



GEOTECHNICAL INVESTIGATION REPORT

FOR POTENTIAL RESIDENTIAL SUBDIVISION

STAGE 1 – INITIAL ADVICE AND HIGH-LEVEL ASSESSMENT

John Paterson Drive, Halswell, Christchurch

Client: John Paterson Estates Ltd

Project Reference: LTC25362
Revision: B
Date: 24 April 2026

Documentation Control:

LandTech Consulting Ltd

Postal Address:

PO Box 119
Christchurch 8013



Christchurch Office:

Unit 3/16 Leslie Hills Drive
Riccarton
Christchurch 8011
P: 03 390 1371

Auckland Office:

17 Nils Andersen Road
Whenuapai
Auckland 0618
P: 09 930 9334

E. info@landtech.nz

W. www.landtech.nz

Document Title:	Geotechnical Investigation Report for Potential Residential Subdivision	
Development Stage	STAGE 1 – INITIAL ADVICE AND HIGH-LEVEL ASSESSMENT	
Address:	John Paterson Drive, Halswell, Christchurch	
Revision:	B	
Client:	John Paterson Estates Ltd	
Project Reference:	LTC25362	
Author:		Mark Trainor, Engineering Geologist BSc, PGDip, MEngNZ
Reviewed & Authorised:		Dwayne Wilson, Director CMEngNZ, CPEng, IntPE(NZ)

REPORT DISTRIBUTION:

Recipient	Release Date	Document Type
John Paterson Estates Ltd	24 April 2026	Revision B (PDF)
Urban Estates Ltd	24 April 2026	Revision B (PDF)
Davie Lovell-Smith	24 April 2026	Revision B (PDF)

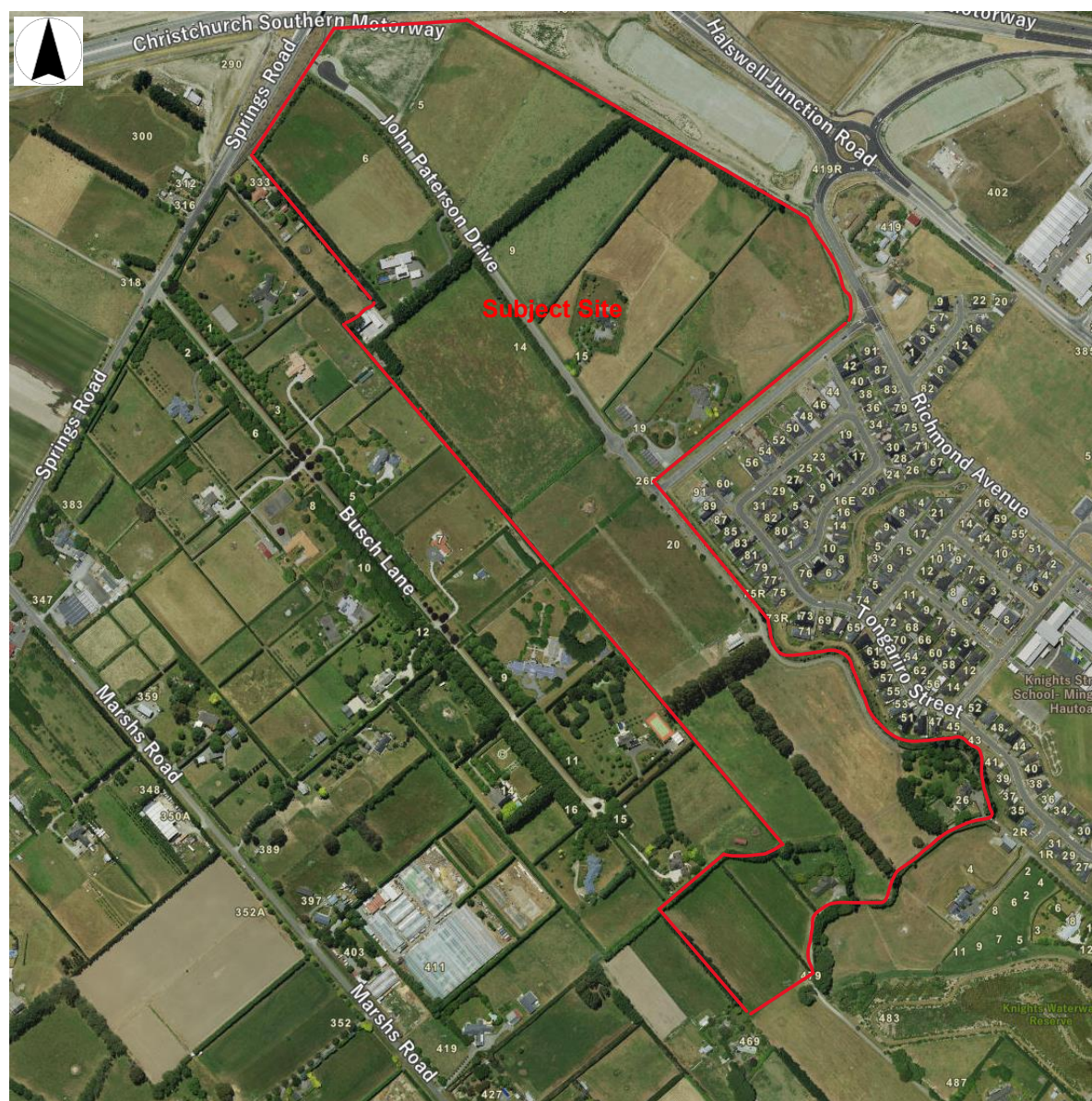
COPYRIGHT:

The information presented in this geotechnical report/document is the property of LandTech Consulting Limited. Use or copying of this document in whole or in part without the previous permission of LandTech Consulting Limited implies a breach of copyright.

Executive Summary:

Project	Address	John Paterson Drive, Halswell, Christchurch
	MBIE Technical Category	N/A - Rural and Unmapped
	Mapped Liquefaction Vulnerability	Possible
Preliminary Site Assessment	Site Subsoil Classification	Class D - Deep or Soft Soil Sites
	Static Settlement Assessment	<25mm
	Geotechnical Hazard Assessment	Subsidence/slippage hazard as per TC2, potential for parts of the site to be TC1
	Depth of unsuitable materials on site (Topsoil/Fill)	0.2m to 0.3m
	Groundwater Depth	3.0m+
Preliminary Geotechnical Recommendations	Ultimate Bearing Capacity within underlying natural soils	200kPa
	Potential Foundations	TC1 and TC2 slabs.
	Additional Considerations and Further Geotechnical Input	Additional shallow and deep testing required prior to development stages. Development setbacks from Knights Stream to be further assessed. Stormwater basin areas to be assessed.

Figure 1: Aerial photograph of investigation site



(Source: Canterbury Maps. Image captured 24 April 2026)

Table of Contents:

1.0	Introduction & Scope of Work	3
2.0	Site Description	3
3.0	Proposed Development	4
4.0	Area Geology	4
5.0	Geological Data Review	5
6.0	Field Investigation	7
7.0	Subsurface Conditions	9
7.1	Topsoil and Fill	9
7.2	Alluvial Deposits	10
7.3	Scala Penetrometer Tests and Shear Vane Tests	10
7.4	CPT and DPSH Tests	10
7.5	Groundwater	11
7.6	Site Seismicity	11
8.0	Past Earthquake Performance	12
9.0	Liquefaction Analysis	13
10.0	Geotechnical Hazard Evaluation	15
10.1	Erosion	15
10.2	Falling Debris	15
10.3	Subsidence	15
10.4	Slippage	16
10.5	Inundation	16
11.0	Natural Hazard Risk Assessment	16
12.0	Geotechnical Recommendations	18
13.0	Future Geotechnical Involvement	19
14.0	Limitations	19

Appendices:

APPENDIX A: LandTech Drawings

APPENDIX B: LandTech Field Logs

APPENDIX C: Deep Test Results

APPENDIX D: Model Earthquake Liquefaction Analysis Outputs

1.0 Introduction & Scope of Work

LandTech Consulting Ltd (LandTech) were engaged by John Paterson Estates Ltd (the Client) to carry out a preliminary geotechnical investigation at John Paterson Drive, Halswell, Christchurch (the Site). The geotechnical investigation relates to initial advice and high-level assessment of the site for potential future residential subdivision.

This geotechnical report summarises the findings of our preliminary investigation, analysis and assessment, which were conducted as per the brief given to us by Barker & Associates Ltd with aim to provide information to develop a Structure Plan for the site. This report includes preliminary evaluation of ground conditions, assessment of potential geohazards, and preliminary recommendations for potential development of the site. This report is not intended to be relied upon for detailed design or consenting purposes, and additional site investigations and geotechnical reporting will be required to support later stages of the development should it proceed. The preliminary geotechnical assessment for the site included the following:

- Desktop study,
- Field investigation (i.e., site walkover, shallow and deep geotechnical investigations),
- A preliminary liquefaction assessment
- Assessment of potential geotechnical development considerations; and
- Provision of this geotechnical report.

2.0 Site Description

The site is located at John Paterson Drive, Halswell, Christchurch, approximately 9.5km southwest of Christchurch Central. According to LINZ ¹, the proposed development site comprised the following Lots, legally described as:

- 5 John Paterson Drive - Section 1 Survey Office Plan 560474
- 6 John Paterson Drive - Section 10 Survey Office Plan 480694
- 9 John Paterson Drive - Lot 2 Deposited Plan 318764
- 14 John Paterson Drive - Lot 7 Deposited Plan 318764
- 15 John Paterson Drive - Lot 3 Deposited Plan 318764
- 19 John Paterson Drive - Lot 4 Deposited Plan 318764
- 20 John Paterson Drive - Lot 6 Deposited Plan 318764
- 26 John Paterson Drive - Section 16 Survey Office Plan 480694
- 479 Marshs Road - Lot 2 DP 81077

¹<https://data.linz.govt.nz/>, accessed 17 December 2025

The Lots making up the proposed development site have a combined area of 32.782ha. The site is shown on Figure 1 (above) and the LandTech *Test Location Plan*, Drawing No. LTC25362 / 1 (attached in Appendix A).

The near-level site is surrounded by rural and residential lifestyle properties with John Paterson Drive running relatively centrally through the northern portion of the site. Tongariro Street runs parallel to the southeast portion of the site, with Springs Road and Halswell Junction Road to the northwest and northeast of the site respectively. Knights Stream borders the site to the south and southeast.

Number 6, 15, 19 and 26 John Paterson Drive and 479 Marshs Road each contain an existing dwelling. The remainder of the site is covered by grass, mature trees and shelter belts.

3.0 Proposed Development

We have been provided with a preliminary development plans by Davie Lovell-Smith which indicates the site would be developed into a residential subdivision comprising approximately 500 residential Lots, roading and infrastructure, and stormwater basins and associated wetland.

4.0 Area Geology

We have reviewed the geomorphological² and geological^{3,4} maps of the area. The geomorphic source indicates the site is located within river plain or channel. The geological sources indicate the site is underlain by Holocene aged Alluvial Deposits.

Alluvial Deposits generally comprise interbedded horizons of fine to coarse-grained sand and silt, as well as layers of cohesive clay and peat. Layers of rounded to sub-rounded, gravel to cobble sized greywacke particles can also be present. Due to their depositional environment the characteristics of Alluvial Deposits can vary widely over short distances. These variations can include vertical and/or horizontal differences in both soil and/or particle size distribution and degree of soil consolidation.

The geotechnical properties of Alluvial Deposits depend on a number of variable factors, including soil composition, level of consolidation, particle size distribution, and organic content. The presence or absence of groundwater can also affect local soil behaviour characteristics. Due to this variability, during seismic events alluvium can be prone to differential settlement, liquefaction and, near river systems, significant lateral spreading.

² *Geomorphological Map of Christchurch and Eastern Canterbury*, Beeg, Junes & Barrell (2015). Accessed via Christchurch Liquefaction Viewer, <https://canterburymaps.govt.nz/map?webmap=ea5f9f0ad09b4192a481f2c76aa91907> on 17 December 2025.

³ *Geology of the Christchurch Urban Area*, Brown and Weeber (1992) Accessed via Canterbury Maps, <https://canterburymaps.govt.nz/> on 17 December 2025.

⁴ *GNS Geological Unit QMAP*, GNS Science. Accessed via New Zealand Geology Web Map, <https://data.gns.cri.nz/geology/> on 17 December 2025.

5.0 Geological Data Review

For the purpose of our investigation, we reviewed available data from the following sources (accessed on 17 December 2025):

- The Christchurch City Council (CCC) District Plan⁵;
- The CCC Floor Level Map⁶;
- Environment Canterbury (ECan) map viewer⁷;
- The ECan Listed Land Use Register (LLUR)⁸; and
- The New Zealand Geotechnical Database (NZGD)⁹.

A summary of the findings of our data review, the results of which have contributed to our geotechnical assessment, model, and recommendations for the site.

- The CCC District Plan webservice shows that the site is located within an area categorised as a *Liquefaction Management Area*.
- The *Christchurch Liquefaction Vulnerability* study by Tonkin & Taylor, July 2020, presents liquefaction vulnerability categories for Christchurch City. Figure 4.14 of the report shows the southeastern half of the site is located with a liquefaction vulnerability area of possible. This indicates there is a greater than 15% probability that liquefaction induced ground damage will be minor to moderate (or greater) for a 500-year event. There is insufficient information to distinguish between the medium and high categories. The northwest half of the site is located within a liquefaction vulnerability area of unlikely. Tonkin and Taylor considered that there is a greater than 85% probability that liquefaction induced ground damage will be none to minor in a 500 year event. However, there is insufficient information to distinguish between very low and low.
- The MBIE *Residential Foundation Technical Category Map* shows that the site is located within an area designated as N/A - Rural and Unmapped. This indicates that normal consenting procedures apply.
- The CCC district plan indicates that the area has a fixed floor level requirement; however, the CCC Floor Level map shows that a finished floor level for the site has not yet been assessed. We recommend contacting CCC to determine the required floor level for the site prior to starting construction/earthworks.

⁵ <https://districtplan.ccc.govt.nz/>

⁶ <https://ccc.govt.nz/services/water-and-drainage>

⁷ <http://canterburymaps.govt.nz/>

⁸ <https://llur.ecan.govt.nz/>

⁹ <http://www.nzgd.org.nz/>

- The ECan LLUR contains records of historical HAIL activities taking place at the site, mainly of Lots west and south of John Paterson Drive. The recorded activities are bulk storage of pesticides and waste disposal to land on the site. We recommend contacting a contamination specialist to conduct an assessment.
- The GNS Mapped Liquefaction – Sept 2010 and Mapped Liquefaction – Feb 2011 maps indicate no liquefaction was observed at the site during the CES based on aerial and satellite photography interpretation. However, liquefaction is mapped approximately 60m south and southeast of the site.
- The digitised 1856 Black Maps¹⁰ indicate that the property and surrounding area was mapped as Grass Plains, consistent with the local environmental conditions.
- We have referred to historical aerial photography for the area¹¹, which indicates that the site has been utilised as farmland / pasture since the earliest available aerial photography from the early 1940's. It appears the site was further subdivided in the early 2000's with the appearance of the current dwellings on several of the Lots.
- The *GNS Science Median Water Table Elevations, Depths to Water Table (25m – grid DEM)* layer (accessed via the NZGD), shows that the groundwater level at the site varies between 2.0m and 6.0m+ below average ground level. Groundwater depths are shown to increase from south to north across the site.
- The ECan Wells and Bores data layer within the Canterbury Maps web viewer shows that four wells are located within the site. The locations of the wells are shown on the LandTech Test Location Plan, Drawing No. LTC25362 / 1 (attached in Appendix A). Initial groundwater level readings from each well are described below.
 - M36/4168 - 7.40m below ground level, recorded on 14 March 1990.
 - M36/8070 - 5.20m below ground level, recorded on 16 March 2006.
 - M36/7502 - 4.70m below ground level, recorded on 17 November 2003.
 - M36/4190 - 3.70m below ground level, recorded on 29 May 1990.

Groundwater readings indicate depths to the water table generally increase to the northwest across the site.

¹⁰ Accessed via Canterbury Maps, <https://ecan.maps.arcgis.com/home/item.html?id=c5f7d946b8fb43ce80fd3441cde5b78e>

¹¹ Accessed via Canterbury Maps, <https://canterburymaps.govt.nz/map?webmap=7d0dc64208474b4c976b90ccc6ce9ae7>

The well borehole logs generally indicate sands and silts overlying gravels at depths between 2.5m and 7.5m below ground level to the termination depth of the well boreholes.

The details of each well borehole are as follows:

- Well borehole (M36/4168, total depth 13.2m below ground level), drilled by McMillan Drilling Ltd on 14 March 1990. Gravels encountered at 7.2m below ground level.
- Well borehole (M36/8070, total depth 18.0m below ground level), drilled by Daly Water Wells Ltd on 16 March 2006. Gravels encountered at 3.5m below ground level.
- Well borehole (M36/7502, total depth 18.0m below ground level), drilled by Daly Water Wells Ltd on 17 November 2003. Gravels encountered at 7.5m below ground level.
- Well borehole (M36/4190, total depth 24.0m below ground level), drilled by McMillan Drilling Ltd on 29 May 1990. Gravels encountered at 2.5m below ground level.

Copies of the well borehole logs are attached in Appendix C.

6.0 Field Investigation

The field investigation for the site took place on 15 and 17 December 2025 and comprised the following components:

- Detailed site inspection.
- Drilling of seven hand auger holes with associated in-situ soil testing.
- Six Cone Penetration Tests (CPTs), continued with Dynamic Probe (Super Heavy) (DPSH) tests upon CPT refusal.

The approximate test locations¹² are indicated on the LandTech *Test Location Plan*, Drawing No. LTC25362 / 1 (attached in Appendix A).

The soil conditions encountered within each of the hand auger holes were logged by LandTech technical staff¹³. The hand auger hole soil logs, which include the results of the soil tests undertaken, are attached in Appendix B.

¹² Field tests and sections were located using a hand-held GPS unit and a measuring tape without survey control and are therefore approximate only.

¹³ Soil was logged in accordance with New Zealand Geotechnical Society *Guideline for the Description of Soil and Rock for Engineering Purposes* (2005).

Dynamic Cone (Scala) Penetrometer testing within each of the hand auger holes was carried out by LandTech technical staff to determine a soil density profile with depth across the site¹⁴. Where appropriate, the undrained shear strength of the fine-grained soils was measured in situ, using a Geovane handheld shear vane¹⁵. The recorded peak and remoulded shear strength values for each shear vane test have been factored in terms of BS1377.

CPT and DPSH tests were carried out by LandTech technical staff using a Pagani TG63-150 CPT rig. The results of this testing are attached in Appendix C and are discussed in Section 0, below.

Groundwater measurements were unable to be recorded on the day of hand auger drilling due to groundwater depths being greater than the termination depths of our hand augers. The hand auger holes were subsequently backfilled following completion of our site investigation. Groundwater was dipped within some of the deeper CPT/DPSH testing upon completion.

¹⁴ In accordance with NZS 4402:1988, Test 6.5.2, *Dynamic Cone Penetrometer*.

¹⁵ In accordance with the New Zealand Geotechnical Society *Guideline for Hand Held Shear Vane Test*, (2001).

7.0 Subsurface Conditions

Subsurface materials encountered at the site during our field investigation generally comprised a surface layer of topsoil and fill, overlying Alluvial Deposits consistent with the mapped geology discussed above. A summary of the subsurface conditions is provided in Table 1. Conditions are discussed further in the sections below. Detailed soil descriptions are provided in the hand auger logs attached in Appendix B.

Table 1: Subsurface Summary

Auger Hole ID	Drill Depth	Depth of Topsoil / Fill	Groundwater Level	Scala Depth
HA01	0.9	0.2	NE	0.9
HA02	3.0	0.3	NE	2.9
HA03	3.0	0.2	NE	2.9
HA04	0.3	0.3	NE	0.4
HA05	3.0	0.2	NE	2.9
HA06	0.6	0.3	NE	0.8
HA07	1.3	0.3	NE	1.3

Table Notes: Measurements are in metres (m) below present ground level (bpgl)
NE = Not Encountered

7.1 Topsoil and Fill

Topsoil and fill were encountered in each hand auger hole from the existing ground surface to depths between 0.2m and 0.3m. Due to the nature of the fill and organic content of the topsoil, these materials are not considered suitable for permanent support of foundations due to the potential for differential settlement.

It should be noted that our hand auger holes were drilled at point locations across the site, in practical locations that were accessible for our drilling and testing equipment. Therefore, it is possible that ground conditions could vary away from these locations. The depths of unsuitable topsoil and potential fill across the site therefore may be greater or lesser than those encountered within our hand auger holes. This possibility should be taken into account when planning any earthworks and/or foundation excavations on the site.

7.2 Alluvial Deposits

Alluvial soils were encountered from below the topsoil and fill to the target (or termination if shallower or deeper than the target) depth of the auger holes at 3.0m below ground surface. The Alluvial Deposits generally comprised interbedded silts and sands.

7.3 Scala Penetrometer Tests and Shear Vane Tests

Scala Penetrometer testing at the hand auger locations ranged between 2 and 20+ blows per 100mm from below the topsoil to the (refusal or target) depth. Where target depth was not achieved, refusal occurred on inferred gravels in the majority of the tests. HA04 refused at 0.4m in gravelly fill material. Undrained shear strength results from the shear vane testing within the fine-grained material ranged between 90kPa and 250+kPa, indicating 'stiff' to 'hard' consistency soils.

7.4 CPT and DPSH Tests

Our CPT testing (CPT02, CPT03 and CPT05) identified interbedded sands and silts from the ground surface to the CPT refusal depths of 3.8m, 4.2m and 8.1m respectively, at which point gravels are inferred. Q_c values for the upper sand and silt layers were generally between 1MPa and 10MPa.

Our DPSH testing, continued through CPT02 and CPT03 (DPSH02 and DPSH03), and undertaken from the ground surface where anchoring of the CPT rig was unable to be achieved (DPSH01, DPSH04 and DPSH06), generally recorded blow counts of 3 to 24 blows per 100mm, indicating weak to dense material is present from below the ground surface.

Table 2: CPT and DPSH Test Summary

Test ID	Test Depth	Depth to Inferred Gravels	Groundwater Level	Refusal Depth
DPSH01	0.0 to 1.4	1.0	HC@1.0	1.4
CPT02 / DPSH02	0.0 to 4.3	3.8	3.2	4.3
CPT03 / DPSH03	0.0 to 4.7	4.2	3.9	4.7
DPSH04	0.0 to 8.1	8.0	HC@0.7	8.1
CPT05	0.0 to 8.2	7.8	3.9	8.2
DPSH06	0.0 to 2.3	0.9	HC@2.2	2.3

Table Notes: Measurements are in metres (m) below present ground level (bpgl)
HC = Hole Collapse

Our deep tests indicate varying depths to gravels below the site. The depth to gravels is greater in the northeast portion of the site where DPSH04 and CPT05 were conducted however, borehole data indicating shallow gravels further northeast and east of the site suggests this is an isolated area with depths to gravels similar to that encountered in our other test locations.

7.5 Groundwater

Groundwater was not encountered within our hand auger holes due to depths exceeding our target, or refusal, drill depths. Groundwater level was measured 3.2m below ground level within CPT02, and at 3.9m below ground level within CPT03 and CPT05.

Groundwater readings from the onsite well boreholes indicate depths to the water table generally increase to the northwest across the site.

Readings from nearby wells sourced from Canterbury Maps indicate that groundwater in the area is prone to seasonal fluctuations. Local groundwater levels may also vary with rainfall levels over shorter time intervals.

7.6 Site Seismicity

For the purpose of applying the requirements of NZS 1170.5:2004, the site subsoil is considered Class D - Deep or Soft Soil Sites. This classification is based on our estimation that the depth of soils underlying the site exceeds those given in Table 3.2 of the standard.

8.0 Past Earthquake Performance

Table 3 below shows modelled and scaled peak ground accelerations (PGAs) for the site during the CES, and the corresponding land damage categories, determined based on our interpretation of aerial photography taken after each of the major CES events¹⁶. Magnitude scaling of the PGAs was conducted in accordance with MBIE Guideline criteria¹⁷. The magnitudes of the June and December 2011 events have also been adjusted to take into account the foreshocks that occurred before each of those main earthquakes.

Table 3: Past (CES) earthquake performance

	September 2010 (Mw 7.1)	February 2011 (Mw 6.2)	June 2011 (Mw 6.2)	December 2011 (Mw 6.1)
PGA (g)	0.32	0.28	0.12	0.11
Scaled PGA _{7.5} (g)	0.29 Tested	0.20 Not tested	0.09 Not tested	0.08 Not tested
Scaled PGA _{10th} (g)	0.18 Tested	0.12 Not tested	0.05 Not tested	0.04 Not tested
Reviewed Damage	Little to none	Little to none	Little to none	Little to none

The NZGD data we reviewed indicates that the site was well tested to Serviceability Limit State (SLS) levels of strong ground motion (SLSA; Mw 7.5 PGA=0.13g) during the September 2010 earthquake event of the CES.

The September 2010 event most closely represents the demand of a SLSA level event. Therefore, we would expect future SLSA-level earthquakes to result in a level/amount of land damage on the site similar to that experienced during the September 2010 event (i.e., little to none).

The February 2011 event exceeded the demand of a SLSB level event (Mw 6.0 PGA=0.19g). Therefore, we would expect similar levels of land damage to occur on the site during future SLSB level events (i.e., little to none).

The September 2010 event was closest to the demands of an Ultimate Limit State (ULS) level event (Mw 7.5 PGA=0.35g). Therefore, a slightly greater degree of liquefaction induced land damage could potentially be experienced at the site during a ULS event in comparison to the site performance following the September 2010 earthquake.

¹⁶ PGA and CES aerial photography sourced from the NZGD.

¹⁷ *Repairing and rebuilding houses affected by the Canterbury earthquakes, Part 3: Technical Category 3* MBIE (2018). Accessed via <https://www.building.govt.nz/building-code-compliance/canterbury-rebuild/repairing-and-rebuilding-houses-affected-by-the-canterbury-earthquakes/>

9.0 Liquefaction Analysis

We have analysed the onsite CPT and DPSH data discussed above for liquefaction in Model Earthquake Events. The analysis has been carried out using proprietary software Geologismiki CLiq Version 3 and LiqSVs Version 2. Liquefaction settlement and land damage potential on the site has been calculated for the three model earthquake events specified in MBIE/NZGS Module 3 - Earthquake geotechnical engineering practice (November 2021), based on a methodology adapted from the same source.

DPSH analysis has been undertaken using fines estimates for the underlying strata and a Hamer Energy Ratio of 78% (i.e., energy ratio of 1.3 to convert to N60). Our analysis was carried out using conservative mean groundwater conditions based on the groundwater depths measured on site and within available onsite well data. The conditions used for each of our analyses are listed below.

The model conditions are given below:

- *Service Limit State A (SLSA)*; where $M_w = 7.5$ and $PGA = 0.13g$.
- *Service Limit State B (SLSB)*; where $M_w = 6.0$ and $PGA = 0.19g$.
- *Ultimate Limit State (ULS)*; where $M_w = 7.5$ and $PGA = 0.35g$; and
- Groundwater Level during all modelled events are set at 3.0m.

Table 4 below shows the results of our analyses; outputs are attached in Appendix D.

Table 4: CPT Liquefaction Analysis Results

Test ID	Result	SLSA	SLSB	ULS
DPSH01	Ground Settlement	<5mm	<5mm	<5mm
	Liquefaction Severity Number	0	0	0
	Ground Damage Category	Little to none	Little to none	Little to none
CPT02/DPSH02	Ground Settlement	<5mm	<5mm	10mm
	Liquefaction Severity Number	0	0	3
	Ground Damage Category	Little to none	Little to none	Little to none
CPT03/DPSH03	Ground Settlement	0mm	<5mm	20mm
	Liquefaction Severity Number	0	1	5
	Ground Damage Category	Little to none	Little to none	Little to none
DPSH04	Ground Settlement	5mm	20mm	130mm
	Liquefaction Severity Number	1	4	28
	Ground Damage Category	Little to none	Little to none	Moderate
CPT05	Ground Settlement	5mm	20mm	75mm
	Liquefaction Severity Number	1	4	15
	Ground Damage Category	Little to none	Little to none	Minor
DPSH06	Ground Settlement	<5mm	<5mm	<5mm
	Liquefaction Severity Number	0	0	0
	Ground Damage Category	Little to none	Little to none	Little to none

The settlements presented in Table 4 above are to the nearest 5mm. Due to the inherent uncertainty in calculating liquefaction induced settlement, the calculated free field settlements (land settlement) are indicative only. Actual settlements on site may vary from those above and do not take into account foundation influences; volume loss from surface expression, loss in bearing strength and influences from lateral spreading.

The results from our modelled liquefaction analysis correlate well with the mapped/observed damage following the CES events. DPSH04 and CPT05, where gravels were encountered at greater depths, indicate an area of potential liquefaction. The results from DPSH04 appear to be overpredicting likely due to the limited inputs available in the analysis software and fines estimations.

Based on the results of our preliminary quantitative liquefaction assessment of the site's model earthquake performance, we consider that up to minor liquefaction-induced land damage is possible during future ULS earthquakes, and that little to no land damage is likely to occur during SLS earthquakes. This indicates that a liquefaction vulnerability category of medium would be applicable for the site. Our analysis estimates differential settlements on the site of approximately 10mm during an SLS event and 40mm during a ULS event, based on half the magnitude of estimated settlement however, the upper liquefaction and settlement levels are isolated to the eastern most portion of the site within the current Lot 3 and Lot 4.

Based on the results of the model liquefaction analysis the majority of the site could be considered TC1, with modelled index settlements of less than 15mm predicted at SLS for the upper 10m below ground surface, and less than 25mm within the same depth interval predicted at ULS. However as mentioned, the eastern portion of the site would likely be considered TC2 under our currently modelling with further deep CPT testing required to refine our current analysis as the liquefaction results appear to be overpredicting with DPSH04. It should also be noted that our current analysis does not account for damage due to lateral spreading on the proximity of Knights Stream.

Based on the south to southeastern portion of the site's distance from Knights Stream this part of the site may fall within TC2 or TC3 degrees of lateral spreading, depending on the distance from the streams edge. Further assessment is required at the detailed design stages to refine this. The remainder of the site is likely to have low potential for liquefaction induced lateral spreading in accordance with TC1 criteria.

10.0 Geotechnical Hazard Evaluation

Section 106 of the Resource Management Act 1991 outlines hazards that must be assessed when a territorial authority considers a Subdivision Consent application. This section outlines our evaluation of possible geotechnical hazards associated with the site, which has been carried out in accordance with CCC requirements¹⁸.

10.1 Erosion

The site is not considered to be subject to active erosion, and is unlikely to accelerate, worsen, or result in erosion over a 100 year timeline.

10.2 Falling Debris

No elevated land exists in close proximity to the site; therefore, the risk of rock fall or land slippage occurring on the site is considered negligible.

10.3 Subsidence

The site is considered prone to liquefaction-induced subsidence in accordance with TC1 and TC2 criteria.

¹⁸ *Geotechnical Assessment to Satisfy Section 106 RMA Matters*, CCC, 2013. Subdivision Bulletin 23.2. <https://ccc.govt.nz/assets/Documents/Consents-and-Licences/resource-consents/subdivision-bulletins/SubdivisionBulletin23-2.pdf>

10.4 Slippage

The site is considered prone to lateral spreading (i.e., slippage) generally in accordance with TC2 criteria. Portions of the site close to Knights Stream will be considered TC3 with setbacks needed to be determined with further assessment and analysis. The remainder of the site likely falls within TC1 potential for lateral spreading (i.e. minimal), however, the TC2 settlement areas in the northeast also require further assessment.

10.5 Inundation

According to the Christchurch City Council floor level website (referenced in Section 5.0), the site is not located within a flood management area, however according to the CCC website the floor level assessment for the site is incomplete.

Given the liquefaction mapped/observed on the site during the CES, the site is considered likely to be inundated with minor quantities of liquefaction ejecta following future large earthquake events.

11.0 Natural Hazard Risk Assessment

The National Policy Statement for Natural Hazards 2025 (NPS-NH) provides a standardised risk assessment matrix as to how natural hazard risks must be addressed in geotechnical and planning reports. The following risk assessment has been applied using the best information available at the time of writing this report and considers natural hazard risks over a 100-year timeframe (to 2126).

The NPS-NH applies to the following hazards.

- a) Flooding
- b) Landslips
- c) Coastal erosion
- d) Coastal inundation
- e) Active faults
- f) Liquefaction and;
- g) Tsunami

The following matrix is used to determine the final risk level for each identified hazard relevant to the site.

Table 5 : Likelihood Levels (100-Year Timeframe)

Likelihood Level	AEP / ARI
Almost Certain	10% AEP (Up to 10 years)
Very Likely	5%–10% AEP (10–20 years)
Likely	2%–5% AEP (20–50 years)
Possible	1%–2% AEP (50–100 years)
Unlikely	0.2%–1% AEP (100–500 years)
Rare	0.02%–0.2% AEP (500–5,000 years)
Very Rare	0.02% AEP (More than 5,000 years)

Table 6 : Consequence Levels

Consequence Level	Damage to Property / Injury or Fatalities
Catastrophic	Total destruction/collapse; high threat to life safety with probable fatalities.
Major	Major structural damage; unsafe for people; potential for many injuries or fatalities
Moderate	Non-structural damage; repairs required; potential for minor injuries
Minor	Minor damage; no loss of use; isolated minor injuries possible
Negligible	No building repairs or injuries

Table 7 : NPS-NH Risk Matrix

		Likelihood Level						
Consequence Level	ARI (years)	Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
	AEP	up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
	AEP	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
	Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
	Major	Very High	Very High	High	High	Medium	Medium	Medium
	Moderate	High	High	High	Medium	Medium	Low	Low
	Minor	Medium	Medium	Medium	Medium	Low	Low	Low
	Negligible	Low	Low	Low	Low	Low	Low	Low

Table 8 : Geotechnical Summary Table

Hazard Type	Likelihood (100yr)	Consequence	NPS-NH Risk Level	Proposed Mitigation	Residual Risk
Flooding	Possible	Moderate	Medium	Raised floor level, RL's, subdivision layout consideration and stormwater management design	Low
Landslips	Not applicable	Negligible	Low	N/A	Low
Coastal Erosion	Not applicable	Negligible	Low	N/A	Low
Coastal Inundation	Not applicable	Negligible	Low	N/A	Low
Active Faults	Very rare	Moderate	Low	B1 compliant structures	Low
Liquefaction	Very rare	Minor	Low	TC2-type raft foundations / ground improvement	Low
Tsunami	Not applicable	Negligible	Low	N/A	Low

Based on our hazard risk assessments, we believe the proposed subdivision to be at low risk from natural hazards.

This risk assessment is based on the best available information regarding regional climate projections at the time of reporting. While long-term climate modelling contains inherent uncertainties, the precautionary approach mandated by the NPS-NH 2025 has been applied to ensure the long-term resilience of the proposed development.

12.0 Geotechnical Recommendations

Based on our current investigation it is probable that the site will be classified as TC2 for development purposes. However, additional deep testing will be required. On account of the shallow dense gravel and lack of liquefaction mapped through the site during the CES there is potential for portions of the site to be classified as TC1. However, this would require several 15.0m deep boreholes to assess the liquefiable nature of the soil profile below our current depths of testing in selected areas.

Future dwelling foundation options would most likely comprise TC1 or TC2 waffle slabs supported via the natural underlying soils or engineered fill if site levelling is required at the subdivision development stage.

Further detailed analysis will be required to determine appropriate setback distances from Knights Stream and for stormwater control measures within the Marshs Road portion of the site.

13.0 Future Geotechnical Involvement

Should the developer wish to continue with the proposed subdivision, a more detailed geotechnical investigation will be required to identify the extent of deep alluvial soils and provide further geotechnical recommendations for the development and subdivision consent application more accurately. This will include additional shallow and deep soil tests including several machine boreholes.

14.0 Limitations

This geotechnical report has been prepared for our Client for the purposes of supporting the Structure Plan for future development of the site. This report may be used by our Client's appointed consultants for preliminary design purposes. This report is not intended for detailed design or consenting purposes. This report shall not be extrapolated for other nearby sites or used for any other purposes without the express approval of LandTech and their Client.

We have attempted to conduct a thorough investigation of the site, within the agreed scope of works. The findings and recommendations in this report are based on the results of tests at point locations; therefore, subsurface conditions could vary away from these locations and/or differ from the assumed geotechnical model. Should exposed soil conditions vary from those described herein we request to be informed so as to determine the continued applicability of our recommendations. However, as stated above, variations still may exist as soils can vary naturally across the site and due to previous human activities. LandTech has no control over and should not be held accountable for these variations.

The geotechnical investigation was confined to geotechnical aspects of the site only and did not involve an assessment for environmental contaminants. In addition, our investigation and analyses have not considered the possibility of fault rupture, which may cause deformations and displacements of the ground directly below the site. These (environmental and fault rupture) assessments are outside of the scope of our geotechnical engagement.

END OF REPORT

APPENDIX A

LandTech Drawings





KEY:


HA01

LandTech Consulting Ltd. augerhole locations, drilled 15/12/2025 to 17/12/2025


CPT/DPSH

LandTech Consulting Ltd. CPT test locations, tested 15/12/2025 to 17/12/2025


M36/****

ECan Well



Existing boundary



Proposed Subdivision



NOTES:

Locations of features approximate only

Original sheet size A3

Boundary information on this *Test Location Plan* adapted from LINZ website: www.data.linz.govt.nz (accessed 15/12/2025)

AMENDMENTS		
DATE	REV	DESCRIPTION
24/04/2026	B	Report Issue

Check all dimensions and levels on site before commencing construction.

This drawing and design remains the property of LandTech Consulting Ltd. and may not be reproduced without approval and permission from LandTech Consulting Ltd.

Test Location Plan

John Paterson Drive
HALSWELL, CHRISTCHURCH



Christchurch Office:
3/16 Leslie Hills Drive, Riccarton, Christchurch 8011

Auckland Office:
17 Nils Andersen Road, Whenuapai, Auckland 0618

Postal Address:
PO Box 119, Christchurch 8013

Website: www.landtech.nz Email: info@landtech.nz

Drawing No: LTC25362/ 1	Drawn by: SW	Date: 24/04/20226
Scale: 1: 5000 (A3)	Checked by: MT	Revision: B
Filename: LTC25362 - Drawings.dwg		

APPENDIX B

LandTech Field Logs

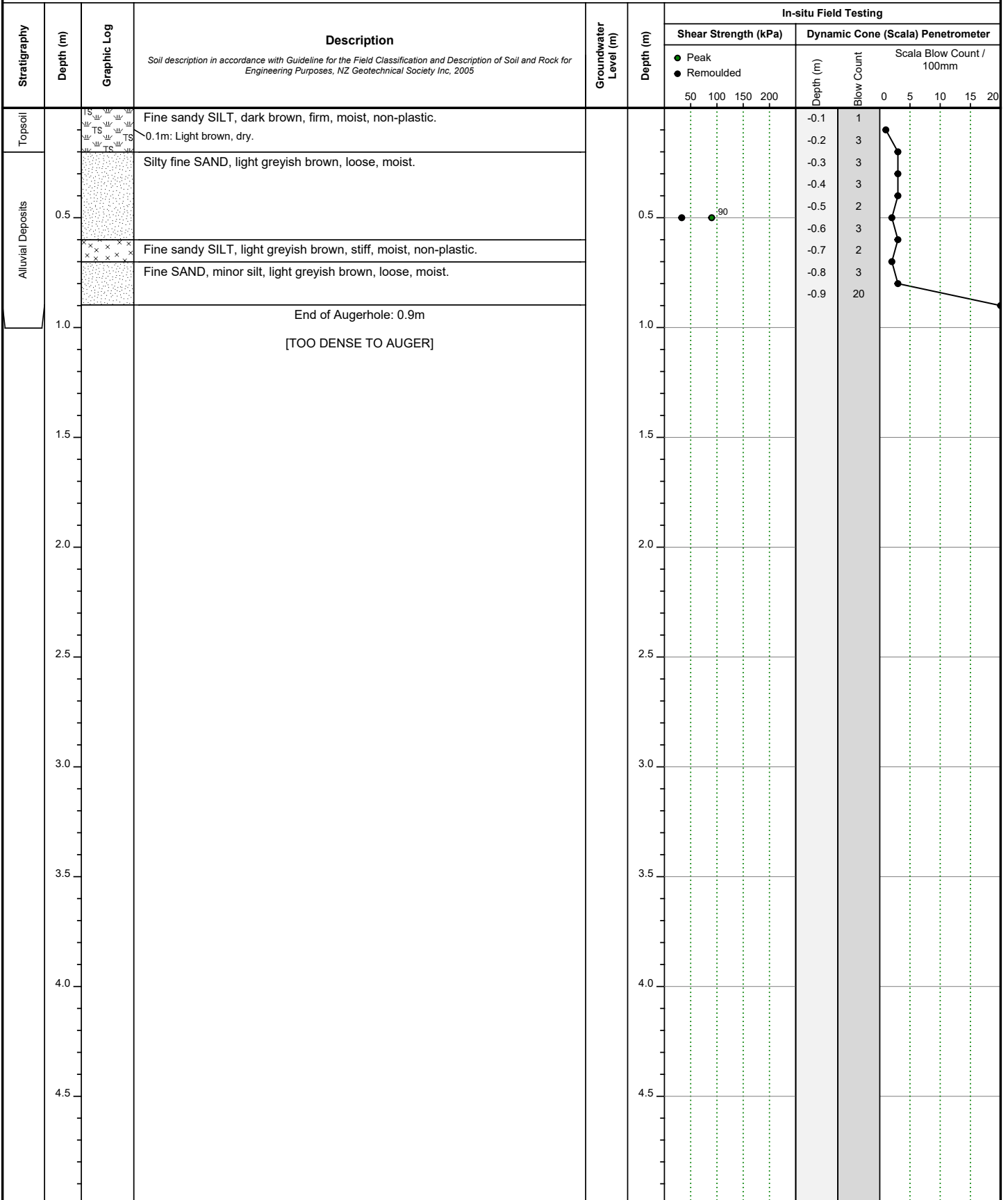


Client: John Paterson Estates Limited 9358263
Project: Proposed Plan Change
Address: John Paterson Drive, Halswell, Christchurch

Augerhole No.: HA01

Sheet No.: 1 of 1

Project No.: LTC25362 **Coordinates:** NZTM2000: E1562468.00, N5175491.00 **Logged By:** SW
Drill Type: 50mm hand auge **Reduced Level:** 18.20m (NZVD2016) **Shear Vane No.:** 3447
Date Started: 17-Dec-25 **Ground Conditions:** Near level, grass **Calibration Factor:** 1.465
Date Finished: 17-Dec-25 **Groundwater Level (m):** Not Encountered **Calibration Date:** 16-Jan-25



Too dense to auger due to inferred natural gravels

In-situ testing in accordance with the following standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001



Client: John Paterson Estates Limited 9358263
Project: Proposed Plan Change
Address: John Paterson Drive, Halswell, Christchurch

Augerhole No.: HA04

Sheet No.: 1 of 1

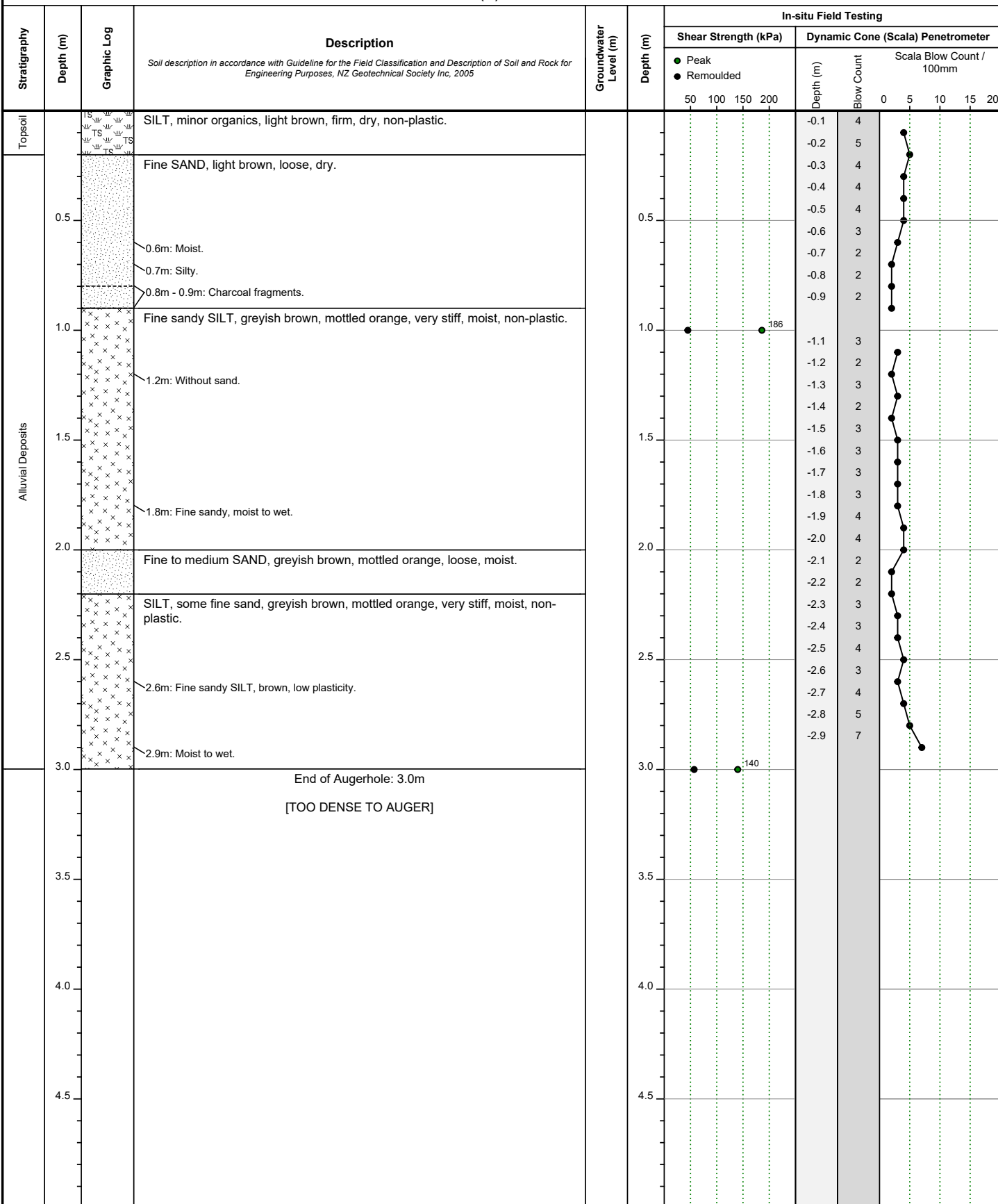
Project No.: LTC25362 **Coordinates:** NZTM2000: E1562340.00, N5176096.00 **Logged By:** SW
Drill Type: 50mm hand auge **Reduced Level:** 19.50m (NZVD2016) **Shear Vane No.:**
Date Started: 17-Dec-25 **Ground Conditions:** Near level, grass **Calibration Factor:**
Date Finished: 17-Dec-25 **Groundwater Level (m):** Not Encountered **Calibration Date:**

Stratigraphy	Depth (m)	Graphic Log	Description Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005	Groundwater Level (m)	Depth (m)	In-situ Field Testing			
						Shear Strength (kPa)	Dynamic Cone (Scala) Penetrometer		
						● Peak ● Remoulded 50100150200	Depth (m)	Blow Count	Scala Blow Count / 100mm
FILL			Sandy SILT, minor fine to coarse subround to subangular gravel, trace rootlets, dark brown, firm, moist, non-plastic.				-0.1	4	
							-0.2	5	
							-0.3	8	
	0.5		End of Augerhole: 0.4m [TARGET DEPTH ACHIEVED]		0.5		-0.4	25	
	1.0				1.0				
	1.5				1.5				
	2.0				2.0				
	2.5				2.5				
	3.0				3.0				
	3.5				3.5				
	4.0				4.0				
	4.5				4.5				

Too dense to auger due to gravelly fill material

In-situ testing in accordance with the following standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

Project No.: LTC25362 **Coordinates:** NZTM2000: E1562233.99, N5176191.81 **Logged By:** SW
Drill Type: 50mm hand auger **Reduced Level:** 19.80m (NZVD2016) **Shear Vane No.:** 3076
Date Started: 15-Dec-25 **Ground Conditions:** Near level, grass **Calibration Factor:** 1.639
Date Finished: 15-Dec-25 **Groundwater Level (m):** Not Encountered **Calibration Date:** 16-Jan-25



Target depth achieved

In-situ testing in accordance with the following standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

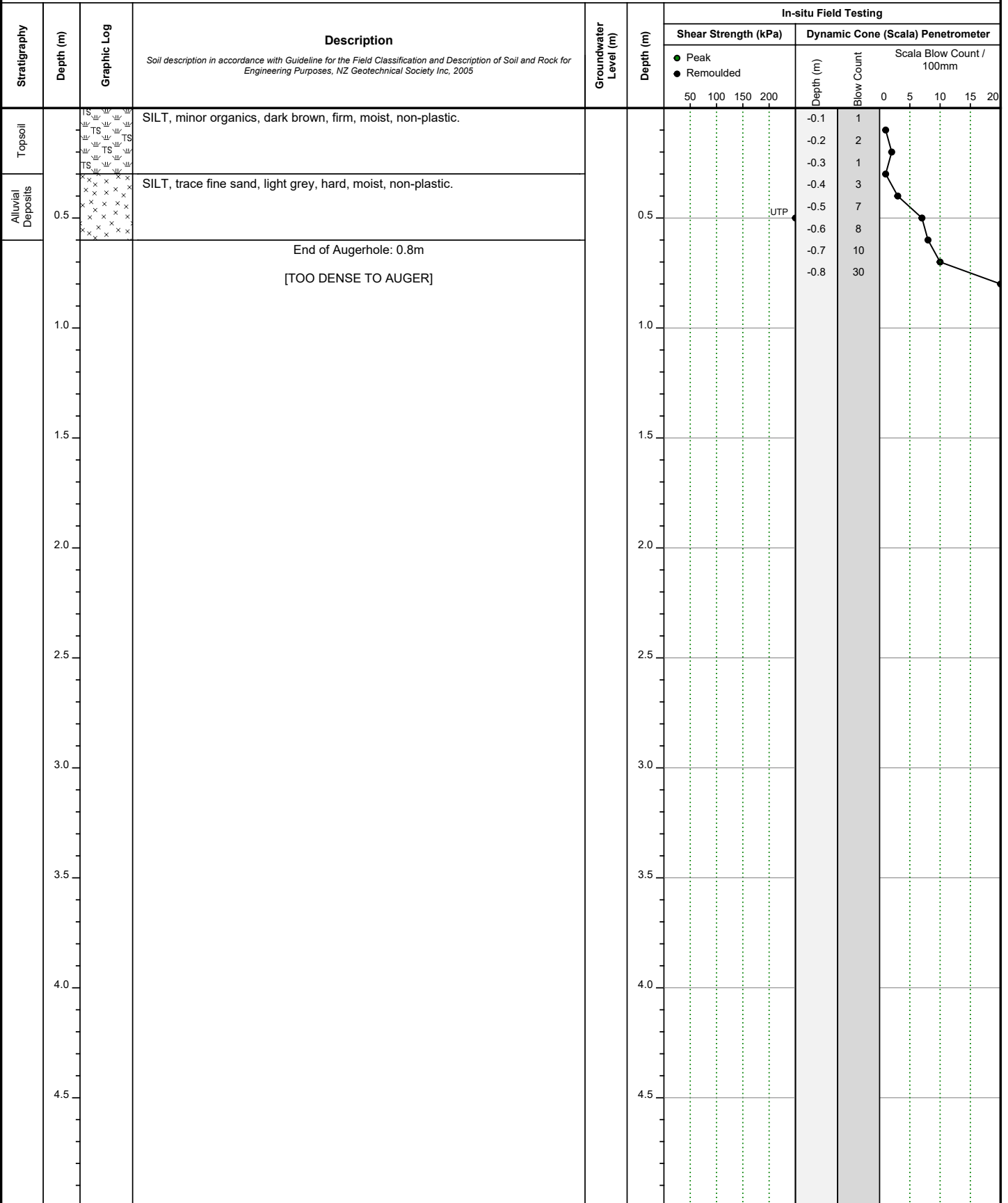


Client: John Paterson Estates Limited 9358263
Project: Proposed Plan Change
Address: John Paterson Drive, Halswell, Christchurch

Augerhole No.: HA06

Sheet No.: 1 of 1

Project No.: LTC25362 **Coordinates:** NZTM2000: E1561911.63, N5176084.19 **Logged By:** BE
Drill Type: 50mm hand auger **Reduced Level:** 20.20m (NZVD2016) **Shear Vane No.:** 3076
Date Started: 17-Dec-25 **Ground Conditions:** Near level, grass **Calibration Factor:** 1.639
Date Finished: 17-Dec-25 **Groundwater Level (m):** Not Encountered **Calibration Date:** 16-Jan-25



Too dense to auger due to inferred natural gravels

In-situ testing in accordance with the following standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

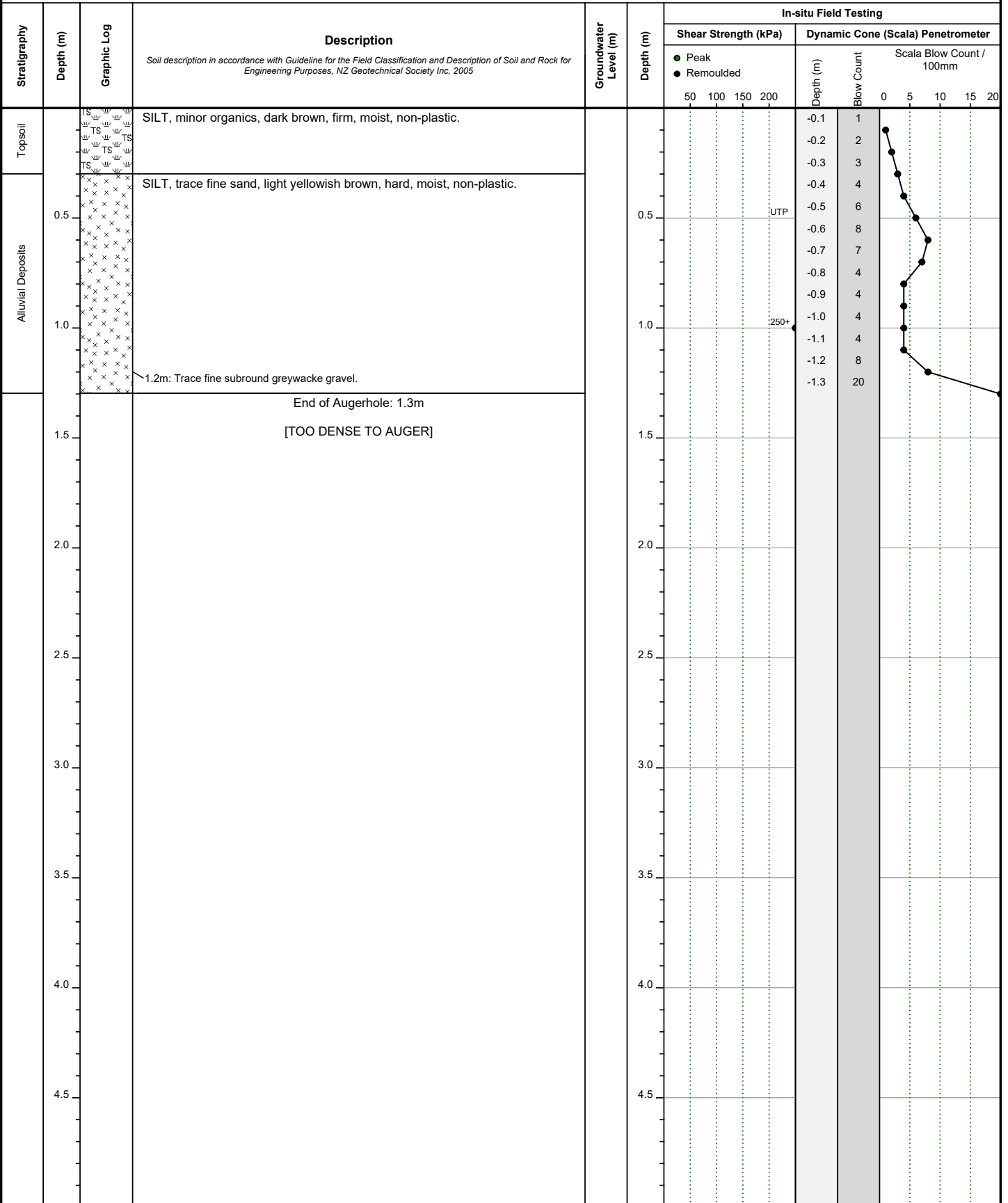


Client: John Paterson Estates Limited 9358263
Project: Proposed Plan Change
Address: John Paterson Drive, Halswell, Christchurch

Augerhole No.: HA07

Sheet No.: 1 of 1

Project No.: LTC25362 **Coordinates:** NZTM2000: E1561775.81, N5176299.38 **Logged By:** BE
Drill Type: 50mm hand auger **Reduced Level:** 22.40m (NZVD2016) **Shear Vane No.:** 3076
Date Started: 17-Dec-25 **Ground Conditions:** Near level, grass **Calibration Factor:** 1.639
Date Finished: 17-Dec-25 **Groundwater Level (m):** Not Encountered **Calibration Date:** 16-Jan-25



Too dense to auger due to inferred natural gravels

In-situ testing in accordance with the following standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

APPENDIX C

Deep Test Results

 DYNAMIC PROBE - SUPER HEAVY LOG										HOLE NO.: DPSH01													
CLIENT: John Paterson Estates Limited 9358263										JOB NO.: LTC25362													
PROJECT: Proposed Plan Change																							
SITE LOCATION: John Paterson Drive, Halswell, Christchurch										OPERATOR: JM		START DATE: 05/12/2025											
CO-ORDINATES: 1562474.00mE, 5175491.00mN (NZTM2000)										ELEVATION: 18.2m (NZVD2016)		END DATE: 15/12/2025											
DEPTH (m)	DATA	(Blows / 100mm)										(Torque / 100Nm)										WATER	DEPTH (m)
		4	8	12	16	20	24	28	32	36	10	20	30	40	50	60	70	80	90				
	2																					Groundwater Not Encountered	1
	2																						2
	1																						3
	1																						4
	1																						5
	1																						6
	1																						7
	3																						8
	6																						9
	6																						10
1	7																					11	
	13																					12	
	19																					13	
	19																					14	
	26																					15	
	EOH: 1.4m Termination Reason: DPSH Refusal																					16	
																							17
																							18
																							19
																							20
																							21
																							22
																							23
																							24
																							25
																							26
																							27
																							28
																							29
																							30
																							31
																							32
																							33
																							34
																							35
																							36
																							37
																							38
																							39
																							40
																							41
																							42
																							43
																							44
																							45
																							46
																							47
																							48
																							49
																							50
																							51
																							52
																							53
																							54
																							55
																							56
																							57
																							58
																							59
																							60
																							61
																							62
																							63
																							64
																							65
																							66
																							67
																							68
																							69
																							70
																							71
																							72
																							73
																							74
																							75
																							76
																							77
																							78
																							79
																							80
																							81
																							82
																							83
																							84
																							85
																							86
																							87
																							88
																							89
																							90
																							91
																							92
																							93
																							94
																							95
																							96
																							97
																							98
																							99
																							100
Remarks:												TEST DETAILS:											
Groundwater not measured due to hole collapse at 1.0m Coordinates from handheld GPS accurate to +/-4m Pagani TG63-150 Rig. 78% energy efficiency DPSH hammer												Weight 63.5 kg											
												Rod Mass 6.2 kg											
NOTES:												Drop Height 750 mm											
												Cone Area Ratio 0.002											
												Predrill 0.1											
												Termination DPSH Refusal											



CONE PENETRATION TEST (CPT) LOG

HOLE NO.:
CPT02

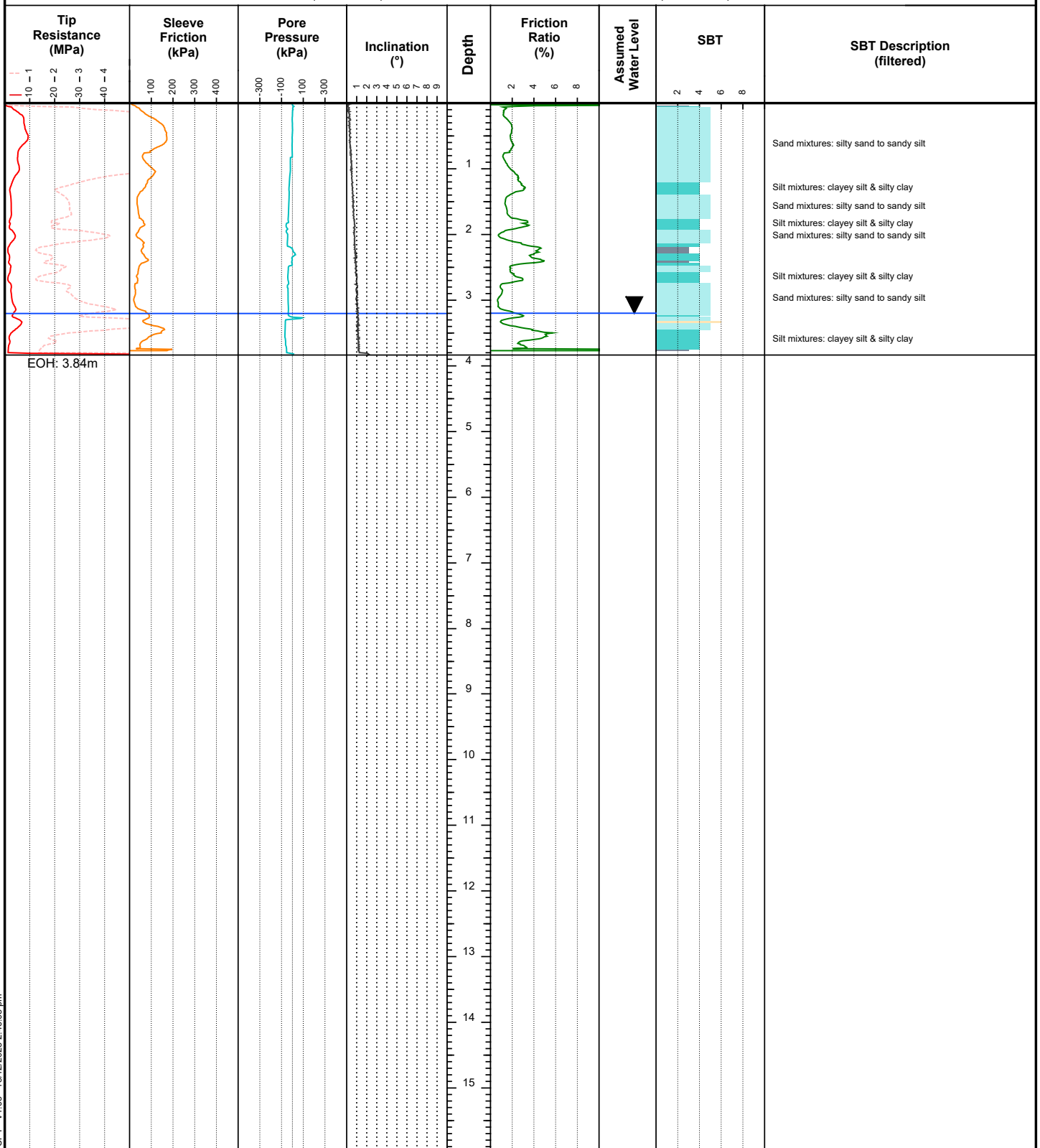
CLIENT: John Paterson Estates Limited 9358263
PROJECT: Proposed Plan Change

JOB NO.:
LTC25362

SITE LOCATION: John Paterson Drive, Halswell, Christchurch
CO-ORDINATES: 1562269.00mE, 5175688.00mN (NZTM2000)

OPERATOR: JM
ELEVATION: 18.3m (NZVD2016)

START DATE: 15/12/2025
END DATE: 15/12/2025



REMARKS: Groundwater measured at 3.8m (Dipmeter) Coordinates from handheld GPS accurate to +/-4m Pagani TG63-150 Rig. Cone specs: Length: 290 mm, Diameter: 35.8 mm, Cone Base Area: 10 cm². Side sleeve surfaces: 150 cm²		TEST DETAILS:	
NOTES:		Cone Number	000953
		Cone Type	PC
		Area Ratio	0.79
		Filter Location	u2
		Termination Reason	Qc refusal

 DYNAMIC PROBE - SUPER HEAVY LOG										HOLE NO.: DPSH02													
CLIENT: John Paterson Estates Limited 9358263										JOB NO.: LTC25362													
PROJECT: Proposed Plan Change																							
SITE LOCATION: John Paterson Drive, Halswell, Christchurch										OPERATOR: JM		START DATE: 15/12/2025											
CO-ORDINATES: 1562269.00mE, 5175688.00mN (NZTM2000)										ELEVATION: 18.3m (NZVD2016)		END DATE: 15/12/2025											
DEPTH (m)	DATA	(Blows / 100mm)										(Torque / 100Nm)										WATER	DEPTH (m)
		4	8	12	16	20	24	28	32	36	10	20	30	40	50	60	70	80	90				
1																							
2																							
3																							
4	3																						
	9																						
	24																						
	29																						
		EQH: 4.3m Termination Reason: DPSH Refusal																					
Remarks:												TEST DETAILS:											
Groundwater measured at 3.2m (Dipmeter) Coordinates from handheld GPS accurate to +/-4m Pagani TG63-150 Rig. 78% energy efficiency DPSH hammer												Weight 63.5 kg Rod Mass 6.2 kg Drop Height 750 mm Cone Area Ratio 0.002 Predrill 3.9 Termination DPSH Refusal											
NOTES:																							

CONE PENETRATION TEST (CPT) LOG

HOLE NO.:
CPT03

CLIENT: John Paterson Estates Limited 9358263

PROJECT: Proposed Plan Change

JOB NO.:
LTC25362

SITE LOCATION: John Paterson Drive, Halswell, Christchurch

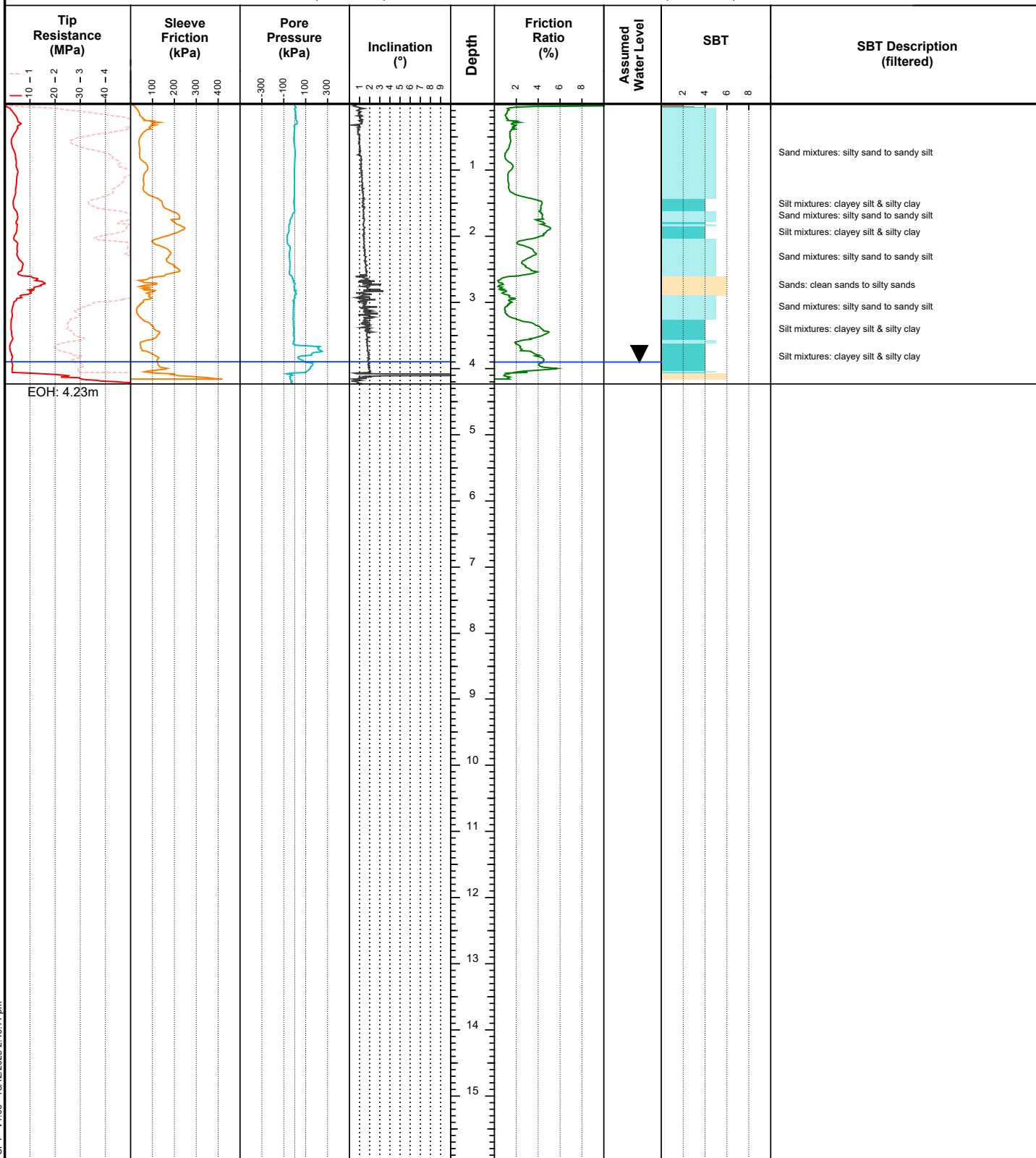
OPERATOR: JM

START DATE: 15/12/2025

CO-ORDINATES: 1562160.00mE, 5175880.00mN (NZTM2000)

ELEVATION: 19.2m (NZVD2016)

END DATE: 15/12/2025



REMARKS:

Groundwater measured at 3.9m (Dipmeter)
Coordinates from handheld GPS accurate to +/-4m
Pagani TG63-150 Rig. Cone specs: Length: 290 mm, Diameter: 35.8 mm, Cone Base Area: 10 cm². Side sleeve surfaces: 150 cm²

NOTES:

TEST DETAILS:

Cone Number 000953

Cone Type PC

Area Ratio 0.79

Filter Location u2

Termination Reason Qc refusal

 DYNAMIC PROBE - SUPER HEAVY LOG										HOLE NO.: DPSH03													
CLIENT: John Paterson Estates Limited 9358263										JOB NO.: LTC25362													
PROJECT: Proposed Plan Change																							
SITE LOCATION: John Paterson Drive, Halswell, Christchurch										OPERATOR: JM		START DATE: 15/12/2025											
CO-ORDINATES: 1562160.00mE, 5175880.00mN (NZTM2000)										ELEVATION: 19.2m (NZVD2016)		END DATE: 15/12/2025											
DEPTH (m)	DATA	(Blows / 100mm)										(Torque / 100Nm)										WATER	DEPTH (m)
		4	8	12	16	20	24	28	32	36	10	20	30	40	50	60	70	80	90				
1																					1		
2																					2		
3																					3		
4																					4		
20																							
16																							
23																							
22																							
		EQH: 4.7m Termination Reason: DPSH Refusal																					
Remarks:												TEST DETAILS:											
Groundwater measured at 3.9m (Dipmeter) Coordinates from handheld GPS accurate to +/-4m Pagani TG63-150 Rig. 78% energy efficiency DPSH hammer												Weight 63.5 kg Rod Mass 6.2 kg Drop Height 750 mm Cone Area Ratio 0.002 Predrill 4.3 Termination DPSH Refusal											
NOTES:																							

 DYNAMIC PROBE - SUPER HEAVY LOG										HOLE NO.: DPSH04													
CLIENT: John Paterson Estates Limited 9358263										JOB NO.: LTC25362													
PROJECT: Proposed Plan Change																							
SITE LOCATION: John Paterson Drive, Halswell, Christchurch										OPERATOR: JM		START DATE: 17/12/2025											
CO-ORDINATES: 1562339.00mE, 5176095.00mN (NZTM2000)										ELEVATION: 19.5m (NZVD2016)		END DATE: 17/12/2025											
DEPTH (m)	DATA	(Blows / 100mm)										(Torque / 100Nm)										WATER	DEPTH (m)
		4	8	12	16	20	24	28	32	36	10	20	30	40	50	60	70	80	90				
1	5	[Bar]																				Groundwater Not Encountered	1
	7	[Bar]																					
	7	[Bar]																					
	7	[Bar]																					
	7	[Bar]																					
	10	[Bar]																					
	9	[Bar]																					
	14	[Bar]																					
	6	[Bar]																					
	11	[Bar]																					
	7	[Bar]																					
2	7	[Bar]																				2	
	3	[Bar]																					
	3	[Bar]																					
	2	[Bar]																					
	1	[Bar]																					
	1	[Bar]																					
	1	[Bar]																					
	1	[Bar]																					
	1	[Bar]																					
	1	[Bar]																					
	1	[Bar]																					
3	2	[Bar]																				3	
	2	[Bar]																					
	1	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
4	3	[Bar]																				4	
	3	[Bar]																					
	3	[Bar]																					
	3	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	3	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
	2	[Bar]																					
Remarks: Groundwater not measured due to hole collapse at 0.7m Coordinates from handheld GPS accurate to +/-4m Pagani TG63-150 Rig. 78% energy efficiency DPSH hammer												TEST DETAILS:											
NOTES:												Weight 63.5 kg											
												Rod Mass 6.2 kg											
												Drop Height 750 mm											
												Cone Area Ratio 0.002											
												Predrill 0.1											
												Termination DPSH Refusal											

Weight	63.5 kg
Rod Mass	6.2 kg
Drop Height	750 mm
Cone Area Ratio	0.002
Predrill	0.1
Termination	DPSH Refusal

CONE PENETRATION TEST (CPT) LOG

HOLE NO.:
CPT05

CLIENT: John Paterson Estates Limited 9358263

PROJECT: Proposed Plan Change

JOB NO.:
LTC25362

SITE LOCATION: John Paterson Drive, Halswell, Christchurch

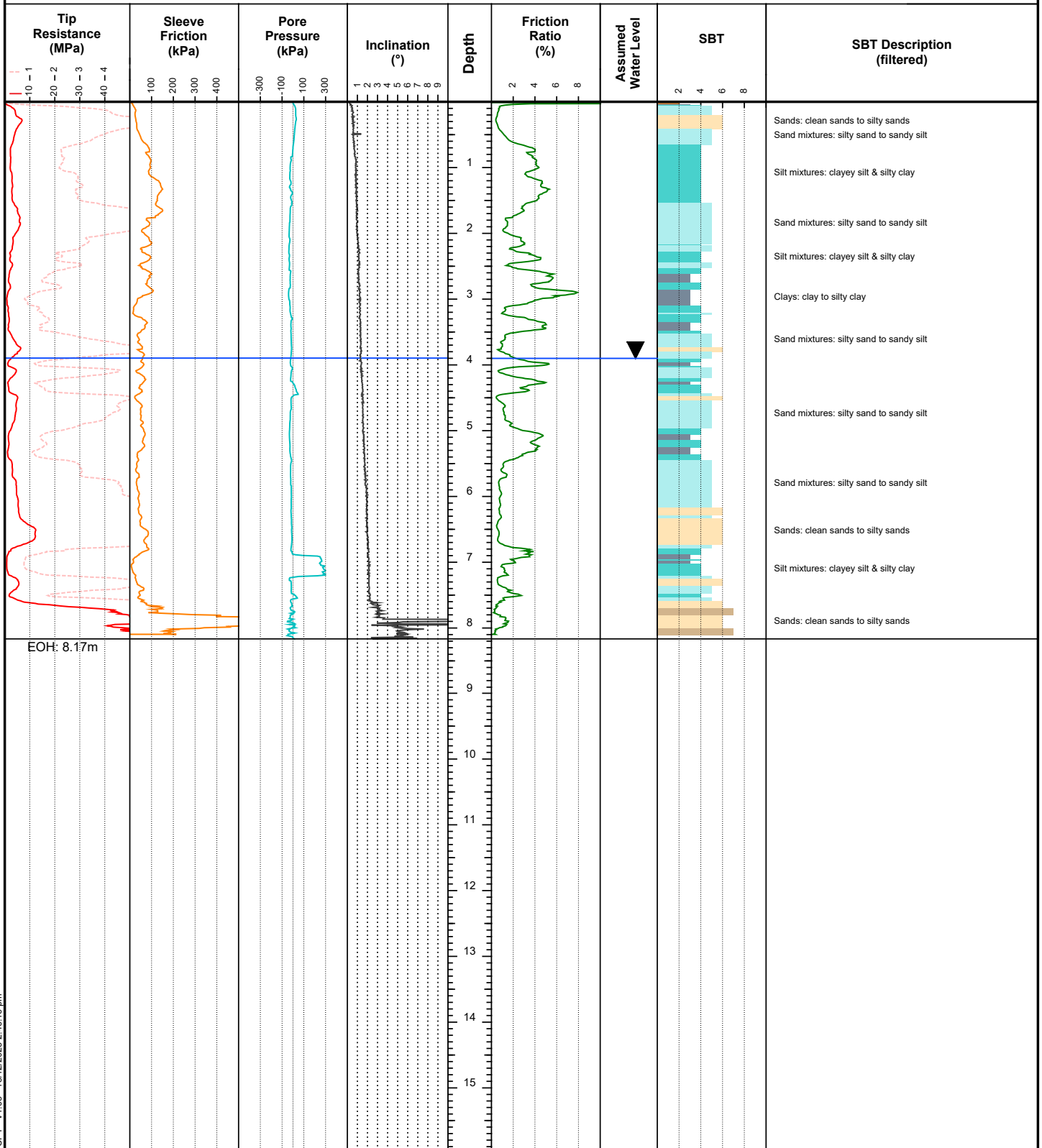
CO-ORDINATES: 1562249.00mE, 5176207.00mN (NZTM2000)

OPERATOR: JM

ELEVATION: 19.8m (NZVD2016)

START DATE: 15/12/2025

END DATE: 15/12/2025



EOH: 8.17m

REMARKS:

Groundwater measured at 3.9m (Dipmeter)
Coordinates from handheld GPS accurate to +/-4m
Pagani TG63-150 Rig. Cone specs: Length: 290 mm, Diameter: 35.8 mm, Cone Base Area: 10 cm². Side sleeve surfaces: 150 cm²

NOTES:

TEST DETAILS:

Cone Number 000953
Cone Type PC
Area Ratio 0.79
Filter Location u2
Termination Reason Qc refusal



DYNAMIC PROBE - SUPER HEAVY LOG

HOLE NO.:
DPSH06

CLIENT: John Paterson Estates Limited 9358263

JOB NO.:
LTC25362

PROJECT: Proposed Plan Change

SITE LOCATION: John Paterson Drive, Halswell, Christchurch

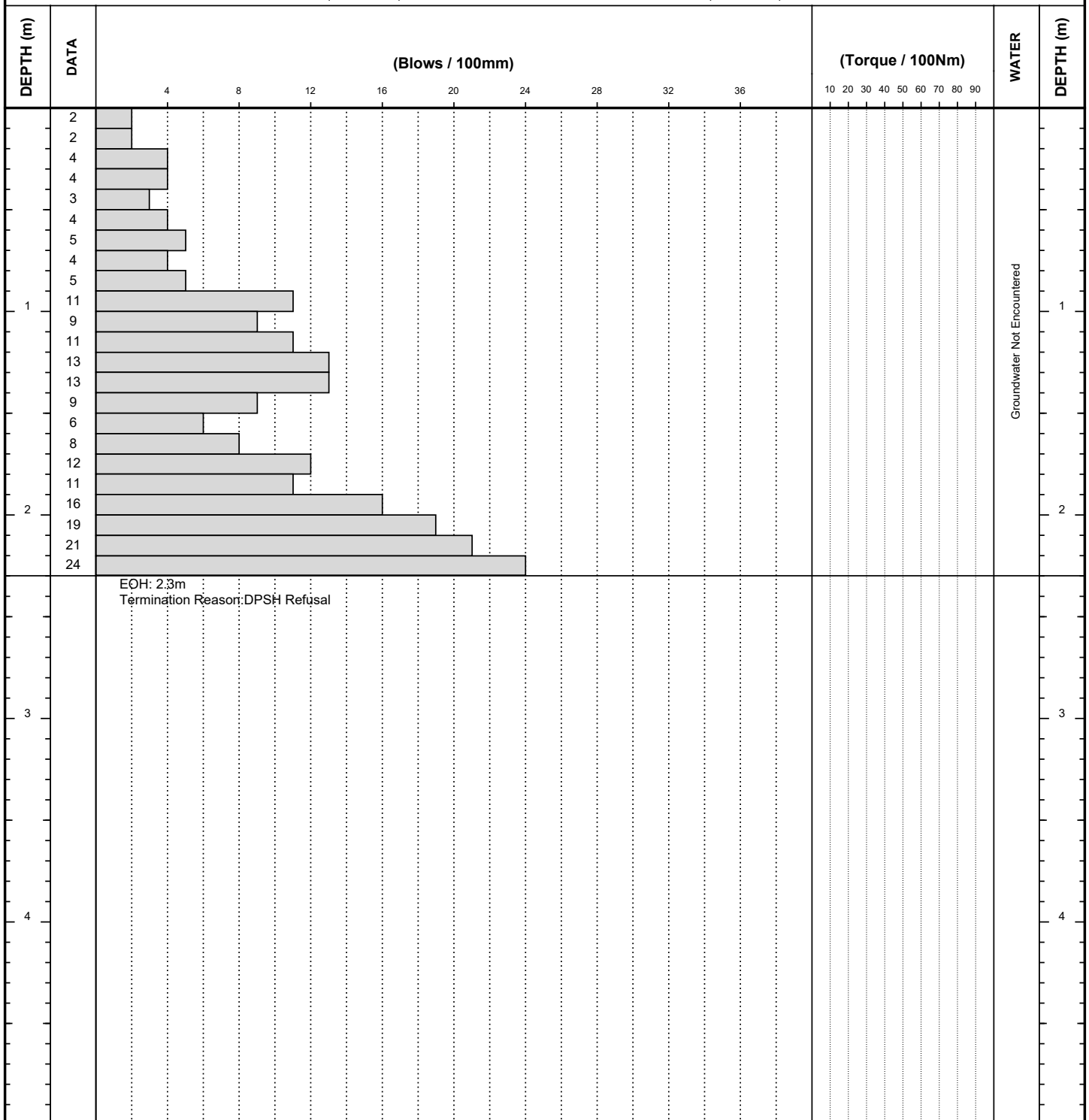
OPERATOR: JM

START DATE: 17/12/2025

CO-ORDINATES: 1561777.81mE, 5176295.38mN (NZTM2000)

ELEVATION: 22.4m (NZVD2016)

END DATE: 17/12/2025



Remarks:		TEST DETAILS:	
Groundwater not measured due to hole collapse at 2.2m Coordinates from handheld GPS accurate to +/-4m Pagani TG63-150 Rig. 78% energy efficiency DPSH hammer		Weight 63.5 kg	
NOTES:		Rod Mass 6.2 kg	
		Drop Height 750 mm	
		Cone Area Ratio 0.002	
		Predrill 0.1	
		Termination DPSH Refusal	

Borelog for well M36/4168

Grid Reference (NZTM): 1561903 mE, 5176189 mN

Location Accuracy: 50 - 300m

Ground Level Altitude: 21.5 m +MSD Accuracy: < 2.5 m

Driller: McMillan Drilling Ltd

Drill Method: Rotary/Percussion

Borelog Depth: 13.2 m Drill Date: 14-Mar-1990



**Environment
Canterbury
Regional Council**
Kaunihera Taiao ki Waitaha

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		0.30m	Earth	SP
			Brown clay	SP
		3.50m		
			Grey gravels	SP
5				
		8.50m		
			Claybound gravels	SP
10				
		10.20m		
			Free gravels	RI
		13.20m		

Borelog for well M36/4190

Grid Reference (NZTM): 1562535 mE, 5175515 mN

Location Accuracy: 2 - 15m

Ground Level Altitude: 18.3 m +MSD Accuracy: < 0.5 m

Driller: McMillan Drilling Ltd

Drill Method: Rotary/Percussion

Borelog Depth: 24.0 m Drill Date: 29-May-1990



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		0.30m	Earth	SP
			Brown sand	SP
		2.50m		
			Grey gravels	SP
		3.70m		
			Sandy gravels	SP
5				
		8.19m		
			Brown sand	SP
		9.50m		
10		10.00m	Claybound gravels	SP
			Free stained gravels	RI
		13.00m		
			Sandy free gravels	RI
15				
		22.00m		
20				
			Sandy claybound gravels	RI
		24.00m		

Borelog for well M36/7502

Grid Reference (NZTM): 1562293 mE, 5175989 mN

Location Accuracy: 2 - 15m

Ground Level Altitude: 19.7 m +MSD Accuracy: < 0.5 m

Driller: McMillan Drilling Ltd

Drill Method: Rotary/Percussion

Borelog Depth: 18.0 m Drill Date: 17-Nov-2003



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		0.40m	Earth and gravels	SP
			Brown clay	SP
		1.80m	Brown moist silty sand	SP
		2.80m	Brown wet silty clay	SP
		4.50m	Brown very wet silty clay	SP
5		7.50m	Blue very sandy gravels	SP
		9.00m	Dark brown claybound sandy gravels	SP
10		10.50m	Brown Water-bearing claywash sandy gravels	SP?
		14.00m	Water-bearing stained light claywash gravels	RI
15		16.00m	Water-bearing stained light claywash gravels	RI
		18.00m		

Borelog for well M36/8070

Grid Reference (NZTM): 1561923 mE, 5176299 mN

Location Accuracy: 10 - 50m

Ground Level Altitude: 22.0 m +MSD Accuracy: < 2.5 m

Driller: Daly Water Wells Ltd

Drill Method: Rotary Rig

Borelog Depth: 18.0 m Drill Date: 16-Mar-2006

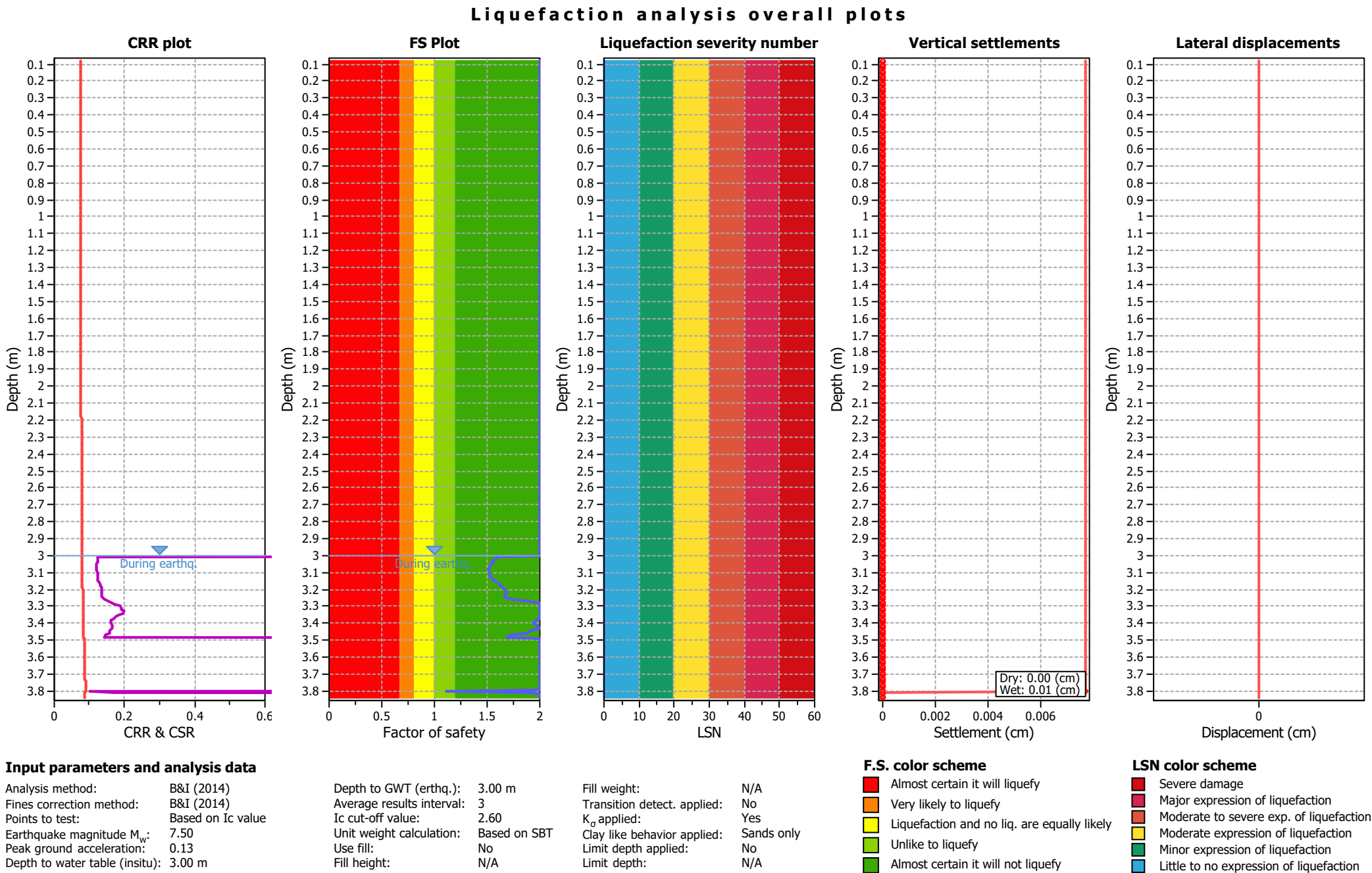


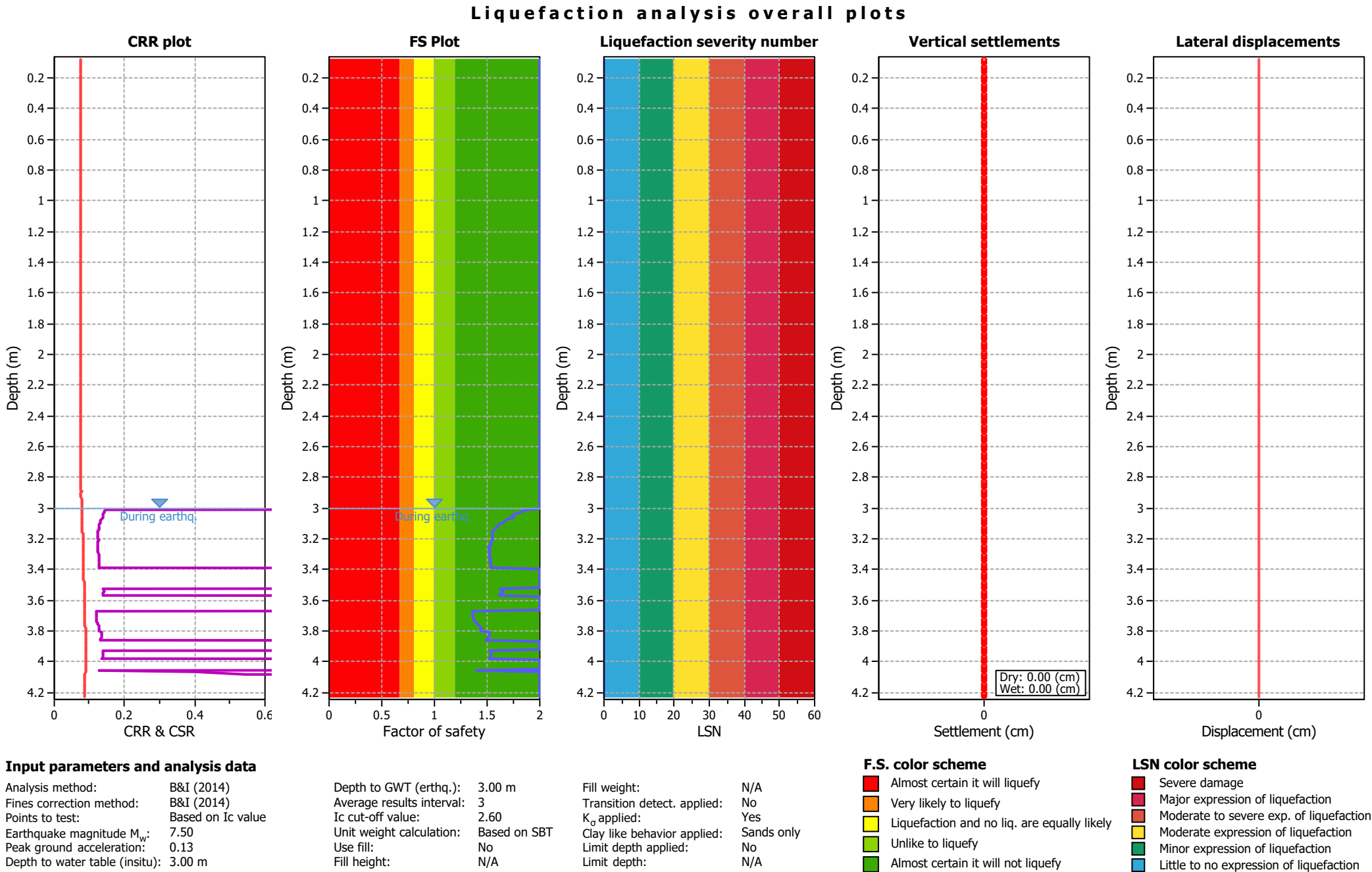
Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			brown topsoil	
		0.80m	brown damp sandy soil	
5		4.90m	grey pug	
		7.20m	brown silty gravels with sand pockets	
10		10.70m	brown water-bearing gravels, some sand	
15		18.00m		

APPENDIX D

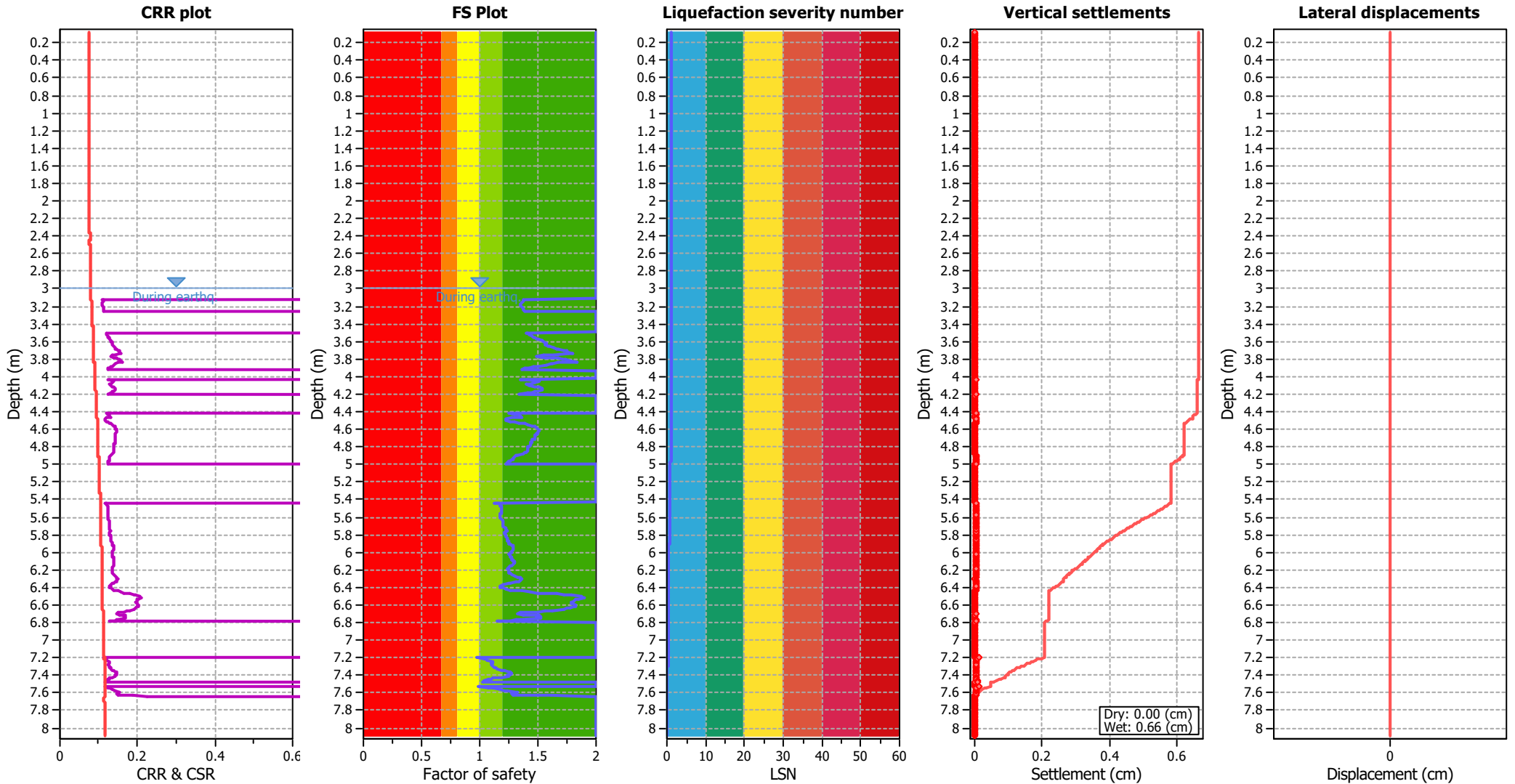
Model Earthquake Liquefaction Analysis Outputs







Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.00 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 ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

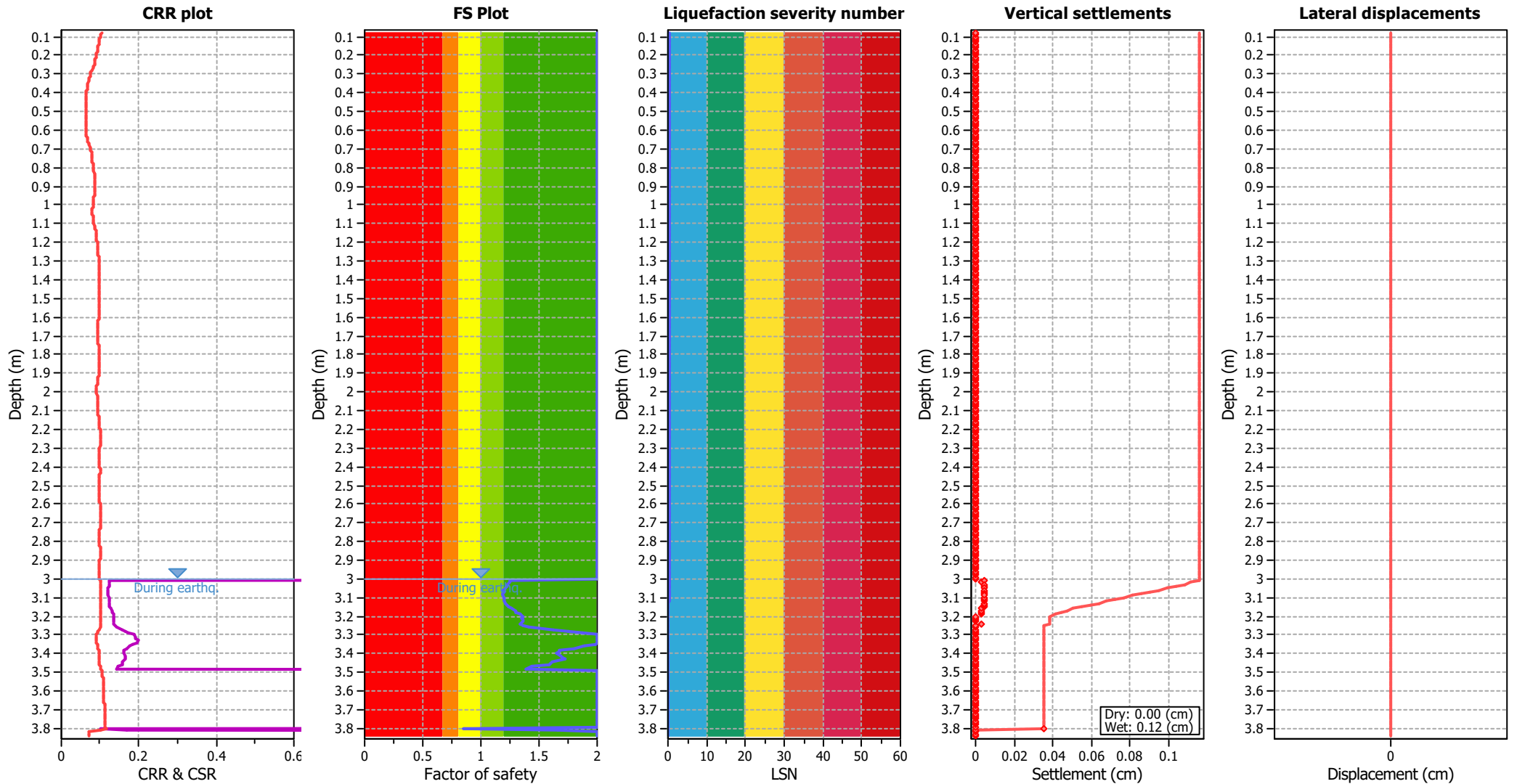
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	3.00 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 ₀ applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

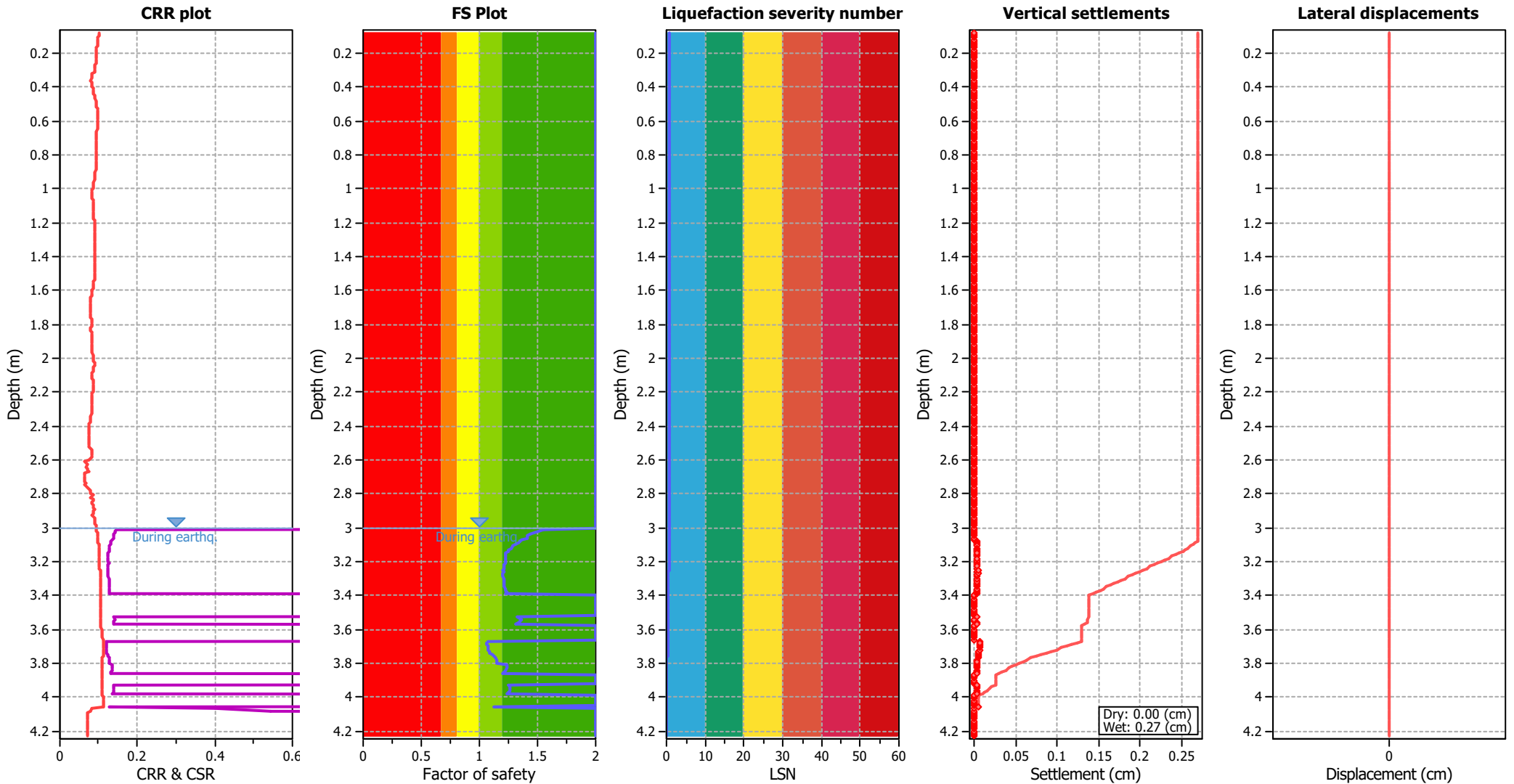
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Orange	Major expression of liquefaction
Yellow	Moderate to severe exp. of liquefaction
Green	Moderate expression of liquefaction
Dark Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.00 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 ₀ applied:	Yes
Earthquake magnitude M _w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

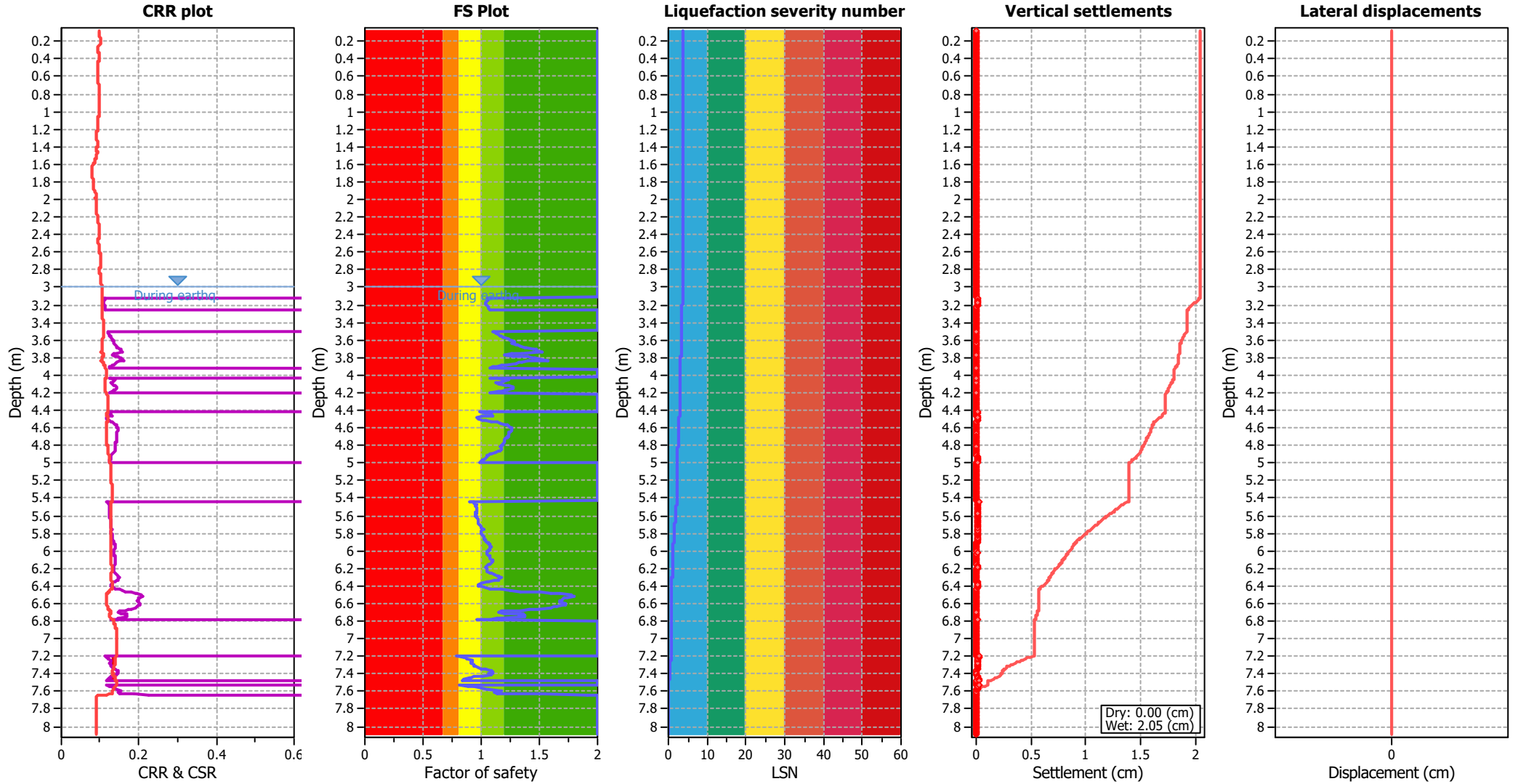
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.00 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_0 applied:	Yes
Earthquake magnitude M_w :	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

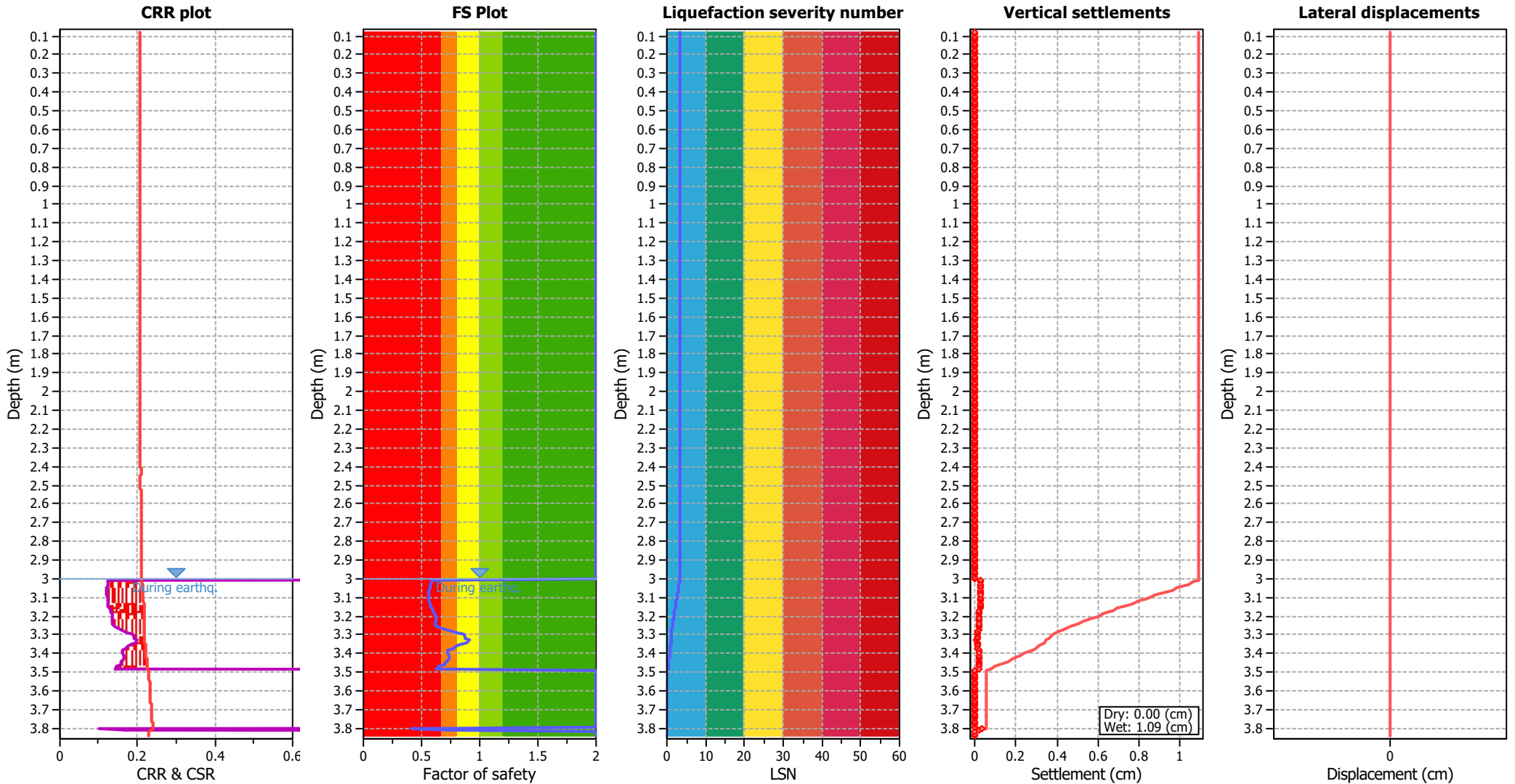
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Dark Green	Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

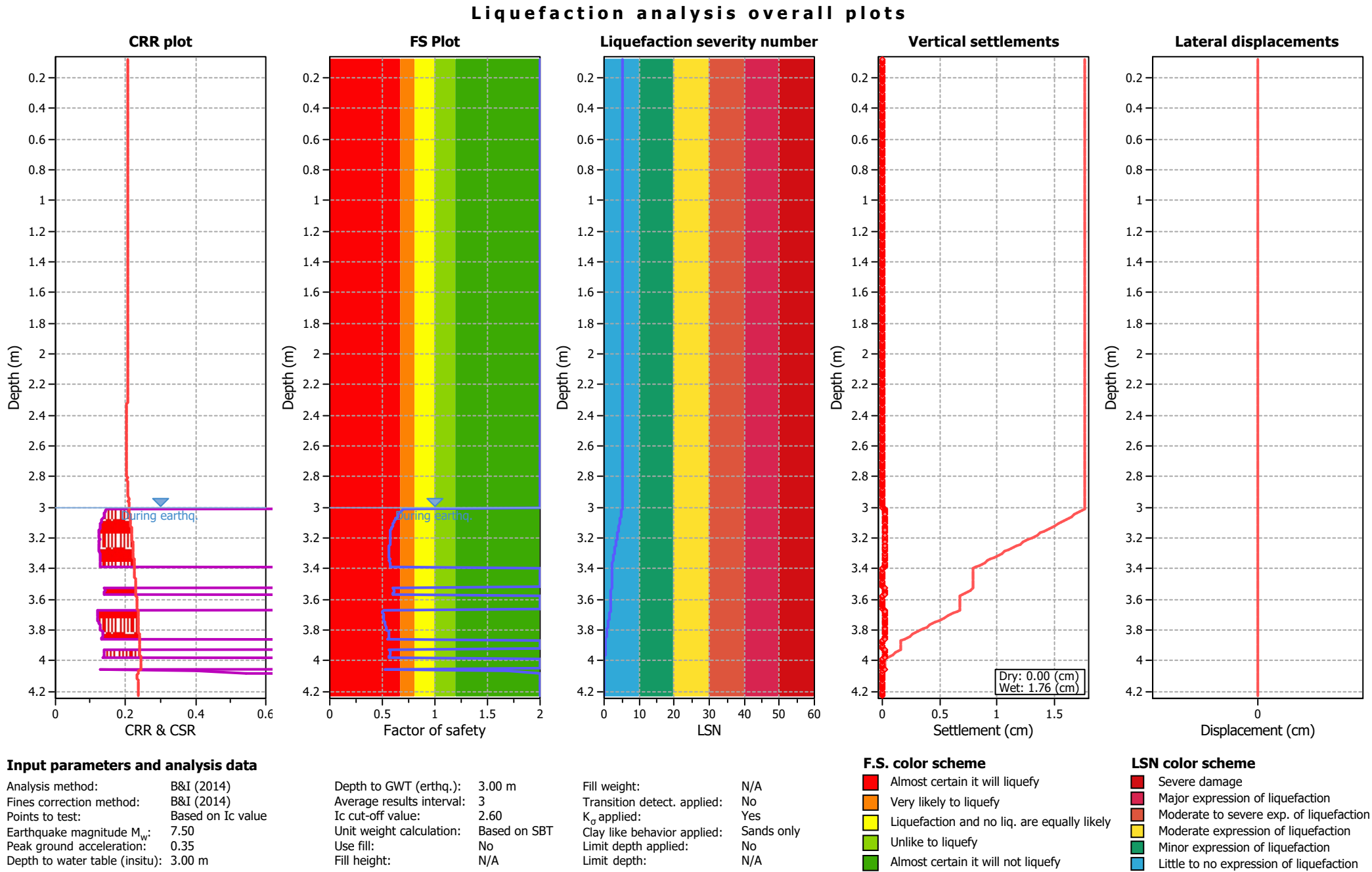
Analysis method:	B&I (2014)	Depth to GWT (earthq.):	3.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

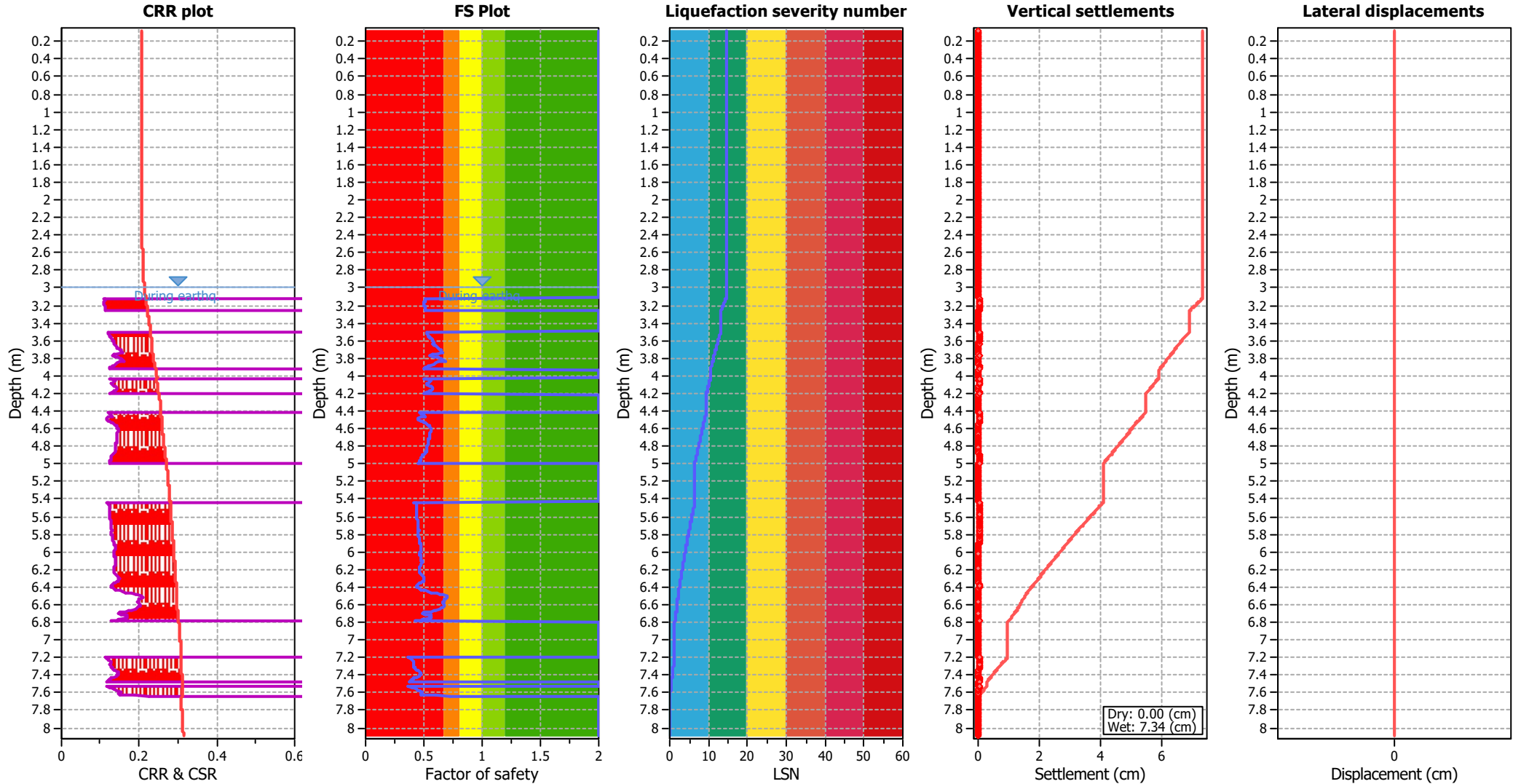
Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Orange	Major expression of liquefaction
Yellow	Moderate to severe exp. of liquefaction
Green	Moderate expression of liquefaction
Dark Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	3.00 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_0 applied:	Yes
Earthquake magnitude M_w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Orange	Major expression of liquefaction
Yellow	Moderate to severe exp. of liquefaction
Green	Moderate expression of liquefaction
Dark Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

SPT BASED LIQUEFACTION ANALYSIS REPORT

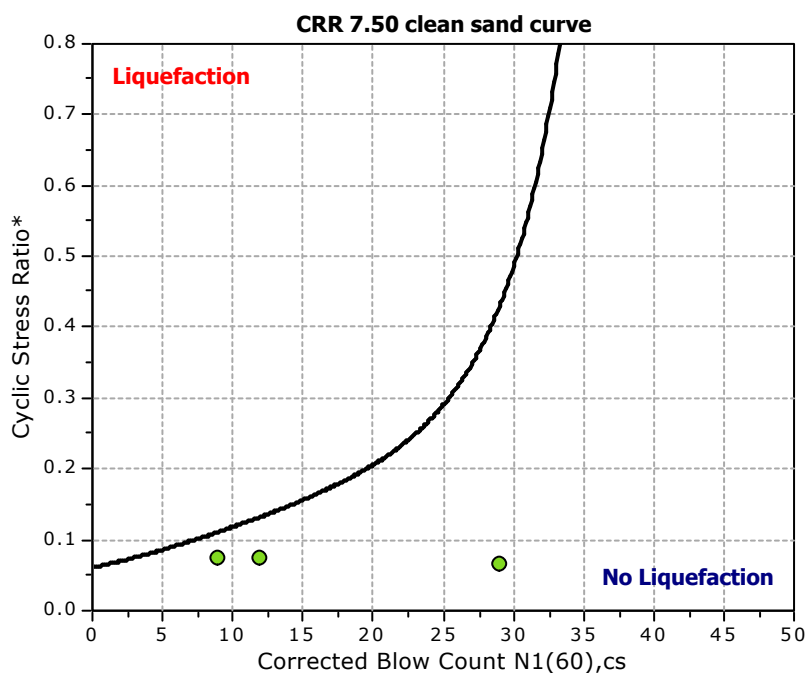
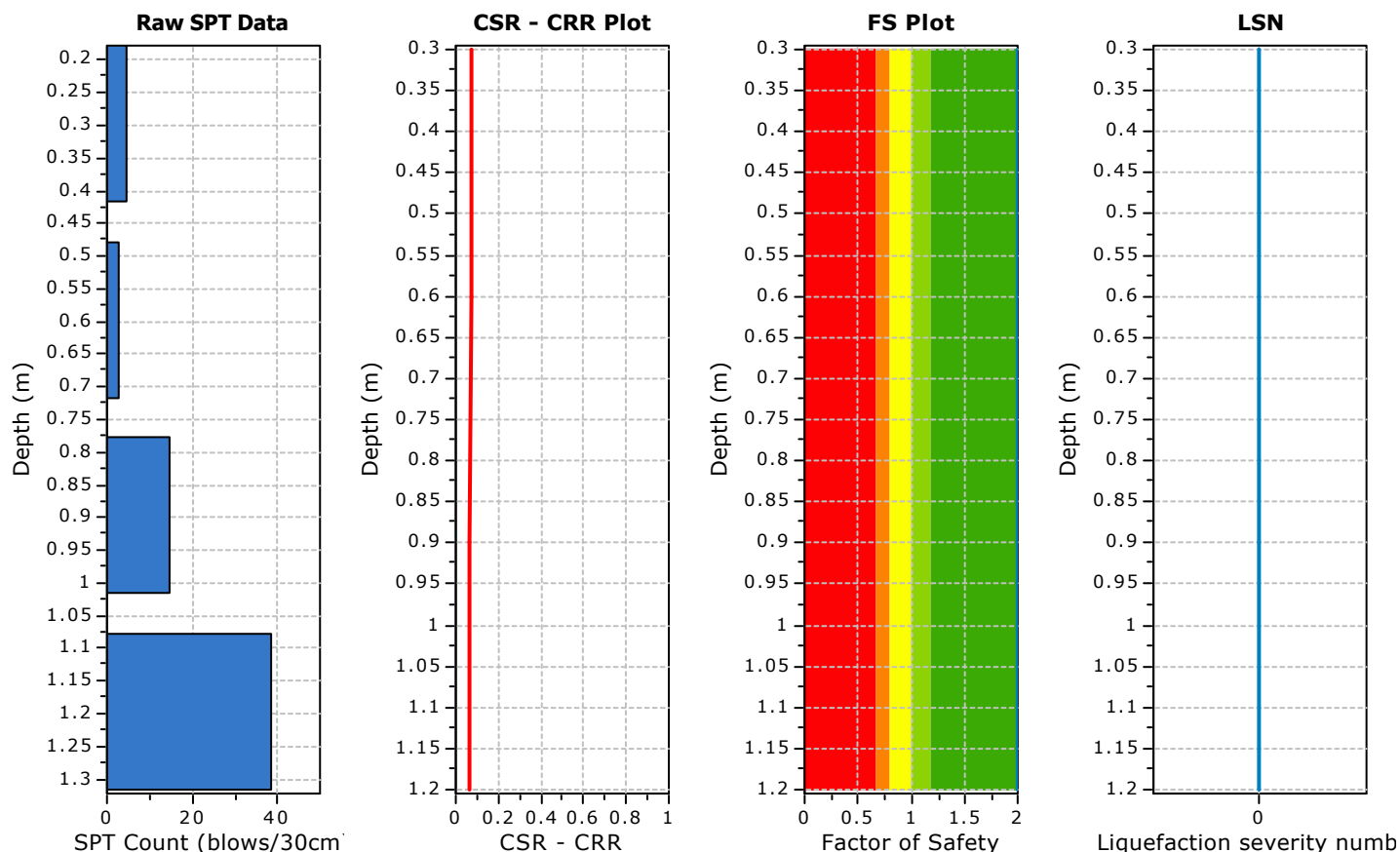
Project title :

SPT Name: DPSH01 SLSA

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.13 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



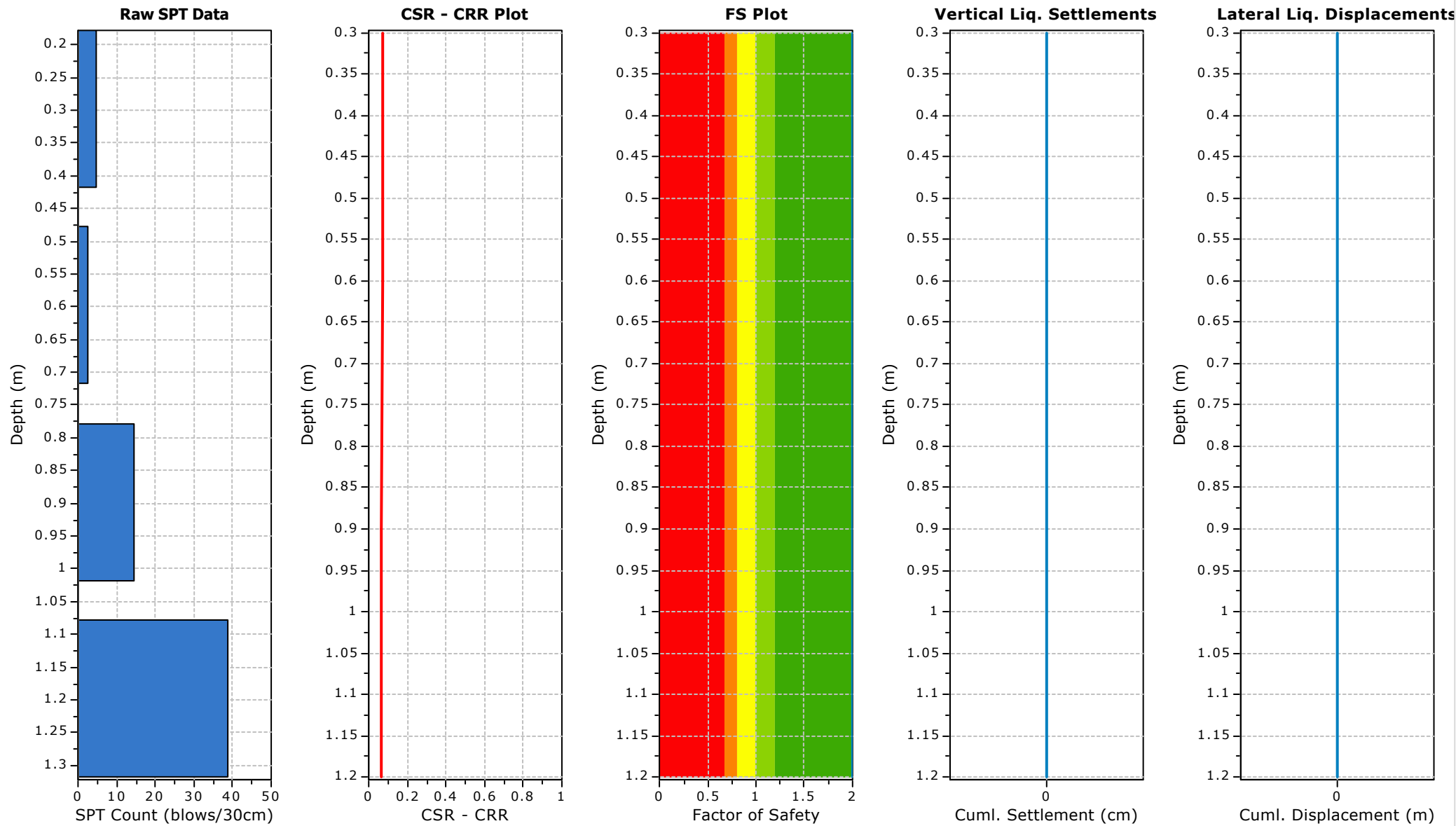
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

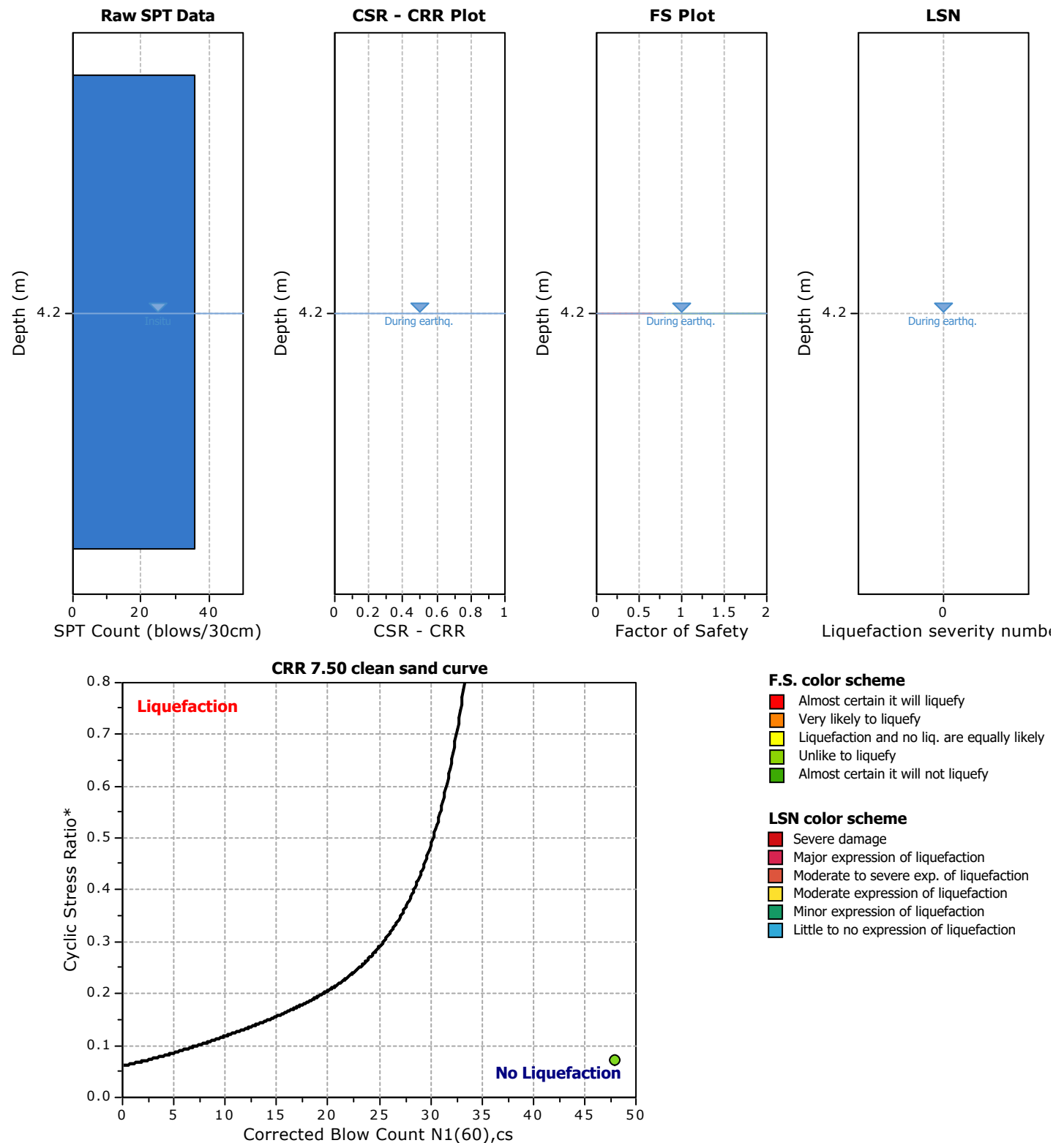
Project title :

SPT Name: DPSH02 SL5A

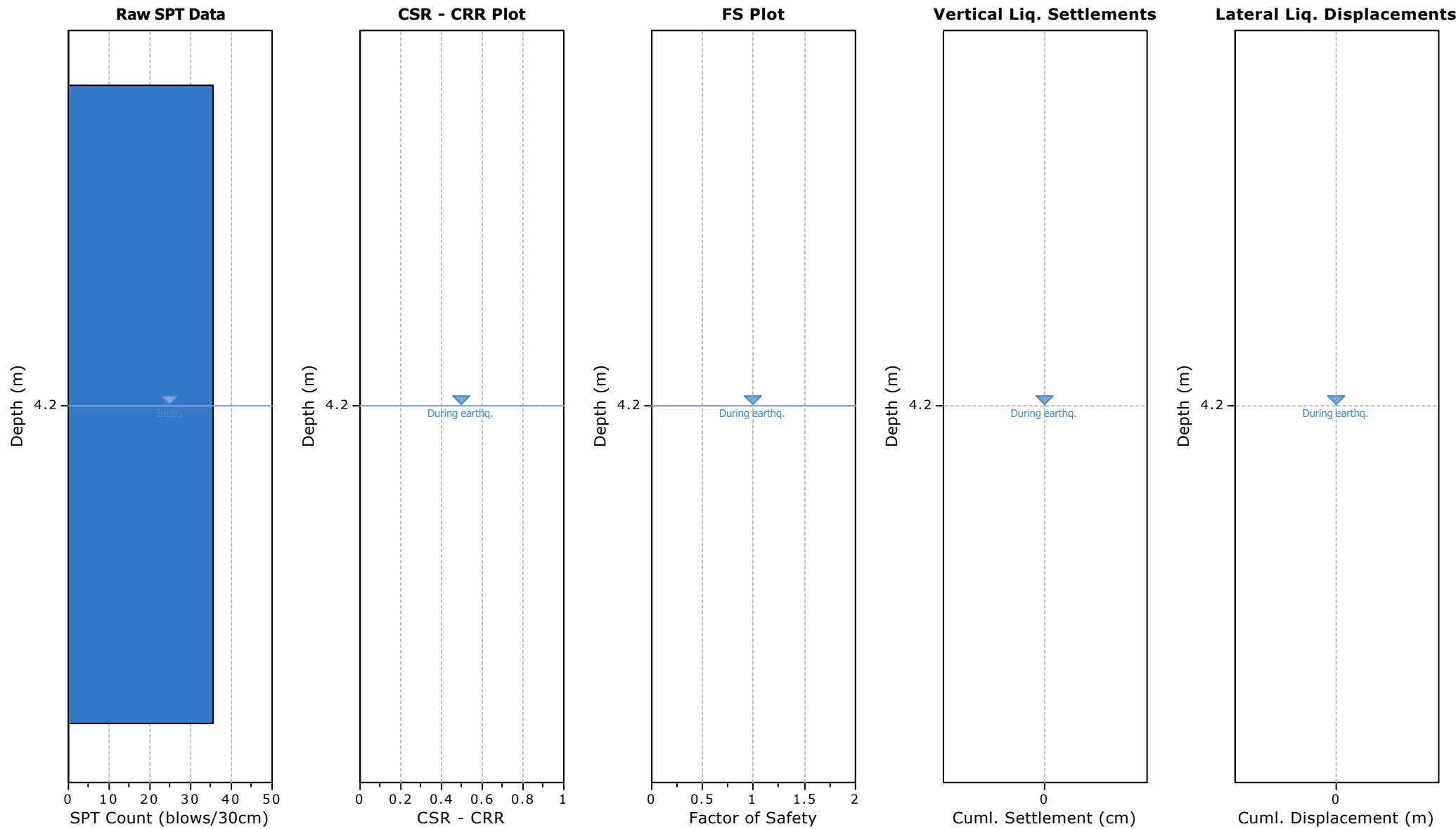
Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.13 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

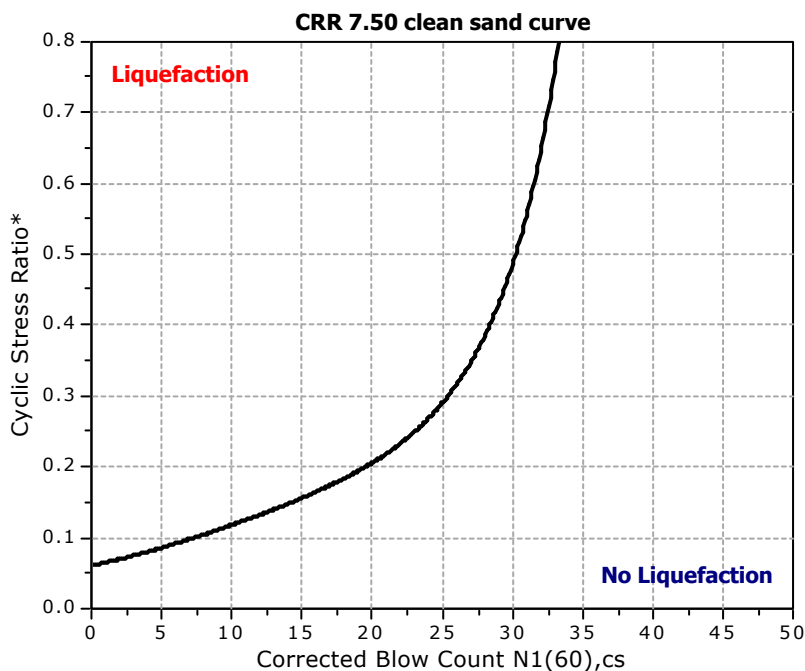
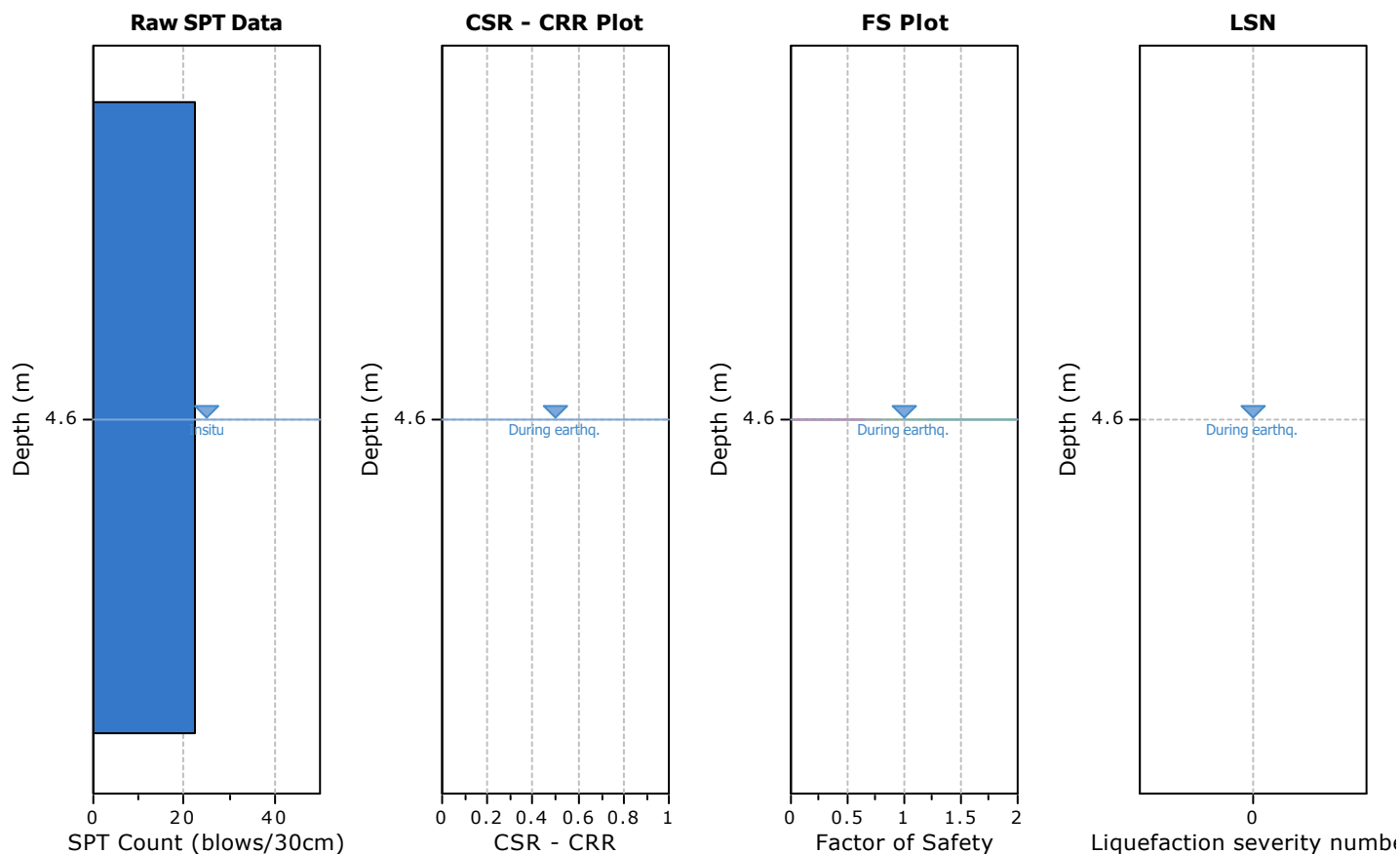
Project title :

SPT Name: DPSH03 SLSA

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.13 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



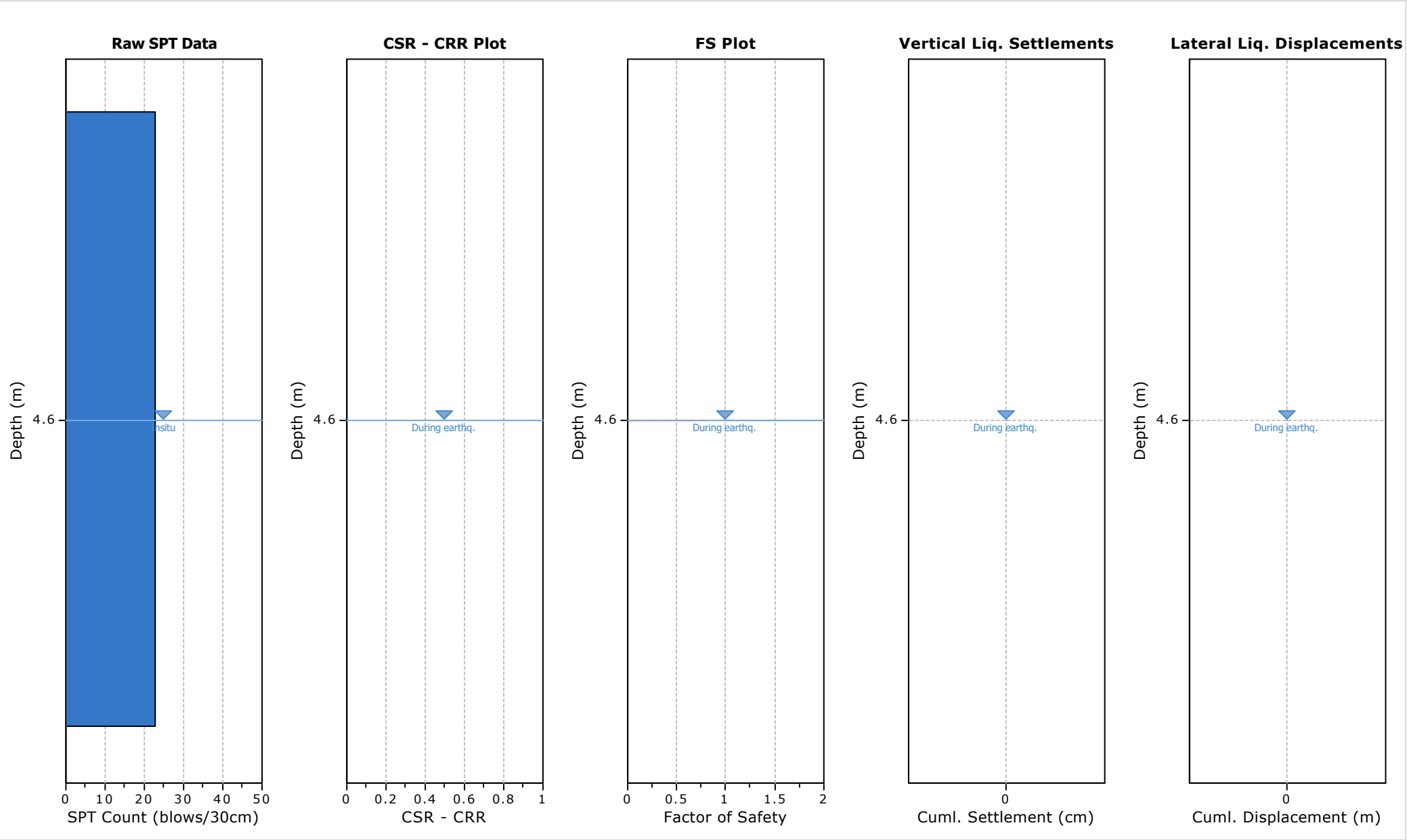
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

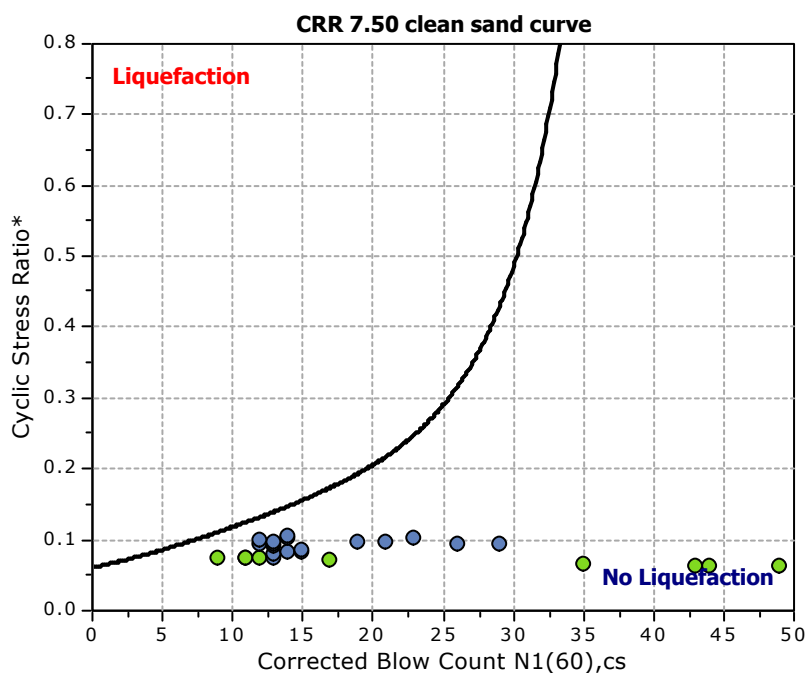
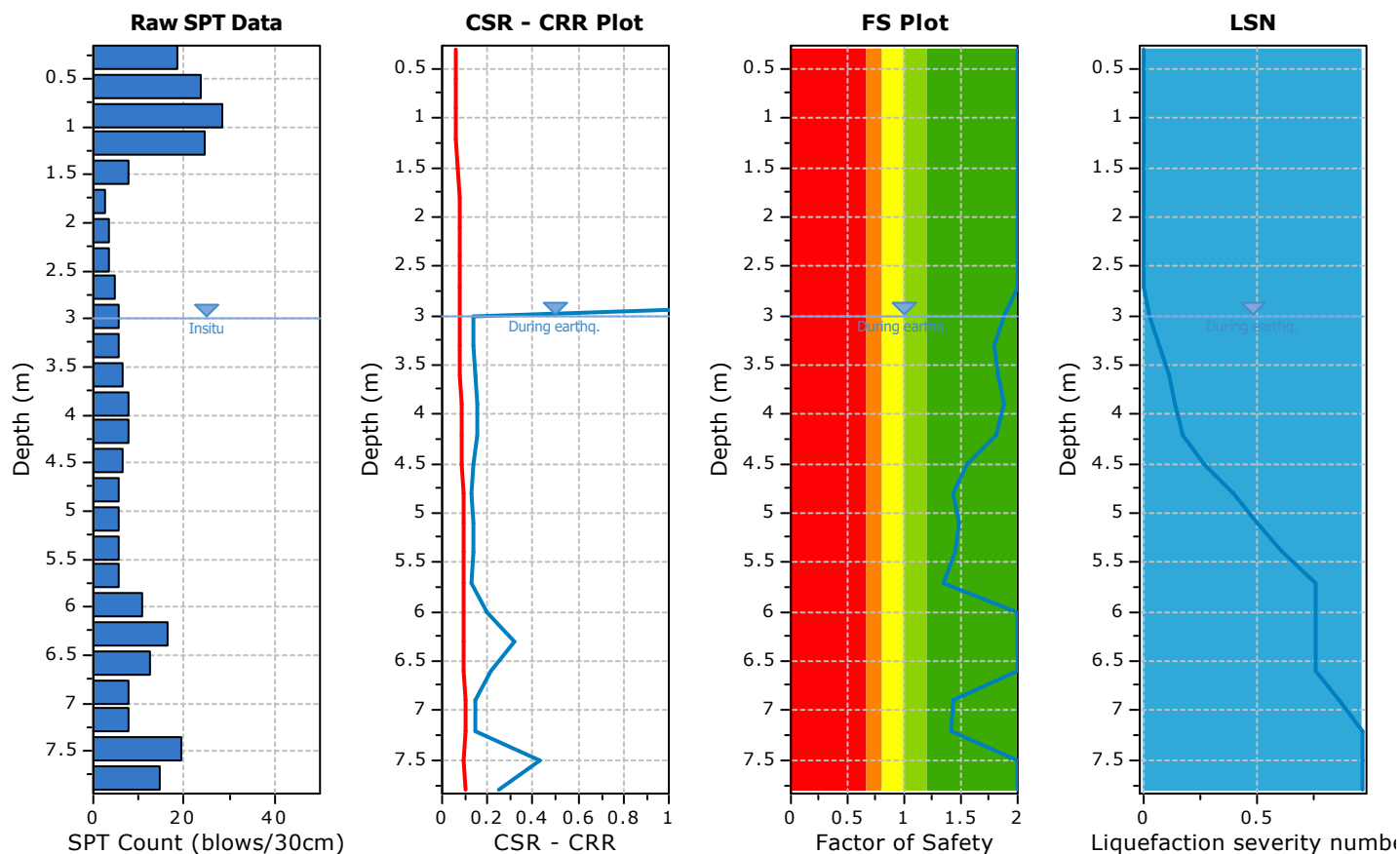
Project title :

SPT Name: DPSH04 SL5A

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.13 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



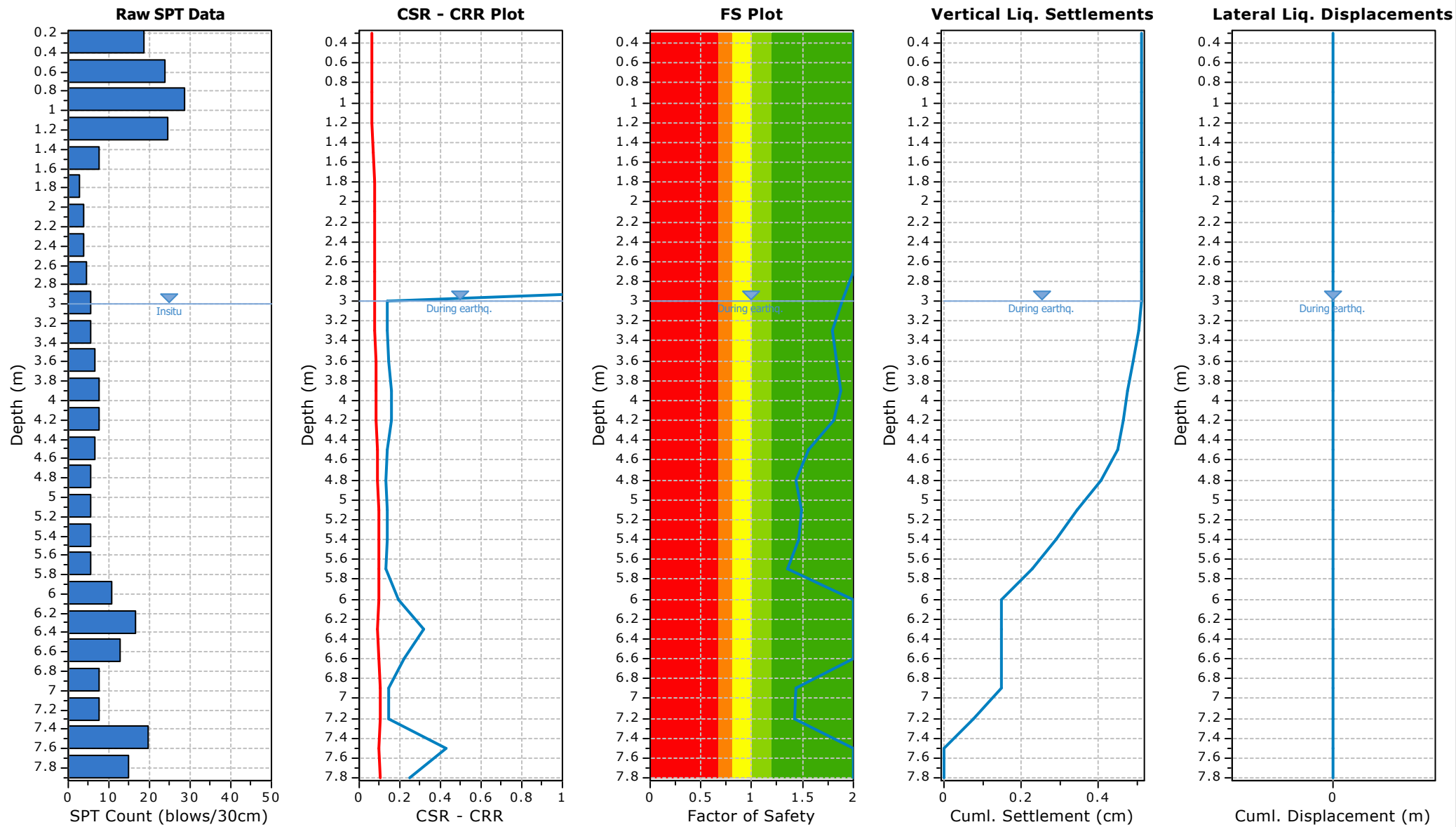
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

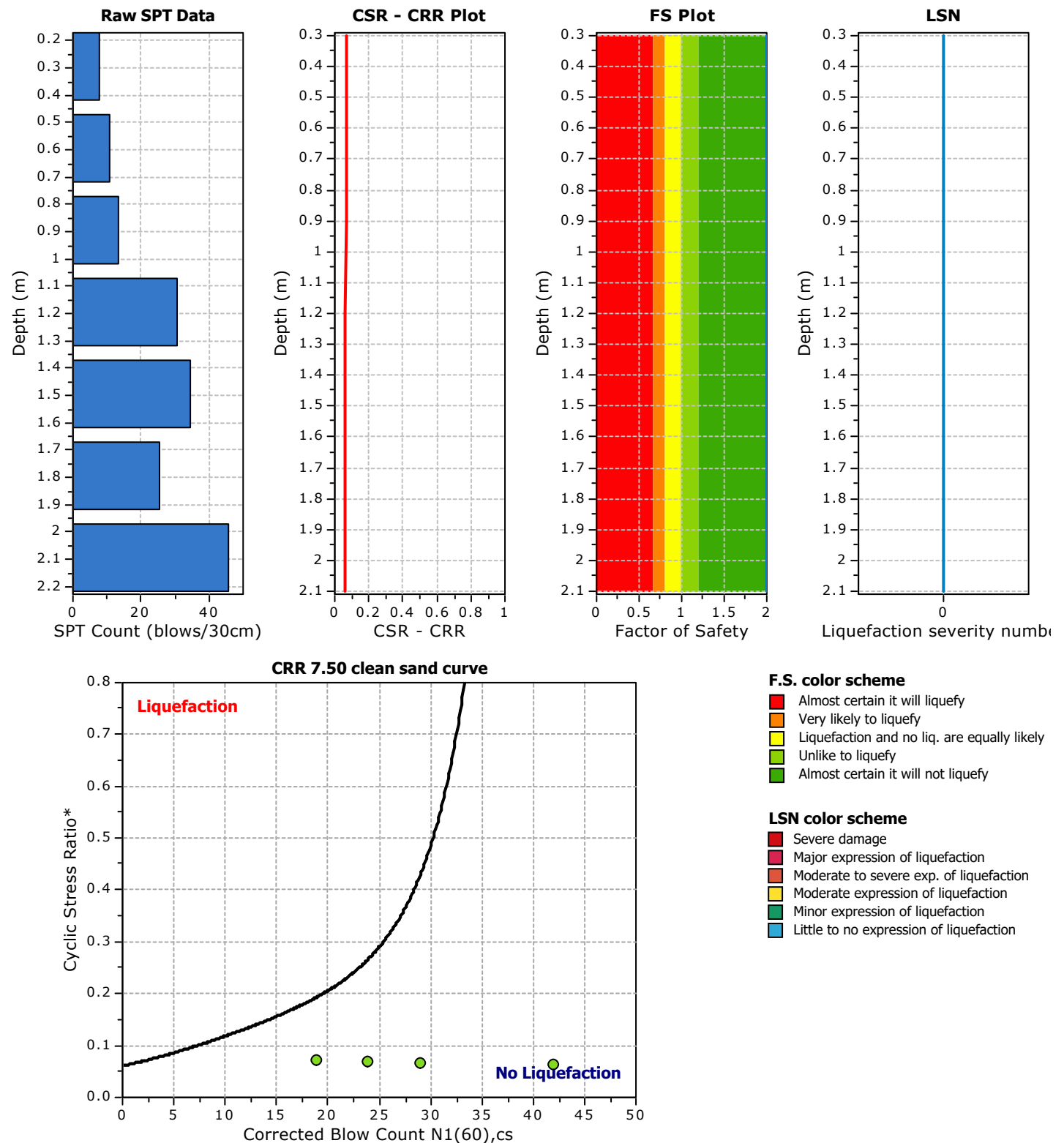
Project title :

SPT Name: DPSH06 SLSA

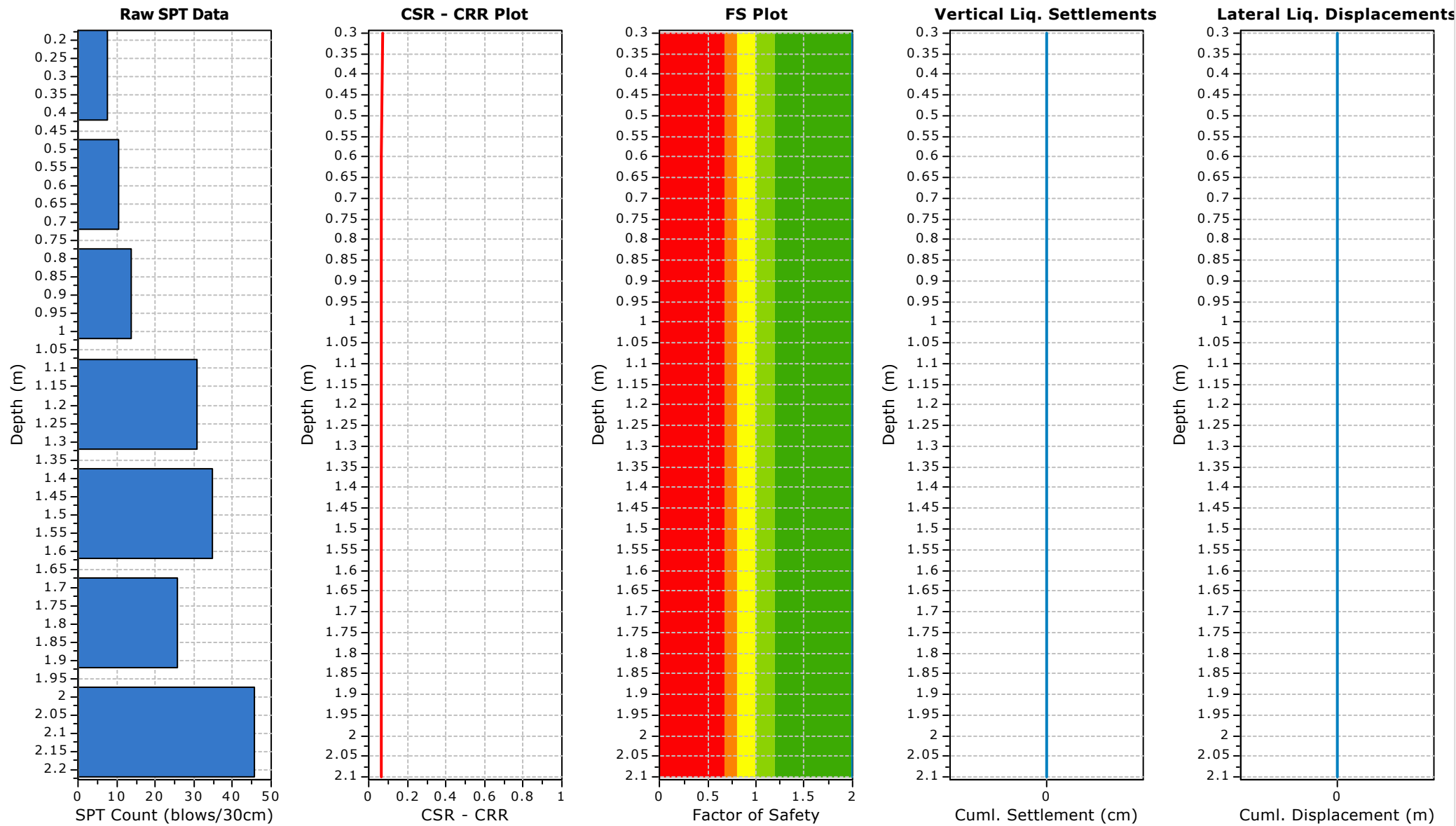
Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.13 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

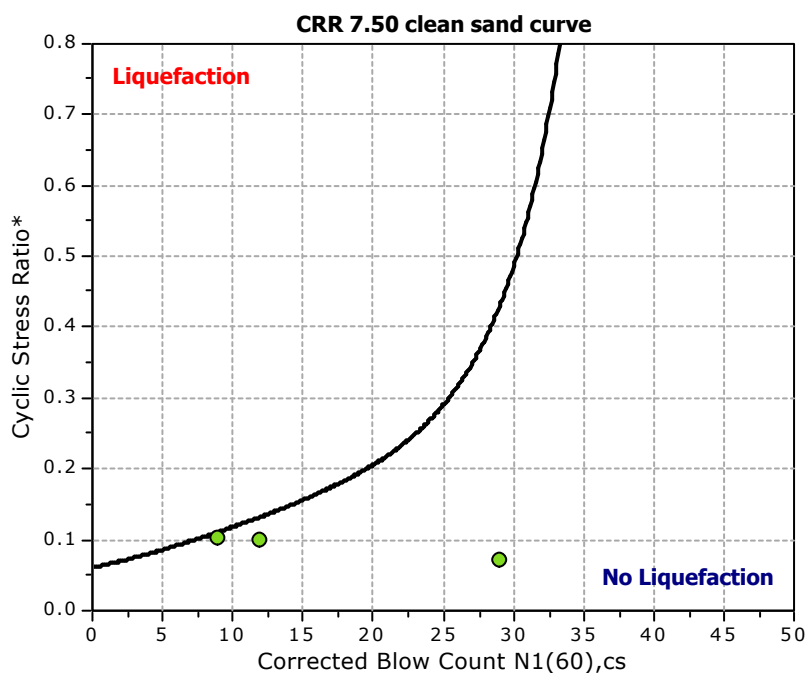
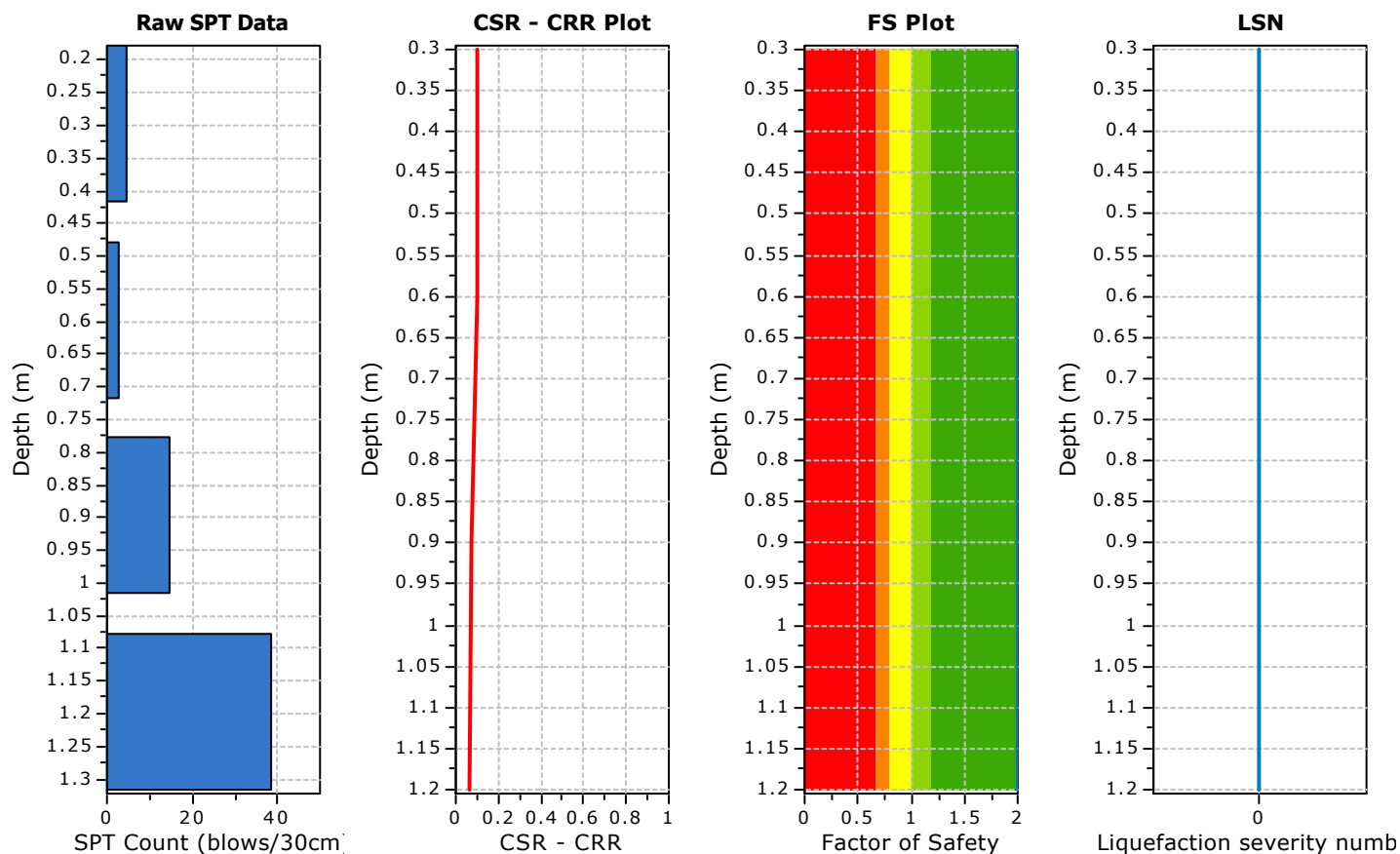
Project title :

SPT Name: DPSH01 SLSB

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	6.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.19 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



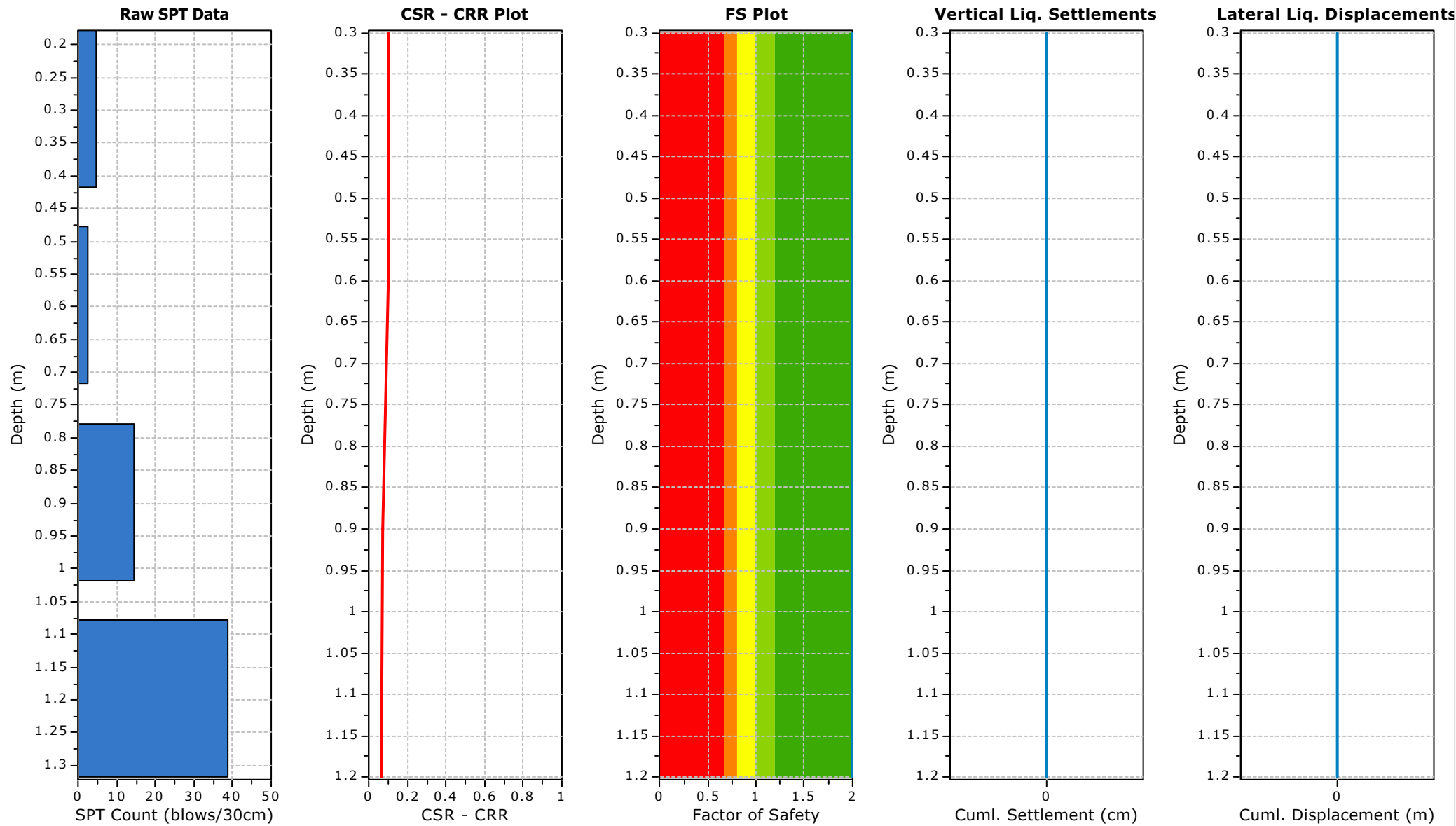
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

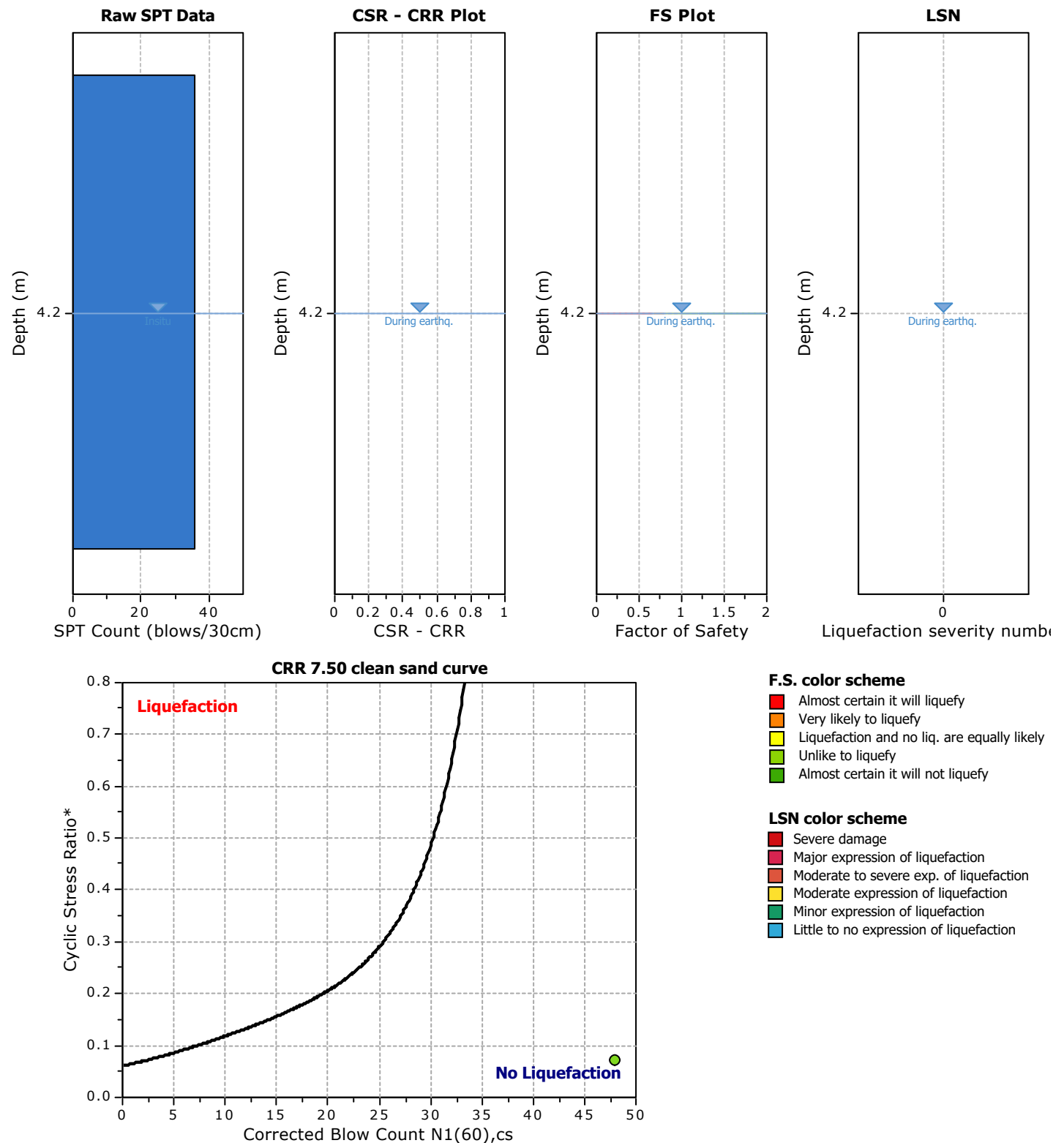
Project title :

SPT Name: DPSH02 SL5B

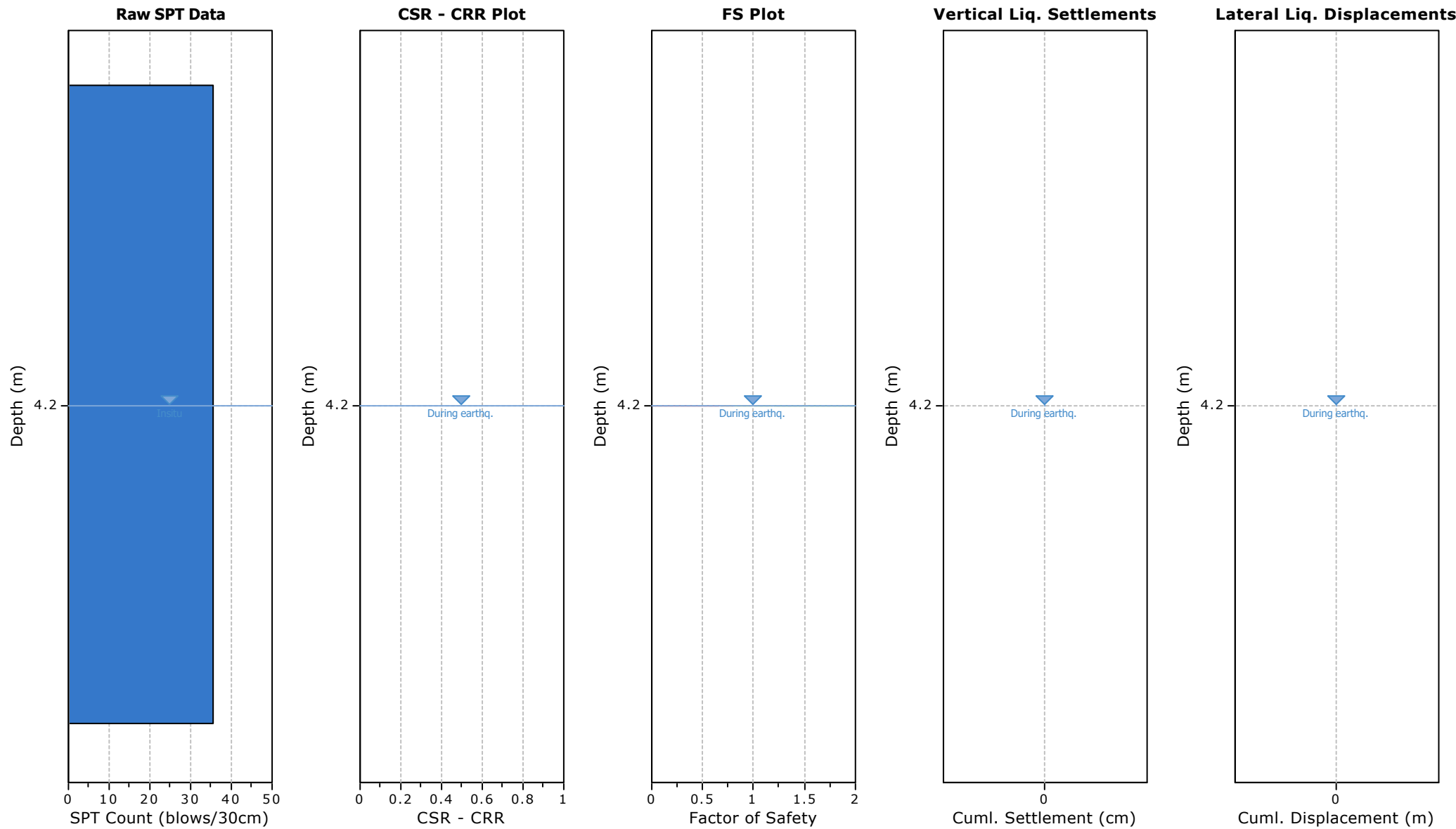
Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	6.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.19 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

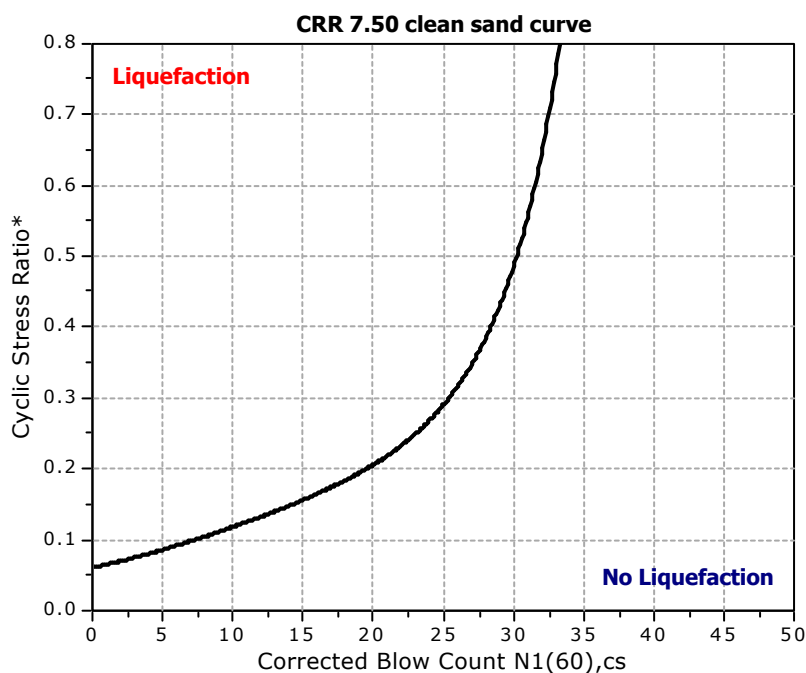
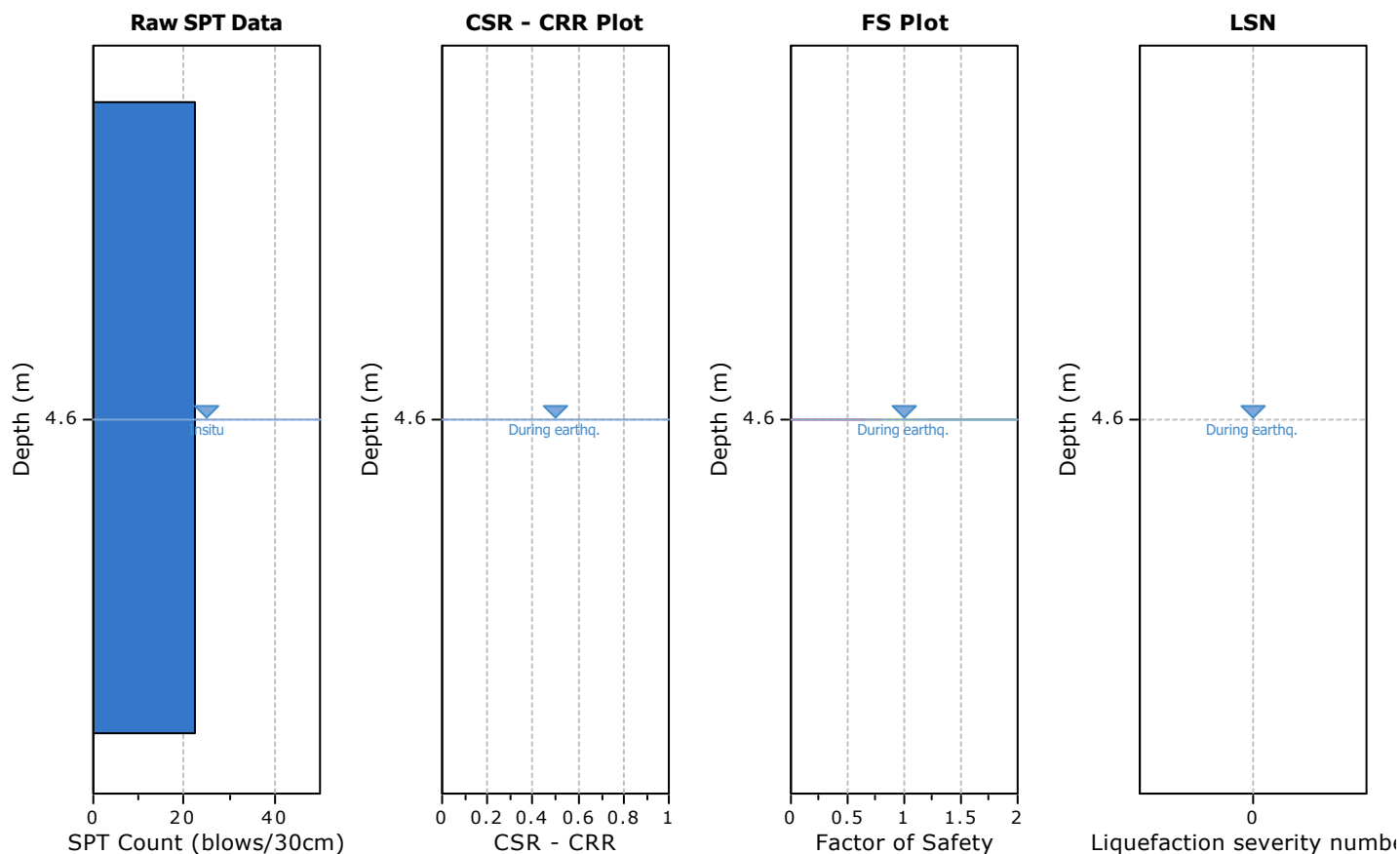
Project title :

SPT Name: DPSH03 SLSB

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	6.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.19 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



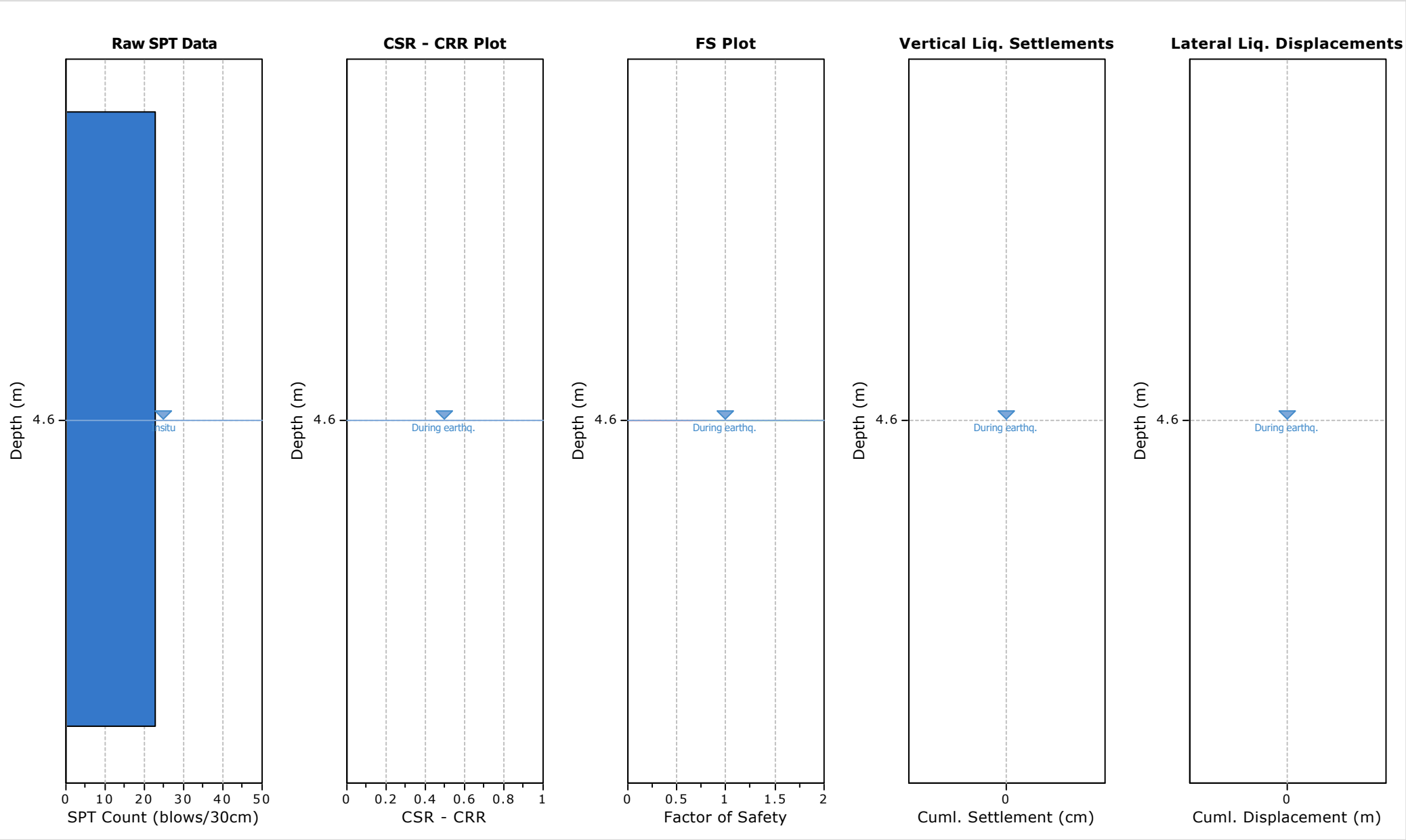
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

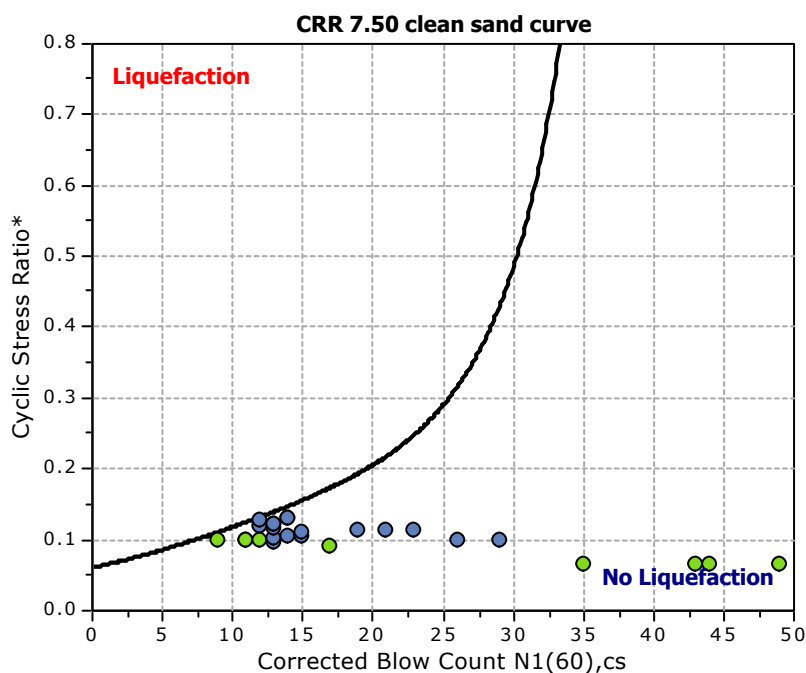
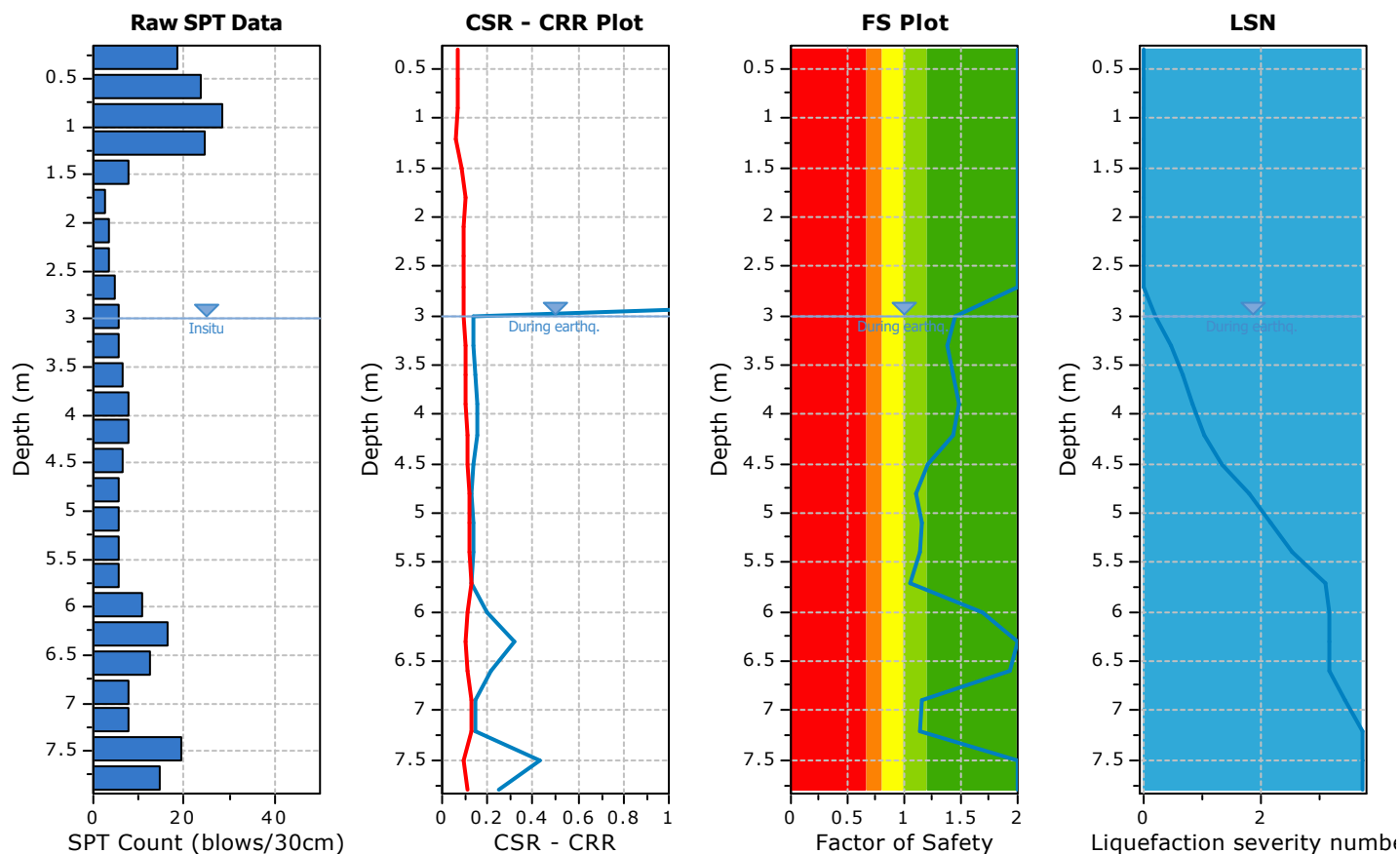
Project title :

SPT Name: DPSH04 SLSB

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	6.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.19 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



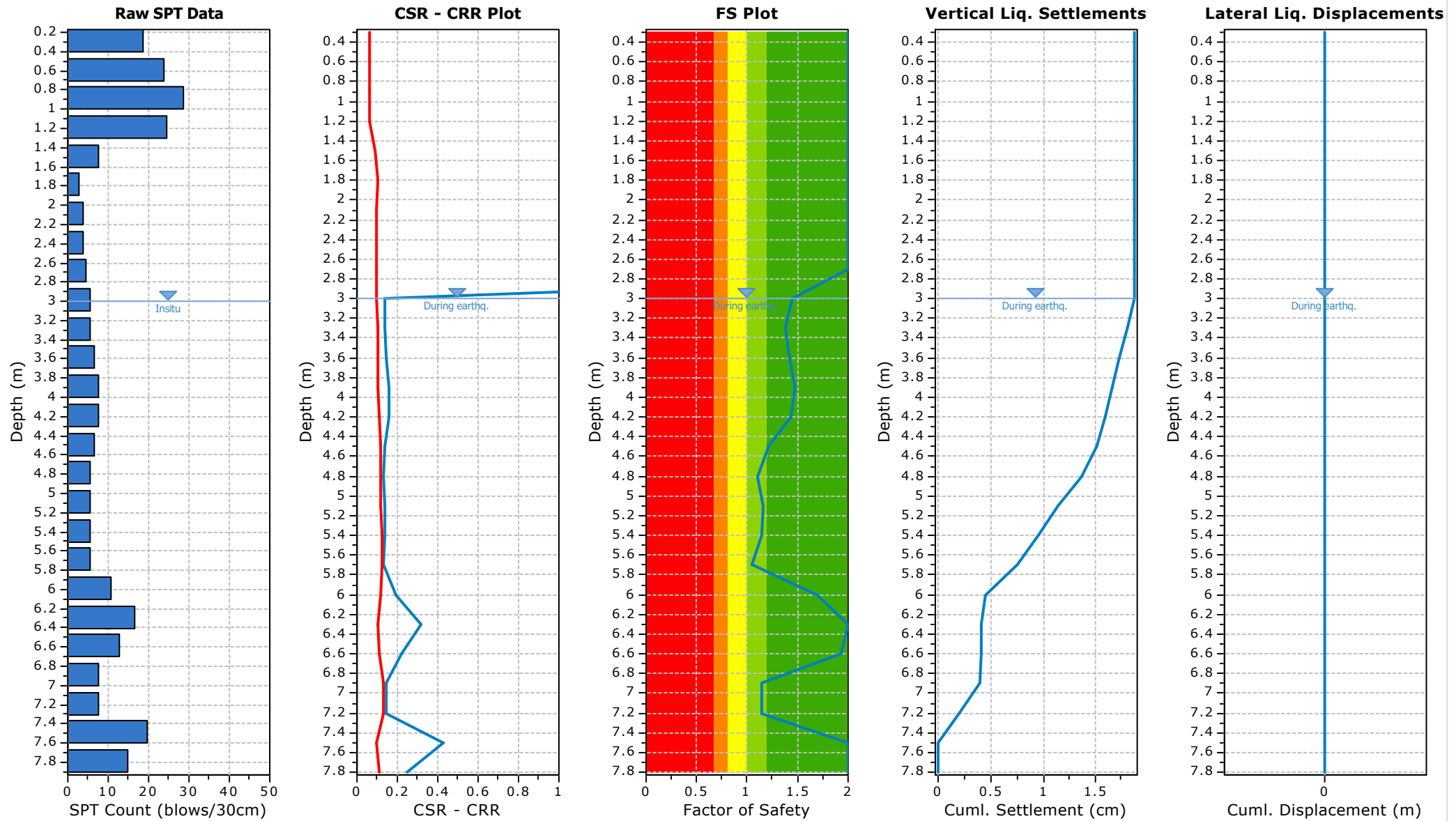
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

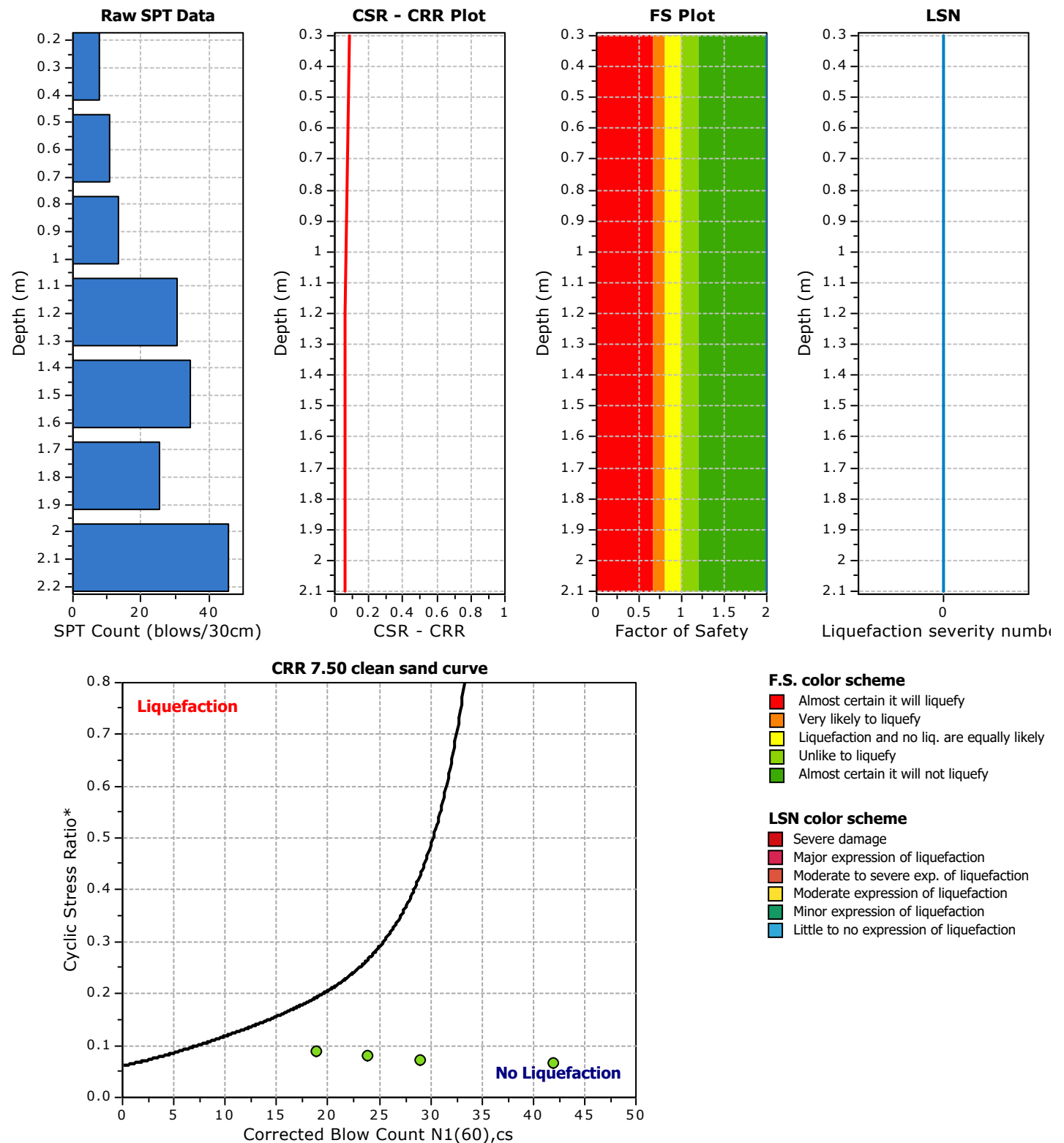
Project title :

SPT Name: DPSH06 SLSB

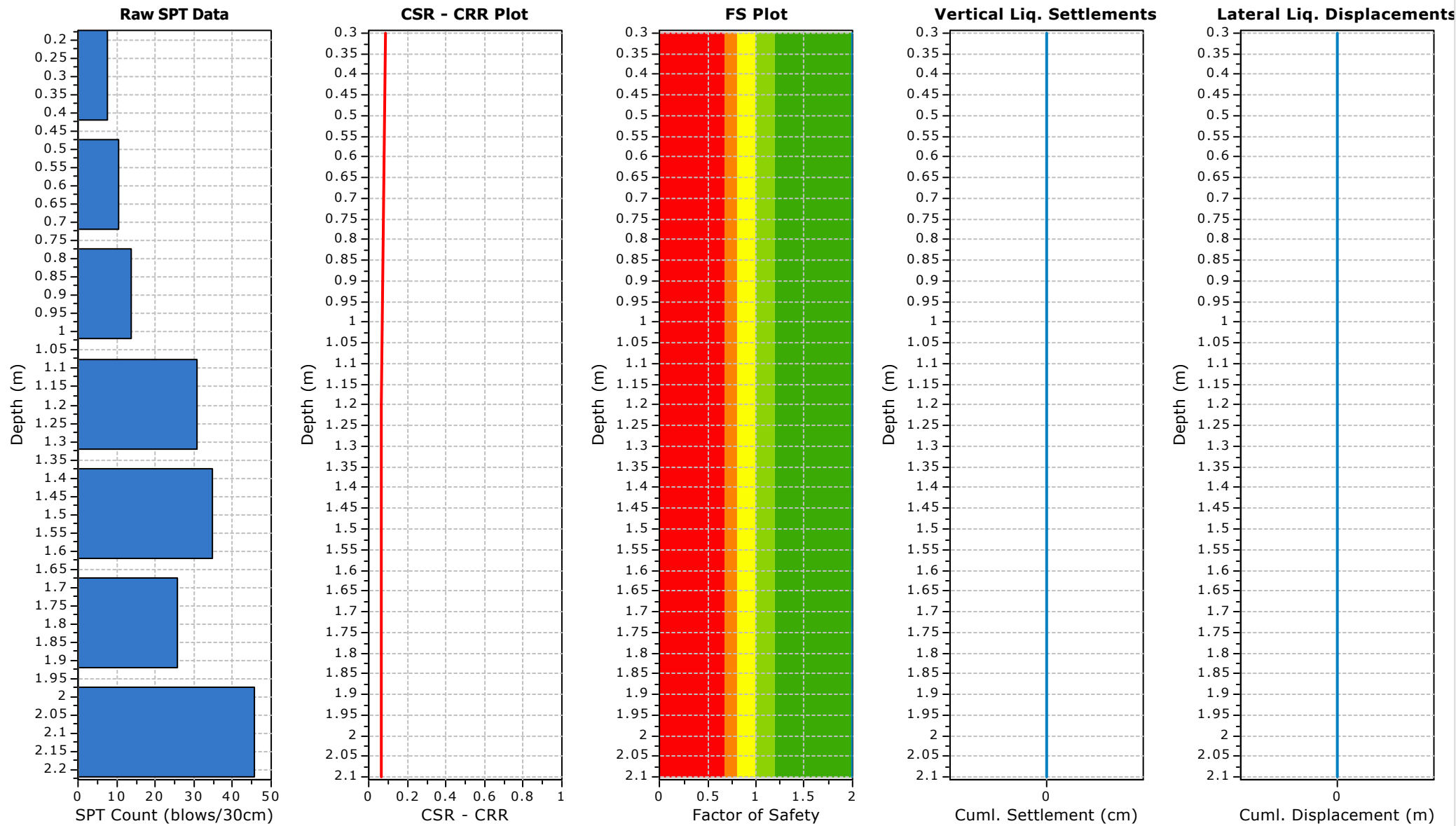
Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	6.00
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.19 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

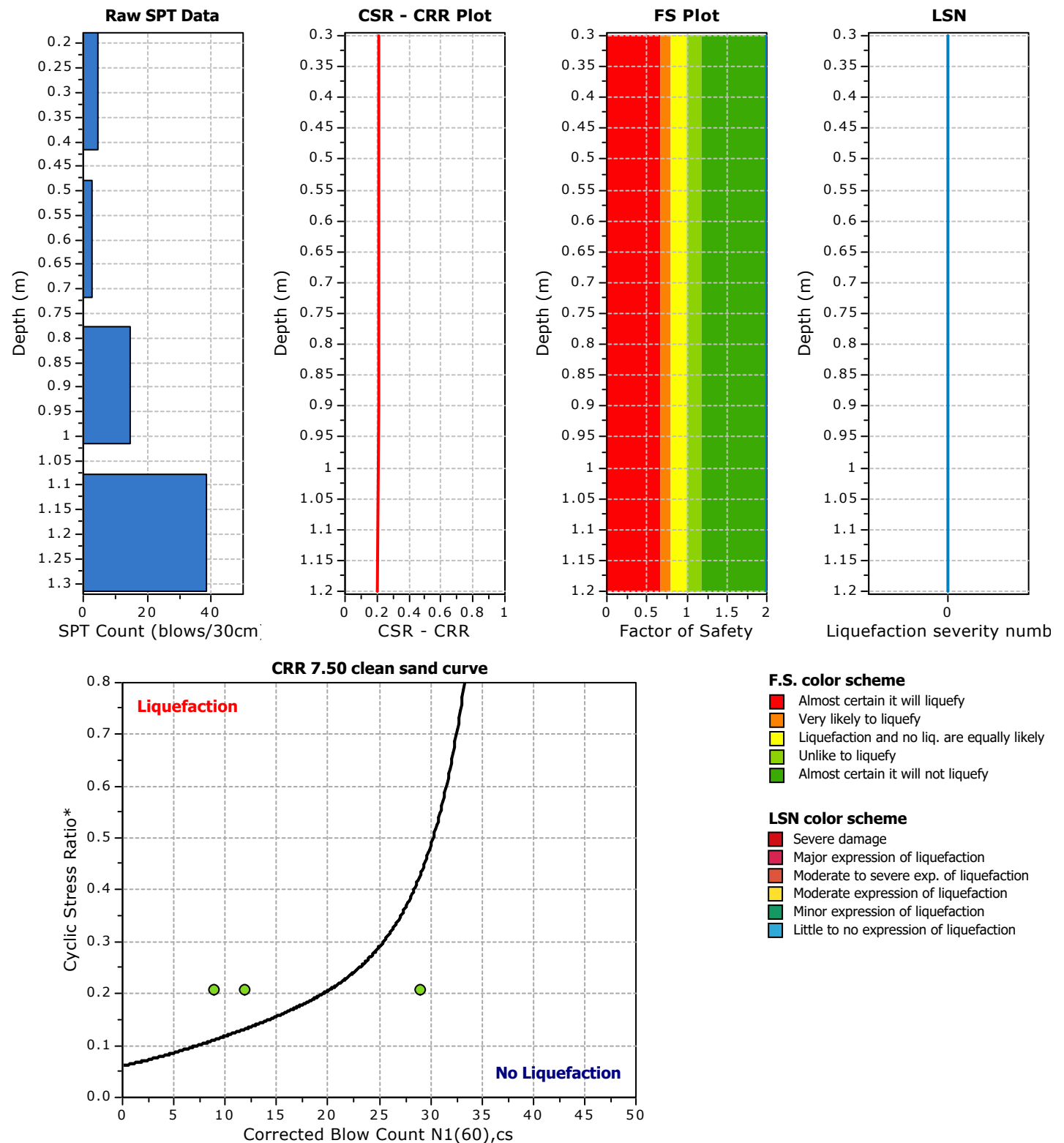
Project title :

SPT Name: DPSH01 ULS

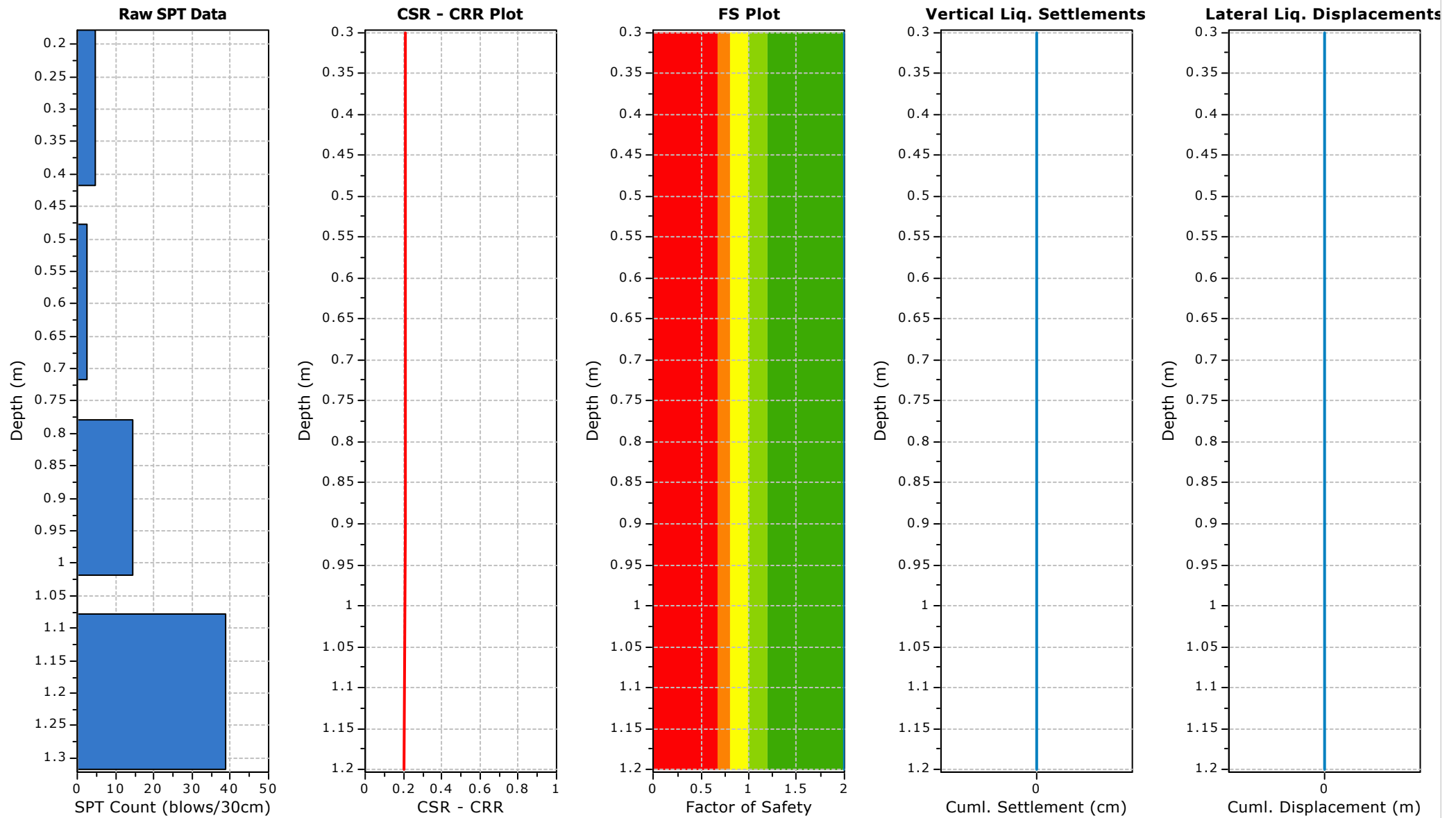
Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.50
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.35 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

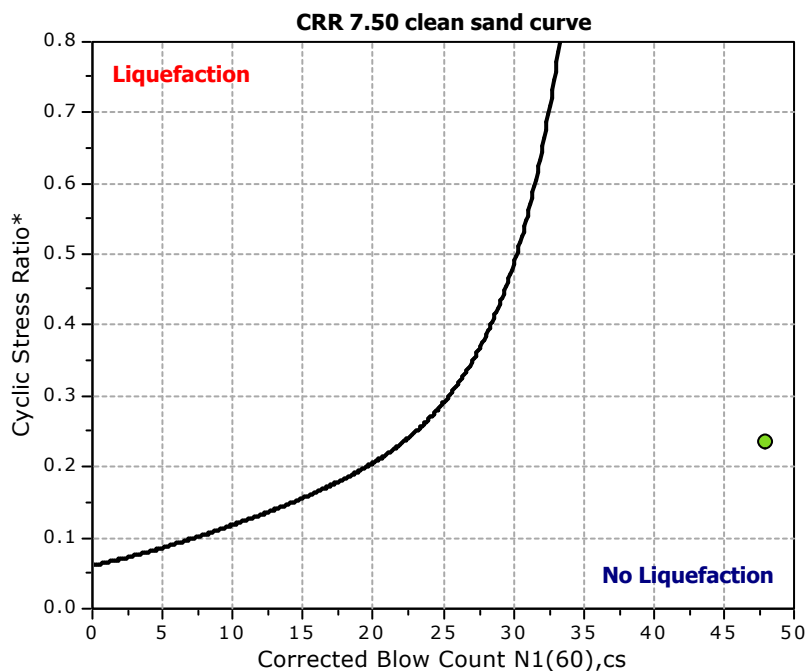
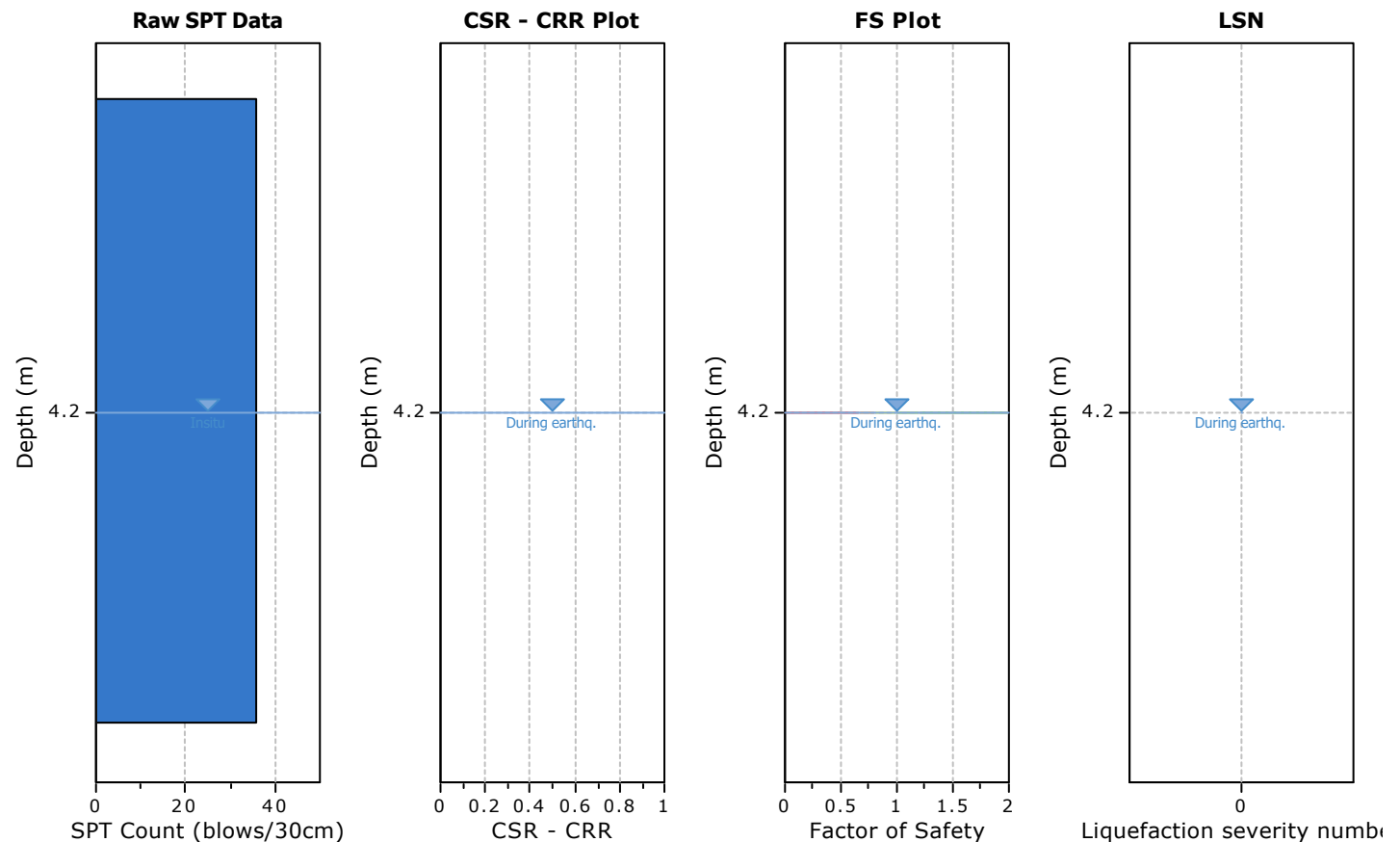
Project title :

SPT Name: DPSH02 ULS

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.50
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.35 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



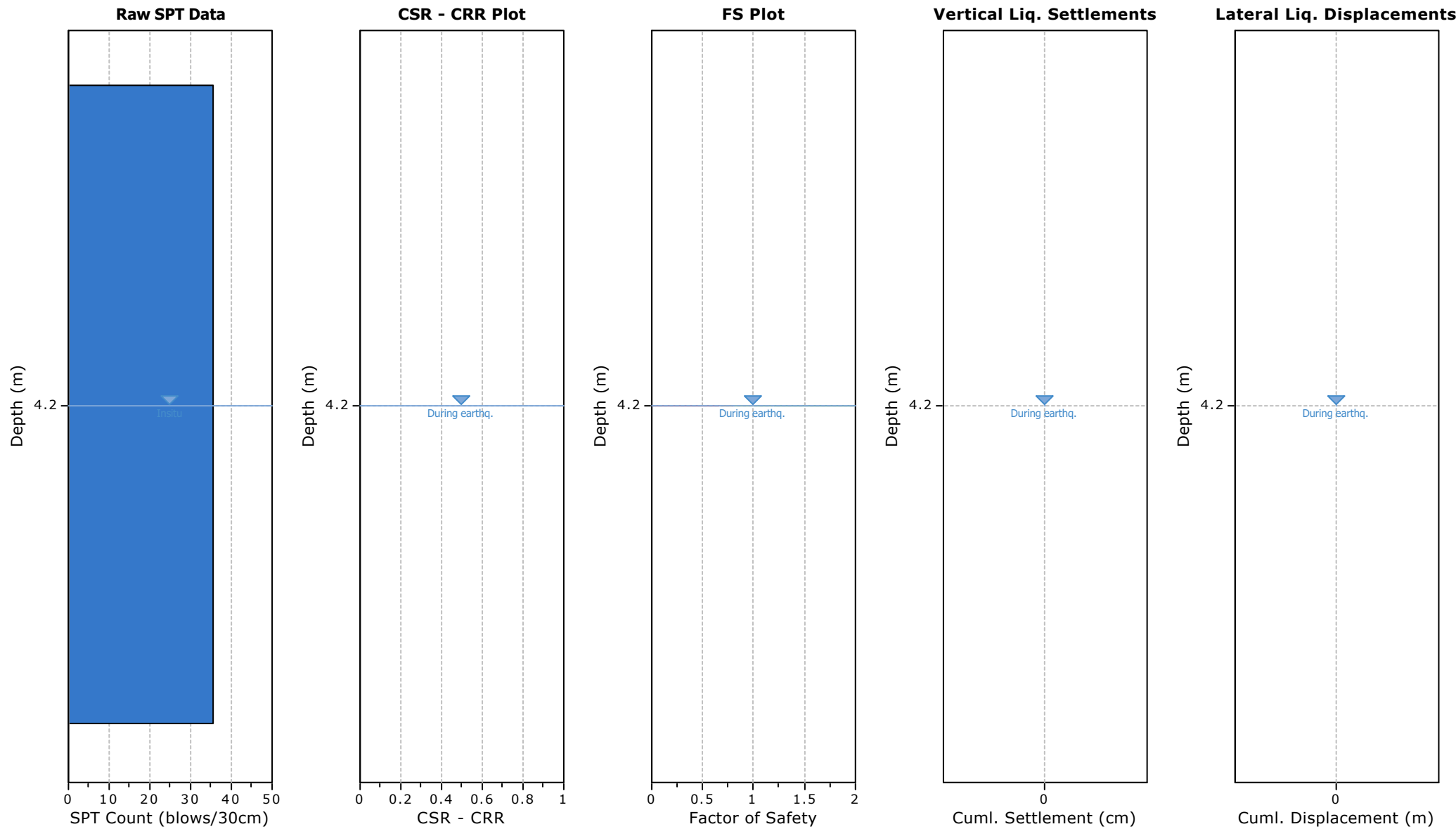
F.S. color scheme

- 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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

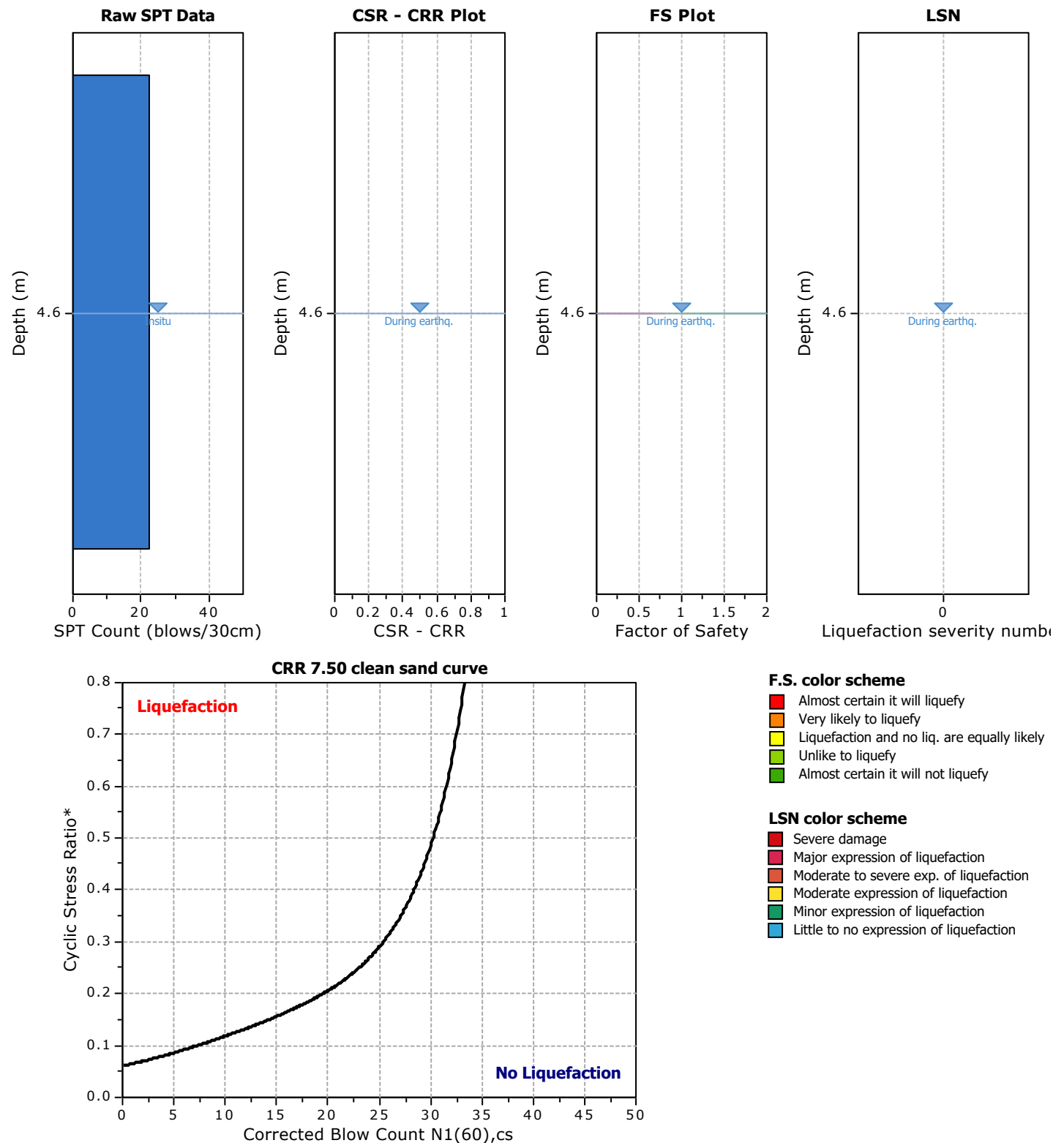
Project title :

SPT Name: DPSH03 ULS

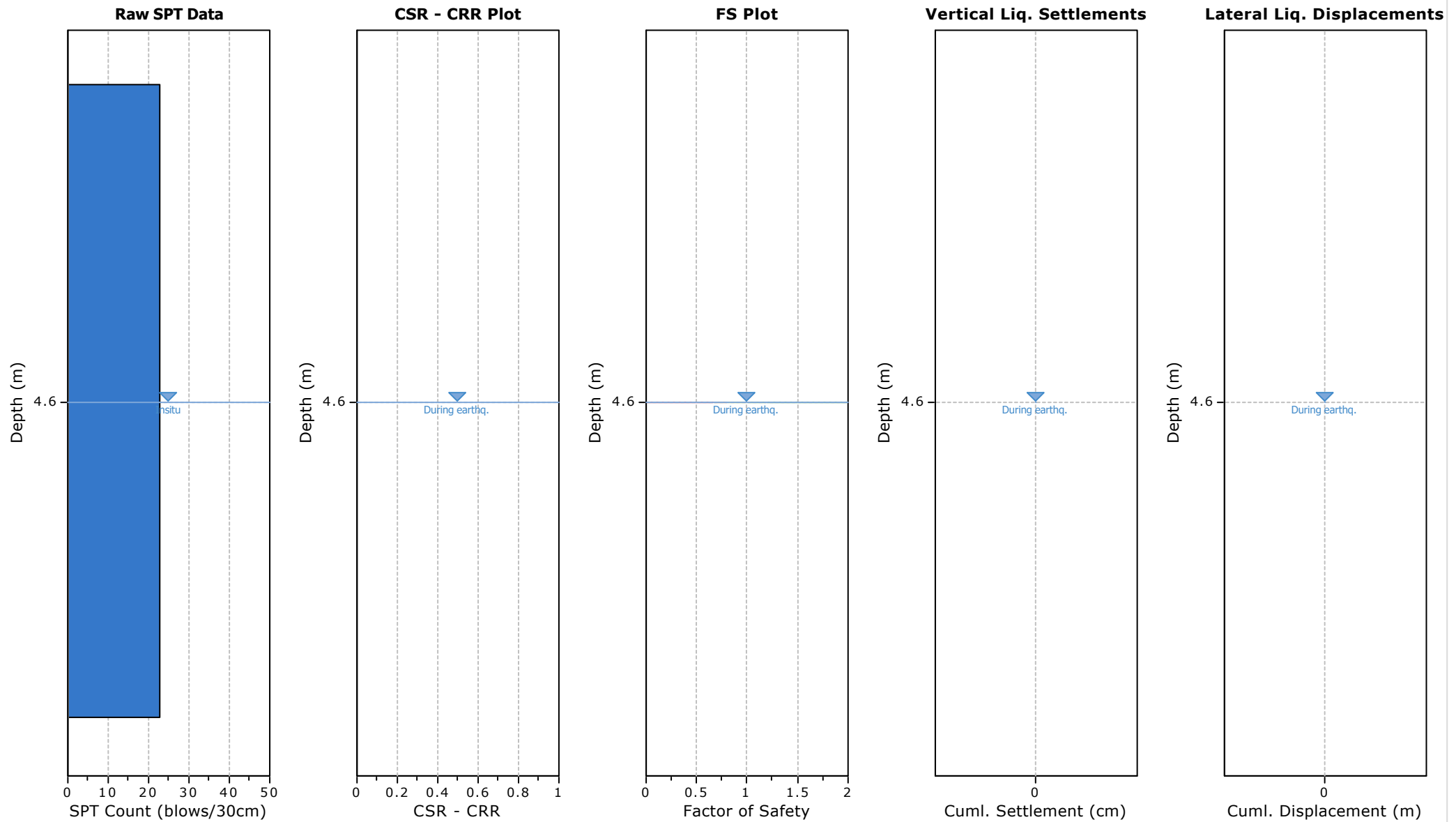
Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.50
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.35 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

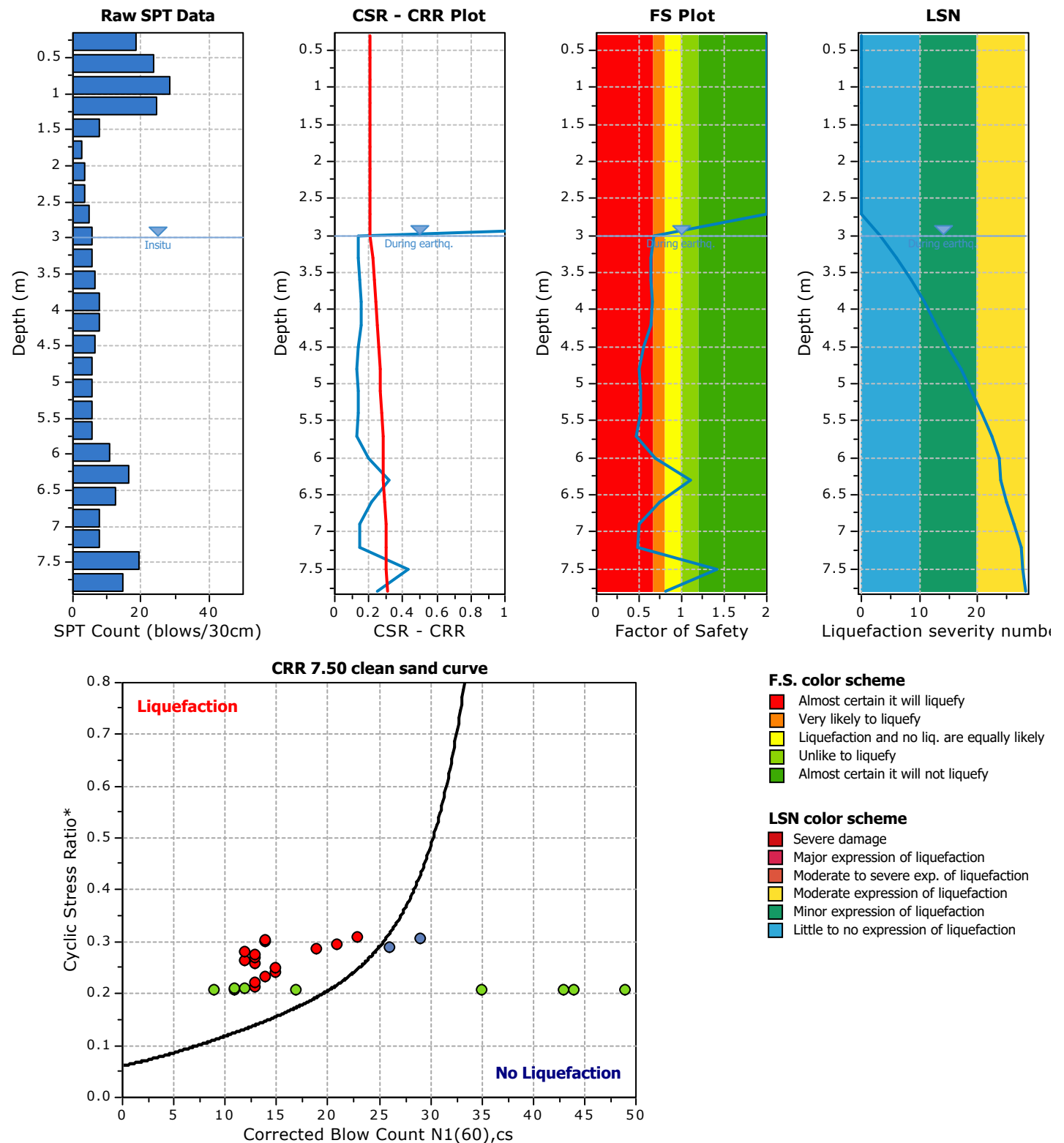
Project title :

SPT Name: DPSH04 ULS

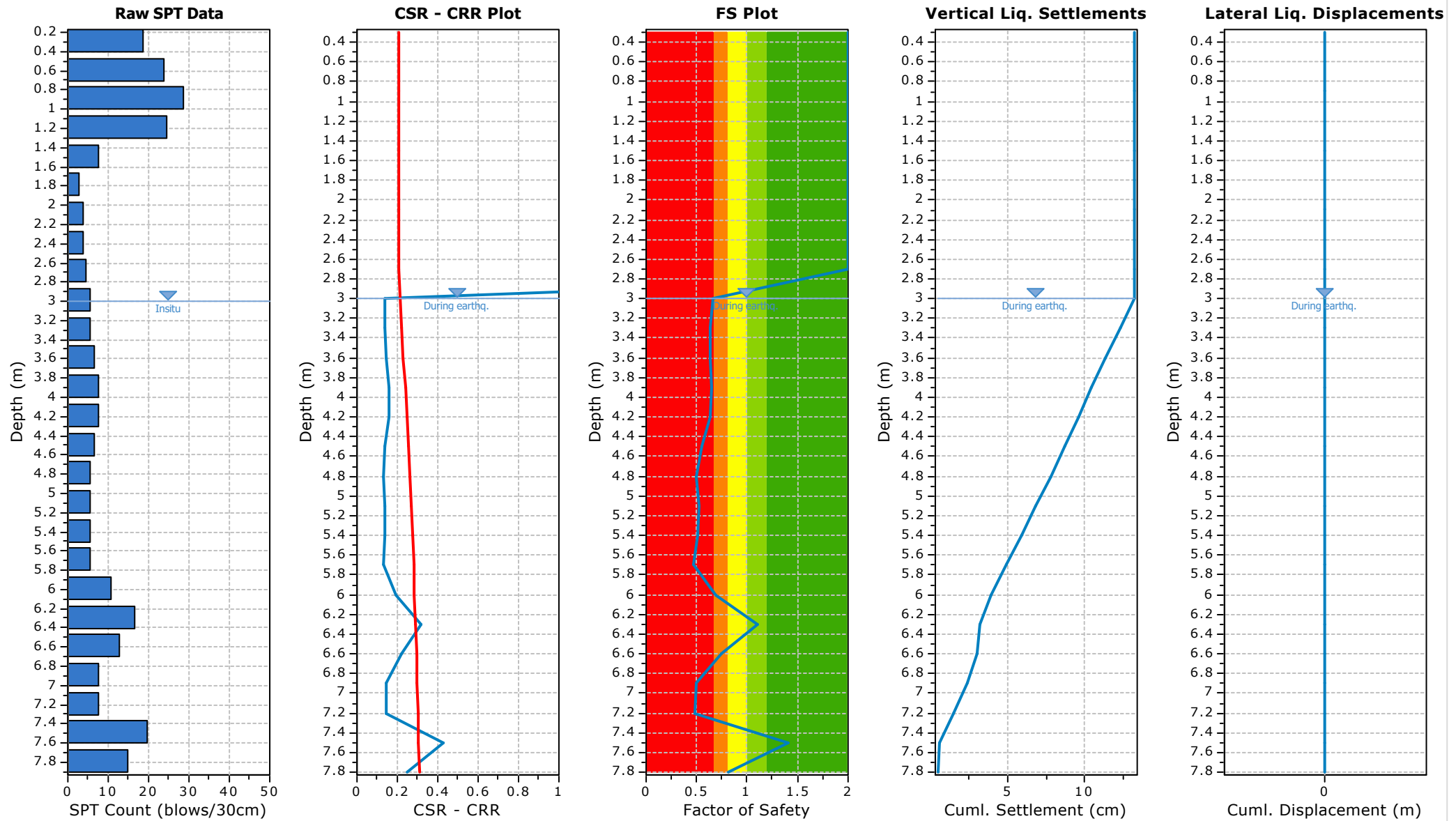
Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.50
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.35 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



SPT BASED LIQUEFACTION ANALYSIS REPORT

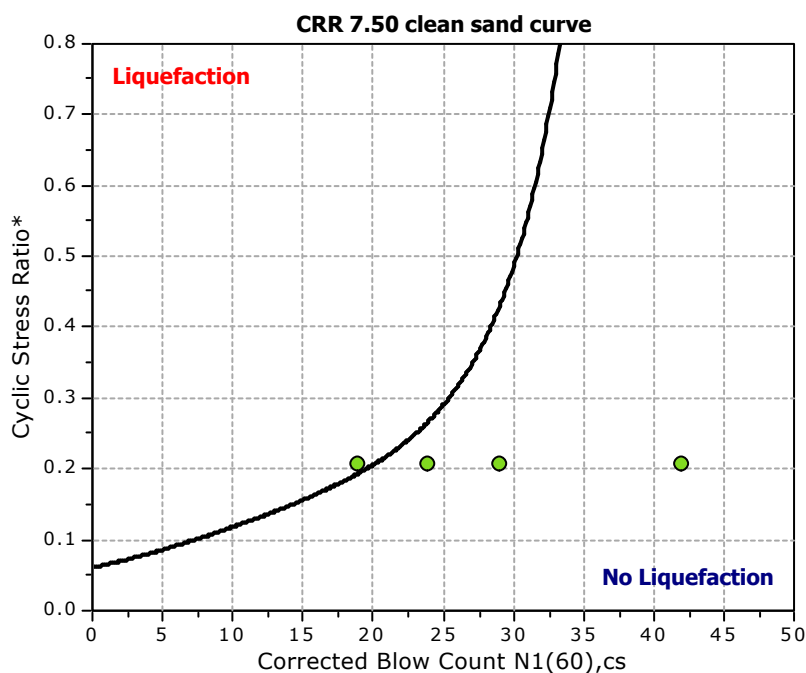
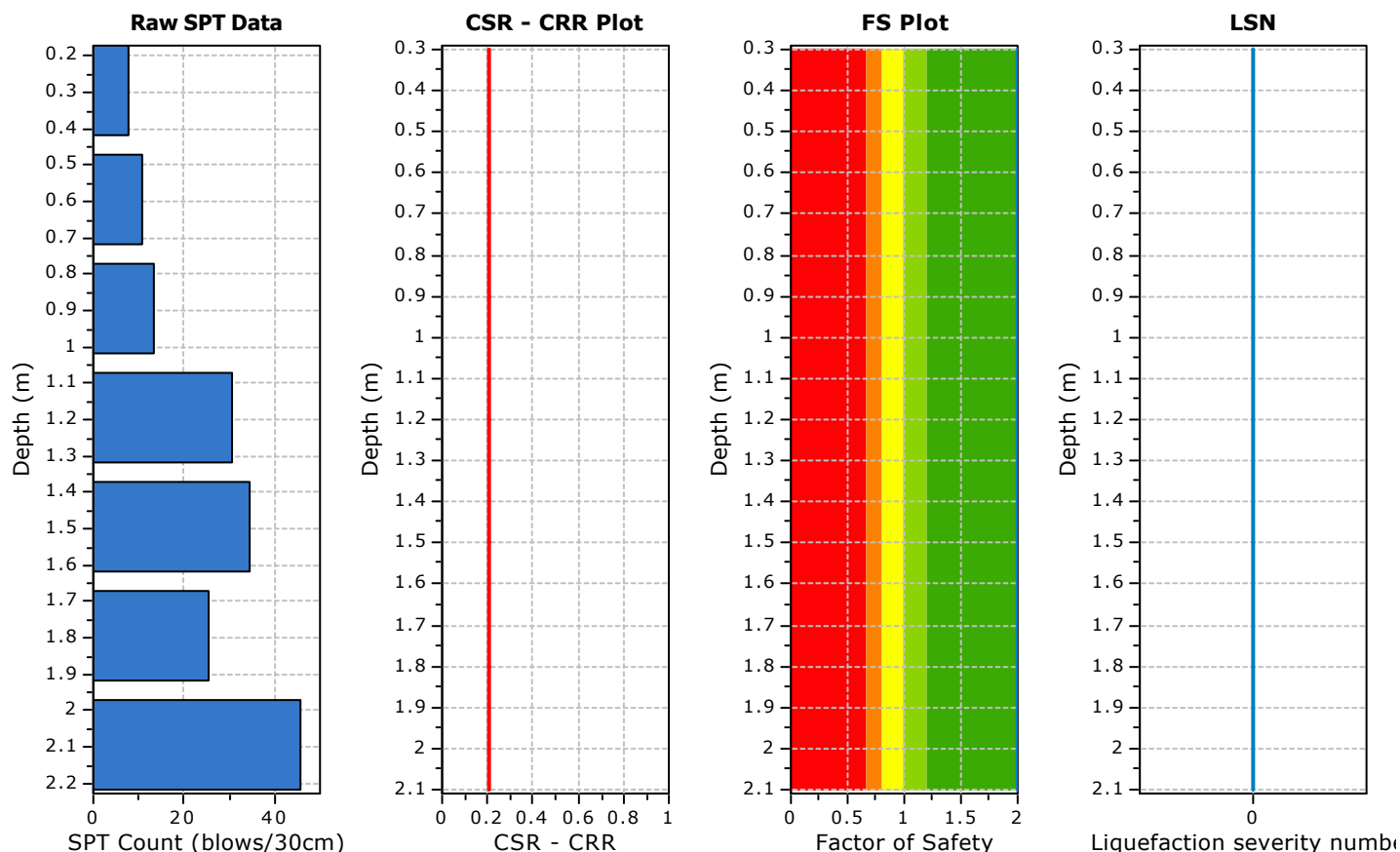
Project title :

SPT Name: DPSH06 ULS

Location :

:: Input parameters and analysis properties ::

Analysis method:	Boulanger & Idriss, 2014	G.W.T. (in-situ):	3.00 m
Fines correction method:	Boulanger & Idriss, 2014	G.W.T. (earthq.):	3.00 m
Sampling method:	Standard Sampler	Earthquake magnitude M_w :	7.50
Borehole diameter:	65mm to 115mm	Peak ground acceleration:	0.35 g
Rod length:	1.00 m	Eq. external load:	0.00 kPa
Hammer energy ratio:	1.30		



F.S. color scheme

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

LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

:: Overall Liquefaction Assessment Analysis Plots ::

