Christchurch City Council

Land Information Memorandum

Property address:

1/32 Ryan Street

LIM number: H01330693

Christchurch City Council

53 Hereford Street, PO Box 73015
Christchurch 8154, New Zealand
Tel 64 3 941 8999
Fax 64 3 941 8984

www.ccc.govt.nz

Land Information Memorandum

Christchurch City Council

Application details

Date issued	29 September 2023
Date received	18 September 2023

Property details

Property address	1/32 Ryan Street, Linwood, Christchurch
Valuation roll number	22442 01702
Valuation information	Capital Value: $0
	Land Value: $0
	Improvements Value: $0
	Please note: these values are intended for Rating purposes
Legal description	Lot 1 DP 585857
Existing owner	A K Residential Limited
	228 Stone Street WANAKA 9305

Council references

Rate account ID	73207902
LIM number	H01330693
Property ID	1199823

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Document information

This Land Information Memorandum (LIM) has been prepared for the purpose of section 44A of the Local Government Official Information and Meetings Act 1987 (LGOIMA). It is a summary of the information that we hold on the property. Each heading or "clause" in this LIM corresponds to a part of section 44A.

Sections 1 to 10 contain all of the information known to the Christchurch City Council that must be included under section 44A(2) LGOIMA. Any other information concerning the land as the Council considers, at its discretion, to be relevant is included at section 11 of this LIM (section 44A(3) LGOIMA). If there are no comments or information provided in these sections this means that the Council does not hold information on the property that corresponds to that part of section 44A.

The information included in this LIM is based on a search of Council records only and there may be other information relating to the land which is unknown to the Council. Please note that other agencies may also hold information relevant to the property, or administer legislation relevant to the use of the land, for example, the Regional Council (Ecan), Heritage New Zealand Pouhere Taonga, and Land Information New Zealand.

Council records may not show illegal or unauthorised building or works on the property. The applicant is solely responsible for ensuring that the land is suitable for a particular purpose.

A LIM is only valid at the date of issue as information is based only upon information the Council held at the time of that LIM request being made.

Property file service

This Land Information Memorandum does not contain all information held on a property file. Customers may request property files by phoning the Council's Customer Call Centre on (03) 941 8999, or visiting any of the Council Service Centres. For further information please visit www.ccc.govt.nz.

To enable the Council to measure the accuracy of this LIM document based on our current records, we would appreciate your response should you find any information contained therein which may be considered to be incorrect or omitted. Please telephone the Customer Call Centre on (03) 941 8999.

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A search of records held by the Council has revealed the following information:

1. Special features and characteristics of the land

Section 44A(2)(a) LGOIMA. This is information known to the Council but not apparent from the district scheme under the Town and Country Planning Act 1977 or a district plan under the Resource Management Act 1991. It identifies each (if any) special feature or characteristic of the land concerned, including but not limited to potential erosion, avulsion, falling debris, subsidence, slippage, alluvion, or inundation, or likely presence of hazardous contaminants.

☎ For enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

- **Coastal Hazard Inundation**

  The Council has a report, Coastal Hazard Assessment for Christchurch and Banks Peninsula (2017), that indicates this property or part of this property may be susceptible to coastal inundation (flooding by the sea). The 2017 report considers four sea level rise scenarios through to the year 2120. A copy of the 2017 report and other coastal hazard information can be found at www.ccc.govt.nz/coastalhazards.

- **Mayoral Flooding Taskforce**

  This property or parts of this property lie within the observed, reported or estimated flood extent of one or more of the flood events between February 2011 and April 2014. For more information please refer to https://ccc.govt.nz/reports/ or phone council on 941-8999.

- **Predicted 1 in 50 Year Flood Extent**

  This property, or parts of this property are predicted to be within the extent of a 1 in 50 year flood event. For new developments a minimum finished floor level may be required for flood limitation purposes under the Building Code. For more information please refer to (https://ccc.govt.nz/floorlevelmap) or phone 941 8999.

- **Property located in Tsunami Risk Zone**

  This property may be affected by flooding by some tsunami scenarios as shown in reports by GNS and NIWA commissioned by ECan and CCC. Links to reports can be found at https://ccc.govt.nz/tsunami-evacuation-zones-and-routes/ and on ECan's web site https://www.ecan.govt.nz by searching for the terms tsunami hazard.

- **Liquefaction Assessment**

  Christchurch City Council holds indicative information on liquefaction hazard for Christchurch. Information on liquefaction, including an interactive web tool, can be found on the Council website at ccc.govt.nz/liquefaction. Depending on the liquefaction potential of the area that the property is in, the Council may require site-specific investigations before granting future subdivision or building consent for the property.

- **Consultant Report Available**

  Land Information New Zealand (LINZ) engaged Tonkin and Taylor to provide a Geotechnical Report on Ground Movements that occurred as a result of the Canterbury Earthquake Sequence. The report indicates this property may have been effected by a degree of earthquake induced subsidence. The report obtained by LINZ can be accessed on their website at https://www.linz.govt.nz and search Information for Canterbury Surveyors.

Related Information

- There is attached a soil investigation report for this property.

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2. Private and public stormwater and sewerage drains

Section 44A(2)(b) LGOIMA. This is information about private and public stormwater and sewerage drains as shown in the Council's records.

☎ For stormwater and sewerage enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

Related Information

- The drainage works associated with this property have not been plotted on the Council's drainage plan. A copy of the field Inspectors pickup/approved site plan showing the drains and house outline is attached.
- The property is shown to be served by a sewer & storm water drain which is shared and that common drains continue through the property.

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3. Drinking Water Supply

Section 44A(2)(ba) and (bb) LGOIMA. This is information notified to the Council about whether the land is supplied with drinking water, whether the supplier is the owner of the land or a networked supplier, any conditions that are applicable, and any information the Council has about the supply.

Please note the council does not guarantee a particular water quality to its customers. If you require information on current water quality at this property please contact the Three Waters & Waste Unit.

☎ For water supply queries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

Water supply

Christchurch City Council is the networked supplier of water to this property. This property is connected to the Christchurch City Council Water Supply. The conditions of supply are set out in the Christchurch City Council Water Supply and Wastewater Bylaw (2022), refer to www.ccc.govt.nz.

Related Information

- The property is known to have drinkable water to the dwelling as this is a requirement for a passed final inspection/ code compliance certificate. But the property states there is either a water meter not in use or no water connection to this property because it is not yet being charged for water supply connected in the rates. The charge for water supply will be added to the rates in the next rates year which starts as of 1 July each year. If you wish to enquire about this please call 941 8999 and ask to speak to the rates team.

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4. Rates

Section 44A(2)(c) LGOIMA. This is information on any rates owing in relation to the land.

☎ For rates enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

(a) Annual rates

Annual rates to 30/06/2024:

	Instalment Amount	Date Due
Instalment 1		31/08/2023
Instalment 2		31/11/2023
Instalment 3		28/02/2024
Instalment 4		31/05/2024

Rates owing as at 29/09/2023: $ 0.00

(b) Excess water charges

For excess water charge enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz/contact-us

(c) Final water meter reading required at settlement?

Property settlements must now ensure all water usage and outstanding debts are accurately accounted for.

To advise of a commercial property settlement, please complete the request for settlement information form at www.ccc.govt.nz/services/rates-and-valuations/solicitors-request

Related Information

- There are no rates values showing at present, as the Councils rates team is yet to load the new rating data into the Council rates database. For new rating information please contact the rates team on 03 941-8999 or email ratesvaluation@ccc.govt.nz.

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5. Consents, certificates, notices, orders, or requisitions affecting the land and buildings

Section 44A(2)(d) LGOIMA. This is information concerning any consent, certificate, notice, order, or requisition, affecting the land or any building on the land, previously issued by the Council. The information in this section may also cover building consent and/or code compliance information issued by building certifiers under the Building Act 1991 and building consent authorities that are not the Council under the Building Act 2004.

You can check the property file to identify whether any consent or certificate was issued by a building certifier under the Building Act 1991.

Section 44A(2)(da) LGOIMA. The information required to be provided to a territorial authority under section 362T(2) of the Building Act 2004. There is currently no information required to be provided by a building contractor to a territorial authority under section 362T(2) of the Building Act 2004. The Building (Residential Consumer Rights and Remedies) Regulations 2014 only prescribed the information that must be given to the clients of a building contractor.

☎ For building enquiries, please phone (03) 941 8999, email EPADutyBCO@ccc.govt.nz or visit www.ccc.govt.nz.

(a) Consents

- BCN/1992/7086 Applied: 27/07/1992 Status: Completed
  1/32 Ryan Street Linwood
  Permit issued 14/08/1992
  GARAGE- Historical Reference PER92002252
- BCN/1993/4178 Applied: 30/04/1993 Status: Completed
  1/32 Ryan Street Linwood
  Accepted for processing 30/04/1993
  Building consent granted 05/05/1993
  Building consent issued 05/05/1993
  Code Compliance Certificate Granted 29/06/1993
  Code Compliance Certificate Issued 29/06/1993
  YUNCA WEGJ - WET- Historical Reference CON93005785
- BCN/2010/4358 Applied: 14/05/2010 Status: Lapsed
  1/32 Ryan Street Linwood
  Accepted for processing 14/05/2010
  Building consent granted 31/05/2010
  PIM Granted 31/05/2010
  PIM Issued 31/05/2010
  Building consent issued 01/06/2010
  Building consent lapsed 18/12/2012
  WOODSMAN MATAI ECR MKII FREE STANDING WETBACK WOODBURNE R CLEAN AIR CERTIFICATION: 071128- Historical Reference ABA10103225
- BCN/2017/11313 Applied: 05/12/2017 Status: Completed
  1/32 Ryan Street Linwood
  Exemption from building consent approved 13/12/2017
  Re-leveling of floor
- BCN/2022/1280 Applied: 01/03/2022 Status: Completed
  1/32 Ryan Street Linwood
  Accepted for processing 08/03/2022
  Building consent granted 31/08/2022
  Building consent issued 02/09/2022
  Code Compliance Certificate Issued 16/08/2023
  Construction of 7 units in one block of 4, one block of 2 and one standalone

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- BCN/2022/1280/A Amendment Applied: 05/04/2023 Status: Completed
  1/32 Ryan Street Linwood
  Accepted for processing 05/04/2023
  Building consent granted 17/04/2023
  Building consent issued 20/04/2023
  Amendment 1 - Rectification of plans incorrectly showing showers in units 2-7 as acrylic with acrylic walls. Now revised to acrylic base with tiled walls

(b) Certificates

Note: Code Compliance Certificates were only issued by the Christchurch City Council since January 1993.

(c) Notices

(d) Orders

(e) Requisitions

Related Information

- Please find an electrical certificate/s attached relating to works that have been carried out on the current building/dwelling at this address.

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6. Certificates issued by a building certifier

Section 44A(2)(e) LGOIMA. This is information notified to the Council concerning any certificate issued by a building certifier pursuant to the Building Act 1991 or the Building Act 2004.

☎ For building enquiries, please phone (03) 941 8999, email EPADutyBCO@ccc.govt.nz or visit www.ccc.govt.nz.

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7. Weathertightness

Section 44A(2)(ea) LGOIMA. This is information notified to the Council under section 124 of the Weathertight Homes Resolution Services Act 2006.

☎ For weathertight homes enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

If there is no information below this means Council is unaware of any formal Weathertight Homes Resolution Services claim lodged against this property.

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8. Land use and conditions

Section 44A(2)(f) LGOIMA. This is information relating to the use to which the land may be put and conditions attached to that use. The planning information provided below is not exhaustive and reference to the Christchurch District Plan and any notified proposed changes to that plan is recommended: https://ccc.govt.nz/the-council/plans-strategies-policies-and-bylaws/plans/christchurch-district-plan/.

There maybe some provisions of the Christchurch City Plan or Banks Peninsula District Plan that affect this property that are still operative.

☎ For planning queries, please phone (03) 941 8999, email DutyPlanner@ccc.govt.nz or visit www.ccc.govt.nz.

- **Regional plan or bylaw**

  There may be objectives, policies or rules in a regional plan or a regional bylaw that regulate land use and activities on this site. Please direct enquiries to Canterbury Regional Council (Environment Canterbury).

(a)(i)Christchurch City Plan & Banks Peninsula District Plan

(ii)Christchurch District Plan

- **Development Constraint**

  Council records show there is a specific condition on the use of this site: Consent Notice

- **Qualifying Matter**

  Property or part of property within the Residential Character Area qualifying matter, which has been publicly notifed

- **Qualifying Matter**

  Property or part of property within the Tsunami Management Area qualifying matter, which has been publicly notifed

- **Liquefaction Management Area (LMA)**

  Property or part of property within the Liquefaction Management Area (LMA) Overlay, which is operative.

- **Residential Character Area**

  Property or part of property within the Christchurch District Plan Character Area Overlay (CA22) Ryan, which has been publicly notifed.

- **District Plan Zone**

  Property or part of property within the Medium density residential zone Zone, which has been publicly notifed.

- **District Plan Zone**

  Property or part of property within the Residential Suburban Density Transition Zone, which is operative.

- **Flood Management Area**

  Property or part of property within the Flood Management Area (FMA) Overlay which is operative.

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(b) Resource consents

If there are any land use resource consents issued for this property the Council recommends that you check those resource consents on the property file. There may be conditions attached to those resource consents for the property that are still required to be complied with.

- RMA/2021/2960 - Subdivision Consent
  32 Ryan Street Linwood
  Subdivision - Fee simple - Two lot boundary adjustment
  Status: Processing complete
  Applied 07/09/2021
  06/04/2022
  s223 Certificate issued 12/05/2022
  s224 Certificate issued 19/05/2022
  01/03/2022
  Granted 01/03/2022
  Decision issued 01/03/2022

- RMA/2021/3827 - Land Use Consent
  32 Ryan Street Linwood
  Construction of six attached and one detached dwellings
  Status: Processing complete
  Applied 16/11/2021
  31/03/2022
  Within scope amendment accepted 23/08/2022
  23/08/2022
  Granted 31/03/2022
  Decision issued 01/04/2022

- RMA/2022/400 - Certification
  32 Ryan Street Linwood
  Minimum Floor Level Certificate
  Status: Processing complete
  Applied 15/02/2022
  Certificate issued 16/02/2022

- RMA/2022/2876 - Combined subdivision / land use consent
  1/32 Ryan Street Linwood
  Subdivision - Fee simple - Ten lots with land use
  Status: Processing complete
  Applied 09/09/2022
  28/10/2022
  s223 Certificate issued 03/03/2023
  s224 Certificate issued 12/06/2023
  Granted 28/10/2022
  Decision issued 31/10/2022

Related Information

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- The Council system shows a Development Constraint/Ongoing Condition Consent notice for this property. The consent notice should be registered against the record of title for the property and a search of that title and the consent notice will provide details in respect of the constraint / condition. If a search of the title does not record the consent notice or the consent notice is not clear then we suggest you contact the duty planner by either calling 941 8999 or emailing DutyPlanner@ccc.govt.nz. The Consent notice is as follows:
  Consent Notice CN Specific TC3 foundation following advice in attached Tetrad Consulting Ltd report 21341 Rev 3 dated Jan 2022.
  Consent Notice CN The access visibility area (AC on DP 585857) shall not have any vegetation/fencing/structures greater than 1.0m in height.

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9. Other land and building classifications

Section 44A(2)(g) LGOIMA. This is information notified to the Council by any statutory organisation having the power to classify land or buildings for any purpose.

☎ For land and building enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

Please refer to Section 1 for details

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10. Network utility information

Section 44A(2)(h) LGOIMA. This is information notified to the Council by any network utility operator pursuant to the Building Act 1991 or the Building Act 2004.

☎ For network enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

- **None recorded for this property**

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11. Other information

Section 44A(3) LGOIMA. This is information concerning the land that the Council has the discretion to include if it considers it to be relevant.

☎ For any enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

(a) Kerbside waste collection

- Your organics are collected Weekly on Monday. Please leave your organics at the Kerbside by 6:00 a.m.
- Your recycling is collected Fortnightly on the Week 2 collection cycle on a Monday. Please leave your recycling at the Kerbside by 6:00 a.m. Your nearest recycling depot is the Metro Place EcoDrop.
- Your refuse is collected Fortnightly on the Week 2 collection cycle on a Monday. Please leave your rubbish at the Kerbside by 6:00 a.m. Your nearest rubbish depot is the Metro Place EcoDrop.

(b) Other

- **Floor Levels Information**

  Christchurch City Council holds a variety of information relevant to building/property development across the city. This includes minimum finished floor levels that need to be set to meet the surface water requirements in clause E1.3.2 of the building code (where this applies), and the requirements of the Christchurch District Plan (where a property is in the Flood Management Area). Where this information has been processed for your site, it can be viewed at https://ccc.govt.nz/floorlevelmap/, otherwise site specific advice can be obtained by emailing floorlevels@ccc.govt.nz

- **Guest Accommodation**

  Guest accommodation (including whole unit listings on Airbnb; BookaBach; etc.) generally requires a resource consent in this zone when the owner is not residing on the site. For more information, please refer to: https://ccc.govt.nz/providing-guest-accommodation/.

- **Community Board**

  Property located in Papanui-Innes-Central Community Board.

- **Tsunami Evacuation Zone**

  This property is in the yellow tsunami evacuation zone. It could potentially be flooded only in a large distant source tsunami. Evacuation is not necessary after a long or strong earthquake. Evacuation is only necessary under an official Civil Defence Tsunami Warning to evacuate the yellow zone. Tsunami sirens should prompt turning on the radio or visiting https://ccc.govt.nz/services/civil-defence. Stay out of the zone until told it is safe to go back.For more information visit https://ccc.govt.nz/services/civil-defence/hazards/tsunami-evacuation-zones-and-routes/

- **Electoral Ward**

  Property located in Central Electoral Ward

- **Listed Land Use Register**

  Hazardous activities and industries involve the use, storage or disposal of hazardous substances. These substances can sometimes contaminate the soil. Environment Canterbury identifies land that is used or has been used for hazardous activities and industries. This information is held on a publically available database called the Listed Land Use Register (LLUR). The Christchurch City Council may not hold information that is held on the LLUR Therefore, it is recommended that you check Environment Canterbury's online database at www.llur.ecan.govt.nz

- **Spatial Query Report**

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A copy of the spatial query report is attached at the end of this LIM. The spatial query report lists land use resource consents that have been granted within 100 metres of this property.

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Tetrad.
Quality by Design

Multi-Unit Development at 32 and 36 Ryan Street, Christchurch

Geotechnical Report

Revision: 4

Date:
01 July 2022

DOCUMENT CONTROL

Project Reference	21341	
Project Name	Multi-Unit Development at 32 and 36 Ryan Street, Christchurch	
Revision	4	
Prepared For	A K Property Limited	
Prepared By		Callum Nish B.E. Hons (Civil), Graduate Engineer
Reviewed By		Steven Roberts CPEng (Geotechnical), CMEngNZ, IntPE(NZ)
Limitations	*This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in accordance with the agreement between the Client and Tetrad Consulting Ltd. Tetrad Consulting Limited Ltd accepts no liability or responsibility whatsoever for any use of or reliance upon this report by any third party. Any copying of this report to external parties requires the permission of the Client and Tetrad Consulting Limited.*	

Report Distribution:		
Recipient	**Release Date**	**Document Type**
Nick Aubrey	01 July 2022	PDF

TABLE OF CONTENTS

Executive Summary

Geotechnical information sourced from the New Zealand Geotechnical Database, show the site has performed poorly during the 2010 to 2011 Canterbury earthquake sequence, with minor to moderate quantities of ejected material and moderate ground surface damage recorded from EQC observations after the February 2011 event.

The geotechnical investigation completed at the site comprised three CPT tests which returned an inferred subsurface soil profile of interbedded silt clay and silty sand to 3.5 m depth and sands to 10 m.

The silty sand and sand deposits below above the water table are loose to medium dense and susceptible to liquefaction-induced settlement, with settlement up to 80 mm predicted for a 25-year (SLS1) event, increasing to 150 mm for a 500-year (ULS) event.

Moderate differential settlements can be expected during a SLS1 and SLS2 event as supported by the moderate LPI values discussed in Section 5.4 of this report, however severe ground damage can be expected after a 500- year event.

Accordingly, an Option 4 waffle slab foundation system on a 0.7 m thick reinforced gravel raft for blocks 2 and 3 (shown in Appendix C) and on a 1.0 m thick reinforced gravel raft (shown in Appendix C) is recommended for the proposed 7-unit residential development. The foundation system is required to meet the performance objectives of the MBIE guidelines, which requires the foundation to provide enough stiffness to support the imposed building weight under a 2m loss of edge ground support and 4m loss of internal ground support.

During a 500-year earthquake event, the foundation system is expected to be sufficiently stiff to prevent irreparable damage to the building units.

In accordance with Section 106 of the Resource Management Act, we don't see any grounds for refusing a subdivision consent for the proposed development based on Section 106 assessment of the RMA.

1 Introduction

Tetrad Consulting Ltd has been engaged by A K Property Ltd to undertake a geotechnical investigation and report for the purpose of supporting a Resource Consent application to subdivide the subject property into two Fee-Simple Lots at 32 and 36 Ryan Street, Phillipstown for the purpose of a 7 - unit residential development.

This report presents the results of a geotechnical investigation to characterize the subsurface soil profile and strength properties for foundation design and discussion of the following:

- Quantify liquefaction susceptibility for a design basis seismic event.
- Confirmation of Ministry of Business, Innovation and Employment land classification for the site.
- Provide foundation recommendations for the proposed development.
- Suitability to subdivide in accordance with Section 106 of the Resource Management Act (RMA).

The scope of this geotechnical report does not include commentary on site-specific environmental issues, which is beyond the scope of our geotechnical engagement.

2 Supporting Documents

The following information sources have been referred to for completion of this report:

- Davis Ogilvie's Subdivision Plan Titled: – *"Proposed Subdivision of Lots 13 & 14 DP 9028 at 32/36 Ryan Street, Philipstown, Christchurch",* reference: 41804_issue A, dated August 2021.
- Coll Architecture's RC plans Titled: *"AK Residential -32 & 36 Ryan Street",* Sheet No's A101 to A306, dated 15th November 2021.

3 Site Description

The setting is a flat site with a total land area of approximately 1,588 m^2 and is located along the east side of the street. The sites are each developed by single storey dwellings, with detached garages towards the rear the sites.

Figure 1: Approximate location of subject site on the east side of Ryan Street

4 Ground Investigation

4.1 Previous Geotechnical Investigation

Relevant previous geotechnical investigations were reviewed using the New Zealand Geotechnical database (NZGD). A borehole 65 m southwest of the site (BH18118) revealed silts to 4 m depth, transitioning to sands to 10 m depth. A ground water table of 1.5 m below ground level (bgl) was also inferred. Hand auger and Scala penetrometer testing 50 m northeast of the site (HA-DCP158243) inferred silt to 2.5 – 3 m underlain by sand or sandy silt and 200 kPa ultimate geotechnical bearing capacity from 0.6 m depth. The ground water table inferred at these hand augers ranged from 1.0 – 1.3 m depth.

4.2 Geotechnical Investigation

Deep ground testing was carried out on the 14th of September 2021 by McMillan Drilling Ltd and comprised two Cone Penetrometer Test (CPT01- CPT03) pushed to a target depth of 10 m complete with excess pore pressure measurements. A historical onsite CPT was found which was tested by Pro-Drill Limited on the 26th of March 2013. In addition, two Scala penetrometer tests (SP01 – SP02) were performed by Tetrad on the 14th of October. The Scala penetrometer and CPT test locations and results are shown in Appendix A and summarized in Table 1 below.

Table 1: Summary of CPT investigation

Test type	Depth of test (m)	Comments
CPT01	10.0 m	Reached target depth
CPT02	10.0 m	Reached target depth
CPT19005	10.0 m	Reached target depth
SP01	1.5 m	Reached target depth

SP02	1.5 m	Reached target depth

5 Subsurface Conditions

5.1 Geology

The geological map of the area (Brown and Webber, 1992) shows that the site as underlain by soils of the Christchurch formation to 25 m. The site is therefore shown to comprise of estuarine, lagoonal, and coastal swamp deposits of silt, sand, clay, and peat, primarily deposited by sea currents and longshore drift. This is underlain by the Riccarton gravel formation, comprising well graded gravel with cobble sizes up to 100 mm diameter.

5.1.1 From Cone Penetrometer Tests

The CPT tests returned an inferred subsurface soil profile comprising interbedded clayey silt to approximately 3.3 m depth. The CPT tests returned cone tip resistance (q_c) values ranging between 1 - 3 MPa to 1.4 m depth for CPT01 and CPT02. CPT19005 returned higher qc values of approximately 5 MPa to 0.6 m depth, decreasing to 2 MPa at 1.3 m depth. Between 1 – 3.5 m, the inferred qc values were relatively consistent between the CPT's. Between 1.3 to 2.5 m, qc values ranged between 0.5 – 2 MPa. Values increased from 2.2 to 2.5 m depth as a thin layer of sand or silty sand was struck. Between 2.5 – 3.3 m depth, a very weak layer of weak clayey silt or organic material was encountered in all CPT's. This had a range of qc values between 0.30 – 0.77 MPa, which indicated the potential for primary consolidation settlement under load as well as secondary settlement over time within this layer. After this depth, values generally increased until up to 10 – 20 MPa showing primarily medium dense to dense sands to 10 m, although CPT01 had a weaker layer between 6.1 – 6.9 m where qc values ranged between 2- 3 MPa.

Figure 2 below shows the cone tip resistance values to 10 m depth

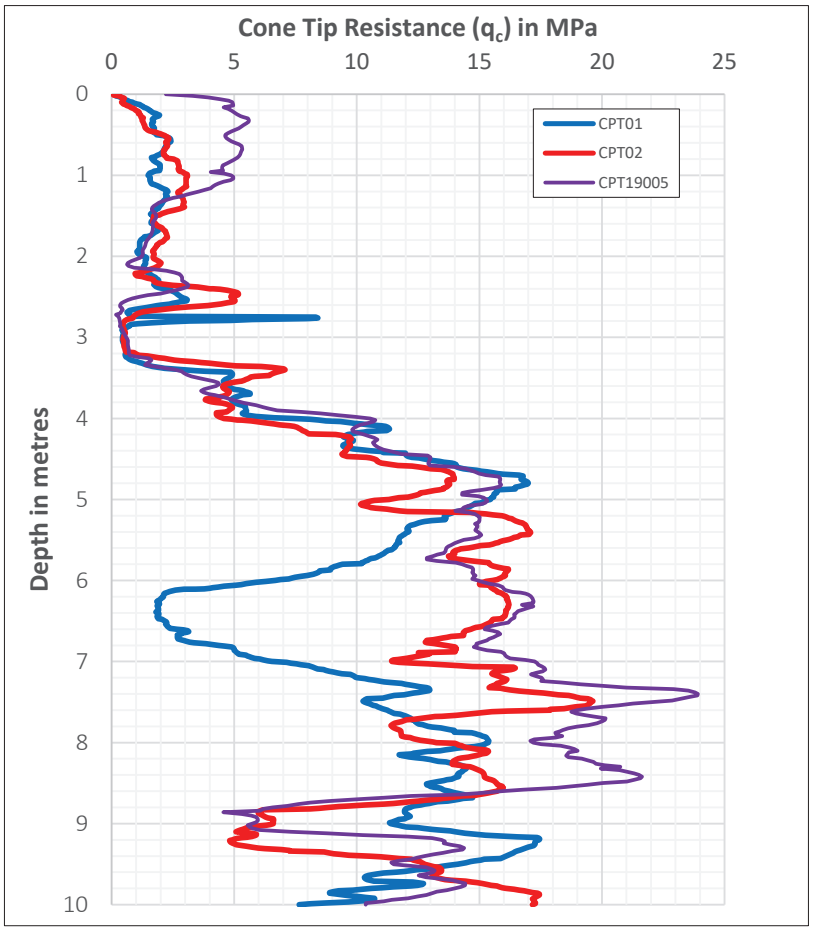

Figure 2: CPT test profiles to MBIE's index depth

5.2 Ground Water Table

To assess the ground water table depth, reference had been made to the GNS Science Median Groundwater Surface Elevations from the NZGD which indicate the water surface contour range based on long term observation records at each site. The water surface contours are stated in terms of the LVD 1937 datum, which is set at 9.043 m above the Christchurch Drainage Datum (CDD). Table 2 below shows the water surface contours for the 15th and 85th percentile in terms of the LVD datum.

Table 2: Water surface contour levels from NZGD

	15th Percentile	Mean	85th Percentile
Water surface Depth (m)	1.53	1.69	2.06

When referenced to the CDD, the 15th Percentile water surface contour level translates to a water table depth of 0.967 m based on an average site ground level of RL 11.54 m as sourced from the Christchurch City Flood Management website.

The 85th Percentile water surface contour level translates to a water table depth of 0.15 m. However, after consideration of the surrounding tests (BH18118 and HA-DCP158243 from the NZGD), an elevated ground water table of 0.5 m below the lowest ground level (bgl) was chosen for liquefaction assessment.

6 Seismic Assessment

6.1 Previous Earthquake Performance

The site has been subjected to repeated ground shaking from the Canterbury earthquake sequence. Reference to the New Zealand Geotechnical Database shows the conditional peak ground accelerations based on the method by Bradley et al (2012). The method combines the empirical strong motion attenuation with distance model, with the actual observation to produce conditional peak ground accelerations. Table 3 below summarises the PGA values for the 2010/2011 earthquake events.

Table 3: Conditional PGA for recent earthquakes (Bradley et al)

Earthquake	Magnitude-M_w	PGA mean	Equivalent $M_{7.5}$ PGA			
			To MBIE	$PGA_{16\_7.5}$	$PGA_{50\_7.5}$	$PGA_{84\_7.5}$
4 Sep 2010	7.1	0.23	0.12	0.28	**0.21**	0.29
22 February 2011	6.2	0.44	0.20	0.43	**0.31**	0.44
13 June 2011	6.0	0.21	0.10	0.10	**0.14**	0.21
23 Dec 2011	5.9	0.17	0.13	0.16	**0.11**	0.16

$PGA_{16\_7.5}$ represents the 16th percentile (i.e 84% probability of exceedance) scaled to a M7.5 earthquake.
$PGA_{84\_7.5}$ represents the 84th percentile (i.e 16% probability of exceedance) scaled to a M7.5 earthquake.

The predicted mean PGA for each earthquake has been converted to an equivalent PGA for magnitude M7.5 earthquake in accordance with MBIE guideline recommendations by the method of Boulanger & Idriss 2014.

The adjusted PGA values are also shown with an 84% and 16% probability of being exceeded. The MBIE value in the table represents the 90% exceedance PGA which is accepted as being "well tested" for an SLS1 event. In this case, the site has been well tested to SLS1 and SLS2 levels of ground shaking from the September 2010 and February 2011 events with a mean $PGA_{50\_7.5}$ value of 0.21g and 0.31g, respectively.

6.2 Liquefaction tests

Liquefaction assessment of the CPT tests has been completed by the method of Idriss and Boulanger (2014).

In applying this method, a water level at 0.50 m was used for triggering of liquefaction in the alluvial deposits.

A 'fines correction' coefficient (CFC) of 0.0[1] was adopted for the liquefaction analysis in the Idriss and Boulanger method.

Liquefaction induced settlement has been quantified by the method of Zhang et al (2002). Table 4 below summarises the predicted liquefaction settlements rounded up to the nearest 5 mm to a test depth of 10 m for a SLS1 and ULS event with PGAs of 0.13g and 0.35g, respectively. A second serviceability earthquake event (SLS2) has also been considered with a PGA of 0.19g and Magnitude M6.0.

Approximately 80 and 90 mm of liquefaction settlement is predicted for a SLS1 and SLS2 events respectively, increasing up to 150 mm for a ULS event.

Table 4:Liquefaction settlements to CPT refusal depth

Test Location	SLS1 (M7.5)	SLS2 (M6.0)	ULS (M7.5)
CPT01	80	90	150
CPT02	55	70	125
CPT19005	55	60	100

6.3 Previous Earthquake Damage from EQC Observations

Table 5 below summarises the liquefaction observations sourced from EQC records obtained from the NZGD and only returned ground surface damage from the February 2011 event. The EQC records suggest the site is susceptible to negligible ground surface damage for earthquake events up to Magnitude M6.2. An approximate range of 25 – 125 mm of settlement under the February 2011 earthquake event was inferred by LiDAR settlements sourced from the NZGD.

Table 5: Summary of EQC liquefaction interpreted from EQC observations

Earthquake Event	Ground surface Damage Observation
September 2010	No observations
February 2011	No lateral spreading but minor to moderate quantities of ejected material
June 2011	No EQC observations
December 2011	No EQC observations

6.4 Liquefaction Potential

We have assessed the 'Liquefaction Potential Indices' number for each of the liquefaction cases identified in Section 6.2 above. The LPI number provides a performance-based assessment of liquefaction ground surface damage and is influenced by the ratio of the non-liquefiable crust layer to the total thickness of liquefiable soil deposit.

The LPI should be considered in the context of both the ground conditions and structure of interest. The ranges provided in Table 6 below are based on triggering calculations using Boulanger and Idriss (2014) method, and analysis and interpretation of liquefaction effects in the 2010-2011 Christchurch earthquake sequence. Table *6* below has been reproduced from, 'Module 3: Identification, Assessment and Mitigation of Liquefaction Hazards": dated May 2016.

[1] Leeves,J.,van Ballegooy,S.,Lees,J., Wentz;2015. *Effect of fines content correlations and liquefaction susceptibility thresholds on liquefaction consequence*, 6th International Conference on Earthquake Geotechnical Engineering, November 2015, New Zealand

Table 6: General performance levels for liquefied deposits

Performance Level	Effects	Characteristics and Consequences	Characteristic LPI
L0	Insignificant	No significant excess pore water pressures (no liquefaction)	LPI = 0
L1	Mild	Limited excess pore water pressures; negligible deformation of the ground, and small settlements	LPI = 0
L2	Moderate	Liquefaction occurs in layers of limited thickness (small proportion of the deposit, say 10 percent or less) and lateral extent; ground deformation results in relatively small differential settlements	LPI < 5
L3	High	Liquefaction occurs in significant portion of the deposit thickness (30 to 50 percent) resulting in transient lateral displacements, moderate differential movements, and settlement of the ground in the order of 100mm to 200mm.	LPI = 5-15
L4	Severe	Complete liquefaction develops in most of the deposit resulting in large lateral displacements of the ground, excessive differential settlement, and total settlement of over 200mm.	LPI > 15
L5	Very severe	Liquefaction resulting in lateral spreading (flow), large permanent lateral ground displacements and/or significant ground distortion (lateral strains/stretch, vertical offsets and angular distortion).	LPI > 20

Liquefaction analysis confirmed liquefaction potential Indices (LPI) values of 3 and 5 for a SLS1 and SLS2 event respectively and increasing to 20 for a ULS event. These values translate to *Moderate* ground surface damage for a SLS1 and *Severe for a* ULS event.

6.5 Lateral Spread

Lateral spread risk has been assessed according to site and ground conditions, as well as proximity to significant waterways or steep changes in ground level. The subject property is well over 150 m from the nearest waterway (over 1 km distance). The site is also generally flat and level with no significant ground elevation over the site.

Ground surface observations presented on the New Zealand Geotechnical Database (NZGD) indicates no observed ground cracking for any of the seismic events on the site. Based on this lateral spread damage is not considered a significant geotechnical risk at this site.

6.6 Technical Land Category Classification

Reference to the MBIE Technical Foundation Category Classification off the NZGD website indicates the site is TC3 rated land for the purpose of foundation design. Liquefaction analysis in Section 6.2 predicts total *free-field* liquefaction between 80 and 90 mm for a SLS1 and SLS2 events respectively and up to 150 mm for a ULS event.

These settlement values are consistent with an MBIE's guideline rating of TC3. Therefore, we recommend a Technical Category 3 Classification for foundation design.

6.7 Seismic Category

The thickness of the alluvial deposits beneath this area of the Christchurch area defines the site as Class D, 'Deep Soils', in terms of the seismic design requirements of NZS 1170.5.

7 Environmental Issues

Although environmental engineering is beyond the scope of our engagement, we have undertaken a review of Environment Canterbury's 'Listed Land Use Register' (LLUR) (http://llur.ecan.govt.nz/). The LLUR is a public record of sites known to have been subject to historical and / or existing potentially contaminating land use activities prescribed in the Hazardous Activity and Industries List (HAIL). A review of the LLUR indicates:

"The Listed Land Use Register does not currently have any information about a Hazardous Activities and Industries List site on this land parcel".

Although the LLUR does not contain any records of potential HAIL at the subject site, the LLUR is not considered a complete record and is being continuously updated, and it is therefore recommended to contact the Christchurch City Council to enquire about any known hazardous activities at the subject site that may require consideration as part of any future consent application.

8 Flood levels

The Christchurch City Council flood hazard maps at:
https://www.ccc.govt.nz/services/stormwater-and-drainage/flooding/floorlevelmap were accessed on 6th of October 2021. The CCC system shows the site is in a flood management area, and accordingly interim flood floor level will likely be required before lodging a building consent application.

9 Bearing Capacity

Ultimate bearing capacity in the shallow soil deposits has been quantified from CPT cone tip resistance values based on the following empirical relationships for shallow foundations bearing on silty clay and silty sand deposits as encountered at all CPT's to 3.5 m depth.

For shallow foundations bearing on clay-like soils, Q_u is calculated from:

- $Q_{ult} = 2 + 0.28q_c$ – in units of kg/cm^2 - Equation 1

For shallow foundations bearing on sandy silt soils, Q_u is calculated from:

- $Q_{ult} = 28 – 0.0052(300 - q_c)^{1.5}$ - in units of kg/cm^2 - Equation 2

The above relationships require the q_c values from the CPT tests to be converted to units of kg/m^2 before calculation of Q_{ult}.

The ultimate bearing capacities in Table 7 are the lower bound values calculated from equations 1 & 2 at test locations CPT1, CPT2 and CPT19005. Bearing capacities vary between 32 to 280 kPa at CPT1, between 21 to 280 kPa at CPT2 and between 34 to 280 kPa over the same depth from 0.6 m to 3.4 m bgl.

The ultimate bearing capacity highlighted in the last row of Table 7 is calculated from the geomean q_c value for the whole soil layer from 0.6 to 3.4 m at the respective CPT test locations. Below 3.4 m the soils become stronger with increasing depth.

Table 7: Ultimate bearing Capacity from CPT's

	CPT01	CPT02	CPT19005
Depth (m)	Lowest Q_u at CPT1 from Equation 1 & Equation 2 - kPa	Lowest Q_u at CPT2 from Equation 1 & Equation 2– kPa	Lowest Q_u at CPT19005 from Equation 1 & Equation 2 - kPa
0.6	251	243	280
0.7	237	236	280
0.8	198	263	280
0.9	226	274	280
1.0	184	280	280
1.1	196	280	280
1.2	250	273	280
1.3	241	279	247
1.4	222	279	199
1.5	199	205	213
1.6	200	212	200
1.7	212	243	199
1.8	154	239	180
1.9	148	209	167
2.0	165	203	158
2.1	171	226	90
2.2	182	155	265
2.3	222	205	278
2.4	241	280	277
2.5	276	280	145
2.6	230	280	56
2.7	94	146	57
2.8	280	78	54
2.9	72	75	66
3.0	68	76	87
3.1	81	76	95
3.2	83	130	99
3.3	137	280	190
3.4	280	280	268
Qu	**176**	**198**	**168**

Scala tests SP1 – SP4 completed on the 15th of October 2021 inferred an average bearing capacity of 300kPa from 0.8 bgl, corresponding to an average Scala test result of 4.5 blows per 100 mm of ground penetration. The average Scala bearing capacity of over 300 kPa from 0.8 m depth does not correlate well with the CPT-derived values in Table 7. For this reason, the lower bearing capacities from the CPT's have been adopted for foundation design.

An ultimate bearing capacity of 200 kPa is recommended at 1.1 m for design of shallow ground improvement and for the concrete foundation system and is discussed further in Section 10 below.

10 Foundation Settlements

Calculation of static settlement is from the one-dimensional consolidation method applied to the weakest upper silt and sand layers and for a soil elastic modulus of 1.2 MPa. The elastic modulus has been assessed from the following empirical relationship of CPT tip resistance verses elastic modulus (Es). In this case, the following relationship was adopted with a lower bound q_c value of 0.5 MPa.

$$Es = 2.5q_c \text{ - in MPa}$$

Static settlement of up to 19 mm is predicted in the shallow silt and sand deposits to 3.3 m bgl, based on an applied foundation load of 20 kPa from the combined self-weight of the building and the foundation. The 1 – D consolidation calculation was performed on a combination of the weakest layers observed from the soil profiles and include the layers from 2.55 - 3.2 m at CPT03. Total static settlement of 26 mm was calculated at this CPT location, with differential settlement estimated at 20 mm to account for potentially greater settlement of the weak clayey silt layer due to inaccuracies associated with quantifying the soils' elastic modulus. In this case we have increased the calculated differential settlement by 30%, from 20 mm to 26 mm.

We therefore anticipate up to 20 mm of differential settlement over a 6 m span due to the imposed foundation loading from the combined structure, foundation with gravel raft, and satisfies the foundation performance requirement in Section B1/VM4 of the NZBC.

11 Assessment against RMA

A suitability assessment of the site for subdivision has been carried out in accordance with Section 106 of the Resource Management Act (RMA).

Section 106 the RMA states *inter alia*

1. …" a consent authority may refuse subdivision consent, or may grant subdivision consent subject to conditions, if it considers that:

(a) *the land in respect of which a consent is sought, or any structure on the land, is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; or*

(b) *any subsequent use that is likely to be made of the land is likely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source*.

(c) *sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.*

Our assessment of the site against the requirements of Section 106 is presented in Table 8 and is based on observations of the subject property and experience of ground conditions within this area of Canterbury.

Table 8: Assessment of hazards and their risk to new subdivision against the RMA

	Potential Susceptibility	
	Risk - Current (Section 106 1a)	Risk - Post Development (Section 106 1b)
Falling Debris	The site is located on relatively flat ground, a significant distance from any hills or rock outcrops; falling debris is not considered a risk.	
Slippage	The site is located on stable in situ loess soils and the site is located adjacent to a mapped areas of slope instability as per the Stage 1 Port Hills GNS report for Mass Soil Movement. Accordingly, mass soil movement is not considered a significant risk over the subject property.	
Erosion	No significant erosion was identified on site.	Fine grained sandy soils have the potential to erode if exposed for long periods. However, dense vegetative cover should prevent this from occurring. All reasonable attempts should be made to protect exposed soils from rainfall and runoff by implementing an erosion and sediment control plan in accordance with council requirements.
Subsidence	Given the encountered ground conditions the site is not considered susceptible to liquefaction settlement. The ground conditions may be susceptible to minor static settlement	The proposed development comprises construction of a residential dwelling and the likely degree of static settlement will not adversely affect this type of structure. Any filling above existing ground levels should only be undertaken with input from a suitably qualified Geotechnical Engineer.
Inundation	The risk of inundation from liquefaction or stormwater run-off is low. However, confirmation of minimum floor level requirements should be sought from the local council authority at the Building Consent stage.	Stormwater run-off should be appropriately managed and discharged to an existing utility service. Floor level requirements (if any) should be confirmed with the local council authority.

Based on the above predicted geotechnical hazards, as shown in Table 8, we conclude there is no reason to refuse subdivision consent in clause 106 (a), based on falling debris, slippage, erosion, subsidence, or inundation.

Any proposed development will have to comply with relevant legislation, Codes and Standards. For example, fills would have to be constructed at safe slopes and cuts would have to be excavated to provide stable slopes.

Any potential location for a future dwelling on the proposed site is unlikely to require significant fill or cut earthworks, however where earthworks are required, they are likely to expose fine grained soil that will be susceptible to erosion if left exposed to weathering for prolonged periods of time.

Erosion by wind, precipitation or inadequately discharged stormwater runoff should be controlled through best construction practice. Provided these best practice methodologies are implemented during construction it is our opinion that development of the site will not result in the acceleration or worsening of these hazards. In our opinion therefore, and not to be construed as a guarantee, Clause 106 1(b) would not provide grounds for refusing a subdivision consent.

Section 106 1(c) is not relevant to a geotechnical appraisal and therefore has not been considered in this report.

A 'Statement of Professional Opinion on the Suitability of Land for Subdivision' is provided in Appendix C.

12 Foundations

12.1 Discussion

The proposed development comprises seven two-storey residential units constructed of light-weight materials in accordance with NZS 3604 type construction. As such, we have considered foundation options outlined in MBIE's Part A: "Repairing and rebuilding houses affected by the Canterbury earthquakes", December 2012, consistent with the TC3 Classification as discussed in Section 6.6 above. The development consists of three blocks of units as shown in appendix C, blocks 1 ,2 and 3 consisting of units 1 -4, 5-6 and 7, respectively. Block 1 has the highest aspect ratio of 5.9, which exceeds MBIE guideline for shallow foundations. Blocks 2 and 3 have aspect ratio between 1.3 and 1.5, respectively.

The soil column from 1 - 2.5, 3.5 - 10 m is susceptible to SLS1 and SLS2 liquefaction-induced settlement during earthquake loading with settlement up to 80 mm predicted for a SLS1 event and increasing to 90 mm for a SLS2 event. During a ULS event between 100 to 150 mm settlement is predicted, with most of the settlement occurring in the soil column from 5.5 to 10 m.

Moderate ground surface damage during SLS1 and SLS2 ground shaking can be expected at this site consistent with the low – moderate LPI values predicted in Section 6.4.

During an ULS event severe ground surface damage can be expected, with excessive differential settlement predicted from the high LPI values. Accordingly, a shallow surface foundation as described in Section 12.2 below would be suitable for the proposed multi-unit development combined gravel raft as specified by Table 8 below. The stiff concrete slab foundation and reinforced gravel raft are expected to supress differential settlement damage during SLS1 and SLS2 ground shaking, whilst mitigating irreparable damage to the units during a ULS event.

12.2 Reinforced Gravel Raft with an Option 4 MBIE foundation

The Option 4 shallow foundation system is required to meet the performance objectives of the MBIE guidelines, which would otherwise require the foundation to provide enough stiffness to support the imposed reduced gravity load of the buildings under a 2m loss of edge ground support and 4 m loss of internal ground support.

For ultimate limit state design of the foundations a 1.0 m thick reinforced gravel raft is recommended for units 1 -4 (block 1 as shown in Appendix C) to provide a stable building platform for construction of the waffle slab foundation. For blocks 2 – 3 as shown in appendix C, a gravel raft of 0.7 m depth with geogrid reinforcement is required. The parameters for each gravel raft is summarised below in Table 8.

Table 8: Required gravel raft thickness and geogrid layer quantities for each block

Block number:	Required gravel raft thickness (m):	Required geogrid layers:
Block 1 (units 1 - 4))	1.0 m	2
Block 2 (units 5 and 6)	0.7 m	2
Block 3 (Unit 7)	0.7 m	2

Calculations have been performed by specific engineering design in Appendix E to determine the appropriate gravel raft thickness. The exposed silty soils at the gravel raft base provide an ultimate bearing capacity of at least 200 kPa based on the cone tip resistance values quantified in Section 8 above.

Excavation for the reinforced gravel raft is required to at least 1.1 m below the lowest adjacent ground level at block 1 and to at least 0.8 m depth at blocks 2 and 3, followed by placement of Bidim A19 geo-cloth over the exposed soils. The base of the gravel raft shall extend at least 0.5 m beyond the foundation footprint at block 1 and at least 0.4 m beyond the foundation footprint at blocks 2 - 3. The gravel raft edges should be battered at 1H:2V and shall be constructed as follows:

- The gravel raft shall be constructed from a well graded fill material comprising stone with at least two subangular faces as per MBIE guideline recommendations.
- The gravel material shall be placed in 150mm thick layers and compacted to 95 % of the MDD value in accordance with NZS 4431:1989.
- At block 1, 2 and 3, after placement of each of the first two layers of compacted fill, a layer of TriAx-160 geogrid (or similar) should be laid before placement of the next gravel layer (2 layers of geogrid required in total).
- The compacted fill density should be confirmed via NDM testing at random intervals not exceeding 3 m in each direction on the first and last layer of compacted material.

In the case where extension of the gravel raft beyond the foundation edge is restricted by either a physical boundary line or from a legal easement instrument, the effected edge of the gravel raft should be reinforced by additional layers of geogrid to reinforce the entire depth of the gravel raft. The additional layers of geogrid shall be spaced at 150 mm vertical intervals and shall extend at least 3 m into the body of the gravel raft.

Refer to Appendix D for the proposed development layout.

13 Further Geotechnical Considerations

13.1 Earthworks

During development of the site appropriate stormwater and erosion control measures should be implemented and monitored throughout construction. Erosion control is likely to require the introduction of silt fences, or other similar devices, to intercept soil run-off and improve the quality of the stormwater that will be discharged from site.

13.2 Review of Foundation Design

To ensure the recommendations in this report have been interpreted correctly, we recommend that Tetrad Consulting Ltd is provided with the final foundation design drawings for an independent review. At the time of construction an appropriate level of construction monitoring will be required to confirm that the inferred near-surface soil profile from the CPT tests is consistent with the observed soil profile during foundation excavation. Any notable variation (organic material, soft spots etc.) of the exposed soil, identified during construction should be brought to the attention of the geotechnical engineer before commencing foundation works.

13.3 Pavement Design

For design of flexible pavement areas, we recommend a CBR value of 4 %, based on interpretation of the Scala penetrometer blow count values.

14 Limitations

This report has been prepared for A K Property Ltd and the Christchurch City Council for the purpose of supporting a building consent application for the proposed multi-unit residential development at the subject property.

No liability is accepted by this company or any employee of this company with respect to its intended use by any other person or persons.

This report has been based on the results of cone penetrometer tests completed at discrete locations; therefore, subsurface soil conditions are 'inferred' based on interpreted data and could vary from the test locations at the time of the geotechnical assessment. Should exposed soil conditions vary from those described herein Tetrad Consulting Ltd requests that it be notified immediately.

The geotechnical investigation was confined to geotechnical aspects of the site only and did not involve the assessment for environmental contaminants.

References

Brown, L.J.; Weeber, J.H. (1992): *Geology of the Christchurch Urban Area*. Institute of Geological & Nuclear Sciences 1:25,000 geological map 1.

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Bradley and Hughes (2012a) *Conditional Peak Ground Accelerations in the Canterbury Earthquakes for Conventional Liquefaction Assessment*. Technical Report for the Ministry of Business, Innovation and Employment, April 2012. 22p.

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New Zealand Geotechnical Database (2012) "Observed Ground Crack Locations", Map Layer CGD0400 – 23 July 2012, retrieved June 2021 from https://canterburygeotechnicaldatabase.projectorbit.com/

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New Zealand Geotechnical Database (2013) "Conditional PGA for Liquefaction Assessment", Map Layer CGD5110 – 21 Feb 2013, retrieved June 2021 from https://canterburygeotechnicaldatabase.projectorbit.com/

Appendix A

- Site Investigation Plan

Tetrad.
Quality by Design

LEGEND

- Cone Penetrometer Test (CPT)
- Dynamic Probe Super Hard Test (DPSH)
- Scala Penetrometer Test (SP)
- Hand Auger Borehole Test (HA)

Notes:
1. CPT01 and CPT02 completed by McMillans Ltd on 15.9.21

2. Historical CPT_19005 sourced from NZGD on 19.8.21

PROJECT	**Multi Unit Development**
ADDRESS	**32 & 36 Ryan Street**
CLIENT	**AK Property Ltd**
TITLE	**Soil Test Location Plan**
JOB NO.	**21341**

Drawing not to scale - Do not scale of drawing

DRAWING NO.	REV.
G1.0	1

Appendix B

- CPT Profiles
- Scala penetrometer results

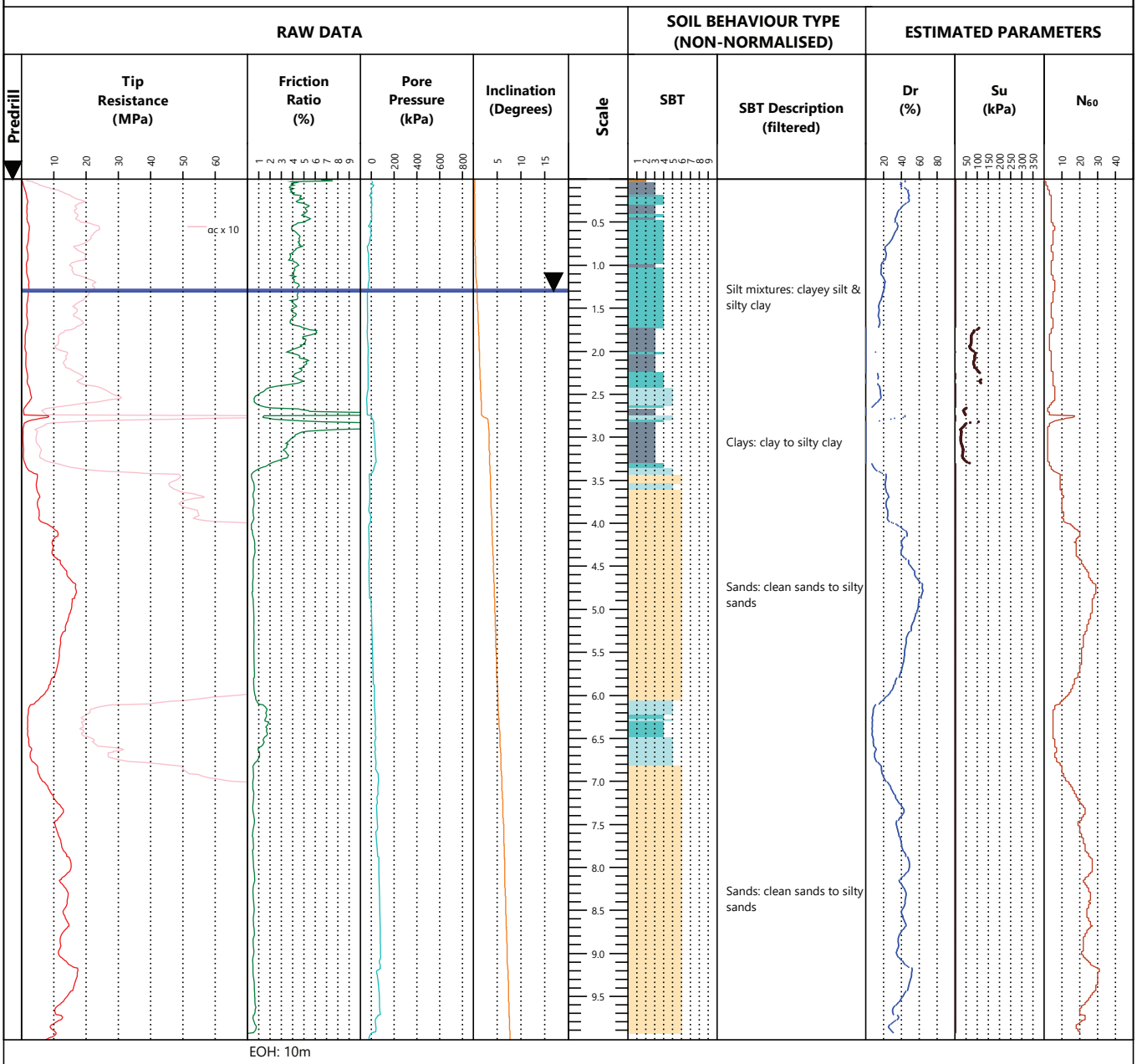
McMILLAN Drilling

Client: Tetrad Consulting		**Bore No.:** CPTu001
Project: 32 Ryan Street, Christchurch		**Job No.:** 20211

Site Location: 32 Ryan Street, Christchurch **Date:** 14/9/2021

Grid Reference: 1572895.15m E, 5179092.31m N (NZTM) - Map or aerial photograph **Rig Operator:** E. Diaz

Elevation: 0.00m **Datum:** Ground **Equipment:** Pagani TG63-150



EOH: 10m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS332
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.3m
Collapse: 2.80m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	22.1643	22.0966
Local Friction	0.2718	0.2701
Pore Pressure	3.0081	3.0072

Termination

Target Depth ✓

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

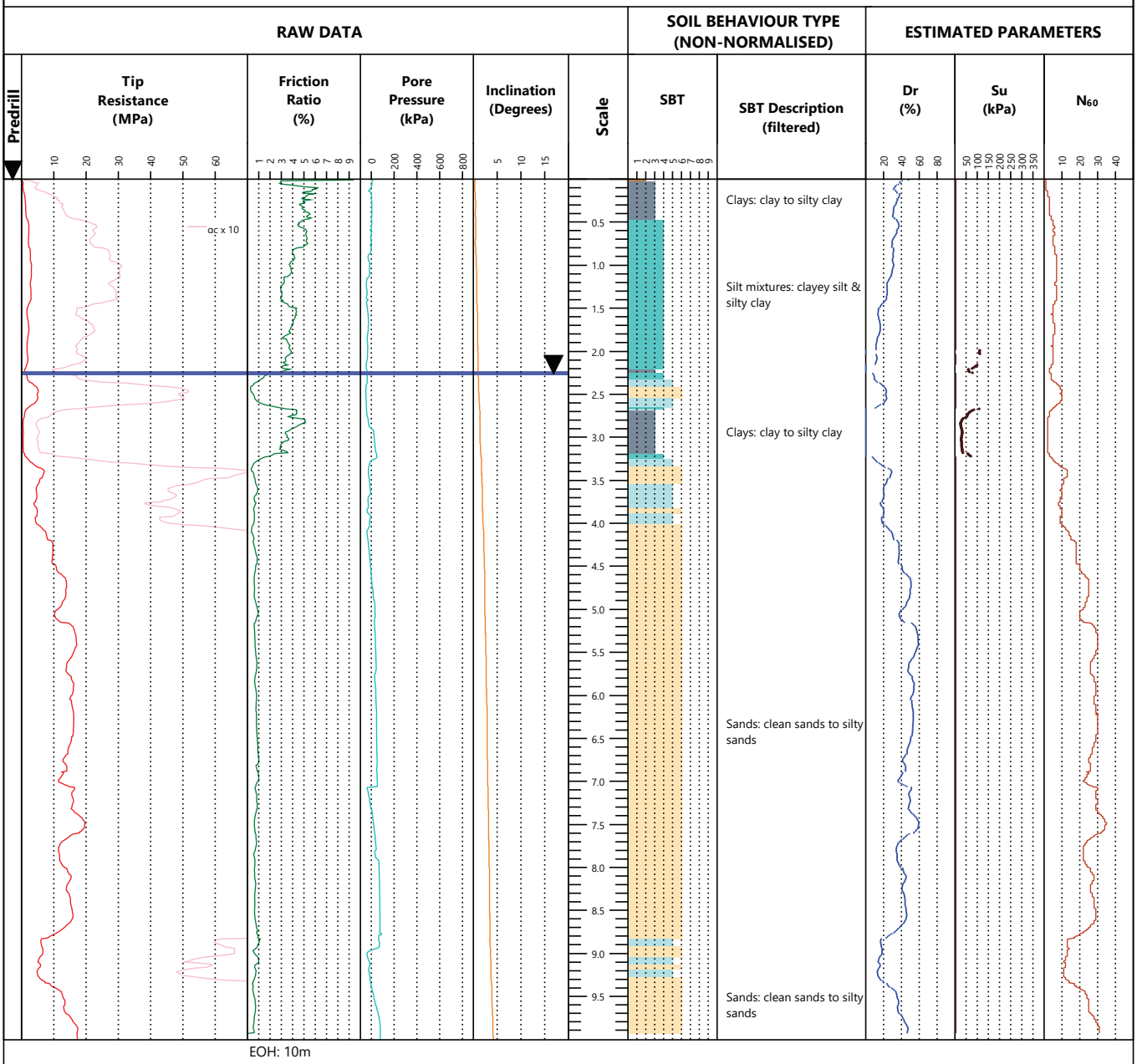
McMILLAN Drilling

Client: Tetrad Consulting		**Bore No.:** CPTu002
Project: 32 Ryan Street, Christchurch		**Job No.:** 20211

Site Location: 32 Ryan Street, Christchurch **Date:** 14/9/2021

Grid Reference: 1572933.57m E, 5179081.36m N (NZTM) - Map or aerial photograph **Rig Operator:** E. Diaz

Elevation: 0.00m **Datum:** Ground **Equipment:** Pagani TG63-150



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS332
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 2.26m
Collapse: 2.96m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	22.1903	22.1331
Local Friction	0.2715	0.2703
Pore Pressure	3.0082	3.0071

Termination

Target Depth ✓

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

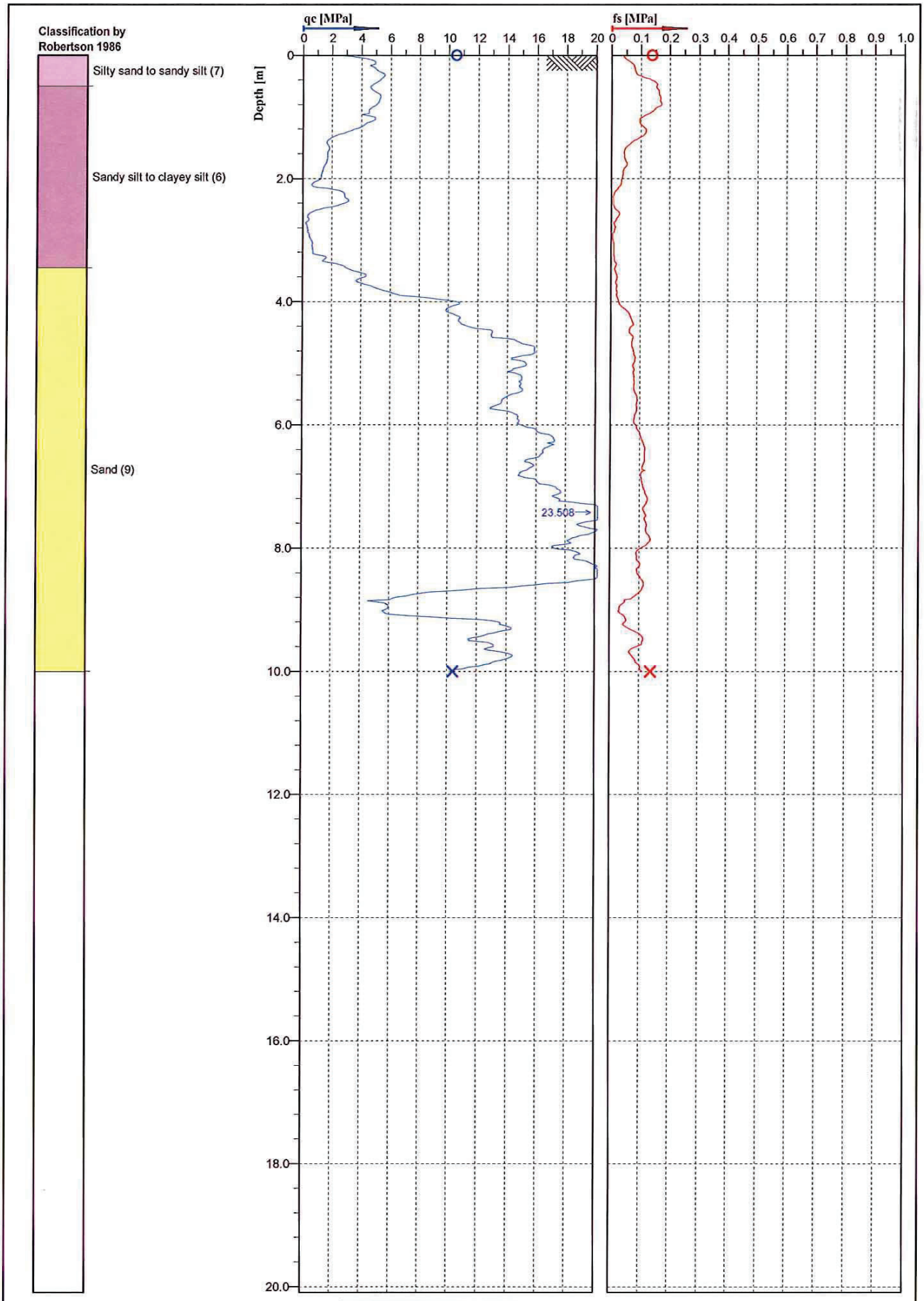
Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

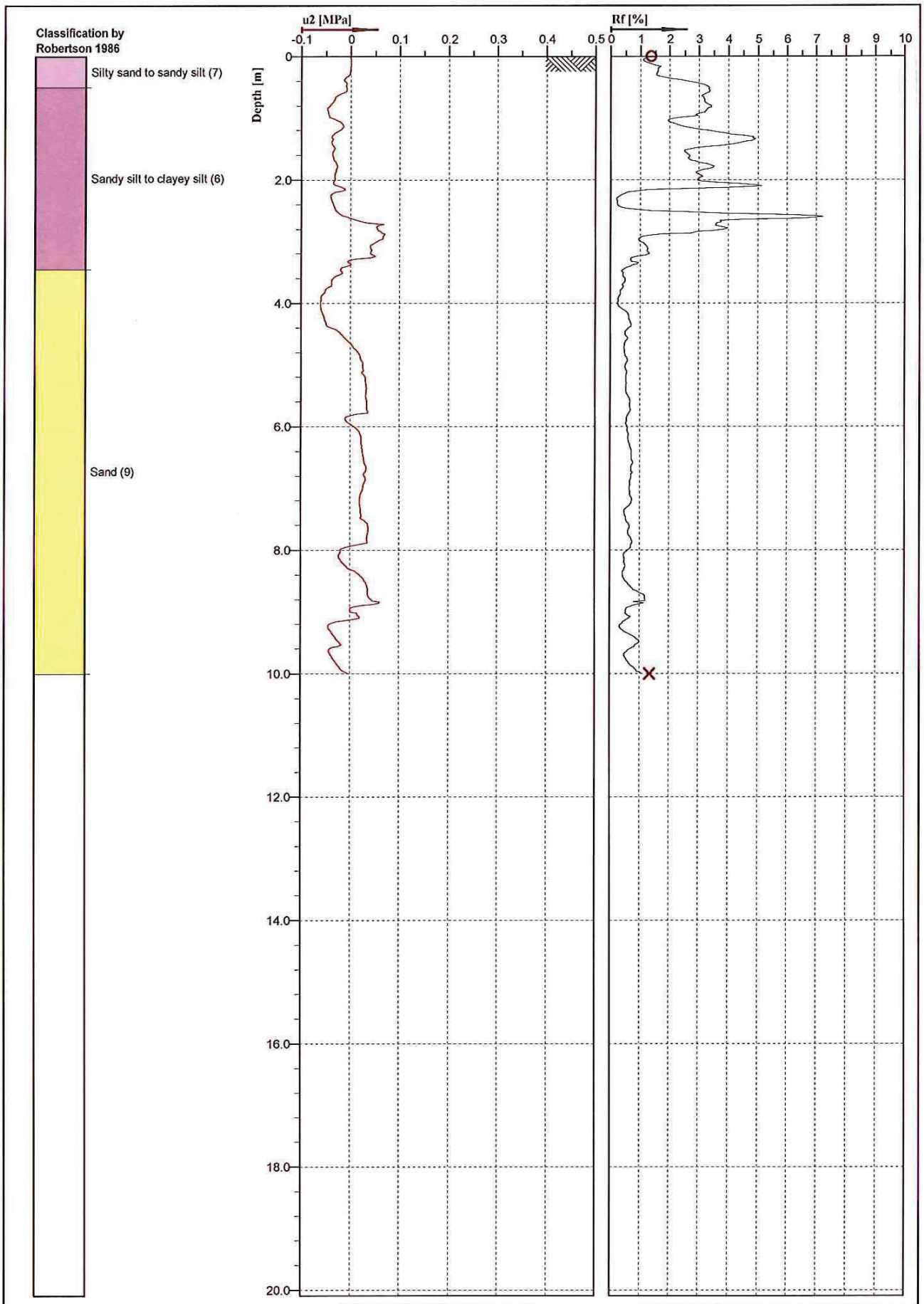


Location: LWD-POD01-CPT008	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: 1
Project ID:	Client: EQC	Date: 26/03/2013	Scale: 1 : 82
Project: 36 RYAN ST		Page: 1/1	Fig:
E1572927 N5179092		File: LWD-POD01-CPT008.cpt	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

U2

Cone No: 4439
Tip area [cm2]: 10
Sleeve area [cm2]: 150



PRO-DRILL
SPECIALIST DRILLING ENGINEERS

U2

Cone No: 4439
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: LWD-POD01-CPT008	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: 1
Project ID:	Client: EQC	Date: 26/03/2013	Scale: 1 : 82
Project: 36 RYAN ST		Page: 1/1	Fig:
E1572927 N5179092		File: LWD-POD01-CPT008.cpt	

Tetrad.	Drill Type: Scala Driller: Callum Nish	SCALA No.	SP01

Client:	A K Property Limited	**Date:**	15/10/2021
Site Address:	32 - 36 Ryan Street, Phillipstown	**Weather:**	Fine
Town/City:	Christchurch	**Project No:**	21341

Geological Formation:	Depth (m)	Sample Description:	Graphic Log	USCS	Water Table	Blow Count	Depth (m)	Blow Count/100 mm
	0.0							0 5 10 15 20
	-0.5						-0.5	
	-1.0						-1.0	
	-1.5						-1.5	
	-2.0						-2.0	
	-2.5						-2.5	
	-3.0						-3.0	
	-3.5							
	-4.0							
	-4.5							

Note:
Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only. While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

Tetrad.
Quality in Design

Drill Type: Scala
Driller: Callum Nish

SCALA No. **SP02**

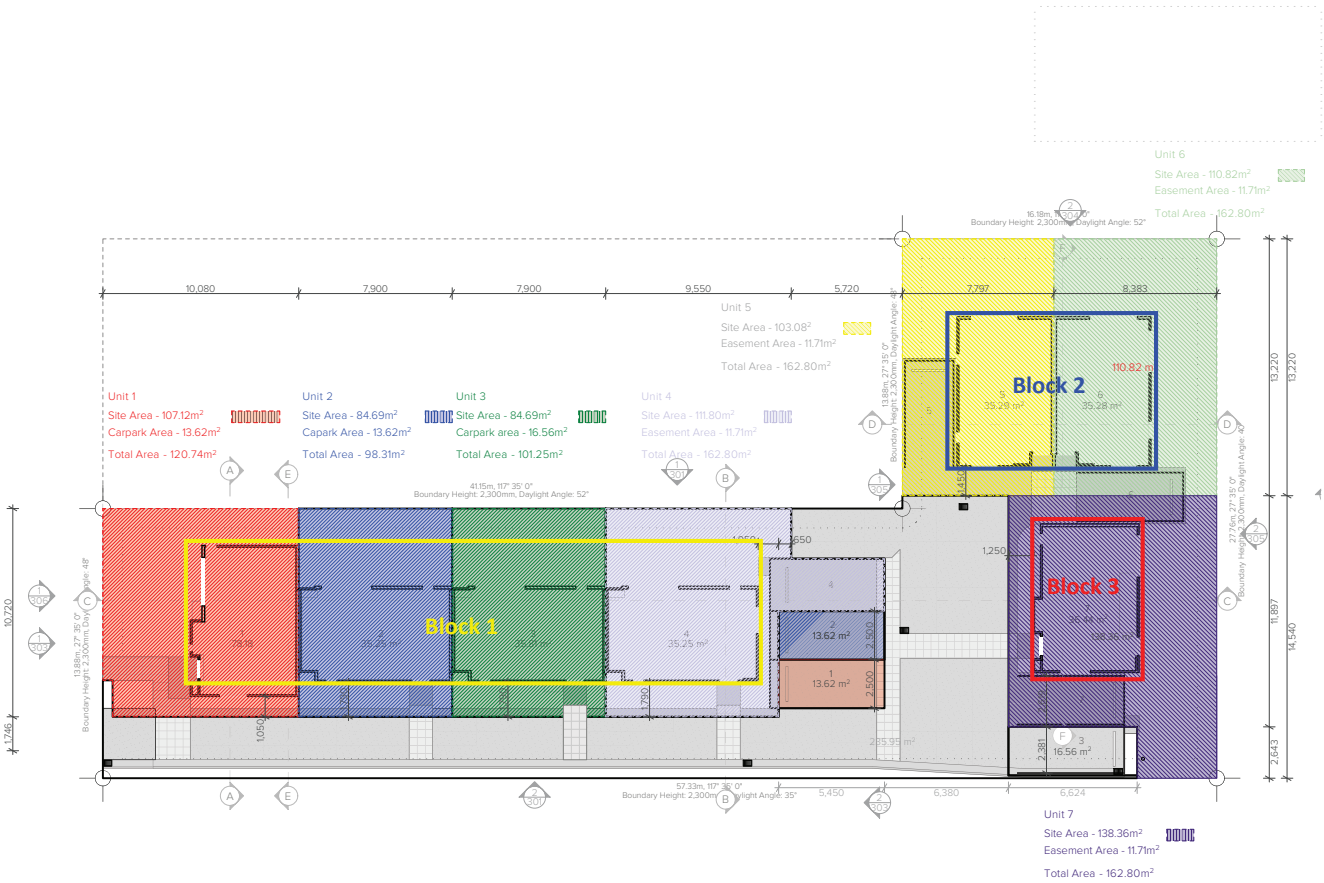
Client:	A K Property Limited	**Date:**	15/10/2021
Site Address:	32 - 36 Ryan Street, Phillipstown	**Weather:**	Fine
Town/City:	Christchurch	**Operator:**	21341

Geological Formation:	Depth (m)	Sample Description:	Graphic Log	USCS	Water Table	Dynamic Cone Penetrometer: Blow Count	Depth (m)	Blow Count/100 mm
	0.0							0 5 10 15 2
	-0.5						-0.5	
	-1.0						-1.0	
	-1.5						-1.5	
	-2.0						-2.0	
	-2.5						-2.5	
	-3.0						-3.0	
	-3.5							
	-4.0							
	-4.5							

Note:
Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only. While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

Appendix C

- Site plan for proposed 7 -unit residential development
- Statement of Professional Opinion



1 Site Subdivision Plan 1:200

coll architecture
021 223 0113 / 03 359 7391 info@collarchitecture.co.nz www.collarchitecture.co.nz

AK Residential - 32 & 36 Ryan Street. Christchurch

Sheet title: Site Subdiivision Plan

Date: 1/03/2022
Drawn by: Josh Campbell-Tie
Scale: 1:200 @ A3

A103

District Plan Zone:
Residential Suburban Density Transition Zone

Legal Description:
Lot: 13 DP: 9028 (32 Ryan St)

Legal Description:
Lot: 14 DP: 9028 (36 Ryan St)

Site Area: 1020.32m²

Total Ground Floor Slab Area: 263.25m²
Total First Floor Area: 237.46m²
Total Floor Area: 500.71m²

Covered bike storage area: 0m²
Total Service, Storage & Waste management space: 50.96m²
Deck area: 97.16m²
Total site coverage: 235.98m² (22.64%)

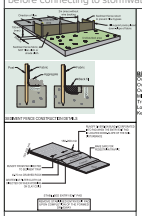
Total Outdoor Living Space: 285.21m²

Site Notes:
Dimensions to foundation

Refer to foundation plan for more detailed drainage

Site to be fully fenced before commencing construction, fence to comply with NZBC clause F5/AS1 part 1

Site Drainage Notes:
All Novaflo drainage to discharge to silt traps before connecting to stormwater drainage



Setout Notes:
Contractor to obtain surveyors certificates during construction to confirm compliance with height in relation to boundary requirements

Unit 1 Ground Floor Area: 40.53m² First Floor Area: 35.44m² Total Floor Area: 75.97m²	Unit 4 Ground Floor Area: 35.25m² First Floor Area: 32.37m² Total Floor Area: 67.62m²	Unit 7 Ground Floor Area: 39.83m² First Floor Area: 36.75m² Total Floor Area: 76.58m²
Unit 2 Ground Floor Area: 35.25m² First Floor Area: 32.37m² Total Floor Area: 67.62m²	Unit 5 Ground Floor Area: 38.29m² First Floor Area: 33.15m² Total Floor Area: 71.44m²	
Unit 3 Ground Floor Area: 35.81m² First Floor Area: 34.23m² Total Floor Area: 70.04m²	Unit 6 Ground Floor Area: 38.29m² First Floor Area: 33.15m² Total Floor Area: 71.44m²	

coll architecture

AK Residential - 32 & 36 Ryan Street. Christchurch

Sheet title:
Site Plan 1:200

Date: 15/11/2021
Drawn by: Josh Campbell-Tie
Scale: 1:200 @ A3

A101

021 223 0113 / 03 359 7391 info@collarchitecture.co.nz www.collarchitecture.co.nz

Statement of Professional Opinion on the Suitability of Land for Subdivision

(Appendix I to the Infrastructure Design Standard)

Issued by: Tetrad Consulting Limited
(Geotechnical engineering firm or suitably qualified engineer)

To: A K Property Limited
(Owner/Developer)

To be supplied to: Christchurch City Council
(Territorial authority)

In respect of: Subdivision of 32/36 Ryan Street
(Description of proposed infrastructure/land development)

At: 32/36 Ryan Street, Phillipstown, Christchurch
(Address)

I Steven Roberts on behalf of Tetrad Consulting Limited
(Geotechnical engineer) *(Geotechnical engineering firm)*

hereby confirm:

1. I am a suitably qualified and experienced geotechnical engineer and was retained by the owner/developer as the geotechnical engineer on the above proposed development.

2. ~~My~~/the geotechnical assessment report, dated 01.07.2022 has been carried out in accordance with the Ministry of Business and Innovation *Guidelines for geotechnical investigation and assessment of subdivisions* and includes:
   (i) Details of and the results of my/the site investigations.
   (ii) A liquefaction assessment.
   (iii) An assessment of ~~rockfall and slippage, including~~ hazards resulting from seismic activity.
   (iv) An assessment of the ~~slope stability and~~ ground bearing capacity confirming the location and appropriateness of building sites.
   (v) Recommendations proposing measures to avoid, remedy or mitigate any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.

3. In my professional opinion, I consider that Council is justified in granting consent incorporating the following conditions:

   Shallow ground improvement to **1.1m** depth below lowest adjacent ground level complete with waffle slab foundation for **Units 1 to 4** inclusive.

   Shallow ground improvement to **0.8m** depth below lowest adjacent ground level complete with waffle slab foundation for **Units 5 to 7** inclusive.

4. This professional opinion is furnished to the territorial authority and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.

5. This certificate shall be read in conjunction with my/the geotechnical report referred to in Clause 2 above, and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

6. The geotechnical engineering firm issuing this statement holds a current policy of professional indemnity insurance of no less than $ 500,000
(Minimum amount of insurance shall be commensurate with the current amounts recommended by IPENZ, ACENZ, TNZ, INGENIUM.)

..... Date: 01.07.2022

(Signature of Engineer)

Qualifications and experience:

CPEng (Geotechnical), MEngNZ, IntPE(NZ)

Appendix D

- Liquefaction analysis results for:
  - SLS1 0.13g
  - SLS2 0.19g
  - ULS 0.35 g

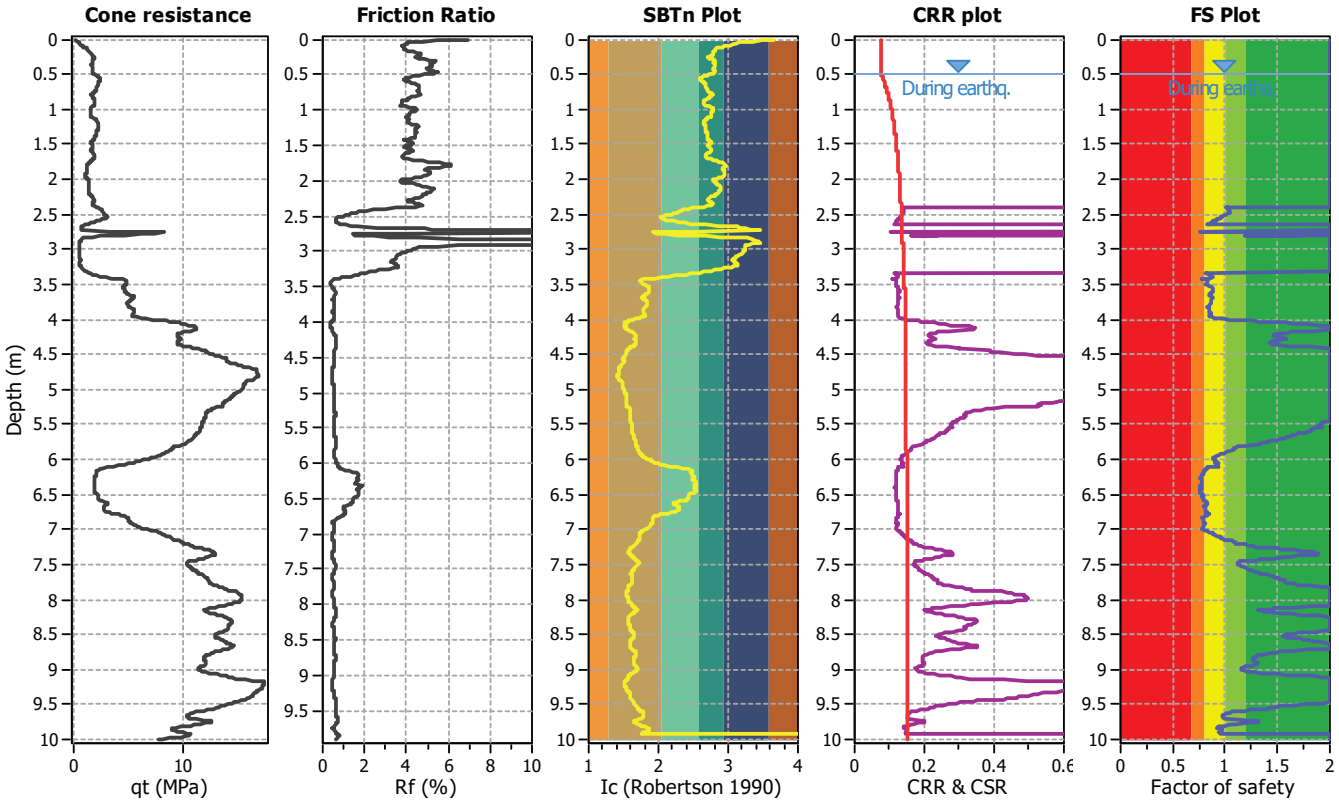
LIQUEFACTION ANALYSIS REPORT

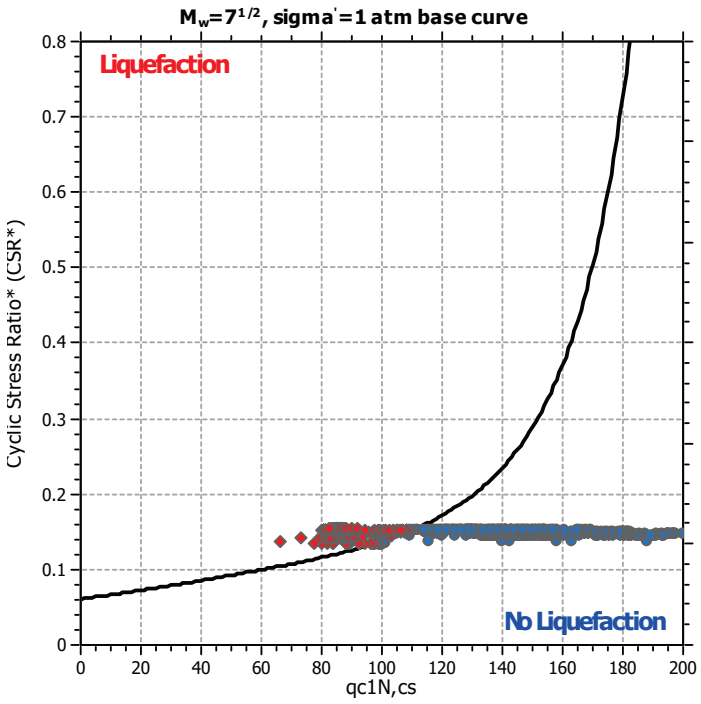
Project title : Multi-unit development **Location : 32 - 36 Ryan Street, Christchurch**

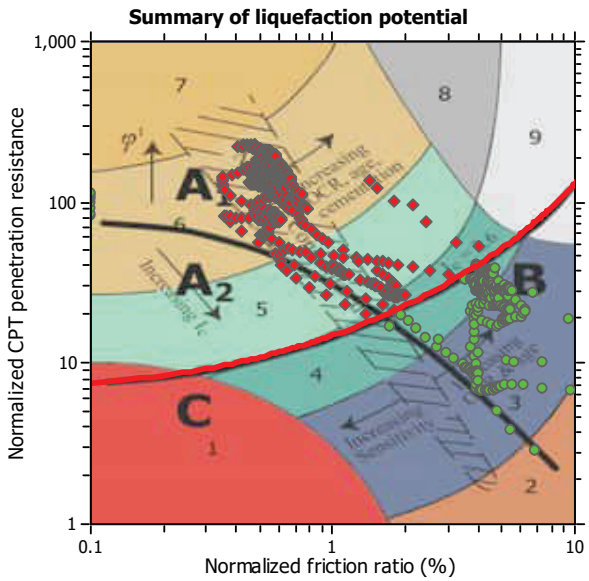
CPT file : CPT01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

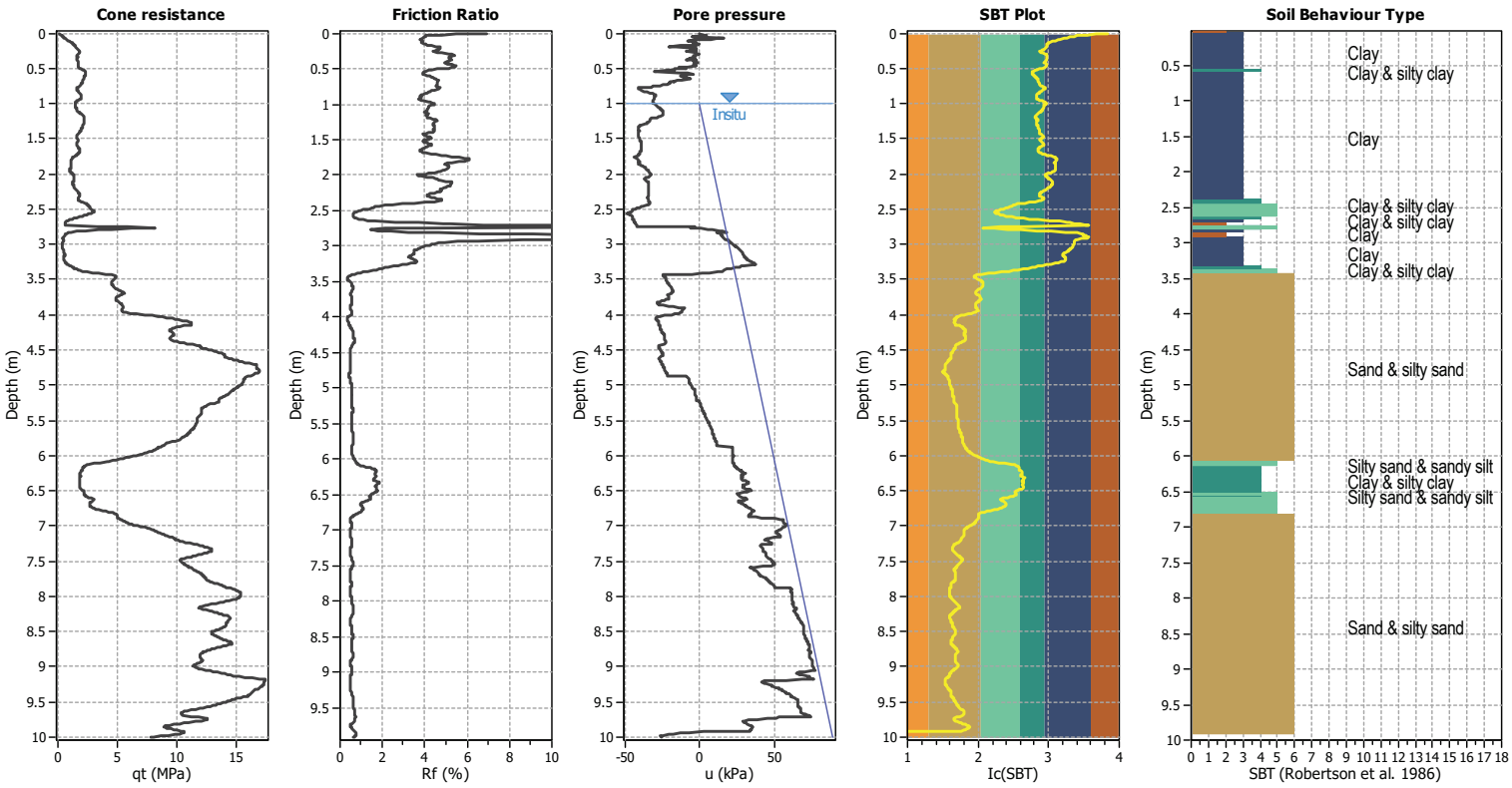






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and 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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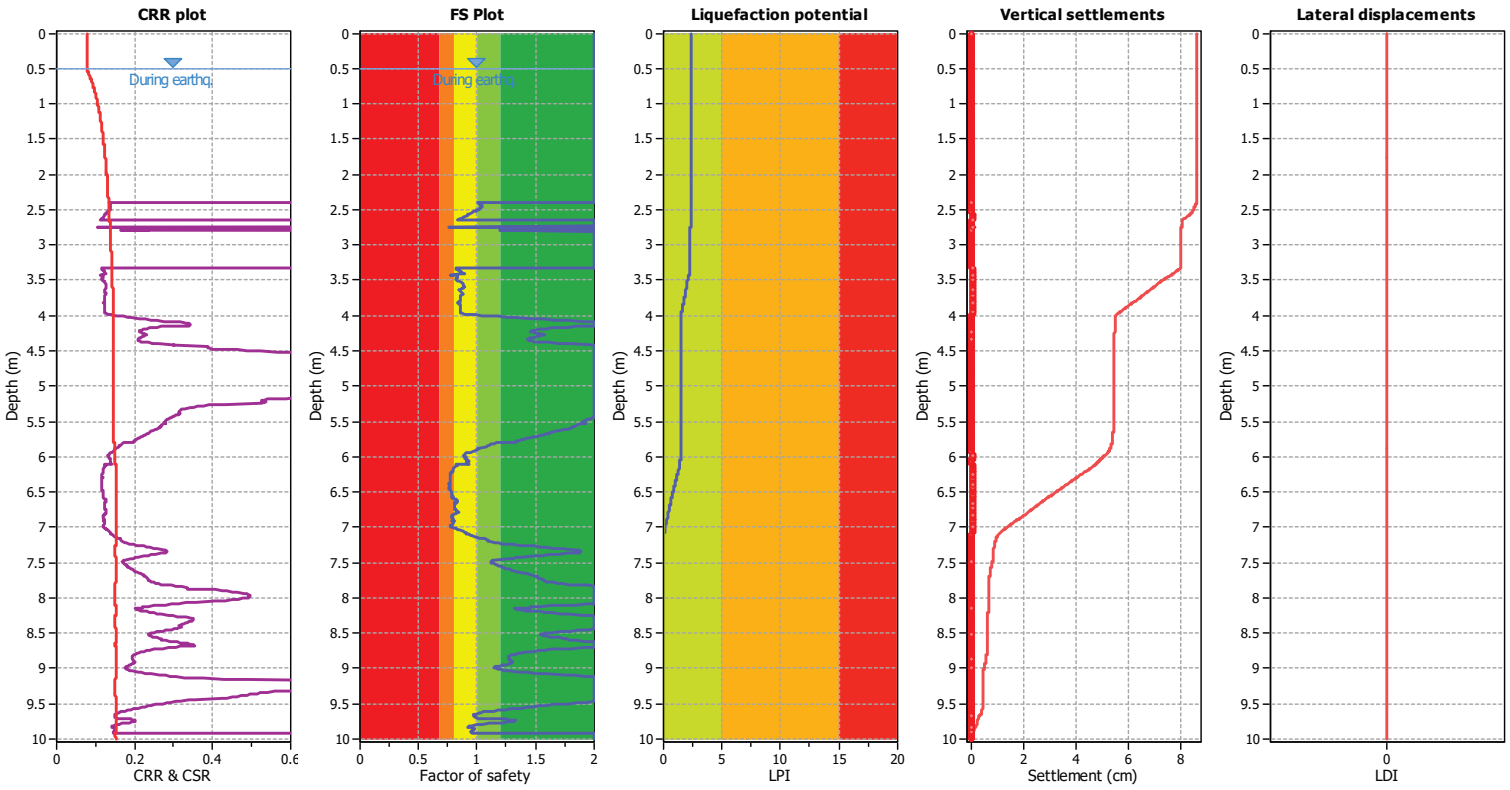
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

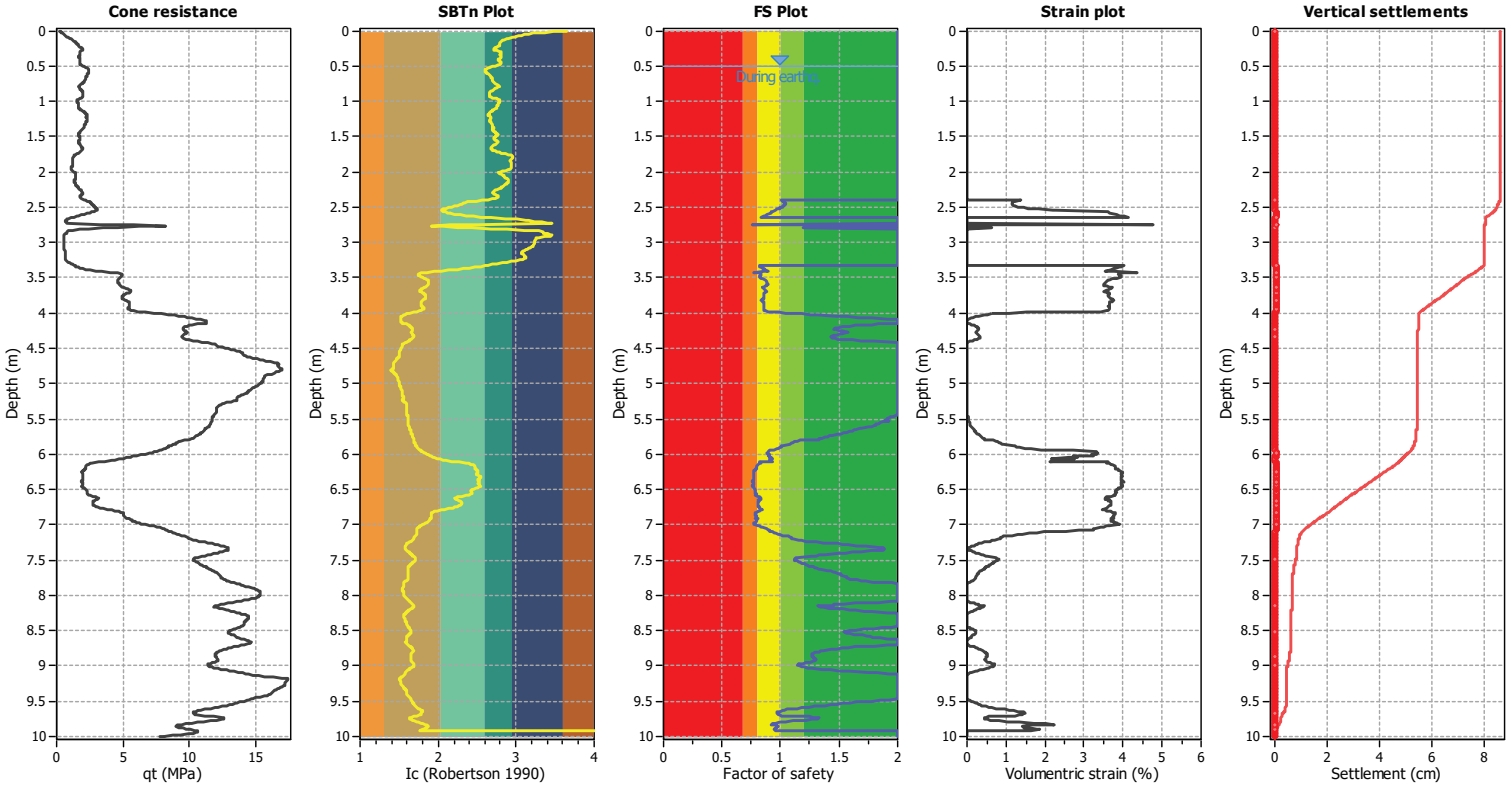
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

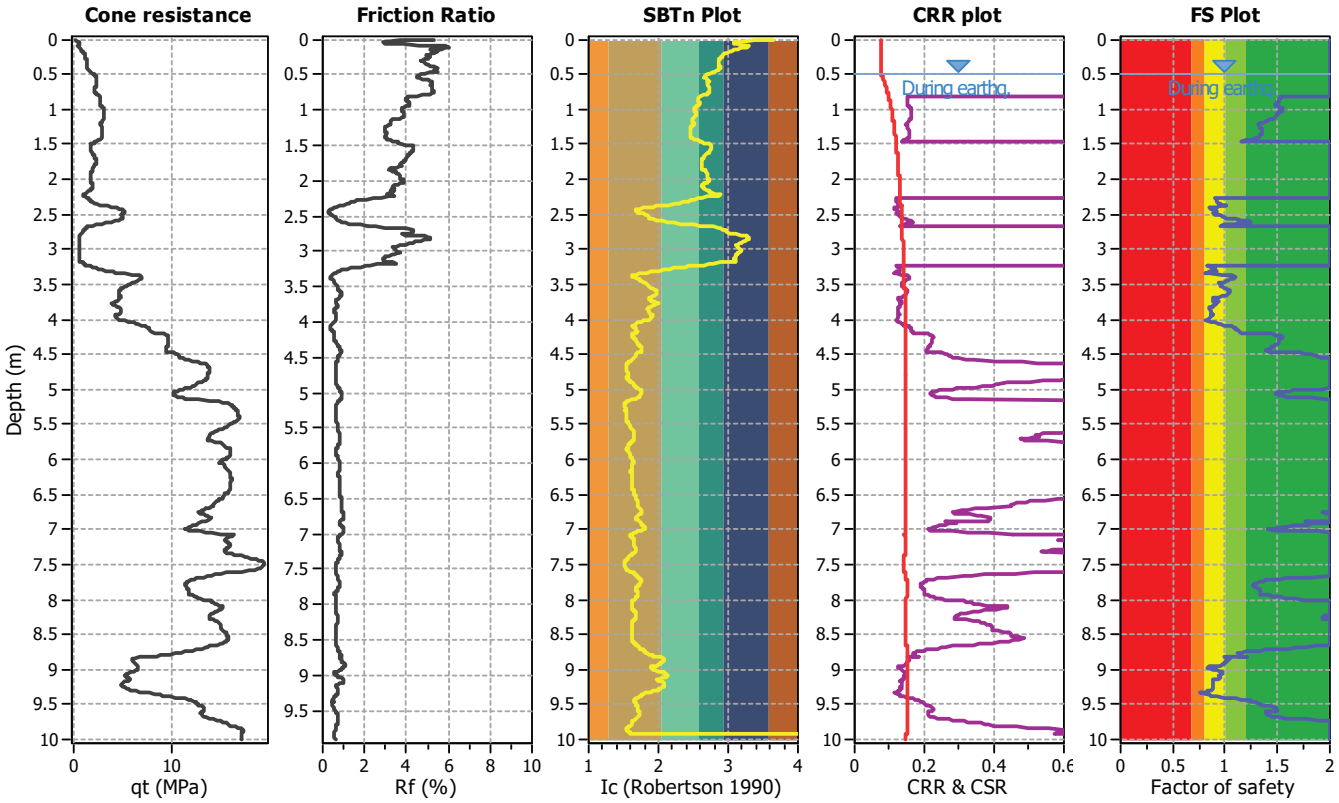
LIQUEFACTION ANALYSIS REPORT

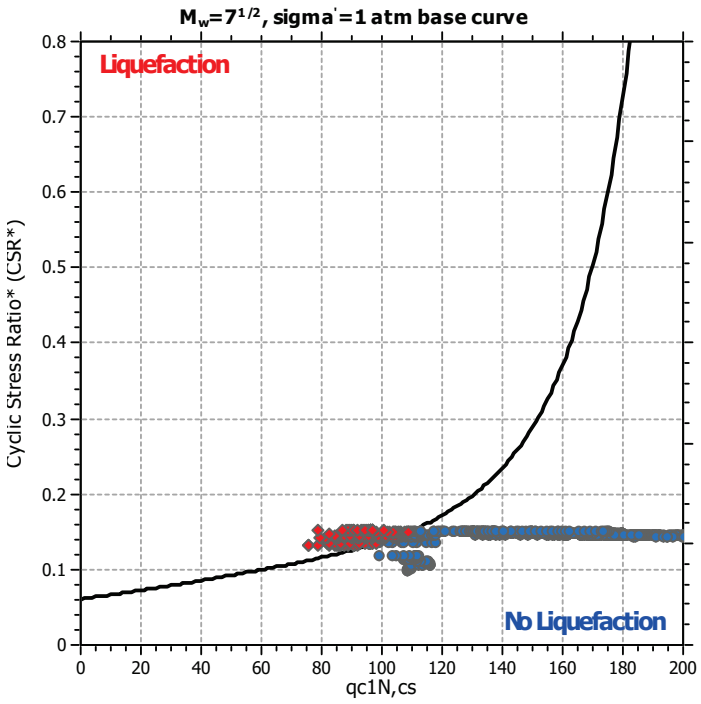
Project title : Multi-unit development **Location : 32 - 36 Ryan Street, Christchurch**

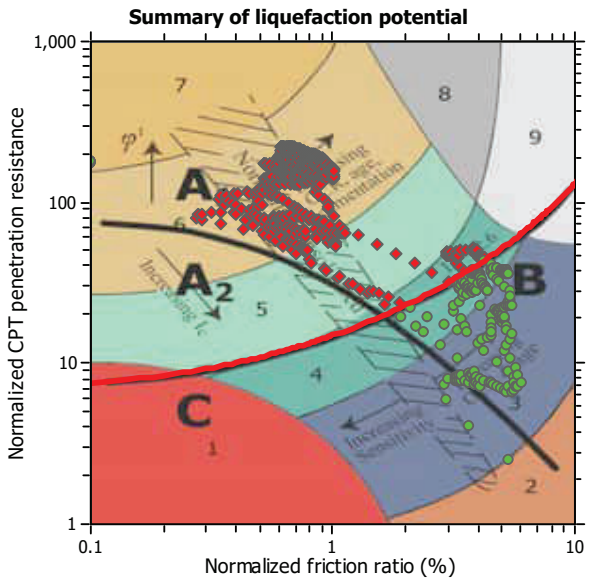
CPT file : CPT02

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

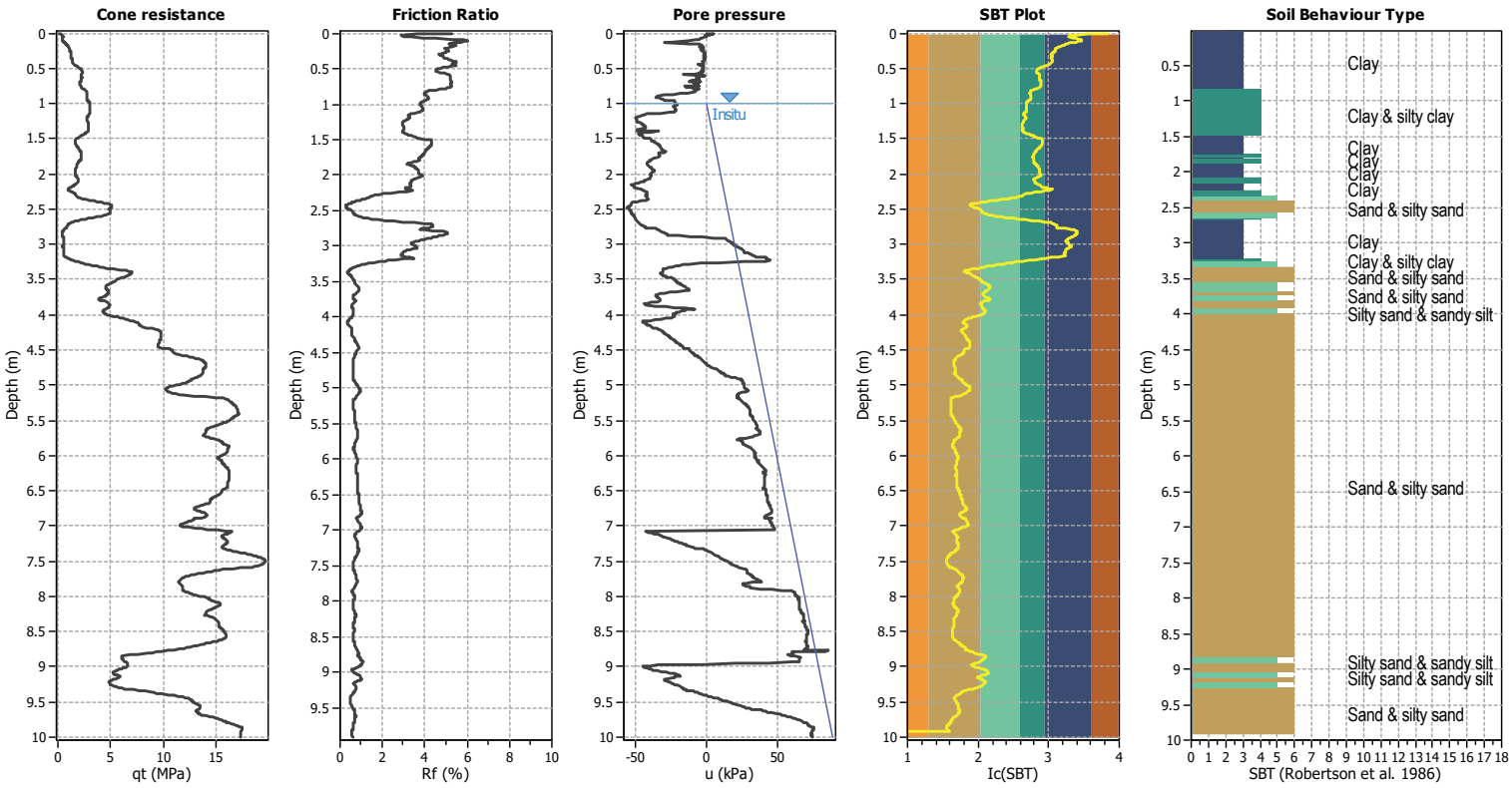






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



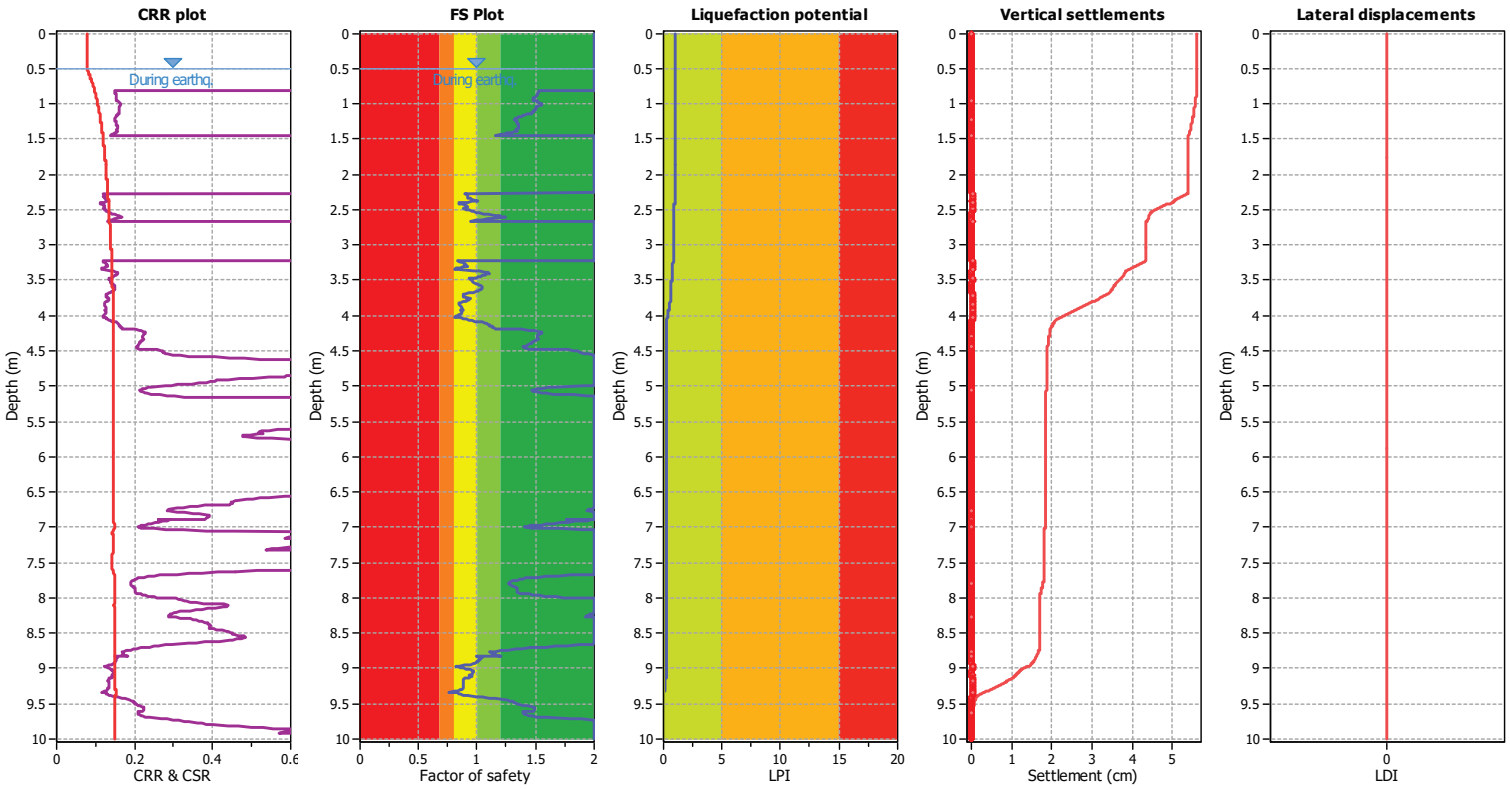
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
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F.S. color scheme

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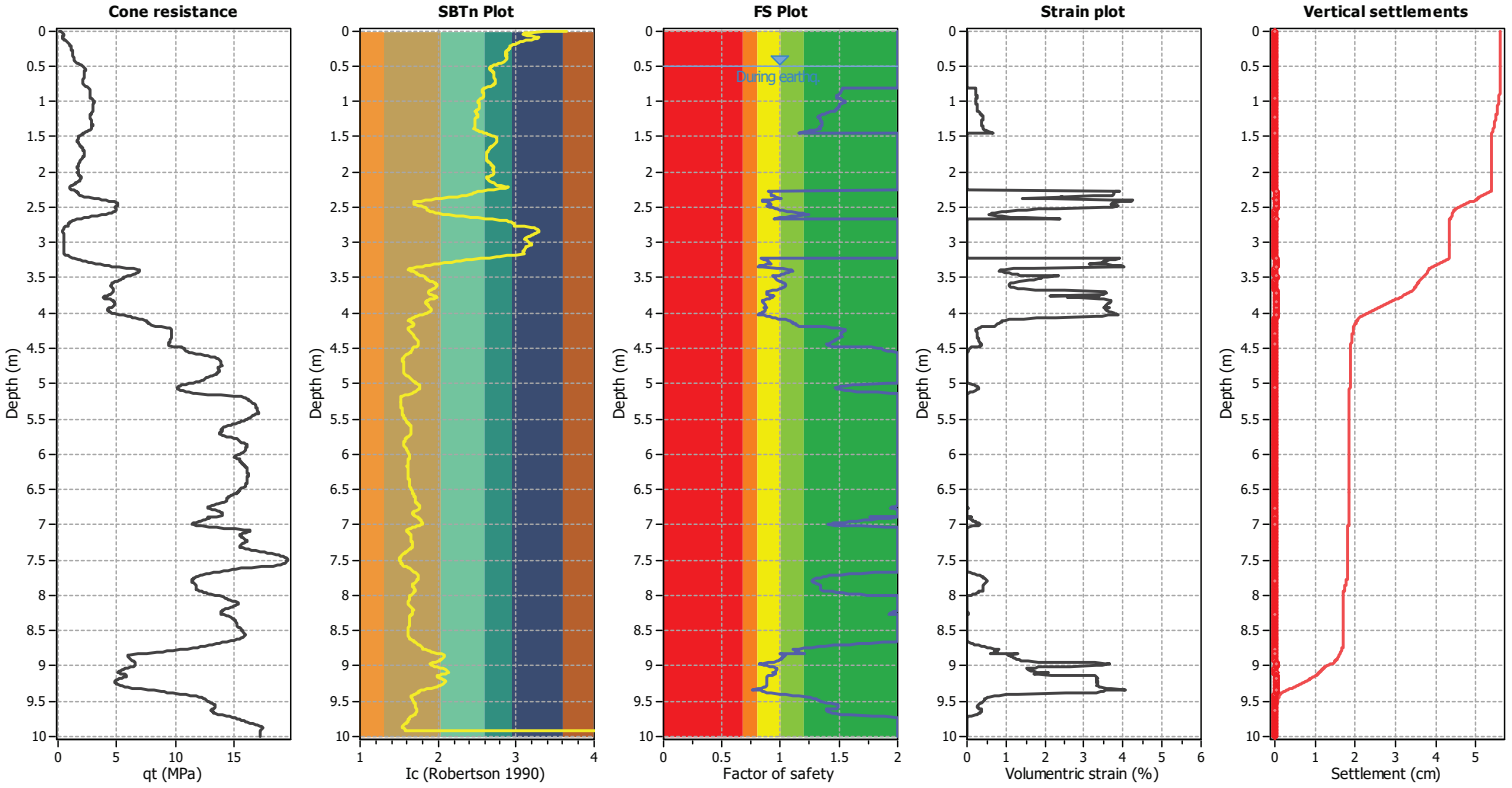
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

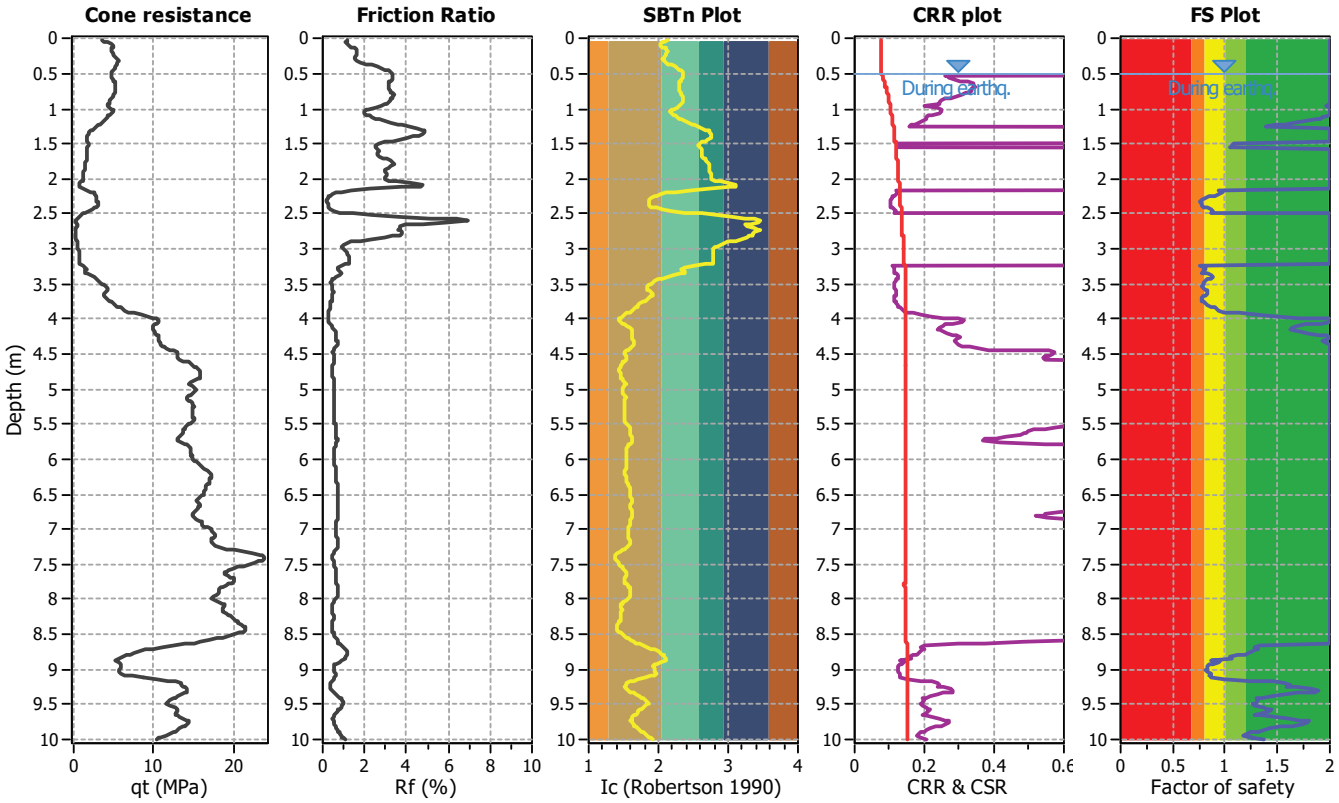
LIQUEFACTION ANALYSIS REPORT

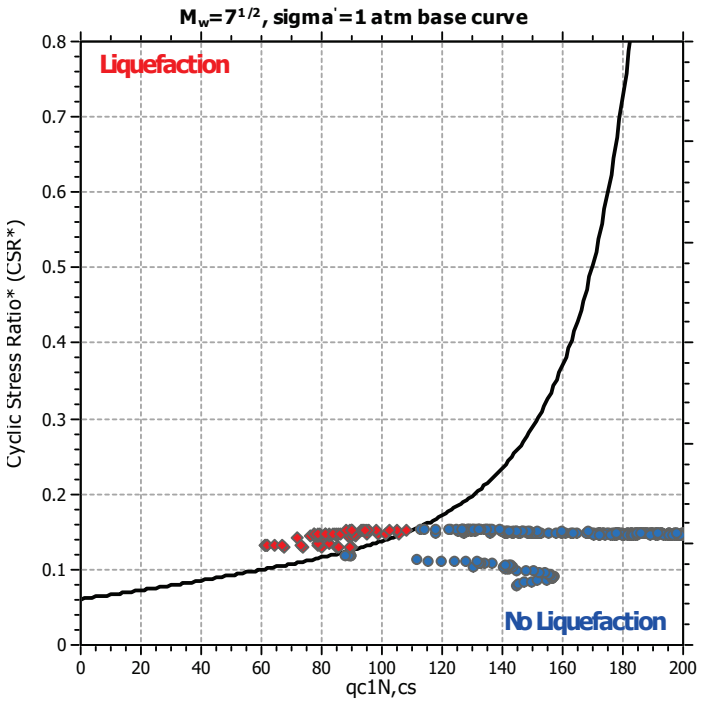
Project title : Multi-unit development **Location : 32 - 36 Ryan Street, Christchurch**

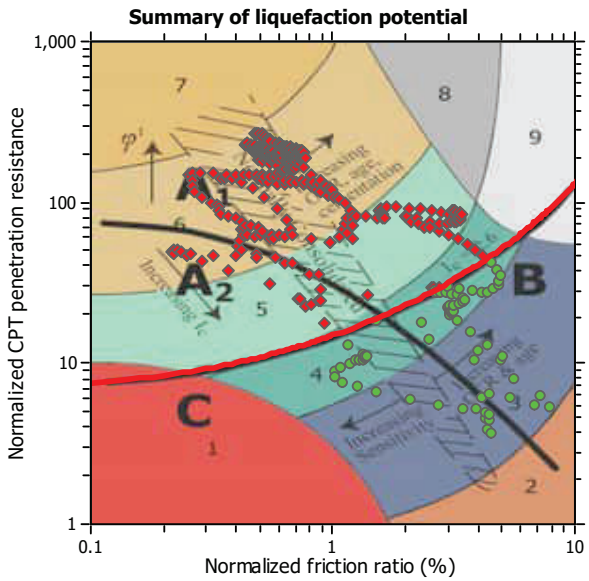
CPT file : CPT19005

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.13	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
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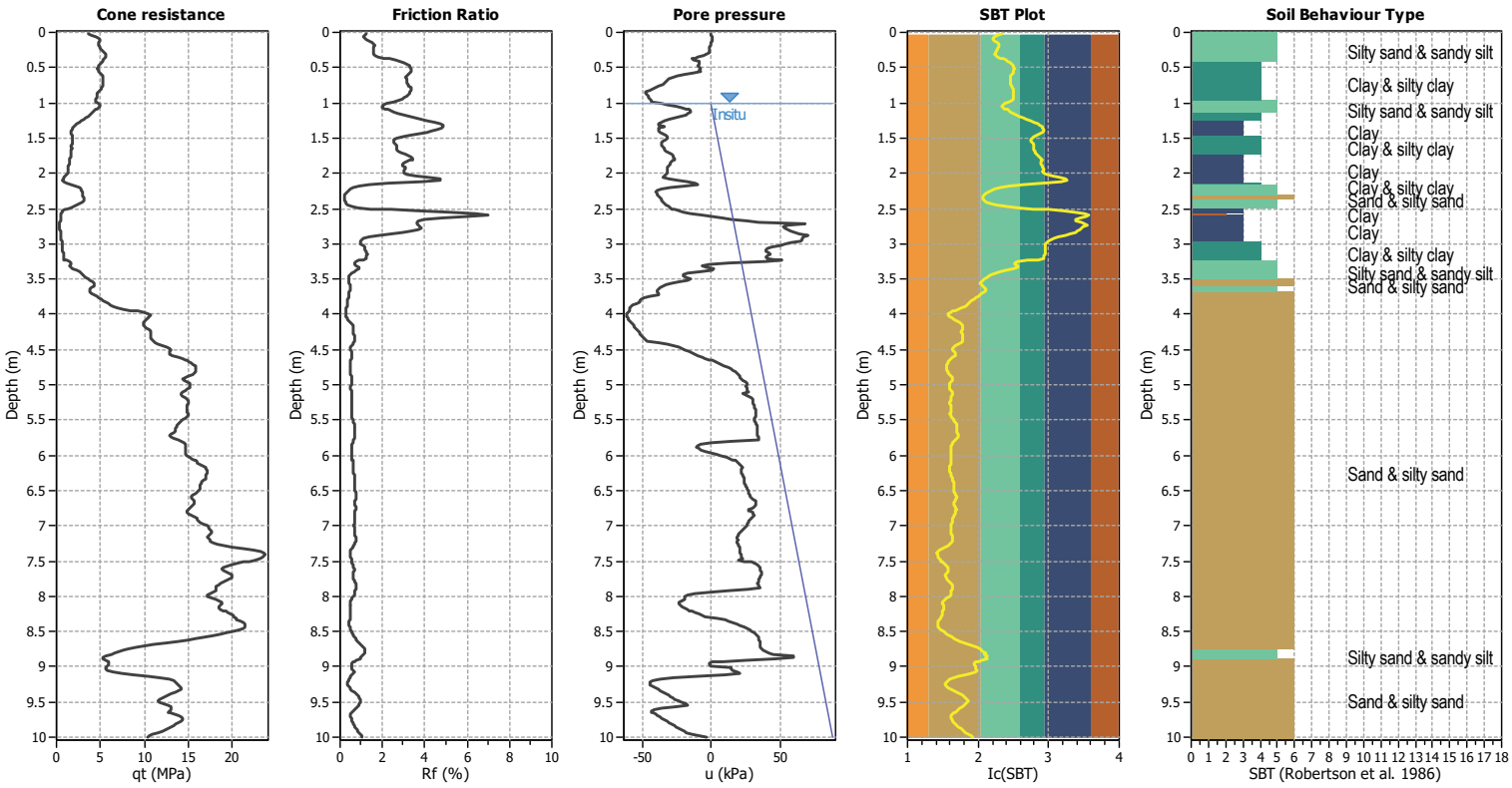
CPT basic interpretation plots



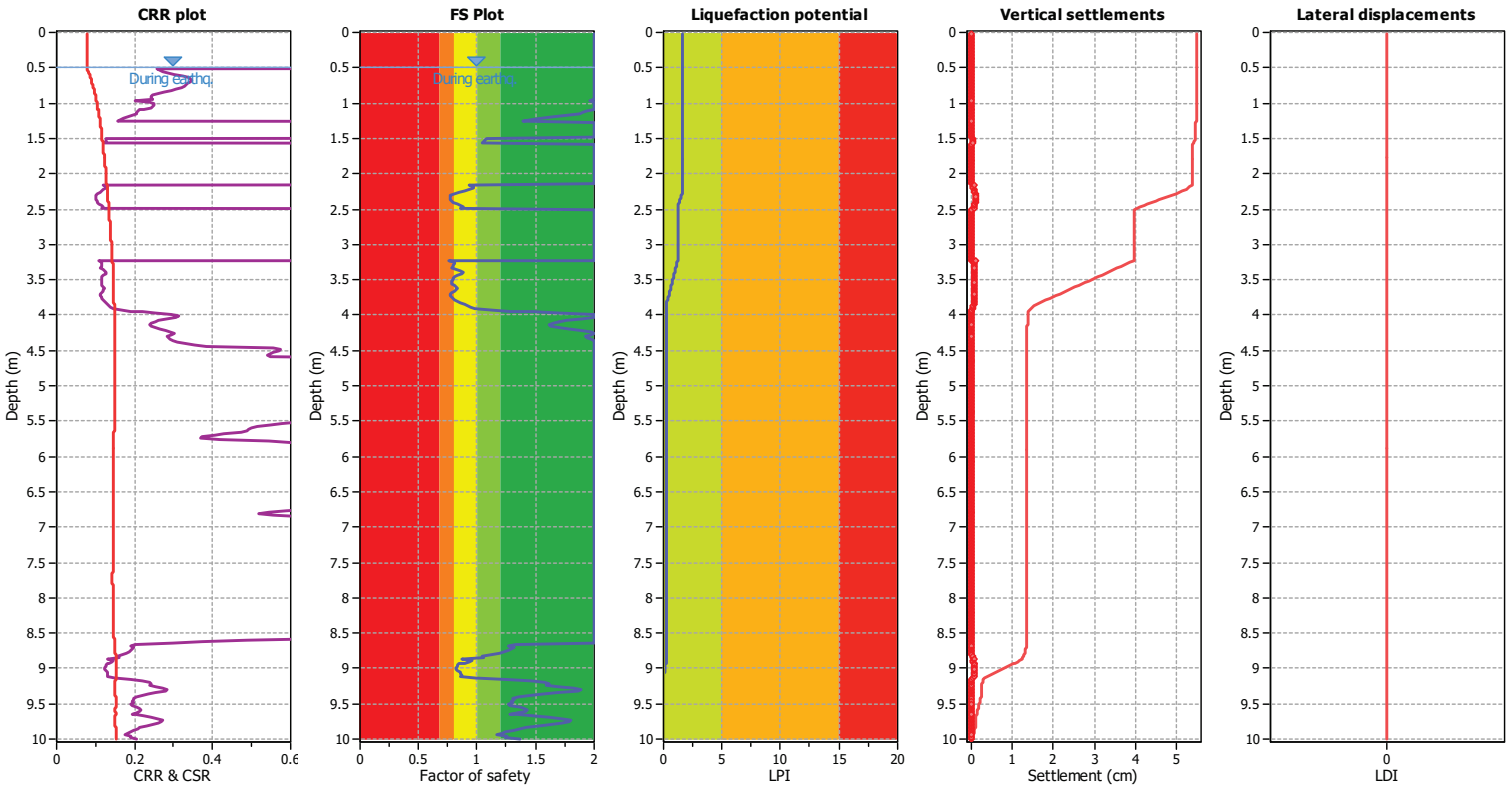
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

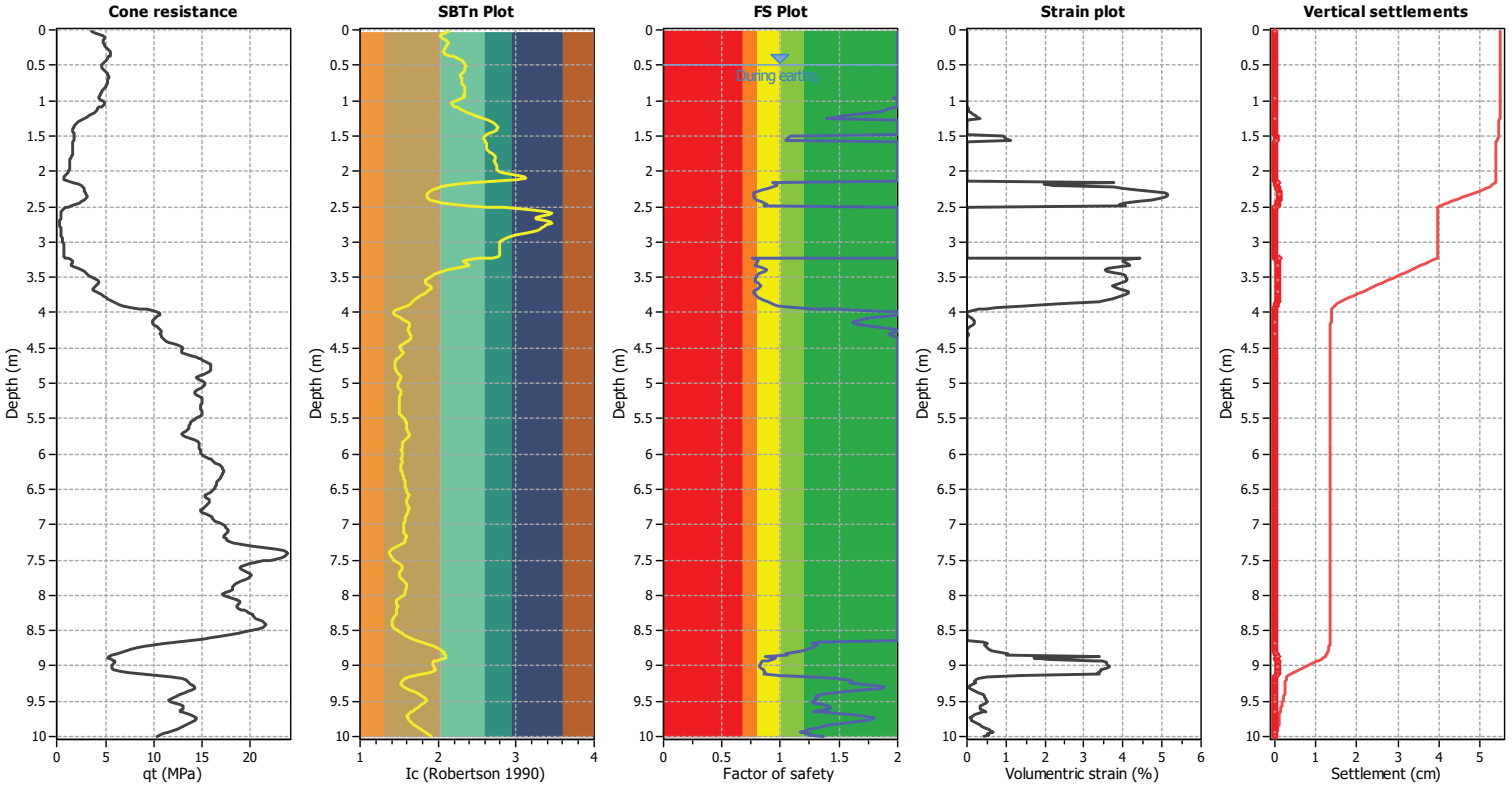
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

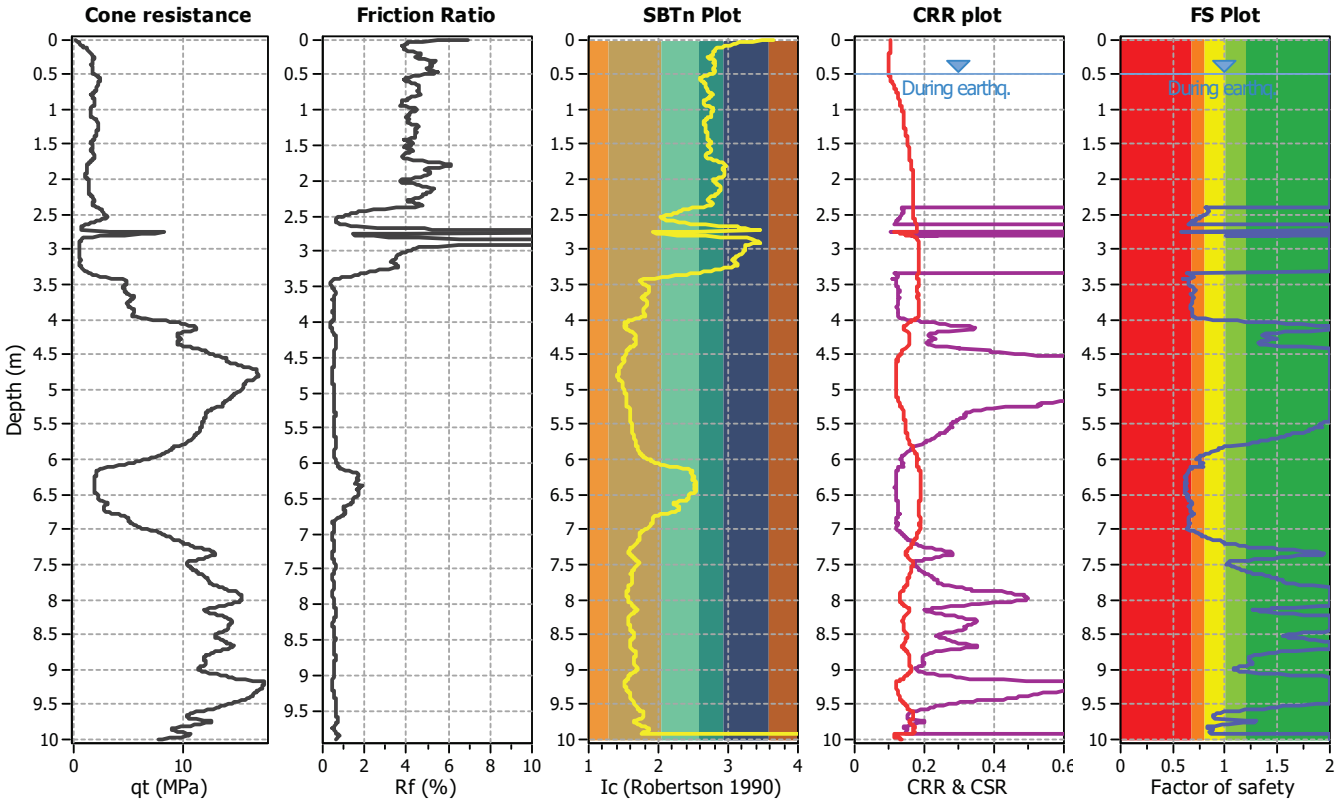
LIQUEFACTION ANALYSIS REPORT

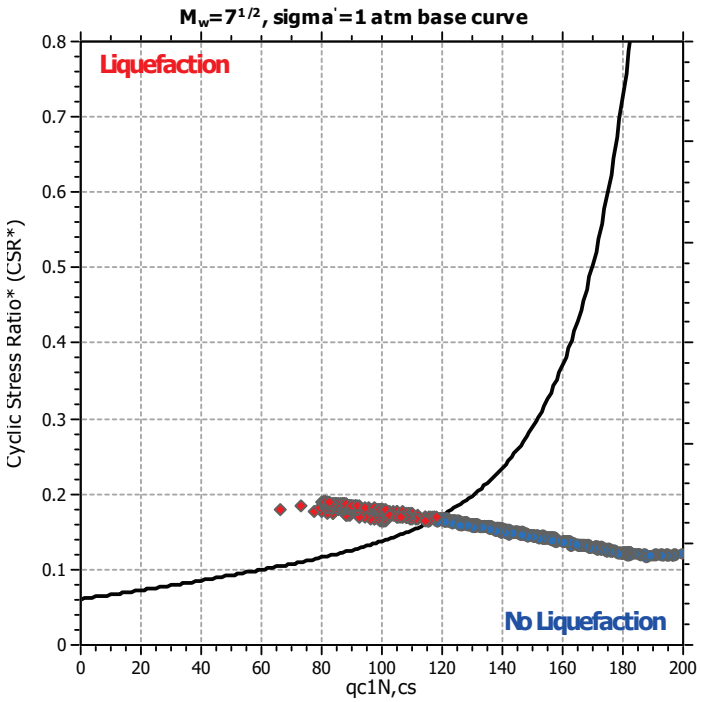
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

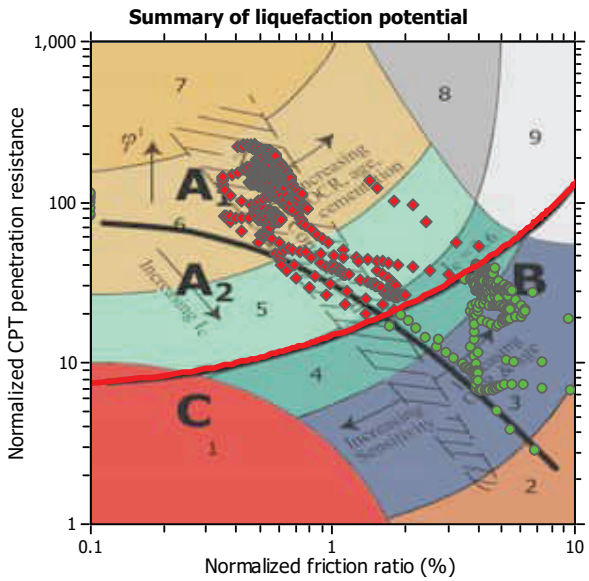
CPT file : CPT01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

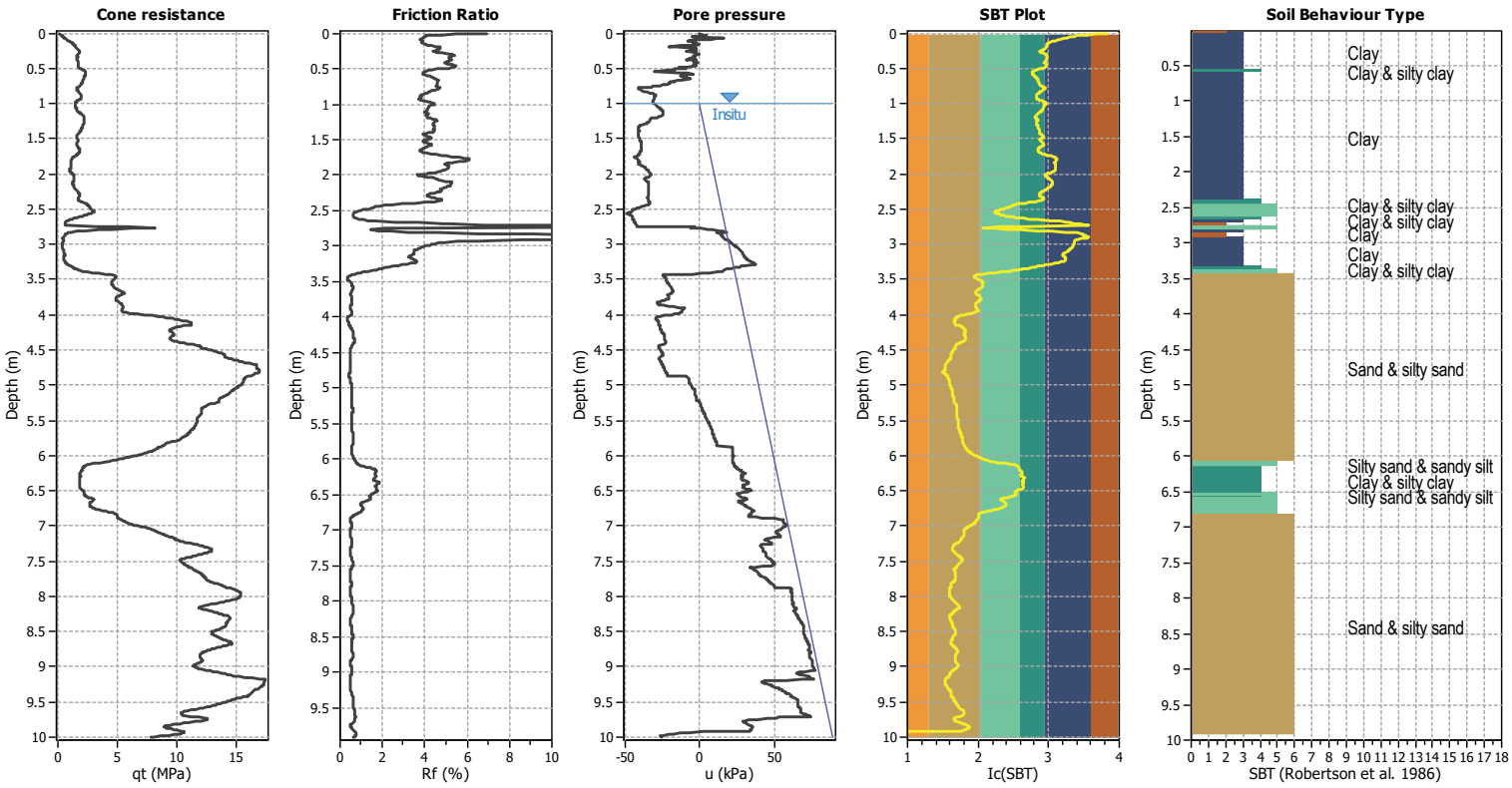






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



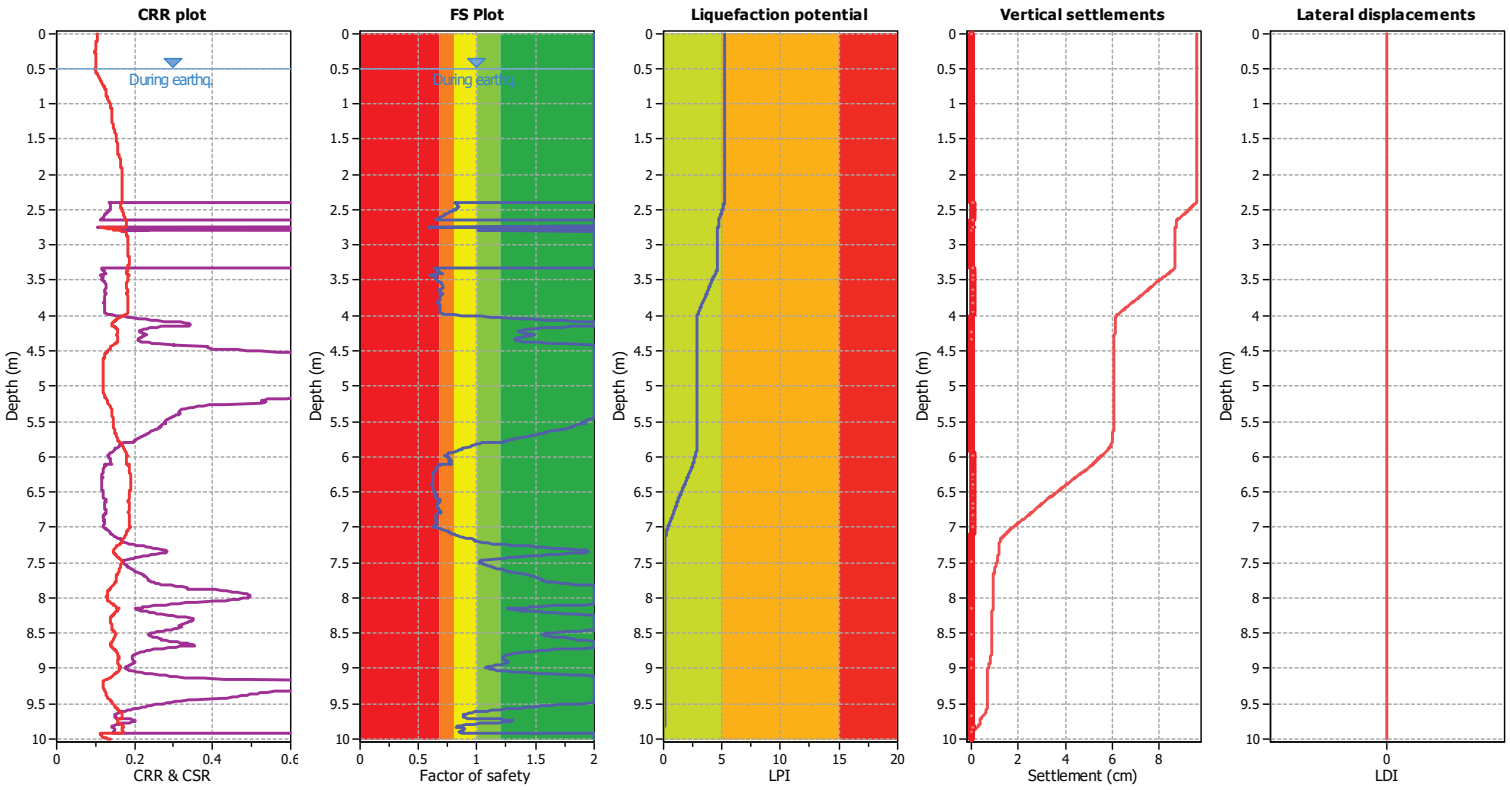
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

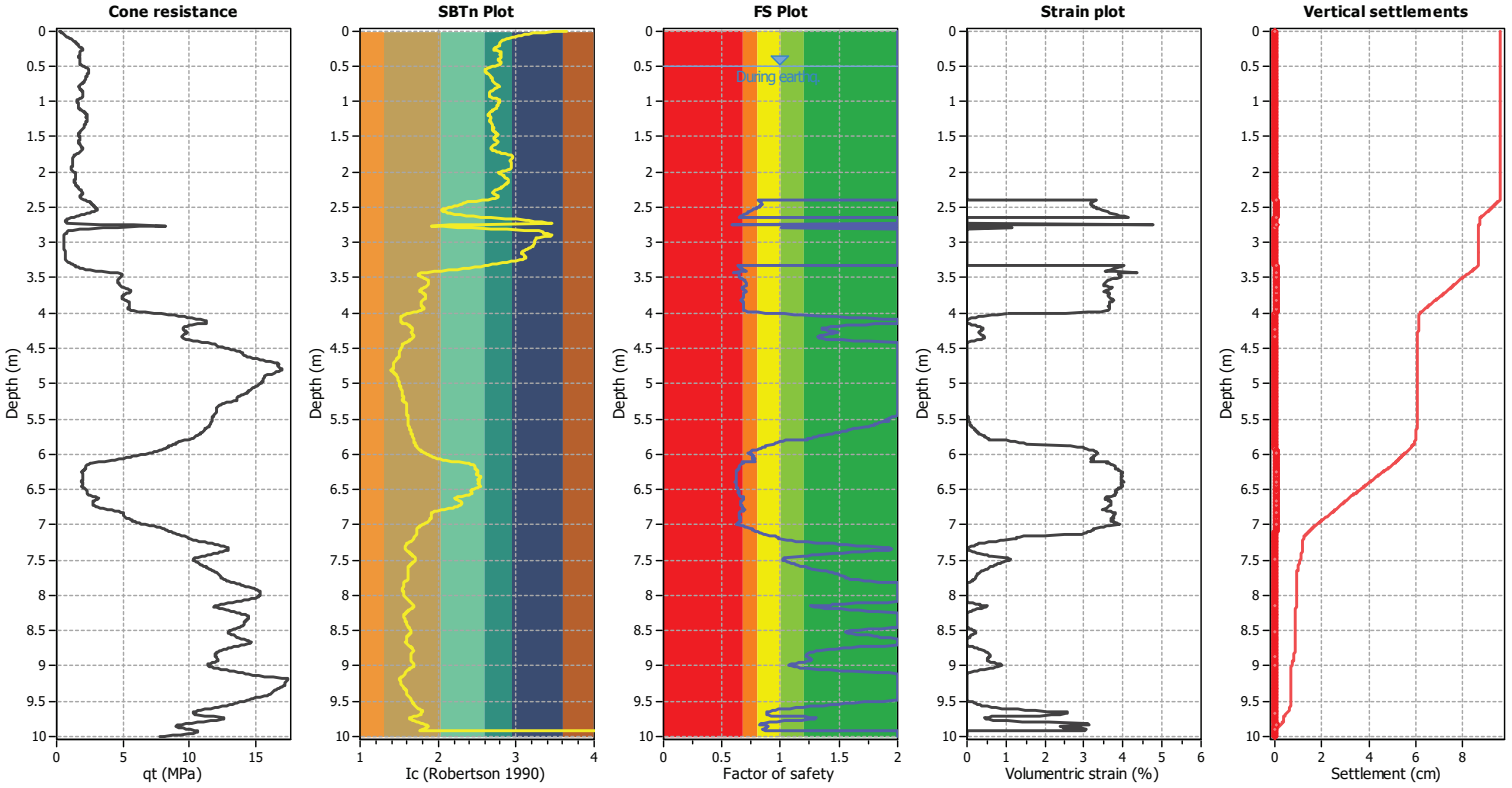
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

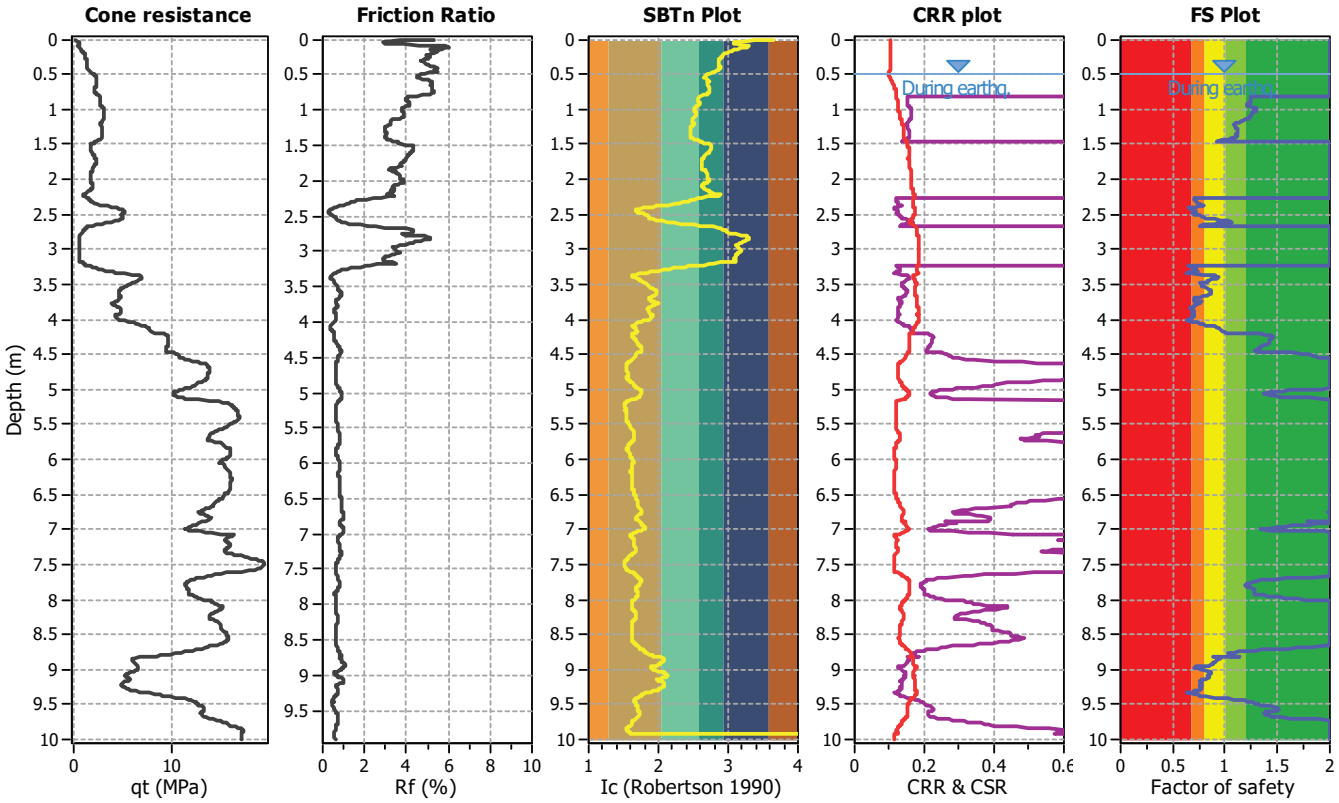
LIQUEFACTION ANALYSIS REPORT

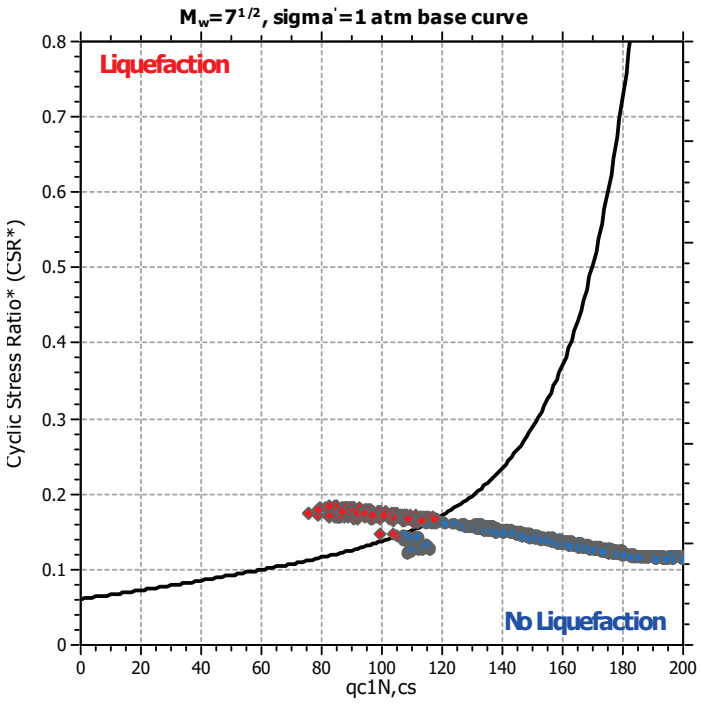
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

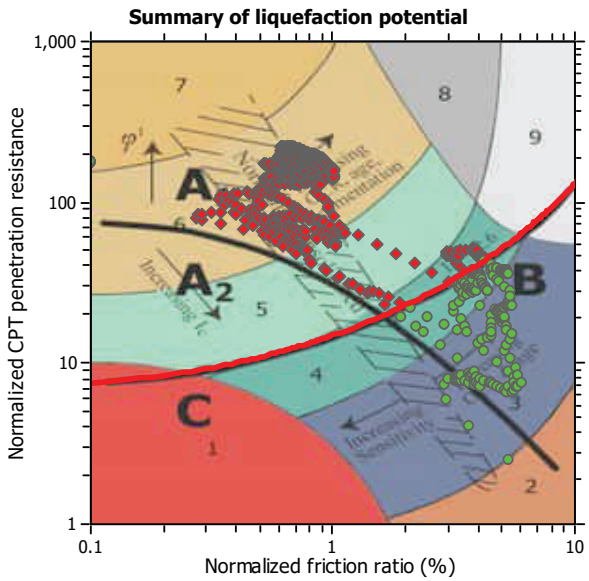
CPT file : CPT02

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

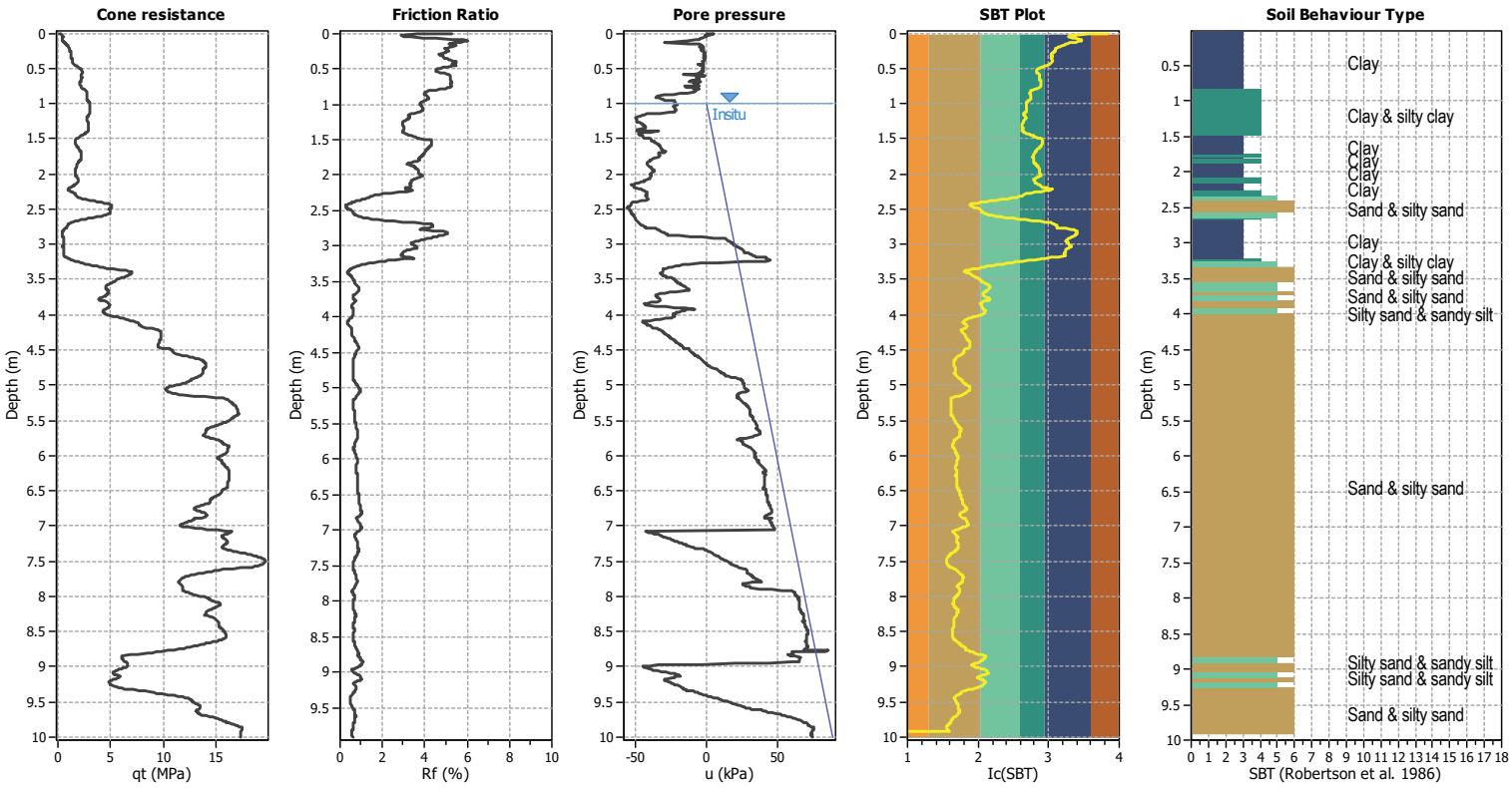






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



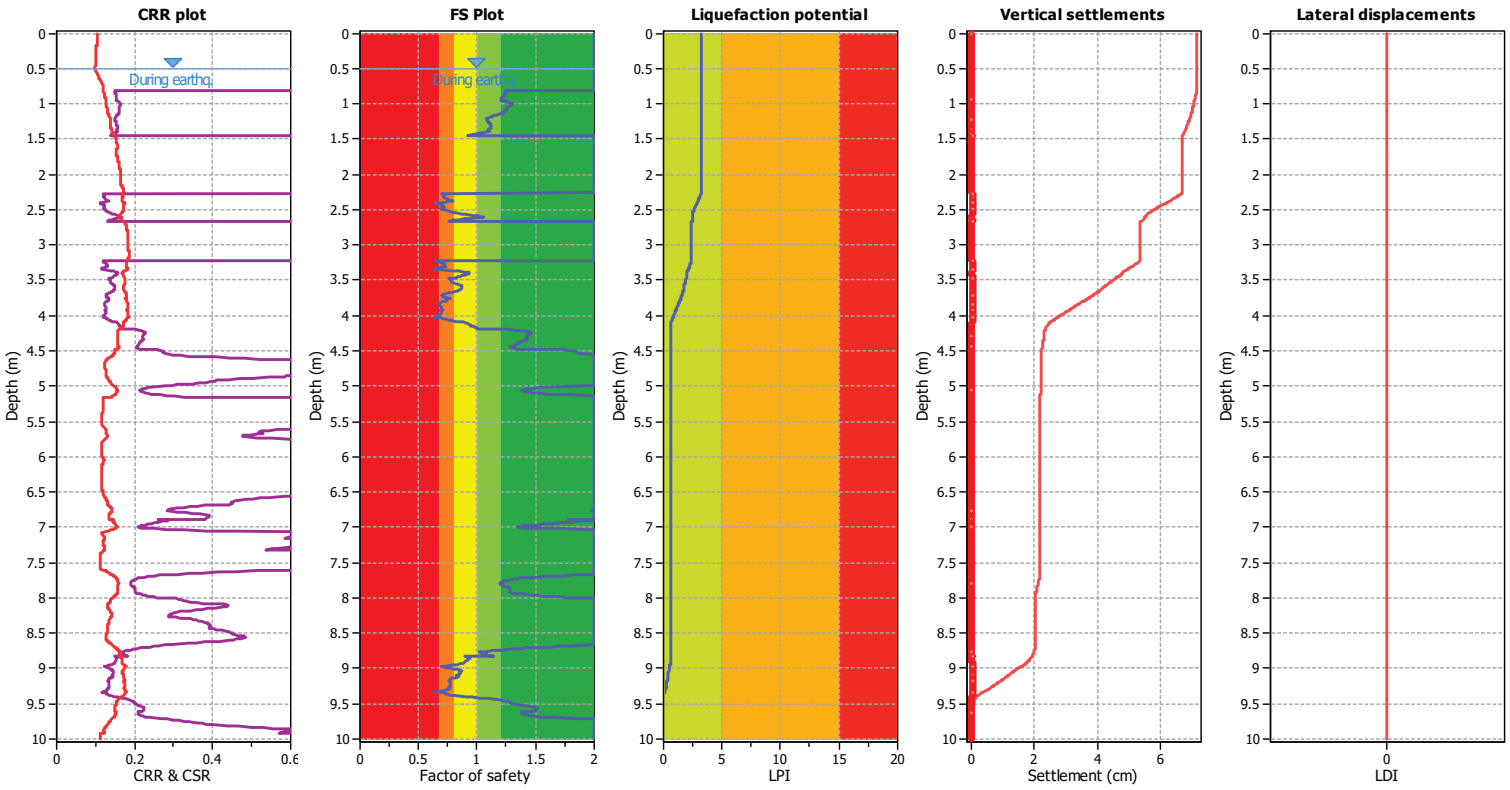
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

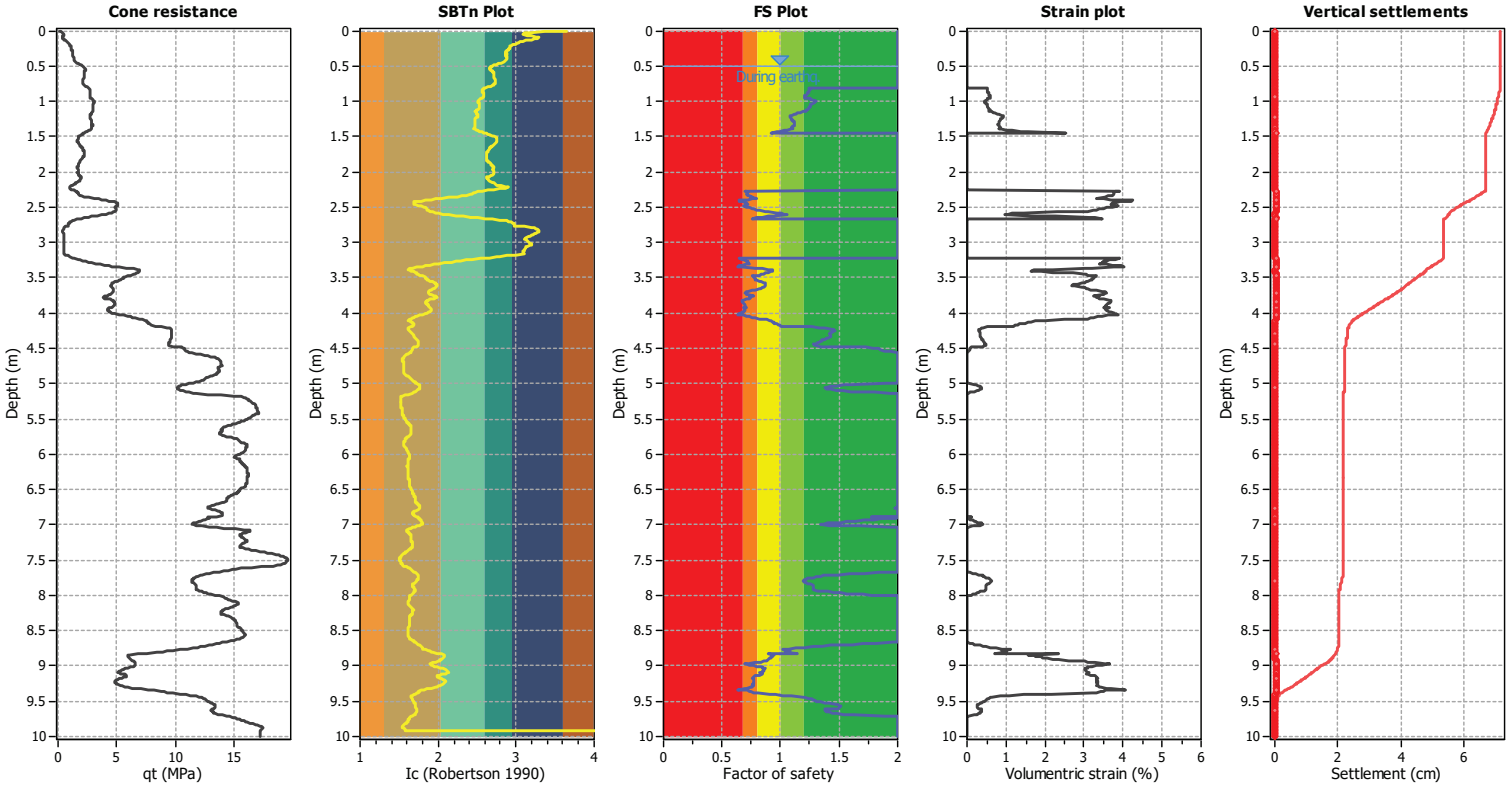
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

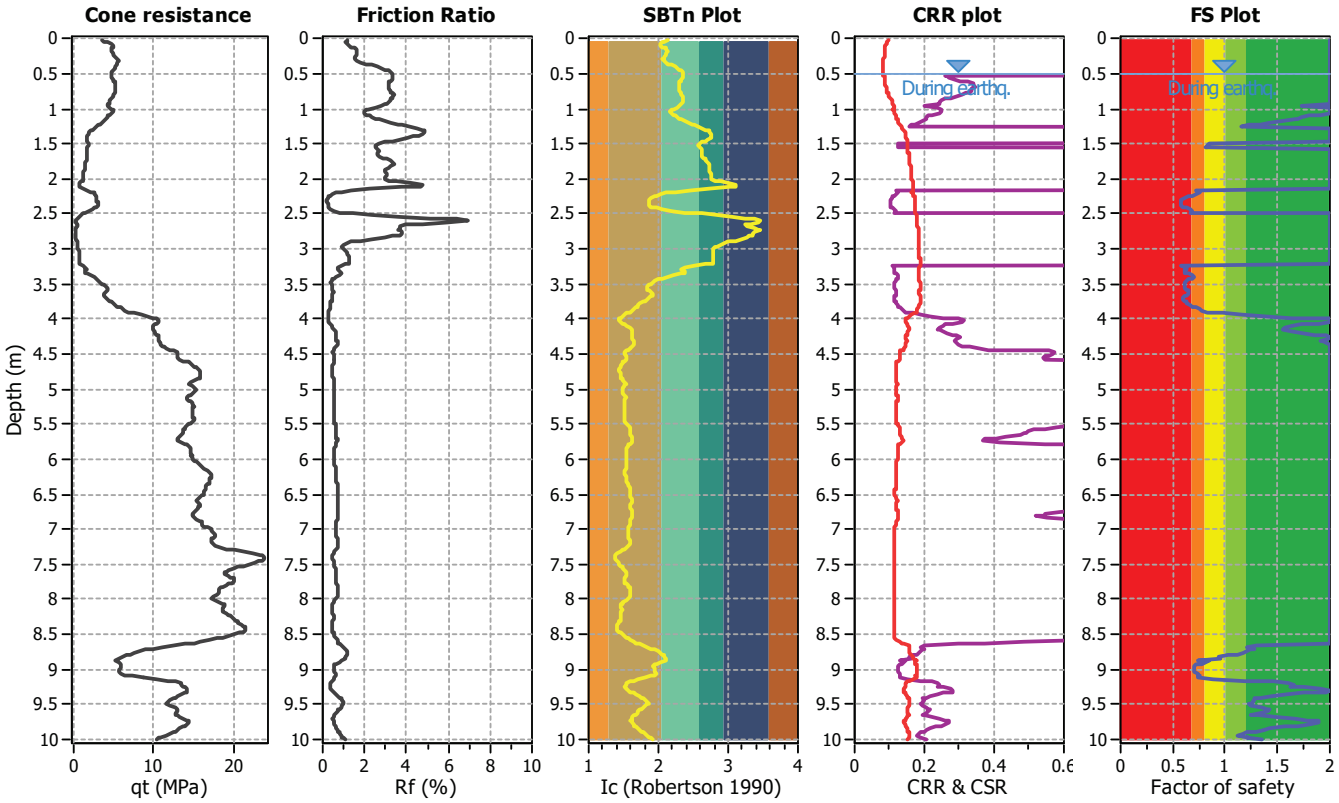
LIQUEFACTION ANALYSIS REPORT

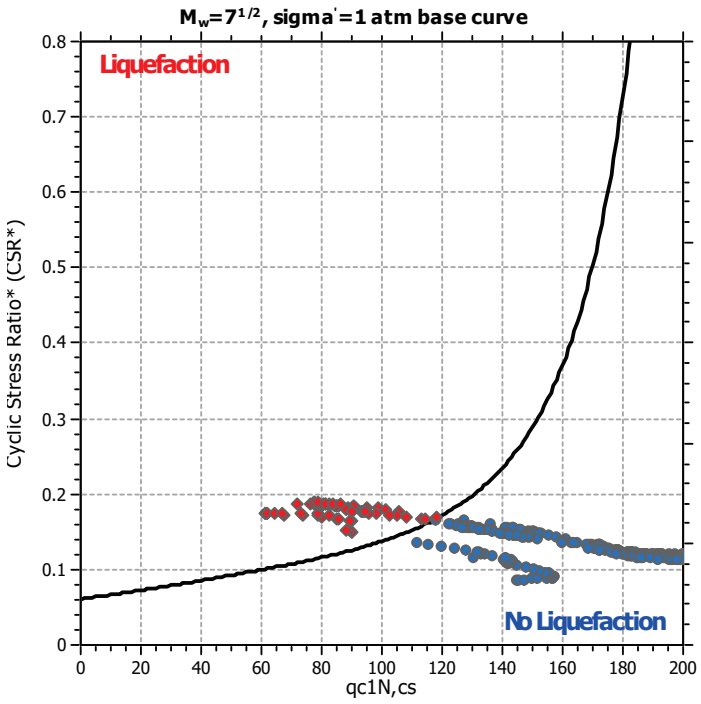
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

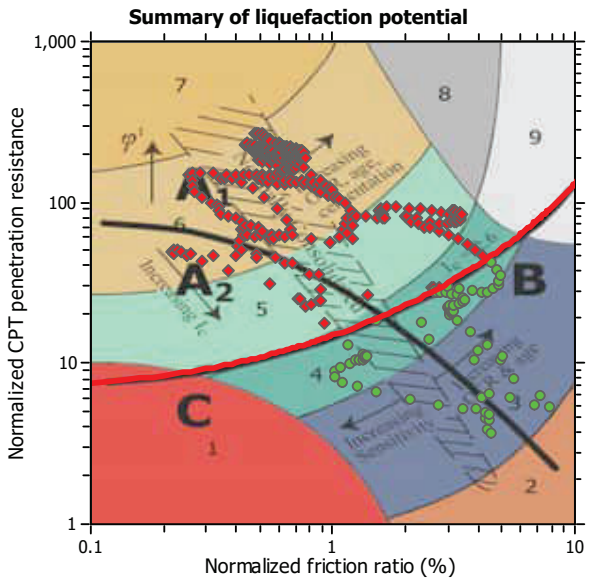
CPT file : CPT19005

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

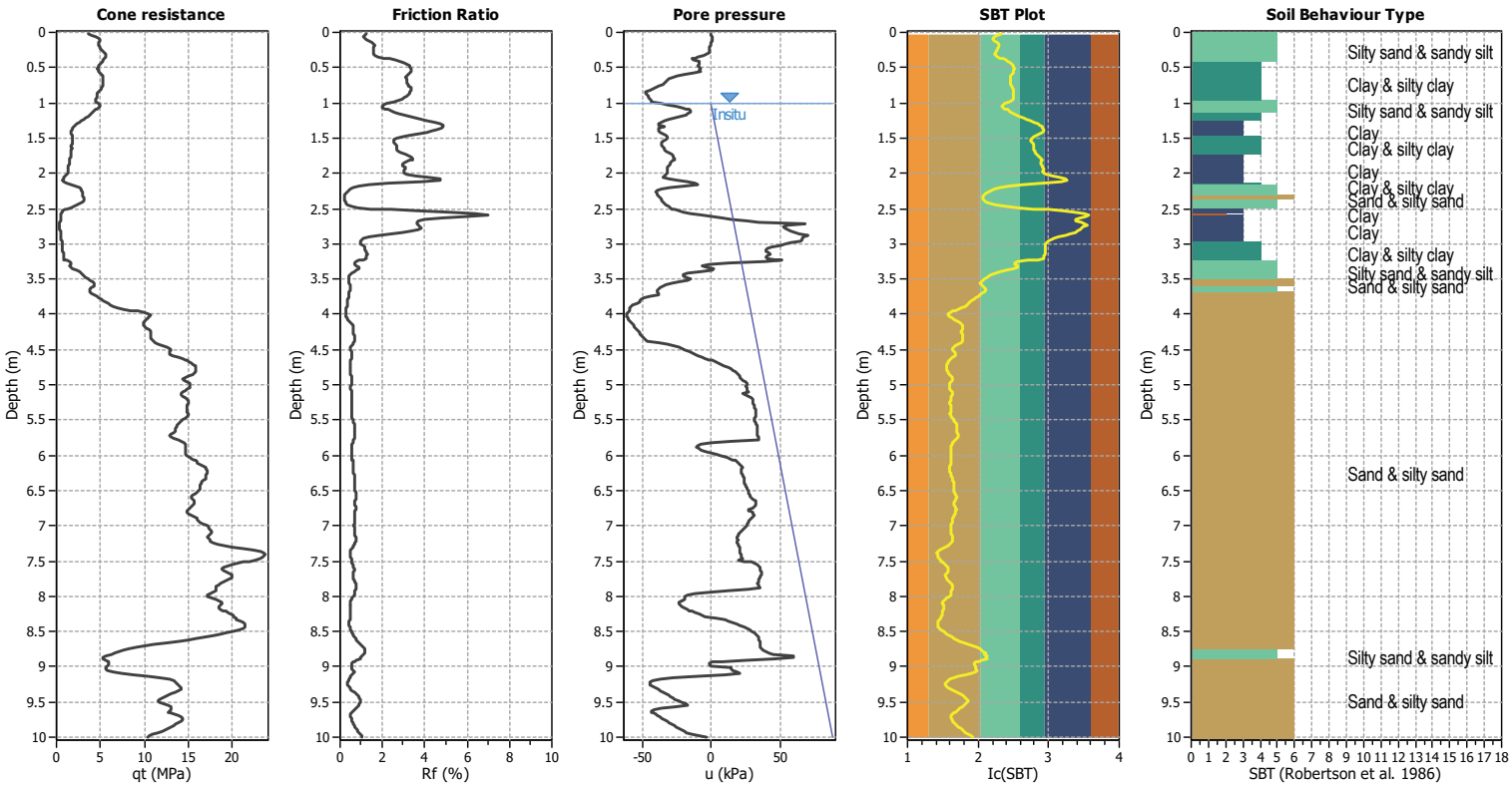






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



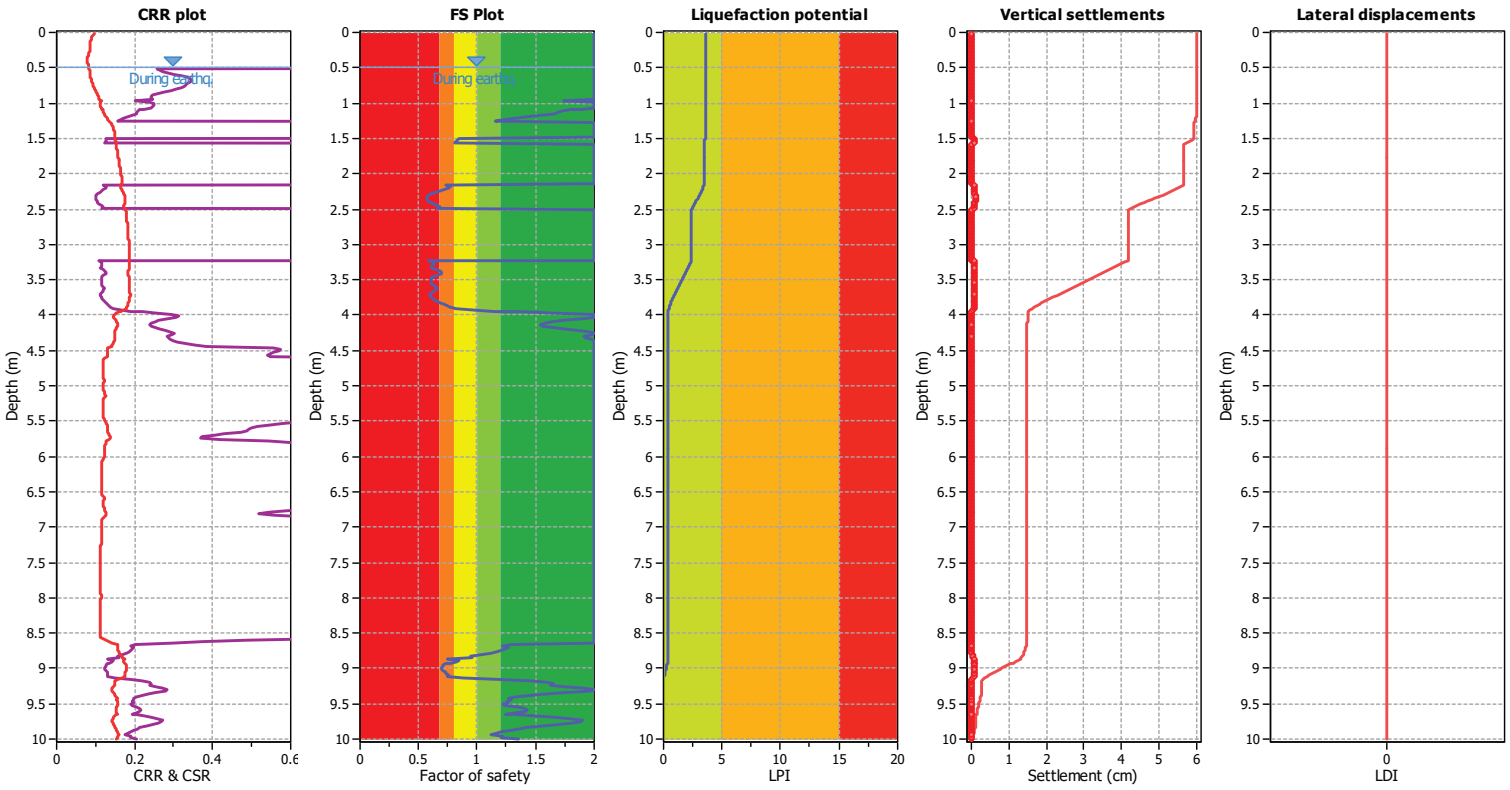
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

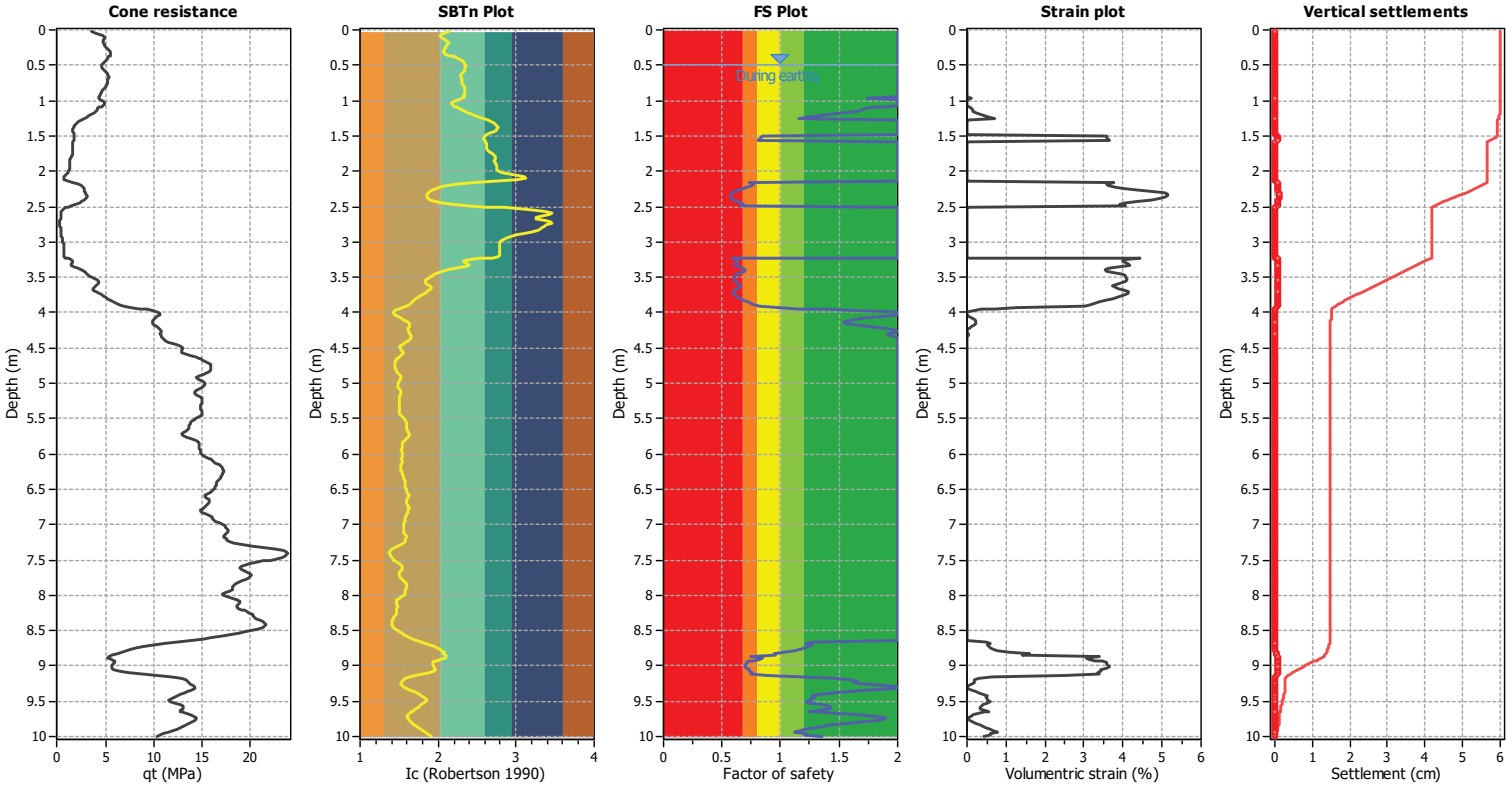
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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Consulting Engineers

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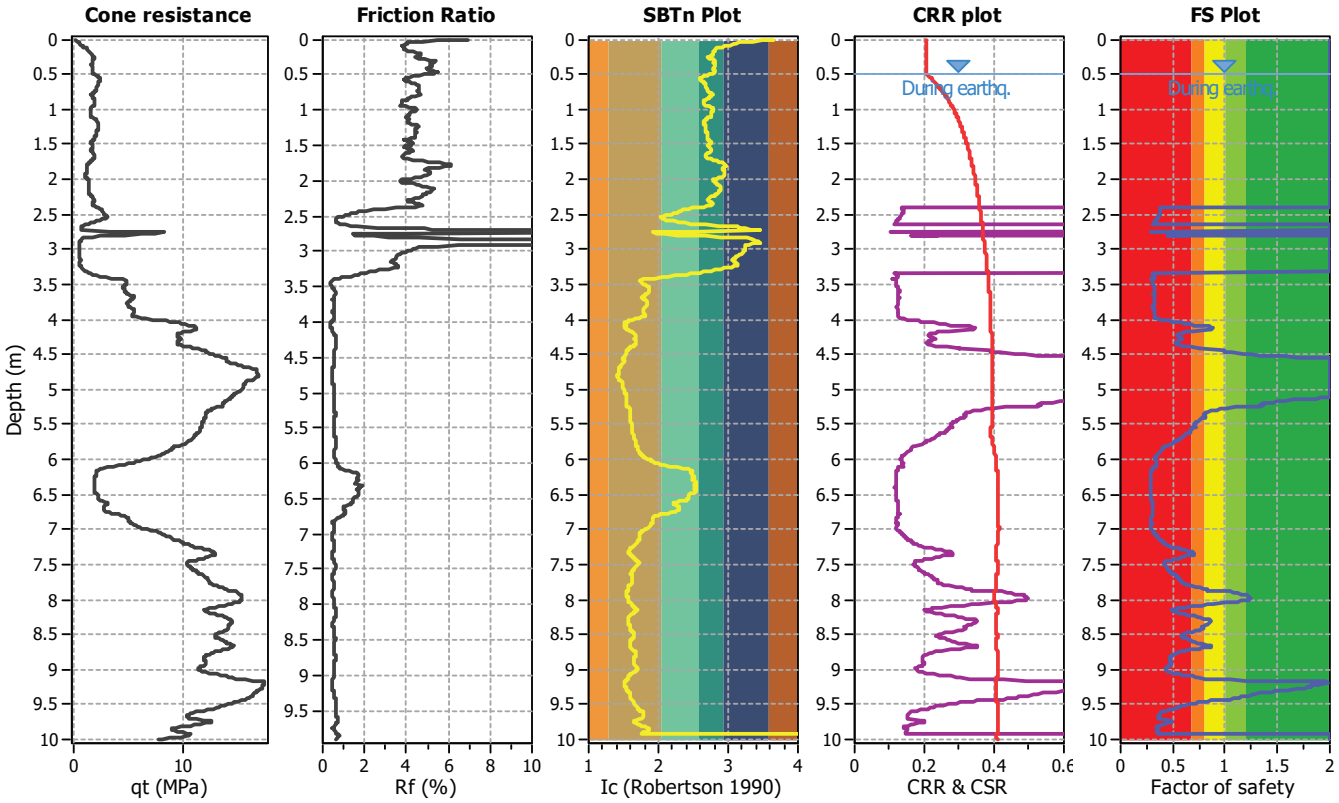
LIQUEFACTION ANALYSIS REPORT

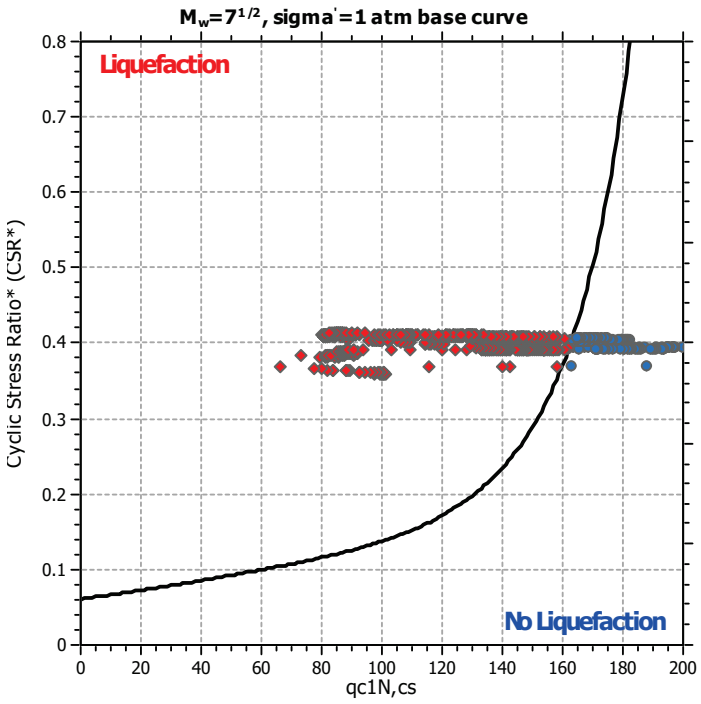
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

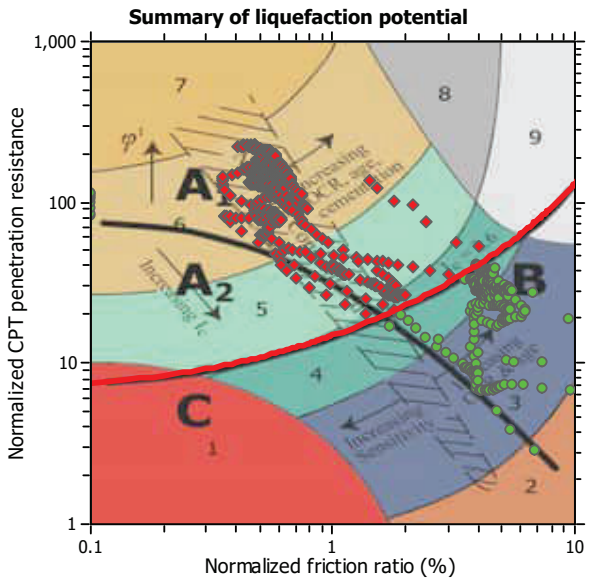
CPT file : CPT01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







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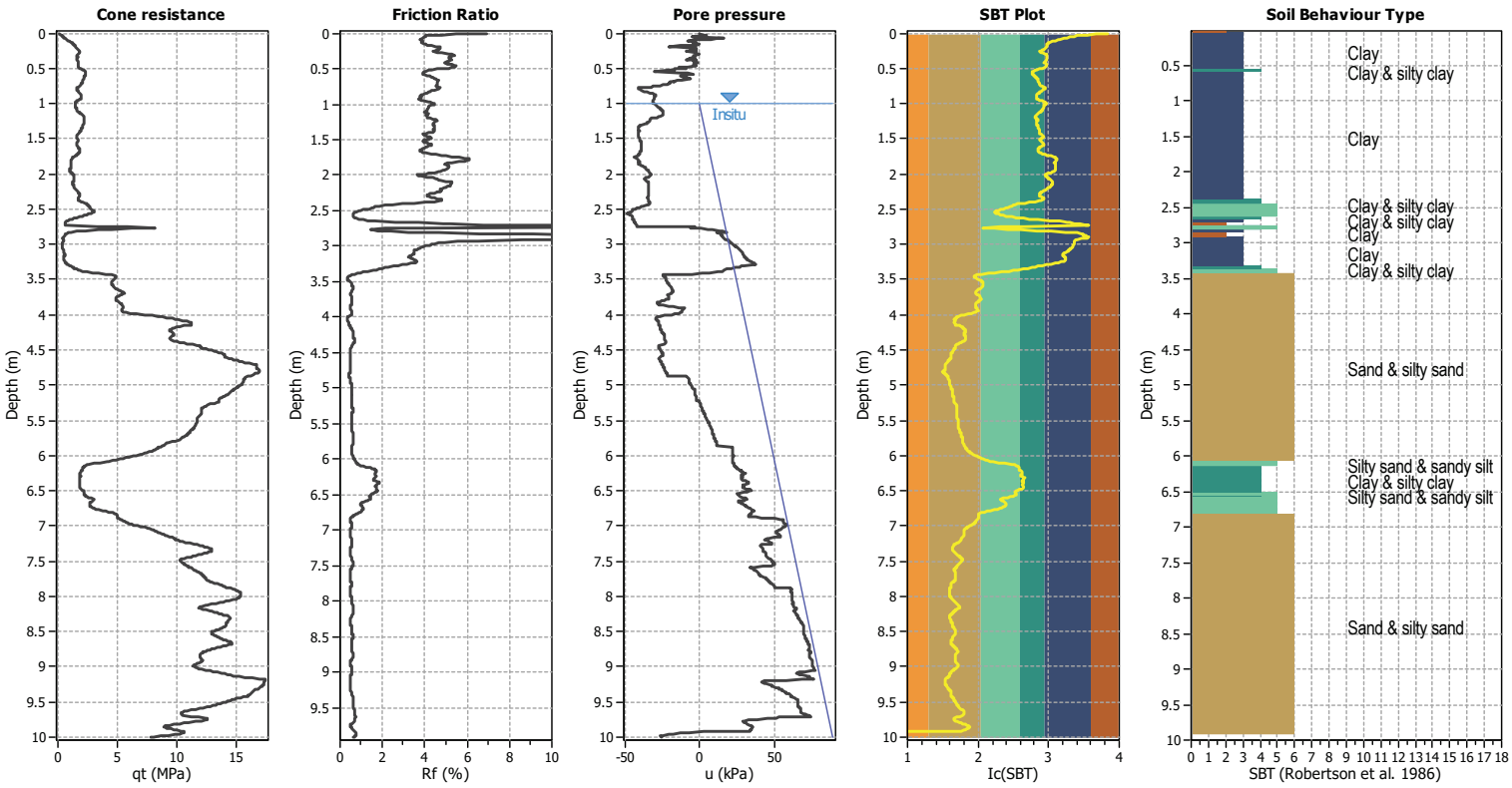
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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
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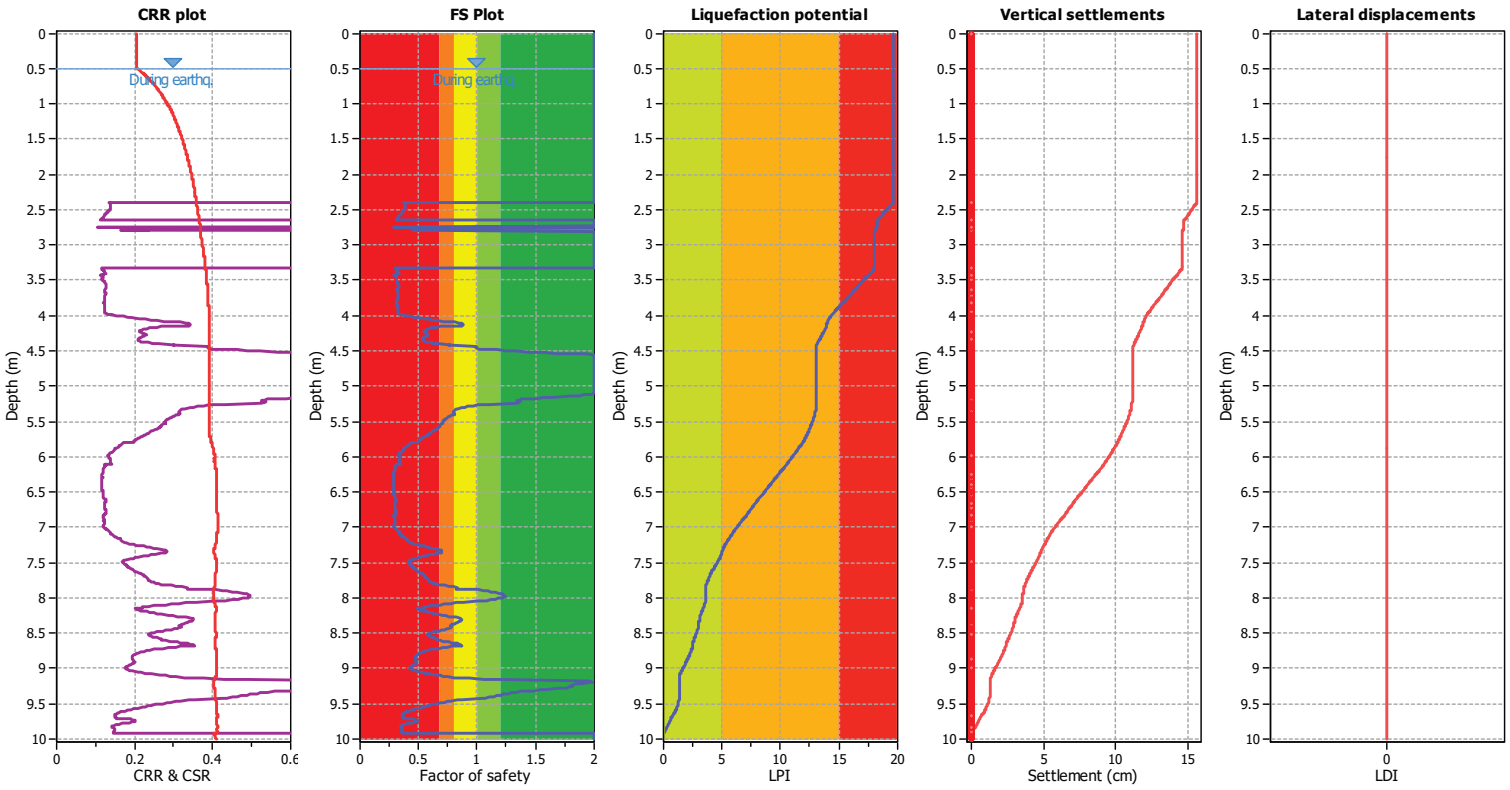
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

F.S. color scheme

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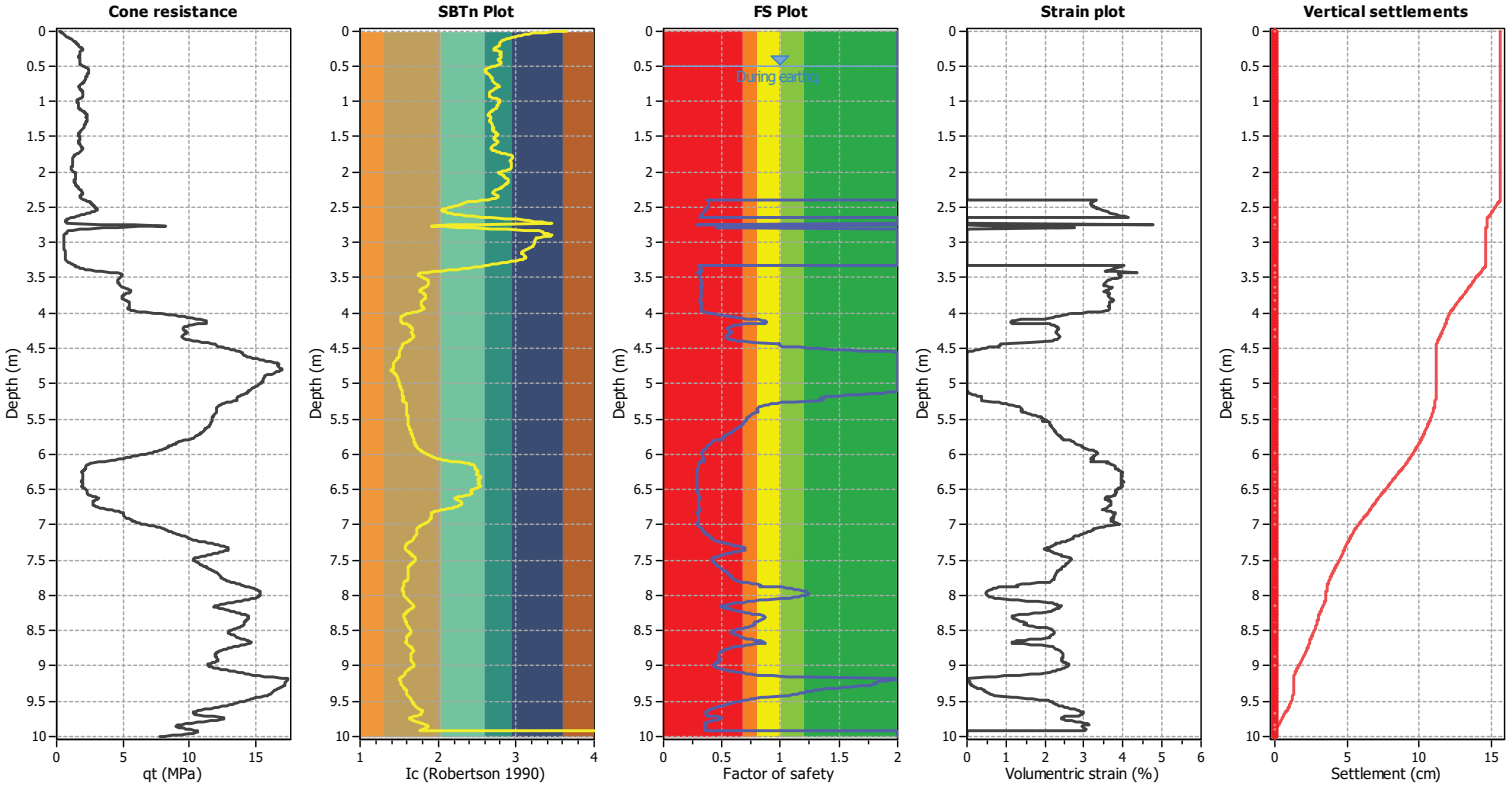
Estimation of post-earthquake settlements



Abbreviations

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I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

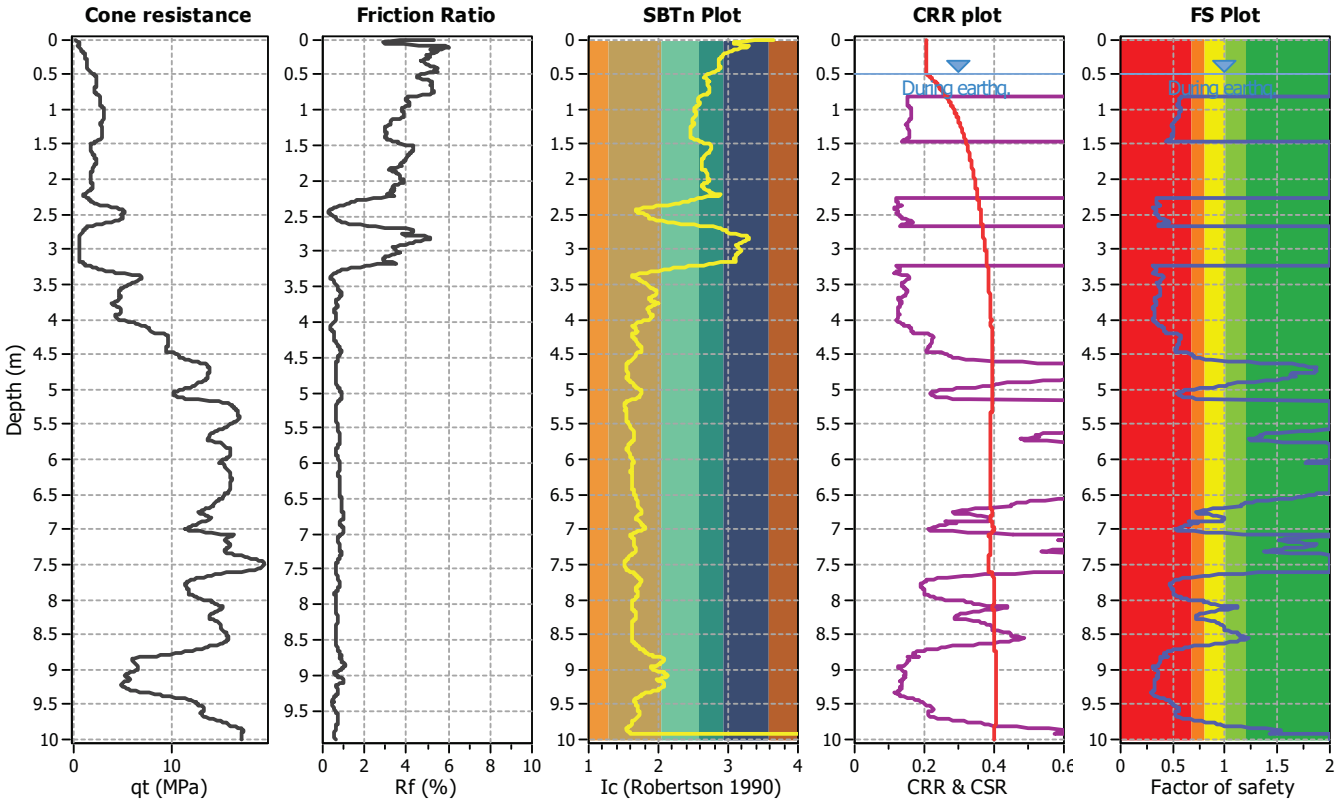
LIQUEFACTION ANALYSIS REPORT

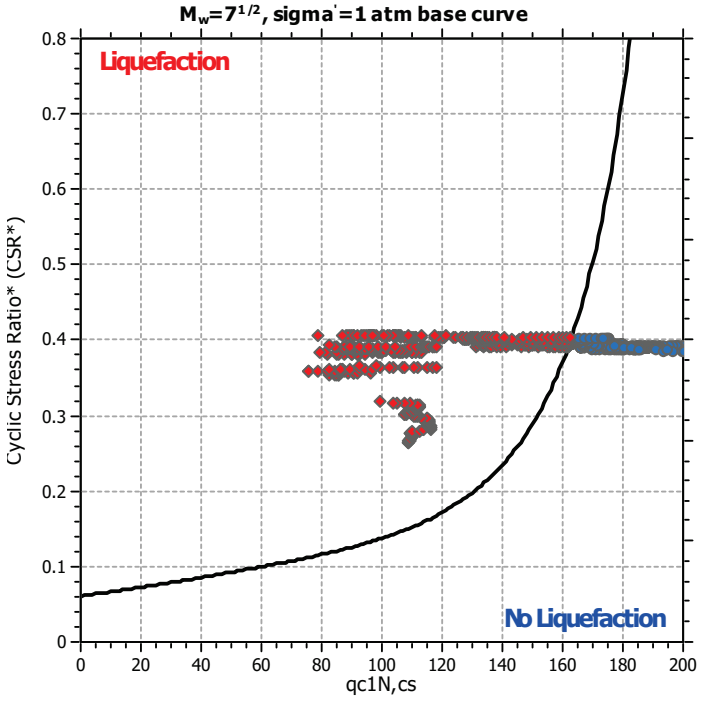
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

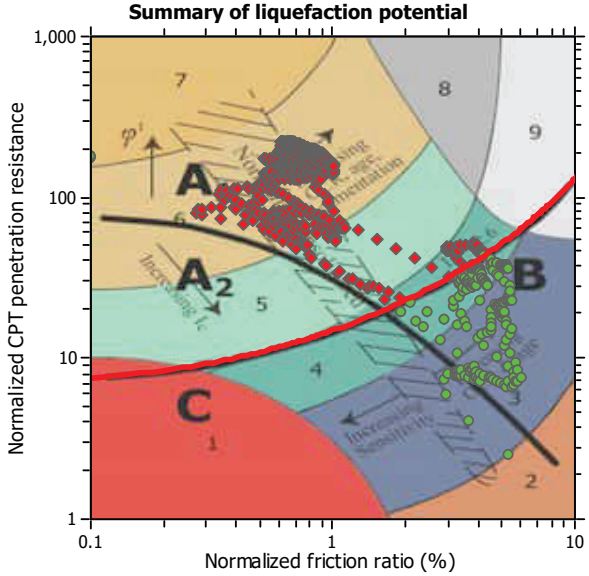
CPT file : CPT02

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

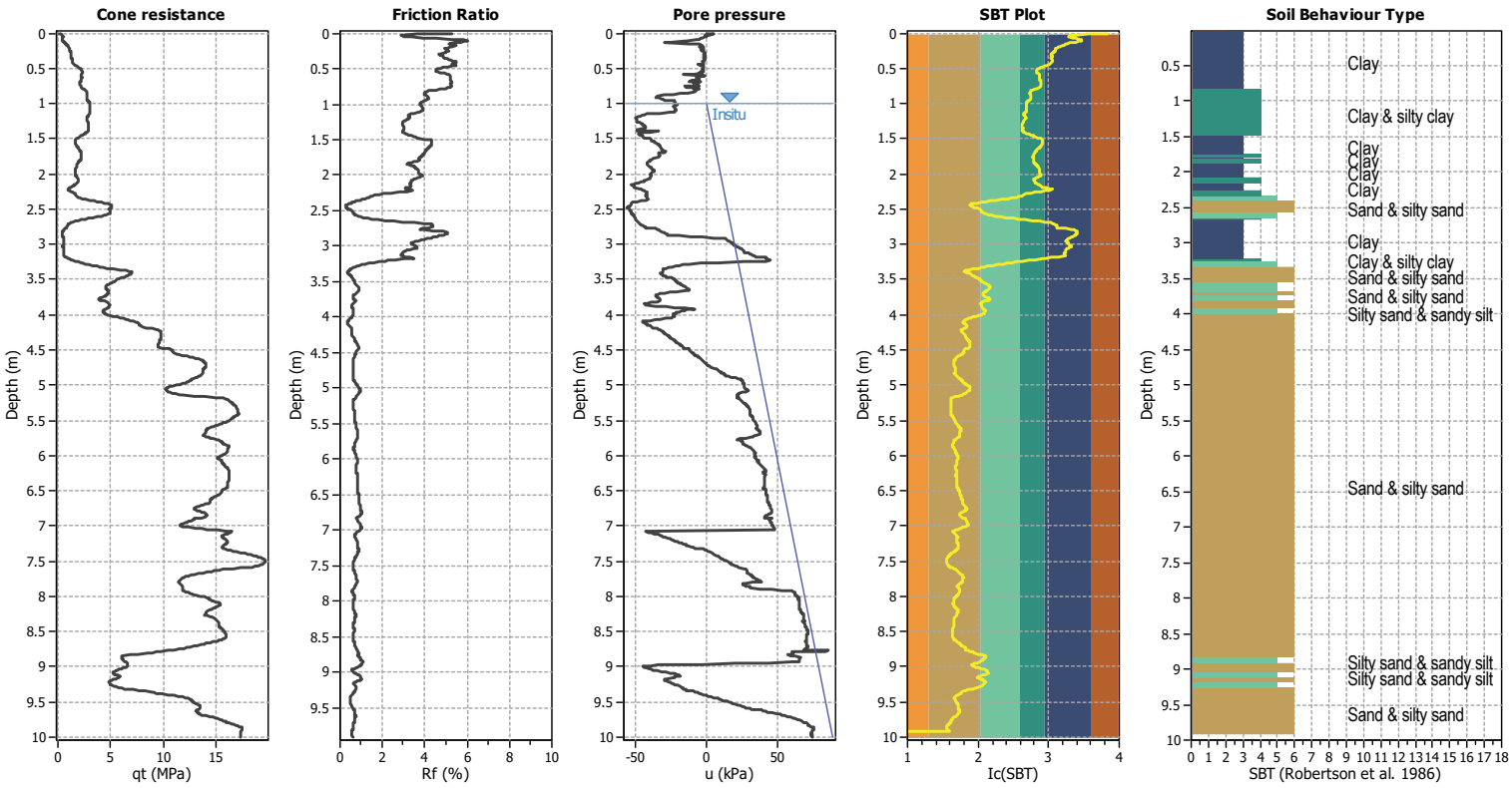






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



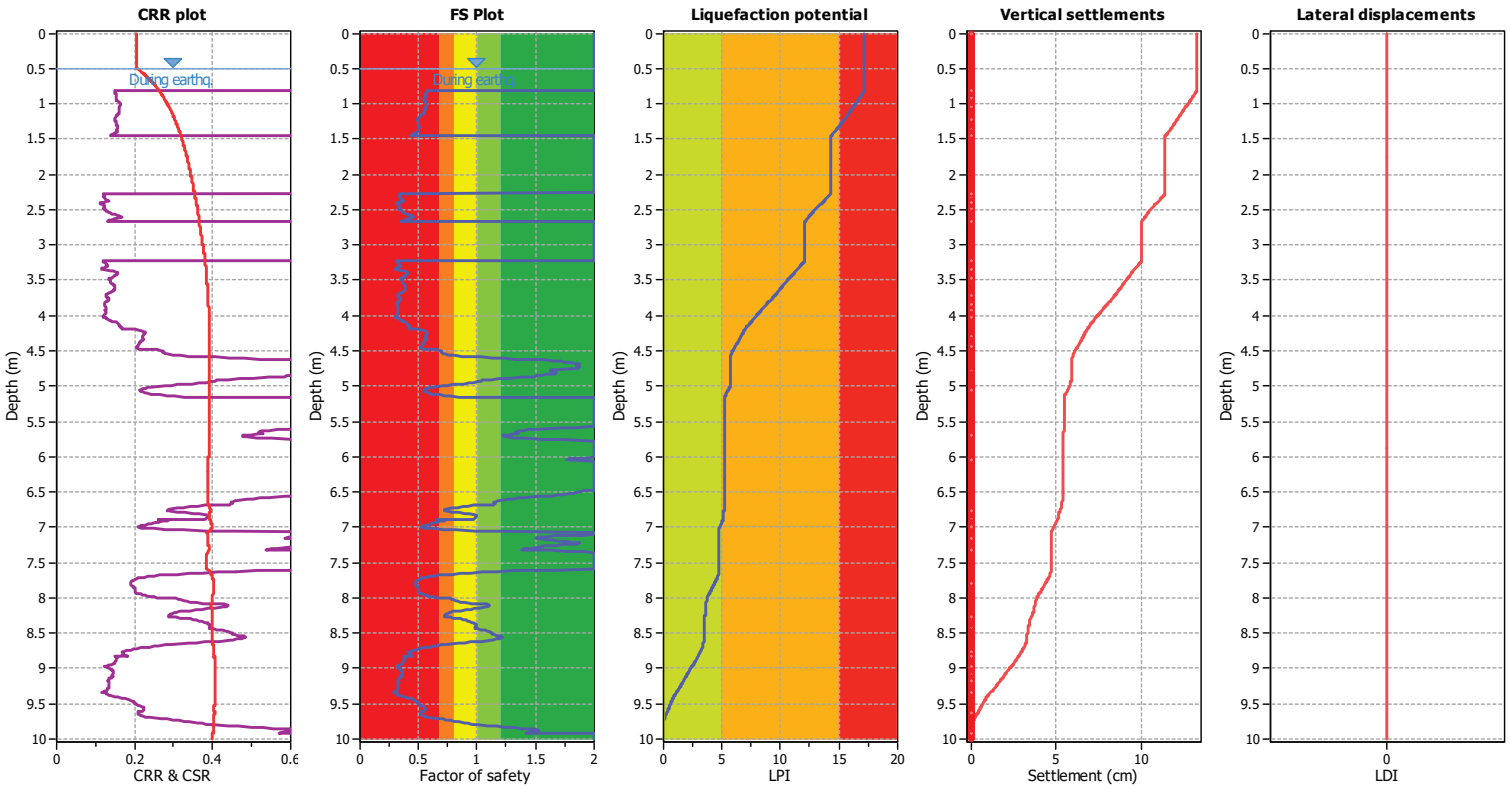
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



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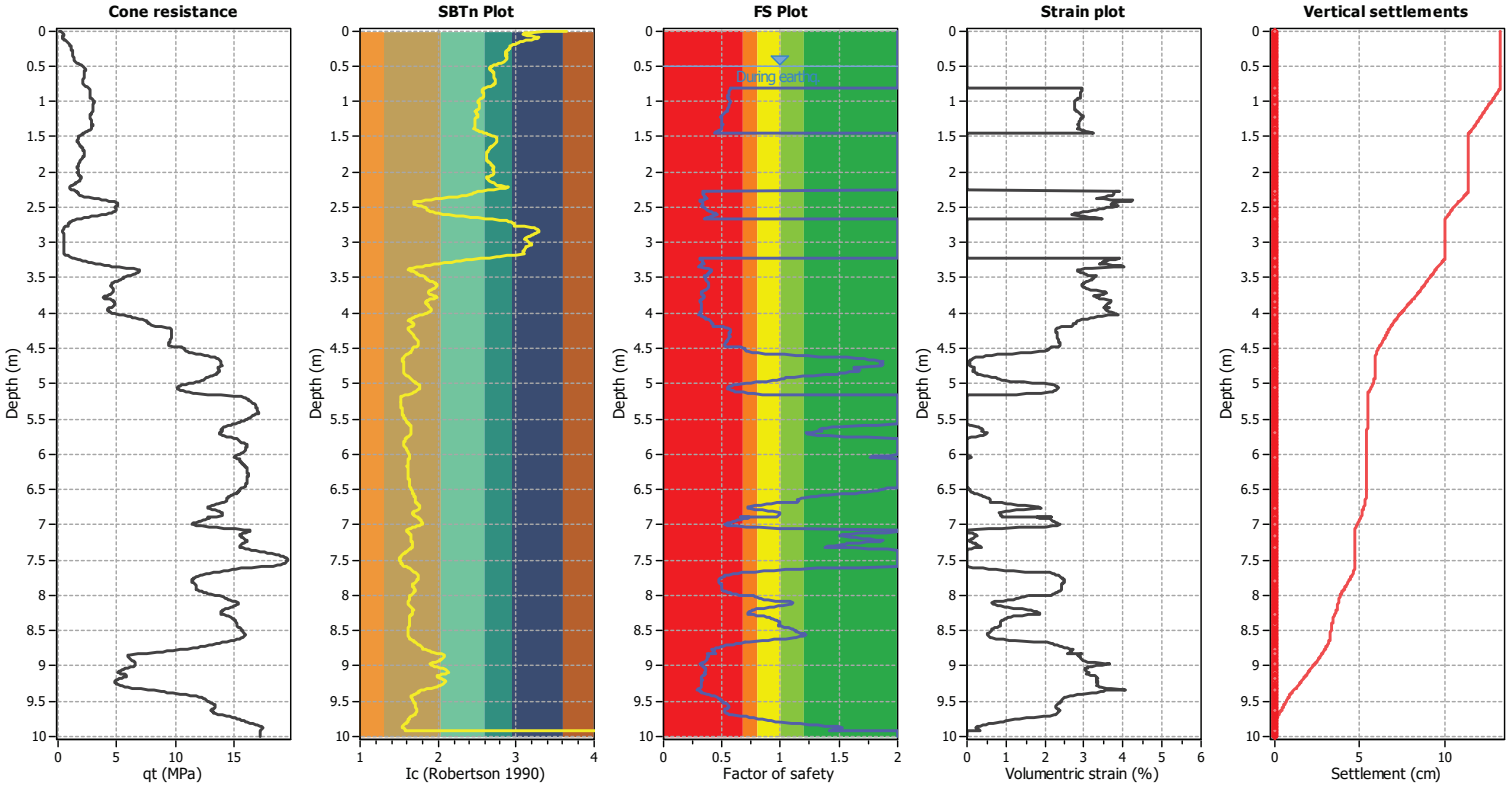
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

LIQUEFACTION ANALYSIS REPORT

Project title : Multi-Unit development **Location : 32_36 Ryan Street**

CPT file : CPT19005

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	Yes
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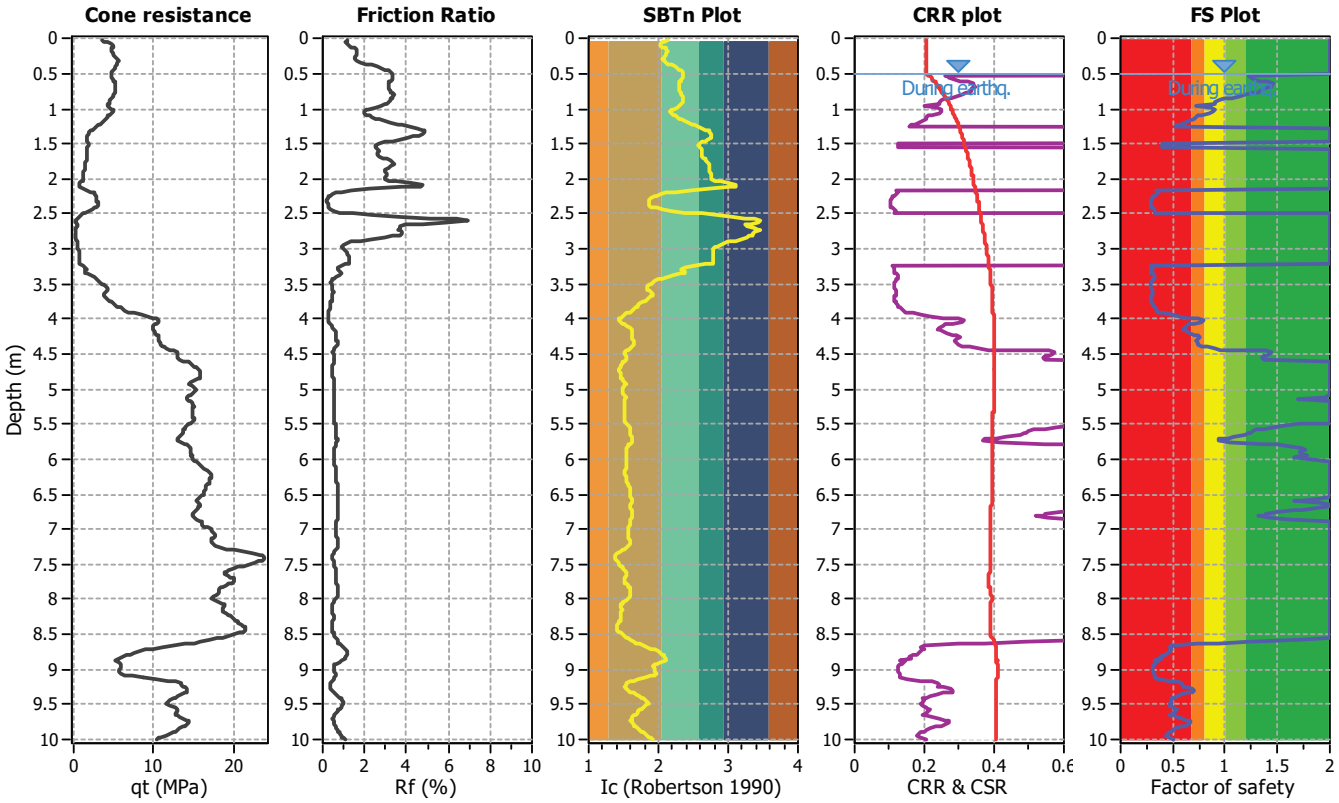
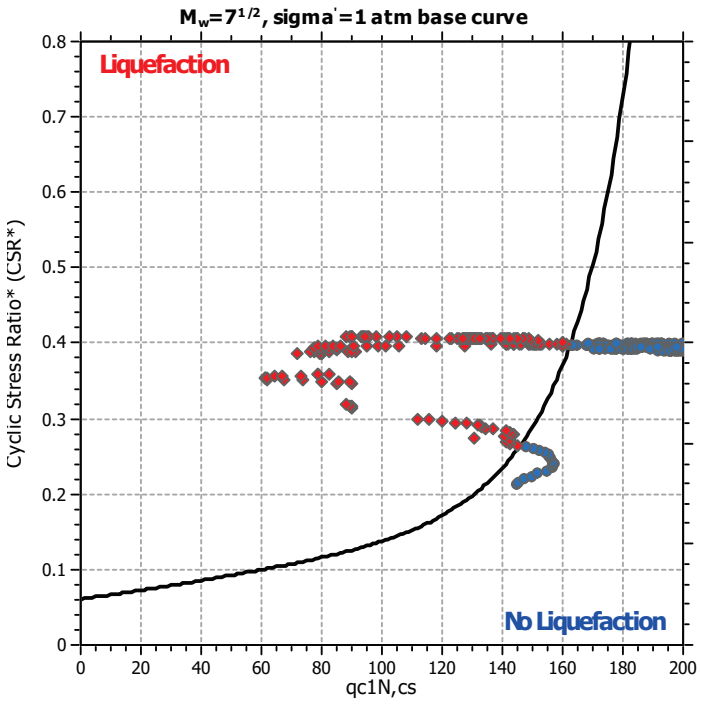
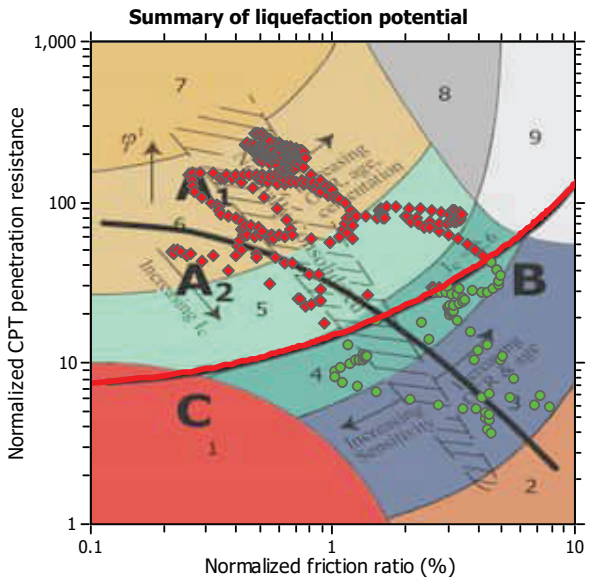
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







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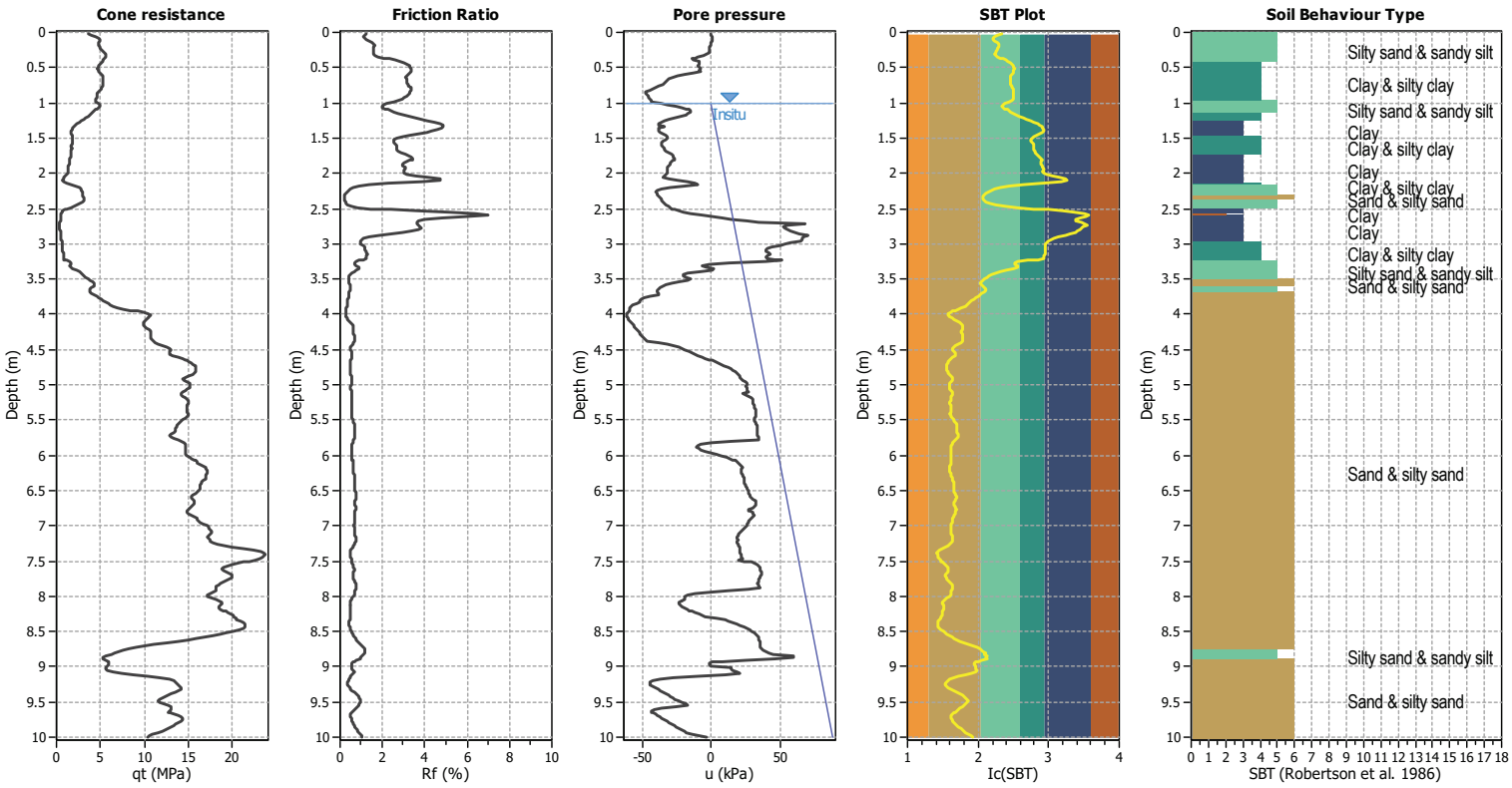
CPT basic interpretation plots



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Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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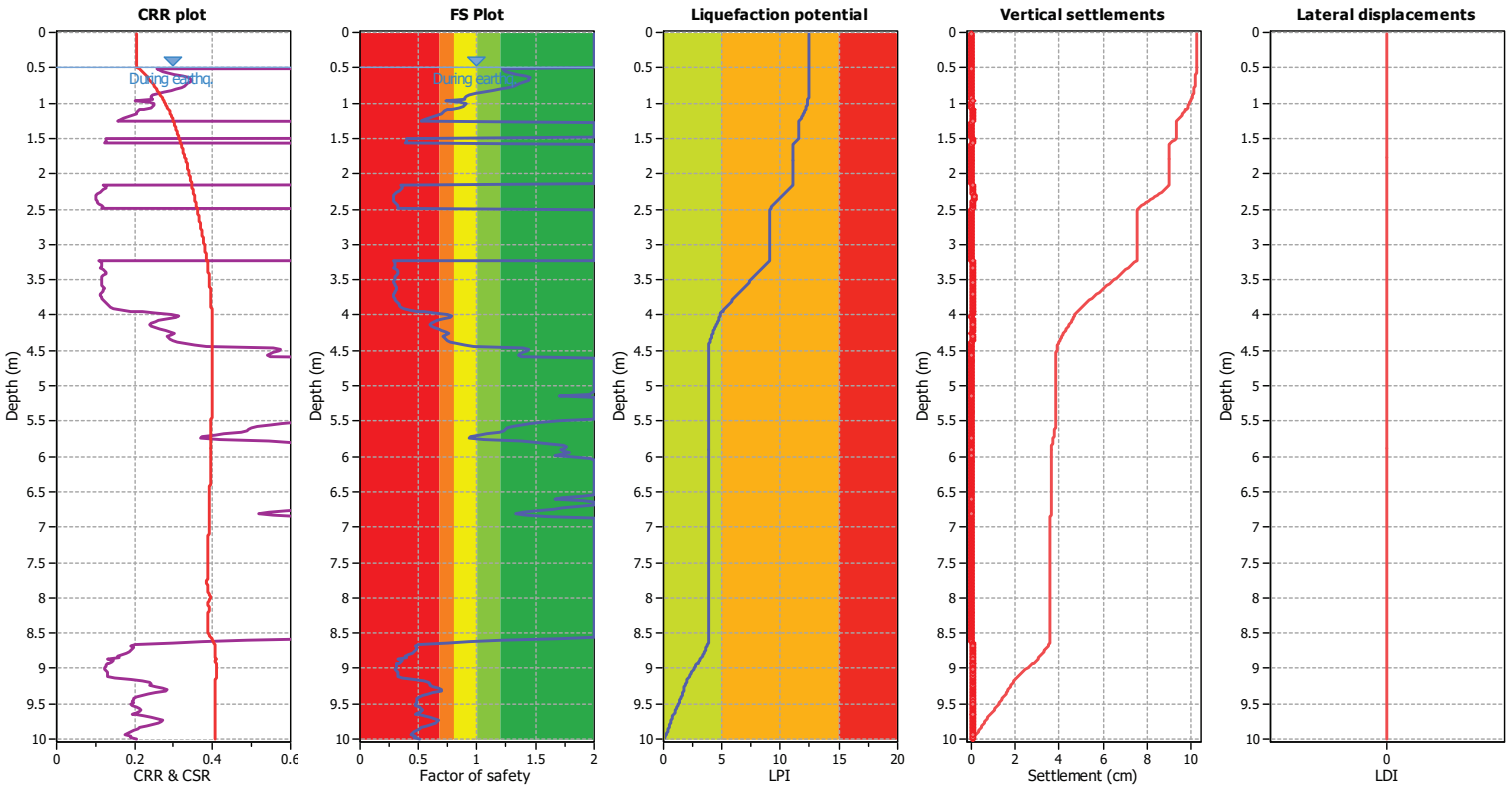
Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
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- Very high risk
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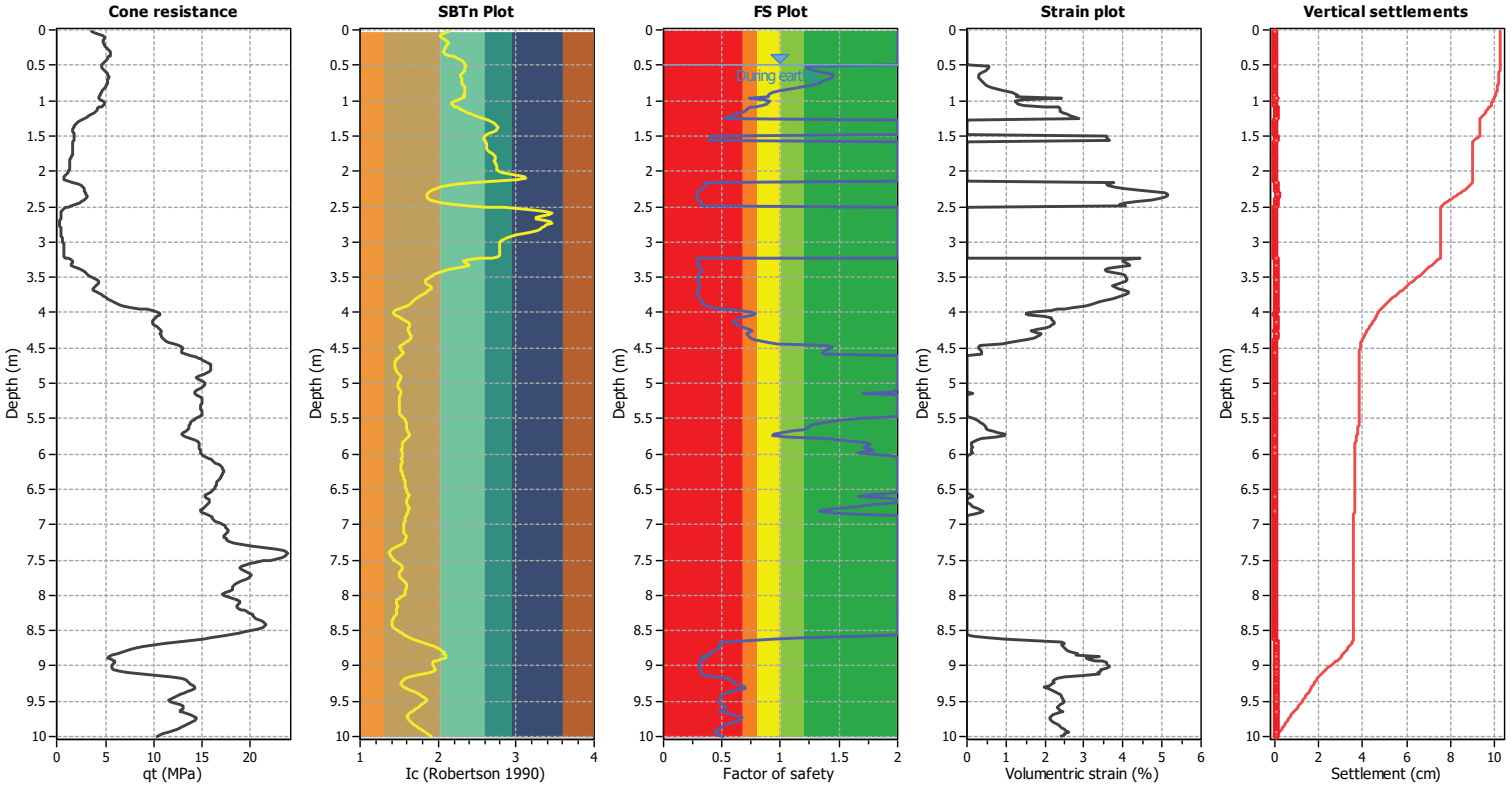

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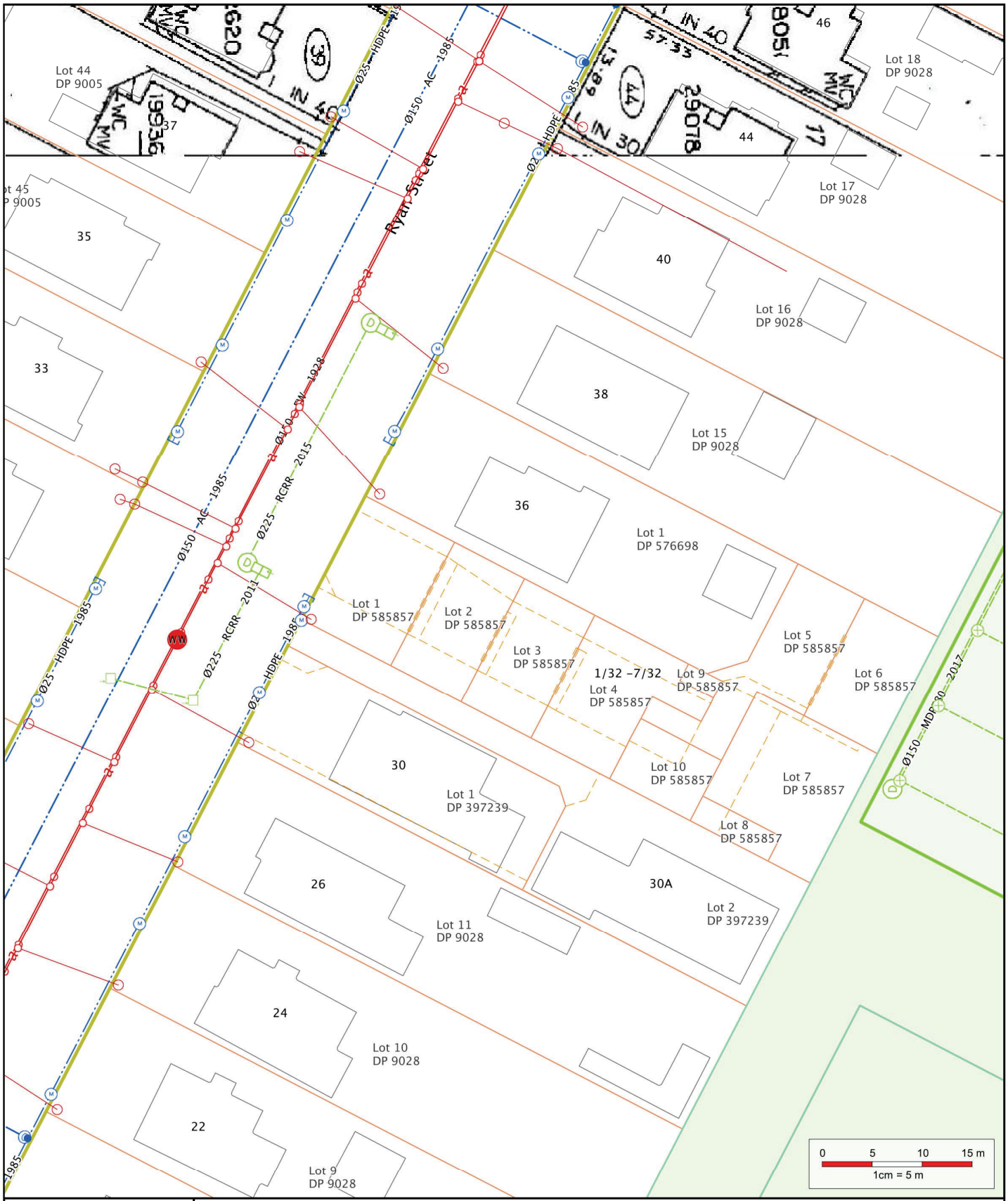


1 : 500 on A4

29/09/2023 9:58:54 AM

Christchurch City Council

ph: 941-8300 fax: 941-8385

Accuracy not guaranteed. Onsite verification required. Display of data scale dependent, full detail available at 1:500.

Private Drainage

Standard Infrastructure
- Bio Gas
- Condensate Trap
- End Cap
- Inlet
- Outlet
- Valve
- Main
- Cable

Water Intake/Supply
- Connector
- Bellows
- Connector
- Hydrant

Water Intake/Supply
- Inlet
- Meter
- Outlet
- Pump
- Restrictor
- Valve
- Air Release
- Butterfly
- Flow restriction
- Gate
- Pressure Activated
- Sluice
- Valve
- Reservoir
- Structure
- Lateral
- Main
- Sub Main

Wastewater
- End Cap
- Valve
- Air Gap Separator
- Vent
- Eye
- Eye (Vertical)
- Outfall
- Pump
- Junction
- Access
- Flush Manhole
- Inspection Point
- Standard Manhole
- Trap
- Vented Manhole
- Lateral
- Main
- Pressure Main

Wastewater
- Lateral Fitting

Local Pressure
- Control Panel
- Boundary Kit
- Tank System
- Site
- Vacuum Chamber
- Vacuum Breather

Stormwater
- Bend
- Change
- Eye
- Flow Restriction
- Inlet
- Dome Sump
- Double Sump
- Gross Debris Trap

Stormwater
- Inlet
- Inlet
- Inlet Headwall
- Pipe End
- Silt Trap
- Single Sump
- Soak Pit
- Triple Sump
- Junction
- Standard Manhole
- Outlet
- Pump
- Structure
- Basin
- Lateral
- Main
- Lateral Fitting
- Double Sump

Stormwater
- Lateral Fitting
- Single Sump
- Soak Pit
- Inspection point
- Manhole

All services
- Pipe Protection
- *a* Abandoned
- *p* Proposed
- *os* Out of service

Landbase
- Easement

Legend

- dp — 80mm downpipe
- io — Inspection port
- tv — 80mm Terminal vent
- bv — 50mm Branch vent
- ss — 100mm soil stack
- gt — Gully trap
- Stormwater, dia noted
- Sanitary drain, dia noted

Pipe Size Notes:
All pipes to be the sizes shown
All pipes 65mm dia and under, gradient 1:40
All pipes 65mm to 100mm dia, gradient 1:60
All pipes 100mm dia and over, gradient 1:100

Plumbing Notes:
All plumbing & drainage shall be as per NZBC G13/AS1/AS2

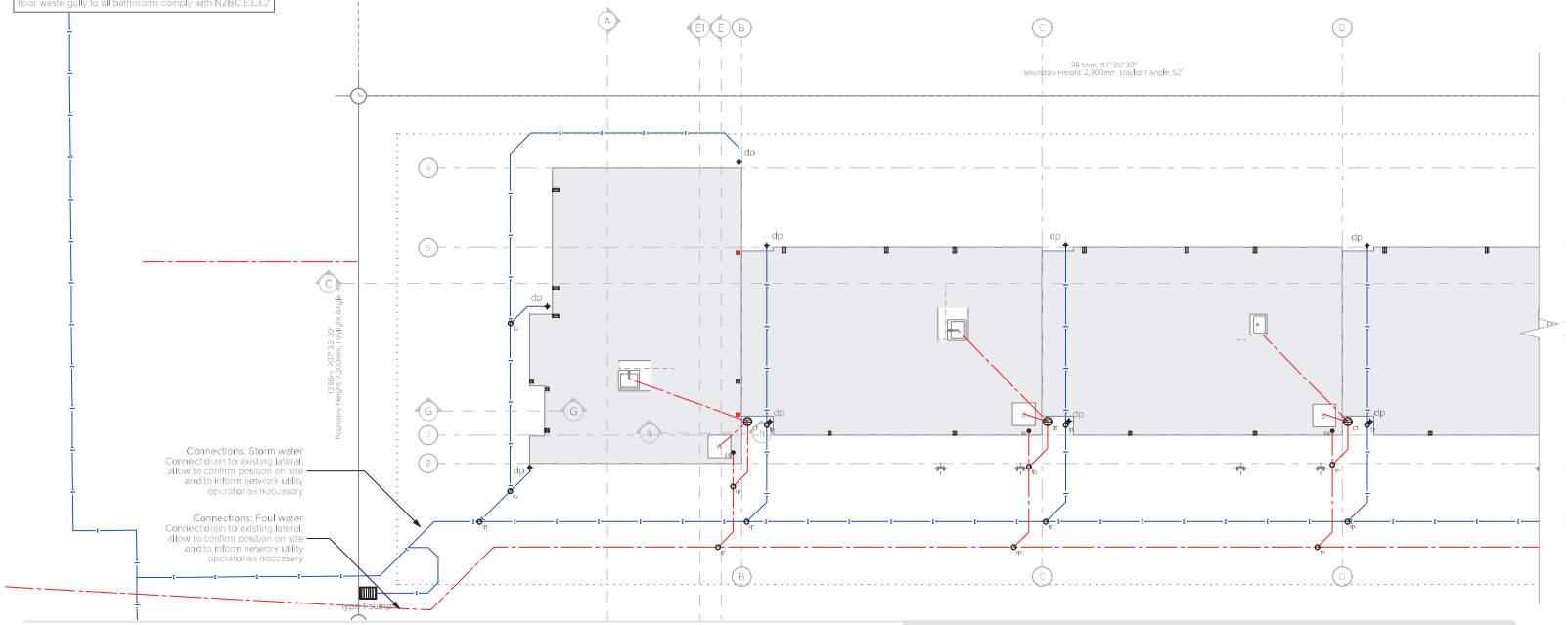
Terminal vents and branch vents shall be installed at a length of less than 10m and down stream from the head of the main or branch drain. This shall be confirmed on site during installation.

Spouting to be separate per unit.

CONFIRM FOUL WATER LATERAL POSITION ON SITE BEFORE PRICING AND WORK COMMENCING

All sinks to have integrated overflows

floor waste gully to all bathrooms comply with NZBC E3.3.2



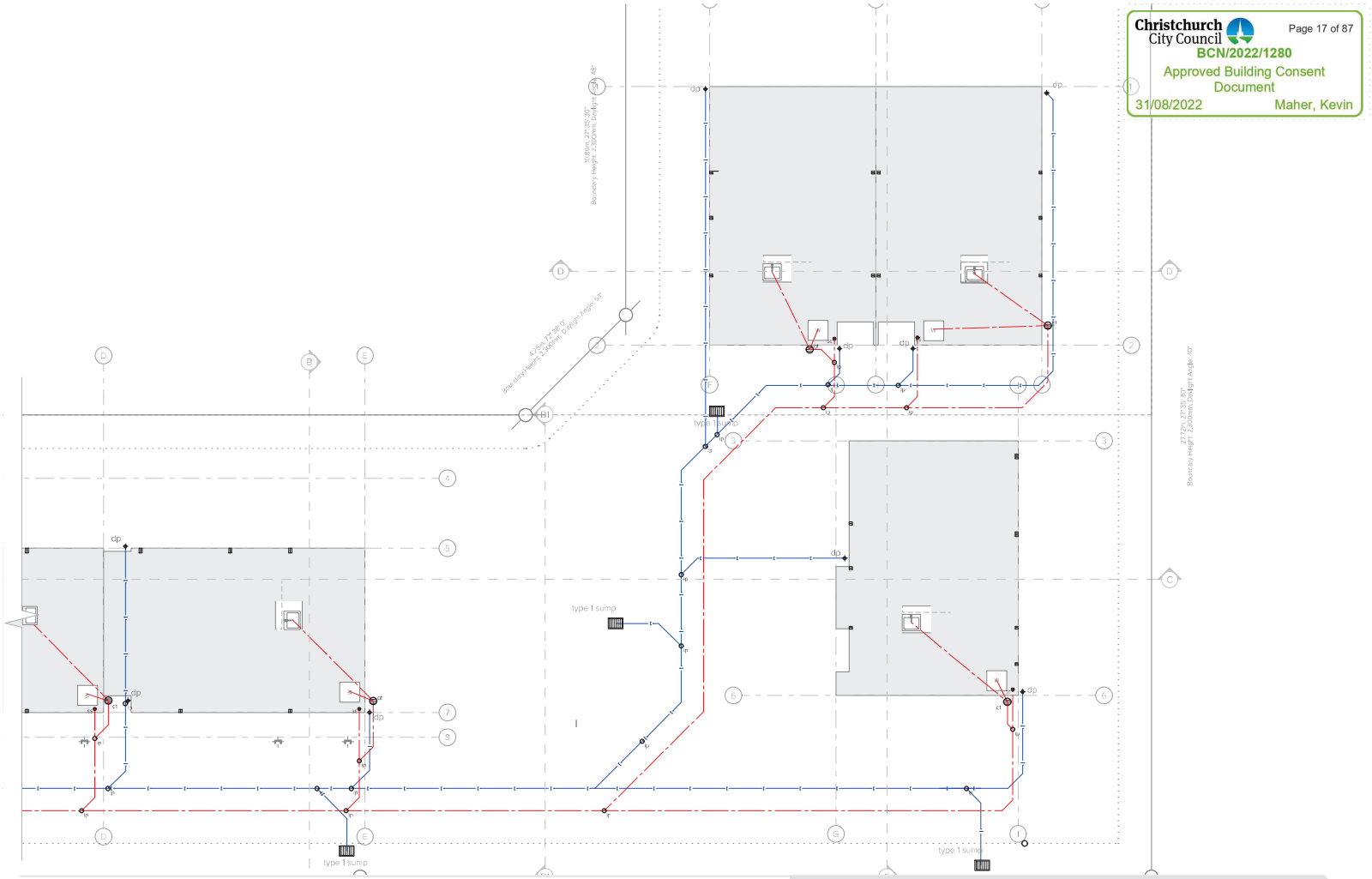
coll architecture | AK Residential - 32 & 36 Ryan Street. Christchurch

Sheet title: Ground Floor Drainage Plan

Date: 25/08/2022
Drawn by: Josh Campbell-Tie
Scale: 1:100 @ A3

A112

021 223 0113 / 03 359 7391 info@collarchitecture.co.nz www.collarchitecture.co.nz



coll architecture | AK Residential - 32 & 36 Ryan Street. Christchurch

Sheet title: Ground Floor Drainage Plan

Date: 25/08/2022
Drawn by: Josh Campbell-Tie
Scale: 1:100 @ A3

A113

021 223 0113 / 03 359 7391 info@collarchitecture.co.nz www.collarchitecture.co.nz

BMC CONTRACTING LTD

w: bmcontracting.nz
p: 021 717315

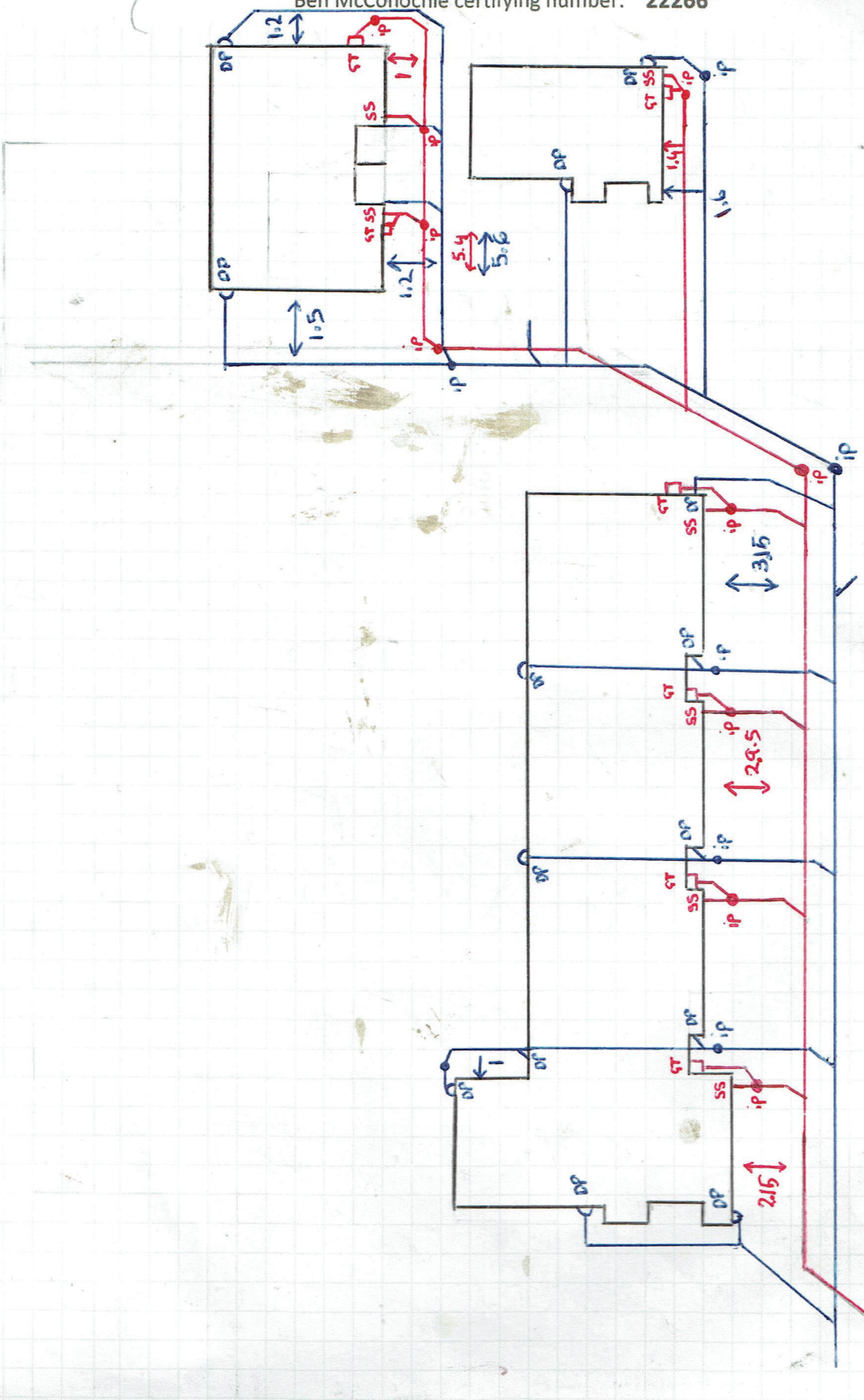
Site address: 32/36 Ryan Street

BC number: 2022/1280

Sewer grade: 1:100

Stormwater grade: 1:100

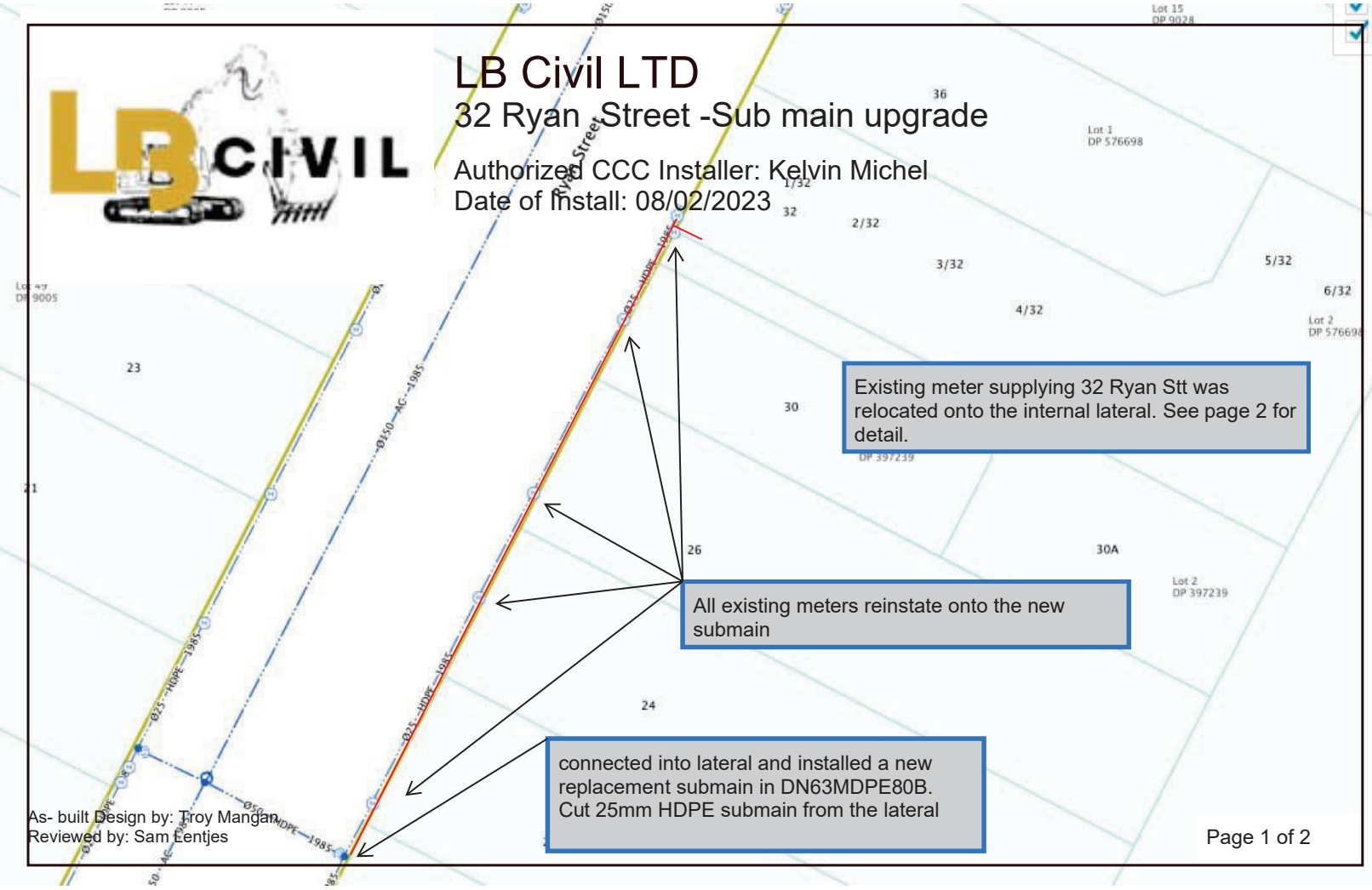
Ben McConochie certifying number: **22266**



LB Civil LTD

32 Ryan Street -Sub main upgrade

Authorized CCC Installer: Kelvin Michel
Date of Install: 08/02/2023



As- built Design by: Troy Mangan
Reviewed by: Sam Lentjes

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Authorized CCC Installer: Kelvin Michel
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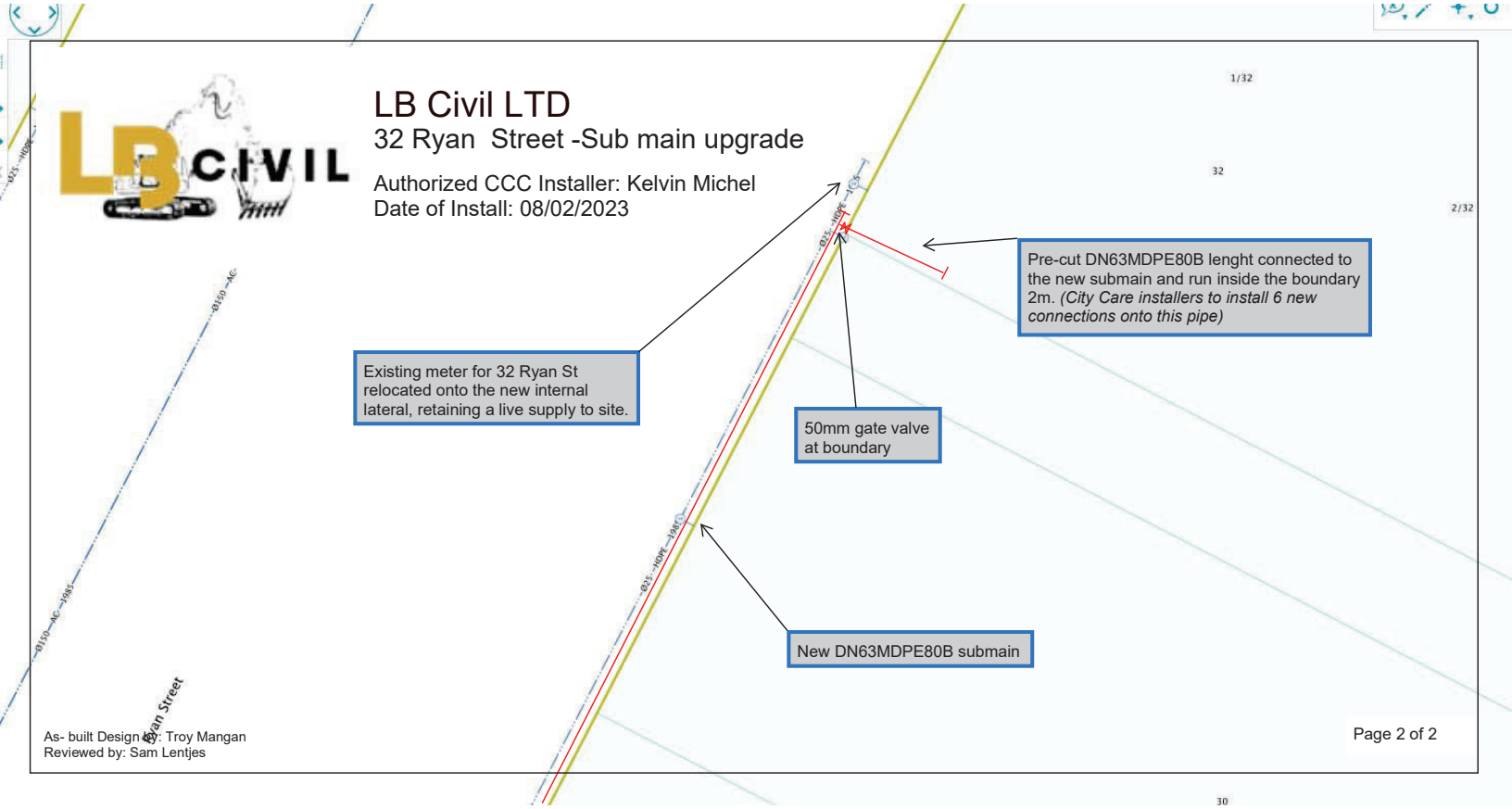

As- built Design by: Troy Mangan
Reviewed by: Sam Lentjes

Certificate of Compliance
Unique ID: 3191.2/E004671

This form has been designed to be used by licensed electrical workers to certify that installations or Part installations under Part 1 or Part 2 of AS/NZS 3000 are safe to be connected to the specified system of electrical supply.

(1) Location of Installation or Part Installation

Address: 32 Ryan Street, Phillipstown, Christchurch 8011 Unit 1

(2) Customer / Occupier / Owner Information

Name: Hiko Heating

Address: 59 McMahon Drive, Halswell, Christchurch 8025

Email: _____ Phone: _____

(3) Electrical Worker Information

Name: Blake Quigley Registration/Practising Licence No.: E004671

Organisation: JAFS Electrical

Phone: 022 463 2212 Email: blake@jafselectrical.co.nz

Name of person(s) being supervised: _____

(4) Work Details

This work is: ☑ Is New Work ☐ Is Addition ☐ Is Alteration ☐ Is Maintenance

The prescribed electrical work is: ☐ Home Owner ☐ Low Risk ☐ General ☑ High Risk

High Risk Specified: Main and men

Reference Standards: ☐ Part 1 of AS/NZS 3000 ☑ Part 2 of AS/NZS 3000 ☐ AS/NZS 3012

☐ Additional Standards _____

Indicate the number of each item installed or altered:

Lighting Outlets: 3 Socket Outlets: 6 Ranges: 1 Water Heaters: 1

Work Done: Mains coming in is 16 mil neutral screen
Pre-wire only the switchboard
63 amp isolating switch then to a 63 amp main switch 32 amp MCB for Hobbs 16 amp MCB for oven 16 amp MCB for hot water 16 amp MCB ac and 16 amp mcb for heater
40 RCD protecting 1x6 amp mcb with 2x 1mm 2c+e
And 2x 16 a mcbs Protecting 2x 2.5 mil power circuits
Second RCD 40 A protecting 6 a MCB with one 2c+e
2x 16 amp mcb protecting 2x 2.5 mm power circuits
6 mm From main earth bar to earth in location
Six mil main earth and a six mil slab bond connected to the main earth electrode
All the breaker range is a abb
By board still needs to be fired pros and set up for meter
Switchboard main switch will also need to be moved down to below 2 m have advised Mitch
Mains done by sub party
I have only wire the switchboard and done dead testing

The work was done within the period: Date Commenced: _____ Date Completed: _____

(5) Certification of Work

I certify that the completed prescribed electrical work to which this certificate applies, has been done lawfully and safely and the information in the certificate is correct in that the installation, or part of the installation:

- ☐ Relies on manufacturer's instructions ☐ Attached/Ref
- ☐ Relies on Declaration of Conformity ☐ Attached/Ref
- ☐ Accordance with certified design ☐ Attached/Ref

Reference: _____

- ☐ Tested in accordance with ESR2010
- ☐ Earthing system that is correctly rated
- ☐ Fittings safe to connect
- ☐ Safe to connect to a power supply

Test Results
Continuity of Earthing System:
Insulation Resistance:
Polarity – Correct Circuit Connections:
Verification of Impedance:
Bonding:
Other:

Signature:

Date: 27/04/2023

Compliance and Electrical Safety Certificate
Unique ID: 3191.4/E004671

This form has been designed to be used by licensed electrical workers to certify that installations or Part installations under Part 1 or Part 2 of AS/NZS 3000 are safe to be connected to the specified system of electrical supply.

(1) Location of Installation or Part Installation

Address: 32 Ryan Street, Phillipstown, Christchurch 8011

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Name: Hiko Heating

Address: 59 McMahon Drive, Halswell, Christchurch 8025

Email: Phone:

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Name: Blake Quigley Registration/Practising Licence No.: E004671

Organisation: JAFS Electrical

Phone: 022 463 2212 Email: blake@jafselectrical.co.nz

Name of person(s) being supervised:

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This work is: ☑ Is New Work ☐ Is Addition ☐ Is Alteration ☐ Is Maintenance

The prescribed electrical work is: ☐ Home Owner ☐ Low Risk ☐ General ☑ High Risk

High Risk Specified: Main and men

Reference Standards: ☐ Part 1 of AS/NZS 3000 ☑ Part 2 of AS/NZS 3000 ☐ AS/NZS 3012 ☐ Additional Standards

Indicate the number of each item installed or altered:

Lighting Outlets: 3 Socket Outlets: 6 Ranges: 1 Water Heaters: 1

Work Done: UNIT 1 Move the whole switchboard done 50 mil as the main switch was sitting too high
Switchboard meter combo is being fed by 16 mil neutral screen
Six mil main earth feed to the main earth electrode
Six mil earth for slab bond
63 amp isolating switch protecting 63 amp main switch 32 amp MCB protecting Hobbs 16 amp MCB protecting oven 16 amp MCB protecting hot water Sondor 16 amp MCB protecting Aircon and a 16 amp MCB protecting heater
48 RCD protecting 6amp mcb with 1x 1mm 2c+e
1x 16 amp mcb Protecting 2×2.5 mm circuits
Leaf space for 1x more mcb (run out of supplies gear)
40 amp RCD protecting a six amp MCB
2x 1mm2c+e
Prep second rcd for 2x more 16 amp mcbs
All switch range is abb
I have not done any testing or no power is
MAINS is run by sub party I have only done the switchboard and dead testing

The work was done within the period: Date Commenced: Date Completed:

(5) Certification of Work

I certify that the completed prescribed electrical work to which this certificate applies, has been done lawfully and safely and the information in the certificate is correct in that the installation, or part of the installation:

- ☐ Relies on manufacturer's instructions — ☐ Attached/Ref
- ☐ Relies on Declaration of Conformity — ☐ Attached/Ref
- ☐ Accordance with certified design — ☐ Attached/Ref

Reference:

- ☐ Tested in accordance with ESR2010
- ☐ Earthing system that is correctly rated
- ☐ Fittings safe to connect
- ☐ Safe to connect to a power supply

Test Results
Continuity of Earthing System:
Insulation Resistance:
Polarity – Correct Circuit Connections:
Verification of Impedance:
Bonding:
Other:

Signature:

Date: 27/04/2023

(6) Electrical Safety Certificate

(to be completed by the person who connects the installation, or part installation to the power supply)

I certify that the installation, or part of the installation as described above, to which this Electrical Safety Certificate applies is connected to a power supply and is safe to use. If maintenance, alteration or addition, has not adversely affected any other part of the installation.

Name: Blake Quigley

Registration/Practising Licence No: E004671

Signature:

Issue Date: 13/07/2023

Connection Date:

Tetrad.
Quality by Design

Multi-Unit Development at 32 and 36 Ryan Street, Christchurch

Geotechnical Report

Revision: 3

Date:
19 January 2022

DOCUMENT CONTROL

Project Reference	21341	
Project Name	Multi-Unit Development at 32 and 36 Ryan Street, Christchurch	
Revision	3	
Prepared For	A K Property Limited	
Prepared By		Callum Nish B.E. Hons (Civil), Graduate Engineer
Reviewed By		Steven Roberts CPEng (Geotechnical), CMEngNZ, IntPE(NZ)
Limitations	*This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in accordance with the agreement between the Client and Tetrad Consulting Ltd. Tetrad Consulting Limited Ltd accepts no liability or responsibility whatsoever for any use of or reliance upon this report by any third party. Any copying of this report to external parties requires the permission of the Client and Tetrad Consulting Limited.*	

Report Distribution:		
Recipient	**Release Date**	**Document Type**
Nick Aubrey	19 January 2022	PDF

TABLE OF CONTENTS

Executive Summary

Geotechnical information sourced from the New Zealand Geotechnical Database, show the site has performed poorly during the 2010 to 2011 Canterbury earthquake sequence, with minor to moderate quantities of ejected material and moderate ground surface damage recorded from EQC observations after the February 2011 event.

The geotechnical investigation completed at the site comprised three CPT tests which returned an inferred subsurface soil profile of interbedded silt clay and silty sand to 3.5 m depth and sands to 10 m.

The silty sand and sand deposits below above the water table are loose to medium dense and susceptible to liquefaction-induced settlement, with settlement up to 80 mm predicted for a 25-year (SLS1) event, increasing to 150 mm for a 500-year (ULS) event.

Moderate differential settlements can be expected during a SLS1 and SLS2 event as supported by the moderate LPI values discussed in Section 5.4 of this report, however severe ground damage can be expected after a 500- year event.

Accordingly, an Option 4 waffle slab foundation system on a 1.0 m thick reinforced gravel raft is recommended for the proposed 7-unit residential development. The foundation system is required to meet the performance objectives of the MBIE guidelines, which requires the foundation to provide enough stiffness to support the imposed building weight under a 2m loss of edge ground support and 4m loss of internal ground support.

During a 500-year earthquake event, the foundation system is expected to be sufficiently stiff to prevent irreparable damage to the building units.

In accordance with Section 106 of the Resource Management Act, we don't see any grounds for refusing a subdivision consent for the proposed development based on Section 106 assessment of the RMA.

1 Introduction

Tetrad Consulting Ltd has been engaged by A K Property Ltd to undertake a geotechnical investigation and report for the purpose of supporting a Resource Consent application to subdivide the subject property into two Fee-Simple Lots at 32 and 36 Ryan Street, Phillipstown for the purpose of a 7 - unit residential development.

This report presents the results of a geotechnical investigation to characterize the subsurface soil profile and strength properties for foundation design and discussion of the following:

- Quantify liquefaction susceptibility for a design basis seismic event.
- Confirmation of Ministry of Business, Innovation and Employment land classification for the site.
- Provide foundation recommendations for the proposed development.
- Suitability to subdivide in accordance with Section 106 of the Resource Management Act (RMA).

The scope of this geotechnical report does not include commentary on site-specific environmental issues, which is beyond the scope of our geotechnical engagement.

2 Supporting Documents

The following information sources have been referred to for completion of this report:

- Davis Ogilvie's Subdivision Plan Titled: – *"Proposed Subdivision of Lots 13 & 14 DP 9028 at 32/36 Ryan Street, Philipstown, Christchurch",* reference: 41804_issue A, dated August 2021.
- Coll Architecture's RC plans Titled: *"AK Residential -32 & 36 Ryan Street",* Sheet No's A101 to A306, dated 15th November 2021.

3 Site Description

The setting is a flat site with a total land area of approximately 1,588 m^2 and is located along the east side of the street. The sites are each developed by single storey dwellings, with detached garages towards the rear the sites.

Figure 1: Approximate location of subject site on the east side of Ryan Street

4 Ground Investigation

4.1 Previous Geotechnical Investigation

Relevant previous geotechnical investigations were reviewed using the New Zealand Geotechnical database (NZGD). A borehole 65 m southwest of the site (BH18118) revealed silts to 4 m depth, transitioning to sands to 10 m depth. A ground water table of 1.5 m below ground level (bgl) was also inferred. Hand auger and Scala penetrometer testing 50 m northeast of the site (HA-DCP158243) inferred silt to 2.5 – 3 m underlain by sand or sandy silt and 200 kPa ultimate geotechnical bearing capacity from 0.6 m depth. The ground water table inferred at these hand augers ranged from 1.0 – 1.3 m depth.

4.2 Geotechnical Investigation

Deep ground testing was carried out on the 14th of September 2021 by McMillan Drilling Ltd and comprised two Cone Penetrometer Test (CPT01- CPT03) pushed to a target depth of 10 m complete with excess pore pressure measurements. A historical onsite CPT was found which was tested by Pro-Drill Limited on the 26th of March 2013. In addition, two Scala penetrometer tests (SP01 – SP02) were performed by Tetrad on the 14th of October. The Scala penetrometer and CPT test locations and results are shown in Appendix A and summarized in Table 1 below.

Table 1: Summary of CPT investigation

Test type	Depth of test (m)	Comments
CPT01	10.0 m	Reached target depth
CPT02	10.0 m	Reached target depth
CPT03	10.0 m	Reached target depth
SP01	1.5 m	Reached target depth

SP02	1.5 m	Reached target depth

5 Subsurface Conditions

5.1 Geology

The geological map of the area (Brown and Webber, 1992) shows that the site as underlain by soils of the Christchurch formation to 25 m. The site is therefore shown to comprise of estuarine, lagoonal, and coastal swamp deposits of silt, sand, clay, and peat, primarily deposited by sea currents and longshore drift. This is underlain by the Riccarton gravel formation, comprising well graded gravel with cobble sizes up to 100 mm diameter.

5.1.1 From Cone Penetrometer Tests

The CPT tests returned an inferred subsurface soil profile comprising interbedded clayey silt to approximately 3.3 m depth. The CPT tests returned cone tip resistance (q_c) values ranging between 1 - 3 MPa to 1.4 m depth for CPT01 and CPT02. CPT03 returned higher qc values of approximately 5 MPa to 0.6 m depth, decreasing to 2 MPa at 1.3 m depth. Between 1 – 3.5 m, the inferred qc values were relatively consistent between the CPT's. Between 1.3 to 2.5 m, qc values ranged between 0.5 – 2 MPa. Values increased from 2.2 to 2.5 m depth as a thin layer of sand or silty sand was struck. Between 2.5 – 3.3 m depth, a very weak layer of weak clayey silt or organic material was encountered in all CPT's. This had a range of qc values between 0.30 – 0.77 MPa, which indicated the potential for primary consolidation settlement under load as well as secondary settlement over time within this layer. After this depth, values generally increased until up to 10 – 20 MPa showing primarily medium dense to dense sands to 10 m, although CPT01 had a weaker layer between 6.1 – 6.9 m where qc values ranged between 2- 3 MPa.

Figure 2 below shows the cone tip resistance values to 10 m depth

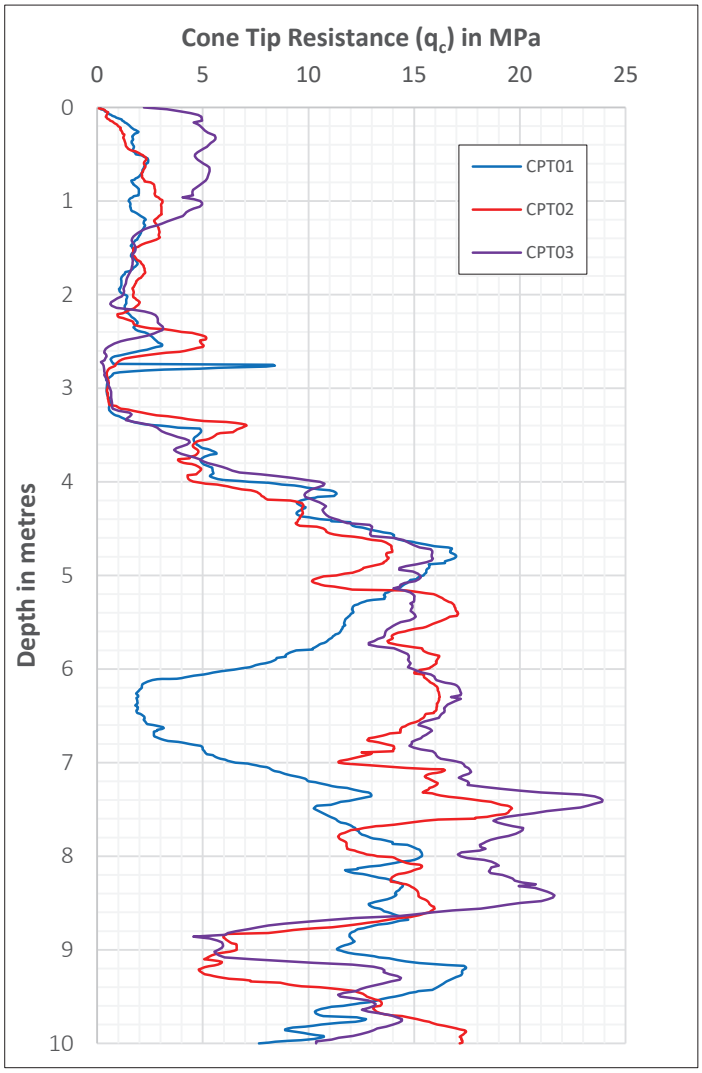

Figure 2: CPT test profiles to MBIE's index depth

5.2 Ground Water Table

To assess the ground water table depth, reference had been made to the GNS Science Median Groundwater Surface Elevations from the NZGD which indicate the water surface contour range based on long term observation records at each site. The water surface contours are stated in terms of the LVD 1937 datum, which is set at 9.043 m above the Christchurch Drainage Datum (CDD). Table 2 below shows the water surface contours for the 15th and 85th percentile in terms of the LVD datum.

Table 2: Water surface contour levels from NZGD

	15th Percentile	Mean	85th Percentile
Water surface Depth (m)	1.53	1.69	2.06

When referenced to the CDD, the 15th Percentile water surface contour level translates to a water table depth of 0.967 m based on an average site ground level of RL 11.54 m as sourced from the Christchurch City Flood Management website.

The 85th Percentile water surface contour level translates to a water table depth of 0.15 m. However, after consideration of the surrounding tests (BH18118 and HA-DCP158243 from the NZGD), an elevated ground water table of 0.5 m below the lowest ground level (bgl) was chosen for liquefaction assessment.

6 Seismic Assessment

6.1 Previous Earthquake Performance

The site has been subjected to repeated ground shaking from the Canterbury earthquake sequence. Reference to the New Zealand Geotechnical Database shows the conditional peak ground accelerations based on the method by Bradley et al (2012). The method combines the empirical strong motion attenuation with distance model, with the actual observation to produce conditional peak ground accelerations. Table 3 below summarises the PGA values for the 2010/2011 earthquake events.

Table 3: Conditional PGA for recent earthquakes (Bradley et al)

Earthquake	Magnitude-M_w	PGA mean	Equivalent $M_{7.5}$ PGA			
			To MBIE	$PGA_{16\_7.5}$	$PGA_{50\_7.5}$	$PGA_{84\_7.5}$
4 Sep 2010	7.1	0.23	0.12	0.28	**0.21**	0.29
22 February 2011	6.2	0.44	0.20	0.43	**0.31**	0.44
13 June 2011	6.0	0.21	0.10	0.10	**0.14**	0.21
23 Dec 2011	5.9	0.17	0.13	0.16	**0.11**	0.16

$PGA_{16\_7.5}$ represents the 16th percentile (i.e 84% probability of exceedance) scaled to a M7.5 earthquake.
$PGA_{84\_7.5}$ represents the 84th percentile (i.e 16% probability of exceedance) scaled to a M7.5 earthquake.

The predicted mean PGA for each earthquake has been converted to an equivalent PGA for magnitude M7.5 earthquake in accordance with MBIE guideline recommendations by the method of Boulanger & Idriss 2014.

The adjusted PGA values are also shown with an 84% and 16% probability of being exceeded. The MBIE value in the table represents the 90% exceedance PGA which is accepted as being "well tested" for an SLS1 event. In this case, the site has been well tested to SLS1 and SLS2 levels of ground shaking from the September 2010 and February 2011 events with a mean $PGA_{50\_7.5}$ value of 0.21g and 0.31g, respectively.

6.2 Liquefaction tests

Liquefaction assessment of the CPT tests has been completed by the method of Idriss and Boulanger (2014).

In applying this method, a water level at 0.50 m was used for triggering of liquefaction in the alluvial deposits.

A 'fines correction' coefficient (CFC) of 0.0[1] was adopted for the liquefaction analysis in the Idriss and Boulanger method.

Liquefaction induced settlement has been quantified by the method of Zhang et al (2002). Table 4 below summarises the predicted liquefaction settlements rounded up to the nearest 5 mm to a test depth of 10 m for a SLS1 and ULS event with PGAs of 0.13g and 0.35g, respectively. A second serviceability earthquake event (SLS2) has also been considered with a PGA of 0.19g and Magnitude M6.0.

Approximately 80 and 90 mm of liquefaction settlement is predicted for a SLS1 and SLS2 events respectively, increasing up to 150 mm for a ULS event.

Table 4:Liquefaction settlements to CPT refusal depth

Test Location	SLS1 (M7.5)	SLS2 (M6.0)	ULS (M7.5)
CPT01	80	90	150
CPT02	55	70	125
CPT03	55	60	100

6.3 Previous Earthquake Damage from EQC Observations

Table 5 below summarises the liquefaction observations sourced from EQC records obtained from the NZGD and only returned ground surface damage from the February 2011 event. The EQC records suggest the site is susceptible to negligible ground surface damage for earthquake events up to Magnitude M6.2. An approximate range of 25 – 125 mm of settlement under the February 2011 earthquake event was inferred by LiDAR settlements sourced from the NZGD.

Table 5: Summary of EQC liquefaction interpreted from EQC observations

Earthquake Event	Ground surface Damage Observation
September 2010	No observations
February 2011	No lateral spreading but minor to moderate quantities of ejected material
June 2011	No EQC observations
December 2011	No EQC observations

6.4 Liquefaction Potential

We have assessed the 'Liquefaction Potential Indices' number for each of the liquefaction cases identified in Section 6.2 above. The LPI number provides a performance-based assessment of liquefaction ground surface damage and is influenced by the ratio of the non-liquefiable crust layer to the total thickness of liquefiable soil deposit.

The LPI should be considered in the context of both the ground conditions and structure of interest. The ranges provided in Table 6 below are based on triggering calculations using Boulanger and Idriss (2014) method, and analysis and interpretation of liquefaction effects in the 2010-2011 Christchurch earthquake sequence. Table *6* below has been reproduced from, 'Module 3: Identification, Assessment and Mitigation of Liquefaction Hazards": dated May 2016.

[1] Leeves,J.,van Ballegooy,S.,Lees,J., Wentz;2015. *Effect of fines content correlations and liquefaction susceptibility thresholds on liquefaction consequence*, 6th International Conference on Earthquake Geotechnical Engineering, November 2015, New Zealand

Table 6: General performance levels for liquefied deposits

Performance Level	Effects	Characteristics and Consequences	Characteristic LPI
L0	Insignificant	No significant excess pore water pressures (no liquefaction)	LPI = 0
L1	Mild	Limited excess pore water pressures; negligible deformation of the ground, and small settlements	LPI = 0
L2	Moderate	Liquefaction occurs in layers of limited thickness (small proportion of the deposit, say 10 percent or less) and lateral extent; ground deformation results in relatively small differential settlements	LPI < 5
L3	High	Liquefaction occurs in significant portion of the deposit thickness (30 to 50 percent) resulting in transient lateral displacements, moderate differential movements, and settlement of the ground in the order of 100mm to 200mm.	LPI = 5-15
L4	Severe	Complete liquefaction develops in most of the deposit resulting in large lateral displacements of the ground, excessive differential settlement, and total settlement of over 200mm.	LPI > 15
L5	Very severe	Liquefaction resulting in lateral spreading (flow), large permanent lateral ground displacements and/or significant ground distortion (lateral strains/stretch, vertical offsets and angular distortion).	LPI > 20

Liquefaction analysis confirmed liquefaction potential Indices (LPI) values of 3 and 5 for a SLS1 and SLS2 event respectively and increasing to 20 for a ULS event. These values translate to *Moderate* ground surface damage for a SLS1 and *Severe for a* ULS event.

6.5 Lateral Spread

Lateral spread risk has been assessed according to site and ground conditions, as well as proximity to significant waterways or steep changes in ground level. The subject property is well over 150 m from the nearest waterway (over 1 km distance). The site is also generally flat and level with no significant ground elevation over the site.

Ground surface observations presented on the New Zealand Geotechnical Database (NZGD) indicates no observed ground cracking for any of the seismic events on the site. Based on this lateral spread damage is not considered a significant geotechnical risk at this site.

6.6 Technical Land Category Classification

Reference to the MBIE Technical Foundation Category Classification off the NZGD website indicates the site is TC3 rated land for the purpose of foundation design. Liquefaction analysis in Section 6.2 predicts total *free-field* liquefaction between 80 and 90 mm for a SLS1 and SLS2 events respectively and up to 150 mm for a ULS event.

These settlement values are consistent with an MBIE's guideline rating of TC3. Therefore, we recommend a Technical Category 3 Classification for foundation design.

6.7 Seismic Category

The thickness of the alluvial deposits beneath this area of the Christchurch area defines the site as Class D, 'Deep Soils', in terms of the seismic design requirements of NZS 1170.5.

7 Environmental Issues

Although environmental engineering is beyond the scope of our engagement, we have undertaken a review of Environment Canterbury's 'Listed Land Use Register' (LLUR) (http://llur.ecan.govt.nz/). The LLUR is a public record of sites known to have been subject to historical and / or existing potentially contaminating land use activities prescribed in the Hazardous Activity and Industries List (HAIL). A review of the LLUR indicates:

"The Listed Land Use Register does not currently have any information about a Hazardous Activities and Industries List site on this land parcel".

Although the LLUR does not contain any records of potential HAIL at the subject site, the LLUR is not considered a complete record and is being continuously updated, and it is therefore recommended to contact the Christchurch City Council to enquire about any known hazardous activities at the subject site that may require consideration as part of any future consent application.

8 Flood levels

The Christchurch City Council flood hazard maps at:
https://www.ccc.govt.nz/services/stormwater-and-drainage/flooding/floorlevelmap were accessed on 6th of October 2021. The CCC system shows the site is in a flood management area, and accordingly interim flood floor level will likely be required before lodging a building consent application.

9 Bearing Capacity

Ultimate bearing capacity in the shallow soil deposits has been quantified from CPT cone tip resistance values based on the following empirical relationships for shallow foundations bearing on silty clay and silty sand deposits as encountered at all CPT's to 3.5 m depth.

For shallow foundations bearing on clay-like soils, Q_u is calculated from:

- $Q_{ult} = 2 + 0.28q_c$ – in units of kg/cm^2 - Equation 1

For shallow foundations bearing on sandy silt soils, Q_u is calculated from:

- $Q_{ult} = 28 – 0.0052(300 - q_c)^{1.5}$ - in units of kg/cm^2 - Equation 2

The above relationships require the q_c values from the CPT tests to be converted to units of kg/m^2 before calculation of Q_{ult}.

The ultimate bearing capacities in Table 7 are the lower bound values calculated from equations 1 & 2 at test locations CPT1, CPT2 and CPT03. Bearing capacities vary between 32 to 280 kPa at CPT1, between 21 to 280 kPa at CPT2 and between 34 to 280 kPa over the same depth from 0.6 m to 3.4 m bgl.

The ultimate bearing capacity highlighted in the last row of Table 7 is calculated from the geomean q_c value for the whole soil layer from 0.6 to 3.4 m at the respective CPT test locations. Below 3.4 m the soils become stronger with increasing depth.

Table 7: Ultimate bearing Capacity from CPT's

	CPT01	CPT02	CPT03
Depth (m)	Lowest Q_u at CPT1 from Equation 1 & Equation 2 - kPa	Lowest Q_u at CPT2 from Equation 1 & Equation 2– kPa	Lowest Q_u at CPT1 from Equation 1 & Equation 2 - kPa
0.6	251	243	280
0.7	237	236	280
0.8	198	263	280
0.9	226	274	280
1.0	184	280	280
1.1	196	280	280
1.2	250	273	280
1.3	241	279	247
1.4	222	279	199
1.5	199	205	213
1.6	200	212	200
1.7	212	243	199
1.8	154	239	180
1.9	148	209	167
2.0	165	203	158
2.1	171	226	90
2.2	182	155	265
2.3	222	205	278
2.4	241	280	277
2.5	276	280	145
2.6	230	280	56
2.7	94	146	57
2.8	280	78	54
2.9	72	75	66
3.0	68	76	87
3.1	81	76	95
3.2	83	130	99
3.3	137	280	190
3.4	280	280	268
Qu	**176**	**198**	**168**

Scala tests SP1 – SP4 completed on the 15th of October 2021 inferred an average bearing capacity of 300kPa from 0.8 bgl, corresponding to an average Scala test result of 4.5 blows per 100 mm of ground penetration. The average Scala bearing capacity of over 300 kPa from 0.8 m depth does not correlate well with the CPT-derived values in Table 7. For this reason, the lower bearing capacities from the CPT's have been adopted for foundation design.

An ultimate bearing capacity of 200 kPa is recommended at 1.1 m for design of shallow ground improvement and for the concrete foundation system and is discussed further in Section 10 below.

10 Foundation Settlements

Calculation of static settlement is from the one-dimensional consolidation method applied to the weakest upper silt and sand layers and for a soil elastic modulus of 1.2 MPa. The elastic modulus has been assessed from the following empirical relationship of CPT tip resistance verses elastic modulus (Es). In this case, the following relationship was adopted with a lower bound q_c value of 0.5 MPa.

$$Es = 2.5q_c \text{ - in MPa}$$

Static settlement of up to 19 mm is predicted in the shallow silt and sand deposits to 3.3 m bgl, based on an applied foundation load of 20 kPa from the combined self-weight of the building and the foundation. The 1 – D consolidation calculation was performed on a combination of the weakest layers observed from the soil profiles and include the layers from 2.55 - 3.2 m at CPT03. Total static settlement of 26 mm was calculated at this CPT location, with differential settlement estimated at 20 mm to account for potentially greater settlement of the weak clayey silt layer due to inaccuracies associated with quantifying the soils' elastic modulus. In this case we have increased the calculated differential settlement by 30%, from 20 mm to 26 mm.

We therefore anticipate up to 20 mm of differential settlement over a 6 m span due to the imposed foundation loading from the combined structure, foundation with gravel raft, and satisfies the foundation performance requirement in Section B1/VM4 of the NZBC.

11 Assessment against RMA

A suitability assessment of the site for subdivision has been carried out in accordance with Section 106 of the Resource Management Act (RMA).

Section 106 the RMA states *inter alia*

1. …" a consent authority may refuse subdivision consent, or may grant subdivision consent subject to conditions, if it considers that:

(a) *the land in respect of which a consent is sought, or any structure on the land, is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; or*

(b) *any subsequent use that is likely to be made of the land is likely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source*.

(c) *sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.*

Our assessment of the site against the requirements of Section 106 is presented in Table 8 and is based on observations of the subject property and experience of ground conditions within this area of Canterbury.

Table 8: Assessment of hazards and their risk to new subdivision against the RMA

	Potential Susceptibility	
	Risk - Current (Section 106 1a)	Risk - Post Development (Section 106 1b)
Falling Debris	The site is located on relatively flat ground, a significant distance from any hills or rock outcrops; falling debris is not considered a risk.	
Slippage	The site is located on stable in situ loess soils and the site is located adjacent to a mapped areas of slope instability as per the Stage 1 Port Hills GNS report for Mass Soil Movement. Accordingly, mass soil movement is not considered a significant risk over the subject property.	
Erosion	No significant erosion was identified on site.	Fine grained sandy soils have the potential to erode if exposed for long periods. However, dense vegetative cover should prevent this from occurring. All reasonable attempts should be made to protect exposed soils from rainfall and runoff by implementing an erosion and sediment control plan in accordance with council requirements.
Subsidence	Given the encountered ground conditions the site is not considered susceptible to liquefaction settlement. The ground conditions may be susceptible to minor static settlement	The proposed development comprises construction of a residential dwelling and the likely degree of static settlement will not adversely affect this type of structure. Any filling above existing ground levels should only be undertaken with input from a suitably qualified Geotechnical Engineer.
Inundation	The risk of inundation from liquefaction or stormwater run-off is low. However, confirmation of minimum floor level requirements should be sought from the local council authority at the Building Consent stage.	Stormwater run-off should be appropriately managed and discharged to an existing utility service. Floor level requirements (if any) should be confirmed with the local council authority.

Based on the above predicted geotechnical hazards, as shown in Table 8, we conclude there is no reason to refuse subdivision consent in clause 106 (a), based on falling debris, slippage, erosion, subsidence, or inundation.

Any proposed development will have to comply with relevant legislation, Codes and Standards. For example, fills would have to be constructed at safe slopes and cuts would have to be excavated to provide stable slopes.

Any potential location for a future dwelling on the proposed site is unlikely to require significant fill or cut earthworks, however where earthworks are required, they are likely to expose fine grained soil that will be susceptible to erosion if left exposed to weathering for prolonged periods of time.

Erosion by wind, precipitation or inadequately discharged stormwater runoff should be controlled through best construction practice. Provided these best practice methodologies are implemented during construction it is our opinion that development of the site will not result in the acceleration or worsening of these hazards. In our opinion therefore, and not to be construed as a guarantee, Clause 106 1(b) would not provide grounds for refusing a subdivision consent.

Section 106 1(c) is not relevant to a geotechnical appraisal and therefore has not been considered in this report.

A 'Statement of Professional Opinion on the Suitability of Land for Subdivision' is provided in Appendix C.

12 Foundations

12.1 Discussion

The proposed development comprises six two-storey residential units constructed of light-weight materials in accordance with NZS 3604 type construction. As such, we have considered foundation options outlined in MBIE's Part A: "Repairing and rebuilding houses affected by the Canterbury earthquakes", December 2012, consistent with the TC3 Classification as discussed in Section 6.6 above. The blocks of units do not exceed an aspect ratio of 3.0, and thus fit within the MBIE guideline for shallow foundations.

The soil column from 1 - 2.5, 3.5 - 10 m is susceptible to SLS1 and SLS2 liquefaction-induced settlement during earthquake loading with settlement up to 80 mm predicted for a SLS1 event and increasing to 90 mm for a SLS2 event. During a ULS event between 100 to 150 mm settlement is predicted, with most of the settlement occurring in the soil column from 5.5 to 10 m.

Moderate ground surface damage during SLS1 and SLS2 ground shaking can be expected at this site consistent with the low – moderate LPI values predicted in Section 6.4.

During a ULS event severe ground surface damage can be expected, with excessive differential settlement predicted from the high LPI values. Accordingly, a shallow surface foundation as described in Section 12.2 below would be suitable for the proposed multi-unit development combined with a 1.0 m thick reinforced gravel raft. The stiff concrete slab foundation and reinforced gravel raft are expected to supress differential settlement damage during SLS1 and SLS2 ground shaking, whilst mitigating irreparable damage to the units during a ULS event.

12.2 Reinforced Gravel Raft with an Option 4 MBIE foundation

The Option 4 shallow foundation system is required to meet the performance objectives of the MBIE guidelines, which would otherwise require the foundation to provide enough stiffness to support the imposed reduced gravity load of the buildings under a 2m loss of edge ground support and 4 m loss of internal ground support.

For ultimate limit state design of the foundations a 1.0 m thick reinforced gravel raft is recommended to provide a stable building platform for construction of the waffle slab foundation. The exposed silty soils at the gravel raft base provide an ultimate bearing capacity of at least 200 kPa based on the cone tip resistance values quantified in Section 8 above.

Excavation for the reinforced gravel raft is required to at least 1.1 m below the lowest adjacent ground level followed by placement of Bidim A19 geo-cloth over the exposed soils. The base of the gravel raft shall extend at least 0.5 m beyond the foundation footprint. The gravel raft edges should be battered at 1H:2V and shall be constructed as follows:

- The gravel raft shall be constructed from a well graded fill material comprising stone with at least two subangular faces as per MBIE guideline recommendations.
- The gravel material shall be placed in 150mm thick layers and compacted to 95 % of the MDD value in accordance with NZS 4431:1989.
- After placement of each of the first two layers of compacted fill, a layer of TriAx-160 geogrid (or similar) should be laid before placement of the next gravel layer (2 layers of geogrid required in total).
- The compacted fill density should be confirmed via NDM testing at random intervals not exceeding 3 m in each direction on the first and last layer of compacted material.

Refer to Appendix D for the proposed development layout.

13 Further Geotechnical Considerations

13.1 Earthworks

During development of the site appropriate stormwater and erosion control measures should be implemented and monitored throughout construction. Erosion control is likely to require the introduction of silt fences, or other similar devices, to intercept soil run-off and improve the quality of the stormwater that will be discharged from site.

13.2 Review of Foundation Design

To ensure the recommendations in this report have been interpreted correctly, we recommend that Tetrad Consulting Ltd is provided with the final foundation design drawings for an independent review. At the time of construction an appropriate level of construction monitoring will be required to confirm that the inferred near-surface soil profile from the CPT tests is consistent with the observed soil profile during foundation excavation. Any notable variation (organic material, soft spots etc.) of the exposed soil, identified during construction should be brought to the attention of the geotechnical engineer before commencing foundation works.

13.3 Pavement Design

For design of flexible pavement areas, we recommend a CBR value of 4 %, based on interpretation of the Scala penetrometer blow count values.

14 Limitations

This report has been prepared for A K Property Ltd and the Christchurch City Council for the purpose of supporting a building consent application for the proposed multi-unit residential development at the subject property.

No liability is accepted by this company or any employee of this company with respect to its intended use by any other person or persons.

This report has been based on the results of cone penetrometer tests completed at discrete locations; therefore, subsurface soil conditions are 'inferred' based on interpreted data and could vary from the test locations at the time of the geotechnical assessment. Should exposed soil conditions vary from those described herein Tetrad Consulting Ltd requests that it be notified immediately.

The geotechnical investigation was confined to geotechnical aspects of the site only and did not involve the assessment for environmental contaminants.

References

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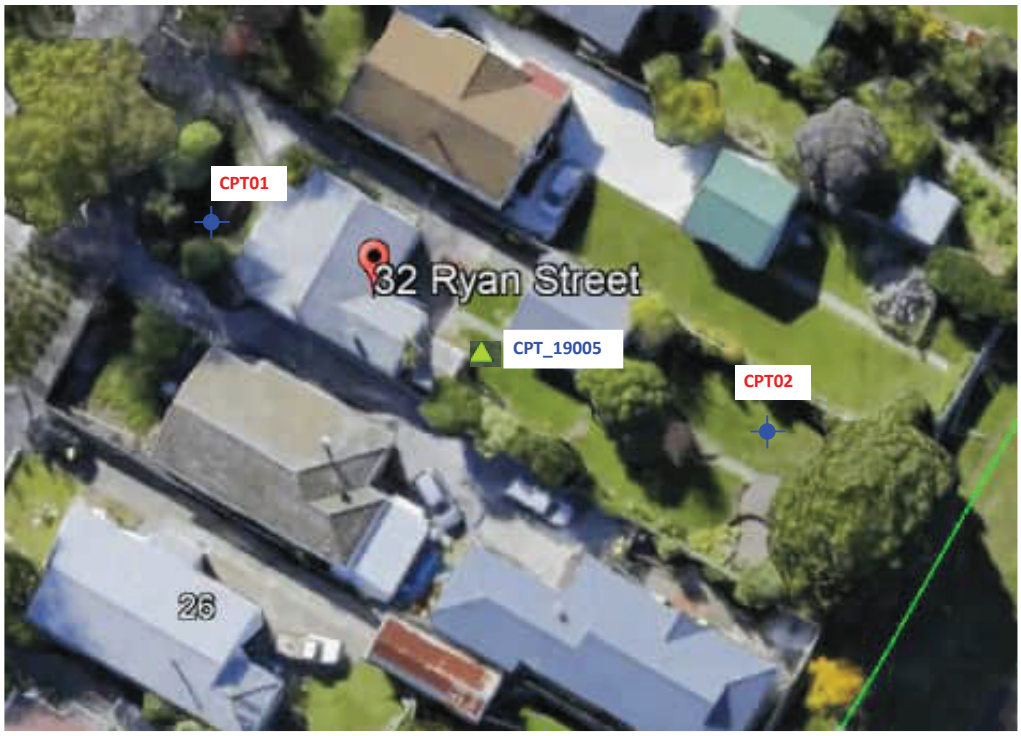
Appendix A

- Site Investigation Plan



Tetrad.
Quality by Design

LEGEND

- Cone Penetrometer Test (CPT)
- Dynamic Probe Super Hard Test (DPSH)
- Scala Penetrometer Test (SP)
- Hand Auger Borehole Test (HA)

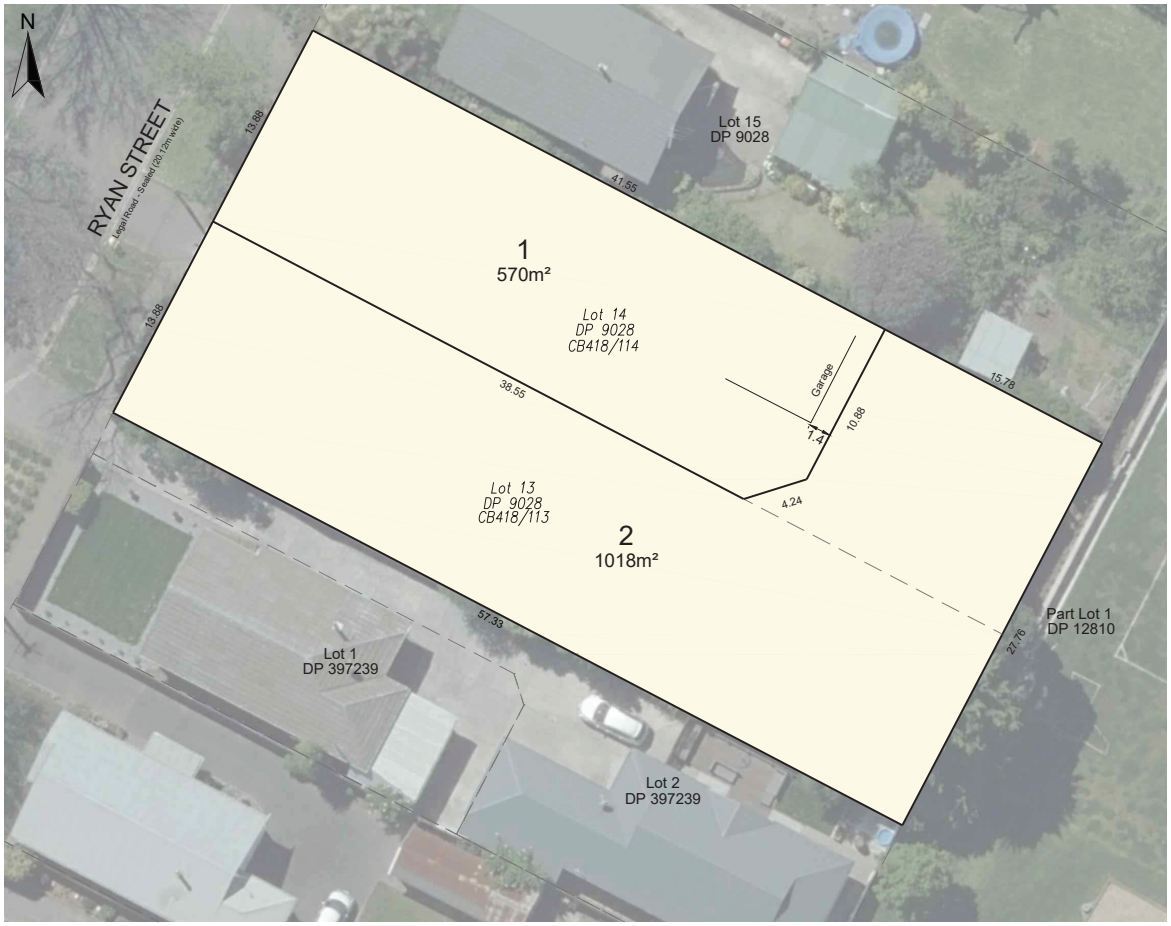
Notes:
1. CPT01 and CPT02 completed by McMillans Ltd on 15.9.21

2. Historical CPT_19005 sourced from NZGD on 19.8.21

PROJECT	**Multi Unit Development**
ADDRESS	**32 & 36 Ryan Street**
CLIENT	**AK Property Ltd**
TITLE	**Soil Test Location Plan**
JOB NO.	**21341**

Drawing not to scale - Do not scale of drawing

DRAWING NO.	REV.
G1.0	1



36 Ryan Street, Phillipstown, Christchurch

Lot 14 DP 9028 RT: CB418/114
Owner(s): N Mason
Area: 794m² more or less

32 Ryan Street, Phillipstown, Christchurch

Lot 13 DP 9028 RT: CB418/113
Owner(s): T S M Arps & J E D Dudson
Area: 794m² more or less

Areas, dimensions and boundaries are subject to final survey.

A full assessment of easements will be undertaken after any engineering is completed. This may result in additional easements.

A	08/21	Scheme Plan	RB
/ issue	/ date	/ reason	/ approved

CAD ref: 41804 - Scheme Plan (301a).dwg

DAVIS OGILVIE
ENGINEERS / SURVEYORS / PLANNERS
Davis Ogilvie & Partners Limited
Level 1, 24 Moorhouse Avenue, Addington, Christchurch 8140
Office 0800 999 333 Email hello@do.nz
www.do.nz

Proposed Subdivision of Lots 13 and 14 DP 9028
32/36 Ryan Street, Phillipstown, Christchurch

/ design	/ drawn	/ QA check	/ dwg
JC	JC	JC	301
/ scale @ A3	/ date	/ file	/ issue
1:250	08/21	41804	A

Appendix B

- CPT Profiles
- Scala penetrometer test results

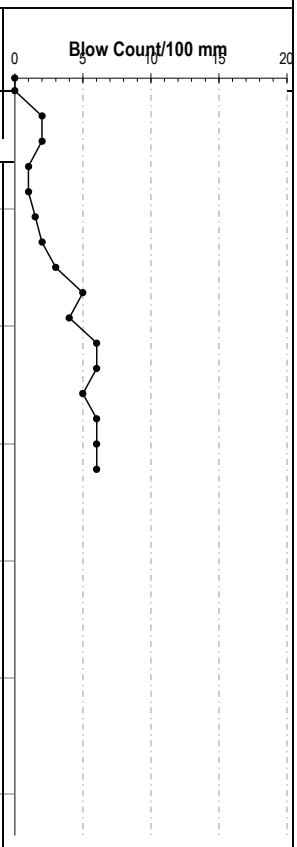
Tetrad.
Quality in Design

Drill Type: Scala
Driller: Callum Nish

SCALA No. **SP01**

Client:	A K Property Limited	**Date:**	15/10/2021
Site Address:	32 - 36 Ryan Street, Phillipstown	**Weather:**	Fine
Town/City:	Christchurch	**Project No:**	21341

Geological Formation:	Depth (m)	Sample Description:	Graphic Log	USCS	Water Table	Blow Count	Depth (m)
	0.0						
	-0.5						-0.5
	-1.0						-1.0
	-1.5						-1.5
	-2.0						-2.0
	-2.5						-2.5
	-3.0						-3.0
	-3.5						
	-4.0						
	-4.5						



Note:
Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only. While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

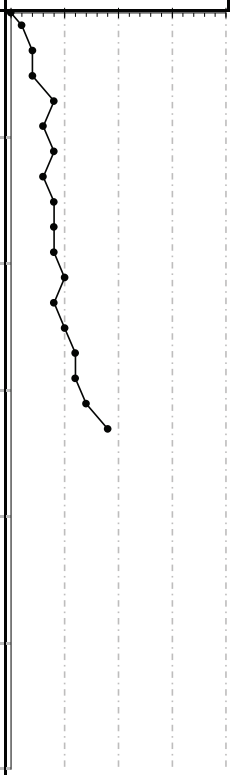
Tetrad.
Quality in Design

Drill Type: Scala
Driller: Callum Nish

SCALA No. **SP02**

Client:	A K Property Limited	**Date:**	15/10/2021
Site Address:	32 - 36 Ryan Street, Phillipstown	**Weather:**	Fine
Town/City:	Christchurch	**Operator:**	21341

Geological Formation:	Depth (m)	Sample Description:	Graphic Log	USCS	Water Table	Dynamic Cone Penetrometer: Blow Count	Depth (m)	Blow Count/100 mm
	0.0							
	-0.5						-0.5	
	-1.0						-1.0	
	-1.5						-1.5	
	-2.0						-2.0	
	-2.5						-2.5	
	-3.0						-3.0	
	-3.5							
	-4.0							
	-4.5							



Note:
Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only. While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

CONE PENETRATION TEST (CPT) REPORT

McMILLAN Drilling

Client: Tetrad Consulting

Location: 32 Ryan Street, Christchurch

Printed: 15/09/2021

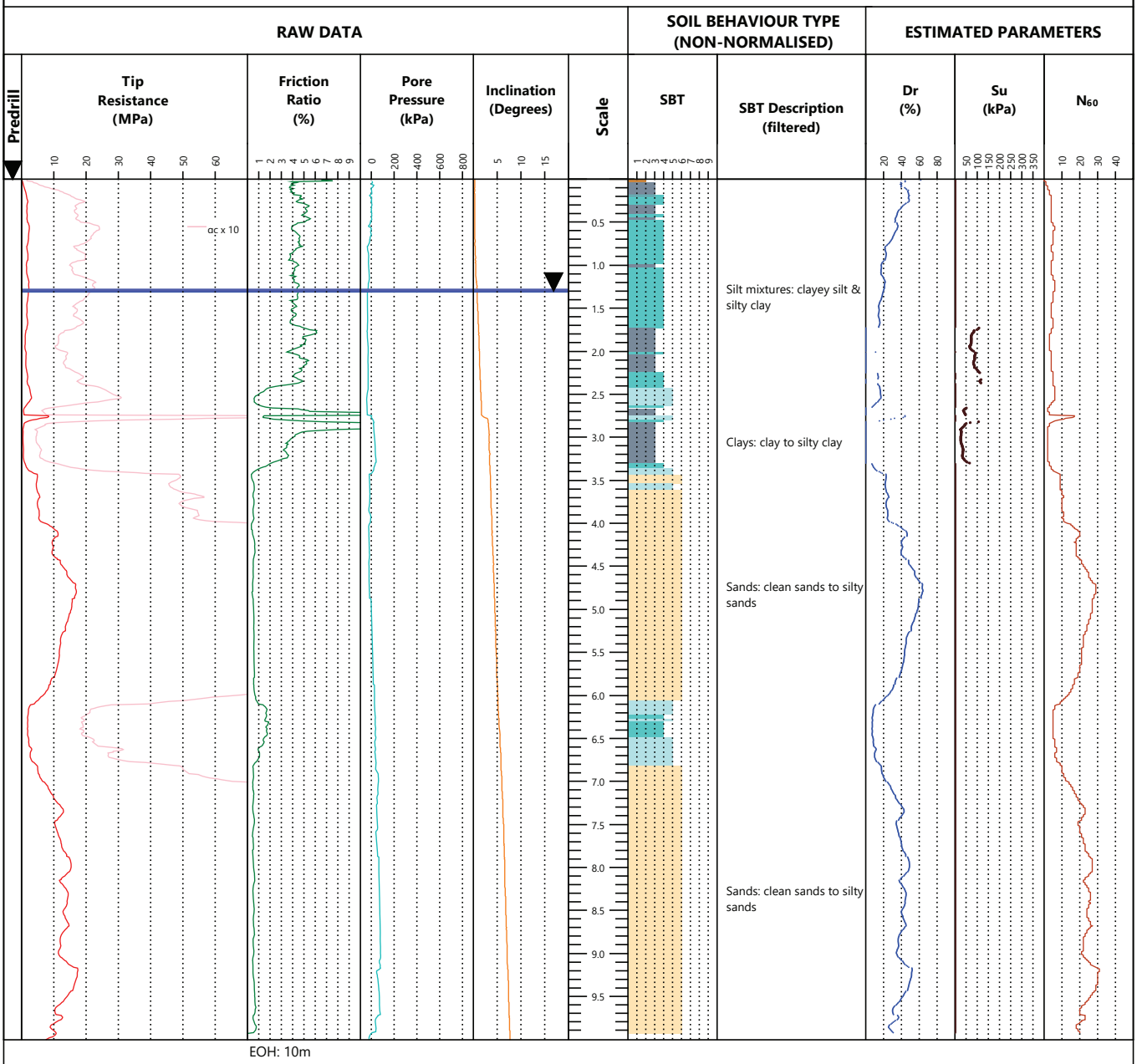
McMILLAN Drilling

Client: Tetrad Consulting		**Bore No.:** CPTu001
Project: 32 Ryan Street, Christchurch		**Job No.:** 20211

Site Location: 32 Ryan Street, Christchurch **Date:** 14/9/2021

Grid Reference: 1572895.15m E, 5179092.31m N (NZTM) - Map or aerial photograph **Rig Operator:** E. Diaz

Elevation: 0.00m **Datum:** Ground **Equipment:** Pagani TG63-150



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS332
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.3m
Collapse: 2.80m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	22.1643	22.0966
Local Friction	0.2718	0.2701
Pore Pressure	3.0081	3.0072

Termination

Target Depth ✓

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations

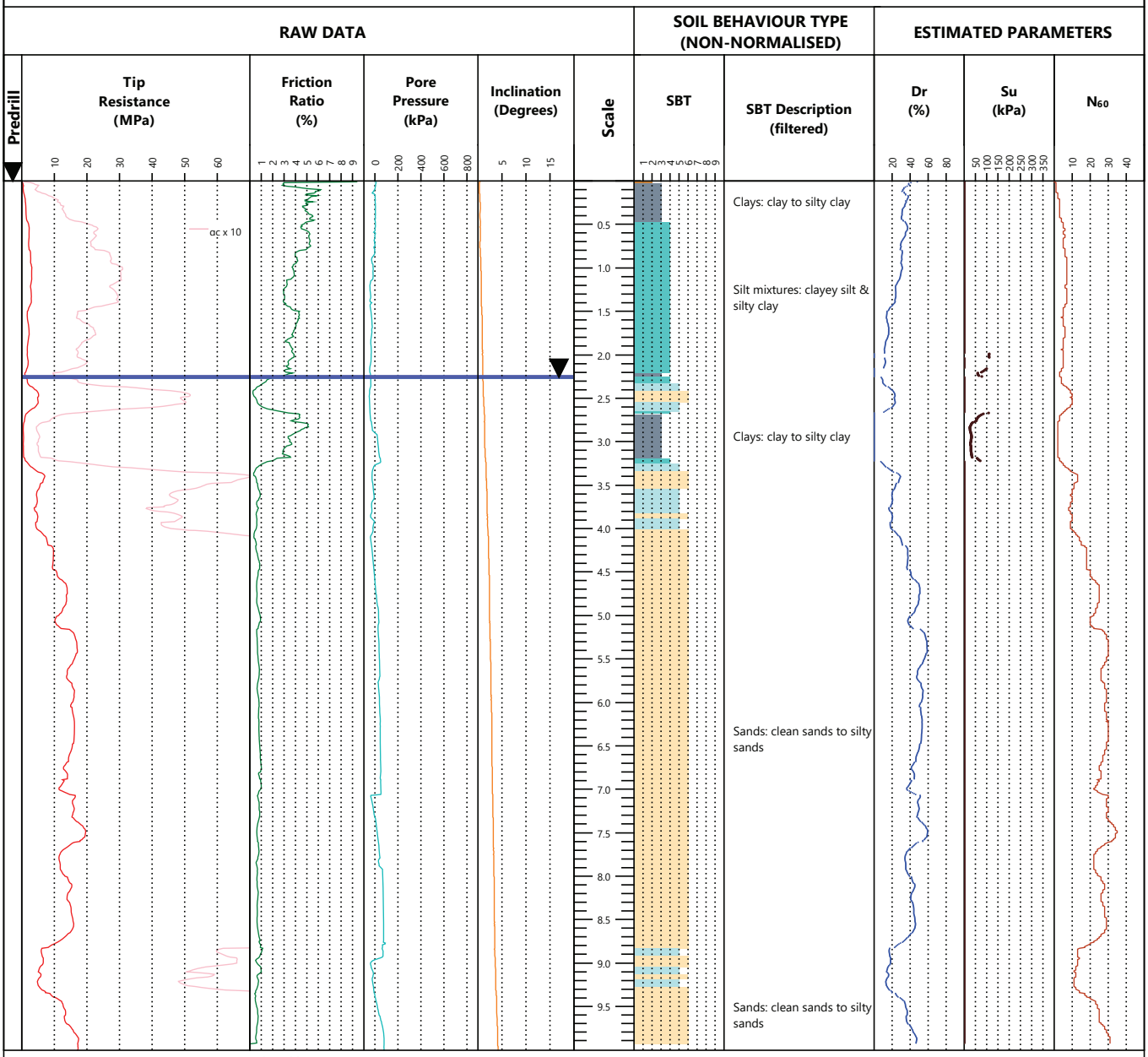
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

McMILLAN Drilling

Client: Tetrad Consulting		**Bore No.:** CPTu002
Project: 32 Ryan Street, Christchurch		**Job No.:** 20211

Site Location: 32 Ryan Street, Christchurch
Date: 14/9/2021
Grid Reference: 1572933.57m E, 5179081.36m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS332
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 2.26m
Collapse: 2.96m

Termination
Target Depth ✓

Effective Refusal
Tip
Gauge
Inclinometer
Other

Zero load outputs (MPa)	Before test	After test
Tip Resistance	22.1903	22.1331
Local Friction	0.2715	0.2703
Pore Pressure	3.0082	3.0071

Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

TEST DETAIL

PointID: CPTu001
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS332
Cone Area Ratio: 0.79

Date: 14/9/2021
Predrill: -
Water Level: 1.3m
Collapse: 2.80m

Termination

Target Depth ☑

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Zero load outputs (MPa)	Before test	After test
Tip Resistance	22.1643	22.0966
Local Friction	0.2718	0.2701
Pore Pressure	3.0081	3.0072

PointID: CPTu002
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS332
Cone Area Ratio: 0.79

Date: 14/9/2021
Predrill: -
Water Level: 2.26m
Collapse: 2.96m

Termination

Target Depth ☑

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Zero load outputs (MPa)	Before test	After test
Tip Resistance	22.1903	22.1331
Local Friction	0.2715	0.2703
Pore Pressure	3.0082	3.0071

McMILLAN Drilling

CPT CALIBRATION AND TECHNICAL NOTES

These notes describe the technical specifications and associated calibration references pertaining to the Pagani piezocone types measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, 10cm^2)

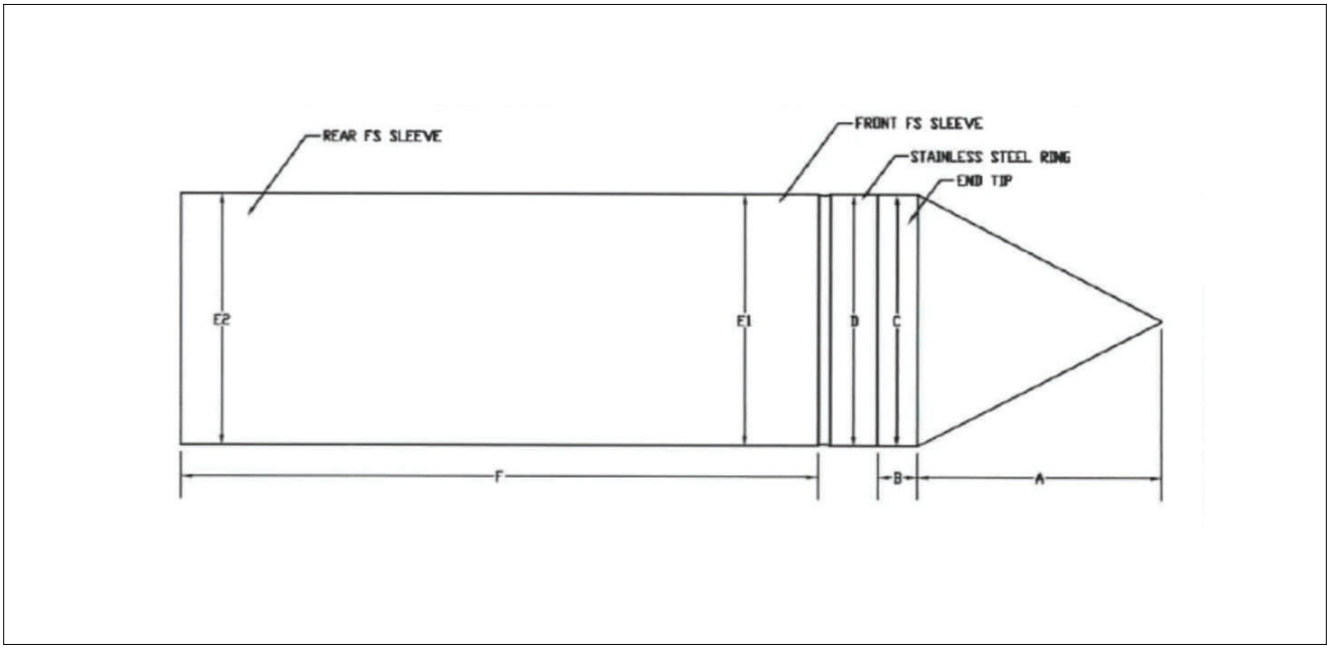
Dimensions

Dimensional specifications are detailed below. All tolerances are routinely checked prior to testing and measurements taken are electronically recorded. All records are kept on file and available on request.

Technical specifications

	Tip	Friction	Pore Pressure	Inclination
Maximum Measuring Range:	50 - 100 MPa	1.60 MPa	2.50 MPa	0° - 20°
Resolution:	24 bit	24 bit	24 bit	12 bit
Accuracy:	0.005 MPa	0.04 MPa	0.04 MPa	0.5°

Length:	320 mm	**Weight:**	1.8 kg
Diameter:	35.8 mm	**Opening angle of bit:**	60°
Cone base area:	10 cm^2	**Side sleeve surfaces:**	150 cm^2
Cone area ratio:	0.80	**Tip and Local Friction sensor displacement:**	80 mm



McMILLAN Drilling

PAGANI® GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE
N° Z198/20

Calibrated system *(Sistema tarato)* :

Serial number	Mks332
Sensor	TIP RESISTANCE
Max. Capacity [MPa]:	100
Scaling Factor:	192020
Tip net area ratio (a_n):	0,79
Sleeve net ratio (b_n):	0,00

Addressee *(destinatario)* :
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:

Manufacturer	AEP transducers
Model	KAL 200 kN
Serial Number	138913

Power press:

Manufacturer	Easydur Italiana
Model	Aura 20T
Serial Number	29084

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date:	16/01/2020
Certificate N.	LAT 091 2020-015
Temperature of calibration	22°C
Humidity	45%

Factory calibration in accordance with ASTM D5778-12

PAGANI® GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE
N° Z198/20

Calibrated system *(Sistema tarato)* :

Serial number	Mks332
Sensor	SLEEVE FRICTION
Max. Capacity [kPa]:	1600
Scaling Factor:	31096

Addressee *(destinatario)* :
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:

Manufacturer	AEP transducers
Model	KAL 50 kN
Serial Number	65495

Power press:

Manufacturer	Easydur Italiana
Model	Aura 10T
Serial Number	29002

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*
Last verification date: 16/01/2020

PAGANI® GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE
N° Z198/20

Calibrated system *(Sistema tarato)* :

Serial number	Mks332
Sensor	PORE PRESSURE
Max. Capacity [kPa]:	2500
Scaling Factor:	10491
Sensor	TILT ANGLE
Max. Inclination [°]:	20
Scaling Factor:	279279

Addressee *(destinatario)* :
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Pressure Generator:

Manufacturer	MENSOR
Model	CPC 4000
Serial Number	41000V56
Sensor Descr	Silicon Pressure Transducer
Sensor Serial Number	41000V3Y

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*
Last verification date: 13/02/2020

The adopted calibration procedure has been developed according to the suggestions given by Prof. Paul W. Mayne (Georgia Institute of technology) and Prof. Diego Lo Presti (University of Pisa)

Cone calibrated by _____ Date of issue 06/11/2020

Appendix C

- Liquefaction analysis results for:
    - SLS1 0.13g
    - SLS2 0.19g
    - ULS 0.35 g

Tetrad
Consulting Engineers

https://tetradconsulting.co.nz/

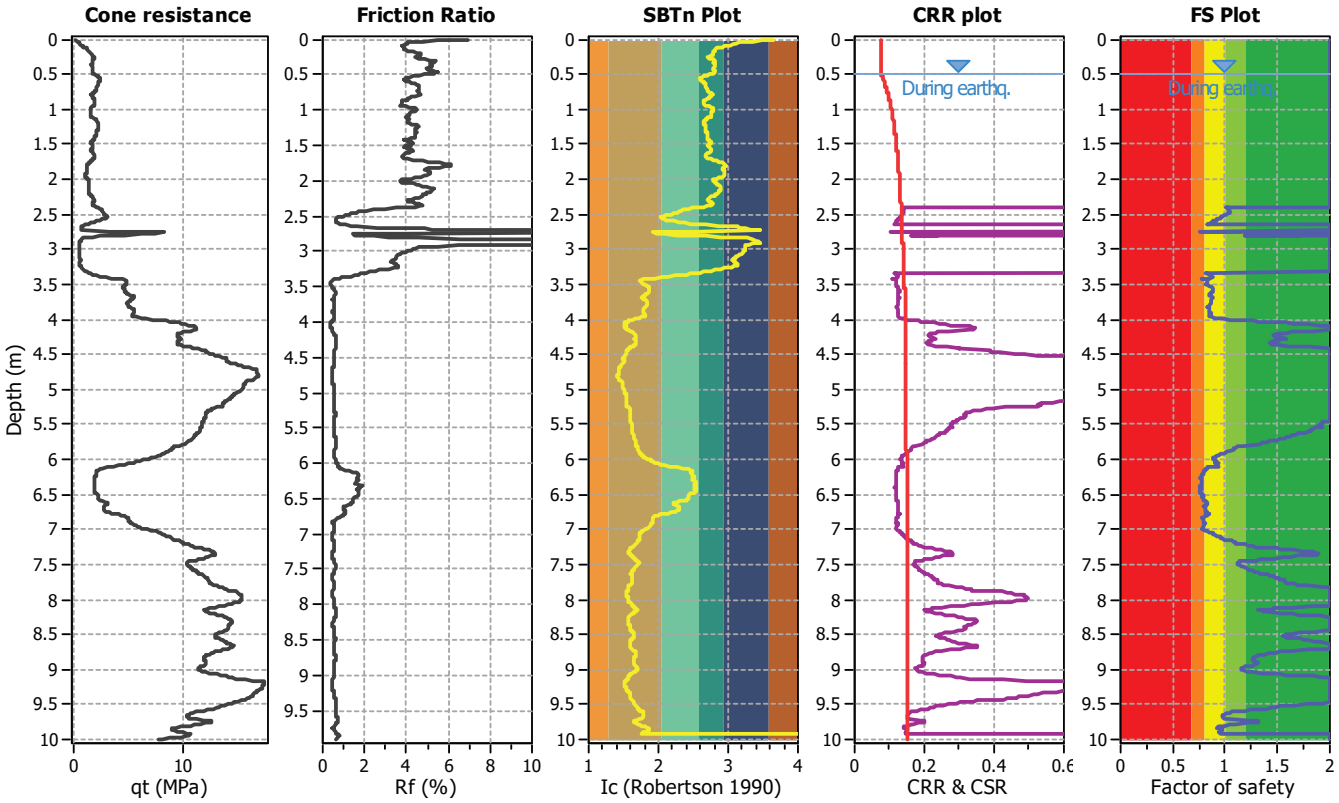
LIQUEFACTION ANALYSIS REPORT

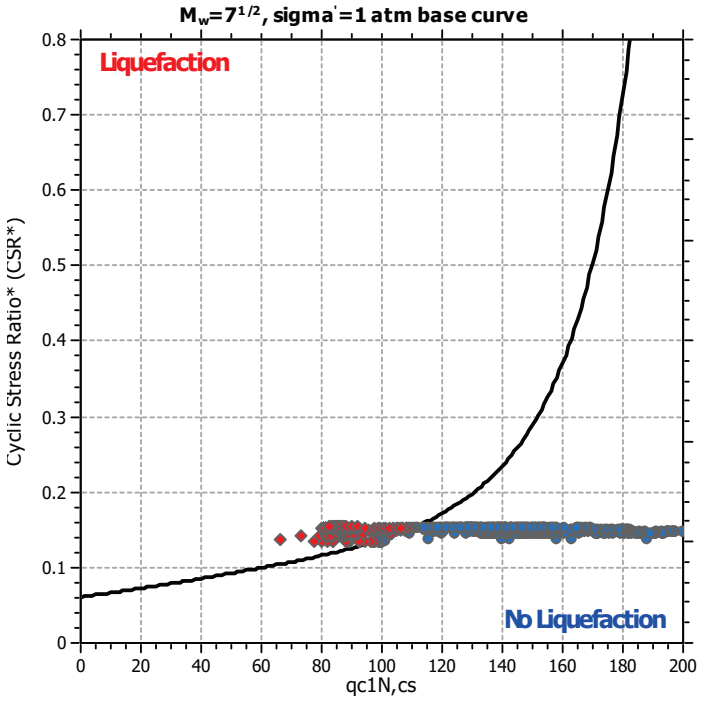
Project title : Multi-unit development **Location : 32 - 36 Ryan Street, Christchurch**

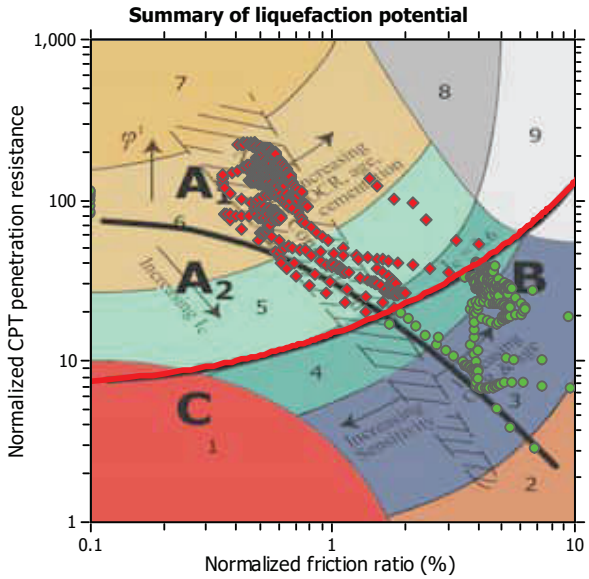
CPT file : CPT01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

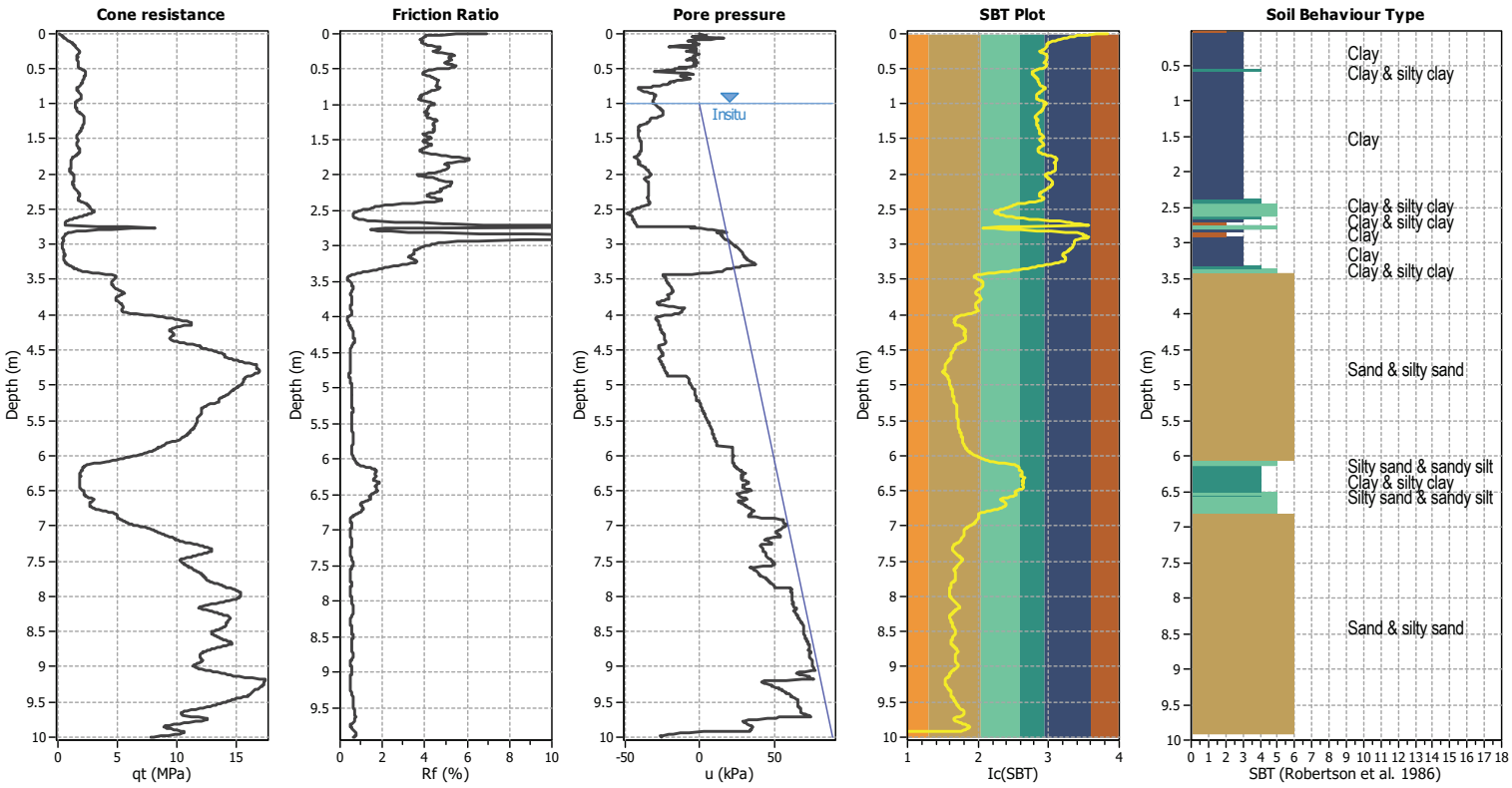






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



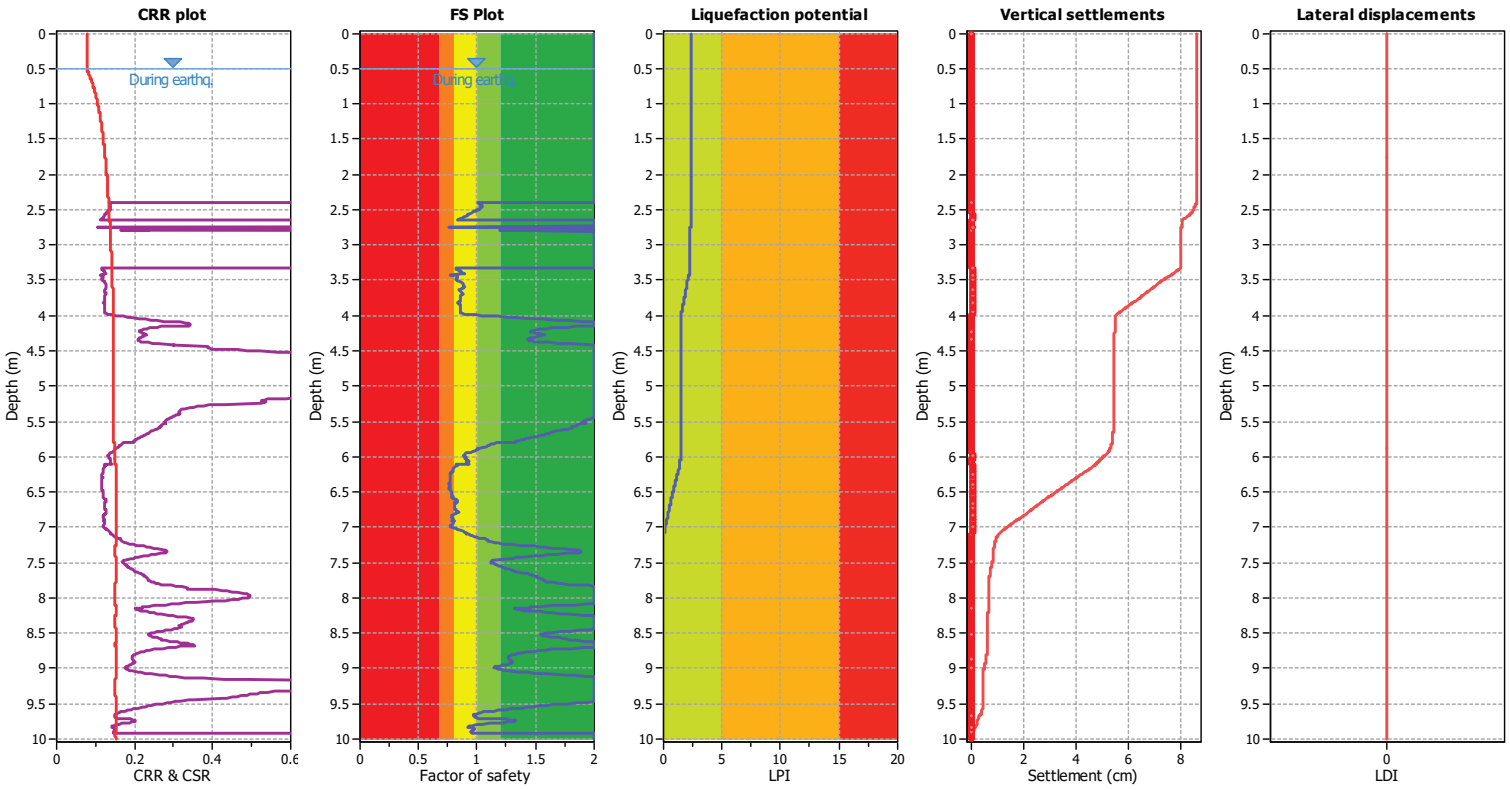
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

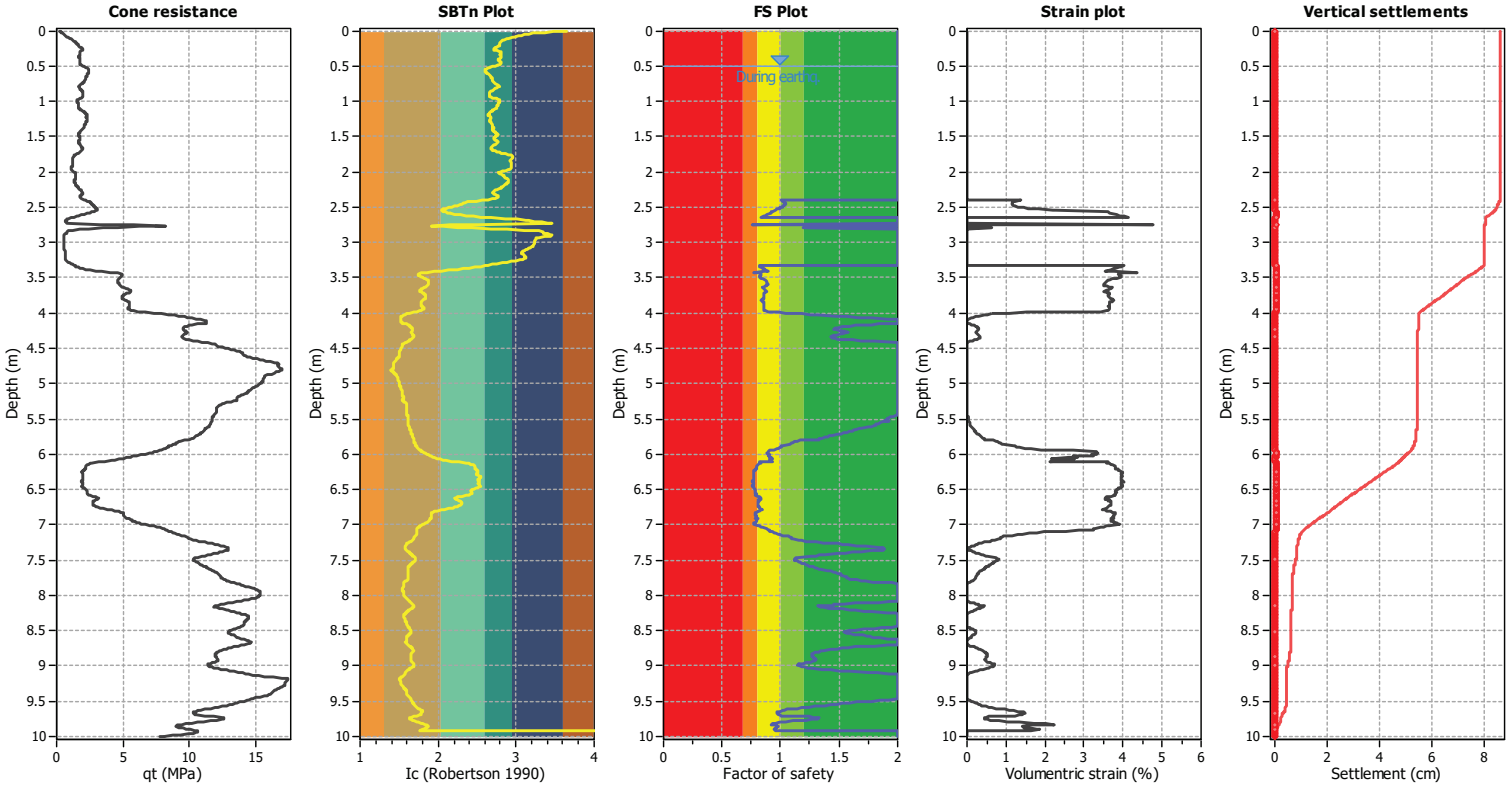
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

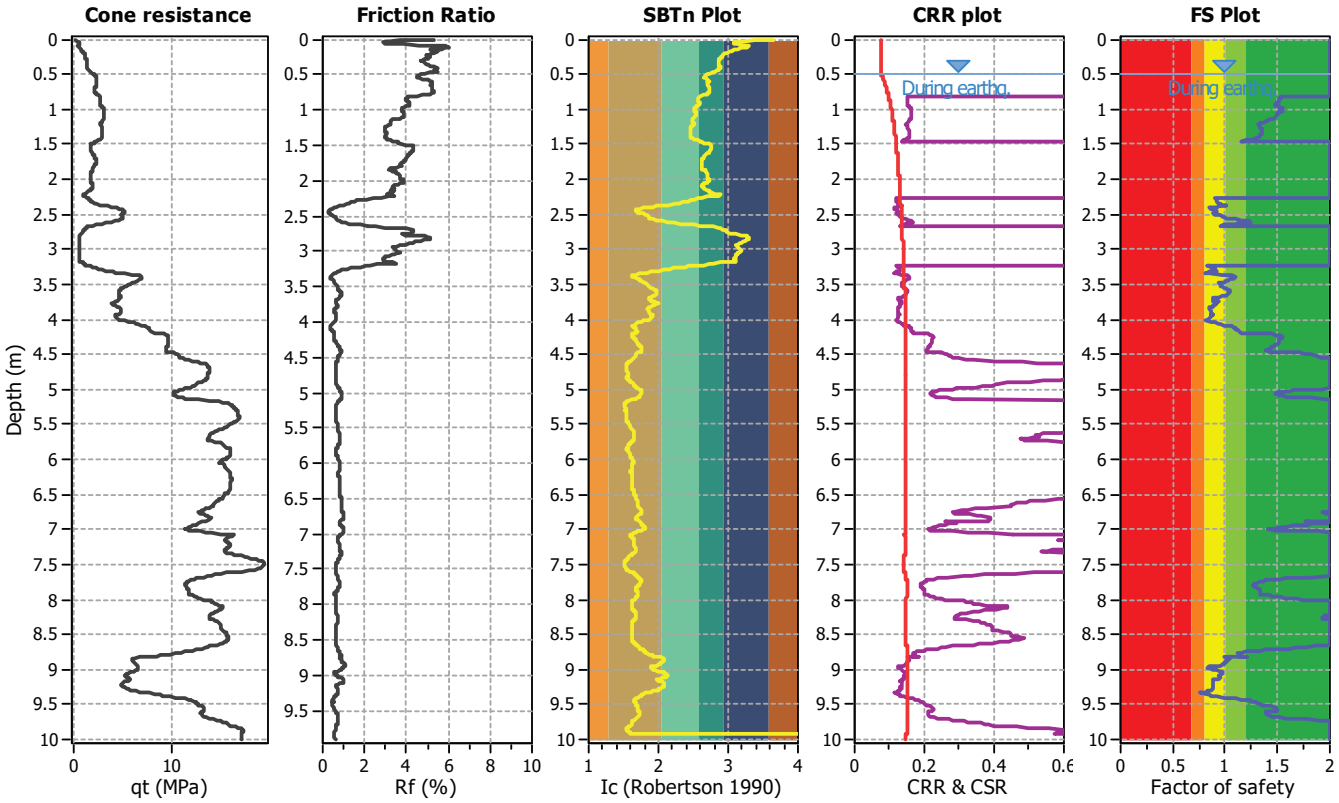
LIQUEFACTION ANALYSIS REPORT

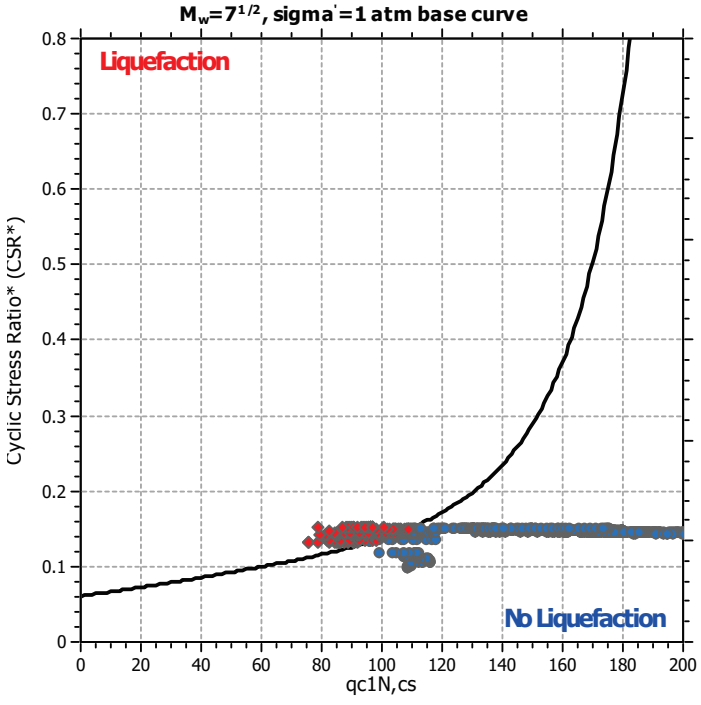
Project title : Multi-unit development **Location : 32 - 36 Ryan Street, Christchurch**

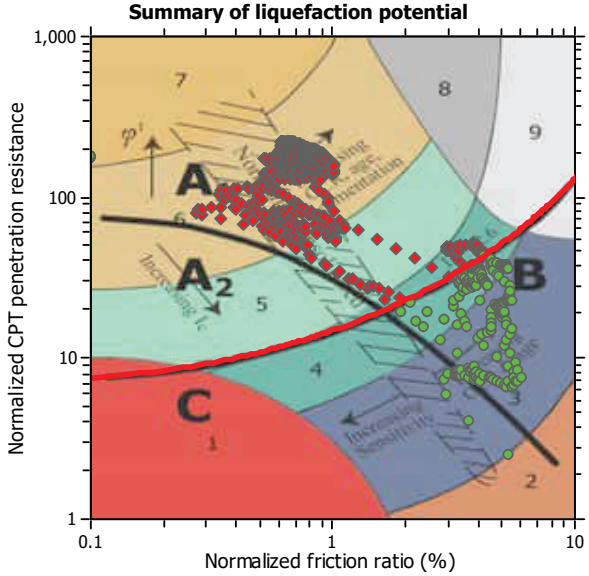
CPT file : CPT02

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

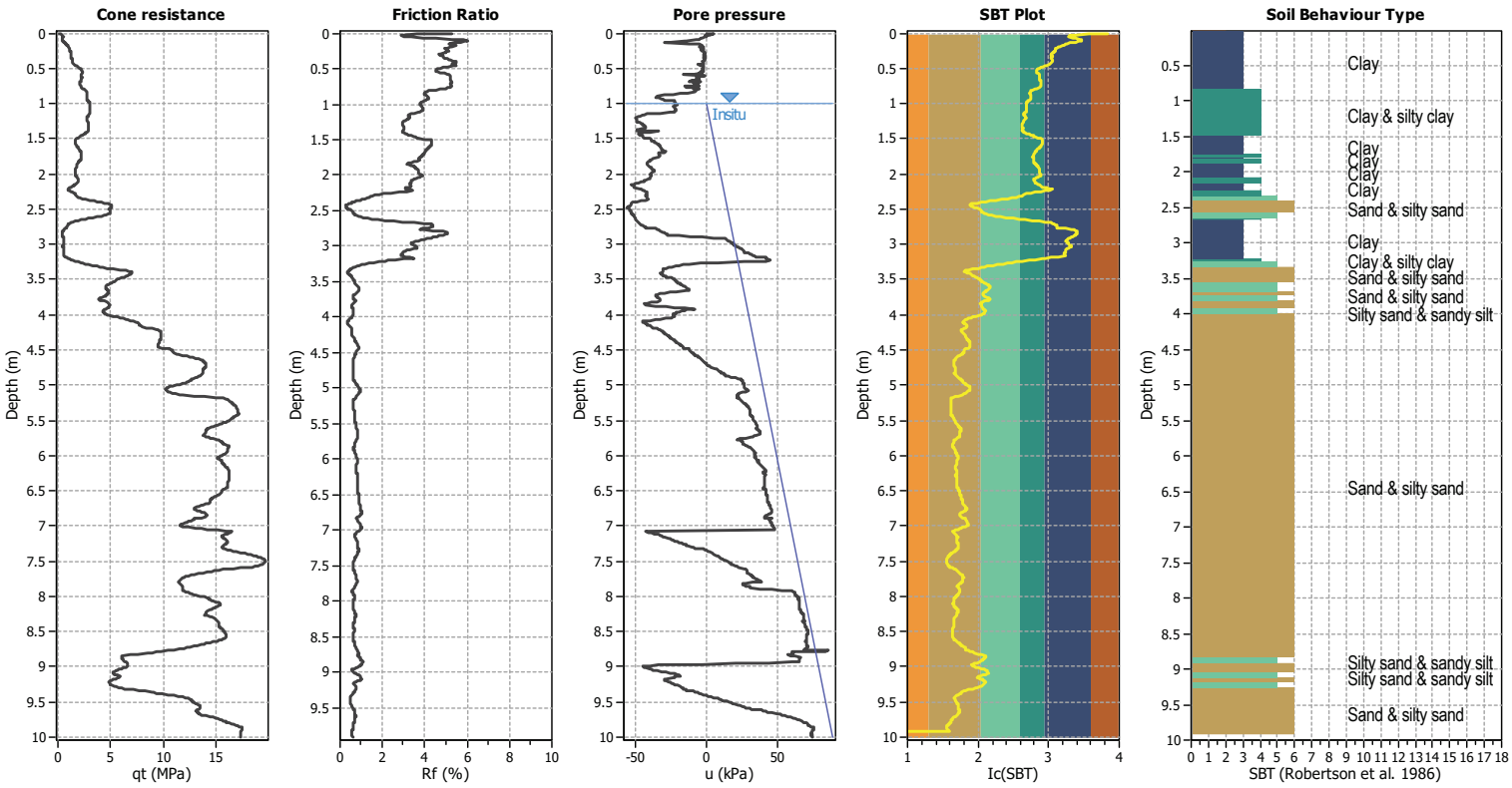






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and 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.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Tetrad
Consulting Engineers

https://tetradconsulting.co.nz/

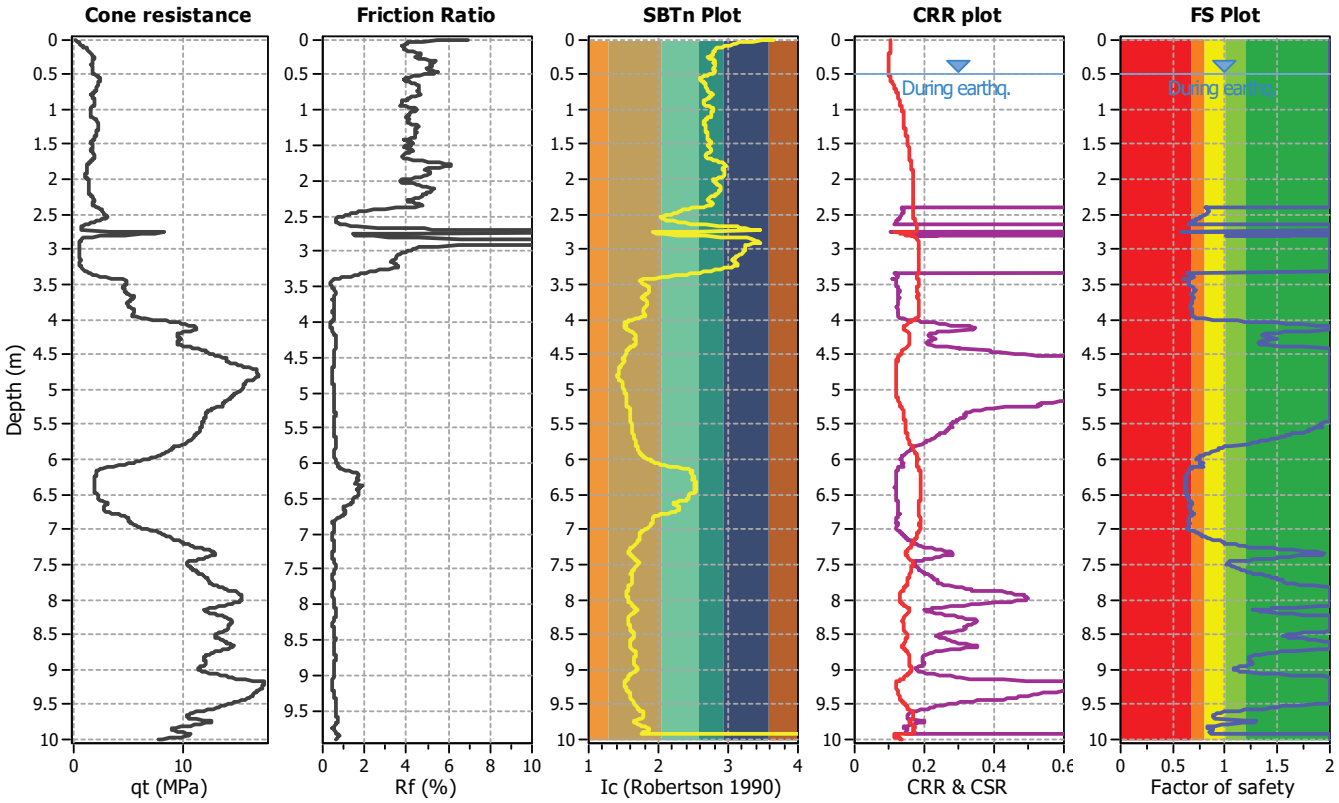
LIQUEFACTION ANALYSIS REPORT

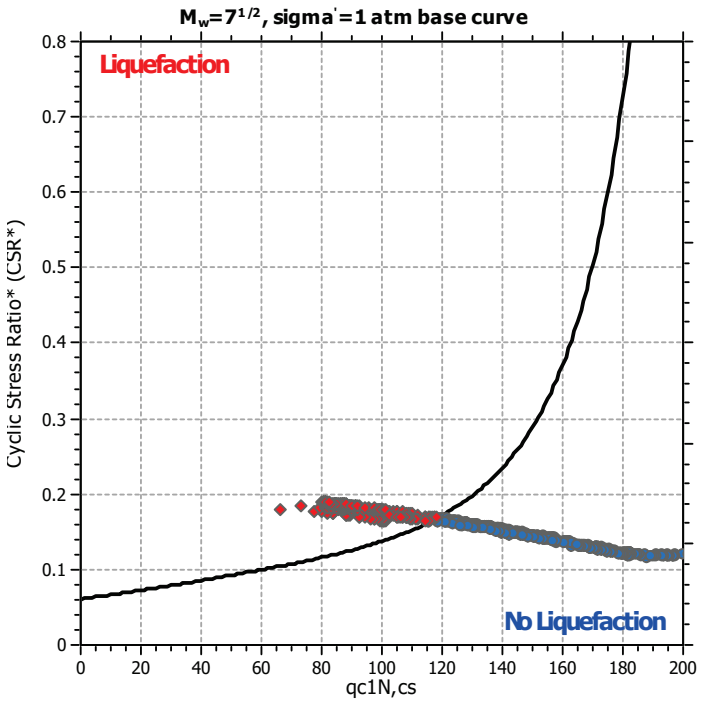
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

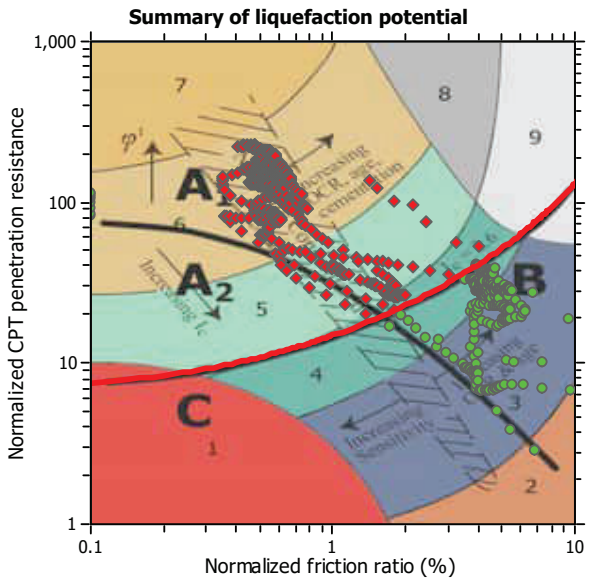
CPT file : CPT01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

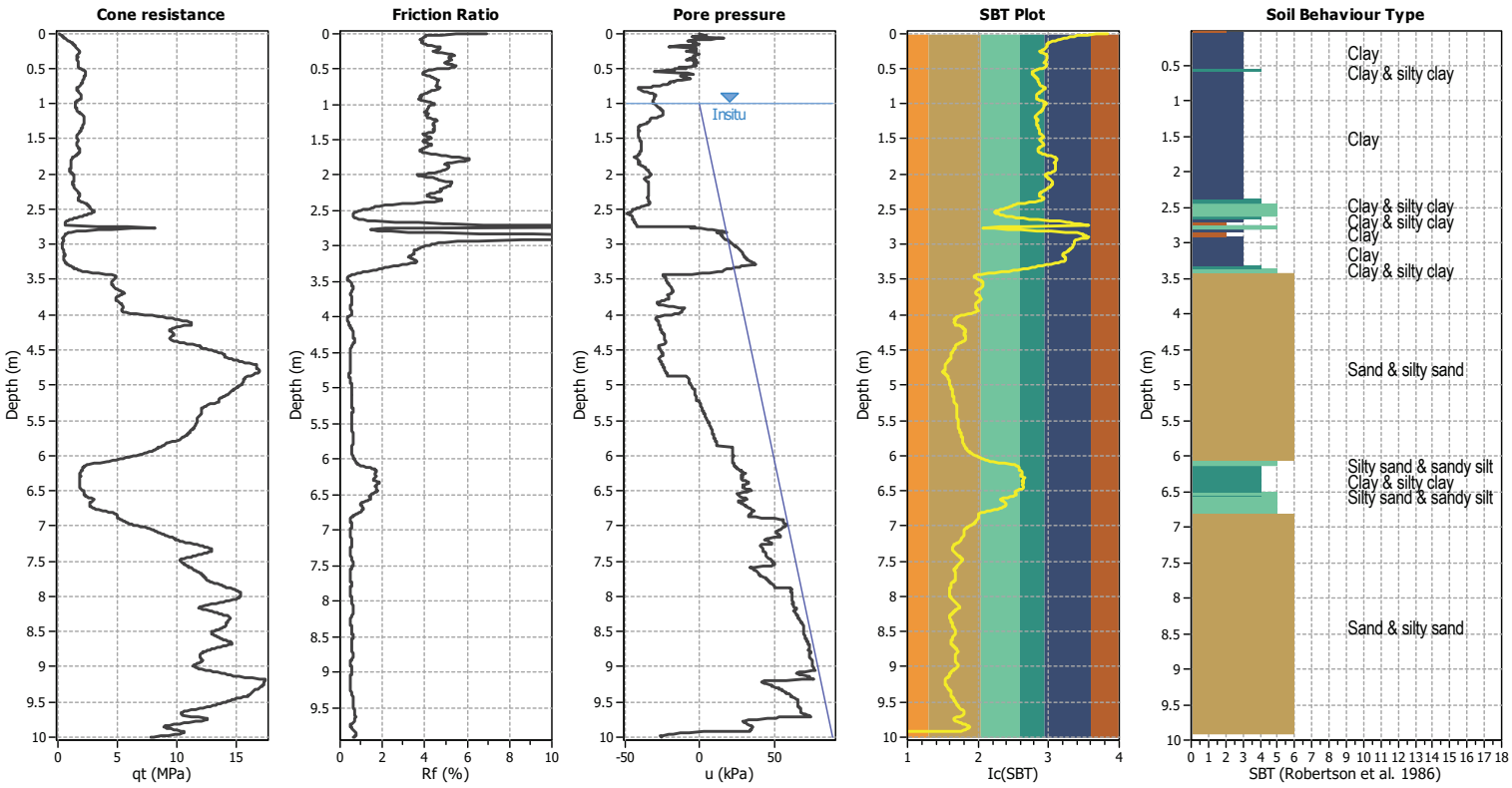






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



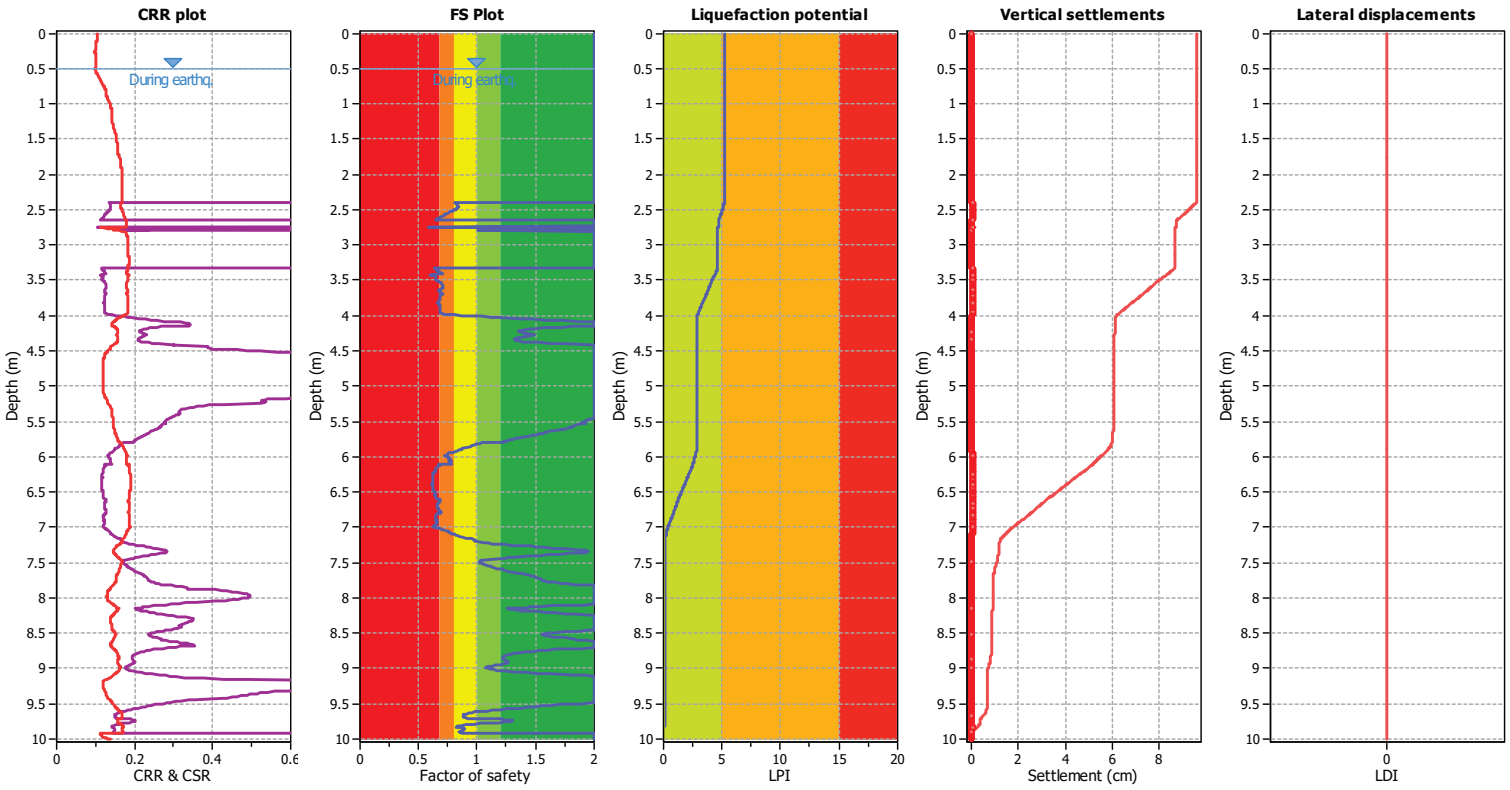
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

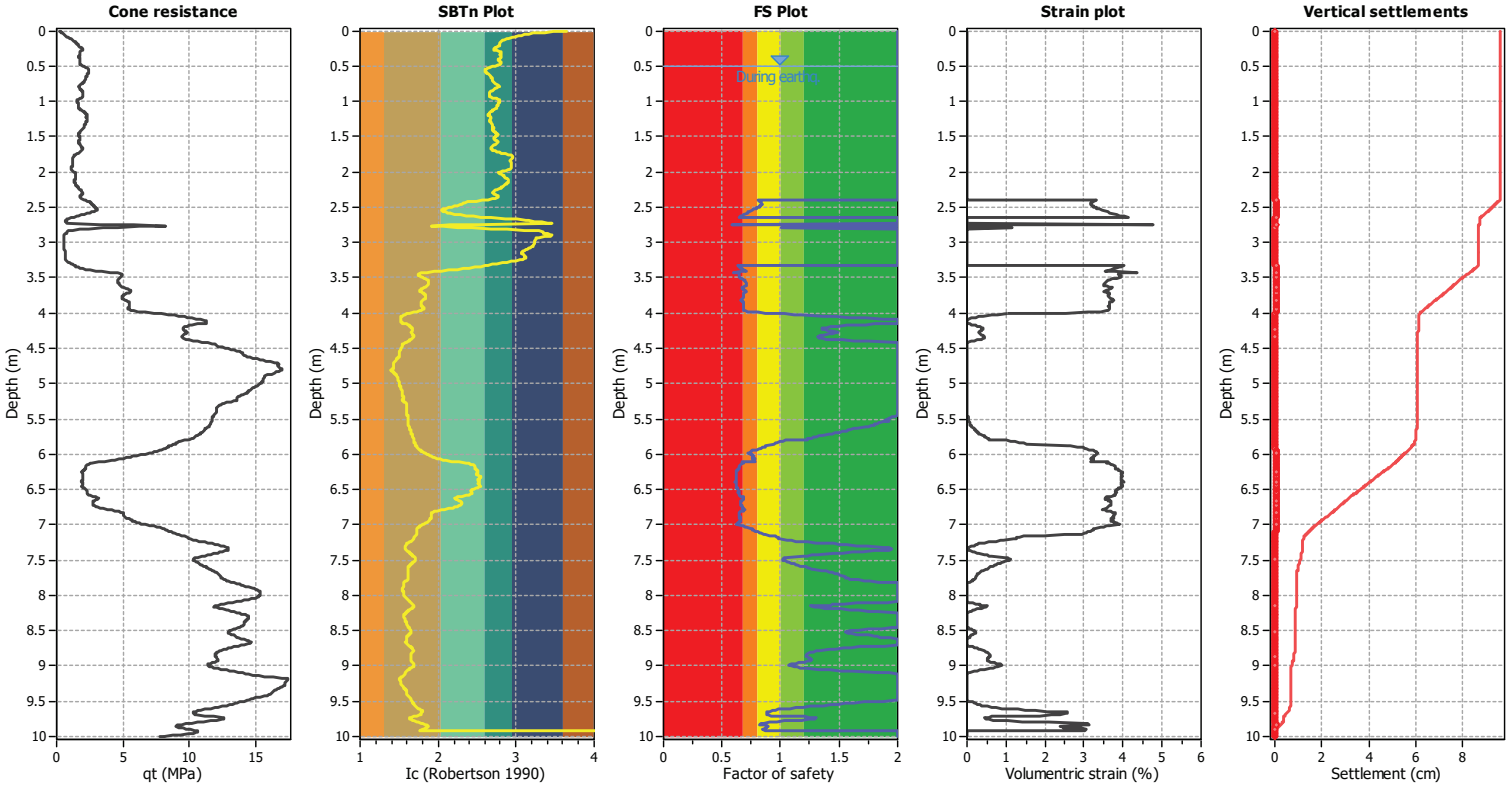
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

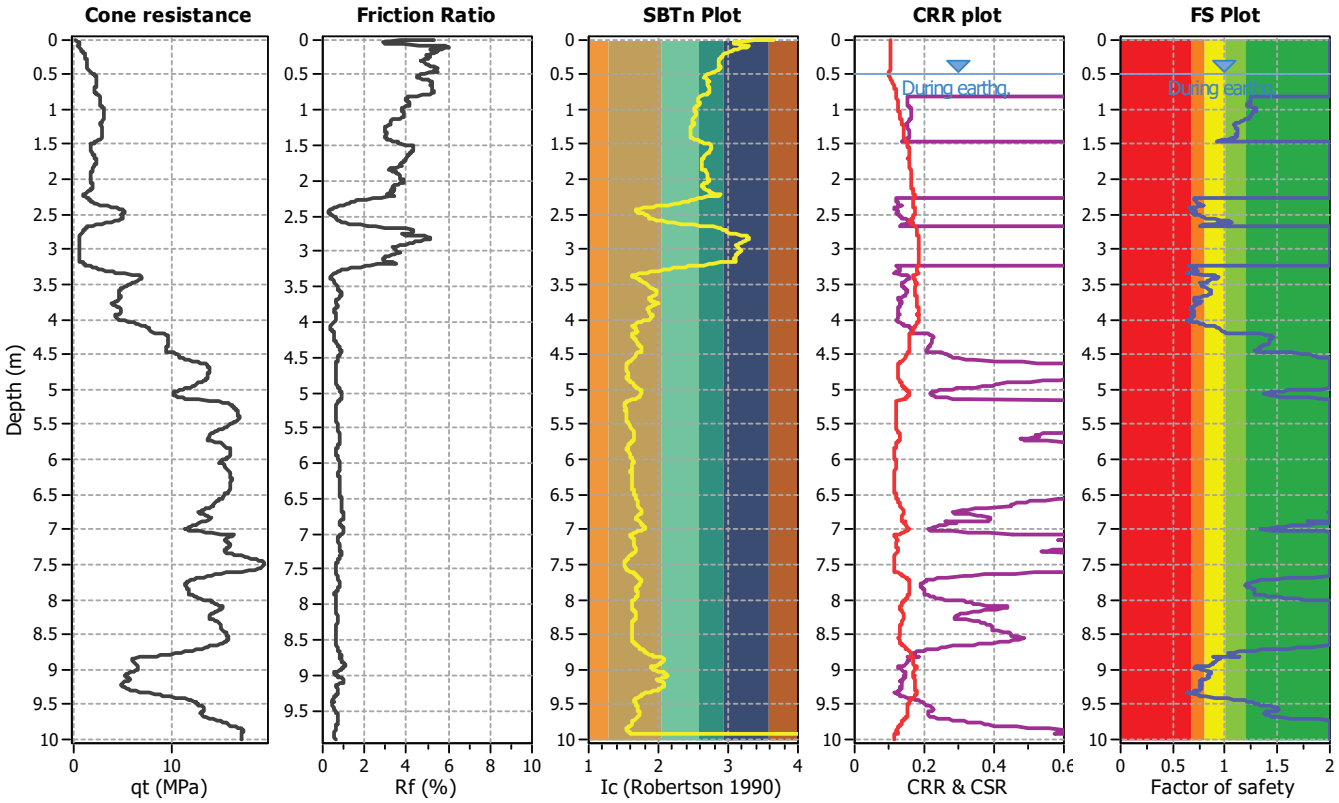
LIQUEFACTION ANALYSIS REPORT

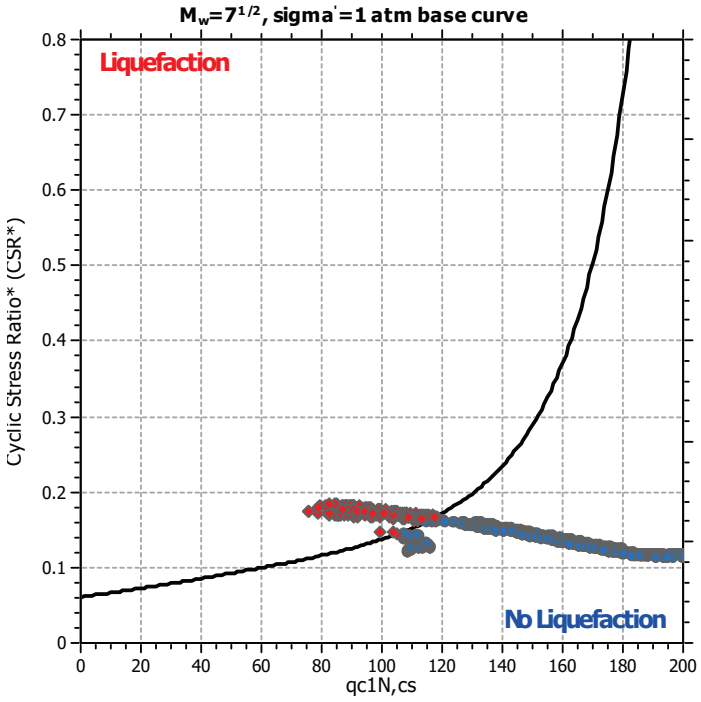
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

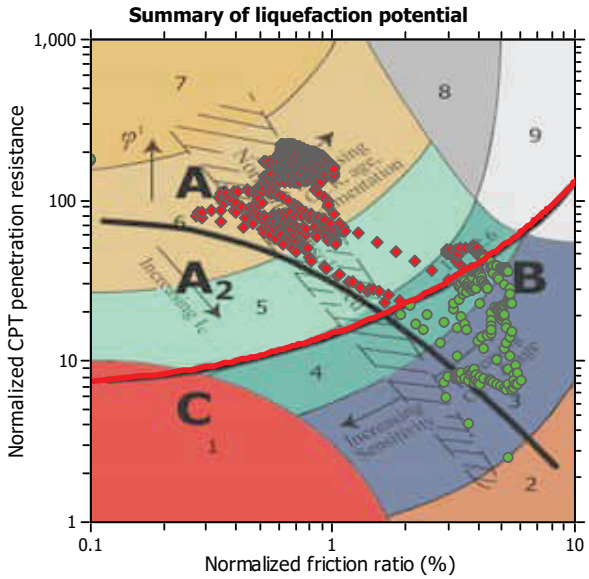
CPT file : CPT02

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

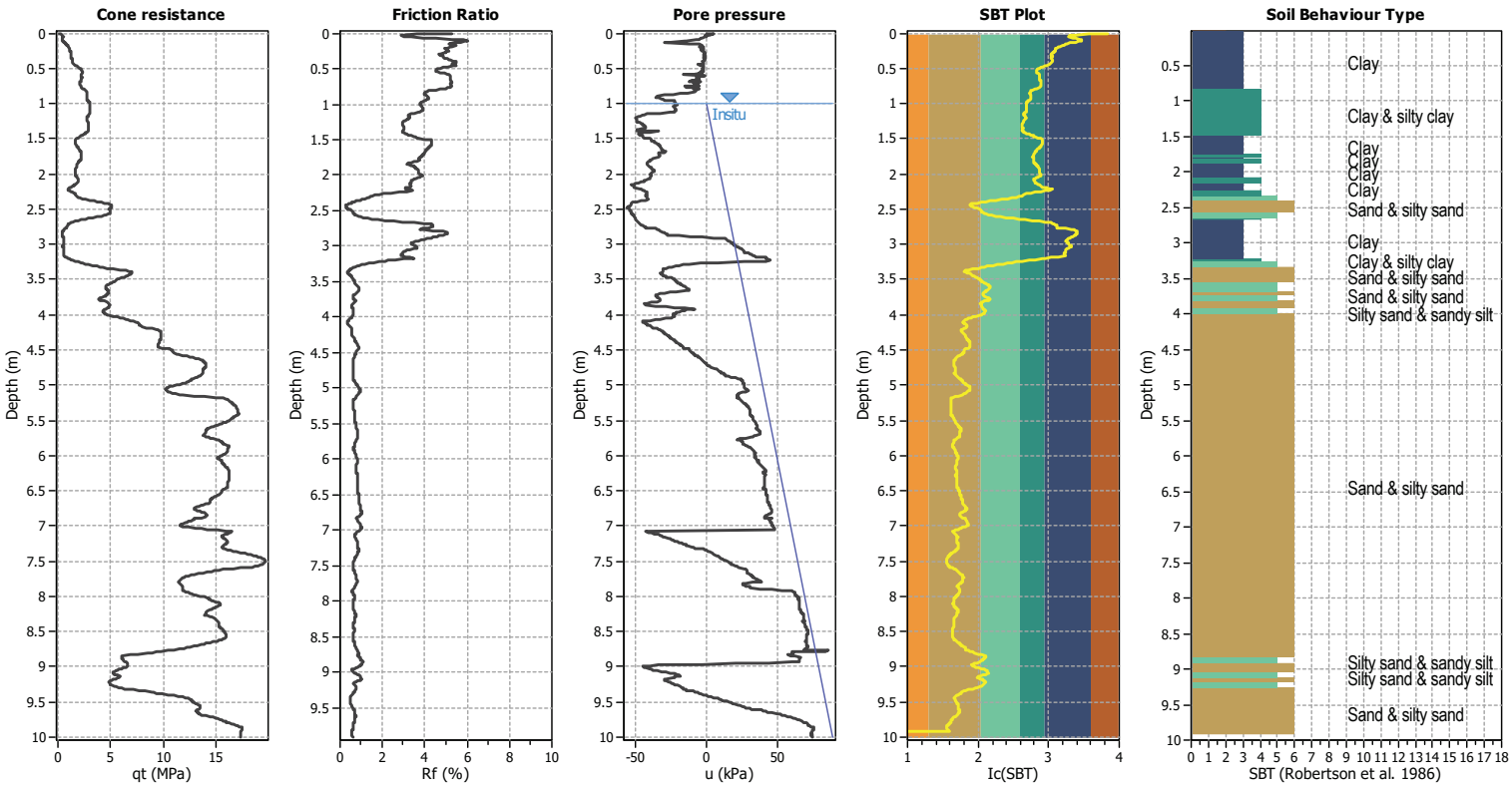






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



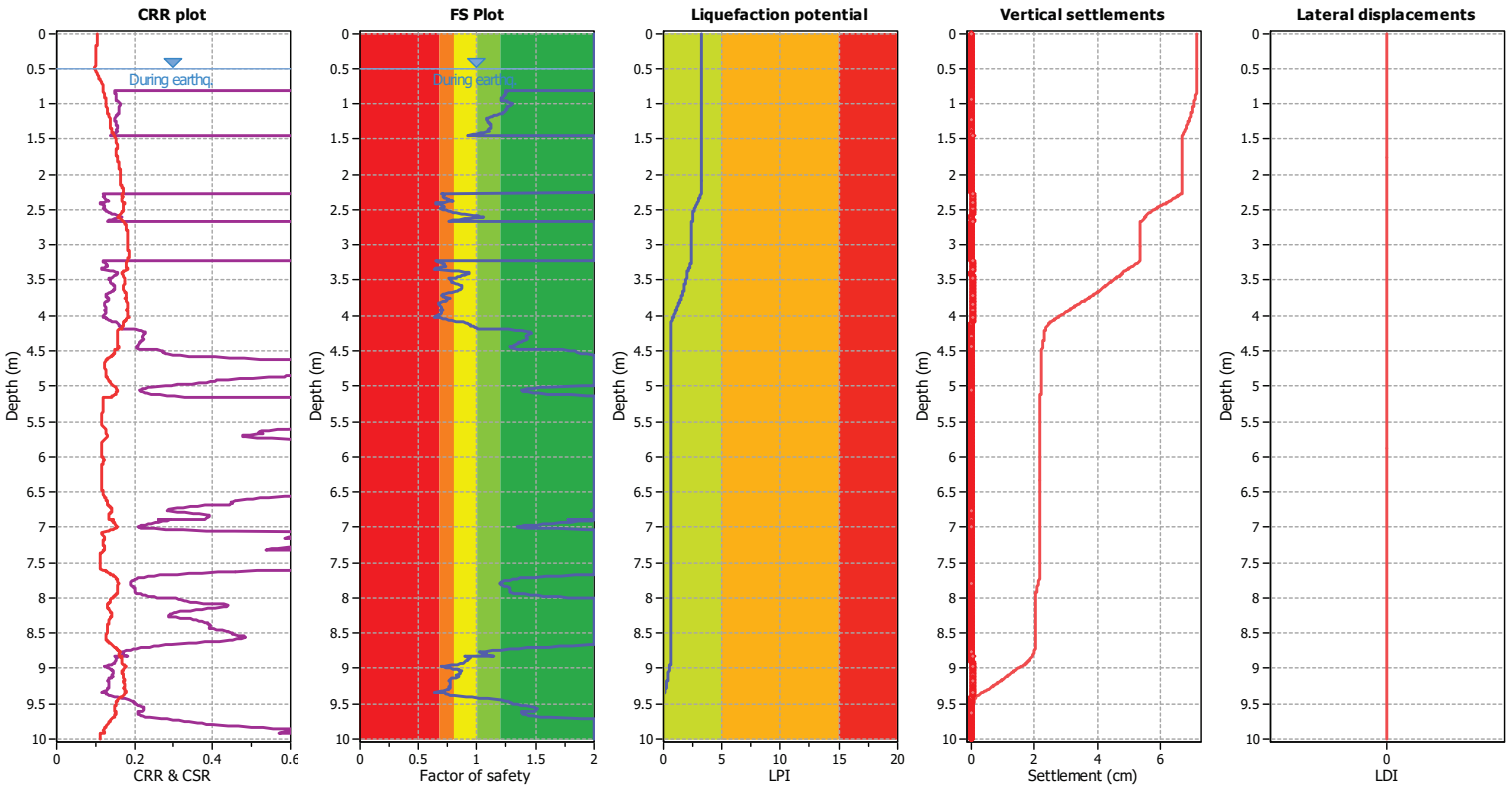
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

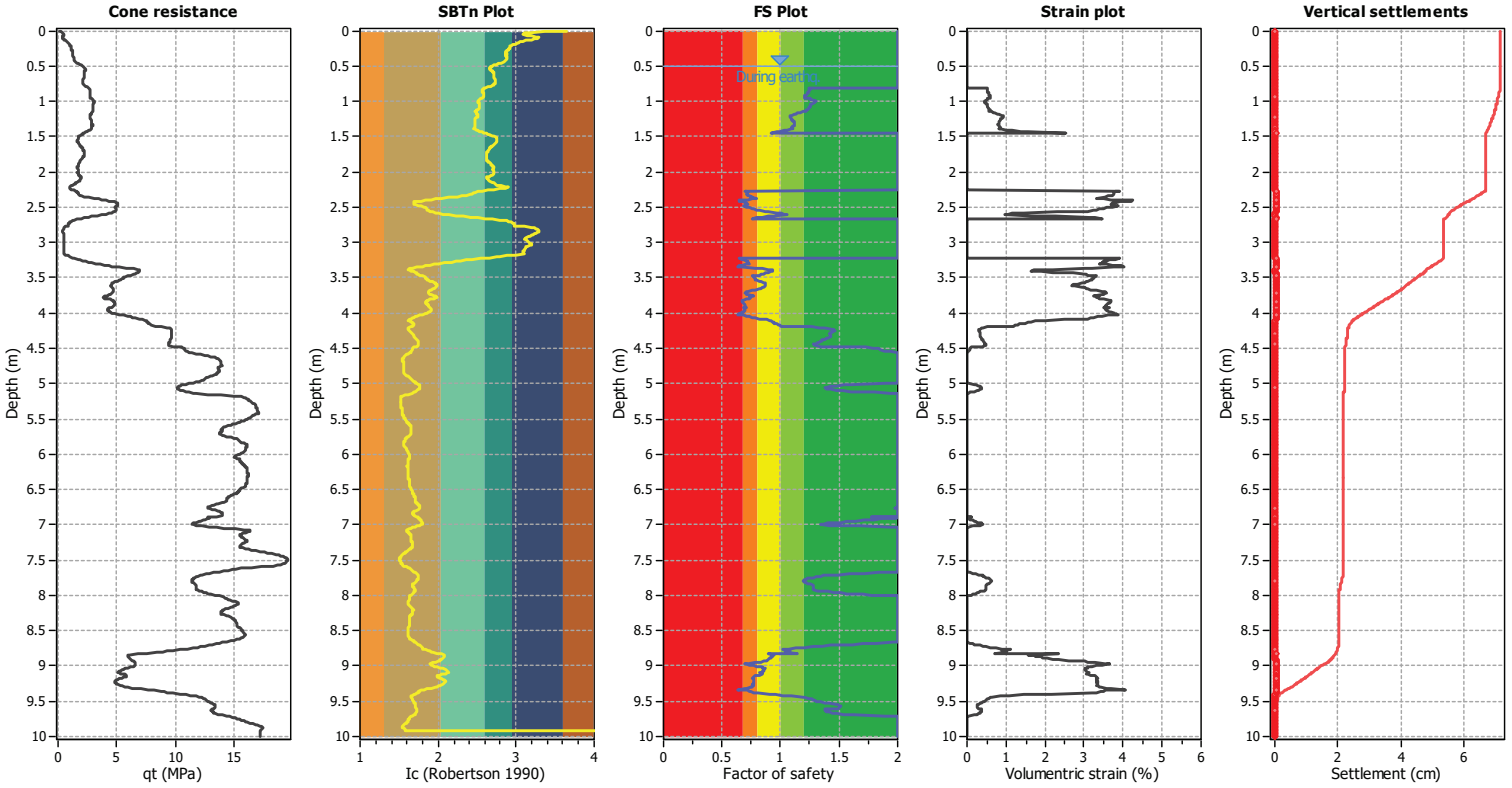
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

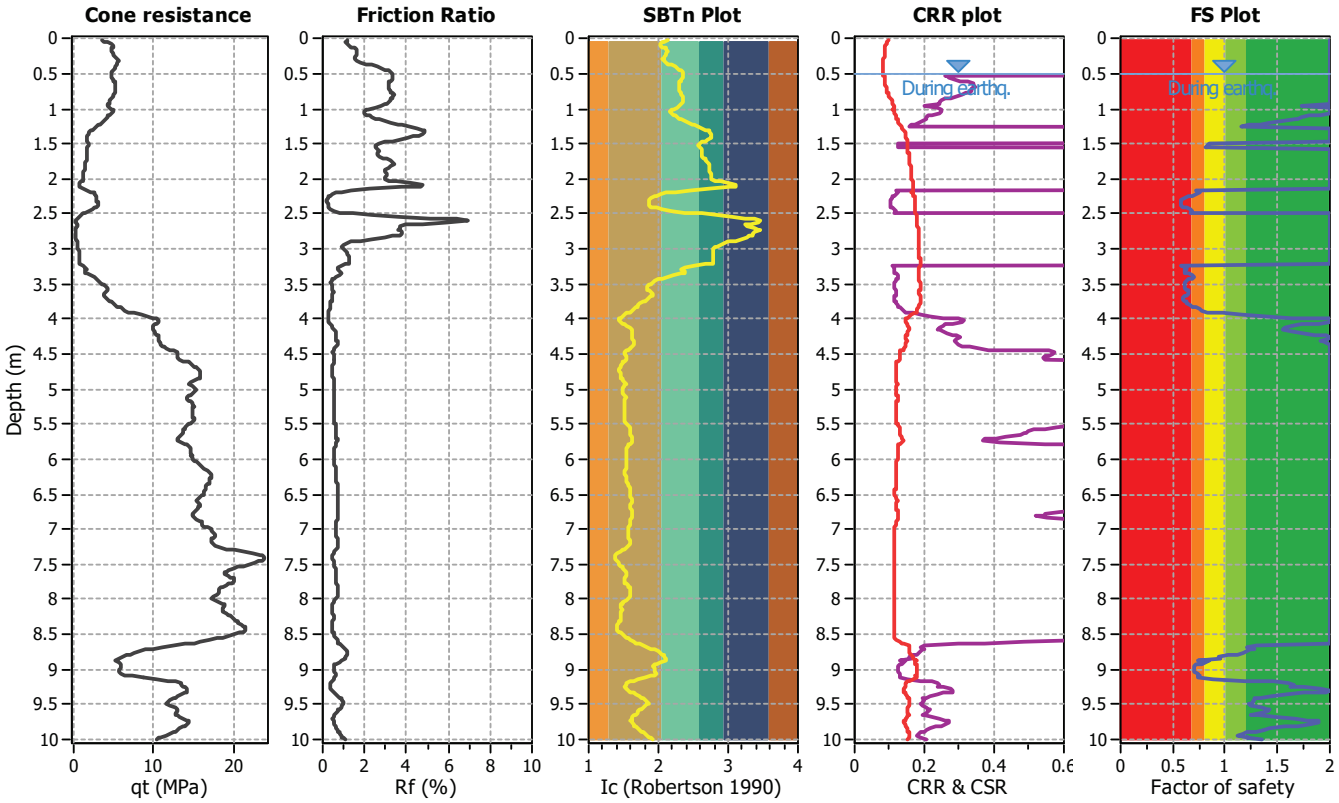
LIQUEFACTION ANALYSIS REPORT

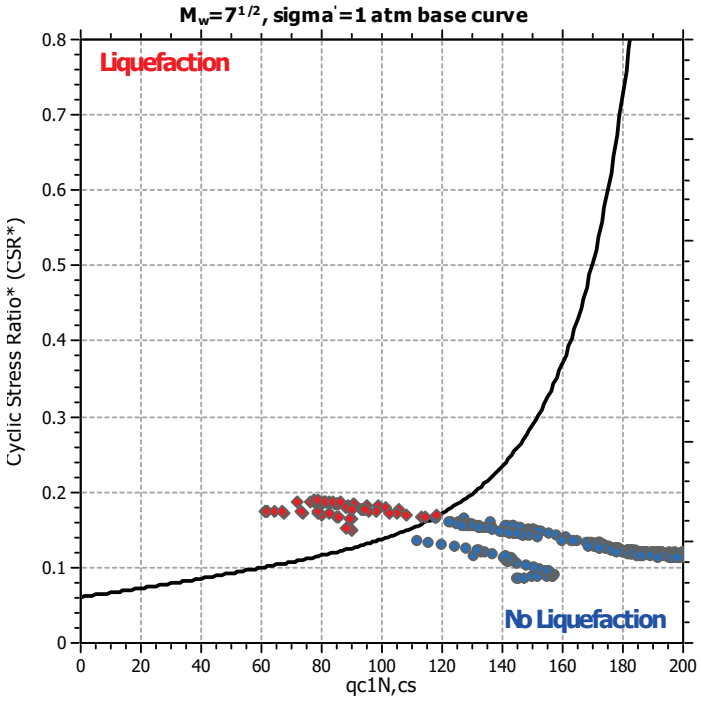
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

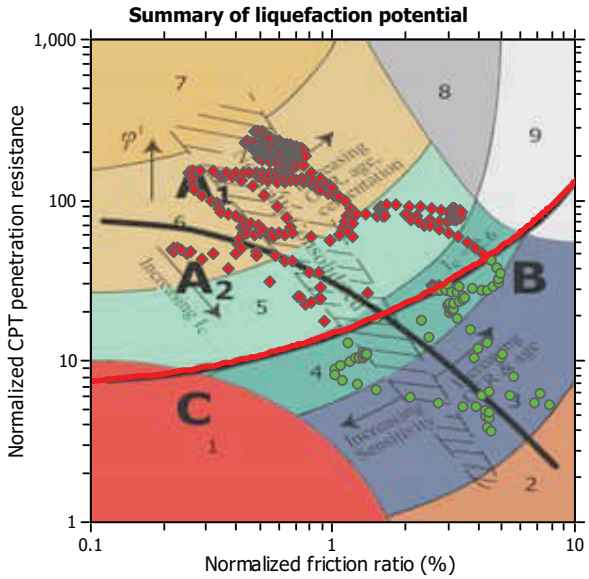
CPT file : CPT03

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

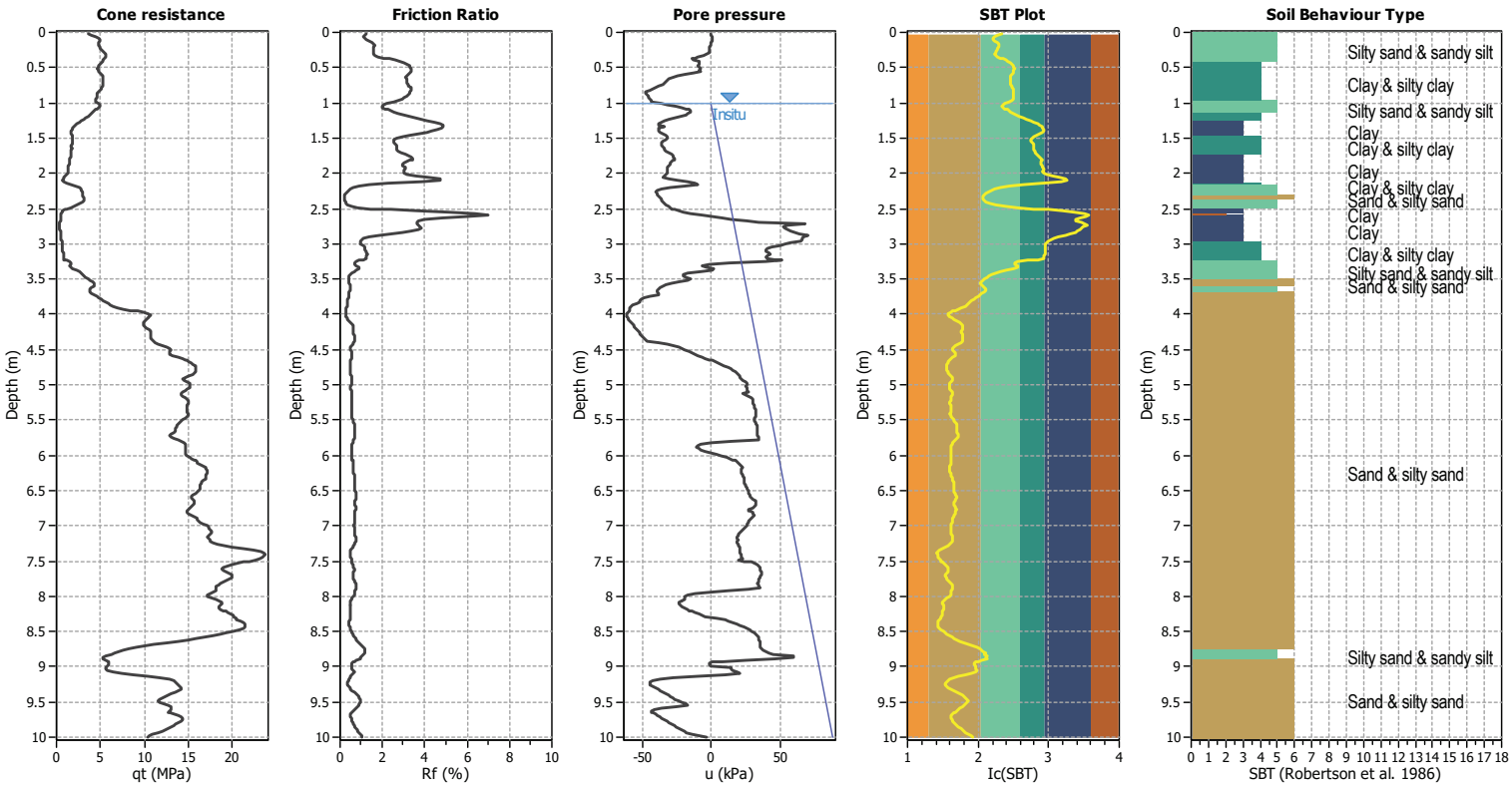






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



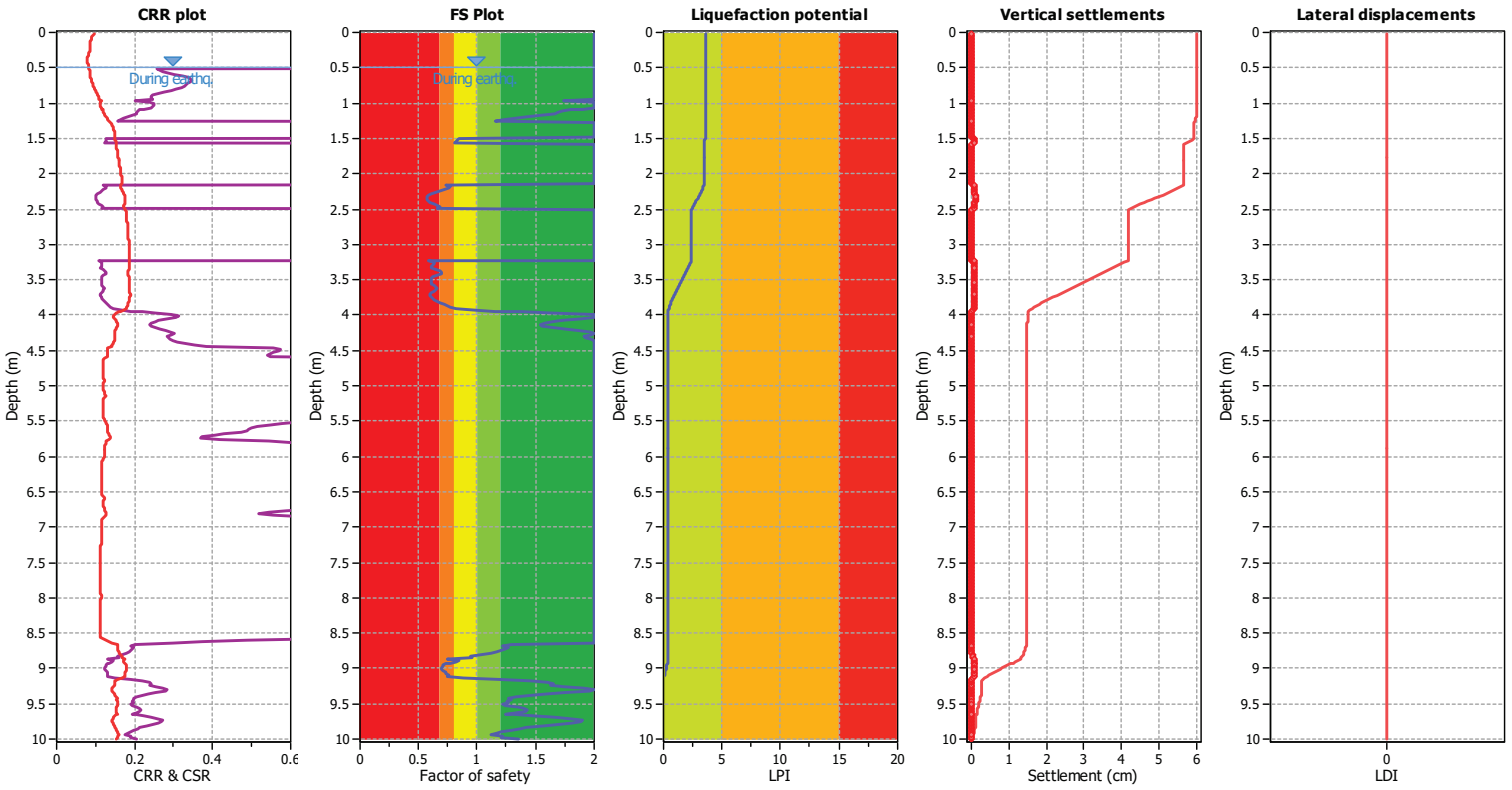
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

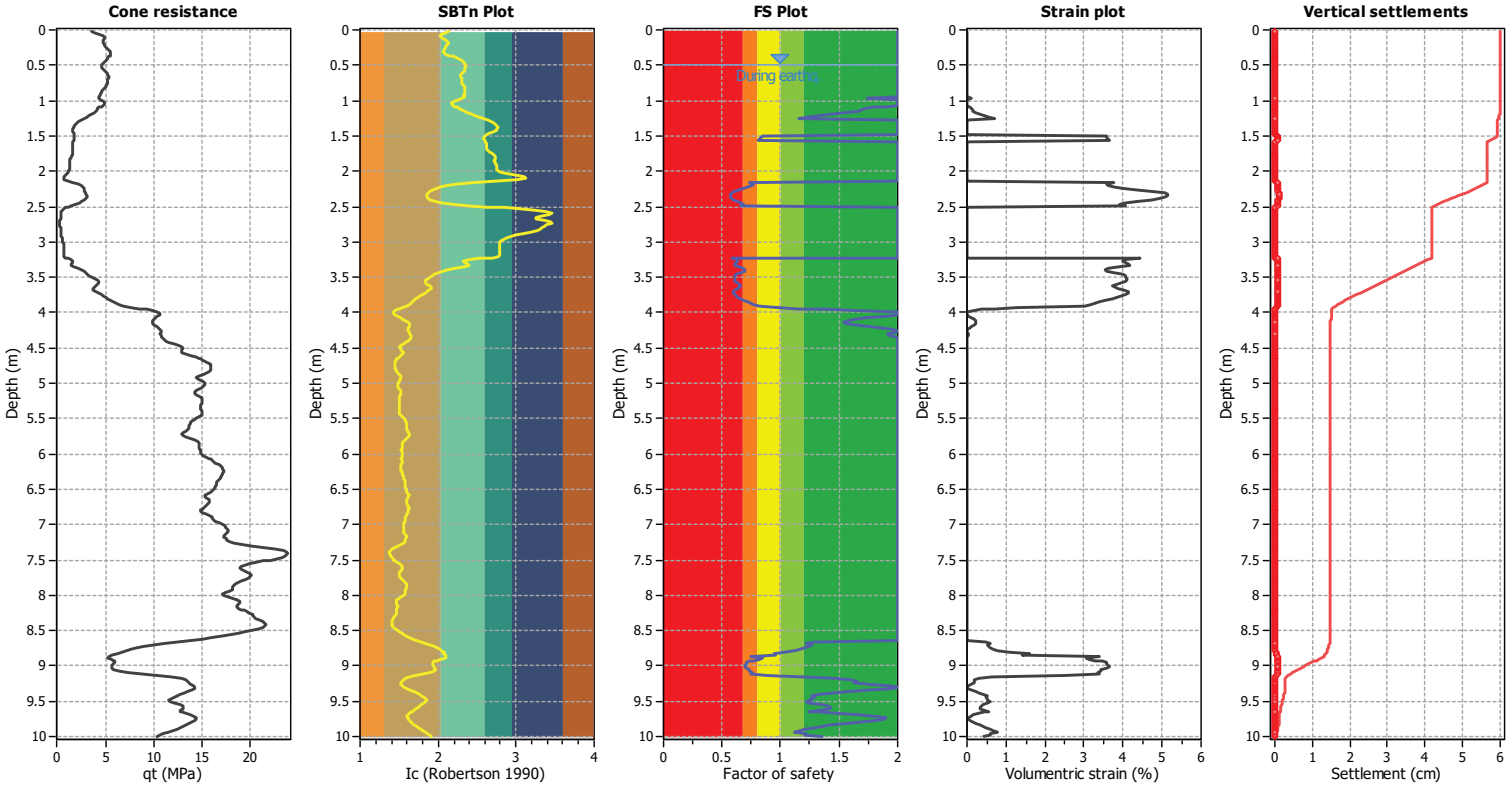
F.S. color scheme

- 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

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Tetrad
Consulting Engineers

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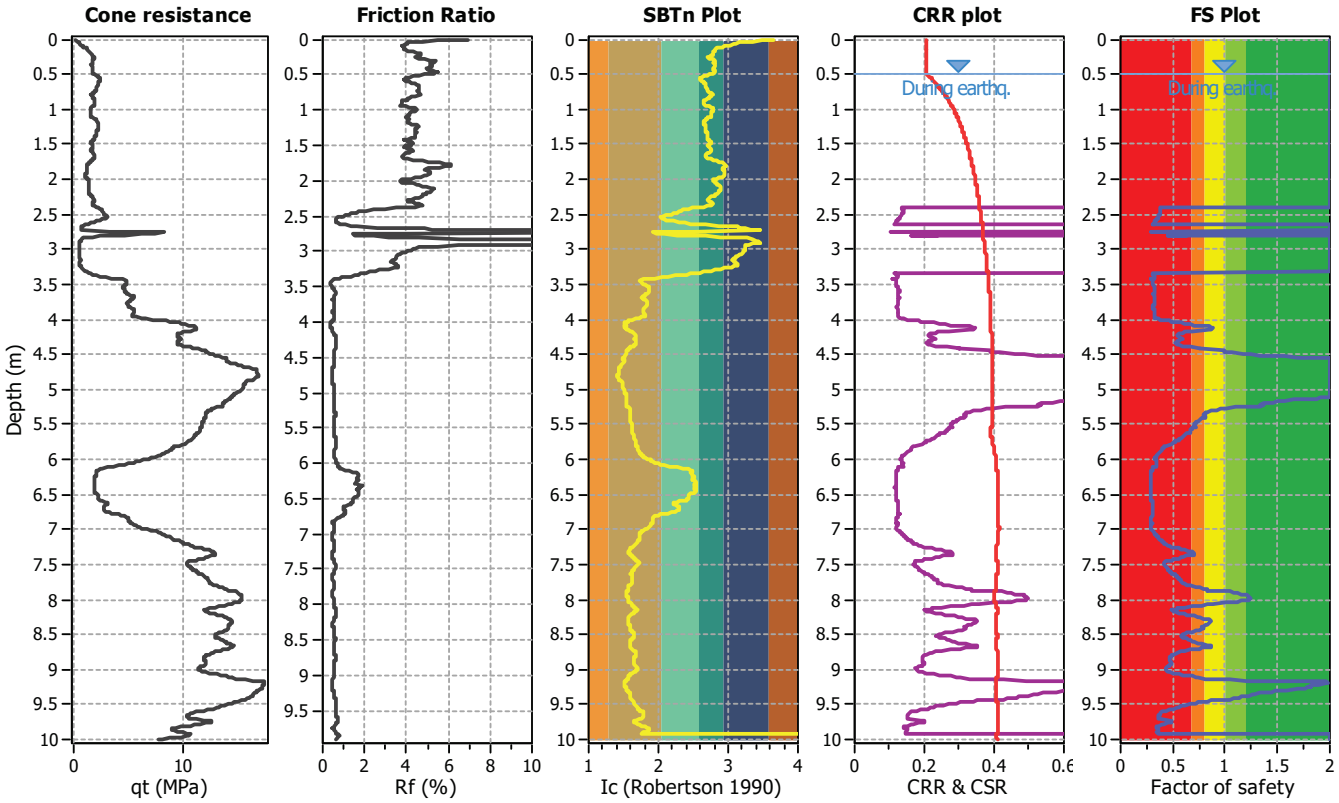
LIQUEFACTION ANALYSIS REPORT

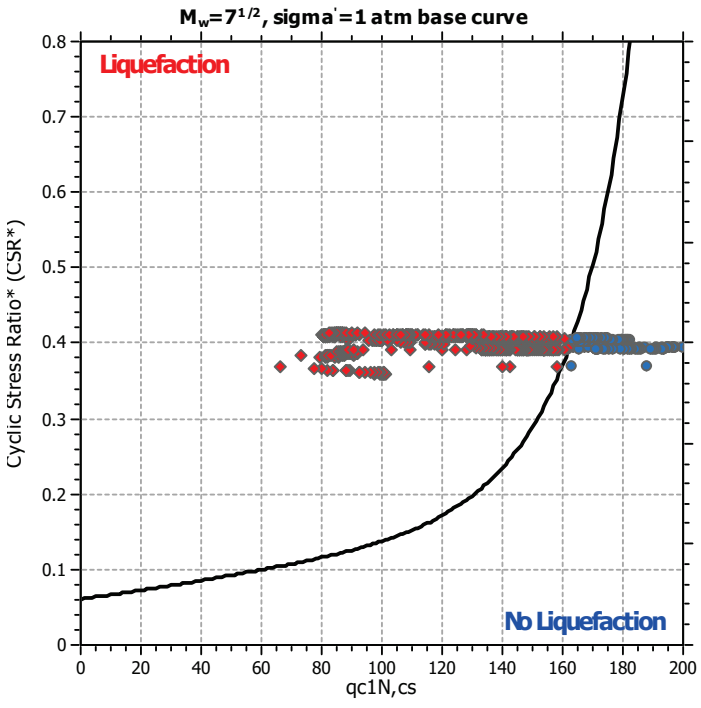
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

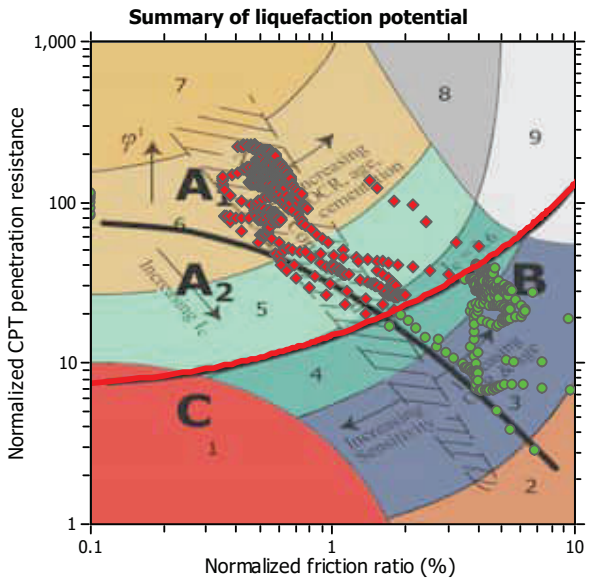
CPT file : CPT01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

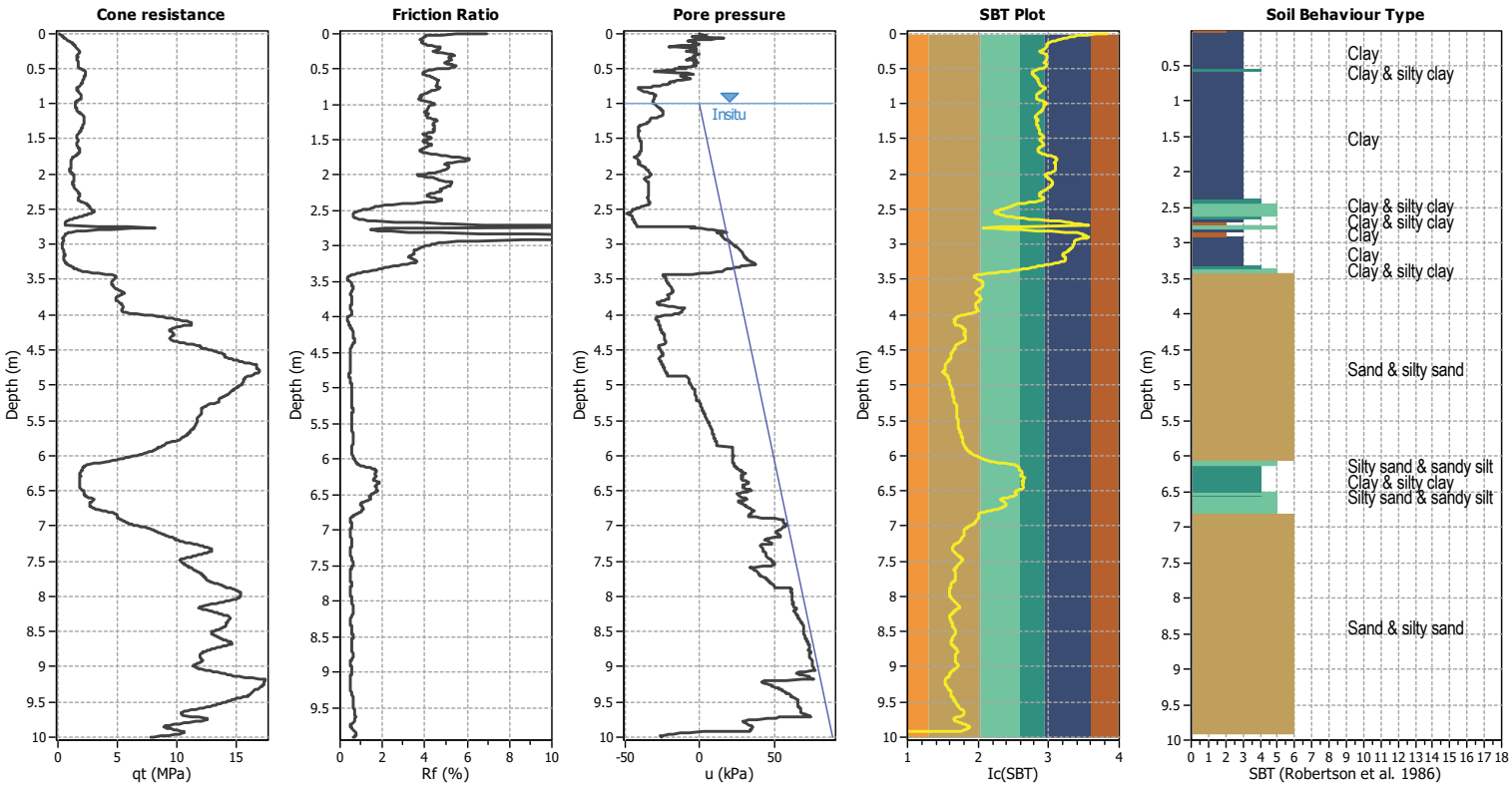






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and 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.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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
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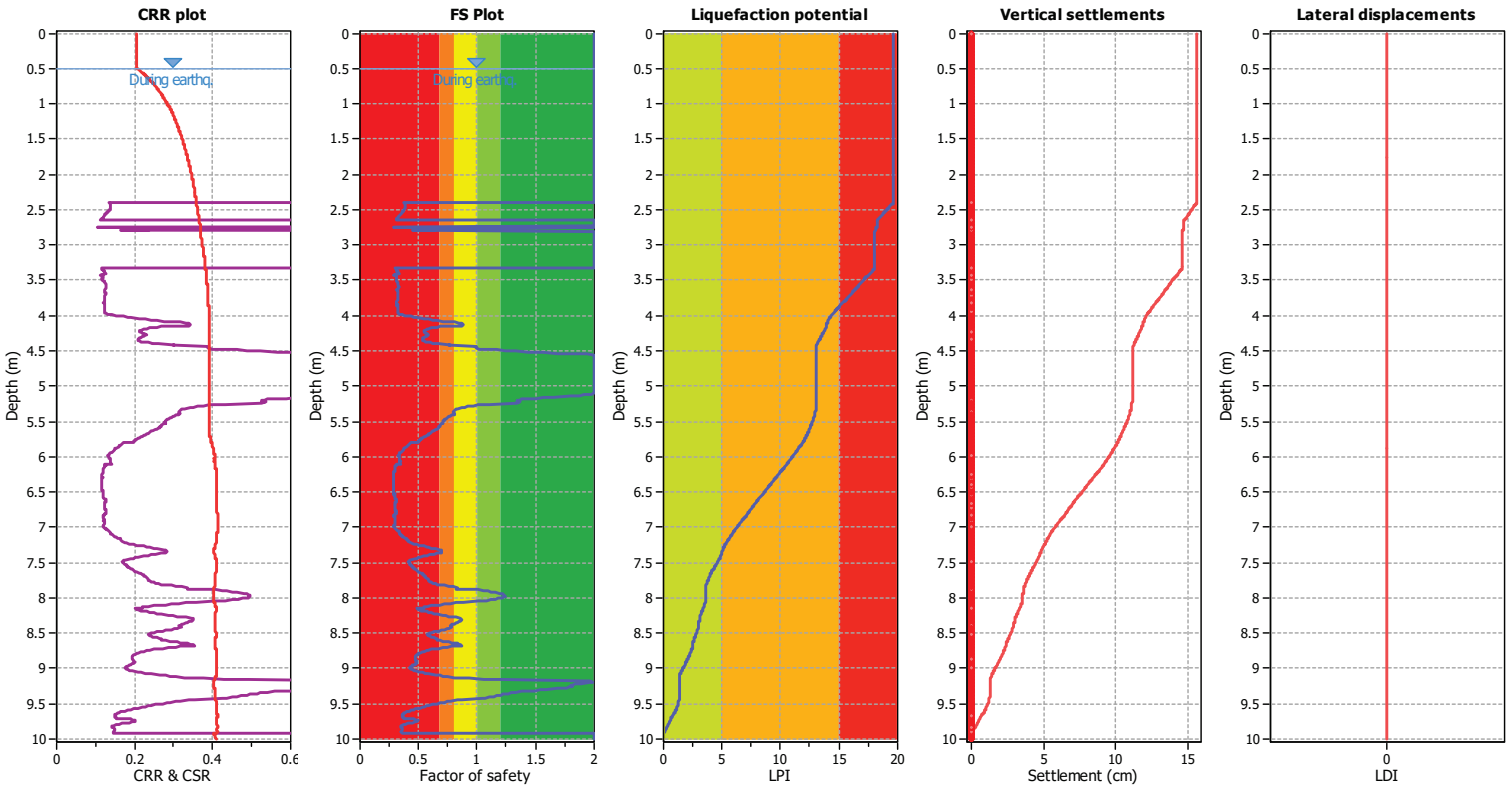
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
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LPI color scheme

- Very high risk
- High risk
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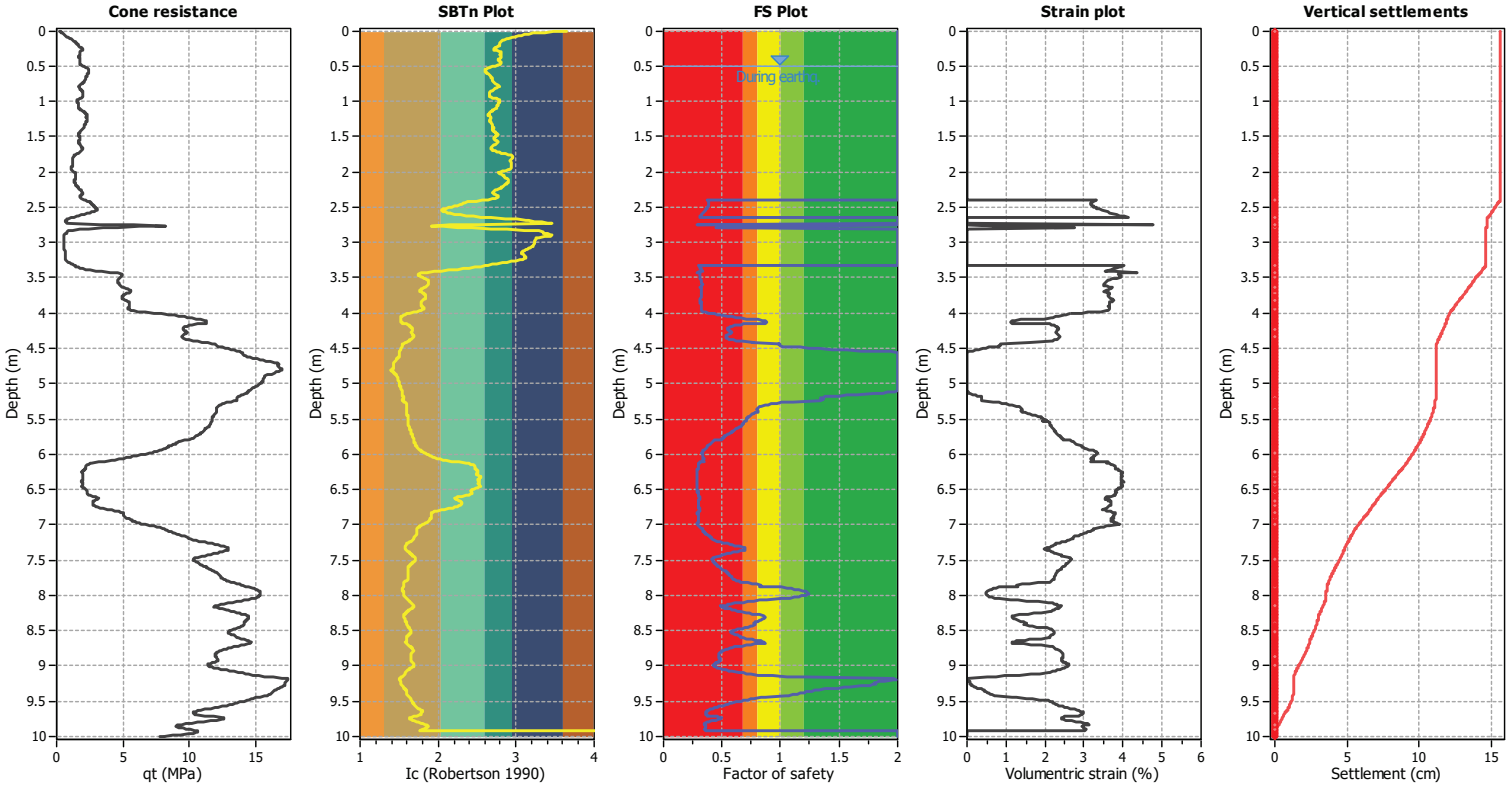
Estimation of post-earthquake settlements



Abbreviations

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I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

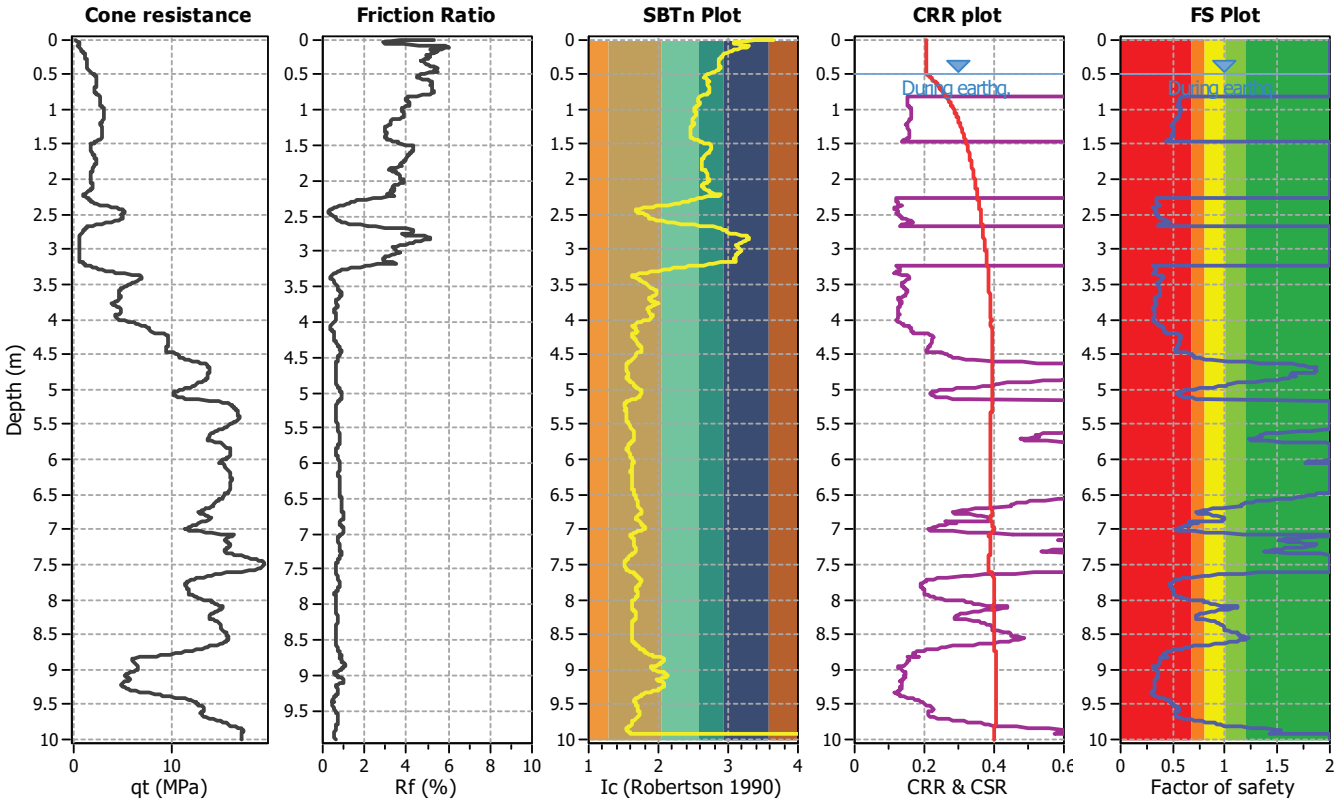
LIQUEFACTION ANALYSIS REPORT

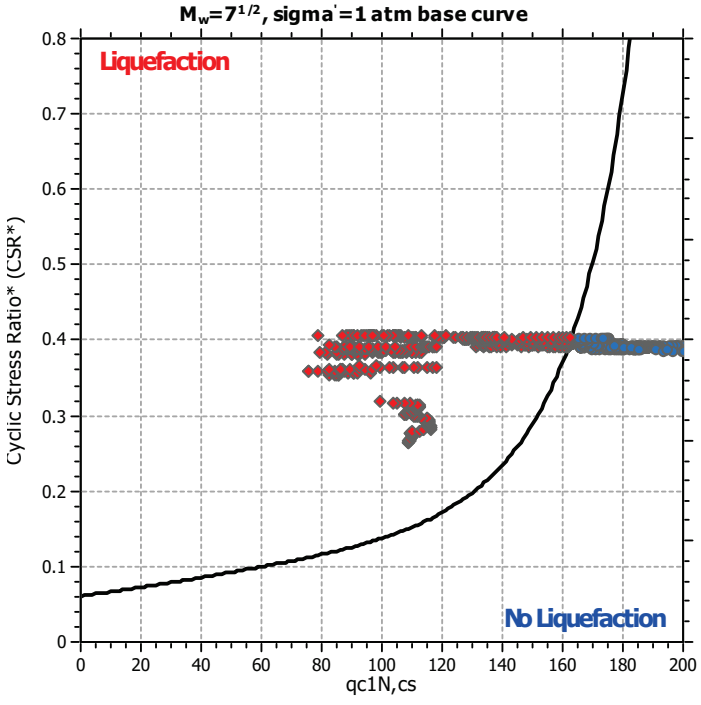
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

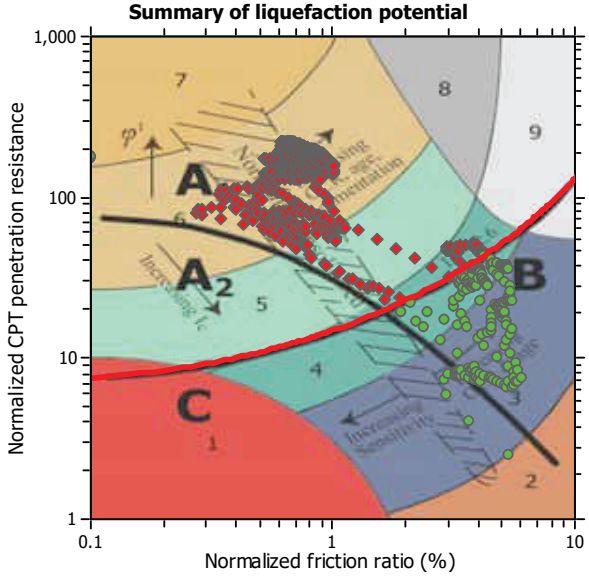
CPT file : CPT02

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







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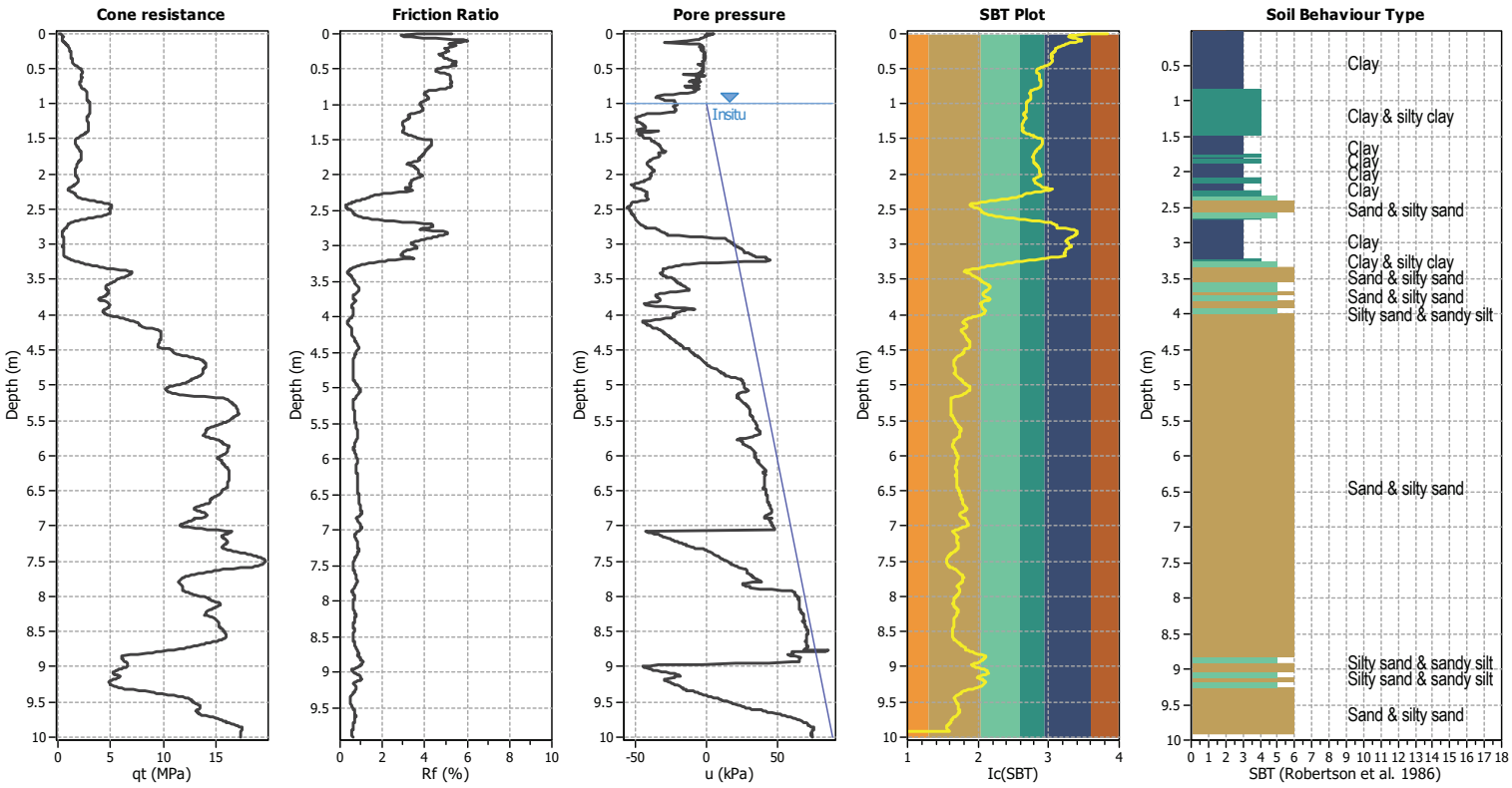
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
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5. Silty sand to sandy silt
6. Clean sand to silty sand
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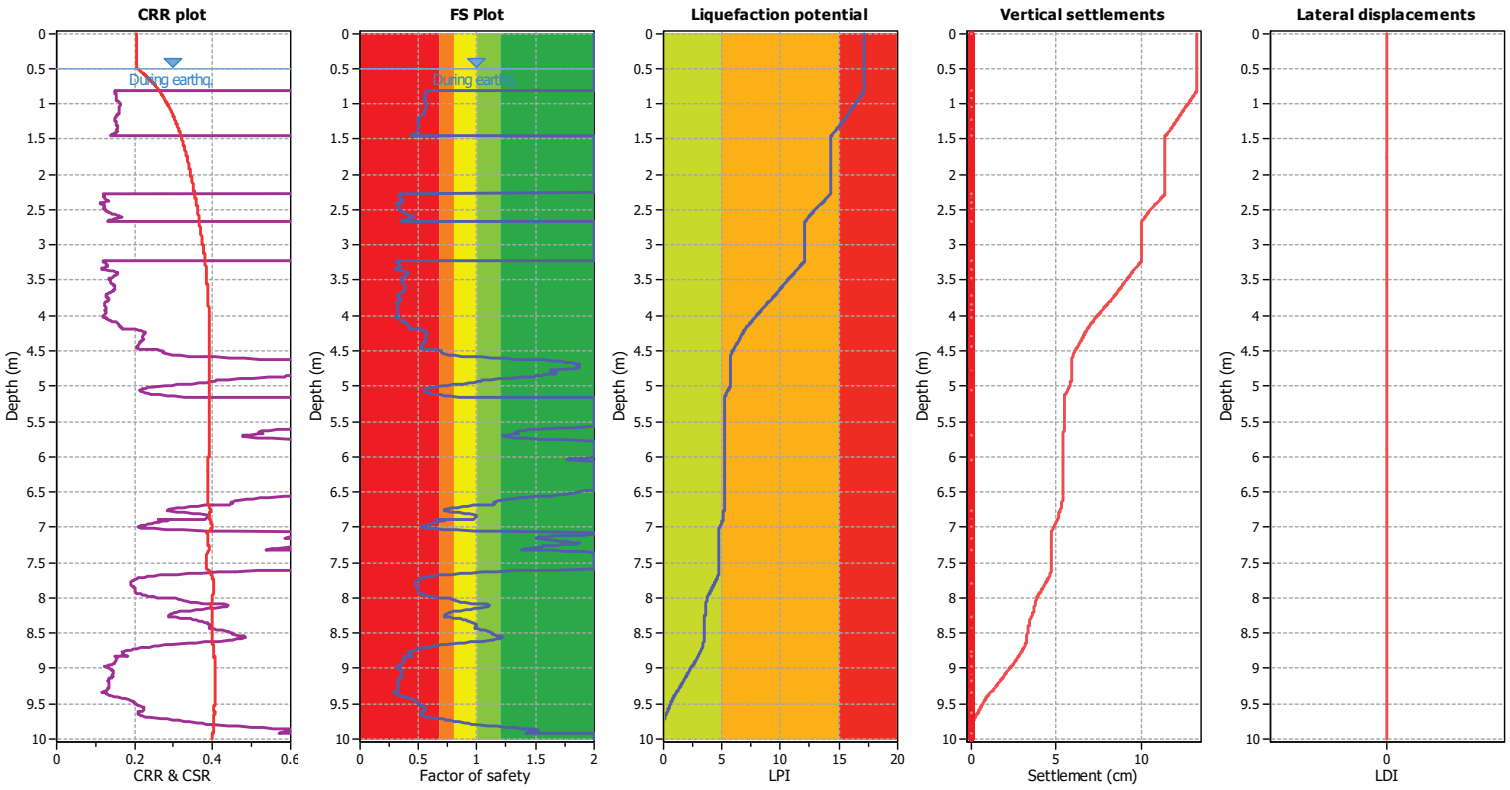
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	10.00 m

F.S. color scheme

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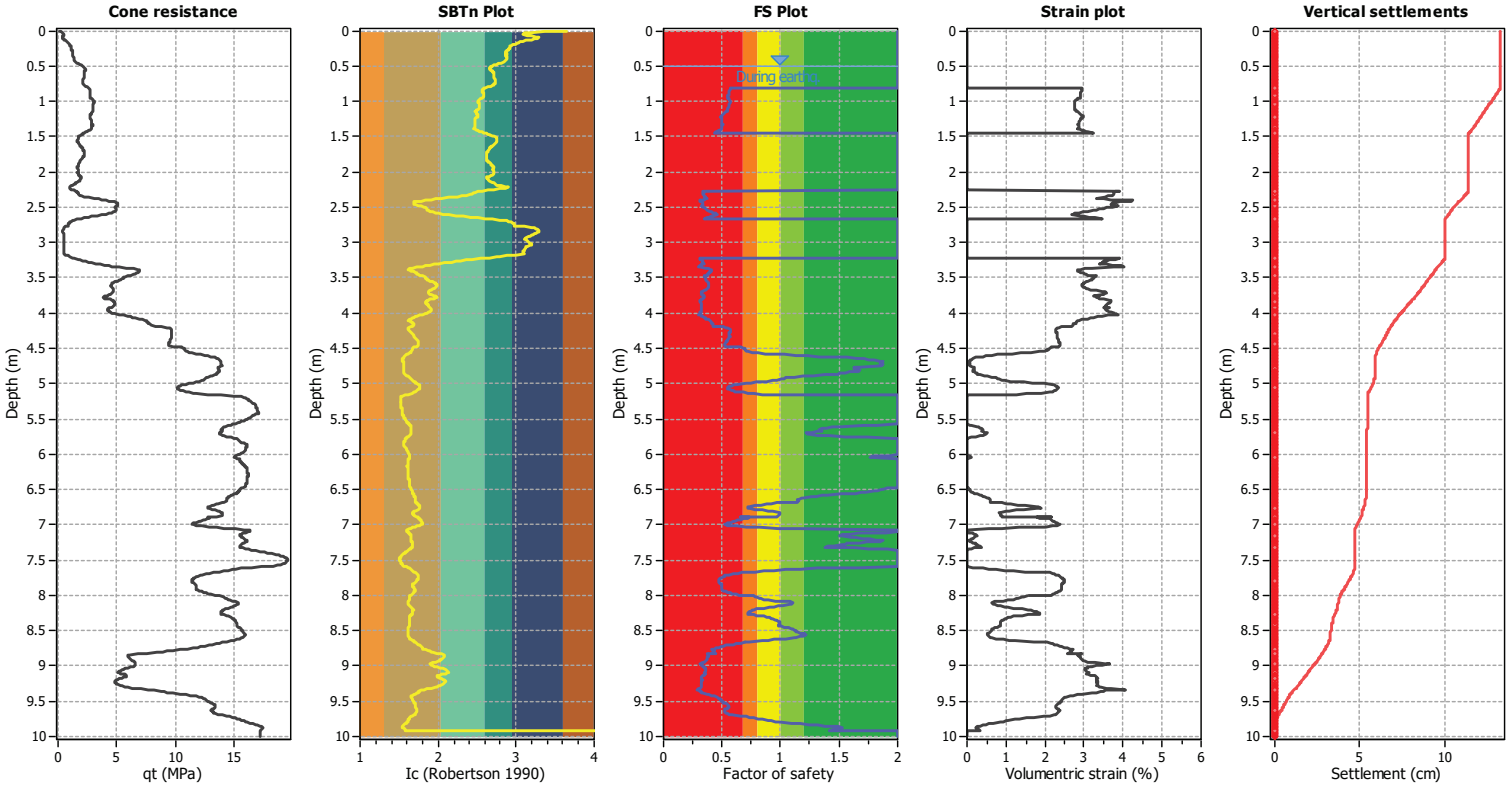
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

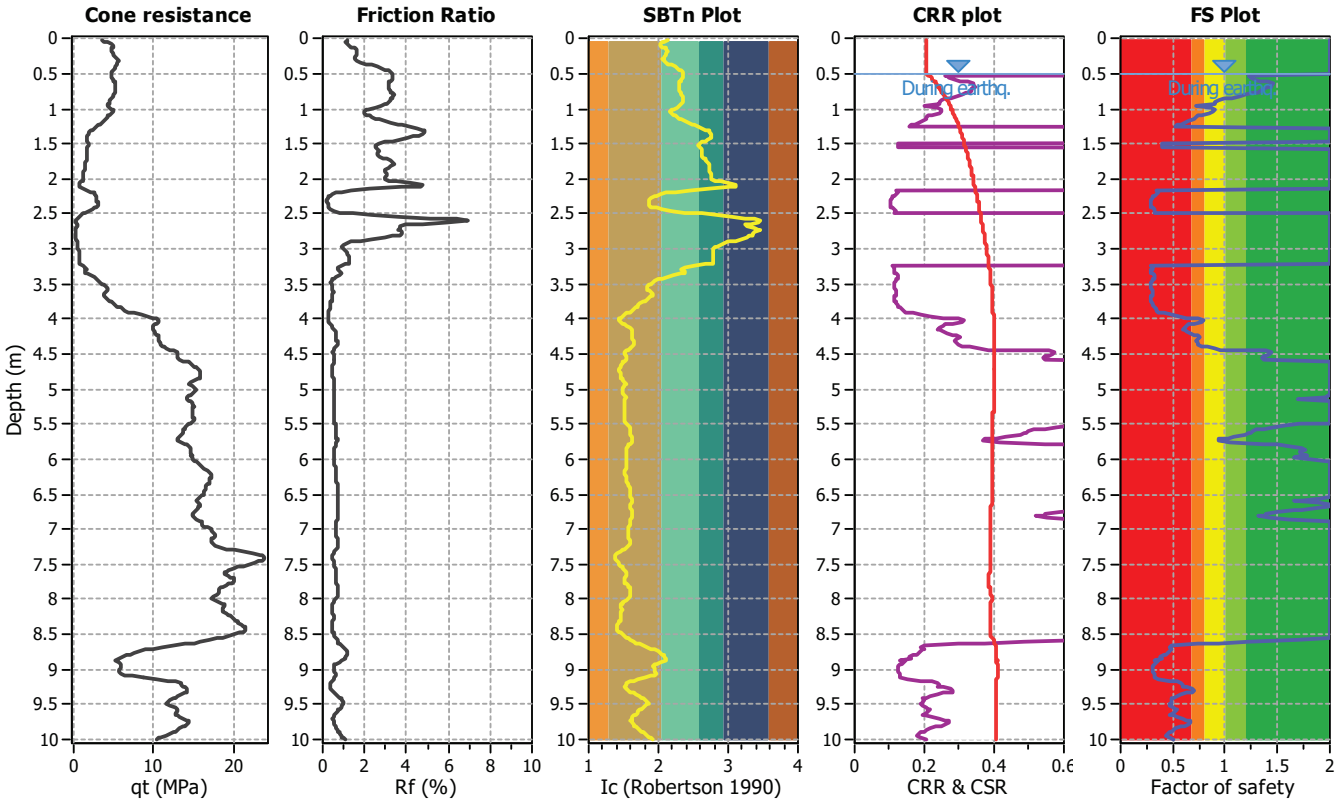
LIQUEFACTION ANALYSIS REPORT

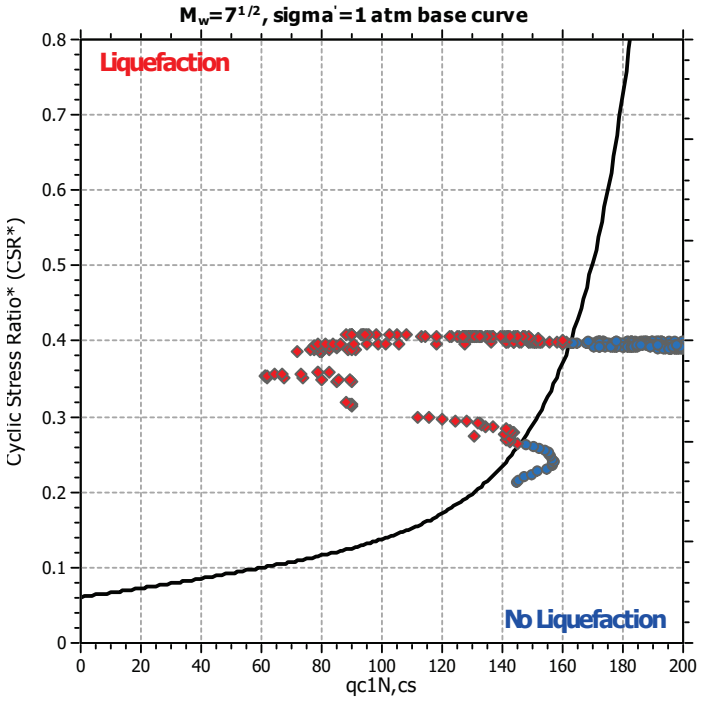
Project title : Multi-Unit development **Location : 32_36 Ryan Street**

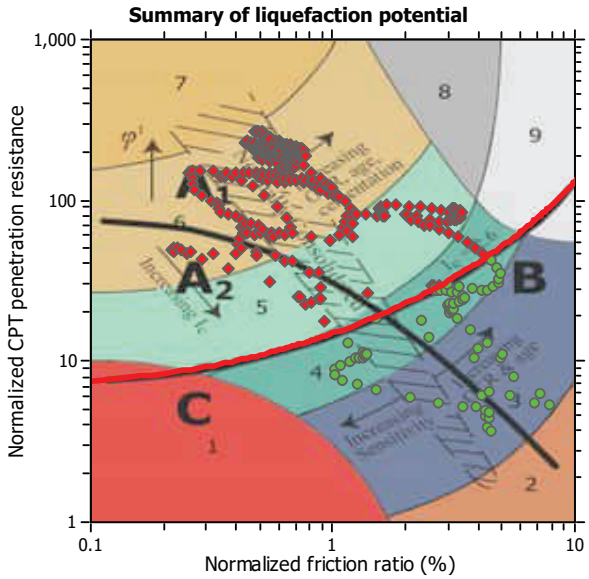
CPT file : CPT03

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 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:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

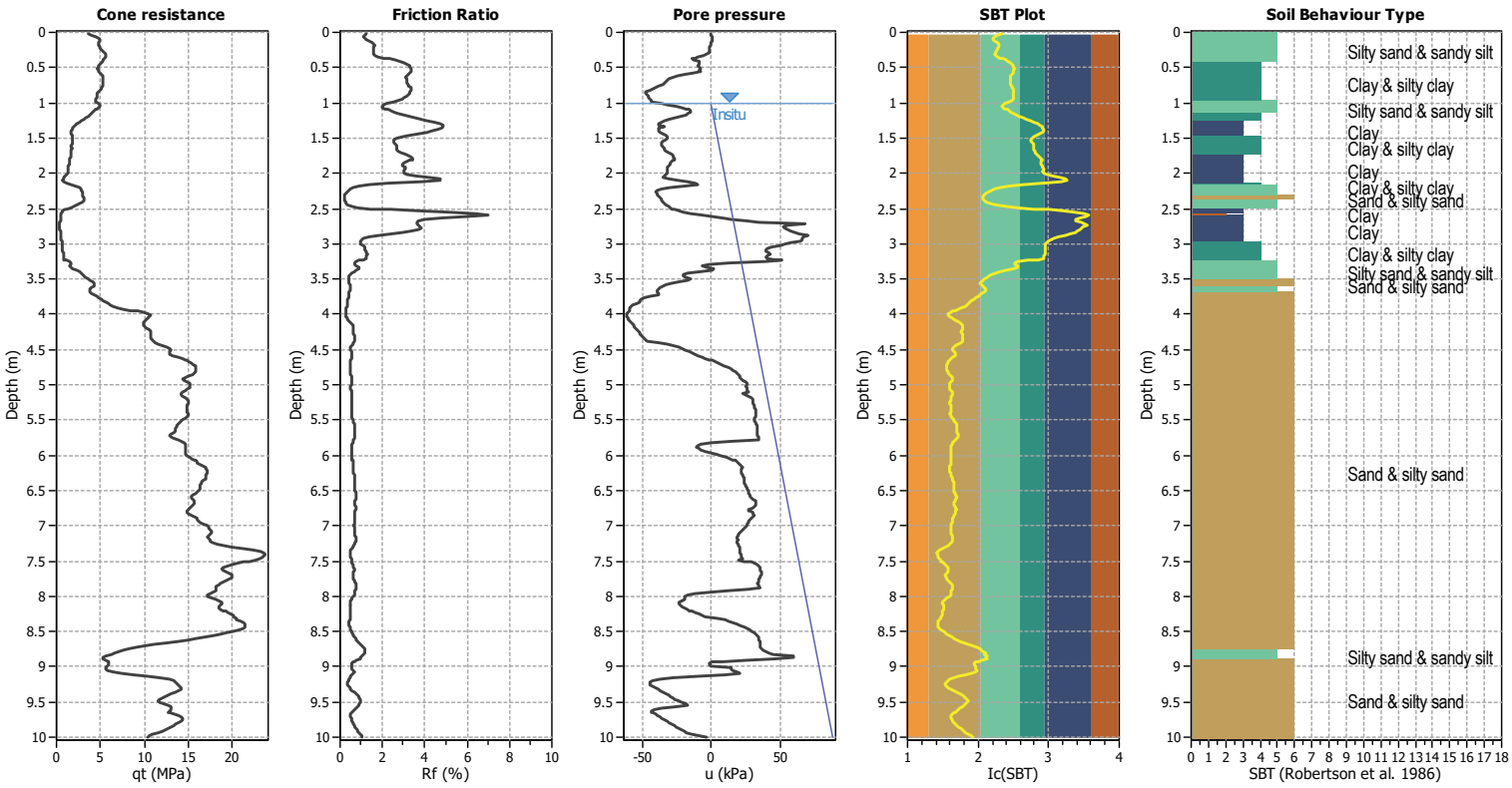






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



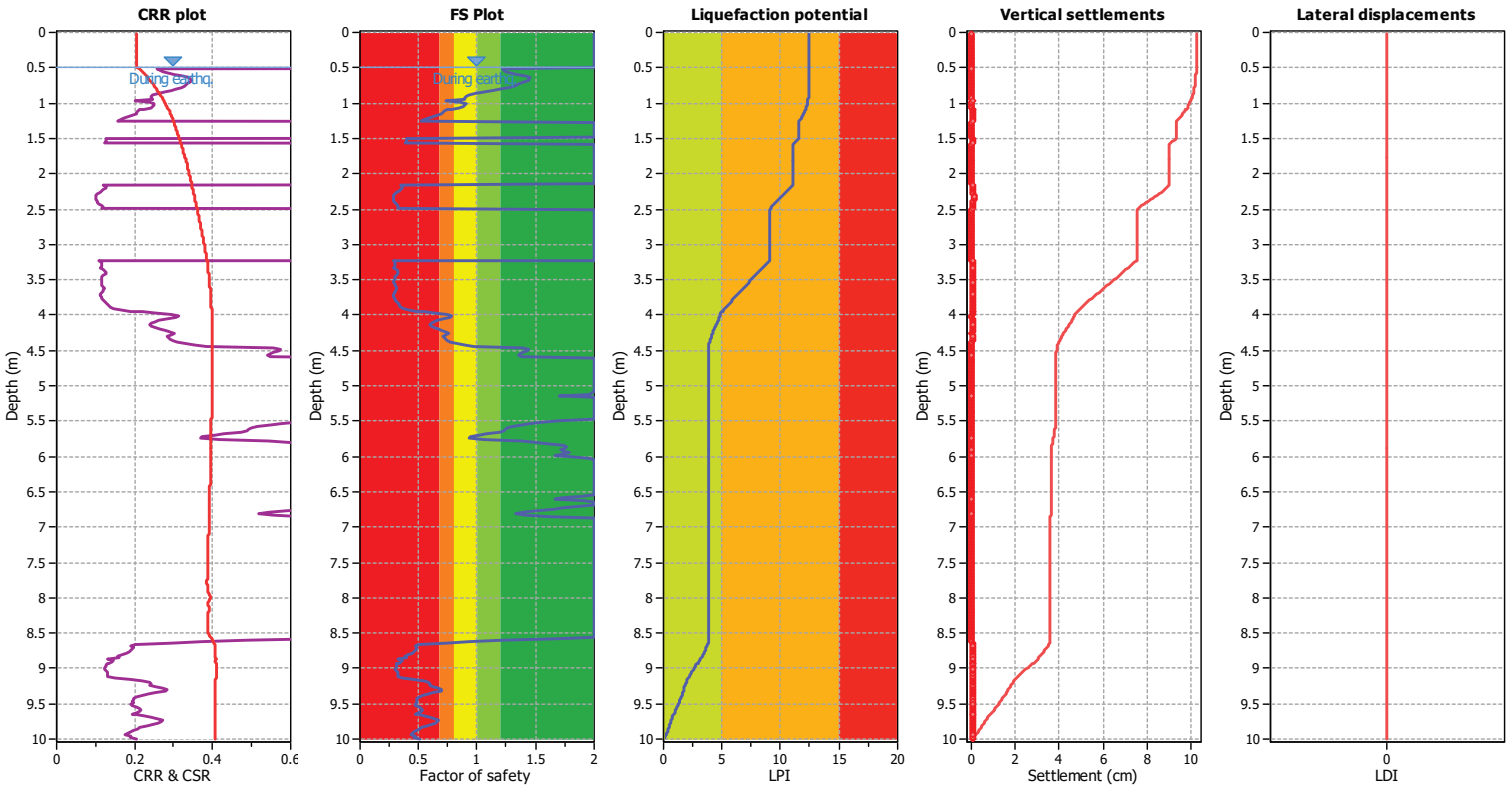
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.00 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
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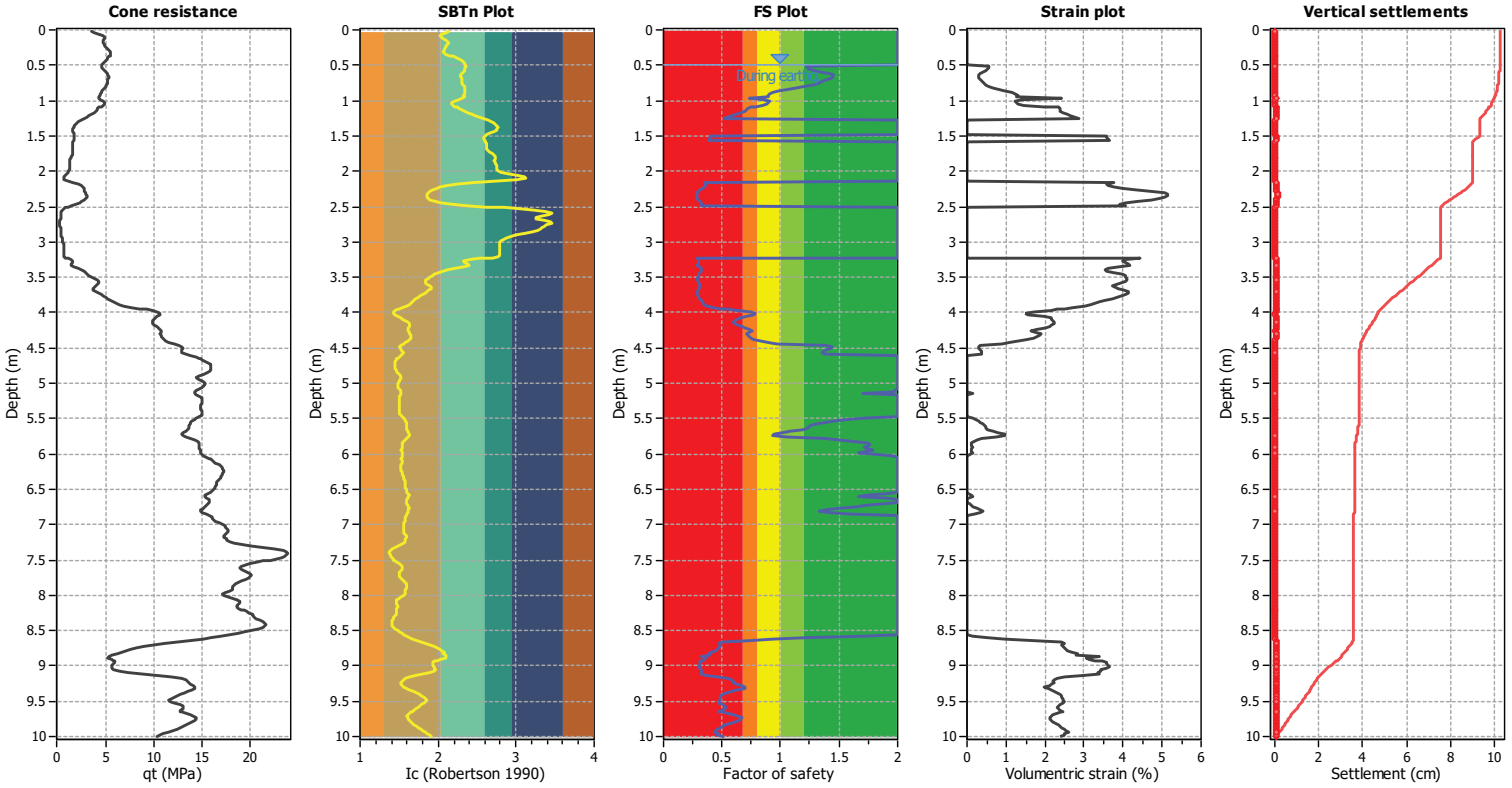
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Appendix D

- Site plan for proposed 7 -unit residential development
- Statement of Professional Opinion

District Plan Zone:
Residential Suburban Density Transition Zone

Legal Description:
Lot: 13 DP: 9028 (32 Ryan St)

Legal Description:
Lot: 14 DP: 9028 (36 Ryan St)

Site Area: 1020.32m²

Total Ground Floor Slab Area: 263.25m²
Total First Floor Area: 237.46m²
Total Floor Area: 500.71m²

Covered bike storage area: 0m²
Total Service, Storage & Waste management space: 50.96m²
Deck area: 97.16m²
Total site coverage: 235.98m² (22.64%)

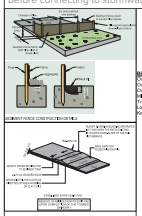
Total Outdoor Living Space: 285.21m²

Site Notes:
Dimensions to foundation

Refer to foundation plan for more detailed drainage

Site to be fully fenced before commencing construction, fence to comply with NZBC clause F5/AS1 part 1

Site Drainage Notes:
All Novaflo drainage to discharge to silt traps before connecting to stormwater drainage



Setout Notes:
Contractor to obtain surveyors certificates during construction to confirm compliance with height in relation to boundary requirements

Unit 1 Ground Floor Area: 40.53m² First Floor Area: 35.44m² Total Floor Area: 75.97m²	Unit 4 Ground Floor Area: 35.25m² First Floor Area: 32.37m² Total Floor Area: 67.62m²	Unit 7 Ground Floor Area: 39.83m² First Floor Area: 36.75m² Total Floor Area: 76.58m²
Unit 2 Ground Floor Area: 35.25m² First Floor Area: 32.37m² Total Floor Area: 67.62m²	Unit 5 Ground Floor Area: 38.29m² First Floor Area: 33.15m² Total Floor Area: 71.44m²	
Unit 3 Ground Floor Area: 35.81m² First Floor Area: 34.23m² Total Floor Area: 70.04m²	Unit 6 Ground Floor Area: 38.29m² First Floor Area: 33.15m² Total Floor Area: 71.44m²	

coll architecture

AK Residential - 32 & 36 Ryan Street. Christchurch

Sheet title:
Site Plan 1:200

Date: 15/11/2021
Drawn by: Josh Campbell-Tie
Scale: 1:200 @ A3

A101

021 223 0113 / 03 359 7391 info@collarchitecture.co.nz www.collarchitecture.co.nz

Statement of Professional Opinion on the Suitability of Land for Subdivision

(Appendix I to the Infrastructure Design Standard)

Issued by: Tetrad Consulting Limited
(Geotechnical engineering firm or suitably qualified engineer)

To: A K Property Limited
(Owner/Developer)

To be supplied to: Christchurch City Council
(Territorial authority)

In respect of: Subdivision of 32/36 Ryan Street
(Description of proposed infrastructure/land development)

At: 32/36 Ryan Street, Phillipstown, Christchurch
(Address)

I Steven Roberts on behalf of Tetrad Consulting Limited
(Geotechnical engineer) *(Geotechnical engineering firm)*

hereby confirm:

1. I am a suitably qualified and experienced geotechnical engineer and was retained by the owner/developer as the geotechnical engineer on the above proposed development.

2. ~~My~~/the geotechnical assessment report, dated 19.01.21 has been carried out in accordance with the Ministry of Business and Innovation *Guidelines for geotechnical investigation and assessment of subdivisions* and includes:
   (i) Details of and the results of my/the site investigations.
   (ii) A liquefaction assessment.
   (iii) An assessment of ~~rockfall and slippage, including~~ hazards resulting from seismic activity.
   (iv) An assessment of the ~~slope stability and~~ ground bearing capacity confirming the location and appropriateness of building sites.
   (v) Recommendations proposing measures to avoid, remedy or mitigate any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.

3. In my professional opinion, I consider that Council is justified in granting consent incorporating the following conditions:
   Shallow ground improvement to 1.1m below lowest adjacent ground level complete with a waffle slab foundation system.

4. This professional opinion is furnished to the territorial authority and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.

5. This certificate shall be read in conjunction with my/the geotechnical report referred to in Clause 2 above, and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

6. The geotechnical engineering firm issuing this statement holds a current policy of professional indemnity insurance of no less than $ 500,000
(Minimum amount of insurance shall be commensurate with the current amounts recommended by IPENZ, ACENZ, TNZ, INGENIUM.)

.....
(Signature of Engineer)

Date: 19.01.2022

Qualifications and experience:

CPEng (Geotechnical), MEngNZ, IntPE(NZ)

WAFFLE SLAB PERFORMANCE ASSESSMENT

The waffle slab deformation is compared to the performance criteria set out in B1/VM4 of NZBC , which is applicable to static foundation load.However, this performance criteria provides a convenient baseline for assessing the deformation limit of ground surface from SLS1 seismic loading.

Required input parameters

1. Consider Ground surface damage assessment at SLS1:

LPI value for SLS1 from Cliq analysis:		Reproduced from Table 6 in Geotechnical Report
@ location CPT01	3	Liquefaction occurs in layers of limited thickness; ground deformation results in relatively small differential settlements.
@ location CPT02	5	Liquefaction occurs in 30 to 50% of the soil deposit; moderate differential settlements

2. Consider Predicted settlements for SLS1 and SLS2 event to MBIE index depth:

For SLS1			*For SLS2*		
@ location CPT01	80	mm	**@ location CPT01**	90	mm
@ location CPT02	55	mm	**@ location CPT02**	70	mm

3. Horizontal distance between CPT test locations:

CPT Distance =: 19 m

	For SLS1	For SLS2	
Inferred ground surface slope (in %):	0.26%	0.21%	Note: Ground slope assessed over 1/2 of the CPT distance
Equivalent slope in mm/m is:	2.6 mm/m	2.1 mm/m	

Compare to performance limit from B1/VM4: 4.17 mm/m i.e 0.41%
(@ 25 mm over a 6 m span)

Conclusion: Inferred ground slope surface at 0.15% is less than 0.41% to B1/VM4 therefore slab performance satisfactory at SLS1 seismic

4. Check if inferred ground surface slope affects curvature demand of regular/irregular waffle slab foundation

Assumption: The performance limit for foundation settlement from B1/VM4 is adopted for a regular foundation slab as per the definition of regular foundation to MBIE guidelines: In this case the foundation length-to-width ratio (L/B) is 3.0 for a 'regular' foundation system.

Input:

Foundation length - L 29.5 m
Foundation width - B 5 m

L/B = **5.90** irregular foundation

If foundation shape is irregular then calculate increased gravel raft stiffness (if required) to maintain performance settlement limit at 25 mm to 6m (i.e 0.41% ground slope)

The additional gravel stiffness is assessed from the increase in curvature demand imposed on the waffle slab from the increased foundation length and/or predicted ground settlement from CLIq assessment for SLS1.

Critical foundation length is assessed at **4.17 m** for a 305 mm thick waffle slab with 220 mm deep concrete ribs at 1.2 m spacing eachway.

Now foundation length for assessment of increased curvature demand is: 8.86 m

Curvature demand can be expressed as: $\Psi = \frac{M_{slab}}{EI}$ in radians where M_{slab} is proportional to L^2

Now for $L_{critical}$ = 4.17 m from above , the increase in slab moment (δM) for L' =0.33L; where L' = 9.74 m

i.e. $\delta M = M.(L'/L_{cr})^2$
$= 5.5$

Note: increase in curvature demand Ψ is: 5.5

REINFORCED GRAVEL RAFT DESIGN

Material Elastic Modulus E:

Concrete:

E_c = 25,000 MPa

Gravel:

Unreinforced[1] E_G = 60 MPa

1. MW Design notes 1983

Reinforced[2] E_{MSL} = 120 MPa

2. EuroGeo4 Paper number 222; Ken Watts & Chris Jenner

Element Stiffness:

Waffle Slab Foundation:

$K_c = f\{\psi, d^3, b, E_c\} = 2083.\psi.b_w.d^3$ Nmm^2 where $K_c \alpha EI$

Gravel Raft:

$K_G = f\{D, b, E_{MSL}\} = 10bD^3$ Nmm^2 where $K_G \alpha E_G I$

Element Stiffness Ratio:

$K_p = K_c/K_G = 208.3.\psi.(b_w/B).(\Delta_{sls}/\Delta_{B1/VM4})(d/D)^3$ unitless

Waffle Slab geometry:

rib depth - d	220	mm
rib width - b_w	100	mm
rib spacing - B	1200	mm

Gravel Raft geometry:

Thickness - D	see below	mm
Tributary width - B	1200	mm

Calculation of gravel raft thickness to achieve flexural compatibility with waffle slab foundation:
(i.e k_p = 1.0)

Gravel Raft thickness: (D) - mm	Element stiffness ratio (k_P) for Δ_{SLS1} < 0.41% and L/B <3.0	Element stiffness ratio (k_p)for Δ_{SLS1}< >0.41% and L/B>3.0	Element stiffness ratio (k_p)for Δ_{SLS2} <> 0.41% and L/B>3.0
400	2.0	19.6	15.6
500	1.0	10.0	8.0
575	0.7	6.6	5.3
600	0.6	5.8	4.6
700	0.4	3.6	2.9
800	0.3	2.4	2.0
975	0.1	1.3	1.1
1000	0.1	**1.3**	**1.0**
1150	0.1	0.8	0.7
1225	0.07	0.7	0.5
1325	0.06	0.5	0.4

Design outcome: 0.975 m thick reinforced gravel raft required for this development

MSL properties

Lateral confining stress at 600 mm depth of mechanically stabilised layer (MSL) = 10 kPa/m [(1)] = σ_3

Maximum shear resistance angle for well graded gravel = 45° [(2)]

Maximum modified dry density (MDD) of compacted MSL = 2.1 - 2.2 t/m^3

MSL resistance to punching shear failure if applicable to non-liquefiable crust layer

$\tau = 2.\{\sigma_3.\tan\phi\}.D_{MSL}$ - kN/m lateral confining force from Tensar geogrid

Input

seismic reduction factor - ϕ	Shear resistance angle ϕ_{gravel}	Tan ϕ_{gravel}
0.8	45	1
	40	0.84
	35	0.7

MSL depth (m) - D_{MSL}	$\sigma_{3\ (kN/m)\ f(DMSL)}$	τ (45°)	τ (40°)	τ (35°)
0.6	6.0	7.2	6.0	5.0
0.7	7.0	9.8	8.1	6.9
0.8	8.0	12.8	10.6	9.0
0.9	9.0	16.2	13.4	11.3
1.0	10.0	20	16.6	14.0

MSL depth (m) - D_{MSL}	$\sigma_{3\ (kN/m)\ f(DMSL)}$	ϕN_v (45°)$^{(3)}$ - kN	ϕN_v (40°)$^{(3)}$ - kN	ϕN_v (35°)$^{(3)}$ - kN
0.6	6.0	5.8	4.8	4.0
0.7	7.0	7.8	6.5	5.5
0.8	8.0	10.2	8.5	7.2
0.9	9.0	13.0	10.8	9.1
1.0	10.0	16.0	13.3	11.2

N_V : Max uniformly distributed load (udl) supported by MSL at each waffle slab rib beam (in kN/m)

(1) Tensar,Tensar Information Bulletin 5th April 2013
(2) Donald P.Coduto, "Foundation Design" 2001
(3) Capacity Reduction Factor - ϕ - of 0.80 applied to gravel raft confining stress

Super imposed foundation load (excluding slab selfweight): G = 6 kPa

Q_b = 3 kPa combined liveload

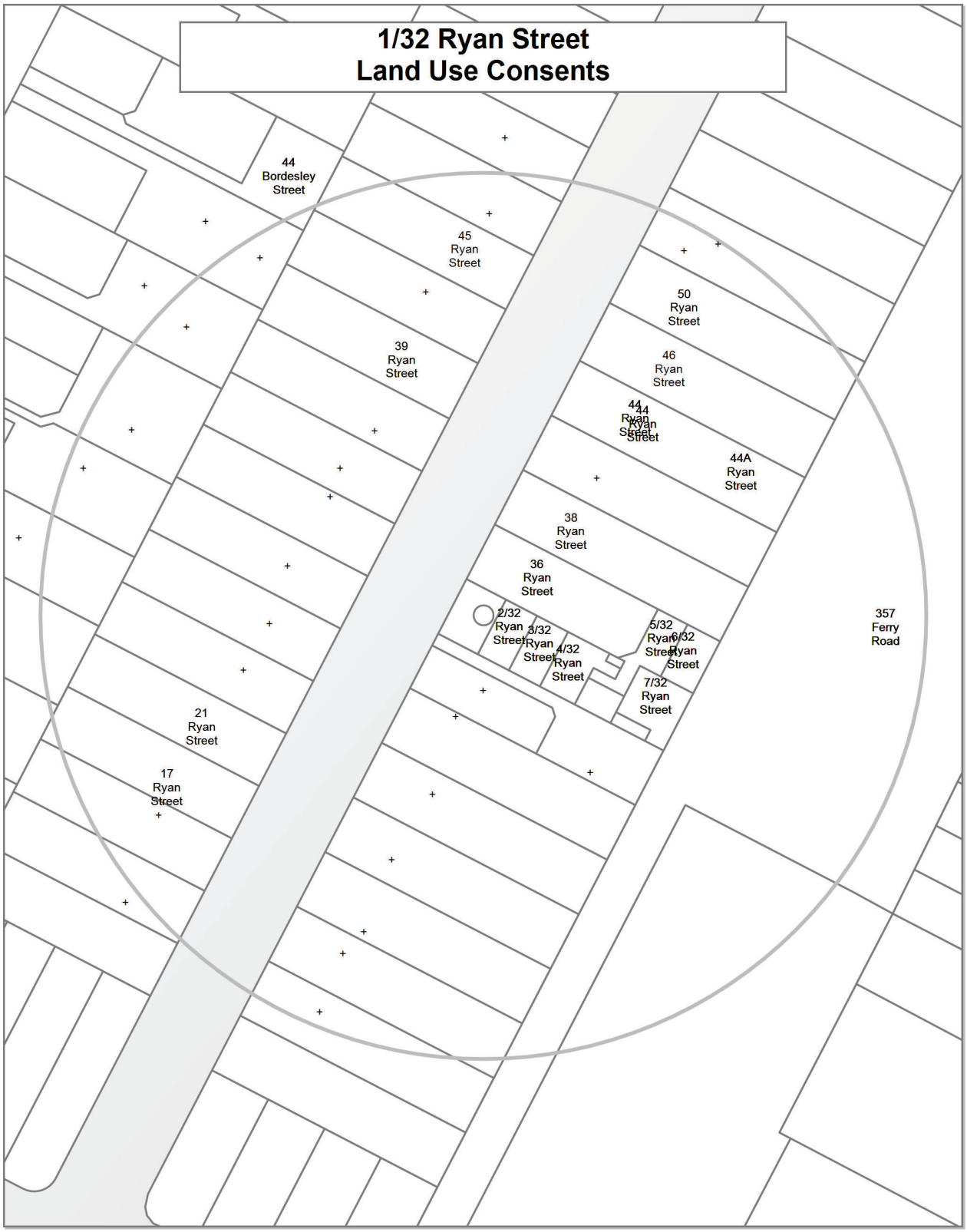
For load combination: G + 0.3Qu + Eu

Q_s = 6.9 kPa

N* = 8.28 kN/m

Conclusion: Require minimum gravel raft thickness at 0.8 m thick

i.e. ϕN_v = 8.5 kN/m i.e > 8.28 ok!


1/32 Ryan Street
Land Use Consents
44
Bordesley
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Ferry
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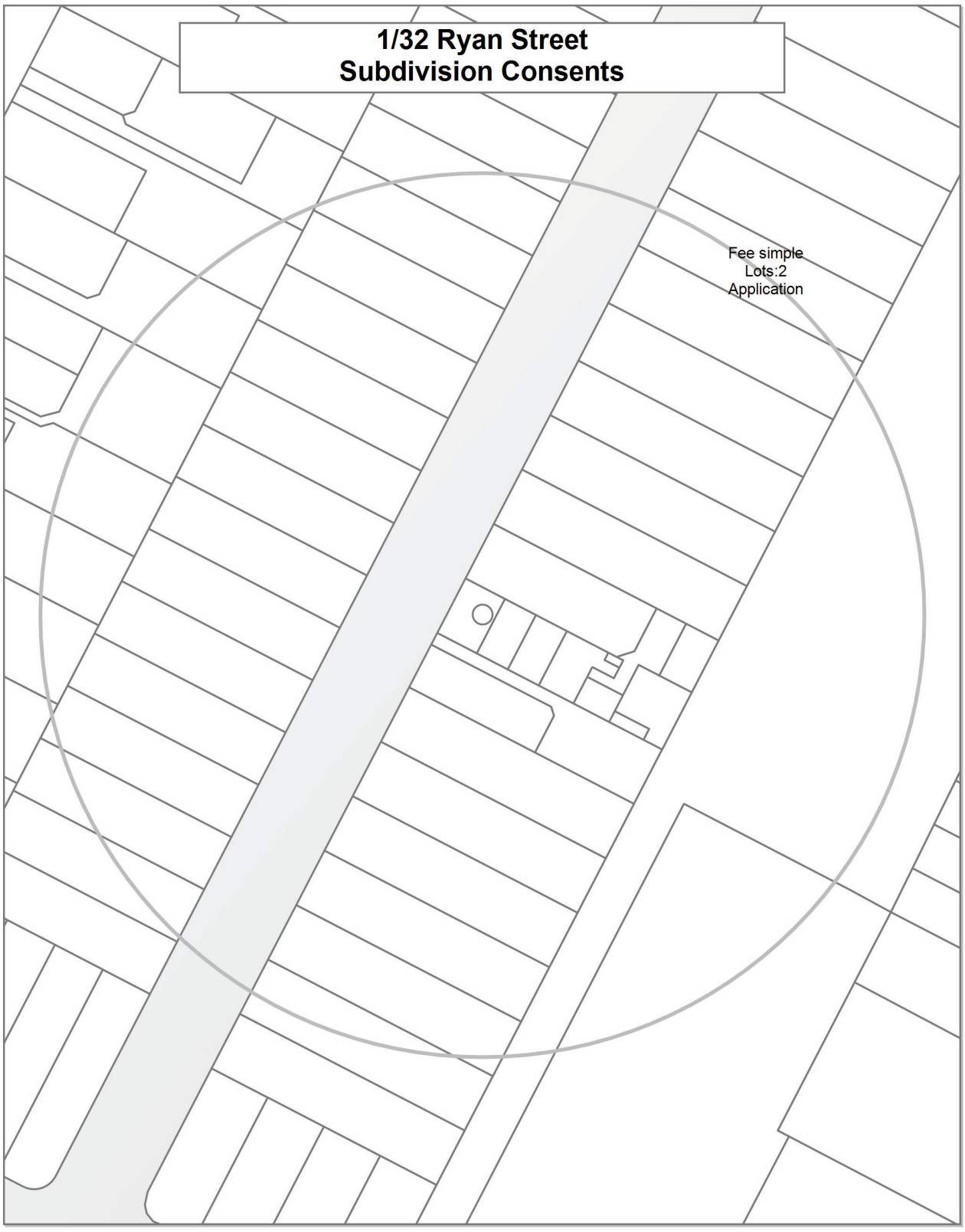
1/32 Ryan Street
Subdivision Consents
Fee simple
Lots:2
Application

Land Use Resource Consents within 100 metres of 1/32 Ryan Street

Note:This list does not include subdivision Consents and Certificates of Compliance issued under the Resource Management Act.

---

17 Ryan Street

RMA/2014/256

Foundations - Historical Reference RMA92024861

Processing complete

Applied 10/02/2014

Decision issued 11/04/2014

Granted 11/04/2014

2/32 Ryan Street

RMA/2021/3827

Construction of six attached and one detached dwellings

Processing complete

Applied 16/11/2021

Decision issued 01/04/2022

Granted 31/03/2022

Within scope amendment accepted 23/08/2022

Within scope amendment decision issued 23/08/2022

RMA/2022/2876

Subdivision - Fee simple - Ten lots with land use

Processing complete

Applied 09/09/2022

s223 Certificate issued 03/03/2023

s224 Certificate issued 12/06/2023

Decision issued 31/10/2022

Granted 28/10/2022

RMA/2022/400
Minimum Floor Level Certificate
Processing complete
Applied 15/02/2022
Certificate issued 16/02/2022

21 Ryan Street

RMA/1992/1066
Erect sleepout with recession plane intrusion. - Historical Reference RES9220910
Processing complete
Applied 27/08/1992
Decision issued 17/09/1992
Granted 17/09/1992

3/32 Ryan Street

RMA/2021/3827
Construction of six attached and one detached dwellings
Processing complete
Applied 16/11/2021
Decision issued 01/04/2022
Granted 31/03/2022
Within scope amendment accepted 23/08/2022
Within scope amendment decision issued 23/08/2022

RMA/2022/2876
Subdivision - Fee simple - Ten lots with land use
Processing complete
Applied 09/09/2022
s223 Certificate issued 03/03/2023
s224 Certificate issued 12/06/2023
Decision issued 31/10/2022
Granted 28/10/2022

RMA/2022/400

Minimum Floor Level Certificate

Processing complete

Applied 15/02/2022

Certificate issued 16/02/2022

357 Ferry Road

RMA/2007/624

Alterations to garden within heritage site - Historical Reference RMA92007857

Processing complete

Applied 19/03/2007

Decision issued 13/04/2007

Granted 13/04/2007

RMA/2011/1078

To erect signage for the Edmonds Factory Gardens which is listed as a Group 4 heritage place - Historical Reference RMA92018633

Processing complete

Applied 02/08/2011

Decision issued 31/08/2011

Granted 30/08/2011

RMA/2016/1617

Stormwater attenuation basin

Processing complete

Applied 15/06/2016

Decision issued 20/07/2016

Granted 20/07/2016

36 Ryan Street

RMA/2021/3827

Construction of six attached and one detached dwellings

Processing complete

Applied 16/11/2021

Decision issued 01/04/2022

Granted 31/03/2022

Within scope amendment accepted 23/08/2022

Within scope amendment decision issued 23/08/2022

RMA/2022/400

Minimum Floor Level Certificate

Processing complete

Applied 15/02/2022

Certificate issued 16/02/2022

38 Ryan Street

RMA/1997/1920

To erect a porch addition which intrudes into the 1.8m boundary setback by 1.370m, and through the northern boundary recession plane. - Historical Reference RES972172

Processing complete

Applied 08/08/1997

Decision issued 21/08/1997

Granted 21/08/1997

39 Ryan Street

RMA/2006/21

Garage extension which exceeds 9m in length - Historical Reference RMA20021902

Processing complete

Applied 11/01/2006

Decision issued 20/02/2006

Granted 16/02/2006

4/32 Ryan Street

RMA/2021/3827

Construction of six attached and one detached dwellings

Processing complete

Applied 16/11/2021

Decision issued 01/04/2022

Granted 31/03/2022

Within scope amendment accepted 23/08/2022

Within scope amendment decision issued 23/08/2022

RMA/2022/2876

Subdivision - Fee simple - Ten lots with land use

Processing complete

Applied 09/09/2022

s223 Certificate issued 03/03/2023

s224 Certificate issued 12/06/2023

Decision issued 31/10/2022

Granted 28/10/2022

RMA/2022/400

Minimum Floor Level Certificate

Processing complete

Applied 15/02/2022

Certificate issued 16/02/2022

44 Bordesley Street

RMA/2001/146

Three unit development where the Certificate of Compliance has expired and site is less than the required size. - Historical Reference RMA20003995

Processing complete

Applied 05/01/2001

Decision issued 24/01/2001

Granted 23/01/2001

RMA/2002/2677

Two relocated dwellings. - Historical Reference RMA20011721

Processing complete

Applied 22/10/2002

Decision issued 08/11/2002

Granted 07/11/2002

RMA/2003/410

Relocate a sleepout 28.2m2 and reposition two relocated dwellings (RMA20011721). - Historical Reference RMA20012669

Processing complete

Applied 11/02/2003

Decision issued 26/02/2003

Granted 26/02/2003

44 Ryan Street

RMA/2022/453

Subdivision - Fee simple - Two lots and associated land use

Processing complete

Applied 21/02/2022

s223 Certificate issued 03/06/2022

s224 Certificate issued 20/07/2023

Decision issued 24/05/2022

Granted 24/05/2022

s223 Certificate issued 03/06/2022

s224 Certificate issued 20/07/2023

Decision issued 24/05/2022

Granted 24/05/2022

44A Ryan Street

RMA/2022/453

Subdivision - Fee simple - Two lots and associated land use

Processing complete

Applied 21/02/2022

s223 Certificate issued 03/06/2022

s224 Certificate issued 20/07/2023

Decision issued 24/05/2022

Granted 24/05/2022

45 Ryan Street

RMA/2023/1290

Minimum floor level certificate

Processing complete

Applied 24/05/2023

Certificate issued 25/05/2023

46 Ryan Street

RMA/2022/5

Minimum Floor Level Certificate

Processing complete

Applied 06/01/2022

Certificate issued 12/01/2022

5/32 Ryan Street

RMA/2021/3827
Construction of six attached and one detached dwellings
Processing complete
Applied 16/11/2021
Decision issued 01/04/2022
Granted 31/03/2022
Within scope amendment accepted 23/08/2022
Within scope amendment decision issued 23/08/2022

RMA/2022/2876
Subdivision - Fee simple - Ten lots with land use
Processing complete
Applied 09/09/2022
Decision issued 31/10/2022
Granted 28/10/2022
s223 Certificate issued 03/03/2023
s224 Certificate issued 12/06/2023

RMA/2022/400
Minimum Floor Level Certificate
Processing complete
Applied 15/02/2022
Certificate issued 16/02/2022

50 Ryan Street

RMA/2008/813
Family flat which intrudes on 1.8m setback and recession plane - Historical Reference RMA92011620
Processing complete
Applied 18/04/2008
Decision issued 11/06/2008
Granted 11/06/2008

6/32 Ryan Street

RMA/2021/3827
Construction of six attached and one detached dwellings
Processing complete
Applied 16/11/2021
Decision issued 01/04/2022
Granted 31/03/2022
Within scope amendment accepted 23/08/2022
Within scope amendment decision issued 23/08/2022

RMA/2022/2876
Subdivision - Fee simple - Ten lots with land use
Processing complete
Applied 09/09/2022
s223 Certificate issued 03/03/2023
s224 Certificate issued 12/06/2023
Decision issued 31/10/2022
Granted 28/10/2022

RMA/2022/400
Minimum Floor Level Certificate
Processing complete
Applied 15/02/2022
Certificate issued 16/02/2022

7/32 Ryan Street

RMA/2021/3827
Construction of six attached and one detached dwellings
Processing complete
Applied 16/11/2021
Decision issued 01/04/2022
Granted 31/03/2022
Within scope amendment accepted 23/08/2022
Within scope amendment decision issued 23/08/2022

RMA/2022/2876
Subdivision - Fee simple - Ten lots with land use
Processing complete
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s223 Certificate issued 03/03/2023
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Decision issued 31/10/2022
Granted 28/10/2022

RMA/2022/400
Minimum Floor Level Certificate
Processing complete
Applied 15/02/2022
Certificate issued 16/02/2022

Data Quality Statement

Land Use Consents
All resource consents are shown for sites that have been labelled with an address. For sites that have been labelled with a cross (+) no resource consents have been found. Sites that have no label have not been checked for resource consents. This will be particularly noticeable on the margins of the search radius. If there are such sites and you would like them included in the check, please ask for the LIM spatial query to be rerun accordingly. This will be done free of charge although there may be a short delay. Resource consents which are on land occupied by roads, railways or rivers are not, and currently cannot be displayed, either on the map or in the list. Resource consents that relate to land that has since been subdivided, will be shown in the list, but not on the map. They will be under the address of the land as it was at the time the resource consent was applied for. Resource consents that are listed as Non-notified and are current, may in fact be notified resource consents that have not yet been through the notification process. If in doubt. Please phone (03)941 8999.
The term “resource consents” in this context means land use consents. Subdivision consents and certificates of compliance are excluded.

Subdivision Consents
All subdivision consents are shown for the sites that have been labelled with consent details. For Sites that have been labelled with a cross (+) no records have been found. Sites that have no label have not been checked for subdivision consents. This will be particularly noticeable on the margins of the search radius. If there are such sites and you would like them included in the check, please ask for the LIM spatial query to be rerun accordingly. This will be done free of charge although there may be a short delay.
The term “subdivision consents” in this context means a resource consent application to subdivide land. Non subdivision land use resource consents and certificates of compliance are excluded.
This report will only record those subdivision applications which have not been completed i.e once a subdivision has been given effect to and the new lots/properties have been established the application which created those lots will not be shown
All subdivision consent information is contained on the map and no separate list is supplied