



# GEOTECHNICAL ASSESSMENT REPORT

70 KENRICK STREET,  
TE AROHA

PROJECT NO: HD2771-1  
KENWYN TRUST  
REFERENCE: GAR-1  
18 OCTOBER 2023

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## Executive summary

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Kenwyn Trust have engaged us to undertake a geotechnical assessment for the site located at 70 Kenrick Street, Te Aroha. They propose to remove the existing dwelling and construct 4 single-storey units. This report is intended to be submitted to the Matamata-Piako District Council (MPDC) in support of a building consent application.

### Our scope included:

- a review of existing information
- an intrusive investigation which included:
  - 5 hand augers (HA) up to 3.0 m below ground level (bgl) with strength testing
  - 2 cone penetration tests (CPT) up to 20 m bgl
- a quantitative liquefaction assessment
- foundation assessment and recommendations
- construction observation requirements

### Our key findings:

- ground conditions consisted of Hinuera Formation, primarily silt, sand and gravel
- groundwater was not encountered within the hand augers. Groundwater was dipped within the CPTs between 3.8 m and 3.9 m bgl
- our assessment indicates the degree of liquefaction induced ground damage is likely to be 'high'. The site lies within a performance level L3 (high anticipated liquefaction effects)
- less than 10 mm of settlement is expected from the proposed earthworks and buildings, no further consideration is necessary for static settlement

### Our recommendations:

- specific design of foundations are undertaken (NZS 3604 type foundations are not suitable due to the assessed liquefaction risk)
- a minimum 1.2 m geogrid reinforced hardfill raft with a TC2 type stiffened concrete ribraft or waffle slab foundation will be suitable for the site
- construction observation by a suitably qualified geo-professional will be needed to provide relevant producer statements (i.e. PS4 for ground conditions)

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PREPARED BY: **Retha Richards**

REVIEWED BY: **Kent Morgan, CPEng**



Geotechnical Engineer  
Retha@hdgeo.co.nz  
Tel 027 309 4555



Senior Geotechnical Engineer  
Kent@hdgeo.co.nz

| Revision No. | Prepared by    | Reviewed by        | Description                                  | Date issued |
|--------------|----------------|--------------------|--|-------------|
| 0            | Retha Richards | Kent Morgan, CPEng | Geotechnical assessment report               | 18.10.2023  |
| 1            | Retha Richards | Kent Morgan, CPEng | Update to Raft foundation detail, Appendix D | 28.11.2023  |

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## Introduction

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Kenwyn Trust have engaged us to undertake a geotechnical assessment for the site located at 70 Kenrick Street, Te Aroha. They propose to remove the existing dwelling and construct 4 single-storey units. This report is intended to be submitted to the Matamata-Piako District Council (MPDC) in support of a building consent application.

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## Scope

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Our scope of our assessment included:

- a review of existing information
- an intrusive investigation which included:
  - 5 hand augers (HA) up to 3.0 m below ground level (bgl) with strength testing
  - 2 cone penetration tests (CPT) up to 20 m bgl
- a quantitative liquefaction assessment
- foundation assessment and recommendations
- construction observation requirements

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## Site description

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The site is located at 70 Kenrick Street, Te Aroha. It is legally described as Lot 4 (DP 425692) and Lot 9 (DP 9205) and covers an area of 1,478 square meters.

The site is generally flat and covered with grass, gardens and an existing dwelling. The site is bounded by residential lots to the north-east and south-west, a camping ground to the west and Kenrick Street to the east.

The site is elevated at approximately 14 m above local datum<sup>1</sup>. A free-face, low-lying terrace (RL 9 m) is located at approximately 65 m to the east of the site. The Waihou River (RL 8 m) is located approximately 400 m to the north and east. A plan showing the site is included in Appendix A.

## Proposed development

Concept plans<sup>2</sup> completed by Edwards White Architects (dated 21 July 2023) show the proposed development concept. The development will consist of 4 single-storey units.

Direct access will be available from Kenrick Street via a new right-of-way. The plans of the proposed development are included in Appendix A.

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<sup>1</sup>Waikato Regional Council Contours, Local Maps, <https://waikatomap.waikatoregion.govt.nz/Viewer/?map=8d6d6fda779b4e59951953ae97d0ec4a>.

<sup>2</sup> Edwards White Architects – Kenwyn Village, Kenrick Street, Te Aroha – Concept plans, dated 21/07/2023.



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## Desk study

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We completed a desktop study prior to the site investigation to identify areas of interest. This included a review of geology maps<sup>3</sup> and review of existing information<sup>4</sup>.

## Geological setting

A geologic map of the area indicates that the site is in an area mapped as Late Pleistocene River deposits (Hinuera Formation). This geology is described as 'cross-bedded pumice sand, silt and gravel with interbedded peat'.

## Previous geotechnical assessments

We completed a preliminary assessment of the site in March 2023. This assessment included a site investigation consisting of 3 hand augers up to 3.0 m depth with strength testing, natural hazards and qualitative liquefaction assessment and preliminary foundation recommendations.

### Key findings:

- the near surface soils found at the site did not meet the requirements for 'good ground' in accordance with NZS 3604:2011 due to near-surface low strength soils
- groundwater was not encountered within the hand augers
- the site investigation encountered soils that ranged from loose to very dense sand and stiff silt
- the site met the criteria for 'land where liquefaction induced ground damage is possible'. We estimate that the liquefaction risk at the site would fall under a performance level of L1 to L2 (mild to moderate anticipated liquefaction effects)
- we considered lateral spreading under liquefied conditions unlikely at the site due to the depth to groundwater (> 3.0 m) and distance to the nearest free face (65 m)

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## Site investigation

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### Ground conditions

Our most recent investigation was completed on 29 September 2023. We assessed ground conditions by reviewing available testing (*HA01, HA02 and HA03*) on or near the site and by completing 5 hand augers (*HA04, HA05, HA06, HA07 and HA08*) up to 3.0 m bgl with strength testing and 2 cone penetration tests (CPT01 and CPT02) up to 20 m bgl.

In-situ strength testing was undertaken using a shear vane and dynamic cone penetrometer test (DCP). Our intrusive site investigation found ground conditions that were consistent with the published geology of the Hinuera Formation. The site investigation plan, soil logs and CPT outputs are included in Appendix B.

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<sup>3</sup>1:250,000 Geological Map of New Zealand (QMAP). *New Zealand Geology Web Map*. GNS, 2013. <http://data.gns.cri.nz/geology/>

<sup>4</sup> HD Geo – HD2771 70 Kenrick Street, Te Aroha – Preliminary Geotechnical Report (PGR-1), dated 14 March 2023.

## Shallow ground conditions

The shallow ground conditions found during the hand auger investigation are summarised in Table 1 below.

**Table 1: Summary of shallow ground conditions**

| Description         | Average depth (m bgl) | Density / Peak undrained shear strength                         | Test #       |
|---------------------|-----------------------|---|--------------|
| Topsoil             | 0.1 to 0.4            | N/A   | HA01 to HA08 |
| Silt, clay & sand   | 0.6 to 2.1            | Stiff to hard (Shear vanes ranging between 69 kPa and 220+ kPa) | HA01 to HA08 |
| Sand, silt & gravel | 1.3 to 3.0            | Medium dense to dense (DCP – 5 to 16 blows per 100 mm)          | HA01 to HA08 |

## Deep ground conditions

The deep ground conditions found during the CPT investigation are summarised in Table 2 below.

**Table 2: Summary of deep investigation results**

| Description (inferred soil type)                             | Average depth (m bgl) | Tip resistance (MPa) | Test #        |
|--|-----------------------|----------------------|---------------|
| Clay to silty clay   | 0.0 to 0.8            | between 1 and 3 MPa  | CPT01 & CPT02 |
| Silty sand to sandy silt, with interbedded lenses of clay    | 0.6 to 2              | between 2 and 6 MPa  |               |
| Sand to silty sand, with interbedded lenses of silt & gravel | 2.1 to 15             | between 2 and 38 MPa |               |
| Clay to silty clay, with interbedded lenses of silt          | 15 to 16              | between 2 and 5 MPa  |               |
| Sand to silty sand   | 16 to 17              | between 9 and 24 MPa |               |
| Clayey silt to silty clay, with interbedded lenses of sand   | 17 to 18              | between 2 and 6 MPa  |               |
| Sand to silty sand/ sandy silt                               | 18 to 19              | between 3 and 18 MPa |               |
| Clayey silt to silty clay                                    | 19 to 20.             | Between 2 and 3 MPa  |               |

## Groundwater

We did not encounter groundwater within the hand augers. Groundwater was dipped within the CPTs at between 3.8 m and 3.9 m bgl. The groundwater levels encountered likely do not represent peak levels and could be higher in the winter months.

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## Geotechnical assessment

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### Liquefaction

We have undertaken a quantitative liquefaction assessment using the CPT data. The assessment has been undertaken in accordance with the NZGS and MBIE guidelines<sup>5</sup>. Outputs from the CPT analysis are included in Appendix B. The liquefaction assessment is included in Appendix C.

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<sup>5</sup> Ministry of Business Innovation and Employment (MBIE) / New Zealand Geotechnical Society (NZGS). Module 3: Identification, assessment, and mitigation of liquefaction hazards. Dated November 2021.

## Assessment inputs

We completed a screening analysis using the CPT data for a 1 in 500-year (ULS) and 1 in 25-year (SLS) design events. The test results were analysed using the proprietary software CLIQ (Geologismiki) and engineering calculations in accordance with recent NZGS guidelines.

The design earthquake for the analysis of liquefaction susceptibility has been taken from Module 1: Overview of the guidelines<sup>6</sup> of MBIE and NZGS. Input parameters for the analysis are listed below:

**Table 3: Input parameters used for our quantitative liquefaction assessment**

| Parameter                                  | Input  |
|--|--|
| Site seismic classification <sup>7</sup> : | Class D (shallow soils)*   |
| Structural importance level <sup>8</sup> : | Importance level 2 – residential   |
| Peak ground acceleration:                  | 0.07 g (SLS) for a 1 in 25-year event<br>0.30 g (ULS) for a 1 in 500-year event,<br>5.9 magnitude earthquake |
| Groundwater depth:                         | between 3.8 m & 3.9 m bgl (dipped within CPTs)   |
| Limit depth:                               | 10 m from current ground level (for indexing)  |

\*The site is Class D however, following Module 1 requirements the PGA is based on Class C conditions.

## Liquefaction susceptibility

The susceptibility of a site to liquefaction is a combination of the expected earthquake shaking for the required design return period, the soil types and their strength/density state, and the groundwater conditions at the site. There are several measures of a site's overall susceptibility to liquefaction including liquefaction potential index (LPI), liquefaction severity number (LSN), ground surface settlement, and lateral spreading.

The CPTs have been assessed under ULS conditions with the analysis limited to 10 m depth for the screening assessment in accordance with the guidelines. Beneath 10 m the effects of liquefaction may contribute to global settlements however are unlikely to have significant surface expression. Liquefaction should be considered below 10 m if deep foundations are proposed.

### Serviceability Limit State (SLS) Earthquake

An SLS earthquake is an event after which there is high expectation that the building or structure can be used as intended without repair or with minimal repair. The assessment showed that under SLS conditions there is no liquefaction damage expected at the site.

### Ultimate Limit State (ULS) Earthquake

A ULS earthquake is an event after which a building should retain its integrity to allow safe evacuation of people but is likely to be severely damaged and may not be repairable. The assessment showed that under ULS conditions there is a liquefaction hazard at the site.

Under ULS conditions, our assessment indicated:

- between 125 and 145 mm of predicted vertical settlement
- Liquefaction Potential Index (LPI) of between 10 and 13 (high risk)

<sup>6</sup> Ministry of Business Innovation and Employment (MBIE) / New Zealand Geotechnical Society (NZGS). Module 1: Overview of the guidelines. Dated November 2021.

<sup>7</sup> NZS 1170.5:2004. *Structural design actions – Earthquake Actions (New Zealand)*. SANZ

<sup>8</sup> NZS 1170.0:2002. *Structural design actions – General Principles*. SANZ



- Liquefaction Severity Number (LSN) of between 20 and 25 (moderate to high expression expected)
- potentially liquefiable layers across most of the soil profile below the assessed groundwater level (between 3.8 and 3.9 m bgl)

### *Groundwater sensitivity check*

We have assessed the site with the encountered groundwater conditions. To understand the overall liquefaction risk, we have completed a sensitivity analysis on the groundwater conditions and assumed a peak high groundwater table of 1.0 m higher (between 2.8 m and 2.9 m below ground level).

The sensitivity analysis predicted:

- increase in overall vertical settlement of 20 to 35 mm (between 145 and 180 mm of predicted vertical settlement)
- Liquefaction Potential Index (LPI) of between 14 and 18 (high to severe risk)
- Liquefaction Severity Number (LSN) between 26 and 34 (high expression expected)

### *Site performance level*

Our assessment indicates that the site lies within performance level L2 to L3 (moderate to high anticipated liquefaction effects) in accordance with Table 5.1 of the latest MBIE and NZGS guidelines<sup>9</sup>.

Under a higher groundwater level, the site performance will increase to L3 (high anticipated liquefaction effects).

This performance level is defined as:

- liquefaction occurs in a significant portion of the deposit (higher than 50 % of the deposit)
- ground deformation in the order of 100 mm to 200 mm
- moderate differential movements

### *Liquefaction summary*

Based upon the assessed risk of liquefaction, liquefaction effects need to be considered in the design of building foundations. Given the change in hazard, we recommend that the higher hazard is designed for. Refer to the 'Foundations' section below for further details.

## **Static settlement**

Based upon a screening assessment of static settlement using the CPT data and the propriety software CPeT, less than 10 mm of settlement is expected from the proposed units (assumed at 10 kPa with a width of 14 m and a length of 9 m based on the proposed development plans). Therefore, we don't believe further consideration is necessary for static settlement.

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<sup>9</sup> Module 3: Identification, assessment and mitigation of liquefaction hazards. Prepared by Ministry for the Environment and Ministry of Business, Innovation and Employment, dated November 2021.

## Foundations

Due to the high liquefaction hazard, standard NZS 3604 type foundations are not suitable for the site. Foundations need to be designed to account for the liquefaction risk. Specific design of the foundations will be needed by a structural engineer.

The use of shallow ground improvement (minimum 1.2 m deep), consisting of a geogrid reinforced hardfill raft, followed by a TC2 type stiffened concrete ribraft or waffle slab foundation will be suitable for the site.

A plan showing the geogrid reinforcement details for the 1.2 m shallow ground improvement is included in Appendix D.

## Construction

The earthworks plan<sup>10</sup> completed by Sustain R (dated 05 September 2023) show the proposed cut/fill across the site. Minor cut (up to 0.3 m) and fill (up to 0.4 m) is proposed for the site to ease grades and create near-level building platforms.

Below the building platforms, we recommend:

- minimum 1.2 m thick hardfill raft
- the subgrade should be proof rolled to identify soft spots
- A19 filter fabric or similar is needed between the subgrade and gravel layer
- backfill with GAP65 or similar and compact (0.1 m thick layer)
- place one layer of geogrid (30/30 or similar) at 0.1 m from the base of the excavation, and the second layer at 0.4 m, placing compacted GAP65 or similar in 150 mm layers between the grids
- following the final geogrid layer, backfill with GAP65 or similar in maximum 150 mm layers
- the GAP65 will need to meet CIV of 24 when tested with a clegg hammer at 0.6 m and 1.2 m.

The following inspections will be needed at the time of construction in order to provide certification (i.e. a PS4):

- inspection of the cleared subgrade once undercut to 1.2 m bgl within the footprint of the building, to ensure all topsoil and any unsuitable surface materials have been removed
- imported GAP65 (or similar) testing to confirm that the specification has been achieved
- inspect placement of the geogrid reinforcement prior to backfilling

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## Limitation

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This report has been prepared for our client, Kenwyn Trust and their professional advisors, for the purpose detailed above and may not be relied on by any other party or for any other purpose. This report contains an assessment based on a site walkover, our desktop study and testing in discrete locations. Inferences about the conditions at the site have been made based on the testing undertaken and our understanding of the geological environment in which the site lies. Further testing and assessment is required during construction.

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<sup>10</sup> Sustain R – 70 Kenrick Street, Te Aroha – Earthworks plan, dated 05/09/2023, rev A.

# APPENDIX A – PROPOSED DEVELOPMENT

**LEGEND:**

- x39.01 EXISTING SPOT HEIGHTS
- 4.5- MAJOR CONTOURS (0.5m CONTOURS)
- 4.25- MINOR CONTOURS (0.1m CONTOURS)
- SW- EXISTING STORMWATER
- S- EXISTING WASTEWATER
- W- EXISTING WATER
- SURFACE FLOWS
- EXISTING FENCE



DRAFT FOR CO-ORDINATION

**Sustain R**

027 724 5260  
Sustainr@gmail.com  
PO Box 228, RAGLAN, NEW ZEALAND - 3265

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| Rev. | AMENDMENT DESCRIPTION | DATE       |
|------|-----------------------|------------|
| A    | ORIGINAL RELEASE      | 05/09/2023 |
|      |                       |            |
|      |                       |            |
|      |                       |            |

**NOTES:**

1) SITE SURVEY LEVELS COURTESY OF ELEVATIONS SURVEYORS LTD.

**CLIENT:** KENWYN TRUST

**PROJECT:** 70 KENRICK STREET, TE AROHA, 3320

**EXISTING SITE PLAN**

**SCALE:** 1:150(A1) / 1:300(A3)  
ORIGINAL SHEET SIZE: A1

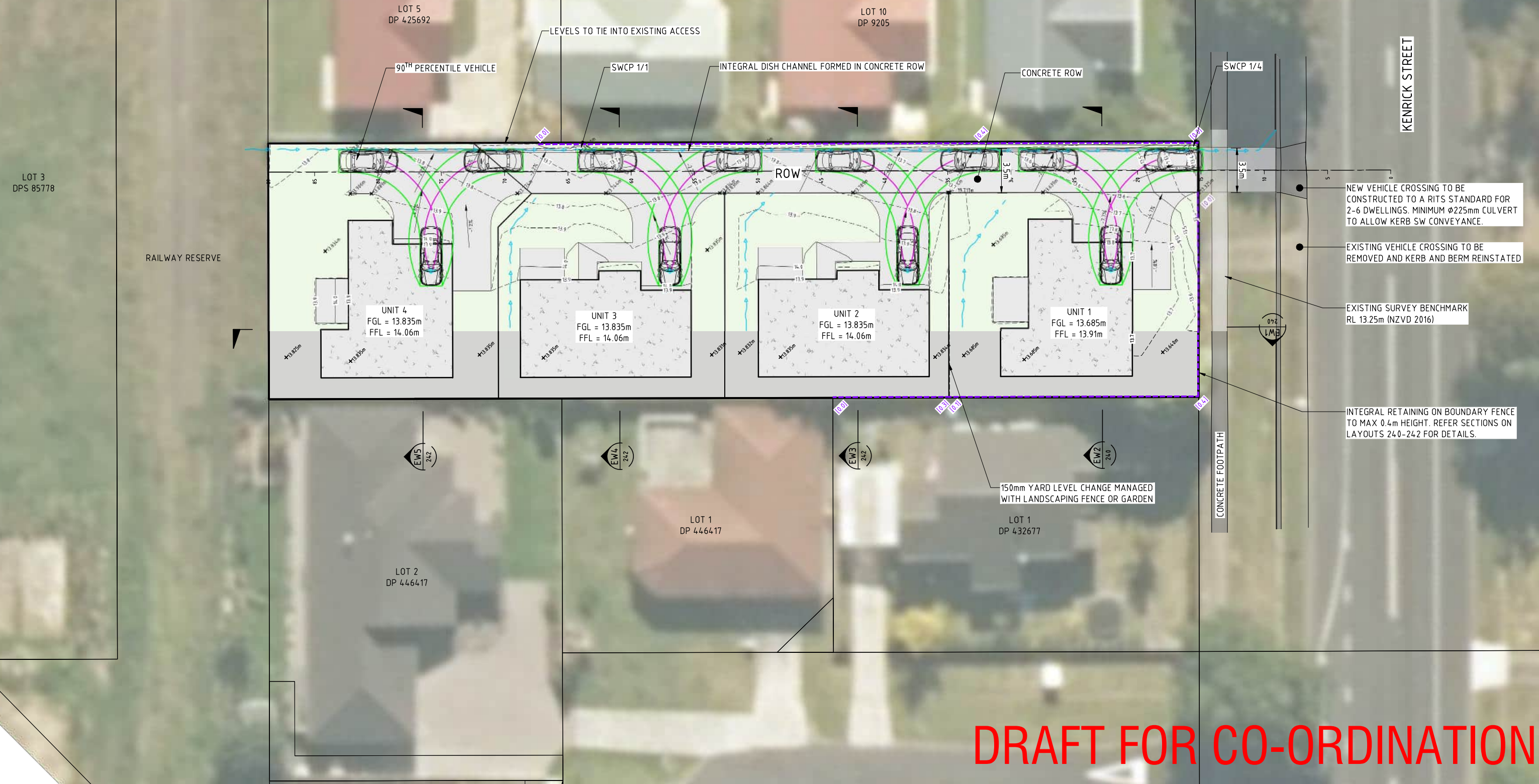
**STATUS:** CONSENTING

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|------------------------------------|----------------------|
| <b>JOB-DRAWING No.</b><br>1056-100 | <b>REVISION</b><br>A |
|------------------------------------|----------------------|



**LEGEND:**

- 45.0 MAJOR CONTOURS (0.5m CONTOURS)
- - - - 42.5 MINOR CONTOURS (0.1m CONTOURS)
- x34.276m DESIGN LEVEL ELEVATIONS
- - - - INTEGRAL FENCE/RETAINING
- [0.3] PROPOSED RETAINING HEIGHTS
- ~ ~ ~ ~ DEVELOPED SECONDARY SURFACE FLOWS
- BUILDING FOUNDATION
- ROW/PATH/DRIVEWAY CONCRETE



NEW VEHICLE CROSSING TO BE CONSTRUCTED TO A RITS STANDARD FOR 2-6 DWELLINGS. MINIMUM Ø225mm CULVERT TO ALLOW KERB SW CONVEYANCE.

EXISTING VEHICLE CROSSING TO BE REMOVED AND KERB AND BERM REINSTATED

EXISTING SURVEY BENCHMARK RL 13.25m (NZVD 2016)

INTEGRAL RETAINING ON BOUNDARY FENCE TO MAX 0.4m HEIGHT. REFER SECTIONS ON LAYOUTS 24.0-24.2 FOR DETAILS.

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**Sustain R**

027 724 5260  
 Sustainr@gmail.com  
 PO Box 228, RAGLAN, NEW ZEALAND - 3265

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**NOTES:**

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**CLIENT:** KENWYN TRUST

**PROJECT:** 70 KENRICK STREET, TE AROHA, 3320

DESIGN LEVELS AND ACCESS PLAN

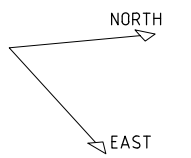
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 ORIGINAL SHEET SIZE: A1

**STATUS:** CONSENTING

**JOB-DRAWING No.** 1056-200

**REVISION** A





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**Sustain R**  
 027 724 5260  
 Sustainr@gmail.com  
 PO Box 228, RAGLAN, NEW ZEALAND - 3265

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NOTES:

CLIENT: KENWYN TRUST

PROJECT: 70 KENRICK STREET, TE AROHA, 3320

| DESIGN LEVELS 3D PERSPECTIVE |   | JOB-DRAWING No. | REVISION |
|------------------------------|---|-----------------|----------|
| SCALE:                       | NOT TO SCALE<br>ORIGINAL SHEET SIZE: A1 | 1056-202        | A        |
| STATUS:                      | CONSENTING                              |                 |          |



**LEGEND:**

- 4.5.0——— MAJOR CONTOURS (0.5m CONTOURS)
- 4.2.5----- MINOR CONTOURS (0.1m CONTOURS)
- INTEGRAL FENCE/RETAINING
- [0.3] PROPOSED RETAINING HEIGHTS

TOTAL EARTHWORKS AREA = 1,470m<sup>2</sup>  
 BULK IN-SITU CUT = 99m<sup>3</sup>  
 BULK IN-SITU FILL = 96m<sup>3</sup>

Surface Analysis:  
 Elevation Ranges

| Number | Color | Minimum Elevation (m) | Maximum Elevation (m) |
|--------|-------|-----------------------|-----------------------|
| 1      | Red   | -0.800                | -0.700                |
| 2      | Red   | -0.700                | -0.600                |
| 3      | Red   | -0.600                | -0.500                |
| 4      | Red   | -0.500                | -0.400                |
| 5      | Red   | -0.400                | -0.300                |
| 6      | Red   | -0.300                | -0.200                |
| 7      | Red   | -0.200                | -0.100                |
| 8      | Red   | -0.100                | 0.000                 |
| 9      | Green | 0.000                 | 0.100                 |
| 10     | Green | 0.100                 | 0.200                 |
| 11     | Green | 0.200                 | 0.300                 |
| 12     | Green | 0.300                 | 0.400                 |
| 13     | Green | 0.400                 | 0.500                 |

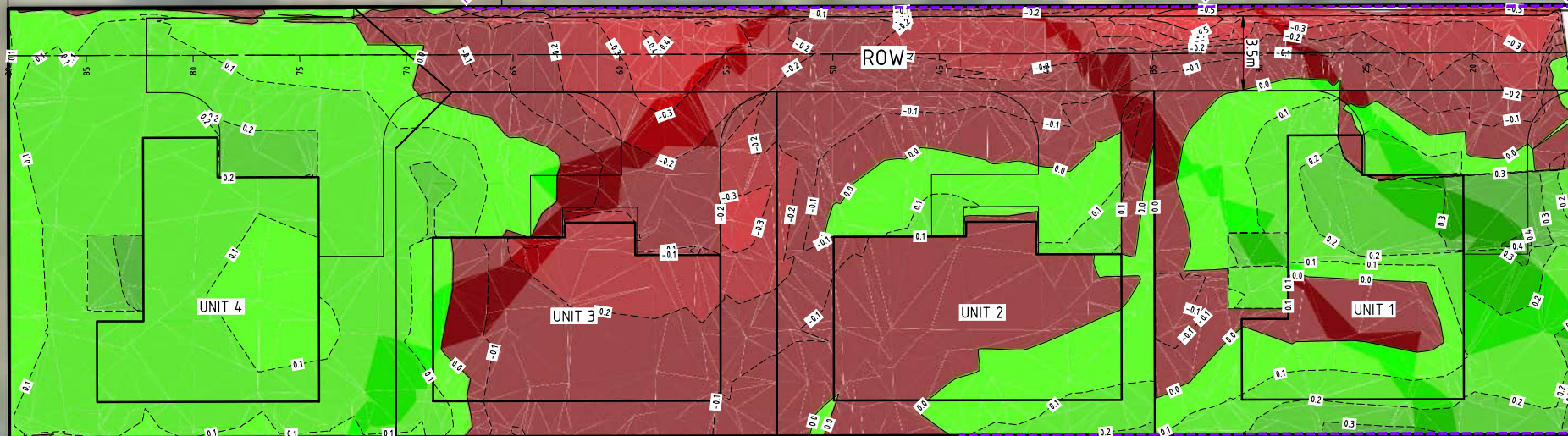
↑ FILL ↓ CUT

LOT 3  
DPS 85778

RAILWAY RESERVE

LOT 5  
DP 425692

LOT 10  
DP 9205



UNIT 4

UNIT 3

UNIT 2

UNIT 1

ROW

LOT 2  
DP 446417

LOT 1  
DP 446417

LOT 1  
DP 432677

KENRICK STREET

EXISTING VEHICLE CROSSING AND DRIVEWAY TO BE RETAINED FOR BULK EARTHWORKS

EXISTING SURVEY BENCHMARK RL 13.25m (NZVD 2016)

INTEGRAL RETAINING ON BOUNDARY FENCE TO MAX 0.4m HEIGHT. REFER SECTIONS ON LAYOUTS 24.0-24.2 FOR DETAILS.

CONCRETE FOOTPATH

DRAFT FOR CO-ORDINATION

**Sustain R**

027 724 5260  
 Sustainr@gmail.com  
 PO Box 228, RAGLAN, NEW ZEALAND - 3265

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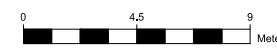
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 1) SITE SURVEY LEVELS COURTESY OF ELEVATIONS SURVEYORS LTD.

CLIENT: KENWYN TRUST

PROJECT: 70 KENRICK STREET,  
 TE AROHA,  
 3320

**EARTHWORKS PLAN**

SCALE: 1:150(A1) / 1:300(A3)  
 ORIGINAL SHEET SIZE: A1  
 STATUS: CONSENTING



JOB-DRAWING No.

1056-210

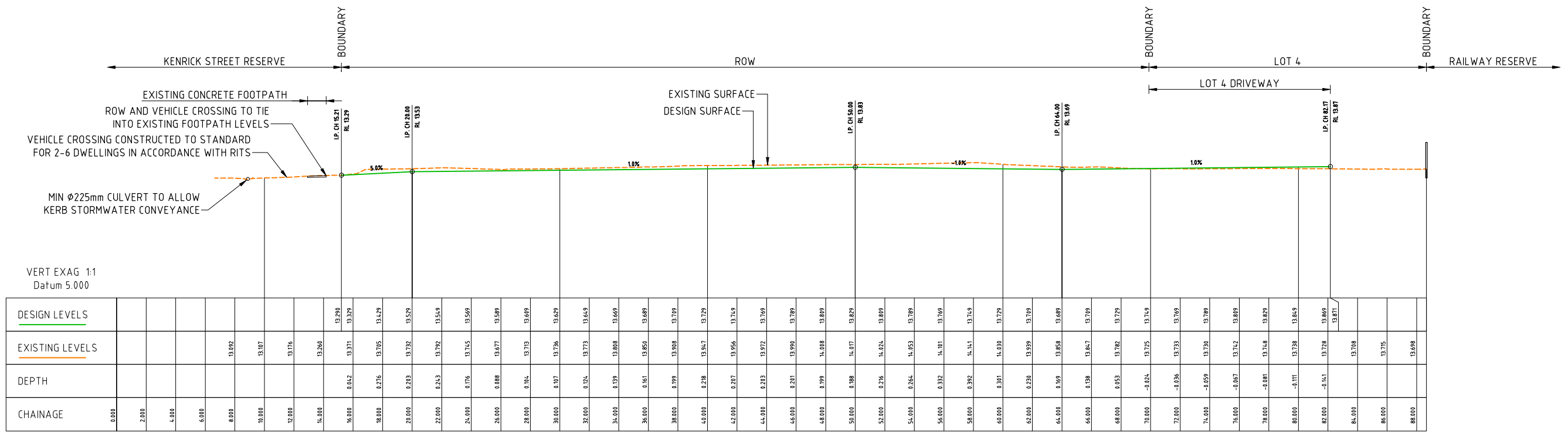
REVISION

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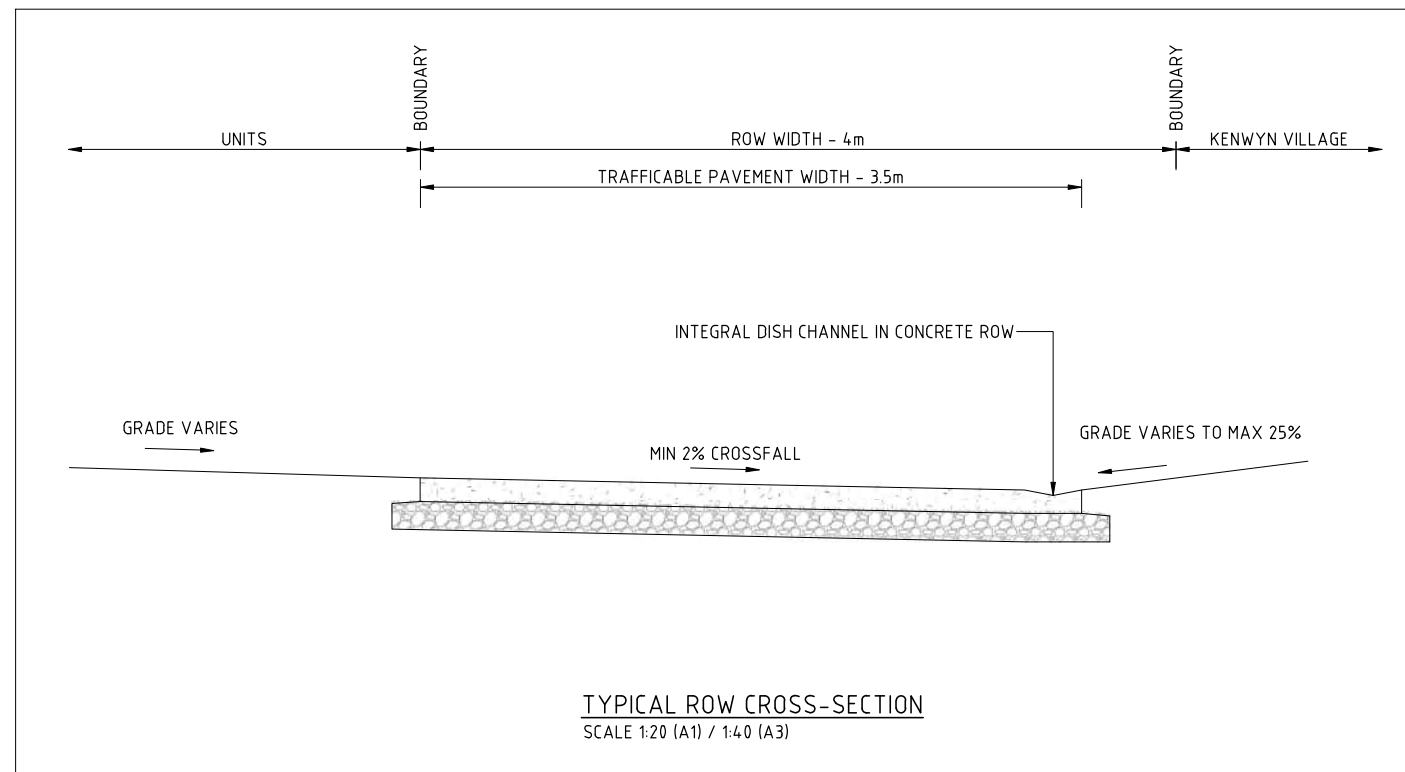








ROW LONG SECTION



**DRAFT FOR CO-ORDINATION**

**Sustain R**  
027 724 5260  
Sustainr@gmail.com  
PO Box 228, RAGLAN, NEW ZEALAND - 3265

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NOTES:

CLIENT: KENWYN TRUST

PROJECT: 70 KENRICK STREET, TE AROHA, 3320

**ROW PROFILE**

SCALE: 1:150(A1) / 1:300(A3)  
ORIGINAL SHEET SIZE: A1

STATUS: CONSENTING

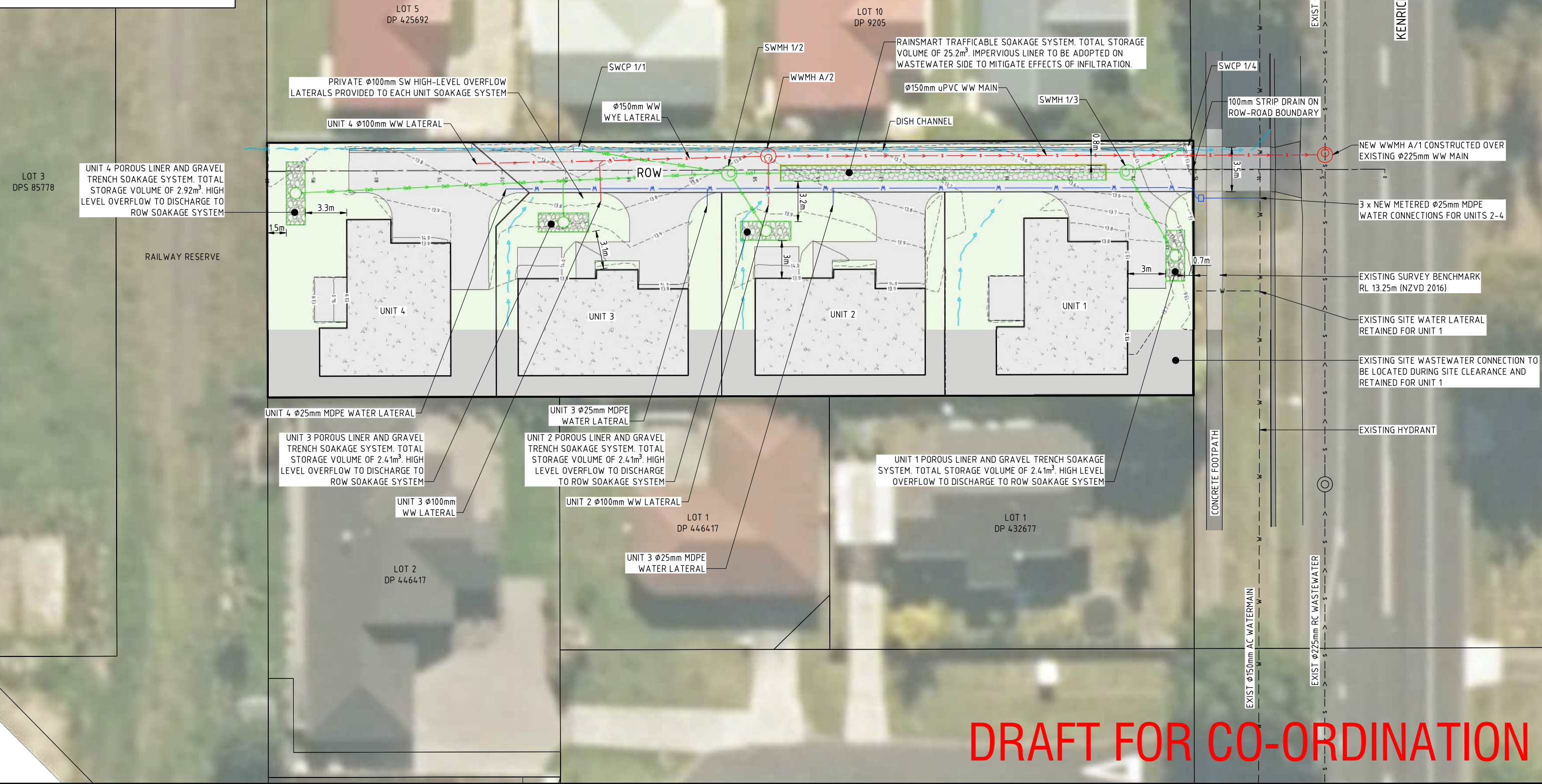
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REVISION **A**



**LEGEND:**

- 4.5.0 — MAJOR CONTOURS (0.5m CONTOURS)
- - - 4.2.5 - - - MINOR CONTOURS (0.1m CONTOURS)
- SWD —> PROPOSED STORMWATER
- S —> PROPOSED WASTEWATER
- W —> PROPOSED WATER
- - - SWD - - -> EXISTING STORMWATER
- - - S - - -> EXISTING WASTEWATER
- - - W - - -> EXISTING WATER
- ~ ~ ~ SECONDARY SURFACE FLOWS
- IMPERVIOUS LINER



DRAFT FOR CO-ORDINATION

**Sustain R**

027 724 5260  
 Sustainr@gmail.com  
 PO Box 228, RAGLAN, NEW ZEALAND - 3265

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| Rev. | AMENDMENT DESCRIPTION | DATE       |
|------|-----------------------|------------|
| A    | ORIGINAL RELEASE      | 05/09/2023 |
|      |                       |            |
|      |                       |            |
|      |                       |            |

**NOTES:**

1) SITE SURVEY LEVELS COURTESY OF ELEVATIONS SURVEYORS LTD.

**CLIENT:** KENWYN TRUST

**PROJECT:** 70 KENRICK STREET, TE AROHA, 3320

**DESIGN LEVELS AND ACCESS PLAN**

SCALE: 1:150(A1) / 1:300(A3) ORIGINAL SHEET SIZE: A1

STATUS: CONSENTING




JOB-DRAWING No. **1056-400** REVISION **A**

# APPENDIX B – SITE PLAN AND INVESTIGATION DATA





**LEGEND**

- Hand auger (HA) 
- Cone penetration test (CPT) 
- Hand auger (HA) - February 2023 

**PROJECT:** 70 Kenrick Street, Te Aroha

**PROJECT No:** HD2771-1

**CLIENT:** Kenwyn Trust

**TITLE:** Site investigation plan

**SCALE:** N/A

**Drawing No:** 01

**Drawing By:** RR

**Rev no:**

|   |            |
|---|------------|
| - | 04.10.2023 |
|   |            |
|   |            |






# INVESTIGATION LOG

Job No.: HD2771  
 No.: HA01  
 Date: 15.02.23  
 Logged By: TD  
 Checked By: RR

Client: Kenwyn Trust  
 Project: 70 Kenrick Street, Te Aroha  
 Location: Alongside driveway of existing house.  
 Co-ordinates: 1838855mE, 5840830mN  
 Elevation: Ground

| Geology           | Geological Interpretation<br><small>(refer to separate Geotechnical and Geological Information sheet for further information)</small> | Depth (m)   | Legend | Scala Penetrometer<br><small>(Blows / 100 mm)</small> | Vane Shear Strength (kPa)<br><small>Vane: 2108</small> | Water |
|-------------------|---|-------------|--------|---|--|-------|
|                   |   |             |        | 2 4 6 8 10 12 14 16 18                                | 50 100 150 200 250                                     |       |
| Topsoil           | TOPSOIL; dark brown. Stiff; moist, moderately sensitive.  | 0.2         | TS     |   | 69   |       |
| Hinuera Formation | Silty CLAY; light brown. Hard; moist; high plasticity.  | 0.4         | x      |   | 18   |       |
|                   | Sandy SILT; light grey. Medium dense to dense; moist; sand, fine.   | 0.6         | x      | 6   | 209+   |       |
|                   |   | 0.8         | x      | 4   |  |       |
|                   |   | 1.0         | x      | 7   |  |       |
|                   |   | 1.2         | x      | 7   |  |       |
|                   |   | 1.4         | x      | 6   |  |       |
|                   |   | 1.6         | x      | 9   |  |       |
|                   |   | 1.8         | x      | 9   |  |       |
|                   |   | 2.0         | x      | 7   |  |       |
|                   |   | 2.2         | x      | 7   |  |       |
|                   |   | 2.4         | x      | 6   |  |       |
|                   |   | 2.6         | x      | 7   | 11   |       |
|                   |   | 2.8         | x      | 9   | 16   |       |
|                   |   | 3.0         | x      | 12  | 13   |       |
|                   |   | EOH: 3.00 m |        |   | 16   |       |
|                   |   |             |        | 13  |  |       |

Groundwater Not Encountered

| Photo  | Remarks   |  |  |  |
|--|---|--|--|--|
|                    | <p>End of log at 3.0m. Target depth.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%; border: none;"> <b>Shear Vanes</b><br/> <input type="checkbox"/> Peak<br/> <input checked="" type="checkbox"/> Remoulded         </td> <td style="width: 33%; border: none;"> <b>Water</b><br/> <input type="checkbox"/> Standing Water Level<br/> <input type="checkbox"/> Out flow<br/> <input type="checkbox"/> In flow         </td> <td style="width: 33%; border: none;"> <b>Investigation Type</b><br/> <input checked="" type="checkbox"/> Hand Auger<br/> <input type="checkbox"/> Investigation Pit<br/> <input type="checkbox"/> Machine Borehole         </td> </tr> </table> | <b>Shear Vanes</b><br><input type="checkbox"/> Peak<br><input checked="" type="checkbox"/> Remoulded   | <b>Water</b><br><input type="checkbox"/> Standing Water Level<br><input type="checkbox"/> Out flow<br><input type="checkbox"/> In flow | <b>Investigation Type</b><br><input checked="" type="checkbox"/> Hand Auger<br><input type="checkbox"/> Investigation Pit<br><input type="checkbox"/> Machine Borehole |
| <b>Shear Vanes</b><br><input type="checkbox"/> Peak<br><input checked="" type="checkbox"/> Remoulded | <b>Water</b><br><input type="checkbox"/> Standing Water Level<br><input type="checkbox"/> Out flow<br><input type="checkbox"/> In flow  | <b>Investigation Type</b><br><input checked="" type="checkbox"/> Hand Auger<br><input type="checkbox"/> Investigation Pit<br><input type="checkbox"/> Machine Borehole |  |  |






# INVESTIGATION LOG

**Job No.:** HD2771  
**No.:** HA02  
**Date:** 15.02.23  
**Logged By:** TD  
**Checked By:** RR

**Client:** Kenwyn Trust  
**Project:** 70 Kenrick Street, Te Aroha  
**Location:** In the middle of the backyard.  
**Co-ordinates:** 1838824mE, 5840849mN  
**Elevation:** Ground

| Geology           | Geological Interpretation<br><small>(refer to separate Geotechnical and Geological Information sheet for further information)</small>           | Depth (m) | Legend | Scala Penetrometer<br><small>(Blows / 100 mm)</small> | Vane Shear Strength (kPa)<br><small>Vane: 2108</small> | Water |
|-------------------|---|-----------|--------|---|--|-------|
|                   |   |           |        | 2 4 6 8 10 12 14 16 18                                | 50 100 150 200 250                                     |       |
| Topsoil           | TOPSOIL; dark brown. Moist.   | 0.0 - 0.2 | TS     |   |  |       |
| Hinuera Formation | SILT, with some clay, with trace sand; brown. Stiff to very stiff; moist; high plasticity, extra sensitive to moderately sensitive; sand, fine. | 0.2 - 1.2 | X      |   | 77<br>18:<br>149<br>18:                                |       |
|                   | SILT, with minor clay; light grey. Very stiff to hard; moist; low plasticity, moderately sensitive to sensitive.                                | 1.2 - 1.8 | X      |   | 113:<br>42   |       |
|                   | Sandy SILT; light brownish grey. Medium dense to dense; moist; sand, fine.  | 1.8 - 2.0 | X      | 6   |  |       |
|                   |   | 2.0 - 2.2 | X      | 6<br>5  |  |       |
|                   |   | 2.2 - 2.4 | X      | 8<br>5  |  |       |
|                   | SAND; grey. Dense; moist; sand, fine to coarse.   | 2.4 - 3.0 | X      | 10<br>8<br>7<br>9<br>12<br>11<br>9                    |  | 209   |
|                   | EOH: 3.00 m   | 3.0       |        |   |  |       |

Groundwater Not Encountered

| Photo   | Remarks  |   |              |                           |   |   |   |
|---|--|---|--------------|---------------------------|---|---|---|
|   | End of log at 3.0m. Target depth. <div style="margin-top: 20px;"> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;"><b>Shear Vanes</b></td> <td style="width: 33%;"><b>Water</b></td> <td style="width: 33%;"><b>Investigation Type</b></td> </tr> <tr> <td> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: black; margin-right: 5px;"></span> Peak</li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> Remoulded</li> </ul> </td> <td> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border-bottom: 2px solid black; margin-right: 5px;"></span> Standing Water Level</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-left: 2px solid black; margin-right: 5px;"></span> Out flow</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-right: 2px solid black; margin-right: 5px;"></span> In flow</li> </ul> </td> <td> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Hand Auger</li> <li><input type="checkbox"/> Investigation Pit</li> <li><input type="checkbox"/> Machine Borehole</li> </ul> </td> </tr> </table> </div> | <b>Shear Vanes</b>  | <b>Water</b> | <b>Investigation Type</b> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: black; margin-right: 5px;"></span> Peak</li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> Remoulded</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border-bottom: 2px solid black; margin-right: 5px;"></span> Standing Water Level</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-left: 2px solid black; margin-right: 5px;"></span> Out flow</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-right: 2px solid black; margin-right: 5px;"></span> In flow</li> </ul> | <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Hand Auger</li> <li><input type="checkbox"/> Investigation Pit</li> <li><input type="checkbox"/> Machine Borehole</li> </ul> |
| <b>Shear Vanes</b>  | <b>Water</b>   | <b>Investigation Type</b>   |              |                           |   |   |   |
| <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: black; margin-right: 5px;"></span> Peak</li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> Remoulded</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border-bottom: 2px solid black; margin-right: 5px;"></span> Standing Water Level</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-left: 2px solid black; margin-right: 5px;"></span> Out flow</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-right: 2px solid black; margin-right: 5px;"></span> In flow</li> </ul>  | <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Hand Auger</li> <li><input type="checkbox"/> Investigation Pit</li> <li><input type="checkbox"/> Machine Borehole</li> </ul> |              |                           |   |   |   |





# INVESTIGATION LOG

Job No.: HD2771  
 No.: HA03  
 Date: 15.02.23  
 Logged By: SW  
 Checked By: RR

Client: Kenwyn Trust  
 Project: 70 Kenrick Street, Te Aroha  
 Location: In the middle of section behind the house.  
 Co-ordinates: 1838814mE, 5840867mN  
 Elevation: Ground

| Geology           | Geological Interpretation<br><small>(refer to separate Geotechnical and Geological Information sheet for further information)</small>   | Depth (m) | Legend | Scala Penetrometer<br><small>(Blows / 100 mm)</small> |   | Vane Shear Strength (kPa)<br><small>Vane: 2108</small> |   |    |    |    | Water |    |    |    |     |     |     |     |
|-------------------|---|-----------|--------|---|---|--|---|----|----|----|-------|----|----|----|-----|-----|-----|-----|
|                   |   |           |        | 2   | 4 | 6  | 8 | 10 | 12 | 14 |       | 16 | 18 | 50 | 100 | 150 | 200 | 250 |
| Top soil          | TOPSOIL; brown. Moist.  |           |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
| Hinuera Formation | SILT, with some clay; brown. Moist; low to moderate plasticity.   | 0.2       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   | SILT, with minor clay and sand; light greyish brown streaked orange. Very stiff; moist; low plasticity, sensitive; sand, fine.          | 0.4       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   | SILT, with some sand, with trace clay; light brown. Very stiff; moist to wet; low plasticity, extra sensitive to sensitive; sand, fine. | 0.6       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   | Sandy SILT, with trace clay; grey. Very stiff; wet; low plasticity, sensitive; sand, fine.  | 1.0       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   | Silty SAND; grey. Medium dense to dense; wet; sand, fine.   | 1.4       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   |   | 1.6       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   |   | 1.8       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   |   | 2.0       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   |   | 2.2       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   | SAND; dark grey & black. Dense; wet; sand, fine to coarse.<br><br>2.4 m: turns grey   | 2.4       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   | 2.6   |           |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
|                   | 2.8   |           |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |
| EOH: 3.00 m       | 3.0   |           |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |

Groundwater Not Encountered

**Photo**

**Remarks**



End of HA at 3.0m - Target depth achieved.

|                                    |   |  |
|------------------------------------|---|--|
| <b>Shear Vanes</b>                 | <b>Water</b>                                  | <b>Investigation Type</b>                      |
| <input type="checkbox"/> Peak      | <input type="checkbox"/> Standing Water Level | <input checked="" type="checkbox"/> Hand Auger |
| <input type="checkbox"/> Remoulded | <input type="checkbox"/> Out flow             | <input type="checkbox"/> Investigation Pit     |
|                                    | <input type="checkbox"/> In flow              | <input type="checkbox"/> Machine Borehole      |



# INVESTIGATION LOG

**Job No.:** HD2771  
**No.:** HA04  
**Date:** 29.09.23  
**Logged By:** SW/TD  
**Checked By:** RR

**Client:** Kenwyn Trust  
**Project:** 70 Kenrick Street, Te Aroha  
**Location:** Proposed Unit 1, west.  
**Co-ordinates:** 1838843mE, 5840824mN  
**Elevation:** Ground

| Geology           | Geological Interpretation<br><small>(refer to separate Geotechnical and Geological Information sheet for further information)</small>         | Depth (m) | Legend | Scala Penetrometer<br><small>(Blows / 100 mm)</small> | Vane Shear Strength (kPa)<br><small>Vane: 3719</small> | Water |
|-------------------|---|-----------|--------|---|--|-------|
|                   |   |           |        | 2 4 6 8 10 12 14 16 18                                | 50 100 150 200 250                                     |       |
| Topsoil           | TOPSOIL; dark brown. Dry.   | 0.2       | TS     |   | 220+   |       |
| Hinuera Formation | SILT, with minor sand, with trace clay; brown. Hard to stiff; moist; low plasticity, moderately sensitive; sand, fine.                        | 0.4       | X      |   | 69   |       |
|                   | SILT, with some sand, with trace clay; grey. Hard to very stiff; moist; low to moderate plasticity, extra sensitive to sensitive; sand, fine. | 0.6       | X      |   | 22   |       |
|                   | SILT, with some sand, with trace clay; grey. Hard to very stiff; moist; low to moderate plasticity, extra sensitive to sensitive; sand, fine. | 0.8       | X      |   | 204  |       |
|                   | SILT, with some sand, with trace clay; grey. Hard to very stiff; moist; low to moderate plasticity, extra sensitive to sensitive; sand, fine. | 1.0       | X      |   | 22   |       |
|                   | Sandy SILT; light brown. Very stiff; wet; non-plastic, sensitive; sand, fine.   | 1.2       | X      |   | 157  |       |
|                   | SAND, with trace gravel; light brown. Medium dense to dense; wet; sand, fine to coarse; gravel, fine to medium, subangular, pumice.           | 1.4       | S      | 8   |  |       |
|                   | SAND, with trace gravel; light brown. Medium dense to dense; wet; sand, fine to coarse; gravel, fine to medium, subangular, pumice.           | 1.6       | S      | 6   |  |       |
|                   | SAND, with trace gravel; light brown. Medium dense to dense; wet; sand, fine to coarse; gravel, fine to medium, subangular, pumice.           | 1.8       | S      | 7   |  |       |
|                   | SAND, with trace gravel; light brown. Medium dense to dense; wet; sand, fine to coarse; gravel, fine to medium, subangular, pumice.           | 2.0       | S      | 6   |  |       |
|                   | SAND, with trace gravel; light brown. Medium dense to dense; wet; sand, fine to coarse; gravel, fine to medium, subangular, pumice.           | 2.2       | S      | 6   |  |       |
|                   | 2.4   | S         | 7      |   |  |       |
|                   | 2.6   | S         | 6      |   |  |       |
|                   | 2.8   | S         | 7      |   |  |       |
|                   | 3.0   | S         | 10     |   |  |       |
|                   | EOH: 3.00 m   | 3.0       | 11     |   |  |       |

Groundwater Not Encountered

### Photo



### Remarks

End of log at 3.0m. Target depth.

| Shear Vanes  | Water  | Investigation Type  |
|--|--|---|
| <input checked="" type="checkbox"/> Peak<br><input type="checkbox"/> Remoulded | <input type="checkbox"/> Standing Water Level<br><input type="checkbox"/> Out flow<br><input type="checkbox"/> In flow | <input checked="" type="checkbox"/> Hand Auger<br><input type="checkbox"/> Investigation Pit<br><input type="checkbox"/> Machine Borehole |





# INVESTIGATION LOG

Job No.: HD2771  
 No.: HA06  
 Date: 29.09.23  
 Logged By: SW/TD  
 Checked By: RR

Client: Kenwyn Trust  
 Project: 70 Kenrick Street, Te Aroha  
 Location: Proposed Unit 2, west.  
 Co-ordinates: 1838829mE, 5840839mN  
 Elevation: Ground

| Geology           | Geological Interpretation<br><small>(refer to separate Geotechnical and Geological Information sheet for further information)</small> | Depth (m) | Legend | Scala Penetrometer<br><small>(Blows / 100 mm)</small> |   | Vane Shear Strength (kPa)<br><small>Vane: 3719</small> |   |    |    |    | Water |    |    |    |     |     |     |     |  |  |  |  |  |  |
|-------------------|---|-----------|--------|---|---|--|---|----|----|----|-------|----|----|----|-----|-----|-----|-----|--|--|--|--|--|--|
|                   |   |           |        | 2   | 4 | 6  | 8 | 10 | 12 | 14 |       | 16 | 18 | 50 | 100 | 150 | 200 | 250 |  |  |  |  |  |  |
| Topsoil           | TOPSOIL; dark blackish brown. Moist.  | 0.0 - 0.2 | TS     |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |  |  |  |  |  |  |
| Hinuera Formation | SILT, with minor sand; brown. Stiff to hard; moist to wet, sensitive to insensitive; sand, fine.                                      | 0.2 - 1.1 | TS     |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |  |  |  |  |  |  |
|                   | 0.8 m: Trace gravel<br><br>1.1 m - 1.2 m: SILT, with some sand; grey. Wet; sand, fine.  | 1.1 - 1.2 | TS     |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |  |  |  |  |  |  |
|                   | SAND, with minor gravel, with trace silt; grey. Dense; wet; well graded; sand, fine to coarse; gravel, fine, subround, pumice.        | 1.2 - 3.0 | TS     |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |  |  |  |  |  |  |
|                   | EOH: 3.00 m   | 3.0       |        |   |   |  |   |    |    |    |       |    |    |    |     |     |     |     |  |  |  |  |  |  |

| Photo                              | Remarks   |  |              |                           |                               |   |  |                                    |                                   |  |  |                                  |   |
|------------------------------------|---|--|--------------|---------------------------|-------------------------------|---|--|------------------------------------|-----------------------------------|--|--|----------------------------------|---|
|                                    | <p>End of log at 3.0m. Target depth.</p> <table border="0"> <tr> <td><b>Shear Vanes</b></td> <td><b>Water</b></td> <td><b>Investigation Type</b></td> </tr> <tr> <td><input type="checkbox"/> Peak</td> <td><input type="checkbox"/> Standing Water Level</td> <td><input checked="" type="checkbox"/> Hand Auger</td> </tr> <tr> <td><input type="checkbox"/> Remoulded</td> <td><input type="checkbox"/> Out flow</td> <td><input type="checkbox"/> Investigation Pit</td> </tr> <tr> <td></td> <td><input type="checkbox"/> In flow</td> <td><input type="checkbox"/> Machine Borehole</td> </tr> </table> | <b>Shear Vanes</b>                             | <b>Water</b> | <b>Investigation Type</b> | <input type="checkbox"/> Peak | <input type="checkbox"/> Standing Water Level | <input checked="" type="checkbox"/> Hand Auger | <input type="checkbox"/> Remoulded | <input type="checkbox"/> Out flow | <input type="checkbox"/> Investigation Pit |  | <input type="checkbox"/> In flow | <input type="checkbox"/> Machine Borehole |
| <b>Shear Vanes</b>                 | <b>Water</b>  | <b>Investigation Type</b>                      |              |                           |                               |   |  |                                    |                                   |  |  |                                  |   |
| <input type="checkbox"/> Peak      | <input type="checkbox"/> Standing Water Level   | <input checked="" type="checkbox"/> Hand Auger |              |                           |                               |   |  |                                    |                                   |  |  |                                  |   |
| <input type="checkbox"/> Remoulded | <input type="checkbox"/> Out flow   | <input type="checkbox"/> Investigation Pit     |              |                           |                               |   |  |                                    |                                   |  |  |                                  |   |
|                                    | <input type="checkbox"/> In flow  | <input type="checkbox"/> Machine Borehole      |              |                           |                               |   |  |                                    |                                   |  |  |                                  |   |



# INVESTIGATION LOG

**Job No.:** HD2771  
**No.:** HA07  
**Date:** 29.09.23  
**Logged By:** SW/TD  
**Checked By:** RR

**Client:** Kenwyn Trust  
**Project:** 70 Kenrick Street, Te Aroha  
**Location:** Proposed Unit 3, west.  
**Co-ordinates:** 1838817mE, 5840854mN  
**Elevation:** Ground

| Geology   | Geological Interpretation<br><small>(refer to separate Geotechnical and Geological Information sheet for further information)</small>             | Depth (m) | Legend                  | Scala Penetrometer<br><small>(Blows / 100 mm)</small> | Vane Shear Strength (kPa)<br><small>Vane: 3719</small> | Water |
|---|---|-----------|-------------------------|---|--|-------|
| Topsoil   | TOPSOIL; dark blackish brown; moist.  | 0.0 - 0.2 | TS                      |   |  |       |
| Hinuera Formation   | SILT, with minor sand, with trace clay; light grey. Stiff to very stiff; moist; low to moderate plasticity, insensitive to sensitive; sand, fine. | 0.2 - 0.4 | [Cross-hatched pattern] |   | 75   |       |
|   |   | 0.4 - 0.6 |                         |   | 141  |       |
|   |   | 0.6 - 0.8 |                         |   | 160  |       |
|   |   | 0.8 - 1.0 |                         |   | 138  |       |
|   |   | 1.0 - 1.2 |                         |   | 22   |       |
|   | SAND, with minor silt; light grey. Dense; moist; uniformly graded; sand, fine.  | 1.2 - 1.4 |                         | 8   |  |       |
|   |   | 1.4 - 1.6 |                         | 8   |  |       |
|   |   | 1.6 - 1.8 |                         | 9   |  |       |
|   |   | 1.8 - 2.0 |                         | 8   |  |       |
|   |   | 2.0 - 2.2 |                         | 9   |  |       |
| SAND, with minor gravel; light grey. Dense; moist; well graded; sand, fine to medium; gravel, fine, subround, pumice. | 2.2 - 2.4   |           | 9                       |   |  |       |
|   | 2.4 - 2.6   |           | 11                      |   |  |       |
|   | 2.6 - 2.8   |           | 9                       |   |  |       |
|   | 2.8 - 3.0   |           | 8                       |   |  |       |
|   | 3.0 - 3.2   |           | 10                      |   |  |       |
|   | EOH: 3.0 m  | 3.0       |                         |   |  |       |

Groundwater Not Encountered

### Photo

### Remarks



End of log at 3.0m. Target depth.

#### Shear Vanes

- Peak
- Remoulded

#### Water

- Standing Water Level
- Out flow
- In flow

#### Investigation Type

- Hand Auger
- Investigation Pit
- Machine Borehole





# INVESTIGATION LOG

**Job No.:** HD2771  
**No.:** HA08  
**Date:** 29.09.23  
**Logged By:** SW/TD  
**Checked By:** RR

**Client:** Kenwyn Trust  
**Project:** 70 Kenrick Street, Te Aroha  
**Location:** Proposed Unit 4, west.  
**Co-ordinates:** 1838806mE, 5840864mN  
**Elevation:** Ground

| Geology           | Geological Interpretation<br><small>(refer to separate Geotechnical and Geological Information sheet for further information)</small> | Depth (m) | Legend    | Scala Penetrometer<br><small>(Blows / 100 mm)</small> | Vane Shear Strength<br><small>(kPa)</small><br><small>Vane: 3719</small> | Water |  |
|-------------------|---|-----------|-----------|---|--|-------|--|
| Top soil          | TOPSOIL; dark brown. Moist.   | 0.0 - 0.2 | TS        |   | 38   |       |  |
| Hinuera Formation | Sandy SILT; light brown. Stiff to very stiff; moist to wet, moderately sensitive to sensitive; uniformly graded; sand, fine.          | 0.2 - 0.8 | TS        |   | 31   |       |  |
|                   | SILT; light grey. Very stiff to stiff; wet; high dilatency, sensitive to moderately sensitive.  | 0.8 - 1.4 | TS        |   | 25   |       |  |
|                   | SILT, with some sand; light grey. Stiff; wet, moderately sensitive; sand, fine.   | 1.4 - 1.6 | TS        |   | 22   |       |  |
|                   | Silty SAND, with minor gravel; light grey. Medium dense to very dense; wet; sand, fine to medium; gravel, fine, subround, pumice.     | 1.6 - 1.8 | TS        | 5   | 34   |       |  |
|                   | SAND, with trace silt; grey. Dense to very dense; wet; well graded; sand, fine to coarse.   | 1.8 - 2.0 | TS        | 7   | 31   |       |  |
|                   |   | 2.0 - 2.2 | TS        | 9   | 91   |       |  |
|                   | EOH: 3.00 m   |           | 2.2 - 2.4 | TS  | 9  |       |  |
|                   |   |           | 2.4 - 2.6 | TS  | 14   |       |  |
|                   |   |           | 2.6 - 2.8 | TS  | 18   |       |  |
|                   |   |           | 2.8 - 3.0 | TS  | 18   |       |  |
|                   |   |           | TS        | 15  |  |       |  |
|                   |   |           | TS        | 12  |  |       |  |

Groundwater Not Encountered

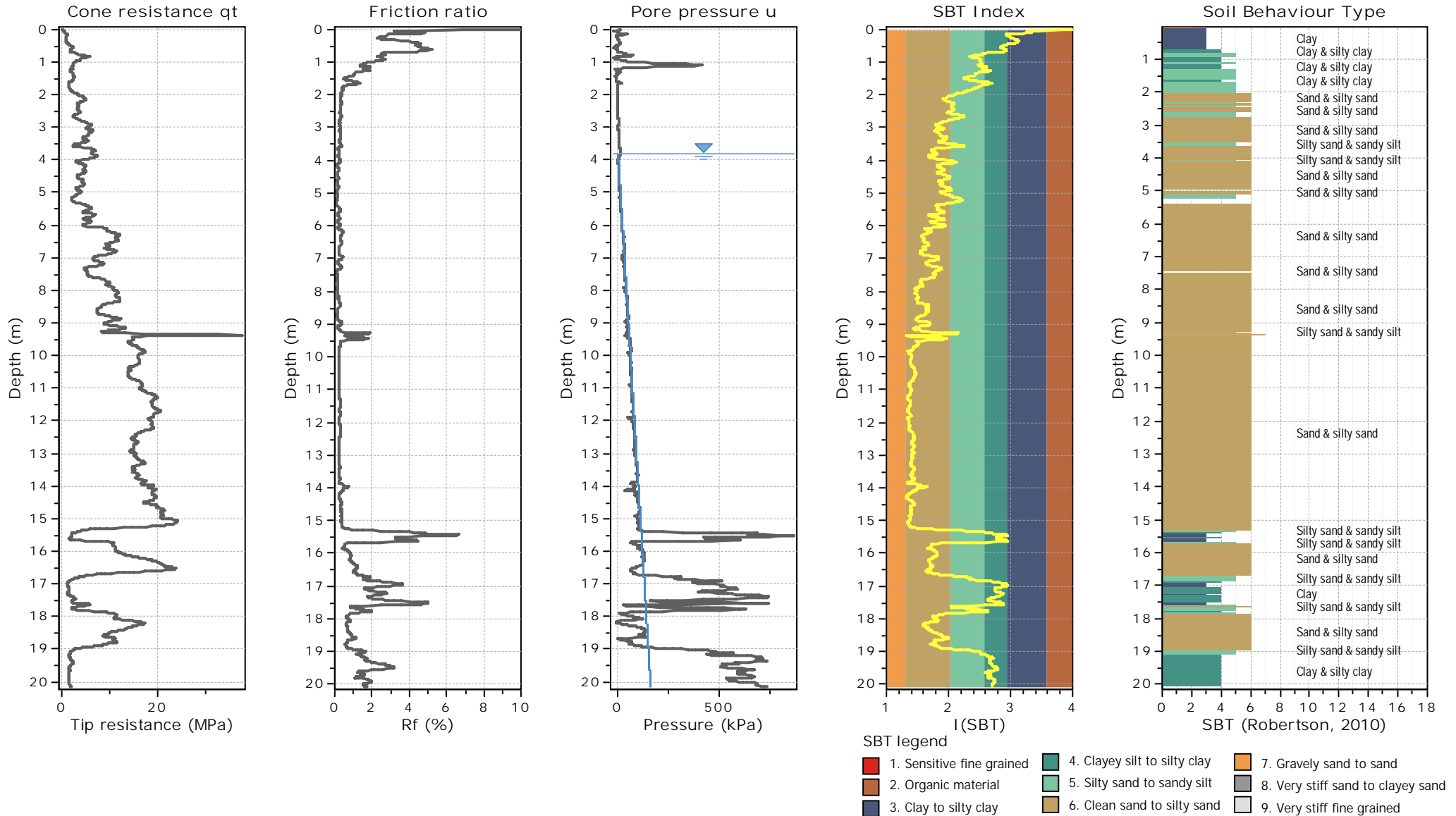
**Photo**

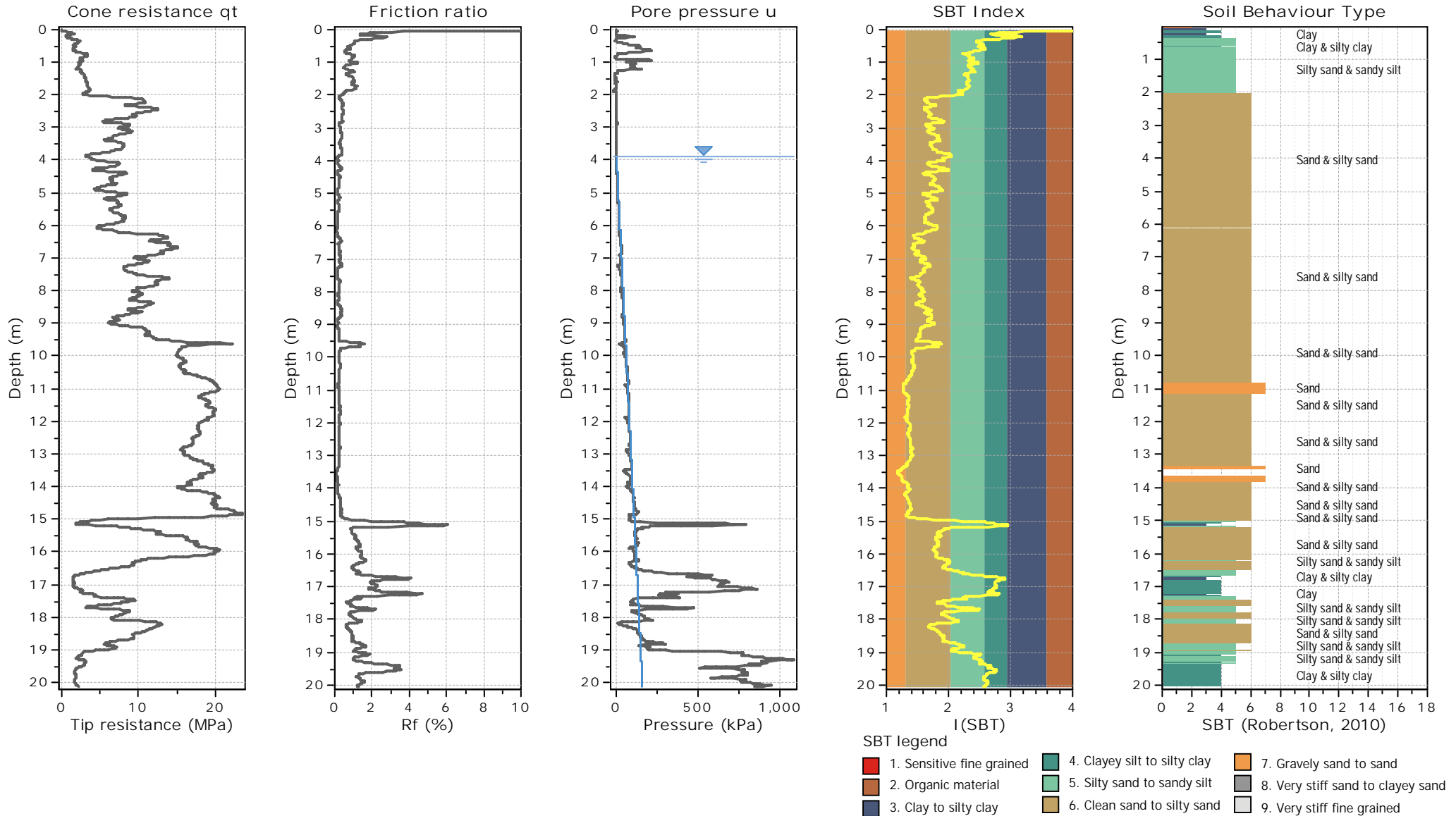
**Remarks**



End of log at 3.0m. Target depth.

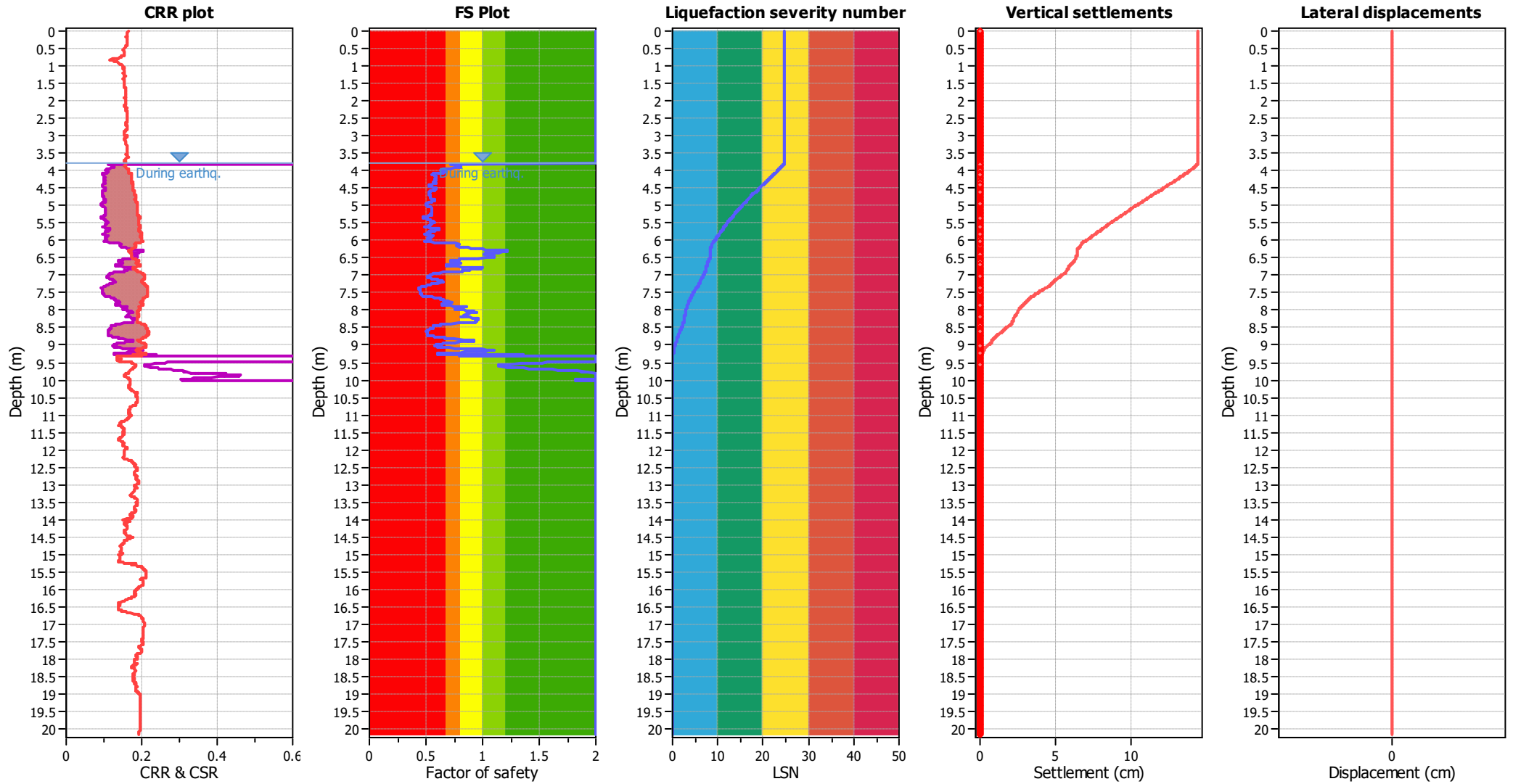
|                                    |   |  |
|------------------------------------|---|--|
| <b>Shear Vanes</b>                 | <b>Water</b>                                  | <b>Investigation Type</b>                      |
| <input type="checkbox"/> Peak      | <input type="checkbox"/> Standing Water Level | <input checked="" type="checkbox"/> Hand Auger |
| <input type="checkbox"/> Remoulded | <input type="checkbox"/> Out flow             | <input type="checkbox"/> Investigation Pit     |
|                                    | <input type="checkbox"/> In flow              | <input type="checkbox"/> Machine Borehole      |





# APPENDIX C – LIQUEFACTION ASSESSMENT

### Liquefaction analysis overall plots



**Input parameters and analysis data**

|                                       |                   |                           |              |                             |            |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|------------|
| Analysis method:                      | B&I (2014)        | Depth to GWT (earthq.):   | 3.80 m       | Fill weight:                | N/A        |
| Fines correction method:              | B&I (2014)        | Average results interval: | 3            | Transition detect. applied: | Yes        |
| Points to test:                       | Based on Ic value | Ic cut-off value:         | 2.60         | K <sub>σ</sub> applied:     | Yes        |
| Earthquake magnitude M <sub>w</sub> : | 5.90              | Unit weight calculation:  | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration:             | 0.30              | Use fill:                 | No           | Limit depth applied:        | Yes        |
| Depth to water table (insitu):        | 3.80 m            | Fill height:              | N/A          | Limit depth:                | 10.00 m    |

**F.S. color scheme**

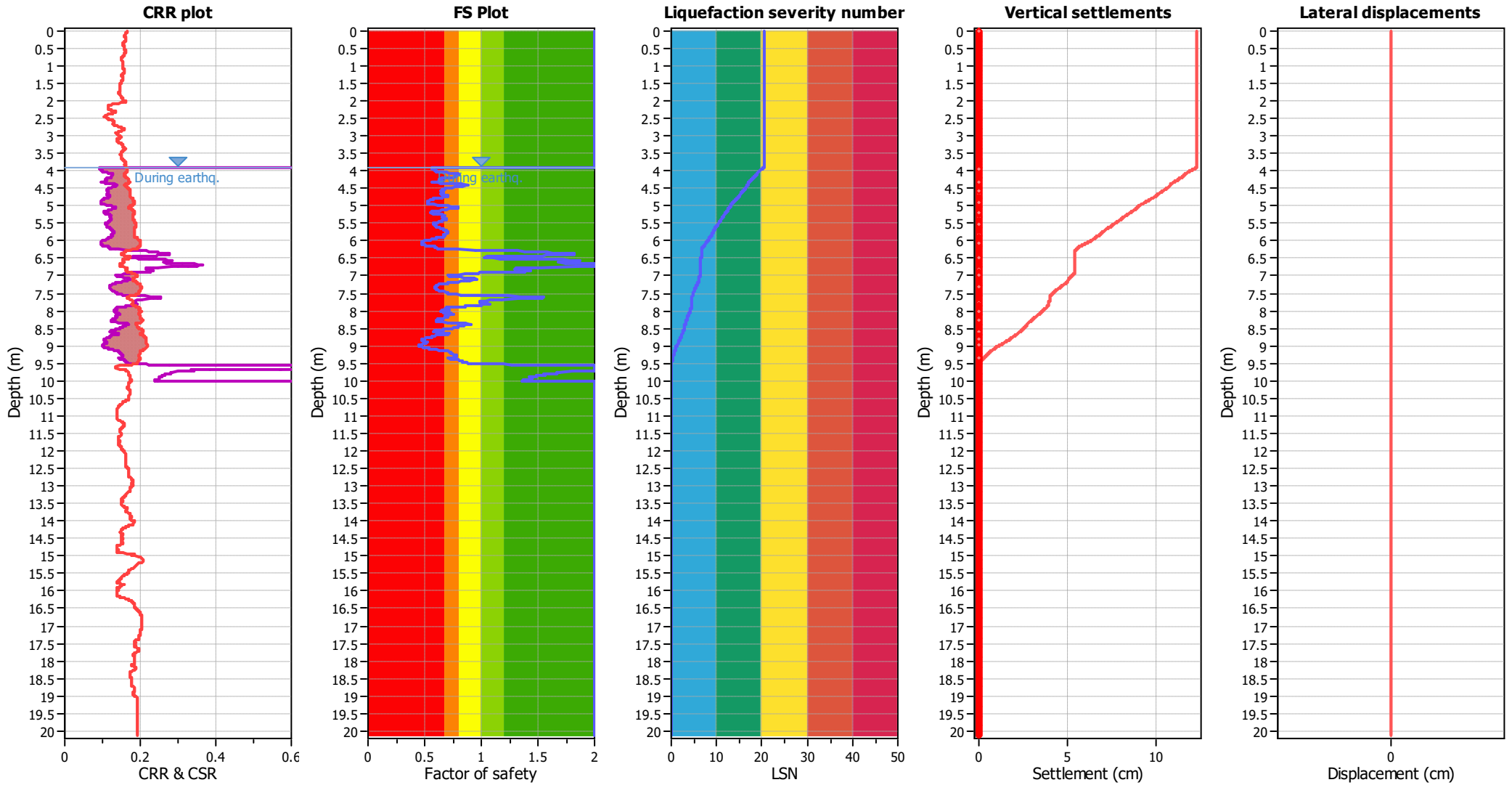
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LSN color scheme**

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



### Liquefaction analysis overall plots



**Input parameters and analysis data**

|                                       |                   |                           |              |                             |            |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|------------|
| Analysis method:                      | B&I (2014)        | Depth to GWT (earthq.):   | 3.90 m       | Fill weight:                | N/A        |
| Fines correction method:              | B&I (2014)        | Average results interval: | 3            | Transition detect. applied: | Yes        |
| Points to test:                       | Based on Ic value | Ic cut-off value:         | 2.60         | K <sub>σ</sub> applied:     | Yes        |
| Earthquake magnitude M <sub>w</sub> : | 5.90              | Unit weight calculation:  | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration:             | 0.30              | Use fill:                 | No           | Limit depth applied:        | Yes        |
| Depth to water table (insitu):        | 3.90 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

**LSN color scheme**

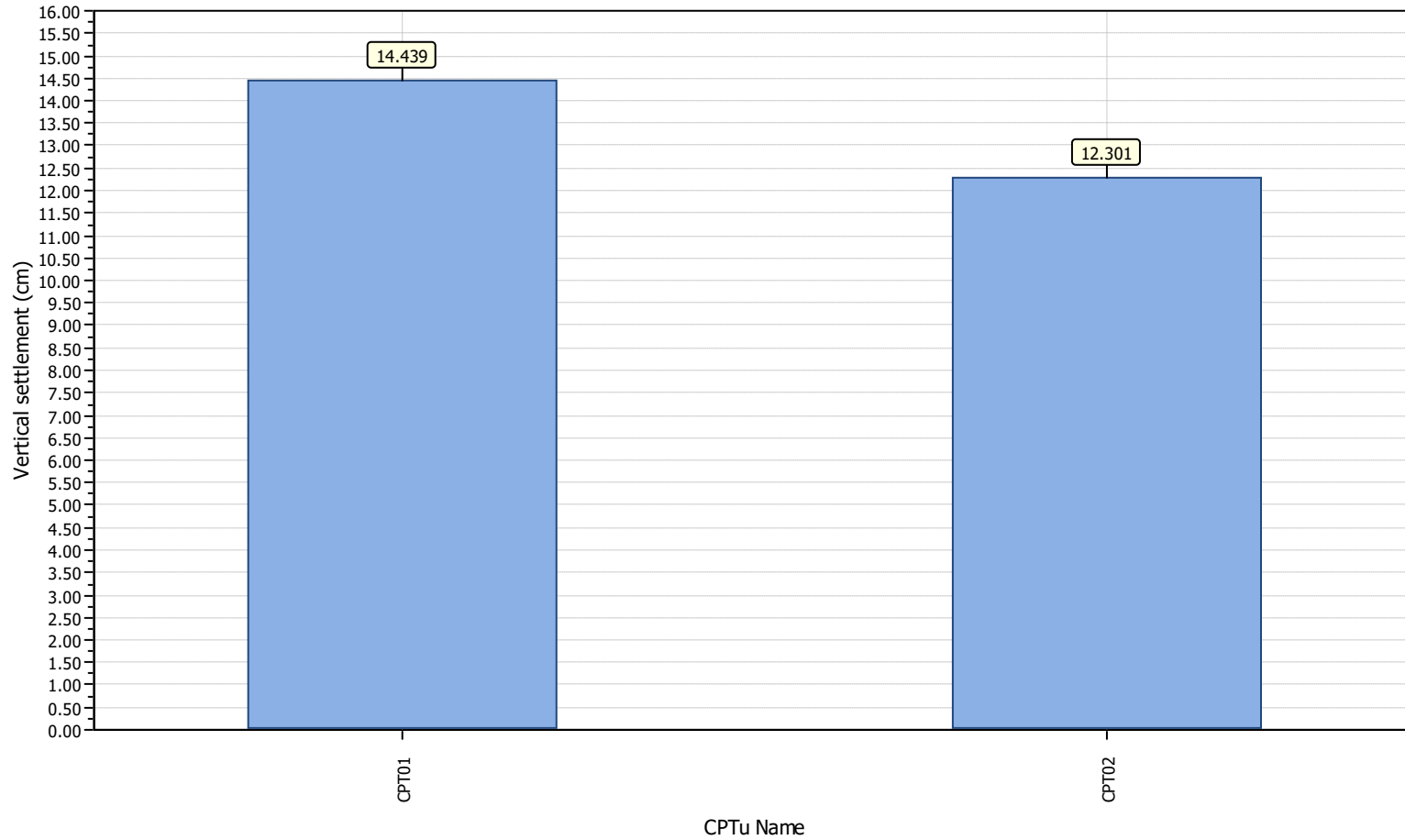
- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction



**Project title : HD2771-1 Kenrick Street**

**Location : Te Aroha**

### Overall vertical settlements report

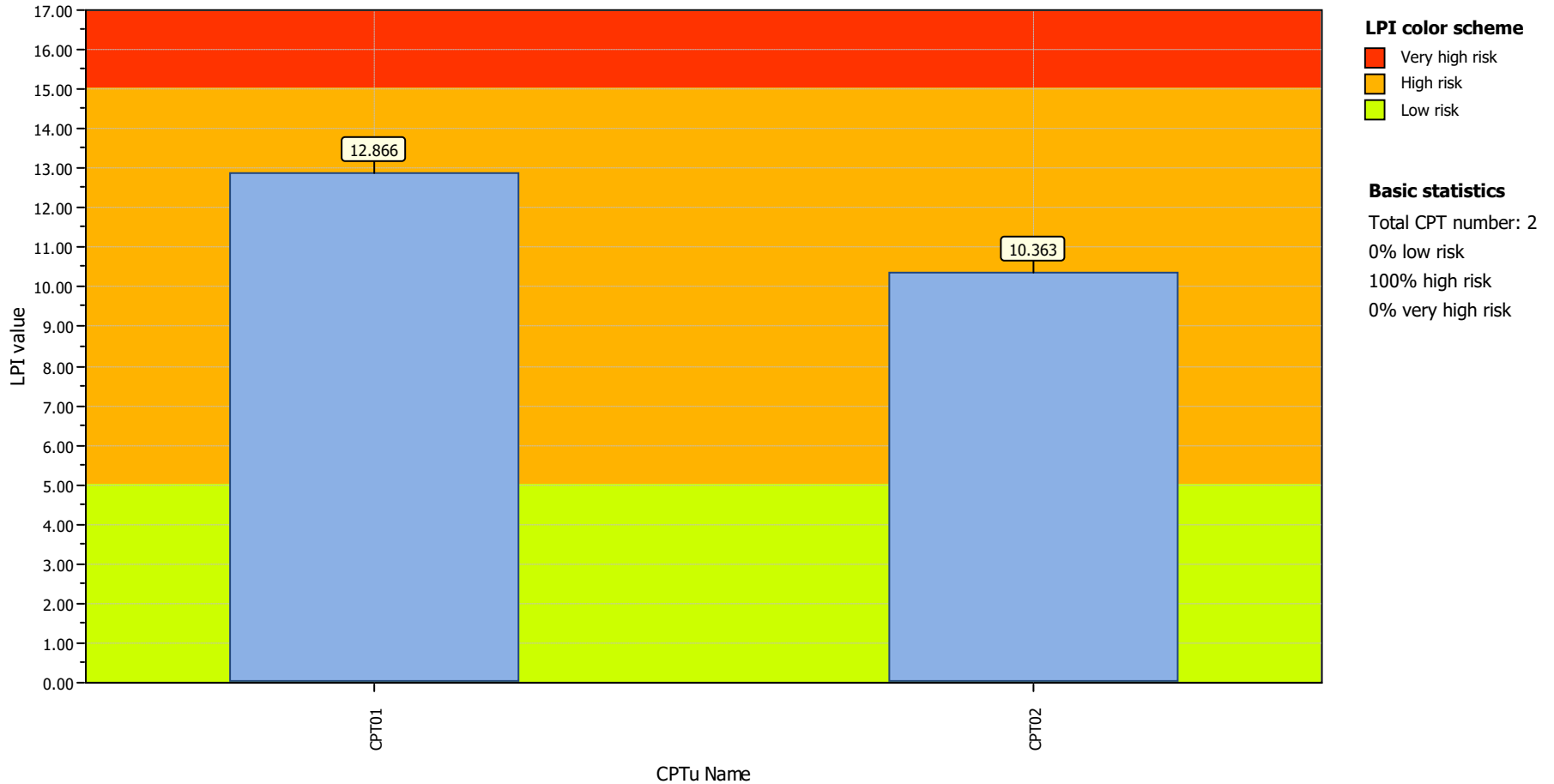




**Project title : HD2771-1 Kenrick Street**

**Location : Te Aroha**

### Overall Liquefaction Potential Index report

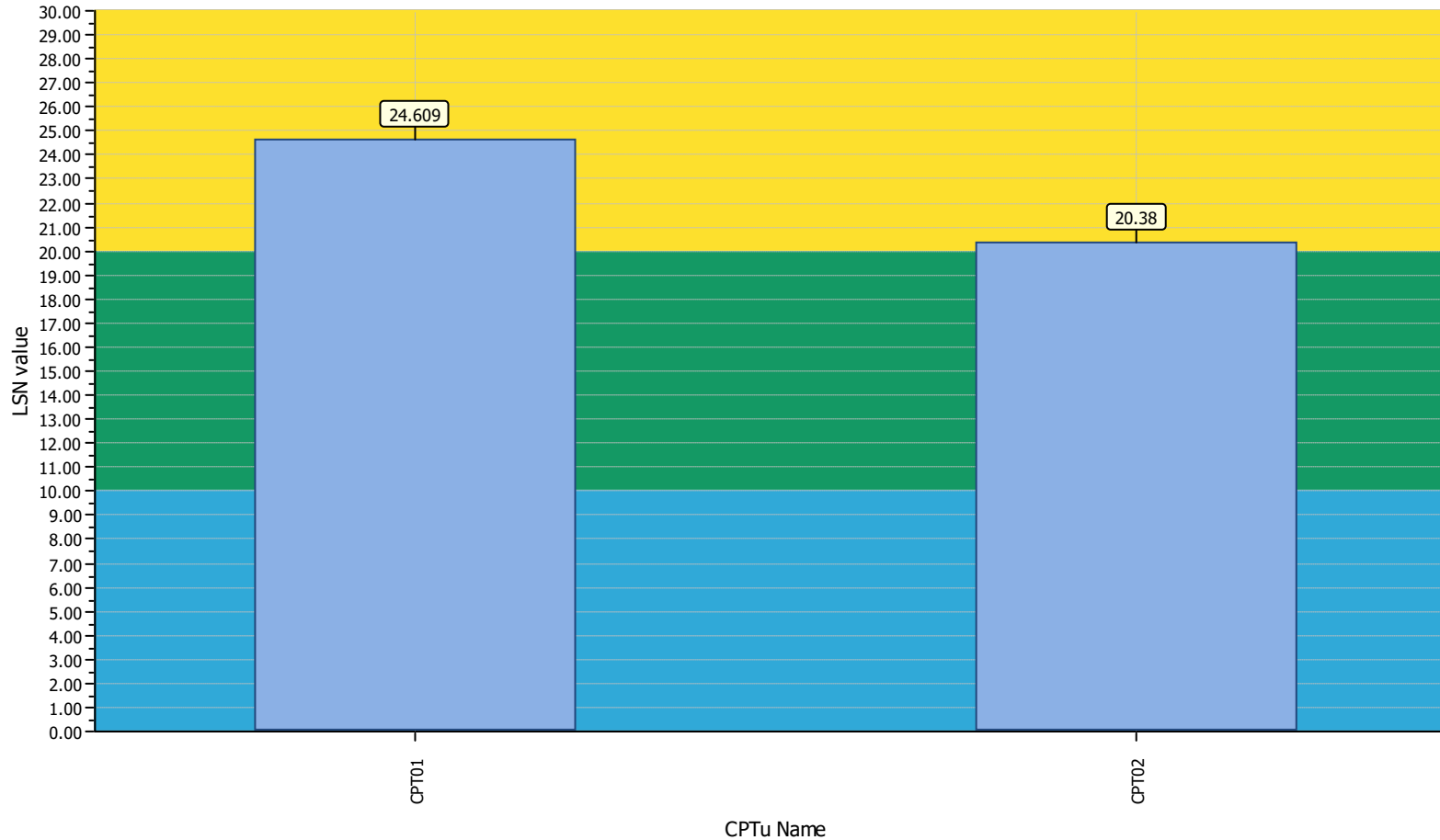




**Project title : HD2771-1 Kenrick Street**

**Location : Te Aroha**

### Overall Liquefaction Severity Number report



#### LSN color scheme

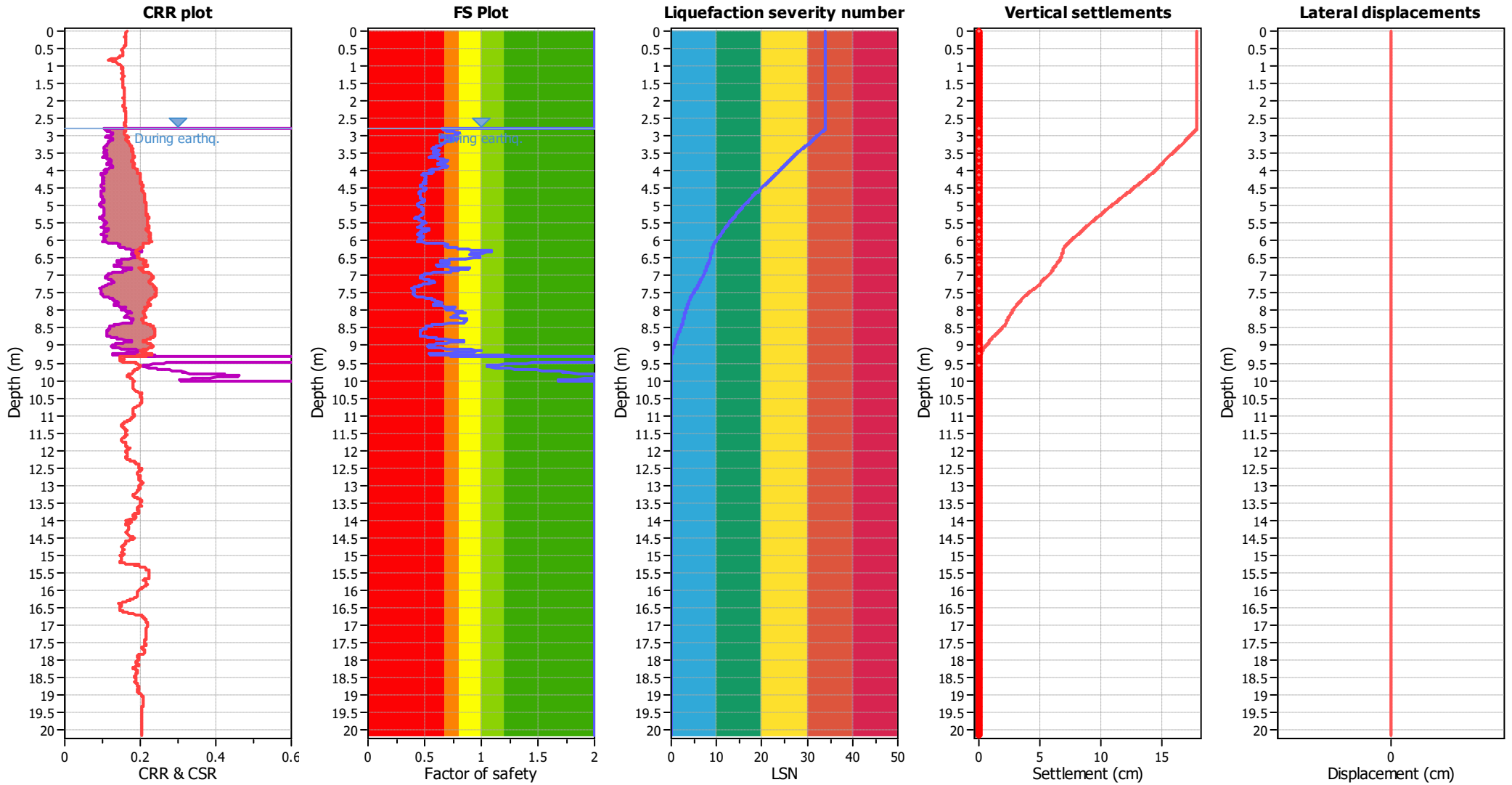
- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

#### Basic statistics

- Total CPT number: 2
- 0% little liquefaction
- 0% minor liquefaction
- 100% moderate liquefaction
- 0% moderate to major liquefaction
- 0% major liquefaction
- 0% severe liquefaction



### Liquefaction analysis overall plots



**Input parameters and analysis data**

|                                       |                   |                           |              |                             |            |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|------------|
| Analysis method:                      | B&I (2014)        | Depth to GWT (earthq.):   | 2.80 m       | Fill weight:                | N/A        |
| Fines correction method:              | B&I (2014)        | Average results interval: | 3            | Transition detect. applied: | Yes        |
| Points to test:                       | Based on Ic value | Ic cut-off value:         | 2.60         | K <sub>σ</sub> applied:     | Yes        |
| Earthquake magnitude M <sub>w</sub> : | 5.90              | Unit weight calculation:  | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration:             | 0.30              | Use fill:                 | No           | Limit depth applied:        | Yes        |
| Depth to water table (insitu):        | 3.80 m            | Fill height:              | N/A          | Limit depth:                | 10.00 m    |

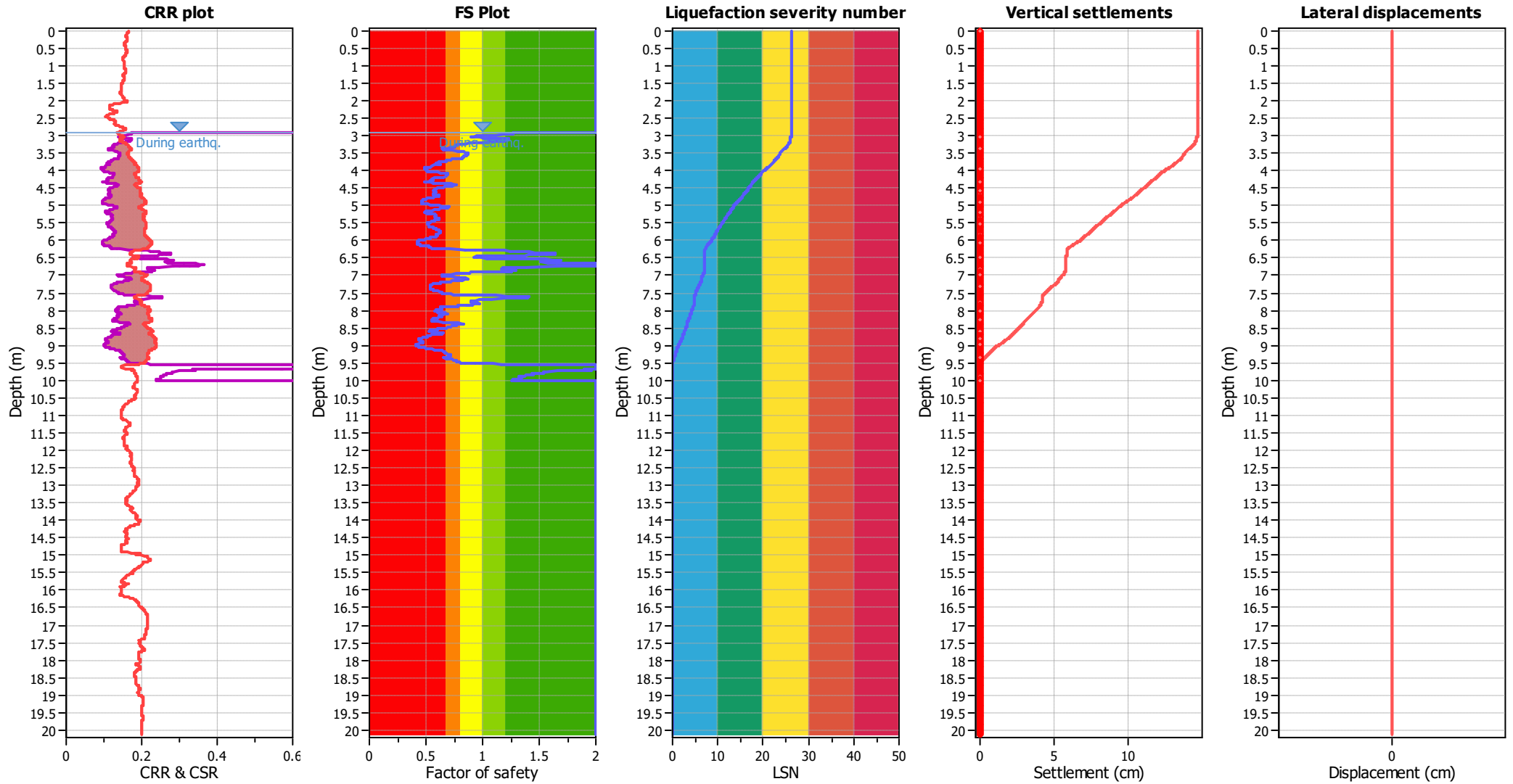
**F.S. color scheme**

- 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

**LSN color scheme**

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

### Liquefaction analysis overall plots



**Input parameters and analysis data**

|                                       |                   |                           |              |                             |            |
|---------------------------------------|-------------------|---------------------------|--------------|-----------------------------|------------|
| Analysis method:                      | B&I (2014)        | Depth to GWT (earthq.):   | 2.90 m       | Fill weight:                | N/A        |
| Fines correction method:              | B&I (2014)        | Average results interval: | 3            | Transition detect. applied: | Yes        |
| Points to test:                       | Based on Ic value | Ic cut-off value:         | 2.60         | K <sub>σ</sub> applied:     | Yes        |
| Earthquake magnitude M <sub>w</sub> : | 5.90              | Unit weight calculation:  | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration:             | 0.30              | Use fill:                 | No           | Limit depth applied:        | Yes        |
| Depth to water table (insitu):        | 3.90 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

**LSN color scheme**

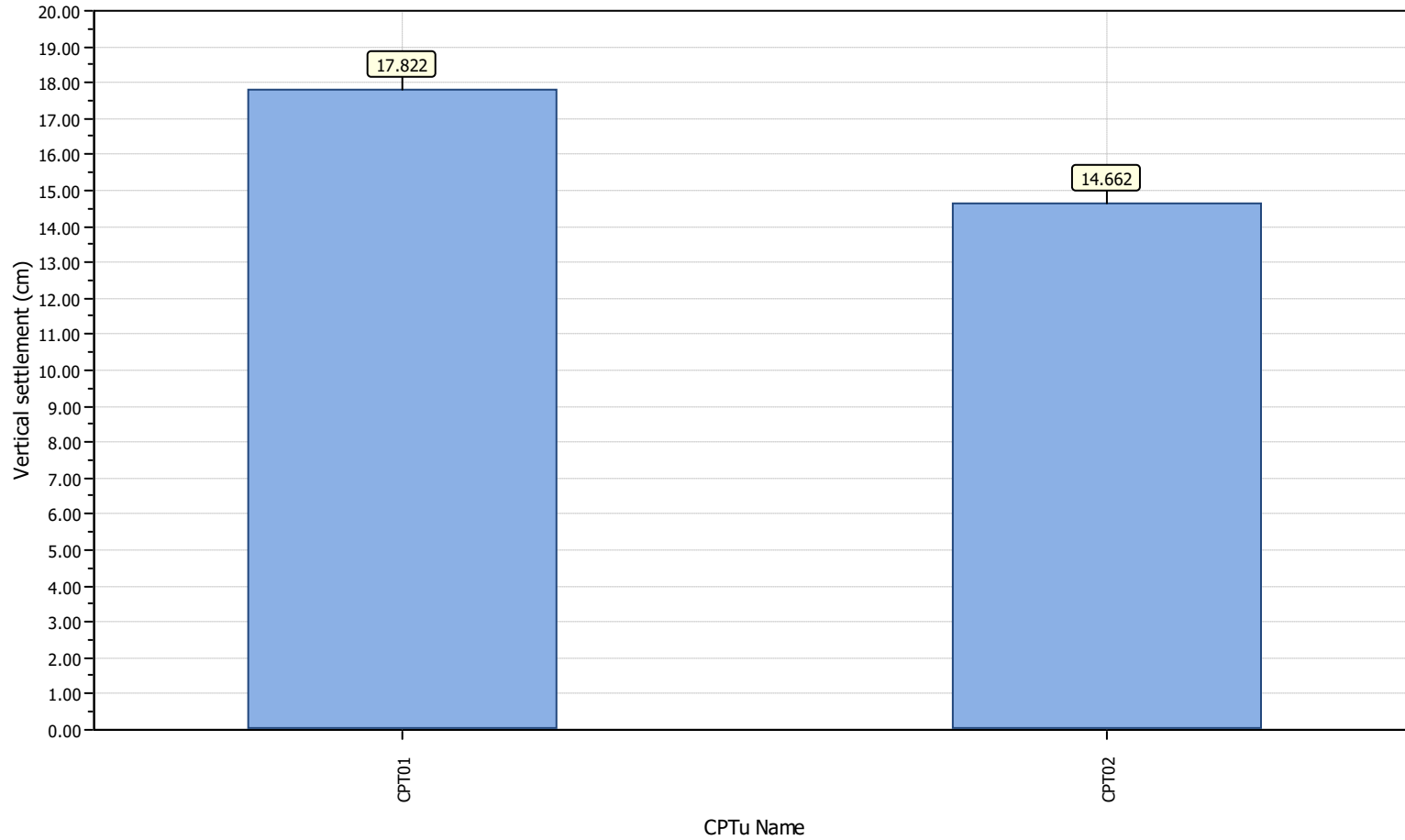
- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction



**Project title : HD2771-1 Kenrick Street**

**Location : Te Aroha**

### Overall vertical settlements report

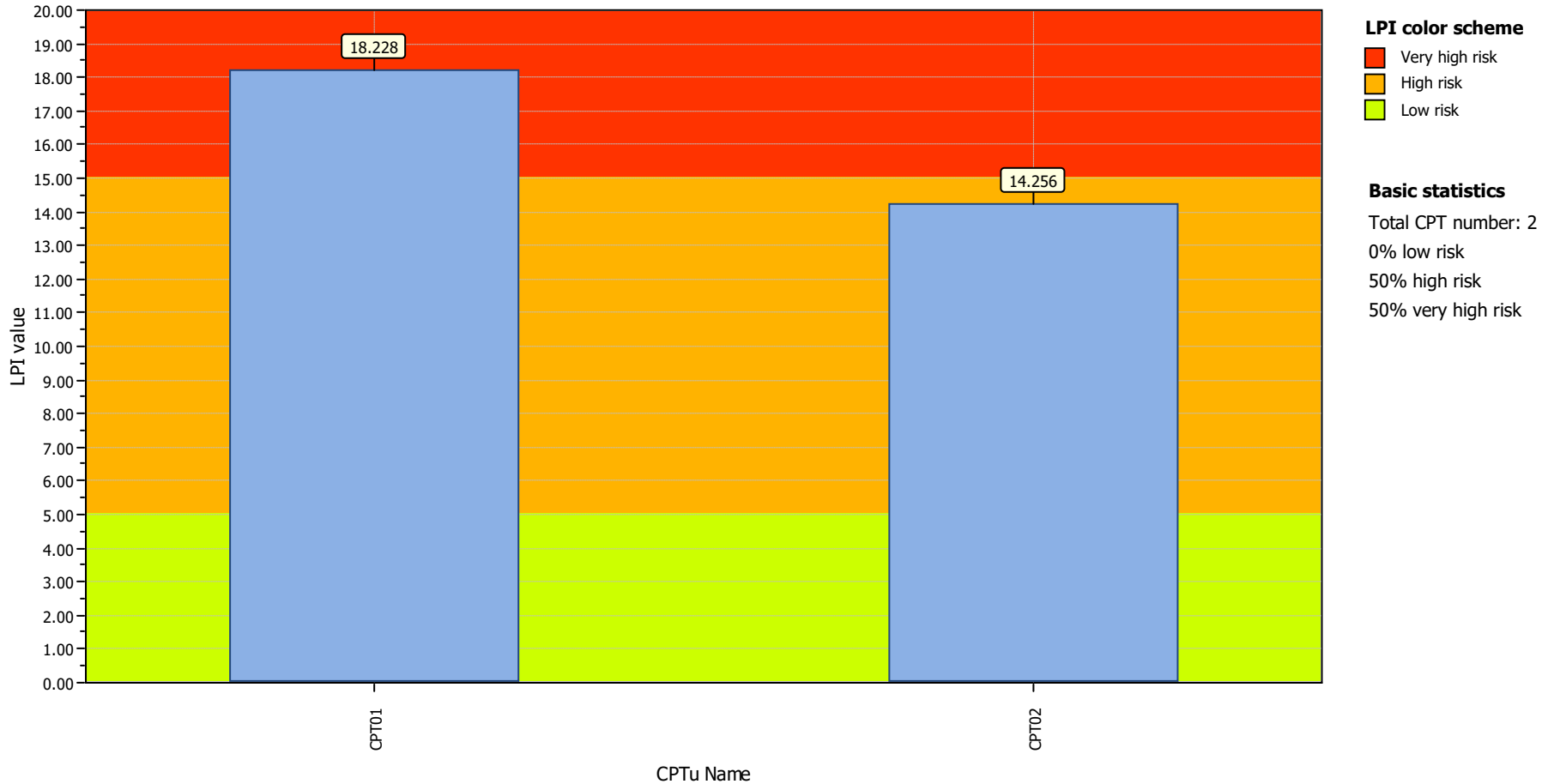




Project title : HD2771-1 Kenrick Street

Location : Te Aroha

### Overall Liquefaction Potential Index report



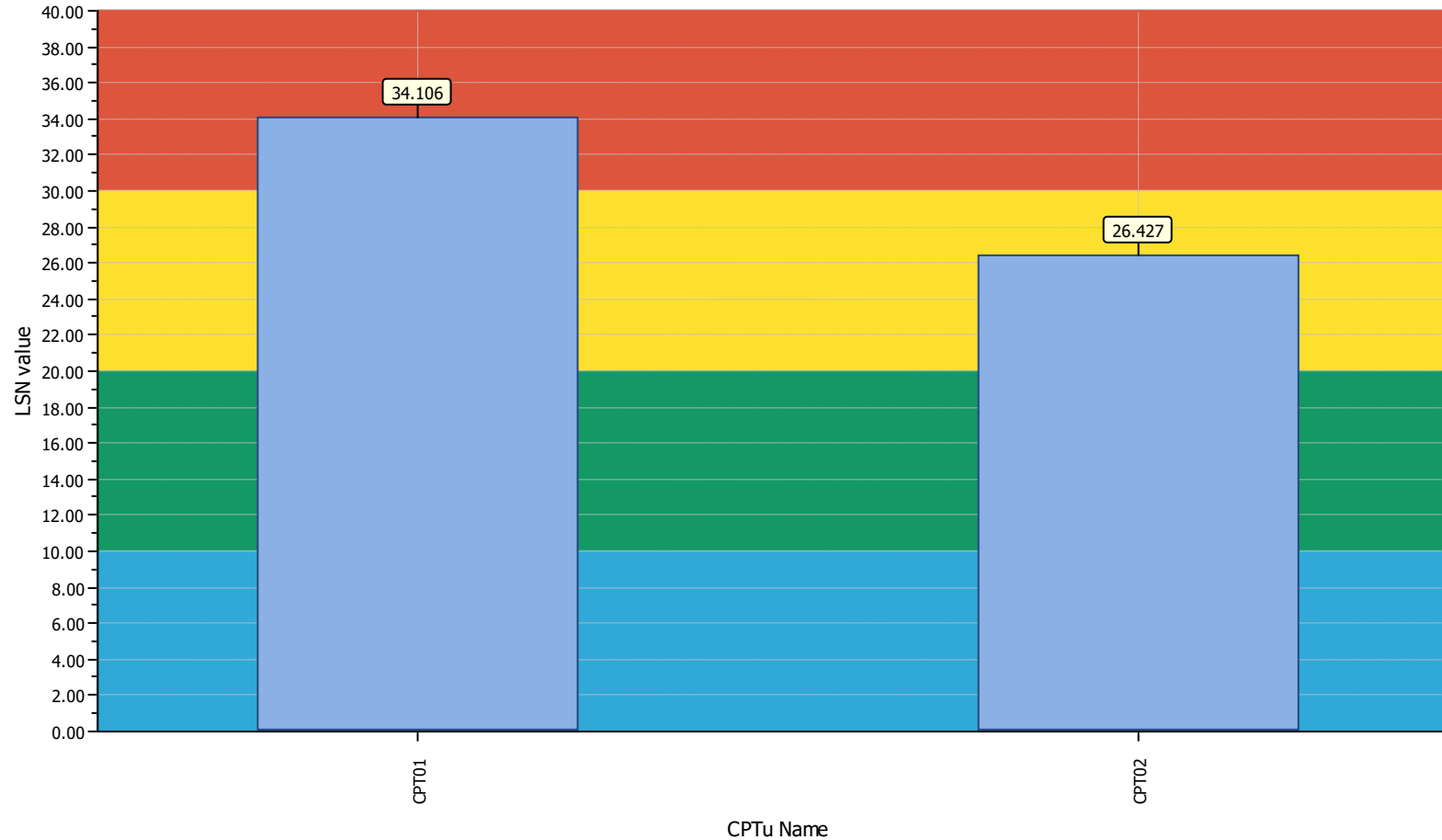




Project title : HD2771-1 Kenrick Street

Location : Te Aroha

### Overall Liquefaction Severity Number report



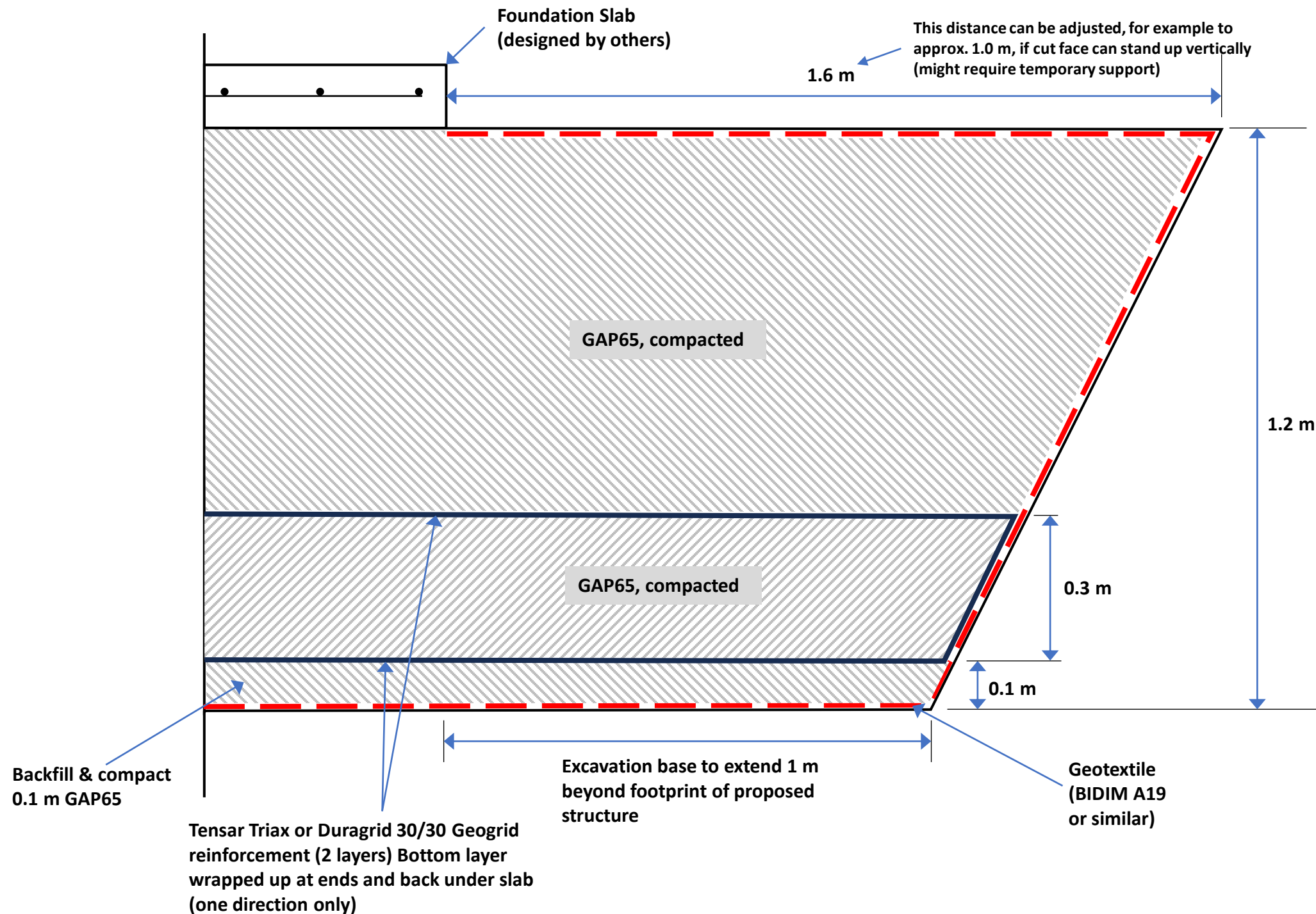
#### LSN color scheme

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

#### Basic statistics

- Total CPT number: 2
- 0% little liquefaction
- 0% minor liquefaction
- 50% moderate liquefaction
- 50% moderate to major liquefaction
- 0% major liquefaction
- 0% severe liquefaction

# APPENDIX D – RAFT FOUNDATION DETAIL



**Excavation and Soil Remediation Methodology:**

1. Excavate and remove all existing loose soils (approximately 1.2 m) until undisturbed natural soils are exposed. A minimum depth of 1.0 m below the underside of foundation beams is required. A minimum width of 1.6 m beyond the outside edge of the building foundation is required.
2. Line base of excavation with geotextile filter fabric (BIDIM A19 or similar approved).
3. Backfill and compact 0.1m of hardfill (GAP65 or similar).
4. Place one layer of geogrid reinforcement (Tensor Triax, Duragrid 30/30 or approved equivalent) at 0.1 m above the base of the excavation and a second layer at 0.4 m above the base of the excavation, placing compacted hardfill in 150 mm layers between the grids.
5. All detailed compaction requirements and testing to be completed in accordance with the geotechnical engineer's specifications and approval.

**PROJECT:** 70 Kenrick Street, Te Aroha

**PROJECT No:** HD2771-1

**CLIENT:** Kenwyn Trust

**TITLE:** Reinforced hardfill raft detail

**SCALE:** N/A

**Drawing No:** 02

**Drawing By:** RR

**Rev no:**

|   |          |
|---|----------|
| 0 | 18.10.23 |
|---|----------|

|   |          |
|---|----------|
| 1 | 28.11.23 |
|---|----------|

