APPENDIX 10

Preliminary Geotechnical Investigation

LDE LAND DEVELOPMENT & EXPLORATION LTD.

RDT Pacific Limited

Preliminary Geotechnical Investigation For Proposed New TKKM Te Wananga Whare Tapere o Takitimu

90-120 Bennett Road, Hastings

Project Reference: 13348_Rev1
24 August 2017

EXECUTIVE SUMMARY

Based on the investigation and appraisal of the site reported herein, the following key conclusions and recommendations have been drawn with respect to the proposed potential school development at the site:

1. The site is generally considered to be stable and suitable for building development.
2. No evidence for land instability, erosion, or fault rupture was identified at the site.
3. The near surface site soils are generally high strength with conventional geotechnical bearing capacities consistent with the minimum requirements of NZS3604 (2011) and NZS4203 (2013). Groundwater is generally located at approximately 2.0m depth.
4. Deep investigations refused on inferred dense gravels between 7.6m to 10.6m. The gravel thickness beneath the site is likely to exceed 100m, and therefore a Class D soil classification is likely to be most appropriate and is recommended for the site.
5. Should any potential step-change be identified during any detailed building stage that emanates from a distinction between a Class C (shallow soil site) or Class D (deep or soft soil site) soil classification that requires confirmation of the soil class for design purposes, then allowance for a machine borehole up to approximately 100m depth should be made within any detailed site investigations.
6. The potential for liquefaction of the subsoils beneath the site is considered to be moderate to high, with calculated values indicative of a Technical Category TC3 equivalent land classification in terms of the Christchurch MBIE Guidelines i.e. sites where liquefaction damage is possible in future large earthquakes and large settlements are predicted. Specific mitigation and design measures are considered necessary for all building structures.
7. There were no areas encountered within the subject property where natural subsurface conditions differed significantly from others to require the implementation of a building avoidance zone plan.
8. It is however recommended that consideration be given to the potential for lateral spreading to occur for any building located within approximately 200m of the infilled stream channel to the east of the site, unless the existing fill is either further investigated or remediated.
9. It is generally expected that additional geotechnical investigations for Building Importance Level (IL) IL1 and IL2 structures would only require conventional hand auger and Scala penetrometer testing in the location of the proposed building footprints. Liquefaction mitigation / resilience requirements indicates that timber floor / pre-fab / enhanced raft foundations is likely to be required.

10. IL3 building structures relying on deep piles for liquefaction mitigation should have at least one deep machine borehole in order to prove the depth and consistency of the inferred dense gravel layer beneath the site. IL3 structures will need detailed investigation and assessment, but are likely to require some form of deep treatment or foundation type, such as deep piles (>7-10m) or cement stone columns and deep soil mixing.

This executive summary must not be taken out of context with the balance of this report. Additional recommendations and considerations are made in the body of the report which provide the context for the above key findings relating to the development under consideration.

CONTENTS

1 GENERAL

Land Development & Exploration Ltd was engaged by RDT Pacific Ltd to undertake a preliminary ground investigation for the potential new TKKM o Te Wananga Whare Tapere o Takitimu, at a site located between 90 & 120 Bennett Road, Hastings.

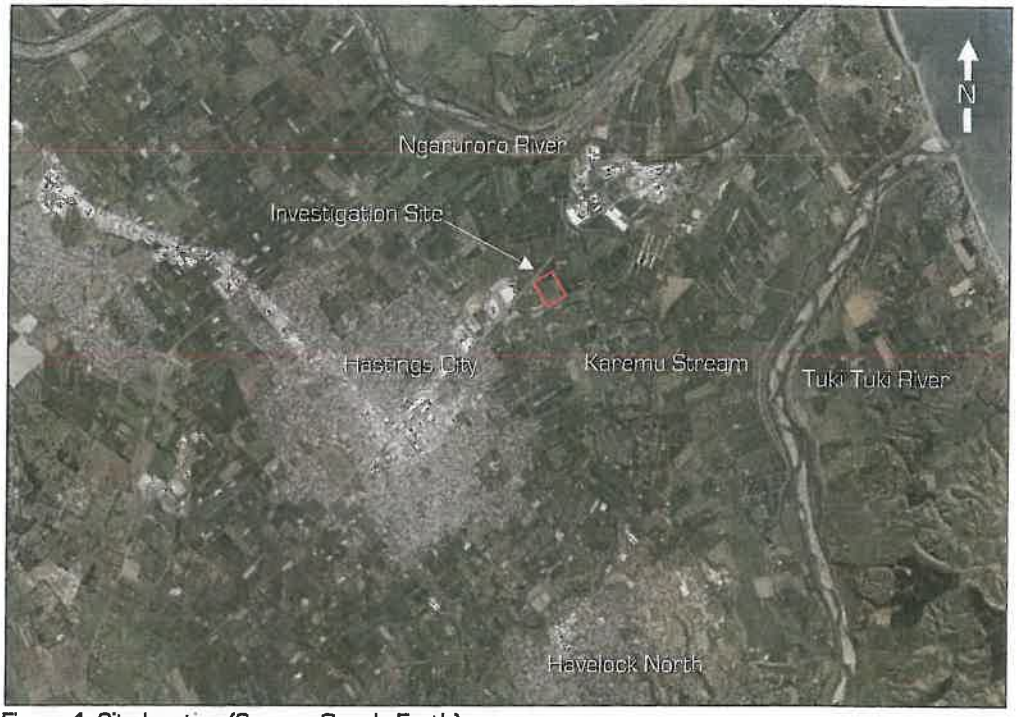

Figure 1: Site location (Source: Google Earth).

The purpose of the preliminary investigation was to '*define the site and determine the best locations for buildings*' in accordance with Section A.4.2.b of the Ministry of Education (MOE) 'Form of Agreement for Consultancy Services'. The investigation of the property was carried out within the pre-purchase due diligence period, and it is understood that the site has been subsequently purchased and that this report is now to be used in support of the MOE application for 'Notice of Requirement' to the Hastings District Council.

The primary purpose of the geotechnical investigation was to identify the broad scale foundation conditions at the site with respect to any significant geotechnical hazards or constraints surrounding the development of any future building configuration.

In accordance with the agreement, the investigation and analysis was undertaken to address the requirements of the Ministry of Educations 'Structural and Geotechnical Guidelines for School Design (2015)'.

A Request for Proposals (RFP) document was supplied which outlined the extent of investigation.

2 SITE SETTING AND CONDITIONS

The subject property is located on the eastern outskirts of Hastings to the east of Bennett Road and south of Otene Road on an essentially flat alluvial surface.

The land surrounding the property is also generally flat and is comprised of rural properties being mixed orchard, vineyard, and open paddocks (Figures 2 & 3). The property itself is in open paddock and is located approximately 500m to 600m west of Karemu Stream and some 400m to 500m north of a tributary to Karemu Stream (Figure 2). The oval shape crossing the southeastern corner of the subject land is an animal training track.

Figure 2: Aerial image showing the approximate property boundary in dashed yellow and the rural character of the area. Note locations of Karemu Stream and tributary (Source: Google Earth).

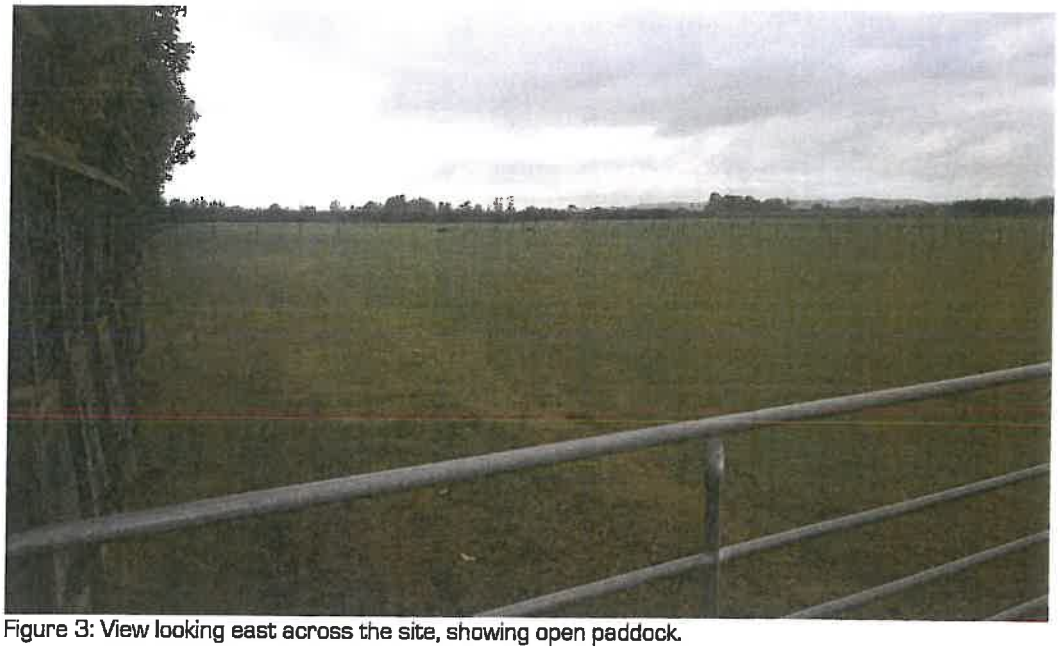

Figure 3: View looking east across the site, showing open paddock.

A review of the Hastings District Council (HDC) historical imagery indicated that to the immediate east of the assessed area is a former gully that has been mostly infilled (Figure 4).

Figure 4: Historic aerial photograph (1949) showing location of former gully to the east of the assessed land area that is now mostly infilled (Source: Hastings District Council Intramaps).

3 Proposed Development

It is understood that no concept drawings have been prepared for the potential development at the site, but is expected to comprise a mix of various size classrooms, buildings, and playing fields. Although buildings are expected to be located closer to the Bennett Road side of the

property than the rear (eastern) boundary, the purpose of the investigation was to establish the variation across the entire site.

The actual building types, layout, size and location of the new facilities are yet to be specified at the time of this investigation and, among other factors, will be subject to the preliminary findings of this report.

4 INVESTIGATION

Our investigation of the site included the following work:

- A desktop study of published and unpublished information of the site.
- A walkover assessment of the site and surrounding area to assess its geomorphology and any features which may potentially influence the long term behaviour of the site.
- Inspections of any existing exposures of the underlying geology, and areas where a high groundwater table is evident.
- Four electronic cone penetrometer tests (CPTs) put down using a specialist rig to refusal at depths of up to 10.7m.
- Four 50mm hand augered boreholes put down to refusal at depths of up to 2.8m. Measurements of the undrained shear strength were taken at 200mm intervals within cohesive soils encountered down through the boreholes using a calibrated shear vane. The soils encountered were generally logged to NZ Geotechnical Society Logging Guidelines for the field classification of soil and rock for engineering purposes.

The locations of the subsurface investigations are shown on Figure 5 below and on the Ground Investigation Plan in Appendix A. The eastern boundary was targeted to assess the presence of any fill associated with the former gully location. Logs of the boreholes and the cone penetrometer test results are presented in Appendix B.

The fieldwork was completed in early winter after a series of heavy rainfall events, with the CPT investigation carried out on 1 June 2017 and the hand auger investigation carried out on 6 June 2017.

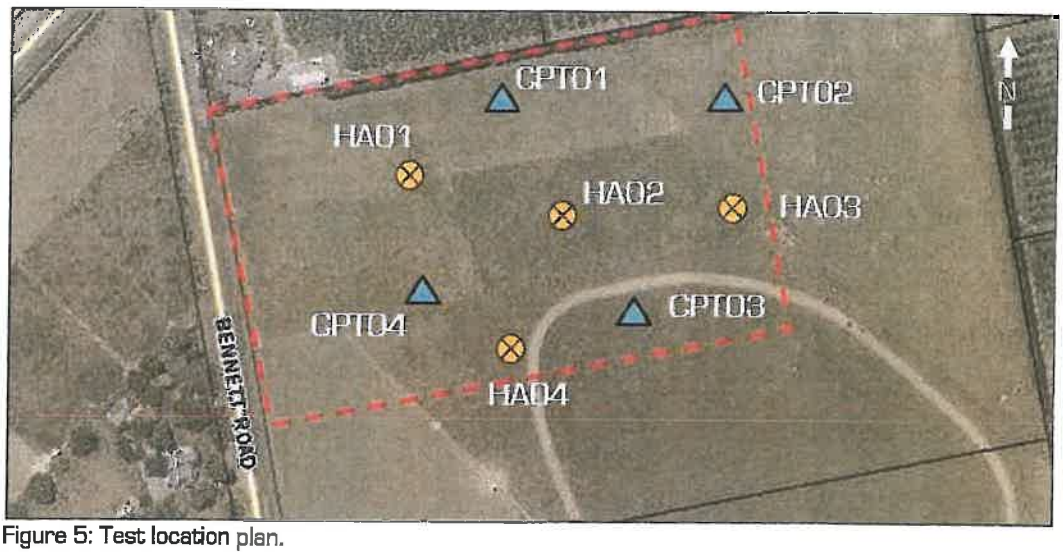

Figure 5: Test location plan.

5 Site Geology and Subsurface Conditions

5.1 Geologic and Geomorphological Setting

The 1:250,000 geological map of the region[1] shows the site as being underlain by poorly consolidated alluvial gravel, sand and mud of Holocene age. The deposits form alluvial terraces that are part of the thick (>200m) sequence of Pleistocene and Holocene predominantly gravel alluvial deposits that make up the wider Heretaunga Plains. The Hawkes Bay Regional Council (HBRC[2]) mapping of the Quaternary Geology maps the site as being underlain by 'finely to moderately interlayered silt and fine sand deposits (overbank flood deposits)'.

The site is not shown to be underlain by any active fault traces or associated fault buffer zones. The nearest active fault trace and associated Fault Avoidance Zone is the inferred trace of the Awanui Fault located approximately 4.6km to the north-west of the site, while the nearest inactive fault is the concealed trace of an unnamed fault of inferred Early Miocene age approximately 2.3km to the south-east of the site.

5.2 Soil Profile and Strength

5.2.1 Topsoil

Organic silt (Topsoil) was encountered across the site within the boreholes put down at the site to depths of between approximately 0.2m and 0.4m below the ground surface existing at the investigation (the existing ground surface).

[1] Lee, J.M.; Townsend, D.; Bland, K.; Kamp, P.J.J. (compilers) 2011: Geology of the Hawke's Bay area: scale 1:250,000.
[2] https://hbviewer.nz/mapviewer.html

No fill or otherwise disturbed ground was encountered in the boreholes in the eastern part of the site, indicating that any fill associated with infilling the former gully area does not extend into the assessed area at the site.

5.2.2 Near Surface Soils

Beneath the topsoil layer, the investigations generally encountered high strength soils, comprising sandy silts to a depth of approximately 1.9m to 2.4m. The undrained shear strengths within these cohesive soils were generally in the range of approximately 100kPa to 150kPa, corresponding to a very stiff consistency.

Below the sandy silt surface soils, non cohesive silty sands of a medium dense to dense consistency were encountered. The hand augers refused within this high strength material upon encountering the groundwater table above this layer, generally resulting in saturated sand infilling the auger holes.

5.2.3 Soils at Depth

The Cone Penetrometer Tests (CPT) indicate that the silty sand materials that prevented the advancement of the hand augers extends down to a depth of approximately 3.3m to 3.8m below the existing ground surface.

Beneath this layer a zone of interlayered medium strength silts and sands extends to approximately 5.0m to 5.8m before returning into dense sand materials to 6.0m to 8.0m depth. The thickness of this dense sand layer was between approximately 1.0m to 2.0m and was underlain by a 1.0m to 3.5m thick layer of low to medium strength clayey silt and silty clay.

The CPT probes were terminated at depths of between approximately 7.6m and 10.6m due to a sudden increase in the strength of the materials resulting in refusal due to rig uplift. This sudden increase in strength is likely to represent the surface of dense floodplain gravels beneath the site that make up the majority of the alluvial sequence forming the Heretaunga Plains.

5.3 Groundwater Levels

The groundwater at the site was consistently encountered between 1.9m and 2.4m depth beneath the ground surface on completion of the boreholes and CPT tests undertaken on the site. The investigations were undertaken in early Winter between 1st and 6th June after several heavy rainfall events, and the permanent groundwater table encountered in the investigation is expected to be representative of typical winter months or extended periods of wet weather. Complete saturation of the site is considered unlikely to occur and the groundwater level is considered unlikely to constrain the proposed site developments.

6 Ground Deformation Potential

6.1 General

This section summarises our assessment of the natural hazards within the property as generally defined in the Building Act (2004) and the potential risk that these present to the proposed building in terms of vertical and lateral ground deformation. This section also includes our assessment of ground beneath the building site which is outside the definition of "Good Ground" as defined by the Compliance Document for the NZ Building Code, NZS3604 (2011) "Timber Framed Buildings" and NZS4229 (2013) "Concrete Masonry Buildings Not Requiring Specific Engineering Design". This is any ground which could foreseeably experience movement of 25mm or greater for any reason including one or a combination of compressible ground, land instability, ground creep, subsidence, seasonal swelling and shrinking, frost heave, changing groundwater level, erosion, dissolution of soil in water, and the effect of tree roots.

6.2 Seismic Loading

The site is likely to be near the boundary between classification as a Class C 'shallow soil site' and Class D 'deep or soft soil site' as defined by NZS 1170.5 (2004) "Structural Design Actions: Part 5: Earthquake actions – New Zealand". The classification of the soil category of the site has an influence on the amount of strengthening works that needs to be specified in the structural design of the buildings, and can therefore have significant construction cost implications across multiple building structures such as a school.

The site is located within the central part of the Heretaunga Plains and is likely to be underlain by thick deposits of floodplain gravels. As per Table 3.2 of NZS 1170.5, the maximum depth of gravels for a Class C classification is 100m. The gravel thickness beneath the site is likely to exceed 100m, and therefore a Class D soil classification is likely to be most appropriate for the site.

As such; we consider that the earthquake design magnitude peak ground accelerations (PGA) in Table 1 below should be used for geotechnical considerations under Serviceability Limit State (SLS) and Ultimate Limit State (ULS) loading.

However, as a Class C classification yields PGA values that are more conservative than Class D, we have also presented the PGA values for Class C in Table 2 for comparison and for use in the liquefaction analyses. The difference between the two scenarios should be evaluated by the building designer for any potential step-change, whereby any assumption about the soil class results in a significant predicted performance of the building during an earthquake i.e. does the building performance significantly deteriorate under a Class C or Class D classification.

Should any potential step-change be identified during any detailed building stage that emanates from a distinction between a Class C or Class D soil classification that requires confirmation of the soil class for design purposes, then allowance for a machine borehole up to approximately 100m depth should be made within any detailed site investigations.

Table 1: Class D peak ground accelerations for buildings of various Importance Levels

Building Use	SLS1 PGA (g)	SLS2 PGA (g)	ULS PGA (g)
Small (<30m²) ancillary buildings (IL1)	0.11	n/a	0.22
Larger ancillary buildings (IL2)	0.11	n/a	0.44
Offices and Classrooms of lightweight construction , with less than 250 students (IL2)	0.11	n/a	0.44
Offices and Classrooms of lightweight construction, with 250 or more students (IL3)	0.11	n/a	0.57
All buildings of more than one suspended level and single story classrooms of heavy construction, with less than 250 students (IL2)	0.11	0.22	0.44
All buildings of more than one suspended level and single story classrooms of heavy construction, with 250 or more occupants (IL3)	0.11	0.33	0.57
Assembly halls, gymnasiums etc. where students may congregate (IL3)	0.11	0.33	0.57

Table 2: Class C peak ground accelerations for buildings of various Importance Levels

Building Use	SLS1 PGA (g)	SLS2 PGA (g)	ULS PGA (g)
Small (<30m²) ancillary buildings (IL1)	0.13	n/a	0.26
Larger ancillary buildings (IL2)	0.13	n/a	0.52
Offices and Classrooms of lightweight construction , with less than 250 students (IL2)	0.13	n/a	0.52
Offices and Classrooms of lightweight construction, with 250 or more students (IL3)	0.13	n/a	0.67
All buildings of more than one suspended level and single story classrooms of heavy construction, with less than 250 students (IL2)	0.13	0.26	0.52
All buildings of more than one suspended level and single story classrooms of heavy construction, with 250 or more occupants (IL3)	0.13	0.39	0.67
Assembly halls, gymnasiums etc. where students may congregate (IL3)	0.13	0.39	0.67

6.3 Fault Line Surface Rupture

The published geological map and the GNS Active Faults Database do not show any faults passing through or nearby the site with the nearest active mapped fault lines to the subject site being approximately 4.6km to the north-west (refer Section 5.1). There also does not appear to be any surface expressions which would indicate the presence of a fault line within the vicinity of the site.

We therefore consider that the surface fault line rupture risk to be similar to many other parts of the Napier-Hastings area in close proximity to large active fault zones and that no further specific investigation or design mitigation is required.

6.4 Liquefaction

6.4.1 General

Liquefaction is the term used to describe the severe strength loss which can occur when saturated loose to medium dense sands and low plasticity silts are subject to seismic shaking. In addition to strength loss, liquefaction may also result in the expulsion of sand, silt and water at the surface, post seismic settlement, and in lateral movement towards areas of lower elevation such as rivers or streams, referred to as lateral spreading. Differences in the level underlying liquefaction due to variations in the ground can result in differential surface settlement. In addition, significant building settlement can occur due to the severe loss of strength and subsequent bearing capacity of the ground.

The Hawke's Bay Regional Council hazard mapping of the area shows the site as being located in a zone of 'high' susceptibility to liquefaction.

The site is underlain by sands and fine grained materials of variable density and thickness below the water table which are likely to be prone to liquefaction. In addition, given the relatively high groundwater table, liquefaction within the zone of influence of the building foundations could result in building settlement.

Analyses have been carried out to determine:

- What material layers beneath the site are likely to be prone to liquefaction under SLS (small to medium earthquakes) and ULS (large earthquakes) seismic shaking.
- The severity of surface damage due to liquefaction.
- The potential magnitude of surface settlement due to consolidation of the liquefied layers.

The analyses adopted the data from each CPT using geotechnical software (CLiq). The analyses have been undertaken at each of the conservative Class C design earthquake PGA values presented in Table 2 in Section 6.2. A groundwater depth of 2.0m was used in the analyses to model expected winter conditions.

We have assessed the liquefaction potential of soils at site using the "simplified procedure" as summarised by "Updated NCEER" method (Youd et al, 2001), and recommended by the New Zealand Geotechnical Society Guidelines (NZGS, 2010). Liquefaction-induced free-field vertical

volumetric strains were estimated for the SLS and ULS design seismic events using the method of Zhang et al. (2002). Default assessment values were utilised within CLiq during the liquefaction analyses. These include, but are not limited to, assuming the existing ground is level, utilising an Ic cut-off of 2.6, applying clean sand and overburden corrections, automatic calculations for soil unit weights and applying automatic corrections to the input data at soil transition layers.

The summary results of the analyses are presented in Appendix C and are discussed in the subsequent sections.

6.4.2 Liquefaction Severity Number

The Liquefaction Severity Number[3] (LSN) provides an indication of the likely future performance of the site due to underlying liquefaction. The determination of the number takes into account the thickness of the layers subject to liquefaction and their proximity to the surface. The magnitude of land damage that may be expected has been categorised into ranges (Table 3 below).

Table 3: LSN ranges and observed land effects

LSN Range*	Predominant performance based on actual observations
0-10	Little to no expression of liquefaction, minor effects
10-20	Minor expression of liquefaction, some sand boils
20-30	Moderate expression of liquefaction, with some sand boils and some structural damage
30-40	Moderate to severe expression of liquefaction, settlement can cause structural damage
40-50	Major expression of liquefaction, undulations and damage to ground surface, severe total and differential settlement of structures
>50	Severe damage, extensive evidence of liquefaction at the surface, severe total and differential settlements affecting structures, damage to services.

* LSN is an approximate indicator of liquefaction effects and do not always reflect the actual liquefaction from seismic events.

6.4.3 Liquefaction Results

The analyses indicate that under earthquake loading there is the potential for some liquefaction of the loose to medium dense silty sand and silt layers underlying the site (Figure 6, left). As the earthquake shaking increases, the number and severity of the subsoils susceptible to liquefaction increases, resulting in essentially the entire subsoil profile beneath the water table indicated to liquefy (Figure 6, right).

[3] Tonkin and Taylor (2013) Liquefaction vulnerability study, Tonkin and Taylor Report 52020.0200/v1.0. February 2013. 52 pages and 14 appendices.

The CPT and liquefaction profiles terminate on the dense layer (gravels) inferred beneath the site at between 7.6m to 10.6m depth. These dense gravels are not likely to undergo any significant liquefaction during either SLS or ULS earthquakes, and are likely to be suitable for supporting deep piles for high value structures (iL3 or more as set out in Tables 1 and 2). However, any pile design that relies on the inferred gravels for bearing / liquefaction resistance should be further investigated (via machine boreholes) to prove the thickness and consistency of the inferred gravel layer.

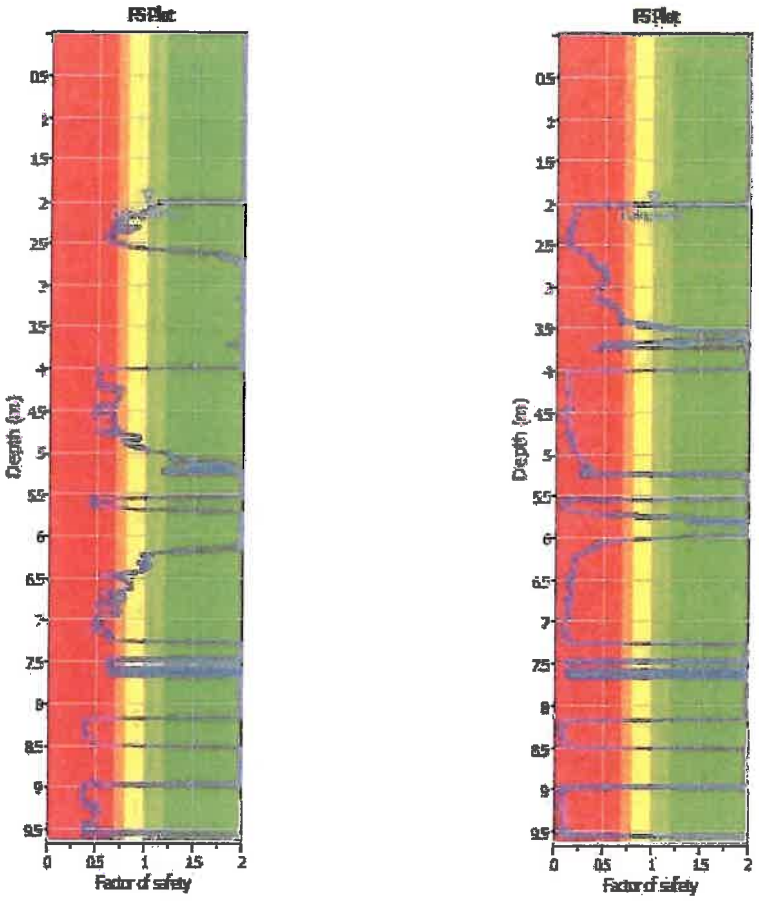

Figure 6: Representative profile of layers susceptible to liquefaction. Plots both from CPT3, with SLS 0.13g PGA on left and ULS 0.67g PGA on right. Note that the illegible words at 2.0m depth are 'During earthq' and indicates the groundwater level used in the calculations.

The results of the liquefaction analyses are presented in Appendix C and are summarised in Table 4 below. In general the results indicated moderate liquefaction potential at the SLS level and a high to very high potential for the subsoils to liquefy under the various ULS conditions.

Table 4: Summary of liquefaction results.

Liquefaction Parameter	Peak Ground Acceleration (PGA)				
	0.13g	0.26g	0.39g	0.52g	0.67g
LPI	3 - 9	10 - 19	15 - 24	19 - 27	21 – 30
Probability	Low to High	High to Very High	Very High	Very High	Very High
LSN	8 - 21	15 - 28	18 - 30	19 - 31	20 – 32
Vertical Settlement (mm)*	40 - 110	60 - 125	75 - 130	80 -135	80 -135

* Calculation assumes no sand boils are present. When sand boils are present, the estimated total settlement is unpredictable.

Analyses of the data from the CPTs put down within the site return LSN values that indicates little to no expression of liquefaction and only minor effects in SLS events, which increases during the various ULS events to moderate expression of liquefaction, with some sand boils and some structural damage likely to occur.

Analyses of the potential settlement that could potentially occur following the liquefaction of the sand and silt layers beneath the site have been carried out using CLiq software.

The liquefaction settlement calculated to occur for a Serviceability Limit State earthquake event is outside the typically acceptable limit of 25mm accepted by the Compliance Document for the NZ Building Code. However, as the bulk of the layers predicted to settle are located below a crust of non liquefiable soil layers, the manifestation of these settlements is likely to be suppressed and to be tolerable for smaller light weight building structures.

Under ULS events and for larger structures which impose loads within the liquefiable materials, the predicted settlements are in excess of 100mm, which will require detailed consideration of the foundation type and design tolerances to ensure that there is sufficient mitigation of liquefaction effects and resilience built into the school development.

6.4.4 Conclusion

Based on the overall potential susceptibility to liquefaction, the relatively high calculated vertical settlements, and moderate prediction of ground damage and liquefaction effects at the ground surface, it is considered that the site has an overall moderate to high susceptibility to liquefaction. The calculated values are indicative of a TC3 land classification in Christchurch.

For normal classroom type structures, this would lend itself to timber floor / prefab style of construction with some additional enhancements, or enhanced concrete slab foundations with ground improvement.

Larger buildings and Importance Level 3 (IL3) structures will need detailed investigation and assessment, but are likely to require some form of deep treatment or foundation type, such as deep piles (>7-10m) or cement stone columns and deep soil mixing.

6.5 Lateral Spreading

Lateral spreading typically occurs in sloping ground or level ground close to waterways (eg river banks, streams, in the backfills behind quay walls). Even a very gentle slope in the ground (of several degrees) will create a bias in the cyclic loads acting on the soil mass during earthquakes which will drive the soil to move in the down-slope direction. Lateral spreading generally manifests within 100m to 150m of a free face, and as the site is 500m to 600m from the Karemu Stream to the east and some 400m from the tributary stream to the south, lateral spreading is generally not considered to pose a significant risk to the proposed school development.

However, the backfill of the former stream channel to the immediate east of the site could potentially act as a pseudo free-face situation if the backfill comprises low-strength materials that do not constrain the former gully side slopes from lateral movement. An indicative lateral spread analysis was therefore carried out on CPT02 and CPT03 to assess the potential lateral spread movement and these results are also presented in Appendix C.

The results indicate that approximately 100mm lateral spread movement could occur in SLS events and up to 300mm could occur in ULS events. As movement of these magnitudes could have significant effects on building structures, it is recommended that any buildings within approximately 200m of the former stream channel also consider the potential for lateral spreading to occur within the foundation design.

Alternatively, additional investigations and/or earthworks could be undertaken to evaluate the nature and condition of the channel back-fill to further evaluate / address the lateral spread potential at the site.

6.6 Slope Stability

The site is essentially flat and is sufficiently isolated from any significant slopes. No slope stability issues are therefore considered to be present at the site.

6.7 Expansive Soils

The near surface soils appear to be non to slightly expansive soils with a liquid limit below 50% and/or a linear shrinkage value below 15% based on their physical characteristics determined during testing. As such; deformations due to the fluctuating water content of the

near surface soils is considered unlikely and conventional foundation depths appropriate to the specific structures is considered to be satisfactory.

6.8 Erosion

There does not appear to be any evidence of surface erosion of significance. There also does not appear to be any evidence of subsurface soil erosion (viz. piping erosion) which could also result in the subsidence of the near surface soils.

Furthermore, the materials underlying the site are not expected to be subject to excessive dissolution (e.g. as a result of acidic groundwater or infiltrating surface water) resulting in surface subsidence.

Surface deformations as a result of a fluctuating groundwater table are not expected to occur at this site.

6.9 Compressible Materials

The organic topsoil/turf layer encountered across the property is likely to be subject to consolidation with loading and must be removed beneath any proposed building footprints, as per the standard requirements for site preparation set out in NZS3604 (2011) and NZS 4229 (2013).

In general, no saturated fine grained material, significant layers of organic material or peat were encountered during the subsurface investigations and differential settlements as a result of long term static loading at this site is considered unlikely for the proposed building structures.

6.10 Frost Heave

Ground deformation as a result of frost heave is not expected to occur.

6.11 Tsunami

The HBRC has mapped the nearest extent of the tsunami inundation zones to be approximately 1.5km to the east of the site towards the coastline[4]. The risk of tsunami inundation at the site is therefore considered to be negligible and no additional design considerations are required for the site.

[4] https://hbviewer.nz/mapviewer.html

7 RECOMMENDATIONS

7.1 General

Recommendations for the preliminary design and other aspects of site development are given in the following sections.

7.2 Building Locations

This investigation indicates that the natural subsurface conditions are reasonably consistent across the property with material of adequate bearing capacity generally encountered near the ground surface in the foundation support zone for buildings.

There were no areas encountered within the subject property where natural subsurface conditions differed significantly from others to require the implementation of a building avoidance zone plan. Unless otherwise investigated further, buildings located within approximately 200m of the infilled gully to the east of the site should have the potential for lateral spreading to occur at the building site considered within the foundation design.

7.3 Considerations for Design

The Structural and Geotechnical Guidelines for School Design aim to provide a design that achieves a balance between minimising the damage from a significant natural hazard event and a cost effective construction solution. It states that considerations must be given to shallow foundations for all buildings. We consider that shallow foundations designed in accordance with the New Zealand Building code are generally appropriate for the site, provided that the liquefaction potential of the subsoils is taken into consideration by either the foundation design or shallow ground improvement within the building footprints

Predicted settlements associated with a ULS earthquake event should be taken into account by the design structural engineer. A minimum geotechnical ultimate bearing capacity of 300kPa is generally expected to be available from below the topsoil layer. This will need to be confirmed by site specific testing for building consent.
It is generally expected that additional geotechnical investigations for IL1 and IL2 building structures would only require conventional hand auger and Scala penetrometer testing in the location of the proposed building footprints.

IL3 building structures relying on deep piles for liquefaction mitigation should have at least one deep machine borehole in order to prove the depth and consistency of the inferred dense gravel layer beneath the site.

8 LIMITATIONS

This report has been prepared exclusively for RDT Pacific and the Ministry of Education with respect to the particular brief given to us. Information, opinions and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. Land Development & Exploration Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

This report was prepared in general accordance with current standards, codes and practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods, and subsurface investigations at discrete locations. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from that described in this report.

This report should be read in its entirety to understand the context of the opinions and recommendations given.

For and on behalf of LDE Ltd

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APPENDIX A

GEOTECHNICAL INVESTIGATION PLAN

LDE DEVELOPMENT & EXPLORATION LTD.

Geotechnical Investigation Plan
Bennett Road, Hastings

DRAWN	BA
CHECKED	DND
DATE	15-Jun-17
PROJECT	13348

APPENDIX B
HAND AUGER LOGS &
CONE PENETROMETER TEST RESULTS

BOREHOLE LOG

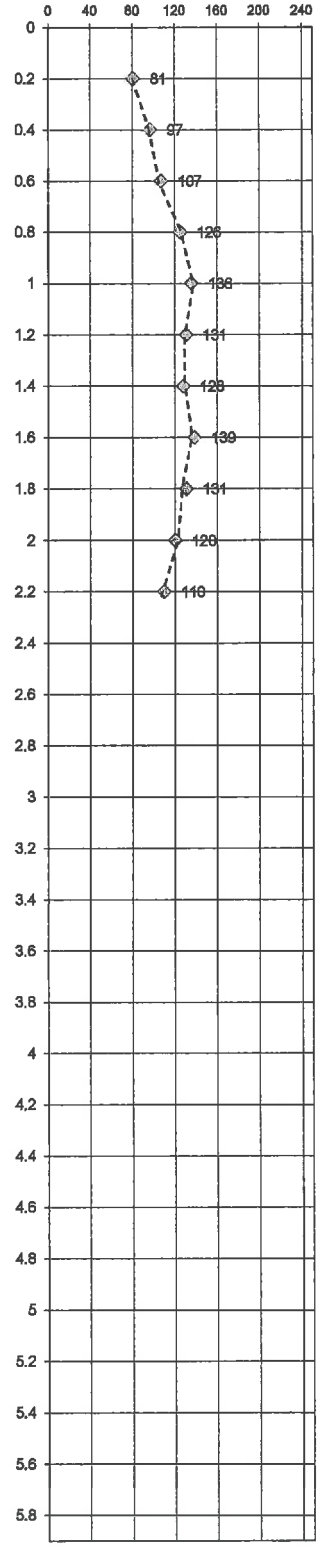
DEVELOPMENT & EXPLORATION LTD.

BOREHOLE No: HA1

Client: RDT Pacific Ltd	**Project:** Geotechincal Investigation	**LDE Project No:** 13348
Project Location: Bennett Road, Hastings	**Borehole Location:** Refer to Site Investigation Plan	**Hole started:** 6/06/2017 **Hole completed:** 6/06/2017
Co-ordinates: mN mE	**Drill method:** 50mm handauger	**Drilled by:** B.Archer **Logged by:** B.Archer

Depth (m)	Graphic	Moisture	Strength	Soil Description	Geology
0.0		M-W		SILT, brown, moist to wet	Organic Topsoil
0.4		M		SILT, trace sand, light brown, moist	Weathered Alluvium
0.6			Vst	very stiff	
0.9				some sand	
1.3		D-M		sandy, dry to moist	
1.7		W		wet	
2.2		S		saturated	
2.3				SAND, silty, greyish brown, saturated	
2.7				End of Borehole @ 2.7m Unable to complete borehole due to saturated sand inflows Water table @ 2.2m	

Undrained Shear Strength (kPa)



Notes: Shear strength lines are indicative only.
Shear strength calibrated and adjusted for plasticity
UTP: Unable to penetrate

BOREHOLE LOG

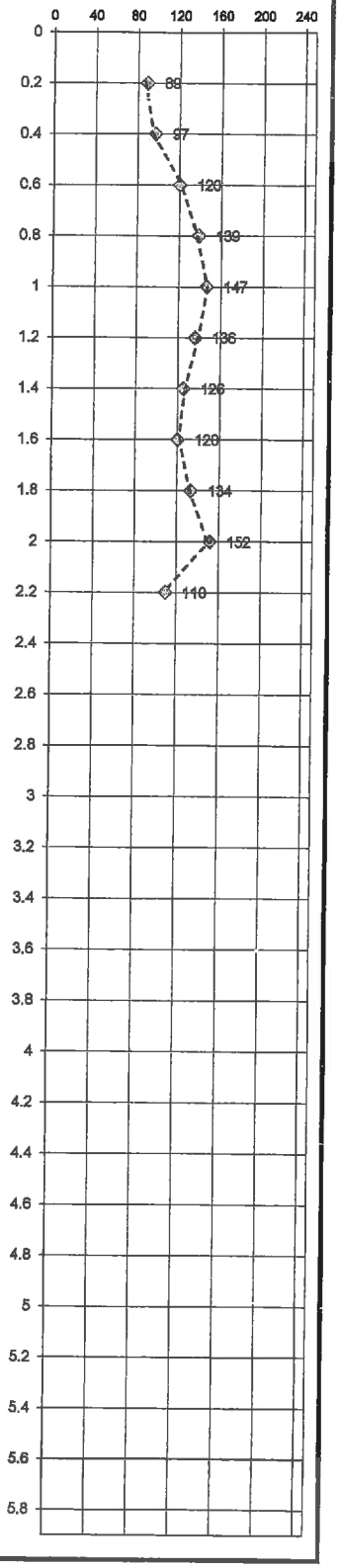
LDE DEVELOPMENT & EXPLORATION LTD.

BOREHOLE No: HA2

Client: RDT Pacific Ltd	**Project:** Geotechincal Investigation	**LDE Project No:** 13348
Project Location: Bennett Road, Hastings	**Borehole Location:** Refer to Site Investigation Plan	**Hole started:** 6/06/2017 **Hole completed:** 6/06/2017
Co-ordinates: mN mE	**Drill method:** 50mm handauger	**Drilled by:** B.Archer **Logged by:** B.Archer

Depth (m)	Graphic	Moisture	Strength	Soil Description	Geology
0.0		M-W		SILT, brown, moist to wet	Organic Topsoil
0.1					
0.2		M	St	SILT, trace sand, light brown, stiff, moist	Weathered Alluvium
0.3					
0.4					
0.5					
0.6			Vst	very stiff	
0.7					
0.8					
0.9					
1.0				some sand	
1.1					
1.2					
1.3					
1.4					
1.5		W		wet	
1.6					
1.7					
1.8					
1.9		S		saturated	
2.0					
2.1					
2.2				SAND, silty, greyish brown, saturated	
2.3					
2.4				End of Borehole @ 2.4m	
2.5				Unable to complete borehole due to saturated sand inflows	
2.6				Water table @ 2.2m	
2.7					
2.8					
2.9					
3.0					
3.1					
3.2					
3.3					
3.4					
3.5					
3.6					
3.7					
3.8					
3.9					
4.0					
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5.0					
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					

Undrained Shear Strength (kPa)



Notes: Shear strength lines are indicative only.
Shear strength calibrated and adjusted for plasticity
UTP: Unable to penetrate

BOREHOLE LOG

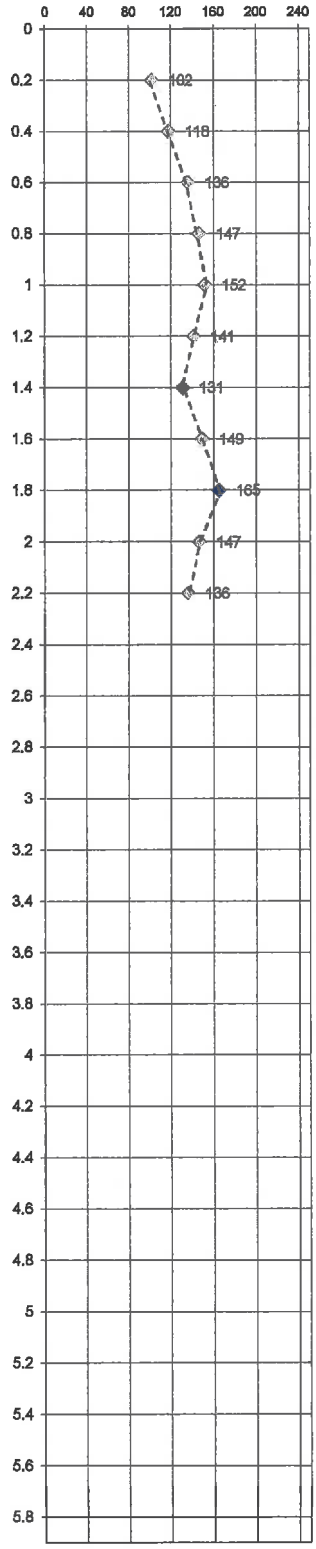
BOREHOLE No: HA3

DEVELOPMENT & EXPLORATION LTD.

Client: RDT Pacific Ltd	**Project:** Geotechincal Investigation	**LDE Project No:** 13348
Project Location: Bennett Road, Hastings	**Borehole Location:** Refer to Site Investigation Plan	**Hole started:** 6/06/2017 **Hole completed:** 6/06/2017
Co-ordinates: mN mE	**Drill method:** 50mm handauger	**Drilled by:** B.Archer **Logged by:** B.Archer

Depth (m)	Graphic	Moisture	Strength	Soil Description	Geology
0.0		M-W		SILT, brown, moist to wet	Organic Topsoil
0.3			Vst		
0.4		M		SILT, trace sand, light brown, moist	Weathered Alluvium
1.3				some clay	
1.8		W		wet	
2.0				yellowish brown	
2.3					
2.4		S		SAND, grey, saturated	
2.8				End of Borehole @ 2.8m Unable to complete borehole due to saturated sand inflows Water table @ 2.4m	

Undrained Shear Strength (kPa)



Notes: Shear strength lines are indicative only.
Shear strength calibrated and adjusted for plasticity
UTP: Unable to penetrate

LDE DEVELOPMENT & EXPLORATION LTD.

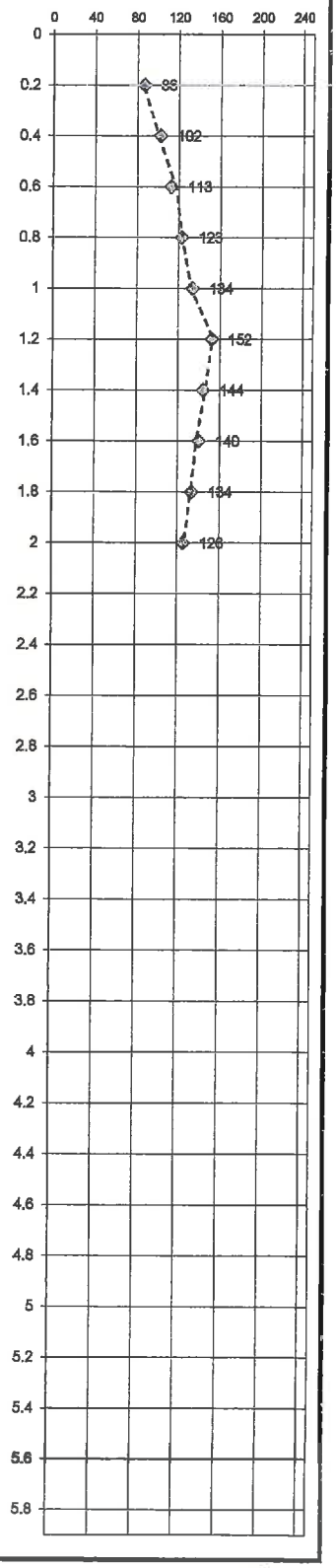
BOREHOLE LOG

BOREHOLE No: HA4

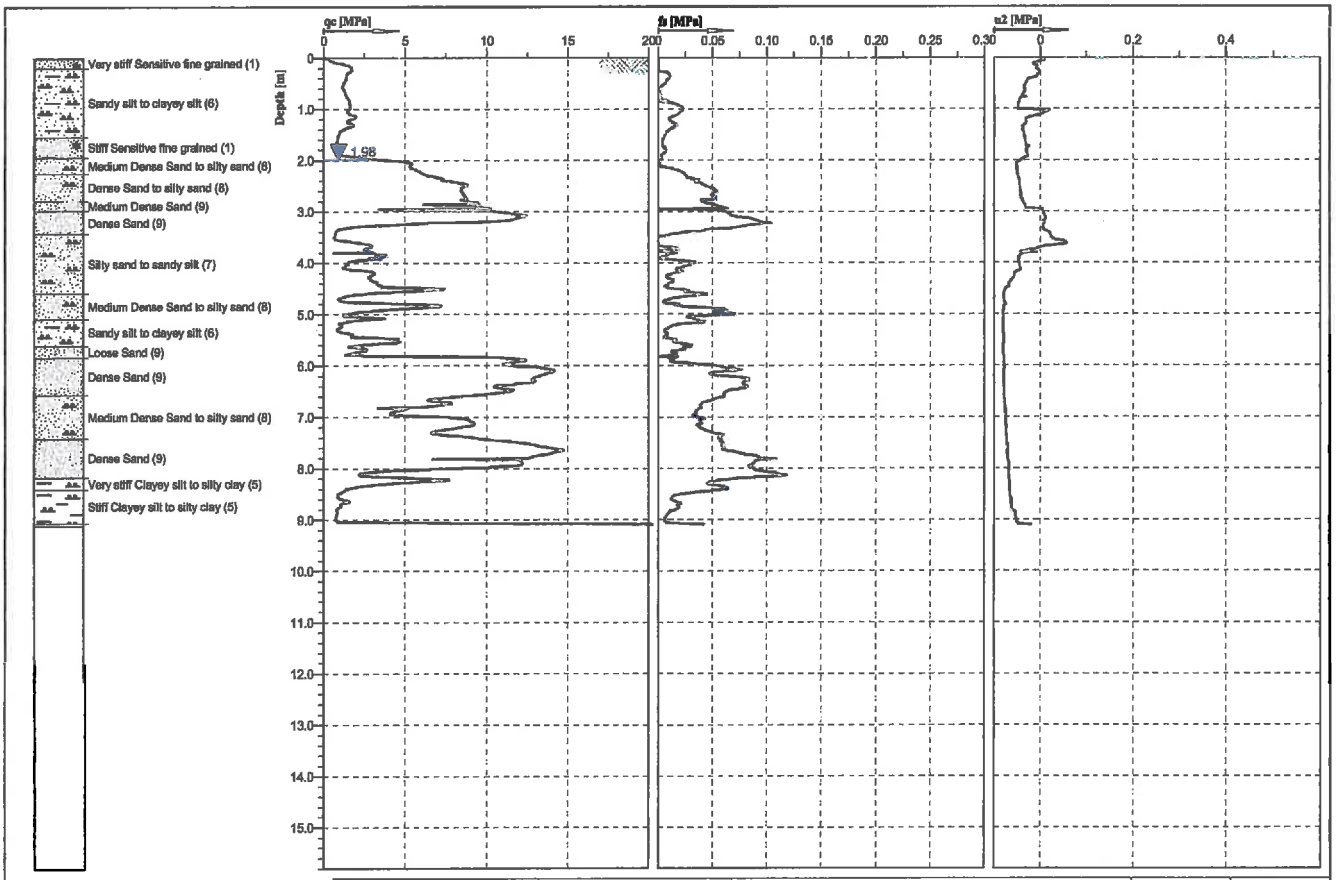
Client: RDT Pacific Ltd	**Project:** Geotechincal Investigation	**LDE Project No:** 13348
Project Location: Bennett Road, Hastings	**Borehole Location:** Refer to Site Investigation Plan	**Hole started:** 6/06/2017 **Hole completed:** 6/06/2017
Co-ordinates: mN mE	**Drill method:** 50mm handauger	**Drilled by:** B.Archer **Logged by:** B.Archer

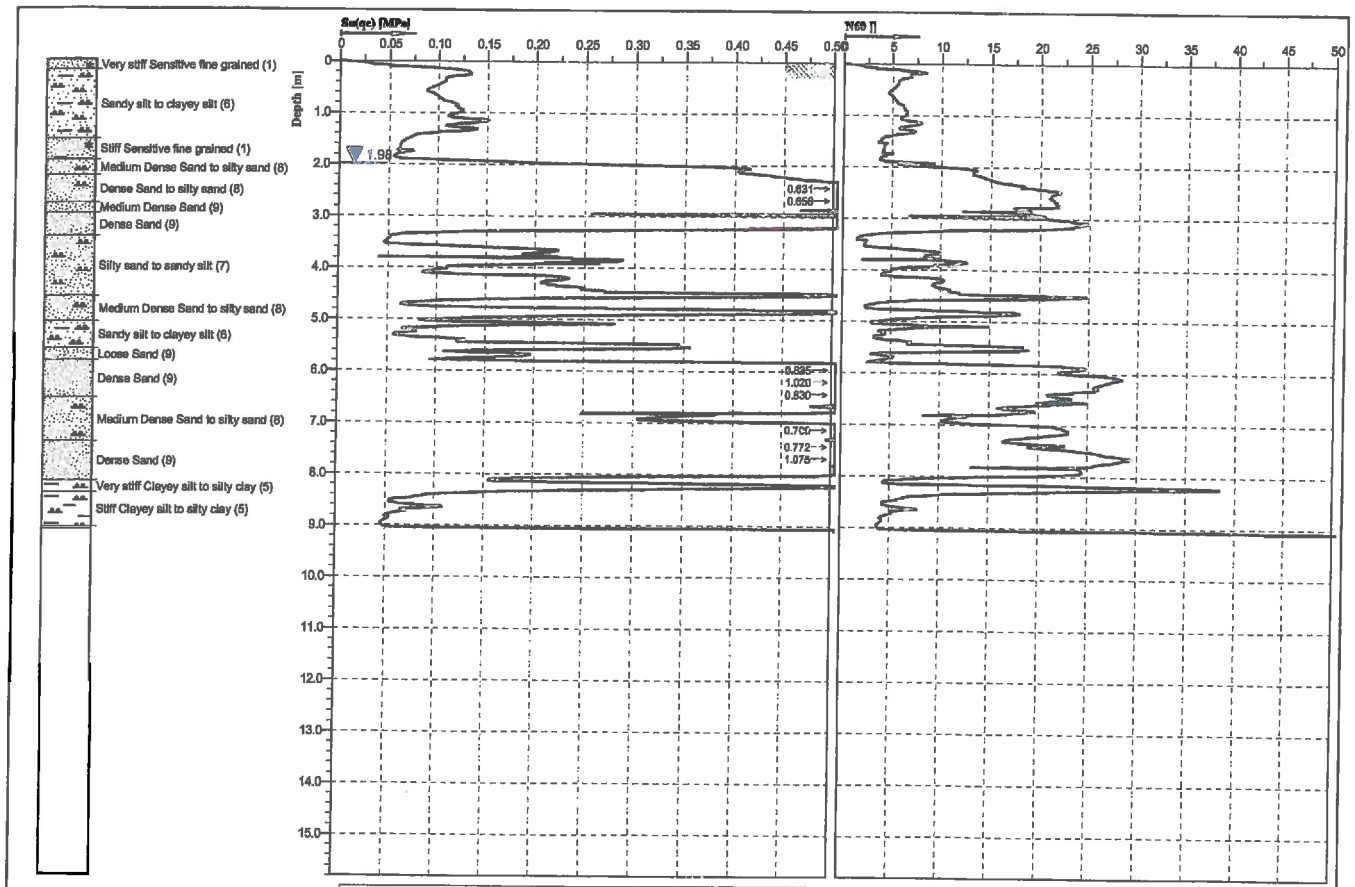
Depth (m)	Graphic	Moisture	Strength	Soil Description	Geology
0.0				SILT, brown, moist to wet	Organic Topsoil
0.1					
0.2			St	stiff	
0.3					
0.4		M	Vst	SILT, sandy, light brown, very stiff, moist	Weathered Alluvium
0.5					
0.6					
0.7					
0.8				some clay	
0.9					
1.0				sandy	
1.1					
1.2					
1.3					
1.4					
1.5					
1.6				yellowish brown	
1.7					
1.8					
1.9		S		grey, saturated	
2.0				End of Borehole @ 2.0m	
2.1				Unable to complete due to auger spin	
2.2				Water table @ 1.9m	
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					
3.1					
3.2					
3.3					
3.4					
3.5					
3.6					
3.7					
3.8					
3.9					
4.0					
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5.0					
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					

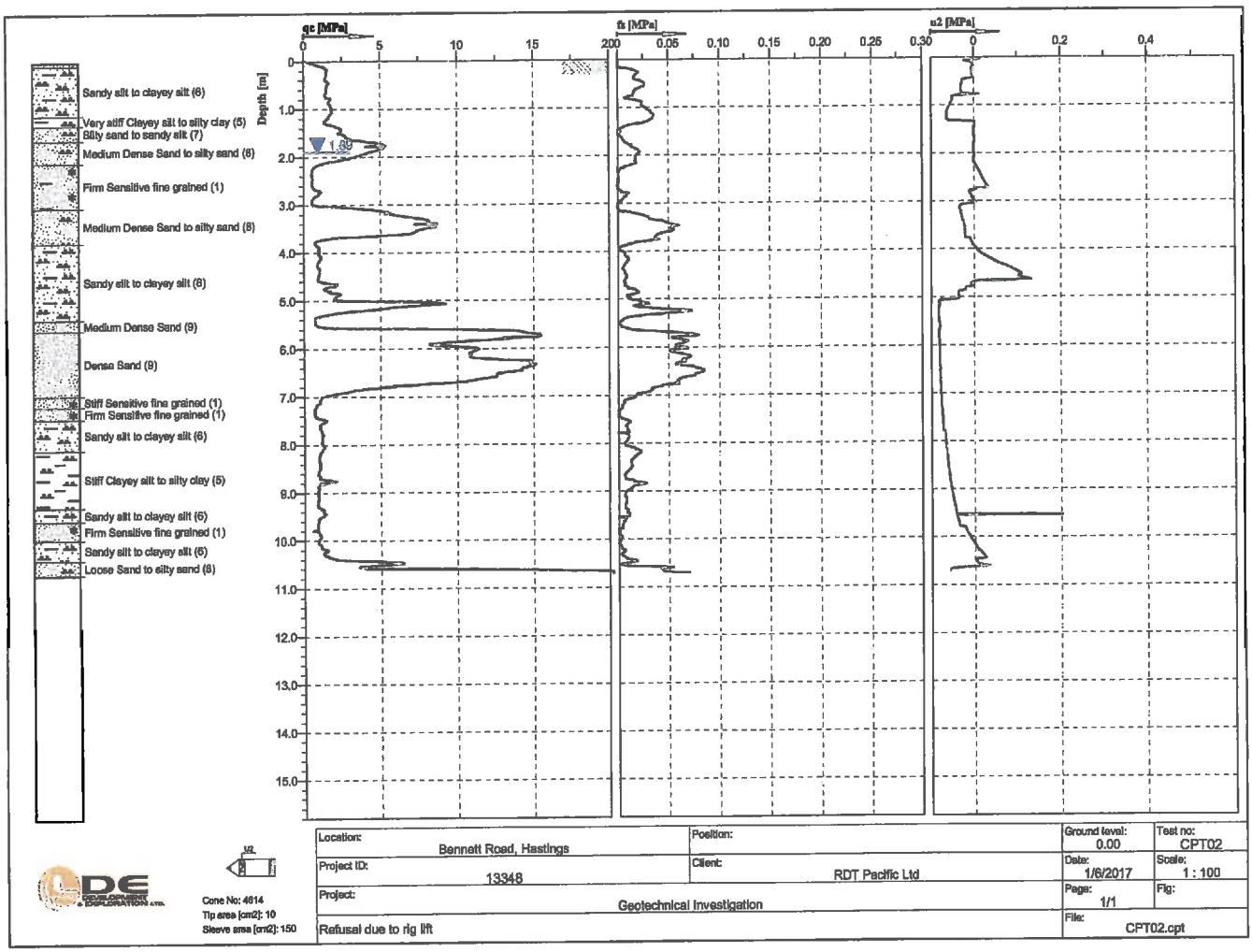
Undrained Shear Strength (kPa)

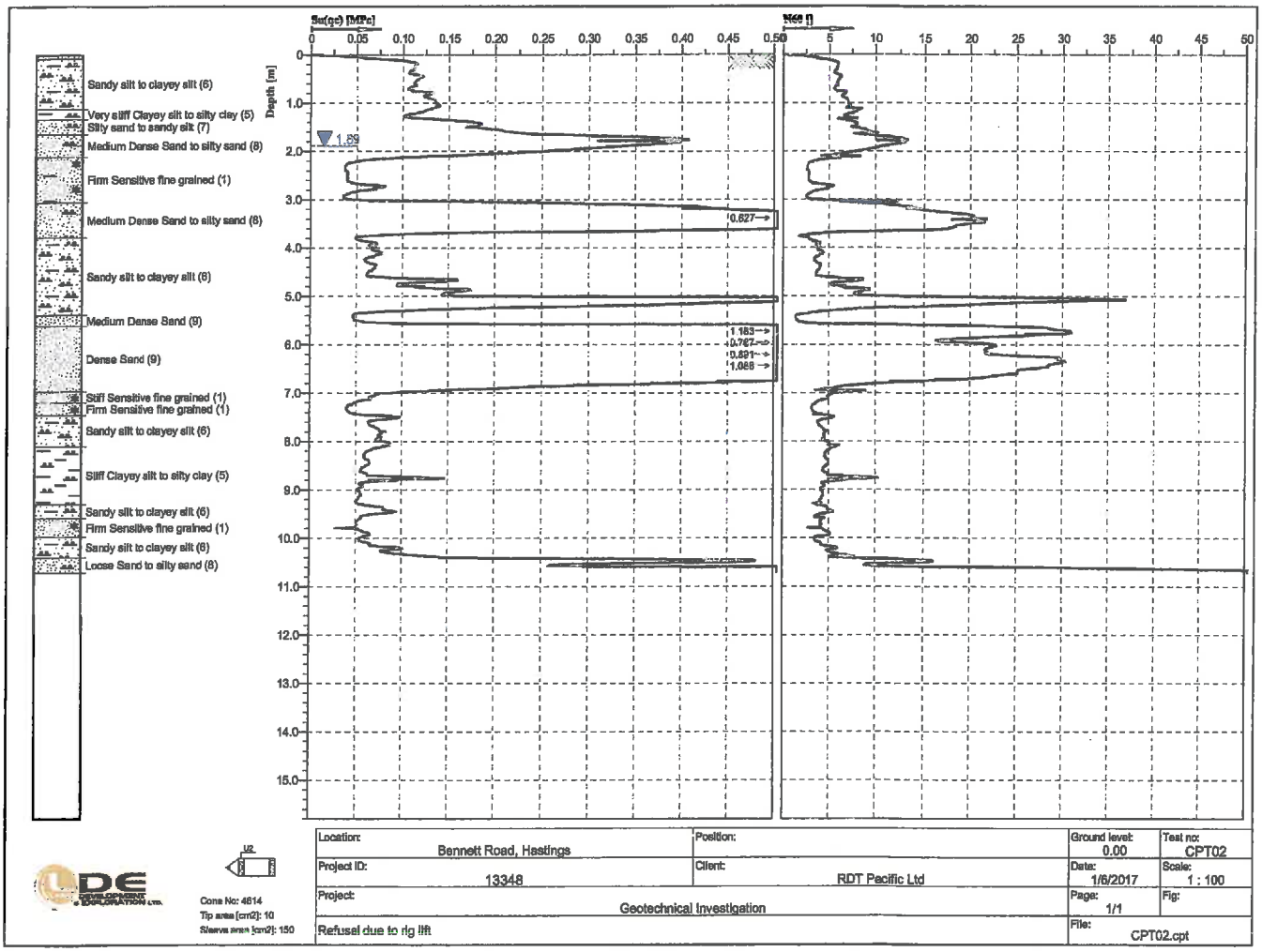


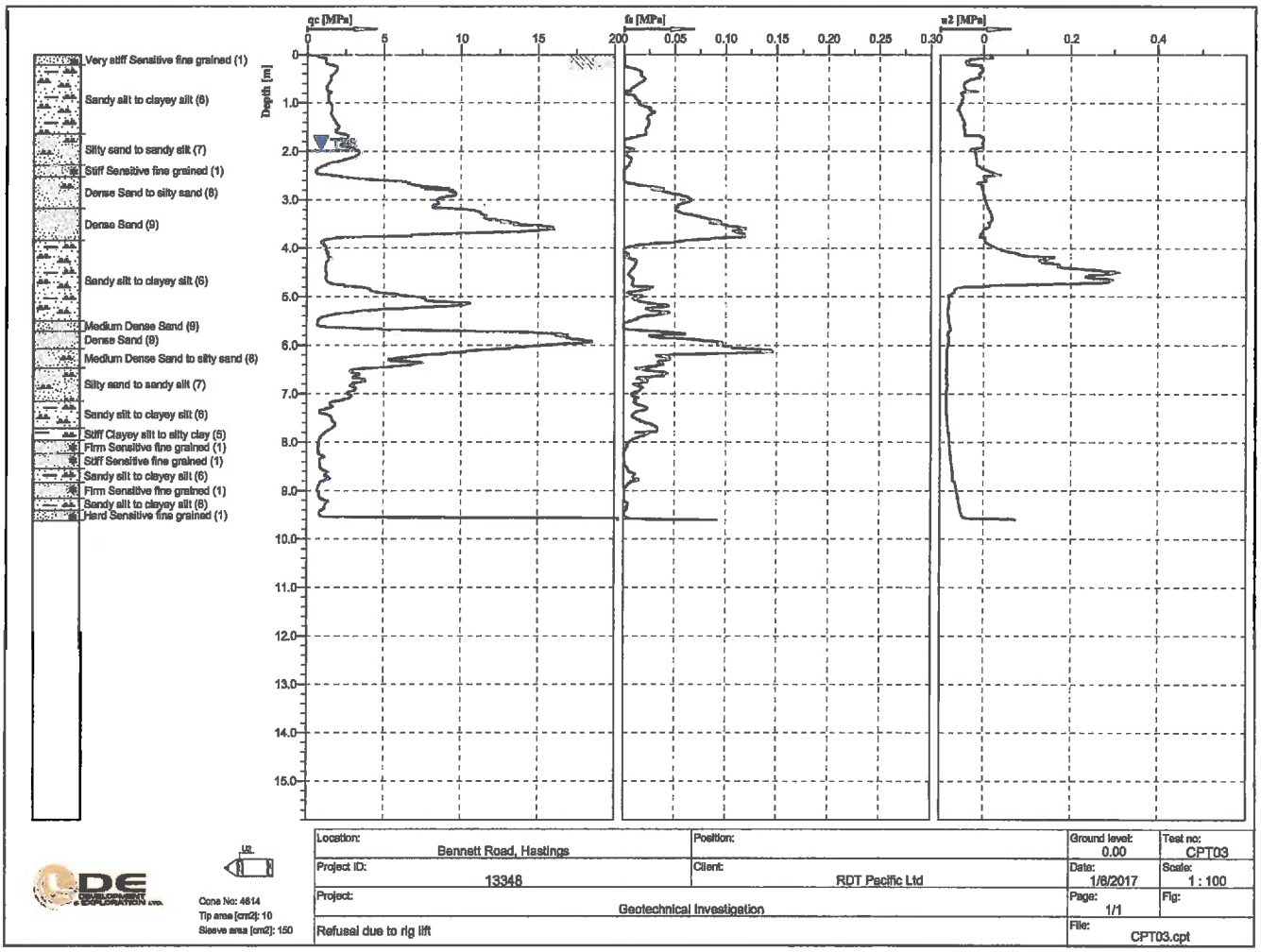
Notes: Shear strength lines are indicative only.
Shear strength calibrated and adjusted for plasticity
UTP: Unable to penetrate

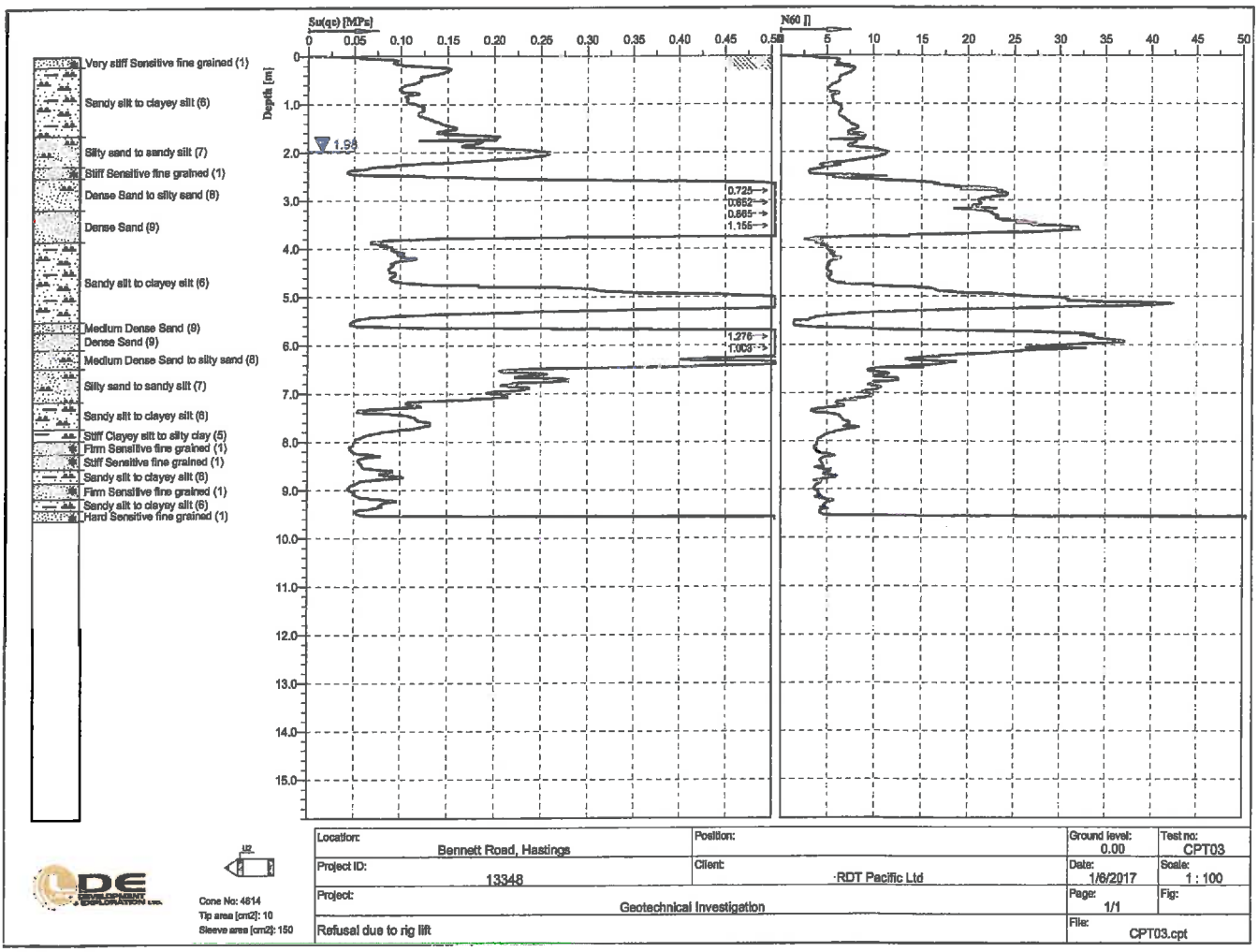

qc [MPa]
fs [MPa]
u2 [MPa]
Depth [m]
Very stiff Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Stiff Sensitive fine grained (1)
Medium Dense Sand to silty sand (8)
Dense Sand to silty sand (8)
Medium Dense Sand (9)
Dense Sand (9)
Silty sand to sandy silt (7)
Medium Dense Sand to silty sand (8)
Sandy silt to clayey silt (6)
Loose Sand (9)
Dense Sand (9)
Medium Dense Sand to silty sand (8)
Dense Sand (9)
Very stiff Clayey silt to silty clay (5)
Stiff Clayey silt to silty clay (5)
1.98
u2
Cone No: 4814
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Bennett Road, Hastings
Position:
Ground level: 0.00
Test no: CPT01
Project ID: 13348
Client: RDT Pacific Ltd
Date: 6/1/2017
Scale: 1 : 100
Project: Geotechnical Investigation
Page: 1/1
Fig:
Refusal due to rig lift
File: CPT01.cpt


Qc(qc) [MPa]
0 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50
N60 []
5 10 15 20 25 30 35 40 45 50
Depth [m]
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0
1.99
0.631
0.659
0.835
1.020
0.830
0.760
0.772
1.075
Very stiff Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Stiff Sensitive fine grained (1)
Medium Dense Sand to silty sand (6)
Dense Sand to silty sand (6)
Medium Dense Sand (9)
Dense Sand (9)
Silty sand to sandy silt (7)
Medium Dense Sand to silty sand (6)
Sandy silt to clayey silt (6)
Loose Sand (9)
Dense Sand (9)
Medium Dense Sand to silty sand (6)
Dense Sand (9)
Very stiff Clayey silt to silty clay (5)
Stiff Clayey silt to silty clay (5)
u2
Cone No: 4614
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Bennett Road, Hastings
Position:
Ground level: 0.00
Test no: CPT01
Project ID: 13348
Client: RDT Pacific Ltd
Date: 6/1/2017
Scale: 1 : 100
Project: Geotechnical Investigation
Page: 1/1
Fig:
Refusal due to rig lift
File: CPT01.cpt


qc [MPa]
fs [MPa]
u2 [MPa]
Depth [m]
Sandy silt to clayey silt (6)
Very stiff Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Medium Dense Sand to silty sand (8)
Firm Sensitive fine grained (1)
Medium Dense Sand to silty sand (8)
Sandy silt to clayey silt (6)
Medium Dense Sand (9)
Dense Sand (9)
Stiff Sensitive fine grained (1)
Firm Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Stiff Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Firm Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Loose Sand to silty sand (8)
Location: Bennett Road, Hastings
Position:
Ground level: 0.00
Test no: CPT02
Project ID: 13348
Client: RDT Pacific Ltd
Date: 1/6/2017
Scale: 1 : 100
Project: Geotechnical Investigation
Page: 1/1
Fig:
Refusal due to rig lift
File: CPT02.cpt
Cone No: 4614
Tip area [cm2]: 10
Sleeve area [cm2]: 150

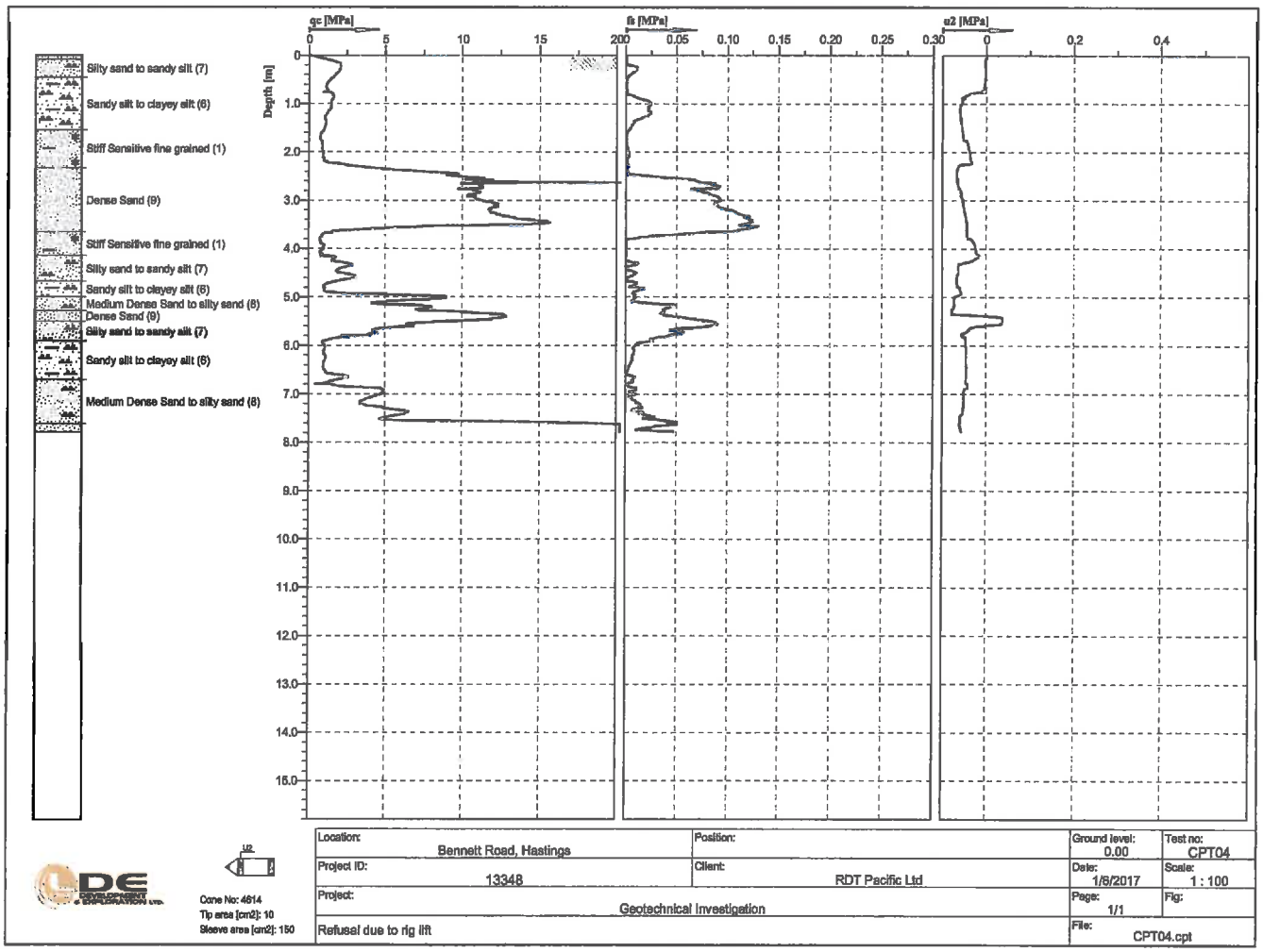

Su(qc) [MPa]
Nkt [-]
Depth [m]
Sandy silt to clayey silt (6)
Very stiff Clayey silt to silty clay (5)
Silty sand to sandy silt (7)
Medium Dense Sand to silty sand (8)
Firm Sensitive fine grained (1)
Medium Dense Sand to silty sand (8)
Sandy silt to clayey silt (6)
Medium Dense Sand (9)
Dense Sand (9)
Stiff Sensitive fine grained (1)
Firm Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Stiff Clayey silt to silty clay (5)
Sandy silt to clayey silt (6)
Firm Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Loose Sand to silty sand (8)
1.59
0.627
1.183
0.767
0.821
1.088
Location: Bennett Road, Hastings
Position:
Ground level: 0.00
Test no: CPT02
Project ID: 13348
Client: RDT Pacific Ltd
Date: 1/6/2017
Scale: 1 : 100
Project: Geotechnical Investigation
Page: 1/1
Fig:
Refusal due to rig lift
File: CPT02.cpt
Cone No: 4614
Tip area [cm2]: 10
Sleeve area [cm2]: 150


qc [MPa]
fs [MPa]
u2 [MPa]
Depth [m]
Very stiff Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Silty sand to sandy silt (7)
Stiff Sensitive fine grained (1)
Dense Sand to silty sand (6)
Dense Sand (9)
Sandy silt to clayey silt (6)
Medium Dense Sand (9)
Dense Sand (9)
Medium Dense Sand to silty sand (8)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Stiff Clayey silt to silty clay (5)
Firm Sensitive fine grained (1)
Stiff Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Firm Sensitive fine grained (1)
Sandy silt to clayey silt (6)
Hard Sensitive fine grained (1)
Cone No: 4614
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location: Bennett Road, Hastings
Position:
Ground level: 0.00
Test no: CPT03
Project ID: 13348
Client: RDT Pacific Ltd
Date: 1/6/2017
Scale: 1 : 100
Project: Geotechnical Investigation
Page: 1/1
Fig:
Refusal due to rig lift
File: CPT03.cpt



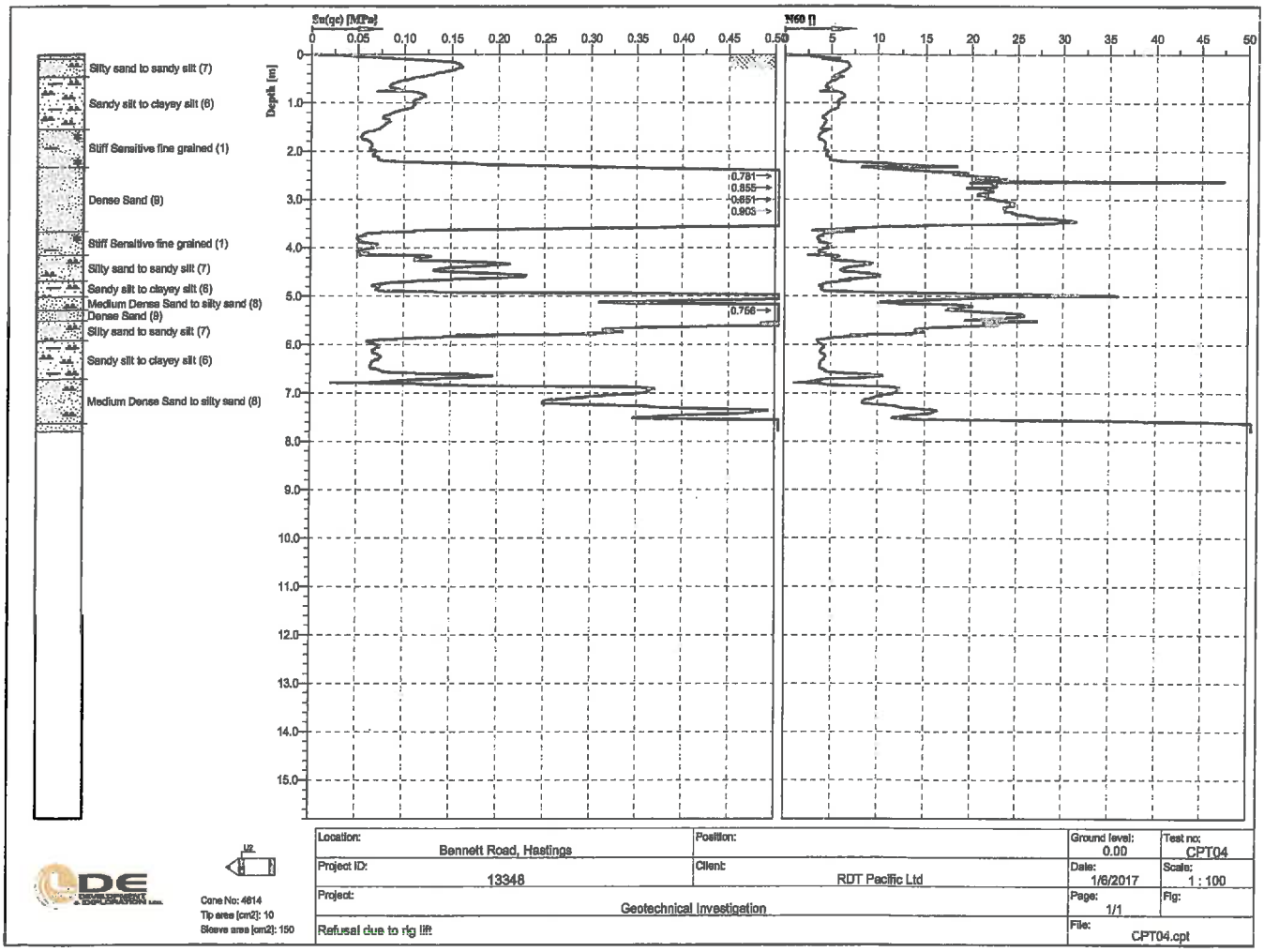
Location: Bennett Road, Hastings	Position:	Ground level: 0.00	Test no: CPT03
Project ID: 13348	Client: RDT Pacific Ltd	Date: 1/6/2017	Scale: 1 : 100
Project: Geotechnical Investigation		Page: 1/1	Fig:
Refusal due to rig lift		File: CPT03.cpt	

Cone No: 4814
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Location: Bennett Road, Hastings		Position:		Ground level: 0.00	Test no: CPT04
Project ID: 13348		Client: RDT Pacific Ltd		Date: 1/6/2017	Scale: 1 : 100
Project: Geotechnical Investigation				Page: 1/1	Fig:
Refusal due to rig lift				File: CPT04.cpt	

Cone No: 4614
Tip area [cm2]: 10
Sleeve area [cm2]: 150


Su(qc) [MPa]
N60 []
Depth [m]
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Stiff Sensitive fine grained (1)
Dense Sand (9)
Stiff Sensitive fine grained (1)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Medium Dense Sand to silty sand (8)
Dense Sand (9)
Silty sand to sandy silt (7)
Sandy silt to clayey silt (6)
Medium Dense Sand to silty sand (8)
0.781
0.855
0.851
0.903
0.766
Location: Bennett Road, Hastings
Position:
Ground level: 0.00
Test no: CPT04
Project ID: 13348
Client: RDT Pacific Ltd
Date: 1/6/2017
Scale: 1 : 100
Project: Geotechnical Investigation
Page: 1/1
Fig:
Refusal due to rig lift
File: CPT04.cpt
Cone No: 4614
Tip area [cm2]: 10
Sleeve area [cm2]: 150

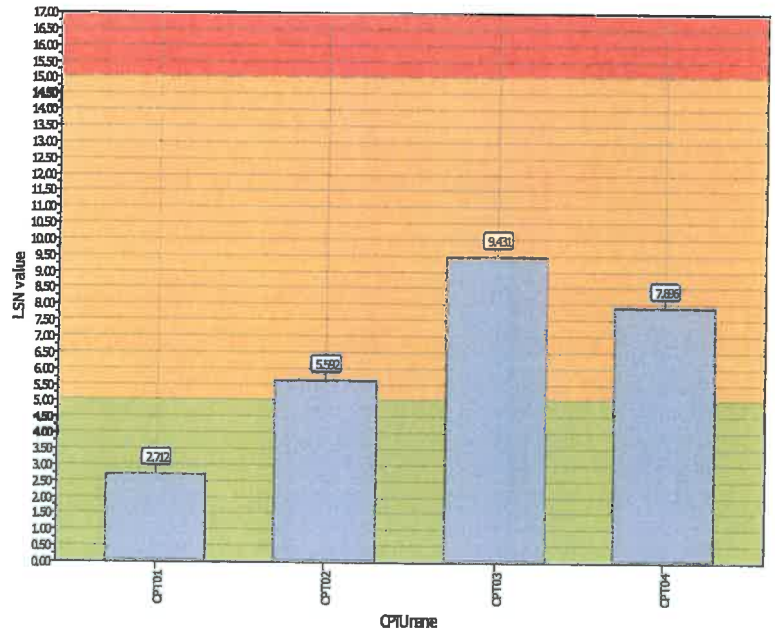
APPENDIX C
LIQUEFACTION ANALYSIS OUTPUTS

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.13g

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

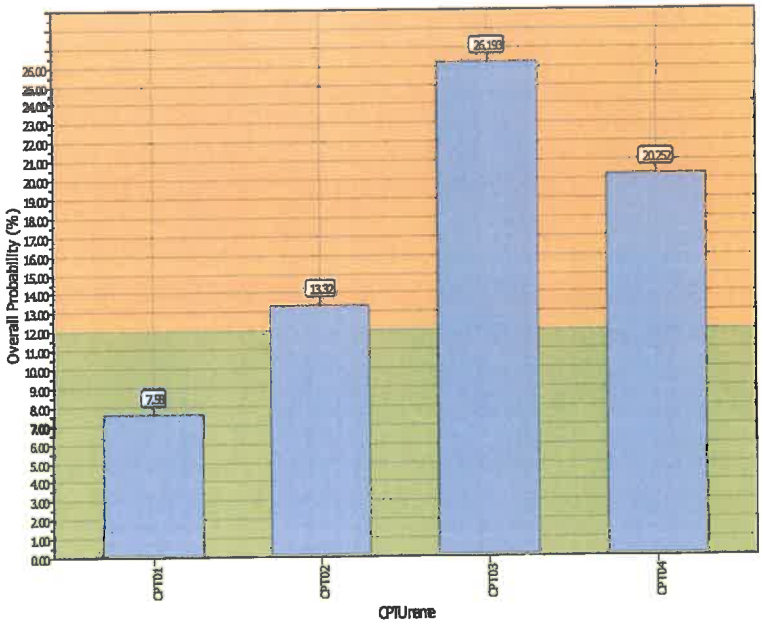
Total CPT number: 4
25.00% low risk
75.00% high risk
0.00% very high risk

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.13g

Overall Probability for Liquefaction report



Probability color scheme

- Very High Probability
- High Probability
- Low Probability

Basic statistics

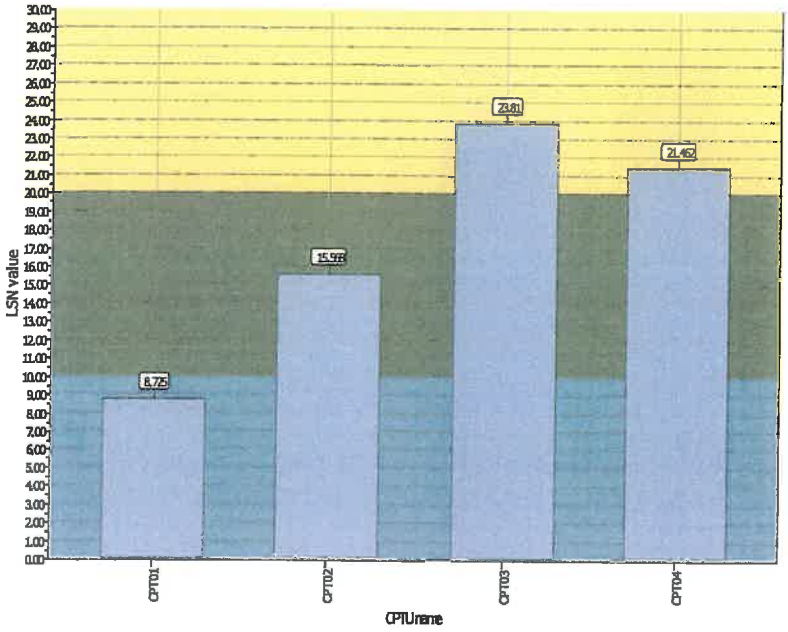
Total CPT number: 4
25.00% low probability
75.00% high probability
0.00% very high probability

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.13g

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: 4

25.00% little liquefaction

25.00% minnor liquefaction

50.00% moderate liquefaction

0.00% moderate to major liquefaction

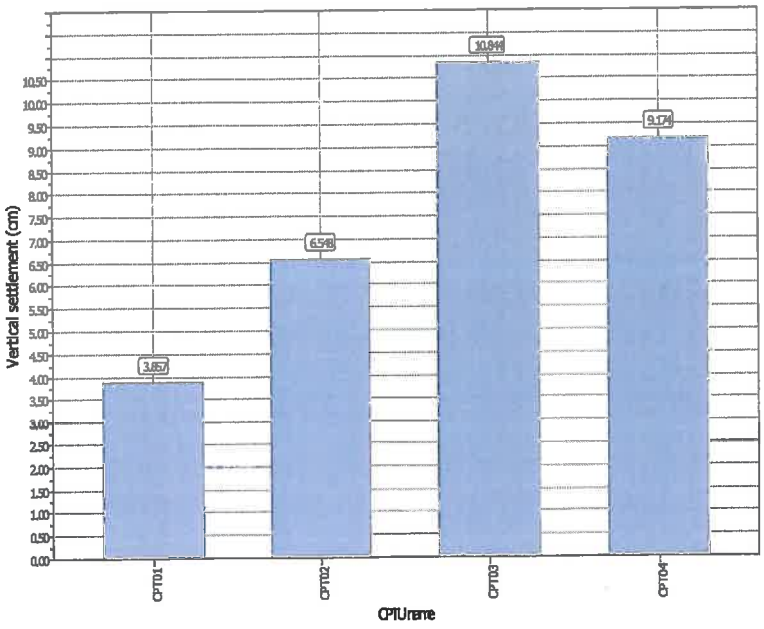
0.00% major liquefaction

0.00% severe liquefaction

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.13g

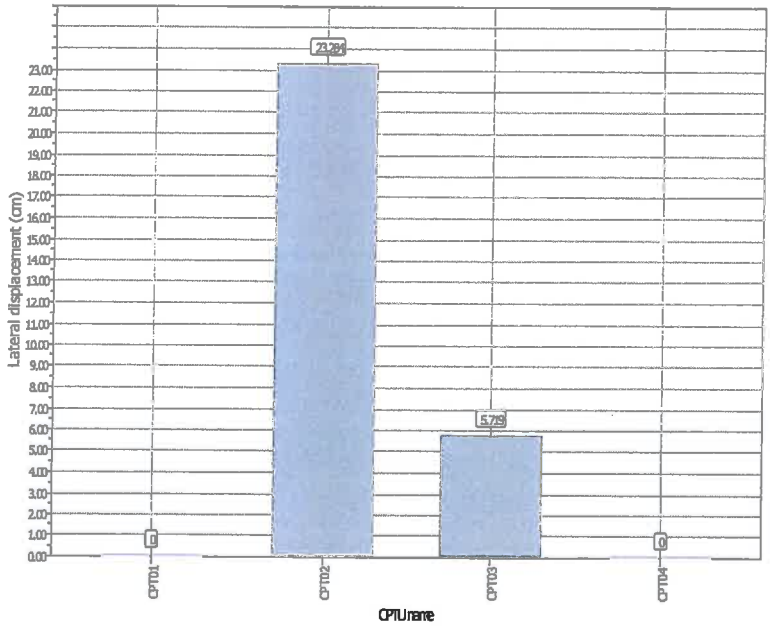
Overall vertical settlements report



Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.13g

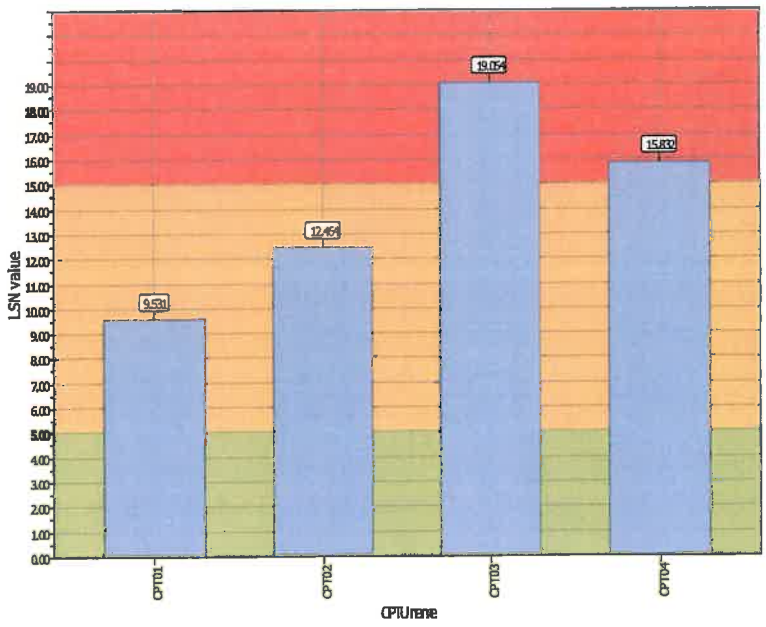
Overall lateral displacements report



Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.26g

Overall Liquefaction Potential Index report



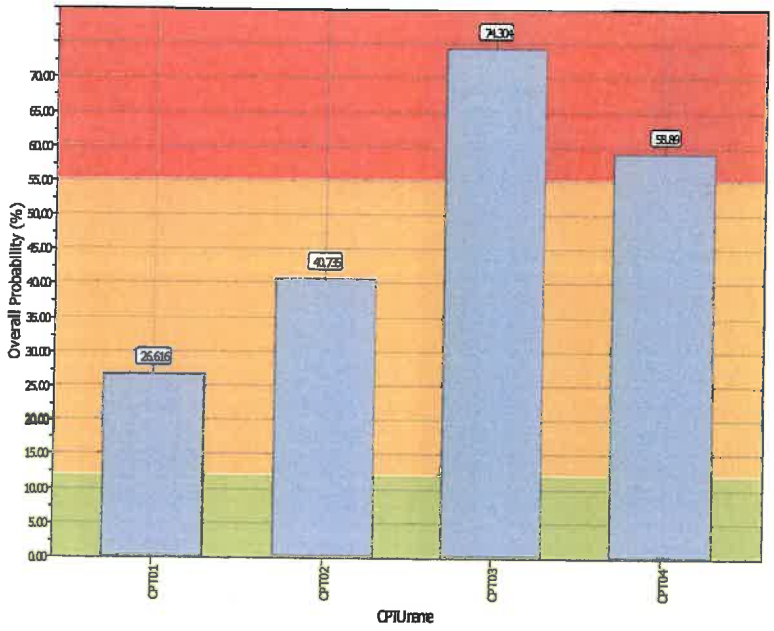
LPI color scheme
- Very high risk
- High risk
- Low risk

Basic statistics
Total CPT number: 4
0.00% low risk
50.00% high risk
50.00% very high risk

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.26g

Overall Probability for Liquefaction report



Probability color scheme
- Very High Probability
- High Probability
- Low Probability

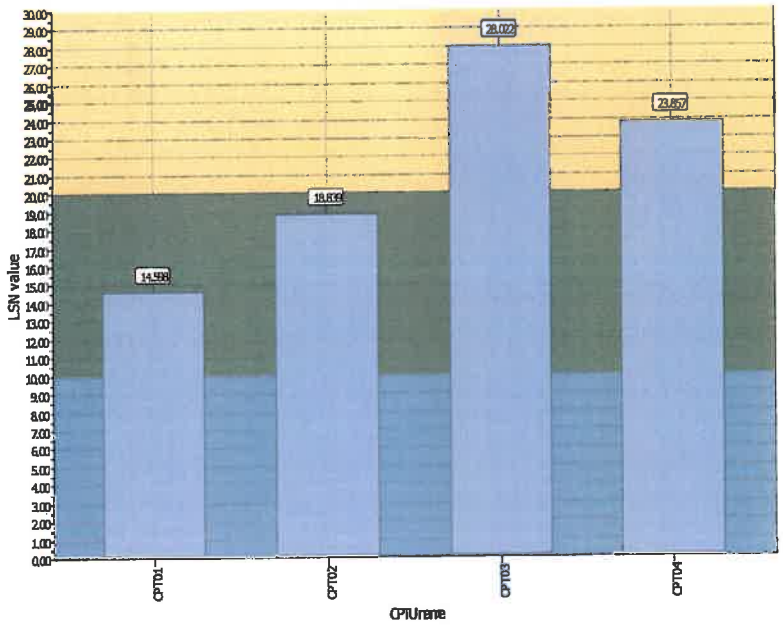
Basic statistics
Total CPT number: 4
0.00% low probability
50.00% high probability
50.00% very high probability

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.26g

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

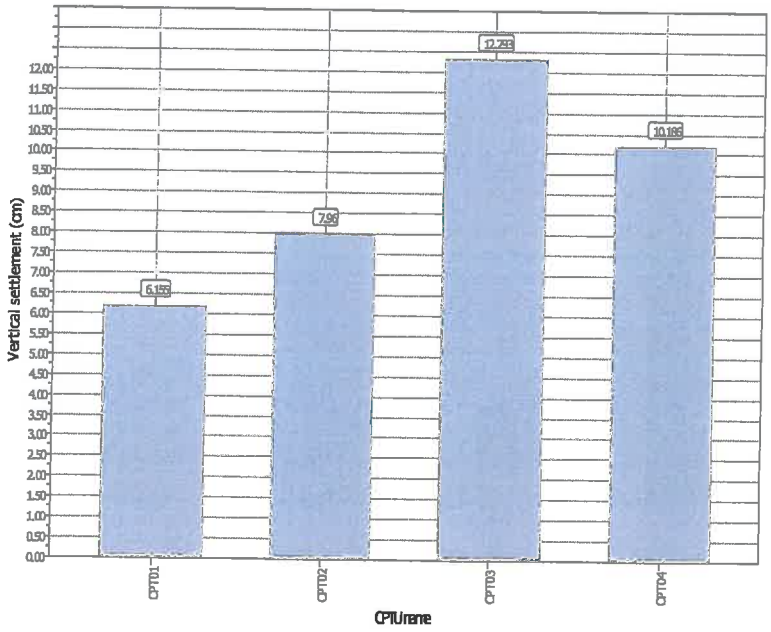
Total CPT number: 4
0.00% little liquefaction
50.00% minnor liquefaction
50.00% moderate liquefaction
0.00% moderate to major liquefaction
0.00% major liquefaction
0.00% severe liquefaction

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.26g

Overall vertical settlements report

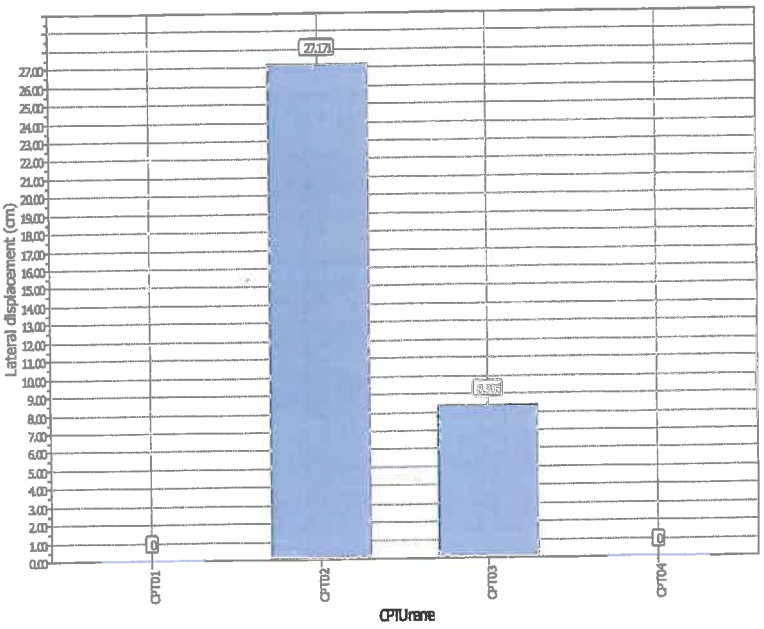


Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.26g

Overall lateral displacements report

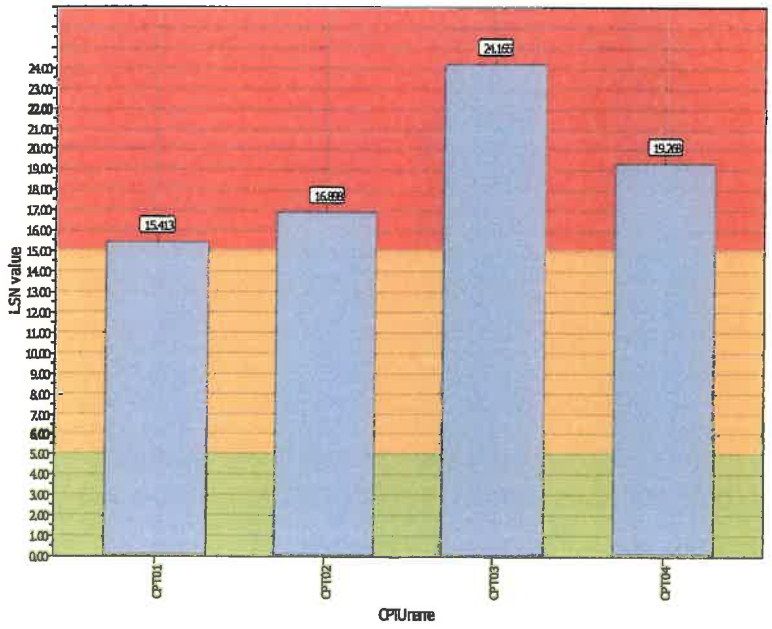


Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.39g

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

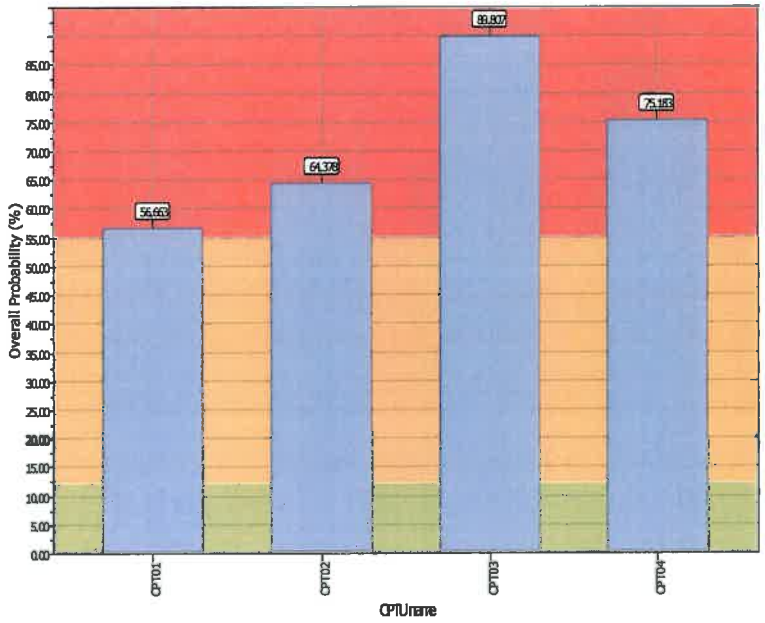
Basic statistics

Total CPT number: 4
0.00% low risk
0.00% high risk
100.00% very high risk

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.39g

Overall Probability for Liquefaction report



Probability color scheme
- Very High Probability
- High Probability
- Low Probability

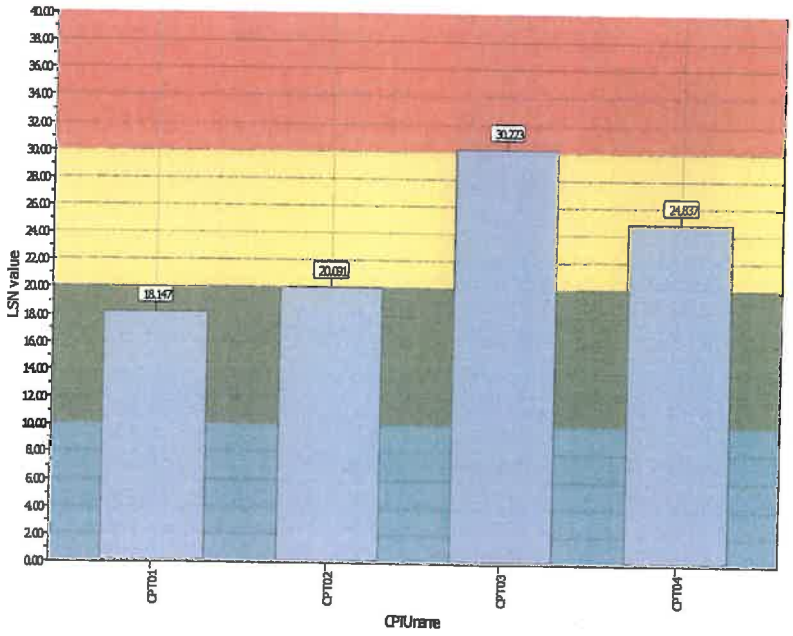
Basic statistics
Total CPT number: 4
0.00% low probability
0.00% high probability
100.00% very high probability

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.39g

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: 4

0.00% little liquefaction

25.00% minnor liquefaction

50.00% moderate liquefaction

25.00% moderate to major liquefaction

0.00% major liquefaction

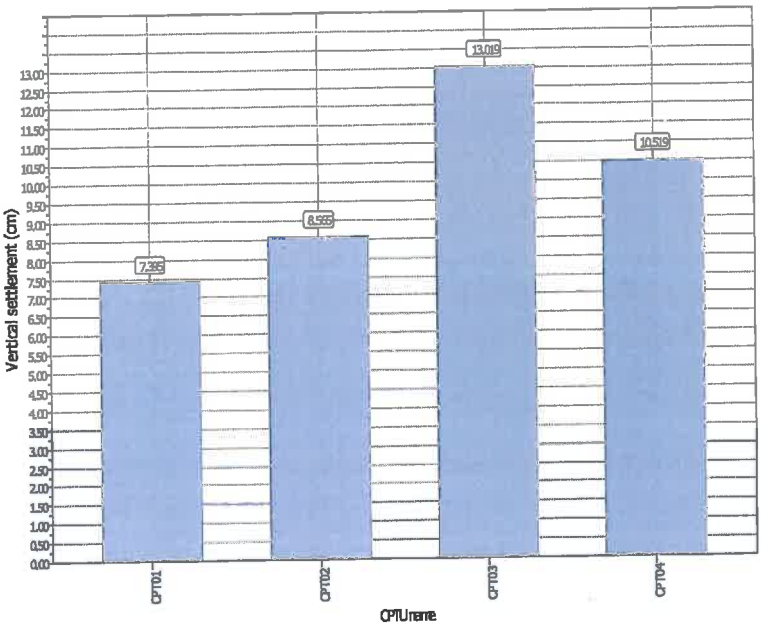
0.00% severe liquefaction

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.39g

Overall vertical settlements report

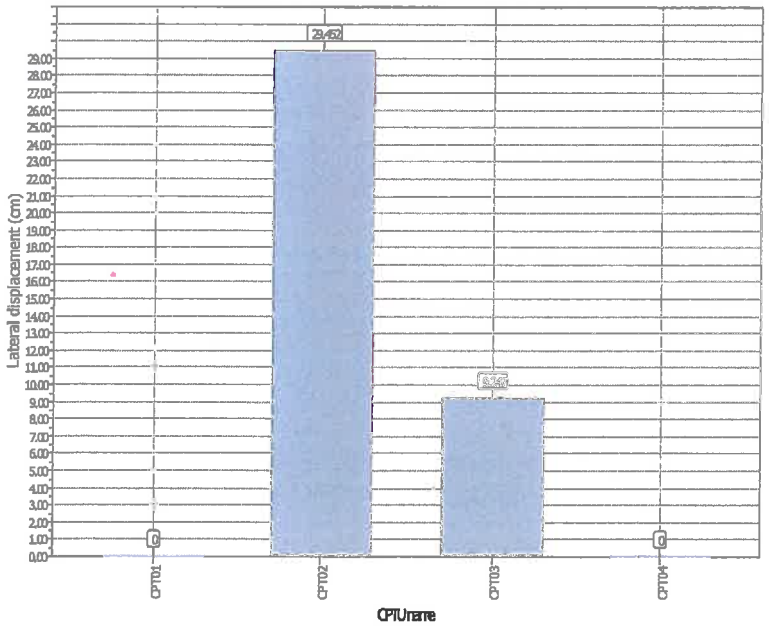


Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.39g

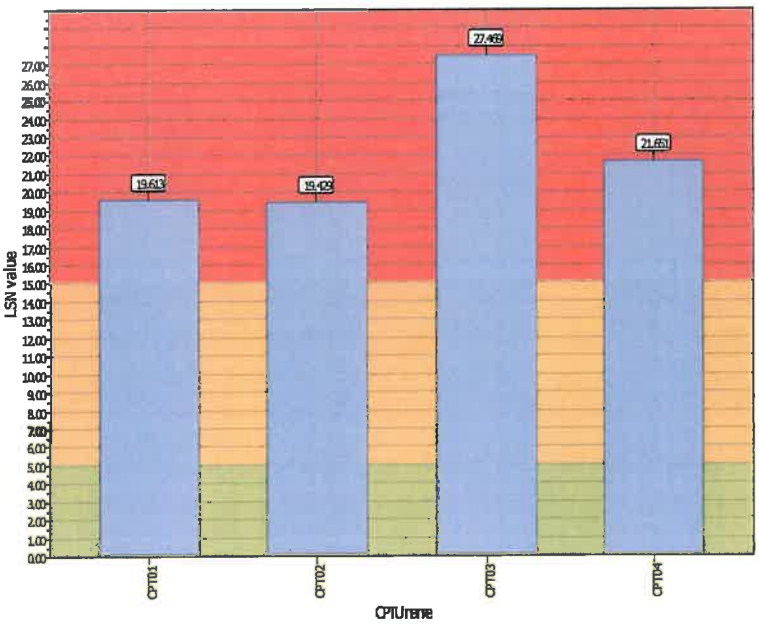
Overall lateral displacements report



Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.52g

Overall Liquefaction Potential Index report



LPI color scheme
- Very high risk
- High risk
- Low risk

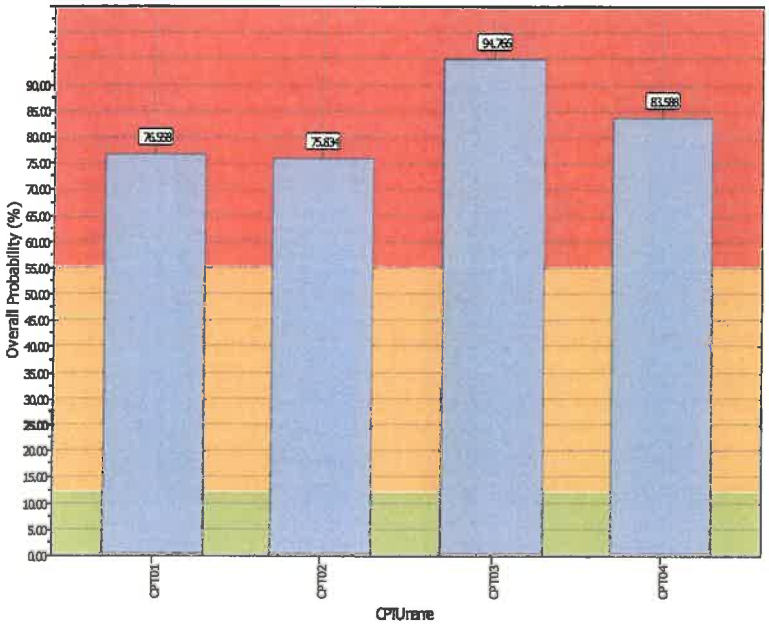
Basic statistics
Total CPT number: 4
0.00% low risk
0.00% high risk
100.00% very high risk

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.52g

Overall Probability for Liquefaction report



Probability color scheme
- Very High Probability
- High Probability
- Low Probability

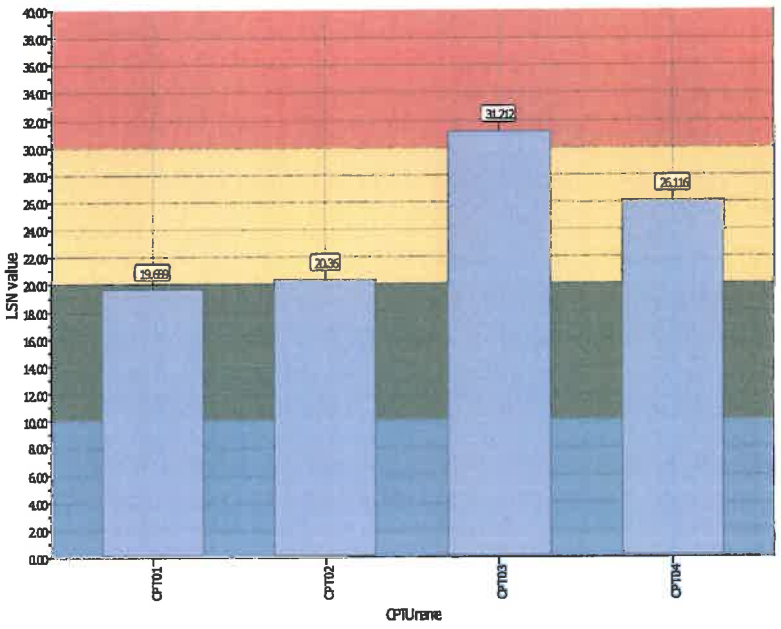
Basic statistics

Total CPT number: 4
0.00% low probability
0.00% high probability
100.00% very high probability

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.52g

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

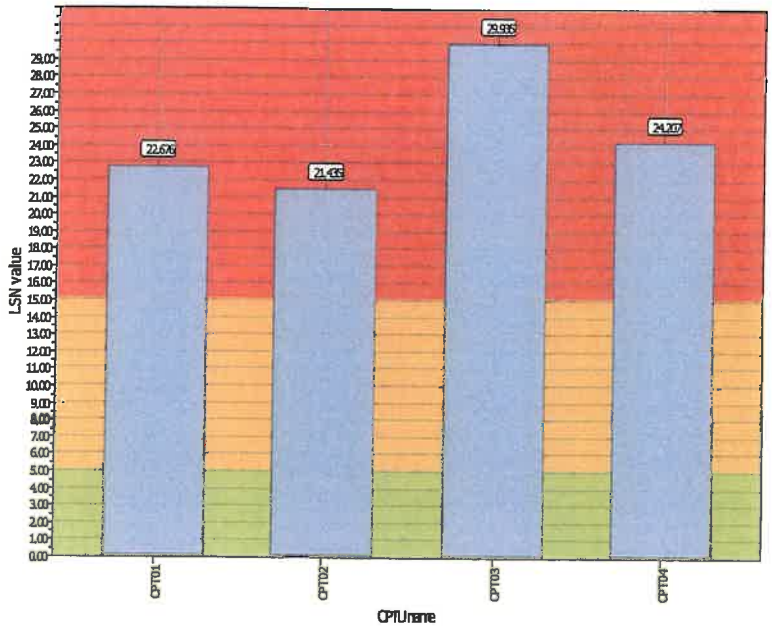
Basic statistics

Total CPT number: 4
0.00% little liquefaction
25.00% minnor liquefaction
50.00% moderate liquefaction
25.00% moderate to major liquefaction
0.00% major liquefaction
0.00% severe liquefaction

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.67g

Overall Liquefaction Potential Index report



LPI color scheme
- Very high risk
- High risk
- Low risk

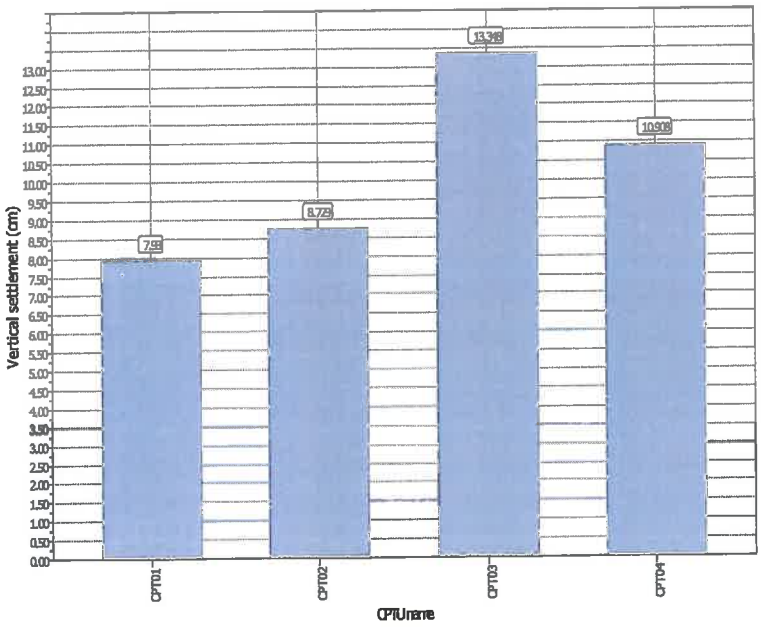
Basic statistics
Total CPT number: 4
0.00% low risk
0.00% high risk
100.00% very high risk

Land Development & Exploration Ltd
32 Grey Street, Gisborne
P.O. Box 671, New Zealand
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.52g

Overall vertical settlements report



Land Development & Exploration Ltd
32 Grey Street, Gisborne
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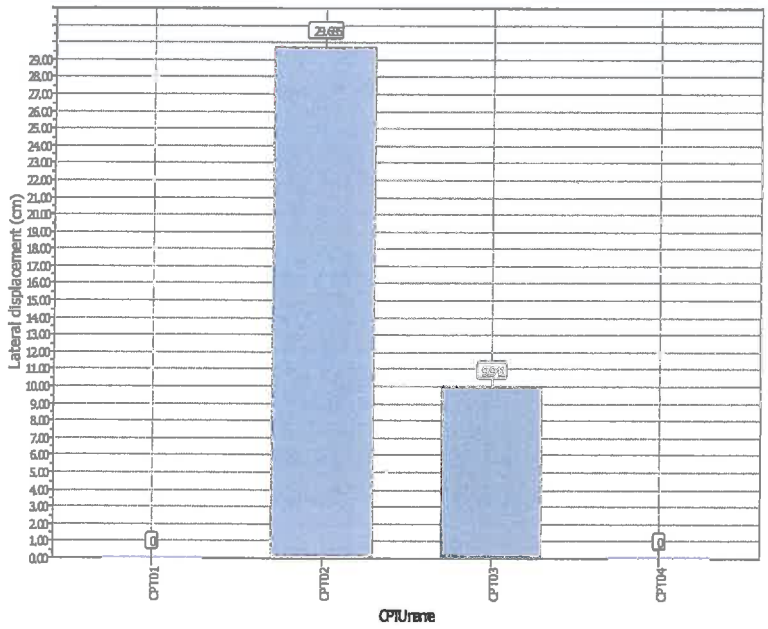
http://www.lde.co.nz

Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.52g

Overall lateral displacements report



Land Development & Exploration Ltd
32 Grey Street, Gisborne
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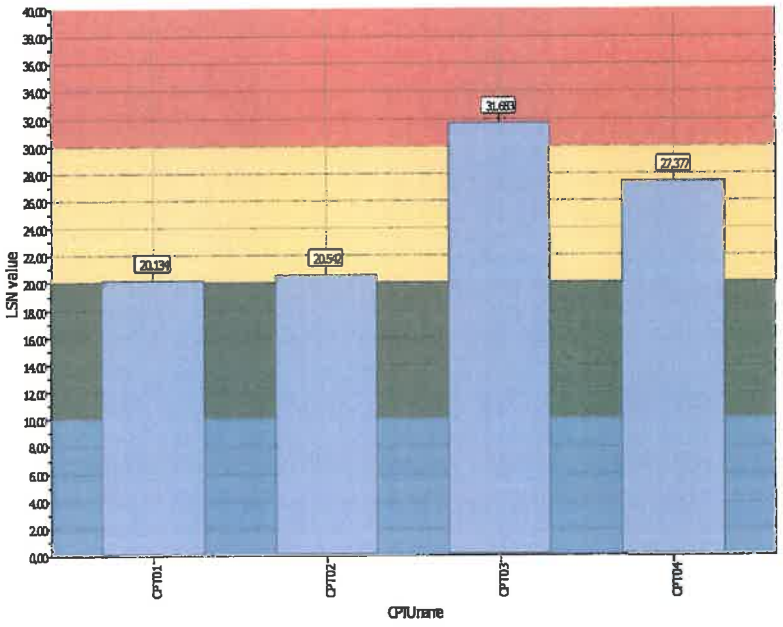
http://www.lde.co.nz

Project title : Ministry of Education
Location : Bennett Road, Hastings - 0.67g

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: 4
0.00% little liquefaction
0.00% minnor liquefaction
75.00% moderate liquefaction
25.00% moderate to major liquefaction
0.00% major liquefaction
0.00% severe liquefaction

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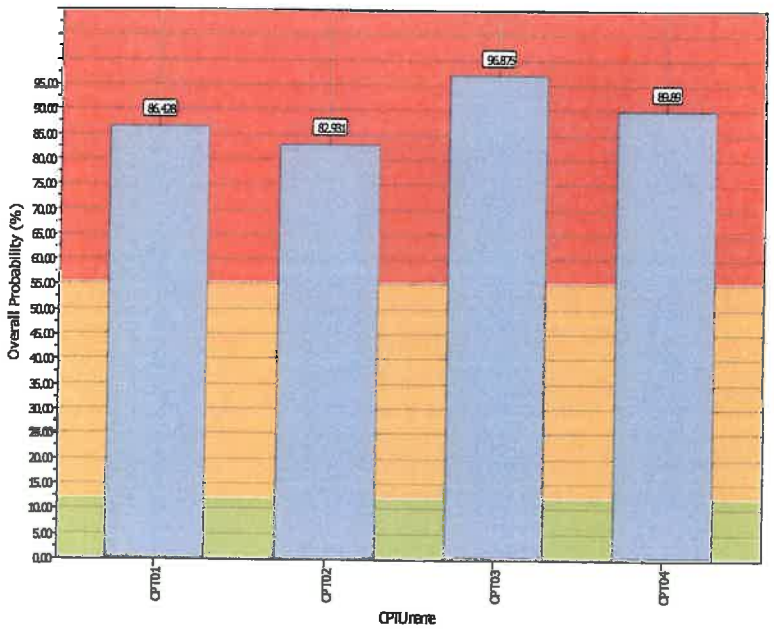
Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.67g

Overall Probability for Liquefaction report



Probability color scheme

- Very High Probability
- High Probability
- Low Probability

Basic statistics

Total CPT number: 4
0.00% low probability
0.00% high probability
100.00% very high probability

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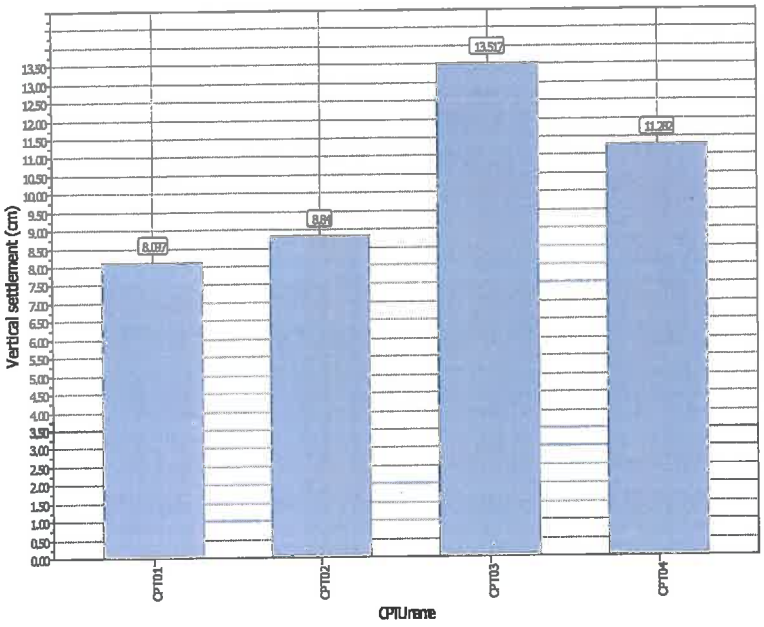
Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.67g

Overall vertical settlements report



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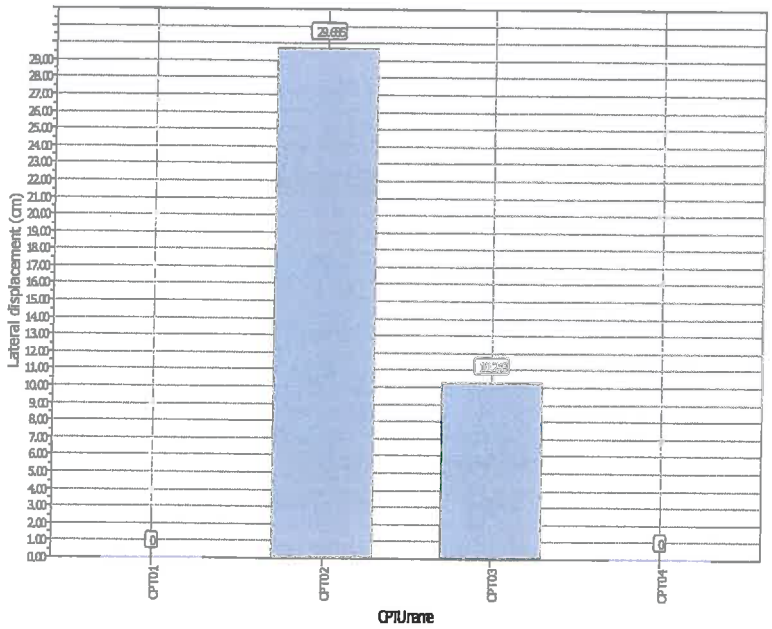
Project title : Ministry of Education

Location : Bennett Road, Hastings - 0.67g

Overall lateral displacements report



LAND DEVELOPMENT & EXPLORATION LTD

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