



REPORT

Geotechnical Investigation

Dufferin Transfer Station, City of Toronto, Ontario

Submitted to:

Mr. Dimitar Dimitrov

Senior Project Manager – Capital Delivery
Infrastructure & Resource Management
Solid Waste Management Services
City of Toronto
35 Vanley Crescent, Building

Submitted by:

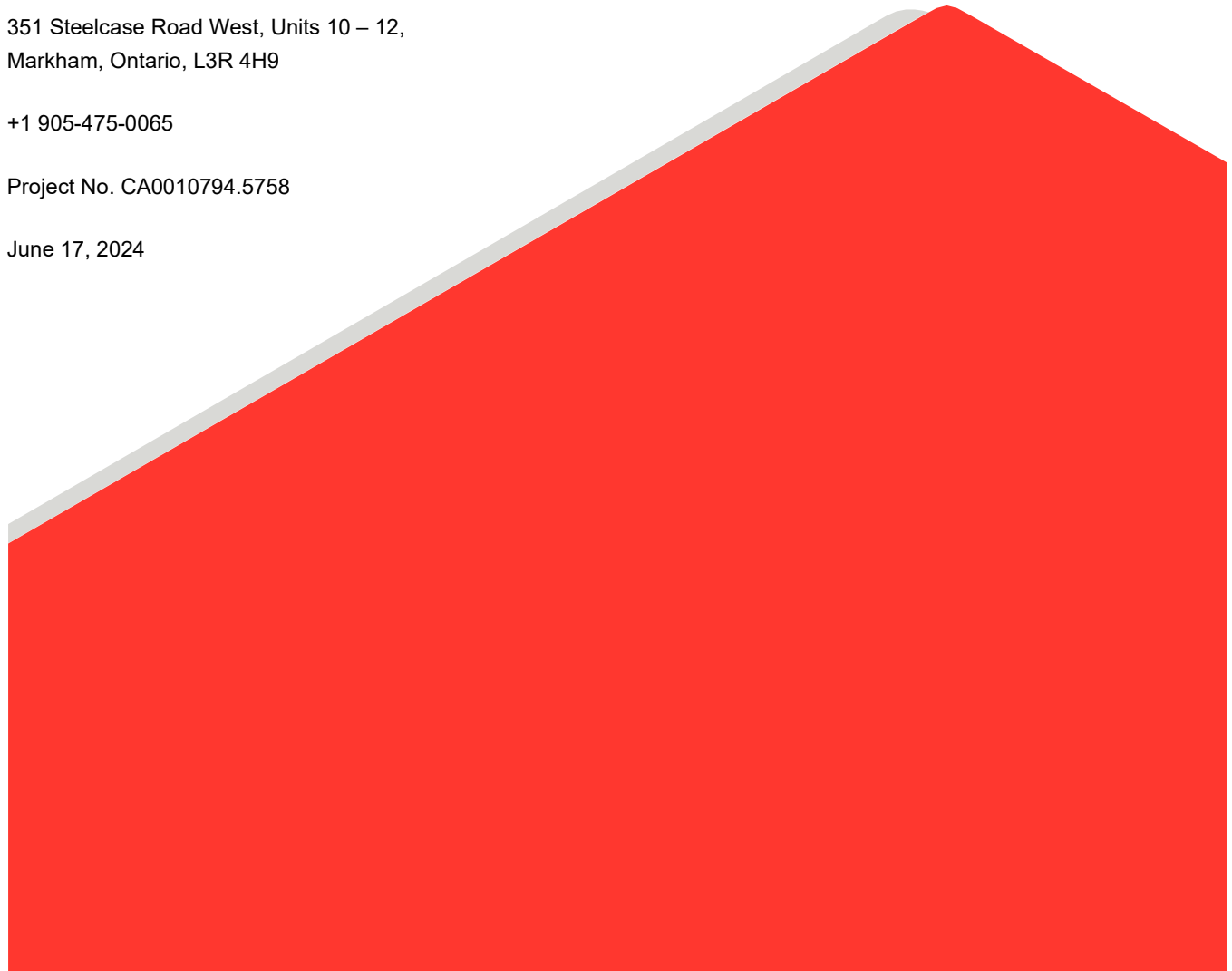
WSP Canada Inc.

351 Steelcase Road West, Units 10 – 12,
Markham, Ontario, L3R 4H9

+1 905-475-0065

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Mr. Dimitar Dimitrov
Senior Project Manager – Capital Delivery
Infrastructure & Resource Management
Solid Waste Management Services
City of Toronto
35 Vanley Crescent, Building 275
Toronto, Ontario
M3J 2B7

GEOTECHNICAL INVESTIGATION FOR DUFFERIN TRANSFER STATION, CITY OF TORONTO, ONTARIO

Dear Mr. Dimitar Dimitrov,

WSP is pleased to provide our Geotechnical Investigation to support the proposed pavement rehabilitation and bunker / prefabricated building design at the Dufferin Transfer Station in the City of Toronto, Ontario.

The purpose of the investigation is to determine the existing subsurface conditions at the site and provide geotechnical recommendations in support of the detailed design of the proposed structures.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

Yours sincerely,
WSP Canada Inc.



Michael Hu, M.Eng., P.Eng.
Geotechnical Engineer

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1.0 INTRODUCTION

WSP Canada Inc. (WSP) was retained by the City of Toronto (City) to undertake a geotechnical investigation for pavement rehabilitation and design of a bunker and a prefabricated building at the Dufferin Transfer Station (hereafter referenced as the Site). The location of the Site is presented on Figure 1, in the Figures section of this report.

The geotechnical report summarizes the investigation procedures and findings, and provides information on the existing pavement structure, subsurface soil, and groundwater conditions within the Site. Based on our current understanding of the project and the investigation findings, WSP has provided geotechnical recommendations for consideration for the proposed scope of work at the Site.

2.0 INVESTIGATION PROCEDURES

2.1 FIELD INVESTIGATION

In accordance with our proposed scope of work, a total of thirteen borehole locations were predetermined and established in the field by a representative of WSP. The specific borehole locations were selected to avoid conflicts with above ground and underground utilities, including water, sewer, gas, hydro, telephone, and cable locations that were verified in the field using Ontario One-call. Alternative borehole locations were also staked out in the field to mitigate the potential for utility conflicts. In addition, WSP retained the services of a private utility locate contractor to clear the specific borehole locations at the Site.

In total, fourteen boreholes were advanced at the site. The boreholes are designated as BH23-01 to BH23-11, BH23-12A, BH23-12B and BH23-13. The drilling was carried out between February 10, 2024, and February 20, 2024. Borehole BH23-12A encountered auger refusal at a depth of about 6.7 below existing ground surface (mbgs); as such, an additional borehole (BH23-12B) was advanced to provide input toward the underlying native soil. To evaluate the pavement quality and asbestos content, the existing pavement structure was cored at eleven borehole locations; the core samples are designated as PC23-01 to PC23-11. The pavement coreholes were 150 mm in diameter and extended to the bottom of the existing asphalt at each location. The approximate borehole and corehole locations are shown on Figure 1.

Boreholes BH23-01 to BH23-11 were advanced to a depth of approximately 1.5 mbgs; Borehole BH23-12A encountered refusal at a depth of approximately 6.7 mbgs; Borehole BH23-12B was advanced to a depth of approximately 9.6 mbgs; and Borehole BH23-13 was advanced to a depth of approximately 6.5 mbgs. All boreholes were advanced using a truck-mounted drilling rig supplied by a licensed drilling subcontractor. A qualified WSP geotechnical engineering technician supervised the drilling, logged, and sampled the borehole at the time of the investigation. Asphalt and granular base thicknesses were recorded at all borehole locations. Soil samples were recovered and retained in labeled air-tight containers for subsequent review by the project engineer and laboratory testing as required.

Soil samples were recovered from all boreholes from the auger and split-spoon samplers, driven in accordance with Standard Penetration Tests (SPTs) procedures (ASTM D1586). The results of SPTs in terms of N values are referred to in this report to define consistency for cohesive (plastic) soils and state of compactness for non-cohesive (non-plastic) materials.

The depth to groundwater and / or borehole “cave-in” was measured upon completion of drilling. The ground surface at the borehole location was reinstated consistent with the pre-drilling condition.

The ground surface elevations at the respective borehole locations were interpolated from the City of Toronto elevation contour maps and the topographical survey plan, and as such should be considered approximate. The ground surface elevations at the borehole locations are shown on the Borehole Logs in Appendix B.

2.2 LABORATORY TESTING PROGRAM

2.2.1 GEOTECHNICAL LABORATORY TESTING

Selected soil samples were submitted to WSP's certified soils laboratory for testing in accordance with Table 2.1. Laboratory test results are summarized on the Borehole Logs in Appendix B and provided in Appendix C.

Table 2.1 Geotechnical Laboratory Testing Summary

GEOTECHNICAL TEST	PROCEDURE/METHODOLOGY	NUMBER OF TESTS
Moisture Content	ASTM D2974 / LS-701	43
Hydrometer Analysis	ASTM WK38106 / LS-702	4
Sieve Analysis	ASTM D422 and/or LS602	3
Atterberg Limits	ASTM D4318	1

2.2.2 ENVIRONMENTAL TESTING

Two soil samples were tested for soil corrosivity parameters including sulphate, sulphide, resistivity, pH, and redox potential. The test results are presented in Appendix D and discussed in Section 4.9.

2.2.3 ASBESTOS LABORATORY TESTING

A total of eleven composite pavement core samples were submitted for asbestos testing (O.Reg.278/05).

Testing was performed using polarized light microscopy (PLM), based on EPA 600, in accordance with the U.S. Environmental Protection Agency Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials (June 1993).

Asbestos test locations are provided on Figure 1. A copy of the asbestos laboratory test results is provided in Appendix F.

3.0 RESULTS OF INVESTIGATION

3.1 SUBSURFACE CONDITIONS (BH23-01 to BH23-11)

3.1.1 EXISTING PAVEMENT STRUCTURE

The existing pavement structure consists of a flexible pavement structure, asphalt underlain by granular fill. The respective asphalt and granular thicknesses at the eleven borehole locations are summarized in Table 3.1. Eleven pavement cores were obtained. The corehole logs are presented in Appendix E.

Table 3.1 Existing Pavement Structure

Borehole No.	Asphalt thickness (mm)					Granular Base Thickness (mm)	Granular Subbase Thickness (mm)	Total Pavement Structure Thickness (mm)
	Top Course (mm)	Second Course (mm)	Third Course (mm)	Base Course (mm)	Total Thickness (mm)			
BH23-01	40	55	40	20	155	220	130	505
BH23-02	40	35	45	40	160	230	180	570
BH23-03	45	45	-	50	140	210	150	500
BH23-04	40	-	-	45	85	120	220	425
BH23-05	70	-	-	50	120	330	200	650
BH23-06	40	-	-	65	105	460	-	565
BH23-07	35	45	-	50	130	360	-	490
BH23-08	35	40	-	55	130	230	130	490
BH23-09	55	-	-	60	115	240	110	465
BH23-10	35	-	-	50	85	280	180	545
BH23-11	45	-	-	65	110	180	240	530
Average	45	-	-	50	120	260	140	520

3.1.2 GRANULAR FILL

Granular fill material was encountered below the asphalt layer in all boreholes with the granular base thicknesses ranging from 120 mm to 460 mm (average 260 mm), and granular subbase thicknesses ranging from 0 mm to 240 mm (average 140 mm). The granular base fill consists of sand with silt and gravel, silty sand with gravel, clayey sand with gravel, and gravel with sand. In addition, pieces of wood were noted from samples recovered from the granular base fill. The granular subbase fill consists of silty sand with gravel, silty sand, and clayey sand with gravel. In addition, pieces of metal and pockets of clay were noted from samples recovered from the granular subbase fill.

At the time of the investigation, the granular fill was dry to moist. Laboratory moisture content test results ranged from approximately 4% to 13%. Standard penetration tests gave "N" values ranging from 13 blows to more than 100 blows per 0.3 m penetration, indicating the granular fill materials have a compact to very dense state of compactness.

Three laboratory particle size distribution analyses were conducted on selected samples of the granular fill. The test results are provided in Table 3.2.

Table 3.2: Granular Fill Particle Distribution Analyses Results

BOREHOLE NO.	SAMPLE NO.	% GRADATION			PRIMARY SOIL CLASSIFICATION
		GRAVEL	SAND	SILT AND CLAY	
BH23-02	AS1(Granular Base)	36	47	17	Silty Sand with gravel
BH23-05	AS1(Granular Base)	25	64	11	Sand with silt and gravel
BH23-09	AS2(Granular Subbase)	18	43	39	Clayey Sand with gravel

It should be noted that the tested samples do not meet the OPSS 1010 gradation specifications for Granular A or Granular B. The particle size distribution analyses results are provided in Appendix C.

3.1.3 FILL MATERIALS

Cohesionless earth fill was encountered beneath the pavement granular fill in all of the boreholes. The cohesionless earth fill materials extended to depths ranging from approximately 0.8 mbgs to 1.5 mbgs. Borehole BH23-09 was terminated in the cohesionless earth fill materials at a depth of 1.5 mbgs. The cohesionless earth fill was variable and comprised of silty sand, sandy with silt and gravel, and silty sand with gravel. In addition, pockets of clay and pieces of rubber were noted from samples recovered from the cohesionless earth fill materials.

The SPT 'N' values in the cohesionless earth fill ranged from 13 blows to more than 100 blows per 0.3 m penetration, indicating the silty sand, sandy with silt and gravel, and silty sand with gravel fill materials have a compact to very dense state of compactness. At the time of the investigation, the cohesionless earth fill was found to be moist. The in-situ moisture contents as determined by laboratory tests, ranged from approximately 4% to 13%.

Cohesive earth fill was encountered beneath the cohesionless earth fill in all boreholes with the exception of Boreholes BH23-06, BH23-08, and BH23-09. These cohesive fill materials extended to the termination depth of approximately 1.5 mbgs in several of the boreholes. The cohesive fill was comprised of silty clay, sandy silty clay with gravel, sandy silty clay and silty clay with sand. In addition, pieces of rubber and trace organics were noted from samples recovered from the cohesive earth fill materials.

The SPT 'N' value in the cohesive earth fill was measured as 5 blows to 61 blows per 300 mm of penetration, indicating the silty clay, sandy silty clay with gravel, sandy silty clay and silty clay with sand fill materials have a firm to hard consistency. At the time of the investigation, the cohesive earth fill was found to be drier than or close to the plastic limit. The in-situ moisture contents as determined by laboratory tests, ranged from approximately 8% to 15%.

One laboratory particle size distribution analysis was conducted on selected sample obtained from the fill materials. The test result is summarized in Table 3.3.

Table 3.3: Fill Particle Size Distribution Analysis Result – BH23-03

BH NO.	SAMPLE NO.	GRAIN SIZE DISTRIBUTION			
		% GRAVEL	% SAND	% SILT	% CLAY
BH23-03	SS2	2	34	39	25

The result of the analysis is shown on the borehole logs in Appendix B. The particle size distribution curve is provided in Appendix C.

3.1.4 SANDY SILTY CLAY TILL

A native sandy silty clay till deposit with trace amounts of gravel was encountered underlying the fill materials in Boreholes BH23-06 and BH23-08. Both boreholes were terminated in the sandy silty clay till deposit, at a depth of 1.5 mbgs.

At the time of the investigation, the sandy silty clay till deposit was found to be drier than the plastic limit. The natural moisture content as determined by laboratory tests ranged between 8% to 10%. Standard penetration tests gave “N” values ranging from 16 blows to 29 blows per 0.3 m penetration, indicating the sandy silty clay till has a very stiff consistency.

One laboratory particle size distribution analysis was conducted on the selected sample obtained from the sandy silty clay till. The test result is provided in Table 3.4.

Table 3.4: Sandy Silty Clay Till Particle Size Distribution Analysis Result – BH23-08

BH NO.	SAMPLE NO.	GRAIN SIZE DISTRIBUTION			
		% GRAVEL	% SAND	% SILT	% CLAY
BH23-08	SS2	2	39	41	18

The result of the analysis is shown on the borehole logs in Appendix B. The particle size distribution curve is provided in Appendix C.

3.2 SUBSURFACE CONDITIONS (BH23-12A and BH23-12B)

3.2.1 EXISTING PAVEMENT STRUCTURE

The existing pavement structure consists of a flexible pavement structure, asphalt underlain by granular fill. A layer of asphalt was encountered at the existing ground surface in BH23-12A and BH23-12B, with a thickness of approximately 100 mm. Granular fill material was encountered below the asphalt layer in both boreholes, with the granular thickness of about 380 mm. The granular fill consists of clayey sand with gravel. At the time of the investigation, the granular fills were moist. Laboratory moisture content test results at approximately 11%. Standard penetration tests gave an “N” value at 16 blows per 0.3 m penetration, indicating the granular fill has a compact state of compactness.

3.2.2 FILL MATERIALS

Cohesive earth fill was encountered beneath the granular fill and cohesionless earth fill in both boreholes. The cohesive fill was comprised of silty clay and sandy silty clay with gravel. In addition, cobbles and pieces of glass were noted from samples recovered from the cohesive earth fill materials. The SPT ‘N’ value in the cohesive earth fill was measured as 16 blows to more than 100 blows per 300 mm of penetration, indicating the silty clay and sandy silty clay with gravel fill materials have a very stiff to hard consistency. At the time of the investigation, the cohesive earth fill was found to be drier or wetter than the plastic limit. The in-situ moisture contents as determined by laboratory tests, ranged from approximately 11% to 19%.

Cohesionless earth fill was encountered beneath the cohesive earth fill in both boreholes. The cohesionless earth fill materials extended to depths ranging from approximately 6.7 mbgs to 7.0 mbgs. Borehole BH23-12A was

terminated due to auger refusal in the cohesionless earth fill materials at a depth of 6.7 mbgs. The cohesionless earth fill was variable and comprised of silty sand, gravel with silt and sand, and silty sand with gravel. In addition, pockets of clay, trace organics and pieces of rubber and glass were noted from samples recovered from the cohesionless earth fill materials.

The SPT ‘N’ values in the cohesionless earth fill ranged from 25 blows to more than 100 blows per 0.3 m penetration, indicating the silty sand, gravel with silt and sand, and silty sand with gravel fill materials have a compact to very dense state of compactness. At the time of the investigation, the cohesionless earth fill was found to be moist to wet. The in-situ moisture contents as determined by laboratory tests, ranged from approximately 6% to 40%.

One laboratory particle size distribution analysis was conducted on selected sample obtained from the fill materials. The test result according to the USCS are summarized in Table 3.5.

Table 3.5: Fill Particle Size Distribution Analysis Result – BH23-12A

BH NO.	SAMPLE NO.	GRAIN SIZE DISTRIBUTION			
		% GRAVEL	% SAND	% SILT	% CLAY
BH23-12A	SS5A	10	55	24	11

The result of the analysis is shown on the borehole logs in Appendix B. The particle size distribution curve is provided in Appendix C.

3.2.3 LEAN CLAY TILL

A native lean clay till deposit with trace amounts of gravel and varying amounts of sand (trace to few) was encountered underlying the fill materials in Borehole BH23-12B. Borehole BH23-12B was terminated in the lean clay till deposit, at a depth of 9.6 mbgs.

At the time of the investigation, the lean clay till deposit was found to be close to the plastic limit. The natural moisture content as determined by laboratory tests ranged between 16% to 19%. Standard penetration tests gave “N” values more than 100 blows per 0.3 m penetration, indicating the lean clay till has a hard consistency.

3.3 SUBSURFACE CONDITIONS (BH23-13)

3.3.1 EXISTING PAVEMENT STRUCTURE

The existing pavement structure consists of a flexible pavement structure. A layer of asphalt was encountered at the existing ground surface in BH23-13, with a thickness of approximately 120 mm. Granular fill material was encountered below the asphalt layer in Borehole BH23-13, with a measured thickness of approximately 350 mm. The granular fill consists of silty sand with gravel; at the time of the investigation, the granular fills were moist, with laboratory moisture content test results at approximately 6%. Standard penetration tests gave “N” value at 20 blows per 0.3 m penetration, indicating the granular fill has a compact state of compactness.

3.3.2 FILL MATERIALS

Cohesionless earth fill was encountered beneath the granular fill in Borehole BH23-13. The cohesionless earth fill materials extended to a depth of approximately 3.4 mbgs. The cohesionless earth fill was variable and comprised

silty sand, and silty sand with gravel. In addition, pockets of clay were noted from samples recovered from the cohesionless earth fill materials.

The SPT 'N' values in the cohesionless earth fill ranged from 5 blows to 20 blows per 0.3 m penetration, indicating the silty sand, and silty sand with gravel fill materials have a loose to compact state of compactness. At the time of the investigation, the cohesionless earth fill was found to be moist to wet. The in-situ moisture contents as determined by laboratory tests, ranged from approximately 5% to 16%.

3.3.3 SILTY CLAY

A native silty clay deposit with few sand was encountered underlying the fill materials in Borehole BH23-13. The silty clay deposit extended to a depth of approximately 4.5 mbgs.

At the time of the investigation, the silty clay deposit was found to be drier than the plastic limit. The natural moisture content as determined by laboratory tests ranged between 12% to 13%. Standard penetration tests gave "N" values ranged from 13 blows to 58 blows per 0.3 m penetration, indicating the silty clay deposit has a stiff to hard consistency.

3.3.4 LEAN CLAY TILL

A native lean clay till deposit with trace amounts of gravel and few amounts of sand was encountered underlying the silty clay deposit in Borehole BH23-13. Borehole BH23-13 was terminated in the lean clay till deposit, at a depth of 6.5 mbgs.

At the time of the investigation, the lean clay till deposit was found to be drier than the plastic limit. The natural moisture content as determined by laboratory tests ranged between 13% to 14%. Standard penetration tests gave "N" values more than 100 blows per 0.3 m penetration, indicating the lean clay till has a hard consistency.

One laboratory particle size distribution analysis was conducted on selected sample obtained from the lean clay till. The test result is provided in Table 3.6.

Table 3.6: Lean Clay Till Particle Size Distribution Analysis Result – BH23-13

BH NO.	SAMPLE NO.	GRAIN SIZE DISTRIBUTION			
		% GRAVEL	% SAND	% SILT	% CLAY
BH23-13	SS7	1	8	47	44

The result of the analysis is shown on the borehole logs in Appendix B. The particle size distribution curve is provided in Appendix C.

One Atterberg Limits test was carried out on the above noted sample. The result is summarized in Table 3.7 below.

Table 3.7: Lean Clay Till Atterberg Limits Result – BH23-13

BOREHOLE NO.	SAMPLE I.D.	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)
BH23-13	SS7	33	19	14

The result of the analysis is summarized on the borehole logs in Appendix B and the plasticity charts are provided in Appendix C.

3.4 GROUNDWATER AND CAVE-IN CONDITIONS

Upon removal of the auger sampling equipment, Boreholes BH23-01 to BH23-11 remained open and dry. The groundwater levels measured in Boreholes BH23-12A, BH23-12B and BH23-13 ranged from approximately 3.0 mbgs to 4.6 mbgs upon completion of drilling and removal of the auger sampling equipment. Boreholes BH23-12A, BH23-12B and BH23-13 caved to depths ranged from approximately 4.1 mbgs to 7.6 mbgs upon completion of drilling and removal of the auger sampling equipment. Monitoring wells were not installed as part of this investigation.

It should be noted that groundwater levels may vary and are subject to seasonal fluctuations in response to precipitation events.

4.0 GEOTECHNICAL INTERPRETATION AND RECOMMENDATIONS

4.1 GENERAL

The following recommendations for the proposed Site development are based on the information obtained from the borehole investigation and laboratory testing. The boreholes were drilled within the vicinity of the proposed structure, and we believe fairly represents the subsurface conditions at the proposed structure locations. These recommendations are intended for designers and should not be construed as instructions to contractors. If significant differences in the subsurface conditions described above are found, we request to be contacted immediately to review and revise our findings and recommendations, if necessary.

4.2 FOUNDATIONS FOR THE BUNKER

4.2.1 FOUNDATION OPTION 1 – ENGINEERED FILL

Based on the soil conditions encountered in BH23-13, fill materials were encountered to a depth of 3.4 mbgs. Competent native deposits were encountered underlying the fill materials. Due to the potential for unacceptable total and differential settlement of foundations founded on the fill, the fill materials are not considered suitable for the subgrade support of the bunker foundations. As one foundation option, fill materials could be removed followed by placement of engineered fill materials to raise the grade back up to the proposed final grades within the footprint of the proposed bunker. The bunker foundations and concrete slab could then be founded within the engineered fill materials.

Based on the subsurface conditions encountered in the Borehole BH23-13, the anticipated depth of subexcavation to the competent native deposits are anticipated to be about 3.4 mbgs (approximate Elevation of about 186.6 masl).

For detailed design assessment and construction purposes, a factored geotechnical resistance at ULS of 225 kPa and a geotechnical resistance at SLS of 150 kPa (assuming 25 mm of settlement) may be used in the design of shallow foundations (minimum width of 0.5 m) founded within engineered fill materials.

Engineered fill materials should not be placed during winter/periods of freezing weather. The removal of the existing fill materials and subsequent replacement with engineered fill materials is recommended to limit potential settlements of the floor slab of the proposed bunker. Engineered fill requirements can be found in Appendix G.

4.2.2 FOUNDATION OPTION 2 – LOWERING FOOTINGS TO FOUND WITHIN COMPETENT NATIVE SOILS

As an alternative to the removal of the fill materials, consideration could be given to lowering the spread and strip footings for the proposed bunker to be founded within the hard native deposits underlying the fill materials. The foundations would need to be lowered to the native hard deposits at an approximate depth of 3.8 mbgs (approximate Elevation of about 186.2 masl) at BH23-13.

However, it should be noted that if the fill materials are left in place beneath the proposed floor slab (with the exception of the foundation areas), the floor slab may experience long-term settlement due to the loose nature and inherent variability of the fill materials as well as the difference in density between the existing fill materials and the materials used to backfill around the foundations.

For detailed design assessment and construction purposes, a factored geotechnical resistance at Ultimate Limit States (ULS) of 300 kPa and a geotechnical resistance at Serviceability Limit States (SLS) of 225 kPa (assuming 25 mm of settlement) may be used in the design of shallow foundations (minimum width of 0.5 m) founded within the native materials.

4.2.3 FOUNDATION OPTION 3 – HELICAL PILES

Alternatively, helical piles advanced through the fill and into the hard silty clay stratum can be considered to support the structure.

Helical piles are generally designed as end bearing and the friction from the fill materials must be ignored. Based on the borehole information, a vertical load bearing capacity of 210 kN per pile at Serviceability Limit States (SLS) and 280 kN at Ultimate Limit States (ULS) are expected to be available per helical pile with an 89 mm round shaft, or 370 kN per pile at SLS and 500 kN at ULS are expected to be available per helical pile with a 44 mm square shaft installed into the hard silty clay stratum encountered at a depth of 3.8 mbgs (as encountered in Borehole BH23-13).

A specialized contractor must be retained to design and install helical piles. The designer should define the depth and type of helical piles according to the soil conditions and the required design loads. Bearing capacity and other design details regarding helical piles can be discussed with the specialized contractor. Field load testing of piles is required to confirm the design bearing capacity. The test helical pile should be loaded to at least two (2) times the design bearing capacity at ULS. The final design of the bi-level drop-off structure must be reviewed by this office to confirm the recommended geotechnical resistance/reaction.

4.3 FOUNDATIONS FOR THE PRE-FABRICATED BUILDING

Based on the encountered subsurface conditions in BH23-12A and BH23-12B, and similar to the bunker, the existing fill materials are considered unsuitable to provide sufficient bearing resistance for the proposed structure due to the potential for excessive total and differential settlement. As such a deep foundation system will be required to support the prefabricated building; as an option, helical piles advanced through the fill and into the lean clay till stratum can be considered to support the structure.

Helical piles are generally designed as end bearing and the friction from the fill materials must be ignored. Based on the borehole information, a vertical load bearing capacity of 210 kN per pile at Serviceability Limit States (SLS) and 280 kN at Ultimate Limit States (ULS) are expected to be available per helical pile with an 89 mm round shaft, or 370 kN per pile at SLS and 500 kN at ULS are expected to be available per helical pile with a 44 mm square

shaft installed into the hard lean clay till encountered at a depth of 7.6 mbgs (as encountered in Borehole BH23-12B).

A specialized contractor must be retained to design and install helical piles. The designer should define the depth and type of helical piles according to the soil conditions and the required design loads. Bearing capacity and other design details regarding helical piles can be discussed with the specialized contractor. Field load testing of piles is required to confirm the design bearing capacity. The test helical pile should be loaded to at least two (2) times the design bearing capacity at ULS. The final design of the bi-level drop-off structure must be reviewed by this office to confirm the recommended geotechnical resistance/reaction.

4.4 EXCAVATIONS

Temporary excavations are to be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA) and local regulations. It is anticipated that excavations in the encountered fill materials will be relatively straight forward using conventional hydraulic backhoe and / or excavating equipment.

Side slopes of temporary excavations must conform to the Occupational Health and Safety Act (OHSA) and local regulations. For guidance, the fill materials as encountered in the boreholes can be classified as Type 3 soil above groundwater table and Type 4 soil below groundwater table. The fill may require shallower slopes depending on the site conditions. Unsupported temporary excavation side-slopes should not exceed 1.0 horizontal to 1.0 vertical in Type 3 soil and 3.0 horizontal to 1.0 vertical in Type 4 soil. Dewatering will be required for excavations below the groundwater level.

Excavation side slopes are to 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 are to be flattened as required to maintain safe working conditions.

If space is restricted such that the side slope cannot be safely cut back in accordance with the OHSA regulation, or sloughing and cave-in are encountered in the excavations, temporary shoring is to be provided. Shoring shall be designed by a qualified Engineer. Construction slopes are recommended to be monitored by WSP geotechnical personnel, particularly following periods of heavy rainfall, spring thaw, or if the trenches are left open for extended periods.

4.5 GROUNDWATER CONTROL

Based on the ground water level observed in the boreholes upon completion of drilling, excavations are not expected to extend below the local groundwater levels; however, it should be recognized that groundwater depths may be influenced by the effects of precipitation as well as seasonal fluctuations. If groundwater is encountered during excavation, the groundwater level must be lowered to at least 1 m below the excavation base to maintain the stability of the base and side slopes of the excavations in these areas using active dewatering. To minimize any related problems, backfilling operations must follow closely after excavation. Surface water should be directed away from the open excavations. It is recommended that the construction be carried out during the dry seasons.

This assessment does not represent an engineering design of a dewatering operation, but a preliminary analysis based on the available data. Ultimately, the selection of the dewatering methods and design of the dewatering operation will be the responsibility of the contractor.

It should be noted that groundwater control measures that extract more than 50,000 L/day of water are subject to a dewatering permit as regulated by the Ministry of the Environment, Conservation and Parks (MECP). An

Environmental Activity and Sector Registry (EASR) is required for construction dewatering between 50,000 to 400,000 L/day, while a Permit to Take Water (PTTW) is required for dewatering greater than 400,000 L/day. In all cases, pumping discharges should conform to the required regional or municipal by-laws.

4.6 SEISMIC DESIGN (SITE CLASS)

For earthquake design the term relevant to the geotechnical conditions is the “Site Class”. The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the Ontario Building Code (2012). The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity, Standard Penetration Test (SPT) resistance, undrained soil shear strength, etc.) in the 30 m of the soil profile extending below the foundation level. There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable/collapsible soils). The site class is then used to obtain acceleration and velocity-based site coefficients F_a and F_v , respectively, used to modify the UHS to account for the effects of site-specific soil conditions in design.

For preliminary design purposes, the subject site can be classified as a Site Class D for seismic site response.

4.7 LATERAL EARTH PRESSURES / SOIL PARAMETERS

The lateral earth pressure for the design of a retaining walls, shoring, foundation walls, or trench boxes can be estimated from the following expression; the expression assumes that the perimeter drainage system prevents the build-up of any hydrostatic pressure behind the wall.

Above groundwater table: $p = K (\gamma z + q)$

Where:

- p = Lateral earth and water pressure in kPa acting at depth z ;
- z = Depth below ground surface, in meters;
- K = Active earth pressure coefficient, (K_a) see Table 4.1 below;
- γ = Unit weight of soil above groundwater table, in kN/m³;
- q = Value of Surcharge (kPa);

The suggested soil parameters (unfactored) are summarized below in Table 4.1. The loading from adjacent structures and construction equipment should be included as a surcharge.

Table 4.1: Lateral Earth Pressure Coefficients (Unfactored)

SOIL TYPE	Effective angle of internal friction (Φ')	K_{active}	K_0 (at rest)	$K_{passive}$	UNIT WEIGHT (kN/m ³)
Granular Fill	32	0.31	0.47	3.25	21
Fill Materials	28	0.36	0.53	2.77	19
Native Lean Clay Till	32	0.31	0.47	3.25	21.5

SOIL TYPE	Effective angle of internal friction (Φ')	K_{active}	K_0 (at rest)	$K_{passive}$	UNIT WEIGHT (kN/m ³)
Native Silty Clay	30	0.33	0.50	3.00	19

4.8 ASBESTOS-CONTAINING MATERIAL

In order to examine the presence of asbestos, eleven (11) composite pavement core samples were submitted for asbestos testing. A summary of pavement corehole locations, along with composite asbestos test results are provided in Table 4.2. A copy of the laboratory Certificate of Analysis from EMC Scientific Incorporated is provided in Appendix F.

Table 4.2: Asbestos Detection Results of Composite Asphalt Layers

COREHOLE NO.	ASBESTOS RESULTS
PC23-01	<0.25 % Chrysotile; 100 % Non-Fibrous
PC23-02	<0.25 % Chrysotile; 100 % Non-Fibrous
PC23-03	<0.25 % Chrysotile; 100 % Non-Fibrous
PC23-04	0.46 % Chrysotile; 99.54 % Non-Fibrous
PC23-05	0.46 % Chrysotile; 99.54 % Non-Fibrous
PC23-06	<0.25 % Chrysotile; 100 % Non-Fibrous -
PC23-07	0.46 % Chrysotile; 99.54 % Non-Fibrous
PC23-08	<0.25 % Chrysotile; 100 % Non-Fibrous
PC23-09	<0.25 % Chrysotile; 100 % Non-Fibrous
PC23-10	None Detected; 100% Non-Fibrous
PC23-11	<0.25 % Chrysotile; 100 % Non-Fibrous

Trace asbestos was detected within the composite layers of all coreholes with the exception of PC23-10; however, it is not considered to be an asbestos-containing material (ACM) (defined as material containing >0.5% asbestos) as per O.Reg. 278/05. The detectable concentration of asbestos still has the potential to pose a risk to workers and public health and safety, if disturbed, and as such, special precautions such as dust suppression should be implemented during the disturbance of this material. In addition, workers should wear appropriate PPE such as a half-face respirator and protective coveralls.

4.9 CORROSIVITY POTENTIAL

Two (2) selected soil samples were submitted to ALS Canada (ALS) for laboratory analyses of pH, resistivity, redox potential, and sulphide concentrations to determine the corrosivity potential of the soil. The tested samples were obtained from BH23-12A SS2 and BH23-13 SS2. Table 4.3 summarizes the ANSI/AWWA rating for the tested soil samples for the potential for corrosion towards buried grey or ductile cast iron pipe. A score of 10 points or more indicates potential for corrosion.

Table 4.3: Results of ANSI/AWWA Soil Corrosivity Potential Rating and Sulphate Content

SAMPLE I.D.	SULPHATE CONTENT (μ G/G OR PPM)	RESISTIVITY (OHMS-CM)	PH	REDOX POTENTIAL (MV)	SULPHIDE (%)	MOISTURE CONTENT (%)	TOTAL POINTS
BH23-12A SS2	485	570/10	9.43/3	169/0	<0.05 Negative/0	Fair Drainage / 1	14
BH23-13 SS2	51	380/10	8.28/0	254/0	<0.05 Negative/0	Fair Drainage / 1	11

Samples BH23-12A SS2 and BH23-13 SS2 are considered corrosive as the total point was greater than 10. Appropriate protection measures against corrosion are recommended to be implemented, as required.

It should, be noted that there are other factors which may influence the corrosion potential, such as; the nature of effluent conveyed, the application of de-icing salts on the Site and subsequent leaching into the subsoils; and stray currents.

4.10 CEMENT TYPE

The soil samples noted above were also submitted for laboratory analyses of soluble sulphates to assess the potential for degradation of buried concrete in contact with the encountered soils. The soluble sulphate concentration of the tested samples ranges from 51 ug/g (51 ppm or 0.0051%) to 485 ug/g (485 ppm or 0.0485%). Based on the results, the potential for sulphate attack on concrete is considered “negligible” based on CSA Standard A23.1, Concrete Materials and Methods of Concrete Construction. It should, however, be noted that the final selection of the type of concrete should be made by the Engineer taking into account all design considerations.

4.11 FROST DEPTH

All footings exposed to seasonal freezing conditions must have at least 1.2 meters of soil cover or equivalent for frost protection. The base of the foundations should be provided with a minimum of 1.2m earth cover or equivalent thickness of exterior-grade extruded polystyrene insulation for frost protection.

Where construction is undertaken during winter conditions, the footing subgrade must be protected from freezing and buildup of snow and ice.

Signature Page

WSP Canada Inc.



Michael Hu, P.Eng.
Geotechnical Engineer



Nick La Posta, P.Eng.
Team Lead, Ground Engineering West

MH/NLP/ac

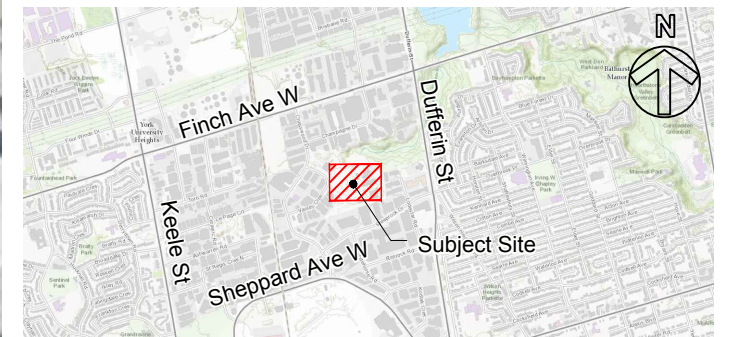
Figures



LEGEND

BOREHOLE/COREHOLE LOCATION (WSP 2024)

KEY MAP



NOTE(S)

1. PROJECTION: UTM NAD83, ZONE17.



CLIENT
CITY OF TORONTO

CONSULTANT



YYYY-MM-DD 2024-03-12

DESIGNED	MH
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PREPARED	WSL
----------	-----

REVIEWED MH

PROJECT
GEOTECHNICAL INVESTIGATION
DUFFERIN TRANSFER STATION
35 VANLEY CRESCENT, TORONTO, ONTARIO

TITLE
BOREHOLE AND COREHOLE LOCATION PLAN

PROJECT NO.	CONTROL
CA0010794.5758	0001

REV.
A

FIGURE 1

APPENDIX A

**Important Information and
Limitations of this Report**



IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: WSP Canada Inc. (WSP) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to WSP by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. WSP cannot be responsible for use of this report, or portions thereof, unless WSP is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without WSP's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, WSP may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to WSP. The report, all plans, data, drawings and other documents as well as all electronic media prepared by WSP are considered its professional work product and shall remain the copyright property of WSP, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of WSP. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of WSP's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, communications between WSP and the Client, and to any other reports prepared by WSP for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. WSP can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, WSP does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that WSP interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: WSP will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of WSP's report. WSP should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of WSP's report.

During construction, WSP should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of WSP's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in WSP's report. Adequate field review, observation and testing during construction are necessary for WSP to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, WSP's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that WSP be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that WSP be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. WSP takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX B

Borehole Logs

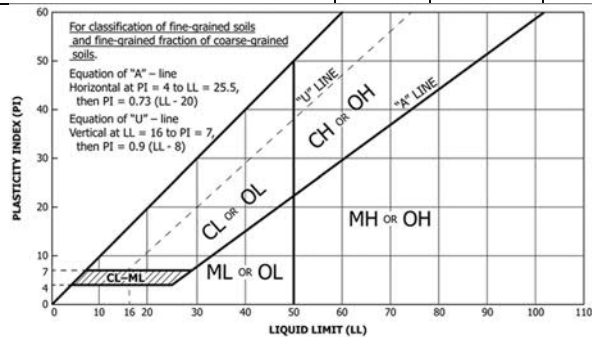
METHOD OF SOIL CLASSIFICATION

The WSP Canada Soil Classification¹ System is based on the Unified Soil Classification System (USCS) (after ASTM D2487)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$		$Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$		Organic Content ^{6,9}	USCS Group Symbol ^{3,5,7}	Primary Group Name ²				
INORGANIC (Organic Content <30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Clean Gravels with <5% fines ³ (by mass)	Well Graded	≥4	(and)	≥1 to ≤3		≤30%	GW	Well-graded GRAVEL ^{4,6}				
				Poorly Graded	<4	(and/or)	<1 or >3			GP	Poorly graded GRAVEL ^{4,6}				
			Gravels with >12% fines ³ (by mass)	Below A Line	n/a						GM	SILTY GRAVEL ^{4,6}			
				Above A Line	n/a						GC	CLAYEY GRAVEL ^{4,5,6}			
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Clean Sands with <5% fines ⁷ (by mass)	Well Graded	≥6	(and)	≥1 to ≤3			SW	Well-graded SAND ^{6,8}				
				Poorly Graded	<6	(and/or)	<1 or >3			SP	Poorly graded SAND ^{6,8}				
			Sands with >12% fines ⁷ (by mass)	Below A Line	n/a						SM	SILTY SAND ^{6,8}			
				Above A Line	n/a						SC	CLAYEY SAND ^{5,6,8}			
			Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content ^{8,10}	USCS Group Symbol ^A	Primary Group Name ^A	
							Dilatancy	Dry Strength		Shine Test	Thread Diameter (mm)				Toughness (of 3 mm thread)
		INORGANIC (Organic Content <30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Nonplastic or PI and LL plot below A-Line on Plasticity Chart ^C below)	Liquid Limit	Rapid	None to Low	Dull to None		3 to >6	Low/can't roll 3 mm	<15%	ML	SILT ^H	
						<50 ^D	None to Slow	Low to Medium		Dull to Slight	3 to 6	Low	15% to 30%	OL	ORGANIC SILT
Liquid Limit	None to V.Slow				Low to Medium	Slight	3 to 6	Low to Medium	<15%	MH	ELASTIC SILT ^H				
	≥50 ^D				None	Medium to High	Dull to Slight	1 to 3	Low to Medium	15% to <30%	OH	ORGANIC SILT			
CLAYS (PI and LL plot above A-Line on Plasticity Chart below) ^A	Liquid Limit			None to Medium Slow	Medium to High	Slight to Shiny	1 to 3	Medium	<15%	CL	LEAN CLAY ^{A,E,F,G,H}				
				<50 ^D	None to V.Slow	Medium to High	Slight to Shiny	1 to 3	Medium	15% to <30%	OL	ORGANIC CLAY ^{E,F,G}			
	Liquid Limit			None	High to V.High	Shiny	<1	High	<15%	CH	FAT CLAY ^{E,F,G,H}				
				≥50 ^D	None	High	Shiny	<1 to 1	High	15% to <30%	OH	ORGANIC CLAY ^{E,F,G}			
	HIGHLY ORGANIC SOILS (Organic Content >30% by mass)				Peat and mineral soil mixtures	Relatively lightweight, possibly spongy. Some water may squeeze from sample. Some shrinkage may occur on air drying. Sand fraction may be visible. Low to high dilatancy. Thread weak near plastic limit. Low to medium dry strength.						30% to <75%	PT	SILTY PEAT, SANDY PEAT	
					Predominantly peat, may contain some mineral soil, fibrous or amorphous peat	Lightweight, spongy. Much water squeezes from sample. Shrinks considerably on air drying (i.e., very high water content). Plant structure identifiable to altered.						75% to 100%		PEAT	

Coarse-Grained Soil Note(s):

- Based on the material passing the 75 mm sieve.
- If field sample contains or drilling observations indicate cobbles or boulders or both, add, "with cobbles" or "with cobbles and boulders". Include notes on the depth(s) encountered, and sizes if possible.
- Gravels with 5% to 12% fines require dual symbols:
(GW-GM) Well-graded GRAVEL with silt,
(GW-GC) Well-graded GRAVEL with clay,
(GP-GM) Poorly graded GRAVEL with silt,
(GP-GC) Poorly graded GRAVEL with clay.
- If soil contains $\geq 15\%$ sand, add "with sand" to Group Name.
- If fines classify as CL-ML, use dual symbol (GC-GM) or (SC-SM) for Group Symbol.
- If the soil has an organic content (OC) $15\% \leq OC < 30\%$ the prefix "Organic" should be added before the Group Name. If the soil has an organic content $3\% \leq OC < 15\%$ add "with organic fines" to Group Name. If the soil contains $> 0\%$ to $\leq 3\%$ organics, the descriptor "trace organics" may be added.
- Sands with 5% to 12% fines require dual symbols:
(SW-SM) Well-graded SAND with silt,
(SW-SC) Well-graded SAND with clay,
(SP-SM) Poorly graded SAND with silt,
(SP-SC) Poorly graded SAND with clay.
- If soil contains $\geq 15\%$ gravel, add "with gravel" to Group Name.



Fine-Grained Soil Note(s):

- If Atterberg limits plot above the A-line but in the 'hatched' area on the plasticity chart, soil is a (CL-ML) SILTY CLAY.
- If the soil contains $> 0\%$ to $\leq 3\%$ organics, the descriptor "trace organics" may be added.
- If fine-grained materials are nonplastic (i.e., a plastic limit (PL) cannot be measured), soil is a (ML) SILT.
- If soil has a liquid limit (LL) $> 30\%$ to $< 50\%$, the term 'medium plasticity' may be included in the description, but the Group Name/Symbol is not changed.
- If soil contains 15% to $< 30\%$ +No.200, add "with sand" or "with gravel".
- If soil contains $\geq 30\%$ +No.200 mainly sand, add "Sandy" to Group Name.
- If soil contains $\geq 30\%$ +No.200 mainly gravel, add "Gravelly" to Group Name.
- If the soil has an organic content (OC) $3\% \leq OC < 15\%$ add "with organic fines" to Group Name.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

GRADATIONAL COMPONENT TERMS

% (by mass)	Term
≤ 5	Use "trace"
> 5 to ≤ 12	Use "few"
> 12 to <30	Use "little"
≥ 30 to <50	Use "some"
≥ 50	Use "mostly"

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); Nd:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven, pushed tube sampler, or geoprobe macro-core – note size
DS	Denison type sample
FS	Foil Sample
GS	Grab Sample
MC	Modified California Samples – note sample diameter and hammer weight
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split-spoon sampler (50 mm OD); larger sizes use MC
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL, w _p	plastic limit
LL, w _L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, G _s)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness²

Term	SPT 'N' (blows/0.3m) ¹
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in general accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grain size. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N' ^{1,2} (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in general accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.

2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.



LOG OF BOREHOLE BH23-01

1 OF 1

PROJECT: Geotechnical Investigation

REF. NO.: CA0010794.5758

CLIENT: City of Toronto

Method: Solid Stem Auger

ENCL NO.: 2

PROJECT LOCATION: Dufferin Transfer Station, Toronto

Diameter: 125 mm

ORIGINATED BY VL

DATUM: UTM NAD83, ZONE 17

Date: Feb-10-2024

COMPILED BY MH

BH LOCATION: N 4846480 E 622846

Equipment: Geotech CME 75 (Truck)

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)	W _p	W	W _L			
193.4	Ground Surface														GR SA SI CL
0.0	ASPHALT: (155 mm)														
193.2															
0.2	GRANULAR BASE: (220 mm)														
193.0	(SW-SM) SAND with silt and gravel, brown; moist, compact.														
0.4	GRANULAR SUBBASE: (130 mm)														
192.9	(SM) SILTY SAND with gravel, brown; moist, compact.		1	SS	15		193								
0.5	FILL: (SM) SILTY SAND, trace gravel; contains clay pockets; brown; moist, compact.														
192.6															
0.8	FILL: (CL) SILTY CLAY, trace gravel, little sand; brown; w~PL, firm.														
1			2	SS	5										
191.9							192								
1.5	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, x 3: Numbers refer to Sensitivity

○ ●=3% Strain at Failure



LOG OF BOREHOLE BH23-02

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846438 E 622945

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 3

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT. (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)						
193.2	Ground Surface														
0.0	ASPHALT: (160 mm)														
193.0															
0.2	GRANULAR BASE: (230 mm) (SM) SILTY SAND with gravel, brown; moist, compact.						193								36 47 (17)
192.8															
0.4	GRANULAR SUBBASE: (180 mm) (SM) SILTY SAND with gravel, brown; moist, compact.		1	SS	25										
192.6															
0.6	FILL: (SM) SAND with silt and gravel, brown; moist, compact.														
192.4															
0.8	FILL: (CL-ML) SANDY SILTY CLAY with gravel, pieces of rubber; dark brown to black; trace organics; w<PL, hard.														
1															
192.4			2	SS	61		192								
191.7															
1.5	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH23-03

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846403 E 622998

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 4

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)						
196.1	Ground Surface														GR SA SI CL
0.0	ASPHALT: (140 mm)						196								
0.1	GRANULAR BASE: (210 mm) (SM) SILTY SAND with gravel, brown; moist, compact.														
195.8															
0.4	GRANULAR SUBBASE: (150 mm) (SM) SILTY SAND, few gravel; brown; moist, compact.		1	SS	25										
195.6															
0.5	FILL: (SM) SILTY SAND with gravel, brown; moist, compact.														
195.3															
0.8	FILL: (CL-ML) SANDY SILTY CLAY, trace gravel; trace oxidation; brown; w~PL, stiff.		2	SS	14		195								2 34 39 25
194.6															
1.5	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH23-04

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846452 E 623172

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 5

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)	W _p	W	W _L			
197.7	Ground Surface														GR SA SI CL
197.6	ASPHALT: (85 mm)														
0.1 197.5	GRANULAR BASE: (120 mm) (SW-SM) SAND with silt and gravel, brown; moist, compact.														
0.2 197.3	GRANULAR SUBBASE: (220 mm) (SM) SILTY SAND, few gravel; clay pockets; brown; moist, compact.		1	SS	13		197								
0.4 196.9	FILL: (SM) SILTY SAND, few gravel, brown; moist, compact.														
0.8 196.2	FILL: (CL) SANDY SILTY CLAY, trace gravel; trace oxidation; brown; w<PL, stiff.		2	SS	9										
1.5	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH23-05

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846492 E 623180

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 6

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT. (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)						
197.1	Ground Surface														
0.0 197.0	ASPHALT: (120 mm)						197								
0.1	GRANULAR BASE: (330 mm) (SW-SM) SAND with silt and gravel, brown; moist, compact.		1A	SS	20										25 64 (11)
196.7															
0.5	GRANULAR SUBBASE: (200 mm) (SM) SILTY SAND, few gravel; clay pockets; brown; moist, compact.		1B	SS											
196.5															
0.7	FILL: (SM) SILTY SAND, few gravel, brown; moist, compact.														
196.3															
0.8	FILL: (CL) SANDY SILTY CLAY, trace gravel; trace oxidation; brown; w~PL, stiff.														
1															
196			2	SS	12										
195.6															
1.5	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH23-06

1 OF 1

PROJECT: Geotechnical Investigation

REF. NO.: CA0010794.5758

CLIENT: City of Toronto

Method: Solid Stem Auger

ENCL NO.: 7

PROJECT LOCATION: Dufferin Transfer Station, Toronto

Diameter: 125 mm

ORIGINATED BY VL

DATUM: UTM NAD83, ZONE 17

Date: Feb-10-2024

COMPILED BY MH

BH LOCATION: N 4846533 E 623139

Equipment: Geotech CME 75 (Truck)

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC NATURAL LIQUID			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)	W _p	W	W _L			
189.9	Ground Surface														GR SA SI CL
0.0 189.8	ASPHALT: (105 mm)														
0.1	GRANULAR BASE: (460 mm) (SM) SILTY SAND with gravel to SILTY SAND, brown; moist, dense.		1	SS	33										
189.3	FILL: (SM) SILTY SAND with gravel, brown; moist, dense.														
0.6															
189.1	(CL) SANDY SILTY CLAY: trace gravel; trace oxidation; brown (TILL); w<PL, very stiff.		2	SS	29		189								
0.8															
1															
188.4	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														
1.5															

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH23-07

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846578 E 623136

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 8

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)	W _p	W	W _L			
191.7	Ground Surface														GR SA SI CL
0.0 191.6	ASPHALT: (130 mm)														
0.1	GRANULAR BASE: (360 mm) (SM) SILTY SAND with gravel to SILTY SAND, brown; moist to wet, compact.		1	SS	26										
191.2	FILL: (SM) SILTY SAND, trace gravel; brown; moist, compact.														
0.5															
190.9	FILL: (CL-ML) SILTY CLAY with sand, trace gravel; trace oxidation; brown to grey; w<PL, firm.		2	SS	7										
0.8															
1															
190.2	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														
1.5															

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH
NOTES+ 3, × 3: Numbers refer
to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH23-08

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846581 E 623112

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 9

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)	W _p	W	W _L			
191.3	Ground Surface														GR SA SI CL
0.0	ASPHALT: (130 mm)														
191.2															
0.1	GRANULAR BASE: (230 mm) (SM) SILTY SAND with gravel, brown; moist, dense.														
190.9															
0.4	GRANULAR SUBBASE: (130 mm) (SM) SILTY SAND, few gravel; brown; moist, dense.		1	SS	34										
190.8															
0.5	FILL: (SM) SILTY SAND with gravel, brown; moist, dense.														
190.5															
0.8	(CL) SANDY SILTY CLAY: trace gravel; trace oxidation; brown (TILL); w<PL, very stiff.		2	SS	16										2 39 41 18
1															
189.8															
1.5	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation

REF. NO.: CA0010794.5758

CLIENT: City of Toronto

Method: Solid Stem Auger

ENCL NO.: 10

PROJECT LOCATION: Dufferin Transfer Station, Toronto

Diameter: 125 mm

ORIGINATED BY VL

DATUM: UTM NAD83, ZONE 17

Date: Feb-10-2024

COMPILED BY MH

BH LOCATION: N 4846538 E 622996

Equipment: Geotech CME 75 (Truck)

CHECKED BY NLP

[illegible]

GROUNDWATER ELEVATIONS

Measurement

1st 2nd 3rd 4th

GRAPH
NOTES

$+^3, \times^3$: Numbers refer to Sensitivity

○ **$\epsilon=3\%$** Strain at Failure



LOG OF BOREHOLE BH23-10

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846487 E 623006

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 11

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kNm ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)						
190.9	Ground Surface														GR SA SI CL
190.8	ASPHALT: (85 mm)														
0.1	GRANULAR BASE: (280 mm) (GW) GRAVEL with sand, brown; dry to moist, very dense.		1	SS	50 / 150mm										
190.5	GRANULAR SUBBASE: (180 mm)														
0.4	(SM) SILTY SAND with gravel, brown; dry to moist, very dense.														
190.4	FILL: (SM) SILTY SAND with gravel, brown; moist, very dense.														
0.5															
190.1	FILL: (CL) SANDY SILTY CLAY, trace gravel; black; w~PL, very stiff.														
0.8															
1															
189.4															
1.5	END OF BOREHOLE Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, x 3: Numbers refer to Sensitivity

○ s=3% Strain at Failure



LOG OF BOREHOLE BH23-11

1 OF 1

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846489 E 623080

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-10-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 12

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)	W _p	W	W _L			
190.6	Ground Surface														GR SA SI CL
190.5	ASPHALT: (110 mm)														
0.1	GRANULAR BASE: (180 mm) (SM) SILTY SAND with gravel, brown; moist, dense.														
190.3	GRANULAR SUBBASE: (240 mm) (SM) SILTY SAND, few gravel; brown; moist, dense.		1	SS	41										
0.3															
190.1	FILL: (SM) SILTY SAND with gravel, brown; moist, dense.														
0.5															
189.8	FILL: (CL-ML) SILTY CLAY with sand, trace gravel; trace oxidation; brown to grey; w<PL, very stiff.														
0.8			2	SS	15										
1															
189.1	END OF BOREHOLE														
1.5	Note(s): 1). Borehole was open and dry upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

CHECKED BY NLP

WSP-SOIL-ROCK-OCTOBER-20-2022.GLB
ENVIRO PID(PPM) AND CGD(PPM)-2016-R02 BH LOGS-CA0010704.5758-DUFFERN.TS - 20240312.GPJ 24-3-12

○ **$\epsilon=3\%$** Strain at Failure

1st 2nd 3rd 4th



LOG OF BOREHOLE BH23-12A

2 OF 2

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846661 E 622887

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-14-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 13

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (C _u) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)						
Continued															
184.8	FILL: (CL) GRAVEL with silt and sand; dark brown; moist to wet, very dense.(Continued)						185								
5.5	FILL: (SM) SILTY SAND with gravel; contains pieces of glass; dark brown; wet, very dense.														
6			8	SS	50 / 75mm		184								
183.6	- Auger refusal at a depth of 6.7mbgs														
6.7	END OF BOREHOLE Note(s): 1). Borehole caved to a depth of 4.1 mbgs upon completion of drilling; 2). Water level was measured at 3.0 mbgs upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation

REF. NO.: CA0010794.5758

CLIENT: City of Toronto

Method: Solid Stem Auger

ENCL NO.: 14

PROJECT LOCATION: Dufferin Transfer Station, Toronto

Diameter: 125 mm

ORIGINATED BY VL

DATUM: UTM NAD83, ZONE 17

Date: Feb-20-2024

COMPILED BY MH

BH LOCATION: N 4846675 E 622863

Equipment: Geotech CME 75 (Truck)

CHECKED BY NLP

[illegible]

Continued Next Page

GROUNDWATER ELEVATIONS

GRAPH
NOTES

$+^3, \times^3$: Numbers refer to Sensitivity

○ **$\epsilon=3\%$** Strain at Failure

Measurement

1st 2nd 3rd 4th



LOG OF BOREHOLE BH23-12B

2 OF 2

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846675 E 622863

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-20-2024

Equipment: Geotech CME 75 (Truck)

REF. NO.: CA0010794.5758

ENCL NO.: 14

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (C _u) (MPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	*N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)						
	Continued														
184.1	FILL: (CL) GRAVEL with silt and sand; dark brown; moist to wet, very dense.(Continued)														
5.5	FILL: (SM) SILTY SAND with gravel; contains pieces of glass; dark brown; wet, very dense.														
6															

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

WSP-SOIL ROCK-OCTOBER-20-2022-CLB
REVISED PER ILM AND CDRP/PLM/2017-02-28 BH LOGS-CA0010794.5758-DUFFERIN TS-20240312-GRP-24-3-12



LOG OF BOREHOLE BH23-13

1 OF 2

PROJECT: Geotechnical Investigation

CLIENT: City of Toronto

PROJECT LOCATION: Dufferin Transfer Station, Toronto

DATUM: UTM NAD83, ZONE 17

BH LOCATION: N 4846643 E 622816

Method: Solid Stem Auger

Diameter: 125 mm

Date: Feb-20-2024

Equipment: Geotech CME 75 (Truck)

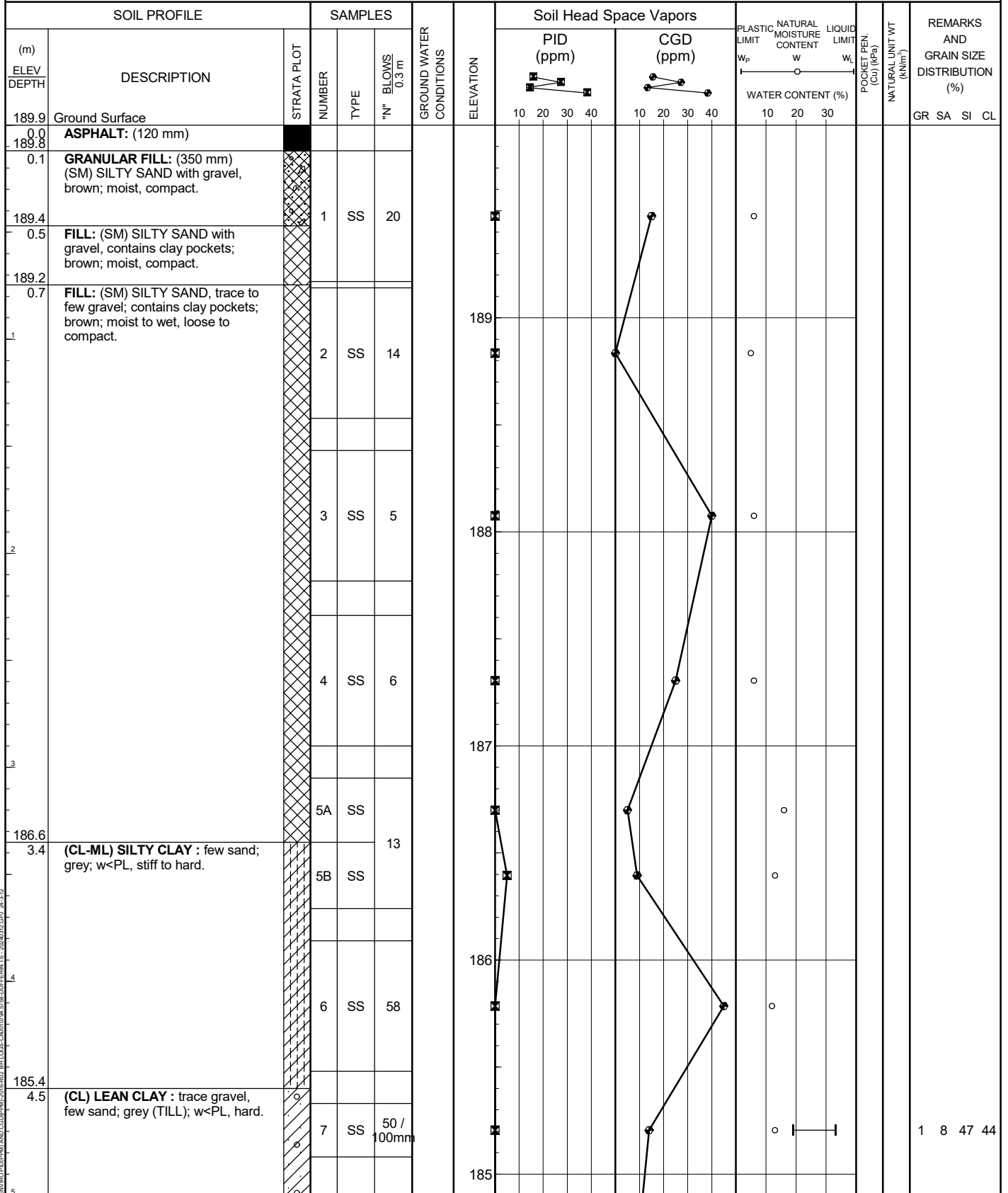
REF. NO.: CA0010794.5758

ENCL NO.: 15

ORIGINATED BY VL

COMPILED BY MH

CHECKED BY NLP





LOG OF BOREHOLE BH23-13

2 OF 2

PROJECT: Geotechnical Investigation

REF. NO.: CA0010794.5758

CLIENT: City of Toronto

Method: Solid Stem Auger

ENCL NO.: 15

PROJECT LOCATION: Dufferin Transfer Station, Toronto

Diameter: 125 mm

ORIGINATED BY VL

DATUM: UTM NAD83, ZONE 17

Date: Feb-20-2024

COMPILED BY MH

BH LOCATION: N 4846643 E 622816

Equipment: Geotech CME 75 (Truck)

CHECKED BY NLP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	Soil Head Space Vapors		PLASTIC NATURAL LIQUID			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			PID (ppm)	CGD (ppm)	W _p	W	W _L			
Continued										WATER CONTENT (%)					GR SA SI CL
6	(CL) LEAN CLAY : trace gravel, few sand; grey (TILL); w<PL, hard.(Continued)		8	SS	100 / 230mm		184								
183.4															
6.5	END OF BOREHOLE Note(s): 1). Borehole caved to a depth of 5.2 mbgs upon completion of drilling; 2). Water level was measured at 3.7 mbgs upon completion of drilling.														

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

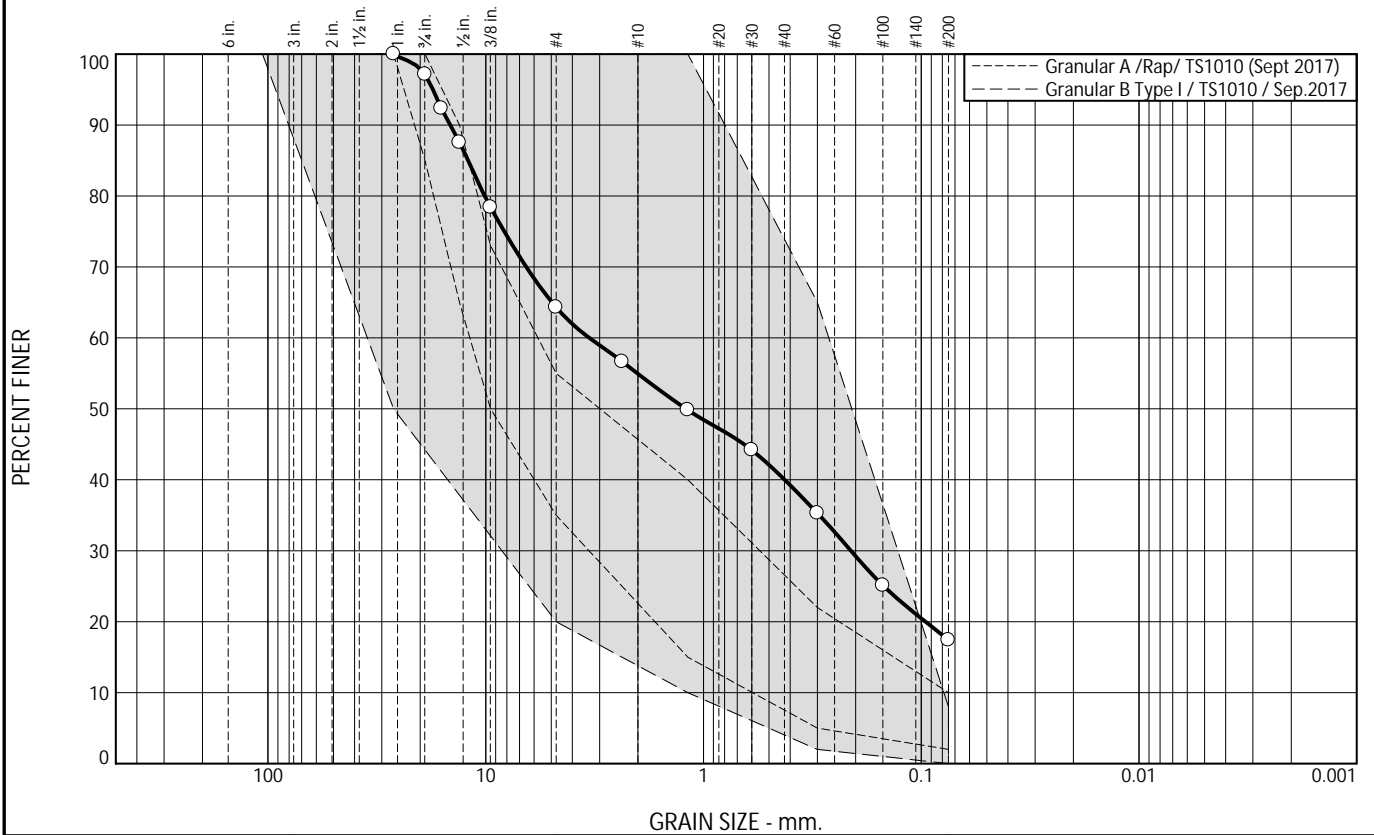
+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

APPENDIX C

Geotechnical Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.8	32.9	9.4	14.9	22.6	17.4	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
26.5mm	100.0	100	
19.00mm	97.1	85-100	
16.00mm	92.4		
13.20mm	87.5	65-90	
9.50mm	78.4	50-73	X
4.75mm	64.3	35-55	X
2.36mm	56.6		
1.18mm	49.8	15-40	X
0.600mm	44.2		
0.300mm	35.3	5-22	X
0.150mm	25.1		
0.075mm	17.4	2-10	X

* Granular A /Rap/ TS1010 (Sept 2017)

Soil Description

PL= Atterberg Limits PI=

LL=

Coefficients

D₉₀= 14.5615 D₈₅= 12.0456 D₆₀= 3.3416

D₅₀= 1.2024 D₃₀= 0.2104 D₁₅=

D₁₀= C_u= C_c=

USCS= Classification AASHTO=

Remarks

Location: BH23-02 AS1
Sample Number: R24-27(1)

Date: Feb 29, 2024



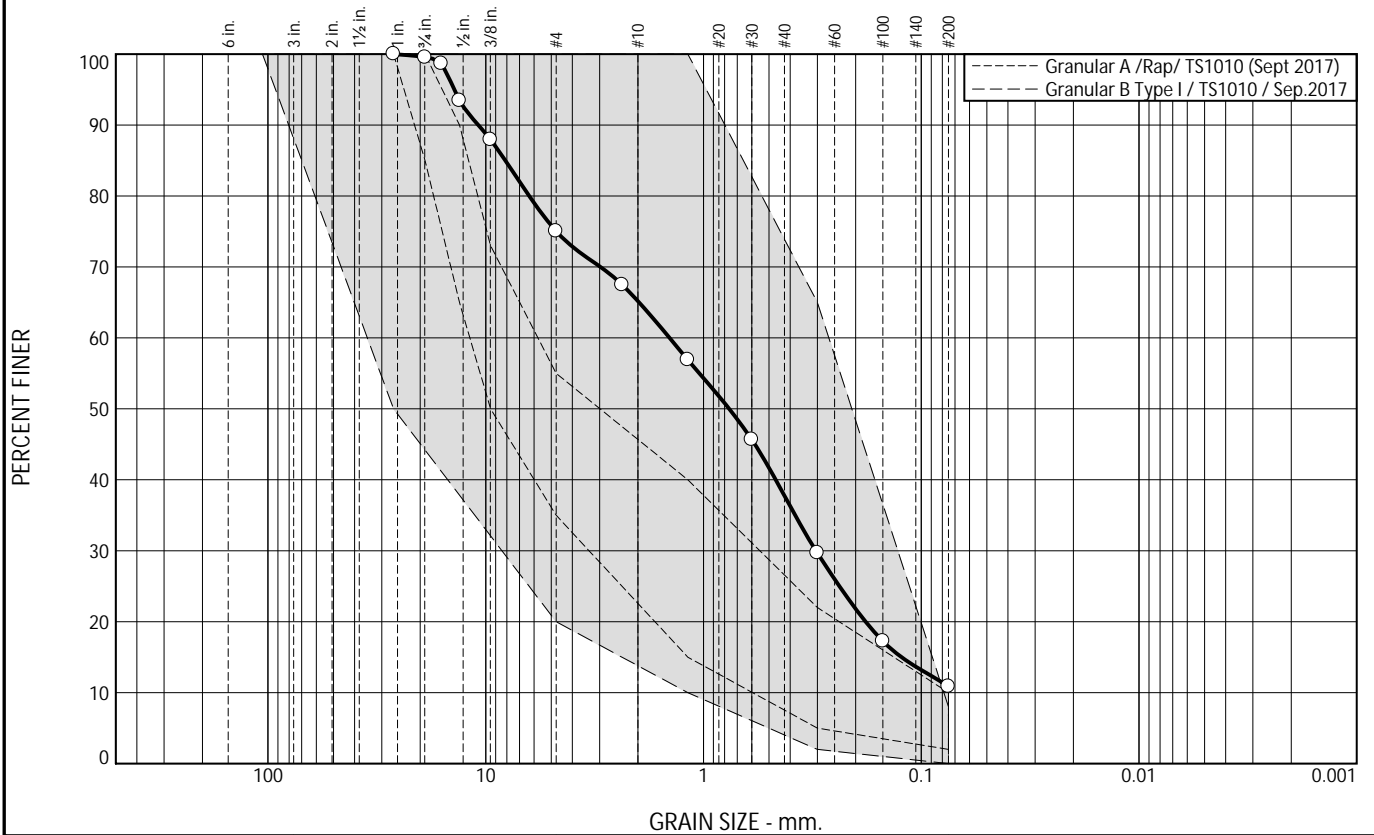
Client: City of Toronto
Project: Dufferin Transfer Station

Project No: CA0010794.5758

Figure 01

Tested By: Pavithra

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.5	24.5	9.8	27.4	27.0	10.8	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
26.5mm	100.0	100	
19.00mm	99.5	85-100	
16.00mm	98.6		
13.20mm	93.4	65-90	X
9.50mm	87.9	50-73	X
4.75mm	75.0	35-55	X
2.36mm	67.5		
1.18mm	56.9	15-40	X
0.600mm	45.7		
0.300mm	29.7	5-22	X
0.150mm	17.2		
0.075mm	10.8	2-10	X

* Granular A /Rap/ TS1010 (Sept 2017)

Soil Description

PL= Atterberg Limits PI=

LL=

Coefficients

D₉₀= 10.8254 D₈₅= 8.1236 D₆₀= 1.4309
D₅₀= 0.7620 D₃₀= 0.3047 D₁₅= 0.1234
D₁₀= C_u= C_c=

USCS= Classification AASHTO=

Remarks

Location: BH23-05 AS1
Sample Number: R24-27(3)

Date: Feb 29, 2024



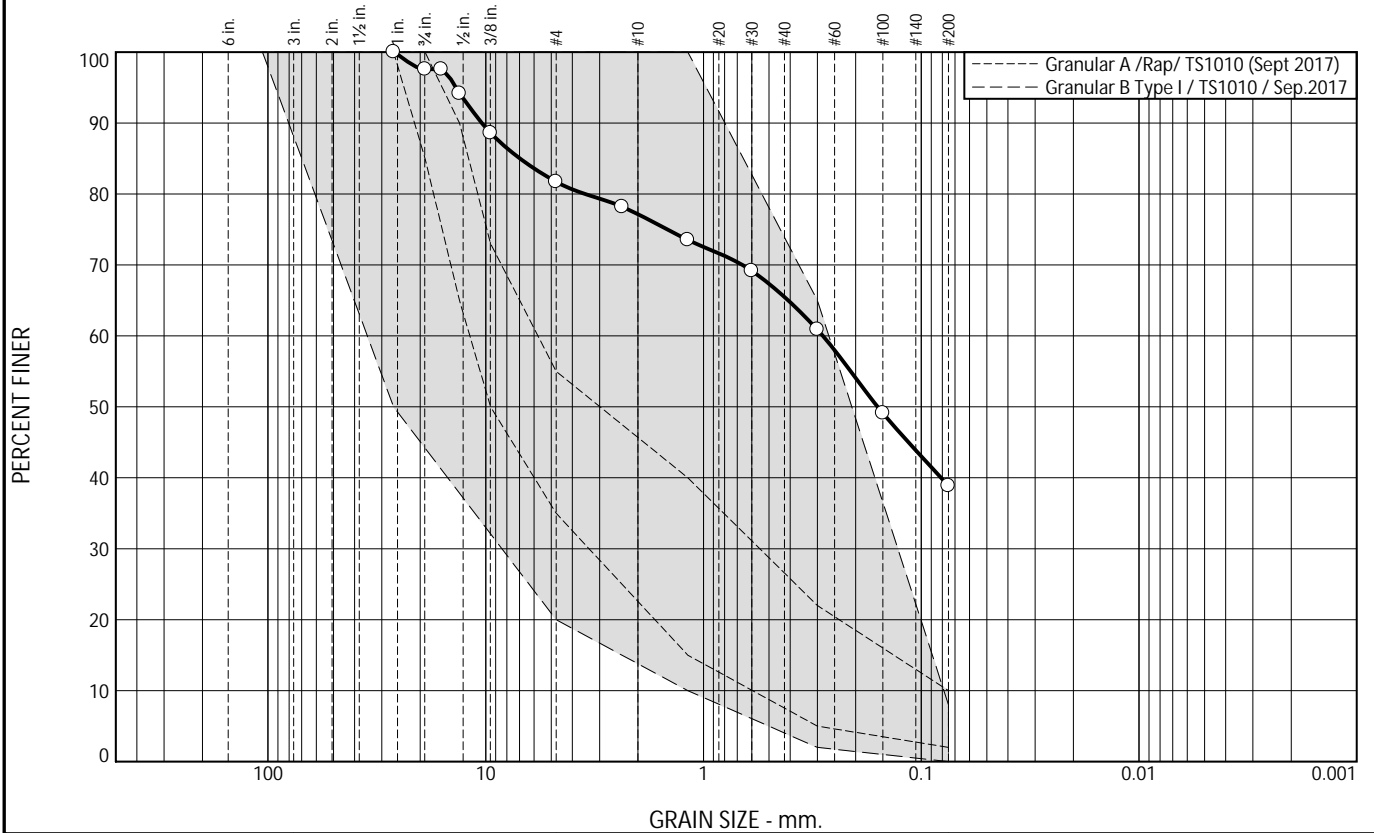
Client: City of Toronto
Project: Dufferin Transfer Station

Project No: CA0010794.5758

Figure 03

Tested By: Pavithra

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.4	15.9	4.6	11.6	26.6	38.9	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
26.5mm	100.0	100	
19.00mm	97.6	85-100	
16.00mm	97.6		
13.20mm	94.2	65-90	X
9.50mm	88.6	50-73	X
4.75mm	81.7	35-55	X
2.36mm	78.2		
1.18mm	73.5	15-40	X
0.600mm	69.2		
0.300mm	60.9	5-22	X
0.150mm	49.1		
0.075mm	38.9	2-10	X

* Granular A /Rap/ TS1010 (Sept 2017)

Soil Description

PL= Atterberg Limits PI=

LL=

Coefficients

D₉₀= 10.4298 D₈₅= 6.9651 D₆₀= 0.2830

D₅₀= 0.1585 D₃₀= D₁₅=

D₁₀= C_u= C_c=

USCS= Classification AASHTO=

Remarks

Location: BH23-09 AS2
Sample Number: R24-27(5)

Date: Feb 29, 2024



Client: City of Toronto
Project: Dufferin Transfer Station

Project No: CA0010794.5758

Figure 05

Tested By: Pavithra

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	2.9	7.6	23.3	38.9	24.8

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
13.2mm	100.0		
9.5mm	99.5		
4.75mm	97.5		
2mm	94.6		
0.850mm	90.8		
0.425mm	87.0		
0.250mm	81.8		
0.150mm	74.5		
0.106mm	69.5		
0.075mm	63.7		
0.0356 mm.	55.7		
0.0257 mm.	52.0		
0.0167 mm.	46.9		
0.0099 mm.	40.9		
0.0071 mm.	37.3		
0.0051 mm.	33.4		
0.0026 mm.	26.9		
0.0011 mm.	20.4		

* (no specification provided)

Soil Description		
<div> <div> PL= <div> Atterberg Limits LL= PI= </div> </div> <div> <div> D₉₀= 0.7119 D₅₀= 0.0217 D₁₀= </div> <div> Coefficients D₈₅= 0.3361 D₃₀= 0.0036 C_u= </div> <div> D₆₀= 0.0545 D₁₅= C_c= </div> </div> <div> USCS= Classification AASHTO= </div> <div> Remarks </div> </div>		

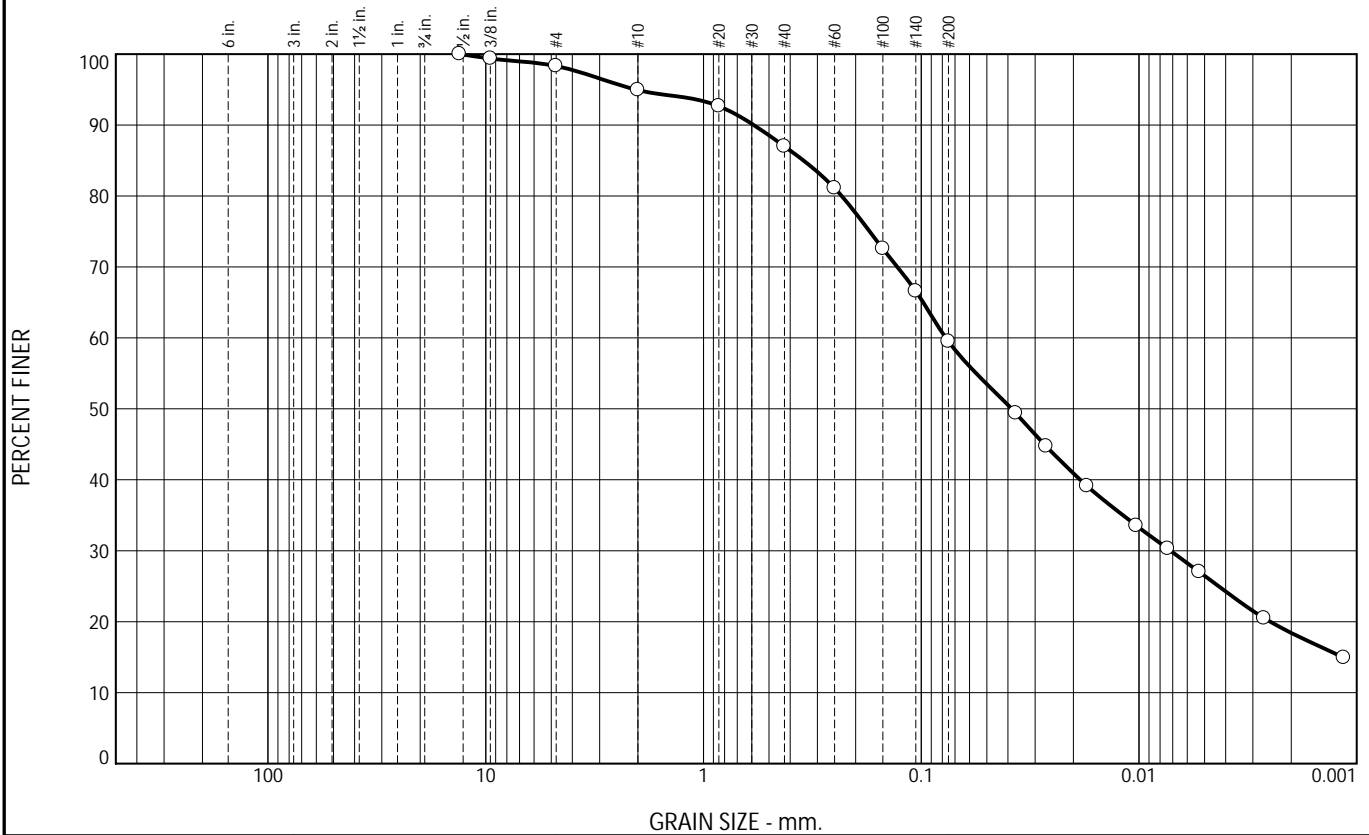
Location: BH23-03 SS2
Sample Number: R24-27(2)

Date: Feb 27, 2024

	Client: City of Toronto	Project No: CA0010794.5758	Figure 02
	Project: Dufferin Transfer Station		

Tested By: Cassandra

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	3.4	7.9	27.5	41.1	18.4

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
13.2mm	100.0		
9.5mm	99.4		
4.75mm	98.3		
2mm	94.9		
0.850mm	92.7		
0.425mm	87.0		
0.250mm	81.1		
0.150mm	72.6		
0.106mm	66.6		
0.075mm	59.5		
0.0368 mm.	49.4		
0.0267 mm.	44.7		
0.0173 mm.	39.1		
0.0103 mm.	33.5		
0.0074 mm.	30.3		
0.0053 mm.	27.0		
0.0027 mm.	20.5		
0.0011 mm.	14.9		

* (no specification provided)

Soil Description

PL=

Atterberg Limits

LL=

PI=

D₉₀= 0.5877

D₅₀= 0.0385

D₁₀=

D₈₅= 0.3474

D₃₀= 0.0072

C_u=

D₆₀= 0.0772

D₁₅= 0.0012

C_c=

USCS=


Classification

AASHTO=

Remarks

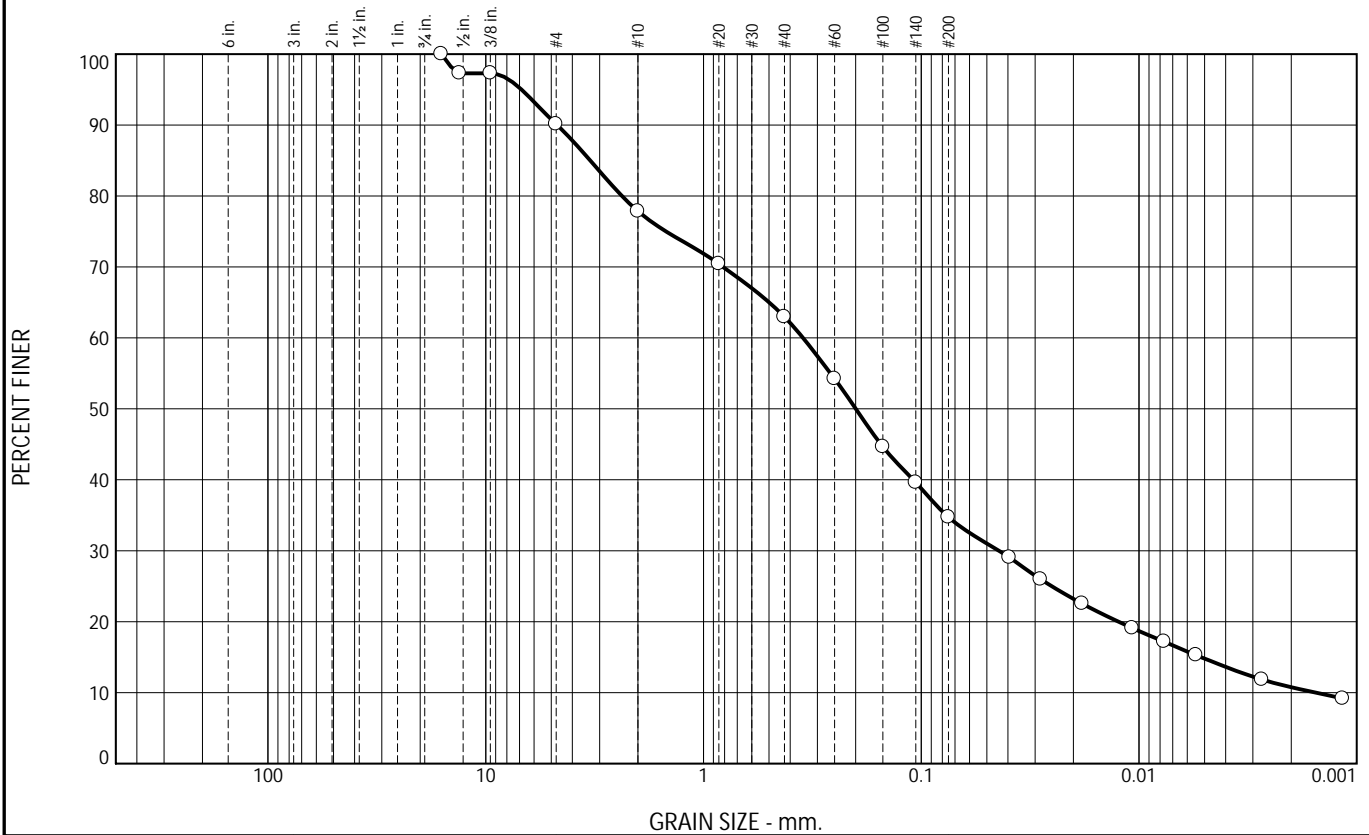
Location: BH23-08 SS2
Sample Number: R24-27(4)

Date: Feb 27, 2024

	Client: City of Toronto
	Project: Dufferin Transfer Station
Project No: CA0010794.5758	Figure 04

Tested By: Cassandra

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.9	12.2	14.9	28.3	23.9	10.8

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16mm	100.0		
13.2mm	97.3		
9.5mm	97.3		
4.75mm	90.1		
2mm	77.9		
0.850mm	70.4		
0.425mm	63.0		
0.250mm	54.2		
0.150mm	44.7		
0.106mm	39.6		
0.075mm	34.7		
0.0394 mm.	29.1		
0.0283 mm.	26.0		
0.0182 mm.	22.6		
0.0107 mm.	19.1		
0.0077 mm.	17.2		
0.0055 mm.	15.3		
0.0027 mm.	11.9		
0.0012 mm.	9.2		

* (no specification provided)

Soil Description

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 4.7055 D₈₅= 3.3126 D₆₀= 0.3492
 D₅₀= 0.1998 D₃₀= 0.0440 D₁₅= 0.0052
 D₁₀= 0.0015 C_u= 226.72 C_c= 3.60

Classification
 USCS= AASHTO=

Remarks

Location: BH23-12A SS5A
Sample Number: R24-27(6)

Date: Feb 27, 2024



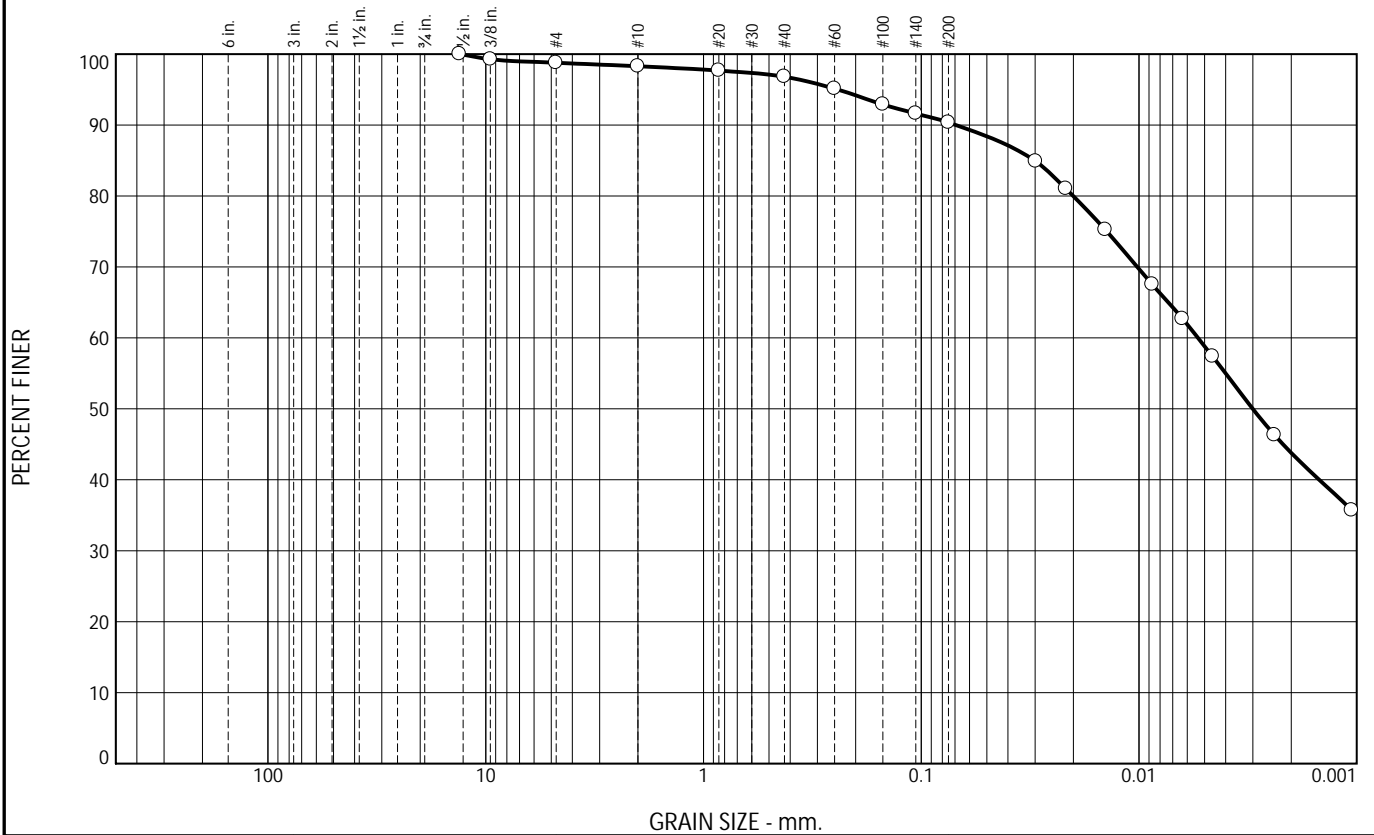
Client: City of Toronto
Project: Dufferin Transfer Station

Project No: CA0010794.5758

Figure 06

Tested By: Cassandra

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.2	0.5	1.5	6.4	46.6	43.8

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
13.2mm	100.0		
9.5mm	99.3		
4.75mm	98.8		
2mm	98.3		
0.850mm	97.7		
0.425mm	96.8		
0.250mm	95.1		
0.150mm	92.9		
0.106mm	91.6		
0.075mm	90.4		
0.0298 mm.	84.9		
0.0217 mm.	81.0		
0.0143 mm.	75.3		
0.0087 mm.	67.5		
0.0063 mm.	62.7		
0.0046 mm.	57.4		
0.0024 mm.	46.3		
0.0011 mm.	35.7		

* (no specification provided)

Soil Description		
<p>PL= 19 <u>Atterberg Limits</u> LL= 33 PI= 14</p> <p> <u>Coefficients</u> D₉₀= 0.0695 D₈₅= 0.0301 D₆₀= 0.0054 D₅₀= 0.0030 D₃₀= D₁₅= D₁₀= C_u= C_c= </p> <p> <u>Classification</u> USCS= CL AASHTO= A-6(12) </p> <p><u>Remarks</u></p>		

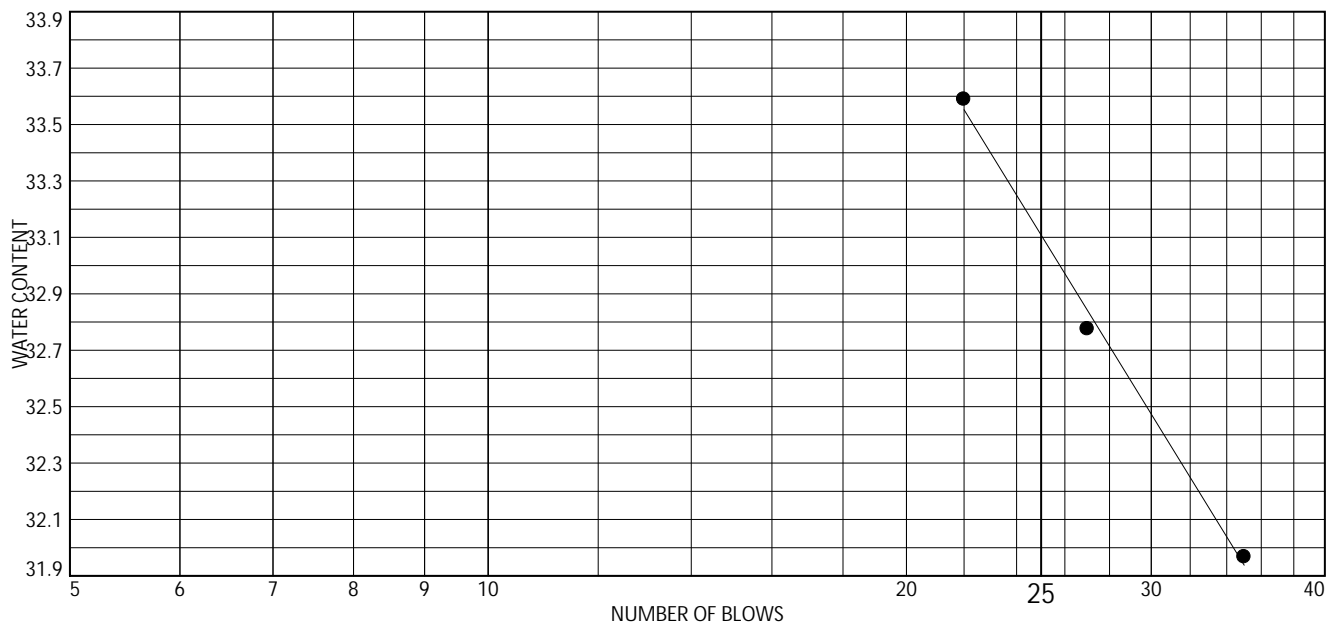
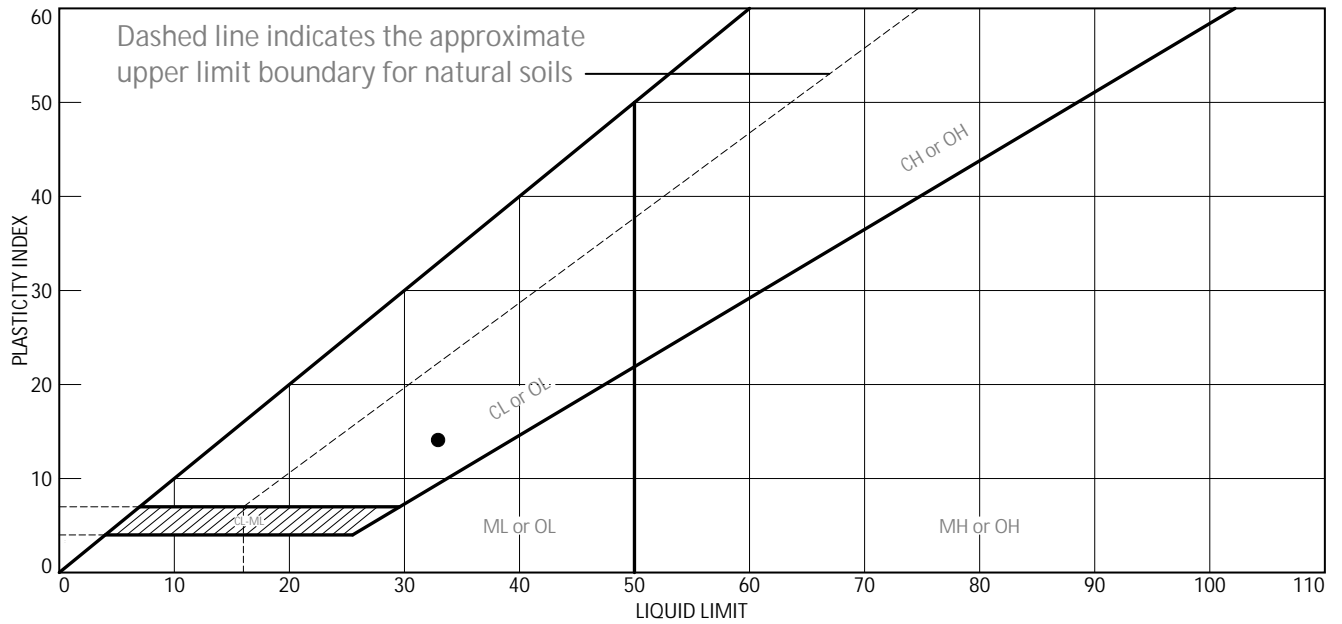
Location: BH23-13 SS7
Sample Number: R24-27(7)

Date: Feb 27, 2024

	Client: City of Toronto
	Project: Dufferin Transfer Station
Project No: CA0010794.5758	Figure 07

Tested By: Cassandra

LIQUID AND PLASTIC LIMITS TEST REPORT



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	33	19	14	96.8	90.4	CL

Project No. CA0010794.5758 Client: City of Toronto

Project: Dufferin Transfer Station

Location: BH23-13 SS7
Sample Number: R24-27(7)



Remarks:

Figure 01

Tested By: Cassandra

APPENDIX D

Environmental Laboratory Test Results

CERTIFICATE OF ANALYSIS

Work Order	: WT2403869	Page	: 1 of 3
Client	: WSP Canada Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Michael Hu	Account Manager	: Amanda Overholster
Address	: 215 Shields Court #1 Markham ON Canada L3R 8V2	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: CA0010794.5758/TASK 102	Date Samples Received	: 22-Feb-2024 16:20
PO	: ----	Date Analysis Commenced	: 27-Feb-2024
C-O-C number	: 20-1004880	Issue Date	: 29-Feb-2024 16:14
Sampler	: CLIENT		
Site	: ----		
Quote number	: Q88011 - RFSQ No. Doc2938706981		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Nik Perkio	Inorganics Analyst	Inorganics, Waterloo, Ontario
Niral Patel		Centralized Prep, Waterloo, Ontario



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	Description
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.



Analytical Results

Sub-Matrix: Soil/Solid					Client sample ID	BH23-12A SS2	BH23-13 SS2	----	----	----
(Matrix: Soil/Solid)										
					Client sampling date / time	21-Feb-2024 15:00	21-Feb-2024 15:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2403869-001	WT2403869-002	-----	-----	-----	
					Result	Result	----	----	----	
Physical Tests										
Conductivity (1:2 leachate)	----	E100-L/WT	5.00	µS/cm	1740	2650	----	----	----	
Moisture	----	E144/WT	0.25	%	9.44	5.92	----	----	----	
Oxidation-reduction potential [ORP]	----	E125/WT	0.10	mV	169	254	----	----	----	
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	0.10	pH units	9.43	8.28	----	----	----	
Resistivity	----	EC100R/WT	100	ohm cm	570	380	----	----	----	
Inorganics										
Sulfides, acid volatile	----	E396-L/WT	0.20	mg/kg	2.30	0.76	----	----	----	
Leachable Anions & Nutrients										
Chloride, soluble ion content	16887-00-6	E236.Cl/WT	5.0	mg/kg	643	1660	----	----	----	
Sulfate, soluble ion content	14808-79-8	E236.SO4/WT	20	mg/kg	485	51	----	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2403869	Page	: 1 of 7
Client	: WSP Canada Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Michael Hu	Account Manager	: Amanda Overholster
Address	: 215 Shields Court #1 Markham ON Canada L3R 8V2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: CA0010794.5758/TASK 102	Date Samples Received	: 22-Feb-2024 16:20
PO	: ----	Issue Date	: 29-Feb-2024 16:17
C-O-C number	: 20-1004880		
Sampler	: CLIENT		
Site	: ----		
Quote number	: Q88011 - RFSQ No. Doc2938706981		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] BH23-12 SS2	E396-L	21-Feb-2024	27-Feb-2024	14 days	6 days	✓	27-Feb-2024	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] BH23-13 SS2	E396-L	21-Feb-2024	27-Feb-2024	14 days	6 days	✓	27-Feb-2024	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH23-12 SS2	E236.Cl	21-Feb-2024	28-Feb-2024	30 days	7 days	✓	28-Feb-2024	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH23-13 SS2	E236.Cl	21-Feb-2024	28-Feb-2024	30 days	7 days	✓	28-Feb-2024	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH23-12 SS2	E236.SO4	21-Feb-2024	28-Feb-2024	30 days	7 days	✓	28-Feb-2024	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH23-13 SS2	E236.SO4	21-Feb-2024	28-Feb-2024	30 days	7 days	✓	28-Feb-2024	28 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH23-12 SS2	E100-L	21-Feb-2024	27-Feb-2024	30 days	6 days	✓	28-Feb-2024	30 days	7 days	✓



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH23-13 SS2	E100-L	21-Feb-2024	27-Feb-2024	30 days	6 days	✓	28-Feb-2024	30 days	7 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH23-12 SS2	E144	21-Feb-2024	----	----	----		27-Feb-2024	----	6 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH23-13 SS2	E144	21-Feb-2024	----	----	----		27-Feb-2024	----	6 days	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] BH23-12 SS2	E125	21-Feb-2024	28-Feb-2024	180 days	7 days	✓	28-Feb-2024	180 days	7 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] BH23-13 SS2	E125	21-Feb-2024	28-Feb-2024	180 days	7 days	✓	28-Feb-2024	180 days	7 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH23-12 SS2	E108A	21-Feb-2024	28-Feb-2024	30 days	7 days	✓	29-Feb-2024	30 days	8 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH23-13 SS2	E108A	21-Feb-2024	28-Feb-2024	30 days	7 days	✓	29-Feb-2024	30 days	8 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1346009	1	12	8.3	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1345398	1	9	11.1	5.0	✓
Moisture Content by Gravimetry	E144	1345635	1	20	5.0	5.0	✓
ORP by Electrode	E125	1346846	1	4	25.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1347034	1	20	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1347116	1	18	5.5	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1347115	1	19	5.2	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1346009	1	12	8.3	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1345398	2	9	22.2	10.0	✓
Moisture Content by Gravimetry	E144	1345635	1	20	5.0	5.0	✓
ORP by Electrode	E125	1346846	1	4	25.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1347034	1	20	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1347116	2	18	11.1	10.0	✓
Water Extractable Sulfate by IC	E236.SO4	1347115	2	19	10.5	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1346009	1	12	8.3	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1345398	1	9	11.1	5.0	✓
Moisture Content by Gravimetry	E144	1345635	1	20	5.0	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1347116	1	18	5.5	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1347115	1	19	5.2	5.0	✓



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3530	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
ORP by Electrode	E125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Oxidation Reduction Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Water Extractable Chloride by IC	E236.Cl ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO ₄ ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.
Resistivity Calculation for Soil Using E100-L	EC100R ALS Environmental - Waterloo	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions



Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl ₂ - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Preparation of ORP by Electrode	EP125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.
Anions Leach 1:10 Soil:Water (Dry)	EP236 ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Distillation for Acid Volatile Sulfide in Soil	EP396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S ₂ J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.

QUALITY CONTROL REPORT

Work Order	: WT2403869	Page	: 1 of 5
Client	: WSP Canada Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Michael Hu	Account Manager	: Amanda Overholster
Address	: 215 Shields Court #1 Markham ON Canada L3R 8V2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: 1 416 817 2944
Project	: CA0010794.5758/TASK 102	Date Samples Received	: 22-Feb-2024 16:20
PO	: ----	Date Analysis Commenced	: 27-Feb-2024
C-O-C number	: 20-1004880	Issue Date	: 29-Feb-2024 16:16
Sampler	: CLIENT ----		
Site	: ----		
Quote number	: Q88011 - RFSQ No. Doc2938706981		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Nik Perkio	Inorganics Analyst	Waterloo Inorganics, Waterloo, Ontario
Niral Patel		Waterloo Centralized Prep, Waterloo, Ontario



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1345398)											
WT2403902-013	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.572 mS/cm	573	0.175%	20%	----
Physical Tests (QC Lot: 1345635)											
WT2403869-001	BH23-12 SS2	Moisture	----	E144	0.25	%	9.44	9.11	3.60%	20%	----
Physical Tests (QC Lot: 1346846)											
WT2403869-001	BH23-12 SS2	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	169	166	1.79%	25%	----
Physical Tests (QC Lot: 1347034)											
TY2401690-010	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.99	8.04	0.624%	5%	----
Inorganics (QC Lot: 1346009)											
EO2401299-001	Anonymous	Sulfides, acid volatile	----	E396-L	0.24	mg/kg	<0.24	<0.24	0.0005	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1347115)											
EO2401299-002	Anonymous	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	<20	0.008	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1347116)											
EO2401299-002	Anonymous	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Soil/Solid						
Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1345398)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1345635)						
Moisture	----	E144	0.25	%	<0.25	----
Inorganics (QCLot: 1346009)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Leachable Anions & Nutrients (QCLot: 1347115)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----
Leachable Anions & Nutrients (QCLot: 1347116)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----



Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Soil/Solid

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1345398)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	99.9	90.0	110	----
Physical Tests (QCLot: 1345635)									
Moisture	----	E144	0.25	%	50 %	98.8	90.0	110	----
Physical Tests (QCLot: 1347034)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	101	98.0	102	----
Inorganics (QCLot: 1346009)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	1.6 mg/kg	124	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1347115)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	5000 mg/kg	103	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1347116)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	5000 mg/kg	101	80.0	120	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Physical Tests (QCLot: 1345398)									
	RM	Conductivity (1:2 leachate)	----	E100-L	1384 µS/cm	101	70.0	130	----
Physical Tests (QCLot: 1346846)									
	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	97.7	90.0	110	----
Leachable Anions & Nutrients (QCLot: 1347115)									
	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	172 mg/kg	106	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1347116)									
	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	601 mg/kg	102	70.0	130	----

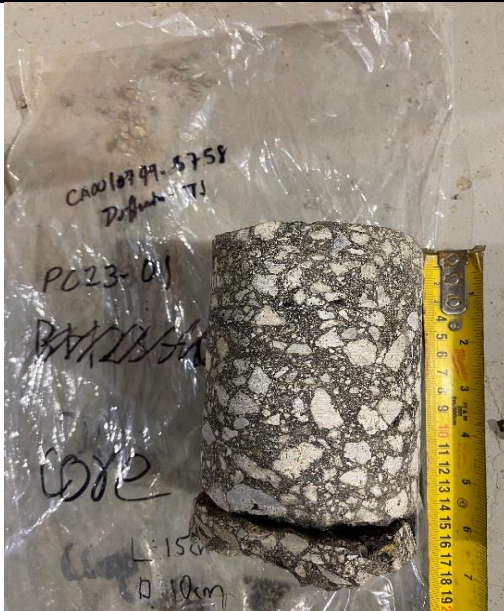


APPENDIX E

Corehole Logs



Pavement Core Log Dufferin Transfer Station



CORE ID PC23-01

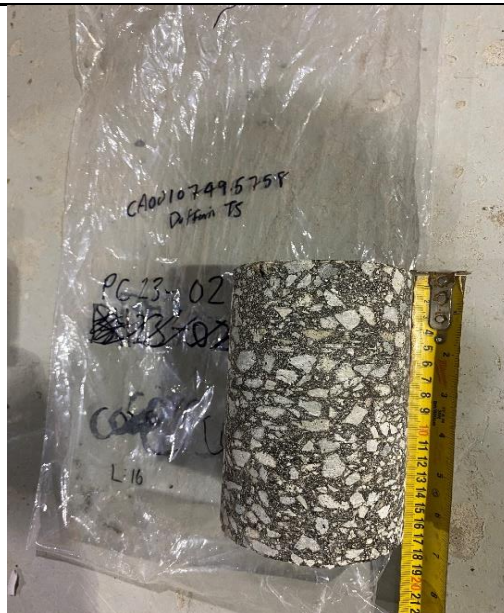
LIFT THICKNESS

Lift 1	40	mm
Lift 2	55	mm
Lift 3	40	mm
Lift 4	20	mm

CONCRETE THICKNESS - mm

TOTAL THICKNESS 155 mm

COMMENTS



CORE ID PC23-02

LIFT THICKNESS

Lift 1	40	mm
Lift 2	35	mm
Lift 3	45	mm
Lift 4	40	mm

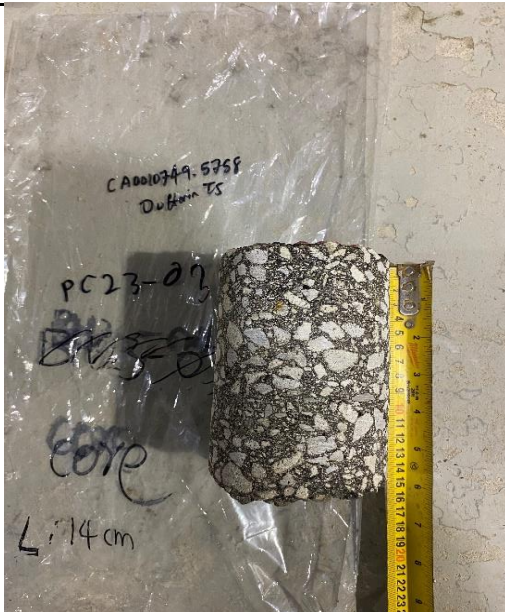
CONCRETE THICKNESS - mm

TOTAL THICKNESS 160 mm

COMMENTS



Pavement Core Log Dufferin Transfer Station



CORE ID PC23-03

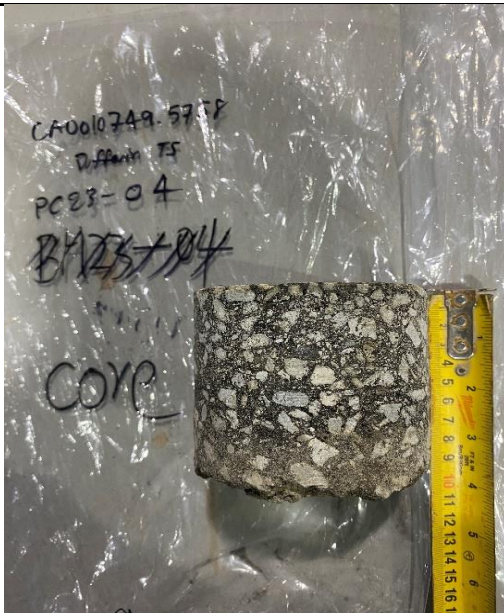
LIFT THICKNESS

Lift 1	45	mm
Lift 2	45	mm
Lift 3	50	mm

CONCRETE THICKNESS - mm

TOTAL THICKNESS 140 mm

COMMENTS



CORE ID PC23-04

LIFT THICKNESS

Lift 1	40	mm
Lift 2	45	mm

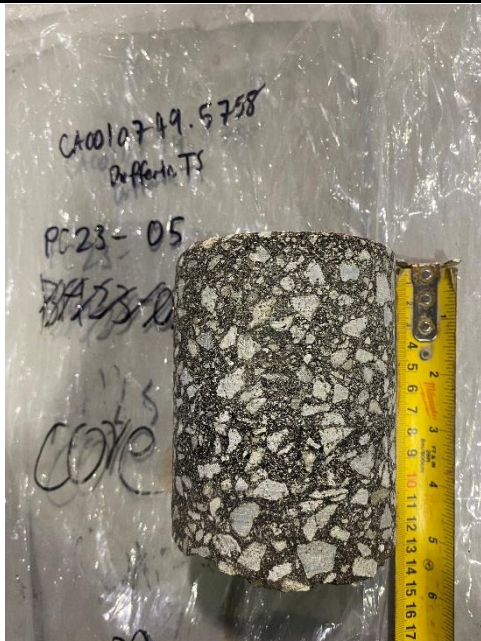
CONCRETE THICKNESS - mm

TOTAL THICKNESS 85 mm

COMMENTS



Pavement Core Log Dufferin Transfer Station



CORE ID PC23-05

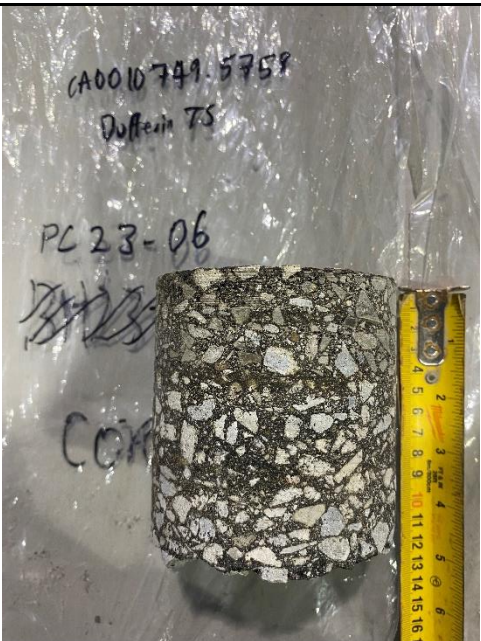
LIFT THICKNESS

Lift 1	70	mm
Lift 2	50	mm

CONCRETE THICKNESS - mm

TOTAL THICKNESS 120 mm

COMMENTS



CORE ID PC23-06

LIFT THICKNESS

Lift 1	40	mm
Lift 2	65	mm

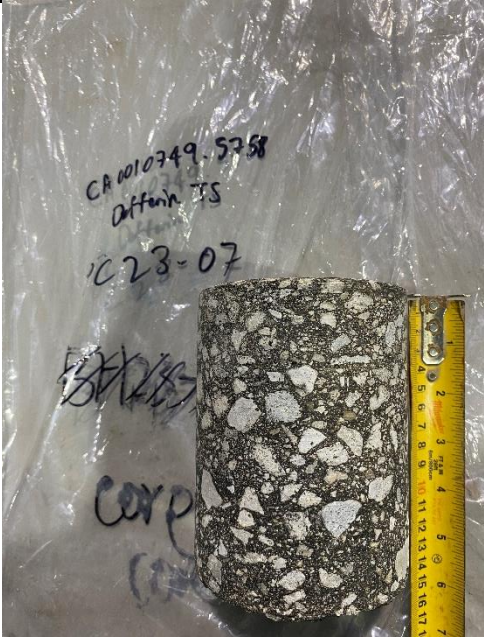
CONCRETE THICKNESS - mm

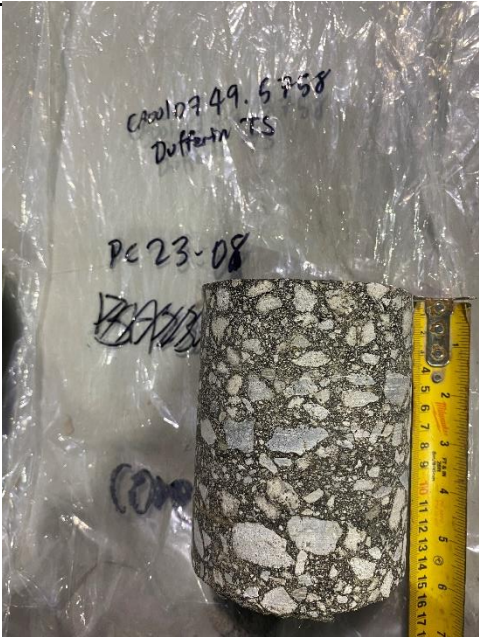
TOTAL THICKNESS 105 mm

COMMENTS



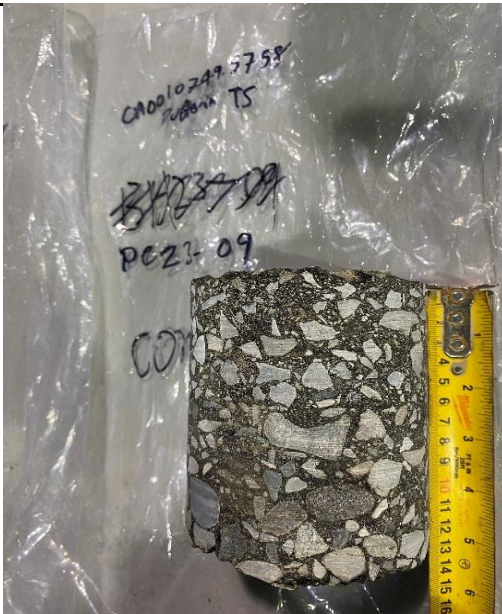
Pavement Core Log Dufferin Transfer Station

	CORE ID	PC23-07	
	LIFT THICKNESS		
	Lift 1	35	mm
	Lift 2	45	mm
	Lift 3	50	mm
	CONCRETE THICKNESS	- mm	
TOTAL THICKNESS	130 mm		
COMMENTS			

	CORE ID	PC23-08	
	LIFT THICKNESS		
	Lift 1	35	mm
	Lift 2	40	mm
	Lift 3	55	mm
	CONCRETE THICKNESS	- mm	
TOTAL THICKNESS	130 mm		
COMMENTS			



Pavement Core Log Dufferin Transfer Station



CORE ID PC23-09

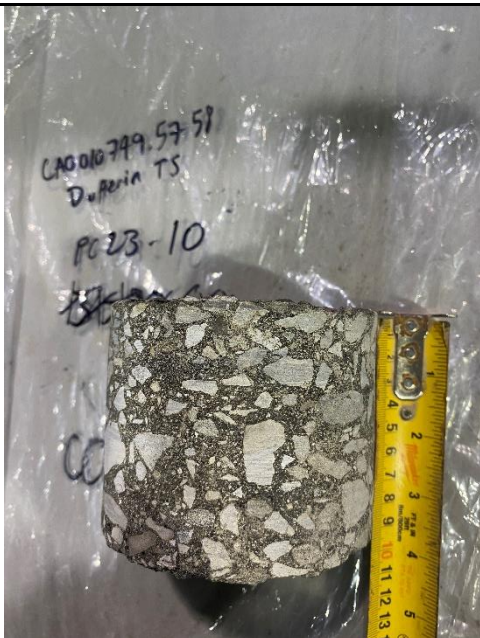
LIFT THICKNESS

Lift 1	55	mm
Lift 2	60	mm

CONCRETE THICKNESS - mm

TOTAL THICKNESS 115 mm

COMMENTS



CORE ID PC23-10

LIFT THICKNESS

Lift 1	35	mm
Lift 2	50	mm

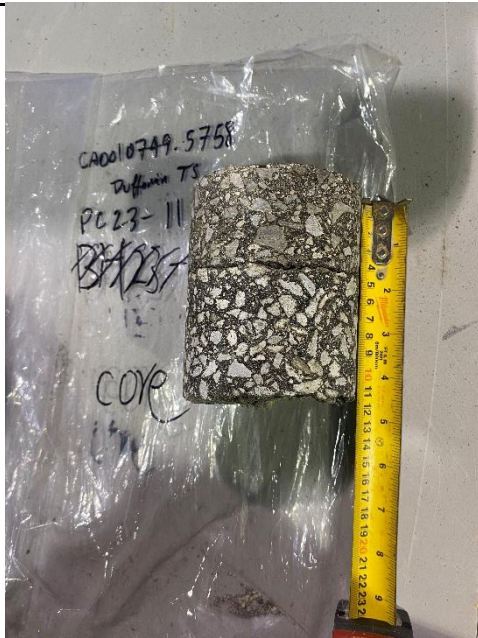
CONCRETE THICKNESS - mm

TOTAL THICKNESS 85 mm

COMMENTS



Pavement Core Log Dufferin Transfer Station



CORE ID PC23-11

LIFT THICKNESS

Lift 1	50	mm
Lift 2	60	mm

CONCRETE THICKNESS - mm

TOTAL THICKNESS 110 mm

COMMENTS

APPENDIX F

Asbestos Laboratory Test Results

Laboratory Analysis Report

To:

Michael Hu
WSP Canada Inc.
351 Steelcase Road West, Unit 9-12
Markham, Ontario
L3R 4H9

EMC LAB REPORT NUMBER: A101017

Job/Project Name: Dufferin Transfer Station

Analysis Method: Polarized Light Microscopy – EPA 600

Date Received: Feb 21/24

Date Analyzed: Feb 28/24

Analyst: Rahul Patel

Reviewed By: Malgorzata Sybydlo

Job No: CA0010794.5758/task 102

Number of Samples: 11

Date Reported: Feb 28/24

Client's Sample ID	Lab Sample No.	Description/Location	Sample Appearance	SAMPLE COMPONENTS (%)		
				Asbestos Fibres	Non-asbestos Fibres	Non-fibrous Material
PC23-01	A101017-1	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	<0.25*	100
PC23-02	A101017-2	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	<0.25*	100
PC23-03	A101017-3	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	<0.25*	100
PC23-04	A101017-4	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	0.46*	99.54
PC23-05	A101017-5	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	0.46*	99.54
PC23-06	A101017-6	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	<0.25*	100
PC23-07	A101017-7	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	0.46*	99.54
PC23-08	A101017-8	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	<0.25*	100
PC23-09	A101017-9	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	<0.25*	100
PC23-10	A101017-10	Asphalt composite sample/Dufferin transfer station	Black, tar	ND		100
PC23-11	A101017-11	Asphalt composite sample/Dufferin transfer station	Black, tar	Chrysotile	<0.25*	100

Note:

1. Bulk samples are analyzed using Polarized Light Microscopy (PLM) and dispersion staining techniques. The analytical procedures are in accordance with EPA 600/R-93/116 method.

EMC LAB REPORT NUMBER: A101017

Client's Job/Project Name/No.: CA0010794.5758/task 102

Analyst: Rahul Patel

2. The results are only related to the samples analyzed. **ND** = None Detected (no asbestos fibres were observed), **NA** = Not Analyzed (analysis stopped due to a previous positive result).
 3. This report may not be reproduced, except in full without the written approval of EMC Scientific Inc. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.
 4. The Ontario Regulatory Threshold for asbestos is 0.5%. The limit of quantification (LOQ) is 0.5%.
 5. Samples analyzed by gravimetric method.
- *Sample analyzed by 400 point count method. The limit of quantification (LOQ) is 0.25%

APPENDIX G

**General Requirements for
Engineered Fill**



GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

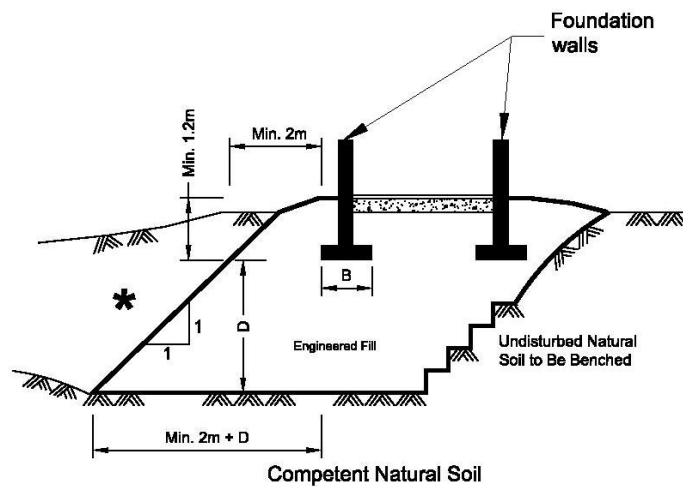
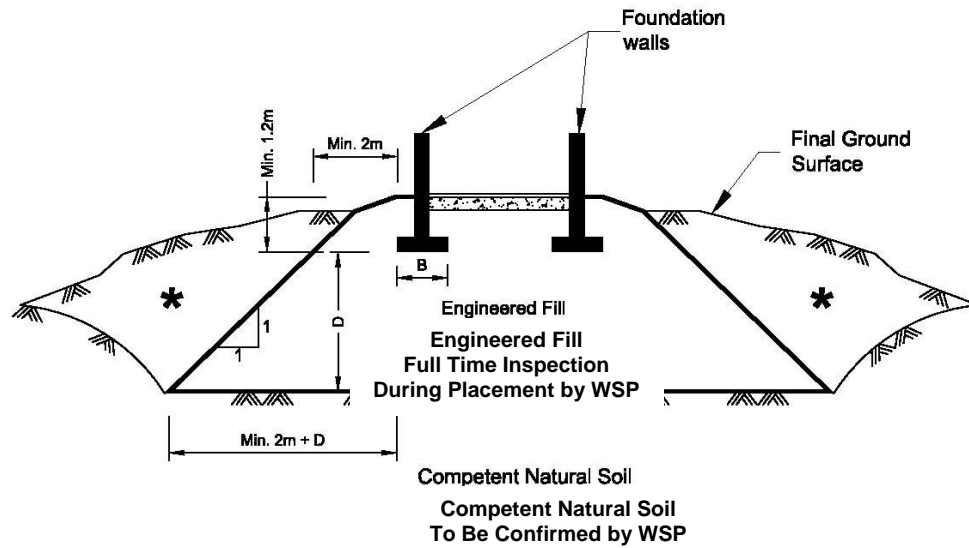
To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows, however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.
2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.
3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and WSP Canada Inc. Without this confirmation no responsibility for the performance of the structure can be accepted by WSP Canada Inc. Survey drawing of the pre and post fill location and elevations will also be required.
4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a WSP Canada Inc. engineer prior to placement of fill.



5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.
6. Full-time geotechnical inspection by WSP Canada Inc. during placement of engineered fill is required. Work cannot commence or continue without the presence of the WSP Canada Inc. representative.
7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.
8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.
9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from WSP Canada Inc. prior to footing concrete placements. All excavations must be backfilled under full time supervision by WSP Canada Inc. to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of WSP Canada Inc.
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.
12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.
13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with WSP Canada Inc. report attached.



* Backfill in this area to be as per WSP report.

