Geotechnical Investigation - 3358 Lakefield Road, Lakefield, Ontario

2020-09-18

Prepared for:
Triple T Holdings

 Reference No.: 5874-001

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1.0 Introduction

Cambium Inc. (Cambium) was retained by Triple T Holdings (Client) to conduct a geotechnical investigation at 3358 Lakefield Road, Lakefield, Ontario (Site) for the proposed residential development.

It is understood that the development consists of roadways, residential units and three (3) storm water management facilities. The geotechnical investigation was required to confirm the existing subsurface conditions throughout the Site and prepare recommendations for excavation, backfill and compaction, dewatering, bearing capacity and foundation design.

This report presents the methodology and findings of the geotechnical investigation at the Site and addresses requirements and constraints for the design and construction.

2.0 Methodology

2.1 Test Pit Investigation

A test pit investigation was conducted on September 9 and 10, 2019 to assess subsurface conditions. A total of 22 test pits, designated TP101-19 through TP122-19, were advanced throughout the Site, as shown on Figure 1. Test pit locations were determined based on correspondence and drawings provided by the Client. The test pit elevations were surveyed relative (m rel) to the top of nut of a fire hydrant (BM1) located at the end of the existing Site driveway, south of the speed skating oval, which was assigned an elevation of 100 m. All test pit and benchmark locations are shown in Figure 1.

The test pits were excavated using a backhoe, provided by the Client, under the supervision of a Cambium technician. All test pits were terminated on unweathered limestone bedrock at depths ranging from 0.74 m below ground surface (mbgs) and 3.38 mbgs. Dynamic Probe Penetration Test (DPT) values were recorded for the sampled intervals as the number of blows required to drive a 19 mm diameter steel rod 150 mm into the soil with an 8 kg hammer falling 750 mm. The DPT values are used in this report to assess consistency of cohesive soils and relative density of non-cohesive materials.

The encountered soil units were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, future reference, possible laboratory testing, and storage. Open test pits were checked for groundwater and general stability prior to backfilling. The test pits were backfilled with the excavated material and compacted with the excavator bucket and the Site was restored as close to pre-investigation conditions as possible.

The prepared test pit logs are provided in Appendix A. Site soil and groundwater conditions and our geotechnical recommendations are presented in the following sections of this report.

2.2 Physical Laboratory Testing

Physical laboratory testing, including seven (7) Particle Size Distribution Analyses (LS-702,705), was completed on selected samples, and natural moisture content testing (LS-701) was completed on all soil samples. Results are presented in Appendix B and are summarized on the borehole logs and described in the subsequent sections of this report.

3.0 Subsurface Conditions

Subsurface conditions at the Site generally consisted of a layer of topsoil underlain by a layer of sand, silt, sandy silt or silty sand glacial till. Weathered shale and limestone bedrock was encountered in numerous test pits, which was excavated to confirm depths to competent, unweathered limestone bedrock. Bedrock was encountered at depths ranging from 0.74 mbgs to 3.38 mbgs, with the weathered bedrock interbedded in sandy and silty materials for a maximum thickness of 1.24 m. No water seepage was observed during the investigation, other than test pit TP118-19 which observed water seepage along the sidewalls of the excavation at 2.16 mbgs with water pooling at the base of the excavation. The test pit locations are shown in Figure 1. The individual soil units are described in detail below and shown on the test pit logs provided in Appendix A.

3.1 Topsoil

A surficial layer of sandy silt to silt topsoil was observed in all test pit locations other than test pits TP107-19 and TP122-19. The topsoil layer was 200 mm to 500 mm in thickness with frequent rootlets and occasional tree roots encountered. The topsoil was described as dry to moist at the time of the investigation.

3.2 Overburden Soils

A gravelly sand with some silt was encountered in test pits TP102-19 and TP104-19. DPT penetration resistances for relative density ranged from 21 to greater than 30, resulting in a dense to very dense state. The natural moisture content ranged from 1.6% to 3.6% and was described as dry to moist at the time of the investigation.

A silty sand to sand and silt till material was encountered in TP114-19 and TP120-19. Similar soil matrices were encountered throughout the investigation with a trace to some gravel, cobbles and clay. At proposed footing depths, the sandy soils were compact to very dense based on DPT penetration resistances of 4 to greater then 30 per 150 mm of penetration. Based on laboratory results, the natural moisture content of the sandy soils ranged from 3.4% to 20.5% and was described as dry to moist during the investigation. It is also noted that trace rootlets were observed in the sandy soils to a maximum depth of 0.75 mbgs in test pit TP122-19.

A sandy gravelly silt to silt with some sand and a trace to some clay layer was observed in test pits TP109-19 and TP118-19, respectively. Similar soil matrices described as sandy silt or silt and sand

were also encountered. Based on the DPT penetration resistances of 9 to 30 blows per 150 mm of penetration, the silty soils were compact to very dense at proposed footing depths. Test pit TP118-19 observed water seepage at 2.16 mbgs with soil samples at this location having a moisture content of 17.3% and 10.5%. The soil was described as saturated in this location. All other locations were described as dry to moist with natural moisture contents ranging from 5.1% to 12%.

Test pit TP113-19 encountered a layer of gravel with some sand, some silt and a trace of clay from 0.28 mbgs to 1.33 mbgs. Trace rootlets were also observed to a depth of 0.70 mbgs. The gravel soil was compact based on DPT penetration resistances of 8 to 14. At the time of the investigation the soil was described as moist with a natural moisture content of 5.6%.

Laboratory particle size distribution analyses were completed for seven (7) samples of the soil encountered at proposed footing depths. The analysis results, based on the Unified Soil Classification System (USCS) scale, are summarized below in Table 1, with full results provided in Appendix B.

Table 1 Particle Size Distribution Analysis – Overburden Soils

Test Pit	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay	% Moisture Content
TP102-19 GS2	1.2 – 1.9	Gravelly sand	30	56	14		3.6
TP104-19 GS1	0.2 – 2.0	Gravelly sand	29	61	10		1.6
TP109-19 GS1	0.2 – 1.8	Sandy gravelly silt	27	32	33	8	5.1
TP113-19 GS1	0.3 – 1.3	Gravel	53	19	18	9	5.6
TP114-19 GS2	0.5 – 1.6	Silty sand	12	48	32	8	8.0
TP118-19 GS1	0.4 – 1.2	Silt	0	13	77	10	17.3
TP120-19 GS2	1.4 – 2.6	Sand and silt	12	42	37	9	7.9

3.3 Limestone Bedrock

Unweathered limestone bedrock was encountered in all test pit locations. The competent limestone bedrock was encountered at depths between 0.74 mbgs and 3.38 mbgs. The individual depths to weathered and unweathered bedrock for the 22 test pit locations are outlined below in Table 2 and Table 3.

Table 2 Depth and Elevations to Weathered Limestone Bedrock

Test Pit ID	Test Pit Elevation (m rel)	Depth to Weathered Bedrock (mbgs)	Elevation to Weathered Bedrock (m rel)
TP102-19	88.63	1.55	87.08
TP105-19	96.54	0.27	96.27
TP106-19	90.21	0.45	89.76
TP107-19	94.37	0.50	93.87
TP108-19	101.52	0.46	101.06
TP109-19	97.81	1.60	96.21
TP111-19	99.98	0.48	99.50
TP112-19	99.81	1.10	98.71
TP114-19	101.95	1.60	100.35
TP115-19	99.27	0.30	98.97
TP116-19	95.74	1.45	94.29
TP122-19	102.72	0.40	102.32

Table 3 Depth and Elevations to Unweathered Limestone Bedrock

Test Pit ID	Test Pit Elevation (m rel)	Depth to Bedrock (mbgs)	Elevation to Bedrock (m rel)
TP101-19	86.02	1.15	84.87
TP102-19	88.63	1.88	86.75
TP103-19	88.26	1.43	86.83
TP104-19	93.33	1.98	91.35
TP105-19	96.54	0.98	95.56
TP106-19	90.21	0.74	89.47
TP107-19	94.37	0.95	93.42
TP108-19	101.52	0.94	100.58
TP109-19	97.81	2.84	94.97
TP110-19	94.17	3.38	90.79
TP111-19	99.98	1.40	98.58
TP112-19	99.81	1.30	98.51
TP113-19	100.39	2.60	97.79
TP114-19	101.95	2.20	99.75
TP115-19	99.27	1.21	98.06
TP116-19	95.74	2.20	93.54
TP117-19	95.34	3.20	92.14
TP118-19	96.21	2.56	93.65
TP119-19	99.66	1.20	98.46
TP120-19	100.92	2.64	98.28
TP121-19	100.08	2.95	97.13
TP122-19	102.72	0.75	101.97

3.4 Groundwater

Water seepage was observed in test pit TP118-19 at 2.16 mbgs. All other test pits were open and dry upon completion. The recovered soil samples were typically brown in colour, indicating that the water table is below the unweathered limestone bedrock.

It should be noted that soil moisture and groundwater levels are affected by seasonal climatic conditions, due to changing precipitation and evaporation rates.

It is understood that previous mapping of the site had indicated the possibility of some seasonal watercourses in the southwestern portion of the site. Additional test pits were added in the southwestern portion of the site to investigate the possibility of such seasonal watercourses. Based on

the moisture content of the soils sampled and the lack of seepage into the test pits, no evidence of seasonal watercourses was encountered at the site during our test pit investigation and laboratory testing program.

3.5 Water Well Records

A study was conducted to determine the potential impact of the development of the neighbouring well users on 7th Line and Peacock Road in Lakefield, ON. According to the Ministry of Environment, Conservation and Parks (MECP) Water Well Information System (WWIS) there are 16 water well records on 7th Line between Lakefield Road and Peacock Road, located within close proximity to the proposed development, and 6 water well records on or off Peacock Road (see Figure 2). The distribution of well record types and other information is outlined below in Table 4.

Table 4 Water Well Record Information

Location	Well Record Count		Depth (mbgs) (1)	Water Found (mbgs) (1)	Static Water Level (mbgs) (1)	Recommended Flow Rate (gpm) (2)	Shale/Weathered Bedrock Encountered (mbgs)	Unweathered Bedrock Encountered (mbgs)
7th Line, Lakefield (between Lakefield Road and Peacock Road)	16	Avg.	22.23	16.40	5.20	2	2.95	5.89
		Max.	45.72	45.72	12.19	6	4.88	9.45
		Min.	7.92	5.45	1.22	1	1.22	2.74
Peacock Road	6	Avg.	22.76	15.06	6.71	9	0.91	3.45
		Max.	30.48	24.69	12.19	36	0.91	5.49
		Min.	14.33	10.67	3.05	1	0.91	2.44
Total	**22**	**Avg.**	**22.38**	**16.06**	**5.91**	**4**	**2.44**	**5.08**

1. *Metres below ground surface*
2. *Assumed to be US Gallons per minute*

Based on all 22 well records assessed on 7th Line and Peacock Road, bedrock was encountered during the advancement of all 22 wells. The average depth at which shale/weathered bedrock was encountered was 2.44 mbgs. The average depth at which competent limestone bedrock was encountered was 5.08 mbgs.

Groundwater was encountered during drilling between 5.45 mbgs and 45.72 with an average depth of 16.06 mbgs. The static water level, after the pump test, was encountered between 1.22 mbgs and

12.19 mbgs with an average static depth of 5.91 mbgs. All 22 water well records confirm that the groundwater encountered during drilling was within the unweathered limestone bedrock and below the proposed depths for the utility services. Static groundwater after the pump test was above observed above the shale bedrock is only two well records (ID # 5104041 and 5111088). Therefore it was determined that the neighbouring well users, particularly adjacent to the development along 7th Line and Peacock Road, would not be affected by the site servicing trenches for the proposed development at 3358 Lakefield Road, Lakefield, ON.

4.0 Geotechnical Considerations

The following recommendations are based on test pit information and are intended to assist designers. Recommendations should not be construed as providing instructions to contractors, who should form their own opinions about site conditions. It is possible that subsurface conditions beyond the test pit locations may vary from those observed. If significant variations are found before or during construction, Cambium should be contacted so that we can reassess our findings, if necessary.

4.1 Site Preparation

Any and all vegetation and organic soils, including topsoil, should be removed from below the proposed location of any residential units, roadways, and utilities. The exposed subgrade should be inspected by qualified geotechnical engineering personnel prior to the placement of any fill or bedding material. The excavations created through the removal of these materials should be backfilled engineered fill consistent with the recommendations provided below.

It is understood that underground utilities will be installed throughout the development. Competent limestone bedrock in the vicinity of test pits TP102-19, TP104-19, TP109-19, BH110-19, TP113-19 TP114-19, TP117-19, TP118-19, TP120-19, and TP121-19 is greater than 1.8 m depth and it is anticipated that utilities will not be installed much deeper than frost depth (1.5 m). As such, trenches for the utilities will be excavated through predominantly soil with some cobbles and weathered limestone is also anticipated.

4.2 Frost Penetration

Based on climate data and design charts, the maximum frost penetration depth at the Site is estimated at 1.5 mbgs.

Footings for the proposed residential units bearing on undisturbed soils should be situated at or below this depth for frost protection or should be protected.

It is assumed that the pavement structure thickness will be less than 1.5 m, so grading and drainage are important for good pavement performance and life expectancy. Any services should be located below this depth or be appropriately insulated.

4.3 Excavations and Shoring

All excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA). The loose to dense soils located above the water table may be classified as Type 3 soils in accordance with OHSA, with unsupported side slopes no steeper than 1H:1V.

Excavation side slopes should be protected from exposure to precipitation and associated ground surface runoff and should be inspected regularly for signs of instability. If localized instability is noted during excavation or if wet conditions are encountered, the side slopes should be flattened as required to maintain safe working conditions or the excavation sidewalls must be fully supported (shored).

4.4 Dewatering

Groundwater was not encountered within the site, and as such dewatering will generally not required for the proposed development. In wetter seasons, some seepage into excavations should be anticipated from courser lenses and seams within the overburden soils

It should be noted that the groundwater table is influenced by seasonal fluctuations and major precipitation events.

4.5 Backfill and Compaction

Native soils and non-organic soils from the site may be appropriate for use as engineered fill below roadways and structures, provided that the actual or adjusted moisture content at the time of the construction is within a range that permits compaction to 100 percent standard Proctor maximum dry density (SPMDD) as determined by nuclear densometer testing. Engineered fill should be placed in maximum 300 mm thick loose lifts. The weathered bedrock consists of large pieces of rock that are too large to be effectively compacted. Any rocks or boulders greater than 150 mm in diameter should be removed prior to placement as engineered fill. Geotechnical inspections and testing of engineered fill are required to confirm acceptable quality.

Any material imported for use as engineered fill should consist of free-draining granular material meeting the specifications of OPSS 1010 Granular B or an approved equivalent. Trench backfill and cover should be compacted to 98 percent of SPMDD, taking care to keep heavy compaction equipment from damaging the utility.

4.6 Foundation Design

Assuming that the Site is prepared as outlined above, the native silt and sand glacial till soils encountered at 1.5 m depth are competent to support structures on conventional strip and spread footings. The footings will be set in generally compact undisturbed native soils or engineered fill extending to such native soils or bedrock, and may be designed for an allowable bearing capacity of 150 kPa at serviceability limit state (SLS) and 225 kPa at ultimate limit state (ULS). Settlement potential at the noted SLS loadings is less than 25 mm and differential settlement should be less than 10 mm.

Alternatively, the conventional strip and spread footings can be founded on the encountered limestone bedrock, as shallow as 0.74 mbgs. Footings should be placed on unweathered bedrock that is clean of any debris. Footings placed on competent, unweathered bedrock can be designed for an allowable bearing capacity of 800 kPa (ULS). Settlement of footings set on bedrock will be negligible so SLS resistances are not relevant.

The quality of the subgrade or rock should be inspected by Cambium during construction, prior to constructing the footings, to confirm bearing capacity estimates.

4.7 Floor Slabs

Inorganic native soils or engineered fill are considered competent to support floor slab loads. Subject to inspections during construction, existing subgrade soils may also be acceptable to support floor slab loads. Subgrade soils should be leveled, proof-rolled and inspected by a geotechnical engineer. Any soft loose areas identified would need to be subexcavated and replaced with compacted engineered fill as discussed in Section 4.5. Given the anticipated subgrade conditions, to create a stable working surface and to distribute loadings, all slabs-on-grade should be constructed on a minimum of 200 mm of OPSS 1010 Granular A compacted to 100 percent of SPMDD.

4.8 Pavement Design

The performance of the pavement is dependent upon proper subgrade preparation. All topsoil and organic materials should be removed down to native material and backfilled with approved engineered fill or native material, compacted to 98 percent SPMDD. The subgrade should be proof rolled and inspected by a Geotechnical Engineer. Any areas where rutting or appreciable deflection is noted should be subexcavated and replaced with suitable fill. The fill should be compacted to at least 98 percent SPMDD.

The recommended minimum pavement structure designs have been developed assuming the heavy duty pavement structure is appropriate for the roadway and any other areas where some truck traffic is anticipated, while the light duty pavement structure is intended for parking areas and driveways. The recommended minimum pavement structure is provided in Table 5.

Table 5 Recommended Minimum Pavement Structure

Pavement Layer	Heavy Duty	Light Duty
Surface Course Asphalt	40 mm HL3 or HL4	50 mm HL3 or HL4
Binder Course Asphalt	50 mm HL8	
Granular Base	150 mm OPSS 1010 Granular A	150 mm OPSS 1010 Granular A
Granular Subbase	400 mm OPSS 1010 Granular B	300 mm OPSS 1010 Granular B

Material and thickness substitutions must be approved by the Design Engineer.

The thickness of the subbase layer could be increased at the discretion of the Engineer, to accommodate site conditions at the time of construction, including soft or weak subgrade soil replacement.

Compaction of the subgrade should be verified by the Engineer prior to placing the granular fill. Granular layers should be placed in 200 mm maximum loose lifts and compacted to at least 98 percent of SPMDD (ASTM D698) standard. The granular materials specified should conform to OPSS standards, as confirmed by appropriate materials testing.

The final asphalt surface should be sloped at a minimum of 2 percent to shed runoff. Any abutting pavements should be sawcut to provide clean vertical joints with new pavement areas.

4.9 Buried Utilities

Trench excavations should generally consider Type 3 soil conditions which can be excavated with unsupported side slopes no steeper than 1H:1V. Significant groundwater seepage into shallow trench excavations is not anticipated, but if encountered, should be controllable using filtered sumps and pumps within the excavations.

The bedding and cover material for any buried utilities should consist of OPSS 1010-3 Granular A or B Type II, placed in accordance with pertinent Ontario Provincial Standard Drawings (OPSD 802.013). The bedding and cover material shall be placed in maximum 200 mm thick lifts and should be compacted to at least 98 percent of SPMDD. The cover material shall be a minimum of 300 mm over

the top of the pipe and compacted to 98 percent SPMDD, taking care not to damage the utility pipes during compaction.

If wet or saturated conditions exist within any utility excavation, consideration should be given to using 19 mm diameter crushed clear stone wrapped in a geotextile filter fabric as pipe bedding.

4.10 Frost Heaving

It should be noted that any native soils not removed to the depth of bedrock or guarded by properly installed insulation may be susceptible to frost and the resultant damage due to the heaving. This is extremely important in the instance of placing any piping, as local frost heaving may cause displacement of the line, resulting in serious damage. If excavations for roads are not to the maximum depth of frost penetration, and frost susceptible fines remain, some frost heaving may occur. The damage due to frost heaving in roads is generally not critical, and likely manageable through annual maintenance, or maintenance as required.

4.11 Design Review and Inspections

Testing and inspections should be carried out during construction operations to examine and approve subgrade conditions, fill material, compaction of pipe bedding, trench backfill, and granular base courses.

We should be contacted to review and approve design drawings, prior to tendering or commencing construction, to ensure that all pertinent geotechnical-related factors have been addressed. It is important that onsite geotechnical supervision be provided at this site for excavation and backfill procedures, deleterious soil removal, subgrade inspections and compaction testing.

5.0 Closing

We trust the information in this report is sufficient for your current needs. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (705) 742-7900.

Respectfully submitted,

CAMBIUM INC.

Stuart Baird, M.Eng., P.Eng.
General Manager – Geotechnical

Juan Monroy, B.Sc.E, EIT
Project Coordinator

SEB/jdm

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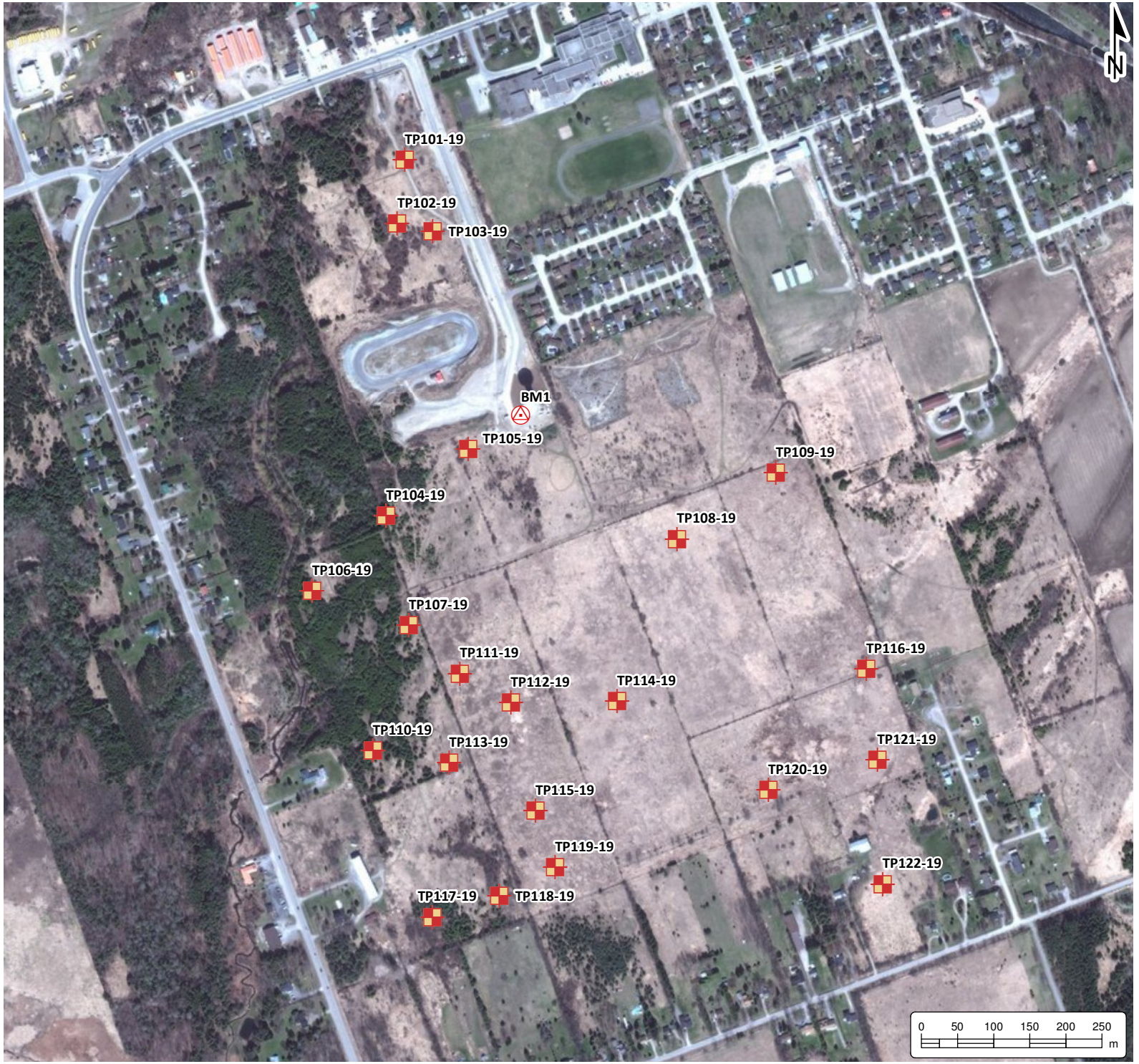
Appended Figures



TEST PIT INVESTIGATION AND REPORT

TRIPLE T HOLDINGS
3358 Lakefield Road,
Lakefield, Ontario

LEGEND

- Benchmark
- Test Pit Location

Notes:
- Benchmark is the Top Nut of Fire Hydrant with an assumed elevation of 100.0m rel.
- Parcel fabric and 2013 aerial imagery obtained March 2017 from the County of Peterborough online GIS.
- Base mapping features are © Queen's Printer of Ontario, 2015 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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TEST PIT LOCATION PLAN

Project No.: 5874-001		Date: September 2019	
		Rev.:	
Scale: 1:7,500		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: JM	Figure:	1

O:\GIS\project_MXDs\5800-5899\5874-001 Triple T Holdings - Test Pit Investigation - 3358 Lakefield Road, Lakefield\2019-09-03 FIG 1 Proposed Test Pit Location Plan.mxd

O:\GIS\MXDs\5800-5899\5874-001 Triple T Holdings - Test Pit Investigation - 3358 Lakefield Road, Lakefield\20200-09-16 FIG 2 - Water Well Records.mxd

GEOTECHNICAL INVESTIGATION
TRIPLE T HOLDINGS INC.
3358 Lakefield Road,
Lakefield, Ontario

LEGEND

Water Well Record

Notes:
- Benchmark is the Top Nut of Fire Hydrant with an assumed elevation of 100.0m rel.
- Parcel fabric and 2013 aerial imagery obtained March 2017 from the County of Peterborough online GIS.
- Base mapping features are © Queen's Printer of Ontario, 2015 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
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WATER WELL RECORDS

Project No.: 5874-001		Date: September 2020	
		Rev.:	
Scale: 1:6,000		Projection: NAD 1983 UTM Zone 17N	
Created by: TLC	Checked by: JM	Figure:	2

Appendix A
Test Pit Logs

TABLE 1: TEST PIT LOGS
3358 Lakefield Road, Lakefield - Triple T Holdings Test Pit Investigation
Technician: Andrew Romig
Cambium Reference No. 5874-001
Completed: Sept. 9, 10 / 2019

Test Pit ID	Depth (mbgs[1])	Soil Sample	Material Description	Depth (m)	DPT[2] (Blows/150 mm)
TP101-19 17T 716400.0 m E, 4921920.0 m N 86.02 m rel	0-0.30 0.30-1.15	GS1	Dark brown, sandy silt, some gravel, some rootlets, dry to moist Light brown, silty sand, some gravel, moist Test pit terminated at 1.15 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15	45/150
TP102-19 17T 716390.0 m E, 4921832.0 m N 88.63 m rel	0-0.32 0.32-1.2 1.2-1.85 @1.55	GS1 GS2	Dark brown, sand and silt, trace rootlets, compact, moist Light brown, gravelly sand, some silt, compact, moist Same as above GSA GS2: 30% Gravel, 56% Sand, 14% Silt & Clay -interbedded in weathered bedrock Test pit terminated at 1.88 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 0.30-0.45 1.20-1.35 1.35-1.50	9 17 30/125 21 30/125
TP103-19 17T 716438.3 m E, 4921820.7 m N 88.26 m rel	0-0.20 0.20-1.43	GS1	Dark brown, sandy silt, some rootlets, compact, moist Light brown, sandy silt, some gravel, some cobbles, compact, moist Test pit terminated at 1.43 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 0.30-0.45 0.45-0.60	10 10 14 30/100
TP104-19 17T 716382.8 m E, 4921391.8 m N 93.33 m rel	0-0.24 0.24-1.98	GS1	Dark brown, sandy silt, some rootlets, trace tree roots, compact, moist Light brown, gravelly sand, trace silt, dense, dry to moist GSA GS1: 29% Gravel, 61% Sand, 10% Silt & Clay Test pit terminated at 1.98 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 1.00-1.15 1.15-1.30	10 30/125 28 30/75
TP105-19 17T 716487.5 m E, 4921518.2 m N 96.54 m rel	0-0.27 0.27-0.98	GS1	Brown, sandy silt, some roolets, compact, dry to moist Light brown, sand, fine grained, some gravel, trace to some silt, compact to dense, moist -interbedded in weathered bedrock Test pit terminated at 0.98 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 0.30-0.15	8 12 30/75
TP106-19 17T 716285.9 m E, 4921317.5 m N 90.21 m rel	0-0.74 @0.45	GS1	Brown, silt, some sand, some rootlets, trace tree roots, loose to compact, moist -interbedded in weathered bedrock Test pit terminated at 0.74 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 0.30-0.45	2 10 30/150
TP107-19 17T 716397.3 m E, 4921283.7 m N 94.37 m rel	0-0.95 @0.50	GS1	Dark brown, silt, some rootlets, trace sand, compact, moist to wet -interbedded in weathered bedrock Test pit terminated at 0.95 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30	8 30/150
TP108-19 17T 716776.6 m E, 4921395.2 m N 101.52 m rel	0-0.28 0.28-0.94 @0.46	GS1	Dark brown, sandy silt, some rootlets, loose, moist Light brown, sandy silt, trace gravel, trace rootlets, loose to compact, moist -interbedded in weathered bedrock Test pit terminated at 0.94 mbgs in unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 0.30-0.45 0.45-0.60	3 4 6 30/125
TP109-19 17T 716914.0 m E, 4921487.3 m N 97.81 m rel	0-0.20 0.20-1.8 @1.60 1.8-2.87	GS1 GS2	Dark brown, silty sand, trace rootlets, loose, dry to moist Light brown, sandy gravelly silt, trace clay, trace cobbles, loose to compact, dry to moist GSA GS1: 27% Gravel, 32% Sand, 33% Silt, 8% Clay -interbedded in weathered bedrock Dark grey, sandy silt, some gravel, trace cobbles, very dense Test pit terminated at 2.84 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 0.30-0.45 0.45-0.60 0.60-0.75	2 6 8 14 32
TP110-19 17T 716356.0 m E, 4921102.0 m N 94.17 m rel	0-0.30 0.30-1.30 1.30-3.38	GS1 GS2	Dark brown, silty sand, some gravel, trace rootlets, compact, dry to moist Light brown, silty sand, some gravel, some cobbles, compact to dense, dry to moist Light brown, sand, some gravel, some cobbles, trace to some silt, dense, moist Test pit terminated at 3.38 mbgs on unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30 0.30-0.45 0.45-0.60 0.60-0.75 0.75-0.90 1.30-1.45 1.45-1.60	26 12 12 16 20 39 9 30/125
TP111-19 17T 716476.6 m E, 4921208.4 m N 99.98 m rel	0-0.33 0.33-1.40 @0.48	GS1	Dark brown, sandy silt, some rootlets, trace gravel, compact, dry to moist Brown, sand, some silt, some gravel, compact to dense, moist -interbedded in weathered bedrock Test pit terminated at 1.40 mbgs in unweathered bedrock No water seepage observed in test pit	0-0.15 0.15-0.30	14 30/125

1. mbgs = metres below ground surface
2. Dynamic probe penetration test, consisting of driving a 19 mm diameter steel rod 150 mm into the soil with an 8 kg hammer falling 750 mm.

TABLE 1: TEST PIT LOGS
3358 Lakefield Road, Lakefield - Triple T Holdings Test Pit Investigation
Technician: Andrew Romig
Cambium Reference No. 5874-001
Completed: Sept. 9, 10 / 2019

Test Pit ID	Depth (mbgs[1])	Soil Sample	Material Description	Depth (m)	DPT[2] (Blows/150 mm)
Test Pit ID	Depth (mbgs[1])	Soil Sample	Material Description	Depth (m)	DPT[2] (Blows/150 mm)
TP112-19	0-0.30	GS1	Dark brown, silty sand, some gravel, some rootlets, compact, moist	0-0.15	30/150
	0.30-1.30	GS2	Dark brown, silt and sand, some gravel, dense, moist		
17T 716545.9 m E, 4921168.5 m N	@1.10		-interbedded in weathered bedrock		
99.81 m rel					
			Test pit terminated at 1.30 mbgs on unweathered bedrock		
			No water seepage observed in test pit		
TP113-19	0-0.28		Dark brown, silt, some sand, some rootlets, compact, moist	0-0.15	7
				0.15-0.30	10
	0.28-1.33	GS1	Brown, gravel, some sand, some silt, trace clay, trace cobbles, trace rootlets (to 0.70 mbgs), compact, moist	0.30-0.45	14
			GSA GS1: 53% Gravel, 19% Sand, 18% Silt, 9% Clay		
17T 716461.4 m E, 4921085.5 m N	1.33-2.60	GS2	Light brown, sand and silt, some gravel, some cobbles, compact to dense, moist	0.45-0.60	12
100.39 m rel				0.60-0.75	14
			Test pit terminated at 2.60 mbgs on unweathered bedrock	0.75-0.90	8
			No water seepage observed in test pit	1.35-1.50	10
				1.50-1.65	30/125
TP114-19	0-0.32		Dark brown, silty sand, some rootlets, dry to moist	0-0.15	1
				0.15-0.30	5
	0.32-0.50	GS1	Brown, sandy silt, loose to compact, moist	0.30-0.45	6
			Light brown, silty sand, some gravel, some cobbles, trace clay, loost to compact, moist		
17T 716693.7 m E, 4921169.0 m N	0.50-1.60	GS2	GSA GS2: 12% Gravel, 48% Sand, 32% Silt, 8% Clay	0.45-0.60	5
101.95m rel	1.60-2.20	GS3	Same as above, moist to wet, interbedded in weathered bedrock	0.60-0.75	4
				0.75-0.90	14
			Test pit terminated at 2.20 mbgs on unweathered bedrock	0.90-1.05	24
			No water seepage observed in test pit	1.60-1.75	11
				1.75-1.90	30/125
TP115-19	0-0.25			0-0.15	4
			Dark brown, sandy silt, some rootlets, compact, moist	0.15-0.30	17
	0.25-1.21	GS1	Light brown, silty sand, trace gravel, dense, moist	0.30-0.45	21
17T 716594.0 m E, 4921024.9 m N	@0.30		-interbedded in weathered bedrock	0.45-0.60	30/125
99.27 m rel					
			Test pit terminated at 1.21 mbgs on unweathered bedrock		
			No water seepage observed in test pit		
TP116-19	0-0.23			0-0.15	2
			Dark brown, silt, some sand, trace gravel, trace rootlets, loose to compact, dry to moist	0.15-0.30	9
	0.23-2.20	GS1	Light brown, silt, some sand to sandy, trace gravel, trace cobbles, compact, moist	0.30-0.45	13
17T 717038.4 m E, 4921216.1 m N	@1.45		-interbedded in weathered bedrock	0.45-0.60	11
95.74 m rel				0.60-0.75	20
			Test pit terminated at 2.20 mbgs on unweathered bedrock	0.75-0.90	30/125
			No water seepage observed in test pit	1.30-1.45	9
				1.45-1.60	17
				1.60-1.75	24
				1.75-1.90	26
TP117-19	0-0.34			0-0.15	9
			Dark brown, silt, trace sand, some rootlets, compact, moist	0.15-0.30	13
	0.34-1.8	GS1	Light brown, sand, some silt, trace gravel, dense, moist	0.30-0.45	26
17T 716440.6 m E, 4920901.9 m N	1.8-3.2	GS2	Light brown, silty sand, some gravel, trace cobbles, dense, moist	0.45-0.60	30
95.34 m rel				1.20-1.35	4
			Test pit terminated at 3.20 mbgs on unweathered bedrock	1.35-1.50	19
			No water seepage observed in test pit	1.50-1.65	30/125
TP118-19	0-0.40		Dark brown, silt, some rootlets, compact, moist	0-0.15	13
				0.15-0.30	12
	0.40-2.15	GS1	Light brown, silt, some sand, some clay, compact, moist	0.30-0.45	30
			GSA GS1: 0% Gravel, 13% Sand, 77% Silt, 10% Clay		
17T 716507.6 m E, 4920915.5 m N	2.15-2.56	GS2	Light brown, sandy silt, some gravel, compact to dense, saturated	1.20-1.35	30/50
96.21 m rel					
			Test pit terminated at 2.56 mbgs on unweathered bedrock		
			Water seepage observed at 2.16 mbgs		
TP119-19	0-0.44			0-0.15	10
			Dark brown, silt, some rootlets, compact moist	0.15-0.30	13
	0.44-1.20	GS1	Light brown, sand, some silt, some gravel, trace rootlets, compact to dense, dry to moist	0.30-0.45	23
17T 716609.7 m E, 4920940.9 m N				0.45-0.60	30/125
99.66 m rel			Test pit terminated at 1.20 mbgs on unweathered bedrock		
			No water seepage observed in test pit		
TP120-19	0-0.20			0-0.15	12
			Dark brown, sandy silt, some rootlets, compact, moist	0.15-0.30	18
	0.20-1.30	GS1	Light brown, silt, some sand, trace gravel, dense, moist	0.30-0.45	21
			Dark brown, sand and silt, some gravel, trace clay, compact, moist		
17T 716905.1m E, 4921040.3 m N	1.30-2.64	GS2	GSA GS2: 12% Gravel, 42% Sand, 37% Silt, 9% Clay	0.45-0.60	23
100.92 m rel				0.60-0.75	30/100
			Test pit terminated at 2.64 mbgs on unweathered bedrock	1.20-1.35	4
			No water seepage observed in test pit	1.35-1.50	5
				1.50-1.65	3
				1.65-1.80	6
				1.80-1.95	10
				1.95-2.10	21
TP121-19	0-0.50		Dark brown, silt and sand, some rootlets, trace gravel, compact, moist	0-0.15	6
				0.15-0.30	19
	0.50-1.80	GS1	Light brown, silt and sand, some cobbles, trace rootlets, dense, trace gravel	0.30-0.45	26
17T 717053.8 m E, 4921089.2 m N	1.80-2.95	GS2	Light brown, silty sand, some gravel, some cobbles, dense, moist	0.45-0.60	30/125
100.08 m rel				1.20-1.35	15
			Test pit terminated at 2.95 mbgs on unweathered bedrock	1.35-1.50	24
			No water seepage observed in test pit	1.50-1.65	24
				1.65-1.80	30/125
TP122-19	0-0.75	GS1	Dark brown, silty sand, trace to some rootlets, trace gravel, compact to dense, dry to moist	0-0.15	12
	@0.40		-interbedded in weathered bedrock	0.15-0.30	30/50
17T 717062.0 m E, 4920916.3 m N					
102.72 m rel			Test pit terminated at 0.75 mbgs on unweathered bedrock		
			No water seepage observed in test pit		

1. mbgs = metres below ground surface
2. Dynamic probe penetration test, consisting of driving a 19 mm diameter steel rod 150 mm into the soil with an 8 kg hammer falling 750 mm.

Appendix B
Physical Laboratory Results

Grain Size Distribution Chart

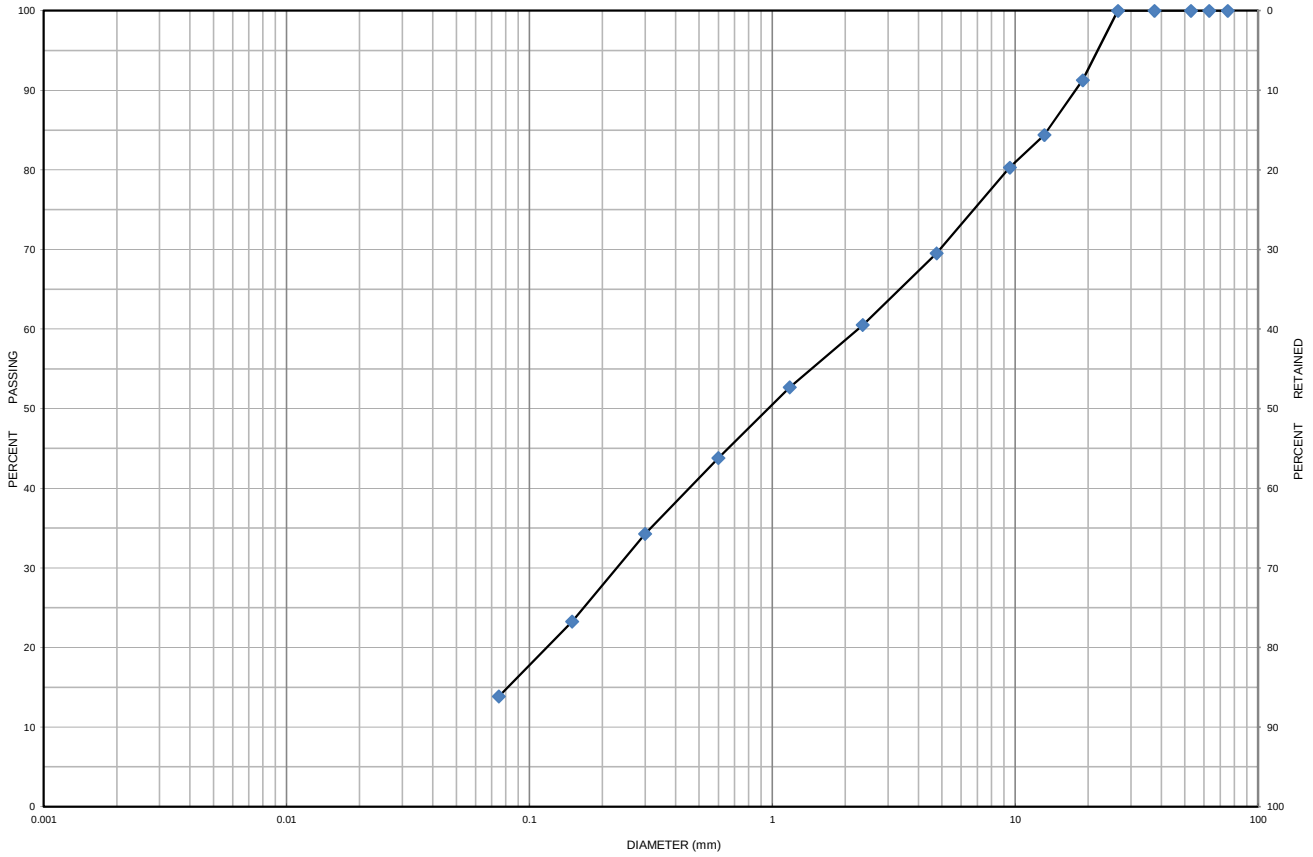
Project Number: *5874-001* **Client:** *Triple T Holdings*

Project Name: *Geotechnical Investigations 3358 Lakefield Road*

Sample Date: *September 9, 2019* **Sampled By:** *Andrew Romig - Cambium Inc.*

Location: *TP 102-19 GS 2* **Depth:** *1.2 m to 1.9 m* **Lab Sample No:** *S-19-0749*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 102-19	GS 2	1.2 m to 1.9 m	30	56	14		3.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravelly Sand some Silt	SP	2.300	0.240	-	-	-

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Grain Size Distribution Chart

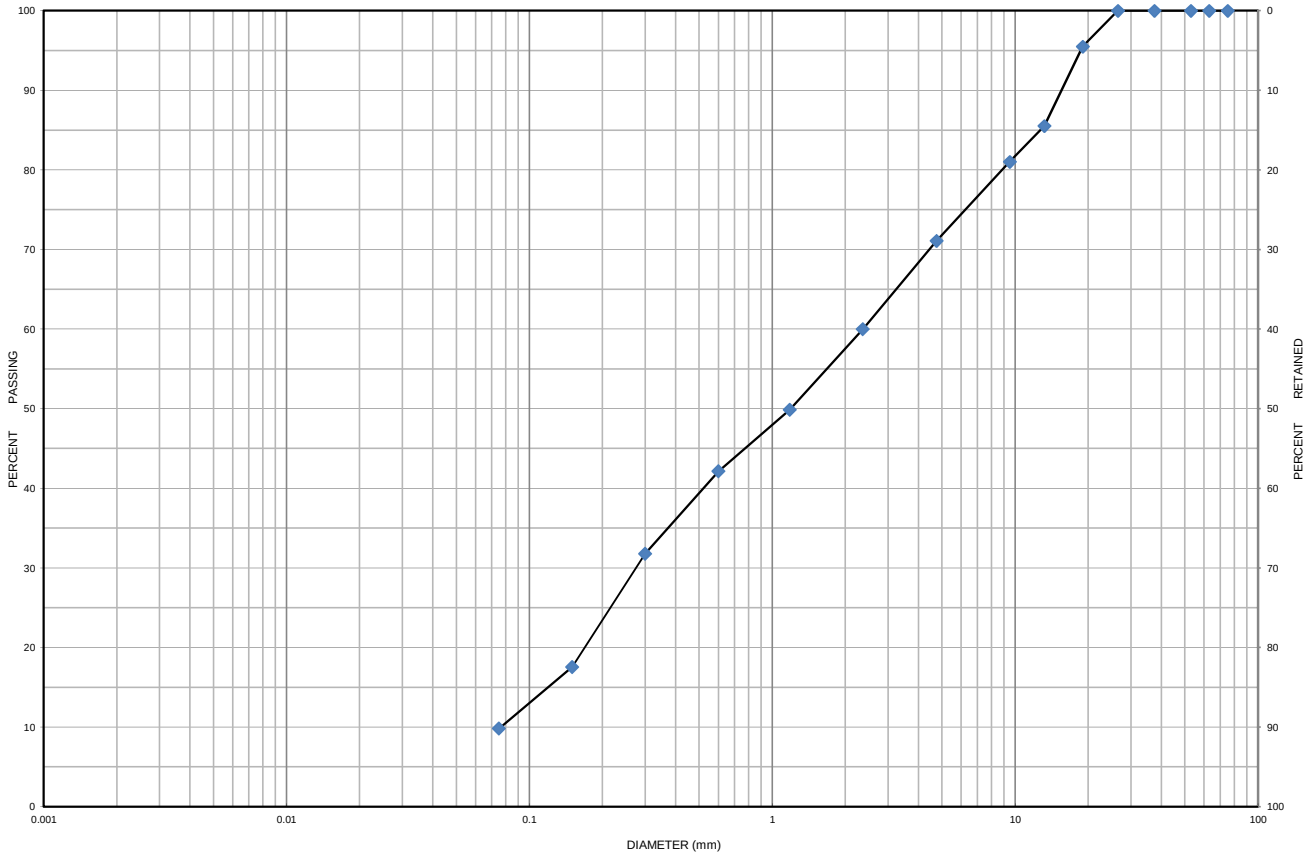
Project Number: *5874-001* **Client:** *Triple T Holdings*

Project Name: *Geotechnical Investigations 3358 Lakefield Road*

Sample Date: *September 9, 2019* **Sampled By:** *Andrew Romig - Cambium Inc.*

Location: *TP 104-19 GS 1* **Depth:** *0.2 m to 0.9 m* **Lab Sample No:** *S-19-0750*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 104-19	GS 1	0.2 m to 0.9 m	29	61	10		1.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravelly Sand trace Silt	SP	2.400	0.280	0.076	31.58	0.43

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Grain Size Distribution Chart

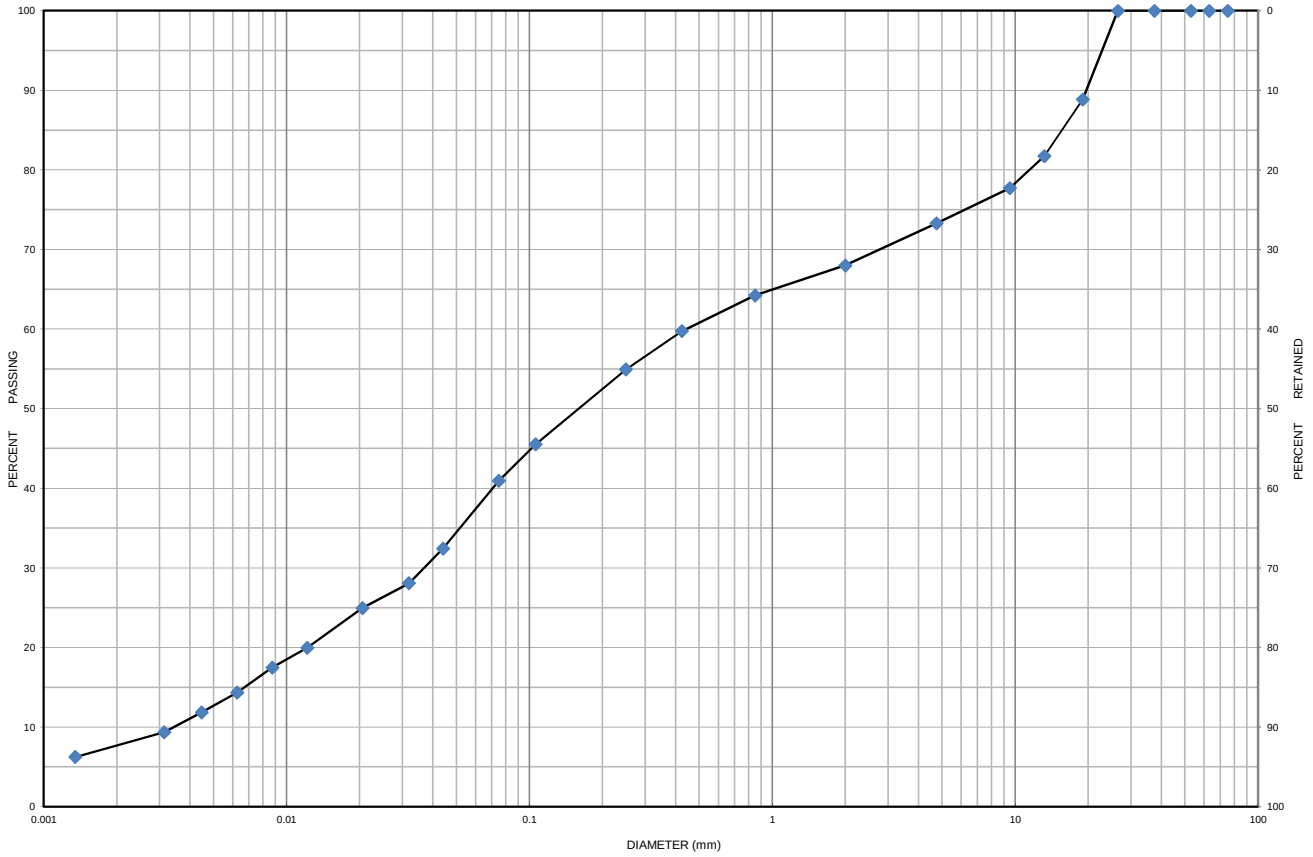
Project Number: *5874-001* **Client:** *Triple T Holdings*

Project Name: *Geotechnical Investigations 3358 Lakefield Road*

Sample Date: *September 9, 2019* **Sampled By:** *Andrew Romig - Cambium Inc.*

Location: *TP 109-19 GS 1* **Depth:** *0.2 m to 1.1 m* **Lab Sample No:** *S-19-0751*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 109-19	GS 1	0.2 m to 1.1 m	27	32	41		5.1

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Gravelly Silt trace Clay	ML	0.440	0.037	0.0034	129.41	0.92

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Grain Size Distribution Chart

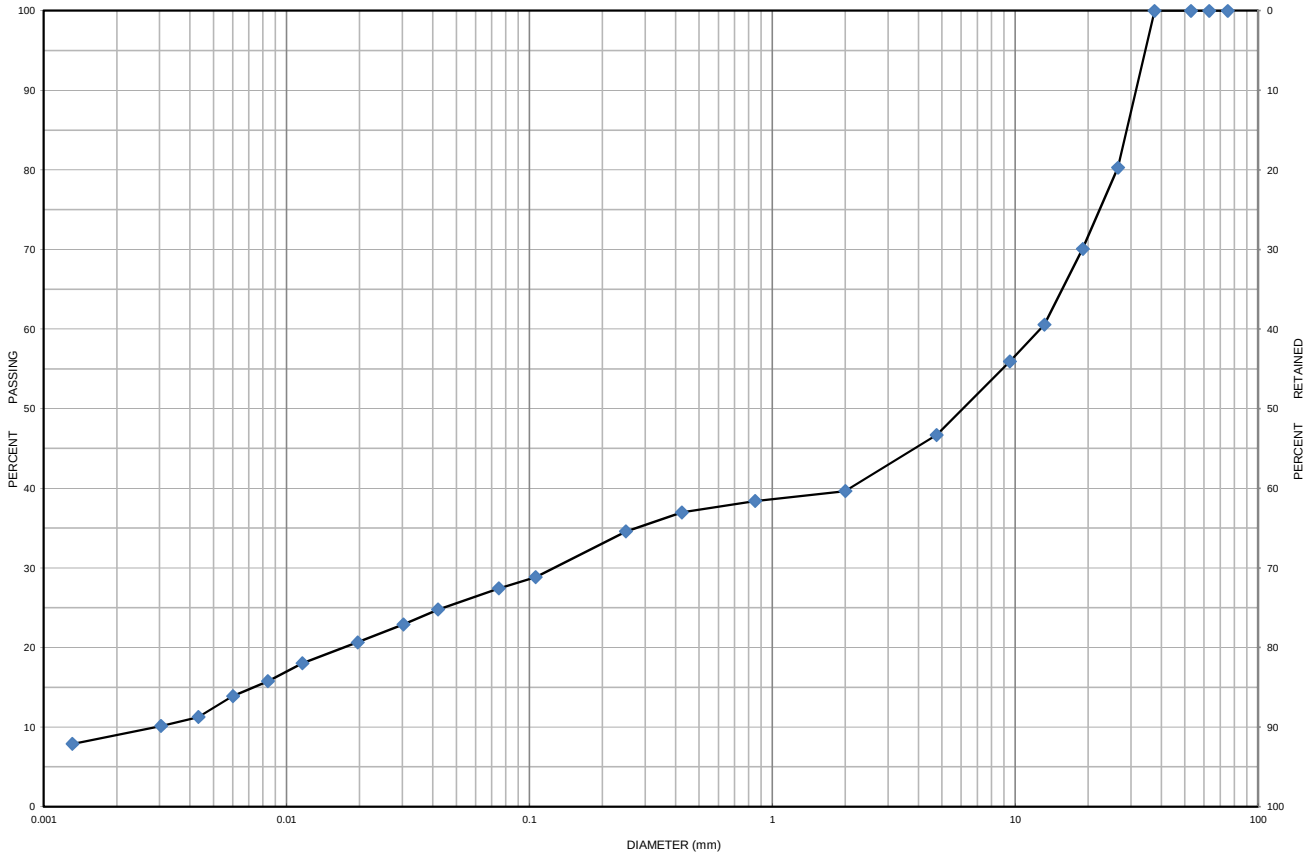
Project Number: *5874-001* **Client:** *Triple T Holdings*

Project Name: *Geotechnical Investigations 3358 Lakefield Road*

Sample Date: *September 9, 2019* **Sampled By:** *Andrew Romig - Cambium Inc.*

Location: *TP 113-19 GS 1* **Depth:** *0.3 m to 1.3 m* **Lab Sample No:** *S-19-0752*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 113-19	GS 1	0.3 m to 1.3 m	53	19	28		5.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravel some Sand some Silt trace Clay	GP	13.200	0.140	0.003	4400.00	0.49

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Grain Size Distribution Chart

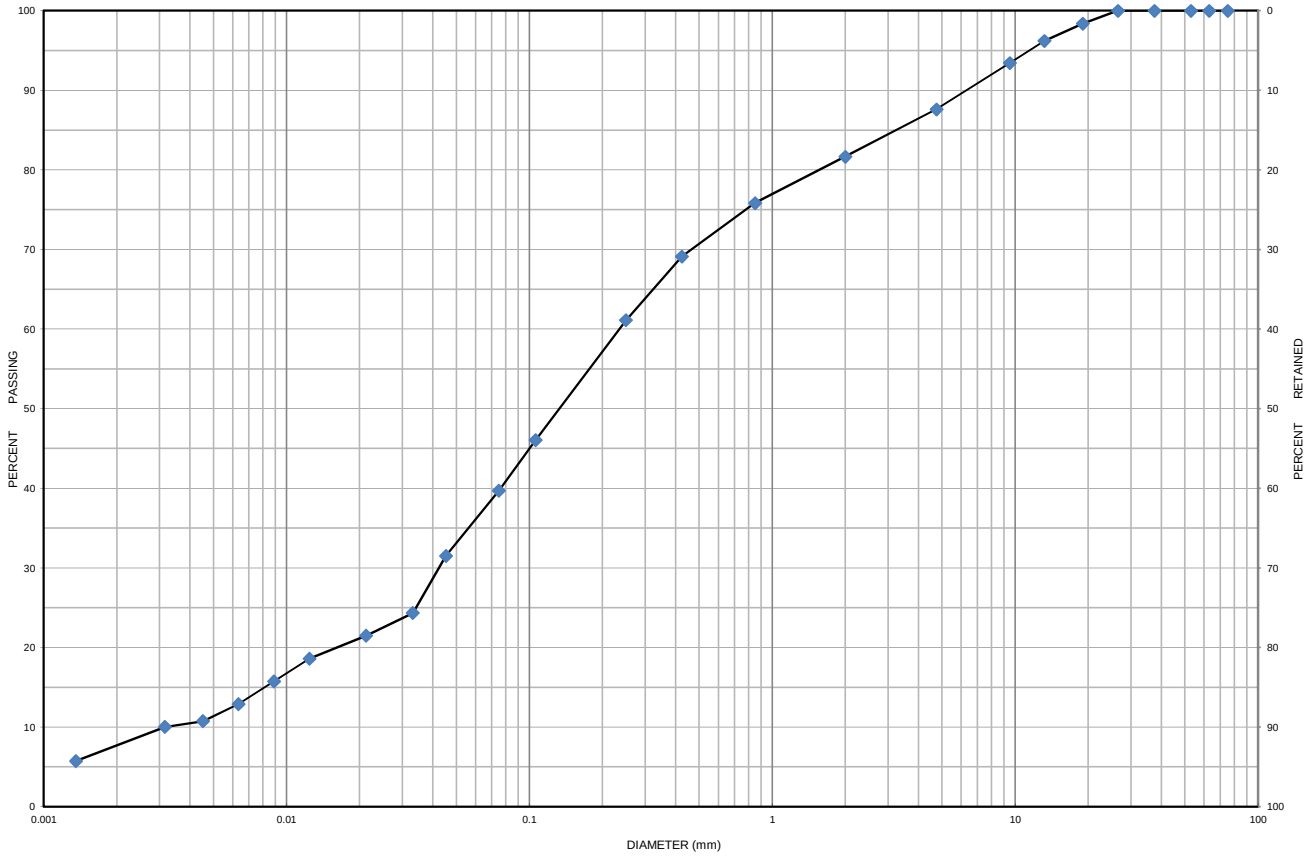
Project Number: *5874-001* **Client:** *Triple T Holdings*

Project Name: *Geotechnical Investigations 3358 Lakefield Road*

Sample Date: *September 9, 2019* **Sampled By:** *Andrew Romig - Cambium Inc.*

Location: *TP 114-19 GS 2* **Depth:** *0.5 m to 1.6 m* **Lab Sample No:** *S-19-0753*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 114-19	GS 2	0.5 m to 1.6 m	12	48	40		8.0

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Gravel trace Clay	SM	0.230	0.042	0.0032	71.88	2.40

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Grain Size Distribution Chart

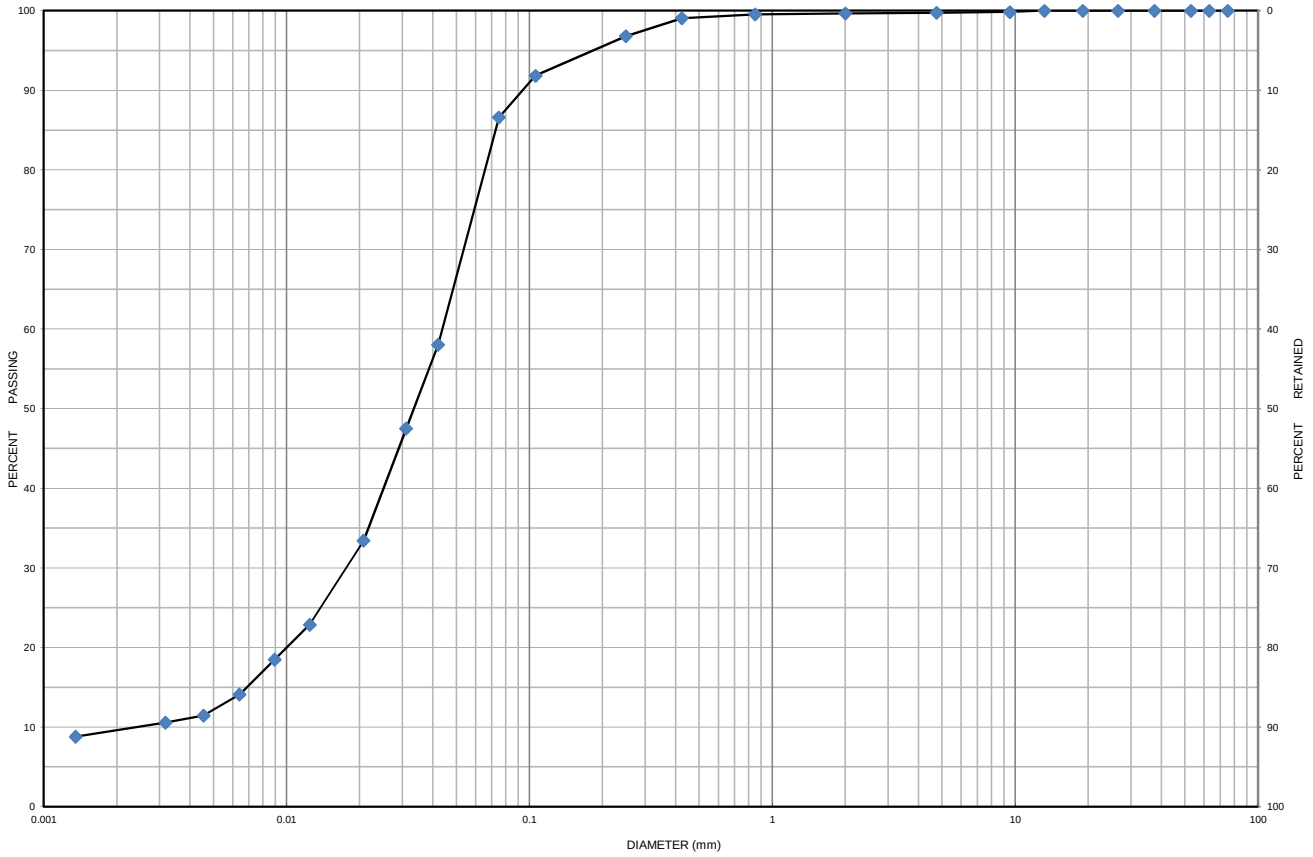
Project Number: *5874-001* **Client:** *Triple T Holdings*

Project Name: *Geotechnical Investigations 3358 Lakefield Road*

Sample Date: *September 9, 2019* **Sampled By:** *Andrew Romig - Cambium Inc.*

Location: *TP 118-19 GS 1* **Depth:** *0.4 m to 1.2 m* **Lab Sample No:** *S-19-0754*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 118-19	GS 1	0.4 m to 1.2 m	0	13	87		17.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt some Sand trace Clay	ML	0.044	0.018	0.0027	16.30	2.73

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Grain Size Distribution Chart

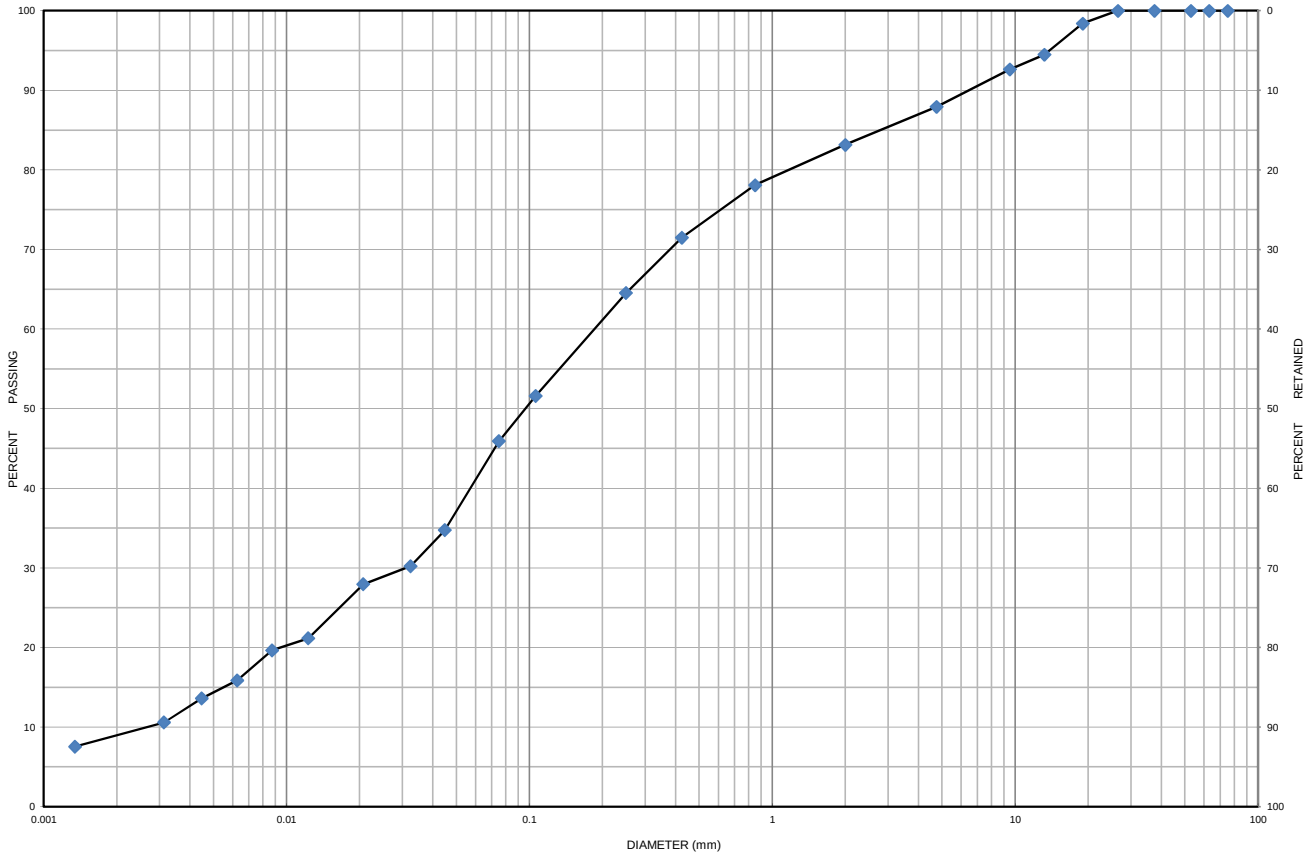
Project Number: *5874-001* **Client:** *Triple T Holdings*

Project Name: *Geotechnical Investigations 3358 Lakefield Road*

Sample Date: *September 9, 2019* **Sampled By:** *Andrew Romig - Cambium Inc.*

Location: *TP 120-19 GS 2* **Depth:** *1.4 m to 2.6 m* **Lab Sample No:** *S-19-0755*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 120-19	GS 2	1.4 m to 2.6 m	12	42	46		7.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand and Silt some Gravel trace Clay	SW-ML	0.180	0.031	0.0028	64.29	1.91

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