Albion Industrial Lands Geotechnical Overview Study, Maple Ridge, BC

Presented To:

Maple Ridge

Dated: July 2025
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This geotechnical study is a high-level overview study which aims to identify the geotechnical conditions and risks for the Albion Industrial Lands area. Site-specific geotechnical investigations are required for any developments proposed at each lot. Ecora and the City of Maple Ridge do not accept any responsibility or liability for the use of this study.

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0	2025-07-25	MB	DCB	DCB	**ISSUED FOR USE**

Limitations of Report

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Ecora's General Conditions are provided in Appendix A of this report.

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1. Introduction

The City of Maple Ridge (the City) retained Ecora Engineering & Environmental Ltd. (Ecora) to undertake a high-level geotechnical study of the Albion Industrial Lands in Maple Ridge, BC.

Ecora's scope of work, completed between March and July 2025, included:

- A detailed background review of publicly available geotechnical information, City provided geotechnical information and aerial imagery.
- A geotechnical site investigation, including two Seismic Cone Penetration Tests (SCPTs), three Cone Penetration Tests (CPTs), and five solid stem auger boreholes.
- Laboratory index testing, including Moisture Content, Sieve tests and Atterberg limits.
- Limited geotechnical analyses.
- Preparation of this report.

Our scope did not include contaminated sites review or hydrotechnical services.

This geotechnical study is a high-level overview which aims to identify the geotechnical conditions and risks for the Albion Industrial Lands area. Site-specific geotechnical investigations are required for any developments proposed at each lot. Ecora and the City of Maple Ridge do not accept any responsibility or liability for the use of this study.

This report is subject to Ecora's General Conditions which are attached in Appendix A.

2. Project Description

Ecora understands that the City is seeking to understand the subsurface conditions of the area referred to as the "Albion Industrial Lands" for high level planning purposes noting that the current land development plans include further industrial use. Specific development plans are not available at this time however we anticipate that they will consist of relatively large structures such as warehouses with large spans and 1-2 levels.

3. Site Description

The “Albion Industrial Lands” is a roughly 173 acres (0.7 km^2) area located in the City of Maple Ridge, southwest of Lougheed Highway (Highway 7) and north of the Fraser River, across from McMillan Island. Kanaka Creek Park borders the site on the northwest of the site. Figure A below presents an overview of the site location, and Figure 1, attached to this report, shows a detailed view the study area, including borehole locations.

A Canadian National Railway runs parallel to Lougheed Highway, and borders the site on the northeast. A dike (#128 – Albion), is located on the northwest (border with Kanaka Creek Park), and forms part of the south border with the Fraser River. The dike does not extend across the entire southwestern border of the site, terminating immediately west of the recycling depot located at 10092 236 Street, Maple Ridge, BC.

The current land use is industrial, with various industries such as lumber, recycling and auto-body shops.

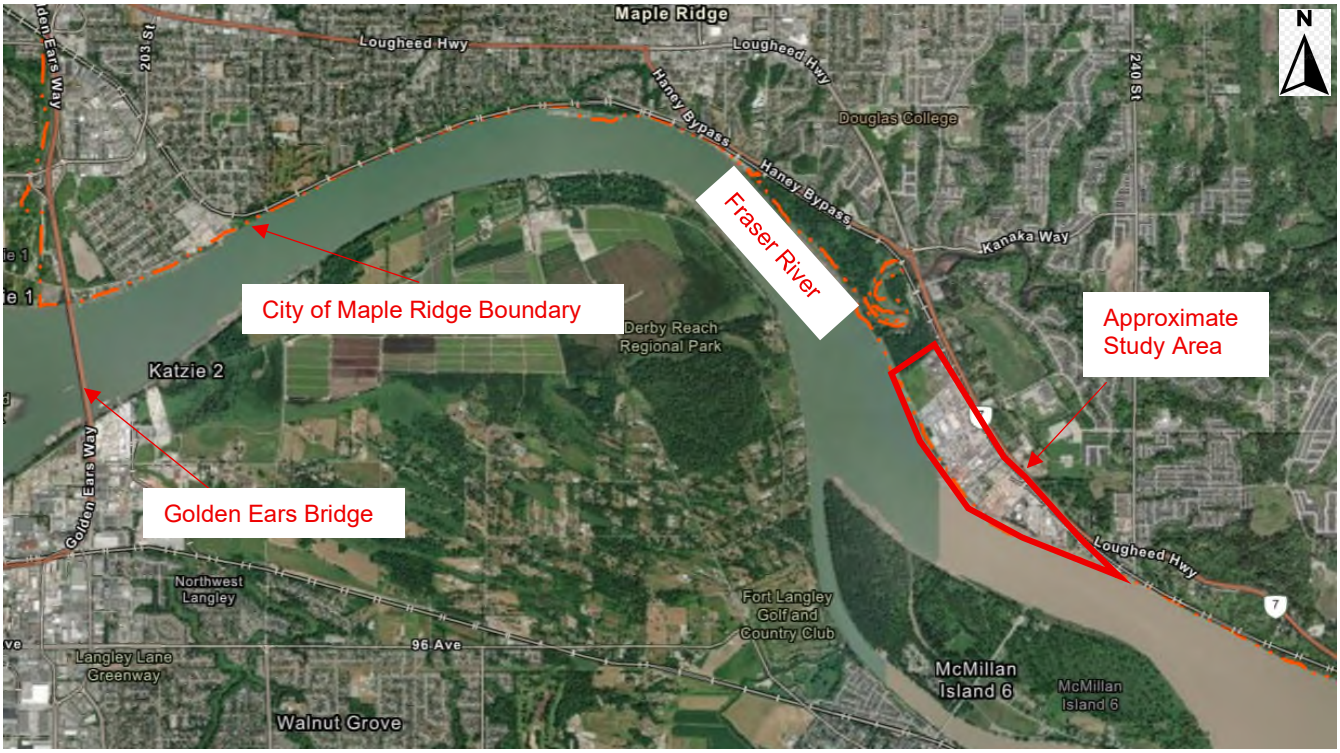

Figure A: Study Area Reference Map

4. Background Review

4.1 Surficial Geology

4.1.1 GSC Map 1484A

Ecora reviewed the Geological Survey of Canada "A" Series Map 1484A, which presents the surficial geology of New Westminster, BC and adjacent areas (see Figure A). Based on the Surficial Geology Map, the majority of the site is underlain by unit "*Fc"* (Fraser River Sediments) which are described as "*Overbank silty to silt clay loam normally up to 2 m thick overlying 15 m or more of Fd (Fd – deltaic and distributary channel fill (includes tidal flat deposits) sandy to silt loam"*. The southeastern tip of the site is mapped as unit "*FLd"* (Fort Langley Formation) which is described as *"marine silty clay to fine sand commonly containing marine shells*".

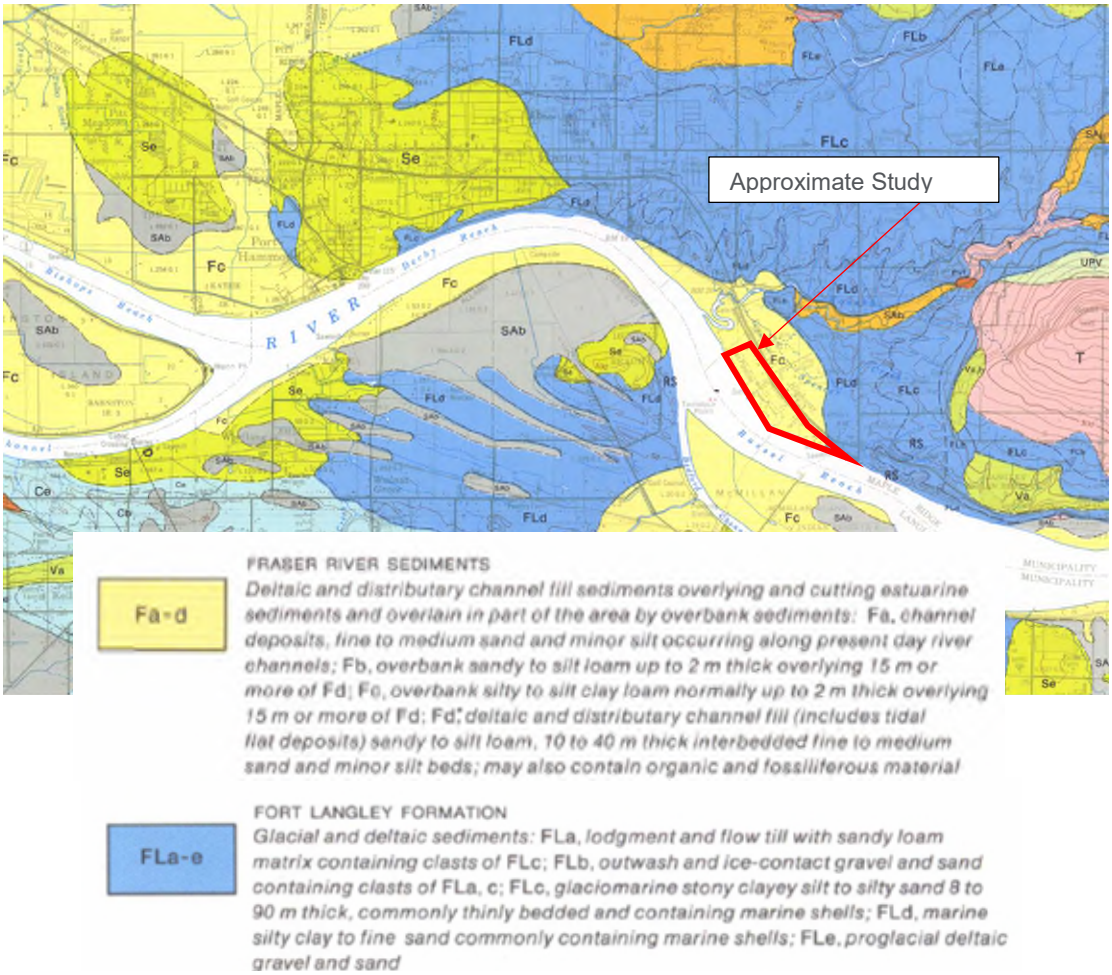

Figure B: Excerpt from Surficial Geology Map of New Westminster (Geological Survey of Canada, "A" Series Map, 1484A)

4.1.2 GSC Open File 3511

Ecora reviewed GeoMap Vancouver - Geological Map of the Vancouver Metropolitan Area (Geological Survey of Canada Open File 3511, 1998) which gives an overview of the soil types and hazards within the Lower Mainland.

Based on this map, the study area is underlain by modern silt, clay and loam, and by ice age silts and clays. The liquefaction hazard is generally moderate to high in modern day sediments, and low in ice-age sediments.

Flood hazard is generally “moderate to high” within the study area.

Slope stability hazard is generally “low”, except from directly adjacent to the Fraser River, where it is “moderate”.

4.2 Aerial Imagery

Ecora reviewed the following aerial imagery:

- UBC Airphotos dated 1938, 1940, 1949, 1951, 1954, 1959, 1963, 1974, 1978, 1982, 1986, 1993, 1996, 2005, 2009 and 2016.
- Google Earth aerial imagery dated 2003, 2004, 2006, 2008, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, and 2024.

In 1938, the study area is generally used as farmland, while some parts are still forested. The railway is also present. By 1949, most of the site use is still farmland, but indications of lumber being processed, such as large docks and logs in the water. In 1959, we can see the terminals for the Albion Ferry on either side of the Fraser River, with one located on the eastern border of the site. Between 1963 and 1969, and for several of the following years, multiple new structures appear throughout the study area. By 1986, the study area is mostly developed, with some small additional structures and land development until 2009. The site remains mostly unchanged between 2009 and the present day.

4.3 iMap Water Wells

Ecora undertook a water well search through iMap BC. Two water wells were found within 150 m of the study area. A summary of the lithology encountered is provided in the two tables below and the water well locations are shown on Figure 1 (attached).

Well #10108 is located within the study area at the southeastern end of the site, and indicates a water level of 1.2 m below ground level. The driller’s soil description is summarized in the table below.

Table 1: Well #10108 Summary

Depth From (m)	Depth To (m)	Driller’s Description
0	3.0	*“Glacial Clay”*

Well #41604 is located outside the study area approximately 150 m north of the northern perimeter, and indicates a water level of 4.8 m below ground level. The driller’s soil description is summarized in the table below.

Table 2: Well #41604 Summary

Depth From (m)	Depth To (m)	Driller’s Description
0	1.5	*“Open pit”*
1.5	13.7	*“Dry sand”*
13.7	18.3	*“Blue clay”*
18.3	19.8	*“Water-bearing sand”*

4.4 BC Public Registry of Environmental Borehole Logs

The BC public registry of environmental borehole logs indicated three borehole records all located within the study area. These boreholes were drilled primarily for environmental characterization rather than geotechnical. Borehole locations are shown on Figure 1 (attached).

Borehole MW09-1 was drilled on August 11, 2009, using solid stem auger, and supervised by personnel from SLR Consulting Ltd. The water table was encountered at 3.6 m below ground level. The encountered lithology is summarized in the table below.

Table 3: Borehole MW09-1 Summary

Depth From (m)	Depth To (m)	Soil Description
0	0.6	*"SAND & GRAVEL (road base), fine to coarse grain, compact, grey, moist"*
0.6	5.5	*"Silty SAND, fine grained, brown, moist, varying content of fine-grained material. Wood debris encountered at 5.1 m"*
5.5	6.1	*"SAND, fine to coarse grain, occasional gravel, grey, saturated"*

Borehole BH16-1/MW16-1D was drilled on December 6th, 2016, using sonic drilling, and supervised by personnel from TRI Environmental Ltd. The water table was encountered 3.04 m below ground level. The encountered lithology is summarized in the table below.

Table 4: Borehole BH16-1/MW16-1D Summary

Depth From (m)	Depth To (m)	Soil Description
0	0.9	*"SAND and GRAVEL (Fill), dark grey, dense, damp, medium to coarse sand and gravel"*
0.9	4.9	*"Silty SAND, brown, compact, damp, fine grained"*
4.9	12.2	*"SAND, grey, compact, wet, medium to fine grained. Trace gravel at 6.86 m. Trace wood and shells at 9.1 m"*

Borehole 12-BH/MW25D was drilled on June 28, 2017, using solid stem auger, and supervised by personnel from WSP Canada Inc. The water table was encountered at 3.0 m below ground level. The encountered lithology is summarized in the table below.

Table 5: Borehole 17-BH/MW25D Summary

Depth From (m)	Depth To (m)	Soil Description
0	1.5	*"Brown SAND and GRAVEL, trace silt, damp to moist, no odour."*
1.5	2.0	*"Wood waste with coarse sand, moist to wet"*
2.0	5.4	*"Grey silty SAND, moist to wet, no odour. Brown mottling at 4.5m. Wet below 3.0m."*
5.4	5.8	*"Grey, clayey SILT, sticky, wet."*
5.8	7.5	*"Grey SAND, medium to coarse, saturated, some woodchips at 6.9m"*

4.5 Previous Geotechnical Investigations

4.5.1 Valley Geotechnical (2021)

Valley Geotechnical Engineering completed a site investigation and provided geotechnical recommendations for the site located at 24138 Lougheed Highway, Maple Ridge, BC, 400 m east of the Albion Industrial Lands.

The site investigation consisted of four auger holes to maximum depths of 9.1 m, and one Cone Penetration Test to a depth of 12 m (refusal). Soils encountered included approximately 0.6 m of loose, black organic silt (topsoil), underlain by dense brown sand. Thin clayey silt seams were encountered around a depth of 7.6 m in two of the auger holes. Groundwater measurements were inconsistent, ranging between 3.0 m below ground level, to completely dry.

They assessed the site as a Site Class “D” and assessed a low chance of liquefaction.

They also completed a slope stability analysis of the south slopes, which resulted in factors of safety above 1.5 for static conditions, and above 1.0 for seismic conditions.

They recommend bearing capacities for foundations of 108 kPa (ULS) and 72 kPa (SLS), based on proper preparation of the bearing surfaces.

4.5.2 Valley Geotechnical (2023)

Valley Geotechnical Engineering completed a site investigation for a proposed development at 23562 River Road, Maple Ridge, BC, located within the Albion Industrial Lands.

The site investigation consisted of 2 auger holes to a depth of 18.3 m, a Cone Penetration Test (CPT) to a depth of 35 m and a seismic cone penetration test (SCPT) to a depth of 35 m below existing ground level. Soil conditions encountered near surface consisted of silty sands with gravel and woodchips underlain by clayey silts and silty sand, underlain by grey sand. Groundwater was encountered between depths of 4.5 m and 5.5 m.

They assessed the sands to be liquefiable and estimated up to 0.8 m of vertical settlement and 1.4 m of horizontal displacement for the design earthquake.

They assessed the upper silty sand and clays to be vulnerable to settlement, and recommended either preloading the site or the use of timber piles. They further recommend the use of piles to limit the disruptions and prevent damage to the existing Fortis BC pipeline. They anticipated timber pile lengths of 16 m to 19 m, with a 300 m diameter.

4.6 Previous Flooding and/or Dike Reports

4.6.1 GeoMedia - Engineering Design Brief (2007)

GeoMedia Engineering Ltd. prepared a design brief to the City of Maple Ridge to enable the emergency repairs of a 2.5 km long section of the Albion Dike.

As part of their design brief, they completed multiple hand pits at 200 m spacing along the dike, and encountered soils varying between sand & gravel, and sand & silt, some gravel. They also completed 7 boreholes, which found the dike material consistent with the hand pits, and foundation soils consisting of soft silt to clayey silt in one borehole (BH1), and fine-grained sand and silty sand in the remaining boreholes. Complete borehole or test pits logs were not available.

They completed a seepage analysis of the dike using Seep-W, which found that seepage breakout was predicted at the downstream (landside) face of the dike.

Slope stability analyses were also completed indicating a Factor of Safety (FoS) of 1.2 for a full flooding case, and a FoS of 1.1 for the sudden drawdown case.

The report recommended that a coarse 75 mm minus sand and gravel be placed on the landside of the dike, re-grading of the landside slope to 3H:1V, placement of 100 kg type riprap and, a vegetation cover of grasses on the dike slopes.

It is unknown if these repairs were completed.

4.6.2 NHC - Fraser River Hydraulic Model Update Report (2008)

This report presents the methodology and results of the update to the 2006 hydraulic modelling of flooding through the Fraser River, based on 2007 Fraser River freshet data. The hydraulic modelling is based on historical flooding along the Fraser River, and is typically consistent with flows for a 10 year return period or higher.

The report recommends a design flood level (m above sea level) for the City of Maple Ridge between 6.0 m (at the Pitt Meadows border), 7.70 m (at Whonnock Creek) and 7.90 m (at the Mission border).

4.6.3 Ministry of Environment (2009)

The 2009 MoE Floodplain Map indicates that the entire portion of the Albion industrial land is within the Fraser River floodplain. Additionally, it indicates two areas where the dike is low, one area of special concern along the dike, and a pumpstation/floodbox at the intersection between the dike and Dock Street.

4.6.4 NHC - Dike Assessment Report (2015)

The dike on the southwest side of the site was assessed in the 2015 Lower Mainland Dike Assessment Report (available online), and was prepared by Northwest Hydraulic Consultants. The dike runs along the riverway from the northern edge to the boundary between 23562 River Road, and 10092 236 Street, where it runs inland and meets the end of 236 Street. The section relevant for this is part of Dike 128 – Albion (Maple Ridge) between approximate chainage 0+660 and 2+320. Table 6 below presents the findings of the assessment.

Table 6: Reproduction of Dike Assessment Report - Dike 128 Summary Table

Rating Item	NHC Rating*	Rationale
Crest Elevation vs DCL	1	Crest elevation is below design flood water level (e.g. at 1+350 crest is at 6.4m GDC and DCL is 7.3m). There are many large gaps throughout the dike length with some sections fully removed by landowners. Dike does not tie into high ground, from 2+320 to 2+618 the dike is missing and only has a proposed alignment.
Geometry	1	Geometry varies but for most of the dike, the crest width is 3 m. Landside slope is typically 3H:1V. Riverside slope varies but is reported to average 1.6H:1V. Some oversteepened riverside slopes could be heavily eroded and fail during a high flow event.

Rating Item	NHC Rating*	Rationale
Geotechnical Stability - General	1	"Dike is constructed from earth fill. Seepage is predicted along downstream face of dike. Seepage and possible piping likely since dike was originally constructed. Previous sloughing events noted from oversteepened and concave appearance of waterside of dike likely from fallen trees."- NHC Settlements will be significant and might be very high locally if there is in fact hog fuel below portions of the dike
Geotechnical Stability - Seismic	1	Extensive liquefaction, seismically induced settlements and lateral spreading are likely. " Seismic study conducted in 2011 concluded that the dike is underlain by soils susceptible to liquefaction under the 1:475 design seismic event. Dike expected to become unstable, experience significant lateral deformation."
Erosion Protection	1	Riprap has been placed along sections of Fraser River RB that experienced erosion. No filter layer placed between angular riprap and dike material. Dike is not set back and runs adjacent to the Fraser River and Kanaka Creek. Erosion has occurred along the Fraser at the upstream end of the Albion Dike, at 236th Street. Bank erosion during a flood event is considered a significant hazard.
Vegetation/Animal Control	2	Vegetation management minimal allowing large trees to grow on the dike slopes and low brush to obstruct views of the dike's condition.

*NHC rating varies between 1 (unacceptable) and 4 (good).

4.6.5 BGC Engineering (2024)

BGC originally completed an assessment of the Albion Dike, and appurtenant structure in 2016. The original assessment found the dike was deficient, and did not meet full provincial standards. The deficiencies included flood elevation, geometry, Right of Way (ROW) and access, geotechnical design (stability and seismic), operations and maintenance manuals, utilities and environmental design and vegetation management. The original study also developed a cost-benefit comparisons in 2012 dollars for dike upgrades.

The 2016 update aimed to update the cost-benefit analysis to 2024 dollars, as well as update the dike consequence classification and seismic guidelines, updated design floods, updated flood depth-damage functions based on Canadian data, and construction, operation and maintenance cost inflation.

BGC confirmed that the current consequence classification is “moderate”, but may change depending on future development.

They found that the dike had a 10- to 25-year return period protection, well below the Provincial requirement of 200-year return period protection for dikes in BC, and 500-year return period protection requirements for dikes on the Lower Fraser River. At the study site, the 200-year return period flood elevation is between 6.0 and 6.3 m, while the 500-year return period flood elevations are between 6.4 to 6.7 m. The 500-year return period flood with climate change (2050) is between 7.0 and 7.4 m.

5. Geotechnical Investigation

Ecora carried out a geotechnical investigation between May 12 and May 15, 2025. A BC1Call was completed prior to any field activities. Permission from all landowners, as well as relevant permits from the City, were acquired prior to any field activities. The utility locating was completed on May 12, 2025, by TerraProbe GeoScience Corp.

During the field program, Ecora completed the following:

- 3 Cone Penetration Tests (CPT 25-02, CPT 25-04 and CPT 25-05) to depths of 35.2 m to 35.4 m.
- 2 Seismic Cone Penetration Tests (SCPT 25-01 and SCPT 25-03) to depths of 18.6 m to 35.4 m.
- 5 shallow auger boreholes (BH 25-01 to BH 25-05) to depths of 6.1 m to 7.6 m.

Auger drilling and CPT/SCPT operations were completed by Southland Drilling Ltd and Schwartz Soil Technical Ltd. Ecora staff members supervised the drilling operations on a full-time basis.

Auger boreholes were completed at an approximate 0.9 m offset from the corresponding CPT/SCPTs.

Figure 1 attached shows the approximate location of the investigations, and Table 7 below summarizes the locations and termination depths. Complete borehole logs are attached in Appendix B, and CPT/SCPT data are attached in Appendix C.

It should be noted that Standard Penetration Tests (SPTs) were not conduced as characterization of strength was undertaken based primarily on the CPT/SCPTs. The auger holes were drilled to sample near surface soils (between 6.1 m and 7.6 m) and for anchoring the CPT rig.

Table 7: Borehole and CPT/SCPT Completion Summary

Test Hole Number	Test Hole Type	Investigation Date	Northing* (m)	Easting* (m)	Ground Surface Geodetic Elevation** (m above sea level)	Termination Depth (m)
SCPT25-01	SCPT	May 14, 2025	5447825	532118	5.6	18.6
CPT25-02	CPT	May 14, 2025	5448215	531352	5.1	35.4
SCPT25-03	SCPT	May 14, 2025	5448745	530999	5.2	35.4
CPT25-04	CPT	May 15, 2025	5448634	530993	5.1	35.4
CPT25-05	CPT	May 15, 2025	5449083	530892	5.4	35.2
BH25-01	Auger Hole	May 14, 2025	5447825	532118	5.6	6.1
BH25-02	Auger Hole	May 14, 2025	5448215	531352	5.1	6.1
BH25-03	Auger Hole	May 14, 2025	5448745	530999	5.2	7.6
BH25-04	Auger Hole	May 15, 2025	5448634	530993	5.1	6.1
BH25-05	Auger Hole	May 15, 2025	5449083	530892	5.4	6.1

* Coordinates acquired with consumer-grade GPS.
**Ground elevation acquired from the BC LiDAR data dated 2017.

6. Laboratory Test Results

A summary of the laboratory test results is presented in Tables 8 and 9 below, and complete results are attached in Appendix D.

Table 8: Moisture Content and Sieve Testing Summary

Borehole Number	Sample Depth (m bgl)	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)	Soil Description
BH25-01	0.5 - 0.7	23.6	N/A			Sandy SILT, trace gravel.
BH25-01	1.8 - 2.1	27.9	N/A			Sandy SILT, trace gravel.
BH25-01	3.6 - 3.9	27.9	N/A			Sandy SILT, trace gravel.
BH25-01	5.5 - 5.8	33.2	N/A			CLAY, some silt.
BH25-02	0.8 - 1.2	15.3	N/A			Sandy SILT, trace gravel.
BH25-02	1.8 - 2.1	21.2	N/A			Sandy SILT, trace gravel.
BH25-02	3.6 - 3.9	29.8	N/A			Clayey SILT.
BH25-02	5.1 - 5.4	26.7	N/A			Clayey SILT.
BH25-03	0.6 - 0.9	23.7	N/A			Clayey SILT.
BH25-03	1.8 - 2.1	30.7	N/A			Sandy SILT.
BH25-03	3.9 - 4.2	23.6	N/A			Clayey SILT.
BH25-03	5.5 - 5.8	32.3	N/A			Clayey SILT.
BH25-03	6.5 - 6.8	27.3	2.3	69.7	28.0	SAND with fines, trace gravel.
BH25-04	0.5 - 0.8	10.3	N/A			SAND & GRAVEL
BH25-04	1.8 - 2.1	14.1	N/A			SAND, some silt.
BH25-04	3.6 - 3.9	19.8	N/A			SAND, trace fines, trace gravel.
BH25-04	5.1 - 5.2	23.7	2.1	92.5	5.4	SAND, trace fines, trace gravel.
BH25-05	0.5 - 0.8	27.1	N/A			Sandy SILT.
BH25-05	1.8 - 2.1	31.9	N/A			Sandy SILT.
BH25-05	3.6 - 3.9	33.2	N/A			SAND, trace silt.
BH25-05	5.1 - 5.2	19.9	N/A			SAND, trace silt.

Table 9: Atterberg Limit Testing Summary

Borehole Number	Sample Depth (m bgl)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Soil Description
BH25-01	3.6 – 3.9	27.9	Non-plastic			Non-plastic sandy SILT, trace gravel.
BH25-02	1.8 – 2.1	21.2	Non-plastic			Non-plastic sandy SILT, trace gravel.
BH25-05	1.8 - 2.1	31.9	29	24	5	Low Plastic sandy SILT.

7. Subsurface Conditions

7.1 Fill

Fill layers were encountered from surface to depths between 0.3 m and 1.2 m. This layer was generally comprised of sand and gravel but is likely to vary throughout the area.

Field descriptions indicated that this material was well graded, dry and brown. Laboratory index testing indicated moisture content between 10.3% and 27.1%

CPT/SCPTs could not penetrate this layer, and drill outs were completed.

7.2 Firm to Stiff Silt and Clay (Fraser River Sediments)

A firm to stiff silt and clay deposit was encountered directly below the fill, extending to depths of between 5.1 m and 6.5 m. BH25-01 terminated in this deposit. This deposit was described as silt to silty clay, some fine sand. The composition was generally sandier in BH25-04 and BH25-05.

Field description indicated this material was non-plastic to low-plastic, moist to wet and varied color between brown and grey. Laboratory index testing indicated a moisture content between 14.1% and 33.9%. Atterberg limits test indicated this deposit varied between non-plastic to low-plastic, with a liquid limit of 29, a plastic limit of 24 and a plasticity index of 5.

CPT/SCPT data in this deposit indicated it behaved as clay, clay and silty clay, and silty sand to sandy silt. The sandier behaviors were more likely towards the deeper parts of this layer. CPT "I_c" values ranged between 2.2 and 3.1.

Undrained shear strengths inferred from the CPTs were variable depending on the CPT/SCPT location but most inferred values were between 100 and 200 kPa.

These fine grained deposits are inferred to be the Fraser River overbank deposits noted on the surficial geology map (see Figure A in section 4.1).

7.3 Compact Sand (Fraser River Sediments)

A compact sand deposit was encountered directly below the silt and clay at a depth of 5.1 m to 6.5 m. The compact sand extended to the CPT termination depths.

Field description indicated this material was fine to medium grained, well graded, brown and moist to wet. Sieve tests indicated a gravel content between 2.1% and 2.3%, sand content between 69.7% and 92.5% and fines content between 5.4% and 28.0%.

CPT/SCPT data in this deposit indicated it behaved as a "sand & silty sand" to "gravelly sand to sand". SCPT25-01 reached refusal in this layer at a depth of 18.6 m. All other CPT/SCPT reached target termination depth in this layer of about 35 m. CPT "I_c" values ranged between 1.2 and 1.6.

The deposits are inferred to be the Fraser River sediments described in Section 4.1.

7.4 Groundwater

The soils were logged as "wet" at depths between 5.1 m and 6.0 m in the auger holes.

Interpolation from the CPT and SCPT pore pressure data indicates a water table between 3.5 m and 4.5 m below ground level. The auger hole groundwater depths correspond to the typical Fraser River levels, while the CPT data indicates the groundwater level is slightly above it.

These measurements were acquired in early spring, and may change due to seasonal variations.

7.5 Shear Wave Velocity Readings

Shear wave velocity measurements ranged between 108 m/s and 324 m/s. The V_{s30} for SCPT25-03 was measured at 220 m/s.

SCPT25-01 did not reach 30 m, the Vs_{18} was 205 m/s. Vs_{30} regression models by Boore (2004) estimates a Vs_{30} of 233 m/s, assuming similar or better ground below the termination depth.

8. Geotechnical Analysis

To support the provision of geotechnical recommendations for the Albion industrial lands, Ecora undertook seismic and stability analyses. These are summarized in the following sections. Interpretation of the results and subsequent development recommendations are provided in Section 9.

8.1 Seismic Analysis

8.1.1 Liquefaction Triggering Analysis

A liquefaction triggering assessment was undertaken using the data acquired from the background review and from the field operations. The analysis was completed using Cliq by GeoLogismiki (V3.5.3.8), a data processing software for liquefaction analysis. The analysis was completed for the 2475-year return period earthquake. A surface PGA of 0.44 g was used based on a Vs_{30} of 215 m/s and the 6th Generation seismic hazard from the Earthquakes Canada online calculator.

A design groundwater depth between 3.5 m and 4.5 m was utilized based on the groundwater pore pressure measurements in the SCPT/CPTs.

The Boulanger and Idriss (2014) CPT triggering methodology was primarily relied upon, however; a shear wave velocity (Vs) approach was also utilized (Kayen et al. (2013)) as a secondary verification. The complete results are presented in Appendix F.

A summary of the results is provided below.

- Fill: The surficial fills are typically above the water table and thus unlikely to liquefy.
- Firm to Stiff Silt and Clay (overbank Fraser River sediments): The analyses indicate that where saturated (i.e. below the groundwater table), these deposits are likely to undergo liquefaction triggering based on their limited plasticity.
- Compact Sands (Fraser River sediments): These saturated deposits are likely to liquefy based on both the CPT-based and shear wave velocity-based assessments.

8.1.2 Liquefaction Induced Settlements

Liquefaction-induced free-field settlements were estimated to be in the order of 600 mm to 1100 mm, noting that these estimates do not include shear-induced (i.e. building load) and ejecta-induced settlements. Liquefaction induced settlements were calculated using the Bray & Olaya (2023) method.

8.1.3 Lateral Spreading

Lateral spreading refers to the horizontal movement of surficial soils, over liquefied sediments during an earthquake. The blocks of surficial soils displace downslope, or towards a free face, such as a river channel, along a shear zone which has developed within the underlying liquefied sediments.

Lateral spreading estimates were calculated for the 2475-year earthquake using the Youd et. al.(2002) methodology, which uses a mean PGA, different than the PGA provided by Earthquakes Canada, which includes consideration of the data scatter. A mean PGA for the site of 0.22 g was used based on an assessment of the hazard in OpenQuake.

Lateral spread displacement estimates vary from 2,100 and 5,000 mm, with higher displacements estimates closer to the river. Youd recommends using a range between half and double these values to account for the data scatter. Any lateral spreading estimate larger than 6,000 mm may result in a flow slide (Youd et al., 2002).

8.2 Slope Stability Analysis

8.2.1 General

Ecora completed a slope stability analysis along several cross-sections within the study area. The objective of this analysis was to provide a high-level understanding of slope stability along the banks of the Fraser River. Site specific assessment will be required for development of individual lots as building loads, fill placement, river setback, etc. will need to be considered.

8.2.2 Input Parameters, Methodology and Assumptions

Cross-section locations are presented in Appendix E attached, and were selected for a representative selection throughout the study area.

The slope stability analysis used limit equilibrium software Slide2 (v9.038) by RocScience. The GLE/Morgenstern-Price method of slices was used for the analysis. A static factor of safety (FoS) of 1.5, and pseudo-static FoS of 1.0 were considered “stable” based on EGBC’s *Landslide Assessments in British Columbia* (2023) professional practice guidelines.

Topographical parameters were taken from the BC Lidar data dated 2017 and bathymetric data was taken from the British-Columbia Nautical Chart Pattullo Bridge to Crescent Island (BC Ministry of Fisheries and Oceans, 1994).

Soil parameters were selected based on correlations between CPT data, $N_{1\,60}$, and Relative Density from *NAVFAC - Soil Mechanics* (1986) and *CalTrans - Geotechnical Manual soil correlations* (2021).

A summary of the soil parameters used is presented below:

Table 10: Slope Stability Input Summary

Soil Name	Strength Type	Unit Weight (kN/m^3)	Cohesion/Undrained Shear Strength (kPa)	Friction Angle (°)
Silt and Clay (Drained)	Mohr-Coulomb	18	-	28.5
Silt and Clay (Undrained)	Undrained	18	75	-
Compact Sand	Mohr-Coulomb	20	-	35

In addition to the input parameters presented above, Ecora used the following assumptions:

- Semi-horizontal soil layers based on CPT and SCPT data.
- Water table from correlation between CPT and SCPT pore pressure data.
- Both drained and undrained behavior were considered for the upper silts and clays under static loading.
- Only undrained behavior was considered for the upper silts and clays under seismic loading.

8.2.3 Results and Discussion

Complete results of the slope stability analysis are presented in Appendix E. Based on the analysis, static conditions indicate stable conditions at distances between 7 m and 11 m from the River's edge. Pseudo-static conditions indicate a setback of at least 12 m.

It should be noted that a post-seismic and/or Newmark-type analysis was not in Ecora's scope of work, but should be completed for any properties adjacent to the shoreline in order to estimate lateral displacement estimates, and allow the structural design to accommodate those.

Additional structure or stockpile loading at the surface will affect both static and pseudo-static stability. An updated slope stability analysis should be completed for any proposed buildings and large stockpiles near the shoreline.

Additionally, Ecora would like to note that these setbacks do not take into account lateral spreading and or post-seismic displacements. These are significant and would impact structures, regardless of the setbacks previously mentioned.

8.3 Settlement

The placement of bulk fills for flood proofing and the loads from new structures has potential to cause consolidation settlement of the fill, firm to stiff silts and compact sands underlying the site.

Site specific settlement analyses will be required once such details are known. Preloading and other ground improvement measures may need to be implemented depending on these analyses.

9. Geotechnical Development Recommendations

Based on the detailed background review, geotechnical investigation and analyses undertaken, Ecora makes the following recommendations for development of the Albion Industrial Lands:

- Due to the potential for liquefaction, lateral spreading, and consolidation settlement, it is possible that larger structures may require pile foundations (designed to accommodate seismic loading) or ground improvement measures. Ground improvement measures could include preload, excavate/replace, soil mixing, stone columns, rammed aggregate piers, dynamic compaction or rapid impact compaction to name a few. The site-specific development constraints (e.g. loads, location, soil conditions, etc.) will determine which measure is best suited.
- For smaller structures it may be possible to take advantage of the crust of non-liquefiable soils above the water table and avoid the need for ground improvement or pile support. As noted earlier, the silt/clay soils at some locations had undrained shear strengths in the order of 100-200 kPa and the depth to the liquefiable sands is deeper (5-6 m). There is potential for these sites to have structures supported on shallow foundations without the need for preloading or ground improvement.
- The presence of liquefiable soils under the study area designates the area as a Site Class “F” as described by the National Building Code of Canada (NBCC) (2020) and the British Columbia Building Code (BCBC) (2024) and thus structures will require a site response analysis to determine surface response spectra for structural design (unless clause #4 of BCBC Section 4.1.8.4 is invoked, with respect to the structure’s fundamental lateral period of less than 0.5 seconds).
- Based on the stability analyses, the zone of instability next to the Fraser River extends about 12 m back from the slope crest and thus the development of new buildings near the river will need to consider slope instability. Site and building-specific evaluation will be required as fill placement and building loads will affect both static and seismic stability.
- Groundwater was encountered at depths of 3.5-4.5 m throughout the study area, The groundwater table is likely influenced by the Fraser River and will fluctuate depending on the season and due to climate change effects. If developers adopt basements for new development, consideration should be given to the high water table during design.
- The study area is outlined as a floodplain within the Fraser River floodplain model (MOE, 2008). The existing Albion Dike through part of the study area, has been assessed by others as in poor condition. The dike should be assessed for its resilience particularly with rising water levels due to climate change. Dike upgrades and/or flood proofing fill placement on lots may be required. A hydrotechnical engineer should be consulted to comment on flooding. Seismic evaluation of the dike is also recommended which should be undertaken in accordance with the Seismic Guidelines for Dike, 2nd Edition (Ministry of Forests, Lands and Natural Resource operations, 2014).
- Given the historical industrial use of the area, there is the potential for soil and groundwater contamination. A Phase 1 Environmental Site Assessment (ESA) is recommended to further understand this risk.
- Key infrastructure is present running through several properties with the study area (including the Fortis BC – High and Intermediate Pressure gas pipeline, CN Railway). Any earthworks, pile driving or ground improvement should consider the effects on these utilities (e.g. from vibrations).
- It is reiterated that this geotechnical assessment was intended to be a high-level overview study to assist the City of Maple Ridge in understanding geotechnical conditions and risks for the area. Site-specific geotechnical investigations will be required for the developments proposed at each lot.

10. Closure

We trust this study meets your requirements. Please contact us if you have any questions or comments.

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Canadian Commission on Building and Fire Codes. "*National Building Code of Canada"*, 2020.

Youd, T. Leslie, Corbett M. Hansen, and Steven F. Bartlett. "*Revised multilinear regression equations for prediction of lateral spread displacement*." Journal of Geotechnical and Geoenvironmental Engineering 128.12 (2002): 1007-1017.

Youd, T. Leslie. "*Application of MLR procedure for prediction of liquefaction-induced lateral spread displacement*." Journal of Geotechnical and Geoenvironmental Engineering 144.6 (2018): 04018033.

Figures

SITE PLAN

ecora™

ALBION INDUSTRIAL LANDS GEOTECHNICAL STUDY MAPLE RIDGE, BC

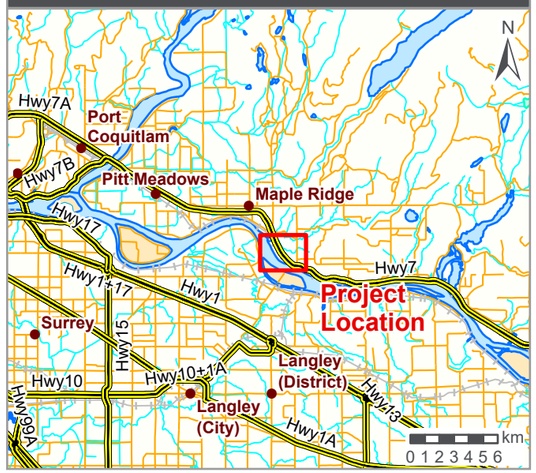
Legend

- Water Wells
- Passed Drilling
- Borehole & CPT/ SCPT Locations
- Borehole Locations
- Albion Dike Alignment
- BC Highways
- Fresh Water Atlas Streams
- City of Maple Ridge Roads
- Freshwater Atlas Rivers
- City of Maple Ridge Legal Parcels
- Study Area

References

Aerial Imagery: Google Earth 6/12/2024

LOCATION MAP



1:10,000

0 100 200 300 400 Meters

Project No.: 2500096
Client: City of Maple Ridge

Date: 2025/06/18
Drawn: CAC Check: AS

NAD 1983 UTM Zone 10N

Figure 1.0

Path: Z:\2025\2500096\geotechnical\11_gis\plots\2400096_site_plan\2500096_sp.aprx

Photographs

Photo 1 **Drilling at location BH25-01/SCPT25-01. Facing south.**

Photo 2 **Drilling at location BH25-02/CPT25-02. Facing northwest.**

Photo 3 Drilling at location BH25-03/SCPT25-03. Facing southwest.

Photo 4 Drilling at location BH25-04/CPT25-04. Facing south.

Photo 5 **Fortis compression station located on McKay Road, near the intersection with River Road.**

Photo 6 **Drilling at location BH25-05/CPT25-05. Facing northeast.**

Appendix A

General Conditions

Statement of General Conditions — Geotechnical

Standard of Care

Ecora Engineering & Environmental Ltd. (Ecora) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report

This report and the recommendations contained in it are intended for the sole use of Ecora's Client. Ecora does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Ecora's Client unless otherwise authorized in writing by Ecora. Any unauthorized use of the report is at the sole risk of the user. In order to properly understand the suggestions, recommendations and opinions expressed herein, reference must be made to the whole of the report. We cannot be responsible for use by any party of portions of the report without reference to the whole report.

Ecora shall have no liability to any third party in relation to the use of or reliance upon this report or for any use unrelated to the intended purpose of the report.

Alternate Report Format

Where Ecora submits both electronic file and hard copy versions of reports, drawings and other project-related documents, only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Ecora shall be deemed to be the original for the Project. Both electronic file and hard copy versions of Ecora's deliverables shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Ecora.

Soil, Rock and Groundwater Conditions

Classification and identification of soils, rocks and geological units have been based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Ecora does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities such as traffic, excavation, groundwater level lowering, pile driving, blasting on the site or on adjacent sites. Excavation may expose the soils to climatic elements such as freeze/thaw and wet /dry cycles and/or mechanical disturbance which can cause severe deterioration. Unless otherwise indicated the soil must be protected from these changes during construction.

Environmental and Regulatory Issues

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 the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Sample Disposal

Ecora will dispose all soil and rock samples for 30 days following issue of this report. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

Construction Services

During construction, Ecora should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Ecora's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Ecora's report. Adequate field review, observation and testing during construction are necessary for Ecora to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Ecora's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Job Site Safety

Ecora is responsible only for the activities of our employees on the jobsite. The presence of Ecora's personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that Ecora never occupy a position of control of the site. The Client undertakes to inform Ecora of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general.

Changed Conditions and Drainage

Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Ecora be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Ecora be employed to visit the site with sufficient frequency to detect if conditions have changed significantly. Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Ecora takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

Services of Sub consultants and Contractors

The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. Ecora may arrange the hiring of these services as a convenience to our Clients. As these services are for the Client's benefit, the Client agrees to hold the Company harmless and to indemnify and defend Ecora from and against all claims arising through such hiring's to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

Appendix B

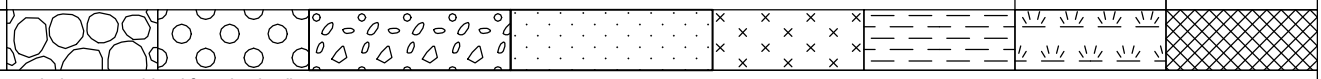
Borehole Logs

TERMS, SYMBOLS AND ABBREVIATIONS USED ON BOREHOLE & TEST PIT LOGS

SOIL DESCRIPTION SEQUENCE OF TERMS - consistency - fraction - grading - moisture - plasticity - additional

The visual field description and classification of soils is made in accordance with the Canadian Foundation Engineering Manual 4th Edition (Canadian Geotechnical Society, 2006) and the International Association of Engineering Bulletin, Rock and Soil Description and Classification for Engineering Geological Mapping (1981) with the exception of particle size criteria which is made on the basis of ASTM D2487-06 Standard Practice for Classification of Soils for Engineering Purposes.

PARTICLE SIZE CRITERIA & GRAPHIC SYMBOL

TYPE	COARSE							FINE		ORGANIC	FILL
	Boulders	Cobbles	Gravel		Sand			Silt	Clay	Organic Soil	Fill
			coarse	fine	coarse	medium	fine				
Size Range (mm)	200	75	19		4.75	2	0.475	0.075	0.002		
Graphic Symbol											

Notes: 1.) Graphic symbols are combined for mixed soil types.
2.) The upper particle size for clay is as per the Canadian Foundation Engineering Manual.

PROPORTIONAL TERMS

FRACTION	TERM	% OF SOIL MASS	EXAMPLE
Major	(....) and (.....) (UPPER CASE)	35 to 50	GRAVEL
Subordinate	(....) y (lower case)	20 to 35	sandy
Minor	some (....) (lower case)	10 to 20	some clay
	trace (....) (lower case)	less than 10	trace silt

CONSISTENCY TERMS FOR COHESIVE SOILS

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	FIELD DIAGNOSTIC CHARACTERISTICS
very soft	< 12	Easily exudes between fingers when squeezed.
soft	12 to 25	Easily indented by fingers.
firm	25 to 50	Can be indented by strong finger or thumb pressure.
stiff	50 to 100	Cannot be indented by thumb pressure.
very stiff	100 to 200	Can be indented by thumb nail.
hard	200 to 500	Difficult to indent by thumb nail.

CONSISTENCY TERMS FOR GRANULAR SOILS

DESCRIPTIVE TERM	SPT 'N' VALUE (BLOWS / 300 mm)	DYNAMIC CONE (SCALA) (BLOWS / 100 mm)
very loose	< 4	0 to 2
loose	4 to 10	1 to 3
compact	10 to 30	3 to 7
dense	30 to 50	7 to 17
very dense	> 50	> 17

Notes: 1.) No correlation implied between the SPT and Scala Penetrometer.
2.) SPT 'N' values are uncorrected.

MOISTURE CONDITION

DESCRIPTIVE TERM	CONDITION	FIELD DIAGNOSTIC CHARACTERISTICS	
		COHESIVE SOILS	GRANULAR SOILS
dry	Looks and feels dry.	Hard, powdery or friable.	Runs freely through hands.
moist	Feels cool, darkened in colour.	Weakened by moisture, but no free water on hands when remoulding.	Tend to cohere.
wet		Weakened by moisture, free forms water on hands when handling.	
saturated	Feels cool, darkened in colour and free water is present on the sample.		

PLASTICITY TERMS FOR COHESIVE SOILS

TERM	DESCRIPTION
high plasticity	Can be moulded or deformed over a wide range of moisture contents without cracking or showing any tendancy to change volume.
medium plasticity	Can be moulded over a wide range of moisture contents however will crack at low moisture contents.
low plasticity	Can be moulded in fingers when moist however crumbles.
non plastic	Has no ability to be moulded at any moisture content, may show quick or dilatant behavior.

GRADING TERMS FOR GRANULAR SOILS

TERM	DESCRIPTION	
well graded	Good representation of all particle sizes from largest to smallest.	
poorly graded	Limited representation of grain sizes - further divided into:	
	uniformly graded	Most particles about the same size.
	gap graded	Absence of one or more intermediate sizes.

SENSITIVITY TERMS FOR COHESIVE SOILS

TERM	S_t RATIO OF PEAK/REMOULDED UNDRAINED SHEAR STRENGTH
quick clay	$S_t > 16$
extra sensitive	$8 < S_t < 16$
sensitive	$4 < S_t < 8$
medium sensitivity	$2 < S_t < 4$
low sensitivity	$S_t < 2$

SAMPLE TYPE

TERM	DESCRIPTION
B	Bulk disturbed sample.
C	Core sample obtained with the use of standard size coring bits.
D	Small disturbed sample.
P	Piston sampler
S	Split spoon sample (obtained by performing the Standard Penetration Test)
T	Shelby tube or thin wall tube.

WATER LEVEL

SYMBOL	DESCRIPTION
▼	Measured in a standpipe, piezometer, or well.
▽	Inferred.

BOREHOLE: BH25-01

Project: Albion Industrial Lands Geotechnical Study
Location: Albion Industrial Lands
Zone: 10 Northing: 5447825 Easting: 532118

Project No: 2500096
Client: City of Maple Ridge
Elevation: 5.6m

DEPTH (m)	DRILLING METHOD	GRAPHICAL LEGEND	DESCRIPTION (For Explanation of Terms, Symbols and Abbreviations See Attached Key Sheet)	SAMPLE TYPE	SAMPLE NUMBER	PARTICLE SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	FINES (%)	STANDARD PENETRATION TEST (N)	DYNAMIC CONE PENETRATION TEST (Blows/300mm) 10 20 30 40 / SCALA PENETRATION TEST (Blows/50mm) 1 2 3 4 / STANDARD PENETRATION TEST (N) 10 20 30 40	POCKET PEN. (kPa) 100 200 300 400 / FIELD VANE (kPa) REMOULDED PEAK 40 80 120 160 / PLASTIC M.C. LIQUID 10 20 30 40	ELEVATION (m)
	Solid Stem Auger		**SAND & GRAVEL (FILL)** (0 m to 0.5 m) Dense SAND & GRAVEL, well graded, brown, dry.									
1			**SILT (SM)** (0.5 m to 5.5 m) Compact SILT, some fine sand, non-plastic, brown, moist.	G	G1							
2				G	G2							
3			Becomes loose and grey.									
4				G	G3							
5												
6			**CLAY (CL)** (5.5 m to 6.1 m) Soft CLAY, some silt, low plasticity, grey, moist. Becomes wet.	G	G4							
			End of hole at 6.1 m below ground level. Target depth reached. Groundwater encountered at 6.0 m below ground level.									

Contractor: Southland Drilling Ltd. Logged By: MB Started: 2025-05-14 Hole Inclination: 90° Completion Depth: 6.1m
Drilling Rig: Truck Rig Reviewed By: DB Completed: 2025-05-14 Hole Orientation: 0° Page 1 of 1

BOREHOLE: BH25-02

Project: Albion Industrial Lands Geotechnical Study
Location: Albion Industrial Lands
Zone:10 Northing: 5448215 Easting: 531352

Project No: 2500096
Client: City of Maple Ridge
Elevation: 5.1m

DEPTH (m)	DRILLING METHOD	GRAPHICAL LEGEND	DESCRIPTION (For Explanation of Terms, Symbols and Abbreviations See Attached Key Sheet)	SAMPLE TYPE	SAMPLE NUMBER	PARTICLE SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	FINES (%)	STANDARD PENETRATION TEST (N)	ELEVATION (m)
0	Solid Stem Auger		**SAND & GRAVEL (FILL)** (0 m to 0.9 m) Dense SAND & GRAVEL, well graded, brown, dry.							
1			**SILT (SM)** (0.9 m to 3.3 m) Compact sandy SILT, fine-grained sand, non-plastic, brown, moist.	G	G1					
2				G	G2					
3										
4			**SILT (ML)** (3.3 m to 6.1 m) Firm clayey SILT, low plasticity, brown, moist.	G	G3					
5			Becomes grey.	G	G4					
6			End of hole at 6.1 m below ground level. Target depth reached. Groundwater encountered at 5.1 m below ground level.							

DYNAMIC CONE PENETRATION TEST (Blows/300mm): 10 20 30 40
SCALA PENETRATION TEST (Blows/50mm): 1 2 3 4
STANDARD PENETRATION TEST (N): 10 20 30 40
POCKET PEN. (kPa): 100 200 300 400
FIELD VANE (kPa): REMOULDED / PEAK — 40 80 120 160
PLASTIC M.C. LIQUID: 10 20 30 40

Contractor: Southland Drilling Ltd. Logged By: MB Started: 2025-05-14 Hole Inclination: 90° Completion Depth: 6.1m
Drilling Rig: Truck Rig Reviewed By:DB Completed: 2025-05-14 Hole Orientation: 0° Page 1 of 1

BOREHOLE: BH25-03

Project: Albion Industrial Lands Geotechnical Study
Location: Albion Industrial Lands
Zone:10 Northing: 5448745 Easting: 530999

Project No: 2500096
Client: City of Maple Ridge
Elevation: 5.2m

DEPTH (m)	DRILLING METHOD	GRAPHICAL LEGEND	DESCRIPTION (For Explanation of Terms, Symbols and Abbreviations See Attached Key Sheet)	SAMPLE TYPE	SAMPLE NUMBER	PARTICLE SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	FINES (%)	STANDARD PENETRATION TEST (N)
0	Solid Stem Auger		**SAND & GRAVEL (FILL)** (0 m to 0.3 m) Dense SAND & GRAVEL, well graded, brown, dry.						
			SILT (SM) (0.3 m to 3.3 m) Compact sandy SILT, fine-grained sand, non-plastic, brown, moist.	G	G1				
2				G	G2				
3									
			SILT (ML) (3.3 m to 6.1 m) Firm clayey SILT, low plasticity, brown, moist.	G	G3				
5			Becomes wet and grey.	G	G4				
6			**SAND (SW)** (6.1 m to 7.6 m) SAND, trace silt, fine to medium grained, well graded, brown, moist.	G	G5				
7									
			End of hole at 7.6 m below ground level. Target depth reached. Groundwater encountered at 5.5 m below ground level.						

DYNAMIC CONE PENETRATION TEST (Blows/300mm): 10 20 30 40
SCALA PENETRATION TEST (Blows/50mm): 1 2 3 4
STANDARD PENETRATION TEST (N): 10 20 30 40

POCKET PEN. (kPa): 100 200 300 400
FIELD VANE (kPa): REMOULDED PEAK 40 80 120 160
PLASTIC M.C. LIQUID 10 20 30 40

ELEVATION (m)

Contractor: Southland Drilling Ltd. Logged By: MB Started: 2025-05-14 Hole Inclination: 90° Completion Depth: 7.6m
Drilling Rig: Truck Rig Reviewed By:DB Completed: 2025-05-14 Hole Orientation: 0° Page 1 of 1

BOREHOLE: BH25-04

Project: Albion Industrial Lands Geotechnical Study
Location: Albion Industrial Lands
Zone:10 Northing: 5448634 Easting: 530993

Project No: 2500096
Client: City of Maple Ridge
Elevation: 5.1m

DEPTH (m)	DESCRIPTION (For Explanation of Terms, Symbols and Abbreviations See Attached Key Sheet)	SAMPLE TYPE	SAMPLE NUMBER
0	**SAND & GRAVEL (FILL)** (0 m to 0.8 m) Dense SAND & GRAVEL, well graded, brown, dry.	G	G1
1	**SAND (SW)** (0.8 m to 3.3 m) SAND, some silt, fine-grained sand, well-graded, brown, moist. Some small (approx. 3 cm in diameter) pockets of brown SILT, low plasticity throughout.	G	G2
3	**SAND (SW)** (3.3 m to 6.1 m) SAND, trace silt, medium to coarse grained, well graded, brown, moist.	G	G3
5	Becomes wet and grey.	G	G4
6	End of hole at 6.1 m below ground level. Target depth reached. Groundwater encountered at 5.1 m below ground level.		

DRILLING METHOD: Solid Stem Auger

PARTICLE SIZE DISTRIBUTION: GRAVEL (%), SAND (%), FINES (%)

STANDARD PENETRATION TEST (N)

DYNAMIC CONE PENETRATION TEST (Blows/300mm) 10 20 30 40
SCALA PENETRATION TEST (Blows/50mm) 1 2 3 4
STANDARD PENETRATION TEST (N) 10 20 30 40

POCKET PEN. (kPa) 100 200 300 400
FIELD VANE (kPa) REMOULDED PEAK 40 80 120 160
PLASTIC M.C. LIQUID 10 20 30 40

ELEVATION (m)

Contractor: Southland Drilling Ltd. Logged By: MB Started: 2025-05-15 Hole Inclination: 90° Completion Depth: 6.1m
Drilling Rig: Truck Rig Reviewed By:DB Completed: 2025-05-15 Hole Orientation: 0° Page 1 of 1

BOREHOLE: BH25-05

Project: Albion Industrial Lands Geotechnical Study
Location: Albion Industrial Lands
Zone:10 Northing: 5449083 Easting: 530892

Project No: 2500096
Client: City of Maple Ridge
Elevation: 5.4m

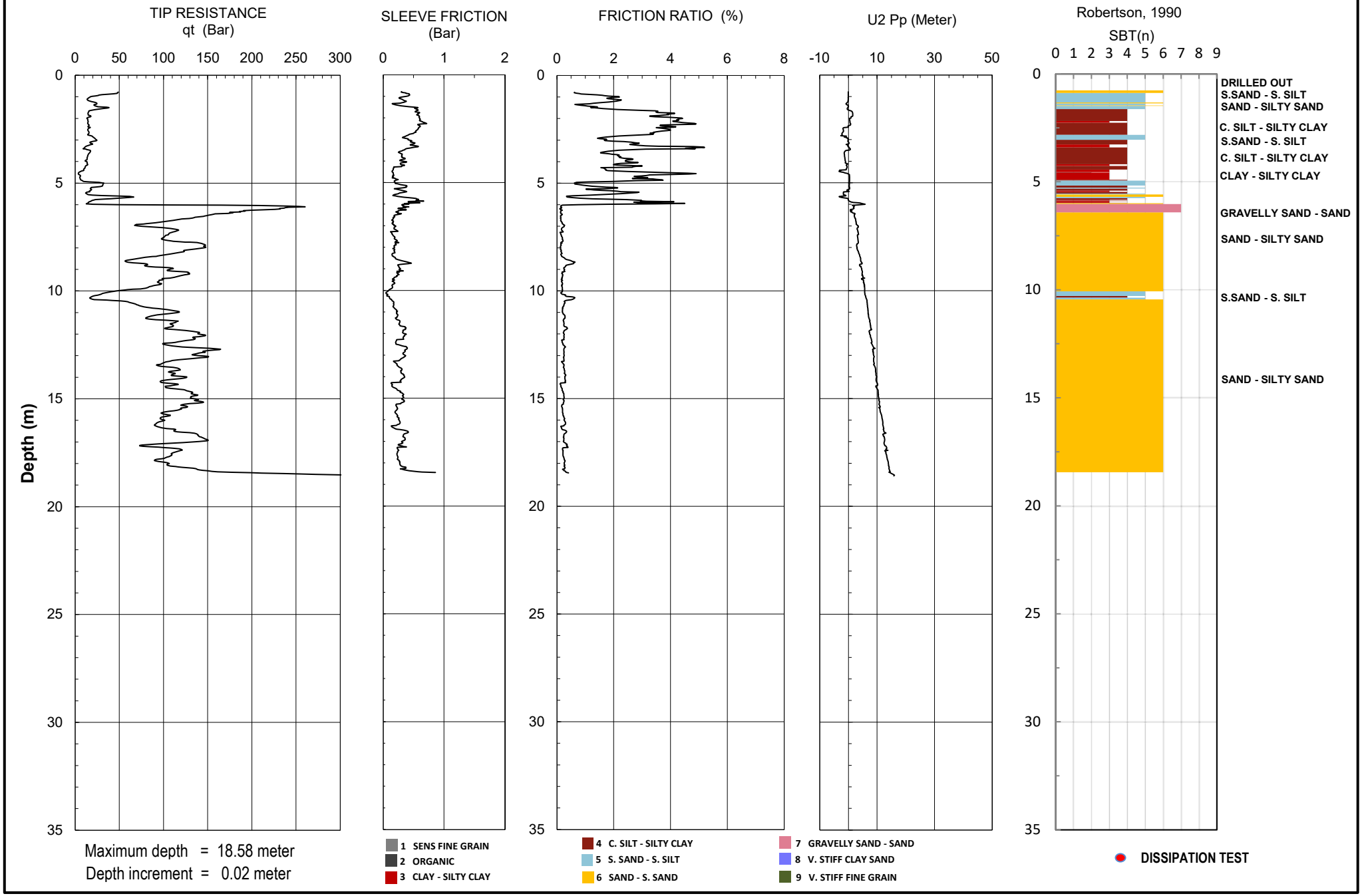
DEPTH (m)	DRILLING METHOD	GRAPHICAL LEGEND	DESCRIPTION (For Explanation of Terms, Symbols and Abbreviations See Attached Key Sheet)	SAMPLE TYPE	SAMPLE NUMBER	PARTICLE SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	FINES (%)	STANDARD PENETRATION TEST (N)	DYNAMIC CONE PENETRATION TEST (Blows/300mm) 10 20 30 40 / SCALA PENETRATION TEST (Blows/50mm) 1 2 3 4 / STANDARD PENETRATION TEST (N) 10 20 30 40	POCKET PEN. (kPa) 100 200 300 400 / FIELD VANE (kPa) REMOULDED PEAK 40 80 120 160 / PLASTIC M.C. LIQUID 10 20 30 40	ELEVATION (m)
0	Solid Stem Auger		**SAND & GRAVEL (FILL)** (0 m to 0.3 m) Dense SAND & GRAVEL, well graded, brown, dry.									
1			**SILT (SM)** (0.3 m to 3.3 m) Compact SILT, some fine sand, non-plastic, poorly graded, brown, dry to moist.	G	G1							
2				G	G2							
3												
4			**SAND (SW)** (3.3 m to 5.7 m) SAND, trace silt, medium to coarse grained, well graded, brown, moist.	G	G3							
5			Becomes wet and grey.	G	G4							
6			**SILT (SM)** (5.7 m to 6.1 m) Compact sandy SILT, fine grained sand, non-plastic, poorly graded, grey, wet.									
			End of hole at 6.1 m below ground level. Target depth reached. Groundwater encountered at 5.5 m below ground level.									

Contractor: Southland Drilling Ltd. Logged By: MB Started: 2025-05-15 Hole Inclination: 90° Completion Depth: 6.1m
Drilling Rig: Truck Rig Reviewed By:DB Completed: 2025-05-15 Hole Orientation: 0° Page 1 of 1

Appendix C

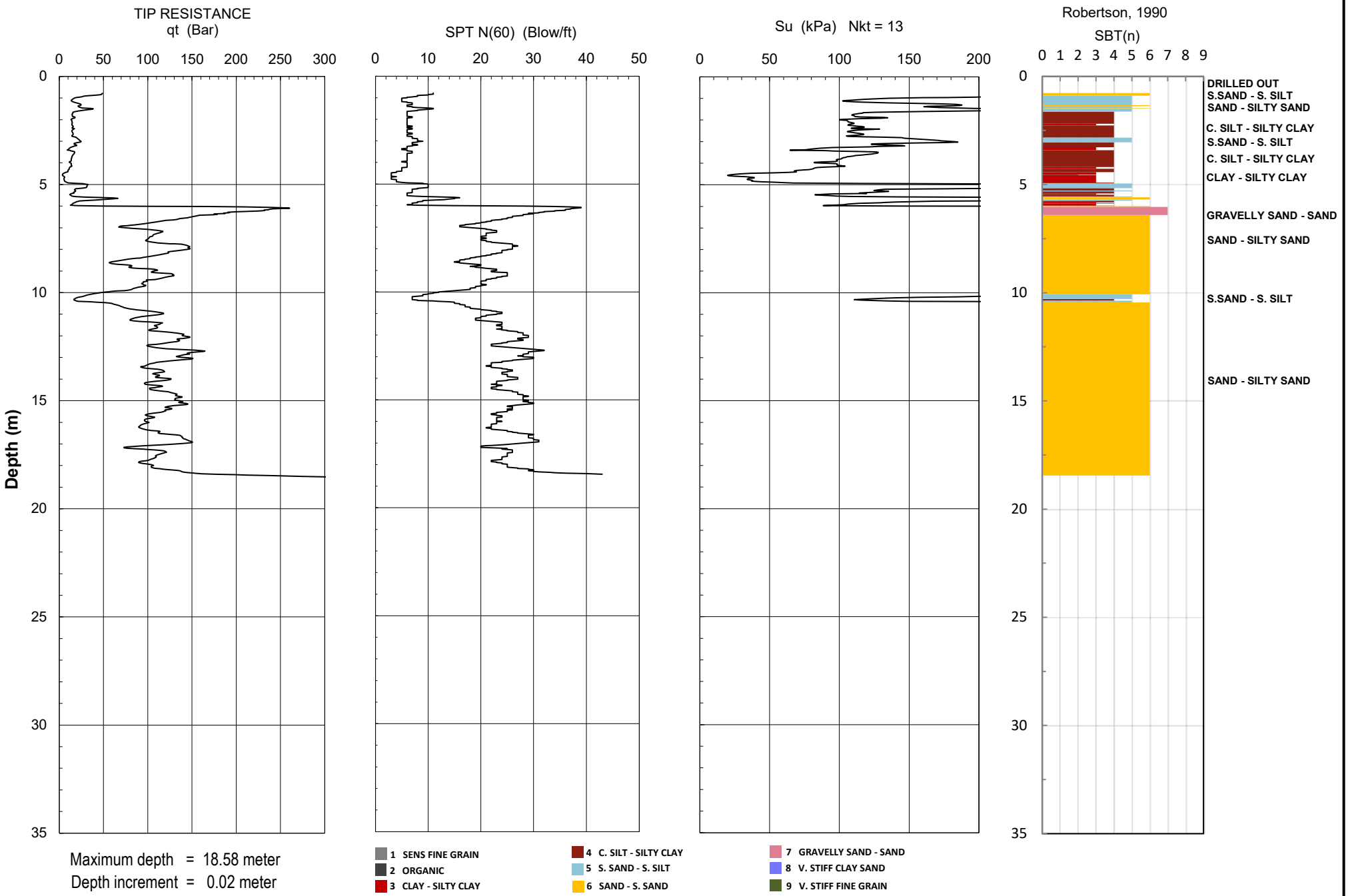
Cone Penetration Test and Seismic Cone Penetration Test Results

Operator: Schwartz Soil Technical	Date: May 14, 2025	
Sounding: SCPT25 - 01	Site: Albion Lands, Maple Ridge	
Cone ID: DPG1427	Ecora project no: 2500096	



Maximum depth = 18.58 meter
Depth increment = 0.02 meter

Operator: Schwartz Soil Technical	Date: May 14, 2025	
Sounding: SCPT25 - 01	Site: Albion Lands, Maple Ridge	
Cone ID: DPG1427	Ecora project no: 2500096	



Maximum depth = 18.58 meter
Depth increment = 0.02 meter

Schwartz
SOIL TECH

SHEAR WAVE VELOCITY DATA

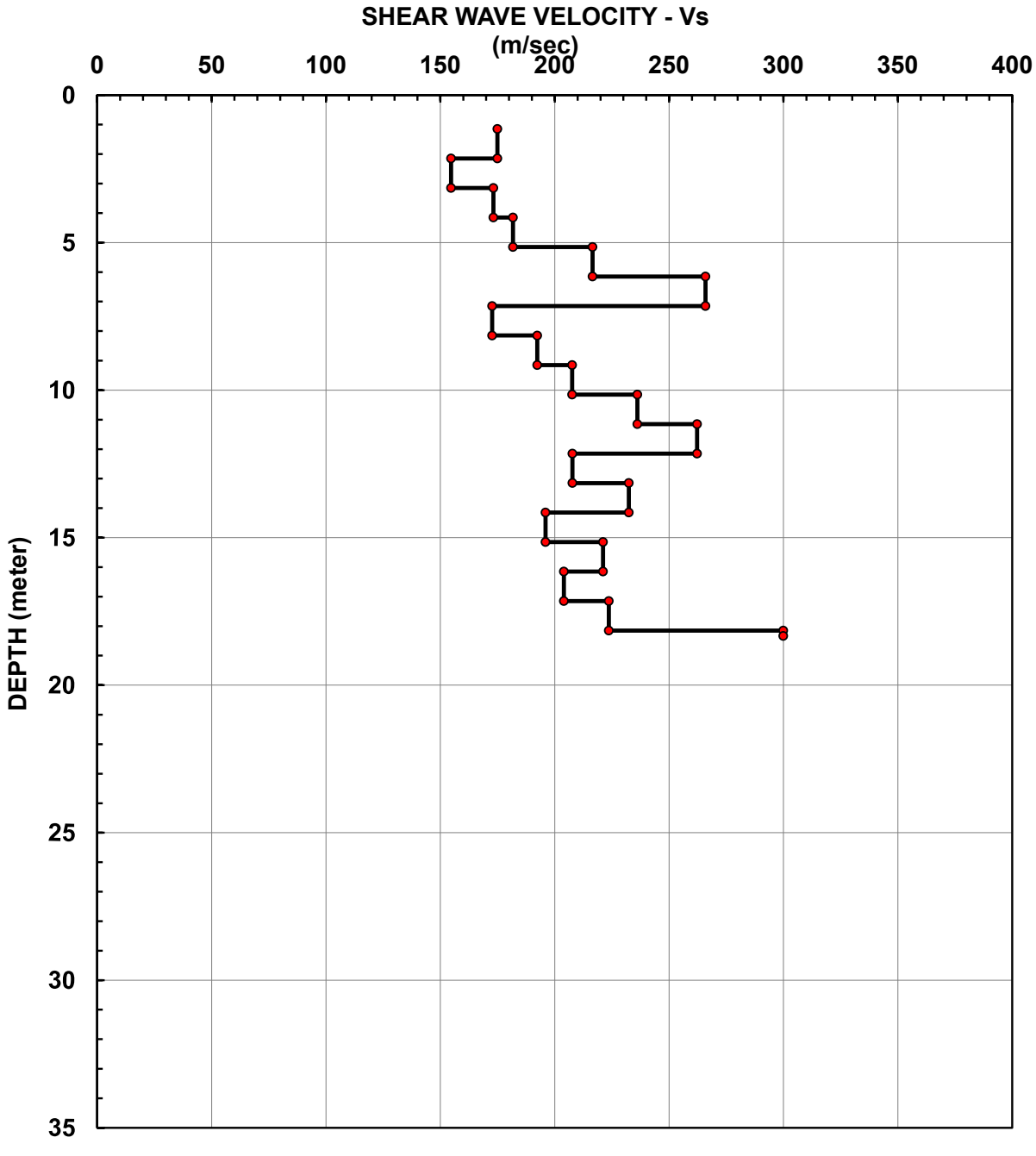
Client:	Ecora	**Date:**	May 14, 2025
Test:	SCPT25 - 01	**Cone ID:**	1427
Site:	Albion Lands, Maple Ridge, BC	**Source offset:**	0.50 m
		Source:	Impact Brackets

Cone tip Depth (m)	Geophone Depth (m)	Wave Path Length (m)	Wave Path Interval (m)	Wave Travel Time interval (ms)	Interval Velocity (m/sec)
1.40	1.15	1.25			
			0.95	5.45	175
2.40	2.15	2.21			
			0.98	6.35	155
3.40	3.15	3.19			
			0.99	5.72	173
4.40	4.15	4.18			
			0.99	5.47	182
5.40	5.15	5.17			
			1.00	4.60	217
6.40	6.15	6.17			
			1.00	3.75	266
7.40	7.15	7.17			
			1.00	5.78	173
8.40	8.15	8.17			
			1.00	5.19	192
9.40	9.15	9.16			
			1.00	4.81	208
10.40	10.15	10.16			
			1.00	4.23	236
11.40	11.15	11.16			
			1.00	3.81	262
12.40	12.15	12.16			
			1.00	4.81	208
13.40	13.15	13.16			
			1.00	4.30	232
14.40	14.15	14.16			
			1.00	5.10	196
15.40	15.15	15.16			
			1.00	4.52	221
16.40	16.15	16.16			
			1.00	4.90	204
17.40	17.15	17.16			
			1.00	4.47	224
18.40	18.15	18.16			
			0.18	0.60	300
18.58	18.33	18.34			

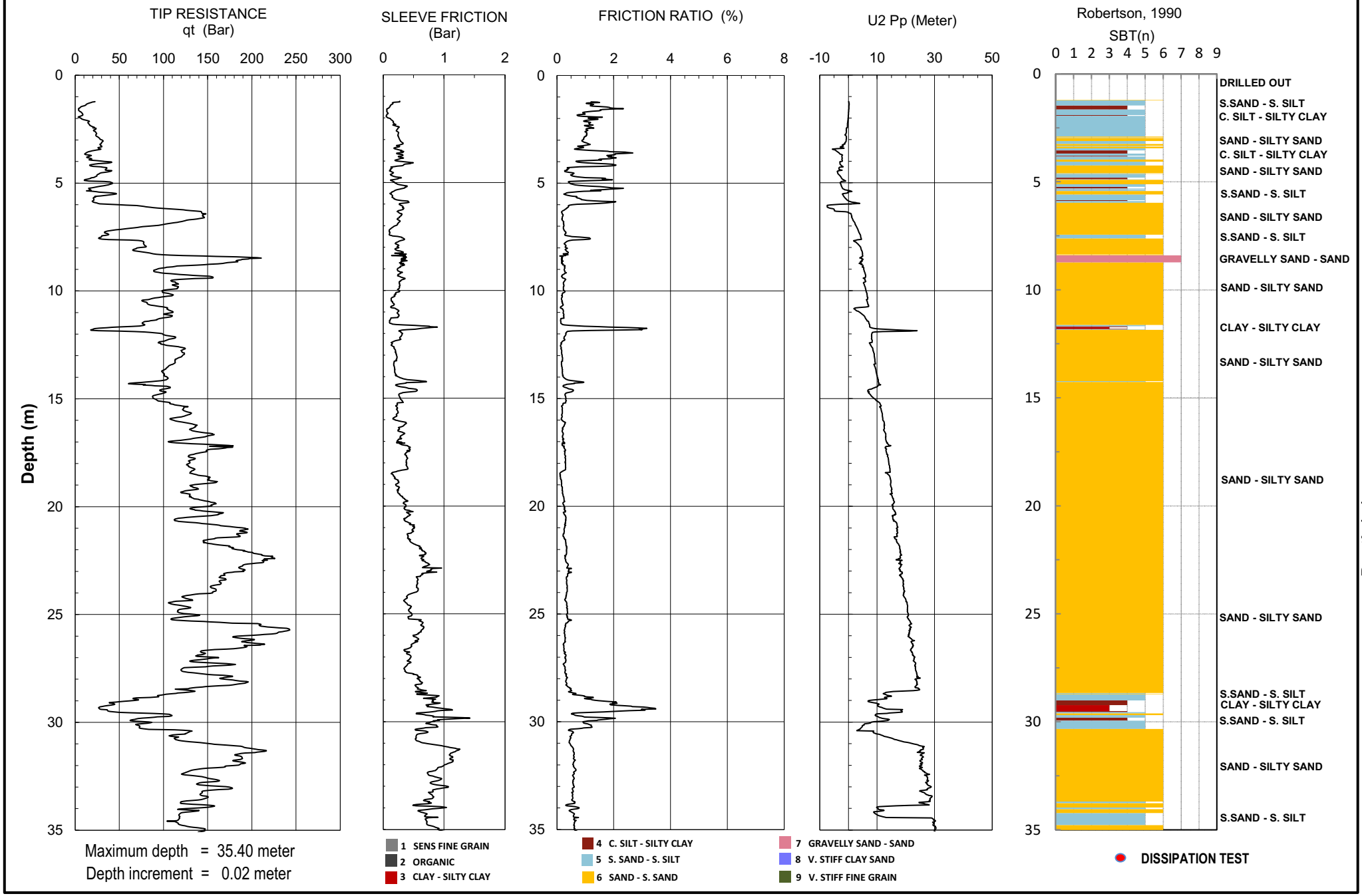
Schwartz SOIL TECH

SHEAR WAVE VELOCITY PROFILE

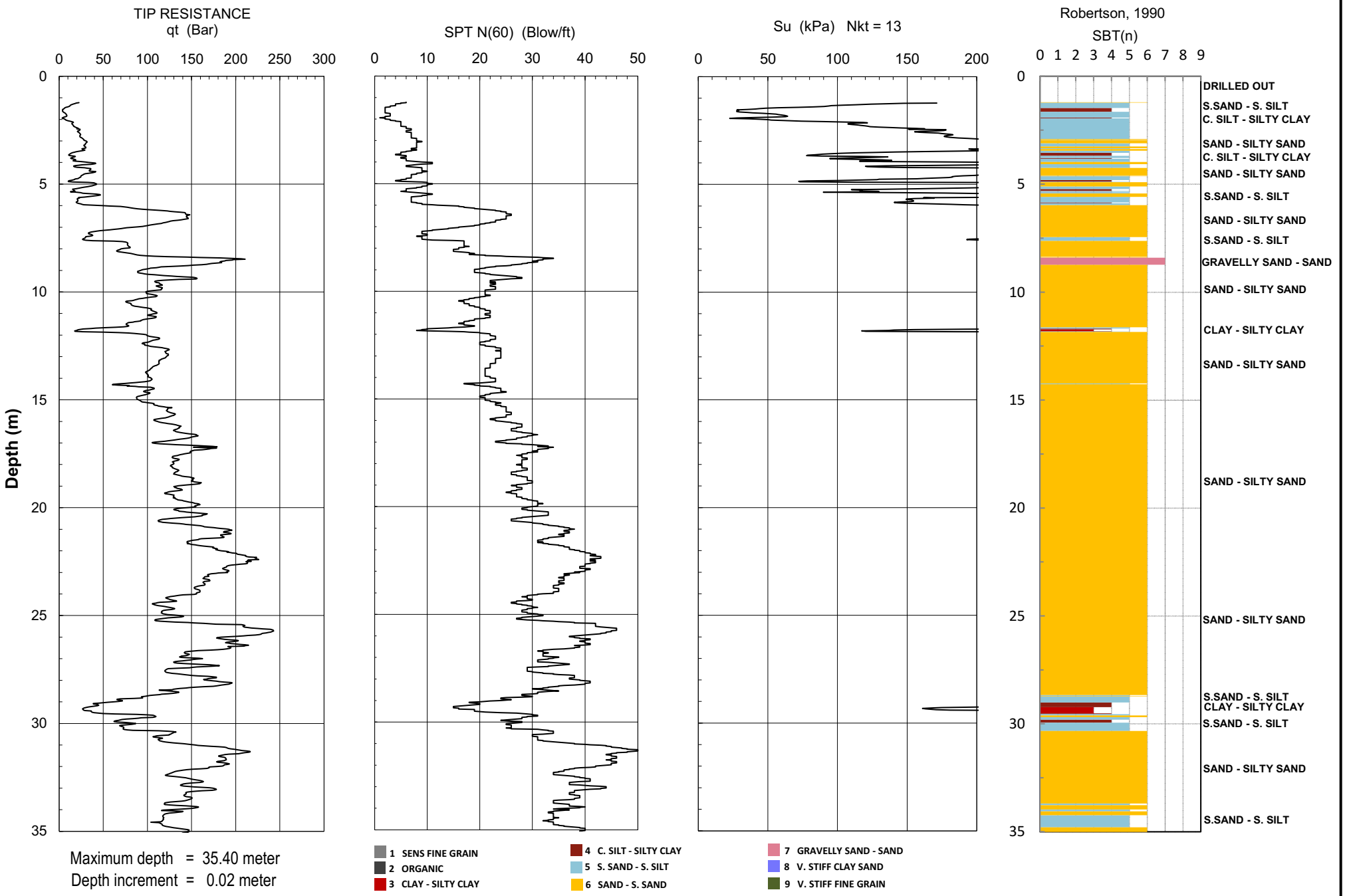
Client:	Ecora	**Date:**	May 14, 2025
Test:	SCPT25 - 01	**Cone ID:**	1427
Site:	Albion Lands, Maple Ridge, BC	**Source offset:**	0.50 m
		Source:	Impact Brackets



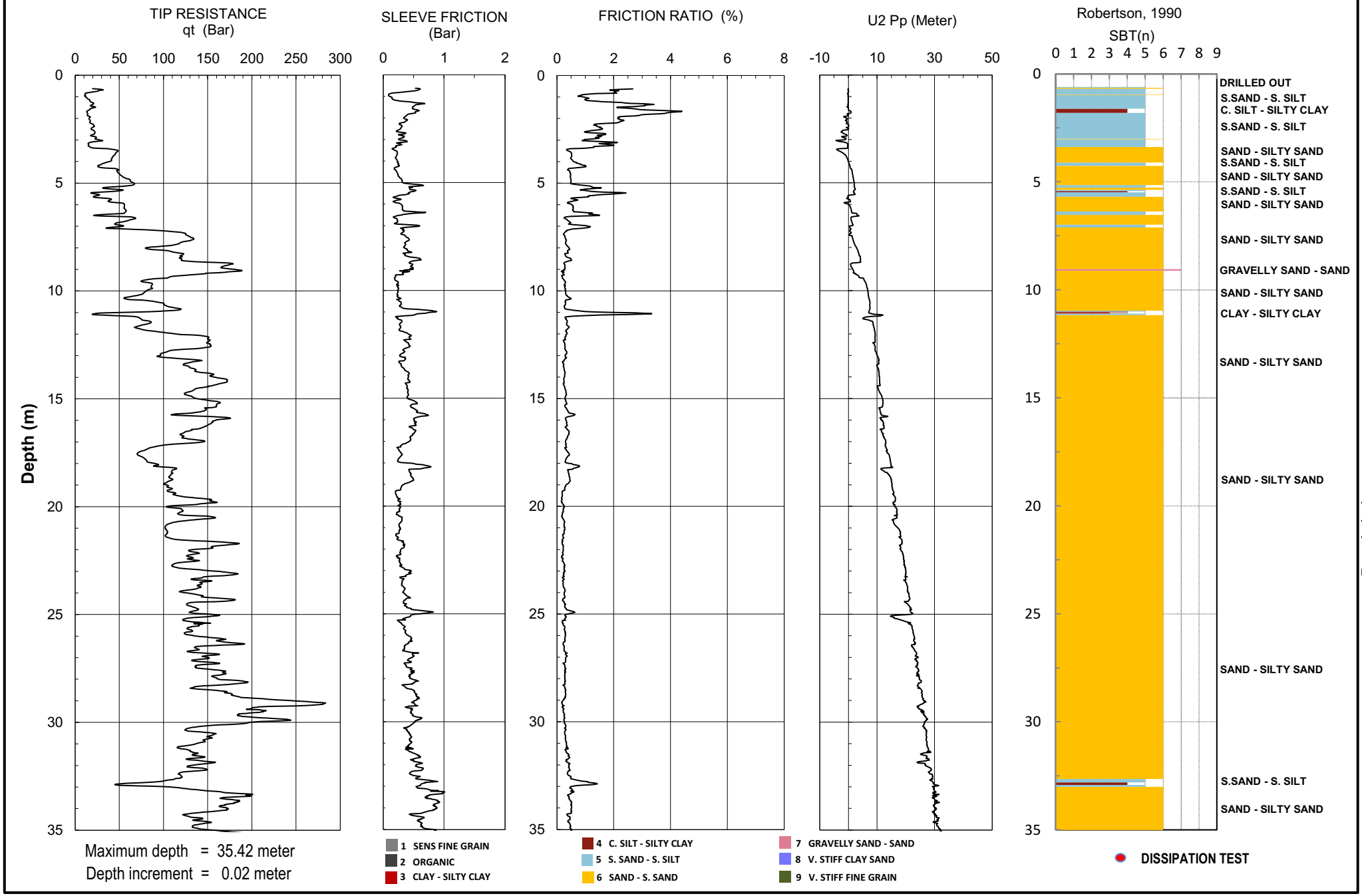
Operator:	Schwartz Soil Technical	Date:	May 14, 2025
Sounding:	CPT25 - 02	Site:	Albion Lands, Maple Ridge
Cone ID:	DPG1427	Ecora project no:	2500096



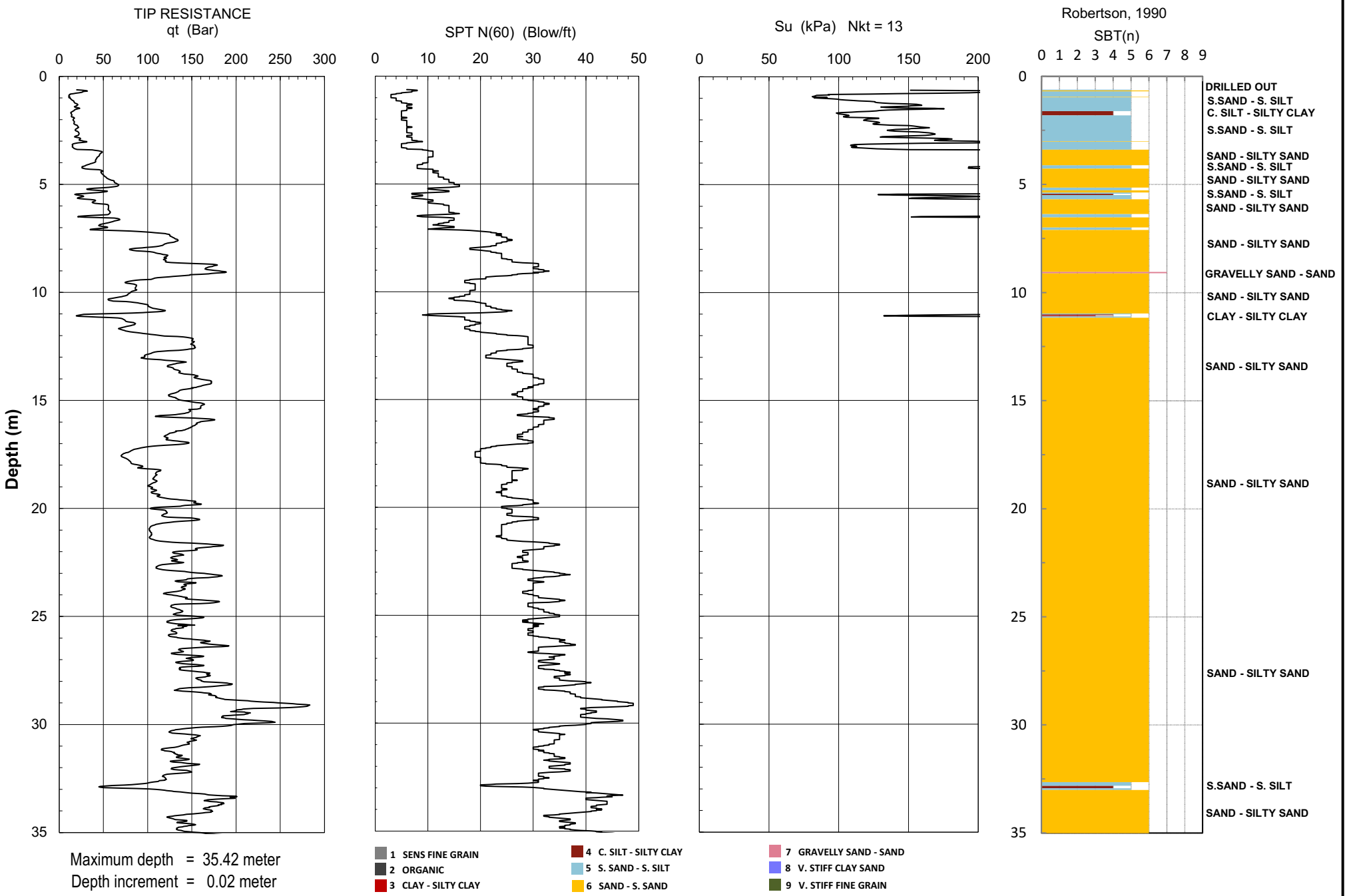
Operator: Schwartz Soil Technical	Date: May 14, 2025	
Sounding: CPT25 - 02	Site: Albion Lands, Maple Ridge	
Cone ID: DPG1427	Ecora project no: 2500096	



Operator: Schwartz Soil Technical	Date: May 14, 2025	
Sounding: SCPT25 - 03	Site: Albion Lands, Maple Ridge	
Cone ID: DPG1427	Ecora project no: 2500096	



Operator: Schwartz Soil Technical	Date: May 14, 2025	
Sounding: SCPT25 - 03	Site: Albion Lands, Maple Ridge	
Cone ID: DPG1427	Ecora project no: 2500096	



Schwartz SOIL TECH

SHEAR WAVE VELOCITY DATA

Client:	Ecora	**Date:**	May 14, 2025
Test:	SCPT25 - 03	**Cone ID:**	1427
Site:	Albion Lands, Maple Ridge, BC	**Source offset:**	0.50 m
		Source:	Impact Brackets

Cone tip Depth (m)	Geophone Depth (m)	Wave Path Length (m)	Wave Path Interval (m)	Wave Travel Time interval (ms)	Interval Velocity (m/sec)
1.40	1.15	1.25			
			0.95	8.82	108
2.40	2.15	2.21			
			0.98	7.31	134
3.40	3.15	3.19			
			0.99	5.85	169
4.40	4.15	4.18			
			0.99	5.21	191
5.40	5.15	5.17			
			1.00	5.66	176
6.40	6.15	6.17			
			1.00	6.21	161
7.40	7.15	7.17			
			1.00	3.75	266
8.40	8.15	8.17			
			1.00	4.18	239
9.40	9.15	9.16			
			1.00	5.47	183
10.40	10.15	10.16			
			1.00	3.98	251
11.40	11.15	11.16			
			1.00	5.39	185
12.40	12.15	12.16			
			1.00	4.46	224
13.40	13.15	13.16			
			1.00	4.29	233
14.40	14.15	14.16			
			1.00	4.07	246
15.40	15.15	15.16			
			1.00	4.68	214
16.40	16.15	16.16			
			1.00	3.86	259
17.40	17.15	17.16			
			1.00	3.56	281
18.40	18.15	18.16			
			1.00	5.24	191
19.40	19.15	19.16			
			1.00	3.59	278
20.40	20.15	20.16			
			1.00	4.10	244
21.40	21.15	21.16			
			1.00	4.38	228
22.40	22.15	22.16			
			1.00	3.63	275
23.40	23.15	23.16			
			1.00	4.40	227
24.40	24.15	24.16			
			1.00	3.50	286
25.40	25.15	25.15			
			1.00	4.00	250
26.40	26.15	26.15			
			1.00	4.81	208
27.40	27.15	27.15			
			1.00	3.63	275
28.40	28.15	28.15			
			1.00	3.09	324
29.40	29.15	29.15			
			1.00	3.20	312
30.40	30.15	30.15			

Schwartz
SOIL TECH

SHEAR WAVE VELOCITY DATA

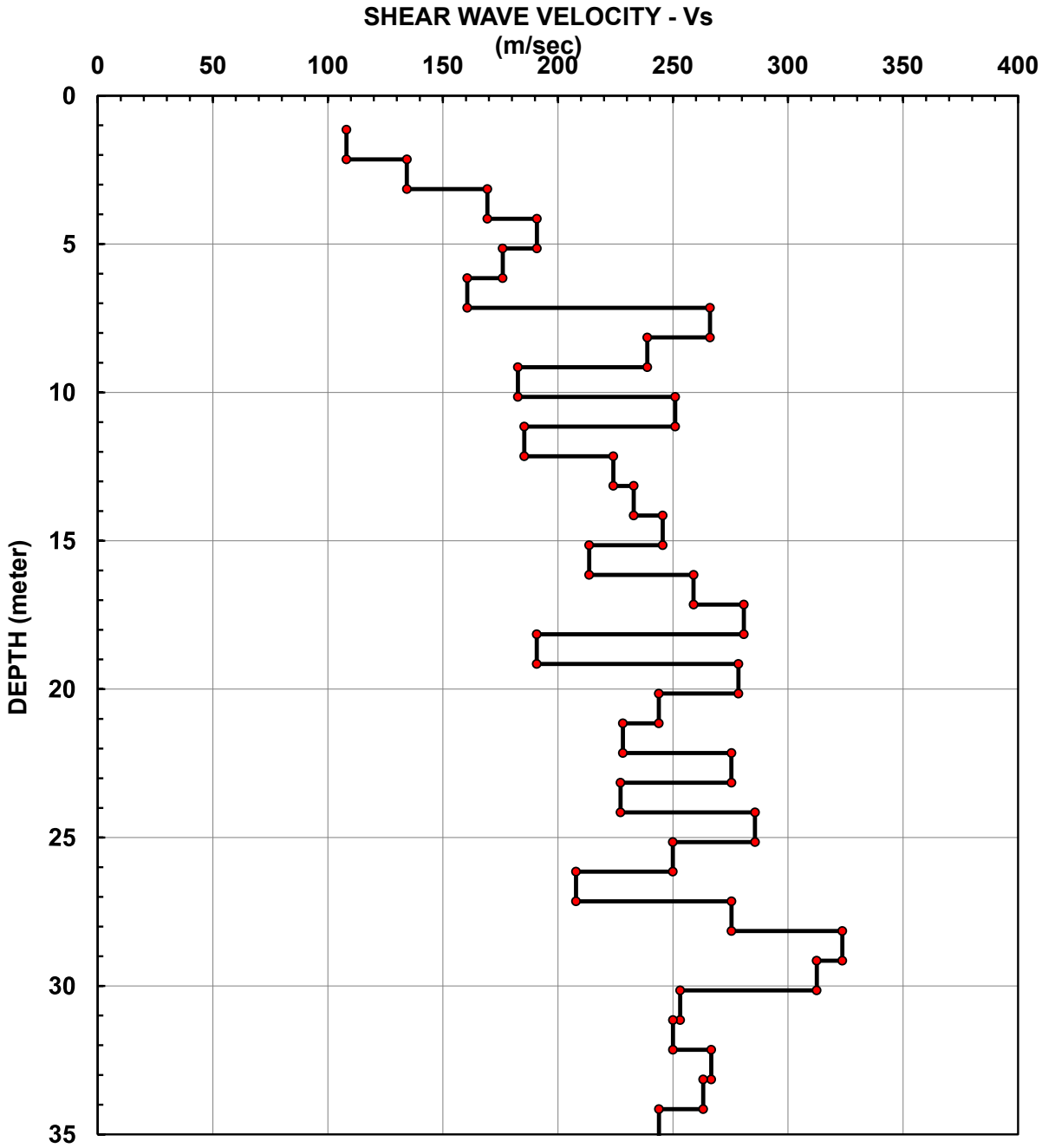
Client:	**Ecora**	**Date:**	**May 14, 2025**
Test:	**SCPT25 - 01**	**Cone ID:**	**1427**
Site:	**Albion Lands, Maple Ridge, BC**	**Source offset:**	**0.50 m**
		Source:	**Impact Brackets**

Cone tip Depth (m)	Geophone Depth (m)	Wave Path (m)	Wave Path Interval (m)	Wave Travel Time interval (ms)	Interval Velocity (m/sec)
29.40	29.15	29.15			
			1.00	3.20	312
30.40	30.15	30.15			
			1.00	3.95	253
31.40	31.15	31.15			
			1.00	4.00	250
32.40	32.15	32.15			
			1.00	3.75	267
33.40	33.15	33.15			
			1.00	3.80	263
34.40	34.15	34.15			
			1.00	4.10	244
35.40	35.15	35.15			

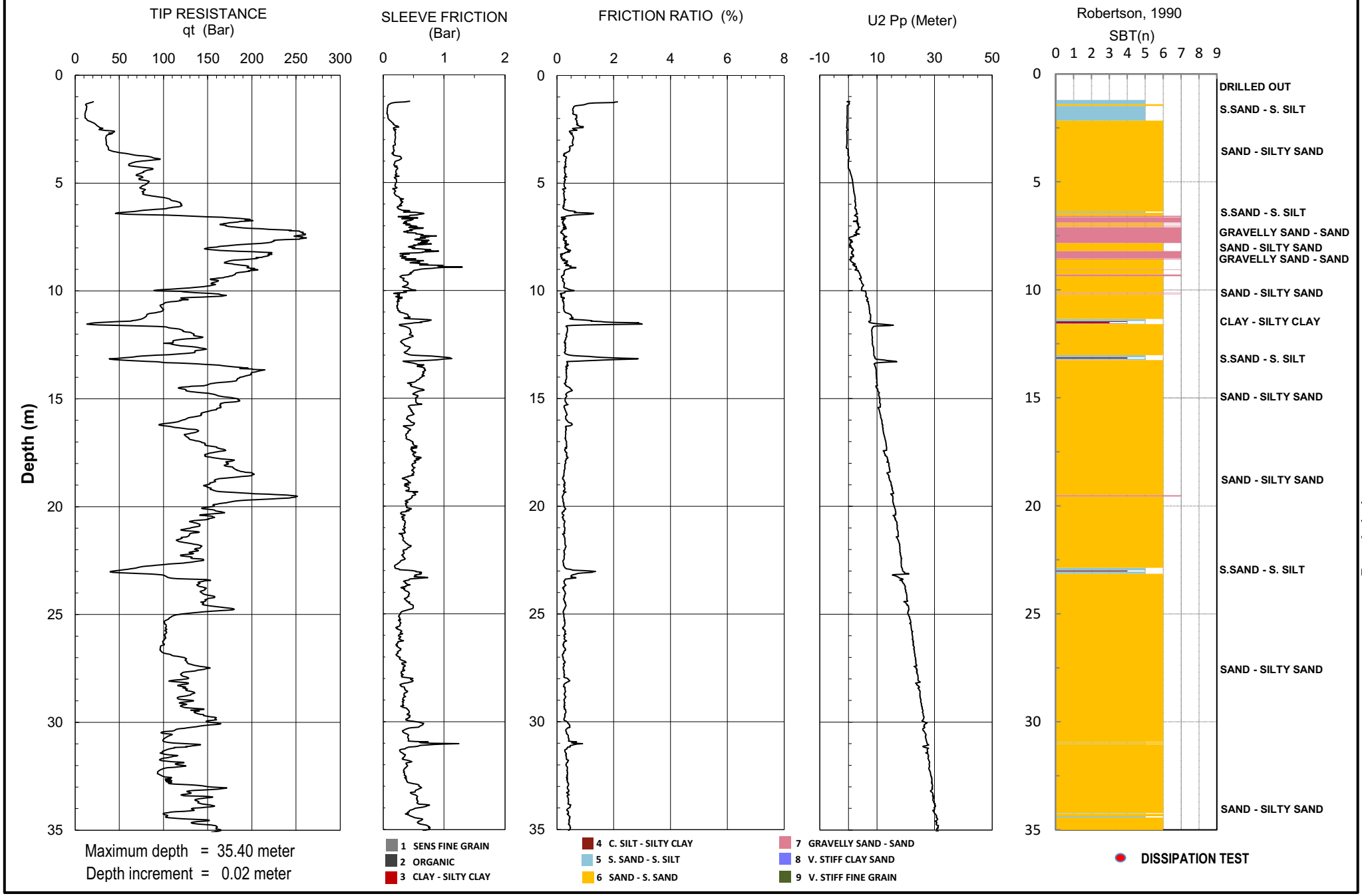
Schwartz SOIL TECH

SHEAR WAVE VELOCITY PROFILE

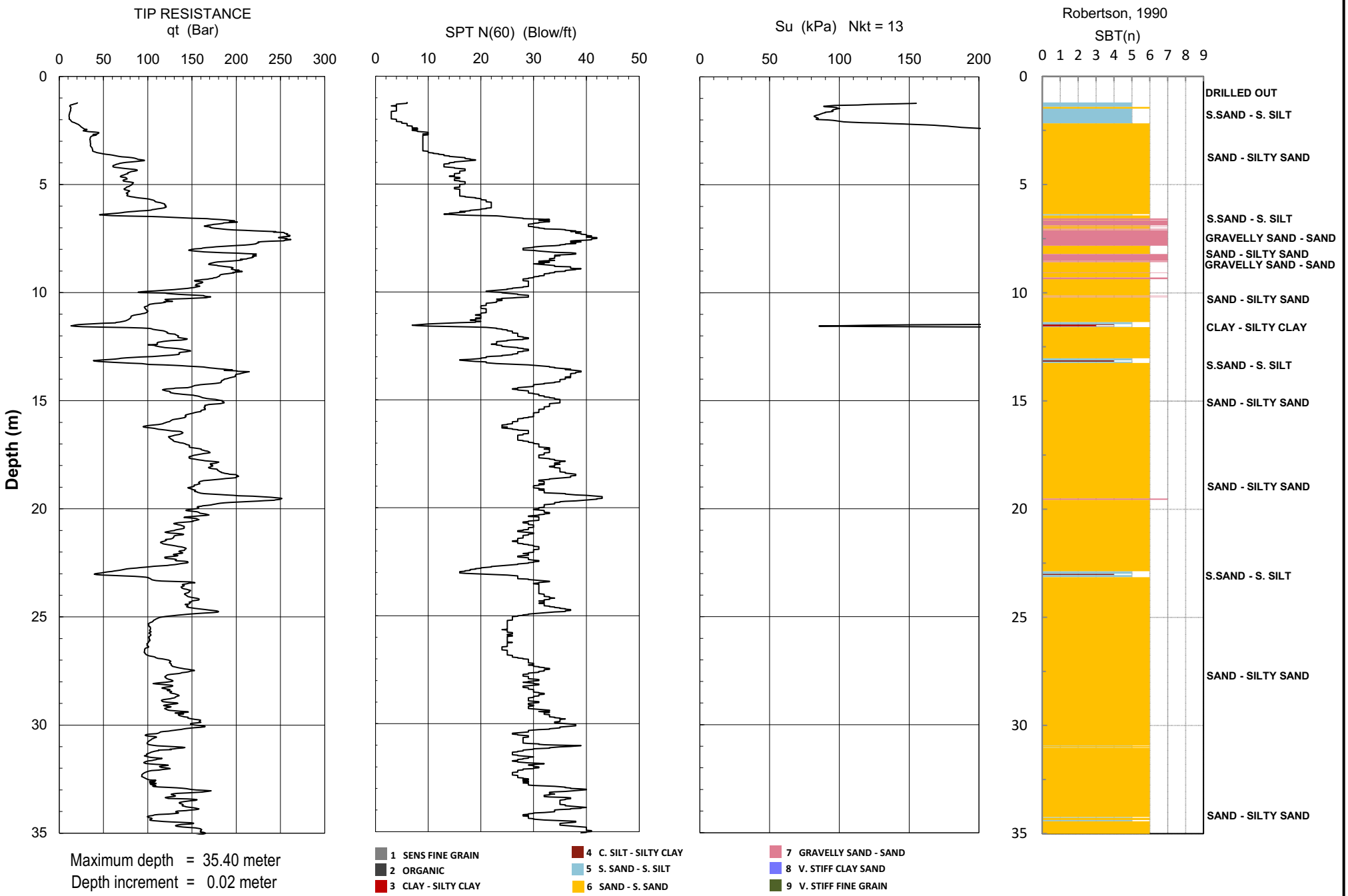
Client:	Ecora	**Date:**	May 14, 2025
Test:	SCPT25 - 03	**Cone ID:**	1427
Site:	Albion Lands, Maple Ridge, BC	**Source offset:**	0.50 m
		Source:	Impact Brackets



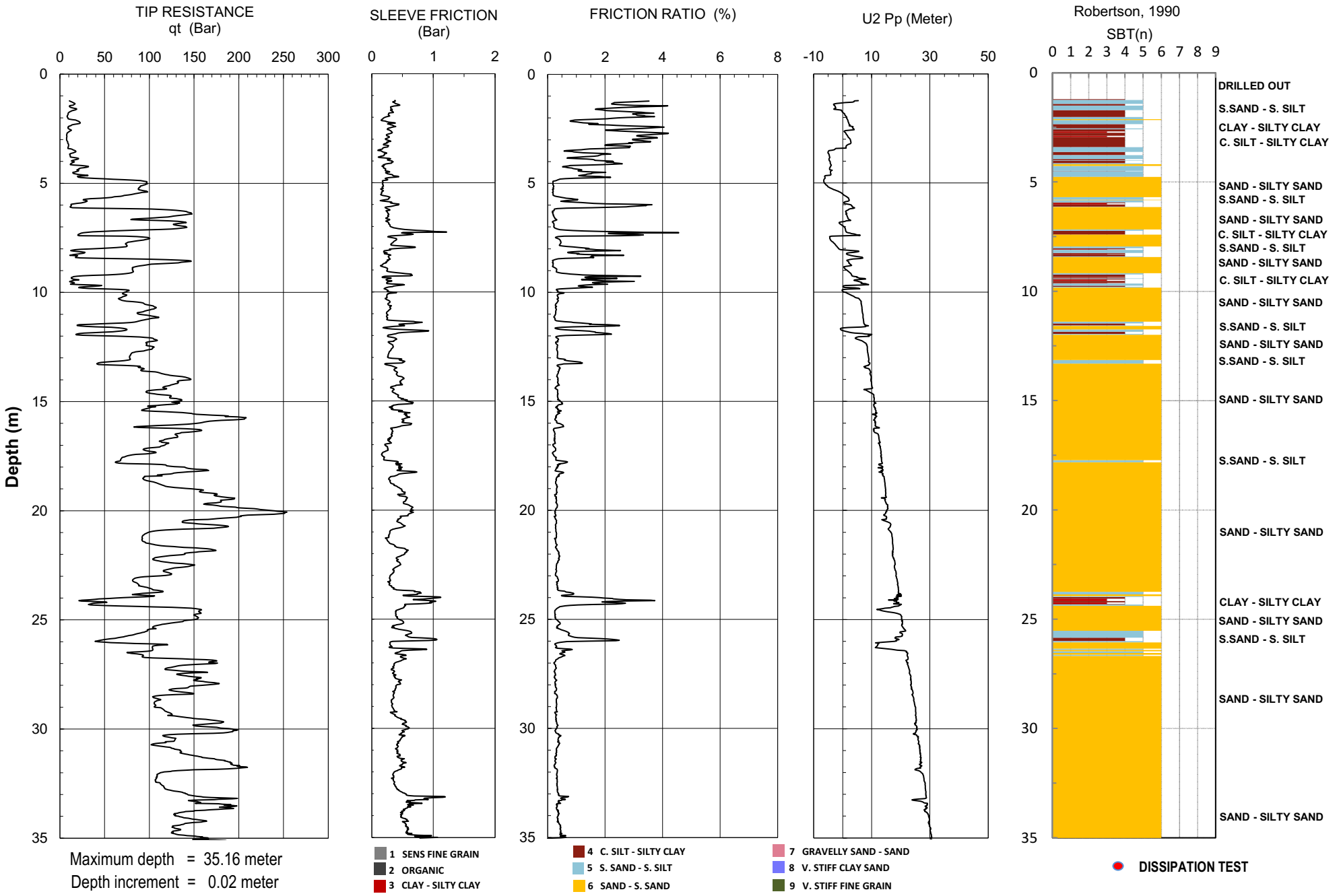
Operator:	Schwartz Soil Technical	Date:	May 15, 2025
Sounding:	CPT25 - 04	Site:	Albion Lands, Maple Ridge
Cone ID:	DPG1603	Ecora project no:	2500096



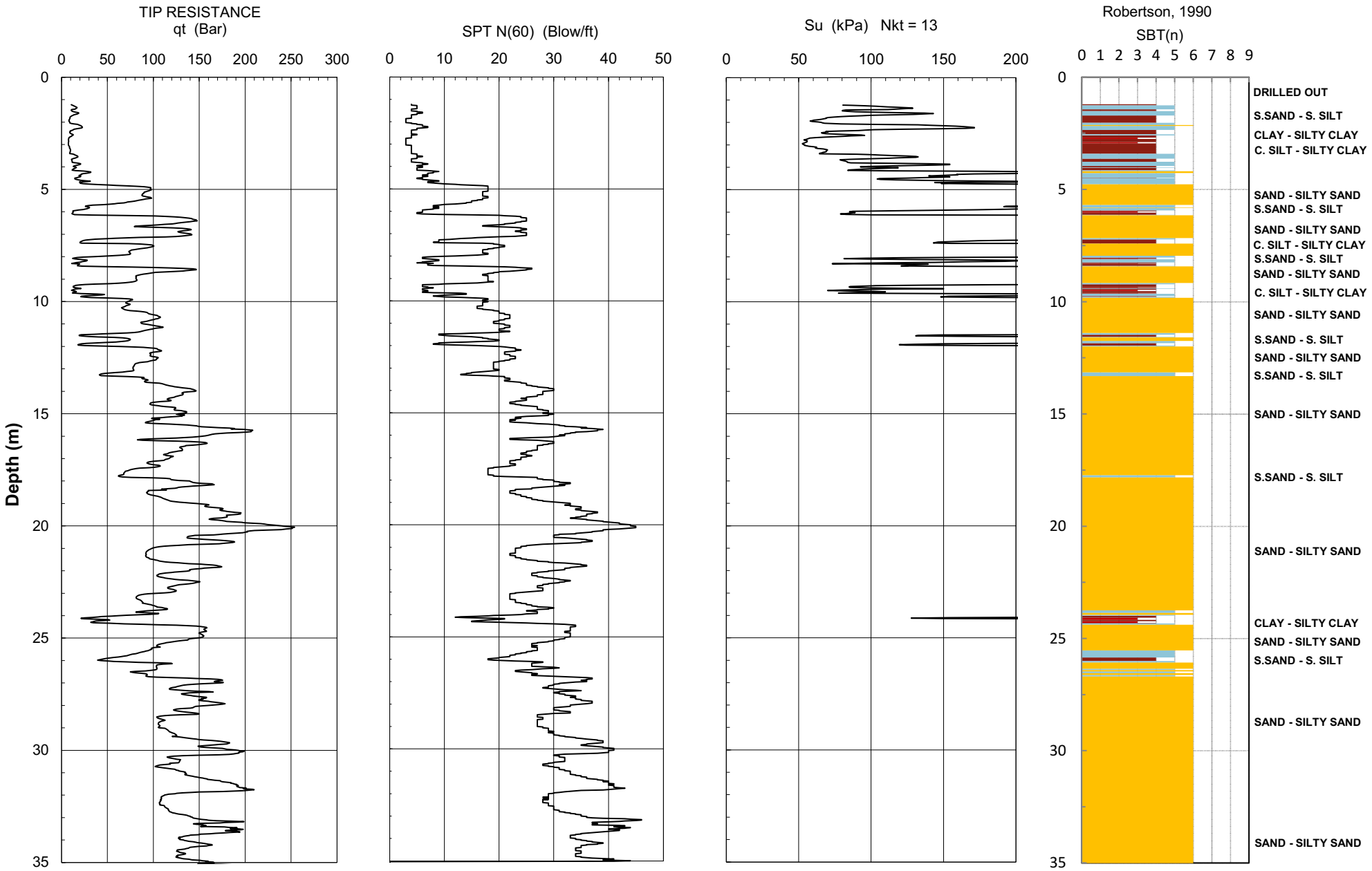
Operator: Schwartz Soil Technical	Date: May 15, 2025	
Sounding: CPT25 - 04	Site: Albion Lands, Maple Ridge	
Cone ID: DPG1603	Ecora project no: 2500096	



Operator:	Schwartz Soil Technical	Date:	May 15, 2025
Sounding:	CPT25 - 05	Site:	Albion Lands, Maple Ridge
Cone ID:	DPG1603	Ecora project no:	2500096



Operator: Schwartz Soil Technical	Date: May 15, 2025	
Sounding: CPT25 - 05	Site: Albion Lands, Maple Ridge	
Cone ID: DPG1603	Ecora project no: 2500096	



Maximum depth = 35.16 meter
Depth increment = 0.02 meter

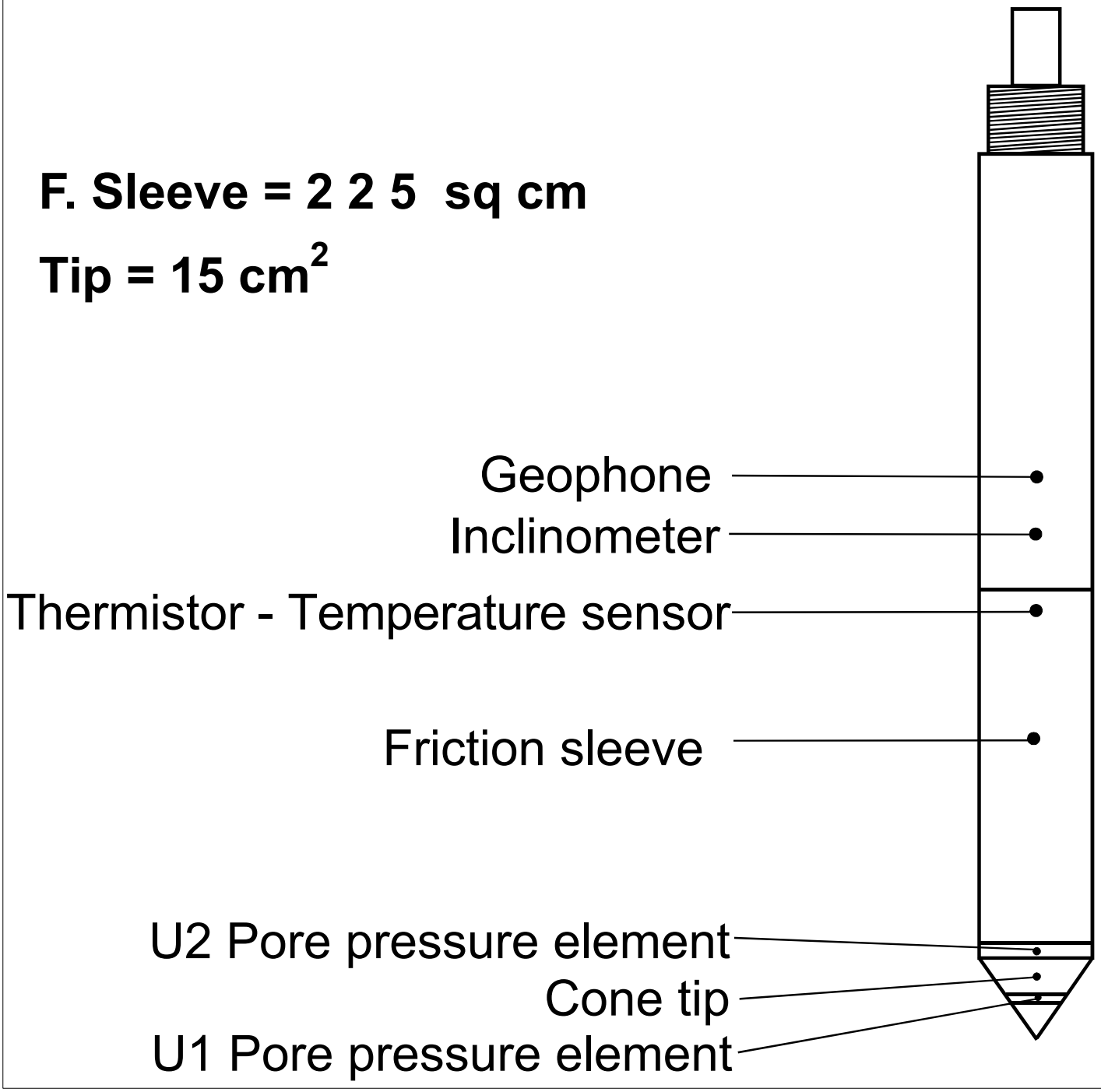
Schwartz SOIL TECH

FIGURE 1

ELECTRONIC PIEZOCONE - CPTU

F. Sleeve = 2 2 5 sq cm

Tip = 15 cm^2

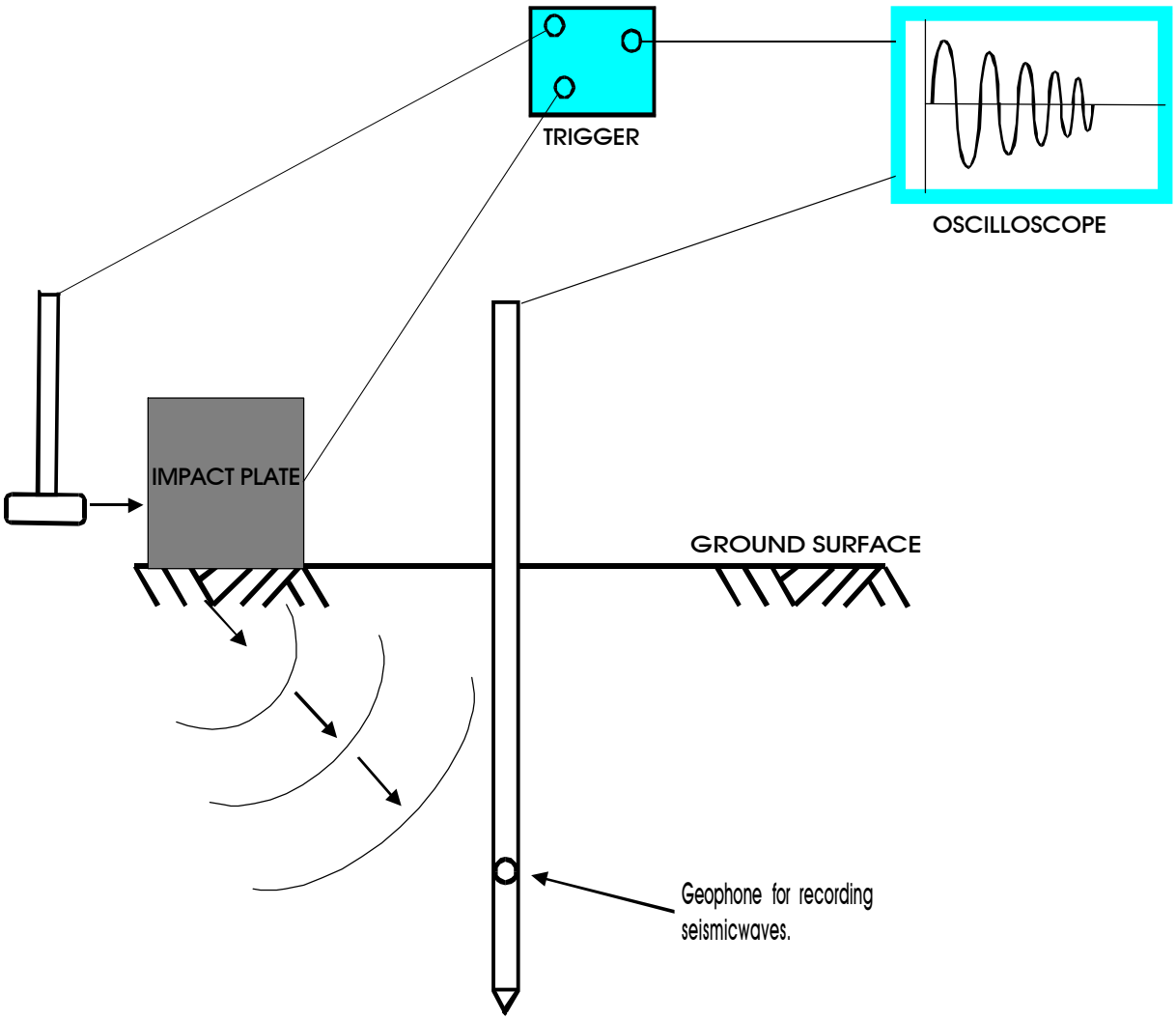


Schwartz SOIL TECH

FIGURE 2

SCPTU TESTING

Vs SEISMIC TESTING WITH IMPACT PLATES. IMPACT PLATES POSITIONED ON THE GROUND ADJACENT TO THE TEST LOCATION



Appendix D

Laboratory Testing Results

MOISTURE CONTENT TEST RESULTS (ASTM D-2216)

Project: Albion Industrial Lands Geotechnical Study

Project Number: 2500096

Client: City of Maple Ridge

Sample No.: 25-225

Date Tested: 10-Jun-2025

Tested By: SQ

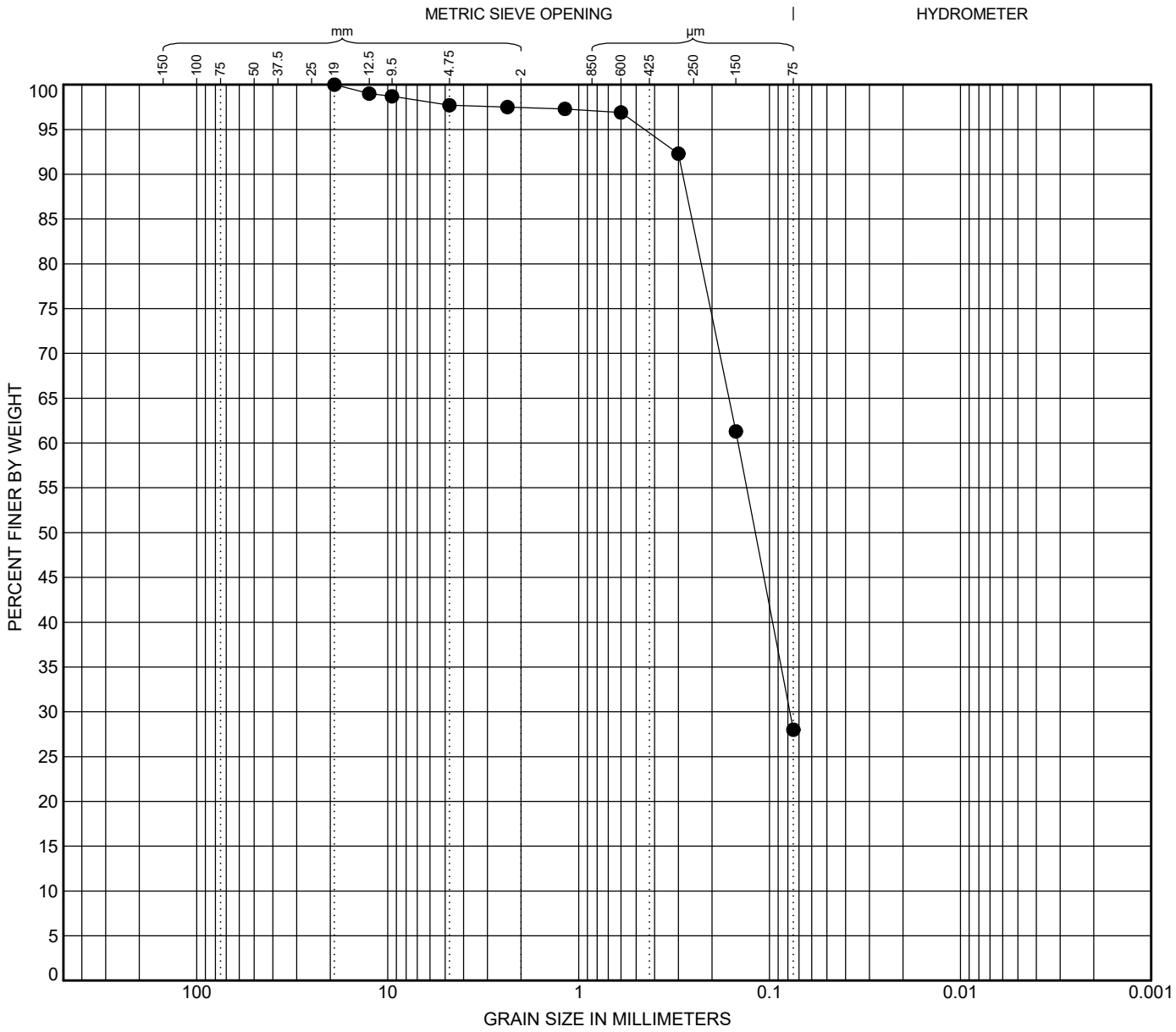
Page: 1 of 1

T.H. Number	Sample Depth (m)	Sample I.D.	Tare Mass (g)	Mass of Wet Soil & Tare (g)	Mass of Dry Soil & Tare (g)	Moisture Content (%)	Additional Information
BH25-01	0.5 - 0.7	G1	16.0	94.6	79.6	23.6%	Sandy SILT, trace gravel.
BH25-01	1.8 - 2.1	G2	15.4	83.7	68.8	27.9%	Sandy SILT, trace gravel.
BH25-01	3.6 - 3.9	G3	396.1	1601.2	1338.1	27.9%	Sandy SILT, trace gravel.
BH25-01	5.5 - 5.8	G4	15.5	124.6	97.4	33.2%	CLAY, some silt.
BH25-02	0.8 - 1.2	G1	15.9	100.5	89.3	15.3%	Sandy SILT, trace gravel.
BH25-02	1.8 - 2.1	G2	524.3	2068.6	1798.7	21.2%	Sandy SILT, trace gravel.
BH25-02	3.6 - 3.9	G3	15.5	121.4	97.1	29.8%	Clayey SILT.
BH25-02	5.1 - 5.4	G4	16.6	112.4	92.2	26.7%	Clayey SILT.
BH25-03	0.6 - 0.9	G1	16.3	99.9	83.9	23.7%	Clayey SILT.
BH25-03	1.8 - 2.1	G2	17.2	102.0	82.1	30.7%	Sandy SILT.
BH25-03	3.9 - 4.2	G3	15.8	123.8	103.2	23.6%	Clayey SILT.
BH25-03	5.5 - 5.8	G4	15.4	150.7	117.7	32.3%	Clayey SILT.
BH25-03	6.5 - 6.8	G5	395.9	1735.0	1447.8	27.3%	SAND with fines, trace gravel.
BH25-04	0.5 - 0.8	G1	15.5	106.9	98.4	10.3%	SAND & GRAVEL
BH25-04	1.8 - 2.1	G2	15.7	94.1	84.4	14.1%	SAND, some silt.
BH25-04	3.6 - 3.9	G3	15.8	146.1	124.6	19.8%	SAND, trace fines, trace gravel.
BH25-04	5.1 - 5.2	G4	485.1	2666.8	2249.0	23.7%	SAND, trace fines, trace gravel.
BH25-05	N/A	G1	15.3	97.3	79.8	27.1%	Sandy SILT.
BH25-05	N/A	G2	400.4	1608.7	1316.7	31.9%	Sandy SILT.
BH25-05	N/A	G3	15.6	118.2	92.6	33.2%	SAND, trace silt.
BH25-05	N/A	G4	15.3	166.2	141.2	19.9%	SAND, trace silt.

GRAIN SIZE DISTRIBUTION ASTM D6913

Project: Albion Industrial Lands Geotechnical Study
Location: Maple Ridge, BC
Source: BH25-03, G5

Project No: 2500096
Client: City of Maple Ridge
Depth: 6.50 m to 6.80 m



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

D_{100}	D_{85}	D_{60}	D_{30}	D_{15}	D_{10}	C_c	C_u	%Gravel	%Sand	%Silt	%Clay
19	**0.255**	**0.146**	**0.0782**					**2.3**	**69.7**	**28.0**	

Description: SAND with Fines, trace Gravel
Natural Moisture Content: 27.3 %
Comments: N/A

Lab Sample Number: 25-228
Date Tested: 2025-06-10
Tested By: SQ

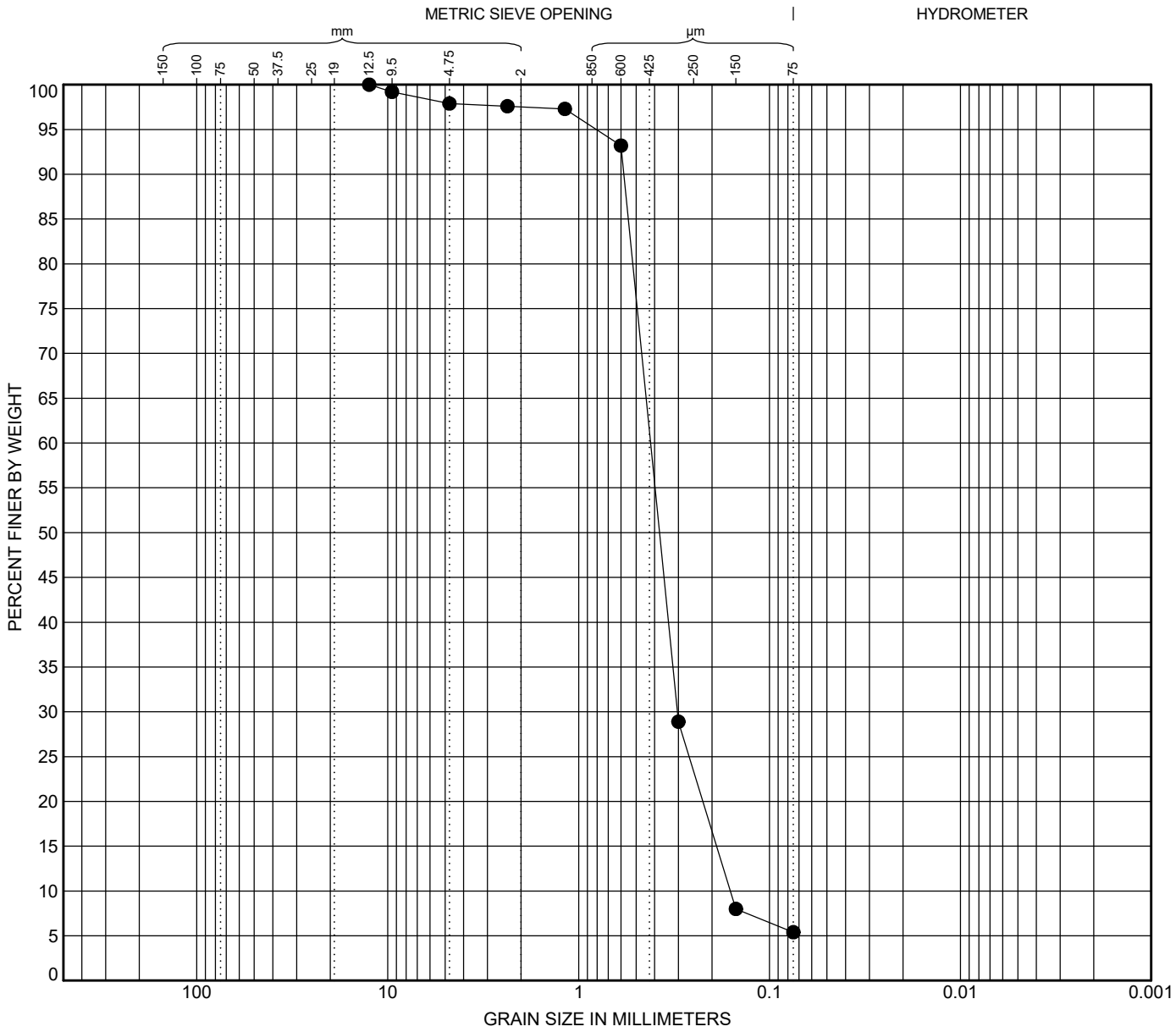
Checked By: M. Berthiaume

GRAIN SIZE DISTRIBUTION 2500096.GPJ DATAECORA2018.GDT 7/10/25

GRAIN SIZE DISTRIBUTION ASTM D6913

Project: Albion Industrial Lands Geotechnical Study
Location: Maple Ridge, BC
Source: BH25-04, G4

Project No: 2500096
Client: City of Maple Ridge
Depth: 5.10 m to 5.20 m



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

D_{100}	D_{85}	D_{60}	D_{30}	D_{15}	D_{10}	C_c	C_u	%Gravel	%Sand	%Silt	%Clay
12.5	**0.549**	**0.419**	**0.304**	**0.189**	**0.160**	**1.37**	**2.62**	**2.1**	**92.5**	**5.4**	

Description: SAND, trace Fines, trace Gravel
Natural Moisture Content: 23.7 %
Comments: N/A

Lab Sample Number: 25-229
Date Tested: 2025-06-10
Tested By: SQ

Checked By: M. Berthiaume

Ecora Engineering & Environmental Ltd.
201–284 Main Street, Penticton, BC

Atterberg Limits

ASTM D4318

Project: Albion Industrial Lands Geotechnical Study
Location: Maple Ridge, BC
Client: City of Maple Ridge
Material Source: BH25-01, G3 @ 3.6 - 3.9 meters

Project No: 2500096
Sample No: 25-226
Date Tested: 11-Jun-2025
Tested By: SQ

Liquid Limit			
Trial Number	1	2	3
Tare Number	L1	L2	L3
Number of Blows	0	0	0
Mass of Moisture (g)	0.00	0.00	0.00
Mass of Dry Soil (g)	0.00	0.00	0.00
Moisture Content (%)	0.0	0.0	0.0

Plastic Limit		
Trial Number	1	2
Tare Number	P1	P2
Mass of Moisture (g)	0.00	0.00
Mass of Dry Soil (g)	0.00	0.00
Moisture Content (%)	0.0	0.0

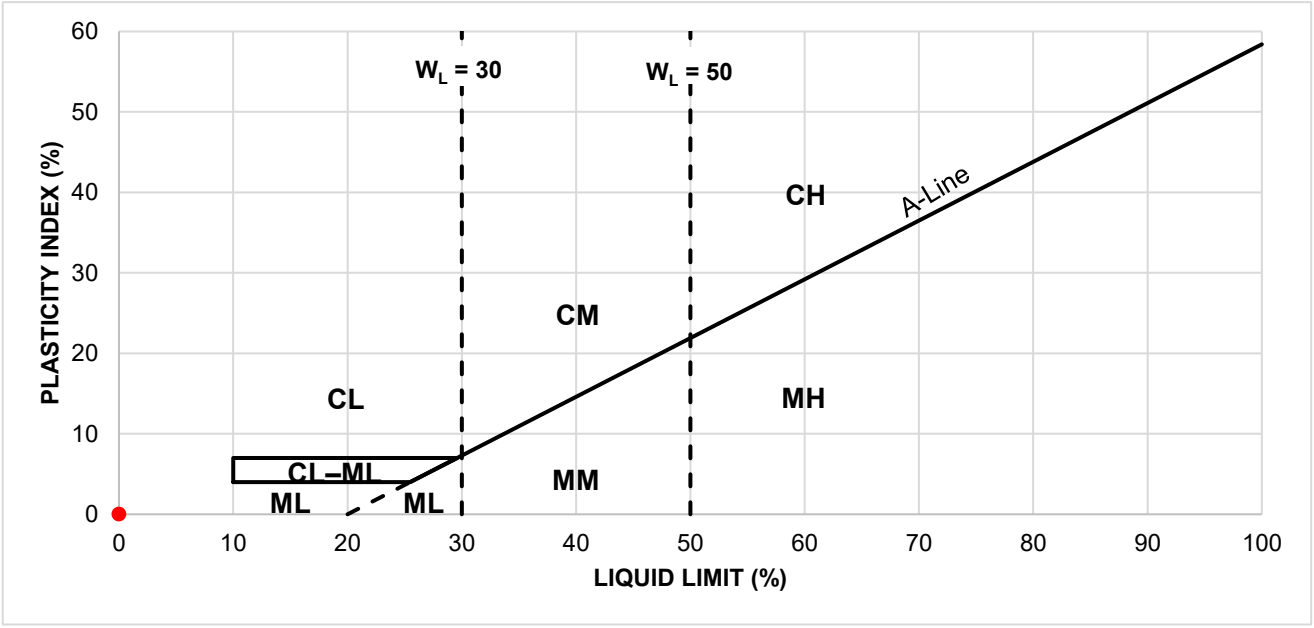
Test Results

Liquid Limit: 0
Plastic Limit: 0
Plasticity Index: 0

Plasticity Classification (based on Liquid Limit WL)

0 to 30	Low Plasticity
30 to 50	Medium Plasticity
> 50	High Plasticity

Sample Description: ML - Non Plastic Sandy Silt, trace Gravel.
Natural Moisture Content: 27.9%



Comments: Nn Plastic - An 1/8" thread could not be formed at any moisture content.

Reviewed By: S. Kraetzer

Ecora Engineering & Environmental Ltd.
201–284 Main Street, Penticton, BC

Atterberg Limits

ASTM D4318

Project: Albion Industrial Lands Geotechnical Study
Location: Maple Ridge, BC
Client: City of Maple Ridge
Material Source: BH25-02, G2 @ 1.8 - 2.1 meters

Project No: 2500096
Sample No: 25-227
Date Tested: 11-Jun-2025
Tested By: SQ

Liquid Limit			
Trial Number	1	2	3
Tare Number	L1	L2	L3
Number of Blows	0	0	0
Mass of Moisture (g)	0.00	0.00	0.00
Mass of Dry Soil (g)	0.00	0.00	0.00
Moisture Content (%)	0.0	0.0	0.0

Plastic Limit		
Trial Number	1	2
Tare Number	P1	P2
Mass of Moisture (g)	0.00	0.00
Mass of Dry Soil (g)	0.00	0.00
Moisture Content (%)	0.0	0.0

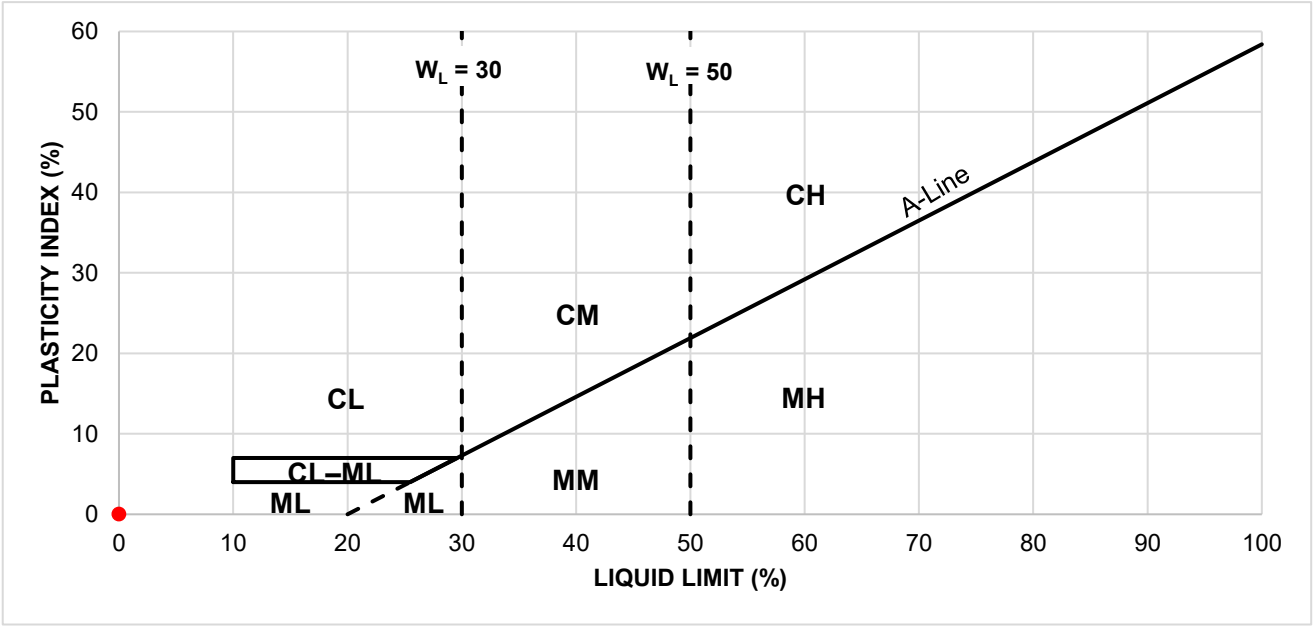
Test Results

Liquid Limit: 0
Plastic Limit: 0
Plasticity Index: 0

Plasticity Classification (based on Liquid Limit WL)

0 to 30	Low Plasticity
30 to 50	Medium Plasticity
> 50	High Plasticity

Sample Description: ML - Non Plastic Sandy Silt, trace Gravel.
Natural Moisture Content: 21.2%



Comments: Nn Plastic - An 1/8" thread could not be formed at any moisture content.

Reviewed By:
S. Kraetzer

Ecora Engineering & Environmental Ltd.
201–284 Main Street, Penticton, BC

Atterberg Limits

ASTM D4318

Project: Albion Industrial Lands Geotechnical Study
Location: Maple Ridge, BC
Client: City of Maple Ridge
Material Source: BH25-05, G2 @ 1.8 - 2.1 meters

Project No: 2500096
Sample No: 25-230
Date Tested: 11-Jun-2025
Tested By: SQ

Liquid Limit			
Trial Number	1	2	3
Tare Number	L1	L2	L3
Number of Blows	18	25	30
Mass of Moisture (g)	3.21	3.01	3.60
Mass of Dry Soil (g)	10.37	10.28	13.18
Moisture Content (%)	31.0	29.3	27.3

Plastic Limit		
Trial Number	1	2
Tare Number	P1	P2
Mass of Moisture (g)	1.20	1.24
Mass of Dry Soil (g)	4.96	5.05
Moisture Content (%)	24.2	24.6

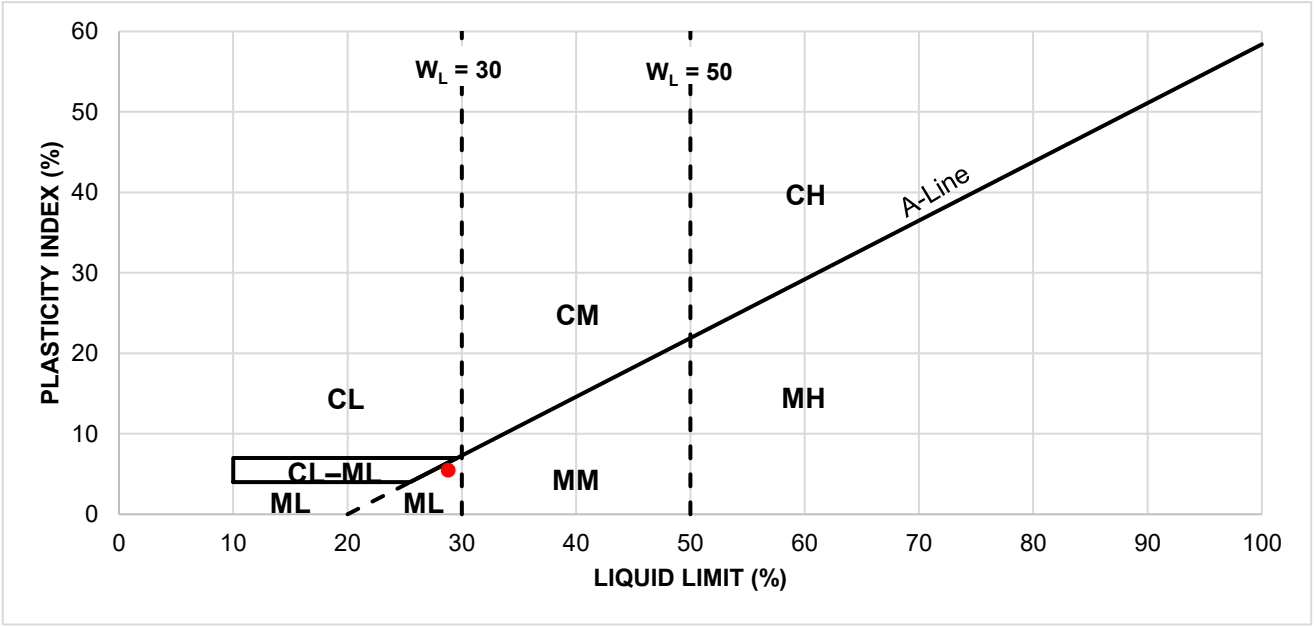
Test Results

Liquid Limit: 29
Plastic Limit: 24
Plasticity Index: 5

Plasticity Classification (based on Liquid Limit WL)

0 to 30	Low Plasticity
30 to 50	Medium Plasticity
> 50	High Plasticity

Sample Description: ML - Low Plastic Sandy Silt
Natural Moisture Content: 31.9%

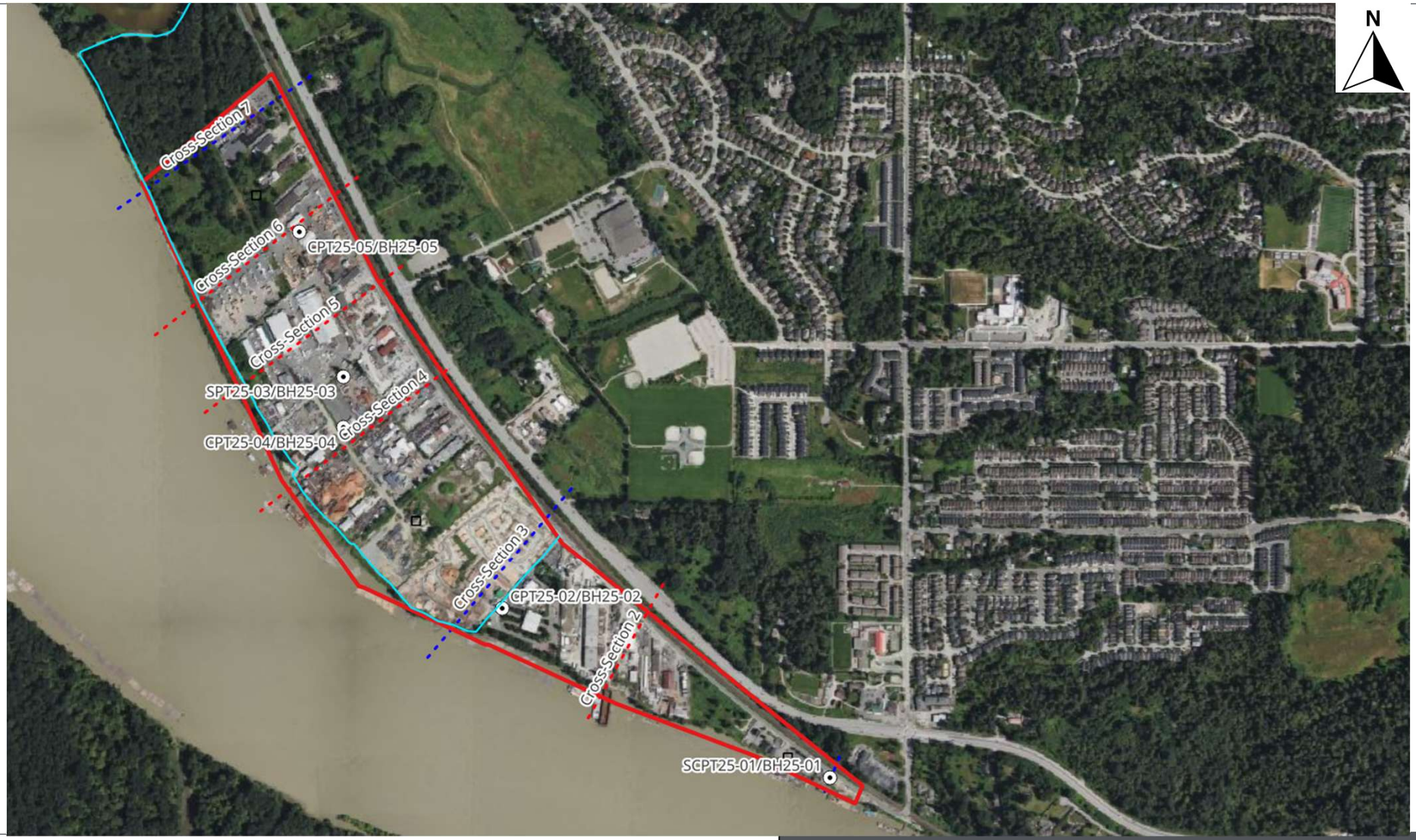


Comments:

Reviewed By: S. Kraetzer

Appendix E

Slope Stability Analysis Results



Legend:
- Study Area
- Approximate Albion Dike Alignment
- Cross-Sections Considered for Analysis
- Cross-Section Analyzed
- Borehole/CPT/SCPT Locations

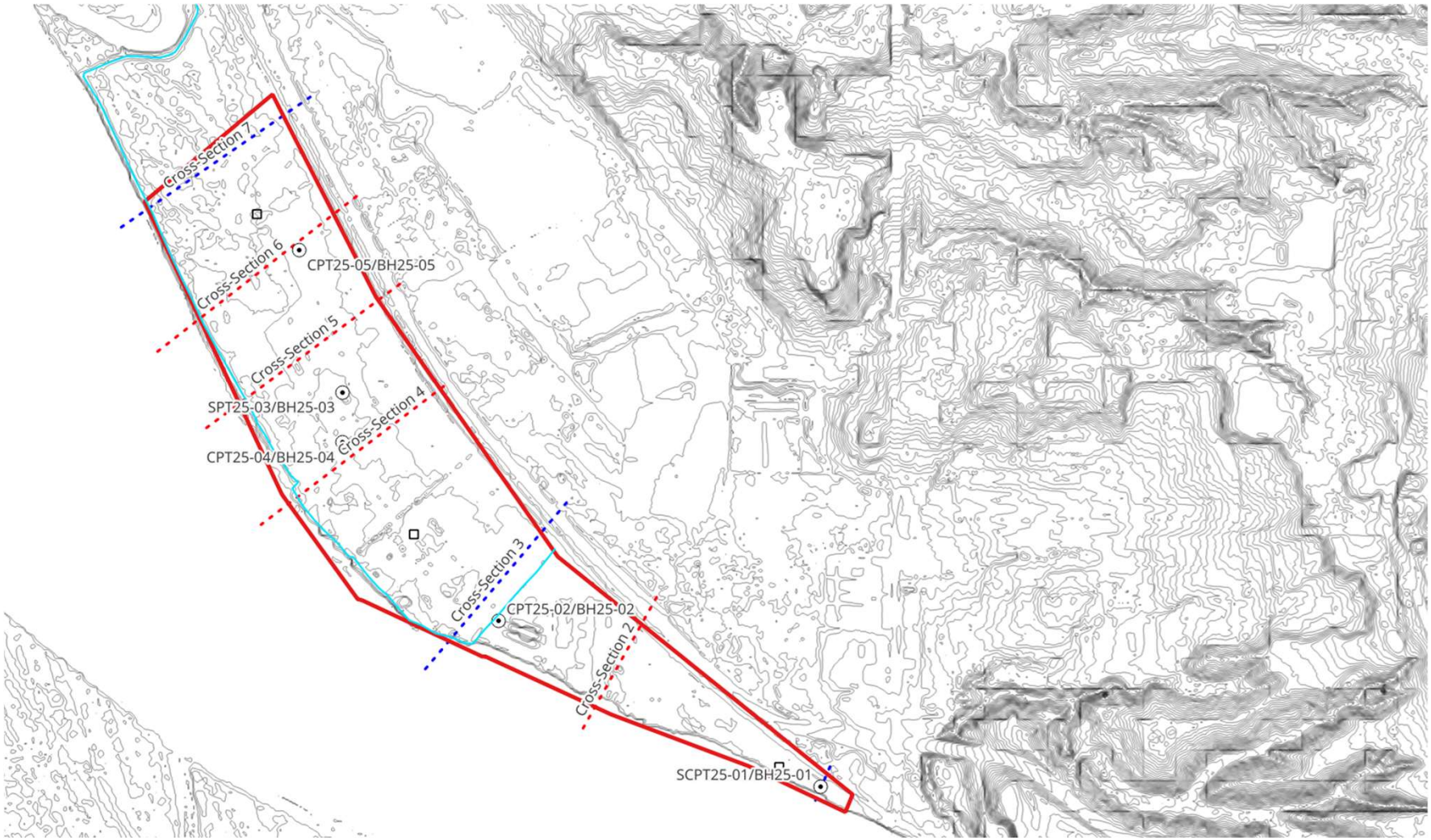
Notes:
Ground surface is based on BC LiDAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section Location

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

ecora



Legend:
- Study Area
- Approximate Albion Dike Alignment
- Cross-Sections Considered for Analysis
- Cross-Section Analyzed
- Borehole/CPT/SCPT Locations

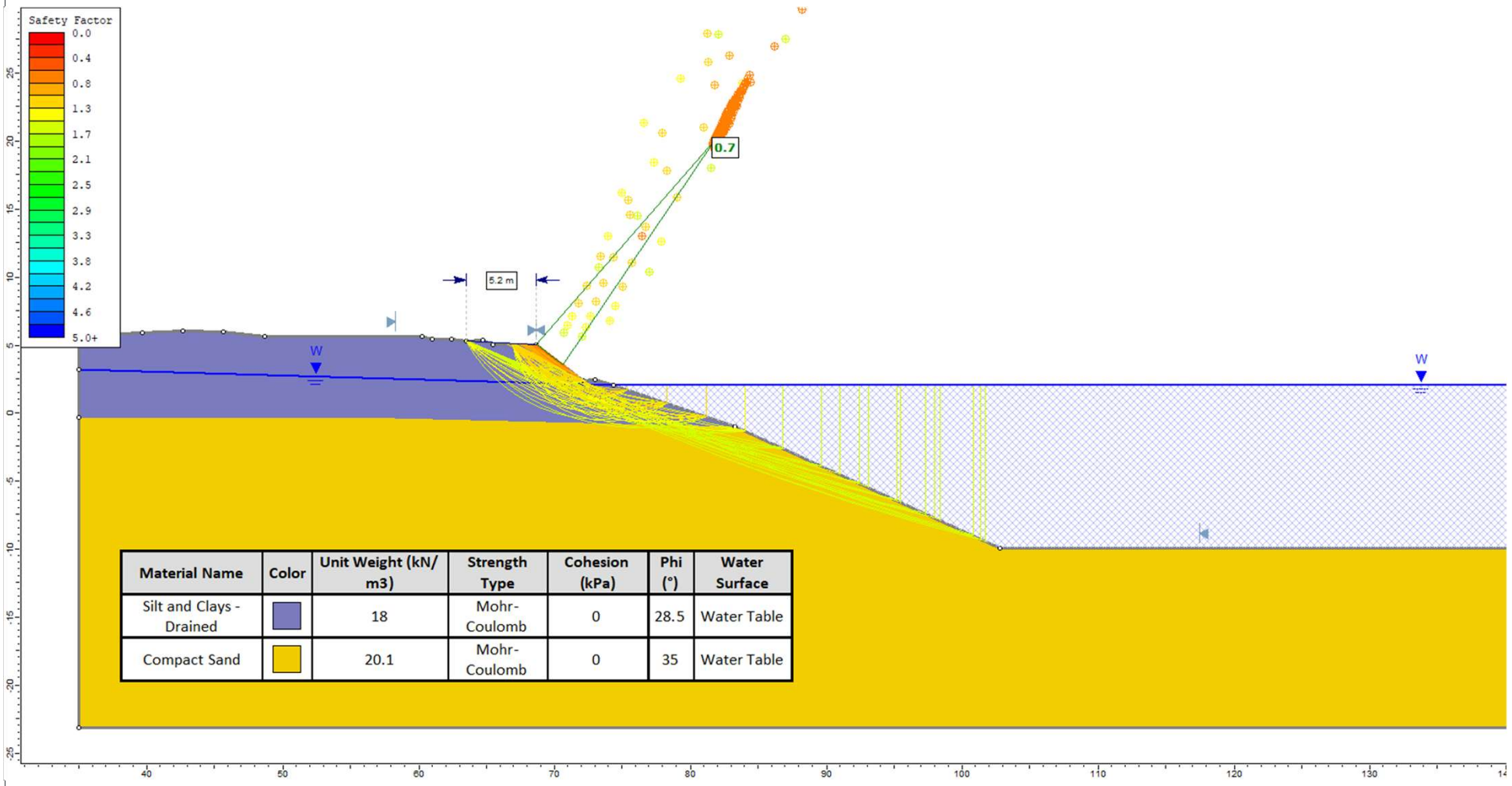
Notes:
Ground surface is based on BC LiDAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section Location (BC LiDAR)

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

ecora



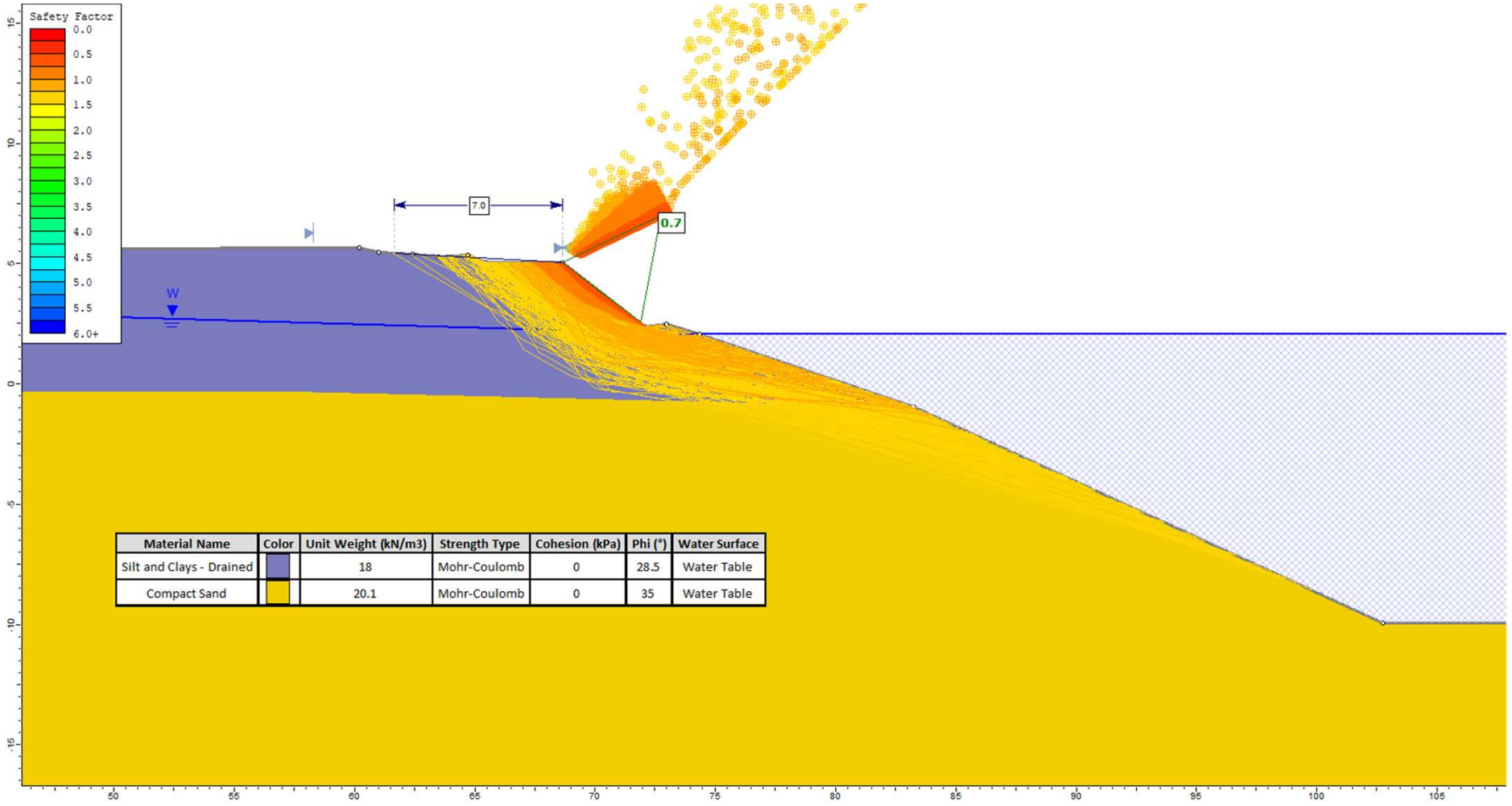
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Silt and Clays - Drained		18	Mohr-Coulomb	0	28.5	Water Table
Compact Sand		20.1	Mohr-Coulomb	0	35	Water Table

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 1 – Static Drained Case

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface
Silt and Clays - Drained		18	Mohr-Coulomb	0	28.5	Water Table
Compact Sand		20.1	Mohr-Coulomb	0	35	Water Table

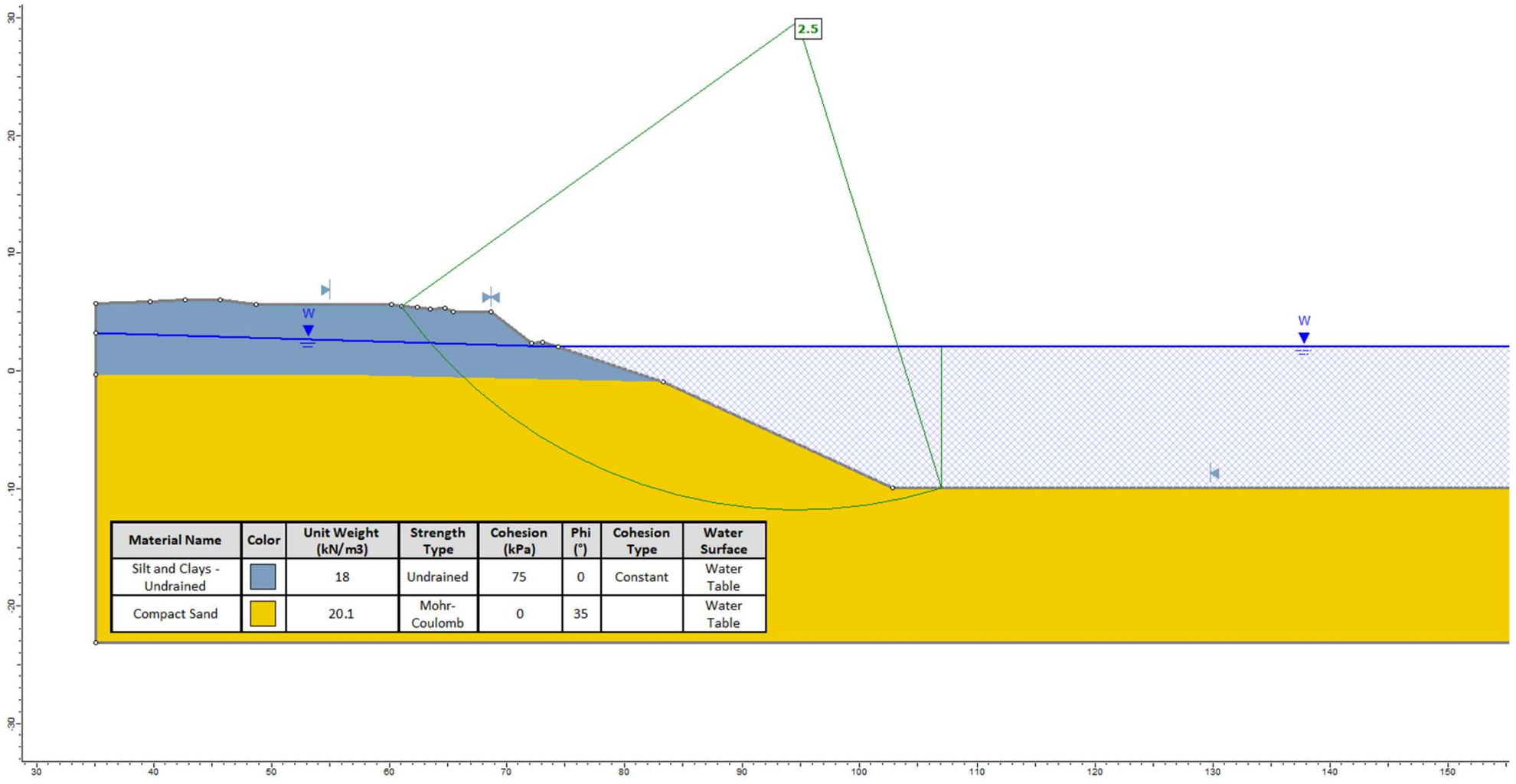
Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 1 – Static Drained Case (Non-Circular)

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

ecora



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Water Surface
Silt and Clays - Undrained		18	Undrained	75	0	Constant	Water Table
Compact Sand		20.1	Mohr-Coulomb	0	35		Water Table

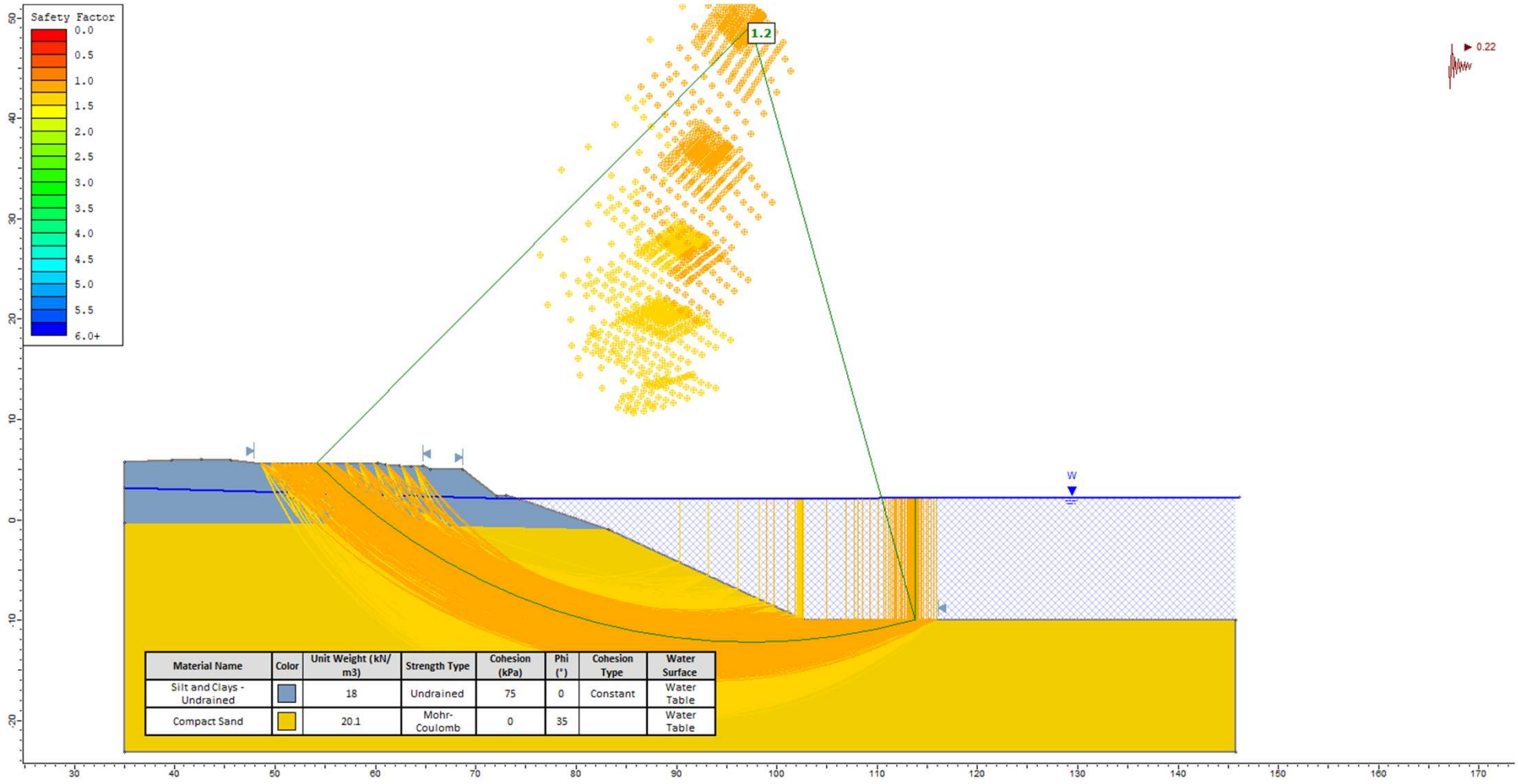
Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 1 – Static Undrained Case

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

ecora



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Water Surface
Silt and Clays - Undrained		18	Undrained	75	0	Constant	Water Table
Compact Sand		20.1	Mohr-Coulomb	0	35		Water Table

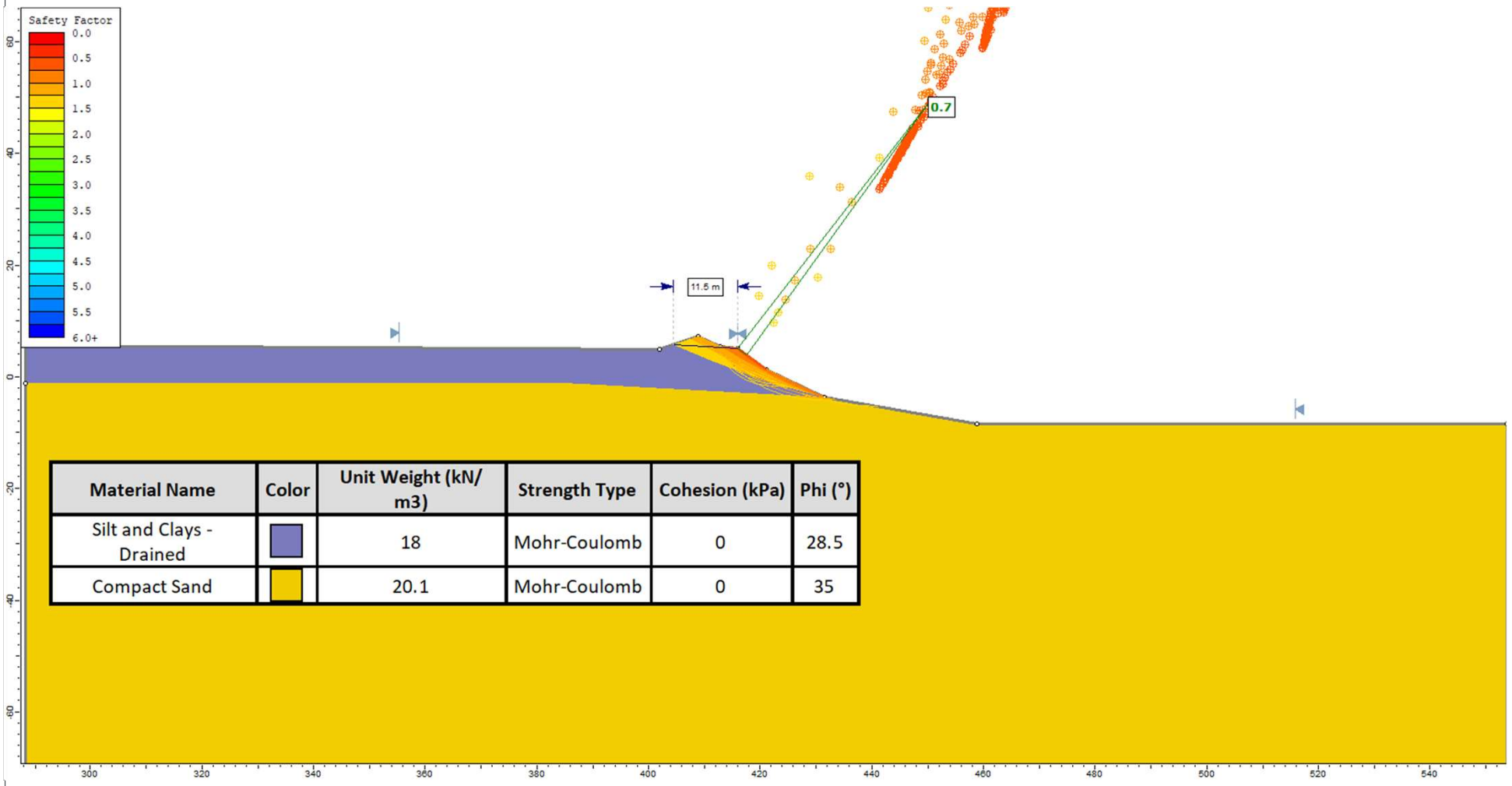
Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 1 – Pseudo-Static

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

ecora



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Silt and Clays - Drained		18	Mohr-Coulomb	0	28.5
Compact Sand		20.1	Mohr-Coulomb	0	35

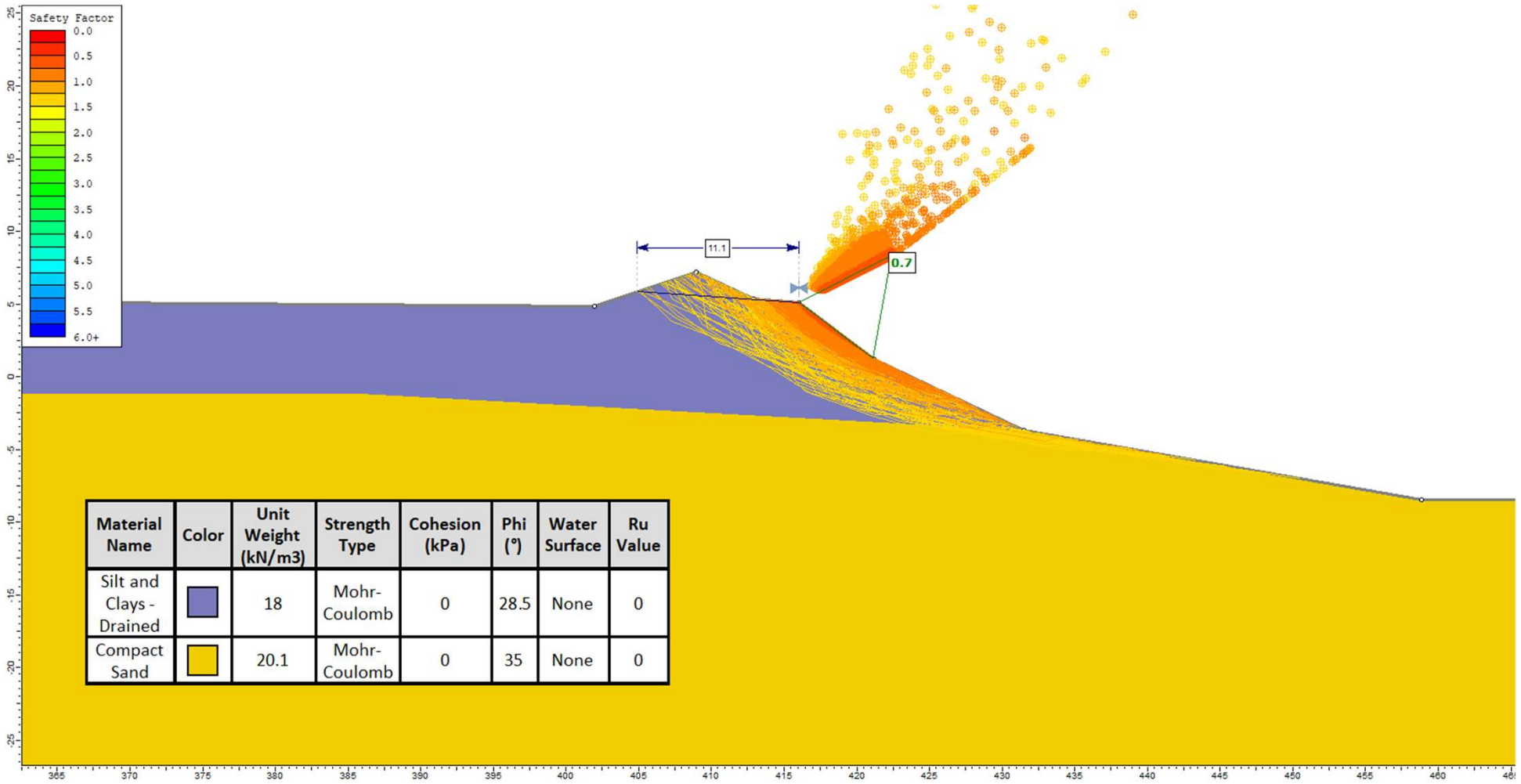
Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 3 – Static Drained Case

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

ecora



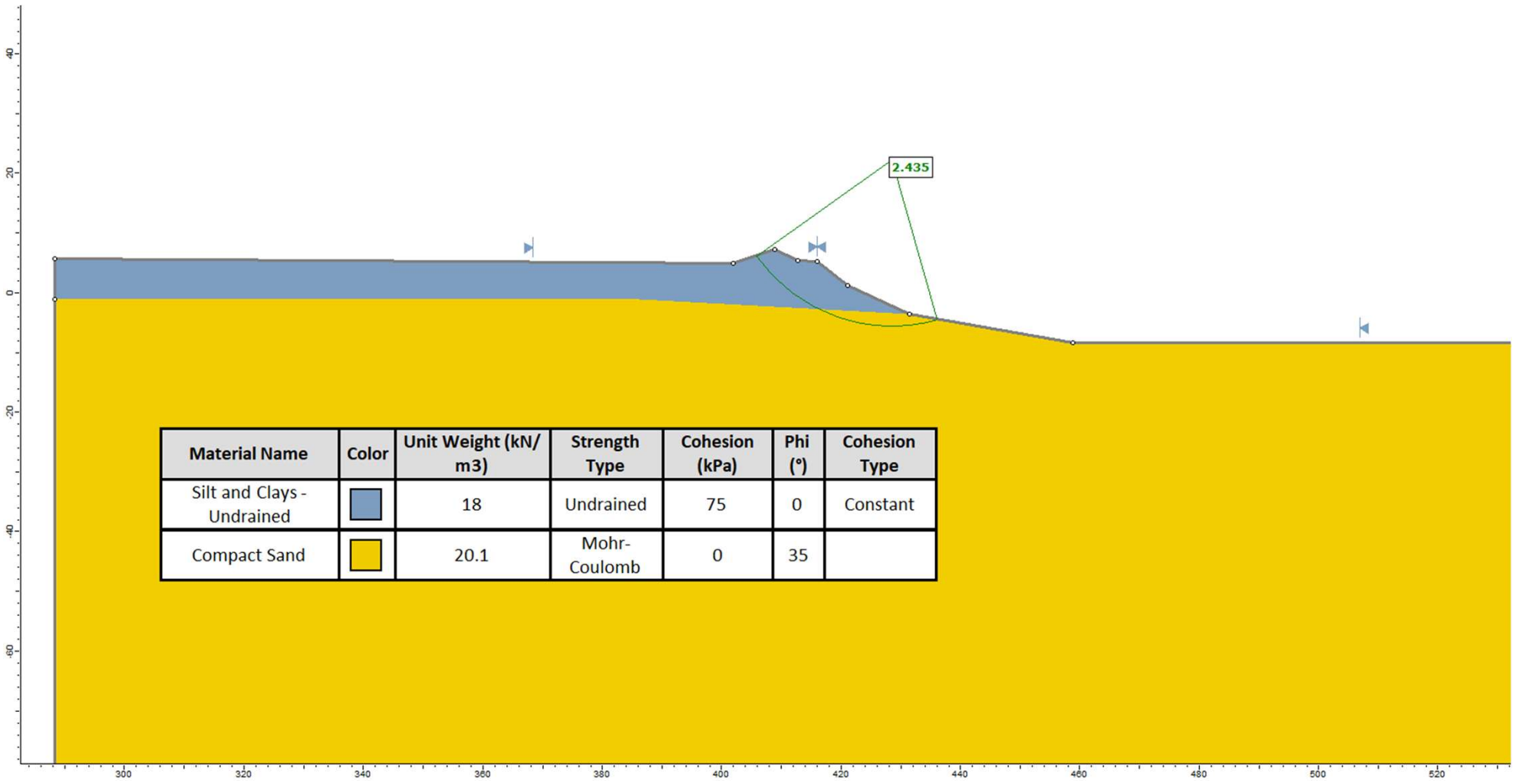
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Silt and Clays - Drained		18	Mohr-Coulomb	0	28.5	None	0
Compact Sand		20.1	Mohr-Coulomb	0	35	None	0

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 3 – Static Drained Case (Non-Circular)

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB



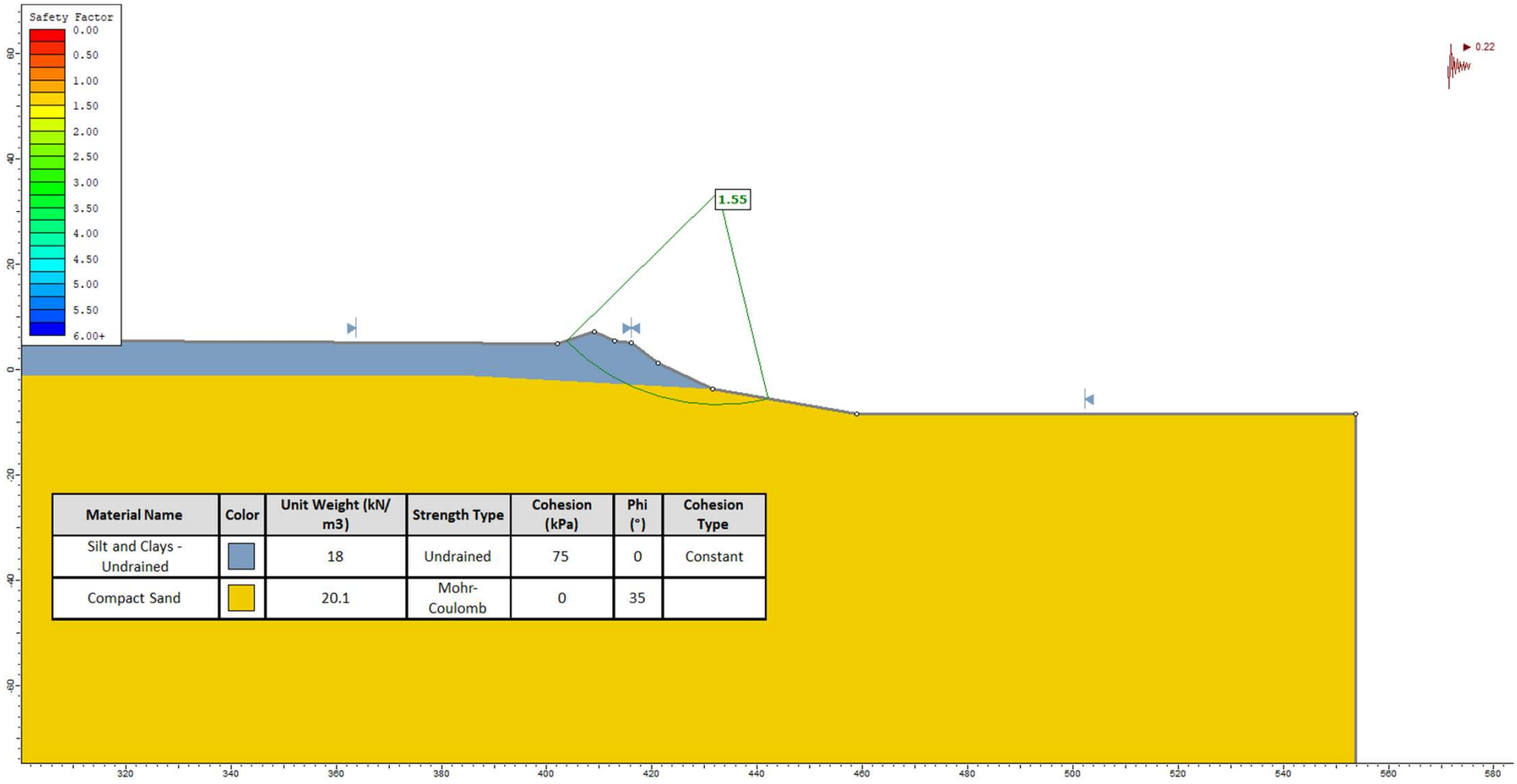
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type
Silt and Clays - Undrained		18	Undrained	75	0	Constant
Compact Sand		20.1	Mohr-Coulomb	0	35	

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 3 – Static Undrained Case

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type
Silt and Clays - Undrained		18	Undrained	75	0	Constant
Compact Sand		20.1	Mohr-Coulomb	0	35	

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 3 – Pseudo-Static

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

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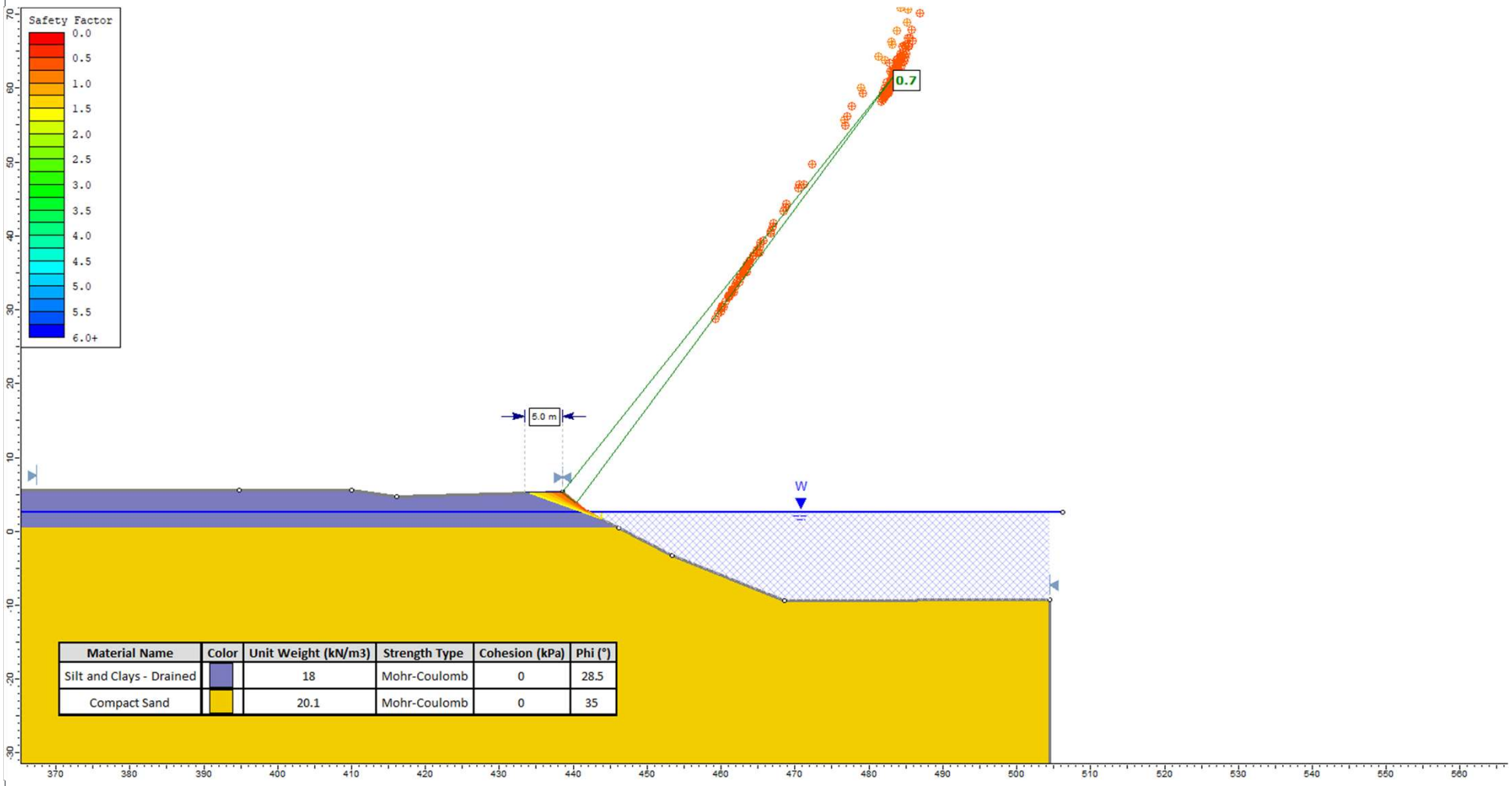


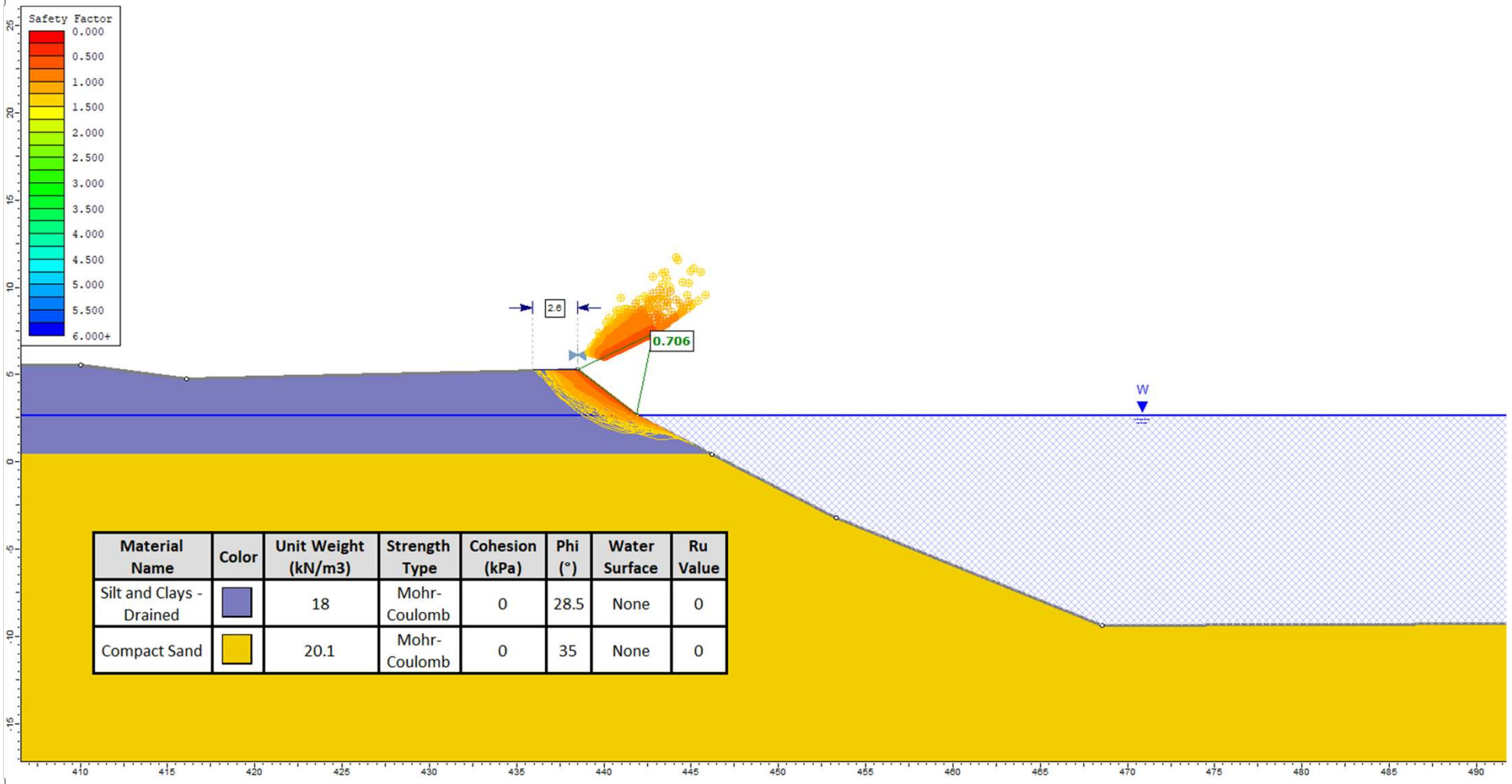
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Silt and Clays - Drained		18	Mohr-Coulomb	0	28.5
Compact Sand		20.1	Mohr-Coulomb	0	35

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 7 – Static Drained Case

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB



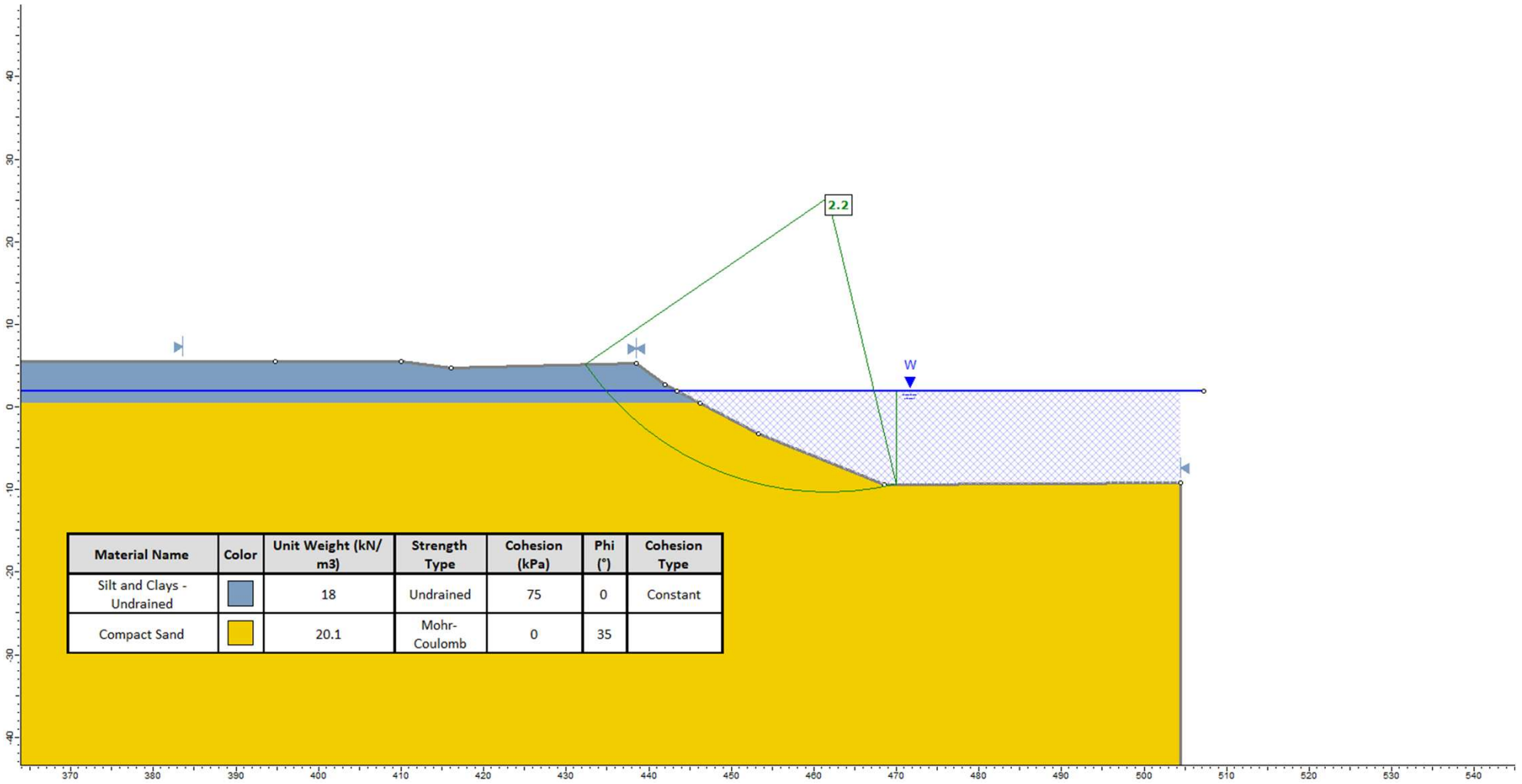
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Ru Value
Silt and Clays - Drained		18	Mohr-Coulomb	0	28.5	None	0
Compact Sand		20.1	Mohr-Coulomb	0	35	None	0

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 7 – Static Drained Case (Non-Circular(

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type
Silt and Clays - Undrained		18	Undrained	75	0	Constant
Compact Sand		20.1	Mohr-Coulomb	0	35	

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 7 – Static Undrained Case

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

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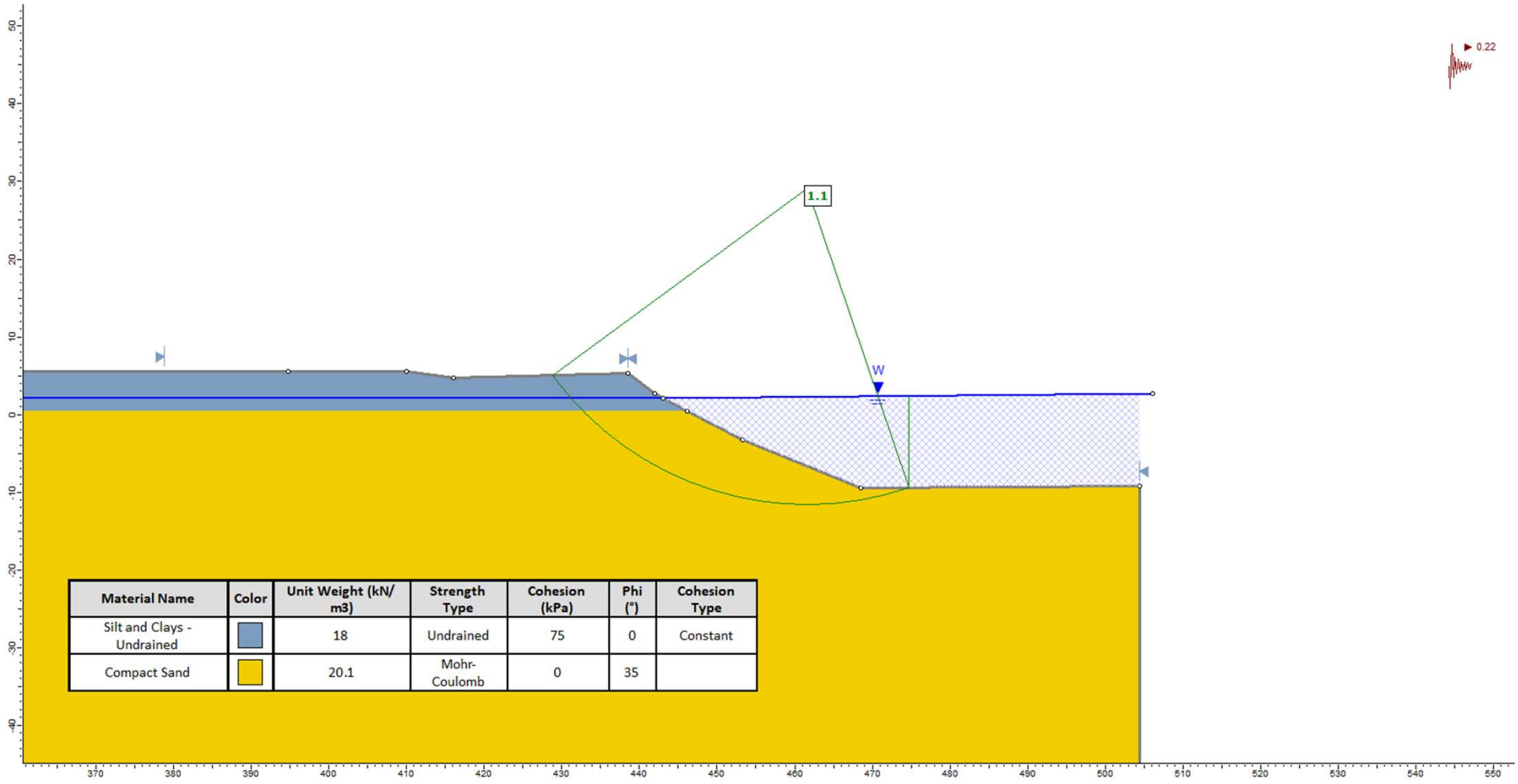

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type
Silt and Clays - Undrained		18	Undrained	75	0	Constant
Compact Sand		20.1	Mohr-Coulomb	0	35	

Notes:
Ground surface is based on BC LidAR dated 2017

Albion Industrial Lands Geotechnical Study

Cross-Section 7 – Pseudo-Static

Project No. 2500096
Client: City of Maple Ridge
Office: Vancouver
Scale: NTS
Date: June 2025
DWN: MB CHK: DCB

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Appendix F

Liquefaction Analysis Results

Ecora
Engineering and Environmental Ltd.
www.ecora.ca

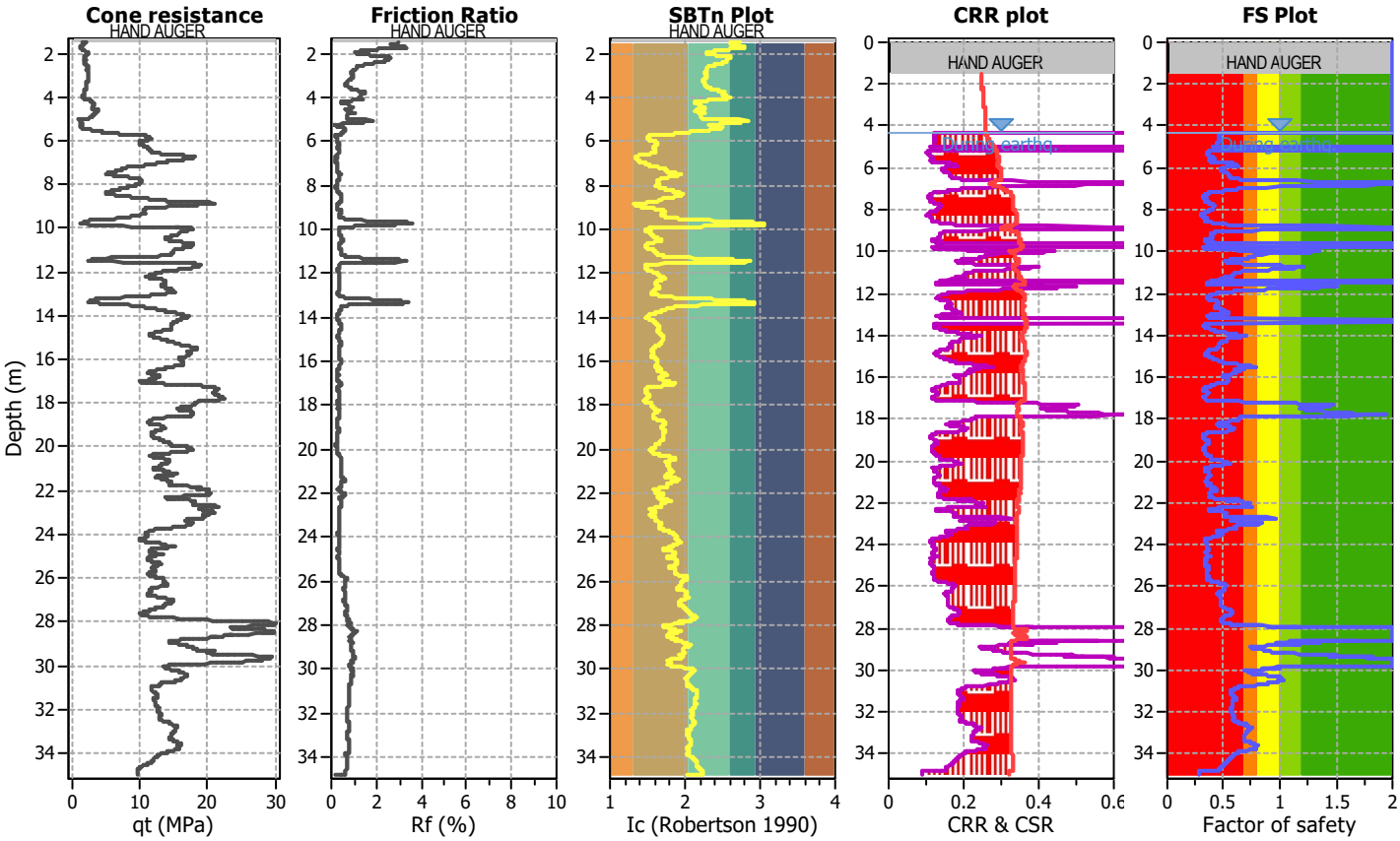
LIQUEFACTION ANALYSIS REPORT

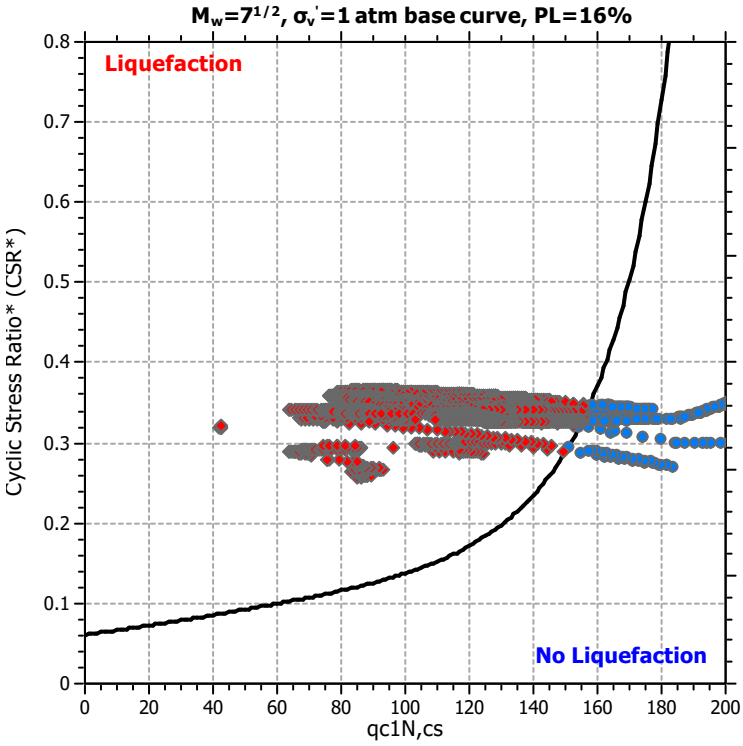
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

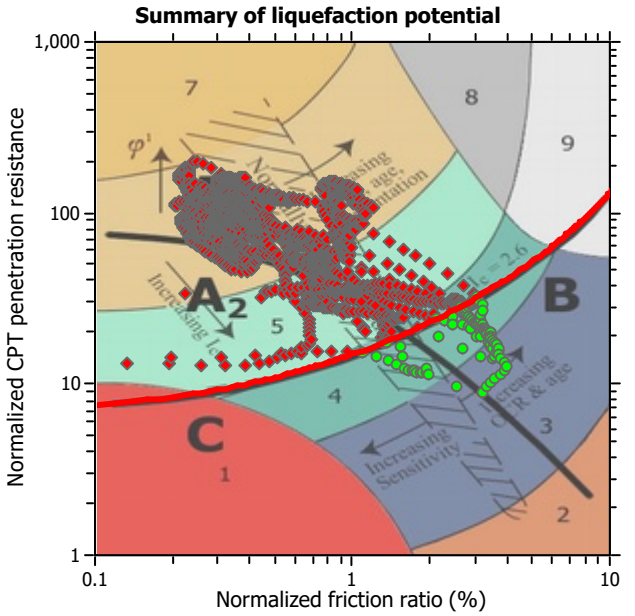
CPT file : Digi - CPT23-01 - ValleyGeo

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	4.30 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.30 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

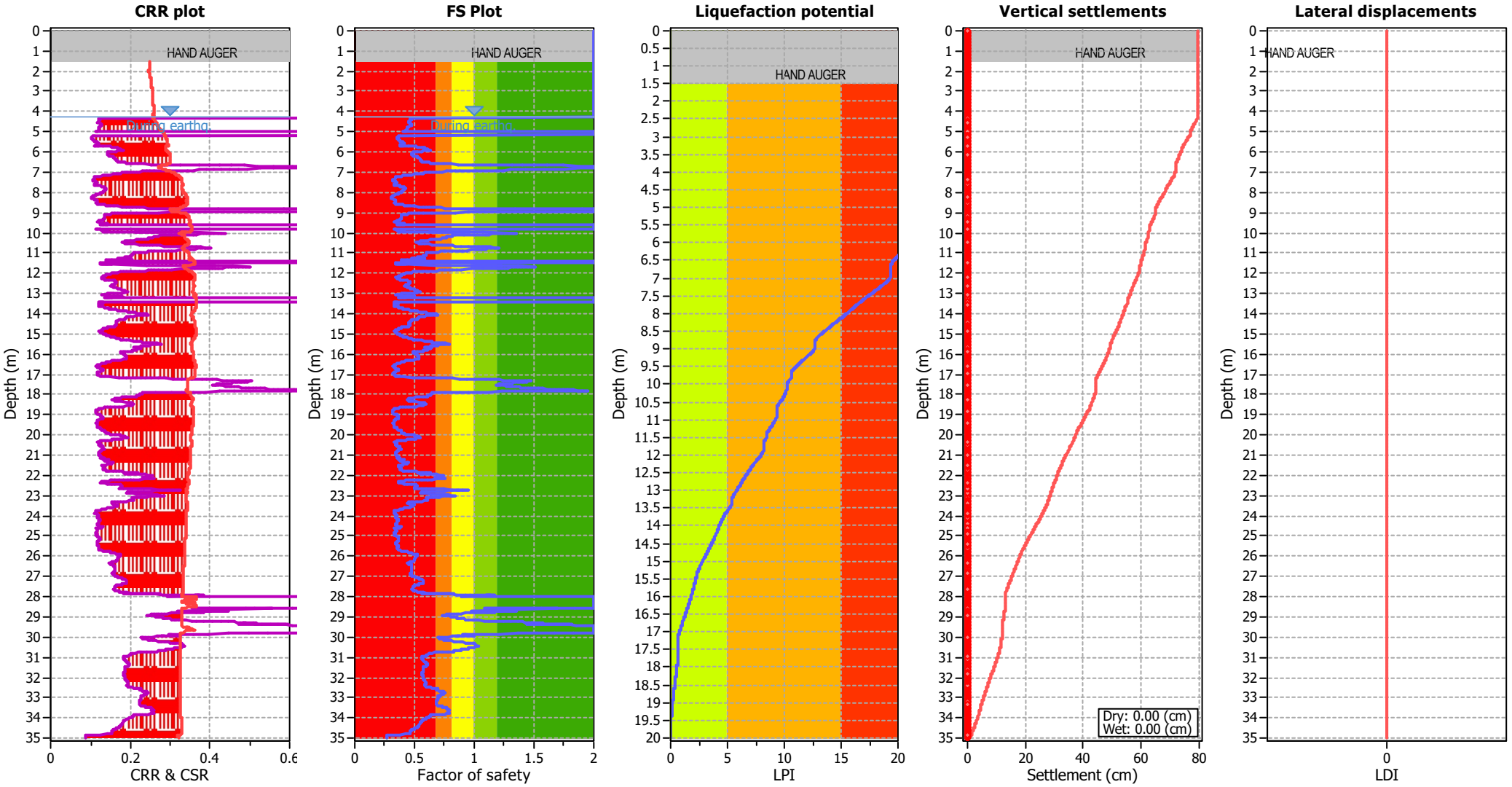






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.30 m	Fill height:	N/A	Limit depth:	N/A

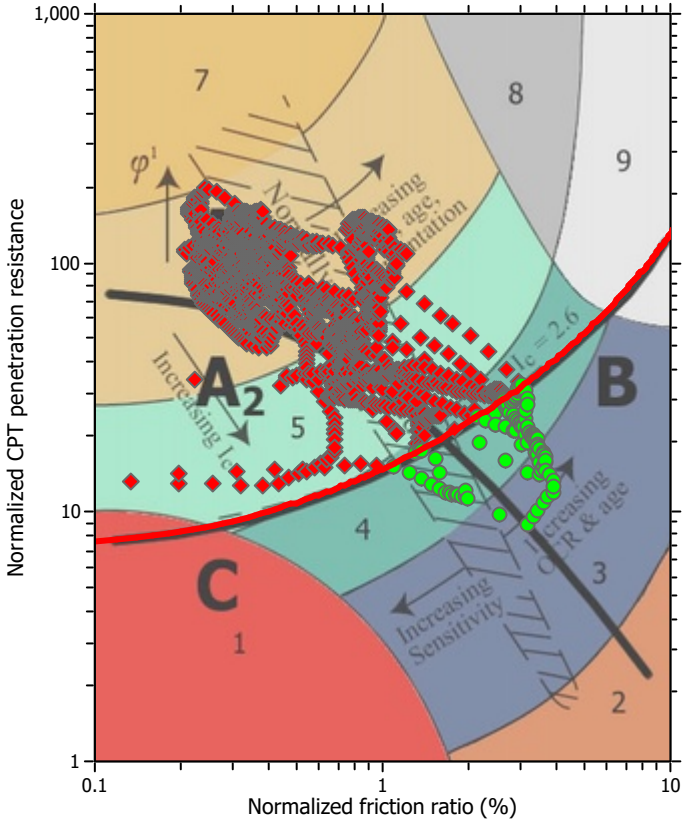
F.S. color scheme

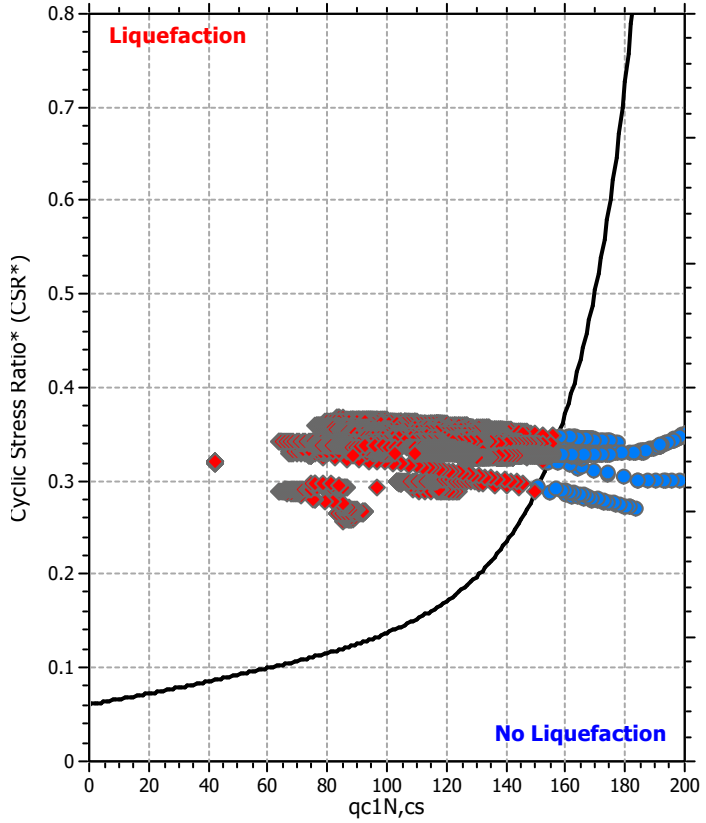
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

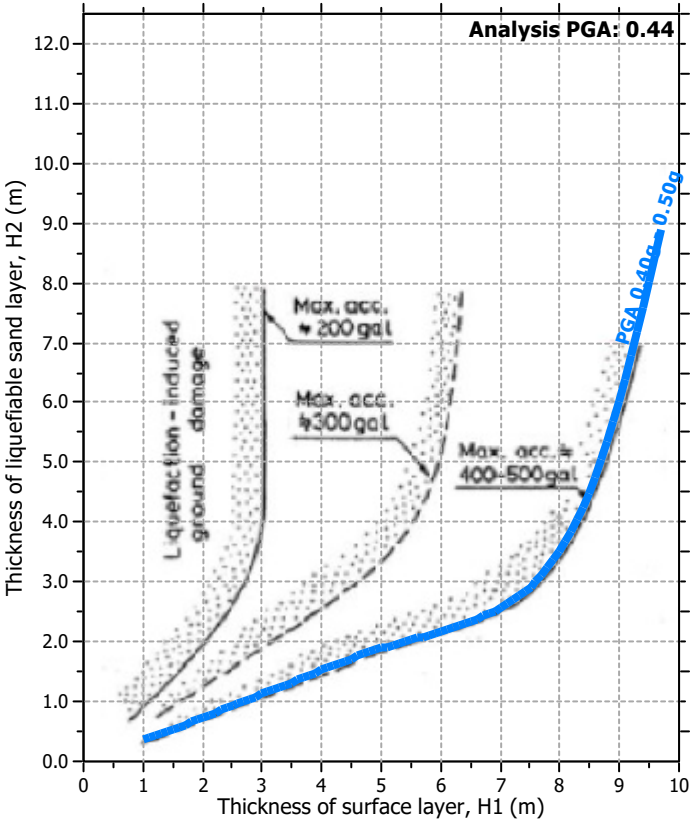
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



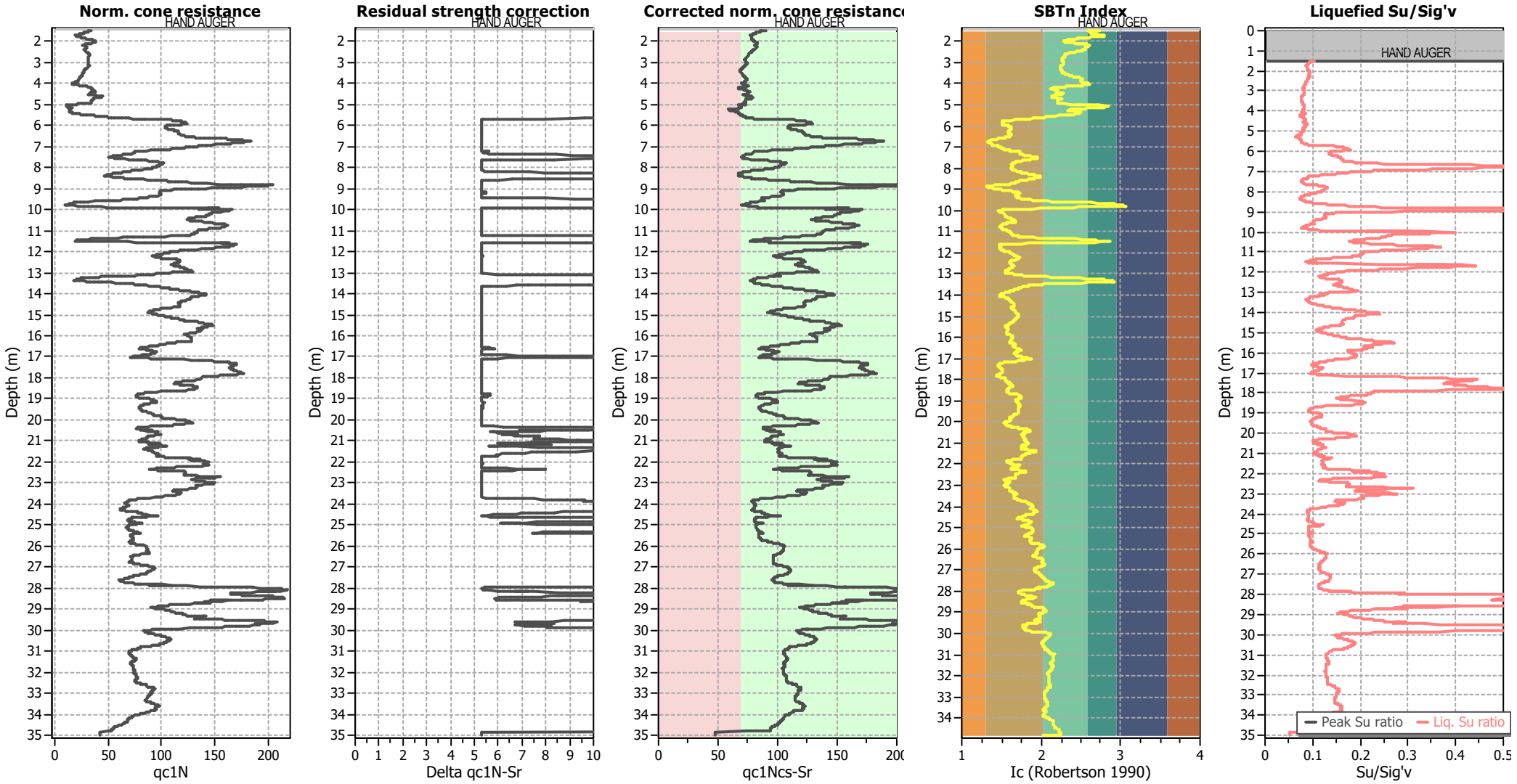




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.30 m	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.30 m	Fill height:	N/A	Limit depth:	N/A

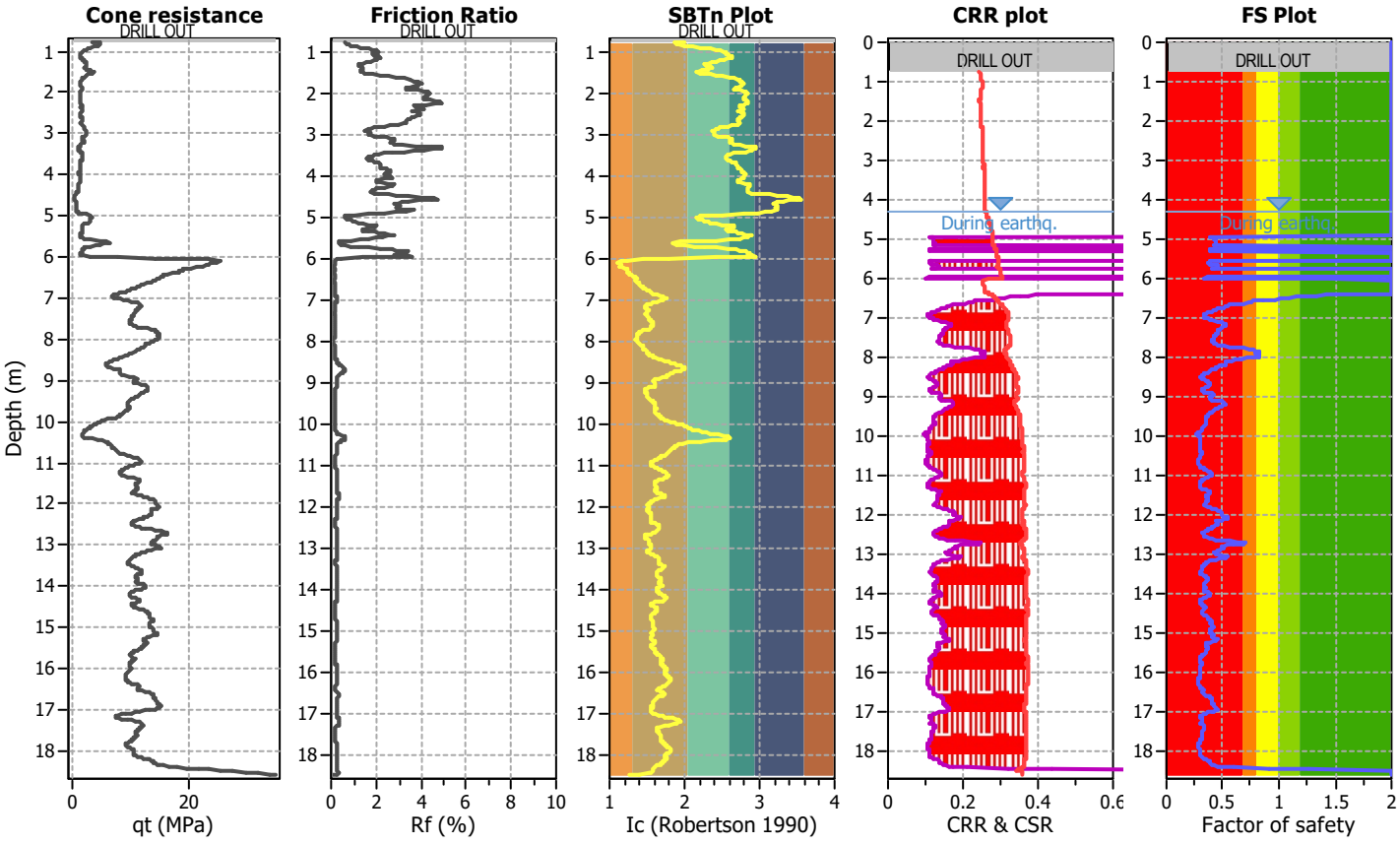
LIQUEFACTION ANALYSIS REPORT

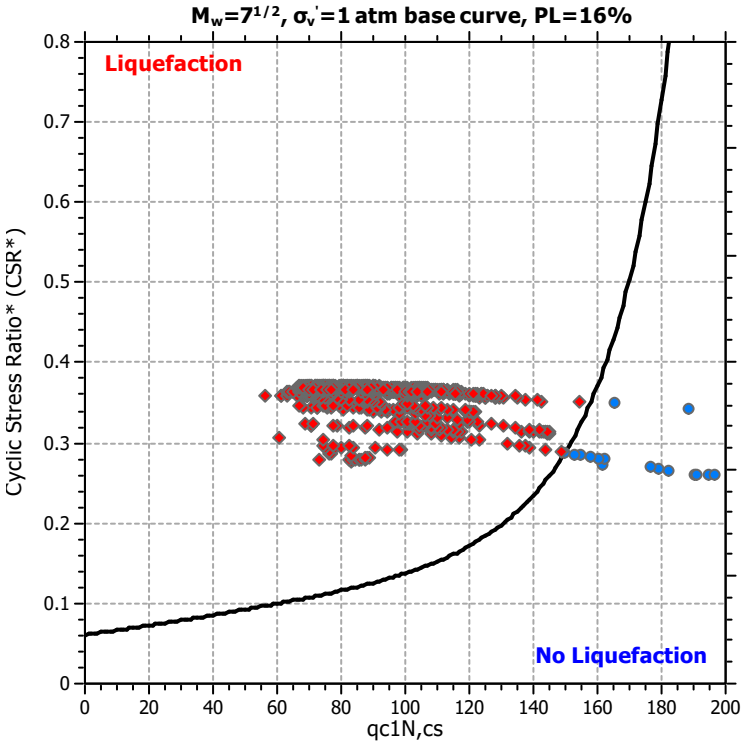
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

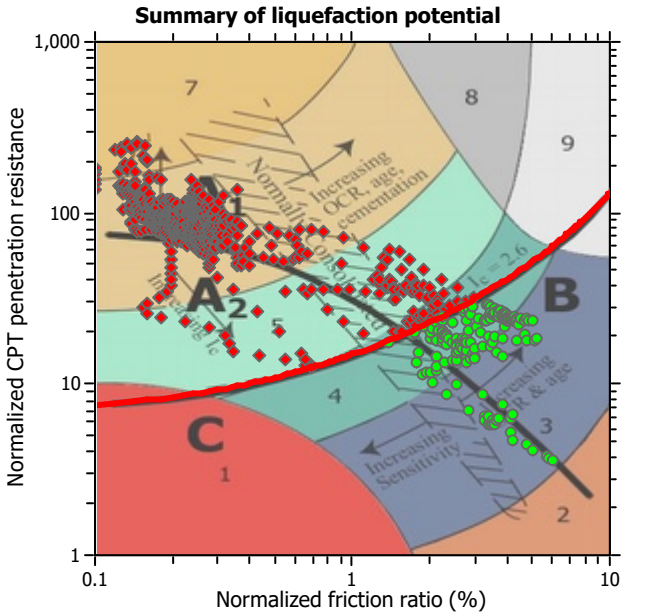
CPT file : SCPT25-01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	4.30 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.30 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

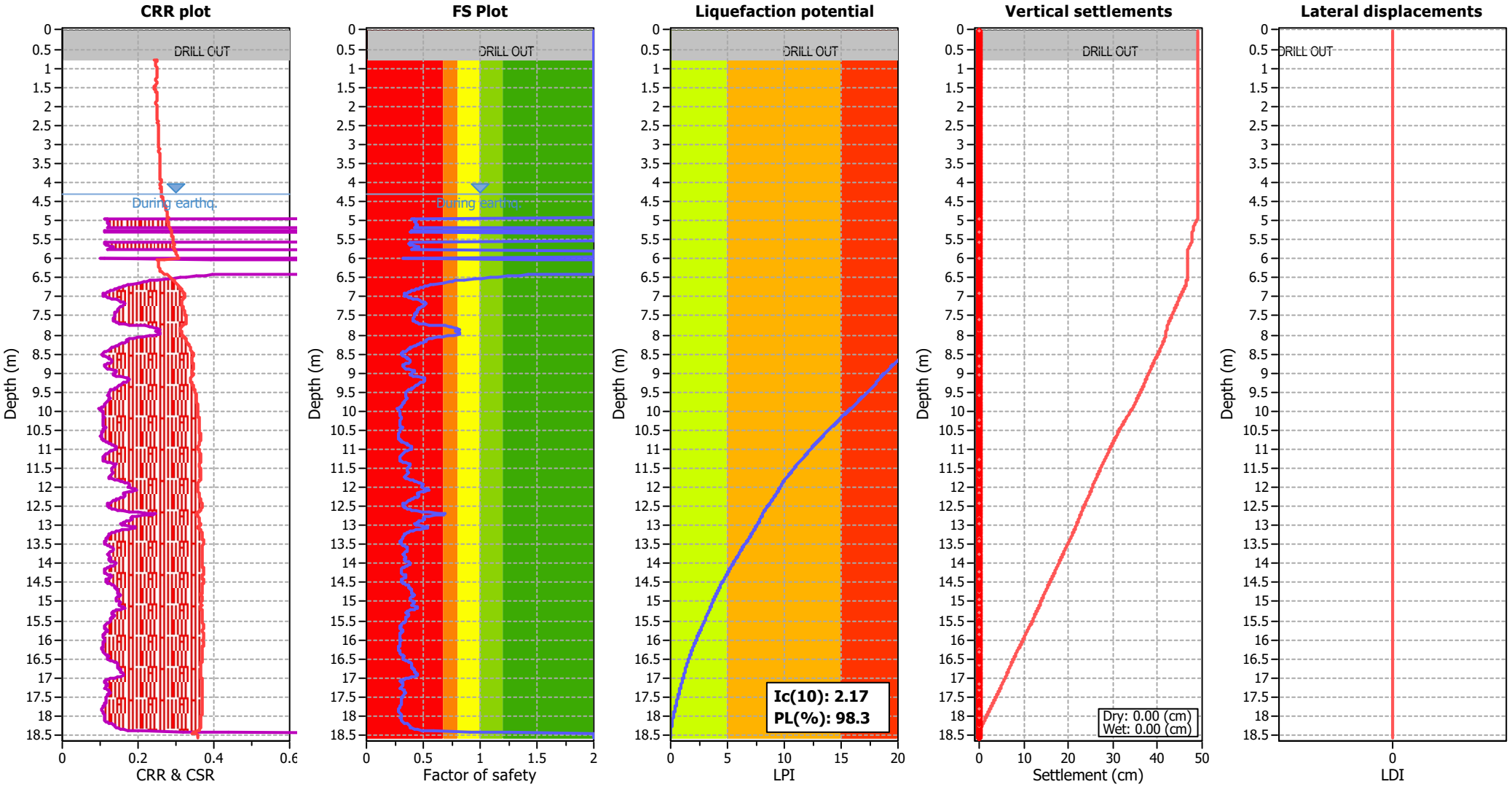






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.30 m	Fill height:	N/A	Limit depth:	N/A

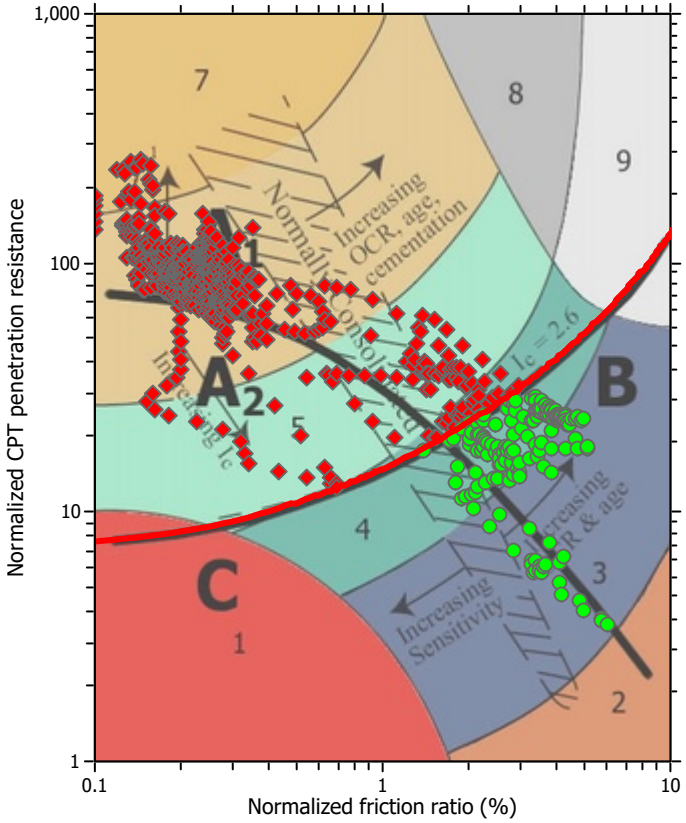
F.S. color scheme

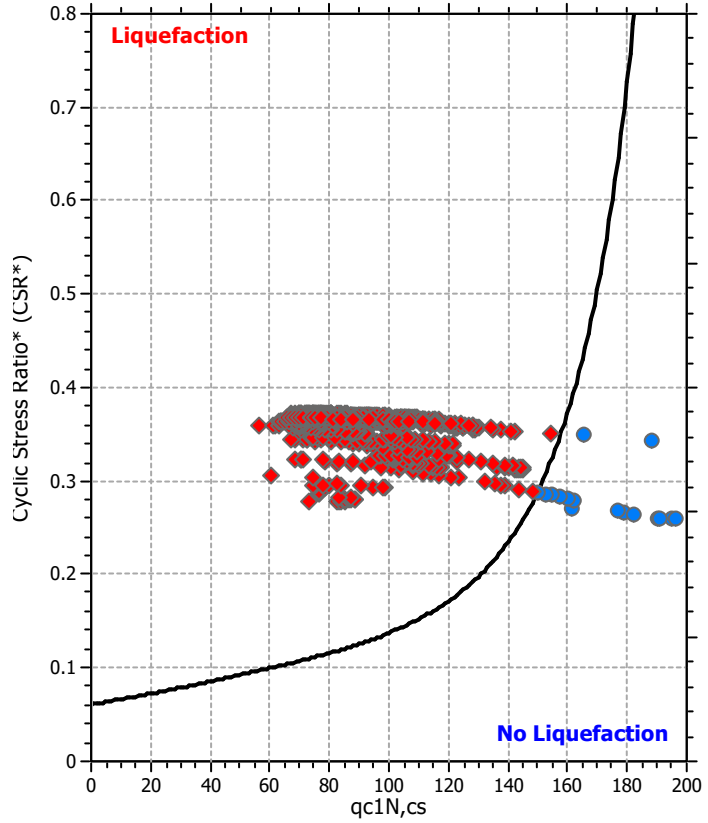
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

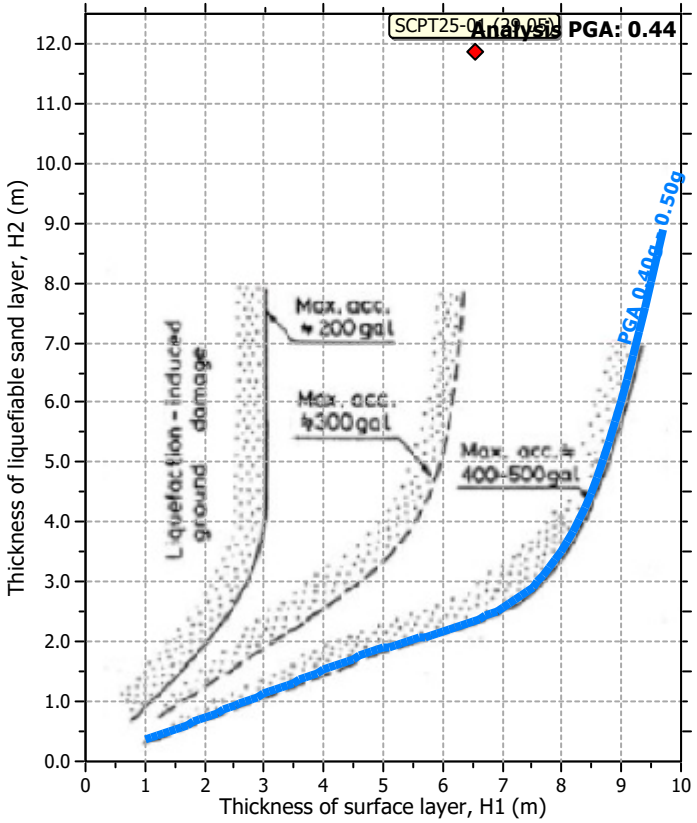
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



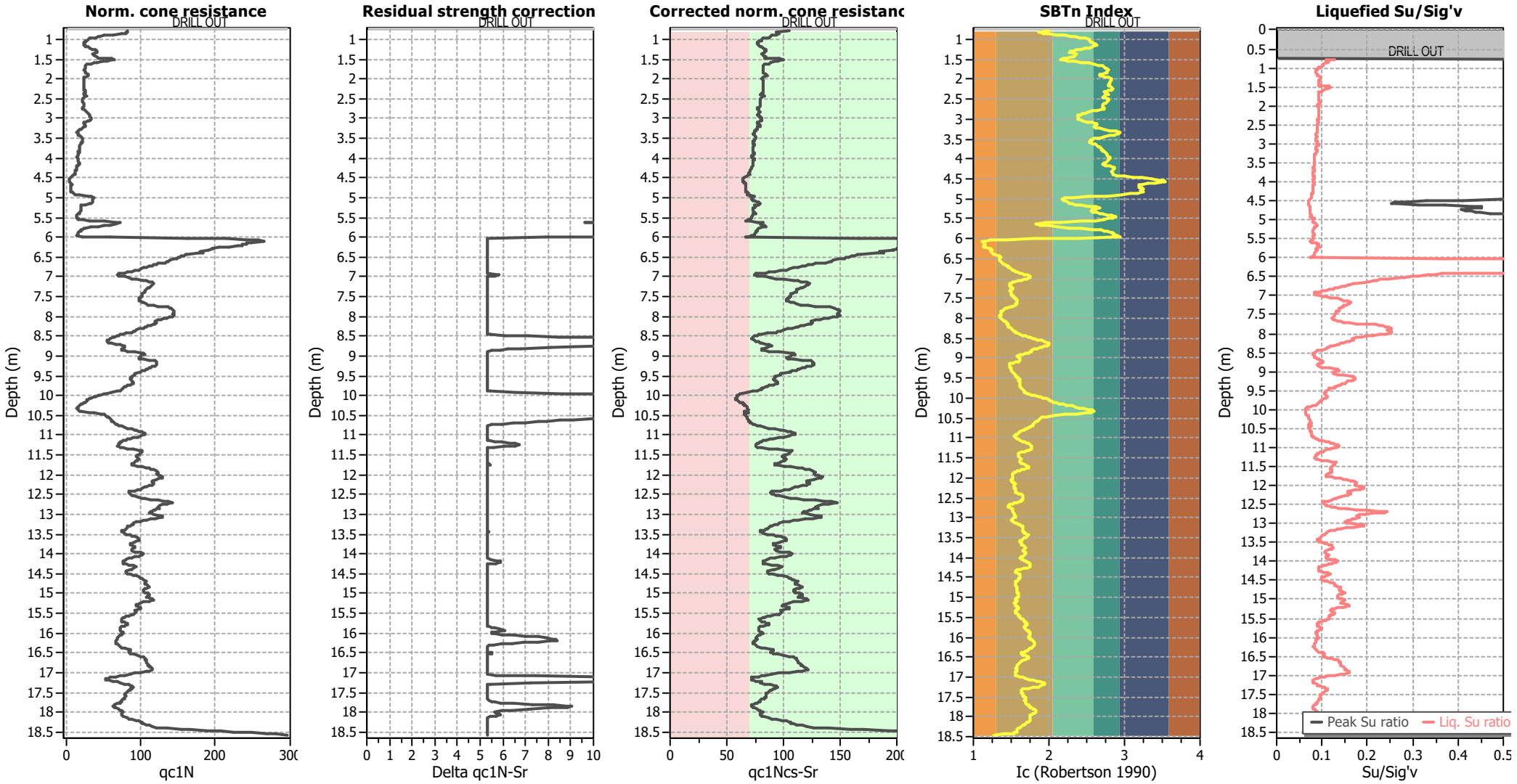




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.30 m	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.30 m	Fill height:	N/A	Limit depth:	N/A

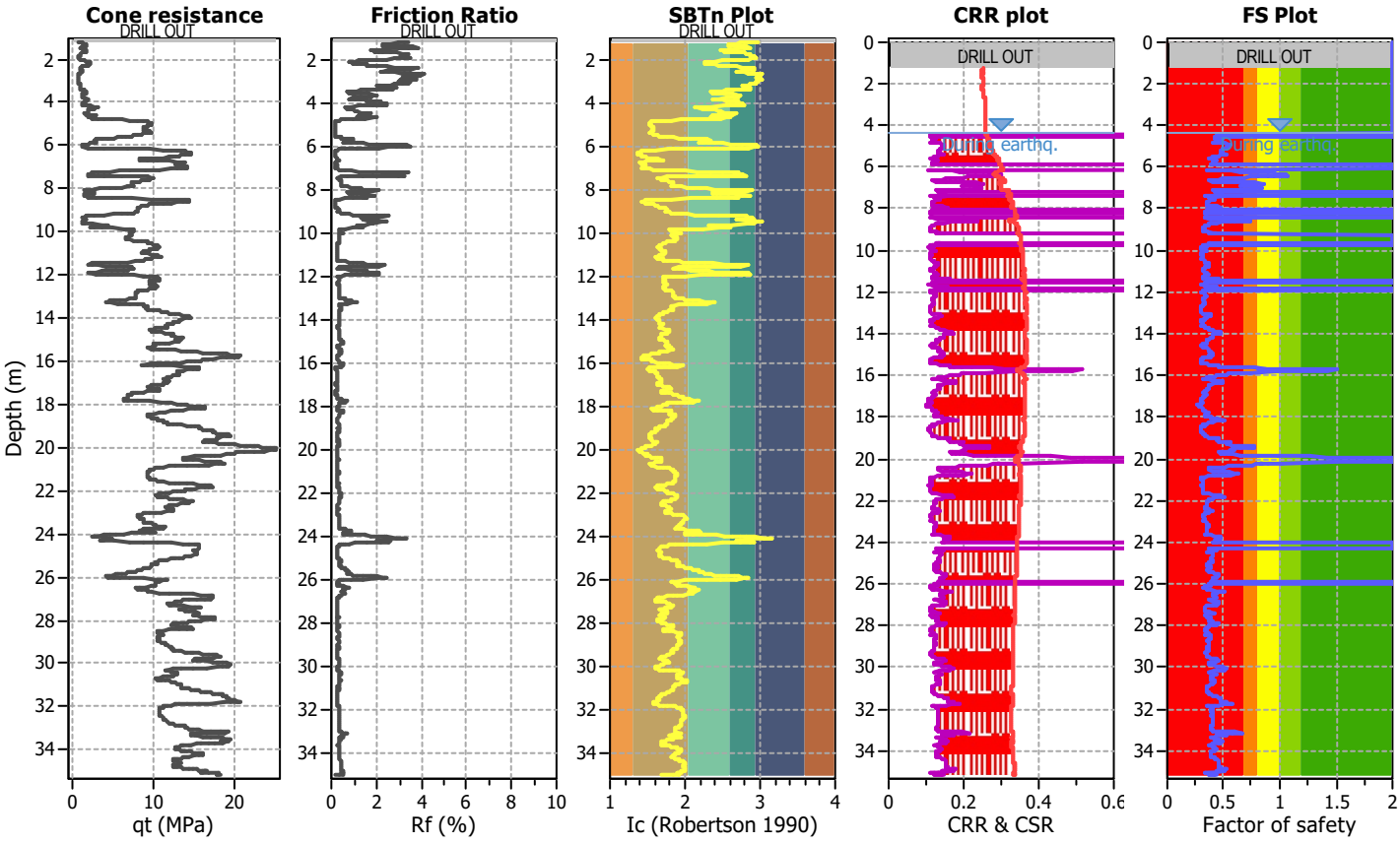
LIQUEFACTION ANALYSIS REPORT

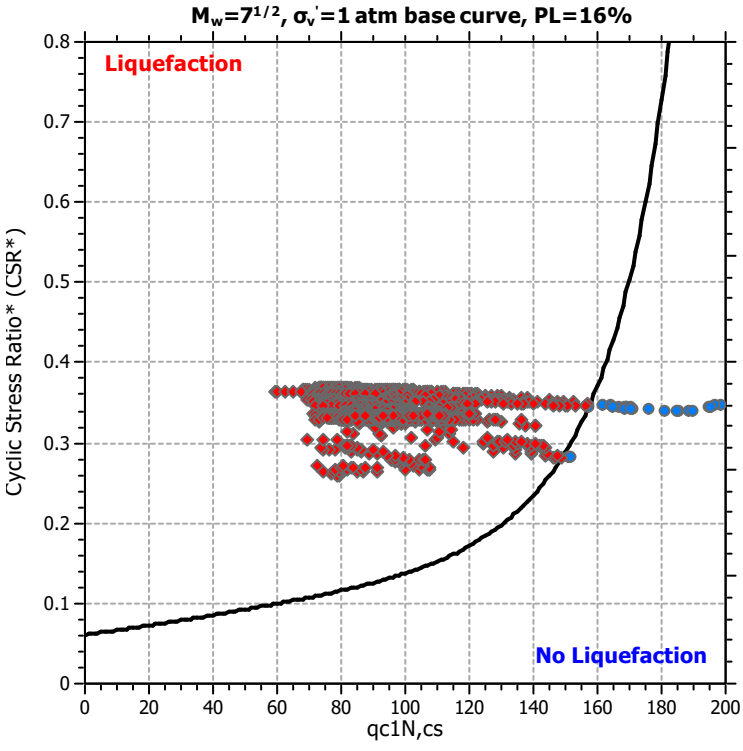
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

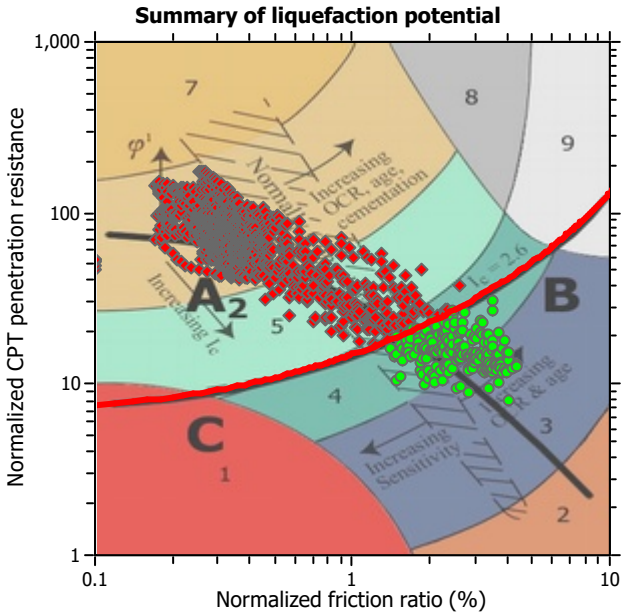
CPT file : CPT25-05

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	4.40 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.40 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

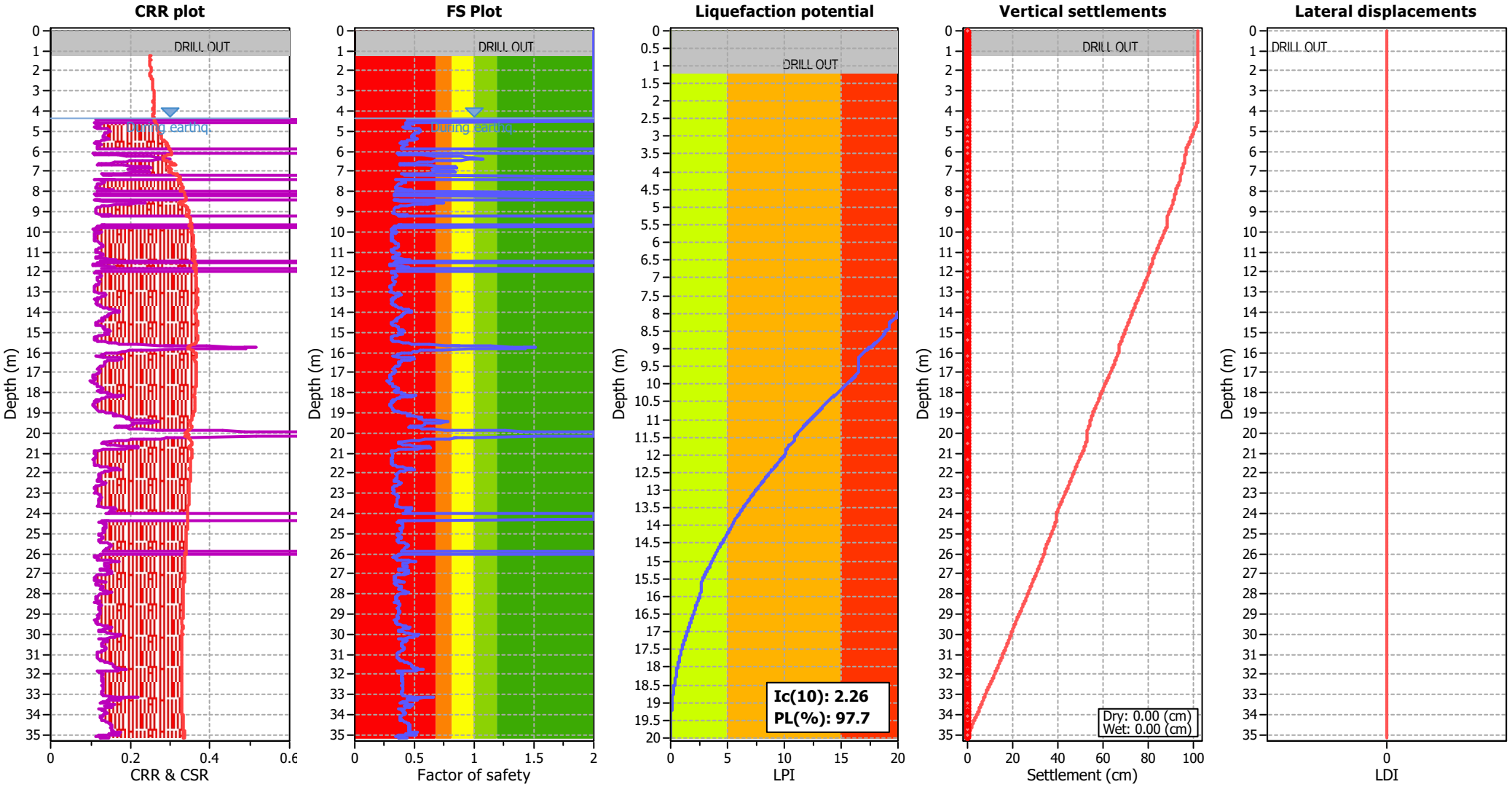






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.40 m	Fill height:	N/A	Limit depth:	N/A

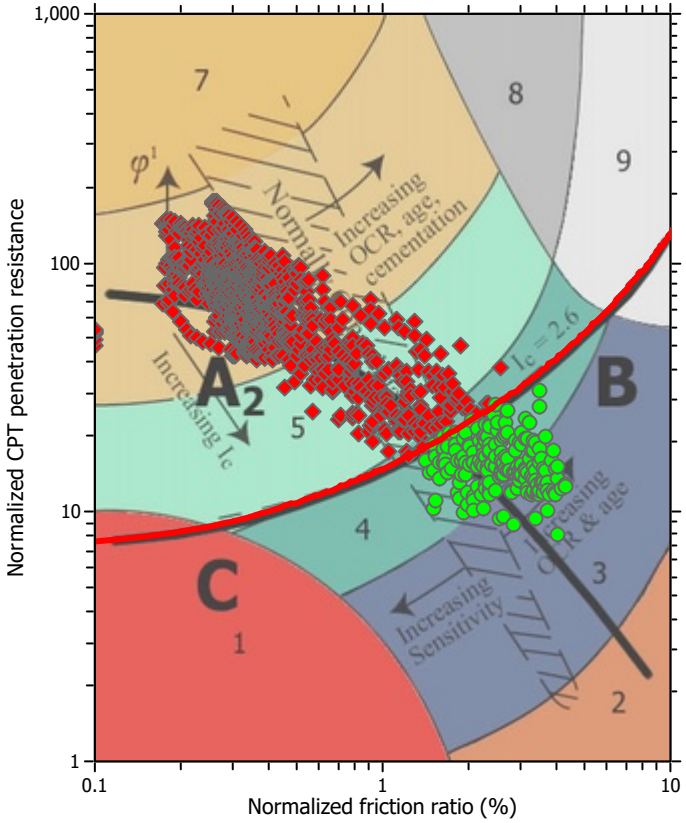
F.S. color scheme

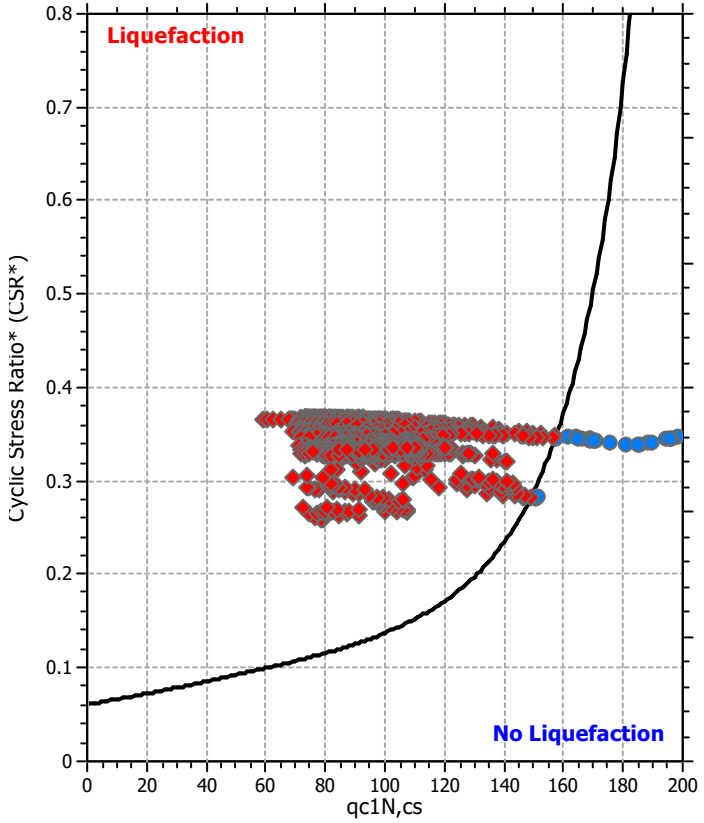
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

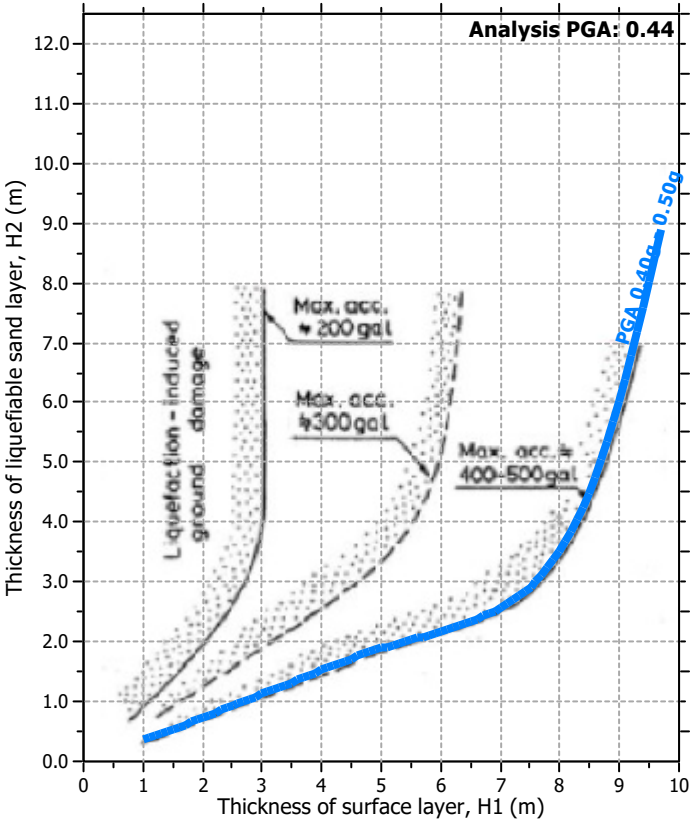
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



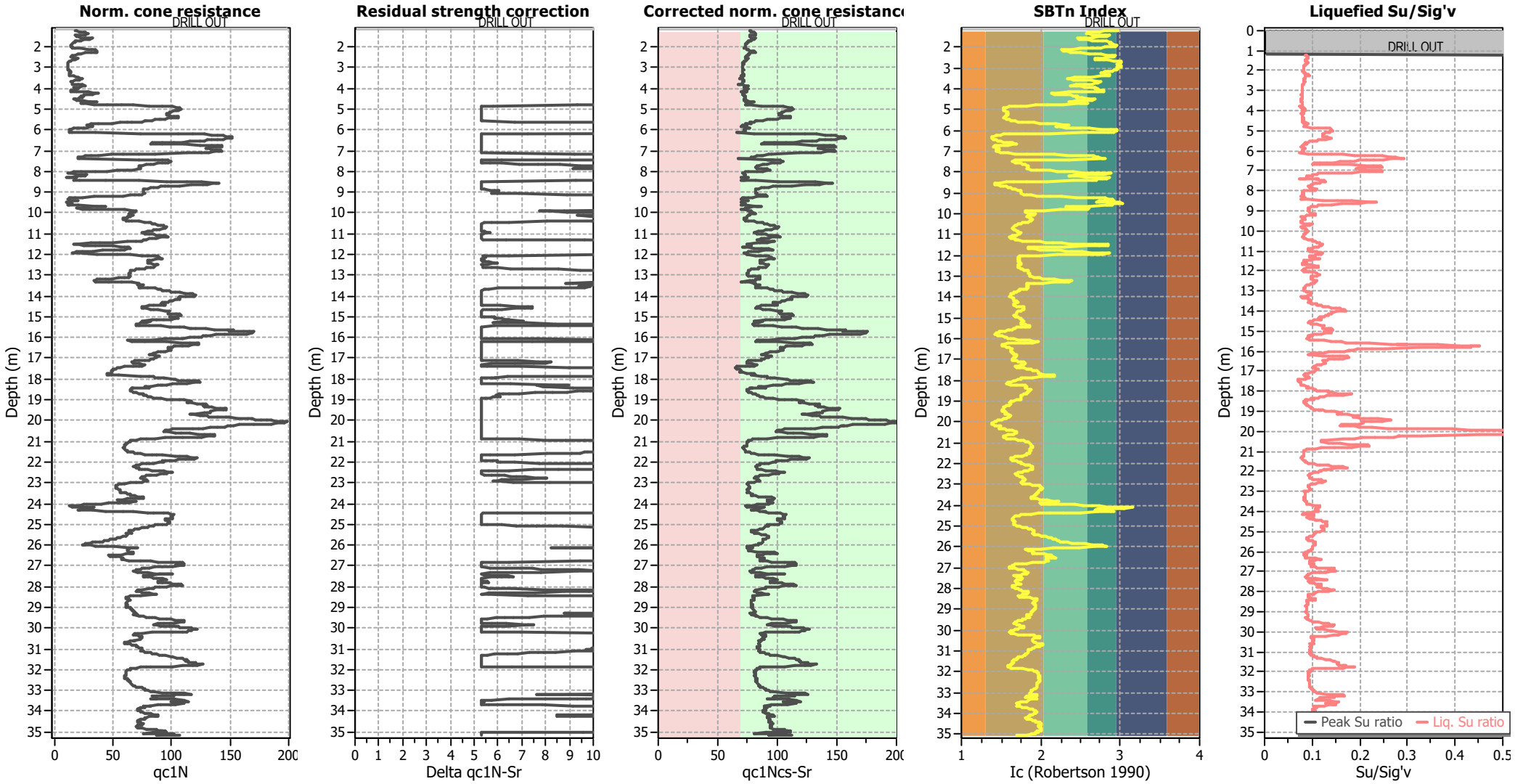




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.40 m	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.40 m	Fill height:	N/A	Limit depth:	N/A

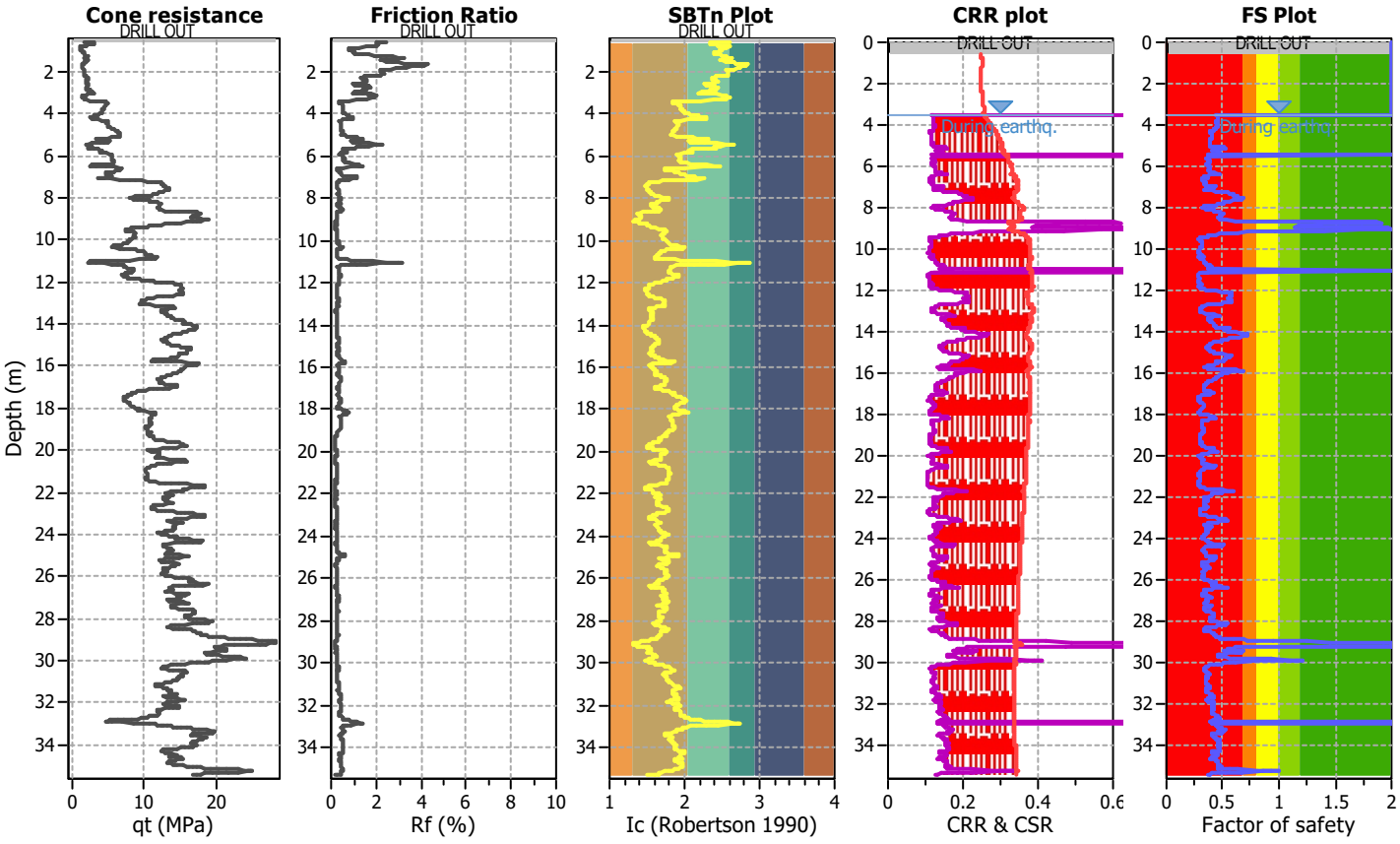
LIQUEFACTION ANALYSIS REPORT

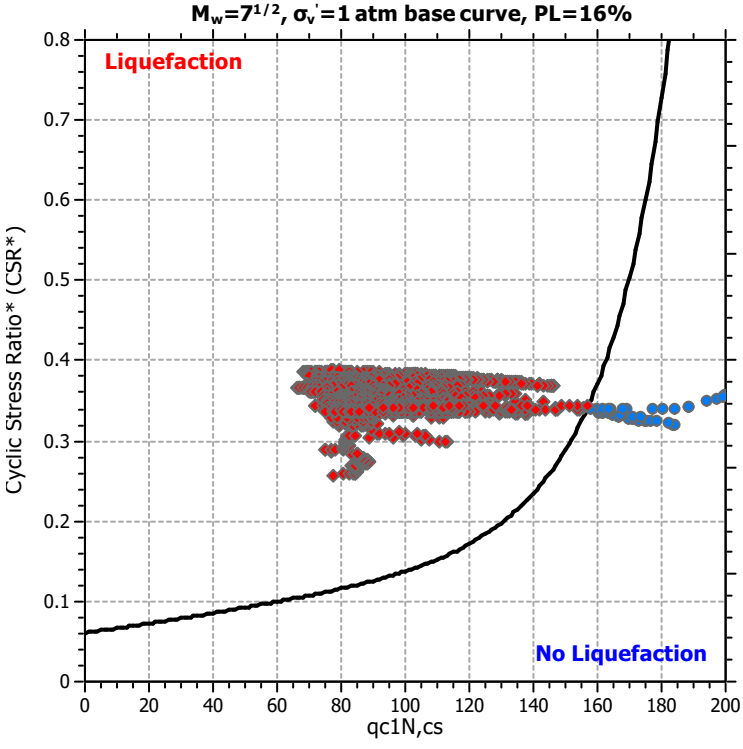
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

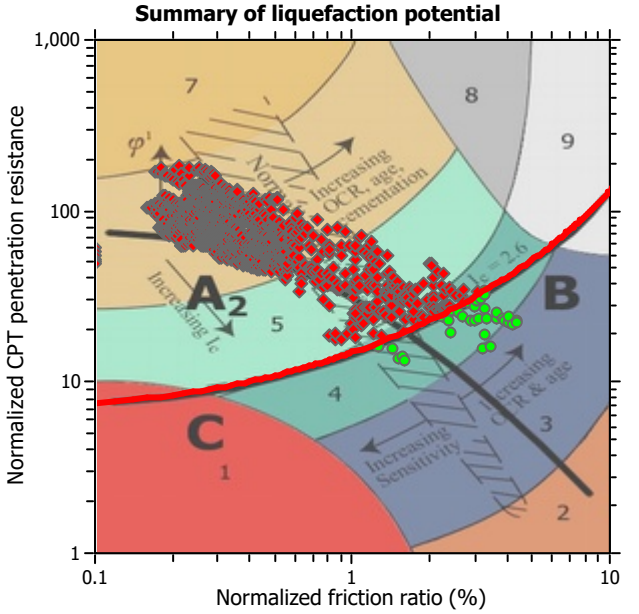
CPT file : SCPT25-03

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	3.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

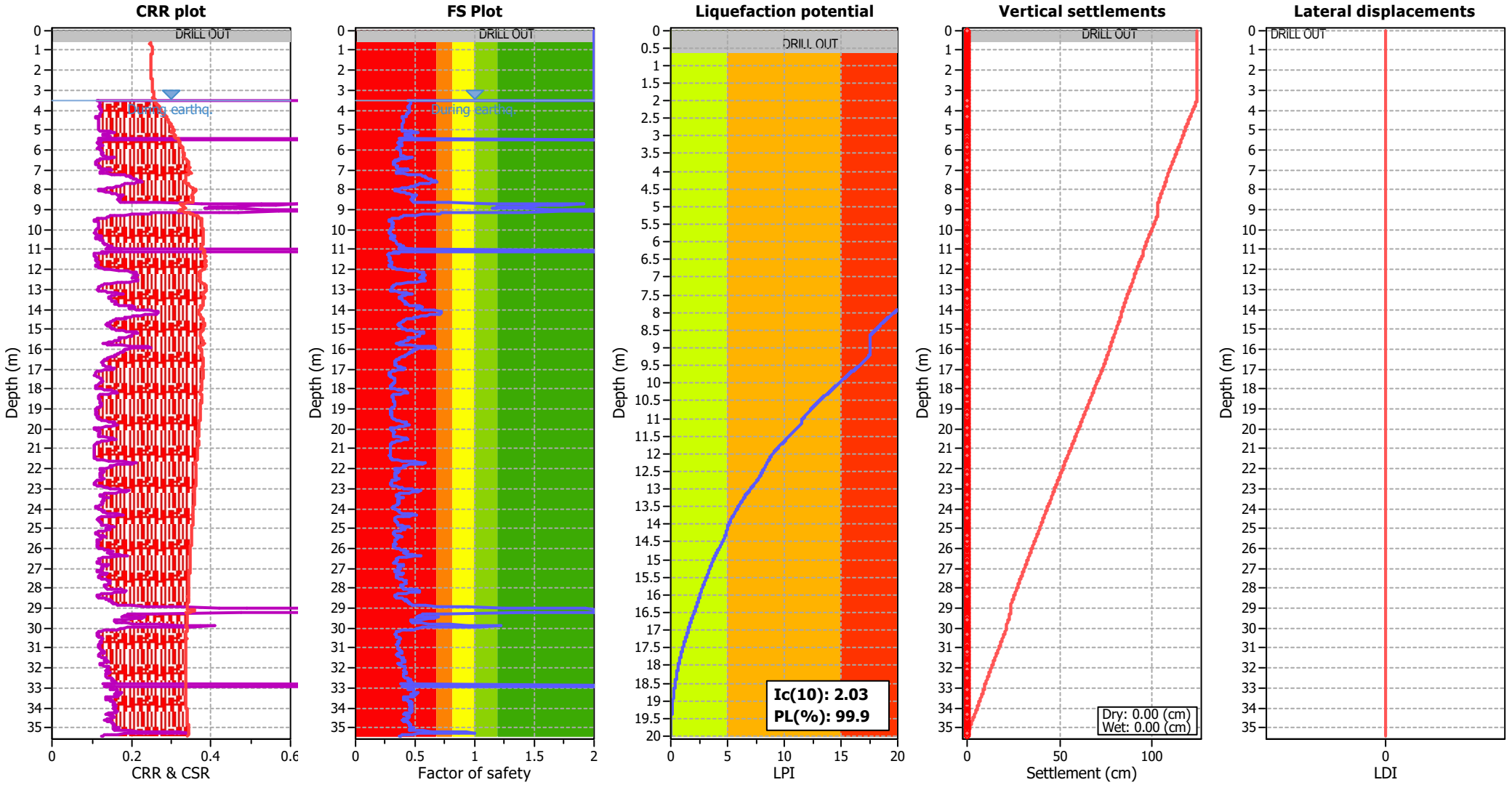






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.50 m	Fill height:	N/A	Limit depth:	N/A

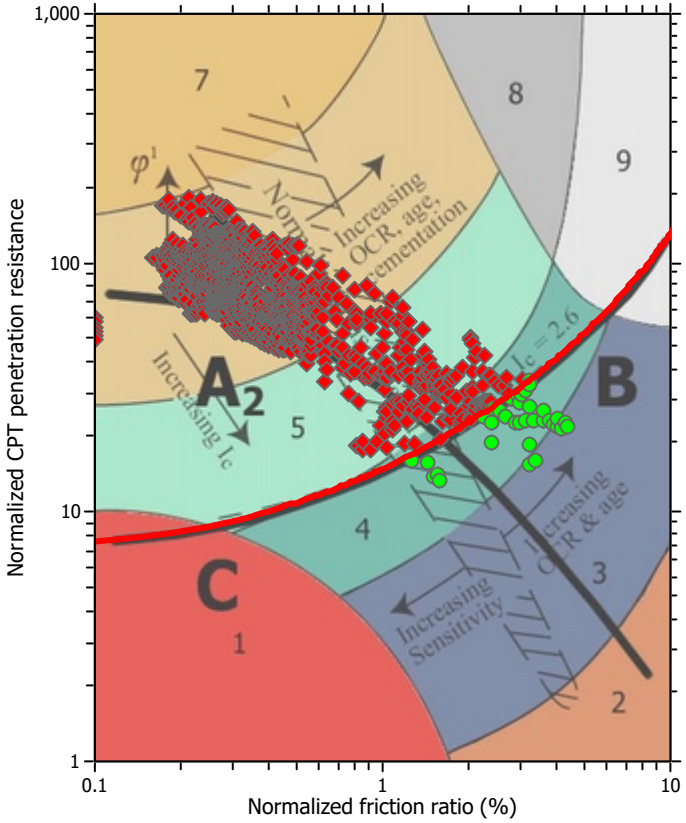
F.S. color scheme

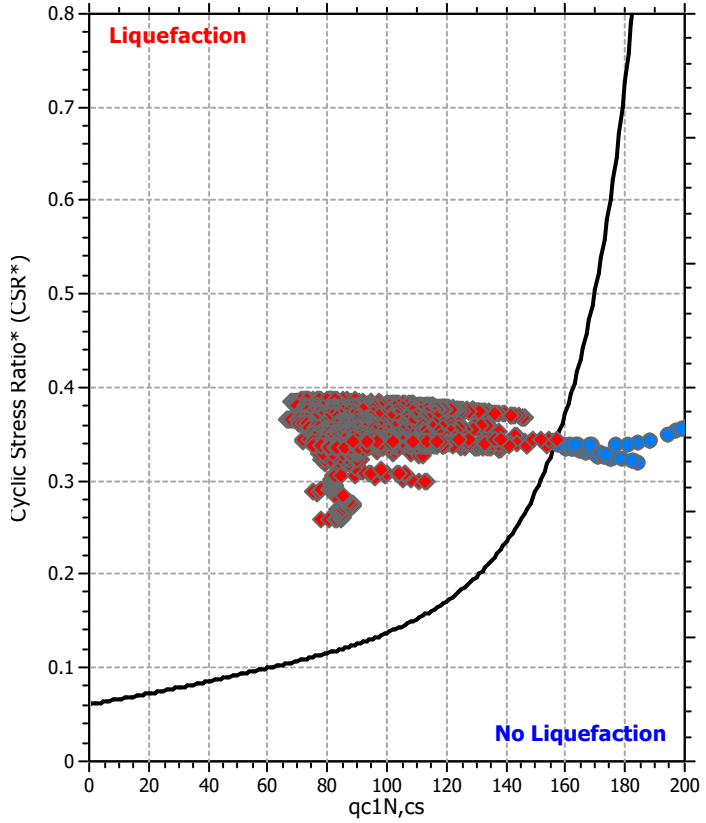
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

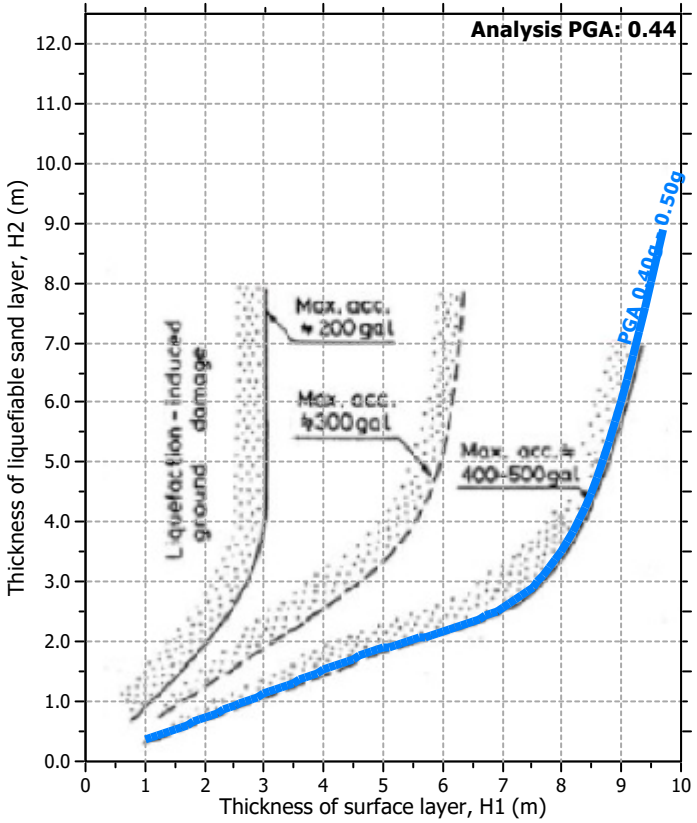
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



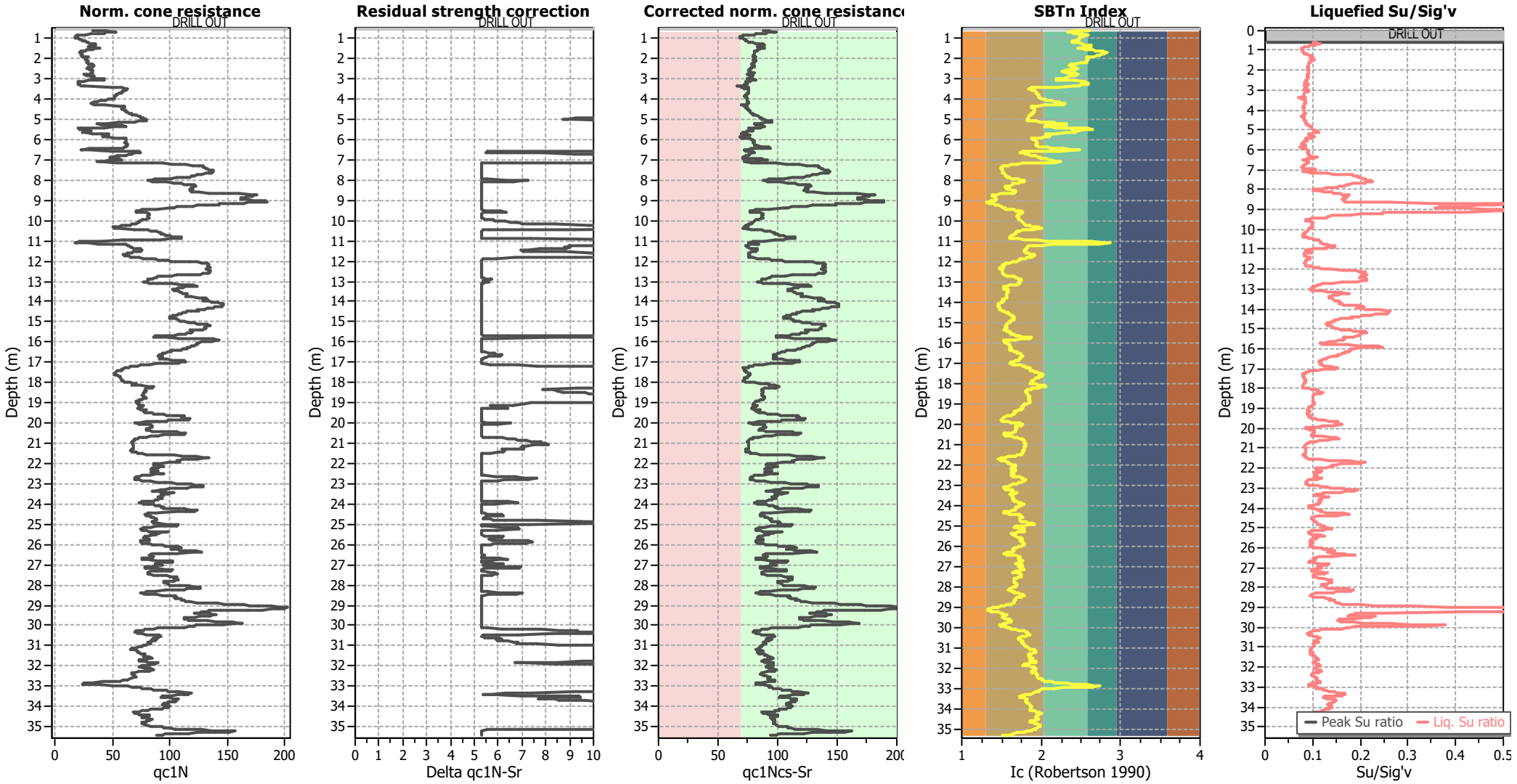




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.50 m	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.50 m	Fill height:	N/A	Limit depth:	N/A

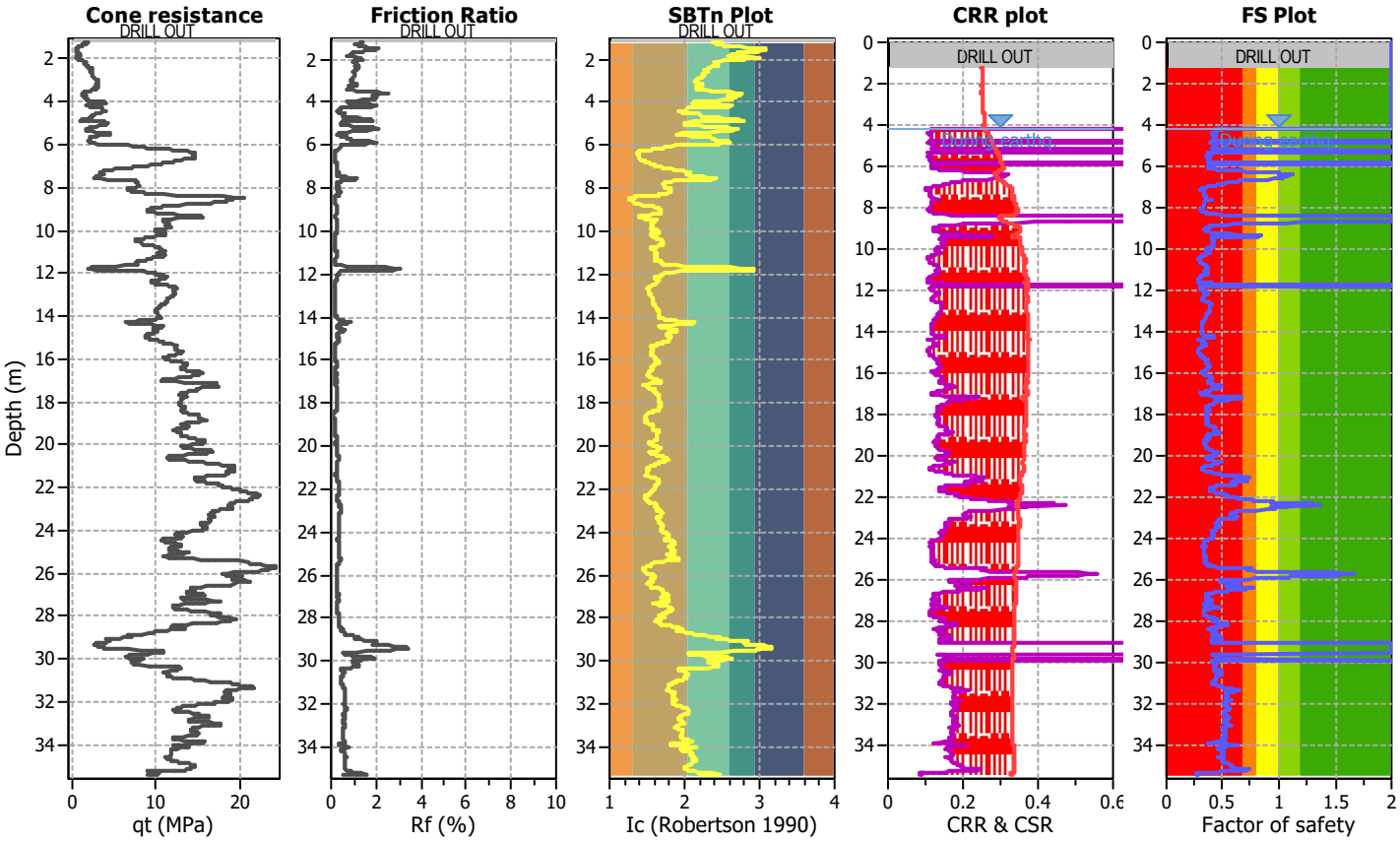
LIQUEFACTION ANALYSIS REPORT

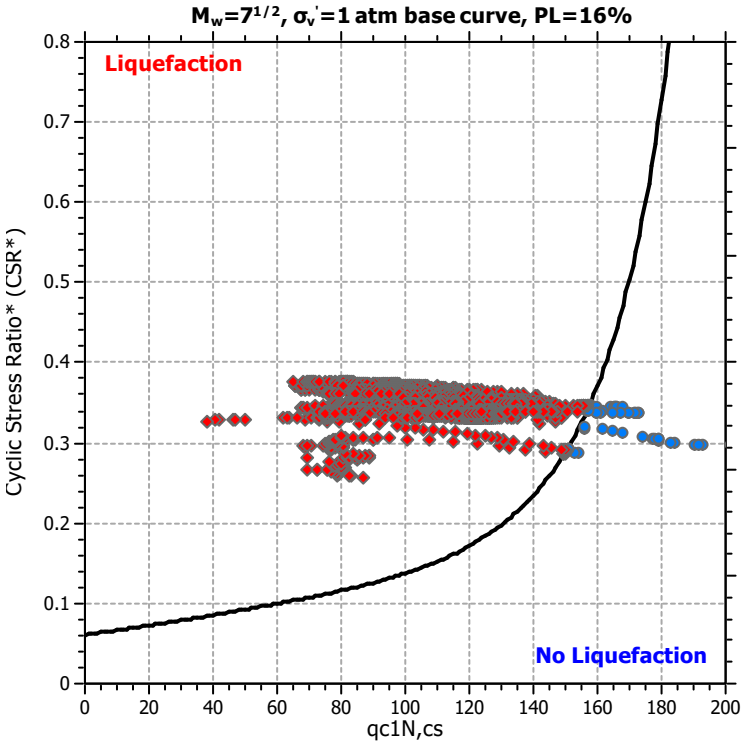
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

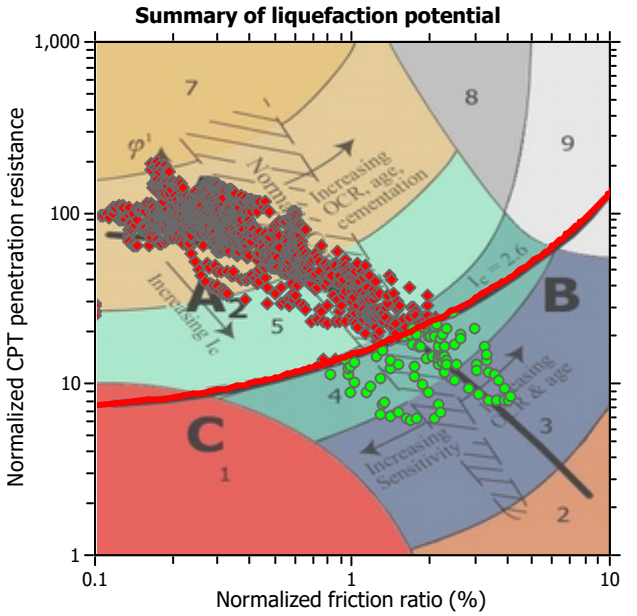
CPT file : CPT25-02

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	4.20 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.20 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
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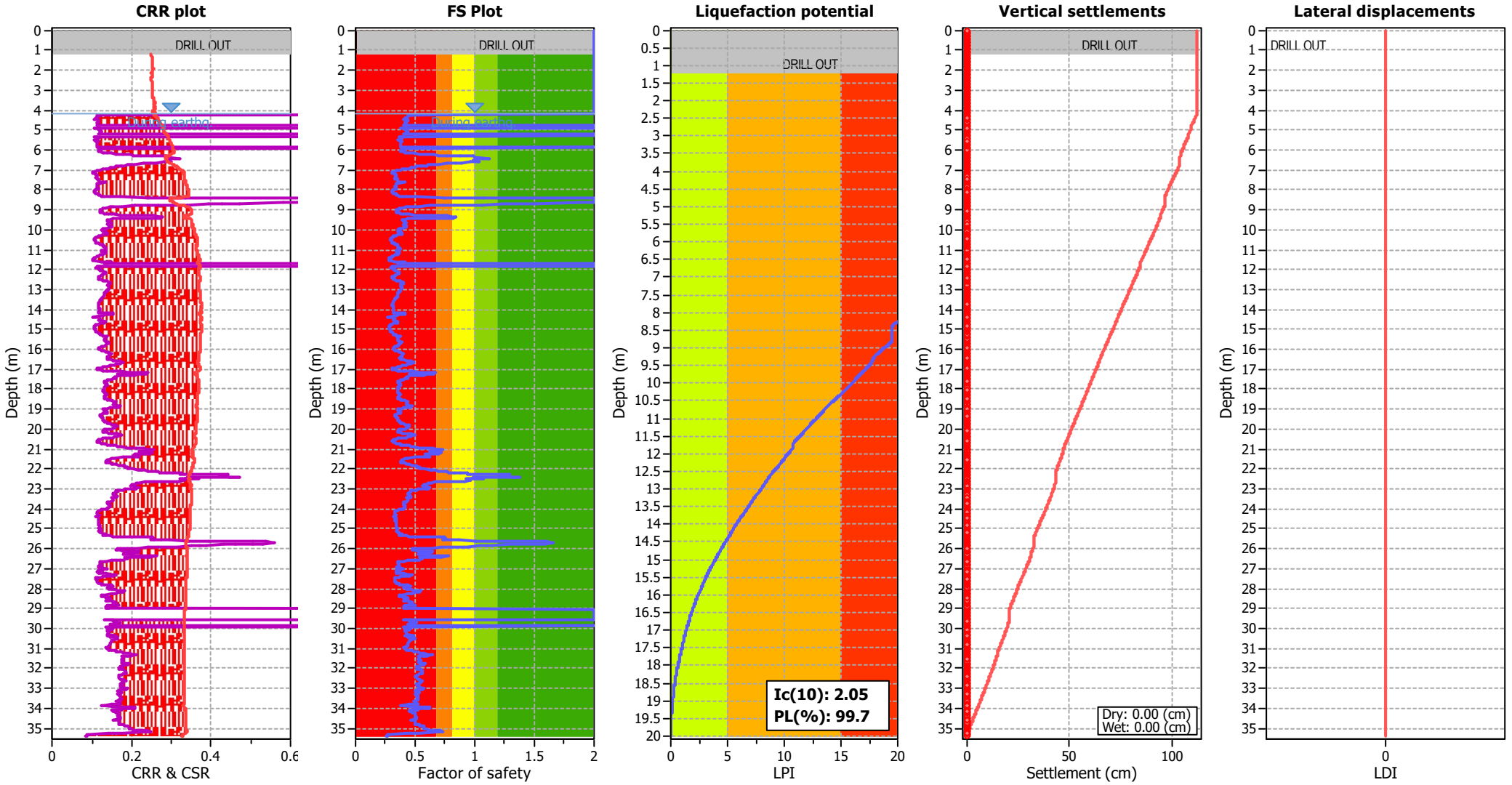
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.20 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
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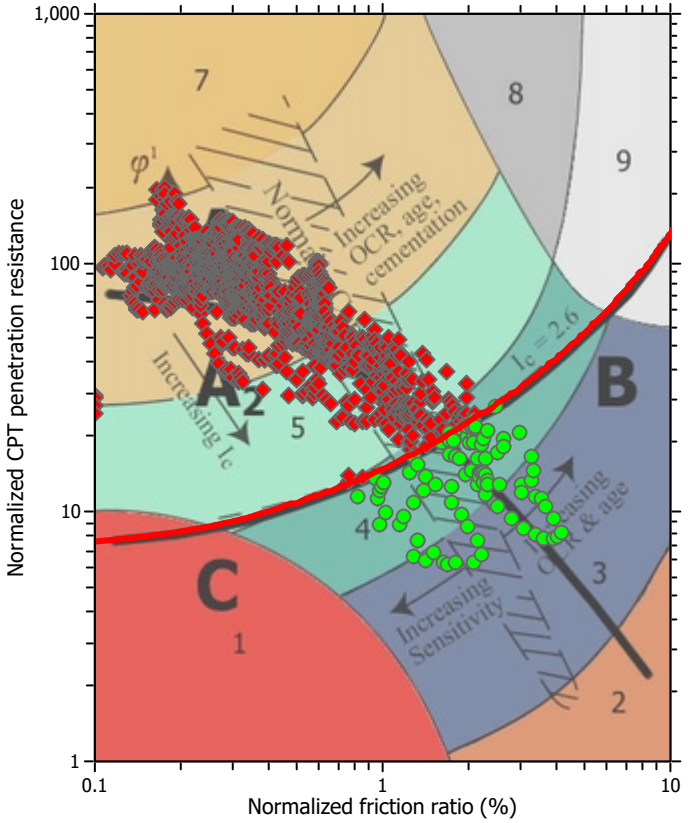
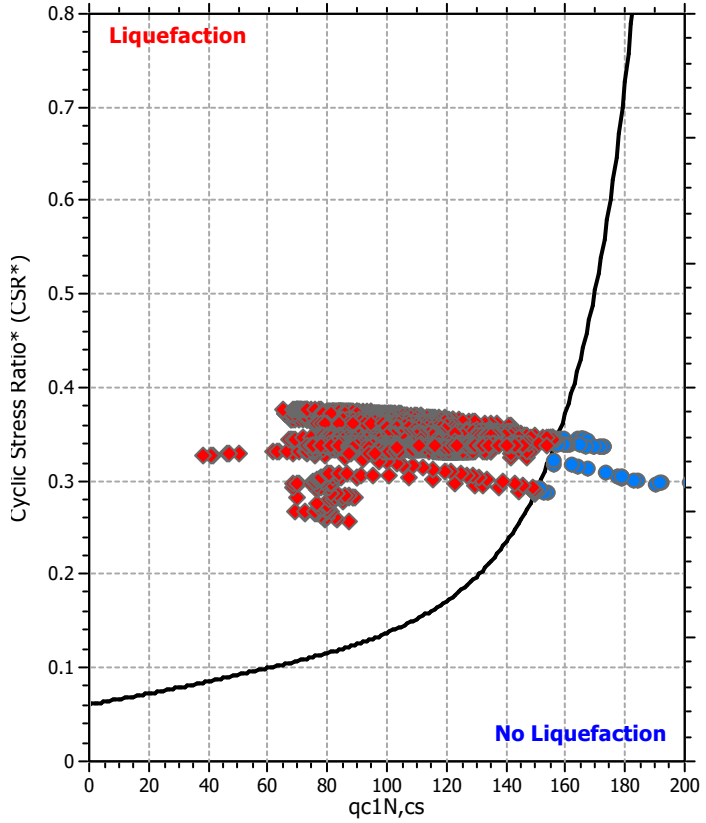
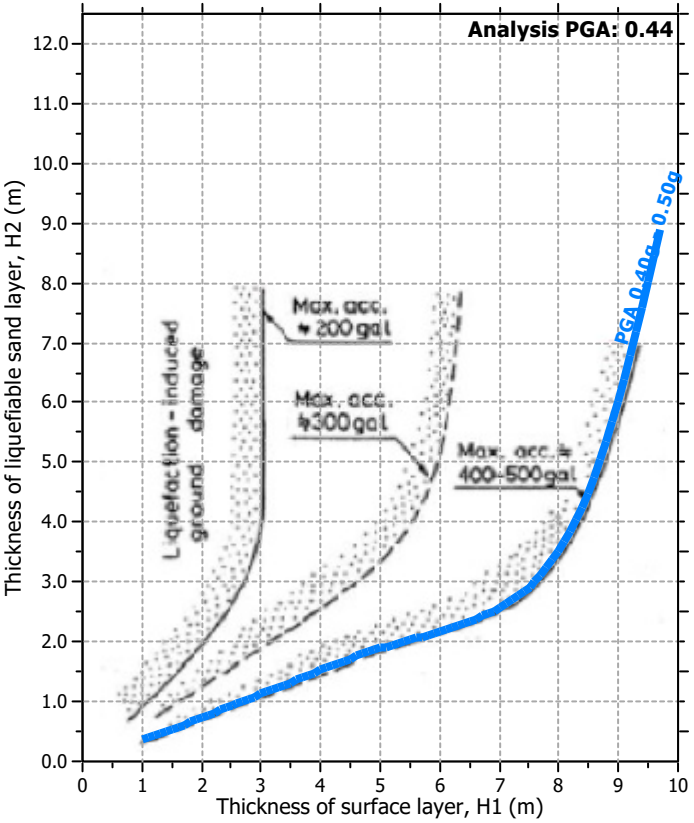
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



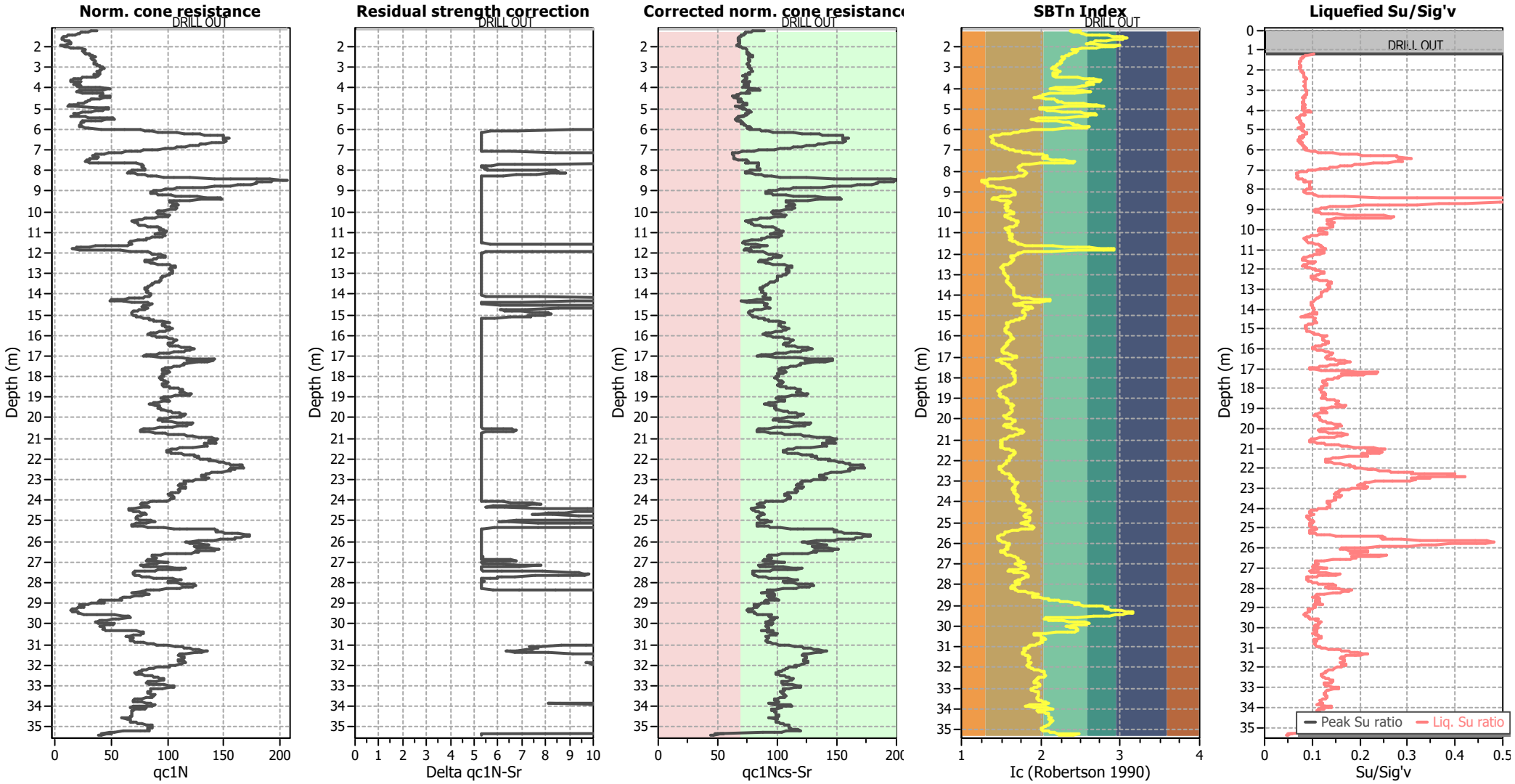




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.20 m	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.20 m	Fill height:	N/A	Limit depth:	N/A

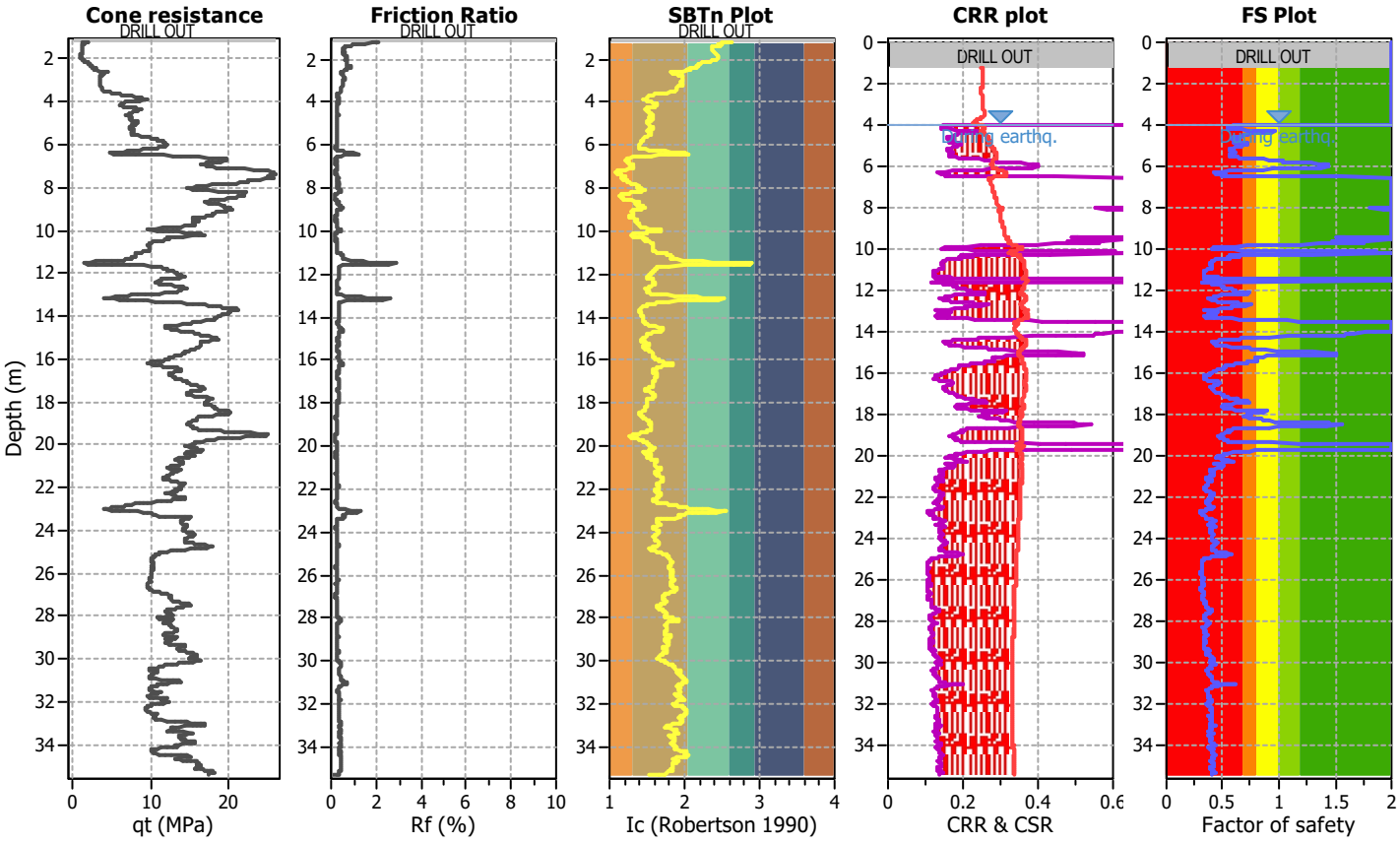
LIQUEFACTION ANALYSIS REPORT

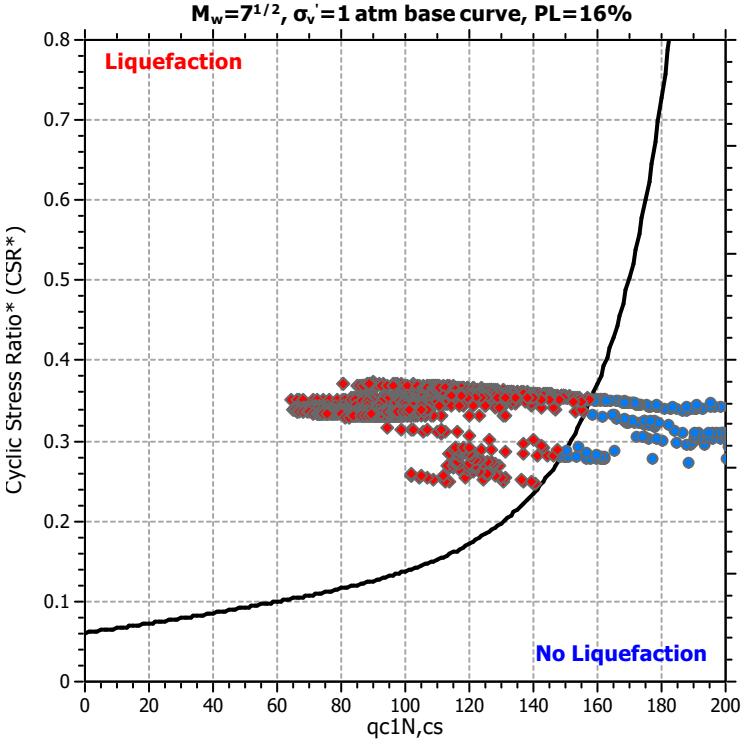
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

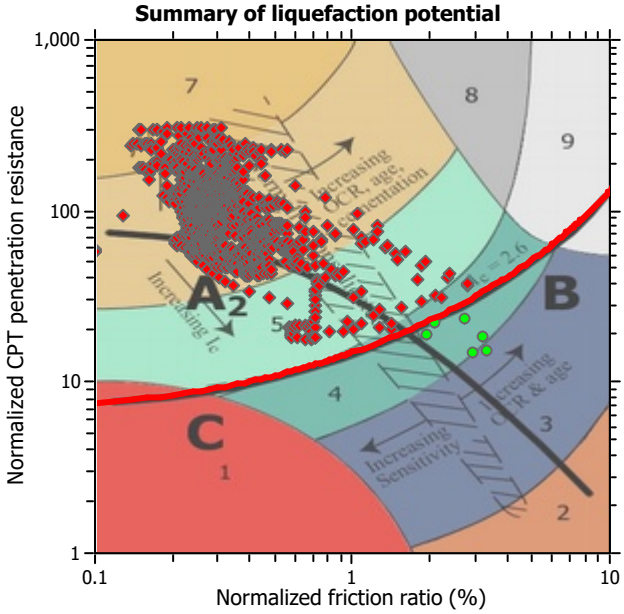
CPT file : CPT25-04

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

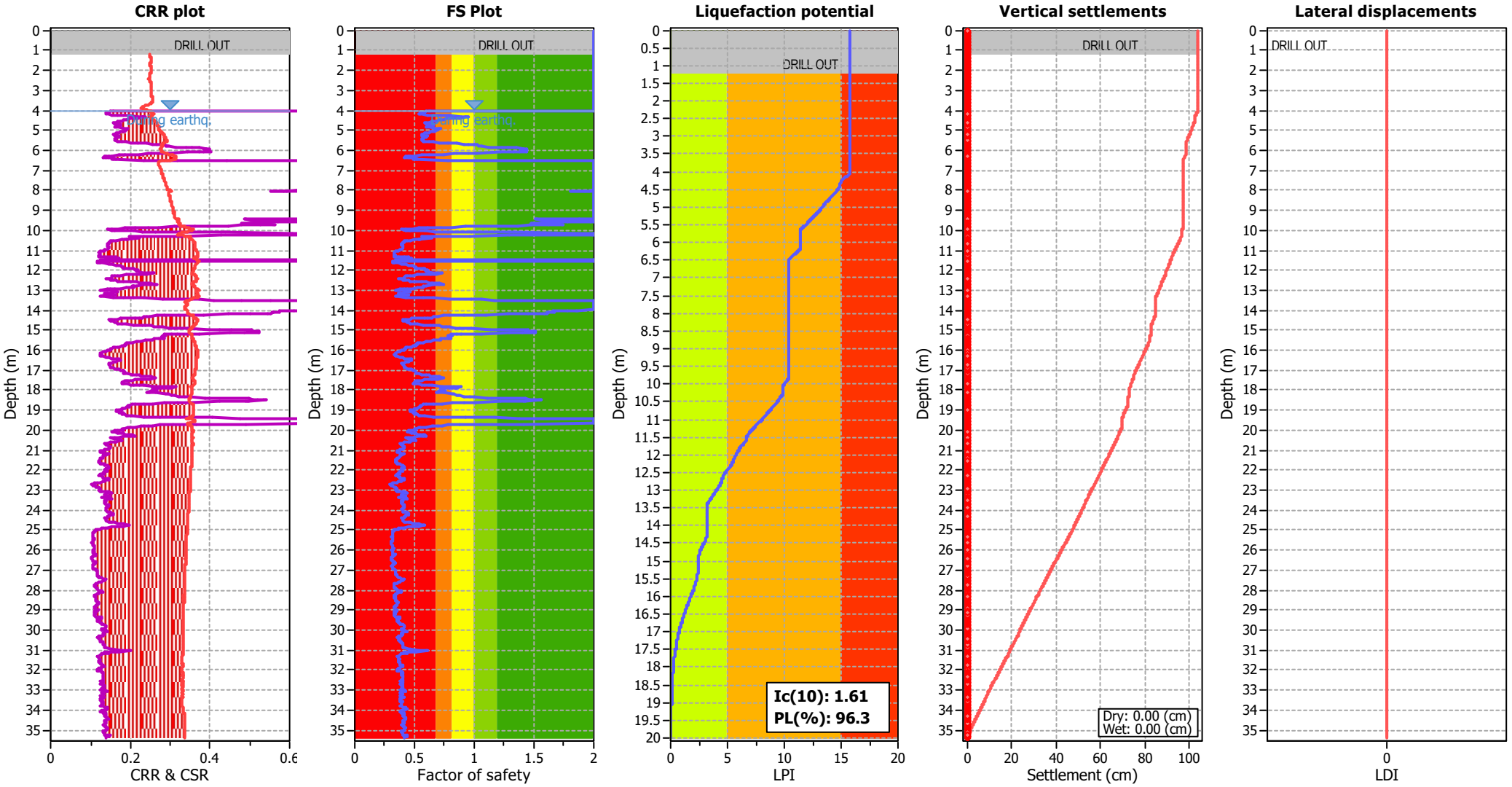






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

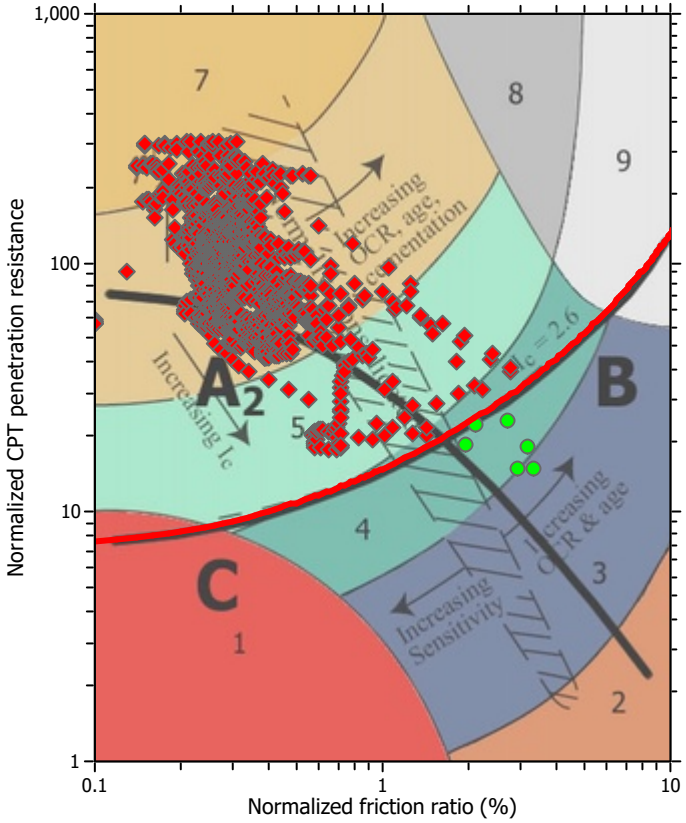
F.S. color scheme

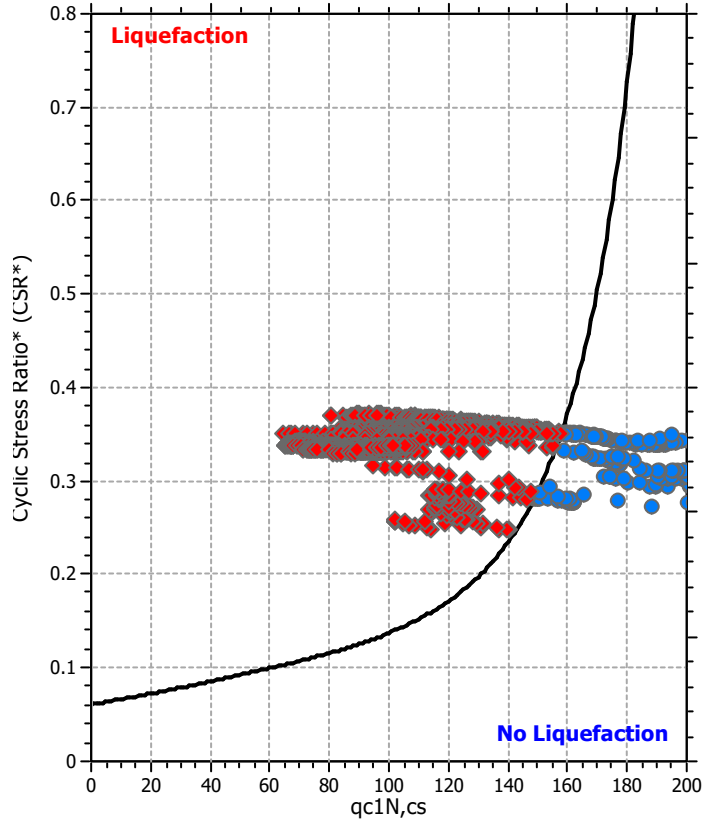
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

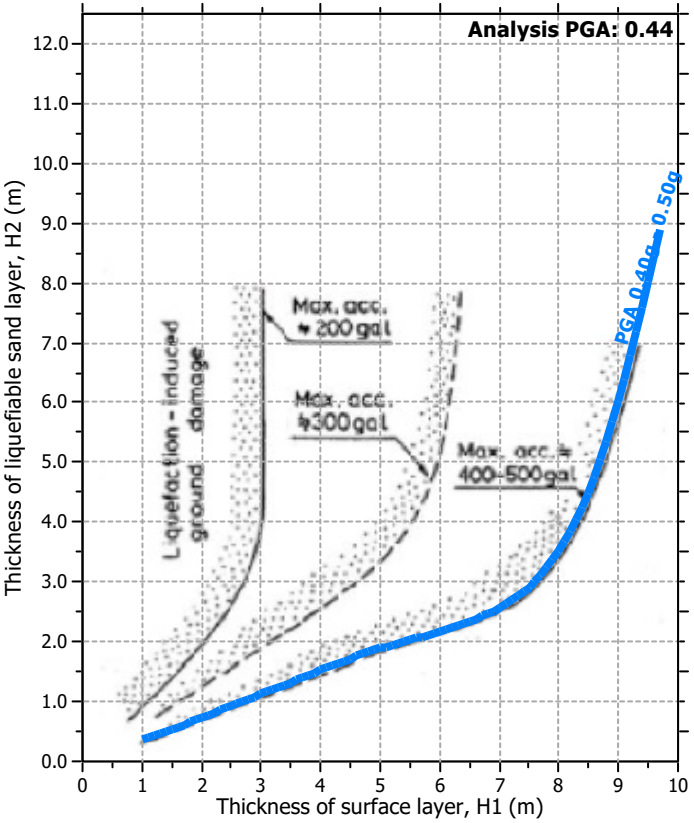
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



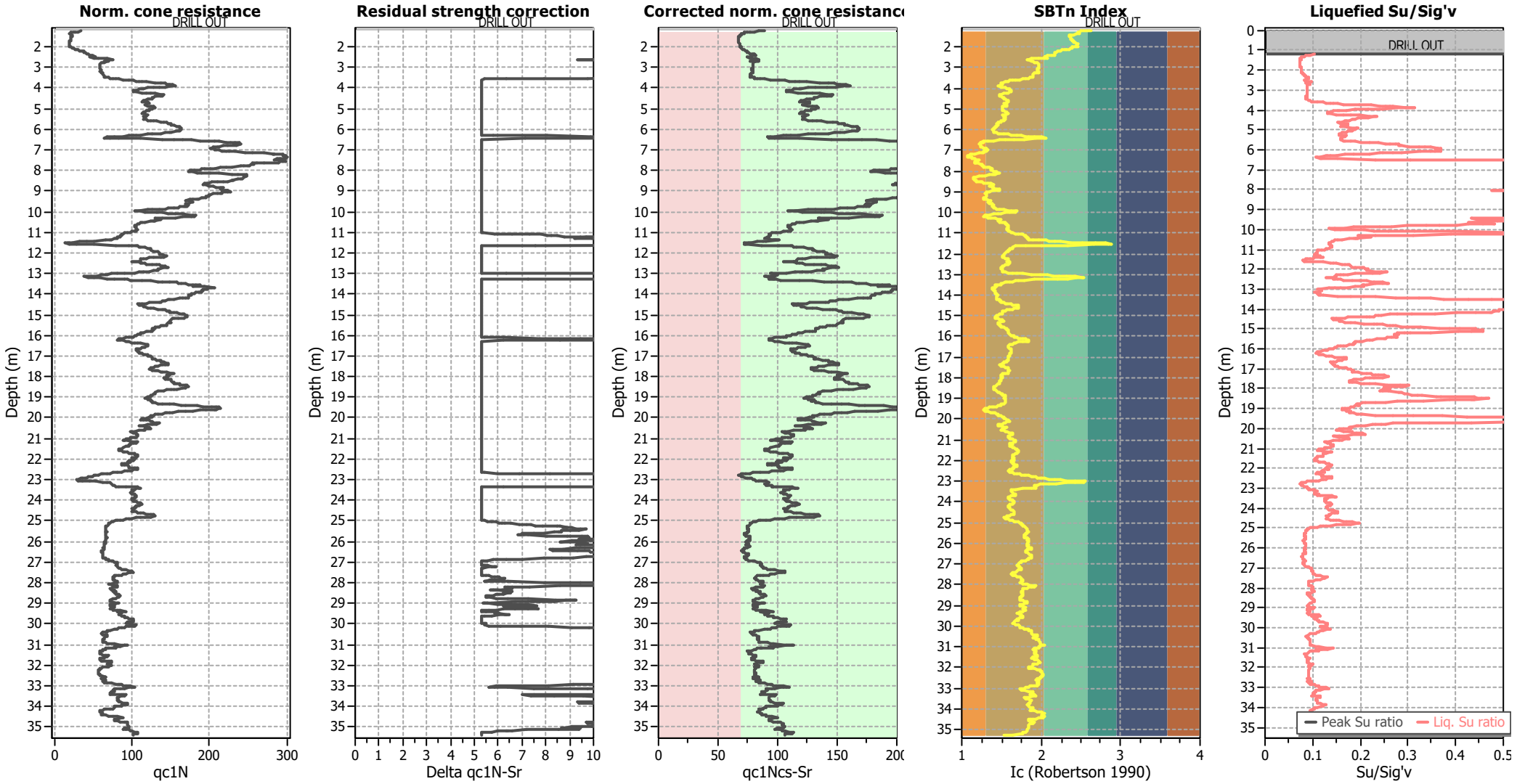




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

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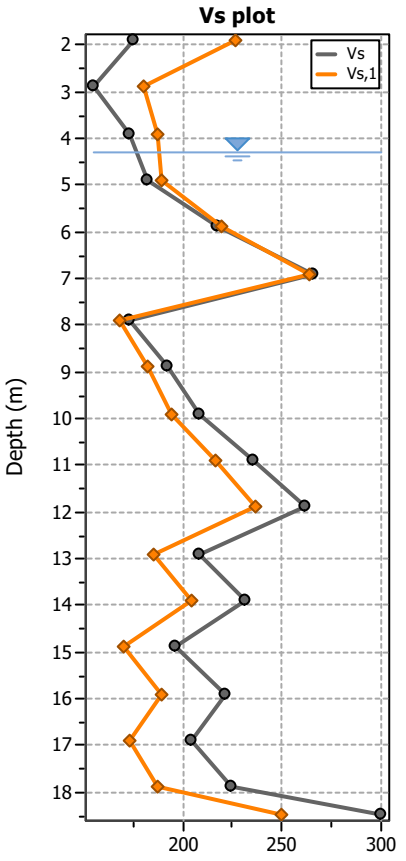
Vs BASED LIQUEFACTION ANALYSIS REPORT (Kayen et al. 2013)

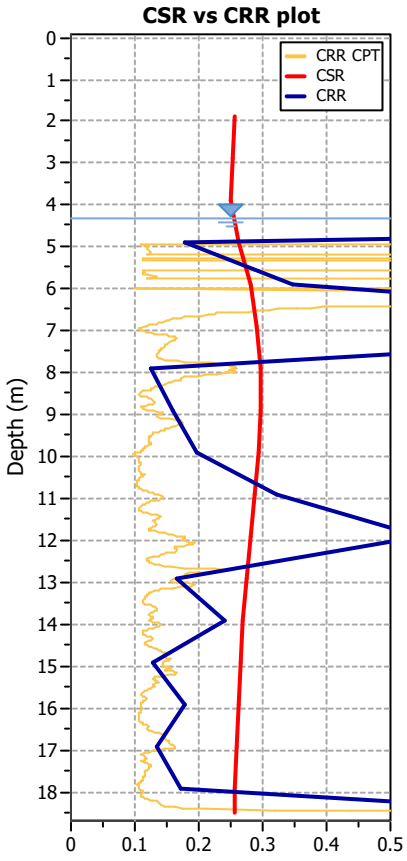
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

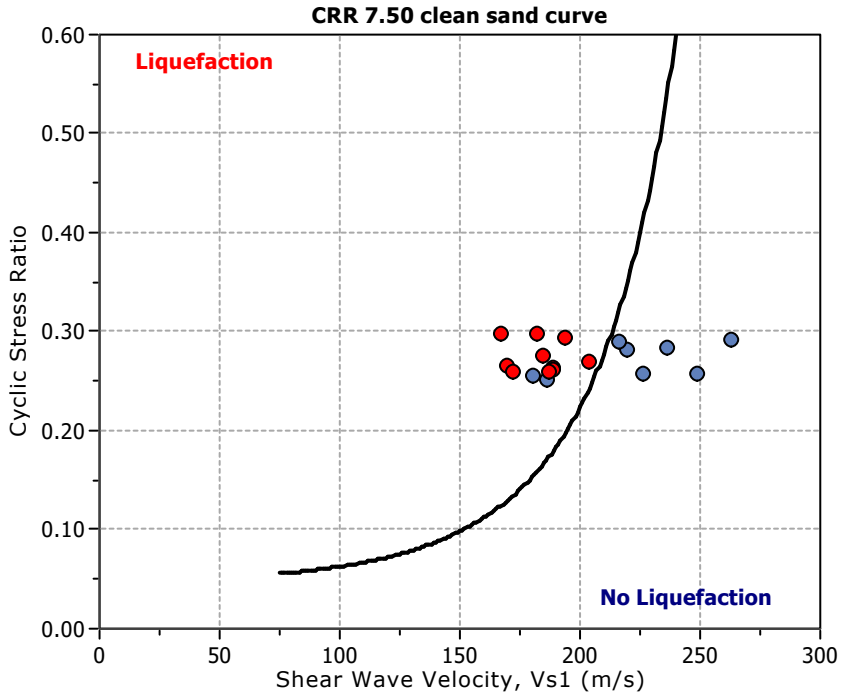
CPT file : SCPT25-01

:: Input parameters and analysis properties ::

Calculation method:	Kayen et. al (2013)
G.W.T. (in-situ):	4.30 m
G.W.T. (earthq.):	4.30 m
Earthquake magnitude M_w:	7.00
Peak ground acceleration:	0.44g







:: Cyclic Stress Ratio fully adjusted (CSR*) numeric results ::

No	Depth (m)	Weight (kN/m³)	u_o (kPa)	Ext. Load (kPa)	σ_v (kPa)	σ'_v (kPa)	r_d	CSR	K_σ	MSF	CSR*	Can Liquefy
1	1.90	19.00	0.00	0.00	36.10	36.10	0.99	0.283	1.00	1.10	2.000	Yes
2	2.90	19.00	0.00	0.00	55.10	55.10	0.98	0.280	1.00	1.10	2.000	Yes
3	3.90	19.00	0.00	0.00	74.10	74.10	0.97	0.276	1.00	1.10	2.000	Yes
4	4.90	19.00	5.89	0.00	93.10	87.21	0.95	0.290	1.00	1.10	0.263	Yes
5	5.90	19.00	15.70	0.00	112.10	96.40	0.93	0.309	1.00	1.10	0.280	Yes
6	6.90	19.00	25.51	0.00	131.10	105.59	0.90	0.320	1.00	1.10	0.291	Yes
7	7.90	19.00	35.32	0.00	150.10	114.78	0.87	0.326	1.00	1.10	0.296	Yes
8	8.90	19.00	45.13	0.00	169.10	123.97	0.84	0.327	1.00	1.10	0.297	Yes
9	9.90	19.00	54.94	0.00	188.10	133.16	0.80	0.323	1.00	1.10	0.294	Yes
10	10.90	19.00	64.75	0.00	207.10	142.35	0.76	0.318	1.00	1.10	0.288	Yes
11	11.90	19.00	74.56	0.00	226.10	151.54	0.73	0.311	1.00	1.10	0.282	Yes
12	12.90	19.00	84.37	0.00	245.10	160.73	0.70	0.303	1.00	1.10	0.275	Yes
13	13.90	19.00	94.18	0.00	264.10	169.92	0.67	0.297	1.00	1.10	0.270	Yes
14	14.90	19.00	103.99	0.00	283.10	179.11	0.65	0.292	1.00	1.10	0.265	Yes
15	15.90	19.00	113.80	0.00	302.10	188.30	0.63	0.288	1.00	1.10	0.261	Yes
16	16.90	19.00	123.61	0.00	321.10	197.49	0.61	0.285	1.00	1.10	0.259	Yes
17	17.90	19.00	133.42	0.00	340.10	206.68	0.60	0.284	1.00	1.10	0.258	Yes
18	18.49	19.00	139.20	0.00	351.31	212.11	0.60	0.283	1.00	1.10	0.257	Yes

Abbreviations

Depth: Depth relative to final conditions free surface (m) during eq.
u_0: Water pressure at test point (kPa) during eq.
σ_v: Total overburden pressure at test point (kPa) during eq.
σ_v': Effective overburden pressure based on GWT during earthquake (kPa) during eq.
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Effective overburden stress factor
K_σ: Magnitude Scaling Factor
CSR*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) numeric results ::

No	Depth (m)	V_s (m/s)	Fines %	n	V_{s1} (m/s)	$CRR_{7.5}$	F.S.	Can Liquefy
1	1.90	175.00	0.00	1.29	226.51	4.000	2.00	Yes
2	2.90	155.00	0.00	1.16	180.50	4.000	2.00	Yes
3	3.90	173.00	0.00	1.08	187.08	4.000	2.00	Yes
4	4.90	182.00	0.00	1.04	188.95	0.178	0.68	Yes
5	5.90	217.00	0.00	1.01	219.72	0.347	1.24	Yes
6	6.90	266.00	0.00	0.99	263.27	1.239	4.26	Yes
7	7.90	173.00	0.00	0.97	167.69	0.124	0.42	Yes
8	8.90	192.00	0.00	0.95	182.56	0.159	0.54	Yes
9	9.90	208.00	0.00	0.93	194.27	0.198	0.67	Yes
10	10.90	236.00	0.00	0.92	216.77	0.323	1.12	Yes
11	11.90	262.00	0.00	0.90	236.92	0.546	1.94	Yes
12	12.90	208.00	0.00	0.89	185.34	0.167	0.61	Yes
13	13.90	232.00	0.00	0.88	203.87	0.241	0.89	Yes
14	14.90	196.00	0.00	0.87	169.98	0.129	0.49	Yes
15	15.90	221.00	0.00	0.86	189.28	0.179	0.69	Yes
16	16.90	204.00	0.00	0.85	172.65	0.134	0.52	Yes
17	17.90	224.00	0.00	0.84	187.43	0.173	0.67	Yes
18	18.49	300.00	0.00	0.83	249.41	0.790	3.07	Yes

:: Cyclic Resistance Ratio (CRR) numeric results ::

No	Depth (m)	V_s (m/s)	Fines %	n	V_{s1} (m/s)	$CRR_{7.5}$	F.S.	Can Liquefy

Abbreviations

Depth: Depth from free surface where Vs was performed (m)
V_s: Estimated Vs (m/s)
n: Stress exponent normalization factor
V_{s1}: Normalized Vs (m/s)
V_{s1c}: Critical value of Vs1, which separates contractive and dilative behavior (kPa)
$CRR_{7.5}$: Cyclic Resistance Ratio for M_w 7.50
F.S.: Factor of safety against liquefaction

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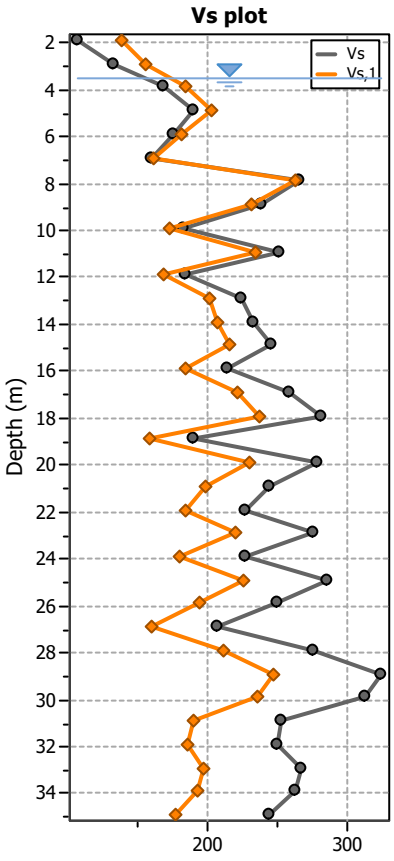
Vs BASED LIQUEFACTION ANALYSIS REPORT (Kayen et al. 2013)

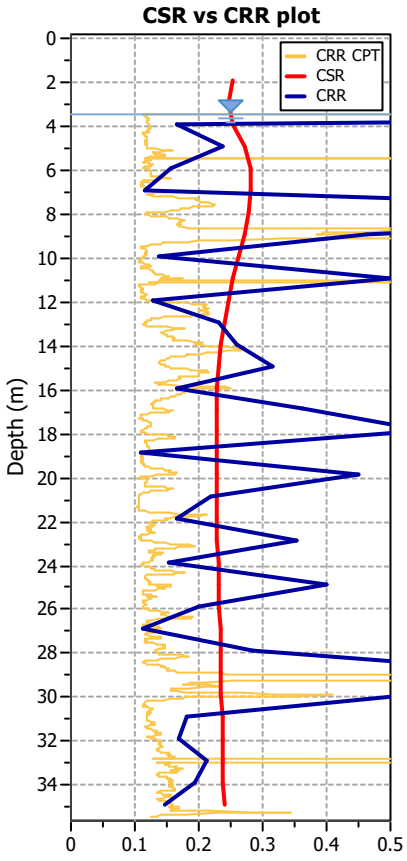
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

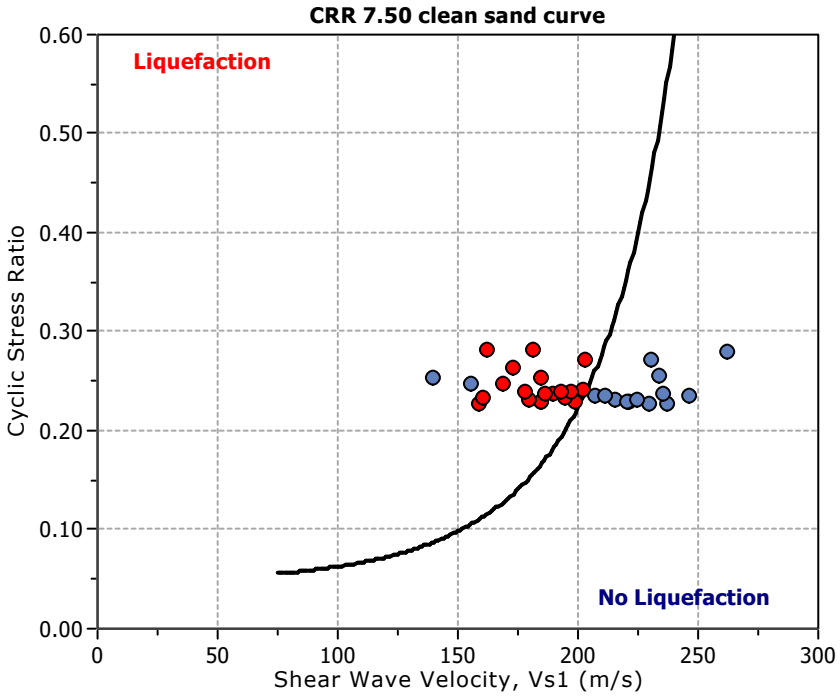
CPT file : SCPT25-03

:: Input parameters and analysis properties ::

Calculation method:	Kayen et. al (2013)
G.W.T. (in-situ):	3.50 m
G.W.T. (earthq.):	3.50 m
Earthquake magnitude M_w:	7.00
Peak ground acceleration:	0.44g







:: Cyclic Stress Ratio fully adjusted (CSR*) numeric results ::

No	Depth (m)	Weight (kN/m³)	u_o (kPa)	Ext. Load (kPa)	σ_v (kPa)	σ'_v (kPa)	r_d	CSR	K_σ	MSF	CSR*	Can Liquefy
1	1.90	19.00	0.00	0.00	36.10	36.10	0.97	0.278	1.00	1.10	2.000	Yes
2	2.90	19.00	0.00	0.00	55.10	55.10	0.95	0.272	1.00	1.10	2.000	Yes
3	3.90	19.00	3.92	0.00	74.10	70.18	0.92	0.279	1.00	1.10	0.253	Yes
4	4.90	19.00	13.73	0.00	93.10	79.37	0.89	0.299	1.00	1.10	0.271	Yes
5	5.90	19.00	23.54	0.00	112.10	88.56	0.85	0.308	1.00	1.10	0.280	Yes
6	6.90	19.00	33.35	0.00	131.10	97.75	0.81	0.310	1.00	1.10	0.282	Yes
7	7.90	19.00	43.16	0.00	150.10	106.94	0.76	0.306	1.00	1.10	0.278	Yes
8	8.90	19.00	52.97	0.00	169.10	116.13	0.72	0.299	1.00	1.10	0.271	Yes
9	9.90	19.00	62.78	0.00	188.10	125.32	0.67	0.289	1.00	1.10	0.263	Yes
10	10.90	19.00	72.59	0.00	207.10	134.51	0.64	0.280	1.00	1.10	0.254	Yes
11	11.90	19.00	82.40	0.00	226.10	143.70	0.60	0.271	1.00	1.10	0.246	Yes
12	12.90	19.00	92.21	0.00	245.10	152.89	0.58	0.264	1.00	1.10	0.240	Yes
13	13.90	19.00	102.02	0.00	264.10	162.08	0.55	0.259	1.00	1.10	0.235	Yes
14	14.90	19.00	111.83	0.00	283.10	171.27	0.54	0.255	1.00	1.10	0.231	Yes
15	15.90	19.00	121.64	0.00	302.10	180.46	0.53	0.252	1.00	1.10	0.229	Yes
16	16.90	19.00	131.45	0.00	321.10	189.65	0.52	0.250	1.00	1.10	0.227	Yes
17	17.90	19.00	141.26	0.00	340.10	198.84	0.51	0.250	1.00	1.10	0.227	Yes
18	18.90	19.00	151.07	0.00	359.10	208.03	0.51	0.250	1.00	1.10	0.227	Yes
19	19.90	19.00	160.88	0.00	378.10	217.22	0.50	0.250	1.00	1.10	0.227	Yes
20	20.90	19.00	170.69	0.00	397.10	226.41	0.50	0.251	1.00	1.10	0.228	Yes
21	21.90	19.00	180.50	0.00	416.10	235.60	0.50	0.251	1.00	1.10	0.228	Yes
22	22.90	19.00	190.31	0.00	435.10	244.79	0.50	0.252	1.00	1.10	0.229	Yes
23	23.90	19.00	200.12	0.00	454.10	253.98	0.50	0.253	1.00	1.10	0.230	Yes
24	24.90	19.00	209.93	0.00	473.10	263.17	0.49	0.254	1.00	1.10	0.231	Yes
25	25.90	19.00	219.74	0.00	492.10	272.36	0.49	0.256	1.00	1.10	0.232	Yes
26	26.90	19.00	229.55	0.00	511.10	281.55	0.49	0.257	1.00	1.10	0.233	Yes
27	27.90	19.00	239.36	0.00	530.10	290.74	0.49	0.258	1.00	1.10	0.234	Yes
28	28.90	19.00	249.17	0.00	549.10	299.93	0.49	0.259	1.00	1.10	0.235	Yes
29	29.90	19.00	258.98	0.00	568.10	309.12	0.49	0.259	1.00	1.10	0.236	Yes
30	30.90	19.00	268.79	0.00	587.10	318.31	0.49	0.260	1.00	1.10	0.236	Yes
31	31.90	19.00	278.60	0.00	606.10	327.50	0.49	0.261	1.00	1.10	0.237	Yes
32	32.90	19.00	288.41	0.00	625.10	336.69	0.49	0.262	1.00	1.10	0.238	Yes
33	33.90	19.00	298.22	0.00	644.10	345.88	0.49	0.263	1.00	1.10	0.239	Yes
34	34.90	19.00	308.03	0.00	663.10	355.07	0.49	0.264	1.00	1.10	0.239	Yes

Abbreviations

Depth: Depth relative to final conditions free surface (m) during eq.
u_0: Water pressure at test point (kPa) during eq.
σ_v: Total overburden pressure at test point (kPa) during eq.
σ_v': Effective overburden pressure based on GWT during earthquake (kPa) during eq.
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Effective overburden stress factor
K_σ: Magnitude Scaling Factor
CSR*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) numeric results ::

No	Depth (m)	V_s (m/s)	Fines %	n	V_{s1} (m/s)	$CRR_{7.5}$	F.S.	Can Liquefy
1	1.90	108.00	0.00	1.29	139.79	4.000	2.00	Yes
2	2.90	134.00	0.00	1.16	156.04	4.000	2.00	Yes
3	3.90	169.00	0.00	1.10	185.25	0.167	0.66	Yes

:: Cyclic Resistance Ratio (CRR) numeric results ::

No	Depth (m)	V_s (m/s)	Fines %	n	V_{s1} (m/s)	$CRR_{7.5}$	F.S.	Can Liquefy
4	4.90	191.00	0.00	1.06	203.03	0.236	0.87	Yes
5	5.90	176.00	0.00	1.03	182.03	0.157	0.56	Yes
6	6.90	161.00	0.00	1.01	162.45	0.115	0.41	Yes
7	7.90	266.00	0.00	0.99	262.44	1.205	4.33	Yes
8	8.90	239.00	0.00	0.97	230.99	0.464	1.71	Yes
9	9.90	183.00	0.00	0.95	173.53	0.136	0.52	Yes
10	10.90	251.00	0.00	0.93	233.84	0.501	1.97	Yes
11	11.90	185.00	0.00	0.92	169.53	0.128	0.52	Yes
12	12.90	224.00	0.00	0.90	202.11	0.232	0.97	Yes
13	13.90	233.00	0.00	0.89	207.18	0.259	1.10	Yes
14	14.90	246.00	0.00	0.88	215.75	0.315	1.36	Yes
15	15.90	214.00	0.00	0.87	185.25	0.167	0.73	Yes
16	16.90	259.00	0.00	0.85	221.43	0.362	1.59	Yes
17	17.90	281.00	0.00	0.84	237.42	0.554	2.44	Yes
18	18.90	191.00	0.00	0.84	159.56	0.111	0.49	Yes
19	19.90	278.00	0.00	0.83	229.75	0.449	1.98	Yes
20	20.90	244.00	0.00	0.82	199.57	0.220	0.97	Yes
21	21.90	228.00	0.00	0.81	184.64	0.165	0.72	Yes
22	22.90	275.00	0.00	0.80	220.58	0.354	1.55	Yes
23	23.90	227.00	0.00	0.79	180.41	0.153	0.66	Yes
24	24.90	286.00	0.00	0.79	225.29	0.399	1.73	Yes
25	25.90	250.00	0.00	0.78	195.25	0.201	0.87	Yes
26	26.90	208.00	0.00	0.77	161.10	0.113	0.49	Yes
27	27.90	275.00	0.00	0.77	211.29	0.284	1.21	Yes
28	28.90	324.00	0.00	0.76	247.01	0.734	3.13	Yes
29	29.90	312.00	0.00	0.76	236.08	0.533	2.26	Yes
30	30.90	253.00	0.00	0.75	190.04	0.182	0.77	Yes
31	31.90	250.00	0.00	0.75	186.45	0.170	0.72	Yes
32	32.90	267.00	0.00	0.74	197.76	0.212	0.89	Yes
33	33.90	263.00	0.00	0.74	193.49	0.195	0.82	Yes
34	34.90	244.00	0.00	0.73	178.34	0.148	0.62	Yes

Abbreviations

Depth: Depth from free surface where Vs was performed (m)
V_s: Estimated Vs (m/s)
n: Stress exponent normalization factor
V_{s1}: Normalized Vs (m/s)
V_{s1c}: Critical value of Vs1, which separates contractive and dilative behavior (kPa)
$CRR_{7.5}$: Cyclic Resistance Ratio for M_w 7.50
F.S.: Factor of safety against liquefaction

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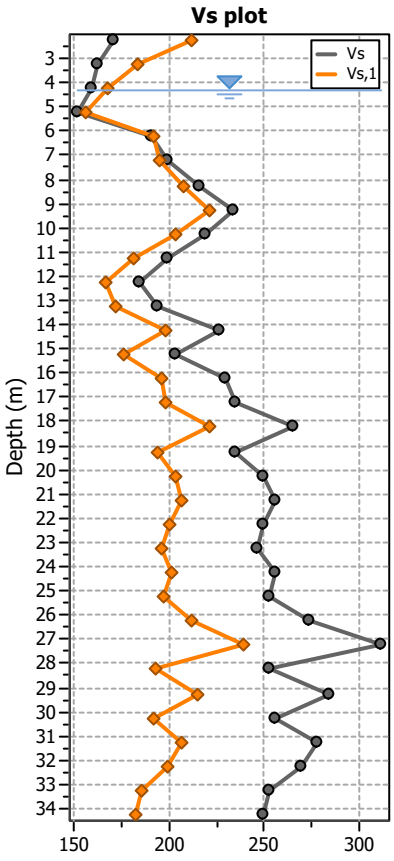
Vs BASED LIQUEFACTION ANALYSIS REPORT (NCEER 1998)

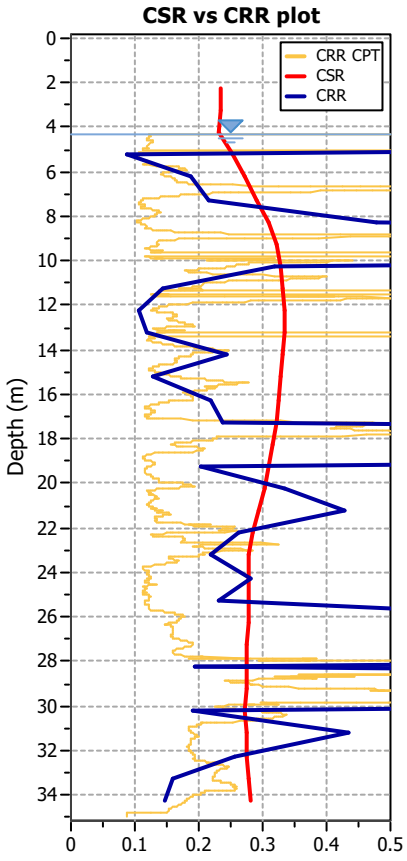
Project title : Albion Industrial Lands Geotechnical Study **Location : City of Maple Ridge**

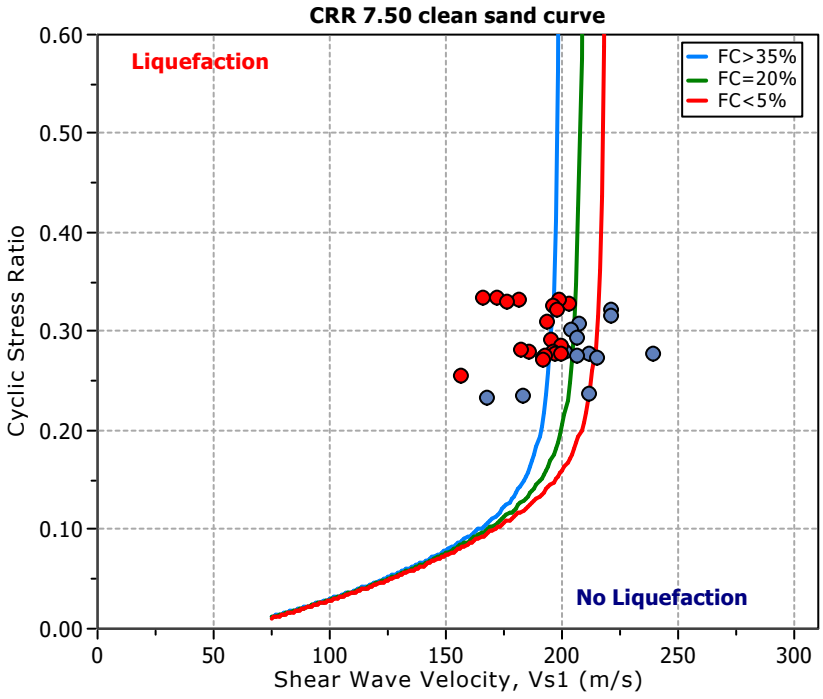
CPT file : Digi - CPT23-01 - ValleyGeo

:: Input parameters and analysis properties ::

Calculation m;ethod:	Kayen et. al (2013)
G.W.T. (in-situ):	4.30 m
G.W.T. (earthq.):	4.30 m
Earthquake magnitude M_w:	7.00
Peak ground acceleration:	0.44g







:: Cyclic Stress Ratio fully adjusted (CSR*) numeric results ::

No	Depth (m)	Weight (kN/m³)	u_o (kPa)	Ext. Load (kPa)	σ_v (kPa)	σ'_v (kPa)	r_d	CSR	K_σ	MSF	CSR^*	Can Liquefy
1	2.25	19.00	0.00	0.00	42.75	42.75	0.98	0.281	1.00	1.19	2.000	Yes
2	3.25	19.00	0.00	0.00	61.75	61.75	0.98	0.279	1.00	1.19	2.000	Yes
3	4.25	19.00	0.00	0.00	80.75	80.75	0.97	0.277	1.00	1.19	2.000	Yes
4	5.25	19.00	9.32	0.00	99.75	90.43	0.96	0.303	1.00	1.19	0.254	Yes
5	6.25	19.00	19.13	0.00	118.75	99.62	0.95	0.325	1.00	1.19	0.272	Yes
6	7.25	19.00	28.94	0.00	137.75	108.81	0.94	0.342	0.99	1.19	0.291	Yes
7	8.25	19.00	38.75	0.00	156.75	118.00	0.94	0.356	0.97	1.19	0.308	Yes
8	9.25	19.00	48.56	0.00	175.75	127.19	0.93	0.367	0.95	1.19	2.000	Yes
9	10.25	19.00	58.37	0.00	194.75	136.38	0.90	0.368	0.94	1.19	0.328	Yes
10	11.25	19.00	68.18	0.00	213.75	145.57	0.87	0.367	0.93	1.19	0.331	Yes
11	12.25	19.00	77.99	0.00	232.75	154.76	0.85	0.365	0.92	1.19	0.333	Yes
12	13.25	19.00	87.80	0.00	251.75	163.95	0.82	0.361	0.91	1.19	0.333	Yes
13	14.25	19.00	97.61	0.00	270.75	173.14	0.79	0.355	0.90	1.19	0.332	Yes
14	15.25	19.00	107.42	0.00	289.75	182.33	0.77	0.349	0.89	1.19	0.329	Yes
15	16.25	19.00	117.23	0.00	308.75	191.52	0.74	0.342	0.88	1.19	0.326	Yes
16	17.25	19.00	127.04	0.00	327.75	200.71	0.71	0.334	0.87	1.19	0.321	Yes
17	18.25	19.00	136.85	0.00	346.75	209.90	0.69	0.325	0.86	1.19	2.000	Yes
18	19.25	19.00	146.66	0.00	365.75	219.09	0.66	0.316	0.86	1.19	0.309	Yes
19	20.25	19.00	156.47	0.00	384.75	228.28	0.63	0.306	0.85	1.19	0.302	Yes
20	21.25	19.00	166.28	0.00	403.75	237.47	0.61	0.295	0.84	1.19	0.294	Yes
21	22.25	19.00	176.09	0.00	422.75	246.66	0.58	0.285	0.84	1.19	0.285	Yes
22	23.25	19.00	185.90	0.00	441.75	255.85	0.56	0.276	0.83	1.19	0.278	Yes
23	24.25	19.00	195.71	0.00	460.75	265.04	0.55	0.273	0.82	1.19	0.278	Yes
24	25.25	19.00	205.52	0.00	479.75	274.23	0.54	0.271	0.82	1.19	0.278	Yes
25	26.25	19.00	215.33	0.00	498.75	283.42	0.53	0.269	0.81	1.19	0.277	Yes
26	27.25	19.00	225.14	0.00	517.75	292.61	0.53	0.266	0.81	1.19	2.000	Yes
27	28.25	19.00	234.95	0.00	536.75	301.80	0.52	0.263	0.80	1.19	0.275	Yes
28	29.25	19.00	244.76	0.00	555.75	310.99	0.51	0.261	0.80	1.19	2.000	Yes
29	30.25	19.00	254.57	0.00	574.75	320.18	0.50	0.257	0.79	1.19	0.271	Yes
30	31.25	19.00	264.38	0.00	593.75	329.37	0.50	0.258	0.79	1.19	0.274	Yes
31	32.25	19.00	274.19	0.00	612.75	338.56	0.50	0.259	0.79	1.19	0.276	Yes
32	33.25	19.00	284.00	0.00	631.75	347.75	0.50	0.260	0.78	1.19	0.279	Yes
33	34.25	19.00	293.81	0.00	650.75	356.94	0.50	0.261	0.78	1.19	0.281	Yes

Abbreviations

Depth: Depth relative to final conditions free surface (m) during eq.
u_0: Water pressure at test point (kPa) during eq.
σ_v: Total overburden pressure at test point (kPa) during eq.
σ_v': Effective overburden pressure based on GWT during earthquake (kPa) during eq.
r_d: Nonlinear shear mass factor
CSR: Cyclic Stress Ratio
MSF: Effective overburden stress factor
K_σ: Magnitude Scaling Factor
CSR^*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) numeric results ::

No	Depth (m)	V_s (m/s)	Fines %	n	V_{s1} (m/s)	V_{s1c} (m/s)	$CRR_{7.5}$	F.S.	Can Liquefy
1	2.25	171.00	0.00	1.24	212.17	215.00	4.000	2.00	Yes
2	3.25	162.00	0.00	1.13	183.35	215.00	4.000	2.00	Yes
3	4.25	159.00	0.00	1.06	168.28	215.00	4.000	2.00	Yes
4	5.25	152.00	0.00	1.03	156.38	215.00	0.089	0.35	Yes

:: Cyclic Resistance Ratio (CRR) numeric results ::

No	Depth (m)	V_s (m/s)	Fines %	n	V_{s1} (m/s)	V_{s1c} (m/s)	$CRR_{7.5}$	F.S.	Can Liquefy
5	6.25	191.00	0.00	1.00	191.81	215.00	0.189	0.69	Yes
6	7.25	199.00	0.00	0.98	195.49	215.00	0.215	0.74	Yes
7	8.25	216.00	0.00	0.96	207.93	215.00	0.478	1.55	Yes
8	9.25	234.00	0.00	0.94	221.07	215.00	4.000	2.00	Yes
9	10.25	219.00	0.00	0.93	203.32	215.00	0.318	0.97	Yes
10	11.25	199.00	0.00	0.91	181.77	215.00	0.144	0.43	Yes
11	12.25	185.00	0.00	0.90	166.41	215.00	0.106	0.32	Yes
12	13.25	194.00	0.00	0.89	172.01	215.00	0.117	0.35	Yes
13	14.25	227.00	0.00	0.87	198.54	215.00	0.244	0.73	Yes
14	15.25	204.00	0.00	0.86	176.13	215.00	0.127	0.39	Yes
15	16.25	230.00	0.00	0.85	196.16	215.00	0.220	0.68	Yes
16	17.25	235.00	0.00	0.84	198.09	215.00	0.239	0.74	Yes
17	18.25	266.00	0.00	0.83	221.72	215.00	4.000	2.00	Yes
18	19.25	235.00	0.00	0.82	193.79	215.00	0.202	0.65	Yes
19	20.25	250.00	0.00	0.82	204.06	215.00	0.334	1.11	Yes
20	21.25	256.00	0.00	0.81	206.90	215.00	0.427	1.45	Yes
21	22.25	250.00	0.00	0.80	200.14	215.00	0.264	0.92	Yes
22	23.25	247.00	0.00	0.79	195.94	215.00	0.218	0.78	Yes
23	24.25	256.00	0.00	0.79	201.30	215.00	0.280	1.01	Yes
24	25.25	253.00	0.00	0.78	197.25	215.00	0.230	0.83	Yes
25	26.25	274.00	0.00	0.77	211.87	215.00	0.981	3.54	Yes
26	27.25	312.00	0.00	0.77	239.34	215.00	4.000	2.00	Yes
27	28.25	253.00	0.00	0.76	192.58	215.00	0.193	0.70	Yes
28	29.25	285.00	0.00	0.76	215.32	215.00	4.000	2.00	Yes
29	30.25	256.00	0.00	0.75	192.01	215.00	0.190	0.70	Yes
30	31.25	278.00	0.00	0.74	207.04	215.00	0.433	1.58	Yes
31	32.25	270.00	0.00	0.74	199.70	215.00	0.258	0.93	Yes
32	33.25	253.00	0.00	0.73	185.88	215.00	0.159	0.57	Yes
33	34.25	250.00	0.00	0.73	182.48	215.00	0.146	0.52	Yes

Abbreviations

Depth: Depth from free surface where Vs was performed (m)
V_s: Estimated Vs (m/s)
n: Stress exponent normalization factor
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