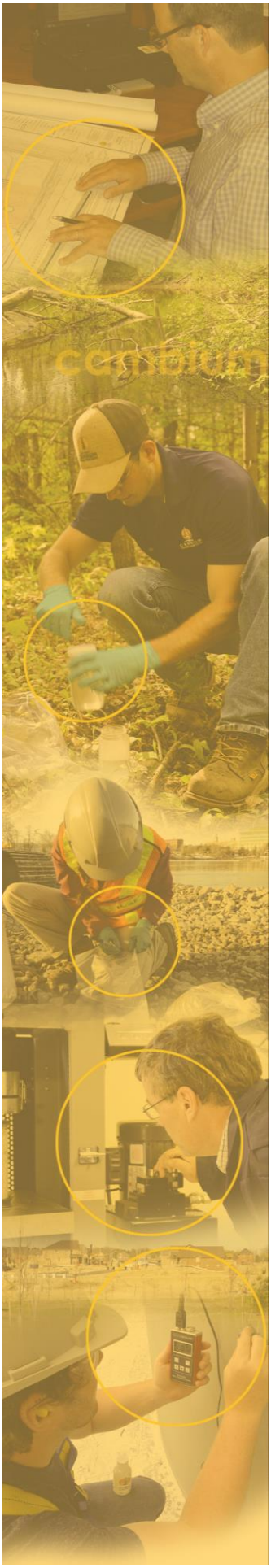

Geotechnical Investigation Report MBQ - Boat Launch Replacement

Cambium Reference No.: 13167-001

July 14, 2021

Prepared for: Mohawks on the Bay of Quinte

Cambium Inc.

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cambium-inc.com

TABLE OF CONTENTS

LIST OF INSERTED TABLES

LIST OF APPENDED FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

Cambium Inc. (Cambium) was retained by the Mohawks on the Bay of Quinte (Client) to undertake a geotechnical investigation at the boat launch ramp at the end of Ferry Lane in Tyendinaga Mohawk Territory, Ontario (Site). The purpose of the investigation was to identify the subsurface conditions and provide specific geotechnical recommendations as input into the planning and design of the replacement of the above noted boat launch ramp. Additional improvements may include but are not limited to: upgraded concrete piers for boat unloading and paving of the roadway leading to the concrete ramp. The purpose of the investigation was to identify the existing site conditions including concrete thicknesses, granular base and subbase thicknesses, groundwater conditions and include recommendations pertaining to pavement and boat launch rehabilitation.

This report presents the methodology and findings of the geotechnical investigation at the Site and provides geotechnical recommendations for the design and rehabilitation of the ramp.

2.0 METHODOLOGY

2.1 BOREHOLE INVESTIGATION

A borehole investigation was conducted at the Site on June 9, 2021 to assess subsurface conditions. A total of three (3) boreholes, designated as BH101-21 through BH103-21, were strategically placed and advanced to depths ranging between 0.7 to 1.7 meters below ground surface (mbgs) where bedrock refusal was encountered. All borehole locations are shown in Figure 1. The location of each borehole was referenced locally by a Cambium technician with UTM coordinates included on the borehole logs provided in Appendix A.

Drilling and sampling was completed using a track-mounted drill rig operating under the supervision of a Cambium technician. The boreholes were advanced to the sampling depths by means of continuous flight solid stem augers. Soil samples were collected at approximately 0.75 m intervals, starting directly below the surface, or whenever a change in soil type occurred. The encountered soil units were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, future reference, possible laboratory testing, and storage. Open boreholes were checked for groundwater and general stability prior to backfilling. All boreholes were backfilled in accordance with O.Reg. 903, as amended, and the property was reinstated to pre-existing conditions.

Borehole logs are provided in Appendix A. Site soil and groundwater conditions are described and geotechnical recommendations are discussed in the following sections of this report.

2.2 PHYSICAL LABORATORY TESTING

Physical laboratory testing, including two (2) sieve analyses (LS-702), was completed on selected soil samples to confirm textural classification and granular reuse potential, and to assess geotechnical parameters. Moisture content testing was completed on all soil samples prior to completing the sieve analysis. Results are presented in Appendix B and are discussed in Section 3.0.

3.0 SUBSURFACE CONDITIONS

The general site conditions consist of 20 mm to 50 mm of asphalt or gravel north of the existing ramp while the ramp itself contained 100 mm of concrete. Below the pavement structure, material containing mostly sand mixed with gravels and silts was encountered. In general, the sand and gravel soil material encountered extended to borehole termination depths while experiencing an increase in silt, clay, and gravel content with depth. The individual soil units are described in detail below with borehole logs for each location attached in Appendix A.

3.1 PAVEMENT / ROAD STRUCTURE

All three (3) boreholes were advanced into the existing surface structure. The encountered surface materials and thicknesses are summarized in Table 1 below:

Table 1 Exisiting Surface Material Thickness

Boreholes	Thickness (mm)
BH101-21 (Asphalt)	20
BH102-21 (Concrete)	100
BH103-21 (Gravel)	50

Boreholes BH101-21 and BH103-21 were advanced into the asphalt and gravel surfaces, respectively, north of the existing ramp. Directly underlying the asphalt, BH101-21 encountered a gravelly sand extending to a depth of 0.6 mbgs. The gravelly sand was found to be black to brown, dense, and moist at the time of the investigation. Underlying the gravelly sand, a sand and gravel soil was encountered and extended to the maximum depth explored (0.69 mbgs). Borehole BH103-21 encountered approximately 50 mm of gravel that resembled a Granular A material, and then transitioned to a sand and gravel soil extending to approximately 0.65 mbgs. The sand and gravel soil had some silt and was generally found to be brown, compact, and moist at the time of the investigation. Underlying the sand and gravel layer, a gravely sand soil was encountered from 0.65 mbgs to 0.76 mbgs, the soil was described as a grey to brown, compact gravelly sand with trace amounts of silt.

BH102-21 was advanced directly into the concrete surface of the existing ramp. Directly beneath the concrete surface, soil material described as a brown gravelly sand with varying amounts of silt and trace clay was observed until a depth of approximately 1.2 mbgs. A soil density change from loose to compact was noted at 0.76 m, however, the soil remained consistent.

The granular road structure material has a loose to dense relative density based on SPT N values ranging from 7 to 40 for 305 mm of penetration and was slightly moist to wet at the time of the investigation with a natural moisture content ranging from 3.2 to 31.1%.

Laboratory particle size distribution analyses were completed for two (2) samples of the granular material, taken from immediately below the asphalt surface. The analysis results, based on the Unified Soil Classification System (USCS) scale, are summarized in Table 2 with full results provided in Appendix B.

Table 2 Particle Size Distribution Analysis – Granular Fill

Sample	Depth (mbgs)	Soil	Gravel (%)	Sand (%)	Silt and Clay (%)
BH102-21 SS1	0.1 – 0.7	Gravel and Sand some Silt	46	42	12
BH103-21 SS1	0.2 – 0.7	Sand and Gravel some Silt	41	44	15

The results of the laboratory testing indicate that the granular fill meets the OPSS 1010 requirements for pavement base material and may be reused as subbase fill.

3.2 NATIVE SUBGRADE SOILS

Native subgrade soils were not believed to be encountered in BH101-21 as the termination depth is believed to have occurred directly underneath the pavement structure fill material.

In BH103-21, a thin layer of silty sand material was encountered beneath the presumed fill material and extended to a depth of 0.84 mbgs before encountering bedrock refusal. The silty sand soil layer can be described as brown, very dense, with some gravel and trace amounts of clay.

In BH102-21, material consisting of a sand and gravel mixture was encountered between approximately 1.2 mbgs and the borehole termination depth of 1.67 mbgs. The soil material resembled the silty sand material encountered in BH103-21, however, the material appeared to contain a higher gravel content. Between 1.22 mbgs and 1.52 mbgs, the soil was described as a grey compact sandy gravel with trace amounts of silt. At 1.52 mbgs, the soil transitioned to a grey, very dense sand and gravel mixture with trace amounts of silt and clay and extended to bedrock refusal at 1.67 mbgs.

3.3 GROUNDWATER

All boreholes were checked for caving (sloughing) and/or groundwater seepage upon completion. Table 3 shows the groundwater level and caving depths at the time of the investigation. Groundwater was encountered at approximately 0.46 mbgs in BH102-21, however, the borehole remained dry upon completion to a depth of 0.76 mbgs. This suggest that the groundwater may have been localized and drained below the caving depth.

Table 3 Groundwater and Borehole Caving Depths

Borehole	Groundwater Level in Borehole Upon Completion (mbgs)	Depth of Borehole Caving (mbgs)
BH101-21	-	-
BH102-21	-	0.76
BH103-21	-	-

It should be noted that soil moisture and groundwater levels at the Site may fluctuate seasonally and in response to climatic events. Given the proximity of the boat launch to the Bay of Quinte, groundwater levels are likely to fluctuate with fluctuations in Lake Ontario's water levels. On June 9, 2021 the International Lake Ontario – Saint Lawrence River Board on behalf of the International Joint Commission (IJC) recorded the surface water level of Lake Ontario at 74.71 mASL.

3.4 BEDROCK

Auger refusal was encountered in all boreholes, based on known local geology it is presumed that refusal was encountered due to bedrock, Table 4 shows the depth at which presumed bedrock was encountered in each borehole.

Table 4 Depth to Bedrock

Boreholes	Presumed Bedrock Depth (mbgs)
BH101-21	0.69
BH102-21	1.67
BH103-21	0.84

4.0 GEOTECHNICAL CONSIDERATIONS

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

4.1 SITE PREPARATION

Any topsoil, organic fill, and any other disturbed material or native soils encountered should be excavated and removed beneath the proposed development footprints. These materials should be excavated and removed to a minimum distance of 1 m around any proposed footprint. Any topsoil and materials with significant quantities of organics and deleterious materials (i.e., construction debris, asphalt etc.) are not appropriate for use as fill. Subgrades should be inspected by a qualified geotechnical engineer prior to construction of the proposed developments.

Any exposed subgrades should be proof-rolled and inspected by a qualified geotechnical engineer prior to placement of any granular fill. Any loose/soft soils identified at the time of proof-rolling that are unable to uniformly be compacted should be sub-excavated and removed. The excavations created through the removal of these materials should be backfilled with approved engineered fill consistent with the recommendations provided below.

The encountered sand soils can be unstable if they are wet or saturated. Such conditions are common in the spring and late fall. Under these conditions, temporary use of granular fill, and possible reinforcing geotextiles, may be required to prevent severe rutting on construction access routes. Where possible, the existing roadways should be used for construction access routes.

4.2 FROST PENETRATION

Based on climate data and design charts, the maximum frost penetration depth below the surface at the site is estimated at 1.5 mbgs. Exterior strip, spread footings, or mat foundations used to found any proposed piers should be founded at or below a depth of 1.5 mbgs. Where foundations extend from above to below the groundwater table / lake surface water, the foundations should be constructed on non-frost susceptible fill materials or consist of insulated foundations.

4.3 EXCAVATION AND SHORING

All excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA). The generally gravelly sand to sandy gravel fill material and compact silty sand and sandy silts may be classified as Type 3 soils above the groundwater table in accordance with OHSA. Type 3 soils may be excavated

with unsupported side slopes no steeper than 1H:1V. If the groundwater table is encountered during construction, below the groundwater table the soils may be classified as Type 4 soils and may be excavated with unsupported side slopes no steeper than 3H:1V.

Excavation side slopes should be protected from exposure to precipitation and associated ground surface runoff and should be inspected regularly for signs of instability. If localized instability is noted during excavation or if wet conditions are encountered, the side slopes should be flattened as required to maintain safe working conditions or the excavation sidewalls must be fully supported (shored). If temporary shoring is required, lateral pressures outlined in Section 4.7 should be applied to determine the appropriate shoring requirements. In the event that shoring is required, sheet piles or soldier piles and lagging is likely the most cost-effective method.

4.4 DEWATERING

Groundwater was encountered borehole BH102-21 as noted in Section 3.6. It is noted that the elevation of the groundwater table will vary due to seasonal conditions and in response to heavy precipitation events. The length of the proposed boat launch and associated infrastructure is currently unknown, therefore, the depth to which the development will advance into Lake Ontario is unknown as well.

Based on the groundwater conditions measured after completing the borehole drilling and provided the following foundation recommendations are followed, little to no groundwater seepage is anticipated in excavations above the lake surface water. However, excavations advanced below the ground water table or below the lake surface water level, seepage is to be expected and a Permit to Take Water (PTTW) or registration on the Environmental Activity and Sector Registry (EASR) through the Ministry of the Environment Conservation and Parks (MOECP) may be required if pumping rates exceed 50,000 L/day.

Excavations below the ground surface water will likely require damming and dewatering. Depending on the extent to which the boat launch is advanced into Lake Ontario and the surface water level at the time of construction, minor damning through use of sandbags or quick dam flood barriers may be possible. If excavations are required into deeper waters, cofferdams may be required to minimize lake water seepage into the construction area. Ground or lake water seepage into the construction area should then be controllable through the use of sumps and pumps. Once a design has been finalized, Cambium should be contacted to provide recommendations for any dewatering requirements on site.

4.5 BACKFILL AND COMPACTION

Excavated topsoil, if any, from the site is not appropriate for use as fill. Excavated gravelly sand and sandy gravel soil from the site, not containing organics, may be appropriate for use as fill below grading, provided that the actual or adjusted moisture content at the time of construction is within a range that permits compaction to required

densities. Some moisture content adjustments may be required depending upon seasonal conditions. Geotechnical inspections and testing of engineered fill are required to confirm acceptable quality.

Any engineered fill below foundations or Granular A bedding for a concrete boat launch ramp should be placed in maximum 200 mm thick lifts and should be compacted to a minimum of 100% of standard Proctor maximum dry density (SPMDD). If conditions are wet at the time of construction, compaction of granular fill may not be possible and 19 mm diameter crushed clear stone wrapped in a geotextile filter fabric (Terrafix 270R or equivalent) should be used in place of engineered fill and/or bedding.

Placement of engineered fill backfill should be verified by onsite compaction testing during construction.

4.6 FOUNDATION DESIGN & BEARING CAPACITIES

Design and construction recommendations for potential foundation systems of boat launch piers are required and outlined below. In the event that the site is be regraded, our foundation recommendations may change depending upon the final grades. Cambium should be contacted to review the final grading plan and provide any necessary changes to our foundation recommendations.

4.6.1 SHALLOW FOUNDATIONS

The following foundation design recommendations are meant for proposed developments which will utilize continuous perimeter strip footings or isolated spread footings. The quality of the subgrade should be inspected by Cambium during construction, prior to constructing the footings, to confirm bearing capacity estimates. Settlement potential at the noted serviceability limit state (SLS) loadings should be less than 25 mm and differential settlement should be less than 10 mm.

The native material encountered onsite is not considered suitable for a bearing material. Where encountered at footing elevations, the material should be over excavated to bedrock and the footings either placed on bedrock or on compacted non-frost susceptible OPSS 1010 Granular ‘B’ Type II granular material overlying bedrock. If Granular ‘B’ Type II is utilized as an engineered fill extending from bedrock up to the underside of proposed footing elevation, the footings may be designed for an allowable bearing capacity of 125 kPa at SLS and 150 kPa at ULS.

If excavations extend to bedrock, the bedrock surface should be inspected by Cambium personnel prior to placement of the foundation to ensure the surface consists of sound bedrock, free of loose debris and cobbles. Foundations bearing on sound clean bedrock can be designed for an allow bearings capacity of 400 kPa at SLS and 500 kPa ULS.

Alternatively, to reduce the risk of foundations being undermined due to wave uprush, infrastructure that is to be founded below the surface water elevation can be constructed of large armour stone founded on 300 mm of 50 mm

clear stone bedding. The clear stone bedding should be placed on competent native material and should inspected and approved by Cambium personnel prior to placement.

4.6.2 BOAT LAUNCH RECOMMENDATIONS

Our understanding is the boat lanuch is likely to consist of a 150 mm reinforced concrete ramp completer with perimeter thickening. Where the launch extends below surface water levels, the launch is to continue as steel grating on beams bearing on concrete footings at each end. To reduce the depth of excavations into native material at the site required to expose bedrock, the boat launch may be constructed on geotextile geogrid (Terrafix TBX1500 or equivalent) founded on competent material inspected by Cambium personnel prior to placement. All topsoil and organic materials should be removed down to native material and backfilled, where necessary, with approved engineered fill or native material, compacted to 98% of SPMDD. The subgrade should be proof rolled and inspected by a Geotechnical Engineer. Any areas where boulders, rutting, or appreciable deflection is noted should be subexcavated and replaced with suitable fill. The fill should be compacted to at least 98% of SPMDD. The reinforced concrete slab may then be founded on 300mm of 50 mm clear stone over the aforementioned geogrid. Consideration should be given to the design of the toe the ramp, particularly keying the toe to reduce the risk of undermining of the toe occurring.

4.7 EROSION PROTECTION

The existing subsoils at the lake surface water level consist of sand to sand and gravel. It is assumed that seasonal water flow velocities and wave uprush will be sufficiently high to require scour and erosion protection.

In order to prevent water from flowing either beneath the boat launch or any associated infrastructure (potentially causing undermining and scouring), or around isolated footings (causing erosion and loss of backfill material), a clay seal or cut-off headwall should be considered.

Erosion protection should be provided around the entirety of the submerged portions of the boat launch using non-woven geotextiles and rip-rap suitable for the hydraulic requirements.

4.8 BACKFILL AND LATERAL EARTH PRESSURES

Backfill for any areas requiring engineered fill, should be accomplished using free-draining, non-frost susceptible granular material complying with OPSS 1010 placed in lifts not exceeding 250 mm in thickness and compacted to 98 % of standard Proctor maximum dry density (SPMDD).

Lateral earth pressure coefficients (K) for the box culvert are provided below. It is assumed that potential lateral loads will result from cohesionless, frictional materials, such as granular backfill.

Ko (at rest)	0.42

Ka (active)	0.27
Kp (passive)	3.7

The following formula may be used to calculate active lateral thrust (Pa) on yielding retaining structures;

$$Pa = (H/2)(Ka)(\gamma H + 2q)$$

where,

H = Height of retaining structure (m)

γ= unit weight of retained soil (kN/m^3)

q = surcharge (kPa)

A unit weight of 22 kN/m^3 should be assumed for compacted granular backfill loadings.

4.9 PAVEMENT RECONSTRUCTION DESIGN

It is understood that the proposed reconstruction is to replace the entirety of the concrete boat launch area and potentially rehabilitate the section of asphaltic concrete between the boat launch and Ferry Lane. The following sections are meant to assist designers, recommendations should not be construed as providing instructions to contractors.

4.9.1 ASPHALTIC CONCRETE PAVEMENT REHABILITATION

For the section of road between Ferry Lane to the boat launch as well as any parking areas, the preferred rehabilitation treatment will involve full depth reclamation of the existing asphaltic concrete into the existing granular material to a depth of 200 mm to obtain at most a 50/50 blend of RAP and granular material. The resulting material should be graded and compacted, followed by proof rolling under the supervision of Cambium personnel. Any noticeably soft areas should be subexcavated and replaced with suitable earth borrow that is compatible with the subgrade soils and/or OPSS.MUNI Granular A or B Type II depending upon the depth of removal. Excess material should be removed from the blended material to result in a grade raise within the tolerance allowed for the subject roadway. Without removal of excess material the rehabilitation procedure outlined below will result in a grade raise of approximately 150 mm. If a grade raise is acceptable, a minimum of 100 mm RAP material can be left in place, regraded and compacted prior to placement of Granular A and asphalt.

A 50 mm thick layer of new OPSS.MUNI Granular A should then be placed and compacted prior to the placement of the asphaltic concrete. The layer of Granular A should provide a level paving platform as well as mitigate the effects of future reflective cracking. All new granular materials should be placed and compacted in maximum lifts of 300 mm and compacted to 98% of the Standard Proctor Maximum Dry Density (SPMDD) value as per ASTM D698.

A total thickness of 100 mm of new HMA comprising one (1) 40 mm thick layer of Superpave 12.5 Traffic Level C over one (1) 60 mm thick layer of Superpave 19.0 Traffic Level CIf desirable, the Superpave 12.5 HMA may be replaced with HL-3, and the Superpave 19.0 HMA may be replaced with HL-8, both conforming to OPSS.MUNI 1150.

4.9.2 PAVEMENT TRANSITIONS

The following transition treatment is suggested to improve the performance of the joint between the new and the existing or resurfaced pavements:

- Neatly saw cut the existing asphaltic concrete;
- Remove the asphaltic concrete and slope the bottom of the excavation within the existing granular base and subbase at 1 horizontal to 1 vertical, or flatter, to avoid undermining of the existing asphaltic concrete.
- To avoid cracking of the asphaltic concrete due to an abrupt change in the thickness of the roadway granular materials where new pavement areas join with the existing pavements, the granular depths should taper up or down at 3 horizontal to 1 vertical, or flatter, to match the existing pavement structure.
- Remove (mill off) 50 mm of the existing asphaltic concrete to a distance of 300 millimetres at the joint and tack coat the asphaltic concrete at the joint in accordance with the requirements in OPSS 310.

4.10 DRAINAGE

As required, the shoulder areas will be built up with existing material and/or newly placed Granular A material during the regrading of the roadway or parking areas to ensure adequate cross fall of the roadway is at a minimum of 2% and any shoulders at a minimum of 5%. The underlying subgrade should also be sloped and crowned to match the overlying pavement grades to promote positive drainage. Adequate ditching should be in place wherever possible to facilitate drainage of the granular road base. The boat launch design should be sufficiently graded to allow for sufficient drainage.

4.11 REUSE OF EXISTING MATERIAL

The existing granular material meets the gradation requirements for OPSS.MUNI Granular B Type II. The material is suitable for reuse as pavement subbase material or grade raise fill, provided that it is tested and approved by geotechnical personnel prior to placement.

All reused material should be placed in maximum lifts of 300 mm and compacted to 98% of the SPMDD.

4.12 DESIGN REVIEW AND INSPECTIONS

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

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

5.0 CLOSING

Cambium trusts that this report meets your requirements at this time. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (613) 389-2323.

Respectfully submitted,

CAMBIUM INC.

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SEB/mdg

\\camfile\Projects\13100 to 13199\13167-001 MBQ - GEO - Boat Launch Ramp, Desoronto\Deliverables\REPORT - GEO\Final\2021-07-14 13167-001 MBQ Boat Launch Geotechnical Investigation

Appended Figures

GEOTECHNICAL INVESTIGATION

MOHAWKS ON THE BAY OF QUINTE
Ferry Lane
Tyendinaga, Ontario

LEGEND

- Benchmark
- Borehole

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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BOREHOLE LOCATION PLAN

Project No.: 13167-001	Date: June 2021 Rev.:	
Scale: 1:1,000	Projection: NAD 1983 UTM Zone 18N	
Created by: TLC	Checked by: MDG	Figure: 1

O:\GIS\MXDs\13100-13199\13167-001 MBQ - GEO - Boat Launch Ramp, Desoronto\2021-06-16 FIG 1 - Borehole Location Plan.mxd

Appendix A

Borehole Logs

Peterborough
Barrie
Oshawa
Kingston
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Log of Borehole: BH101-21

Client: Mohawks on the Bay of Quinte
Project Name: MBQ - Ferry Lane Boat Launch
Project No.: 13167-001
Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Date Completed: June 9th, 2021
Location: 35 Ferry Lane, Deseronto, ON
UTM: 18 T **N:** 4893754.37 **E:** 333376.17
Elevation: 76.9

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	TYpe	% Recovery	SPT (N)/DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (20 40 60 80)	Well Installation	Log Notes
76.90 / 76.88 / 0		ASPHALT 20mm Asphalt								
0.1										
0.2		GRAVELLY SAND black to brown, dense, moist								
0.3										
0.4			1	SS	76	50	6.3%			
0.5										
76.29 / 0.6										
		SAND AND GRAVEL grey to brown, very dense, moist, occasional cobbles	2	SS	–	–	3.2%			Depth = 0.69m SPT refusal encountered.
0.7										Depth = 0.76m Auger refusal encountered. BH terminated on presumed Bedrock.
0.8		END OF BOREHOLE @ 0.76 m								
0.9										
1										
1.1										
1.2										
1.3										
1.4										
1.5										
1.6										
1.7										
1.8										

GRAINSIZE DISTRIBUTION: DEPTH | GRAVEL | SAND | SILT | CLAY

Logged By: Farhan Imtiaz **Input By:** Farhan Imtiaz

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Oshawa
Kingston
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Log of Borehole: BH102-21

Client: Mohawks on the Bay of Quinte
Project Name: MBQ - Ferry Lane Boat Launch
Project No.: 13167-001
Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Date Completed: June 9th, 2021
Location: 35 Ferry Lane, Deseronto, ON
UTM: 18 T **N:** 4893733.24 **E:** 333384.87
Elevation: 75.7

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	TYpe	% Recovery	SPT (N)/DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (20 40 60 80)	Well Installation	Log Notes
75.70 / 0		CONCRETE 100mm Concrete								
75.60 / 0.1		SAND AND GRAVEL brown, loose, moist, some silt, trace clay	1	SS	33	7	14.7%			Depth = 0.46m Depth of first groundwater encounter. Depth = 0.76m Depth of borehole caving.
74.94 / 0.8		GRAVELLY SAND brown, compact, wet, trace silt, trace clay	2	SS	38	10	31.1%			
74.48 / 1.2		SANDY GRAVEL grey, compact, moist, trace silt	3	SS	–	–	9.6%			
74.18 / 1.5		SAND AND GRAVEL grey, very dense, wet, trace silt, trace clay	4	SS	17	50	43.5%			Depth = 1.67m SPT refusal encountered. Depth = 1.76m Auger refusal encountered. BH terminated on presumed Bedrock.
1.8		END OF BOREHOLE @ 1.76 m								

GRAINSIZE DISTRIBUTION	DEPTH	GRAVEL	SAND	SILT	CLAY
	0.1	46	42	12	

Logged By: Farhan Imtiaz **Input By:** Farhan Imtiaz

Peterborough
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Log of Borehole: BH103-21

Client: Mohawks on the Bay of Quinte
Project Name: MBQ - Ferry Lane Boat Launch
Project No.: 13167-001
Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Date Completed: June 9th, 2021
Location: 35 Ferry Lane, Deseronto, ON
UTM: 18 T **N:** 4893748.98 **E:** 333377.77 **Elevation:** 76.8

SUBSURFACE PROFILE			SAMPLE							
Elevation (m)	Depth	Lithology	Description	Number	TYpe	% Recovery	SPT (N)/DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (20 40 60 80)	Well Installation	Log Notes
76.80	0										Depth = 0.01m Borehole advanced through gravel surface between concrete ramp and asphalt on Ferry Lane.
76.75			GRAVEL 50mm Gravel Surface								
	0.1		SAND AND GRAVEL brown, compact, moist, some silt								
	0.2										
	0.3										
	0.4			1	SS	42	10	4.5%			
	0.5										
	0.6										
76.14											
	0.7		GRAVELLY SAND grey to brown, compact, moist, trace silt	2	SS	–	–	8.3%			
76.04											
	0.8		SILTY SAND brown, very dense, moist, some gravel, trace clay	3	SS	4	50	12.0%			Depth = 0.84m SPT refusal encountered.
	0.9		END OF BOREHOLE @ 0.91 m								Depth = 0.91m Auger refusal encountered. BH terminated on presumed Bedrock.
	1										
	1.1										
	1.2										
	1.3										
	1.4										
	1.5										
	1.6										
	1.7										
	1.8										

GRAINSIZE DISTRIBUTION

DEPTH	GRAVEL	SAND	SILT	CLAY
0.15	41	44	15	

Logged By: Farhan Imtiaz **Input By:** Farhan Imtiaz

Appendix B

Physical and Chemical Laboratory Testing Results

Grain Size Distribution Chart

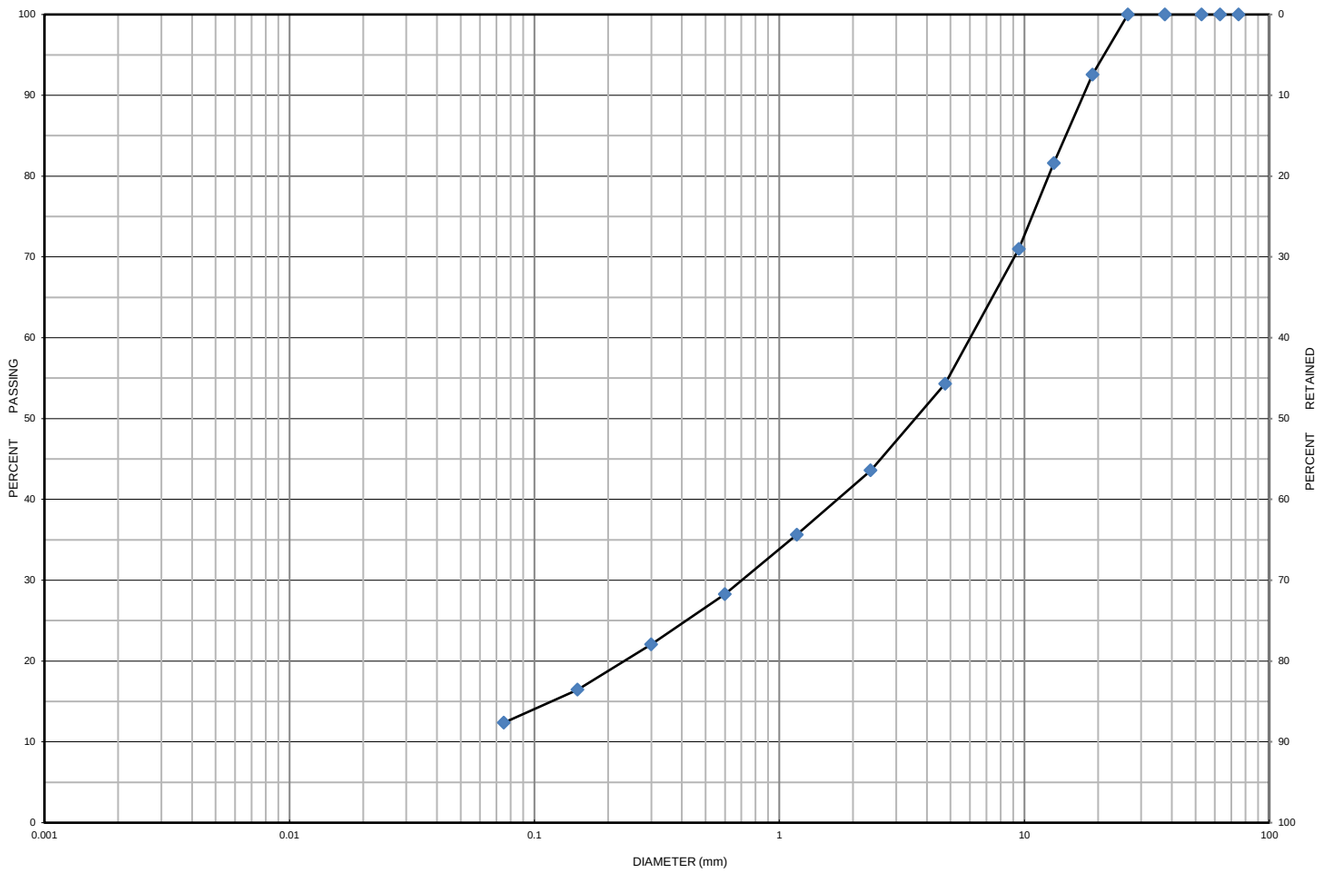
Project Number: *13167-001* **Client:** *Mohawks of the Bay of Quinte*

Project Name: *Geotechnical Investigation - MBQ Boat Launch Ramp, Desoronto*

Sample Date: *June 9, 2021* **Sampled By:** *Mackenzie Garrison - Cambium Inc.*

Location: *BH 102-21 SS 1* **Depth:** *0.1 m to 0.7 m* **Lab Sample No:** *S-21-0658*

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



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

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 102-21	SS 1	0.1 m to 0.7 m	46	42	12		14.7

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravel and Sand some Silt	SP	1.600	0.700	0.000	-	-

Additional information available upon request

Issued By: _____ (Senior Project Manager) *Date Issued:* *June 22, 2021*

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Form: L6V.2 - Grad.Hydo

Grain Size Distribution Chart

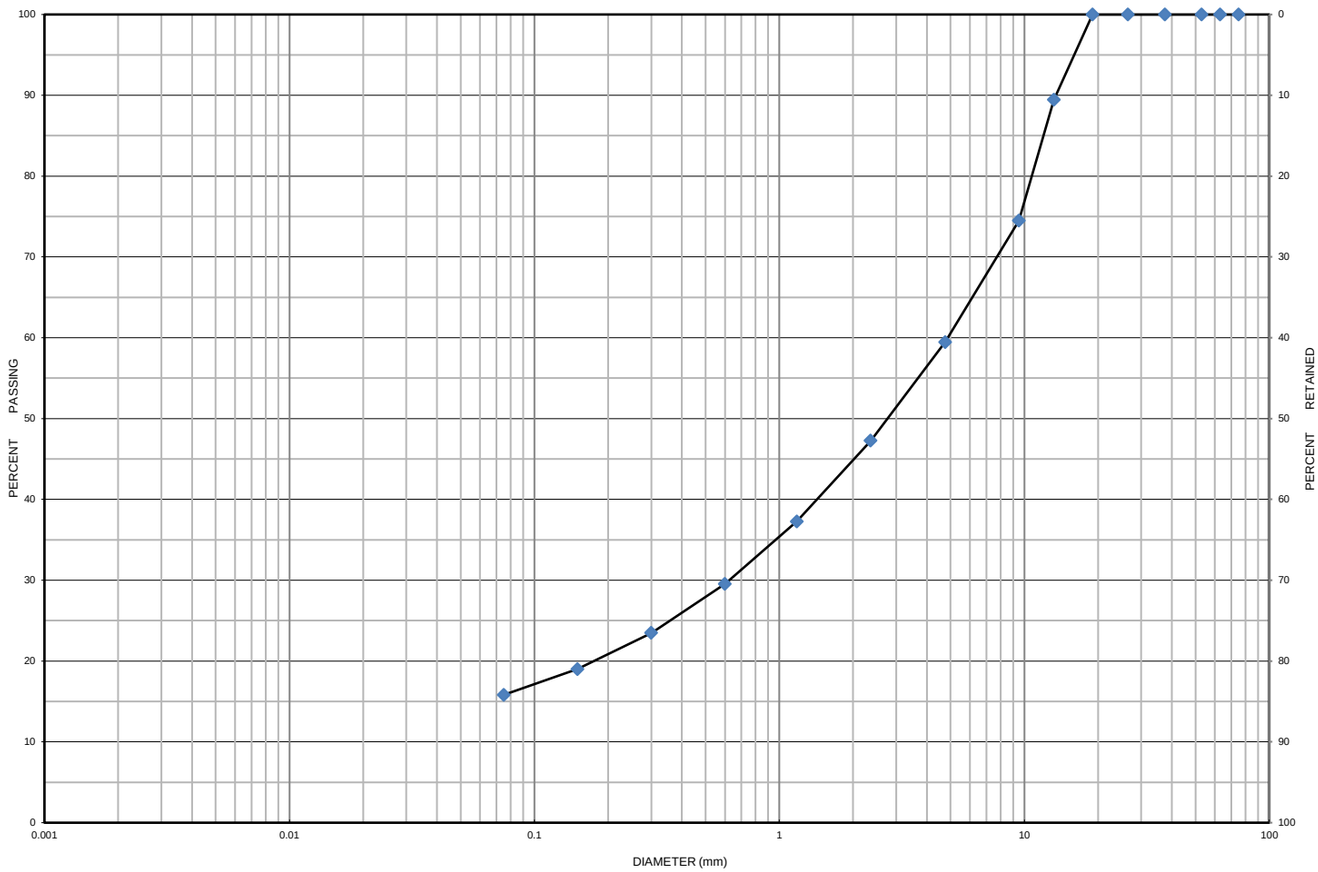
Project Number: *13167-001* **Client:** *Mohawks of the Bay of Quinte*

Project Name: *Geotechnical Investigation - MBQ Boat Launch Ramp, Desoronto*

Sample Date: *June 9, 2021* **Sampled By:** *Mackenzie Garrison - Cambium Inc.*

Location: *BH 103-21 SS 1* **Depth:** *0.2 m to 0.7 m* **Lab Sample No:** *S-21-0659*

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



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

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-21	SS 1	0.2 m to 0.7 m	41	44	15		4.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand and Gravel some Silt	SM	4.950	0.630	0.000	-	-

Additional information available upon request

Issued By: _____ (Senior Project Manager) *Date Issued:* *June 22, 2021*

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Form: L6V.2 - Grad.Hydo

Moisture Content

Project Number:	13167-001	**Lab Number:**	S-21-0657
Project Name:		**Date Tested:**	2021-06-09
Client:		**Tested By:**	CJ
Date Taken:	2021-06-17		

Borehole Number	Sample Number	Sample Depth (m)	Water Weight (g)	Water Content (%)	Additional Observations
101	1	0.152-0.610	17.7	6.3	8,N/R
101	2	0.610-0.762	7.8	3.2	1,8,N/R
102	1	0.030-0.640	53.2	14.7	1,N/R
102	2	0.762-1.219	41.1	31.1	1,5,N/R
102	3	1.219-1.372	31.9	9.6	N/R
103	1	0.152-0.640	7.3	4.5	N/R
103	2	NaN-0.792	16.2	8.3	N/R
103	3	0.762-0.838	7.4	12.0	N/R
102	4	1.524-1.615	79.7	43.5	2,N/R

1 – Contains organics
2 – Contains rubble
3 – Hydrocarbon Odour
4 – Unknown Chemical Odour
5 – Saturated – free water visible
6 – Very moist – near optimum moisture content
7 – Moist – below optimum moisture
8 – Dry – dry texture – powdery
9 – Very small – caution may not be representative
10 – Hold sample for gradation analysis