Castle and Land Development Ltd.

Claresholm Area Structure Plan

Geotechnical Assessment Report

6/13/2025 | Revision 0

Submitted to: Castle and Land Development Ltd.
Prepared by McElhanney Ltd.

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Contents

Appendices:

1. Introduction

McElhanney Ltd. (McElhanney) was retained by David Mulholland of Castle and Land Development Inc. (the Client) to provide geotechnical engineering services for an Area Structure Plan (ASP) for portions of land located in Claresholm, AB. This report provides the results of the geotechnical assessment and analysis, as well as preliminary recommendations on geotechnical aspects of site development, foundation design and construction at the site. The full property location is shown on Figure 1 (Appendix A).

Authorization to proceed was provided by David Mulholland via a signed client agreement on February 13, 2025. This report is subject to the Statement of Limitations – Geotechnical Services (Appendix E).

1.1 SCOPE OF WORK

McElhanney has completed this geotechnical assessment in general accordance with the client agreement dated January 12, 2025. In conducting the geotechnical assessment and submitting this report, McElhanney has:

- Completed a desktop review of previous studies and existing public data including surficial geology, bedrock and seismic hazard;
- Performed a field assessment including drilling eleven (11) boreholes in priority development areas identified by the Client;
- Completed laboratory testing on select soil samples; and
- Prepared this report summarizing the results of the geotechnical assessment and preliminary geotechnical recommendations for the design and construction of the proposed development.

1.2 REFERENCES

The following sources were reviewed during the preparation of this report:

1. Alberta Geological Survey. (2004). Bedrock Geology of Alberta. Alberta Energy Regulator. https://static.ags.aer.ca/files/document/MAP
2. Alberta Geological Survey. (2004). *Surficial Geology: Sediments and Landforms*. Alberta Energy Regulator. https://ags.aer.ca/our-science/surficial-geology/sediments-and-landforms
3. Natural Resources Canada. (2003). *The Geological Atlas of Canada*. Government of Canada. https://atlas.gc.ca/atlas-en.htm
4. Town of Claresholm. (2017). *Servicing Standards for Municipal Improvements.*

2. Project and Site Description

The geotechnical investigation was completed in the northern (Area A) and southern (Area C) portions of the land, with the middle quarter section (Area B) not being investigated as part of this scope of work. The areas are located on the western side of 8th Street W, west of downtown Claresholm, AB. Both sites are currently active farmland and are relatively flat with minor rolling changes in topography.

Area A is bordered to the north by 59th Avenue W, to the east by 8th Street W and downtown Claresholm, to the south by Area B and to the west by private farmland. Area C is bordered to the north by Starline Road (Highway 520), to the east by 8th Street W and residential homes, and to the south and west by private farmland. Figure 2 and 3 in Appendix A shows the highlighted area that was the focus of the geotechnical investigation. The borehole locations were selected to gain a overview of the subsurface conditions of the site and avoid preliminary environmental areas under review at the time of the investigation.

Based on preliminary discussions with the Client, specific design parameters for foundation design options will be determined from detailed geotechnical investigations conducted at a later date once specific development details are known. This investigation and report provide general foundation recommendations based on the soils encountered and McElhanney's understanding of similar projects.

2.1 LOCAL GEOLOGY

The Town of Claresholm is located in southern Alberta within the western edge of the Interior Plains and near the transition to the Foothills of the Rocky Mountains. The region has a relatively stable geological foundation underlain by sedimentary bedrock, primarily composed of sandstone, shale, and mudstone, which were deposited from ancient seas that once covered the region during the Cretaceous period.

During the last glacial period, the area was covered by the Laurentide Ice Sheet, which advanced and retreated multiple times, most recently receding approximately 12,000 years ago. These glacial events significantly influenced the local terrain and subsurface conditions. As the glaciers moved through the region, they eroded and reworked surface materials, leaving behind a variety of glacial deposits.

The soils in the Claresholm area primarily consist of glacial till, with lenses of sand, silt, and gravel common throughout the subsurface. These materials were deposited as ground moraine and glaciofluvial sediments during glacial retreat, resulting in a gently rolling landscape with localized lowlands and ridges. The depth of these surface materials can vary, but bedrock typically lies well below, often only exposed in deeper cuts or along river valleys.

3. Field Assessment

The Geotechnical Field Assessment was carried out on April 22 and 23, 2025 and consisted of drilling eleven boreholes – five in Area A and six in Area C. The boreholes were drilled by All Service Drilling of Calgary, AB using solid stem auger and SPT hammer techniques to depths ranging between 4.6 and 9.6 metres below ground surface (mbgs). Utility location tickets were submitted via Utility Safety Partners and reviewed prior to the field assessment to identify underground utilities.

Following completion of the boreholes, standpipes were installed, and they were backfilled with drill cuttings and sealed with bentonite chips. The subsurface conditions encountered in the boreholes were observed and recorded by a McElhanney representative. The soils observed in the field were classified in accordance with the Modified Unified Soil Classification System (MUSCS). The borehole locations were surveyed by McElhanney with a handheld GPS and are accurate to within 4 metres (m). Figures 2 and 3 in Appendix A show the borehole locations.

Upon completion of the field program, select soil samples were submitted to Artech Consulting Ltd.'s soils laboratories in Cranbrook, BC for index testing including moisture contents, Atterberg limits, and grain size analyses. Select soil samples were also shipped to AGAT Laboratories in Calgary, AB for environmental testing. The laboratory testing results are summarized on the borehole logs in Appendix B and the laboratory test reports in Appendix C.

4. Soil and Groundwater Conditions

A summary of the subsurface conditions observed at the borehole locations is provided below. The detailed borehole logs are included in Appendix B. Note that subsurface conditions across the site may vary in areas not specially investigated. All depths provided in this section are referenced from the ground surface at the time of field investigation.

4.1 TOPSOIL

Organic-rich topsoil was encountered at the surface in all five boreholes in Area A but only Borehole 25-08 in Area C. It extended to depths ranging from 0.3 to 1.0 mbgs. The topsoil was an organic-rich farm soil composed of clay and silt with roots and plant matter. It was soft, damp and dark brown.

4.2 SILT

A silt layer was encountered in Boreholes 25-05, 07, 08 and 09. It was encountered at the surface, or between 0.3 and 0.6 mbgs, and extended as deep as 1.5 mbgs.

The silt had a hydrometer result reporting 54.7 percent silt, 24.4 percent clay, 20.3 percent sand and 0.5 percent gravel. An Atterberg Limits test in the silt reported a Liquid Limit of 28 percent and Plastic Limit of 15 percent, suggesting a low to medium plasticity.

The silt was firm to stiff, light brown and damp. Moisture contents in the silt were around 19 percent.

4.3 GLACIAL TILL

Glacial silt till was the main soil unit encountered during the investigation. It was encountered under the topsoil or silt in all boreholes except Boreholes 25-06, 10 and 11 where it was found at the surface. The silt till was sandy and clayey with trace gravel, coal flakes and white inclusions. Hydrometer results in the till reported about 20 percent clay, 55 percent silt, 23 percent sand and 2 percent gravel.

The till was low to medium plastic, with Atterberg Limit tests reporting a Liquid Limit around 28 percent and Plastic Limit around 13 percent. Moisture contents were between 10 and 20 percent, with an average of about 13 percent.

The till was stiff to hard in consistency and increased with depth. SPT N values in the till ranged from 10 to refusal. N values in the upper 2 m were generally around 13 blows per 300 mm of penetration, but that increased to about 35 blows below 3 m.

Cobbles were encountered during drilling in BH25-06. Cobbles and boulders should be anticipated to be present throughout the glacial till strata within the subject site.

4.4 BEDROCK

Bedrock was not encountered during the investigation. While drilling refusal occurred early in Borehole 25-06 at 4.6 m below ground surface, it is unlikely to be bedrock and is more likely due to a localized dense or cemented soil layer. The depth to bedrock in this area is suspected to typically range between 10 to 30 m in depth based on the Alberta Geological Survey, but may be variable.

4.5 GROUNDWATER

Groundwater seepage was not encountered during drilling. Monitoring wells were installed in every borehole and groundwater level readings were taken on April 23, 2025, after drilling, as well as again on May 9, 2025. The results of the groundwater monitoring are shown below.

Table 4.5: Summary of Groundwater Measurements

Borehole No.	Total Piezo Depth (m)	Groundwater Measurements	
		April 23, 2025	May 9, 2025
		Depth (m)	Depth (m)
25-01	9.6	Dry	4.9
25-02	9.6	Dry	3.4
25-03	9.6	Dry	5.6
25-04	9.6	3.9	3.5
25-05	9.6	7.9	3.6
25-06	4.6	Dry	4.4
25-07	9.6	Dry	4.0
25-08	9.6	Dry	4.0
25-09	9.6	Dry	4.4
25-10	9.6	7.2	4.3
25-11	9.6	Dry	3.9

Depth of water level is measured from ground surface.

Groundwater was measured at depths ranging from 3.5 to 5.6 mbgs. Groundwater elevations are expected to fluctuate on a seasonal basis and will be highest after periods of heavy precipitation and snowmelt. Sloughing of the borehole walls was not noted during drilling.

4.6 ROUTINE LABORATORY TESTING

The laboratory index test results are summarized below in Table 4.6.

Table 4.6: Summary of Laboratory Test Results

Borehole No.	Sample No.	Depth (mbgs)	Grain Size Distribution (%)					Liquid Limit (%)	Plastic Limit (%)	Soil Type
			Fines	Clay	Silt	Sand	Gravel			
25-01	1S03	2.5	-	-	-	-	-	24	11	CL
	1S04	3.2	73.3	20.9	52.4	22.8	3.9	-	-	
25-02	2S02	1.6	73.9	20.1	53.8	23.3	2.8	-	-	
25-03	3S04	3.2	-	-	-	-	-	28	12	CL
25-04	4S02	1.7	-	-	-	-	-	40	13	CL
	4S08	6.2	77.3	13.4	63.9	22.1	0.6	-	-	
25-05	5S01	1.0	79.1	24.4	54.7	20.3	0.5	-	-	
	5S09	7.1	-	-	-	-	-	33	12	CL
25-06	6S02	1.8	74.8	21.3	53.5	24.1	1.1	-	-	
	6S04	3.2	-	-	-	-	-	25	14	CL
25-07	7S02	1.8	-	-	-	-	-	28	15	CL
	7S04	3.2	71.5	21.2	50.3	25.3	3.2	-	-	
25-08	8S06	4.8	84.3	15.5	68.8	15.0	0.7	-	-	
25-09	9S07	5.6	-	-	-	-	-	26	14	CL
25-10	10S02	1.7	67.4	17.1	50.3	25.4	7.2	-	-	
25-11	11S03	2.5	-	-	-	-	-	27	14	CL

*Modified Unified Soil Classification System (MUSCS)

4.7 SOIL CHEMISTRY

Samples from Boreholes 25-02, 05, 06 and 09 were tested for resistivity, soluble pH and water-soluble sulphate concentrations. The water-soluble sulfate concentrations ranged from 0.04 to as high as 1.01 percent, which indicates a severe potential for chemical attack of subsurface concrete. The results are presented in Table 4.7.

Table 4.7: Water-Soluble Sulfate Test Results

Borehole No.	Depth (mbgs)	Soil Type	Resistivity (ohm.cm)	Soluble pH	SO_4 (%)
25-02	2.4	Till	582	8.70	0.13
25-05	1.7	Till	351	8.57	0.35
25-06	2.4	Till	416	8.13	1.01
25-09	1.7	Till	814	8.50	0.04

5. Discussion and Recommendations

5.1 GEOTECHNICAL EVALUATION

The geotechnical recommendations provided in this report are preliminary and intended to support the planning process for the Area Structure Plan (ASP). These recommendations are based on the subsurface conditions encountered during this investigation and McElhanney's experience with similar developments. They are not intended for detailed design.

Once specific development plans are available, a site-specific geotechnical investigation should be undertaken. This future investigation should be tailored to the proposed development layout and will provide the necessary design parameters for foundation selection, site grading, and construction planning.

Based on the findings of this geotechnical assessment, the site appears to be suitable for development from a geotechnical perspective with consideration of the recommendations and discussion provided in this report. The subsurface conditions are consistent across the site based on the investigation area. Shallow foundations bearing on Engineered Fill or stiff native glacial till are considered a suitable foundation for the development provided that the allowable settlement discussed in Section 5.4.2 is acceptable. Deep foundations may be required for structures with strict settlement criteria. Pending favourable site conditions, shallow foundations are typically the most economically viable foundation option. Where firm silt soils are encountered at the footing bearing elevation, over excavation and replacement with Engineered Fill will be required.

Foundation recommendations shall be based on development plans and a detailed geotechnical investigation.

The following sections provide discussion and recommendations as input for planning and design based on the current project understanding.

5.2 SITE PREPARATION

The following recommendations are provided for subgrade preparation of grade-supported load-bearing structures:

- Remove any existing vegetation, organic soil, loose fill soils/materials and other deleterious materials underlying all building structures and paved areas. Undesirable soil or debris may be encountered during construction that will necessitate consultation with McElhanney and possible revisions to these recommendations and construction procedures. An observational approach should be adopted whereby the contractor and engineering team work collaboratively to identify risks and design site-specific remedial approaches.

- All prepared subgrades should be inspected in the field by the Geotechnical Engineer of Record or their representative to confirm that the subgrade conditions are consistent with the design conditions assumed in this report, as well as to confirm the complete removal of the existing organic soils found on site.
- Soft, loose, wet, and/or otherwise unsuitable subgrade surfaces can be repaired by sub-excavation and replaced with Engineered Fill (Section 5.3). To maintain subgrade uniformity, soft area repair should be carried out using fill soils of similar characteristics to the in-situ subgrade soils.
- Subject to field review at the time of construction, any sub-excavations within the proposed development limits should be backfilled to design subgrade elevation with approved fill material in accordance with the material selection, placement and compaction specifications for Engineered Fill (Section 5.3).

General site grading fills outside of the building structure envelope, if required to raise local site grades, should consist of approved common fill comprising clean inorganic granular materials from local or imported sources. Subject to surface grading, drainage and settlement tolerances required for site grading design, common fill materials may be placed in uniform layers not exceeding 200 mm compacted thickness and compacted as per Section 5.3.

5.3 ENGINEERED FILL

Any fill soil placed to support structural or grade supported elements of the development must be Engineered Fill consisting of well-graded sand and gravel with less than 5% fines (material passing the 0.075 mm sieve) and a maximum aggregate size not exceeding 75 mm. Any granular materials proposed for use as Engineered Fill should be tested and approved by the Geotechnical Engineer before placement. Table 5.3.1 provides recommended gradations for granular base, granular sub-base (well graded gravel) and drain rock materials. The Well Graded Gravel is considered an approved gradation for Engineered Fill.

Table 5.3.1: Recommended Granular Fill Gradations

SIEVE SIZE (mm)	CRUSHED GRANULAR BASE COURSE (GBC)	WELL GRADED GRAVEL / GRANULAR SUB-BASE (GSB) (SCREENED PIT RUN)	FRACTURED DRAIN ROCK	RADON ROCK	
	TOWN OF CLARESHOLM	MMCD		SIZE 5 CONC. AG.	20 MM SUBDRAIN
75		100	-		
38			100		
25		50 - 85		90 - 100	
20	100		0 - 100	20 - 55	100
14				0 - 10	90 - 100
12.5	60 - 95				
9.5			0 - 5	0 - 5	45 - 75
5.0			0		0 - 15
2.00	25 - 55		-		0 - 5
0.400	10 - 30		-		
0.150		0 - 15			
0.080	2 - 10	0 - 5	-	<2	<2

Notes: Gradations are presented for the Town of Claresholm Town Servicing Standards 2017 and the 2019 Master Municipal Construction Documents (MMCD), Section 31 05 17 Aggregate and Granular Materials. Regardless of specification used, it is preferred that there be less than 5% fines (<0.075 mm). Size #5 Concrete Aggregate. ASTM C33.

Fill required to bring the site up to grade, including backfill around footings, should be well graded select sand or gravel. The existing native low plastic silt till soils found on site may be suitable for re-use as backfill. Consultation with a geotechnical engineer is required before soils can be re-used.

Table 5.3.2: Recommended Compaction Levels

Fill Location	Recommended Minimum Compaction Level (% of SPMDD*)
Building Areas	
New fill greater than 0.6 m thickness (including trenches)	100%
New fill less than 0.6 m thick (including trenches)	98%
Engineered fill below footings	100%
Under structural concrete slabs	95%
Under concrete slab-on-grade	98% (100% for top 150 mm)
Other Development Areas	
Under paved or concrete areas, access roads, parking	98% (100% for top 150 mm)
Exterior building area outside of pavement structures	95%

** SPMDD – Standard Proctor Maximum Dry Density*

The lift thicknesses should be governed by the ability of the selected compaction equipment to uniformly achieve the recommended density. However, it is generally recommended to use lifts with a maximum compacted thickness of 200 mm for granular fill and a maximum compacted thickness of 150 mm for

cohesive soils. Uniformity is of most importance. Granular fill is best compacted with large smooth drum vibratory rollers. In areas which require higher compaction, it is recommended that granular fill be placed at moisture contents 0 to 2 percent below the Optimum Moisture Content (OMC). This will help reduce compactive effort and potential risk of subgrade disturbance needed to achieve maximum density.

Fill placement and compaction during the winter months is challenging due to the difficulty in moisture conditioning fill soils and obtaining high compaction levels. Materials and methodology should be reviewed prior to construction if cold weather compaction of fills is proposed. High compaction levels can only be achieved using fill soils that are unfrozen. Structural fills or engineered fills that support structures/features that are sensitive to movement, must not be placed on soil that is in a frozen state or has recently been in a frozen state.

5.4 ALBERTA BUILDING CODE

In accordance with the 2019 National Building Code – Alberta Edition (NBC-AE), the use of Limit States Design (LSD) is required for the design of buildings and their structural components including foundations. The limit states of LSD design are classified into two groups; the Ultimate Limit States (ULS) and the Serviceability Limit States (SLS). The ULS design requirements in the NBC-AE reference the Structural Commentaries in the User Guide of the National Building Code of Canada (NBCC).

5.4.1 Ultimate Limit States (ULS)

The ULS case is primarily concerned with safety and the levels of load and resistance at the point of collapse or structural failure. The geotechnical value for this case is the ultimate resistance. For foundation design this ultimate resistance value is reduced using a Geotechnical Resistance Factor (GRF) which is based on the reliability index of the geotechnical data used to determine the ultimate resistance for the foundation loading case. The following GRF values should be used for foundation design for shallow:

Table 5.4.1: LSD Geotechnical Resistance Factors

Geotechnical Case	Resistance Factors
SHALLOW FOUNDATIONS (FOOTINGS AND MATS)	
Vertical resistance by semi-empirical analysis and in-situ test data	0.5

* NBCC - Users Guide - Structural Commentaries (Part 4 of Division B) - Commentary K –Foundations.

5.4.2 Serviceability Limit States (SLS)

The SLS occurs when the foundation loads cause movements or vibrations that are greater than are tolerable for the intended use of the structure. The SLS case is addressed by determining the maximum available resistance to keep the foundation deformation within tolerable limits under service loads (i.e. settlement, lateral deflection, etc.). Typically, the foundation loads, configurations and serviceability tolerances have to be known to properly determine geotechnical SLS resistance values. In some

foundation cases, like small footings, basic assumptions can be used to provide preliminary SLS resistance values under specific stated conditions.

For axial loading conditions, the SLS resistance is addressed by determining the limiting load to keep foundation settlements within tolerable limits. Tolerable total and differential settlements should be verified by the structural engineer, but for normal structures the tolerable limit of total settlement for foundations is typically about 25 mm.

5.4.3 Seismic Classification

The NBC-AE requires buildings to be designed to resist a minimum earthquake force. The formula for obtaining minimum earthquake force is dependent of several factors including Foundation Factors (F_a and F_v) which should be determined using a Site Class of D for this site (NBC-AE Table 4.1.8.4.A). The subgrade soil is a thin layer of organic topsoil overlying stiff to hard silt till, which likely extends to bedrock at an unknown depth. Based on the results of the drilling program, the till appears to extend across the entire site and as such this material will govern the seismic site classification.

The NBCC 2020 seismic hazard calculation for this site is peak horizontal ground acceleration (PGA) corresponding to a design earthquake having a 2% probability of being exceeded in 50 years of 0.168g and peak ground velocity (PGV) of 0.157 m/s (NBCC 2020, Appendix D).

5.5 SHALLOW FOUNDATIONS

Shallow concrete foundations consisting of strip and spread footings bearing on Engineered Fill supported by stable stiff native till are the recommended foundation option for these sites. Based on the findings of the field investigation, footings within proposed building footprints should be founded directly on undisturbed stiff till subgrade, and/or Engineered Fill that has been prepared in accordance with Section 5.3 and approved by the Geotechnical Engineer.

Recommendations for design and construction of shallow concrete footing foundations for these sites are as follows:

- The subgrade bearing surfaces for all foundation construction must be inspected and approved by a Geotechnical Engineer or their representative prior to placing formwork or Engineered Fill.
- To ensure a uniform stress distribution, the entire foundation must be constructed on a uniform bearing surface (e.g. avoiding a mixture of soils). Constructing portions of the foundation on varying subgrade materials may result in differential settlement. Where a level and uniform bearing surface cannot be achieved over an uneven subgrade (such as cobbly granular soils), a minimum 100 mm thick leveling course of Granular Base Course (GBC) or Fractured Drainrock compacted to 100% SPMDD could be placed below foundation elements meeting the specification provided in Table 5.3.1 (Section 5.3).

Groundwater seepage and/or surface water runoff must not be allowed to enter or collect in foundation excavations. Any water or snow that accumulates in the footing excavations must be removed and the subgrade allowed to dry before construction of the footings.

5.6 SITE DRAINAGE

Positive surface drainage should be maintained away from development and trench areas in all directions, considering existing infrastructure adjacent to the proposed development. Surface drainage of all developed areas should be maintained with a recommended minimum 2% cross-slope, particularly away from structure foundations and behind the retaining walls. The site grading must be designed such that water cannot pond on or beside parking areas, roadways or buildings. Infiltration of surface water should not be permitted within 3 m of structure foundations.

5.7 GROUNDWATER AND SURFACE WATER

Groundwater was measured in the installed standpipe piezometers at depths between 3.5 and 5.6 mbgs. Groundwater elevations are expected to fluctuate on a seasonal basis and will be highest after periods of heavy precipitation and snowmelt.

Where groundwater seepage is encountered during construction, the groundwater should not be permitted to collect in the bottom of the excavations during construction and a contingency plan should be made to pump out or drain excavations with sump pumps and to divert water away from the excavation. If significant groundwater seepage is encountered the geotechnical engineer should be contacted to review.

5.8 TEMPORARY EXCAVATIONS

Excavations will be required for foundations and underground utility installations. All excavation work must comply with the requirements of the Alberta Occupational Health and Safety Act (OHS Act, 2023), OHS Regulation (2023) and OHS Code (2023), or the most recent update at the time of construction. The OHS Code contains the technical requirements that support the Act and Regulation.

Specifically with reference to Section 442 the OHS Code, the soils on this site would be classified as“likely to crack or crumble”. From Section 451 of the OHS Code, the soils may be cut to within 1.5 m of the base at an angle of not less than 45 degrees measured from the vertical or 1 (V) to 1 (H). The lower 1.5 m of excavation can be cut to a near vertical face if reviewed and approved by a qualified Geotechnical Engineer. If groundwater seepage is encountered, slopes will need to be flattened and should be reviewed by the Geotechnical Engineer.

If space does not permit the slopes to be cut back, some form of temporary shoring must be installed to protect workers in the trench. All temporary surcharge loads should be kept back from the excavated faces a distance of at least one-half the depth of the excavation. All vehicles delivering materials to the site should be kept back from excavated faces at least 1.0 m or one times the excavation depth,

whichever is greater. Fill materials used to bring the site to grade after excavation may consist of low to medium plastic imported clay, sand fill, or an approved granular fill.

5.9 UTILITIES

5.9.1 Frost Protection

Services and utilities at this site should be installed with a minimum depth of cover of 2.4 m for the sewer and water lines and 2.5 m for the watermain to the top of pipe from the final finished surface grade as per the town of Claresholm construction standards. If shallow burial depths are proposed, engineered insulation solutions will be required to prevent frost penetration. Insulation design options and review can be provided upon request.

5.9.2 Trench Backfill

The trench backfill should be placed in maximum vertical lifts of 200 mm compacted thickness (or less to suit available compaction equipment) and compacted uniformly to meet the specifications presented in this report. The pipe bedding should be compatible with the size, type and class of pipe and the requirements of pipe provider. In the absence of special provisions and specifications, for preliminary design, it is recommended to use a minimum thickness of 100 mm of granular pipe bedding material below the pipe. The bedding should also extend to a width sufficient to permit compaction with vibratory plate compactors and should extend vertically a minimum of 300 mm above the top of the pipe. The granular bedding and structural envelope should meet the specifications of the Town of Claresholm, civil design and the pipe manufacturer's recommendations. Type 1 is equivalent to Class "B" Bedding as outlined in the Town of Claresholm Servicing Standards for Municipal Improvements (December 2017).

Table 5.9.2: Recommended Gradation for Pipe Bedding (Type 1 and 3)

Sieve Size (mm)	Type 1 (Standard)	Type 3 (Drain Rock)
	Percent Passing (%)	
50		100
38		90 – 100
25		20 – 60
19	90 – 100	0 – 15
12.5	65 – 85	
9.5	50 – 75	0 – 15
4.75	25 – 50	
2.36	10 – 35	
1.18	6 – 26	
0.600	3 – 17	
0.075	0 – 5	

Master Municipal Construction Documents (MMCD, 2019)

For utilities placed above the water table (approximately 3.5 mbgs) the Type 1 Pipe Bedding should be used. For any deeper utility installations or where significant groundwater seepage is encountered, the Type 3 bedding may be required.

Backfilling above pipe bedding zone should be performed based on recommendations provided for Engineered Fill compaction depending on the area type, and at the very least achieve a minimum of 95% SPMDD.

5.10 PAVEMENT STRUCTURE

Pavement structure recommendations are based on the guidelines from the Town of Claresholm Servicing Standards for Municipal Improvements (December 2017). They are meant to be minimum requirements, and an independent design will be required once the final land use design is confirmed to align with expected traffic demands.

Table 5.10: Town of Claresholm Pavement Structure Recommendations

Pavement Structure	Asphalt Concrete (mm)	20mm Crushed Levelling Course (mm)	Pit Run Base Course (mm)	Subgrade Prepared to 98% SPD (mm)	Geotextile	Total Structure (mm)
Local Road	75	100	250	200	Yes	625
Collector Road	90	100	300	300	Yes	790
Arterial/ Industrial/ Commercial	125	150	350	300	Yes	925

Based on Table 7.1 of the Town of Claresholm Servicing Standards for Municipal Improvements (December 2017), the Local Road classification applies to a traffic volume of up to 800 vehicles per day and the Collector Road classification applies to a traffic volume of up to 5,000 vehicles per day.

5.10.1 Pavement Materials

The performance of the proposed pavement sections will be, in part, dependent on achieving an adequate level of compaction in subgrade and pavement materials. The recommended levels of compaction for the granular fills are outlined in Section 5.3. The asphalt concrete should be compacted to a minimum of 97 percent of Marshall Density based on a 50-blow laboratory Marshall Test. It is recommended to use pavement materials conforming to the following specifications.

Table 5.10.1: Asphalt Concrete

Marshall Parameter	Specification
Blows per Face	50
Stability (kN minimum)	8.0
Flow (0.25 mm units)	8.0 – 16.0
Air Voids (percent) – design	3.5 ± 0.3
VMA (percent)	14.5 – 15.5

Aggregate materials for asphalt and granular base course should be composed of sound, hard, durable

particles free from organics and other foreign material. It is recommended to use aggregates conforming to the Town of Claresholm specifications or the Master Municipal Construction Documents (MMCD, 2019).

The material specifications included both gradation and other performance indicators including requirements for CBR, LA Abrasion, and Plasticity Index on fines. Based on availability of local materials at the time of tendering or construction, alternate materials could be considered upon review by the geotechnical engineer.

5.10.2 Geotextiles

The use of a non-woven geotextile filter fabric as a separation barrier between the pavement gravel and the subgrade is recommended to minimize the movement of fines into the gravel base course. The suggested geotextile specification is:

Table 5.10.2: Type 2 Non-Woven Filter Cloth Specification*

Parameter		Unit	ASTM Test	Specification
Strength	Grab Tensile Strength (min.)	N	D4632	700
	Grab Elongation at Failure (min.)	%	D4632	50
	Static (CBR) Puncture (min.)	N	D6241	1375
	Trapezoidal Tear (min.)	N	D4533	250
Hydraulic	Apparent Opening Size (max.)	mm	D4751	0.30
	Permittivity (min.)	per sec.	D4491	1.5
	Water Flow Rate	L/min/m^2	D4491	6120
Endurance	UV Resistance	% @ 500 hrs.	D4355	70

*Medium Weight Non-Woven Filter Cloth (Layfield LP6, LP7; Propex 601, 701; CCIS-601C)

The addition of a geotextile at the subgrade surface on this type of subgrade material would not reduce the granular thickness requirements significantly but is intended to ensure that the gravel structure does not migrate into or be lost into the existing site soils, thereby maintaining the full thickness of the gravel base and sub-base.

5.10.3 Drainage

All pavement area surface and subgrade should be sloped and graded to effectively remove all surface and subsurface water as rapidly as possible. It is recommended to provide adequate surface drainage with cross slope crowns of at least 2 percent on regularly maintained gravel surfaces. Yard and parking areas should be sloped and graded to effectively remove all surface water as rapidly as possible. To minimize the occurrence of surface water ponding, surface grades of at least 2 percent are recommended. Allowing water to pond on the surface will lead to infiltration of the water into the subgrade which could result in weakening of the subgrade soils. For large parking areas, additional grade may be needed to shed water from the surface.

6. Design and Construction Review

The recommendations provided are based on general geotechnical site development criteria under this ASP. No building design or construction plans were included or reviewed at this stage.

7. Recommendations for Further Study

McElhanney recommends a detailed geotechnical investigation(s) be completed once a land development plan is decided and specific developments have been proposed. This may include, but not be limited to, drilling boreholes and excavating test pits in the proposed building locations where additional soil information is required.

8. Limitations

This report has been prepared for the exclusive use of Castle and Land Development Ltd. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **McElhanney Ltd.** accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. No other warranty, expressed or implied, is made. The Statement of Limitations – Geotechnical Services that govern the use of this report and our geotechnical consulting services on this project are attached (Appendix E) and are to be considered part of this report.

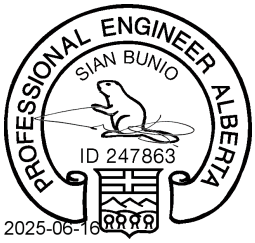
The recommendations provided in this report or in other correspondence related to this project are based on the information available on the proposed development, observations made at the subject site, interpretation of the data obtained from subsurface investigations, and our experience with similar soils and subsurface conditions. As the soils investigation represents a very small statistical sampling of the subsurface conditions, subsurface conditions could vary significantly from those described in this report, and in such instances, adjustments to design and construction of the proposed structures might be necessary, and McElhanney must be notified immediately when site conditions differ from those described in this report.

9. Closure

We trust that this information is sufficient for your present needs. Should you have any questions or require additional information, please do not hesitate to contact the author of this report.

Sincerely,
McElhanney Ltd.

Prepared By:



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Reviewed by

Responsible Member:

PERMIT TO PRACTICE
MCELHANNEY LTD.
RM SIGNATURE: _____
RM APEGA ID #: 156961
DATE: June 16, 2025
PERMIT NUMBER: P006383
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

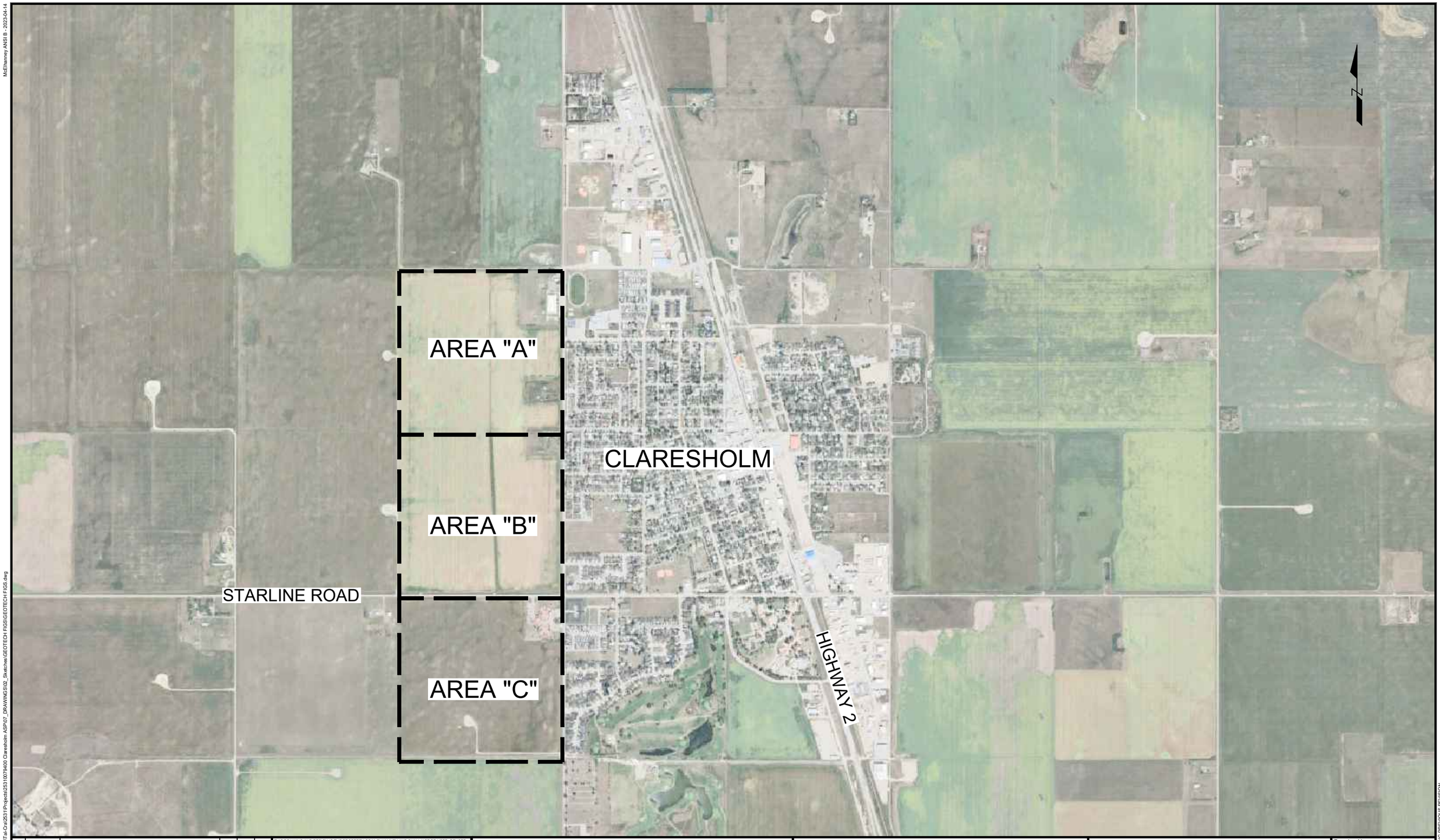
Kai Runtz, P.Eng.
Geotechnical Engineer

Ryan Gibbard, P.Eng
Senior Geotechnical Engineer

Appendices:

Appendix A - Figures
Appendix B - Borehole Logs
Appendix C - Laboratory Test Results
Appendix D - NBCC 2020 Seismic Hazard Calculations
Appendix E - Statement of Limitations – Geotechnical Services

APPENDIX A – FIGURES



Rev	Date	Description	Drawn	Design	App'd
0	2025-05-28				

ORIGINAL DWG SIZE: ANSI B (11" x 17")

McElhanney
Suite 203
502 Bow Valley Trail
Canmore AB
Canada T1W 1N9
T 403 609 3992

DAVID MULHOLLAND

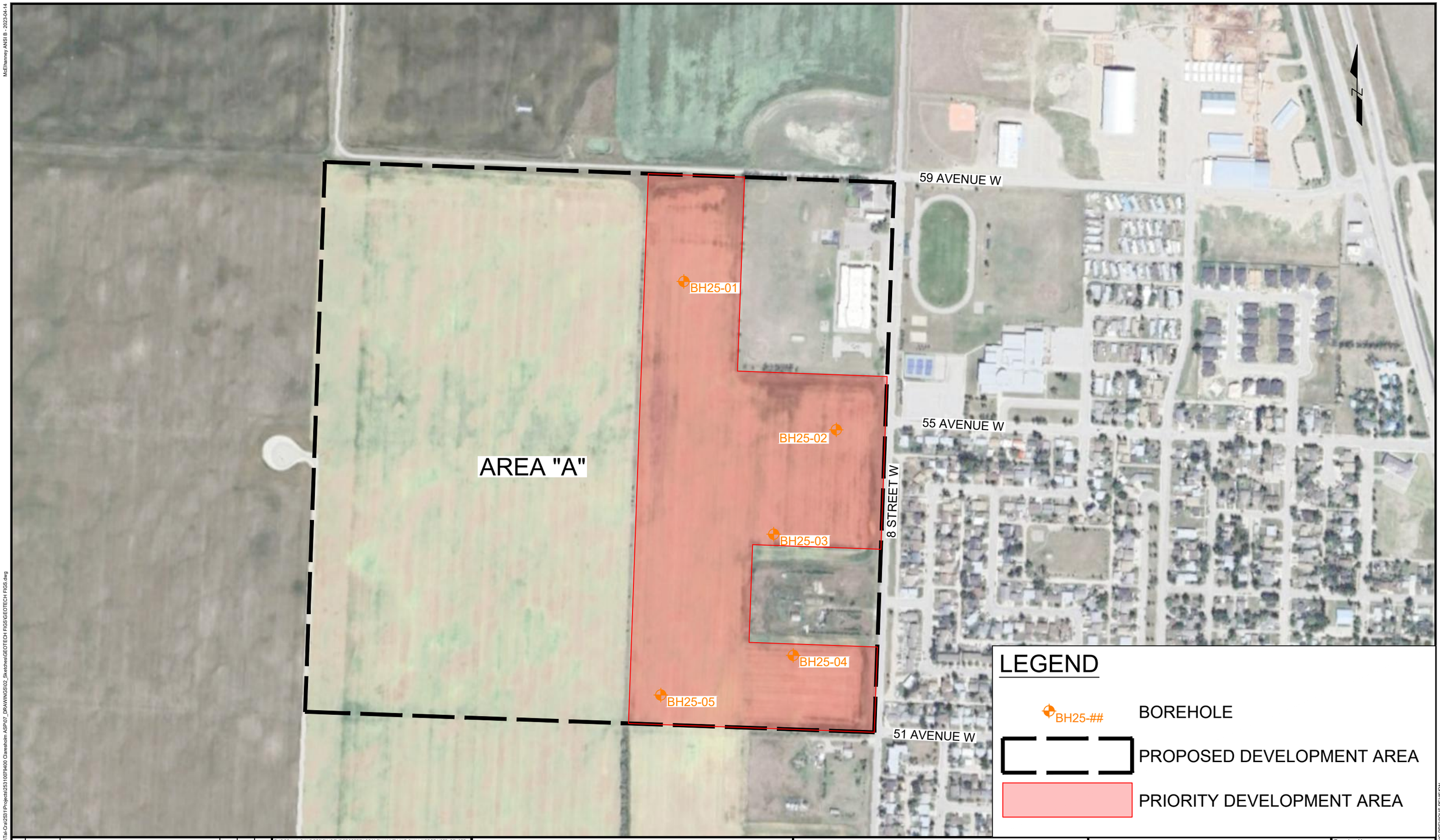
CLARESHOLM ASP GEOTECHNICAL REPORT LOCATION PLAN

Drawing No.

FIG-1

Project Number	Rev.
2351-00794-00	0

DESTROY ALL PRINTS BEARING PREVIOUS REVISION



LEGEND

- BH25-## — BOREHOLE
- PROPOSED DEVELOPMENT AREA
- PRIORITY DEVELOPMENT AREA

Rev	Date	Description	Drawn	Design	App'd
0	2025-05-28				

0 1:5,000 250

ORIGINAL DWG SIZE: ANSI B (11" x 17")

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Canmore AB
Canada T1W 1N9
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DAVID MULHOLLAND

CLARESHOLM ASP
GEOTECHNICAL REPORT
AREA "A" BOREHOLE PLAN

Drawing No. FIG-2

Project Number	Rev.
2351-00794-00	0

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

STARLINE ROAD

43 AVENUE W

8 STREET W

39 AVENUE W

AREA "C"

BH25-11

BH25-10

BH25-09

BH25-07

BH25-08

BH25-06

N

LEGEND

BH25-## BOREHOLE

PROPOSED DEVELOPMENT AREA

PRIORITY DEVELOPMENT AREA

Rev	Date	Description	Drawn	Design	App'd
0	2025-05-28				

0 1:5,000 250

ORIGINAL DWG SIZE: ANSI B (11" x 17")

McElhanney

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Canmore AB
Canada T1W 1N9
T 403 609 3992

DAVID MULHOLLAND

CLARESHOLM ASP
GEOTECHNICAL REPORT
AREA "C" BOREHOLE PLAN

Drawing No.

FIG-3

Project Number	Rev.
2351-00794-00	0

APPENDIX B – BOREHOLE LOGS

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-01
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5545471.51 313824.33	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/Tracked	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
	TOPSOIL: organic farm soil, clay, silty, frequent roots and plant matter, soft, damp, dark brown				
0.60	TILL: silt, sandy, clayey, trace gravel, low to medium plastic, stiff, damp, grey, trace coal flakes	AU 1S01			
1		SPT 1S02	100	6-10-12 (22)	
2	- very stiff - light brown, crumbly	AU 1S03			LL 24% PL 11% PI 13% Gravel 3.9% Sand 22.8% Silt 52.4% Clay 20.9%
3		SPT 1S04	100	10-16-17 (33)	
4	- hard, dry to damp	AU 1S05			
5	- trace rounded gravel	SPT 1S06	85	11-17-37 (54)	
6		AU 1S07			
7	- dark brown	SPT 1S08	100	6-14-27 (41)	
8		SPT 1S09	102	7-5-50/140 mm (R)	
9		SPT 1S10	100	14-14-27 (41)	
9.60	Terminated at 9.60 m. Target depth reached. Dry and open on April 23, 2025 immediately after drilling..				Dry on April 23, 2025

GRAPHIC LOG

WELL DIAGRAM

▲ N Value
● Moisture Content (%)
I Plastic/Liquid Limit (%)
□ Fines Content (%)

20 40 60 80

McElhanney

LOGGED BY:	RM	START DATE:	April 22, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 22, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-02
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5545258.83 314044.85	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/Tracked	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
	TOPSOIL: organic farm soil, clay, silty, frequent roots and plant matter, soft, damp, dark brown				
0.60	TILL: silt, sandy, clayey, trace gravel, low to medium plastic, stiff, damp, grey, trace coal flakes	AU 2S01			
1					
	- trace coal, brown	SPT 2S02	100	4-5-9 (14)	Gravel 2.8% Sand 23.3% Silt 53.8% Clay 20.1%
2		AU 2S03			
3		SPT 2S04	100	14-29-25 (54)	
	- trace cobbles				
4		AU 2S05			
	- hard, dry to damp, light brown	SPT 2S06	100	9-18-28 (46)	
5		AU 2S07			
6	- dark brown	SPT 2S08	100	10-18-21 (39)	
7					
8		SPT 2S09	100	8-15-18 (33)	
		AU 2S10			
9					
9.60		SPT 2S11	100	7-14-21 (35)	Dry on April 23, 2025
	Terminated at 9.60 m. Target depth reached. Dry and open on April 23, 2025 immediately after drilling..				

▲ N Value
● Moisture Content (%)
I Plastic/Liquid Limit (%)
□ Fines Content (%)

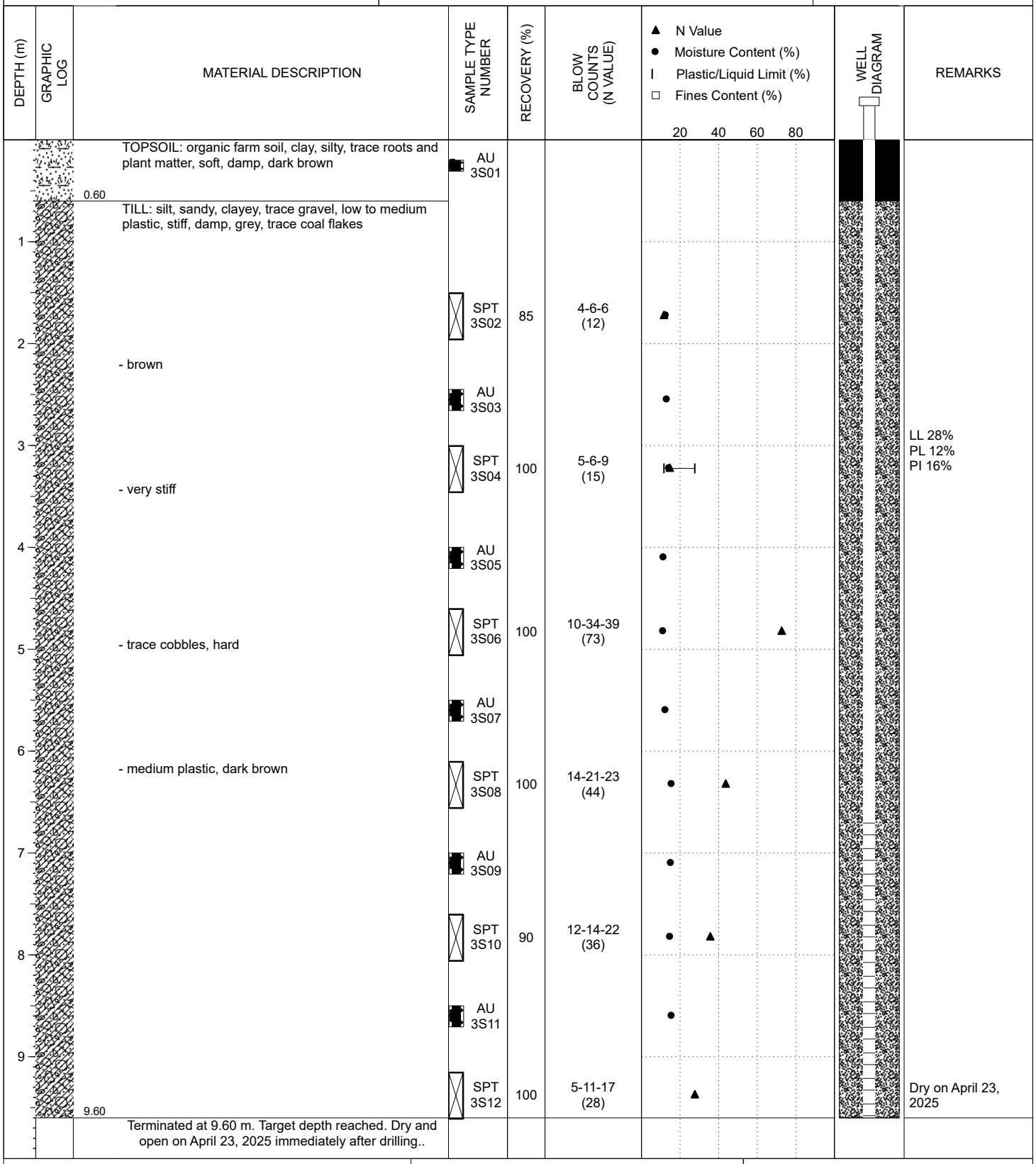
20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 22, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 22, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-03
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5545108.00 313955.58	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	



McElhanney

LOGGED BY:	RM	START DATE:	April 22, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 22, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-04
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5544933.70 313984.65	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
0	TOPSOIL: organic farm soil, clay, silty, trace roots and plant matter, firm, damp, dark brown				
1.00		AU 4S01			
1	TILL: silt, sandy, clayey, trace gravel, low to medium plastic, stiff, damp, light brown, trace coal flakes, white inclusions	SPT 4S02	100	4-6-9 (15)	LL 40% PL 13% PI 27%
2		AU 4S03			
3	- 10 cm silty sand seam - low plastic, very stiff	SPT 4S04	100	11-15-12 (27)	
4		AU 4S05			WL at 3.9 m on April 23, 2025
5	- hard	SPT 4S06	100	8-18-25 (43)	
		AU 4S07			
6	- some clay	SPT 4S08	100	18-25-28 (53)	Gravel 0.6% Sand 22.1% Silt 63.9% Clay 13.4%
7		AU 4S09			
8		SPT 4S10	100	17-21-29 (50)	
		AU 4S11			
9		SPT 4S12	100	9-15-21 (36)	
9.60	Terminated at 9.60 m. Target depth reached. Water level at 3.8 m on April 23, 2025.				
10					

N Value
Moisture Content (%)
Plastic/Liquid Limit (%)
Fines Content (%)
20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 22, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 22, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-05
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5544875.66 313794.27	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
	TOPSOIL: organic farm soil, clay, silty, trace roots and plant matter, soft, damp, dark brown				
0.60					
1	SILT: clayey, sandy, trace gravel, low to medium plastic, firm, damp, light brown	AU 5S01			Gravel 0.5% Sand 20.3% Silt 54.7% Clay 24.4%
1.50					
2	TILL: silt, sandy, clayey, trace gravel, low plastic, stiff, damp, light brown, trace coal flakes	SPT 5S02	100	4-5-7 (12)	
		AU 5S03			
3		SPT 5S04	100	9-11-20 (31)	
4		AU 5S05			
4.60					
5	SILT: trace clay, trace sand, trace gravel, low to medium plastic, hard, damp, brown	SPT 5S06	75	15-29-48 (77)	
5.20					
	TILL: silt, sandy, clayey, trace gravel, low to medium plastic, hard, damp, brown, trace coal flakes	AU 5S07			
6		SPT 5S08	100	10-18-35 (53)	
	- silt seams				
7		AU 5S09			LL 33% PL 12% PI 21%
8		SPT 5S10	100	7-11-19 (30)	WL at 7.9 m on April 23, 2025
	- very stiff	AU 5S11			
9		SPT 5S12	100	7-9-14 (23)	
9.60					
10	Terminated at 9.60 m. Target depth reached. Water level at 7.9 m on April 23, 2025.				

N Value
Moisture Content (%)
Plastic/Liquid Limit (%)
Fines Content (%)
20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 22, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 22, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-06
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5543299.28 313981.06	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
0	TILL: silt, sandy, clayey, trace gravel, low to medium plastic, firm, damp, grey, trace coal flakes, white inclusions	AU 6S01			
1	- stiff	SPT 6S02	100	3-4-6 (10)	Gravel 1.1% Sand 24.1% Silt 53.5% Clay 21.3%
2		AU 6S03			
3	- very stiff, brown	SPT 6S04	100	4-10-10 (20)	LL 25% PL 14% PI 11%
4	4.60	SPT 6S05	100	50/50 mm (R)	Dry on April 23, 2025
5	Terminated at 4.60 m. Refusal reached. Dry and open on April 23, 2025 immediately after drilling..				
6					
7					
8					
9					

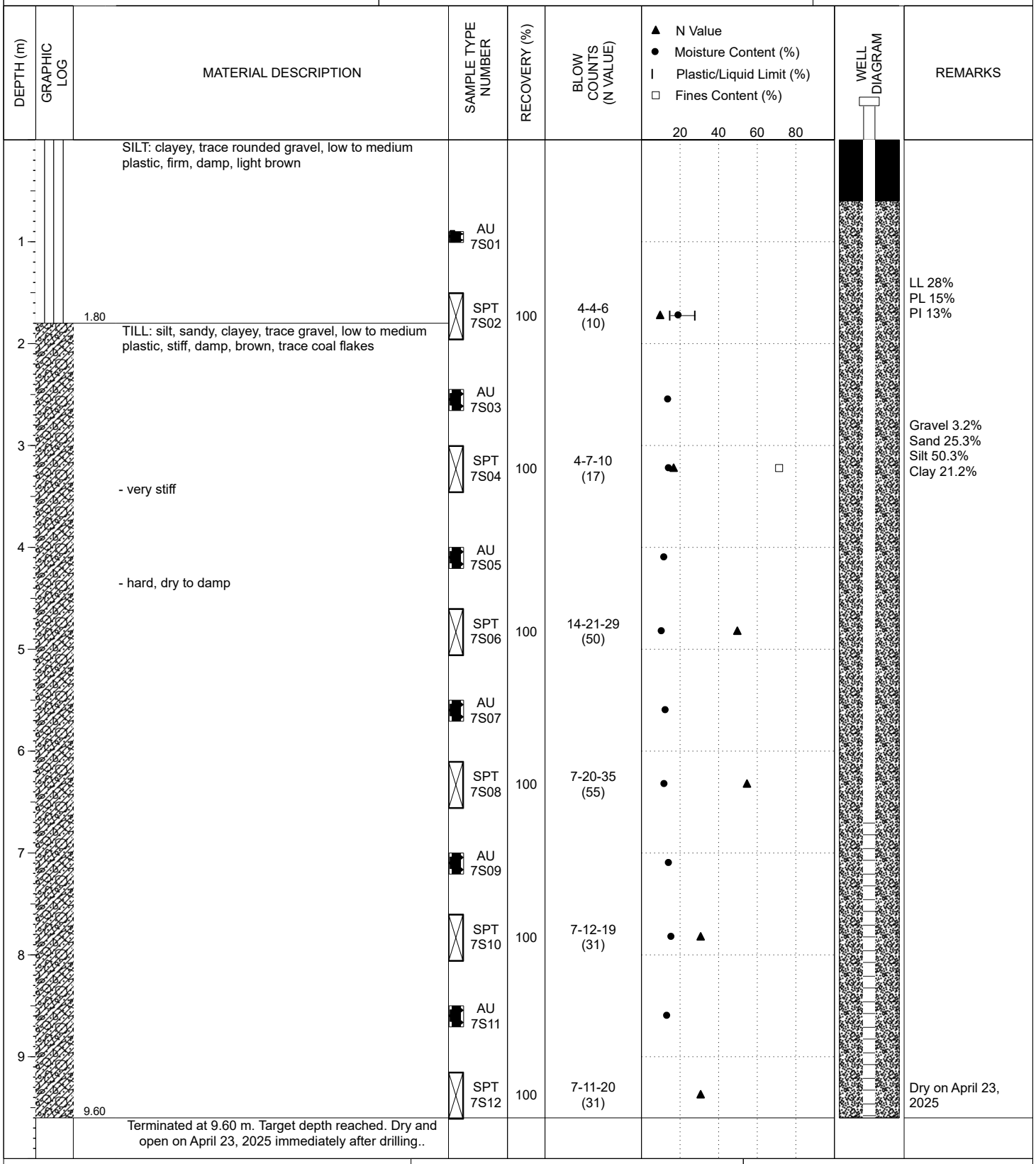
N Value
Moisture Content (%)
Plastic/Liquid Limit (%)
Fines Content (%)
20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 23, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 23, 2025
COMPLETION DEPTH:	4.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-07
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5543550.90 313988.22	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	



McElhanney

LOGGED BY:	RM	START DATE:	April 23, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 23, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-08
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5543402.15 313775.42	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
	TOPSOIL: organic farm soil, clay, silty, trace roots and plant matter, soft, damp, dark brown				
0.30	SILT: clayey, trace gravel, low to medium plastic, firm, damp, grey				
1		AU 8S01			
1.50	TILL: silt, sandy, clayey, trace gravel, low to medium plastic, stiff, damp, brown, trace coal flakes	SPT 8S02	100	4-4-6 (10)	
2	- very stiff	AU 8S03			
3		SPT 8S04	60	9-11-13 (24)	
4		AU 8S05			
5	- some clay, some sand, dry to damp	SPT 8S06	95	11-32-50/140 mm (R)	Gravel 0.7% Sand 15.0% Silt 68.8% Clay 15.5%
		AU 8S07			
6		SPT 8S08	100	10-21-31 (52)	
7		AU 8S09			
8		SPT 8S10	100	7-16-21 (37)	
		AU 8S11			
9		SPT 8S12	100	8-17-44 (61)	Dry on April 23, 2025
9.60	Terminated at 9.60 m. Target depth reached. Dry and open on April 23, 2025 immediately after drilling..				

▲ N Value
● Moisture Content (%)
I Plastic/Liquid Limit (%)
□ Fines Content (%)

20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 23, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 23, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-09
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5543598.43 313709.74	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
0	SILT: clayey, trace gravel, trace sand, low to medium plastic, stiff, damp, brown				
		AU 9S01			
1.50	TILL: silt, sandy, clayey, trace gravel, low to medium plastic, stiff, damp, brown, trace coal flakes	SPT 9S02	95	4-6-9 (15)	
		AU 9S03			
	- silt seams	SPT 9S04	95	10-20-27 (47)	
		AU 9S05			
	- dry to damp	SPT 9S06	100	7-21-25 (46)	
		AU 9S07			LL 26% PL 14% PI 12%
		SPT 9S08	100	10-25-35 (60)	
		AU 9S09			
		SPT 9S10	95	9-13-20 (33)	
		AU 9S11			
9.60	Terminated at 9.60 m. Target depth reached. Dry and open on April 23, 2025 immediately after drilling..	SPT 9S12	100	6-15-24 (39)	Dry on April 23, 2025

N Value
Moisture Content (%)
Plastic/Liquid Limit (%)
Fines Content (%)
20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 23, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 23, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-10
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5543800.49 313817.10	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
0	TILL: silt, sandy, some clay, trace gravel, low to medium plastic, stiff, damp, brown, trace coal flakes	AU 10S01			Gravel 7.2% Sand 25.4% Silt 50.3% Clay 17.1%
1	- very stiff, silt seams	SPT 10S02	50	5-7-8 (15)	
2		AU 10S03			
3	- hard, dry to damp	SPT 10S04	100	8-12-15 (27)	
4		AU 10S05			
5		SPT 10S06	100	8-18-34 (52)	
6		AU 10S07			
7		SPT 10S08	100	10-24-38 (62)	
8		AU 10S09			WL at 7.2 m on April 23, 2025
9		SPT 10S10	100	10-35-50 (85)	
10		AU 10S11			
	- damp to moist	SPT 10S12	100	8-12-18 (30)	
	9.60 Terminated at 9.60 m. Target depth reached. Water level at 7.2 m on April 23, 2025.				

N Value
Moisture Content (%)
Plastic/Liquid Limit (%)
Fines Content (%)
20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 23, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 23, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

CLIENT:	Castle and Land Development Ltd.	PROJECT:	Claresholm ASP Geotechnical Investigation	BOREHOLE No.	BH25-11
CONTRACTOR:	All Service Drilling	CO-ORDS N/E:	5543897.58 313745.40	PROJECT No.	2531-00794-00
METHOD:	Solid Stem/ASP	LOCATION:	Claresholm, AB	ELEVATION:	

DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY (%)	BLOW COUNTS (N VALUE)	REMARKS
0	TILL: silt, sandy, clayey, trace gravel, low plastic, stiff, damp, brown, trace coal flakes				
1		AU 11S01			
		SPT 11S02	90	5-6-7 (13)	
2		AU 11S03			LL 27% PL 14% PI 13%
3	- hard, dry to damp	SPT 11S04	100	7-14-49 (63)	
4		AU 11S05			
		SPT 11S06	100	11-21-32 (53)	
5		AU 11S07			
6		SPT 11S08	100	9-21-38 (59)	
7		AU 11S09			
	- damp	SPT 11S10	100	8-14-18 (32)	
8		AU 11S11			
9	- gravelly	SPT 11S12	100	12-21-21 (42)	Dry on April 23, 2025
	9.60 Terminated at 9.60 m. Target depth reached. Dry and open on April 23, 2025 immediately after drilling..				

N Value
Moisture Content (%)
Plastic/Liquid Limit (%)
Fines Content (%)
20 40 60 80

WELL DIAGRAM

McElhanney

LOGGED BY:	RM	START DATE:	April 23, 2025
REVIEWED BY:	SB	COMPLETION DATE:	April 23, 2025
COMPLETION DEPTH:	9.60 m		Sheet 1 of 1

APPENDIX C – LABORATORY TEST REPORTS

ARTECH CONSULTING LTD.
MATERIALS TESTING & INSPECTION

PHONE: 250-489-1940 FAX: 250-489-1667 EMAIL: info@artechconsulting.ca
229 Industrial Rd F, Cranbrook, BC V1C 6N4 www.artechconsulting.ca

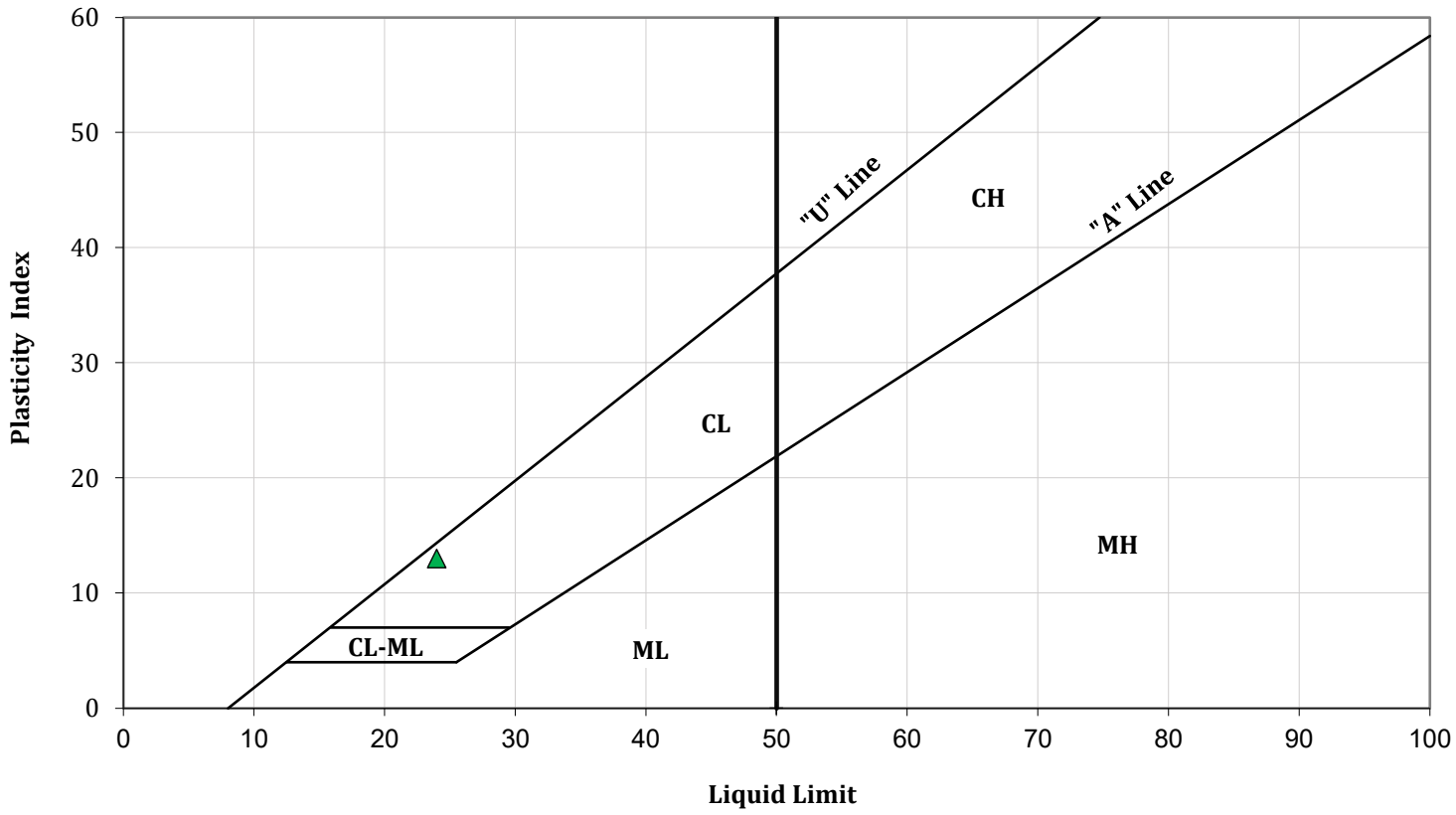
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25242
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-01 1S03	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	14.1%	24	11	13



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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229 Industrial Rd F, Cranbrook, BC V1C 6N4 www.artechconsulting.ca

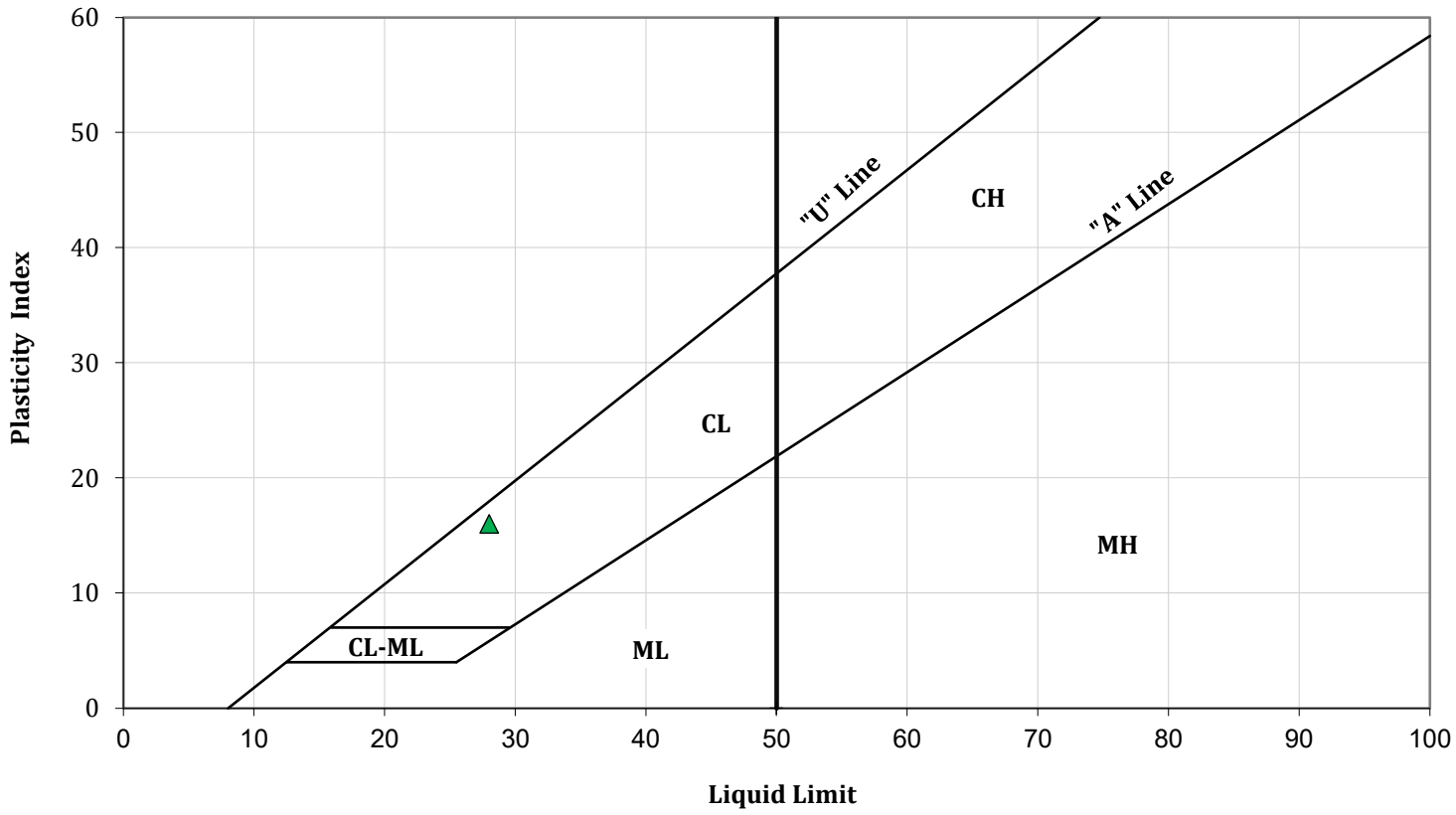
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25262
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-03 3S04	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	14.4%	28	12	16



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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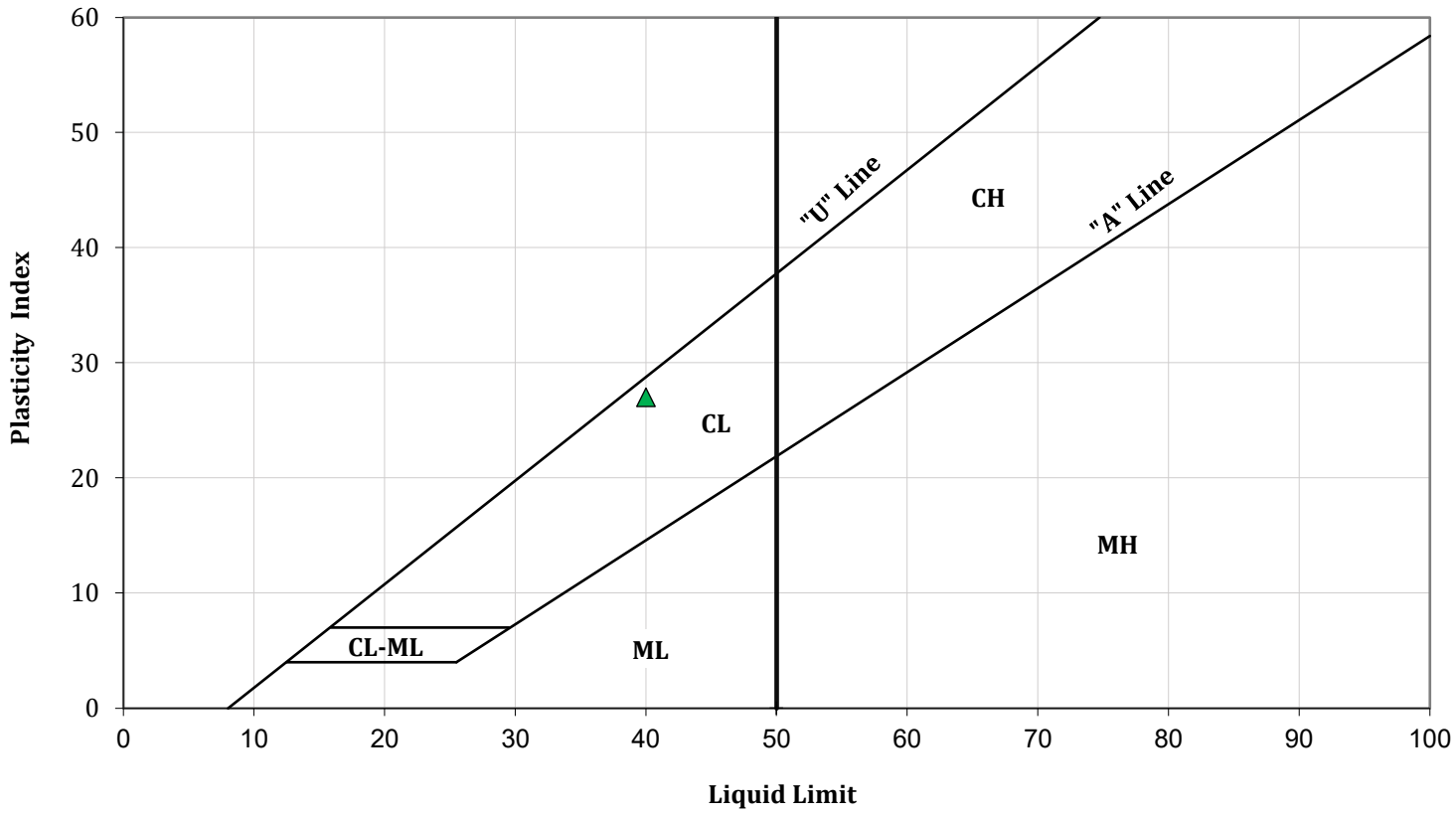
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25271
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-04 4S02	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	17.7%	40	13	27



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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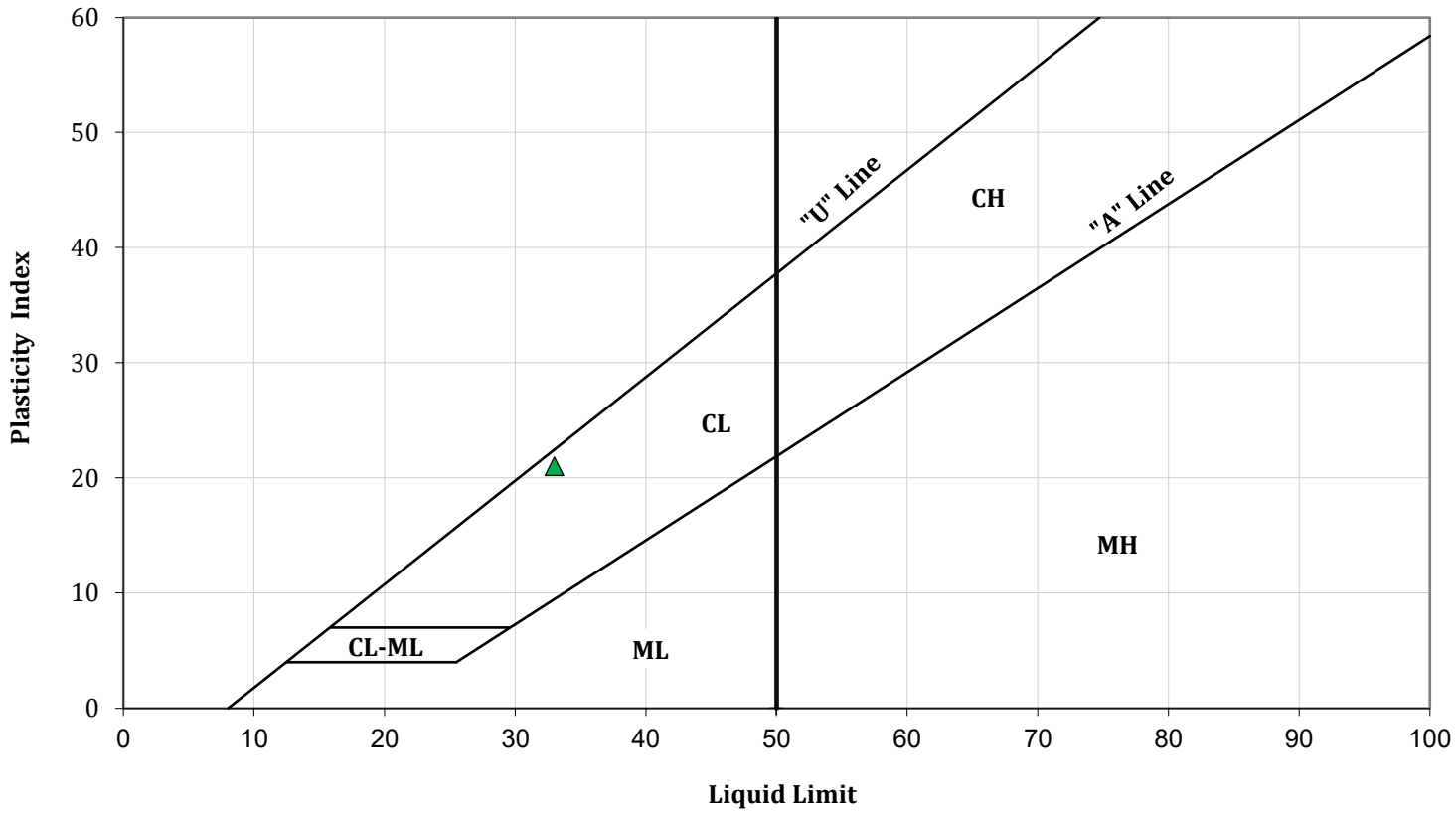
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25288
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-05 5S09	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	16.0%	33	12	21



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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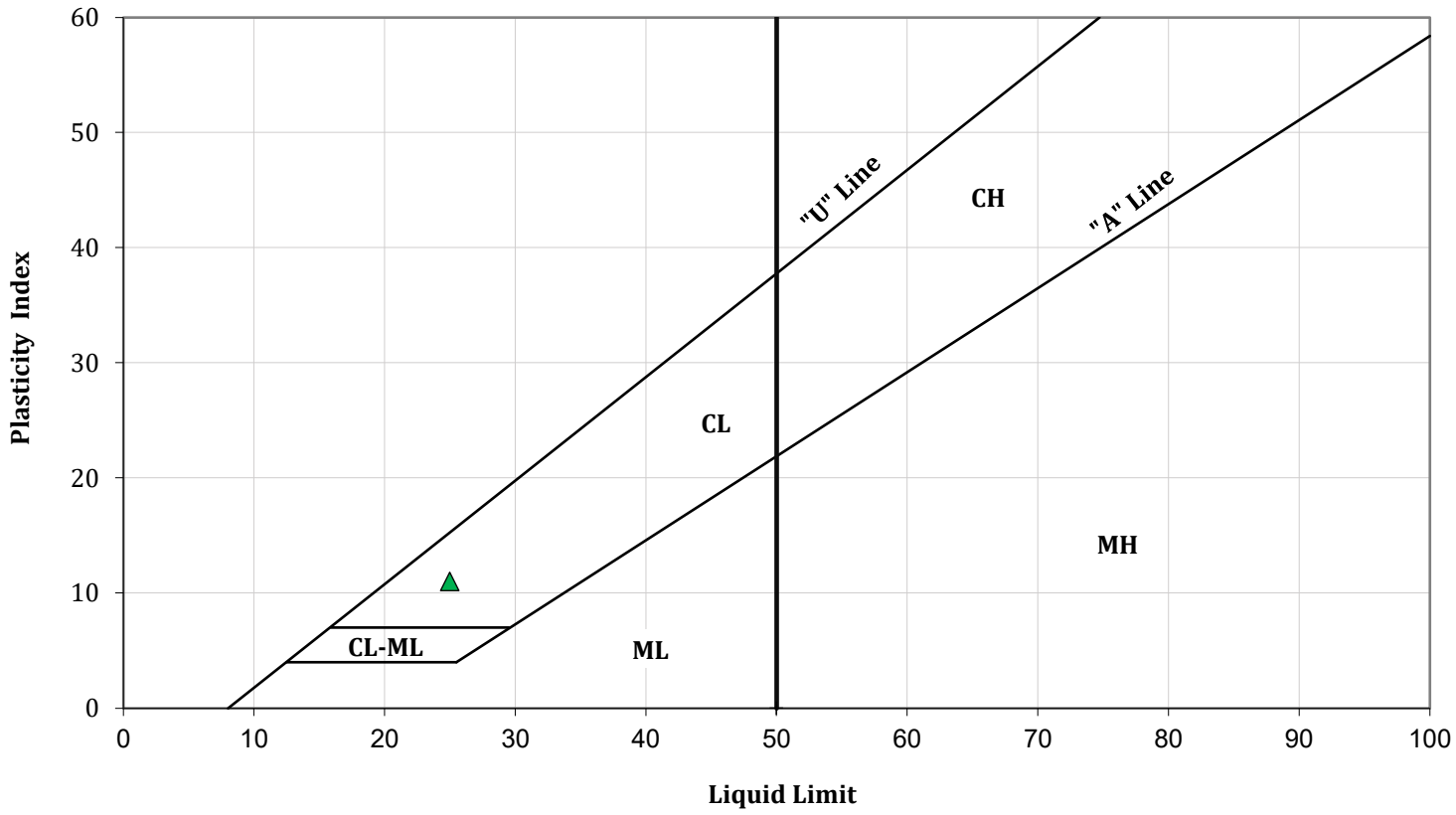
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25292
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-06 6S04	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	15.2%	25	14	11



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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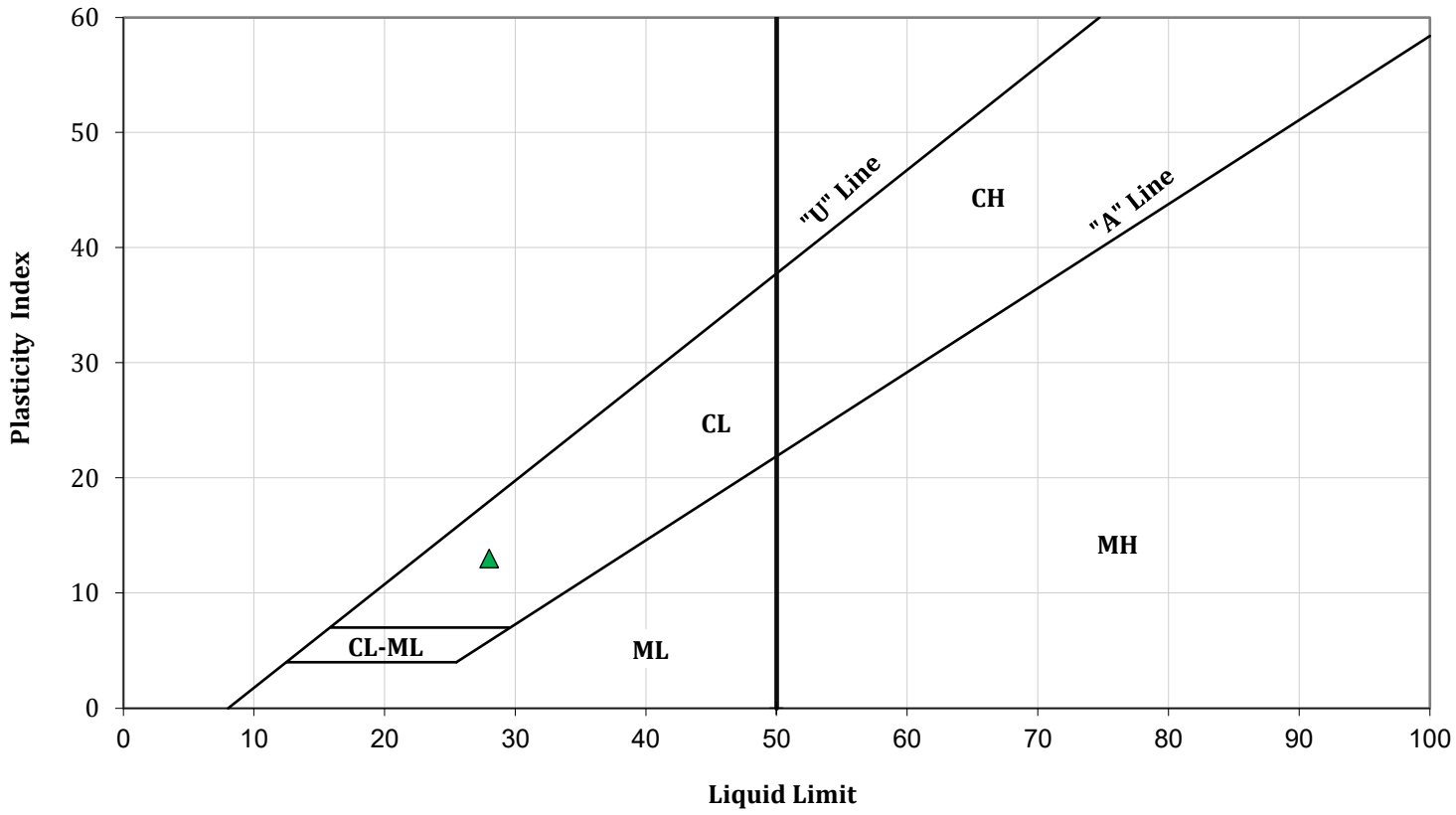
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25294
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-07 7S02	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	19.3%	28	15	13



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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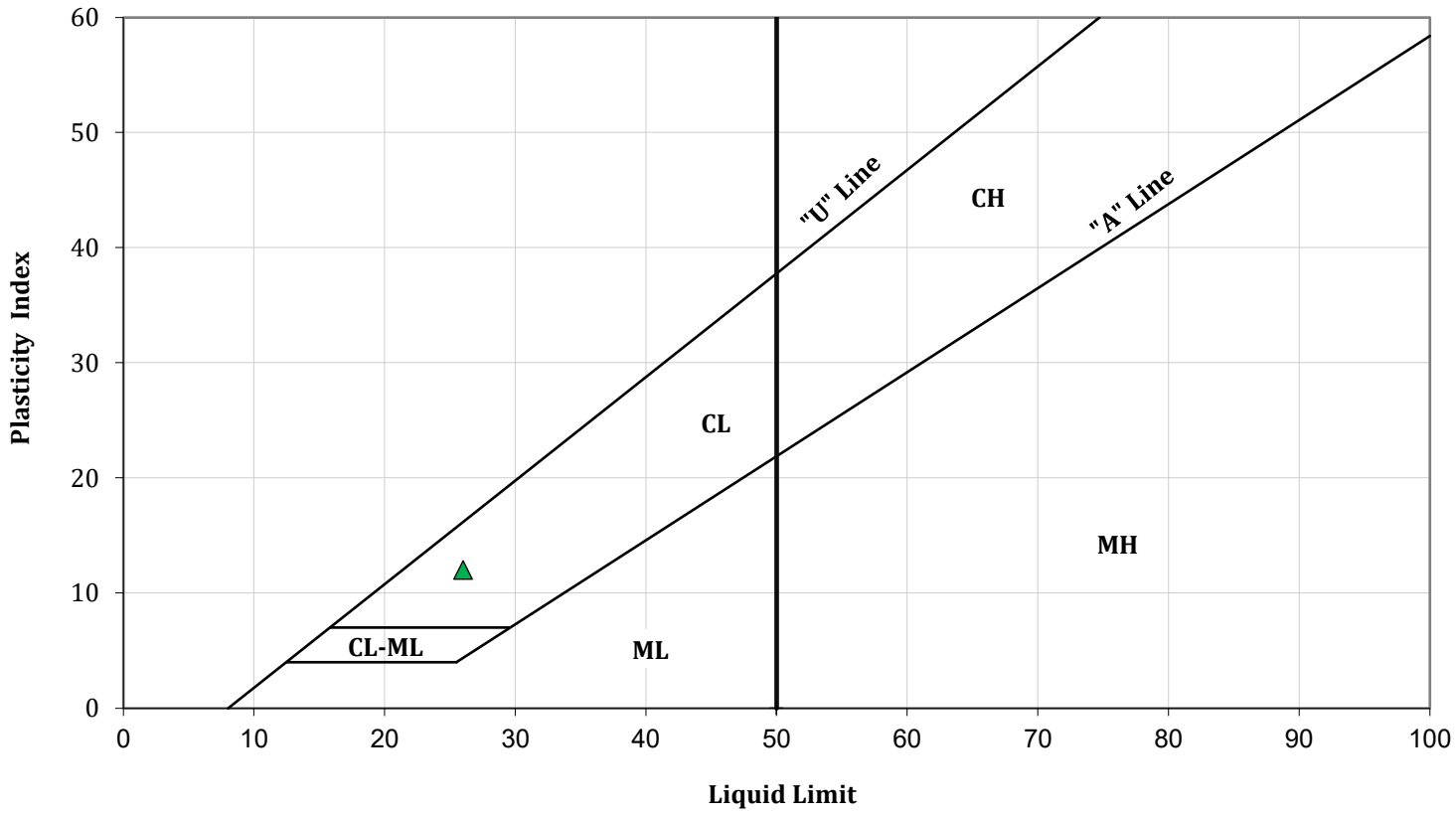
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25318
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-09 9S07	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	13.8%	26	14	12



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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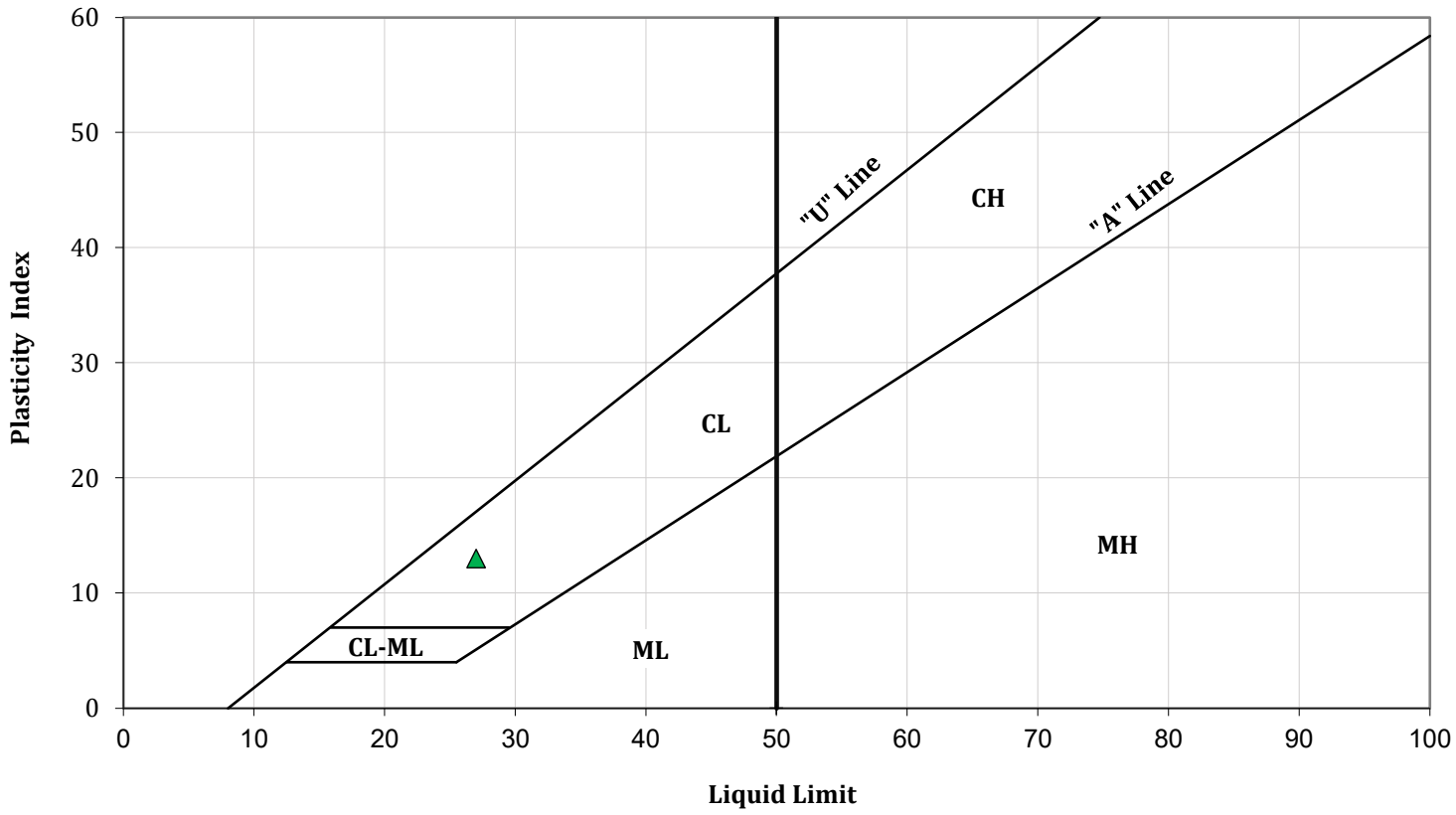
ATTERBERG LIMITS REPORT

Tested in accordance with ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Project No:	25.0005.AR	**Lab ID:**	S25336
Project:	McElhanney General		
Client:	McElhanney Consulting Services Ltd.	**Client Project:**	2531-00794-00 Claresholm
Attn:	Roan McMillan	**Date Received:**	April 28, 2025
CC:	-		
Sample Description:	-	**Sample Date:**	April 22, 2025
Sample ID:	BH25-11 11S03	**Sample Time:**	-
Sample Source:	Geotechnical Investigation	**Sampled By:**	Client

Method: Dry Preparation (air-dried)

Soil Classification (USCS)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
CL	12.2%	27	14	13



Comments: -

Report Date: May 12, 2025

Reviewed By: Bryan Morrison, BSc.

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PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

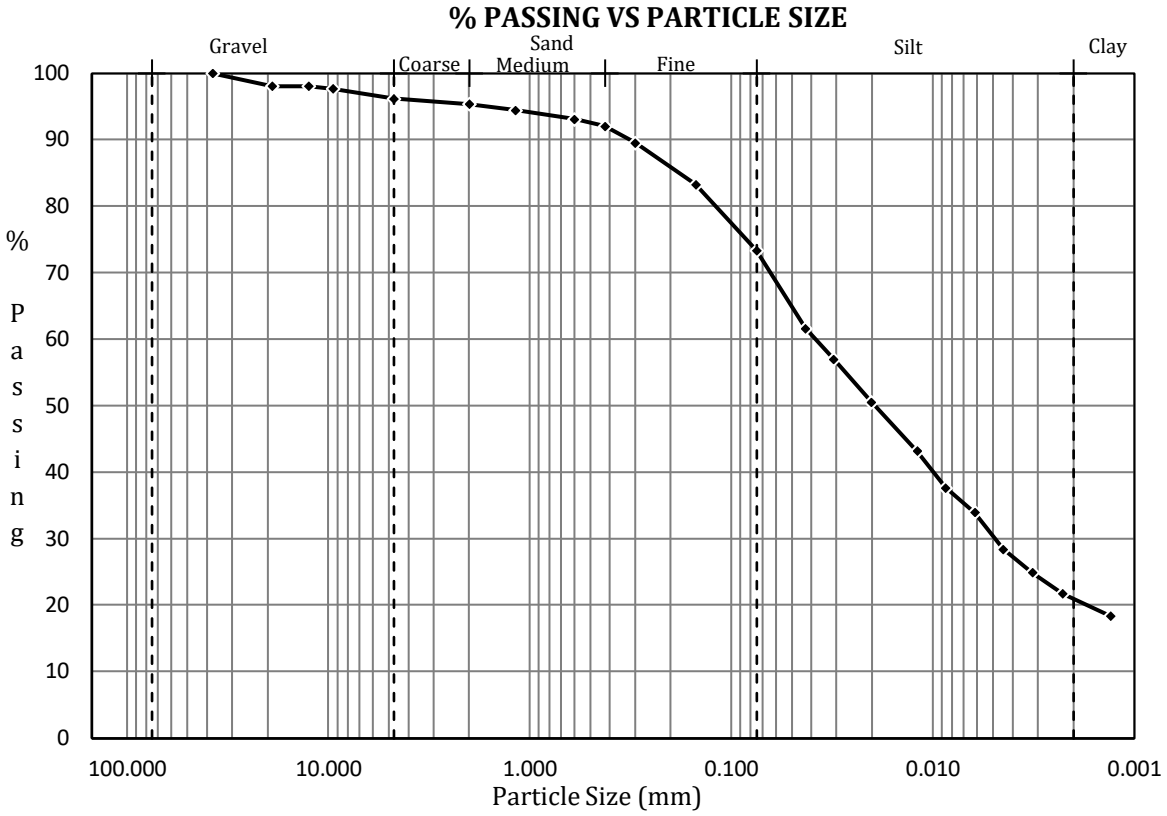
Lab ID: S25243
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: Sandy, clayey SILT, trace gravel
Sample ID BH25-01 1S04
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	100.0
19	98.0
12.5	98.0
9.5	97.6
4.75	96.1
2.00	95.3
1.18	94.4
0.600	93.1
0.425	92.0
0.300	89.5
0.150	83.2
0.075	73.3

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0428	61.6
0.0311	57.0
0.0201	50.5
0.0119	43.2
0.0086	37.6
0.0062	33.9
0.0045	28.4
0.0032	24.9
0.0023	21.7
0.0013	18.3



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	3.9 %
Sand:	< 4.75mm and > 0.075mm	22.8 %
Silt:	< 0.075mm and > 0.002mm	52.4 %
Clay:	< 0.002mm	20.9 %

Moisture Content : 11.4 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
Bryan Morrison, BSc.

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PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

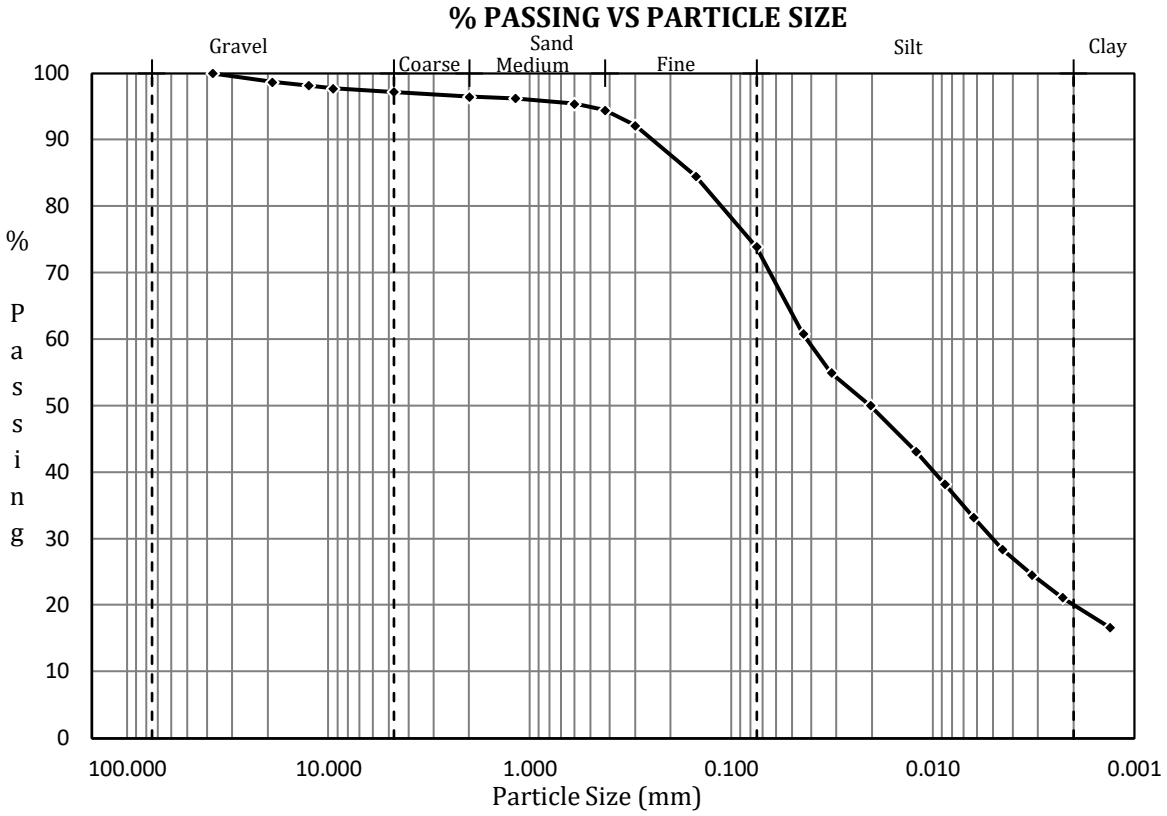
Lab ID: S25251
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: Sandy, clayey SILT, trace gravel
Sample ID BH25-02 2S02
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	100.0
19	98.6
12.5	98.1
9.5	97.7
4.75	97.2
2.00	96.4
1.18	96.2
0.600	95.4
0.425	94.4
0.300	92.1
0.150	84.5
0.075	73.8

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0439	60.8
0.0318	54.9
0.0204	50.0
0.0121	43.1
0.0087	38.1
0.0063	33.2
0.0045	28.4
0.0032	24.5
0.0023	21.1
0.0013	16.7



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	2.8 %
Sand:	< 4.75mm and > 0.075mm	23.3 %
Silt:	< 0.075mm and > 0.002mm	53.8 %
Clay:	< 0.002mm	20.1 %

Moisture Content : 14.6 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
Bryan Morrison, BSc.

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PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

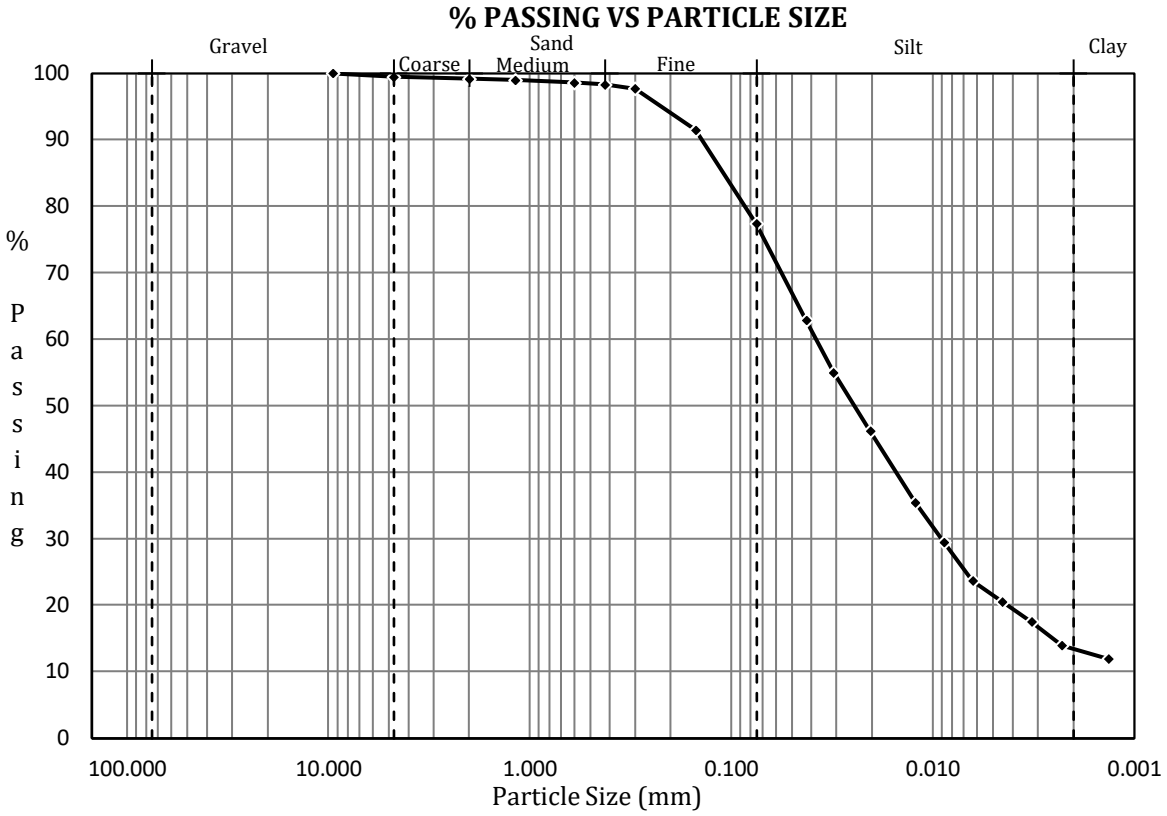
Lab ID: S25277
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: Sandy SILT, some clay
Sample ID BH25-04 4S08
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	
19	
12.5	
9.5	100.0
4.75	99.4
2.00	99.1
1.18	98.9
0.600	98.6
0.425	98.2
0.300	97.6
0.150	91.4
0.075	77.3

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0424	62.8
0.0310	55.0
0.0204	46.1
0.0122	35.4
0.0088	29.5
0.0063	23.6
0.0045	20.5
0.0032	17.5
0.0023	13.9
0.0013	11.9



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	0.6 %
Sand:	< 4.75mm and > 0.075mm	22.1 %
Silt:	< 0.075mm and > 0.002mm	63.9 %
Clay:	< 0.002mm	13.4 %

Moisture Content : 12.6 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
Bryan Morrison, BSc.

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PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

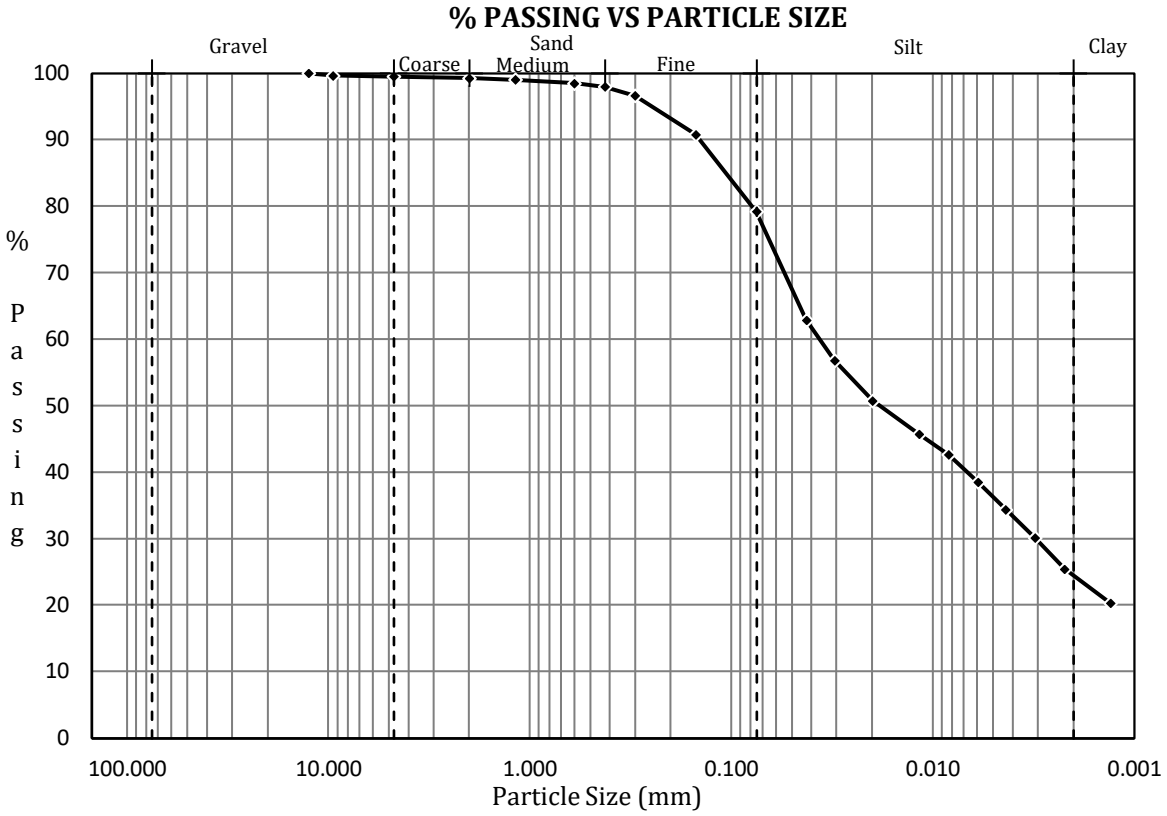
Lab ID: S25281
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: Sandy, clayey SILT
Sample ID BH25-05 5S01
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	
19	
12.5	100.0
9.5	99.6
4.75	99.5
2.00	99.2
1.18	99.0
0.600	98.5
0.425	97.9
0.300	96.6
0.150	90.8
0.075	79.1

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0423	62.8
0.0307	56.8
0.0198	50.7
0.0117	45.7
0.0083	42.6
0.0060	38.5
0.0043	34.4
0.0031	30.1
0.0022	25.4
0.0013	20.3



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	0.5 %
Sand:	< 4.75mm and > 0.075mm	20.3 %
Silt:	< 0.075mm and > 0.002mm	54.7 %
Clay:	< 0.002mm	24.4 %

Moisture Content : 16.6 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
Bryan Morrison, BSc.

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PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

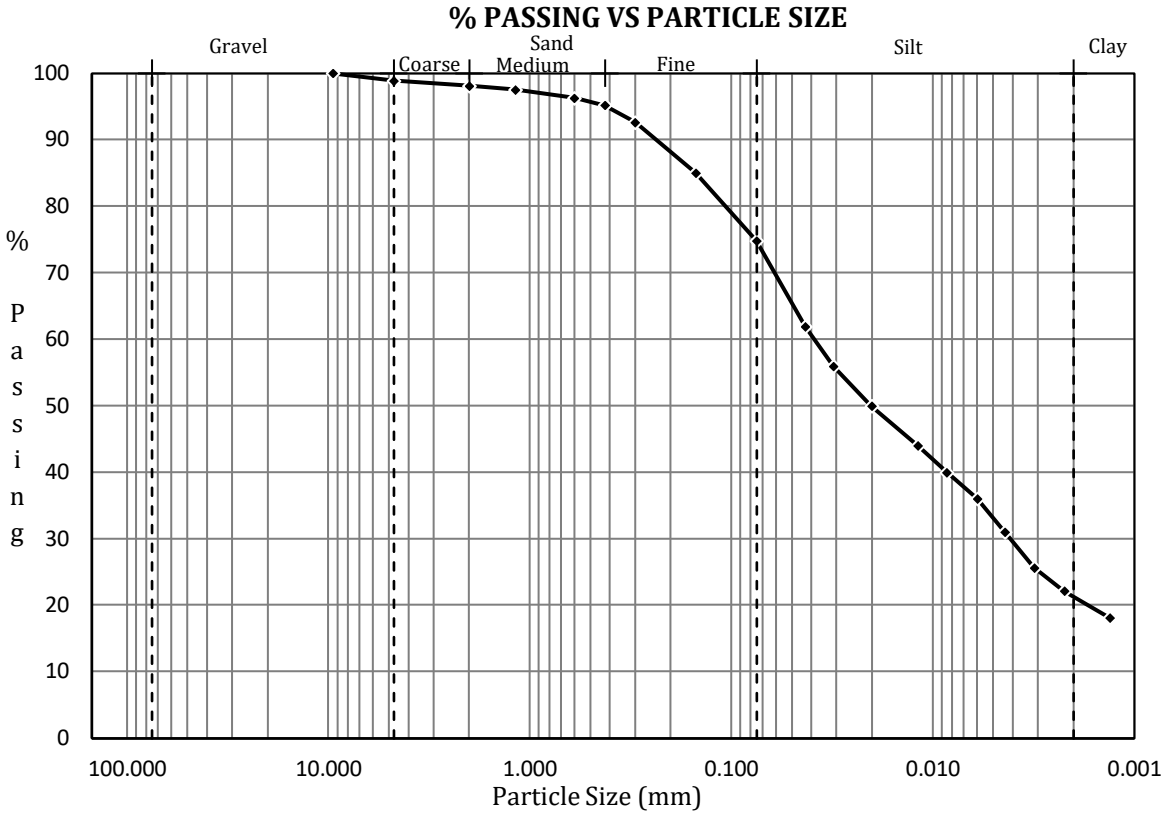
Lab ID: S25291
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: Sandy, clayey SILT, trace gravel
Sample ID BH25-06 6S02
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	
19	
12.5	
9.5	100.0
4.75	98.9
2.00	98.1
1.18	97.5
0.600	96.2
0.425	95.2
0.300	92.6
0.150	85.0
0.075	74.8

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0428	61.8
0.0310	55.9
0.0201	49.9
0.0118	43.9
0.0085	39.9
0.0060	36.0
0.0044	31.0
0.0031	25.6
0.0022	22.1
0.0013	18.0



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	1.1 %
Sand:	< 4.75mm and > 0.075mm	24.1 %
Silt:	< 0.075mm and > 0.002mm	53.5 %
Clay:	< 0.002mm	21.3 %

Moisture Content : 14.6 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
Bryan Morrison, BSc.

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PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

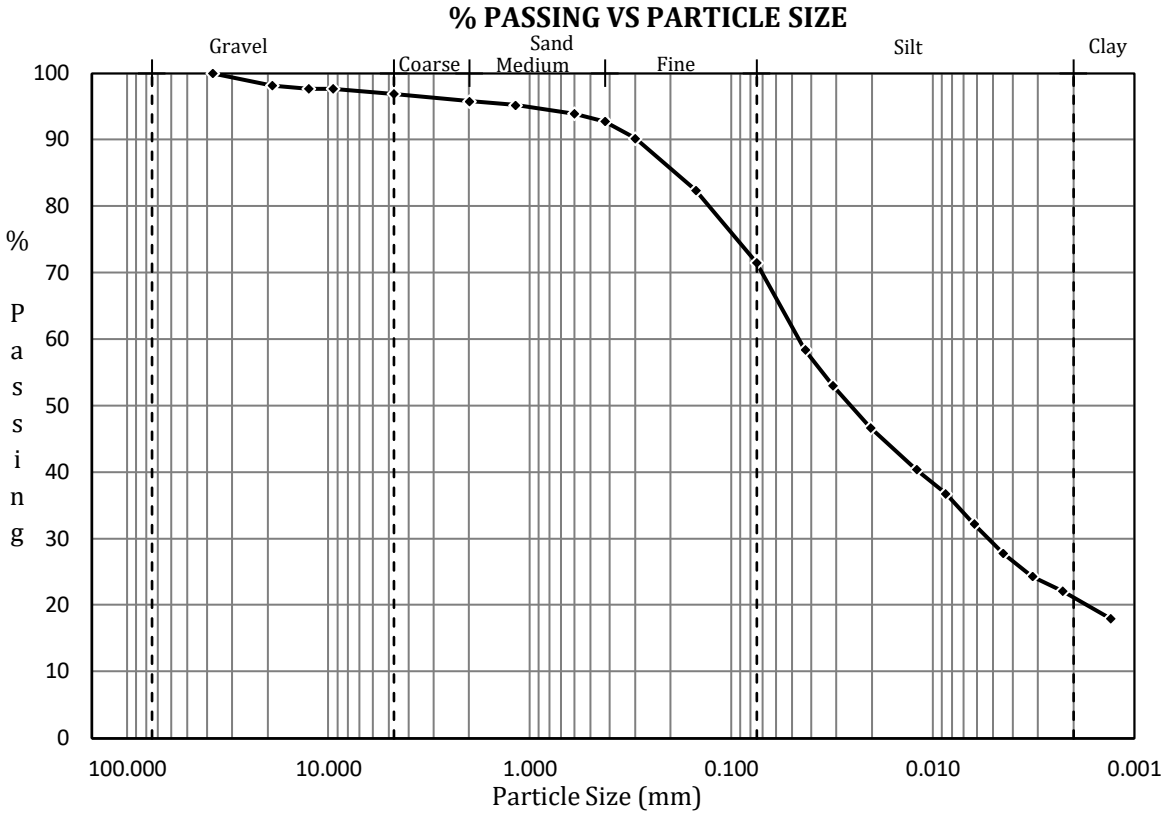
Lab ID: S25296
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: Sandy, clayey SILT, trace gravel
Sample ID BH25-07 7S04
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	100.0
19	98.1
12.5	97.6
9.5	97.6
4.75	96.8
2.00	95.8
1.18	95.2
0.600	93.9
0.425	92.7
0.300	90.2
0.150	82.4
0.075	71.5

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0430	58.4
0.0312	53.0
0.0204	46.7
0.0120	40.4
0.0086	36.8
0.0062	32.2
0.0045	27.8
0.0032	24.3
0.0023	22.1
0.0013	18.0



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	3.2 %
Sand:	< 4.75mm and > 0.075mm	25.3 %
Silt:	< 0.075mm and > 0.002mm	50.3 %
Clay:	< 0.002mm	21.2 %

Moisture Content : 14.3 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
Bryan Morrison, BSc.

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ARTECH CONSULTING LTD.
MATERIALS TESTING & INSPECTION

PHONE: 250-489-1940 FAX: 250-489-1667 EMAIL: info@artechconsulting.ca
229 Industrial Rd F, Cranbrook, BC V1C 6N4 www.artechconsulting.ca

PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

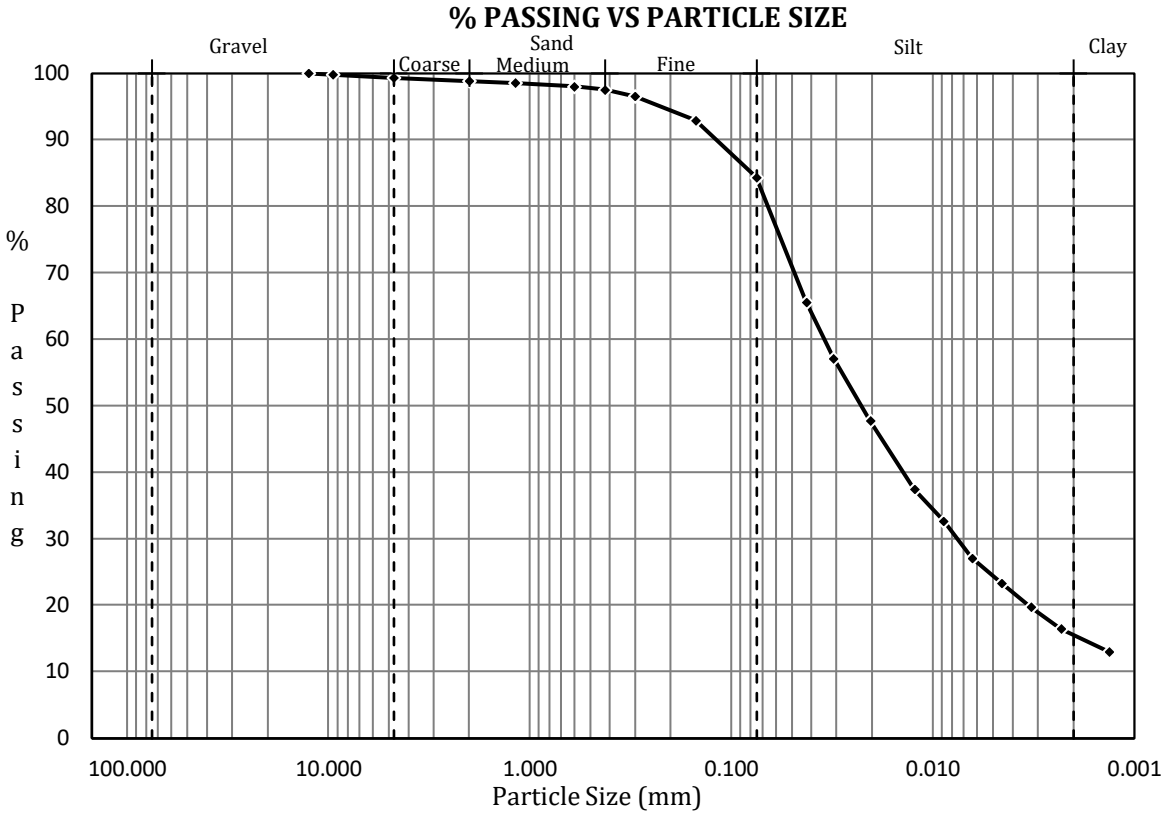
Lab ID: S25308
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: SILT, some sand, some clay
Sample ID BH25-08 8S06
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	
19	
12.5	100.0
9.5	99.8
4.75	99.3
2.00	98.8
1.18	98.5
0.600	98.0
0.425	97.5
0.300	96.5
0.150	92.9
0.075	84.3

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0424	65.5
0.0311	57.1
0.0204	47.7
0.0123	37.4
0.0088	32.6
0.0064	27.0
0.0045	23.3
0.0033	19.7
0.0023	16.4
0.0013	13.0



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	0.7 %
Sand:	< 4.75mm and > 0.075mm	15.0 %
Silt:	< 0.075mm and > 0.002mm	68.8 %
Clay:	< 0.002mm	15.5 %

Moisture Content : 12.1 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
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PARTICLE SIZE ANALYSIS (HYDROMETER) REPORT

Tested in accordance with AASHTO T88 Particle Size Analysis of Soils (modified)

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Attn: Roan McMillan
CC: -

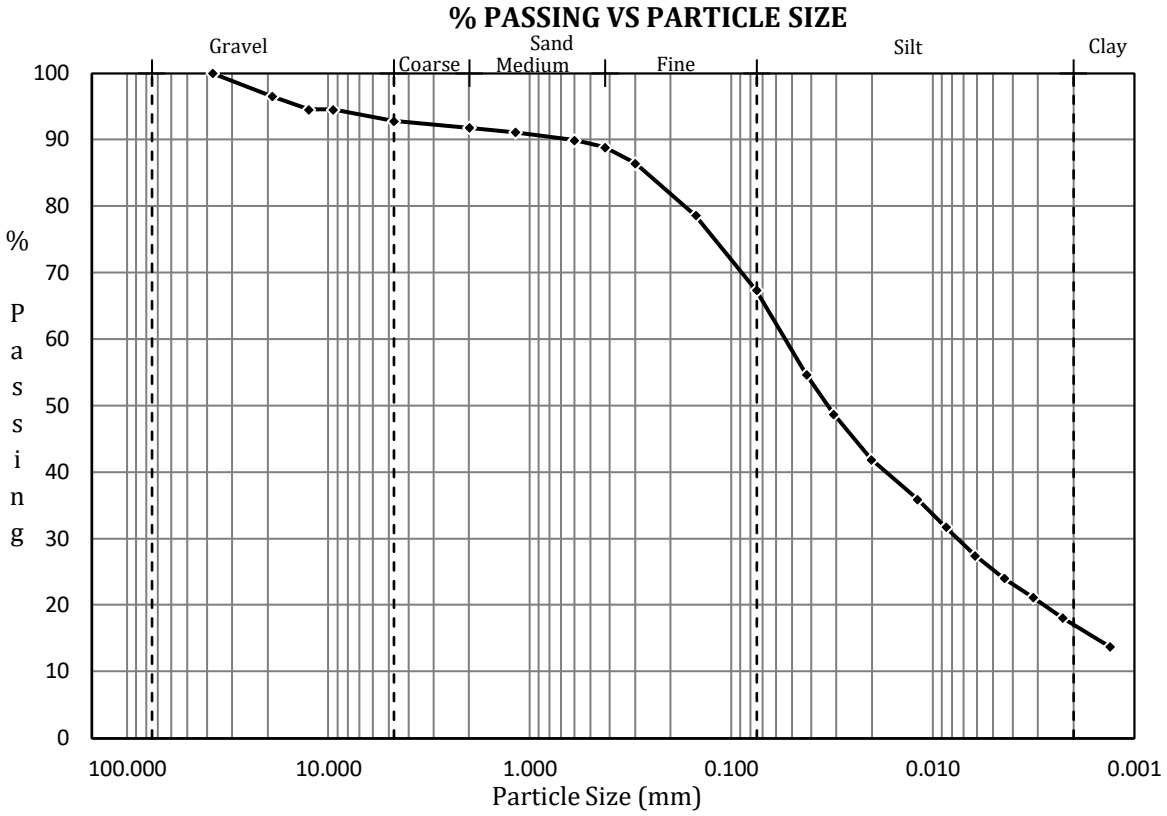
Lab ID: S25324
Client Project: 2531-00794-00 Claresholm
Date Received: April 28, 2025

Sample Description: Sandy SILT, some clay, trace gravel
Sample ID BH25-10 10S02
Sample Source: Geotechnical Investigation

Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Sieve Analysis	
Sieve Size (mm)	% Passing
150	
75	
37.5	100.0
19	96.5
12.5	94.5
9.5	94.5
4.75	92.8
2.00	91.8
1.18	91.1
0.600	89.9
0.425	88.8
0.300	86.4
0.150	78.6
0.075	67.3

Hydrometer Analysis	
Diameter of particle (mm)	% Smaller than
0.0424	54.7
0.0310	48.7
0.0202	41.9
0.0119	35.9
0.0086	31.7
0.0062	27.4
0.0044	24.0
0.0032	21.1
0.0023	18.0
0.0013	13.8



Summary

Cobble:	>75mm	0.0 %
Gravel:	< 75mm and > 4.75mm	7.2 %
Sand:	< 4.75mm and > 0.075mm	25.4 %
Silt:	< 0.075mm and > 0.002mm	50.3 %
Clay:	< 0.002mm	17.1 %

Moisture Content : 12.6 %
Comments : -

Report Date: May 12, 2025

Reviewed By:
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MOISTURE CONTENT REPORT

Tested in accordance with ASTM D2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25241	BH25-01 1S02	14.6%
S25242	BH25-01 1S03	14.1%
S25243	BH25-01 1S04	11.4%
S25244	BH25-01 1S05	13.2%
S25245	BH25-01 1S06	11.6%
S25246	BH25-01 1S07	10.6%
S25247	BH25-01 1S08	12.9%
S25248	BH25-01 1S09	15.0%
S25249	BH25-01 1S10	14.2%

Comments: -

Report Date: May 12, 2025

Reviewed by: Bryan Morrison, BSc.

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Tested in accordance with ASTM D2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25250	BH25-02 2S01	17.1%
S25251	BH25-02 2S02	14.6%
S25252	BH25-02 2S04	12.7%
S25253	BH25-02 2S05	12.6%
S25254	BH25-02 2S06	12.5%
S25255	BH25-02 2S07	12.6%
S25256	BH25-02 2S08	14.4%
S25257	BH25-02 2S09	15.6%
S25258	BH25-02 2S10	14.3%
S25259	BH25-02 2S11	16.2%

Comments: -

Report Date: May 12, 2025

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25260	BH25-03 3S02	12.7%
S25261	BH25-03 3S03	13.2%
S25262	BH25-03 3S04	14.4%
S25263	BH25-03 3S05	11.5%
S25264	BH25-03 3S06	11.3%
S25265	BH25-03 3S07	12.5%
S25266	BH25-03 3S08	15.7%
S25267	BH25-03 3S09	15.3%
S25268	BH25-03 3S10	14.9%
S25269	BH25-03 3S11	15.7%

Comments: -

Report Date: May 12, 2025

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25270	BH25-04 4S01	18.8%
S25271	BH25-04 4S02	17.7%
S25272	BH25-04 4S03	11.1%
S25273	BH25-04 4S04	13.2%
S25274	BH25-04 4S05	13.2%
S25275	BH25-04 4S06	12.9%
S25276	BH25-04 4S07	13.0%
S25277	BH25-04 4S08	12.6%
S25278	BH25-04 4S09	14.9%
S25279	BH25-04 4S10	14.8%
S25280	BH25-04 4S11	16.3%

Comments: -

Report Date: May 12, 2025

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25281	BH25-05 5S01	16.6%
S25282	BH25-05 5S03	12.2%
S25283	BH25-05 5S04	12.3%
S25284	BH25-05 5S05	13.8%
S25285	BH25-05 5S06	19.8%
S25286	BH25-05 5S07	15.1%
S25287	BH25-05 5S08	15.7%
S25288	BH25-05 5S09	16.0%
S25289	BH25-05 5S10	16.0%
S25290	BH25-05 5S12	15.5%

Comments: -

Report Date: May 12, 2025

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Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25291	BH25-06 6S02	14.6%
S25292	BH25-06 6S04	15.2%
S25293	BH25-06 6S05	12.8%

Comments: -

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25294	BH25-07 7S02	19.3%
S25295	BH25-07 7S03	13.9%
S25296	BH25-07 7S04	14.3%
S25297	BH25-07 7S05	11.9%
S25298	BH25-07 7S06	10.6%
S25299	BH25-07 7S07	12.6%
S25300	BH25-07 7S08	12.0%
S25301	BH25-07 7S09	14.3%
S25302	BH25-07 7S10	15.6%
S25303	BH25-07 7S11	13.4%

Comments: -

Report Date: May 12, 2025

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25304	BH25-08 8S02	15.6%
S25305	BH25-08 8S03	10.5%
S25306	BH25-08 8S04	12.2%
S25307	BH25-08 8S05	13.2%
S25308	BH25-08 8S06	12.1%
S25309	BH25-08 8S07	13.5%
S25310	BH25-08 8S08	13.5%
S25311	BH25-08 8S09	14.6%
S25312	BH25-08 8S10	13.4%
S25313	BH25-08 8S11	15.1%

Comments: -

Report Date: May 12, 2025

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25314	BH25-09 9S03	12.3%
S25315	BH25-09 9S04	12.4%
S25316	BH25-09 9S05	11.6%
S25317	BH25-09 9S06	12.2%
S25318	BH25-09 9S07	13.8%
S25319	BH25-09 9S08	12.0%
S25320	BH25-09 9S09	13.9%
S25321	BH25-09 9S10	14.1%
S25322	BH25-09 9S11	14.1%

Comments: -

Report Date: May 12, 2025

Reviewed by: Bryan Morrison, BSc.

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25323	BH25-10 10S01	12.6%
S25324	BH25-10 10S02	12.6%
S25325	BH25-10 10S03	14.1%
S25326	BH25-10 10S04	11.5%
S25327	BH25-10 10S05	13.9%
S25328	BH25-10 10S06	12.4%
S25329	BH25-10 10S07	12.1%
S25330	BH25-10 10S08	12.0%
S25331	BH25-10 10S09	17.3%
S25332	BH25-10 10S10	15.1%
S25333	BH25-10 10S11	16.4%

Comments: -

Report Date: May 12, 2025

Reviewed by: Bryan Morrison, BSc.

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Project No: 25.0005.AR
Project: McElhanney General
Client: McElhanney Consulting Services Ltd.

Client Project: 2531-00794-00 Claresholm

Attn: Roan McMillan
CC: -

Date Received: April 28, 2025

Sample Source: Geotechnical Investigation
Sample Date: April 22, 2025
Sample Time: -
Sampled By: Client

Lab ID	Sample ID	Moisture Content
S25334	BH25-11 11S01	14.3%
S25335	BH25-11 11S02	14.3%
S25336	BH25-11 11S03	12.2%
S25337	BH25-11 11S04	11.9%
S25338	BH25-11 11S05	11.7%
S25339	BH25-11 11S06	12.3%
S25340	BH25-11 11S07	10.8%
S25341	BH25-11 11S08	11.2%
S25342	BH25-11 11S09	13.9%
S25343	BH25-11 11S10	14.0%
S25344	BH25-11 11S11	8.2%

Comments: -

Report Date: May 12, 2025

Reviewed by: Bryan Morrison, BSc.

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AGAT Laboratories

Geotechnical Materials Division
3801 21 Street NE
Calgary, AB T2E 6T5

Determination of Minimum Laboratory Soil Resistivity
AASHTO T 288

Client: McElhanney
Location: BC
ATTN: Roan McMillan

Project: 2531-00794-00
Client Sample ID: Multiple samples
Sampling Dates: 22-Apr-25 and 23-Apr-25
Testing Dates: 16-May-25

AGAT ID: Multiple samples
Work Order: 25UN00962
Sampled by: Client
Tested By: NI
Version: 0

Sample Description: Crush Sample
Sample preparation: Air dry, initial water mix saturated for at least 12 hours, additional water increases saturated for more than 0.5 hour

Resistivity Box Size: 22.2 x 4 x 3.2 cm
Cross-sectional area (A): 3 x 2.4 cm = 7.2 cm^2
Volume: 80 cm^3

A/L= 1 cm

Method: 4-electrode method using M.C. Miller Soil Box

Test Results

Distilled Water Resistivity = 490000 Ω.cm

				Meter Reading (Ω)								
				Added distilled water (Calculated Water Content)								Minimum Resistivity (Ω.cm)
AGAT ID	Sample Client ID	Sampling Date	Depth (m)	10%	15%	20%	25%	30%	35%	40%	45%	
25-278	2S03,BH25-02	22-Apr-25	2.4	7500	2650	736	-	619	598	582	625	582
25-279	5S02,BH25-05	22-Apr-25	1.7	6330	1790	476	367	351	359	-	-	351
25-280	6S03,BH25-06	23-Apr-25	2.4	5900	605	535	481	451	433	416	422	416
25-281	9S02, BH25-09	23-Apr-25	1.7	5450	-	-	942	928	814	860	872	814

Note: Resistivity (Ω.cm) = A/L factor of the resistivity box x The meter reading

Ghareib H.
Reviewer

5/20/2025
Review Date

Ghareib Hamrouni
Signature

AGAT Laboratories

Geotechnical Materials Division
3801 21 Street NE,
Calgary, AB T2E 6T5

Test Sample Information

Test Information

Water Soluble Soil Sulphate Content (ASTM C1580)

pH of Soil - Corrosion Testing (AASHTO T289-91)

AGAT Sample Information

AGAT Work Order#: 25UN00962

Test Received: 6/9/2025

Client Sample Information

Client : McElhanney

Project Name/ ID: 2531-00794-00

Attention: Roan McMillan

Material Type: Crush Sample

Sampled By: Client

Sample Location: NA

AGAT Geotech ID	AGAT Alternative ID	Sample ID	Water Soluble Sulphate Ion (%)	pH
25-278	6736872	2S03,BH25-02	0.13	8.70
25-279	6736873	5S02,BH25-05	0.35	8.57
25-280	6736874	6S03,BH25-06	1.01	8.13
25-281	6736875	9S02, BH25-09	0.04	8.50

AGAT Laboratories

2620 21st Street NE
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CANADA T2E 7L3
TEL (403) 765-1200

http://www.agatlabs.com

CLIENT NAME: MCELHANNEY LIMITED
1800 Willowbrook Dr
CRANBROOK, BC V1C7H9
(778) 994-8415
ATTENTION TO: Roan McMillan
PROJECT:
AGAT WORK ORDER: 25C291168
ROCK ANALYSIS REVIEWED BY: Jewel Shibu, Lab Supervisor
DATE REPORTED: Jun 09, 2025
PAGES (INCLUDING COVER): 7
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 765-1200

Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information is available on request from AGAT Laboratories, in accordance with ISO/IEC 17025:2017, ISO/IEC 17025:2005 (Quebec), DR-12-PALA and/or NELAP Standards.*
- *This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

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Certificate of Analysis

AGAT WORK ORDER: 25C291168

PROJECT:

CLIENT NAME: MCELHANNEY LIMITED

ATTENTION TO: Roan McMillan

(284-735) Water Soluble Sulphate In Soil (ASTM C1580)

DATE SAMPLED: Apr 22, 2025 | **DATE RECEIVED: May 14, 2025** | **DATE REPORTED: Jun 09, 2025** | **SAMPLE TYPE: Other**

Sample ID (AGAT ID)	Analyte:	Water Soluble Sulfate (ASTM C1580)
	Unit:	%
	RDL:	0.02
25-278 (6736872)		0.13
25-279 (6736873)		0.35
25-280 (6736874)		1.01
25-281 (6736875)		0.04

Comments: RDL - Reported Detection Limit

6736872-6736875 **Non-accredited test. Inquire with lab for details.

Analysis performed at AGAT Calgary (unless marked by *)
Insufficient Sample : IS
Sample Not Received : SNR

Certified By:

Jewel Shibu

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 25C291168

PROJECT:

CLIENT NAME: MCELHANNEY LIMITED

ATTENTION TO: Roan McMillan

(284-758) pH of Soil Used in Corrosion testing (AASHTO T289-91)

DATE SAMPLED: Apr 22, 2025 | **DATE RECEIVED: May 14, 2025** | **DATE REPORTED: Jun 09, 2025** | **SAMPLE TYPE: Other**

Sample ID (AGAT ID)	Analyte:	pH of soil - Corrosion Testing
	Unit:	pH units
	RDL:	0.2
25-278 (6736872)		8.70
25-279 (6736873)		8.57
25-280 (6736874)		8.13
25-281 (6736875)		8.50

Comments: RDL - Reported Detection Limit

6736872-6736875 **Non-accredited test. Inquire with lab for details.

Analysis performed at AGAT Calgary (unless marked by *)
Insufficient Sample : IS
Sample Not Received : SNR

Certified By: Jewel Shibu

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Quality Assurance

AGAT WORK ORDER: 25C291168

PROJECT:

CLIENT NAME: MCELHANNEY LIMITED

ATTENTION TO: Roan McMillan

Rock Analysis

Date Received: May 14, 2025

Date Reported: Jun 09, 2025

(284-735) Water Soluble Sulphate In Soil (ASTM C1580)

	Water Soluble Sulfate (ASTM C1580)
6736872	
Original	< 0.02
Rep #1	< 0.02
RPD	NA
Method Blank	< 0.02
Result Value	
Reference Material	
Nominal	
Recovery	87%
Lower Limit	
Upper Limit	

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

(284-758) pH of Soil Used in Corrosion testing (AASHTO T289-91)

	pH of soil - Corrosion Testing
6736872	
Original	8.50
Rep #1	8.65
RPD	1.8%
Method Blank	< 0.2
Result Value	
Reference Material	
Nominal	
Recovery	101%
Lower Limit	
Upper Limit	

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.
Duplicate/ Replicate NA: Results are less than 10X the RDL and RPD will not be calculated

Certified By: Jewel Shibu

AGAT Laboratories

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Method Summary

CLIENT NAME: MCELHANNEY LIMITED

AGAT WORK ORDER: 25C291168

PROJECT:

ATTENTION TO: Roan McMillan

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Rock Analysis			
Water Soluble Sulfate (ASTM C1580)	ARD-284-18031		SPECTROPHOTOMETER
pH of soil - Corrosion Testing	ARD-284-18026	AASHTO T289-91 (2008)	POTENTIOMETER

APPENDIX D – NBCC 2020 SEISMIC HAZARD CALCULATIONS

Government of Canada / Gouvernement du Canada

Canada.ca › Natural Resources Canada › Earthquakes Canada

2020 National Building Code of Canada Seismic Hazard Tool

This application provides seismic values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1. of Division B of the NBC 2020.

Seismic Hazard Values

User requested values

Code edition	NBC 2020
Site designation X_S	X_D
Latitude (°)	50.023
Longitude (°)	-113.598

Please select one of the tabs below.

NBC 2020 | Additional Values | Plots | API | Background Information

The 5%-damped spectral acceleration ($S_a(T,X)$, where T is the period, in s, and X is the site designation) and peak ground acceleration (PGA(X)) values are given in units of acceleration due to gravity (g, 9.81 m/s^2). Peak

ground velocity (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

NBC 2020 - 2%/50 years (0.000404 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.369	0.317	0.18	0.09	0.0368	0.0195	0.168	0.157

The log-log interpolated 2%/50 year $S_a(4.0, X_D)$ value is : **0.0458**

▼ Tables for 5% and 10% in 50 year values

NBC 2020 - 5%/50 years (0.001 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.224	0.196	0.113	0.058	0.0195	0.00728	0.0991	0.0992

The log-log interpolated 5%/50 year $S_a(4.0, X_D)$ value is : **0.0254**

NBC 2020 - 10%/50 years (0.0021 per annum) probability

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$

$S_a(0.2, X_D)$	$S_a(0.5, X_D)$	$S_a(1.0, X_D)$	$S_a(2.0, X_D)$	$S_a(5.0, X_D)$	$S_a(10.0, X_D)$	$PGA(X_D)$	$PGV(X_D)$
0.14	0.13	0.0774	0.0397	0.0116	0.00353	0.0611	0.0671

The log-log interpolated 10%/50 year $S_a(4.0, X_D)$ value is : **0.0157**

Download CSV

← Go back to the seismic hazard calculator form

Date modified: 2021-04-06

APPENDIX E – STATEMENT OF LIMITATIONS

Statement of Limitations – Geotechnical Services

Use of this Report. This report was prepared by McElhanney Ltd. ("**McElhanney**") for the particular site, design objective, development and purpose (the "**Project**") described in this report and for the exclusive use of the client identified in this report (the "**Client**"). The data, interpretations and recommendations pertain to the Project and are not applicable to any other project or site location and this report may not be reproduced, used or relied upon, in whole or in part, by a party other than the Client and Building Authority, without the prior written consent of McElhanney. The Client may provide copies of this report to its affiliates, contractors, subcontractors and regulatory authorities for use in relation to and in connection with the Project provided that any reliance, unauthorized use, and/or decisions made based on the information contained within this report are at the sole risk of such parties. McElhanney will not be responsible for the use of this report on projects other than the Project, where this report or the contents hereof have been modified without McElhanney's consent, to the extent that the content is in the nature of an opinion, and if the report is preliminary or draft. This is a technical report and is not a legal representation or interpretation of laws, rules, regulations, or policies of governmental agencies. The professional services retained for this Project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in this report. In particular, environmental conditions such as surface and subsurface contamination are outside the scope of this report.

Standard of Care and Disclaimer of Warranties. This study and report have been prepared in accordance with generally accepted engineering and scientific judgments, principles and practices. McElhanney expressly disclaims any and all warranties in connection with this report including, without limitation, any warranty that this report and the associated site review work has uncovered all potential geotechnical liabilities associated with the subject property.

Effect of Changes. All evaluations and conclusions stated in this report are based on facts, observations, site-specific details, legislation and regulations as they existed at the time of the site assessment. Some conditions are subject to change over time and the Client recognizes that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site may substantially alter such evaluations and conclusions. Construction activities can significantly alter soil, rock and other geologic conditions on the site. McElhanney should be requested to re-evaluate the conclusions of this report and to provide amendments as required prior to any reliance upon the information presented herein upon any of the following events: a) any changes (or possible changes) as to the site, purpose, or development plans upon which this report was based, b) any changes to applicable laws subsequent to the issuance of the report, c) new information is discovered in the future during site excavations, construction, building demolition or other activities, or d) additional subsurface assessments or testing conducted by others.

Subsurface Risks. Soil, rock and groundwater data were collected in general accordance with the standards and methods described in the document. The classification and identification of soils, rocks and geologic formations was based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Interpretations of groundwater levels and flow direction are based on water level observations at selected test hole locations and are expected to fluctuate. Observations at test holes indicate the approximate subsurface conditions at those locations only. Subsurface conditions between test holes were based, by necessity, on judgement and assumptions of what exists between the actual locations sampled, and may vary significantly from actual site conditions and all persons making use of this report should be aware of, and accept, this risk. Even a comprehensive sampling and testing program, implemented in accordance with appropriate equipment by experienced personnel, may fail to detect all or certain conditions.

Information from Client and Third Parties. McElhanney has relied in good faith on information provided by the Client and third parties noted in this report and has assumed such information to be accurate, complete, reliable, non-fringing, and fit for the intended purpose without independent verification. McElhanney accepts no responsibility for any deficiency, misstatements or inaccuracy contained in this report as a result of omissions or errors in information provided by third parties or for omissions, misstatements or fraudulent acts of persons interviewed.

Underground Utilities and Damages. In the performance of the services, McElhanney has taken reasonable precautions to avoid damage or injury to subterranean structures or utilities. Subsurface sampling may result in unavoidable contamination of certain subsurface areas not known to be previously contaminated such as, but not limited to, a geologic formation, the groundwater or other hydrous body. McElhanney will adhere to an appropriate standard of care during the conduct of any subsurface sampling.

Independent Judgments. McElhanney will not be responsible for the independent conclusions, interpretations, interpolations and/or decisions of the Client, or others, who may come into possession of this report, or any part thereof. This restriction of liability includes decisions made to purchase, finance or sell land or with respect to public offerings for the sale of securities.

Construction. The subsurface information contained in this report were obtained for the owner's information and design. The extent and detail of assessments necessary to determine all relevant conditions that may affect construction costs would normally be greater than the assessments carried out for this report. Accordingly, a contingency fund to allow for the possibility of variations of subsurface conditions should be included in the construction budget to cover costs associated with modifications of the design and construction procedures resulting from conditions that vary from the assumptions in this report. If during construction, subsurface conditions are found to be other than those described in this report, McElhanney is to be notified and may alter or modify the geotechnical report recommendations. If McElhanney is not retained to provide services during construction, then McElhanney is not responsible for confirming or recording that subsurface conditions do not materially differ from those interpreted conditions contained in this report or for confirming or recording that construction activities have not adversely affected subsurface conditions or the recommendations contained in this report.

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McElhanney

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