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Kids First Aranui Creche
BU 2112-001 EQ2

Detailed Engineering Evaluation
Quantitative Report
Version FINAL

284 Breezes Road, Aranui

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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284 Breezes Road
Aranui

Christchurch City Council

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Kids First Aranui Crèche

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Detailed Engineering Evaluation

Quantitative Report - SUMMARY

Version FINAL

284 Breezes Road, Aranui

Background

This is a summary of the Quantitative report for the children's centre, and is based in general on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, NZS 3604:2011 Timber-Framed buildings and a visual inspection and site measure up carried out on the 3rd of September 2012.

Brief Description

The Kids First Aranui Crèche building is located at 284 Breezes Road, Aranui. The original construction date of the building is unknown but is estimated to be constructed in the 1960's. The original building was used for residential purposes before extensions were added to the northern and southern ends in 1994 when the building was converted for use as a children's day-care centre.

The building is a single storey timber framed structure on subfloor framing. The roof is pitched up to ridges and consists of lightweight metal cladding and timber sarking fixed to timber purlins. The timber purlins are supported by timber rafters which span between load bearing timber framed walls and ridge beams. The floor is timber on timber joists and bearers. The foundations consist of a reinforced concrete perimeter foundation wall and reinforced concrete piles internally. The original structure and the extensions are externally clad with timber weatherboard. The internal walls are all clad with plasterboard lining.

The building dimensions are approximately 20m long by 7m wide at the north end and 13m wide at the south end with a total floor area of 181m^2. The overall height of the building is 4m with wall stud heights of 2.4m.

Key Damage Observed

Key damage observed includes:-

- Minor cracking to plasterboard wall linings throughout the building, primarily above window and door openings. These cracks are not considered to be significant enough to compromise the structural integrity of the building.

Critical Structural Weaknesses

The site is considered to be moderately susceptible to liquefaction, however due to the nature of the structure (light timber framed single storey structure), any settlement induced by soil liquefaction is not expected to cause premature collapse of the building.

Indicative Building Strength (from DEE and CSW assessment)

Based on the Quantitative Analysis carried out on the structure using NZS 3604:2011 for Timber-Framed buildings and referencing the New Zealand Society for Earthquake Engineering (NZSEE) guidelines, the building has been assessed to be in the order of >100% NBS along the building and >100% NBS across. Based on this, the overall %NBS for the building is >100% NBS.

Recommendations

As the building has been assessed to have a %NBS greater than 67% NBS, it is not considered to be either an Earthquake Prone or Earthquake Risk Building. In addition there are no immediate collapse hazards, or any significant Critical Structural Weaknesses associated with the structure, therefore general occupancy of the building is permitted.

Repair work should be carried out on all cracking to plasterboard linings. Moderate ground liquefaction can be expected under significant earthquakes; however there is no evidence of any foundation damage or settlement at the time of this report. Therefore foundation strengthening or repairs are presently not contemplated. Future ground damage from earthquakes may lead to minor foundation settlement or damage which can be rectified by re-levelling and localised repairs as necessary.

1. Background

GHD has been engaged by the Christchurch City Council to undertake a Detailed Engineering Evaluation of the Kids First Crèche located at 284 Breezes Road, Aranui.

This report is a Quantitative Assessment of the building structure, and is based in general on NZS 3604:2011 Timber Framed buildings and the New Zealand Society for Earthquake Engineering (NZSEE) guidelines.

A Quantitative Assessment involves a full site measure of the building which is used to determine bracing capacity in accordance with manufacturers' guidelines where available. When the manufacturers' guidelines are not available, values for material strengths are taken from Table 11.1 of the NZSEE guidelines for the Assessment and Improvement of the Structural Performance of Buildings in Earthquakes. The demand for the building is determined in accordance with NZS 3604:2011 and the percentage of new building standard (%NBS) is assessed.

At the time of this report, no modelling of the building structure had been previously carried out. The detailed analysis for the report consisted of an analysis of the bracing capacity of the structure. No further analysis or calculations were carried out.

2. Compliance

This section contains a brief summary of the requirements of the various statutes and authorities that control activities in relation to buildings in Christchurch at present.

2.1 Canterbury Earthquake Recovery Authority (CERA)

CERA was established on 28 March 2011 to take control of the recovery of Christchurch using powers established by the Canterbury Earthquake Recovery Act enacted on 18 April 2011. This act gives the Chief Executive Officer of CERA wide powers in relation to building safety, demolition and repair. Two relevant sections are:

Section 38 – Works

This section outlines a process in which the chief executive can give notice that a building is to be demolished and if the owner does not carry out the demolition, the chief executive can commission the demolition and recover the costs from the owner or by placing a charge on the owners' land.

Section 51 – Requiring Structural Survey

This section enables the chief executive to require a building owner, insurer or mortgagee carry out a full structural survey before the building is re-occupied.

We understand that CERA will require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). It is anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications. The quantitative assessment involves analytical calculation of the buildings strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

It is anticipated that factors determining the extent of evaluation and strengthening level required will include:

- The importance level and occupancy of the building
- The placard status and amount of damage
- The age and structural type of the building
- Consideration of any critical structural weaknesses
- The extent of any earthquake damage

2.2 Building Act

Several sections of the Building Act are relevant when considering structural requirements:

Section 112 – Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67% NBS however where practical achieving 100% NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67% NBS.

2.2.1 Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

- In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
- In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
- There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
- There is a risk that that other property could collapse or otherwise cause injury or death; or
- A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as Earthquake Prone if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

This section gives the territorial authority the power to require strengthening work within specified timeframes or to close and prevent occupancy to any building defined as dangerous or Earthquake Prone.

Section 131 – Earthquake Prone Building Policy

This section requires the territorial authority to adopt a specific policy for Earthquake Prone, dangerous and insanitary buildings.

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

We anticipate that any building with a capacity of less than 33% NBS (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67% NBS of new building standard as recommended by the Policy.

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply 'as near as is reasonably practicable' with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

2.4 Building Code

The building code outlines performance standards for buildings and the Building Act requires that all new buildings comply with this code. Compliance Documents published by The Department of Building and Housing can be used to demonstrate compliance with the Building Code.

After the February Earthquake, on 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
- Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

3. Earthquake Resistance Standards

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

The likely capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a building's capacity based on a comparison of loading codes from when the building was designed and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 1 below.

Description	Grade	Risk	%NBS	Existing Building Structural Performance	Improvement of Structural Performance: Legal Requirement	Improvement of Structural Performance: NZSEE Recommendation
Low Risk Building	A or B	Low	Above 67	Acceptable (improvement may be desirable)	The Building Act sets no required level of structural improvement (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS.	100%NBS desirable. Improvement should achieve at least 67%NBS
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended		Not recommended. Acceptable only in exceptional circumstances
High Risk Building	D or E	High	33 or lower	Unacceptable (Improvement	Unacceptable	Unacceptable

Figure 1 NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE

Table 1 compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Percentage of New Building Standard (%NBS)	Relative Risk (Approximate)
>100	<1 time
80-100	1-2 times
67-80	2-5 times
33-67	5-10 times
20-33	10-25 times
<20	>25 times

Table 1 %NBS compared to relative risk of failure

4. Building Description

The Kids First Aranui Crèche building is located at 284 Breezes Road, Aranui. The original building was used for residential purposes before extensions were added to the northern and southern ends of the building in 1994 when the building was converted for use as a crèche. The original construction date of the building is unknown but is estimated to be in the 1960's.

The building is a single storey timber framed structure on subfloor framing. The roof is pitched up to ridges and consists of lightweight metal cladding and timber sarking fixed to timber purlins. The timber purlins are supported by timber rafters which span between load bearing timber framed walls and ridge beams. The original structure and the extensions are externally clad with timber weatherboard while the internal walls are all clad with plasterboard lining. The floor is timber on timber joists and bearers. The foundations consist of a reinforced concrete perimeter foundation wall and un-braced reinforced concrete piles internally.

The building dimensions are approximately 20m long by 7m wide at the north end and 13m wide at the south end with a total floor area of 181m^2. The height of the building is 4m with wall stud heights being 2.4m.

A sketch of the building plan showing walls that are capable of providing bracing and openings are shown in Figure 2.

4.1 Gravity Load Resisting System

Gravity loads from the roof cladding are supported by timber purlins. These loads are then transferred from the purlins to the timber roof rafters. The roof rafters are supported, for the most part, by load bearing timber framed external walls and ridge beams. Where an original external wall was removed, during the construction of the extension to the south, a timber beam has been provided to support the roof loads. This is highlighted in Photograph 4. The ridge beams transfer gravity loads from the rafters into the load bearing timber framed walls. Loads transferred through the external walls are then transmitted through to the concrete perimeter foundation walls and then to the ground below. Internal gravity loads are transferred through the suspended timber floor system to the concrete pile foundations.

4.2 Lateral Load Resisting System

Lateral loads acting on the structure in both the long and short directions of the building are resisted by timber framed, braced, plasterboard walls. Seismic forces acting on the roof structure during an earthquake are distributed to the braced walls through diaphragm action of the plasterboard lined ceiling. The braced walls are distributed throughout the building in both the long and short directions. The braced walls then transfer the lateral loads to the subfloor structure. The lateral loads to the sub-floor structure are then distributed by diaphragm action provided by the floor into the concrete perimeter foundation walls. The concrete perimeter foundation walls are expected to provide bracing for the subfloor structure.

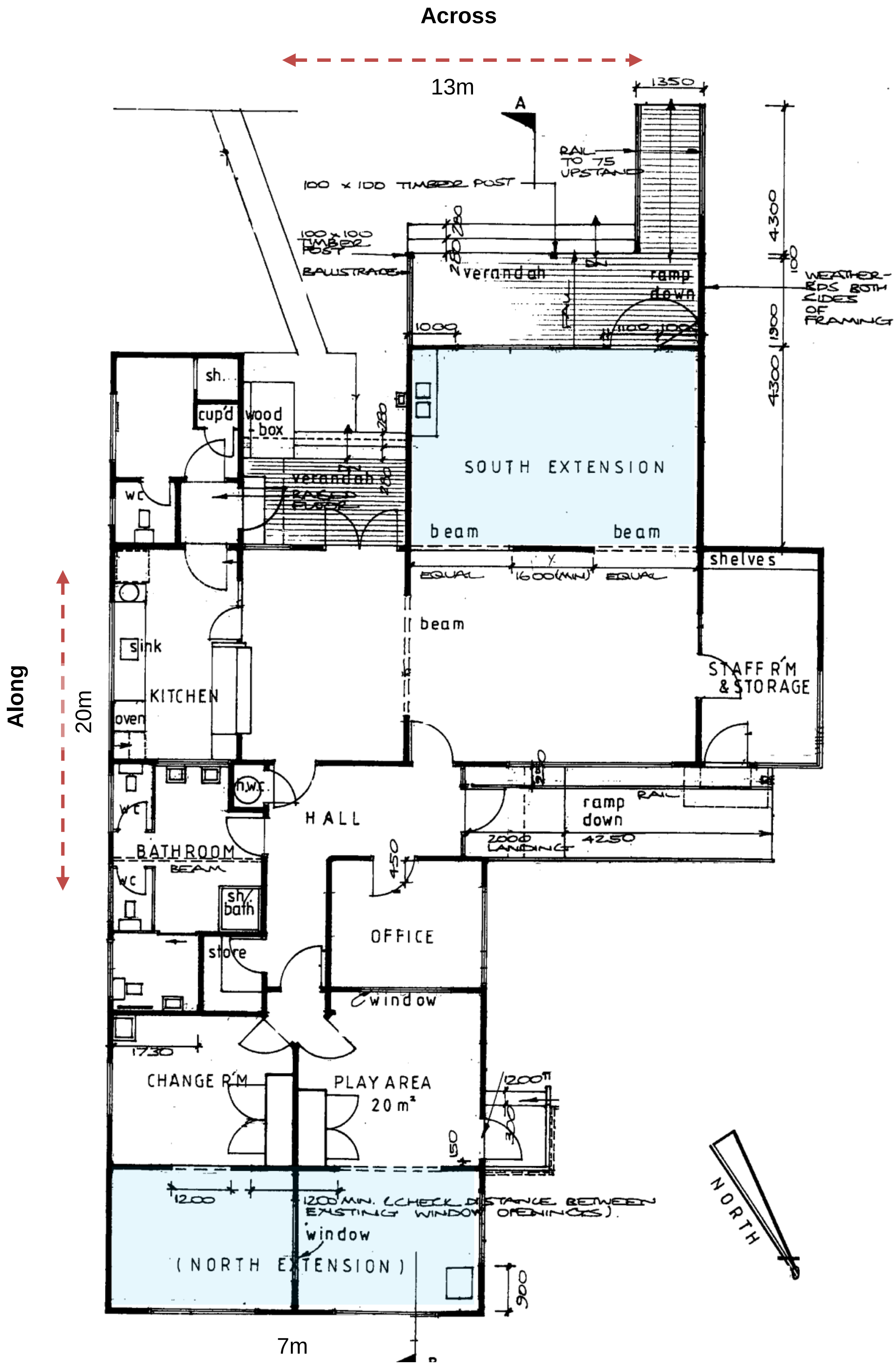


Figure 2 Plan Sketch of building showing bracing walls and openings

5. Damage Assessment

5.1 Surrounding Buildings

Kids First Crèche Aranui is located in a residential area with adjacent residential buildings located to the north-west and south-east. No apparent damage was noted to the surrounding buildings or adjoining properties.

5.2 Residual Displacements and General Observations

No residual displacements of the structure were noticed during our inspection of the building.

Cracking was noted to the internal plasterboard linings in several locations throughout the building, primarily above window and door openings (See Photograph 4, Photograph 5, Photograph 6 and Photograph 10). The damage to the plasterboard linings are due to movement of the structure during an earthquake. The ductile timber wall frames are able to accommodate movement during an earthquake; however the plasterboard linings have behaved in a more brittle manner and have cracked as a result of the movement. These lining cracks are not considered to be compromise the structural integrity of the building.

5.3 Ground Damage

There was no evidence of ground damage on the property. No liquefaction or ground movement was evident in the sub-floor space, as viewed from the access hatch location (See Photograph 9). Significant areas of the sub-floor space could not be inspected due to lack of access. Signs of liquefaction outside the building footprint and adjacent to the site can be seen on aerial photographs following the 22 February 2011 earthquake.

6. Survey and Investigation

Given the low level of structural damage and no settlement of the foundations noted, a floor level survey or any intrusive structural investigations have not been undertaken for this building.

7. Geotechnical Investigation

The site is situated within a residential area, within the suburb of Aranui, in eastern Christchurch. It is relatively flat at approximately 5m above mean sea level. The site is within an inside bend of the Avon River, with the closest point of the river approximately 1km to the west. The Avon River flows into the Christchurch Estuary approximately 2km east of the site.

7.1 Published Information on Ground Conditions

7.1.1 Published Geology

The geological map of the area[1] indicates that the site is underlain by:

- Holocene marine soils of the Christchurch Formation, comprising dominantly sand of fixed and semi-fixed dunes and beaches.

7.1.2 Environment Canterbury Logs

Information from Environment Canterbury (ECan) indicates that six boreholes are located within a 35m radius of the site (see Table 2). Of these boreholes, only one was greater than 3m. This lithographic log indicates that the site is underlain by clay and sand to ~38.1 mbgl. The shallow logs also indicate sand.

Table 2 ECan Borehole Summary

Bore Name	Log Depth	Groundwater	Distance & Direction from Site
M35/2319	94m	artesian	260m NE
M35/17061	2.8m	N/A	30m NE
M35/17062	2.6m	N/A	15m SE
M35/17063	2.8m	N/A	20m S
M35/17064	1.8m	N/A	20m SW

It should be noted the quality of soil logging descriptions included on the boreholes is unknown and were likely written by the well driller and not a geotechnical professional or to a recognised geotechnical standard. In addition strength data is not recorded.

7.1.3 EQC Geotechnical Investigations

The Earthquake Commission has undertaken geotechnical testing in the area of the site. Information pertaining to this investigation is included in the Tonkin & Taylor Report for Wainoni[2]. Two investigation points were undertaken within 180 m of the property, as summarised in Table 3.

[1] Brown, L. J. and Weeber J.H. 1992: Geology of the Christchurch Urban Area. Institute of Geological and Nuclear Sciences 1:25,000 Geological Map 1. Lower Hutt. Institute of Geological and Nuclear Sciences Limited.

Table 3 EQC Geotechnical Investigation Summary Table

Bore Name	Grid Reference	Depth (m bgl)	Log Summary
CPT - WAI 70	2485925 mE	0.0 – 1.0	Surface Soil
	5743306 mN	1.0 – 14.0	SAND, with some gravel
		14.0 – 27.6	Dense to very dense SAND mixtures (some silt and gravel)
			(WT at 7m bgl)
CPT - WAI 87	2485635 mE	0.0 – 1.0	Surface Soil
	5743330 mN	1.0 – 9.4	SAND mixtures
		9.4 – 9.6	SILT mixtures (silty clay to sandy silt)
		9.6 – 15.0	SAND, medium dense to dense
		15.0 – 16.0	SILT mixtures (silty clay to sandy silt)
		16.0 – 22.5	SAND, dense to very dense
			(WT at 1m bgl)

7.1.4 Land Zoning

Canterbury Earthquake Recovery Authority (CERA) has indicated the site is situated within the Green Zone, indicating that repair and rebuild may take place.

Land in the CERA green zone has been divided into three technical categories. These categories describe how the land in expected to perform in future earthquakes. The technical categories – TC1 (grey), TC2 (yellow) and TC3 (blue) describe how the land is expected to perform in future earthquakes.

The site is indicated as being within the TC2 (yellow) zone[3]. This means that moderate land damage from liquefaction is possible in future significant earthquakes. For TC2 areas, site-specific geotechnical work is required to determine the foundation solutions required for each building.

7.1.5 Post February Aerial Photography

Aerial photography taken following the 22 February 2011 earthquake shows signs of liquefaction outside the building footprint and adjacent to the site, as shown in Figure 3.

[2] Tonkin & Taylor Ltd. (2011): Christchurch Earthquake Recovery, *Geotechnical Factual Report, Wainoni*

[3] CERA Landcheck website, http://cera.govt.nz/my-property

Figure 3 Post February 2011 Earthquake Aerial Photography

7.2 Seismicity

7.2.1 Nearby Faults

There are many faults within the Canterbury region, however only those considered most likely to have an adverse effect on the site are detailed below.

Table 4 Summary of Known Active Faults[4,5]

Known Active Fault	Distance from Site	Direction from Site	Max Likely Magnitude	Avg Recurrence Interval
Alpine Fault	125 km	NW	~8.3	~300 years
Greendale (2010) Fault	27 km	W	7.1	~15,000 years
Hope Fault	100 km	N	7.2~7.5	120~200 years
Kelly Fault	110 km	NW	7.2	150 years
Porters Pass Fault	60 km	NW	7.0	1100 years

Recent earthquakes since 4 Semteber 2011 have identified the presence of a previously unmapped active fault system underneath the Canterbury Plains, including Christchurch City and the Port Hills.

[4] Stirling, M.W, McVerry, G.H, and Berryman K.R. (2002) A New Seismic Hazard Model for New Zealand, Bulletin of the Seismological Society of America, Vol. 92 No. 5, pp 1878-1903, June 2002.

[5] GNS Active Faults Database, http://maps.gns.cri.nz/website/af/viewer

Research and published information on this system is in development and not generally available. Average recurrence intervals are yet to be estimated.

7.2.2 Ground Shaking Hazard

This seismic activity has produced earthquakes of Magnitude-6.3 with peak ground accelerations (PGA) up to twice the acceleration due to gravity (2g) in some parts of the city. This has resulted in widespread liquefaction throughout Christchurch.

New Zealand Standard NZS 1170.5:2004 quantifies the Seismic Hazard factor for Christchurch as 0.30, being in a moderate to high earthquake zone. This value has been provisionally upgraded recently (from 0.22) to reflect the seismicity hazard observed in the earthquakes since 4 September 2010.

7.3 Field Investigations

In order to further understand the ground conditions at the site, intrusive testing comprising one piezocone CPT and two hand augers with scala penetrometer tests was conducted at the site on 30 May 2012.

The locations of the tests are tabulated in Table 5.

Table 5 Coordinates of Investigation Locations

Investigation	Depth (m bgl)	Easting (NZTM)	Northing (NZTM)
CPT 01	20	2485798 mE	5743397 mN
HA 01	3.3	2485789 mE	5743395 mN
HA 02	2.3	2485775 mE	5743378 Mn

The CPT investigations were undertaken by McMillans Drilling Ltd on 26 June 2012. Refusal was reached at 20m due to the presence of dense sand.

Interpretation of output graphs[6] from the investigation showing Cone Tip Resistance (q_c), Friction Ratio (Fr), Inferred Lithology and Inferred Liquefaction Potential are presented in Table 2.

[6] McMillans Drilling CPT data plots, Appendix C.

7.4 Ground Conditions Encountered

The two hand augers and scala penetrometers undertaken on 30 May 2012, are summarised in Table 6.

Table 6 Summary of Ground Investigation Results

Depth (m bgl)	Ground Conditions Encountered	Scala blows per 100mm
0.0 – 0.8	TOPSOIL; dark brown. Firm; moist.	1 to 6
0.8 – 3.3	Medium SAND; with some gravel; light brown. Medium dense to dense; dry to saturated. Gravel, fine to medium, subrounded to rounded, greywacke.	2 to 25
3.3	End of Borehole - Collapsing	

Groundwater was encountered at 2 m (HA 01) and 1.9 m (HA 02) during the investigation.

7.4.1 Summary of CPT-Inferred Lithology

Table 7 Summary of CPT-Inferred Lithology

Depth (m)	Lithology [1]	Cone Tip Resistance q_c (MPa)	Friction Ratio Fr (%)	Relative Density Dr (%)
0 – 0.6	Pre-drilled			
0.6 – 20	SAND; medium dense to dense.	6 – 26	1 – 3	60 to 90

Groundwater was inferred to be at 2 m below ground level.

7.5 Liquefaction Assessment

7.5.1 Parameters used in Analysis

Assumptions made for the analysis process are as follows:

- D_{50} particle sizes for the site soil (sands) from CPT soil analysis;
- Importance Category 2, post seismic event (50-year design life);and,
- PGA 0.35g (ULS), 0.13g (SLS)

The following equation has been used to approximate soil unit weight from the CPT investigation data: [7]

$$\gamma = \frac{\gamma_w Gs}{2.65}\left(0.27 \log Fr + 0.36 \log\left(\frac{qc}{p_{atm}}\right) + 1.236\right)$$

[7] Robertson P.K., & Cabal K.L. 2010: *Estimating soil unit weight from CPT*. Gregg Drilling & Testing Inc.: Signal Hill, California, USA.

This typically gave values ranging between 16 and 21 kN/m^3 (saturated).

The liquefaction analysis process has been conducted using the methodology from Robertson & Wride[8], and from the NZGS Guidelines[9]. Settlements were estimated using the methodology outlined in Zhang et al (2002)

7.5.2 Results of Liquefaction Analysis

The results of the liquefaction analysis, as outlined in Table 8, indicate that depths of 3.5 m to 3.6 m and 5.5 m to 14 m are considered highly liquefiable.

Table 8 Summary of Liquefaction Susceptibility

Depth (m)	Lithology	Triggering Factor F_L	Liquefaction Susceptibility [10]
0 – 3.5	SANDS (clean sand to silty sand)	1.2 – 5	Low
3.5 – 3.6	SANDS	0.8 – 1	High
3.6 – 5.5	SANDS	1.2 – 2	Low
5.5 – 14	SANDS	0.7 – 1.5	High
14 – 16	SANDS	1.2 – 3	Low
16 – 18	SANDS	0.6 – 2	Moderate
18 – 20	SANDS	1 – 3	Low

Estimated settlements are in the order of 99 mm for a ULS event, and zero mm for a SLS event.

7.6 Interpretation of Ground Conditions

7.6.1 Liquefaction Assessment

Overall, the site is considered to be moderately susceptible to liquefaction. This is based on:

- Evidence of liquefaction in the nearby area from the post-earthquake aerial photography;
- Estimated ULS settlement from the CPT results of 99 mm is in line with CERA TC2 classification of the area; and,
- The saturated sand layers of 3.5 m to 3.6 m and 5.5 m to 14 m are indicated to be highly susceptible, as outlined in Table 8.

[8] Robertson P.K. & Wride C.E. (1998): *Evaluating cyclic liquefaction potential using the cone penetration test.* Canadian Geotechnical Journal, 35: pp. 442–459.

[9] Cubrinovski M., McManus K.J., Pender M.J., McVerry G., Sinclair T., Matuschka T., Simpson K., Clayton P., Jury R. 2010: *Geotechnical earthquake engineering practice: Module 1 – Guideline for the identification, assessment and mitigation of liquefaction hazards*. NZ Geotechnical Society

[10] Table 6.1, NZGS Guidelines Module 1 (2010)

7.6.2 Slope Failure and/or Rockfall Potential

The site is located within Linwood, a flat suburb in eastern Christchurch. Global slope instability is considered negligible. However, any localised retaining structures and/or embankments should be further investigated to determine the site-specific slope instability potential.

7.6.3 Foundation Recommendations

Based on the information presented above, we recommend the following for the subject site:

- Given the additional information considered in this report, it is now recommended that a soil class of **D** be adopted (in accordance with NZS 1170.5:2004).
- Any remedial works to foundations (or proposed new structures) be undertaken in accordance with DBH's guidelines for **TC2** land, due to the significant levels of estimated settlement.

8. Seismic Capacity Assessment

8.1 Qualitative Assessment

An initial Qualitative Assessment has been completed by GHD for the Kids First Aranui Crèche building. This included a visual inspection of the building which was undertaken on 19th January 2012 and a review of available drawings and other relevant documents.

The Qualitative Assessment consisted of a visual inspection of the building's interior and exterior to determine the structural systems and likely behaviour of the building during an earthquake. The site was assessed for damage, including observing the ground conditions, checking for damage in areas where damage would be expected for the structure type observed and noting general damage observed throughout the building in both structural and non-structural elements.

The %NBS score determined for the building has been based on the IEP procedure described by the NZSEE and on the information obtained from visual observations of the building only. The site was considered to be susceptible to liquefaction which is treated as a Critical Structural Weakness (CSW). Therefore a 30% reduction factor for this CSW was also applied to the %NBS. Following the Qualitative Assessment, an initial capacity of the building was assessed to be 59% NBS. This %NBS is now superseded by the capacity of the building assessed through a more detailed Quantitative Assessment as outlined below.

8.2 Quantitative Assessment

A Quantitative Assessment of the building was carried out using the information gathered from a full site measure of the building on the 3rd of September 2012. From this information, the building's bracing capacity was determined in accordance with NZS 3604:2011 and the NZSEE guidelines. The demand for the building was calculated in accordance with NZS 3604:2011 and the percentage of New Building Standard (%NBS) was assessed.

8.2.1 Building demand

The demand on the structure was determined in accordance with Section 5 of NZS 3604:2011. The bracing unit demand per square metre was determined from Table 5.8. In accordance with Table 5.8 of NZS 3604:2011 (for a single storey building with light roof, light single-storey cladding on heavy subfloor framing) a bracing demand of 17 BU/m^2 for the subfloor structure and 11 BU/m^2 for the single storey walls is taken. As the building is located in Christchurch (Earthquake Zone 2) on Class D soils, a multiplication factor of 0.8 is applied to reduce the demand in accordance with Table 5.8 of NZS 3604:2011. Therefore the total bracing demand for the building is;

$$\text{Single storey walls } BU_{demand} = (0.8 \text{ x } 11 \ BU/m^2 \text{ x } 181m^2)$$

$$= 1593 \text{ BUs}$$

$$\text{Subfloor structure } BU_{demand} = (0.8 \text{ x } 17 \ BU/m^2 \text{ x } 181m^2)$$

$$= 2462 \text{ BUs}$$

8.2.2 Wall bracing capacity

A bracing design analysis has been carried out and submitted with the consent documents in 1994 for the extensions/alterations to the building. However the bracing calculations were prepared with no calculated assessment for contributions from existing walls in the original building.

Therefore, the bracing capacity ratings for walls specifically detailed as bracing elements in the 1994 extensions have been determined in accordance with the GIB Bracing Systems product manual published in 1992 or the 3604 Fix List Bracing Elements" publication by BRANZ in 1992.

For walls that have a standard plasterboard lining and not specified as a bracing element, the capacity of the wall linings was determined in accordance with Table 11.1 of the NZSEE guidelines and the "3604 Fix List Bracing Elements" publication by BRANZ in 1992.

For this purpose, the strength value of gypsum wall board given in Table 11.1 of the NZSEE guidelines (3kN/m each side) was converted to equivalent bracing units (1kN = 20BU) and then multiplied by the strength reduction factor of 0.7. This value was used for all walls with plasterboard lining on one side only. Therefore the bracing capacity for walls with plasterboard lining on only one side is taken as;

$$\mathrm{BU_{equivalent}} = \left(0.7\ \mathrm{x}\ \frac{3\mathrm{kN}}{\mathrm{m}}\ \mathrm{x}\ \frac{20\mathrm{BU}}{\mathrm{kN}} = 42\mathrm{BU/m\ each\ side}\right)$$

For walls that are lined with plasterboard on both sides, the value calculated from Table 11.1 of NZSEE guidelines will be 84 BU/m. However this value is judged to be high considering modern wall bracing systems have lower bracing ratings. Therefore the bracing capacity for walls with plasterboard lining on both sides is taken as 60 BU/m from the "3604 Fix List Bracing Elements" publication by BRANZ in 1992.

Section 11.4 of the NZSEE guidelines states that shear panels can utilise their full bracing capacity for aspect ratios (height-to-width) up to 2:1. For aspect ratios greater than 2:1 and up to 3.5:1 a limiting factor can be applied in accordance with the NEHRP Recommended Provisions (BSSC, 2000) as follows;

$$Aspect\ Ratio\ Factor = \frac{2\ x\ Width\ of\ Wall}{Wall\ Height}$$

Any sections of wall with an aspect ratio greater than 3.5:1 were not included for the purpose of the bracing calculations. The walls in this building are 2.4m in height, and as such any wall less than 0.7m in length was not considered for the bracing calculations.

The above limiting factors for Aspect Ratio were only applied to walls that have a standard plasterboard lining and not specified as a bracing element. For walls that were explicitly specified as bracing elements, the bracing ratings provided by their manufacturers were used in accordance with their guidelines.

The subfloor bracing capacity is assumed to be provided by the reinforced concrete perimeter foundation wall. The bracing capacity rating for this was determined as 300BUs/m in accordance with Table 5.11 of NZS 3604:2011. As the bracing capacity rating for the foundation wall is very high, the bracing capacity will far exceed the bracing demand for the subfloor structure. As such no bracing analysis was carried out for the subfloor structure as the single-storey wall bracing capacity is more critical.

The calculated wall bracing capacities along and across the building are shown in Table 9.

Table 9 Bracing Units Provided

Direction	Bracing Units Provided
Along the building	1683 BUs
Across the building	1594 BUs

8.2.3 %NBS

The bracing capacity both along and across the building are compared to the demand to determine the critical direction, and therefore the overall %NBS for the building. The %NBS value is calculated as follows;

$$\%\text{NBS} = \frac{\text{BU}_{\text{provided}}}{\text{BU}_{\text{demand}}} \text{ x } \%100$$

The %NBS for both along and across the building is presented in Table 10.

Table 10 %NBS

Direction	%NBS
Along the building	>100%
Across the building	>100%

Following a detailed assessment the building has been assessed as having a seismic capacity of >100% New Building Standard (NBS). Under the NZSEE guidelines the building is not considered to be either an Earthquake Prone or Earthquake Risk building as it achieves above 67% NBS.

8.3 Discussion of Results

The results obtained are consistent with the amount of bracing present in the building. A number of lengths of wall were discounted due to their length being less than the minimum required to achieve a width: height ratio of less than 3.5:1. The moderate liquefaction potential at the site was considered insignificant as any liquefaction induced settlement is not expected to cause a premature collapse of a single storey, timber framed structure.

The building has a strength greater than 67% NBS and therefore is not deemed to be Earthquake Prone or Earthquake Risk.

8.4 Occupancy

As the building has been assessed to have a %NBS greater than 67% NBS, it is not considered to be an Earthquake Prone or Earthquake Risk building. In addition there are no immediate collapse hazards, or critical structural weaknesses associated with the structure that could cause the collapse of the structure. Therefore general occupancy of the building is permitted.

9. Recommendations and Conclusions

The building has been assessed to have a %NBS greater than 67% NBS and is not considered to be either an Earthquake Prone or Earthquake Risk building. In addition, there are no immediate collapse hazards, or critical structural weaknesses associated with the structure, therefore general occupancy of the building is permitted.

Repair work should be carried out on all cracking to plasterboard linings. Moderate ground liquefaction can be expected under significant earthquakes; however there is no evidence of any foundation damage or settlement at the time of this report. Therefore foundation strengthening or repairs are presently not contemplated. Future ground damage from earthquakes may lead to minor foundation settlement or damage which can be rectified by re-levelling and localised repairs as necessary.

10. Limitations

10.1 General

This report has been prepared subject to the following limitations:

- No intrusive structural investigations have been undertaken.
- No level or verticality surveys have been undertaken.
- No material testing has been undertaken.
- No calculations, other than the wall bracing calculations, have been carried out on the structure.

It is noted that this report has been prepared at the request of Christchurch City Council and is intended to be used for their purposes only. GHD accepts no responsibility for any other party or person who relies on the information contained in this report.

10.2 Scope and Limitations of Geotechnical Investigation

The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent geotechnical engineer before being used for any other purpose. GHD Limited (GHD) accepts no responsibility for other use of the data by third parties.

Where drill hole or test pit logs, cone tests, laboratory tests, geophysical tests and similar work have been performed and recorded by others under a separate commission, the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

The advice tendered in this report is based on information obtained from the desk study investigation location test points and sample points. It is not warranted in respect to the conditions that may be encountered across the site other than at these locations. It is emphasised that the actual characteristics of the subsurface materials may vary significantly between adjacent test points, sample intervals and at locations other than where observations, explorations and investigations have been made. Subsurface conditions, including groundwater levels and contaminant concentrations can change in a limited time. This should be borne in mind when assessing the data.

It should be noted that because of the inherent uncertainties in subsurface evaluations, changed or unanticipated subsurface conditions may occur that could affect total project cost and/or execution. GHD does not accept responsibility for the consequences of significant variances in the conditions and the requirements for execution of the work.

The subsurface and surface earthworks, excavations and foundations should be examined by a suitably qualified and experienced Engineer who shall judge whether the revealed conditions accord with both the assumptions in this report and/or the design of the works. If they do not accord, the Engineer shall modify advice in this report and/or design of the works to accord with the circumstances that are revealed.

An understanding of the geotechnical site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances which arise from the issue of the report which have been modified in any way as outlined above.

Appendix A

Photographs

Photograph 1 North (front) elevation.

Photograph 2 View of the crèche from the south (rear).

Photograph 3 View of the crèche from the south.

Photograph 4 Vertical cracking in plasterboard lining of timber beam where original exterior wall was removed.

Photograph 5 Cracking in plasterboard lining of timber beam where original exterior wall was removed.

Photograph 6 Vertical cracking in plasterboard lining of support wall for timber beam.

Photograph 7 Roof rafters of the original structure as seen from access hatch.

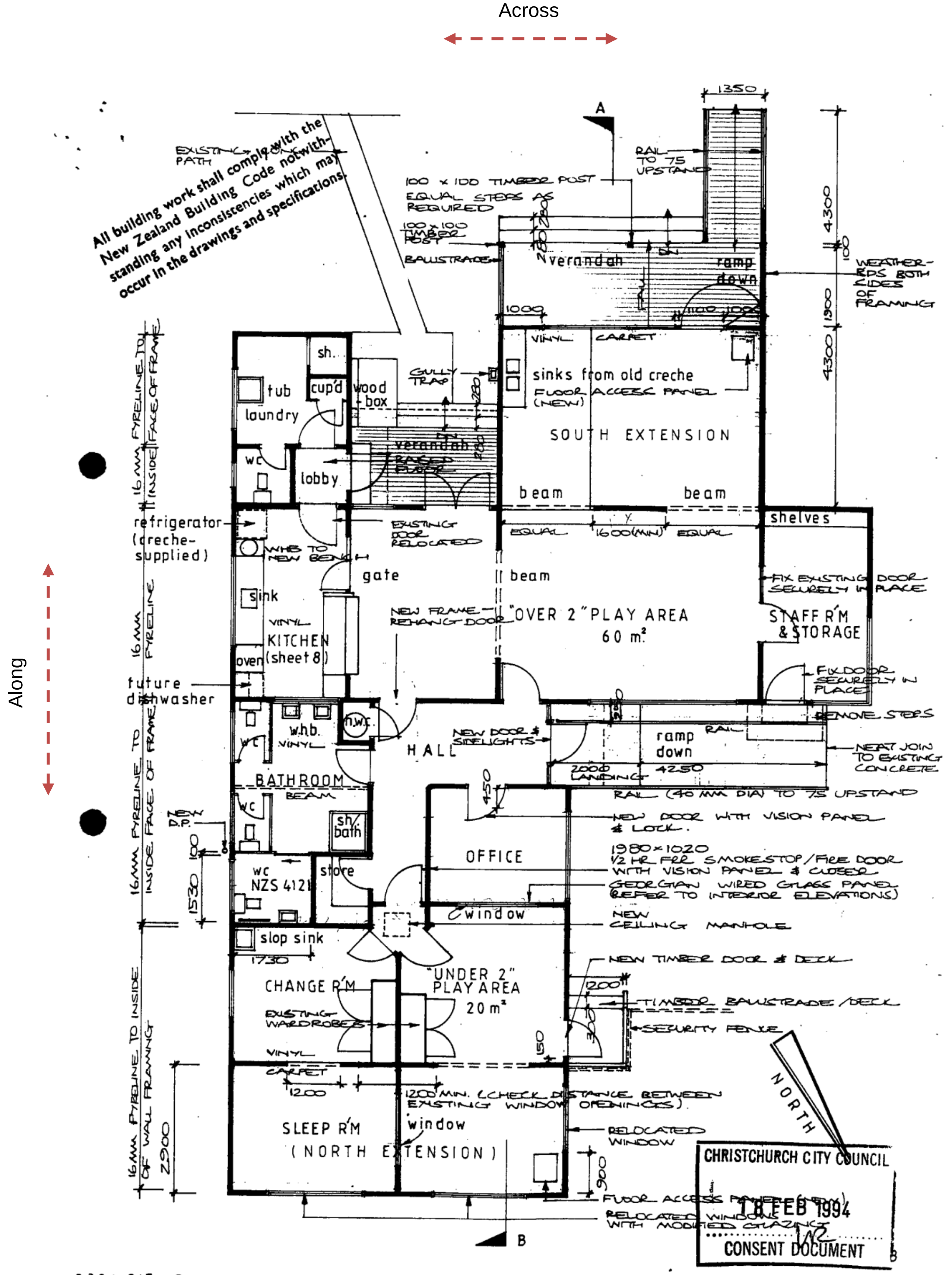
Photograph 8 Roof sarking elements acting as a bracing diaphragm.

Photograph 9 Suspended timber floor support system of the original structure as seen from the access manhole.

Photograph 10 Minor cracking to the ceiling plasterboard in the bathroom.

Appendix B

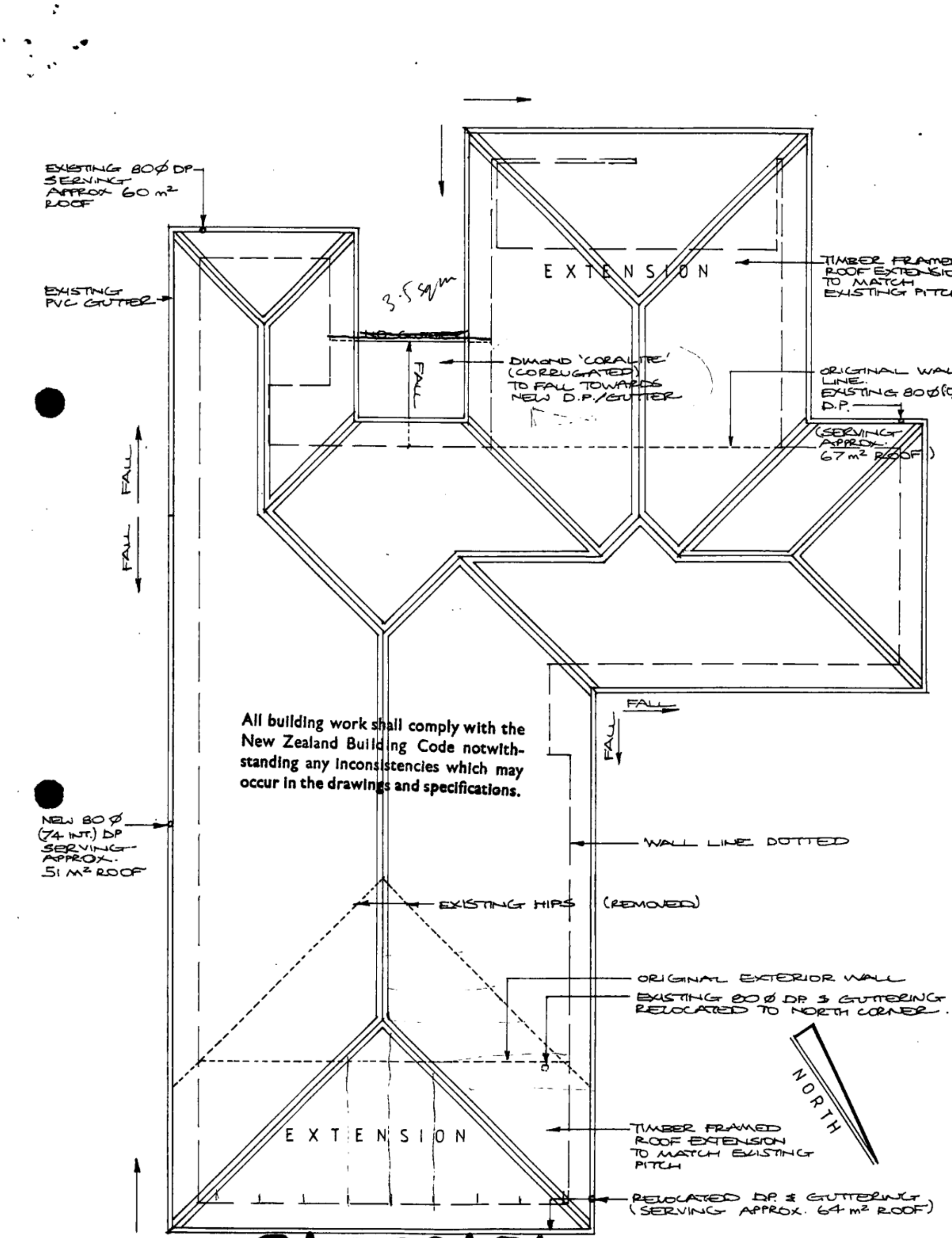
Existing Drawings / Sketches



9394-247 RAINBOW CRECHE RELOCATION — REVISED FLOOR PLAN

284 BREEZES ROAD, ARANUI — DEC.'93, 1:100, J.N. 9335

FILE COPY



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9394-247 RAINBOW CRECHE RELOCATION

284 BREEZES ROAD , ARANUI

ROOF PLAN

10

1 : 100

JAN. 94

N. 9335

Appendix C

Geotechnical Information

Bore or Well No: M35/2319
Well Name:
Owner: WEVERLEY

Environment Canterbury
Your regional council

Street of Well: PAGES RD
File No:
Locality: ARANUI
Allocation Zone: Christchurch/West Melton
NZGM Grid Reference: M35:858-434 QAR 4
NZGM X-Y: 2485800 - 5743400
Location Description:
Uses:
ECan Monitoring:
Well Status: Not Used

Drill Date: 31 Jan 1933
Water Level Count: 0
Well Depth: 94.40m -GL
Strata Layers: 9
Initial Water Depth: 3.70m -MP
Aquifer Tests: 0
Diameter:
Isotope Data: 0
Yield/Drawdown Tests: 0

Measuring Point Ait: 4.80m MSD QAR 3
Highest GW Level:
GL Around Well: 0.00m -MP
Lowest GW Level:
MP Description:
First Reading:
Last Reading:
Driller: not known
Calc. Min. GWL: 0.10m -MP
Drilling Method: Unknown
Last Updated: 18 Oct 2006
Casing Material:
Last Field Check:
Pump Type: Unknown
Yield:
Screens:
Drawdown:
Screen Type:
Specific Capacity:
Top GL:
Bottom GL:
Aquifer Type: Flowing Artesian
Aquifer Name: Linwood Gravel

Unknown No: M35/17064
Well Name: CCC BorelogID 6933
Owner: CCC borelog

Street of Well:		**File No:**	
Locality:		**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:85769-43360 QAR 3		
NZGM X-Y:	2485769 - 5743360		
Location Description:		**Uses:**	Foundation/Investigation Bore
ECan Monitoring:			
Well Status:	Filled in		

Drill Date:	12 Sep 2006	**Water Level Count:**	0
Well Depth:	1.80m -GL	**Strata Layers:**	8
Initial Water Depth:	-1.60m -MP	**Aquifer Tests:**	0
Diameter:		**Isotope Data:**	0
		Yield/Drawdown Tests:	0
Measuring Point Ait:	5.56m MSD QAR 4	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:		**Calc. Min. GWL:**	
Drilling Method:		**Last Updated:**	27 Mar 2008
Casing Material:		**Last Field Check:**	
Pump Type:			
Yield:		**Screens:**	
Drawdown:		**Screen Type:**	
Specific Capacity:		**Top GL:**	
		Bottom GL:	
Aquifer Type:			
Aquifer Name:			

Borelog for well M35/17064

Gridref: M35:85769-43360 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 5.56 +MSD
Well name : CCC BorelogID 6933
Drill Method : Not Recorded
Drill Depth : -1.8m Drill Date : 12/09/2006

Environment Canterbury Regional Council

Depth(m)	Full Drillers Description	Formation Code
-0.10m	gravel	
-0.20m	dark brown sandy silt	
-0.30m	brown sand ./ stones	
-1.00m	brown sand	
-1.20m	dark brown silty sand	
-1.40m	brown damp sand	
-1.70m	brown moist sand	
-1.80m	brown saturated sand	

Unknown No: M35/17063
Well Name: CCC BorelogID 6932
Owner: CCC borelog

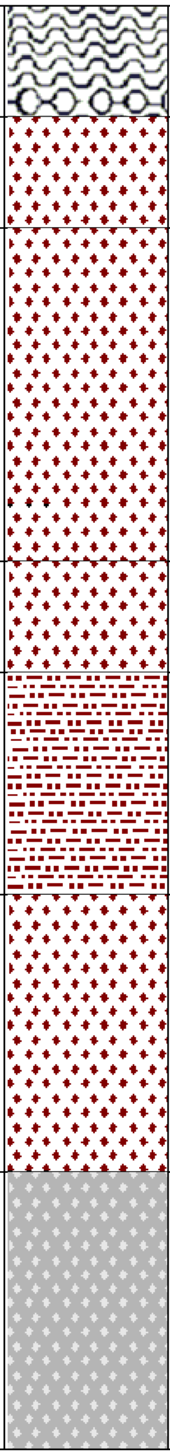
Environment Canterbury
Your regional council

Street of Well:		**File No:**	
Locality:		**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:85785-43361 QAR 3		
NZGM X-Y:	2485785 - 5743361		
Location Description:		**Uses:**	Foundation/Investigation Bore
ECan Monitoring:			
Well Status:	Filled in		

Drill Date:	12 Sep 2006	**Water Level Count:**	0
Well Depth:	2.60m -GL	**Strata Layers:**	7
Initial Water Depth:		**Aquifer Tests:**	0
Diameter:		**Isotope Data:**	0
		Yield/Drawdown Tests:	0
Measuring Point Ait:	5.58m MSD QAR 4	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:		**Calc. Min. GWL:**	
Drilling Method:		**Last Updated:**	27 Mar 2008
Casing Material:		**Last Field Check:**	
Pump Type:			
Yield:		**Screens:**	
Drawdown:		**Screen Type:**	
Specific Capacity:		**Top GL:**	
		Bottom GL:	
Aquifer Type:			
Aquifer Name:			

Borelog for well M35/17063

Gridref: M35:85785-43361 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 5.58 +MSD
Well name : CCC BorelogID 6932
Drill Method : Not Recorded
Drill Depth : -2.6m Drill Date : 12/09/2006



Depth(m)	Full Drillers Description	Formation Code
0 to -0.20m	sandy topsoil	
-0.20m to -0.40m	brown sand / brick	
-0.40m to -1.00m	brown damp sand	
-1.00m to -1.20m	brown moist sand	
-1.20m to -1.60m	dark brown silty sand	
-1.60m to -2.10m	brown saturated sand	
-2.10m to -2.60m	grey saturated sand	

Unknown No: M35/17062
Well Name: CCC BorelogID 6931
Owner: CCC borelog

Environment Canterbury
Your regional council

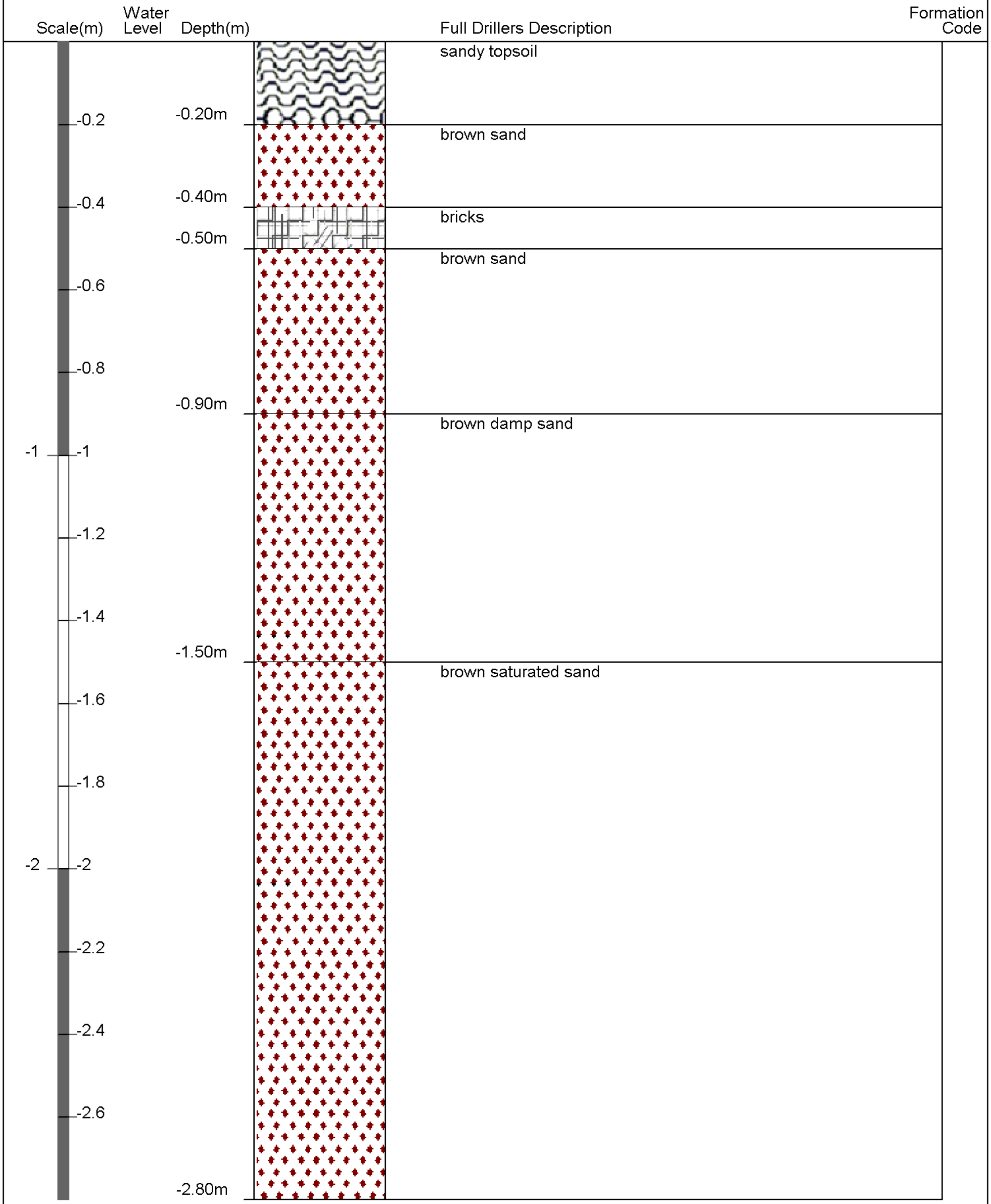
Street of Well:
File No:
Locality:
Allocation Zone: Christchurch/West Melton
NZGM Grid Reference: M35:85791-43369 QAR 3
NZGM X-Y: 2485791 - 5743369
Location Description:
Uses: Foundation/Investigation Bore
ECan Monitoring:
Well Status: Filled in

Drill Date: 12 Sep 2006
Water Level Count: 0
Well Depth: 2.80m -GL
Strata Layers: 6
Initial Water Depth: -1.55m -MP
Aquifer Tests: 0
Diameter:
Isotope Data: 0
Yield/Drawdown Tests: 0

Measuring Point Ait: 5.59m MSD QAR 4
Highest GW Level:
GL Around Well: 0.00m -MP
Lowest GW Level:
MP Description:
First Reading:
Last Reading:
Driller:
Calc. Min. GWL:
Drilling Method:
Last Updated: 27 Mar 2008
Casing Material:
Last Field Check:
Pump Type:
Yield:
Screens:
Drawdown:
Screen Type:
Specific Capacity:
Top GL:
Bottom GL:
Aquifer Type:
Aquifer Name:

Borelog for well M35/17062

Gridref: M35:85791-43369 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 5.59 +MSD
Well name : CCC BorelogID 6931
Drill Method : Not Recorded
Drill Depth : -2.8m Drill Date : 12/09/2006



Unknown No:	M35/17061
Well Name:	CCC BorelogID 6930
Owner:	CCC borelog

Environment Canterbury
Your regional council

Street of Well:		**File No:**	
Locality:		**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:85809-43389 QAR 3		
NZGM X-Y:	2485809 - 5743389		
Location Description:		**Uses:**	Foundation/Investigation Bore
ECan Monitoring:			
Well Status:	Filled in		

Drill Date:	12 Sep 2006	**Water Level Count:**	0
Well Depth:	2.80m -GL	**Strata Layers:**	4
Initial Water Depth:	-1.65m -MP	**Aquifer Tests:**	0
Diameter:		**Isotope Data:**	0
		Yield/Drawdown Tests:	0
Measuring Point Ait:	5.58m MSD QAR 4	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:		**Calc. Min. GWL:**	
Drilling Method:		**Last Updated:**	27 Mar 2008
Casing Material:		**Last Field Check:**	
Pump Type:			
Yield:		**Screens:**	
Drawdown:		**Screen Type:**	
Specific Capacity:		**Top GL:**	
		Bottom GL:	
Aquifer Type:			
Aquifer Name:			

Borelog for well M35/17061

Gridref: M35:85809-43389 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 5.58 +MSD
Well name : CCC BorelogID 6930
Drill Method : Not Recorded
Drill Depth : -2.8m Drill Date : 12/09/2006

Environment Canterbury Regional Council

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
-0.2		-0.20m	sandy topsoil	
-0.4, -0.6, -0.8		-0.90m	brown sand	
-1, -1.2, -1.4		-1.60m	brown damp sand	
-1.6, -1.8, -2, -2.2, -2.4, -2.6		-2.80m	brown saturated sand	

Borelog for well M35/2319

Gridref: M35:858-434 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 4.8 +MSD
Driller : not known
Drill Method : Unknown
Drill Depth : -94.4m Drill Date : 31/01/1933

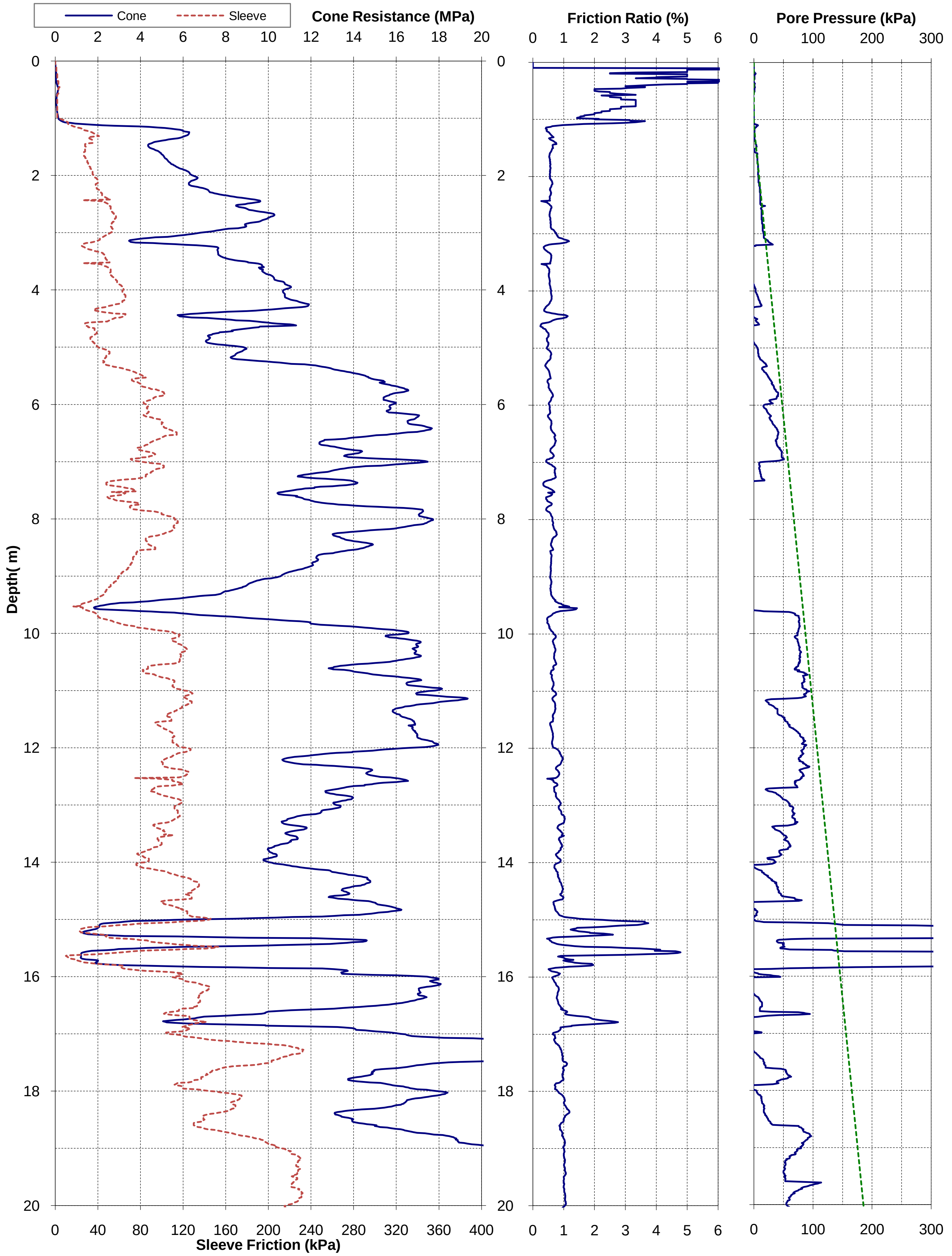
Environment Canterbury Regional Council

Water Level: Artesian

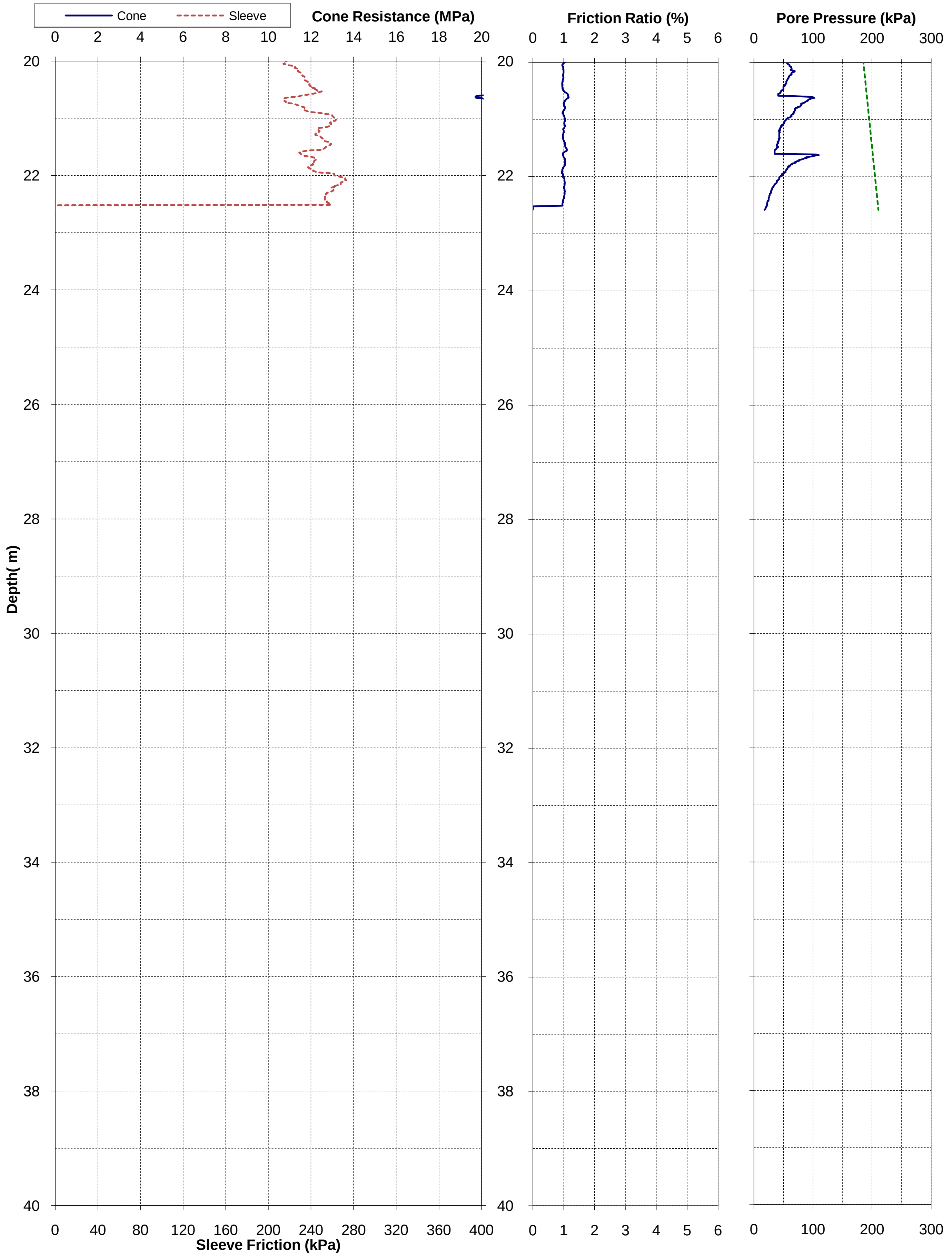
Depth(m)	Full Drillers Description	Formation Code
- 38.1m	Clay & sand	ch
- 47.2m	Blue shingle, water at 39.6 rises 0.9m	ri
- 61.5m	Brown sand	br
- 67.6m	Blue clay & sand	br
- 73.1m	Brown shingle, water at 69.4m	li-1
- 82.9m	Blue clay	li-2
- 86.8m	Brown shingle, water at 85.9m	li-2
- 90.5m	Blue clay	li-2
- 94.4m	Brown shingle, flows at 131.0m3/d at surface & rises 3.6m	li-3

Scale(m): -10, -20, -30, -40, -50, -60, -70, -80, -90

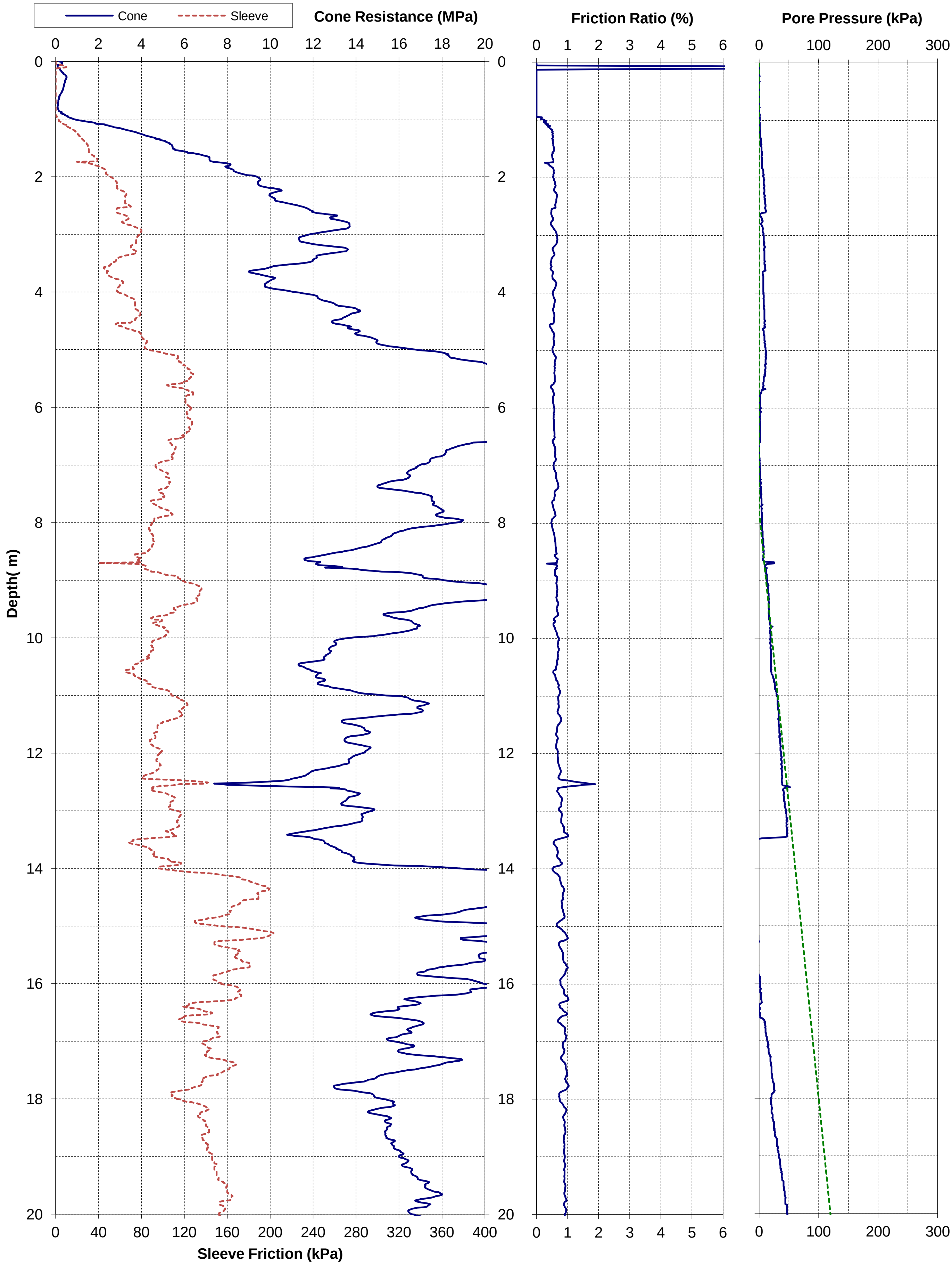
Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			Page:	1 of 2	CPT-WAI-87
Test Date:	5-Jul-2011	Location:	Wainoni	Operator:	Opus	
Pre-Drill:	1.2m	Assumed GWL:	1.1mBGL	Located By:	Survey GPS	
Position:	2485635.5mE	5743330.9mN	4.794mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



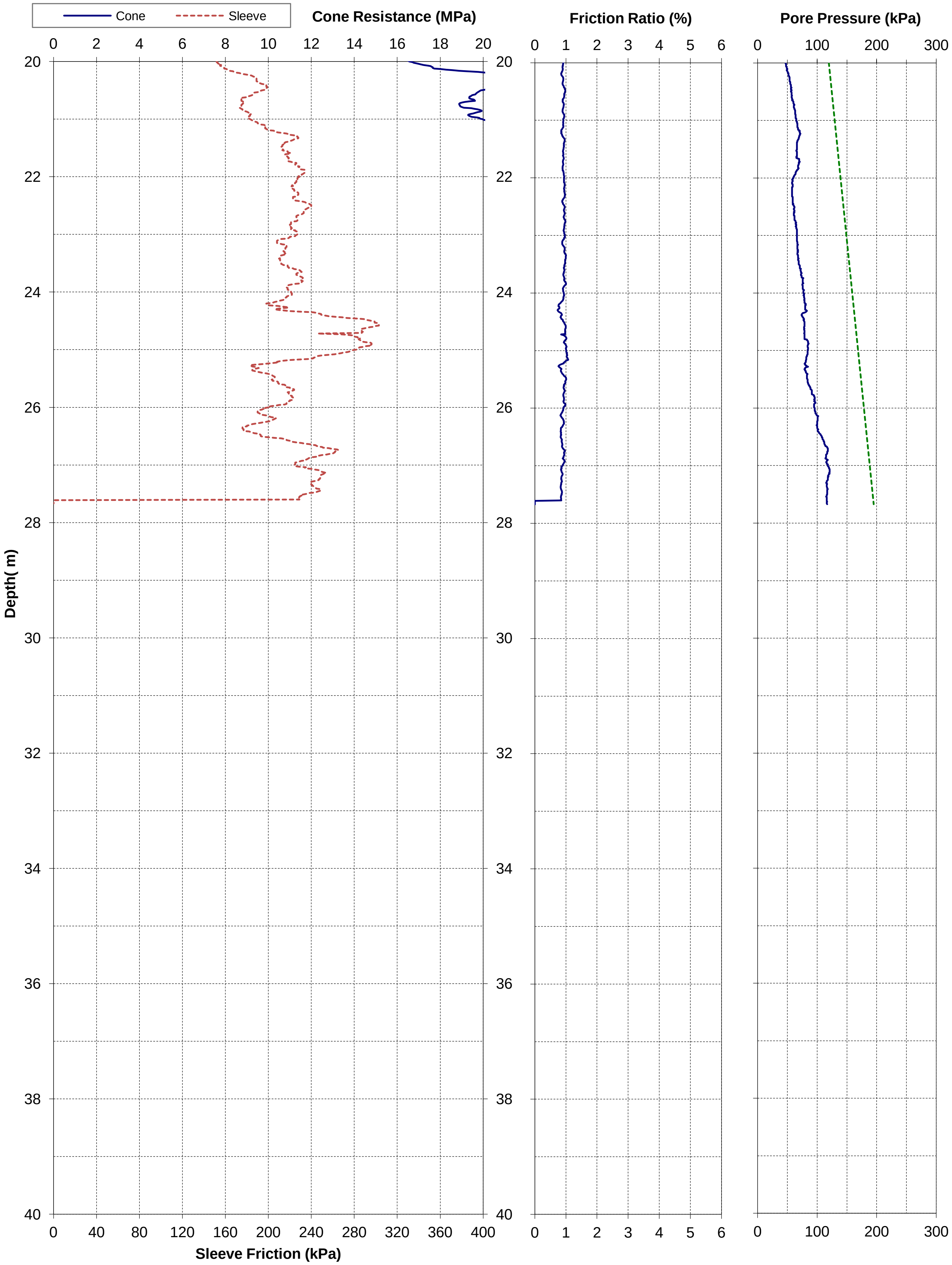
Project:	Christchurch 2011 Earthquake - EQC Ground Investigations		Page: 2 of 2	CPT-WAI-87
Test Date:	5-Jul-2011	Location: Wainoni	Operator: Opus	
Pre-Drill:	1.2m	Assumed GWL: 1.1mBGL	Located By: Survey GPS	
Position:	2485635.5mE 5743330.9mN	4.794mRL	Coord. System: NZMG & MSL	
Other Tests:			Comments:	



Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			Page:	1 of 2	CPT-WAI-70
Test Date:	15-Sep-2011	Location:	Wainoni	Operator:	Perry	
Pre-Drill:	1.2m	Assumed GWL:	7.8mBGL	Located By:	Survey GPS	
Position:	2485925.8mE	5743306.5mN	4.235mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			Page:	2 of 2	CPT-WAI-70
Test Date:	15-Sep-2011	Location:	Wainoni	Operator:	Perry	
Pre-Drill:	1.2m	Assumed GWL:	7.8mBGL	Located By:	Survey GPS	
Position:	2485925.8mE	5743306.5mN	4.235mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



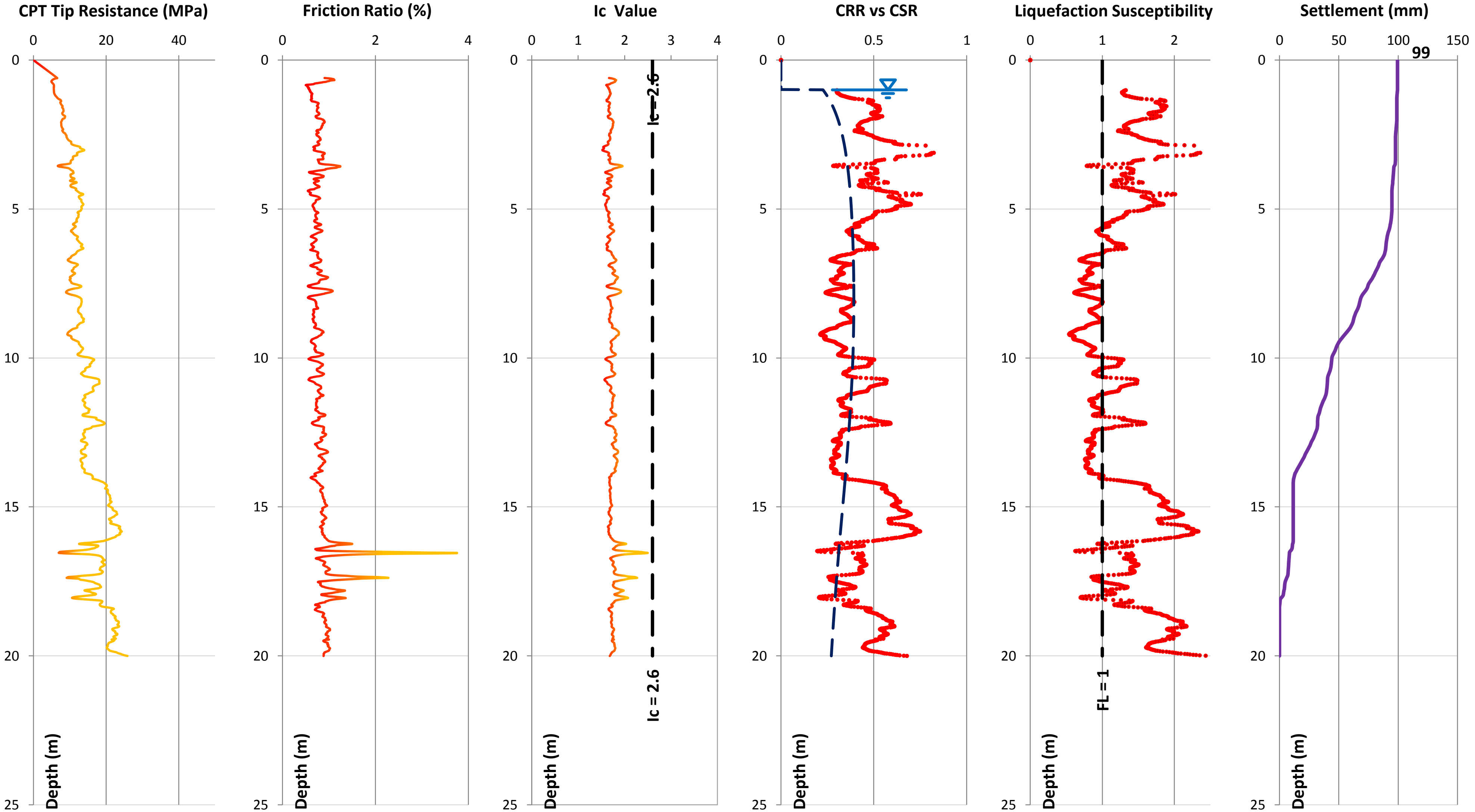
SOIL LIQUEFACTION SUSCEPTIBILITY ASSESSMENT

LOCATION :	CPT 01	SHEET :	
PROJECT :	Aranui Creche - 284 Breezes Road	CALCULATED :	DW
JOB NO :	51 30596 19	CHECKED BY :	HNN
TEST DATE :	27 Jun 2012	DATE :	16 Jul 2012

PGA (a_{max}):	0.35 g	Groundwater Level (m bgl):	1.0	Bore depth (m):	20
EQ Magnitude:	7.5	Atmospheric Pressure (kPa):	101	Test data step (m):	0.01

Total Estimated Settlement (mm)

99



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SOIL LIQUEFACTION SUSCEPTIBILITY ASSESSMENT

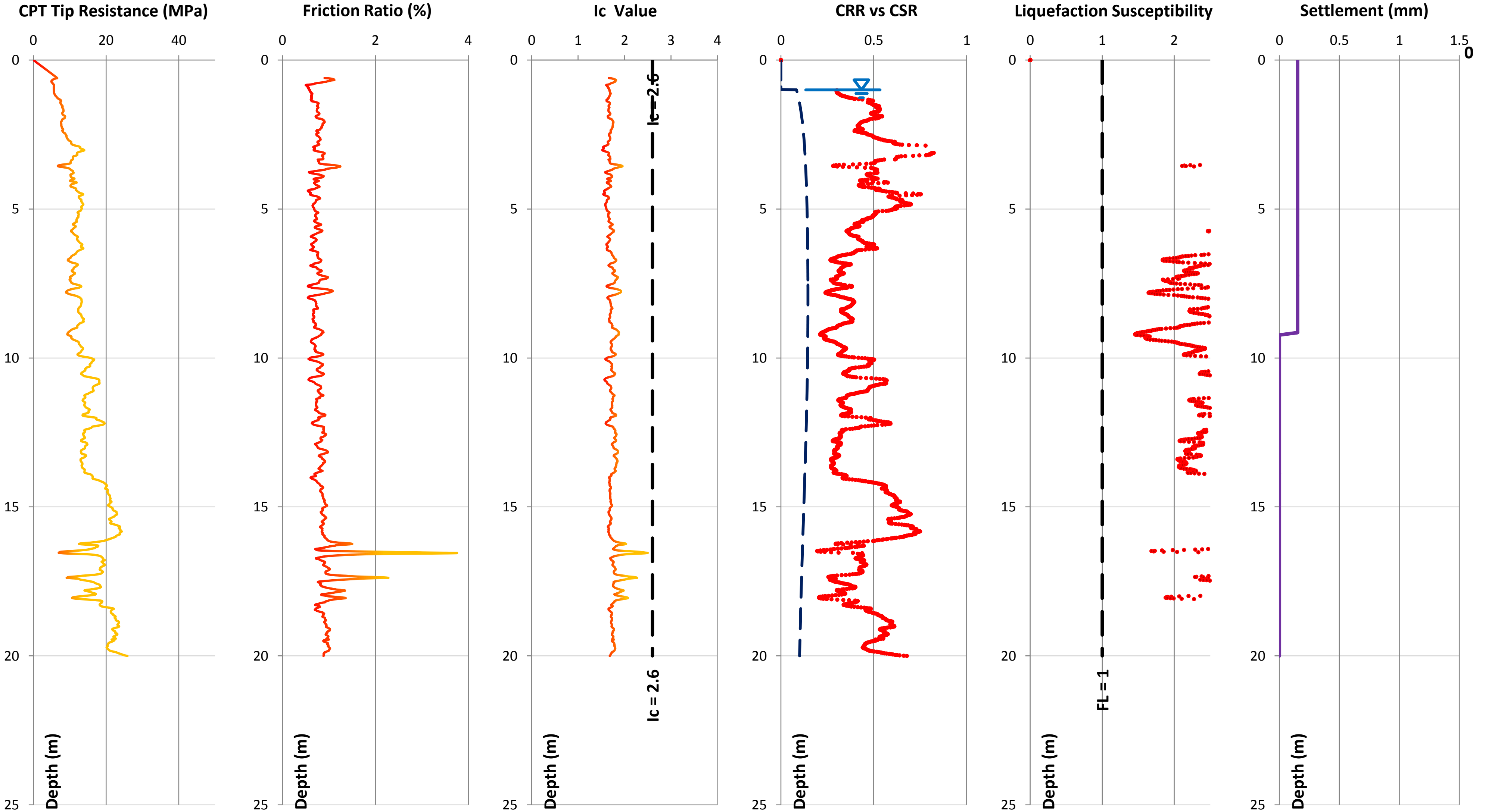
LOCATION :	CPT 01	SHEET :	
PROJECT :	Aranui Creche - 284 Breezes Road	CALCULATED :	DW
JOB NO :	51 30596 19	CHECKED BY :	HNN
TEST DATE :	27 Jun 2012	DATE :	16 Jul 2012

PGA (a_{max}): **0.13 g**
EQ Magnitude: **7.5**

Groundwater Level (m bgl): **1.0**
Atmospheric Pressure (kPa): **101**

Bore depth (m): **20**
Test data step (m): **0.01**

Total Estimated Settlement (mm)
0



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Appendix D

CERA Building Evaluation Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Kids First Aranui	Reviewer:	Stephen Lee
	Unit / No: / Street	CPEng No:	1006840
Building Address:	284 Breezers Road	Company:	GHD
Legal Description:	Lot1, DP27621	Company project number:	513059619
		Company phone number:	(03) 3780900
	Degrees / Min / Sec		
GPS south:	42 / 30 / 59.71	Date of submission:	8/03/2013
GPS east:	172 / 42 / 1.16	Inspection Date:	19/01/12
		Revision:	FINAL
Building Unique Identifier (CCC):	BU 2112-001 EQ2	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silty sand	Soil Profile (if available):	Sand
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	None detected
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	13.75

Building

No. of storeys above ground:	1	single storey = 1	
		Ground floor elevation (Absolute) (m):	14.07
Ground floor split?	no	Ground floor elevation above ground (m):	0.32
Storeys below ground	0		
Foundation type:	other (describe)	if Foundation type is other, describe:	Strip footing, precast piles
Building height (m):	5.00	height from ground to level of uppermost seismic mass (for IEP only) (m):	3
Floor footprint area (approx):			
Age of Building (years):	40	Date of design:	1992-2004
Strengthening present?	yes	If so, when (year)?	1965
		And what load level (%g)?	
Use (ground floor):	public	Brief strengthening description:	Bracing analysis and porvision
Use (upper floors):			
Use notes (if required):	Creche		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	frame system		
Roof:	timber truss	truss depth, purlin type and cladding	
Floors:	timber	joist depth and spacing (mm)	
Beams:	timber	type	Timber lintels
Columns:			
Walls:	non-load bearing	0	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	lightweight timber framed walls		note typical wall length (m)	7
Ductility assumed, μ:	3.00			
Period along:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls		note typical wall length (m)	6
Ductility assumed, μ:	3.00			
Period across:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

north (mm):		leave blank if not relevant
east (mm):		
south (mm):		
west (mm):		

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	Timber
Roof Cladding:	Metal	describe	Lightweight metal roof
Glazing:	timber frames		
Ceilings:	plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Christopher W. Hadlee (additions only), Feb 1994
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	partial	original designer name/date	Unknown, Oct 2006

Damage

Site: (refer DEE Table 4-2)

Site performance:	Good	Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):	Minor Plasterboard Cracking		
Across	Damage ratio:	0%		
	Describe (summary):	Minor Plasterboard Cracking		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	Cracking to linings throughout

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	100%	#### %NBS from IEP below	If IEP not used, please detail assessment methodology: bracing schedule
	Assessed %NBS after:	100%		
Across	Assessed %NBS before:	100%	#### %NBS from IEP below	
	Assessed %NBS after:	100%		

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
FINAL	Shashank Kumar	David Lee		Nick Waddington		08/03/2013