MEMORANDUM

Date: October 20, 2025
To: Kathryn Scott, CAO/Clerk
From: Jackson Mercer, P. Eng.
CC: Chris Kirby, P. Eng., Erik Giles, P. Eng.

RE: Offshore Geotechnical Investigation for the New Raw Water Intake Pipe, Blind River, Ontario

Dear Mrs. Scott,

TULLOCH Engineering Inc. (TULLOCH) was retained by the Town of Blind River (Client) to complete a geotechnical investigation to support the design of the proposed new raw water intake pipe as part of the ongoing municipal water infrastructure upgrade project located in Blind River, Ontario. TULLOCH understands that the proposed raw water intake pipe will consist of a 400 mm diameter HDPE pipe that will span approximately 360 linear meters into Lake Huron with an accompanying T-shaped intake structure at the end.

This memorandum documents the findings from the geotechnical investigation conducted between February 24 to 26, 2025, to evaluate the subsurface conditions along the lakebed of Lake Huron within the proposed pipe alignment. A site plan outlining the borehole locations completed for the drilling investigation is attached to this memorandum.

The findings of this memorandum provide factual geotechnical investigation data and geotechnical design recommendations, based on the site investigation data, our understanding of the project scope and our engineering experience. Common terminology used in this memorandum can be found attached to this memorandum, and specific terminology is referenced in table notes or the body of the document.

1. SITE INFORMATION AND REGIONAL GEOLOGY

The project site is accessible from Martin Street in Blind River, Ontario and spans approximately 360 m south from the shoreline of Lake Huron. The investigation was conducted during winter conditions while the shoreline of Lake Huron had adequate ice thickness to safely access the borehole locations with the drilling equipment and all-terrane vehicles.

Based on a review of the Northern Ontario Engineering Geology Terrain Study (NOEGTS) (OGS 2005) and the Bedrock Geology of Ontario (OGS 2011) mapping as published by the Ontario Geological Survey, the site surficial geology consists of a till material predominantly of sand to silty sand matrix. The bedrock geology comprises of siltstone, wacke, argillite, and minor sandstone, of the McKim and Pecors Formation belonging to the Elliot Lake and Hough Lake Groups, in the Huronian Supergroup. The topography of the site is undulating to rolling, with moderate relief, and exhibits missed wet and dry drainage conditions.

2. SITE INVESTIGATION AND METHODOLOGY

The field investigation was undertaken from February 24 to 26, 2025. The investigation was conducted during the winter months after the ice thickness was deemed safe for the drilling equipment and personnel. The investigation consisted of advancing nine (9) geotechnical boreholes referenced as BH-25-01-700 to BH-25-09-708. The top of lakebed was taken as the measurement datum for depth measurements as it was encountered in each borehole, noted as "ground surface". The boreholes were advanced through the ice surface to a termination or refusal depth between 2.97 to 6.07 meters below the top of ice elevation throughout the proposed intake pipe alignment in general accordance with the proposed pipe elevation profile. The following Table 2-1 summarizes the borehole investigation.

Table 2-1: Summary of Borehole Information

Borehole No.	Easting (m)	Northing (m)	Ice Elevation (m)	Lakebed Elevation (m)	Termination Elevation (m)	Depth of Borehole Below Ice Surface (m)
BH-25-01-700	349 232	5 116 228	176.2	175.52	173.23	2.97
BH-25-02-701	349 222	5 116 207	176.21	175.7	172.96	3.25
BH-25-03-702	349 207	5 113 174	175.8	175.04	171.38	4.42
BH-25-04-703	349 197	5 116 142	176.23	175.38	171.11	5.12
BH-25-05-704	349 187	5 116 102	176.19	174.09	171.04	5.15
BH-25-06-705	349 180	5 116 060	176.20	173.82	171.08	5.12
BH-25-07-706	349 177	5 116 011	176.18	173.54	170.80	5.38
BH-25-08-707	349 178	5 115 957	176.20	173.33	171.04	5.16
BH-25-09-708	349 181	5 115 905	176.20	173.03	170.13	6.07

Boreholes were advanced using a tripod drill equipped with a motorized cathead hammer, owned and operated by Landcore Drilling from Chelmsford, Ontario. The boreholes were advanced using NWT casing, with an OD (outside diameter) of 90 mm.

Soil samples were obtained using standard split spoon equipment in conjunction with Standard Penetration Tests (SPT) performed in accordance with ASTM D1586. SPT sampling generally occurred at 0.76 m intervals and were conducted using a motorized cathead and anvil weighing approximately 63 kg.

The drilling and soil sampling program were directed by a TULLOCH representative, who logged the drilling operations and identified the soil samples as they were retrieved. Detailed borehole logs for the proposed site can be found attached to this memorandum.

The recovered soil samples were transported to TULLOCH's CCIL-Certified Laboratory in Sault Ste. Marie, Ontario, for detailed examination and testing. A select number of soil samples were also submitted to Testmark Laboratories in Garson, Ontario, for soil corrosivity analysis. All samples will be stored at the laboratory for three (3) months and then disposed of unless directed otherwise.

3. LABORATORY TESTING PROGRAM

A geotechnical laboratory testing program was performed on representative samples in accordance with ASTM standards. Table 3-1 provides a list of the testing program. Detailed laboratory reports for particle size distribution curves, moisture content, and corrosivity testing can be found attached to this memorandum.

Table 3-1: Summary of Soil Laboratory Testing Program

Item No.	Test	Number of Tests	ASTM Standard
1	Washed Sieve Analysis	4	ASTM D422
2	Moisture Content	5	ASTM D2216
3	Atterberg Limits	1	ASTM D4318
4	Corrosivity Analysis[1]	2	Various

Note(s): [1] Sub-contracted laboratory tests

4. SUBSURFACE CONDITIONS

4.1. General

The following sections briefly summarize the soil stratigraphy encountered during the investigation. Detailed borehole and associated laboratory testing reports are attached to this memorandum. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The soil encountered on the project site consisted of the main deposits outlined below and are described as they were encountered from ground surface during the investigation.

4.1.1. (SM) SILTY SAND

A silty sand deposit was encountered in BH-25-01-700, BH-25-02-701, and BH-25-07-706 along the lakebed surface. The deposit was found to range in thickness from approximately 0.6 m to 1.5 m. The deposit was visually found to contain fine to coarse grained sand and tactilely display non-plastic and non-cohesive behaviour. The material was generally observed to be grey in colour. Field moisture observations of retrieved split spoon samples indicated the material was wet at the time of the investigation. The SPT ‘N’ value in this deposit ranged from 0 to 24 blows per 30 cm of sampler advancement in all boreholes, indicating material of very loose to compact compactness.

4.1.2. (SP) SAND

A sand deposit was encountered at ground surface in BH-25-02-701 to -06-705 and BH-25-08-707 to -09-708 and interlayered with silt deposits in BH-25-04-703. The deposit was found to range in thickness from approximately 0.3 m to 2.9 m, and BH-25-08-707 and -09-708 were terminated in this deposit. The sand deposit was found to be poorly graded, generally containing fine to medium grained sand and trace to some non-plastic fines. The material was observed to be grey in colour and demonstrated non-cohesive behaviour. Field moisture observations of retrieved split spoon samples indicated the sand was wet at the time of the investigation. SPT ‘N’ values in this deposit ranged from 2 to 17 blows per 30 cm of advancement, indicating a very loose to compact material compactness.

Laboratory testing on one representative sample yielded a moisture content of 19.7%.

One (1) representative sample was also taken for grain size distribution testing. The grain size distribution of major soil constituents found in the deposit is shown below in Table 4-1. The grain size distribution plot can be found in the laboratory reports attached to this memorandum.

Table 4-1: Grain Size Distribution Summary – (SP) SAND

Borehole No.	Sample No.	Size Fraction (%)		
		Gravel	Sand	Fines
BH-25-09-708	SS02	0.0	97.5	2.5

4.1.3. (ML) SILT to Sandy SILT

A silt to sandy silt deposit was encountered underlying the poorly graded sand deposit in BH-25-03-702 to -06-705, interlayered with the sand deposit in -04-703, and underlying the sandy silt deposit in -07-706. The deposit ranged in thickness from approximately 0.5 to 2.8 m. Boreholes BH-25-03-702 to -07-705 were terminated within this deposit. The silt deposit was typically found to be tactilely non-plastic and contained varying amounts of fine-grained sand with increasing sand content at lower depths in BH-25-05-704 to BH-25-07-706. The material was observed to be grey in colour and demonstrated non-cohesive behaviour. Field moisture observations of retrieved split spoon samples indicated the sand was wet at the time of the investigation. SPT 'N' values in this deposit ranged from 0 to 15 blows per 30 cm of advancement, indicating a very loose to compact material compactness.

Laboratory testing on representative samples of the silt yielded moisture contents ranging from 16.0% to 33.3%, with an average of 26.7%.

Two (2) representative samples were also taken for grain size distribution testing. The grain size distribution of major soil constituents found in the deposit is shown below in Table 4-2. Grain size distribution plots can be found in the laboratory reports attached to this memorandum.

Table 4-2: Grain Size Distribution Summary – (ML) SILT

Borehole No.	Sample No.	Size Fraction (%)		
		Gravel	Sand	Fines
BH-25-05-704	SS04	10.6	42.9	46.5
BH-25-07-706	SS03	0.0	25.6	74.4

4.1.4. (SW) Gravelly SAND

A gravelly sand deposit was encountered underlying the silty sand deposit in BH-25-02-701. The thickness of the deposit was found to be approximately 1.2 m, where the termination depth of the borehole was reached within this deposit. The gravelly sand deposit was found to contain fine to coarse grained sand and trace amounts of non-plastic fines. The material was observed to be grey in colour and demonstrated non-cohesive behaviour. Field moisture observations of retrieved split spoon samples indicated the gravelly sand was wet at the time of the investigation. SPT 'N' values in this deposit/material ranged from 43 to 47 blows per 30 cm of advancement, indicating a dense material compactness.

One (1) representative sample was also taken for grain size distribution testing. The grain size distribution of major soil constituents found in the deposit is shown below in Table 4-3. The grain size distribution plot can be found in the laboratory reports attached to this memorandum.

Table 4-3: Grain Size Distribution Summary – (SW) Gravelly SAND

Borehole No.	Sample No.	Size Fraction (%)		
		Gravel	Sand	Fines
BH-25-02-701	SS04	20.6	72.1	7.3

4.1.5. (CL) SILTY CLAY

A silty clay deposit was encountered underlying the silty deposit in BH-25-03-702. The thickness of the deposit was found to be approximately 1.5 m, where the termination depth of the borehole was reached within this deposit. The silty clay deposit was observed to have a varved structure, be brown in colour, and tactilely demonstrated low to medium plastic and cohesive behaviour. Field moisture observations of retrieved split spoon samples indicated the water content of the silty clay exceeded the plastic limit of the material at the time of the investigation. SPT 'N' values in this deposit/material ranged from 3 to 4 blows per 30 cm of advancement, indicating a soft material consistency.

Laboratory testing on one representative sample of the silty clay yielded a moisture content of 30.7%.

Atterberg Limits testing conducted on one sample of the silty clay deposit yielded a Plastic Limit of 18%, a Liquid Limit of 37%, and a Plasticity Index of 19. The Atterberg Limits testing result can be found in the laboratory reports attached to this memorandum.

4.2. Bedrock

Bedrock coring was considered outside of the scope of this investigation; as such, no bedrock coring was conducted to confirm the presence of the cobbles to boulders or the bedrock surface when shallow refusal was encountered in BH-25-01-700 and BH-25-02-701. Discussion on bedrock lithology and engineering design parameters for rock core samples obtained during other phases of the Blind River Ontario Water Intake Project are presented in the report titled 23-0821-2050-001-Blind River Water Intake (Rev. 1) issued by TULLOCH in February 2025.

4.3. Groundwater Conditions

Groundwater level measurements were not taken during the drilling operation as the investigation took place along the lakebed of Lake Huron.

5. GEOTECHNICAL DESIGN CONSIDERATIONS

5.1. General

This section of the memorandum provides our interpretation of the available geotechnical data and presents geotechnical recommendations intended to provide guidance with respect to the pipe installation options and foundation design for the water intake structure proposed to be constructed at the end of the raw water intake pipe, near BH-25-09-708, and other general construction considerations. Where comments are made regarding construction, they are provided only to highlight any aspects that could affect the design of the project. Contractors bidding on or undertaking the construction should make their own interpretation of the provided subsurface information with respect to their planned construction methods, equipment selection, scheduling, and the like.

As soil conditions can vary between the borehole locations, a geotechnical engineer from TULLOCH should be retained to inspect and review subgrade conditions during construction to ensure the findings in this memorandum are consistent with the exposed onsite conditions. If the subsurface soils are found to vary significantly from the conditions encountered during the geotechnical investigation, TULLOCH should be contacted to update the recommendations in this memorandum.

5.2. Pipe Installation Options

5.2.1. Trenched Installation

At the time of writing this report, it is understood that open trenching is one of the desired installation methods for the 400 mm diameter HDPE water intake pipe. Based on a review of the Preliminary New Water Intake & Huron Street Reconstruction Drawing C2 Plan and Profile REV. D issued on November 14, 2024, it is understood that the intake pipe is proposed to be installed approximately 0.75- 2.25 m below the bottom of lakebed (referred to as “ meters below ground surface or mbgs” to simplify discussion). The deepest buried depth is at the point near the shoreline, while the shallowest is located at the raw water intake structure in the lake. It is also understood that the installation and employment of hydraulic isolation (e.g. sheet pile walls or alternative cofferdam measures) and active de-watering activities to complete the pipe installation work in dry conditions would considerably increase the overall cost of the project and would be economically unfeasible.

As such, it is anticipated that trenched pipe installation would include the use of a large mobile barge and excavators to advance the trench. This method would lead to difficulties maintaining an open excavation underwater due to the tidal forces sloughing in material from the walls without the use of excavation support systems, such as trench boxes. Additionally, preparing the connections between HDPE pipe segments through the use of HDPE pipe butt fusion and sinking the pipe into place, with the use of internal liquid (e.g., water) ballast to reduce buoyancy, would be difficult to complete in segments and would likely require the entire length of approximately 360.0 m of pipe to be fused and installed at once, as the fusing process cannot be completed underwater. This would require the use of a considerable amount of excavation support system segments, which would be economically unfeasible.

Ensuring adequate pipe bedding and backfill practices would also be difficult for this project for open trench option, as compaction testing of trench backfill material would not be feasible underwater. There is the inherent risk that the tidal forces along the lakebed would likely scour or erode any loose trench backfill material placed during the trench backfilling operations. Scouring or erosion of the trench backfill material paired with seasonal fluctuations in tidal forces would induce increased loading on the pipe alignment and would likely lead to damage and potentially premature failure of the pipe.

Finally, this method would also cause considerable disturbance to the ecological environment along the lakebed during and after construction. Although ecological concerns are not addressed in the findings of this memorandum, it is good practice to minimize the environment impact.

5.2.2. Trenchless Installation

Alternatively, to the trenched installation methods discussed above, trenchless installation methods should be taken into consideration. Based on the findings of this geotechnical investigation, the subsurface conditions encountered along the lakebed of Lake Huron in the proposed HDPE pipe alignment would be suitable for such trenchless construction methods, which are discussed further below.

5.2.2.1. Installation Depth

The proposed pipeline profile and the raw water intake structure are shown in the Preliminary New Water Intake & Huron Street Reconstruction Drawing C2 Plan and Profile REV. D issued on November 14, 2024, or the latest revision. From a review of this drawing, it is understood that the proposed conduit elevation profile would vary from approximately 2.25 mbgs near the shoreline of Lake Huron to approximately 0.75 mbgs at the intake structure located near BH-25-09-708.

For Horizontal Directional Drilling (HDD) installation, the burial depth will vary adjacent to the entry and receiving pits. At these locations, the cover depth should be at least 3D to maintain the bore stability, where D is the diameter of the conduit. Installing the conduit within the geological settings discussed above will reduce the risk of unacceptable settlement during the installation.

Section 5.2.6 below summarizes the parameters required to estimate settlement and stresses acting on the conduit.

5.2.2.2. Installation Method

Two (2) trenchless technologies were considered for the offshore water intake pipeline installation, given the site geology and replacement pipeline alignment. These include:

- **Horizontal Direction Drilling (HDD)**: HDD involves the boring and enlargement of an uncased borehole, which is kept open using a bentonite-water or bentonite-polymer-water slurry referred to as drill fluid. A relatively small diameter pilot hole is typically bored from an entry pit to a receiving pit along the proposed installation alignment. The drill bit or cutting head at the lead end of the drill string is used to steer the hole along the designed bore path. Accordingly, the bore path can be curved for this type of installation to provide sufficient soil cover between the pipeline and the surface of the proposed crossing alignment. After executing the pilot hole, the borehole is then enlarged using a reamer until the desired bore diameter is achieved, typically slightly larger than the conduit, and the conduit is pulled through the borehole on the final reaming pass. Given the offshore location of this work and the curved bore path proposed for the pipeline alignment, this method is considered the most feasible and economical option.

- **Micro-tunnelling**: Micro-tunneling involves the use of a Micro-tunnel Boring Machine (MTBM) to advance a small tunnel heading through the ground along the proposed bore path. The MTBM is typically placed in a launch pit, and the MTBM and conduit, situated behind the MTBM, are advanced by pipe jacking. The cutting head of the MTBM is often lubricated with a bentonite slurry that is designed based on the sub-surface soil conditions. The MTBM cutter head excavates a tunnel of a slightly larger diameter than the conduit to reduce the friction on the conduit during advancement. De-watering is necessary during construction to facilitate bore pit operations and prevent workplace flooding. MTBM operations tend to be used for larger-scale operations and often have a higher associated cost. Given the offshore location and size and length of the bore path proposed for this pipeline alignment, it is not considered economical.

Table 5-1 summarizes TULLOCH’s assessment of the applicable trenchless technologies for the proposed trenchless HDPE water intake pipe installation. Based on Table 5-1, HDD is the recommended method for the proposed installation due to the small size of the pipe installation, the length of installation required between the sending pit and the proposed water intake structure, no de-watering requirement, the potential presence of shallow medium to high strength bedrock inferred from past investigations near the project site, and relatively low cost. Considering the constructability and economics, HDD is the preferred option when installed by an experienced contractor with adequate experience.

HDD borings are typically done from the ground surface without the use of deep staging excavations, reducing the extent of groundwater control required. HDD also has the ability to control the movement of the reamer to allow for steering of the bore path safely along the proposed alignment under Lake Huron. The maximum pressure of the drilling fluid must be controlled to prevent the drilling fluid from migrating into the Lake during construction. Preventing and mitigating inadvertent drilling fluid returns should be part of the planning and construction of an HDD installation.

It is the contractor’s responsibility for the slurry design and tooling systems for the HDD installation based on the specific site geotechnical conditions as presented in the borehole logs in this report.

It is assumed that more expensive options, such as micro-tunnelling, are likely not economically feasible in this area. The final choice of equipment and the method of tunnelling should be the Contractor’s responsibility.

Successful completion of any trenchless technology or tunnelling project largely depends on an appropriate selection of equipment and methods and the skills and experience of the Contractor. The final selection of the trenchless crossing technique should be made by the Contractor based on their experience and equipment capabilities in addition to their assessment of the subsurface conditions. The soil deposits and groundwater conditions described above may pose several constraints to trenchless installations.

Table 5-1: Trenchless Method Evaluation

Trenchless Technology	Constructability	Cost	Installation Stresses on the Pipeline	Lake Bed Settlement Control
HDD	• Entry and receiving pits can be minimized or not required depending on the design and bore path required • A workspace should be provided at both ends for storage and equipment • Feasible in medium strength rock • Locally, the rock may be susceptible to raveling for large diameter bores • No to minimal de-watering is anticipated during construction • Sufficient installation accuracy over long distances	• Normally very economic	• Typically, lower than Jack and Bore	• Satisfactory settlement control provided the proper design of drill fluid mix and pressure
Micro-Tunneling	• Requires large entry and exit pits • De-watering is required in entry and exit pits. De-watering is feasible in the lake but not an economic measure. • Given the offshore location of this work, these are not feasible • Micro-tunneling work can be extremely accurate	• Highest cost option	• Typically, lower than Jack and Bore	• Satisfactory settlement control can be achieved

5.2.3. Trenchless Crossing Design Parameters

From a review of the findings from the geotechnical investigation, Table 6-2 summarizes the recommended geotechnical parameters for the HDD design within the sandy overburden at the crossing location just north of the shoreline of Lake Huron. As bedrock coring was outside of the scope of this investigation, it has been assumed that the bedrock conditions will be generally consistent with the findings from the report titled 23-0821-2050-001-Blind River Water Intake (Rev. 1) issued by TULLOCH in February 2025. The following summarizes TULLOCH's guidance for the crossing design:

- Based on the shallow refusal encountered in BH-25-01-700 and BH-25-02-701, the HDD may cross through cobbles, boulders or bedrock when advanced near the shoreline of Lake Huron. The contractor should ensure that the equipment performing the work can advance through the bedrock conditions equivalent to those discussed in 23-0821-2050-001-Blind River Water Intake (Rev. 1) issued by TULLOCH in February 2025 and meet the settlement criteria developed for the project.

- The crossing pipeline should be designed for the *in-situ* earth pressures/Lake water pressure for subsurface conditions encountered at the site, plus any additional earth pressure imposed by surface surcharge loads. Given the alignment is largely within Lake Huron, this has been presumed to be negligible. Should additional surcharge loading be anticipated, TULLOCH should be contacted to update these recommendations.

- The *in-situ* earth pressures in the subsurface deposits can be determined using the parameters in Tables 5-2 and 5-3 by the sum of the effective unit weight of each material times its thickness overlying the conduit centerline.

- The design of the conduit should account for the *in-situ* stress and additional stresses due to installation and surcharge loads at the ground surface during the crossing design life.

- Boussinesq's equation (1985), i.e. for calculating ground stresses due to point load or line load at the surface, can be used to estimate the vertical and horizontal stress acting at the conduit centerline.

- Pullback forces on the conduit can be estimated using methods such as PRCI Publication PR-277-144507-Z01 or equivalent using the friction factors listed in Tables 5-2 and 5-3 and assuming a drilling fluid specific gravity of 1.1.

Table 5-2: Overburden (Sand) Properties

Soil Property	Symbol	Unit	Soil Type			
			Sand	Silty Sand	Silt	Silty Clay
Effective Internal Friction Angle	ϕ'	degree	30	28	26	-
Shear Strength	S_u	kPa	-	-	-	50
Unit Weight	γ	kN/m³	20	19	18	18
Earth Pressure Coefficient at Rest	K_0	Unitless	0.5	0.5	0.6	-
Passive Lateral Earth Pressure Coefficient	K_p	Unitless	3.0	2.8	2.6	-
Active Lateral Earth Pressure Coefficient	K_a	Unitless	0.3	0.4	0.4	-
Vertical Modulus of Subgrade Reaction	K	kN/m³	15,000	8,000	8,000	8,000
Deformation Modulus	E'	MPa	16	7.0	5.0	10
Friction Coefficient for HDD Pullback Forces	μ	Unitless	0.2 - 0.4	0.2 - 0.4	0.2 - 0.4	0.2 - 0.4

Table 5-3: Rock (Greywacke) Mass Properties1

Rock Property	Symbol	Unit	Value
Unit Weight of Rock Mass	γ	kN/m^3	25
Earth Pressure Coefficient at Rest	K_0	Unitless	0.44
Intact Rock Strength[2]	σ_{ci}	MPa	75.6
Geological Strength Index	GSI	Unitless	50
Rock Mass Compressive Strength[3]	σ_{cm}	MPa	13.2
Deformation Modulus[4]	E_m	MPa	8700
Poisson's Ratio	v	–	0.2
Friction Angle (Residual)	ϕ'	degree	40

Note(s): [1] This table is based on the finding from the report titled 23-0821-2050-001-Blind River Water Intake (Rev. 1) issued by TULLOCH in February 2025. [2] The intact rock strength is estimated from the average unconfined compression testing values on retrieved rock cores on site. [3] σcm=(0.0034m_i^0.8) σc [1.029+0.025e^((-0.1m_i))]^GSI (Eberhardt, 2003); [4] Given by Em= √(σc/100)*10^((GSI-10)/40) (Hoek and Brown, 1998).

5.2.4. *Construction Considerations*

The following considerations should be accounted for during the crossing design:

- As the majority of the trenchless pipe alignment is located underlying Lake Huron and due to the potential for very poor to poor rock quality found in 23-0821-2050-001-Blind River Water Intake (Rev. 1), the conduit should be pulled into place as soon as practical after the initial pilot bore. TULLOCH recommends requiring the contractor to install the conduit during the 1st reaming pass after the initial pilot bore. The initial pilot bore should be as small as practical.

- The contractor should be equipped with appropriate tooling systems that should be selected to handle the possibility of cobbles and boulders as well as advancement through the medium to high strength bedrock encountered throughout the site. The selected contractor should have a contingency plan to handle boulders/cobbles if encountered at the site.

5.2.5. *Temporary Excavations*

As bedrock was encountered within 1.0 m below ground surface during the investigation discussed in 23-0821-2050-001-Blind River Water Intake (Rev. 1) and visible near the existing wastewater located near the project site, where the presumed sending pit would be located, the use of temporary excavation and support systems are unlikely. Should open excavations for the entry and receiving pits be adopted, they must be carried out in a manner that complies with the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91.

5.3. General Water Intake Structure Foundation Discussion

This report provides geotechnical foundation design parameters in terms of Limit State Design, the factored geotechnical resistance of its foundation to withstand the imposed factored Ultimate Limit State loads – (ULS) Design Approach and limiting the deformation of the foundation to acceptable levels under the Service loads – (SLS) Design Approach.

Based on a discussion with the Client and their Design Team, an acceptable settlement tolerance of 25 mm of total settlement and 19 mm differential settlement has been considered.

TULLOCH understands that the proposed raw water intake structure will consist of single Model T24MFE T-shaped dual 610 mm diameter screened intake structures encased in a protection crib that will be supplied by Johnson Screens. Each of the two proposed intake structures is proposed to be approximately 2.24 m in length and will sit approximately 0.9 m above the lakebed attached to a vertically oriented elbow section of 400 mm diameter intake pipe.

5.3.1. Geotechnical Design Parameters

Based on the results of the investigation, one (1) major soil deposit can be considered for design of the proposed raw water intake structure located near BH-25-09-708 and is shown below in Table 5-4 with the following design parameters.

Table 5-4: Summary of Geotechnical Parameters

Material	Depth (mbgs)	Depth Below Top of Ice (m)	Unit Weight (kN/m^3)	Internal Friction Angle (°)
Compact Sand	0 – 3	3.2 – 6.1	20	30

5.3.2. Shallow Foundations

The ULS resistance presented below has an assumed loading factor of 0.5, and the SLS reaction assumes a total allowable settlement of 25 mm and 19 mm of differential settlement. It has been assumed that a square spread foundation will be constructed at the base of the vertically oriented elbow bend in the water intake pipe near BH-25-09-708. The below bearing capacities assume square spread foundations ranging in size from 1.0 to 6.0 m, experiencing vertical and concentric loads only, with a minimum foundation embedment of 0.5 m. The assumed embedment depth is based on the conceptual water intake pipe alignment and elevation profile drawings available at the time of writing this memorandum.

- Factored ULS Geotechnical Resistance: 125 kPa
- SLS Reaction: 100 kPa

Uplift and dynamic loading due to tidal forces or freeze/thaw action have not been considered in the recommendations provided above. Should uplifting or dynamic loading be anticipated for foundation design, or if significantly differing soil conditions are encountered during construction, TULLOCH should be contacted to provide updated recommendations.

5.3.3. Sliding Resistance

The ultimate resistance to lateral loads should be calculated as per the following recommendations:

- An ultimate friction factor of $\tan(\delta) = 0.34, where\ \delta = 19°$, at the interface between native sand and cast-in-place concrete foundation.

The ultimate sliding resistance should be properly factored in for use in design. Shear-key or dowels could be considered if higher lateral resistance is required. A resistance factor of 0.8 is recommended for sliding resistance in the design.

5.4. Soil Corrosivity Assessment

Representative testing was completed for soil corrosivity and sulphate concentrations at the borehole locations on site. The results of the testing are shown below in Table 5-2. Samples were tested at Testmark Laboratories in Garson, Ontario. Detailed results can be found attached to this memorandum.

Table 5-5: Soil Corrosivity Results

Borehole No. / Sample No.	Depth (mbgs)	Resistivity (Ω cm)	pH	Redox Potential (mV)	Sulfide (µg/g)	Chloride (%)	Sulphate (%)
BH-25-03 / SS01	0.0	18,100	5.84	350	<0.3[1]	3.6	18
BH-25-08 / SS01	0.0	12,000	6.56	340	<0.3[1]	1.3	22

Note(s): [1]Sulfide testing detection limit 0.3 µg/g

The results of the chemical testing were assessed in reference to the AWWA C-105 Standard from the ANSI/AWWA Corrosivity Rating System. A score greater than 10 indicates the requirement of corrosion protective measures for buried metallic infrastructure. The samples analyzed for the boreholes referenced above in Table 5-2 scored a ranking of 2, which is below the threshold.

In addition, chloride ions can lead to corrosion of steel. Typically, soils with chloride concentrations greater than 500 µg/g are considered corrosive. As noted in the table, chloride concentrations are less than 500 µg/g. Corrosion protection measures are not required in these areas of the site to protect subsurface infrastructure.

The concentration of sulphate indicates the degree of potential sulphate attack for concrete buried at the site. As shown in the table, the sulphate concentrations are less than 1000 µg/g, indicating a low degree of sulphate attack. Type GU Portland Cement should be suitable for use at this site. Detailed laboratory test results are presented attached to this memorandum.

6. CLOSURE

This geotechnical investigation and desktop study memorandum has been prepared by TULLOCH for the exclusive use of the Town of Blind River and their authorized agents for the construction of the proposed new raw water intake pipe and structure located along the bottom of Lake Huron in Blind River, Ontario. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering for the above-noted location. No warranty or other conditions, expressed or implied, should be understood; please see the Notice to Reader attached to this memorandum, which should be reviewed as it forms an integral part of this document.

We trust that the information in this memorandum will be found to be complete and adequate for your consideration. Should further elaboration be required for any portion of this project, we would be pleased to provide assistance.

Sincerely,

Laura Meneghetti
Geotechnical Engineering Technologist

Jackson Mercer, P. Eng.
Geotechnical Engineer

Reviewed By:
George Liang, Ph.D., P. Eng.
Geotechnical Engineering Lead

LICENSED PROFESSIONAL ENGINEER
J. R. MERCER
100515660
2023-10-20
PROVINCE OF ONTARIO

Attachment(s)/Enclosure(s): Site Plan, Terminology, Site Photo Log, Borehole Logs, Laboratory Testing Reports, Notice to Reader

Site Plan

BOREHOLE LOCATION PLAN

0
200
METER

PROJECT LOCATION

COORDINATES		
NAME	EASTING	NORTHING
BH-25-01-700	349 232	5 116 228
BH-25-02-701	349 222	5 116 207
BH-25-03-702	349 207	5 116 174
BH-25-04-703	349 197	5 116 142
BH-25-05-704	349 187	5 116 102
BH-25-06-705	349 180	5 116 060
BH-25-07-706	349 177	5 116 011
BH-25-08-707	349 178	5 115 957
BH-25-09-708	349 181	5 115 905

NOTES:

1. COORDINATES ARE IN UTM ZONE 17T (NAD83 CSRS).

LEGEND:

BH–25–01 ⌖ BOREHOLE LOCATION

No.	DATE	BY	ISSUES / REVISIONS
0	2025-04-30	LM	ISSUED FOR REPORT

TULLOCH

DRAWING:
BOREHOLE
LOCATION PLAN

PROJECT:
BLIND RIVER WATER INTAKE
GEOTECHNICAL INVESTIGATION

DRAWN BY: L. MENEGHETTI
CHECKED BY: J. MERCER
PROJECT No. : 23-0821
DESIGNED BY:
APPROVED BY:
DRAWING No. 23-0821-001
REVISION No. 0
SCALE: AS NOTED
DATE: 2025-04-30

P:\2023\230821 Blind River Water Intake\Geotechnical\03 Drawings\03.02 Current\offshore siteplan\23–0821–001.dwg

Terminology

ABBREVIATIONS, TERMINOLOGY AND PRINCIPAL SYMBOLS USED IN REPORT AND BOREHOLE LOGS

BOREHOLES AND TEST PIT LOGS

Soils

AS	Auger/Grab Sample	w	Water Content
SS	Split Spoon	wP	Plastic Limit
SH	Shelby Tube	wL	Liquid Limit
PISTON	Thin-walled Piston	VANE	Field Vane
WS	Washed Sample	OR	Organic Content
SC	Soil Core	GR	Gravel
BS	Block Sample	SA	Sand
WH	Weight of Rods & Hammer	SI	Silt
WR	Weight of Rods	CL	Clay

Bedrock

TCR	Total Core Recover	VN	Vein
SCR	Solid Core Recovery	CO	Contact
FI	Fracture Frequency Index	KV	Karstic Void
HQ	Rock Core (63.5 mm dia.)	MB	Mechanical Break
NQ	Rock Core (47.6 mm dia.)	PL	Planar
BQ	Rock Core (36.5 mm dia.)	CU	Curved
JN	Joint	UN	Undulating
FLT	Fault	IR	Irregular
SH	Shear	SM	Smooth
SK	Slickensided	SR	Slightly Rough
BD	Bedding	R	Rough
FO	Foliation	VR	Very rough

IN SITU SOIL TESTING

Standard Penetration Test (SPT) "N" value is the number of blows required to drive a 51 mm OD split barrel sampler into the soil a distance of 300 mm with a 63.5kg weight free falling a distance of 760 mm after an initial penetration of 150 mm has been achieved.

Dynamic Cone Penetration Test (DCPT) is the number of blows required to drive a cone with a 60-degree apex attached to "A" size drill rods continuously into the soil for each 300 mm penetration with a 63.5 kg weight free falling a distance of 760 mm.

Cone Penetration Test (CPT) is an electronic cone point with a 10 cm base area with a 60-degree apex pushed through the soil at a penetration rate of 2cm/s.

Field Vane Test (FVT) consists of a vane blade, a set of rods and torque measuring apparatus used to determine the undrained shear strength of cohesive soils.

SOIL DESCRIPTIONS

The soil descriptions and classifications are based on an expanded Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories: coarse grained, fine grained and highly organic soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 75 mm. To aid in quantifying material amounts by weight within the respective grain size fractions, the following terms have been included to expand the USCS:

Soil Classification	
Clay	<0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.075 to 4.75 mm
Gravel	4.751 to 75 mm
Cobbles	75 to 300 mm
Boulders	>300 mm

Terminology	Proportion
“trace”, sand, etc.	1% to 10%
"some"	10% to 20%
Sandy, Gravelly, etc.	20% to 35%
“and” SAND, SILT, (non-cohesive)	>35%
“with” SAND, SILT, (cohesive)	>35%

Notes:

1. Soil properties, such as strength, gradation, plasticity, structure, etc., dictate the soils engineering behaviour over the grain size fractions;
2. With the exception of soil samples tested for grain size distribution or plasticity, all soil sample classifications are based on visual and tactile observations and, therefore, constitute an approximate description.

The following table outlines the qualitative terms used to describe the relative density condition of cohesionless soils related to the SPT “N” value:

Cohesionless Soils

Compactness	SPT “N” Value (blows/30cm)
Very Loose	0 to 4
Loose	5 to 10
Compact	11 to 30
Dense	31 to 50
Very Dense	>50

The following table outlines the qualitative terms used to describe the consistency of cohesive soils related to undrained shear strength and SPT “N” value:

Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT “N” Value (blows/30 cm)
Very Soft	<12.5	< 2
Soft	12.5 to 25	2 to 4
Firm	25 to 50	5 to 8
Stiff	50 to 100	9 to 15
Very Stiff	100 to 200	16 to 30
Hard	> 200	>30

Note: Utilizing the SPT “N” value to correlate the consistency and undrained shear strength of cohesive soils is very approximate and needs to be used with caution.

Particle Sizes

Constituent	Description	Size (mm)	Size (in)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse	19 to 75	0.75 to 3
	Fine	4.75 to 19	(4) to 0.75
SAND	Coarse	2.00 to 4.75	(10) to (4)
	Medium	0.425 to 2.00	(40) to (10)
	Fine	0.075 to 0.425	(200) to (40)
SILT/CLAY	Classified by Plasticity	< 0.075	< (200)

Note: Brackets () indicate US Standard Sieve Size Number

ROCK CORING

Rock Quality Designation (RQD) is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section is broken during coring or handling, the pieces are fitted together and, if 100 mm or greater included in the total sum.

Intact Rock Strength

Intact Strength (MPa)	Description
< 1	Extremely low strength
1 to 5	Very low strength
5 to 25	Low strength
25 to 50	Medium strength
50 to 100	High strength
100 to 250	Very high strength
>250	Extremely high strength

Rock Mass Quality

RQD Classification	RQD Value (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

Rock Mass Weathering

Term	Description
Unweathered (Fresh)	No visible sign of material weathering and slight discoloration on major discontinuity surfaces.
Slightly Weathered	Discoloration indicates the weathering of rock material and discontinuity of surfaces. All of the rock material may be discoloured by weathering and may be somewhat weaker than its fresh condition.
Moderately Weathered	Less than half the rock material is decomposed and/or disintegrates to soil. Fresh or discoloured rock is present either as a continuous framework of as core stones.
Highly Weathered	More than half the rock material is decomposed and/or disintegrated to soil. Fresh or discoloured rock is present either as a discontinuous framework or as core stones.
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is largely intact.
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

Joint and Foliation Spacing

Description	Spacing
Very Wide	Greater than 3 m
Wide	1 m to 3 m
Moderately Close	0.3 m to 1 m
Close	50 mm to 300 mm
Very Close	Less than 50 mm

Bedding Thickness

Description	Spacing
Very thick	Greater than 2 m
Thick	0.6 m to 2 m
Medium	0.2 m to 0.6 m
Thin	60 mm to 0.2 m
Very thin	20 mm to 60 mm
Laminated	6 to 20 mm
Thinly Laminated	Less than 6 mm

SYMBOLS

General

w_N	Natural water content within the soil sample
γ	Unit weight
γ'	Effective unit weight
γ_D	Dry unit weight
γ_{SAT}	Saturated unit weight
ρ	Density
ρ_s	Density of solid particles
ρ_w	Density of water
ρ_D	Dry density
ρ_{SAT}	Saturated density
e	Void ratio
n	Porosity
S	Degree of saturation
E_{50}	Fifty percent secant modulus

Consistency

w_L	Liquid Limit
w_P	Plastric Limit
I_P	Plasticity Index
w_S	Shrinkage Limit
I_L	Liquidity Index
I_C	Consistency Index
e_{max}	Void ratio in loosest state
e_{min}	Void ratio in densest state
I_D	Density Index (formerly relative density)

Shear Strength

S_u	Undrained shear strength parameter (total stress)
c'	Effective cohesion intercept
ϕ'	Effective friction angle
τ_P	Peak shear strength
τ_R	Residual shear strength
δ	Angle of interface friction
μ	Coefficient of friction = tan ϕ'

Consolidation

C_c	Compression index (normally consolidated range)
C_r	Recompression index (over consolidated range)
m_v	Coefficient of volume change
c_v	Coefficient of consolidation
T_v	Time factor (vertical direction)
U	Degree of consolidation
σ_v'	Effictive overburden pressure
OCR	Overconsolidation ratio

Site Photo Log

Photo 1: BH-25-01-700 during advancement. Photo taken facing west.

Photo 2: BH-25-02-701 during advancement. Photo taken facing northeast.

CLIENT

Town of Blind River

PROJECT

Blind River Water Intake Offshore Geotechnical Investigation

CONSULTANT

TULLOCH
ENGINEERING

YYYY-MM-DD	2025-04-16
PREPARED	LM
DESIGNED	
REVIEWED	JM
APPROVED	

TITLE

BH-25-01-700 and BH-25-02-701 Site Photographs

PROJECT NO.	Phase/Task	Rev.	FIGURE
23-0821			1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25 mm

0

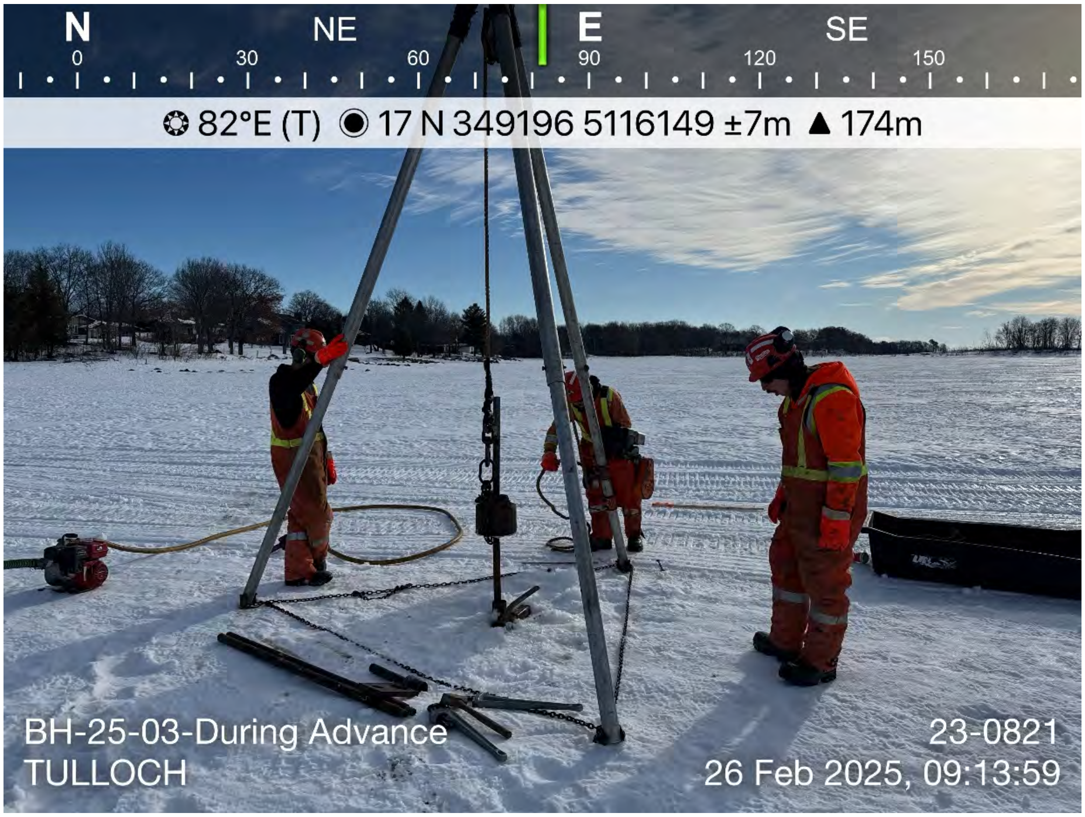


Photo 3: BH-25-03-702 during advancement. Photo taken facing east.

Photo 4: BH-25-04-703 during advancement. Photo taken facing north.

CLIENT
Town of Blind River

PROJECT
Blind River Water Intake Offshore Geotechnical Investigation

CONSULTANT
TULLOCH ENGINEERING

YYYY-MM-DD	2025-04-16
PREPARED	LM
DESIGNED	
REVIEWED	JM
APPROVED	

TITLE
BH-25-03-702 and BH-25-04-703 Site Photographs

PROJECT NO.	Phase/Task	Rev.	FIGURE
23-0821			2

Photo 5: BH-25-05-704 during advancement. Photo taken facing east.

Photo 6: BH-25-06-705 during advancement. Photo taken facing northwest.

CLIENT
Town of Blind River

PROJECT
Blind River Water Intake Offshore Geotechnical Investigation

CONSULTANT
TULLOCH
ENGINEERING

YYYY-MM-DD	2025-04-16
PREPARED	LM
DESIGNED	
REVIEWED	JM
APPROVED	

TITLE
BH-25-05-704 and BH-25-06-705 Site Photographs

PROJECT NO.	Phase/Task	Rev.	FIGURE
23-0821			3

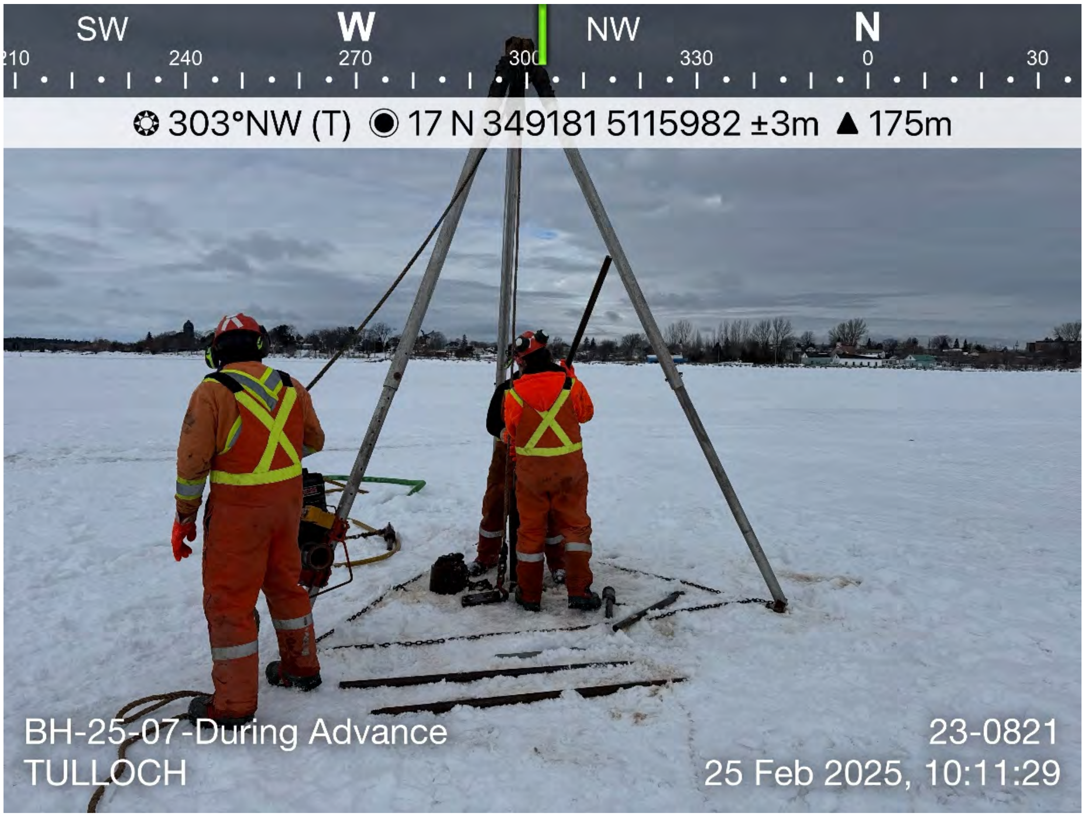


Photo 7: BH-25-07-706 during advancement. Photo taken facing northwest.

Photo 8: BH-25-08-707 during advancement. Photo taken facing east.

CLIENT
Town of Blind River

PROJECT
Blind River Water Intake Offshore Geotechnical Investigation

CONSULTANT
TULLOCH
ENGINEERING

YYYY-MM-DD 2025-04-16
PREPARED LM
DESIGNED
REVIEWED JM
APPROVED

TITLE
BH-25-07-706 and BH-25-07-708 Site Photographs

PROJECT NO.	Phase/Task	Rev.	FIGURE
23-0821			4

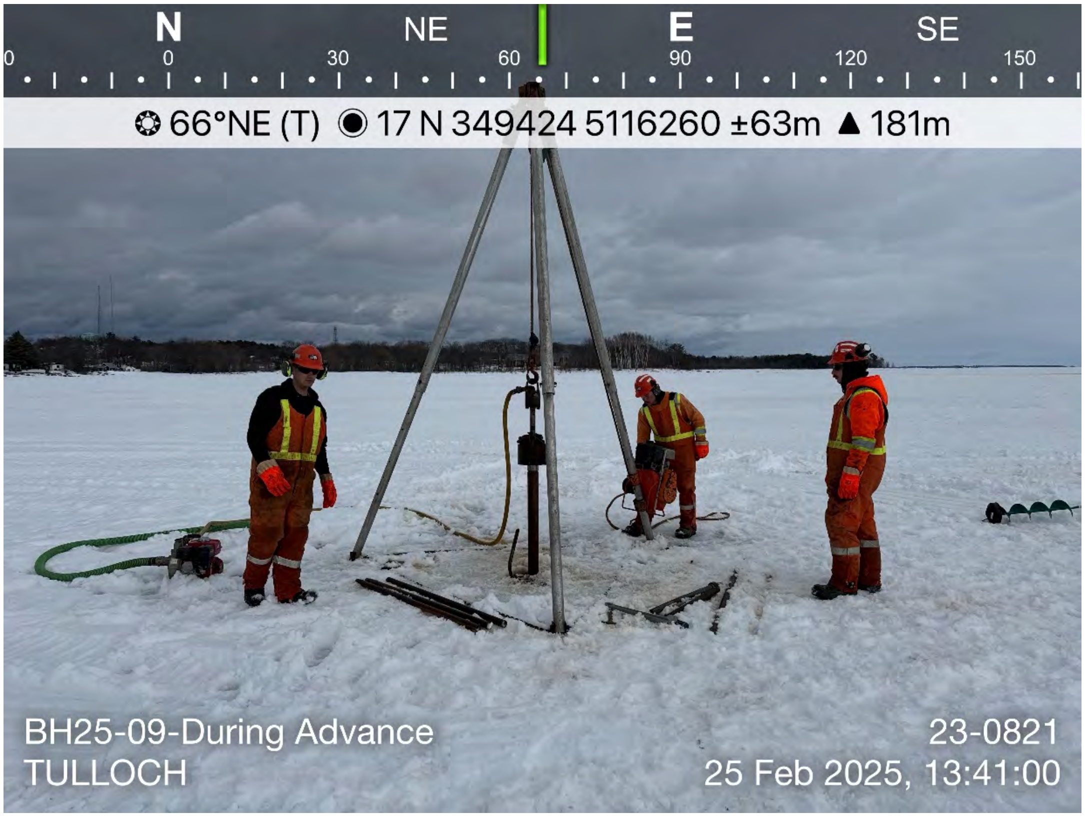


Photo 9: BH-25-09-708 during advancement. Photo taken facing northeast.

CLIENT	Town of Blind River
PROJECT	Blind River Water Intake Offshore Geotechnical Investigation
CONSULTANT	TULLOCH ENGINEERING
YYYY-MM-DD	2025-04-16
PREPARED	LM
DESIGNED	
REVIEWED	JM
APPROVED	
TITLE	BH-25-09-708 Site Photographs
PROJECT NO.	23-0821
Phase/Task	
Rev.	
FIGURE	5

Borehole Logs

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-25-01-700

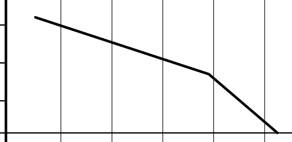
1 OF 1 **METRIC**

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.26 NORTHING 5116228 EASTING 349232 CHECKED BY LM

SOIL PROFILE			SAMPLES								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)	GROUND WATER CONDITIONS	ELEVATION (M)	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ POCKET PEN + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT w LIQUID LIMIT W_L WATER CONTENT (%) 20 40 60	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.20 0.00	TOP OF ICE ELEVATION: 176.20 m LAKE WATER LAKEBED ELEVATION: 175.52 m	△ △ △ △						176			
175.52 0.68	(SM) SILTY SAND, fine to coarse grained, grey, non-cohesive, wet, compact		SS01	SS	24	46					Casing refusal at 174.73 m Readvanced spoon from 175.29 to 174.68 m
								175			
			SS03	SS	22	71					
174.00 2.20	Switched to DCPT to continue advancement at 174.00 m							174			
173.23 2.97	END OF BOREHOLE DUE TO DCPT REFUSAL										



200 + : Numbers refer to Field Vane Over Limit

$+^3, \times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-25-02-701

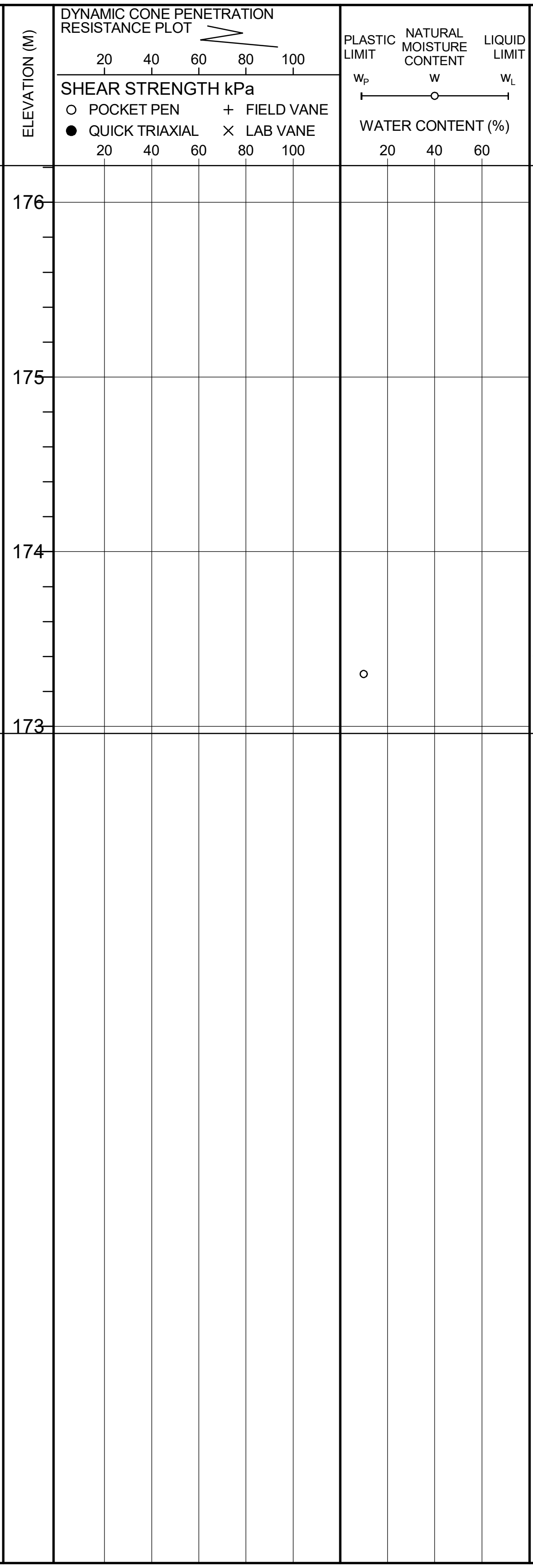
1 OF 1 **METRIC**

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.26 NORTHING 5116207 EASTING 349222 CHECKED BY LM

SOIL PROFILE			SAMPLES					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.21								
0.00	TOP OF ICE ELEVATION: 176.21 m LAKE WATER LAKEBED ELEVATION: 175.70 m	△ △ △						
175.70 0.51	(SP) SAND, fine to medium grained, trace non-plastic fines, grey, non-cohesive, wet, loose		SS01	SS	5	50		
174.79 1.42	(SM) SILTY SAND, fine to medium grained, non-plastic, grey, non-cohesive, wet, loose		SS02	SS	4	71		
174.18 2.03	(SW) Gravelly SAND, fine to coarse grained sand, fine grained gravel, trace non-plastic fines, grey, non-cohesive, wet, compact to dense		SS03	SS	43	33		
			SS04	SS	47	67		Casing refusal at 173.46 m, spoon advanced to termination depth 21 72 (7)
172.96 3.25	END OF BOREHOLE AT 172.96 m DUE TO HEAVE AND CASING REFUSAL							



200 + : Numbers refer to Field Vane Over Limit

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

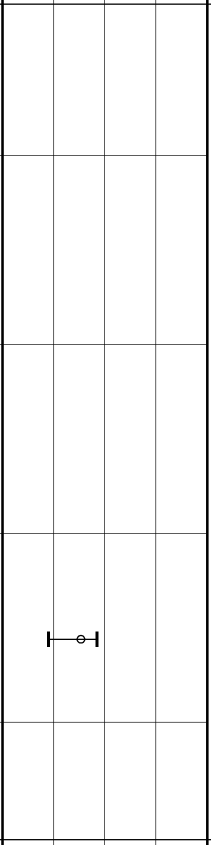
RECORD OF BOREHOLE No BH-25-03-702

1 OF 1

METRIC

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM
CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW
DRILLER Landcore Drilling DATE 2025.02.26 NORTHING 5116174 EASTING 349207 CHECKED BY LM

SOIL PROFILE			SAMPLES								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)	GROUND WATER CONDITIONS	ELEVATION (M)	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ POCKET PEN + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
175.80 0.00	TOP OF ICE ELEVATION: 175.80 m LAKE WATER LAKEBED ELEVATION: 175.04 m	△									
175.04 0.76	(SP) SAND, fine to medium grained, trace non-plastic fines, grey, non-cohesive, wet, very loose to loose		SS01	SS	2	38		175			
			SS02	SS	5	33		174			
173.67 2.13	(ML) SILT, non-plastic, trace fine grained sand, grey, non-cohesive, wet, loose		SS03	SS	5	38		173			
172.91 2.89	(CL) SILTY CLAY, low to medium plasticity, grey, varved brown, cohesive, w>PL, soft		SS04	SS	3	79					
	- intermittent fine to medium grained sand seams, wet, loose		SS05	SS	4	96		172			
171.38 4.42	END OF BOREHOLE AT 171.38 m										



200 + : Numbers refer to Field Vane Over Limit $+^3, \times^3$: Numbers refer to Sensitivity   ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-25-04-703

1 OF 1

METRIC

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.24 NORTHING 5116142 EASTING 349197 CHECKED BY LM

SOIL PROFILE			SAMPLES						DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ POCKET PEN + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 20 40 60	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)	GROUND WATER CONDITIONS	ELEVATION (M)			
176.23 0.00	TOP OF ICE ELEVATION: 176.23 m LAKE WATER LAKEBED ELEVATION: 175.38 m	△ △ △ △ △						176			
175.38 0.85	(SP) SAND, fine to medium grained, some non-plastic fines, brown, non-cohesive, wet, loose to very loose		SS01	SS	5	50		175			
			SS02	SS	3	38		174			
173.75 2.48	(ML) SILT, non-plastic, trace to some fine grained sand, grey, non-cohesive, wet, very loose		SS03A/B	SS	3	100					
173.25 2.98	(SP) SAND, fine to medium grained, grey, non-cohesive, wet, loose		SS04A/B	SS	6	100		173			
172.94 3.29	(ML) SILT, non-plastic, some fine to medium grained sand, grey, non-cohesive, wet, loose										
172.48 3.75	(SP) SAND, coarse grained, grey, non-cohesive, wet, loose		SS05	SS	4	4		172			
171.72 4.51	(ML) SILT, non-plastic, some fine to medium grained sand, grey, non-cohesive, wet, very loose		SS06	SS	1	100					
171.11 5.12	END OF BOREHOLE AT 171.11 m										

200 + : Numbers refer to Field Vane Over Limit

$+^3, \times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No BH-25-05-704

1 OF 1

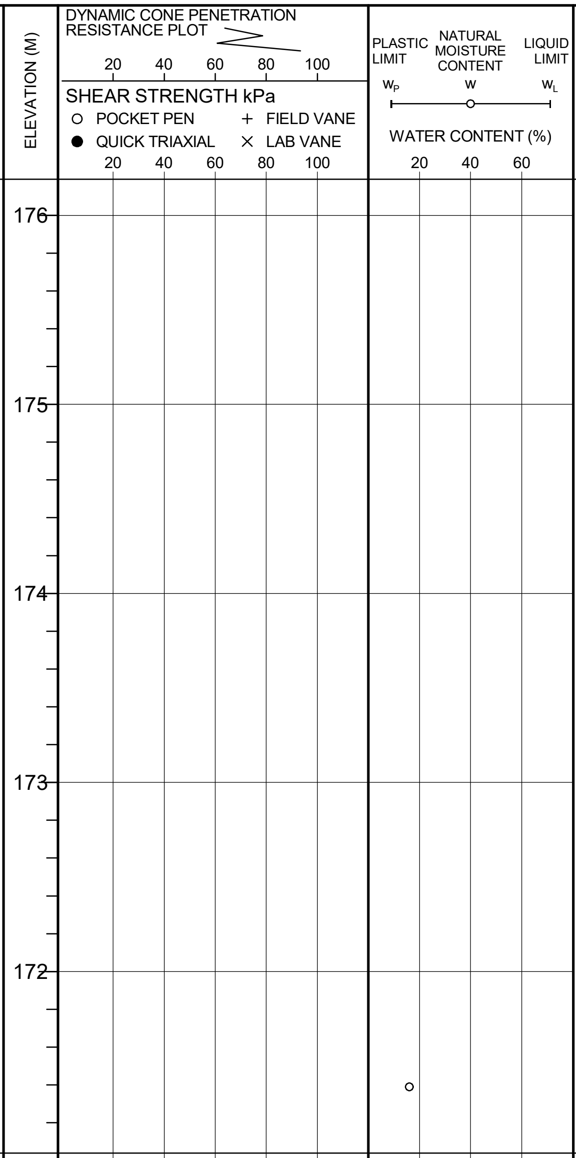
METRIC

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.24 NORTHING 5116102 EASTING 349187 CHECKED BY LM

SOIL PROFILE			SAMPLES					REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)	GROUND WATER CONDITIONS	GR	SA	SI	CL
176.19 0.00	TOP OF ICE ELEVATION: 176.19 m LAKE WATER LAKEBED ELEVATION: 174.09 m	△									
174.09 2.10	(SP) SAND, fine to medium grained, some non-plastic fines, grey, non-cohesive, wet, very loose		SS01A/ B	SS	0	75					
173.79 2.40	(ML) SILT, non-plastic, trace fine grained sand, with organic debris, grey, non-cohesive, wet, very loose										
			SS02	SS	1	100					
172.41 3.78	(ML) SILT and (SP) SAND, fine to medium grained, trace fine grained gravel, grey, non-cohesive, wet, compact		SS03	SS	10	58					
			SS04	SS	15	50		11	31	(58)	
171.04 5.15	END OF BOREHOLE AT 171.04 m										



200 + : Numbers refer to Field Vane Over Limit

+3, ×3 : Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH
ENGINEERING

RECORD OF BOREHOLE No BH-25-06-705

1 OF 1

METRIC

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.25 NORTHING 5116060 EASTING 349180 CHECKED BY LM

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION (M)	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ POCKET PEN + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 20 40 60	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)					
176.20 0.00	TOP OF ICE ELEVATION: 176.20 m LAKE WATER LAKEBED ELEVATION: 173.82 m						176 175 174			
173.82 2.38	(SP) SAND, fine to medium grained, trace non-plastic fines, brown, non-cohesive, wet, very loose	SS01	SS	2	33					
173.21 2.99	(ML) SILT, non-plastic, trace to some fine grained sand, grey, non-cohesive, wet, very loose	SS02	SS	1	100		173			
		SS03	SS	4	63		172			
171.69 4.51	(ML) Sandy SILT, non-plastic, fine grained sand, grey, non-cohesive, wet, loose	SS04	SS	6	67					
171.08 5.12	END OF BOREHOLE AT 171.08 m									

200+ : Numbers refer to Field Vane Over Limit

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-25-07-706

1 OF 1

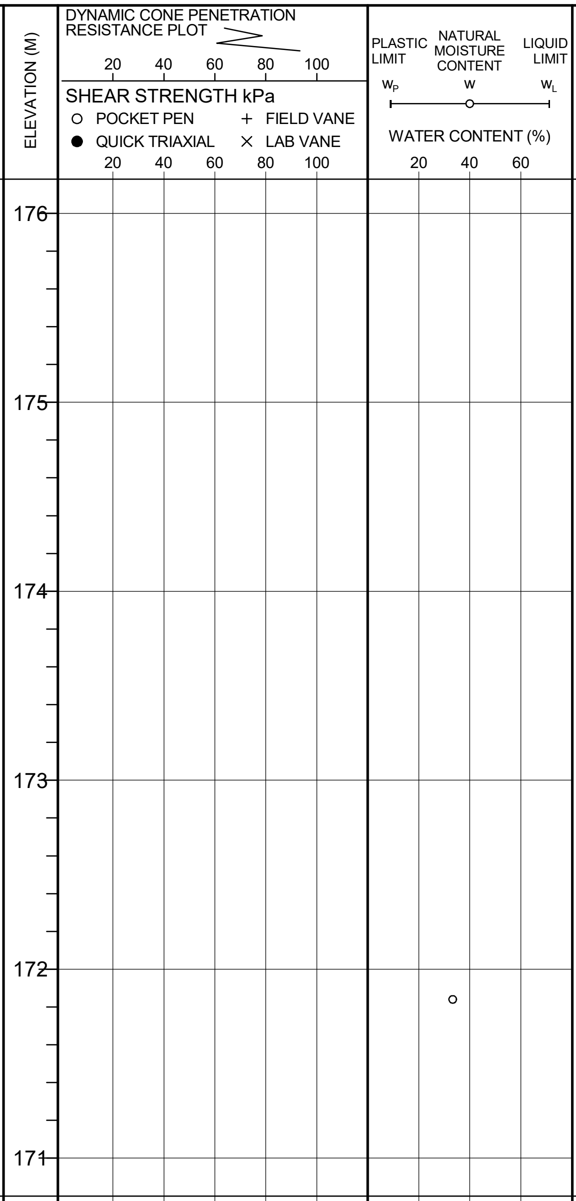
METRIC

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.26 NORTHING 5116011 EASTING 349177 CHECKED BY LM

SOIL PROFILE			SAMPLES					REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)	GROUND WATER CONDITIONS	GR SA SI CL
176.18 0.00	TOP OF ICE ELEVATION: 176.18 m LAKE WATER LAKEBED ELEVATION: 173.54 m	△						
173.54 2.64	(SM) SILTY SAND, non-plastic, fine grained, grey, non-cohesive, wet, very loose		SS01	SS	0	4		
172.93 3.25	(ML) SILT, non-plastic, trace fine grained sand, grey, with organic debris, non-cohesive, wet, very loose		SS02	SS	0	54		
172.17 4.01	(ML) Sandy SILT, non-plastic, fine to medium grained sand, grey, non-cohesive, wet, loose		SS03	SS	4	100		0 26 (74)
			SS04	SS	6	50		
170.80 5.38	END OF BOREHOLE AT 170.80 m							



200 + : Numbers refer to Field Vane Over Limit

$+^3, \times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-25-08-707

1 OF 1

METRIC

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.26 NORTHING 5115957 EASTING 349178 CHECKED BY LM

SOIL PROFILE			SAMPLES								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)	GROUND WATER CONDITIONS	ELEVATION (M)	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ POCKET PEN + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 20 40 60	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.20 0.00	TOP OF ICE ELEVATION: 176.20 m LAKE WATER LAKEBED ELEVATION: 173.33 m	△						176 175 174			
173.33 2.87	(SP) SAND, fine to medium grained, trace to some non-plastic fines, grey, non-cohesive, wet, loose to compact	⁘	SS01	SS	7	50		173			
		⁘	SS02	SS	17	17		172			
		⁘	SS03	SS	13	25					
171.04 5.16	END OF BOREHOLE AT 171.04 m										

$^{200}+$: Numbers refer to Field Vane Over Limit $+^{3}, \times^{3}$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-25-09-708

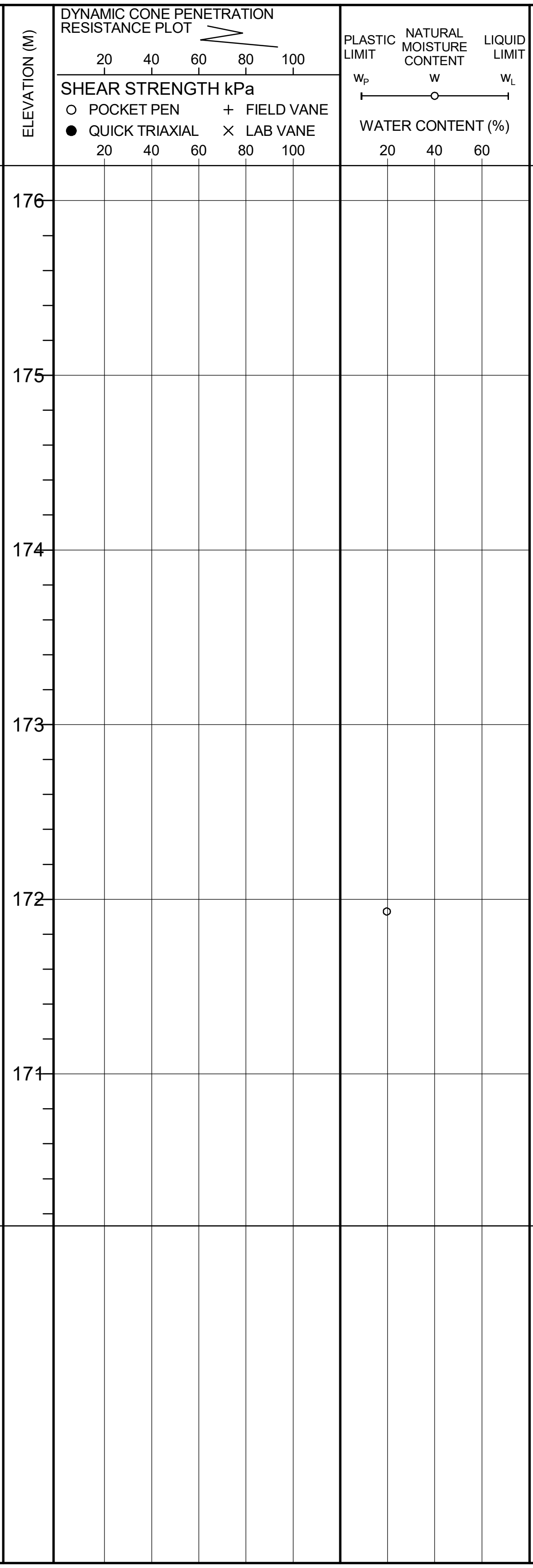
1 OF 1 **METRIC**

JOB NUMBER 23-0821 LOCATION Blind River, Ontario ORIGINATED BY JM

CLIENT Town of Blind River DATUM UTM 17T BOREHOLE TYPE Tripod & Cathead COMPILED BY GW

DRILLER Landcore Drilling DATE 2025.02.25 NORTHING 5115905 EASTING 349181 CHECKED BY LM

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO (%)		GR	SA	SI	CL
176.20 0.00	TOP OF ICE ELEVATION: 176.20 m LAKE WATER LAKEBED ELEVATION: 173.03 m	△									
173.05 3.15	(SP) SAND, fine to medium grained, trace to some non-plastic fines, grey, non-cohesive, wet, compact	⁘	SS01	SS	10	42					
			SS02	SS	11	25		0	97	(3)	
			SS03	SS	12	17					
170.13			SS04	SS	11	38					
6.07	END OF BOREHOLE AT 170.13 m										



200 + : Numbers refer to Field Vane Over Limit

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

Laboratory Testing Reports

CSA A283 Certified Laboratory for Concrete Testing
CCIL Certified Laboratory for Aggregates and Asphalt Testing
CCIL Certified Technicians

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 23-0821

DATE SAMPLED: 2025-02-26

PROJECT: Blind River Water Intake
2025 Offshore GI

SOURCE: Boreholes

DATE TESTED: 2025-03-28

TESTED BY: T. Linley

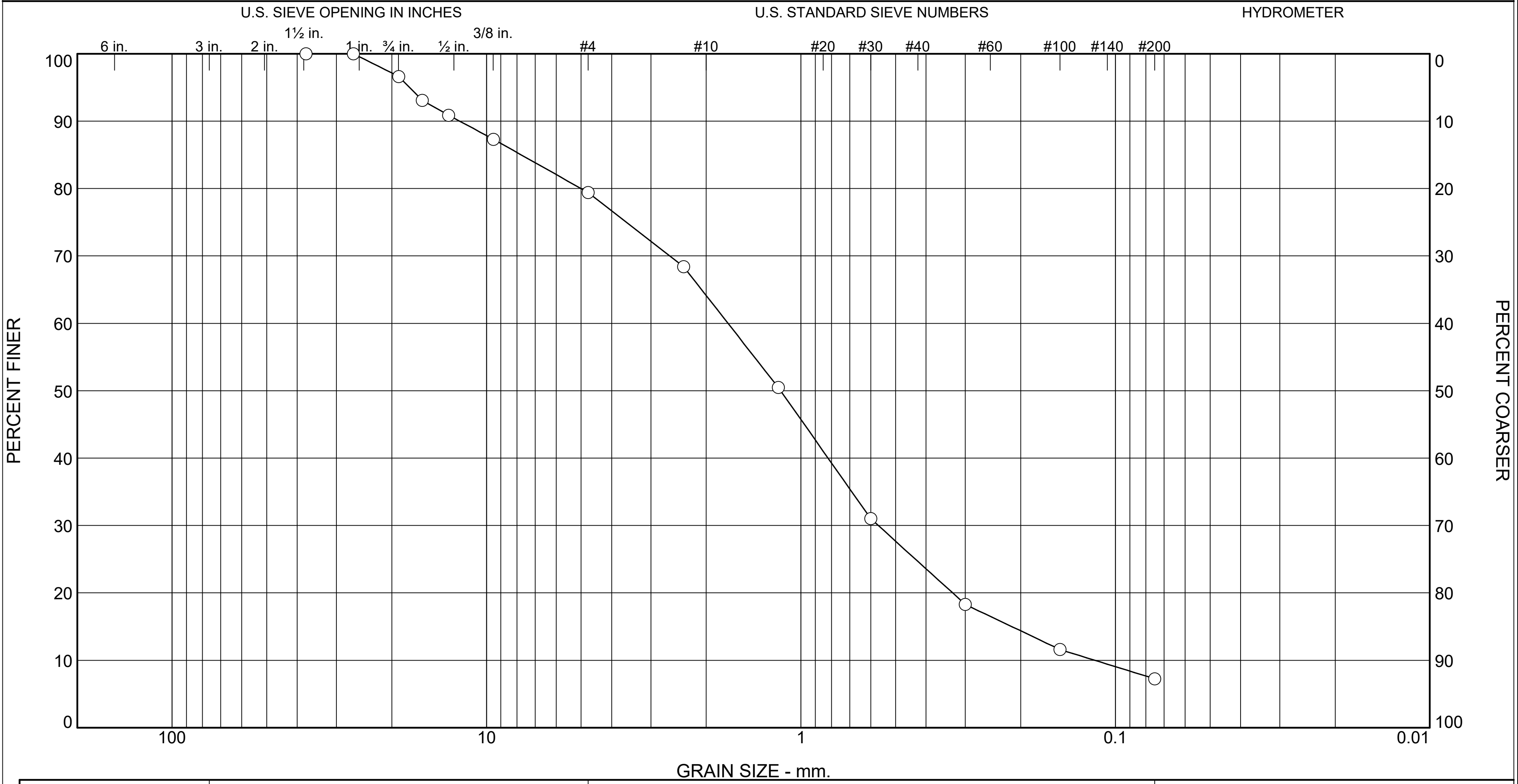
			Gross (inc. Tare) (g)				
Tare ID	**Sample ID**	**Depth (m)**	**Wet Weight**	**Dry Weight**	**TARE**	**Mass Lost**	**Water %**
	BH-25-02 SS04	2.1 to 2.7	1287.70	1193.68	241.00	94.02	9.9%

REMARKS:

CLIENT: Town of Blind River

COPIES TO:

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt
○	0.0	3.4	17.2	15.3	39.4	17.4	7.3

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: BH-25-02 Depth: 2.1m - 2.7m Sample Number: SS04	Feb 26, 2025		Mar 31, 2025

Client Town of Blind River

Project Blind River Water Intake

Project No. 23-0821 **Figure**

TULLOCH
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Daren.Stadnisky@TULLOCH.ca

Tested By: C. Johnson

GRAIN SIZE DISTRIBUTION TEST DATA

2025-04-01

Client: Town of Blind River
Project: Blind River Water Intake
Project Number: 23-0821
Location: BH-25-02
Depth: 2.1m - 2.7m **Sample Number:** SS04
Date Sampled: Feb 26, 2025 **Date Tested:** Mar 31, 2025
Tested by: C. Johnson

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 1132.40
Tare Wt. = 241.80
Minus #200 from wash = 6.4%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
1193.70	241.80	37.5mm	0.00	0.00	100.0	0.0
		26.5mm	0.00	0.00	100.0	0.0
		19mm	32.20	0.00	96.6	3.4
		16mm	33.60	0.00	93.1	6.9
		13.2mm	21.10	0.00	90.9	9.1
		9.5mm	33.90	0.00	87.3	12.7
		#4	75.30	0.00	79.4	20.6
		#8	104.80	0.00	68.4	31.6
		#16	170.60	0.00	50.5	49.5
		#30	185.10	0.00	31.0	69.0
		#50	121.30	0.00	18.3	81.7
		#100	63.60	0.00	11.6	88.4
		#200	41.30	0.00	7.3	92.7

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	3.4	17.2	20.6	15.3	39.4	17.4	72.1			7.3

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.1162	0.2135	0.3294	0.5676	0.8199	1.1610	1.7061	5.0068	7.7595	12.1798	17.5613

Fineness Modulus	C_u	C_c
3.57	14.68	1.62

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 23-0821
DATE SAMPLED: 2025-02-26

PROJECT: Blind River Water Intake
2025 Offshore GI
SOURCE: Boreholes

DATE TESTED: 2025-03-28
TESTED BY: T. Linley

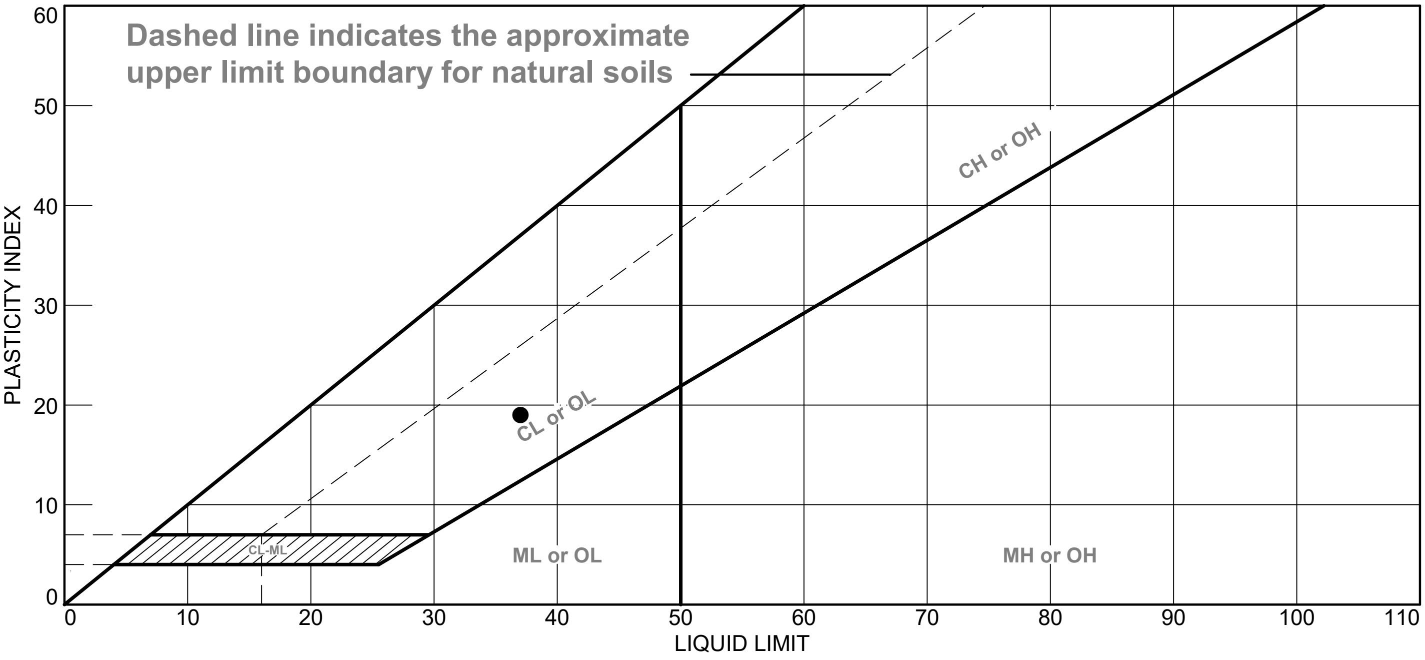
			Gross (inc. Tare) (g)				
Tare ID	**Sample ID**	**Depth (m)**	**Wet Weight**	**Dry Weight**	**TARE**	**Mass Lost**	**Water %**
	BH-25-03 SS04	2.3 to 2.9	883.04	715.19	168.51	167.85	30.7%

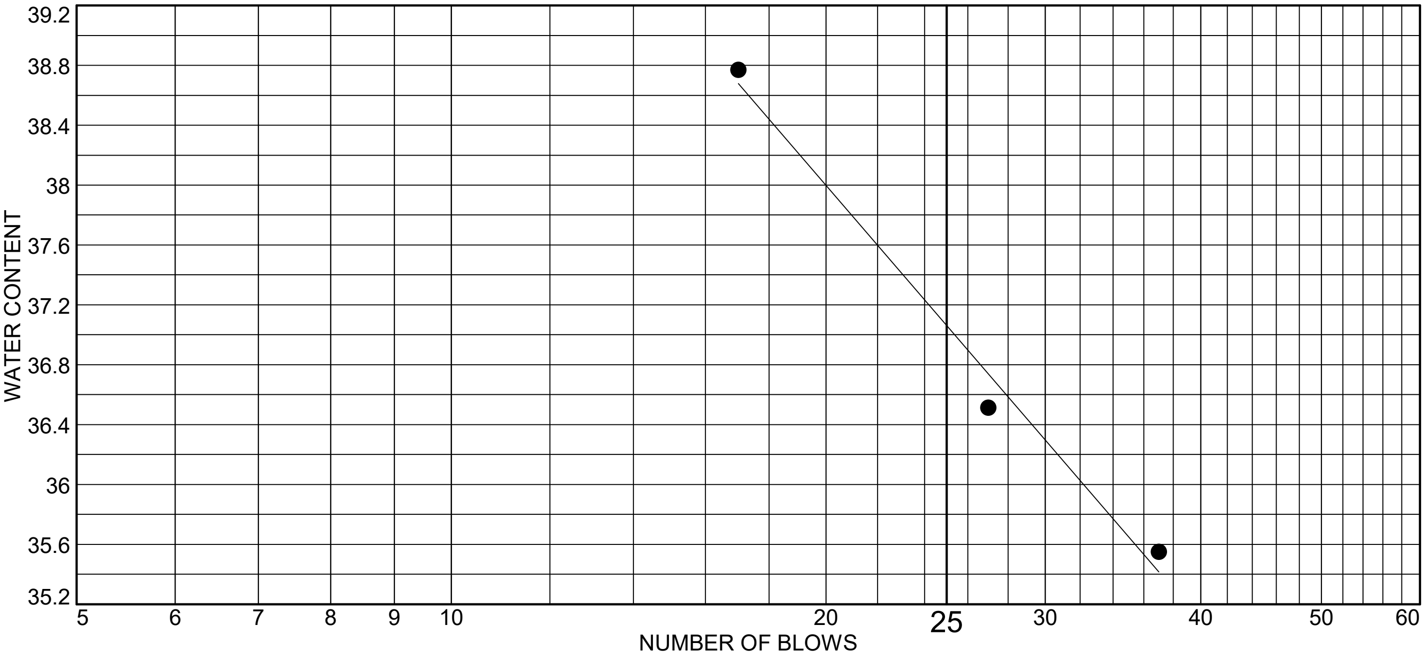
REMARKS:

CLIENT: Town of Blind River

COPIES TO:

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		37	18	19			

Project No. 23-0821 **Client:** Town of Blind River

Project: Blind River Water Intake

Source of Sample: BH-25-03 **Depth:** 2.3m - 2.9m
Sample Number: SS04

Remarks:

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Figure

Tested By: J. Draper

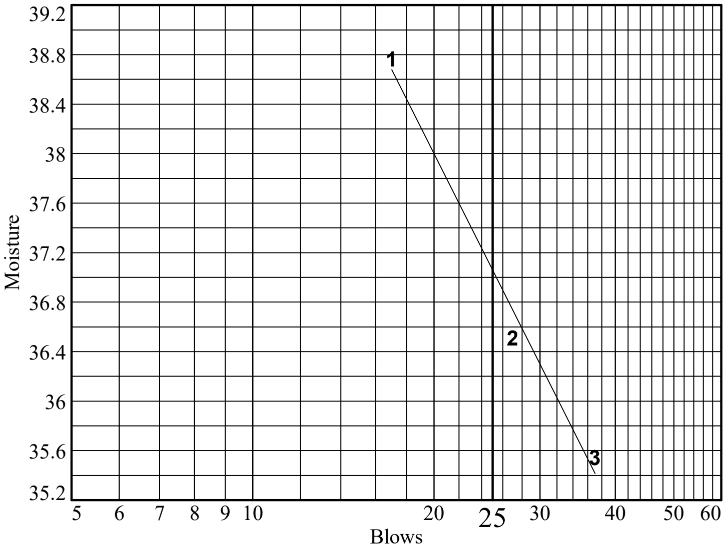
LIQUID AND PLASTIC LIMIT TEST DATA

2025-04-01

Client: Town of Blind River
Project: Blind River Water Intake
Project Number: 23-0821
Location: BH-25-03
Depth: 2.3m - 2.9m
Sample Number: SS04
Tested by: J. Draper

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	50.71	38.77	46.65			
Dry+Tare	44.41	33.45	39.27			
Tare	28.16	18.88	18.51			
# Blows	17	27	37			
Moisture	38.8	36.5	35.5			



Liquid Limit= 37
Plastic Limit= 18
Plasticity Index= 19
Natural Moisture= 30.7
Liquidity Index= 0.7

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	31.35	39.55			
Dry+Tare	29.47	37.82			
Tare	18.85	28.10			
Moisture	17.7	17.8			

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
883.04	715.19	168.51	30.7

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 23-0821
DATE SAMPLED: 2025-02-26

PROJECT: Blind River Water Intake
2025 Offshore GI
SOURCE: Boreholes

DATE TESTED: 2025-03-28
TESTED BY: T. Linley

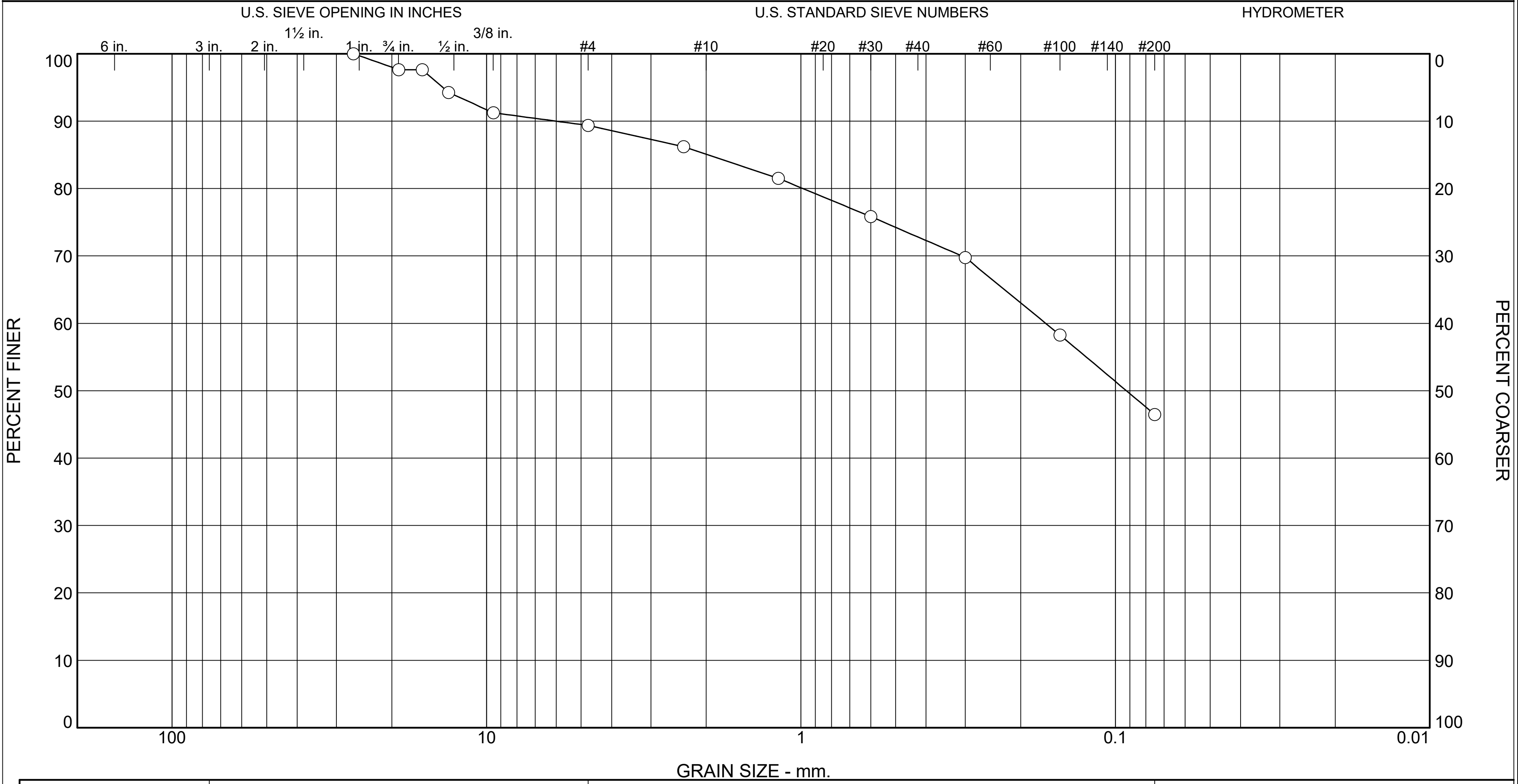
			Gross (inc. Tare) (g)				
Tare ID	**Sample ID**	**Depth (m)**	**Wet Weight**	**Dry Weight**	**TARE**	**Mass Lost**	**Water %**
	BH-25-05 SS04	2.4 to 3.0	873.09	787.32	250.89	85.77	16.0%

REMARKS:

CLIENT: Town of Blind River

COPIES TO:

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt
○	0.0	2.3	8.3	4.3	12.3	26.3	46.5

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: BH-25-05 Depth: 2.4m - 3.0m Sample Number: SS04	Feb 26, 2025		Mar 31, 2025

Client Town of Blind River

Project Blind River Water Intake

Project No. 23-0821

Figure

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Tested By: S. Campbell

GRAIN SIZE DISTRIBUTION TEST DATA

2025-04-01

Client: Town of Blind River
Project: Blind River Water Intake
Project Number: 23-0821
Location: BH-25-05
Depth: 2.4m - 3.0m **Sample Number:** SS04
Date Sampled: Feb 26, 2025 **Date Tested:** Mar 31, 2025
Tested by: S. Campbell

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 550.60
Tare Wt. = 250.90
Minus #200 from wash = 44.1%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
787.30	250.90	26.5mm	0.00	0.00	100.0	0.0
		19mm	12.70	0.00	97.6	2.4
		16mm	0.00	0.00	97.6	2.4
		13.2mm	18.10	0.00	94.3	5.7
		9.5mm	16.20	0.00	91.2	8.8
		#4	10.10	0.00	89.4	10.6
		#8	17.00	0.00	86.2	13.8
		#16	25.10	0.00	81.5	18.5
		#30	30.40	0.00	75.8	24.2
		#50	32.60	0.00	69.8	30.2
		#100	61.70	0.00	58.3	41.7
		#200	63.20	0.00	46.5	53.5

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	2.3	8.3	10.6	4.3	12.3	26.3	42.9			46.5

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.0923	0.1666	0.9859	1.9799	6.0231	13.7703

Fineness Modulus
1.50

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CCIL Certified Laboratory for Aggregates and Asphalt Testing
CCIL Certified Technicians

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 23-0821

DATE SAMPLED: 2025-02-26

PROJECT: Blind River Water Intake
2025 Offshore GI

SOURCE: Boreholes

DATE TESTED: 2025-03-28

TESTED BY: T. Linley

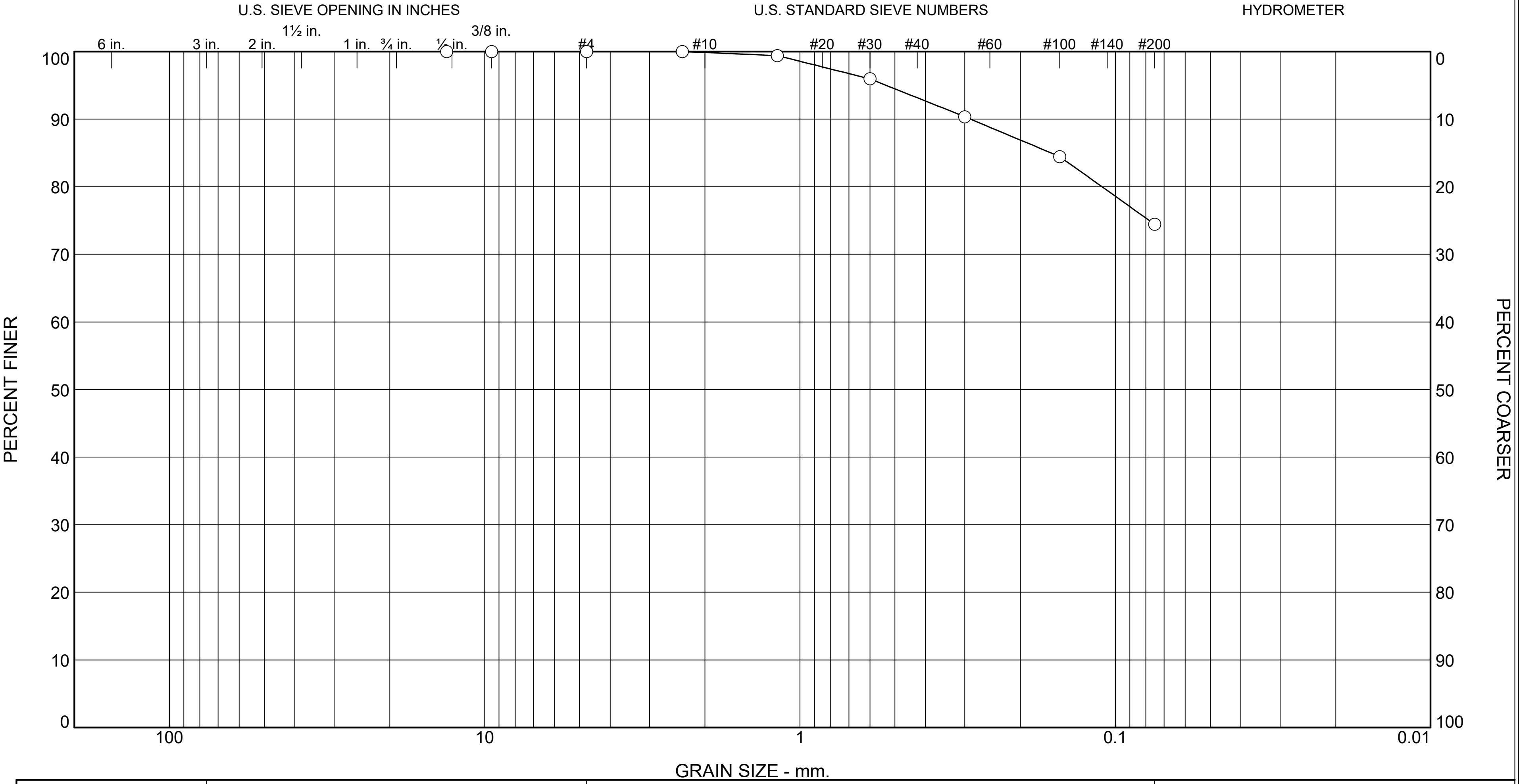
			Gross (inc. Tare) (g)				
Tare ID	**Sample ID**	**Depth (m)**	**Wet Weight**	**Dry Weight**	**TARE**	**Mass Lost**	**Water %**
	BH-25-07 SS03	1.4 to 2.0	710.89	590.88	230.24	120.01	33.3%

REMARKS:

CLIENT: Town of Blind River

COPIES TO:

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt
○	0.0	0.0	0.0	0.1	6.7	18.8	74.4

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: BH-25-07 Depth: 1.4m - 2.0m Sample Number: SS03	Feb 26, 2025		Mar 31, 2025

Client Town of Blind River

Project Blind River Water Intake

Project No. 23-0821 **Figure**

TULLOCH ENGINEERING

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Tested By: T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

2025-04-01

Client: Town of Blind River
Project: Blind River Water Intake
Project Number: 23-0821
Location: BH-25-07
Depth: 1.4m - 2.0m **Sample Number:** SS03
Date Sampled: Feb 26, 2025 **Date Tested:** Mar 31, 2025
Tested by: T. Linley

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 337.30
Tare Wt. = 230.20
Minus #200 from wash = 70.3%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
590.90	230.20	13.2mm	0.00	0.00	100.0	0.0
		9.5mm	0.00	0.00	100.0	0.0
		#4	0.00	0.00	100.0	0.0
		#8	0.00	0.00	100.0	0.0
		#16	2.20	0.00	99.4	0.6
		#30	12.40	0.00	96.0	4.0
		#50	20.20	0.00	90.4	9.6
		#100	21.30	0.00	84.4	15.6
		#200	36.10	0.00	74.4	25.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.1	6.7	18.8	25.6			74.4

D_{5}	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
								0.1102	0.1601	0.2879	0.5333

Fineness Modulus
0.30

TULLOCH

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CCIL Certified Laboratory for Aggregates and Asphalt Testing
CCIL Certified Technicians

CCIL
Canadian Council of Independent Laboratories
Conseil canadien des laboratoires indépendants

WATER CONTENT TEST

TEST METHOD: LS 701 / ASTM C 566 / D 2216

CONTRACT NO: 23-0821

DATE SAMPLED: 2025-02-26

PROJECT: Blind River Water Intake
2025 Offshore GI

SOURCE: Boreholes

DATE TESTED: 2025-03-28

TESTED BY: T. Linley

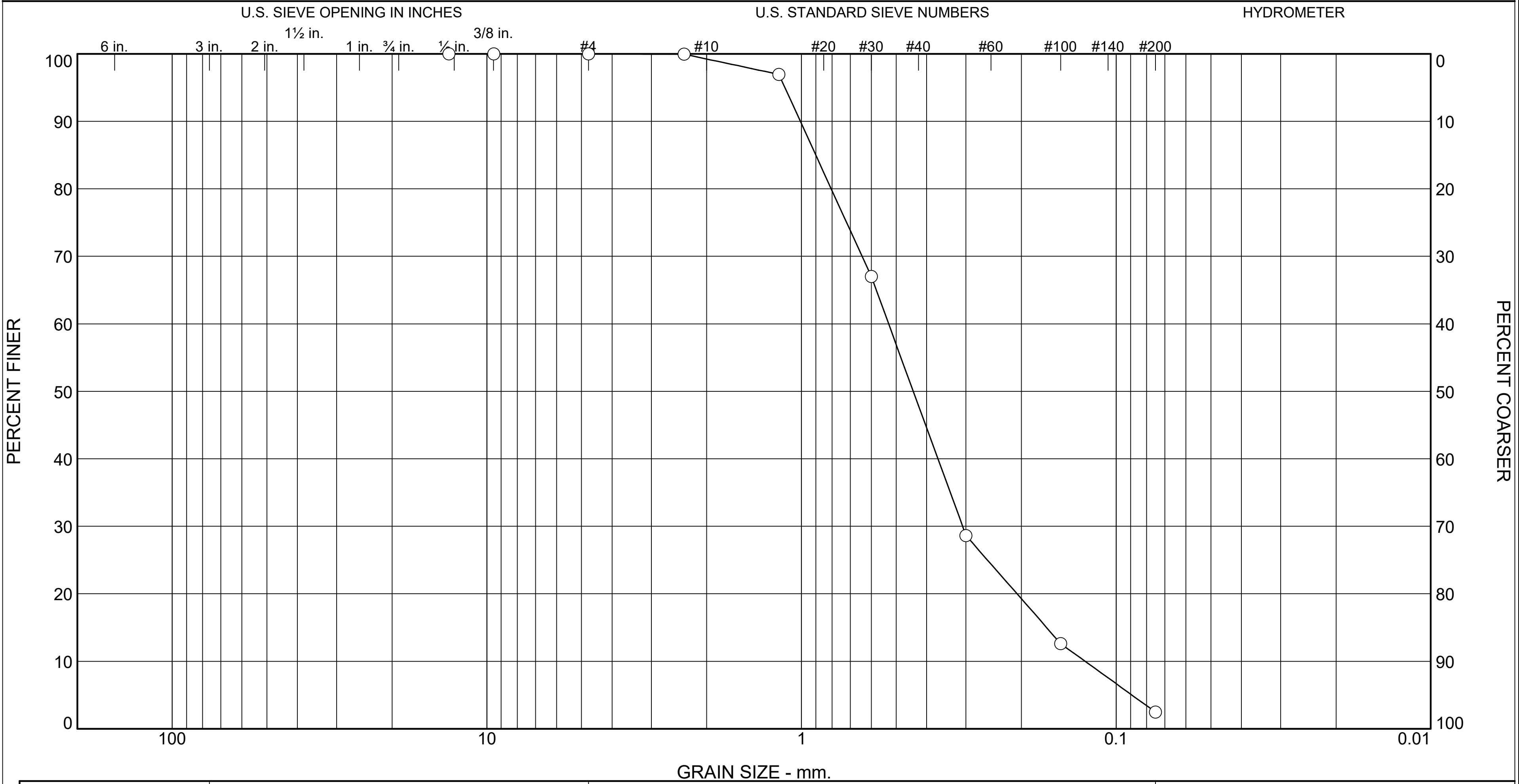
			Gross (inc. Tare) (g)				
Tare ID	**Sample ID**	**Depth (m)**	**Wet Weight**	**Dry Weight**	**TARE**	**Mass Lost**	**Water %**
	BH-25-09 SS02	0.8 to 1.4	357.60	325.86	164.88	31.74	19.7%

REMARKS:

CLIENT: Town of Blind River

COPIES TO:

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt
○	0.0	0.0	0.0	0.8	51.3	45.4	2.5

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: BH-25-09 Depth: 0.8m - 1.4m Sample Number: SS02	Feb 26, 2025		Mar 31, 2025

Client Town of Blind River

Project Blind River Water Intake

Project No. 23-0821

Figure

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Tested By: T. Linley

GRAIN SIZE DISTRIBUTION TEST DATA

2025-04-01

Client: Town of Blind River
Project: Blind River Water Intake
Project Number: 23-0821
Location: BH-25-09
Depth: 0.8m - 1.4m **Sample Number:** SS02
Date Sampled: Feb 26, 2025 **Date Tested:** Mar 31, 2025
Tested by: T. Linley

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 322.90
Tare Wt. = 164.90
Minus #200 from wash = 1.9%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
325.90	164.90	13.2mm	0.00	0.00	100.0	0.0
		9.5mm	0.00	0.00	100.0	0.0
		#4	0.00	0.00	100.0	0.0
		#8	0.10	0.00	99.9	0.1
		#16	4.80	0.00	97.0	3.0
		#30	48.20	0.00	67.0	33.0
		#50	61.80	0.00	28.6	71.4
		#100	25.80	0.00	12.6	87.4
		#200	16.30	0.00	2.5	97.5

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.8	51.3	45.4	97.5			2.5

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0891	0.1255	0.1663	0.2065	0.3075	0.3684	0.4413	0.5286	0.8045	0.9007	1.0084	1.1290

Fineness Modulus	C_u	C_c
1.95	4.21	1.43

CERTIFICATE OF ANALYSIS

Client:	Jackson Mercer	Work Order Number:	569716
Company:	Tulloch Engineering - Sault Ste. Marie	PO #:	
Address:	71 Black Road Unit 8 Sault Ste. Marie, ON, P6B 0A3	Regulation:	Information not provided
		Project #:	23-0821
Phone/Fax:	(705) 949-1457 / (705) 949-9606	DWS #:	
Email:	jackson.mercer@tulloch.ca	Sampled By:	Tulloch
Date Order Received:	3/31/2025	Analysis Started:	3/31/2025
Arrival Temperature:	15 C	Analysis Completed:	4/7/2025

WORK ORDER SUMMARY

ANALYSES WERE PERFORMED ON THE FOLLOWING SAMPLES. THE RESULTS RELATE ONLY TO THE ITEMS TESTED.

Sample Description	Lab ID	Matrix	Type	Comments	Date Collected	Time Collected
BH-25-03 SS01	2121941	Soil	None		2/26/2025	
BH-25-08 SS01	2121942	Soil	None		2/25/2025	

METHODS AND INSTRUMENTATION

THE FOLLOWING METHODS WERE USED FOR YOUR SAMPLE(S):

Method	Lab	Description	Reference
Anions Soil (A5)	Garson	Determination of Anions in Soil	Modified from SW846-9056A
Cond Soil (A12)	Garson	Determination of conductivity in soil (1:2)	Modified from EPA SW846-9050A
Moisture (A99)	Garson	Determination of Percent Moisture	In-House
pH Soil (A2.0)	Garson	Determination of soil pH by Ion Selective Electrode	Modified from EPA SW-846 9045D
RedOx - Soil (T06)	Mississauga	Determination of RedOx Potential of Soil	Modified from APHA-2580B
Resistivity Soil (R12)	Garson	Determination of Resistivity in Soil (1:2)	Modified from Carter 18.3
Sulphide/S (R98)	Garson	Determination of Sulphide in Soil	In-House

REPORT COMMENTS

RedOx - Soil (A6): Hold time exceeded for methods BEFORE receipt at lab

CERTIFICATE OF ANALYSIS

Tulloch Engineering - Sault Ste. Marie

Work Order Number: 569716

This report has been approved by:

Aline de Chevigny
Production Coordinator

CERTIFICATE OF ANALYSIS

Tulloch Engineering - Sault Ste. Marie

Work Order Number: 569716

WORK ORDER RESULTS

Sample Description	BH - 25 - 03 SS01		BH - 25 - 08 SS01		
Sample Date	2/26/2025 12:00 AM		2/25/2025 12:00 AM		
Lab ID	2121941		2121942		
Anions (Soil)	**Result**	**MDL**	**Result**	**MDL**	**Units**
Bromide	<0.2	0.2	<0.2 [<0.2]	0.2	µg/g
Chloride	3.6	0.4	1.3 [1.3]	0.4	µg/g
Fluoride	<0.2	0.2	<0.2 [<0.2]	0.2	µg/g
Nitrate (as N)	3.8	0.2	1.8 [1.9]	0.2	µg/g
Nitrite (as N)	<0.1	0.1	<0.1 [<0.1]	0.1	µg/g
Sulphate	18	2	22 [21]	2	µg/g

Sample Description	BH - 25 - 03 SS01		BH - 25 - 08 SS01		
Sample Date	2/26/2025 12:00 AM		2/25/2025 12:00 AM		
Lab ID	2121941		2121942		
General Chemistry	**Result**	**MDL**	**Result**	**MDL**	**Units**
% Moisture	21.6	0.1	16.0	0.1	%
Conductivity	55	1	84	1	µS/cm
pH	5.84	N/A	6.56	N/A	pH
RedOx (vs. S.H.E.)	350	N/A	340	N/A	mV
Resistivity (Calc.)	18100	N/A	12000	N/A	ohm-cm
Sulphide	<0.3	0.3	<0.3	0.3	µg/g

CERTIFICATE OF ANALYSIS

LEGEND

Dates: Dates are formatted as mm/dd/year throughout this report.

MDL: Method detection limit or minimum reporting limit.

[ ]: Results for laboratory replicates are shown in square brackets immediately below the associated sample result for ease of comparison.

Organic Soil Analysis: Data reported for organic analysis in soils samples are corrected for moisture content.

Quality Control: All associated Quality Control data is available on request.

LCL: Lower Control Limit.

UCL: Upper Control Limit.

QAQCID: This is a unique reference to the quality control data set used to generate the reported value. Contact our lab for this information, as it is traceable through our LIMS.

Field Data: Reports containing Field Parameters represent data that has been collected and provided by the client. Testmark is not responsible for the validity of this data which may be used in subsequent calculations.

Sample Condition Deviations: A noted sample condition deviation may affect the validity of the result. Results apply to the sample(s) as received.

Reproduction of Report: Report shall not be reproduced, except in full, without the approval of Testmark Laboratories Ltd.

ICPMS Dustfall Insoluble: The ICPMS Dustfall Insoluble Portion method analyzes only the particulate matter from the Dustfall Sampler which is retained on the analysis filter during the Dustfall method.

Regulation Comparisons: Disclaimer: Please note that regulation criteria are provided for comparative purposes, however the onus on ensuring the validity of this comparison rests with the client.

QUALITY CONTROL DATA

THIS SECTION REPORTS QC RESULTS ASSOCIATED WITH THE TEST BATCH; THESE ARE NOT YOUR SAMPLE RESULTS.
QAQC details include only values where sufficient sample data allowed measurement.

Anions (Soil)

Blank: LRB-6 (Blank) (6)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Bromide	0.2	µg/g	0	<0.2	0.6	20250403.A5G
Chloride	0.4	µg/g	0	<0.4	1.2	20250403.A5G
Fluoride	0.02	µg/g	0	<0.02	0.6	20250403.A5G
Nitrate (as N)	0.2	µg/g	0	<0.2	0.6	20250403.A5G
Nitrite (as N)	0.1	µg/g	0	<0.1	0.18	20250403.A5G
Sulphate	0.4	µg/g	0	<0.4	6	20250403.A5G

Positive Control: LFB-5 (0.1/0.02/0.002 mg/g equiv) (5)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Bromide	N/A	%	80	101	120	20250403.A5G
Chloride	N/A	%	80	102	120	20250403.A5G
Fluoride	N/A	%	80	97.8	120	20250403.A5G
Nitrate (as N)	N/A	%	80	104	120	20250403.A5G
Nitrite (as N)	N/A	%	80	110	120	20250403.A5G
Sulphate	N/A	%	80	103	120	20250403.A5G

Positive Control: LFB-7 (0.2/0.1/0.02 mg/g equiv) (7)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Bromide	N/A	%	80	99.1	120	20250403.A5G
Chloride	N/A	%	80	104	120	20250403.A5G
Fluoride	N/A	%	80	100	120	20250403.A5G
Nitrate (as N)	N/A	%	80	99.4	120	20250403.A5G
Nitrite (as N)	N/A	%	80	96.9	120	20250403.A5G
Sulphate	N/A	%	80	101	120	20250403.A5G

Sample Replicate: % RPD (8)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Sulphate	N/A	%	0	4.7	35	20250403.A5G

General Chemistry

Calibration Check: Lab Control Sample (2)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Conductivity	N/A	%	475	500	525	20250401.TM-G.A12B

Method Blank: Method Blank (1)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Conductivity	1	µS/cm	0	<1	5	20250401.TM-G.A12B

Positive Control: Lab Control - 200 (7)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
RedOx (vs. S.H.E.)	N/A	mV	175	199	225	20250404.TM-M.A6B

Positive Control: LCS (pH 8) (2)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
pH	N/A	pH	7.8	7.92	8.2	20250401.TM-G.R2C

Positive Control: LFB-7 (7)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Sulphide	0.05	µg/g	0.24	0.288	0.36	20250401.R98B

Positive Control: LRB-6 (Blank) (6)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Sulphide	0.02	µg/g	0	<0.02	0.06	20250401.R98B

Positive Control: ORP - Soil Control 90 (8)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
RedOx (vs. S.H.E.)	N/A	mV	75	91	105	20250404.TM-M.A6B

Sample Replicate: % RPD (3)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
pH	N/A	pH	0	0.07	0.3	20250401.TM-G.R2C

Sample Replicate: % RPD (8)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
Conductivity	N/A	%	0	4.7	10	20250401.TM-G.A12B

Sample Replicate: % RPD (9)

Parameter	MDL	Units	LCL	Result	UCL	QAQCID
RedOx (vs. S.H.E.)	N/A	%	0	0.3	10	20250404.TM-M.A6B

THIS INDEX SHOWS HOW YOUR SAMPLES ARE ASSOCIATED TO THE CONTROLS INCLUDED IN THE IDENTIFIED BATCHES.

Sample Description	Lab ID	Method	QAQCID	Prep QAQCID
BH - 25 - 03 SS01	2121941	Anions Soil (A5)	20250403.A5G	
BH - 25 - 03 SS01	2121941	Cond Soil (A12)	20250401.TM-G.A12B	
BH - 25 - 03 SS01	2121941	Moisture (A99)	20250331.TM-G.A99C	
BH - 25 - 03 SS01	2121941	pH Soil (A2.0)	20250401.TM-G.R2C	
BH - 25 - 03 SS01	2121941	RedOx - Soil (T06)	20250404.TM-M.A6B	
BH - 25 - 03 SS01	2121941	Resistivity Soil (R12)	20250401.TM-G.R12B	
BH - 25 - 03 SS01	2121941	Sulphide/S (R98)	20250401.R98B	
BH - 25 - 08 SS01	2121942	Anions Soil (A5)	20250403.A5G	
BH - 25 - 08 SS01	2121942	Cond Soil (A12)	20250401.TM-G.A12B	
BH - 25 - 08 SS01	2121942	Moisture (A99)	20250331.TM-G.A99C	
BH - 25 - 08 SS01	2121942	pH Soil (A2.0)	20250401.TM-G.R2C	
BH - 25 - 08 SS01	2121942	RedOx - Soil (T06)	20250404.TM-M.A6B	
BH - 25 - 08 SS01	2121942	Resistivity Soil (R12)	20250401.TM-G.R12B	
BH - 25 - 08 SS01	2121942	Sulphide/S (R98)	20250401.R98B	
BH - 25 - 08 SS01	2121942r	Anions Soil (A5)	20250403.A5G	

Notice to Reader

NOTICE TO READER

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