APPENDIX D

Engineering Report

PROJECT

3MS RESIDENTIAL DEVELOPMENT

REPORT

ENGINEERING DESIGN STATEMENT



8 December 2020 (Revision 4)

Prepared for 3MS of Cambridge GP Ltd

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ENGINEERING CONSULTANTS

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1 Introduction

3Ms of Cambridge GP Ltd (3MS) are developing residential subdivision on the western edge of the township of Cambridge, Waikato. The development is located within a new structure plan area made up of three individual growth cells; C1, C2 and C3 (refer to figure 1 below). The 3MS development is a 40Ha residential development is located in southeast corner of the C2 growth cell.

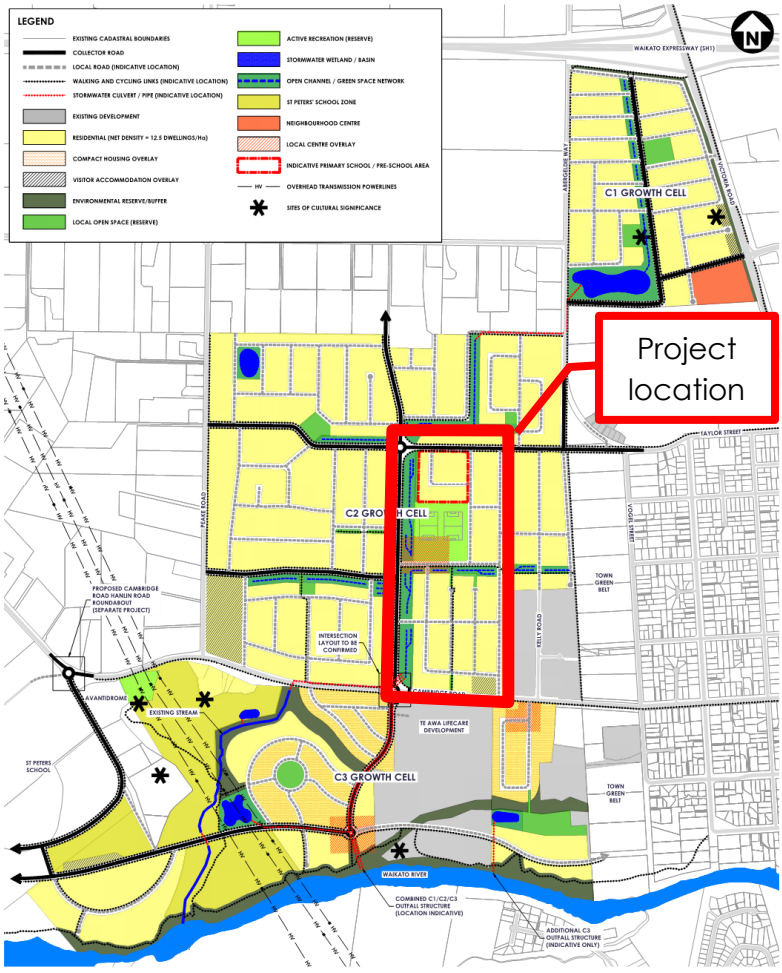


Figure 1 – Structure plan area (C1, C2 and C3 growth cells)

The project involves the development of infrastructure within the site to accommodate ~300 new residential sites along with 8.6Ha retirement village development, neighbour centre and new 4.0Ha school site. The development site also includes strategic development infrastructure required to service the wider structure plan area (to be delivered by Waipa District Council). The subdivision is expected to be developed over several stages with the initial stage focussing on the delivery of the school site.

An extensive review of the planning and infrastructure requirement for the C1, C2 and C3 growth cell areas has already been completed by WDC as part of the structure plan development. This document demonstrates how the proposed development delivers a subdivision in general accordance with the approved structure plan and provides for future development within the balance of structure plan area.

1.1 Location and site description

The current 3MS development site is a 40Ha rural section located at 1863 & 1871 Cambridge Road, Cambridge. This property was previously a dry stock farm with flat topography. Drainage for the site is provided through existing farm drains which discharge into the Waikato River via an existing culvert under Cambridge Road to the west of the site and stream to the south.

The development site has a single road frontage on Cambridge as the primary point of access to the south. The site is surrounded by neighbouring rural properties to the north and west and adjoin the existing Kelly Road residential development to the east.

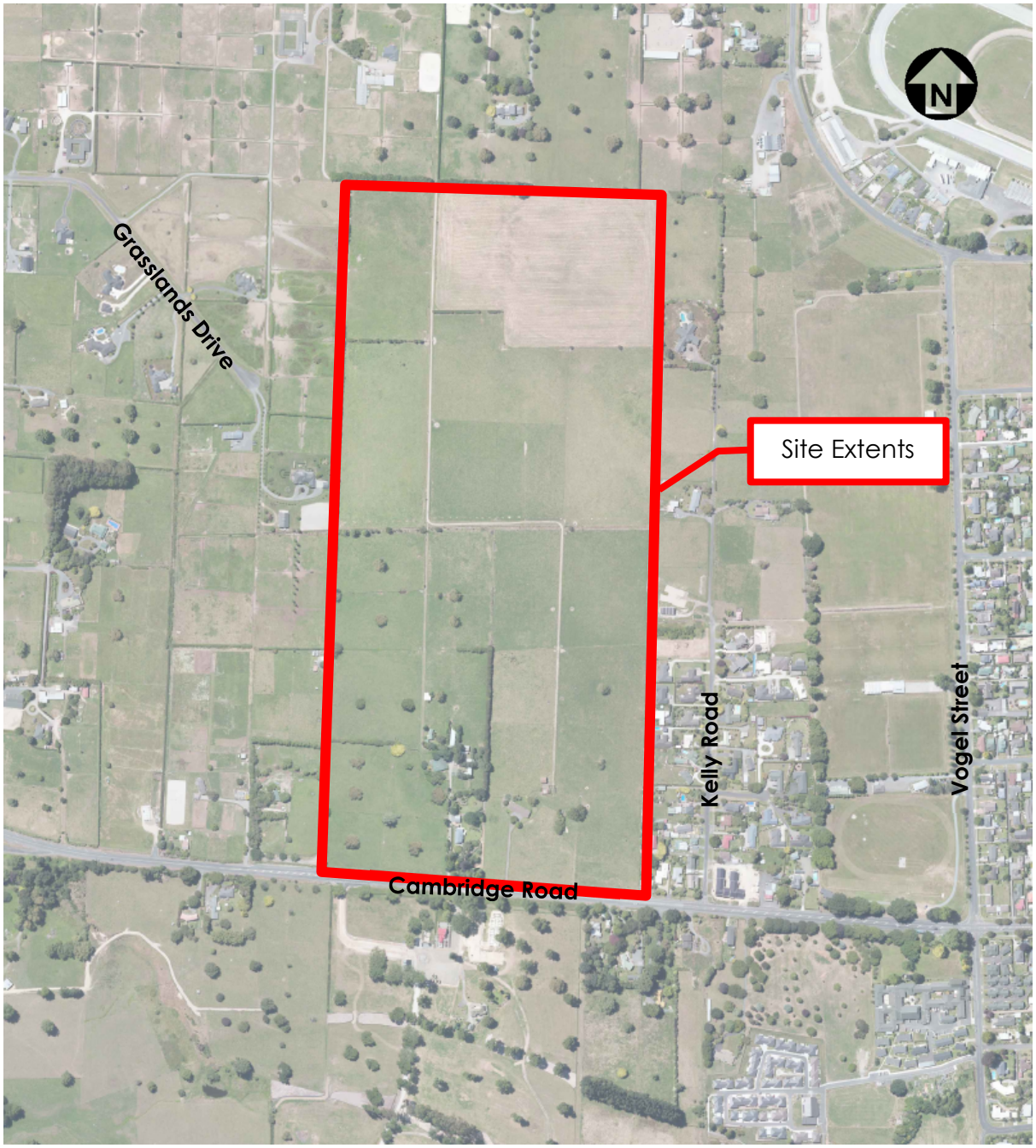


Figure 2 – Project site location

1.2 Document purpose

The purpose of this document is to detail the specific infrastructure required to service the proposed 3MS development and confirm the subdivision can be adequately serviced through the new and existing service networks. It is also confirms the philosophies, standards, design parameters and key assumptions to be used in the detailed design of development infrastructure.

2 Scope

This report has been developed to provide specific information and guidance for development of the following infrastructure designs within the proposed growth cell areas;

- Bulk earthworks
- Roads, footpaths and cycle facilities
- Stormwater
- Wastewater
- Water supply

The following aspects are not currently covered by this document;

- Landscaping
- Street lighting
- Reserves and public spaces

It is expected that further details and guidance will be added to this document as the project developments.

3 Design Inputs

This section outlines the key inputs collated for the development of infrastructure designs for the of the structure plan to date. Information has been obtained from a range of third-party sources with varying levels of detail and accuracy[1].

3.1 Survey information

3.1.1 Lidar survey

2008 Lidar tiles for the structure plan area were sourced from Waikato Regional Council (WRC) on 19th October 2017. The information was supplied in NZTM projection and has been converted to Mount Eden 2000 projection by Cogswell Surveys Ltd.

3.1.2 Topographical survey

The following table contains a list of the topographical survey information collected relating to the growth cell areas.

Description	Approx extents	Source
3d Topographical GPS data from Victor Jia property (C2 growth cell)	45Ha	Churchill Timms Ltd

Table 1 - Survey information sources

3.1.3 Aerial photography

2016 aerial photography were sourced from Waipa District Council on 10th November 2017 in enhanced compression wavelet format (.ecw). This information was supplied in NZTM project and converted to Mount Eden 2000 projection for design.

[1] Information received from third party sources is included in this document but has not been independently verified.

3.3 Services information

3.3.1 Three waters

Electronic network layout information was sourced from Waipa District council from the GIS system. Information on stormwater, wastewater and water supply assets were obtained and current as at October 2017.

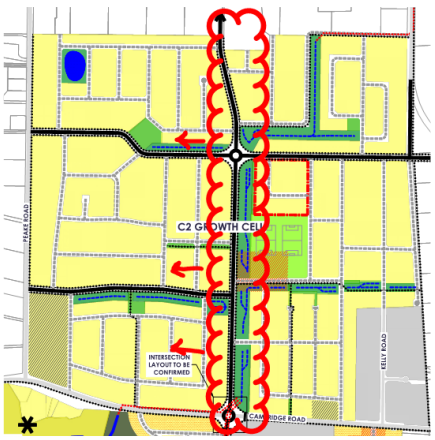
3.3.2 Utilities

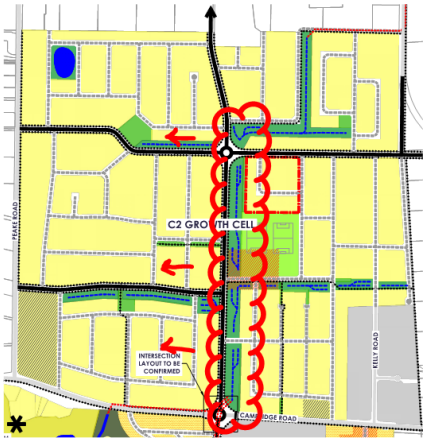
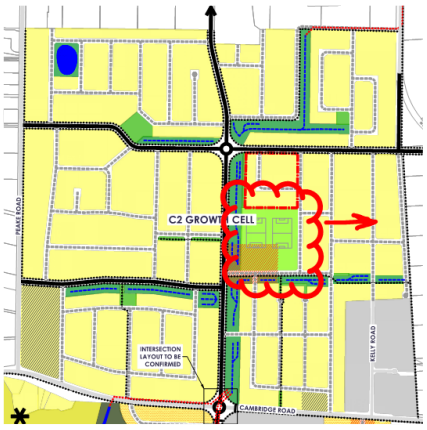
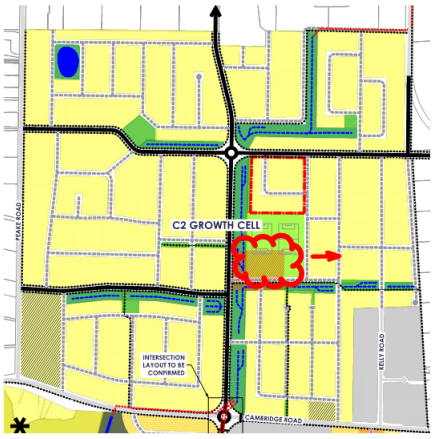
Information was obtained from the following service providers via a B4UDIG request (dated 15th October 2017);

- Chorus (telecommunications/fibre)
- First Gas (gas network)
- Ultrafast (fibre)
- LINZ (survey marks)

3.4 Structure plan integration

The approved structure plan has been used as the basis for coordination of services and integration with future development areas adjoining the property. 3MS have been working closely with WDC on the integration of their proposed subdivision with the structure plan to ensure the development is in general accordance with the approved structure plan. To achieve this the following minor adjustments have been proposed to the current structure plan layout;

Adjustment	Comments	Justification
C2 Central Collector Road shifted by 100m to the west		• Provides same connectivity and access within C2 growth cell • Delays WDC investment in central roading infrastructure reducing short-term council debt (i.e. lower interest costs)

Adjustment	Comments	Justification
C2 Central Stormwater Swale shifted by 100-200m to the west		• Provides same stormwater network outcomes treatment for sub-catchments within C2 growth cell • Delays WDC investment in central stormwater infrastructure reducing short-term council debt (i.e. lower interest costs)
C2 Active Recreational Reserve to be relocated within C2 growth cell (new location to be confirmed by WDC)		• Delays WDC investment in central recreational reserve infrastructure reducing short-term council debt (i.e. lower interest costs)
C2 Local Neighbourhood Centre site location shifted ~240m to the east		• Provides same recreational facilities within C2 growth cell • Improves connection with the adjacent town belt reserve • Delays WDC investment in central recreational reserve infrastructure reducing short-term council debt (i.e. lower interest costs)

Refer to **Appendix A** for a plan showing how the above changes have been integrated into the structure plan and coordinated with the proposed 3MS development. Specific details on how the above adjustments have been accommodated within the proposed engineering solutions to service the 3MS development is detailed in Section 6 of this report.

4 Constraints

This section summarises some of the existing constraints identified within or adjoining the 3MS development site. These constraints may impact proposed infrastructure designs and should be considered as part of any proposed solutions.

4.1 Existing developments

4.1.1 Kelly Road residential development

The existing ground levels at the rear of the existing residential properties on Kelly Road (adjoining the eastern boundary) are not to be altered by the project works

4.1.2 Groundwater levels

Site measurements of groundwater taken as part of previous geotechnical investigations show ground water levels within the site are within 2m of existing ground in some part of the site. These levels will limit and/or set the allowable levels for infrastructure throughout the development (i.e. roads and pipe networks).

4.1.3 WDC strategic infrastructure

WDC have completed master planning of infrastructure requirements across all growth cells within the C1 and C2/C3 structure plan area to confirm the strategic infrastructure required to service these development areas. There a number of WDC infrastructure assets have been identified as being located within, or adjacent to, the 3MS development site which will need to interface and coordinate with the design of the 3MS development. Specific WDC projects these are as follows;

- New C2/C3 Intersection and Cambridge Road Upgrade
- C2 Eastern Stormwater Swale
- C2 Terminal Wastewater Pump Station and Rising Main

The proposed 3MS engineering solution demonstrates how these projects have been integrated into the adjusted structure plan (refer to Section 3.4 above) and coordinated with the proposed 3MS development.

5 Standards and References

This following table outlines the design standards and references to be used for design of infrastructure solutions for the 3MS development.

Standard / Reference	Issue	Comments
General		
WDC Development and Subdivision Manual	May 2015	
Regional Infrastructure Technical Specification (RITS)	May 2018	
NZS 4404:2010 Land Development and Subdivision Infrastructure	October 2010	
Earthworks		
Ministry of Business, Innovation & Employment: Planning and engineering guidance for potentially liquefaction-prone land	September 2017	
Roading		
Austroads Guide to Road Design Part 3: Geometric Design	September 2016	
Austroads Guide to Road Design Part 4: Intersections and Crossings (General)	June 2017	
Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections	June 2017	
Austroads Guide to Road Design Part 4B: Roundabouts	December 2015	
Austroads Guide to Road Design Part 6: Roundabouts	December 2015	
NZTA Manual of traffic, signs and marking Part 1 and 2 (MOTSAM)	August 2010	
NZTA Traffic Control Devices Manual (TCD)	August 2015	
Cycling and Pedestrians		
Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling	June 2017	
RTS 14 Guidelines for facilities for blind and vision impaired pedestrians	May 2015	
Design Manual for Bicycle Traffic: CROW Fietsberaad 2016	December 2016	
Christchurch Cycle Design Guidelines: Christchurch City Council	July 2016	

Standard / Reference	Issue	Comments
Stormwater		
Austroads Guide to Road Design Part 5: Drainage (General and Hydrology Considerations)	May 2013	
Austroads Guide to Road Design Part 5B: Drainage (Open Channels, Culvert and Floodways)	May 2013	
Auckland City Council Technical Publication 10 – Stormwater Management Devices: Design Guidelines Manual 2003 (TP10)	May 2003	

Table 2 - Standards and reference documents

6 Engineering Solutions

6.1 Earthworks

6.1.1 Design philosophy

The following is a description of the earthworks design philosophy for the 3MS development;

- Moderate contouring of development site to achieve suitable lot levels and stormwater grading requirements.
- Overland flow paths for the stormwater to be located within public reserves (where possible).
- The design shall optimise the project earthworks requirements with an aim to reduce the amount of fill required to be disposed of off-site during future stages of the project

6.1.2 Key assumptions

The following are some key assumptions relating to earthworks design;

- Residential lots to be graded as flat as can be achieved with a minimum grade of 0.5% applied where possible. Areas of the site may require batters or low retaining structure (up to 1.5m high) where specific stormwater grading requirements interface with minimum lot levels.
- Minimum batter slopes of 1V:4H to be used
- Individual lot owners will be responsible for completing specific geotechnical investigation and foundation design for future buildings.

Refer to **Appendix D** for a copy of the **Preliminary Geotechnical Investigation and Site Suitability Report** which includes a detailed summary of site geotechnical parameters and information to be used as part of the design (prepared by BTW Consultants).

6.2 Roads, footpaths and cycle facilities

6.2.1 Design philosophy

The following is a description of the transportation network design philosophy for the 3MS development;

- **Development to 'deliver a cyclist/pedestrian focussed transport network that also serves cars'** – *this is an approach that aligns closely with the key objectives outlined in the "Waipa District Cycling & Walking Strategy" (2008) by;*
    - **Delivering "an environment that supports cycling"**
    - **Encouraging "more people cycling more often"**
    - **Providing "improved safety for cyclists"**

  This concept is a departure from the traditional approach to transport system design which tends to prioritise the requirements for cars/trucks ahead of other modes of transport.
- Hierarchical pattern for the pedestrian and cycling network; strategic, collector and local connections
- A pedestrian and cycling network integrated with local public transport routes and supported by a high level of amenity/facilities (i.e. seating, lighting, refuse stations, cycle stands and maintenance facilities, refreshment stations)
- Hierarchical roading pattern for internal streets; Collector Roads, Local Roads and Local Access Roads
- Transport network is to provide connections to the wider existing and future transport networks (in accordance with the approved structure plan)

Refer to **Appendix B** for a copy of the proposed walking and cycling strategy for the development which demonstrates key elements noted above.

6.2.2 Key assumptions

The following are some key assumptions relating to the transportation design;

- Main traffic access for the development to be via central and northern collector roads within the C2 growth cell
- On road cycle facilities and off-road shared paths to be provided on all Collector Roads
- Shared paths or footpaths to be provided on both sides of all roads
- Cycle movements will be prioritised on strategic corridors/connections
- Pedestrian and cycle network to integrate with nominated transport corridors and connections within the approved structure plan to ensure fully connectivity with the future developments and neighbourhood destinations

6.2.3 Structure Plan Integration

Figure 4 below demonstrates how the proposed 3MS roading layout will integrate with the wider transport network proposed for the wider structure plan area.

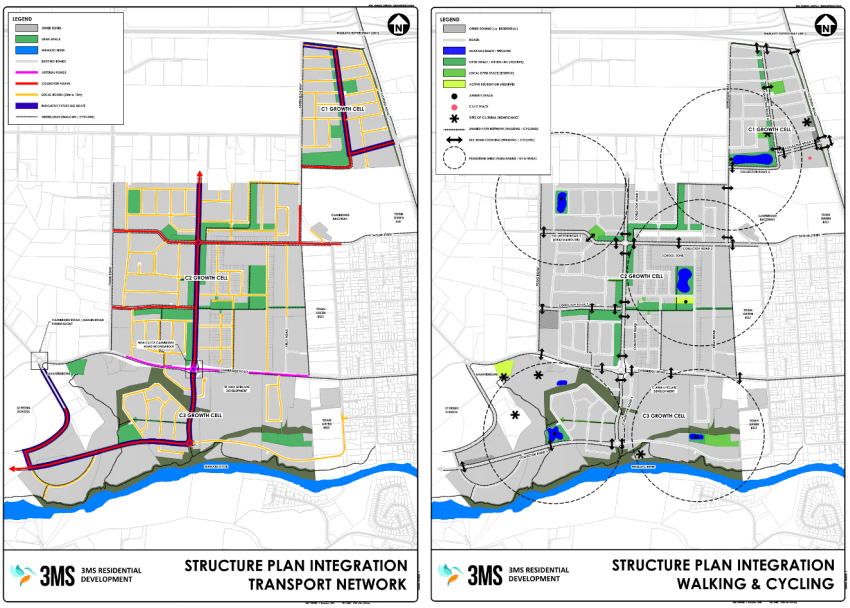


Figure 3 - Structure Plan Integration (Transport Network & Walking/Cycling)

The proposed roading layout includes key local road connections providing linkages with the central C2 collector road on the eastern boundary of the site which is forms part of the wider structure plan. Road connections on the Cambridge Road frontage has also been developed to allow for a staged delivery which integrates with planned upgrades required as part of the structure plan network.

Key pedestrian and cycling routes and links through the 3MS development have also been provided in accordance with the structure plan (refer to **Appendix B** for further details).

6.2.4 Road hierarchy and classification

The following road classifications have been assumed for the design;

Road Name	Classification
Existing Roads[2]	
Cambridge Road	Arterial
Proposed Roads	
C2 North-eastern Collector Road	Collector

[2] *Existing classification based on Waipa District Plan, Appendix T5 – Road Hierarchy (November 2016)*

Road Name	Classification
Road 10	Local Road
Road 11	Local Road
Road 12	Local Road
Road 13	Local Access Road
Road 14	Local Access Road
Road 15	Local Road
Road 16	Local Access Road
Road 17	Local Road
Road 18	Local Access Road
Road 20	Local Road
Road 21	Local Road
Road 22	Local Access Road
Road 23	Local Road
Road 30	Local Road

Table 3 - Road hierarchy and classification

Refer to **Appendix B** for a general arrangement of the proposed roading network within the development including the roads listed above.

6.2.5 Speeds parameters

The following table outlines the posted and design speeds used for geometric design.

Road Name	Current Posted speed	Proposed Posted speed	Proposed Design Speed
Cambridge Road	80	50	-
C2 Central Collector Road	-	40	50
C2 North-eastern Collector Road	-	40	50
Road 10	-	30	30
Road 11	-	30	30
Road 12	-	30	30
Road 13	-	30	30
Road 14	-	30	30
Road 15	-	30	30
Road 16	-	30	30
Road 17	-	30	30
Road 18	-	30	30

Road Name	Current Posted speed	Proposed Posted speed	Proposed Design Speed
Road 19	-	30	30
Road 20	-	30	30
Road 21	-	30	30
Road 22	-	30	30
Road 23	-	30	30
Road 24	-	30	30
Road 30	-	30	30
Road 31	-	30	30

Table 4 - Speed parameters

6.2.6 Geometric elements

6.2.6.1 Typical cross section

The initial dimensions to be used for each of the cross-sectional elements under each road classification has been taken from the current structure plan and are noted in the tables below. It is expected that further development of the typical road cross sections will be undertaken as the design progresses to provide more detail and better alignment with urban design outcomes.

Collector Road (25m Reserve)	
Traffic lanes:	3.5m
Flush median:	2.5m
Shoulder:	None
Kerb profile:	WDC barrier kerb
Road-cycleway separation (raised planted median):	1.5m
Two-way cycleway lanes:	2.0m (4.0m total width)
Planted berm:	1.6m (LHS) & 1.4m (RHS)
Grass berm:	1.6m (LHS only)
Footpath:	1.8m (both sides)
Utilities corridor:	1.8m (both sides)
Parking bays:	3.2m (where present)

Local Road (20m Reserve)	
Traffic lanes:	3.0m
Shoulder:	None
Kerb profile:	WDC barrier kerb
Planted berm:	2.5m (both sides)
Shared path:	3.0m (both sides)
Utilities corridor:	1.5m
Parking bays:	2.5m (where present)

Local Road (20m Reserve – Strategic Connection)	
Traffic lanes:	3.0m
Shoulder:	None
Kerb profile:	WDC barrier kerb
Road-cycleway separation (raised planted median):	1.7m
Planted berm:	2.5m (LHS only)
Shared path:	3.0m (LHS) & 3.3m (RHS)
Utilities corridor:	1.5m (LHS) & 2.0m (RHS)
Parking bays:	2.5m (where present)

Local Access Road (17m Reserve - Standard)	
Traffic lanes:	3.0m
Shoulder:	None
Kerb profile:	WDC barrier kerb
Grass berm:	2.5m (both sides)
Shared path:	3.0m (LHS only)
Footpath:	1.5m (RHS only)
Utilities corridor:	0.75m
Parking bays:	2.5m (where present)

In addition to the above cross-sectional elements the following pedestrian and cycling amenities to be included as part of the design;

- Seating at regular intervals
- Low level lighting on shared paths/cycle lanes (where required)
- Refreshment stations (i.e. drinking fountains and drink bottle fillers)
- Cycle stands at key destinations
- Refuse stations (i.e. rubbish bins)
- Route maps (including cultural/heritage references where appropriate)

Refer to **Appendix B** for further details on the typical road cross sections listed above.

6.2.6.2 Geometric parameters

The following geometric parameters have been adopted;

- **Driver reaction time: 2.0s** (General minimum value for most road types – Austroads Part 3; Table 5.2)
- **Longitudinal deceleration coefficient: 0.36 for cars** (desirable maximum for most urban and rural road types – Austroads Part 3; Table 5.3)
- **Longitudinal deceleration coefficient: 0.36 for trucks** (desirable maximum for most urban and rural road types – Austroads Part 3; Table 5.3)
- Curves with Adverse Crossfall; adverse cross fall shall not exceed 3% except in urban areas with an operating speed less than or equal to 70km/hr. Minimum horizontal raduii with adverse crossfall criteria to be based on Austroads Part 3; Table 7.10.
- Sight lines ate intersections (Austroads Part 4A)
- Sight lines at pedestrian and cycling crossing locations shall be kept clear and protected with 'no stopping at all times' markings (where appropriate) and aligned with safe stopping distances and an appropriate operating speed environment

6.2.6.3 Horizontal alignment

Horizontal alignments of road within the subdivision Is based on the urban design layout developed in association with urban designers from ChowHill Consultants. The proposed roads network generally follows a grid type formation with no horizontal curvature; similar to existing street patterns within the wider Cambridge township (refer to **Appendix B** for further details).

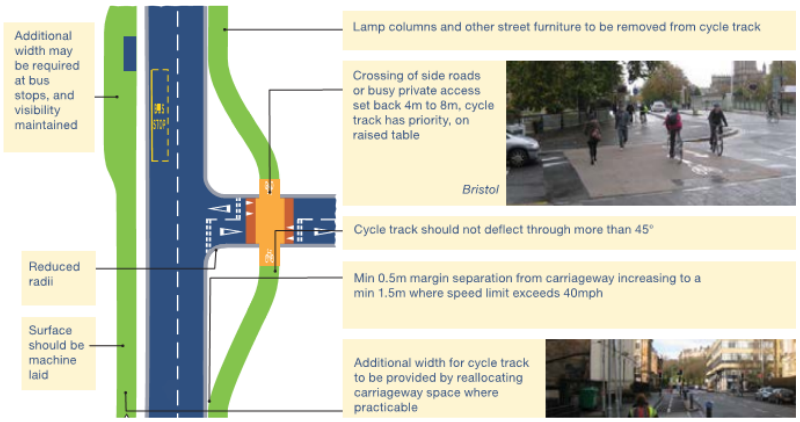
6.2.6.4 Vertical alignment

The vertical alignment of new road alignments will be designed to meeting the following minimum requirements.

Parameter	Value	Reference
Minimum gradient	**0.4%**	Regional Technical Infrastructure Specification (RITS), Section 3.3.2.5
Minimum curve length	**20m** (Vd<50 & A>1%) **10m** (Vd<50 & A<1%)	Regional Technical Infrastructure Specification (RITS), Section 3.3.2.6

6.2.6.5 Intersection form

At-grade intersections to be specified for all intersection locations using standard junction layouts. Table 5 provides some indicative intersection forms to be used for the development (subject to confirmation).

Location	Intersection form
General:	
Collector Road / Local Road	Urban Channelised T-Junction - CHR(S) with provision for priority cycleway access on side road; i.e, 
Local Road / Local Road	Urban Basic Right-turn Treatment – BAR with specific speed reduction design elements (i.e. raised table); i.e. 

Location	Intersection form
Local Road / Local Access Road	Unchannelised and 'Giveway Controlled' T-Junction or cross roads with specific speed reduction design elements (i.e. raised table); i.e. 

Table 5 - Indicative intersection form

Consideration should be given to the intersection spacing requirements as the roading network layout is refined. Typical intersection spacings are noted in Table 6 below.

Road type	Side road spacing	Reference
Local Road	**Same side** – 60m **Opposite sides** – 30m	Regional Technical Infrastructure Specification (RITS), Table 3-4
Collector Road	**Same side** – 90m **Opposite sides** – 45m	Regional Technical Infrastructure Specification (RITS), Table 3-4

Table 6 - Intersection spacing

Further work to determine the final form of individual intersections as part of finalising the development layout.

6.2.6.6 Cul-de-sacs

The general layout for cul-de-sac heads is outlined in Table 7.

Road type	Proposed Layout	Reference
Road 13	**Offset bulbous head (9.0m radius)**	
Road 14	**Offset bulbous head (9.0m radius)**	
Road 18	**Offset head with parking**	Regional Technical Infrastructure Specification (RITS), D3.1.7

Table 7 – Cul-de-sac form

6.2.6.7 Private ways

Private accesses are to be provided in situations where two or more sections do not have direct access on to the adjacent road reserve. These accesses are to be based on the following design criteria.

Parameter	Value	Reference
Carriageway width	**3.0m** *(2 to 3 households units)* **5.0m** *(4 to 6 household units)*	Waipa District Council Operative District Plan; Appendix T4
Minimum curve radius	**20m** *(at inside of curve)*	Regional Technical Infrastructure Specification (RITS), Section 3.3.11.4

6.2.6.8 Parking

Recessed parking bays to be provided on both Load Road and Local Access Roads to meet development parking requirements. Table 8 below outlines some initial guidelines for parking provisions within the development areas.

Provision	Requirement	Reference
Parking spaces required	**Local (through road)** – 1 park per lot **Local (cul-de-sac)** – 0.75 park per lot	WDC Development and Subdivision Manual, Section 3, Table 1
Parking bay width	**Collector** – 3.1m **Local** – 2.5m	
Parking bay length	6.6m (standard bay)	Regional Technical Infrastructure Specification (RITS), D3.1.8

Table 8 - Parking requirements

Specific parking provisions for individual development areas to be confirmed as part of final development layout.

6.3 Stormwater

6.3.1 Design philosophy

The following is a description of the stormwater design philosophy for the 3MS development;

- *Develop a technically sound and workable overall stormwater management system for the 3MS development that provides site drainage and flood protection while working with other urban design elements of the development.*
- *Design a stormwater system that meets the WDC level of service requirements (as defined within the RITS)*
- *Implement site specific stormwater management within the framework outlined within the SMP for the C2 growth cell in accordance with WDC's global discharge consent.*

6.3.2 Key assumptions

The following is a list of assumptions relating to the stormwater design;

- *All water within the 3MS development site to managed within the property as part of the initial development phase*
- *The 3MS stormwater system must integrate with the stormwater network proposed for the wider structure plan area*
- *The 'trunk swale' and downstream piped outlet will be constructed by WDC in the future in accordance with approved Stormwater Management Plan (SMP)*

6.3.3 Structure Plan Integration

Figure 4 below demonstrates how the proposed 3MS stormwater solution will integrate with the wider stormwater network proposed for the wider structure plan area.

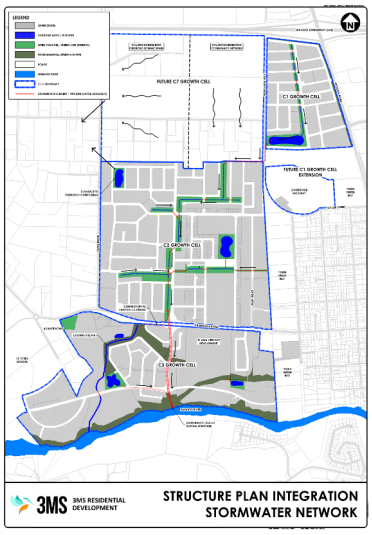


Figure 4 - Structure Plan Integration (Stormwater Network)

The main feature of this network is the east-west stormwater connection that passes through the centre of the 3MS site. The proposed 3MS stormwater solution will provide this east-west connection through the establishment of large forebays which can be upgraded in the future to function as the conveyance swales proposed in this location as part of the SMP (refer to the 3-Waters Assessment Report in **Appendix C** for further details).

6.3.4 SMP compliance

The following is a summary of the LID points proposed 3MS stormwater solution.

Typical components	Waikato Catchment - C2 south (9 points with no natural waterways within the development)	3MS Approach	Points
LID Devices	TOTAL MINIMUM REQUIRED IS 5 POINTS		6
Infiltration devices to reduce runoff volume.	Meeting the capture and infiltration requirements for the 10-year ARI event for 100% of the site.	Sized as part of 3MS consent application	6
Source Control	TOTAL MINIMUM REQUIRED IS 4 POINTS		4
Use of building or site materials that do not contaminate	Residential roofs gutters, downspouts made of non-contaminant leaching materials (assuming 50% or residential and commercial)	Developers Tool Box	1
Water re-use	Site use for garden watering and for non-potable inside waters uses including laundry and toilets is 3 points	Developers Tool Box	3
		TOTAL POINTS	10

The above table shows the proposed 3MS stormwater solution easily achieves the required points required through the SMP (refer to the 3-Waters Assessment Report in **Appendix C** for further details).

6.3.5 Design parameters

*Refer to **Appendix C** for a copy of the **3-Waters Assessment Report** which includes a detailed summary of stormwater parameters and information to be used as part of the design (prepared by Harrison Grierson Consultants).*

6.4 Wastewater

6.4.1 Design philosophy

The following is a description of the wastewater design philosophy for the 3MS development;

- *The 3MS development to be serviced by gravity reticulation networks discharging into a central wastewater pump stations within the catchment*
- *The wastewater reticulation design will need to provide for future development of the rest of this C2 cell*

6.4.2 Key assumptions

The following is a list of assumptions relating to the wastewater design;

- *There shall be no allowance made in the design for wastewater flows from existing catchments (i.e. Kelly Road)*
- *Any upgrades required to the existing network in the vicinity of Cambridge Road, Vogel Street and Vogel Place to meet additional wastewater demand from the new growth cell areas will be completed by WDC prior to the completion of the first development stage.*

6.4.3 Structure Plan Integration

The proposed 3MS wastewater solution will provide the initial C2 terminal wastewater pump station forming the central wastewater collection network for the C2 growth cell. This approach is consistent with the proposed wastewater servicing strategy outlined in the structure plan and will allow WDC to install additional upstream pump stations in the future to service future development within the wider C2 growth cell area. To accommodate this strategy within the 3MS gravity network the following provisions will be included;

- *Upsizing of key gravity pipelines to accommodate discharges from future WDC wastewater pump stations to the west and north of the site*
- *Positioning connection points to the wastewater network at the boundary of the site to allow for future connections without affecting completed development infrastructure*

Refer to the 3-Waters Assessment Report in **Appendix C** for further details.

6.4.4 Design parameters

*Refer to **Appendix C** for a copy of the **3-Waters Assessment Report** which includes a detailed summary of wastewater parameters and information to be used as part of the design (prepared by Harrison Grierson Consultants).*

6.5 Water Supply

6.5.1 Design philosophy

The following is a description of the water supply design philosophy for the 3MS development;

- *The primary water supply connection for the 3MS site into the Cambridge reticulation is from the existing DN200 on Cambridge Road.*
- *WDC bulk water mains to be provided within the 3Ms development to form part of the network servicing the wider structure plan area.*

6.5.2 Key assumptions

The following is a list of assumptions relating to the water supply design;

- *It is assumed that the existing Cambridge gravity water network will have sufficient pressure / flow to supply the 3MS site, without the need for any booster pumps.*
- *WDC will utilise the existing water supply town reticulation model for Cambridge to assess any impacts on existing infrastructure.*

6.5.3 Structure Plan Integration

The proposed 3MS water supply solution will include the initial north-south bulk main along with bulk mains within the new collector road at the north end of the site. These strategic water supply pipelines form the initial stages of the water supply network for the C2 growth cell. This approach is consistent with the proposed water supply network outlined in the structure plan and will allow WDC to service future to service further development within the wider C2 growth cell area through future connection to these main. Refer to the 3-Waters Assessment Report in **Appendix C** for further details.

6.5.4 Design parameters

*Refer to **Appendix C** for a copy of the **3-Waters Assessment Report** which includes a detailed summary of water supply parameters and information to be used as part of the design (prepared by Harrison Grierson Consultants).*

6.6 Utility Services

6.6.1 Design philosophy

The following is a description of the utility services design philosophy for the 3MS development;

- *Main connections to service 3MS development to be taken from existing services on Cambridge Road*
- *Allowance for future service connections to service future development within tC2 growth cell to be provided within local and collector road links*

6.6.2 Key assumptions

The following is a list of assumptions relating to the utility services design;

- *Existing overhead power lines on Cambridge Road to be undergrounded by Waipa Networks as part of the development (separate WDC project)*
- *Sufficient capacity is available within the existing utility networks to service the 3MS development*

6.6.3 Structure Plan Integration

The proposed 3MS development will provide common services trenches within road services to allow for the installation of utility networks across the subdivision. Utility networks will be sized[3] to accommodate future development within the C2 growth cell where required.

6.6.4 Design parameters

6.6.4.1 Common services trenches

Table 9 below outlines initial dimensions have been specified for common services trenches in new road reserves for the provision of utility services.

Table 9 - Parking requirements

Common services trenches	
Cambridge Road Widening (southern side only)	2.0m
Collector Road	1.8m (both sides)
Local Roads	1.5m (both sides)
Local Access Roads	0.75m (both sides)

[3] *Design networks to be completed by individual utility provides (separate projects)*

6.6.4.2 Power supply

3MS have engaged with Waipa Networks regarding the provision for power supply with the proposed subdivision. A preliminary design has been developed which will be updated to reflect the final development as part of the detailed design process.

6.6.4.3 Telecommunications network

3MS have engaged with had initial discussion with Ultrafast Fibre regarding the provision for power supply with the proposed subdivision. A preliminary design will be developed as part of the detailed design process to accommodate the development and future development within the C2 growth cell.

6.6.4.4 Gas supply

3MS have engaged with had initial discussion with FirstGas regarding the provision for gas supply with the proposed subdivision. A preliminary design will be developed as part of the detailed design process to accommodate the development along with a final decision on whether this service will be provided within the development.

Appendix A

Structure Plan Integration Plans

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

LEGEND

- EXISTING CADASTRAL BOUNDARIES
- ARTERIAL ROAD
- COLLECTOR ROAD
- LOCAL ROAD (INDICATIVE LOCATION)
- WALKING AND CYCLING LINKS (INDICATIVE LOCATION)
- STORMWATER CULVERT / PIPE (INDICATIVE LOCATION)
- EXISTING DEVELOPMENT
- RESIDENTIAL (NET DENSITY = 12.5 DWELLINGS/Ha)
- COMPACT HOUSING OVERLAY
- VISITOR ACCOMMODATION OVERLAY
- ENVIRONMENTAL RESERVE/BUFFER
- LOCAL OPEN SPACE (RESERVE)
- ACTIVE RECREATION (RESERVE)
- STORMWATER WETLAND / BASIN
- OPEN CHANNEL / GREEN SPACE NETWORK
- ST PETERS' SCHOOL ZONE
- NEIGHBOURHOOD CENTRE
- LOCAL CENTRE OVERLAY
- INDICATIVE PRIMARY SCHOOL / PRE-SCHOOL AREA
- HV — OVERHEAD TRANSMISSION POWERLINES
- SITES OF CULTURAL SIGNIFICANCE

N

WAIKATO EXPRESSWAY (SH1)

ABERGELDIE WAY

VICTORIA ROAD

C1 GROWTH CELL

CAMBRIDGE RACEWAY

TOWN GREEN BELT

TAYLOR STREET

SCHOOL SITE

PEAKE ROAD

C2 GROWTH CELL

VOGEL STREET

TOWN GREEN BELT

CAMBRIDGE ROAD / HANLIN ROAD ROUNDABOUT

NEW C2/C3 CAMBRIDGE ROAD ROUNDABOUT

KELLY ROAD

CAMBRIDGE ROAD

AVANTIDROME

EXISTING STREAM

TE AWA LIFECARE DEVELOPMENT

ST PETERS SCHOOL

C3 GROWTH CELL

TOWN GREEN BELT

WAIKATO RIVER

COMBINED C1/C2/C3 OUTFALL STRUCTURE (LOCATION INDICATIVE)

3MS

3MS RESIDENTIAL DEVELOPMENT

STRUCTURE PLAN INTEGRATION GENERAL ARRANGEMENT

DRAWING REVISION: G

DATE PRINTED: 30 November 2020 FILE NAME: 17001-SK-100.dwg

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

LEGEND

- OTHER ZONES
- SOAKAGE BASIN / WETLAND
- OPEN CHANNEL / GREEN LINK (RESERVE)
- ENVIRONMENTAL RESERVE/BUFFER
- ROADS
- WAIKATO RIVER
- CELL BOUNDARY
- STORMWATER CULVERT / PIPE (INDICATIVE LOCATION)

N

WAIKATO EXPRESSWAY (SH1)

C7a DISCHARGES INTO PUKERORO SCHEME DRAIN

C7b DISCHARGES INTO C2 DRAINAGE NETWORK

FUTURE C7 GROWTH CELL

ABERGELDIE WAY

VICTORIA ROAD

C1 GROWTH CELL

FUTURE C1 GROWTH CELL EXTENSION

DICHARGE TO PUKERORO SCHEME DRAIN

CAMBRIDGE RACEWAY

TOWN GREEN BELT

TAYLOR STREET

PEAKE ROAD

C2 GROWTH CELL

TOWN GREEN BELT

KELLY ROAD

CONNECTION TO EXISTING C3 STREAM

CAMBRIDGE ROAD

AVANTIDROME

EXISTING STREAM

TE AWA LIFECARE DEVELOPMENT

ST PETERS SCHOOL

C3 GROWTH CELL

TOWN GREEN BELT

WAIKATO RIVER

COMBINED C1/C2/C3 OUTFALL STRUCTURE

3MS

3MS RESIDENTIAL DEVELOPMENT

STRUCTURE PLAN INTEGRATION STORMWATER NETWORK

DRAWING REVISION: C

DATE PRINTED: 1 December 2020 FILE NAME: 17001-SK-102.dwg

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

LEGEND

- OTHER ZONES
- OPEN SPACE
- WAIKATO RIVER
- EXISTING ROADS
- ARTERIAL ROADS
- COLLECTOR ROADS
- LOCAL ROADS (20m & 15m)
- INDICATIVE FUTURE BUS ROUTE
- GREEN LINKS (WALKING / CYCLING)

N

WAIKATO EXPRESSWAY (SH1)

ABERGELDIE WAY

VICTORIA ROAD

C1 GROWTH CELL

CAMBRIDGE RACEWAY

TOWN GREEN BELT

TAYLOR STREET

PEAKE ROAD

C2 GROWTH CELL

TOWN GREEN BELT

CAMBRIDGE ROAD / HANLIN ROAD ROUNDABOUT

NEW C2/C3 CAMBRIDGE ROAD ROUNDABOUT

KELLY ROAD

CAMBRIDGE ROAD

AVANTIDROME

TE AWA LIFECARE DEVELOPMENT

ST PETERS SCHOOL

C3 GROWTH CELL

TOWN GREEN BELT

WAIKATO RIVER

3MS

3MS RESIDENTIAL DEVELOPMENT

STRUCTURE PLAN INTEGRATION TRANSPORT NETWORK

DRAWING REVISION: C

DATE PRINTED: 1 December 2020 FILE NAME: 17001-SK-103.dwg

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

LEGEND

- OTHER ZONING (i.e. RESIDENTIAL)
- ROADS
- SOAKAGE BASIN / WETLAND
- OPEN SWALE / GREEN LINK (RESERVE)
- LOCAL OPEN SPACE (RESERVE)
- ACTIVE RECREATION (RESERVE)
- AMENITY SPACE
- CIVIC SPACE
- SITES OF CULTURAL SIGNIFICANCE
- SHARED PATH NETWORK (WALKING / CYCLING)
- KEY ROAD CROSSING (WALKING / CYCLING)
- PEDESTRIAN SHED (400m RADIUS / 5min WALK)

N

WAIKATO EXPRESSWAY (SH1)

ABERGELDIE WAY

COLLECTOR ROAD 6

VICTORIA ROAD

C1 GROWTH CELL

COLLECTOR ROAD 7

COLLECTOR ROAD 6

COLLECTOR ROAD 1

CAMBRIDGE RACEWAY

TOWN GREEN BELT

TAYLOR STREET

COLLECTOR ROAD 2 (GRASSLANDS DR)

COLLECTOR ROAD 2

SCHOOL ZONE

PEAKE ROAD

C2 GROWTH CELL

COLLECTOR ROAD 3

COLLECTOR ROAD 1

KELLY ROAD

TOWN GREEN BELT

CAMBRIDGE ROAD

AVANTIDROME

TE AWA LIFECARE DEVELOPMENT

ST PETERS SCHOOL

COLLECTOR ROAD 4

C3 GROWTH CELL

TOWN GREEN BELT

COLLECTOR ROAD 5

WAIKATO RIVER

3MS

3MS RESIDENTIAL DEVELOPMENT

STRUCTURE PLAN INTEGRATION
WALKING & CYCLING

DRAWING REVISION: C

DATE PRINTED: 8 December 2020 FILE NAME: 17001-SK-104.dwg

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

LEGEND

- OTHER ZONES
- ROADS
- ENVIRONMENTAL RESERVE/BUFFER
- LOCAL OPEN SPACE (RESERVE)
- SOAKAGE BASIN / WETLAND
- OPEN SWALE / GREEN LINK (RESERVE)
- ACTIVE RECREATION (RESERVE)
- AMENITY SPACE
- CIVIC SPACE (INDICATIVE LOCATION)
- SITES OF CULTURAL SIGNIFICANCE

N

WAIKATO EXPRESSWAY (SH1)

ABERGELDIE WAY

VICTORIA ROAD

C1 GROWTH CELL

RACECOURSE ROAD

CAMBRIDGE RACEWAY

TOWN GREEN BELT

TAYLOR STREET

PEAKE ROAD

C2 GROWTH CELL

KELLY ROAD

TOWN GREEN BELT

CAMBRIDGE ROAD

AVANTIDROME

TE AWA LIFECARE DEVELOPMENT

ST PETERS SCHOOL

C3 GROWTH CELL

TOWN GREEN BELT

WAIKATO RIVER

3MS

3MS RESIDENTIAL DEVELOPMENT

STRUCTURE PLAN INTEGRATION
OPEN SPACE NETWORK

DRAWING REVISION: C

DATE PRINTED: 1 December 2020 FILE NAME: 17001-SK-105.dwg

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

LEGEND

- OTHER ZONES
- OPEN SPACE
- ROADS
- WAIKATO RIVER
- CELL BOUNDARY
- STAGE ONE
- STAGE TWO
- STAGE THREE

N

WAIKATO EXPRESSWAY (SH1)

ABERGELDIE WAY

VICTORIA ROAD

C1 GROWTH CELL

STAGE ONE

PEAKE ROAD

C2 GROWTH CELL

STAGE THREE

STAGE ONE

STAGE TWO

KELLY ROAD

CAMBRIDGE RACEWAY

TOWN GREEN BELT

TAYLOR STREET

TOWN GREEN BELT

CAMBRIDGE ROAD

AVANTIDROME

STAGE ONE

TE AWA LIFECARE DEVELOPMENT

STAGE ONE

ST PETERS SCHOOL

C3 GROWTH CELL

STAGE TWO

STAGE ONE

TOWN GREEN BELT

STAGE ONE

STAGE TWO

WAIKATO RIVER

STAGE THREE

3MS

3MS RESIDENTIAL DEVELOPMENT

STRUCTURE PLAN INTEGRATION STAGING PLAN

DRAWING REVISION: C

DATE PRINTED: 1 December 2020 FILE NAME: 17001-SK-106.dwg

Appendix B

3MS Master Plan

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

PROJECT

3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN SET



CLIENT

3MS OF CAMBRIDGE GP LTD

MCCAFFREY
ENGINEERING CONSULTANTS

HG

DRAWING REVISION: A

DATE PRINTED: 7 December 2020 FILE NAME: 17001-C-0100.dwg

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DRAWING No.	DRAWING TITLE	REV
	GENERAL	
17001-C-0100	COVER SHEET	B
17001-C-0101	DRAWING LIST	B
17001-C-0105	GENERAL ARRANGEMENT	F
17001-C-0109	SHEET LAYOUT	B
	EARTHWORKS	
17001-C-0110	EARTHWORKS DESIGN CONTOURS GENERAL ARRANGEMENT	B
17001-C-0112	EARTHWORKS CUT FILL DIAGRAM GENERAL ARRANGEMENT	B
17001-C-0121	EARTHWORKS DESIGN CONTOURS LAYOUT PLAN SHEET 1 OF 3	B
17001-C-0122	EARTHWORKS DESIGN CONTOURS LAYOUT PLAN SHEET 2 OF 3	B
17001-C-0123	EARTHWORKS DESIGN CONTOURS LAYOUT PLAN SHEET 3 OF 3	B
	ROADING	
17001-C-0200	ROADING GENERAL ARRANGEMENT	C
17001-C-0201	ROADING LAYOUT PLAN SHEET 1 OF 3	C
17001-C-0202	ROADING LAYOUT PLAN SHEET 2 OF 3	C
17001-C-0203	ROADING LAYOUT PLAN SHEET 3 OF 3	C
17001-C-0204	TYPICAL CROSS SECTIONS SHEET 1	G
17001-C-0205	TYPICAL CROSS SECTIONS SHEET 2	F
17001-C-0207	TRANSPORT NETWORK WALKING & CYCLING NETWORK GENERAL ARRANGEMENT	D
17001-C-0208	TRANSPORT NETWORK CAMBRIDGE ROAD INTERFACE INTERIM & FUTURE LAYOUT	A
17001-C-0221	C2 NORTH-EASTERN COLLECTOR ROAD PLAN & LONGITUDINAL SECTION SHEET 1 OF 2	C
17001-C-0222	C2 NORTH-EASTERN COLLECTOR ROAD PLAN & LONGITUDINAL SECTION SHEET 2 OF 2	C
17001-C-0231	ROAD 10 PLAN & LONGITUDINAL SECTION SHEET 1 OF 3	C
17001-C-0232	ROAD 10 PLAN & LONGITUDINAL SECTION SHEET 2 OF 3	C
17001-C-0233	ROAD 10 PLAN & LONGITUDINAL SECTION SHEET 3 OF 3	C
17001-C-0241	ROAD 11 PLAN & LONGITUDINAL SECTION SHEET 1 OF 2	C
17001-C-0242	ROAD 11 PLAN & LONGITUDINAL SECTION SHEET 2 OF 2	C
17001-C-0251	ROAD 12 PLAN & LONGITUDINAL SECTION	C
17001-C-0261	ROAD 13 & 14 PLAN & LONGITUDINAL SECTION	C
17001-C-0281	ROAD 15 PLAN & LONGITUDINAL SECTION	C
17001-C-0291	ROAD 16 PLAN & LONGITUDINAL SECTION	C
17001-C-0311	ROAD 18 PLAN & LONGITUDINAL SECTION	C
17001-C-0331	ROAD 20 PLAN & LONGITUDINAL SECTION SHEET 1 OF 2	C
17001-C-0332	ROAD 20 PLAN & LONGITUDINAL SECTION SHEET 2 OF 2	A
17001-C-0351	ROAD 21 PLAN & LONGITUDINAL SECTION SHEET 1 OF 2	C
17001-C-0352	ROAD 21 PLAN & LONGITUDINAL SECTION SHEET 2 OF 2	A
17001-C-0371	ROAD 22 PLAN & LONGITUDINAL SECTION SHEET 1 OF 2	C
17001-C-0381	ROAD 23 PLAN & LONGITUDINAL SECTION SHEET 1 OF 2	C
17001-C-0382	ROAD 23 PLAN & LONGITUDINAL SECTION SHEET 2 OF 2	C
17001-C-0391	ROAD 17 PLAN & LONGITUDINAL SECTION SHEET	C
17001-C-0395	TYPICAL LOCAL ROAD & LOCAL ROAD INTERSECTION	C
17001-C-0396	TYPICAL COLLECTOR & LOCAL ROAD INTERSECTION	B
	STORMWATER	
17001-C-0400	STORMWATER GENERAL ARRANGEMENT	B
17001-C-0401	STORMWATER LAYOUT PLAN SHEET 1 OF 3	B
17001-C-0402	STORMWATER LAYOUT PLAN SHEET 2 OF 3	B
17001-C-0403	STORMWATER LAYOUT PLAN SHEET 3 OF 3	B
17001-C-0420	STORMWATER CENTRAL BASIN PLAN & TYPICAL SECTION	A
17001-C-0430	STORMWATER CENTRAL SWALE INTERIM & FUTURE LAYOUT	A
	WASTEWATER	
17001-C-0500	WASTEWATER GENERAL ARRANGEMENT	B
17001-C-0501	WASTEWATER LAYOUT PLAN SHEET 1 OF 3	B
17001-C-0502	WASTEWATER LAYOUT PLAN SHEET 2 OF 3	B
17001-C-0503	WASTEWATER LAYOUT PLAN SHEET 3 OF 3	B
17001-C-0510	WASTEWATER LONGITUDINAL SECTION SHEET 1	B
17001-C-0511	WASTEWATER LONGITUDINAL SECTION SHEET 2	B
17001-C-0520	WASTEWATER PUMP STATION DETAILS	B
	WATER SUPPLY	
17001-C-0600	WATER SUPPLY GENERAL ARRANGEMENT	B
17001-C-0601	WATER SUPPLY LAYOUT PLAN SHEET 1 OF 3	B
17001-C-0602	WATER SUPPLY LAYOUT PLAN SHEET 2 OF 3	B
17001-C-0603	WATER SUPPLY LAYOUT PLAN SHEET 3 OF 3	B
	UTILITY SERVICES	
17001-C-0700	UTILITY SERVICES GENERAL ARRANGEMENT	B
17001-C-0701	UTILITY SERVICES LAYOUT PLAN SHEET 1 OF 3	B
17001-C-0702	UTILITY SERVICES LAYOUT PLAN SHEET 2 OF 3	B
17001-C-0703	UTILITY SERVICES LAYOUT PLAN SHEET 3 OF 3	B

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MACCAFFREY — DATE: 17.04.20

DRAWN BY: G. JONES — DATE: 17.04.20

APPROVED BY: — — DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: DRAWING LIST

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

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DRAWING No.: 17001-C-0101

FILE NAME: 17001-C-0101.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 10 20 40 60 80 100 200 300 400 500

GRASSLANDS DRIVE

ROAD 17

COLLECTOR ROAD 2

MoE SCHOOL SITE

ROAD 23

ROAD 21

ROAD 22

STORMWATER RESERVE

ROAD 10

ROAD 20

ROAD 18

STORMWATER RESERVE

STORMWATER RESERVE

ROAD 14

ROAD 15

ROAD 16

ROAD 11

SUPERLOT SITE

ROAD 10

ROAD 12

ROAD 13

CAMBRIDGE ROAD

TE AWA LIFECARE DEVELOPMENT

KELLY ROAD

VOGEL STREET

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- INDICATIVE BLOCK BOUNDARIES
- COLLECTOR ROAD
- LOCAL ROAD
- LOCAL ACCESS ROAD
- GENERAL RESIDENTIAL
- COMPACT RESIDENTIAL OVERLAY
- TERRACED RESIDENTIAL HOUSING
- VISITOR ACCOMMODATION OVERLAY
- INDICATIVE SCHOOL AREA
- NEIGHBORHOOD CENTRE
- STORMWATER RESERVE
- LOCAL OPEN SPACE (RESERVE)
- ACTIVE RECREATION (RESERVE)

REV	DESCRIPTION	BY	DATE
F	FOR INFORMATION	GCJ	10.08.20
E	FOR INFORMATION	LPM	06.07.20
D	FOR INFORMATION	LPM	24.04.20
C	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 15.01.20
DRAWN BY: G. JONES	DATE: 15.01.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: GENERAL ARRANGEMENT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:5000

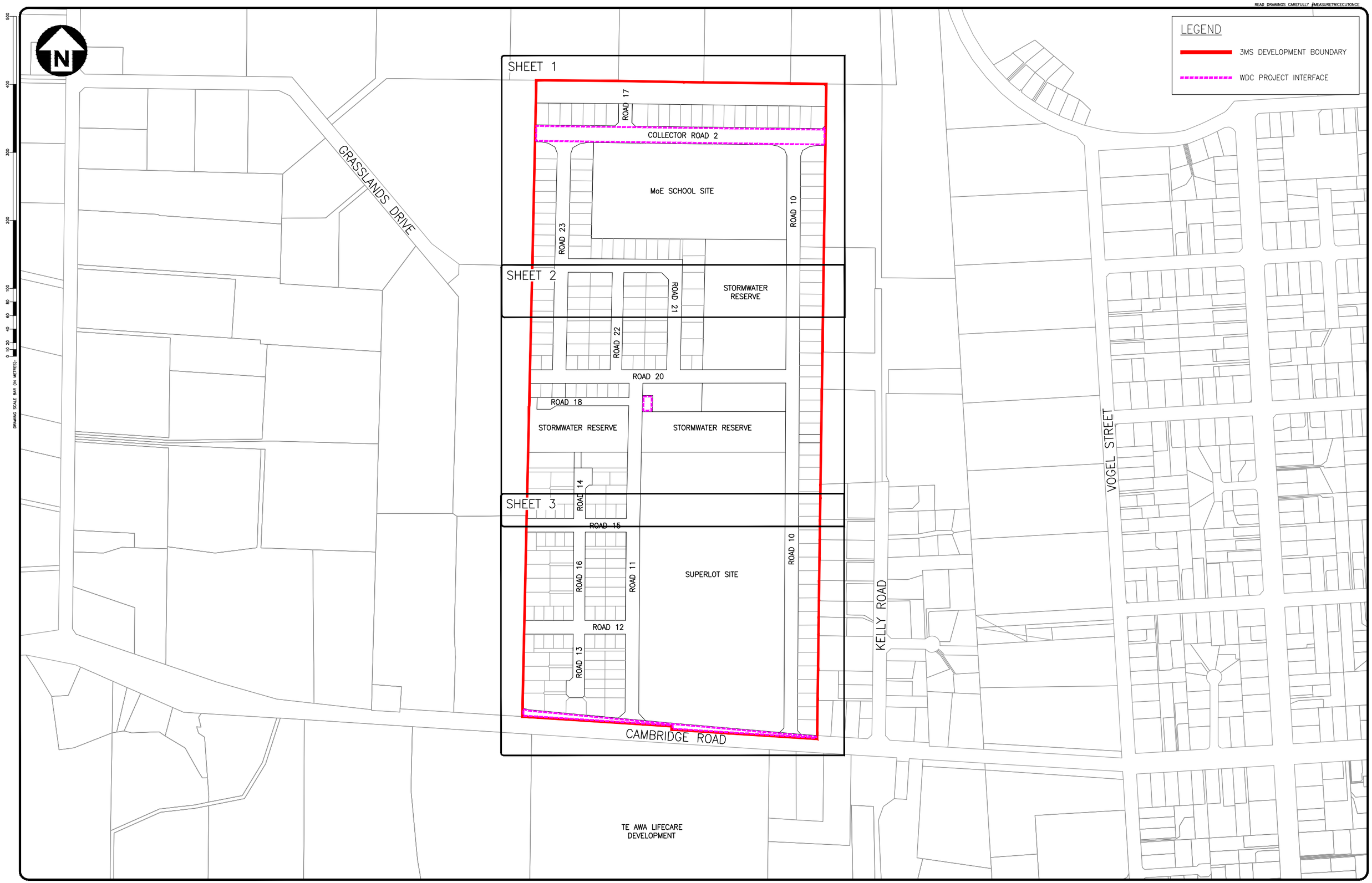
REVISION No.: F

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0105

FILE NAME: 17001–C–0105.dwg

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REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

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DESIGNED BY: L. MCCAFFREY — DATE: 03.04.20

DRAWN BY: G. JONES — DATE: 03.04.20

APPROVED BY: — — DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: SHEET LAYOUT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DRAWING SCALE: 1:5000

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0109

DATE PRINTED: 7 December 2020

FILE NAME: 17001-C-0109.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUDARY
- 1.0 — DESIGN CONTOUR (1.0m INTERVAL)
- DESIGN CONTOUR (0.1m INTERVAL)

NOTES:

1. CONCEPT DESIGN ONLY. EARTHWORKS CONTOURS SHOWN ARE BASED ON PROPOSED DESIGN SURFACE LEVELS
2. DESIGN OF EARTHWORKS (AND ASSOCIATED INFRASTRUCTURE) IS STILL SUBJECT TO FURTHER DESIGN DEVELOPMENT AND APPROVAL BY RELEVANT AUTHORITIES
3. THE FINAL STRUCTURE PLAN LAYOUT IS SUBJECT TO CONFIRMATION BY WAIPA DISTRICT COUNCIL
4. EXISTING CONTOURS SHOWN ARE BASED ON WRC LIDAR INFORMATION (2007/2008)

DRAWING SCALE BAR (IN METRES): 0 10 20 40 60 80 100 200 300 400 500

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE	03.04.20
DRAWN BY	G. JONES	DATE	03.04.20
APPROVED BY	–	DATE	–

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: EARTHWORKS DESIGN CONTOURS

GENERAL ARRANGEMENT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:5000

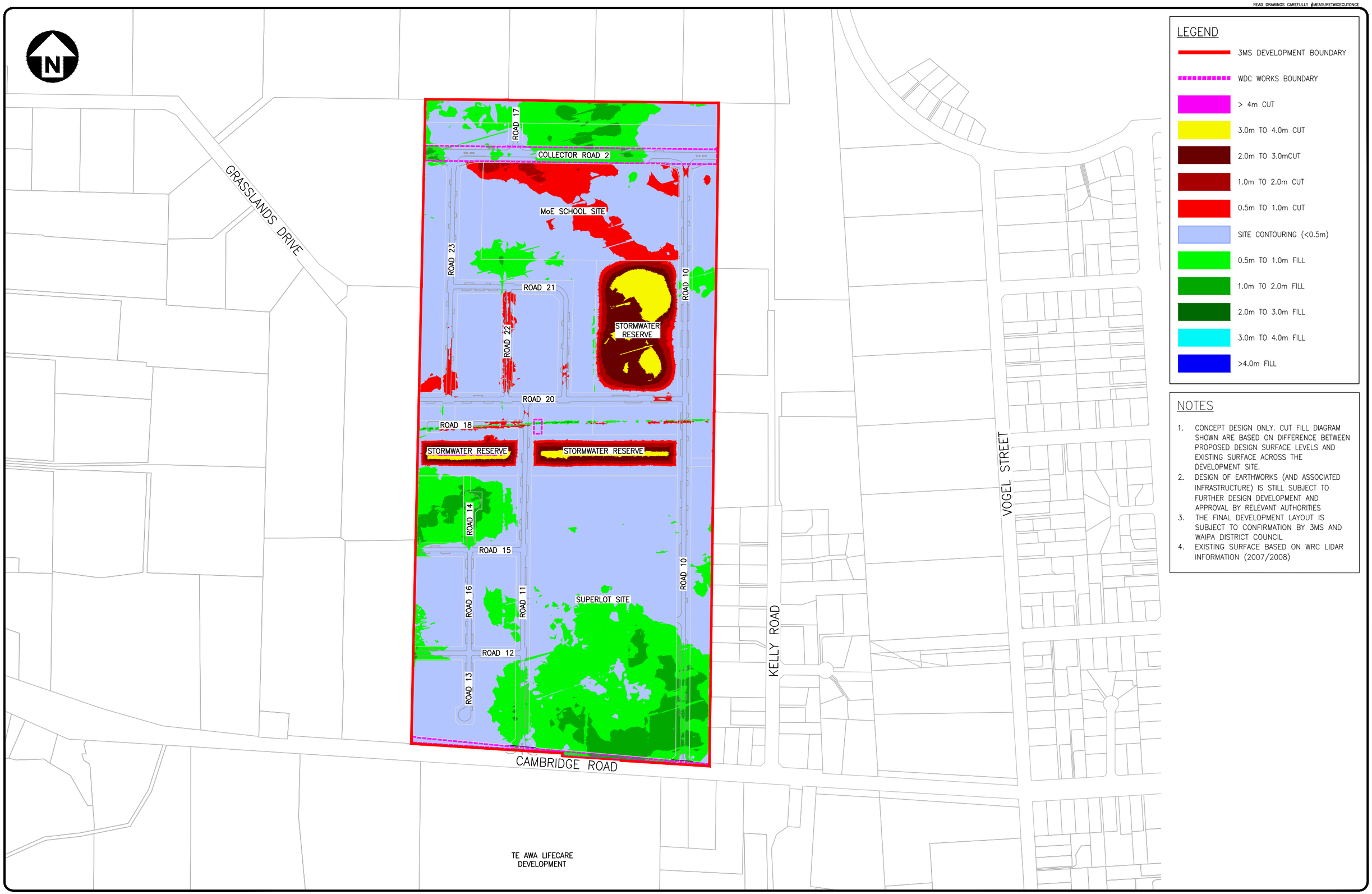
DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0110

REVISION No.: B

FILE NAME: 17001-C-0110.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- > 4m CUT
- 3.0m TO 4.0m CUT
- 2.0m TO 3.0mCUT
- 1.0m TO 2.0m CUT
- 0.5m TO 1.0m CUT
- SITE CONTOURING (<0.5m)
- 0.5m TO 1.0m FILL
- 1.0m TO 2.0m FILL
- 2.0m TO 3.0m FILL
- 3.0m TO 4.0m FILL
- >4.0m FILL

NOTES

1. CONCEPT DESIGN ONLY. CUT FILL DIAGRAM SHOWN ARE BASED ON DIFFERENCE BETWEEN PROPOSED DESIGN SURFACE LEVELS AND EXISTING SURFACE ACROSS THE DEVELOPMENT SITE.
2. DESIGN OF EARTHWORKS (AND ASSOCIATED INFRASTRUCTURE) IS STILL SUBJECT TO FURTHER DESIGN DEVELOPMENT AND APPROVAL BY RELEVANT AUTHORITIES
3. THE FINAL DEVELOPMENT LAYOUT IS SUBJECT TO CONFIRMATION BY 3MS AND WAIPA DISTRICT COUNCIL
4. EXISTING SURFACE BASED ON WRC LIDAR INFORMATION (2007/2008)

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 13.03.20
DRAWN BY	G. JONES	DATE 13.03.20
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: EARTHWORKS CUT FILL DIAGRAM GENERAL ARRANGEMENT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

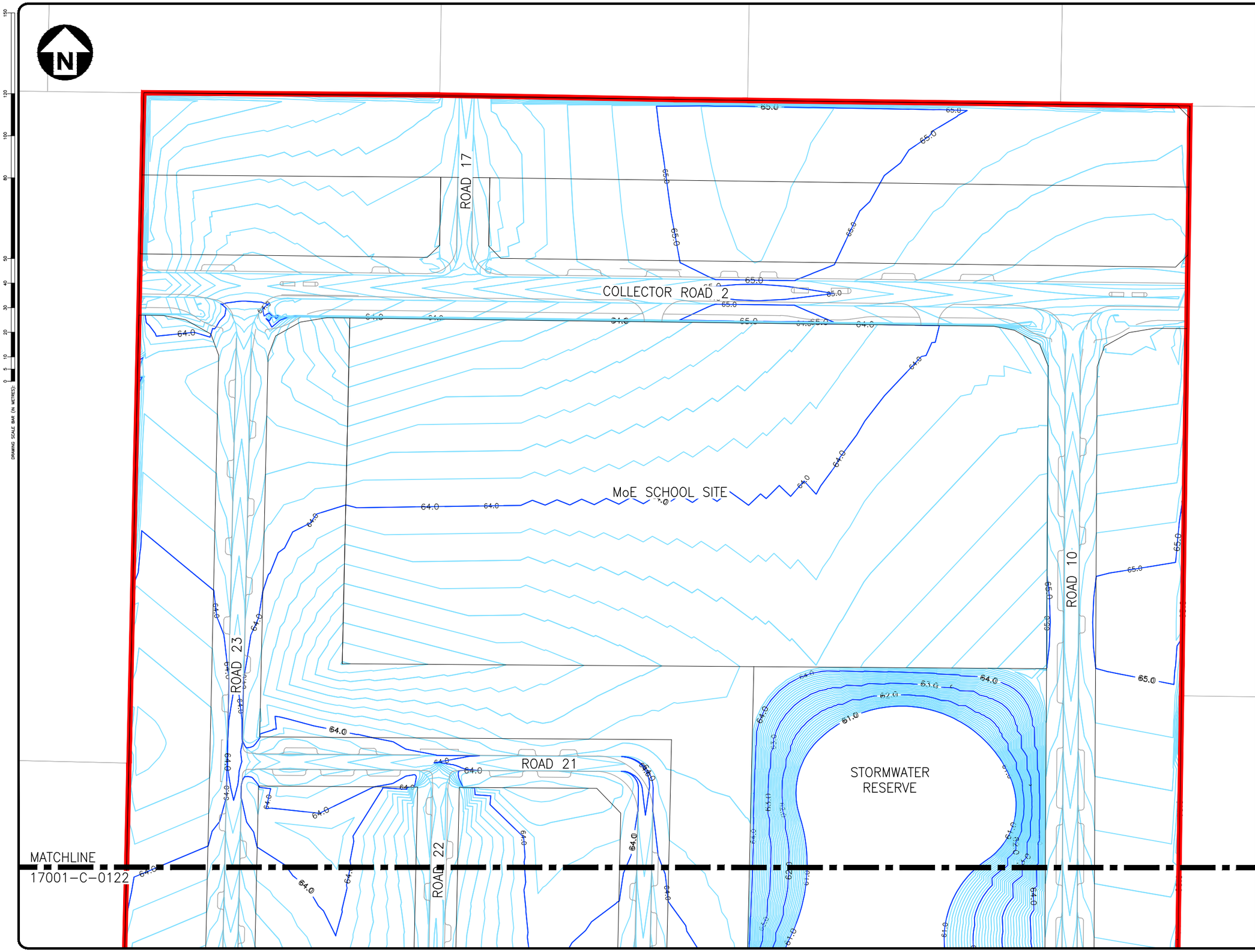
DATE PRINTED: 7 December 2020

DRAWING SCALE	1:5000
REVISION No.	B
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001–C–0112

FILE NAME: 17001–C–0112.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

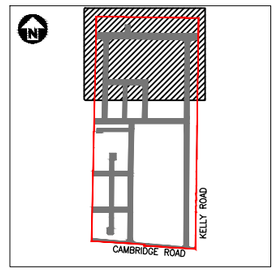


LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- 66 — DESIGN CONTOUR (1.0m INTERVAL)
- DESIGN CONTOUR (0.2m INTERVAL)

NOTES:

1. CONCEPT DESIGN ONLY. EARTHWORKS CONTOURS SHOWN ARE BASED ON PROPOSED DESIGN SURFACE LEVELS
2. DESIGN OF EARTHWORKS (AND ASSOCIATED INFRASTRUCTURE) IS STILL SUBJECT TO FURTHER DESIGN DEVELOPMENT AND APPROVAL BY RELEVANT AUTHORITIES
3. THE FINAL STRUCTURE PLAN LAYOUT IS SUBJECT TO CONFIRMATION BY WAIPA DISTRICT COUNCIL
4. EXISTING CONTOURS SHOWN ARE BASED ON WRC LIDAR INFORMATION (2007/2008)



KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 03.04.20
DRAWN BY: G. JONES	DATE: 03.04.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: EARTHWORKS DESIGN CONTOURS LAYOUT PLAN SHEET 1 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500	REVISION No.: B
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001-C-0121	

FILE NAME: 17001-C-0121.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

17001-C-012
MATCHLINE

ROAD 23
ROAD 22
ROAD 21
ROAD 20
ROAD 18
ROAD 15
ROAD 14
ROAD 11
ROAD 10

STORMWATER RESERVE
STORMWATER RESERVE
STORMWATER RESERVE

SUPERLOT SITE

MATCHLINE
17001-C-0123

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- 66 DESIGN CONTOUR (1.0m INTERVAL)
- DESIGN CONTOUR (0.2m INTERVAL)

NOTES:

1. CONCEPT DESIGN ONLY. EARTHWORKS CONTOURS SHOWN ARE BASED ON PROPOSED DESIGN SURFACE LEVELS
2. DESIGN OF EARTHWORKS (AND ASSOCIATED INFRASTRUCTURE) IS STILL SUBJECT TO FURTHER DESIGN DEVELOPMENT AND APPROVAL BY RELEVANT AUTHORITIES
3. THE FINAL STRUCTURE PLAN LAYOUT IS SUBJECT TO CONFIRMATION BY WAIPA DISTRICT COUNCIL
4. EXISTING CONTOURS SHOWN ARE BASED ON WRC LIDAR INFORMATION (2007/2008)

KELLY ROAD
CAMBRIDGE ROAD

KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 03.04.20
DRAWN BY: G. JONES	DATE: 03.04.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: EARTHWORKS DESIGN CONTOURS LAYOUT PLAN SHEET 2 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500	REVISION No.: B
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001-C-0122	

FILE NAME: 17001-C-0122.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 5 10 20 30 40 50 80 100 120 150

17001-C-0122
MATCHLINE

ROAD 15

ROAD 16

ROAD 11

ROAD 12

ROAD 13

ROAD 10

SUPERLOT SITE

CAMBRIDGE ROAD

64.0

65.0

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- 66 — DESIGN CONTOUR (1.0m INTERVAL)
- DESIGN CONTOUR (0.2m INTERVAL)

NOTES:

1. CONCEPT DESIGN ONLY. EARTHWORKS CONTOURS SHOWN ARE BASED ON PROPOSED DESIGN SURFACE LEVELS
2. DESIGN OF EARTHWORKS (AND ASSOCIATED INFRASTRUCTURE) IS STILL SUBJECT TO FURTHER DESIGN DEVELOPMENT AND APPROVAL BY RELEVANT AUTHORITIES
3. THE FINAL STRUCTURE PLAN LAYOUT IS SUBJECT TO CONFIRMATION BY WAIPA DISTRICT COUNCIL
4. EXISTING CONTOURS SHOWN ARE BASED ON WRC LIDAR INFORMATION (2007/2008)

KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 03.04.20
DRAWN BY	G. JONES	DATE 03.04.20
APPROVED BY	—	DATE —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: EARTHWORKS DESIGN CONTOURS LAYOUT PLAN SHEET 3 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

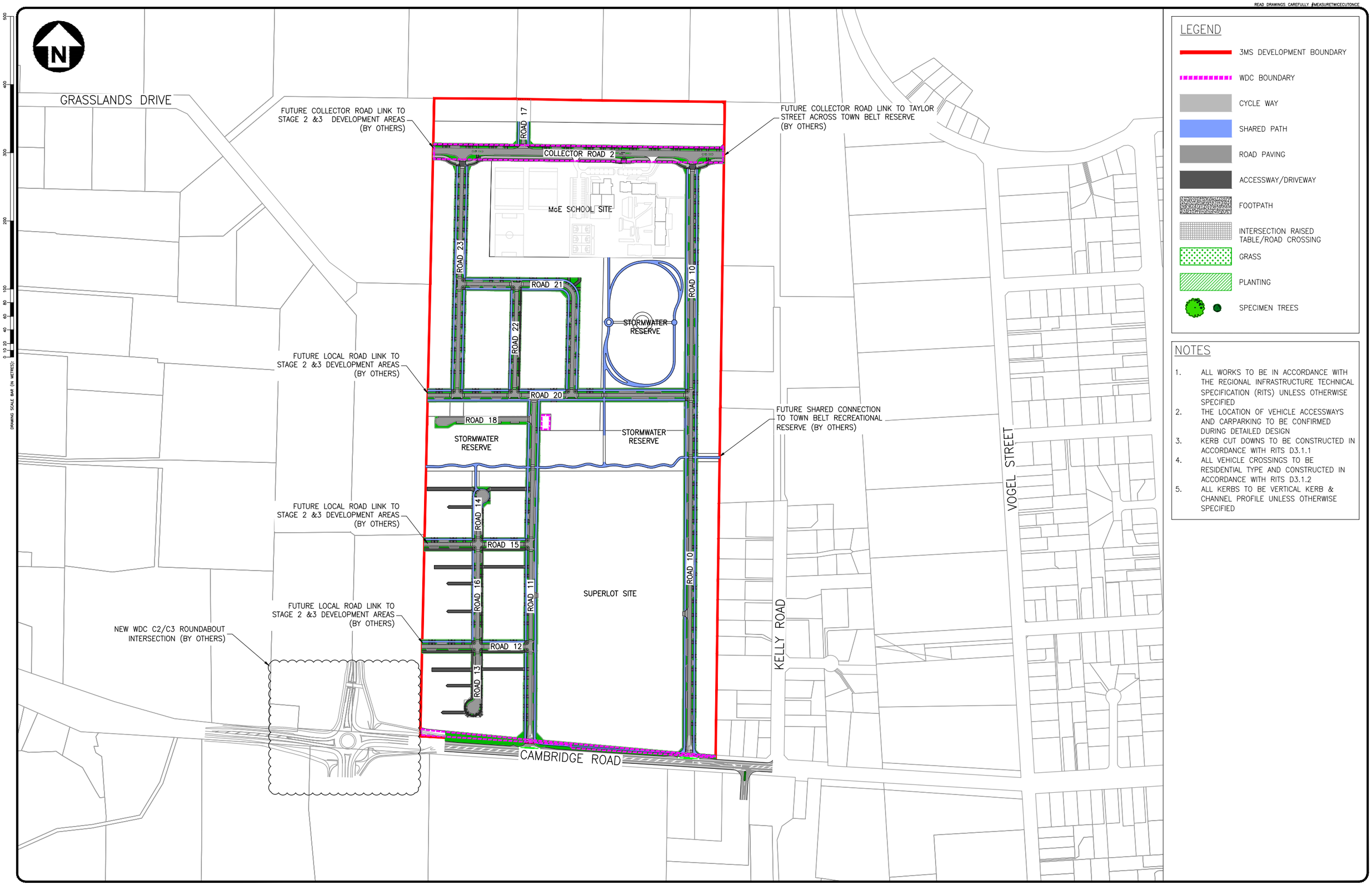
REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0123

FILE NAME: 17001-C-0123.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	27.11.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE	30.03.20
DRAWN BY	G. JONES	DATE	30.03.20
APPROVED BY	–	DATE	–

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING GENERAL ARRANGMENT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:5000

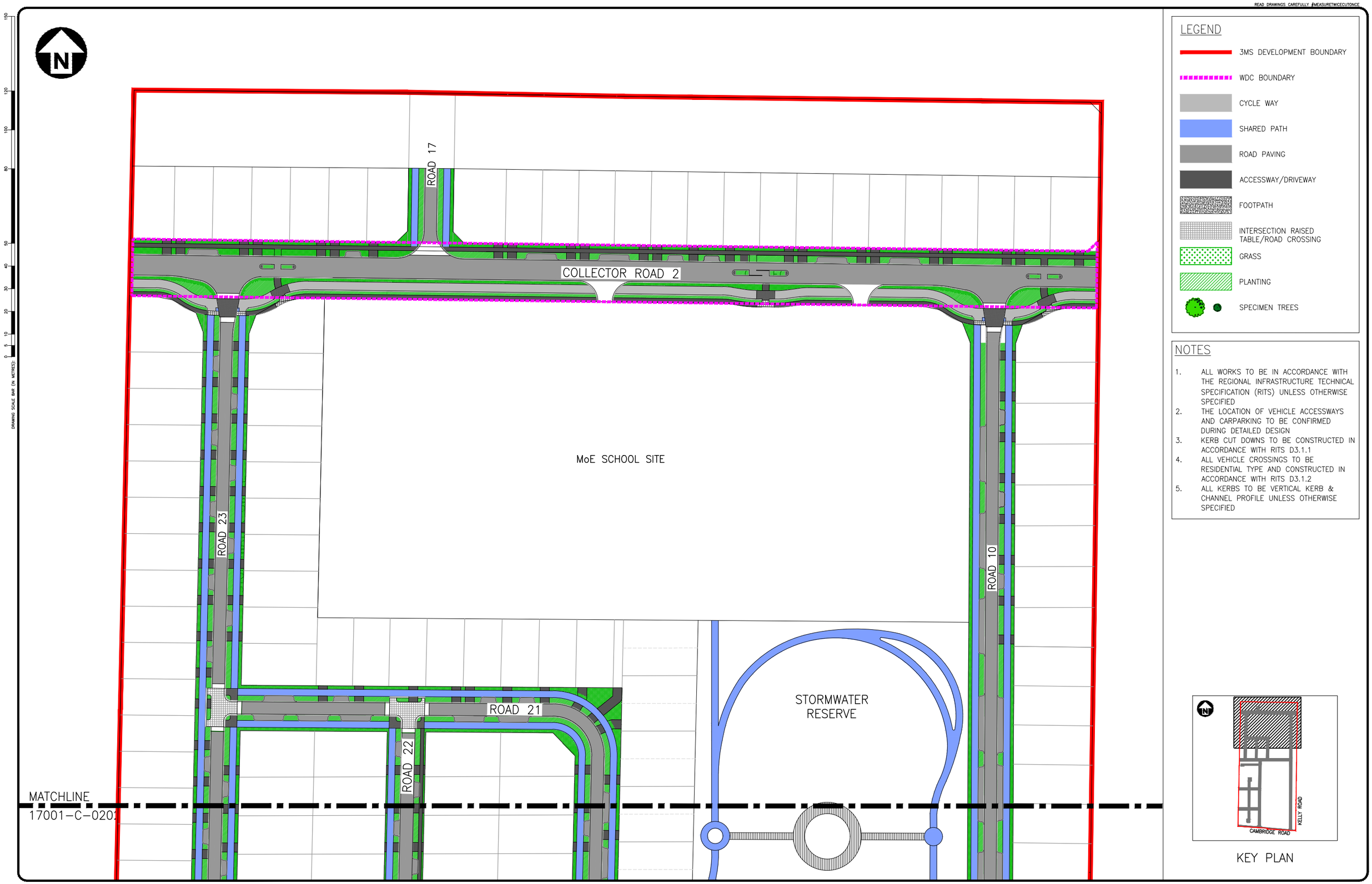
REVISION No.: C

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0200

FILE NAME: 17001-C-0200.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED

KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	27.11.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 30.03.20
DRAWN BY	G. JONES	DATE 30.03.20
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

REVISION No.: C

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0201

FILE NAME: 17001-C-0201.dwg

READ DRAWINGS CAREFULLY IMEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 5 10 20 30 40 50 80 100 120 150

N

17001–C–0201
MATCHLINE

ROAD 23
ROAD 22
ROAD 21
ROAD 10
ROAD 20
ROAD 18
ROAD 11
ROAD 14

STORMWATER RESERVE

STORMWATER RESERVE

STORMWATER RESERVE

SUPERLOT SITE

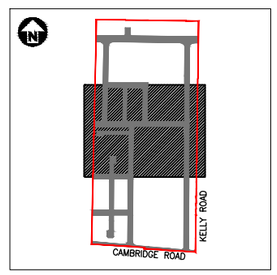
MATCHLINE
17001–C–0203

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	27.11.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 30.03.20
DRAWN BY	G. JONES	DATE 30.03.20
APPROVED BY	—	DATE —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING LAYOUT PLAN

SHEET 2 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE	1:1500
REVISION No.	C
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001–C–0202

FILE NAME: 17001–C–0202.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

N

17001-C-0202
MATCHLINE

ROAD 15

ROAD 16

ROAD 11

ROAD 12

ROAD 13

ROAD 10

SUPERLOT SITE

PROPOSED INTERFACE WITH EXISTING CAMBRIDGE ROAD CORRIDOR. REFER TO 17001-C-0208 FOR FURTHER DETAILS

CAMBRIDGE ROAD

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED

KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	27.11.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE	30.03.20
DRAWN BY	G. JONES	DATE	30.03.20
APPROVED BY	—	DATE	—

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING LAYOUT PLAN

SHEET 3 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

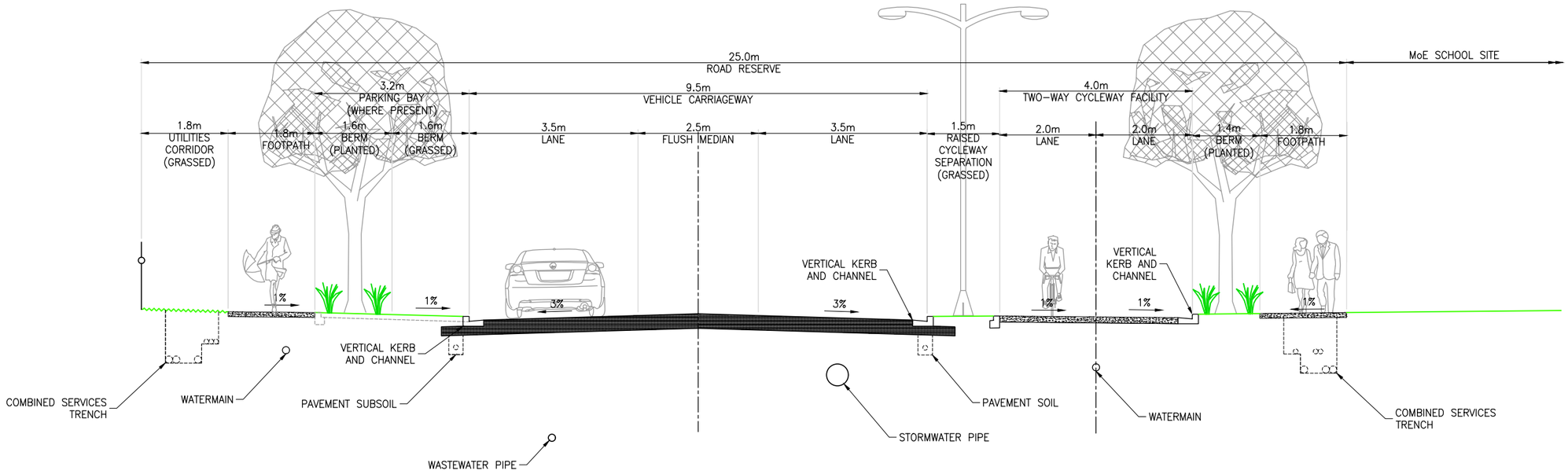
DATE PRINTED: 7 December 2020

DRAWING SCALE	1:1500
REVISION No.	C
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001-C-0203

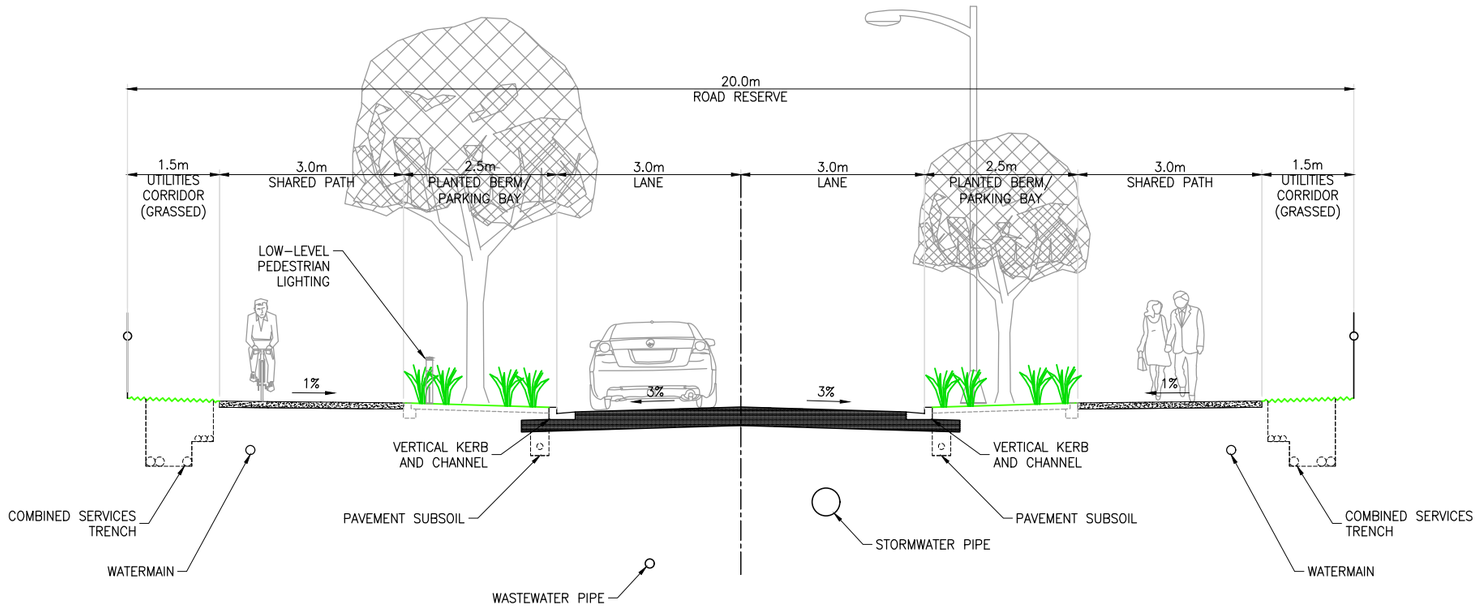
FILE NAME: 17001-C-0203.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 0.5 1 2 4 6 8 10



TYPICAL CROSS SECTION – 25m WDC COLLECTOR ROAD
(COLLECTOR ROAD 2)



TYPICAL CROSS SECTION – 20m LOCAL ROAD
(ROAD 10, 12, 15, 17, 19, 20 21 & 23)

NOTES:

1. TYPICAL SECTIONS SHOWN ARE CONCEPTS FOR DISCUSSION PURPOSES ONLY.
2. LOCATION OF WATER SERVICES SHOWN IS INDICATIVE ONLY AND SUBJECT TO FURTHER DESIGN.

REV	DESCRIPTION	BY	DATE
I	FOR INFORMATION – COLLECTOR ROAD UPDATED	LPM	27.11.20
H	FOR INFORMATION – 3MS ONLY UPDATE	LPM	04.11.20
G	FOR INFORMATION	GCJ	10.08.20
F	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 15.01.20
DRAWN BY	G. JONES	DATE 15.01.20
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

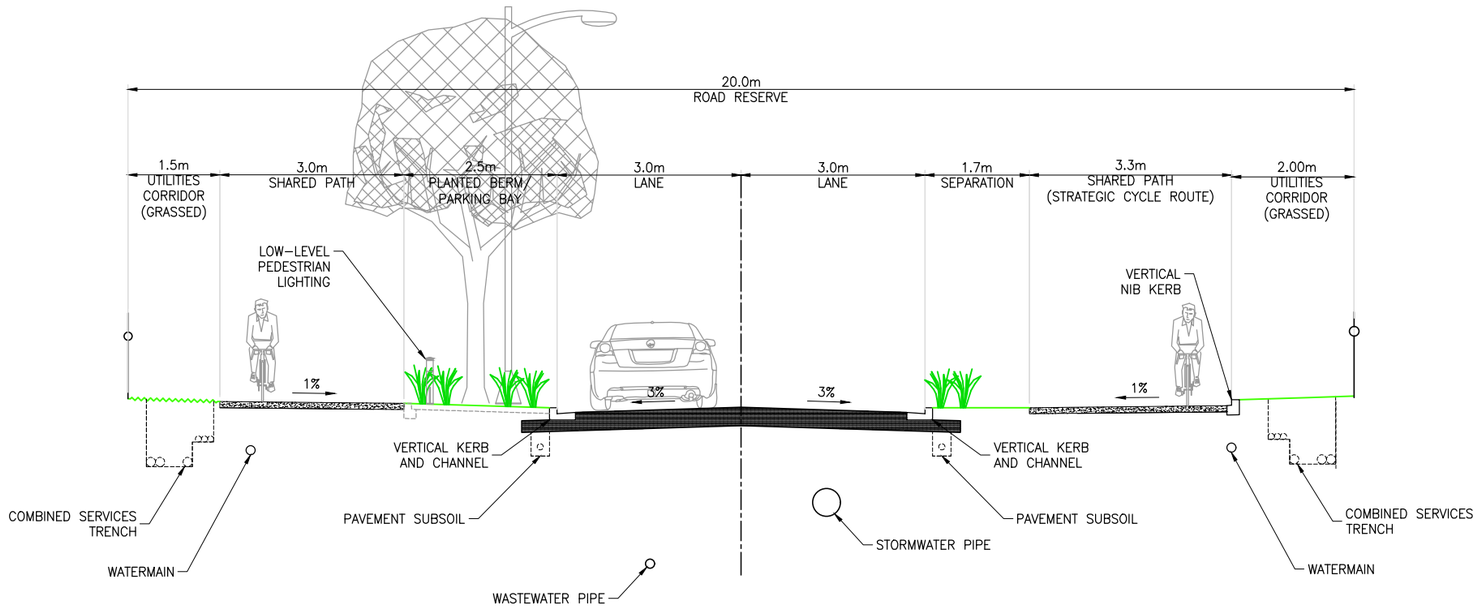
DRAWING TITLE: ROADING NETWORK
TYPICAL CROSS SECTIONS
SHEET 1

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS
DATE PRINTED: 7 December 2020

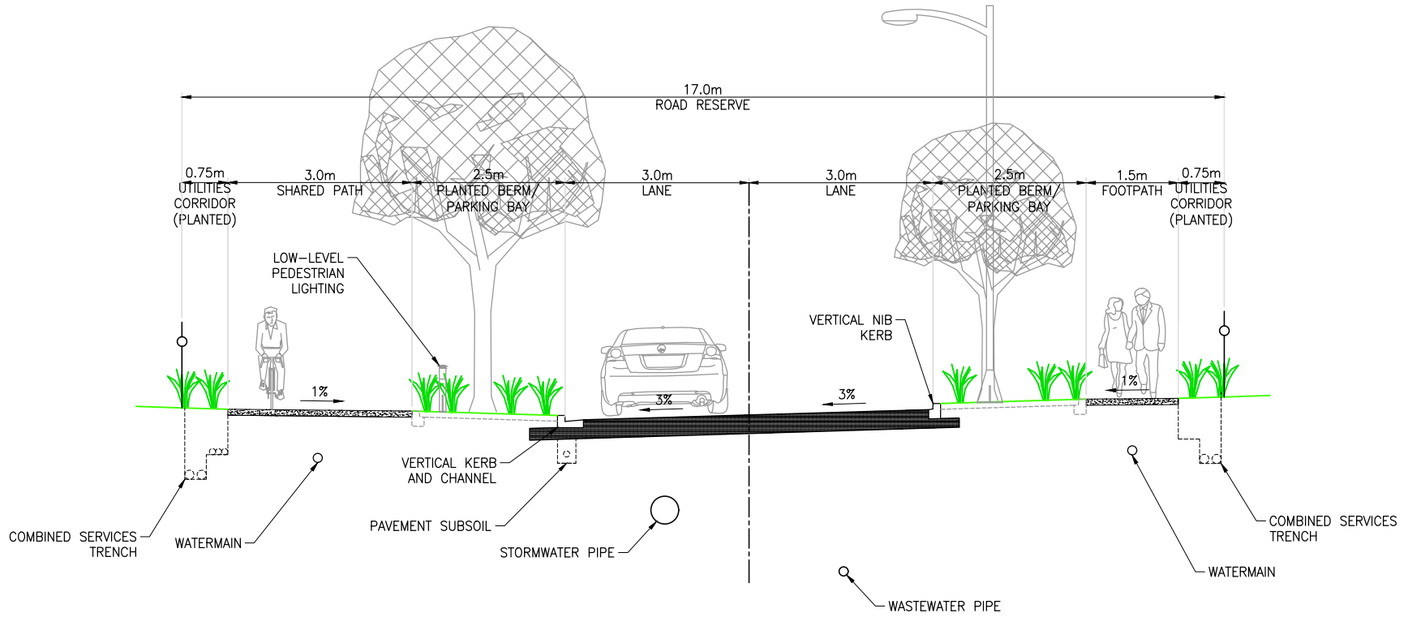
DRAWING SCALE: 1:100
REVISION No.: I
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001-C-0204
FILE NAME: 17001-C-0204.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 0.5 1 2 4 6 8 10



TYPICAL CROSS SECTION – 20m LOCAL ROAD / STRATEGIC CYCLING CONNECTION (ROAD 11)



TYPICAL CROSS SECTION – 17m LOCAL ACCESS ROAD (ROAD 13, 14, 16 & 22)

NOTES:

1. TYPICAL SECTIONS SHOWN ARE CONCEPTS FOR DISCUSSION PURPOSES ONLY.
2. LOCATION OF WATER SERVICES SHOWN IS INDICATIVE ONLY AND SUBJECT TO FURTHER DESIGN.

REV	DESCRIPTION	BY	DATE
G	FOR INFORMATION – 3MS ONLY UPDATE	LPM	03.11.20
F	FOR INFORMATION	GCJ	10.08.20
E	FOR INFORMATION	GCJ	17.04.20
D	FOR INFORMATION	LPM	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 15.01.20
DRAWN BY	G. JONES	DATE 15.01.20
APPROVED BY	—	DATE —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING NETWORK TYPICAL CROSS SECTIONS

SHEET 2

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DRAWING SCALE: 1:100

REVISION No.: G

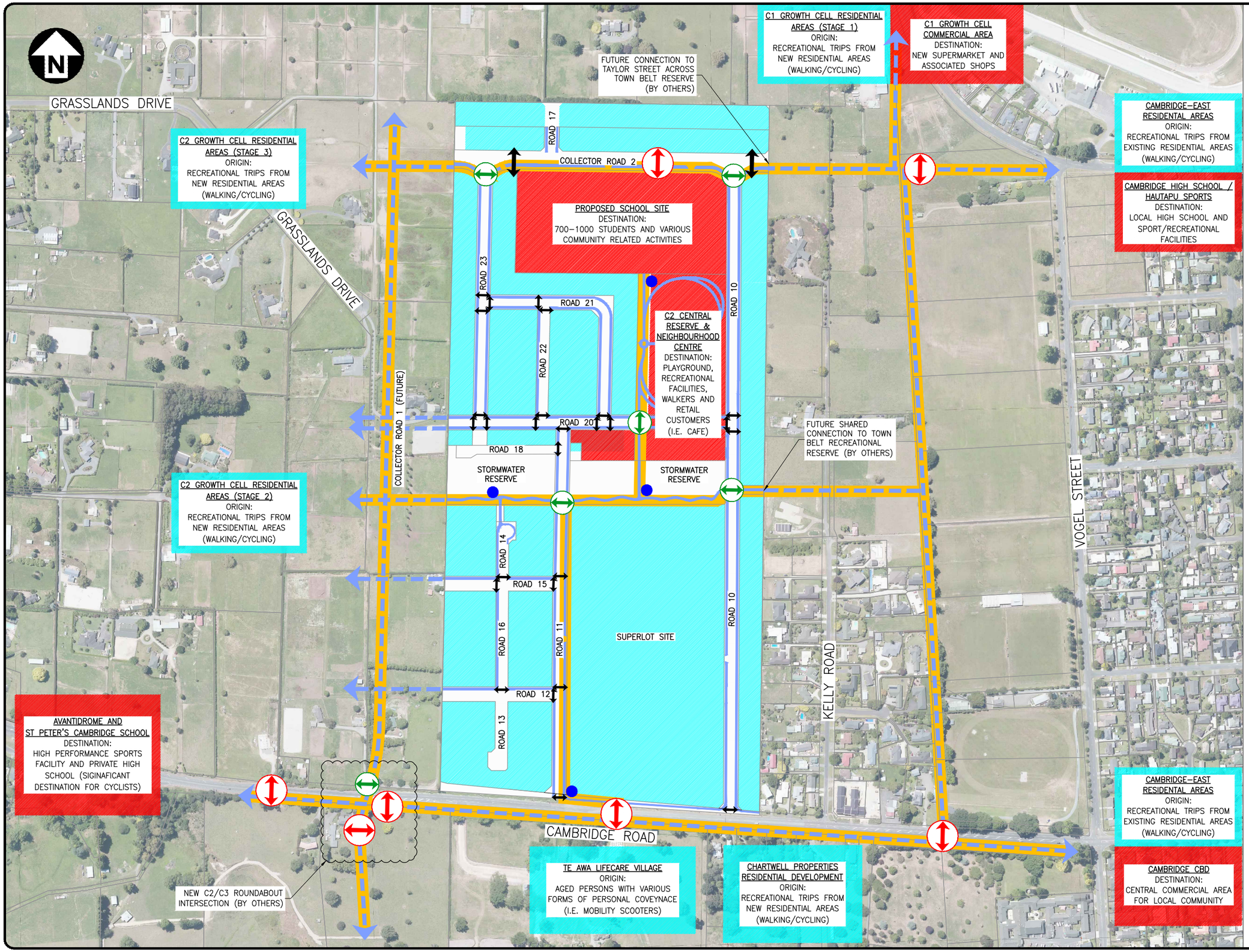
DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0205

DATE PRINTED: 7 December 2020

FILE NAME: 17001-C-0205.dwg

READ DRAWINGS CAREFULLY & MEASURETWICEBEFORECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- CENTRAL CYCLEWAY (TWO–WAY)
- SHARED PATH
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING

STRUCTURE PLAN WALKING/CYCLING STRATEGY

- ORIGIN — WALKING/CYCLING JOURNEY ORIGIN
- DESTINATION — WALKING/CYCLING JOURNEY DESTINATION
- STRATEGIC CONNECTIVITY
- FUTURE WALKING/CYCLING NETWORK LINK
- STRATEGIC WALKING/CYCLING CROSSING
- PRIORITY WALKING/CYCLING CROSSING (i.e. VEHICLES GIVE–WAY)
- STANDARD WALKING/CYCLING CROSSING
- POSSIBLE CYCLE PARKING/ RELATED AMENITIES FACILITIES

REV	DESCRIPTION	BY	DATE
D	FOR INFORMATION	GCJ	27.11.20
C	FOR INFORMATION	LPM	17.03.20
B	FOR INFORMATION	GCJ	30.03.20
A	FOR INFORMATION	LPM	31.01.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 31.01.20
DRAWN BY	L. MCCAFFREY	DATE 31.01.20
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: TRANSPORT NETWORK WALKING & CYCLING NETWORK

GENERAL ARRANGEMENT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:5000

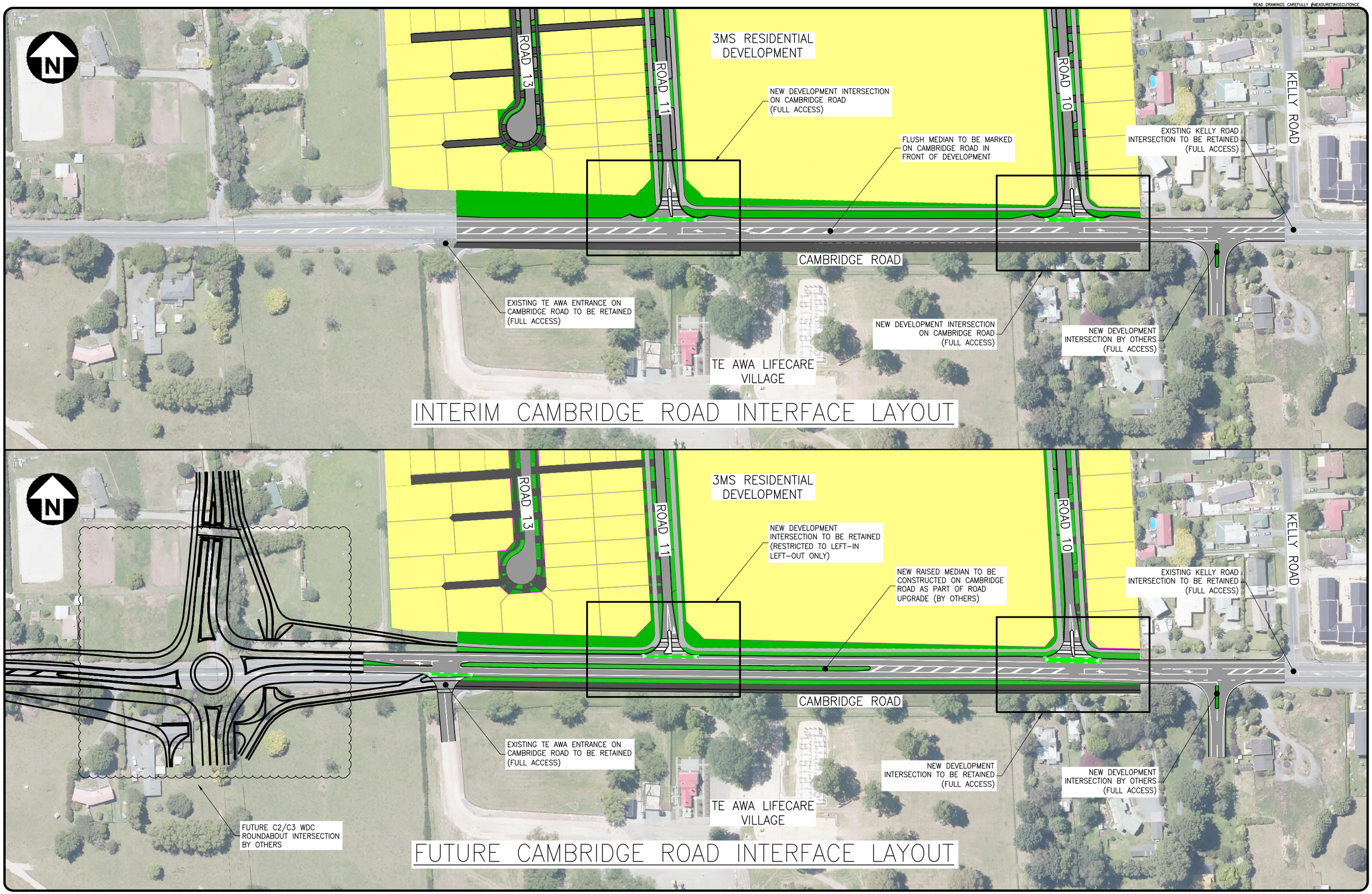
REVISION No.: D

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0207

FILE NAME: 17001–C–0207.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



INTERIM CAMBRIDGE ROAD INTERFACE LAYOUT

FUTURE CAMBRIDGE ROAD INTERFACE LAYOUT

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	LPM	27.11.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 27.11.20
DRAWN BY	L. MCCAFFREY	DATE 27.11.20
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: TRANSPORT NETWORK CAMBRIDGE ROAD INTERFACE

INTERIM AND FUTURE LAYOUT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:2000

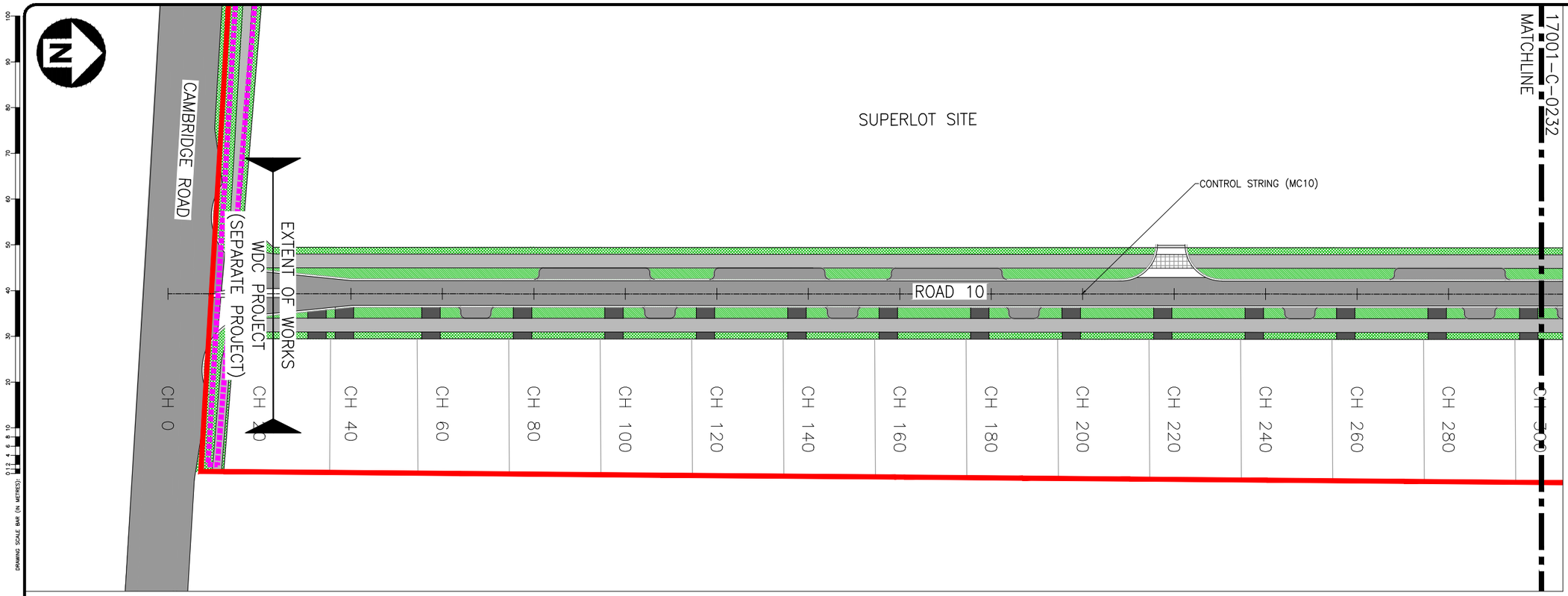
REVISION No.: A

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0207

FILE NAME: 17001-C-0208.dwg

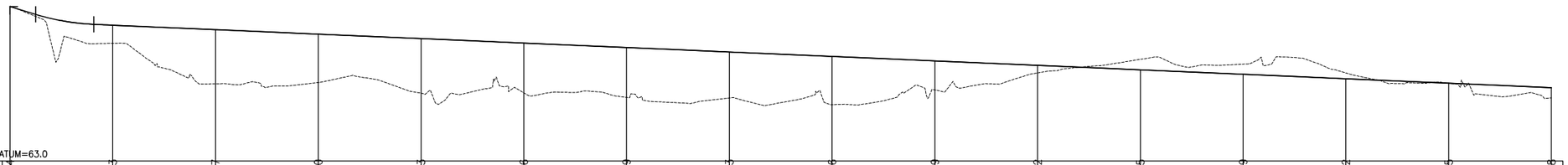
READ DRAWINGS CAREFULLY ∴MEASURETWICECUTONCE



LAYOUT PLAN
SCALE = 1:1000

LEGEND
- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES
1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	66.004	65.643	65.557
EXISTING SURFACE	66.010	65.290	64.501
VERTICAL PROFILE	-3% L=5m	R=441.2m L=11.3m	-0.43% L=441.7m
HORIZONTAL ELEMENTS	D=684.28m		
DISTANCE	0	20	40

DESIGN SURFACE	65.479	65.383	65.296
EXISTING SURFACE	64.528	64.319	64.328
VERTICAL PROFILE			
HORIZONTAL ELEMENTS			
DISTANCE	60	80	100

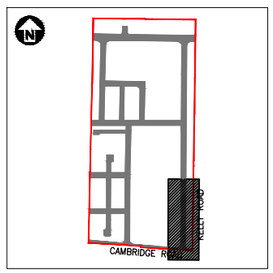
DESIGN SURFACE	65.209	65.123	65.036
EXISTING SURFACE	64.238	64.225	64.096
VERTICAL PROFILE			
HORIZONTAL ELEMENTS			
DISTANCE	120	140	160

DESIGN SURFACE	64.949	64.862	64.775
EXISTING SURFACE	64.382	64.715	64.979
VERTICAL PROFILE			
HORIZONTAL ELEMENTS			
DISTANCE	180	200	220

DESIGN SURFACE	64.689	64.602	64.515
EXISTING SURFACE	64.885	64.714	64.515
VERTICAL PROFILE			
HORIZONTAL ELEMENTS			
DISTANCE	240	260	280

DESIGN SURFACE	64.428		
EXISTING SURFACE	64.228		
VERTICAL PROFILE			
HORIZONTAL ELEMENTS			
DISTANCE	300		

LONGITUDINAL SECTION – (MC10)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 10 PLAN & LONGITUDINAL SECTION

SHEET 1 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000

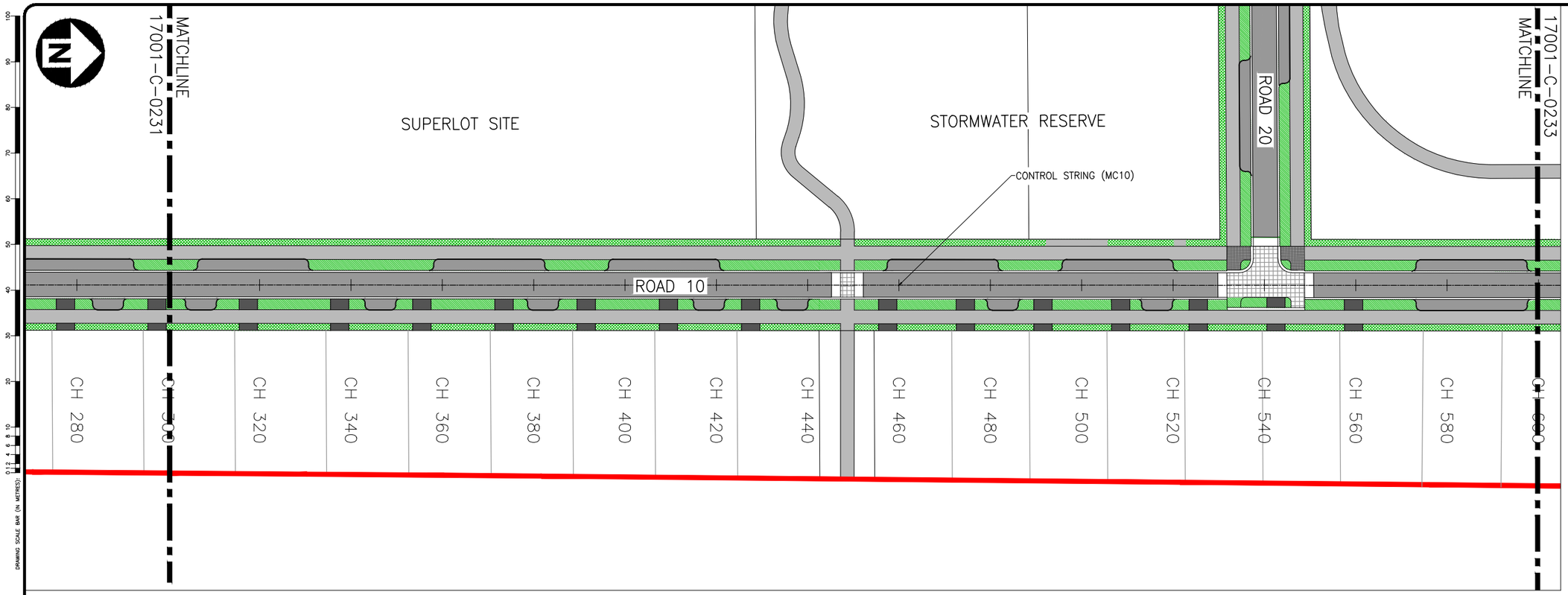
REVISION No.: C

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0231

FILE NAME: 17001-C-0231.dwg

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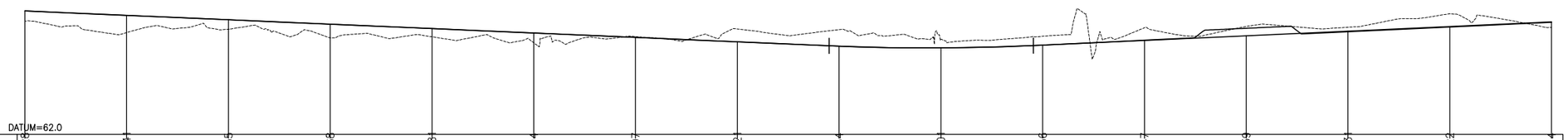
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

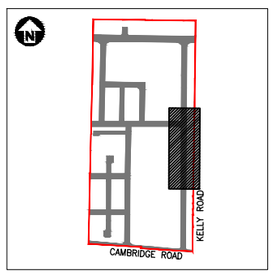
NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
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DESIGN SURFACE	64.426	64.34	64.255	64.168	64.081	63.994	63.907	63.82	63.734	63.70	63.756	63.847	63.939	64.03	64.122	64.214		
EXISTING SURFACE	64.228	64.003	64.070	63.899	63.92	63.803	63.924	64.073	64.06	63.873	63.930	64.098	64.123	64.109	64.373	64.104		
VERTICAL PROFILE	−0.43%								R=4500m			0.46%						
	L=441.7m								L=40.2m			L=241.2m						
HORIZONTAL ELEMENTS	D=684.28m																	
DISTANCE	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600		

LONGITUDINAL SECTION – (MC10)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

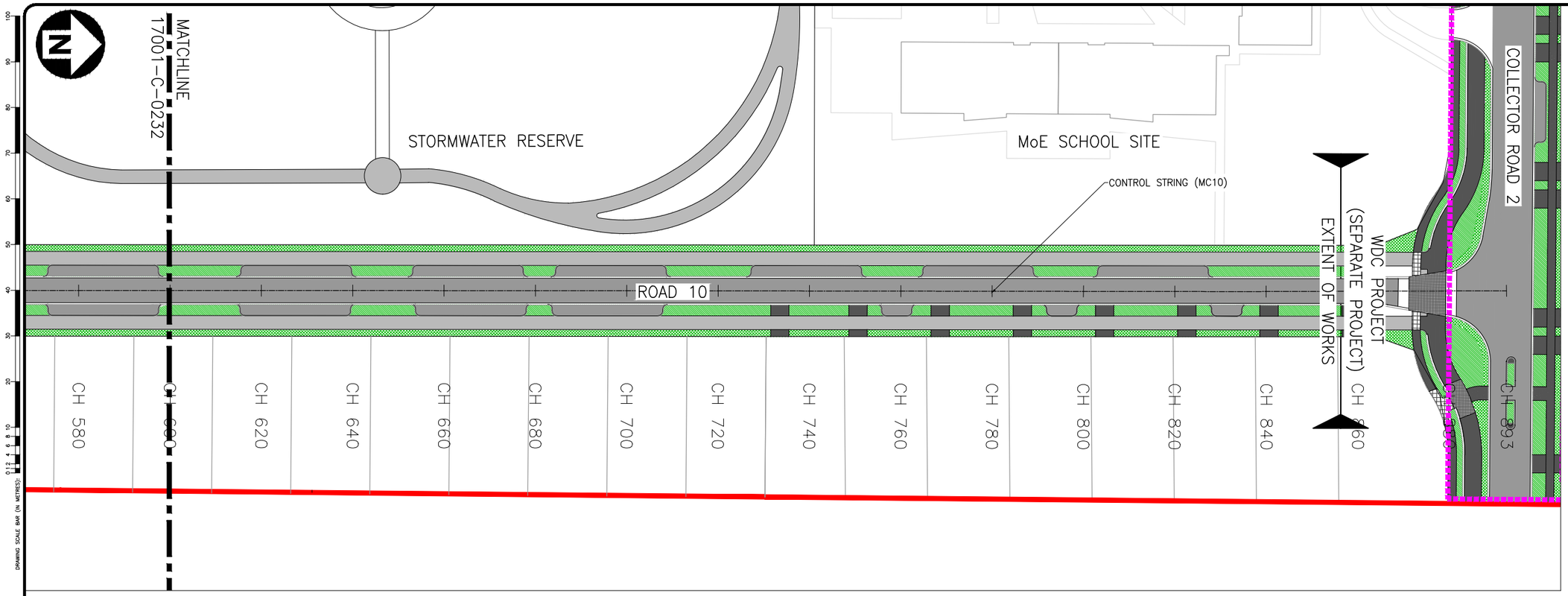
PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 10
PLAN & LONGITUDINAL SECTION
SHEET 2 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS
DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001-C-0232
FILE NAME: 17001-C-0232.dwg

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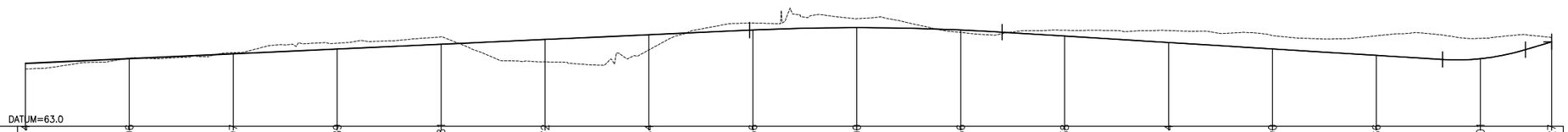
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

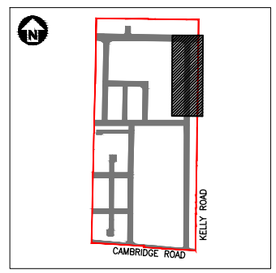
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DESIGN SURFACE	64.214	64.306	64.397	64.489	64.581	64.672	64.764	64.856	64.906	64.856	64.738	64.614	64.490	64.366	64.301	64.622			
EXISTING SURFACE	64.104	64.311	64.418	64.601	64.723	64.239	64.471	64.989	65.073	64.807	64.849	64.844	64.747	64.744	64.694	64.711			
VERTICAL PROFILE	0.46%							R=4500m			-0.62%				R=441.2m		3%		
	L=241.2m							L=48.6m			L=84.8m				L=16m		L=5m		
HORIZONTAL ELEMENTS	D=684.28m							D=150.66m						D=58.76m					
DISTANCE	600	620	640	660	680	700	720	740	760	780	800	820	840	860	880	893.7			

LONGITUDINAL SECTION – (MC10)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
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APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 10 PLAN & LONGITUDINAL SECTION

SHEET 3 OF 3

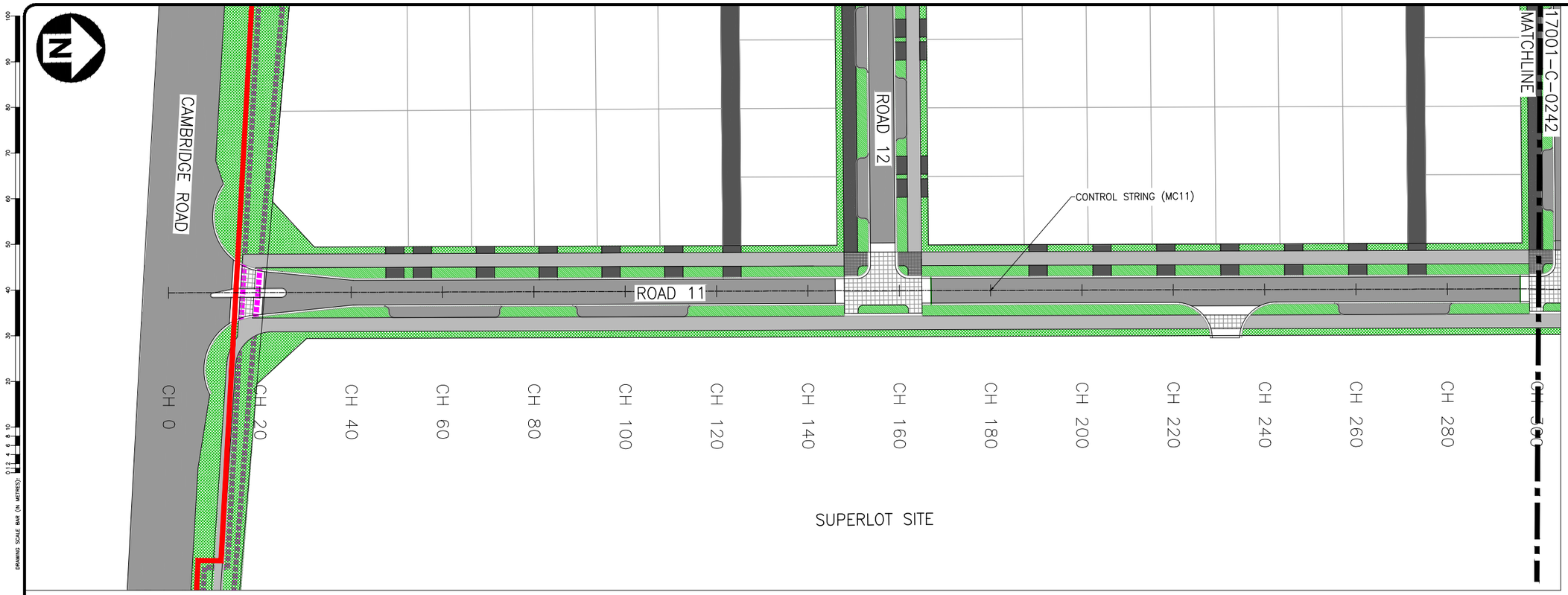
PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000	REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001-C-0233	

FILE NAME: 17001-C-0233.dwg

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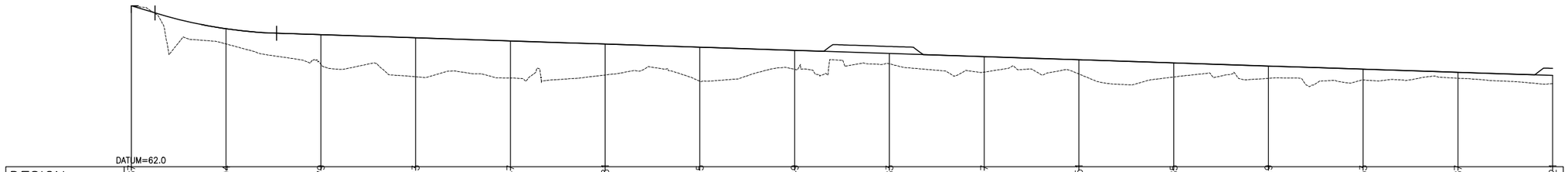
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

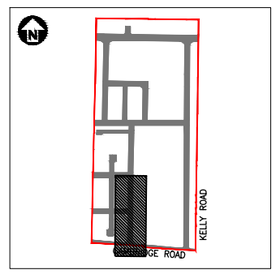
NOTES

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5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	65.384	64.904	64.779	64.713	64.647	64.581	64.515	64.449	64.383	64.317	64.251	64.185	64.119	64.053	63.987	63.921					
EXISTING SURFACE	65.384	64.584	64.155	63.895	63.867	63.930	63.799	64.050	64.165	63.992	63.952	63.888	63.860	63.825	63.863	63.747					
VERTICAL PROFILE	-3% L=5m	R=961.5m L=25.7m								-0.33% L=421m											
HORIZONTAL ELEMENTS	D=309.66m																				
DISTANCE	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300					

LONGITUDINAL SECTION – (MC11)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

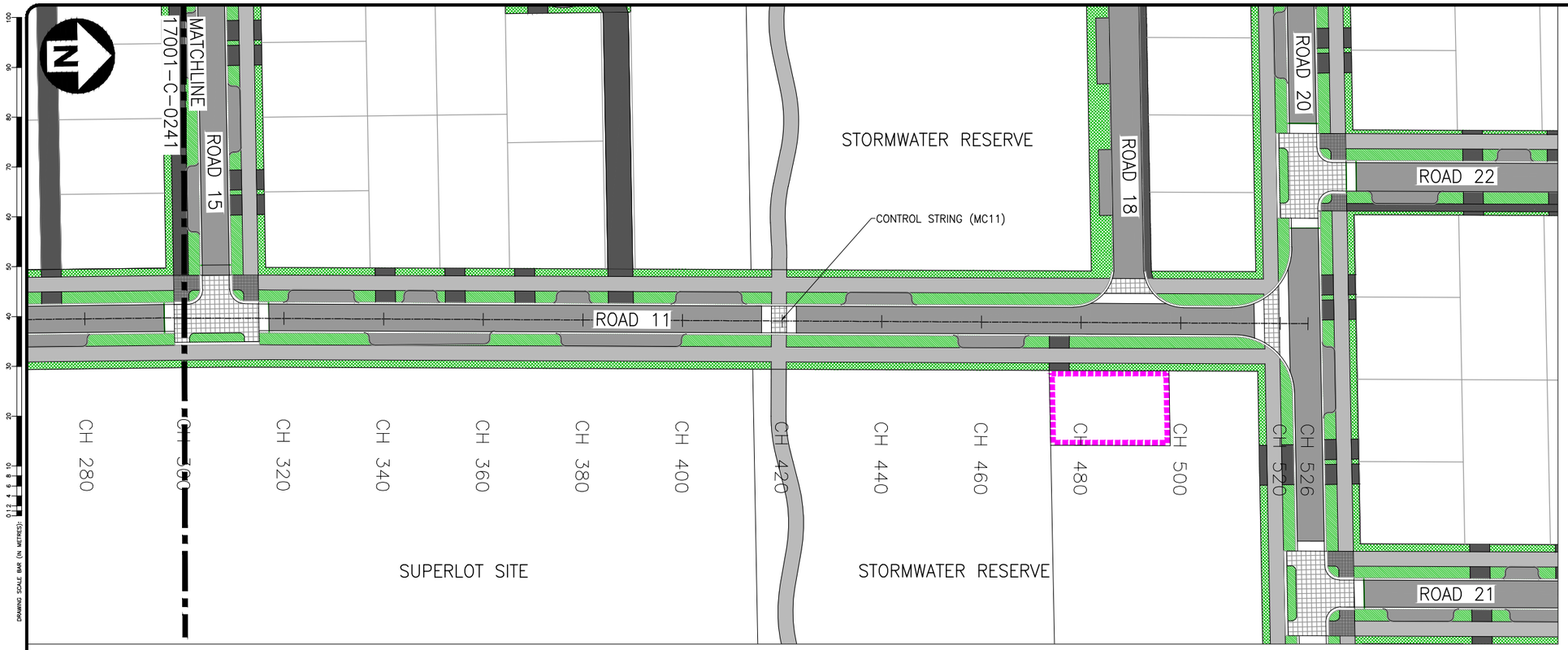
DRAWING TITLE: ROAD 11
PLAN & LONGITUDINAL SECTION
SHEET 1 OF 2

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS
DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000	REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001-C-0241	

FILE NAME: 17001-C-0241.dwg

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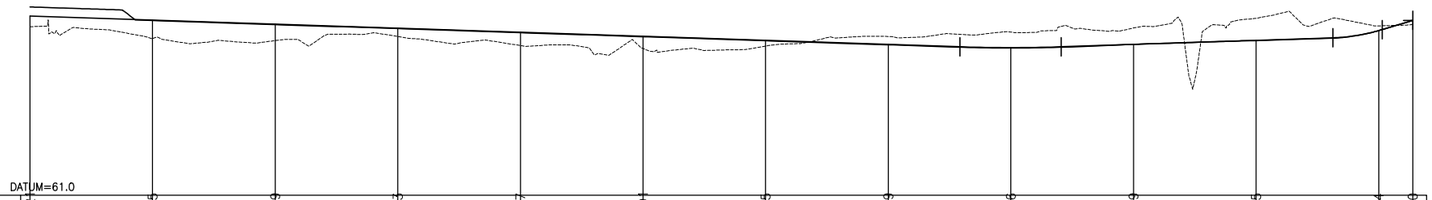
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

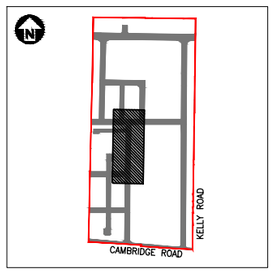
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DESIGN SURFACE	63.924	63.855	63.789	63.725	63.657	63.591	63.525	63.459	63.406	63.459	63.525	63.684	63.854
EXISTING SURFACE	63.747	63.552	63.520	63.587	63.440	63.392	63.432	63.589	63.659	63.726	63.884	63.761	63.786
VERTICAL PROFILE	−0.33%								R=2500m	0.33%		R=300.3m	3%
	L=421m								L=16.5m	L=44.3m		L=8m	L=5m
HORIZONTAL ELEMENTS	D=309.66m						D=215.89m						
DISTANCE	300	320	340	360	380	400	420	440	460	480	500	520	525.6

LONGITUDINAL SECTION – (MC11)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

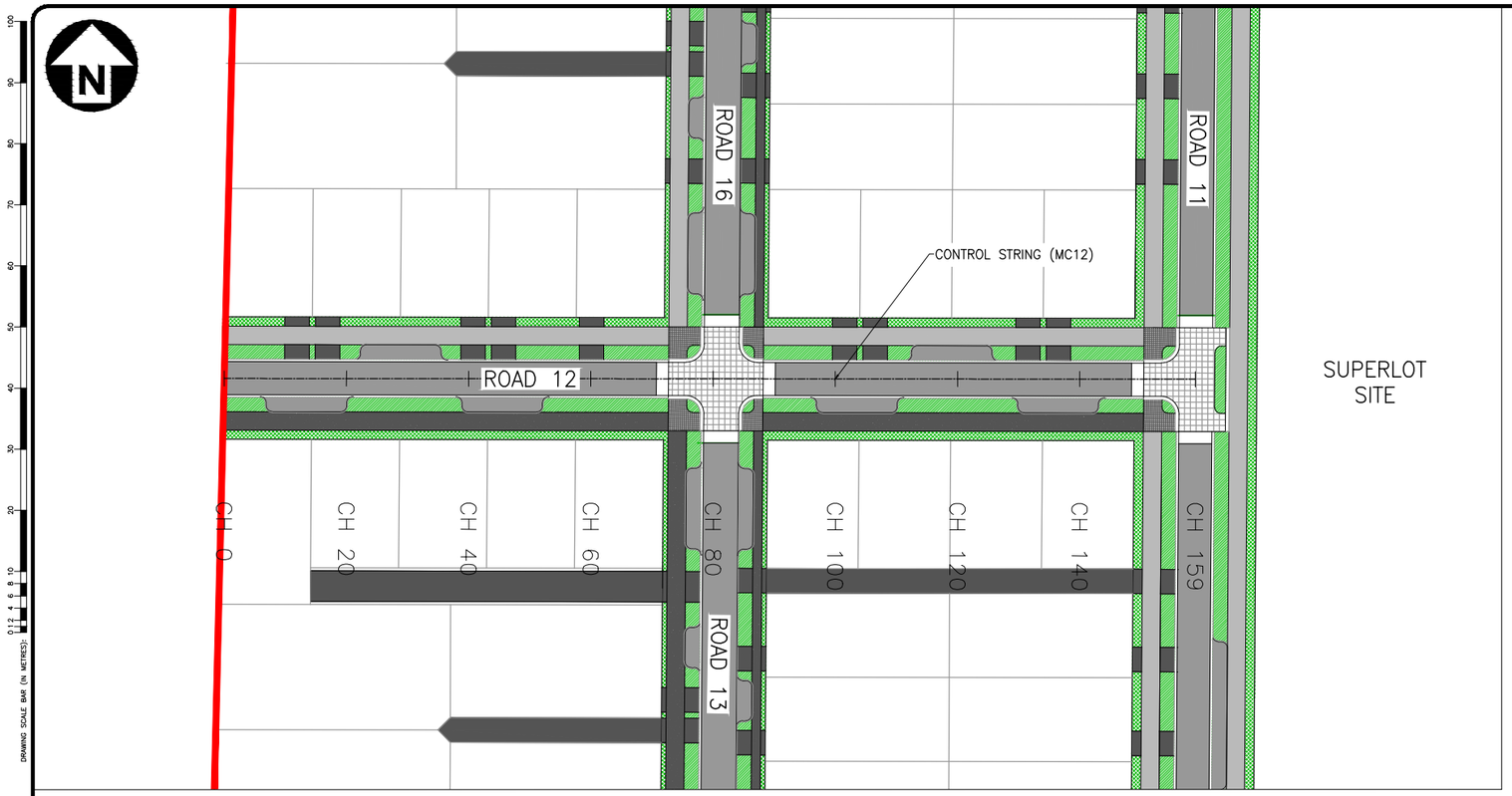
PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 11
PLAN & LONGITUDINAL SECTION
SHEET 2 OF 2

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS
DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001-C-0242
FILE NAME: 17001-C-0242.dwg

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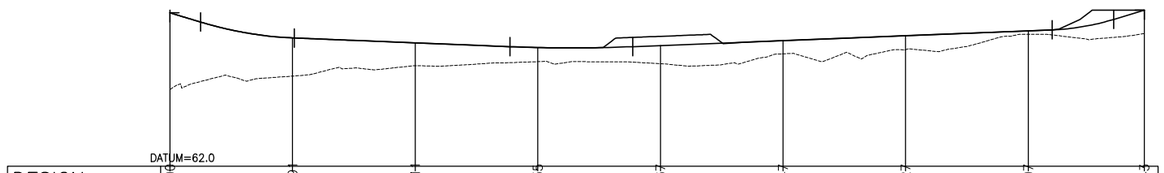
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

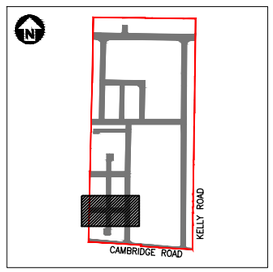
NOTES

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DESIGN SURFACE	64.506	64.094	64.014	63.935	63.967	64.047	64.127	64.207	64.543
EXISTING SURFACE	63.250	63.469	63.639	63.705	63.672	63.832	63.900	64.152	64.162
VERTICAL PROFILE	-3% L=5m	R=588.2m L=15.3m	-0.4% L=35.2m	R=2500m L=20m	0.4% L=68.4m			R=384.6m L=10m	3% L=5m
HORIZONTAL ELEMENTS	D=158.92m								
DISTANCE	0	20	40	60	80	100	120	140	158.9

LONGITUDINAL SECTION – (MC12)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

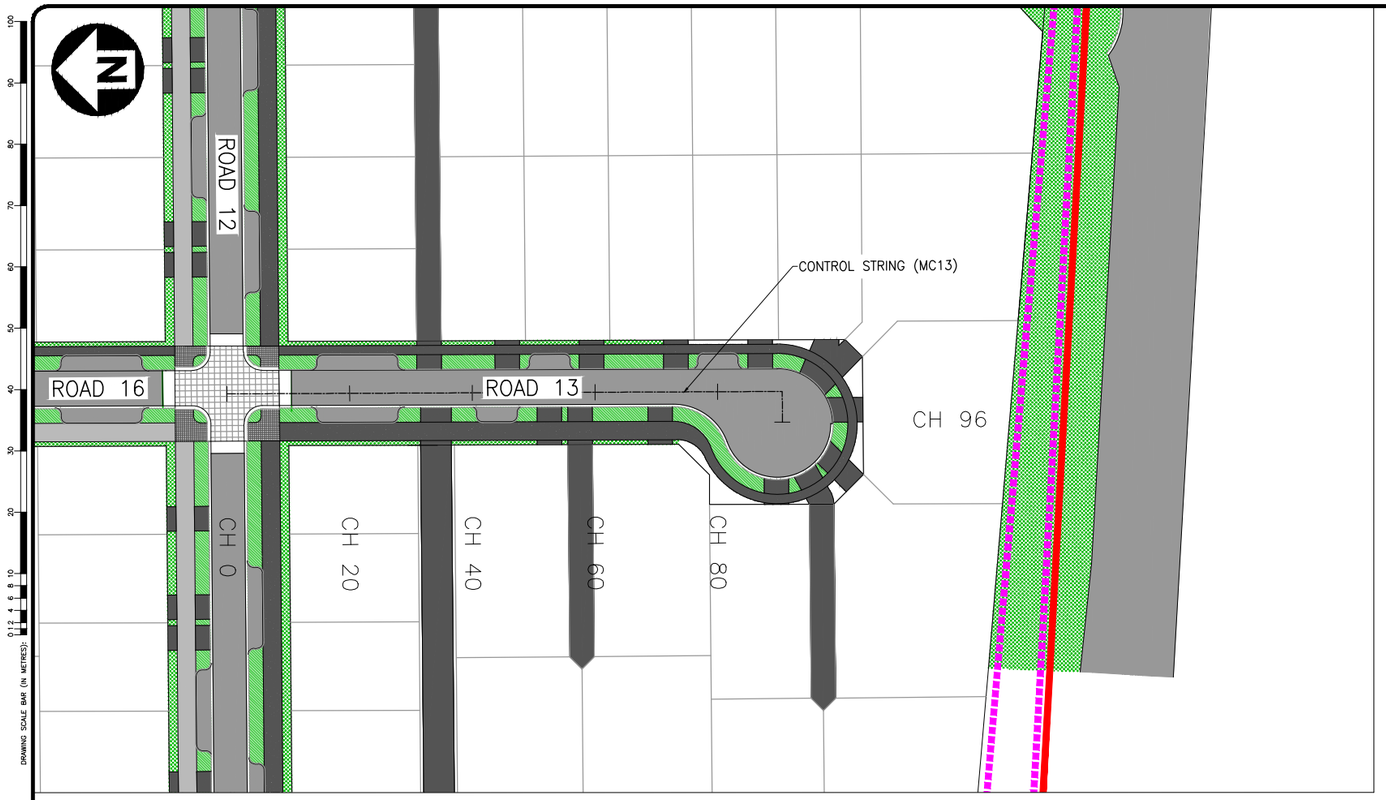
PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 12
PLAN & LONGITUDINAL SECTION
SHEET 1

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS
DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0251
FILE NAME: 17001–C–0251.dwg

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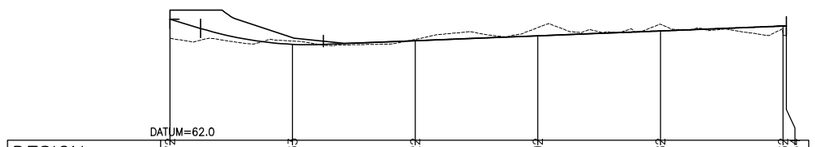
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

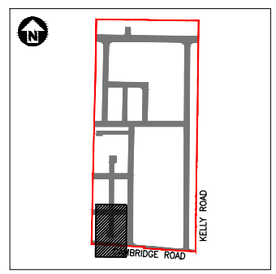
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3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	63.974	63.563	63.622	63.702	63.784	63.862 63.884
EXISTING SURFACE	63.663	63.616	63.643	63.836	63.894	63.727 63.702
VERTICAL PROFILE	−3% L=5m	R=588.2m L=20m	0.4% L=75.6m			
HORIZONTAL ELEMENTS	D=90.56m					D=10m
DISTANCE	0	20	40	60	80	100 100.6

LONGITUDINAL SECTION – (MC13)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 13
PLAN & LONGITUDINAL SECTION

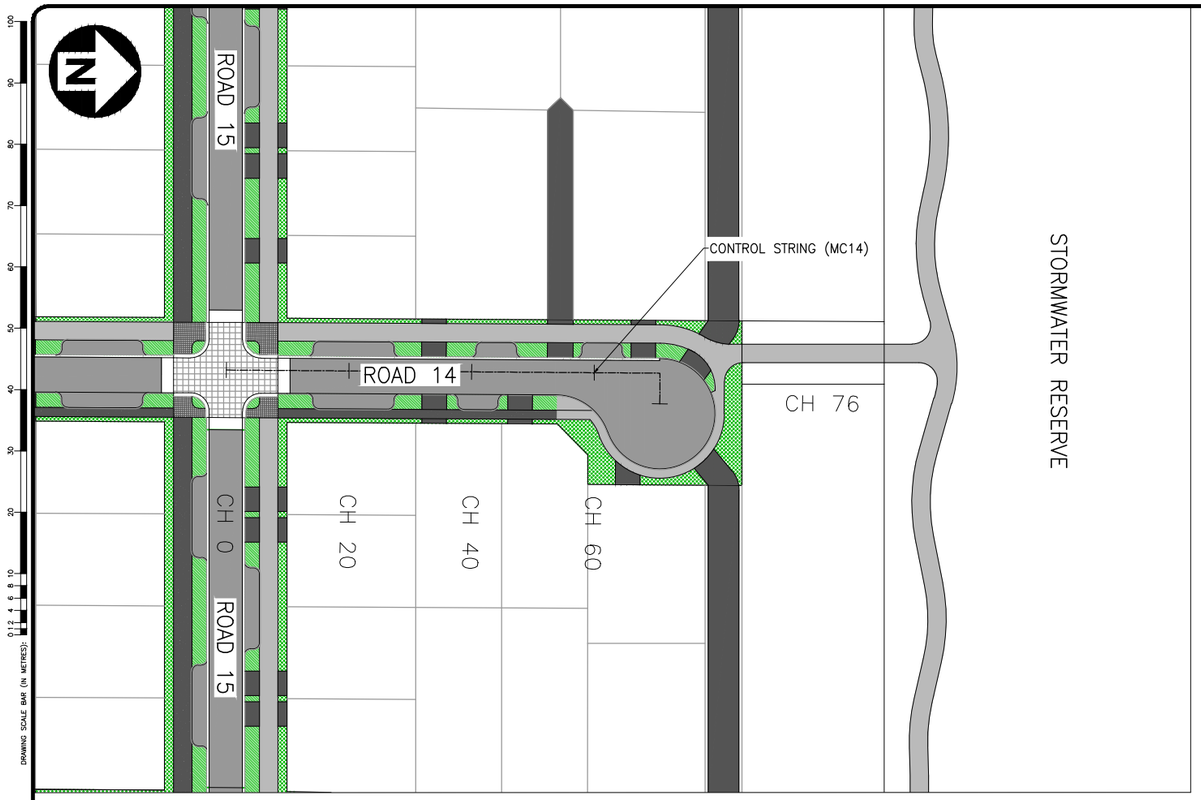
PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0261

FILE NAME: 17001–C–0261.dwg

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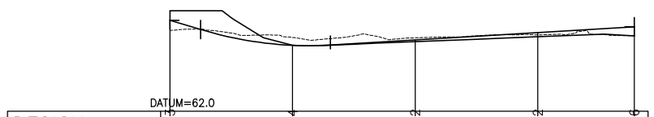
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

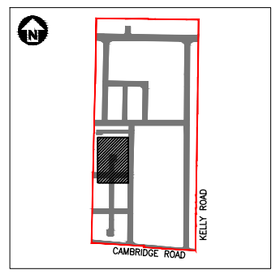
NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	63.483	63.074	63.162	63.282	63.376
EXISTING SURFACE	63.315	63.204	63.197	63.244	63.231
VERTICAL PROFILE	−3% L=5m	R=588.2m L=21.2m	0.6% L=49.6m		
HORIZONTAL ELEMENTS	D=70.73m			D=5m	
DISTANCE	0	20	40	60	75.7

LONGITUDINAL SECTION – (MC14)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

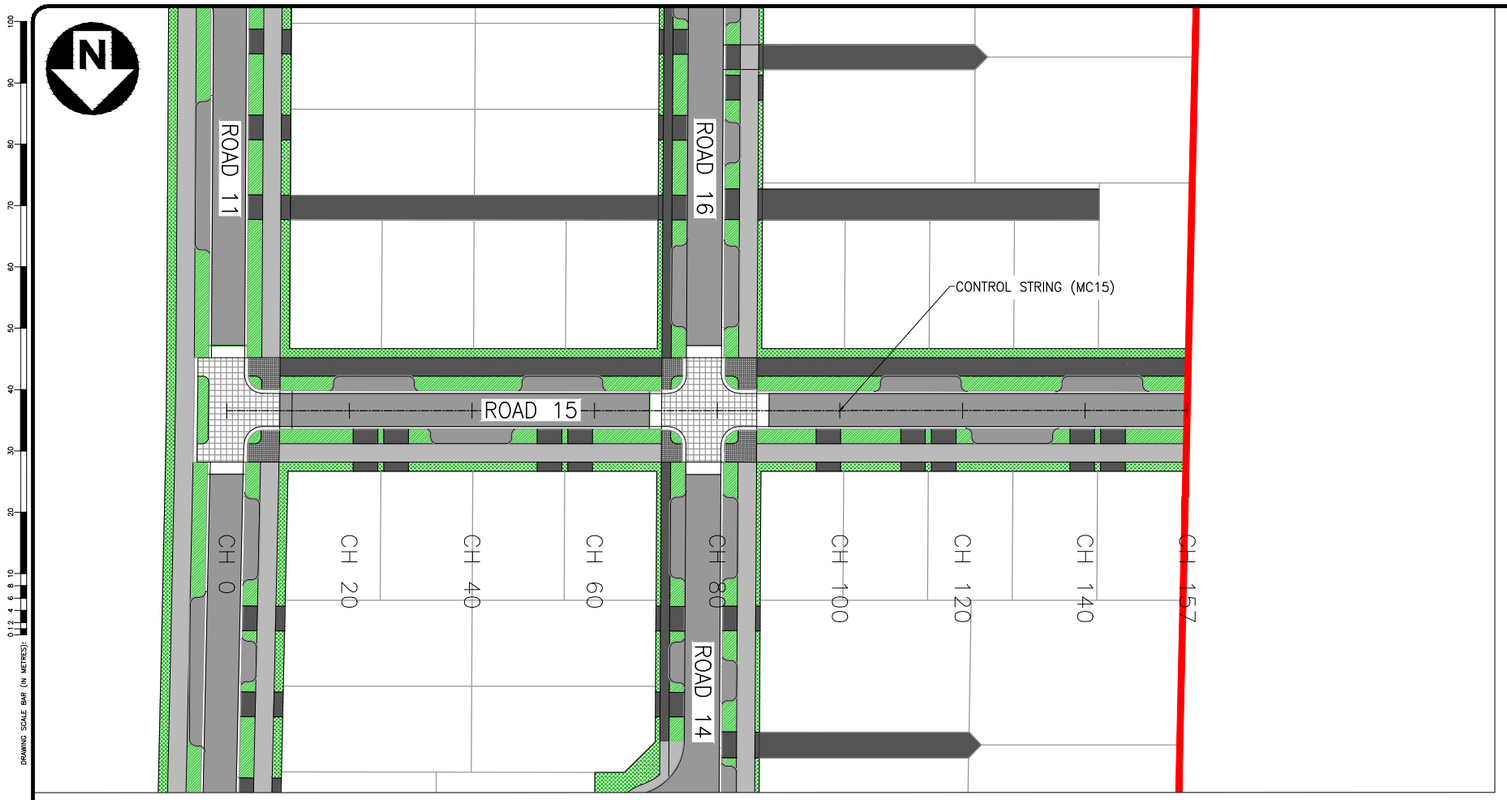
PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 14
PLAN & LONGITUDINAL SECTION

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS
DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0271
FILE NAME: 17001–C–0271.dwg

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DRAWING SCALE BAR (IN METRES)

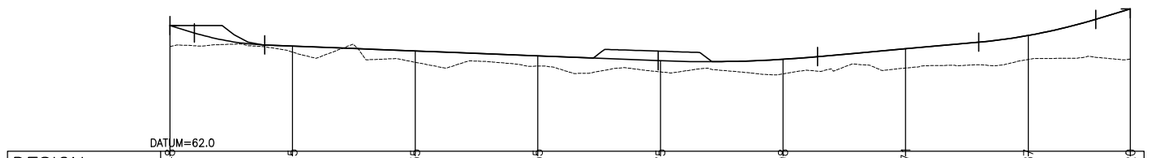
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

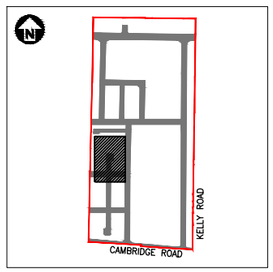
1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	64.048	63.715	63.635	63.554	63.475	63.498	63.677	63.887	64.329
EXISTING SURFACE	63.707	63.616	63.450	63.388	63.293	63.26	63.356	63.496	63.501
VERTICAL PROFILE	-3% L=4m	R=441.2m L=11.5m	-0.4% L=64.2m		R=2000m L=26m	0.9% L=26.3m		R=909.1m L=19.1m	3% L=5.7m
HORIZONTAL ELEMENTS	D=156.66m								
DISTANCE	0	20	40	60	80	100	120	140	156.7

LONGITUDINAL SECTION – (MC15)

HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 15 PLAN & LONGITUDINAL SECTION

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000

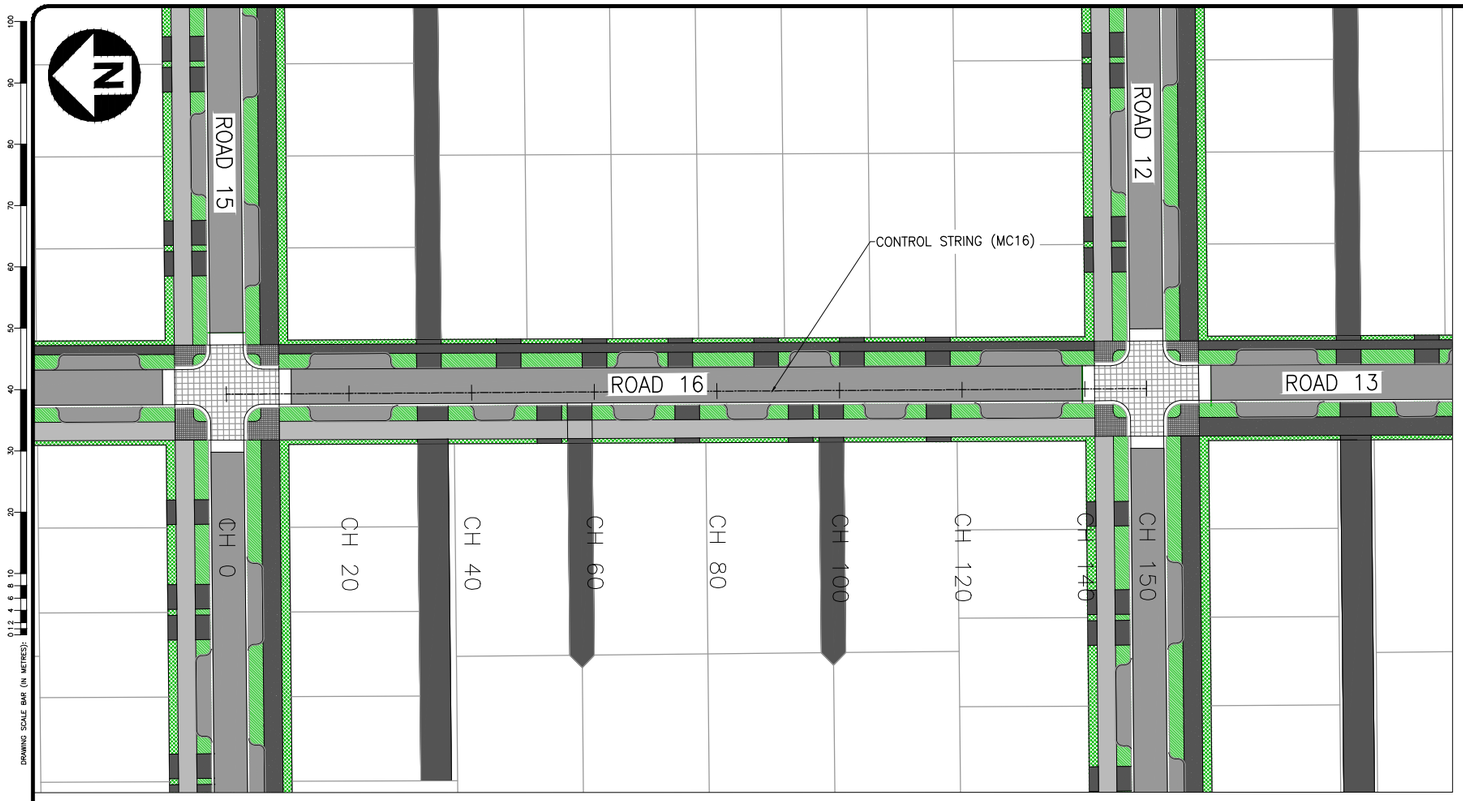
REVISION No.: C

DISCIPLINE: CIVIL ENGINEERING

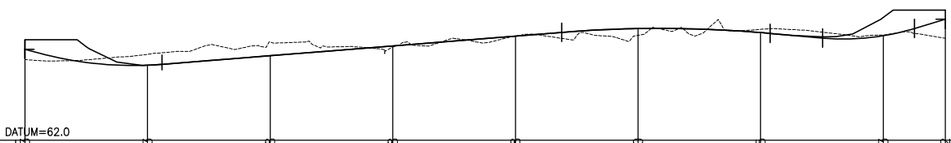
DRAWING No.: 17001–C–0281

FILE NAME: 17001–C–0281.dwg

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LAYOUT PLAN
SCALE = 1:1000

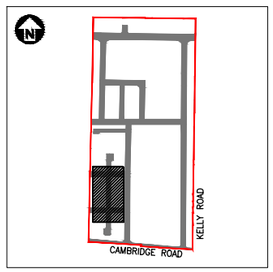


DESIGN SURFACE	63.483	63.223	63.378	63.536	63.698	63.824	63.755	63.704	63.972
EXISTING SURFACE	63.315	63.399	63.599	63.522	63.698	63.710	63.807	63.715	63.663
VERTICAL PROFILE	-3% L=0m	R=588.2m L=22.4m	0.8% L=65.2m		R=2000m L=34m	-0.9% L=8.6m	R=384.6m L=15m	3% L=5m	
HORIZONTAL ELEMENTS	D=150.11m								
DISTANCE	0	20	40	60	80	100	120	140	150.1

LONGITUDINAL SECTION – (MC16)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100

LEGEND
- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES
1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 16
PLAN & LONGITUDINAL SECTION

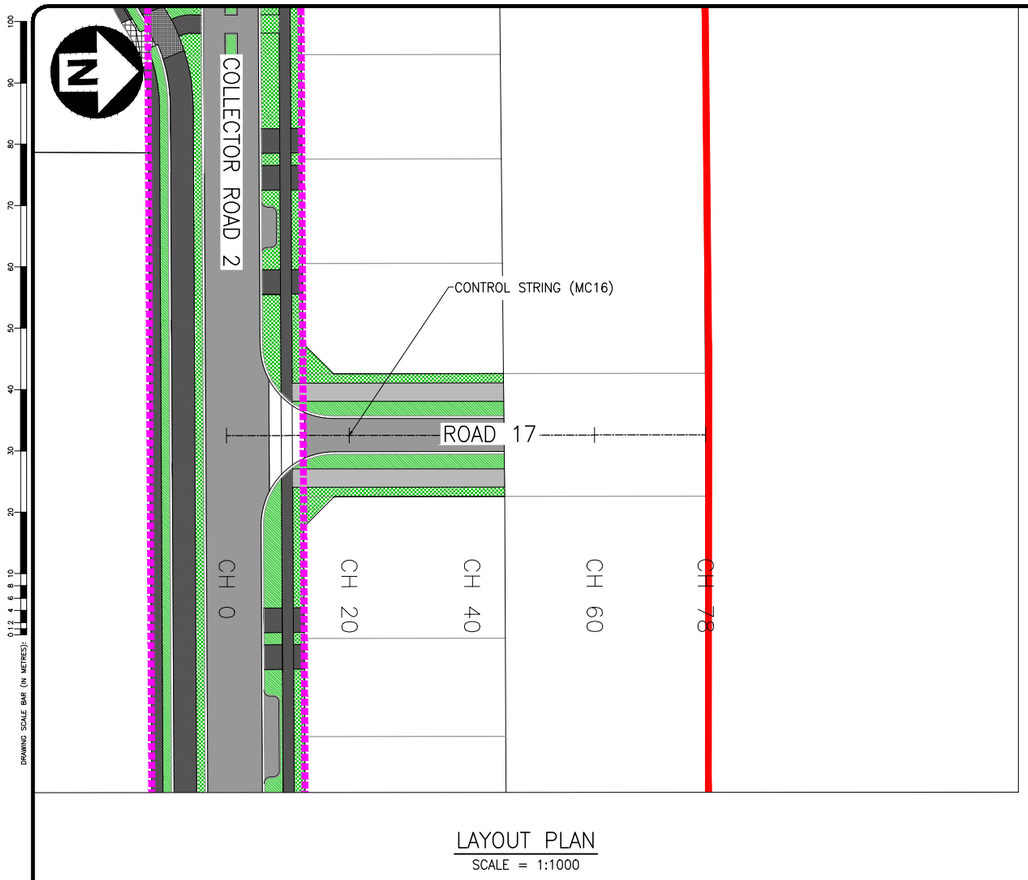
PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0291

FILE NAME: 17001–C–0291.dwg

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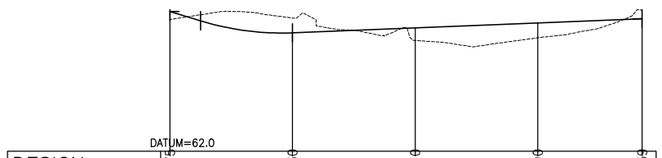
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

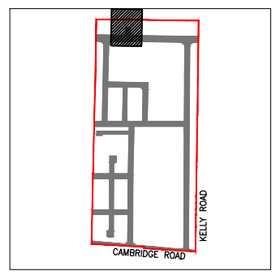
NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	64.275	63.936	64.016	64.096	64.159
EXISTING SURFACE	64.148	64.172	63.805	63.850	64.300
VERTICAL PROFILE	-3% L=5m	R=441.2m L=15m	0.4% L=57m		
HORIZONTAL ELEMENTS	D=77.03m				
DISTANCE	0	20	40	60	77

LONGITUDINAL SECTION – (MC17)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 17
PLAN & LONGITUDINAL SECTION

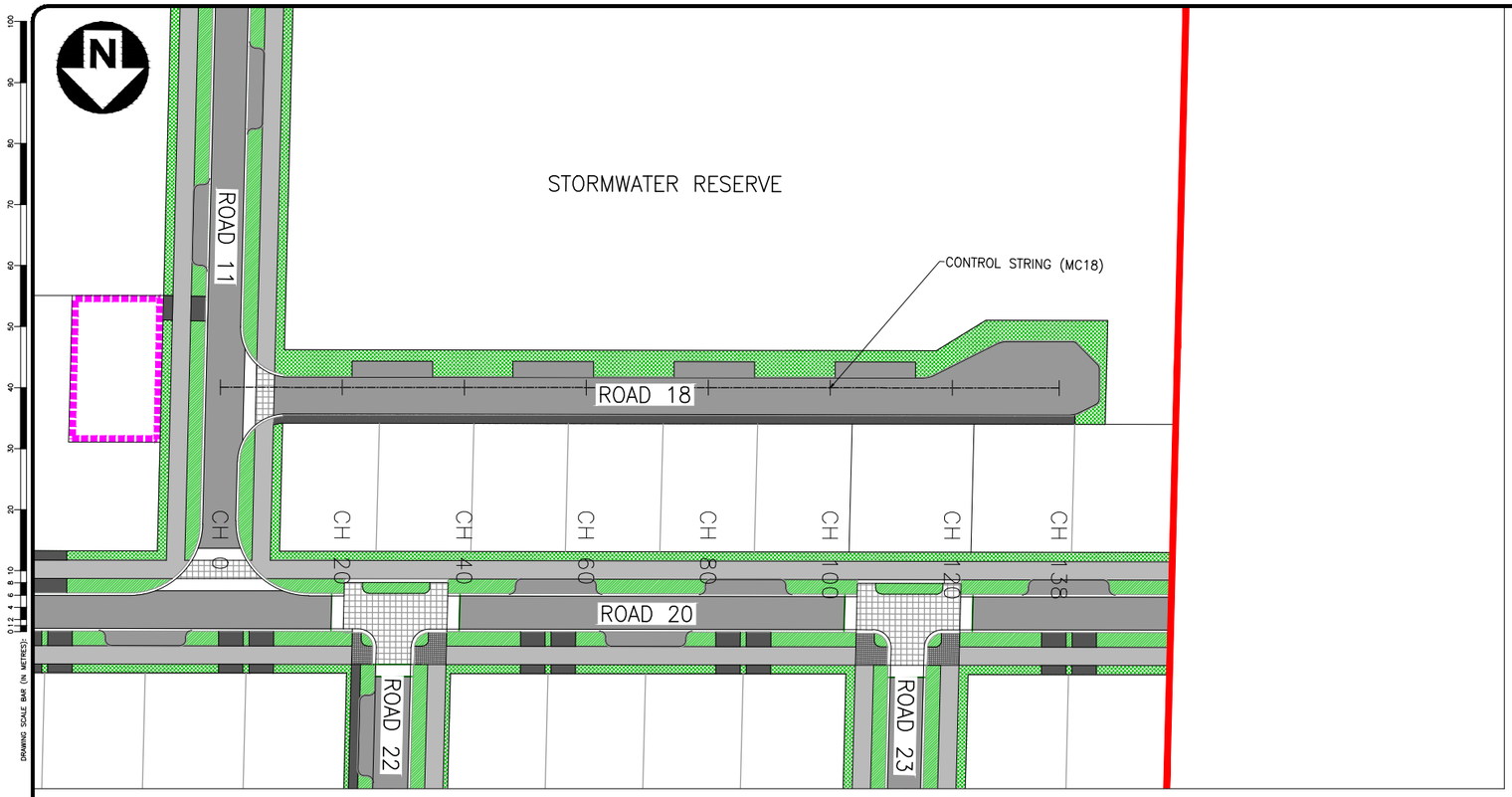
PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: A
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0291

FILE NAME: 17001–C–0292.dwg

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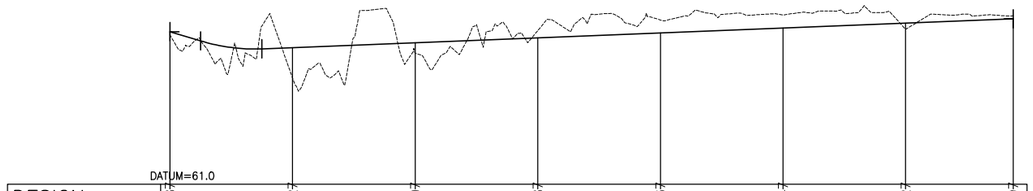
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

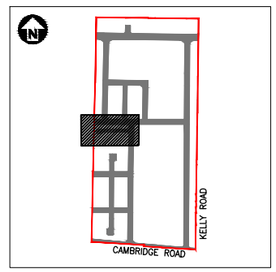
NOTES

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2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	63.487	63.227	63.307	63.387	63.467	63.547	63.627	63.697
EXISTING SURFACE	63.434	62.728	63.137	63.505	63.678	63.761	63.533	63.745
VERTICAL PROFILE	-3%	R=294.1m		0.4%				
	L=5m	L=10m		L=122.6m				
HORIZONTAL ELEMENTS	D=137.55m							
DISTANCE	0	20	40	60	80	100	120	137.6

LONGITUDINAL SECTION – (MC18)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 18 PLAN & LONGITUDINAL SECTION

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000

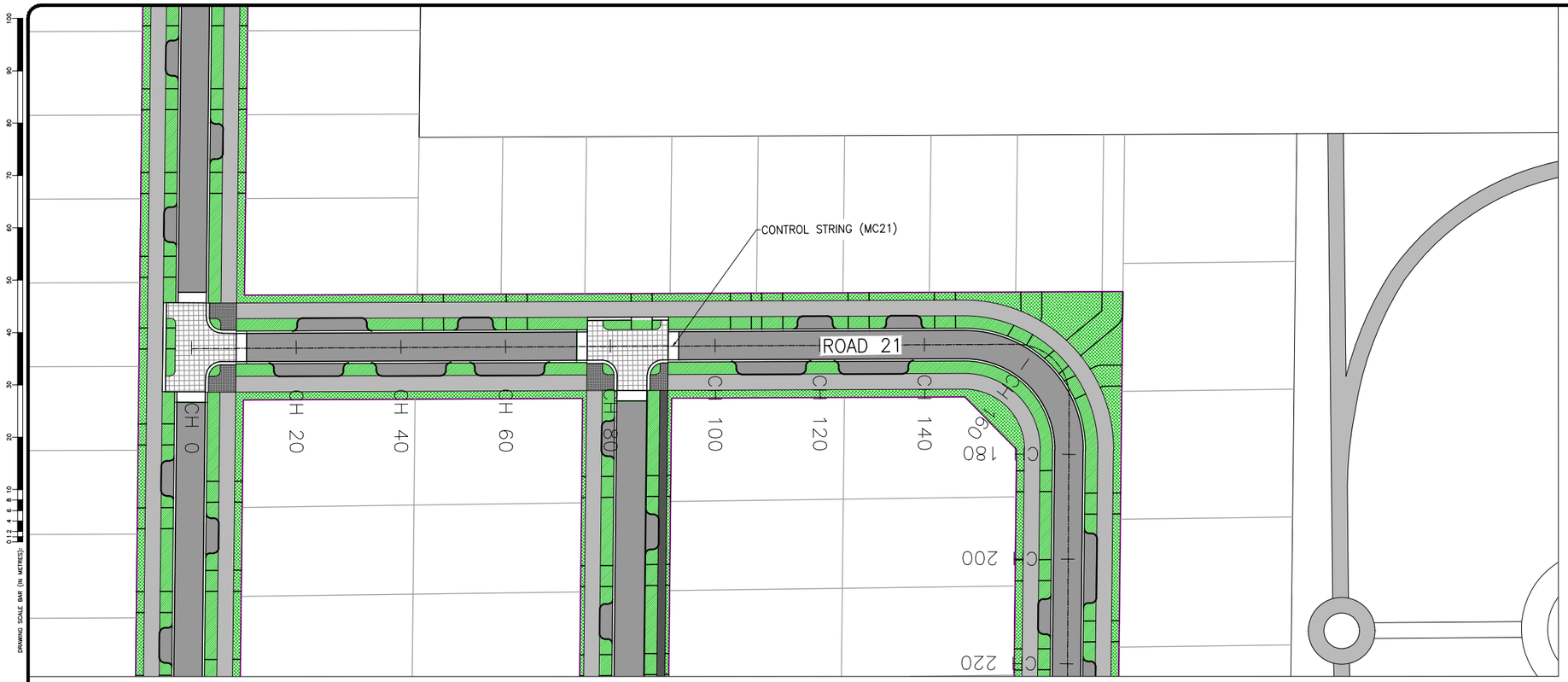
REVISION No.: C

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0311

FILE NAME: 17001–C–0311.dwg

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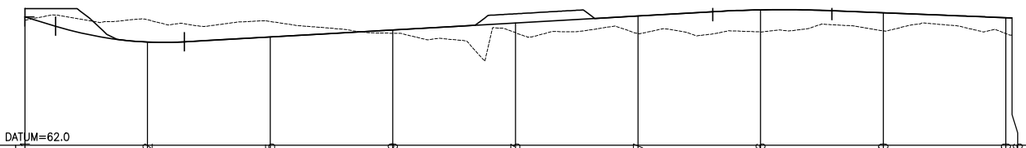
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

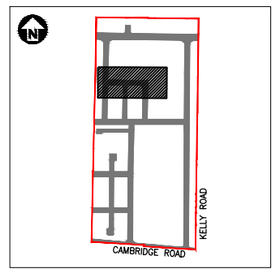
NOTES

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2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	64.091	63.682	63.765	63.879	63.993	64.107	64.206	64.169	64.089 / 64.076
EXISTING SURFACE	64.038	64.045	64.017	63.826	63.835	63.822	63.847	63.865	63.819 / 63.797
VERTICAL PROFILE	−3% L=5m	R=588.2m L=21m	0.57% L=86.2m				R=2000m L=19.4m	−0.4% L=158.4m	
HORIZONTAL ELEMENTS	D=147.54m							R=20m L=31.71m	
DISTANCE	0	20	40	60	80	100	120	140	160 / 161

LONGITUDINAL SECTION – (MC21)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	GCJ	12.11.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 12.11.20
DRAWN BY: G. JONES	DATE: 12.11.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 21 PLAN & LONGITUDINAL SECTION

SHEET 1 OF 2

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000

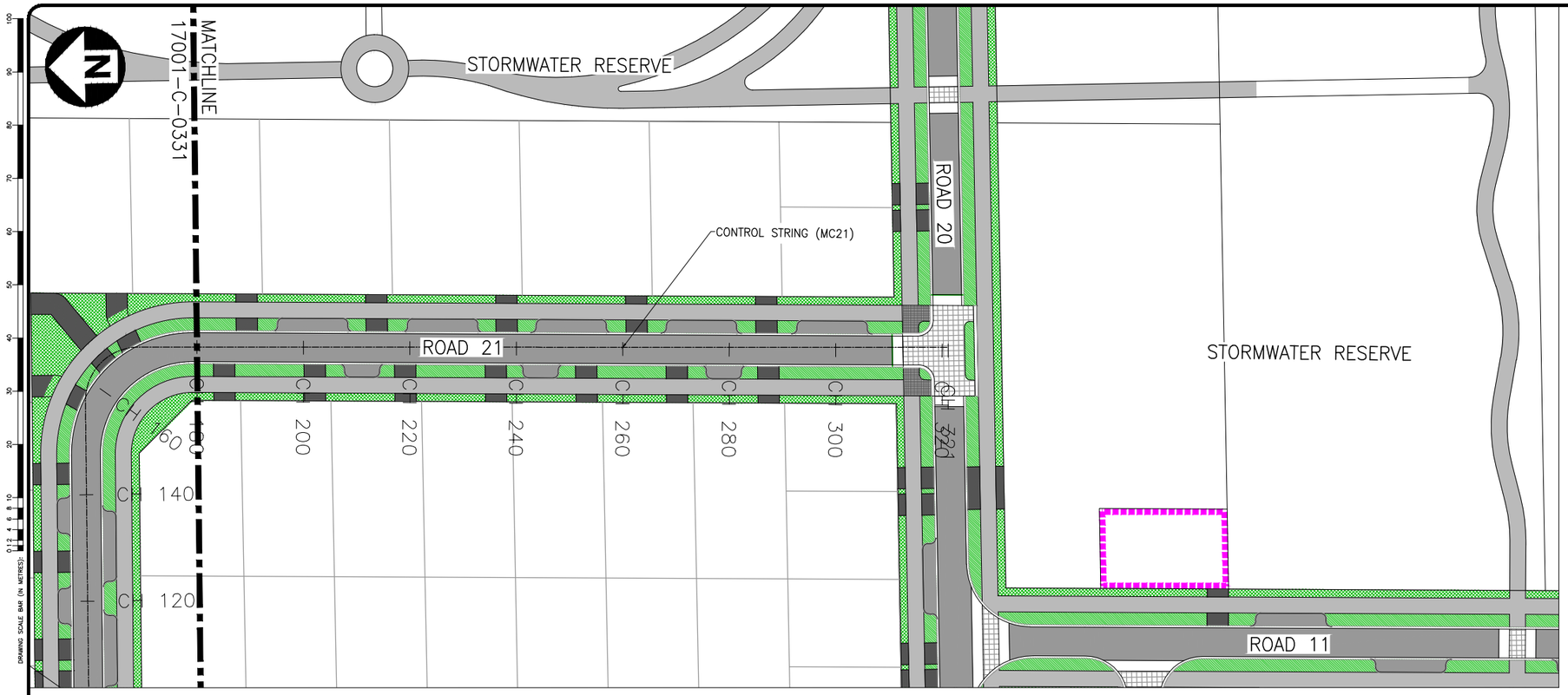
REVISION No.: A

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0321

FILE NAME: 17001–C–0321.dwg

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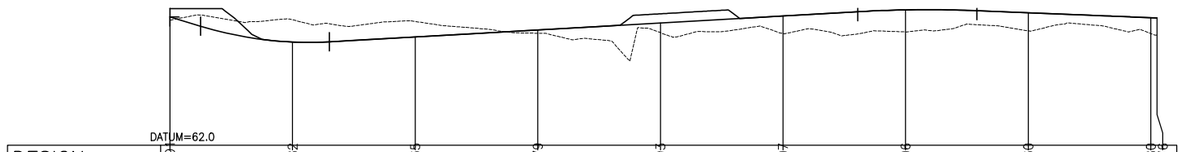
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

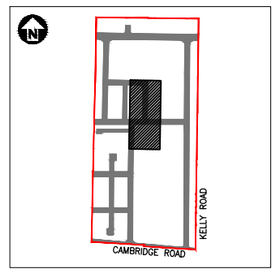
NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	64.094	63.682	63.765	63.879	63.993	64.107	64.206	64.169	64.086 64.076
EXISTING SURFACE	64.038	64.045	64.017	63.826	63.835	63.822	63.847	63.865	63.819 63.797
VERTICAL PROFILE	−3% L=5m	R=588.2m L=21m		0.57% L=86.2m			R=2000m L=19.4m	−0.4% L=158.4m	
HORIZONTAL ELEMENTS	D=147.54m							R=20m L=31.71m	
DISTANCE	0	20	40	60	80	100	120	140	160 161

LONGITUDINAL SECTION – (MC21)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	GCJ	12.11.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 12.11.20
DRAWN BY: G. JONES	DATE: 12.11.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

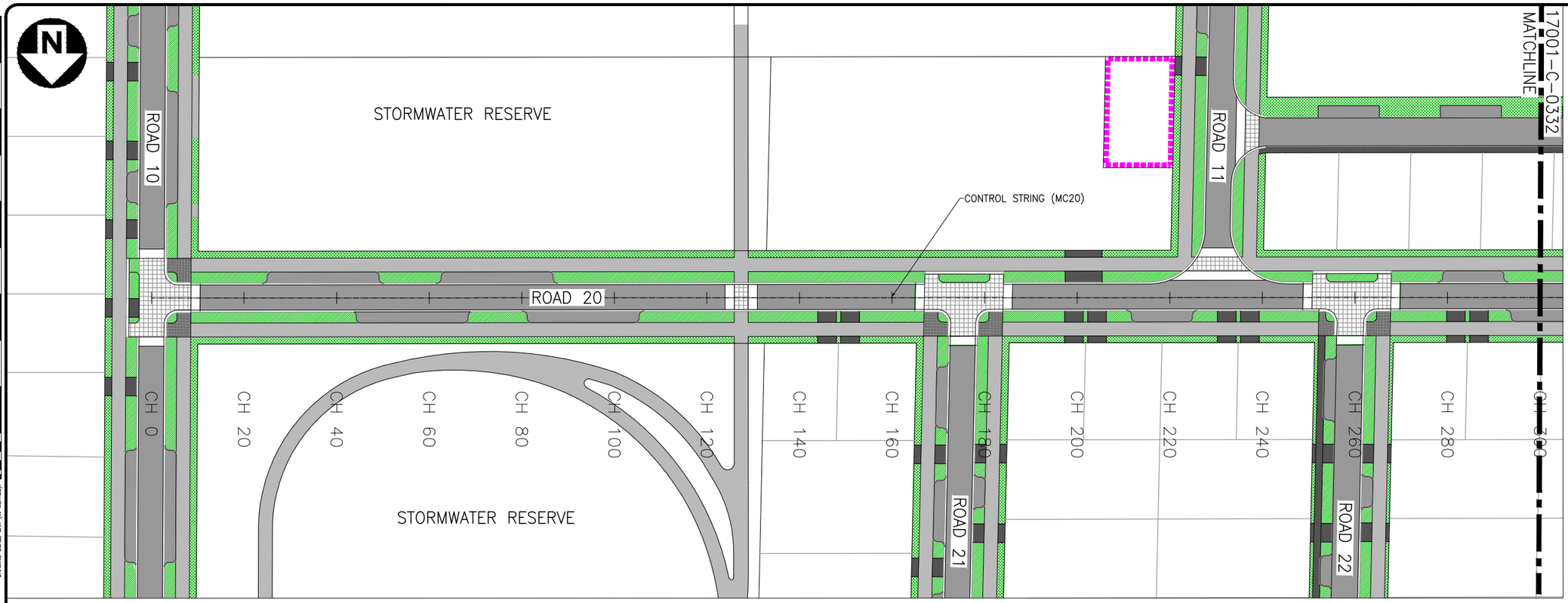
DRAWING TITLE: ROAD 21
PLAN & LONGITUDINAL SECTION
SHEET 1 OF 2

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS
DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: A
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001-C-0322
FILE NAME: 17001-C-0322.dwg

READ DRAWINGS CAREFULLY & MEASURE TWICE CUT ONCE

DRAWING SCALE BAR (IN METRES): 0 1 2 4 6 8 10 20 30 40 50 60 70 80 90 100



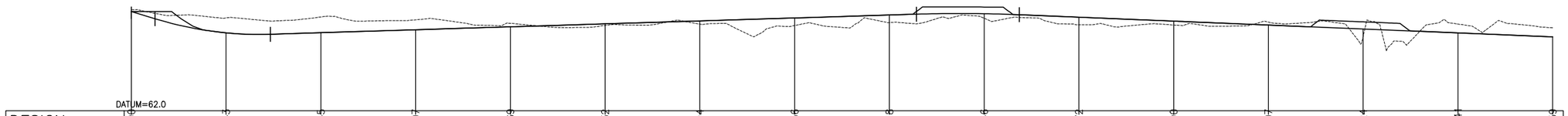
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	64.096	63.643	63.645
EXISTING SURFACE	64.129	63.956	63.977
VERTICAL PROFILE	−3% L=5m	R=735.3m L=24.3m	0.31% L=136.3m
HORIZONTAL ELEMENTS	D=386.19m		
DISTANCE	0	20	40

DESIGN SURFACE	63.707	63.769	63.832
EXISTING SURFACE	63.918	63.843	63.799
VERTICAL PROFILE			
HORIZONTAL ELEMENTS			
DISTANCE	60	80	100

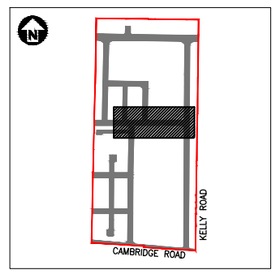
DESIGN SURFACE	63.894	63.956	64.018
EXISTING SURFACE	63.828	63.797	63.859
VERTICAL PROFILE			R=3000m L=21.7m
HORIZONTAL ELEMENTS			
DISTANCE	120	140	160

DESIGN SURFACE	64.046	63.972	63.894
EXISTING SURFACE	63.949	63.813	63.808
VERTICAL PROFILE		−0.41% L=146.8m	
HORIZONTAL ELEMENTS			
DISTANCE	180	200	220

DESIGN SURFACE	63.807	63.724	63.647
EXISTING SURFACE	63.868	63.565	63.828
VERTICAL PROFILE			
HORIZONTAL ELEMENTS			
DISTANCE	240	260	280

DESIGN SURFACE	63.559	
EXISTING SURFACE	63.748	
VERTICAL PROFILE		
HORIZONTAL ELEMENTS		
DISTANCE	300	

LONGITUDINAL SECTION – (MC20)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 20
PLAN & LONGITUDINAL SECTION

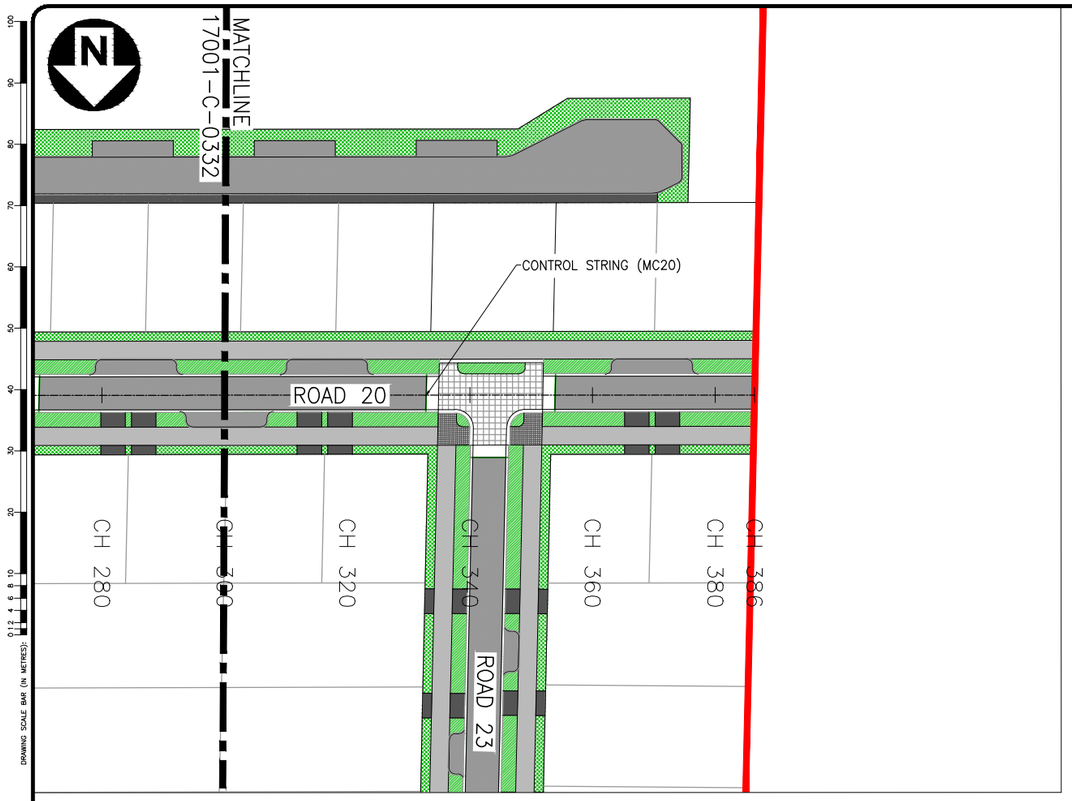
PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000	REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001-C-0331	

FILE NAME: 17001-C-0331.dwg

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

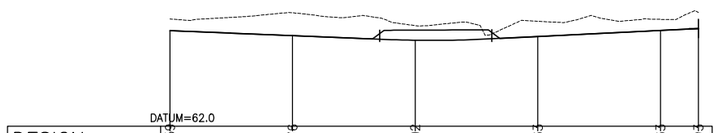


LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

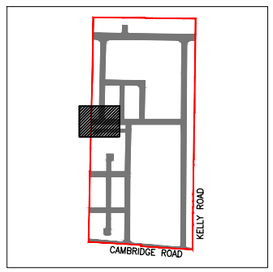
1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. THE LOCATION OF VEHICLE ACCESSWAYS AND CARPARKING TO BE CONFIRMED DURING DETAILED DESIGN
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4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	63.559	63.476	63.402	63.463	63.563	63.593
EXISTING SURFACE	63.748	63.850	63.640	63.710	63.742	63.856
VERTICAL PROFILE	−0.41% L=146.8m		R=2000m L=18.3m		0.5% L=33.7m	
HORIZONTAL ELEMENTS	D=386.19m					
DISTANCE	300	320	340	360	380	386.2

LONGITUDINAL SECTION – (MC20)

HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	GCJ	12.11.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 12.11.20
DRAWN BY: G. JONES	DATE: 12.11.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 20 PLAN & LONGITUDINAL SECTION

SHEET 2 of 2

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000

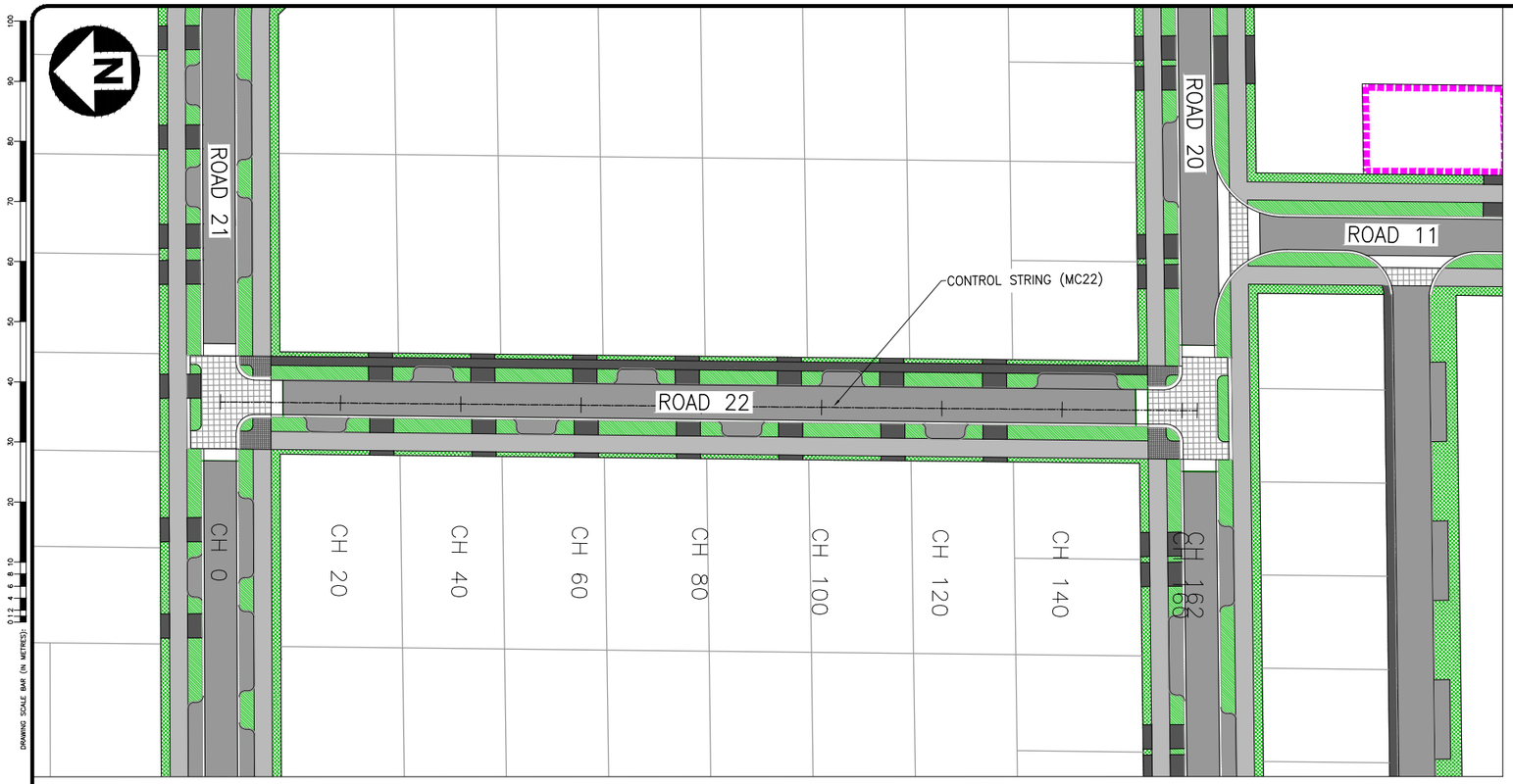
REVISION No.: A

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0332

FILE NAME: 17001-C-0332.dwg

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE



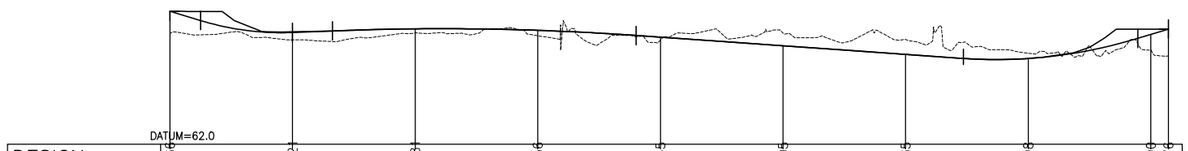
LAYOUT PLAN
SCALE = 1:1000

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

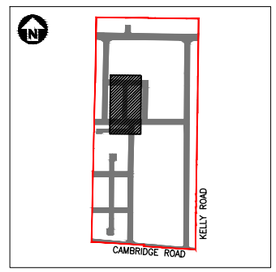
NOTES

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DESIGN SURFACE	64.166	63.822	63.881	63.856	63.745	63.609	63.465	63.399	63.796	63.876
EXISTING SURFACE	63.802	63.703	63.812	63.769	63.696	63.810	63.706	63.483	63.538	63.433
VERTICAL PROFILE	−3% L=5m	R=441.2m L=15m	0.4% L=6.5m	R=4500m L=49.5m		−0.7% L=53.4m		R=769.2m L=28.5m	3% L=5m	
HORIZONTAL ELEMENTS	D=162.87m									
DISTANCE	0	20	40	60	80	100	120	140	160	162.9

LONGITUDINAL SECTION – (MC22)
HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 30.03.20
DRAWN BY: G. JONES	DATE: 30.03.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: ROAD 22
PLAN & LONGITUDINAL SECTION

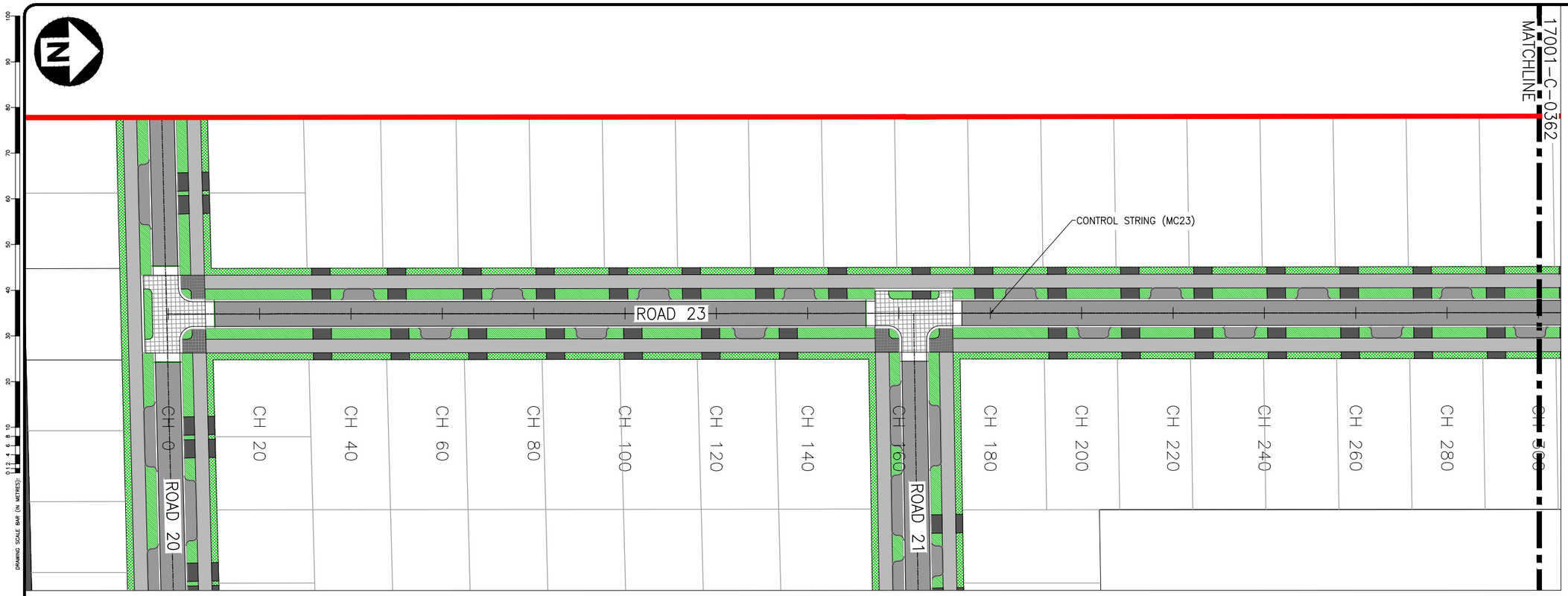
PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000
REVISION No.: C
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0351

FILE NAME: 17001–C–0351.dwg

READ DRAWINGS CAREFULLY & MEASURETWICECUTONCE

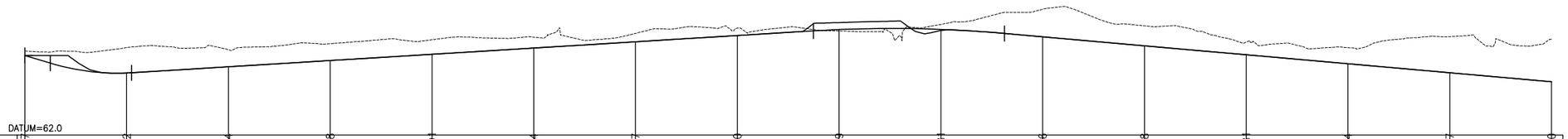


LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

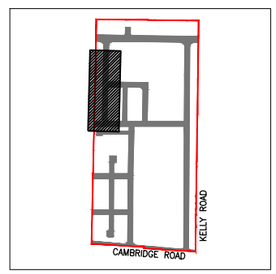
1. ALL WORKS TO BE IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
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4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	63.567	63.224	63.344	63.468	63.594	63.714	63.837	63.966	64.079	64.084	63.936	63.758	63.581	63.404	63.227	63.056					
EXISTING SURFACE	63.654	63.724	63.680	63.799	63.878	63.929	64.003	64.107	64.050	64.184	64.478	64.152	63.832	63.722	63.939	63.889					
VERTICAL PROFILE	-3%	R=441.2m			0.62%				R=2500m			-0.89%									
	L=5m	L=16m			L=134m				L=37.5m			L=115.8m									
HORIZONTAL ELEMENTS	D=358.18m																				
DISTANCE	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300					

LONGITUDINAL SECTION – (MC23)

HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	GCJ	17.02.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 17.02.20
DRAWN BY: G. JONES	DATE: 17.02.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 23 PLAN & LONGITUDINAL SECTION

SHEET 1

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

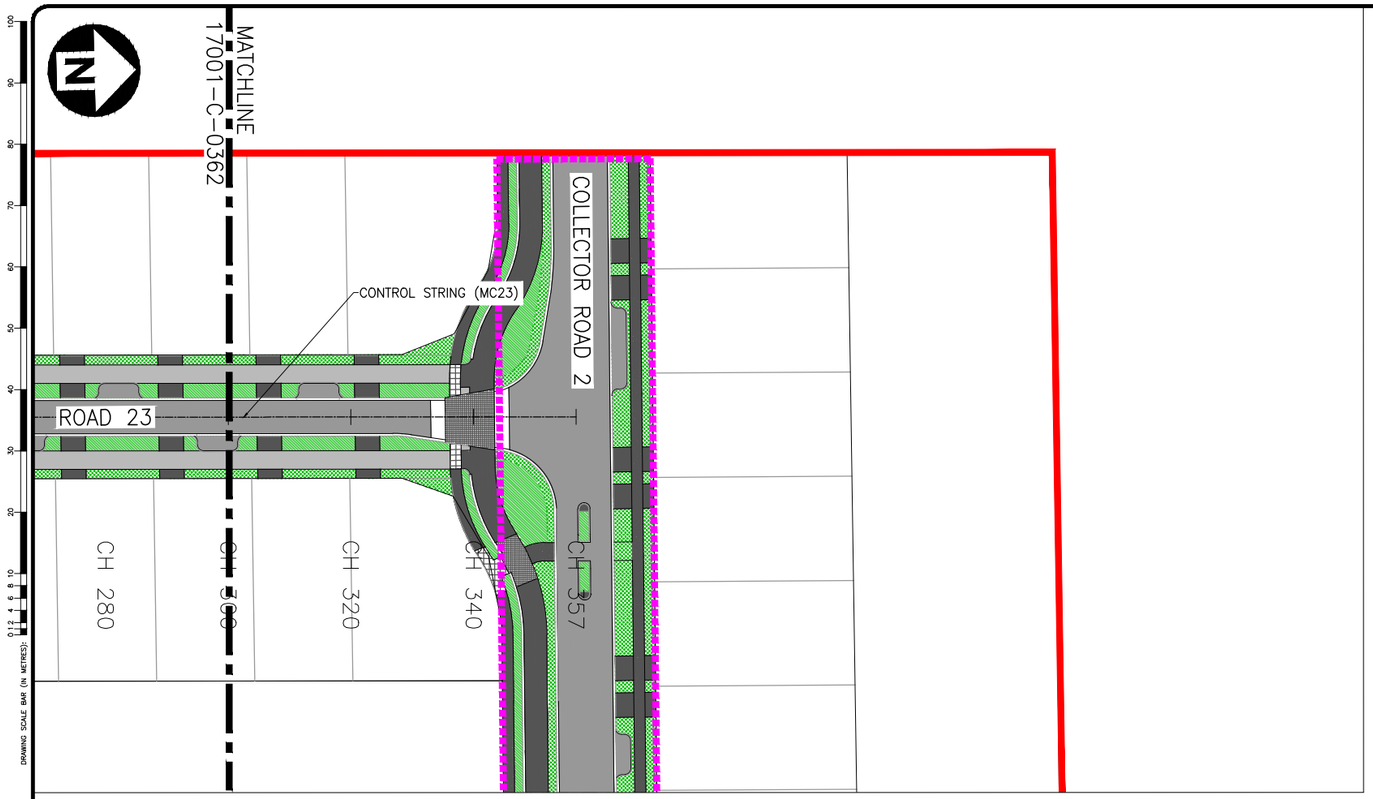
DRAWING SCALE: 1:1000

REVISION No.: A

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0361

FILE NAME: 17001-C-0361.dwg

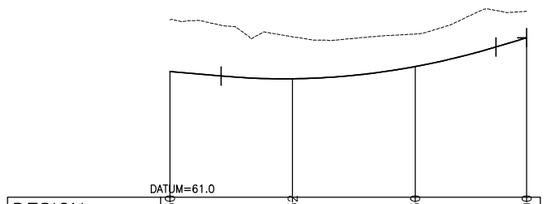


LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC BOUNDARY
- CYCLE WAY
- SHARED PATH
- ROAD PAVING
- ACCESSWAY/DRIVEWAY
- FOOTPATH
- INTERSECTION RAISED TABLE/ROAD CROSSING
- GRASS
- PLANTING
- SPECIMEN TREES

NOTES

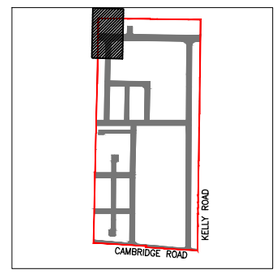
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3. KERB CUT DOWNS TO BE CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.1
4. ALL VEHICLE CROSSINGS TO BE RESIDENTIAL TYPE AND CONSTRUCTED IN ACCORDANCE WITH RITS D3.1.2
5. ALL KERBS TO BE VERTICAL KERB & CHANNEL PROFILE UNLESS OTHERWISE SPECIFIED



DESIGN SURFACE	63.056	62.932	63.136	63.609
EXISTING SURFACE	63.889	63.616	63.660	64.030
VERTICAL PROFILE	−0.89% L=115.8m	R=1153.8m L=44.8m		3% L=5m
HORIZONTAL ELEMENTS	D=358.18m			
DISTANCE	300	320	340	358.2

LONGITUDINAL SECTION – (MC23)

HORIZONTAL SCALE=1:1000; VERTICAL SCALE=1:100



KEY PLAN

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	GCJ	12.11.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 12.11.20
DRAWN BY: G. JONES	DATE: 12.11.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROAD 23 PLAN & LONGITUDINAL SECTION

SHEET 2

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000

REVISION No.: A

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0362

FILE NAME: 17001-C-0362.dwg

READ DRAWINGS CAREFULLY & MEASURE TWICE CUT ONCE

DRAWING SCALE BAR (IN METRES): 0 0.5 1 2 3 4 5 10 15 20 25

RS1(30)/RS1(40)

RS1(30)/RS1(40)

SHARED PATH

LOCAL ROAD

SHARED PATH

RP2/RP76

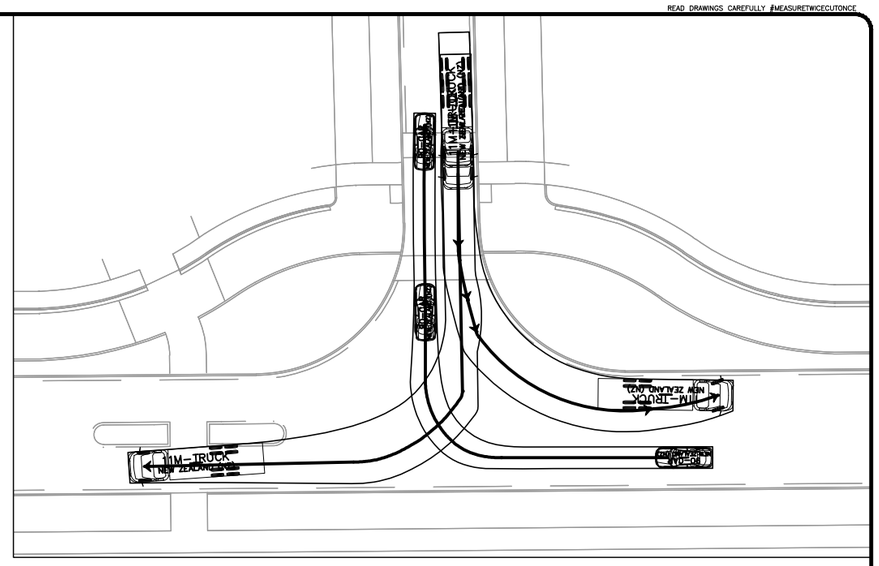
GIVE WAY

TO CYCLISTS & PEDESTRIANS

RP2/RP76

GIVE WAY

TO CYCLISTS & PEDESTRIANS



VEHICLE TRACKING – 11.0m TRUCK AND 90% PERCENTILE CAR (RTS18)

SCALE = N.T.S

RLU1/RG22

LANE ENDS

RLU3/RG22

ENDS

RAISED CROSSING FOR CYCLEWAY

RLU1/RG21

LANE BEGINS

RLU3/RG21

BEGINS

FOOTPATH

CYCLEWAY

RLU3/RG22

RP2

GIVE WAY

FOOTPATH

CYCLEWAY

RLU3/RG21

RLU1/RG21

BEGINS

LANE BEGINS

12m KERB RADIUS

RLU3/RG22

RLU1/RG22

ENDS

LANE ENDS

COLLECTOR ROAD

FOOTPATH

SHARED PATH

FOOTPATH

SHARED PATH

RLU4/RG21

ONLY ONLY

BEGINS

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	L. MCCAFFREY	DATE 30.03.20
DRAWN BY	G. JONES	DATE 30.03.30
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING
TYPICAL INTERSECTION LAYOUT
LOCAL / COLLECTOR ROAD

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE	1:250
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001–C–0395
REVISION No.	C

FILE NAME: 17001–C–0395.dwg

READ DRAWINGS CAREFULLY // MEASURE TWICE CUT ONCE

DRAWING SCALE BAR (IN METRES): 0 0.5 1 2 3 4 5 10 15 20 25

SHARED PATH

CARPARK

CARPARK

LOCAL ROAD

SHARED PATH

CARPARK

LOCAL ROAD

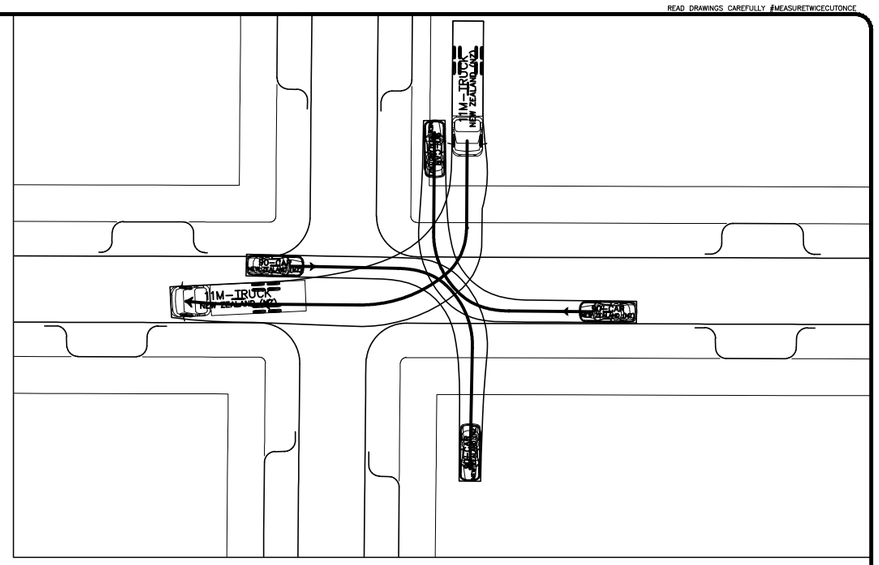
FOOTPATH

CARPARK

AB5

RP2

GIVE WAY



VEHICLE TRACKING – 11.0m TRUCK AND 90% PERCENTILE CAR (RTS18)
SCALE = N.T.S

SHARED PATH

CARPARK

CARPARK

LOCAL ROAD

LOCAL ROAD

CARPARK

CARPARK

SHARED PATH

RAISED TABLE PROVIDING LEVEL CROSSING AT INTERSECTION FOR PEDESTRIANS/CYCLISTS

TREE PITS TO BE INSTALLED WITHIN RAISED TABLE TO PROVIDE PROTECTION TO WAITING PEDESTRIANS/CYCLISTS

RP2

GIVE WAY

SHARED PATH

CARPARK

LOCAL ROAD

CARPARK

FOOTPATH

REV	DESCRIPTION	BY	DATE
C	FOR INFORMATION	GCJ	10.08.20
B	FOR INFORMATION	GCJ	17.04.20
A	FOR INFORMATION	GCJ	30.03.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY — DATE: 30.03.20

DRAWN BY: G. JONES — DATE: 30.03.20

APPROVED BY: — — DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING
TYPICAL INTERSECTION LAYOUT

LOCAL / LOCAL ROAD

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:250

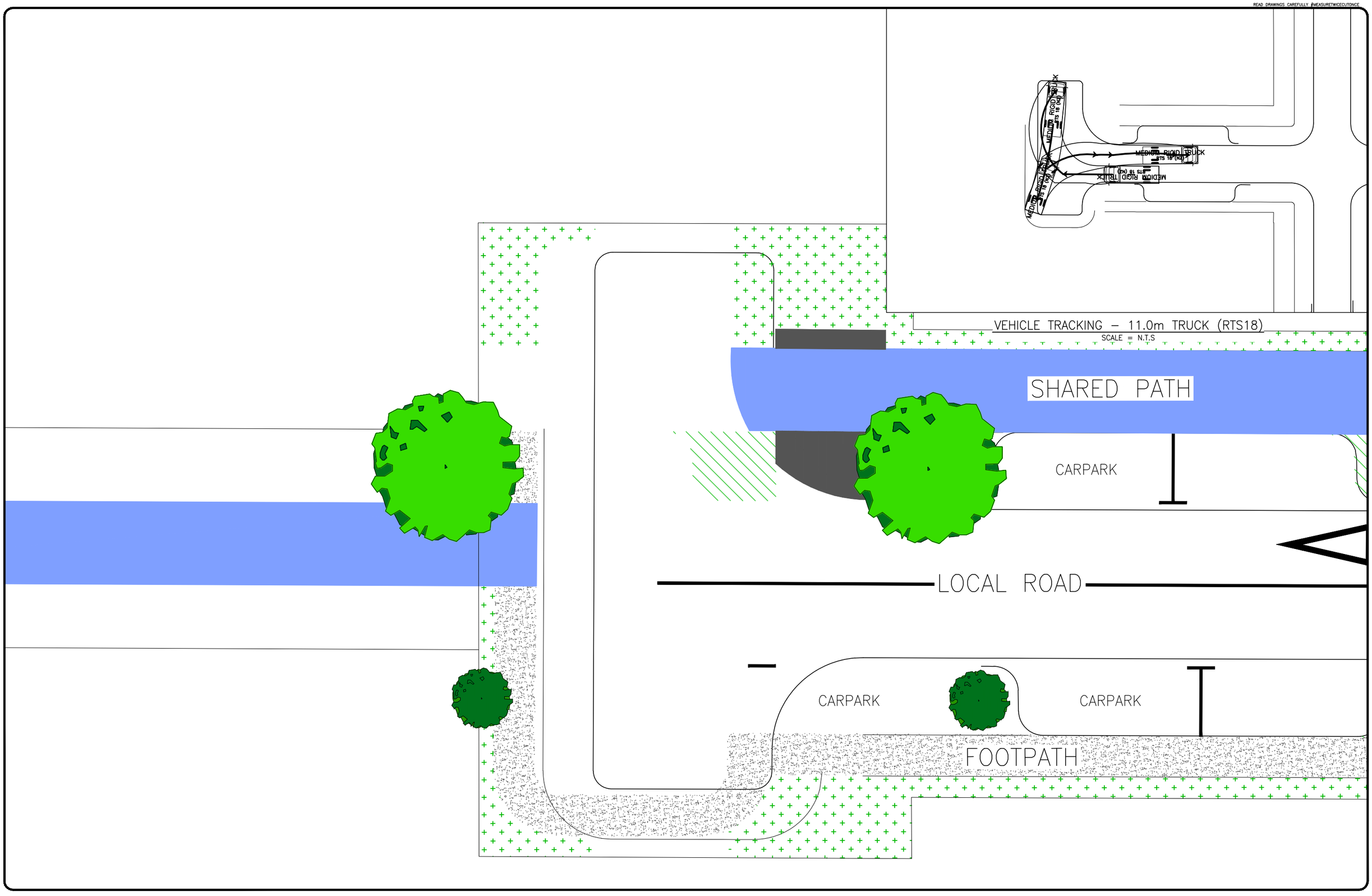
REVISION No.: C

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0396

FILE NAME: 17001-C-0396.dwg

READ DRAWINGS CAREFULLY MEASURETWICECUTONCE



VEHICLE TRACKING – 11.0m TRUCK (RTS18)

SCALE = N.T.S

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	GCJ	DD.MM.YY

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: DD.MM.YY
DRAWN BY: G. JONES	DATE: DD.MM.YY
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: ROADING
TYPICAL INTERSECTION LAYOUT

LOCAL / LOCAL ROAD

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:250

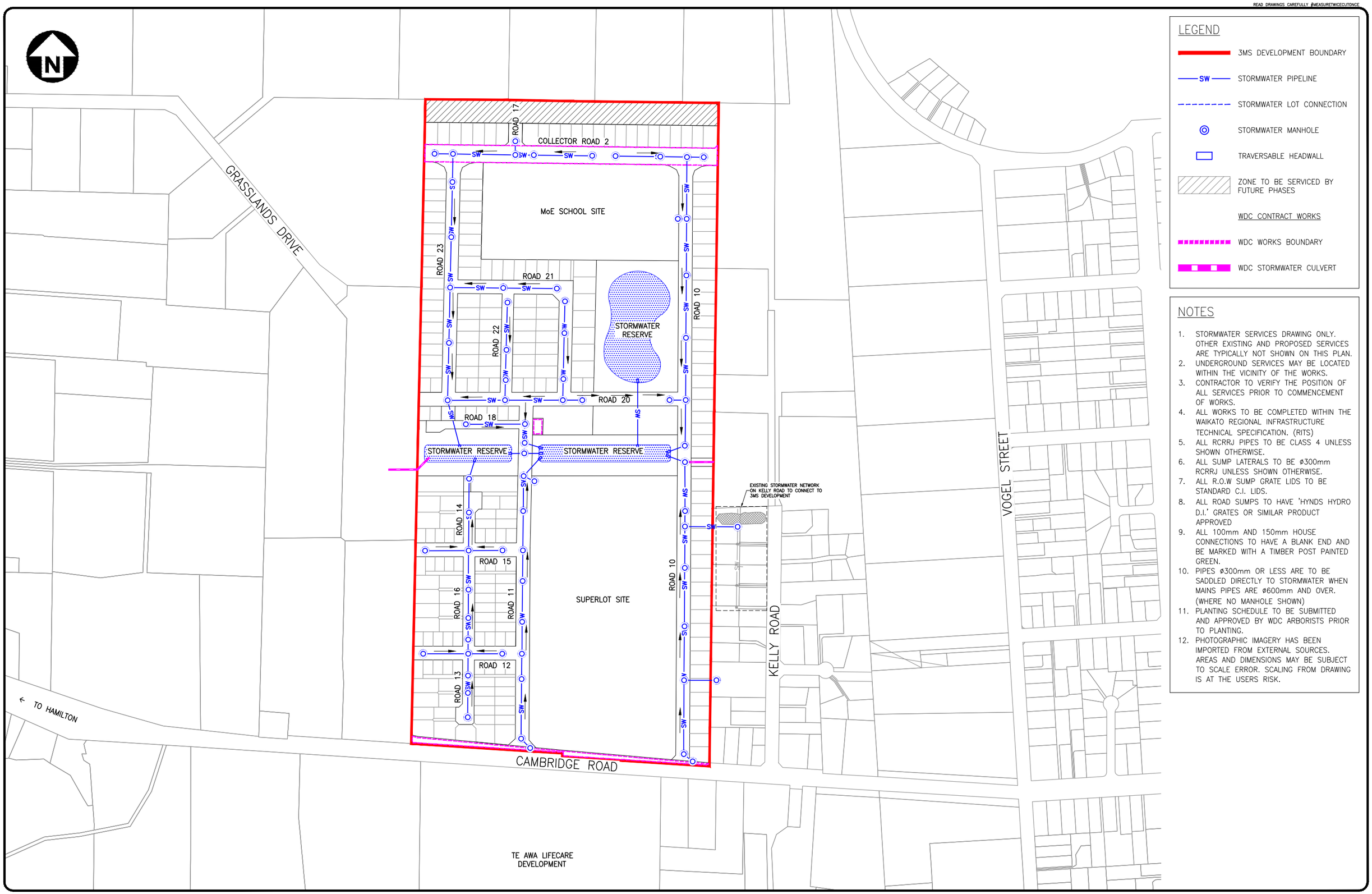
REVISION No.: A

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0396

FILE NAME: 17001-C-0397.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
- STORMWATER LOT CONNECTION
- STORMWATER MANHOLE
- TRAVERSABLE HEADWALL
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC STORMWATER CULVERT

NOTES

1. STORMWATER SERVICES DRAWING ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
2. UNDERGROUND SERVICES MAY BE LOCATED WITHIN THE VICINITY OF THE WORKS.
3. CONTRACTOR TO VERIFY THE POSITION OF ALL SERVICES PRIOR TO COMMENCEMENT OF WORKS.
4. ALL WORKS TO BE COMPLETED WITHIN THE WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION. (RITS)
5. ALL RCRRJ PIPES TO BE CLASS 4 UNLESS SHOWN OTHERWISE.
6. ALL SUMP LATERALS TO BE ø300mm RCRRJ UNLESS SHOWN OTHERWISE.
7. ALL R.O.W SUMP GRATE LIDS TO BE STANDARD C.I. LIDS.
8. ALL ROAD SUMPS TO HAVE 'HYNDS HYDRO D.I.' GRATES OR SIMILAR PRODUCT APPROVED
9. ALL 100mm AND 150mm HOUSE CONNECTIONS TO HAVE A BLANK END AND BE MARKED WITH A TIMBER POST PAINTED GREEN.
10. PIPES ø300mm OR LESS ARE TO BE SADDLED DIRECTLY TO STORMWATER WHEN MAINS PIPES ARE ø600mm AND OVER. (WHERE NO MANHOLE SHOWN)
11. PLANTING SCHEDULE TO BE SUBMITTED AND APPROVED BY WDC ARBORISTS PRIOR TO PLANTING.
12. PHOTOGRAPHIC IMAGERY HAS BEEN IMPORTED FROM EXTERNAL SOURCES. AREAS AND DIMENSIONS MAY BE SUBJECT TO SCALE ERROR. SCALING FROM DRAWING IS AT THE USERS RISK.

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	RG	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE 02.12.20
DRAWN BY	A.ZHANG	DATE 02.12.20
APPROVED BY	—	DATE —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER GENERAL ARRANGEMENT

PRODUCED BY: HG

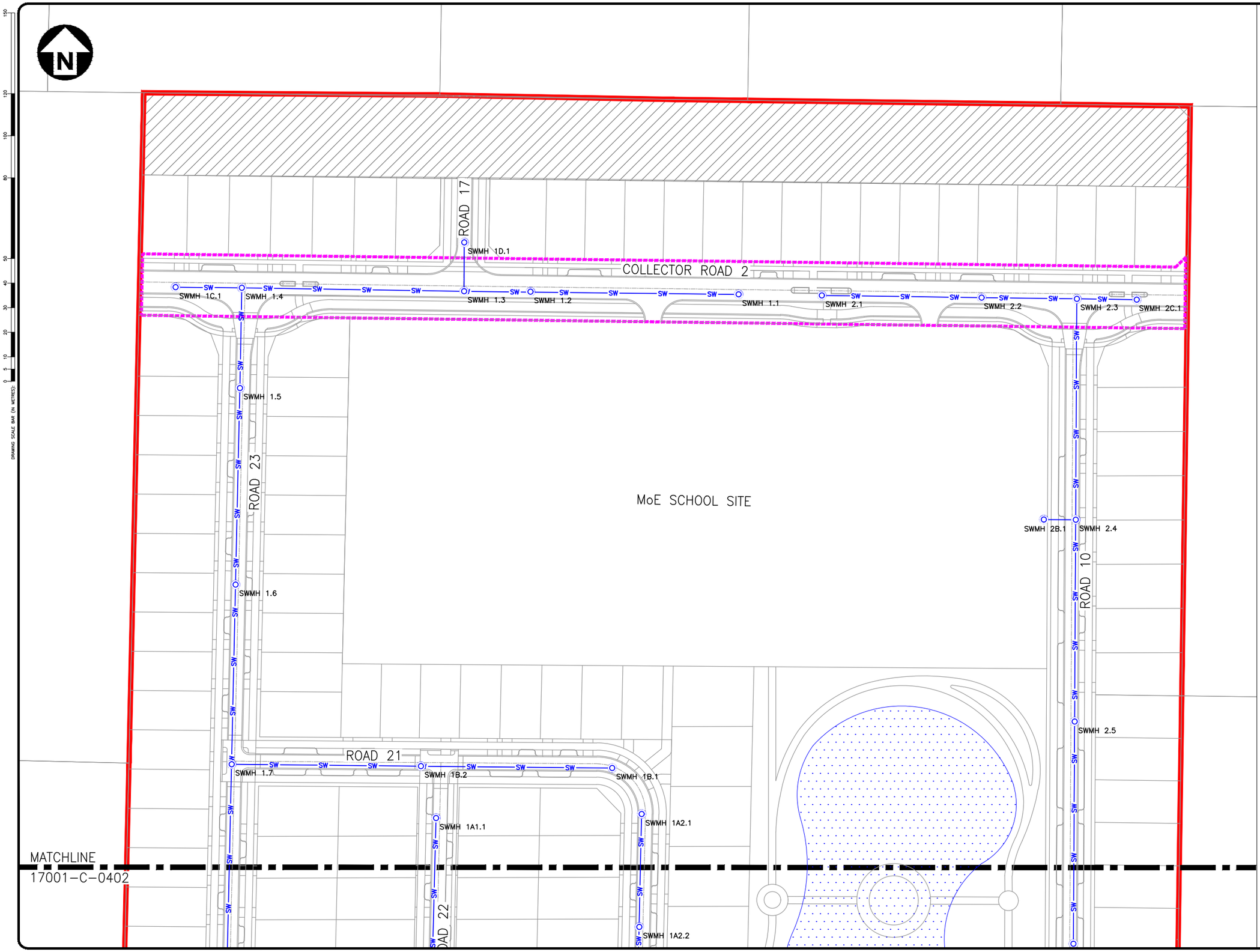
DATE PRINTED: 7 December 2020

DRAWING SCALE	1:5000
REVISION No.	B
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001–C–0400

FILE NAME: 17001–C–0400.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0



LEGEND

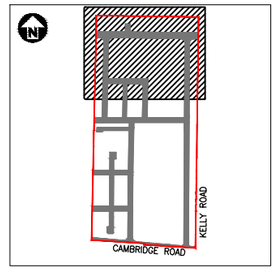
- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
- STORMWATER LOT CONNECTION
- STORMWATER MANHOLE
- TRAVERSABLE HEADWALL
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC STORMWATER CULVERT

NOTES

1. STORMWATER SERVICES DRAWING ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
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12. PHOTOGRAPHIC IMAGERY HAS BEEN IMPORTED FROM EXTERNAL SOURCES. AREAS AND DIMENSIONS MAY BE SUBJECT TO SCALE ERROR. SCALING FROM DRAWING IS AT THE USERS RISK.



KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	RG	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE	02.12.20
DRAWN BY	A.ZHANG	DATE	02.12.20
APPROVED BY	—	DATE	—

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE	1:1500
REVISION No.	B
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001-C-0401

FILE NAME: 17001-C-0401.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 5 10 20 30 50 80 100 120 150

17001–C–0401
MATCHLINE

SWMH 1.7 — SWMH 1B.2 — SWMH 1B.1

SWMH 1A1.1 — SWMH 1A2.1

SWMH 1A2.2

SWMH 1.8

SWMH 1A1.2

SWMH 1A1.3 — SWMH 1A2.3

ROAD 23 — ROAD 22 — ROAD 21 — ROAD 10

BASIN 1

SWMH 2.6

ROAD 20

SWMH 1.9 — SWMH 1A.3 — SWMH 1A.2 — SWMH 1A.1 — SWMH 2A.1 — SWMH 2.7

ROAD 18

SWMH 3E.1 — SWMH 3E.2

SWMH 3E.3 — SWMH 3E.4

SWMH 1.10 — FOREBAY 1 — SWMH 3F.1 SWMH 3F.2 — SWMH 3F.3 — FOREBAY 2 — SWMH 2.8

SWMH 2.9
OUTLET 5

SWMH 3.11 — SWMH 5.9

SWMH 4.6

SWMH 5.8 — SWMH 5B.1

FUTURE WDC CULVERT

FUTURE WDC CULVERT OUTLET

SWMH 3.10

ROAD 11

SUPERLOT SITE

ROAD 14

SWMH 3.9 — SWMH 5.7

PICK UP RUNOFF IMPOUNDED BY NEW LOTS (EXISTING KELLY ROAD RUNOFF)

SWMH 4.5

MATCHLINE
17001–C–0403

LEGEND

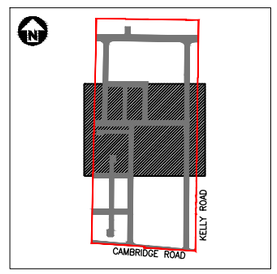
- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
- STORMWATER LOT CONNECTION
- STORMWATER MANHOLE
- TRAVERSABLE HEADWALL
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC STORMWATER CULVERT

NOTES

1. STORMWATER SERVICES DRAWING ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
2. UNDERGROUND SERVICES MAY BE LOCATED WITHIN THE VICINITY OF THE WORKS.
3. CONTRACTOR TO VERIFY THE POSITION OF ALL SERVICES PRIOR TO COMMENCEMENT OF WORKS.
4. ALL WORKS TO BE COMPLETED WITHIN THE WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION. (RITS)
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6. ALL SUMP LATERALS TO BE ø300mm RCRRJ UNLESS SHOWN OTHERWISE.
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8. ALL ROAD SUMPS TO HAVE 'HYNDS HYDRO D.I.' GRATES OR SIMILAR PRODUCT APPROVED
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KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	RG	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER LAYOUT PLAN

SHEET 2 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0402

FILE NAME: 17001–C–0402.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 5 10 20 30 40 50 80 100 120 150

N

17001-C-0402
MATCHLINE

ROAD 15

SWMH 3B.1 — SWMH 3.8 — SWMH 3D.1 — SWMH 5.6

SWMH 5.5

SWMH 3.7

ROAD 16

ROAD 11

SWMH 3.6

SWMH 5.4

SWMH 3.5

ROAD 12

SWMH 3C.1 — SWMH 3.4 — SWMH 3A.1 — SWMH 5.3

SWMH 3.3

SWMH 5.2

ROAD 13

SWMH 3.2

SWMH 3.1

SUPERLOT SITE

SWMH 4.4

SWMH 4.3

ROAD 10

SWMH 4.2 — SWMH 4B.1

INLET TO PICK UP RUNOFF IMPOUNDED BY NEW LOTS (EXISTING KELLY ROAD RUNOFF)

SWMH 5.1

SCRUFFY DOME INLET

SWALE

SWMH 5A.1

SWMH 4.1

SCRUFFY DOME INLET

SWMH 4A.1

CAMBRIDGE ROAD

LEGEND

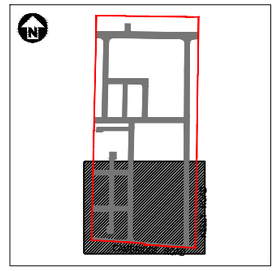
- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
- STORMWATER LOT CONNECTION
- STORMWATER MANHOLE
- TRAVERSABLE HEADWALL
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC STORMWATER CULVERT

NOTES

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KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	RG	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE 02.12.20
DRAWN BY	A.ZHANG	DATE 02.12.20
APPROVED BY	—	DATE —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER LAYOUT PLAN

SHEET 3 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

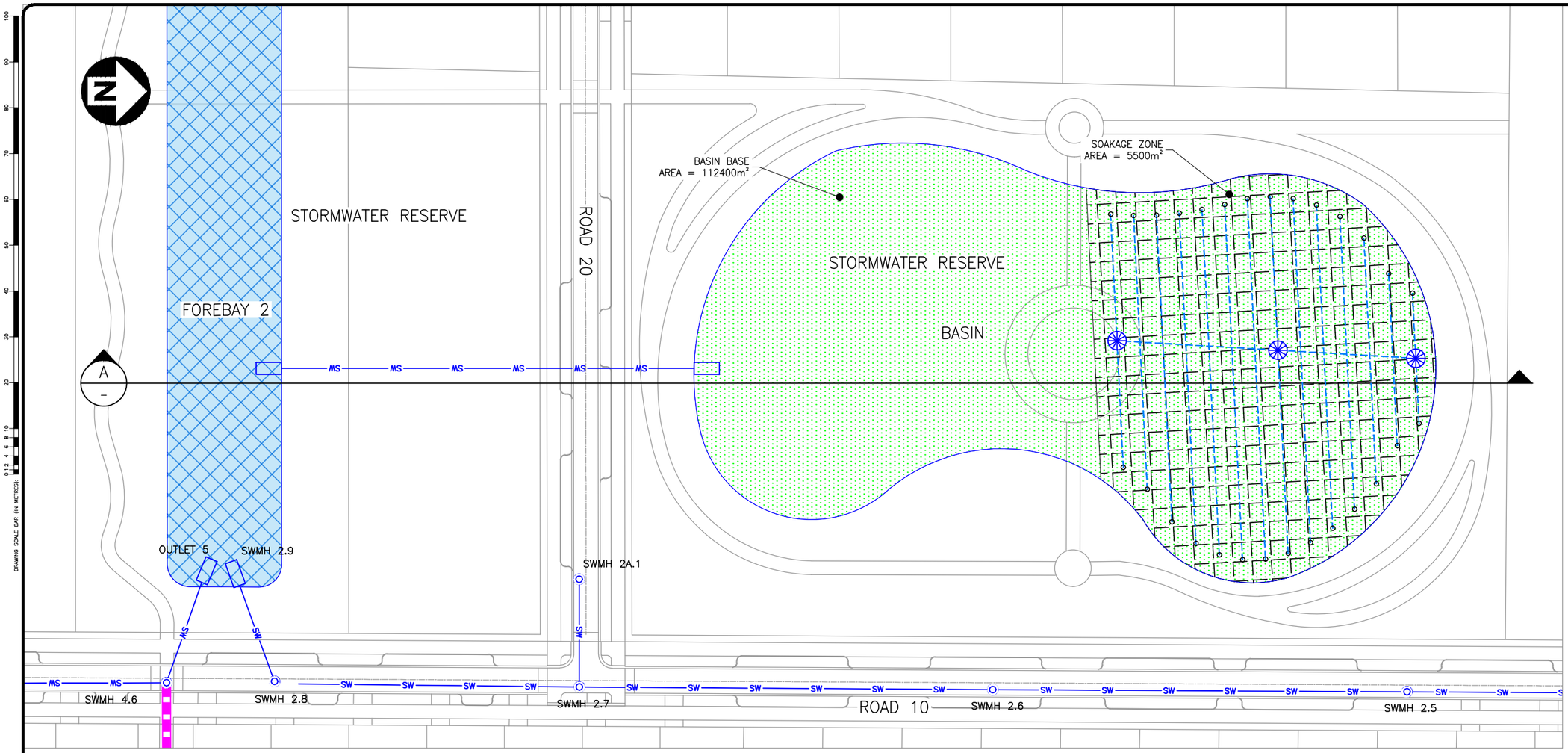
REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

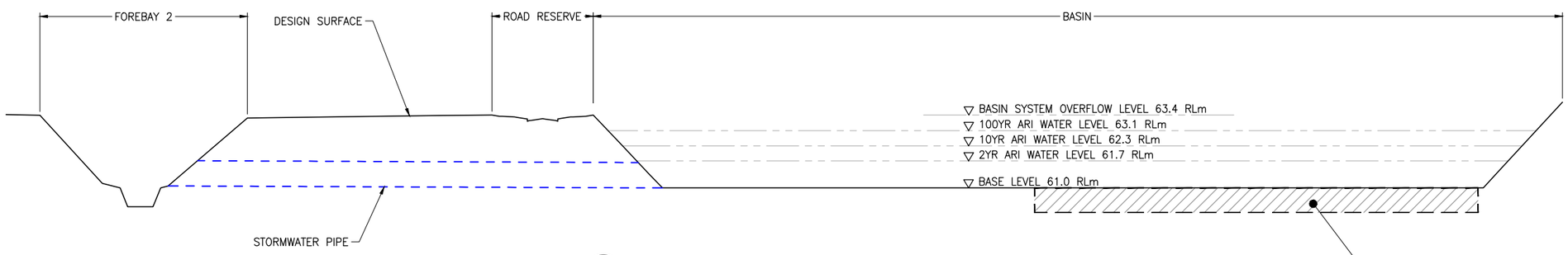
DRAWING No.: 17001-C-0403

FILE NAME: 17001-C-0403.dwg

READ DRAWINGS CAREFULLY & MEASURE TWICE CUT ONCE



LAYOUT PLAN
SCALE = 1:1000



A — TYPICAL SECTION – FOREBAY 2 & BASIN
SCALE = 1:1000 HORI / 1:200 VERT

LEGEND

- EXISTING CADASTRAL BOUNDARIES
- 3MS DEVELOPMENT BOUNDARY
- STORMWATER INFILTRATION BASIN
- SW — STORMWATER PIPE
- SUBSOIL PIPE
- SCRUFFY/INLET RISER
- MAINTENANCE MANHOLE
- TRAVERSABLE HEADWALL
- FLUSHING RISER INLET
- SOAKAGE ZONE

WDC CONTRACT WORKS

- WDC STORMWATER CULVERT

NOTES:

1. ALL STORMWATER DEVICES AND PLANTING TO BE IN GENERAL ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS)

DRAWING SCALE BAR (IN METRES): 0 1 2 4 6 8 10

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	AXZ	02.12.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER BASIN PLAN AND TYPICAL SECTION

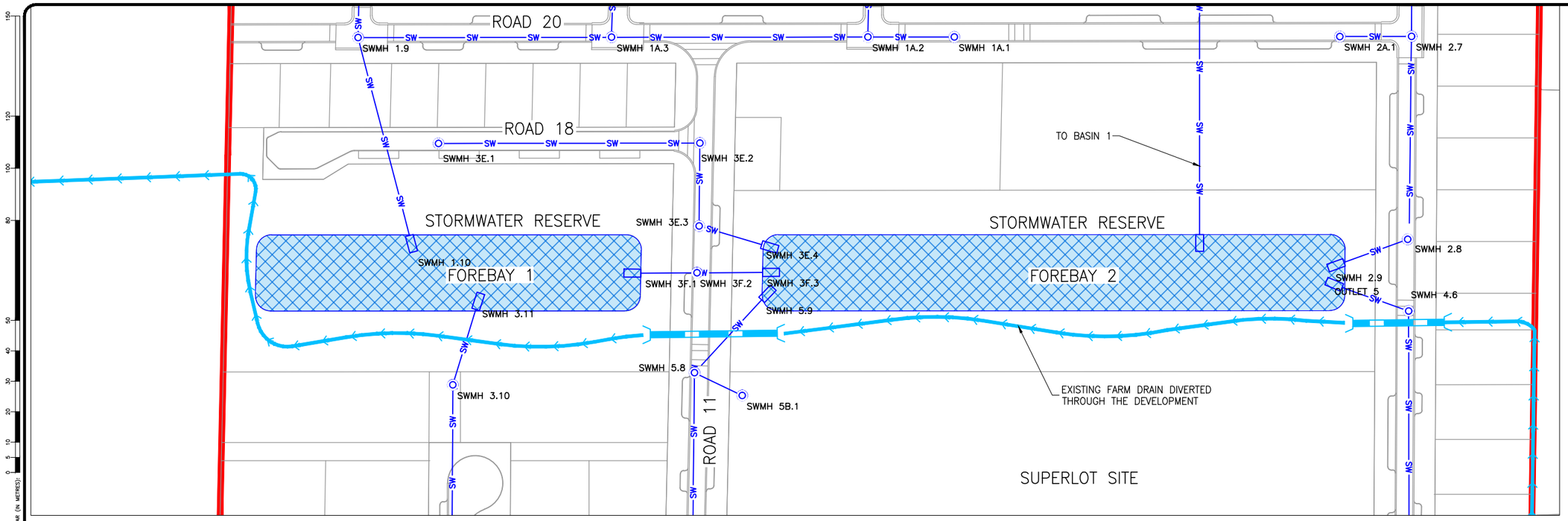
PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000	REVISION No.: A
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001–C–0420	

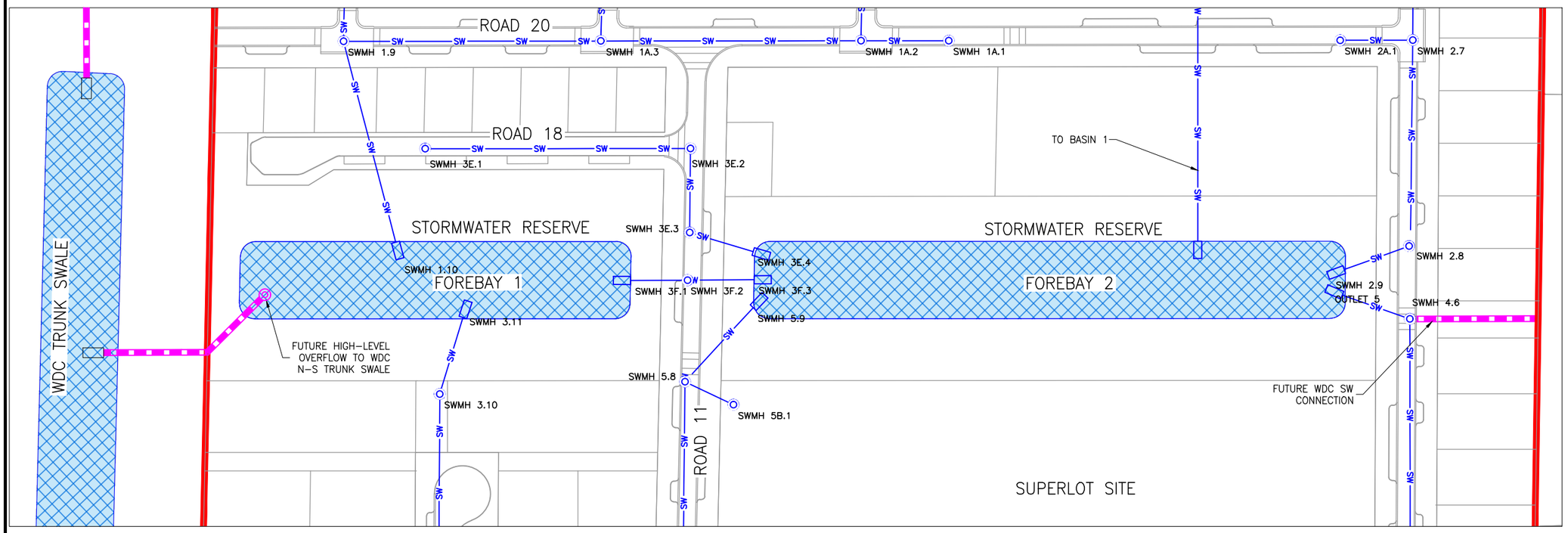
FILE NAME: 17001–C–0420.dwg

READ DRAWINGS CAREFULLY & MEASURETWICECUTONCE



3MS FOREBAY LAYOUT PLAN

SCALE = 1:1500



FUTURE WDC STORMWATER INTEGRATION LAYOUT PLAN

SCALE = 1:1500

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
- STORMWATER LOT CONNECTION
- STORMWATER MANHOLE
- TRAVERSABLE HEADWALL
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC STORMWATER CULVERT

NOTES

1. STORMWATER SERVICES DRAWING ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
2. UNDERGROUND SERVICES MAY BE LOCATED WITHIN THE VICINITY OF THE WORKS.
3. CONTRACTOR TO VERIFY THE POSITION OF ALL SERVICES PRIOR TO COMMENCEMENT OF WORKS.
4. ALL WORKS TO BE COMPLETED WITHIN THE WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION. (RITS)
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REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	AXZ	02.12.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE 02.12.20
DRAWN BY	A.ZHANG	DATE 02.12.20
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER FOREBAY LAOUT PLAN AND FUTURE INTEGRATION

PRODUCED BY: HG

DRAWING SCALE: 1:1500

REVISION No.: A

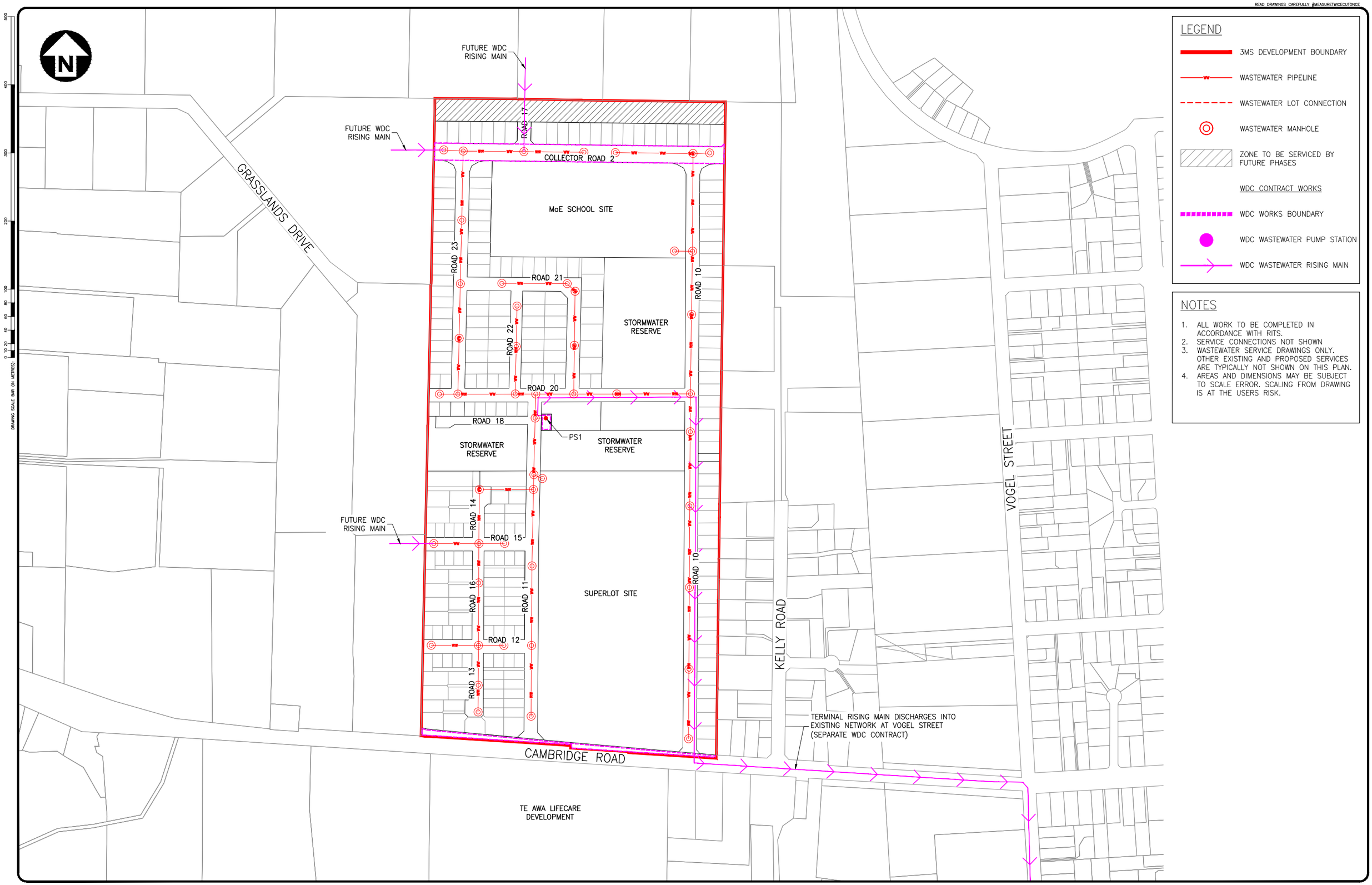
DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0430

DATE PRINTED: 7 December 2020

FILE NAME: 17001-C-0430.dwg

READ DRAWINGS CAREFULLY & MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

NOTES

1. ALL WORK TO BE COMPLETED IN ACCORDANCE WITH RITS.
2. SERVICE CONNECTIONS NOT SHOWN
3. WASTEWATER SERVICE DRAWINGS ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
4. AREAS AND DIMENSIONS MAY BE SUBJECT TO SCALE ERROR. SCALING FROM DRAWING IS AT THE USERS RISK.

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER GENERAL ARRANGEMENT

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:5000	REVISION No.: B
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001–C–0500	

FILE NAME: 17001–C–0500.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

FUTURE WDC RISING MAIN

WWMH C5.2

WWMH C5.1

ROAD 17

FUTURE WDC RISING MAIN

COLLECTOR ROAD 2

WWMH C4.1 WWMH C.3 WWMH C.2 WWMH C.1 WWMH D.1 WWMH D.2 WWMH D1.1

MoE SCHOOL SITE

ROAD 23

WWMH C.4

ROAD 10

WWMH D2.1 WWMH D.3

WWMH C2.2

WWMH C.5 ROAD 21 WWMH C2.1

WWMH C2.3

WWMH C3.1

MATCHLINE
17001-C-0502

ROAD 22

WWMH D.4

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

NOTES

1. ALL WORK TO BE COMPLETED IN ACCORDANCE WITH RITS.
2. SERVICE CONNECTIONS NOT SHOWN
3. WASTEWATER SERVICE DRAWINGS ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
4. AREAS AND DIMENSIONS MAY BE SUBJECT TO SCALE ERROR. SCALING FROM DRAWING IS AT THE USERS RISK.

KELLY ROAD
CAMBRIDGE ROAD

KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE	02.12.20
DRAWN BY	A.ZHANG	DATE	02.12.20
APPROVED BY	—	DATE	—

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

DISCIPLINE: CIVIL ENGINEERING

REVISION No.: B

DRAWING No.: 17001-C-0501

FILE NAME: 17001-C-0501.dwg

READ DRAWINGS CAREFULLY /MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

17001–C–0501
MATCHLINE

WWMH C.5
WWMH C2.1
WWMH C2.3
WWMH C3.1
WWMH C.6
WWMH C3.2
WWMH C2.4
WWMH D.4
ROAD 23
ROAD 22
ROAD 21
ROAD 10
STORMWATER RESERVE
WWMH C.1
WWMH C.7
ROAD 20
WWMH C.8
WWMH A.9
WWMH A.8
WWMH A.7
WWMH A.6
ROAD 18
WWMH B.6
WWMH B.7
WWMH A.5
STORMWATER RESERVE
STORMWATER RESERVE
ROAD 11
WWMH B.5
WWMH B2.1
WWMH B1.6
WWMH B.4
SUPERLOT SITE
WWMH A.4
ROAD 14
MATCHLINE
17001–C–0503

LEGEND

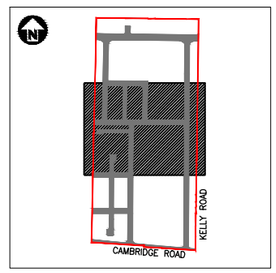
- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

NOTES

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KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE	02.12.20
DRAWN BY	A.ZHANG	DATE	02.12.20
APPROVED BY	–	DATE	–

CLIENT NAME: 3MS

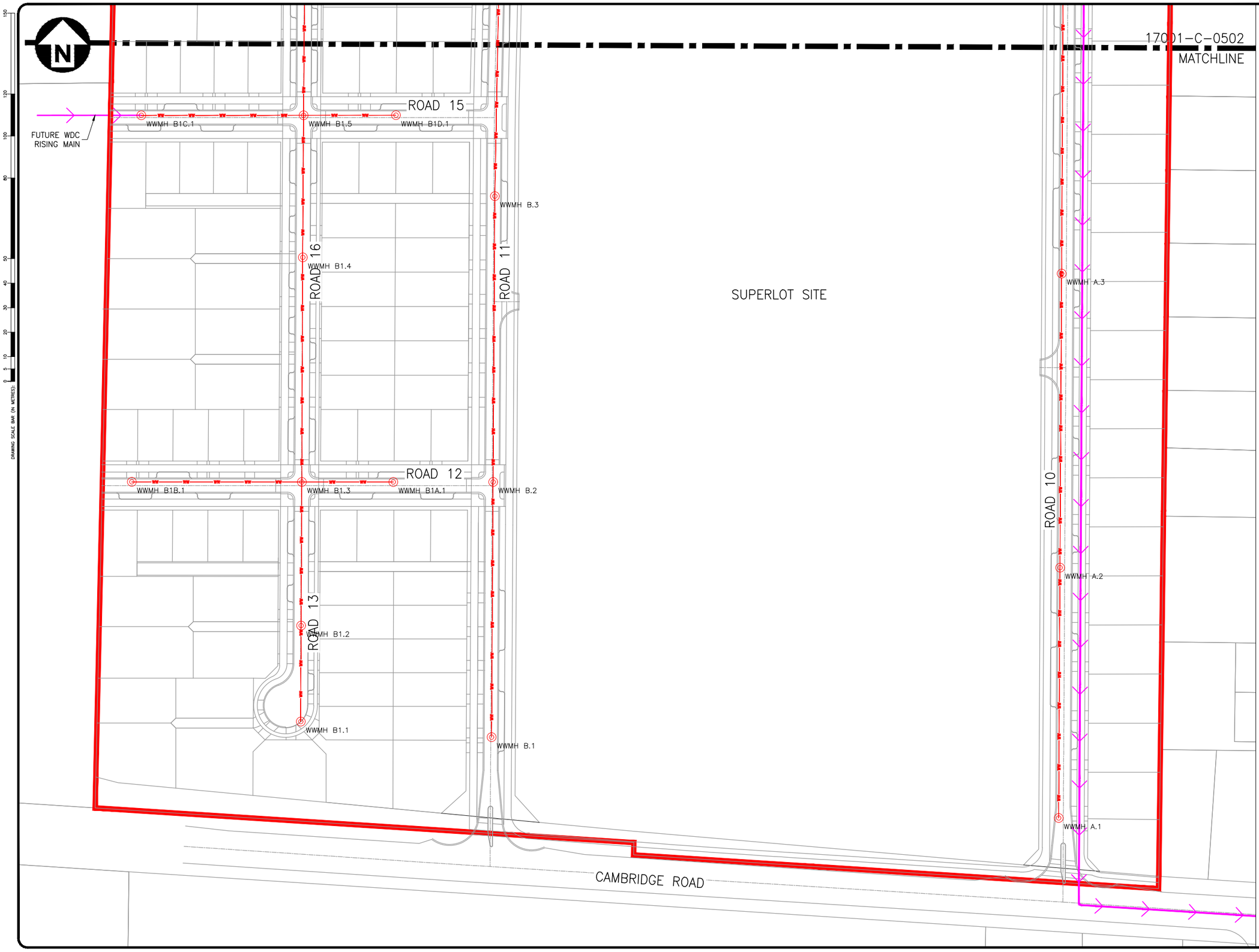
PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: WASTEWATER LAYOUT PLAN
SHEET 2 OF 3

PRODUCED BY: HG
DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500
REVISION No.: B
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0502
FILE NAME: 17001–C–0502.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

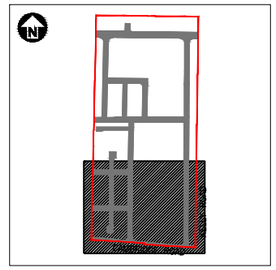
- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

NOTES

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KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER LAYOUT PLAN

SHEET 3 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

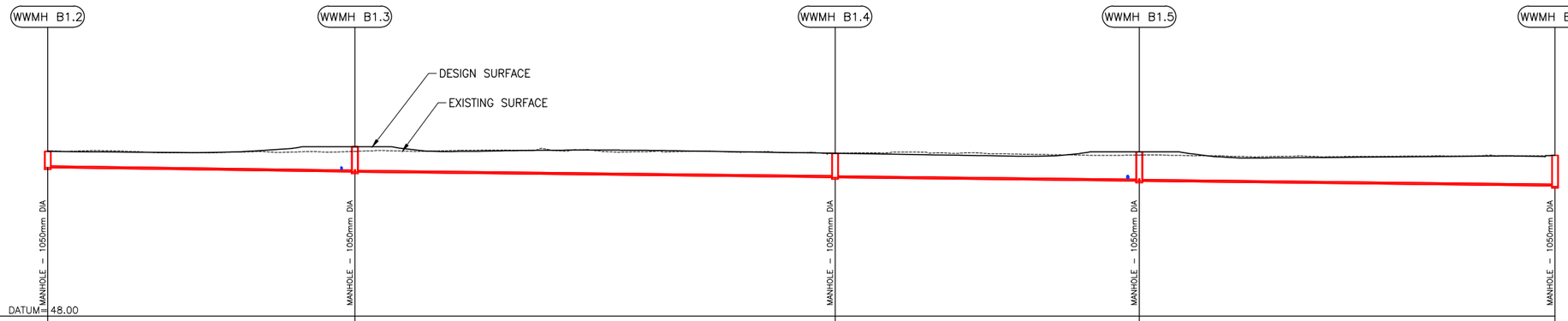
DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0503

FILE NAME: 17001-C-0503.dwg

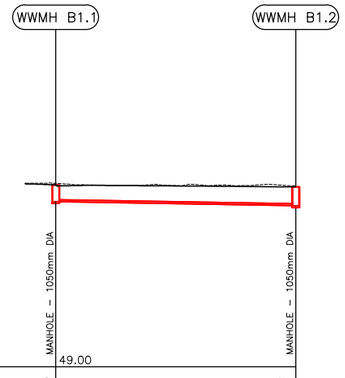
READ DRAWINGS CAREFULLY. MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES)
0 1 2 4 6 8 10 20 30 40 50 60 70 80 90 100



FINISHED LEVEL	63.67		64.13		63.50		63.64		63.31
DEPTH TO INVERT	1.52	1.54	2.39	2.41	2.29	2.31	2.77	2.79	2.90
INVERT LEVEL	62.15	62.13	61.73	61.71	61.21	61.19	60.86	60.84	60.40
PIPE GRADE SIZE & TYPE		1 in 150 150ø uPVC SN16		1 in 180 150ø uPVC SN16		1 in 180 150ø uPVC SN16		1 in 180 150ø uPVC SN16	
CHAINAGE	39.14	(58.5)	97.67	(91.5)	189.18	(58.0)	247.15	(79.2)	326.38

WW PIPELINE B1



FINISHED LEVEL	63.83		63.67
DEPTH TO INVERT	1.36		1.52
INVERT LEVEL	62.47		62.15
PIPE GRADE SIZE & TYPE		1 in 120 150ø uPVC SN16	
CHAINAGE	0.00	(39.1)	39.14

WW PIPELINE B1

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER CRITICAL GRAVITY LINE LONGITUDINAL SECTIONS SHEET 1

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1000

REVISION No.: B

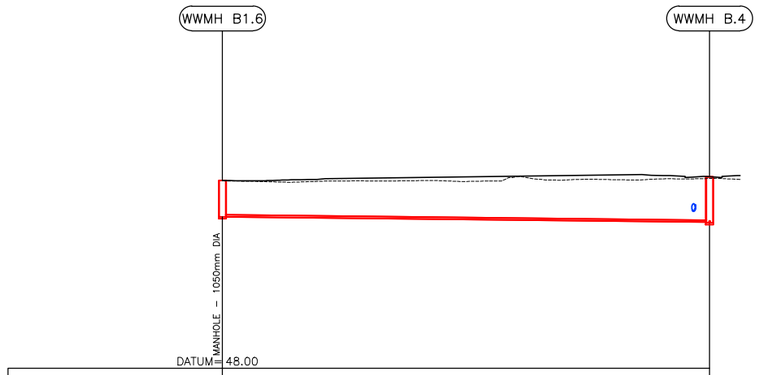
DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0510

FILE NAME: 17001-C-0510.dwg

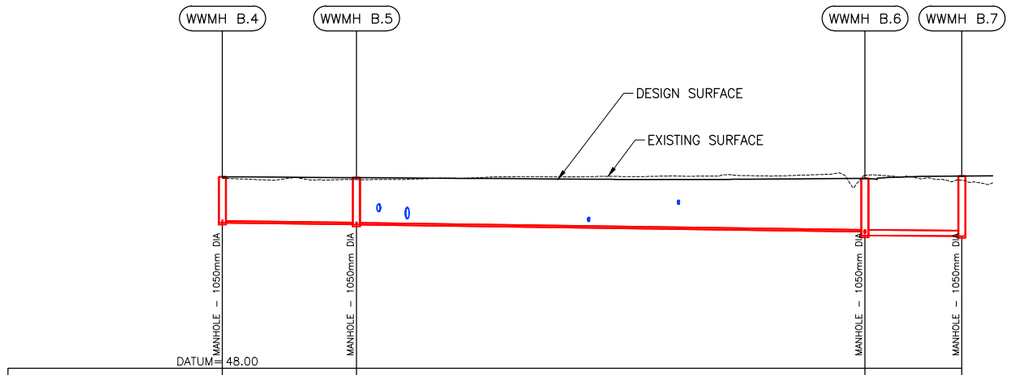
READ DRAWINGS CAREFULLY // MEASURE TWICE CUT ONCE

DRAWING SCALE BAR (IN MILLIMETRES)



FINISHED LEVEL	63.31		63.60
DEPTH TO INVERT	2.91 2.96		3.70 3.76
INVERT LEVEL	60.40 60.34		59.90 59.84
PIPE GRADE SIZE & TYPE		1 in 180 150ø uPVC SN16	
CHAINAGE	326.38	(79.5)	405.84

WW PIPELINE B1



FINISHED LEVEL	63.60	63.53	63.47	63.66
DEPTH TO INVERT	3.74 3.76	3.81 3.83	4.35 4.65	4.89 4.89
INVERT LEVEL	59.86 59.84	59.72 59.70	59.12 58.82	58.77 58.77
PIPE GRADE SIZE & TYPE		1 in 180 150ø uPVC SN16	1 in 142 150ø uPVC SN16	1 in 300 450ø uPVC SN16
CHAINAGE	332.77	(21.9) 354.62	(82.9) 437.56	(15.8) 453.38

WW PIPELINE B

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER CRITICAL GRAVITY LINE LONGITUDINAL SECTIONS SHEET 2

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:750

REVISION No.: B

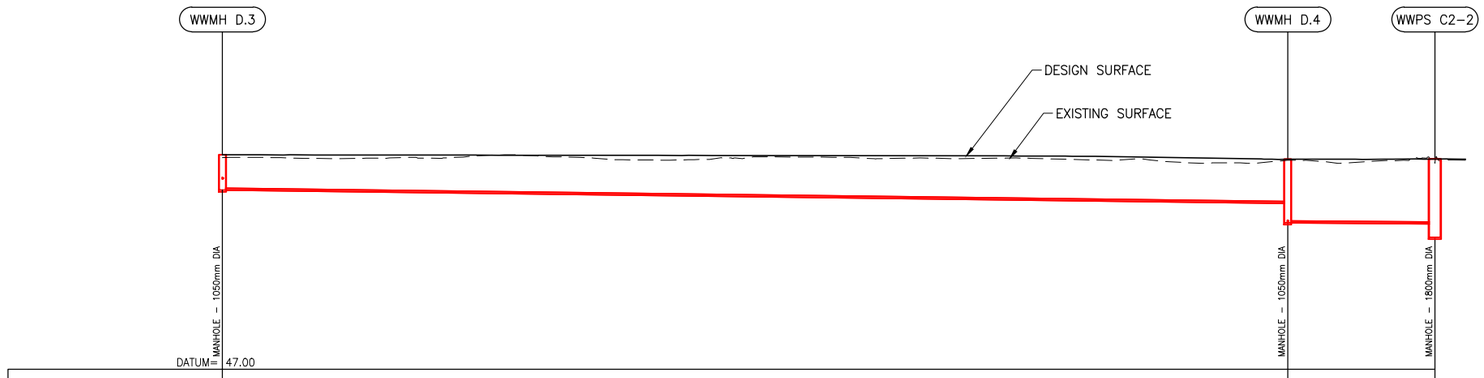
DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0511

FILE NAME: 17001–C–0511.dwg

READ DRAWINGS CAREFULLY // MEASURE TWICE CUT ONCE

DRAWING SCALE BAR (IN MILLIMETRES)



DATUM = 47.00

FINISHED LEVEL	64.47				64.11			64.13		
DEPTH TO INVERT	2.86	2.88			3.60	5.18		5.27	6.38	
INVERT LEVEL	61.62	61.60			60.51	58.94		58.86	57.75	
PIPE GRADE SIZE & TYPE		1 in 160 150ø uPVC SN16				1 in 300 150ø uPVC SN16				
CHAINAGE	262.19	(173.8)			435.95	(24.0)		459.95		

WW PIPELINE D

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	GCJ	10.08.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: WS	DATE: 17.04.20
DRAWN BY: HB	DATE: 17.04.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER LONGITUDINAL SECTIONS

SHEET 3

PRODUCED BY: BTW COMPANY

DATE PRINTED: 7 December 2020

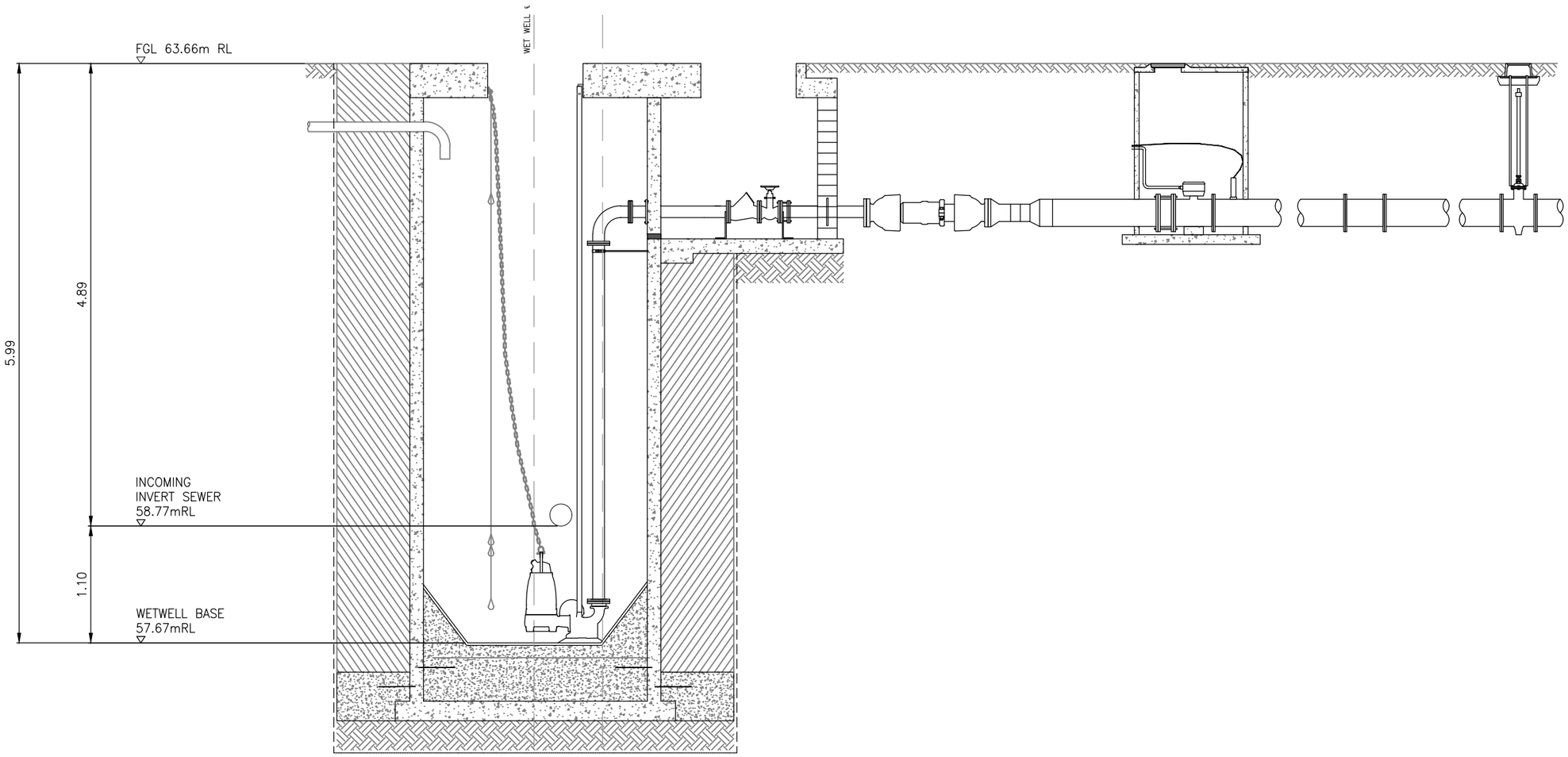
DRAWING SCALE: 1:750

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0512

FILE NAME: 17001-C-0512.dwg



C2 TERMINAL WASTEWATER PUMP STATION NO. 1

SCALE N.T.S.

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	01.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE	01.12.20
DRAWN BY	A.ZHANG	DATE	01.12.20
APPROVED BY	–	DATE	–

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER

PUMP STATION DETAILS

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: N.T.S.

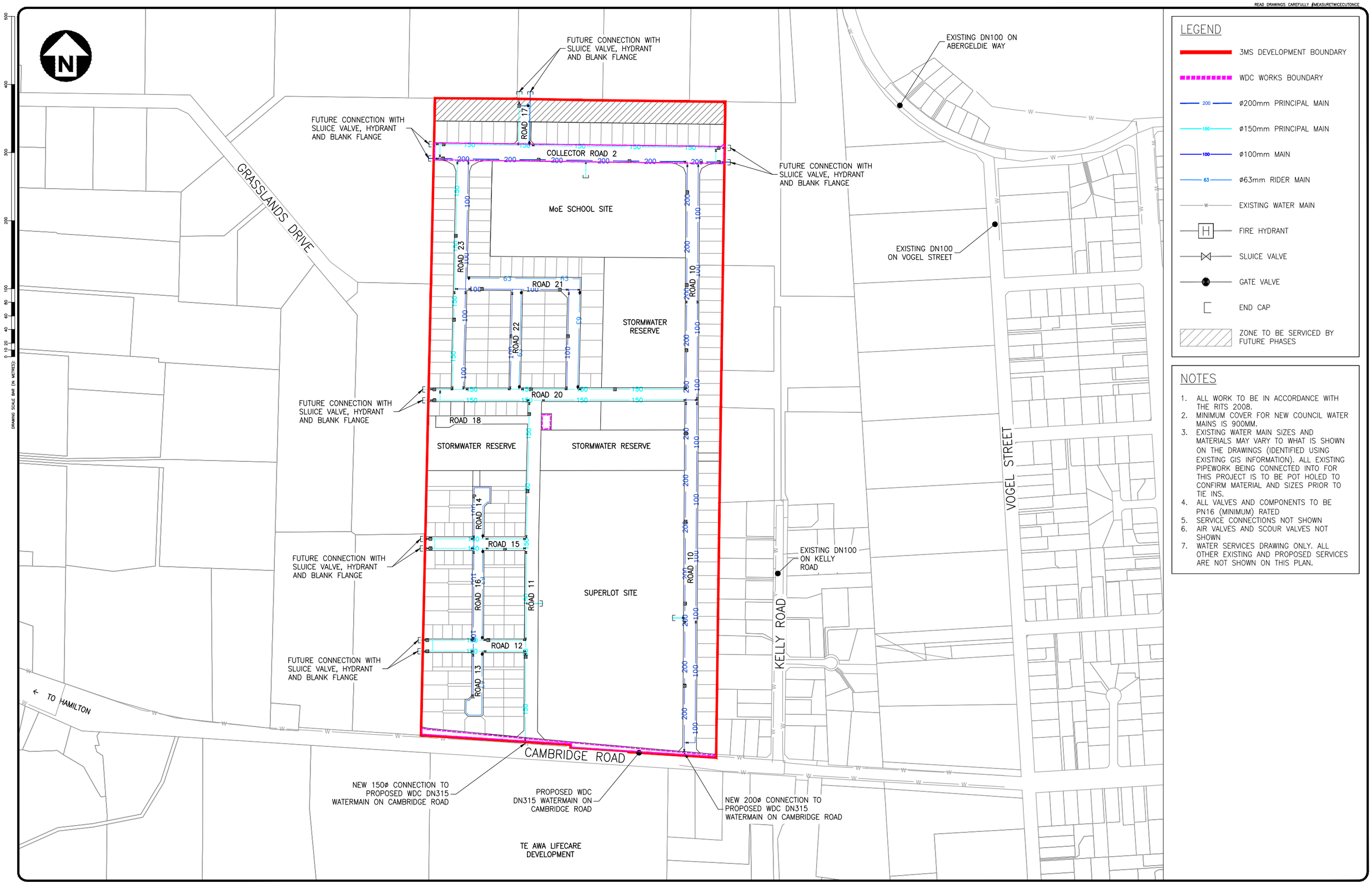
DISCIPLINE: CIVIL ENGINEERING

REVISION No.: B

DRAWING No.: 17001–C–0520

FILE NAME: 17001–C–0520.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
- ø150mm PRINCIPAL MAIN
- ø100mm MAIN
- ø63mm RIDER MAIN
- EXISTING WATER MAIN
- FIRE HYDRANT
- SLUICE VALVE
- GATE VALVE
- END CAP
- ZONE TO BE SERVICED BY FUTURE PHASES

NOTES

1. ALL WORK TO BE IN ACCORDANCE WITH THE RITS 2008.
2. MINIMUM COVER FOR NEW COUNCIL WATER MAINS IS 900MM.
3. EXISTING WATER MAIN SIZES AND MATERIALS MAY VARY TO WHAT IS SHOWN ON THE DRAWINGS (IDENTIFIED USING EXISTING GIS INFORMATION). ALL EXISTING PIPEWORK BEING CONNECTED INTO FOR THIS PROJECT IS TO BE POT HOLED TO CONFIRM MATERIAL AND SIZES PRIOR TO TIE INS.
4. ALL VALVES AND COMPONENTS TO BE PN16 (MINIMUM) RATED
5. SERVICE CONNECTIONS NOT SHOWN
6. AIR VALVES AND SCOUR VALVES NOT SHOWN
7. WATER SERVICES DRAWING ONLY. ALL OTHER EXISTING AND PROPOSED SERVICES ARE NOT SHOWN ON THIS PLAN.

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	SVDM	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY GENERAL ARRANGEMENT

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:5000

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0600

FILE NAME: 17001–C–0600.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN MILLIMETRES): 0 2 4 6 8 10 20 30 40 50 60 70 80 90 100

CONNECTION TO FUTURE PHASES

CONNECTION TO FUTURE PHASES

CONNECTION TO FUTURE PHASES

ROAD 17

COLLECTOR ROAD 2

ROAD 23

ROAD 21

ROAD 22

ROAD 10

MoE SCHOOL SITE

STORMWATER RESERVE

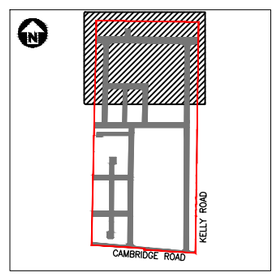
MATCHLINE
17001-C-0602

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
- ø150mm PRINCIPAL MAIN
- ø100mm MAIN
- ø63mm RIDER MAIN
- EXISTING WATER MAIN
- FIRE HYDRANT
- SLUICE VALVE
- GATE VALVE
- END CAP
- ZONE TO BE SERVICED BY FUTURE PHASES

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KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	01.12.20
A	FOR INFORMATION	SVDM	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 01.12.20
DRAWN BY: A.ZHANG	DATE: 01.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0601

FILE NAME: 17001-C-0601.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

17001-C-0601
MATCHLINE

CONNECTION TO FUTURE PHASES

ROAD 23
ROAD 22
ROAD 21
ROAD 20
ROAD 18
ROAD 14
ROAD 11
ROAD 10
ROAD 15

STORMWATER RESERVE
STORMWATER RESERVE
STORMWATER RESERVE
SUPERLOT SITE

MATCHLINE
17001-C-0603

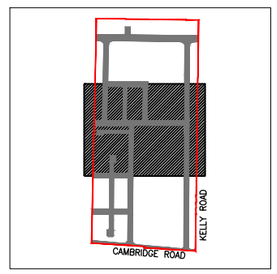
DRAWING SCALE BAR (IN MILLIMETRES): 0 2 4 6 8 10

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
- ø150mm PRINCIPAL MAIN
- ø100mm MAIN
- ø63mm RIDER MAIN
- EXISTING WATER MAIN
- FIRE HYDRANT
- SLUICE VALVE
- GATE VALVE
- END CAP
- ZONE TO BE SERVICED BY FUTURE PHASES

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6. AIR VALVES AND SCOUR VALVES NOT SHOWN
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KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	SVDM	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE	02.12.20
DRAWN BY	A.ZHANG	DATE	02.12.20
APPROVED BY	—	DATE	—

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY LAYOUT PLAN

SHEET 2 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0602

FILE NAME: 17001-C-0602.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

17001-C-0602
MATCHLINE

ROAD 15

ROAD 16

ROAD 11

ROAD 12

ROAD 13

ROAD 10

SUPERLOT SITE

CONNECTION TO FUTURE PHASES

CONNECTION TO FUTURE PHASES

NEW OD PE 150 CONNECTION TO PROPOSED WDC DN315 WATER MAIN

CAMBRIDGE ROAD

NEW OD PE 200 CONNECTION TO PROPOSED WDC DN315 WATER MAIN

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
- ø150mm PRINCIPAL MAIN
- ø100mm MAIN
- ø63mm RIDER MAIN
- EXISTING WATER MAIN
- FIRE HYDRANT
- SLUICE VALVE
- GATE VALVE
- END CAP
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KEY PLAN

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	SVDM	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	DATE
M.FARRELL	02.12.20
DRAWN BY	DATE
A.ZHANG	02.12.20
APPROVED BY	DATE
—	—

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY LAYOUT PLAN

SHEET 3 OF 3

PRODUCED BY: HG

DATE PRINTED: 7 December 2020

DRAWING SCALE: 1:1500

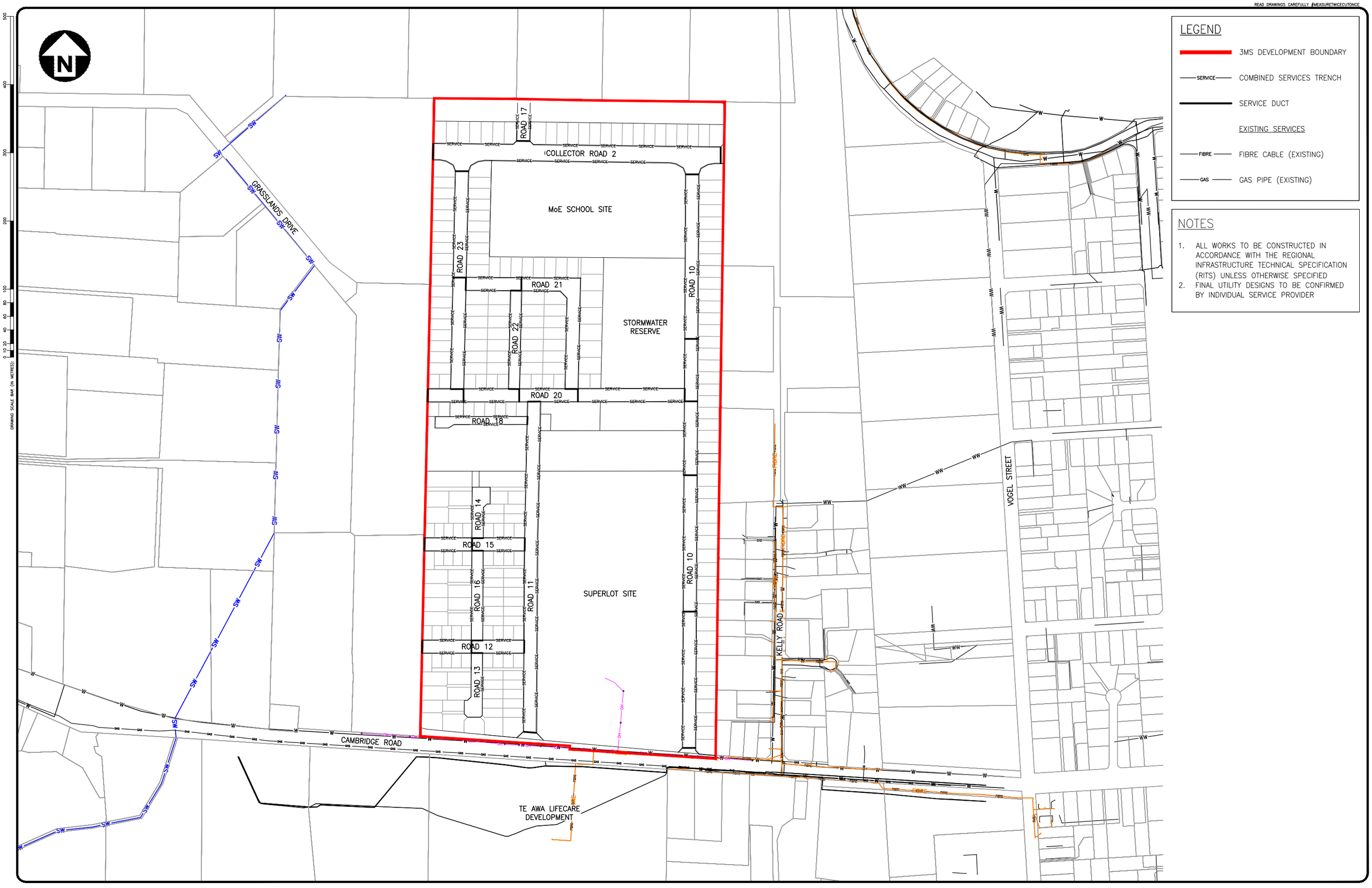
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DRAWING No.: 17001-C-0603

FILE NAME: 17001-C-0603.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- SERVICE — COMBINED SERVICES TRENCH
- SERVICE DUCT

EXISTING SERVICES

- FIBRE — FIBRE CABLE (EXISTING)
- GAS — GAS PIPE (EXISTING)

NOTES

1. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS) UNLESS OTHERWISE SPECIFIED
2. FINAL UTILITY DESIGNS TO BE CONFIRMED BY INDIVIDUAL SERVICE PROVIDER

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION – 3MS ONLY UPDATE	GCJ	27.11.20
A	FOR INFORMATION	GCJ	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: L. MCCAFFREY	DATE: 17.04.20
DRAWN BY: G. JONES	DATE: 17.04.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: UTILITY SERVICES GENERAL ARRANGEMENT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DRAWING SCALE: 1:5000

REVISION No.: B

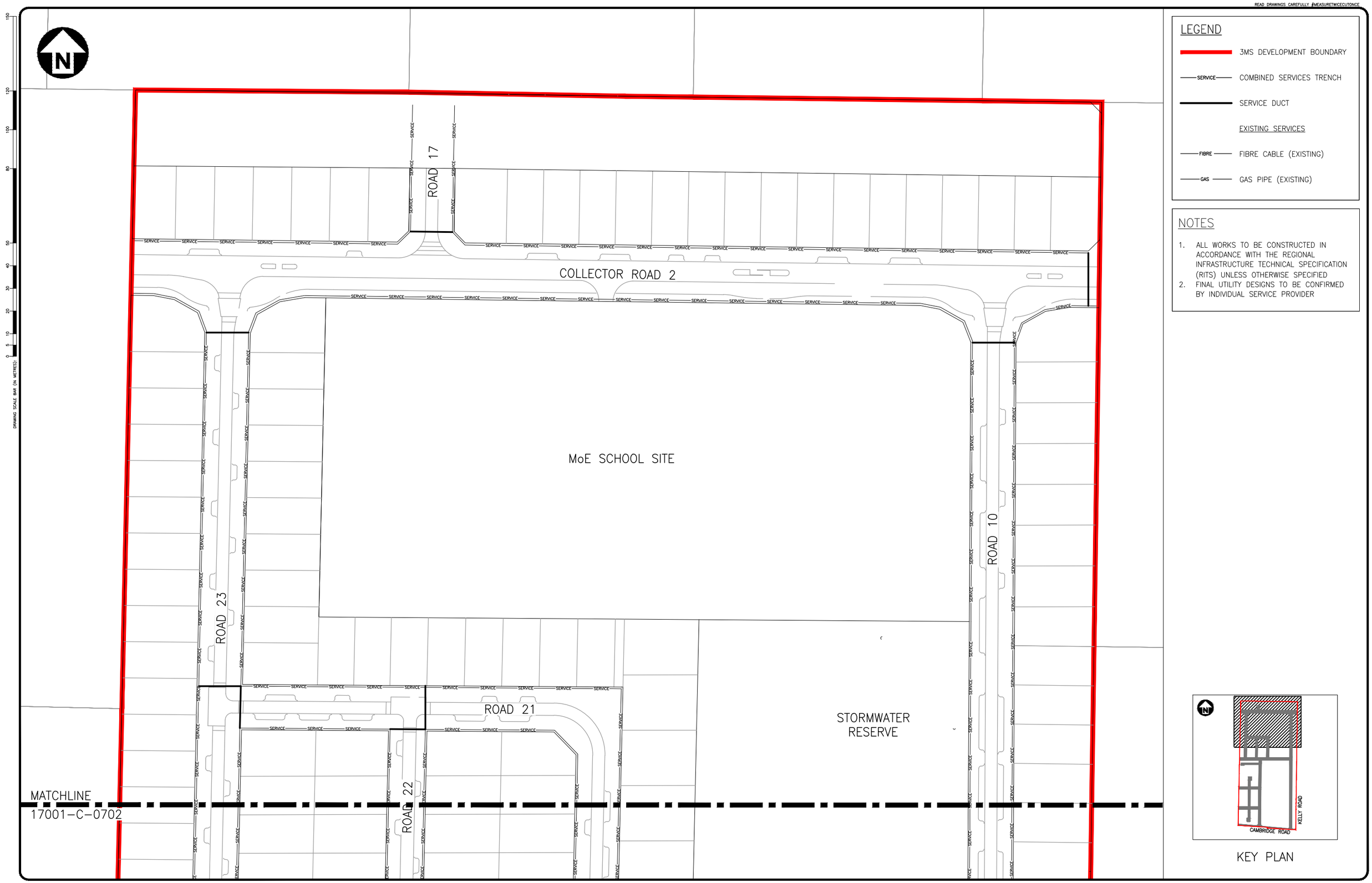
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CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: UTILITY SERVICES LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

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17001–C–0701
MATCHLINE

ROAD 23

ROAD 22

ROAD 21

STORMWATER RESERVE

ROAD 20

ROAD 18

STORMWATER RESERVE

STORMWATER RESERVE

ROAD 11

ROAD 10

ROAD 14

SUPERLOT SITE

MATCHLINE
17001–C–0703

ROAD 15

LEGEND

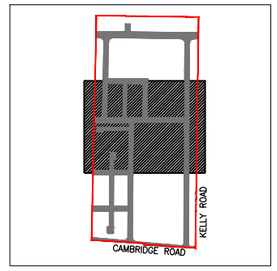
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- SERVICE — COMBINED SERVICES TRENCH
- SERVICE DUCT

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DRAWN BY: G. JONES — DATE: 17.04.20
APPROVED BY: – — DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: UTILITY SERVICES LAYOUT PLAN

SHEET 2 OF 3

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DRAWING No.: 17001–C–0702

FILE NAME: 17001–C–0702.dwg

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17001-C-0702
MATCHLINE

ROAD 15
ROAD 16
ROAD 11
ROAD 12
ROAD 13
ROAD 10

SUPERLOT SITE

POWER

CAMBRIDGE ROAD

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- SERVICE — COMBINED SERVICES TRENCH
- SERVICE DUCT

EXISTING SERVICES

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MASTER PLAN

DRAWING TITLE: UTILITY SERVICES LAYOUT PLAN

SHEET 3 OF 3

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DISCIPLINE: CIVIL ENGINEERING

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Appendix C

3-Waters Assessment Report (HG)

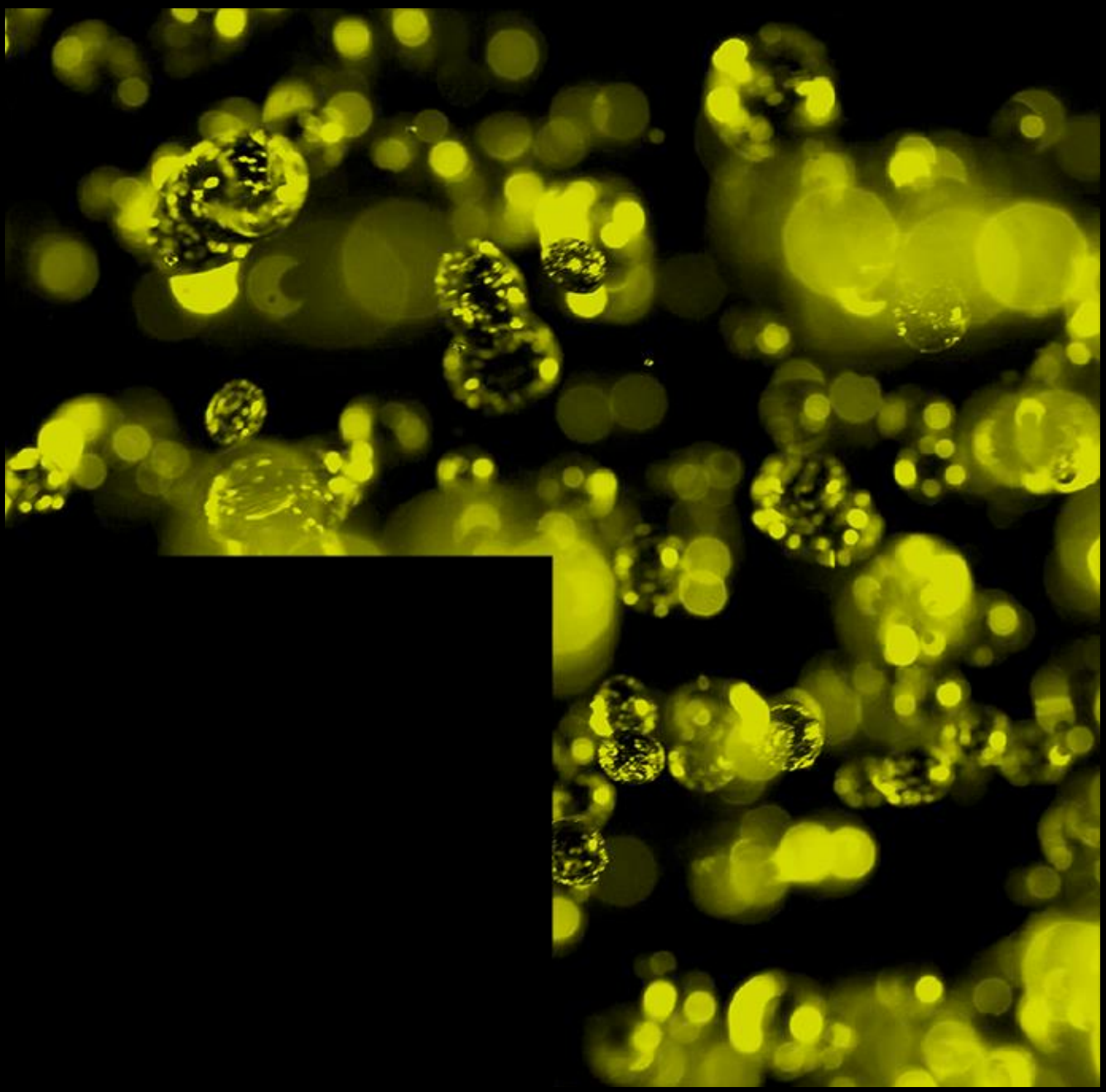
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3MS RESIDENTIAL DEVELOPMENT

3-Waters Assessment

3Ms of Cambridge Limited

Technical Memo



DOCUMENT CONTROL RECORD

CLIENT	3Ms of Cambridge Limited
PROJECT	3MS Residential Development
HG PROJECT NO.	2000615
HG DOCUMENT NO.	
DOCUMENT	3-Waters Assessment – 3MS Residential Development

ISSUE AND REVISION RECORD

DATE OF ISSUE	3 December 2020
STATUS	Final



ORIGINATOR	Matthew Farrell - Senior Civil Engineer



REVIEWED	Scott King - Engineering Manager



APPROVED FOR ISSUE	Scott King - Engineering Manager
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1.0 INTRODUCTION

Harrison Grierson has been commissioned by 3MS of Cambridge Limited (3MS) to prepare a 3-waters assessment in support of a consent application for the residential subdivision of their properties to the west of Cambridge.

The 3MS site is approximately 41Ha and is within the Waipa District Council (WDC) C2 Growth Cell as indicated in Figure 1, below.

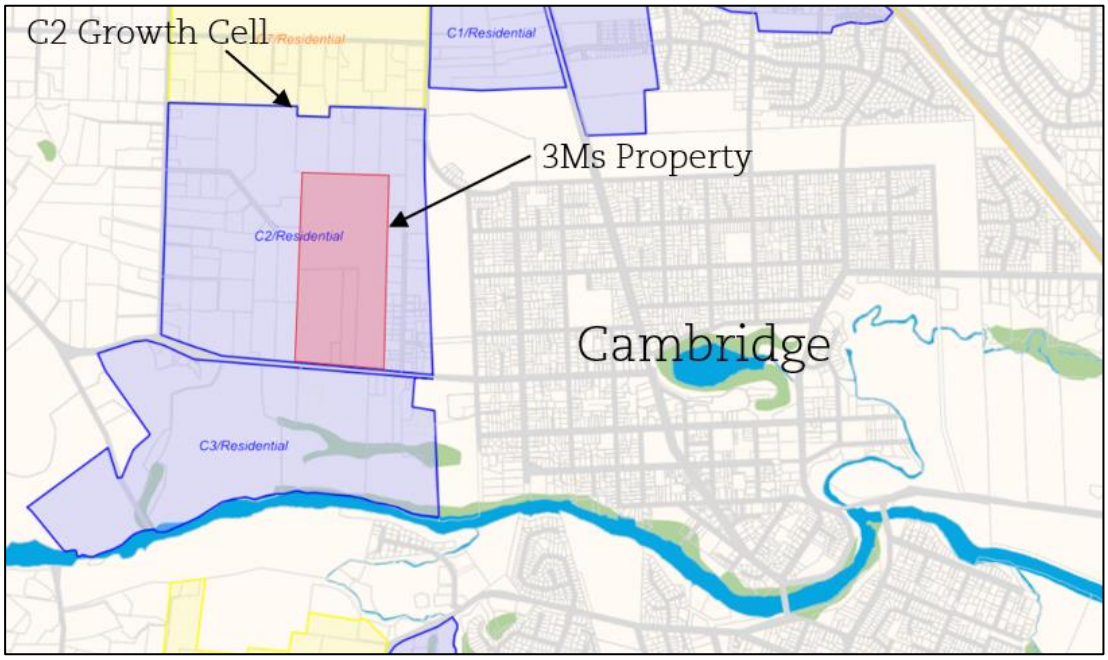
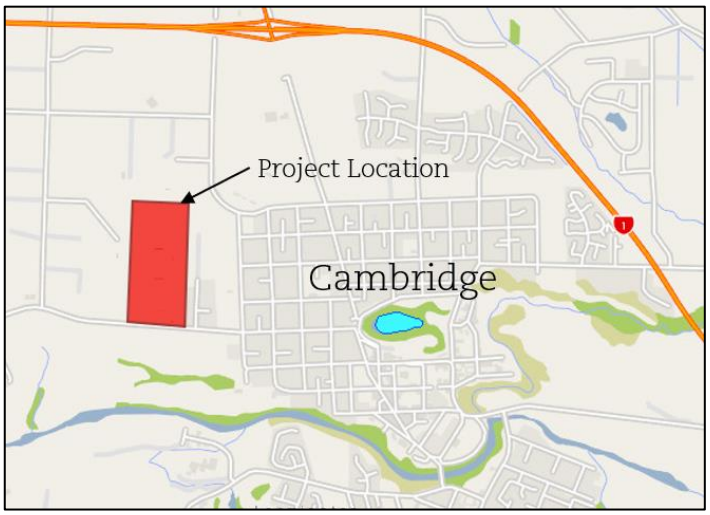


Figure 1 3MS project location

2.0
SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Site Address	Cambridge Road, Cambridge, Waipa
Site Location	 *Figure 2:* Project Location (Waikato Regional Council Maps)
Legal Description	LOT 1 DPS 85575, LOT 2 DPS 85575, PT LOT 1 DP 29023, LOT 1 DPS 31006, LOT 2 DP 29023, LOT 1 DPS 75243
Site Area	40.84 Ha
Local Authority	Waipa District Council (WDC)
Zone	Deferred Residential Zone
Future Growth Waipa 2050	C2 Residential
Existing Topography	The site is relatively flat and sits within the greater C2 Growth Cell (approximately 161Ha). The properties under assessment essentially form a rectangular shape, measuring approximately 950m x 425m, resulting in a gross area of approximately 41ha. The area is generally flat in contour, falling gently from an elevation of around RL 65m in the southeast and northeast corners, to a farm drain around RL 63m. The farm drain is roughly in the middle of the property flowing east to west. Much of the area sits at or about RL 64m.
Existing Structures and Land Use	The vast majority of the area is in rural use, although there are also a few residential properties along the Cambridge Road boundary.
Existing Services	**Water Supply** The site is currently outside the Cambridge Water Supply area, however, there is a public 200mm diameter PVC water main on the northern side of Cambridge Road servicing

properties along Cambridge and Peak Roads as far west as St Peter's School.

There is a 20mm and a 100mm connection to the 3MS properties.

WDC are in the process of replacing the DN200 pipeline with a DN315 bulk supply line from the Alpha Street Water Treatment Plant. This upgrade is intended to supply the C1, C2 and C3 Growth cells and will extend past the 3MS property.

Wastewater

There are no public sewer networks servicing the site.

There is a small gravity network servicing the properties on Kelly Road to the east of the 3MS site. This gravity network drains to a wastewater pump station about 400m along Kelly Road. This pump station discharges from an 80mm diameter rising main into the Cambridge gravity network at the western end of Williams Street.

WDC are in the process of installing a new 300mm diameter rising main along Cambridge Road from the southeast corner of the 3MS property, discharging into the gravity network at Vogel Street. This new rising main is intended to service the C2 Growth Cell area.

Stormwater

The 3MS site has a farm drain that flows east to west, roughly bisecting the property in half. This drain joins another farm drain that runs from the northwest of the C2 Growth cell. This drain services a portion of Grasslands Drive and then flows south to a 300m culvert before daylighting into the gulley on the southern side of Cambridge road where it ultimately flows into the Waikato River.

Proposed Development

The intended subdivision is expected to be made up of the following property types:

TABLE 1: Subdivision Property Type Details

	TOTAL AREA (HA)	NO. OF LOTS
General Residential	10.49	186
Future Development Site	1.41	N/A
Terraced Residential	0.56	14
Compact Residential	1.80	56
High Density Housing	0.32	20
Neighbourhood Centre Area	0.27	1
Super-Lot Site (Retirement Village)	1.07	1
MoE School Site	6.81	1
ROW Access Lots	0.04	N/A
WDC Collector Road	4.57	N/A
3MS Road Reserves	0.58	N/A
Utility Reserve Area (WW Pump Station)	0.33	N/A
Stormwater Reserve Area	8.6	N/A
Recreational Reserve Area	3.99	N/A
TOTAL	**40.84**	

There will be approximately 500 residential lots in the full development (assuming 24 lots in the Future Development Site and 200 residences in the Super-lot site), a gross density of about 12 lots per hectare.

The proposed preliminary layouts are shown in Figure 3 and included in the Appendices.

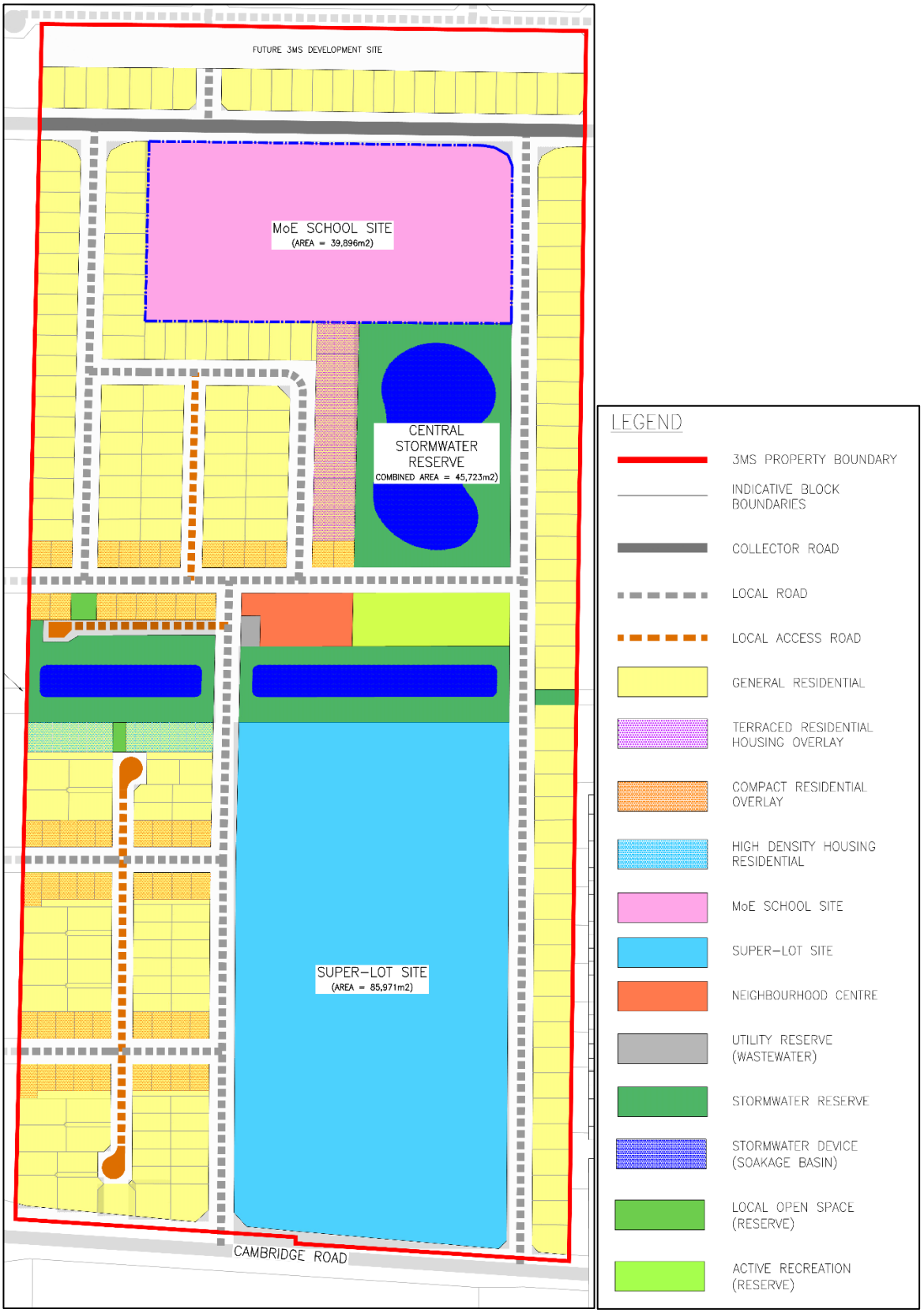


Figure 3 Proposed Layout

3.0
WATER SUPPLY

3.1 BACKGROUND REVIEW

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

- Waikato Local Authority Shared Services Regional Infrastructure Technical Specification (RITS)
- NZS 4404:2010 Land Development and Subdivision Infrastructure
- SNZ PAS 4509:2008 New Zealand Fire Service Firefighting Water Supplies Code of Practice
- Master Planning Design Strategy - Water Supply (BTW 2020)
- Cambridge Growth Cells C2 and C3 Report (HG 2015)

3.2 WATER SUPPLY

A high-level assessment has been undertaken to determine the possibility of servicing the 3MS site from the existing 200mm diameter water pipe adjacent to Cambridge Road. This would be a temporary connection until it is replaced by the new 315mm diameter WDC bulk water main.

Based on earlier discussions with WDC we have assumed that the WDC network will be able to supply the C2 growth cell including this development.

The water reticulation shown on the masterplan drawings (17001-C-0601 to 0603) is a concept layout based on the demand calculations in section 3.2.1. This network will be modelled and refined at detailed design.

3.2.1 DEMAND

Table 2, below, is an assessment of the expected domestic demand for the proposed 3MS development. This has been calculated using lot numbers and areas based on the development layout drawing 17001-SK-094 in Appendix 1.

A daily demand of 260 l/person/day and population of three people per dwelling has been used for the assessment. This is based on the RITS requirement of a minimum of 2.7 people per dwelling. This rate has been applied to all the residential zones as the number of lots is known.

The Super-lot in the south of 3MS property is expected to be developed as a retirement village. We have estimated that there will be 200 dwellings on this site based on an average of just over 400m^2 per dwelling.

We have estimated an additional 24 lots for the Future Residential Development Site based on the number of lots directly south of this zone.

The MoE School demand is based on a pupil and staff compliment of 1056 people and an average demand of 23 l/person/day.

Peak flow rates have been calculated using a rate of 5 times the average flow rate.

TABLE 2: Water Demand

LAND USAGE	TOTAL AREA (HA)	NO. OF LOTS	ESTIMATED POPULATION	AVERAGE DAILY DEMAND (M3/D)	AVERAGE DAILY FLOW (L/S)	PEAK FLOW (L/S)
General Residential	10.49	186	558	145.1	1.68	8.4
Future Residential Development Site	1.41	24[1]	72	18.7	0.22	1.1
Terraced Residential	0.56	14	42	10.9	0.13	0.6
Compact Residential	1.80	56	168	43.7	0.51	2.5
High Density Housing	0.32	20	60	15.6	0.18	0.9
Super-Lot Site (Retirement Village)	8.60	200	600	156.0	1.81	9.0
MoE School Site	3.99	1	1056	24.3	0.28	1.4
Neighbourhood Centre Area	0.33	1	15	3.9	0.04	0.2
Total	**27.50**	**502**	**2571**	**418.1**	**4.84**	**24.2**

3.3 FIREFIGHTING SUPPLY

This development will be designed to meet the RITS requirement of SNZ PAS 4509 FW2 firefighting standard. This requires a network capable of flows of 25 l/s during network demand of 60% of peak flow and minimum of 100 kPa residual pressure.

Using the peak demand flow of 24.2 l/s (Table 2) the network will need to meet a fire flow demand of 39.5 l/s.

3.4 INTEGRATION WITH C2 GROWTH CELL

The design of the water network for the 3MS development will not be a stand-alone design. It is expected that there will be full integration with the greater C2 Growth Cell, and the detailed design model will include these flows into the model.

The previous design by BTW for the C2 Master Planning included a 200mm diameter bulk water supply along the central collector road. The intention for the current 3MS development is that this will now be included within the development. The 200mm diameter main will connect to the WDC water supply on Cambridge Road at the SE corner of the development. It will run up the eastern side of the development and connections to the greater C2 Growth Cell will be included at the northwest and northeast corners of the 3MS development.

Additional water main connections will also be provided along the eastern side of the 3MS development for future C2 Growth Cell developments.

Modelling of the development to include the future phases of the growth cell will require integration with the WDC water network model during the detailed design stage.

[1] *Estimated number of residences/lots*

3.5 SUMMARY

The network will be refined and modelled to meet these requirements at detailed design.

An initial assessment of the connections servicing the development at peak fire flows show the development would require a minimum of two 150mm diameter connections to the WDC bulk main. This would result in peak pipe velocities of approximately 1.5 m/s in each connection. As mentioned in 3.4 one of these connections will be upgraded to at least a 200mm diameter to accommodate additional supply to the greater C2 Growth Cell.

The demand and flows will need to be verified with WDC to confirm there is adequate capacity to meet the proposed phases of the development.

4.0 STORMWATER MANAGEMENT

4.1 DESIGN REQUIREMENTS

The stormwater management will be designed in accordance with the following policy and guidance documents

- Waikato Local Authority Shared Services Regional Infrastructure Technical Specifications (RITS)
- Waikato Stormwater Management Guideline (TR2020/07)
- Stormwater Management Plan, Cambridge C1 and C2/C3 Infrastructure, Cambridge West – Pukeroro and Waikato River Catchments (WDC 2019) (SMP)
- Cambridge C1 and C2/C3 Structure Plans: Stormwater Report (BECA 2017)
- Preliminary Geotechnical Investigation and Site Suitability report (BTW 2020)
- Cambridge C1 and C2/C3 Infrastructure: Groundwater Model and Assessment report (BECA 2019)

Stormwater runoff from any new impervious areas within the development will require primary stormwater management for the 10-year ARI storm.

4.2 SOIL CONDITIONS AND SOAKAGE REQUIREMENTS

Review of previous geotechnical reports state that the 3MS site sits on soil of the Hinuera Formations. These are alluvial sediments generally consisting of silts and sands. The geotechnical reports also identified an underlying iron pan layer in parts of the site (the full extent of this pan is not known at this stage but inferred extents are show in Figure 4). This iron pan is a thin, relatively low permeability layer that results in a perched water table. For this reason on-lot soakage for properties sited above this pan is not recommended as it would require punching through the iron pan layer for each on-lot soakage device.

The BTW preliminary geotechnical report confirmed the presence of a perched groundwater table at approximately 2m depth and an unconfined aquifer (true groundwater) starting at an approximate depth of 6 to 7 metres depth.

The presence of the deeper aquifer indicates suitability for stormwater soakage at a deeper level.

The Stormwater Management Plan, Cambridge C1 and C2/C3 Infrastructure, Cambridge West – Pukeroro and Waikato River Catchments (WDC 2019) (SMP) assessed the soakage for the greater C2 Growth cell as having soakage rates between 35 – 860 mm/hr with an average of 216 mm/hr. This would be considered as relatively good soakage potential as it exceeds the 150 mm/hr minimum rate recommended in the RITS for soakage devices.

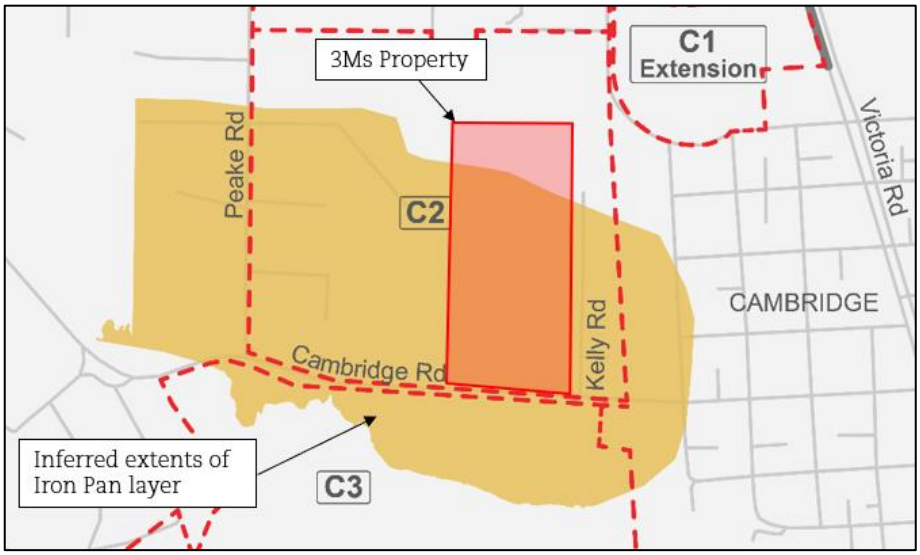


Figure 4 Inferred extents of iron pan layer (SMP)

4.3 STORMWATER MANAGEMENT DESIGN

As per the regional guidelines, all the stormwater will need to be treated to acceptable standards before discharge from the site. Our proposed approach for the stormwater system is to maximise soakage to ground. As on-lot soakage is not considered a suitable option for stormwater management (due to the presence of the iron pan layer) we intend providing a central stormwater soakage basin to treat and soak stormwater for the entire 3MS development.

The primary stormwater system will be a piped gravity network that will convey all stormwater runoff to the central soakage basin. This network will be designed to cater for the 10-year storm events. Stormwater from larger events, or in the case of blocked pipes, will be conveyed overland along road and reserve corridors to the central soakage system. For areas with isolated low points the piped network will be designed to cater for the 50-year event to reduce ponding periods in those locations.

The general stormwater scheme is shown in Figure 5, below. The scheme shows all stormwater being directed to the forebays then flow through a pipe into the soakage basin (Basin 1). The soakage basin will have a soakage array in the northern end that will allow stormwater to soak through the iron pan layer to the aquifer below.

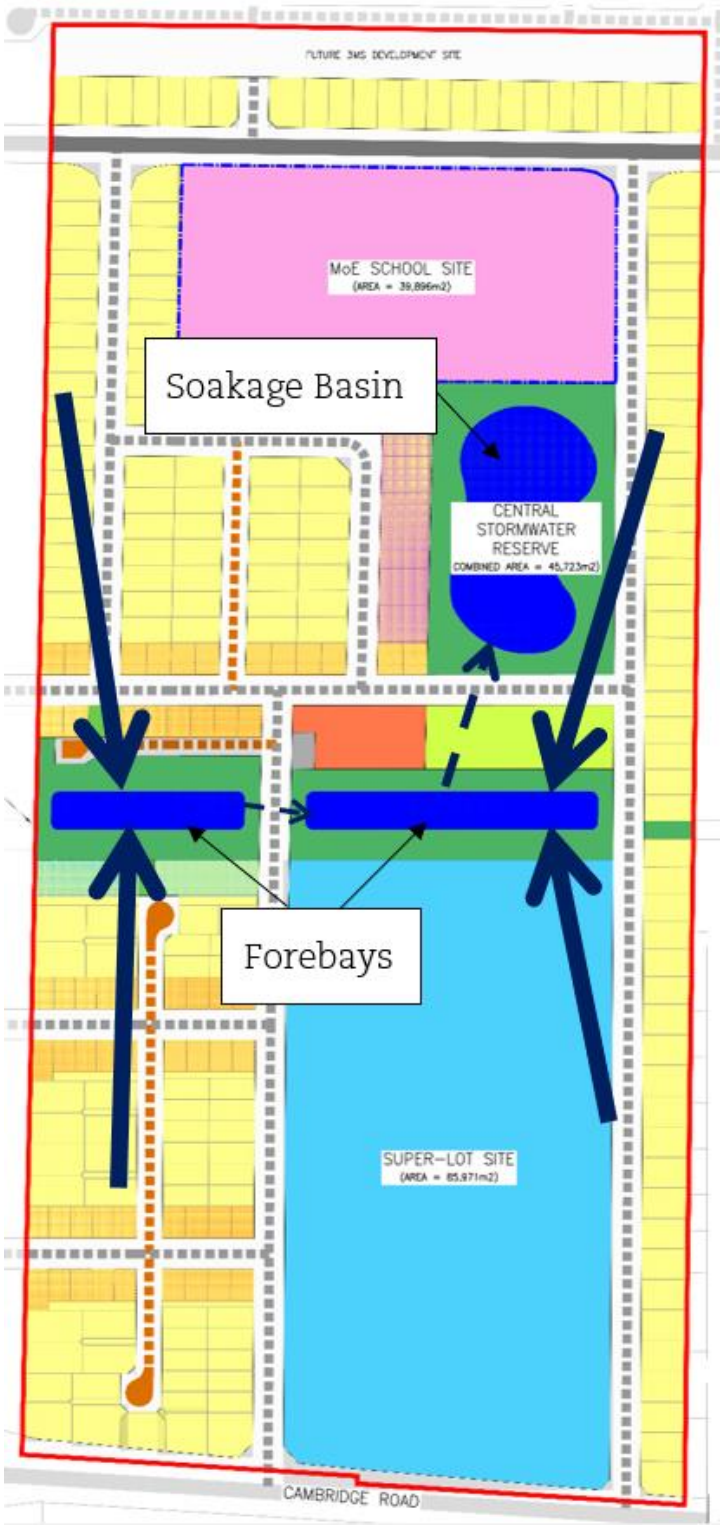


Figure 5 Stormwater scheme

4.3.1 PRELIMINARY STORMWATER ASSESSMENT

A preliminary assessment was carried out on the property to determine the feasibility of the proposed central soakage system.

This included calculating the stormwater runoff volumes for the 2, 10, 50 and 100-year storm events using the Rational Method. The results were then used to assess the required soakage area and storage volume for the central soakage basin. The results of the critical storms for each event are summarised in Table 3 and detailed calculations included in the Appendices.

A soakage design rate of 100 mm/hr has been used based on the average rate of 216 mm/hr provided in the SMP. A soakage base area of 5,500m^2 was used when assessing the required storage volumes for the soakage basin.

Rainfall data was obtained from the NIWA HIRDS website and corrected to cater for climate change of 2.1^{o}C.

TABLE 3: Stormwater Storage and Soakage Summary

STORM EVENT	CRITICAL STORM DURATION (H)	TOTAL RUNOFF (M3)	VOLUME TO SOAKAGE (M3)	REQUIRED STORAGE (M3)	TIME TO CLEAR (H)
ARI = 2	6	12,037	3,300	8,737	16
ARI = 10	12	23,213	6,600	16,613	30
ARI = 50	12	33,022	6,600	26,422	48
ARI = 100	24	44,315	13,200	31,115	57

The preliminary earthworks design has a total soakage basin volume of approximately 40,000m^3 Our calculations indicate that the proposed basin has adequate volume to store the 100-year event and clear it within 72 hours at using a soakage zone of 5,500m^2.

The flood levels shown in figure 6 below (extracted from Master Plan drawing 17001-C-0420) show a flood depth of 2.1m for the 100-year event. The calculations to determine the flood storage levels do not include the available storage within the forebays. Inclusion of the forebays would further reduce the flood depths and will be addressed at the detailed design stage when the basin sizing is finalised, and site-specific soakage test data is available.

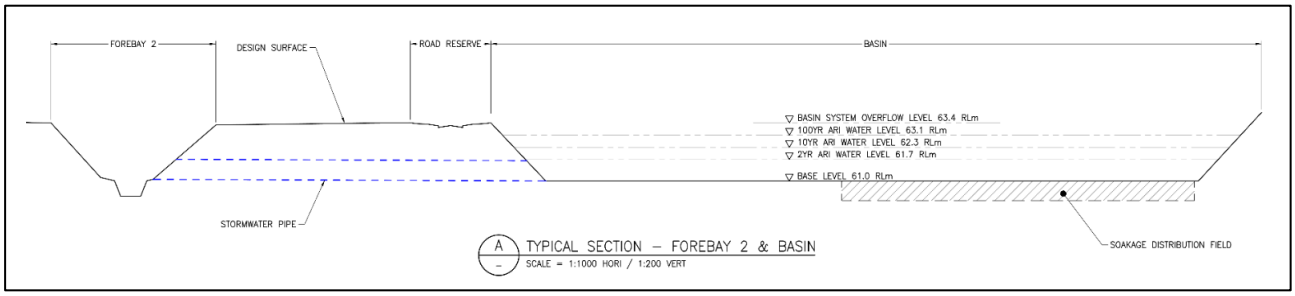


Figure 6 Section through Stormwater forebays and soakage basin

4.3.2 STORMWATER RETICULATION

An initial stormwater network (Master Plan drawings 17001-C-401 to 403) was created that has confirmed that the whole development can be serviced using a piped network. All of the pipes were able to meet the RITS minimum grade requirements with outlets into the forebays.

4.4 FLOOD RISK

The SMP has confirmed that the site is not at risk of flooding from the Waikato River.

In the event that the proposed basin system fails to soak the stormwater to ground the system will backup and overflow to the west of Forebay 1 and flow into the existing farm drain system.

It is worth noting that the system would only overflow once the basin depth exceeds 2.4m (0.3m above the 100-year event storage level). The total storage volume at this depth (including the forebays) is approximately 56,000m3, this is 1.8 times the required storage for the 100-year storm event.

4.5 COMPLIANCE WITH SMP AND STRUCTURE PLAN

The proposed scheme complies with the SMP and the structure plans for the C2 Growth cell areas. The scheme provides treatment and disposal of the stormwater within 72 hours, achieved through reduced runoff and increased deep infiltration.

The SMP proposes a trunk swale system to drain the C2 Growth cell to the Waikato River. This swale is intended to run along the western boundary of the 3MS property ultimately discharging into the Waikato River. A second large swale is proposed that will convey flows from the east of the 3MS property. This swale is expected to flow east to west through the 3MS property and into the north–south trunk swale. Figure 7 shows the integration of the 3MS Property within the C2 Structure Plan

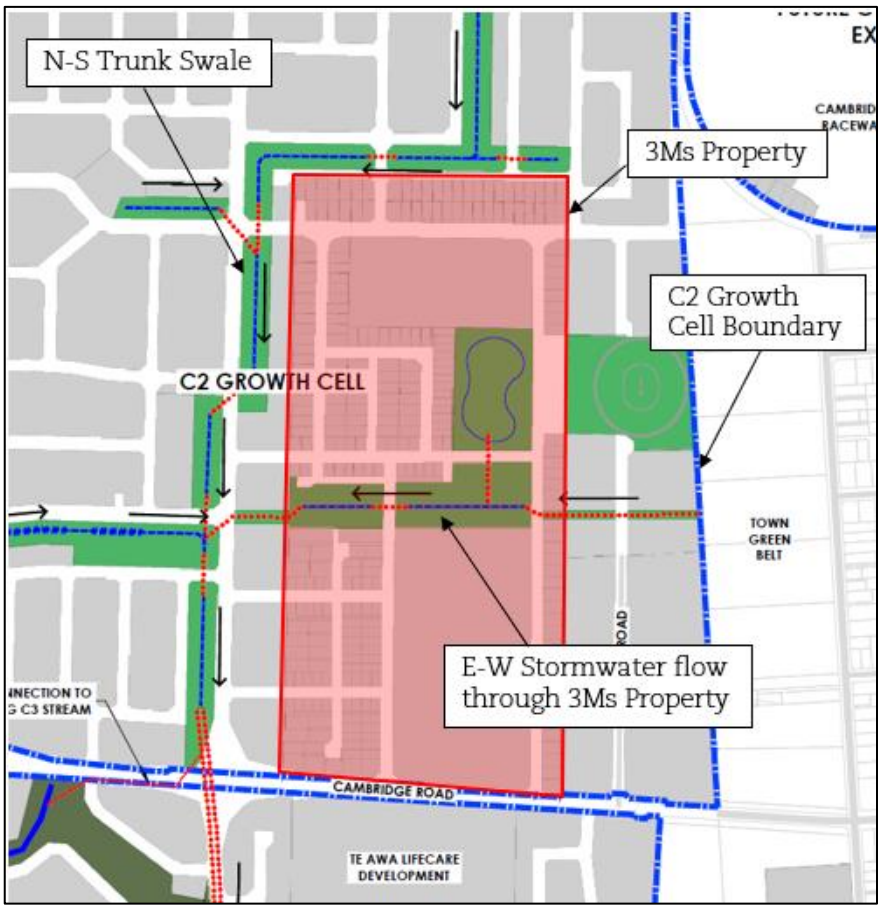


Figure 7 Structure plan stormwater integration

The positioning of the stormwater reserve within the proposed 3MS development allows for integration with the C2 Structure Plan. The forebays can be extended to create the east-west swale connecting the east of the C2 Growth cell with the north-south trunk swale. However, we believe there would be greater benefit in retaining the 3MS soakage system and integrating flows from the east into Forebay 2, as shown in Figure 8 below. A high-level outlet from Forebay 1 to the WDC N-S trunk swale would be added to allow for the increased runoff. This would effectively convert the 3MS soakage system into a soakage and detention system for the eastern part of the C2 Growth Cell developments. The benefit of this is that it would increase infiltration at source and reduce runoff to the Waikato River while retaining the amenity benefits of the stormwater reserve.

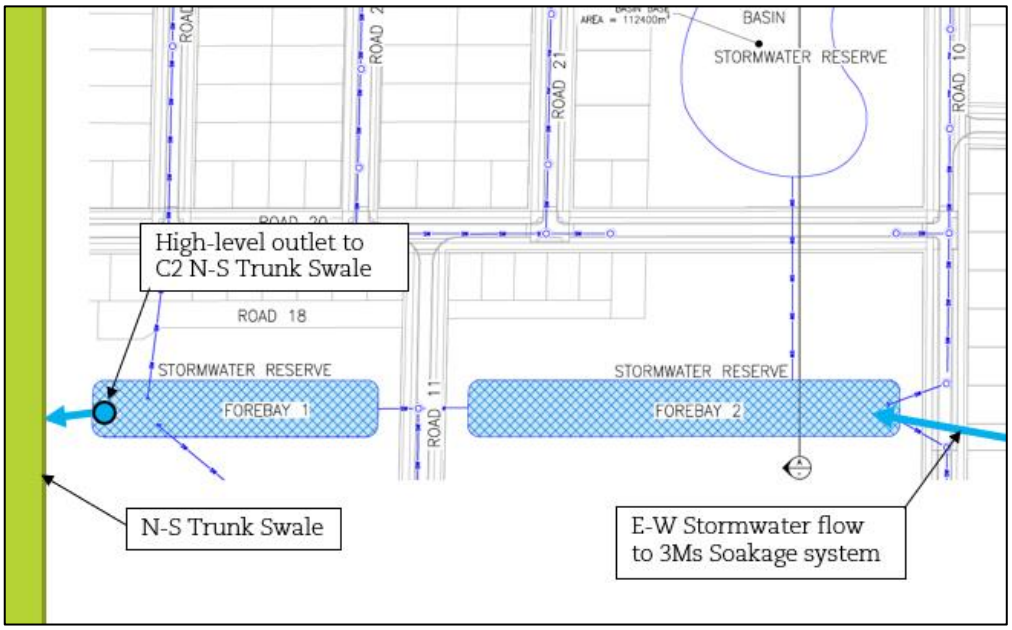


Figure 8 Proposed detention and soakage integration (ref. drawing 17001-C-0430 in Appendix C)

4.5.1 COMPLIANCE WITH SMP TOOL BOX

The SMP provides guidance and WRC scoring matrix requirements for the C2 growth cell. The scoring is based on the WRC low impact design (LID) scoring matrix set out in the Waikato Regional Stormwater Management Guideline.

The 3MS development is within the C2 South catchment in the SMP. The SMP recommends a minimum score of 9 points to comply with the WRC stormwater management guidelines.

The proposed stormwater management for the development differs slightly from the SMP and is based on the following LID measures:

- Collection and treatment of all runoff from the 3MS development is carried out in the central soakage basin for storm event up to the 100-year ARI.
- Reduced water consumption and runoff by including water reuse systems within the buildings
- Building requirements that prohibit the use of water contaminating materials

This list of measures should be considered as the minimum level of measures to be provided within the development. Additional LID elements may be added during the detailed design phase.

The WRC scores for these measures exceed the SMP requirement of 9 and are provided in Table 4.

TABLE 4: Toolbox for 3MS Residential Development			
TYPICAL COMPONENTS	**WAIKATO CATCHMENT - C2 SOUTH (9 POINTS WITH NO NATURAL WATERWAYS WITHIN THE DEVELOPMENT)**	**3MS APPROACH**	**POINTS**
LID DEVICES	**TOTAL MINIMUM REQUIRED IS 5 POINTS**		**6**
Infiltration devices to reduce runoff volume.	Meeting the capture and infiltration requirements for the 100-year ARI event for 100% of the site.	Sized as part of 3MS consent application	6
SOURCE CONTROL	**TOTAL MINIMUM REQUIRED IS 4 POINTS**		**4**
Use of building or site materials that do not contaminate	Residential roofs gutters, downspouts made of noncontaminant leaching materials (assuming 50% or residential and commercial)	Developers Toolbox	1
Water re-use	Site use for garden watering and for non-potable inside waters uses including laundry and toilets is 3 points	Developers Toolbox	3
		TOTAL POINTS	**10**

4.5.2 STORMWATER INTEGRATION WITH NEIGHBOURING PROPERTIES

The existing farm drain running through the 3MS property will be diverted to run through the Stormwater Reserve parallel to the forebays. This will allow for upstream flows from the undeveloped areas at the northern end of Kelly Road (east of the 3MS property) to remain connected to the existing farm drain network. This drain will eventually be piped from Kelly Road to Forebay 2 when these areas are developed.

The existing properties on the southwestern portion of Kelly Road currently slope towards the 3MS development. The new stormwater network will extend to include these properties as the earthworks of the 3MS development will impound runoff in this area.

4.6 SUMMARY

Based on our assessments of the site we believe the central soakage basin is a suitable option to manage the stormwater from the site while allowing integration with the planned greater C2 growth cell stormwater systems.

Additional soakage testing is required to confirm the soakage rates below the iron pan layer at the stormwater basin area before detailed design can be carried out.

5.0 WASTEWATER

5.1 WASTEWATER PROPOSAL

Based on the size of the development and small lot sizes this development will require piped reticulation to a wastewater treatment plant.

The closest gravity network is located in Kelly Road. This is a small network with a small pump station pumping to the Cambridge network in Williams Street. This pump station and reticulation is not able to meet the flow demands from the 3MS development.

We recommend that this development is serviced by gravity network to a central wastewater pump station that will discharge to an agreed manhole within the Cambridge wastewater network.

5.2 WASTEWATER FLOW

For the purposes of this assessment we have used the following wastewater parameters:

- Population rate of three people per dwelling,
- Wastewater flow rates of 180 l/person/day,
- Peak flow factors from RITS Table 5-2
- Infiltration allowance of 2250 litres per hectare per day
- Surface water ingress allowance of 16500 litres per hectare per day

The table below summarises the flows and emergency storage for the 3MS development

TABLE 5 Wastewater Flows

LAND USE	POPULATION	CUMULATIVE AVERAGE DAILY FLOW (M3/DAY)	CUMULATIVE PEAK DAILY FLOW (M3/DAY)	CUMULATIVE PEAK WET WEATHER FLOW (M3/DAY)	CUMULATIVE 9 HOUR STORAGE VOLUME (M3)
General Residential	558	135	392	565	51
Future Residential Development site	72	153	430	626	57
Terraced Residential	42	162	458	664	61
Compact Residential	183	203	562	797	76
High Density Housing	60	216	582	822	81
Super-Lot Site (Retirement Village)	600	355	931	1313	133
MoE School Site	1056	575	1501	1949	216
Neighbourhood Centre Area	15	579	1510	1964	217

5.3 RETICULATION SYSTEM

An initial wastewater network has been designed for the project (Master Plan drawings 17001-C-0501 to 0511 in Appendix 3). The layout of the sewer reticulation has been

largely dictated by the road network, but also by the topography and its location in relation to the greater Cambridge sewer reticulation system.

A wastewater pump station has been positioned centrally within the 3MS development. As this is the first development within the C2 Growth Cell it is expected that this pump station will ultimately become the terminal pump station for the greater C2 Growth Cell. It is expected that all the other C2 pump stations will discharge into the designated manholes on the northern and western side of the 3MS development (as shown in Master Plan drawings 17001-C-0501 to 503) and the gravity network from these points to the 3MS wastewater pump station will be designed to cater for the additional flows.

The preliminary network was assessed to verify the position of the pump station would be able to service the entire development.

Using the RITS minimum pipe grades all of the pipes are able to drain to the selected wastewater pump station location. The invert level of the discharge pipe to the wastewater pump station was found to be 4.9 m below the design surface. This would result in a wet well depth of about 6.0m (based on the previous wastewater pump station design carried out by BTW).

5.4 SUMMARY

The current layout for the 3MS development can be serviced with a gravity network to a central wastewater pump station. The 3MS wastewater pump station is also expected to service future developments within the C2 Growth cell as the terminal pump station. The detailed design will be carried out to accommodate future developments in the zone.

6.0 CONCLUSION

This report has identified suitable 3-waters infrastructure solutions for the proposed development that are technically feasible and comply with the District and Regional Council requirements. This report also demonstrates that these options are also consistent with the SMP and integrate with the structure plan for the C2 zone.

From a technical, 3-waters infrastructure, perspective there is no reason why the proposed development could not proceed.

7.0 LIMITATIONS

7.1 GENERAL

This report is for the use by 3Ms of Cambridge Limited only, and should not be used or relied upon by any other person or entity or for any other project.

This report has been prepared for the particular project described to us and its extent is limited to the scope of work agreed between the client and Harrison Grierson Consultants Limited. No responsibility is accepted by Harrison Grierson Consultants Limited or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

APPENDICES

APPENDIX 1
3MS RESIDENTIAL DEVELOPMENT LAYOUT

READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

DRAWING SCALE BAR (IN MILLIMETRES): 0 2 4 6 8 10 20 30 40 50 60 70 80 90 100

LEGEND

- 3MS PROPERTY BOUNDARY
- INDICATIVE BLOCK BOUNDARIES
- COLLECTOR ROAD
- LOCAL ROAD
- LOCAL ACCESS ROAD
- GENERAL RESIDENTIAL
- TERRACED RESIDENTIAL HOUSING OVERLAY
- COMPACT RESIDENTIAL OVERLAY
- HIGH DENSITY HOUSING RESIDENTIAL
- MoE SCHOOL SITE
- SUPER–LOT SITE
- NEIGHBOURHOOD CENTRE
- UTILITY RESERVE (WASTEWATER)
- STORMWATER RESERVE
- STORMWATER DEVICE (SOAKAGE BASIN)
- LOCAL OPEN SPACE (RESERVE)
- ACTIVE RECREATION (RESERVE)

FUTURE 3MS DEVELOPMENT SITE

MoE SCHOOL SITE
(AREA = 39,896m2)

CENTRAL STORMWATER RESERVE
COMBINED AREA = 45,723m2)

KELLY ROAD

3Ms PROPERTY BOUNDARY

SUPER–LOT SITE
(AREA = 85,971m2)

CAMBRIDGE ROAD

TE AWA LIFECARE DEVELOPMENT

PROPERTY ASSESSMENT

BASED ON THE REFINED STRUCTURE PLAN:	
GENERAL RESIDENTIAL – AREA	10.49 Ha
GENERAL RESIDENTIAL – No. LOTS	186 LOTS
TERRACED RESIDENTIAL – AREA	0.56 Ha
TERRACED RESIDENTIAL – No. LOTS	14 LOTS
COMPACT RESIDENTIAL – AREA	1.80 Ha
COMPACT RESIDENTIAL – No. LOTS	56 LOTS
HIGH DENSITY HOUSING – AREA	0.32 Ha
HIGH DENSITY HOUSING – No. LOTS	20 LOTS
R.O.W ACCESS LOTS – AREA	0.27 Ha
WDC COLLECTOR ROAD AREA	1.07 Ha
ROAD RESERVE AREA	6.81 Ha
UTILITY RESERVE AREA	0.04 Ha
STORMWATER RESERVE AREA	4.57 Ha
RECREATIONAL RESERVE AREA	0.58 Ha
NEIGHBOURHOOD CENTRE AREA	0.33 Ha
SUPER–LOT SITE	8.60 Ha
MOE SCHOOL SITE	3.99 Ha
FUTURE DEVELOPMENT SITE	1.41 Ha
TOTAL AREA	40.84 Ha
TOTAL RESIDENTIAL LOTS	276 LOTS
TOTAL No. RYMAN DWELLINGS (ASSUMED)	200 UNITS
GROSS DENSITY	15.1 LOTS/Ha
NET DENSITY	21.6 LOTS/Ha

NOTES

1. LAYOUT SHOWN IS INDICATIVE AND HAS BEEN DEVELOPED FOR COMPARISON PURPOSES ONLY
2. STRUCTURE PLAN SHOWN IS BASED ON THE APPROVED LAYOUT CONFIRMED AS PART OF PLAN CHANGE 7 INCLUDING AMENDMENTS WITHIN THE 3MS PROPERTY TO ACCOMMODATE CLIENT DEVELOPMENT REQUIREMENTS
3. PROPOSED SCHOOL SITE SHOWN HAS BEEN AMENDED TO ACHIEVE A MINIMUM LOT SIZE OF 4.0Ha (AS REQUESTED BY THE MINISTRY OF EDUCATION)
4. INDIVIDUAL RESIDENTIAL LOTS SHOWN ARE INDICATIVE ONLY AND ARE BASED ON THE FOLLOWING SIZE PARAMETERS:
   - COMPACT – LESS THAN 400m^2
   - GENERAL – GREATER THAN 400m^2

DESIGNED BY	DATE	DRAWN BY	DATE	APPROVED BY	DATE	APPROVAL STATUS
L. MCCAFFREY	25.08.20	L. MCCAFFREY	25.08.20	–	–	FOR INFORMATION

PROJECT NAME: 3M RESIDENTIAL DEVELOPMENT PROJECT

REV	DESCRIPTION	BY	DATE
J	FOR INFORMATION	LPM	30.11.20
I	FOR INFORMATION	LPM	10.11.20
H	FOR INFORMATION	LPM	29.10.20
G	FOR INFORMATION	LPM	28.10.20

CLIENT NAME: 3MS

DRAWING TITLE: 3Ms PROPERTY LAYOUT

ALTERNATIVE DEVELOPMENT LAYOUT

PRODUCED BY: MCCAFFREY ENGINEERING CONSULTANTS

DATE PRINTED: 30 November 2020

DRAWING SCALE: 1:3000

REVISION No.: J

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–SK–094

FILE NAME: 17001–SK–094.dwg

APPENDIX 2
STORMWATER CALCULATIONS

SOAKAGE BASIN EVALUATION	Storm Event	ARI = 2	File No	
PROJECT NAME : C2 Development	**Main Soakage Basin**		Date	3/12/2020
			Prepared By	mzf

E1 METHOD C.A = 25.61 Equivalent catchment

		hours				1	2	6	12	24
Storm Duration:		mins	10	20	30	60	120	360	720	1440
Catchment Area:	A	ha	25.61	25.61	25.61	25.61	25.61	25.61	25.61	25.61
CC Adjusted rainfall Intensity:	i	mm/hr	66.5	46.5	37.2	25.0	16.3	7.9	4.8	2.9
Runoff:	Rc	m^3	**2,837**	**3,970**	**4,762**	**6,398**	**8,336**	**12,091**	**14,818**	**17,693**
Runoff per second		m^3/s	4.73	3.31	2.65	1.78	1.16	0.56	0.34	0.20
Soakage Area	A_{SP}	m^2	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500
Soakage Rate:	Sr	mm/hour	100	100	100	100	100	100	100	100
Volume Soaked to Ground:	V_{SOAK}	m^3	**92**	**183**	**275**	**550**	**1,100**	**3,300**	**6,600**	**13,200**
Basin Storage Volume		m^3	30,646	30,646	30,646	30,646	30,646	30,646	30,646	30,646
Vol. Within Soakage Media:		m^3	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045
Storage Volume required:	V_{STOR}	m^3	2,745	3,786	4,487	5,848	7,236	8,791	8,218	4,493
Soakage volume + storage:	Vtot	m^3	31,783	31,874	31,966	32,241	32,791	34,991	38,291	44,891
Basin Buffer Volume		m^3	28,946	27,905	27,204	25,843	24,455	22,900	23,473	27,198
Storage Check			**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
Time to clear:		hr	5.0	6.9	8.2	10.6	13.2	16.0	14.9	8.2

Soakage Basin

Basin Volume:	30,646 m^3	below RL63.1m
Basin base area:	11,400 m^2	
Soakage area:	5,500 m^2	
Soakage Media Depth	0.50 m	
Soakage Media Volume Factor	0.38	
Soakage volume:	1,045 m^3	
Soakage Rate:	200 mm/hr	
Soakage FOS	0.50	
Design Soakage Rate	100 mm/hr	

$$V_{SOAK} = \frac{A_{sp}.S_r}{1000}$$

$$Rc = 10.C.i.A$$

$$V_{STOR} = Rc - V_{SOAK}$$

Can 10 min Storm clear within 24 Hours YES

Rain Fall Data Sourced from NIWA/HIRDS

Rainfall intensities (mm/hr)

ARI = 2	Historic mm	Adjusted for 2.1° CC mm
10m	56.9	66.5
20m	40.1	46.5
30m	32.3	37.2
1h	21.9	25.0
2h	14.4	16.3
6h	7.1	7.9
12h	4.4	4.8
24h	2.6	2.9
48h	1.6	1.7
72h	1.1	1.2

Equivalent catchment

Catchment Type	Area (Ha)	Runoff Coefficient C	Equivalent Catchment CA
General Residential	10.49	0.65	6.819
Future Residential Development Site	1.41	0.65	0.917
Terraced Residential	0.56	0.80	0.448
Compact Residential	1.80	0.80	1.440
High Density Housing	0.32	0.80	0.256
ROW Access Lots	0.27	0.80	0.216
WDC Collector Road Reserve	1.07	0.80	0.856
Road Reserve Area	6.81	0.80	5.448
Utility Reserve (WWPS)	0.04	0.45	0.018
Stormwater Reserve	4.57	0.30	1.371
Recreational Reservve	0.58	0.30	0.174
Neighborhood Centre Area	0.33	0.80	0.264
Super-Lot Site	8.60	0.65	5.590
MoE School Site	3.99	0.45	1.796
		Total	**25.612**

SOAKAGE BASIN EVALUATION	Storm Event	ARI = 10	File No	
PROJECT NAME : C2 Development	**Main Soakage Basin**		Date	3/12/2020
			Prepared By	mzf

E1 METHOD C.A = 25.61 0

		hours				1	2	6	12	24
Storm Duration:		mins	10	20	30	60	120	360	720	1440
Catchment Area:	A	ha	25.61	25.61	25.61	25.61	25.61	25.61	25.61	25.61
CC Adjusted rainfall Intensity:	i	mm/hr	105.6	73.7	59.1	39.5	25.8	12.5	7.6	4.5
Runoff:	Rc	m^3	**4,507**	**6,289**	**7,571**	**10,120**	**13,209**	**19,142**	**23,316**	**27,910**
Runoff per second		m^3/s	7.51	5.24	4.21	2.81	1.83	0.89	0.54	0.32
Soakage Area	A_{SP}	m^2	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500
Soakage Rate:	Sr	mm/hour	100	100	100	100	100	100	100	100
Volume Soaked to Ground:	V_{SOAK}	m^3	**92**	**183**	**275**	**550**	**1,100**	**3,300**	**6,600**	**13,200**
Basin Storage Volume		m^3	30,646	30,646	30,646	30,646	30,646	30,646	30,646	30,646
Vol. Within Soakage Media:		m^3	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045
Storage Volume required:	V_{STOR}	m^3	**4,415**	**6,106**	**7,296**	**9,570**	**12,109**	**15,842**	**16,716**	**14,710**
			27,276							
Soakage volume + storage:	Vtot	m^3	31,783	31,874	31,966	32,241	32,791	34,991	38,291	44,891
Basin Buffer Volume		m^3	27,276	25,585	24,395	22,121	19,582	15,849	14,975	16,981
Storage Check			**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
Time to clear:		hr	8.0	11.1	13.3	17.4	22.0	28.8	30.4	26.7

Soakage Basin

Basin Volume:	30,646	m^3
Basin base area:	11,400	m^2
Soakage area:	5,500	m^2
Soakage Media Depth	0.50	m
Soakage Media Volume Factor	0.38	
Soakage volume:	1,045	m^3
Soakage Rate:	200	mm/hr
Soakage FOS	0.50	
Design Soakage Rate	100	mm/hr

below RL63.1m

$$V_{SOAK} = \frac{A_{sp}.S_r}{1000}$$

$$Rc = 10.C.i.A$$

$$V_{STOR} = Rc - V_{SOAK}$$

Can 10 min Storm clear within 24 Hours YES

Rain Fall Data Sourced from NIWA/HIRDS

Rainfall intensities (mm/hr)

ARI = 10	Historic mm	Adjusted for 2.1° CC mm
10m	90.4	105.6
20m	63.3	73.7
30m	50.8	59.1
1h	34.2	39.5
2h	22.4	25.8
6h	10.9	12.5
12h	6.7	7.6
24h	4.0	4.5
48h	2.3	2.6
72h	1.7	1.9

Equivalent catchment

Catchment Type	Area (Ha)	Runoff Coefficient C	Equivalent Catchment CA
General Residential	10.49	0.65	6.819
Future Residential Development Site	1.41	0.65	0.917
Terraced Residential	0.56	0.80	0.448
Compact Residential	1.80	0.80	1.440
High Density Housing	0.32	0.80	0.256
ROW Access Lots	0.27	0.80	0.216
WDC Collector Road Reserve	1.07	0.80	0.856
Road Reserve Area	6.81	0.80	5.448
Utility Reserve (WWPS)	0.04	0.45	0.018
Stormwater Reserve	4.57	0.30	1.371
Recreational Reservve	0.58	0.30	0.174
Neighborhood Centre Area	0.33	0.80	0.264
Super-Lot Site	8.60	0.65	5.590
MoE School Site	3.99	0.45	1.796
		Total	**25.612**

SOAKAGE BASIN EVALUATION	Storm Event	ARI = 50	File No	
PROJECT NAME : C2 Development	**Main Soakage Basin**		Date	3/12/2020
			Prepared By	mzf

E1 METHOD C.A = 25.61 Equivalent catchment

		hours				1	2	6	12	24
Storm Duration:		mins	10	20	30	60	120	360	720	1440
Catchment Area:	A	ha	25.61	25.61	25.61	25.61	25.61	25.61	25.61	25.61
CC Adjusted rainfall Intensity:	i	mm/hr	149.5	104.5	83.6	56.1	36.6	17.6	10.8	6.4
Runoff:	Rc	m^3	**6,382**	**8,924**	**10,709**	**14,359**	**18,726**	**27,102**	**33,169**	**39,559**
Runoff per second		m^3/s	10.64	7.44	5.95	3.99	2.60	1.25	0.77	0.46
Soakage Area	A_{SP}	m^2	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500
Soakage Rate:	Sr	mm/hour	100	100	100	100	100	100	100	100
Volume Soaked to Ground:	V_{SOAK}	m^3	**92**	**183**	**275**	**550**	**1,100**	**3,300**	**6,600**	**13,200**
Basin Storage Volume		m^3	30,646	30,646	30,646	30,646	30,646	30,646	30,646	30,646
Vol. Within Soakage Media:		m^3	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045
Storage Volume required:	V_{STOR}	m^3	**6,290**	**8,741**	**10,434**	**13,809**	**17,626**	**23,802**	**26,569**	**26,359**
Soakage volume + storage:	Vtot	m^3	31,783	31,874	31,966	32,241	32,791	34,991	38,291	44,891
Basin Buffer Volume		m^3	25,401	22,950	21,257	17,882	14,065	7,889	5,122	5,332
Storage Check			**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
Time to clear:		hr	11.4	15.9	19.0	25.1	32.0	43.3	48.3	47.9

Soakage Basin

Basin Volume:	30,646 m^3	below RL63.1m
Basin base area:	11,400 m^2	
Soakage area:	5,500 m^2	
Soakage Media Depth	0.50 m	
Soakage Media Volume Factor	0.38	
Soakage volume:	1,045 m^3	
Soakage Rate:	200 mm/hr	
Soakage FOS	0.50	
Design Soakage Rate	100 mm/hr	

$$V_{SOAK} = \frac{A_{sp}.S_r}{1000}$$

$$Rc = 10.C.i.A$$

$$V_{STOR} = Rc - V_{SOAK}$$

Can 10 min Storm clear within 24 Hours YES

Rain Fall Data Sourced from NIWA/HIRDS

Rainfall intensities (mm/hr)

ARI = 50	Historic mm	Adjusted for 2.1° CC mm
10m	128.0	149.5
20m	89.5	104.5
30m	71.6	83.6
1h	48.0	56.1
2h	31.3	36.6
6h	15.1	17.6
12h	9.2	10.8
24h	5.5	6.4
48h	3.2	3.7
72h	2.3	2.7

Equivalent catchment

Catchment Type	Area (Ha)	Runoff Coefficient C	Equivalent Catchment CA
General Residential	10.49	0.65	6.819
Future Residential Development Site	1.41	0.65	0.917
Terraced Residential	0.56	0.80	0.448
Compact Residential	1.80	0.80	1.440
High Density Housing	0.32	0.80	0.256
ROW Access Lots	0.27	0.80	0.216
WDC Collector Road Reserve	1.07	0.80	0.856
Road Reserve Area	6.81	0.80	5.448
Utility Reserve (WWPS)	0.04	0.45	0.018
Stormwater Reserve	4.57	0.30	1.371
Recreational Reservve	0.58	0.30	0.174
Neighborhood Centre Area	0.33	0.80	0.264
Super-Lot Site	8.60	0.65	5.590
MoE School Site	3.99	0.45	1.796
		Total	**25.612**

SOAKAGE BASIN EVALUATION	Storm Event ARI = 100		File No	
PROJECT NAME : C2 Development	**Main Soakage Basin**		Date	3/12/2020
			Prepared By	mzf

E1 METHOD C.A = 25.61 Equivalent catchment

		hours				1	2	6	12	24
Storm Duration:		mins	10	20	30	60	120	360	720	1440
Catchment Area:	A	ha	25.61	25.61	25.61	25.61	25.61	25.61	25.61	25.61
CC Adjusted rainfall Intensity:	i	mm/hr	171.7	119.1	95.4	63.7	41.5	20.0	12.1	7.2
Runoff:	Rc	m^3	**7,329**	**10,171**	**12,220**	**16,303**	**21,239**	**30,692**	**37,333**	**44,512**
Runoff per second		m^3/s	12.21	8.48	6.79	4.53	2.95	1.42	0.86	0.52
Soakage Area	A_{SP}	m^2	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500
Soakage Rate:	Sr	mm/hour	100	100	100	100	100	100	100	100
Volume Soaked to Ground:	V_{SOAK}	m^3	**92**	**183**	**275**	**550**	**1,100**	**3,300**	**6,600**	**13,200**
Basin Storage Volume		m^3	30,646	30,646	30,646	30,646	30,646	30,646	30,646	30,646
Vol. Within Soakage Media:		m^3	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045
Storage Volume required:	V_{STOR}	m^3	**7,237**	**9,988**	**11,945**	**15,753**	**20,139**	**27,392**	**30,733**	**31,312**
Soakage volume + storage:	Vtot	m^3	31,783	31,874	31,966	32,241	32,791	34,991	38,291	44,891
Basin Buffer Volume		m^3	24,454	21,703	19,746	15,938	11,552	4,299	958	379
Storage Check			**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
Time to clear:		hr	13.2	18.2	21.7	28.6	36.6	49.8	55.9	56.9

Soakage Basin

Basin Volume:	30,646	m^3	below RL63.1m
Basin base area:	11,400	m^2	
Soakage area:	5,500	m^2	
Soakage Media Depth	0.50	m	
Soakage Media Volume Factor	0.38		
Soakage volume:	1,045	m^3	
Soakage Rate:	200	mm/hr	
Soakage FOS	0.50		
Design Soakage Rate	100	mm/hr	

$$V_{SOAK} = \frac{A_{sp}.S_r}{1000}$$

$$Rc = 10.C.i.A$$

$$V_{STOR} = Rc - V_{SOAK}$$

Can 10 min Storm clear within 24 Hours YES

Rain Fall Data Sourced from NIWA/HIRDS

Rainfall intensities (mm/hr)

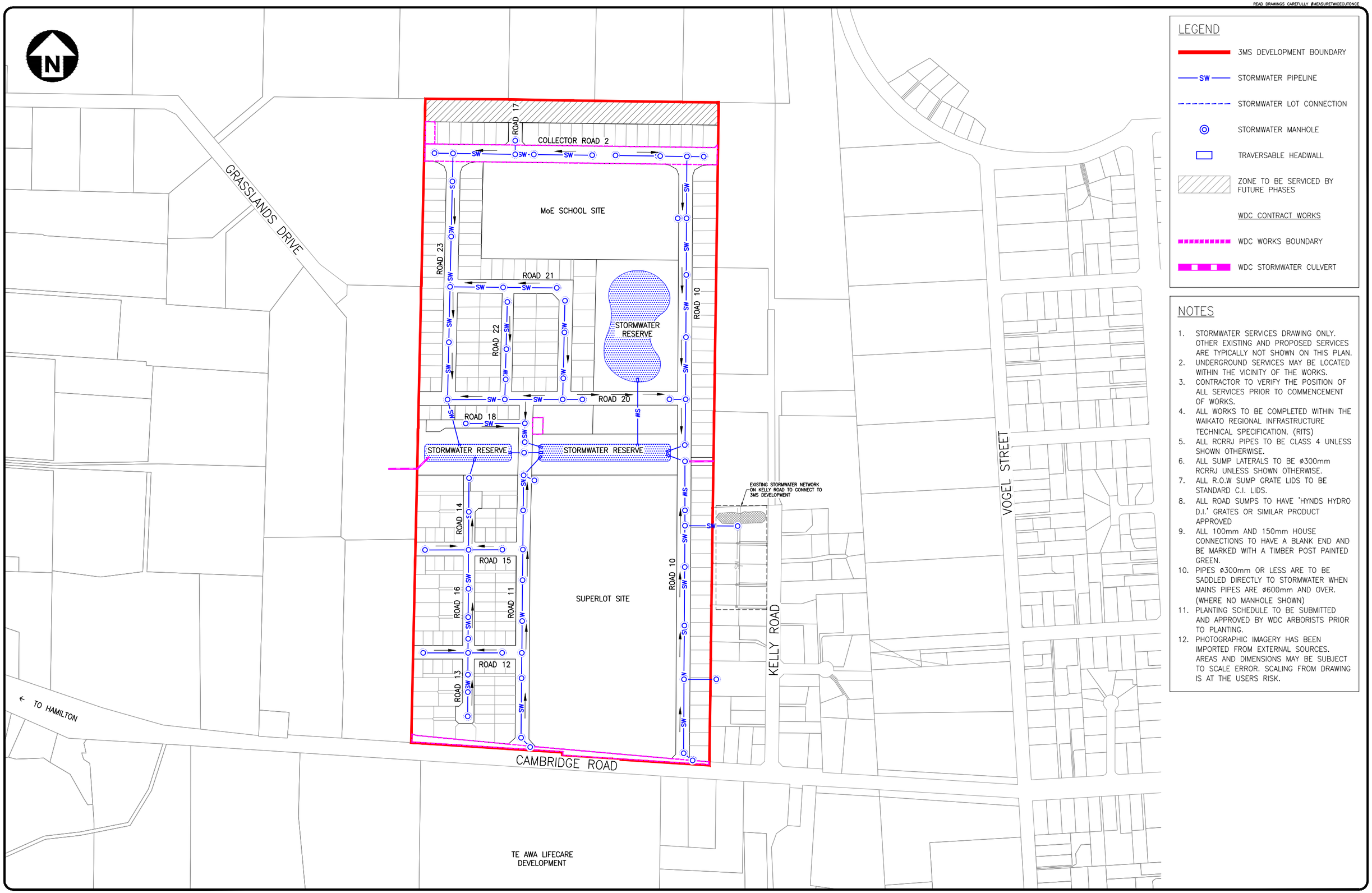
ARI = 100	Historic mm	Adjusted for 2.1° CC mm
10m	147.0	171.7
20m	102.0	119.1
30m	81.7	95.4
1h	54.5	63.7
2h	35.5	41.5
6h	17.1	20.0
12h	10.4	12.1
24h	6.2	7.2
48h	3.6	4.2
72h	2.6	3.0

Equivalent catchment

Catchment Type	Area (Ha)	Runoff Coefficient C	Equivalent Catchment CA
General Residential	10.49	0.65	6.819
Future Residential Development Site	1.41	0.65	0.917
Terraced Residential	0.56	0.80	0.448
Compact Residential	1.80	0.80	1.440
High Density Housing	0.32	0.80	0.256
ROW Access Lots	0.27	0.80	0.216
WDC Collector Road Reserve	1.07	0.80	0.856
Road Reserve Area	6.81	0.80	5.448
Utility Reserve (WWPS)	0.04	0.45	0.018
Stormwater Reserve	4.57	0.30	1.371
Recreational Reservve	0.58	0.30	0.174
Neighborhood Centre Area	0.33	0.80	0.264
Super-Lot Site	8.60	0.65	5.590
MoE School Site	3.99	0.45	1.796
		Total	**25.612**

APPENDIX 3
3-WATERS MASTER PLAN DRAWINGS

READ DRAWINGS CAREFULLY ∴MEASURETWICECUTONCE



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
- STORMWATER LOT CONNECTION
- STORMWATER MANHOLE
- TRAVERSABLE HEADWALL
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC STORMWATER CULVERT

NOTES

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REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	RG	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER GENERAL ARRANGEMENT

PRODUCED BY: HG

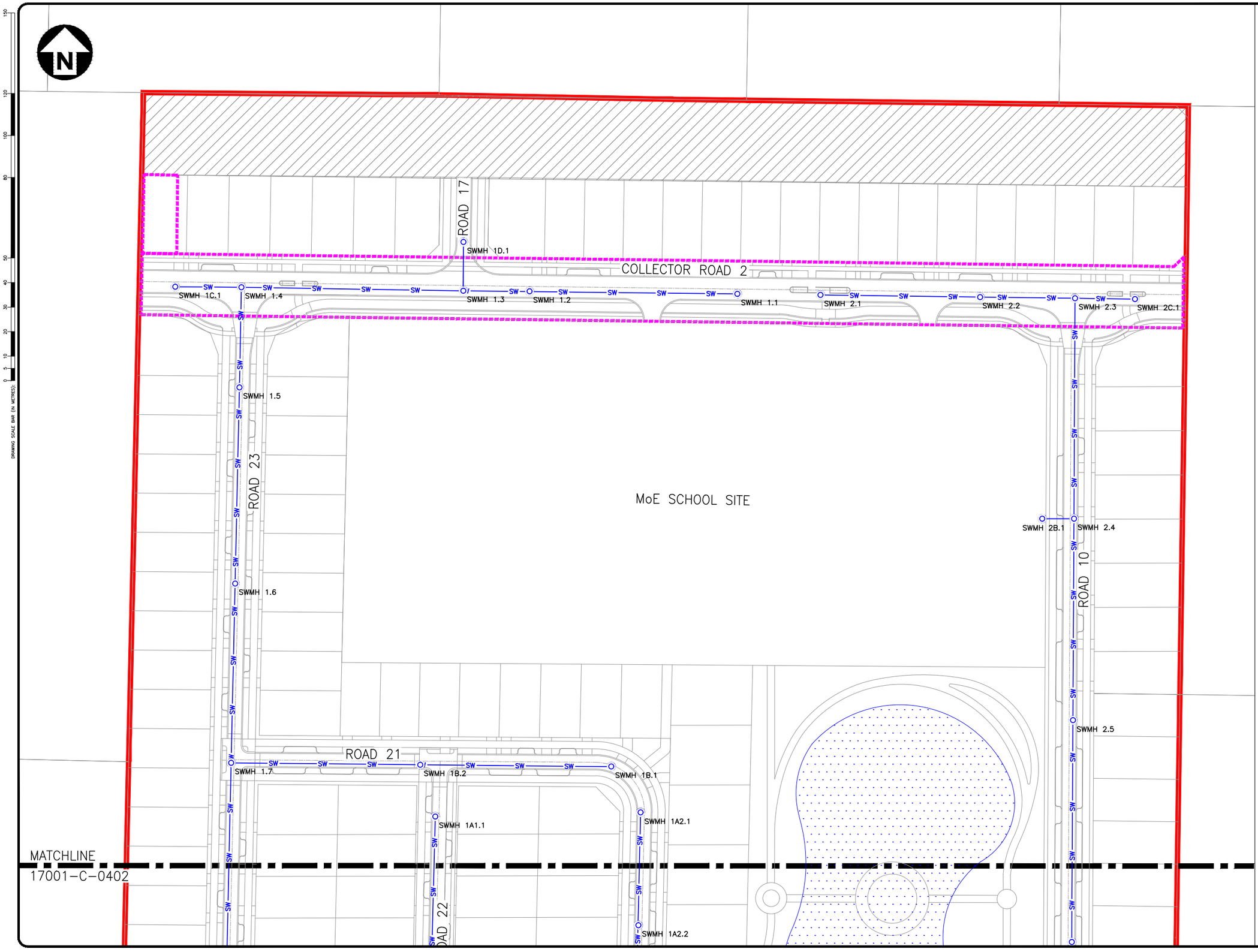
DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:5000	REVISION No.: B
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001–C–0400	

FILE NAME: 17001–C–0400.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0



LEGEND

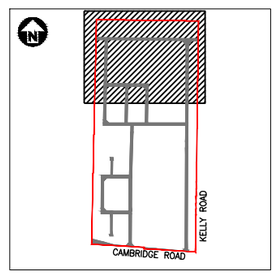
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DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0401

FILE NAME: 17001-C-0401.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

17001–C–0401
MATCHLINE

SWMH 1.7 · SWMH 1B.2 · SWMH 1B.1 · SWMH 1A1.1 · SWMH 1A2.1 · SWMH 1A2.2 · SWMH 1.8 · SWMH 1A1.2 · SWMH 1A2.3 · SWMH 1A1.3 · SWMH 2.6

ROAD 23 · ROAD 22 · ROAD 21 · ROAD 10

BASIN 1

ROAD 20

SWMH 1.9 · SWMH 1A.3 · SWMH 1A.2 · SWMH 1A.1 · SWMH 2A.1 · SWMH 2.7

ROAD 18

SWMH 3E.1 · SWMH 3E.2 · SWMH 3E.3 · SWMH 3E.4 · SWMH 1.10 · SWMH 3F.1 · SWMH 3F.2 · SWMH 3F.3 · SWMH 5.9 · SWMH 3.11 · SWMH 2.8 · SWMH 2.9 · OUTLET 5 · SWMH 4.6

FOREBAY 1 · FOREBAY 2

FUTURE WDC CULVERT · FUTURE WDC CULVERT OUTLET

SWMH 5.8 · SWMH 5B.1 · SWMH 3.10 · SWMH 3.9 · SWMH 5.7 · SWMH 4.5

ROAD 11 · ROAD 14

SUPERLOT SITE

PICK UP RUNOFF IMPOUNDED BY NEW LOTS (EXISTING KELLY ROAD RUNOFF)

MATCHLINE
17001–C–0403

LEGEND

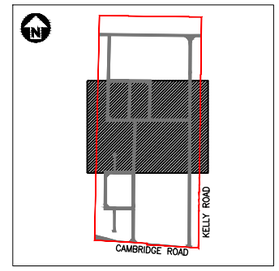
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- STORMWATER MANHOLE
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DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER LAYOUT PLAN

SHEET 2 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0402

FILE NAME: 17001–C–0402.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

N

17001-C-0402
MATCHLINE

ROAD 15

SWMH 3B.1 — SWMH 3.8 — SWMH 3D.1 — SWMH 5.6

SWMH 5.5

ROAD 16

SWMH 3.7

ROAD 11

SUPERLOT SITE

SWMH 3.6

SWMH 5.4

SWMH 3.5

ROAD 12

SWMH 3C.1 — SWMH 3.4 — SWMH 3A.1 — SWMH 5.3

SWMH 3.3

SWMH 5.2

ROAD 13

SWMH 3.2

SWMH 3.1

SWMH 5.1

SCRUFFY DOME INLET

SWALE

SWMH 5A.1

CAMBRIDGE ROAD

SWMH 4.4

SWMH 4.3

ROAD 10

SWMH 4.2

SWMH 4B.1

INLET TO PICK UP RUNOFF IMPOUNDED BY NEW LOTS (EXISTING KELLY ROAD RUNOFF)

SWMH 4.1

SCRUFFY DOME INLET

SWMH 4A.1

LEGEND

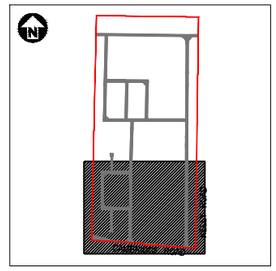
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A	FOR INFORMATION	RG	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER LAYOUT PLAN

SHEET 3 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0403

FILE NAME: 17001-C-0403.dwg

READ DRAWINGS CAREFULLY & MEASURE TWICE CUT ONCE

DRAWING SCALE BAR (IN METRES): 0 1 2 4 6 8 10 20 30 40 50 60 70 80 90 100

STORMWATER RESERVE

FOREBAY 2

ROAD 20

BASIN BASE
AREA = 112400m²

SOAKAGE ZONE
AREA = 5500m²

STORMWATER RESERVE

BASIN

A

OUTLET 5

SWMH 2.9

SWMH 2A.1

SWMH 4.6

SWMH 2.8

SWMH 2.7

ROAD 10

SWMH 2.6

SWMH 2.5

LEGEND

- EXISTING CADASTRAL BOUNDARIES
- 3MS DEVELOPMENT BOUNDARY
- STORMWATER INFILTRATION BASIN
- SW — STORMWATER PIPE
- SUBSOIL PIPE
- SCRUFFY/INLET RISER
- MAINTENANCE MANHOLE
- TRAVERSABLE HEADWALL
- FLUSHING RISER INLET
- SOAKAGE ZONE

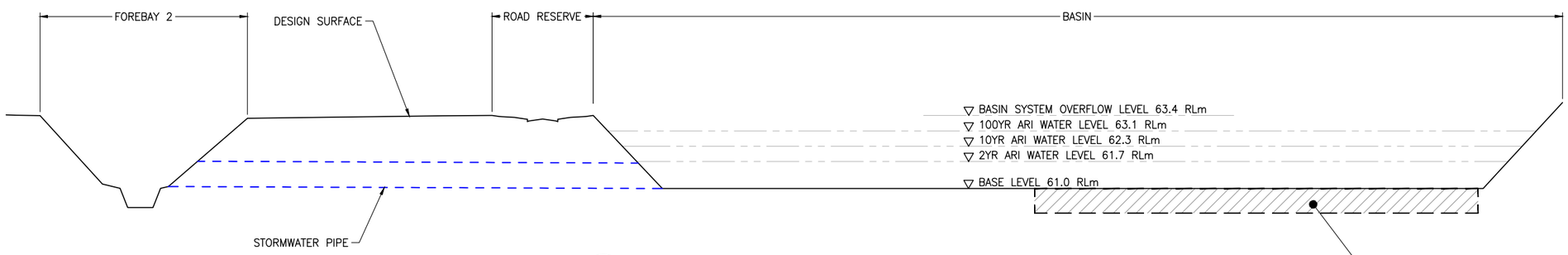
WDC CONTRACT WORKS

- WDC STORMWATER CULVERT

NOTES:

1. ALL STORMWATER DEVICES AND PLANTING TO BE IN GENERAL ACCORDANCE WITH THE REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION (RITS)

LAYOUT PLAN
SCALE = 1:1000



A — TYPICAL SECTION – FOREBAY 2 & BASIN
SCALE = 1:1000 HORI / 1:200 VERT

REV	DESCRIPTION	BY	DATE
A	FOR INFORMATION	AXZ	02.12.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER BASIN PLAN AND TYPICAL SECTION

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1000

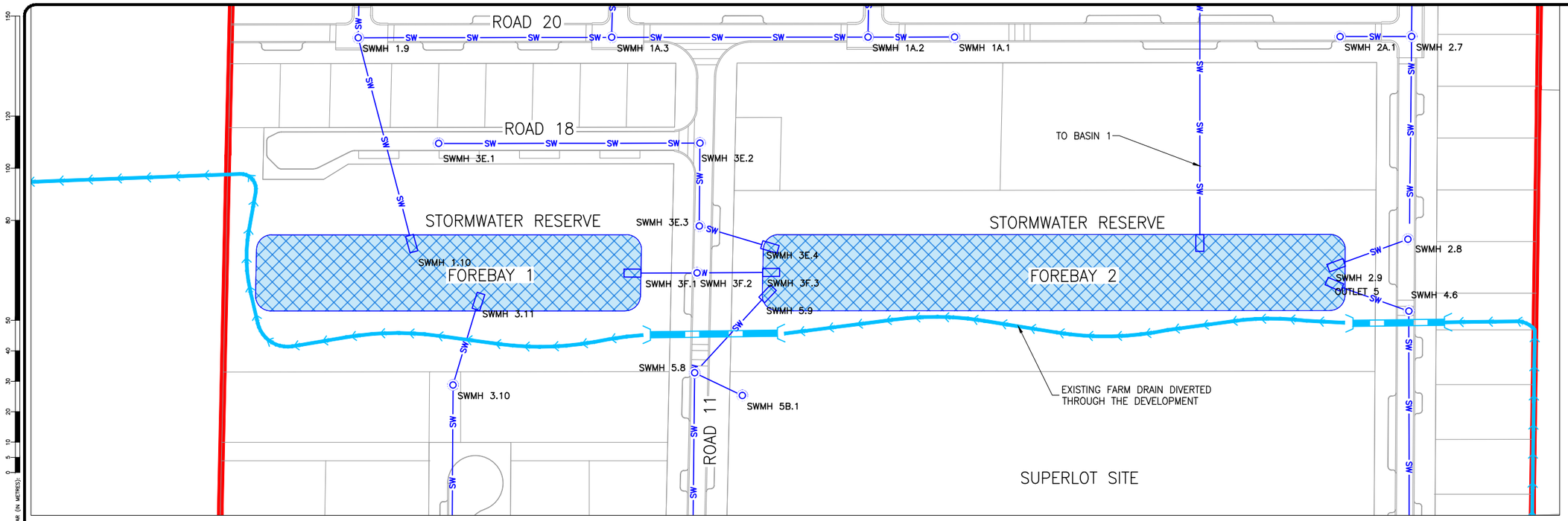
REVISION No.: A

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0420

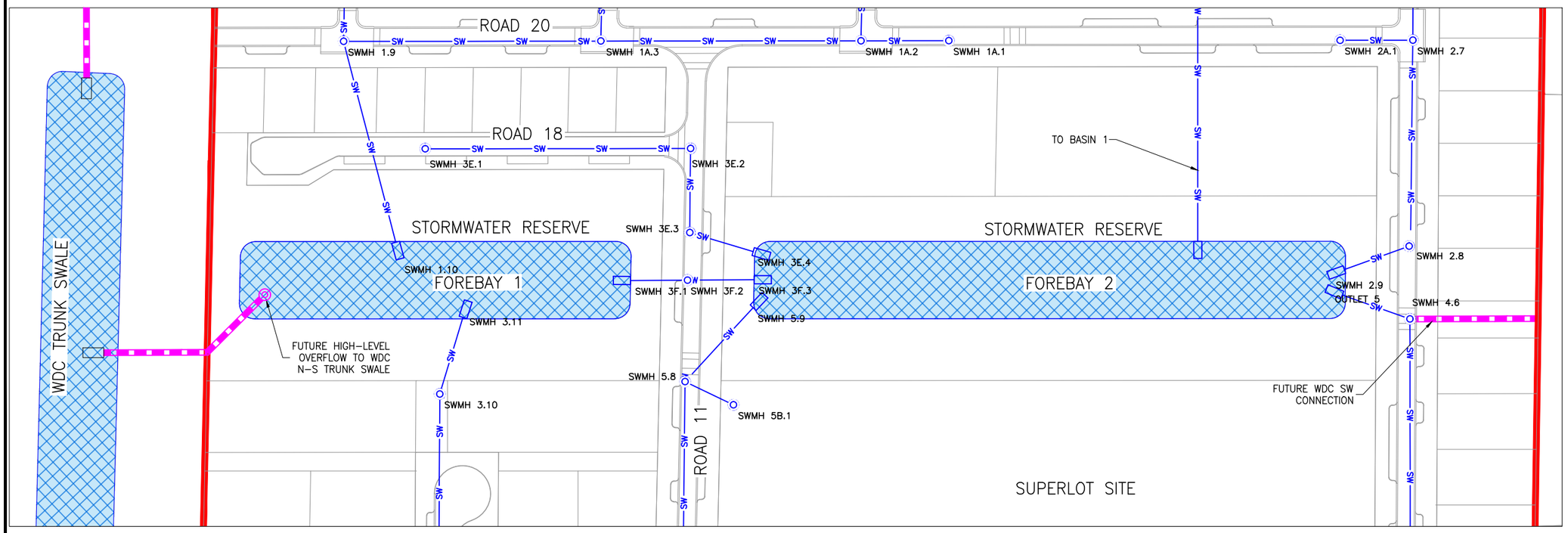
FILE NAME: 17001–C–0420.dwg

READ DRAWINGS CAREFULLY & MEASURETWICECUTONCE



3MS FOREBAY LAYOUT PLAN

SCALE = 1:1500



FUTURE WDC STORMWATER INTEGRATION LAYOUT PLAN

SCALE = 1:1500

DRAWING SCALE BAR (IN METRES): 0 5 10 20 30 40 50 80 100 120 150

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
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- STORMWATER MANHOLE
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APPROVAL STATUS: FOR INFORMATION

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DRAWN BY	A.ZHANG	DATE 02.12.20
APPROVED BY	–	DATE –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: STORMWATER FOREBAY LAOUT PLAN AND FUTURE INTEGRATION

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE	1:1500
REVISION No.	A
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001-C-0430

FILE NAME: 17001-C-0430.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 0 10 20 40 60 80 100 200 300 400 500

FUTURE WDC RISING MAIN

FUTURE WDC RISING MAIN

GRASSLANDS DRIVE

ROAD 17

COLLECTOR ROAD 2

MoE SCHOOL SITE

ROAD 23

ROAD 21

ROAD 22

STORMWATER RESERVE

ROAD 10

ROAD 20

ROAD 18

PS1

STORMWATER RESERVE

STORMWATER RESERVE

ROAD 14

ROAD 15

FUTURE WDC RISING MAIN

ROAD 16

ROAD 11

SUPERLOT SITE

ROAD 12

ROAD 13

ROAD 10

KELLY ROAD

VOGEL STREET

TERMINAL RISING MAIN DISCHARGES INTO EXISTING NETWORK AT VOGEL STREET (SEPARATE WDC CONTRACT)

CAMBRIDGE ROAD

TE AWA LIFECARE DEVELOPMENT

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

NOTES

1. ALL WORK TO BE COMPLETED IN ACCORDANCE WITH RITS.
2. SERVICE CONNECTIONS NOT SHOWN
3. WASTEWATER SERVICE DRAWINGS ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
4. AREAS AND DIMENSIONS MAY BE SUBJECT TO SCALE ERROR. SCALING FROM DRAWING IS AT THE USERS RISK.

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER GENERAL ARRANGEMENT

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:5000

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0500

FILE NAME: 17001–C–0500.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

FUTURE WDC RISING MAIN

WWMH C5.2

WWMH C5.1

ROAD 17

FUTURE WDC RISING MAIN

COLLECTOR ROAD 2

WWMH C4.1 WWMH C.3 WWMH C.2 WWMH C.1 WWMH D.1 WWMH D.2 WWMH D1.1

MoE SCHOOL SITE

ROAD 23

WWMH C.4

ROAD 10

WWMH D2.1 WWMH D.3

WWMH C2.2

WWMH C.5 ROAD 21 WWMH C2.1

WWMH C2.3

WWMH C3.1

MATCHLINE
17001-C-0502

ROAD 22

WWMH D.4

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

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KELLY ROAD
CAMBRIDGE ROAD

KEY PLAN

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APPROVED BY: —	DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500	REVISION No.: B
DISCIPLINE: CIVIL ENGINEERING	
DRAWING No.: 17001-C-0501	

FILE NAME: 17001-C-0501.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN METRES): 150 120 100 80 50 40 30 20 10 5 0

17001–C–0501
MATCHLINE

WWMH C.5
WWMH C2.1
WWMH C2.3
WWMH C3.1
WWMH C.6
WWMH C3.2
WWMH C2.4
WWMH D.4
ROAD 23
ROAD 22
ROAD 21
ROAD 10
STORMWATER RESERVE
WWMH C.1
WWMH C.7
ROAD 20
WWMH C.8
WWMH A.9
WWMH A.8
WWMH A.7
WWMH A.6
ROAD 18
WWMH B.6
WWMH B.7
WWMH A.5
STORMWATER RESERVE
STORMWATER RESERVE
ROAD 11
WWMH B.5
WWMH B2.1
WWMH B1.6
WWMH B.4
SUPERLOT SITE
WWMH A.4
ROAD 14
MATCHLINE
17001–C–0503

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

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KELLY ROAD
CAMBRIDGE ROAD

KEY PLAN

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CLIENT NAME: 3MS

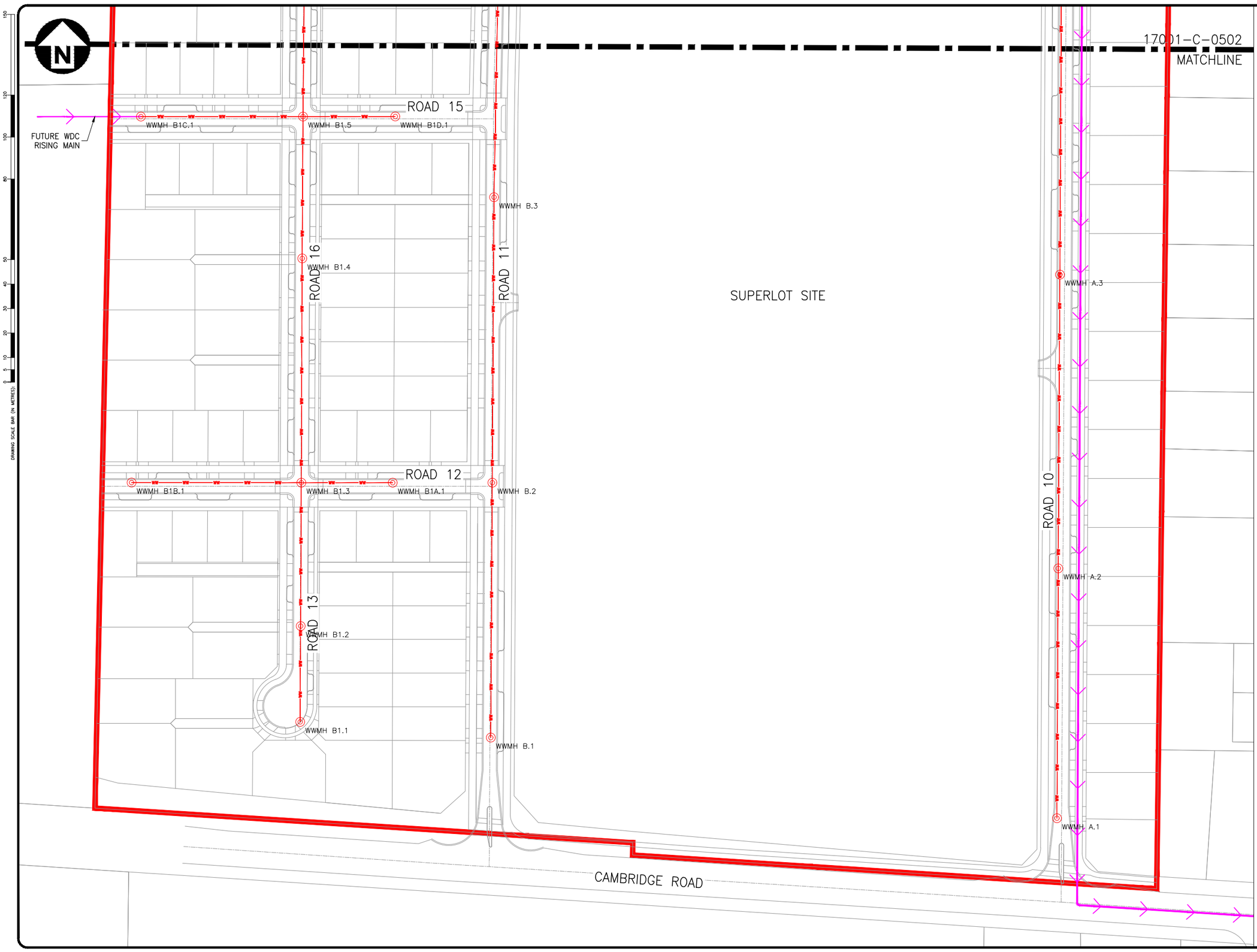
PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT
MASTER PLAN

DRAWING TITLE: WASTEWATER LAYOUT PLAN
SHEET 2 OF 3

PRODUCED BY: HG
DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500
REVISION No.: B
DISCIPLINE: CIVIL ENGINEERING
DRAWING No.: 17001–C–0502
FILE NAME: 17001–C–0502.dwg

READ DRAWINGS CAREFULLY & MEASURE TWICE CUT ONCE



LEGEND

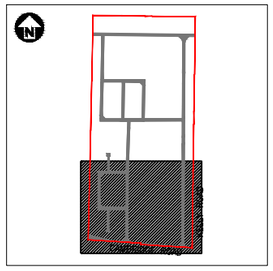
- 3MS DEVELOPMENT BOUNDARY
- WASTEWATER PIPELINE
- WASTEWATER LOT CONNECTION
- WASTEWATER MANHOLE
- ZONE TO BE SERVICED BY FUTURE PHASES

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC WASTEWATER PUMP STATION
- WDC WASTEWATER RISING MAIN

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APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER LAYOUT PLAN

SHEET 3 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0503

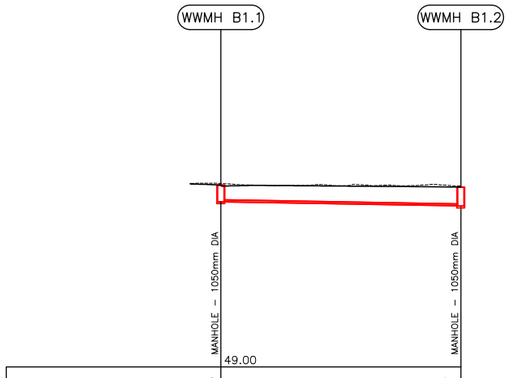
FILE NAME: 17001-C-0503.dwg

DRAWING SCALE BAR (IN METRES): 0 1 2 4 6 8 10 20 30 40 50 60 70 80 90 100



FINISHED LEVEL	63.67		64.13		63.50		63.64		63.31
DEPTH TO INVERT	1.52 1.54		2.39	2.41	2.29	2.31	2.77	2.79	2.90
INVERT LEVEL	62.15	62.13	61.73	61.71	61.21	61.19	60.86	60.84	60.40
PIPE GRADE SIZE & TYPE		1 in 150 150ø uPVC SN16		1 in 180 150ø uPVC SN16		1 in 180 150ø uPVC SN16		1 in 180 150ø uPVC SN16	
CHAINAGE	39.14	(58.5)	97.67	(91.5)	189.18	(58.0)	247.15	(79.2)	326.38

WW PIPELINE B1



FINISHED LEVEL	63.83		63.67
DEPTH TO INVERT	1.36		1.52
INVERT LEVEL	62.47		62.15
PIPE GRADE SIZE & TYPE		1 in 120 150ø uPVC SN16	
CHAINAGE	0.00	(39.1)	39.14

WW PIPELINE B1

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL — DATE: 02.12.20

DRAWN BY: A.ZHANG — DATE: 02.12.20

APPROVED BY: — — DATE: —

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER CRITICAL GRAVITY LINE LONGITUDINAL SECTIONS SHEET 1

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1000

REVISION No.: B

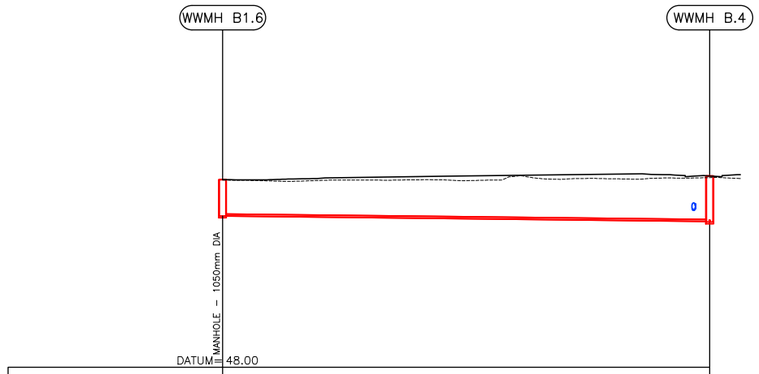
DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0510

FILE NAME: 17001-C-0510.dwg

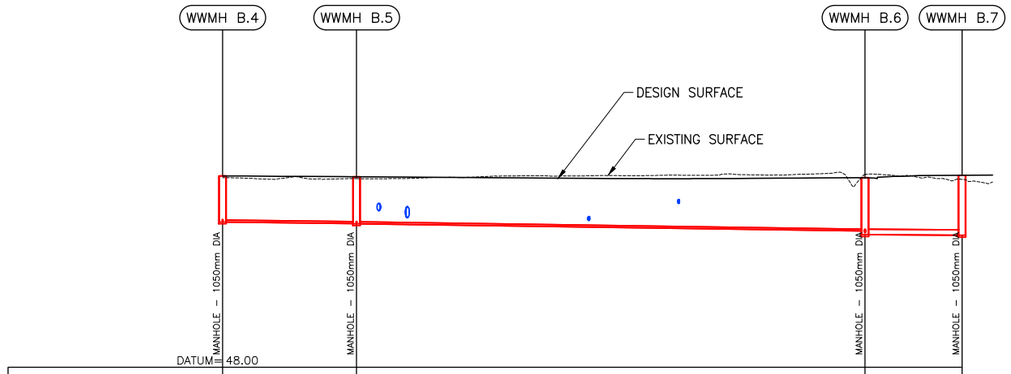
READ DRAWINGS CAREFULLY #MEASURETWICECUTONCE

DRAWING SCALE BAR (IN MILLIMETRES)



FINISHED LEVEL	63.31		63.60
DEPTH TO INVERT	2.91 2.96		3.70 3.76
INVERT LEVEL	60.40 60.34		59.90 59.84
PIPE GRADE SIZE & TYPE		1 in 180 150ø uPVC SN16	
CHAINAGE	326.38	(79.5)	405.84

WW PIPELINE B1



FINISHED LEVEL	63.60	63.53	63.47	63.66
DEPTH TO INVERT	3.74 3.76	3.81 3.83	4.35 4.65	4.89 4.89
INVERT LEVEL	59.86 59.84	59.72 59.70	59.12 58.82	58.77 58.77
PIPE GRADE SIZE & TYPE		1 in 180 150ø uPVC SN16	1 in 142 150ø uPVC SN16	1 in 300 450ø uPVC SN16
CHAINAGE	332.77	(21.9) 354.62	(82.9) 437.56	(15.8) 453.38

WW PIPELINE B

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL — DATE: 02.12.20

DRAWN BY: A.ZHANG — DATE: 02.12.20

APPROVED BY: – — DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER CRITICAL GRAVITY LINE LONGITUDINAL SECTIONS SHEET 2

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

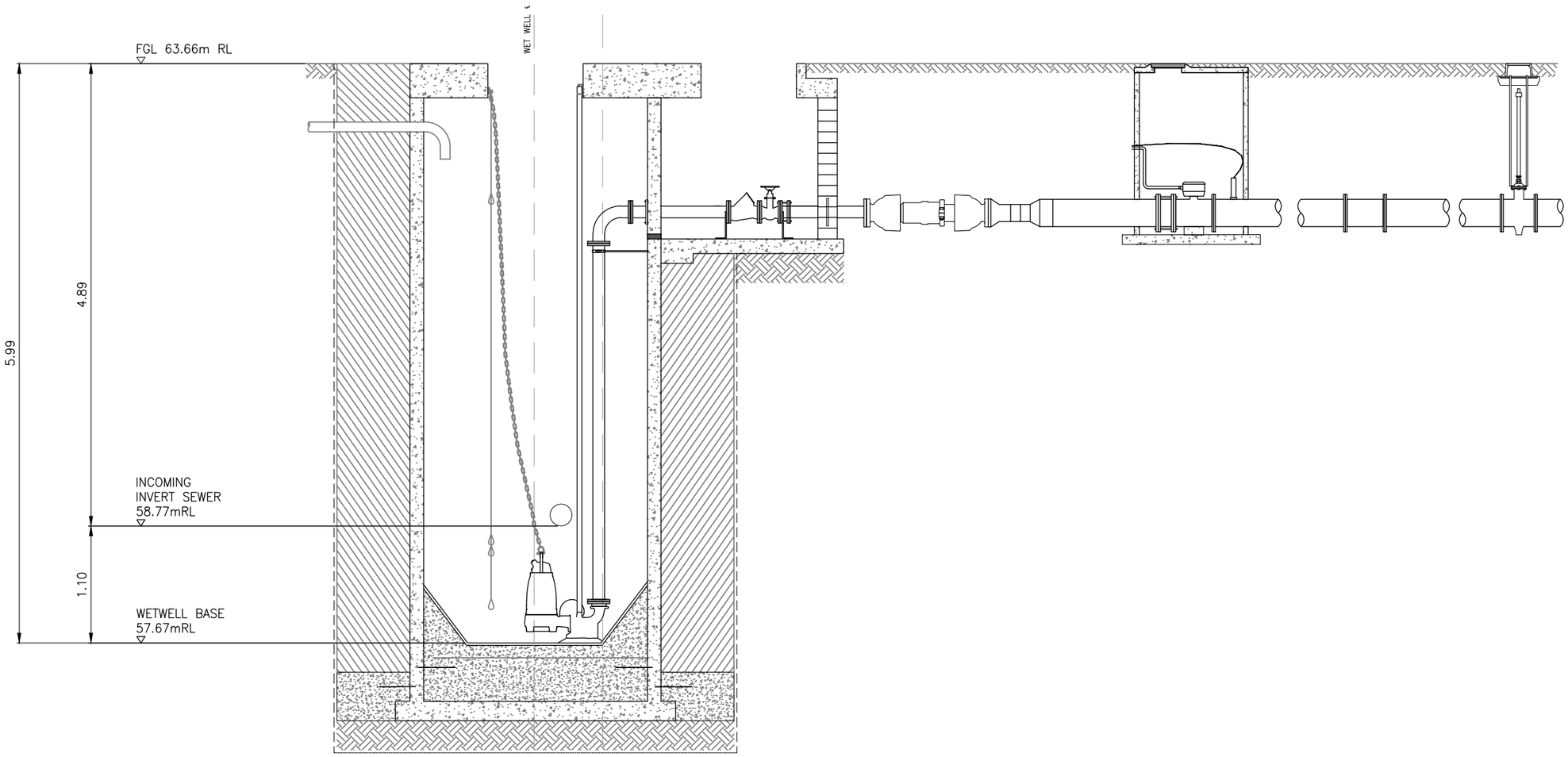
DRAWING SCALE: 1:750

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0511

FILE NAME: 17001–C–0511.dwg



C2 TERMINAL WASTEWATER PUMP STATION NO. 1

SCALE N.T.S.

REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	01.12.20
A	FOR INFORMATION	HB	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY	M.FARRELL	DATE	01.12.20
DRAWN BY	A.ZHANG	DATE	01.12.20
APPROVED BY	–	DATE	–

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WASTEWATER

PUMP STATION DETAILS

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE	N.T.S.
REVISION No.	B
DISCIPLINE	CIVIL ENGINEERING
DRAWING No.	17001–C–0520

FILE NAME: 17001–C–0520.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

FUTURE CONNECTION WITH SLUICE VALVE, HYDRANT AND BLANK FLANGE

FUTURE CONNECTION WITH SLUICE VALVE, HYDRANT AND BLANK FLANGE

FUTURE CONNECTION WITH SLUICE VALVE, HYDRANT AND BLANK FLANGE

EXISTING DN100 ON ABERGELDIE WAY

EXISTING DN100 ON VOGEL STREET

EXISTING DN100 ON KELLY ROAD

GRASSLANDS DRIVE

ROAD 17

COLLECTOR ROAD 2

MoE SCHOOL SITE

ROAD 23

ROAD 21

ROAD 22

STORMWATER RESERVE

ROAD 10

ROAD 20

ROAD 18

STORMWATER RESERVE

STORMWATER RESERVE

ROAD 14

ROAD 15

ROAD 16

ROAD 11

SUPERLOT SITE

ROAD 12

ROAD 13

KELLY ROAD

VOGEL STREET

← TO HAMILTON

CAMBRIDGE ROAD

NEW 150ø CONNECTION TO PROPOSED WDC DN315 WATERMAIN ON CAMBRIDGE ROAD

PROPOSED WDC DN315 WATERMAIN ON CAMBRIDGE ROAD

NEW 200ø CONNECTION TO PROPOSED WDC DN315 WATERMAIN ON CAMBRIDGE ROAD

TE AWA LIFECARE DEVELOPMENT

DRAWING SCALE BAR (IN METRES): 0 10 20 40 60 80 100 200 300 400 500

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
- ø150mm PRINCIPAL MAIN
- ø100mm MAIN
- ø63mm RIDER MAIN
- EXISTING WATER MAIN
- FIRE HYDRANT
- SLUICE VALVE
- GATE VALVE
- END CAP
- ZONE TO BE SERVICED BY FUTURE PHASES

NOTES

1. ALL WORK TO BE IN ACCORDANCE WITH THE RITS 2008.
2. MINIMUM COVER FOR NEW COUNCIL WATER MAINS IS 900MM.
3. EXISTING WATER MAIN SIZES AND MATERIALS MAY VARY TO WHAT IS SHOWN ON THE DRAWINGS (IDENTIFIED USING EXISTING GIS INFORMATION). ALL EXISTING PIPEWORK BEING CONNECTED INTO FOR THIS PROJECT IS TO BE POT HOLED TO CONFIRM MATERIAL AND SIZES PRIOR TO TIE INS.
4. ALL VALVES AND COMPONENTS TO BE PN16 (MINIMUM) RATED
5. SERVICE CONNECTIONS NOT SHOWN
6. AIR VALVES AND SCOUR VALVES NOT SHOWN
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REV	DESCRIPTION	BY	DATE
B	FOR INFORMATION	AXZ	02.12.20
A	FOR INFORMATION	SVDM	17.04.20

APPROVAL STATUS: FOR INFORMATION

DESIGNED BY: M.FARRELL	DATE: 02.12.20
DRAWN BY: A.ZHANG	DATE: 02.12.20
APPROVED BY: –	DATE: –

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY GENERAL ARRANGEMENT

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:5000

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0600

FILE NAME: 17001–C–0600.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

DRAWING SCALE BAR (IN MILLIMETRES): 0 2 4 6 8 10 20 30 40 50 60 70 80 90 100

CONNECTION TO FUTURE PHASES

CONNECTION TO FUTURE PHASES

CONNECTION TO FUTURE PHASES

ROAD 17

COLLECTOR ROAD 2

ROAD 23

MoE SCHOOL SITE

ROAD 10

ROAD 21

ROAD 22

STORMWATER RESERVE

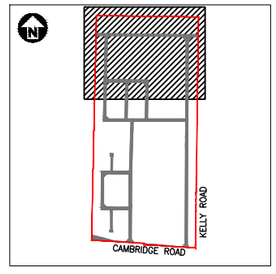
MATCHLINE
17001-C-0602

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
- ø150mm PRINCIPAL MAIN
- ø100mm MAIN
- ø63mm RIDER MAIN
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CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY LAYOUT PLAN

SHEET 1 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0601

FILE NAME: 17001-C-0601.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

17001–C–0601
MATCHLINE

CONNECTION TO FUTURE PHASES

ROAD 23
ROAD 22
ROAD 21
ROAD 20
ROAD 18
ROAD 14
ROAD 15
ROAD 11
ROAD 10

STORMWATER RESERVE
STORMWATER RESERVE
STORMWATER RESERVE
SUPERLOT SITE

MATCHLINE
17001–C–0603

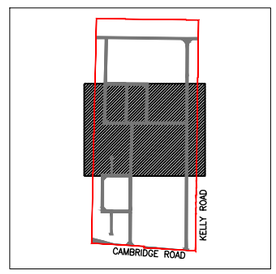
DRAWING SCALE BAR (IN MILLIMETRES): 0 2 4 6 8 10 20 30 40 50 60 70 80 90 100

LEGEND

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- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
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APPROVED BY	—	DATE	—

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY LAYOUT PLAN

SHEET 2 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

DRAWING SCALE: 1:1500

REVISION No.: B

DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001–C–0602

FILE NAME: 17001–C–0602.dwg

READ DRAWINGS CAREFULLY // MEASURETWICECUTONCE

17001-C-0602
MATCHLINE

ROAD 15

ROAD 16

ROAD 11

ROAD 12

ROAD 13

ROAD 10

SUPERLOT SITE

CONNECTION TO FUTURE PHASES

CONNECTION TO FUTURE PHASES

NEW OD PE 150 CONNECTION TO PROPOSED WDC DN315 WATER MAIN

CAMBRIDGE ROAD

NEW OD PE 200 CONNECTION TO PROPOSED WDC DN315 WATER MAIN

LEGEND

- 3MS DEVELOPMENT BOUNDARY
- WDC WORKS BOUNDARY
- ø200mm PRINCIPAL MAIN
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- ø100mm MAIN
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A	FOR INFORMATION	SVDM	17.04.20

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DESIGNED BY	DATE
M.FARRELL	02.12.20
DRAWN BY	DATE
A.ZHANG	02.12.20
APPROVED BY	DATE
—	—

CLIENT NAME: 3MS

PROJECT NAME: 3MS RESIDENTIAL DEVELOPMENT

MASTER PLAN

DRAWING TITLE: WATER SUPPLY LAYOUT PLAN

SHEET 3 OF 3

PRODUCED BY: HG

DATE PRINTED: 2 December 2020

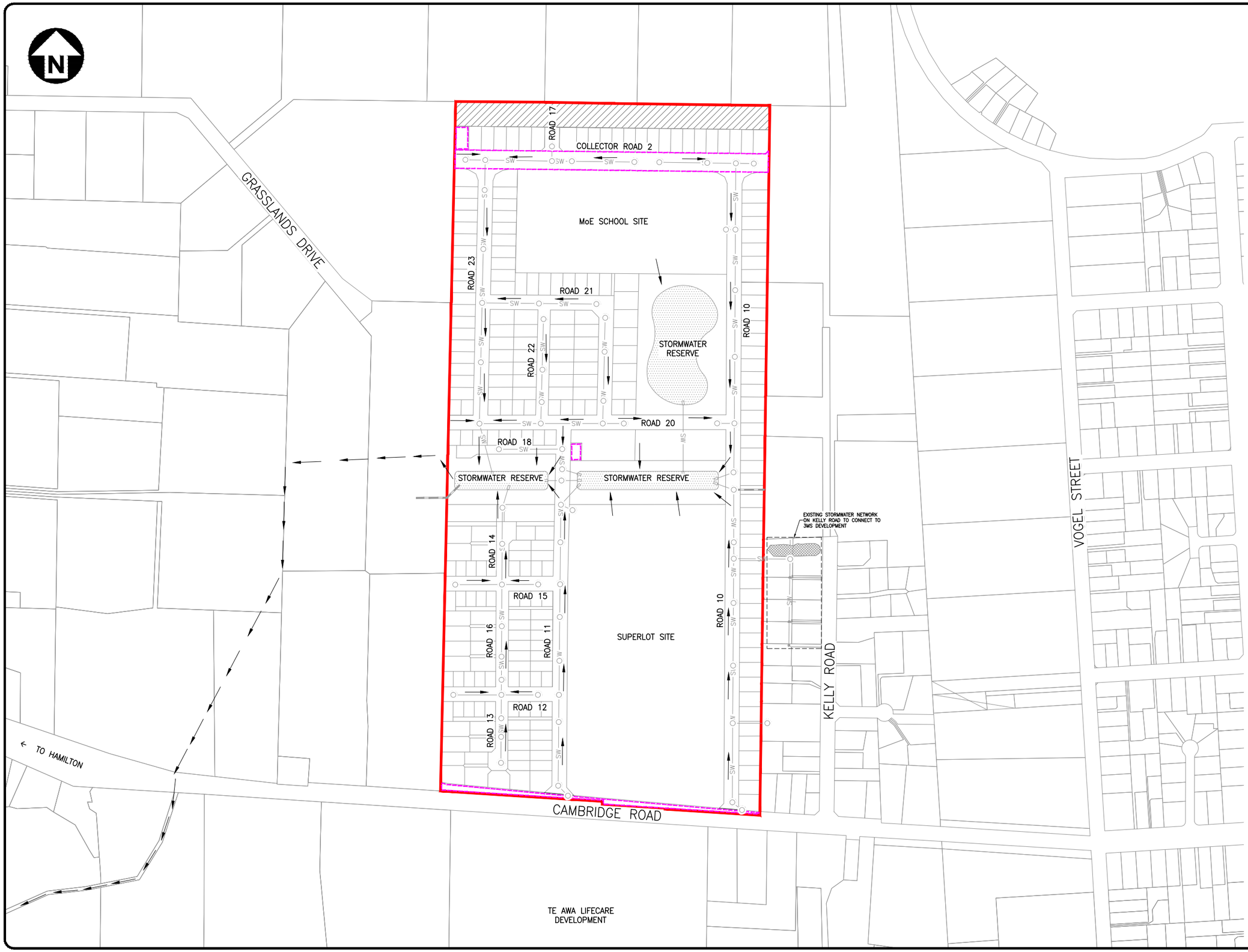
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DISCIPLINE: CIVIL ENGINEERING

DRAWING No.: 17001-C-0603

FILE NAME: 17001-C-0603.dwg



LEGEND

- 3MS DEVELOPMENT BOUNDARY
- SW — STORMWATER PIPELINE
- STORMWATER LOT CONNECTION
- STORMWATER MANHOLE
- TRAVERSABLE HEADWALL
- ZONE TO BE SERVICED BY FUTURE PHASES
- OVERLAND FLOW PATH

WDC CONTRACT WORKS

- WDC WORKS BOUNDARY
- WDC STORMWATER CULVERT

NOTES

1. STORMWATER SERVICES DRAWING ONLY. OTHER EXISTING AND PROPOSED SERVICES ARE TYPICALLY NOT SHOWN ON THIS PLAN.
2. UNDERGROUND SERVICES MAY BE LOCATED WITHIN THE VICINITY OF THE WORKS.
3. CONTRACTOR TO VERIFY THE POSITION OF ALL SERVICES PRIOR TO COMMENCEMENT OF WORKS.
4. ALL WORKS TO BE COMPLETED WITHIN THE WAIKATO REGIONAL INFRASTRUCTURE TECHNICAL SPECIFICATION. (RITS)
5. ALL RCRRJ PIPES TO BE CLASS 4 UNLESS SHOWN OTHERWISE.
6. ALL SUMP LATERALS TO BE ø300mm RCRRJ UNLESS SHOWN OTHERWISE.
7. ALL R.O.W SUMP GRATE LIDS TO BE STANDARD C.I. LIDS.
8. ALL ROAD SUMPS TO HAVE 'HYNDS HYDRO D.I.' GRATES OR SIMILAR PRODUCT APPROVED
9. ALL 100mm AND 150mm HOUSE CONNECTIONS TO HAVE A BLANK END AND BE MARKED WITH A TIMBER POST PAINTED GREEN.
10. PIPES ø300mm OR LESS ARE TO BE SADDLED DIRECTLY TO STORMWATER WHEN MAINS PIPES ARE ø600mm AND OVER. (WHERE NO MANHOLE SHOWN)
11. PLANTING SCHEDULE TO BE SUBMITTED AND APPROVED BY WDC ARBORISTS PRIOR TO PLANTING.
12. PHOTOGRAPHIC IMAGERY HAS BEEN IMPORTED FROM EXTERNAL SOURCES. AREAS AND DIMENSIONS MAY BE SUBJECT TO SCALE ERROR. SCALING FROM DRAWING IS AT THE USERS RISK.

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DRAWN BY	A.ZHANG	DATE 02.12.20
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CLIENT NAME: 3MS

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MASTER PLAN

DRAWING TITLE: STORMWATER OVERLAND FLOW PATH

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Appendix D

Geotechnical Technical Suitability Report (BTW)

(Bound separately)

3MS Site - Cambridge

(Part of C2 Growth Cell)

Geotechnical Suitability Report

for 3MS of Cambridge

Rev B - 08/12/2020

BTWCOMPANY

SURVEYING | ENGINEERING | PLANNING & ENVIRONMENT













Geotechnical Suitability Report

for 3MS of Cambridge

	Reviewed	
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191324
Rev B - 08/12/2020

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1 INTRODUCTION

BTW Company Ltd (BTW) has been engaged by 3MS of Cambridge (3MS) to provide a geotechnical suitability report for the revised subdivision layout at 1871 Cambridge Road, Cambridge.

This report supersedes the previous BTW reports for the proposed 3MS subdivision titled *'Geotechnical Completion Report – Working Draft'* dated 30/07/2020 and '*Preliminary Geotechnical Investigation and Site suitability'*, dated 06/03/2020. In addition, site pavement subgrade testing (California Bearing Ratio test (CBR)) was undertaken on the site following issuing of the documents referenced above. This information has also been incorporated into this report to supplement test pit information.

The proposed subdivision layout has been revised, and as such the testing inference and recommendations within the previously produced reports have been revised to reflect the new proposed layout.

An earthworks plan has been prepared showing cut/fill areas and most cut and fill depths are typically 1 metre or less, with up to 500 mm across the site as typical (excluding the proposed stormwater ponds, which require up to 4.0 metres of cut in places).

There is a significant amount of cut to fill from the stormwater disposal ponds within 3MS boundary, a feature that dominates the earthworks focus at the site. There will be a significant amount of cut to dump material anticipated from the stormwater ponds also.

1.1 Scope of Document

The scope of this has been adjusted to suit the revised subdivision layout and includes the following.

- Assessment of proposed cut/fill strategy to confirm suitability of materials.
- Assessment of settlement risk and identification of additional testing/mitigation required to address this (if any).
- Assessment of earthquake risks (liquefaction/lateral spreading) for the development and identification of additional testing/mitigations required to address these (if any).
- Assessment of preliminary subgrade CBR for pavement designs.

It is noted that groundwater and soakage assessment relating of the revised stormwater basins and disposal strategy is specifically excluded from this report (completed by others).

1.2 Waipa District Council requirements

Waipa District Council (WDC), as part of the intended Subdivision Resource Consent process, will require all works be completed in accordance with the Regional Infrastructure Technical Specification (RITS).

The Regional Infrastructure Technical Specification, Section 2 Earthworks and Geotechnical Requirements, requires a Geotechnical Completion Report which, in turn, references the requirements of NZS 4404:2010 Section 2.6. This report will form the basis of the Geotechnical Completion Report as the subdivision design and earthworks commence.

1.3 Previous work

A number of previous investigations into the C2 growth cell have been undertaken by various engineering consultancies. Some of this information has been considered in forming the recommendations contained within this report. The previous reporting applicable to this investigation is summarised in Table 1.1 below.

Table 1.1: Summary of previous reporting pertaining to the development area

Consultancy	Report title	Date	Job number	Prepared for
Beca	Geotechnical Factual Report – Cambridge Structure Plan C1 to C3 Hydrogeological Investigation	15 February 2017	4284909 | NZ1-13691526-2 0.2	WDC
Beca	Cambridge C1, C2 & C3 Plan Change: Geotechnical Factual Report	9 March 2018	3208540 | NZ1-15157009-40 0.40	WDC
Beca	Cambridge C1, C2 and C3 Plan Change Liquefaction Hazard Assessment	16 April 2018	3208540 | NZ1-15150773-72 0.72	WDC
Beca	Cambridge C1 and C2/C3 Infrastructure: Geotechnical Factual Report Addendum 1	13 May 2019	3208540 | NZ1-16069482-15 0.15	WDC
Beca	Cambridge C1 and C2/C3 Infrastructure: Groundwater Model and Assessment	29 May 2019	3209296 | NZ1-15757392-111 0.111	WDC
Beca	Cambridge C1 and C2/C3 Infrastructure: Geotechnical Factual Report Addendum 2	23 August 2019	3413691 | NZ1-16371746-15 0.15 | 23	WDC
Tonkin and Taylor	MoE School Site Evaluations: Cambridge West. Preliminary Geotechnical Assessment	March 2019	1008725.1000	MoE

WDC = Waipa District Council

MoE = Ministry of Education

The two most relevant documents from Table 1.1 are the '*Cambridge C1 and C2/C3 Infrastructure: Groundwater Model and Assessment report*' and the '*Geotechnical Factual Report – Cambridge Structure Plan C1 to C3 Hydrogeological Investigation*'.

1.4 Site Description

The proposed new residential subdivision is located along the western boundary of the Cambridge township, in an area identified by WDC as part of the long term development of Cambridge, a locality plan is shown in Figure 1.1 below. This development area is an element within the C2 growth cell.

It is understood that the development is to cover 40.8 hectare (approximate area) and comprise of approximately 335 residential housing lots, commercial development and a school site.



Figure 1.1: Locality plan of the proposed subdivision development and environs.

The proposed development is located on what can be best described as near level to gently undulating ground. The existing low point within the site is the farm drain that runs east-west through the site.

The subdivision is to comprise of a school site to the north, stormwater reserve in the approximate centre of the site, with a super lot in the southern end of the proposed development. Refer to Figure 1.2 for a proposed development plan for the site.

Note: Figure 1.2 also shows the testing 'zones' within the proposed subdivision. There are three major testing zones:

- Central Testing Zone: The central zone has been subdivided into the following zones based on the geomorphology (in part) of the of the subdivision
  - Southern and Middle: comprising of the super lot and residential dwellings
  - Northern: comprising Stormwater Reserve, School site, residential housing, commercial area recreational area
- Western Testing Zone: comprising residential lots and part of the Stormwater Reserve
- Northern Testing Zone: comprising residential lots

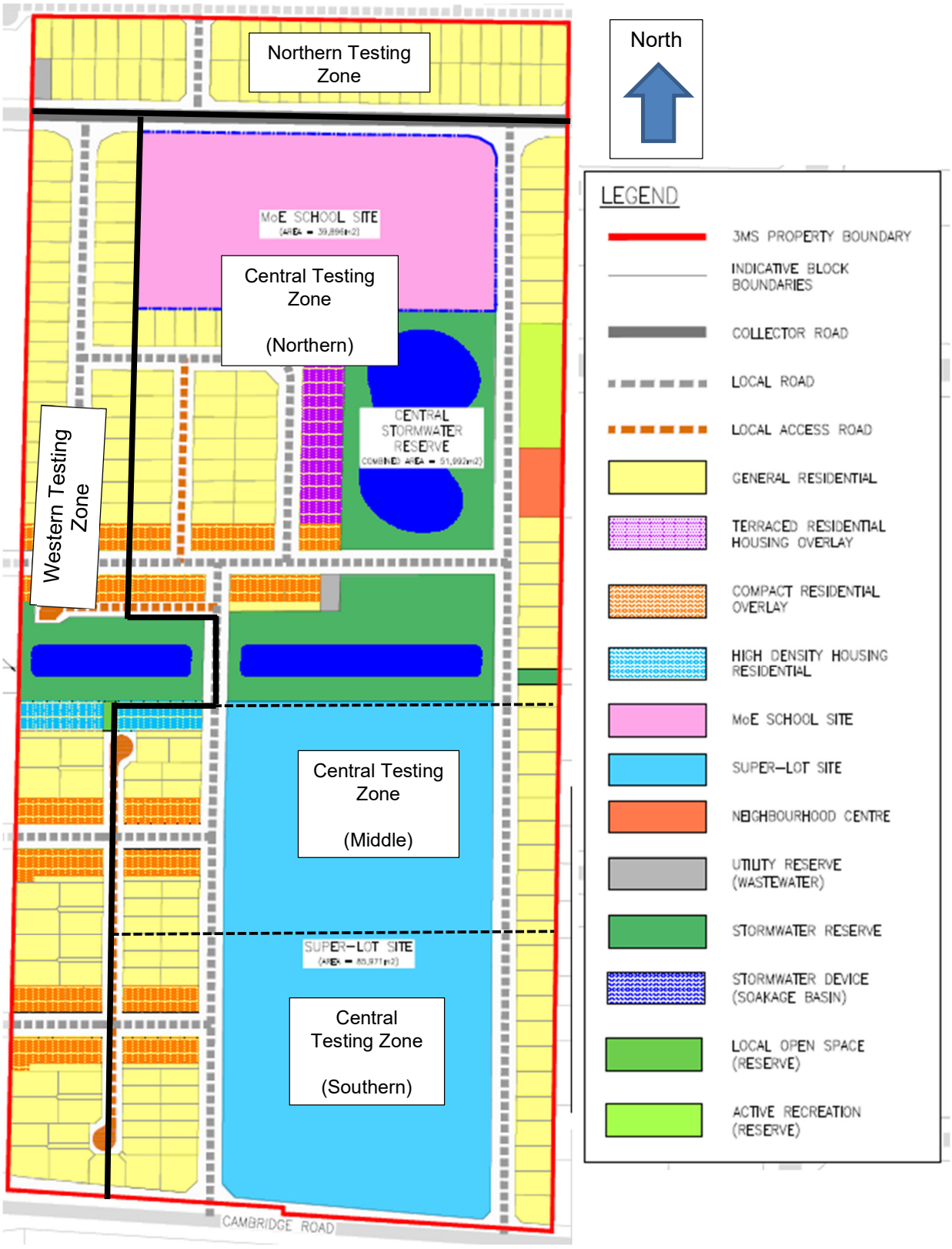


Figure 1.2: Proposed Site Development Layout

1.5 Site Testing Location Summary

As the scheme plan for the development has been revised a testing location comparison for the 'old' subdivision layout/staging compared to the 'new' subdivision layout is presented in Table 1.2

Table 1.2: Summary of geotechnical testing and distribution of tests in the old and new development stages.

Old Stage	Testing Zone	CBR	Hand Auger	CPT	Test Pit	Central Collector	North-eastern Collector
1B	-	1 & 2	1,2 & 4	1 to 3	1	A to D	-
2	-	3 to 6	3,5 to 7	4 to 6	2 to 4, 8 & 9	E to H	-
3	-	7 to 10	8 to 12	7 to 11	5 to 7	I to R	A to H
major part of 1B, 2 & 3	Central	1 to 10	1 to 11	1 to 10	8 & 9	-	B to H
minor part of 1B, 2 & 3	Western	-	-	-	1 to 7	A to P	-
minor part of 3	Northern	-	12	11		Q & R	A

2 TESTING LOCATIONS

2.1 Site Testing

Site testing has been undertaken across the site in several distinct phases and these phases are summarised in Table 2.1 , Table 2.2 and Table 2.3.

Field investigations for subdivision suitability were undertaken by BTW company on the 21st to 23rd January 2020. Testing was undertaken for foundation and pavement design (CBR) recommendations for local roads. The respective testing is summarised in Table 2.1.

Table 2.1: Summary of soil tests undertaken by BTW.

Testing For	Scala Penetrometer (metres BEGL)	Hand auger (metres BEGL)	Shear Vane (metres BEGL)	No. of Tests
Foundations	3.0	2.0	0.5 to 2.0	12
Pavements	2.0	2.0	0.5 to 2.0	10

Hand augers comprised of 50 mm Ø borings to the depth above.

Shear Vane readings were undertaken at 200 mm centres where soil conditions permitted.

Subconsultant WSP was engaged to undertake the Cone Penetrometer Testing (CPT). This testing was undertaken on the 23rd January 2020, the results are summarised in Table 2.2.

Table 2.2: Summary of CPT testing

Target Depth (metres BEGL)	Achieved Depth (metres BEGL)	No. of Tests
20	20	11

The soil results from this testing is presented in Appendix A.1.

2.1.1 Description of Additional Testing

Additional testing was undertaken to confirm the soils that were to be encountered in the areas of cut and within the proposed stormwater swales (since deleted from the design). The additional testing is presented in Table 2.3.

Table 2.3: Summary of Testing Parameter.

Test ID	Date	No. of Tests	Test Depth (range metres)	Strength Tests undertaken	Comments
Test Locations A to F (Hand Augers)	3 July 2020	6	1.2	Yes	Testing in areas of cut to 3MS Plan 17001 - C0112
Test Pits 1 to 9	8 July 2020	9	4.0 to 6.0	-	Adjacent to Beca CPT Nos. 1, 4, 6, 8, 11, 14, 16, 21, 23

2.1.2 Test Pits

On the 8th of July 2020 BTW undertook a series of test pit excavations (to a depth of between 4.0 to 6.0 metres below existing ground level (BEGL)) adjacent to the Beca CPT test locations (as shown on Figure 2.2) in order to:

- Confirm the underlying soil sequence (visually) within the proposed cut (swales)
- Identify what soils in the swales would not be suitable for use as bulk filling (if required)
- Identify areas that will require specific treatment

The results from the test pit excavations are shown in Appendix A.2.

2.1.3 Hand Tests

Six additional hand tests were undertaken in areas of cut that had been shown on the 3MS Plan 17001 - C0112. The purpose of the testing was to identify the soils within the proposed areas of cut outside of the stormwater swales as shown in Figure 2.1 .

As the design depth of the cut is to approximately 0.5 to 1.0 metres deep, the investigation was targeted to this depth.

2.2 Location of Site Testing

The location of site testing from January 2020 is presented in Figure 2.1 while the testing from July 2020 is presented in Figure 2.2.

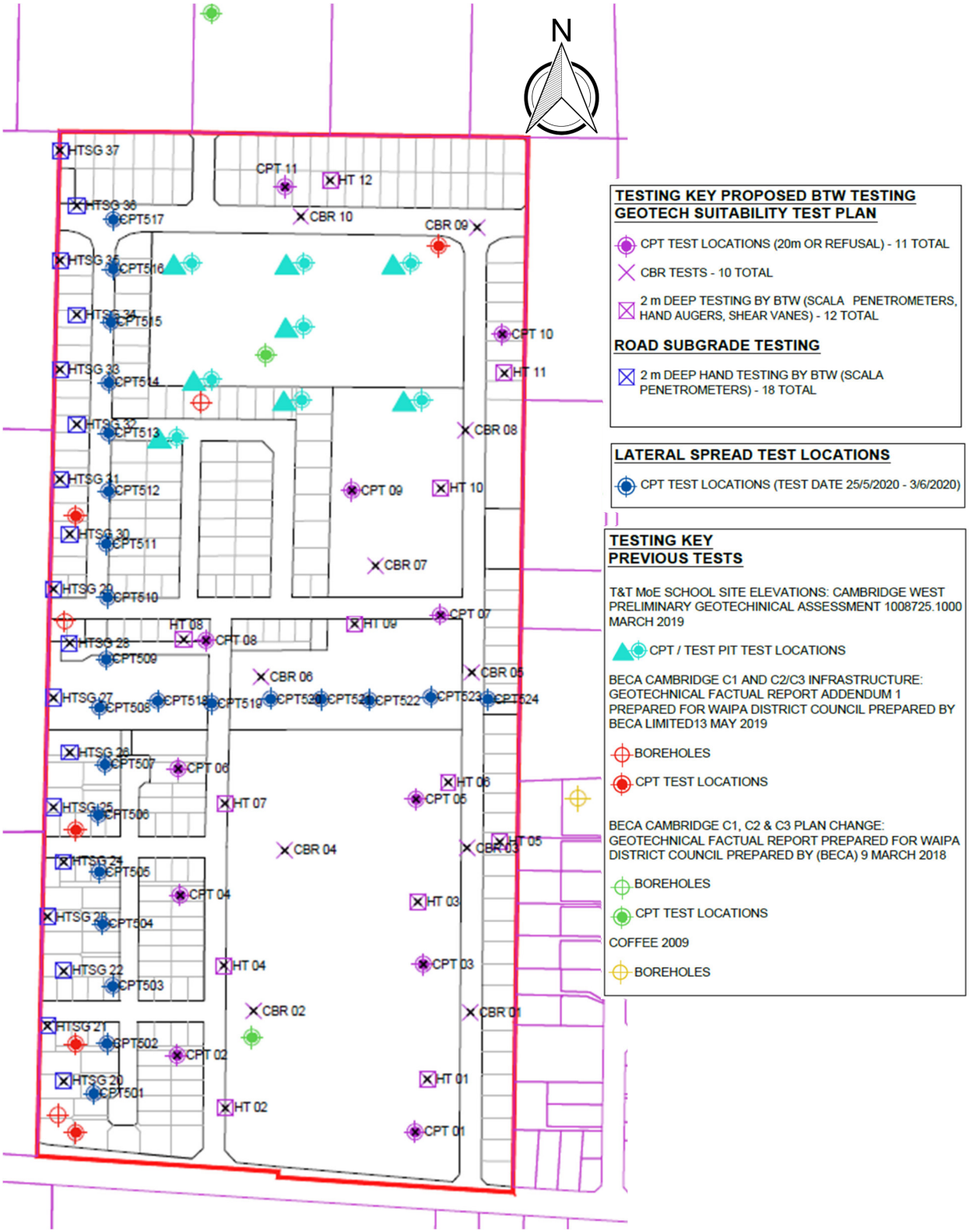


Figure 2.1: Hand Auger Test sites from January 2020 with additional testing locations (by others) presented on previous subdivision scheme plan.

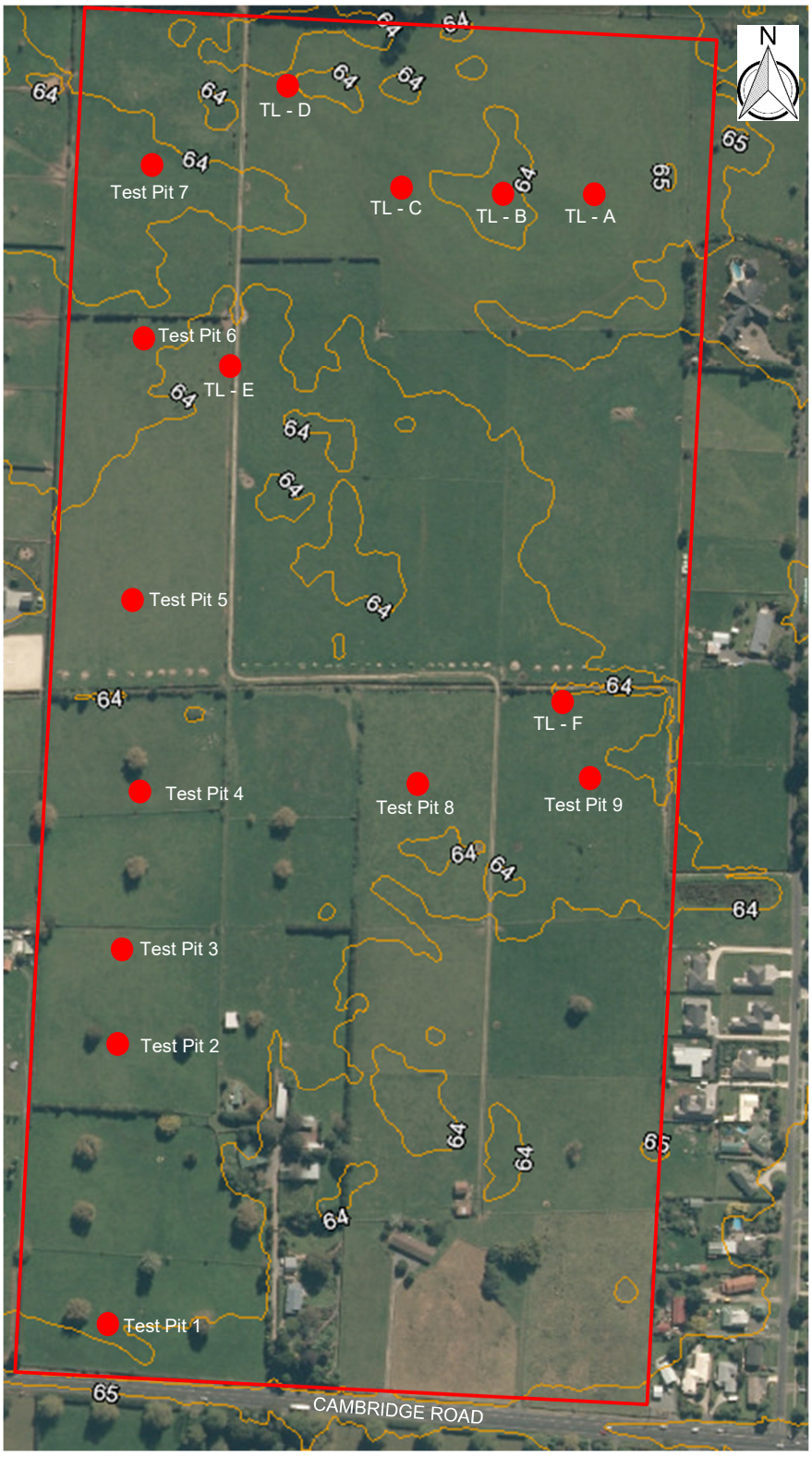


Figure 2.2: Location of soil testing locations (test pits and hand augers).

2.3 Published Geology

Published geological information as shown on Kear and Schofield (1965) Sheet N65 Hamilton (1st edition) which shows that the site sits on the surface of the Hinuera Formation. In addition to the Hinuera Formation soils, an area of postulated peat is located within the proposed development area.

The Hinuera Formation is comprised of alluvial sediments consisting of pumiceous and rhyolitic gravel, sand and silt and minor peat, deposited in two phases.

The first phase occurred between 24,000 to 18,000 years ago when a high energy river system deposited coarse, sand gravel and pumice, with occasional silt lenses across the Waikato Basin. The sediments deposited during this period tend to be well sorted, dense soils, with high strengths.

During the second phase (18,000 to 14,000 years ago) due to changes in the climate and sediment supply, the sediments deposited tended to comprise fine sand and silt which were deposited in a low energy river basin. These soils tend to be less well sorted, have lower densities and strength than those deposited during phase one.

Some interesting points regarding the Hinuera Formation are provided by Hume et al. (1975):

> *'Two apparently paradoxical features are noted. The first is the variability of the Hinuera sediments in detail. No stratigraphic columns are alike, and the sequence of lithologies, textures, and sedimentary structures is as different between the sections erected at the same locality as between other sections. The second feature is the uniform appearance of the Hinuera Formation on a regional scale.'*
> *The different lithologies typically occur in erosional contact with each other, both vertically and latterly, and do not occur in regular or predictable stratigraphic patterns'*

2.3.1 Revision to Geological Map N65 'Hamilton'

The geological map N65 'Hamilton' published by Kear and Schofield (1968) as shown in Figure 2.3 shows that the site rests on Hinuera Formation sediments (described in Section 2.3) with an inferred area of peat and associated soft silt and organic soils through the middle of the subdivision occurring at the ground surface.

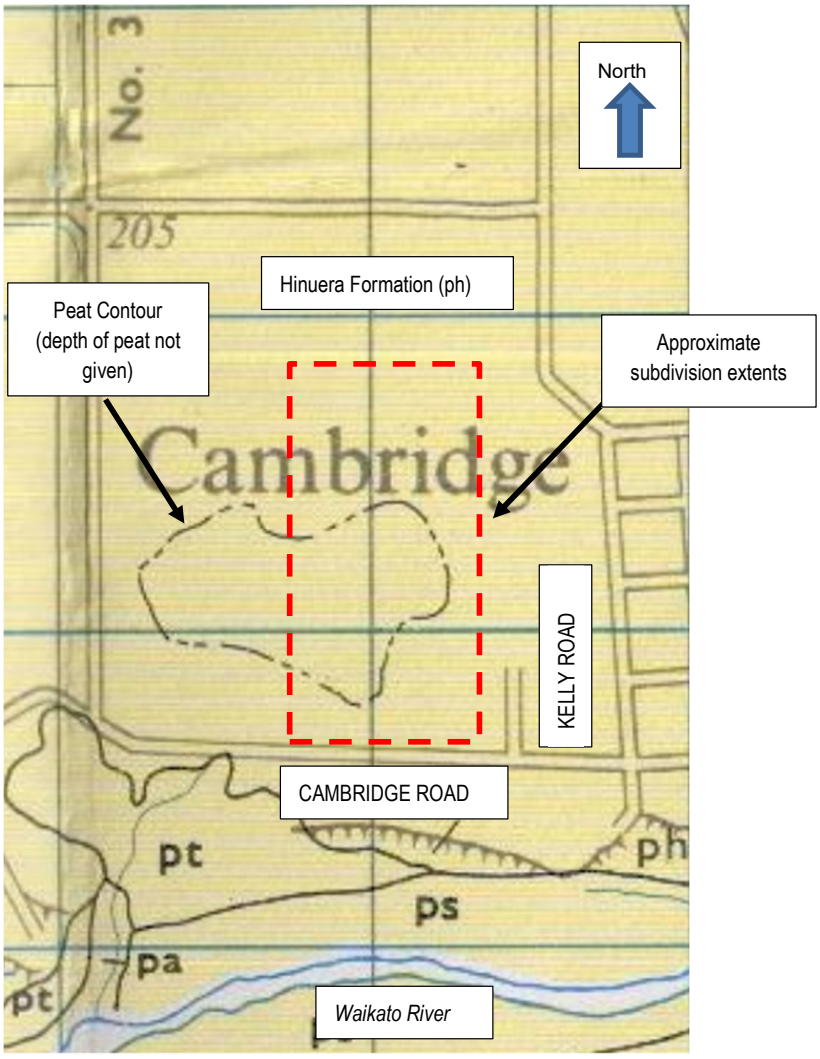


Figure 2.3: Part of the geological map N56 Hamilton (from Kear and Schofield 1968).

Based on the extensive shallow testing undertaken by BTW across the site, it can be said with certainty that the area of peat and by inference soft silt and organic soils does not occur as shown by Kear and Schofield (1968). Very thin (>200 mm thick) organic soils do occur at the surface along the eastern boundary as identified by previous BTW reporting, but for practical design purposes the site can be treated as a typical Hinuera Formation sequence.

However, this does not discount the possibility of peat/organic silt soils occurring elsewhere across the site.

2.4 Soil Landscape Units

Within the Hamilton Basin, a predictable relationship between landform units and soil types (both engineering soils and pedological soils) exists.

The relationship between the main landscape units and geological materials (engineering soils) in the Hamilton Basin is shown in Figure 2.4.

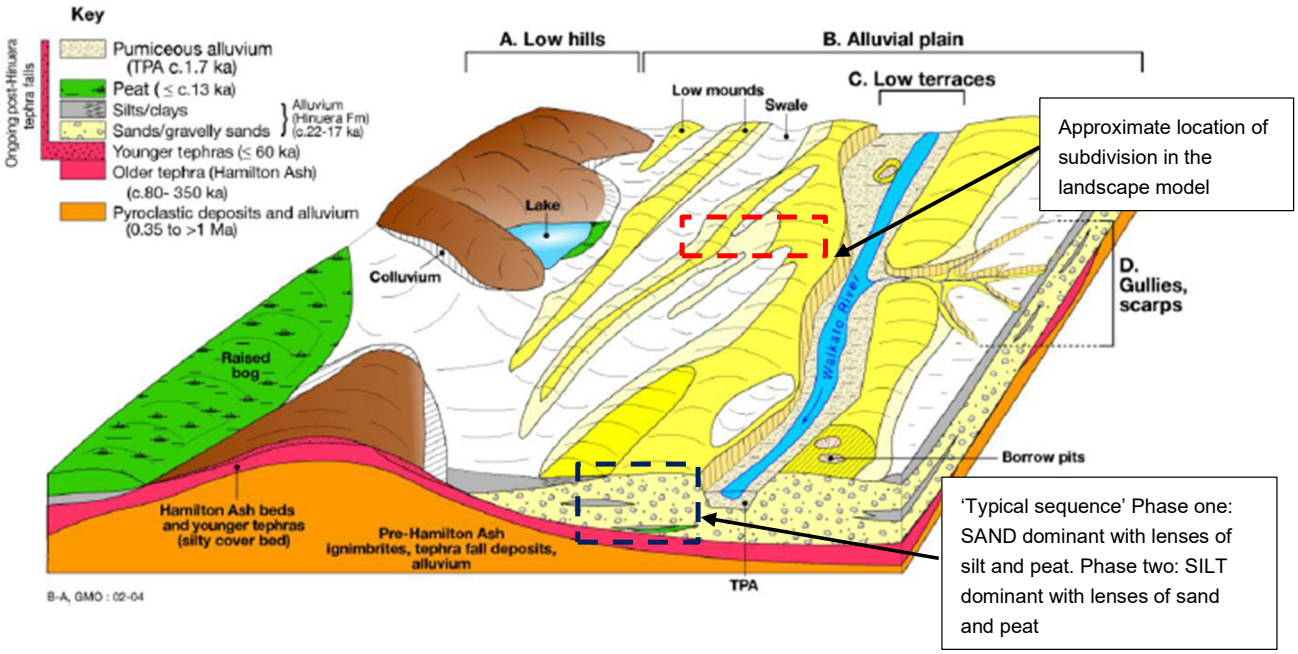


Figure 2.4: Main landscape units and geological materials (engineering soils) in the Hamilton Basin (Lowe 2010).

The main pedological units within the Waikato Basin (soil-landscape model) are shown in Figure 2.5

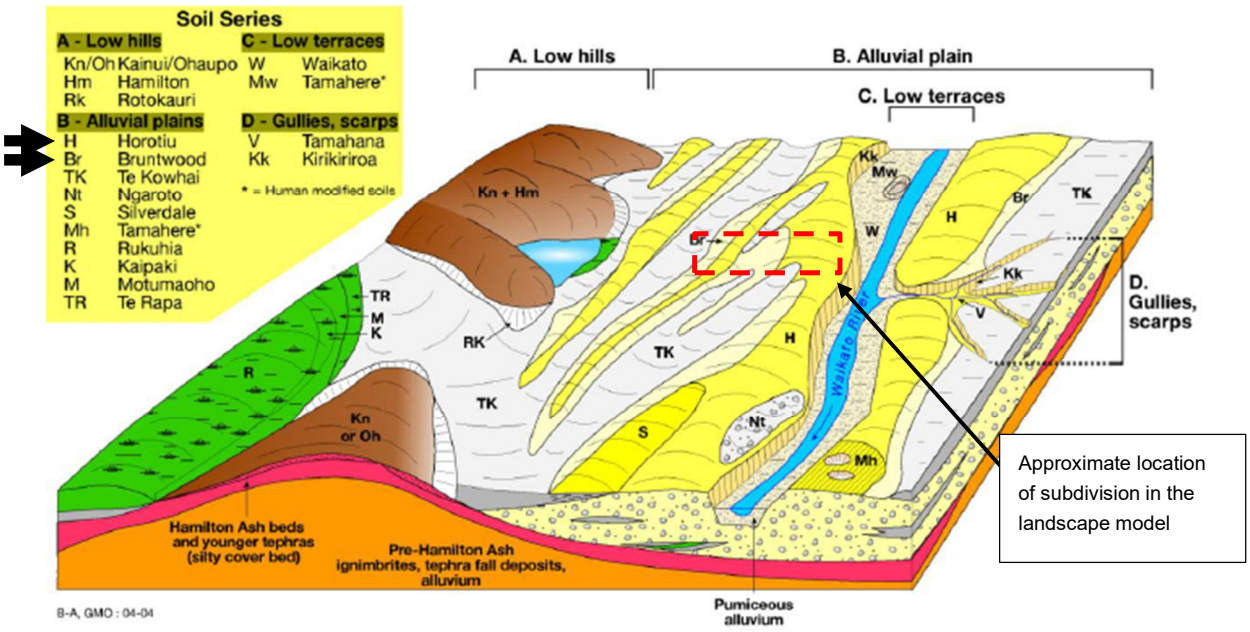


Figure 2.5: Hamilton Basin (soil-landscape model) (Lowe 2010).

2.5 Soils Detailed Description

Soils testing for the subdivision is presented based on the proposed 'testing zones'. Refer to Figure 1.2 for the 'testing zone' extents.

Note: The proposed school falls outside the scope of this document.

2.5.1 Central Testing Zone (Southern) - Shallow Soils

Hand Testing

This portion of the proposed subdivision is located at the southern end of the subdivision and is adjacent to Cambridge Road. This area will comprise half of the super lot with the balance being made up of residential dwellings of various densities.

The soils within the central testing zone have been tested by the following testing procedures to the depths given in Table 2.4 below.

Table 2.4: Summary of testing within Central Testing Zone (Southern).

Testing	**Scala Penetrometer** (metres BEGL)	**Hand auger** (metres BEGL)	**Shear Vane** (metres BEGL)	**Testing Depth Range** (metres BEGL)	**No. of Tests**	**Identifier**
Hand Testing (Shallow soils)	3.0	2.0	0.5 to 2.0	3.0	3	TL A, B, & D
Cone Penetrometer Testing (Deep soils)	-	-	-	19.92	3	CPT 1 to 3

The generalised soil sequence is presented in Table 2.5. The description is based on the hand augers and Scala Penetrometers results and is valid to a depth of 2.9 metres below existing ground level (BEGL).

Table 2.5: Generalised soil sequence within Central Testing Zone (Southern)

Major Soil Fraction	Identified at Test Location	Geological Unit	Soils Description	Depth to top of major soil fraction (metres)	Range in thickness of major soil fraction (metres)
TOPSOIL	A, B & D	-	TOPSOIL	0	0.1
SILT	"	Hinuera Formation "	firm to stiff, clayey SILT	0.1	0.8 to 1.0
SAND	"		loose, silty fine SAND or fine SAND with some silt	0.8 to 1.0	0.3 to 0.8
SILT	A & B		firm to stiff, clayey SILT or SILT with some fine sand	1.3 to 1.7	0.3 to 0.8 (min)
Based on Scala Penetrometer results only					
SAND	A, B & D	Hinuera Formation	assumed loose to medium dense, SAND	1.9 to 2.1	0.9 to 1.0

Test Locations A and D bored to depths of 2.0 metres BEGL respectively. End of Bore Hole: End of Auger – Target depth achieved.

100 mm thick firm clayey SILT at 1.1 metres omitted from log @ TL-A

100 mm thick soft organic SILT at 1.8 metres omitted from log @ TL-D

Dilatant soils identified at:

TL-B at depths of 1.2 to 1.9 metres BEGL

TL-D at depths of 1.7 to 1.9 metres BEGL

Iron pan layers:

No iron pan or manganese nodules identified in soil testing

Groundwater Levels

Groundwater levels were recorded at the 'end of day' and the groundwater levels are presented in Table 2.6 below.

Table 2.6: Measured groundwater levels within the hand auger bore hole (22 February 2020).

Test Location	Depth of bore hole (metres)	Approx. depth to groundwater level	Notes
A to B, C	2.0	-	No groundwater found or expected at this depth

2.5.2 Central Testing Zone (Southern) - Deep Soils (CPT Testing)

Based on the observed qt trace and soil behaviour type graph the soil sequence at depth (for CPT tests 1 to 3) is inferred to be that of a the Hinuera Formation with altering patterns of dense (assumed) sand soils and lower strength (assumed) silt soils to a depth of 20 metres BEGL shown in Table 2.7.

Table 2.7: Measured groundwater levels from CPT testing (22 February 2020).

CPT Location	Depth of test (metres)	Approx. depth to groundwater level	Notes
1	19.92	8.0	Assumed true groundwater level (refer Beca summary)
2	19.92	2.0	Assumed perched
3	19.92	7.3	Assumed true groundwater level (refer Beca summary)

Beca in their Groundwater Model and Assessment report dated 29 May 2019 show in Figure 6 (page 7) that the thickness of the Hinuera Formation under the proposed development is approximately 25 meters thick.

Summary Description of Soils Encountered

The combined shallow hand tests and deep CPT testing revealed a general soil profile of low strength soils for the first 3.0 to 3.5 metres BEGL. Underlying these low strength soils are dense (assumed) sand layer with a thickness of 2 to 8 metres. This alternating sequence of (assumed) dense sand and low strength silt soils then occur to the base of the 20-metre-deep CPT tests.

Groundwater level varies across the site and ranges from 2.0 to 8.0 metres below existing ground level in general agreement with the Beca groundwater model.

2.5.3 Central Testing Zone (Middle) Shallow Soils

Hand Testing

This testing area is located in the approximate middle of the Central Testing Zone and extends as far north as the west/east running central stormwater reserve. This lot will comprise the northern half of the super lot with the balance being made up of residential dwellings of various densities.

The soils within the Central (middle) zone have been tested by the following testing procedures to the depths given in Table 2.8 below.

Table 2.8: Summary of testing within Central Testing Zone (Middle).

Testing For	Scala Penetrometer (metres BEGL)	Hand auger (metres BEGL)	Shear Vane (metres BEGL)	Testing Depth Range (metres BEGL)	No. of Tests	Identifier
Hand Testing (Shallow soils)	3.0	2.0	0.5 to 2.0	3.0	3	TL C, E to F
Cone Penetrometer Testing (Deep soils)	-	-	-	19.2 to 19.3	3	CPT 4 to 6

The generalised soil sequence is presented in Table 2.9. The description is based on the hand augers and Scala Penetrometers results and is valid to a depth of 2.9 metres BEGL.

Table 2.9: Generalised soil sequence within Central Testing Zone (Middle)

Major Soil Fraction	Identified at Test Location	Geological Unit	Soils Description	Depth to top of major soil fraction (metres)	Range in thickness of major soil fraction (metres)
TOPSOIL	C, E to G	-	TOPSOIL	0	0.1
SILT	"	Hinuera Formation	firm to stiff clayey SILT or fine sandy SILT	0.1	0.6 to 1.0
SAND	"		loose to medium dense, fine SAND with some silt or silty fine SAND	0.7 to 1.1	0.3 to 1.1
SILT	E & F		stiff to firm, clayey SILT	1.2 to 1.4	0.4 to 0.5
SAND	"		loose to medium dense, silty fine SAND	1.6 to 1.9	0.1 to 0.4
Based on Scala Penetrometer results only					
SAND	C, E to G	Hinuera Formation	assumed loose to dense SAND	1.9	0.9 (min)

Test Locations C, E to F bored to depths of 2.0 metres BEGL respectively. End of Bore Hole: End of Auger – Target depth achieved.

100 mm thick firm, clayey SILT at 1.5 metres omitted from log @ TL-C

100 mm thick stiff, clayey SILT at 1.8 metres omitted from log @ TL-D

Dilatant soils identified at:

TL-F at depths of 1.6 to 1.9 metres BEGL

TL-G at depths of 1.8 to (min) 2.0 metres BEGL

Iron pan layers:

TL-C at depths of 1.3 to 1.5 metres BEGL slightly iron stained soils occurred

TL-C at depths of 1.6 to 1.8 metres BEGL slightly iron stained soils occurred

TL-E at depths of 0.5 to 0.7 metres BEGL heavily iron stained soils occurred

TL-E at depths of 0.7 to 1.4 metres BEGL moderately iron stained soils occurred

TL-E at depths of 1.4 to 1.9 metres BEGL heavily iron stained soils occurred

TL-E at depths of 1.9 to (min) 2.0 metres BEGL slightly iron stained soils occurred

TL-F at depths of 0.1 to 0.9 metres BEGL moderately iron stained soils occurred

TL-G at depths of 0.1 to 0.8 metres BEGL moderately iron stained soils occurred

TL-G at depths of 0.7 to 0.9 metres BEGL many manganese nodules occurred

Groundwater Levels

Groundwater levels were recorded at the 'end of day' and the groundwater levels are presented in Table 2.10 below.

Table 2.10: Measured groundwater levels within the hand auger bore holes (22 February 2020).

Test Location	Depth of bore hole (metres)	Approx. depth to groundwater level	Notes
C & E	2.0	-	No groundwater found or expected at this depth
G	2.0	1.5	Assumed perched.

2.5.4 Central Testing Zone (Middle) - Deep Soils (CPT Testing)

Based on the observed qt trace and soil behaviour type graph the soil sequence at depth (for CPT tests 4 to 6 is inferred to be that of a the Hinuera Formation with altering patterns of dense (assumed) sand soils and lower strength (assumed) silt soils to a depth of 20 metres BEGL.

An extremely deep (approximately 8 metres thick) dense sand layer occurs from a depth of 3.5 metres BEGL at CPT 4. At CPT 5 and 6 the alternating pattern of dense sand layer sand lower strength silt layers occur within this depth range as shown in Table 2.11 below.

Table 2.11: Measured groundwater levels from CPT testing (22 February 2020).

CPT Location	Depth of test (metres)	Approx. depth to groundwater level	Notes
4	19.92	2.3	Assumed perched
5	19.92	7.6	Assumed true groundwater level (refer Beca summary)
6	19.92	7.0	Assumed true groundwater level (refer Beca summary)

Beca in their Groundwater Model and Assessment report dated 29 May 2019 show in Figure 6 (page 7) that the thickness of the Hinuera Formation under the proposed development is approximately 25 meters thick.

Summary Description of Soils Encountered

The combined shallow hand tests and deep CPT testing revealed a general soil profile of low strength soils for the first 3.0 to 3.5 metres BEGL. Interestingly, there is no surface crust at these test locations.

The low strength upper surface soils extend to a depth of 3.0 to 3.5 metres where the dense (assumed) sand soils observed in the CPT traces occur.

Groundwater level varies across the site and ranges from 2.3 to 7.6 metres BEGL in general agreement with the Beca groundwater model.

2.5.5 Central Testing Zone (Northern) - Shallow Soils

Hand Testing

The Central Testing Zone (Northern) is located at the northern end of the proposed development and is bound by the northern eastern collector road. This portion of the development comprises the proposed new school complex, residential dwellings, neighbourhood centre and Stormwater Reserve.

The soils within the Central Testing Zone (Northern) have been tested by the following testing procedures to the depths given in Table 2.12 below.

Table 2.12: Summary of testing within the Central Testing Zone (Northern).

Testing For	Scala Penetrometer (metres BEGL)	Hand auger (metres BEGL)	Shear Vane (metres BEGL)	Testing Depth Range (metres BEGL)	No. of Tests	Identifier
Hand Testing (Shallow soils)	3.0	2.0	0.5 to 2.0	3.0	4	TL H to L
Cone Penetrometer Testing (Deep soils)	-	-	-	10.0 to 19.9	4	CPT 7 to 11

The generalised soil sequence is presented in Table 2.13 below. The description is based on the hand augers and Scala Penetrometers results and is valid to a depth of 2.9 metres BEGL.

Table 2.13: Generalised soil sequence within the Central Testing Zone (Northern).

Major Soil Fraction	Identified at Test Location	Geological Unit	Soils Description	Depth to top of major soil fraction (metres)	Range in thickness of major soil fraction (metres)
TOPSOIL	H to K	-	TOPSOIL	0	0.1
SILT	H to I	Hinuera Formation	firm to very stiff, clayey SILT or fine sandy SILT	0 to 0.1	0.4 to 1.1
SAND	"		loose to medium dense, silty fine SAND or medium SAND with some silt	0.5 to 1.1	0.3 to 1.2 (min)
SILT	H to J		firm to stiff fine sandy SILT or clayey SILT	1.0 to 1.4	0.2 to 0.4
SAND	"		medium dense, silty fine or medium SAND	1.2 to 1.8	0.2 to 0.6 (min)
SILT	J		firm, fine sandy SILT or clayey SILT	1.7	0.3 (min)
Based on Scala Penetrometer results only					
SAND	H to L	Hinuera Formation	medium dense (assumed) SAND	2.0 to 2.4	0.6 to 0.9 (min)
SILT	J		stiff (assumed) SILT	2.0	0.4

Test Locations I to K bored to depths of 2.0 metres BEGL respectively. End of Bore Hole: End of Auger – Target depth achieved.

Test Location L bored to depths of 1.4 metres BEGL respectively. End of Bore Hole: Unable to recover sample.

No TOPSOIL identified at TL-L

100 mm thick loose, fine SAND with some silt omitted from log @ TL-I

Dilatant soils identified at:

TL-H at depths of 1.7 to (min) 2.0 metres BEGL

TL-J at depths of 1.7 to (min) 2.0 metres BEGL

Iron pan layers

TL-H at depths of 0 to 0.5 metres BEGL heavily iron stained soils occurred

TL-H at depths of 0.5 to 0.7 metres BEGL moderately iron stained soils occurred

TL-H at depths of 1.0 to 1.2 metres BEGL many manganese nodules occurred

Groundwater Levels

Groundwater levels were recorded at the 'end of day' and the groundwater levels are presented in Table 2.14 below.

Table 2.14: Measured groundwater levels within the hand auger bore holes (22 February 2020).

Test Location	Depth of bore hole (metres)	Approx. depth to groundwater level	Notes
I to L	1.4 or 2.0	-	No groundwater found or expected at this depth

2.5.6 Central Testing Zone (Northern) - Deep Soils (CPT Testing)

Based on the observed qt trace and soil behaviour type graph the soil sequence at depth (for CPT tests 7 to 11 is inferred to be that of a the Hinuera Formation with altering patterns of dense (assumed) sand soils and lower strength (assumed) silt soils to a depth of 20 metres BEGL as shown in Table 2.15.

Table 2.15: Measured groundwater levels from CPT testing (22 February 2020).

CPT Location	Depth of test (metres)	Approx. depth to groundwater level	Notes
7	19.92	2.3	Assumed perched
8	19.92	2.2	
9	10.06	3.5	
10	19.92	2.7	
11	19.92	6.7	Assumed true groundwater level (refer Beca summary)

Beca in their Groundwater Model and Assessment report dated 29 May 2019 show in Figure 6 (page 7) that the thickness of the Hinuera Formation under the proposed development is approximately 25 meters thick.

Summary Description of Soils Encountered

The combined shallow hand tests and deep CPT testing revealed a general soil profile of low strength soils for the first 3.5 to 5.2 metres BEGL in Test Locations I to J and CPTs 7 to 9, where a dense (assumed) Sand layer with a thickness of 2 to 5 metres starts to occur. This alternating sequence of (assumed) dense sand and low strength (assumed) silt soil to the base of the 20-metre-deep CPT tests.

The soil sequence as identified at Test Locations K and L and CPT 10 and 11 shows low strength Silt over dense SAND to a depth of 3 metres BEGL. Thereafter, the soil sequence is consistent with those described above.

Groundwater level varies across the site and ranges from 2.2 to 6.7 metres below existing ground level in general agreement with the Beca groundwater model. The shallow water level depths found in CPTs 7 to 10 are considered to be from perched water trapped on a locally impermeable soil layer.

2.5.7 Western Testing Zone Investigations

The soils information and logging within this section of the development has been derived from 'combined' information, consisting of the Scala penetrometer data that was originally obtained for the Central Collector road California Bearing Raito (CBR) determination, and the soil test pits for the formally proposed central swale drain.

The generalised soil sequence is presented in Table 2.5 below. The description is based on the hand augers and Scala Penetrometers results and is valid to a depth of 2.9 metres below existing ground level (BEGL).

Table 2.16: Generalised soil sequence within Western Testing Zone.

Major Soil Fraction	Identified at Test Location	Geological Unit	Soils Description	Depth to top of major soil fraction (metres)	Range in thickness of major soil fraction (metres)
Based on Scala Penetrometer results only					
SILT	A, E, F, H K, N P	Hinuera Formation	firm to stiff, SILT with occasional very soft layers in the upper 1 metre of the soil profile	0	1.2 to >2.0
SAND			medium dense SAND	1.2	

Groundwater Levels

Groundwater levels were obtained from the test pit investigations and are presented in Table 2.6 below.

Table 2.17: Measured groundwater levels (8 July 2020).

Test Pit ID	Depth of Test Pit (metres)	Approx. depth to groundwater level	Notes
1	4.0	1.2 to 2.4	Occurring as a weep across the face of the test pit between the depths shown
2	6.0	2.2 to 2.6	
3	6.0	-	None encountered
4	6.0	2.8	Ground water flows (pressure) increasing as test pits moved to the north
5	6.0	2.3	
6	6.0	2.9	
7	4.6	2.7	

Summary Description of Soils Encountered

The soils encountered are typical of that of a soil sequence that overlies the upper part of the Hinuera Formation sequence. The upper (typical) 1.5 metres of the profile comprises of relatively low strength clayey silt which over lies medium dense (inferred) Sand soil.

At the southern end of the testing zone an area of low strength organic peat/peat soil sequence occurs. The extent of this soil sequence has not been defined.

2.5.8 Northern Testing Zone Investigations

As the soils information within this testing area have been derived from 'combined' information that is, the Scala penetrometer information from the Central Collector and north-eastern collector roads California Bearing Raito (CBR) tests, while the soil log is in part influenced by the hand auger test (Hand Auger Test 12) for the old Stage 3.

Table 2.18: Generalised soil sequence within the Northern Testing Zone.

Major Soil Fraction	Geological Unit	Soils Description	Depth to top of major soil fraction (metres)	Range in thickness of major soil fraction (metres)
SILT	Hinuera Formation	firm to stiff, clayey SILT	0	0.9 to 1.1
SAND		medium dense to dense, medium SAND with some silt and fine gravel.	0.9 to 1.1	(min) 0.9 to 1.1

Summary Description of Soils Encountered

The soils encountered are typical of that of a soil sequence that overlies the upper part of the Hinuera Formation sequence. The upper (typical) 1.5 metres of the profile comprises of relatively low strength clayey silt which over lies medium dense (inferred) Sand soil.

2.6 Soil Landscape Model and Derived Soil Properties

Based on the information and testing above, a soil landscape model for the site has been prepared. The model identifies the elements within the soil model, the expected engineered properties and suitability for use as bulk earth fill. In addition to the above, a basic description of pedological soils will be made and their suitability for use as re-spread topsoil across the subdivision, use in subdivision planters etc.

2.7 Soil Landscape Model

The established model of Lowe (2010) shows that the landscape model comprises of braided river channels (underlain by sand) often separated by swales (comprised of silt). The identified model within the 3MS site is in agreement within that of Lowe (2010). However, there are some local differences that have been identified by the site investigations.

2.7.1 Identified Landscape Units

The site can be broken into two zones, that is the Bar and Swale morphology, comprising of undulating topography highs (river channels – bars) and lows (swales - low lying areas adjacent to the bars) with Sand being the dominant soils encountered. This configuration is typical of braided river systems. The Bar and Swale morphology (braided river system) occurs mainly in the Central Testing Zone, with the most visible examples occurring at the southern end, part of the 'Middle' subzone and to the northern extent of the Northern subzone and to a lesser extent in Northern Testing Zone.

In the approximate middle of the subdivision (Central Testing Zone - Middle), there is a large swale between the two braided river channel systems and can be effectively considered to be an island upon which a lowland forest (Kahikatea forest) grew on a river floodplain. Within the large swale existed small scale streams the morphology of which is still evident today.

In the southwestern corner of the subdivision is a postulated isolated peat/organic silt deposit. This unit is probably backed onto an isolated lake or abandoned river channel and was frequently flooded from an adjacent river channel.

A plan of the postulated landform extents and location of the test locations is shown in Figure 2.6.

2.7.2 Groundwater Patterns

Perched groundwater was identified across the subdivision in the test pits. The identified trend in the Central Swale was that of being shallow at the southern end BEGL and increasing in depth at the northern end. The respective depths of the groundwater are presented in Table 2.19.

Table 2.19: Summary of identified Groundwater levels from test pits

Test Pit	1	2	3	4	5	6	7	8	9
Measured Groundwater	1.2 to 2.4	2.2 to 2.6	Nil (1)	2.8	2.3	3.9 (2)	3.3 (2)	3.8	3.9

Notes

(1) No groundwater identified

(2) Groundwater inflows with such velocity that that side of test pits rapidly collapsed.

Within the test pits, the velocity and inflow rate increased as the tests moved towards the north. At test pits 6 and 7 the ground water inflows were such that the sides of the test pits collapsed within 5 minutes of being fully exposed. It is thought that the increase in water volume is from the more porous sands that occur adjacent to the test pits in the braided river area to the north.

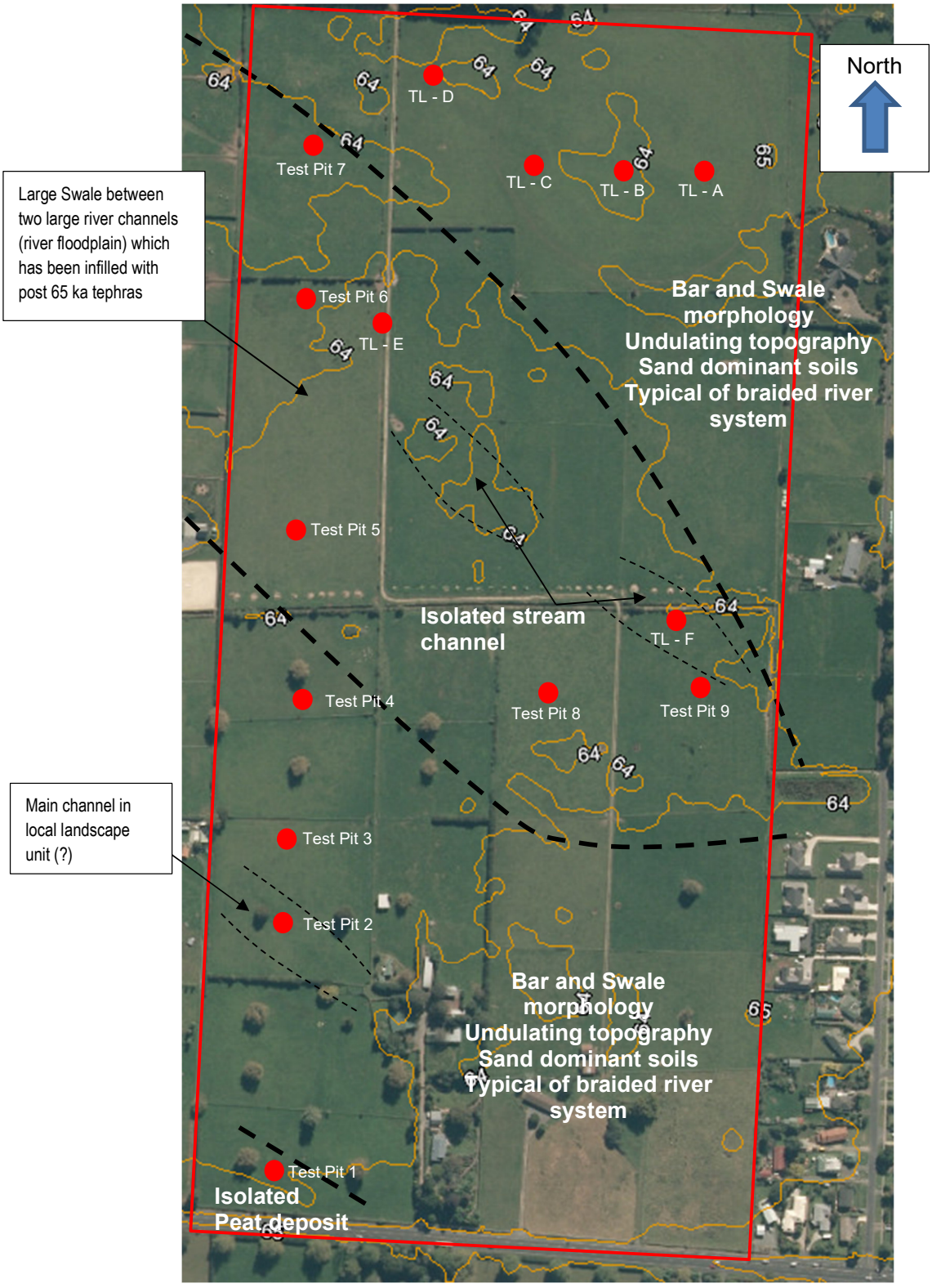


Figure 2.6: Identified Soil-landform of the development site.

2.8 Recoverable Soil for Bulk Earthworks

Based on the landscape model above and the respective inputs, a summary table showing the depth to the 'pit sand' layer and unrecoverable/recoverable soils from the upper Phase Two Hinuera Formation deposit has been presented in Table 2.20 (overleaf). Reference should be made to the Test Pit logs in Appendix A.2 for a full description of the soils encountered in each test put and the individual assessment of that soils suitability for re-use.

From Table 2.20, the following can be generally observed:

- The thickness of the Phase Two sediment package is on average 4.0 metres thick (With the top of Phase One Sand 'pit sand' occurring at an average of 4.0 metres below existing ground level (BEGL).
- Within Test Pit 1 there was no recoverable soil other than the pedological soil profile.
- The soil at Test Pit 2 was vertically all recoverable for re-use within the subdivision.
- At Test Pits 4, 5, 7 to 9 the unrecoverable soils occur at the top of the 'Pit Sand' layer.
- Alternating layers of recoverable and non-recoverable soils occur in Test Pit 6, with a recoverable soil splitting the unrecoverable soil layer in Test Pits 3 and 7.
- Once in the 'Pit Sand' layer, the sands extended to a depth of at least 6.0 metres BEGL.
- A preliminary estimate of recoverable soils for reuse in the in the top 4.0 metres of the soil profile is approximately 52%. This estimate was compiled based on test pit logging and should be taken to +/- 25%.
- Some of the shallower silt soils that have been classified as probably suitable to cut to waste may be recoverable with proper drying techniques.

Table 2.20: Summary of Soil Depths, recoverable soils and possible cut to waste soil depths

	Test Pit Number:	1	2	3	4	5	6	7	8	9
	Landform	Peat	River Channel			Swale			Swale	
Hinuera Formation Depositional Unit		[1.2 to 4.0]	None	[1.3 - 2.8] (1.5) [3.8 - 4.4] (0.6)	[2.6 - 3.8] (1.2)	[2.2 - 4.9] (2.7)	[2.6 - 3.9] (1.3)	[2.2 - 3.3] (1.1) [3.6 - 4.6] (1.0)	[1.5 - 4.1](2.6)	[1.6 - 3.6] (2.0)
Phase Two		UR: 2.8 RC: 1.2		UR: 2.1 RC: 2.3	UR: 1.2 RC: 2.6	UR: 2.7 RC: 2.2	UR: 1.3 RC: 3.5	UR: 2.1 RC: 2.5	UR:2.6 RC: 1.5	UR: 2.0 RC: 1.6
Phase One Depth from existing ground level to Phase one Sand (Pit Sand)		-	2.3(1)	4.4	3.8	4.9	4.8	4.6	4.1	3.6

(1) Boundary between phase One and Two deposits difficult to distinguish between in a test pit most likely true boundary at about 4.0 metres
[3.8- 4.4] (1.2) = [depth range] & (thickness) of unrecoverable unit
UR: = Unrecoverable for placed earthfall or of marginal suitability based on test pit observations. Unit in metres of thickness.
RC: = Recoverable soil for subdivision bulk earthfill or topsoil rereading. Unit in metres of thickness.

2.9 Pedological Soils

In general the soil model in Figure 2.5 and the site investigation as part of this report indicates that the soils encountered in this site are either Bruntwood or Horotiu soil series. A picture of which is shown in Figure 2.7.

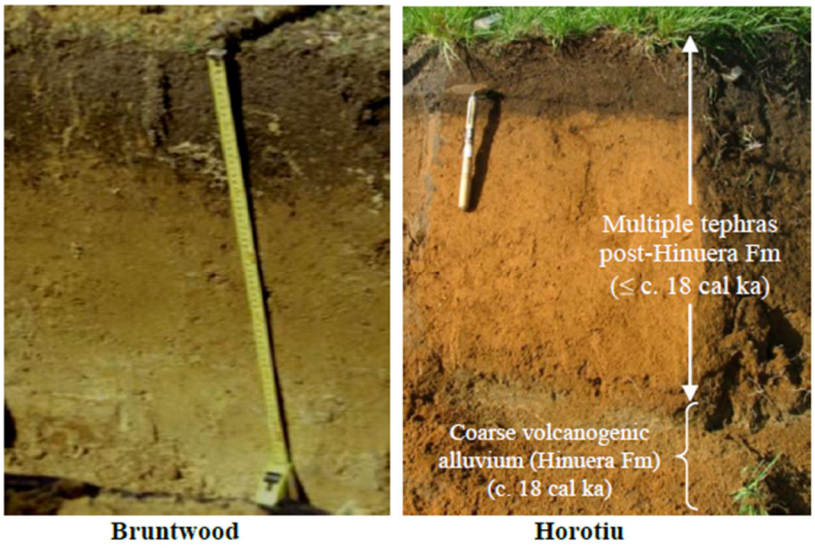


Figure 2.7: Bruntwood and Horotiu soil series (from Lowe 2010).

In general, it is expected that the Horotiu soil will occur more extensively across the development. The average thickness of the Horotiu soil is 0.7 metres with the Bruntwood soil having an average thickness of 0.5 metres.

Should additional pedological soils be required elsewhere in the subdivision, It is recommended that the Horotiu soil be stripped and stockpiled from the area of proposed fill.

2.9.1 Horotiu Soil Properties

Horotiu silt loams have a moderately deep rooting depth and are well drained soils with moderate permeability. Storage of readily available water in the root zone is moderately high. Textures are commonly silt loam on a lower subsoil of sand or gravelly sand. Phosphate retention is high.

The soils are extremely versatile, deep and well drained, and suited to a wide range of uses. With the addition of fertilisers, a wide range of annual and permanent crops are able to be grown, and the soils are highly suitable for horticulture, cropping, pasture and forestry. As these soils dry out in summer, irrigation may be required. The soils excellent physical properties make them of high actual value for food production.

3 LIQUEFACTION ANALYSIS

A liquefaction assessment within the proposed building footprint has been undertaken using a Cone Penetration Tests (CPT) which was undertaken by sub-consultants WSP on the 23rd January 2020 with a design depth of 20.0 metres.

The CPT data has been interpreted in accordance with the MBIE (2015) and MBIE (2016). The raw CPT data was processed using GeoLogismiki Cliq V3.0.3.2 and a directory of these outputs can be found in Table 3.1 and full results in Appendix B.

Please note the final comments regarding site liquefaction vulnerability and site risk as a whole applies to the development generally and can be extrapolated beyond the immediate area of the CPT tests.

3.1.1 Earthquake Design Parameters

In accordance with MBIE 2017, for the design of the proposed subdivision, the following information is provided in Table 3.1, which are the parameters used in the CPT analysis software to determine liquefaction hazard susceptibility potentials.

Table 3.1: Earthquake design parameters for the proposed buildings within the proposed subdivision.

Site seismic classification:	**Class D** (shallow soil sites)
Structure importance level:	**Level 2** (Normal structures)
Peak ground acceleration:	1 in 100-year event: **0.21g**
	1 in 500-year event: **0.25g**
Groundwater Depth:	CPT 1; As-measured: 8.0 m BEGL; EQ **Design: 7.0 m BEGL** CPT 2; As-measured: 2.0 m BEGL; EQ **Design: 6.0 m BEGL** CPT 3; As-measured: 7.3 m BEGL; EQ **Design: 8.0 m BEGL** CPT 4; As-measured: 2.3 m BEGL; EQ **Design: 5.0 m BEGL** CPT 5; As-measured: 7.6 m BEGL; EQ **Design: 6.0 m BEGL** CPT 6; As-measured: 7.0 m BEGL; EQ **Design: 6.0 m BEGL** CPT 7; As-measured: 2.3 m BEGL; EQ **Design: 5.0 m BEGL** CPT 8; As-measured: 2.2 m BEGL; EQ **Design: 6.0 m BEGL** CPT 9; As-measured: 3.5 m BEGL; EQ **Design: 5.0 m BEGL** CPT 10; As-measured: 2.7 m BEGL; EQ **Design: 5.0 m BEGL** CPT 11; As-measured: 6.7 m BEGL; EQ **Design: 5.0 m BEGL**
Depth of CPT testing:	CPT 1: 19.92 m BEGL CPT 2: 19.92 m BEGL CPT 3: 19.92 m BEGL CPT 4: 19.93 m BEGL CPT 5: 19.92m BEGL CPT 6: 19.92m BEGL CPT 7: 19.92m BEGL CPT 8: 19.92m BEGL CPT 9: 19.06m BEGL CPT 10: 19.92m BEGL CPT 11: 19.92m BEGL
Earthquake Magnitude	**5.9**

▪ Groundwater note: Groundwater has been measured from the assumed standing water level. Based on site observations and the Beca groundwater model this has been assumed to be at a level of 6.0 metres BEGL.

3.2 Settlement

3.2.1 Previous Model

The Beca liquefaction reports assumptions did not allow for the addition of filling either controlled or uncontrolled to the soil's profiles. The Beca report identified that:

- Total ground settlement may be up to 75 mm
- Differential settlement may be up to 50 mm due to liquefaction at shallow depth
- Testing Zone Northern has a medium liquefaction vulnerability (based on five CPT test across the area)
- For a 1 in 100-year earthquake event there would be no liquefaction damage
- During a 1 in 500-year earthquake event there would be minor to moderate liquefaction damage

3.2.2 Site Specific Testing

In accordance with MBIE 2017 (Section 3) the proposed earthquake return periods for a damage causing earthquake has been analysed and are presented in Table 3.2 (1 in 100 year event) and Table 3.3 (1 in 500 year event), full results can be found in Appendix B.1 and Appendix B.2 respectively.

Table 3.2: Liquefaction risk and potential settlement for the upper 10 metres of the soil profile 1 in 100 year event (0.21g).

Area	CPT ID	Ground water (m BEGL)	LPI	LPI – Risk	LSN	LSN – Damage	Total settlement (mm)	Differential Settlement (Range – mm)	Degree of liquefaction induced Ground Damage Expected
Central Testing Zone (Southern)	1	10.0	0	Low	1	Little to none	9	7 to 15	None to minor
	2	4.0	0	Low	1	Little to none	11		
	3	10.3	0	Low	3	Little to none	25		
Central Testing Zone (Middle)	4	3.0	0	Low	0	Little to none	0	0 to 7	None to minor
	5	8.6	0	Low	1	Little to none	8		
	6	8.0	0	Low	1	Little to none	10		
Central Testing Zone (Northern)	7	3.0	0	Low	3	Little to none	28	4 to 19	None to minor
	8	4.0	0	Low	1	Little to none	7		
	9	3.0	0	Low	1	Little to none	5		
	10	3.0	0	Low	3	Little to none	28		
Northern Testing Zone	11	6.7	1	Low	6	Little to none	51	up to 34	Minor to moderate

Assumed fill depths used in the model:

CPT 1: 1 metre; CPT 2: 0.5 metres; CPT 6: 1 metre; CPT 11: 1 metre. Elsewhere, fill depth: 0 metres

Table 3.3: Liquefaction risk and potential settlement for the upper 10 metres of the soil profile in 1 in 500 year event (0.25g).

Area	CPT ID	Ground Water (m BEGL)	LPI	LPI – Risk	LSN	LSN – Damage	Total Settlement (mm)	Differential Settlement (Range – mm)	Degree of liquefaction induced Ground Damage Expected
Central Testing Zone (Southern)	1	10.0	0	Low	1	Little to none	19	13 to 19	None to minor
	2	4.0	0	Low	3	Little to none	28		
	3	10.3	1	Low	4	Little to none	35		
Central Testing Zone (Middle)	4	3.0	0	Low	0	Little to none	2	0 to 10	None to minor
	5	8.6	0	Low	3	Little to none	15		
	6	8.0	0	Low	2	Little to none	15		
Central Testing Zone (Northern)	7	3.0	1	Low	5	Little to none	44	8 to 30	None to minor
	8	4.0	1	Low	4	Little to none	31		
	9	3.0	0	Low	2	Little to none	12		
	10	3.0	1	Low	5	Little to none	44		
Northern Testing Zone	11	6.7	2	Low	10	Little to none	75	up to 50	Minor

Assumed fill depths used in the model:

CPT 1: 1 metre; CPT 2: 0.5 metres; CPT 6: 1 metre; CPT 11: 1 metre. Elsewhere, fill depth: 0 metres

Discussion of results

In both cases (the 1 in 100 and 1 in 500 year events) the vertical settlements observed, along with the Liquefaction Potential Index (LPI) and Liquefaction Severity Number (LSN) are all at the less severe end of the damage range spectrum and are consistent with those identified by Beca in their report dated 16 April 2018.

It should be noted that the calculations in Table 3.2 and Table 3.3 have an allowance for filling to the depths shown in the foot notes in the tables.

In the 1 in 100-year case liquefaction analysis, damage and surface expression is thought to be none to minor (refer to Appendix A, page 72 to 87 of MBIE 2017 for pictorial representation of the damage classes). In terms of differential settlement all of Central Testing Zone will be least affected, with no expected liquefaction damage or only relatively minor vertical settlements (in the range of 0 to 19 mm). The Northern Testing Zone in theory, will be the worst affected portion of the development with mild liquefaction damage and relatively minor differential settlement occurring of up to 34 mm of differential settlement being the upper limit for the Northern Testing Zone.

The 1 in 500-year case shows a similar pattern to that calculated in the 1 in 100-year case, however the effects are slightly magnified. No real liquefaction risk was identified in Central Testing Zone (Southern and Middle) (expected differential settlement in the range of 0 to 19 mm), with the effects in Central Testing Zone (Northern) slightly increased as is the differential settlement (typically 8 to 30 mm). Within Northern Testing Zone settlement is calculated to be up to 50mm (based on a single CPT test). The damage is still relatively minor and within the

expected degree of vertical settlement calculated by Beca (Cambridge C1 C2 and C3 Plan Change Liquefaction Hazard Assessment 2018).

The variability across the proposed development is a function of the variable nature of the Hinuera Formation deposition and form (refer to Section 2.3, Hume et al. 1975). As a result, in places outside the testing there could be more or less settlement and or liquefaction that what has been discussed above.

3.3 Subdivisions Liquefaction Vulnerability Category

On the basis of the CPT test within this subdivision and the shallow hand testing methods, the subdivision liquefaction vulnerability category has been measured against Table 4.4 in MBIE (2017).

While the testing has been extensive - it has not been exhaustive - and therefore it is not possible to give a precise classification of the risk. However, it can be said with some certainty that based on the information in Table 3.2 and Table 3.3 **that liquefaction-induced ground damage is unlikely to minor.**

It should be noted that Beca (Cambridge C1 C2 and C3 Plan Change Liquefaction Hazard Assessment 2018) arrived at a classification liquefaction risk of medium liquefaction vulnerability (refer to Table 4.4 in MBIE 2017). This report has arrived at a lower overall site risk on account of:

- Higher density of site-specific testing
- Assumed lower groundwater level
    - Due to the swale lowering perched groundwater levels and calculations working from a lower groundwater level
    - Bulk earthfall increasing (in places) the depth between the groundwater and surface level

As a result of these differences from the Beca classification, this report has arrived at a lower risk profile for the site.

4 PRELIMINARY FOUNDATION RECOMMENDATIONS

This soils investigation has determined that the existing soil conditions across the proposed subdivision does not meet the NZS 3604:2011 definition of 'Good Ground' – 'any soil or rock capable of permanently withstanding an ultimate bearing capacity of 300 kPa, (i.e. an allowable bearing pressure of 100 kPa using a factor of safety of 3.0).' Therefore, an NZS 3604 type foundation will not be appropriate.

However, the soils as presented do allow for the use of either proprietary rib-raft foundation or engineer designed rib raft foundations, subject to the provisions described below.

The tests were conducted during summer in prolonged dry weather condition and therefore the shear vane test results were not considered as the soils are not at its normal or worst soil moisture conditions. These preliminary results will be further confirmed in the site specific detailed geotechnical investigation for each lot in the subdivision

Foundations in Bulk Earth Fill

Depending in the depth of the bulk earth fill and the compaction achieved, it may be possible to use NZS 3604:2011 type foundations. For this to be achieved the bulk earth fill will need to be placed to a minimum of 5 blows per 100 mm on the Scala penetrometer (minimum ultimate bearing capacity of 300 kPa).

Some lots in the proposed development may require recontouring either by cutting or filling during subdivision earthworks to provide recommended final building platform levels. In this case, specific building platform and foundation requirements will be dealt with in more detail at the time of the Subdivision Geotechnical Completion Report when the final development contours are known.

4.1 Raft Foundations

In areas of high risk of differential settlement of high foundation loadings, a gravel raft and waffle raft foundation maybe the most practical option.

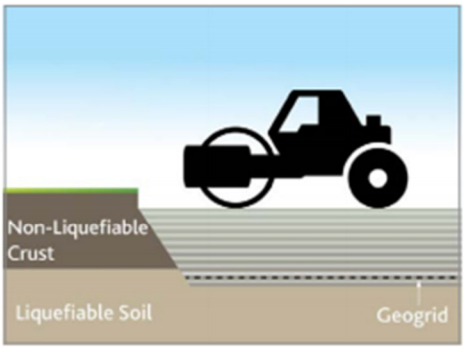
4.2 Subgrade Improvement layers

Where the risk of liquefaction damage with the subdivision is greatest the most practical method to stabilise the subsoil layers, mitigate liquefaction damage and to facilitate relevelling of buildings will be to construct a gravel raft under the foundation and to comply with MBIE TC2 foundation design requirements. Figure 4.1 below, outlines the methods and procedures.

15.3.10.1(b) Type G1d – Reinforced Crushed Gravel Raft

This method provides a geogrid reinforced gravel raft to a depth of 1.2m **beneath the foundation elements**.

Figure 15.11a: Reinforced Crushed Gravel Raft (Type G1d)



The following requirements generally apply:

1. The construction of a dense raft of engineered crushed gravel fill is required to a minimum depth of **1.2m** beneath the foundation elements.
2. The excavation base should extend at least **1m** beyond the footprint of the proposed structure.
3. **Two** layers of geogrid are required in the base of the raft. In areas of 'major' lateral stretch, three layers of geogrid are required.

Figure 4.1: Reinforced gravel raft construction method (MBIE).

4.3 Alternative Foundations

4.3.1 Driven Timber Piles

The alternative method would be to drive timber piles into the dense sand layers under the subdivision expected to be at depths of between 3 to 5 metres BEGL.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Site Suitability

The proposed development site is suitable for the development of a residential subdivision. The site investigation has identified that the development is to be located on soils derived from the Hinuera Formation sediments and in general these soils are more than suitable for the construction of buildings, roads and associated infrastructure. However, it is noted by Hume et al. (1975) and identified in site testing that rapid changes in soil texture can take place over short distances for the site.

5.2 Liquefaction and Differential Settlement

In general, the groundwater depth and soils encountered (at the testing locations) are not anticipated to be prone to liquefaction damage and settlement. However, outside of these testing areas settlement may occur, and the liquefaction effects and vertical settlements may be greater than that described below.

The liquefaction risk within the development has been assessed for the 1 in 100 and 1 in 500-year events as being:

- In both scenarios, liquefaction-induced ground damage is unlikely to minor.
- In a 100-year event differential settlement with a calculated settlement of between 0 to 34 mm may occur across the site.
- For a 500-year event a differential settlement with a calculated settlement of between 0 to 50 mm may occur.

5.3 Foundation Design

The soils encountered generally fall outside the definition of NZS 3604:2011 ‘Good Ground’ which is typical of Hinerura Formation soils. However, the soils as presented do allow for the use of either proprietary rib-raft foundation or engineer designed rib raft foundations.

The excavation of low strength soil and the replacement with subgrade improvement layers may make it possible to construct NZS 3604 type concrete foundations. In the case of larger structures, a reinforced gravel raft may need to be constructed. The reinforced gravel raft may also need to be constructed in areas of higher differential settlement.

Specific testing at the time of Building Consent will confirm the specific foundation requirements for the proposed structure(s).

5.4 Groundwater

Groundwater across the site was assessed to be generally in agreement with the Beca groundwater model. That is, true groundwater at a depth of approximately 8 metres below Existing Ground Level (BEGL). Shallower perched groundwater also occurred at depths of between 2 to 4 metres BEGL across the proposed subdivision. The spatial and temporal extents of these perched groundwater layers was not established but will change as rainfall intensity changes between seasons.

6 APPLICABILITY

Recommendations contained in this report are based on data from boreholes, observation of exposed soil and test results. Inferences about the nature and continuity of subsoils away from these locations are made but cannot be guaranteed.

In all circumstances, if variations in subsoil conditions occur which differ from those described or are assumed to exist, or if unforeseen ground conditions are found from past farming activities, the site should be inspected by a suitably qualified Engineer. The Engineer will make an informed judgement and provide advice on appropriate improvement measures if necessary.

Groundwater, the suitability of the soakage basins proposed, and hydrological changes across the 3MS site post-installation of the stormwater basins is not specifically assessed in this report (by others). It has however assumed that there will be a general lowering of the perched water tables identified at the site for the purposes of the liquefaction analysis completed.

This report has been prepared specifically for the 3MS Development. No responsibility is accepted by BTW Company Ltd for use of any part of this report for other development sites in or around the specific Lots tested, or in any other contexts without BTW's written approval.

REFERENCES

Hume T.M., Sherwood A.M., Nelson C.S.; 1975: Alluvial sedimentology of the Upper Pleistocene Hinuera Formation, Hamilton Basin, New Zealand. Journal of the Royal Society of New Zealand, 41-262:

Kear, D: Schofield, J.C.; Sheet N65 Hamilton (1st Edition) "Geological Map of New Zealand" : 1:63,360. Department of Scientific and Industrial Research Wellington, New Zealand.

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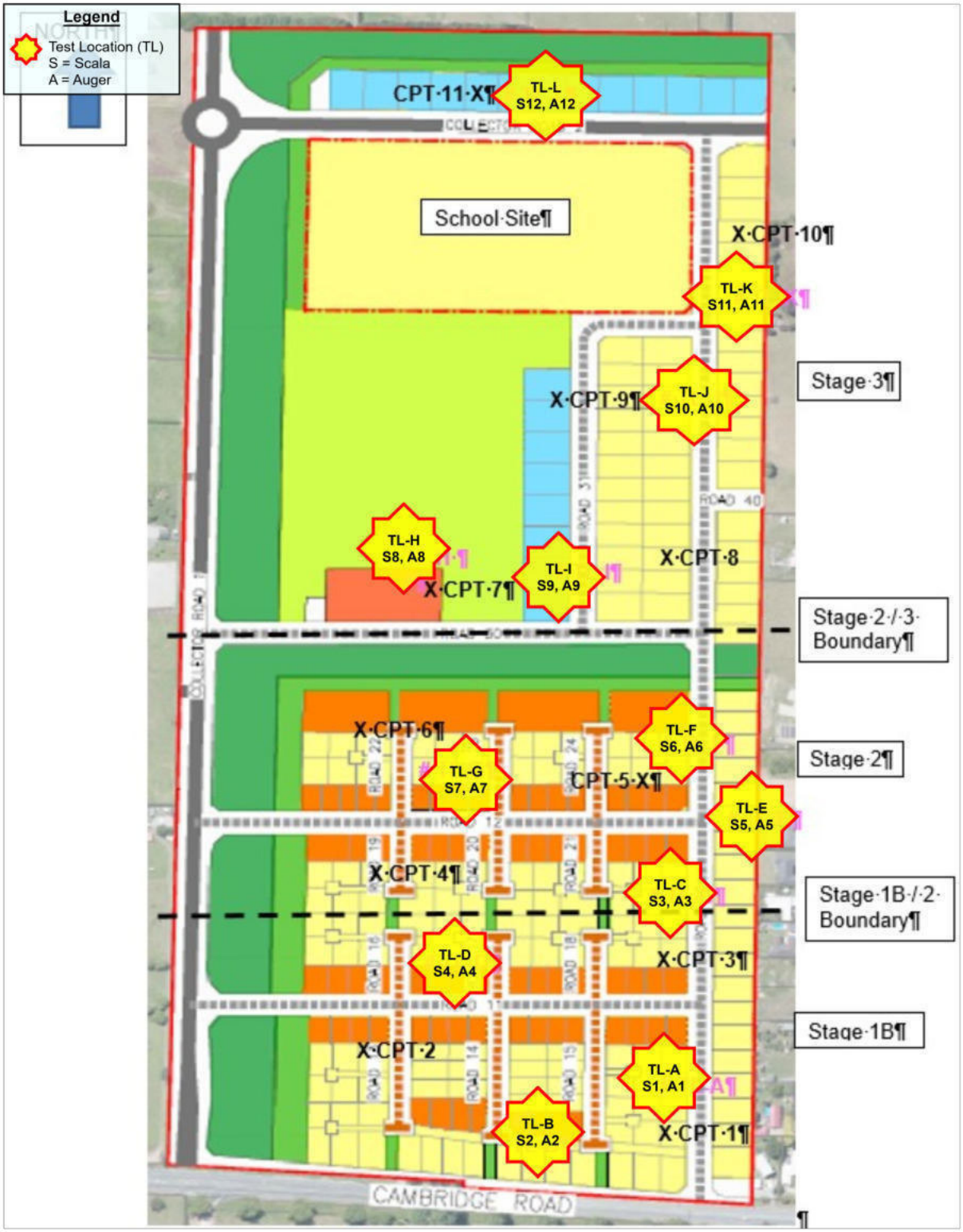
Standards New Zealand; 1989: Code of Practice for earth fill for residential development (NZS 4431:1989). 27p.

APPENDIX A GEOTECHNICAL INFOMATION

A.1 Hand Testing Results (January 2020)

Soil Report

Client:	3MS	**BTW Job No:**	191324
		BTW Project Manager:	Mathew Dickey
Location:	Cambridge Road, Cambridge	**Tested By:**	BGM
Test Date:	22/01/2020		
Description:	Geotechnical Suitability - Hand Testing		



Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

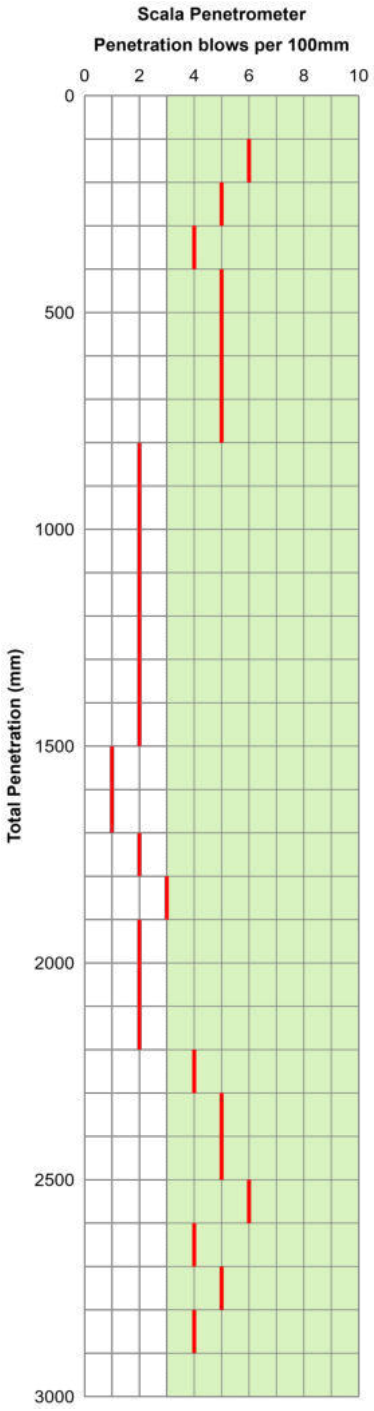
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-A
Scala: S1
Desc: Stage 1B



Test Location: TL-A
Auger: A1
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry brown clayey SILT (HINUERA FORMATION).		
400	Dry yellowish brown clayey SILT.		199.0
500	Becoming clayey SILT with minor fine sand		
800	Dry yellowish brown fine silty SAND.		74.0
900	Dry yellowish brown clayey SILT.		
1000	Dry light grey medium SAND, with some silt.		
1100	Dry light yellowish brown clayey SILT.		
1200	Becoming dry to moist		
1700	End of auger		
1900			
2000			

Soil Report

Client: 3MS

Location: Cambridge Road, Cambridge

Test Date: 22/01/2020

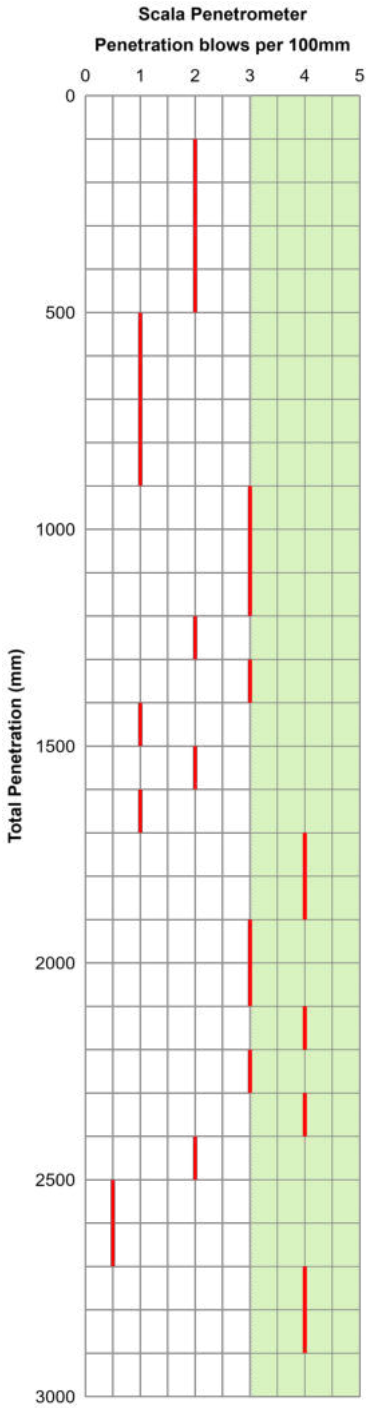
Description: Geotechnical Suitability - Hand Testing

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

Tested By: BGM

Test Location: TL-B
Scala: S2
Desc: Stage 1B



Test Location: TL-B
Auger: A2
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry brown clayey SILT (HINUERA FORMATION).		
500	Dry light grey clayey SILT.		85.0
900	Light grey fine SAND, with some silt.		
1100	Becoming brownish orange		
1200	Dry light grey clayey SILT dilatant.		
1700	Moist greyish brown clayey SILT dilatant.		
1900	Moist light grey SILT, with some fine sand.		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

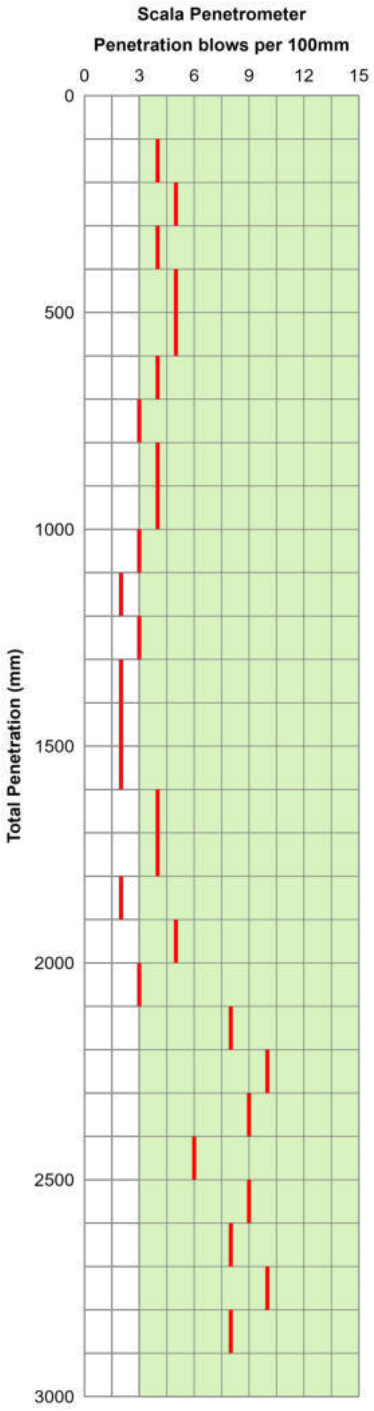
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-C
Scala: S3
Desc: Stage 2



Test Location: TL-C
Auger: A3
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry brown clayey SILT (HINUERA FORMATION).		
300	Dry yellowish brown clayey SILT.		131.0
500			
900	Dry light grey clayey SILT.		
1000	Dry brownish orange fine sandy SILT.		171.0
1100	Dry light grey fine SAND, with some silt.		
1300	Becomig moist to wet & slightly iron stained		
1500	Dry yellowish brown clayey SILT.		
1600	Moist light grey fine silty SAND slightly iron stained.		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

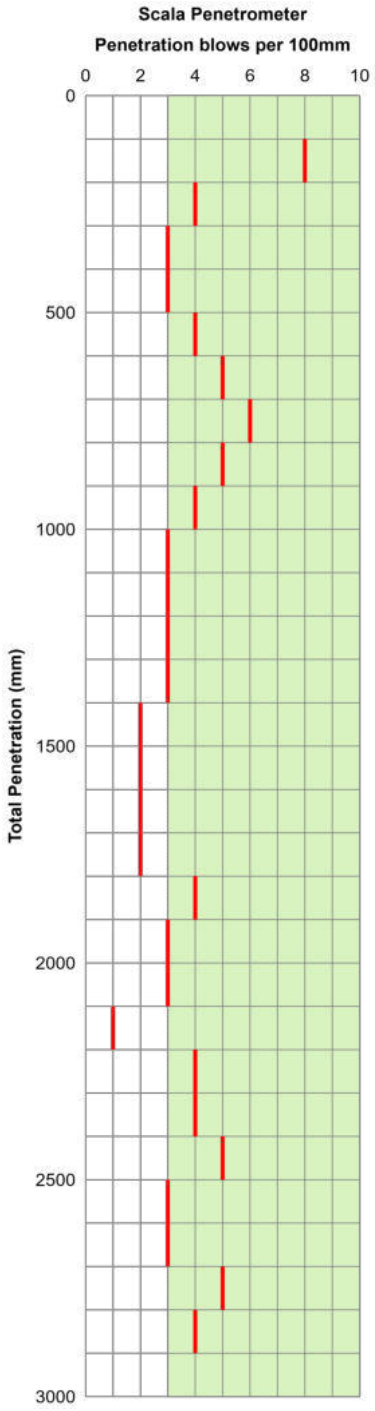
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-D
Scala: S4
Desc: Stage 1B



Test Location: TL-D
Auger: A4
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry brownish orange clayey SILT (HINUERA FORMATION).		
500	Dry light grey clayey SILT.		199.0
700	Becoming light greyish brown		
1000			199.0
1100	Dry light brownish grey fine sandy SILT.		
1400	Dry brownish orange fine silty SAND.		
1600	Becoming moist		
1700	Becoming wet & dilatant		
1800	Wet light brown organic SILT dilatant.		
1900	Wet light brown fine silty SAND.		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

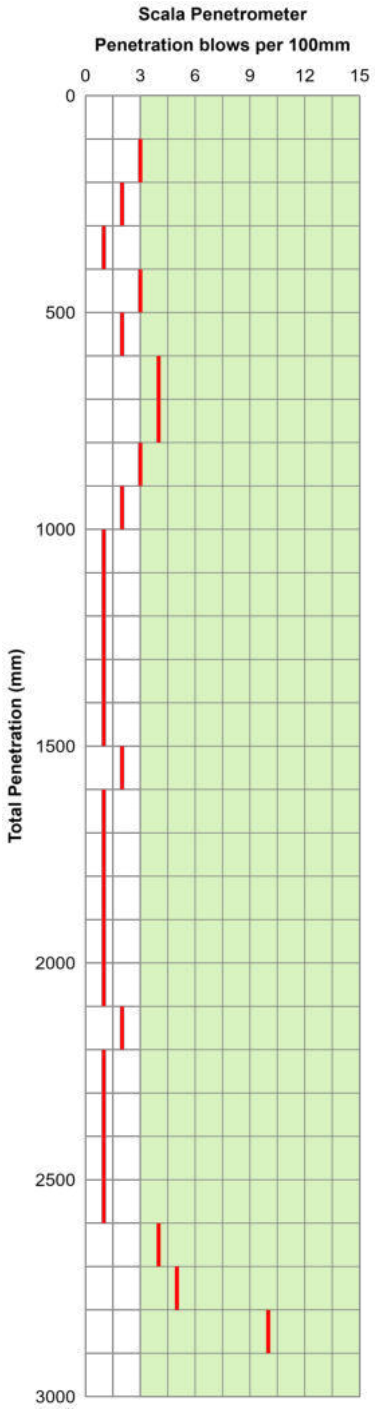
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-E
Scala: S5
Desc: Stage 2



Test Location: TL-E
Auger: A5
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry light brown clayey SILT (HINUERA FORMATION).		
500	Wet grey clayey SILT heavily iron stained.		139.0
700	Dry light grey fine silty SAND moderately iron stained.		
1400	Dry light grey clayey SILT moderately iron stained.		
1600	Becoming moist to wet		
1900	Moist light grey fine silty SAND slightly iron stained.		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

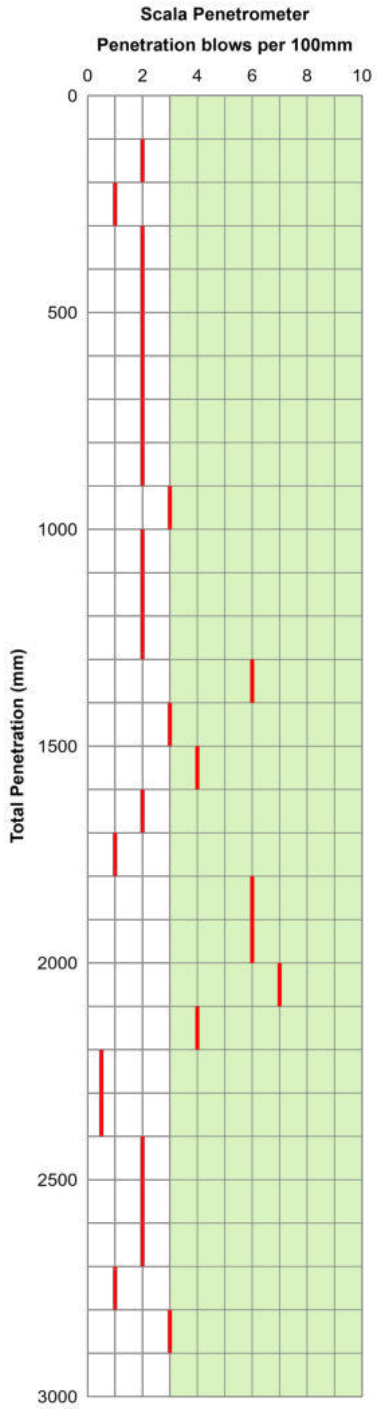
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-F
Scala: S6
Desc: Stage 2



Test Location: TL-F
Auger: A6
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		137.0
100	Dry brown clayey SILT (HINUERA FORMATION).		
200	Dry light yellowish brown clayey SILT moderately iron stained.		
500			
900	Moist light yellowish brown fine silty SAND.		
1100	Moist light grey fine silty SAND.		
1200	Moist light grey clayey SILT.		
1600	Moist light grey fine silty SAND dilatant.		
1800	Moist greenish grey clayey SILT dilatant.		
1900	Moist light grey fine SAND, with some silt.		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

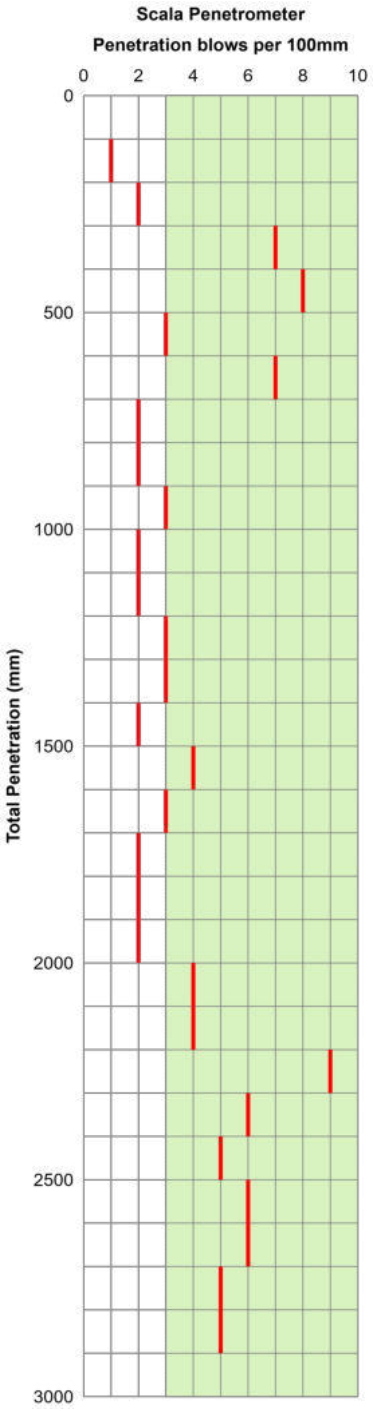
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-G
Scala: S7
Desc: Stage 2



Test Location: TL-G
Auger: A7

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry reddish brown clayey SILT moderately iron stained (HINUERA FORMATION).		199.0
500	Becoming moist with moderate iron staining and many manganese nodules		
700			
900	Moist reddish brown fine silty SAND.		
1300	Becoming brown		
1540	Water Table		
1800	Becoming wet and very dilatant		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

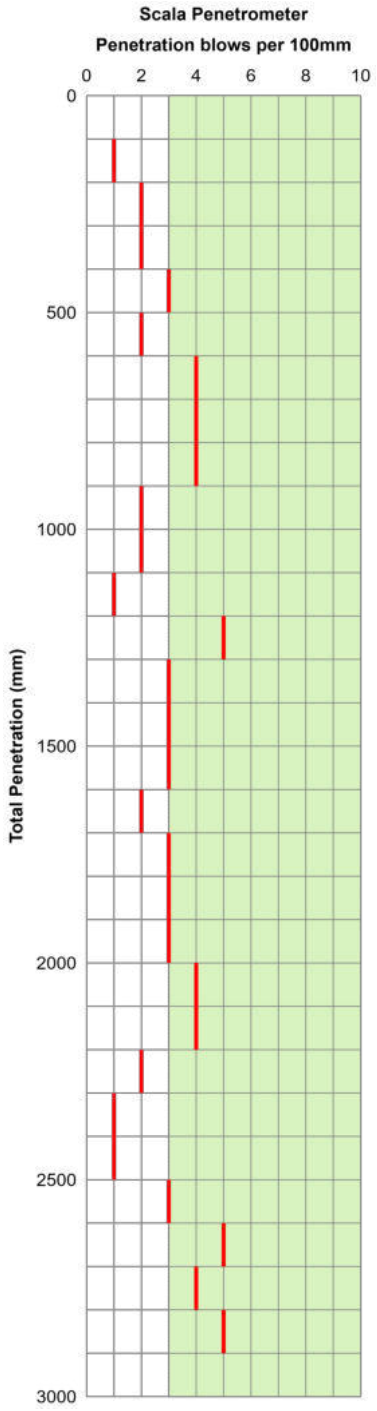
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-H
Scala: S8
Desc: Stage 3



Test Location: TL-H
Auger: A8
Desc: NO Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		159.0
100	Dry reddish brown clayey SILT heavily iron stained (HINUERA FORMATION).		
500	Dry yellowish brown clayey SILT moderately iron stained.		
700	Dry brownish orange fine silty SAND.		
1000	Dry light brown clayey SILT many manganese nodules.		
1200	Moist light grey fine silty SAND.		
1700	Becomes wet, some fine gravels and slightly dilatant		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

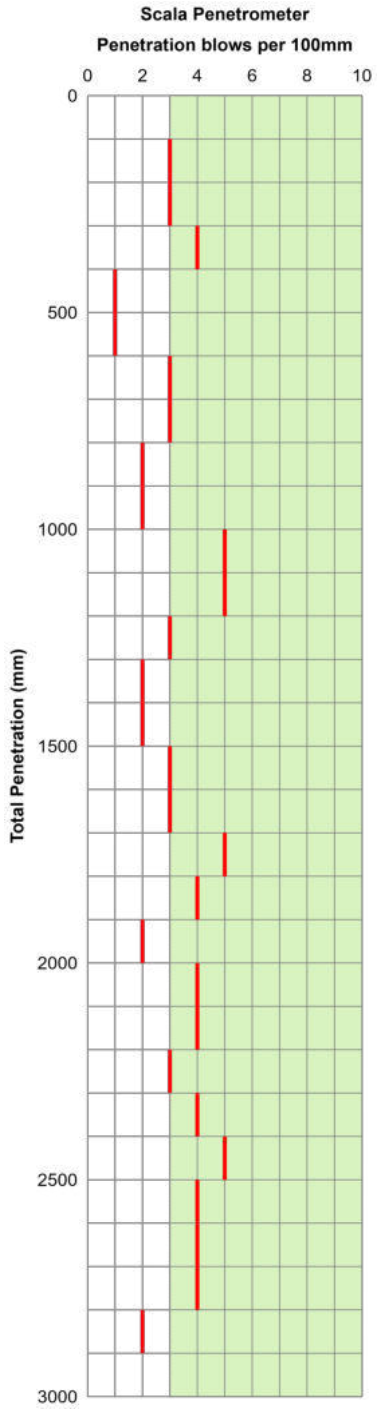
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-I
Scala: S9
Desc: Stage 3



Test Location: TL-I
Auger: A9
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry brown clayey SILT (HINUERA FORMATION).		
200	Dry light grey clayey SILT.		
500	Dry light grey fine SAND, with some silt.		199.0
600	Dry brown fine sandy SILT.		
800	Dry light grey fine SAND, with some silt.		
1000	Moist light grey fine sandy SAND.		
1400	Moist greenish grey clayey SILT.		
1800	Moist light yellowish brown medium silty SAND.		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

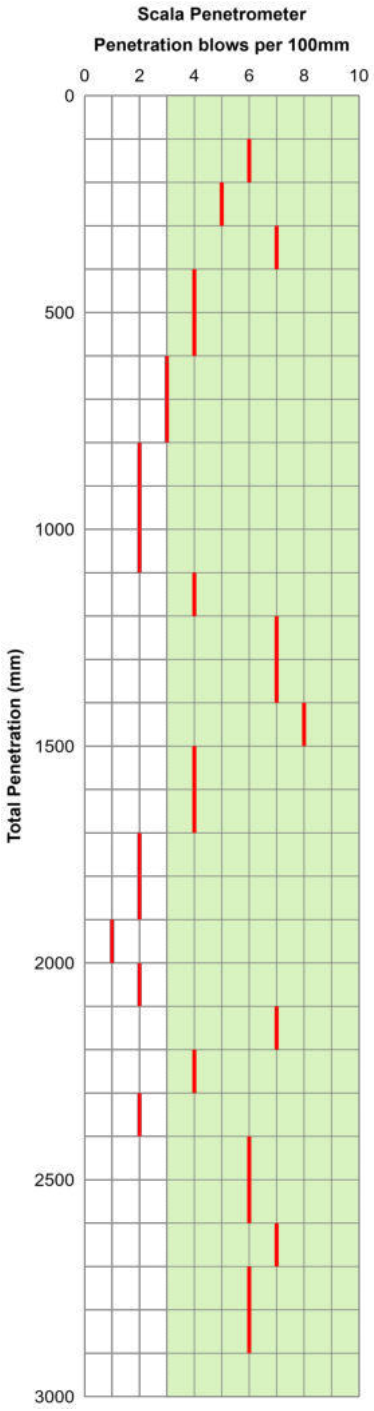
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-J
Scala: S10
Desc: Stage 3



Test Location: TL-J
Auger: A10
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		105.0
100	Dry brown clayey SILT (HINUERA FORMATION).		
200	Dry light grey clayey SILT.		
500	Dry light grey fine silty SAND.		
1000	Moist light grey fine silty SAND.		
1100	Moist light grey fine sandy SILT.		
1400	Moist light yellowish brown fine silty SAND.		
1700	Moist light grey fine sandy SILT dilatant.		
1800	Moist light greyish brown clayey SILT dilatant.		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

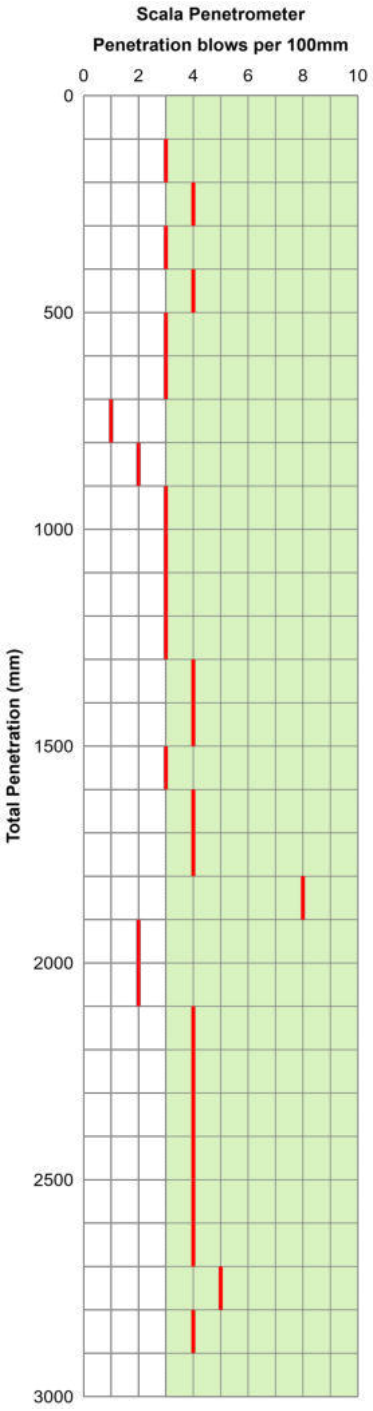
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-K
Scala: S11
Desc: Stage 3



Test Location: TL-K
Auger: A11
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	TOPSOIL.		
100	Dry yellowish brown clayey SILT (HINUERA FORMATION), with minor fine sand.		77.0
800	Dry yellowish brown medium SAND, with some silt.		
1200	Becoming brownish orange		
1400	Becoming moist		
1700	Becoming light yellowish brown with minor fine to medium gravel		
2000	End of auger		

Soil Report

Client: 3MS

BTW Job No: 191324

BTW Project Manager: Mathew Dickey

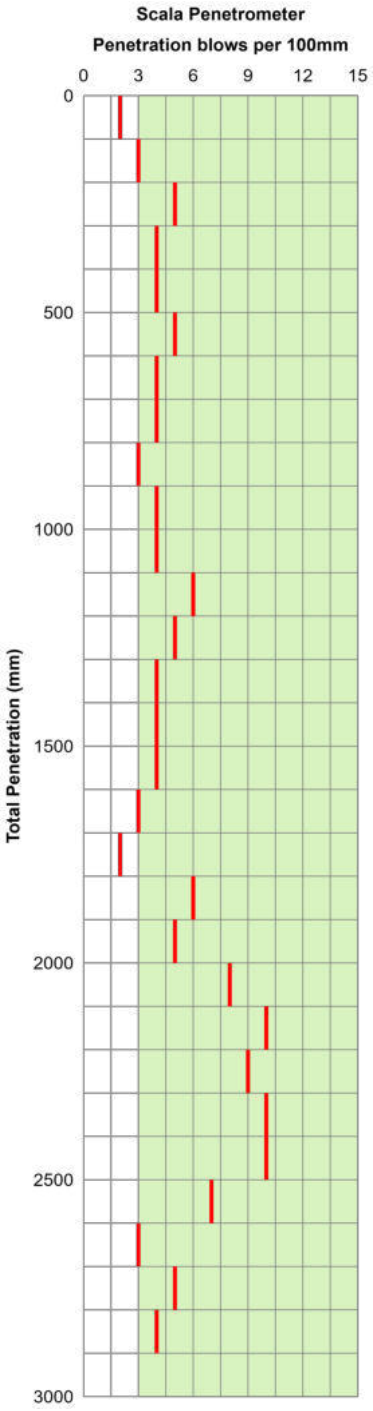
Location: Cambridge Road, Cambridge

Tested By: BGM

Test Date: 22/01/2020

Description: Geotechnical Suitability - Hand Testing

Test Location: TL-L
Scala: S12
Desc: Stage 3



Test Location: TL-L
Auger: A12
Desc: No Groundwater Encountered

Depth (mm)	Description	Log	Shear Vane kPa
0	Dry yellowish brown clayey SILT.		142.0
500			
600	Wet yellowish brown SILT, with some fine sand.		
1100	Dry yellowish brown medium SAND, with some silt, with fine gravel.		
1400			

Unable to recover sample

A.2 Test Pit Logs

Test Pit No. 1		
Client: 3MS		**Address:** Cambridge Road Cambridge
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 1 test location in Central Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.4	clayey SILT	Site Topsoil or pit sand binder	No
0.4 to 1.2	Alternating SILT/ SAND sequence	Pit sand binder	No
1.2 to 4.0	Organic SILT, dilatant SILT	uncontrolled Filling where site 'pit sand' is won	Probable

Groundwater
Groundwater Seeping from face at a depth of: 1.2 to 1.4 metres BEGL

Landscape Location and Pedological Soil Type
Waikato landscape unit position (based on Lowe 2010): Swale?
Soil (pedological) classified as: -

Test Pit No. 2		
Client: 3MS		**Address:** Cambridge Road Cambridge
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 4 test location in Central Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.8	clayey SILT	Site Topsoil or pit sand binder	No
0.8 to 2.3	Alternating SILT/ SAND sequence	Pit sand binder Contains Iron Pan @ 2.3 m	No Probable
2.3 to 6.0	medium to coarse Sand with minor silt	Site fill as 'Pit Sand'	No

Groundwater
Groundwater Seeping from face at a depth of: 2.2 to 2.6 metres BEGL

Waikato landscape unit position (based on Lowe 2010): low mound (former river channel)
Soil (pedological) classified as: Horotiu silt loam

Test Pit No. 3		
Client: 3MS	**Address:** Cambridge Road Cambridge	
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 6 test location in Central Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.8	clayey SILT	Site Topsoil or pit sand binder	No
0.8 to 1.3	clayey SILT	Pit sand binder	No
1.3 to 2.8	clayey SILT	uncontrolled Filling where site 'pit sand' is won	Probable
2.8 to 3.8	silty fine SAND	Pit sand binder	No
3.8 to 4.4	Iron pan over clayey SILT	uncontrolled Filling where site 'pit sand' is won	Probable
4.4 to 6.0	medium to coarse Sand with minor silt	Site fill as 'Pit Sand'	No

Groundwater
Groundwater Seeping from face at a depth of: -

Waikato landscape unit position (based on Lowe 2010): low mound (former river channel)
Soil (pedological) classified as: Horotiu silt loam

Test Pit No. 4		
Client: 3MS		**Address:** Cambridge Road Cambridge
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 8 test location in Central Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.6	clayey SILT	Site Topsoil or pit sand binder	No
0.6 to 2.6	Alternating SILT/ SAND sequence	Pit sand binder	No
2.6 to 3.8	Organic SILT, dilatant SILT Iron pan @ 2.7 metres	uncontrolled Filling where site 'pit sand' is won	Probable
3.8 to 6.0	medium to coarse Sand with minor silt	Site fill as 'Pit Sand'	No

Groundwater
Groundwater Seeping from face at a depth of: 2.8 metres BEGL

Waikato landscape unit position (based on Lowe 2010): low mound (former river channel)
Soil (pedological) classified as: Horotiu silt loam

Test Pit No. 5		
Client: 3MS		**Address:** Cambridge Road Cambridge
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 11 test location in Central Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.4	clayey SILT	Site Topsoil or pit sand binder	No
0.2 to 2.2	silty fine SAND	Pit sand binder	No
2.2 to 4.9	Organic SILT, dilatant SILT Iron pan @ 3.8 metres	uncontrolled Filling where site 'pit sand' is won	Probable
4.9 to 6.0	medium to coarse Sand with minor silt	Site fill as 'Pit Sand'	No

Groundwater
Groundwater Seeping from face at a depth of: 2.3 metres BEGL

Waikato landscape unit position (based on Lowe 2010): side of low mound (Swale)
Soil (pedological) classified as: Bruntwood silt loam

Test Pit No. 6		
Client: 3MS		**Address:** Cambridge Road Cambridge
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 14 test location in Central Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.6	clayey SILT	Site Topsoil or pit sand binder	No
0.6 to 2.6	clayey SILT	Pit sand binder	No
2.6 to 3.9	Organic SILT, dilatant SILT Iron pan @ 2.7 metres	uncontrolled Filling where site 'pit sand' is won	Probable
3.9 to 4.8	silty fine SAND	Pit sand binder	No
4.8 to 6.0	medium to coarse Sand with minor silt	Site fill as 'Pit Sand'	No

Groundwater
Groundwater Seeping from face at a depth of: 3.9 metres BEGL

Waikato landscape unit position (based on Lowe 2010): side of low mound (Swale)
Soil (pedological) classified as: Bruntwood silt loam

Test Pit No. 7		
Client: 3MS	**Address:** Cambridge Road Cambridge	
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 16 test location in Central Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.4	clayey SILT	Site Topsoil or pit sand binder	No
0.4 to 2.2	clayey SILT	Pit sand binder	No
2.2 to 3.3	Organic SILT, dilatant SILT Iron pan @ 2.4 to 2.7 metres	uncontrolled Filling where site 'pit sand' is won	Probable
3.3 to 3.6	Sand	Pit sand binder / Site fill	No
3.6 to 4.6	Organic SILT, dilatant SILT 2 x Iron pan horizons	uncontrolled Filling where site 'pit sand' is won	Probable
4.6+	medium to coarse Sand with minor silt	Site fill as 'Pit Sand'	No

Groundwater
Groundwater Seeping from face at a depth of: 3.3 metres BEGL

Waikato landscape unit position (based on Lowe 2010): side of low mound (Swale)
Soil (pedological) classified as: Bruntwood silt loam

Test Pit No. 8		
Client: 3MS		**Address:** Cambridge Road Cambridge
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 21 test location in Eastern Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.6	clayey SILT	Site Topsoil or pit sand binder	No
0.6 to 1.5	silty fine SAND	Pit sand binder	No
1.5 to 2.2	Organic SILT	uncontrolled Filling where site 'pit sand' is won	Probable
2.2 to 4.1	clayey SILT Iron pan @ 4.0 metres	uncontrolled Filling where site 'pit sand' is won	Probable
4.1 to 5.1	silty fine SAND	Pit sand binder	No

Groundwater
Groundwater Seeping from face at a depth of: 3.8 metres BEGL

Waikato landscape unit position (based on Lowe 2010): side of low mound (Swale)
Soil (pedological) classified as: Horotiu silt loam

Test Pit No. 9		
Client: 3MS	**Address:** Cambridge Road Cambridge	
Date of Test pit: 8 July 2020	**BTW Job No:** 191324	**Inspected by:** BGM
Location of Test Pit: Adjacent to Beca CPT 23 test location in Eastern Swale		

Photo of Test Pit



Soil Log and Description			
Depth (m) BEGL	Soil Description	Use	Cut to Waste
0 to 0.6	clayey SILT	Site Topsoil or pit sand binder	No
0.6 to 1.6	silty fine SAND	Pit sand binder	No
1.6 to 3.1	Organic SILT	uncontrolled Filling where site 'pit sand' is won	Probable
3.1 to 3.6	clayey SILT Iron pan @ 3.1 metres	uncontrolled Filling where site 'pit sand' is won	Probable
3.6 to 3.9	medium SAND with minor silt	Pit sand binder	No

Groundwater
Groundwater Seeping from face at a depth of: 3.9 metres BEGL

Waikato landscape unit position (based on Lowe 2010): side of low mound (Swale)
Soil (pedological) classified as: Bruntwood silt loam

APPENDIX B CPT TEST RESULTS

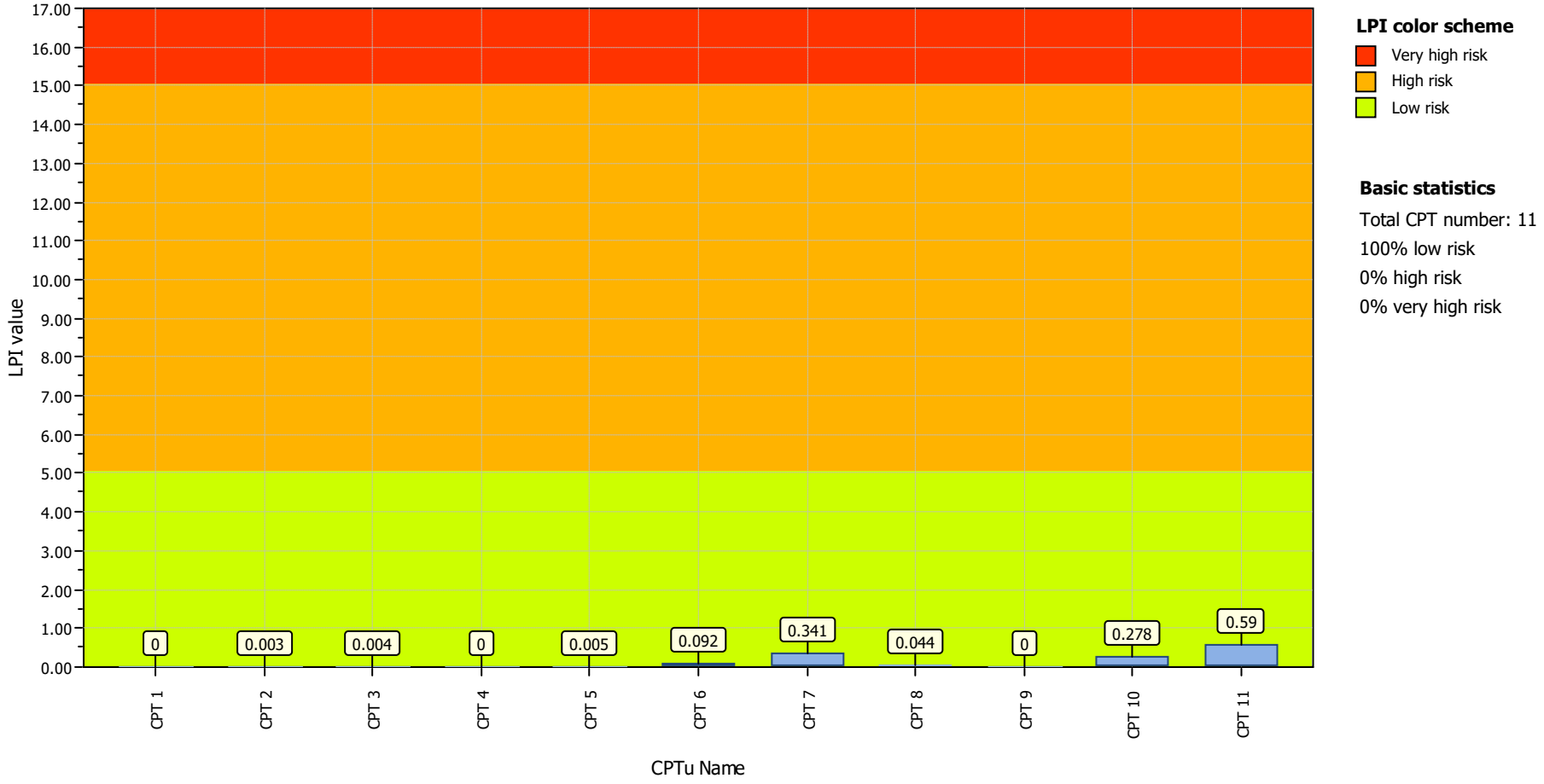
B.1 1 in 100-year results

BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

Project title : 3MS Geotechnical Suitability Investigation - Liquefaction Analysis

Location : Cambridge Road, Cambridge

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

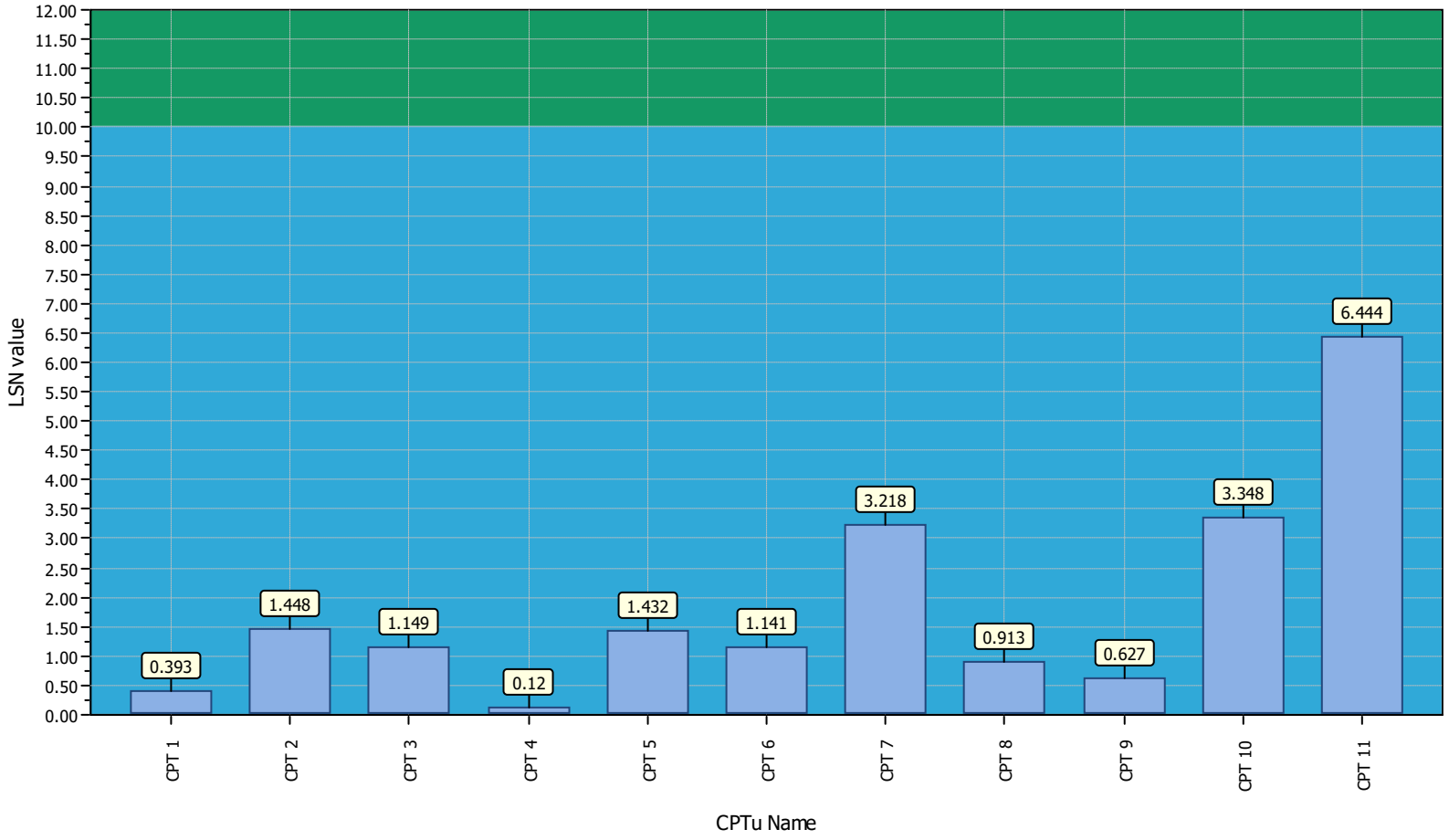
Total CPT number: 11
100% low risk
0% high risk
0% very high risk

BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

Project title : 3MS Geotechnical Suitability Investigation - Liquefaction Analysis

Location : Cambridge Road, Cambridge

Overall Liquefaction Severity Number report



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

Basic statistics

Total CPT number: 11

100% little liquefaction

0% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

0% severe liquefaction

BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

Project title : 3MS Geotechnical Suitability Investigation - Liquefaction Analysis

Location : Cambridge Road, Cambridge

Overall vertical settlements report

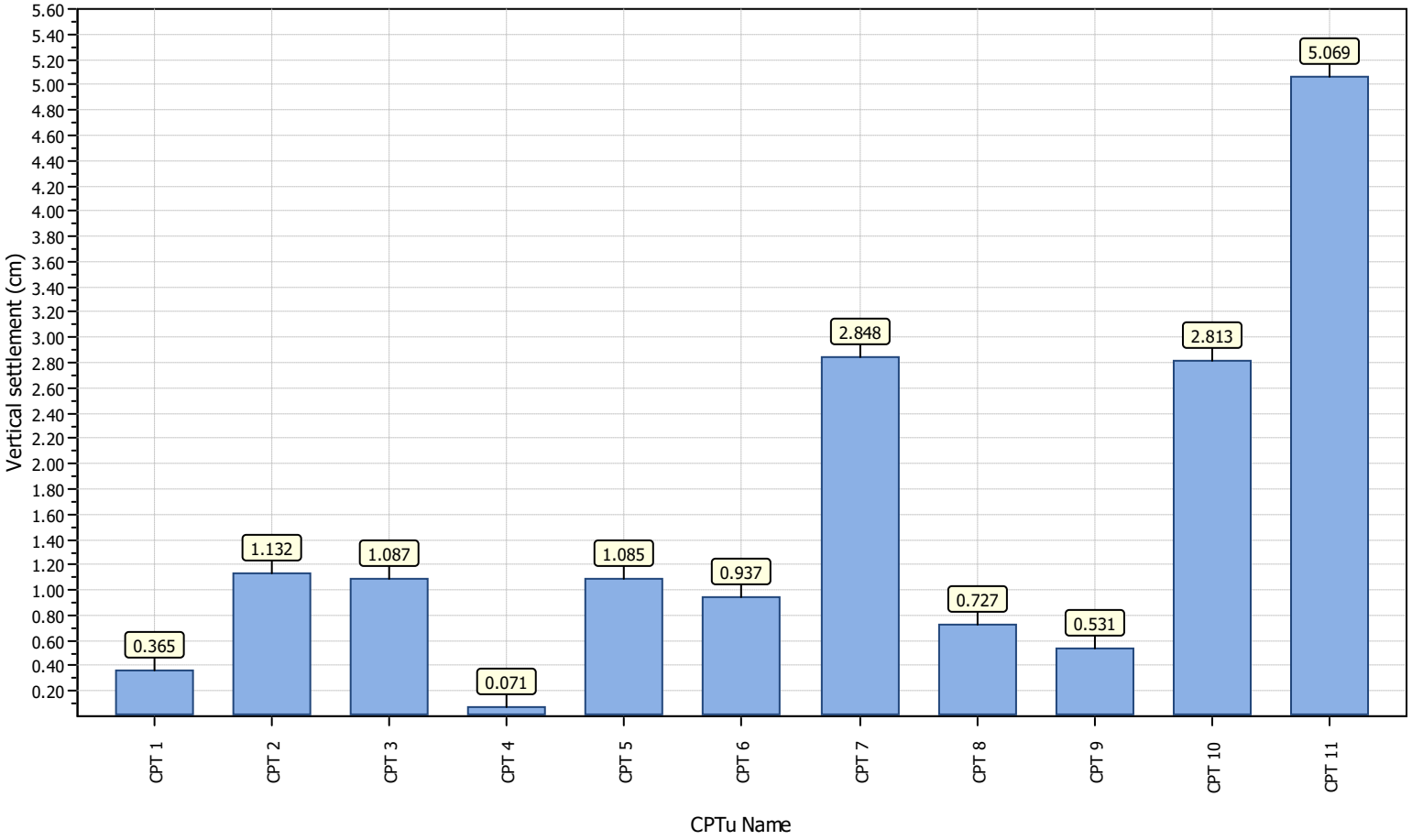


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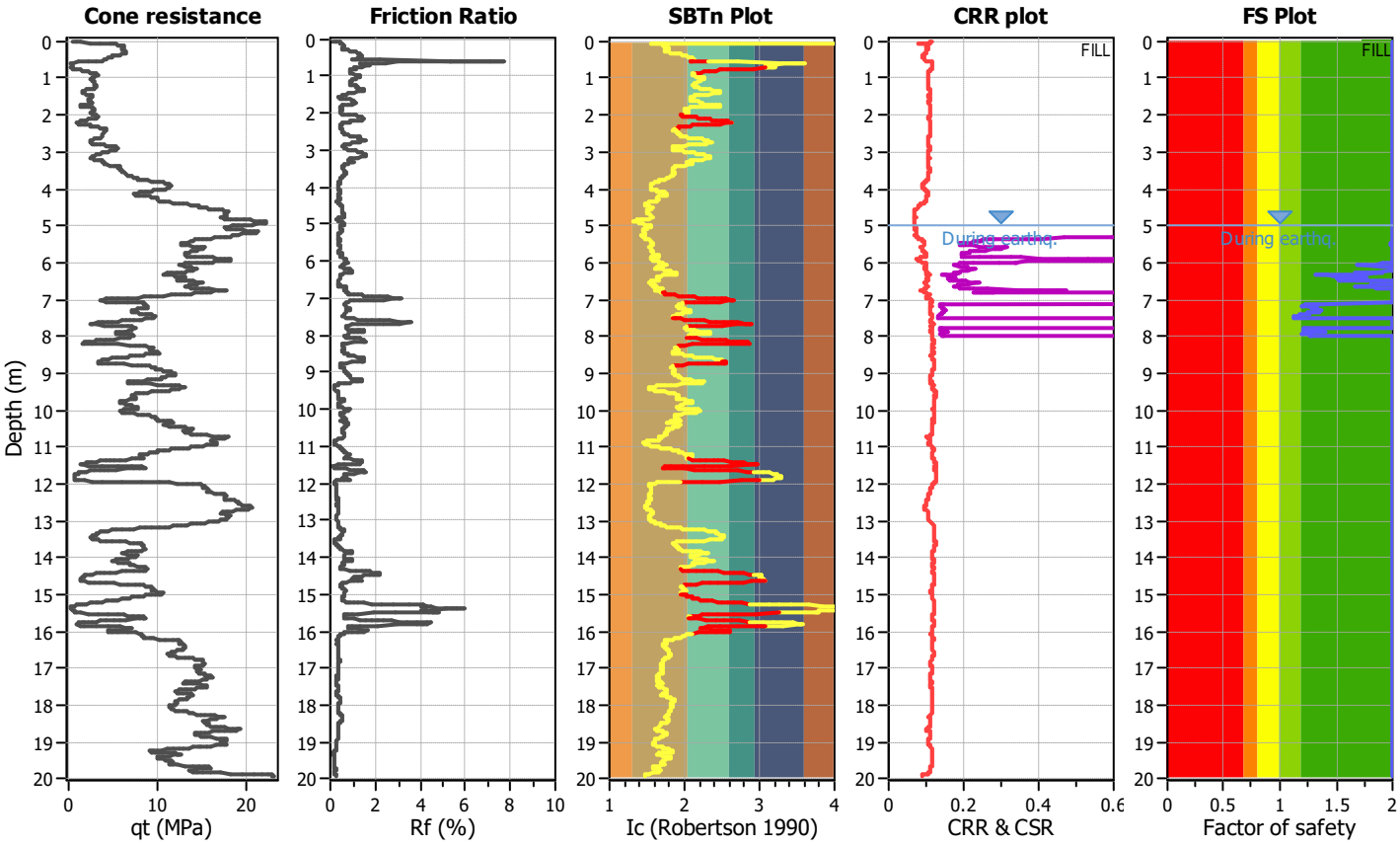
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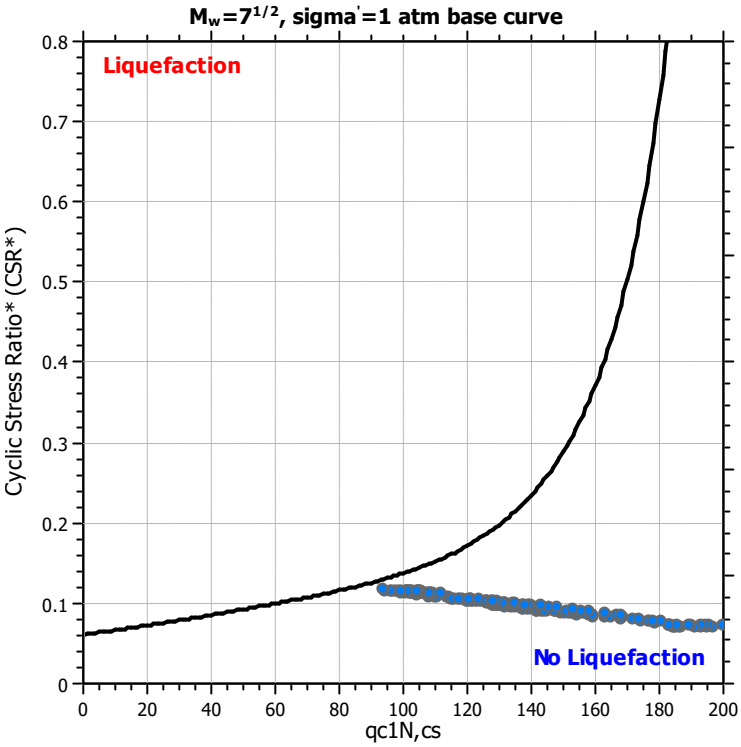
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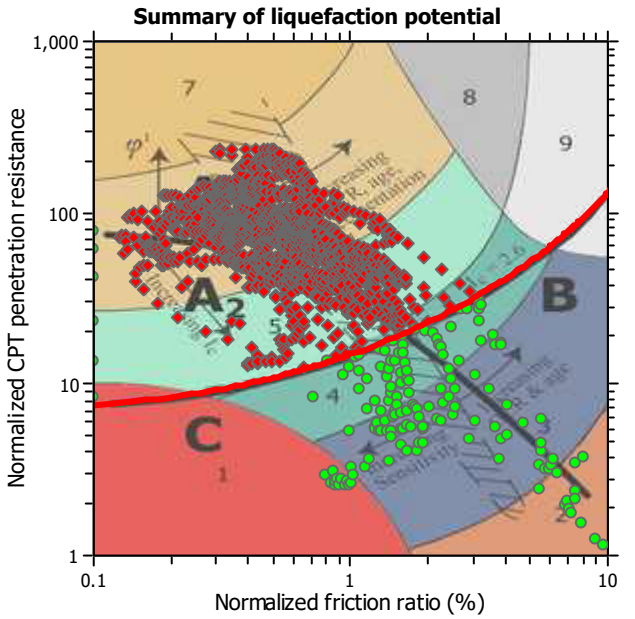
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	8.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	7.00 m	Fill height:	2.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

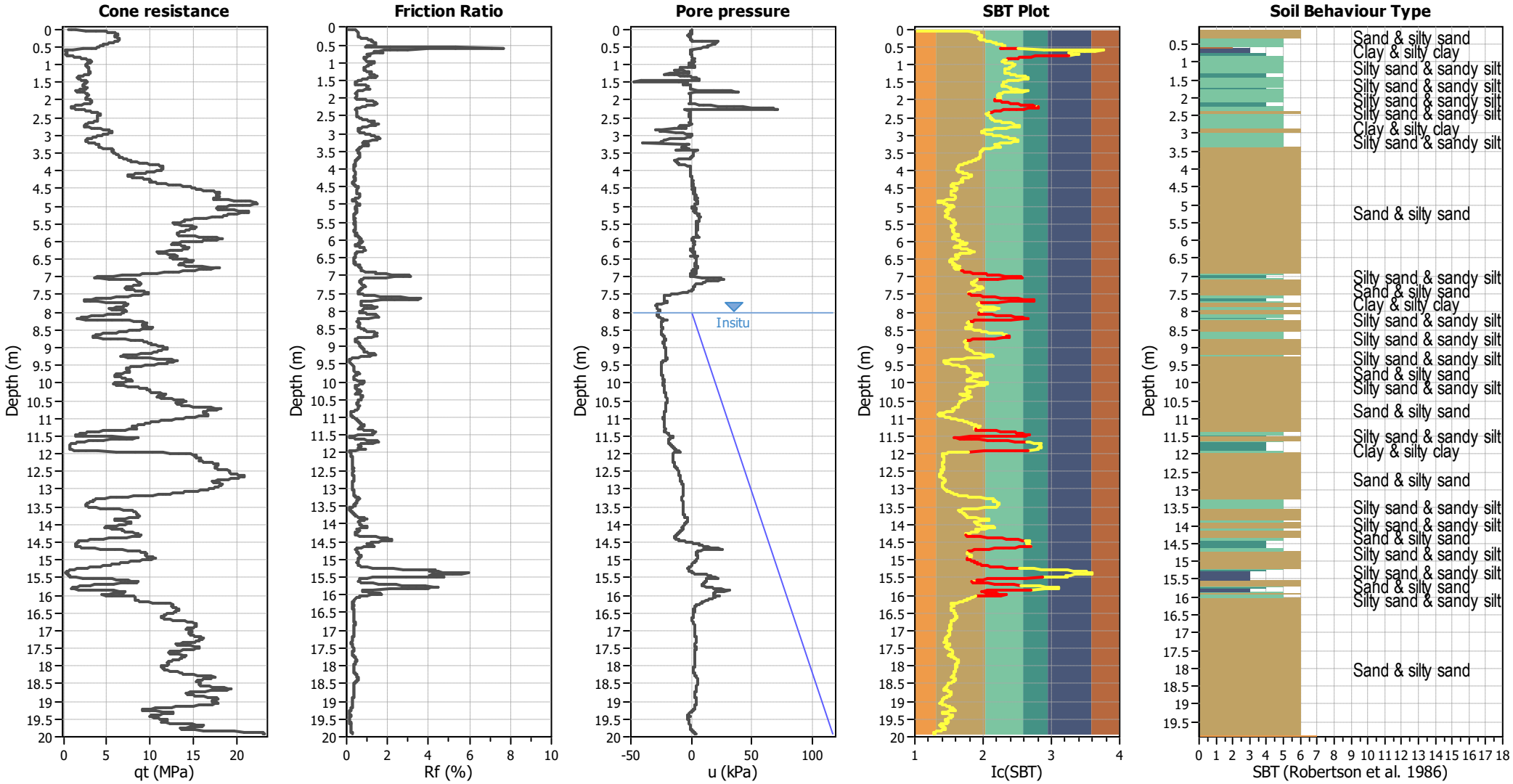






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



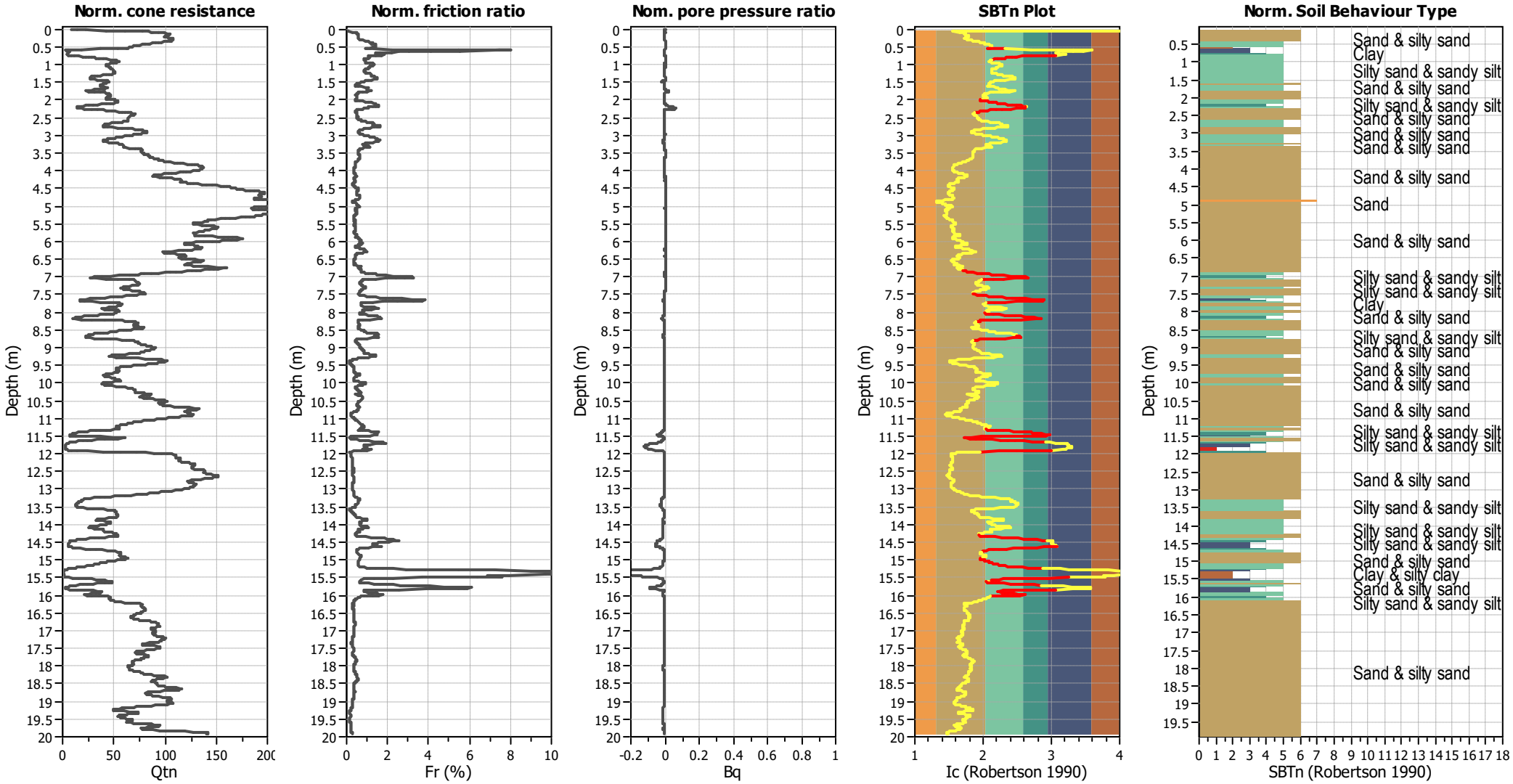
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



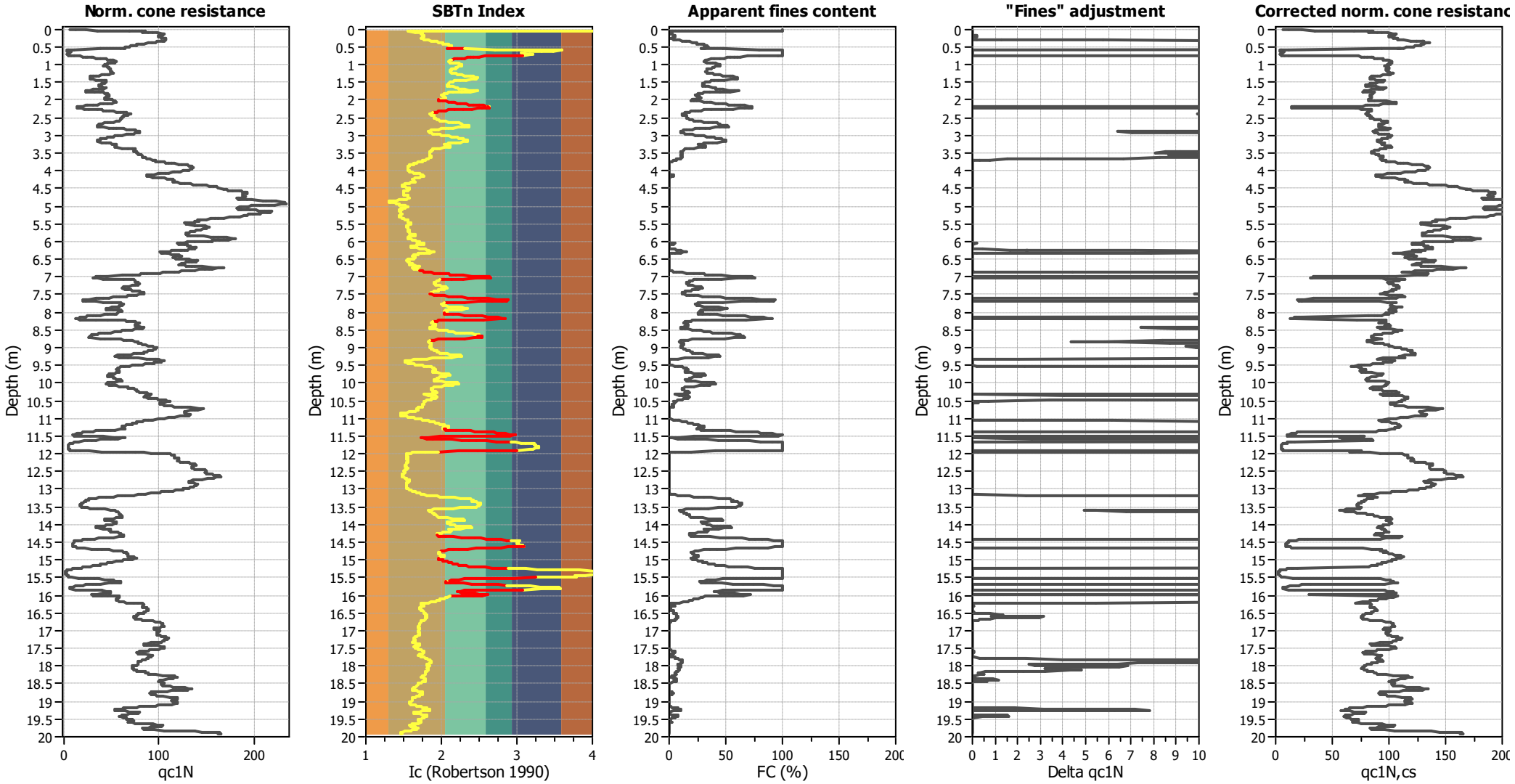
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

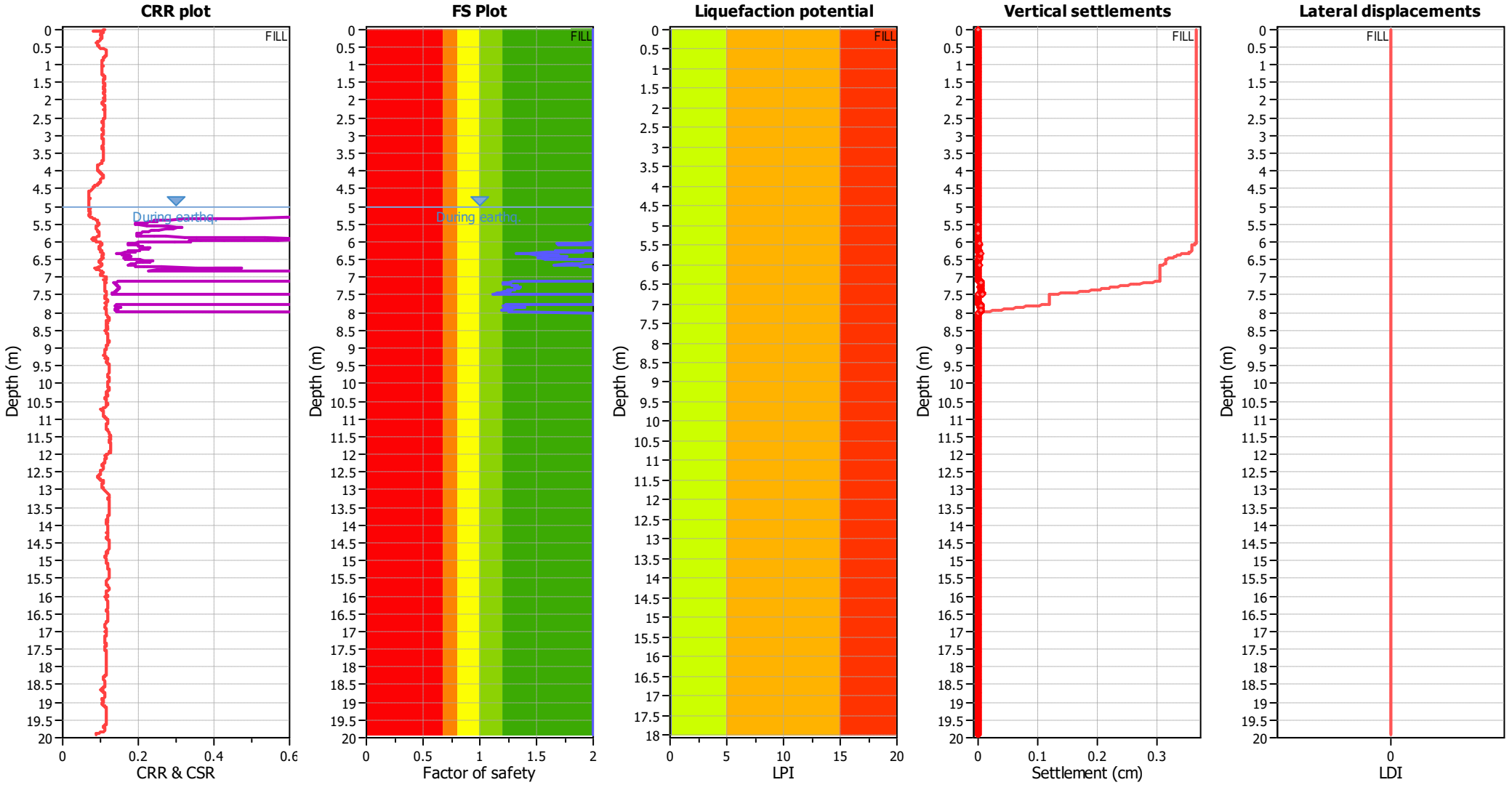
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

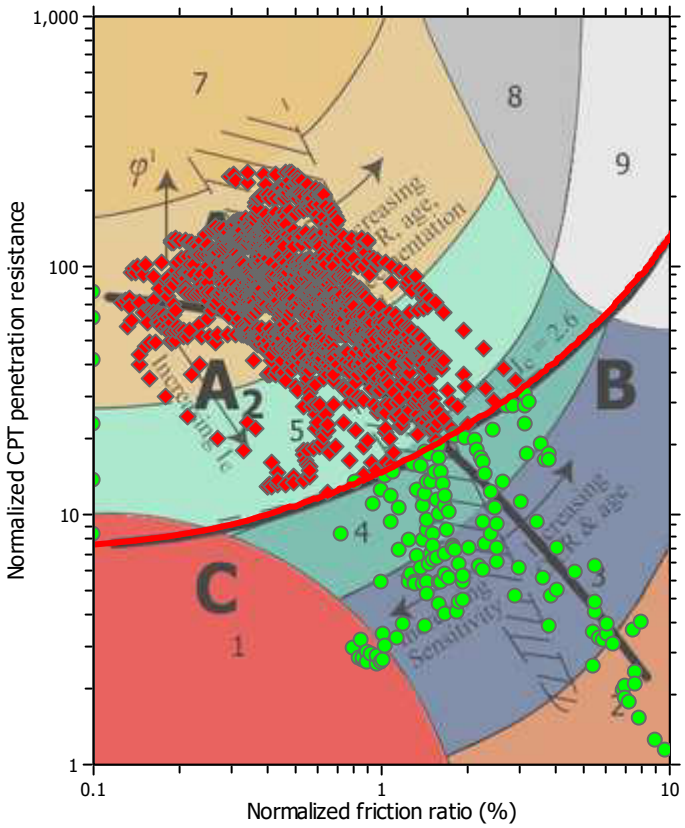
F.S. color scheme

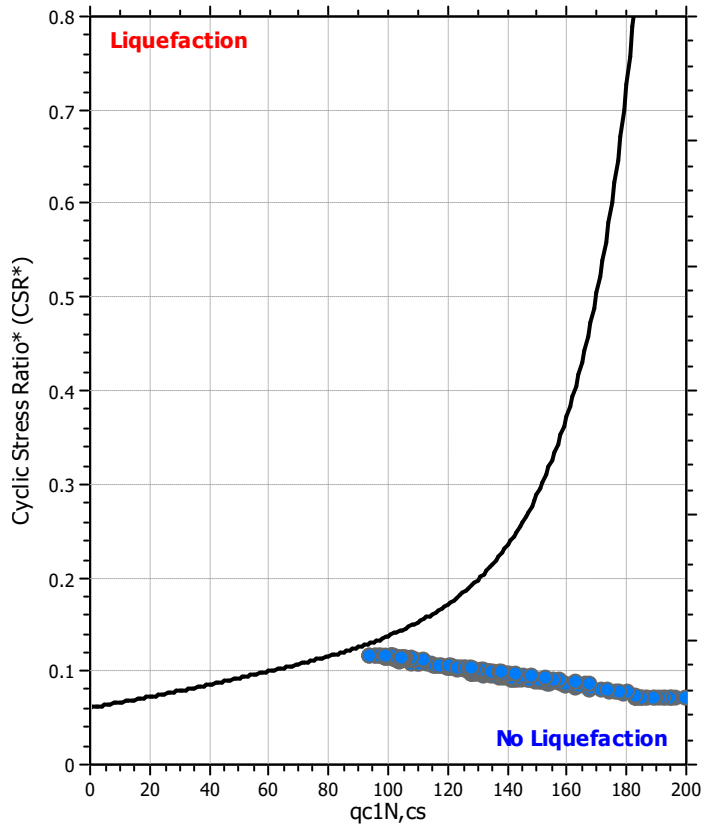
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

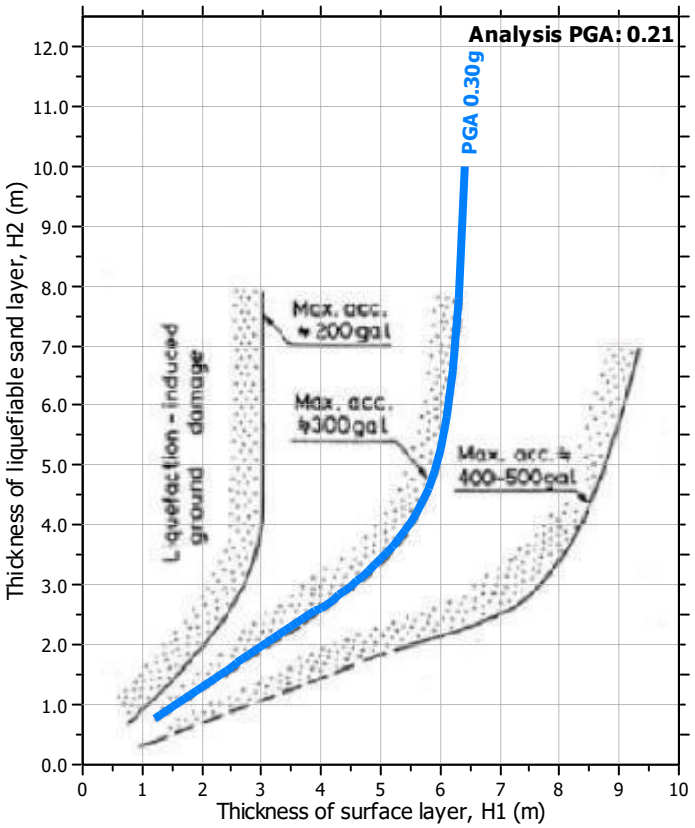
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



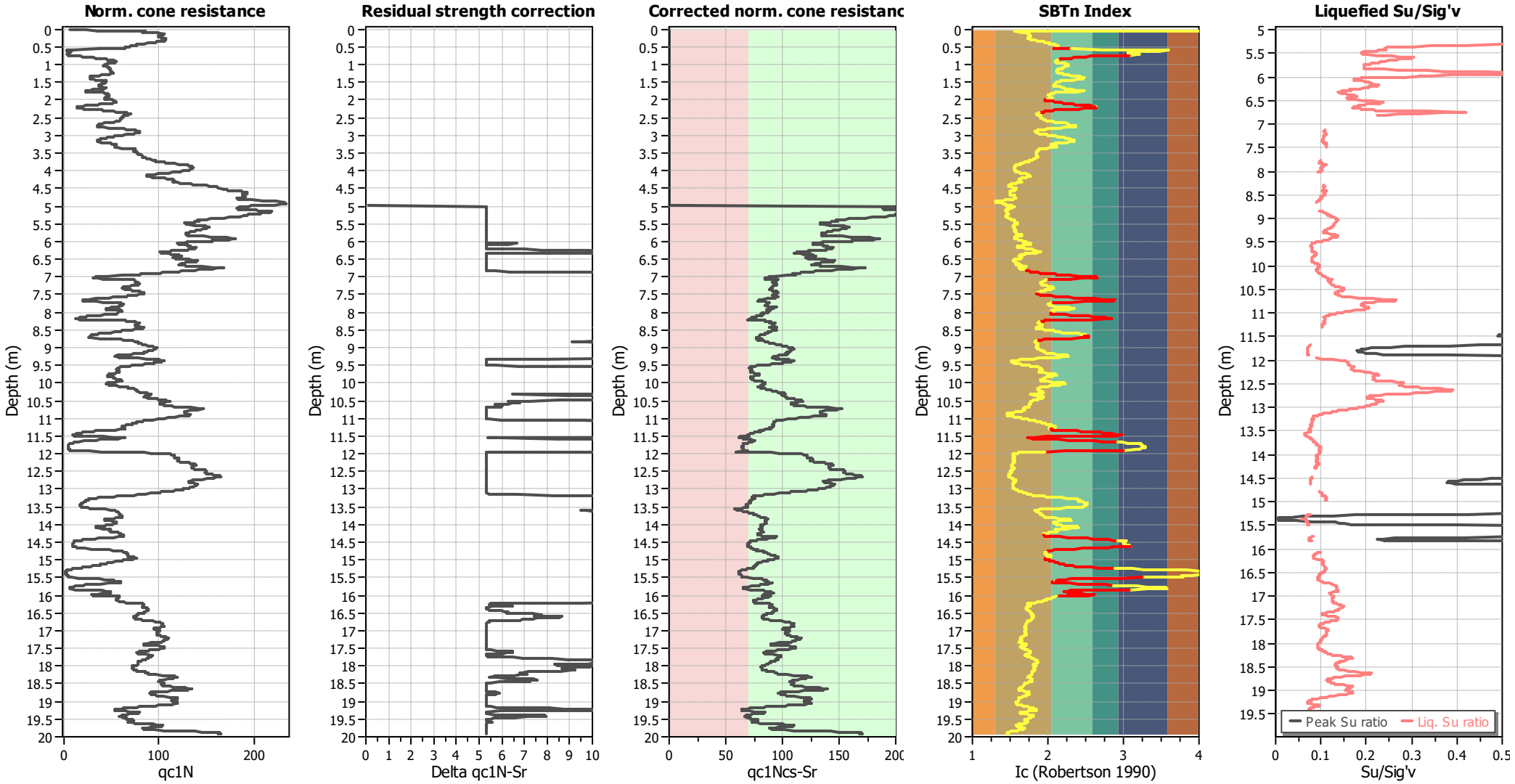




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

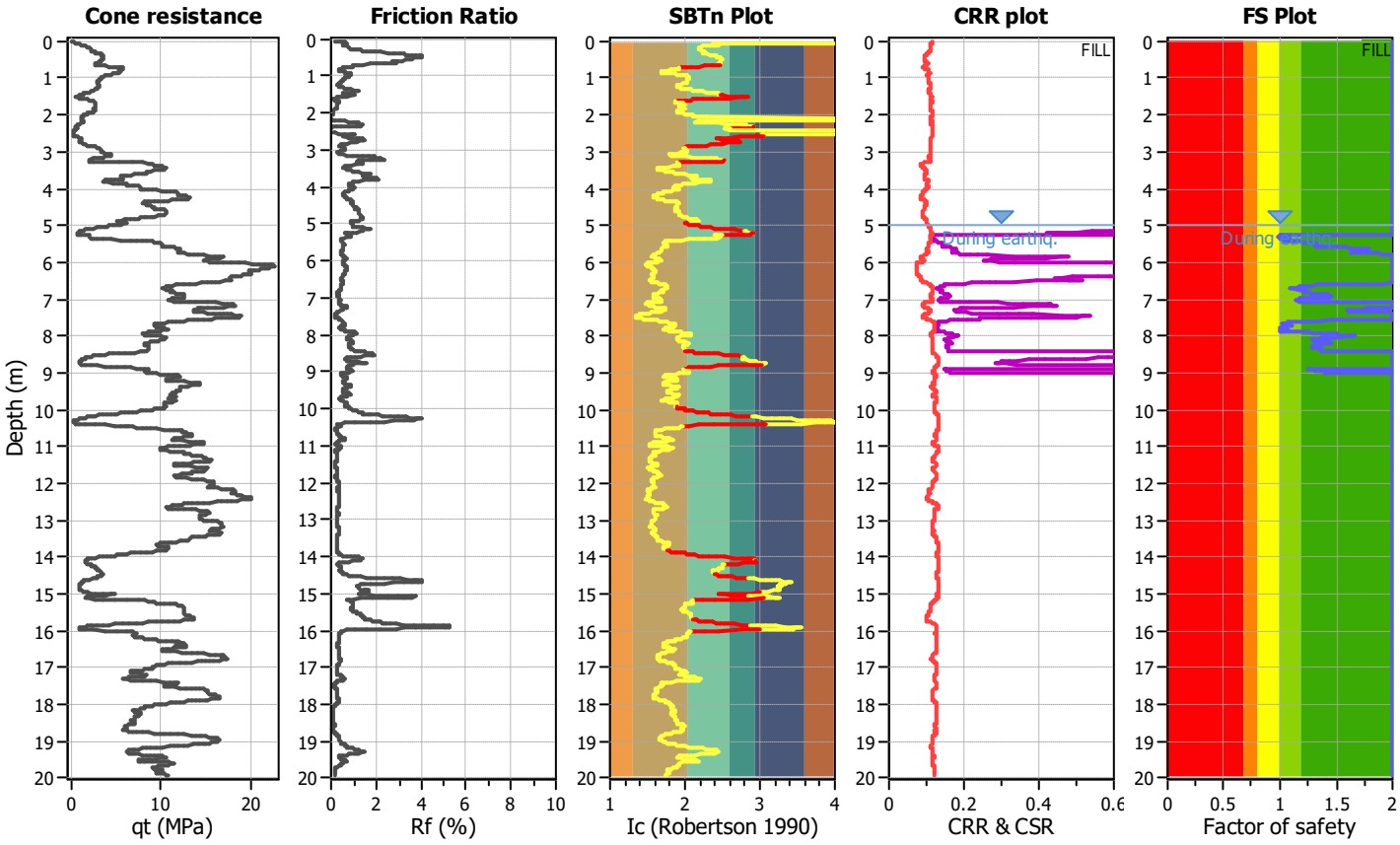
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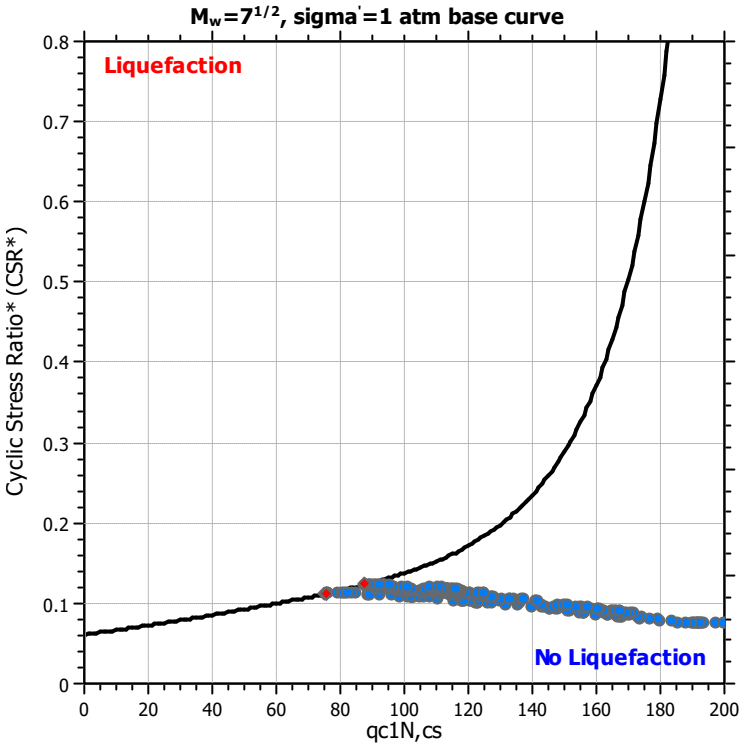
LIQUEFACTION ANALYSIS REPORT

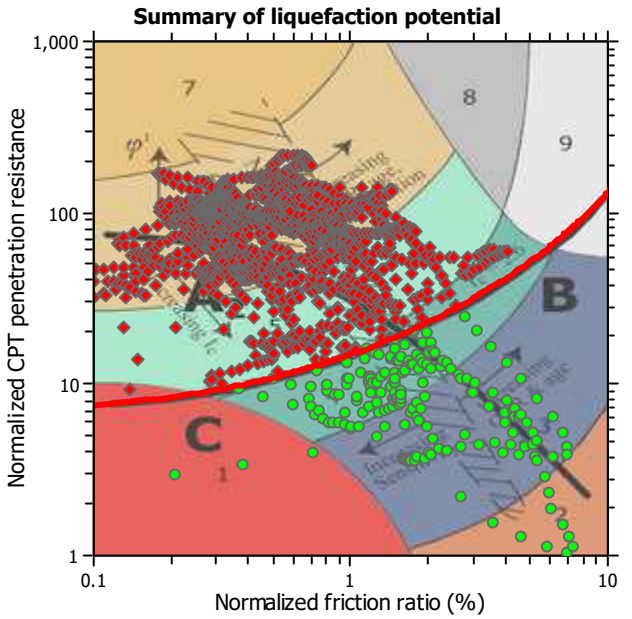
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

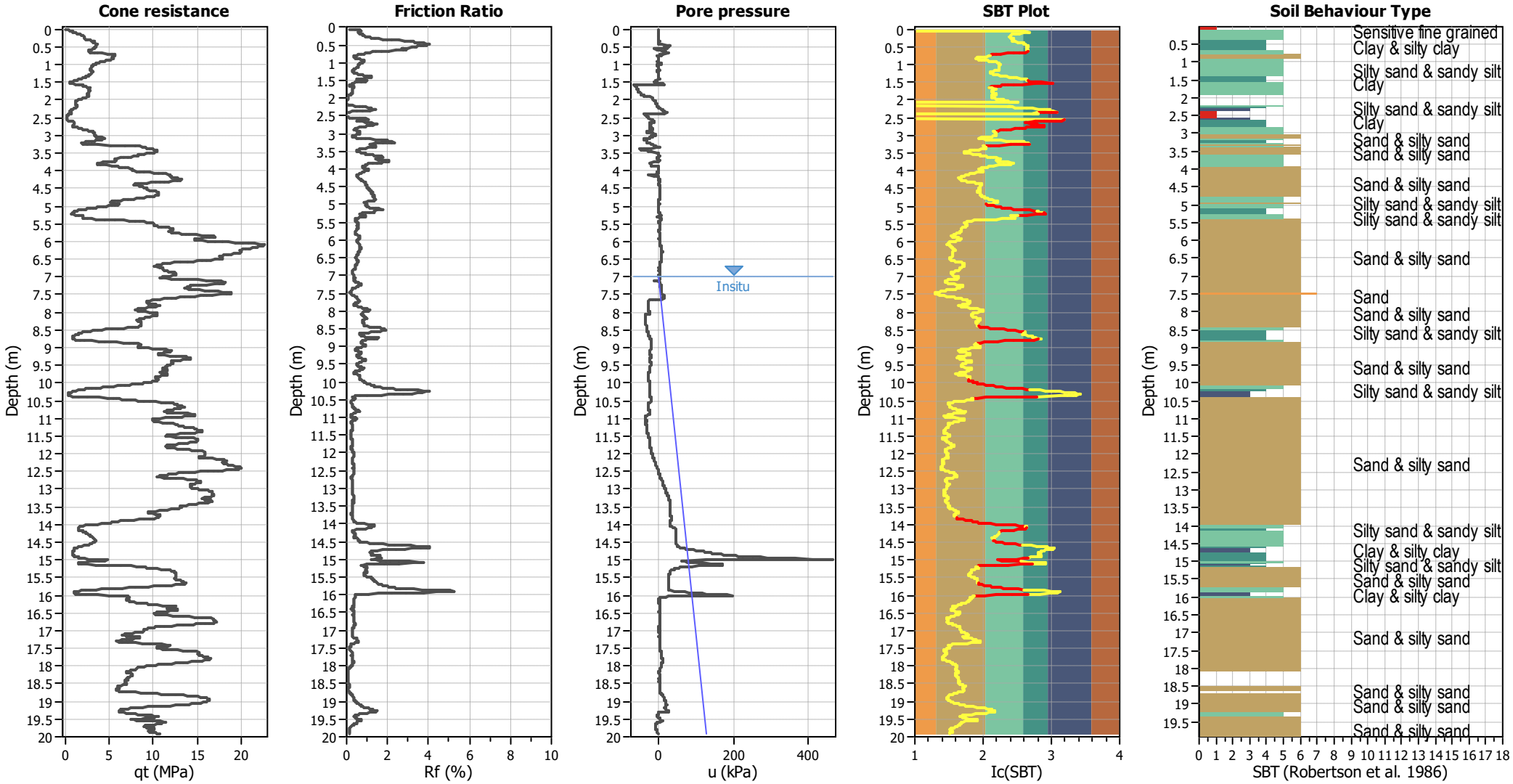






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



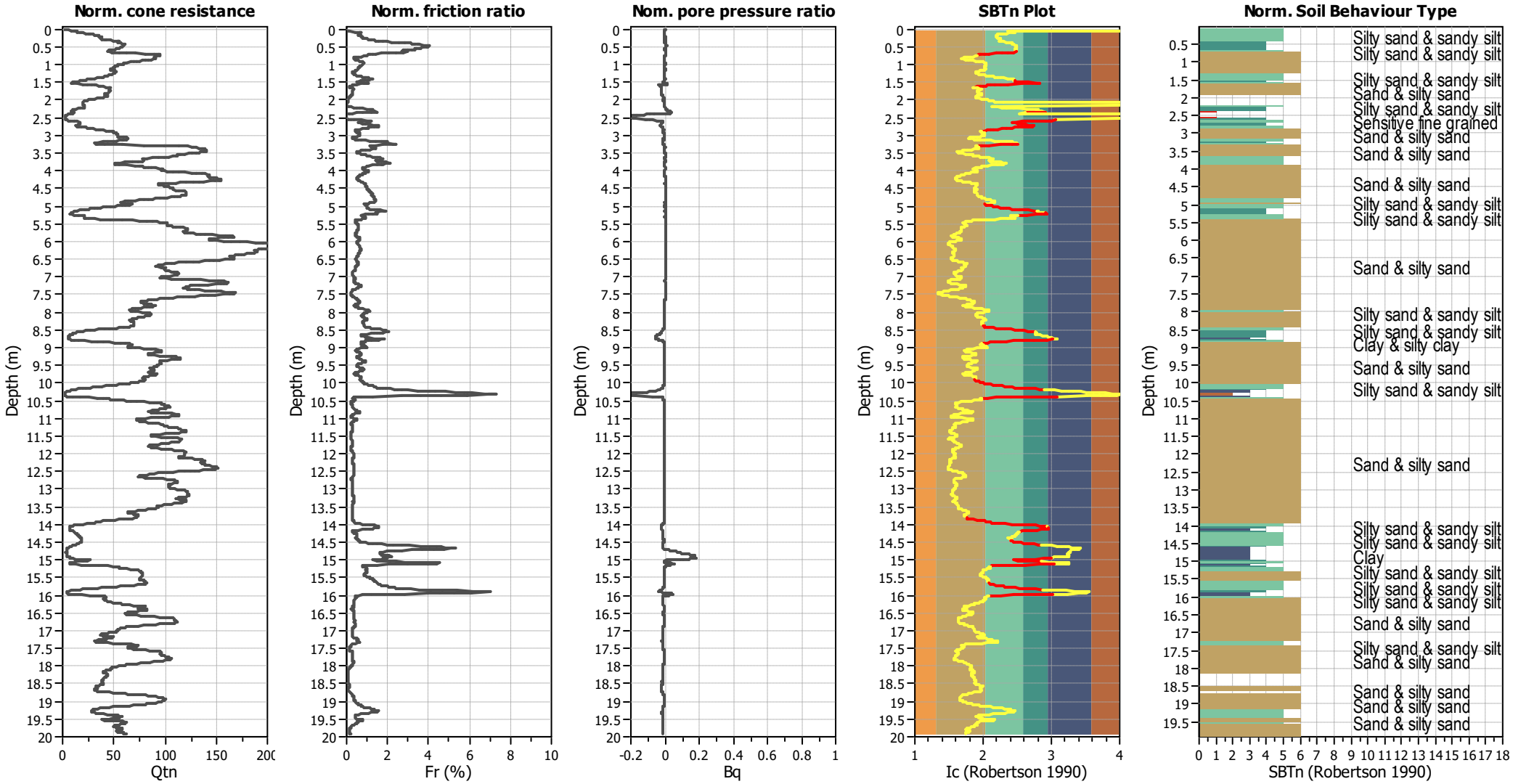
Input parameters and analysis data

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Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



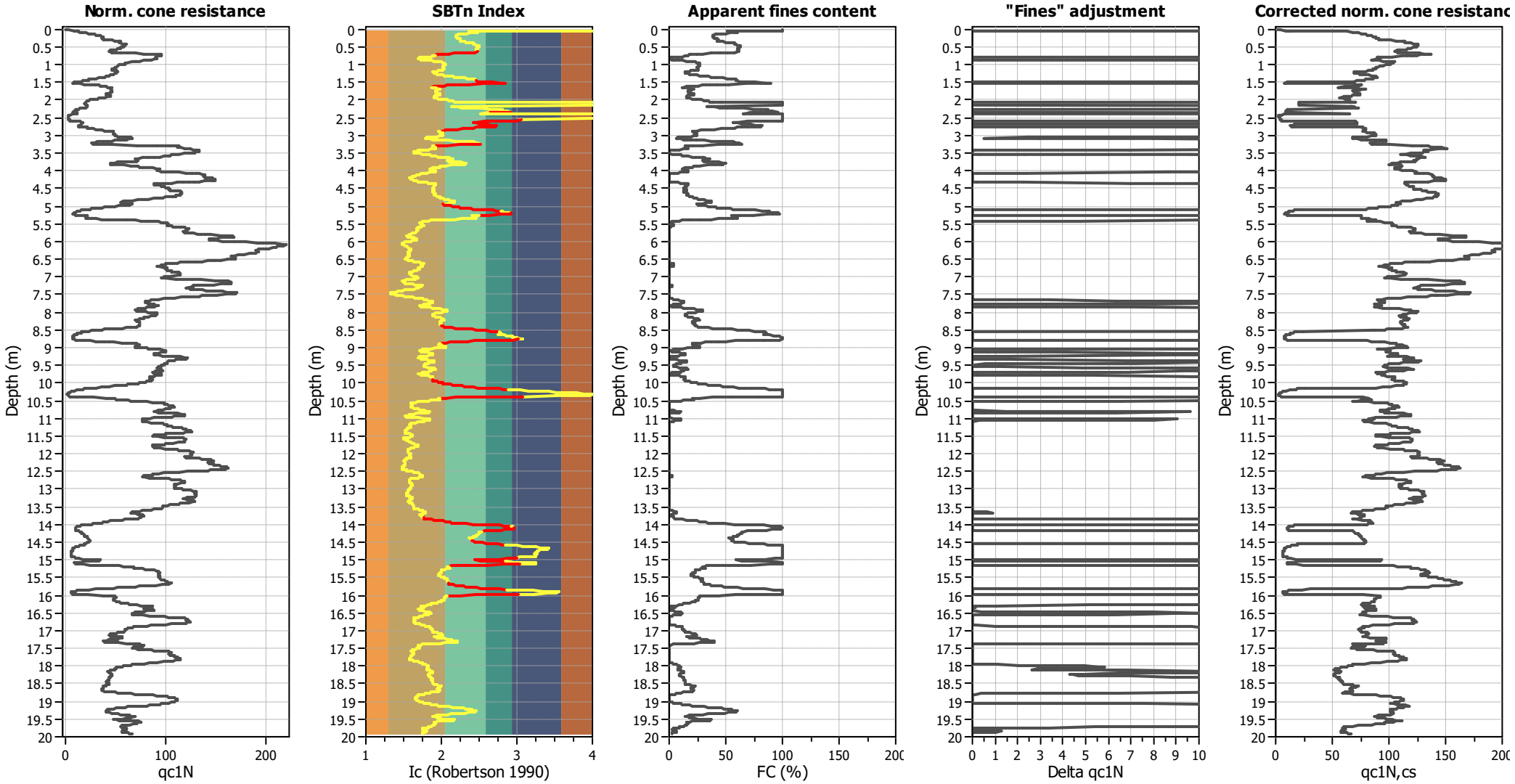
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

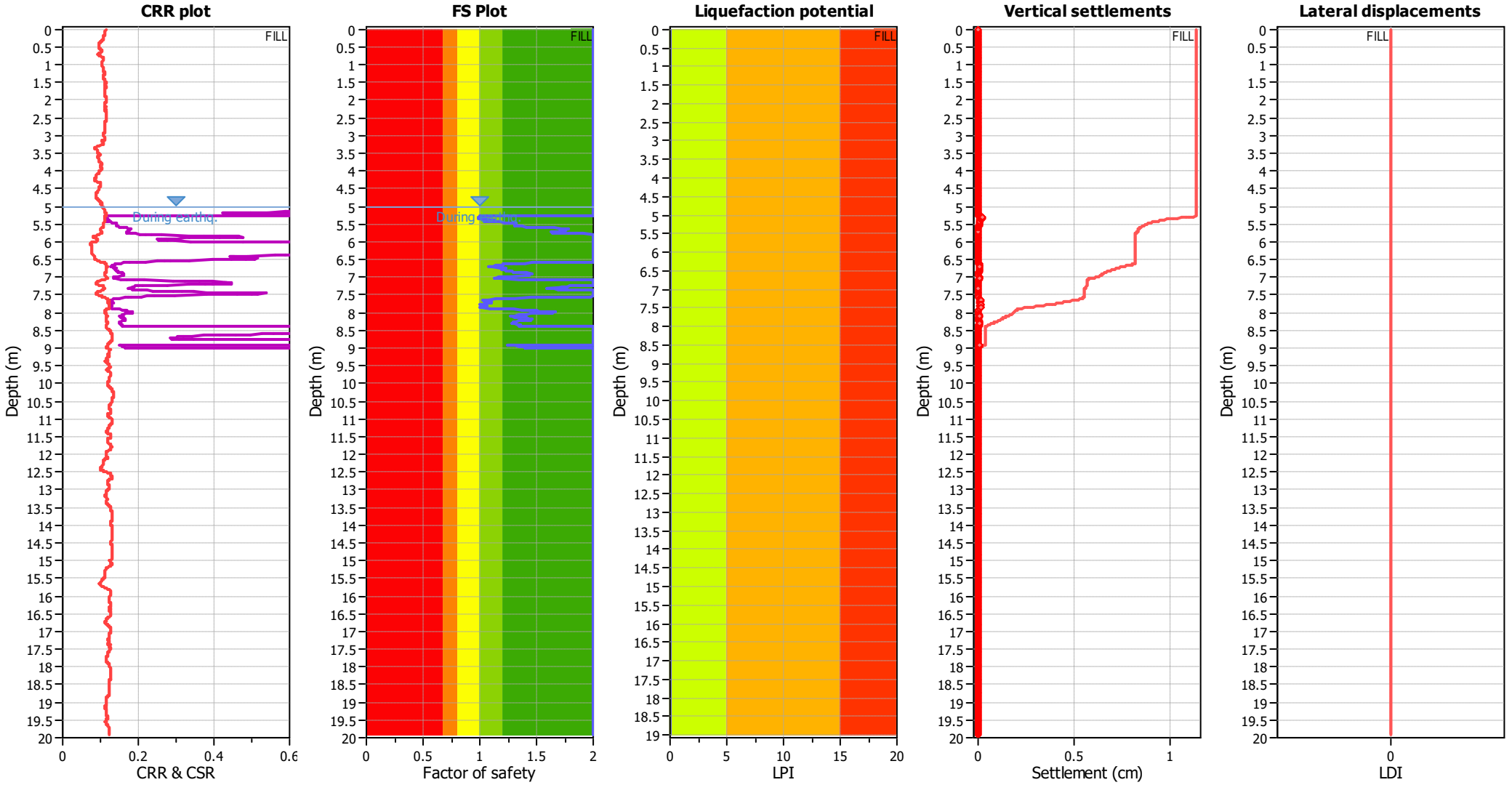
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

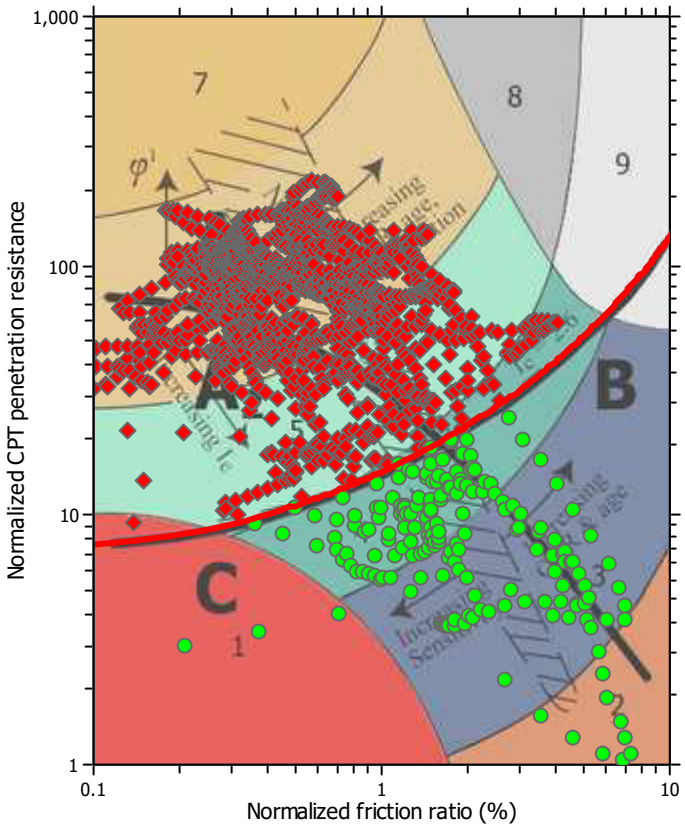
F.S. color scheme

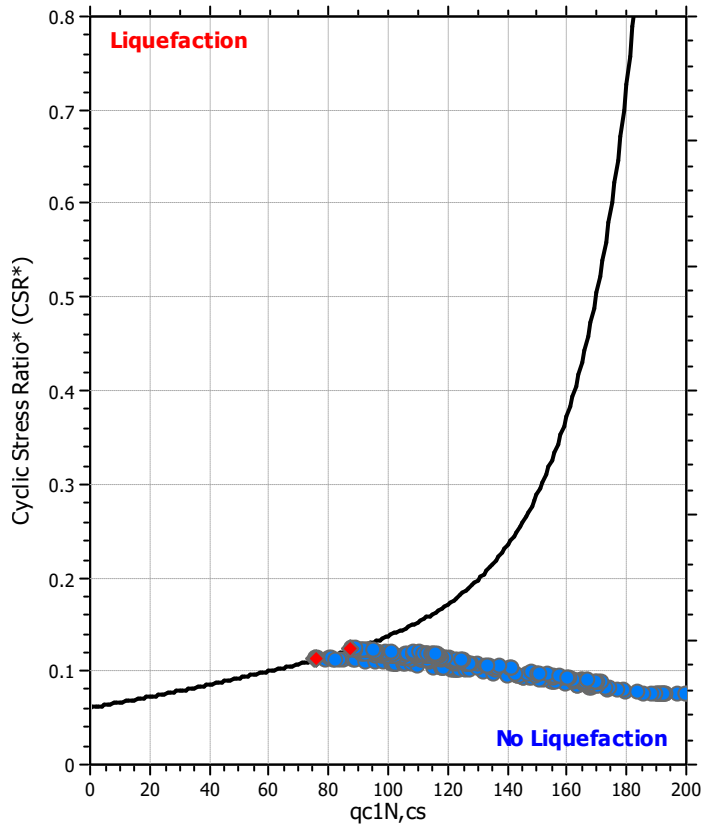
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

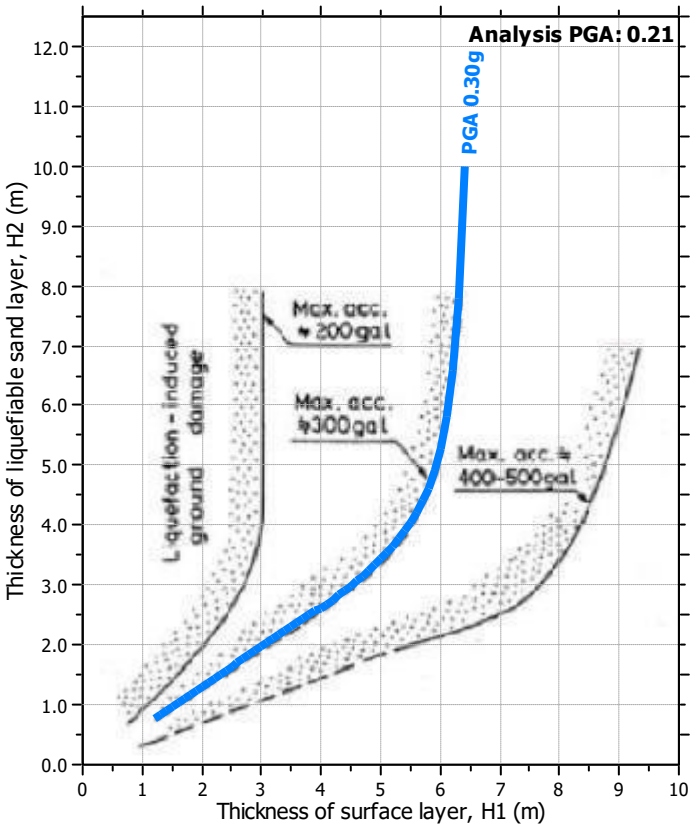
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



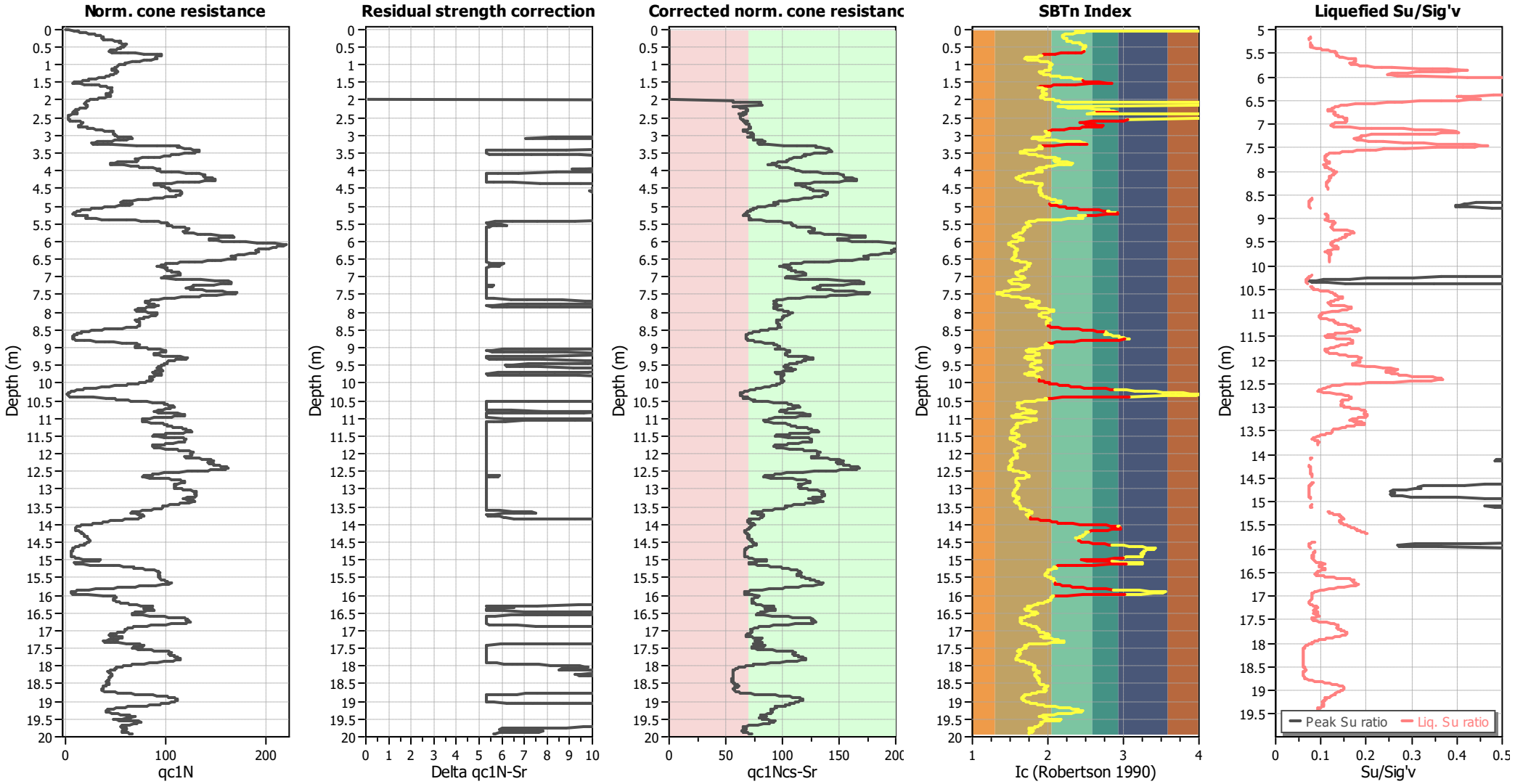




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

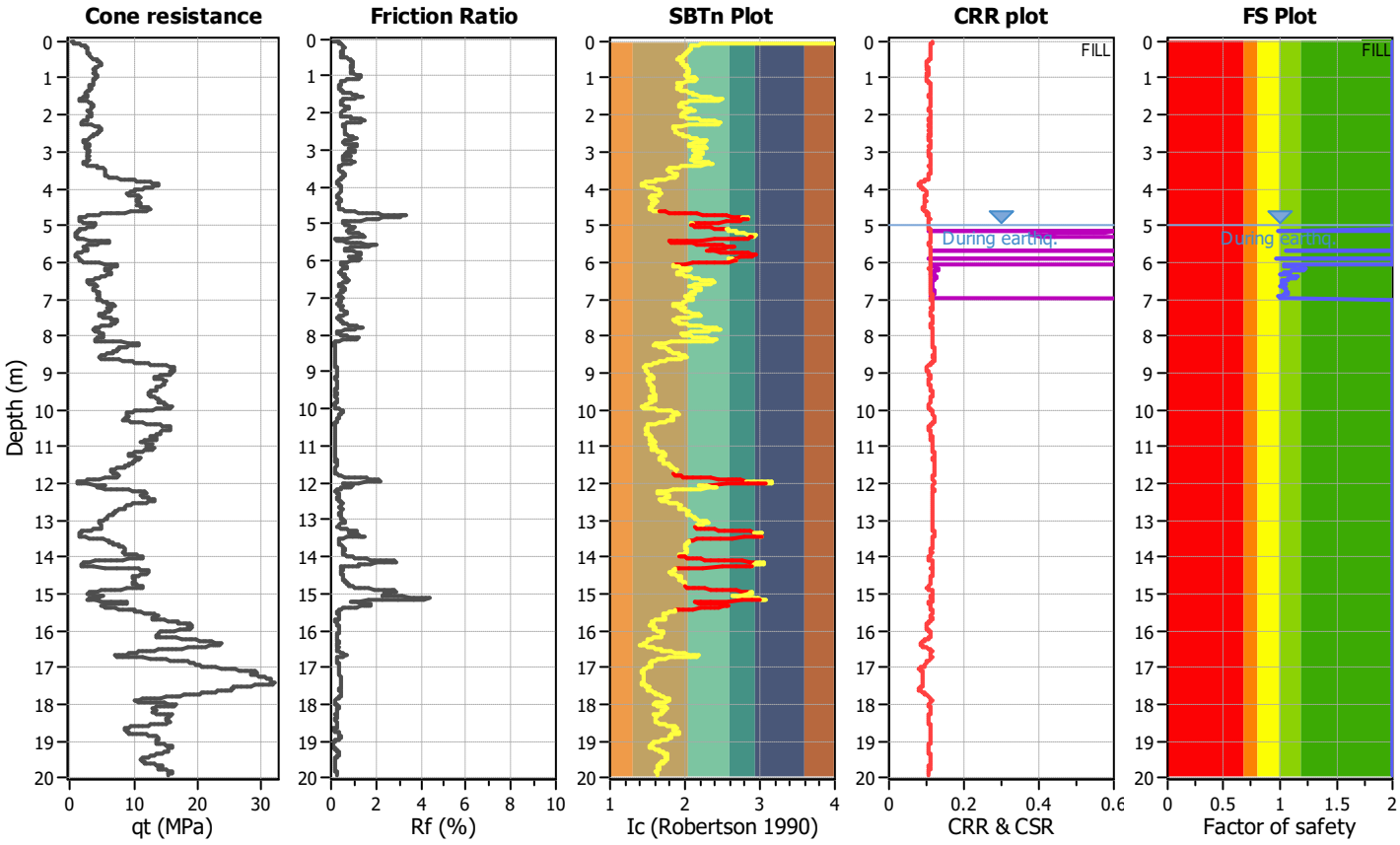
BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

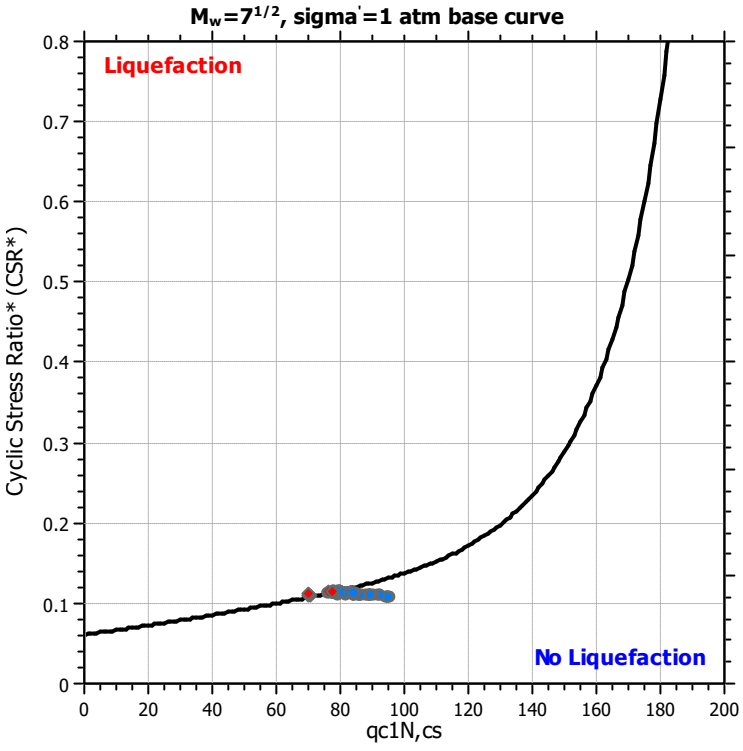
LIQUEFACTION ANALYSIS REPORT

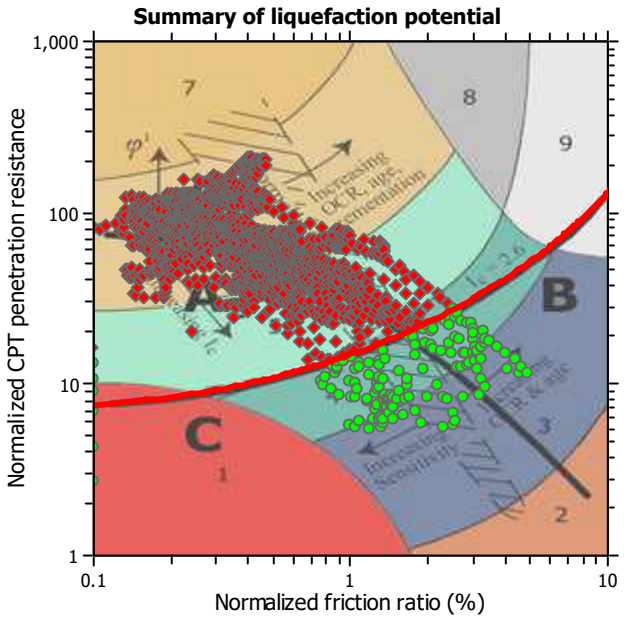
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 3

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	9.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	8.00 m	Fill height:	3.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

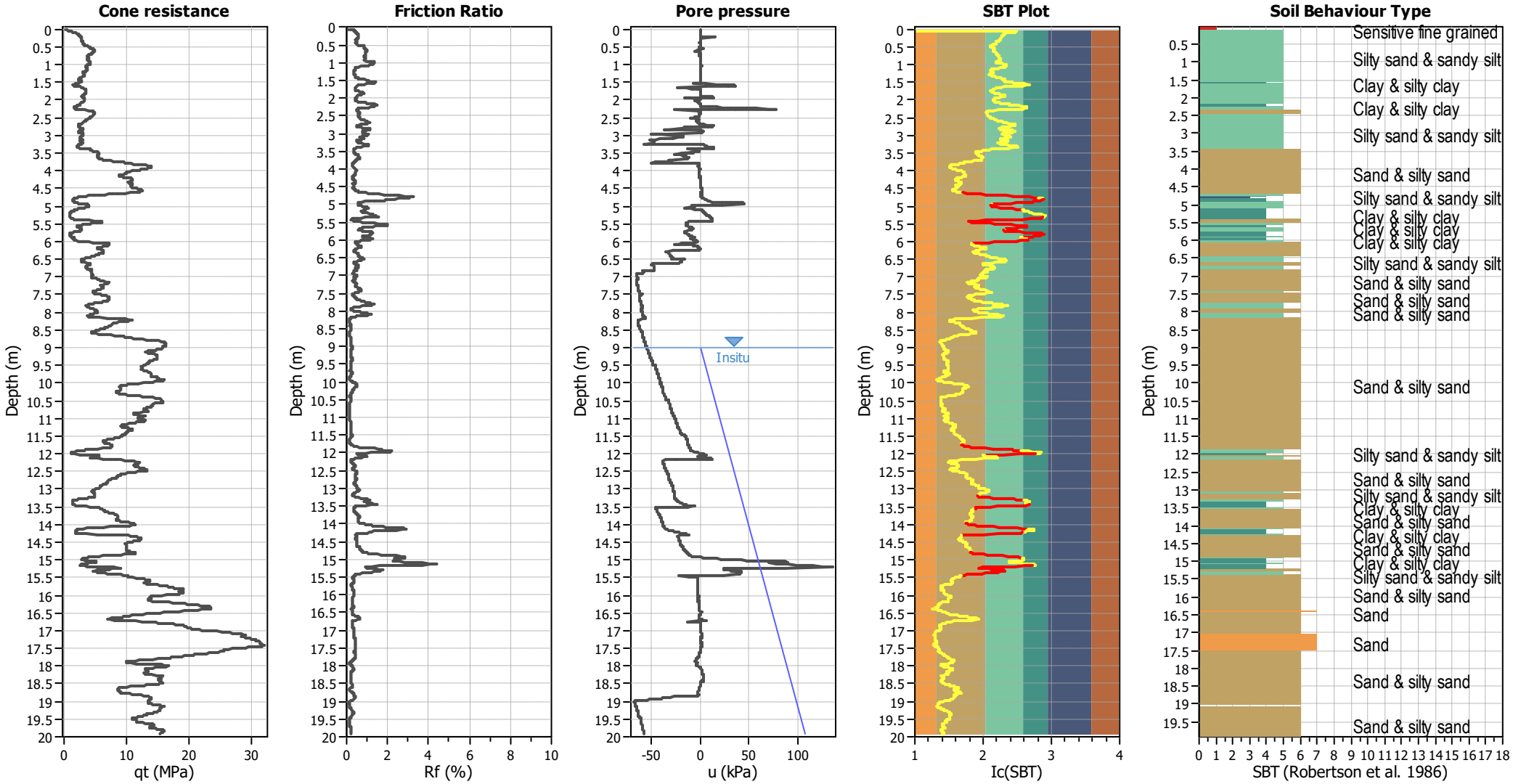






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



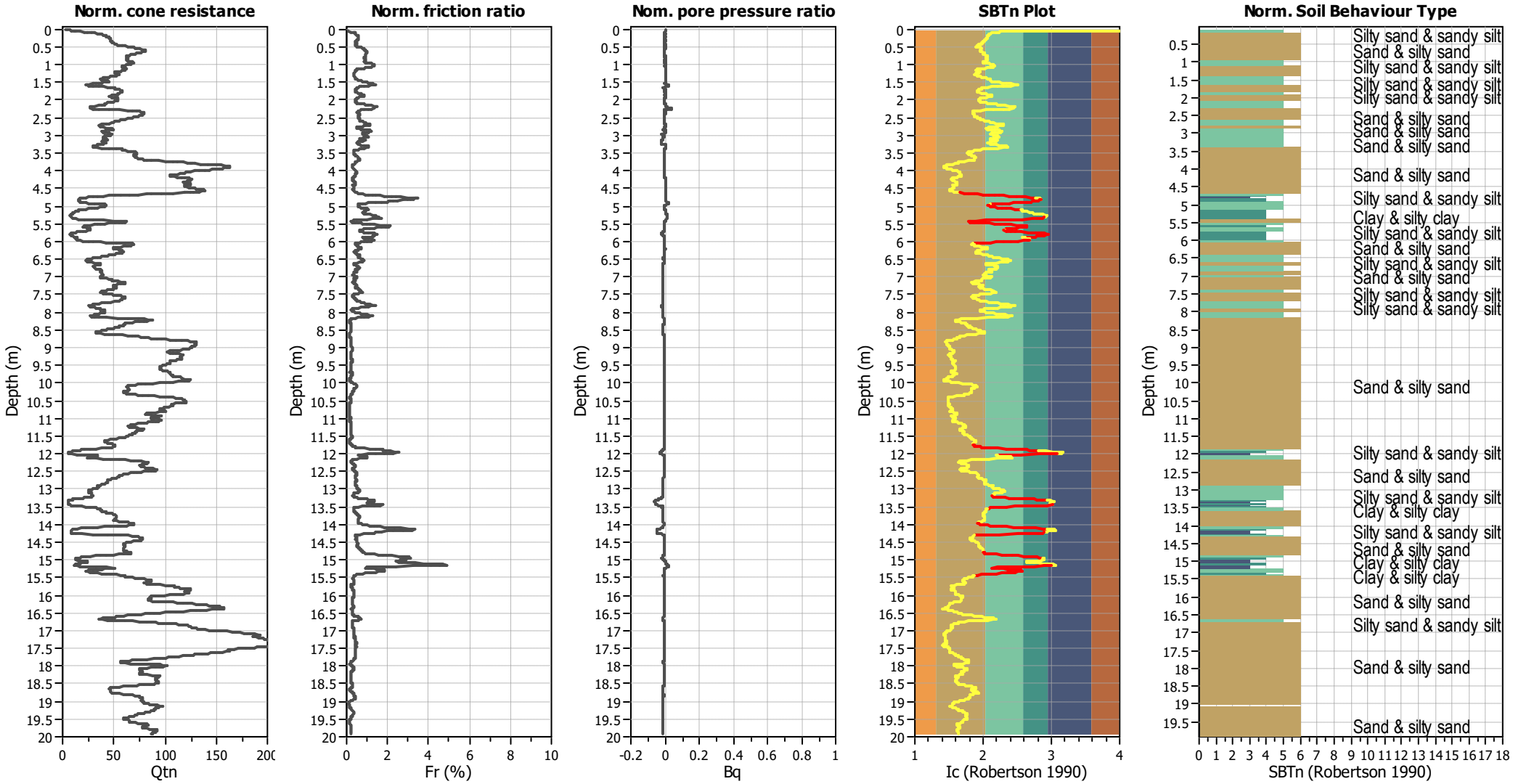
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



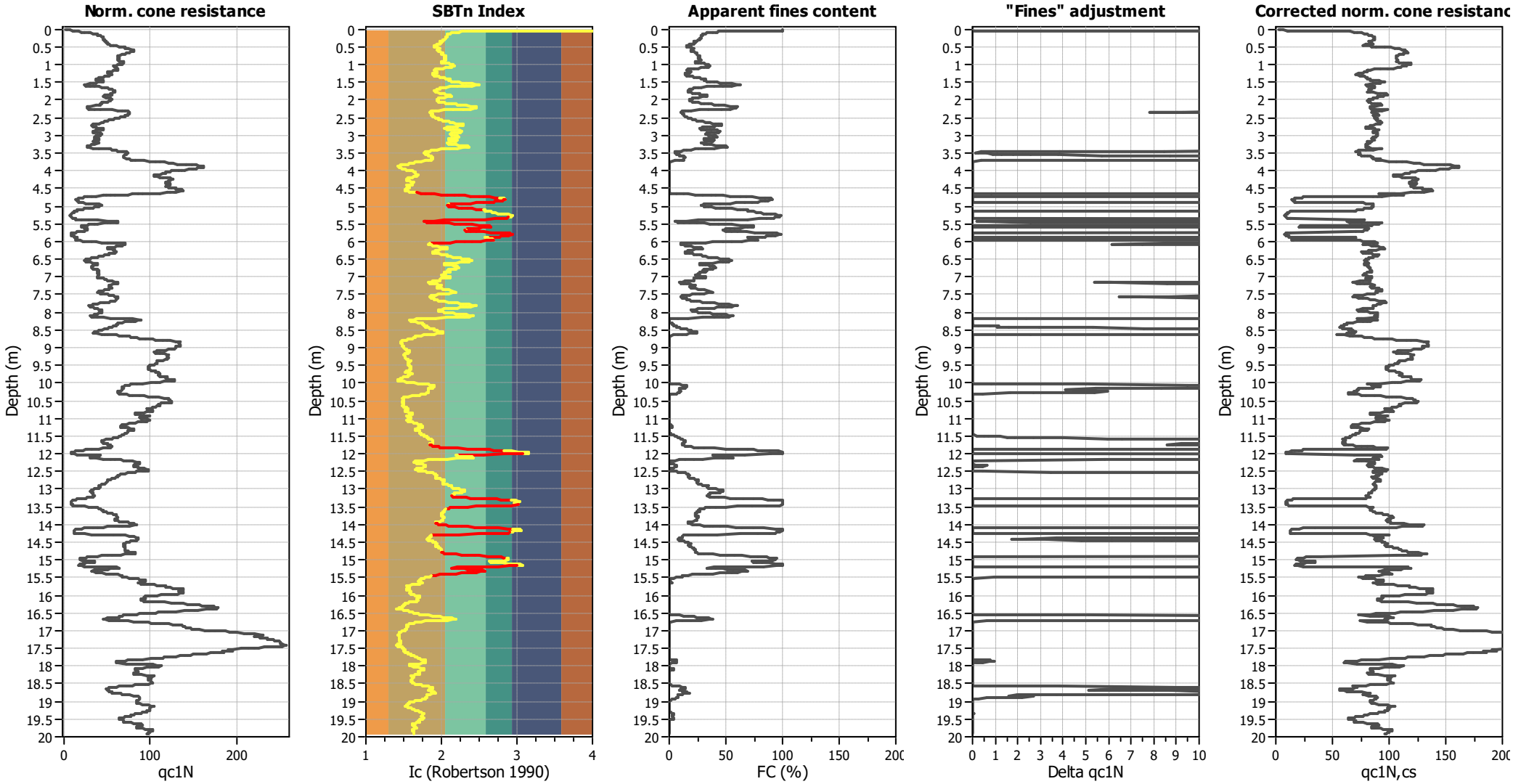
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

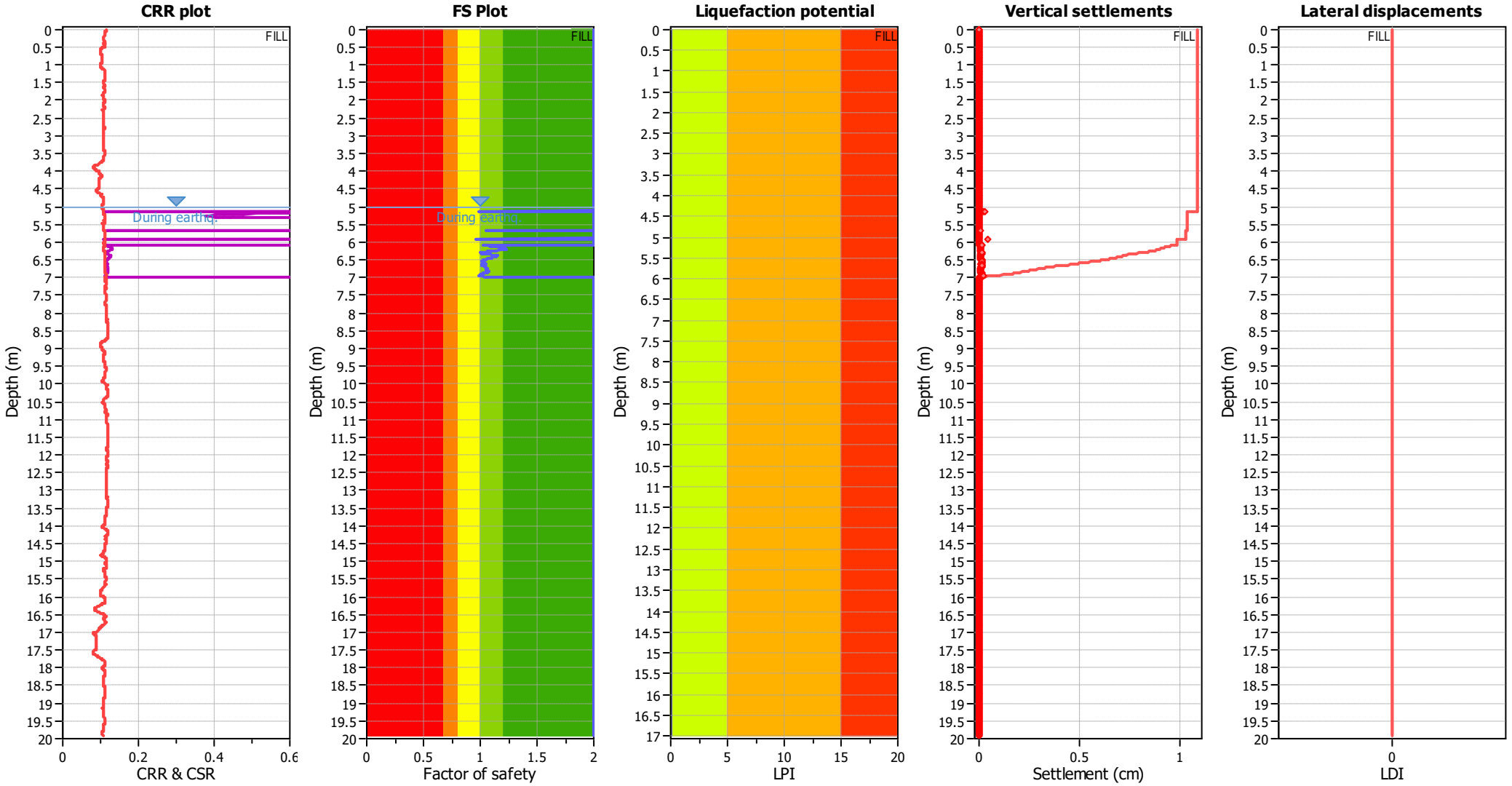
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

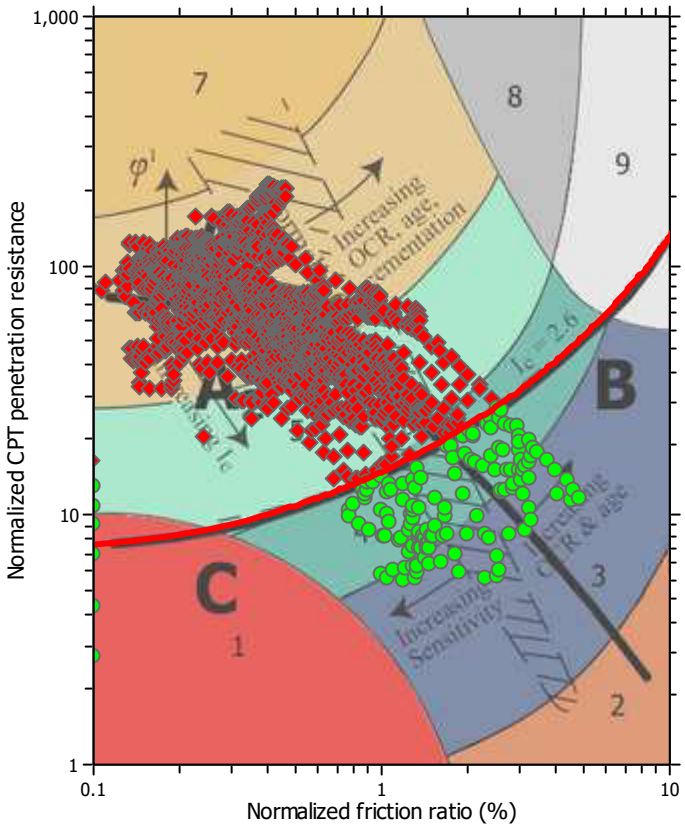
F.S. color scheme

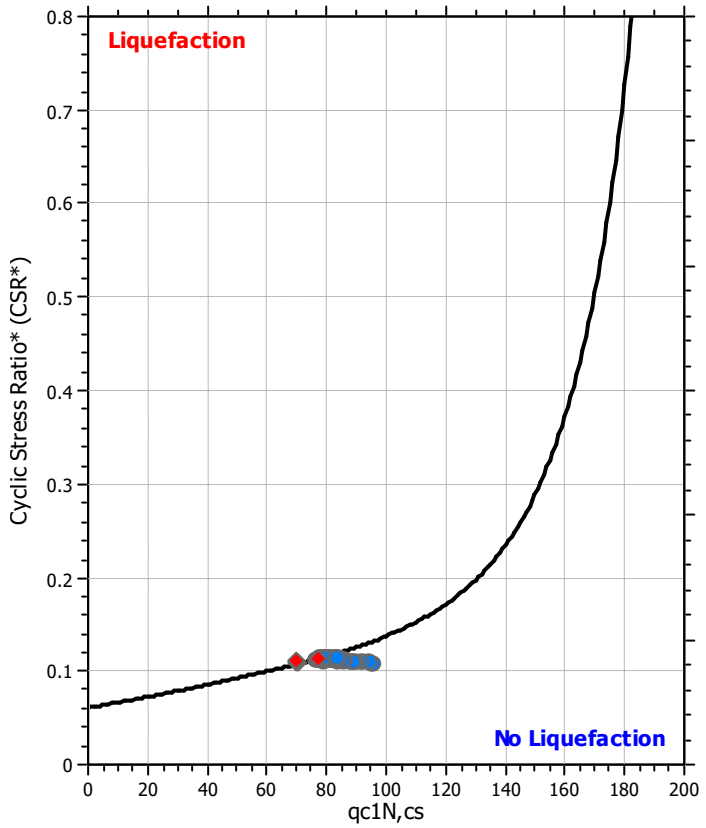
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

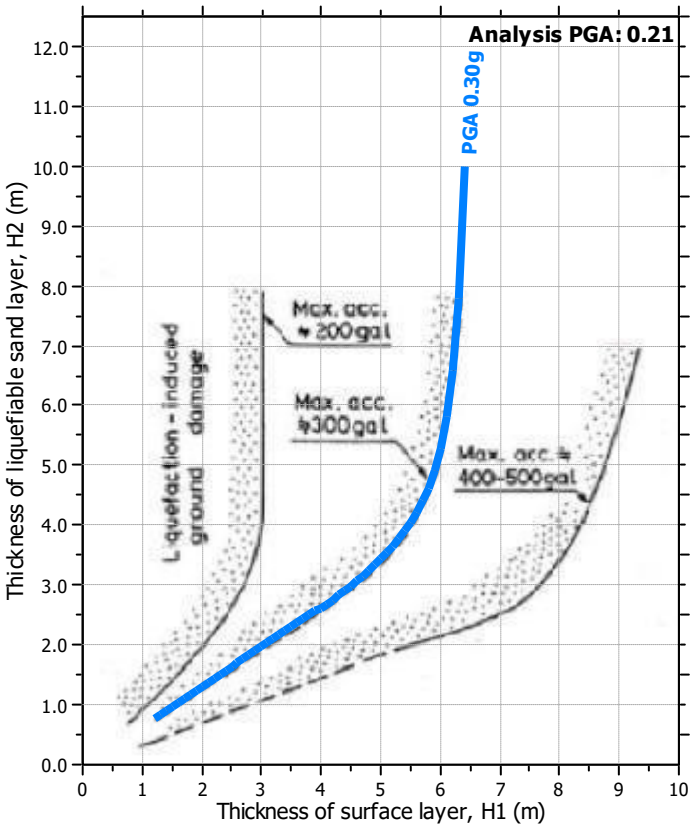
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



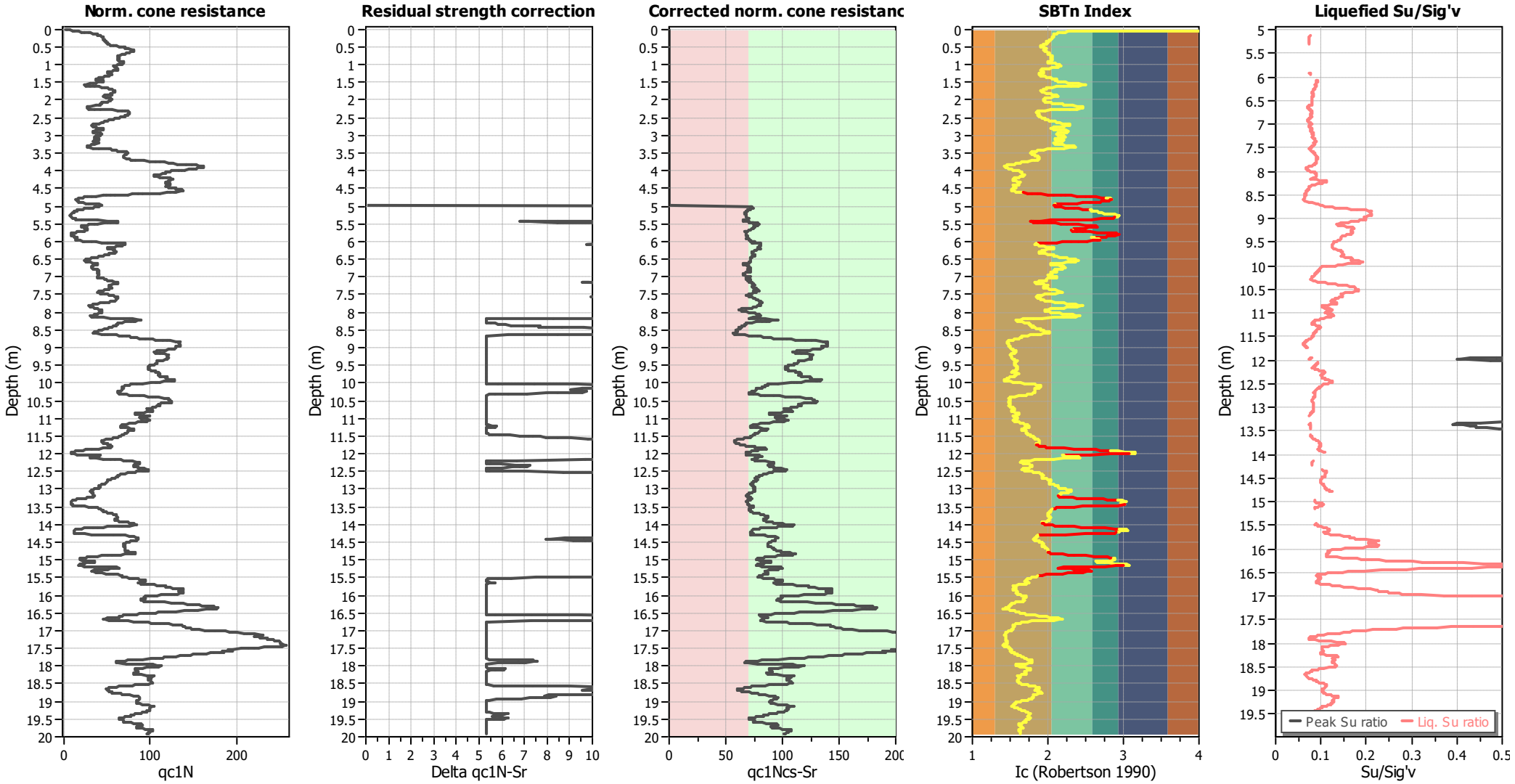




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

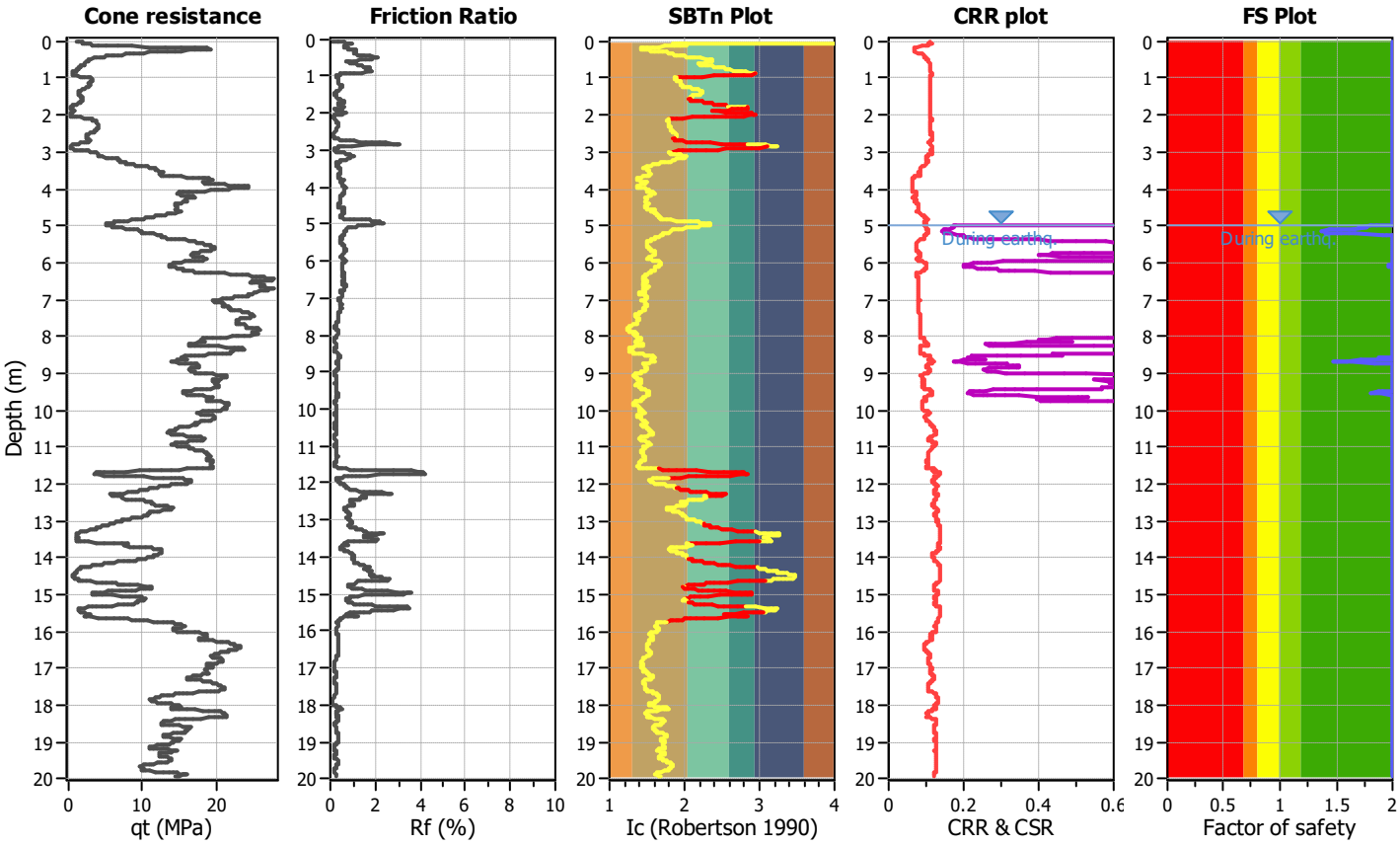
BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

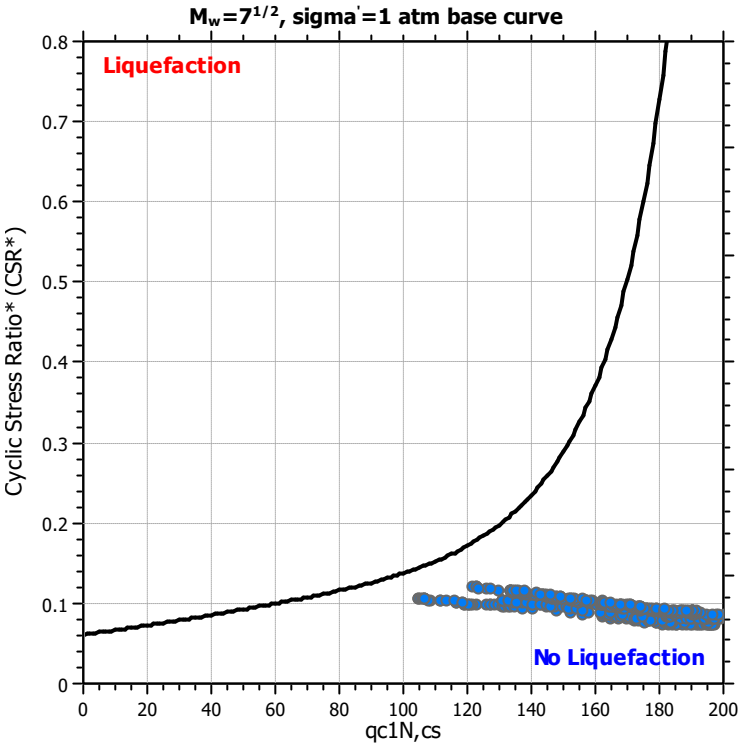
LIQUEFACTION ANALYSIS REPORT

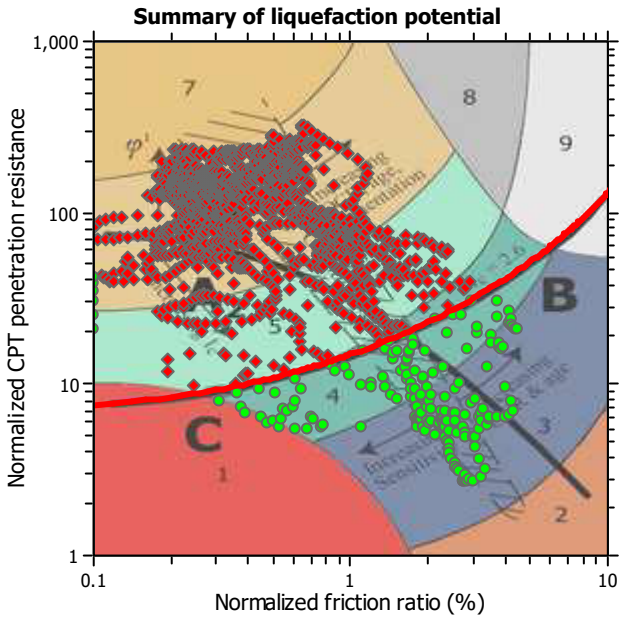
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 4

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

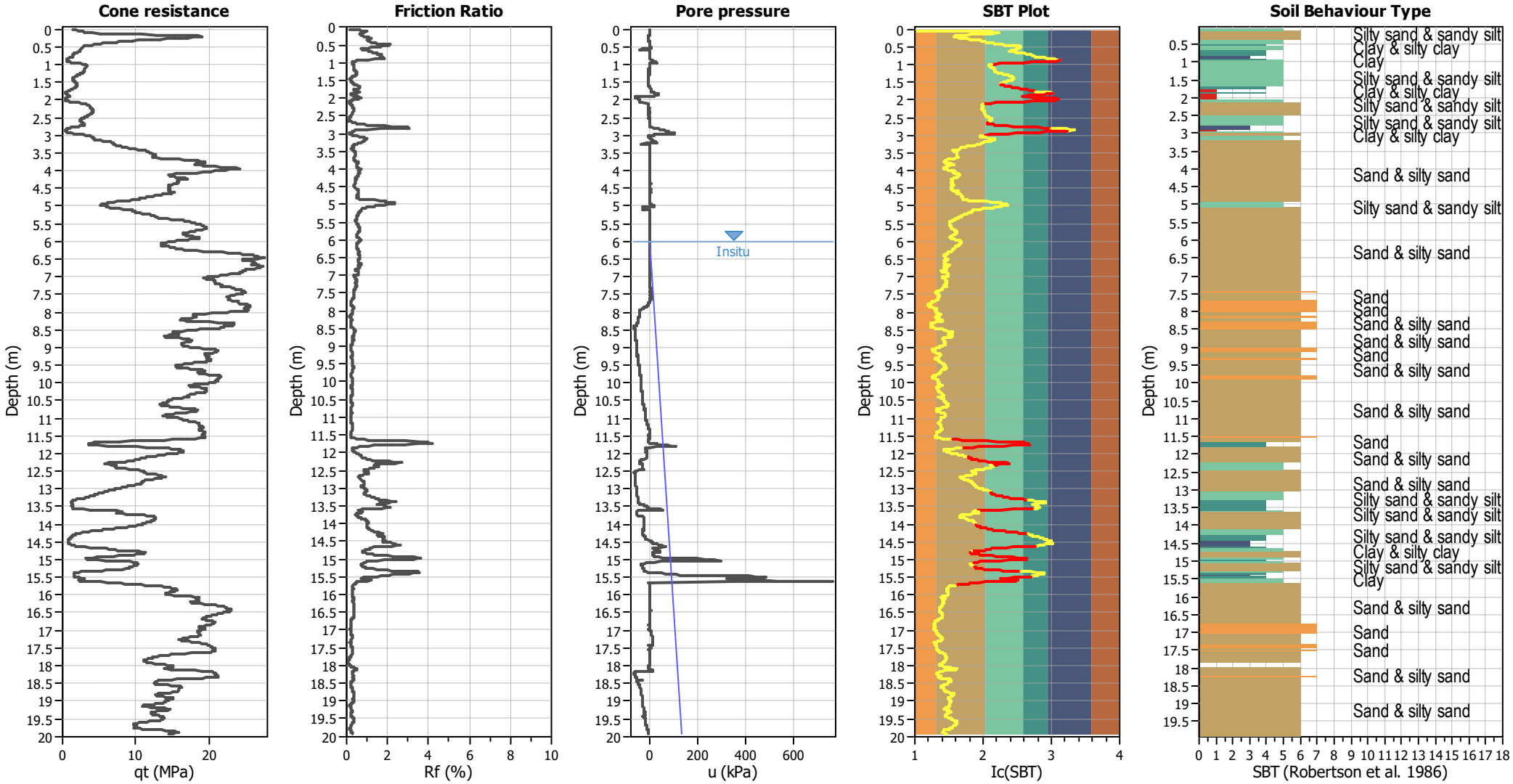






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



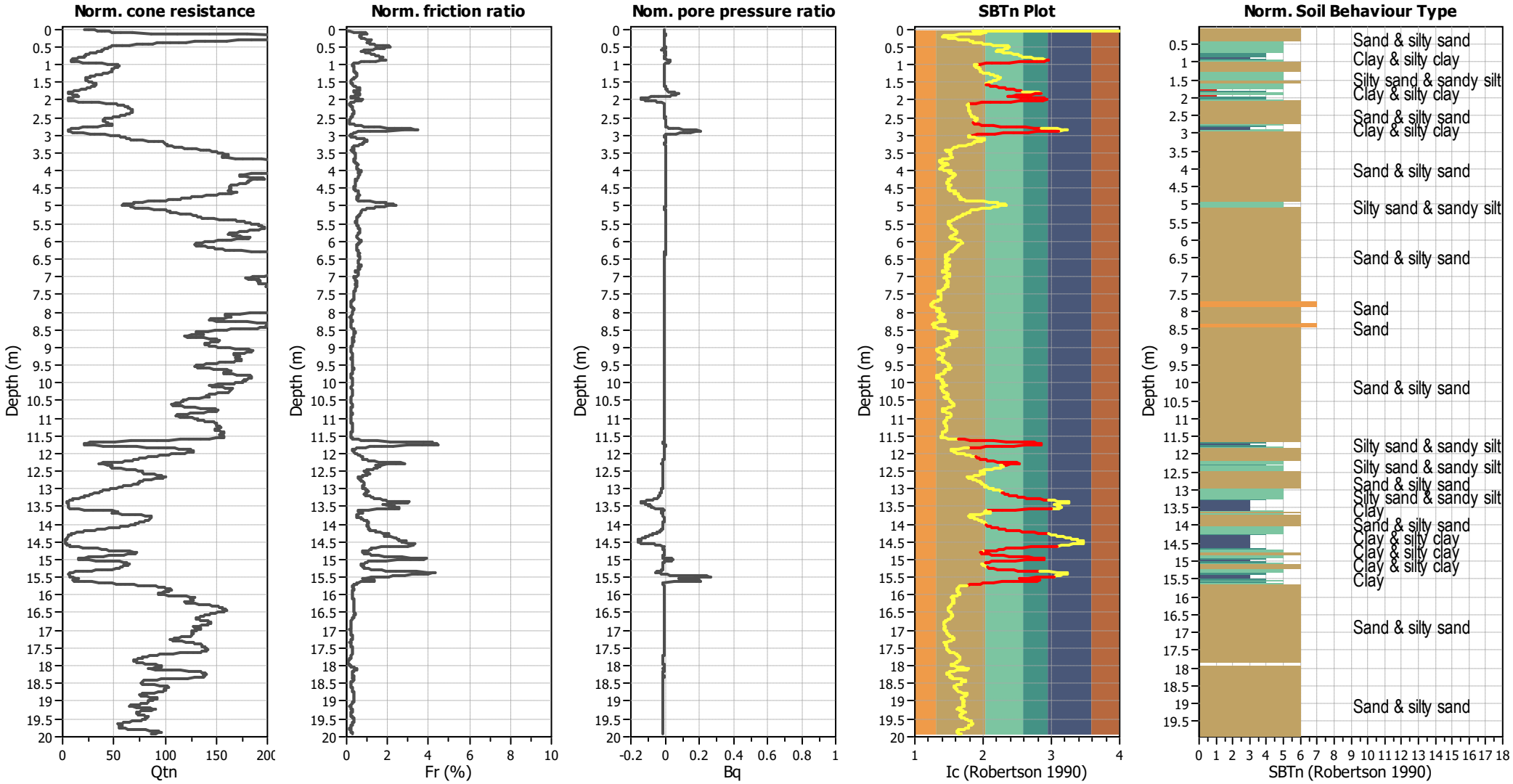
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



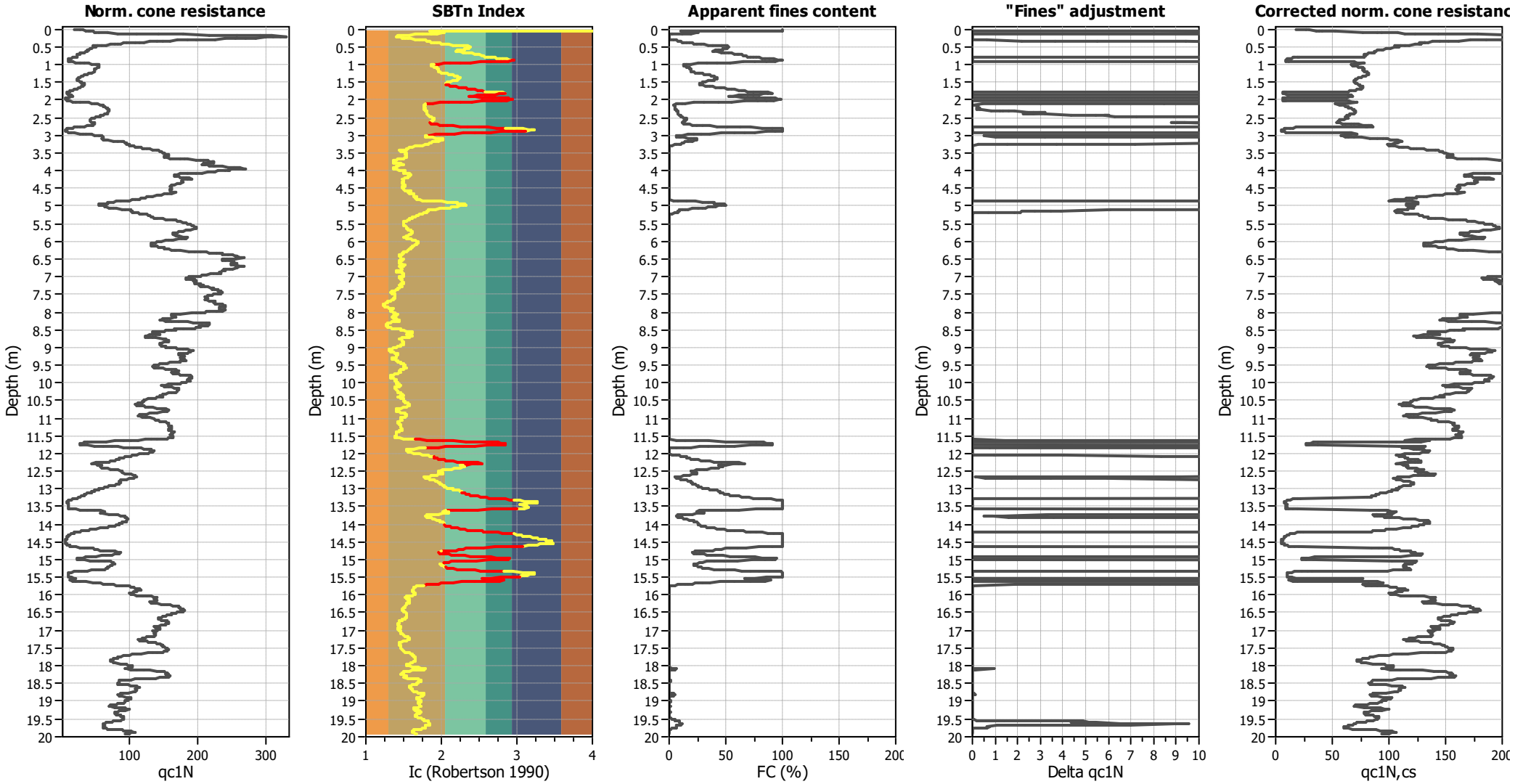
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
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7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

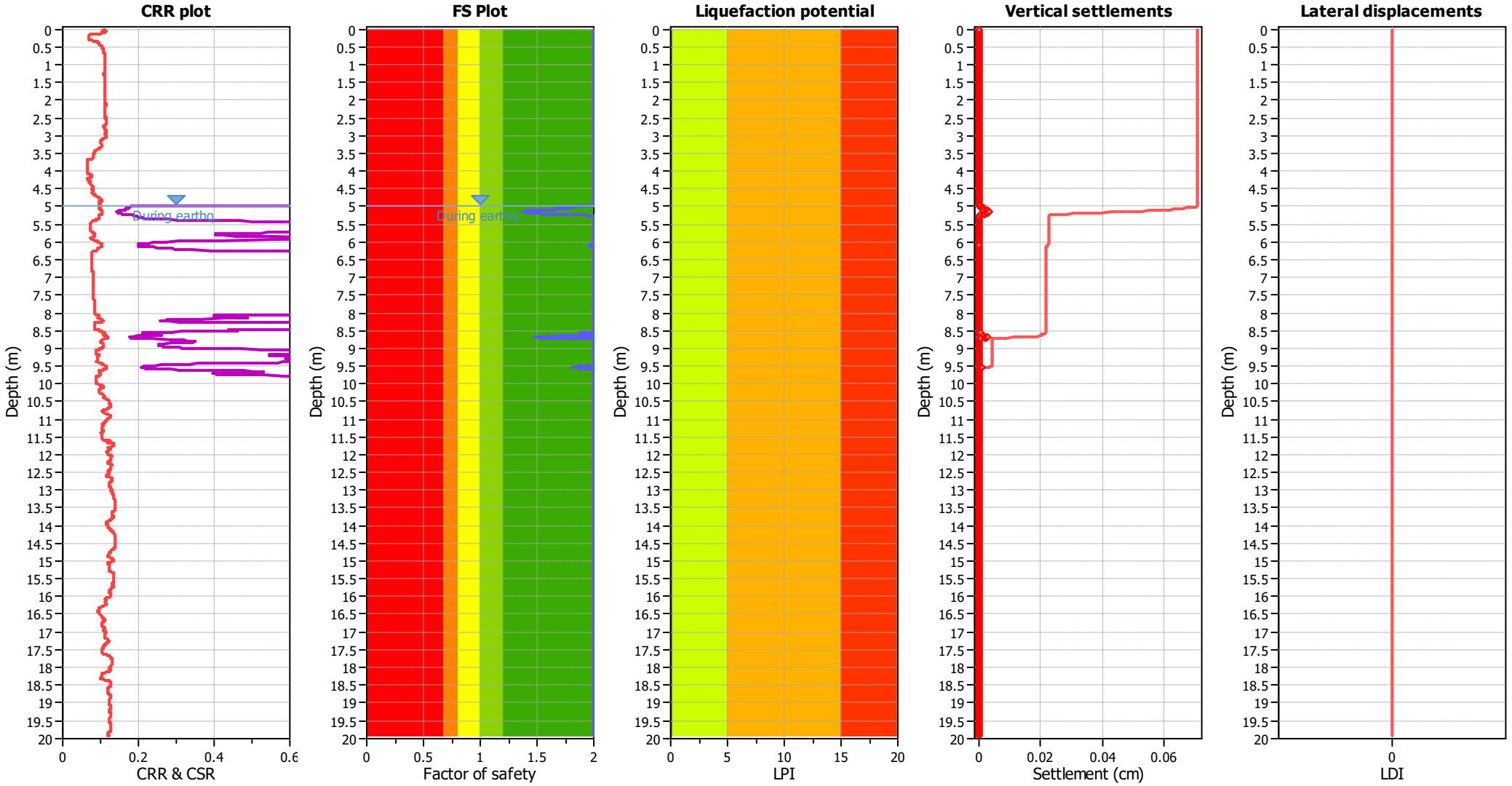
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

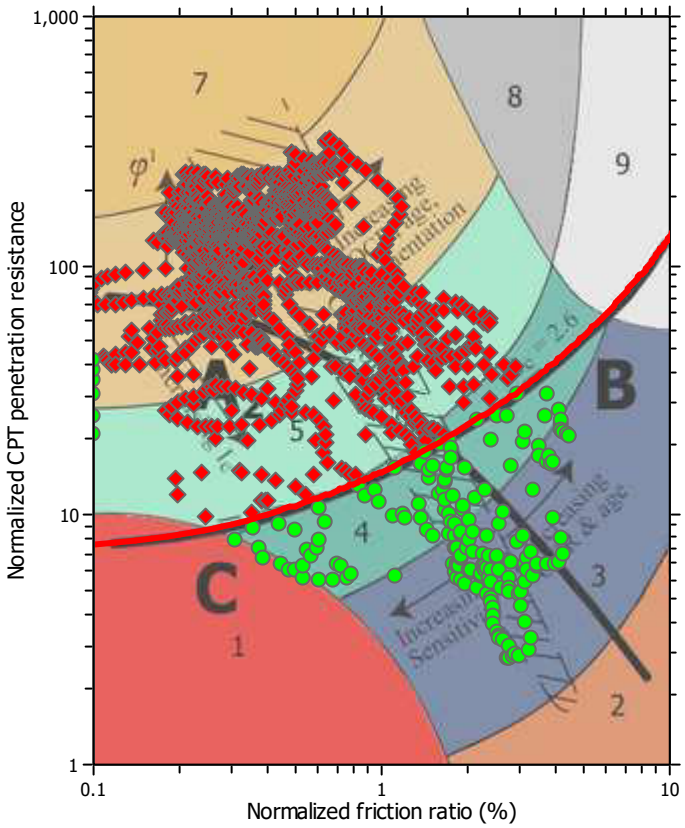
F.S. color scheme

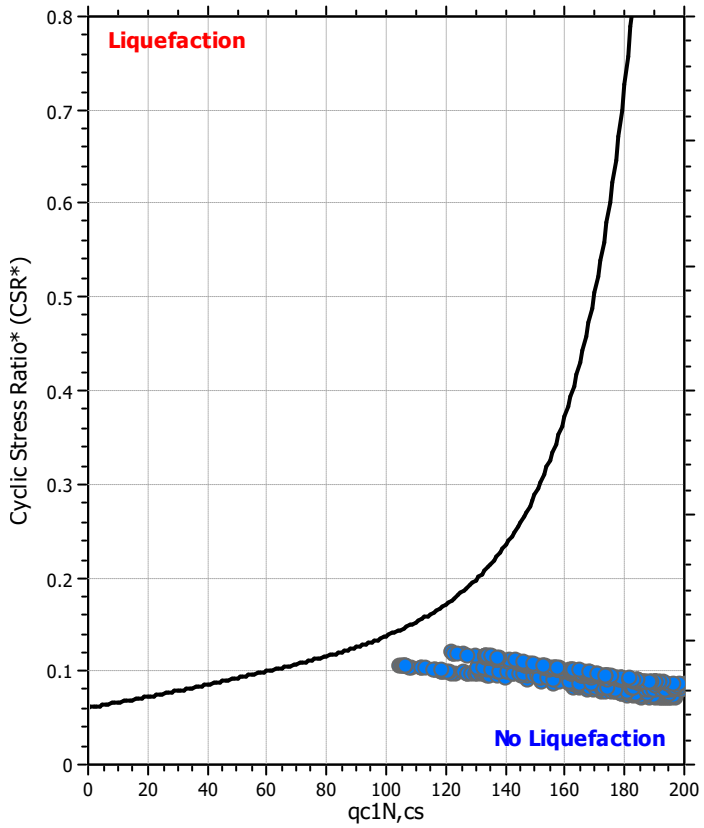
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

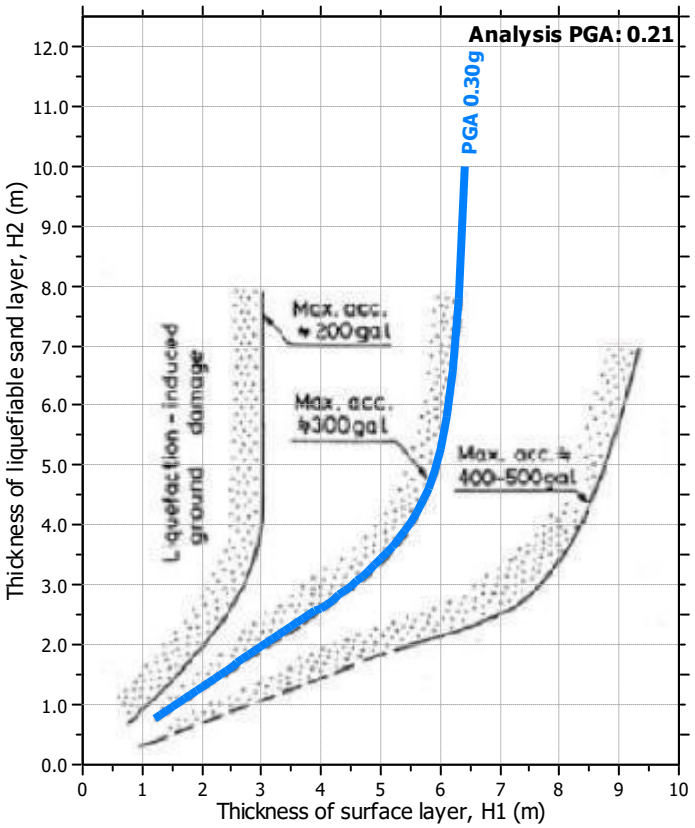
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



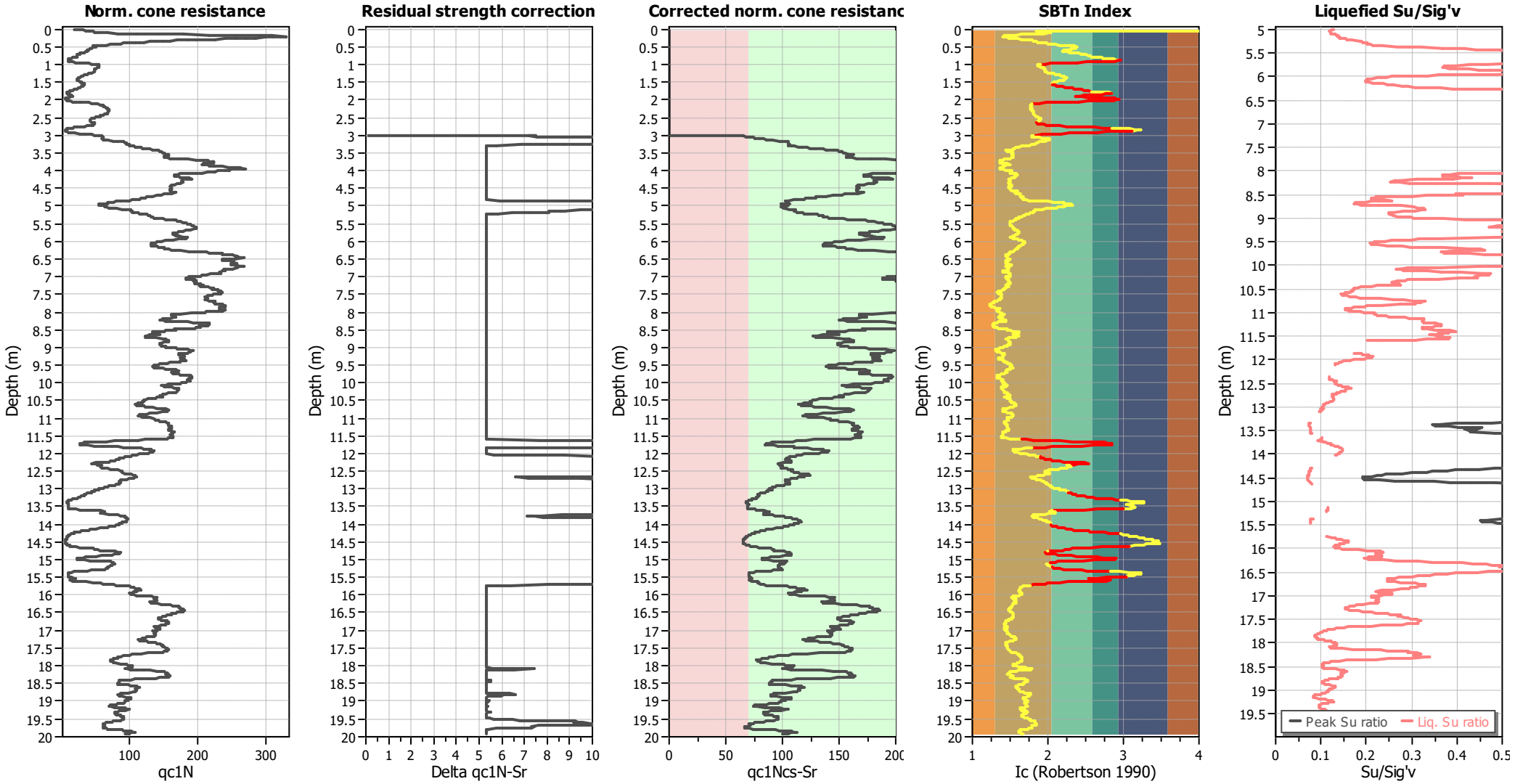




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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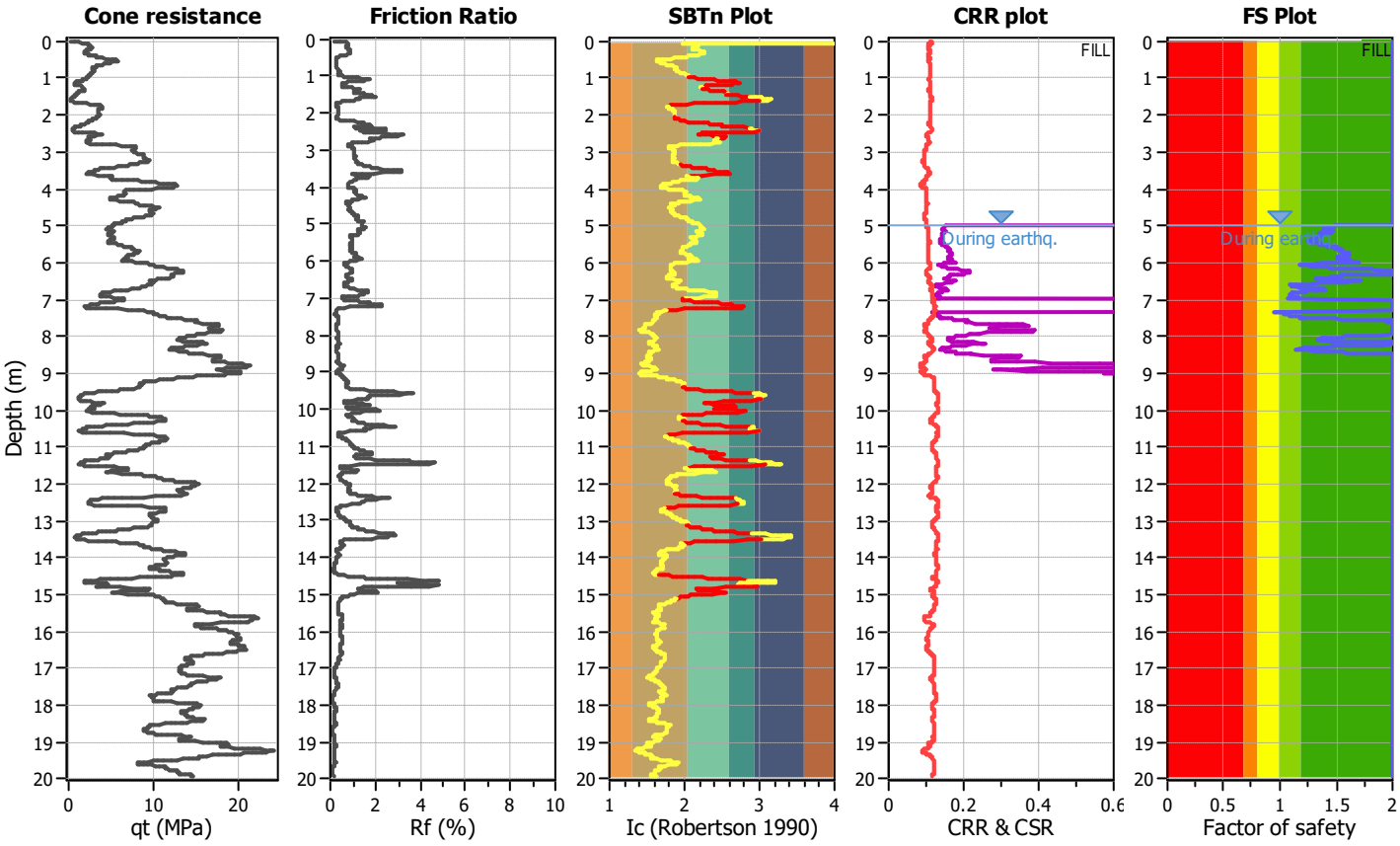
LIQUEFACTION ANALYSIS REPORT

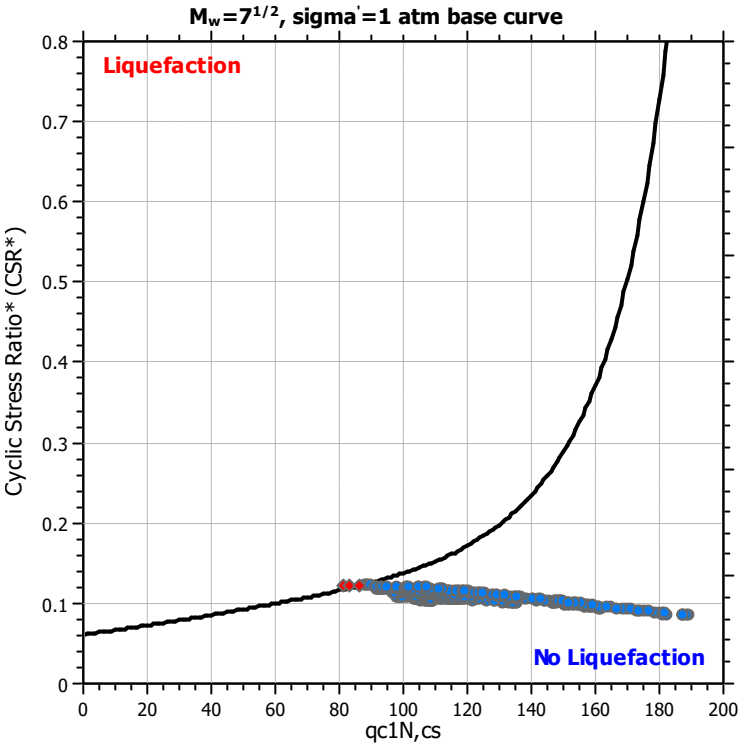
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**

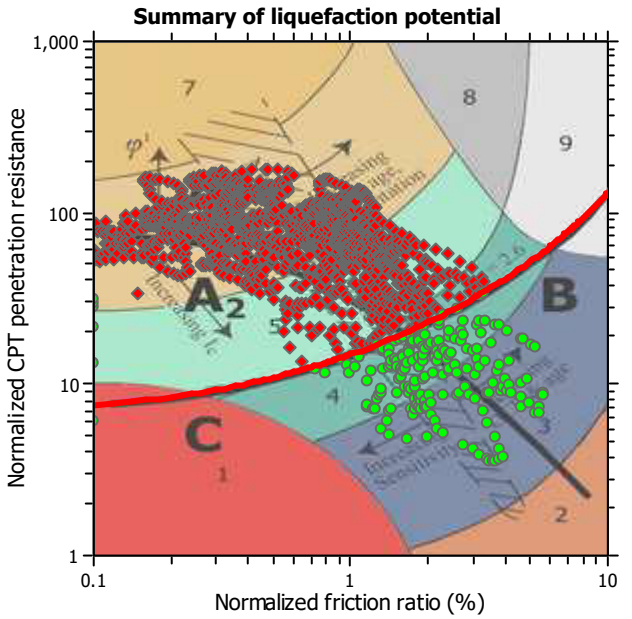
CPT file : CPT 5

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

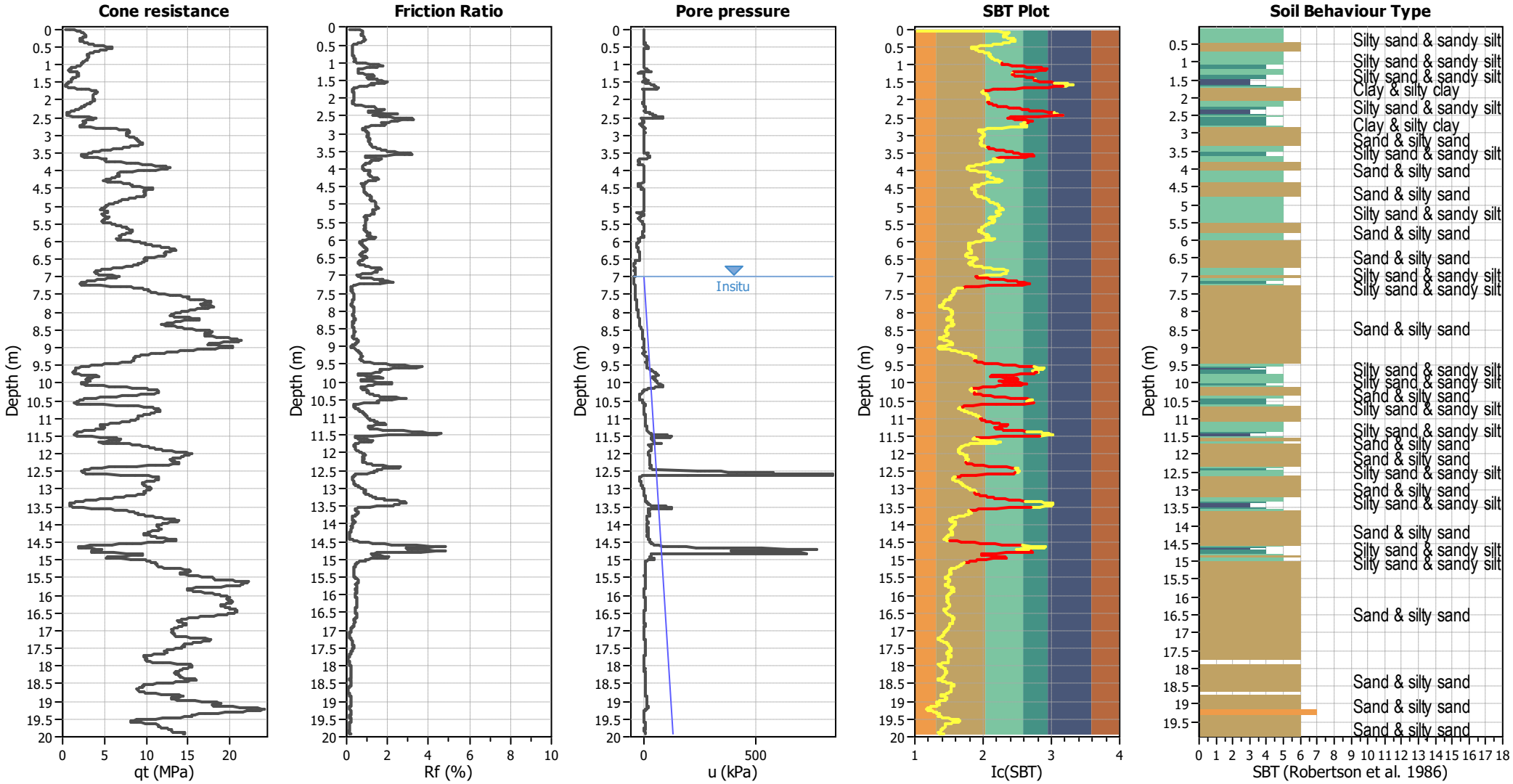






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



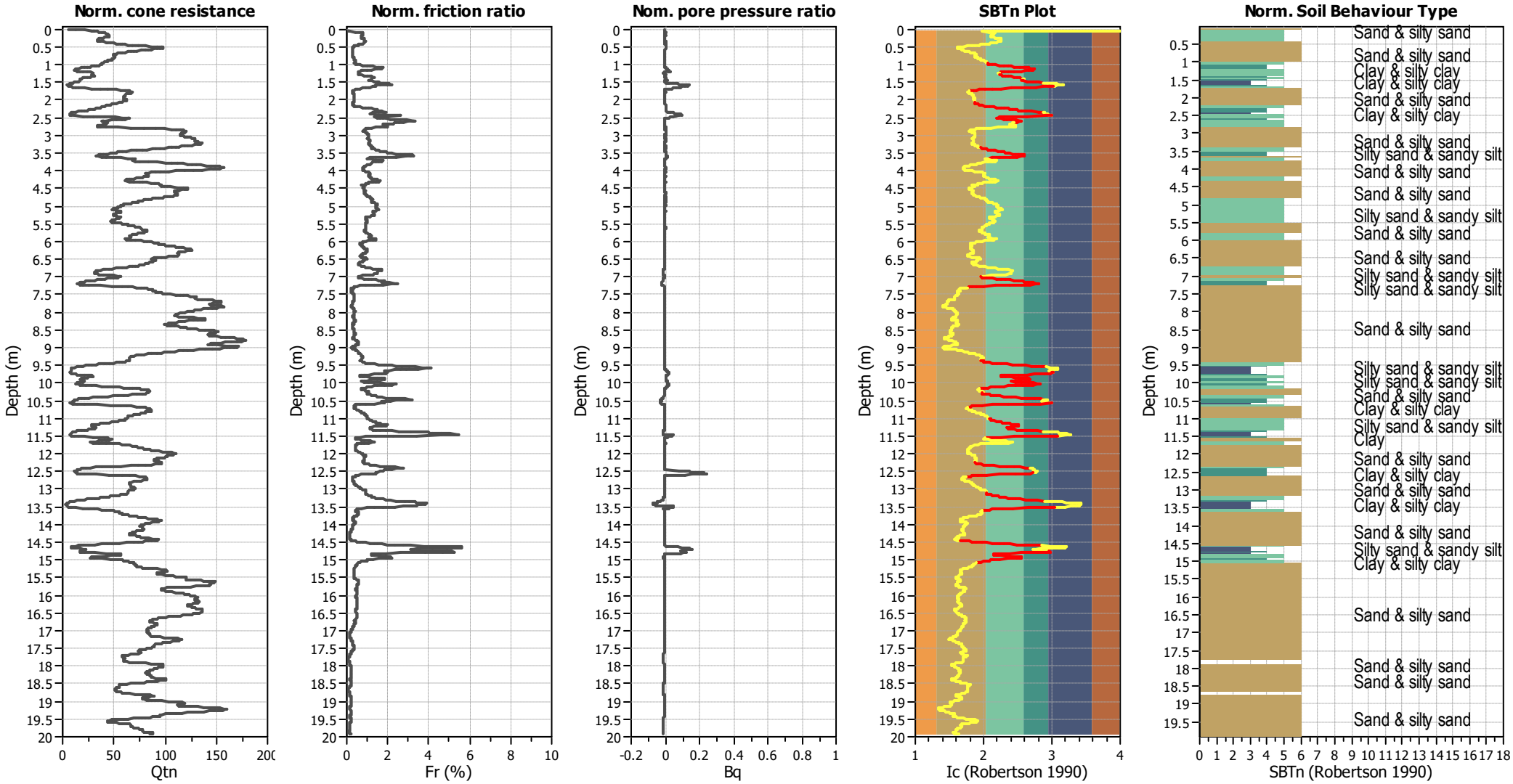
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



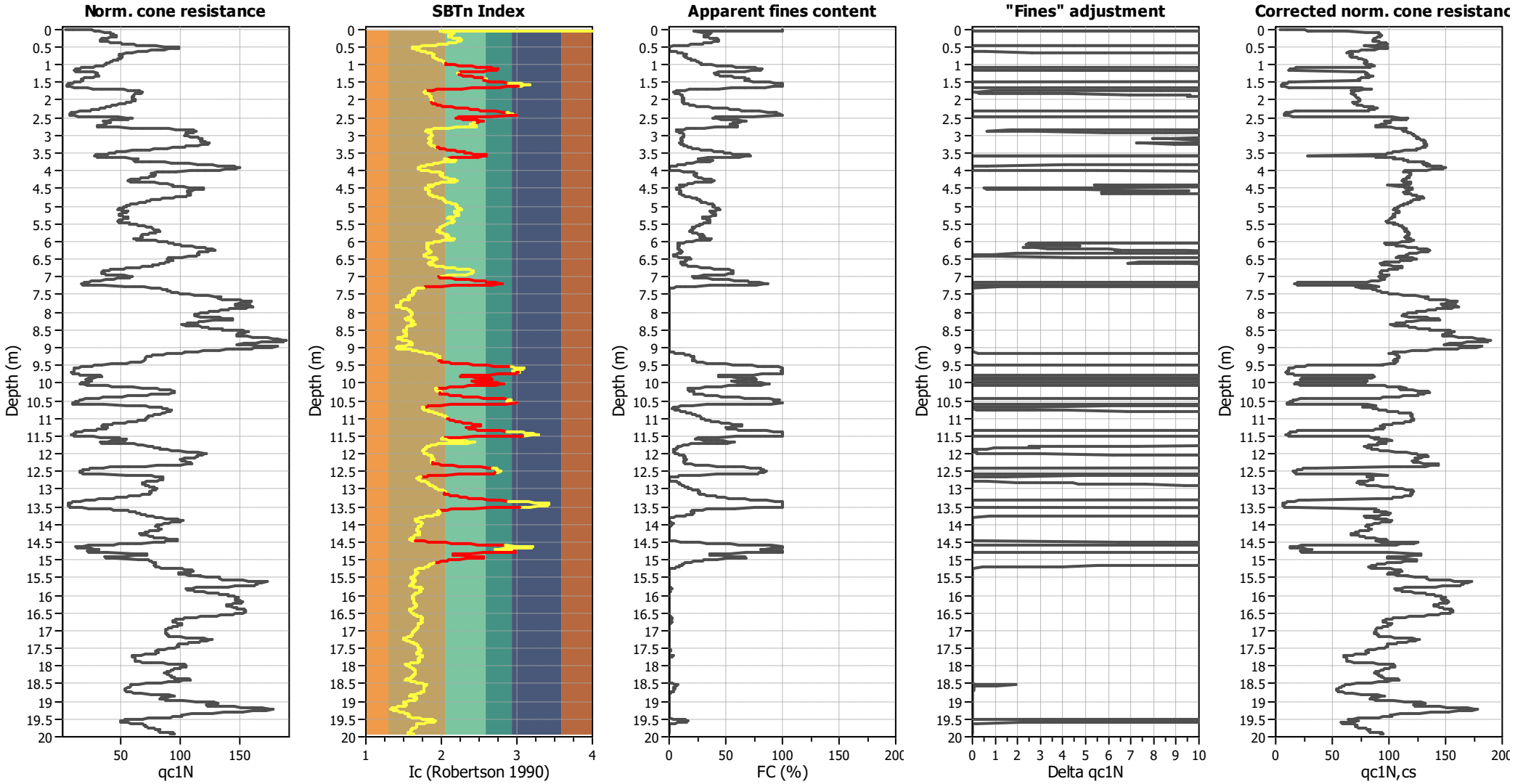
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

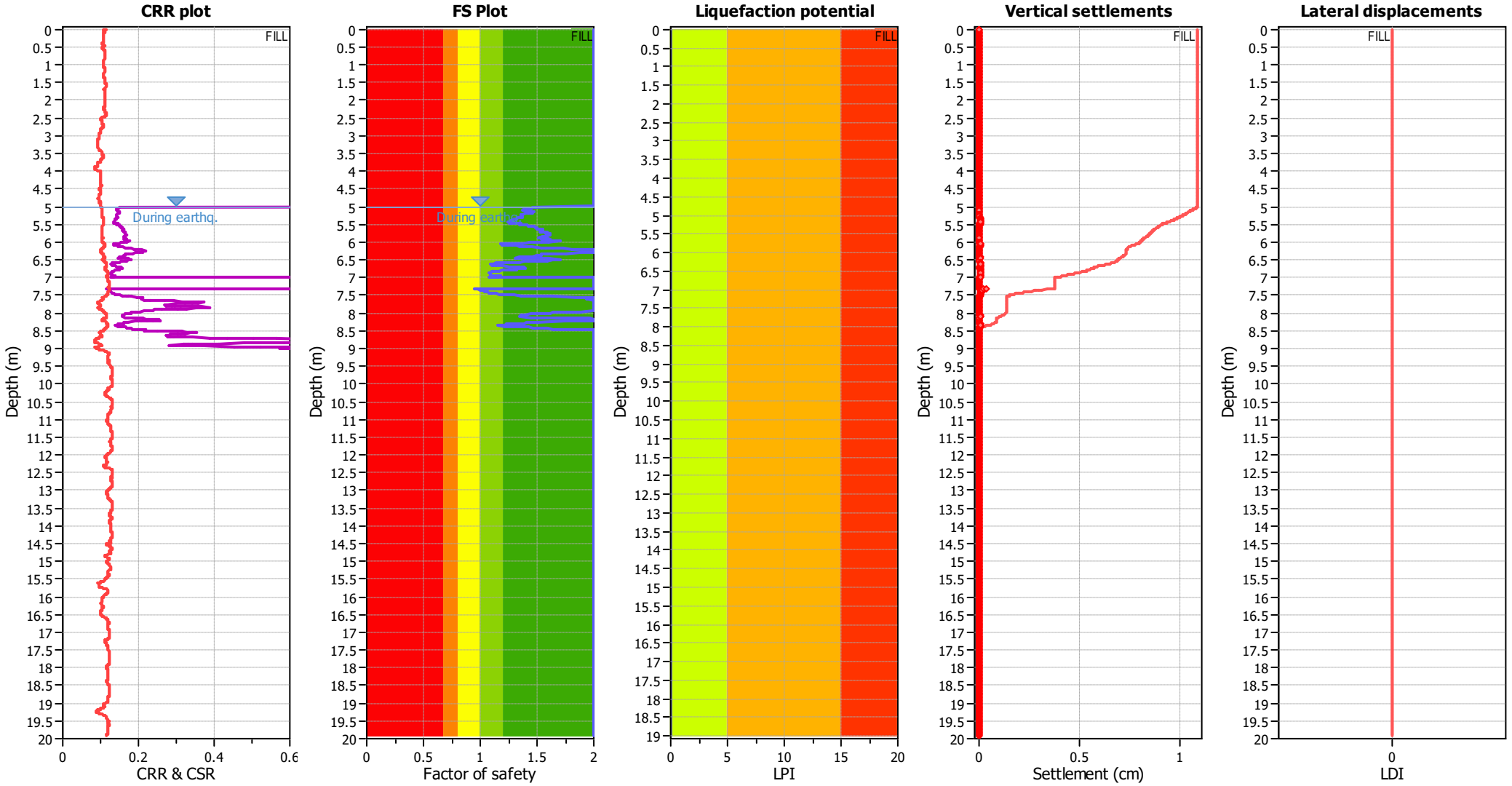
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

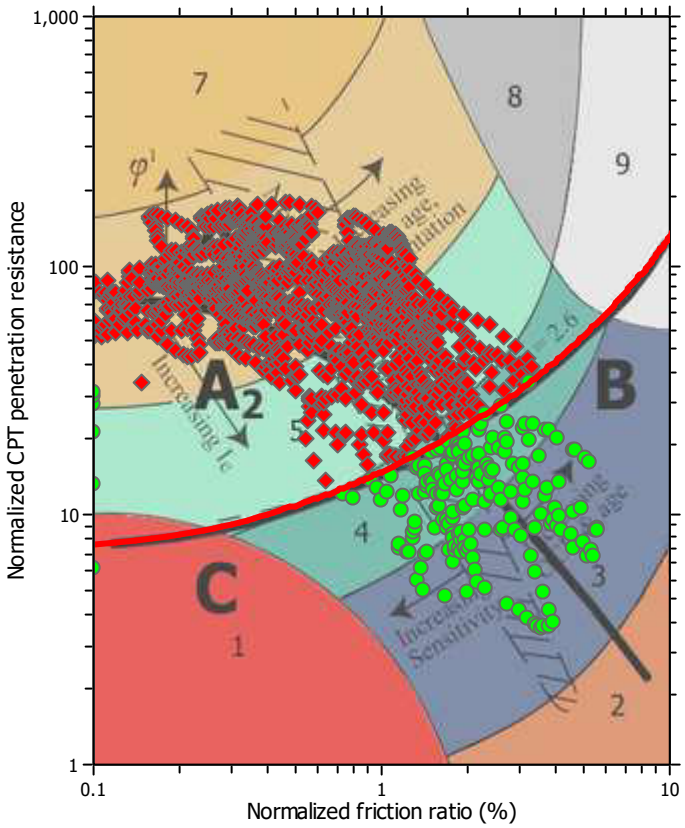
F.S. color scheme

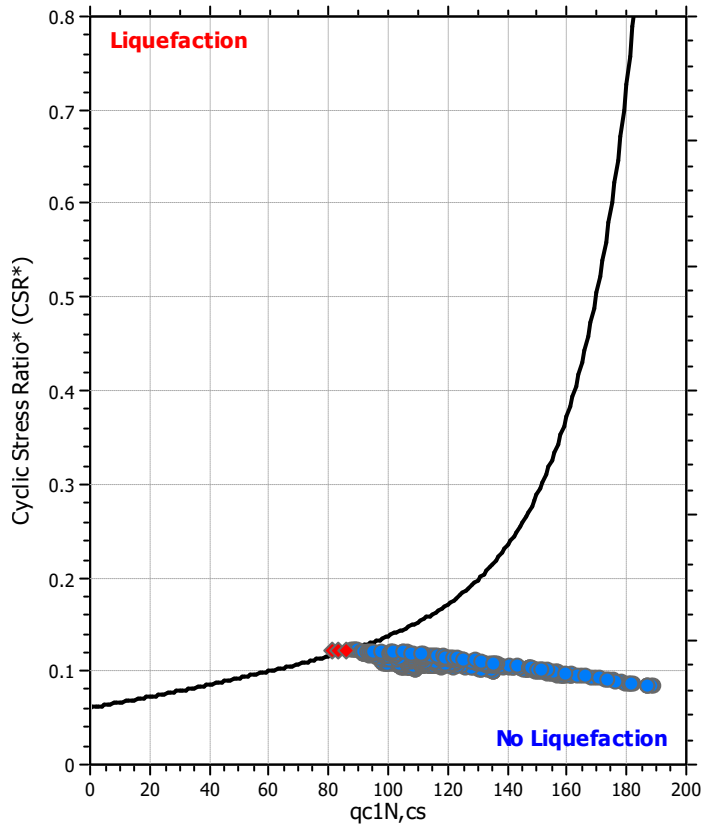
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

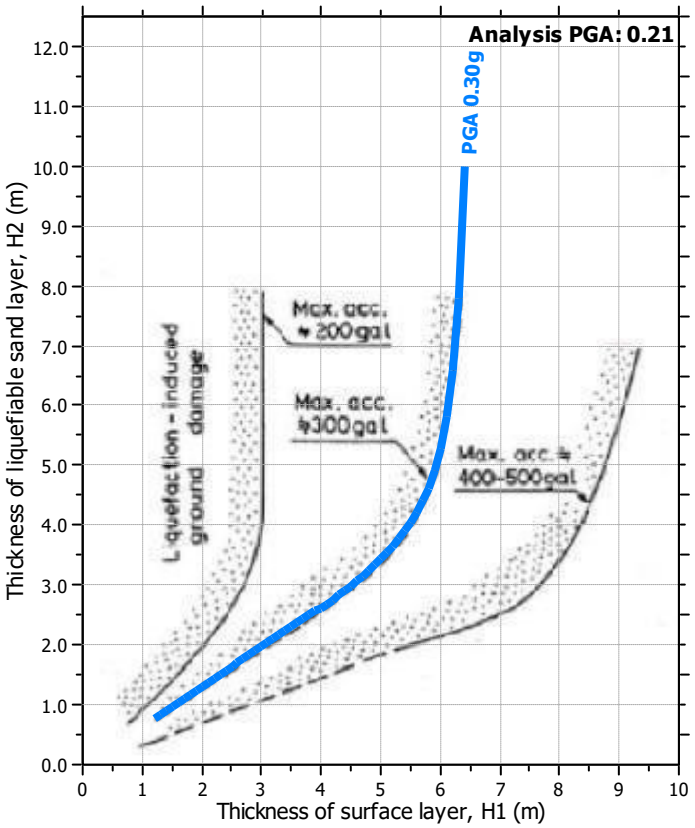
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



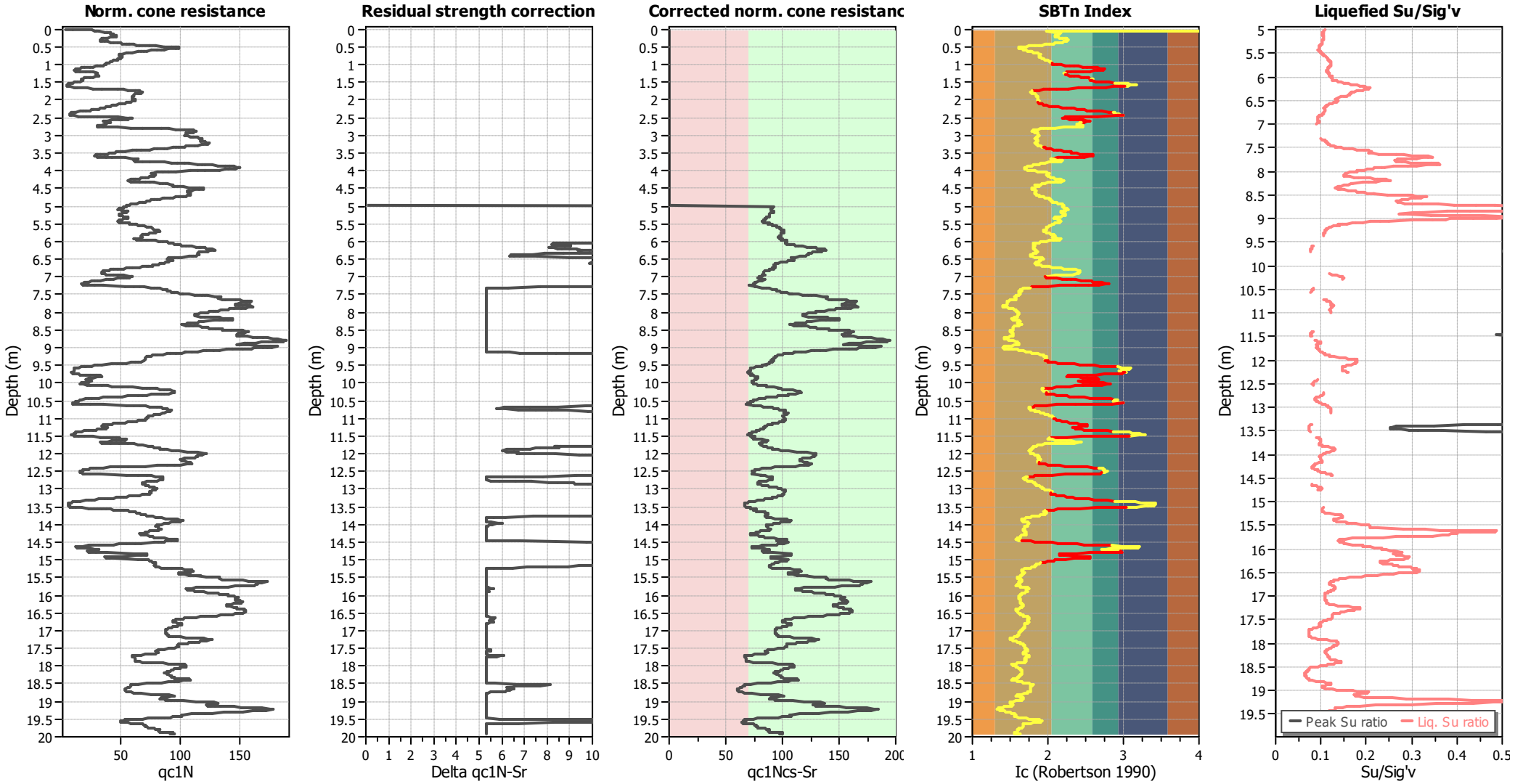




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

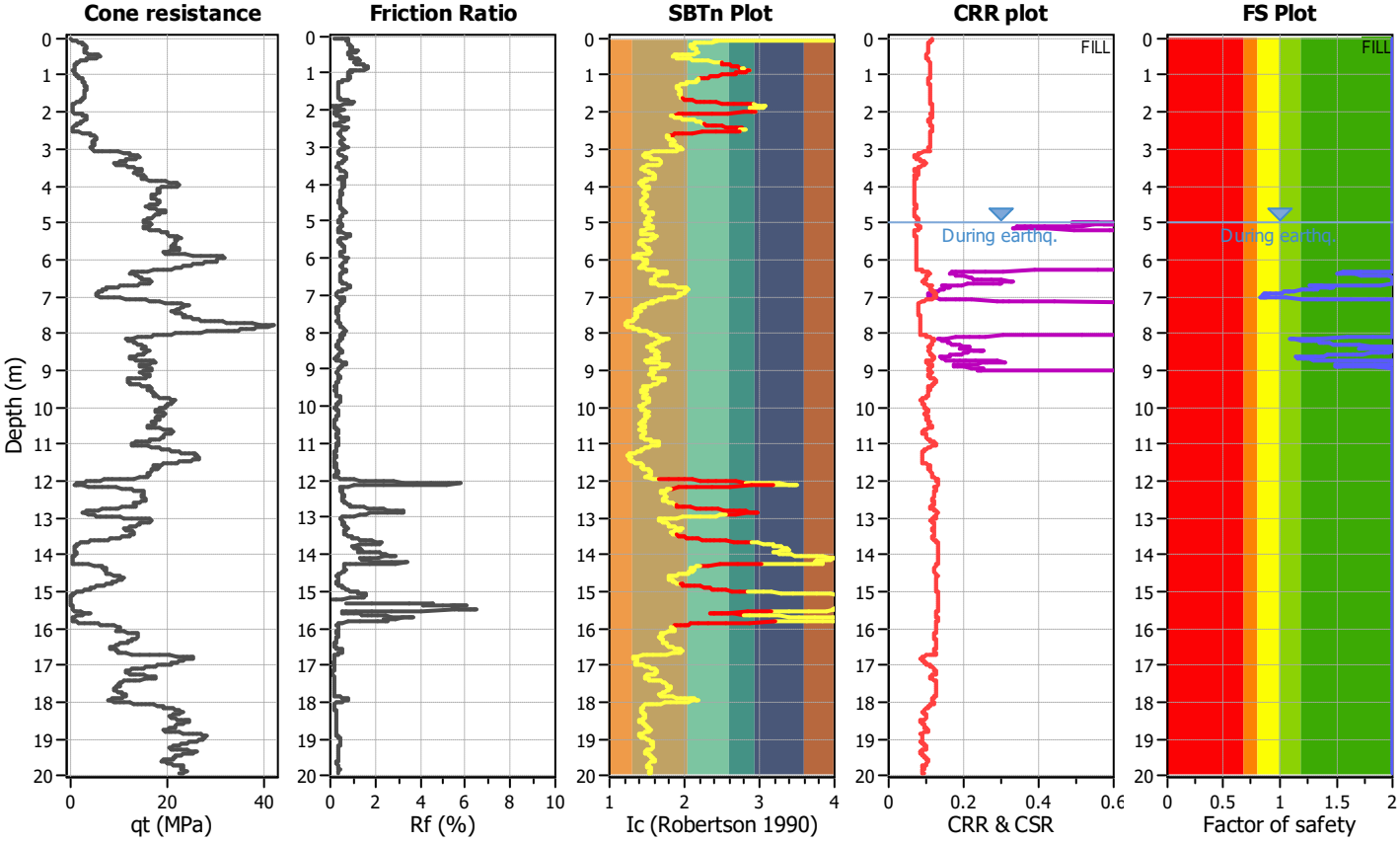
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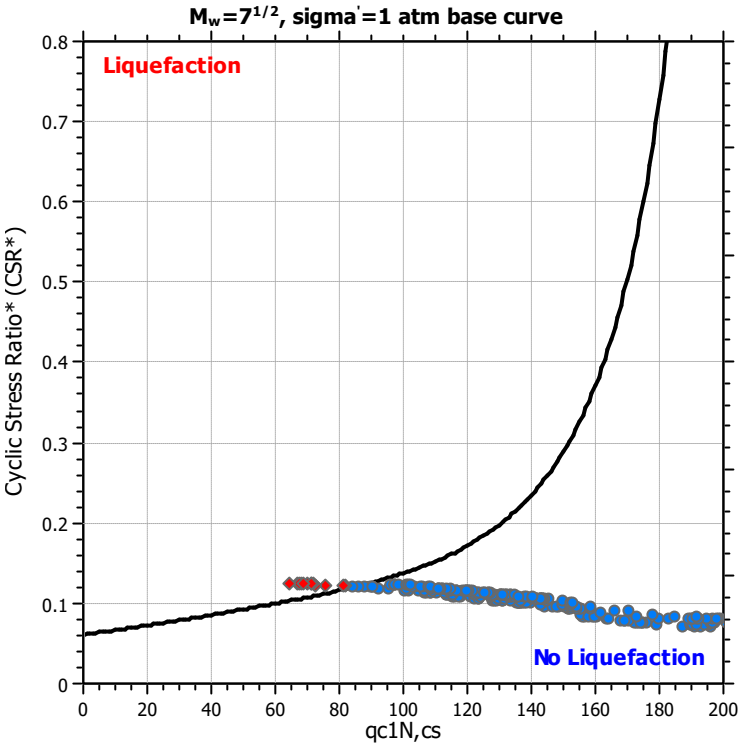
LIQUEFACTION ANALYSIS REPORT

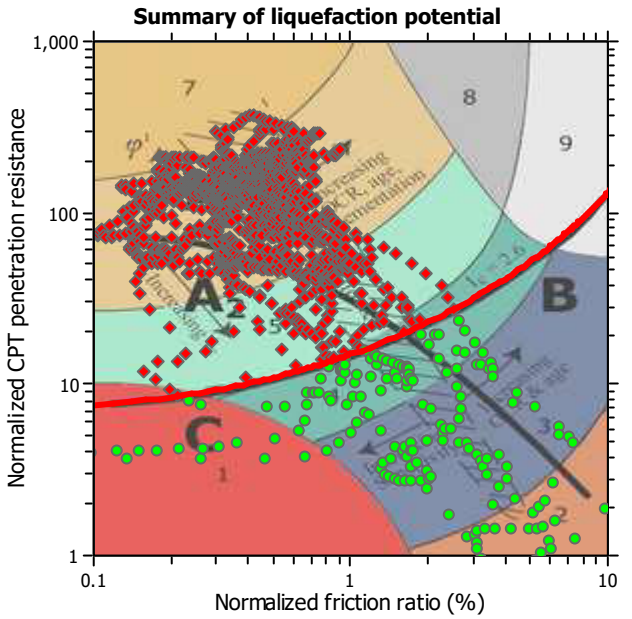
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 6

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

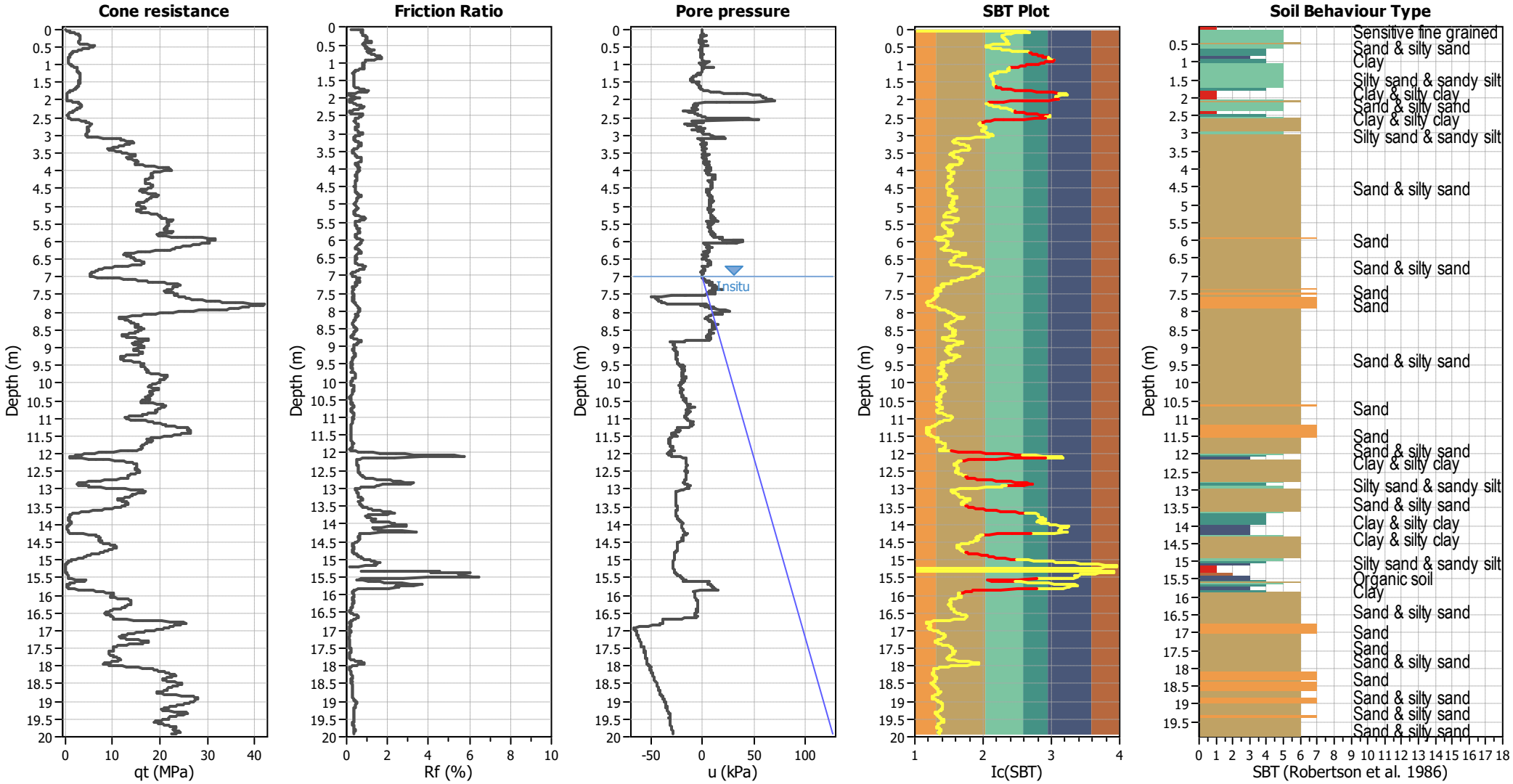






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



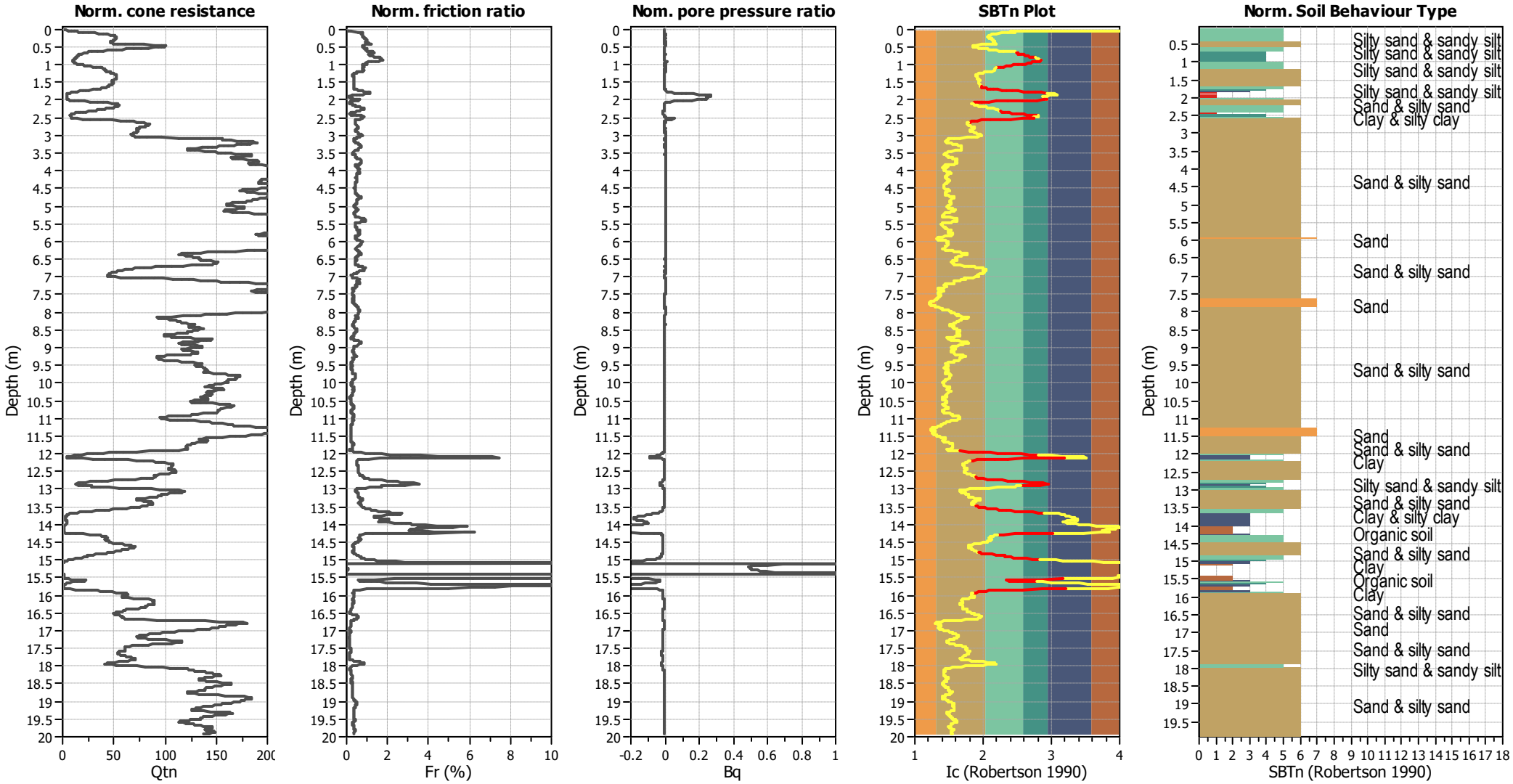
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



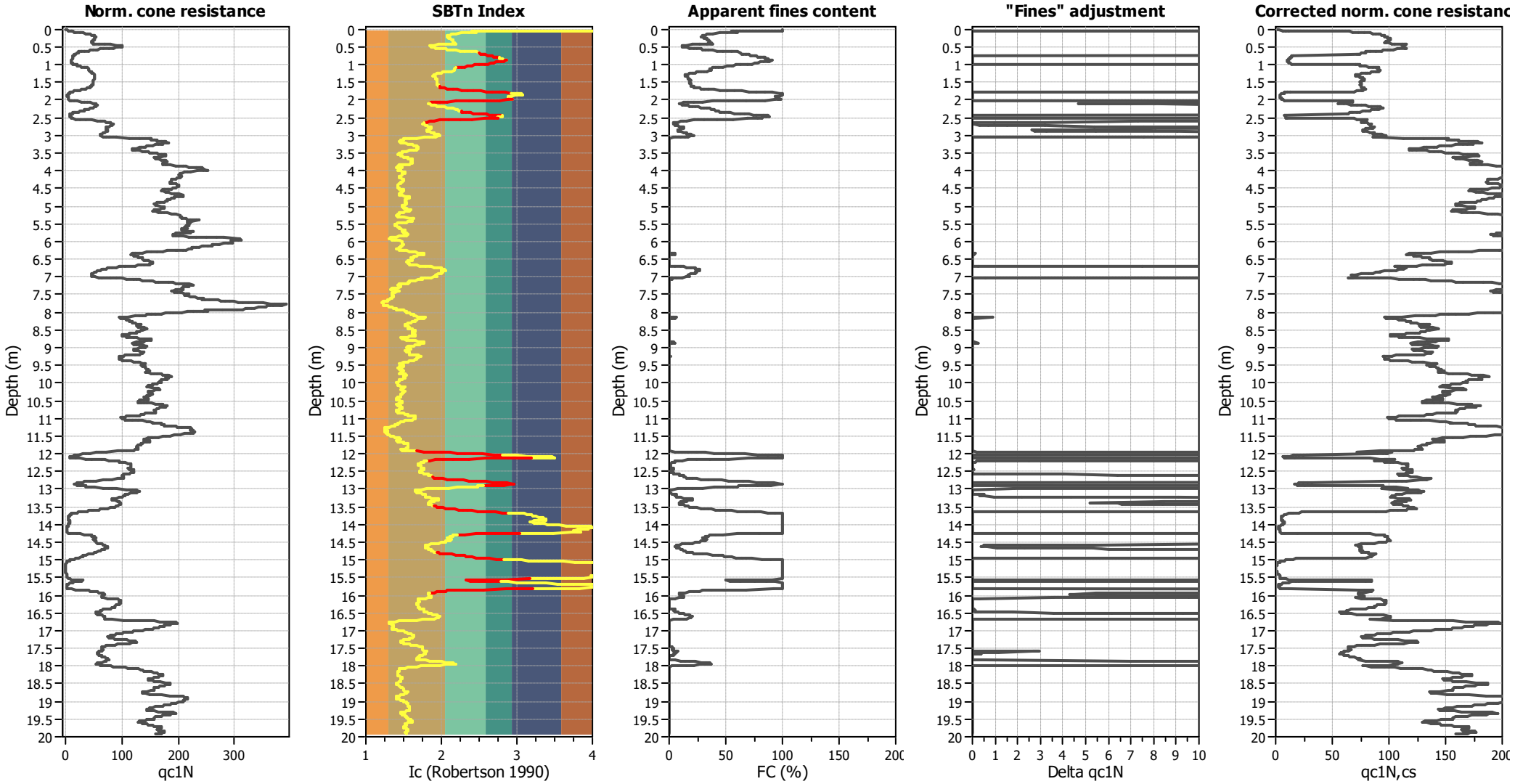
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

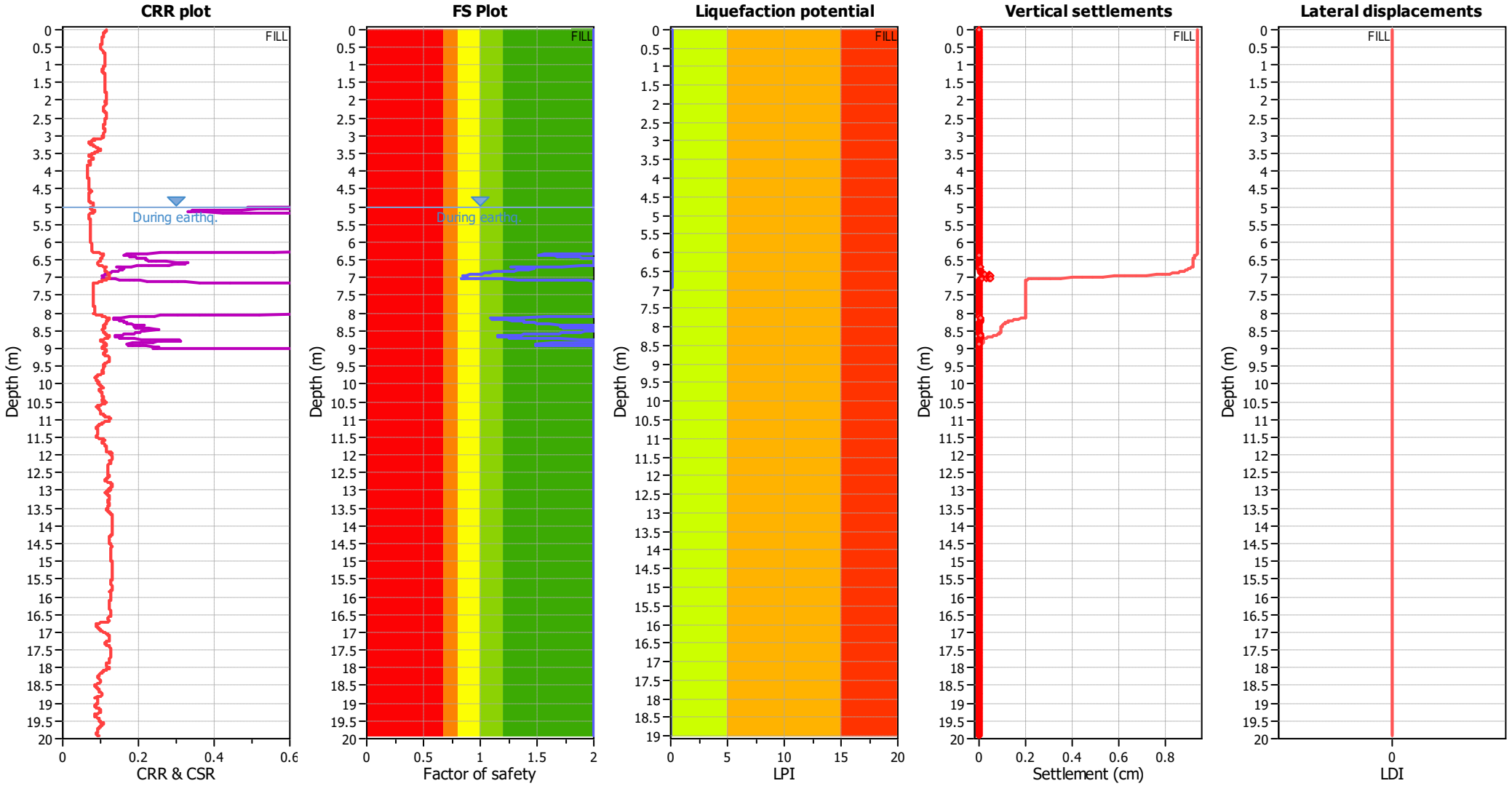
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

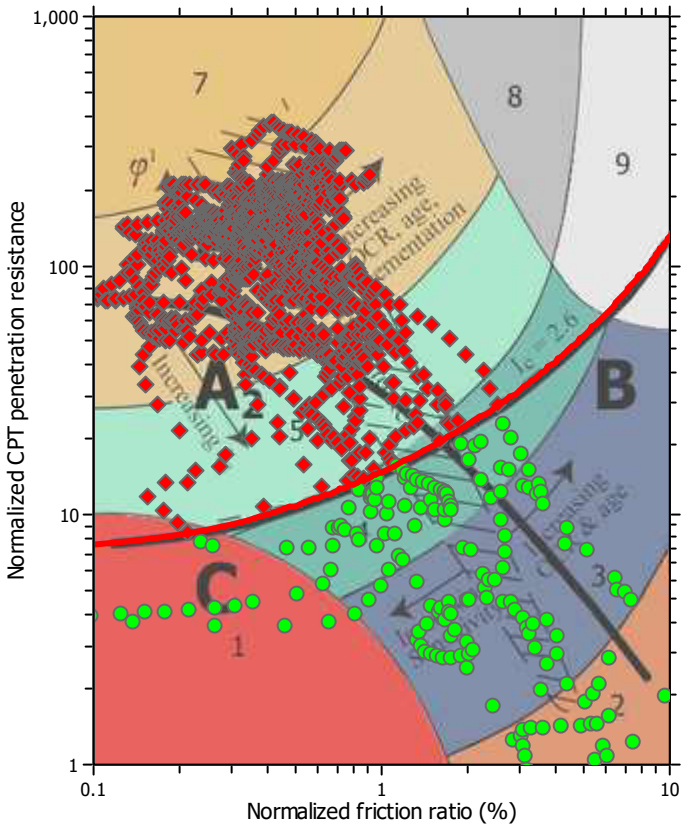
F.S. color scheme

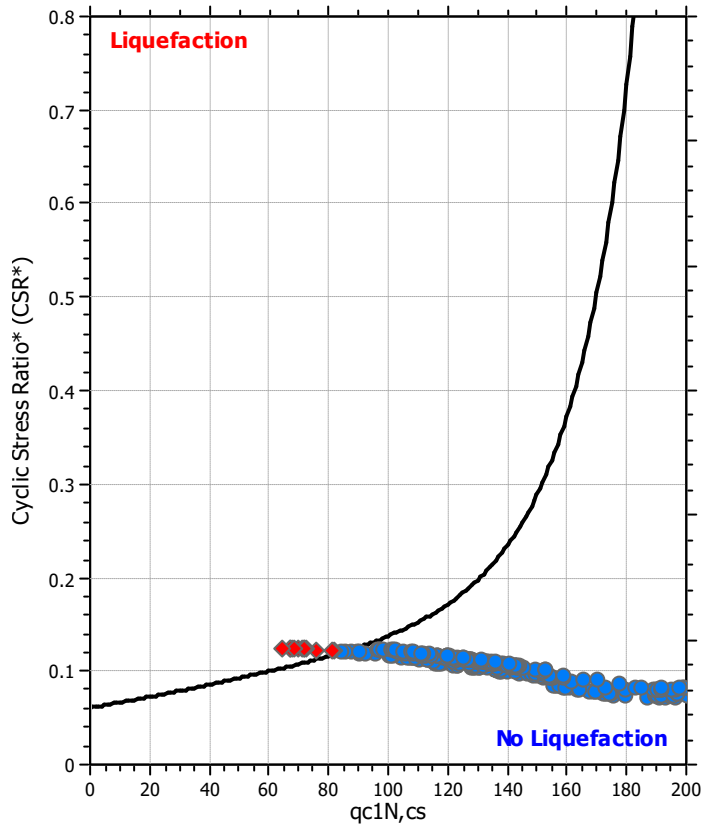
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

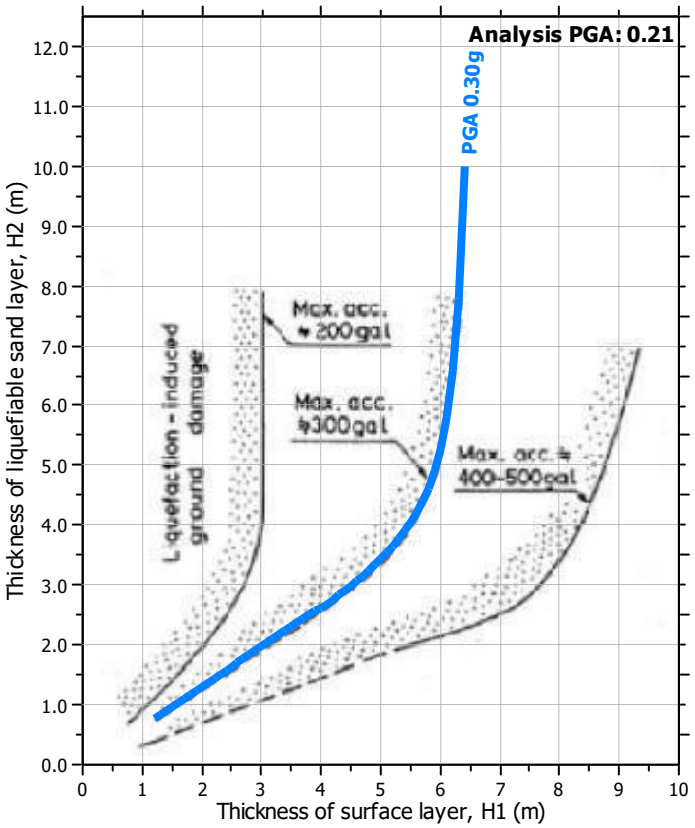
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



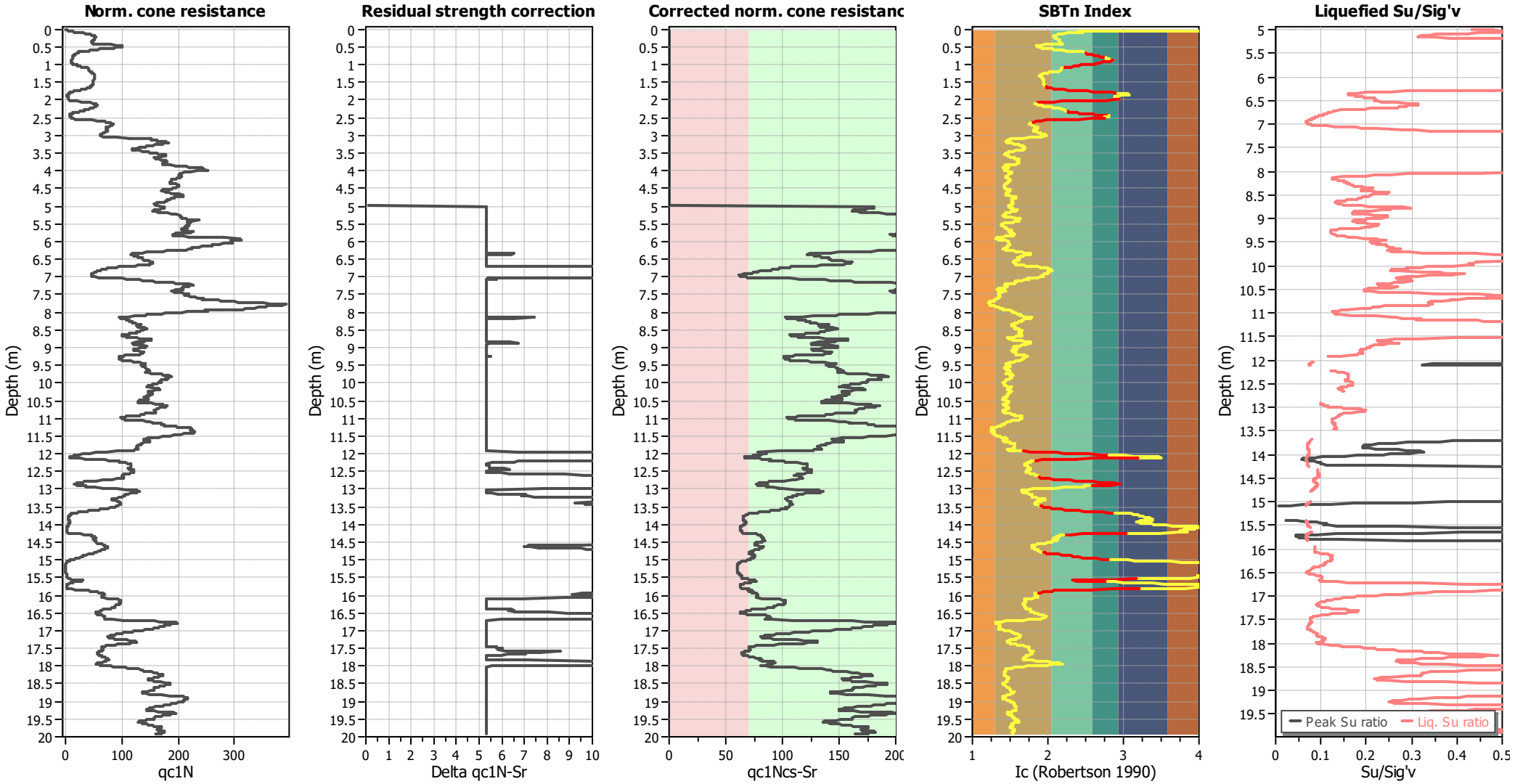




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

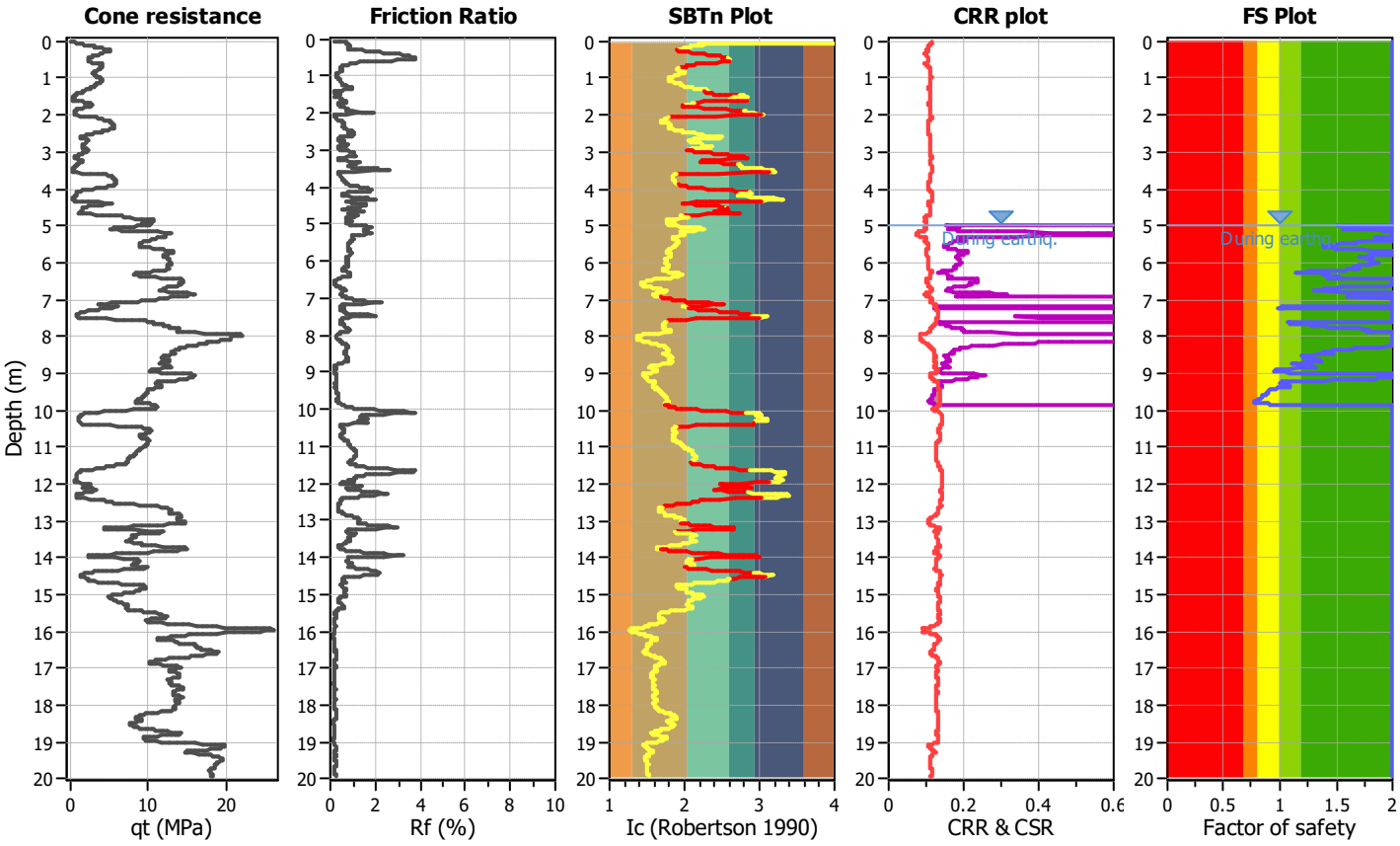
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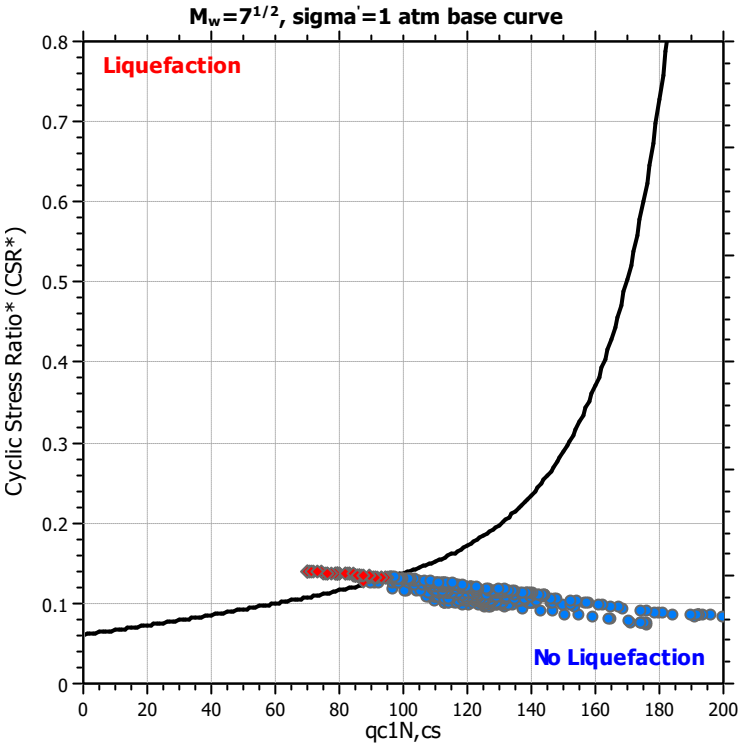
LIQUEFACTION ANALYSIS REPORT

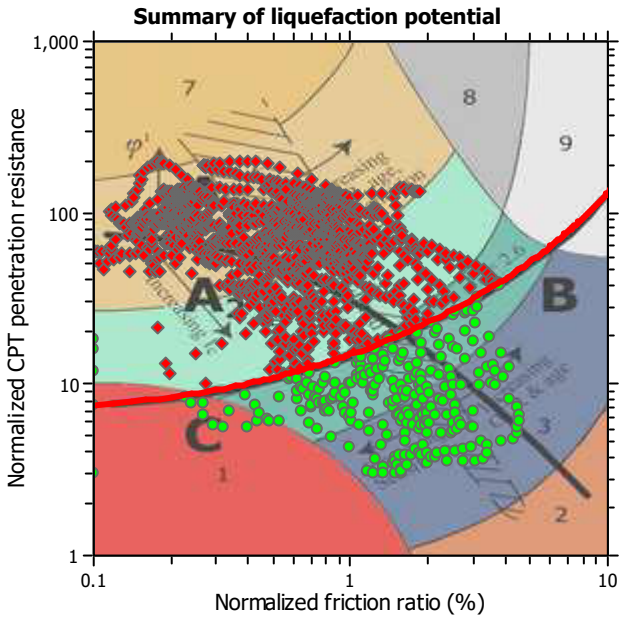
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 7

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

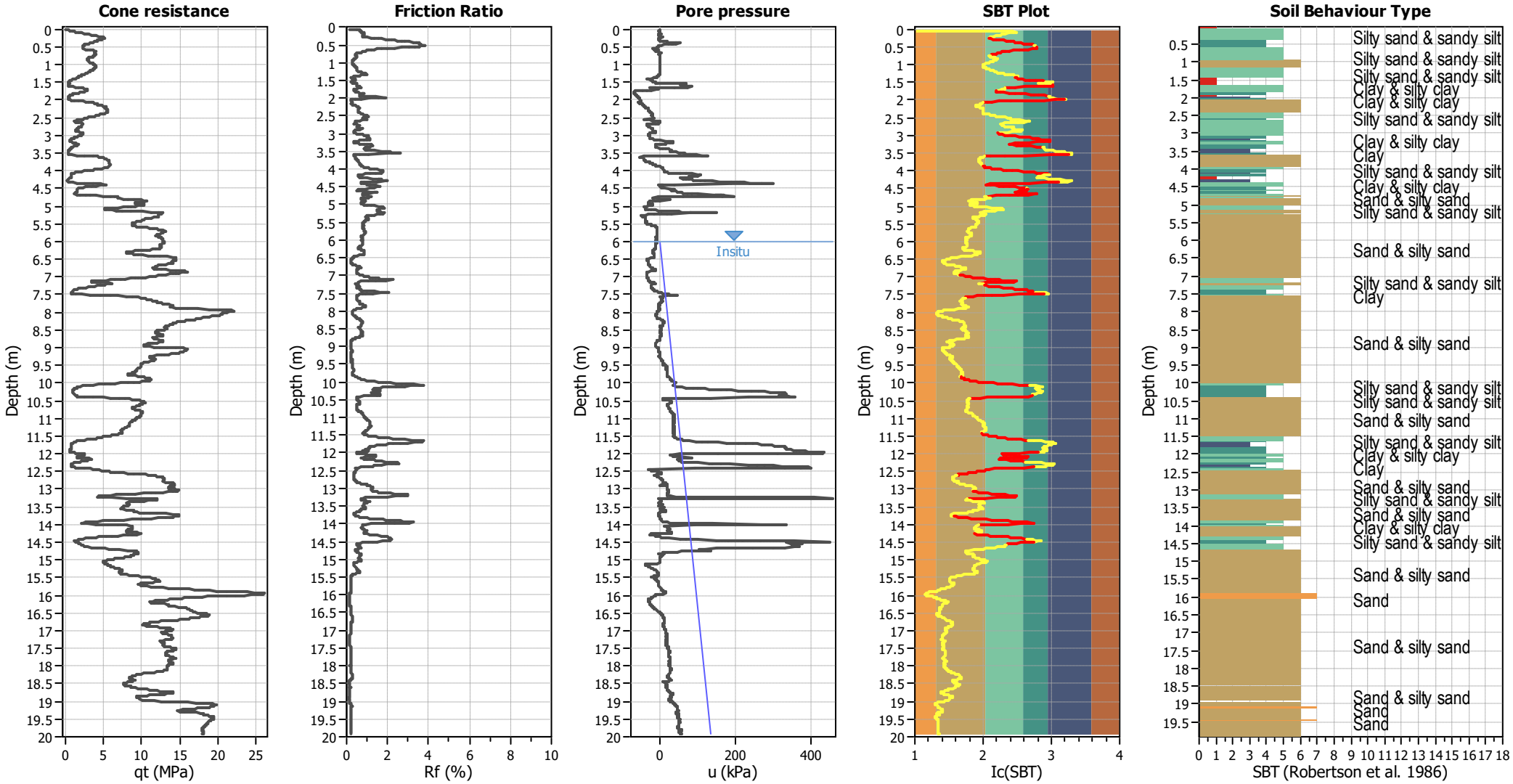






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



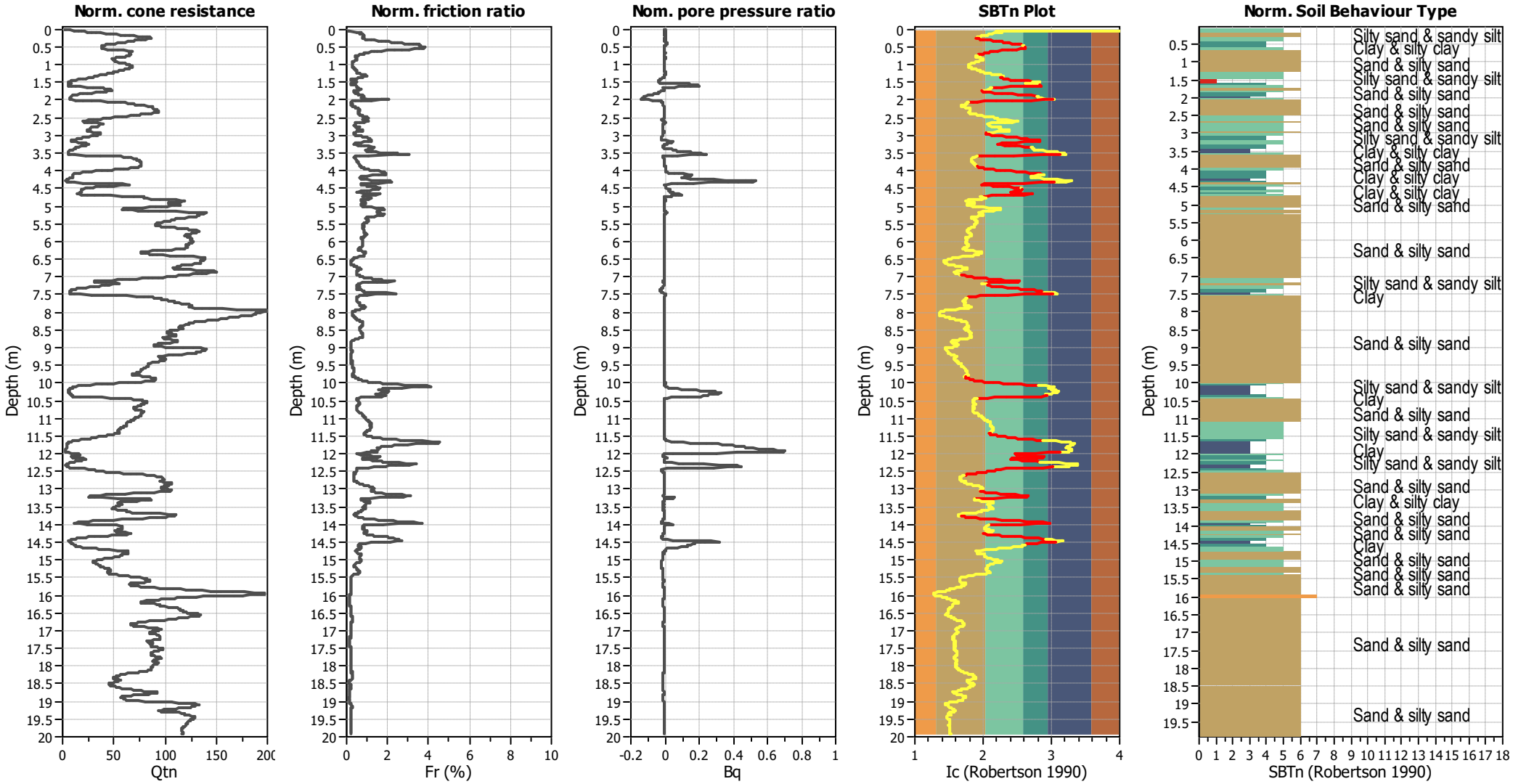
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



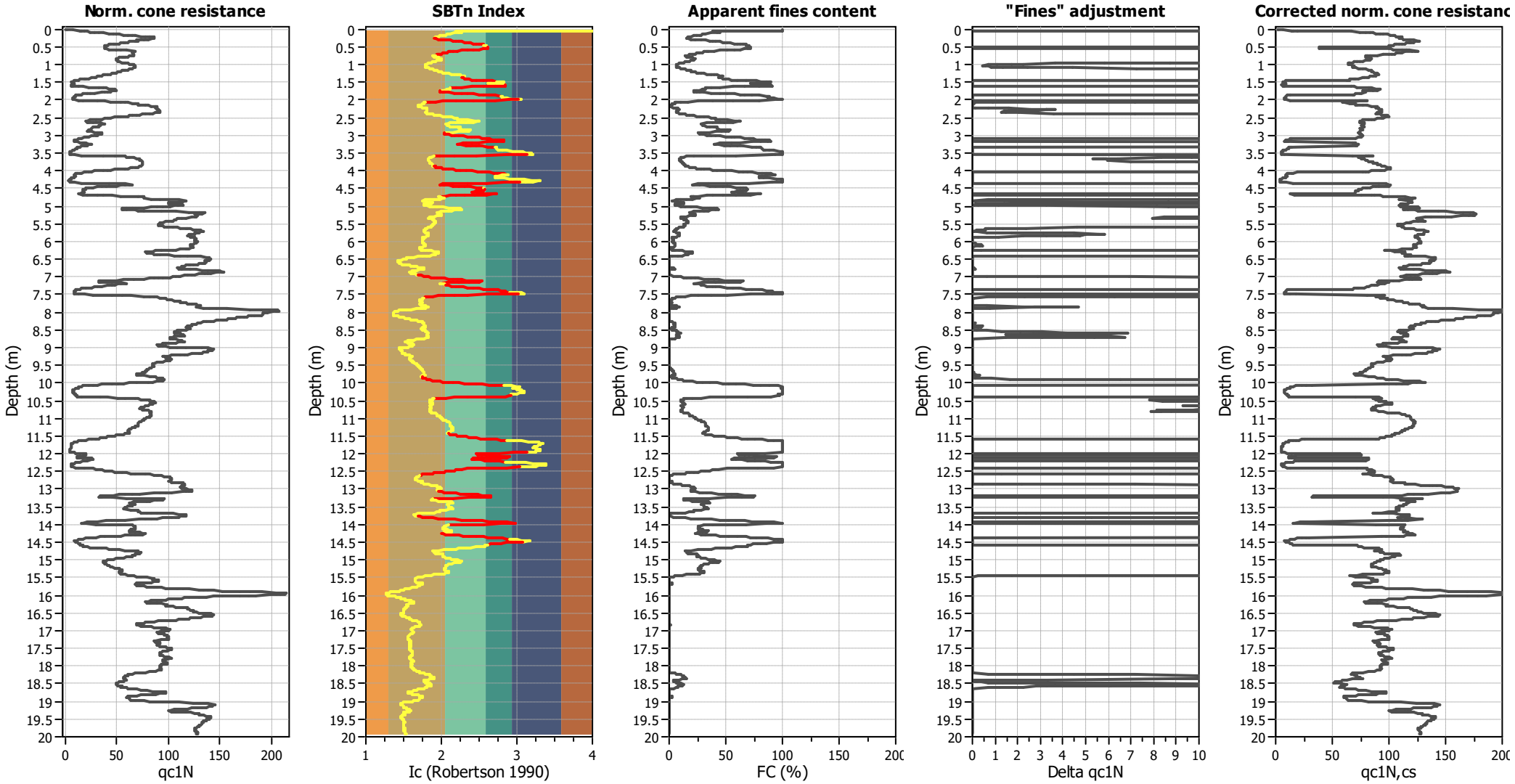
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

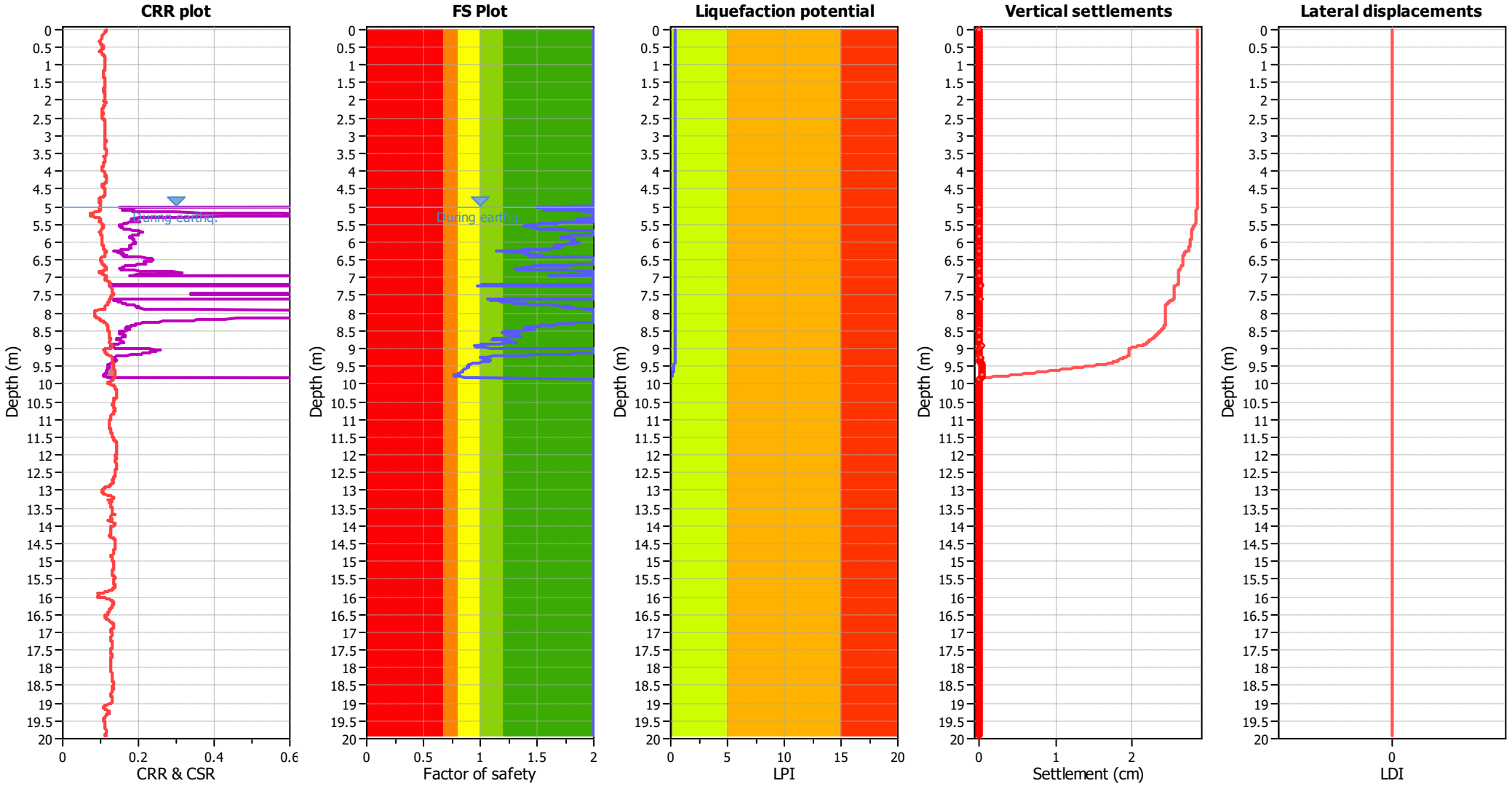
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

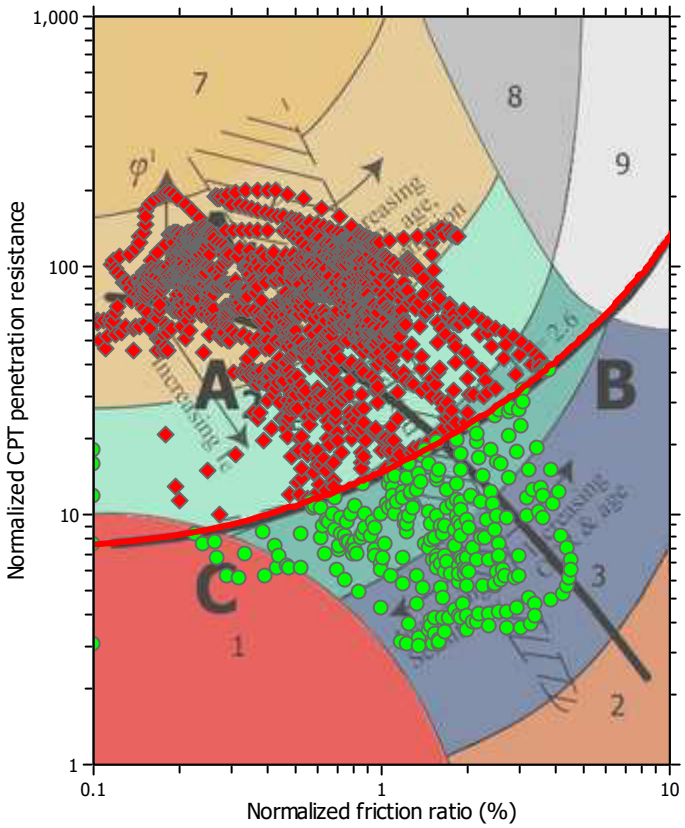
F.S. color scheme

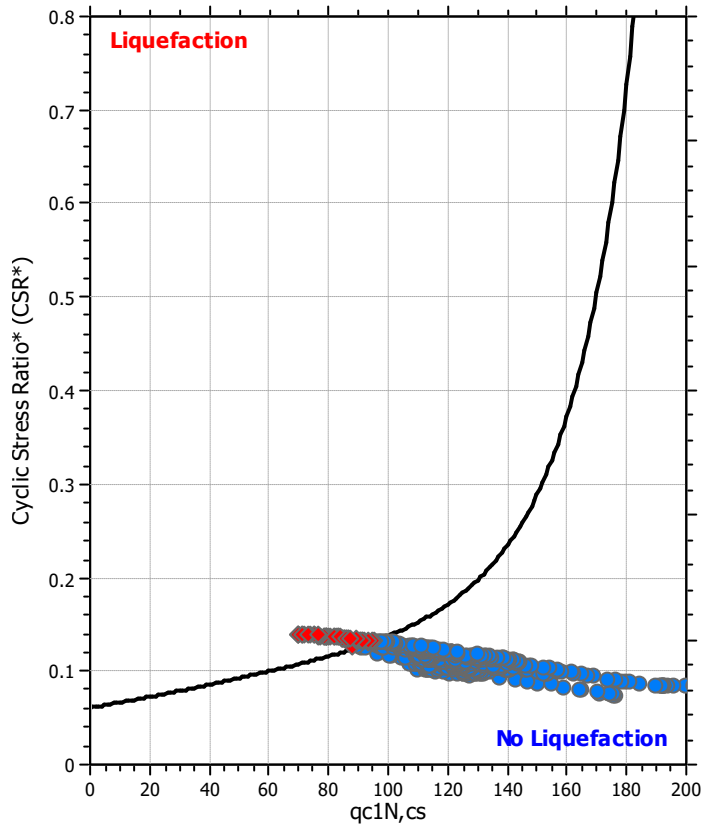
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

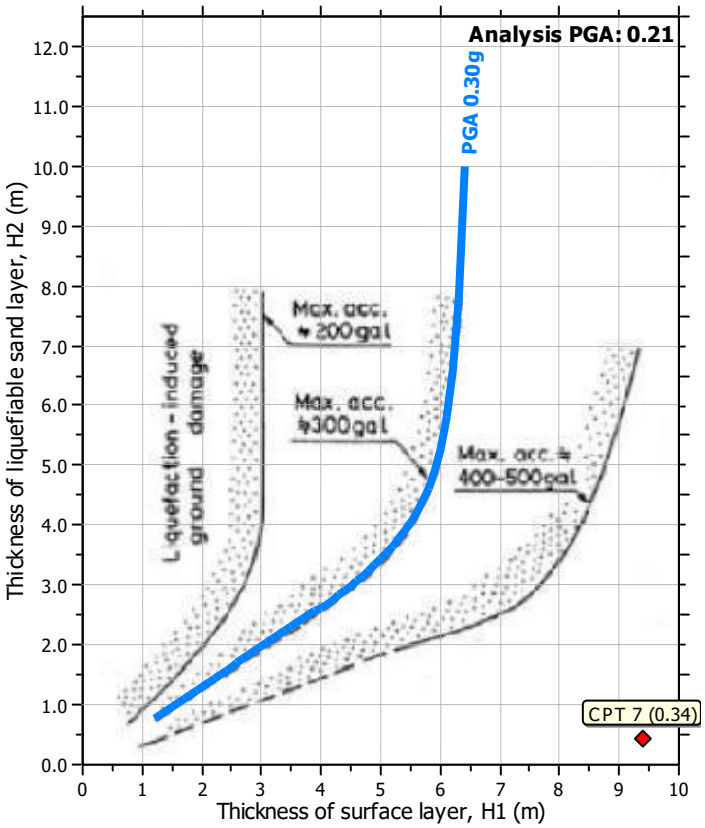
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



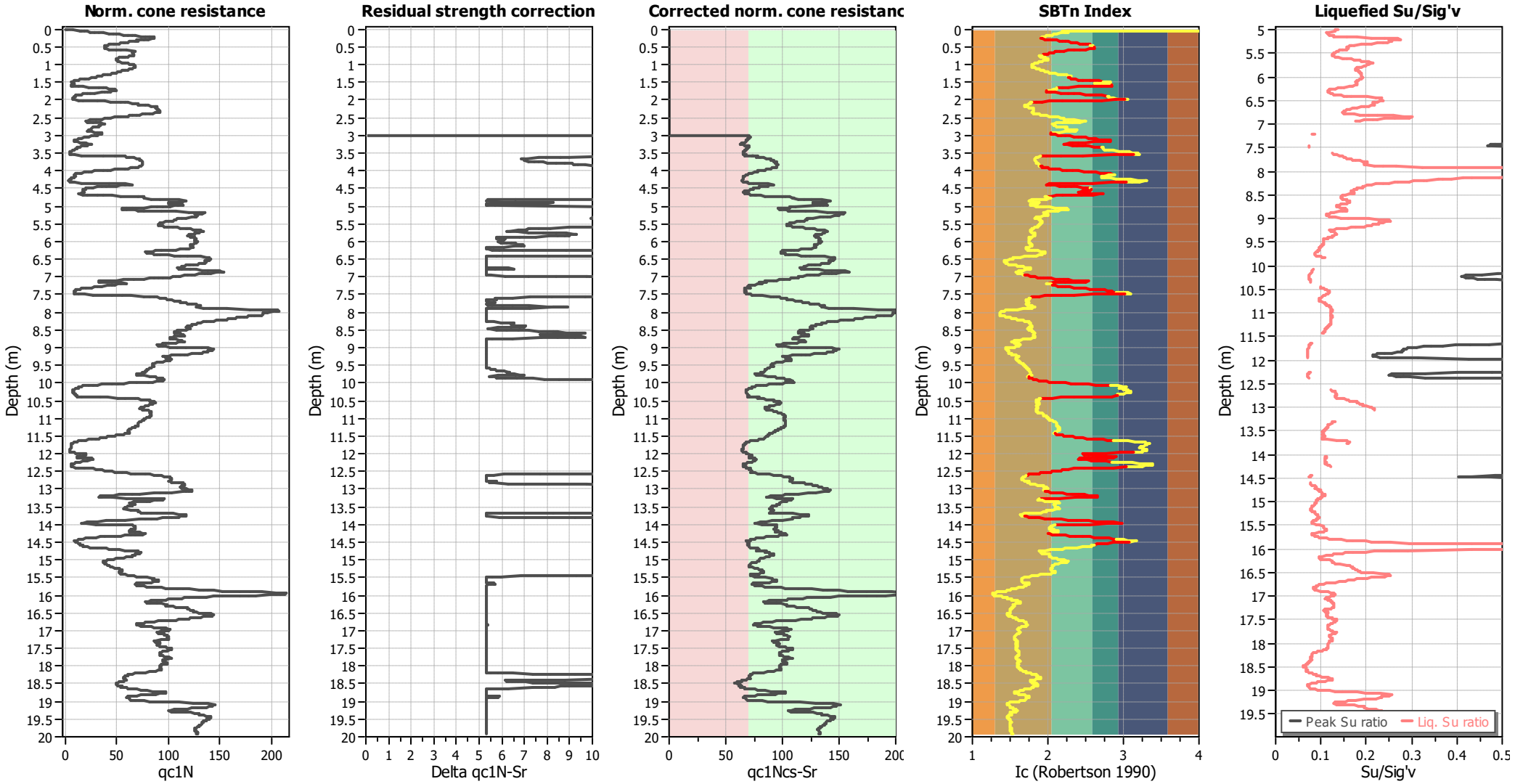




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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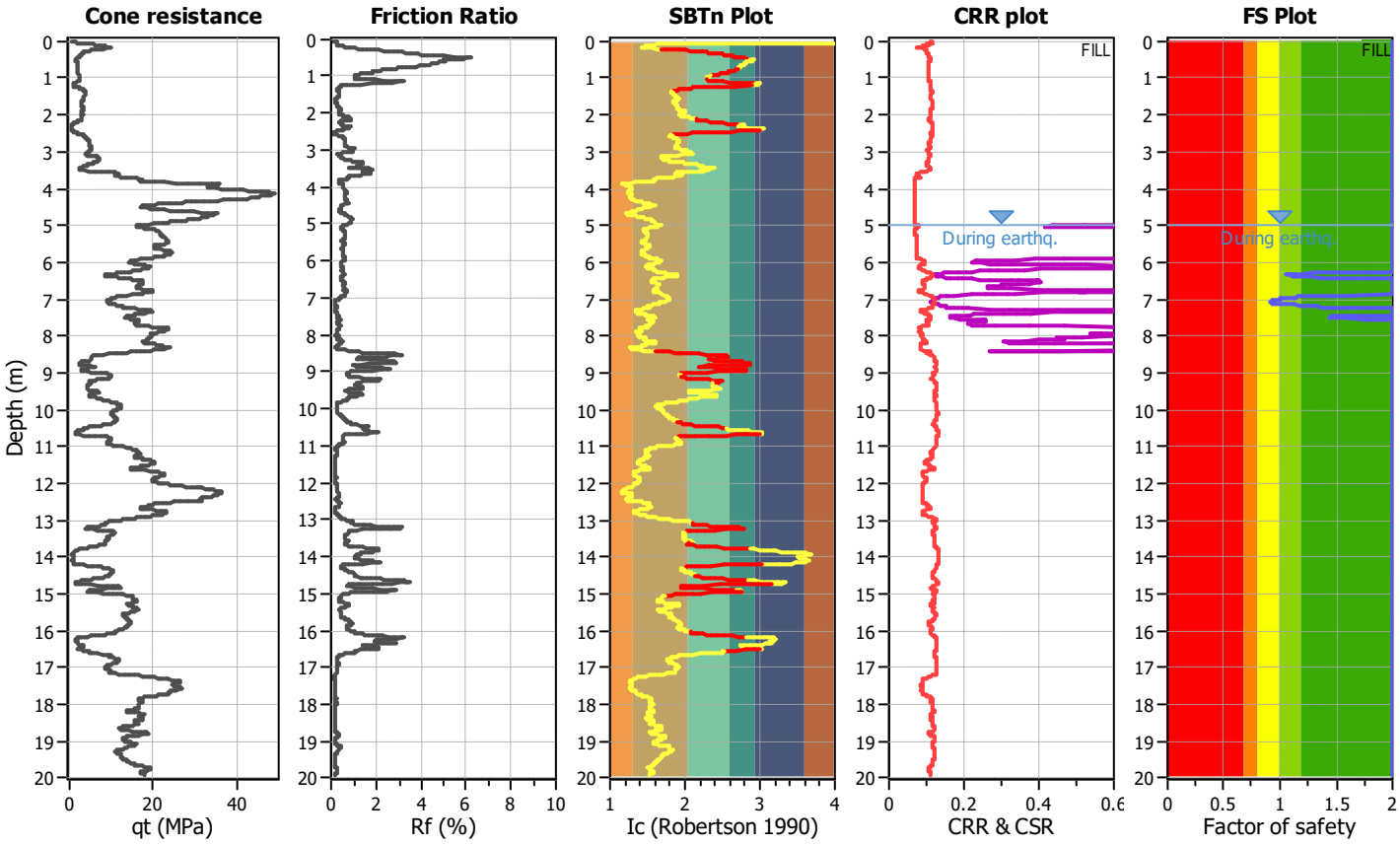
LIQUEFACTION ANALYSIS REPORT

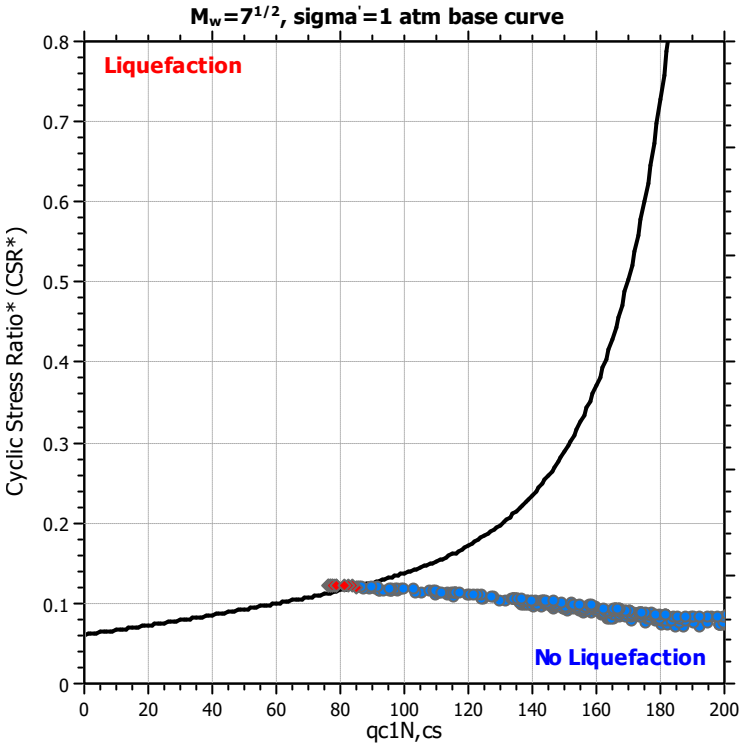
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**

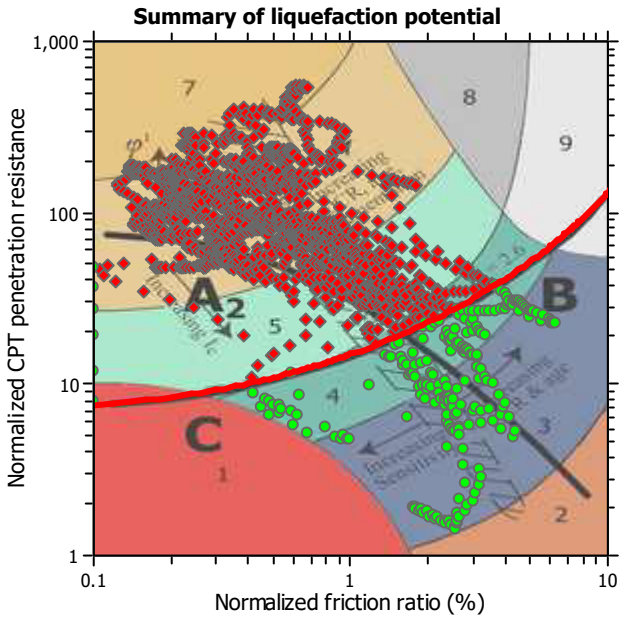
CPT file : CPT 8

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m³	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

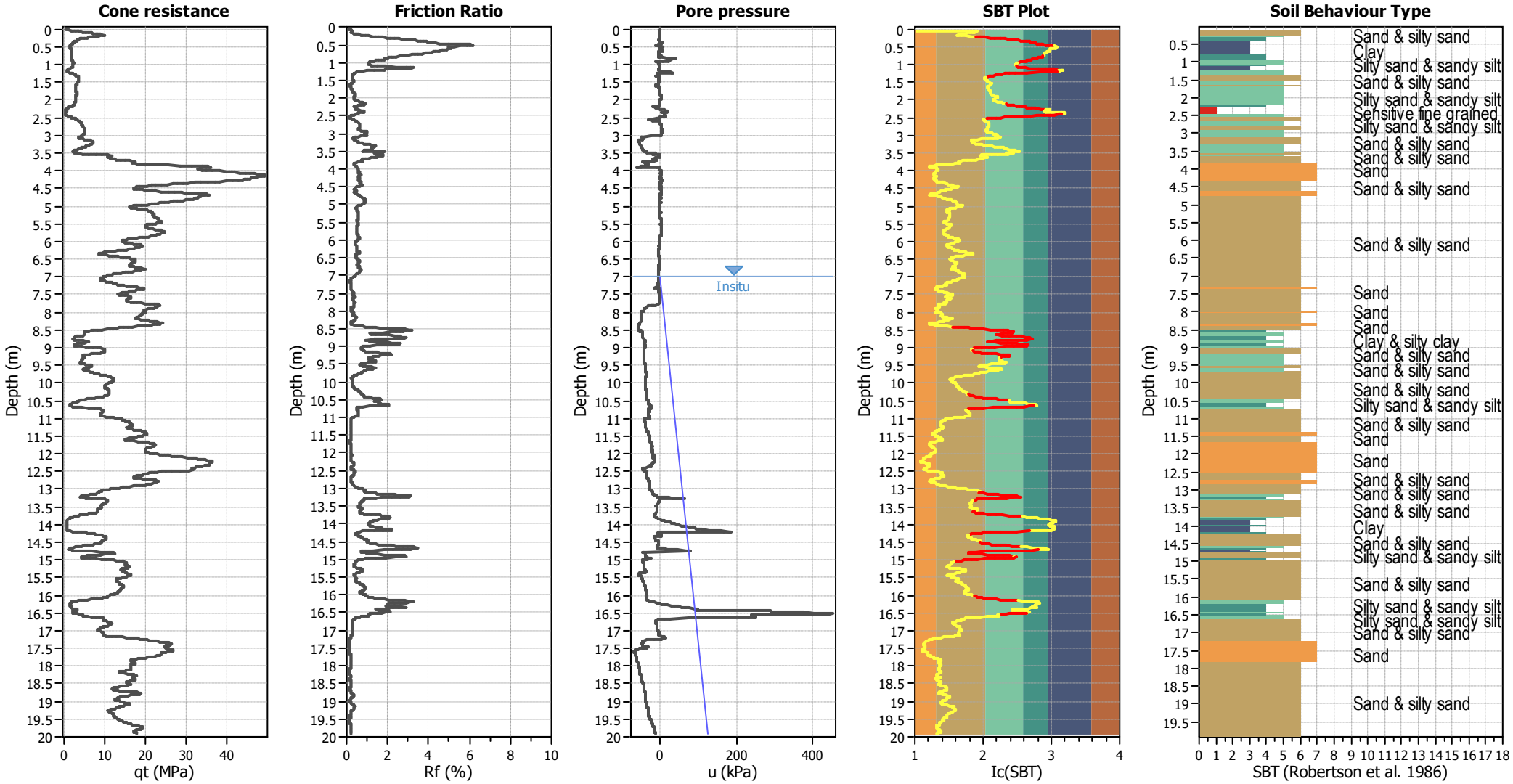






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



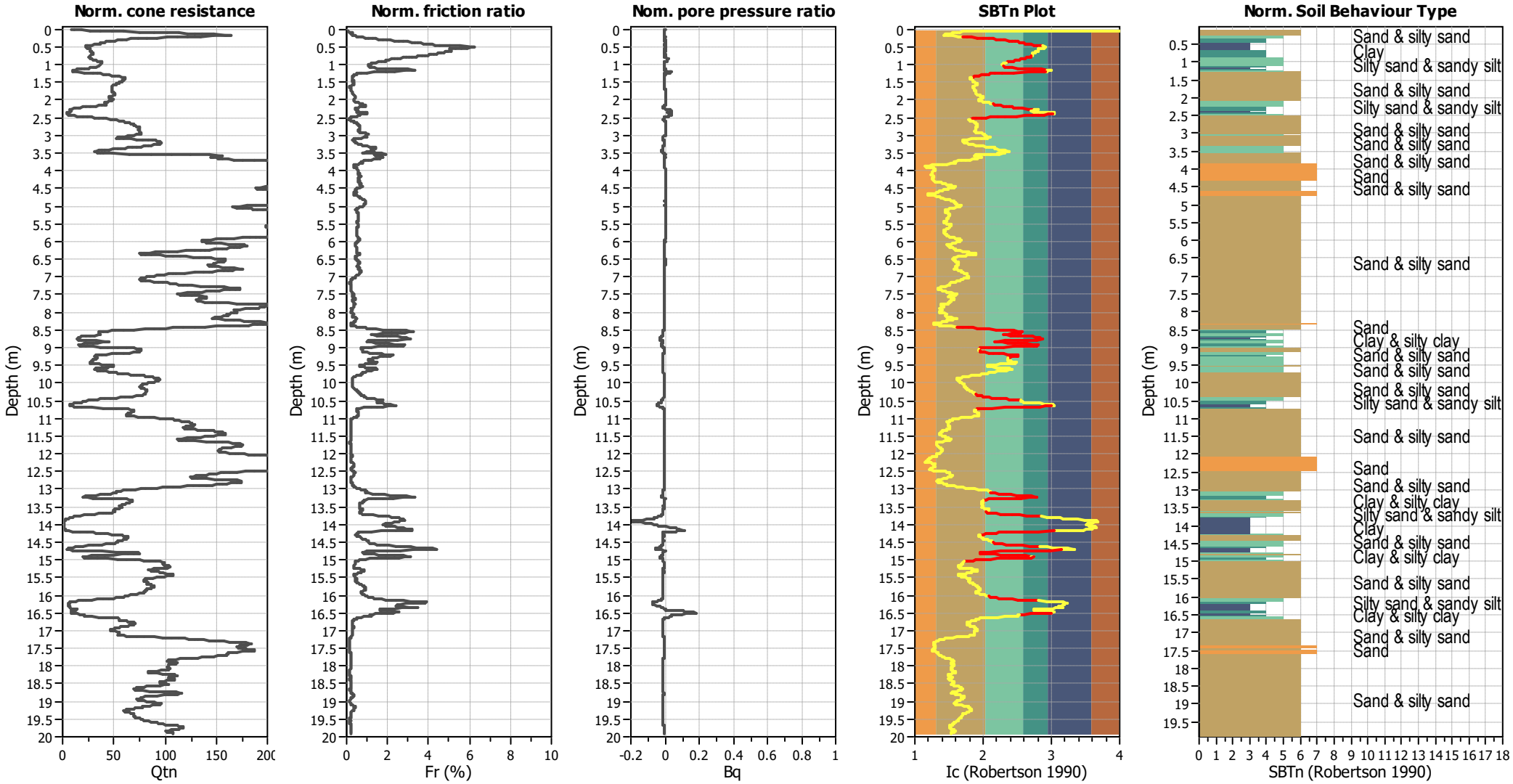
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



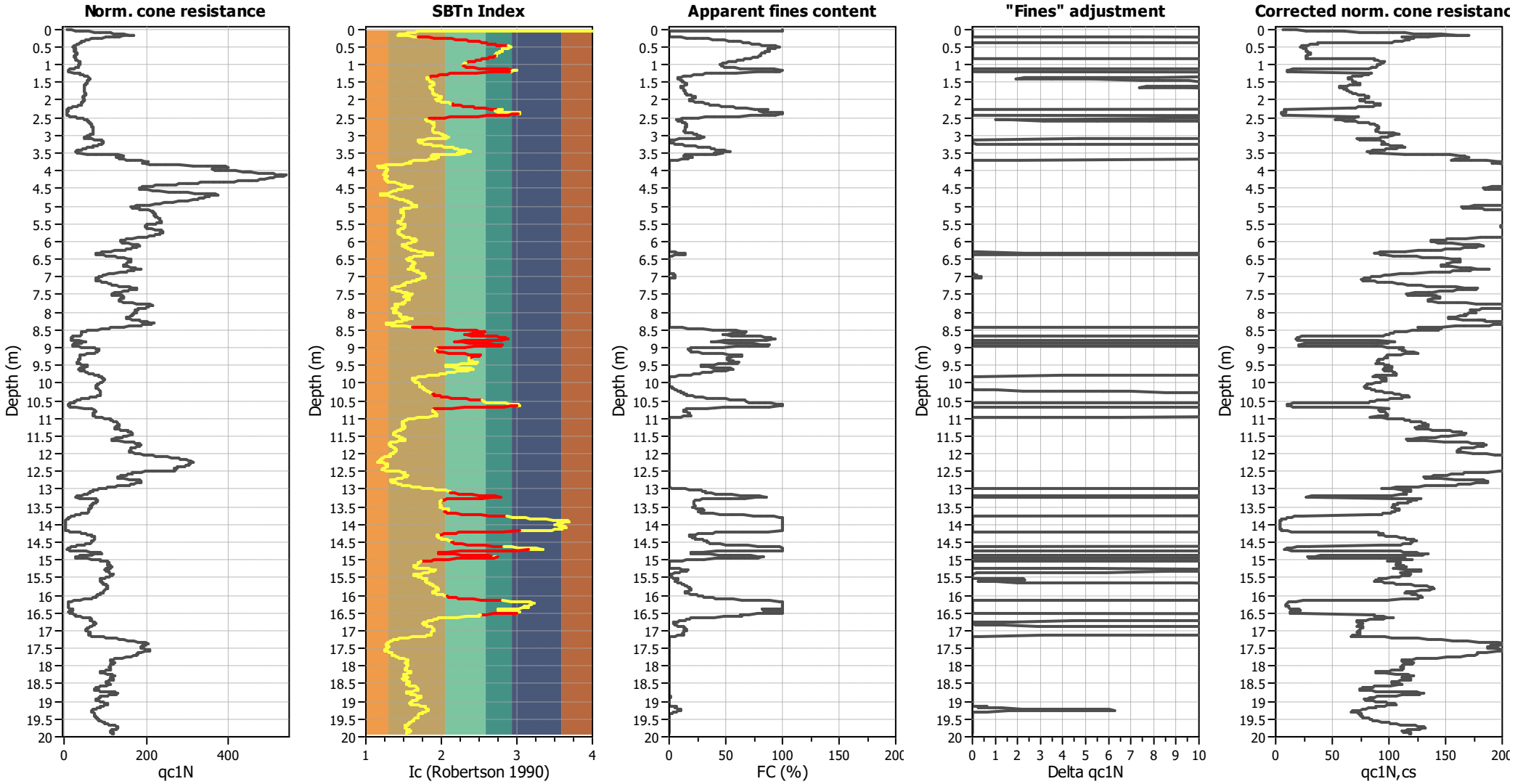
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

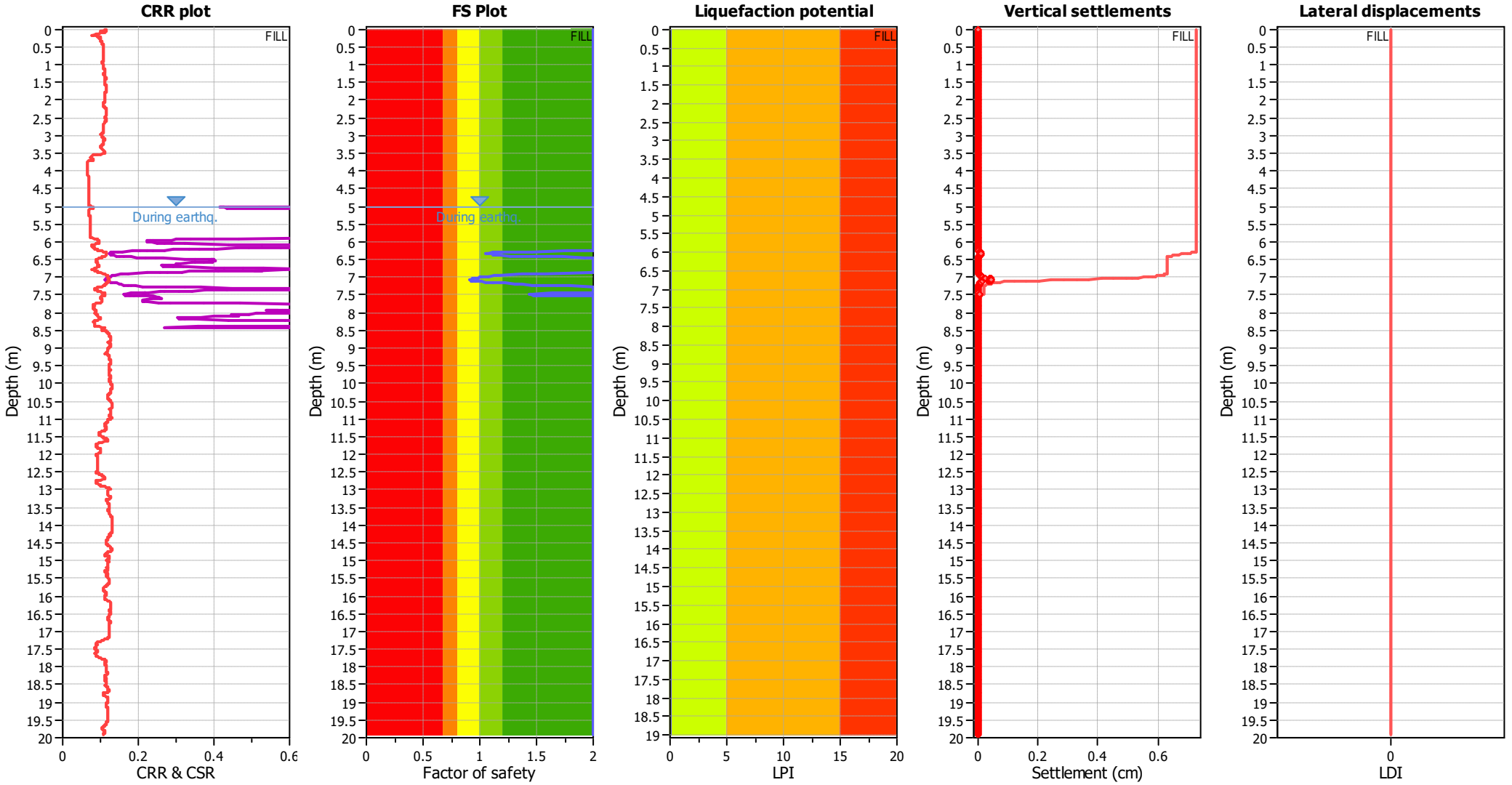
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m^3
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

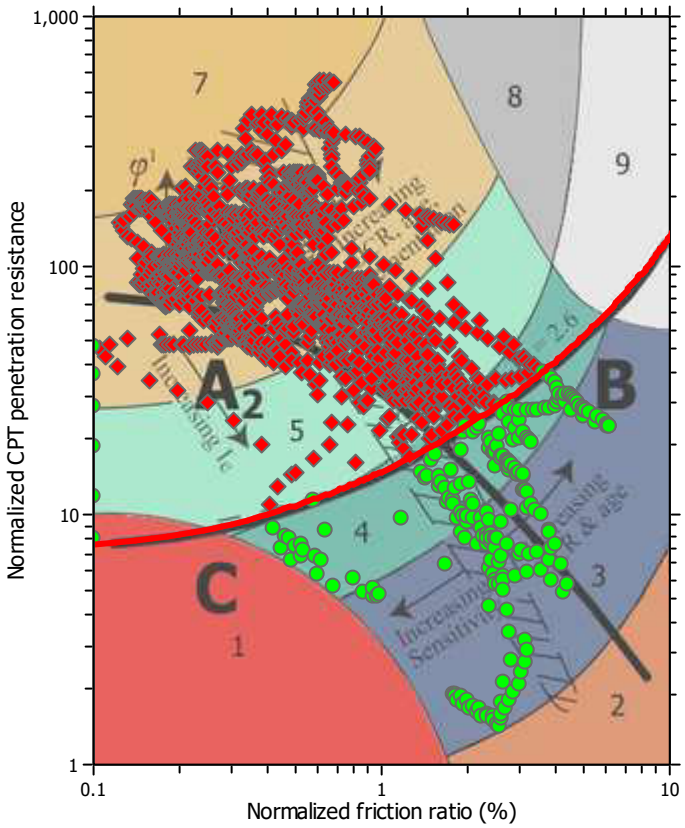
F.S. color scheme

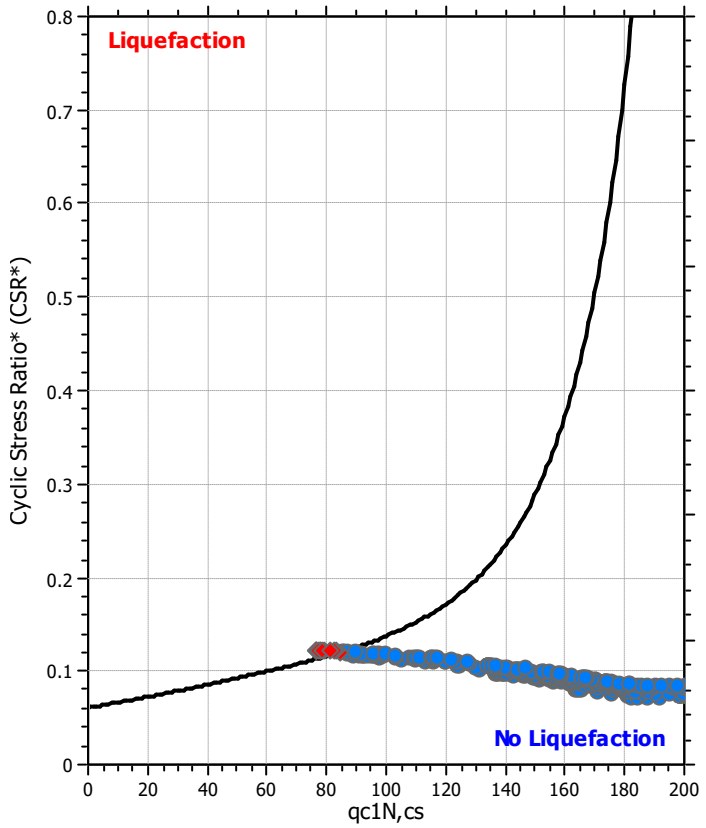
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

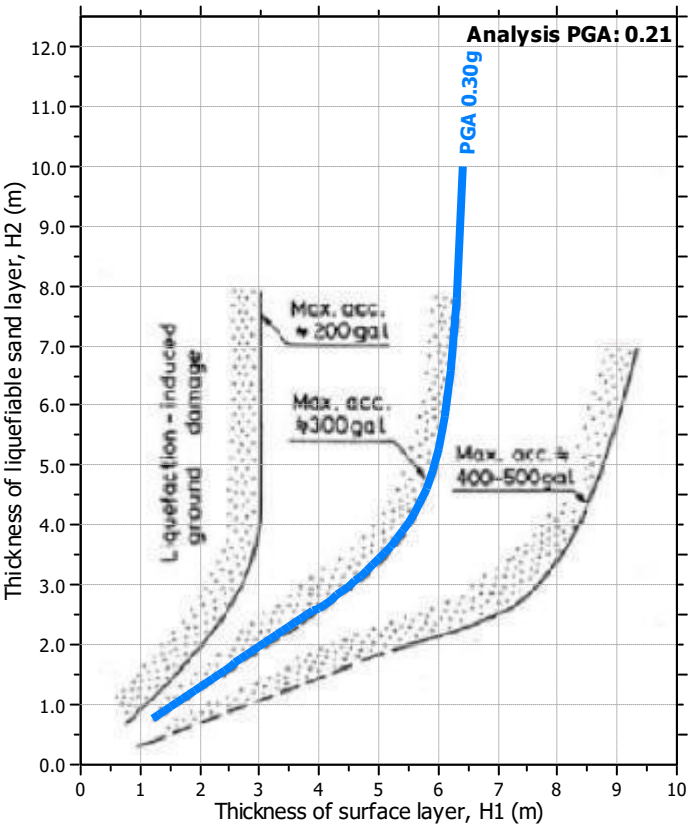
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



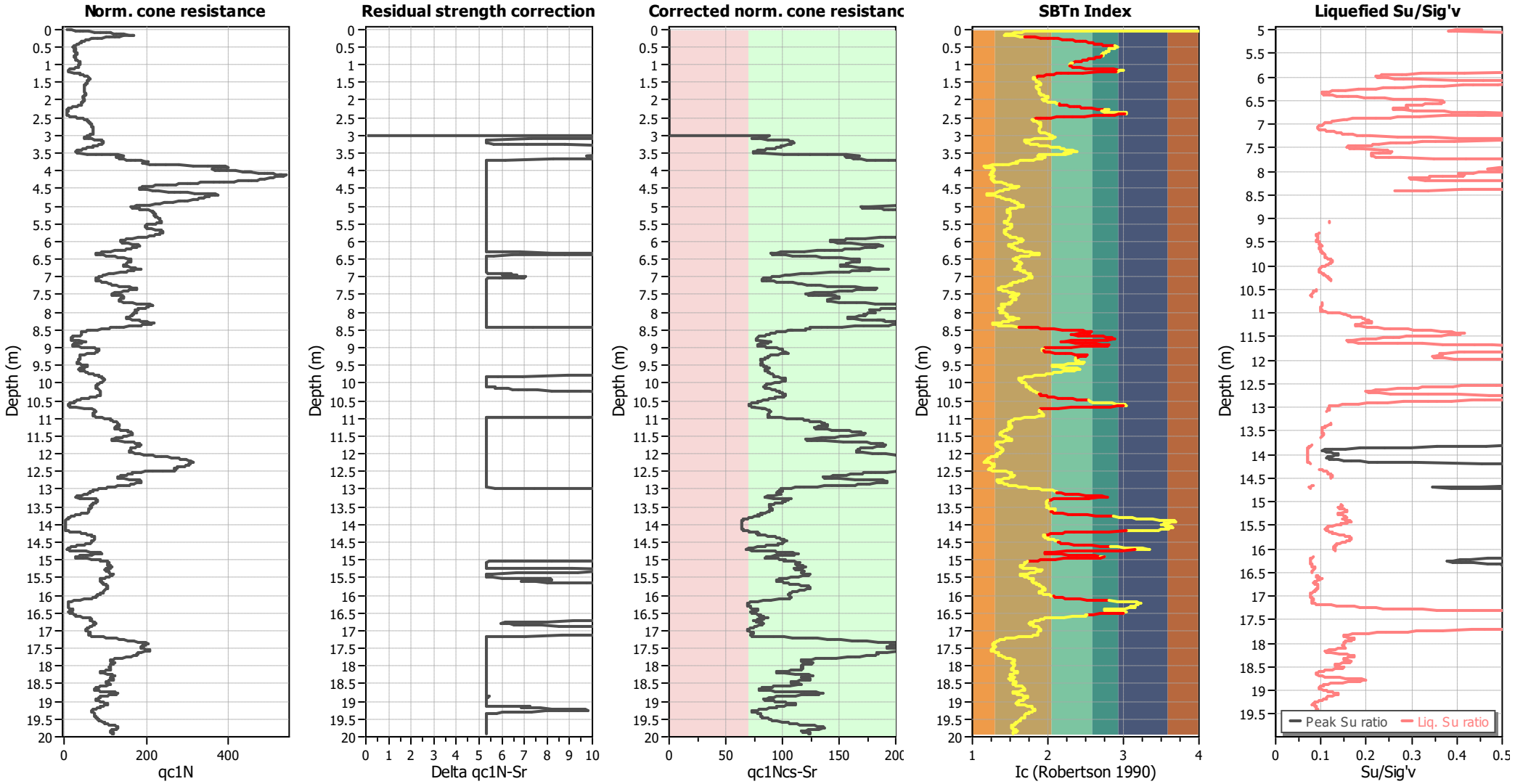




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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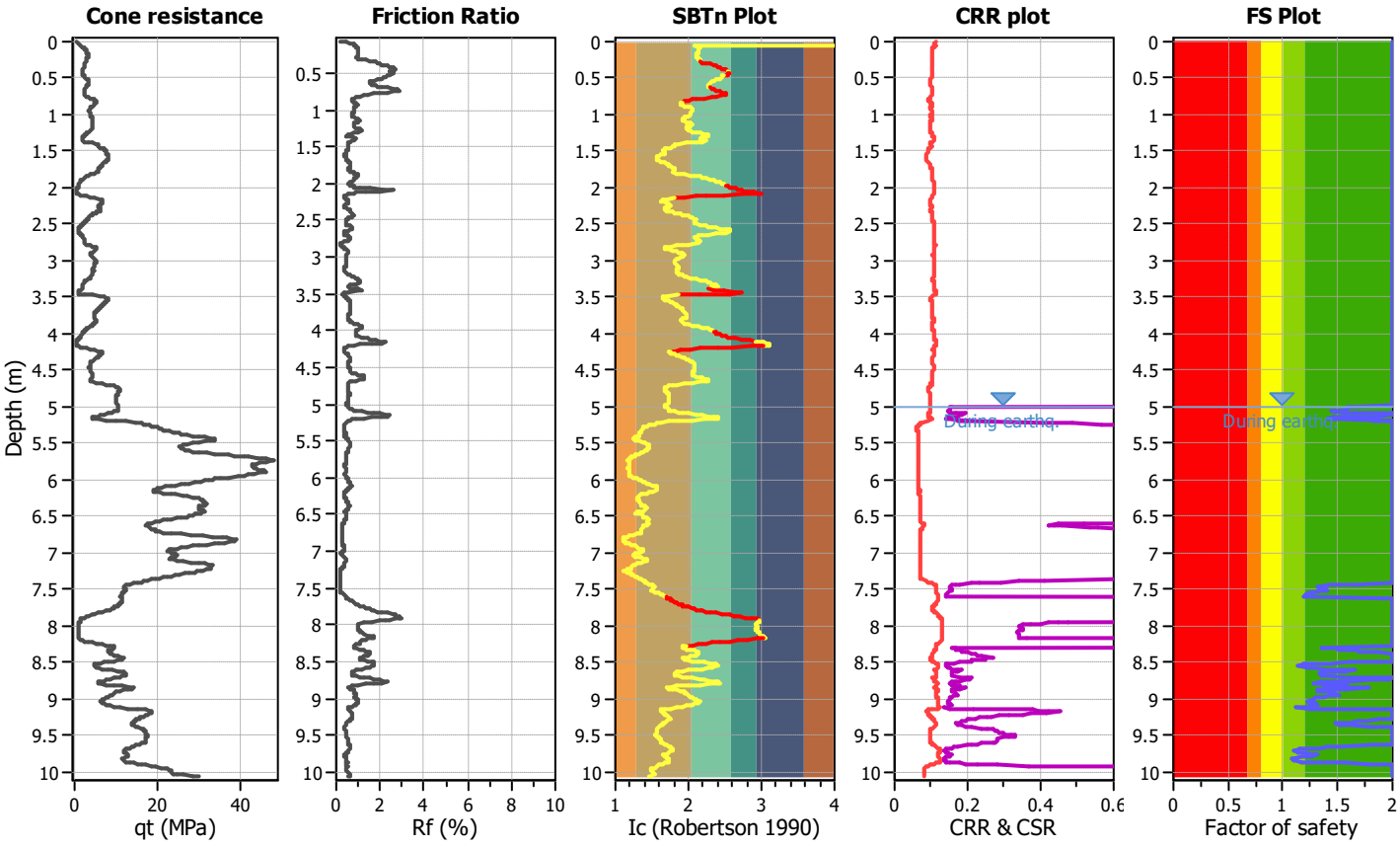
LIQUEFACTION ANALYSIS REPORT

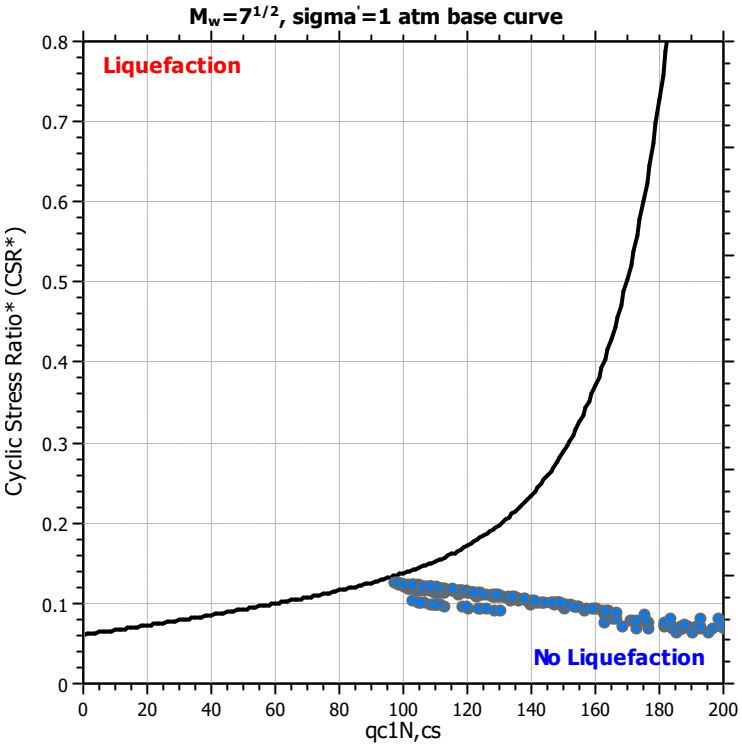
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**

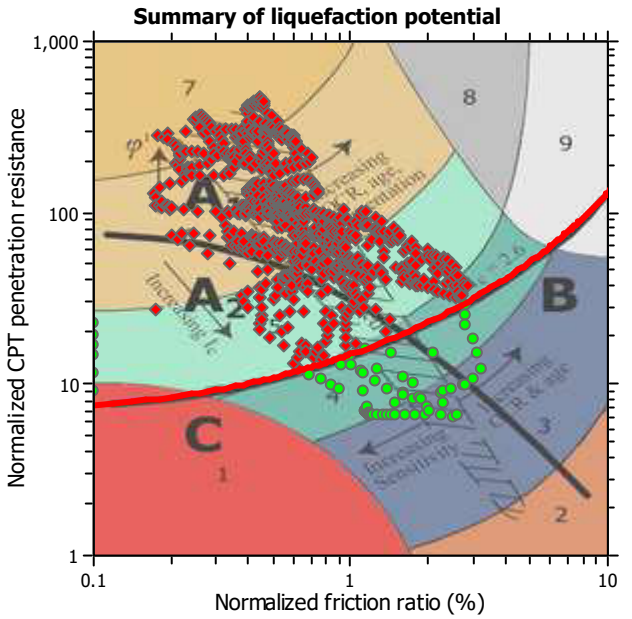
CPT file : CPT 9

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.60	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

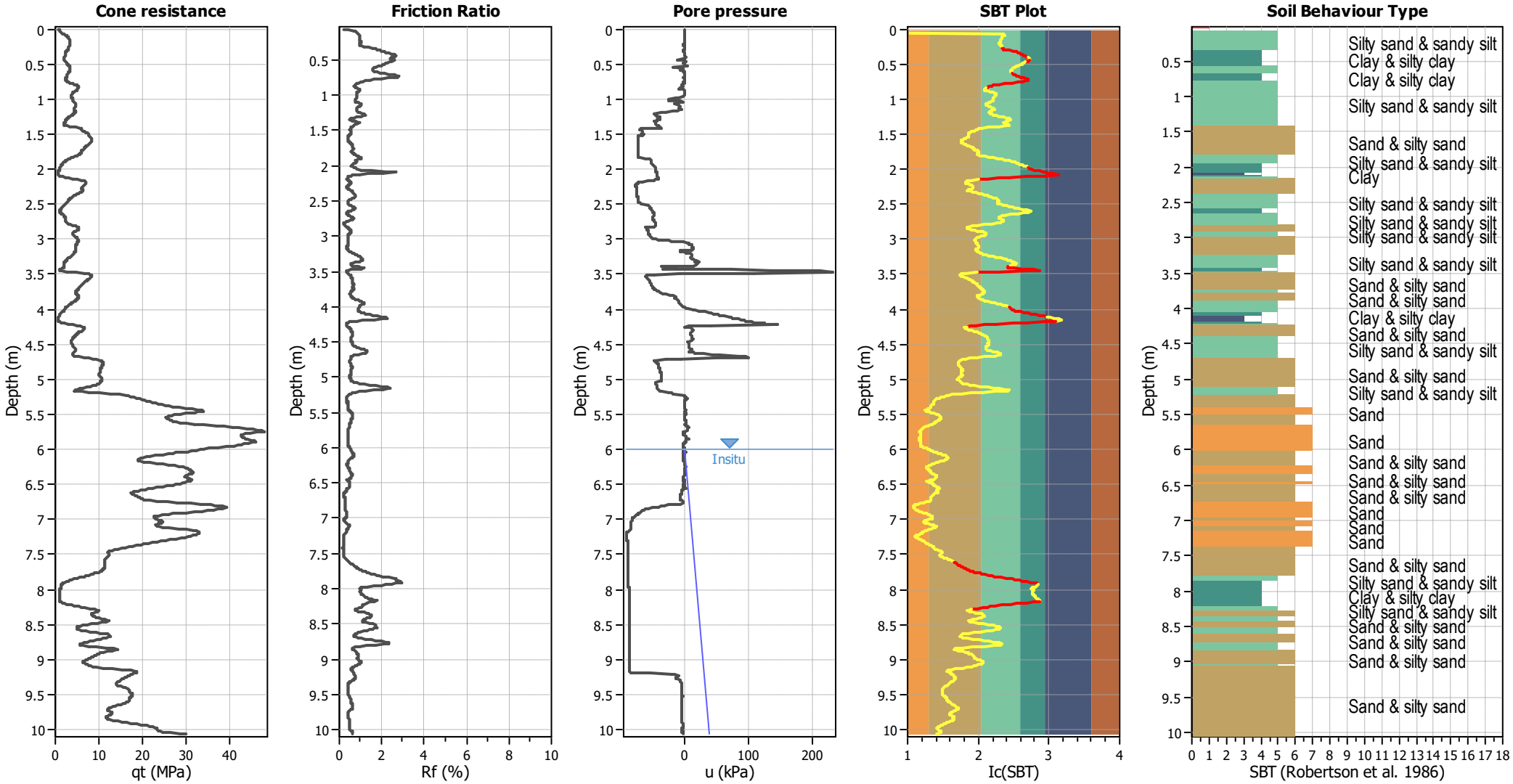






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



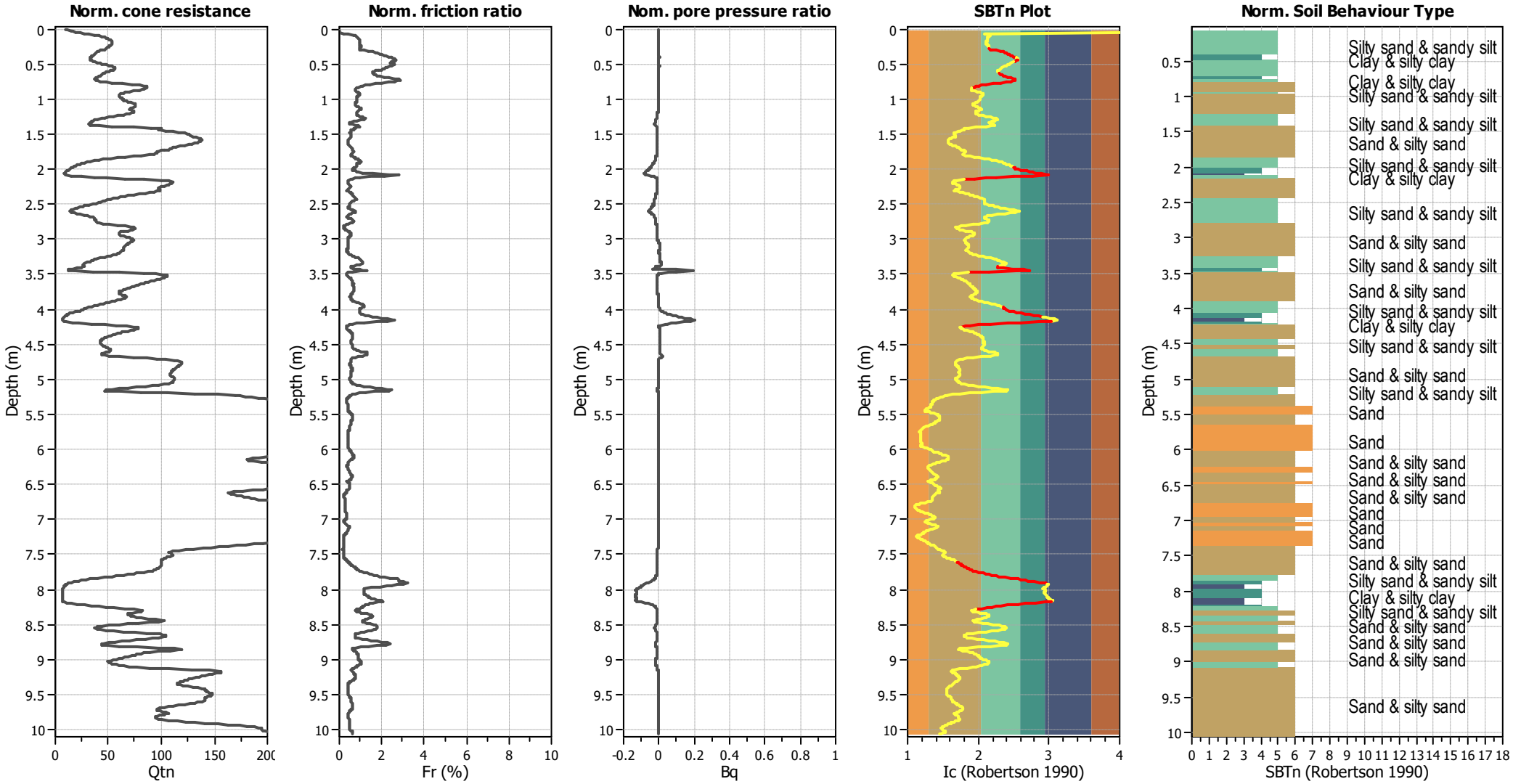
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



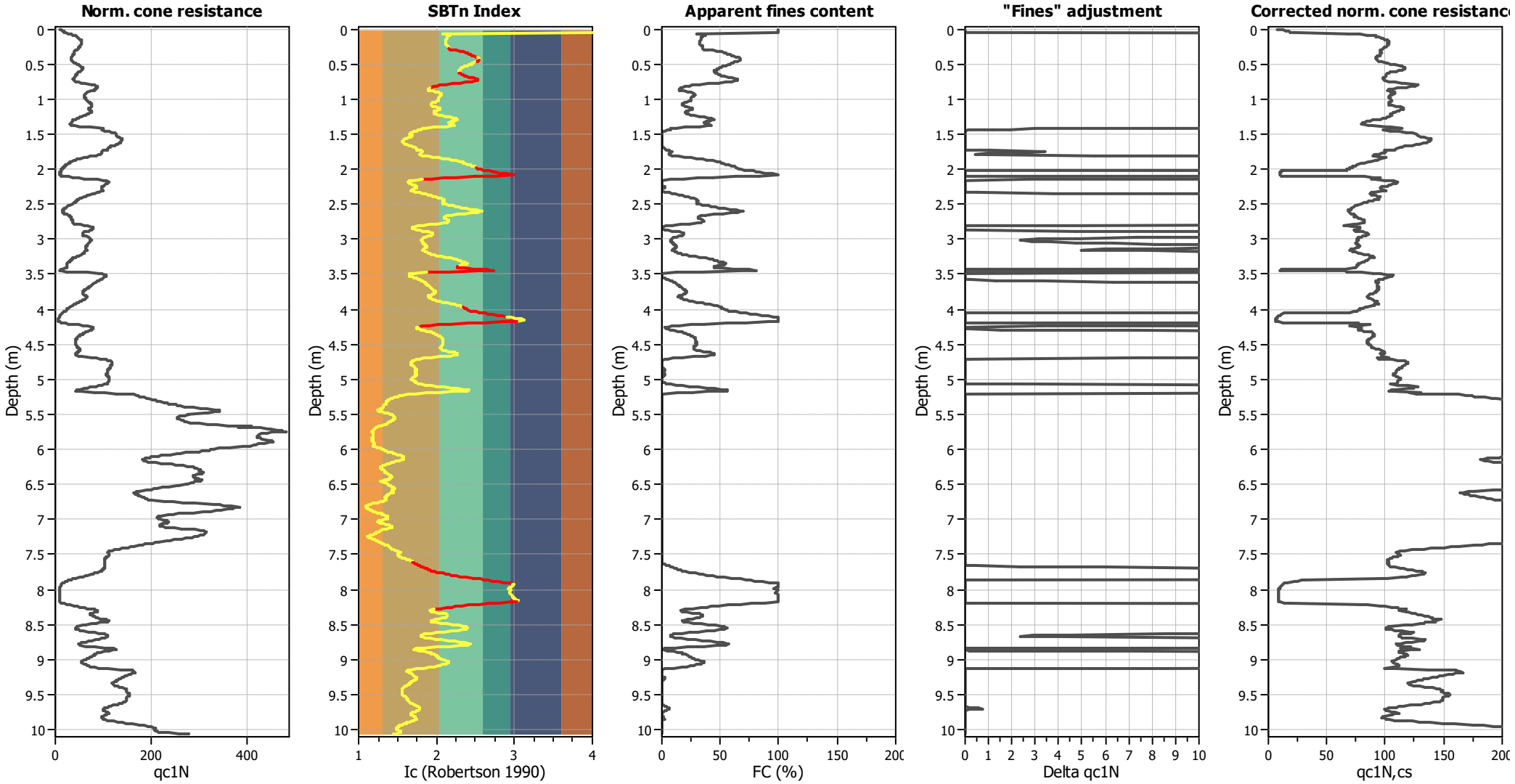
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
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6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

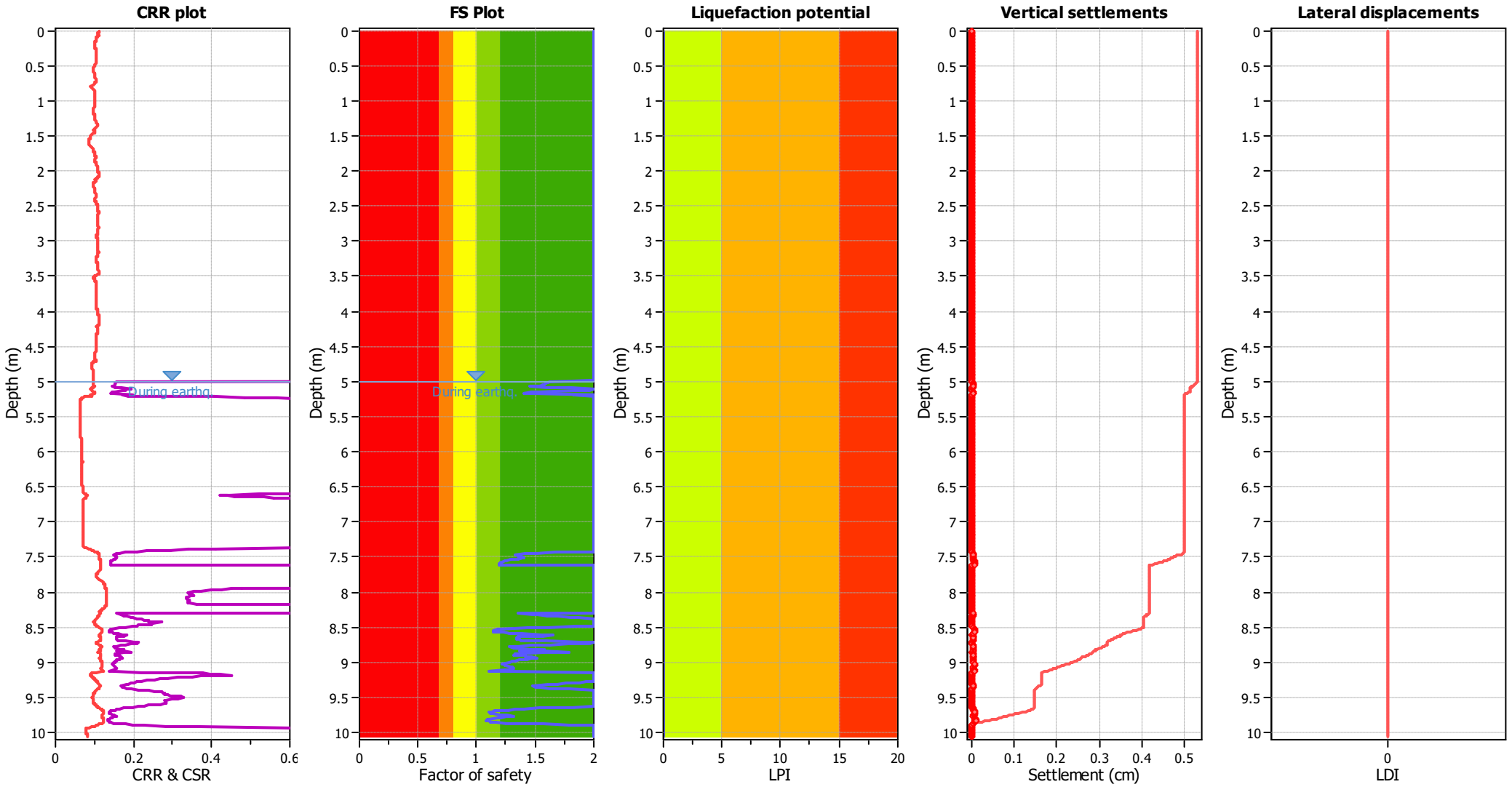
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

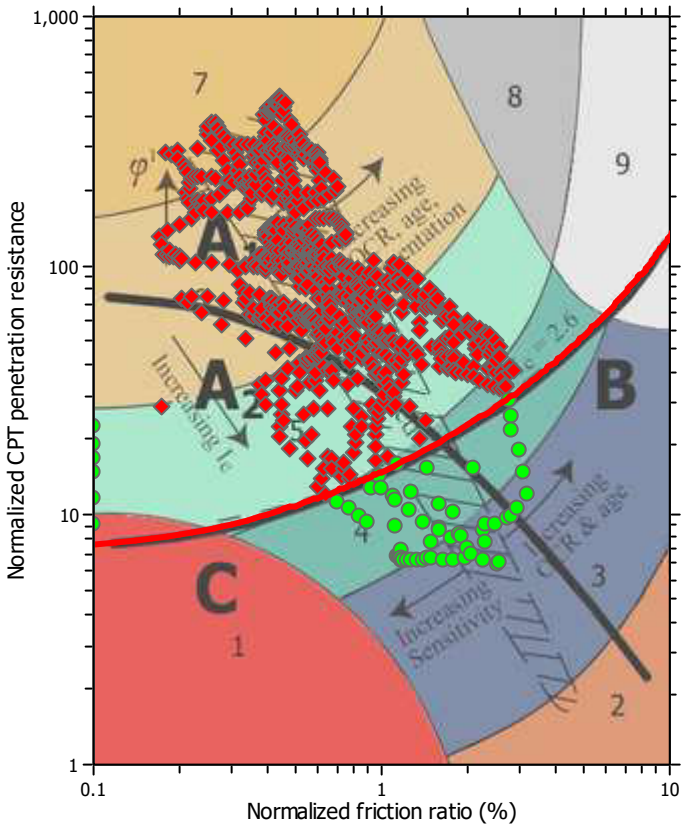
F.S. color scheme

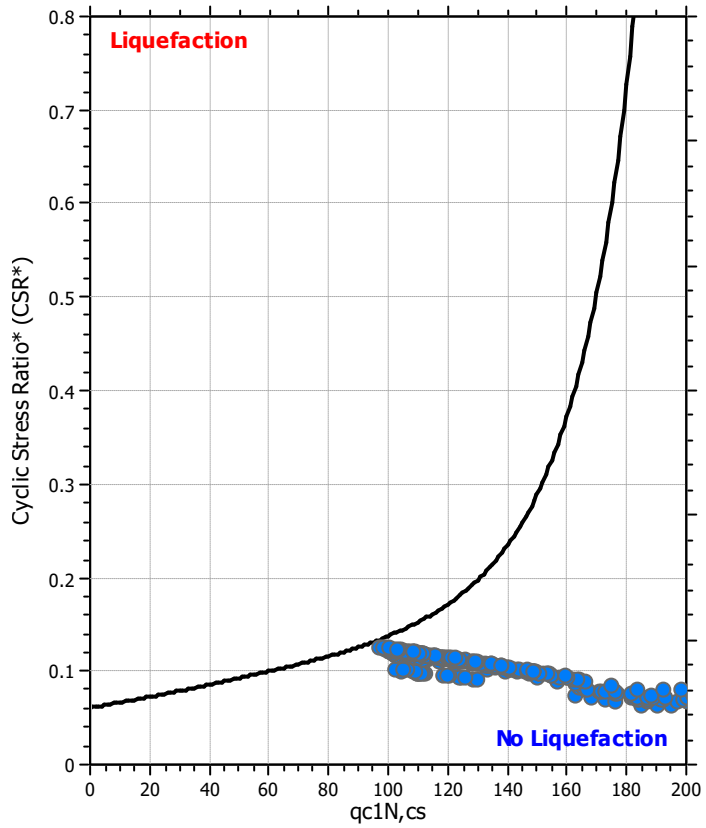
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

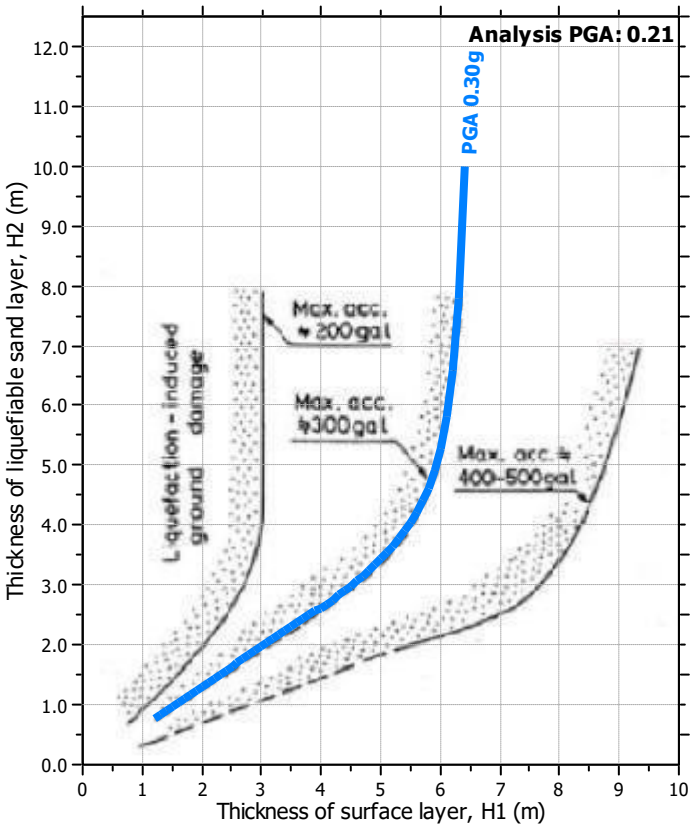
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



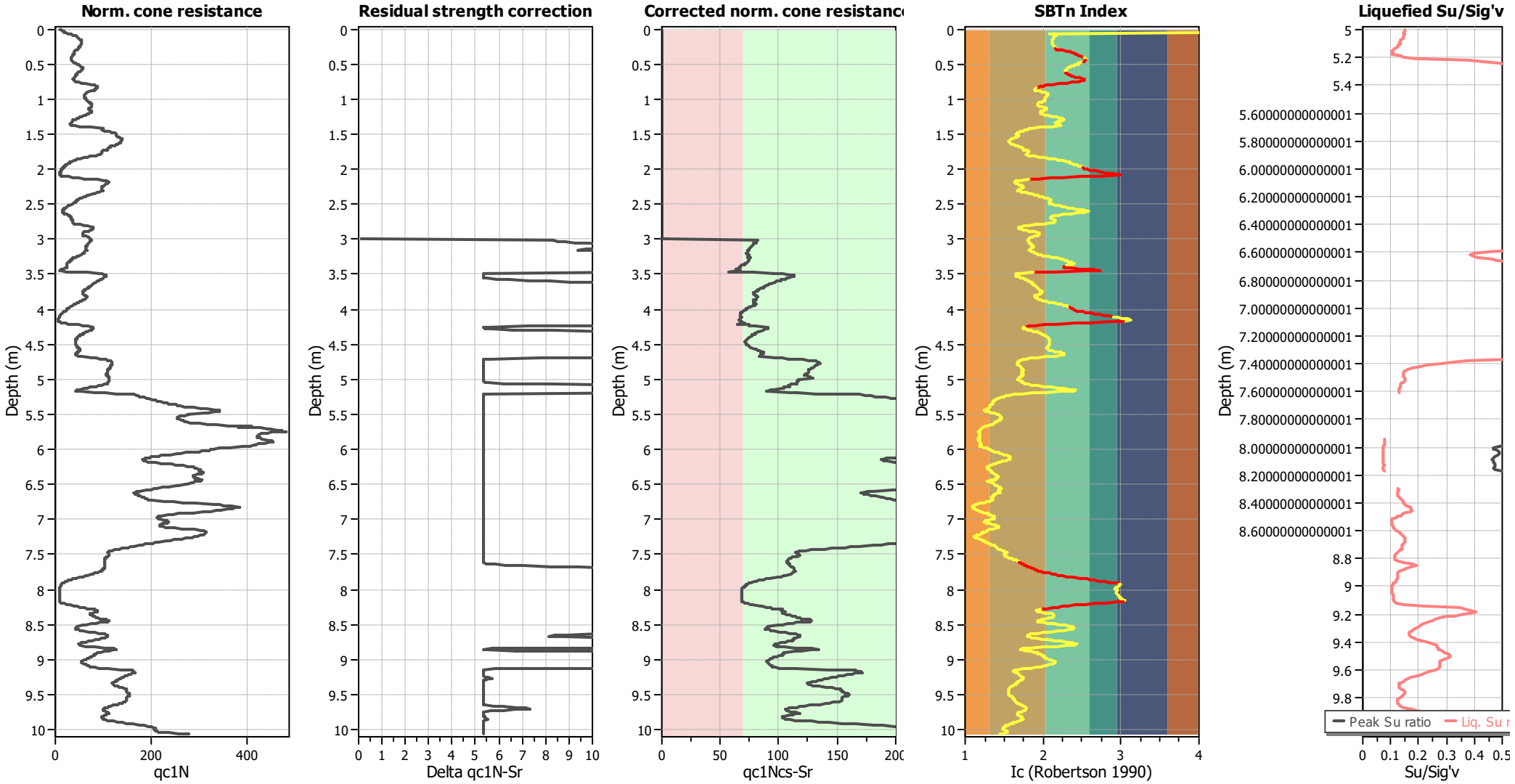




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

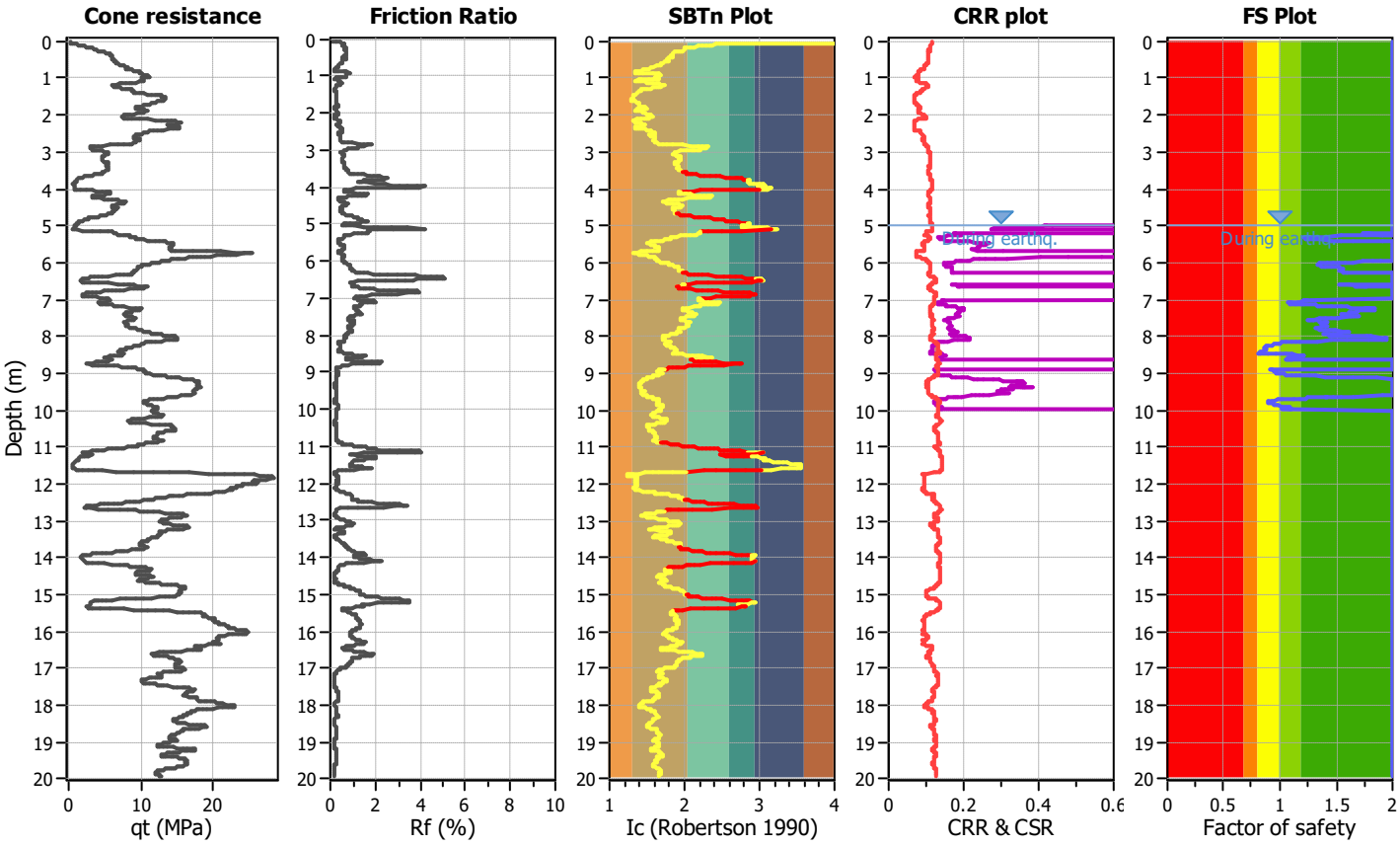
BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

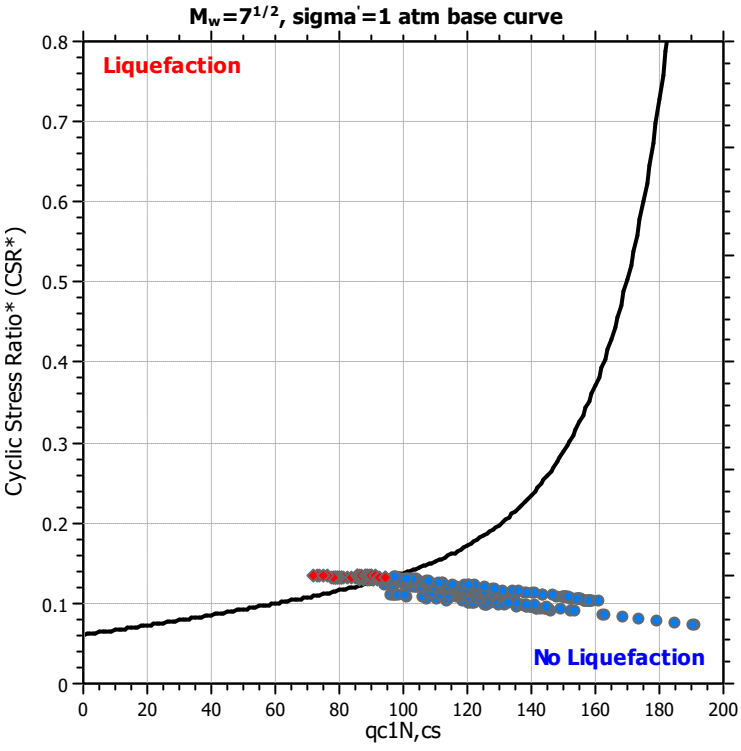
LIQUEFACTION ANALYSIS REPORT

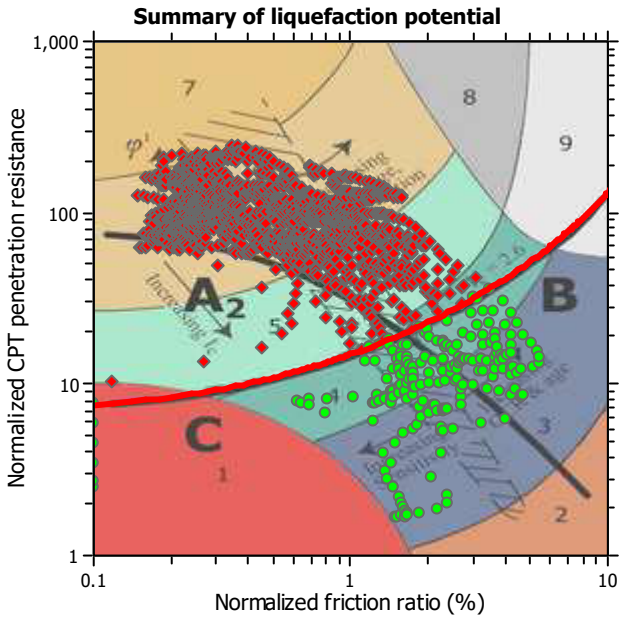
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 10

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

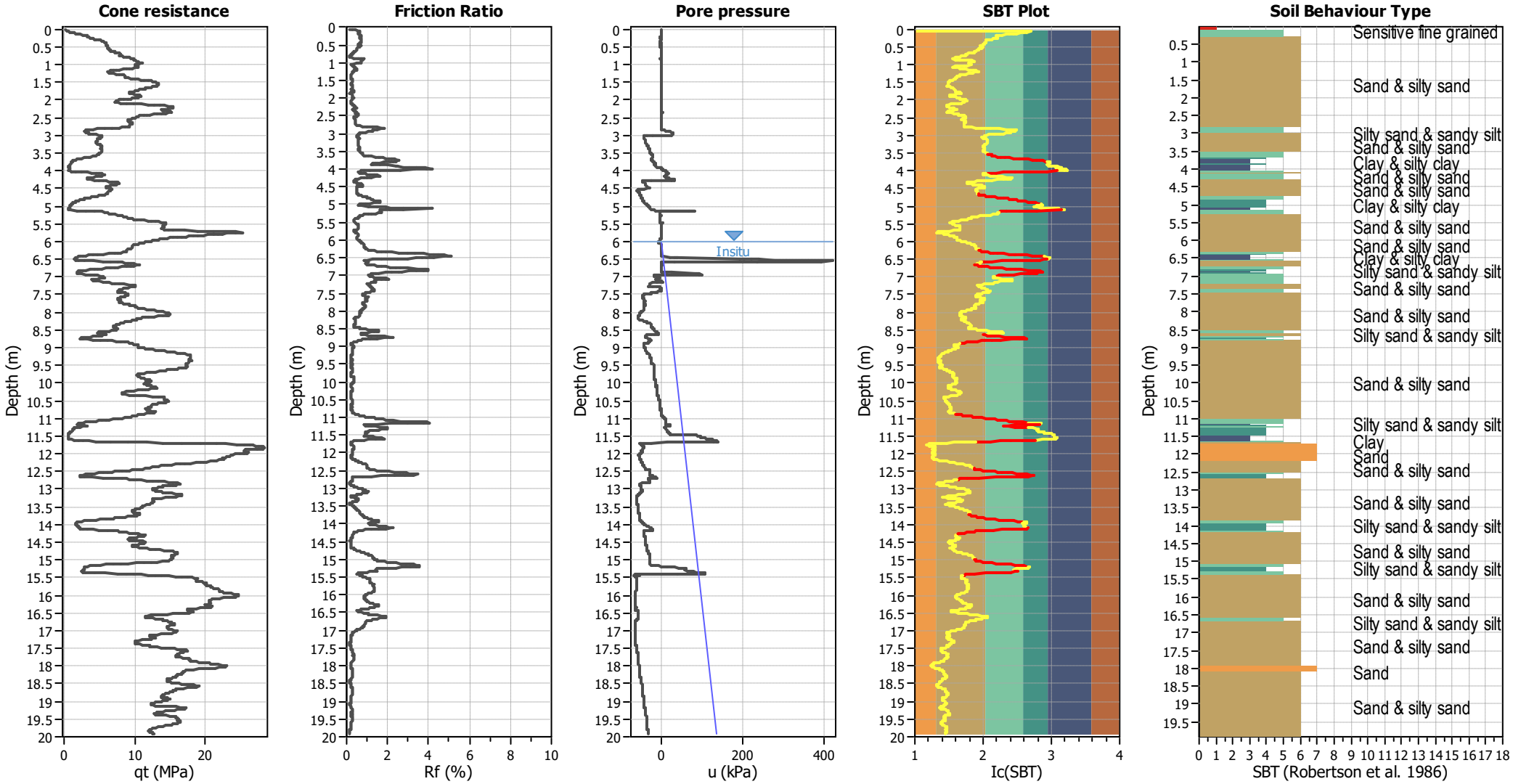






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



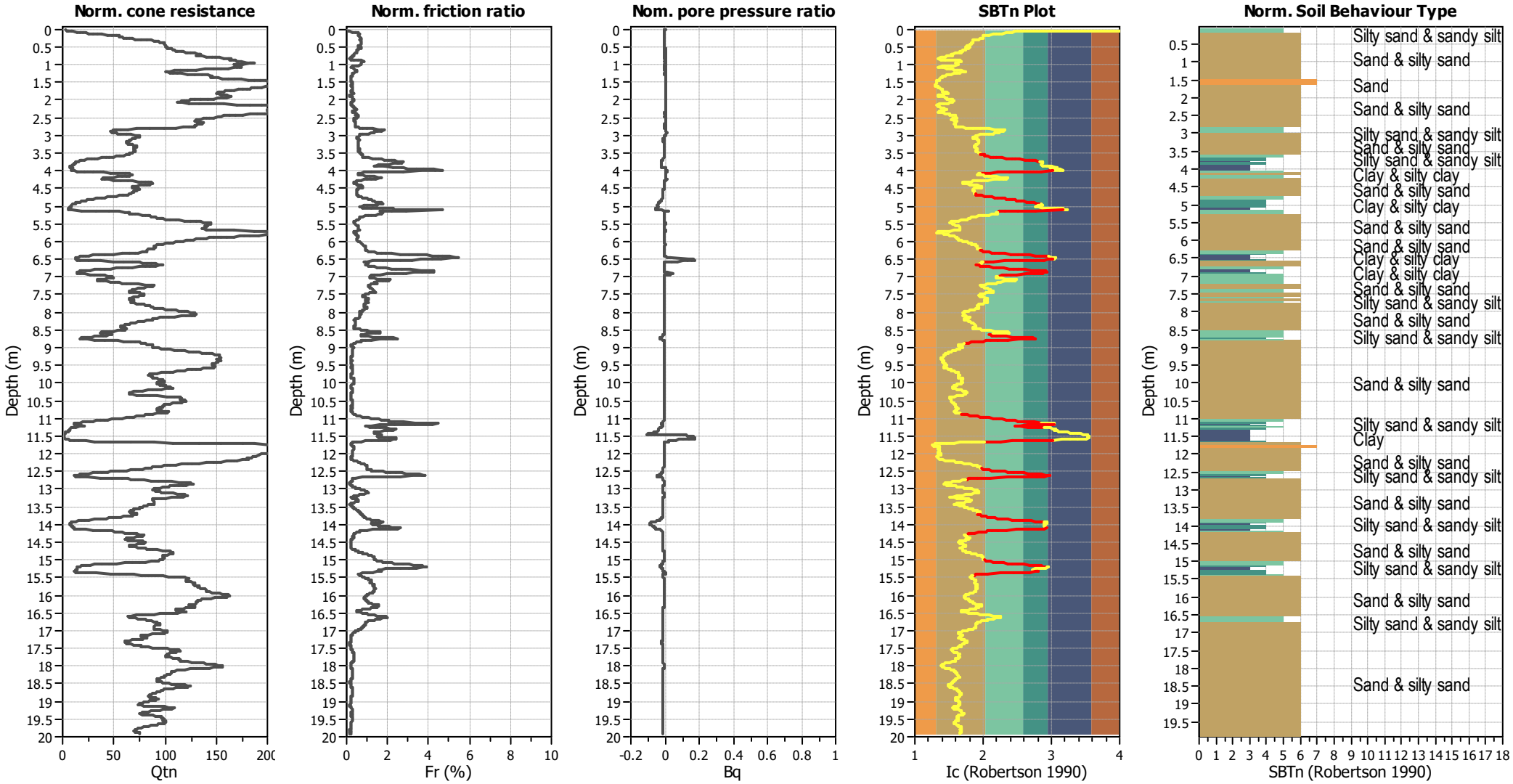
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



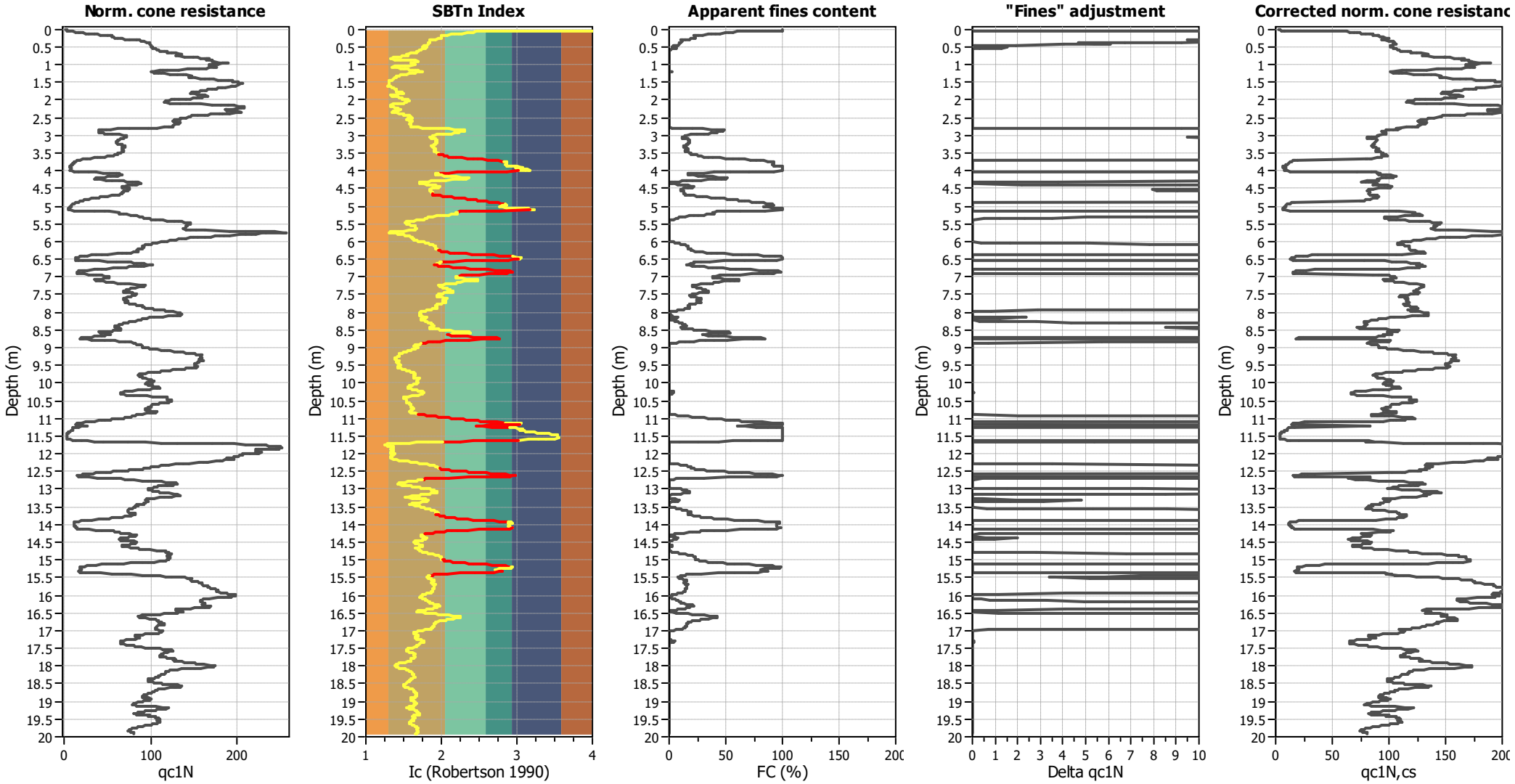
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

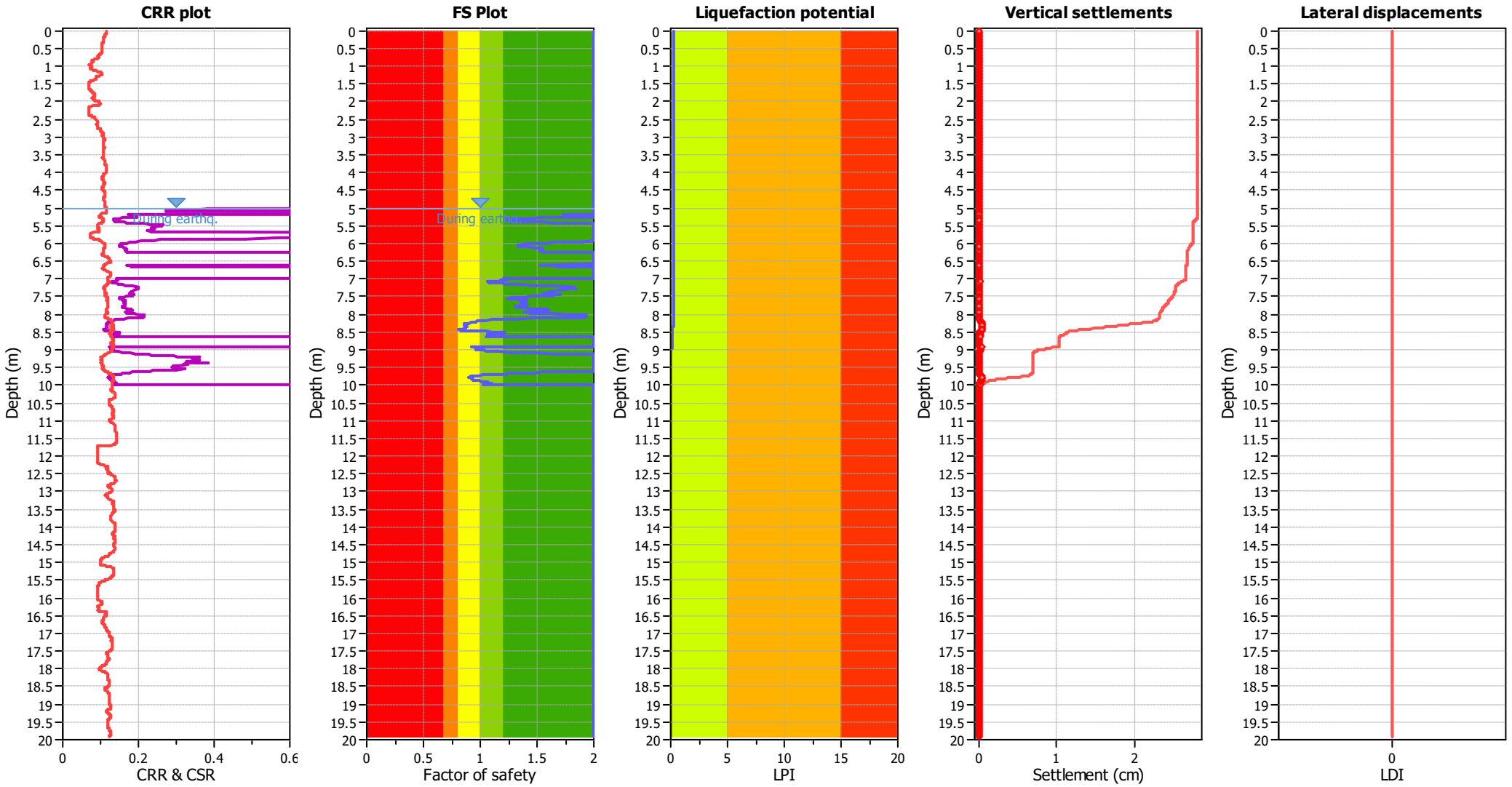
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

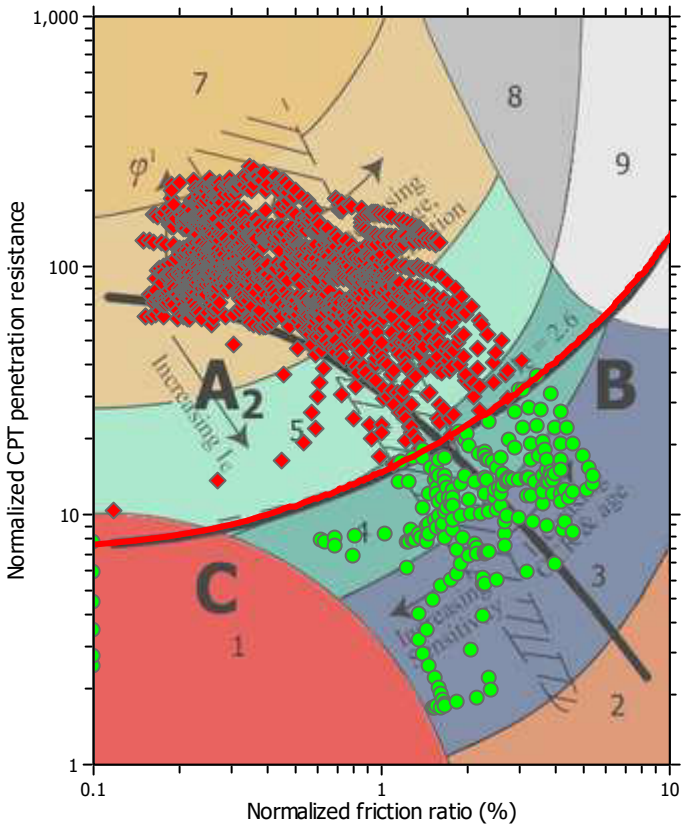
F.S. color scheme

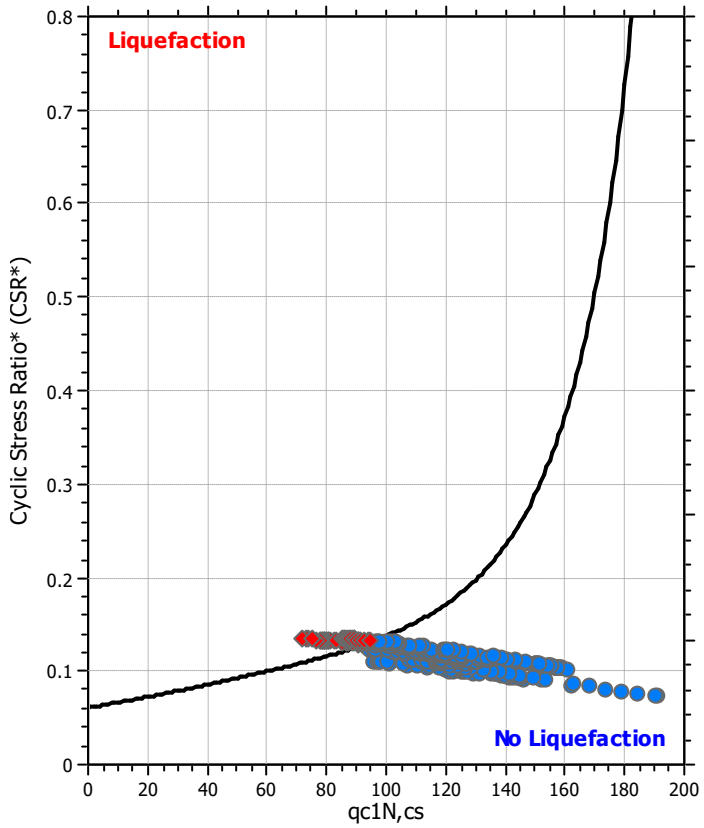
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

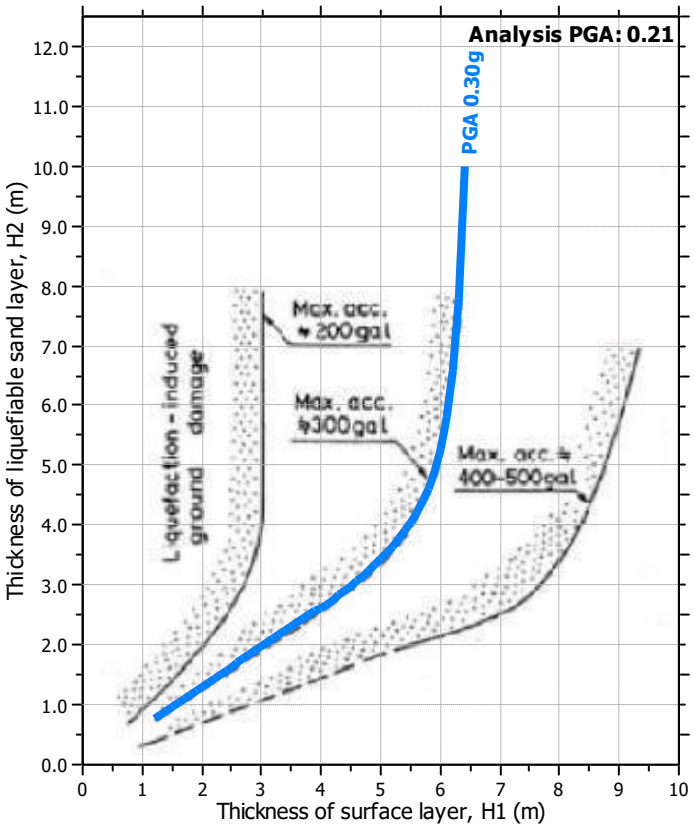
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



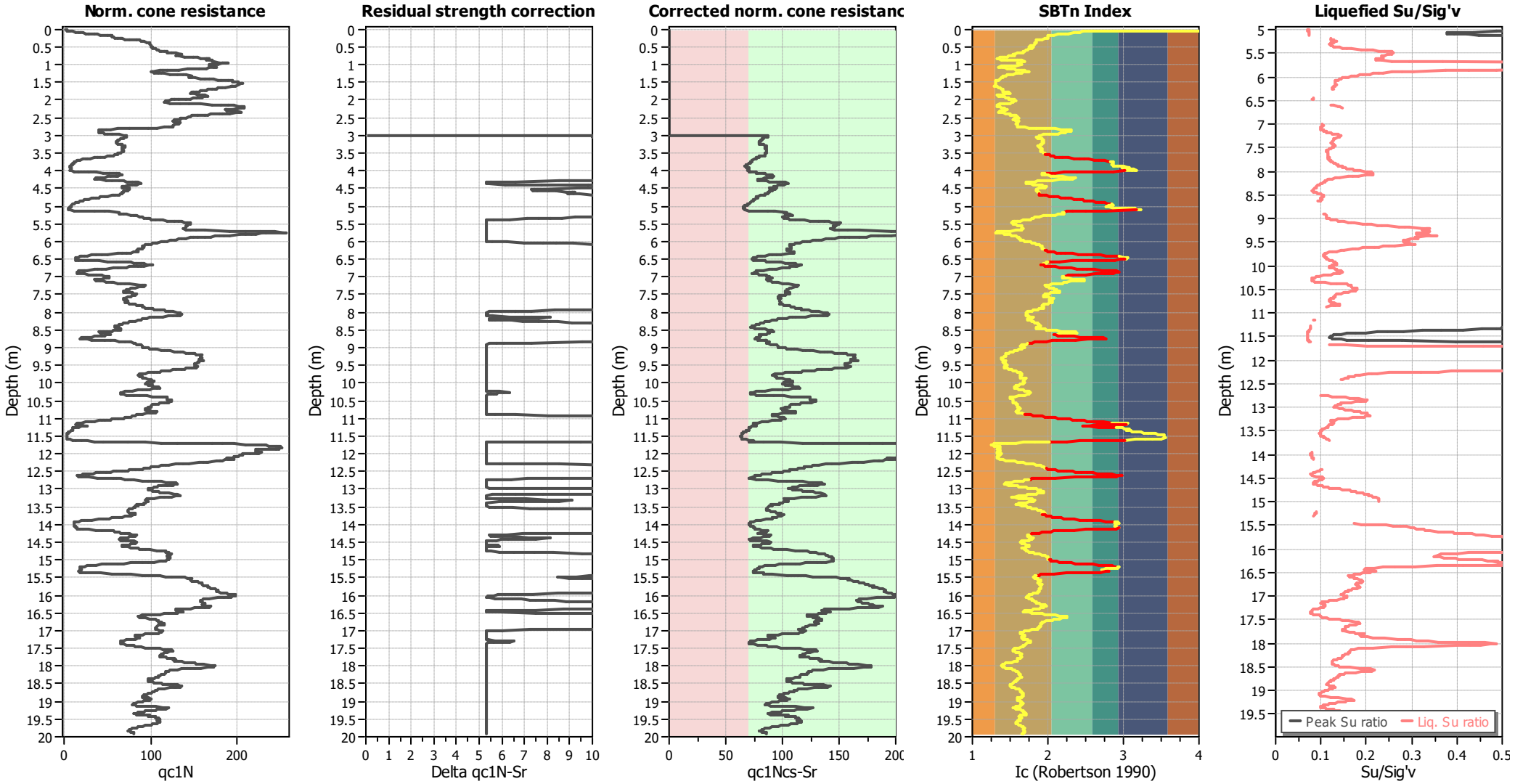




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

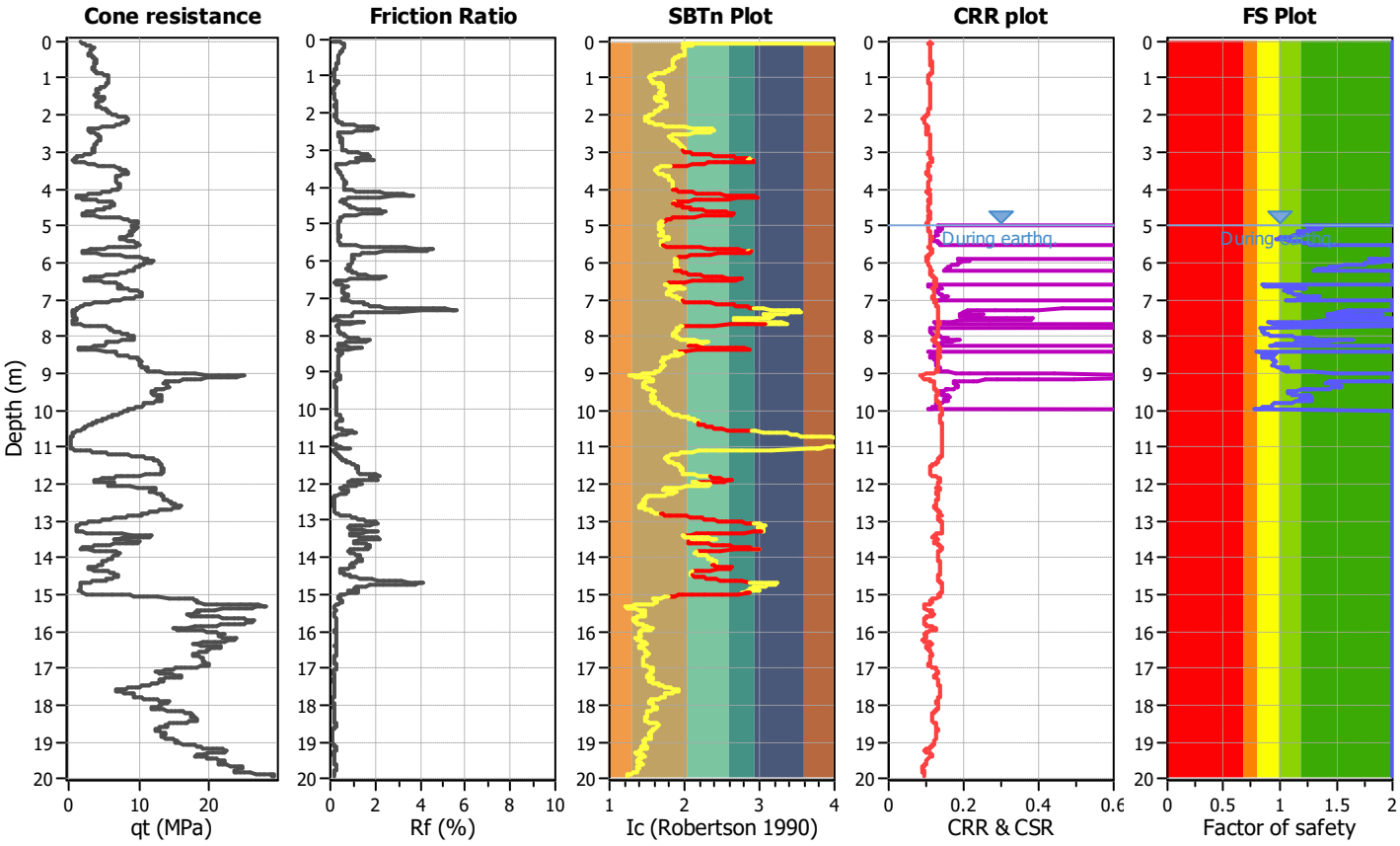
BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

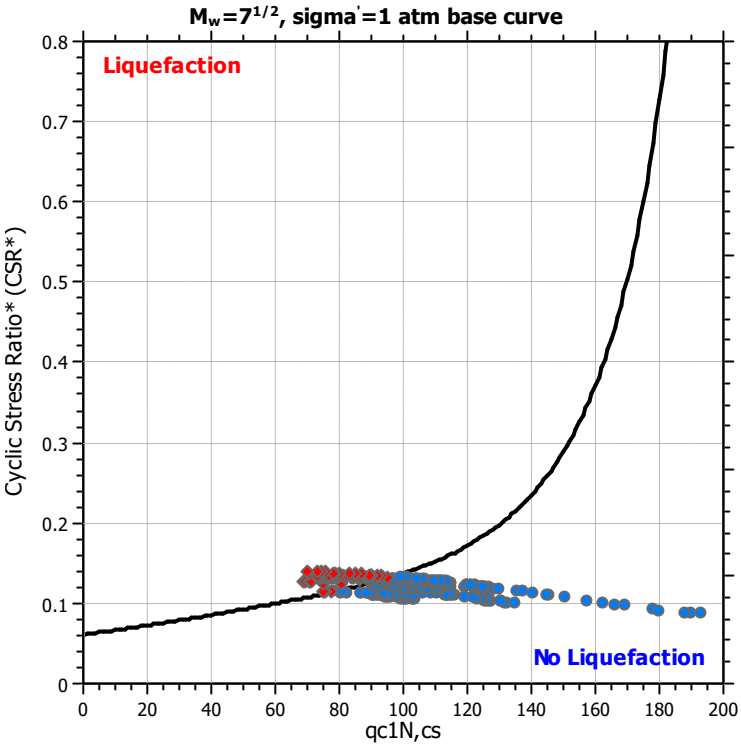
LIQUEFACTION ANALYSIS REPORT

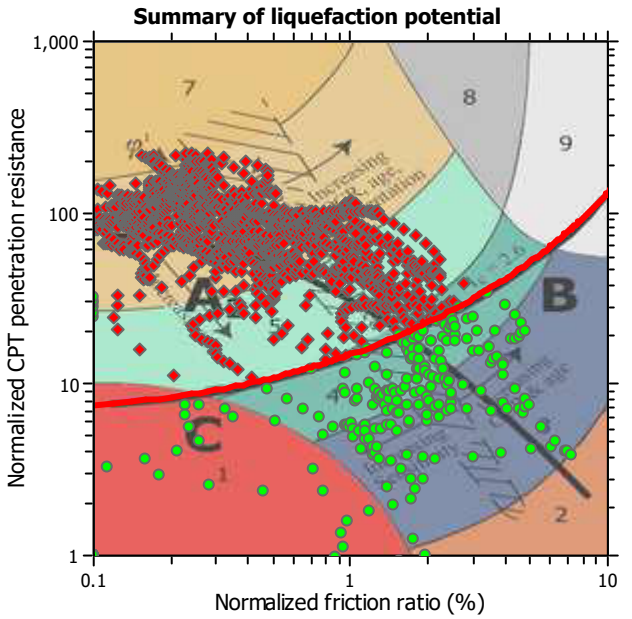
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 11

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.21	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

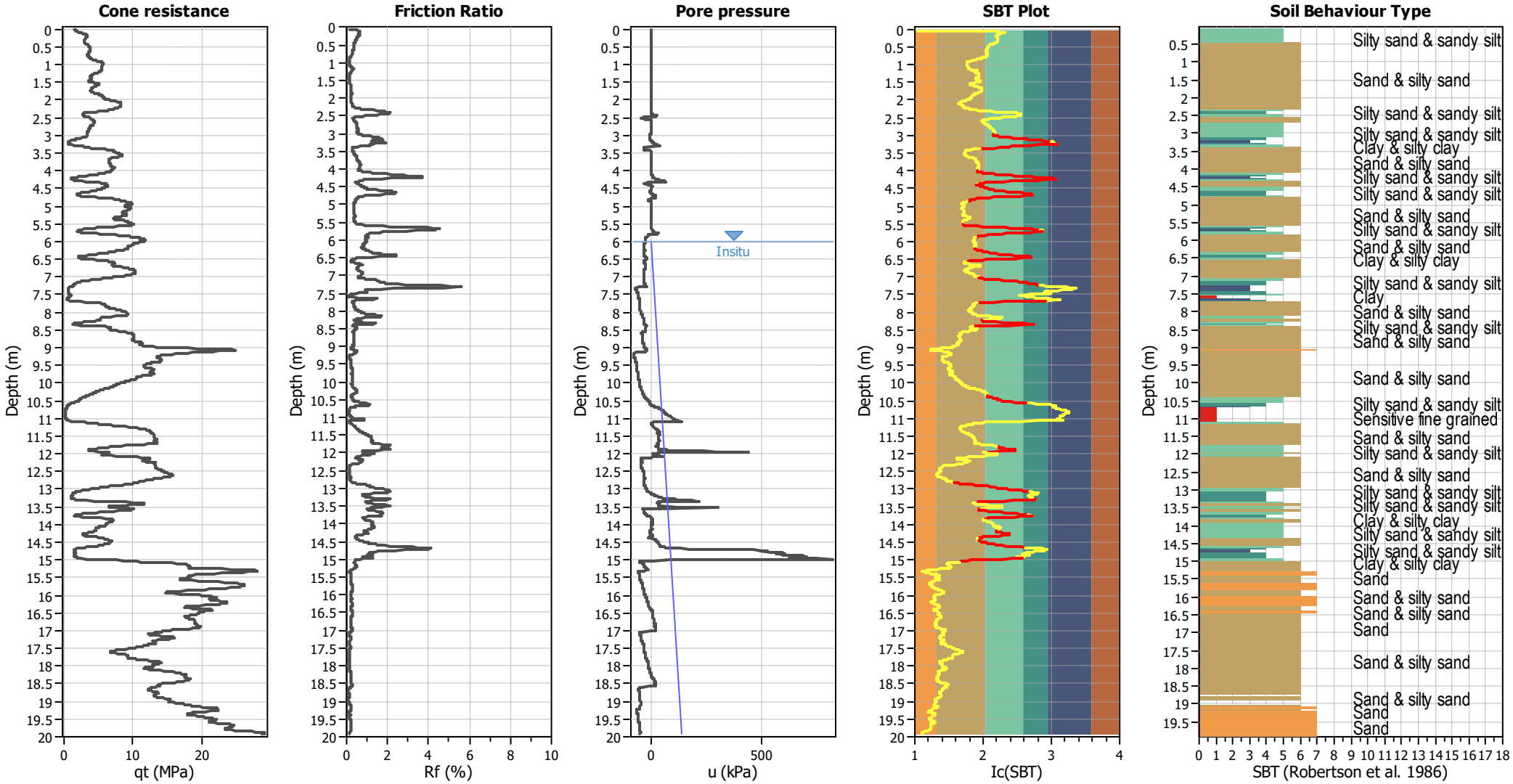






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



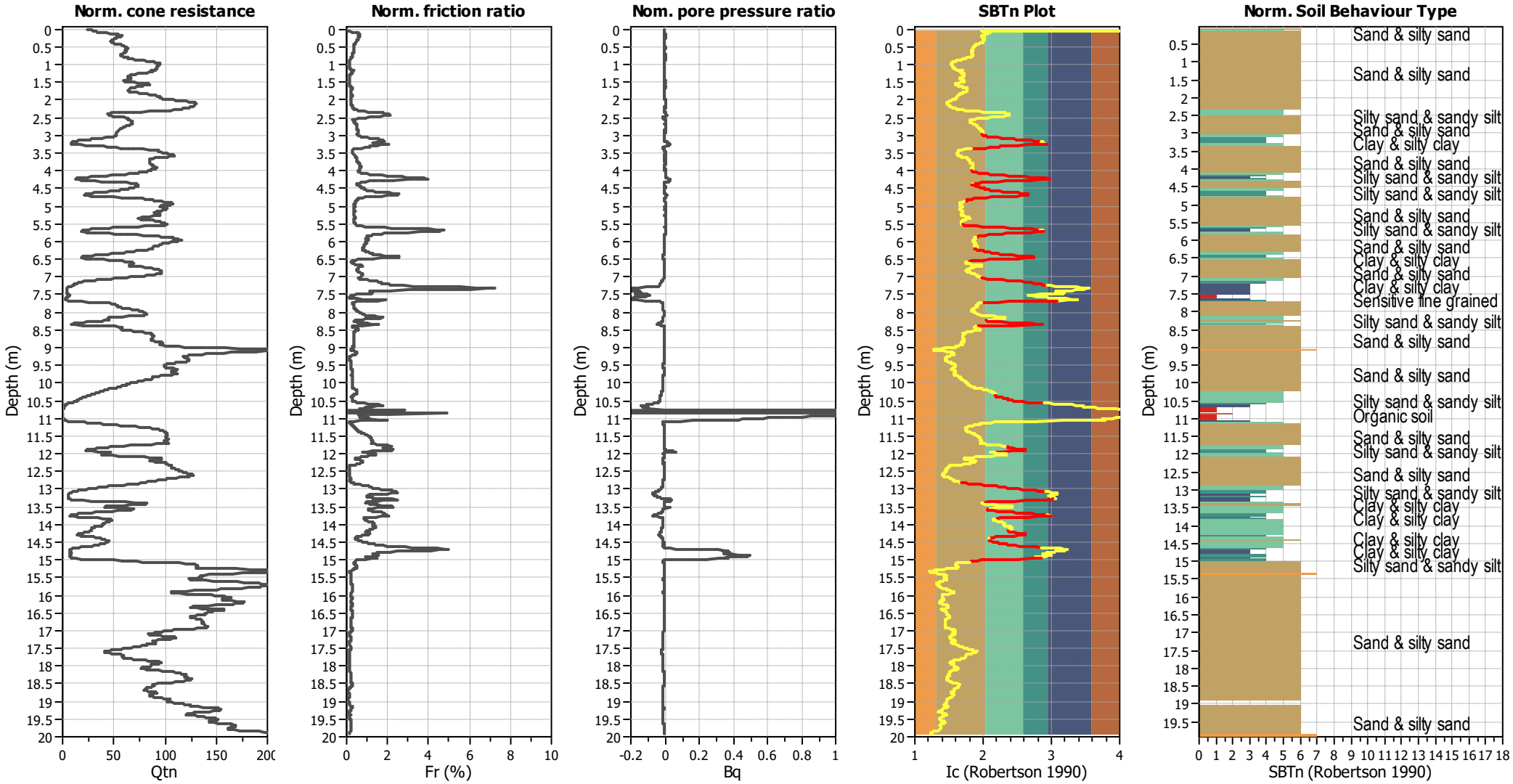
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



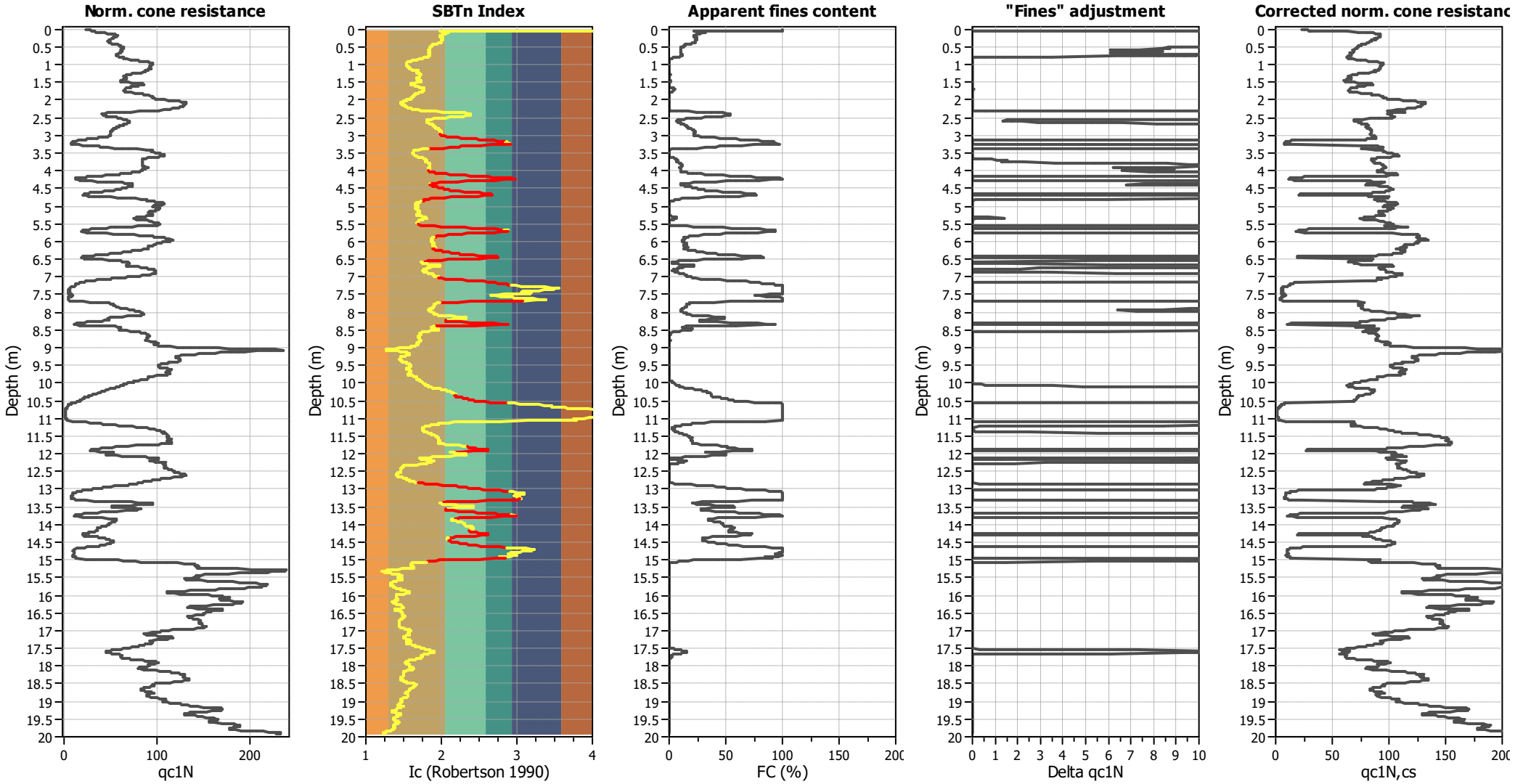
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
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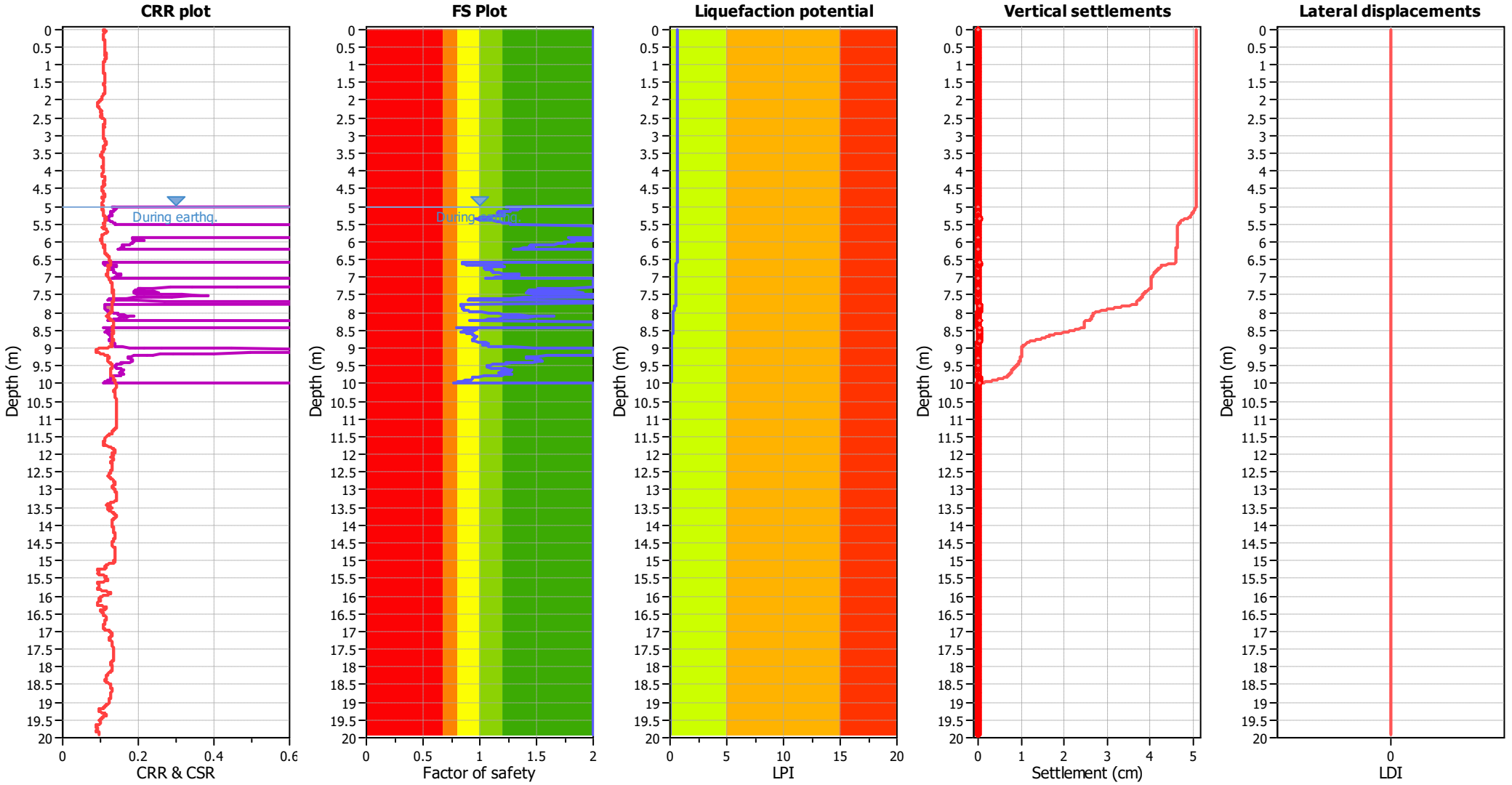
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

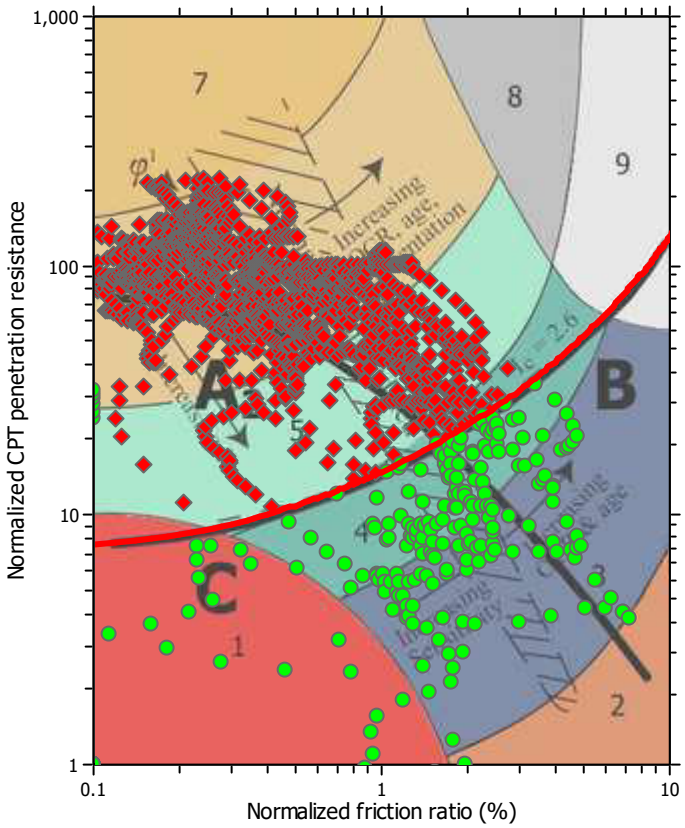
F.S. color scheme

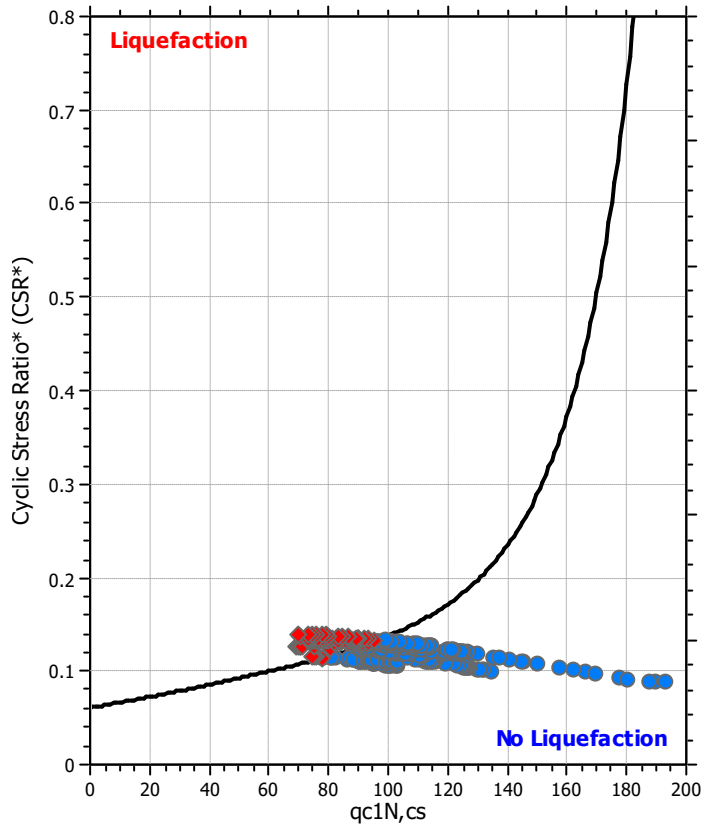
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

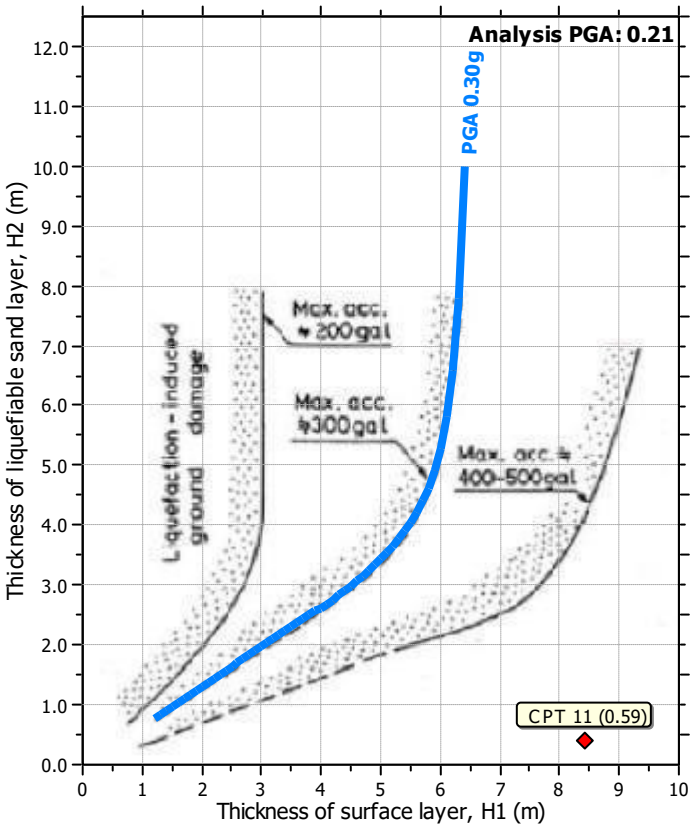
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



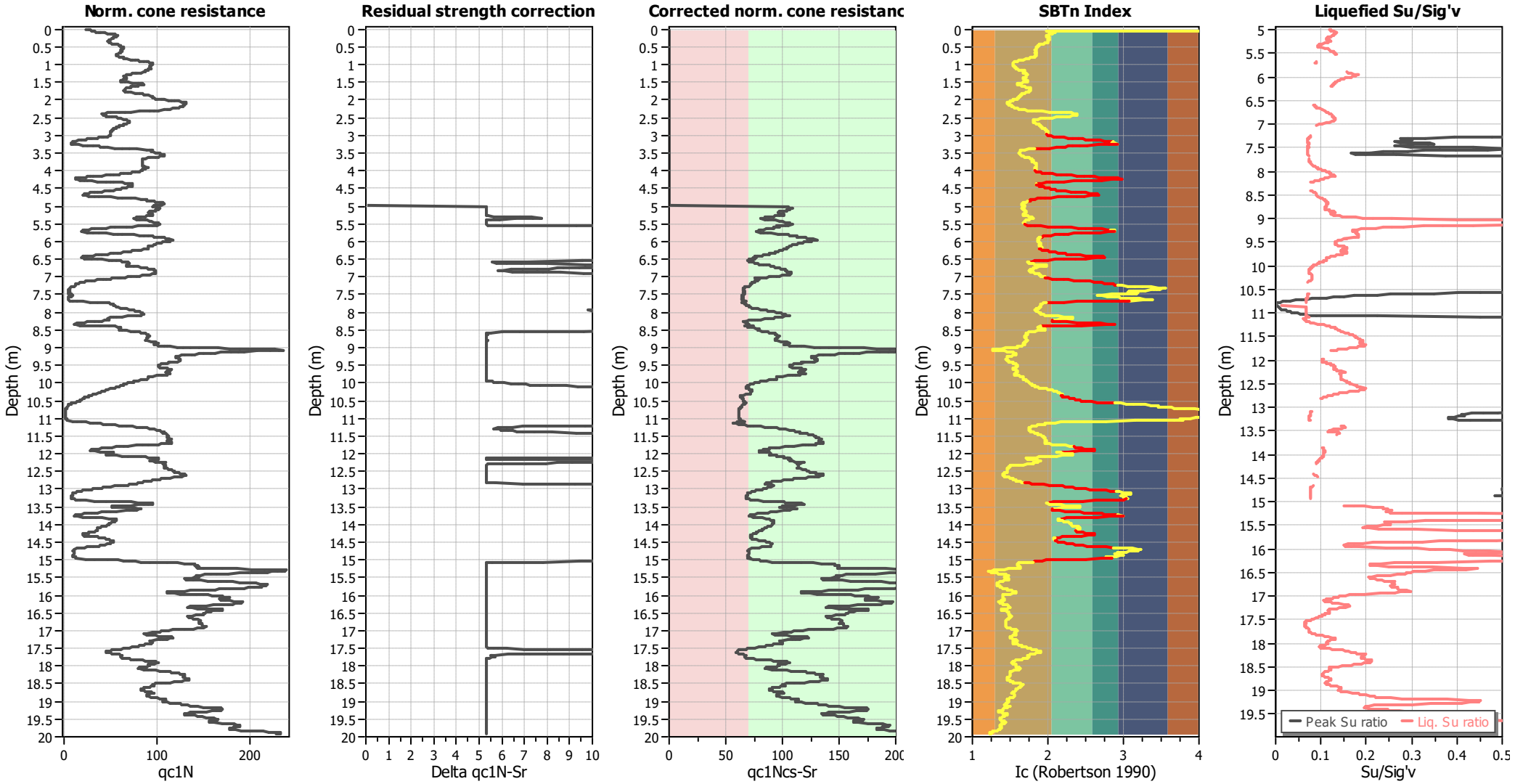




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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

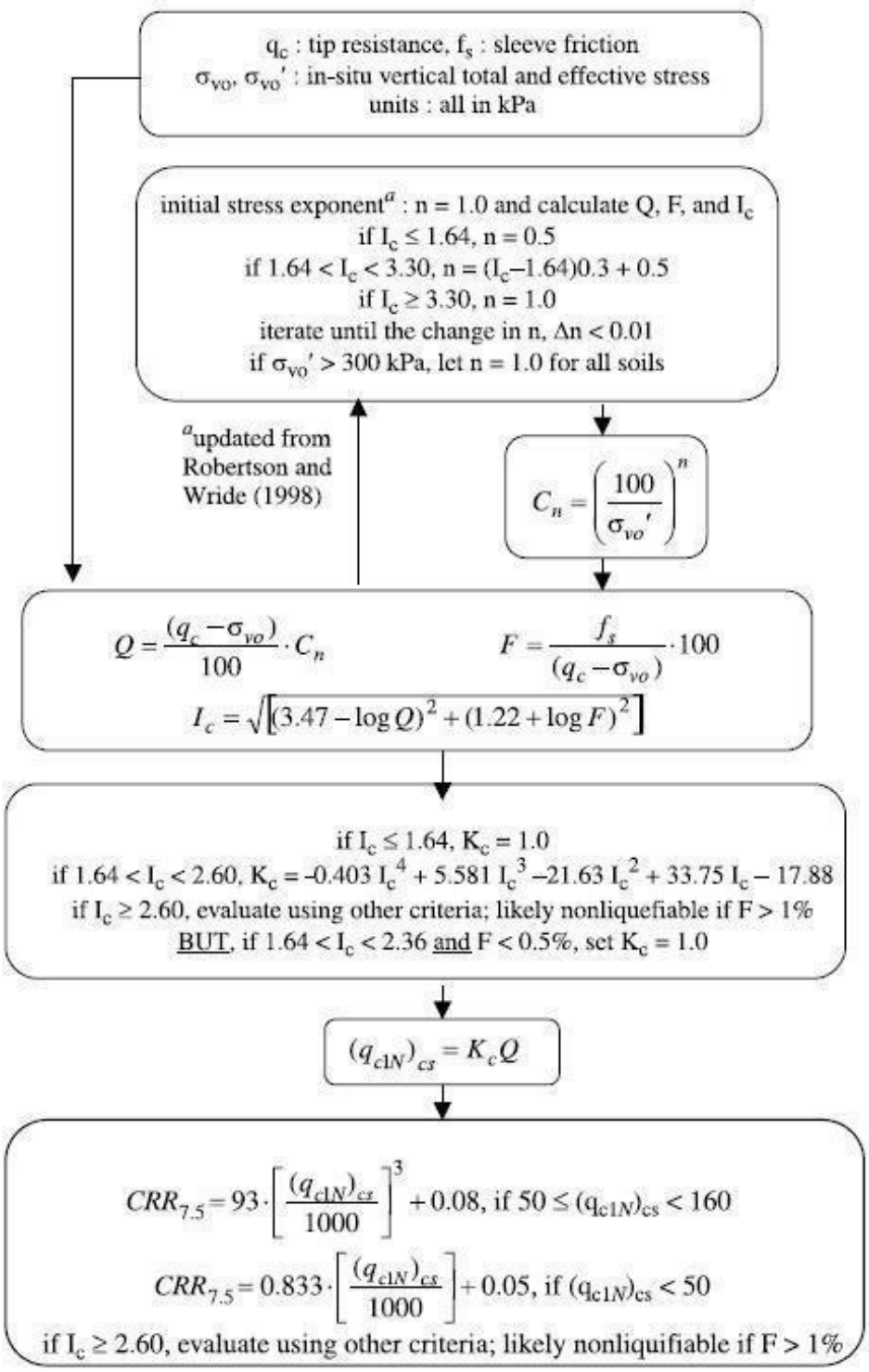


Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.21	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

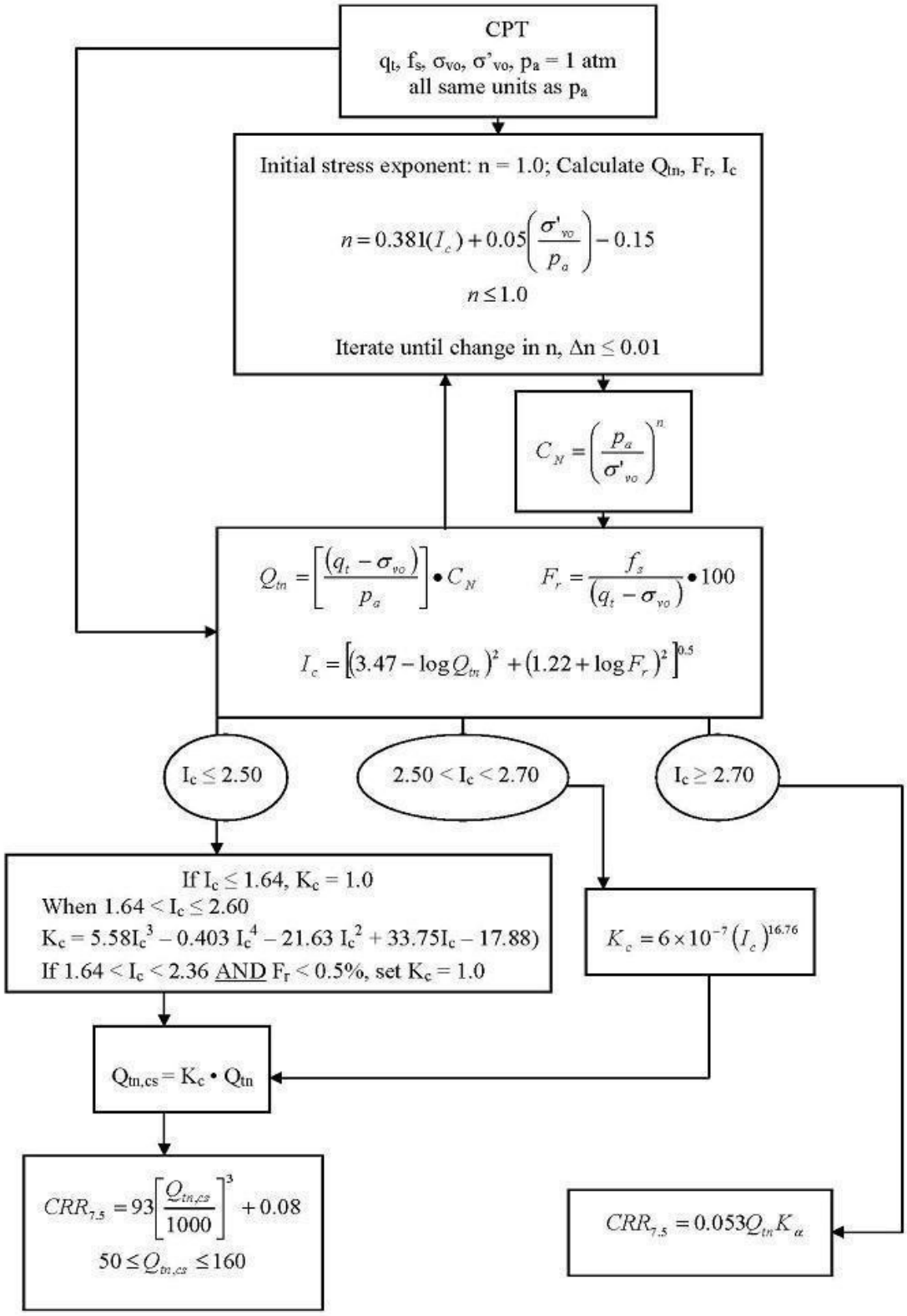
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

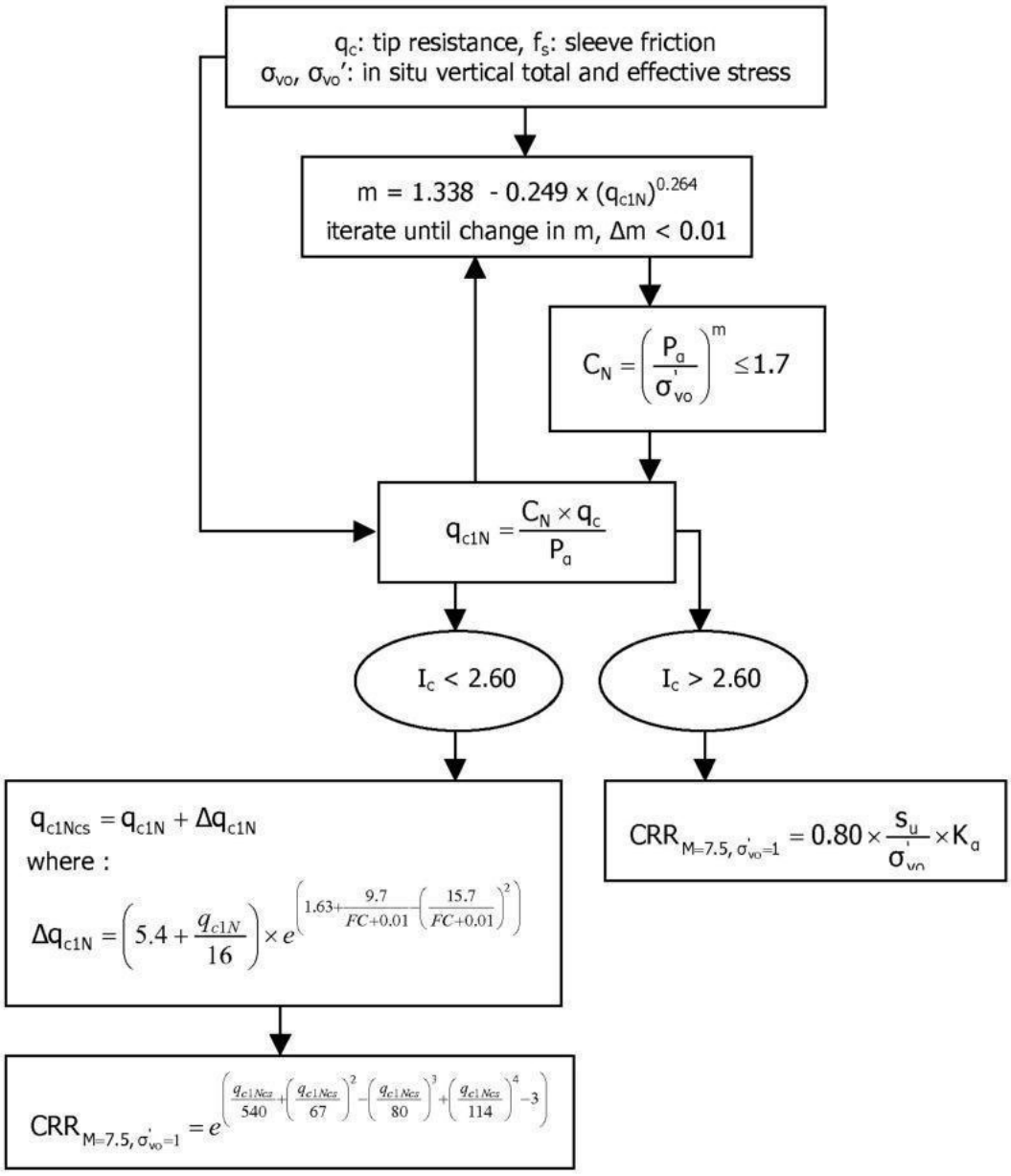
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

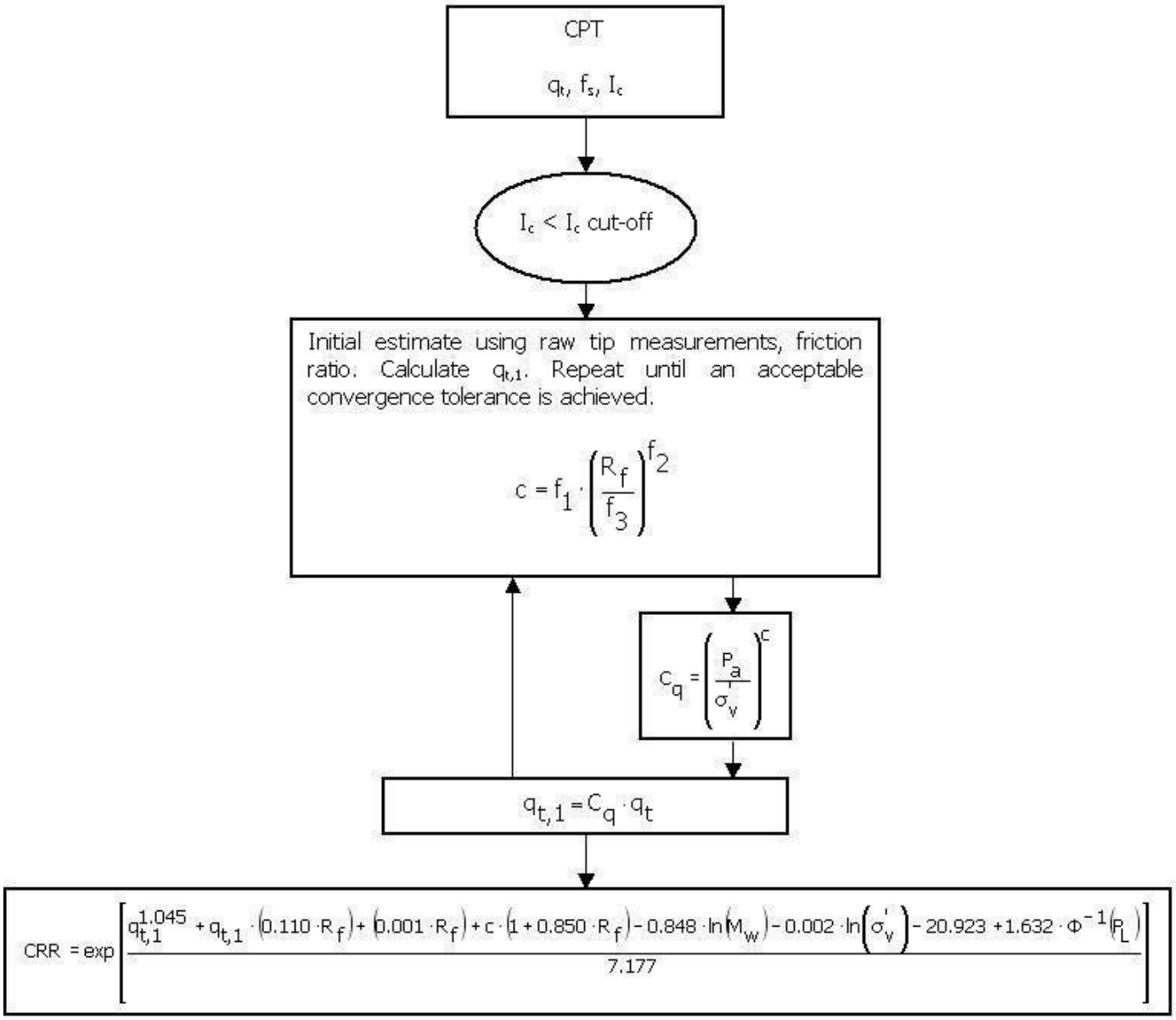


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

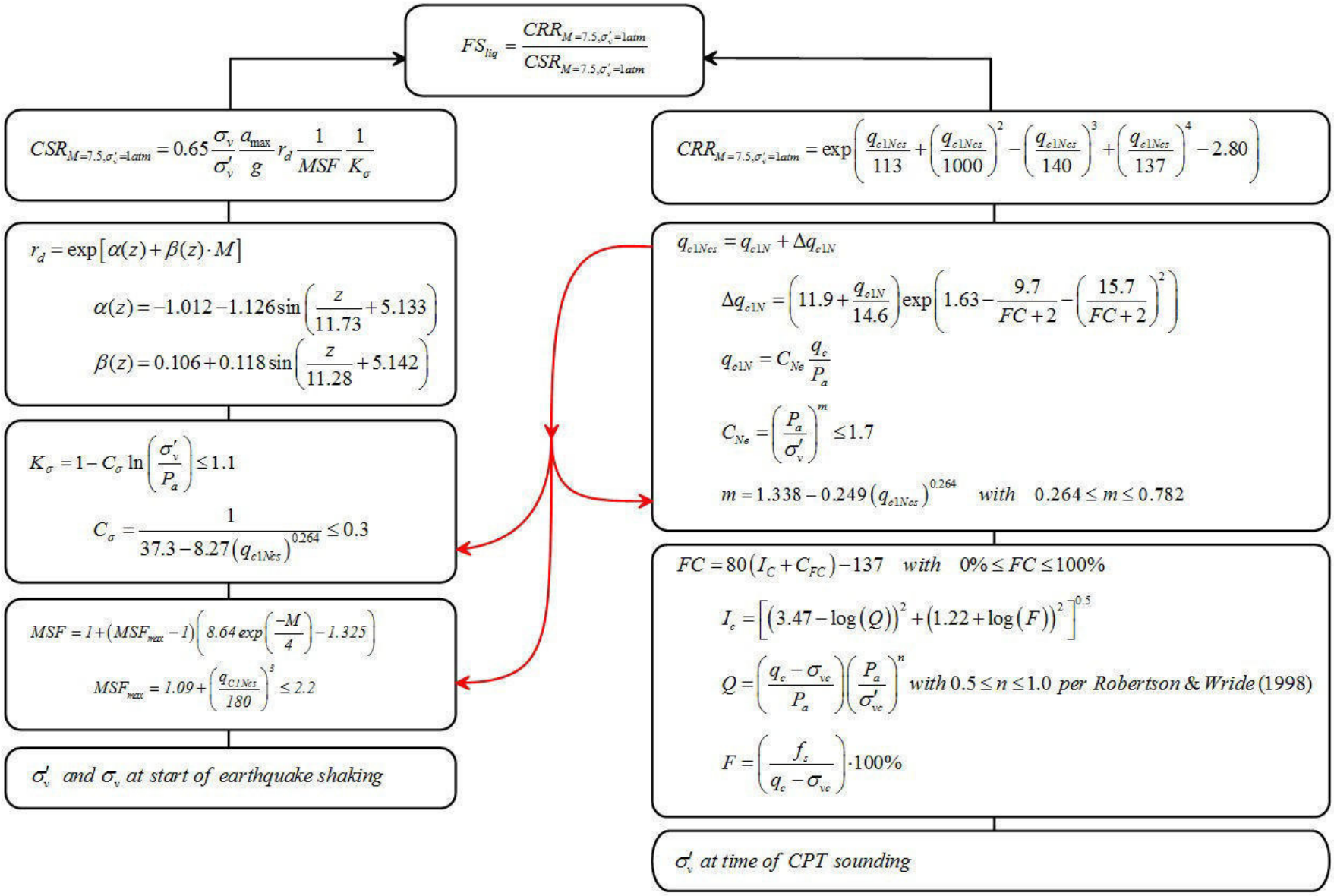
Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



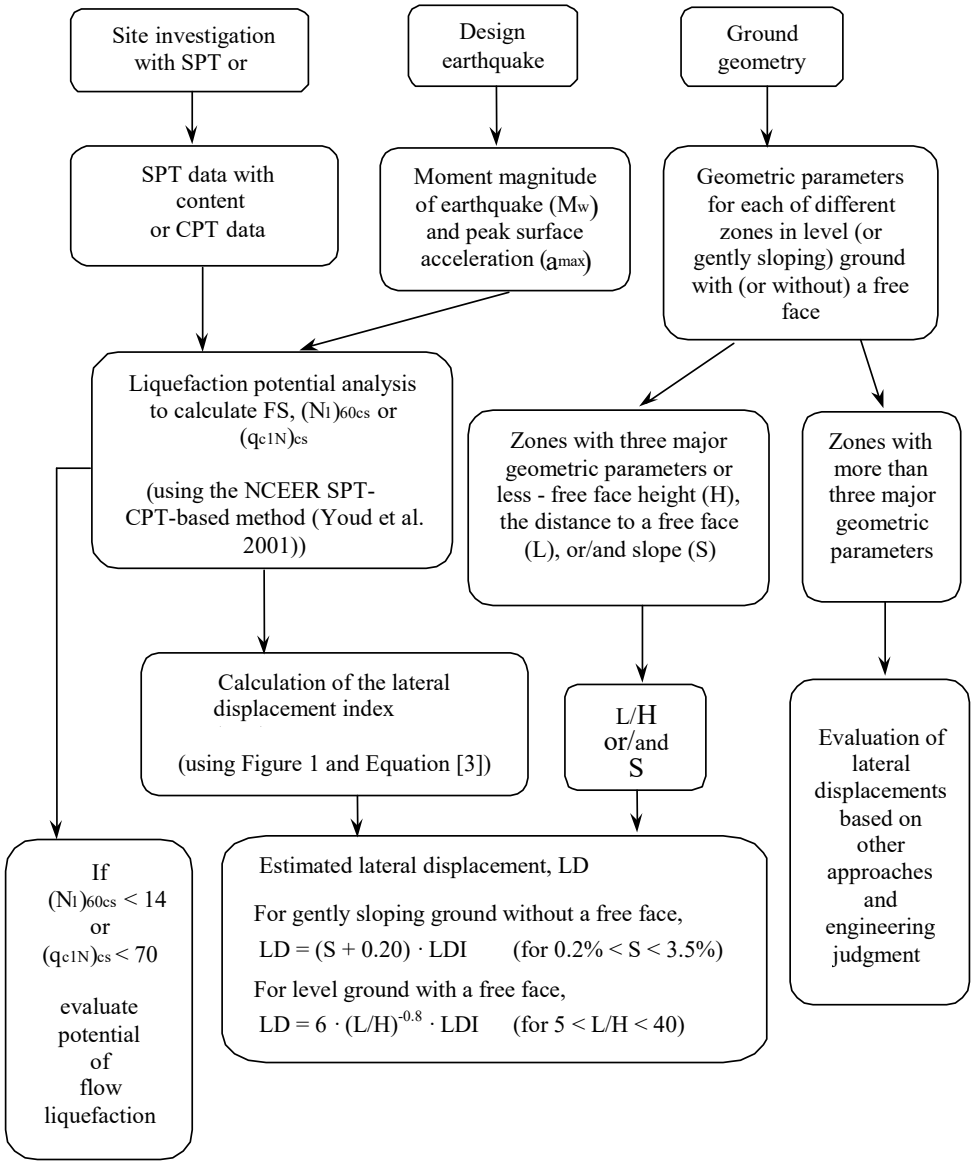
Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



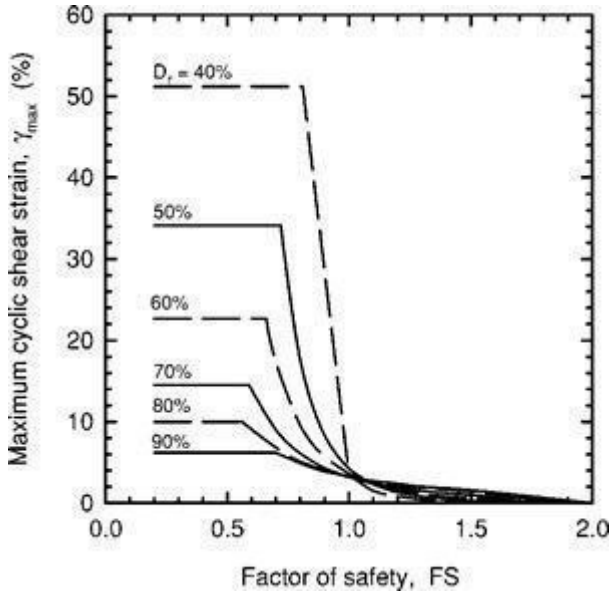
Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)



Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



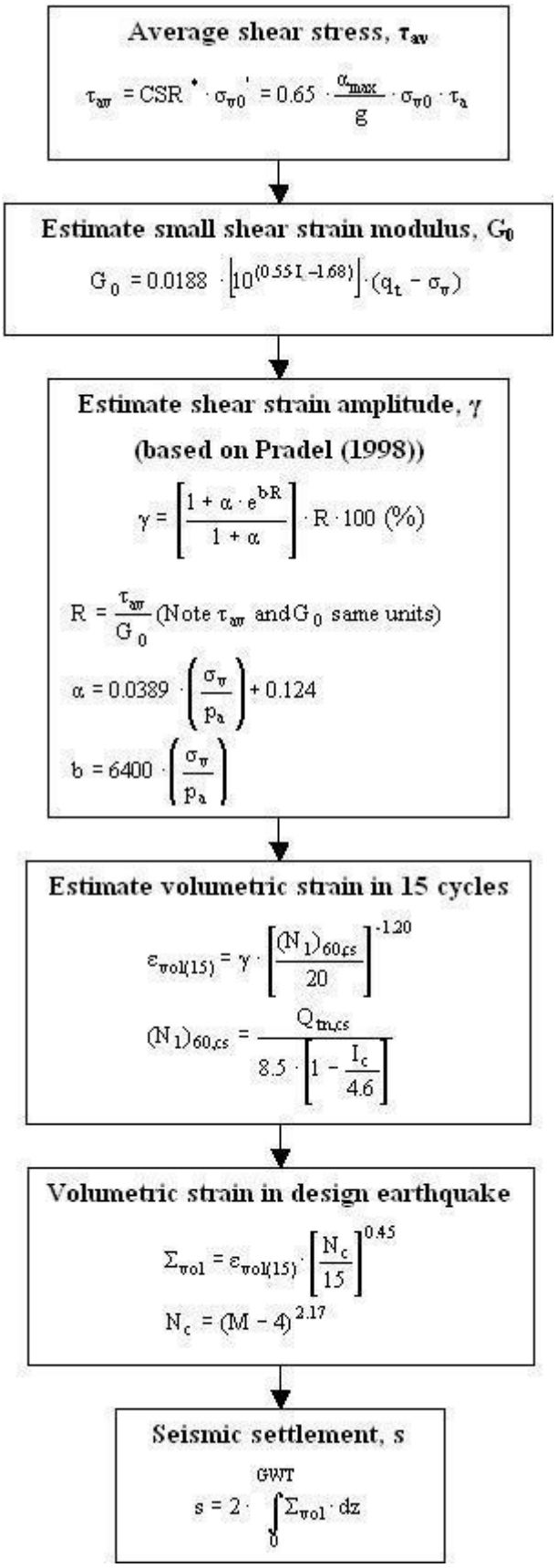
[1] Figure 1

$$LDI = \int_0^{z_{max}} \gamma_{max} dz$$

[1] Equation [3]

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

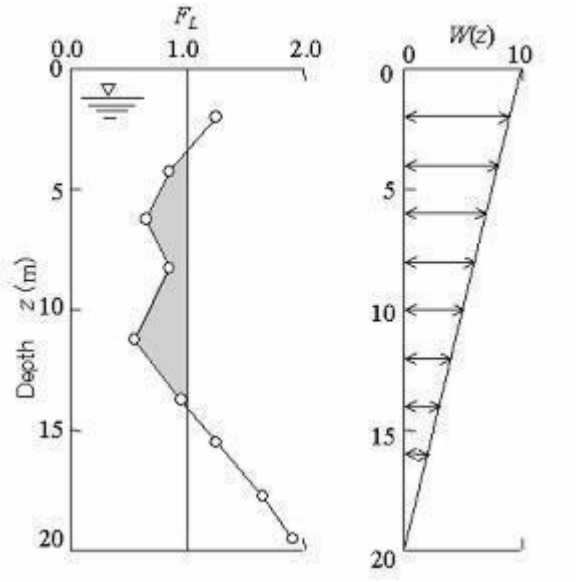
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\mathbf{LPI} = \int_0^{20} (10 - 0{,}5z) \times F_L \times dz$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) + 4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B + 0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

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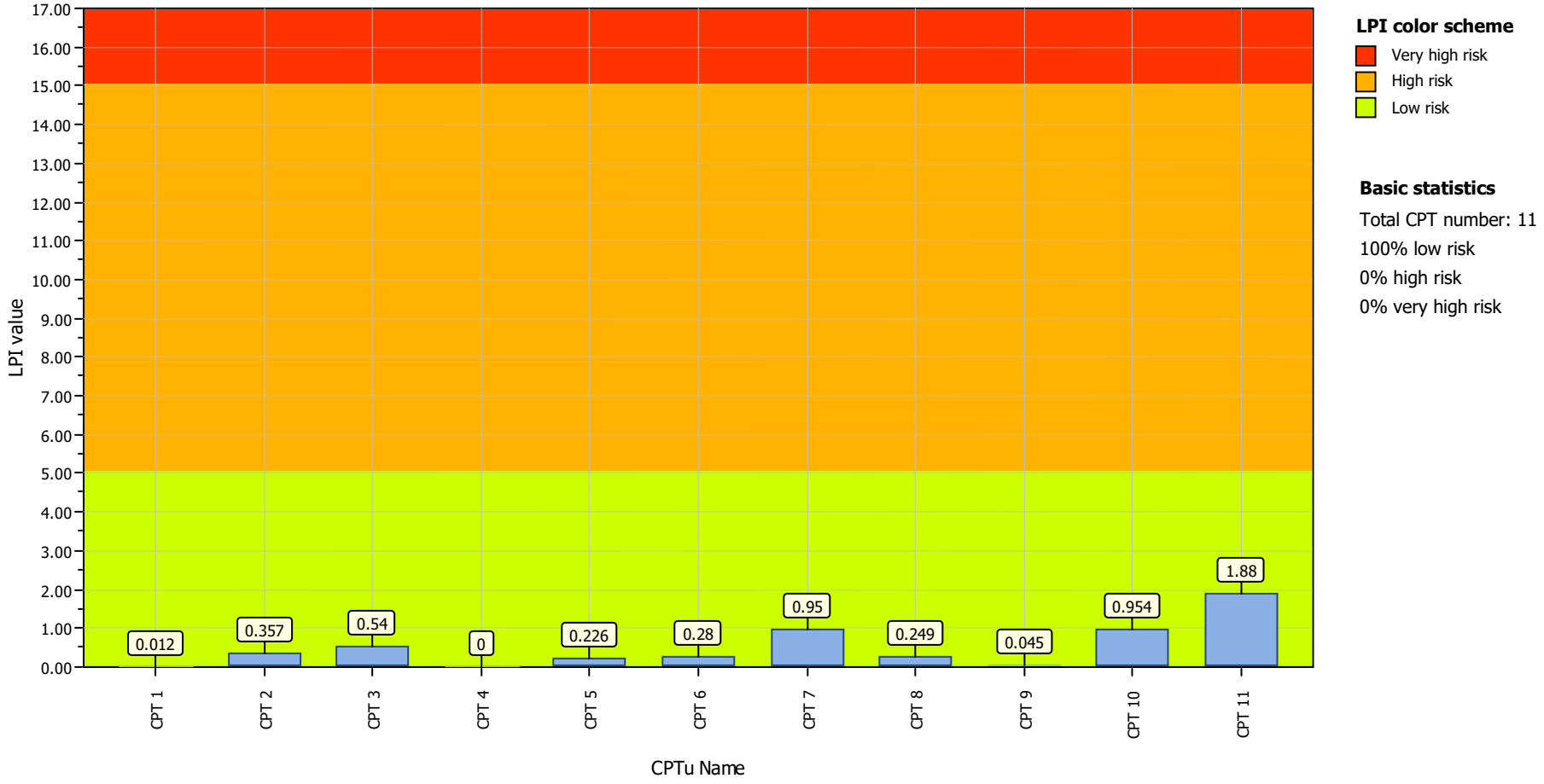
B.2 1 in 500-year results

BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

Project title : 3MS Geotechnical Suitability Investigation - Liquefaction Analysis

Location : Cambridge Road, Cambridge

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

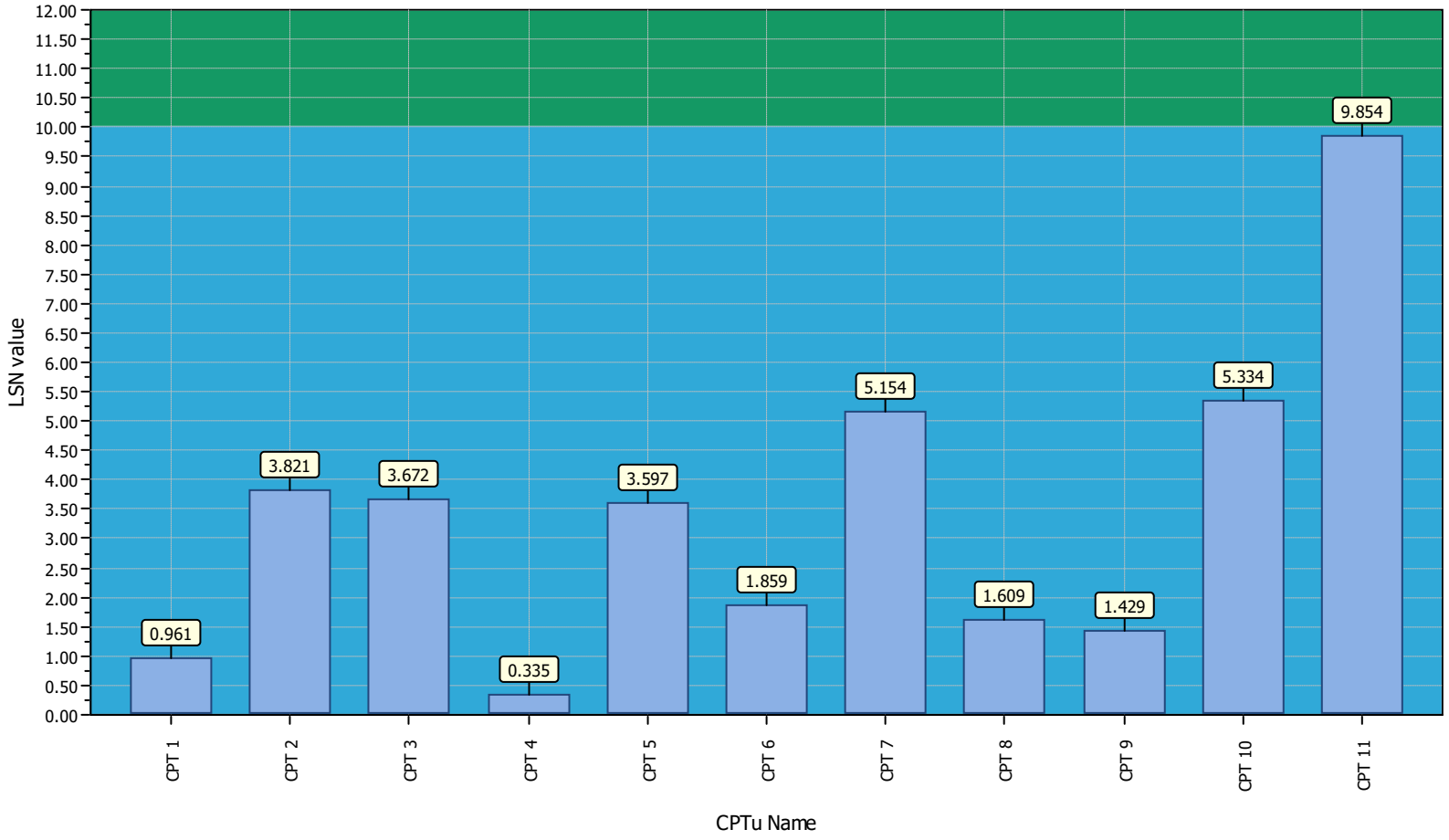
Total CPT number: 11
100% low risk
0% high risk
0% very high risk

BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

Project title : 3MS Geotechnical Suitability Investigation - Liquefaction Analysis

Location : Cambridge Road, Cambridge

Overall Liquefaction Severity Number report



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

Basic statistics

Total CPT number: 11

100% little liquefaction

0% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

0% severe liquefaction

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Project title : 3MS Geotechnical Suitability Investigation - Liquefaction Analysis

Location : Cambridge Road, Cambridge

Overall vertical settlements report

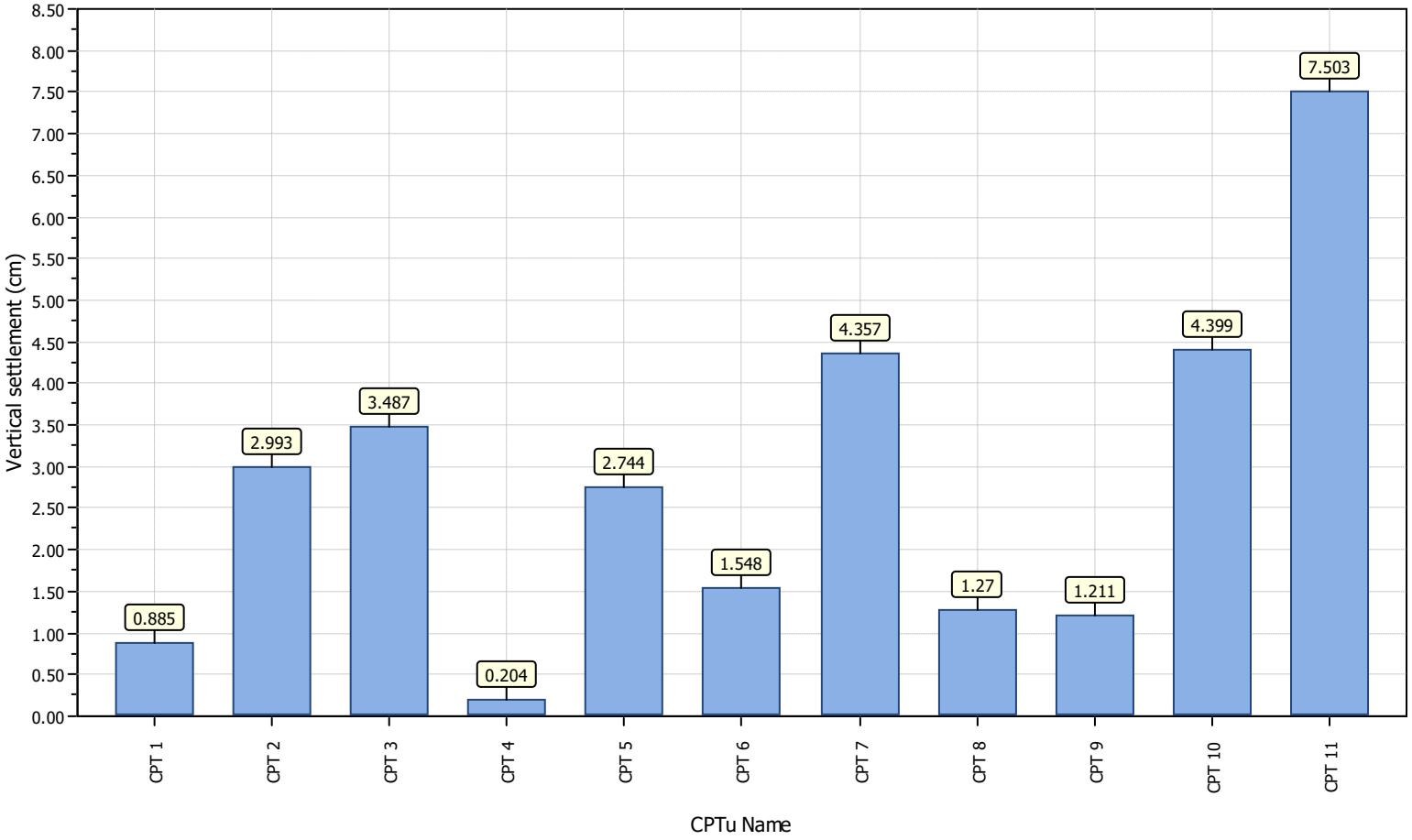


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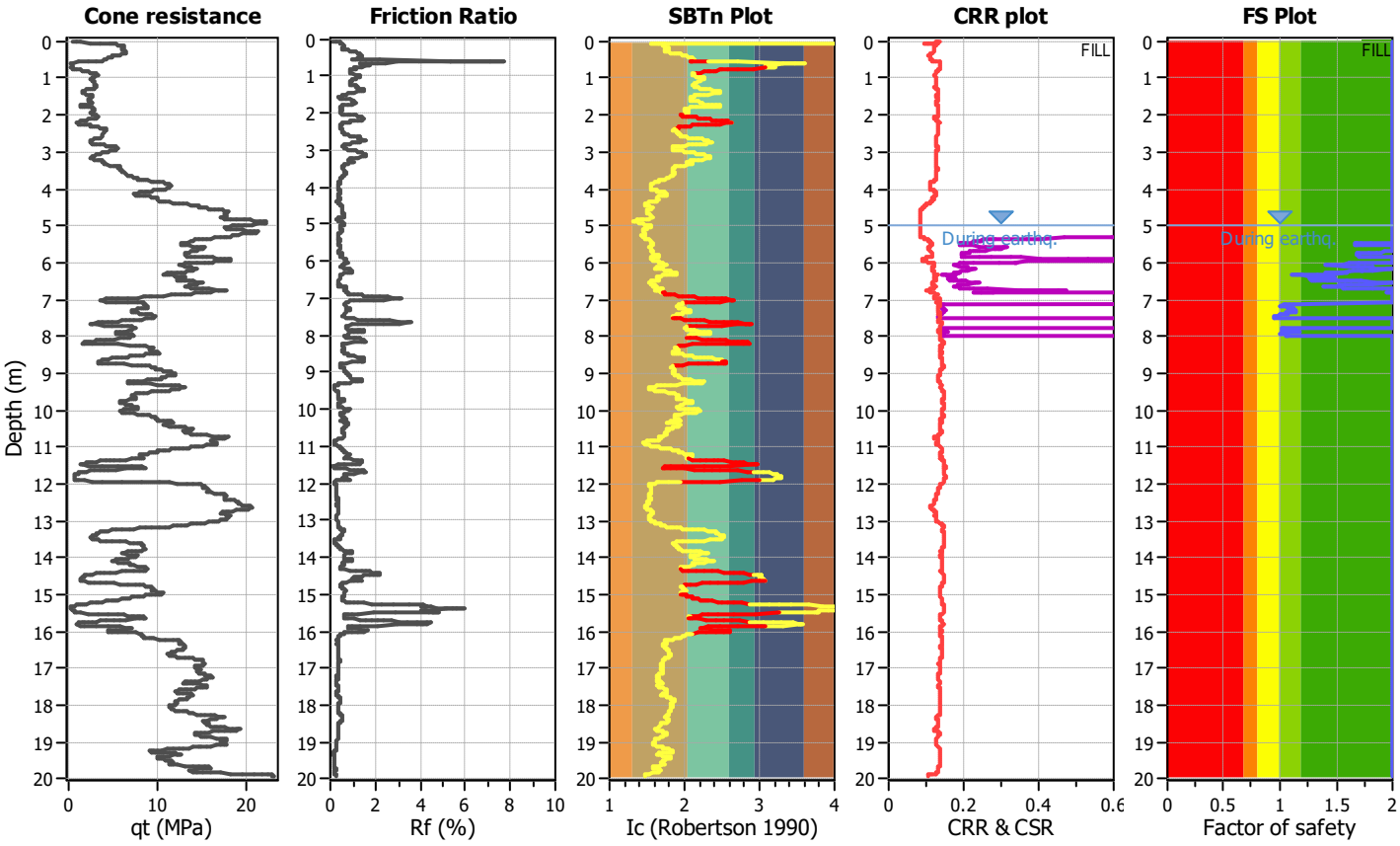
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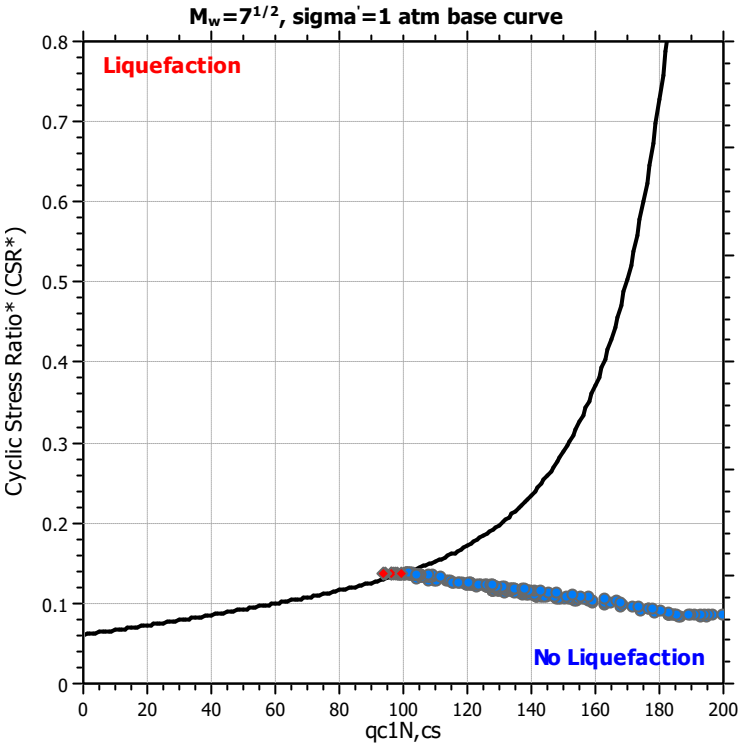
LIQUEFACTION ANALYSIS REPORT

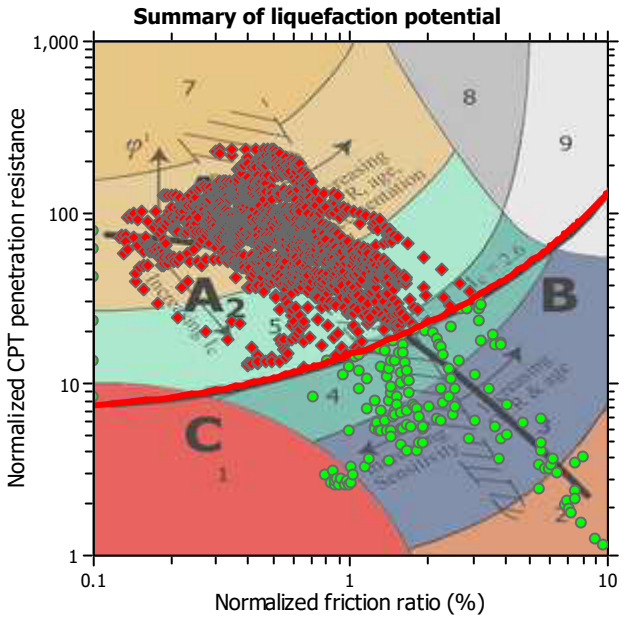
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	8.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	7.00 m	Fill height:	2.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

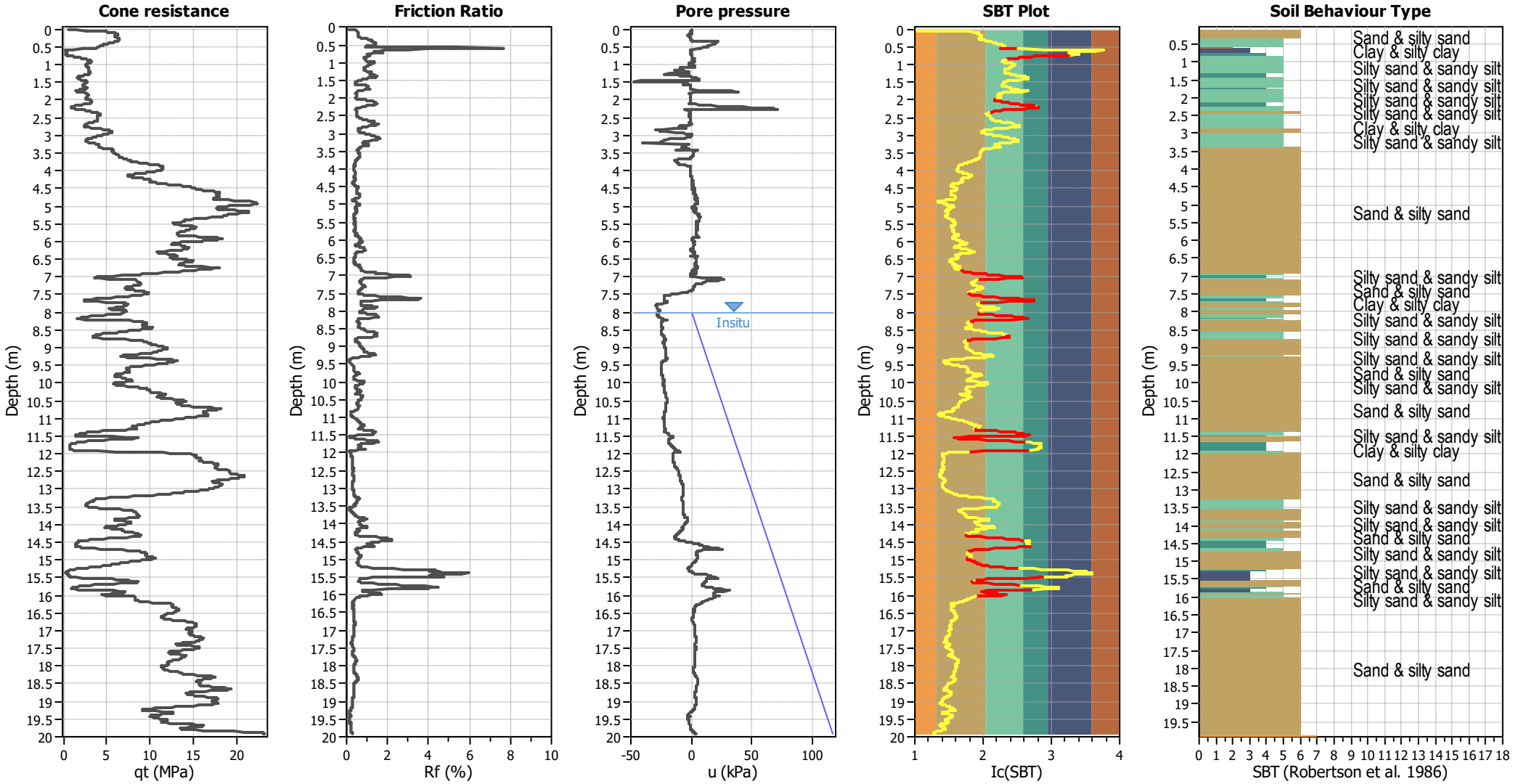






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



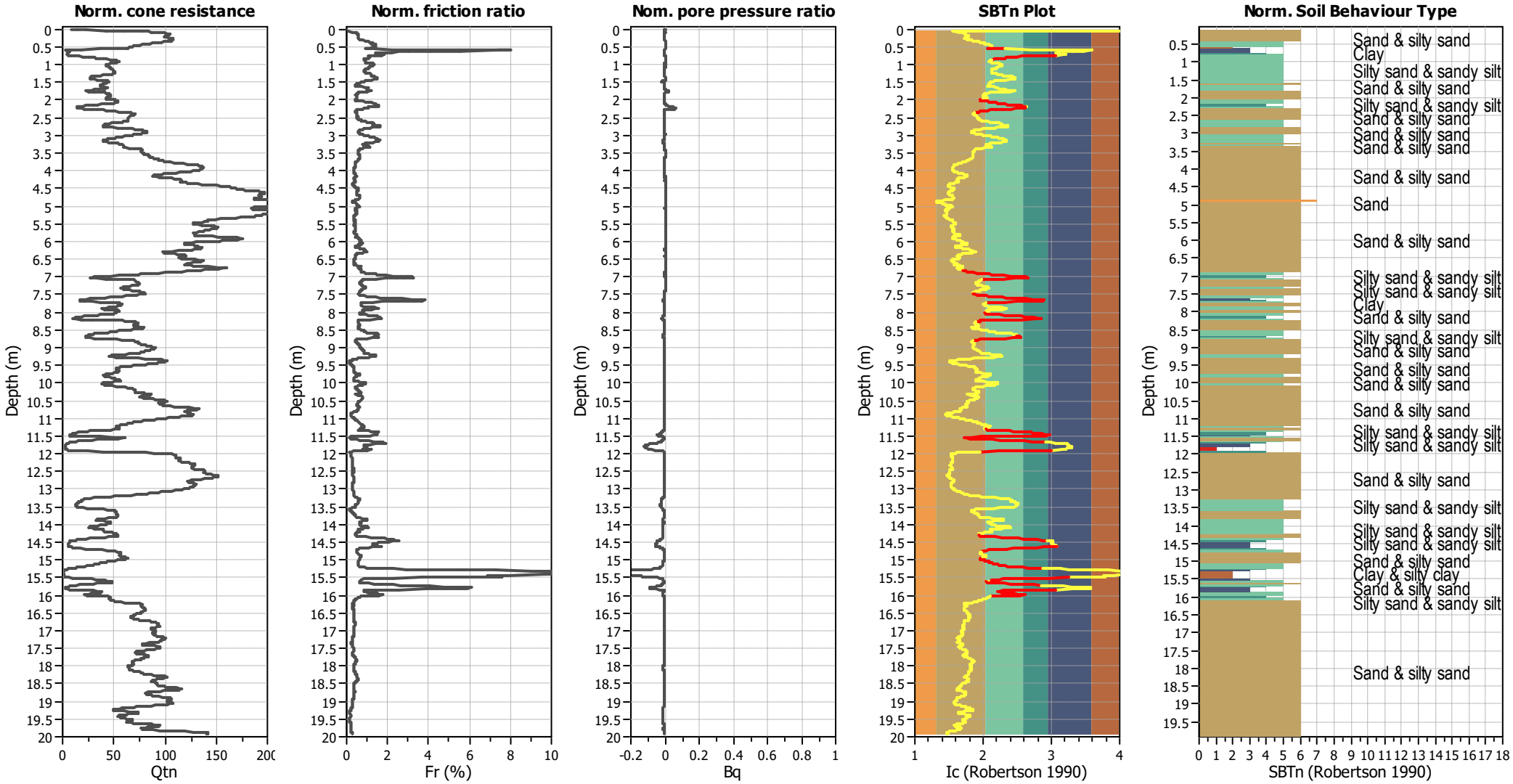
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



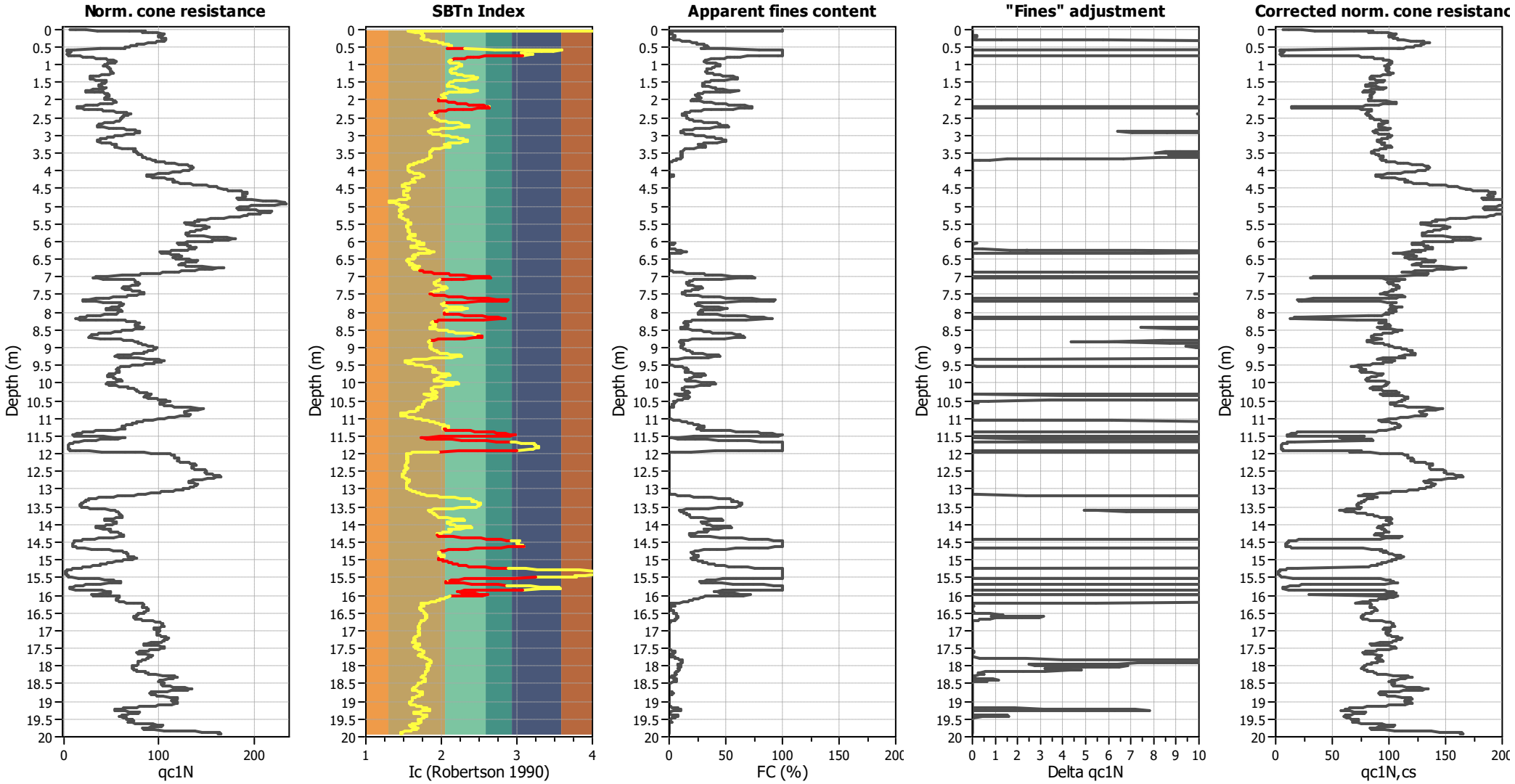
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

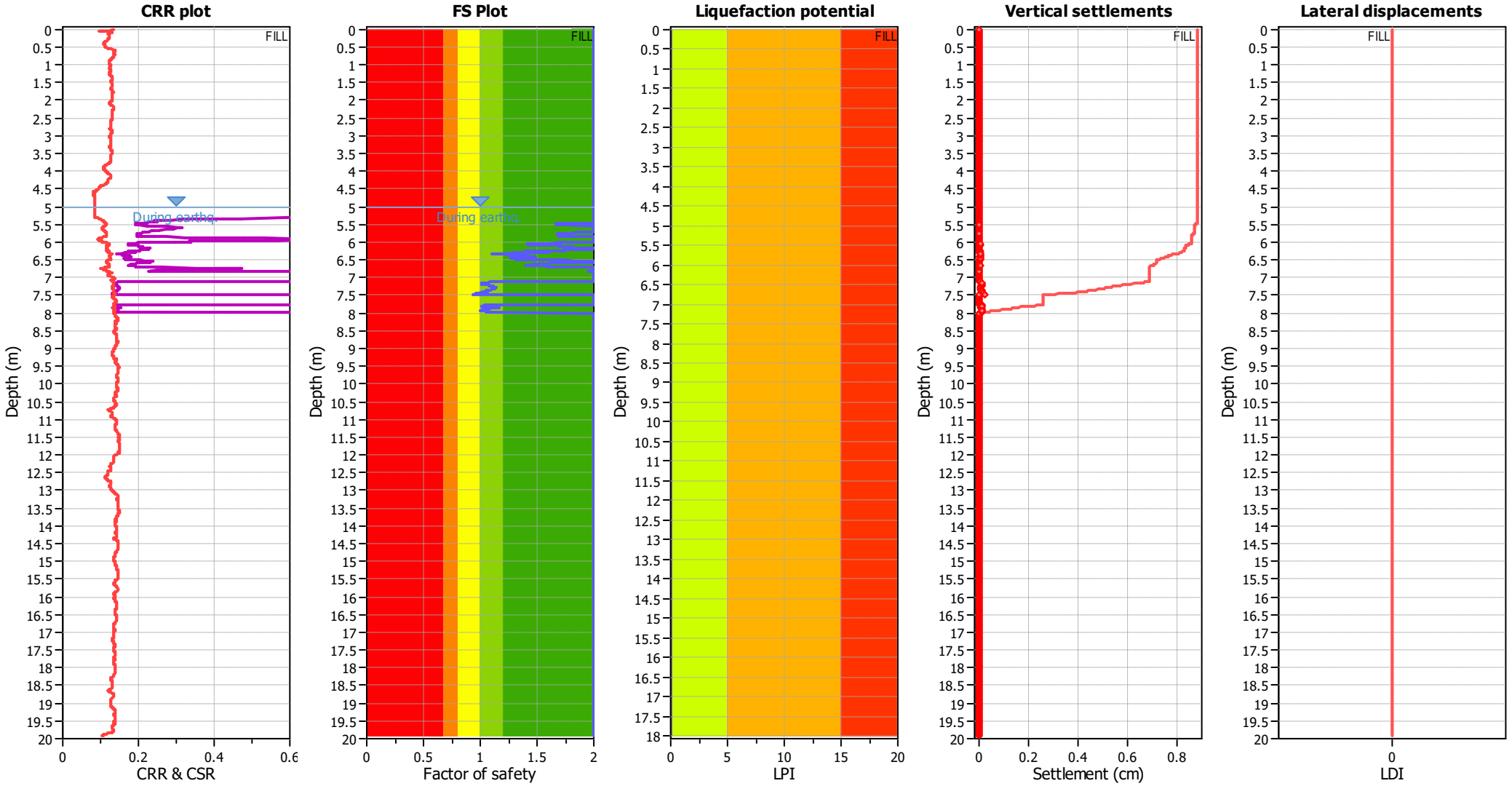
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m^3
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

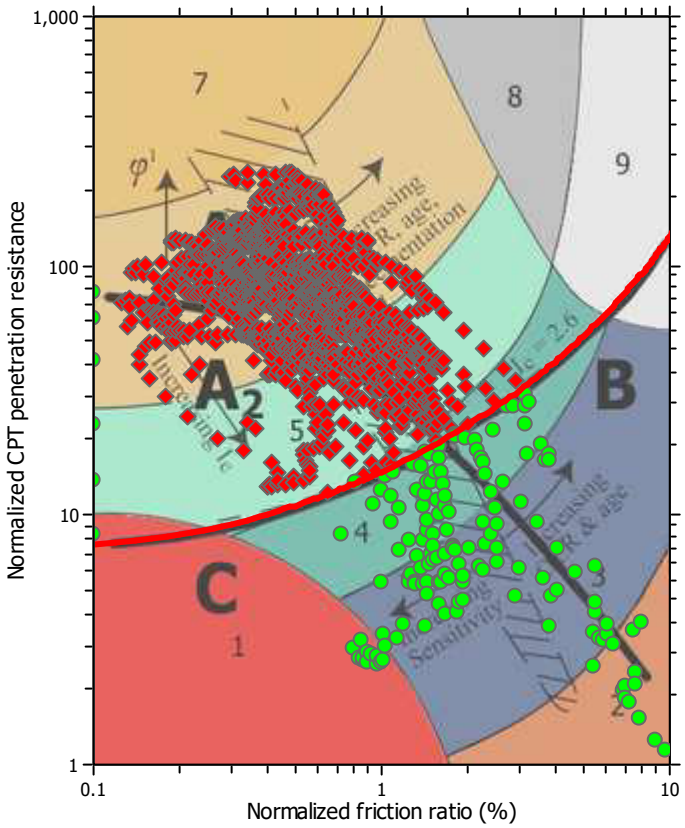
F.S. color scheme

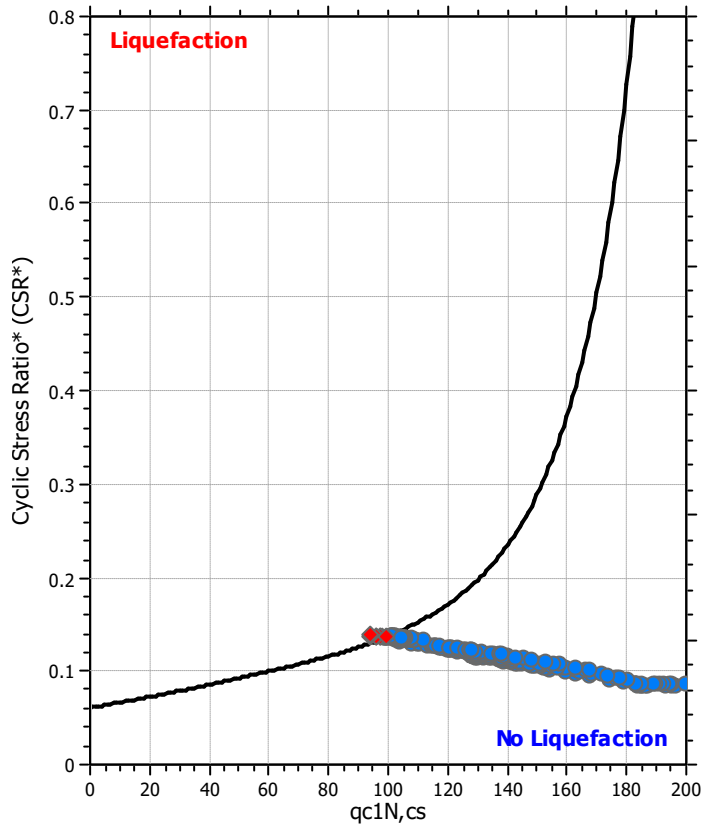
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

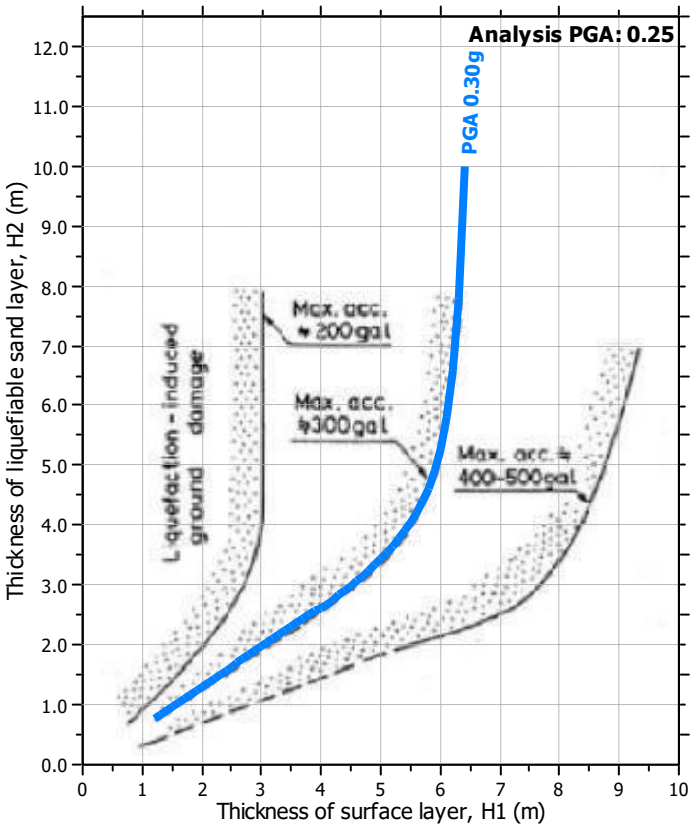
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



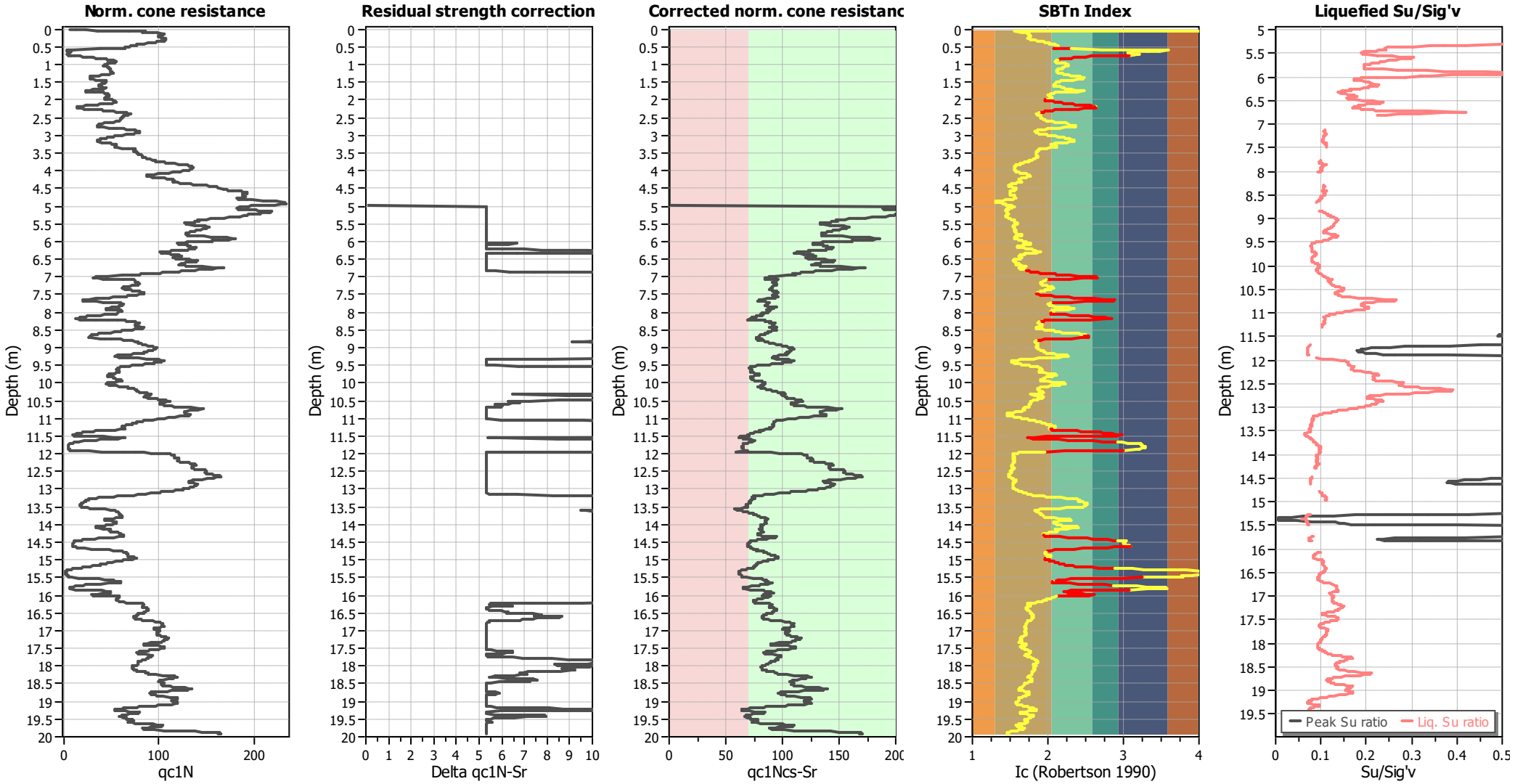




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	7.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	8.00 m	Fill height:	2.00 m	Limit depth:	10.00 m

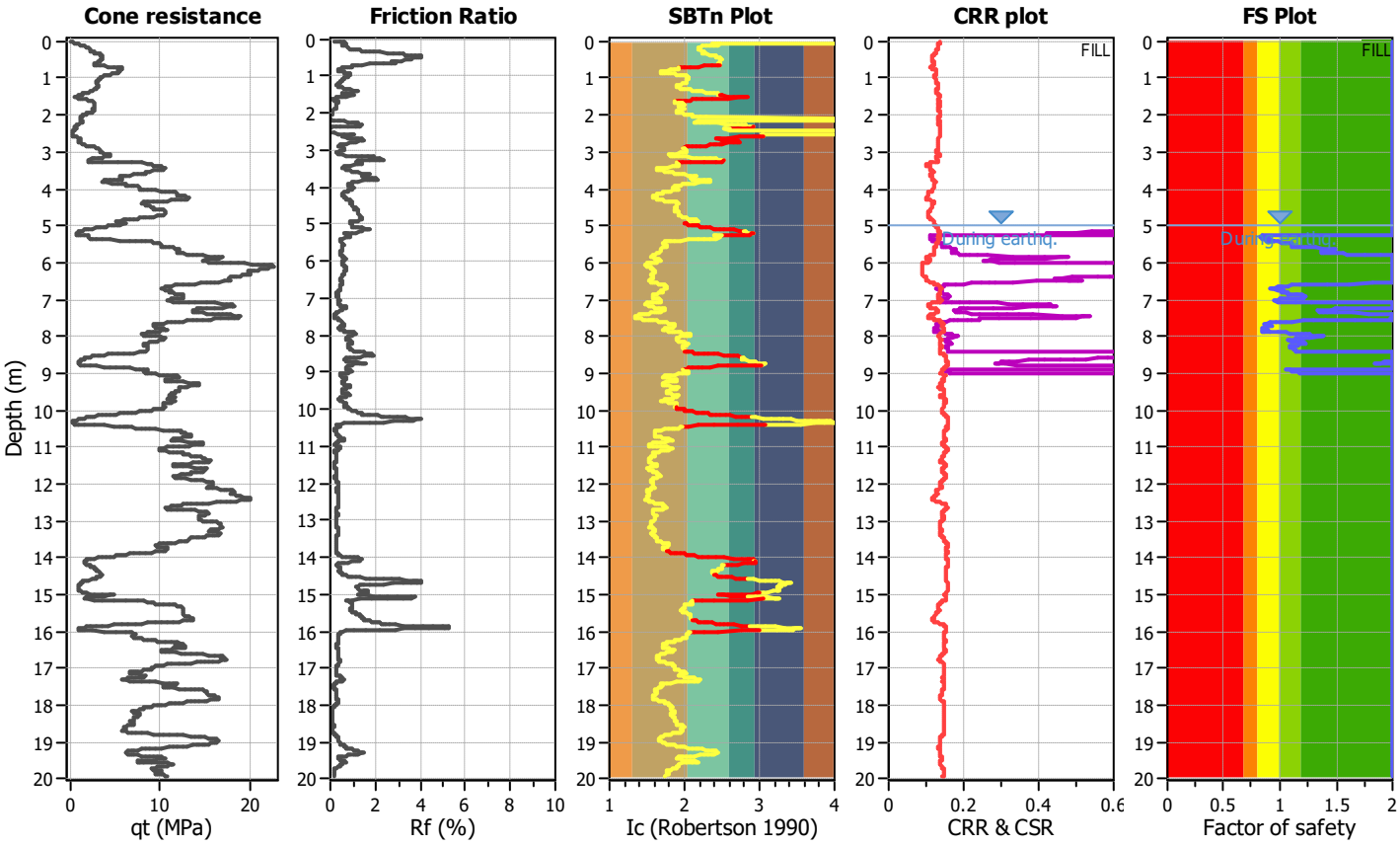
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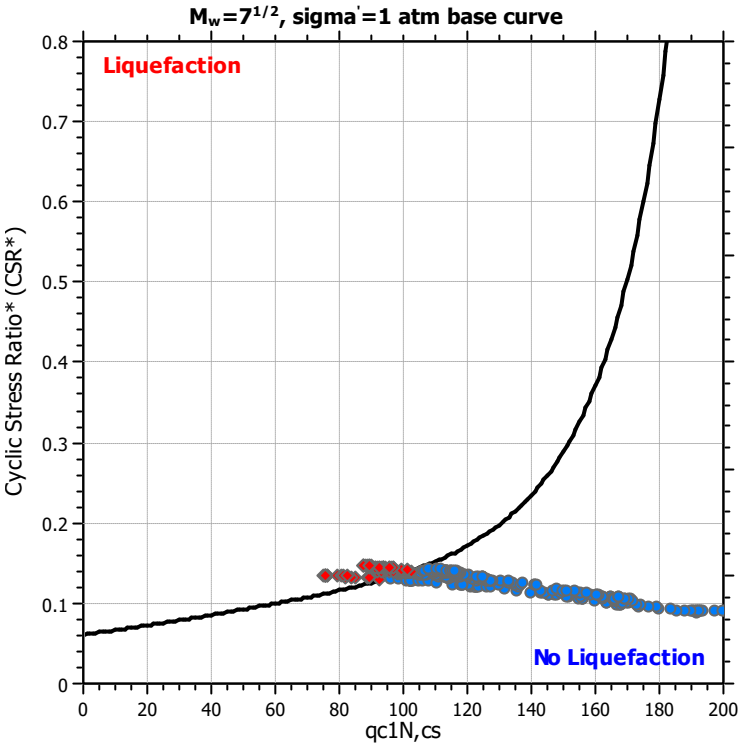
LIQUEFACTION ANALYSIS REPORT

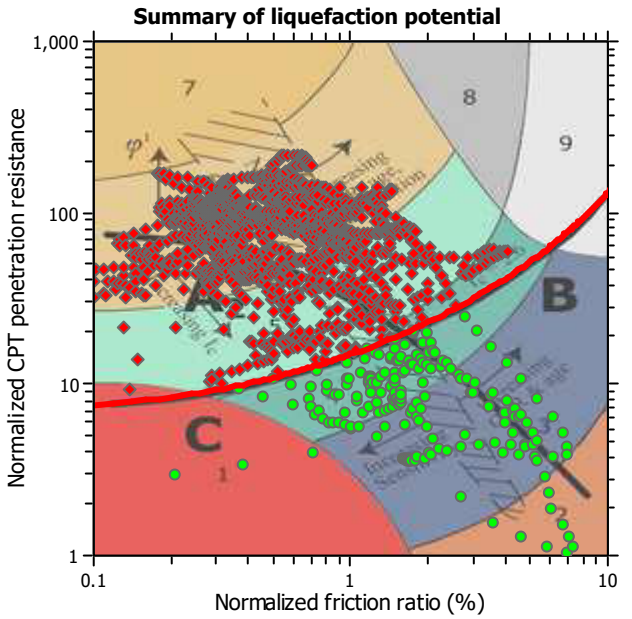
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

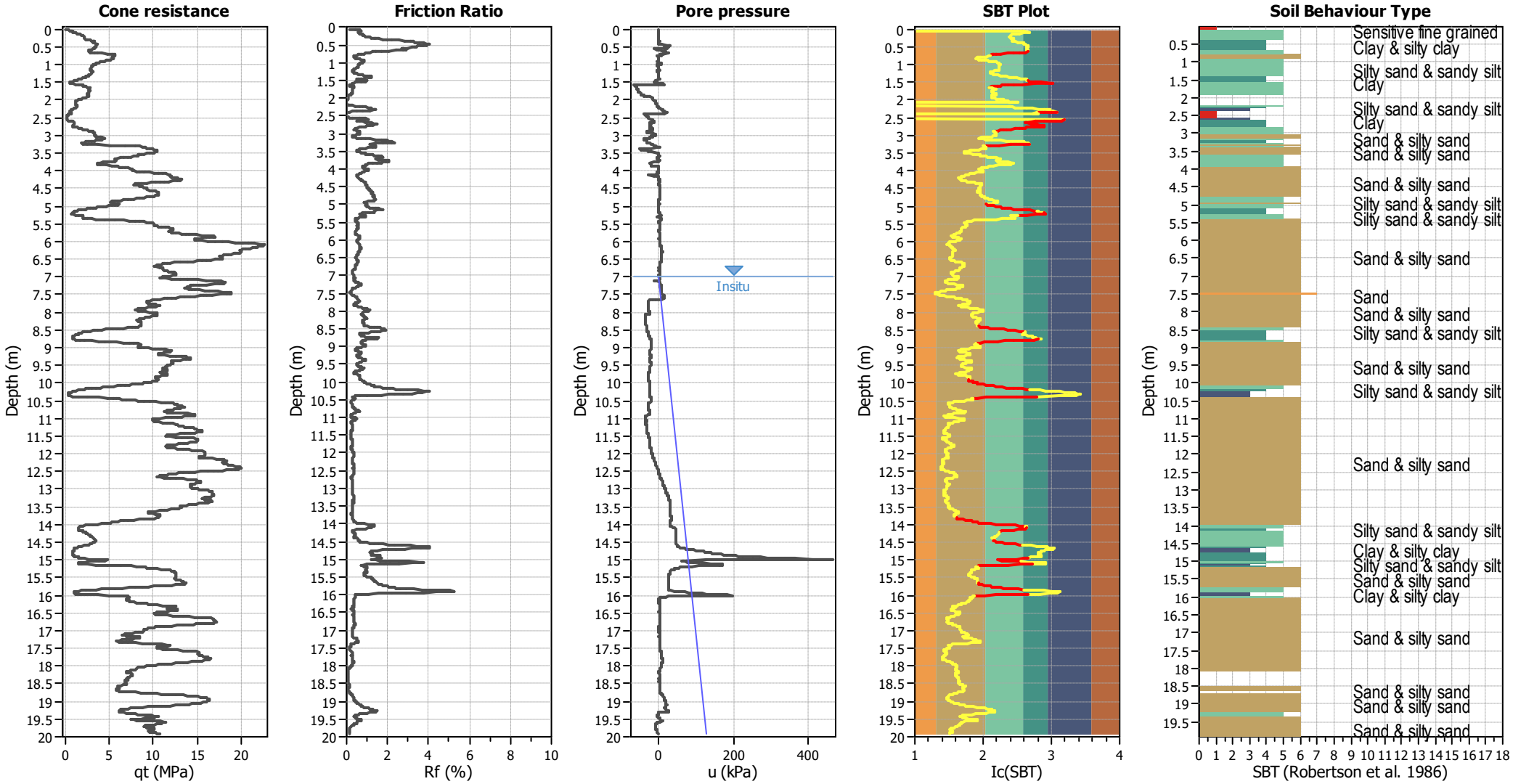






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



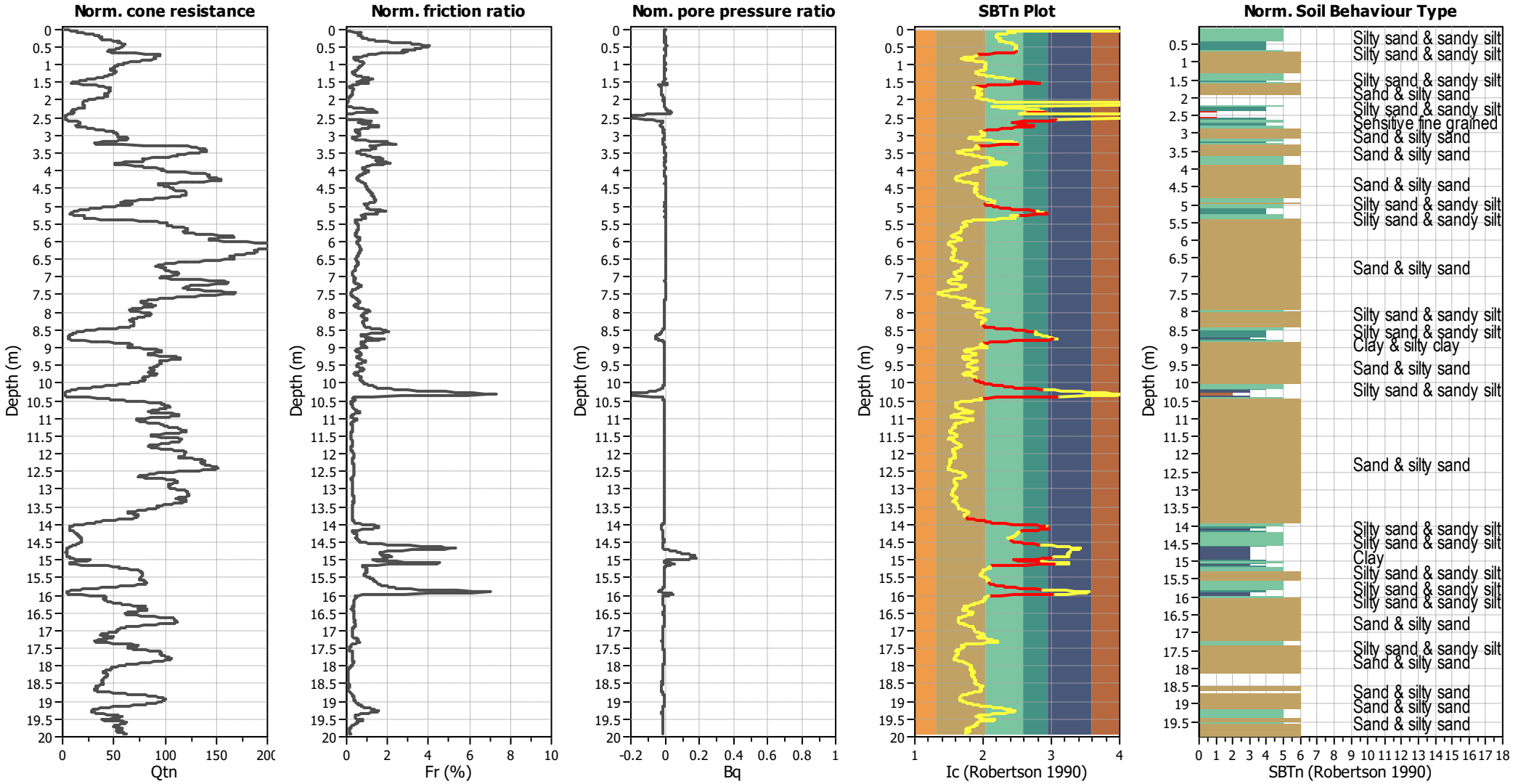
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



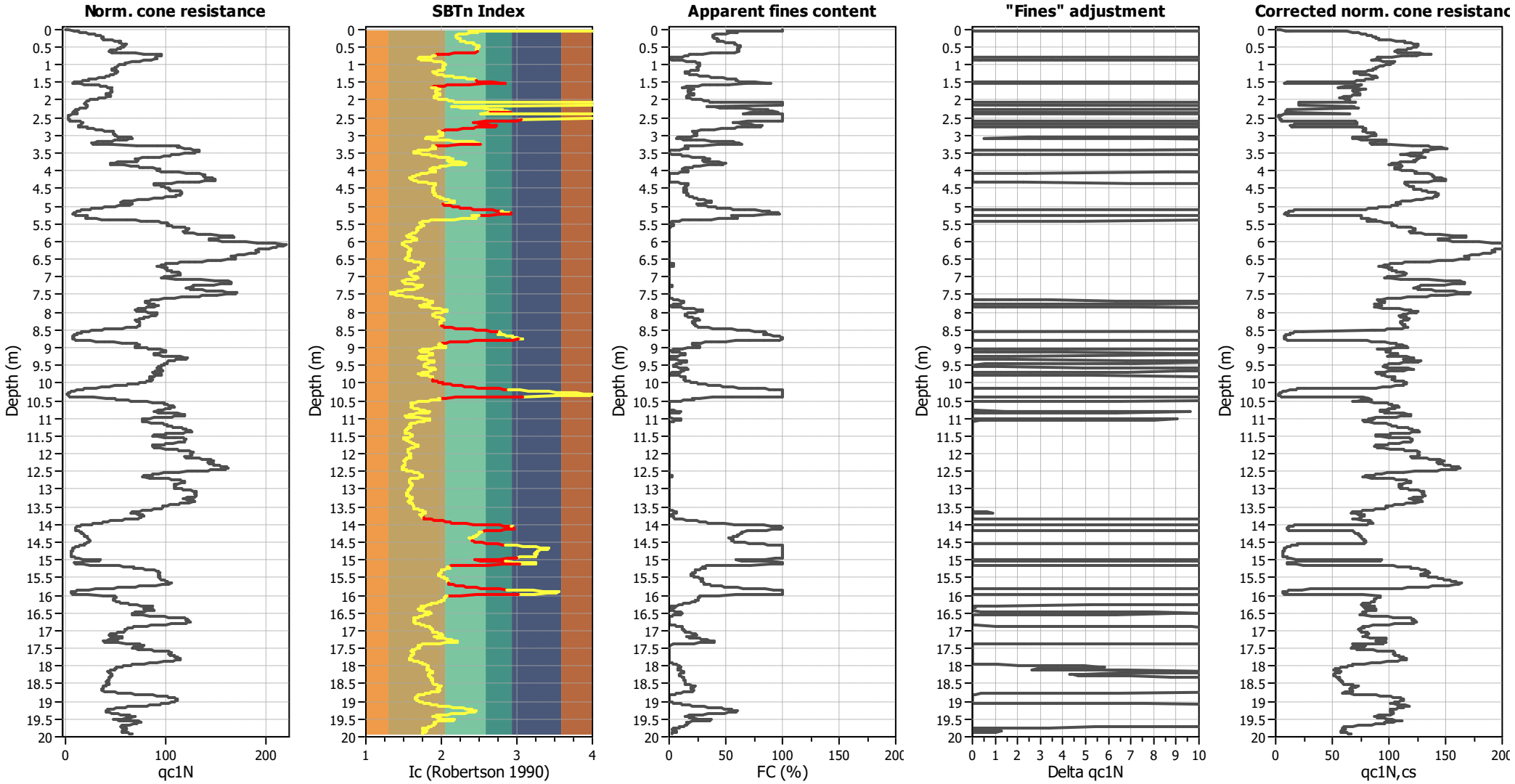
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

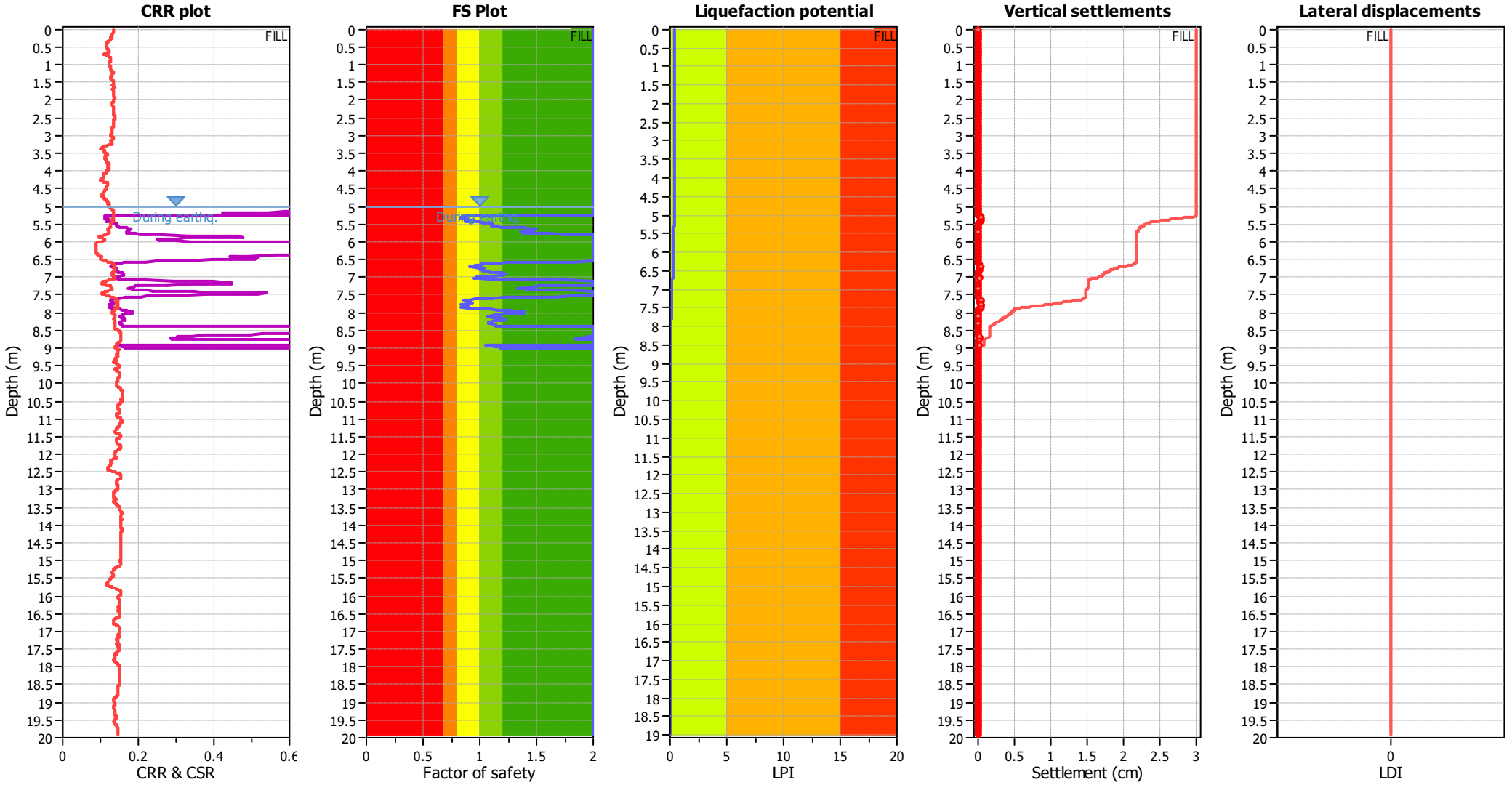
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

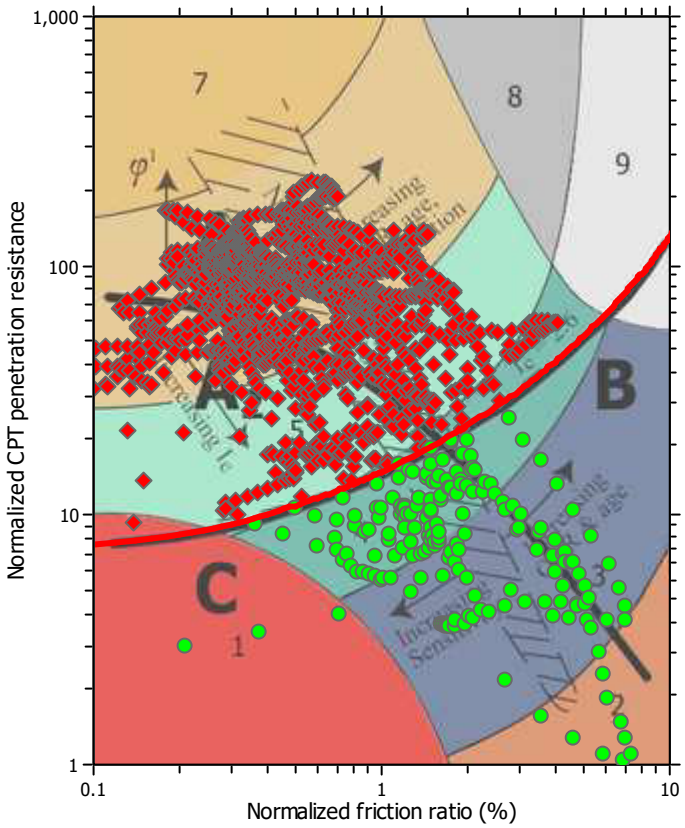
F.S. color scheme

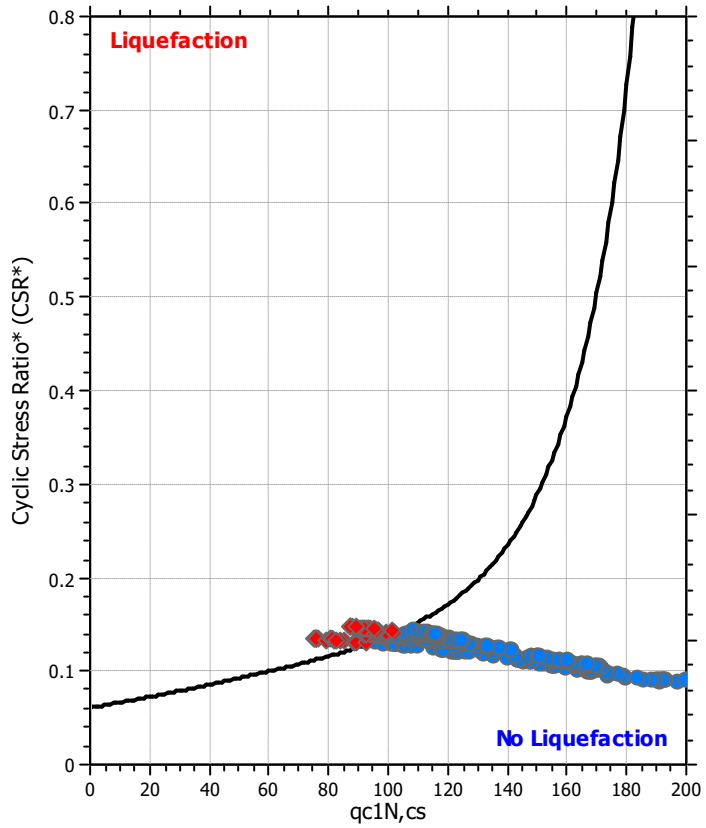
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

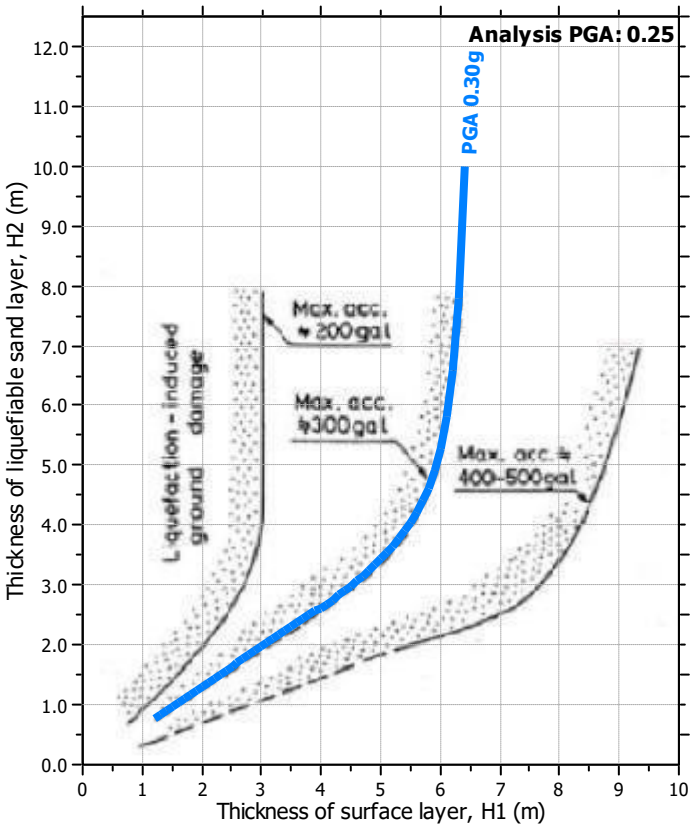
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



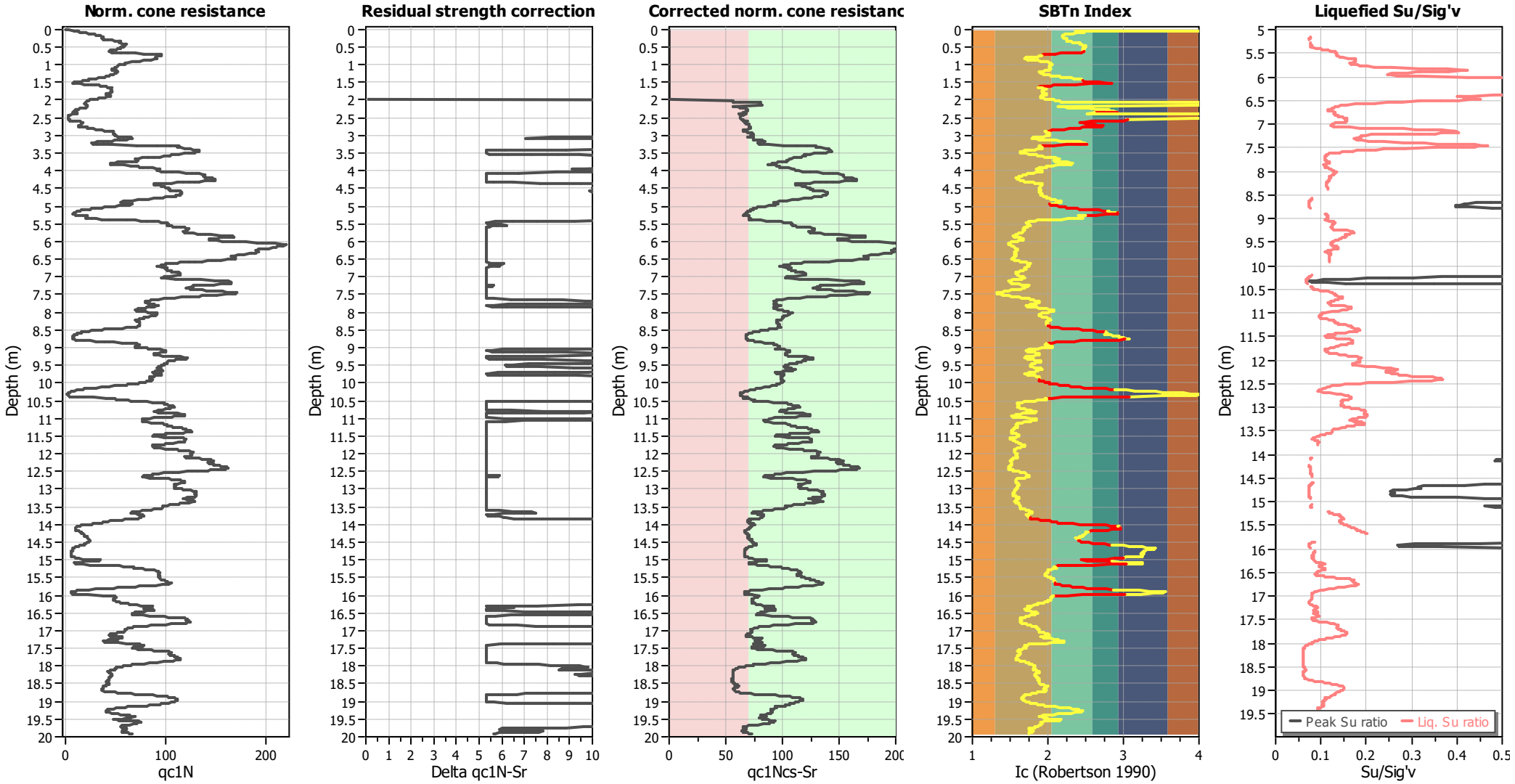




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

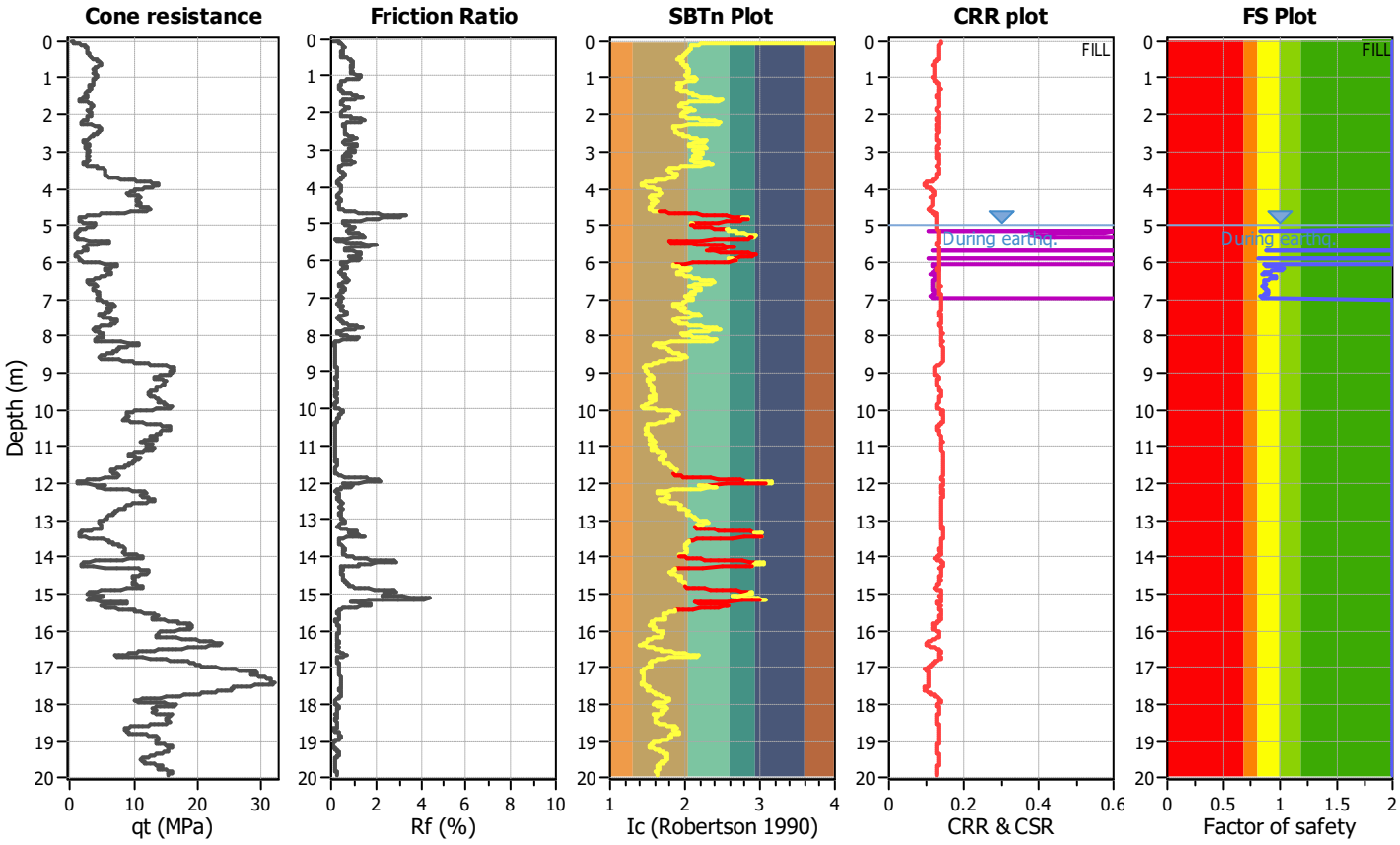
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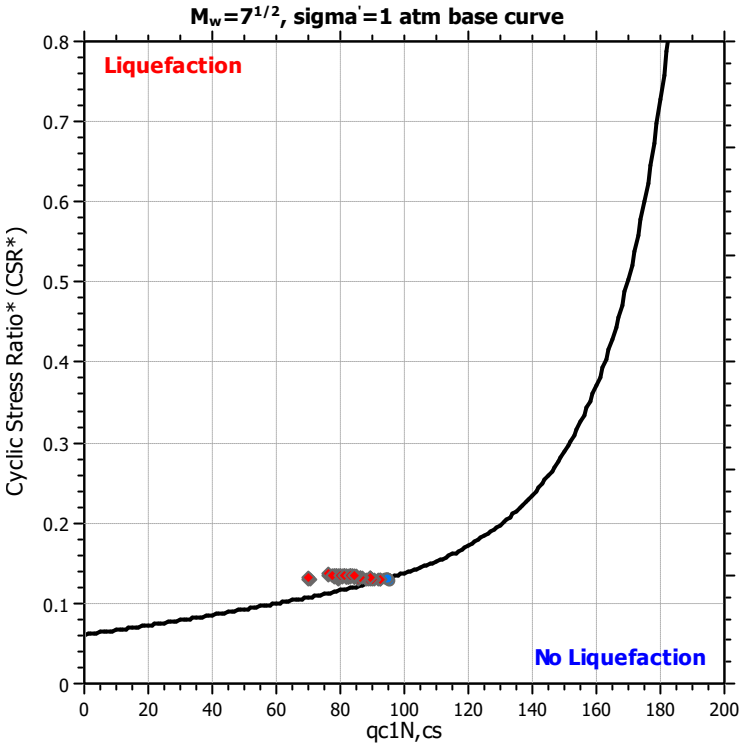
LIQUEFACTION ANALYSIS REPORT

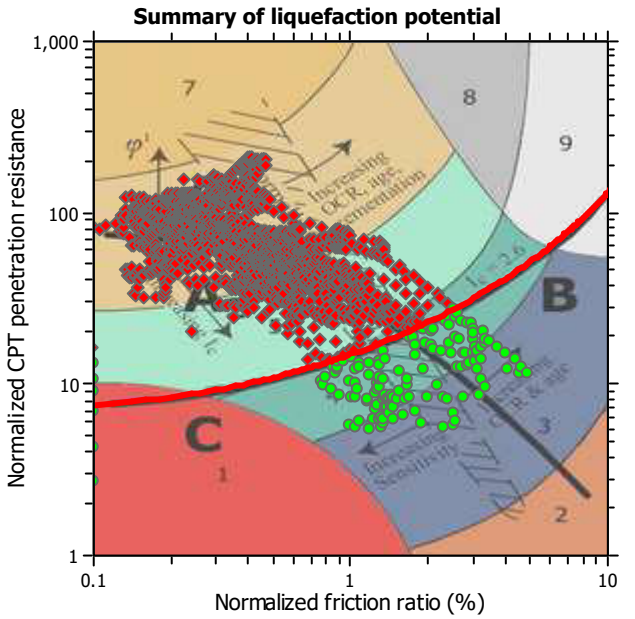
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 3

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	9.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	8.00 m	Fill height:	3.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

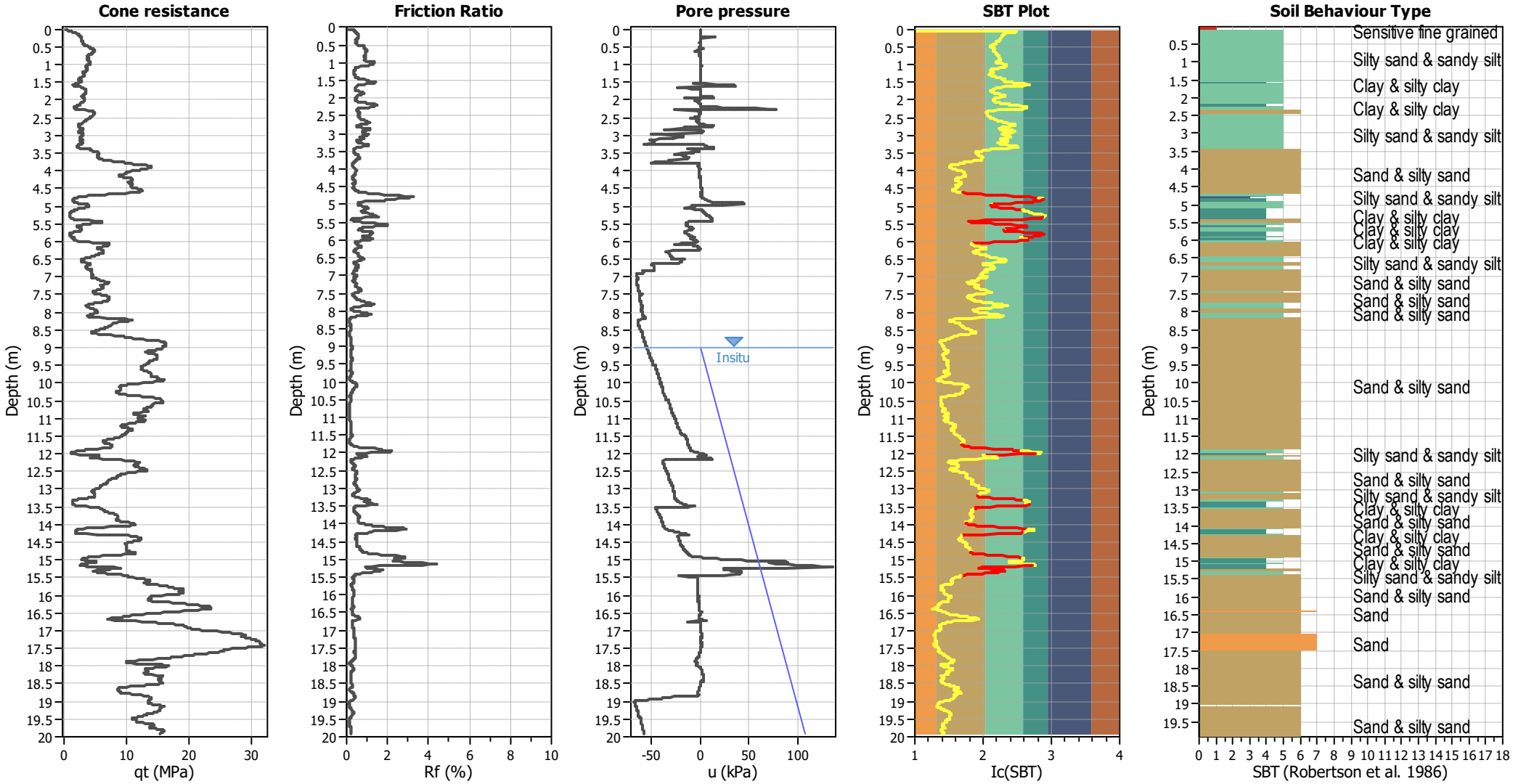






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



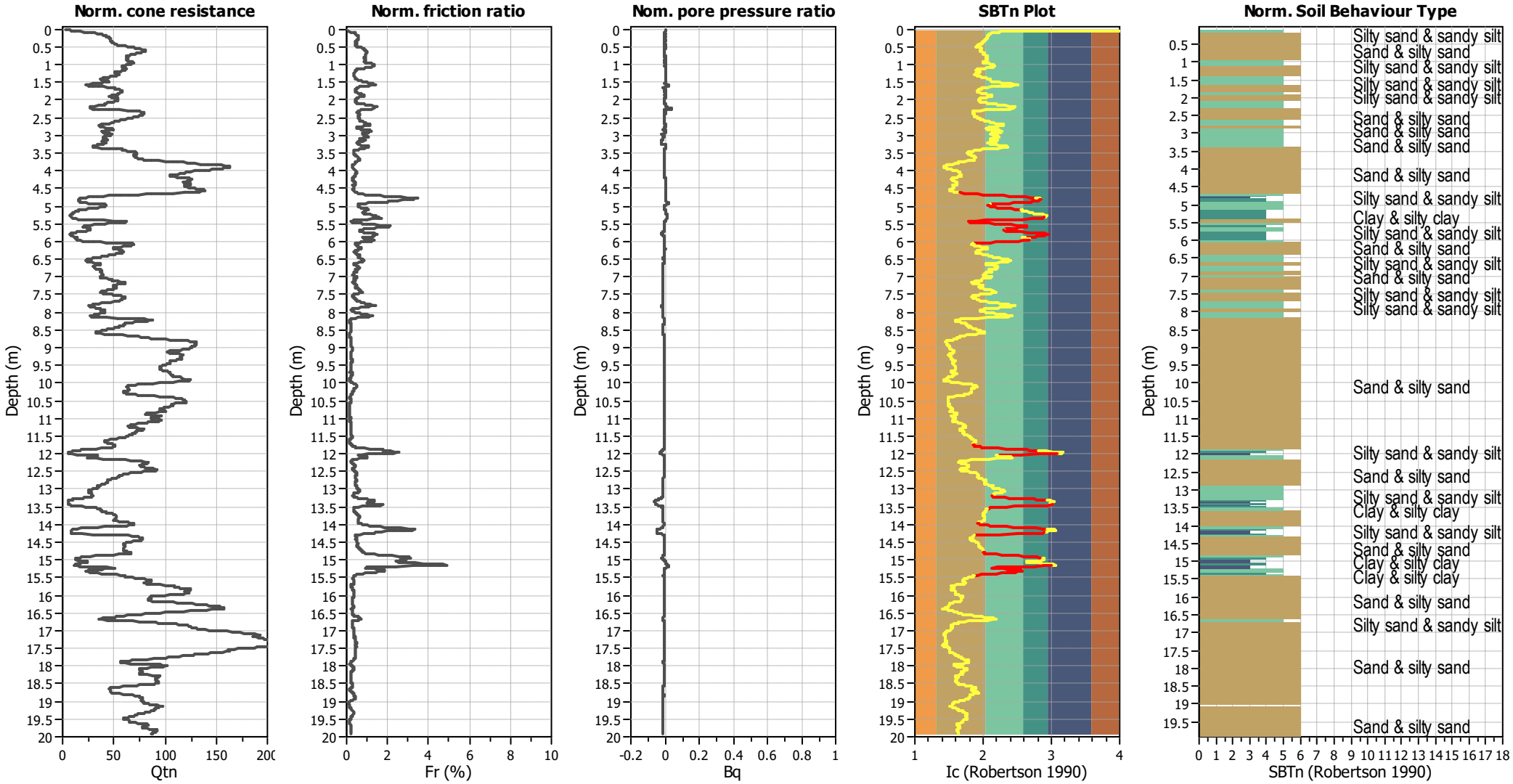
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



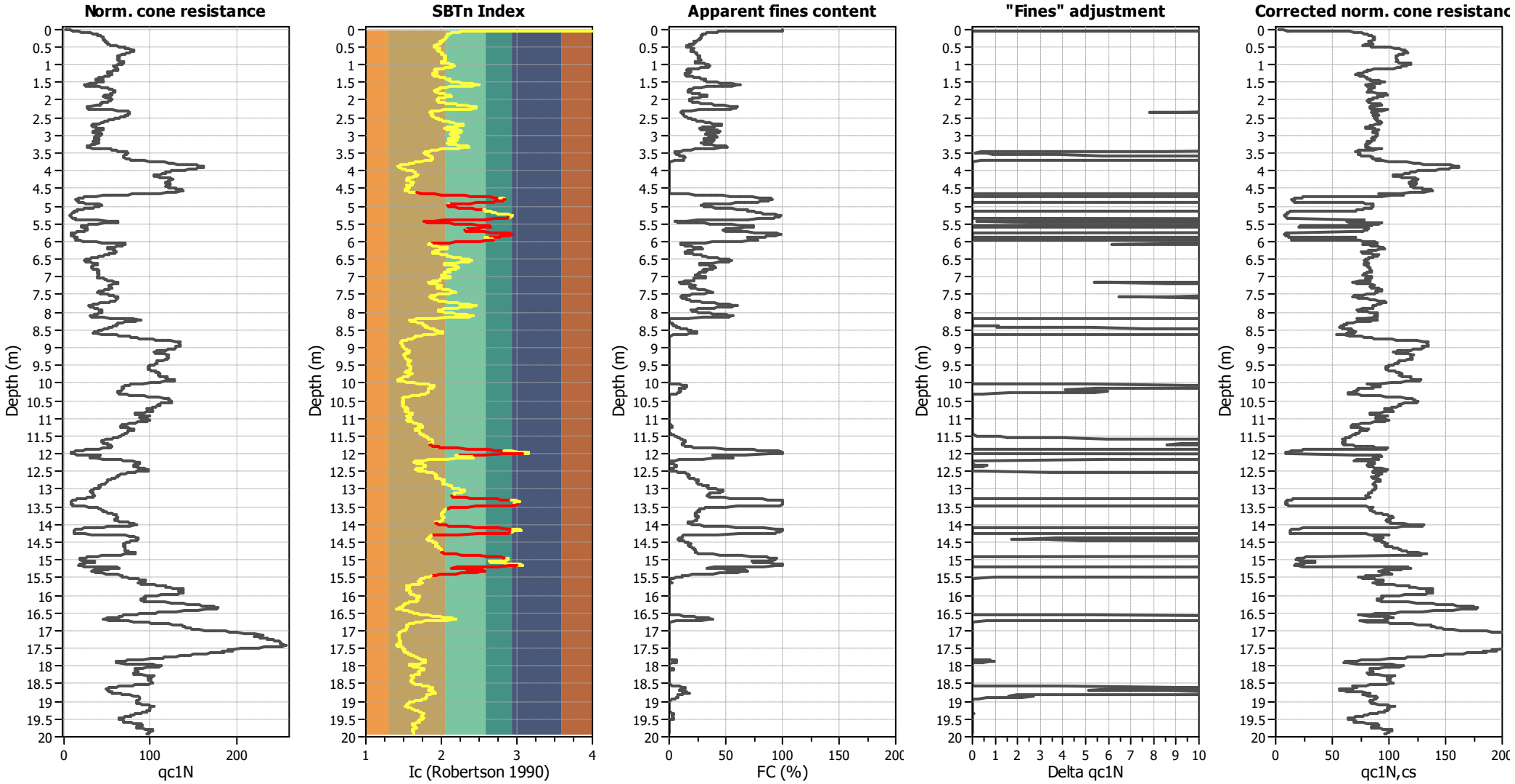
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

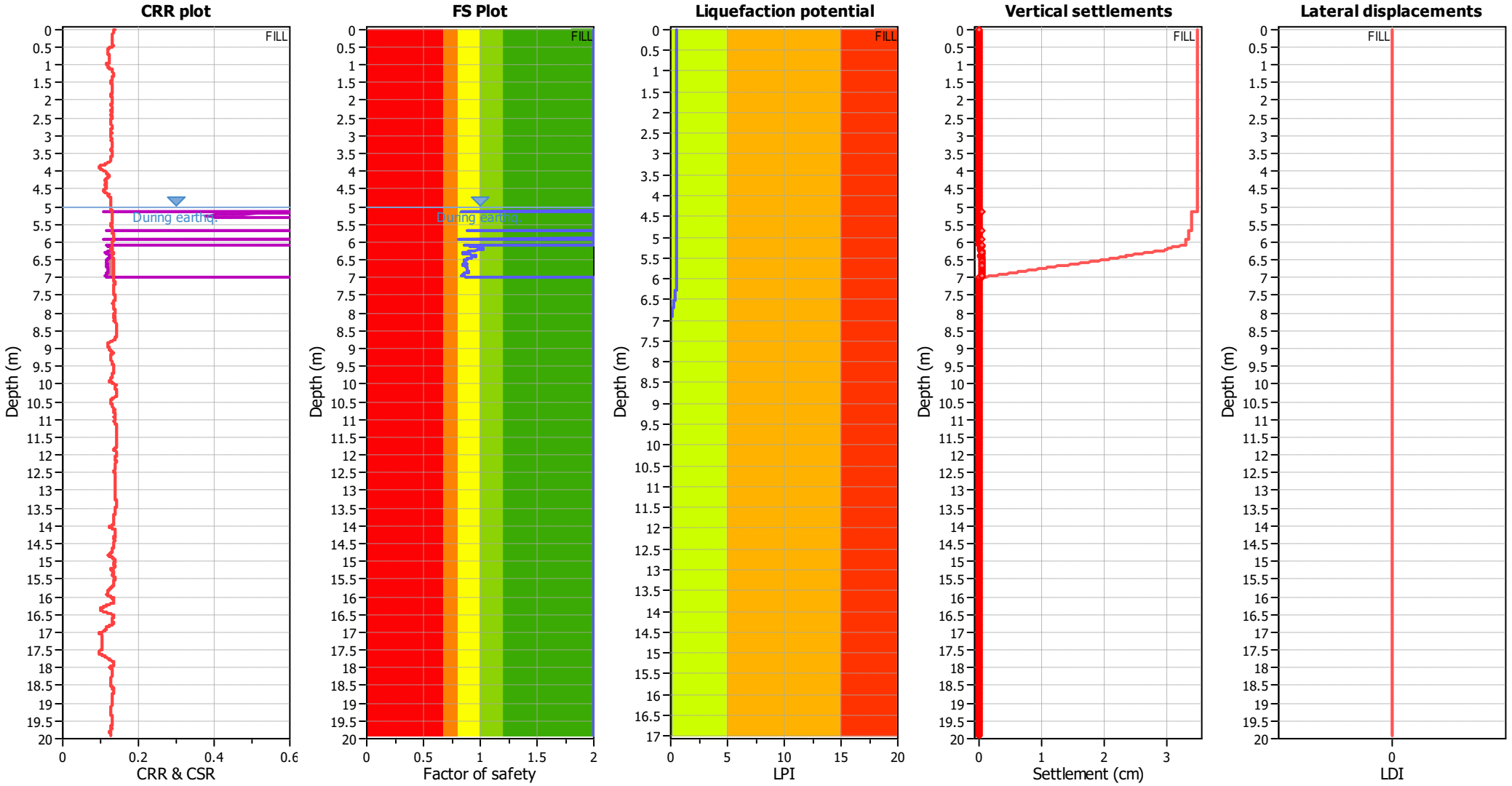
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

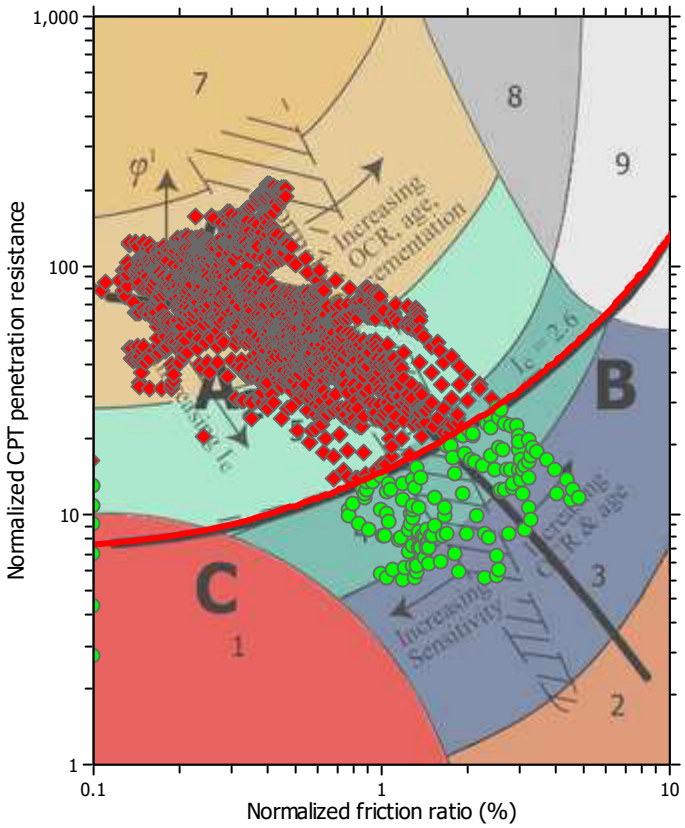
F.S. color scheme

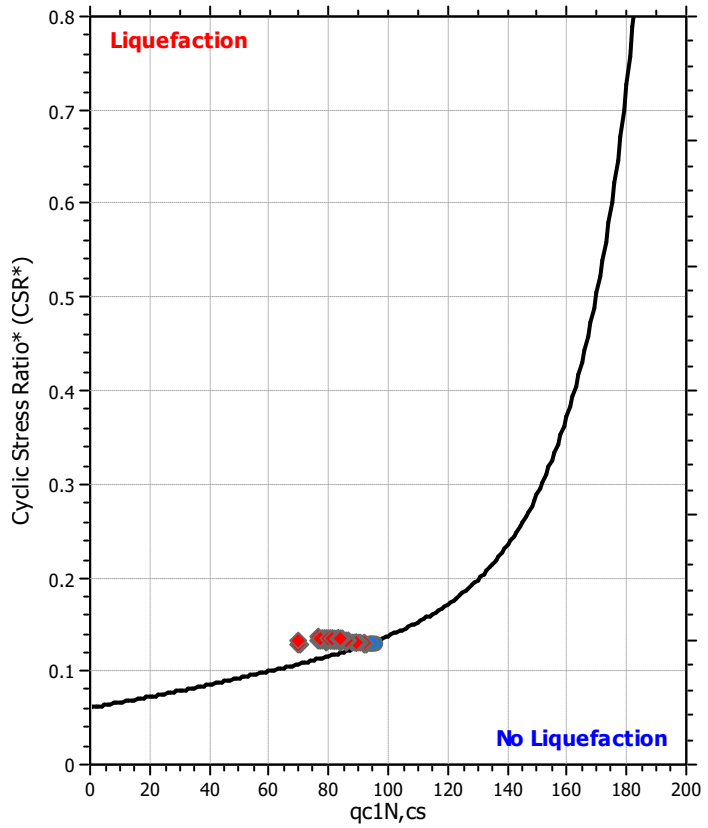
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

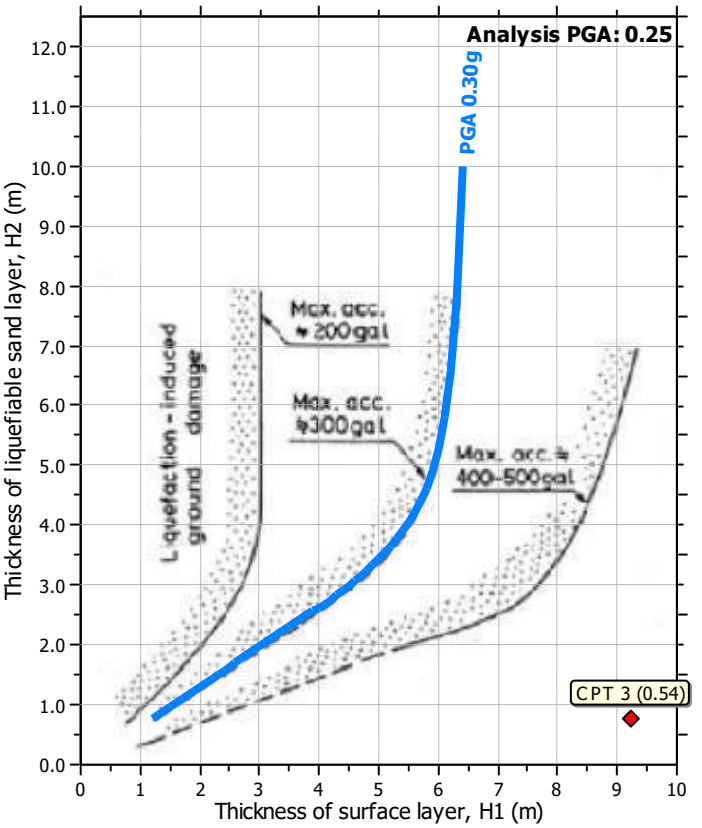
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



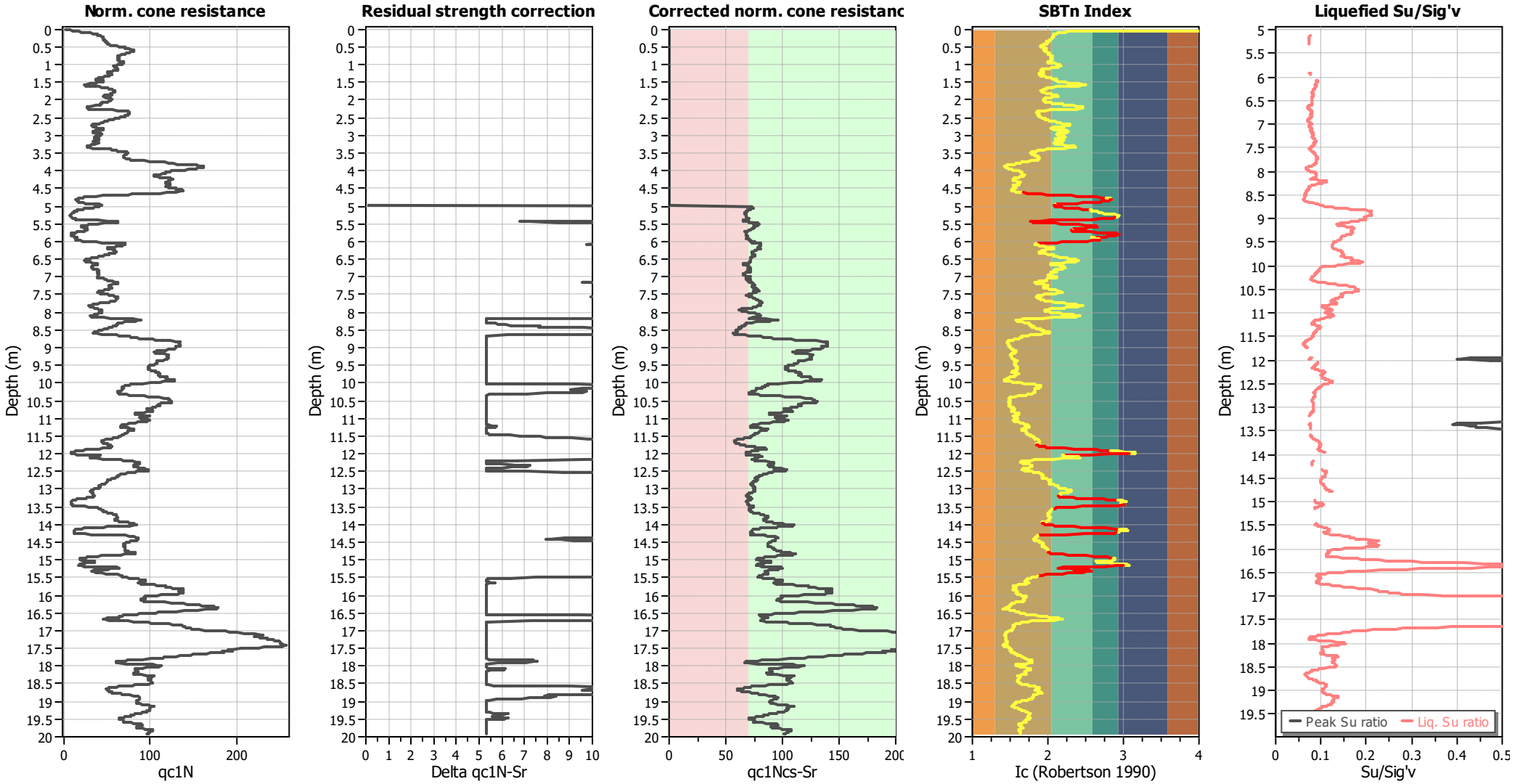




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	8.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 m	Fill height:	3.00 m	Limit depth:	10.00 m

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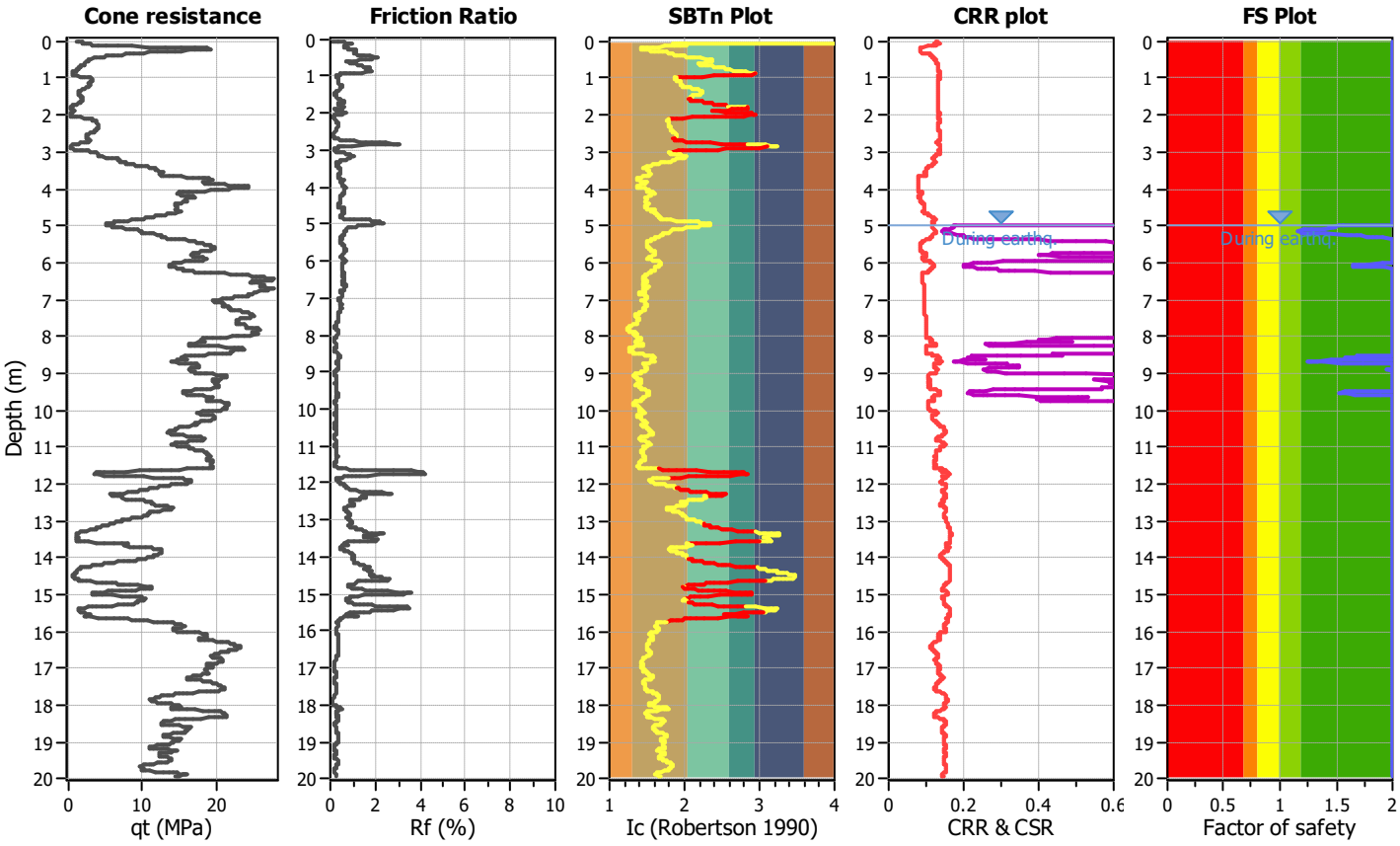
LIQUEFACTION ANALYSIS REPORT

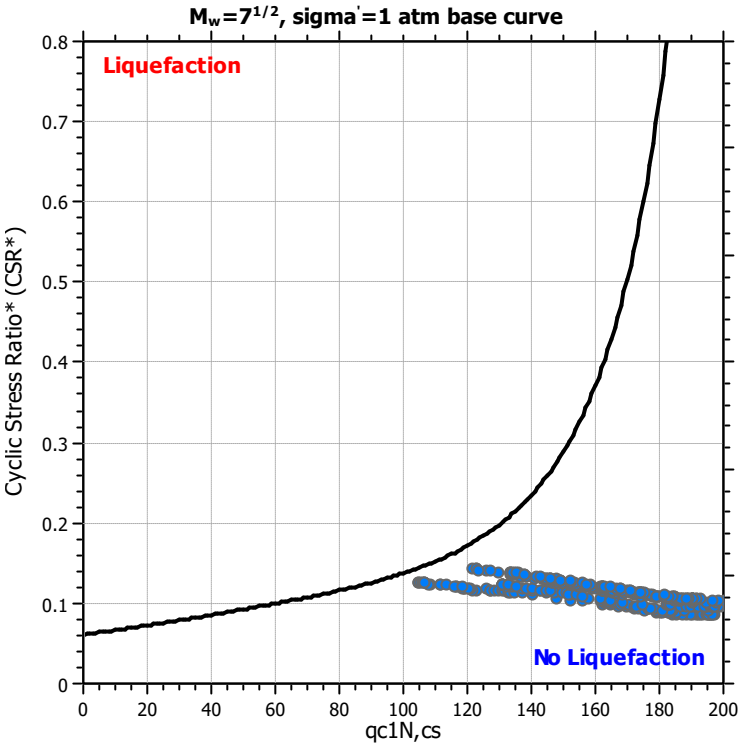
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**

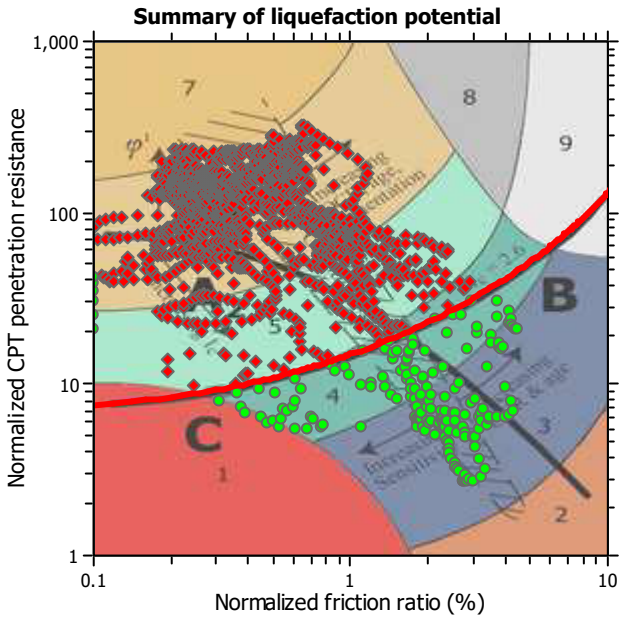
CPT file : CPT 4

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

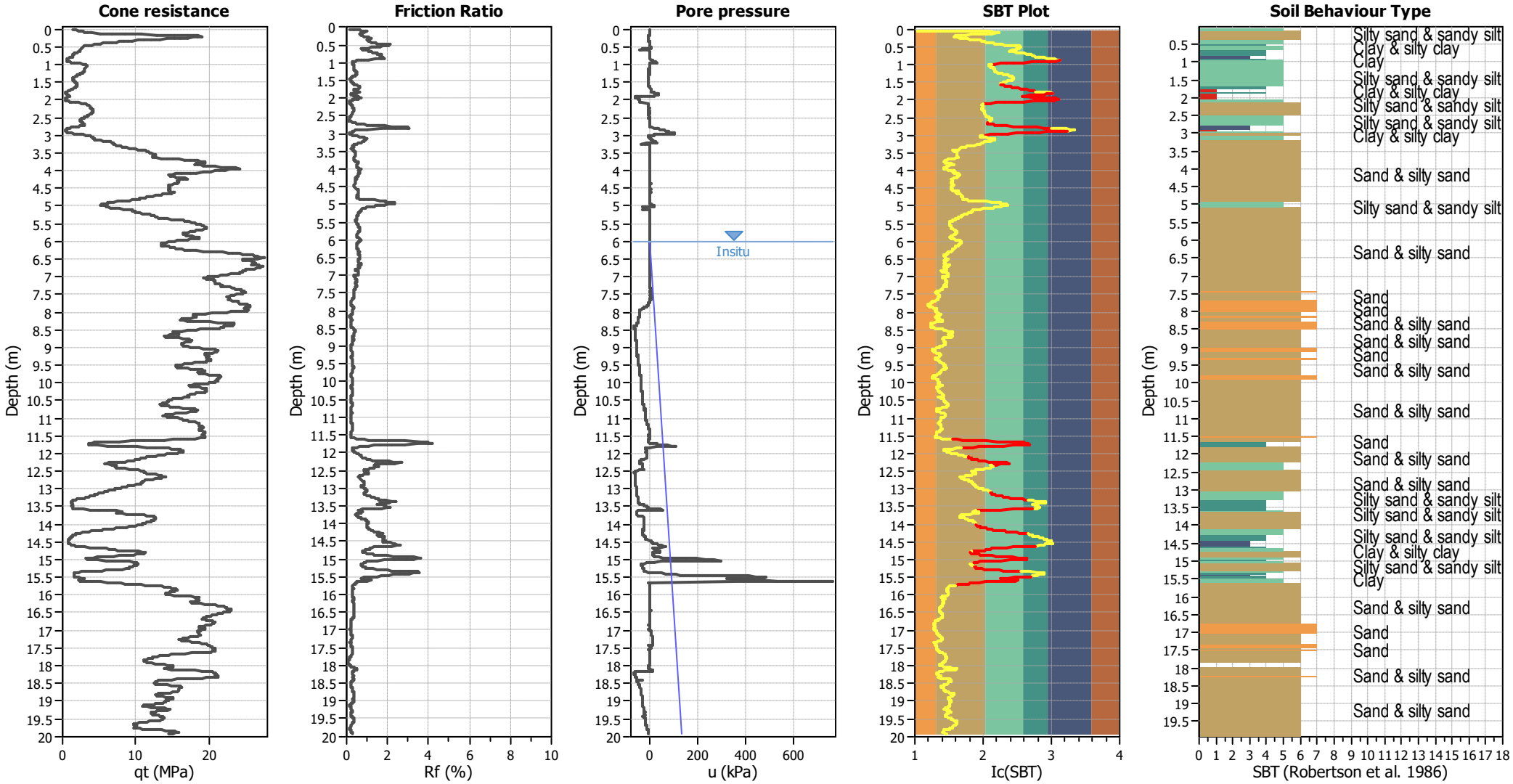






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



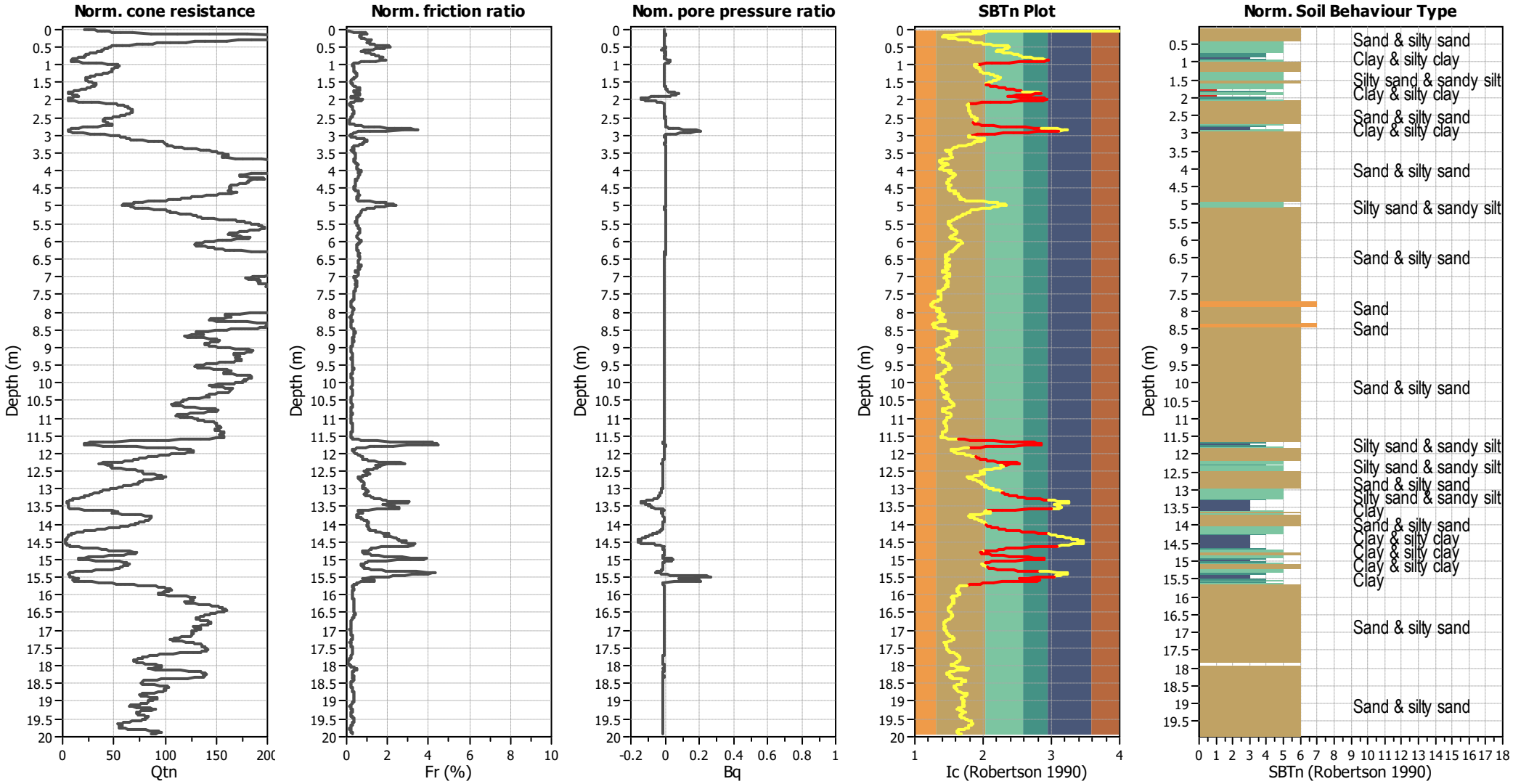
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



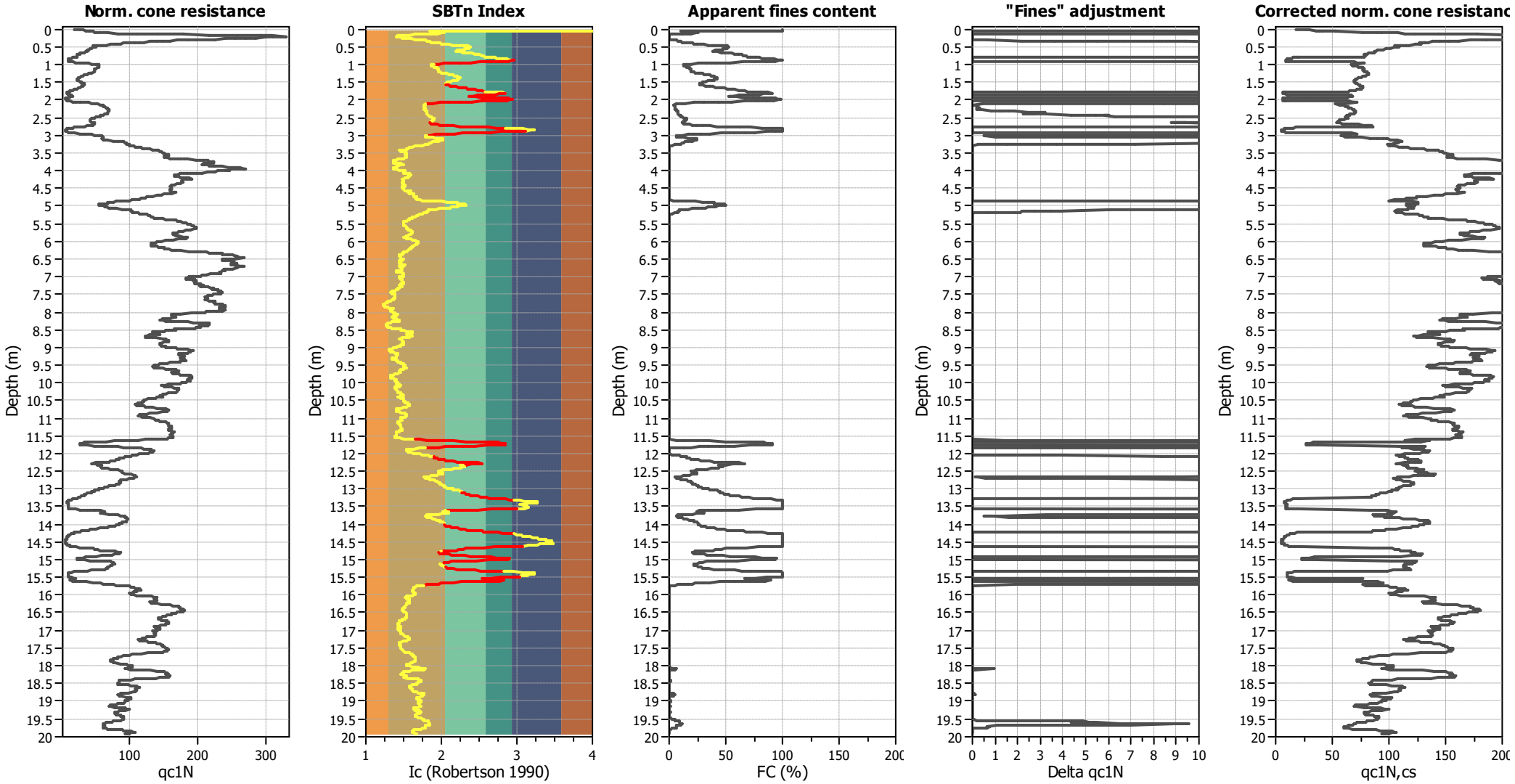
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

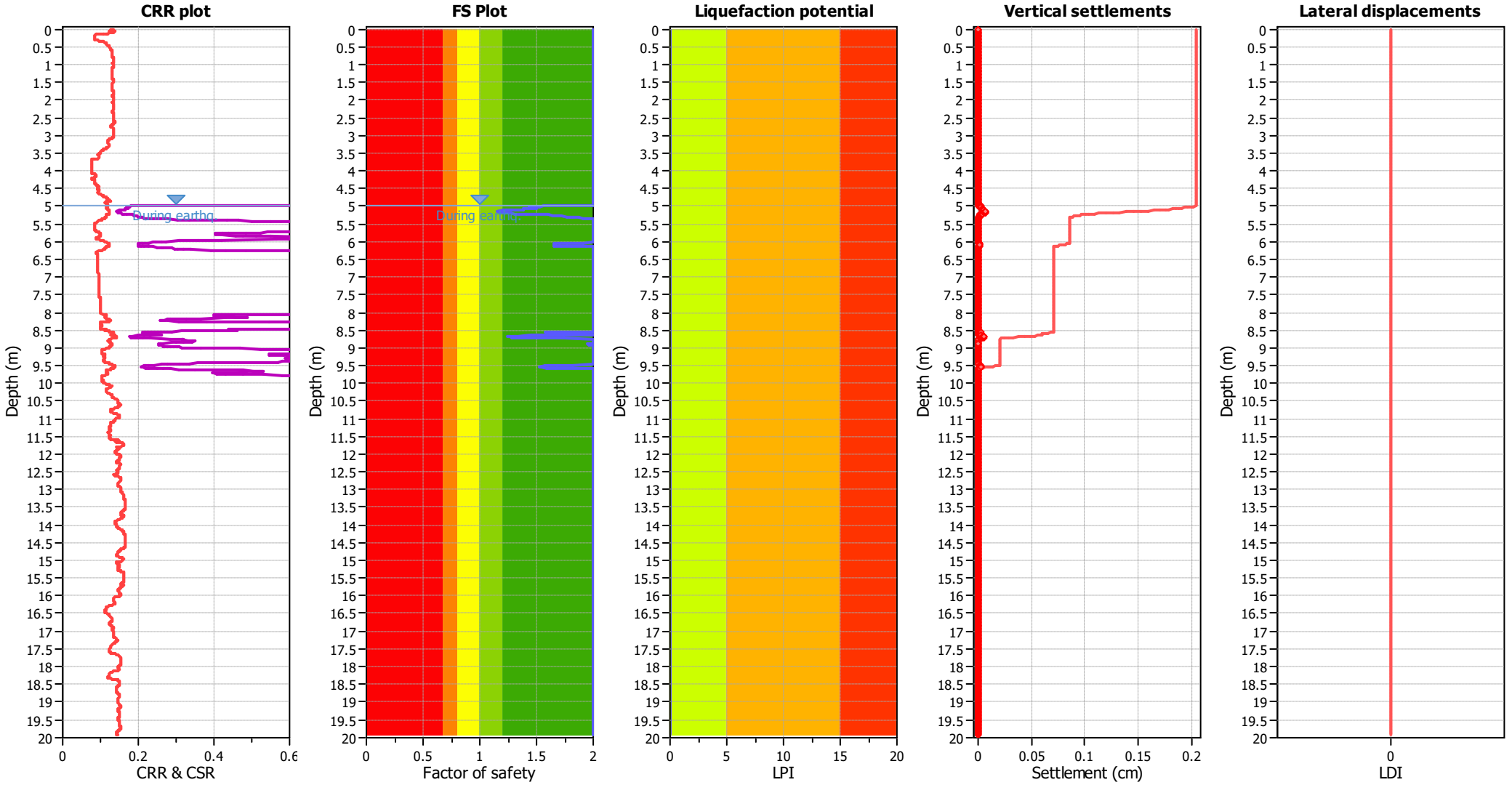
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

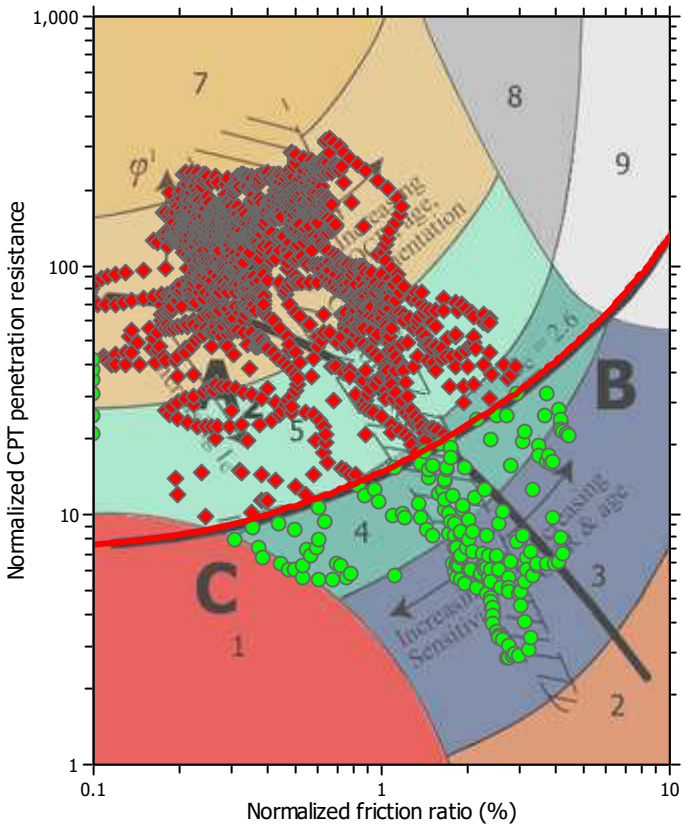
F.S. color scheme

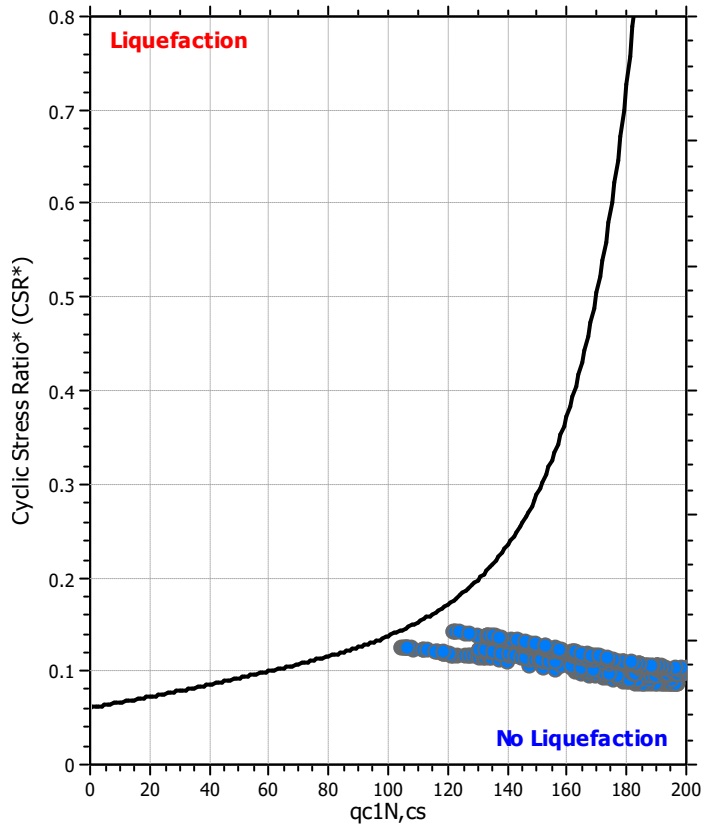
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

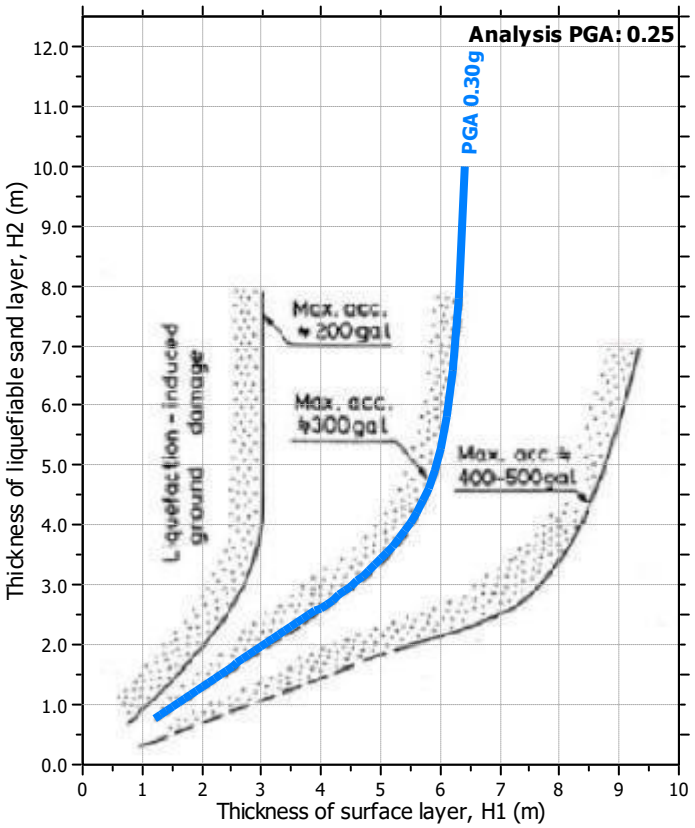
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



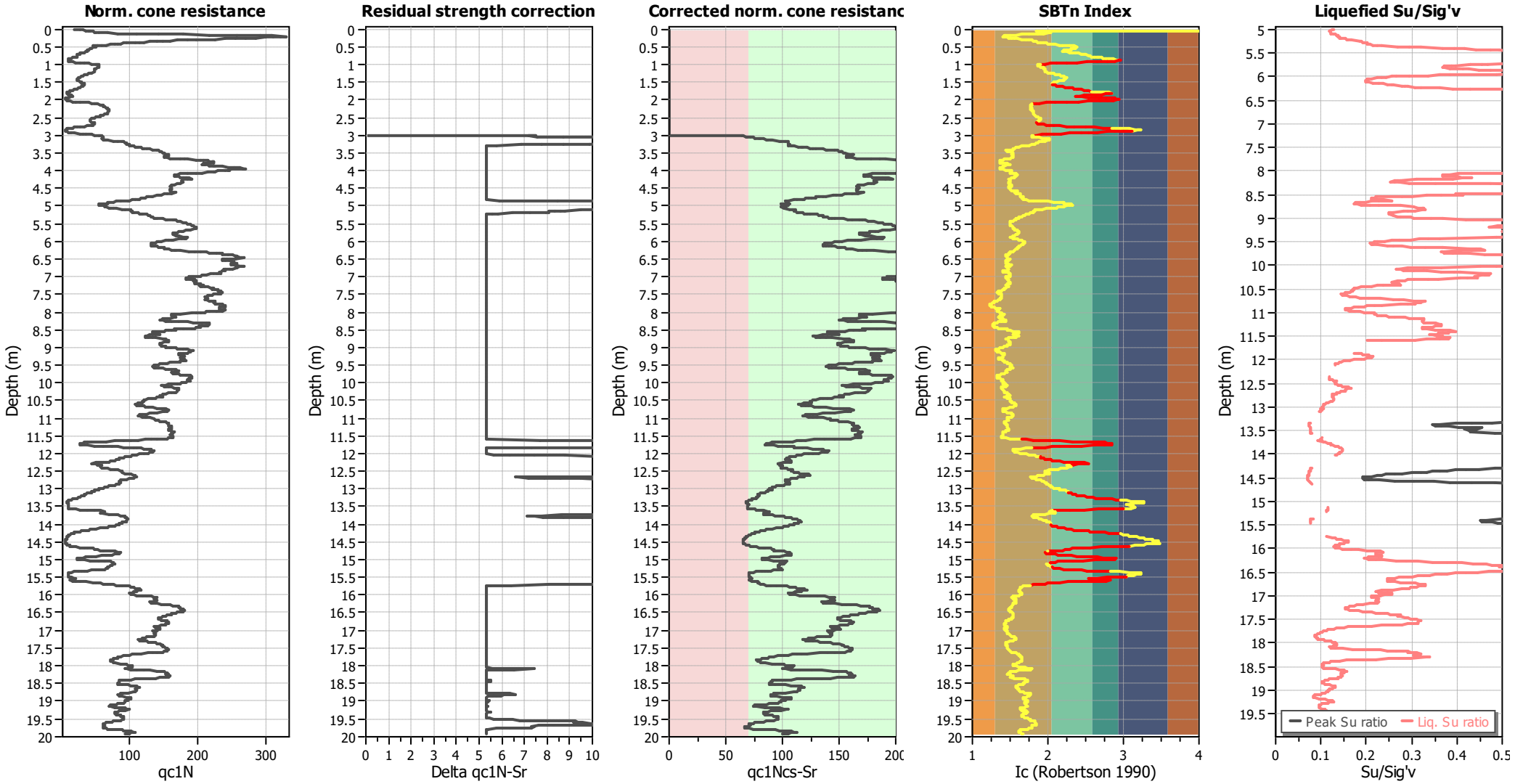




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

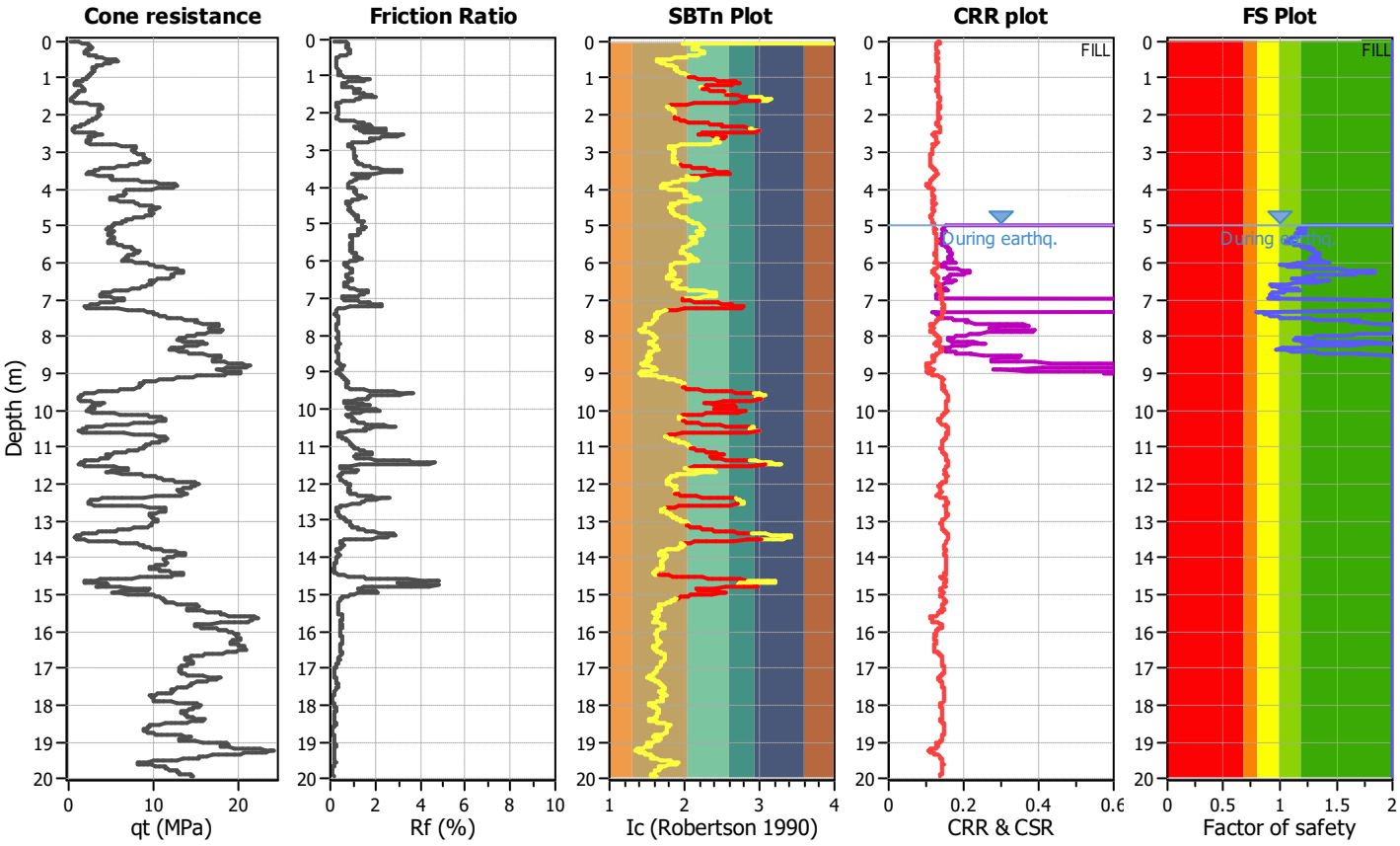
BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

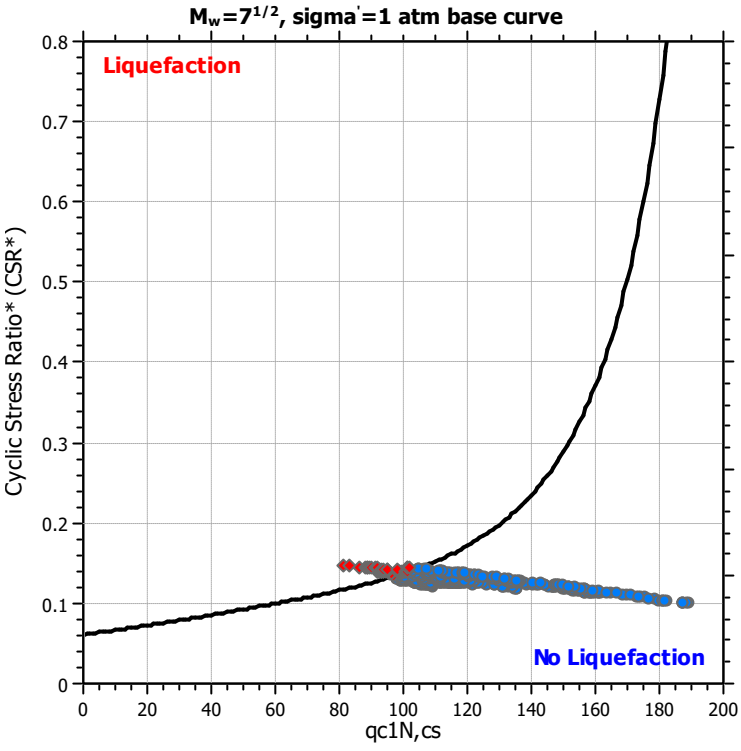
LIQUEFACTION ANALYSIS REPORT

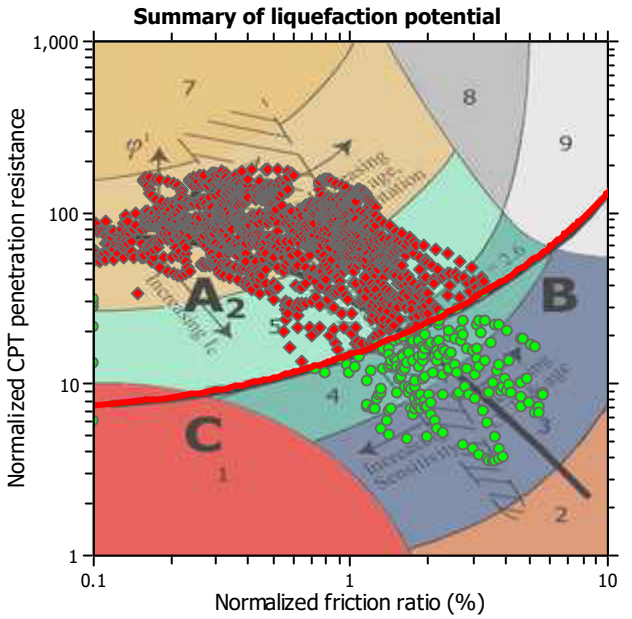
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 5

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

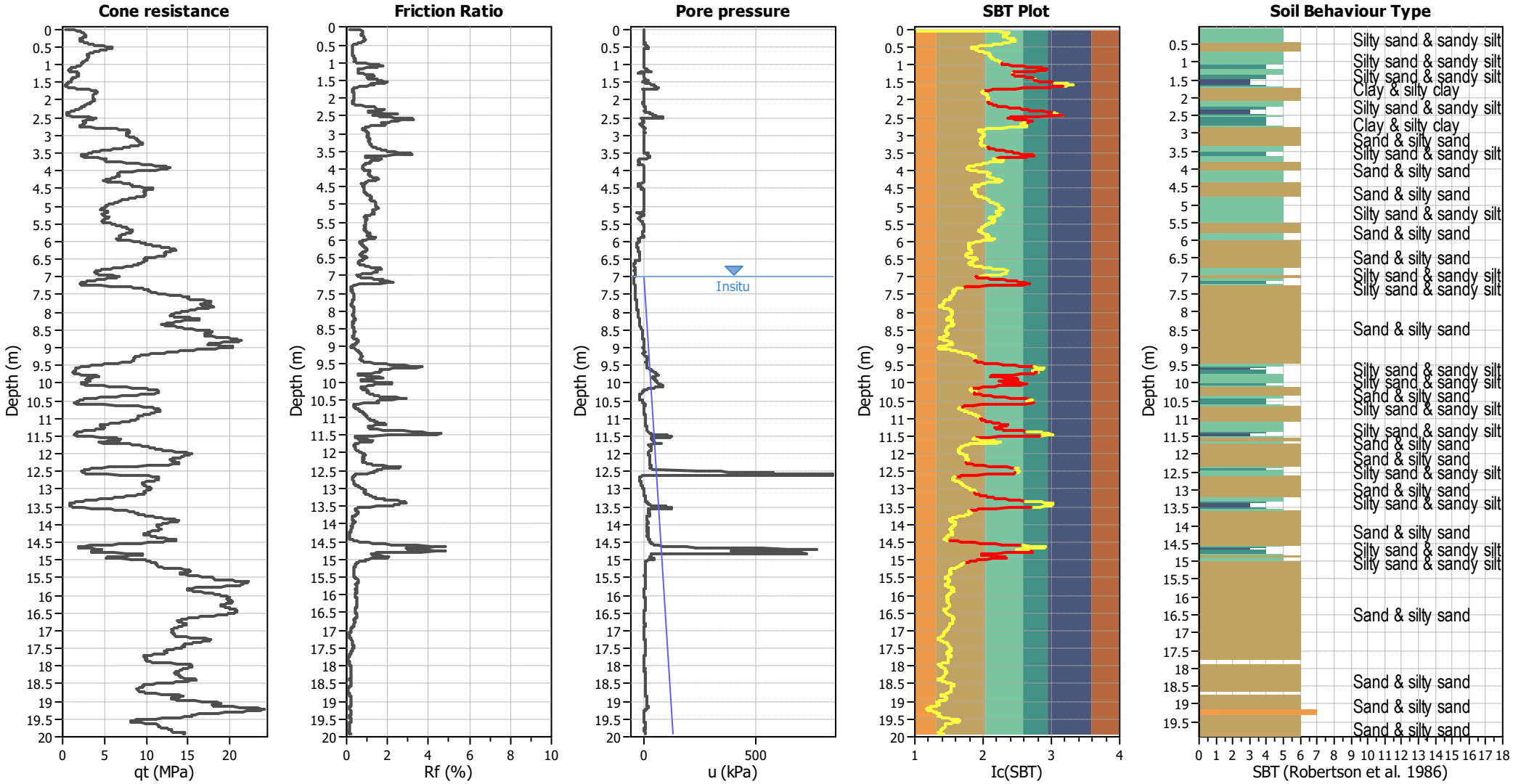






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



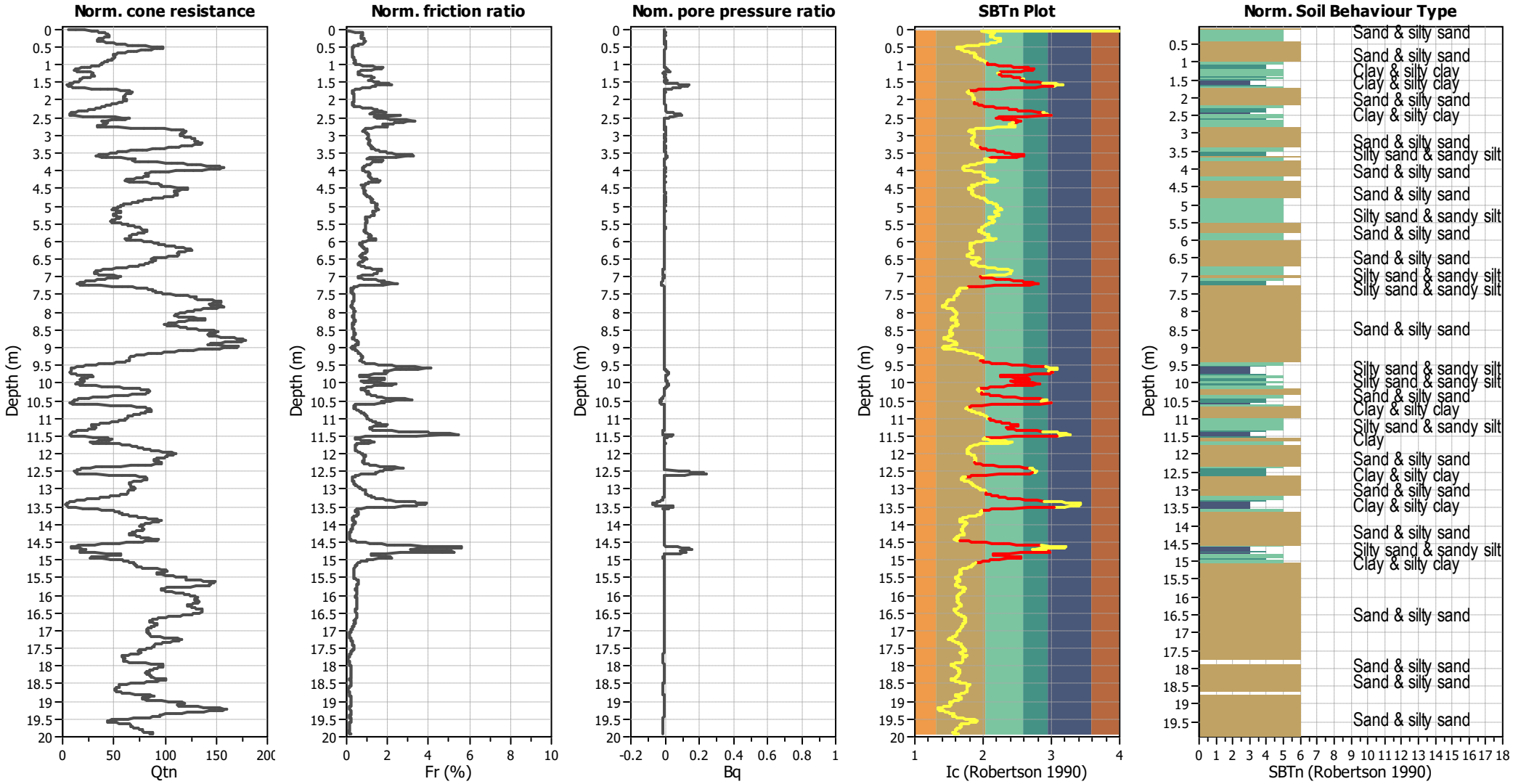
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



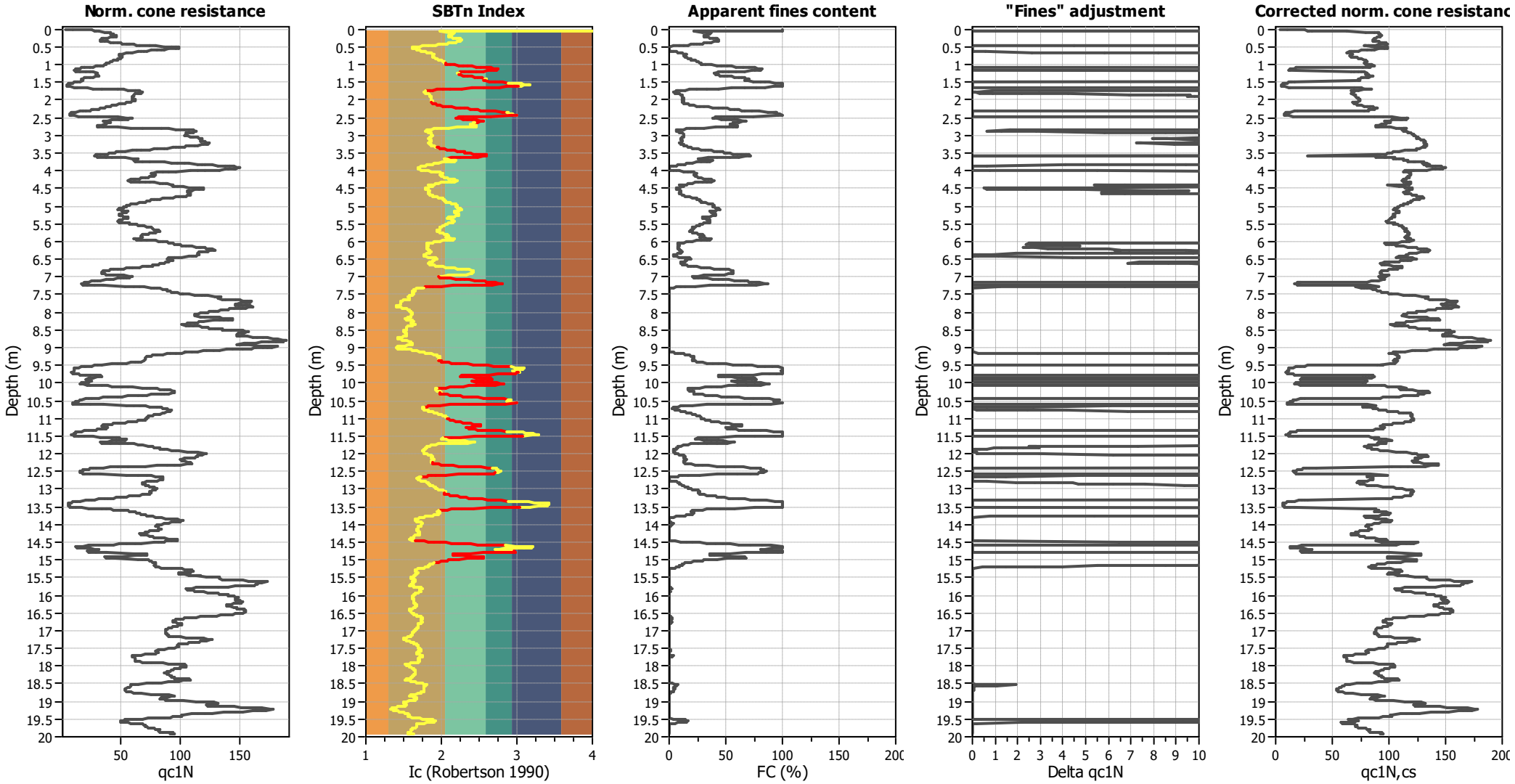
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

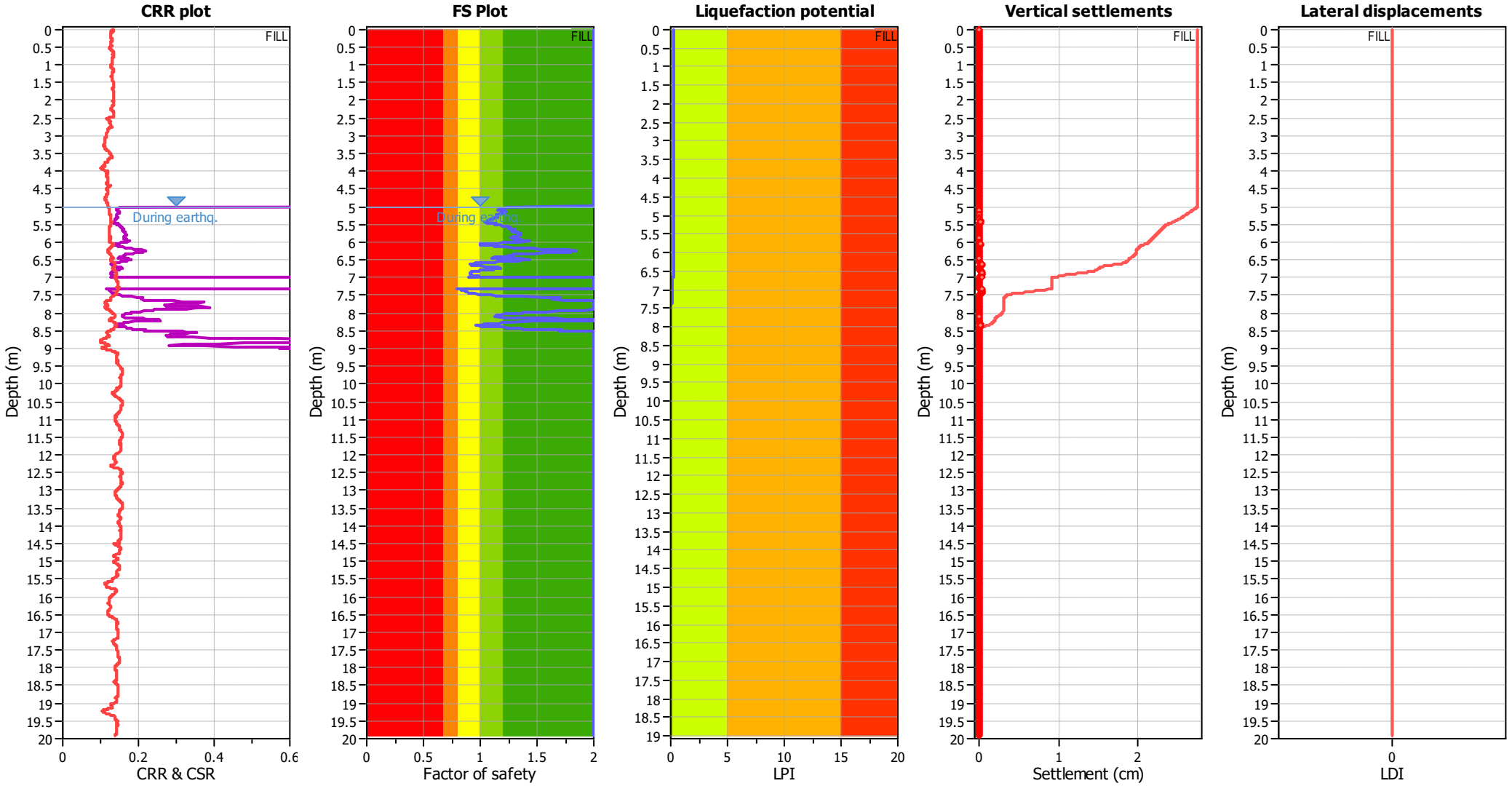
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

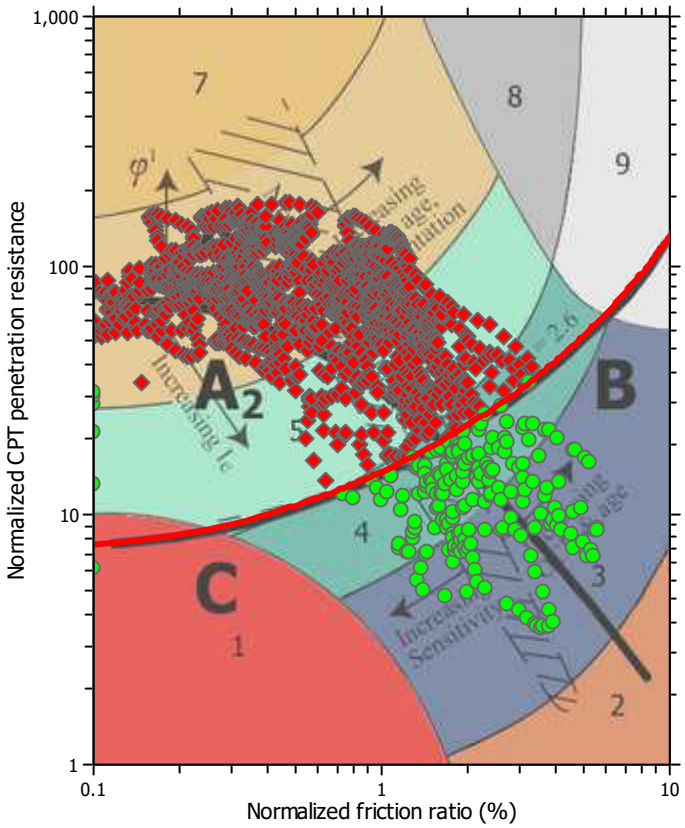
F.S. color scheme

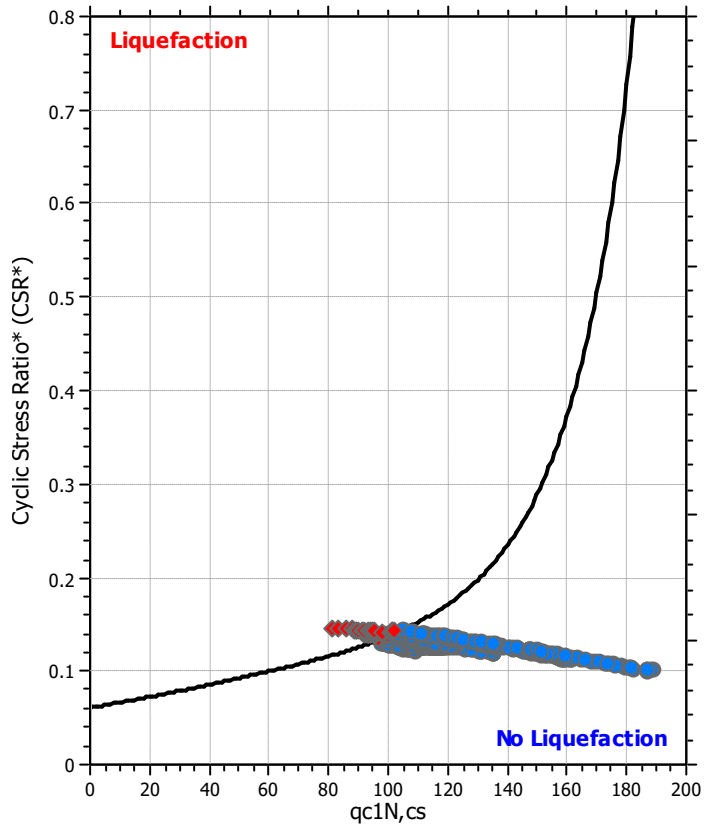
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

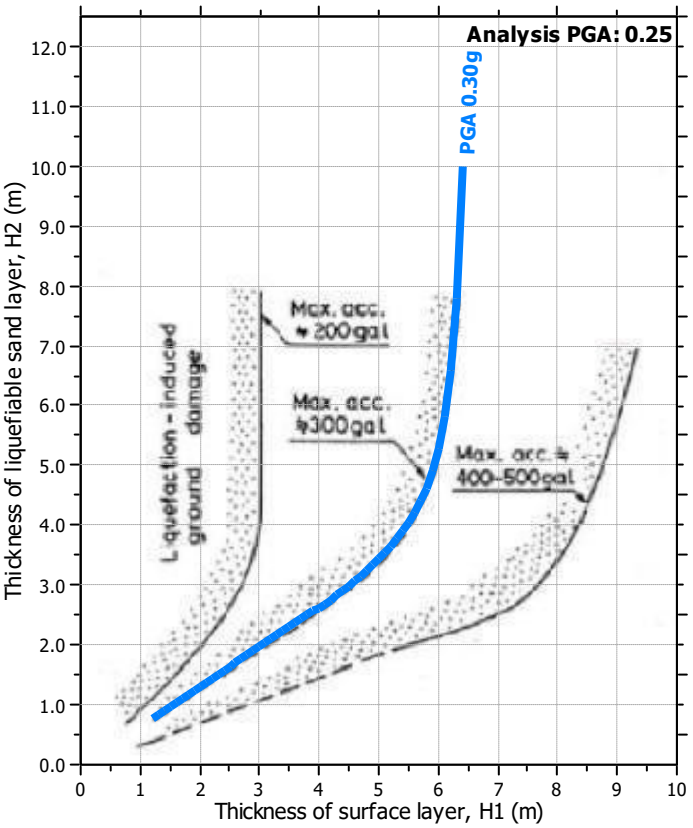
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



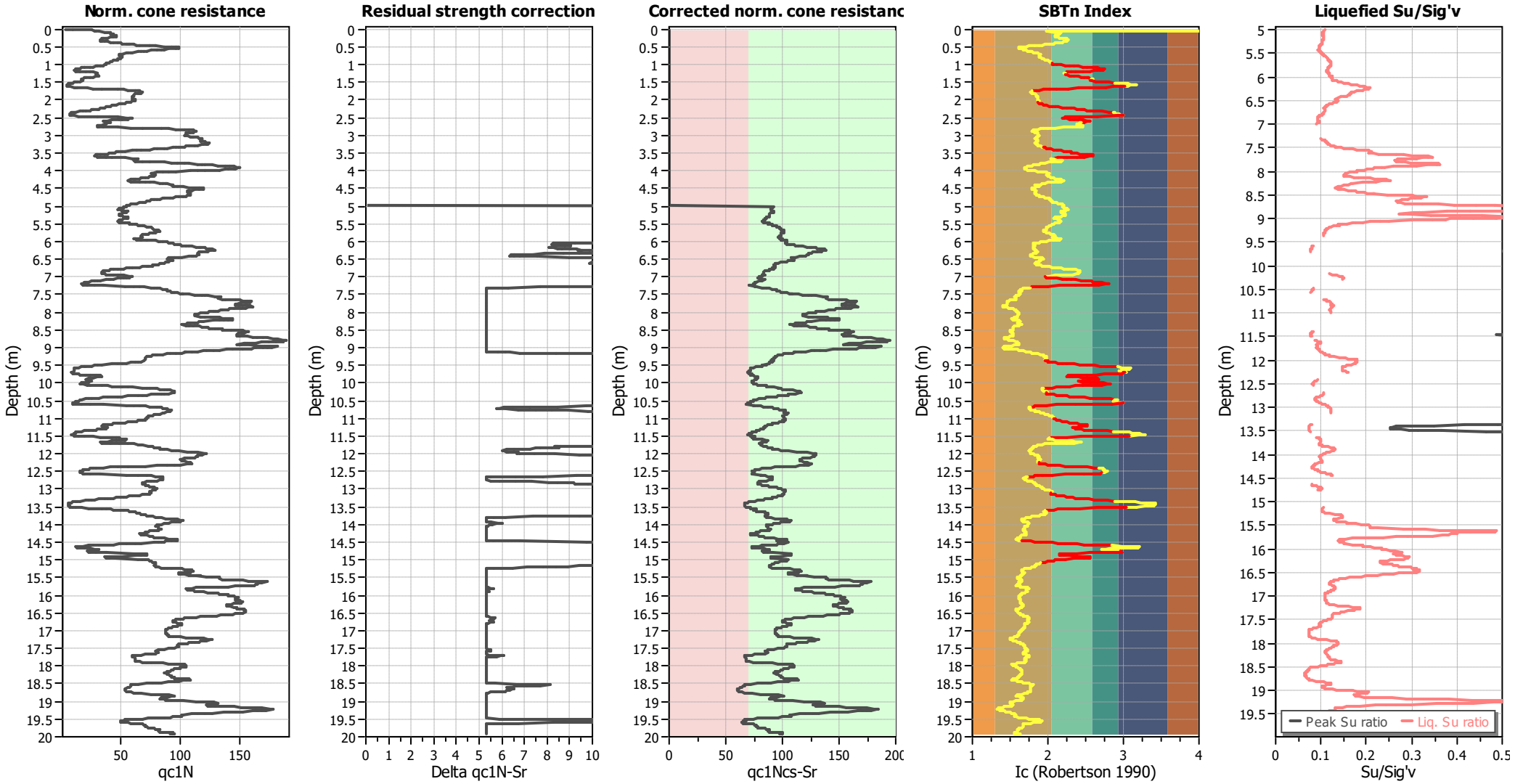




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

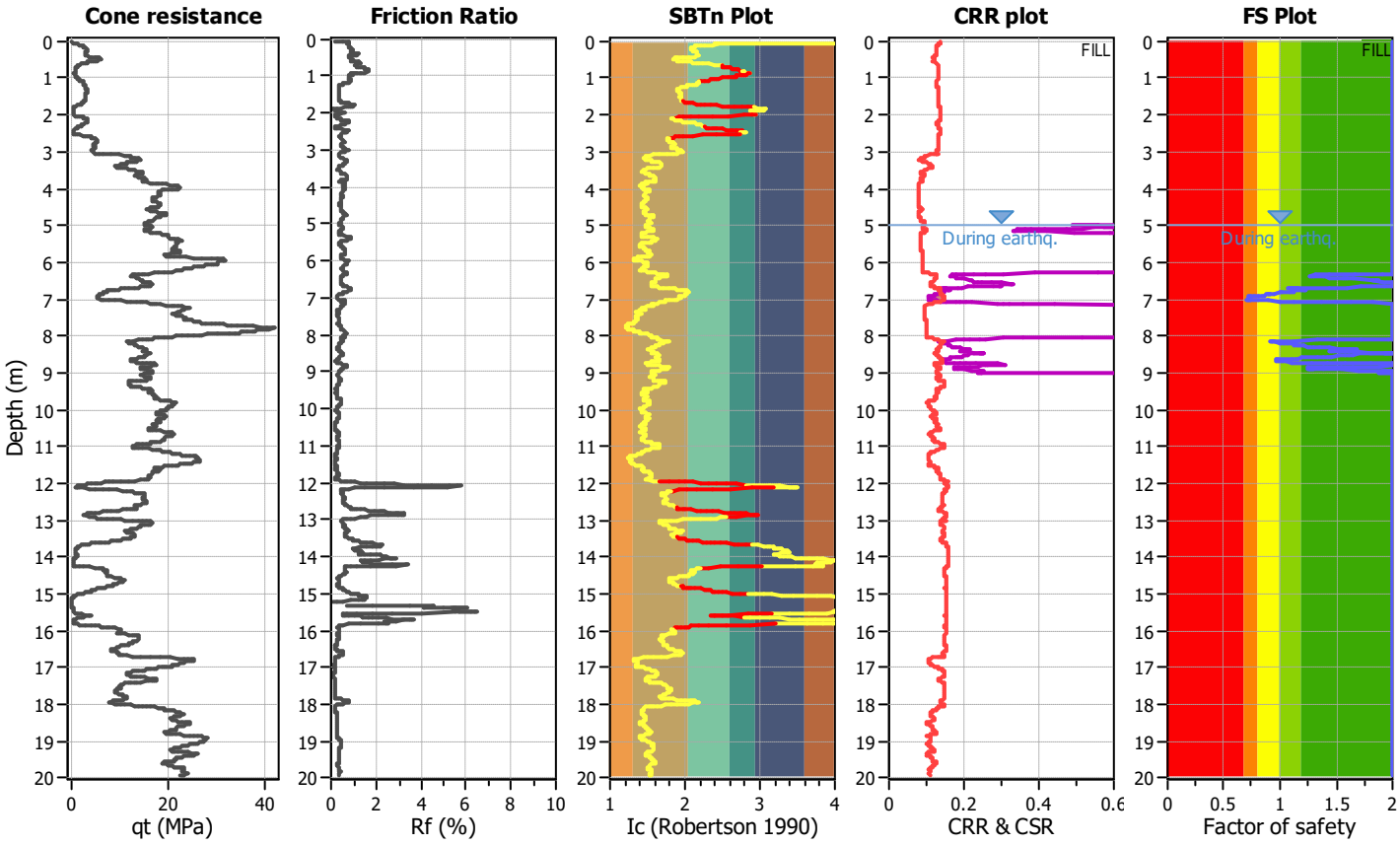
BTW Company Ltd
517 Anglesea Street
Hamilton
www.btw.nz

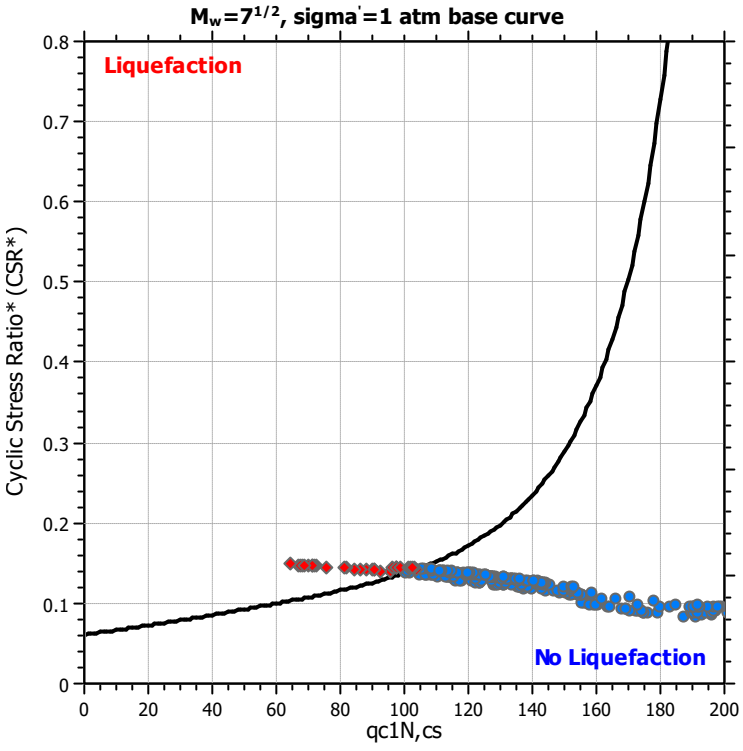
LIQUEFACTION ANALYSIS REPORT

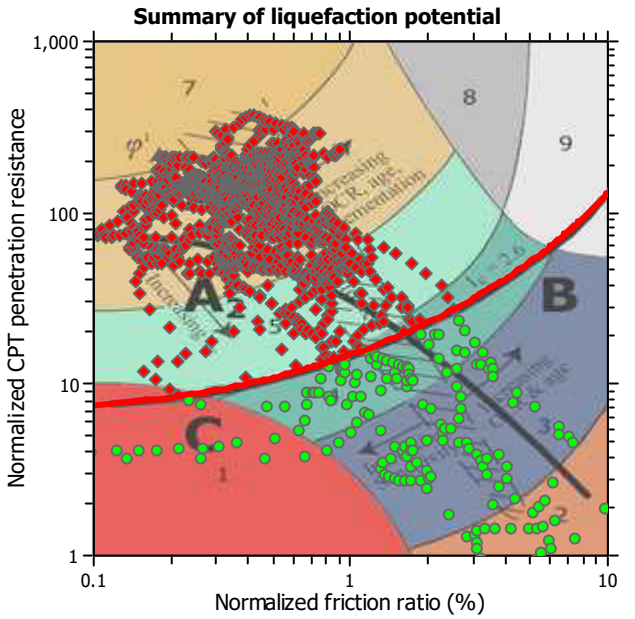
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 6

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m³	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

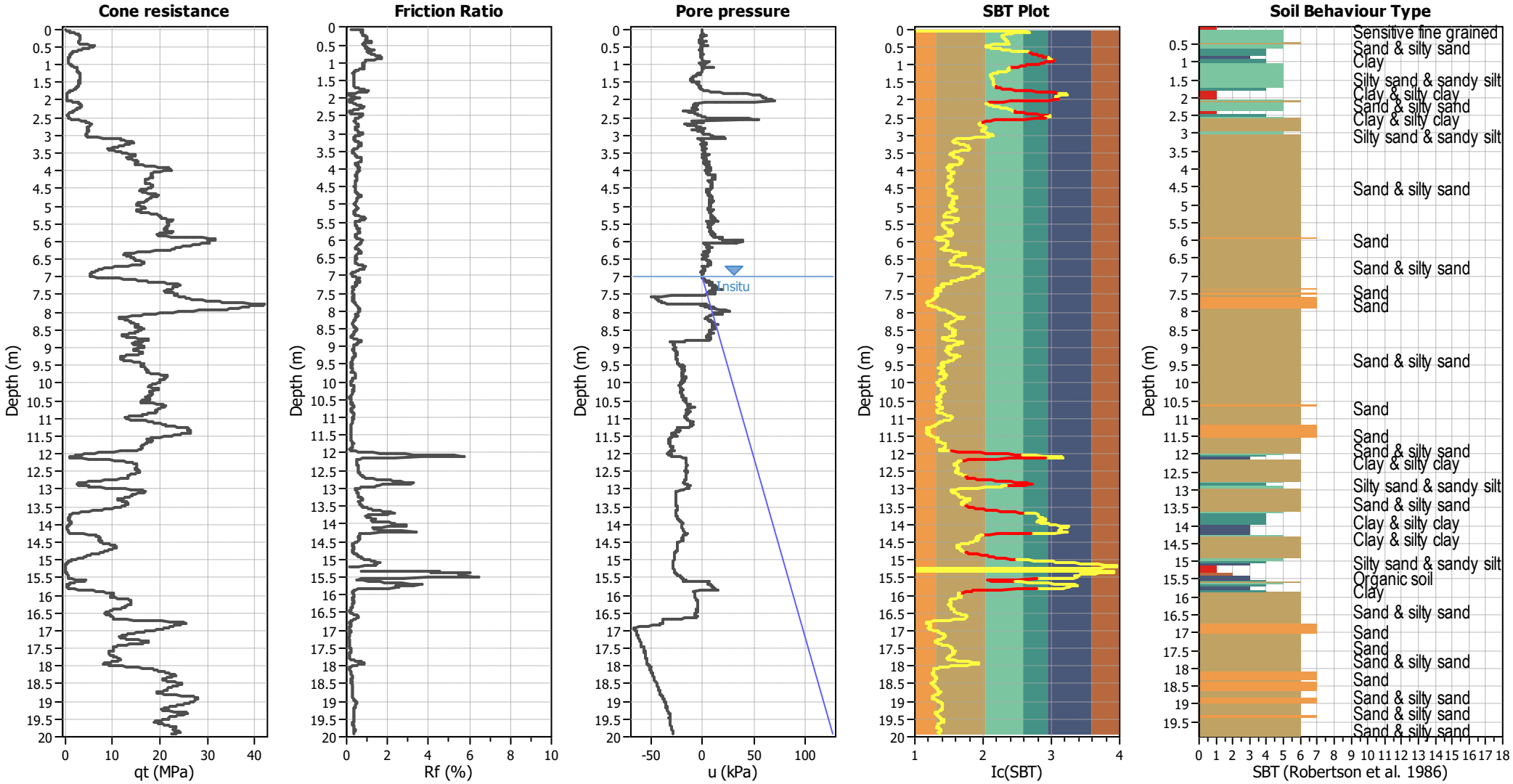






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



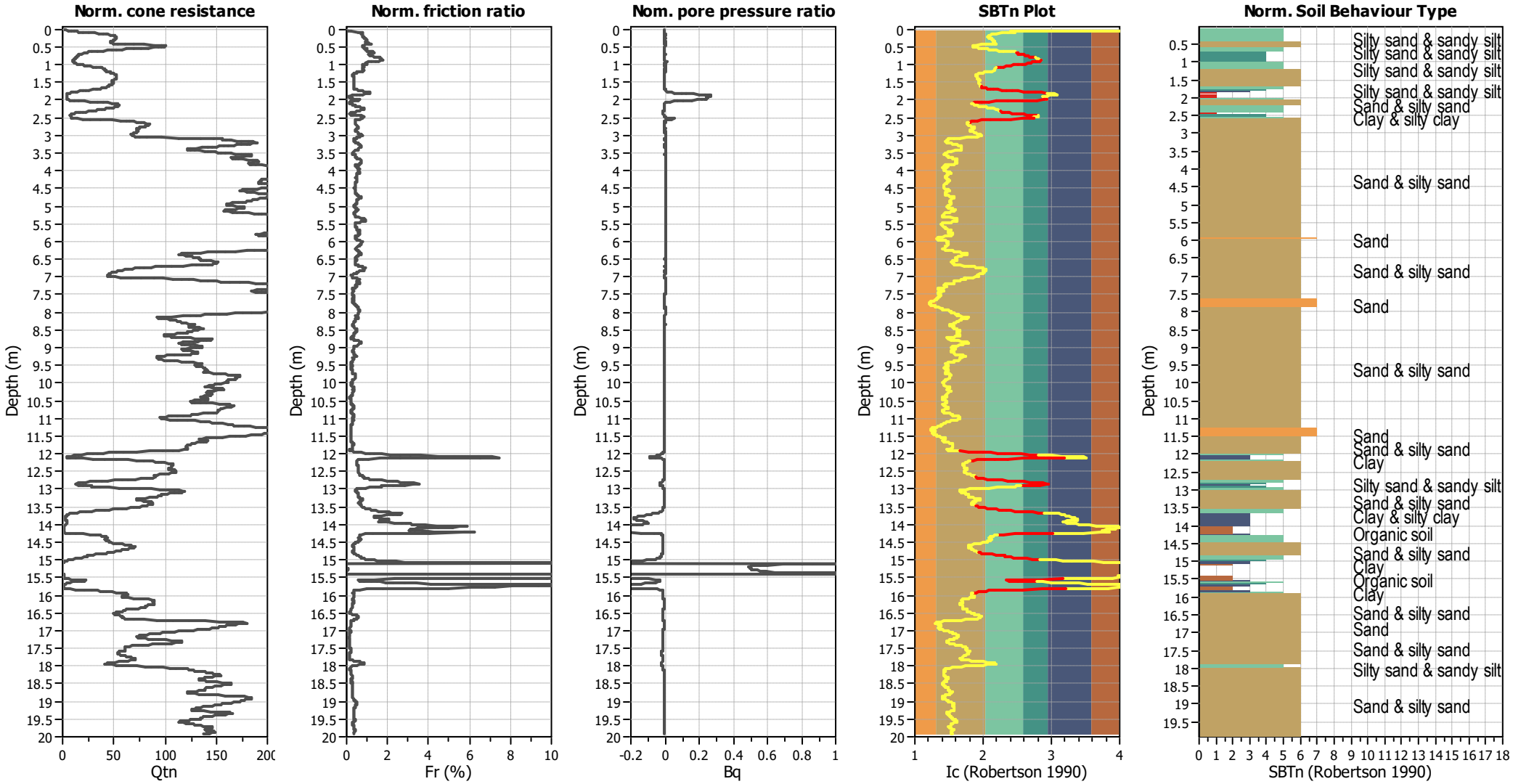
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



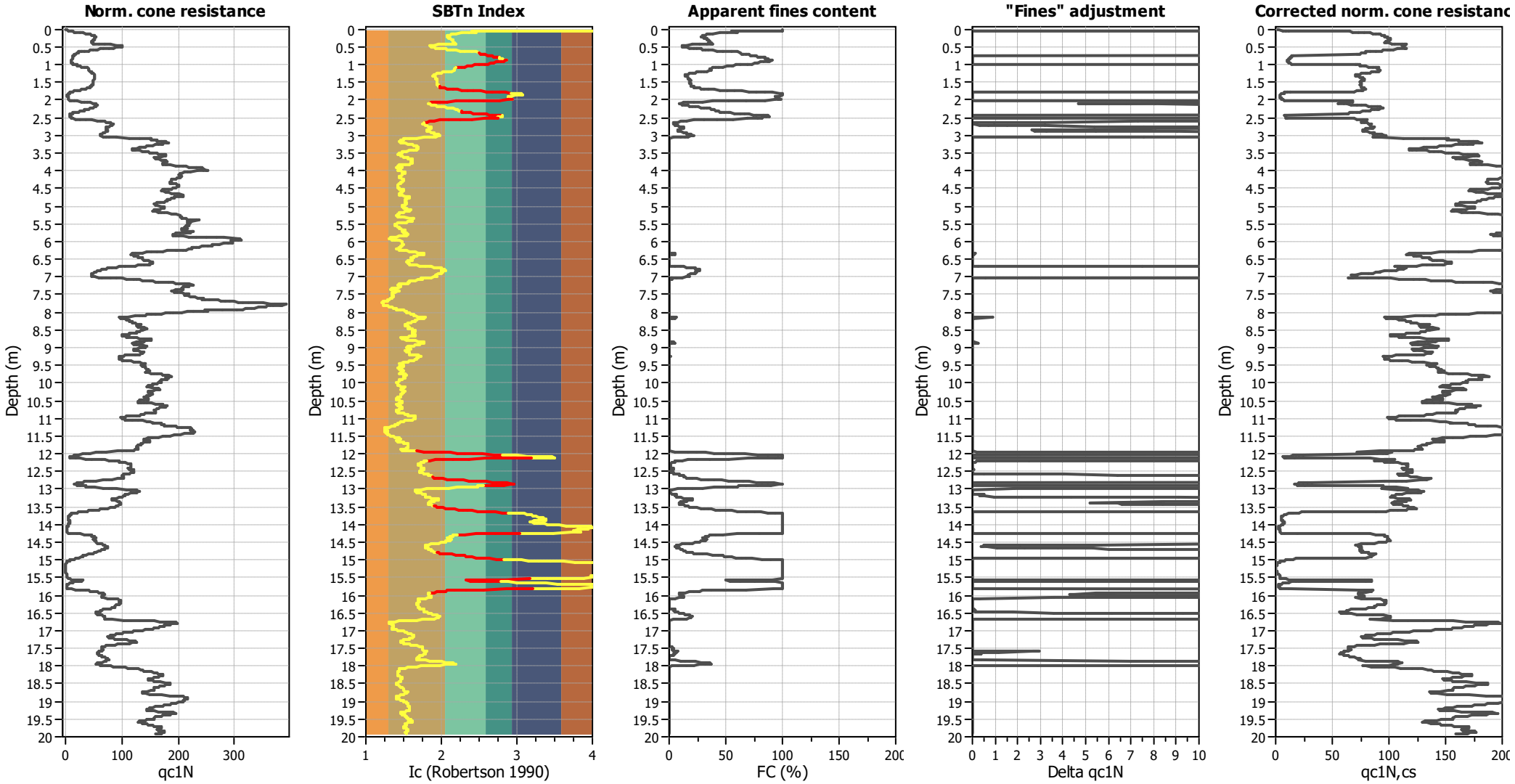
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

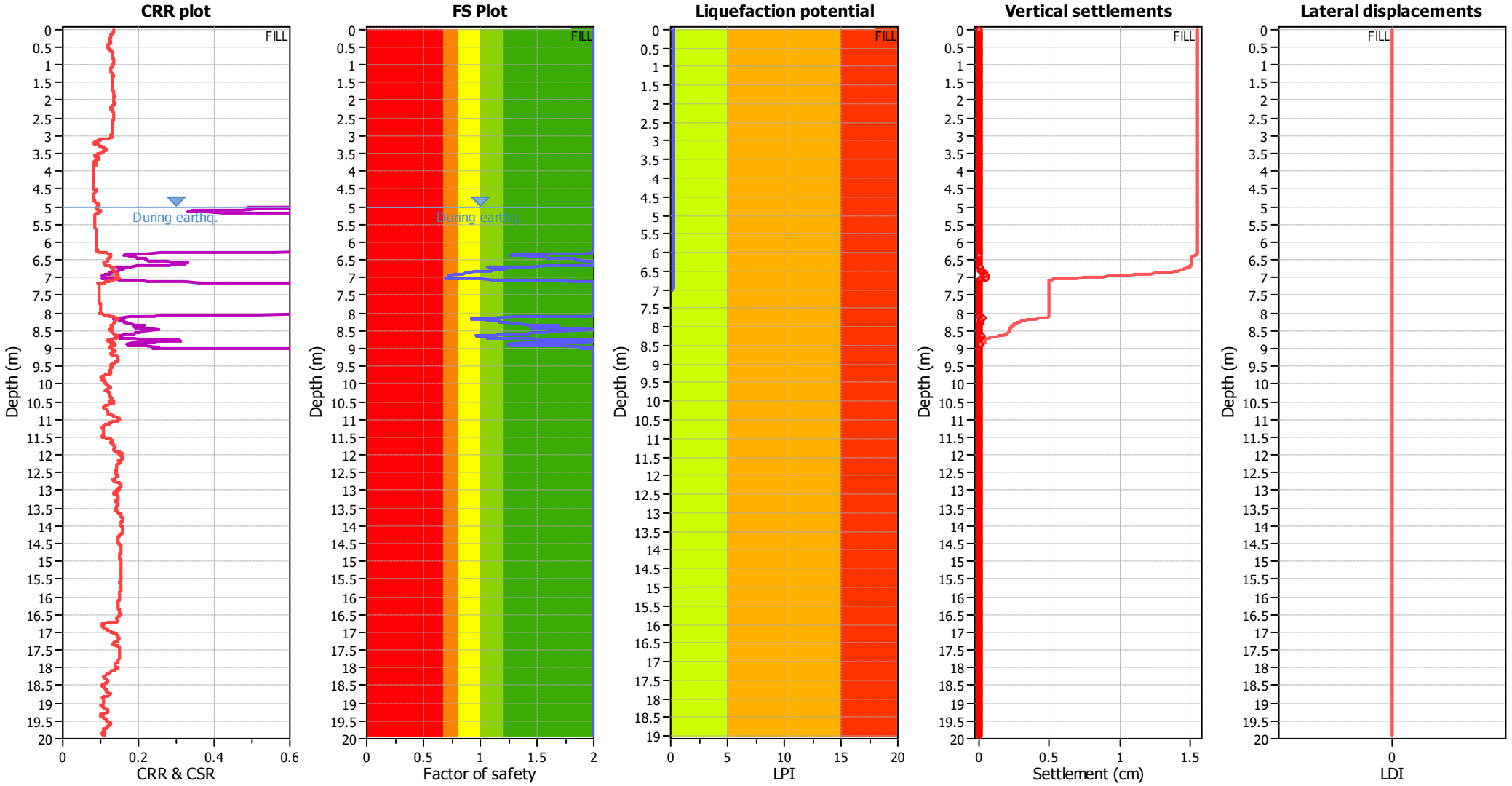
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

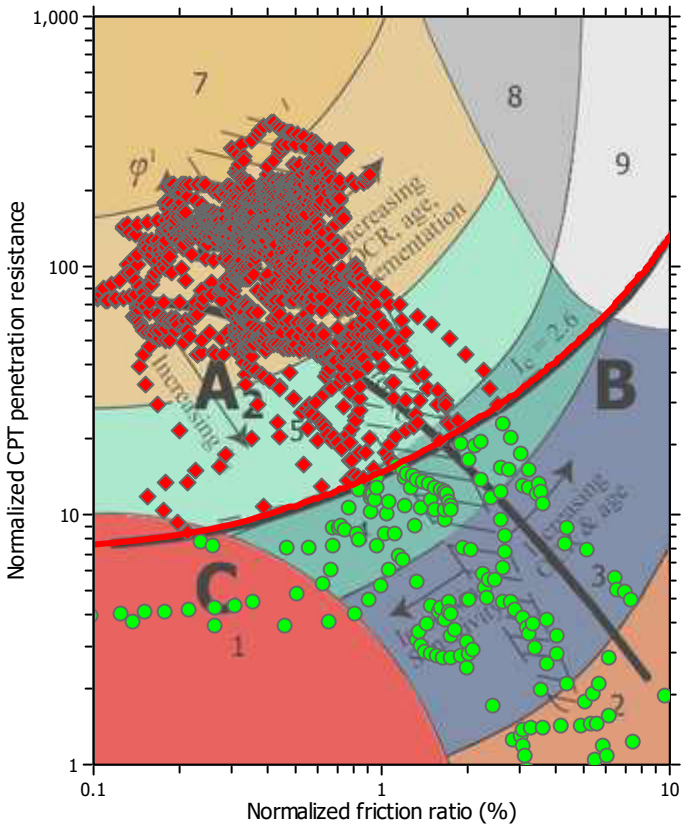
F.S. color scheme

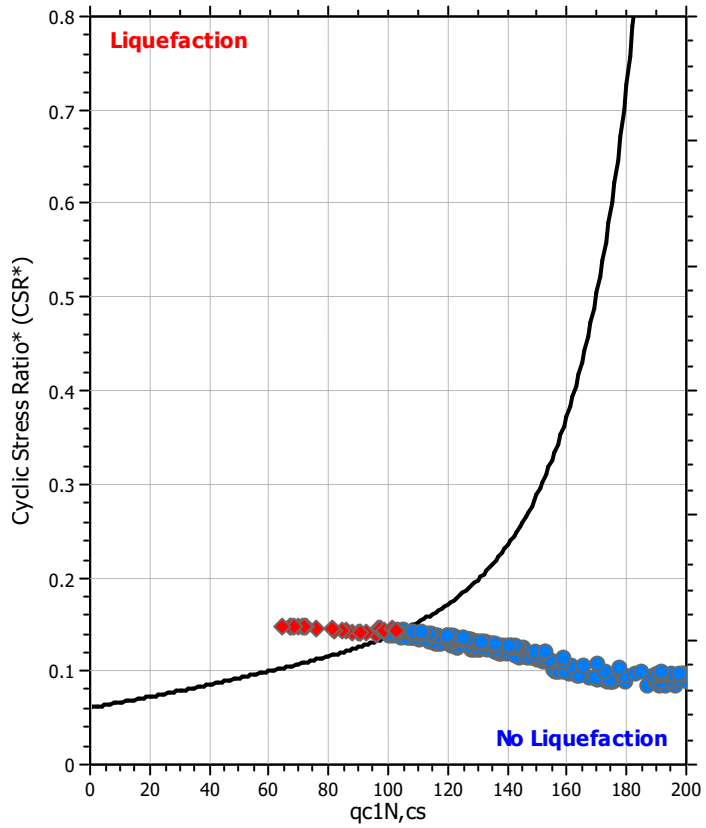
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

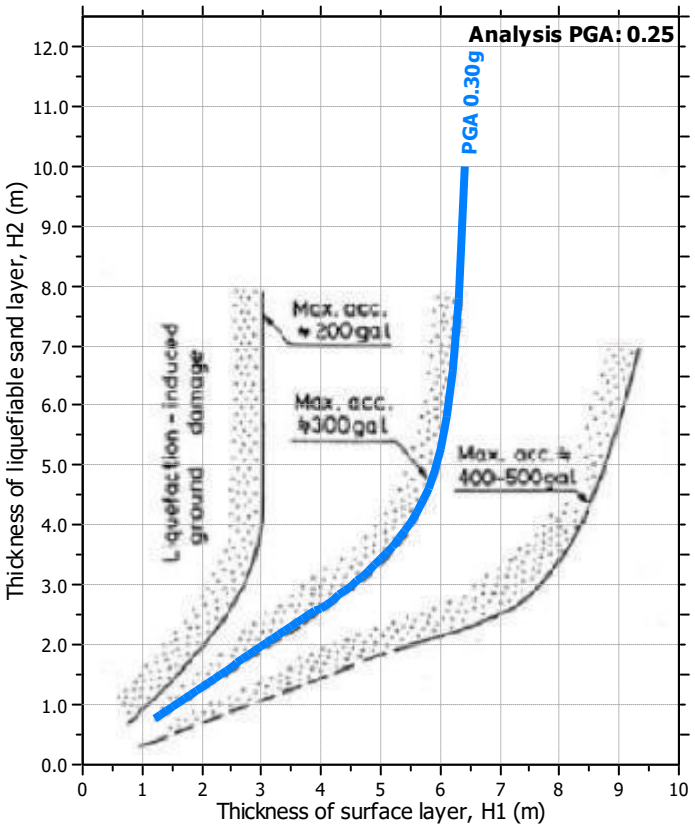
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



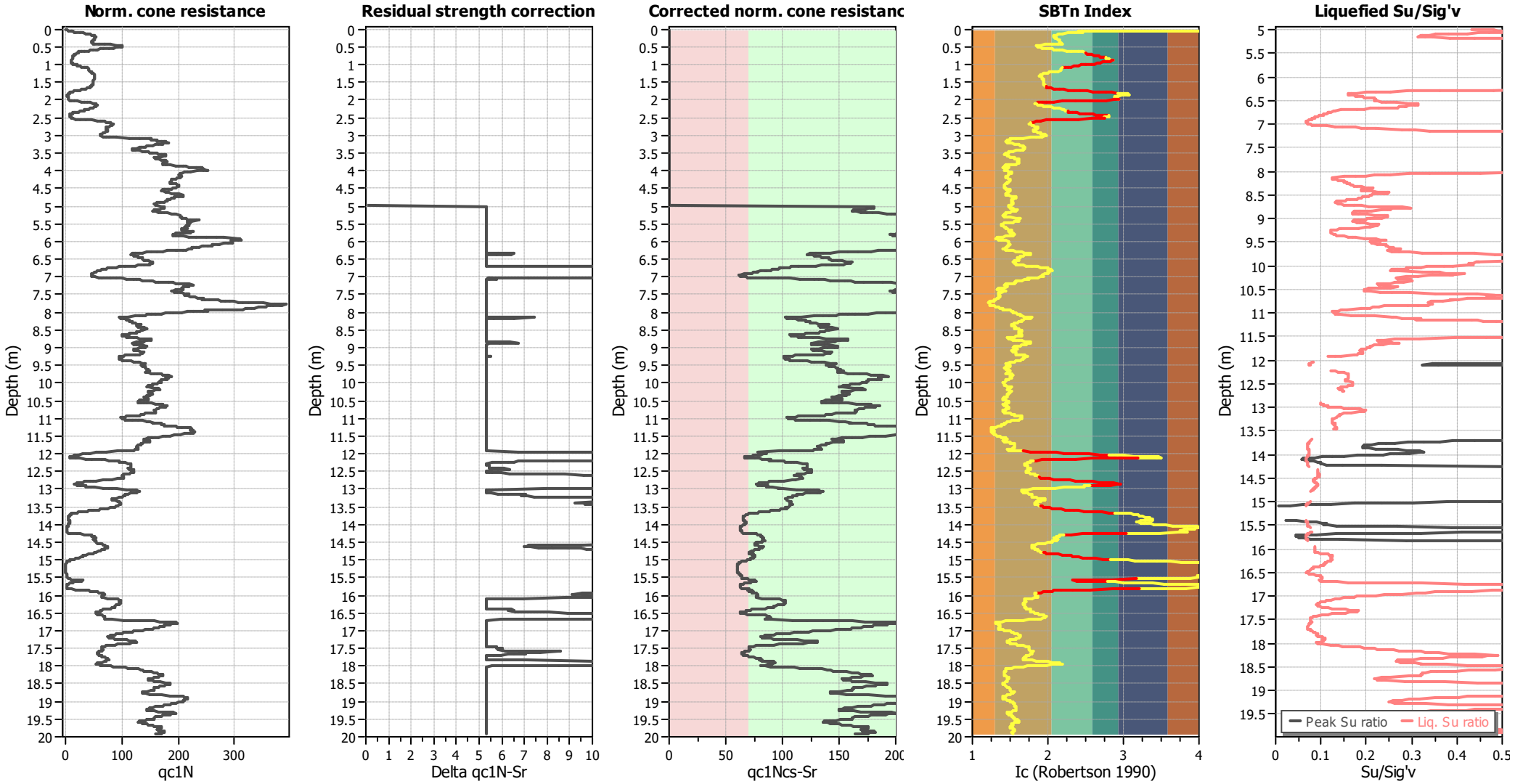




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

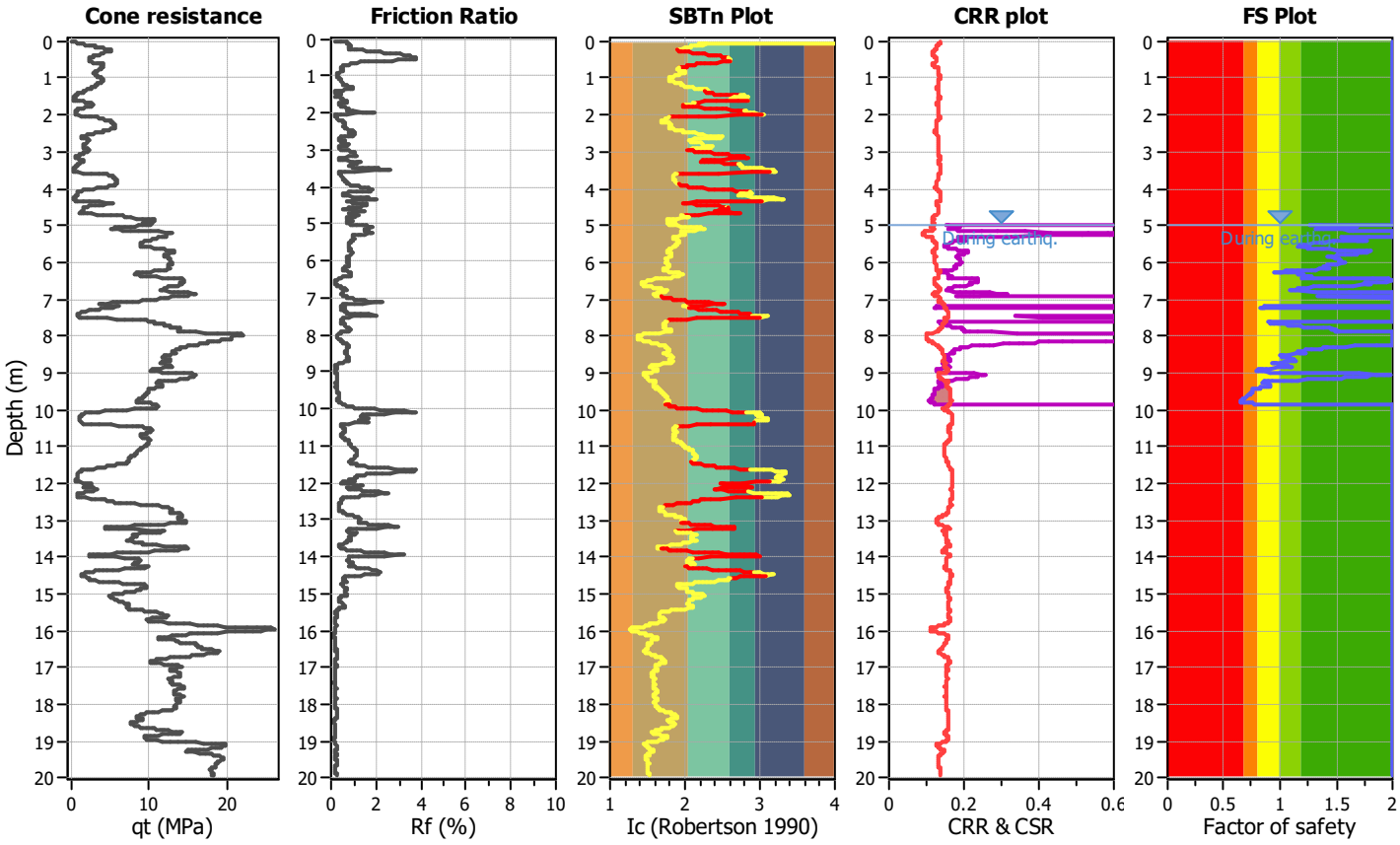
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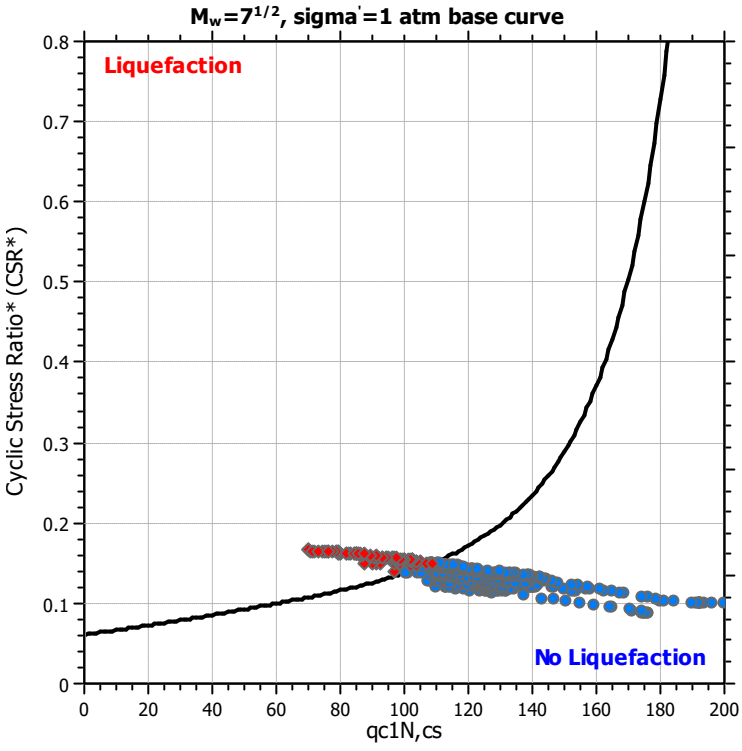
LIQUEFACTION ANALYSIS REPORT

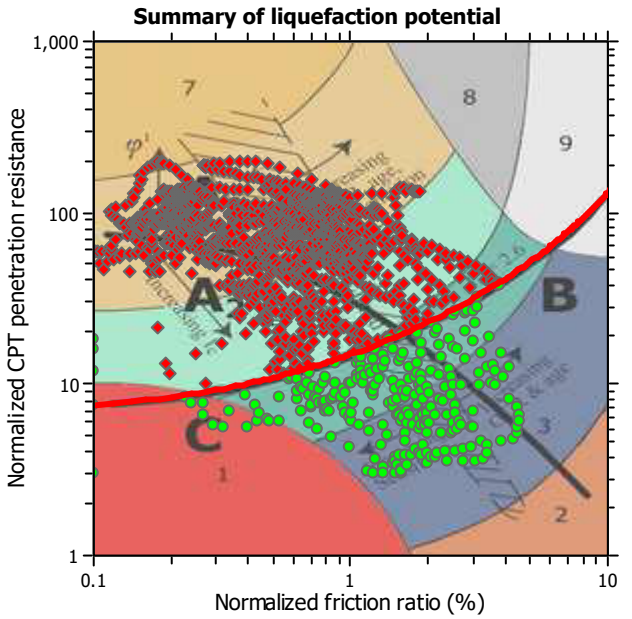
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 7

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

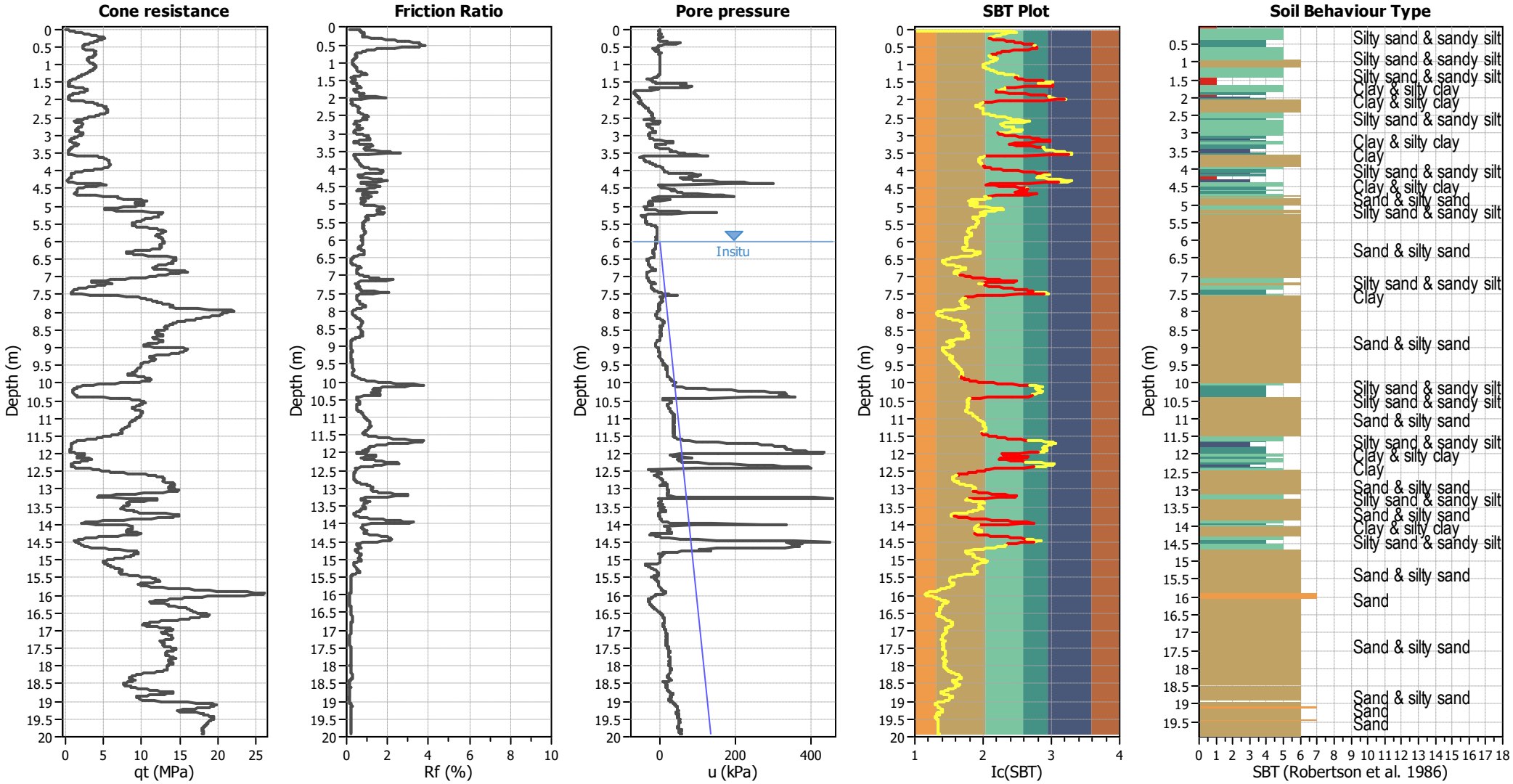






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



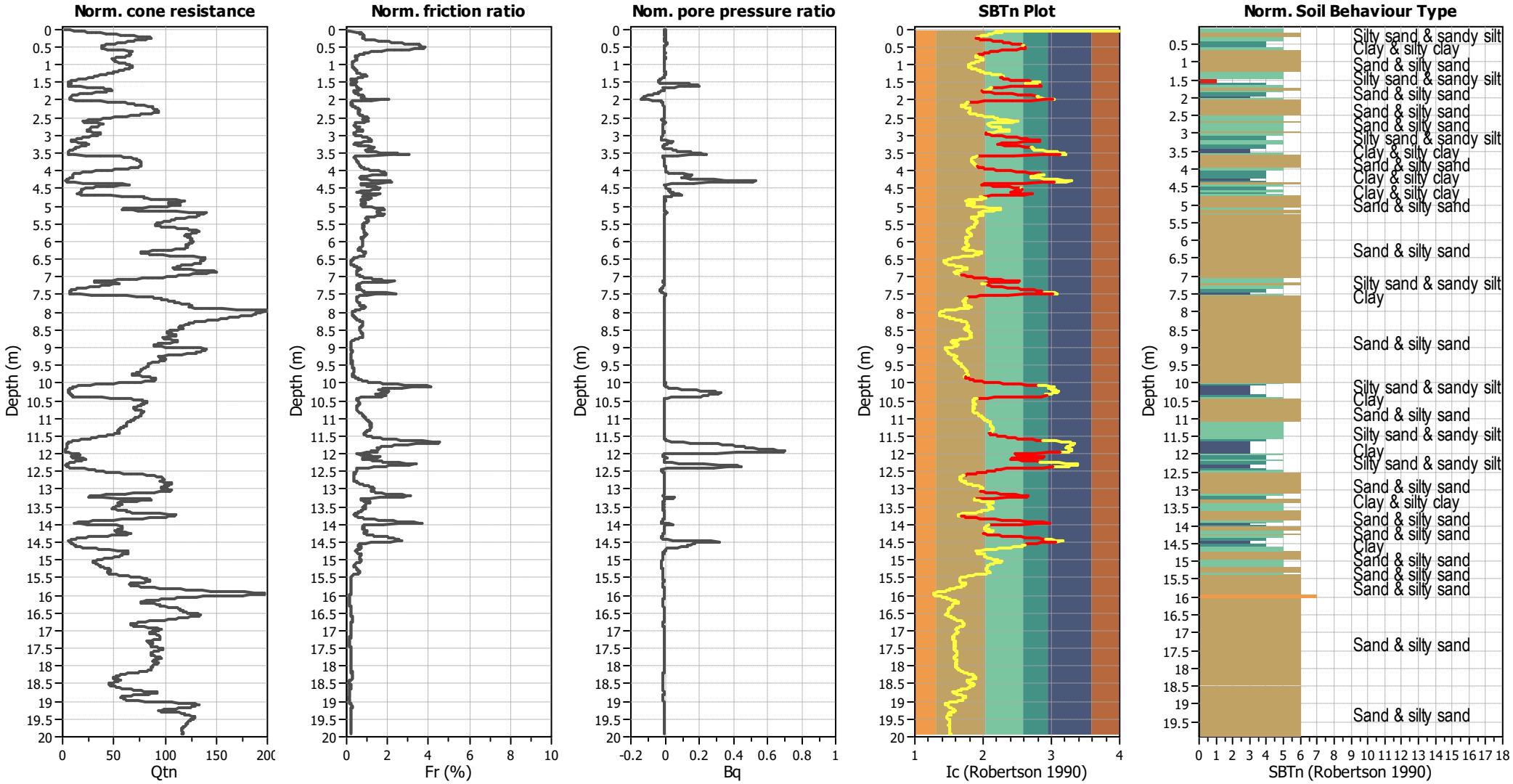
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



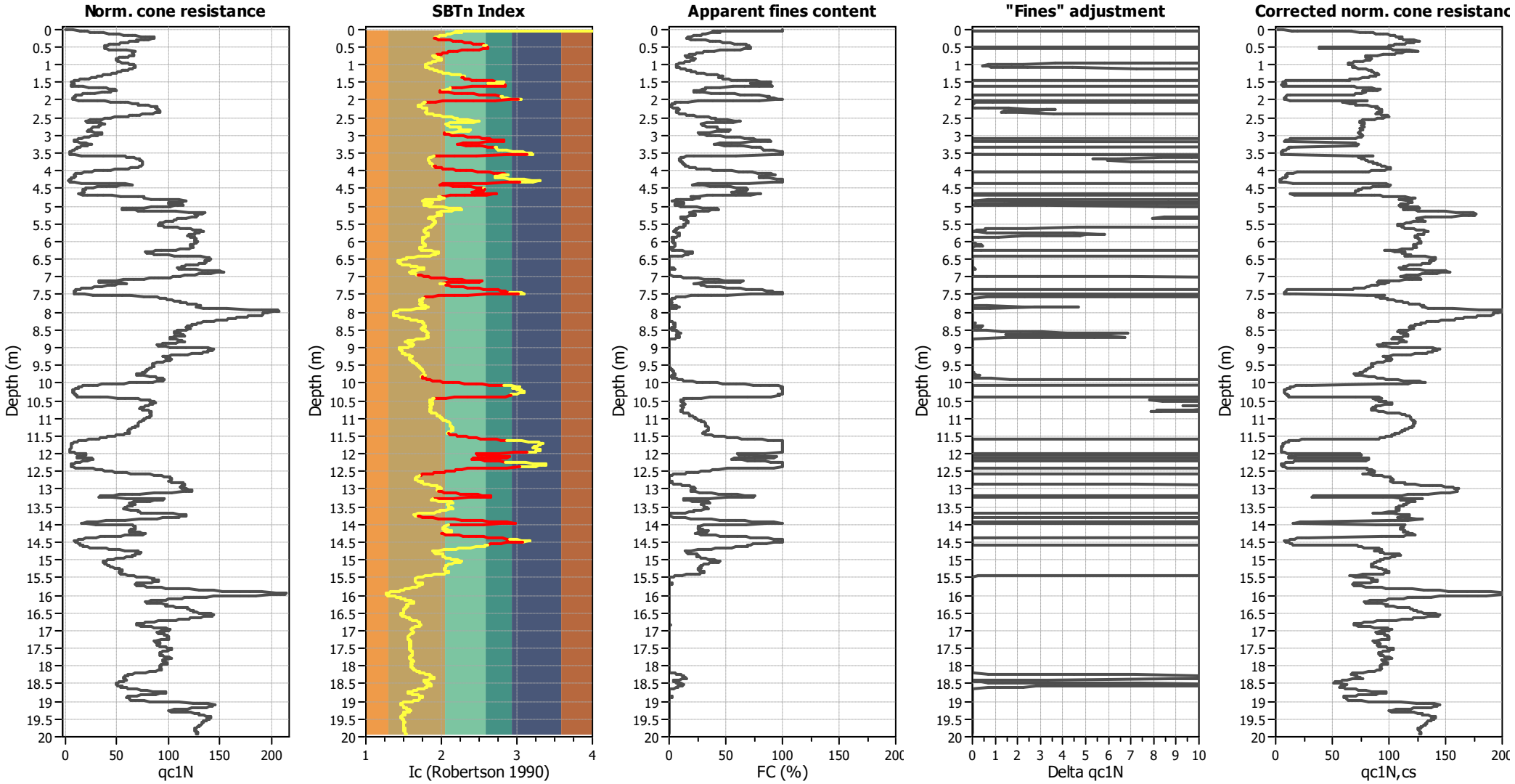
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

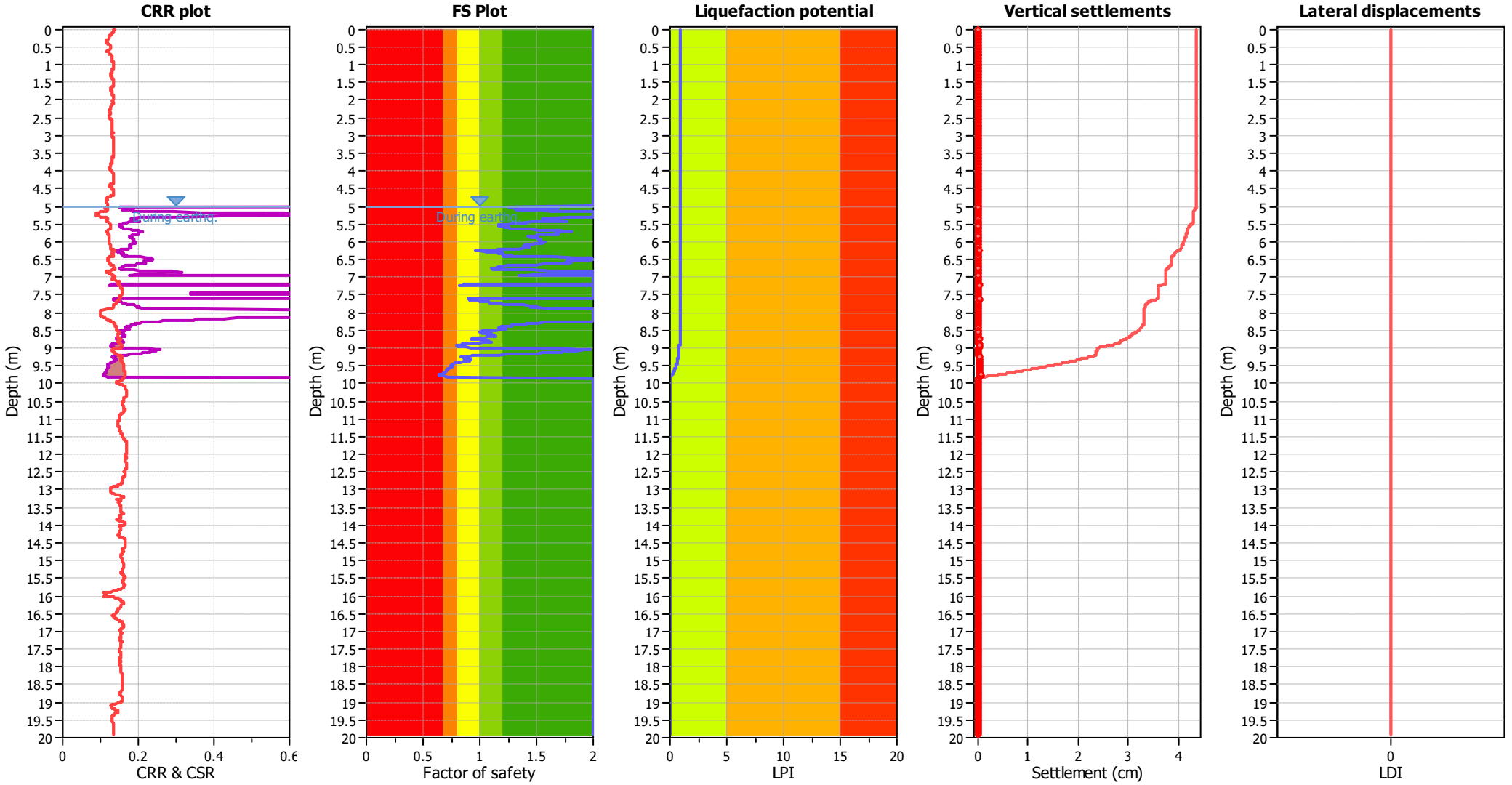
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

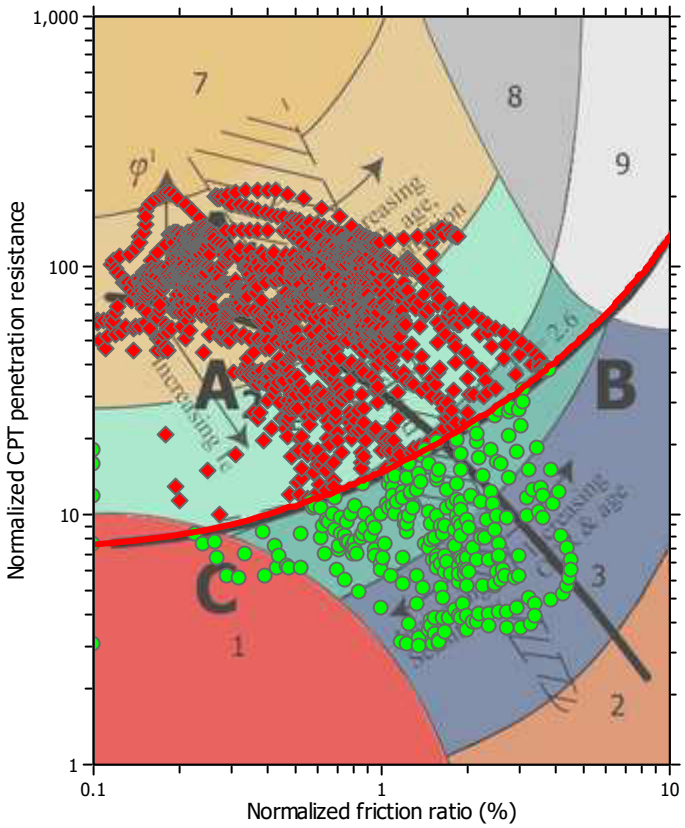
F.S. color scheme

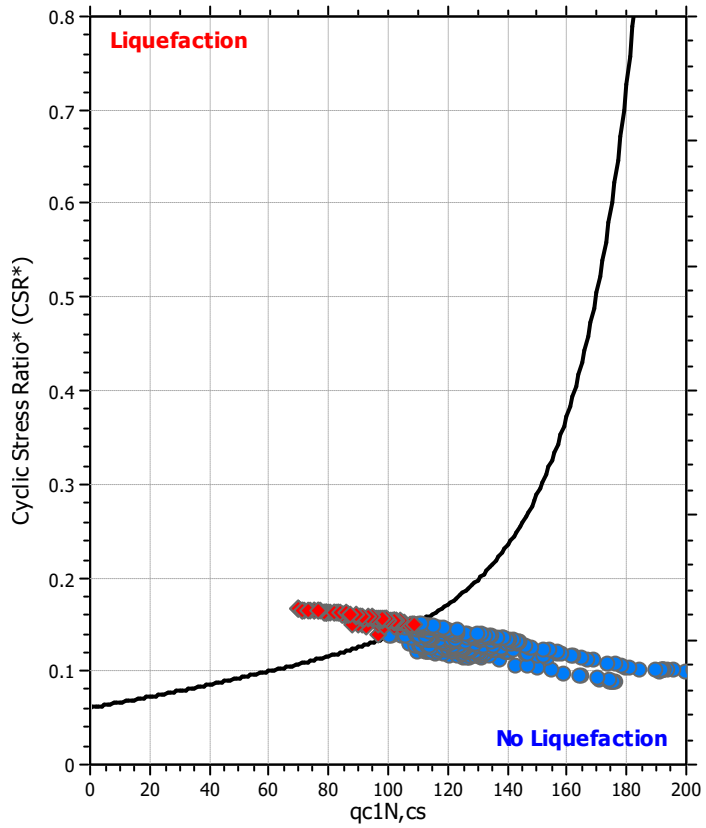
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

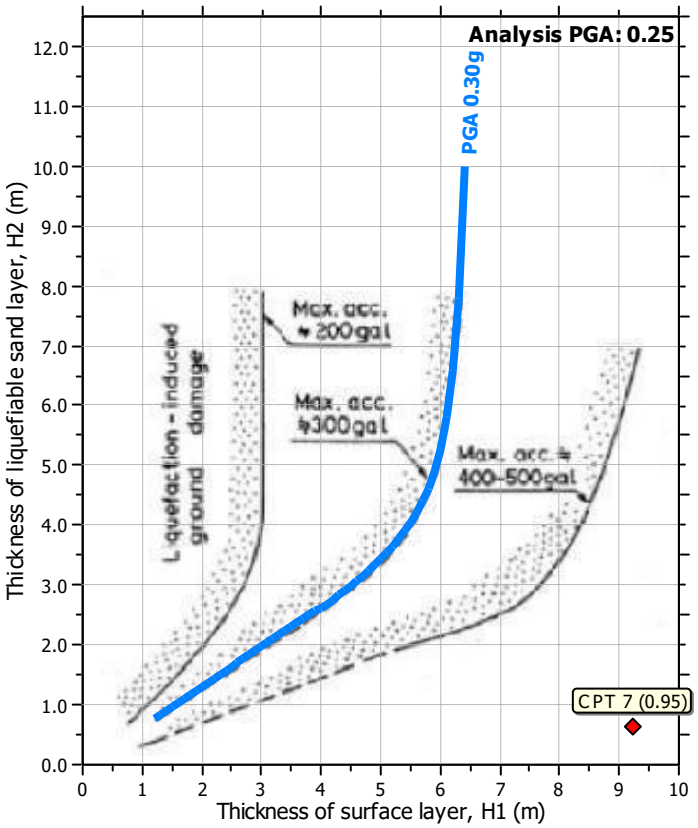
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



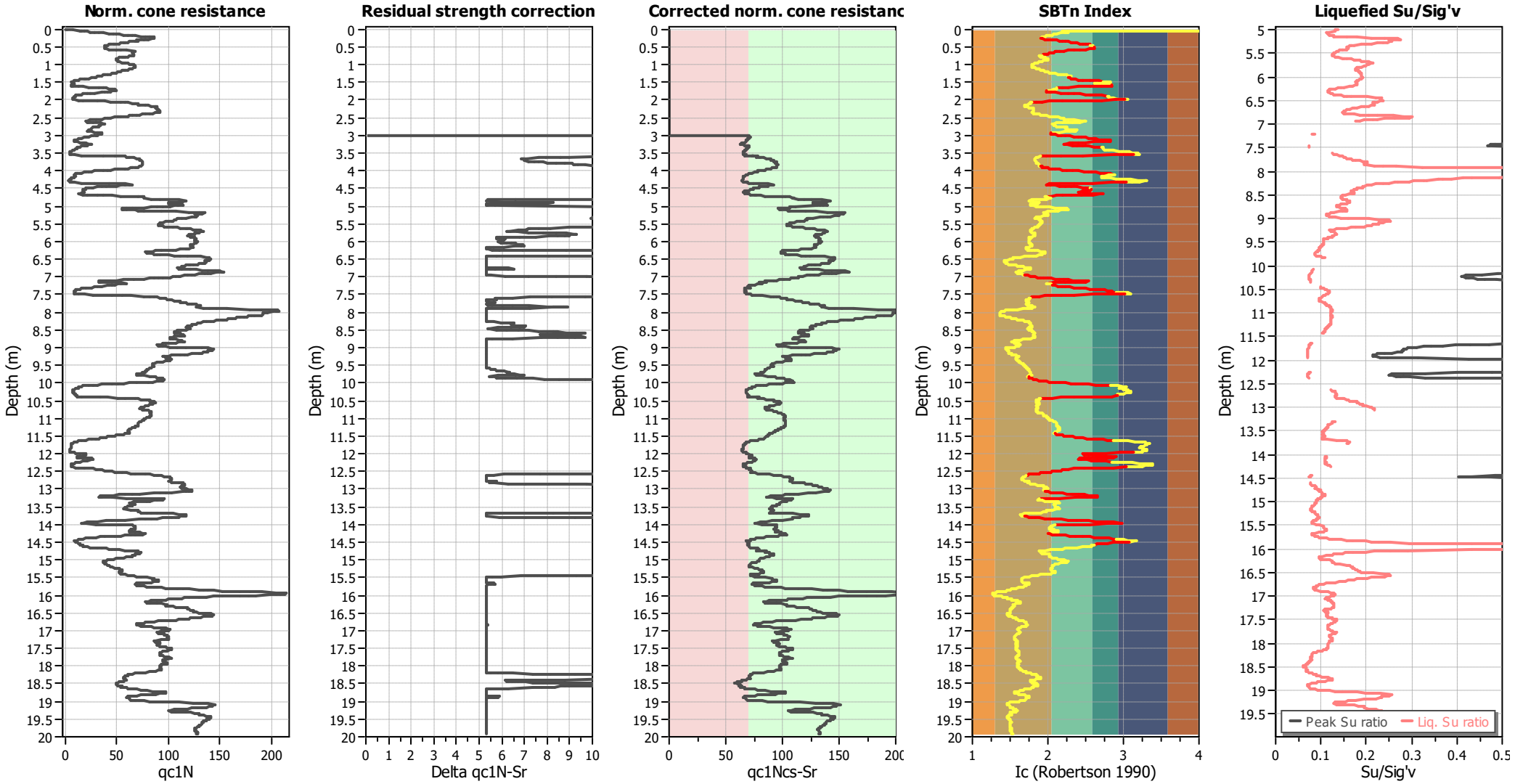




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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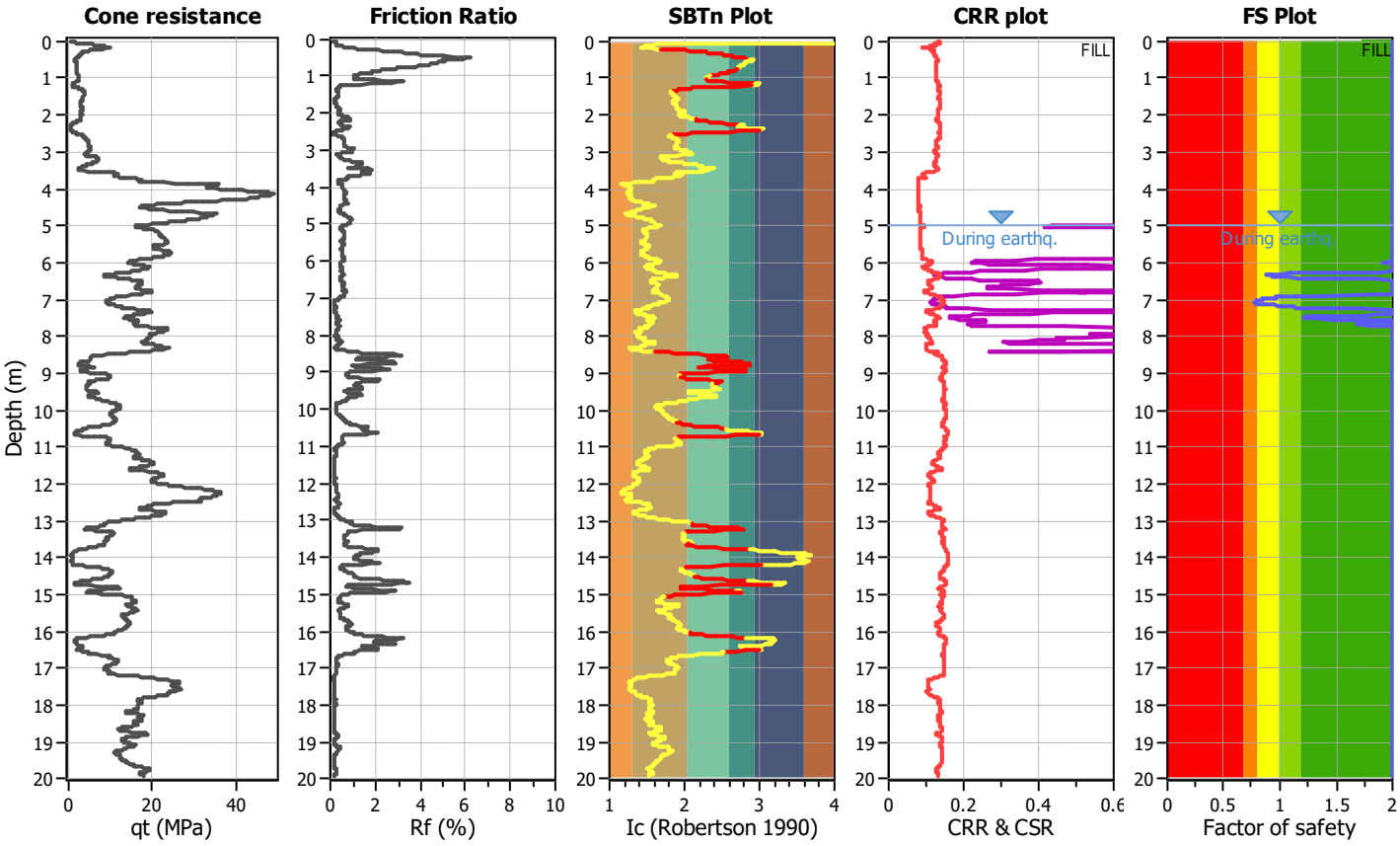
LIQUEFACTION ANALYSIS REPORT

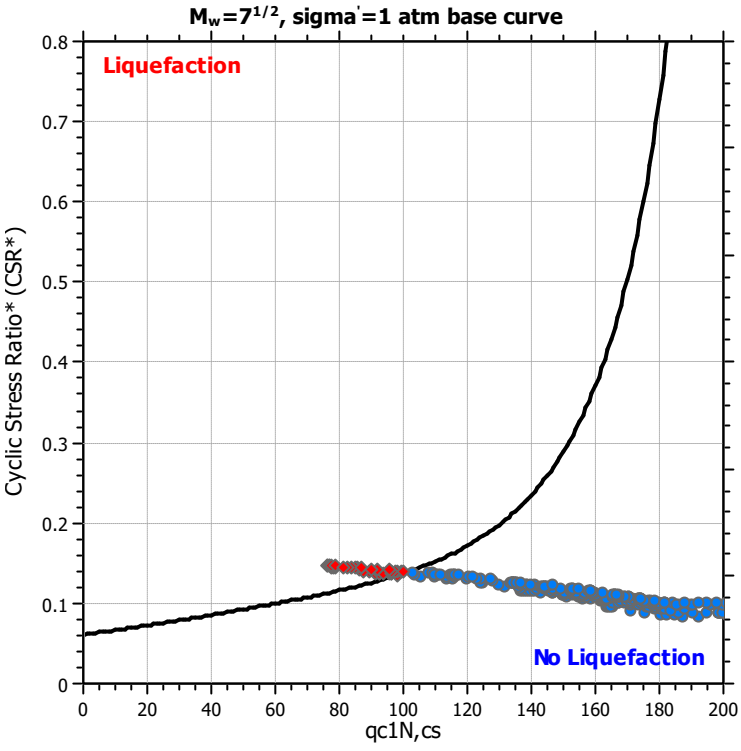
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**

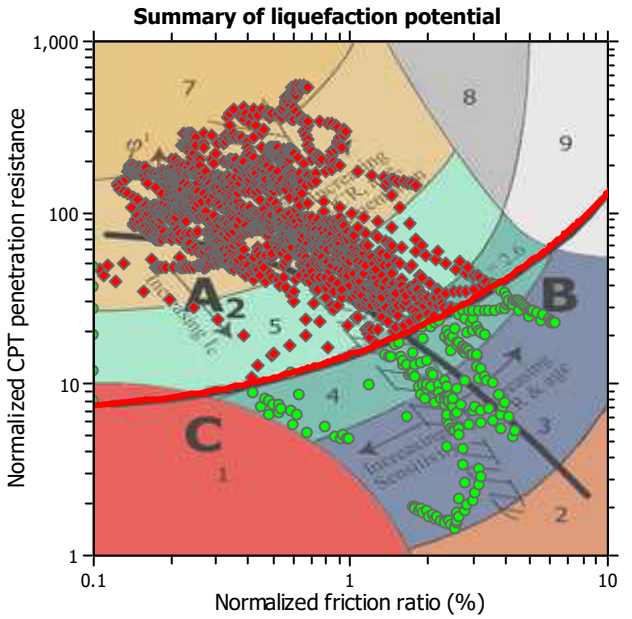
CPT file : CPT 8

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	7.00 m	Use fill:	Yes	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	1.00 m	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	18.00 kN/m^3	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

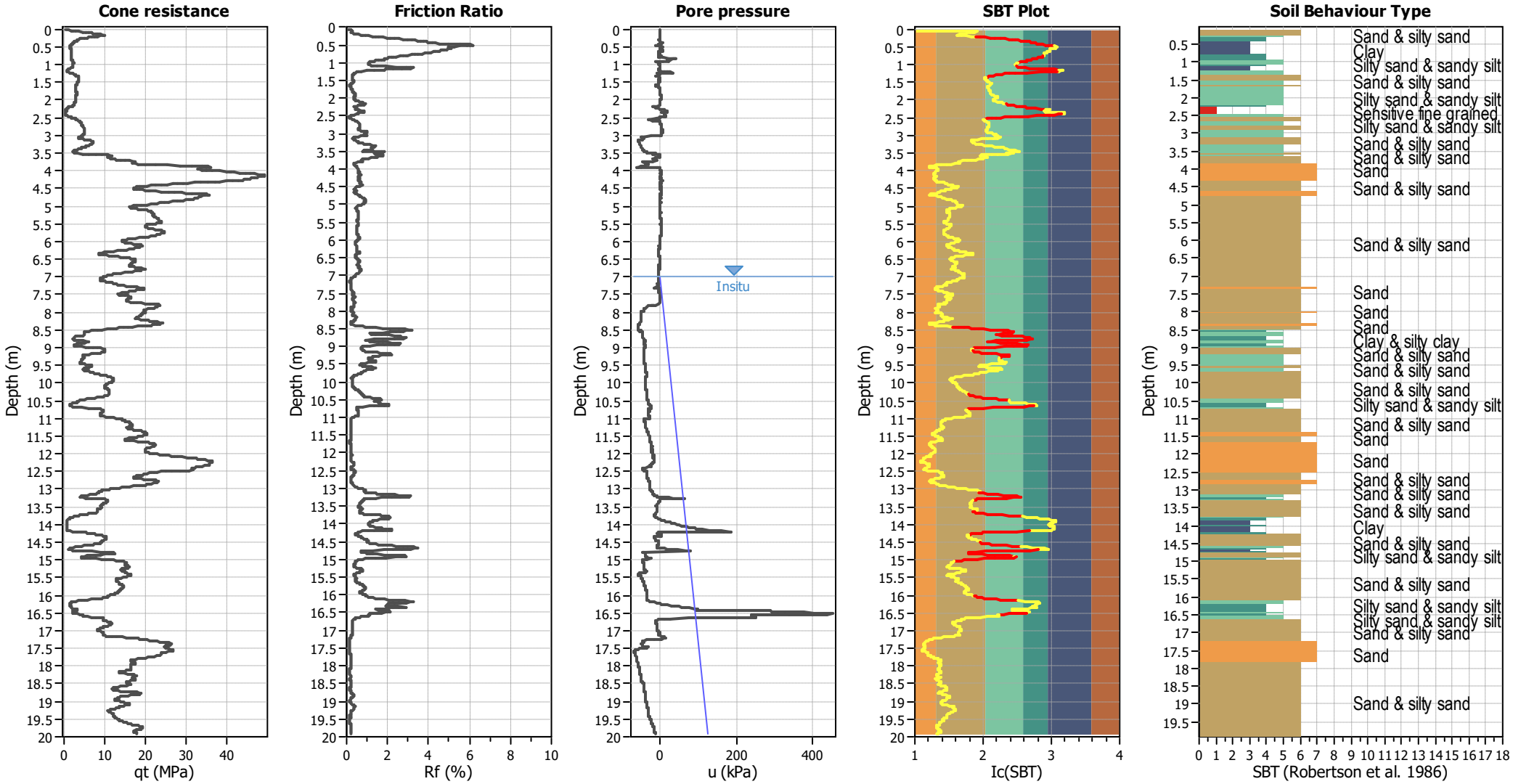






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



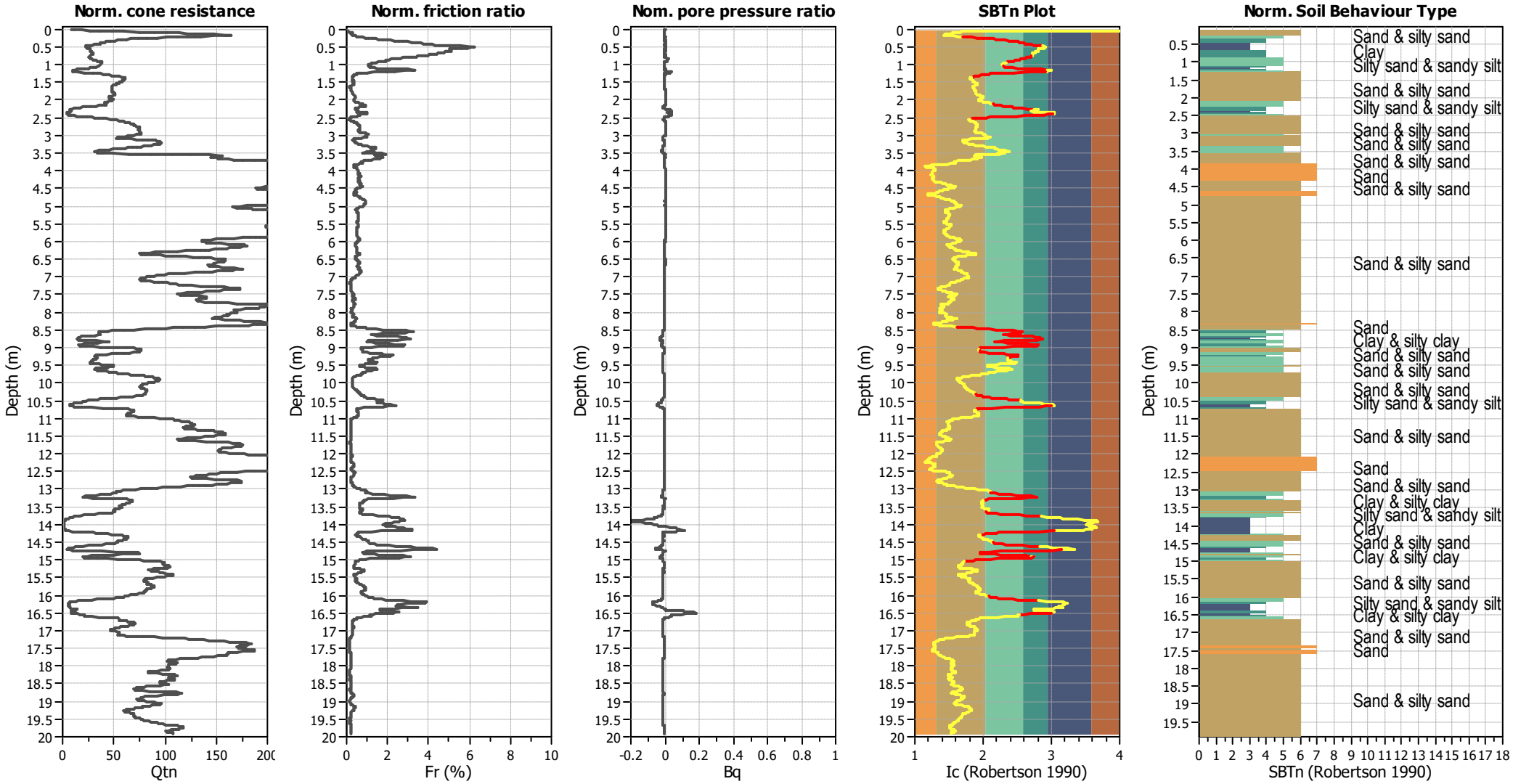
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



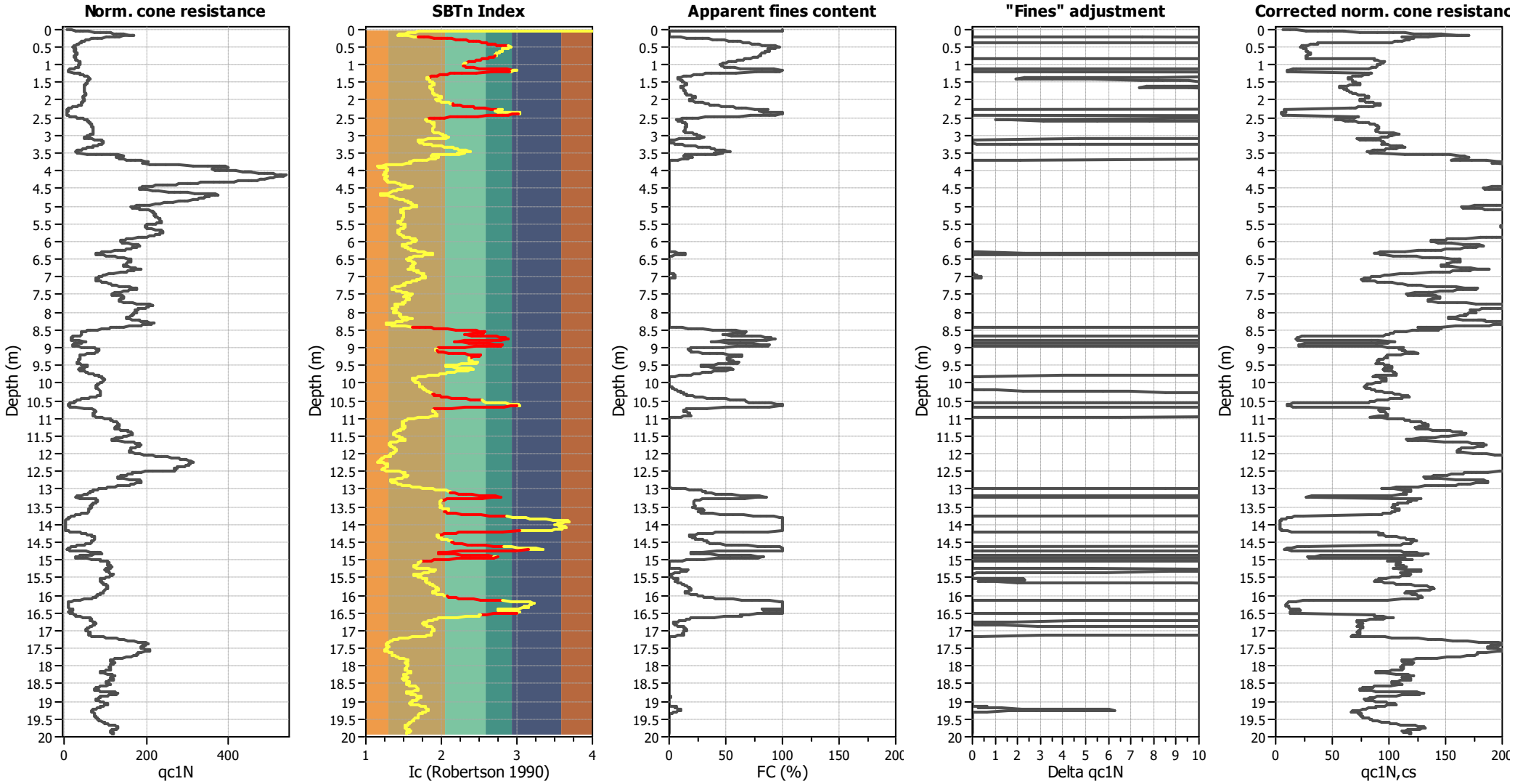
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

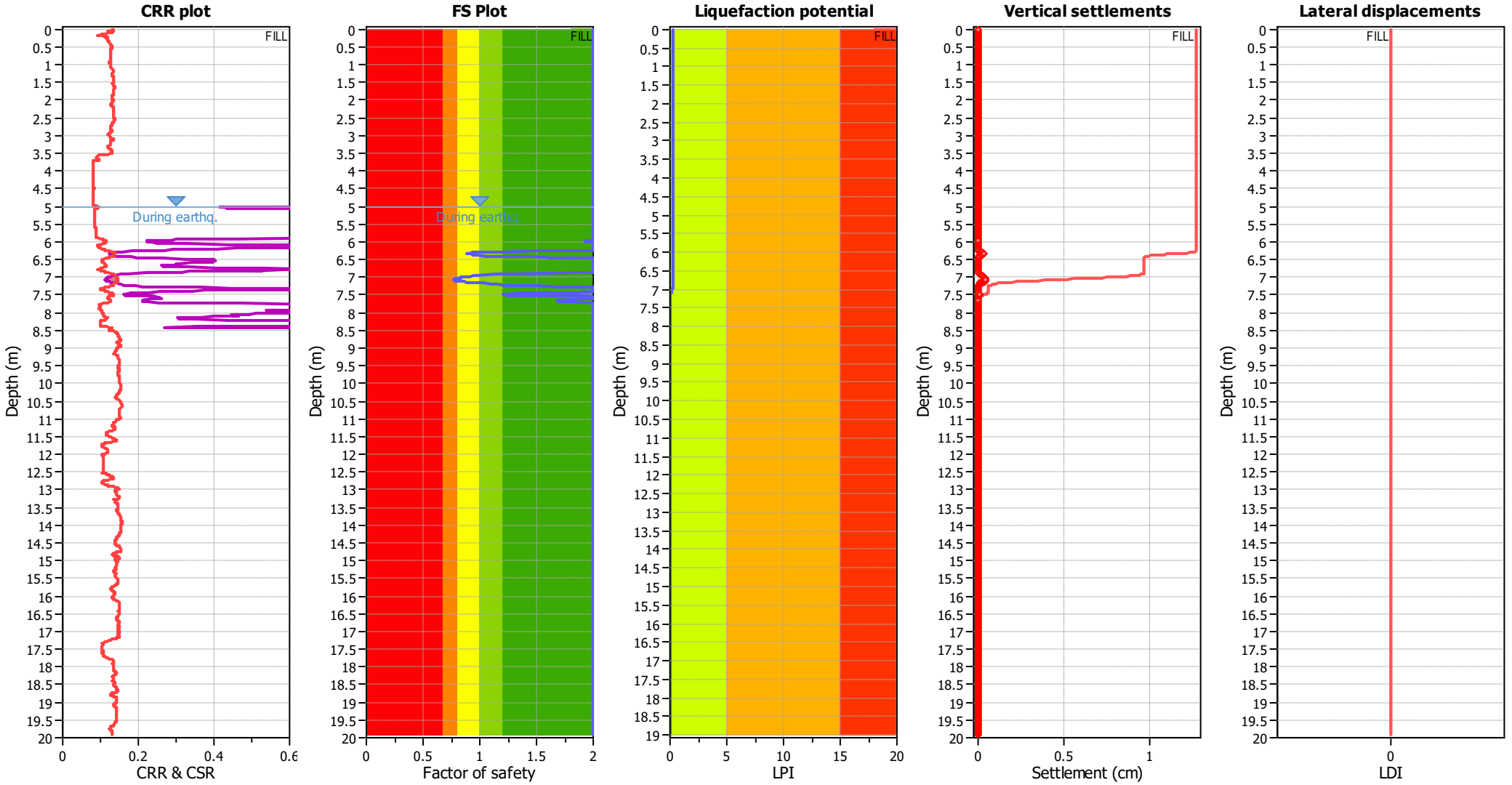
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

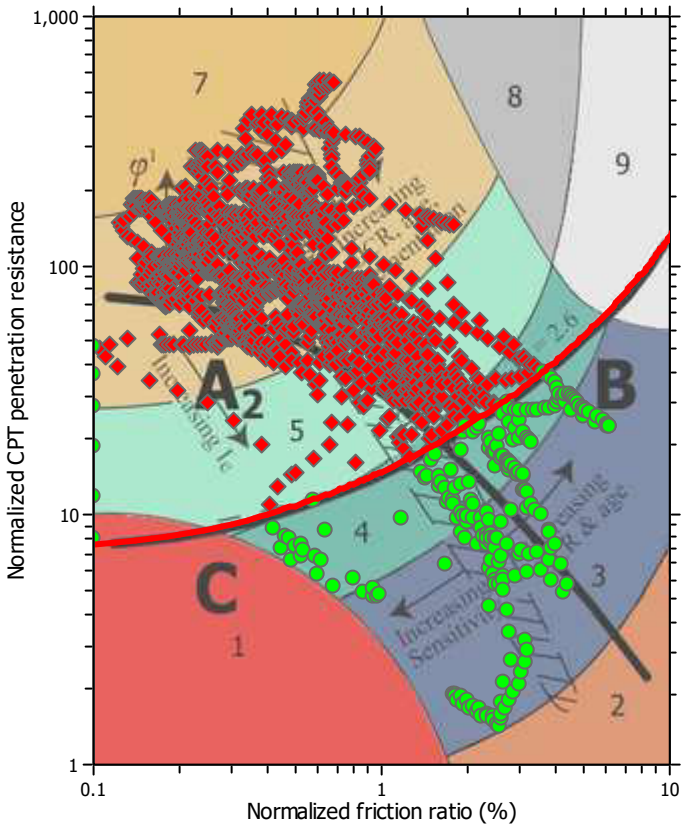
F.S. color scheme

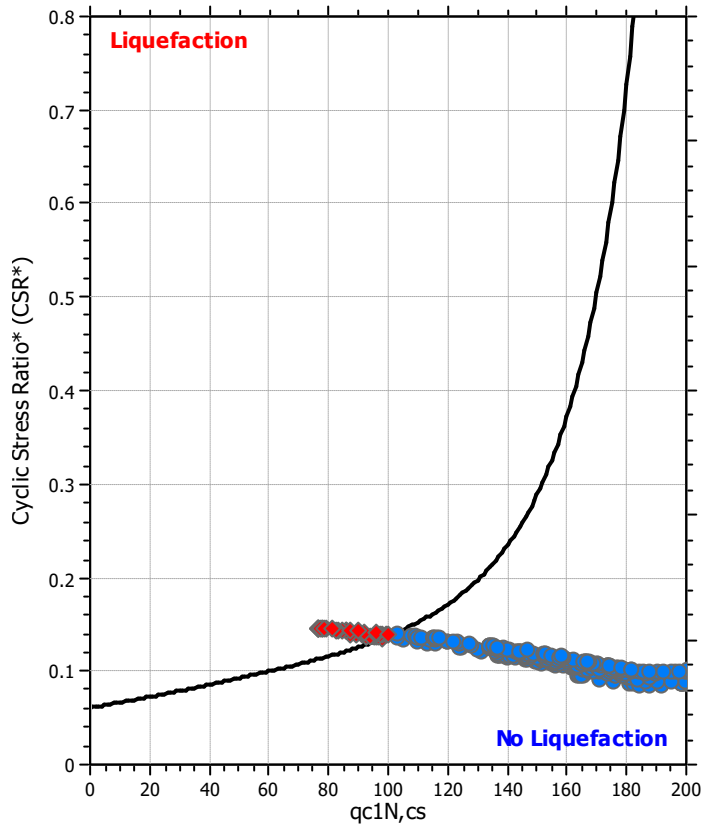
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

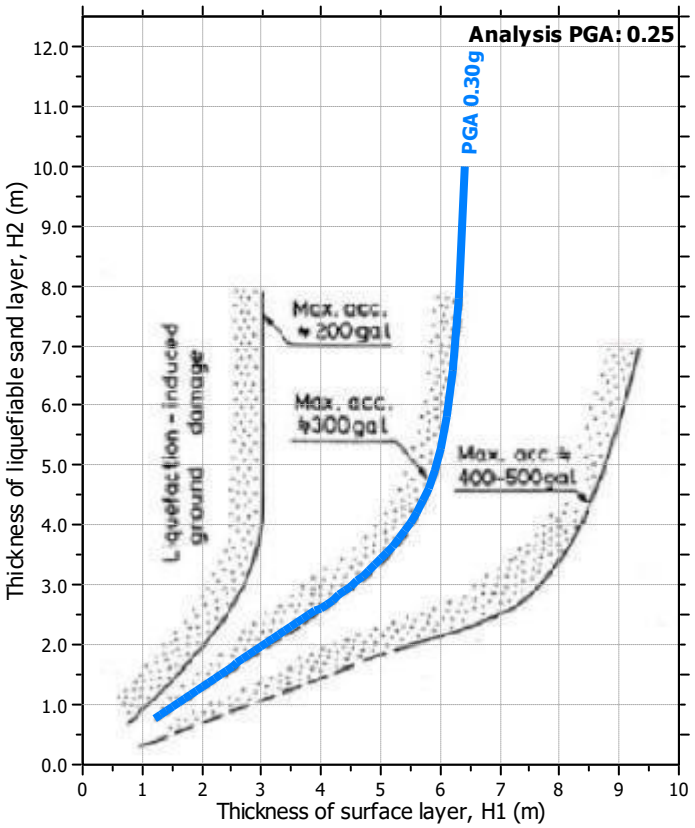
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



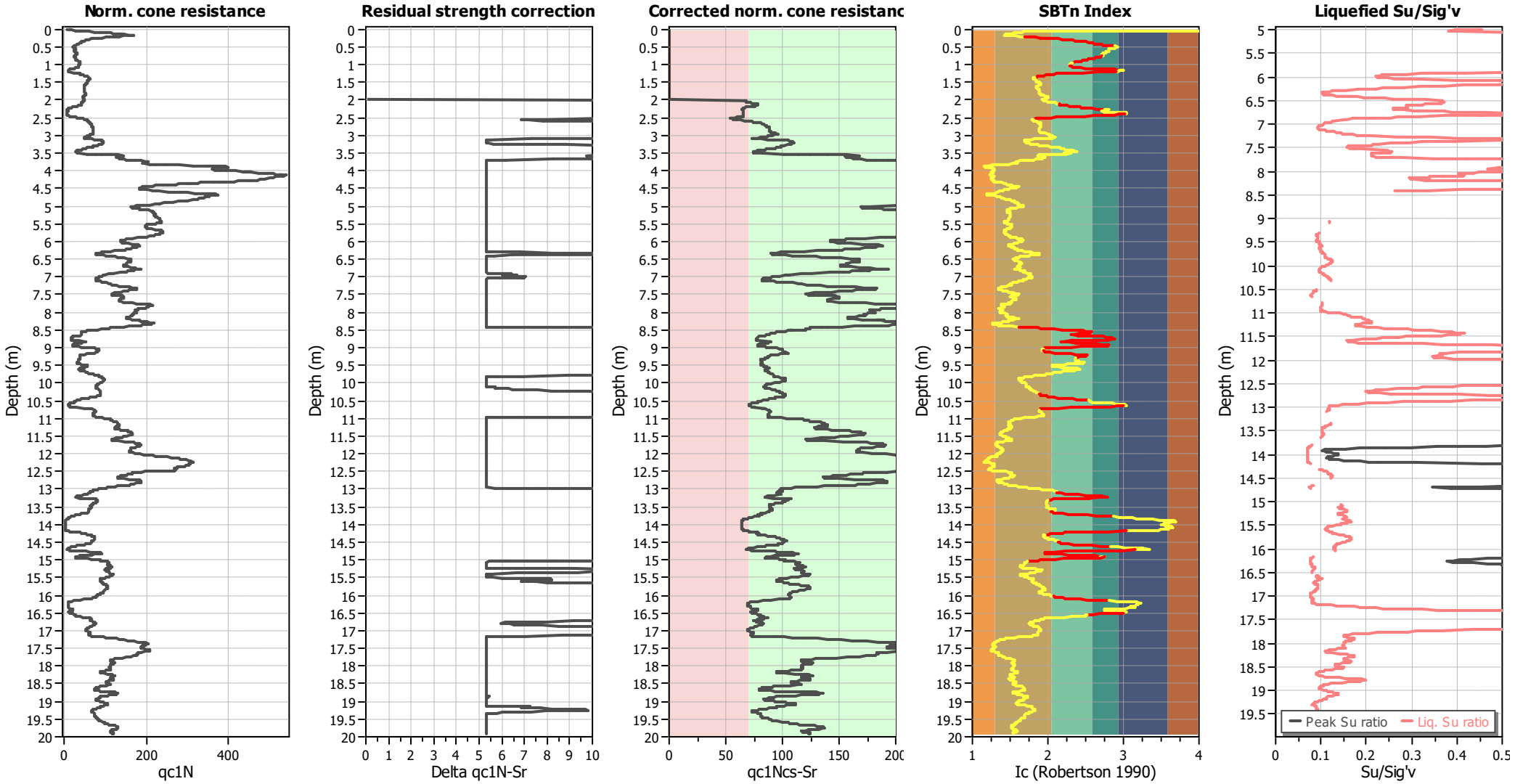




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	18.00 kN/m³
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	Yes	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 m	Fill height:	1.00 m	Limit depth:	10.00 m

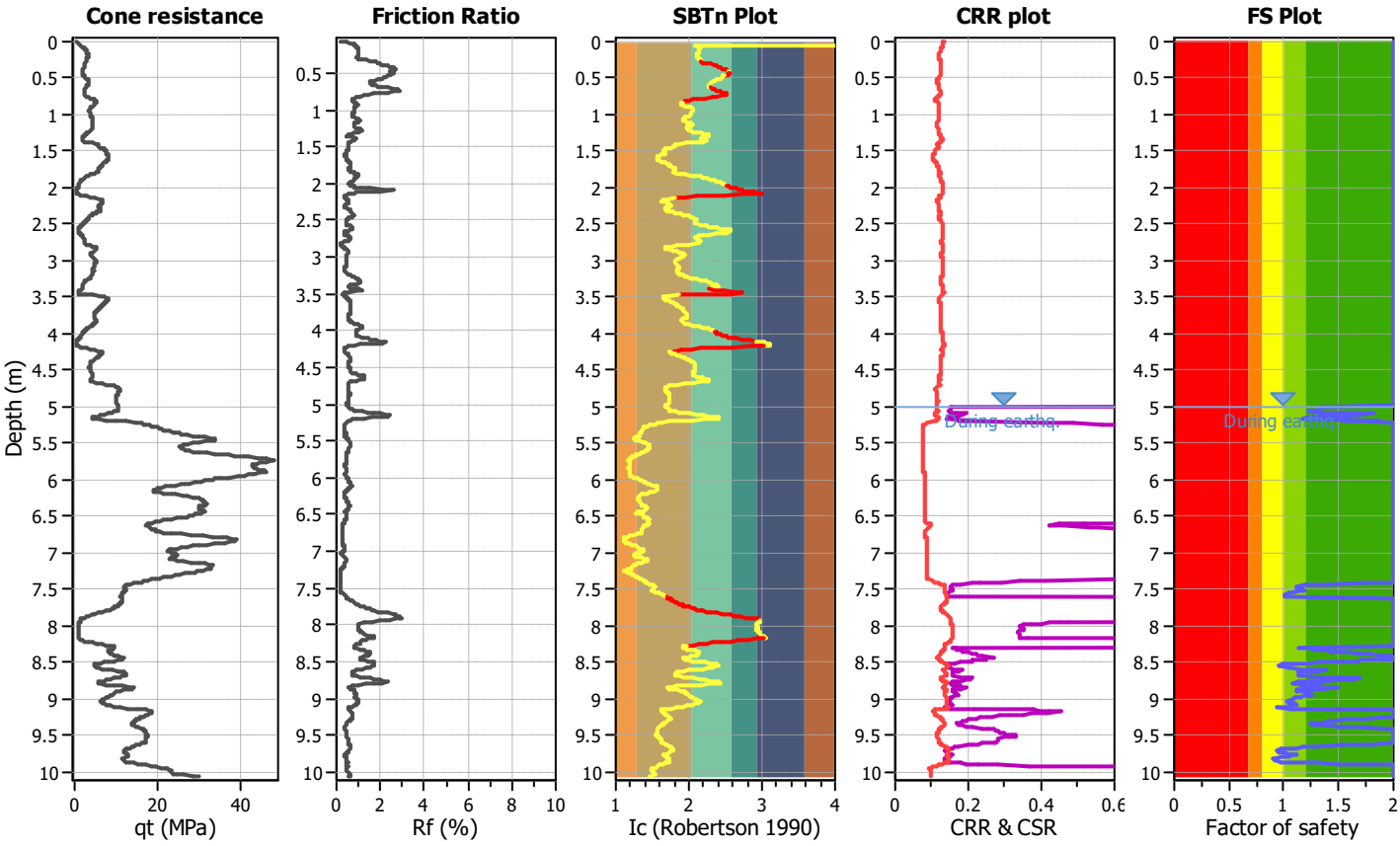
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Hamilton
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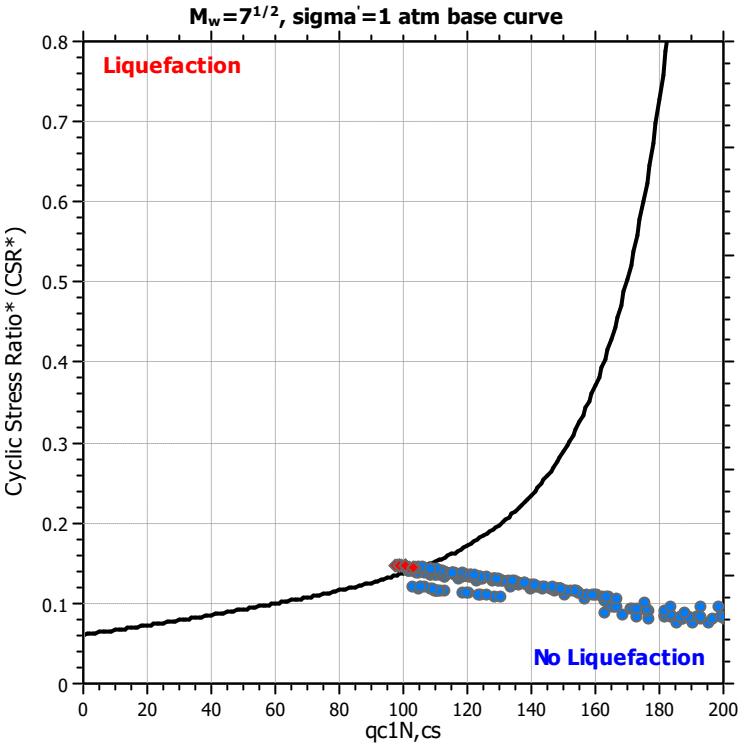
LIQUEFACTION ANALYSIS REPORT

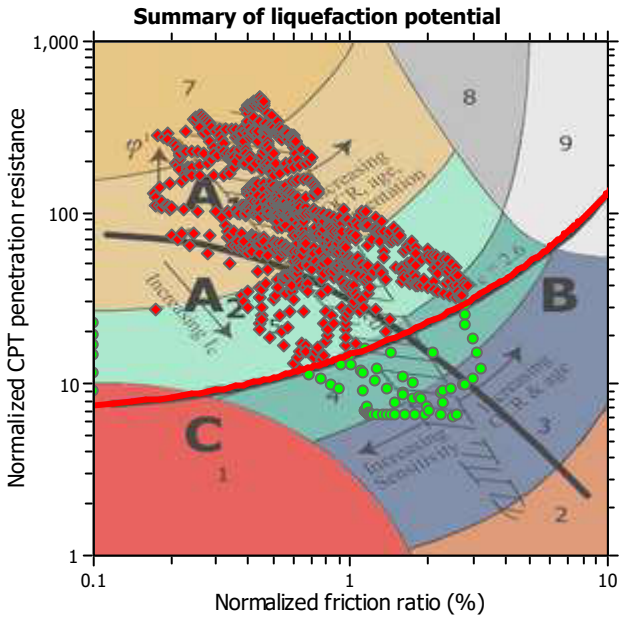
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 9

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.60	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

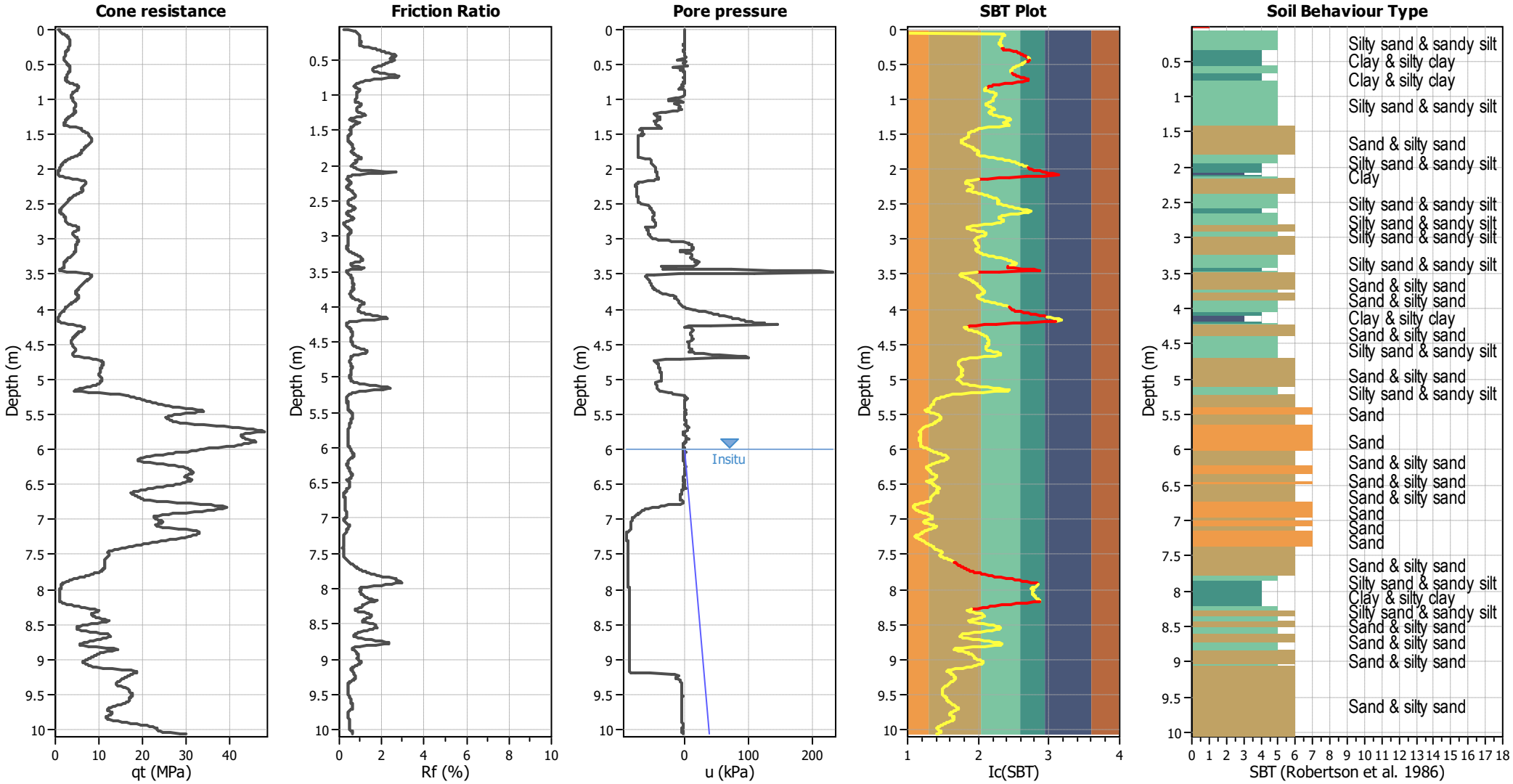






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



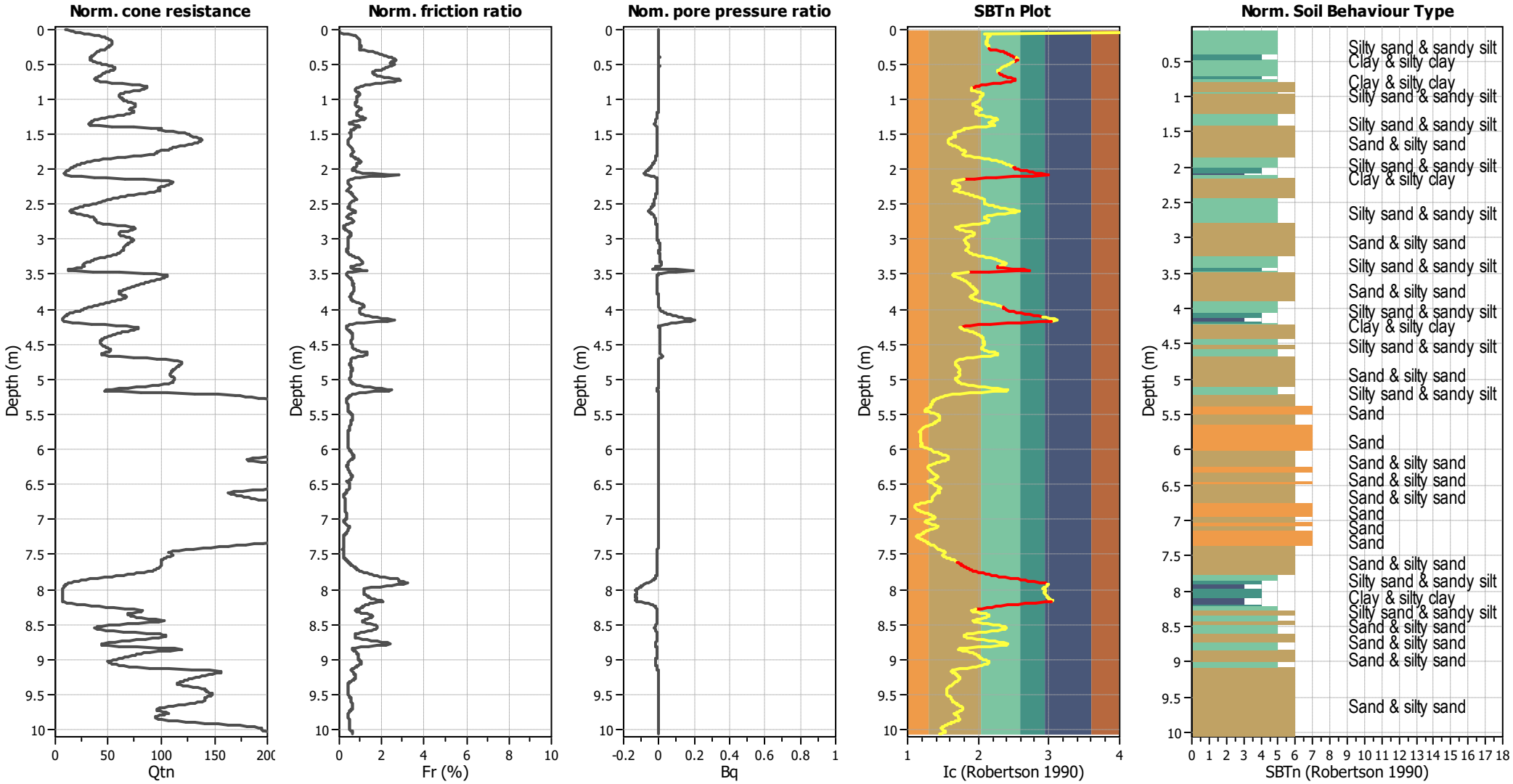
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



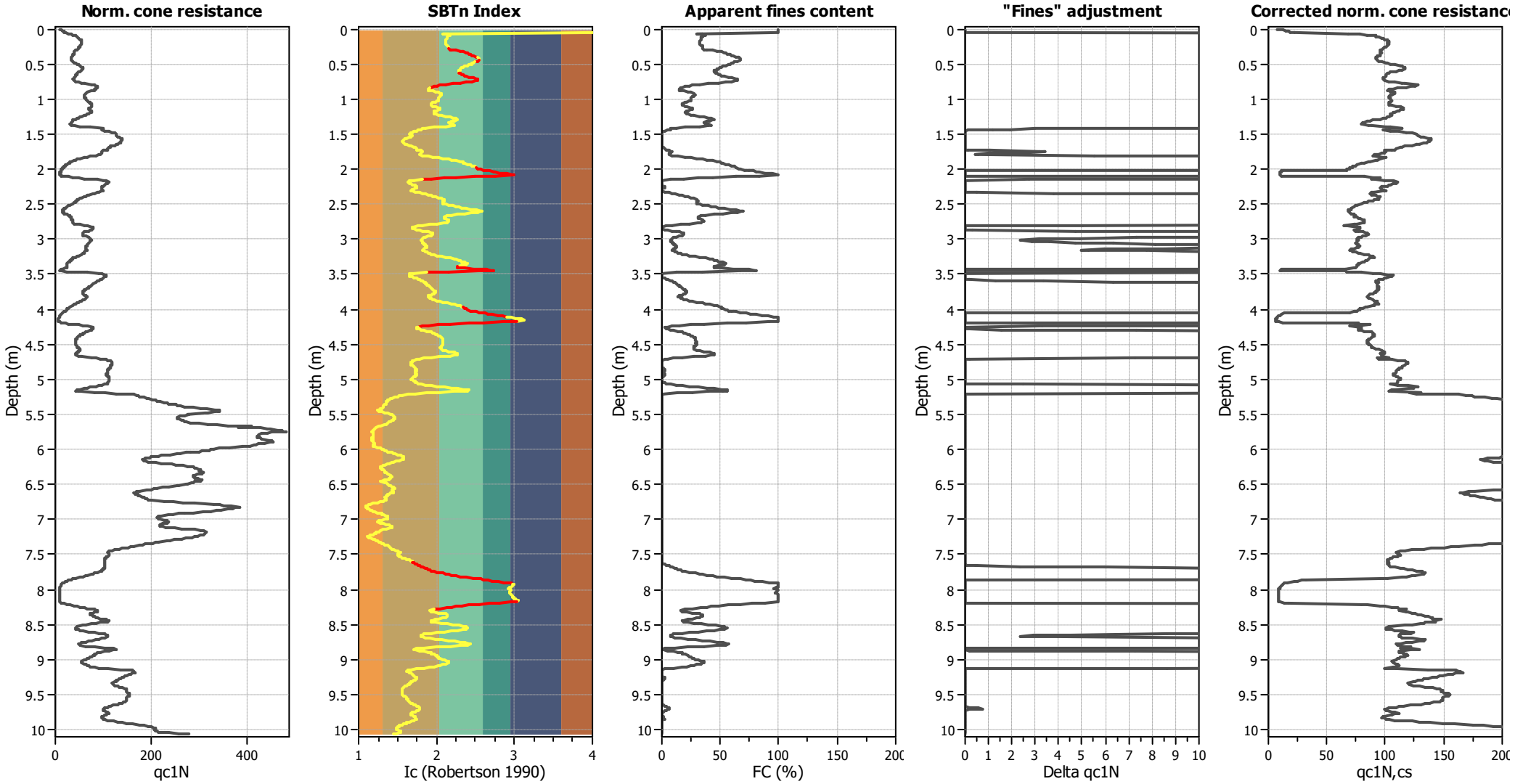
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

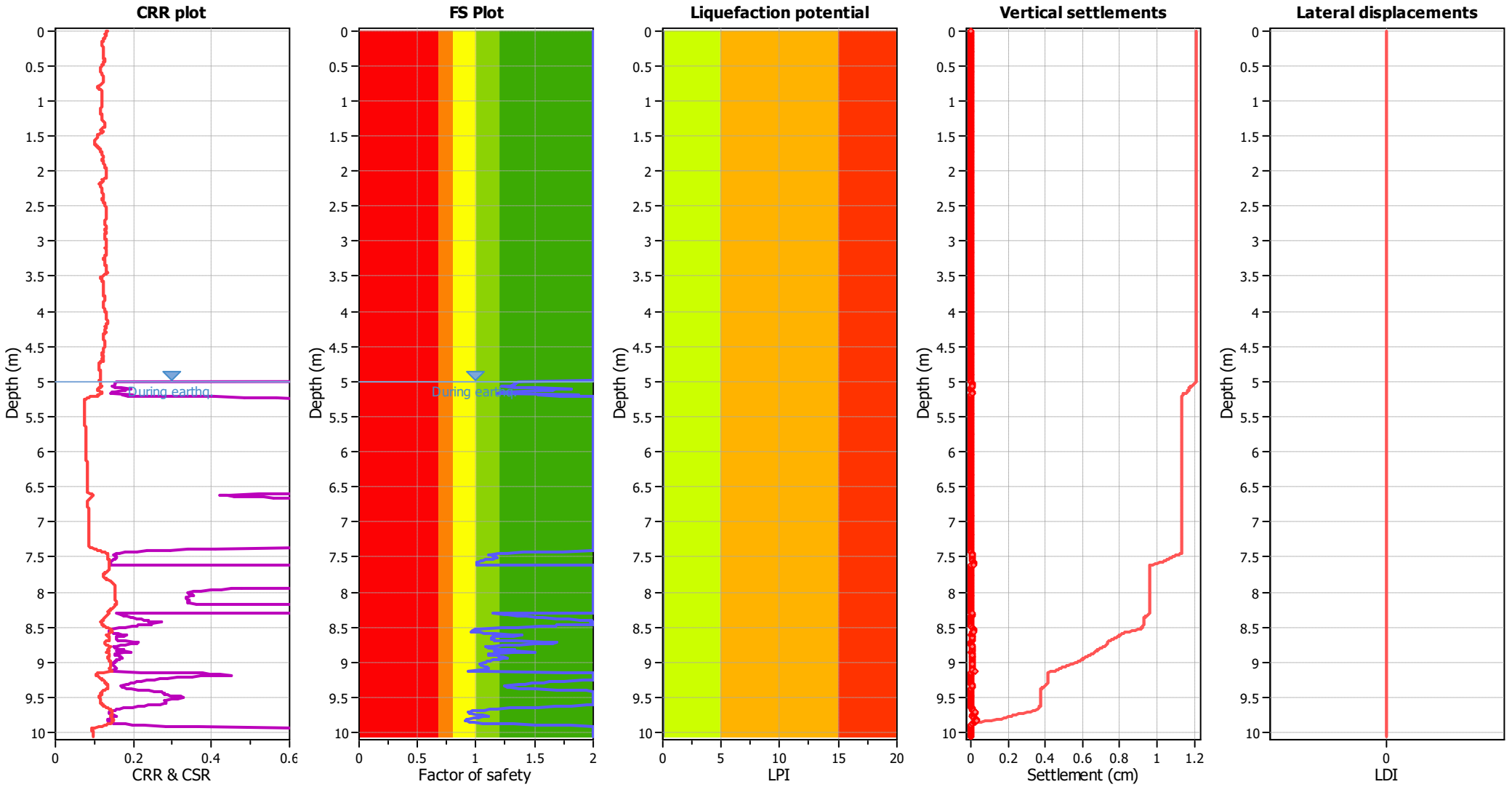
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

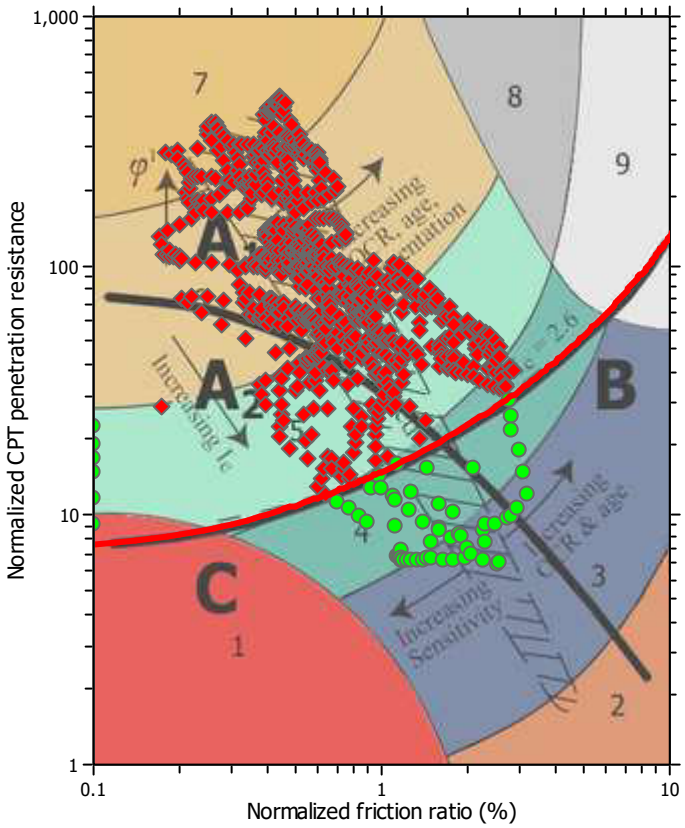
F.S. color scheme

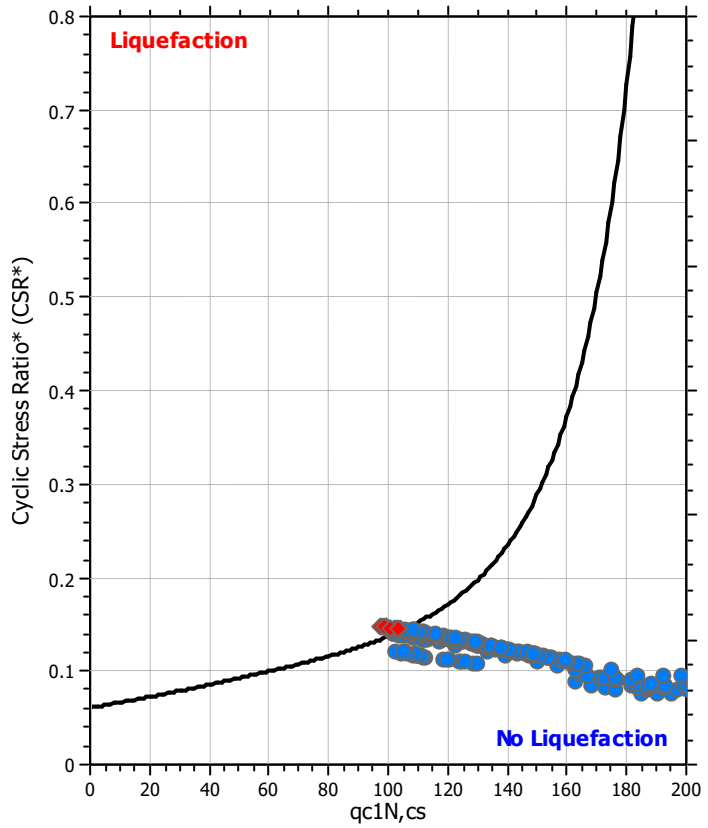
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

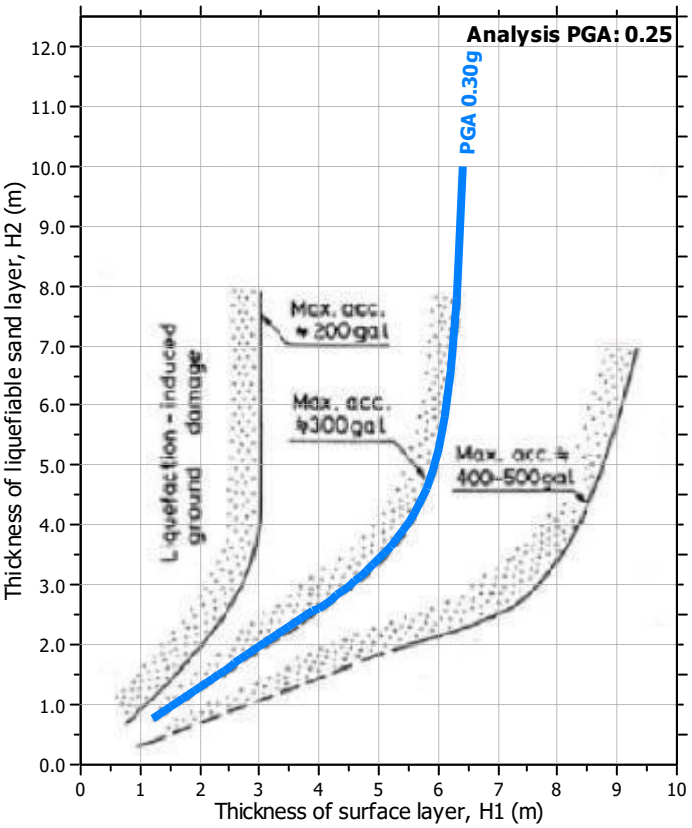
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



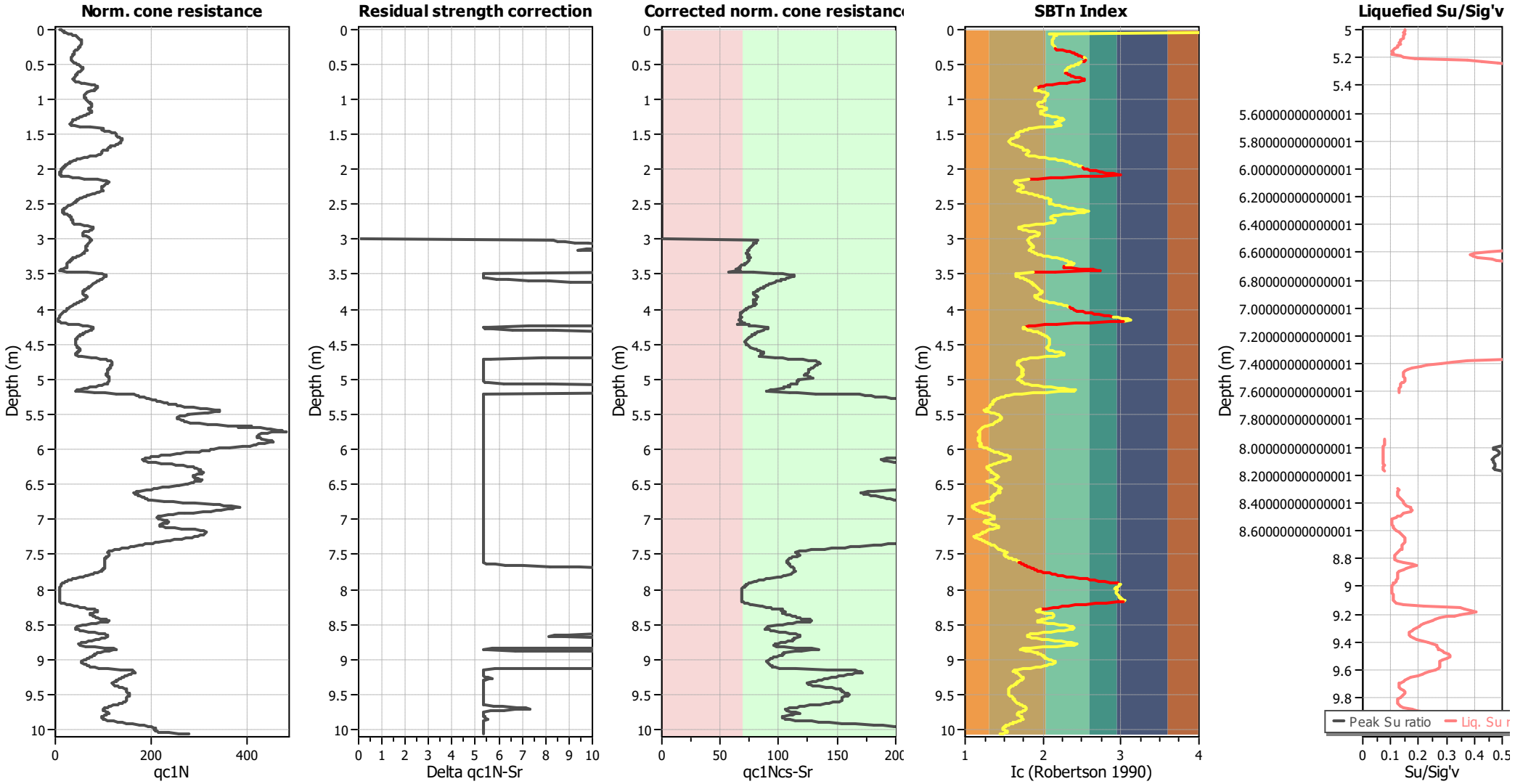




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.60	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

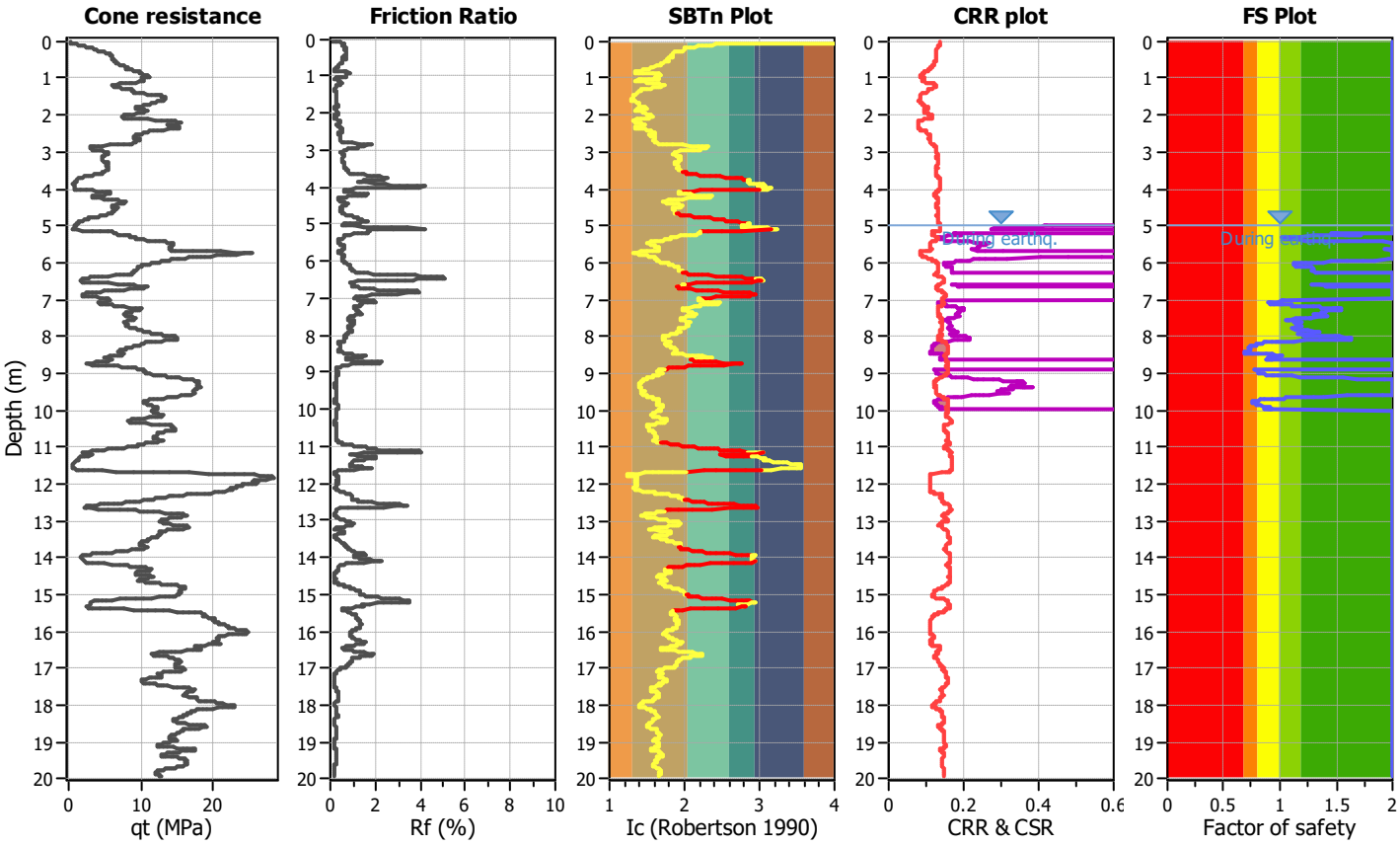
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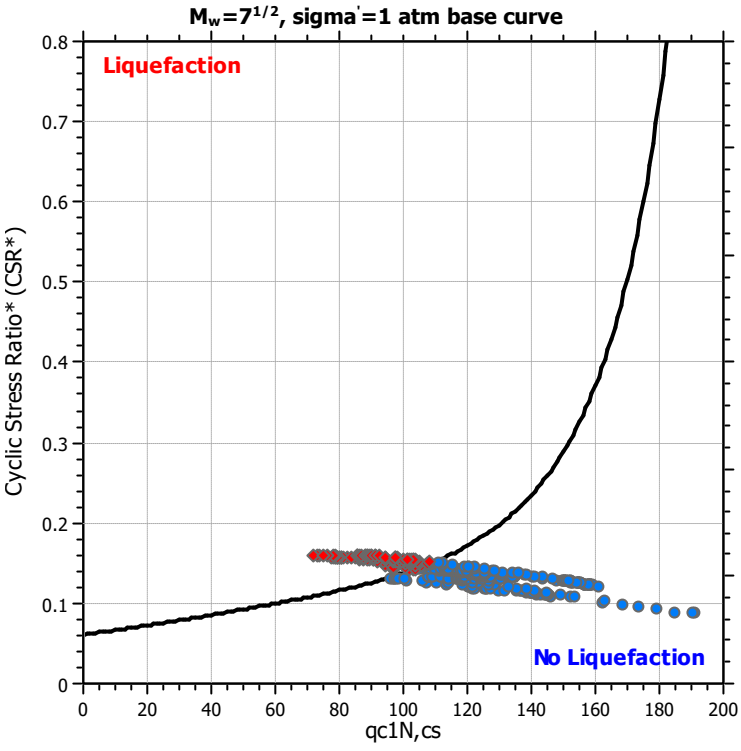
LIQUEFACTION ANALYSIS REPORT

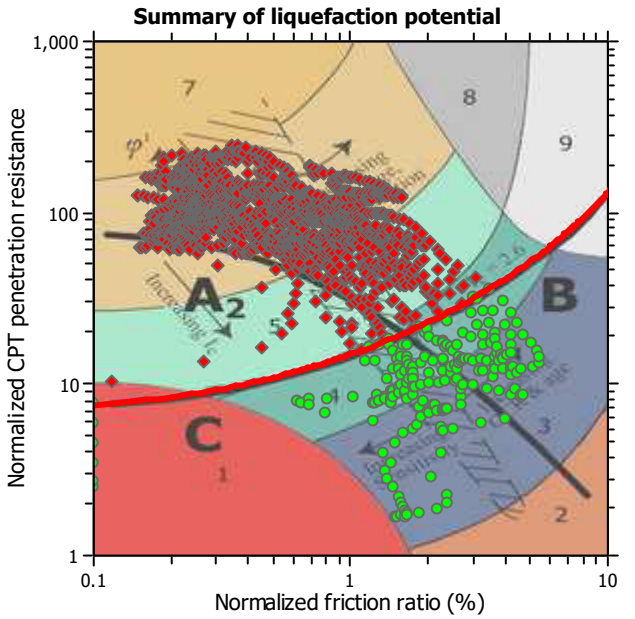
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 10

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

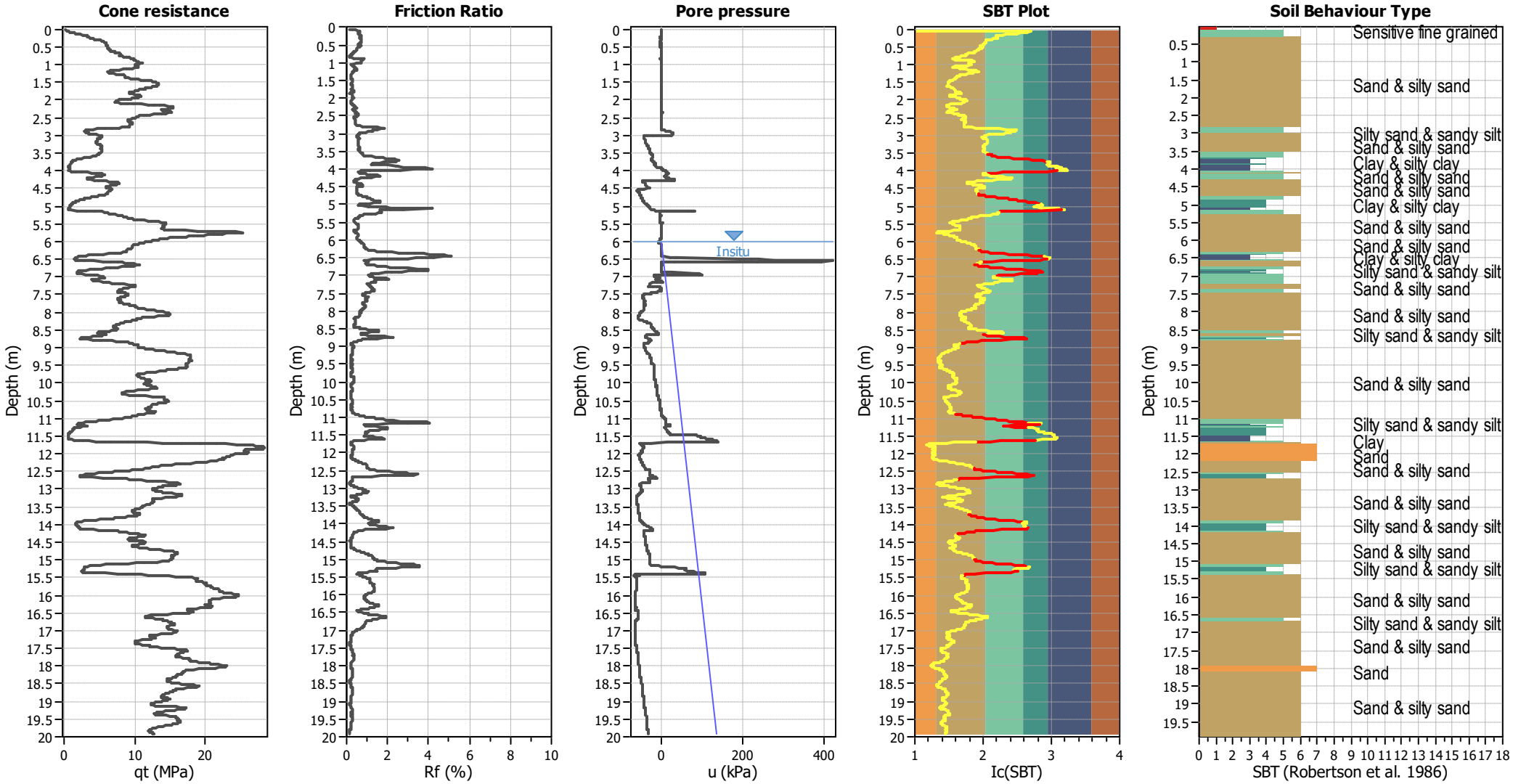






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



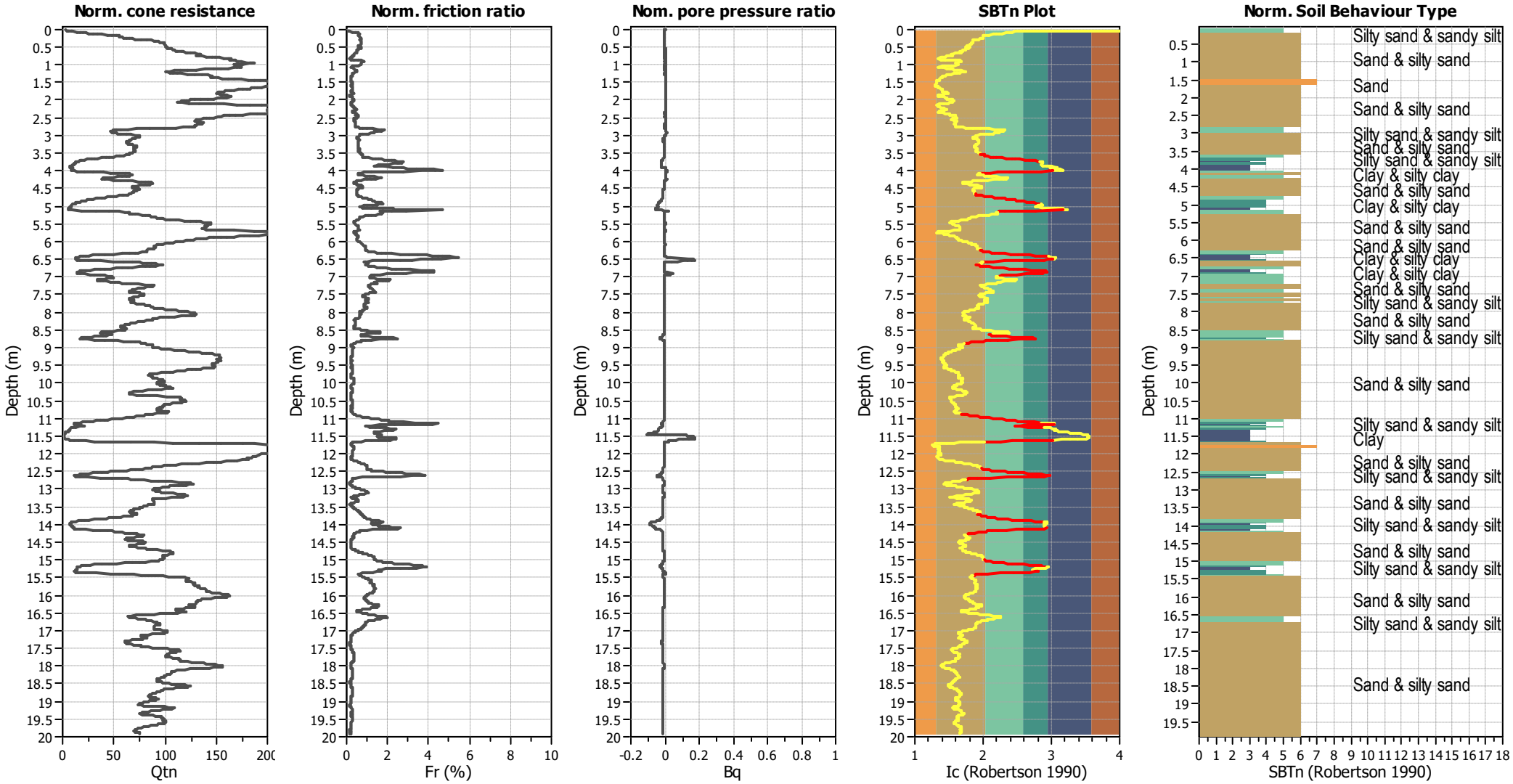
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



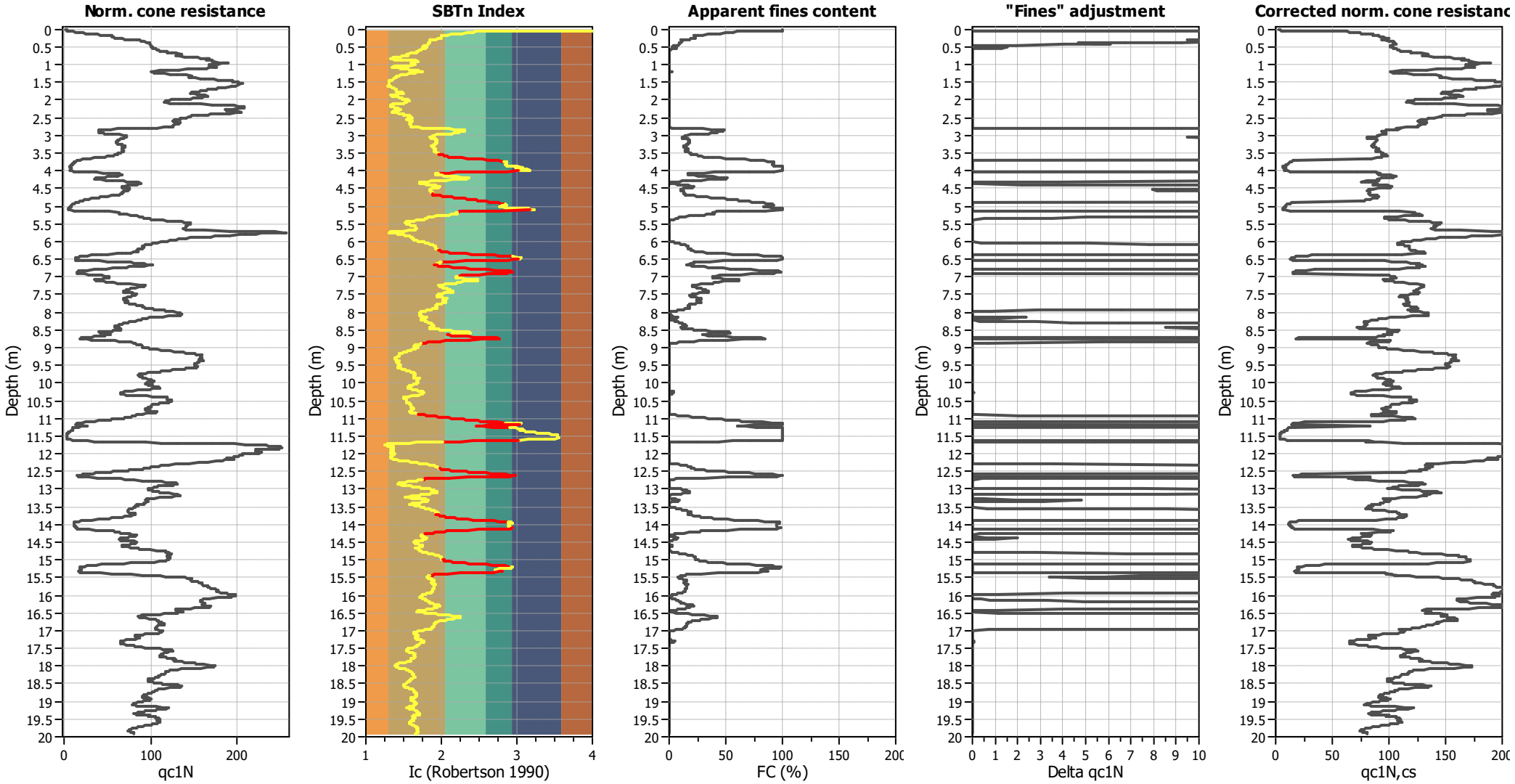
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

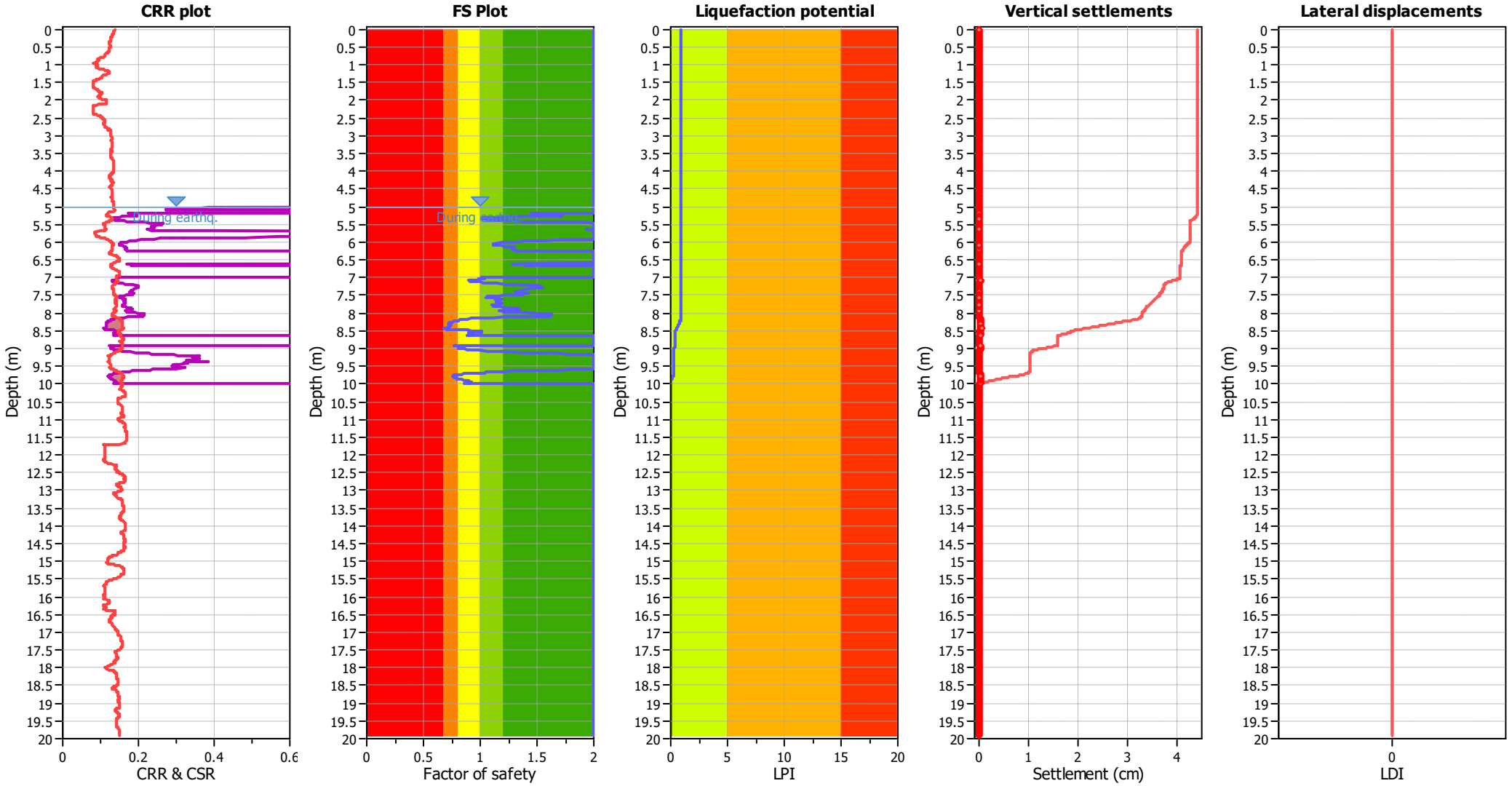
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

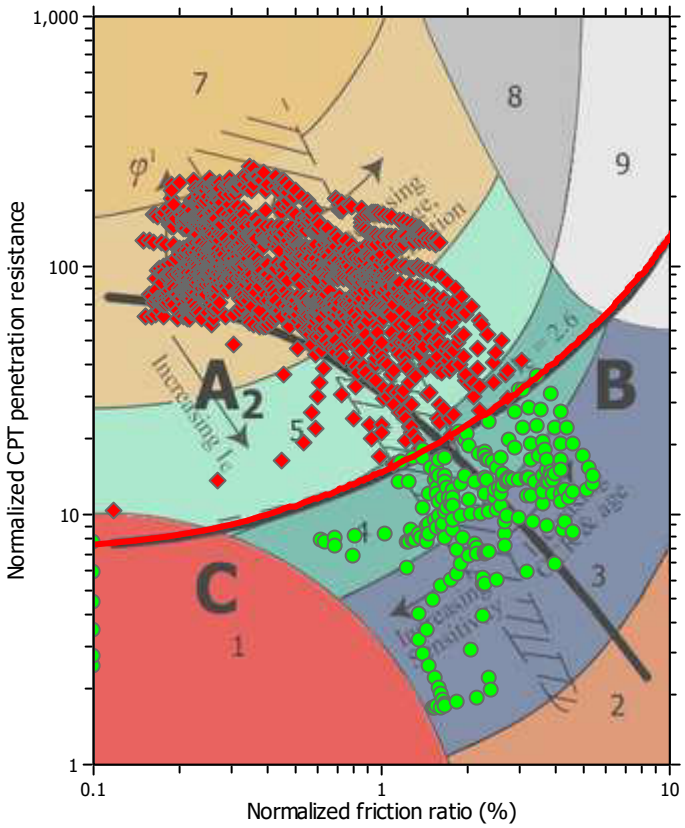
F.S. color scheme

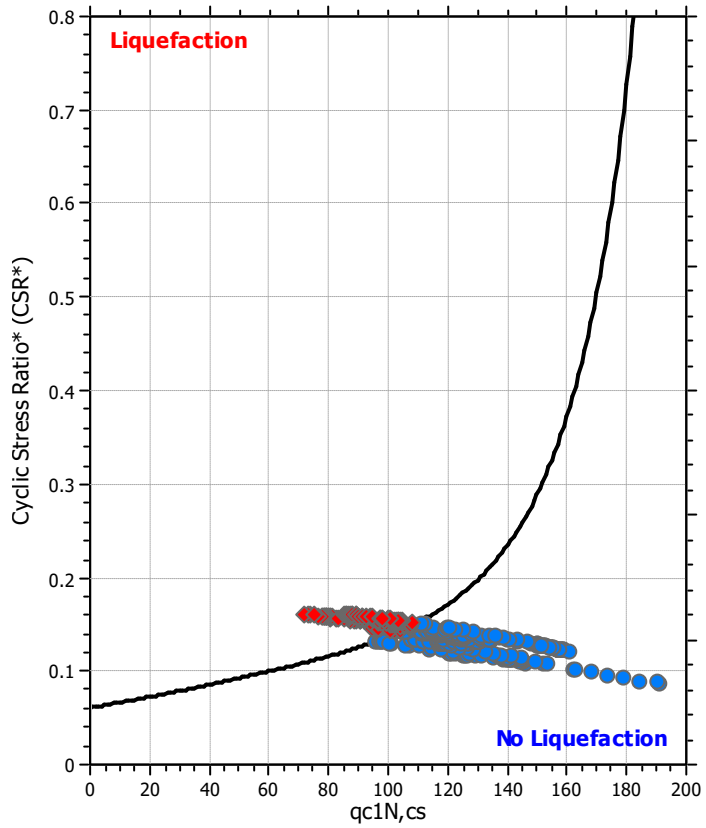
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

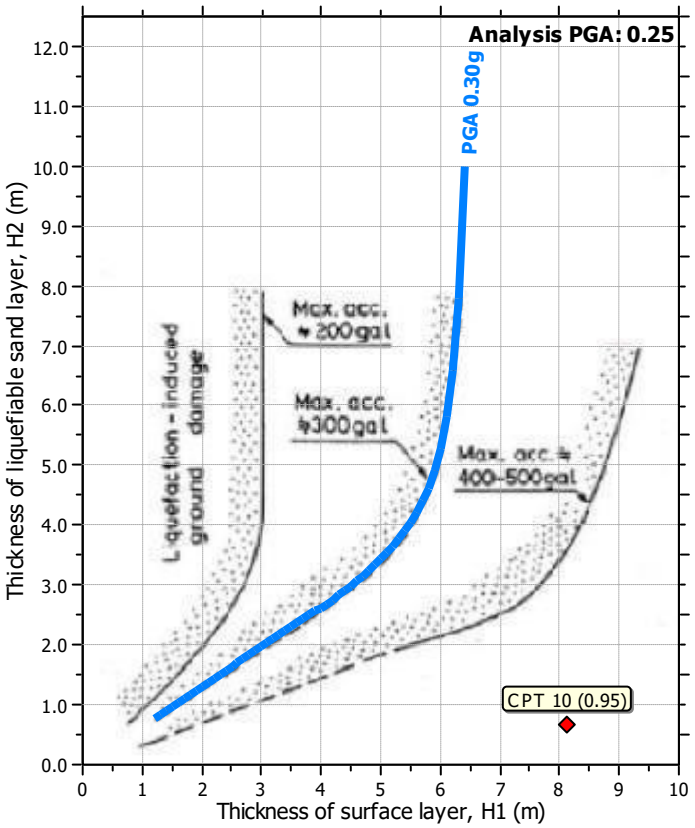
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



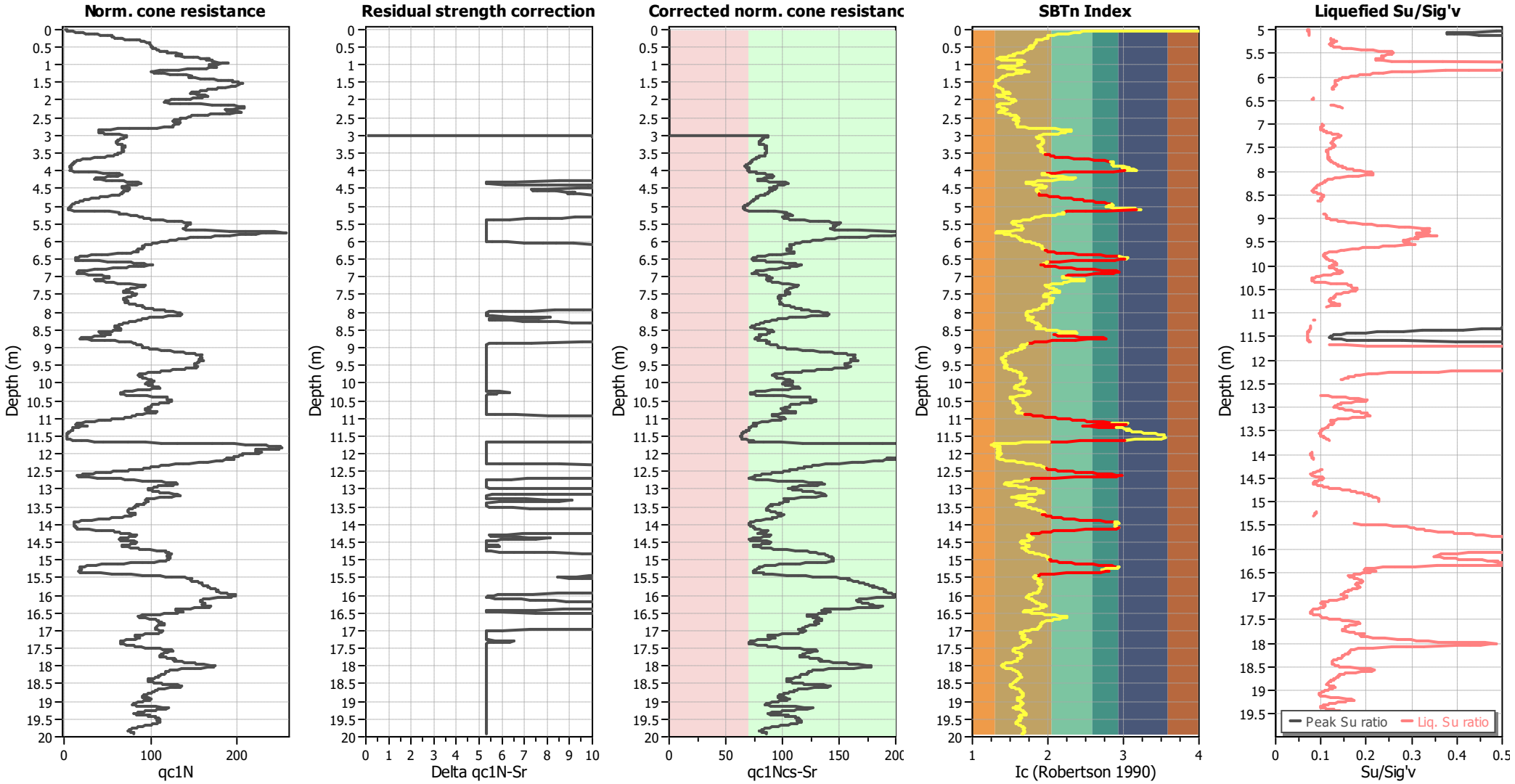




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

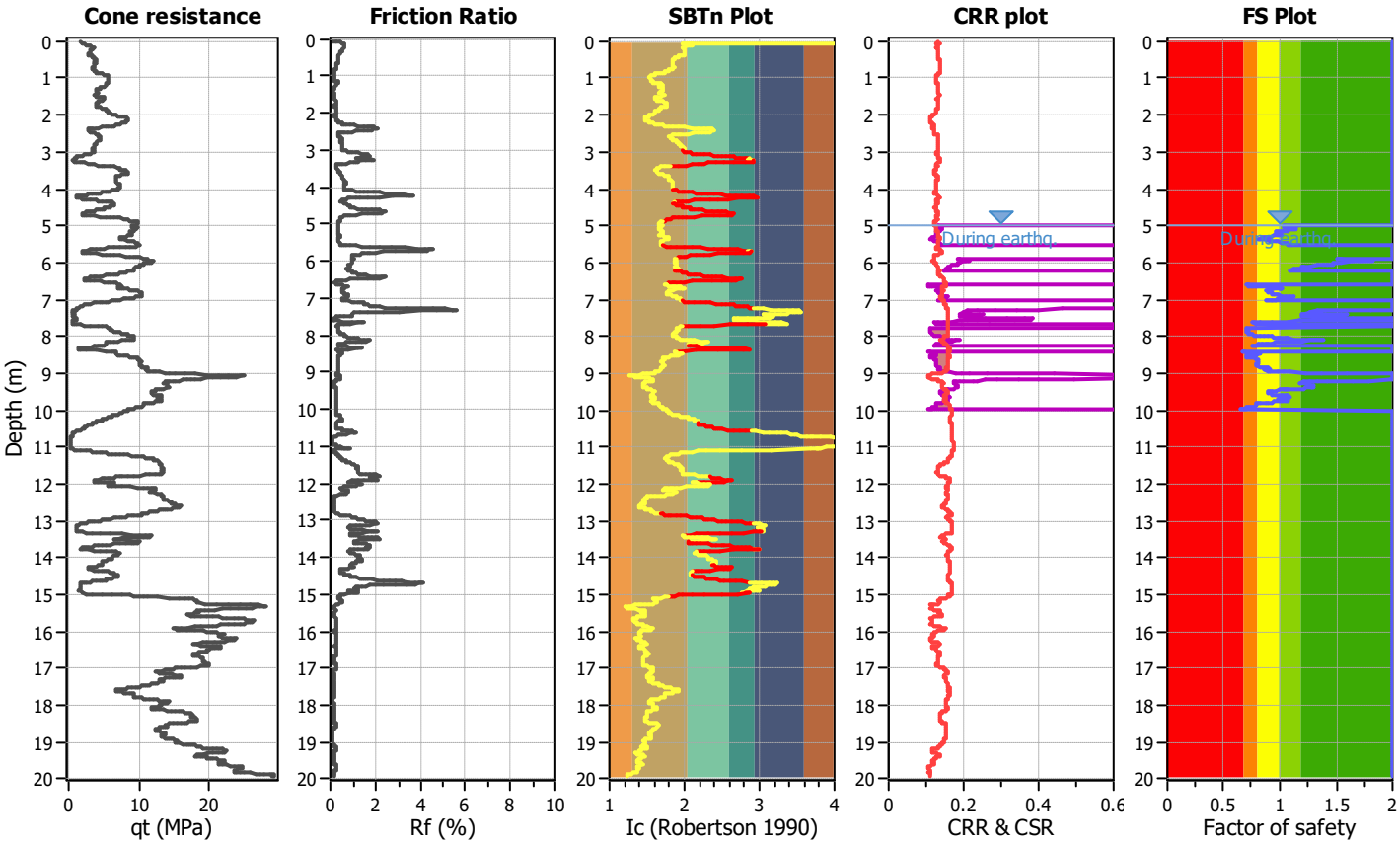
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517 Anglesea Street
Hamilton
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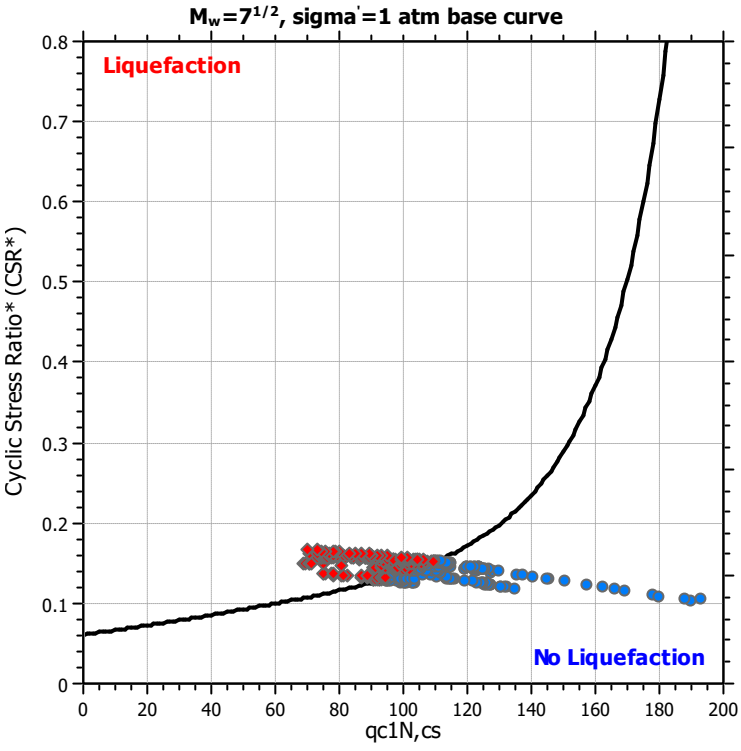
LIQUEFACTION ANALYSIS REPORT

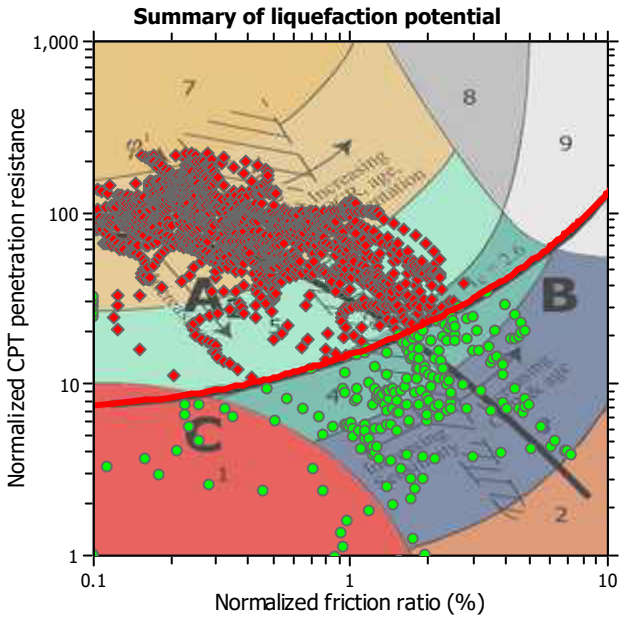
Project title : 3MS Geotechnical Suitability Investigation - **Location : Cambridge Road, Cambridge**
CPT file : CPT 11

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

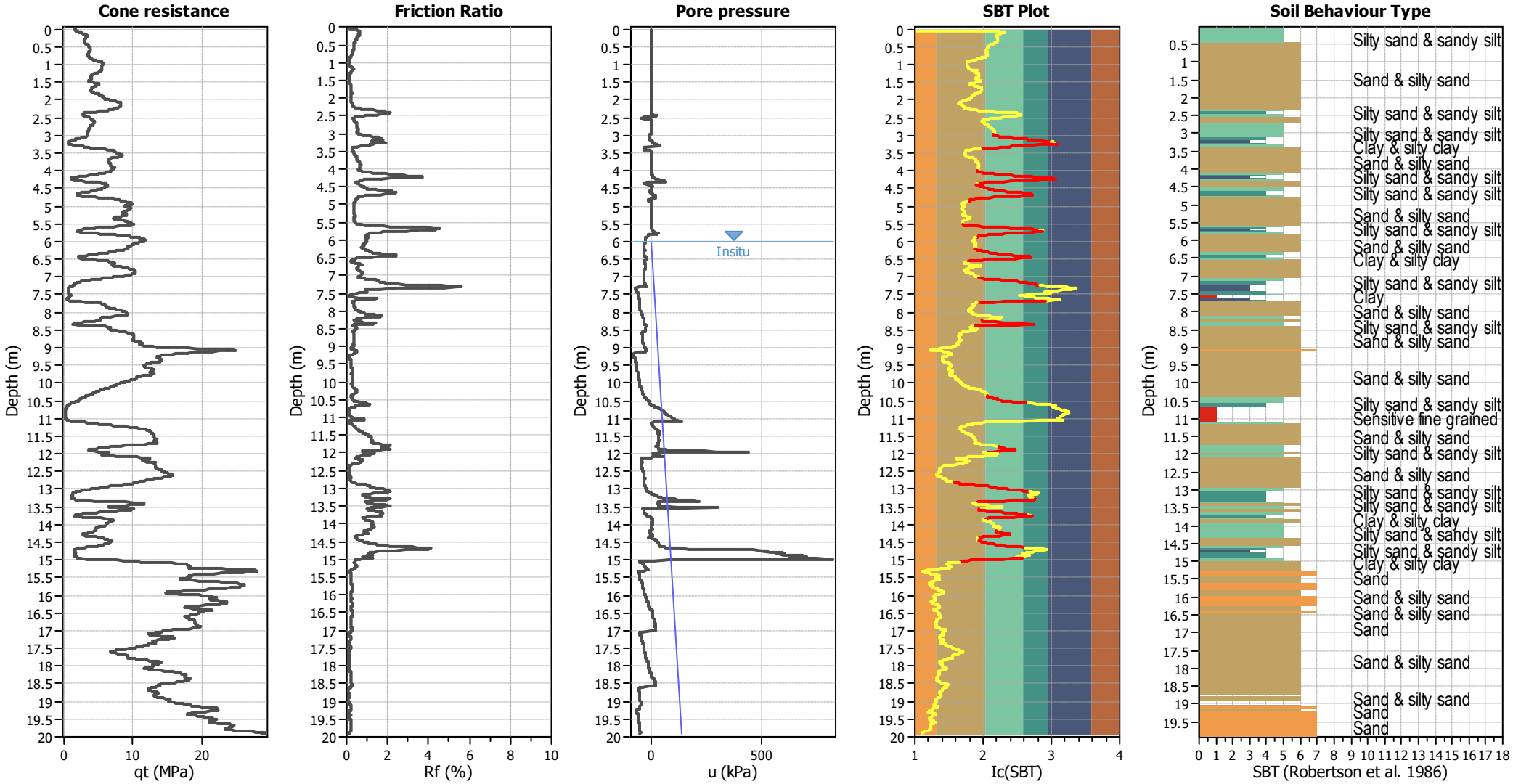






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



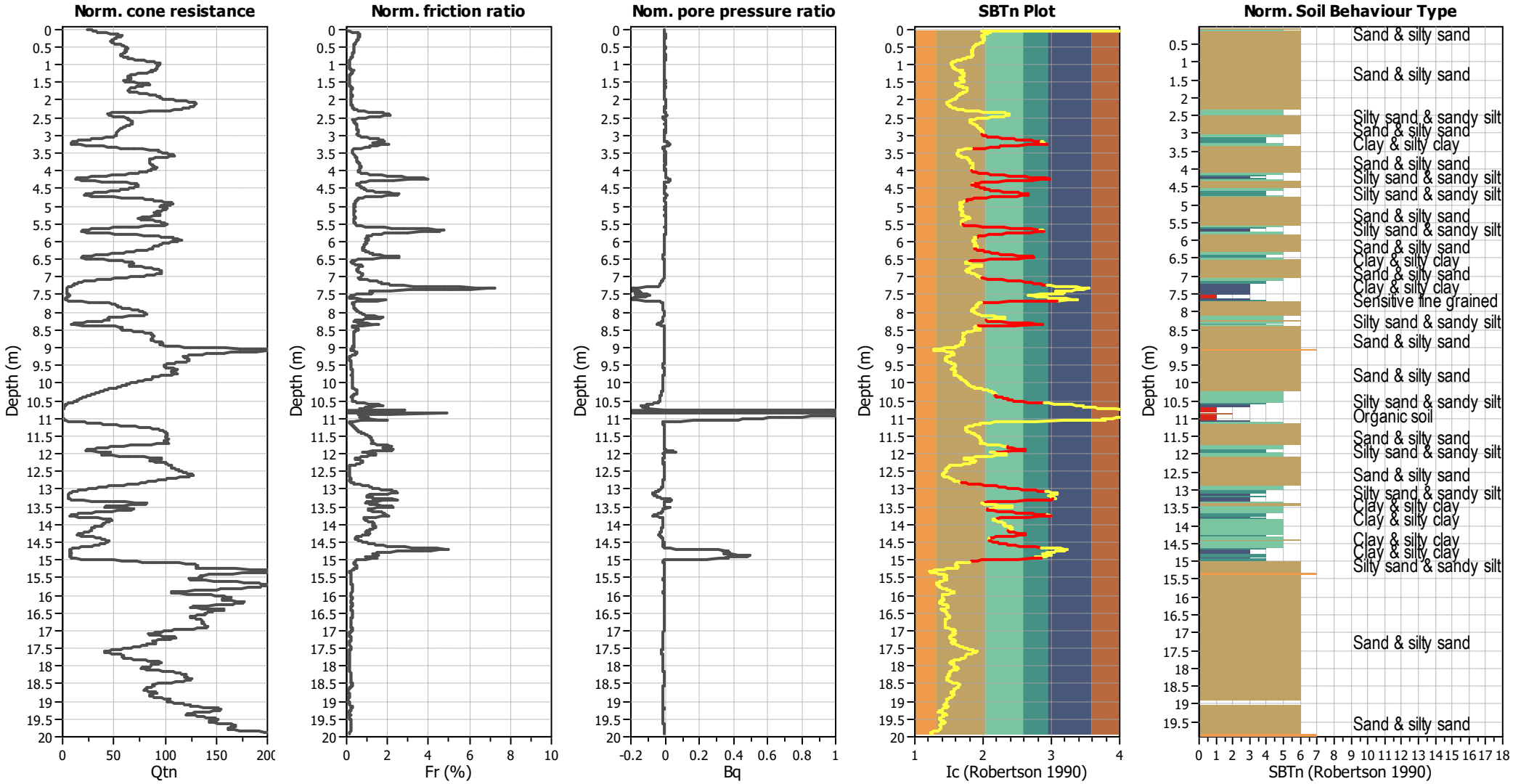
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



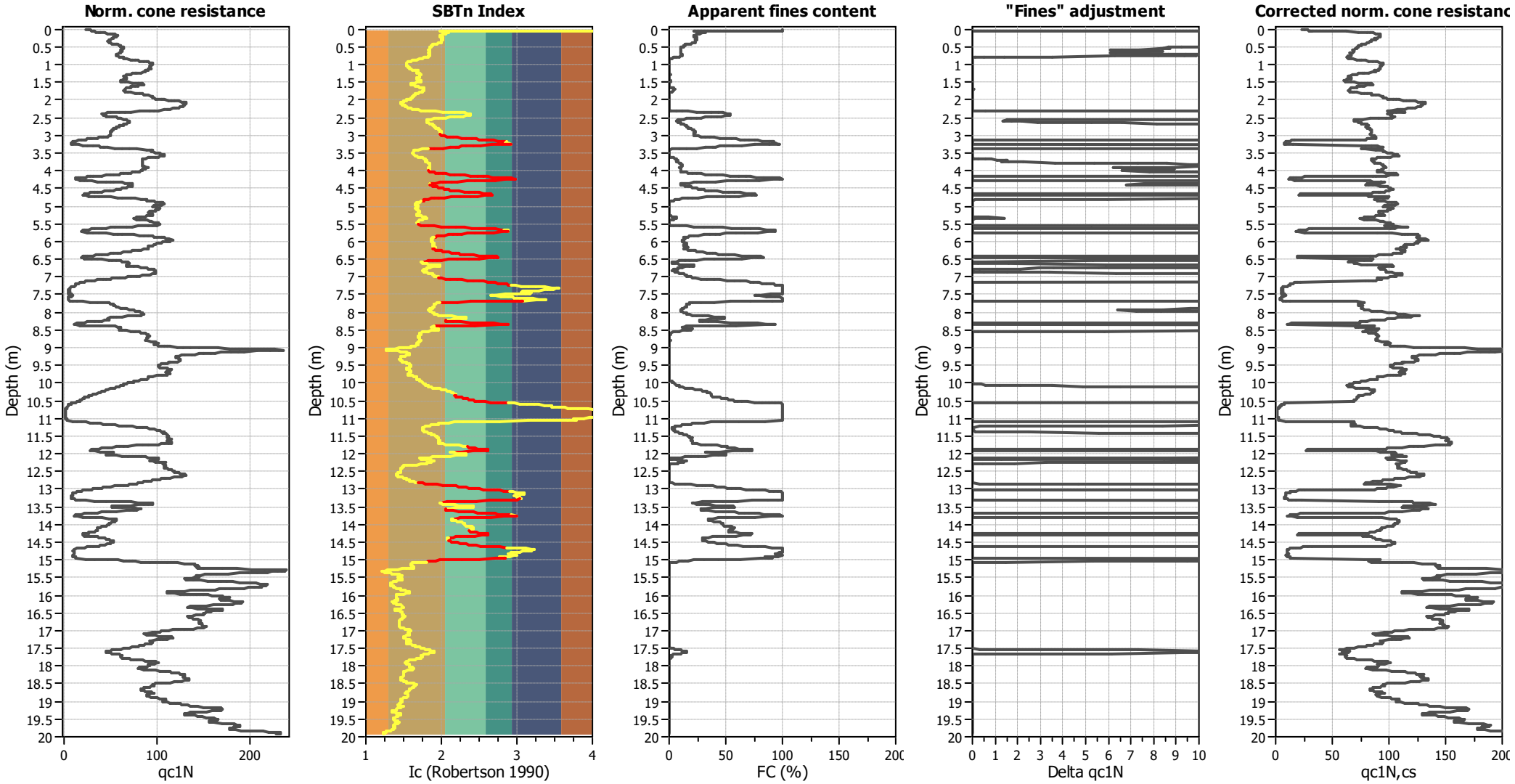
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

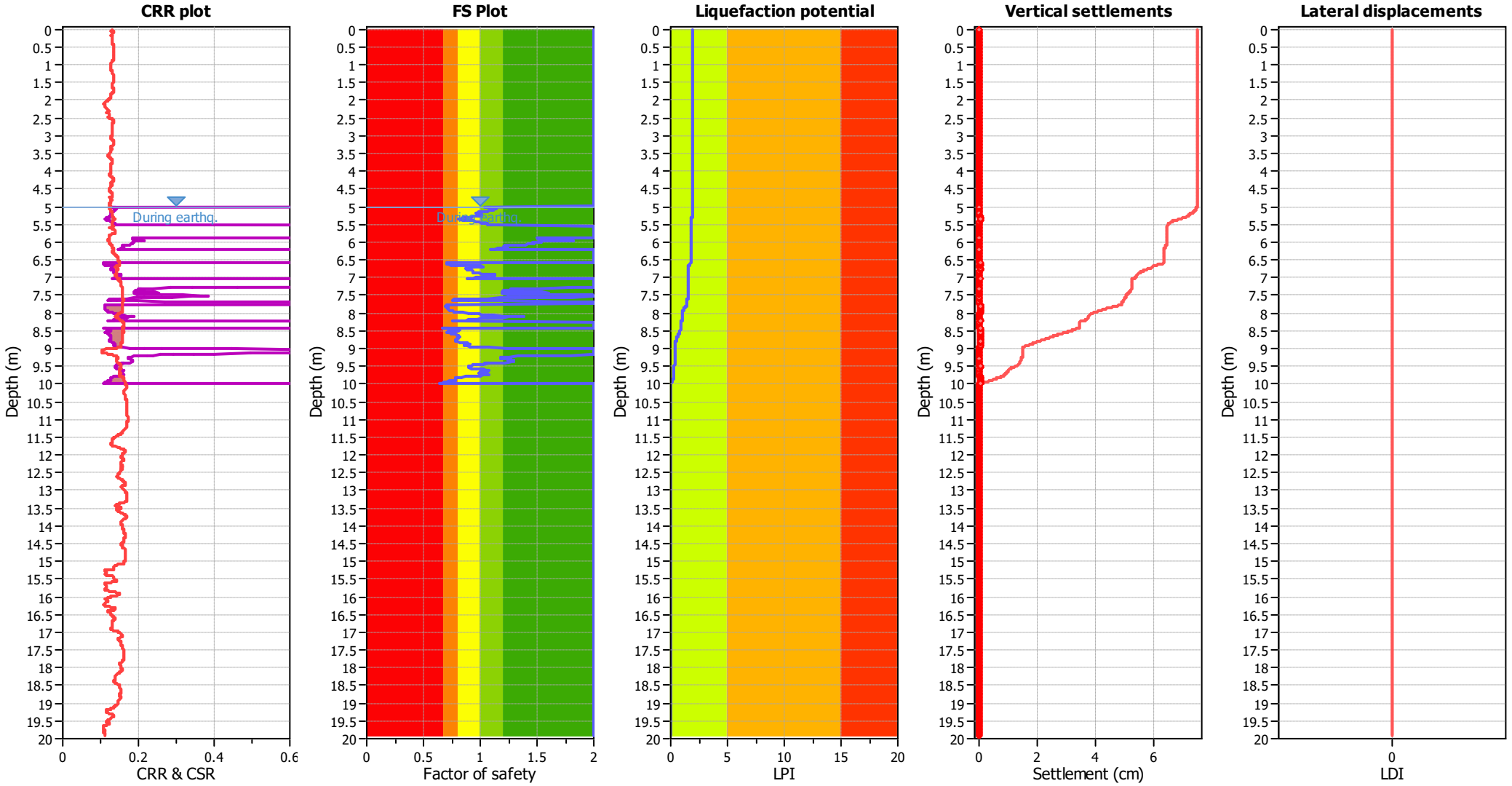
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

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Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

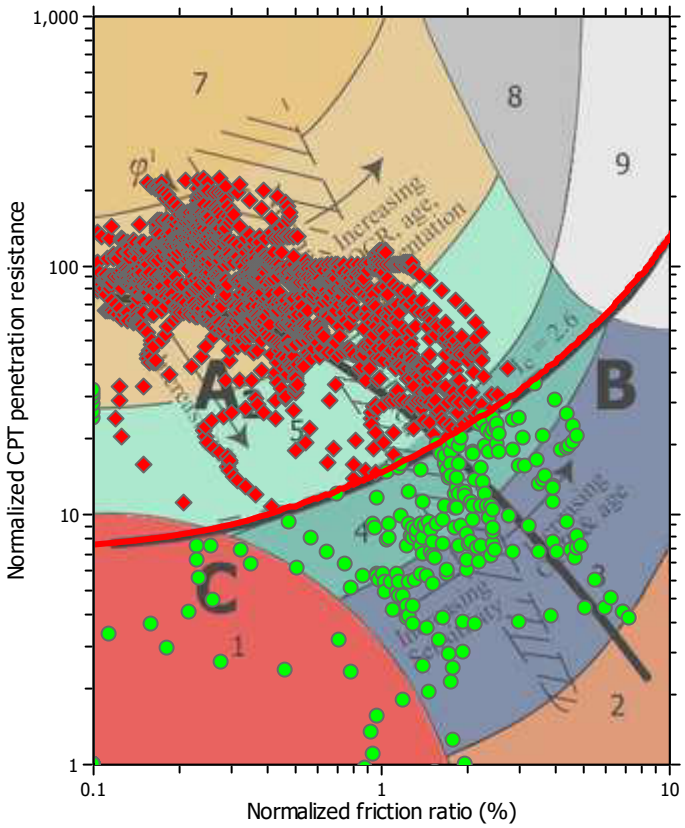
F.S. color scheme

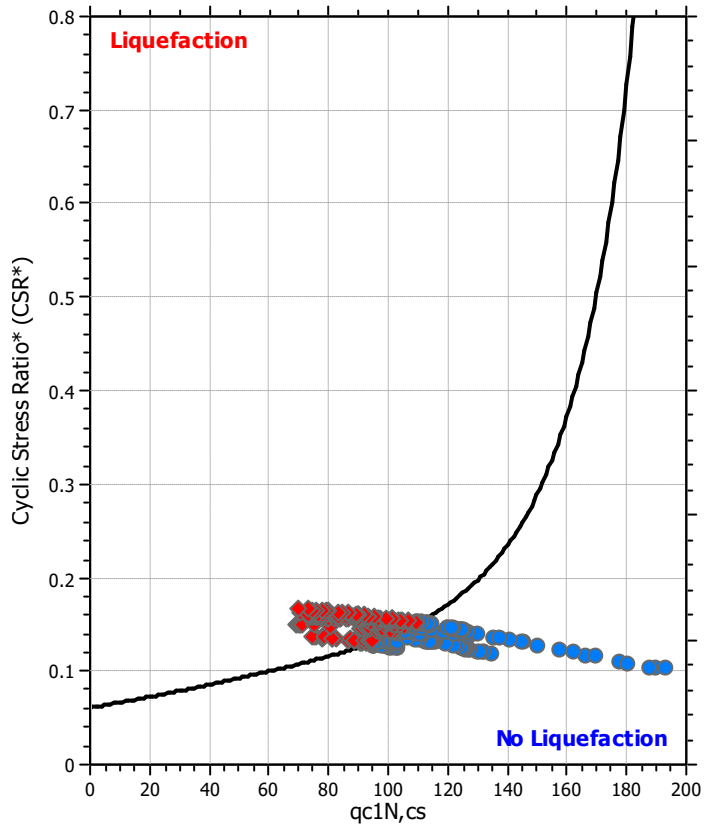
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

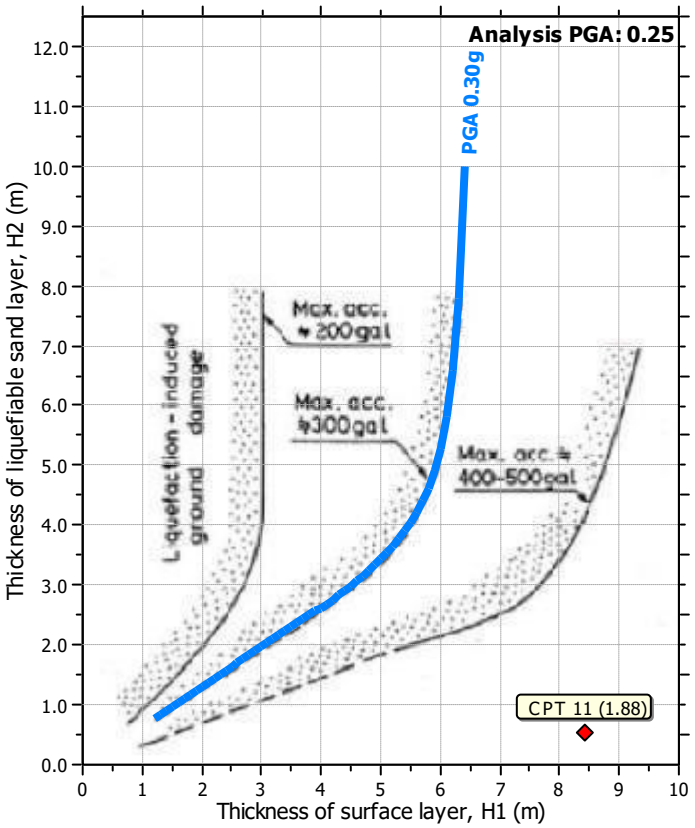
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



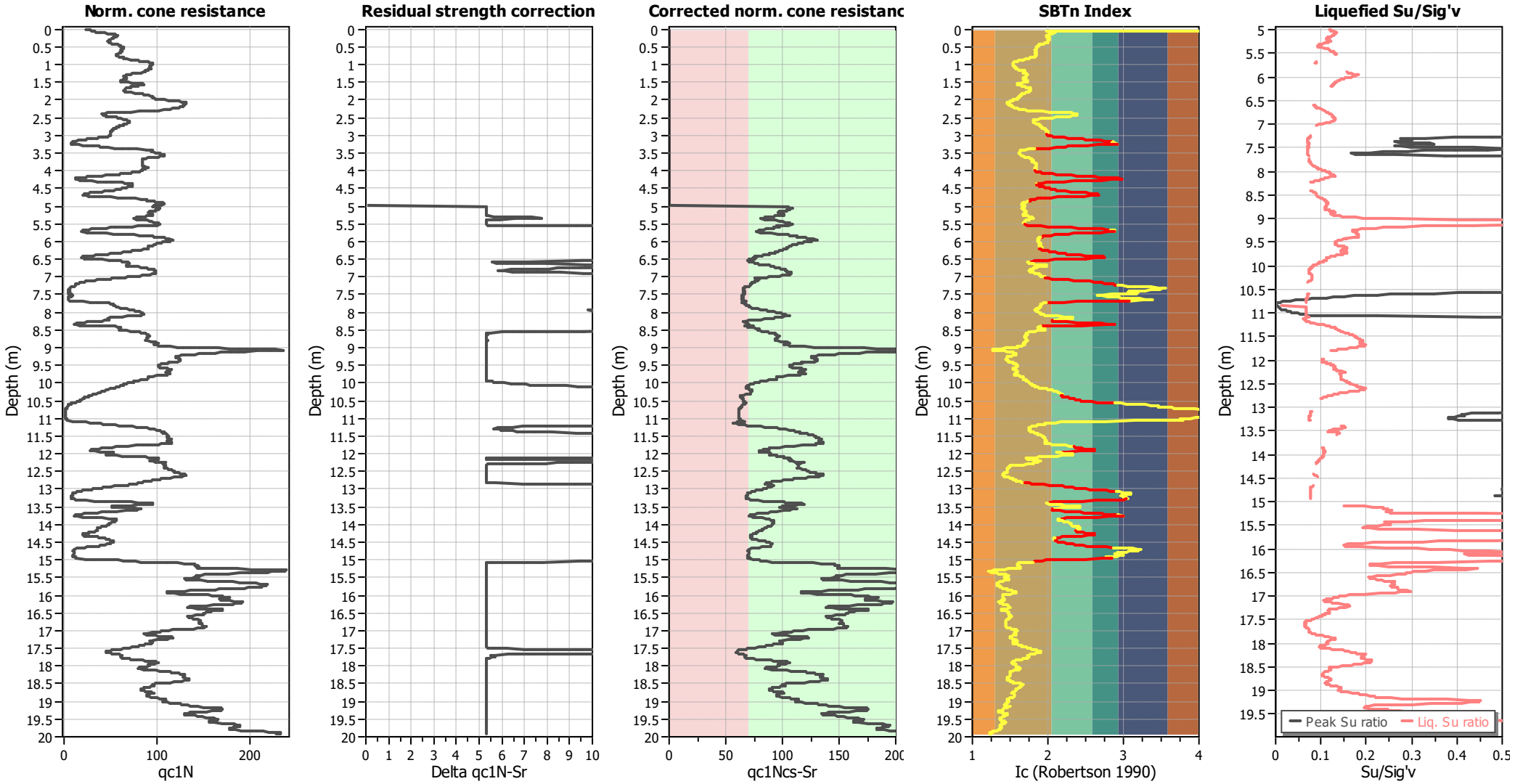




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

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

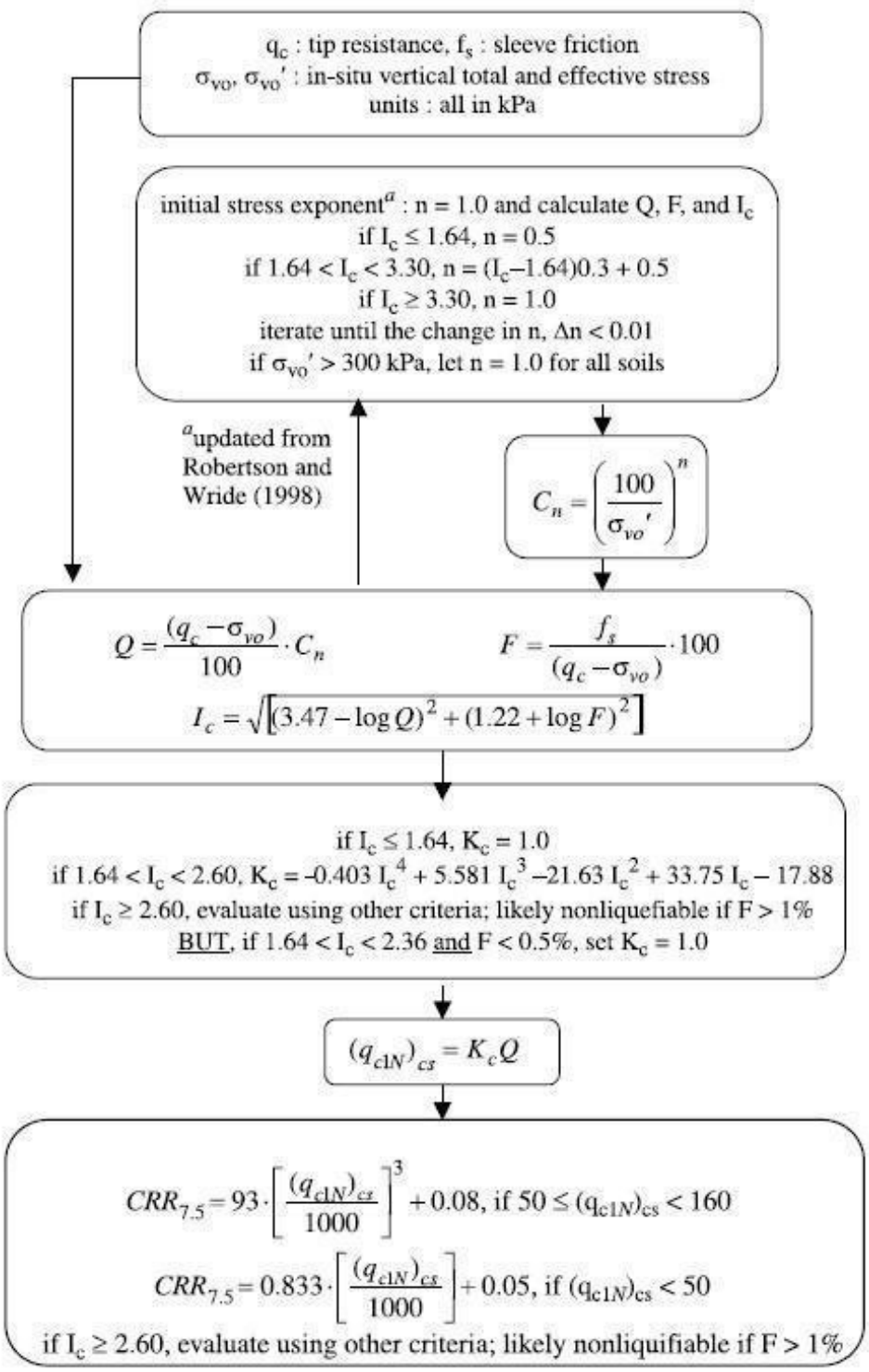


Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
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Earthquake magnitude M_w:	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.25	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	10.00 m

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

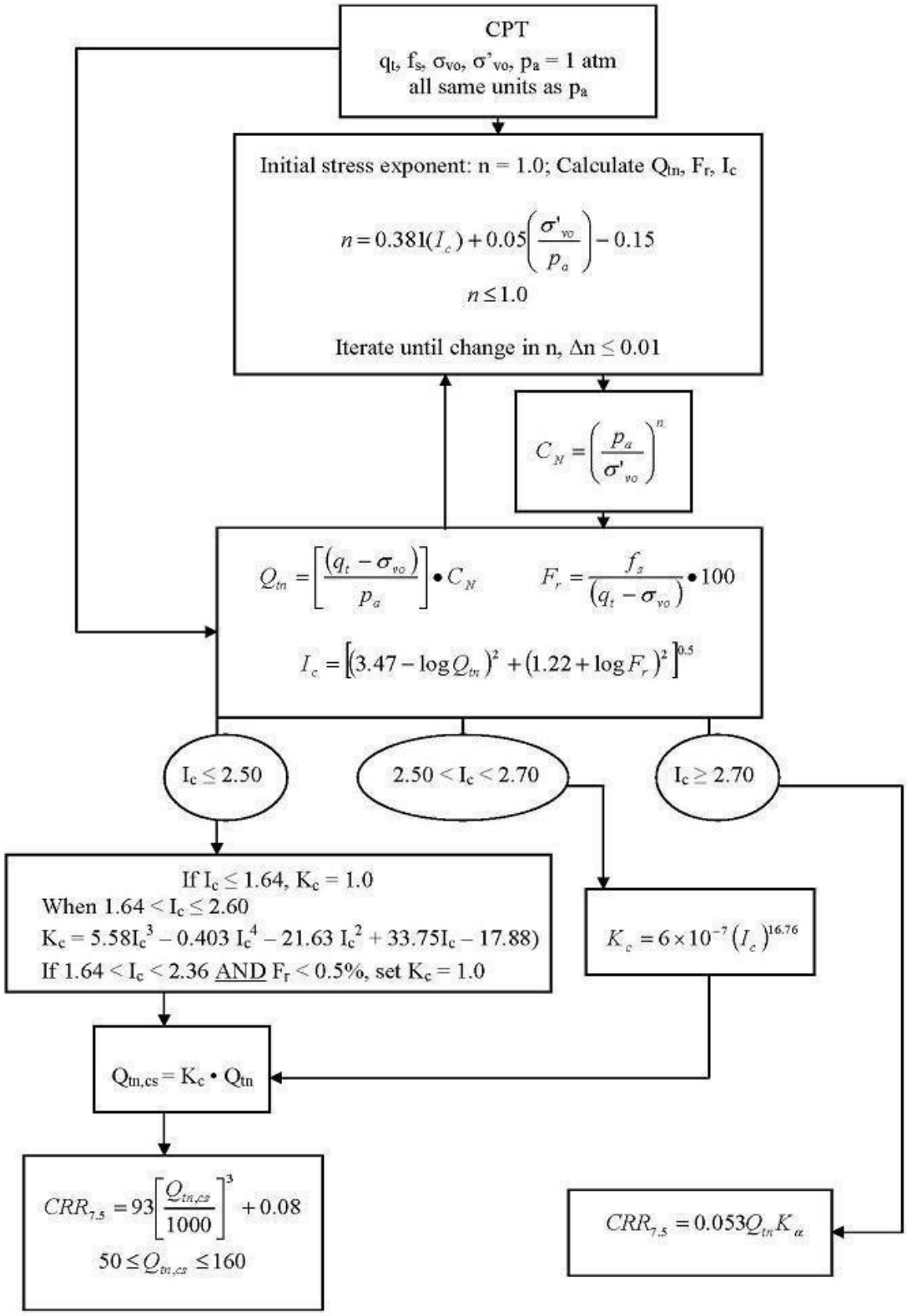
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

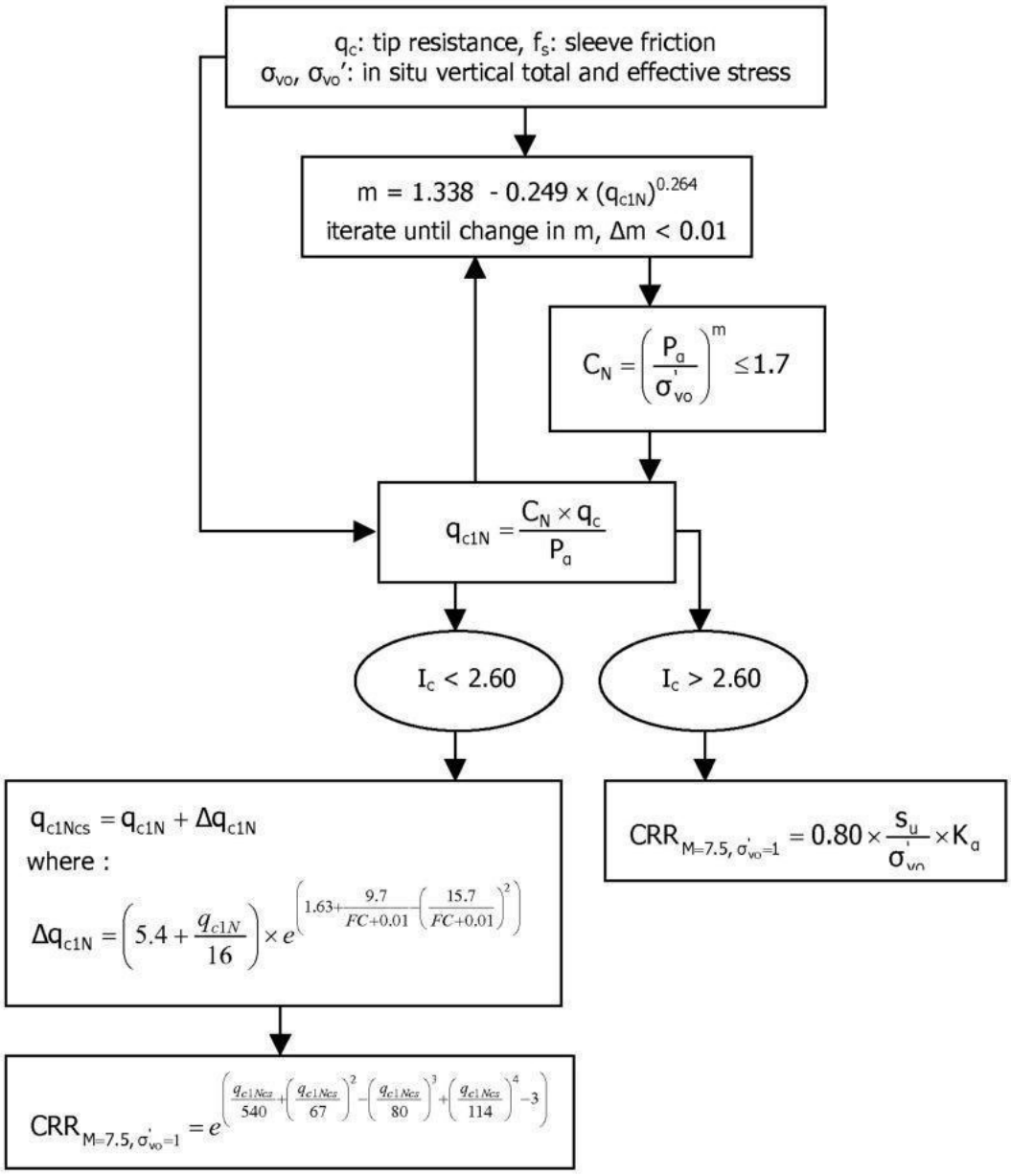
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

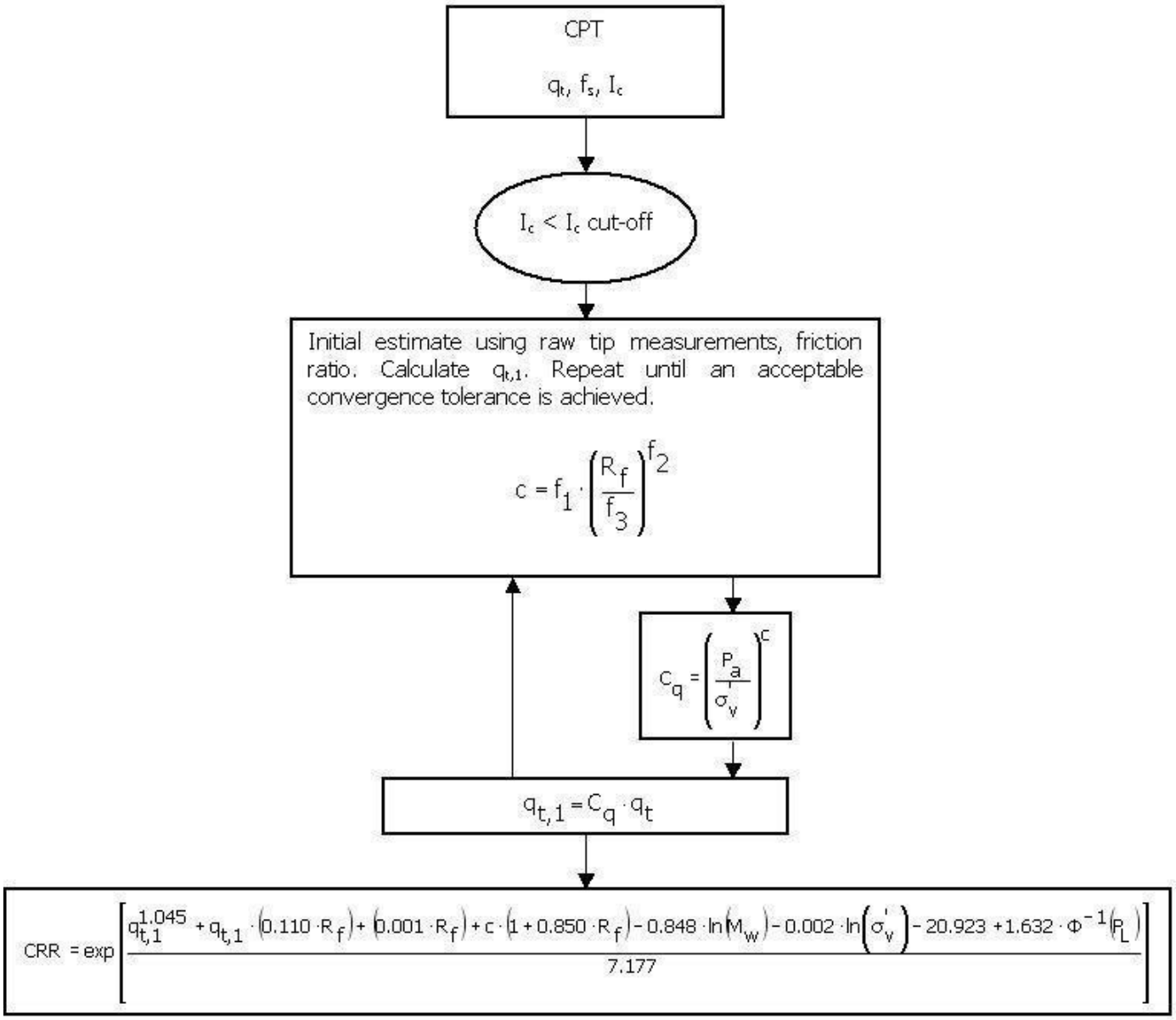


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

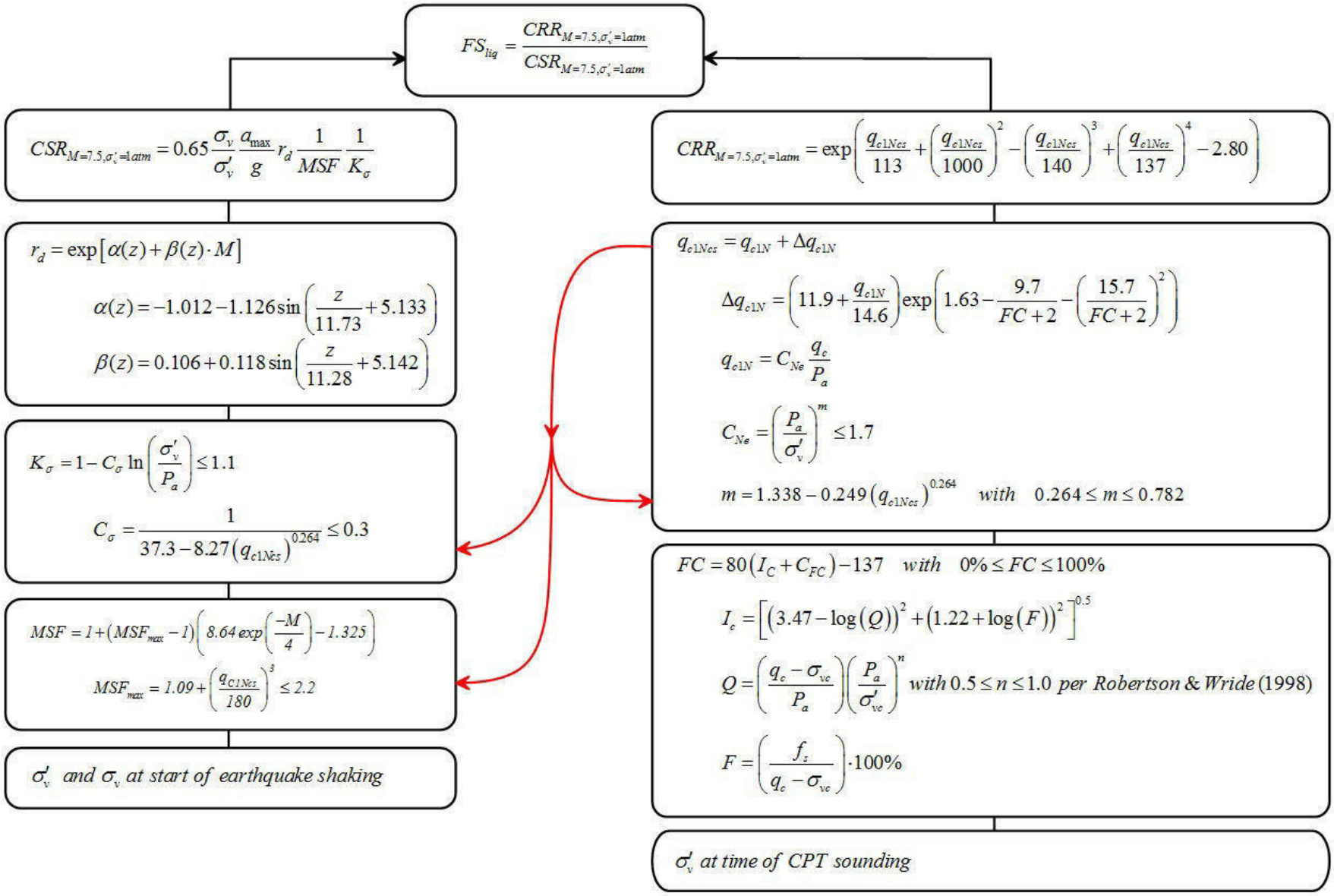
Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



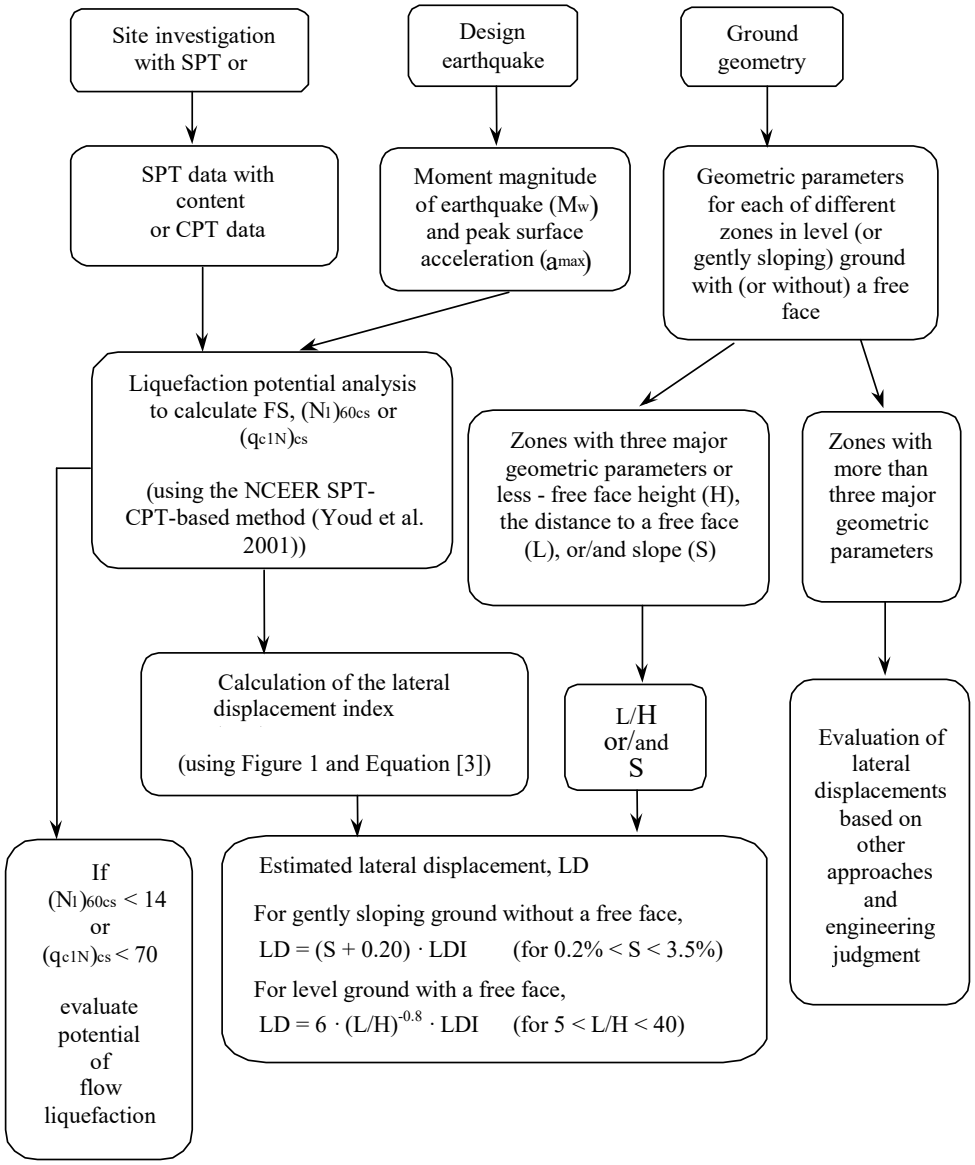
Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



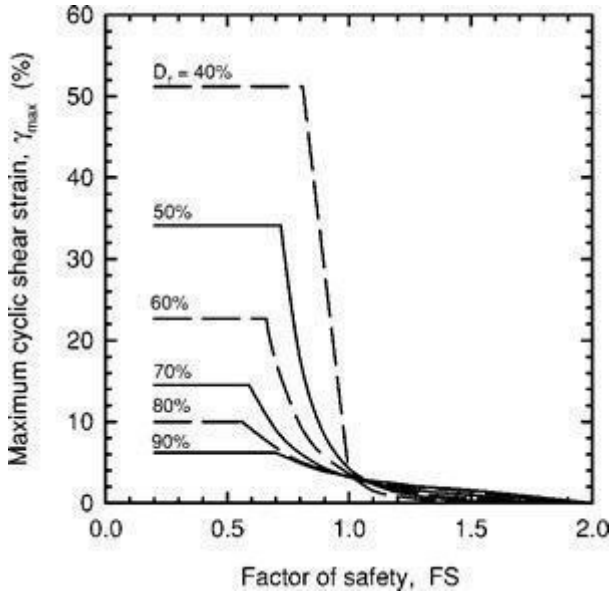
Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)



Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



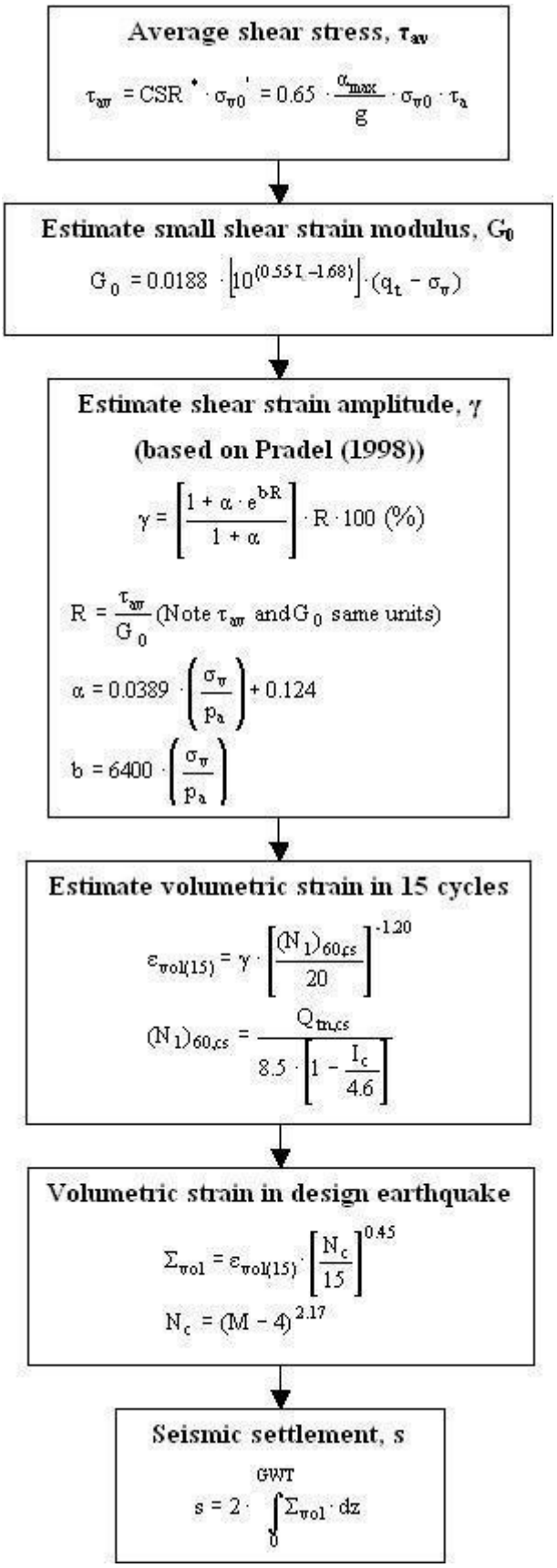
[1] Figure 1

$$LDI = \int_0^{z_{max}} \gamma_{max} dz$$

[1] Equation [3]

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

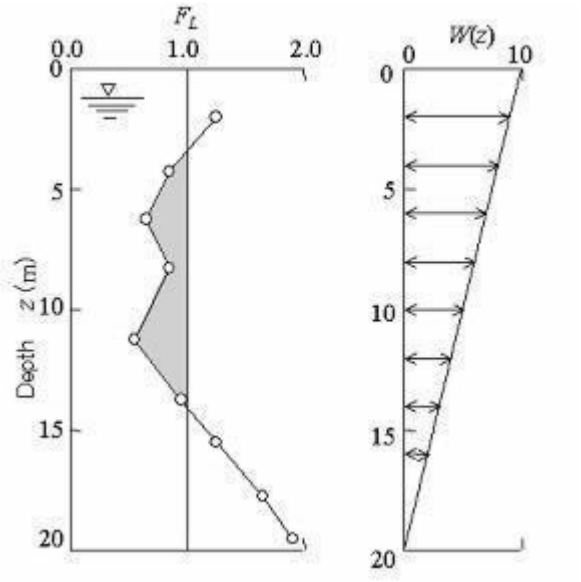
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\mathbf{LPI} = \int_0^{20} (10 - 0{,}5z) \times F_L \times dz$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) + 4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B + 0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

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APPENDIX C PRELIMINARY EARTHWORKS SPECIFICATIONS

It is understood that that bulk earth fill for the development will be sourced from the excavation of the stormwater ponds and placed on site where suitable.

The bulk of the fill is to be placed along the southern (Cambridge Road) end of the development and be used to infill the undulating paleo river channels. Fill is also to be placed along the western side of the development adjacent to intersection of Roads 14 and 15 and within the Central Testing Area (Northern) (infilling paleo channels). With minor filling elsewhere across the site. The depth of the fill is generally within the range of 1 to 2 metres deep as shown in Figure 6.1. Site contouring of up to 0.5 metres depth will be carried out across the development site as a hole on an as needed basis.

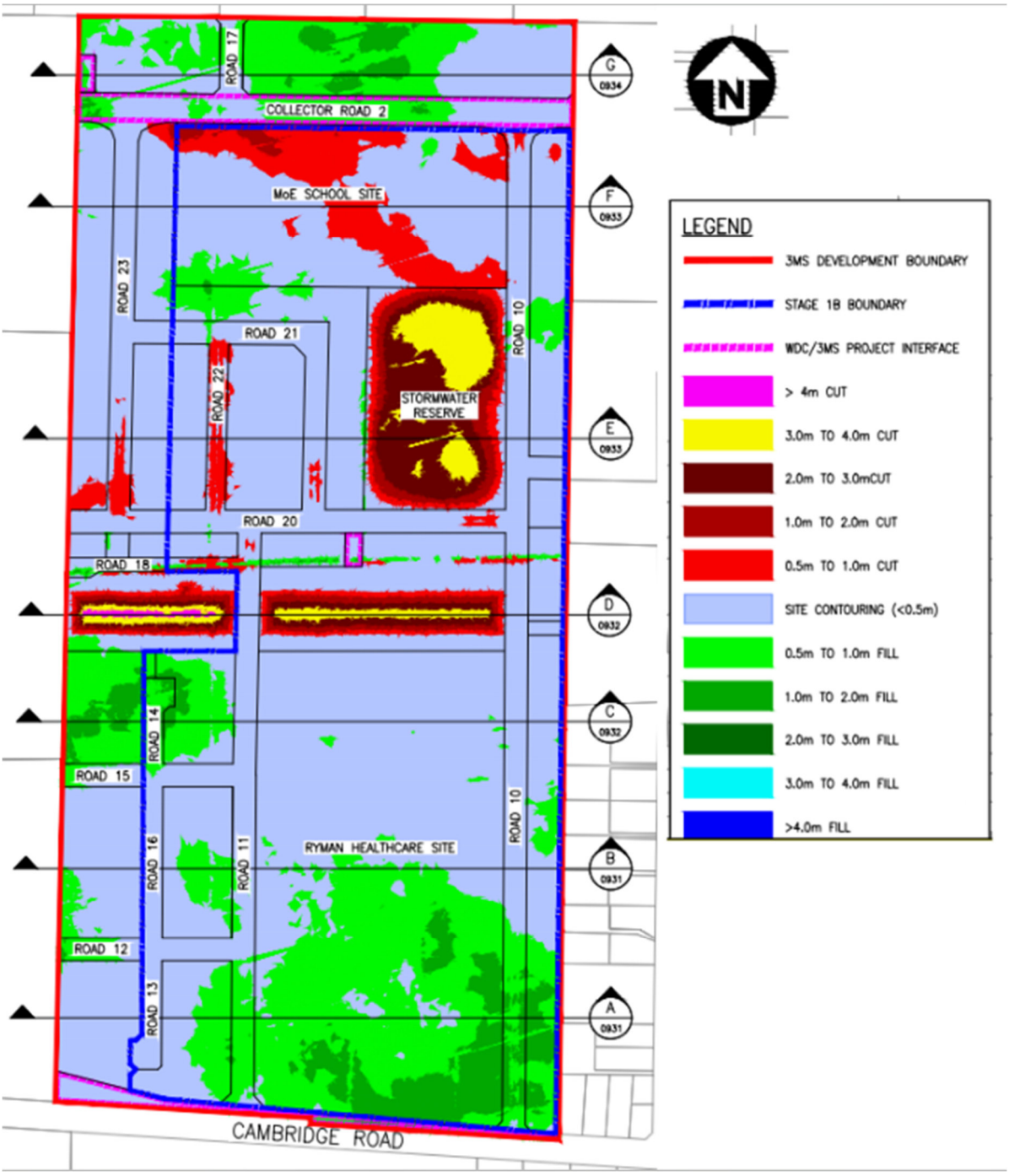


Figure 6.1: Proposed cut / fill areas within the proposed subdivision

C.1 Technical Specification

This part of the document is a technical specification for the earthworks at the site and does not replace any part of the earthworks contractual arrangement with the Client.

General guidance on placing and acceptance for using compacted fill at the site:

- Where the soils are excavated and are at normal field water content levels, these soils are expected to be able to be excavated from the swale and placed with no drying. Where the soils are excavated from areas with perched groundwater or a high silt content, these soils will need to be placed and dried back or mixed with dryer sands to achieve optimum water content prior to placement.
- Ensure good site drainage to prevent further saturation of the soil, including 'sealing off' the exposed areas by compaction. Typically, in the Waikato climate it is often difficult to dry soil by reducing the water content by more than 10 % without significant effort.
- A minimum undrained (dial reading) shear strength of between 60 to 70 kPa and Scala penetrometer probe results of minimum 5 blows per 100 mm (dependent on material being tested) is required to be used for any areas where 'Good Ground' is intended to be achieved.
    - Note as a rule of thumb the Scala penetrometer is to be used to test non cohesive soils (sands) while the shear vane will be used to test cohesive soils (silts).
- Where testing has shown that this is not the case in the existing soil, 'Good Ground' will not be achievable by the Contractor with un-modified soils. Any soft soils will indicate a weak soil layer, possibly due to excess water content. Any soil in excess of the testing values above prior to placement indicates that they may have dried beyond the plastic limit and will need to be addressed prior to compaction.

Survey set-out, survey and as-builts are proposed to be undertaken in conjunction with good construction practices.

C.2 Construction observation and schedule of engineer's inspections

Structural observation of construction will be carried out in accordance with IPENZ, Construction Monitoring Services (CM3).

C.2.1 CM3 inspections

- Review the extent agreed with the client, including random samples of important work procedures.
- For compliance with the requirements of the drawings and specifications.
- To review important completed work prior to enclosure or as appropriate.

Plus, any specific construction inspections as listed in Specific items below.

C.2.2 Specific items

Soil testing occurred onsite prior to the commencement of bulk earthworks.

Specific items of construction requiring engineering inspection, including but not limited to:

- After each 0.5 metres of earthworks lift or every 2,000 m^3 of placed fill.
- At final finished levels (only this level if less than 1 metre fill depth).
- Once the first 4,000 m^3 of fill has been placed.
- If wet or unsuitable soil is identified such as:
    - Peat and organic silt.
    - Heavily iron stained clayey silt.

Typically, the engineer or representative will visit the site every few days.

The Engineer or the Engineer's representative will require a minimum of 48 hours' notice before a required inspection. If the contractor does not adhere to the minimum inspection schedule outlined above or in accordance with (CM3), then the Engineer can request work to be redone to the required standards at the cost to the contractor.

C.3 Machine Compaction Recommendations

Fill shall be placed and compacted in layers 200 to 300 mm thick (loose) and compacted with 6 to 8 passes of the compaction machinery. Actual layer thickness and number of passes will depend on the material and size of the compaction machinery. Based on the proposed site-won fill material, the project geotechnical engineer recommends a minimum 10 tonne vibratory roller for sand and a sheep foot roller for silt.

Weaving or pumping of the soils or subgrade during compaction can be due to either; the water content is excessive, or the material has been over-compacted. Where weaving or pumping occurs, the material will likely require replacement, alternatively the project geotechnical engineer can be consulted for alternative options.

C.4 Erosion Control and temporary drainage

All works shall be undertaken with appropriate sediment and erosion control measures to minimise any sediment leaving the immediate area of the earthworks. The measures shall include silt fences, established entranceways and cut off drains as necessary.

Refer to the Waikato Regional Council's 'Erosion and sediment control guidelines' which can be found at their website http://www.waikatoregion.govt.nz/Environment/Natural-resources/Land-and-soil/Erosion/Earthworks-Erosion-and-Sediment-Control/Erosion-and-sediment-control-guidelines/ (Noting that parts of the hardcopy guideline are now superseded, hence the webpage reference).

During the construction period, measures shall be taken to prevent excessive waterlogging of surface materials yet to be excavated or compacted or both, and to prevent fill material from being eroded and re-deposited at lower levels. Such measures should include:

- The surfaces of the fill and cuts should be graded to prevent ponding.
- Temporary drains should be constructed at the toe of steep slopes to intercept surface run-off and to lead drainage water away to a stable watercourse or pipe stormwater system.
- Surface water should be prevented from discharging over batter faces by drains formed to intercept surface run-off and discharge via stable channels or pipes, preferably into stable watercourses or piped stormwater systems.
- The upper surface of fills are to be sealed off, such as by compaction with rubber tyred or smooth wheeled plant whenever rain is pending, or when the site is to be left unattended.
- The completed battered surfaces of fills should be compacted with appropriate plant which may include sheepsfoot roller or similar non-smooth compaction plant to reduce run-off velocities.
- Silt traps and retention ponds shall be constructed wherever they are necessary. These shall be cleaned out, as required, to ensure that adequate silt storage is maintained.
- Temporary barriers or fences choked with brush, sacking or the like, shall be used to reduce flow velocities and to trap silt.

- Sections of natural ground shall be left unstripped to act as grass (or other vegetation) filters for run-off from adjacent areas.
- All earthwork areas shall be re-topsoiled (and grassed, hydroseeded or other planting in reference to the project landscaping design) as soon as possible after completion of the earthworks and drainage works.

C.5 Requirements, TESTING & EXAMINATION of MATERIALS

All structural fill shall be compacted in layers of no more than 200 mm and compacted to achieve a minimum of 95% of Maximum Dry Density (MDD). The minimum testing frequency and the required tests are as follows.

C.6 Shear vane Testing

Shear vanes shall conform with the New Zealand Geological Society 'Guideline for handheld shear vane test' 2001.

Shear vane testing shall conform with the Test Method for Determining the Shear Vane Strength of a cohesive soil using a Handheld shear vane, NZGS 2001. (Appendix A of the 'Guideline for handheld shear vane test')

The test shall be completed for each (maximum) 0.5 metre depth of fill.

Placed soil must test to the strength specified by the Geotechnical Engineer to the project to satisfy 'Good Ground' definition as per NZS 3604 or as directed by the geotechnical engineer if engineer designed foundations are to be utilised.

Testing shall be undertaken by the Geotechnical Engineer to the project to determine the bearing capacity of the finished subgrade, who will carry out tests in a representative pattern over the prepared surface.

C.7 Scala Penetrometer Testing

Scala Penetrometer testing may be used to validate the suitability of placed infill in roadways (where suitable), trench back fill and in residential and commercial lots.

The test will be completed for each 0.5 metre of fill or has determined between the engineer and contractor.

Placed soil must test to the strength specified by the Geotechnical Engineer to the project to satisfy 'Good Ground' definition as per NZS 3604 or as directed by the geotechnical engineer if engineer designed foundations are to be utilised.

C.8 Site Clearing and Topsoil

The Contractor shall clear all vegetation to dump off site at an approved landfill area. All areas of pasture within the construction area shall be stripped removing the grass turf layer to stockpile to be re-spread and compacted over any earthworks areas with any surplus material cut to waste and removed from site

The Contractor shall strip the topsoil layer and stockpile the material at the designated topsoil stockpile area to be re-spread for reinstatement at the conclusion of the earthworks process.

Prior to the placement of any fill the stripped area shall be inspected by the Engineer or the Engineer's representative and any remaining topsoil or unsuitable soil removed as directed.

C.9 Cut to Fill

The Contractor shall complete all structural earth fills to the profiles and levels shown on the design drawings.

Batters shall be cut / filled and compacted to the profile slopes given on the typical cross-sections and where adjoining the existing ground profile, blended to achieve an aesthetically pleasing transition.

C.10 Subgrade Preparation and Finishing

The Contractor shall complete all works to the profiles and levels shown on the drawings.

Fill and cut Subgrades shall be constructed in accordance with TNZ F/01:1997 with the entire surface of the Subgrade made firm, uniform and smooth by blading and rolling. The surface of the Subgrade shall be finished so that all points are within ±15 mm as measured along the length of a three (3) metre straight edge, when laid parallel to the centreline of the road and from a cross-section camber board placed at right angles to the centreline.

Upon completion of the Subgrade preparation phase, the Contractor shall request confirmation from the Engineer to continue with the placement of topsoil and other works such as retaining.

C.10.1 Expected CBR value (roads within Western Testing Area)

It is expected based on the soil results in this report and on those from previous BTW testing within the proposed subdivision that a CBR value of 4 (approximately 3 blows per 100 mm) will be appropriate for the internal roads. The undercut depth is expected to range from 0.5 to 1.0 metres below existing ground level.

C.11 Undercut of Unsuitable Material

Any areas of Subgrade that appear to be structurally weak or fail to achieve a CBR value of at least 4, obtained by Scala penetrometer testing (approximately 3 blows / 100 mm), will need to have the pavement design adjusted.

It shall be the decision of the Engineer to determine pavement treatment, such as the depth and area that shall or shall not be undercut and backfilled with an approved granular hardfill material. All excavated unsuitable material shall be cut to waste.

Earthworks for cutting and filling are as follows:

- Topsoil and vegetation including loose and soft soils and organic materials should be stripped and cleared from the areas affected.
- Generally, in-situ materials with minimal drying can be used for filling subject to passing the compaction specification as stipulated in NZS 4431, Earth fill for Residential Development. Sensitive fine grained soils (soft clays and silts), soils with plasticity index greater than 10%, usually found on the low lying areas of the site should not be used for filling. Materials used for filling should be certified by the Geotechnical Engineer on site.
- All benching of slopes should be done to ensure that the filling is keyed into the underlying natural ground. The width of the benches is estimated to be approximately the same as the

width of the bulldozer with a reverse gradient back into the slope. Depth of the benches should be determined by the Geotechnical Engineer on site.

C.12 Earthworks Completion

C.12.1 Post-fill Survey

Following the completion of engineered filling the contractor shall arrange for the development surveyor to survey the final surface of the engineered fill, prior to placement of topsoil.

C.12.2 Top soiling and Grassing

All top soiling and grassing shall be undertaken in accordance with RITS Section 2.2.4.6. The topsoil thickness shall be 150 to 300 mm (consolidated) thick.

Unless otherwise instructed, the contractor shall use the stockpiled material removed during site preparation. Should there be a shortage of stockpiled materials, the contractor shall obtain the approval of the engineer for the importation of topsoil from sources external to the site. All topsoil, both stockpiled and imported, must be clean friable soil, screened so as to be free from any gravel, stones or excessive amounts of sand, and shall be capable of supporting the vegetation specified.

Topsoil shall be spread over all areas to be revegetated to a minimum consolidation thickness of 150 mm and a maximum consolidation thickness of 300 mm. Spreading shall not be done when the ground or the topsoil is excessively wet or otherwise in a condition detrimental to the work.

The seed and fertiliser shall be uniformly distributed and harrowed into the topsoil to a depth of 15 to 20 mm, leaving a smooth, evenly graded, open textured surface which will not hold water. The contractor shall not compact the topsoiled surface.

The contractor shall maintain, dress and re-sow as necessary, the topsoiled and revegetated surfaces until all surfaces are completely covered with a good strike of revegetation and free from furrows or potholes. The contractor shall also cut the grass by suitable mowing methods until the end of the contract maintenance period.

As a minimum the grass mix shall be no less than:

- 17 Kg / ha perennial rye grass (Yatsyn or Ellet)
- 4 Kg / ha Kopu or Aran white clover
- 4Kg / ha Pawera Red clover

Final Survey

Following the completion of topsoiling the contractor shall arrange for the development surveyor to survey the final surface after placement of topsoil.