PetoMacCallum Ltd.
CONSULTING ENGINEERS

PROPOSED CLUBHOUSE
GEORGIAN BAY CLUB
COLLINGWOOD, ONTARIO
FOR
GEORGIAN BAY CLUB

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PML Ref.: 03BF050

October, 2003

Peto MacCallum Ltd.
CONSULTING ENGINEERS

October 7, 2003

PML Ref.: 03BF050

Mr. Rupert Crighton
Construction Manager
Georgian Bay Club
P.O. Box 40
Collingwood, Ontario
L9Y 3Z4

Dear Mr. Crighton

Geotechnical Investigation
Proposed Clubhouse
Georgian Bay Club
Collingwood, Ontario

We are pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Verbal authorization for this work was provided by Mr. R. Crighton, to be confirmed in writing.

An approximate 20 by 50 m clubhouse is proposed, at the top of an approximate 12 m high embankment. The building will be 2 storeys, which includes a drive through basement level.

The purpose of this investigation was to determine the subsurface soil and groundwater conditions at the site and based on this information, provide an assessment of the slope stability, as well as comments and geotechnical recommendations for foundation design.

## INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out on September 29, 2003, and consisted of one borehole drilled to 9.6 m depth, and two boreholes to about 5 m depth, at the locations shown on Drawing No. 1, appended.

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

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BARRIE, BRAMPTON, HAMILTON, KITCHENER, TORONTO

Representative samples of the overburden 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 characteristic of the substrata. Groundwater conditions were closely monitored during the course of the fieldwork.

The boreholes were located in the field in conjunction with a representative from Georgian Bay Club, who also provided the following temporary benchmark, TBM:

TBM: Grade Stake near southeast corner
of proposed clubhouse
Elevation 220.50, geodetic (as shown on Drawing 1)

All recovered soil samples were returned to our laboratory for detailed examination and moisture content determinations.

## 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, groundwater observations, and the results of laboratory moisture content determinations.

The boreholes have revealed localized topsoil and fill over a major silt till deposit.

A 100 mm thick topsoil mantle was noted in borehole 1.

Fill was encountered under the topsoil, borehole 1, and at surface in borehole 2 to a depth of about 600 mm. The fill consisted of sandy silt with trace gravel, and appeared to reflect regrading at the site.

A major silt till deposit was encountered under the fill (boreholes 1 and 2) and at surface at borehole 3, and extended the full depth in the boreholes. The deposit was typically dense to very dense. A sand layer, some 2 m thick was found embedded within the till.

No free water was observed during or upon completion of drilling in any of the boreholes, and the groundwater table was considered to be below the depth of exploration.

Groundwater levels will be subject to seasonal fluctuations.

## ENGINEERING CONSIDERATIONS

### Slope Stability

The building is proposed at the top of an approximate 12 m high embankment overlooking the 18th green and fairway. At the time of this investigation, the building site had already been rough graded by cutting a plateau into the embankment. The crest of the slope will be near elevation 215, sloping down to the fairway at an overall inclination of about 3 horizontal to 1 vertical.

The boreholes have revealed that the slope is comprised of dense to very dense silt till, with no groundwater noted within the slope. Cognizant of the subsurface conditions, and overall inclination of the embankment, there is an adequate safety factor of about 2.0 against an overall global slope failure.

It is noted that a retaining wall is planned along the cart path just west of the building. As a guide, the retaining walls should be designed such that the downhill earth slope is no steeper than 2 horizontal to 1 vertical (2H:1V). Further input and geotechnical review can be provided when further details are available.

### Footings

The building will be 2 storeys, which includes a drive through basement at elevation 217.5. The proposed building can be supported on spread footings founded on the native silt till, where a design bearing capacity of 200 kPa is available for design. Competent till is anticipated near elevation 216.5, 218.2 and 216.0, generally within 0.6 m below present grade, at boreholes 1, 2 and 3, respectively.

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

Prior to placement of structural concrete, all founding surfaces should be reviewed by Peto MacCallum Ltd. to confirm founding levels, verify the design bearing capacity is available and/or reassess the available soil capacity, as may be necessitated by actual field conditions.

### Floor Slab-On-Grade

Basement floor slab on grade is considered feasible, subject to subgrade preparation as discussed below.

Subgrade preparation should involve stripping of topsoil and other obvious deleterious materials down to competent inorganic soil. The exposed surface should then be proof rolled under the supervision of Peto MacCallum Ltd., using a heavy compactor. Any excessively loose/soft, wet zones identified during this process should be sub-excavated and replaced with select on site soil, placed in maximum 200 mm thick lifts compacted to a minimum 95% Standard Proctor maximum dry density.

Upfill, where required, should comprise select on site soil placed in maximum 200 mm thick lifts and compacted to at least 95% Standard Proctor maximum dry density.

A minimum 200 mm thick layer of clear crushed stone (20 mm nominal size) or OPS Granular 'A', compacted to 100% Standard Proctor maximum dry density is recommended as a moisture barrier under the floor. An underfloor drainage system is not considered necessary. Where a vapour sensitive floor finish is to be used, a polyethylene sheet vapour barrier or equivalent should be incorporated under the slab.

Exterior grades should be established to accentuate surface run off away from the building.

**Basement Walls**

Basement walls should be designed to resist the unbalanced lateral earth pressure due to backfill against the wall. The lateral earth pressure, p, may be computed using the following equation assuming a triangular pressure distribution:

$$p = K(\gamma h + q)$$

Where

$K$ = lateral earth pressure coefficient (assuming level backfill)
= 0.5 for rigid restrained wall

$\gamma$ = unit weight of free draining granular backfill
= 21.2 kN/m$^3$

$h$ = depth at which pressure is computed (m)

$q$ = surcharge adjacent to the wall (kPa)

It is recommended that the backfill behind the wall comprise free draining material such as Ontario Provincial Standard Specification (OPSS) Granular 'B' or equivalent, and that a perimeter weeping tile system be incorporated to prevent the build-up of hydrostatic pressure behind the wall. The weeping tile should be surrounded by a minimum 150 mm thick layer of clear crushed stone (20 mm nominal size) or pea gravel, fully wrapped

with synthetic filter fabric to prevent migration of fines which may otherwise clog the system. The weeping tile should be positively sloped to a frost-free sump or outlet.

Site soils are not suitable for reuse as free draining backfill. Imported material will be required and should comprise OPSS Granular 'B' or equivalent.

Backfill should be placed in maximum 200 mm lifts, compacted to 95% Standard Proctor maximum dry density. Over compaction should be avoided, as this could exert excess pressure on walls. Suitable bracing and/or precautions should be taken to ensure the wall is not damaged during backfilling/compaction operations.

## Excavation and Groundwater Control

Excavation will be carried out through local fill into the native till deposit. The site soils should be considered as Type 3, requiring excavation side walls to be constructed at no steeper than 1 horizontal to 1 vertical from the base of the excavation, in accordance with the Occupational Health and Safety Act.

Groundwater is not anticipated within the depth of construction.

## Review and Construction Inspection and Testing

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, particularly where foundation and/or service trenches exist.

Earthworks operations should be carried out under the supervision of Peto MacCallum Ltd. to approve subgrade preparation, backfill materials, placement and compaction procedures and verify a 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.

## 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 contact our office.

Sincerely

**PETO MacCALLUM LTD.**


Turney Lee-Bun, P.Eng.
Branch Manager

TLB:jlb

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# LIST OF ABBREVIATIONS

## PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N': - THE NUMBER OF BLOWS REQUIRED TO ADVANCE TO 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/0.3m | ckPa | DENSENESS | 'N' BLOWS/0.3m |
|---|---|---|---|---|
| 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 | | |

W.T.P.L. WETTER THAN PLASTIC LIMIT D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

## TYPE OF SAMPLE

| | | | |
|---|---|---|---|
| S.S | SPLIT SPOON | T.W. | THINWALL OPEN |
| W.S. | WASHED SAMPLE | T.P. | THINWALL PISTON |
| S.B. | SCRAPER BUCKET SAMPLE | O.S. | OESTERBERG SAMPLE |
| A.S. | AUGER SAMPLE | F.S. | FOIL SAMPLE |
| C.S. | CHUNK SAMPLE | R.C. | ROCK CORE |
| S.T. | SLOTTED TUBE SAMPLE | | |

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

## SOIL TESTS

| | | | |
|---|---|---|---|
| Qu | UNCONFINED COMPRESSION | L.V. | LABORATORY VANE |
| Q | UNDRAINED TRIAXIAL | F.V. | FIELD VANE |
| Qcu | CONSOLIDATED UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| Qd | DRAINED TRIAXIAL | | |

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# LOG OF BOREHOLE NO. 1

**PROJECT** Proposed Clubhouse
**LOCATION** Georgian Bay Club, Collingwood, Ontario
**BORING METHOD** Continuous Flight Solid Stem Augers
**BORING DATE** September 29, 2003
**OUR PROJECT NO.** 03BF050
**ENGINEER** JFW
**TECHNICIAN** RM

| SOIL PROFILE | | | | SAMPLES | | | SHEAR STRENGTH $C_u$(kPa) ▲ 50 100 150 200; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; BLOWS/0.3M 20 40 60 80 | LIQUID LIMIT $W_L$; PLASTIC LIMIT $W_P$; WATER CONTENT $W$; $W_P$ $W$ $W_L$; WATER CONTENT % 10 20 30 | GROUND WATER OBSERVATIONS AND REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES | | | |
| | GROUND ELEVATION 217.20 | | | | | | | | |
| 0.10 | TOPSOIL: Dark brown, silt | | 217 | 1 | SS | 26 | | | |
| 0.60 | FILL: Compact, brown, sandy silt, trace gravel, damp | | | | | | | | |
| | SILT TILL: Dense to very dense, brown, silt, some sand to sandy, some gravel, occ. cobbles, moist | | 216 | 2 | SS | 36 | | | |
| 1.50 | | | | 3 | SS | 50/130mm | | | |
| | | | 215 | 4 | SS | 60 | | | |
| 3.00 | | | 214 | 5 | SS | 50/100mm | | | |
| | | | 213 | | | | | | |
| 4.50 | 4.50 numerous cobbles and boulders | | | 6 | SS | 50/150mm | | | |
| | | | 212 | | | | | | |
| 6.00 | | | 211 | 7 | SS | 58 | | | |
| | | | 210 | | | | | | |
| 7.50 | | | | 8 | SS | 57 | | | |
| | | | 209 | | | | | | |
| 9.00 | | | 208 | | | | | | |
| 9.60 | BOREHOLE TERMINATED AT 9.60 m | | | 9 | SS | 57 | | | Upon completion of augering<br>No free water<br>Cave at 6.7 m |

NOTES

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**PetoMacCallum Ltd.**
CONSULTING ENGINEERS

# LOG OF BOREHOLE NO. 2

*PROJECT* Proposed Clubhouse
*LOCATION* Georgian Bay Club, Collingwood, Ontario
*BORING METHOD* Continuous Flight Solid Stem Augers
*BORING DATE* September 29, 2003
*OUR PROJECT NO.* 03BF050
*ENGINEER* JFW
*TECHNICIAN* RM

| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES |
|---|---|---|---|---|---|---|
| | GROUND ELEVATION 218.95 | | | | | |
| | FILL: Compact, brown, sandy silt, trace gravel, with topsoil inclusions | | | 1 | SS | 16 |
| 0.60 | SILT TILL: Dense to very dense, brown, sandy silt, trace gravel, moist | | 218 | 2 | SS | 40 |
| 1.50 | occ. sand layer | | 217 | 3 | SS | 56 |
| 2.10 | SAND: Compact, brown, silty sand to sandy silt, moist | | | 4 | SS | 25 |
| 3.00 | | | 216 | 5 | SS | 27 |
| 4.00 | SILT TILL: Very dense, brown, sandy silt, some gravel, moist | | 215 | | | |
| 4.50 4.70 | BOREHOLE TERMINATED AT 4.70 m | | | 6 | SS | 50/100mm |

SHEAR STRENGTH $C_u$(kPa) ▲
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M
20 40 60 80

LIQUID LIMIT ____ $W_L$
PLASTIC LIMIT ____ $W_P$
WATER CONTENT ____ W
$W_P$ W $W_L$
WATER CONTENT %
10 20 30

GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering
No free water
Cave at 4.0 m

*NOTES*

*CHECKED BY*

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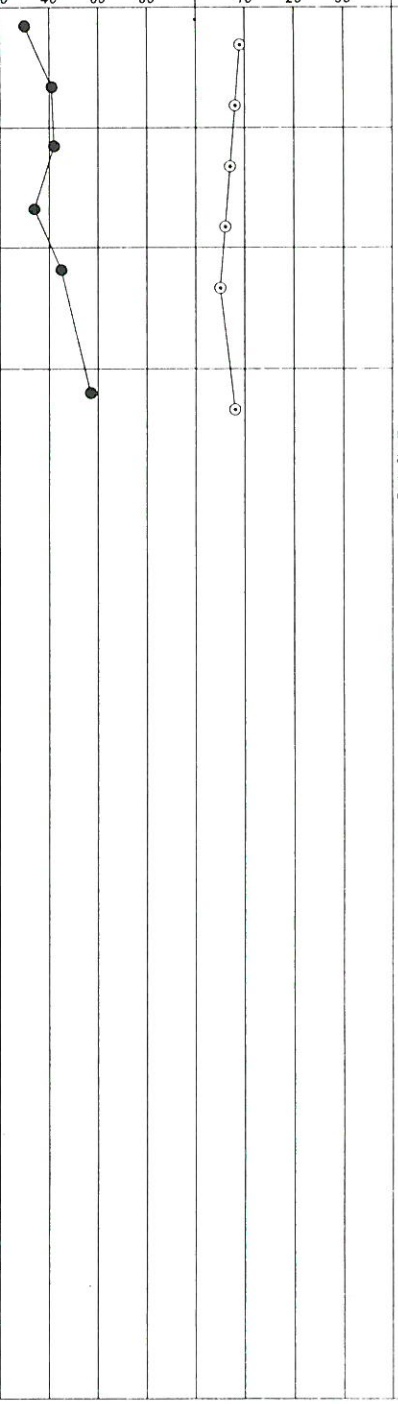
# LOG OF BOREHOLE NO. 3

PROJECT Proposed Clubhouse
LOCATION Georgian Bay Club, Collingwood, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE September 29, 2003
OUR PROJECT NO. 03BF050
ENGINEER JFW
TECHNICIAN RM

| DEPTH in METRES | DESCRIPTION | LEGEND | ELEVATION | NUMBER | TYPE | BLOWS/0.3m N - VALUES |
|---|---|---|---|---|---|---|
| | GROUND ELEVATION 216.00 | | | | | |
| | SILT TILL: Dense, dark brown, sandy silt, some gravel | | | 1 | SS | 30 |
| 0.60 | hard, brown, clayey silt, some gravel | | 215 | 2 | SS | 41 |
| 1.50 | | | | 3 | SS | 42 |
| 2.10 | dense, sandy silt, trace to some gravel, occ. cobbles and boulders | | 214 | | | |
| | | | | 4 | SS | 34 |
| 3.00 | | | 213 | | | |
| | | | | 5 | SS | 45 |
| 4.00 | very dense, grey, silt, trace sand, trace gravel | | 212 | | | |
| 4.50 | | | | | | |
| 5.00 | BOREHOLE TERMINATED AT 5.00 m | | 211 | 6 | SS | 57 |

SHEAR STRENGTH $C_u$(kPa) ▲ (50, 100, 150, 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M (20, 40, 60, 80)

LIQUID LIMIT ____ $W_L$
PLASTIC LIMIT ____ $W_P$
WATER CONTENT ____ W
$W_P$ W $W_L$
WATER CONTENT % (10, 20, 30)



GROUND WATER OBSERVATIONS AND REMARKS

Upon completion of augering
No free water
Cave at 3.0 m

NOTES

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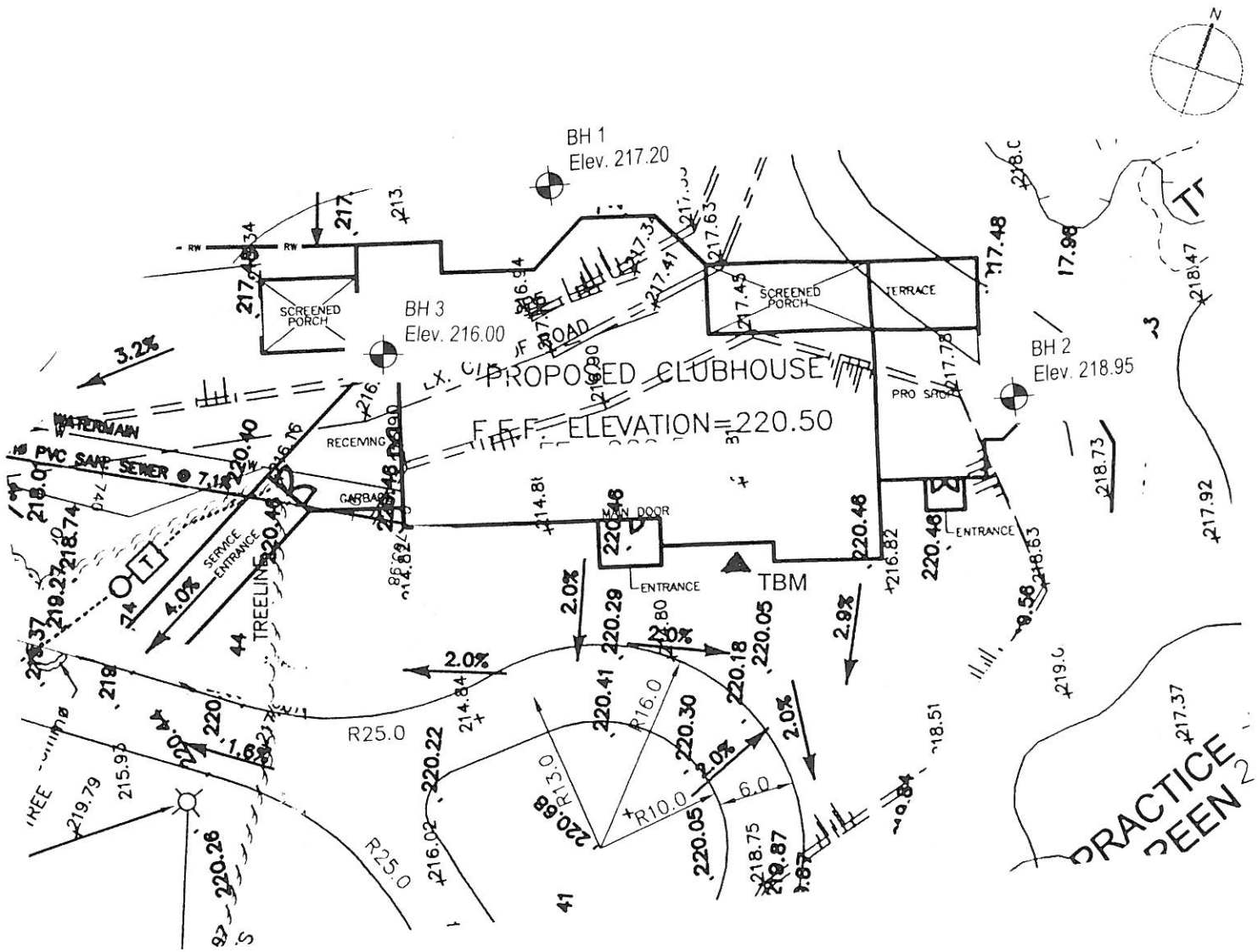


## LEGEND

| | |
|---|---|
| BH 1<br>217.20 | Borehole 1<br>Ground Surface Elevation |
| TBM<br>Elev. 220.50 | Temporary Bench Mark<br>(Grade Stake, as indicated in field by client) |

**BOREHOLE LOCATION PLAN**

PROPOSED CLUBHOUSE
GEORGIAN BAY CLUB
COLLINGWOOD, ONTARIO

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| DATE | SCALE | JOB NO. | DRAWING NO. |
|---|---|---|---|
| OCT 2003 | 1 : 500 | 03BF050 | 1 |