Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
PROPOSED TEN LOT RESIDENTIAL SUBDIVISION
211 DOCK ROAD
BARRIE, ONTARIO

for

AZURE HOMES INC.

PETO MacCALLUM LTD.
19 CHURCHILL DRIVE
BARRIE, ONTARIO
L4N 8Z5
PHONE: (705) 734-3900
FAX: (705) 734-9911
EMAIL: barrie@petomaccallum.com

Distribution:
1 cc: Azure Homes Inc (+email)
1 cc: Urbantech Consulting (+email)
1 cc: PML Barrie

PML Ref.: 17BF030
Revised Report: 1
May 2018

Peto MacCallum Ltd.
CONSULTING ENGINEERS

May 17, 2018

PML Ref.: 17BF030
Revised Report: 1

Mr. Rob Mitchell
Azure Homes Inc.
Newmarket South Post Office
P.O. Box 71038
Newmarket, Ontario
L3X 1Y8

Dear Mr. Mitchell

Geotechnical Investigation
Proposed Ten Lot Residential Subdivision
211 Dock Road
Barrie, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Authorization for this assignment was provided by Mr. O. Somerville of Urbantech Consulting, on behalf of the Client, in an email dated June 22, 2017.

A ten lot residential subdivision is proposed for the parcel of land at 211 Dock Road. The development will be fully serviced with a single road with cul-de-sac. Full depth basements are planned for the houses.

The purpose of this investigation was to assess the subsurface conditions at the site, and based on this information, provide comments and geotechnical engineering recommendations for house foundations and basements, site servicing, and pavement design.

Geo-environmental services (observations, recording, testing or assessment of the environmental conditions of the soil and ground water) were not within the terms of reference for this assignment, and no work has been carried out in this regard. It is recommended that the environmental quality of site soils, be verified in order to assess the suitability of excavated soil for reuse on-site. Also, if excess soils requiring transportation off-site are generated, a program of sampling and testing will be needed to determine the chemical properties of the soil to evaluate appropriate Receiving Site options, in accordance with the MOECC document; Management of Excess Soil – A Guide for Best Management Practices, January, 2014.

The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed works as addressed in the report. Any changes in the proposed plans will require review by PML to assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

INVESTIGATION PROCEDURES

The field work for this investigation was carried out on September 22, 2017, and consisted of Boreholes 1 to 3 advanced to depths of 5.0 to 6.4 m below existing grade. Borehole locations are shown on Drawing 1, appended.

PML laid out the boreholes in the field based on a plan provided by the Client. Co-ordination for clearances of underground utilities was provided by PML.

The boreholes were advanced using continuous flight hollow stem augers, powered by a track mounted CME-55 drill rig, equipped with an automatic hammer, supplied and operated by a specialist drilling contractor working under the full-time supervision of a member of our engineering staff.

Representative samples of the site soils were recovered at frequent depth intervals for identification purposes using a conventional split spoon sampler. Standard penetration tests were carried out simultaneously with the sampling operations to assess the strength characteristics of the subsoil. Ground water conditions in the boreholes were assessed during drilling by visual examination of the soil samples, the sampler, and drill rods as the sample was retrieved, and measurement of the water level in the open boreholes upon completion, if any.

Wells comprised of 50 mm diameter slotted pipe with filter sand and above grade protective covers were installed in all three boreholes to permit ground water level monitoring. It should be noted that the wells become the property of the Owner and will have to be decommissioned by the Owner. PML would be pleased to assist in this regard.

The surface elevations of the boreholes were established in the field by PML and were referend to the following Temporary Bench Mark (TBM), with assigned elevation, as shown on Drawing 1 and described as follows:

TBM: Top of Square SIB with Yellow Marking Tape at Southwest Corner of Site
Elevation 100.00 (metric, assigned)

All recovered soil samples were returned to our laboratory for moisture content determinations and detailed examination to confirm field classification. Three soil samples, one from each borehole, were submitted for grain size analysis. Grain size analyses results are presented on Figures 1 to 3, appended. Atterberg Limits tests were conducted on one of the three samples.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions, including soil classifications, inferred stratigraphy, Standard Penetration test N values, well installation details, ground water observations and the results of laboratory moisture content determinations and Atterberg Limits testing.

Due to the soil sampling procedures and limited sample size, the depth demarcations on the borehole logs must be viewed as "transitional" zones between layers, and cannot be construed as exact geologic boundaries between layers. PML would be pleased to assist in defining geologic boundaries during construction, if required.

Topsoil

A 350 to 400 mm thick layer of topsoil was found at the surface of all the boreholes.

Sandy Silt

A 300 mm thick sandy silt layer was encountered and penetrated in Borehole 2 at 0.4 and 0.7 m depth (elevation 95.25 to 95.95). The unit was loose and was moist with moisture content of 8%.

Sand

A 2.2 and 0.4 m thick layer of sand was encountered in Boreholes 2 and 3 below the topsoil or sandy silt, extending to 2.9 m / elevation 93.1 and 0.8 m / elevation 96.6, respectively. The sand had variable silt and gravel content. Cobbles and boulders were noted in Borehole 3. The unit was dense to very dense in Borehole 2 and loose in Borehole 3. The sand was moist in Borehole 3 (moisture content of 4%) and wet in Borehole 2 (moisture content 8 to 17%).

Sand and Gravel

A major sand and gravel deposit was encountered in Boreholes 1 and 2 below the topsoil and upper soil units extending to the depth of the borehole. The unit contained trace to some silt, and cobbles and boulders were noted. It is noted that Borehole 1 met auger refusal at 5.0 m depth and this is believed to be due to boulders. Two samples of the material were submitted for a grain size analysis and the results are presented on Figure 1 and 2, attached. The material was dense to very dense, locally compact near the surface in Borehole 1. The deposit was moist to wet with depth with moisture contents of 2 to 15%.

Layered Clayey Silt/Silty Clay

A layered clayey silt/silty clay unit was encountered in Borehole 3, occurring from 0.8 m / elevation 96.6 to 5.2 m /elevation 92.2. A sample of the material was submitted for a grain size analysis and the result is presented on Figure 3, appended. Atterberg Limits testing showed the material had a plastic limit of 19% with a liquid limit of about 41%. The unit was typically very stiff to hard and was drier than plastic limit to about plastic limit. Wet layers were noted at depth.

Sandy Silt Till

A sandy silt till deposit was encountered in Borehole 3 below the clayey silt/silty clay unit at 5.2 m depth extending to the 6.4 m depth of the borehole. Cobbles and boulders were noted. The material was very dense and moist with a moisture content of 10%. The deposit had wet sand layers.

Ground Water

The first water strike during drilling, the ground water levels measured in the boreholes upon completion of augering, and measured water levels in the wells on October 11, 2017 are summarized in the table below, on borehole by borehole basis:

Borehole	**WATER LEVEL (m)**					
	First Strike During Drilling		**Upon Completion of Augering**		**Water Level in Well on October 11, 2017**	
	Depth (m)	Elevation	Depth (m)	Elevation	Depth (m)	Elevation
1	2.1	94.0	3.5	92.6	2.8	93.3
2	0.7	95.3	1.5	94.5	0.7	95.3
3	6.0	91.4	4.8	92.6	0.1	97.3

The ground water was 0.7 to 2.8 m below grade (elevations 93.3 to 95.3) in Boreholes 1 and 2 where the permeable sand and gravel deposit was present. In Borehole 3 the ground water was under some artesian pressure being first encountered at about 6.0 m and stabilizing near the existing ground surface.

Ground water levels are subject to seasonal variations, and fluctuations in response to precipitation.

Geotechnical ENGINEERING CONSIDERATIONS

General

A ten lot subdivision is proposed for the parcel of land at 211 Dock Road. The development will be fully serviced with a single road with cul-de-sac. Full depth basements are planned for the houses.

At the time of this report, no design had been completed on any site grading/servicing, and building finished grades and founding levels were not available.

The boreholes encountered competent soils below 1 m depth (capable of supporting the proposed houses). However, there is a high ground water table and also artesian ground water. In the areas associated with Boreholes 1 and 2 it is recommended that basements and site servicing be kept above the ground water as much as possible to avoid dewatering. In areas associated with Borehole 3, excavation below 2 m may require depressurizing of the artesian ground water to avoid blow out of the base of excavations. As such, raised grades will be required for development of the site.

Due to the restriction on tree clearing at the site, the southeast part of the site was not accessible. It is recommended that this area be further investigated in order to more fully delineate the subsurface soil and ground water conditions across the site and impacts to design and construction.

As noted above, raising the site grade is warranted to avoid ground water related issues. Where grades are to be raised under structures (houses, roads and site servicing), the fill needs to be constructed as engineered fill. In general the topsoil and upper 0.5 m of loose native soil should be removed prior to constructing engineered fill. Engineering fill should comprise select soil placed in thin lifts and compacted to 100% Standard Proctor maximum dry density under houses, and 95% Standard Proctor maximum dry density under roads and services. Further recommendations can be provided if required.

Foundations

The native soils are dense/very dense or very stiff to hard below about 1 m depth. Footings founded a minimum 1 m below existing grade on native soil can be designed for a net geotechnical bearing resistance at Serviceability Limit State (SLS) of 150 kPa, and a factored bearing resistance at Ultimate Limit State (ULS) of 225 kPa.

Higher bearing is available at depth, however greater effort for ground water control will be required.

At the bearing resistance at SLS, total settlement should not exceed 25 mm.

Footings subject to frost action should be provided with a minimum 1.2 m of earth cover or equivalent.

Prior to placement of structural concrete, all founding surfaces should be reviewed by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions revealed in the excavation.

Basement Walls and Floor Slabs

It is recommended that basements be established a minimum 0.5 m above the ground water level. In this regard, the ground water table was recorded at 2.8 m depth / elevation 93.3 in Borehole 1, and at 0.7 m depth / elevation 95.3 in Borehole 2. In the area of Borehole 3, basements can extend as much as 2.0 m below existing grade (elevation 95.4), without depressurization of the underlying artesian ground water table.

Additional boreholes with water level monitoring wells in the southeast part of the site are recommended to better define the soil and ground water conditions across the property.

Full depth basements are proposed for all houses. Basement walls must be designed to resist the unbalanced horizontal earth pressure imposed by the backfill adjacent to the walls. The lateral earth pressure, P, may be computed using the following equation and assuming a triangular pressure distribution:

$$P = K(\gamma h + q) + C_p$$

Where P = lateral pressure at depth h (m) below ground surface (kPa)
K = lateral earth pressure coefficient of backfill = 0.5
h = depth below grade (m) at which lateral pressure is calculated
γ = unit weight of compacted granular backfill = 21.0 kN/m^3
q = surcharge loads (kPa)
C_p = compaction pressure

The above equation assumes that drainage measures will be incorporated to prevent the buildup of hydrostatic pressure. In this regard, foundation wall backfill should comprise free draining granular material conforming to OPSS Granular B. Alternatively, a proprietary drainage board product can be utilized with on-site soils as backfill. A weeping tile system should be installed to prevent the build-up of hydrostatic pressure behind the wall. The weeping tiles should be protected by a properly designed granular filter or geotextile to prevent migration of fines into the system. The drainage pipe should be placed on a positive grade and lead to a frost-free outlet.

Foundation/basement wall backfill should be placed in thin lifts compacted to a minimum 95% Standard Proctor maximum dry density. Over compaction close to the walls should be avoided as this could generate excessive pressure on the walls.

Basement floor slab construction is feasible on native soils or engineered fill. A minimum 200 mm thick base layer of crushed stone (nominal 19 mm size) is recommended directly under the slab in conjunction with an underfloor drainage system, with frost free sump pit/pump. A polyethylene sheet vapour barrier should be incorporated under the ground floor slab if a vapour sensitive floor finish is planned.

Exterior grades should be established to promote surface drainage away from the buildings.

Reference is made to appended Figure 4 for general recommendations regarding drainage and backfill requirements for basement walls and floor slabs.

Site Servicing

Site servicing inverts have not been provided for this site. In this regard, it has been assumed that invert depths will be maximum 3.0 m below proposed grade.

Trench Excavation and Ground Water Control

Trench excavation and ground water control is discussed under Excavation and Ground Water Control later in the report.

Bedding

It is anticipated that services will be supported in native soils or engineered fill, and bearing capacity issues are not anticipated. Where poor subgrade soils are encountered at the design invert, it may be necessary to sub-excavate and provide an increased thickness of bedding, subject to geotechnical field review.

Standard granular bedding in accordance with OPSS compacted to 95% Standard Proctor maximum dry density should be satisfactory. For flexible pipes, bedding and cover material should comprise OPSS Granular A. For rigid pipes, bedding material should comprise OPSS Granular A, and cover material may comprise select trench backfill free of oversized (200 mm diameter or less) or excessively wet material.

Backfill

Trench backfill should comprise select inorganic soil placed in maximum 200 mm thick lifts compacted to minimum 95% Standard Proctor maximum dry density, to minimize post construction settlement. Topsoil, organic/peat, excessively wet, frozen, oversized (greater than 200 mm diameter), or otherwise deleterious material should not be incorporated as trench backfill. The moisture content should be within 2% of optimum in order to achieve the specified compaction, and should be closer to the optimum moisture content in the upper 1 m to prevent instability issues. Ideally the backfill should comprise excavated site soil in order to minimize differential frost heave.

The excavated soils at the site will comprise the predominate native granular soils. Excavated inorganic soils from above the ground water table are expected to be generally suitable for reuse as trench backfill. Inorganic material from below the ground water table will be too wet for reuse unless allowed to dry out or mixed with drier soil to render the material suitable for reuse. Weather will also impact the moisture conditions of the soil and suitability for reuse. Geotechnical review of the excavated soil and approval for use as backfill will be necessary during construction.

Earthworks operations should be inspected by PML to verify subgrade preparation, backfill materials, placement and compaction efforts and ensure the specified degree of compaction is achieved throughout.

Excavation and Ground Water Control

Excavation will encounter topsoil over the native soils. Harder digging can be expected in the very dense soils and the presence of cobbles and boulders should not be disregarded in the sand and gravel deposit.

The site soils should be considered as Type 3 soil, soil requiring excavation side walls to be constructed at no steeper than one horizontal to one vertical (1H:1V) from the base of the excavation in accordance with the Occupational Health and Safety Act.

For excavation above the ground water table in areas around Boreholes 1 and 2 or in excavation maximum 2 m depth around Borehole 3, it is expected that ground water seepage should be managed using conventional sump pumping techniques.

For excavation below the ground water table near Boreholes 1 and 2 and excavation below 2.0 m depth near Borehole 3, dewatering or depressurization of the ground water table will be required. The water levels should be lowered a minimum 0.5 m below the deepest excavation. Dewatering should be designed and installed by specialists in the field.

In general, it is recommended the work be scheduled following periods of prolonged dry weather, when the ground water table is usually at its lowest, in order to minimize the quantity of water to be handled.

Water taking in Ontario is governed by the Ontario Water Resources Act (OWRA) and the Water Taking and Transfer Regulation O.Reg. 387/040, Section 34 of the OWRA requires any one taking more than 50,000 L/d to obtain a Permit-to-Take-Water (PTTW). This requirement applies to all withdrawals, whether for consumption, temporary construction dewatering or permanent drainage improvements. Projects assessed to be taking more than 50,000 L/d but less than 400,000 L/d of ground water can obtain a permit/permission online via the Environmental Activity and Sector Registry (EASR) system. If it is assessed that more than 400,000 L/d is required then a Category 3 PTTW will be required.

Based on the discussion above, a PTTW or registry on the EASR will be required where excavation is required below the ground water table. A site specific Hydrogeological Site Assessment will be required in support of a PTTW or registry on the EASR.

Pavement Design and Construction

The following typical pavement thicknesses are proposed for planning purposes, based on the near surface sand to sandy silt soils at the site. A review should be conducted when the road subgrade material is known.

MATERIAL	LIGHT DUTY (LOCAL RESIDENTIAL ROADS)
Asphalt (mm)	90
Granular A Base Course (mm)	150
Granular B Subbase Course (mm)	300
Total Thickness (mm)	540

Following rough grading, subgrade preparation should include proofrolling and compacting the exposed subgrade with a heavy compactor. Any unstable zones identified during proofrolling should be sub-excavated and replaced with compacted select material.

Imported material for the granular base and subbase should conform to OPSS gradation specifications for Granular A and Granular B, and should be compacted to 100% Standard Proctor maximum dry density. Asphalt should be compacted in accordance with OPSS 310.

The pavement design considers that construction will be carried out during the drier time of the year and that the subgrade is stable, as determined by proofrolling operations. Where wet and/or unstable subgrade is identified, remediation may include increasing the depth of subbase, the use of Granular B Type II and/or use of geogrid reinforcement, subject to geotechnical review during construction.

For the pavement to function properly, it is essential that provisions be made for water to drain and not collect in the base material. The incorporation of subdrains is recommended in conjunction with crowning of the final surface to promote drainage away from the structure. Subdrains should be installed at least 300 mm below the subgrade level. For details regarding pipe, filter cloth or pipe sock, bedding and cover material, refer to OPSD 216 Series. Subdrains should lead to a frost free outlet and/or be connected to storm sewer system. Maintenance holes/catch basins should be backfilled using free draining material with frost tapers and stub drains extending out from the structures. The above measures will help drain the pavement structure as well as minimize frost movement between maintenance hole/catch basins and pavement.

Geotechnical Review and Construction Inspection and Testing

It is recommended that additional boreholes with water level monitoring wells be completed to more fully define the soil and ground water conditions across the site.

It is recommended that the final drawings be submitted to PML for geotechnical review for compatibility with the site conditions and the recommendations provided in this report.

Earthworks operations should be carried out under the supervision of PML to approve subgrade preparation, backfill materials, placement and compaction procedures and verify specified compaction standards are achieved throughout.

Prior to placement of structural concrete for footings, the founding surface must be inspected to verify the design bearing capacity is available or to make recommendations for remediation, if required.

The comments and recommendations provided in the report are based on the information revealed in the boreholes. Conditions away from and between boreholes may vary. Geotechnical review during construction should be on going to confirm the subsurface conditions are substantially similar to those encountered in the boreholes, which may otherwise require modification to the original recommendations.

CLOSURE

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.

LICENSED PROFESSIONAL ENGINEER
G. R. WHITE
MAY 17/2018
PROVINCE OF ONTARIO

Geoffrey R. White, P.Eng.
Associate
Manager, Geotechnical and Geoenvironmental Services

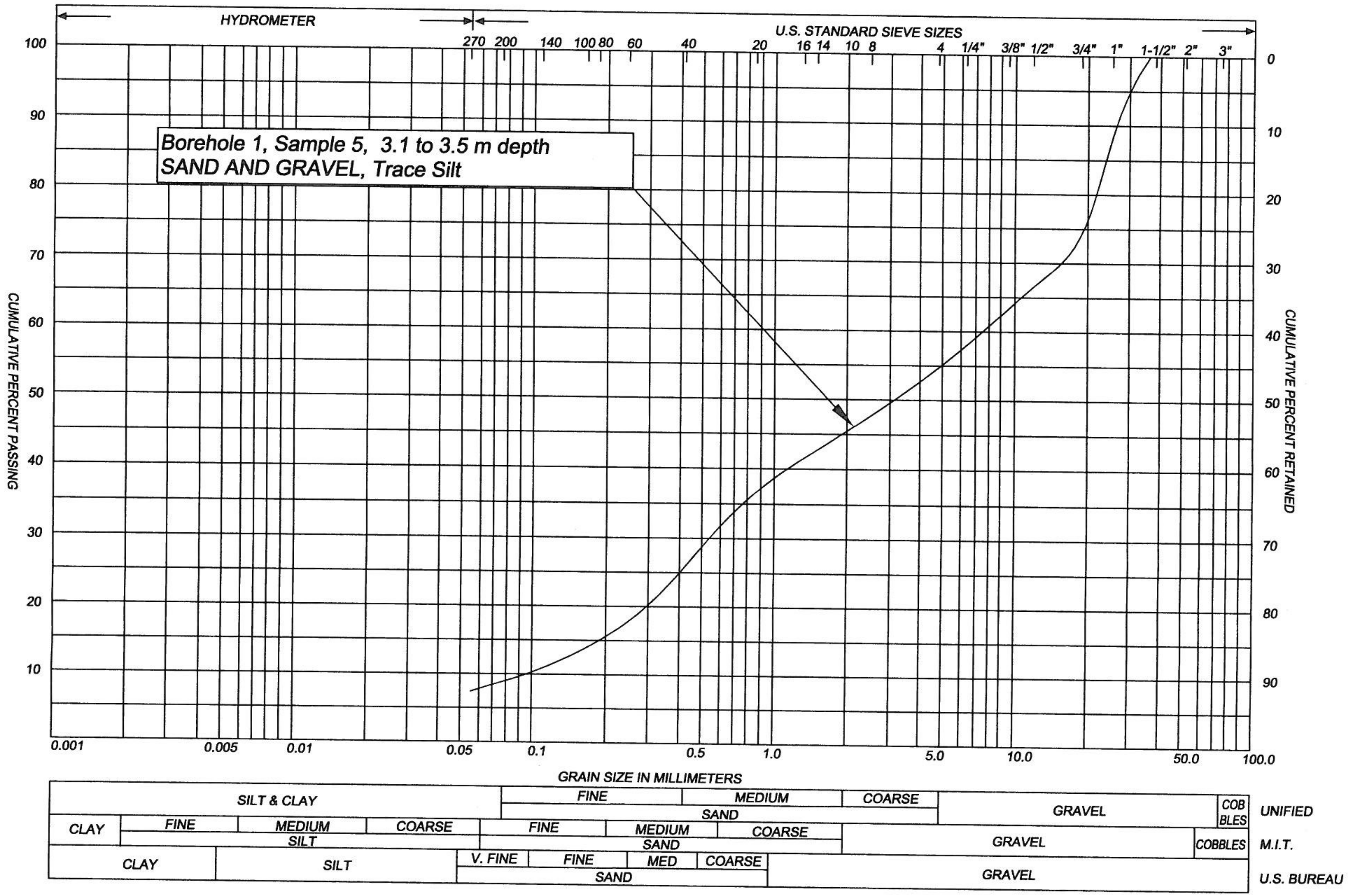
GRW/TLB:jlb

Enclosure(s):
Figure 1 to 3 - Particle Size Distribution Charts
Figure 4 - General Recommendations Regarding Drainage and Backfill Requirements for Basement Wall and Floor Slab Construction
List of Abbreviations
Log of Borehole Nos. 1 to 3
Drawing No. 1 - Borehole Location Plan

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

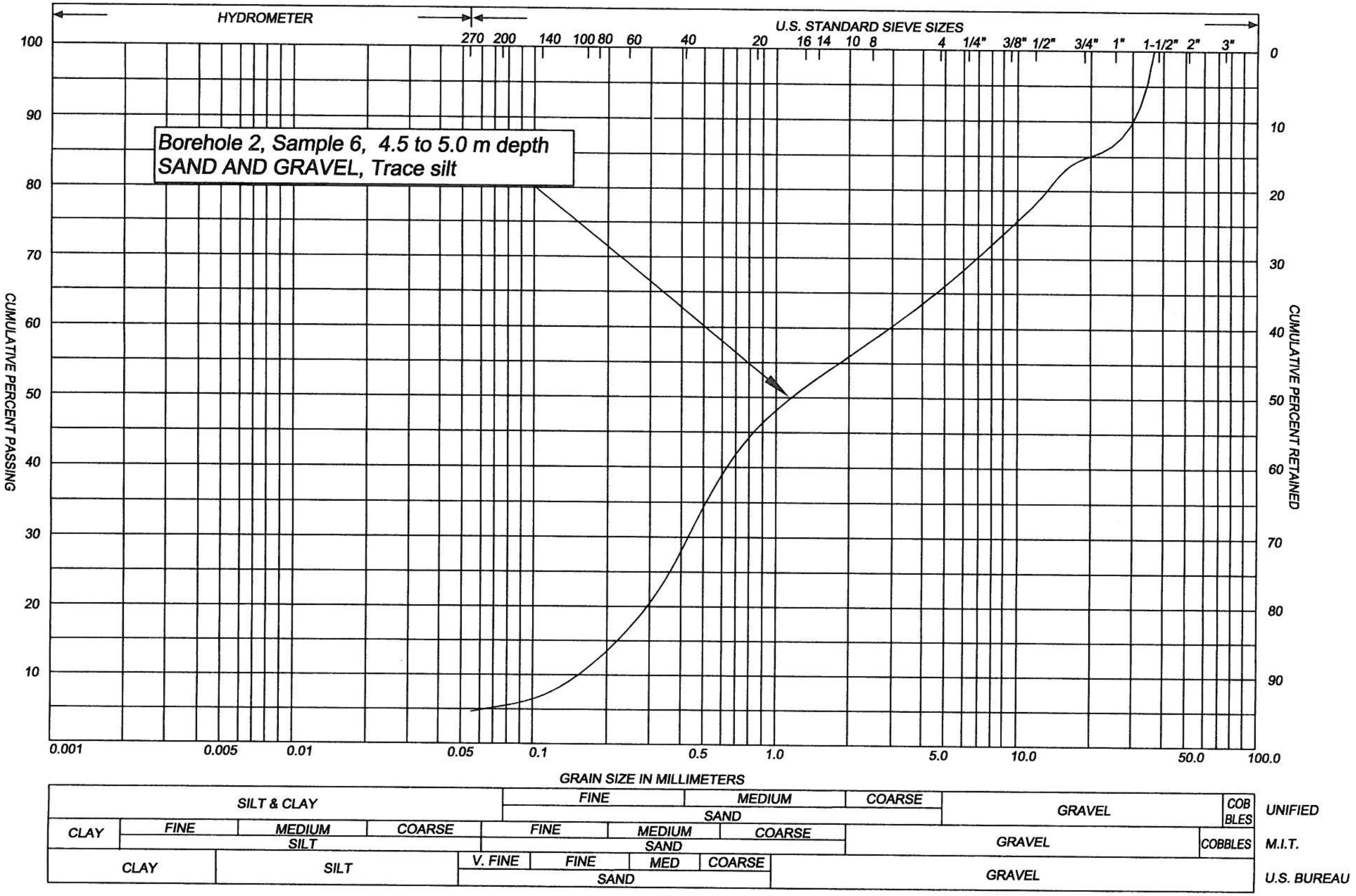
PML Ref.: 17BF030
Figure No.: 1


Borehole 1, Sample 5, 3.1 to 3.5 m depth
SAND AND GRAVEL, Trace Silt

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17BF030
Figure No.: 2

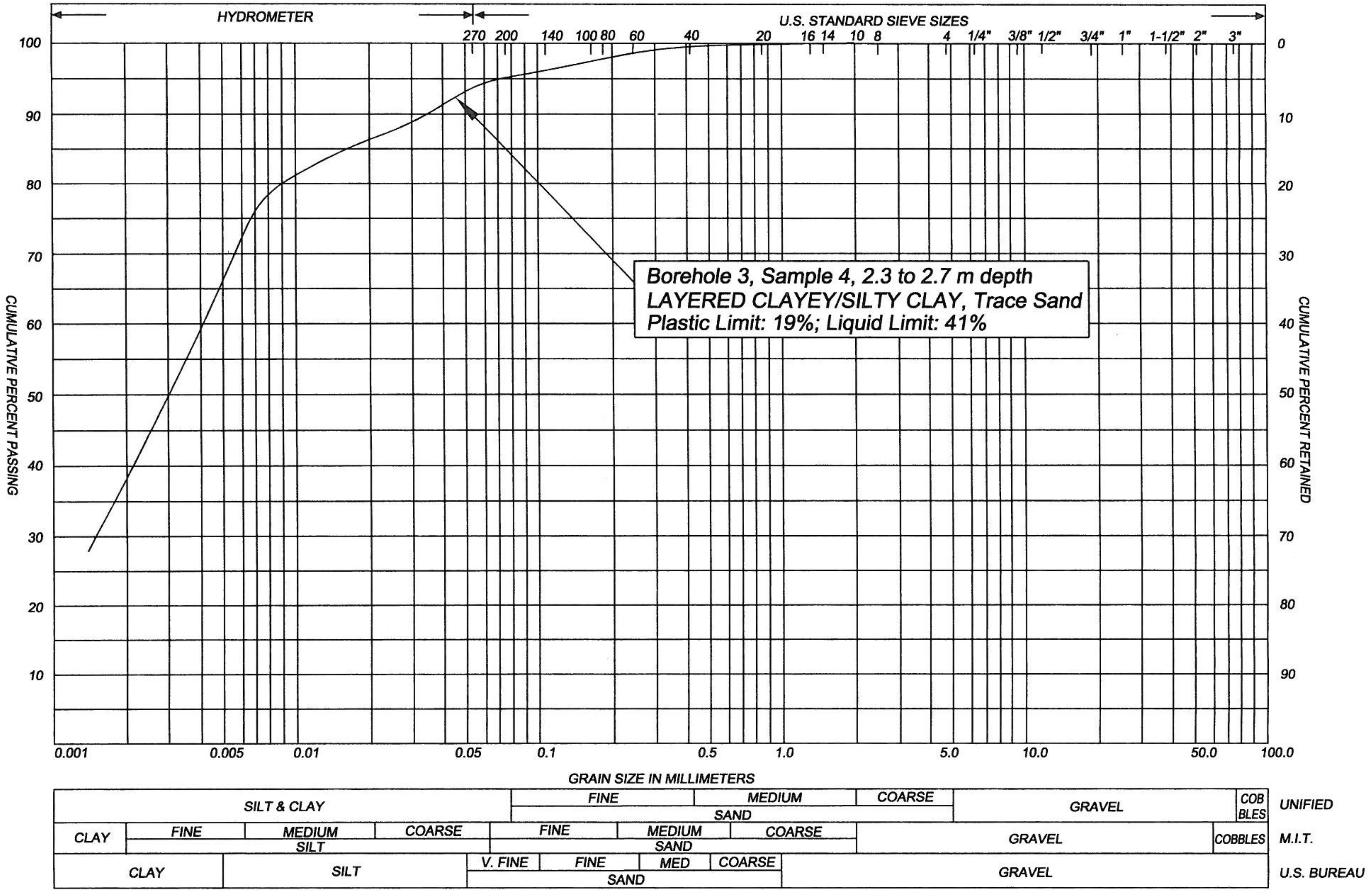


Borehole 2, Sample 6, 4.5 to 5.0 m depth
SAND AND GRAVEL, Trace silt

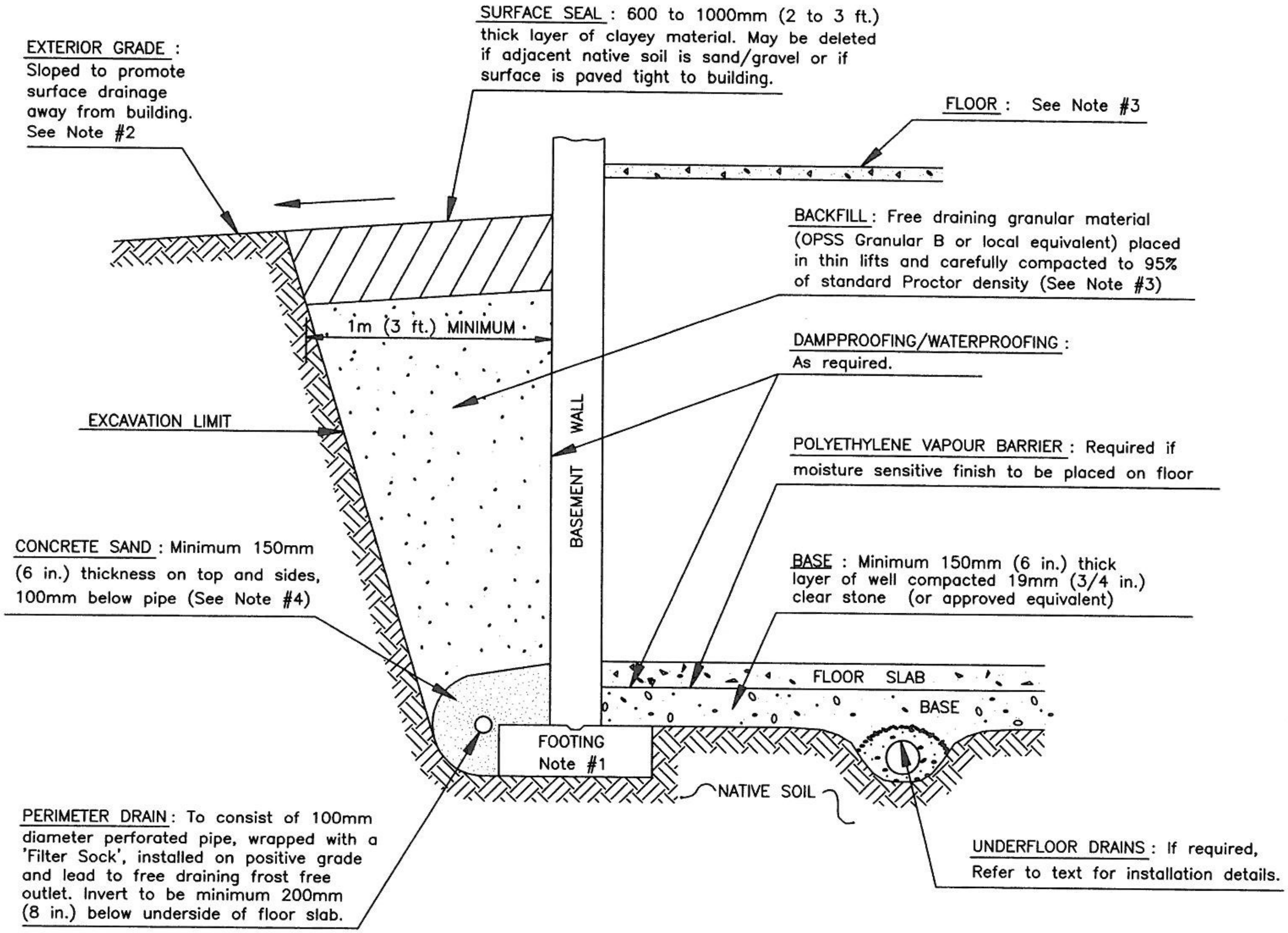
Peto MacCallum Ltd.
CONSULTING ENGINEERS

PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17BF030
Figure No.: 3



Borehole 3, Sample 4, 2.3 to 2.7 m depth
LAYERED CLAYEY/SILTY CLAY, Trace Sand
Plastic Limit: 19%; Liquid Limit: 41%



EXTERIOR GRADE : Sloped to promote surface drainage away from building. See Note #2

SURFACE SEAL : 600 to 1000mm (2 to 3 ft.) thick layer of clayey material. May be deleted if adjacent native soil is sand/gravel or if surface is paved tight to building.

FLOOR : See Note #3

BACKFILL : Free draining granular material (OPSS Granular B or local equivalent) placed in thin lifts and carefully compacted to 95% of standard Proctor density (See Note #3)

DAMPPROOFING/WATERPROOFING : As required.

EXCAVATION LIMIT

POLYETHYLENE VAPOUR BARRIER : Required if moisture sensitive finish to be placed on floor

CONCRETE SAND : Minimum 150mm (6 in.) thickness on top and sides, 100mm below pipe (See Note #4)

BASE : Minimum 150mm (6 in.) thick layer of well compacted 19mm (3/4 in.) clear stone (or approved equivalent)

PERIMETER DRAIN : To consist of 100mm diameter perforated pipe, wrapped with a 'Filter Sock', installed on positive grade and lead to free draining frost free outlet. Invert to be minimum 200mm (8 in.) below underside of floor slab.

UNDERFLOOR DRAINS : If required, Refer to text for installation details.

NOTES

1. Footing may be constructed by placement of structural concrete neat against natural soil. Drain to be installed in a similar manner immediately above footing maintaining 200mm (8 in.) distance between top of drain and underside of floor slab.
2. Exterior grade to be minimum 300mm (12 in.) below interior floor slab, or other means established to prevent entry of surface water into building through building openings.
3. Basement wall to be supported by floor system or interior bracing prior to commencement of backfill placement. Heavy construction equipment should not be permited within a distance from the foundation wall equivalent to half the wall height. Overcompaction of backfill to be avoided as excessive lateral earth pressure may result.
4. Concrete sand may be replaced with clear stone, if wrapped in approved geotextile.
5. Refer to text for details regarding founding levels, competent bearing material and construction details specific to particular site.

STANDARD DRAWING

GENERAL RECOMMENDATIONS REGARDING DRAINAGE AND BACKFILL REQUIREMENTS FOR BASEMENT WALL AND FLOOR SLAB CONSTRUCTION

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN:	N.A.	DATE	SCALE	JOB NO.	FIGURE NO.
CHECKED:		JAN 2005	N.T.S.	17BF030	4
APPROVED:					

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	ST	Slotted Tube Sample
WS	Washed Sample	TW	Thinwall Open
SB	Scraper Bucket Sample	TP	Thinwall Piston
AS	Auger Sample	OS	Oesterberg Sample
CS	Chunk Sample	FS	Foil Sample
GS	Grab Sample	RC	Rock Core

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

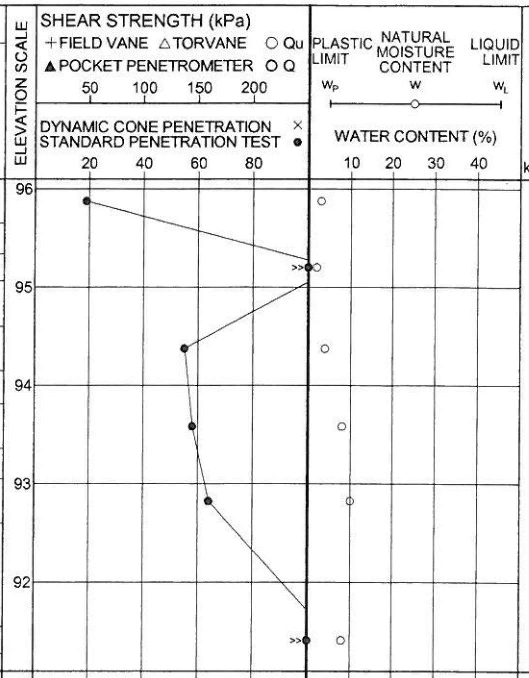
Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

LOG OF BOREHOLE/MONITORING WELL NO. 1

1 of 1

PROJECT Proposed Ten Lot Residential Subdivision
LOCATION 211 Dock Road, Barrie, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE September 22, 2017
PML REF. 17BF030
ENGINEER GW
TECHNICIAN GW

DEPTH / ELEV (metres)	SOIL PROFILE DESCRIPTION	NUMBER	TYPE	"N" VALUES
0.0	SURFACE ELEVATION 96.10			
	TOPSOIL: Dark brown, sand, trace silt, moist	1	SS	19
0.35 95.75	SAND AND GRAVEL: Compact to very dense, brown, sand and gravel, trace silt, cobbles and boulders, moist	2	SS	72/275 mm
		3	SS	55
2.1 94.0	Becoming wet	4	SS	58
		5	SS	64
		6	SS	90/275 mm
5.0 91.1	BOREHOLE TERMINATED UPON REFUSAL TO AUGER AT 5.0 m			



GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Stick-up casing
Concrete

Bentonite seal

First water strike at 2.1 m

50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 3.5 m
No cave
Water Level Readings:

Date	Depth	Elev.
2017-10-11	2.8	93.3

NOTES

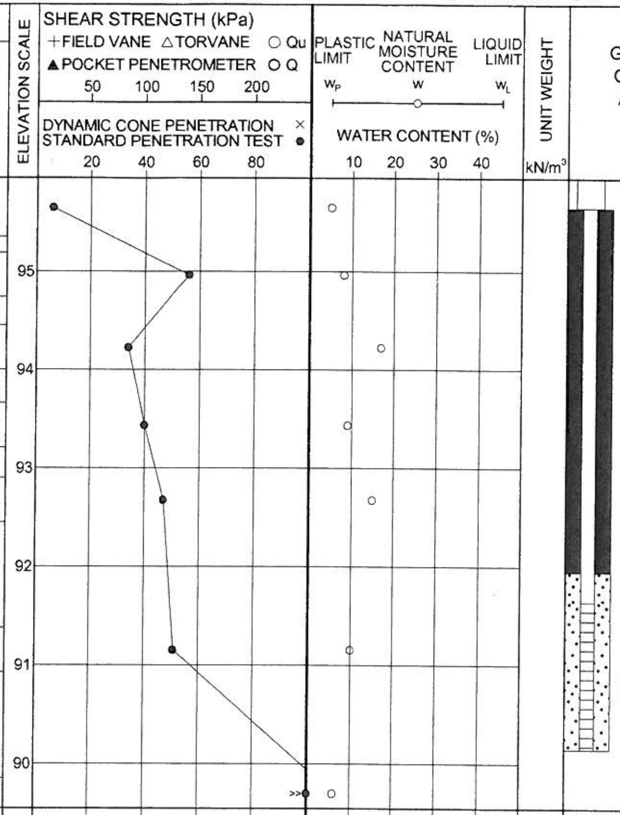
PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 2

1 of 1

PROJECT Proposed Ten Lot Residential Subdivision
LOCATION 211 Dock Road, Barrie, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE September 22, 2017
PML REF. 17BF030
ENGINEER GW
TECHNICIAN GW

DEPTH ELEV (metres)	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 95.95				
0.40	TOPSOIL: Dark brown, sand, trace silt, moist		1	SS	6
0.70	SANDY SILT: Loose, brown, sandy silt, moist				
95.25	SAND: Very dense to dense, brown to grey, sand, some silt to silty, some gravel, wet		2	SS	56
			3	SS	34
2.9			4	SS	40
93.1	SAND AND GRAVEL: Dense to very dense, brown, sand and gravel, trace silt, wet		5	SS	47
			6	SS	51
6.4			7	SS	79/250 mm
89.6	BOREHOLE TERMINATED AT 6.4 m				



GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Stick-up casing
Concrete

First water strike at 0.7 m

Bentonite seal

50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 1.5 m
Cave at 5.5 m
Water Level Readings:

Date	Depth	Elev.
2017-10-11	0.7	95.3

NOTES

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 3

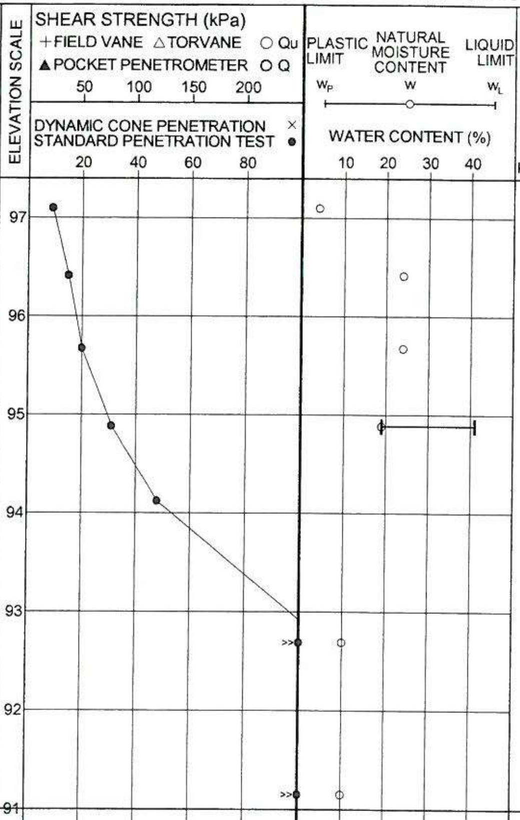
1 of 1

PROJECT Proposed Ten Lot Residential Subdivision
LOCATION 211 Dock Road, Barrie, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE September 22, 2017
PML REF. 17BF030
ENGINEER GW
TECHNICIAN GW

SURFACE ELEVATION 97.40

DEPTH / ELEV (metres)	DESCRIPTION
0.40 97.00	TOPSOIL: Dark brown, sand, trace silt, moist
0.80 96.60	SAND: Loose, brown, sand, trace silt, trace gravel, cobbles and boulders, moist
5.2 92.2	LAYERED CLAYEY SILT/SILTY CLAY: Very stiff to hard, grey, layered clayey silt to silty clay, trace sand, APL to DTPL WET LAYERS
6.4 91.0	SANDY SILT TILL: Very dense, grey, sandy silt, trace gravel, cobbles and boulders, wet sand layers, moist
	BOREHOLE TERMINATED AT 6.4 m

NUMBER	TYPE	"N" VALUES
1	SS	9
2	SS	15
3	SS	20
4	SS	31
5	SS	48
6	SS	71/275 mm
7	SS	75/275 mm



UNIT WEIGHT kN/m^3

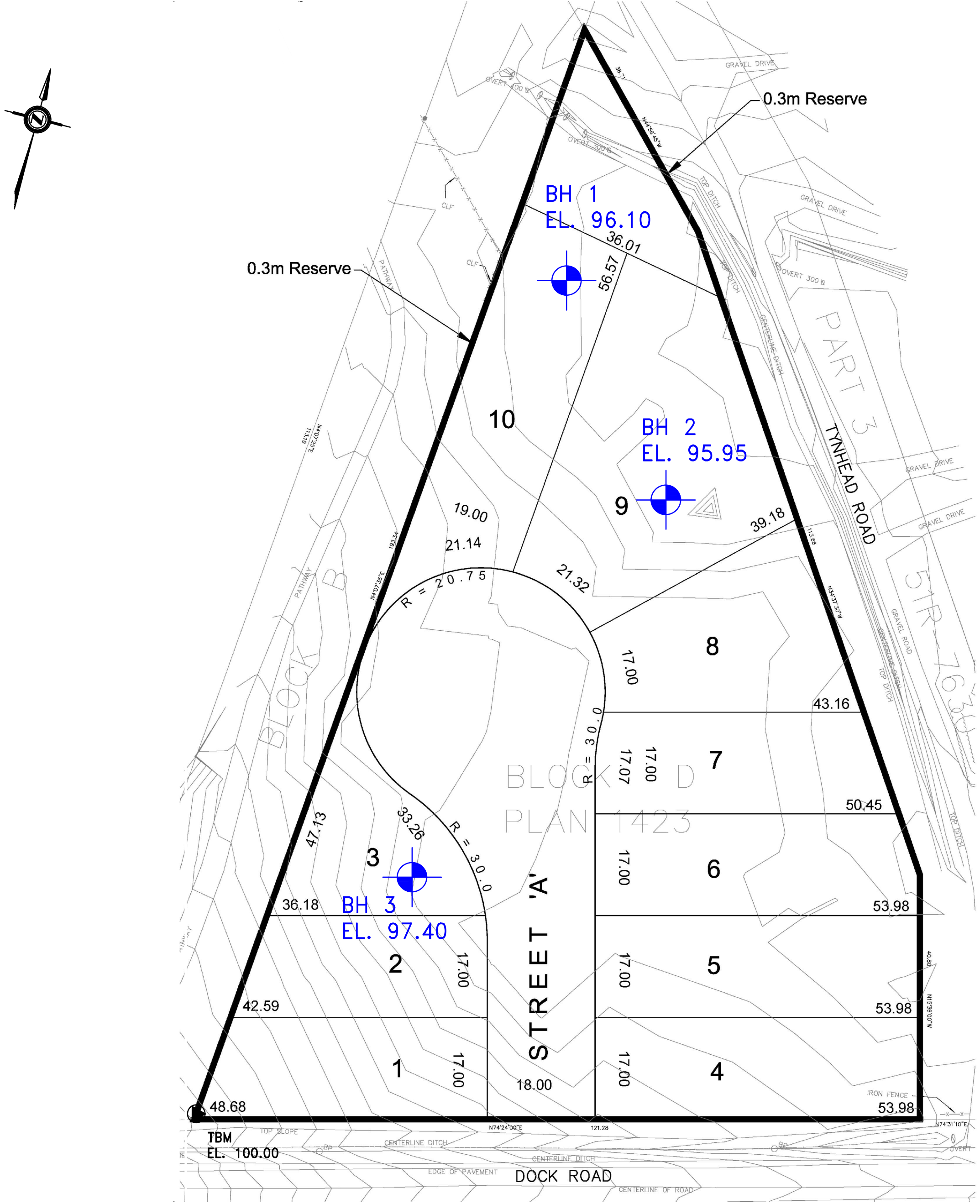
GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

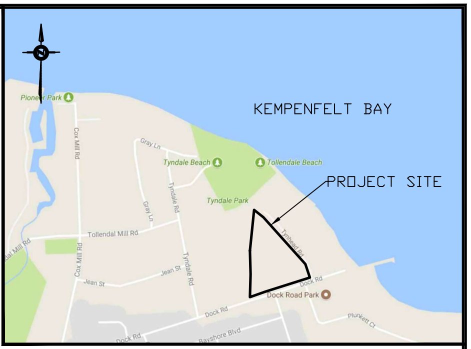
Stick-up casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand
First water strike at 6.0 m

Upon completion of augering
Water at 4.8 m
No cave
Water Level Readings:

Date	Depth	Elev.
2017-10-11	0.1	97.3

NOTES





KEY PLAN
BARRIE, ONTARIO

LEGEND:

BH 1 EL. 96.10 — BOREHOLE 1 (WITH MONITORING WELL)
SURFACE ELEVATION

TBM EL. 100.00 — TEMPORARY BENCH MARK (TBM)
TOP OF SQUARE SIB WITH YELLOW MARKING
TAPE AT SOUTHWEST CORNER OF SITE
ELEVATION 100.00 (METRIC, ASSIGNED)

REFERENCE:
BASE PLAN PROVIDED BY CLIENT

0m 10 20 30 40 50

BOREHOLE LOCATION PLAN

PROPOSED TEN LOT RESIDENTIAL SUBDIVISION
211 DOCK ROAD
BARRIE, ONTARIO

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	RB	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	GW	MAY 2018	AS SHOWN	17BF030	1
APPROVED	GW				