347 Pido Road
Peterborough, Ontario K9J 6X7
Canada
www.ghd.com

Our ref: 11216754-01

13 December 2021

JMCD Holdings Inc.
81 Pattermead Cr.
Ottawa, ON K1V 0B9

Attention: Chris Donegan

Re: Evaluation of ANSI Pitted Outwash Plain in Proposed Rural Subdivision Garden Hill, Cobourg, Ontario

Introduction

It is proposed to construct a rural residential subdivsion on the property located north of Ganaraska Road (Northumberland County Road 9) and east of Mill Street with residential address 3852 Ganaraska Road in the hamlet of Garden Hill and Municipality of Port Hope (see Figure 1). As part of the application for this development, Cambium Consulting and Engineering (Cambium) prepared a Natural Heritage Constraints Plan as part of an Environmental Impact Study for the proposed development. It was indentified by Cambium that in the woodlot south of the hydro corridor that a Pitted Outwash Plain was possibly present that had been identified as an area of natural and scientific interest (ANSI). GHD Limited (GHD) has been retained to carry out a limited investigation of the area of the wood lot south of the hydro corridor to assess whether the pitted outwash plain is present and the conditions related to it, if it is present.

Method

The investigation was initiated with a review of the Natural Heritage Constraints Plan, the Physiography and Quaternary Geology for the area. This was augmented by the advancement of three test holes on site with a rubber tire backhole operated by Behan Construction to view the subsurface soil strata present and to collect samples for gradation testing and examination of the aggregate present in the samples for type and shape. Further exploration of the woodlot was made by GHD on foot with some shallow excavation using hand tools to further evaluate the soil substrata.

Findings

The physiography for the site is shown on Figure 2 in the enclosures and indicates the site is in a sand plain in the South Slope but is close to a contact point with the the Oak Ridges Moraine just to the north of the site. The Ontario Department of Mines and Northern Affairs mapping show the woodlot area containing kame moraine deposits with disected terrain present. The Surficial Geology of Southern Ontario from the Ministry of Natural Resources indicates the site soil deposits in the woodlot consist of modern alluvial deposits as shown in Figure 3 of the enclosures.

The site geology was further investigated with three test holes advanced to depths ranging from 1.2 to 1.5 m (see Figure 4 for locations and Appendix A for logs). Two of the test pits were

excavated at the base of a draw feature on the west side of the woodlot. The first was at the dripline from the tree cover of the wood lot and the second was about 10m north of the first test pit. The third test pit was located just to the east of a fence line present to the south of the woodlot which is at the midpoint of the property in an east west direction. The test pit was in a slight depression topographically.

The test holes on the west side encountered surficial topsoil underlain by a poorly differentiated sandy silt to silty sand that was in turn underlain by peat. Below the peat layer, interbedded silts and sands were encountered with occasional gravel layers. A sample taken at a 1.2 to 1.5 m depth in Test Pit 1 and tested for gradation indicated the soil was made up of 5% gravel; 19% sand sized particles, 66% silt sized particles and 10% clay sized particles in the interbedded deposit (see Appendix B for Gradation Results). A sample taken at a 1.0 to 1.2 m depth in Test Pit 2 and tested for gradation indicated the soil was made up of 14% gravel, 58% sand sized particles, 25% silt sized particles and 3% clay sized particles in the interbedded deposit.

The third test hole was located in a slight depression on the east side of the woodlot and was moved about 10 m east after intercepting a tile drain which was water bearing. The test hole encountered surficial topsoil to a 0.6 m depth underlain by a bedded sand, silt and clay soil with occasional gravel layers. A sample taken at a 1.2 to 1.5 m depth in Test Pit 3 and tested for gradation indicated the soil was made up of 5% sand sized particles, 86% silt sized particles and 9% clay sized particles in the interbedded deposit.

An examination of the aggregate from the samples taken in the test holes (see photos in Appendix B) indicated that the rock had 30% to 50% igneous and metamorphic rock content with corner rounding evident but not the total rounding associated with near shore deposition (See photo in Appendix B of typical rock deposits from a kame deposit vs rocks found on the Lake Ontario shoreline).

Groundwater seepage was assoicated with the buried peat layer in Test Pits 1 and 2 and discharge from the ground to form the headwaters of a small stream occurred about 10 m north of Test Pit 2. This water flow was present in an ever increasing deeper valley to the north and then west which had eroded into the kame deposit and formed the disected terrain described on the Department of Mines and Northern Affairs map. Groundwater was encountered at a 0.6m depth in Test Pit 3.

Conclusions

During the Pleistocene in the formation of the Oak Ridges Moraine a lobe of ice was gradually forced northwards from the Lake Ontario Basin resulting in the erosion of the limestone bedrock present. This northward moving lobe met a lobe of ice just north of Garden Hill moving south west and the soil being formed from the crushing and erosion of the limestone makes up the underlying dense silt till deposited at depth on the site under study. When the ice lobes receded the melt water deposited the interbedded silts sands and gravels over the till creating the interbedded kame deposits. The source rock for these deposits was a mixture of the limestone to the south and igneous and metamorphic rock found to the northeast of the site in Marmora and Madoc. Outwash plains are formed generally in a fan shape on the downstream sides of the morains and kames due to meltwater flowing away carrying the previously deposited kame or moraine soil and depositing it in a layered deposit over a broad area in the depressions surrounding the kame deposits. The narrower deposit at the beginning of the plain is pitted since the heavier particles drop first in the melt water as the water slows with sands in the middle and silts and clays towards the ends of the plain.

The agricultural field immediately south of the wood lot has a slightly higher ground associated with a fence line that runs north south at about the half way point on the property and to the west of the fence line has a draw feature which drains towards the woodlot. The soil at the surface to just over a 1m depth is consistent with the recent alluvial deposits including the buried peat associated with a stream that joins the creek that cuts through the woodlot on a diagonal. This tributary has contributed to the disected nature of the kame deposit in the woodlot. The soil underlying this appears to be bedded kame deposit with alternating layers of fine and coarse grained sands and silts and aggregates that are not predominantly limestone (see photos Appendix C). There are two depressions running north-south on the east side of the fence line which also drain back north towards the woodlot. This soil was found to be fine grained sands and silts with a bedded texture. This is indicative of the kame deposits laid over the original moraine deposits with the aggregates being rounded and an even mixture of limestone and igneous. It is concluded that the woodlot on the property contains the source material for the outwash plain but that the pitted outwash plain is present to the west of the woodlot between Mill Street and the pond created by the dam at Northumberland County Road 9 (Ganaraska Road). The site soils are recently deposited alluvial soil that overlies the bedded kame deposits.

We trust that this meets your requirements, should you have any questions please contact our office.

Sincerely,
GHD

Andy Fawcett, P.Eng.
Senior Engineer

Enclosures

Data Disclaimer

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Paper Size ANSI A

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

N

GHD

JMCD GARDEN HILL
3852 GANARASKA ROAD PORT HOPE
PT LOT 16, CON 8 GEOGRAPHIC TOWNSHIP OF HOPE
MUNICIPALITY OF PORT HOPE
COUNTY OF NORTHUMBERLAND

Outwash Plain Investigation

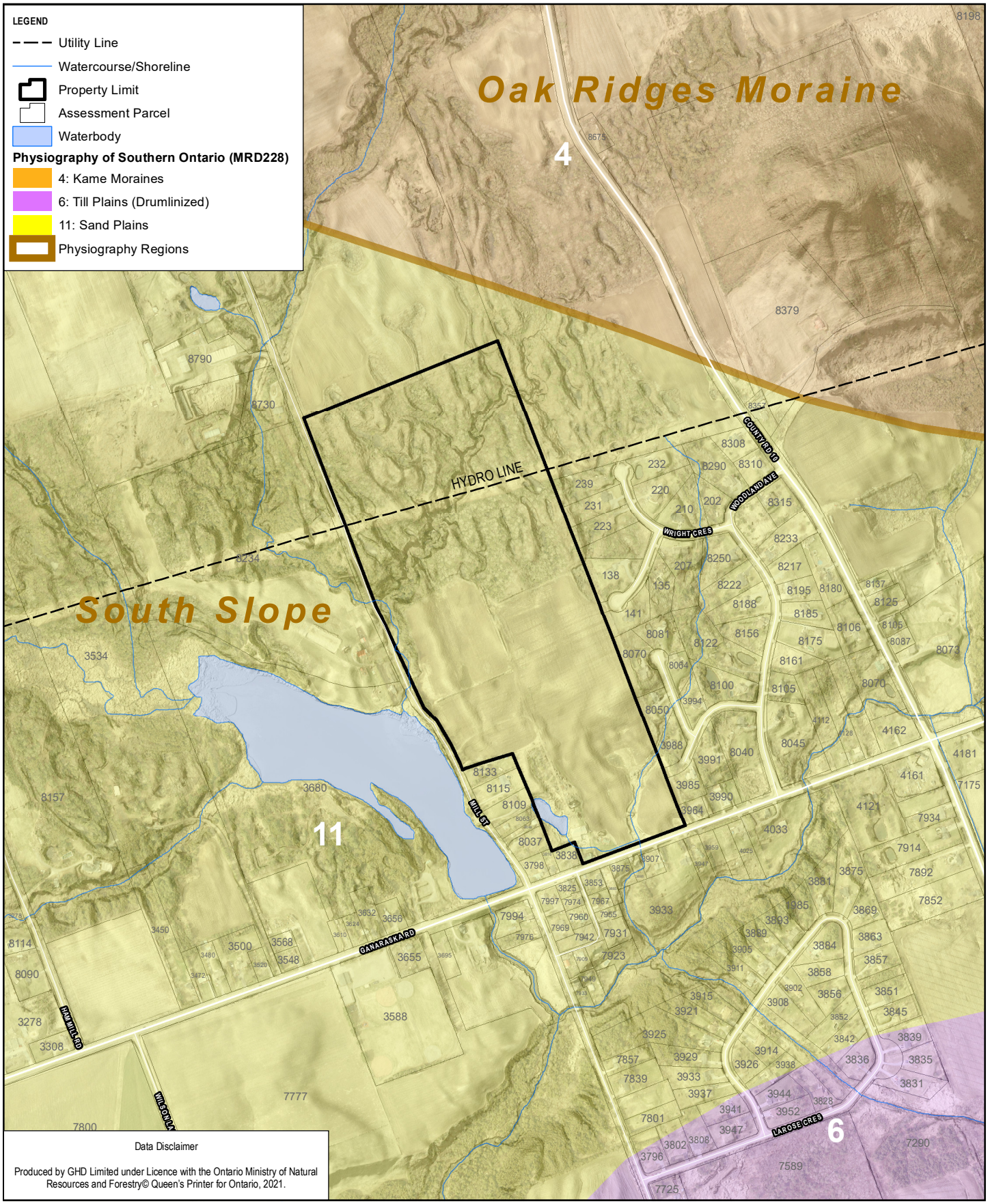
SITE LOCATION PLAN

Project No. **11216754**
Revision No.
Date **Dec 7, 2021**

FIGURE 1

O:\GIS\PROJECTS\11216000s\11216754\Layouts\202112_RPT001\11216754_202112_RPT001_GIS001 - Site Location Plan.mxd
Print date: 07 Dec 2021 - 05:55

Data source: © County of Northumberland, 2018.



Paper Size ANSI A

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

N

GHD

JMCD GARDEN HILL
3852 GANARASKA ROAD, PORT HOPE ON
PLOT 16, CONCESSION 2 GEOTOWNSHIP OF HOPE MUNICIPALITY OF PORT HOPE
COUNTY OF NORTHUMBERLAND

Outwash Plain Investigation

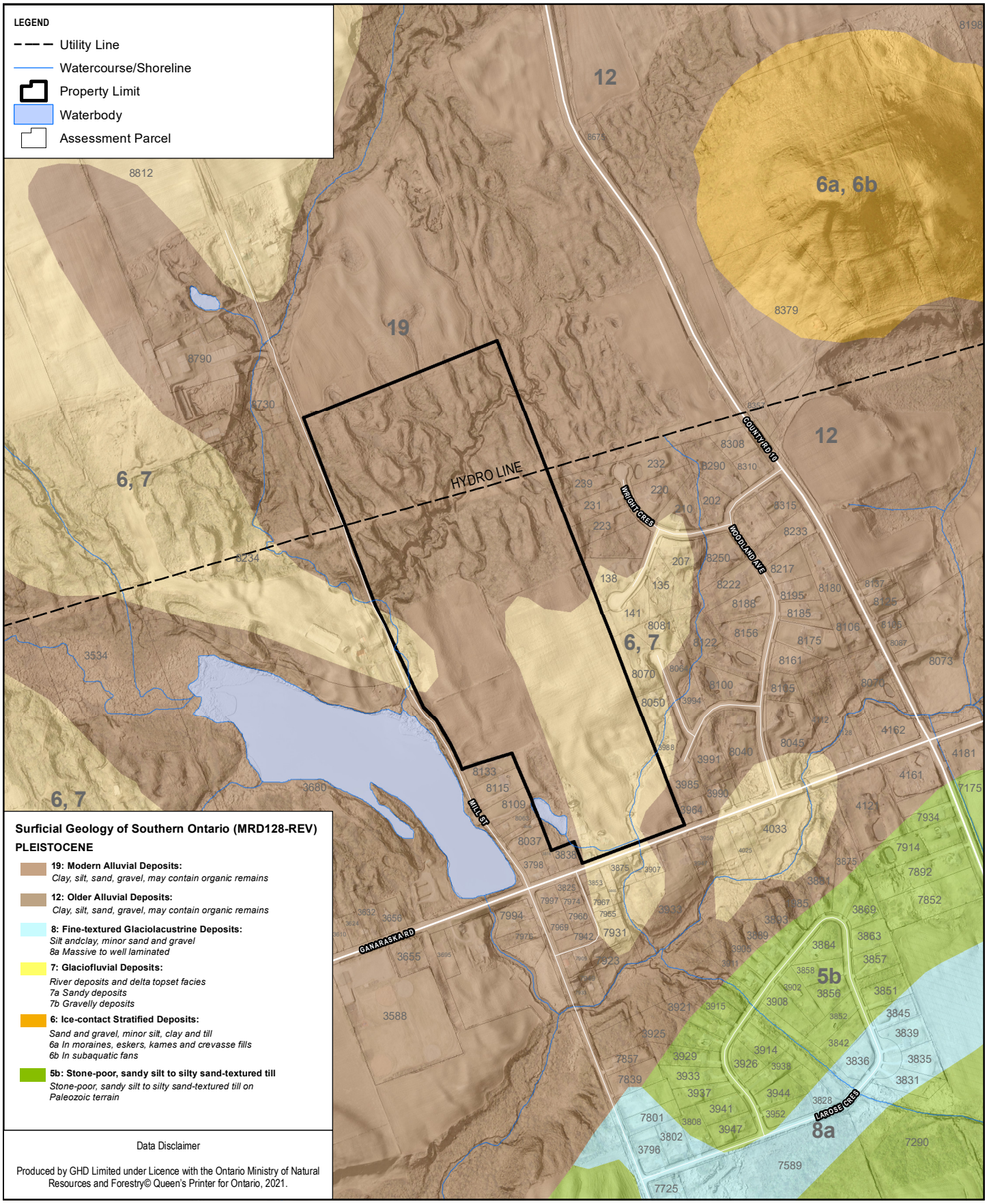
PHYSIOGRAPHY

Project No. **11216754**
Revision No.
Date **Dec 7, 2021**

FIGURE 2

O:\GIS\PROJECTS\11216000s\11216754\Layouts\202112_RPT001\11216754_202112_RPT001_GIS002 - Physiography.mxd
Print date: 07 Dec 2021 - 06:22

Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228 ISBN 978-1-4249-5158-1., © County of Northumberland, 2018.



Paper Size ANSI A

0 70 140 210 280

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

N

GHD

JMCD GARDEN HILL
3852 GANARASKA ROAD, PORT HOPE, ON
PT LOT 16, CON 8, GEO. TOWNSHIP OF HOPE
MUNICIPALITY OF PORT HOPE
COUNTY OF NORTHUMBERLAND

HYDROGEOLOGICAL INVESTIGATION

SURFICIAL GEOLOGY

Project No. **11216754**
Revision No.
Date **Dec 7, 2021**

FIGURE 3

O:\GIS\PROJECTS\11216000s\11216754\Layouts\202112_RPT001\11216754_202112_RPT001_GIS003 - Surficial Geology.mxd
Print date: 07 Dec 2021 - 06:37

MRD128-REV. Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 128 – Revised., © County of Northumberland, 2018.

Paper Size ANSI A

0 30 60 90 120

Metres

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N

N

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JMCD GARDEN HILL
3852 GANARASKA ROAD, PORT HOPE, ON
PT LOT 16, CON 8, GEO. TOWNSHIP OF HOPE
MUNICIPALITY OF PORT HOPE
COUNTY OF NORTHUMBERLAND

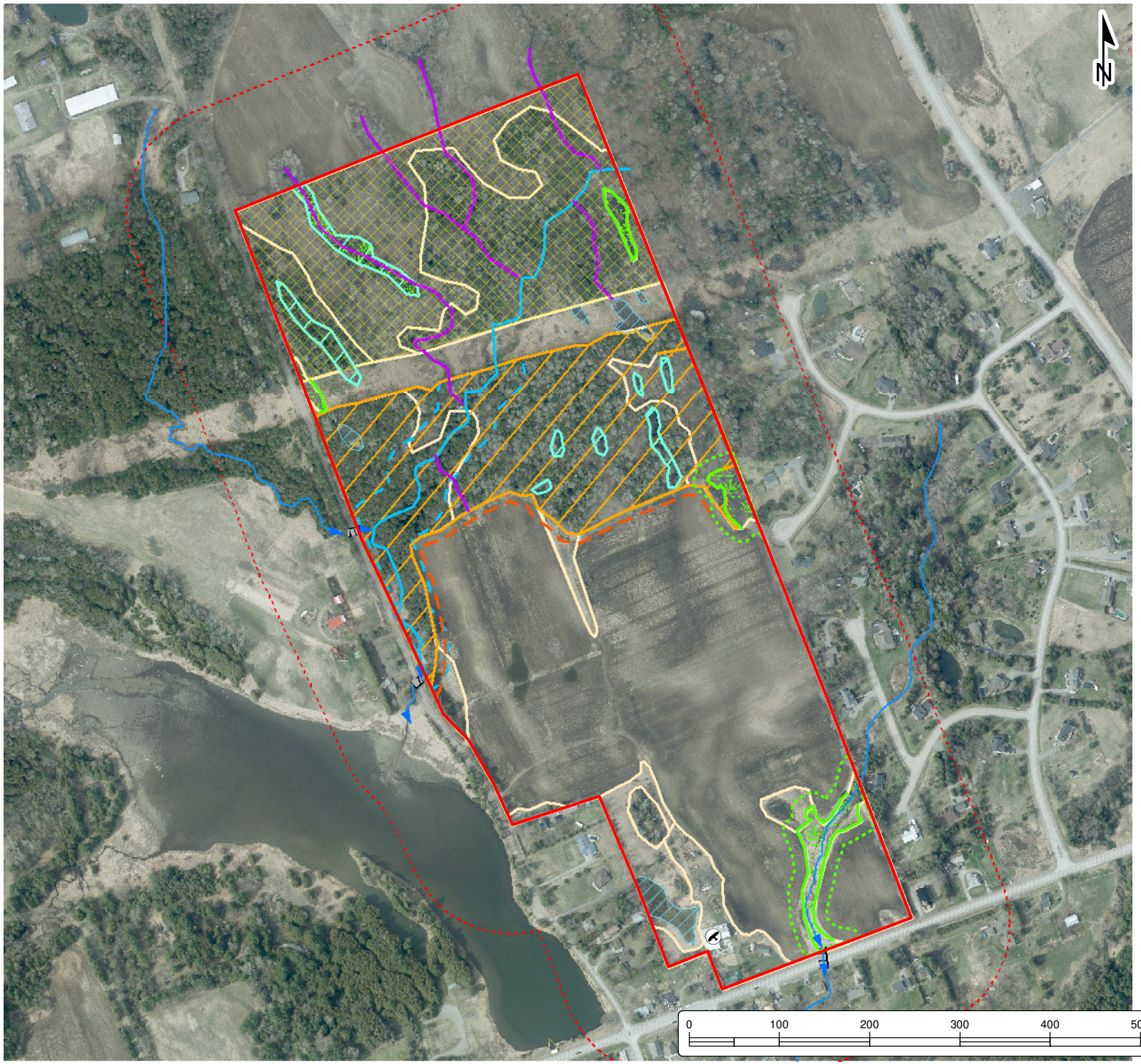
HYDROGEOLOGICAL INVESTIGATION
TEST HOLE LOCATIONS

Project No. **11216754**
Revision No.
Date **Dec 9, 2021**

FIGURE 4

O:\GIS\PROJECTS\11216000s\11216754\Layouts\202112_RPT001\11216754_202112_RPT001_GIS004 - Test Hole Location.mxd
Print date: 09 Dec 2021 - 09:40

Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228 ISBN 978-1-4249-5158-1., © County of Northumberland, 2018.



ENVIRONMENTAL IMPACT STUDY

CHRISTOPHER DONEGAN
3852 Ganaraska Road
Port Hope, Ontario

LEGEND

- 120 m Adjacent Lands
- Site (37 ha)
- 15 m Wetland Setback
- Wetland Boundary (Delineated with GRCA)
- Wetland
- Vegetation Communities
- 10 m Woodland Dripline Setback
- Significant Woodlands (within Settlement Area) (7.7 ha)
- Significant Woodlands (Outside Settlement Area)
- Field Verified Watercourse
- 30 m Watercourse Setback
- Culvert
- Drainage Feature
- Pond
- Vernal Pool
- Watercourse, Permanent (Ontario Hydro Network Mapping)
- Barn Swallow Nesting Habitat

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources and Forestry 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.

CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

NATURAL HERITAGE CONSTRAINTS - DRAFT

Project No.: 12728-001		Date: September 2021	
Scale: 1:6,000		Projection: NAD 1983 UTM Zone 17N	
Created by: DJL	Checked by: JPP	Figure:	3

O:\GIS\MXDs\12700-12799\12728-001 Christopher Donegan - EIS - 3852 Ganaraska Rd, Port Hope\2021-09-14 FIG 3 - Natural Heritage Constraints - Draft.mxd

Appendix A
Test Hole Logs

REFERENCE No.: 11216754 ENCLOSURE No.: A-1

TEST PIT No.: TP1
ELEVATION: m

TEST PIT REPORT

CLIENT: Stalwood Homes
PROJECT: Garden Hill Pitted Outwash ANSI
LOCATION: 3852 Ganaraska Rd. Garden Hill
DESCRIBED BY: M. Yee DATE: 28 October 2021
CHECKED BY: DATE:

LEGEND

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

Depth Feet	Depth Metres	Elevation (m) BGS	Symbol	STRATIGRAPHY	Sample Type & Number	OVC ppm	Tests Type	▼ INF
				TOPSOIL (406mm)				
		0.41		**SM** - SILTY SAND, poorly sorted fine grained sand, brown, compact, moist				
		0.91		**PEAT** - clayey organics, woody fibres, wet, non plastic				
		1.22		**ML** Interbedded SILTS and Sands, trace clay, light brown, non plastic, moist, compact	GS1			
		1.52		**END OF TEST PIT**				

NOTES :
-End of test pit at 1.52 m bgs
-Groundwater seepage observed at 1.22 m bgs
-Groundwater rapidly accumulated in hole at a rate of 0.33 m over 5 minutes
-UTM 17T 707783W 4882070N

1
0.5
2
3
1.0
4
5
1.5
6
2.0
7

File: N:\CA\PETERBOROUGH\PROJECTS\66211216754\WORKSHARE\11216754-DSG-21-10-28-GARDEN HILL OUTWASH.GPJ Library File: GHD_GEOTECH_V05.GLB Report: TEST PIT LOG Date: 28/10/21

REFERENCE No.: 11216754 ENCLOSURE No.: A-2

GHD

TEST PIT No.: TP2
ELEVATION: m

TEST PIT REPORT

CLIENT: Stalwood Homes
PROJECT: Garden Hill Pitted Outwash ANSI
LOCATION: 3852 Ganaraska Rd. Garden Hill
DESCRIBED BY: M. Yee DATE: 28 October 2021
CHECKED BY: DATE:

LEGEND

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

Depth Feet	Depth Metres	Elevation (m) BGS	Symbol	STRATIGRAPHY	Sample Type & Number	OVC ppm	Tests Type	▼ INF
				TOPSOIL (406mm)				
		0.41		**SM** - SILTY SAND, poorly sorted fine grained sand, brown, compact, moist				
		0.81		**PEAT** - clayey organics, woody fibres, wet, non plastic				
		0.91		**ML** Interbedded SILTS and Sands, trace clay, light brown, non plastic, moist, compact				
		1.01		**SWG** - Interbedded SANDS and GRAVELS, few silt, well sorted fine to medium grained sand with coarse sand, well sorted fine to coarse gravel,rounded to sub-rounded gravel, brown, wet, compact	GS1			
		1.22		**END OF TEST PIT**				

NOTES :
-End of test pit at 1.22 m bgs
-Groundwater seepage observed at 0.91 m bgs and 1.22 m bgs
-Groundwater rapidly accumulated in hole at a rate of 0.33 m over 5 minutes
-Caving observed at 1.01 m bgs
-UTM 17T 707775W 4882076N

1 2 3 4 5 6 7
0.5 1.0 1.5 2.0

File: N:\CA\PETERBOROUGH\PROJECTS\66211\216754\WORKSHARE\11216754-DSG-21-10-28-GARDEN HILL OUTWASH.GPJ Library File: GHD_GEOTECH_V05.GLB Report: TEST PIT LOG Date: 28/10/21

REFERENCE No.: 11216754 ENCLOSURE No.: A-3

GHD

TEST PIT No.: TP3
ELEVATION: m

TEST PIT REPORT

CLIENT: Stalwood Homes
PROJECT: Garden Hill Pitted Outwash ANSI
LOCATION: 3852 Ganaraska Rd. Garden Hill
DESCRIBED BY: M. Yee DATE: 28 October 2021
CHECKED BY: DATE:

LEGEND

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

Depth Feet	Depth Metres	Elevation (m) BGS	Symbol	STRATIGRAPHY	Sample Type & Number	OVC ppm	Tests Type	▼ INF
				TOPSOIL (610mm)				
2	0.5	0.61		**ML** - SILT, trace of fine grained sand, light brown, compact, moist				
3	1.0			becomes grey, more sandy with depth				
4								
5	1.5	1.52			GS1			
				END OF TEST PIT				

NOTES :
-End of test pit at 1.52 m bgs
-surface water seepage observed at 0.61 m bgs
-surface water rapidly accumulated in hole at a rate of 0.33 m over 10 minutes
-UTM 17T 707896W 4882036N

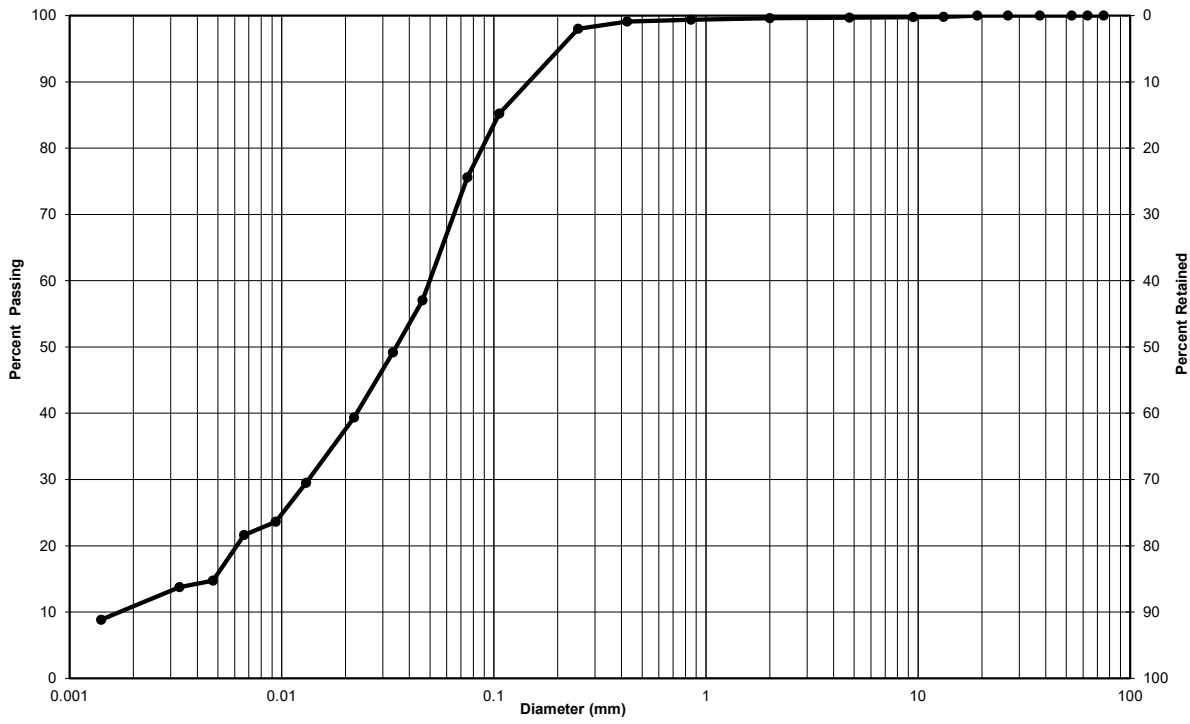
6 2.0
7

File: N:\CA\PETERBOROUGH\PROJECTS\66211216754\WORKSHARE\11216754-DSG-21-10-28-GARDEN HILL OUTWASH.GPJ Library File: GHD_GEOTECH_V05.GLB Report: TEST PIT LOG Date: 28/10/21

Appendix B
Laboratory Testing

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

Client:	JMCD Holdings	**Lab No.:**	AG-21-178
Project/Site:	Garden Hill Outwash	**Project No.:**	11216754
Borehole no.:	TP1	Sample no.:	
Depth:	5'	Enclosure:	



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

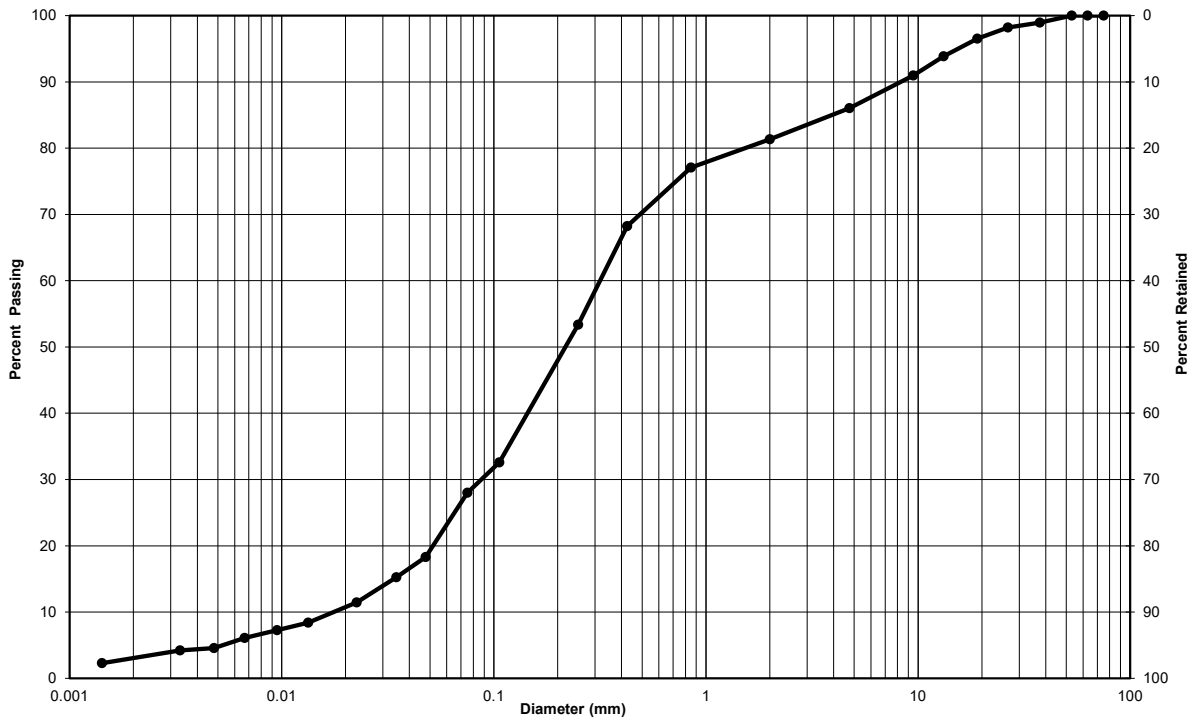
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silt with sand (ML)	0	24	76
Silt-size particles (%):	66		
Clay-size particles (%) (<0.002mm):	10		

Remarks:

Performed by:	Josh Sullivan	**Date:**	November 3, 2021
Verified by:	Joe Sullivan	**Date:**	November 4, 2021

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

Client:	JMCD Holdings	**Lab No.:**	AG-21-179
Project/Site:	Garden Hill Outwash	**Project No.:**	11216754
Borehole no.:	TP2	Sample no.:	
Depth:	4'	Enclosure:	



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

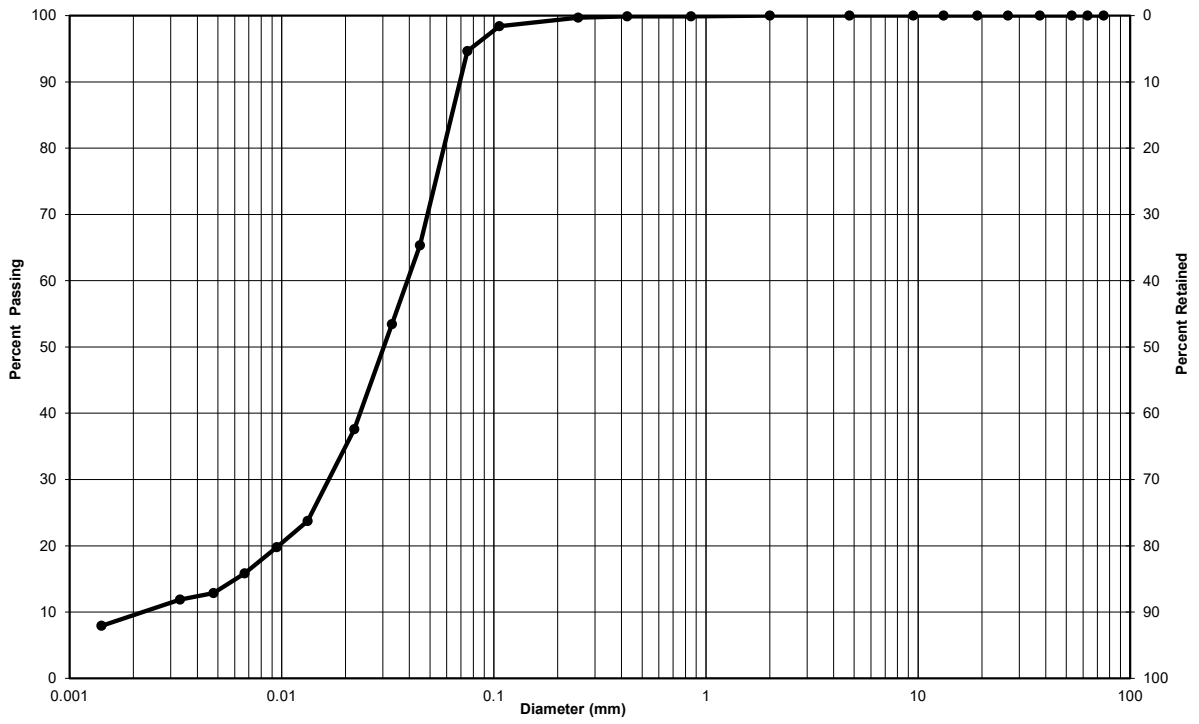
Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silty sand (SM)	14	58	28
Silt-size particles (%):	25		
Clay-size particles (%) (<0.002mm):	3		

Remarks:

Performed by:	Josh Sullivan	**Date:**	November 3, 2021
Verified by:	Joe Sullivan	**Date:**	November 4, 2021

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

Client:	JMCD Holdings	**Lab No.:**	AG-21-180
Project/Site:	Garden Hill Outwash	**Project No.:**	11216754
Borehole no.:	TP3	Sample no.:	
Depth:	5'	Enclosure:	



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

Soil Description	Gravel (%)	Sand (%)	Clay & Silt (%)
Silt (ML)	0	5	95
Silt-size particles (%):	86		
Clay-size particles (%) (<0.002mm):	9		

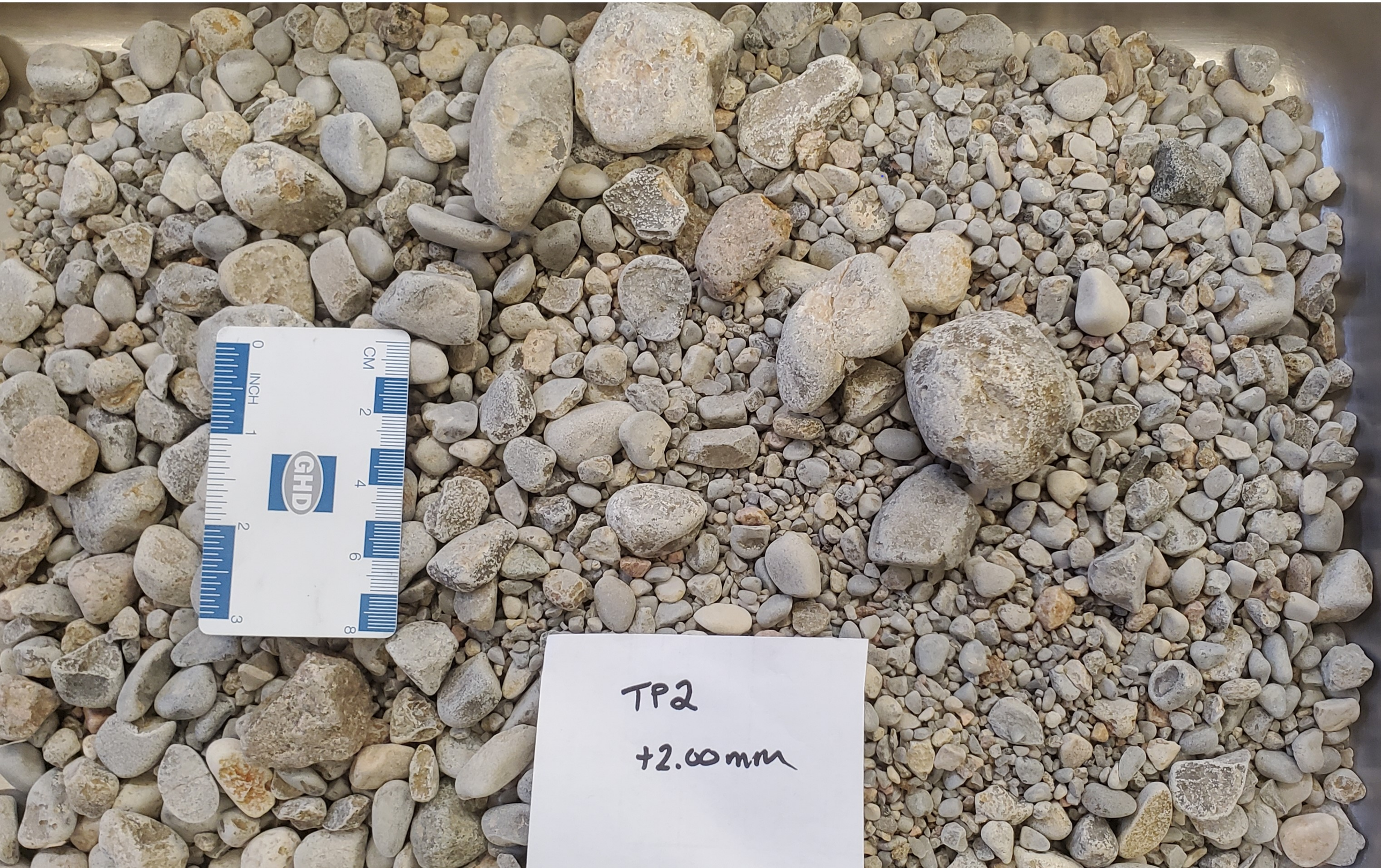
Remarks:

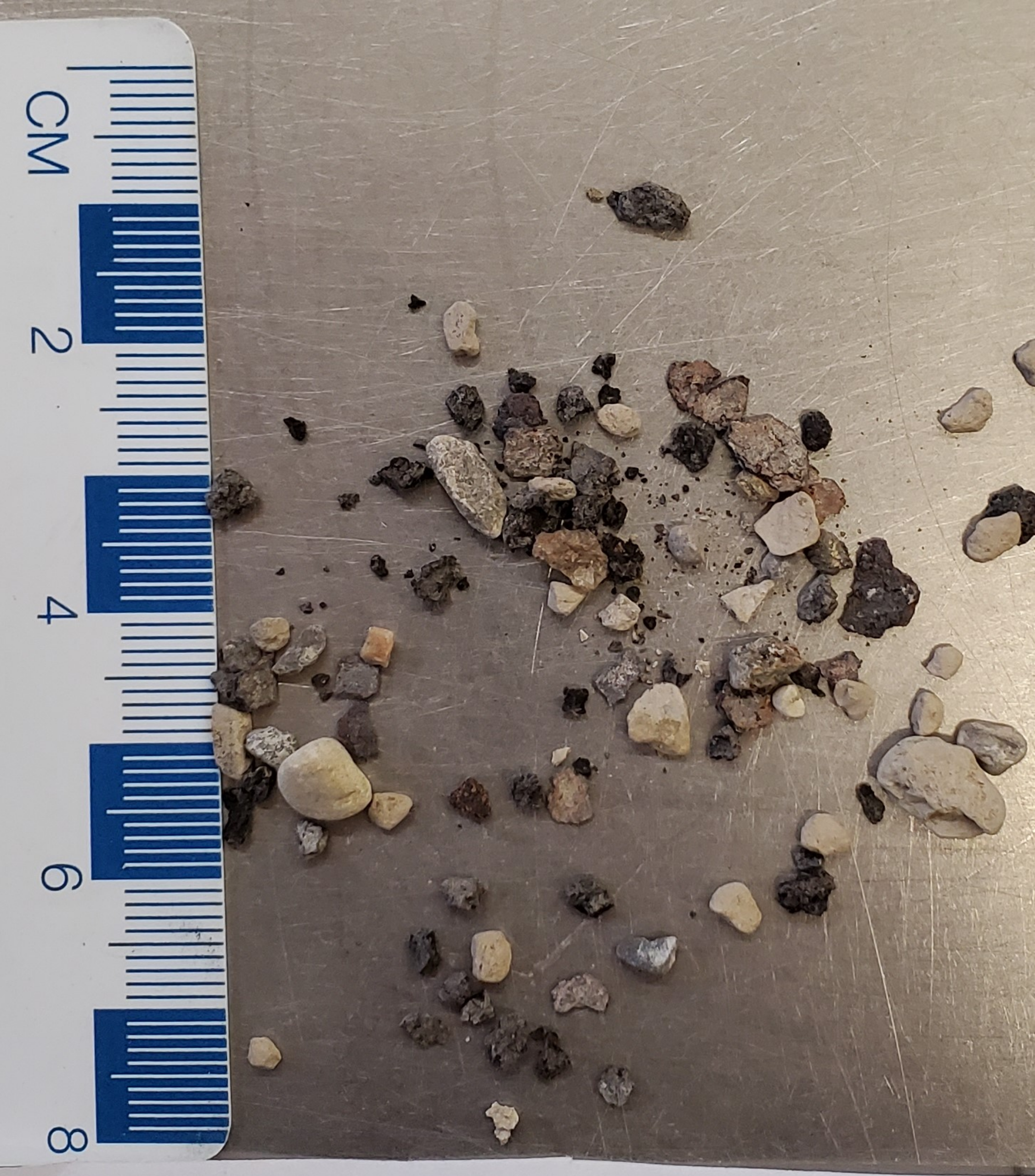
Performed by:	Josh Sullivan	**Date:**	November 3, 2021
Verified by:	Joe Sullivan	**Date:**	November 4, 2021

Appendix C
Photos

TP 1

+2.00mm


GHD
TP2
+2.00mm



TP3

+2.00mm

347 Pido Road
Peterborough, Ontario K9J 6X7
Canada
www.ghd.com

Typical Kame Aggregate Finlays Beaver Meadow Road Pit Hamilton Township

Typical South Slope aggregate Finlays Van Luven Road Pit Hamilton Township