	46.40	
Mass of soil, g	168.40	
Water content %	15.0%	

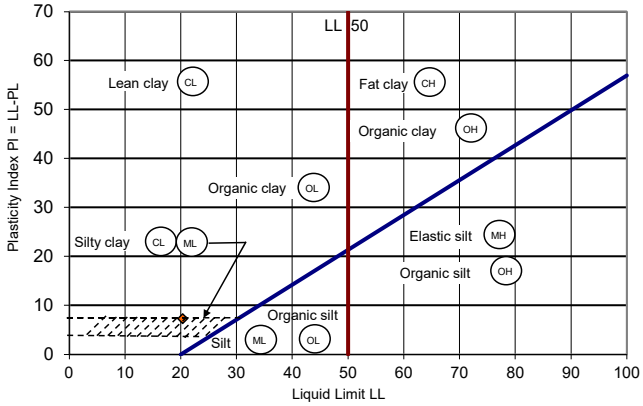
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☑ Dry preparation
- ☐ Wet preparation

Results



Soil Plasticity Chart ASTM D2487



Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content W^n
20	13	7	15.0

Remarks:

Performed by:	Josh Sullivan	**Date:**	August 10, 2021
Verified by:	Joe Sullivan	**Date:**	August 11, 2021

Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)

Client:	Consolidated Fastrate (Ottawa) Holdings ltd	**Lab no.:**	G-20-13
Project/Site:	New warehouse, Somme Street, Ottawa, On	**Project no.:**	11215612-A2

Borehole no.:	2	Sample no.:	4	Depth:	2.3 - 3.0m
Soil description:				Date sampled:	7-Aug-20

Apparatus:	Hand Crank/ Motor Driven	Balance no.:	1	Porcelain bowl no.:	1
Liquid limit device no.:	1	Oven no.:	1	Spatula no.:	1
Sieve no.:	1	Glass plate no.:	1		

Liquid Limit (LL):

	Test No. 1	Test No. 2	Test No. 3
Number of blows	30	27	20
Water Content:			
Tare no.	S15	S16	S29
Wet soil+tare, g	43.61	38.30	40.40
Dry soil+tare, g	34.97	31.57	32.70
Mass of water, g	8.64	6.73	7.70
Tare, g	22.02	21.72	21.82
Mass of soil, g	12.95	9.85	10.88
Water content %	66.7%	68.3%	70.8%

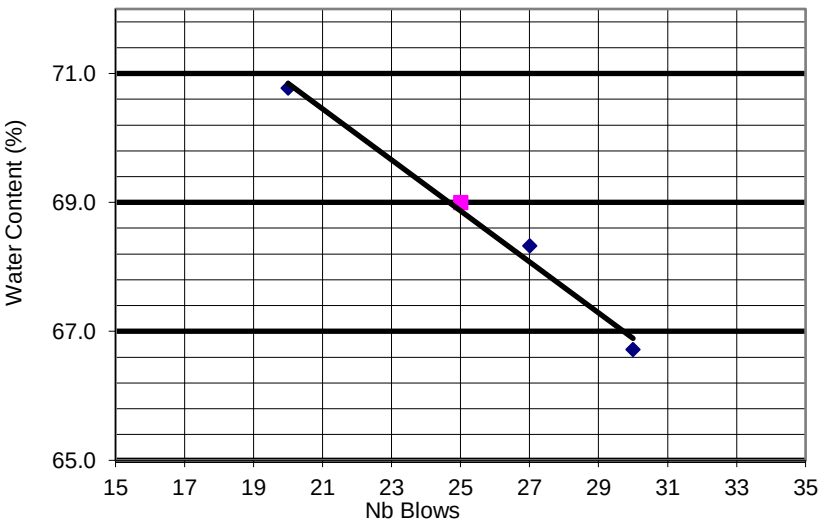
Plastic Limit (PL) - Water Content:		
Tare no.	S14	S20
Wet soil+tare, g	27.14	27.75
Dry soil+tare, g	26.20	26.85
Mass of water, g	0.94	0.90
Tare, g	21.84	22.53
Mass of soil, g	4.36	4.32
Water content %	21.6%	20.8%
Average water content %	21.2%	

Natural Water Content (W^n):		
Tare no.	S8	
Wet soil+tare, g	44.50	
Dry soil+tare, g	33.60	
Mass of water, g	10.90	
Tare, g	14.30	
Mass of soil, g	19.30	
Water content %	56.5%	

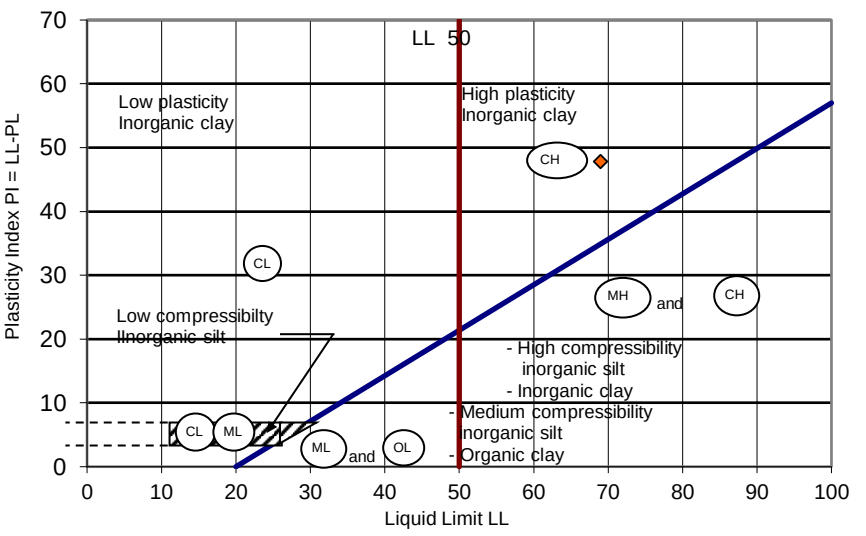
Soil Preparation:

- ☑ Cohesive <425 µm
- ☐ Cohesive >425 µm
- ☐ Non-cohesive
- ☐ Dry preparation
- ☑ Wet preparation

Results



Soil Plasticity Chart



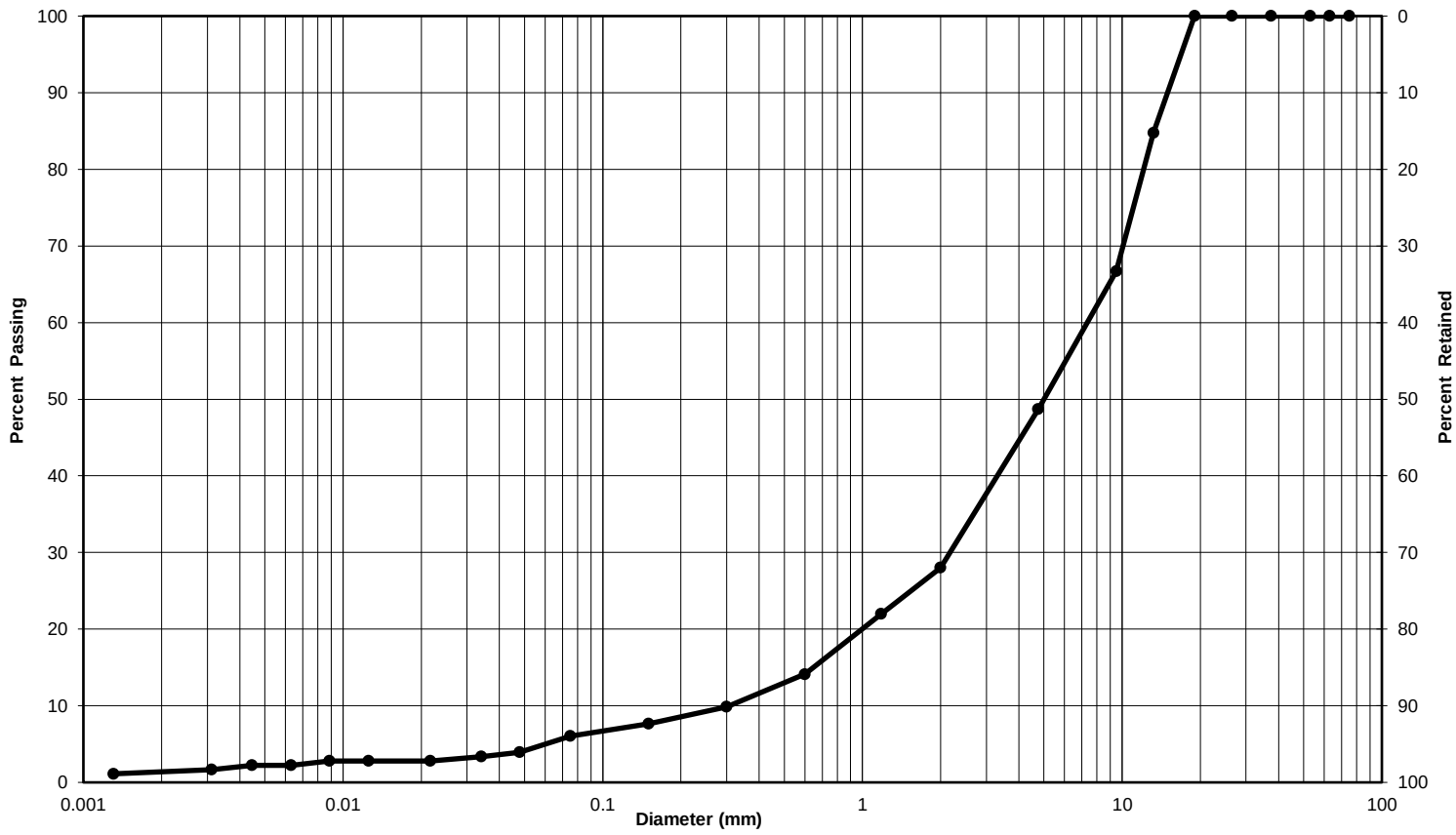
Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content W^n
69	21	48	56

Remarks:

Performed by:	Z. Mathurin	**Date:**	August 27, 2020
Verified by:		**Date:**	September 4, 2020

Particle-Size Analysis of Soils
MTO LS-702 (Geotechnical)

Client:	Consolidated Fastrate (Ottawa) Holdings Ltd.	**Lab No.:**	G-20-13
Project, Site:	New Warehouse, Somme Street, Ottawa, ON	**Project No.:**	11215612
Borehole No.:	1	Sample No.:	3
Depth:	1.5 - 2.1m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

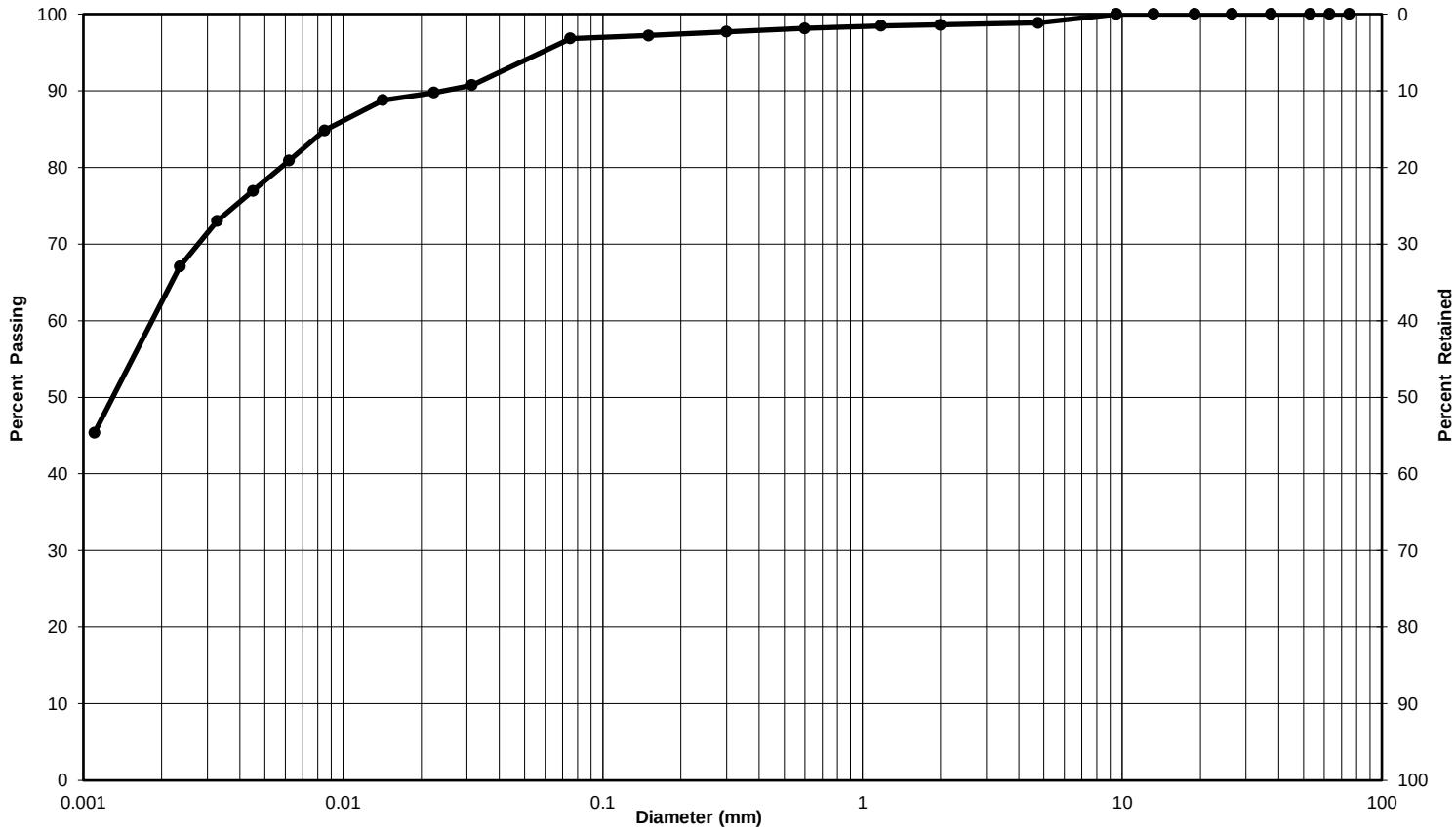
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Gravel and Sand, trace Silt, trace Clay	51	43	6
			1 %

Remarks:

Performed by:	Z. Mathurin	**Date:**	August 27, 2020
Verified by:		**Date:**	September 4, 2020

Particle-Size Analysis of Soils
MTO LS-702 (Geotechnical)

Client:	Consolidated Fastrate (Ottawa) Holdings Ltd.	**Lab No.:**	G-20-13
Project, Site:	New Warehouse, Somme Street, Ottawa, ON	**Project No.:**	11215612
Borehole No.:	2	Sample No.:	4
Depth:	2.3 - 3.0m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

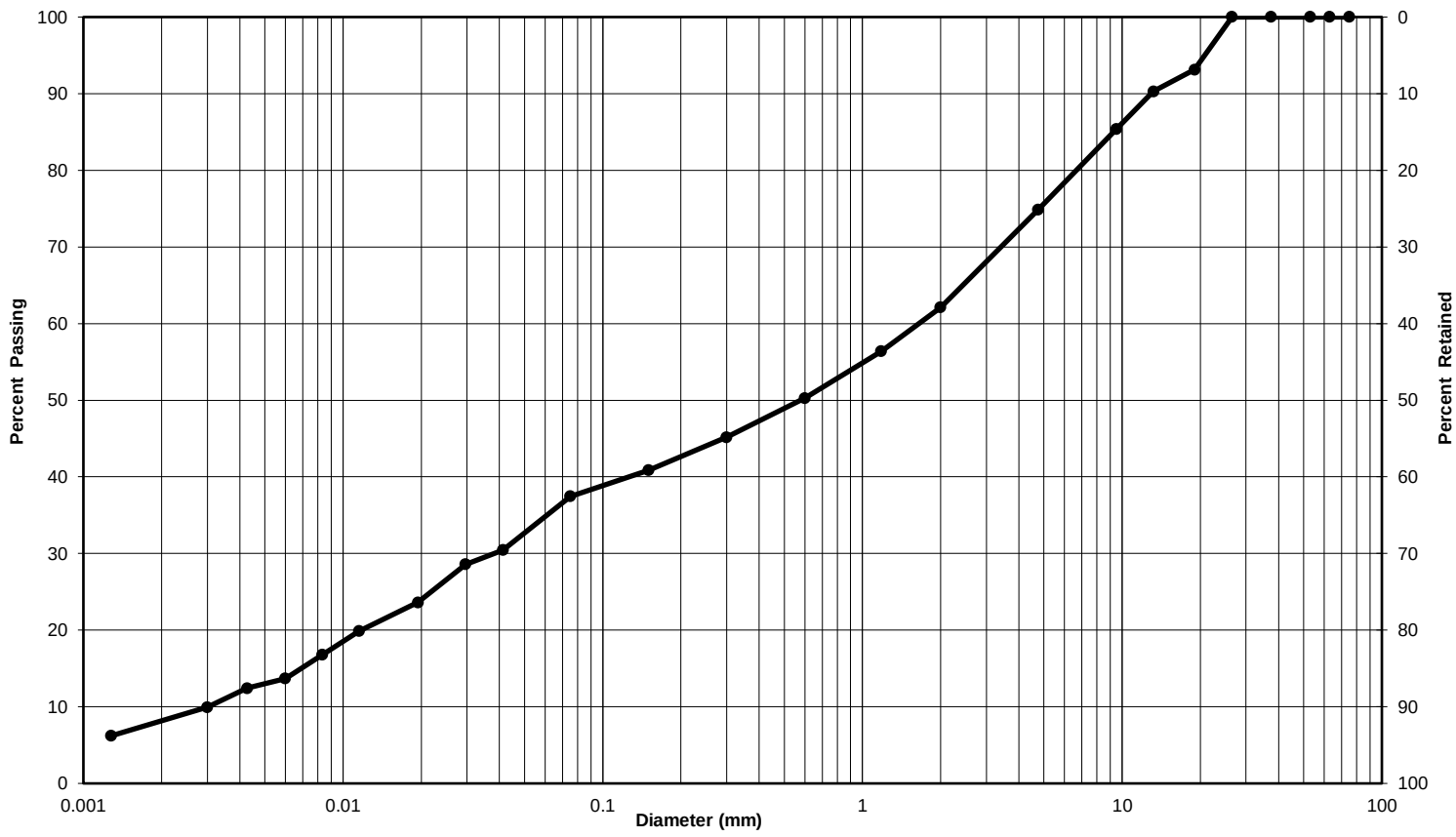
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Clay and Silt, trace Sand, trace Gravel	1	2	97
Clay-size particles (<0.002 mm):			61 %

Remarks:

Performed by:	Z. Mathurin	**Date:**	August 27, 2020
Verified by:		**Date:**	September 4, 2020

Particle-Size Analysis of Soils
MTO LS-702 (Geotechnical)

Client:	Consolidated Fastrate (Ottawa) Holdings Ltd.	**Lab No.:**	G-20-13
Project, Site:	New Warehouse, Somme Street, Ottawa, ON	**Project No.:**	11215612
Borehole No.:	2	Sample No.:	7
Depth:	4.5 - 6.1m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

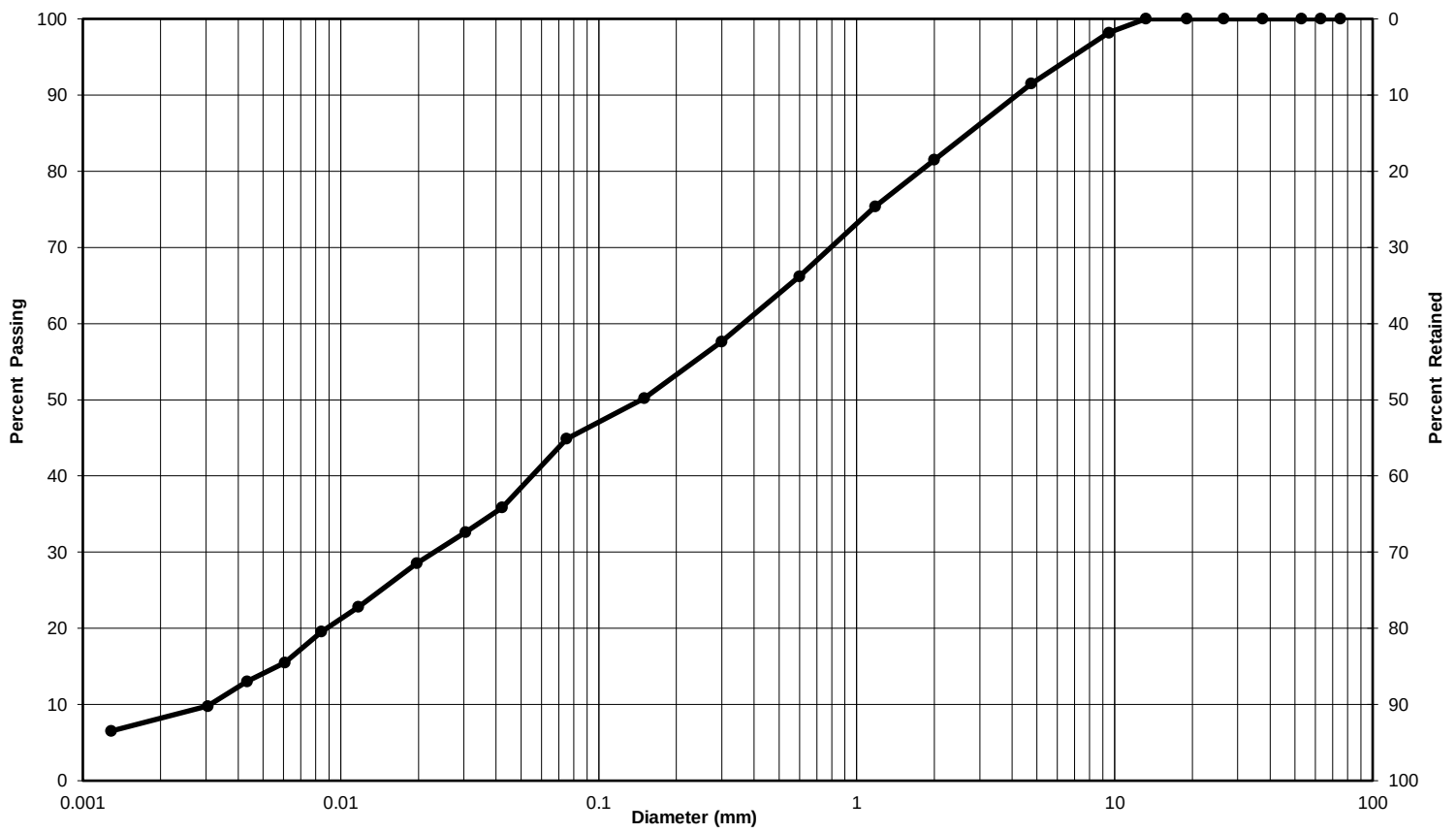
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Gravelly, Silty, Sand, trace Clay	25	38	37
Clay-size particles (<0.002 mm):			8 %

Remarks:

Performed by:	Z. Mathurin	**Date:**	August 27, 2020
Verified by:		**Date:**	September 4, 2020

Particle-Size Analysis of Soils
MTO LS-702 (Geotechnical)

Client:	Consolidated Fastrate (Ottawa) Holdings Ltd.	**Lab No.:**	G-20-13
Project, Site:	New Warehouse, Somme Street, Ottawa, ON	**Project No.:**	11215612
Borehole No.:	3	Sample No.:	10
Depth:	6.9 - 7.5m	Enclosure:	-



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Particle-Size Limits as per USCS (ASTM D-2487)					

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Sand and Silt, trace Gravel, trace Clay	8	47	45
Clay-size particles (<0.002 mm):			8 %

Remarks:

Performed by:	Z. Mathurin	**Date:**	August 27, 2020
Verified by:		**Date:**	September 4, 2020

Moisture Content of Soils (ASTM D 2216)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Project No.:**	11231101

Oven No.: B33-02932 **Scale No.:** 10

BH No.:	BH1	BH1	BH1	BH1	BH1	BH1	BH1	BH1
	SS1	SS2A	SS2B	SS3	SS4	SS5A	SS5B	SS6
	3"-2'	2.5-2'10"	2'10"-4.5'	5-7'	7.5-9.5'	10-10'8"	10'8"-12'	
Container no.	N25	S40	N18	N20	N23	N15	N13	NO RECOVERY
Mass of container + wet soil (g)	233.32	166.90	185.70	290.57	265.60	180.34	126.64	
Mass of container + dry soil (g)	220.09	156.92	176.04	276.32	246.39	169.56	85.39	
Mass of container (g)	45.78	45.80	45.25	46.05	46.17	46.15	45.12	
Mass of dry soil (g)	174.3	111.1	130.8	230.3	200.2	123.4	40.3	
Mass of water (g)	13.2	10.0	9.7	14.3	19.2	10.8	41.3	
Moisture content (%)	7.6	9.0	7.4	6.2	9.6	8.7	102.4	

BH No.:	BH1	BH1	BH1	BH1	BH1	BH1	BH1	BH1
	SS7	SS8A	SS8B	SS9	SS10	SS11	SS12	SS13
	15-17'	17.5-19'	19-19.5'	20-22'	22.5-24.5'	25-27'	27.5-29.5'	30-32'
Container no.	N1	N4	N10	N17	N8	N9	N16	N7
Mass of container + wet soil (g)	278.30	213.70	240.62	252.25	238.93	201.02	246.61	203.55
Mass of container + dry soil (g)	262.26	200.59	226.34	236.87	228.08	189.49	231.05	191.76
Mass of container (g)	45.80	46.34	45.40	45.80	45.62	45.75	46.75	45.08
Mass of dry soil (g)	216.5	154.3	180.9	191.1	182.5	143.7	184.3	146.7
Mass of water (g)	16.0	13.1	14.3	15.4	10.9	11.5	15.6	11.8
Moisture content (%)	7.4	8.5	7.9	8.0	5.9	8.0	8.4	8.0

Remarks:

Performed By:	Jade Gorman	**Date:**	August 10, 2021
Verified by :	Joe Sullivan	**Date:**	August 11, 2021

Moisture Content of Soils (ASTM D 2216)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Project no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Lab No.:**	11231101

Oven No.: B33-02932 **Scale No.:** 10

BH No.:	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2
	SS1A	SS1B	SS2	SS3A	SS3B	SS4	SS5	SS6A
	3"-1.5'	1.5-2'	2.5-4.5'	5-5'5"	5'5"-7'	7.5-9.5'	10-12'	12.5'-12'8"
Container no.	N14	N12	N21	N19	N5	T6	Z48	T2
Mass of container + wet soil (g)	174.43	177.11	281.71	266.40	269.35	207.95	199.66	151.70
Mass of container + dry soil (g)	169.52	165.71	267.18	246.46	249.63	199.32	184.55	142.47
Mass of container (g)	45.42	47.01	45.23	45.24	46.36	45.90	45.46	46.27
Mass of dry soil (g)	124.1	118.7	222.0	201.2	203.3	153.4	139.1	96.2
Mass of water (g)	4.9	11.4	14.5	19.9	19.7	8.6	15.1	9.2
Moisture content (%)	4.0	9.6	6.5	9.9	9.7	5.6	10.9	9.6
BH No.:	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2
	SS6B	SS6C	SS7A	SS7B	SS8	SS9	SS10	SS11
	12'8"-12'10"	12'10"-14.5'	15-15.5'	15.5'-17'	17.5-19.5'	20-22'	22.5-24.5'	25-27'
Container no.	S18	S39	N6	S37	Z47	S20	Z60	N11
Mass of container + wet soil (g)	119.33	171.21	217.62	216.49	207.82	292.03	245.95	186.74
Mass of container + dry soil (g)	110.90	147.07	191.26	194.79	188.53	268.92	226.39	175.42
Mass of container (g)	46.62	46.88	44.84	46.95	45.88	45.81	46.79	46.06
Mass of dry soil (g)	64.3	100.2	146.4	147.8	142.7	223.1	179.6	129.4
Mass of water (g)	8.4	24.1	26.4	21.7	19.3	23.1	19.6	11.3
Moisture content (%)	13.1	24.1	18.0	14.7	13.5	10.4	10.9	8.8

Remarks:

Performed By: Jade Gorman **Date:** August 10, 2021

Verified by : Joe Sullivan **Date:** August 11, 2021

Moisture Content of Soils (ASTM D 2216)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Project no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Lab No.:**	11231101

Oven No.: B33-02932 **Scale No.:** 10

BH No.:	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2
	SS12	SS13	SS14	SS15	SS16A	SS16B	SS17	SS18
	25.5-27.5'	30-32'	32.5-33'1"	35-37.5'	37.5-37'11"	37'11"-39.5'		42.5-44.5'
Container no.	Z57	S42	S32	S14	N24	N2	NO RECOVERY	S19
Mass of container + wet soil (g)	194.57	243.64	324.30	153.82	193.01	177.26		167.57
Mass of container + dry soil (g)	182.50	225.66	298.54	140.73	169.48	162.64		154.66
Mass of container (g)	47.10	46.28	46.23	45.69	46.17	45.34		45.95
Mass of dry soil (g)	135.4	179.4	252.3	95.0	123.3	117.3		108.7
Mass of water (g)	12.1	18.0	25.8	13.1	23.5	14.6		12.9
Moisture content (%)	8.9	10.0	10.2	13.8	19.1	12.5		11.9
BH No.:	BH2	BH3	BH3	BH3	BH3	BH3	BH3	BH3
	SS19	SS1	SS2A	SS2B	SS3	SS4	SS5	SS6
	45-47'	3"2'	2.5-3'	3-4.5'	5-7'	7.5-9.5'	11-12'	12.5-14.5'
Container no.	Z10	T15	S21	N27	N26	N3	S12	Z35
Mass of container + wet soil (g)	280.41	152.86	168.64	127.67	189.62	218.13	237.71	267.69
Mass of container + dry soil (g)	257.18	138.71	156.14	111.54	178.16	207.09	223.83	245.63
Mass of container (g)	45.63	46.45	45.80	46.20	46.18	45.73	46.68	45.80
Mass of dry soil (g)	211.6	92.3	110.3	65.3	132.0	161.4	177.2	199.8
Mass of water (g)	23.2	14.2	12.5	16.1	11.5	11.0	13.9	22.1
Moisture content (%)	11.0	15.3	11.3	24.7	8.7	6.8	7.8	11.0

Remarks:

Performed By: Jade Gorman **Date:** August 10, 2021

Verified by : Joe Sullivan **Date:** August 11, 2021

Moisture Content of Soils (ASTM D 2216)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Project no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Lab No.:**	11231101

Oven No.: B33-02932 **Scale No.:** 10

BH No.:	BH3	BH3	BH3	BH3	BH3	BH3	BH3	BH3
	SS7	SS8	SS9	SS10A	SS10B	SS11	SS12	SS13
		17.5-19.5'	20-22'	22.5-23'	23-24.5'	25-27'	27.5-29.5'	30-30'10"
Container no.	NO RECOVERY	T3	Z59	S34	S36	Z42	Z37	S28
Mass of container + wet soil (g)		313.52	205.80	266.00	231.33	241.74	209.23	215.78
Mass of container + dry soil (g)		289.92	195.39	248.34	213.60	228.08	197.56	201.01
Mass of container (g)		46.54	47.06	45.98	47.55	46.42	45.91	46.34
Mass of dry soil (g)		243.4	148.3	202.4	166.1	181.7	151.7	154.7
Mass of water (g)		23.6	10.4	17.7	17.7	13.7	11.7	14.8
Moisture content (%)		9.7	7.0	8.7	10.7	7.5	7.7	9.5
BH No.:	BH4	BH4	BH4	BH4	BH4	BH4	BH4	BH4
	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8
	3"-2'	2.5-4.5'	5-7'		10-12'	12.5-14.5'	15-17'	15.5-17.5'
Container no.	S26	Z29	S17	NO RECOVERY	S27	Z50	T14	T8
Mass of container + wet soil (g)	223.60	225.82	263.66		222.97	116.87	151.70	224.79
Mass of container + dry soil (g)	194.94	201.43	250.71		188.87	83.71	133.21	192.23
Mass of container (g)	46.01	46.15	45.21		46.16	47.05	45.34	46.06
Mass of dry soil (g)	148.9	155.3	205.5		142.7	36.7	87.9	146.2
Mass of water (g)	28.7	24.4	13.0		34.1	33.2	18.5	32.6
Moisture content (%)	19.2	15.7	6.3		23.9	90.5	21.0	22.3

Remarks:

Performed By: Jade Gorman **Date:** August 10, 2021

Verified by : Joe Sullivan **Date:** August 11, 2021

Moisture Content of Soils (ASTM D 2216)

Client:	Con	**Project no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Lab No.:**	11231101

Oven No.: B33-02932 **Scale No.:** 10

BH No.:	BH4	BH4	BH4	BH4	BH4	BH4	BH4	BH4
	SS9A	SS9B	SS10	SS11	SS12	SS13	SS14	SS15
	20-21.5'	21.5-22'	22.5-24.5'	25-27'	27.5-29.5'		32.5-34.5'	35-37'
Container no.	Z31	T1	N22	S30	S29	NO RECOVERY	S45	T9
Mass of container + wet soil (g)	197.83	262.26	335.05	205.12	240.22		242.41	271.90
Mass of container + dry soil (g)	171.06	223.24	300.88	168.62	221.98		224.01	254.61
Mass of container (g)	45.87	45.83	45.42	45.70	45.78		46.07	45.78
Mass of dry soil (g)	125.2	177.4	255.5	122.9	176.2		177.9	208.8
Mass of water (g)	26.8	39.0	34.2	36.5	18.2		18.4	17.3
Moisture content (%)	21.4	22.0	13.4	29.7	10.4		10.3	8.3
BH No.:	BH4	BH5	BH5	BH5	BH5	BH5	BH5	BH5
	SS16	SS1	SS2A	SS2B	SS3	SS4	SS5	SS6
	37.5-39.5'	3"-2'	2.5-3'	3-4.5'		7.5-9.5'	10-12'	
Container no.	N32	N28	Z5	N29	USED FOR HYDROMETER	N34	N36	NO RECOVERY
Mass of container + wet soil (g)	171.49	204.87	277.76	199.82		184.69	171.27	
Mass of container + dry soil (g)	156.21	166.78	240.15	176.72		171.19	157.43	
Mass of container (g)	45.50	45.93	45.70	45.71		46.67	45.36	
Mass of dry soil (g)	110.7	120.9	194.5	131.0		124.5	112.1	
Mass of water (g)	15.3	38.1	37.6	23.1		13.5	13.8	
Moisture content (%)	13.8	31.5	19.3	17.6		10.8	12.3	

Remarks:

Performed By:	Jade Gorman	**Date:**	August 10, 2021
Verified by :	Joe Sullivan	**Date:**	August 11, 2021

Moisture Content of Soils (ASTM D 2216)

Client:	Consolidated Fastfrate (Ottawa) Holdings Inc.	**Project no.:**	SS-21-66
Project/Site:	New Warehouse and Offices / Somme Street, Ottawa	**Lab No.:**	11231101

Oven No.: B33-02932 **Scale No.:** 10

BH No.:	BH5	BH5	BH5	BH5	BH5	BH5		
	SS7	SS8	SS9	SS10	SS11A	SS11B		
	15-17'	17.5-19.5'	20-22'	22.5-24.5'	25-25'10"	25'10"-26'3"		
Container no.	N30	N35	N33	S44	S13	T13		
Mass of container + wet soil (g)	240.14	211.88	229.19	230.05	189.96	186.46		
Mass of container + dry soil (g)	214.80	197.53	214.27	211.44	180.54	166.64		
Mass of container (g)	46.40	46.08	47.12	46.44	46.30	46.88		
Mass of dry soil (g)	168.4	151.5	167.2	165.0	134.2	119.8		
Mass of water (g)	25.3	14.4	14.9	18.6	9.4	19.8		
Moisture content (%)	15.0	9.5	8.9	11.3	7.0	16.5		
BH No.:								
Container no.								
Mass of container + wet soil (g)								
Mass of container + dry soil (g)								
Mass of container (g)								
Mass of dry soil (g)								
Mass of water (g)								
Moisture content (%)								

Remarks:

Performed By:	Jade Gorman	**Date:**	August 10, 2021
Verified by :	Joe Sullivan	**Date:**	August 11, 2021

Moisture Content of Soils (ASTM D2216)

Client: Consolidated Fastrate (Ottawa) Holdings Ltd
Project: New Warehouse, Somme Street, Ottawa, On
Location: Ottawa, On

Lab No.: G-20-13
Project No.: 11215612

Apparatus Used for Testing

Oven no.: 1 Scale no.: 1

Sample No.	BH1SS1	BH1SS2	BH1SS3	BH1SS4	BH1SS6	BH1SS7	BH1SS8	BH1SS9
Container no.	S18	S21	Bowl	S16	S15	S29	S43	S34
Mass of container + wet soil (g)	70.9	78.5	350.4	83.1	92.1	95.5	91.5	87.1
Mass of container + dry soil (g)	65.2	75.7	335.8	77.9	86.7	88.1	76.9	72.9
Mass of container (g)	22.7	21.8	0.0	21.8	22.1	21.8	22.1	14.6
Mass of dry soil (g)	42.5	53.9	335.8	56.1	64.6	66.3	54.8	58.3
Mass of water (g)	5.7	2.8	14.6	5.2	5.4	7.4	14.6	14.2
Moisture content (%)	13.4	5.2	4.3	9.3	8.4	11.2	26.6	24.4

Sample No.	BH1SS10	BH2SS1	BH2SS2	BH2SS2	BH2SS4	BH2SS4	BH2SS6	BH2SS6
Container no.	S5	S28	S41	S41	S8	S8	S9	S9
Mass of container + wet soil (g)	89.8	76.8	75.9	75.9	44.5	44.5	100.3	100.3
Mass of container + dry soil (g)	84.6	64.2	58.4	58.4	33.6	33.6	89.4	89.4
Mass of container (g)	22.2	21.9	22.9	22.9	14.3	14.3	21.7	21.7
Mass of dry soil (g)	62.4	42.3	35.5	35.5	19.3	19.3	67.7	67.7
Mass of water (g)	5.2	12.6	17.5	17.5	10.9	10.9	10.9	10.9
Moisture content (%)	8.3	29.8	49.3	49.3	56.5	56.5	16.1	16.1

Remarks:

Performed by: Z. Mathurin **Date:** August 27, 2020

Verified by : **Date:** September 4, 2020

Moisture Content of Soils (ASTM D2216)

Client: Consolidated Fastrate (Ottawa) Holdings Ltd
Project: New Warehouse, Somme Street, Ottawa, On
Location: Ottawa, On

Lab No.: G-20-13
Project No.: 11215612-A2

Apparatus Used for Testing

Oven no.: 1 Scale no.: 1

Sample No.	BH2SS7	BH2SS8	BH2SS9	BH2SS10	BH2SS11	BH2SS12	BH2SS13	BH2SS14
Container no.	S11	S31	S38	S26	S36	S39	S35	S10
Mass of container + wet soil (g)	90.6	75.1	79.5	99.9	83.8	101.3	55.7	73.1
Mass of container + dry soil (g)	84.1	66.7	74.3	93.7	79.0	92.5	55.6	55.5
Mass of container (g)	21.5	21.6	21.5	21.6	22.1	22.0	14.5	22.0
Mass of dry soil (g)	62.6	45.1	52.8	72.1	56.9	70.5	41.1	33.5
Mass of water (g)	6.5	8.4	5.2	6.2	4.8	8.8	0.1	17.6
Moisture content (%)	10.4	18.6	9.8	8.6	8.4	12.5	0.2	52.5

Sample No.	BH3SS1	BH3SS2	BH3SS3	BH3SS4	BH3SS5	BH3SS6	BH3SS7	BH3SS8
Container no.	S37	S25	S22	S20	S14	S7	S17	S2
Mass of container + wet soil (g)	87.3	73.4	76.6	102.3	66.7	57.8	89.6	102.2
Mass of container + dry soil (g)	78.7	71.6	72.4	97.8	64.3	56.4	83.5	96.5
Mass of container (g)	22.0	21.8	22.2	22.5	21.8	21.7	21.5	21.8
Mass of dry soil (g)	56.7	49.8	50.2	75.3	42.5	34.7	62.0	74.7
Mass of water (g)	8.6	1.8	4.2	4.5	2.4	1.4	6.1	5.7
Moisture content (%)	15.2	3.6	8.4	6.0	5.6	4.0	9.8	7.6

Remarks:

Performed by: Z. Mathurin **Date:** August 27, 2020

Verified by : **Date:** September 4, 2020

Moisture Content of Soils (ASTM D2216)

Client: Consolidated Fastrate (Ottawa) Holdings Ltd
Project: New Warehouse, Somme Street, Ottawa, On
Location: Ottawa, On

Lab No.: G-20-13
Project No.: 11215612-A2

Apparatus Used for Testing

Oven no.: 1 Scale no.: 1

Sample No.	BH3SS9	BH3SS10	BH3SS11	BH3SS12	BH3SS13	BH4SS1	BH4SS2	BH4SS3
Container no.	S12	S32	S13	S4	S120	S6	S23	S40
Mass of container + wet soil (g)	88.7	84.4	88.7	77.6	85.2	93.5	76.9	96.9
Mass of container + dry soil (g)	84.0	79.9	84.5	75.9	79.6	85.7	73.6	93.1
Mass of container (g)	21.6	21.7	24.1	21.8	21.9	21.9	22.3	22.3
Mass of dry soil (g)	62.4	58.2	60.4	54.1	57.7	63.8	51.3	70.8
Mass of water (g)	4.7	4.5	4.2	1.7	5.6	7.8	3.3	3.8
Moisture content (%)	7.5	7.7	7.0	3.1	9.7	12.2	6.4	5.4

Sample No.	BH4SS4	BH4SS5	BH4SS6	BH4SS8	BH4SS9	BH4SS11		
Container no.	S19	S1	S130	S42	S110	88		
Mass of container + wet soil (g)	105.4	92.9	44.1	101.8	98.5	73.0		
Mass of container + dry soil (g)	101.9	86.7	41.8	94.3	92.8	66.5		
Mass of container (g)	21.9	22.0	22.1	21.8	21.7	1.5		
Mass of dry soil (g)	80.0	64.7	19.7	72.5	71.1	65.0		
Mass of water (g)	3.5	6.2	2.3	7.5	5.7	6.5		
Moisture content (%)	4.4	9.6	11.7	10.3	8.0	10.0		

Remarks:

Performed by: Z. Mathurin **Date:** August 27, 2020

Verified by : **Date:** September 4, 2020

Moisture Content of Soils (ASTM D2216)

Client: Consolidated Fastrate (Ottawa) Holdings Ltd
Project: New Warehouse, Somme Street, Ottawa, On
Location: Ottawa, On

Lab No.: G-20-13
Project No.: 11215612-A2

Apparatus Used for Testing

Oven no.: 1 Scale no.: 1

Sample No.	BH4SS12	BH4SS13	BH4SS14					
Container no.	70	42	44					
Mass of container + wet soil (g)	60.0	67.4	72.1					
Mass of container + dry soil (g)	54.0	61.2	64.6					
Mass of container (g)	1.5	1.4	1.4					
Mass of dry soil (g)	52.5	59.8	63.2					
Mass of water (g)	6.0	6.2	7.5					
Moisture content (%)	11.4	10.4	11.9					
Sample No.								
Container no.								
Mass of container + wet soil (g)								
Mass of container + dry soil (g)								
Mass of container (g)								
Mass of dry soil (g)								
Mass of water (g)								
Moisture content (%)								

Remarks:

Performed by: Z. Mathurin **Date:** August 27, 2020

Verified by : **Date:** September 4, 2020

Uniaxial Compressive Strength of Intact Rock Core Specimens
(ASTM D7012 - Method C)

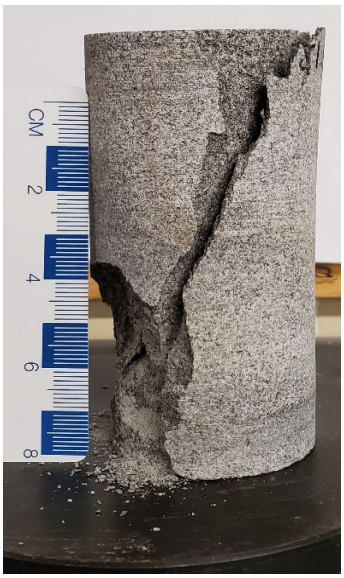
Client:	Consolidated Fastfrate (Ottawa) Holdings Inc	**Lab No.:**	SS-21-66
Project/Site:	New Warehouse and Offices Somme Street, Ottawa	**Project No.:**	11231101

Borehole No.:	BH2-21	**Sampled ID:**	Run #2
Depth:	51'5" - 51'8" (1570 to 1579.4cm)	**Date Sampled:**	n/a

Lithological Description: Limestone

Initial Specimen Parameters	
Diameter, mm	47.0
Height, mm	94.0
Height-to-Diameter Ratio	2.0
Volume, cm^3	163.1
Mass, g	466.5
Bulk Density, kg/m^3	2860
Moisture Condition	As Received
Moisture Content, %	0.2

Maximum Applied Load, kN	241.3
Compressive Strength, MPa	139.1



REMARKS:

PERFORMED BY: Jesse Carreau **DATE:** August 3, 2021

VERIFIED BY: Joe Sullivan **DATE:** August 5, 2021

Unconfined Compressive Strength of Intact Rock Core Specimen
ASTM D 7012, ASTM D 4543

Client : Consolidated Fastrate (Ottawa) Holdings ltd

Project : New Warehouse, Somme Street, Ottawa, O

Project N° : G-20-13

Sample N° : BH2-RC1

Depth : 30'11"- 31'5"

Sampling Date : August 7, 2020

Testing Apparatus Used : **Loading device N°** 1 **Caliper N°** 1

Technical Data

				Average	
Diameter :	47	46.9	47	47.0	(mm)
Length :	95	94.9	95.2	95.0	(mm)
Straightness (0.5mm maximum) (S1) :	0.3	0.3	0.3	0.3	(mm)
Flatness (25µm maximum) (FP2) :	Ok	Ok	Ok	Ok	
Parallelism (0.25 ° maximum) (FP2) :	0.15	0.2	0.2	0.15	(°)

Mass : 435.4 (g) Volume: 164644 (mm^3)

Density : 2644 (kg/m^3)

Moisture Conditions : Dry

Loading Rate (0.5 to 1.0 MPa / sec) : 0.8 (MPa/sec)

Type of Fracture : 3

Test Duration (2-15 Minutes) : 3 (minutes)

Maximum Applied Load : 216.97 ☑ kN ☐ lbs

Compressive Strength : 125.2 (MPa)

View of Specimen

Before Test :

After Test :

Remarks :

Analysed by : Z. Mathurin **Date :** September 4, 2020

Verified by : **Date :** September 4, 2020

Appendix C

Analytical Lab Results

eurofins | Environment Testing

Certificate of Analysis

Client:	GHD Limited (Ottawa) 400-179 Colonnade Rd. Ottawa, ON K2E 7J4	Report Number:	1936331
		Date Submitted:	2020-08-11
		Date Reported:	2020-08-25
		Project:	11215612-A2
Attention:	Mr. Ryan Vanden Tillaart	COC #:	210163
PO#:	73520576		
Invoice to:	GHD Limited (Ottawa)		

Dear Ryan Vanden Tillaart:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Addrine Thomas 2020.08.25 15:09:43 -04'00'

Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Client: GHD Limited (Ottawa)
400-179 Colonnade Rd.
Ottawa, ON
K2E 7J4
Attention: Mr. Ryan Vanden Tillaart
PO#: 73520576
Invoice to: GHD Limited (Ottawa)

Report Number: 1936331
Date Submitted: 2020-08-11
Date Reported: 2020-08-25
Project: 11215612-A2
COC #: 210163

				Lab I.D.	1509594
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2020-08-11
				Sample I.D.	BH3-SS3
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Anions	Cl	0.002	%		0.008
	SO4	0.01	%		0.08
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.52
	pH	2.00			8.66
	Resistivity	1	ohm-cm		1920
Redox Potential	REDOX Potential		mV		205
Subcontract	Moisture-Humidite	0.25	%		8.54
	S2-	0.2	ug/g		<0.20

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: GHD Limited (Ottawa)
400-179 Colonnade Rd.
Ottawa, ON
K2E 7J4
Attention: Mr. Ryan Vanden Tillaart
PO#: 73520576
Invoice to: GHD Limited (Ottawa)

Report Number: 1936331
Date Submitted: 2020-08-11
Date Reported: 2020-08-25
Project: 11215612-A2
COC #: 210163

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 387642 **Analysis/Extraction Date** 2020-08-13 **Analyst** AET **Method** C CSA A23.2-4B			
Chloride		98	90-110
Run No 387870 **Analysis/Extraction Date** 2020-08-14 **Analyst** AET **Method** SUBCONTRACT-A			
Moisture-Humidite	<0.25 %	101	
S2-	<0.20 ug/g	98	
Run No 387916 **Analysis/Extraction Date** 2020-08-18 **Analyst** SG **Method** Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	97	90-110
pH	5.63	100	90-110
Resistivity			
Run No 388007 **Analysis/Extraction Date** 2020-08-19 **Analyst** SKH **Method** AG SOIL			
SO4	<0.01 %	96	70-130
Run No 388317 **Analysis/Extraction Date** 2020-08-25 **Analyst** AET **Method** C SM2580B			
REDOX Potential	258 mV	101	

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Appendix D

Water Well Record from the Ministry of the Environment, Conservation and Parks

Ministry of the Environment
Ontario

The Ontario Water Resources Act Page 93

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 1527383 MUNICIP 15002 CON. CON. K6

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC	LOT
[redacted]	[redacted]ucester	6	26

[redacted] Box 4208 stn. "E" Ottawa, Ontario K1S 5B2

DATE COMPLETED DAY 16 MO 8 YR 93

RC ELEVATION RC BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Brown	Sand	Stone		0	5
Gray	Hardpan	Boulders		5	28
Gray	Sandstone		Hard	28	100

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
58	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
88	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
NOT TESTED	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6 1/4	1 ☐ STEEL 2 ☒ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.188	0	39
5 15/16	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		39	100
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER ETC.)
37.5	0	Cement - Grouted

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☒ PUMP 2 ☐ BAILER	20 GPM	1 HOURS ___ MINS

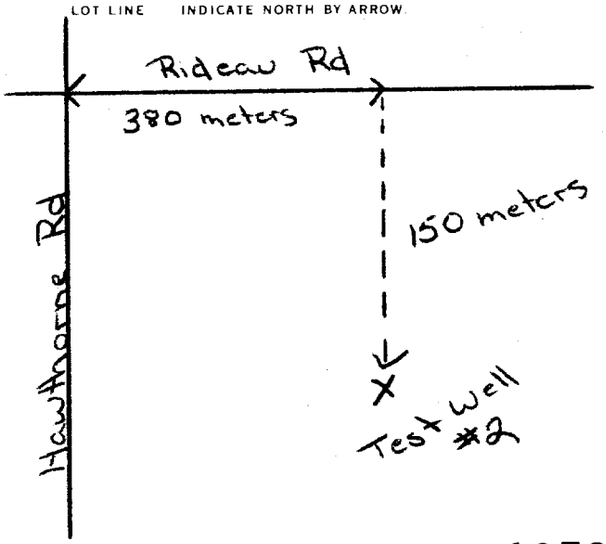
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
7'6" FEET	14'6" FEET	1 ☒ PUMPING 2 ☐ RECOVERY	13'11" FEET	14 FEET	14'4" FEET	14'6" FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☐ CLEAR 2 ☒ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	50 FEET	5 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE INDICATE NORTH BY ARROW.



DRILLERS REMARKS 135946

FINAL STATUS OF WELL	1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING
WATER USE	1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED
METHOD OF CONSTRUCTION	1 ☐ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☒ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENCE NUMBER
Capital Water Supply Ltd.	1558
ADDRESS: Box 490 Stittsville, Ontario K2S 1A6	
NAME OF WELL TECHNICIAN: S.Miller/T. Harrison	WELL TECHNICIAN'S LICENCE NUMBER: T0097/T2251
SIGNATURE OF TECHNICIAN/CONTRACTOR	SUBMISSION DATE: DAY 18 MO 8 YR 93

OFFICE USE ONLY

DATA SOURCE	CONTRACTOR	DATE RECEIVED
	1558	SEP 21 1993
DATE OF INSPECTION	INSPECTOR	
REMARKS		

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Ministry of the Environment
Ontario

The Ontario Water Resources Act Page 94

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 — 1527384 — MUNICIP. 15002 — CON. COX — 26

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON. BLOCK, TRACT, SURVEY, ETC.	LOT
Ottawa Carleton	Gloucester	6	26

[redacted]
Box 4208 stn "[redacted]" Ottawa, Ontario K1S 5B2

DATE COMPLETED: DAY 16 MO 8 YR 93

NG — RC. — ELEVATION — RC — BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
Gray & White	Sandstone		Hard	0	100

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
30	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
84	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
NOT TESTED	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6 1/4	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.188	0	22
6 1/16	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		22	100
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE — DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
20'8"	0	Grouted cement (3)

71 PUMPING TEST

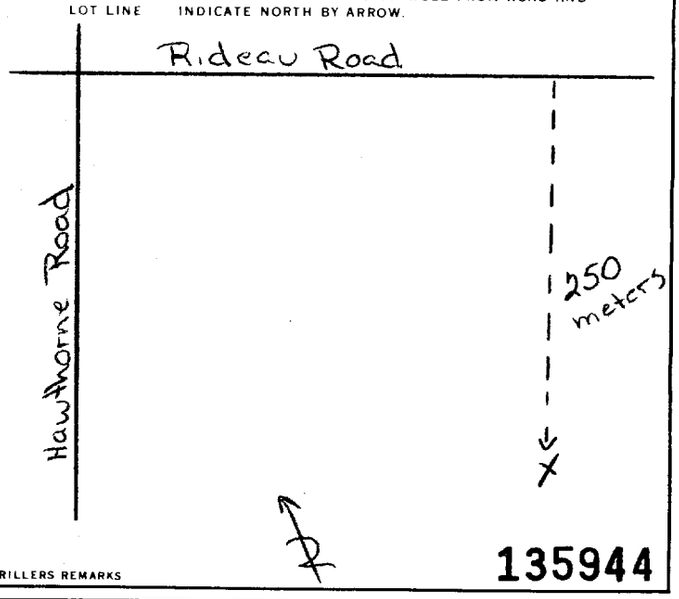
PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☒ PUMP 2 ☐ BAILER	15-20 GPM	1 HOURS ___ MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING (1 ☐ PUMPING 2 ☒ RECOVERY)	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
21'6" FEET	24'4" FEET		23'6" FEET	24 FEET	24'4" FEET	24'4" FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST	RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
GPM	40 FEET	1 ☐ CLEAR 2 ☒ CLOUDY	☐ SHALLOW ☒ DEEP	50 FEET	5 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS: 135944

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☒ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: Capital Water Supply Ltd.
WELL CONTRACTOR'S LICENCE NUMBER: 1558
ADDRESS: Box 490 Stittsville, Ontario K2S 1A6
NAME OF WELL TECHNICIAN: S. Miller/T. Harrison
WELL TECHNICIAN'S LICENCE NUMBER: T0097/T2251
SIGNATURE OF TECHNICIAN/CONTRACTOR
SUBMISSION DATE: DAY 18 MO 8 YR 93

OFFICE USE ONLY

DATA SOURCE — CONTRACTOR: 1558 — DATE RECEIVED: SEP 21 1993
DATE OF INSPECTION — INSPECTOR
REMARKS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

Appendix E

Slope Stability Analysis Results under Dynamic Compaction Conditions

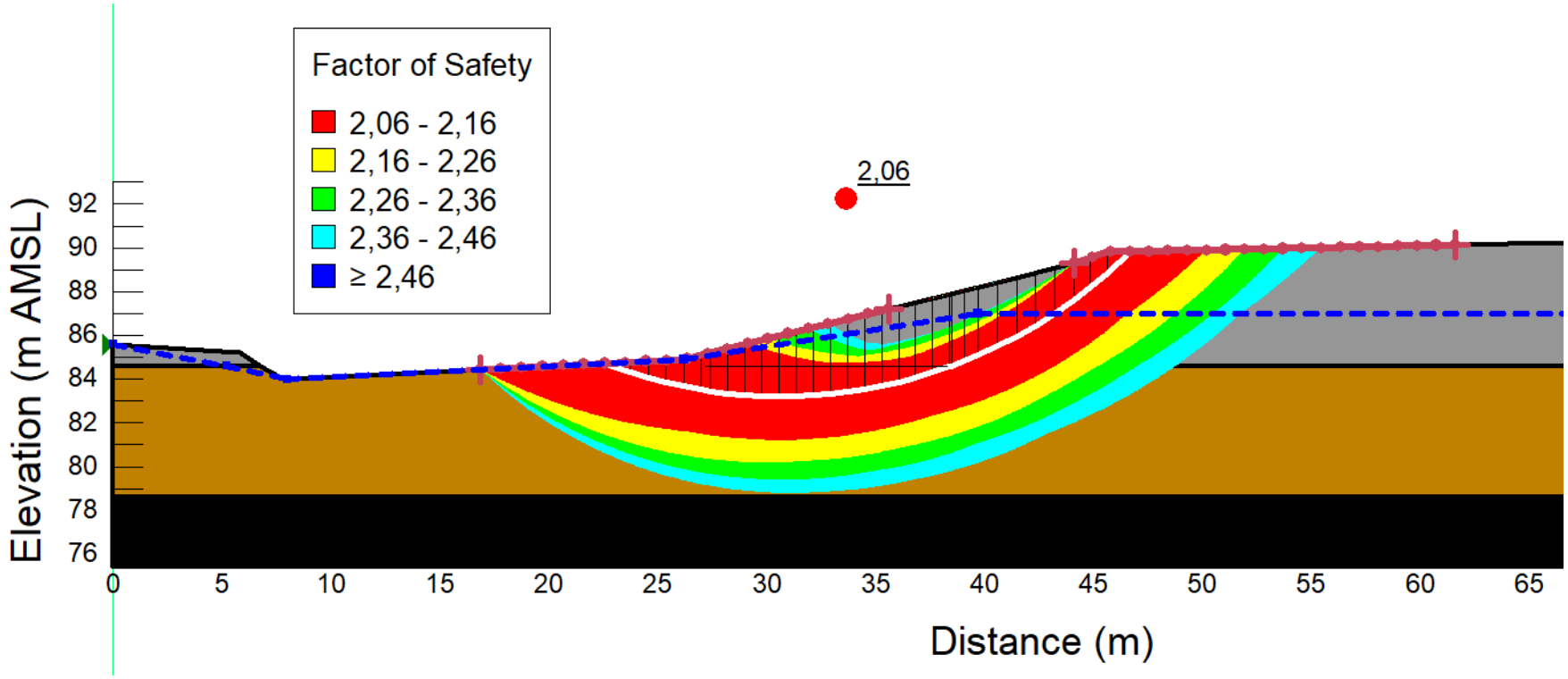
GHD	Global Slope Stability Analysis Consolidated FastFrate (Ottawa) Holdings Inc Slope Stability Analysis Results Under Dynamic Compaction Loads	2022-10-17

Geotechnical Parameters Used in the Global Slope Stability Analysis

Geotechnical Parameters	Existing Backfill	Native Sandy Silt	Limestone
Material Model	Mohr-Coulomb	Mohr-Coulomb	Bedrock (Impenetrable)
Unit Weight, γ (kN/m^3)	18	17	Not applicable
Phi, ϕ (°)	25	34	Not applicable
Cohesion, Cu (kPa)	4	2	Not applicable

Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Geotechnical Parameters Used		

GHD	Global Slope Stability Analysis Figure 1: North Slope Static loading conditions	2022-10-17



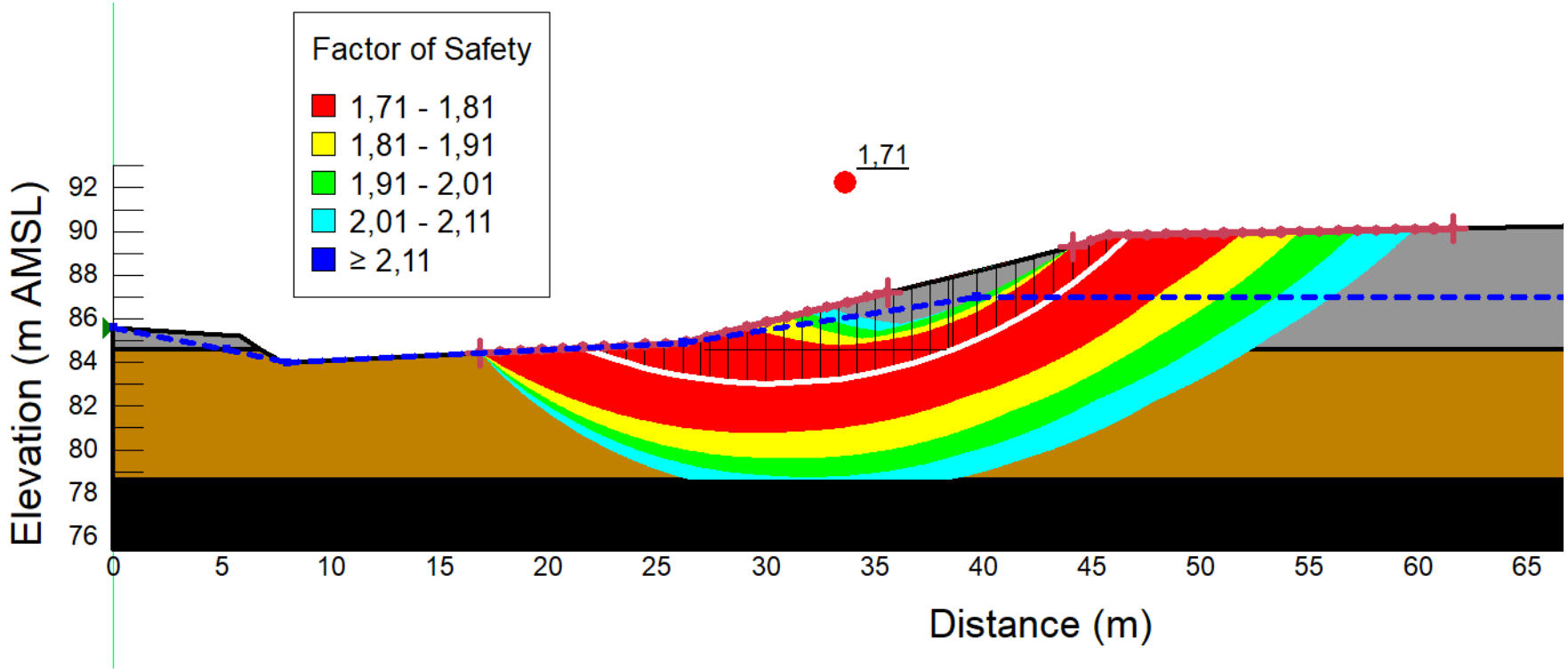
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

Global Slope Stability Analysis

Figure 2: North Slope

Pseudo-Static Loadings Conditions (Pounder Dropping)

2022-10-17



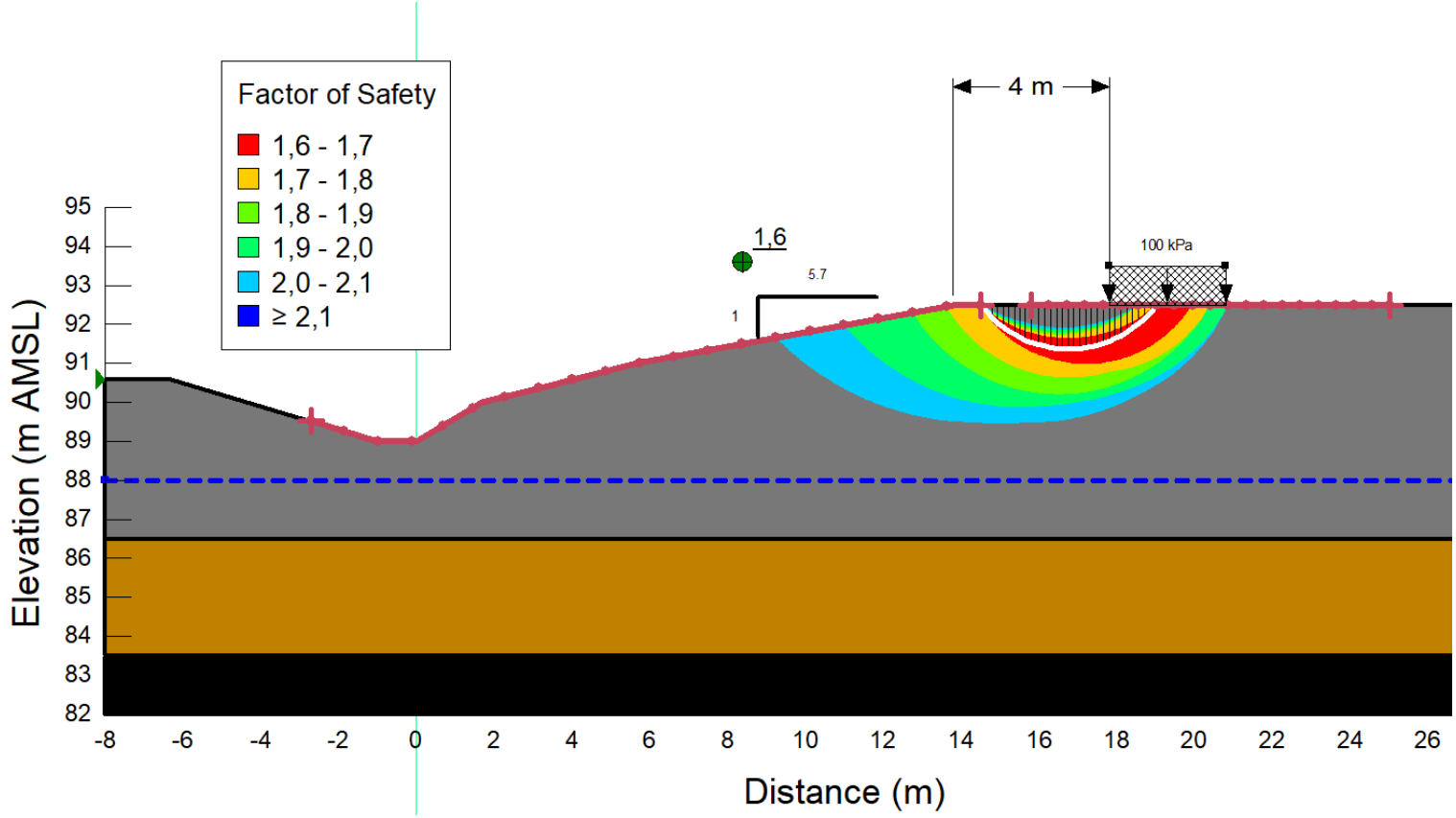
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Pseudo-Static (Kh = 0.05g)		

Global Slope Stability Analysis

Figure 3: West Slope

Static loading conditions

2022-10-17



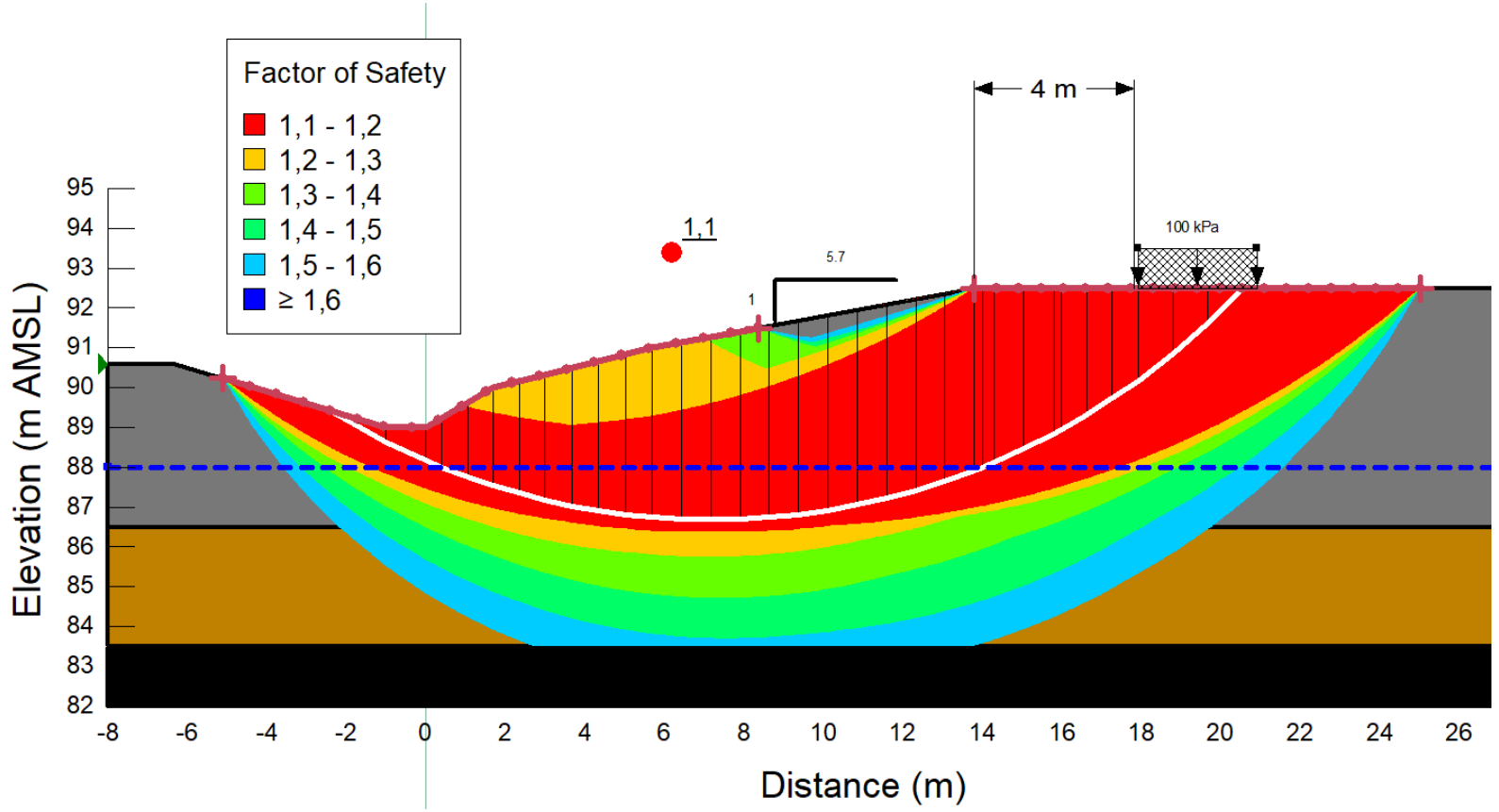
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

Global Slope Stability Analysis

Figure 4: West Slope

Pseudo-Static Loadings Conditions (Pounder Dropping)

2022-10-17



Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Pseudo-Static (Kh = 0.35g)		

Appendix F

Slope Stability Analysis Results following the Final Slop Projected Geometry

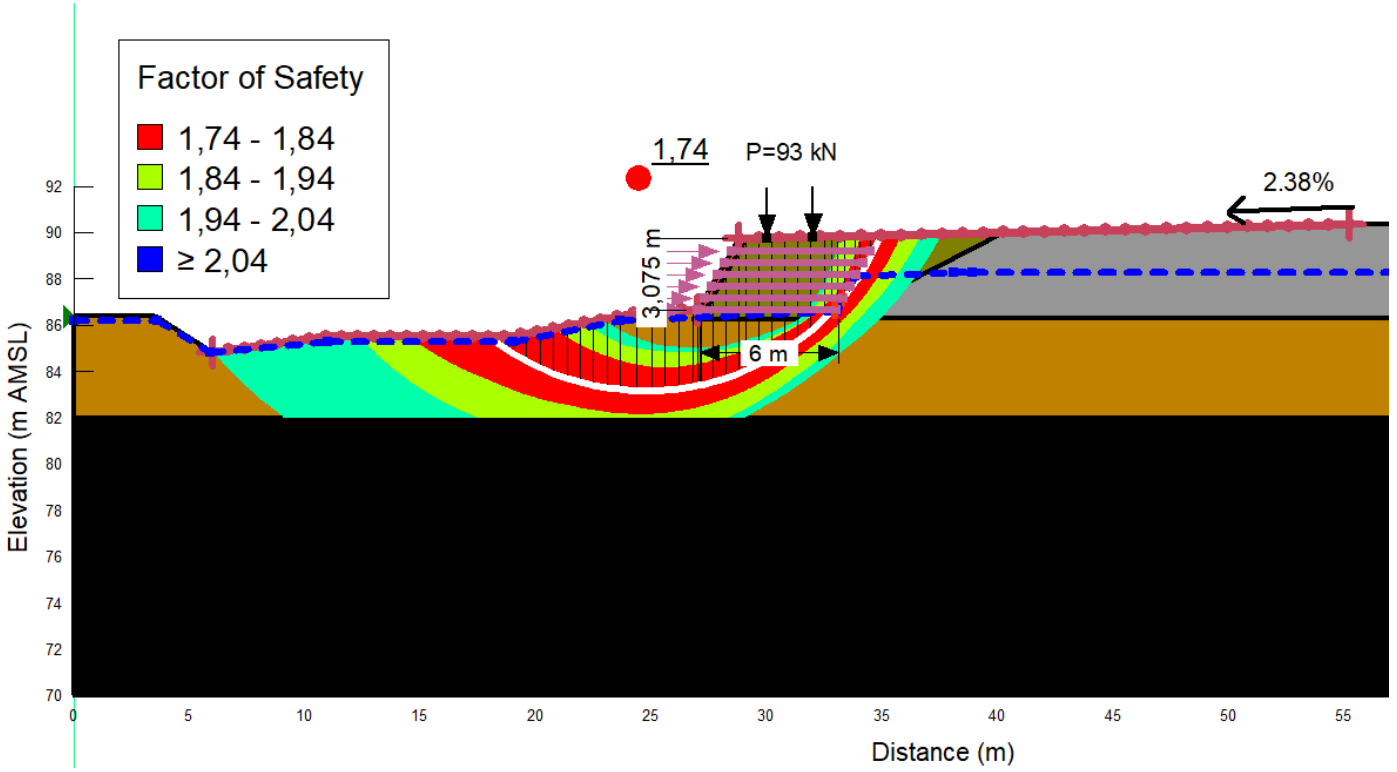
GHD	Global Slope Stability Analysis Consolidated FastFrate (Ottawa) Holdings Inc Slope Stability Analysis Results Following the Final Slope Projected Geometry	2022-10-17

Geotechnical Parameters Used in the Global Slope Stability Analysis

Geotechnical Parameters	Existing Backfill	Native Sandy Silt	Reinforced Fill	Limestone	Soil Pocked
Material Model	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Bedrock (Impenetrable)	Mohr-Coulomb
Unit Weight, γ (kN/m^3)	18	17	18	Not applicable	18
Phi, ϕ (°)	25	34	25	Not applicable	25
Cohesion, Cu (kPa)	4	2	[4]	Not applicable	4

Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Geotechnical Parameters Used		

GHD	Global Slope Stability Analysis Figure 1: North Slope -Cross-Section A Static loading conditions	2022-10-17



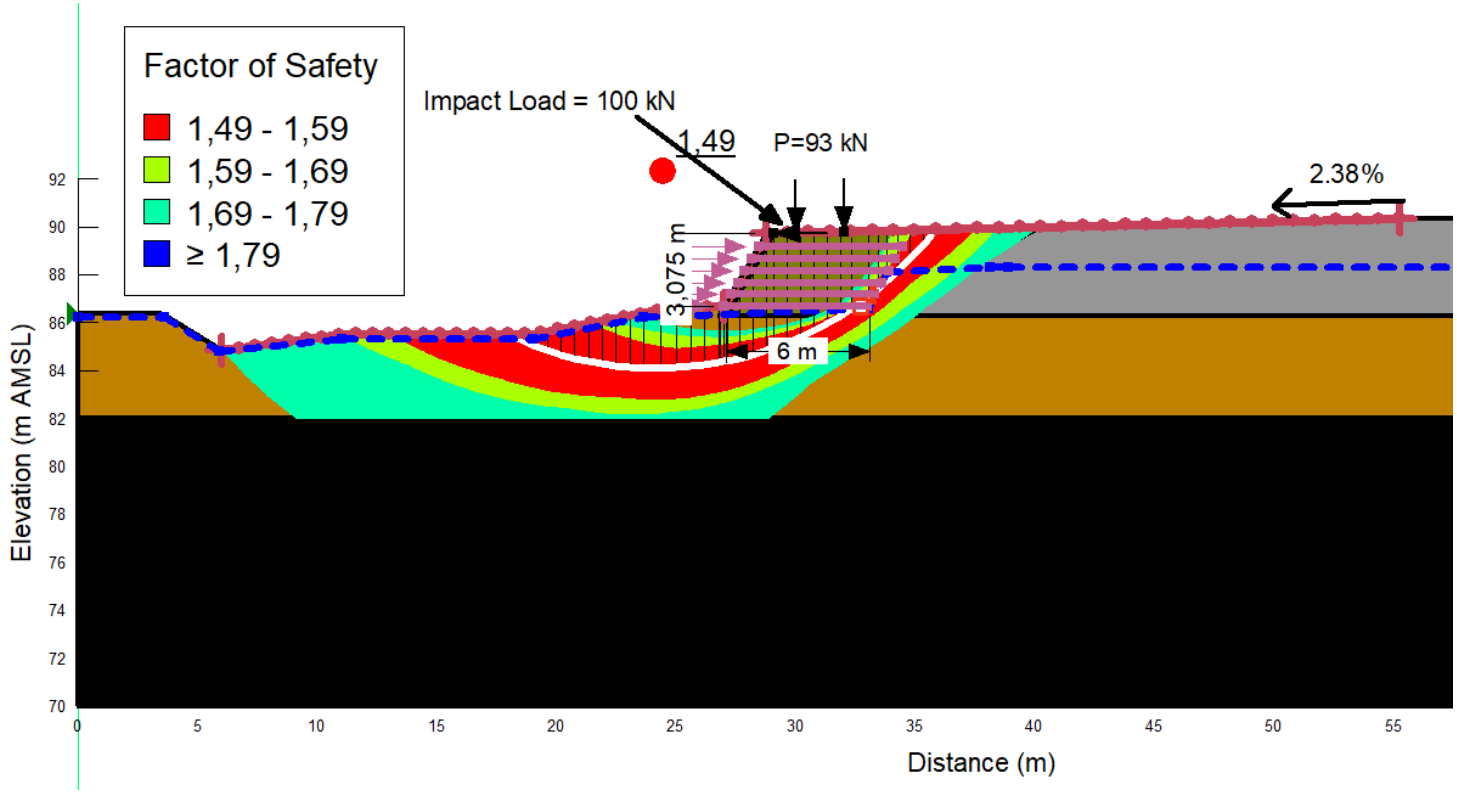
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

Global Slope Stability Analysis

Figure 2: North Slope -Cross-Section A

Static loading conditions and truck load impact on safety barrier

2022-10-17



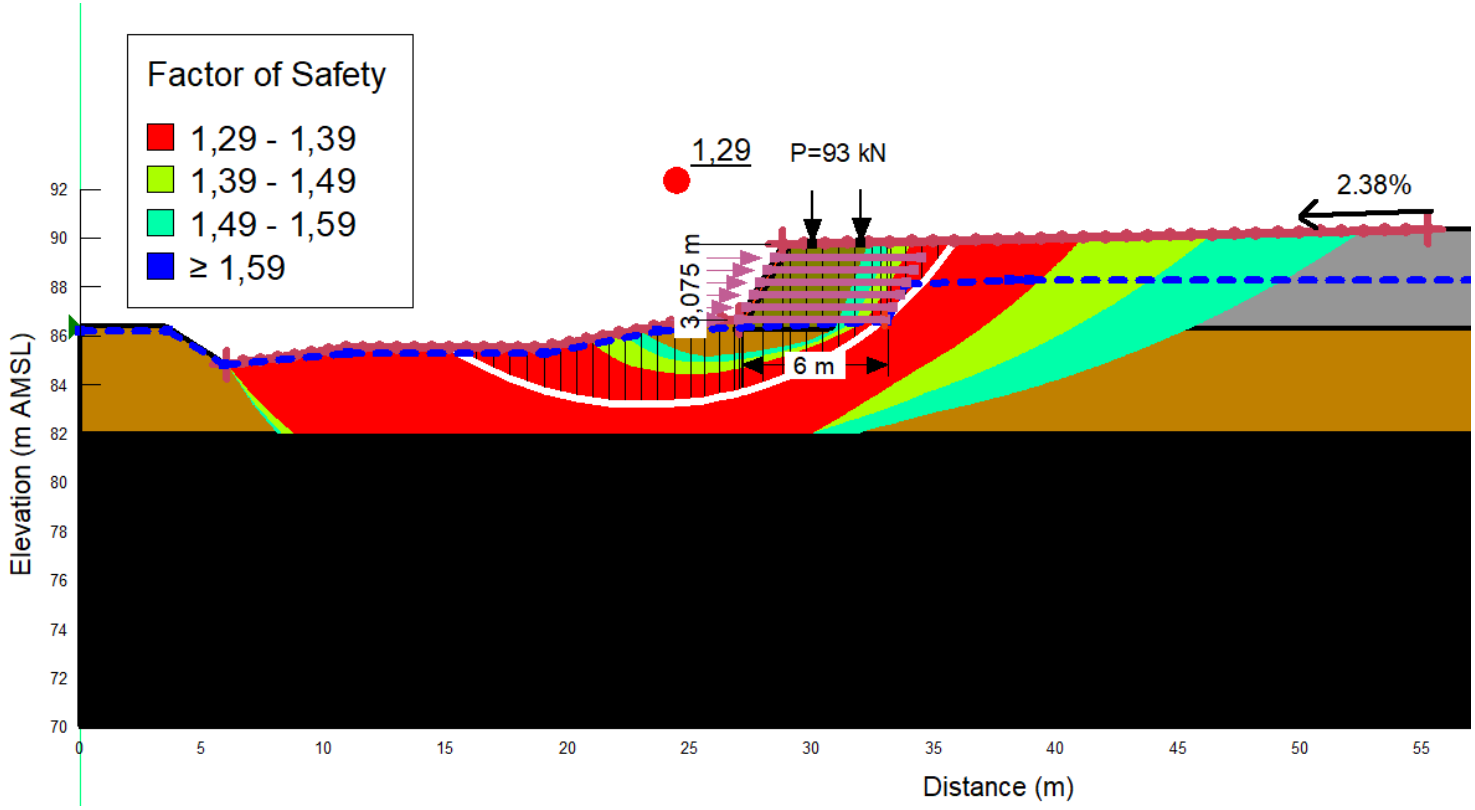
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

Global Slope Stability Analysis

Figure 3: North Slope -Cross-Section A

Pseudo-Static Loadings Conditions

2022-10-17



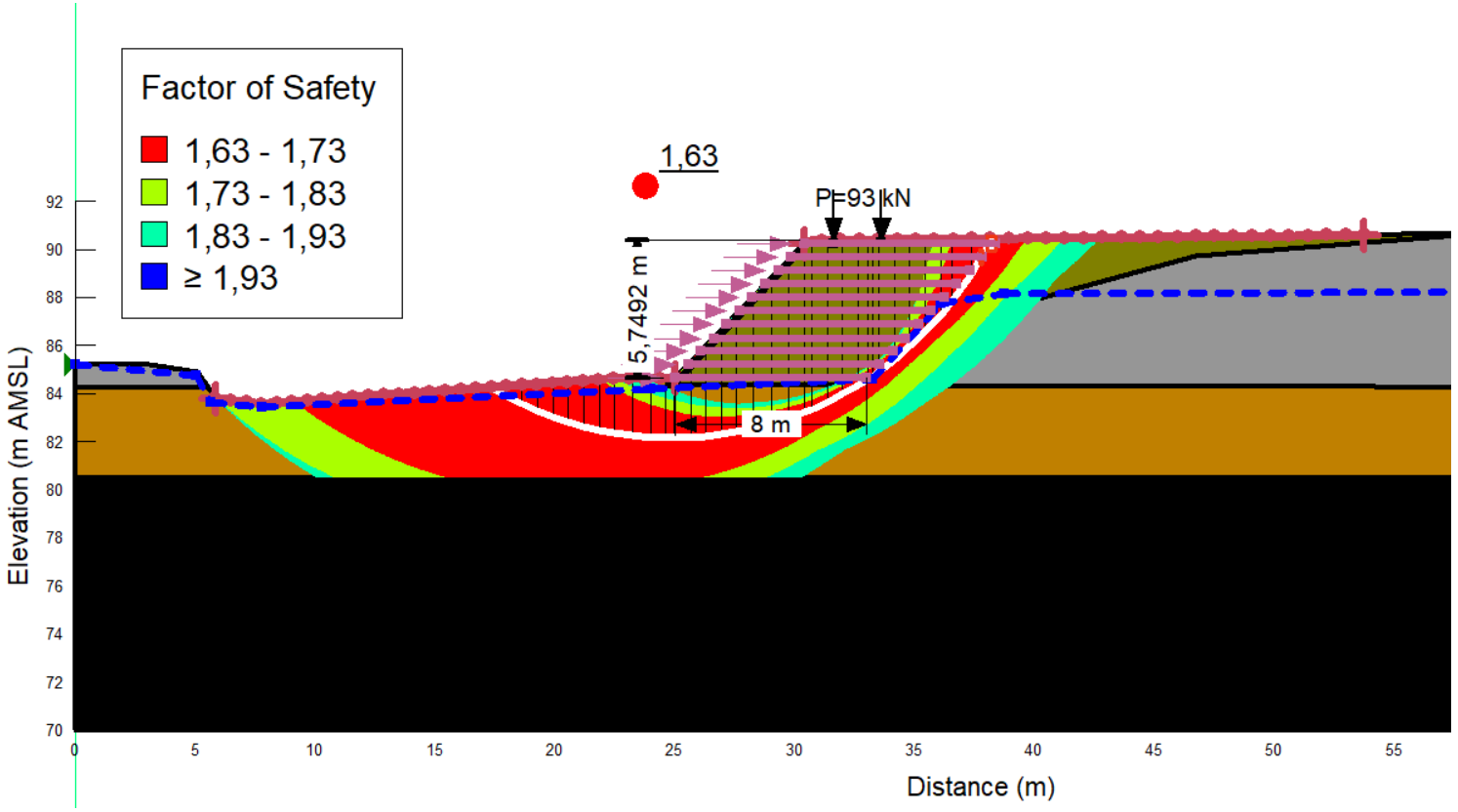
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Pseudo-Static (Kh = 0.154g)		

Global Slope Stability Analysis

Figure 4: North Slope -Cross-Section B

Static loading conditions

2022-10-17



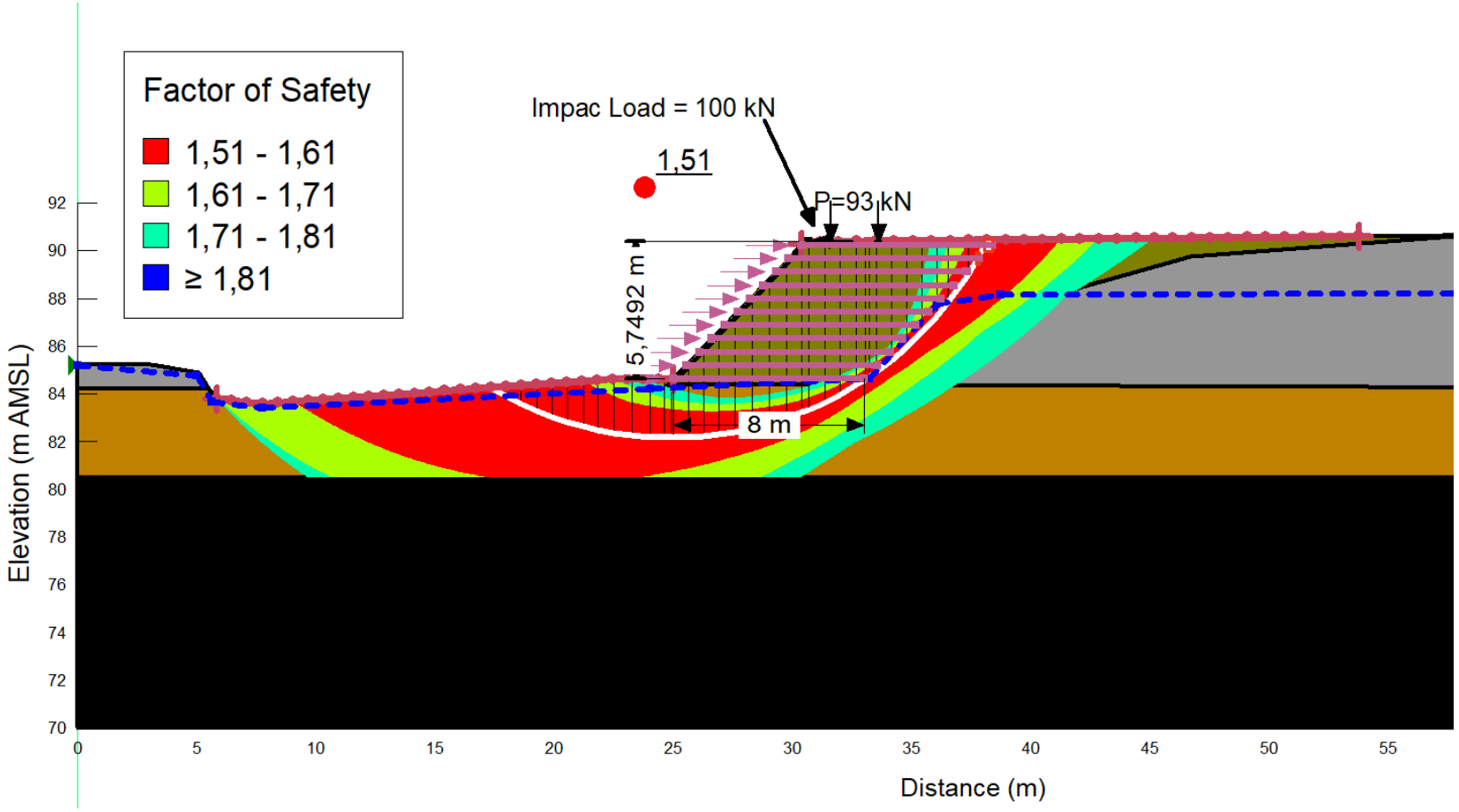
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

Global Slope Stability Analysis

Figure 5: North Slope -Cross-Section B

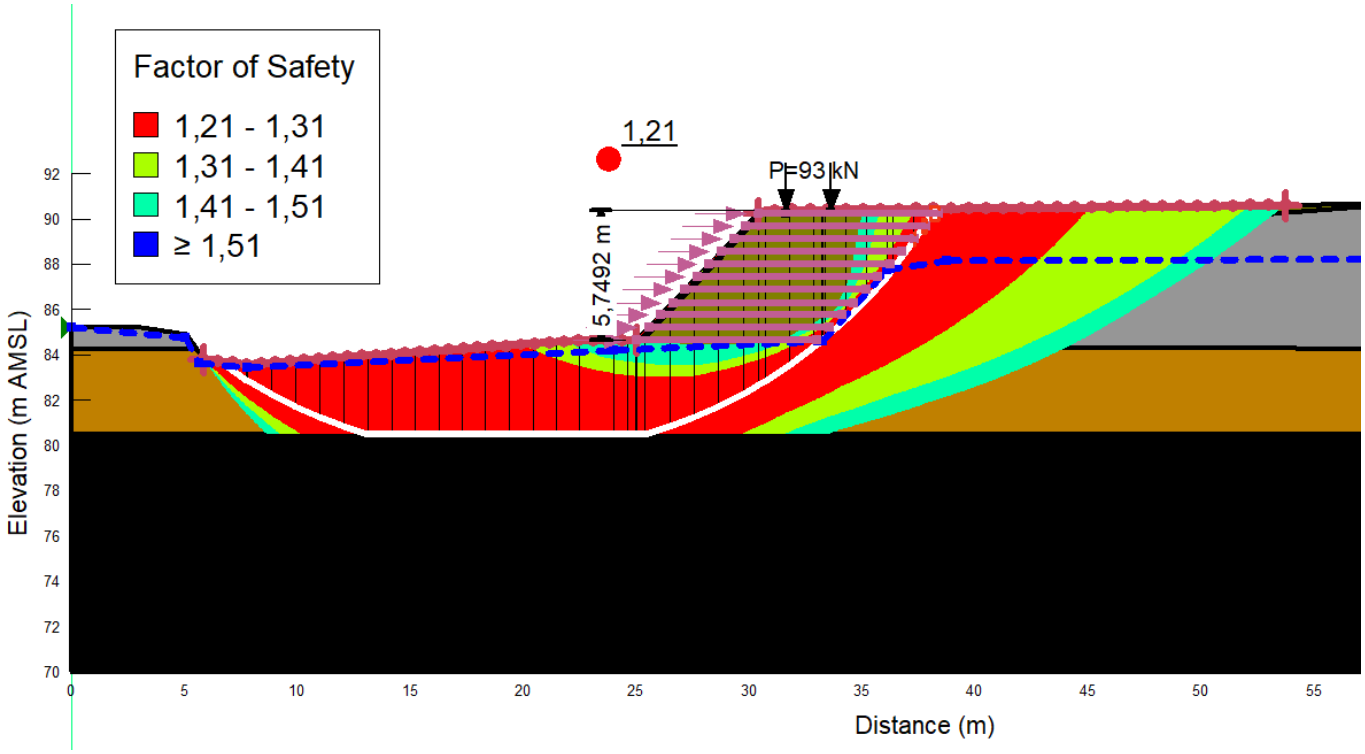
Static loading conditions and truck load impact on safety barrier

2022-10-17



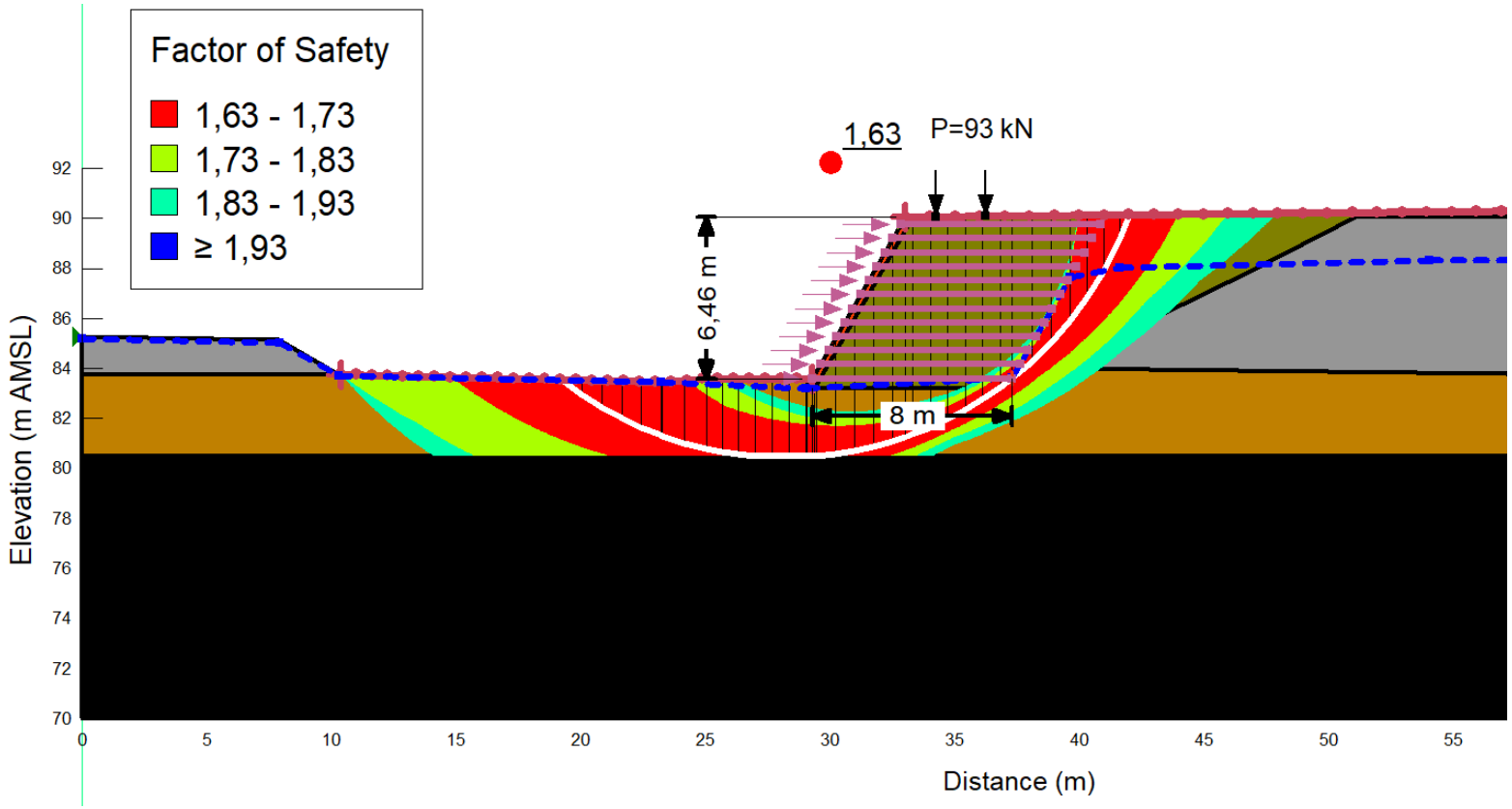
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

	Global Slope Stability Analysis Figure 6: North Slope -Cross-Section B Pseud-Static Loadings Conditions	2022-10-17



Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Pseudo-Static (Kh = 0.154g)		

GHD	Global Slope Stability Analysis Figure 7: North Slope -Cross-Section C Static loading conditions	2022-10-17



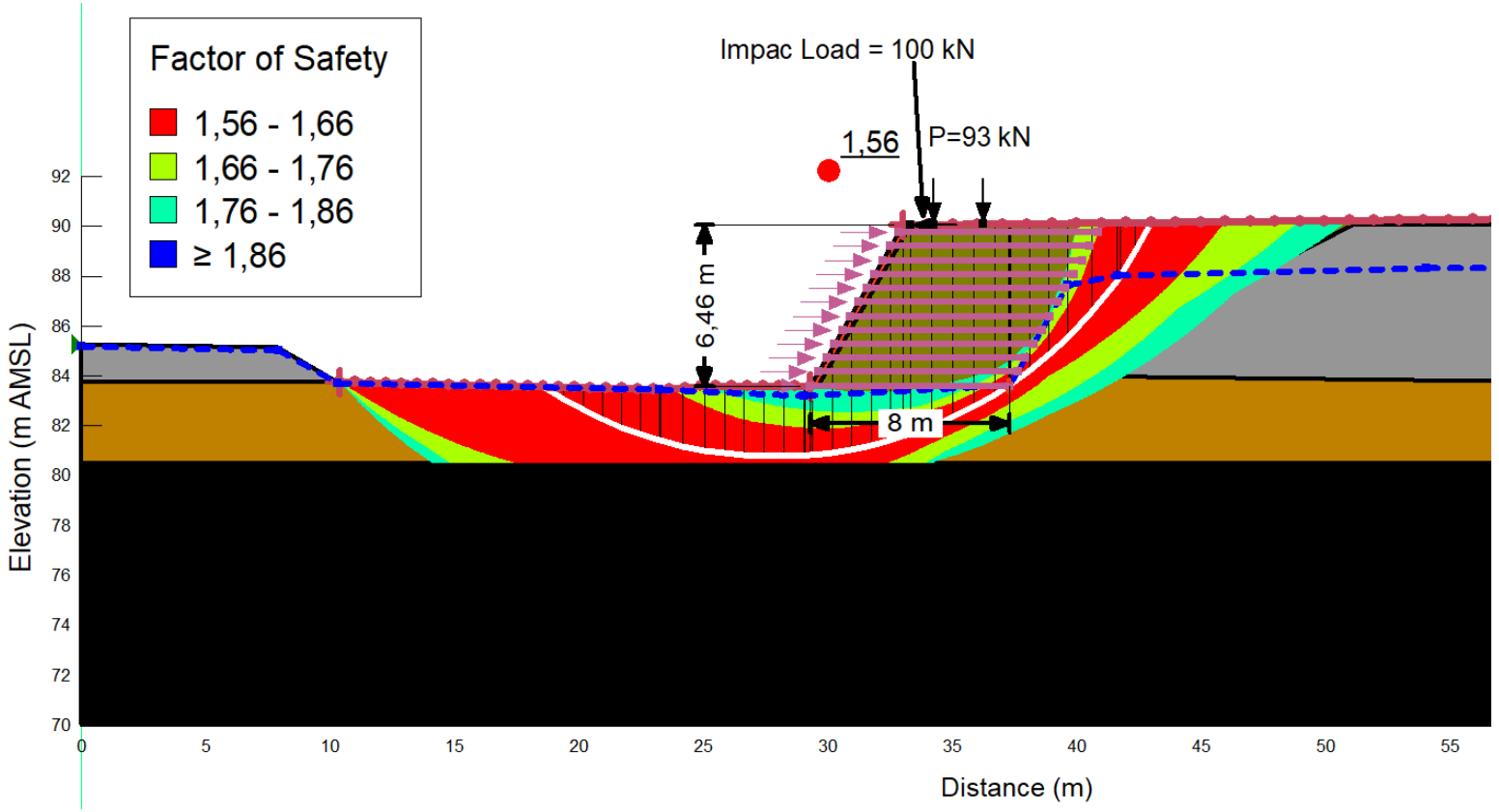
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

Global Slope Stability Analysis

Figure 8: North Slope -Cross-Section C

Static loading conditions and truck load impact on safety barrier

2022-10-17



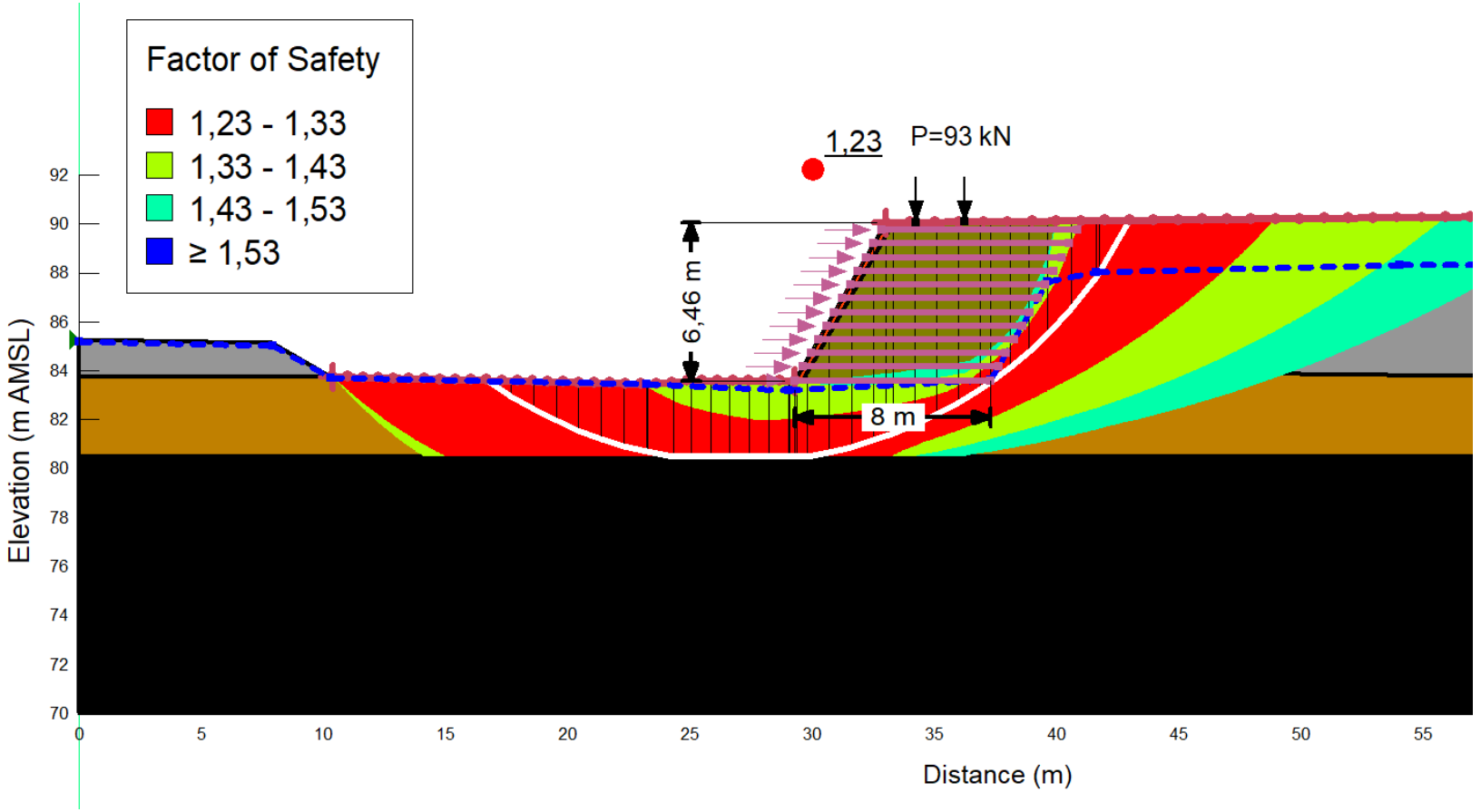
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

Global Slope Stability Analysis

Figure 9: North Slope -Cross-Section C

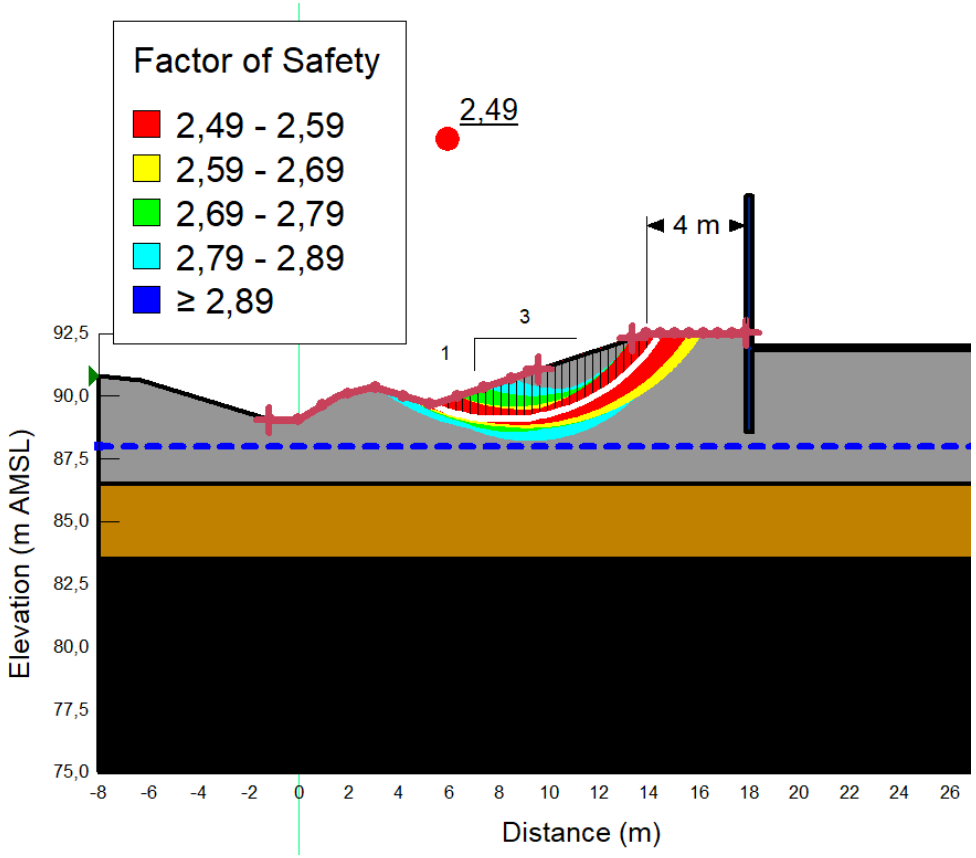
Pseud-Static Loadings Conditions

2022-10-17



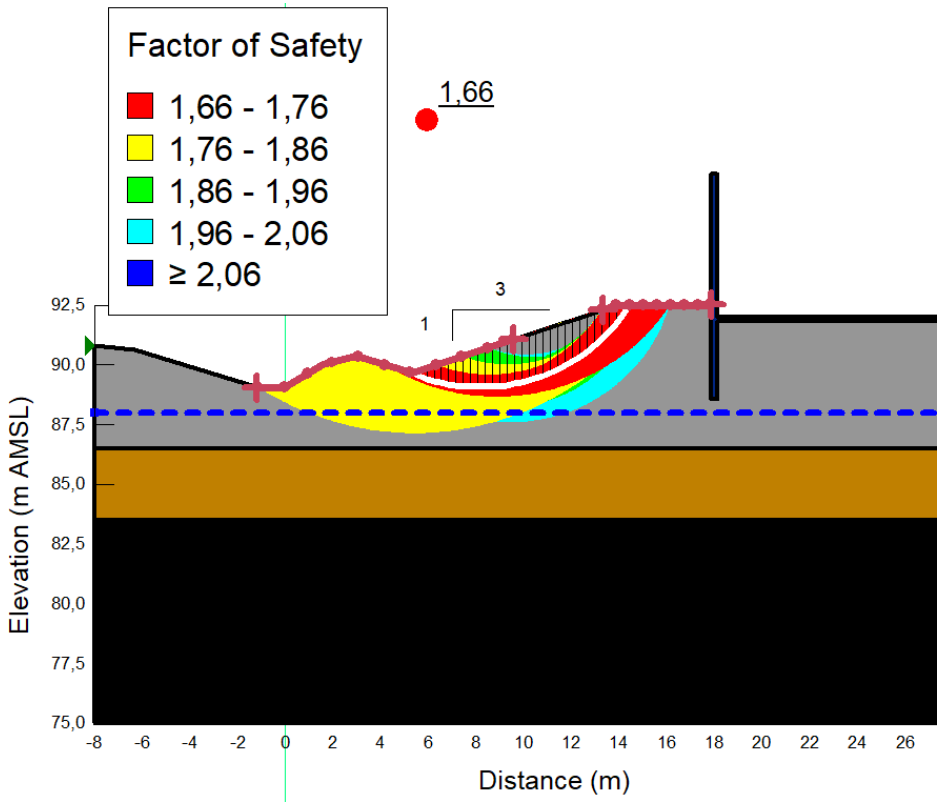
Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Pseudo-Static (Kh = 0.154g)		

GHD	Global Slope Stability Analysis Figure 10: West Slope Static loading conditions	2022-10-17



Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Static		

GHD	Global Slope Stability Analysis Figure 11: West Slope Pseud-Static loading conditions	2022-10-17



Client:	Consolidated FastFrate (Ottawa) Holdings Inc	**Prepared by:**	David Rizk, ing. (Qc)
Projet:	Proposed Industrial Development		
Reference:	12576381-RPT-1		
Location:	Intersection of Rideau Street and Somme Street, Ottawa, Ontario	**Reviewed by:**	Denis Roy, ing. (Qc), M.B.A.
Analysis:	Pseudo-Static (Kh = 0.154g)		

Appendix G

Maccaferri Retaining Structure Drawings

PROJECT: SOMME STREET

OTTAWA, ON

FASTFRATE FACILITY

MACCAFERRI GREEN TERRAMESH SYSTEM

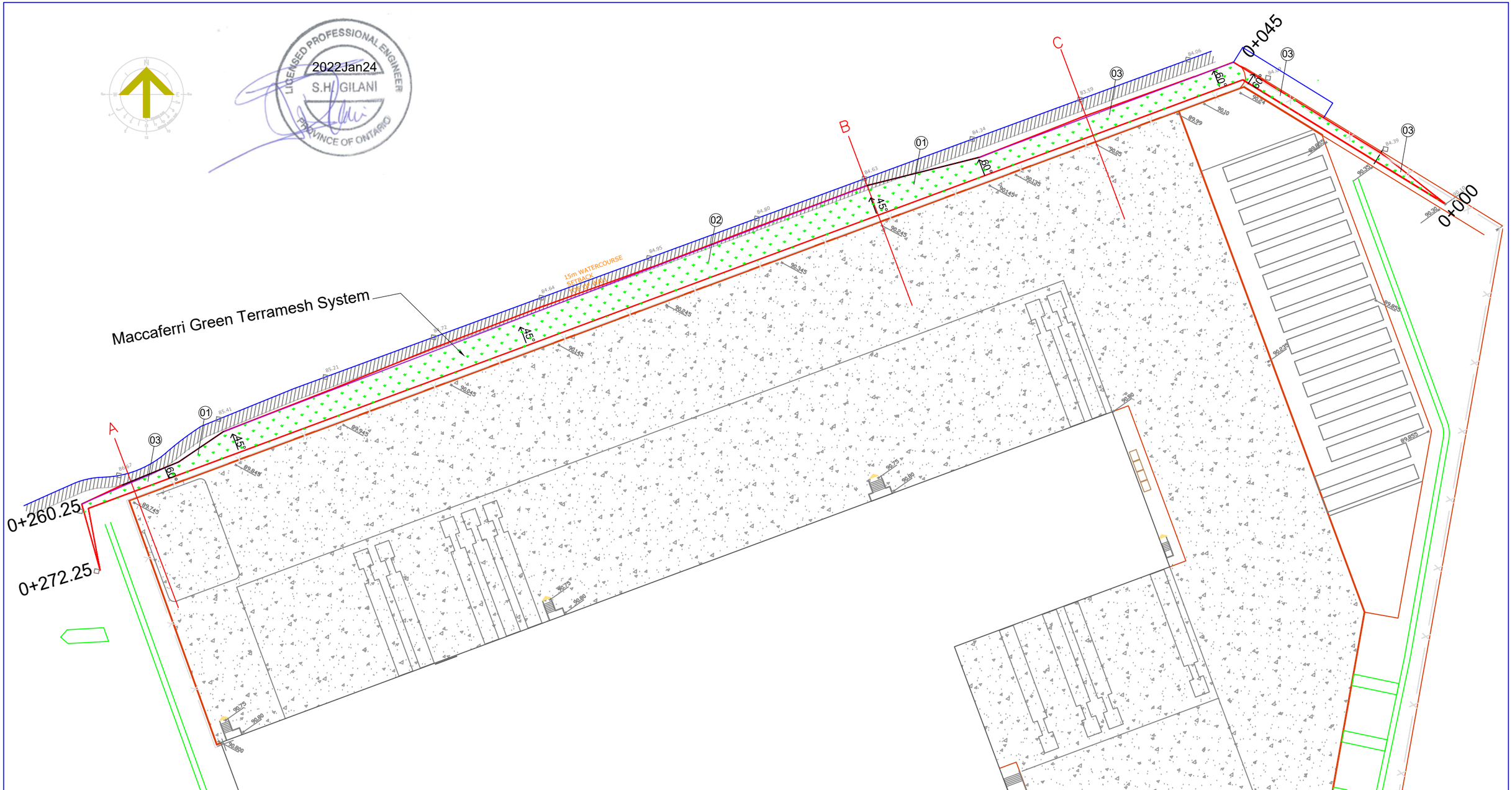
DRAWINGS:

CA21023_1	* Plan View
CA21023_2,3	* Elevation View
CA21023_4	* Cross Section A
CA21023_5	* Cross Section B
CA21023_6	* Cross Section C
CA21023_7	* Construction Notes
CA21023_8	* Installation Guide

Rev:	Issue / Revision:	By:	Date:
2	Issued for Construction	JN	20/12/21
1	Issued to Client for review	JN	15/12/21
0	Issued to Client for review	JN	20/07/21

MACCAFERRI

Maccaferri Canada Ltd.
400 Collier MacMillan Drive, Unit B
Cambridge, ON CANADA N1R 7H7
Ph. (519) 623-9990 Fax (519) 623-1309



Rev:	Issue / Revision:	Drawn:	App:	Date:
2	Issued for Construction	JN		20/12/21
1	Issued to Client for review	JN		15/12/21
0	Issued to Client for review	JN		20/07/21

Project Title: SOMME STREET
OTTAWA, ON
FASTFRATE FACILITY

Project No: CA21023
Client:
Drawing No: CA21023 _1
Scale: NTS
Rev: 2

Designed:		Date:
Drawn:	JN	Date: 20/07/21
Checked:		Date:
Approved:		Date:

Drawing Title: PLAN VIEW

GHD

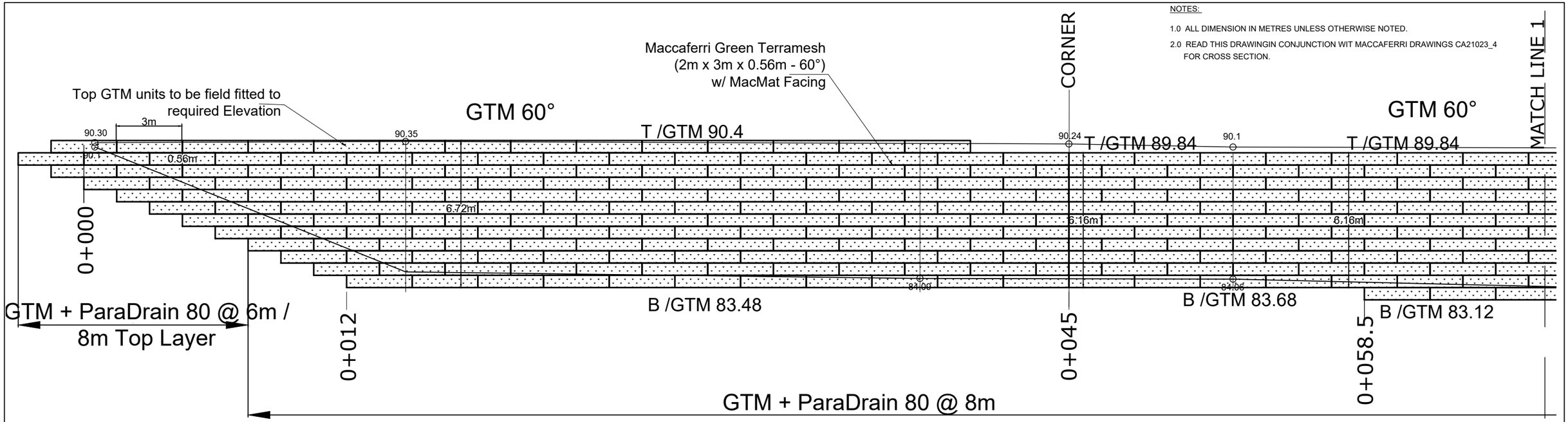
MACCAFERRI

Maccaferri Canada Ltd.
400 Collier MacMillan Drive, Unit B
Cambridge, ON CANADA N1R 7H7
Ph. (519) 623-9990 Fax (519) 623-1309

NOTES:

1.0 ALL DIMENSION IN METRES UNLESS OTHERWISE NOTED.

2.0 READ THIS DRAWINGIN CONJUNCTION WIT MACCAFERRI DRAWINGS CA21023_4 FOR CROSS SECTION.



LICENSED PROFESSIONAL ENGINEER
2022Jan24
S.H. GILANI
PROVINCE OF ONTARIO

Rev:	Issue / Revision:	Drawn:	App:	Date:
2	Issued for Construction	JN		20/12/21
1	Issued to Client for review	JN		15/12/21
0	Issued to Client for review	JN		20/07/21

Project Title:	SOMME STREET OTTAWA, ON FASTFRATE FACILITY		
Project No:	CA21023	Client:	
Drawing No:	CA21023 _2	Scale: NTS	Rev: 2

Designed:		Date:	
Drawn:	JN	Date:	20/07/21
Checked:		Date:	
Approved:		Date:	

Drawing Title: ELEVATION VIEW

GHD

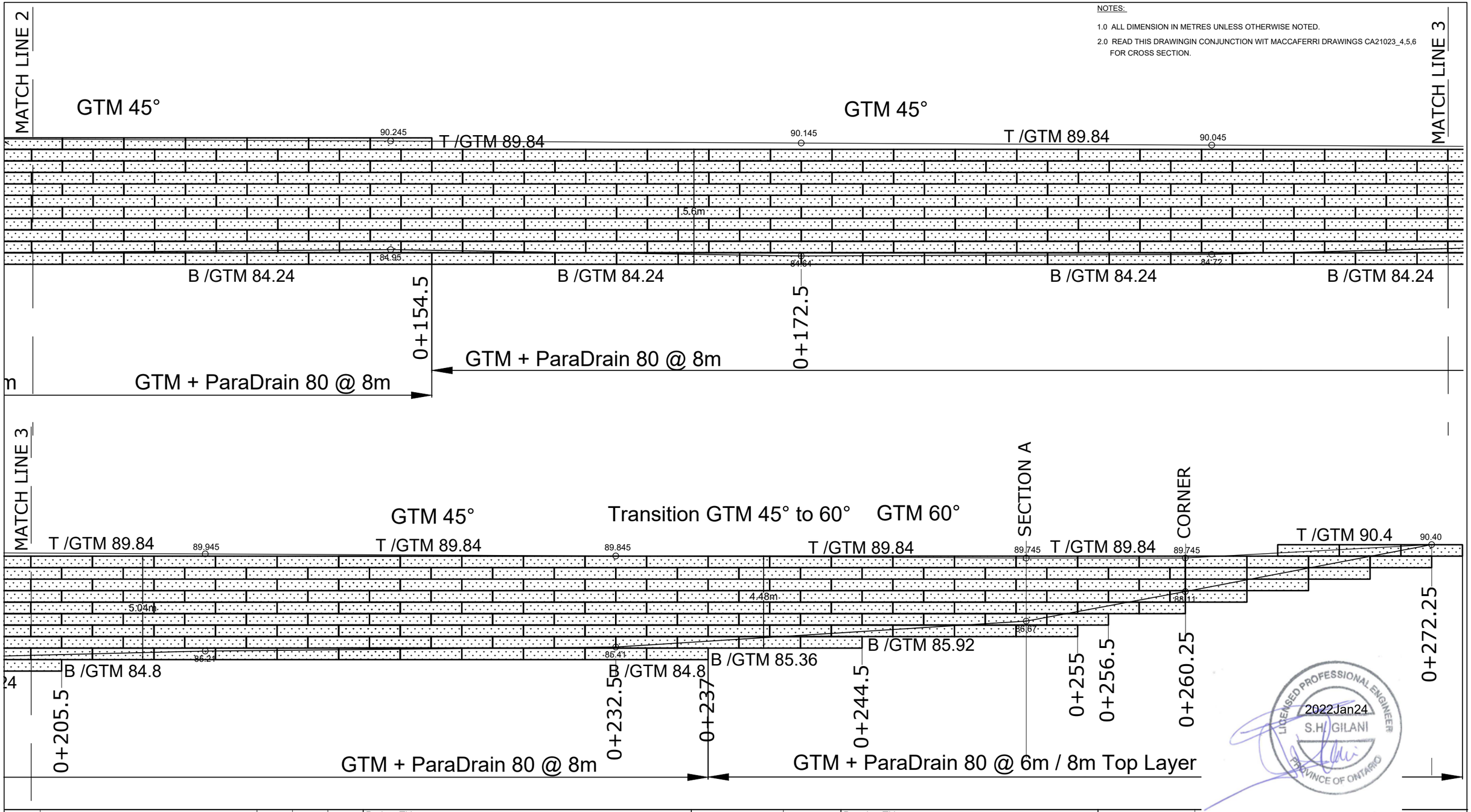
MACCAFERRI

Maccaferri Canada Ltd.
400 Collier MacMillan Drive, Unit B
Cambridge, ON CANADA N1R 7H7
Ph. (519) 623-9990 Fax (519) 623-1309

NOTES:

1.0 ALL DIMENSION IN METRES UNLESS OTHERWISE NOTED.

2.0 READ THIS DRAWINGIN CONJUNCTION WIT MACCAFERRI DRAWINGS CA21023_4,5,6 FOR CROSS SECTION.



LICENSED PROFESSIONAL ENGINEER
2022Jan24
S.H. GILANI
PROVINCE OF ONTARIO

Rev:	Issue / Revision:	Drawn:	App:	Date:
2	Issued for Construction	JN		20/12/21
1	Issued to Client for review	JN		15/12/21
0	Issued to Client for review	JN		20/07/21

Project Title:	SOMME STREET OTTAWA, ON FASTFRATE FACILITY		
Project No:	CA21023	Client:	
Drawing No:	CA21023 _2	Scale: NTS	Rev: 2

Designed:	Date:	Drawing Title: ELEVATION VIEW
Drawn: JN	Date: 20/07/21	
Checked:	Date:	
Approved:	Date:	

GHD

MACCAFERRI

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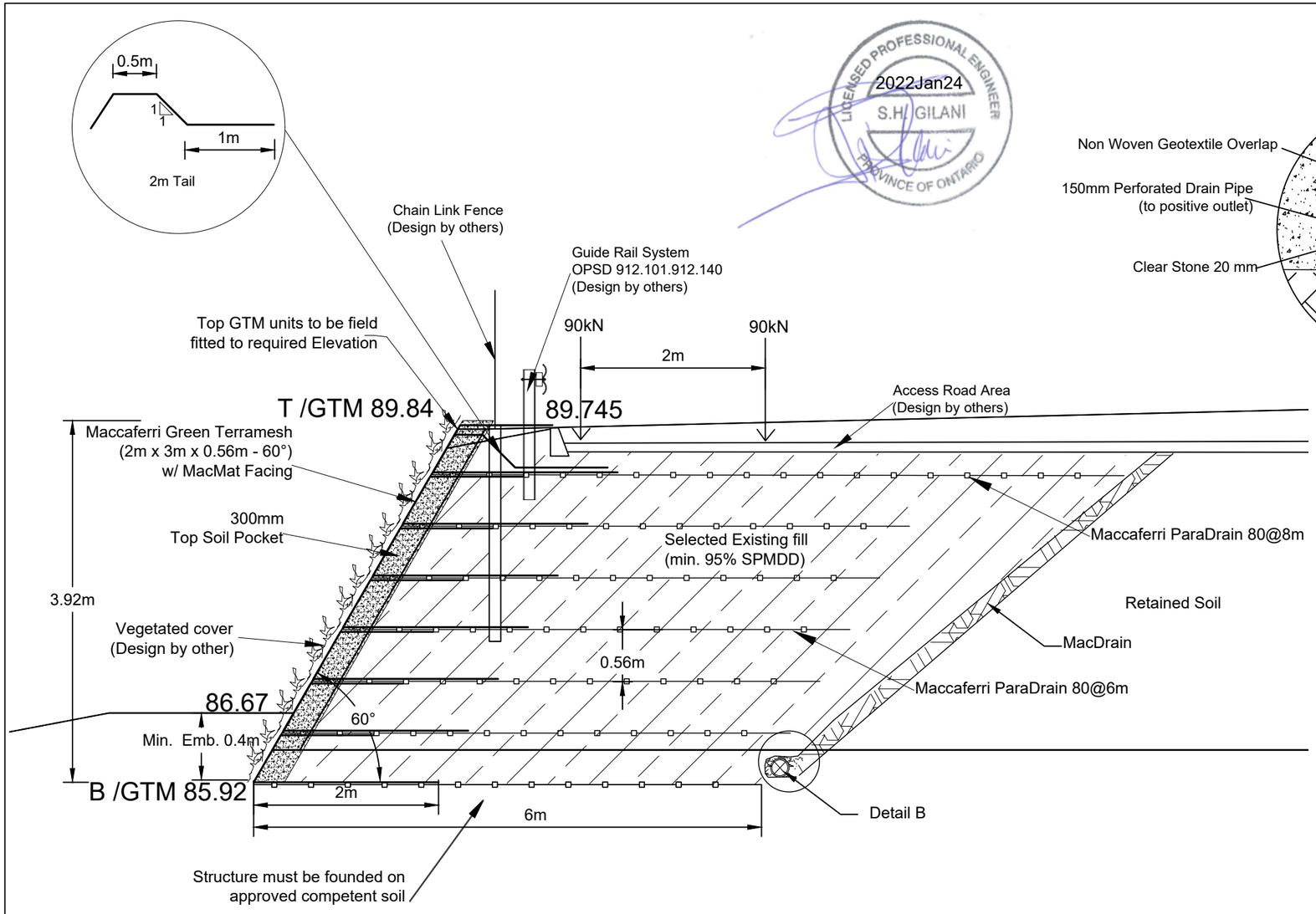
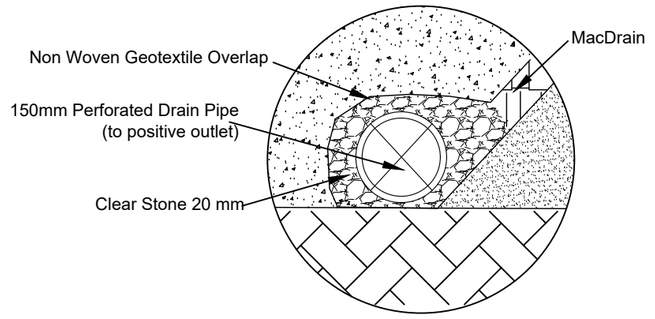
Ph. (519) 623-9990 Fax (519) 623-1309



DETAIL B
SUBDRAIN
SCALE: N.T.S



NOTES:

1.0 DESIGN PARAMETERS

1.1 THE DESIGN PRESENTED HEREIN IS BASED ON THE SOIL PARAMETERS, FOUNDATION CONDITIONS, GROUNDWATER CONDITIONS AND LOADINGS STATED IN SECTION 1.2.

1.2 THE DESIGN OF THE GREEN TERRAMESH SYSTEM STRUCTURE IS BASED ON THE FOLLOWING SOIL PARAMETERS PROVIDED BY GHD GEOTECHNICAL INVESTIGATION/11215612/RPT-1 AND EMAIL DATED 12/16/2021

	FRICTION ANGLE (°)	EFFECTIVE COHESION (kPa)	MOIST. UNIT WT. (kN/m3)
SELECTED EXISTING FILL	25	4	18
FOUNDATION SOIL	34	2	17
RETAINED SOIL	25	4	18

1.3 FACTORS OF SAFETY
MINIMUM FACTOR OF SAFETY FOR SLIDING = 1.5(STATIC) 1.1(SEISMIC)
MINIMUM FACTOR OF INTERNAL STABILITY = 1.5(STATIC) 1.1(SEISMIC)

1.3.2 GLOBAL STABILITY IS THE RESPONSIBLITY OF GHD

1.4 SEISMIC DESIGN
HORIZONTAL ACCELERATION COEFFICIENT = 0.15g (50% of 0.3g)

1.5 STRUCTURE IS DESIGN USING 180kN AXLE LOAD

1.6 DESIGN OF STRUCTURE IS BASED UPON THE ASSUMPTION THAT GROUNDWATER IS AT ELEVATION 86.9m

2.0 READ DETAIL IN CONJUNCTION WITH STANDARD CONSTRUCTION NOTES FOR MACCAFERRI GREEN TERRAMESH SYSTEM PROVIDED WITH THIS DRAWING.

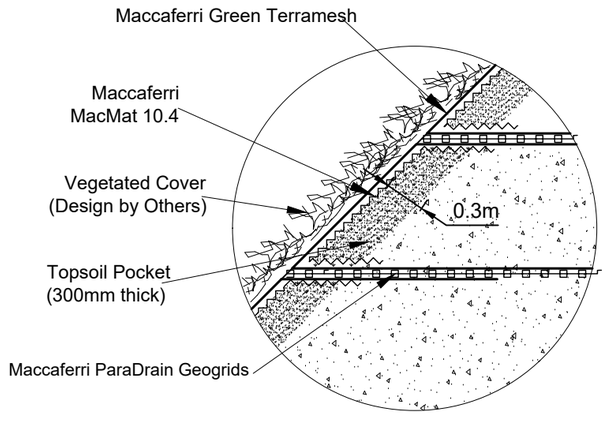
3.0 DESIGN TO BE REVIEWED BY PROJECT ENGINEER TO DETERMINE SUITABILITY OF STRUCTURE TO SITE CONDITIONS.

4.0 FOUNDATION IS TO BE REVIEWED BY THE PROJECT GEOTECHNICAL ENGINEER.

5.0 ONCE REINFORCED SLOPE SYSTEM HAS BEEN CONSTRUCTED, NO AUGURING OR EXCAVATION USING EXCAVATOR SHALL BE ALLOWED INTO REINFORCED SOIL ZONE. IF PENETRATION IN THE SOIL REINFORCEMENT IS REQUIRED , EXPOSE INDIVIDUAL LAYERS OF REINFORCEMENT AND CUT AN OPENING WITH SHARP INSTRUMENT CLEANLY THROUGH THE GEOGRID REINFORCEMENT.

6.0 THE SOIL DESIGN PARAMETERS STATED IN NOTE 1.2 SHALL BE BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF CONSTRUCTION. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER IMMEDIATELY.

DETAIL
GREEN TERRAMESH UNIT FACING
SCALE: N.T.S



* NO MORE THAN 0.56m OF COMPACTED SELECTED EXISTING FILL (Cv=100m2/year, mv = 0.18m2/MN) TO BE PLACED PER DAY

Rev:	Issue / Revision:	Drawn:	App:	Date:
2	Issued for Construction	JN		20/12/21
1	Issued to Client for review	JN		15/12/21
0	Issued to Client for review	JN		20/07/21

Project Title: SOMME STREET
OTTAWA, ON
FASTFRATE FACILITY

Project No: CA21023
Client:
Drawing No: CA21023 _4
Scale: NTS
Rev: 2

Designed:	JN	Date: 20/07/21
Drawn:	JN	Date: 20/07/21
Checked:		Date:
Approved:		Date:

Drawing Title: CROSS SECTION A
Green Terramesh System

GHD

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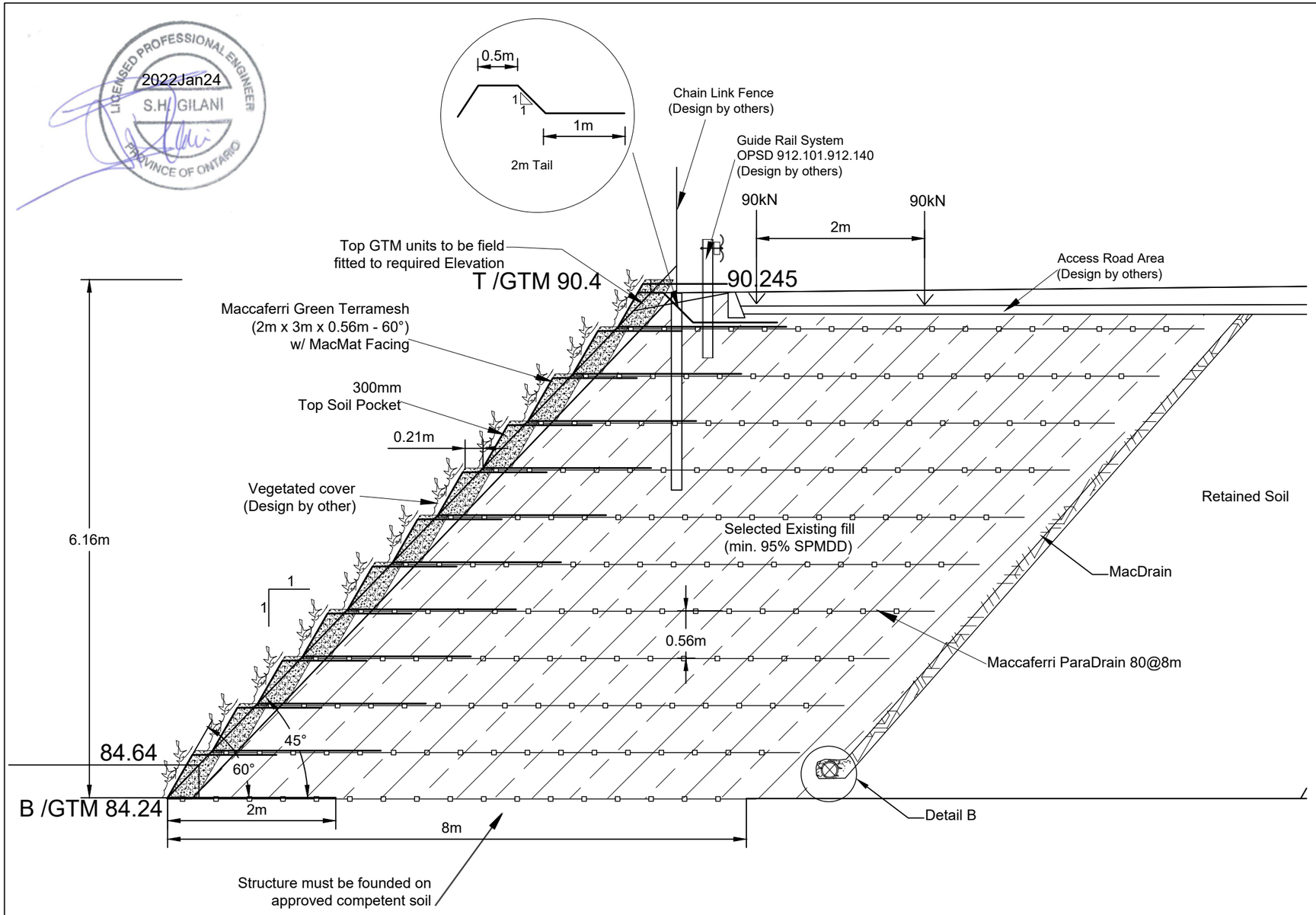


* NO MORE THAN 0.56m OF COMPACTED SELECTED EXISTING FILL (Cv=100m2/year, mv = 0.18m2/MN) TO BE PLACED PER DAY

NOTES:

1.0 DESIGN PARAMETERS

1.1 THE DESIGN PRESENTED HEREIN IS BASED ON THE SOIL PARAMETERS, FOUNDATION CONDITIONS, GROUNDWATER CONDITIONS AND LOADINGS STATED IN SECTION 1.2.

1.2 THE DESIGN OF THE GREEN TERRAMESH SYSTEM STRUCTURE IS BASED ON THE FOLLOWING SOIL PARAMETERS PROVIDED BY GHD GEOTECHNICAL INVESTIGATION/11215612/RPT-1 AND EMAIL DATED 12/16/2021

	FRICTION ANGLE (°)	EFFECTIVE COHESION (kPa)	MOIST. UNIT WT. (kN/m3)
SELECTED EXISTING FILL	25	4	18
FOUNDATION SOIL	34	2	17
RETAINED SOIL	25	4	18

1.3 FACTORS OF SAFETY
MINIMUM FACTOR OF SAFETY FOR SLIDING = 1.5(STATIC) 1.1(SEISMIC)
MINIMUM FACTOR OF INTERNAL STABILITY = 1.5(STATIC) 1.1(SEISMIC)

1.3.2 GLOBAL STABILITY IS THE RESPONSIBLITY OF GHD

1.4 SEISMIC DESIGN
HORIZONTAL ACCELERATION COEFFICIENT = 0.15g (50% of 0.3g)

1.5 STRUCTURE IS DESIGN USING 180kN AXLE LOAD

1.6 DESIGN OF STRUCTURE IS BASED UPON THE ASSUMPTION THAT GROUNDWATER IS AT ELEVATION 86.9m

2.0 READ DETAIL IN CONJUNCTION WITH STANDARD CONSTRUCTION NOTES FOR MACCAFERRI GREEN TERRAMESH SYSTEM PROVIDED WITH THIS DRAWING.

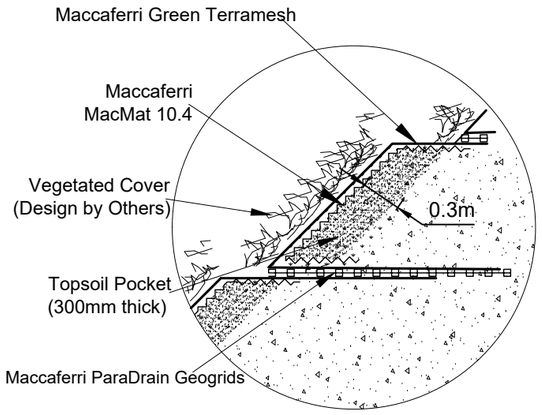
3.0 DESIGN TO BE REVIEWED BY PROJECT ENGINEER TO DETERMINE SUITABILITY OF STRUCTURE TO SITE CONDITIONS.

4.0 FOUNDATION IS TO BE REVIEWED BY THE PROJECT GEOTECHNICAL ENGINEER.

5.0 ONCE REINFORCED SLOPE SYSTEM HAS BEEN CONSTRUCTED, NO AUGURING OR EXCAVATION USING EXCAVATOR SHALL BE ALLOWED INTO REINFORCED SOIL ZONE. IF PENETRATION IN THE SOIL REINFORCEMENT IS REQUIRED , EXPOSE INDIVIDUAL LAYERS OF REINFORCEMENT AND CUT AN OPENING WITH SHARP INSTRUMENT CLEANLY THROUGH THE GEOGRID REINFORCEMENT.

6.0 THE SOIL DESIGN PARAMETERS STATED IN NOTE 1.2 SHALL BE BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF CONSTRUCTION. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER IMMEDIATELY.

DETAIL
GREEN TERRAMESH UNIT FACING
SCALE: N.T.S



Rev:	Issue / Revision:	Drawn:	App:	Date:
2	Issued for Construction	JN		20/12/21
1	Issued to Client for review	JN		15/12/21
0	Issued to Client for review	JN		20/07/21

Project Title: SOMME STREET
OTTAWA, ON
FASTFRATE FACILITY

Project No: CA21023
Client:
Drawing No: CA21023 _5
Scale: NTS
Rev: 2

Designed:	JN	Date: 20/07/21
Drawn:	JN	Date: 20/07/21
Checked:		Date:
Approved:		Date:

Drawing Title: CROSS SECTION B
Green Terramesh System

GHD

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NOTES:

1.0 DESIGN PARAMETERS

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	FRICTION ANGLE (°)	EFFECTIVE COHESION (kPa)	MOIST. UNIT WT. (kN/m3)
SELECTED EXISTING FILL	25	4	18
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RETAINED SOIL	25	4	18

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MINIMUM FACTOR OF INTERNAL STABILITY = 1.5(STATIC) 1.1(SEISMIC)

1.3.2 GLOBAL STABILITY IS THE RESPONSIBLITY OF GHD

1.4 SEISMIC DESIGN
HORIZONTAL ACCELERATION COEFFICIENT = 0.15g (50% of 0.3g)

1.5 STRUCTURE IS DESIGN USING 180kN AXLE LOAD

1.6 DESIGN OF STRUCTURE IS BASED UPON THE ASSUMPTION THAT GROUNDWATER IS AT ELEVATION 86.9m

2.0 READ DETAIL IN CONJUNCTION WITH STANDARD CONSTRUCTION NOTES FOR MACCAFERRI GREEN TERRAMESH SYSTEM PROVIDED WITH THIS DRAWING.

3.0 DESIGN TO BE REVIEWED BY PROJECT ENGINEER TO DETERMINE SUITABILITY OF STRUCTURE TO SITE CONDITIONS.

4.0 FOUNDATION IS TO BE REVIEWED BY THE PROJECT GEOTECHNICAL ENGINEER.

5.0 ONCE REINFORCED SLOPE SYSTEM HAS BEEN CONSTRUCTED, NO AUGURING OR EXCAVATION USING EXCAVATOR SHALL BE ALLOWED INTO REINFORCED SOIL ZONE. IF PENETRATION IN THE SOIL REINFORCEMENT IS REQUIRED , EXPOSE INDIVIDUAL LAYERS OF REINFORCEMENT AND CUT AN OPENING WITH SHARP INSTRUMENT CLEANLY THROUGH THE GEOGRID REINFORCEMENT.

6.0 THE SOIL DESIGN PARAMETERS STATED IN NOTE 1.2 SHALL BE BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF CONSTRUCTION. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER IMMEDIATELY.

* NO MORE THAN 0.56m OF COMPACTED SELECTED EXISTING FILL (Cv=100m2/year, mv = 0.18m2/MN) TO BE PLACED PER DAY

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1	Issued to Client for review	JN		15/12/21
0	Issued to Client for review	JN		20/07/21

Project Title: SOMME STREET
OTTAWA, ON
FASTFRATE FACILITY

Project No: CA21023
Client:

Drawing No: CA21023 _6
Scale: NTS
Rev: 2

Designed:	JN	Date: 20/07/21
Drawn:	JN	Date: 20/07/21
Checked:		Date:
Approved:		Date:

Drawing Title: CROSS SECTION C
Green Terramesh System

GHD

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CONSTRUCTION NOTES FOR MACCAFERRI GREEN TERRAMESH SYSTEM

MATERIALS

GREEN TERRAMESH SHALL BE GALVANIZED WITH POLIMAC COATING 8x10 HEXAGONAL DOUBLE TWIST WIRE MESH TYPE AS PER ASTM A975.

1.2 REINFORCED BACKFILL SHALL BE SELECTED EXISTING FILL AND HAVE THE REQUIRED SOIL PARAMETERS AS DEFINED ON THE CROSS SECTIONS PROVIDED.

1.3 REINFORCED BACKFILL MATERIAL SHALL BE SELECTED EXISTING FILL AND MUST BE APPROVED BY THE GEOTECHNICAL ENGINEER BEFORE USE.

1.5 REINFORCED BACKFILL MATERIAL SHALL BE FREE OF EXCESS MOISTURE, MUCK, SOD, SNOW, FROZEN LUMPS, ORGANICS, OR DELETERIOUS MATERIALS. NO STONE SIZES GREATER THAN 100mm SHALL BE PLACED DIRECTLY AGAINST THE REINFORCEMENT.

2.0 DRAINAGE

2.1 PERMANENT SURFACE WATER DIVERSIONS SHALL BE REQUIRED AND CONSTRUCTED IN ACCORDANCE WITH THE GRADING DESIGN DRAWINGS.

2.2 THIS DESIGN IS BASED ON THE ASSUMPTION THAT THE REINFORCED REINFORCED BACKFILL MATERIAL SHALL BE FREE OF SUBSURFACE MOISTURE/WATER. IT IS THE RESPONSIBILITY OF THE CONSTRUCTOR CONSTRUCTOR TO ENSURE THAT PROPER SUBSURFACE IS PROVIDED.

2.3 AT THE END OF EACH WORKDAY, BACKFILL SURFACE SHALL BE GRADED A MINIMUM OF 2% AWAY FROM THE WALL FACE AND COMPACTED WITH A SMOOTH WHEEL ROLLER TO MINIMIZE PONDING.

2.4 THE ENGINEERING, ANALYSIS, DESIGN AND MITIGATION OF SURFACE DRAINAGE AND SEEPAGE OF GROUND WATER IS THE RESPONSIBILITY OF THE CONSTRUCTOR.

3.0 TECHNICAL REQUIREMENTS

3.1 PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL CLEAR AND GRADE THE REINFORCED BACKFILL AREA, REMOVING TOP SOIL, BRUSH, SOD AND OTHER ORGANIC DELETERIOUS MATERIALS. ANY UNSUITABLE SOILS SHALL BE OVER EXCAVATED AND REPLACED AND COMPACTED WITH REINFORCED BACKFILL MATERIAL TO PROJECT SPECIFICATIONS OR AS OTHERWISE DIRECTED BY THE GEOTECHNICAL ENGINEER.

3.2 GREEN TERRAMESH SHALL BE INSTALLED ACCORDING TO MACCAFERRI CANADA LTD.'S SPECIFICATIONS.

3.3 GREEN TERRAMESH SHALL BE INSTALLED USING THE CORRECT BATTER ANGLE AS SHOWN ON THE DRAWING(S).

3.4 FILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 200mm IN UNCOMPACTED THICKNESS FOR HEAVY COMPACTION EQUIPMENT. FOR ZONES WHERE COMPACTION IS ACHIEVED WITH HAND OPERATED EQUIPMENT FILL SHALL BE PLACED IN LIFTS NOT EXCEEDING 150mm IN UNCOMPACTED THICKNESS. ONLY HAND OPERATED EQUIPMENT SHALL BE ALLOWED WITHIN ONE METRE OF THE FRONT FACE.

3.5 FILL BEYOND ONE METRE FROM THE FRONT FACING SHALL BE COMPACTED AS REQUIRED BY PROJECT SPECIFICATIONS OR TO A MINIMUM OF 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY (SPMDD) AS DETERMINED IN ACCORDANCE WITH ASTM D698 AT A MOISTURE CONTENT OF -1/+2% POINT FROM OPTIUM.

3.6 THE FACING ELEMENT OF THE GREEN TERRMESH SHALL BE MONITORED DURING BACKFILL PLACEMENT AND COMPACTION. MODIFICATIONS TO THE COMPACTION EQUIPMENT AND PROCEDURES MAY BE NECESSARY TO PREVENT EXCESSIVE DEFORMATION OF THE FACING.

3.7 FOUNDATION SHALL BE PROOF ROLLED USING A SMOOTH DRUM ROLLER TO 98% SPMDD OR PER PROJECT SPECIFICATIONS. IT IS THE RESPONSIBILITY OF THE CONSTRUCTOR TO CONFIRM THAT THE SITE IS ADEQUATELY PREPARED.

3.8 VERIFICATION OF MATERIAL SPECIFICATIONS, TESTING METHODS AND FREQUENCY AND COMPACTION ARE THE RESPONSIBILITY OF THE ENGINEER.

4.0 SPECIAL PROVISIONS

4.1 MACCAFERRI CANADA LTD. ASSUMES NO LIABILITY FOR INTERPRETATION OR VERIFICATION OF SUBSURFACE CONDITIONS, SUITABILITY OF THE ASSUMED SOIL DESIGN PARAMETERS, SHOWN ON THE CROSS SECTION, AND INTERPRETATION OF GROUNDWATER CONDITIONS.

4.2 IT IS THE RESPONSIBILITY OF THE CONSTRUCTOR TO VERIFY THAT THE ACTUAL SITE CONDITIONS ARE AS DESCRIBED ON THE CROSS SECTION. ANY DISCREPANCIES SHALL BE REPORTED TO MACCAFERRI AND THE GEOTECHNICAL ENGINEER.

4.3 THE SOIL DESIGN PARAMETERS STATED ON THE CROSS SECTION SHALL BE VERIFIED BY THE CONSTRUCTOR PRIOR TO COMMENCEMENT OF CONSTRUCTION. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER IMMEDIATELY.

4.4 THE BEARING CAPACITY OF THE FOUNDATION SOIL MUST BE APPROVED BY THE ENGINEER.

4.5 ANY REVISIONS TO THE DESIGN PARAMETERS STATED ON THE CROSS SECTION OR STRUCTURE GEOMETRY SHALL REQUIRE DESIGN MODIFICATIONS PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS ON THE STRUCTURAL DRAWINGS WITH SITE DRAWINGS PRIOR TO COMMENCEMENT OF CONSTRUCTION AND NOTIFY MACCAFERRI AND THE ENGINEER IMMEDIATELY OF ANY DISCREPANCIES.

4.6 THE ACCOMPANYING DRAWING(S) SHALL BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DOCUMENTS.

4.7 THESE CONSTRUCTION NOTES MUST BE READ IN CONJUNCTION WITH PRODUCT SPECIFICATIONS AND PRODUCT INSTALLATION GUIDE FOR THE GREEN TERRAMESH SYSTEM.

4.8 THIS DESIGN IS VALID ONLY FOR THE PROPOSED GREEN TERRAMESH SYSTEM AS SHOWN HEREIN.

4.9 THE DESIGN PROVIDED HEREIN IS PRELIMINARY IN NATURE AND MUST BE VERIFIED BY A CONSULTING ENGINEER PRIOR TO COMMENCEMENT OF CONSTRUCTION. MACCAFERRI CANADA LTD. ASSUMES NO RESPONSIBILITY OR LIABILITY IF CONSTRUCTION IS COMMENCED WITHOUT SUCH VERIFICATION BY A CONSULTING ENGINEER.

4.10 REINFORCED SLOPES SUCH AS GREEN TERRAMESH MUST BE VEGETATED AFTER CONSTRUCTION TO MINIMIZE OR PREVENT EROSION FROM RAINFALL AND RUNOFF ON THE FACE. IT IS THE RESPONSIBILITY OWNER OR THE OWNER'S REPRESENTATIVE TO SEEK THE SERVICES OF A COMPETENT HORTICULTURAL/ LANDSCAPE SPECIALIST, IN ORDER TO RECOMMEND THE MOST APPROPRIATE RECOMMEND THE MOST APROPIATE PLANT SPECIES, PLANT DENSITY AND MACCAFERRI LTD. ASSUMES NO RESPONSIBILTY OR LIABILITY FOR THE CHOICE CHOICE OF THE VEGETATION METHOD SELECTED FOR THE GREEN TERRAMESH FACING.

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2	Issued for Construction	JN		20/12/21
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Project Title:	SOMME STREET OTTAWA, ON FASTFRATE FACILITY		
Project No:	CA21023	Client:	
Drawing No:	CA21023 _7	Scale: NTS	Rev: 2

Designed:		Date:
Drawn:	JN	Date: 20/07/21
Checked:		Date:
Approved:		Date:

Drawing Title: CONSTRUCTION NOTES GREEN TERRAMESH SYSTEM

GHD

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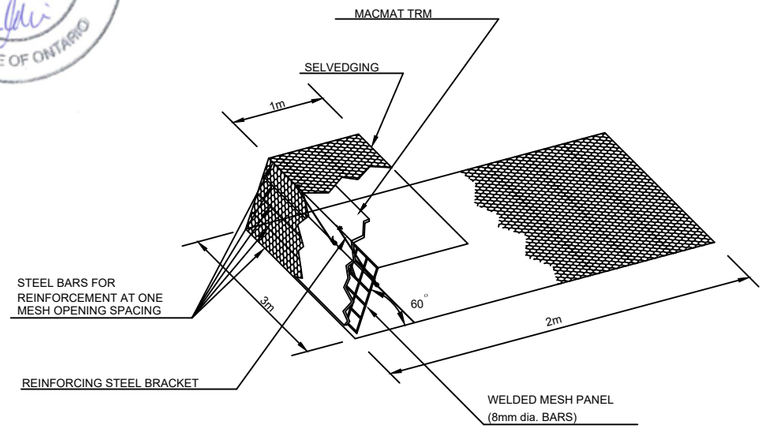
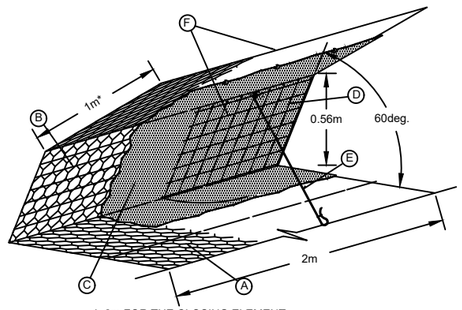
GREEN TERRAMESH + GEOGRIDS CONSTRUCTION SEQUENCE





* 2m FOR THE CLOSING ELEMENT

A = GREEN TERRAMESH UNIT IN DOUBLE TWISTED WIRE MESH,TYPE 8X10,HEAVILY ZINC COATED WITH POLIMAC COATED WIRE Ø2.70/3.70mm

C = MACMAT TURF REINFORCEMENT MAT (TRM)

E = REINFORCING STEEL BRACKET

B = ZINC/PVC COATED METALLIC REINFORCING WIRES Ø3.40/4.40mm, INSERTED INTO THE DOUBLE TWIST MESH

D = WELDED GRID MESH (Ø8mm)

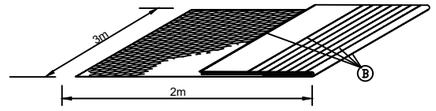
F = HEAVILY ZINC COATED STEEL FIXING RINGS, Ø3.00mm

G = EARTH TYPE (ABOVE WATER TABLE) VEGETAL SOIL

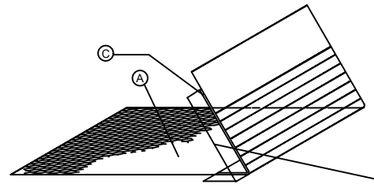
H = SOIL FILL

NOTE:

1) ALL DIMENSIONS IN mm's UNLESS OTHERWISE SPECIFIED.

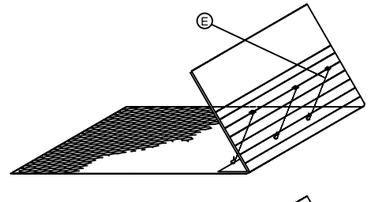


GREEN TERRAMESH UNIT PROVIDED WITH ONE FOLD, TO SIMPLIFY PLACEMENT IN THE STRUCTURE, WITH STEEL REINFORCING BARS, WELDED MESH PANEL AND REINFORCING STEEL BRACKET

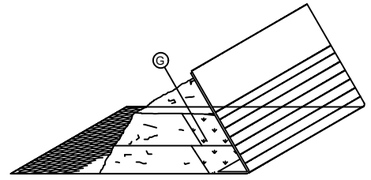


PLACEMENT AND OPENING OF THE UNIT ALONG THE LOWER REINFORCING WIRE

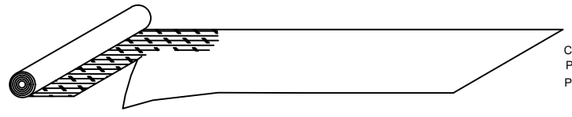
EDGE OF THE EROSION CONTROL MAT TO BE OVERLAPPED TO THE ADJACENT UNIT



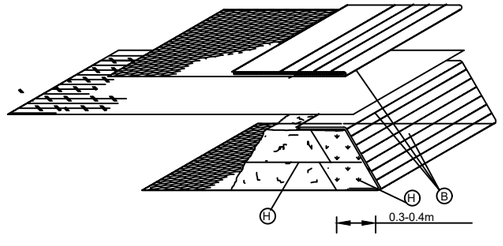
INSTALLATION OF REINFORCING STEEL SUPPORT BRACKETS



BACK FILLING UP TO THE DESIRED LEVEL



CUTTING OF THE GEOGRID USING THE CUTTER
PLACE THE GEOGRIDS IN HORIZONTAL LAYERS PERPENDICULAR TO THE FACE .



FOLDING OF THE EXTERNAL T.M. FACE ALONG THE UPPER REINFORCING WIRE.
PLACEMENT OF THE GEOGRID, FOLLOWED BY THE PLACEMENT OF THE NEXT T.M. UNIT AND LACING BY STAINLESS STEEL RINGS TO THE UNIT UNDERNEATH

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Project Title: SOMME STREET, OTTAWA, ON, FASTFRATE FACILITY
Project No: CA21023
Client:
Drawing No: CA21023 _8
Scale: NTS
Rev: 2

Designed: JN	Date: 20/07/21	
Drawn: JN	Date: 20/07/21	
Checked:	Date:	
Approved:	Date:	

Drawing Title: Installation Guide GREEN TERRAMESH SYSTEM

GHD

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