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Client

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Appendices

1 Introduction

Englobe Corp. (Englobe) was retained by Ontario Aboriginal House Services (OAHS), the Client, to carry out a geotechnical investigation for the proposed residential development, located in White River, Ontario. The purpose of the geotechnical investigation was to explore the subsoils and groundwater conditions at the subject site and prepare a geotechnical report with general recommendations for foundation design and construction.

2 Project and Site Description

The project site is located along Superior Street (located to the east) and Ontario street (located to the west) with the development footprint spread over ten (10) land parcels (lots 59 to 63, and lots 94 to 98). Based on preliminary information provided by OAHS, we understand that there will be two sets of townhouse structures along Superior Street, each containing two 3-bedroom and one 2-bedroom suites, and two sets of connecting townhouse structures along Ontario Street, each containing four 2-bedroom units. We understand that there are no plans for any basements or crawls spaces below grade. A site location plan is provided as Drawing 1 in Appendix A.

3 Field and Laboratory Investigation

3.1 Field Program

Prior to the field drilling activities public utility companies were contacted through Ontario One-Call to complete the ground disturbance clearances by marking underground and overhead facilities in the field and to acquire corresponding drawings for clearances. A private locator was also utilized to clear borehole locations. A ground disturbance package was prepared and included as part of the safety package and hazard assessment.

The fieldwork for the geotechnical investigation was completed on December 2nd, 2020. A track mounted drill rig owned and operated by Maple Leaf Drilling, equipped with solid and hollow stem augers, was used for completing the borehole drilling. The borehole locations are shown on Drawing 2 in Appendix A. The following table summarizes the borehole drilling.

Table 1 Borehole Completion Summary

Borehole No.	Sample Depth (m)
BH-01	5.0
BH-02	5.0
BH-03	5.0
BH-04	5.0
BH-05	6.7
BH-06	5.0
BH-07	3.0

The field drilling was supervised by Englobe geotechnical personnel and the field investigation was carried out in general conformance with the professional standards set out in the Canadian Foundation Engineering Manual (CFEM 2006, 4th Edition), applicable Ontario Regulations, and the ASTM international standards. The following paragraphs summarize the geotechnical activities completed for the field program.

Soil samples were recovered from the boreholes at regular depth intervals using a 50 mm outside diameter split spoon sampler in accordance with ASTM D1586 Standard Penetration Test (SPT). The recorded SPT N-values and corresponding soil unit density or consistency are provided on the borehole logs, provided in Appendix B. The subsurface stratigraphy was generally logged in accordance with Unified Soil Classification System (USCS).

Groundwater levels were measured in the open boreholes upon completion of drilling and the observations are noted on the borehole logs (Appendix B) and described in Section 4.2.

All boreholes were backfilled with soil cuttings and a bentonite seal at the surface in accordance with Ontario Regulation 903 as amended, under the Ontario Water Resources Act.

Soil samples were sealed in airtight plastic bags and transported to the Thunder Bay laboratory for testing and visual examination.

3.2 Laboratory Testing

As previously discussed, the soil samples obtained during this investigation were returned to the Thunder Bay laboratory for visual examination, as well as routine laboratory testing. A total of fifty-five (55) moisture content tests and one (1) gradation analysis were completed on representative samples. The lab test results are plotted on the borehole logs (Appendix B), are summarized in Section 4.1, and grain size distribution is provided in Appendix C.

It is important to note that as per the standard policy of Englobe, the soil samples will be stored for a period of three months from the date of sampling. These soil samples will be discarded after the three month period described above unless prior arrangements have been made for longer storage.

4 Subsurface Conditions

This section presents a summary of the subsurface soil and groundwater conditions encountered during the field drilling portion of the geotechnical investigation. The full site-specific details of the subsoil and groundwater conditions are presented on the borehole logs in Appendix B.

4.1 Subsoil Conditions

Based on results of the field geotechnical investigation, the subsurface conditions generally consisted of a surficial layer topsoil (100 mm in thickness) overlying sand, underlain by silt with layers of sand. The variations of measured N-values with depth in exploratory boreholes, are presented graphically in Appendix C.

4.1.1 Sand to Silty Sand

Layers of sand to silty sand of variable thickness were encountered below the topsoil at all borehole locations extending to depths ranging from 1.0 m to 2.6 m below grade. In addition some silt layers were encountered in the sand/silty sand layered deposit but may have been borehole slough from the overlying layers. The sand layers were generally described a containing trace silt to silty, trace gravel, yellow or brown in colour, and damp to wet. The natural moisture content measured on samples of the layered deposit ranged from 14 to 22 percent.

Based on SPT ‘N’ values of 1 to 12 blows per 300 mm penetration, the compactness of this deposit was described as very loose to compact, generally loose. Details of the descriptions and depths can be found on the borehole logs provided in Appendix B

4.1.2 Silt

A deposit of silt was encountered below the sand/silty sand layers at depths of 1.0 m to 2.6 m below grade that extended to the termination depth of the boreholes (3.5 m to 6.7 m). The silt was described as containing trace to some sand, trace to some clay, trace gravel, wet, and brown or grey in colour. It is important to note that sand layers were observed at select boreholes in the silt during drilling however, may have been encountered due to borehole slough from the overlying sand layer. The natural moisture content measured on samples of the layered deposit ranged from 17 to 40 percent, but generally in the range of 20 percent.

Based on SPT ‘N’ values of 0 (weight of hammer) to 34 blows per 300 mm penetration, the compactness of this deposit was described as very loose to dense, but generally considered to be compact.

One sieve analysis was carried out on a sample of the silt unit which is summarized in the following table, with the grains size curve provided in Appendix C.

Table 2 Particle Size Distribution Analysis

Borehole No.	Sample Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH-02	3.8 to 4.4	0	10	88	2

4.2 Groundwater

Groundwater observations and measurements taken in the open boreholes are presented on the appended borehole logs and summarized in the table below.

Table 2 Water Level Measurements

Borehole No.	Groundwater Depth (m)
BH-01	None Observed
BH-02	None Observed
BH-03	None Observed
BH-04	3.1
BH-05	None Observed
BH-06	0.5
BH-07	1.4

It is important to note that the groundwater conditions described in this report refer only to those observed at the place and time of observation noted in the report. Cave in was generally at surface or where groundwater was observed in the boreholes, as such groundwater values in the table above may be directly related to cave in depths. The groundwater conditions can vary locally due to seasonal fluctuations, groundwater regimes encountered at the site or as a consequence of construction activities on the site or adjacent sites.

Groundwater levels will fluctuate seasonally and/or yearly. As such, the groundwater level should be established in advance of the construction operations (i.e. at time of tender or following award, prior to starting site work) such that adequate groundwater control plans can be developed.

5 Geotechnical Design Recommendations

5.1 General Geotechnical Discussion

The overburden soils encountered at the site are suitable for the proposed development. Shallow foundations including strip, spread, and raft slabs are all feasible. However, there are concerns associated with potential high groundwater conditions and the soils at site that are highly sensitive to disturbance. Shallow foundations with insulation to protect from frost penetration are recommended. Raft slabs could also be considered. The following sections summarize the foundation and construction recommendations for the proposed development.

5.2 Shallow Foundations

Footings placed on the native subgrade or engineered fill at the depth required for frost protection (see Section 5.3) are acceptable for the townhouse foundations. Shallow insulated footings placed on the native subgrade or engineered fill at 1 m below finished grade (see Section 5.3) are acceptable for the townhouse foundations. The following table summarizes the ULS and SLS parameters from 1 m to 2.5 m below grade.

Table 3 Geotechnical Bearing Resistances ULS and SLS Reactions

Soil Type (depth) m.	Factored ULS Resistance (kPa)	Factored Reaction at SLS* (kPa)
Native Sands or silts to 2.2 m	150	100
300 mm of Engineered Fill overtop approved native soil to 2. m5	300	200

Based on the above noted design bearing pressures, and assuming proper subgrade preparation, settlements of the foundation units on soil for the structure will be well within the generally accepted tolerance range for this type of structure (i.e. 25 mm total and 19 mm differential). Based on the loose nature of the site soils the use of engineered fill over bearing soils is recommended.

Prior to placing footings on the native subgrade, the subgrade shall be cleaned thoroughly and be free of any overburden soils, deleterious materials, water, snow or ice prior to pouring concrete. A lean mix mud-slab (50 mm thick) is recommended to protect all strip and spread footing bearing surfaces once inspected and approved. Alternatively, as briefly mentioned above, the footing areas should be over excavated a minimum depth of 300 mm and replaced with engineered fill comprised of OPSS Granular A, compacted to 98 percent of the SPMDD. Depending on the constructability concern, a non-woven geotextile may be required prior to placement of engineered fill. The non-woven geotextile would act as a separator layer between the native soils and engineered fill. The requirements should be field determined by geotechnical personnel once the subgrade has been stripped for inspection. Light compaction equipment (with little vibration effort) should be planed, or a heavier gravity compactor (no vibration) in order to prevent the bearing soils from being disturbed. More information on backfill and excavation in the site soils is provided in Section 6.1.

Organics, fill, and other deleterious materials, must be removed from the area of influence of the foundations down to native subgrade, or as discussed previously. All founding subgrades must be inspected and approved by a qualified member of this firm prior to forming footings or placing engineered fill. The contractor should minimize worker traffic within the foundation formwork and the excavation must be maintained in an unwatered condition during foundation construction. If the founding subgrade is excessively disturbed during excavation and foundation construction operations, it may have to be subexcavated and replaced with engineered fill or non-shrink fill. Footings should be a minimum of 450 mm wide. The design is based upon the assumption that the footings will be properly formed (i.e. earth forms are not acceptable) and any required rebar is placed in accordance with standard practices. Backfill around the foundations should consist of a well graded free draining Granular B Type III.

The area of influence below the building footprint or individual foundation units, in cross section, is described as a trapezoid that extends outwards, horizontally from the edges of the foundation, a minimum of 300 mm and then downwards on a 45º (1V:1H) outward angle to undisturbed native competent soil.

5.3 Frost Consideration

All exterior footings and isolated footings supported on soil and subject to frost penetration must have frost protection (permanent and during construction) to the depths of local anticipated frost penetration.

Based on the 2006 CFEM Section 13.4.2, the frost penetration for the White River area is approximately 2.2 m where the ground is kept clear of snow cover.

If a sufficient depth of earth cover cannot be provided for frost protection, or shallow foundations are the preferred option, equivalent expanded extruded polystyrene (EEP) insulation may be used in conjunction with available soils cover to provide frost protection. If EEP is used for frost protection, precautions must be taken to protect the insulation from accidental spillage of hydrocarbons, solvents or other destructive products.

A 2.2 m earth cover from the final grade to the base of the foundations is recommended for frost protection. Alternatively, 60 mm thick expanded polystyrene will provide an equivalent earth cover for frost protection for footings established at 1 m below finished grade. In general, 12 mm of polystyrene will provide equivalent frost heave protection to 300 mm of soil cover. Alternative insulation methods can be considered and the manufacturers recommendations shall be reviewed to determine insulation thicknesses required for 2.2 m of frost penetration.

As noted, foundations can be founded at a higher elevation (1.0 m) provided they are supported on an approved subgrade and/or a pad of a minimum thickness of 300 mm of compacted engineered fill and insulated. The following general insulation design can be used. The following insulation design was based on the generalized design curves (Robinsky and Bespflug, 1973) for minimum insulation requirements for heated structures founded on sandy soil. Synthetic insulation (i.e. Styrofoam SM, HI-40, HI-60, HI-100, depending on loading, or equivalent), minimum 60 mm thick, should be placed down the face of the foundation wall to the top of footing, and then extend outwards horizontally beyond the foundation edge a minimum of 1.2 m. Beyond the building footprint, the horizontal insulation should be sloped downwards slightly (i.e. 2 to 3%) to promote drainage away from the structure. The insulation should be overlapped (or step jointed) and pegged or spot glued together. The insulation must be unbroken and any damaged pieces must be replaced. The insulation should have a minimum of 300 mm of permanent soil cover. To reduce the risk of damage to the polystyrene insulation from an accidental hydrocarbon spill, it is recommended that the insulation be covered, where appropriate, with a layer of 6 mil polyethylene (i.e. maintenance areas, garage entrances, below parking lots, etc.).

Soils that are sensitive to frost heave may experience heave during the winter/spring months, only to settle back once thawed. As such, the founding subgrades for footings, slab on grade, services, etc. must be protected from frost penetration at all times during foundation excavation and construction operations. Should freezing temperatures occur during construction, the Contractor must undertake to prevent frost penetration into the natural soils (straw, insulated traps, etc.) until such a time that footings, slab on grade, services, etc. are adequately protected (soil cover, insulation, heat is supplied to the building, etc.).

Concrete cannot be placed against materials with subzero temperatures.

In addition, active monitoring of the subgrade temperatures may be warranted depending upon the time of year that construction is undertaken.

It winter construction is anticipated, a detailed winter construction plan shall be provided by the Contractor prior to the commencement of the project.

5.4 Slab on Grade

Slab on grade construction may be used at the subject site. All organic soils and other deleterious materials (i.e. fill, etc.) should be removed from below the slab on grade. The resulting subgrade should then be inspected and approved. The contractor should be prepared to locally excavate deeper to remove unacceptable areas that may become apparent during construction operations. The approved subgrade can then brought up to the underside of the vapour retarder with engineered fill consisting of an imported granular material meeting OPSS.MUNI 1010 for Granular B Type III, or other approved locally available fill, compacted to a minimum 98 percent SPMDD or better. A well-graded coarse grained soil is described as having no excess particles in any size range with no intermediate sizes lacking (i.e. smooth, concave distribution curve). Generally, the distribution curve for this backfill should fall in the middle of the specification and be limited to maximum sized particles of 75 mm or less (to prevent damage when backfilling against underground structures) and should contain at a minimum 2% fines to facilitate compaction efforts. The use of a well-graded material will facilitate compaction operations.

The use of a vapour retarder will be dependent upon the floor coverings to be used and the floor covering manufacturers' recommendations should be followed. For preliminary design, a manufactured vapour retarder system (i.e. min 6 mil polyethylene, etc.) over top of the engineered fill may be used. The vapour retarder manufacturer's specifications must be adhered to (minimum overlaps, taping/sealing at openings, sealed around utility and foundation or column perforations, etc.) and the integrity of the system must be maintained (i.e. no holes, tears, or other perforations). The concrete supplier and finisher should undertake to use a mix and placement methodology that will minimize the potential for slab curling.

5.5 Earthquake Parameters

Considering the geotechnical values, intend of structure, and surroundings, soil liquefaction is not considered an issue, and based on 2012 OBC, Table 4.1.8.4A, Site Classification for Seismic Site Response, the subject site would have Site Class D. It is likely that the Site Class could be improved through shear wave analysis.

5.6 Drainage

It is understood that the proposed buildings will not have below grade structures (i.e. basements), and full perimeter foundation drains and underslab drainage should not be necessary provided the bottom of the finished slab elevation is a minimum of 150 mm above exterior grade. It is noted however that the installation of a footing and underslab drainage system is the preferred option.

The surface of the finished grade around the exterior of the building should be relatively impermeable and contouring of the perimeter exterior grade surface must direct all surface waters away from the structure.

6 Construction Recommendations

6.1 Excavations, Dewatering, and Backfill

All excavations for the development must comply with Ontario Regulation 213/91 (Construction Projects) under the Occupational Health and Safety Act. The fill and native soil deposits contacted in the boreholes would be classified as Type 3 soils (O.Reg. 213/91, s. 226(4)). Temporary cut slopes within Type 3 soils should be at a slope of 2:1 (H: V) or flatter from the base of excavation as per O.Reg. 213/91, s. 234(2) (free of groundwater effects). If wet deposits are contacted, excavation side slopes may be expected to slough to flatter slopes, potentially as flat as 3:1 (H: V) or flatter.

Where space limitations (from utility poles, existing underground services, above ground structures, etc.) do not permit overburden cut slopes at inclinations specified above, a steeper cut slope can be employed if supported by appropriately designed shoring, designed and constructed by a specialized shoring engineer/contractor. A support system comprising vertical soldier piles with timber lagging may be suitable. Some movement/slumping of the cohesionless sandy soils should be expected. All utility owners of existing facilities nearby planned excavations shall be consulted to acquire off set distances. Those offset distances shall be maintained throughout construction.

As described in Section 4.2, groundwater was observed at relatively shallow depths in some boreholes. A dry subgrade condition must be maintained at all times during foundation construction until both footing and foundation wall construction, and backfilling, are a sufficient height above the prevailing water table (i.e. at a minimum 1 m). Groundwater levels will fluctuate seasonally/yearly. The Contractor must undertake to establish the groundwater level in advance of the construction operations such that adequate groundwater control plans can be developed.

The Contractor must also undertake to control surface water that develops from precipitation or snow melt curing construction.

A positive dewatering system installed by a dewatering specialist will most likely be required to lower the groundwater level in order to maintain a safe and adequately dry excavations. Where groundwater seepage and/or sloughing occurs, the excavation side slopes will need to be flattened or adequately braced to ensure stability. Every excavation that a worker may be required to enter shall be kept reasonably free of water (O.Reg. 213/91, s. 230). Care should be taken to direct surface runoff away from open excavations.

An Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW) is required by the Ministry of Environment and Climate Change in the event that the daily taking of groundwater exceeds 50,000 L or 400,000 L per day, respectively.

It must be emphasized that, when wet, silty soils (such as encountered at this site) can be easily disturbed through excavation operations, foot traffic, etc. and such disturbed soils can lose a significant amount of the native bearing. To minimize the potential for disturbance, the groundwater must be drawn down a sufficient depth below the base of the excavation (i.e. 500 mm to 1 m). In addition, the placement of a working pad of engineered fill / mudslab overtop of the fine grained soil is strongly recommended.

Ultimately, the method of dewatering will be the choice of the contractor. The importance and benefits of maintaining a dry stable subgrade during excavation and foundation construction cannot be stressed enough. Failure by the contractor to adequately control the groundwater, and/or rainwater, surficial runoff, etc., can result in disturbance to the founding subgrades, which can result in having to carry out corrective measures (i.e. additional excavation, time delays, etc.) to improve the subgrade. Corrective measures required to improve subgrades where groundwater is not adequately controlled will be at the Contractors cost. As part of the Contractors proposed methodology of construction, the Contractor should be requested to submit a dewatering plan prior to commencement of the project that details how they will control groundwater. The plan should include all aspects from methodology (i.e. sump holes and pumps, drainage ditches, vacuum well points), to construction of system (sump hole details, placement, etc.), to operation of system, etc.

The majority of the native soils were not found to meet any OPSS Form 1010 specification and can therefore only be used in areas of landscaping or elsewhere where movement of the ground surface is not of concern.

Any material to be used as engineered fill on this site must be tested and approved by this office prior to delivery to the site. It should be noted that engineered fill(s) should be placed in lifts of thickness less than the effective compaction depth of the equipment used to carry out the compaction operations (i.e. if using a heavy diesel Wacker lifts should be a maximum of 300 mm thick, etc.). All engineered fill must be placed and compacted to 100 percent of the SPMDD. Due to the sensitivity of disturbance to native soils during compaction, non vibratory compaction equipment is recommended. Ideally, any backfill at site for utility and other site facilities should be completed prior to constructing the footings to minimize possible settlement associated with disturbing the bearing soils.

All engineered fill must be free of frost, ice, and snow, and at an appropriate moisture content and temperature to allow compaction. Once a lift of engineered fill is placed, compacted, and accepted, it is considered acceptable to backfill overtop of this lift if the lift is unfrozen or if there is minimal frost within the surface of the lift. If the surface of a granular fill lift is frozen, the Contractor shall, in conjunction with an Englobe representative, confirm depth of frost prior to backfilling. It is noted that frost penetration can be reduced through the use of insulated tarps, with or without heat source (depending upon ambient temperatures), and by ensuring backfilling operations are continuous.

6.2 Construction Inspection and Testing

During construction foundations and placement of any engineered fill, testing should be carried out for quality assurance. Soils testing for the project would include engineered site visits for inspection of bearing surfaces, confirm that backfill meets specifications outlined in this report. In addition, the QA services would include general monitoring of excavated and existing slopes for stability concern.

During placement of concrete for townhouse construction, materials testing shall be performed to determine the slump and air content of the concrete, and concrete cylinders shall be cast for compressive strength testing in accordance with the requirements of CSA A23.1 and A23.2. Field sampling and testing of concrete shall be according to OPSS 904. Preparation of the test cylinders, curing, and testing should be carried out by Englobe as part of the QA testing program.

Englobe maintains CSA/CCIL certified concrete laboratories Thunder Bay, North Bay, or Sudbury and can provide concrete sampling and testing services for the project as required. Englobe staff also provide quality testing services for foundation construction.

We trust that the above information meets your present requirements and appreciate this opportunity to provide geotechnical consulting services to you. If you have any questions or comments, please contact the report signatory.

7 Statement of Limitations

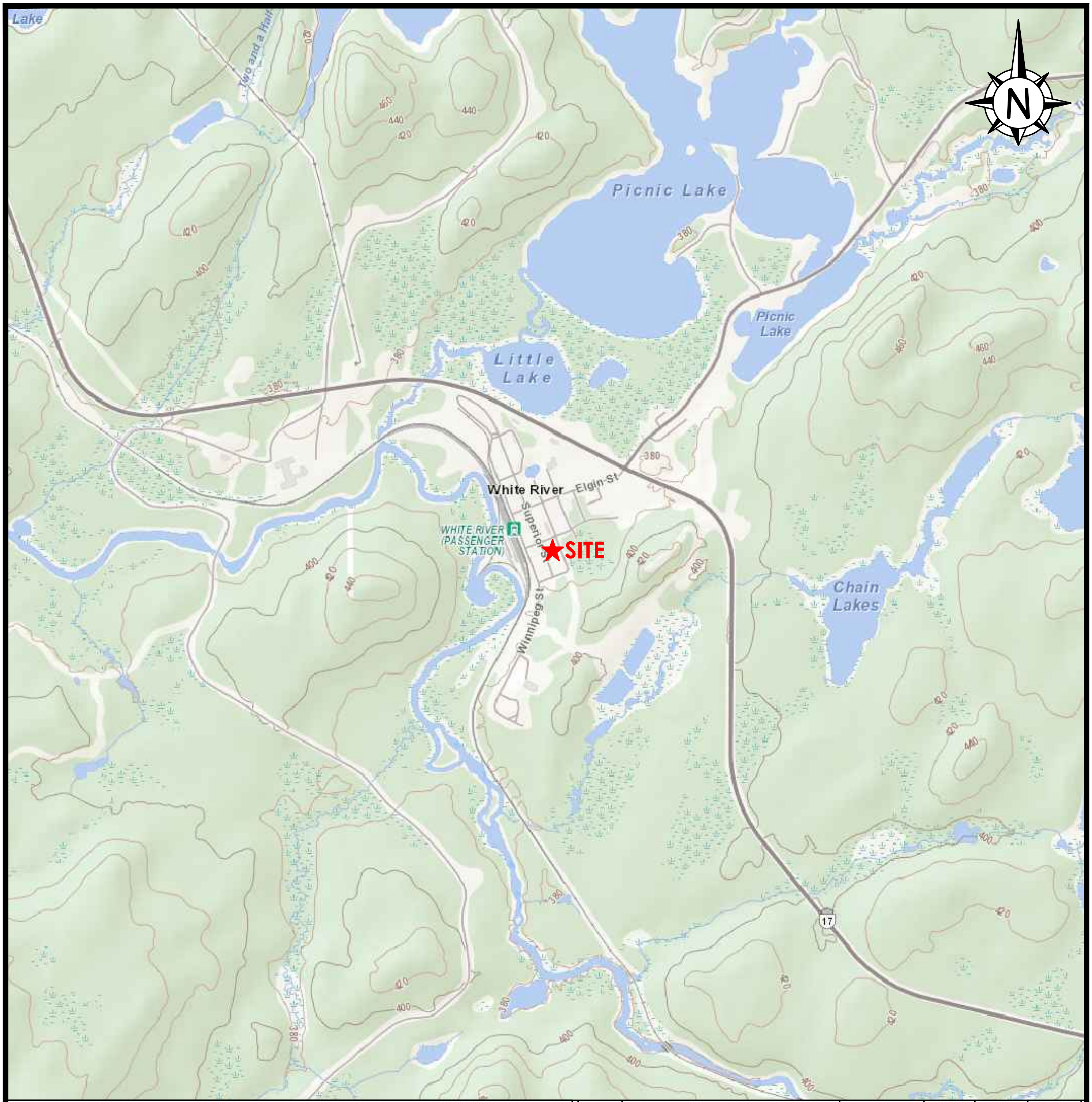
The geotechnical recommendations provided in this report are preliminary in nature and are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design in not known at the time of report preparation, we recommend that we be retained during the design stage to verify that the geotechnical recommendations have been correctly interpreted in the design. Also, Englobe should be contacted if any further clarification and/or elaboration are needed concerning the geotechnical aspects of the project.

The geotechnical recommendations provided in this report are intended for design consideration only and care not intended as specifications or instructions to contractors. Any use which a party makes of this report, or decisions made based on it, are the responsibility of the that said party, and must also accept the responsibility for means and methods of construction, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect their work. Englobe accepts no responsibility and denies any liability whatsoever for any damages arising from improper or unauthorized use of the report or parts thereof.

It is important to note that the geotechnical investigation involves a limited sampling of the site gathered at specific test hole locations and the conclusions in this report are based on this information gathered. The subsurface geotechnical, hydrogeological, environmental and geologic conditions between and beyond the test holes will differ from those encountered at the test holes. Also, such conditions are not uniform and can vary over time. Should subsurface conditions be encountered which differ materially from those indicated at the test holes, we request that we be notified in order to assess the additional information and determine whether or not changes should be made as a result of the conditions.

Appendix A Drawings

Drawing 1a & 1b: Key Plans
Drawing 2: Borehole Location Plan & Profile



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Ontario Aboriginal Housing Services

OAHS Residential Development
Superior Street / Ontario Street
White River, Ontario

Key Plan (Macro)

Englobe

2–120 Progress Court
North Bay, Ontario, P1A 0C2
705-476-2550

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Verify by: CW
Draw by: DM
Approval by: JRB
Drawing no: 1a
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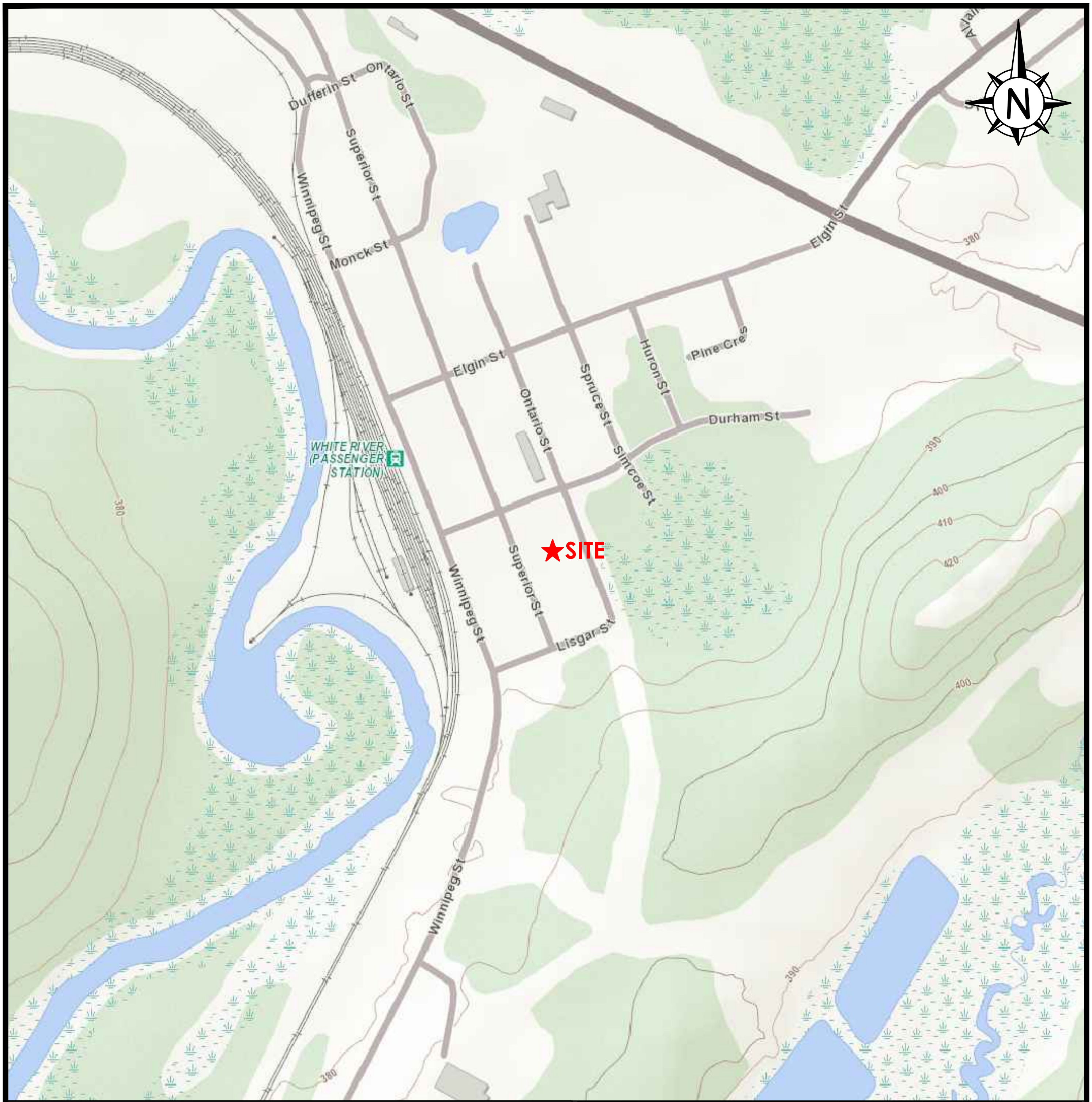

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Ontario Aboriginal Housing Services

OAHS Residential Development
Superior Street / Ontario Street
White River, Ontario

Key Plan (Micro)

Englobe

2–120 Progress Court
North Bay, Ontario, P1A 0C2
705-476-2550

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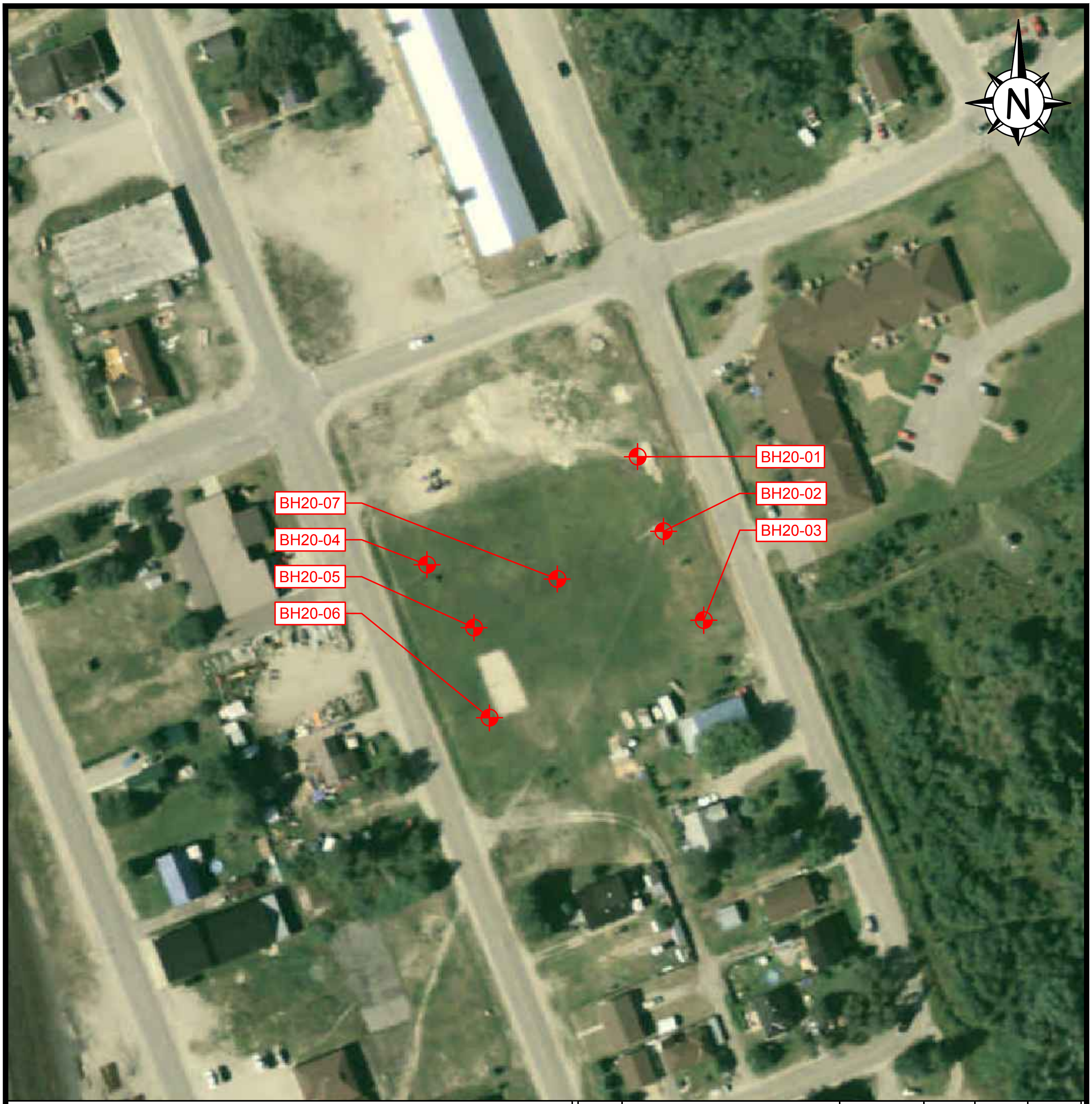

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Ontario Aboriginal Housing Services

OAHS Residential Development
Superior Street / Ontario Street
White River, Ontario

Borehole Location Plan

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705-476-2550

Discipline: Geotechnical
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Appendix B Borehole Logs

List of Abbreviations

Boreholes BH 01 to BH 04

Enclosure No. 1
Page 1 of 2

LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS	Auger Sample
CS	Chunk Sample
DS	Denison type sample
FS	Foil Sample
NFP	No Further Progress
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
RC	Rock core with size & percentage of recovery
SS	Split Spoon
ST	Slotted Tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 60° cone attached to AW rod driven by a 63 kg hammer falling 760 mm.

Plotted as —•—•—•—•

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	*Compactness Condition*
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

3. SOIL DESCRIPTION (Cont'd)

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	*Consistency*
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole.
The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

¨ - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

5. LABORATORY TESTS

P	Standard Proctor Test
A	Atterberg Limit Test
GS	Grain Size Analysis
H	Hydrometer Analysis
C	Consolidation

SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as ‘fill’. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.

2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.

3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled ‘possibly’ or ‘probable’ etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients’ request, through a series of closely positioned unsampled auger probes combined with core drilling.

4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

ENCLOSURE NO.: 2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 1

Englobe

REFERENCE 02005976 DATUM TBM

LOCATION See Borehole Location Plan; Appendix No. 1, Dwg No. 2

ORIGINATED BY JH

PROJECT OAHS White River

BOREHOLE TYPE Truck Mounted CME 45 - Solid Stem Augers

COMPILED BY DM

CLIENT Ontario Aboriginal Housing Services

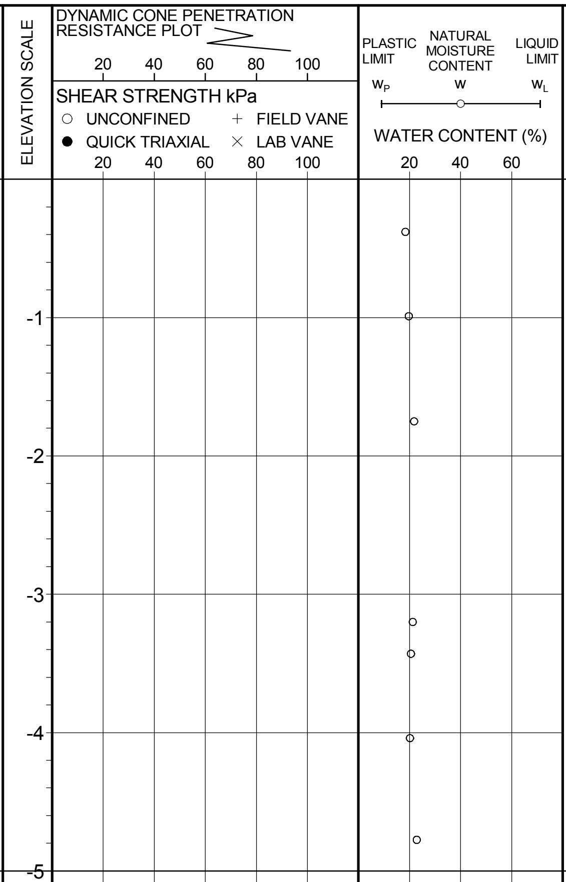
DATE (Started) 02 December 2020

DATE (Completed) 02 December 2020

TIME (Completed) 9:05:00 AM

CHECKED BY CW

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES	
0.0	Ground Surface					
0.0 0.0	TOPSOIL (~100 mm)					
-0.1 0.1	SAND (~150 mm)					
-0.3 0.3	SILTY SAND - trace clay		1	AS		
	damp, yellow/brown, compact		2	SS	12	
-1.5 1.5	SAND - trace silt, yellow/brown, wet, very loose		3	SS	4	
-2.1 2.1	SILT - some sand, yellow/brown, wet					
-3.1 3.1	SILTY SAND - yellow brown, wet		4a	SS	10	
-3.4 3.4	SILT - some clay, grey/brown, wet		4b			
	- trace sand, grey		5	SS	6	
			6	SS	8	
-5.0 5.0	End of Borehole					



UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 100 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1)	- ▽	- ⊠
2)	- ▽	-
3)	- ▼	-

MEL-GEO 02005976 - BOREHOLE LOGS, OAHS WHITE RIVER - NEW.GPJ MEL-GEO.GDT 13/01/21

ENCLOSURE NO.: 3 (Pg. 1 of 1)

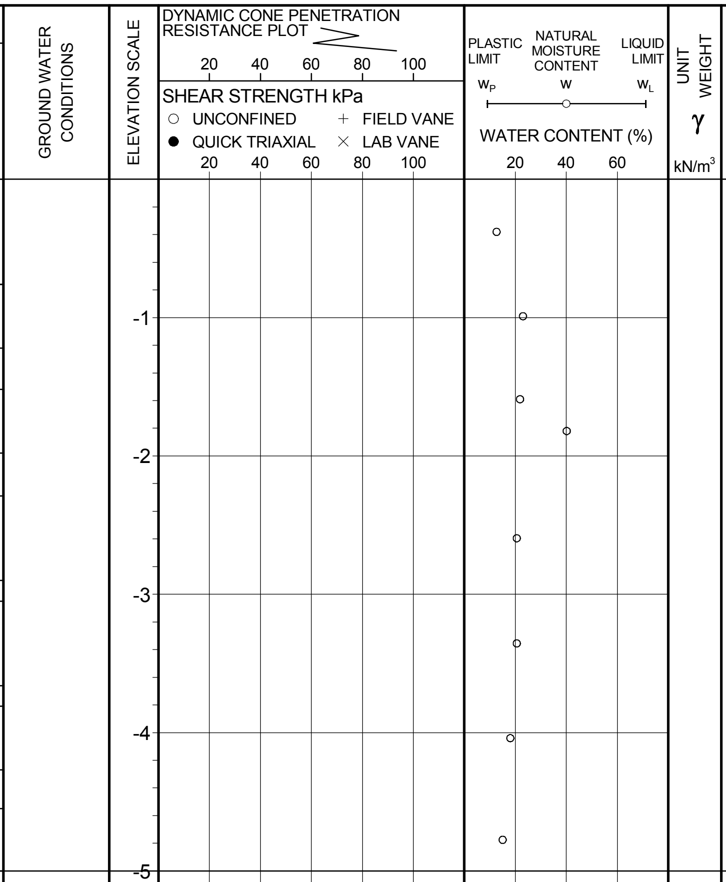
METRIC

RECORD OF BOREHOLE NO. 2

Englobe

REFERENCE 02005976 DATUM TBM
LOCATION See Borehole Location Plan; Appendix No. 1, Dwg No. 2
ORIGINATED BY JH
PROJECT OAHS White River
BOREHOLE TYPE Truck Mounted CME 45 - Solid Stem Augers
COMPILED BY DM
CLIENT Ontario Aboriginal Housing Services
DATE (Started) 02 December 2020
DATE (Completed) 02 December 2020
TIME (Completed) 10:30:00 AM
CHECKED BY CW

SOIL PROFILE			SAMPLES			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES	GR	SA	(SI	CL)
0.0	Ground Surface								
0.0 -0.1 0.1	TOPSOIL (~100 mm)								
	SILTY SAND - trace gravel, brown		1	AS					
-0.8									
0.8	SAND - trace organics, brown/black, damp		2	SS	1				
-1.7	trace gravel		3a						
1.7	SILT - some clay, grey, wet		3b	SS	14	0	10	88	2
	trace sand		4	SS	10				
			5	SS	9				
	trace clay, sand, gravel		6	SS	34				
	some gravel, trace sand		7	SS	31				
-5.0									
5.0	End of Borehole								



COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 100 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS		
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1)	- ▽	-
2)	- ▽	-
3)	- ▼	-

Englobe Corp.

120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@englobecorp.com

MEL-GEO 02005976 - BOREHOLE LOGS, OAHS WHITE RIVER - NEW.GPJ MEL-GEO.GDT 13/01/21

ENCLOSURE NO.: 4 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 3

Englobe

REFERENCE 02005976 DATUM TBM

LOCATION See Borehole Location Plan; Appendix No. 1, Dwg No. 2

ORIGINATED BY JH

PROJECT OAHS White River

BOREHOLE TYPE Truck Mounted CME 45 - Solid Stem Augers

COMPILED BY DM

CLIENT Ontario Aboriginal Housing Services

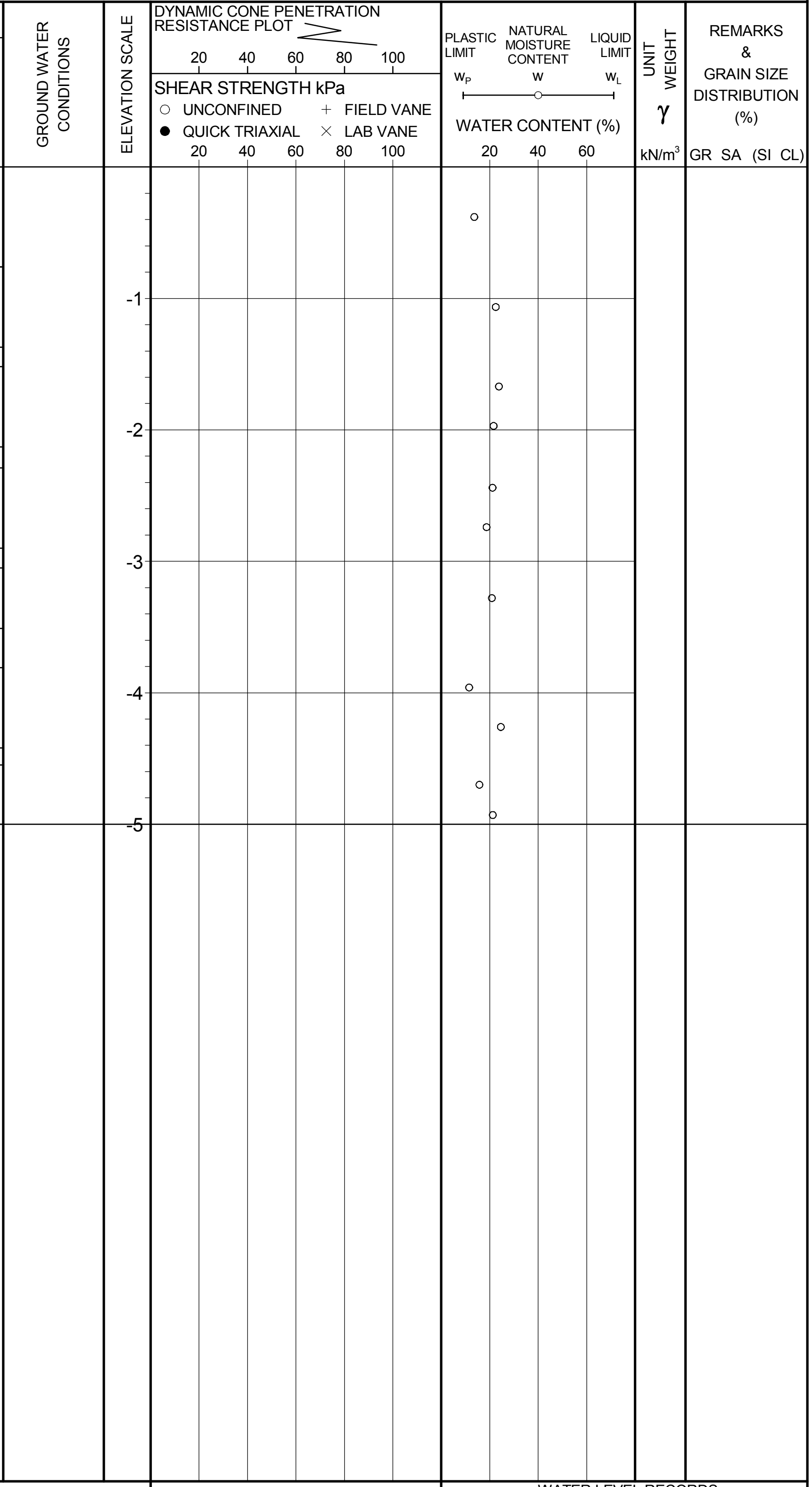
DATE (Started) 02 December 2020

DATE (Completed) 02 December 2020

TIME (Completed) 12:00:00 PM

CHECKED BY CW

SOIL PROFILE		SAMPLES		
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	NUMBER	TYPE	"N" VALUES
0.0	Ground Surface			
-0.1 0.0	TOPSOIL (~100 mm)			
0.1	SAND - trace silt, yellow, dry, loose	1	AS	
	brown, damp	2	SS	7
	wet	3A	SS	8
	some silt	3B		
-2.6 2.6	SILT - some sand, brown/grey, wet	4A 4B	SS	17
	trace sand	5	SS	6
-3.8 3.8	SAND - some silt, brown/grey, wet	6A	SS	9
-4.1 4.1	SILT - trace sand, grey, wet	6B		
-4.6 4.6	SAND - trace silt, brown, wet	7A	SS	10
-4.9 -5.0 4.9	SILT - trace sand, grey, wet	7B		
5.0	End of Borehole			



COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+³, ×³ : Numbers on right refer to Sensitivity

Numbers on left refer to values greater than 100 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1)	- ▽	- ⊠
2)	- ▼	-
3)	- ▼	-

ENCLOSURE NO.: 5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 02005976 DATUM TBM

LOCATION See Borehole Location Plan; Appendix No. 1, Dwg No. 2

ORIGINATED BY JH

PROJECT OAHS White River

BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers

COMPILED BY DM

CLIENT Ontario Aboriginal Housing Services

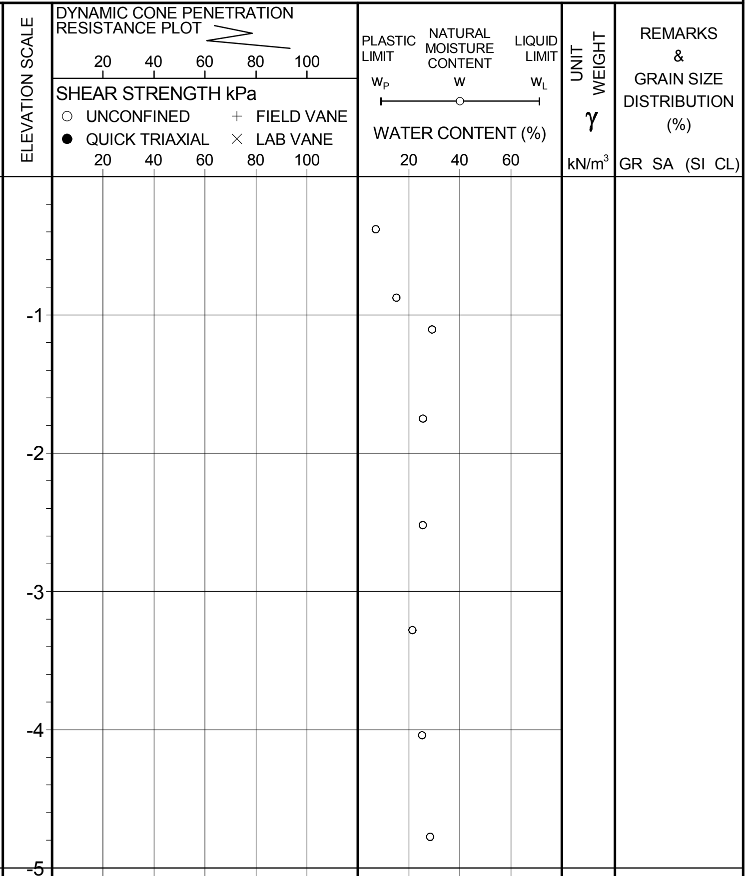
DATE (Started) 02 December 2020

DATE (Completed) 02 December 2020

TIME (Completed) 5:18:00 PM

CHECKED BY CW

ELEV DEPTH	SOIL PROFILE – DESCRIPTION (see Enclosure No. 1)	SAMPLES – NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS
0.0	Ground Surface				
0.0 0.0	TOPSOIL (~25 mm)				
	SAND - brown, dry, loose	1	AS		
	damp	2A 2B	SS	8	
-1.0 1.0	SILT - some sand, grey, moist, stiff to very stiff				
	wet	3	SS	25	
		4	SS	18	
		5	SS	10	∇
		6	SS	9	
-5.0		7	SS	11	
5.0	End of Borehole				



COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+³, ×³ : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 100 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 02/12/20 5:18:00 PM	3.14 ∇	-
2)	-	-
3)	-	-

MEL-GEO 02005976 - BOREHOLE LOGS, OAHS WHITE RIVER - NEW.GPJ MEL-GEO.GDT 13/01/21

ENCLOSURE NO.: 6 (Pg. 1 of 1)

METRIC

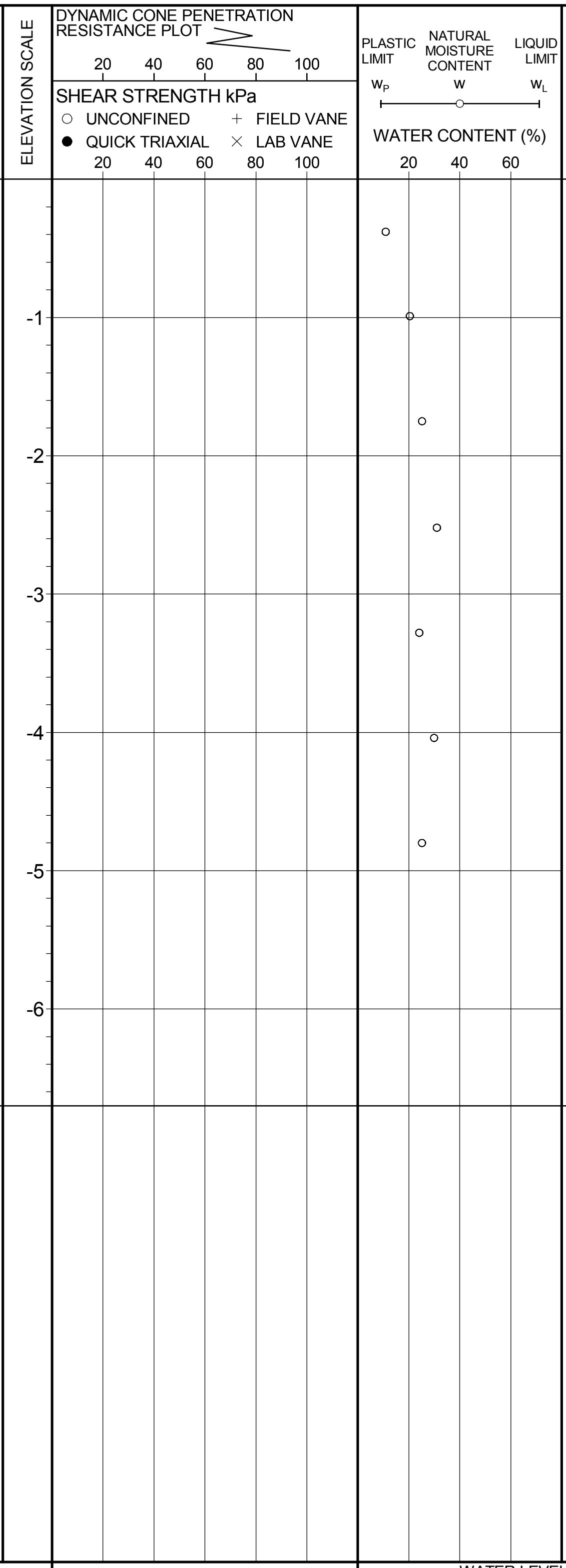
RECORD OF BOREHOLE NO. 5

REFERENCE 02005976
DATUM TBM
LOCATION See Borehole Location Plan; Appendix No. 1, Dwg No. 2
ORIGINATED BY JH

PROJECT OAHS White River
BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers
COMPILED BY DM

CLIENT Ontario Aboriginal Housing Services
DATE (Started) 02 December 2020
DATE (Completed) 02 December 2020
TIME (Completed) 2:55:00 PM
CHECKED BY CW

ELEV DEPTH	SOIL PROFILE DESCRIPTION (see Enclosure No. 1)	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
0.0	Ground Surface						
-0.2 0.2	TOPSOIL (~150 mm)						
0.2	SAND - light brown, loose	1	AS				
	brown, moist	2	SS	6			
-1.5 1.5	SILTY SAND - brown, wet, loose	3	SS	11			
-2.3 2.3	SILT - trace sand, grey, wet, stiff	4	SS	15			
	trace gravel, clay, organics	5	SS	10			
		6	SS	11			
		7	SS	3			
		8	SS	WH			
-6.7 6.7	End of Borehole						



COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+³, ×³ : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 100 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1)	- ▽	-
2)	- ▽	-
3)	- ▼	-

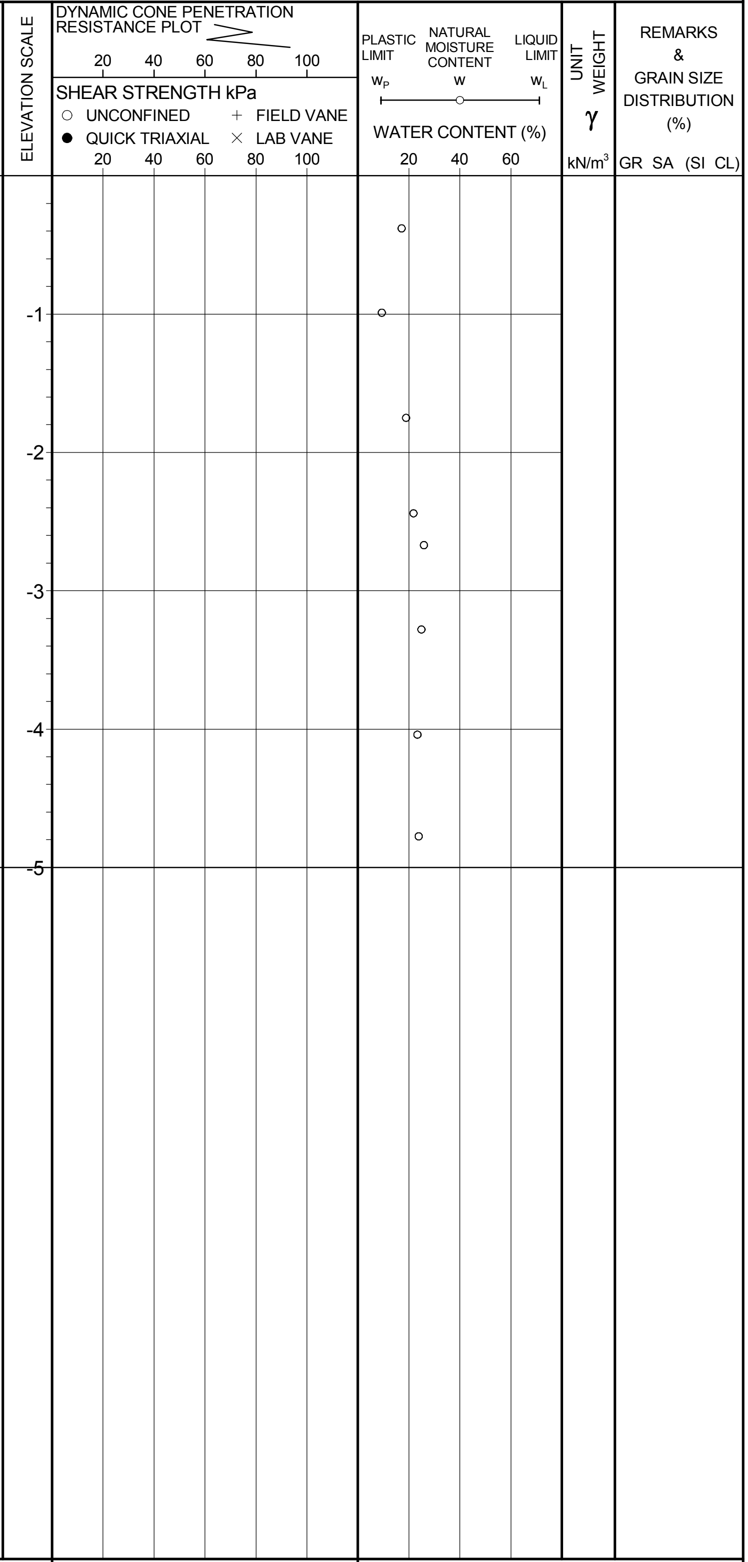
ENCLOSURE NO.: 7 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 6

REFERENCE 02005976 DATUM TBM LOCATION See Borehole Location Plan; Appendix No. 1, Dwg No. 2 ORIGINATED BY JH
PROJECT OAHS White River BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM
CLIENT Ontario Aboriginal Housing Services DATE (Started) 02 December 2020 TIME (Completed) 4:05:00 PM CHECKED BY CW
DATE (Completed) 02 December 2020

ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS
0.0	Ground Surface				
0.0 -0.2	TOPSOIL (~200 mm)				
0.2	SILTY SAND - brown, dry to damp, loose	1	AS		∇
-0.8 0.8	SAND - brown, damp, loose	2	SS	6	
	wet	3	SS	12	
		4A 4B	SS	11	
-2.6 2.6	SILT - grey, wet, firm to stiff				
		5	SS	9	
		6	SS	7	
		7	SS	7	
-5.0 5.0	End of Borehole				



COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+³, ×³ : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 100 kPa
○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 02/12/20 4:05:00 PM	0.5 ∇	-
2)	-	-
3)	-	-

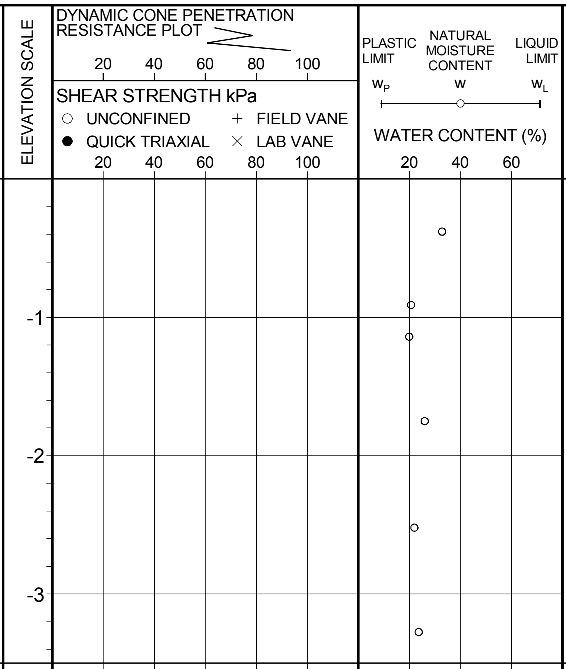
ENCLOSURE NO.: 8 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 7

REFERENCE 02005976 DATUM TBM
LOCATION See Borehole Location Plan; Appendix No. 1, Dwg No. 2
ORIGINATED BY JH
PROJECT OAHS White River
BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers
COMPILED BY DM
CLIENT Ontario Aboriginal Housing Services
DATE (Started) 02 December 2020
DATE (Completed) 02 December 2020
TIME (Completed) 12:55:00 PM
CHECKED BY CW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	NUMBER	TYPE	"N" VALUES	
0.0	Ground Surface				
0.0 -0.2	TOPSOIL (~150 mm)				
0.2	SAND - brown, loose	1	AS		
		2A 2B	SS	11	
-1.1 1.1	SILT - trace sand, grey, firm				∇
-1.5 1.5	SAND - brown, wet, loose	3	SS	6	
-2.3 2.3	SILT - trace sand, grey, wet, firm	4	SS	17	
		5	SS	14	
-3.5 3.5	End of Borehole				



UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA (SI CL)

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+³, ×³ : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 100 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 02/12/20 12:55:00 PM	1.4 ∇	-
2)	-	-
3)	-	-

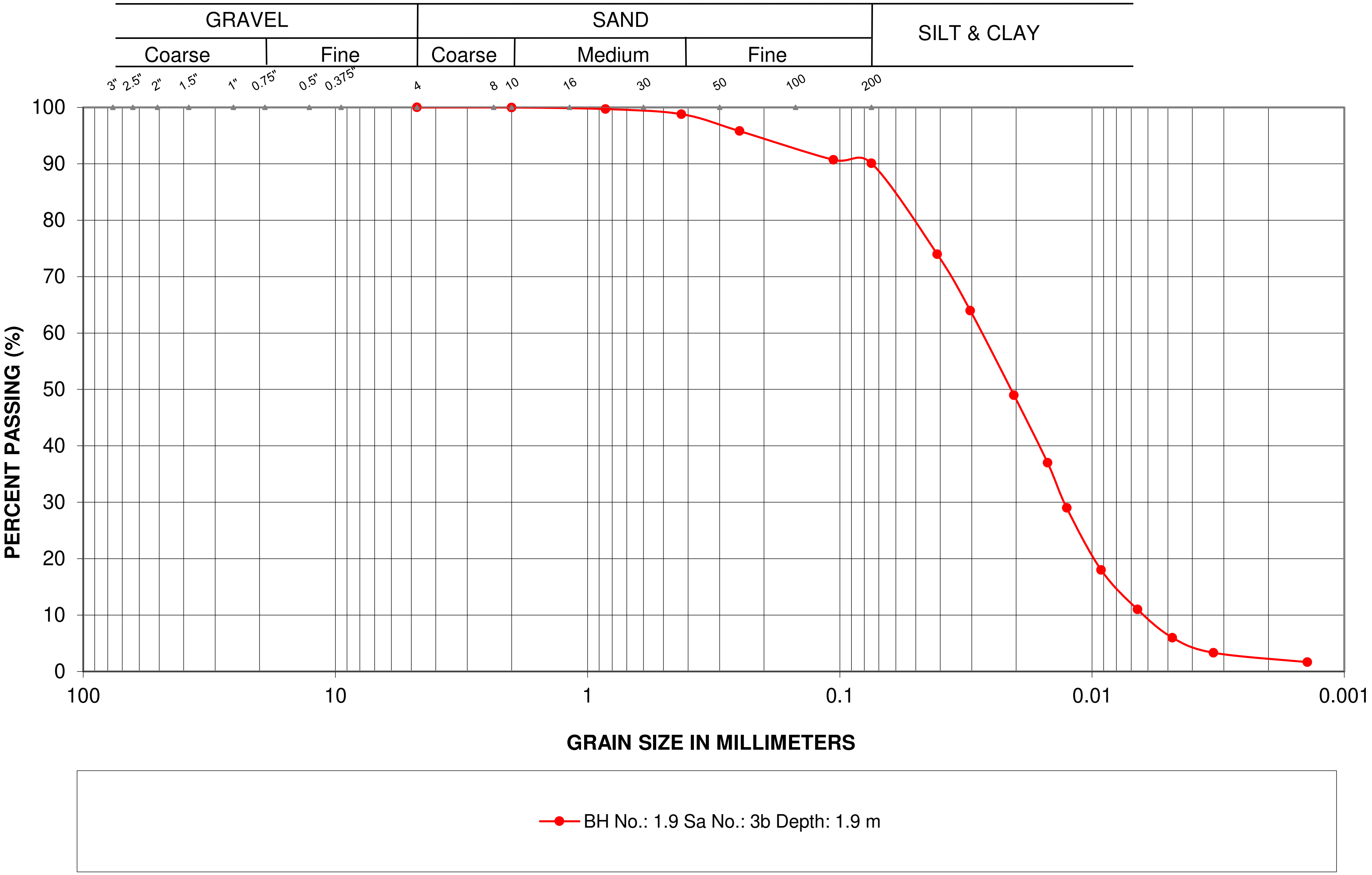
MEL-GEO 02005976 - BOREHOLE LOGS, OAHS WHITE RIVER - NEW.GPJ MEL-GEO.GDT 13/01/21

Appendix C Laboratory Test Results

Particle Size Distribution Analyses

Reference No.: 02005976
Date: January 20, 2021

GRAIN SIZE ANALYSIS



SILT

PROJECT: OAHS White River
LOCATION: White River, Ontario

Englobe Corp.

FIGURE L-1