Christchurch City Council
PRK_0555_BLDG_015 EQ2
Summerhouse Rose Garden
Mona Vale, 65 Fendalton Road

QUALITATIVE ASSESSMENT REPORT
FINAL

- Rev B
- 30 April 2013

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Contents

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Approval

	Signature	Date	Name	Title
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1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on the building PRK_0555_BLDG_015 EQ2 located at 65 Fendalton Road. This building is a small single storey building that is used as a garden shelter at Mona Vale. It is constructed from timber framed walls with a timber framed roof. The building's walls and roof are clad with timber. An aerial photograph illustrating the location of the building is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type are given in Section 5 of this report.

- Figure 1 Aerial Photograph of 57 Princess Street

The qualitative assessment includes a summary of the building damage as well as an initial assessment of the current seismic capacity compared with current seismic code loads using the Initial Evaluation Procedure (IEP).

This Qualitative report for the building structure is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, and visual inspections on 18th July 2012.

1.2. Key Damage Observed

Key damage observed includes:-

No external or internal damage was observed during our site inspection

1.3. Critical Structural Weaknesses

No potential critical structural weaknesses were identified for this building.

1.4. Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the buildings original capacity has been assessed to be in the order of 69%NBS. No damage was observed during our site investigation therefore the post earthquake capacity is also in the order of 69%NBS.

The building has been assessed to have a seismic capacity in the order of 69% NBS and is therefore not potentially earthquake prone. Since the capacity is greater than 67% NBS no further assessment is required at this stage.

1.5. Recommendations

It is recommended that:

a) There is no damage to the building that would cause it to be unsafe to occupy.
b) We consider that barriers around the building are not necessary.

2. Introduction

Sinclair Knight Merz was engaged by Christchurch City Council to prepare a qualitative assessment report for the building located at 65 Fendalton Road following the magnitude 6.3 earthquake which occurred in the afternoon of the 22nd of February 2011 and the subsequent aftershocks.

The Qualitative Assessment uses the methodology recommended in the Engineering Advisory Group document "Guidance on Detailed Engineering Evaluation of Earthquake affected Non-residential Buildings in Canterbury" (part 2 revision 5 dated 19/07/2011 and part 3 draft revision dated 13/12/2011). The qualitative assessment includes a summary of the building damage as well as an initial assessment of the likely current Seismic Capacity compared with current seismic code requirements.

A qualitative assessment involves inspections of the building and a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available.

The purpose of the assessment is to determine the likely building performance and damage patterns, to identify any potential critical structural weaknesses or collapse hazards, and to make an initial assessment of the likely building strength in terms of percentage of new building standard (%NBS).

This report describes the structural damage observed during our inspection and indicates suggested remediation measures. The inspection was undertaken from floor levels and was a visual inspection only. Our report reflects the situation at the time of the inspection and does not take account of changes caused by any events following our inspection. A full description of the basis on which we have undertaken our visual inspection is set out in 7.

The NZ Society for Earthquake Engineering (NZSEE) Initial Evaluation Procedure (IEP) was used to assess the likely performance of the building in a seismic event relative to the New Building Standard (NBS). 100% NBS is equivalent to the strength of a building that fully complies with current codes. This includes a recent increase of the Christchurch seismic hazard factor from 0.22 to 0.3[1].

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure had been carried out. No Construction drawings were made available, and these have been considered in our evaluation of the building. The building description below is based on our visual inspections.

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[1] http://www.dbh.govt.nz/seismicity-info

3. Compliance

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

3.1. 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

3.2. Building Act

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

3.2.1. 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).

3.2.2. 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.

3.2.3. 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.

3.2.4. 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.

3.2.5. 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.

3.2.6. Section 131 – Earthquake Prone Building Policy

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

3.3. 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. Council recognises that it may not be practicable for some repairs to meet that target. The council will work closely with building owners to achieve sensible, safe outcomes;
- 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 34%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.

3.4. 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:

a) Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)

b) 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)

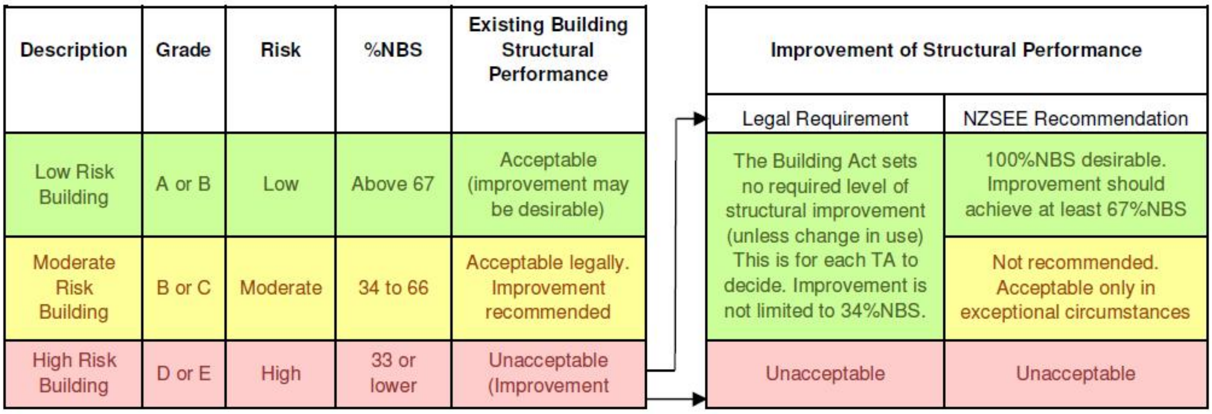
The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

4. 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 buildings 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 2 below.

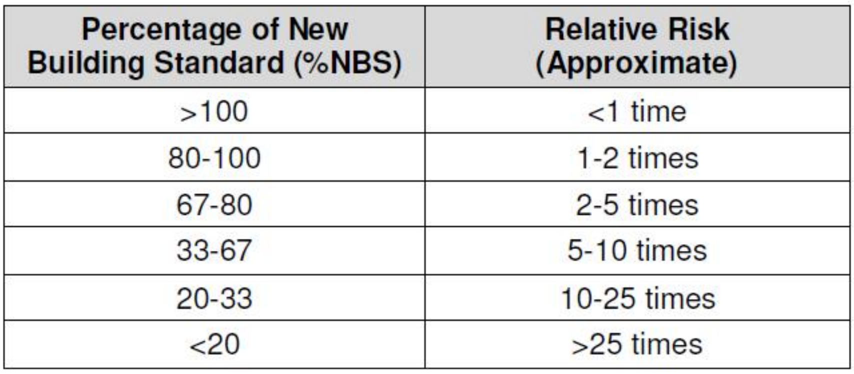


Description	Grade	Risk	%NBS	Existing Building Structural Performance	Improvement of Structural Performance	
					Legal Requirement	NZSEE Recommendation
Low Risk Building	A or B	Low	Above 67	Acceptable (improvement may be desirable)	The Building Act sets no required level of structural improvement (unless 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 2: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines**

Table 1 below provides an indication of the risk of failure for an existing building with a given percentage NBS, relative to the risk of failure for a new building that has been designed to meet current Building Code criteria (the annual probability of exceedance specified by current earthquake design standards for a building of 'normal' importance is 1/500, or 0.2% in the next year, which is equivalent to 10% probability of exceedance in the next 50 years).

- **Table 1: %NBS compared to relative risk of failure**



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

5. Building Details

5.1. Building description

Building PRK_0555_BLDG_015 EQ2 is a small single storey building that is used as a garden shelter at Mona Vale. It is constructed from timber framed walls with a timber framed roof. The building’s walls and roof is clad with timber. The structure is found on concrete strip footings and a concrete slab on grade.

5.2. Gravity Load Resisting system

The hip roof structure consists of timber rafters and purlins which are supported on the timber framed walls and supported by the concrete strip footings

5.3. Seismic Load Resisting system

For the purposes of this report the longitudinal direction of the building is defined as being in the north-south direction and the transverse direction is defined as being in the east-west direction.

Lateral loads acting in the longitudinal and the transverse direction will be resisted by the timber framed walls and the concrete footing foundations

5.4. Geotechnical Conditions

A geotechnical desktop study was carried out for this site. The main conclusions from this report are:

- The site has been assessed as NZS1170.5 Class D (deep or soft soil) from adjacent borehole logs.
- Liquefaction risk is low to medium at this site.
- Interpretation of the most relevant local investigation suggests the site is underlain by clay, sand and gravel to 0-16m, Clay and Peat 16-20m, and Brown Shingle beyond 20m.

Unless a change of use is intended for the site we do not believe that any further geotechnical investigations are required. Specific ground investigation should be undertaken if significant alterations or new structures are proposed. If any excavations are required on the site further investigation of the potential for contamination should be undertaken. The full geotechnical desktop study can be found in Appendix 4 – Geotechnical Desktop Study

6. Damage Summary

SKM undertook inspections on 18th July 2012. The following was observed during the time of inspection:

1) No external or internal damage was observed during our site inspection.
2) No visual evidence of settlement was noted at this site. Therefore a level survey is not required at this stage of assessment.

7. Initial Seismic Evaluation

7.1. The Initial Evaluation Procedure Process

This section covers the initial seismic evaluation of the building as detailed in the NZSEE 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes'. The IEP grades buildings according to their likely performance in a seismic event. The procedure is not yet recognised by the NZ Building Code but is widely used and recognised by the Christchurch City Council as the preferred method for preliminary seismic investigations of buildings[2].

The IEP is a coarse screening process designed to identify buildings that are likely to be earthquake prone. The IEP process ranks buildings according to how well they are likely to perform relative to a new building designed to current earthquake standards, as shown in Table 2. The building grade is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have. A building is earthquake prone for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building—

a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and
b) would be likely to collapse causing—
    i. injury or death to persons in the building or to persons on any other property; or
    ii. damage to any other property.

A moderate earthquake is defined as 'in relation to a building, an earthquake that would generate shaking at the site of the building that is of the same duration as, but that is one-third as strong as, the earthquake shaking (determined by normal measures of acceleration, velocity and displacement) that would be used to design a new building at the site.'

An earthquake prone building will have an increased risk that its strength will be exceeded due to earthquake actions of approximately 10 times (or more) than that of a building having a capacity in excess of 100% NBS (refer Table 1)[3]. Buildings in Christchurch City that are identified as being earthquake prone are required by law to be followed up with a detailed assessment and strengthening work within 30 years of the owner being notified that the building is potentially earthquake prone[4].

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[2] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf
[3] NZSEE June 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p 2-13
[4] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

Table 2: IEP Risk classifications

Description	Grade	Risk	%NBS	Structural performance
Low risk building	A+	Low	> 100	Acceptable. Improvement may be desirable.
	A		100 to 80	
	B		80 to 67	
Moderate risk building	C	Moderate	67 to 33	Acceptable legally. Improvement recommended.
High risk building	D	High	33 to 20	Unacceptable. Improvement required.
	E		< 20	

The IEP is a simple desktop study that is useful for risk management. No detailed calculations are done and so it relies on an inspection of the building and its plans to identify the structural members and describe the likely performance of the building in a seismic event. A review of the plans is also likely to identify any critical structural weaknesses. The IEP assumes that the building was properly designed and built according to the relevant codes at the time of construction. The IEP method rates buildings based on the code used at the time of construction and some more subjective parameters associated with how the building is detailed and so it is possible that %NBS derived from different engineers may differ.

This assessment describes only the likely seismic Ultimate Limit State (ULS) performance of the building. The ULS is the level of earthquake that can be resisted by the building without collapse or other forms of failure. The IEP does not attempt to estimate Serviceability Limit State (SLS) performance of the building, or the level of earthquake that would start to cause damage to the building[5]. This assessment concentrates on matters relating to life safety as damage to the building is a secondary consideration.

The NZ Building Code describes that the relevant codes for determining %NBS are primarily:

- AS/NZS 1170 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard
- NZS4230:2004 Design of Reinforced Concrete Masonry Structures
- NZS 3603:1993 Timber Structures Standard
- NZS 3604:2011 Timber Framed Buildings

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[5] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p2-9

7.2. Design Criteria and Limitations

Following our inspection 18th July 2012, SKM carried out a preliminary structural review. The structural review was undertaken using the available information which was as follows:

- SKM site measurements and inspection findings of the building. Please note no intrusive investigations were undertaken.
- Structural drawings were not available

The design criteria used to undertake the assessment include:

- Standard design assumptions for typical office and factory buildings as described in AS/NZS1170.0:2002
  - 50 year design life, which is the default NZ Building Code design life.
  - Structure importance level 2 which represents structures presenting a degree of hazard to life and other property.
  - Ductility level of 1.5 has been used for both directions, based on our assessment and code requirements at the time of design. This represents a limited ductile structure which is appropriate given the timber framing in this structure.
  - Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011

This IEP was based on our visual inspection of the building and a review of the available structural drawings. Since it is not a full design and construction review, it has the following limitations:

- It is not likely to pick up on any original design or construction errors (if they exist)
- Other possible issues that could affect the performance of the building such as corrosion and modifications to the building will not be identified
- The IEP deals only with the structural aspects of the building. Other aspects such as building services are not covered.
- The IEP does not involve a detailed analysis or an element by element code compliance check.

7.3. Survey

There was no visible settlement of the structure, nor were there any significant ground movement issues around the building. The building is adjacent to land which is zoned TC2 under the CERA Residential Technical Categories Map. Due to these factors we do not recommend that any survey be undertaken at this stage of the assessment.

7.4. Critical Structural Weaknesses

No Structural weaknesses were identified in this building

7.5. Qualitative Assessment Results

The building has had its capacity assessed using the Initial Evaluation Procedure based on the information available. The buildings capacity expressed as a percentage of new building standard (%NBS) is in order of that shown below in Table 3.

Table 3: Qualitative Assessment Summary

Item	%NBS
Likely Seismic Capacity of Building	69

Our qualitative assessment found that the building is likely to be classed as a ‘Low Risk Building’ (capacity above 67% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.

8. Further Investigation

Due to the likely seismic rating of this building being greater that 67%, and the lack of any structural damage no further investigation is required at this stage of the assessment.

9. Conclusion

A qualitative assessment was carried out on the building PRK_0555_BLDG_015 EQ2 located at Mona Vale. This building has been assessed to have a likely seismic capacity in the order of 69%NBS and is therefore a ‘low risk building’.

Due to the likely seismic rating of this building and the lack of any structural damage no further investigation is required.

It is recommended that:

a) There is no damage to the building that would cause it to be unsafe to occupy.
b) We consider that barriers around the building are not necessary.

10. Limitation Statement

This report has been prepared on behalf of, and for the exclusive use of, SKM's client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and the Client. It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to, and the assumptions made by, SKM. The report may not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

Without limiting any of the above, in the event of any liability, SKM's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited in as set out in the terms of the engagement with the Client.

It is not within SKM's scope or responsibility to identify the presence of asbestos, nor the responsibility of SKM to identify possible sources of asbestos. Therefore for any property pre-dating 1989, the presence of asbestos materials should be considered when costing remedial measures or possible demolition.

There is a risk of further movement and increased cracking due to subsequent aftershocks or settlement.

Should there be any further significant earthquake event, of a magnitude 5 or greater, it will be necessary to conduct a follow-up investigation, as the observations, conclusions and recommendations of this report may no longer apply Earthquake of a lower magnitude may also cause damage, and SKM should be advised immediately if further damage is visible or suspected.

11. Appendix 1 – Photos

	
Photo 1: Rose garden with summerhouse in the background	Photo 2: East Elevation
	
Photo 3: South Elevation	Photo 4: North Elevation


18/07/2012

Photo 5: North East Elevation


18/07/2012

Photo 6: Timber framed wall


18/07/2012

Photo 7: Concrete strip footing


18/07/2012

Photo 8: Internal view of the summerhouse, with plaque attached to ceiling

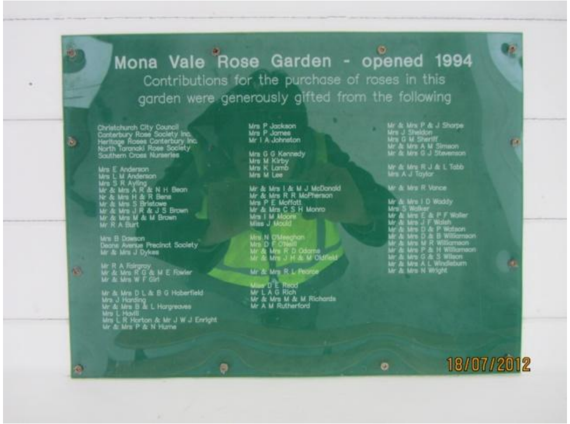


Photo 9: Plaque showing the year of opening, refer to photo 8 for location of plaque

12. Appendix 2 – IEP Reports

Table IEP-1 Initial Evaluation Procedure – Step 1

(Refer Table IEP - 2 for Step 2; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

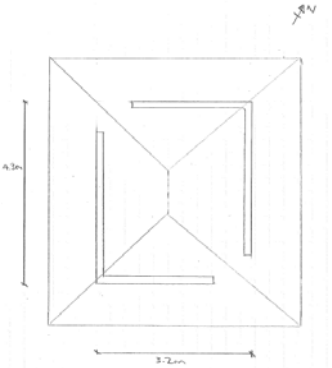
Building Name: SUMMERHOUSE - rose gdn
Location: Mona Vale, 165 Fendalton Road

Ref. ZB01276.105
By NLC
Date 25/07/2012

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)

1.2 Sketch of building plan



1.3 List relevant features

This is small single storey timber framed structure. It has a timber framed roof that is clad in timber roof shingles. The structure has concrete footings with a concrete floor slab. The plaque inside the building has indicated the building was built in 1994, therefore we have taken a design era of 1992-2004 for our assessment.

1.4 Note information sources

Tick as appropriate

Visual Inspection of Exterior	☑	
Visual Inspection of Interior	☑	
Drawings (note type)	☐	Architectural Drawings
Specifications	☐	
Geotechnical Reports	☑	Partial
Other (list)	☐	

Inspection Date: 18/07/2012
SKM geotech desk study. Dated August 2012

Table IEP-2 Initial Evaluation Procedure – Step 2

(Refer Table IEP - 1 for Step 1; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	SUMMERHOUSE - rose gdn	Ref.	ZB01276.105
Location:	Mona Vale, 165 Fendalton Road	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	25/07/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 2 - Determination of (%NBS)b

2.1 Determine nominal (%NBS) = (%NBS)nom

Pre 1935			○	See also notes 1, 3
1935-1965			○	
1965-1976	Seismic Zone;	A	○	
		B	○	
		C	○	See also note 2
1976-1992	Seismic Zone;	A	○	
		B	○	
		C	○	
1992-2004			●	

b) Soil Type

From NZS1170.5:2004, Cl 3.1.3	A or B Rock	○
	C Shallow Soil	○
	D Soft Soil	●
	E Very Soft Soil	○

From NZS4203:1992, Cl 4.6.2.2	a) Rigid	○
(for 1992 to 2004 only and only if known)	b) Intermediate	●

c) Estimate Period, T

building Ht = 2.5 meters

	Longitudinal	Transverse	
Ac =			m2
	○ MRCF	○ MRCF	
	○ MRSF	○ MRSF	
	○ EBSF	○ EBSF	
	● Others	● Others	
	○ CSW	○ CSW	
	○ MSW	○ MSW	

Can use following:

$T = 0.09h_n^{0.75}$	for moment-resisting concrete frames
$T = 0.14h_n^{0.75}$	for moment-resisting steel frames
$T = 0.08h_n^{0.75}$	for eccentrically braced steel frames
$T = 0.06h_n^{0.75}$	for all other frame structures
$T = 0.09h_n^{0.75}/A_c^{0.5}$	for concrete shear walls
T <= 0.4sec	for masonry shear walls

Where hn = height in m from the base of the structure to the uppermost seismic weight or mass.

Ac = ΣAi(0.2 + Lwi/hn)2

Ai = cross-sectional shear area of shear wall i in the first storey of the building, in m2

lwi = length of shear wall i in the first storey in the direction parallel to the applied forces, in m

with the restriction that lwi/hn shall not exceed 0.9

Longitudinal	Transverse	
0.1	0.1	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	22.2	$(\%NBS)_{nom}$
Transverse	22.2	$(\%NBS)_{nom}$

		Factor
Note 1: For buildings designed prior to 1965 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.25.	No ▼	1
For buildings designed 1965 - 1976 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.33 - Zone A or 1.2 - Zone B	No ▼	1
Note 2: For reinforced concrete buildings designed between 1976 -1984 (%NBS)nom by 1.2	No ▼	1
Note 3: For buildings designed prior to 1935 multiply (%NBS)nom by 0.8 except for Wellington where the factor may be taken as 1.	No ▼	1

Longitudinal	22.2	$(\%NBS)_{nom}$
Transverse	22.2	$(\%NBS)_{nom}$

Continued over page

Building Name:	SUMMERHOUSE - rose gdn	Ref.	ZB01276.105
Location:	Mona Vale, 165 Fendalton Road	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	25/07/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

2.2 Near Fault Scaling Factor, Factor A
If T < 1.5sec, Factor A = 1

a) Near Fault Factor, N(T,D) 1
(from NZS1170.5:2004, Cl 3.1.6)

b) Near Fault Scaling Factor = 1/N(T,D) **Factor A** 1.00

2.3 Hazard Scaling Factor, Factor B

Select Location: Christchurch

a) Hazard Factor, Z, for site
(from NZS1170.5:2004, Table 3.3)

Z = 0.3

Z 1992 = 0.8

Type Z 1992 above

Auckland	0.6	Palm Nth	1.2
Wellington	1.2	Dunedin	0.6
Christchurch	0.8	Hamilton	0.67

b) Hazard Scaling Factor

For pre 1992 = 1/Z

\# For 1992 onwards = Z 1992/Z

(Where Z 1992 is the NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))

Factor B 2.67

2.4 Return Period Scaling Factor, Factor C

a) Building Importance Level 2
(from NZS1170.0:2004, Table 3.1 and 3.2)

b) Return Period Scaling Factor from accompanying Table 3.1 **Factor C** 1.00

2.5 Ductility Scaling Factor, D

a) Assessed Ductility of Existing Structure, μ
(shall be less than maximum given in accompanying Table 3.2)

Longitudinal	1.5	μ Maximum = 6
Transverse	1.5	μ Maximum = 6

b) Ductility Scaling Factor

For pre 1976 = k_μ

For 1976 onwards = 1

(where k_μ is NZS1170.5:2005 Ductility Factor, from accompanying Table 3.3)

Longitudinal	**Factor D**	1.00
Transverse	**Factor D**	1.00

2.6 Structural Performance Scaling Factor, Factor E

Select Material of Lateral Load Resisting System

Longitudinal	Timber
Transverse	Timber

a) Structural Performance Factor, S_p
from accompanying Figure 3.4

Longitudinal	Sp	0.85
Transverse	Sp	0.85

b) Structural Performance Scaling Factor

Longitudinal	$1/S_p$	**Factor E**	1.18
Transverse	$1/S_p$	**Factor E**	1.18

2.7 Baseline %NBS for Building, $(\%NBS)_b$
(equals $(\%NSB)_{nom}$ x A x B x C x D x E)

Longitudinal	69.6	(%NBS)b
Transverse	69.6	(%NBS)b

Table IEP-3 Initial Evaluation Procedure – Step 3

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	SUMMERHOUSE - rose gdn	Ref.	ZB01276.105
Location:	Mona Vale, 165 Fendalton Road	By	NLC
Direction Considered:	**a) Longitudinal**	Date	25/07/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness | **Effect on Structural Performance** (Choose a value - Do not interpolate) | **Building Score**

3.1 Plan Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	●	**Factor A**	1
Comment					

3.2 Vertical Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	●	**Factor B**	1
Comment					

3.3 Short Columns

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	●	**Factor C**	1
Comment					

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect
Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	● 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect
Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Height Difference > 4 Storeys	○ 0.4	○ 0.7	○ 1
Height Difference 2 to 4 Storeys	○ 0.7	○ 0.9	○ 1
Height Difference < 2 Storeys	○ 1	○ 1	● 1

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

	Severe	Significant	Insignificant		
Effect on Structural Performance	○ 0.5	○ 0.7	● 1	**Factor E**	1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 1

Record rationale for choice of Factor F:

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F)

PAR 1

Table IEP-3 Initial Evaluation Procedure – Step 3

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	SUMMERHOUSE - rose gdn	Ref.	ZB01276.105
Location:	Mona Vale, 165 Fendalton Road	By	NLC
Direction Considered:	**b) Transverse**	Date	25/07/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness	**Effect on Structural Performance** (Choose a value - Do not interpolate)				**Building Score**

3.1 Plan Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	●	**Factor A**	1
Comment					

3.2 Vertical Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	●	**Factor B**	1
Comment					

3.3 Short Columns

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	●	**Factor C**	1
Comment					

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	● 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Height Difference > 4 Storeys	○ 0.4	○ 0.7	○ 1
Height Difference 2 to 4 Storeys	○ 0.7	○ 0.9	○ 1
Height Difference < 2 Storeys	○ 1	○ 1	● 1

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

	Severe	Significant	Insignificant		
Effect on Structural Performance	○ 0.5	○ 0.7	● 1	**Factor E**	1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum.

Factor F 1

Record rationale for choice of Factor F:

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F)

PAR 1

Table IEP-4 **Initial Evaluation Procedure – Steps 4, 5 and 6**

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 3 for Step 3)

Building Name:	SUMMERHOUSE - rose gdn	Ref.	ZB01276.105
Location:	Mona Vale, 165 Fendalton Road	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	25/07/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 4 - Percentage of New Building Standard (%NBS)

	Longitudinal	Transverse
4.1 Assessed Baseline (%NBS)$_b$ (from Table IEP - 1)	69	69
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	1.00	1.00
4.3 PAR x Baseline (%NBS)$_b$	69	69

4.4 Percentage New Building Standard (%NBS) **69**

(Use lower of two values from Step 4.3)

Step 5 - Potentially Earthquake Prone?

(Mark as appropriate)

%NBS ≤ 33 NO

Step 6 - Potentially Earthquake Risk?

%NBS < 67 NO

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade **B**

Evaluation Confirmed by

Signature

Name

CPEng. No

Relationship between Seismic Grade and % NBS :

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	80 to 67	67 to 33	33 to 20	< 20

13. Appendix 3 – CERA Standardised Report Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: SUMMERHOUSE - rose gdn
Unit | No: | Street
Building Address: Mona Vale | 65 | Fendalton Road
Legal Description:
Degrees | Min | Sec
GPS south:
GPS east:
Building Unique Identifier (CCC): PRK_0555_BLDG_015

Reviewer: James Carter
CPEng No: 1017618
Company: Sinclair Knight Merz
Company project number: ZB01276.105
Company phone number: 03 940 4900
Date of submission: 30-Apr
Inspection Date: 18th July 2012
Revision: B
Is there a full report with this summary?: yes

Site

Site slope: flat
Soil type: mixed
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available): Depth range (mBLG)
Soil type
0 – 16 m Clay, Sand and Gravel
16 – 20 m Clay and Peat
20 m+ Brown Shingle
If Ground improvement on site, describe: n/a
Approx site elevation (m): 0.00

Building

No. of storeys above ground: 1 single storey = 1
Ground floor split?: no
Storeys below ground: 0
Foundation type: strip footings
Building height (m): 2.50
Floor footprint area (approx): 14
Age of Building (years): 18

Ground floor elevation (Absolute) (m): 0.00
Ground floor elevation above ground (m): 0.00
if Foundation type is other, describe:
height from ground to level of uppermost seismic mass (for IEP only) (m): 2.5
Date of design: 1992-2004

Strengthening present?: no
Use (ground floor): other (specify)
Use (upper floors):
Use notes (if required): Garden Shelter
Importance level (to NZS1170.5): IL2

If so, when (year)?:
And what load level (%g)?:
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber framed
Floors: concrete flat slab
Beams: timber
Columns: timber
Walls:

rafter type, purlin type and cladding: timber cladding
slab thickness (mm): 125
type: no floor beams present, roof structure as detailed above
typical dimensions (mm x mm):

Lateral load resisting structure

Lateral system along: lightweight timber framed walls
Ductility assumed, μ: 1.50
Period along: 0.10 0.00
Total deflection (ULS) (mm): 5
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

note typical wall length (m): 0.6
estimate or calculation?: estimated
estimate or calculation?: estimated
estimate or calculation?:

Lateral system across: lightweight timber framed walls
Ductility assumed, μ: 1.50
Period across: 0.10 0.00
Total deflection (ULS) (mm): 5
maximum interstorey deflection (ULS) (mm):

note typical wall length (m): 0.6
estimate or calculation?: estimated
estimate or calculation?: estimated
estimate or calculation?:

Separations:

north (mm):
east (mm):
south (mm):
west (mm):

leave blank if not relevant

Non-structural elements

Stairs: | n/a
Wall cladding: other light | describe: timber
Roof Cladding: Other (specify) | describe: timber
Glazing: | n/a
Ceilings: | n/a
Services(list): none

Available documentation

Architectural: none | original designer name/date:
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: SKM desk study dated August 2012

Damage

Site:
(refer DEE Table 4-2)

Site performance: 1 | Describe damage: no damage observed
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: no damage observed on site
Describe (summary): Small structure with no structural damage

Across
Damage ratio: 0%
Describe (summary): Small structure with no structural damage

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

Diaphragms | Damage?: no | Describe: n/a
CSWs: | Damage?: no | Describe: n/a
Pounding: | Damage?: no | Describe: n/a
Non-structural: | Damage?: no | Describe: n/a

Recommendations

Level of repair/strengthening required: none | Describe: n/a
Building Consent required: no | Describe: n/a
Interim occupancy recommendations: full occupancy | Describe: n/a

Along
Assessed %NBS before: 69% %NBS from IEP
Assessed %NBS after: 69%

If IEP not used, please detail assessment methodology: Qualitative Assessment carried out this includes the NZSEEE IEP - refer to SKM report

Across
Assessed %NBS before: 69% %NBS from IEP
Assessed %NBS after: 69%

14. Appendix 4 – Geotechnical Desktop Study

Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	105
Address	Mona Vale, 65 Fendalton Road, (Summer House)
Report date	August 2012
Author	Ain Kim
Reviewer	Leah Bateman
Approved for issue	Yes

1. Introduction

This report outlines the geotechnical information that Sinclair Knight Merz (SKM) has been able to source from our database and other sources in relation to the property listed above. We understand that this information will be used as part of an initial qualitative Detailed Engineering Evaluation (DEE), and will be supplemented by more detailed information and investigations to allow detailed scoping of the repair or rebuild of the building.

2. Scope

This geotechnical desk top study incorporates information sourced from:

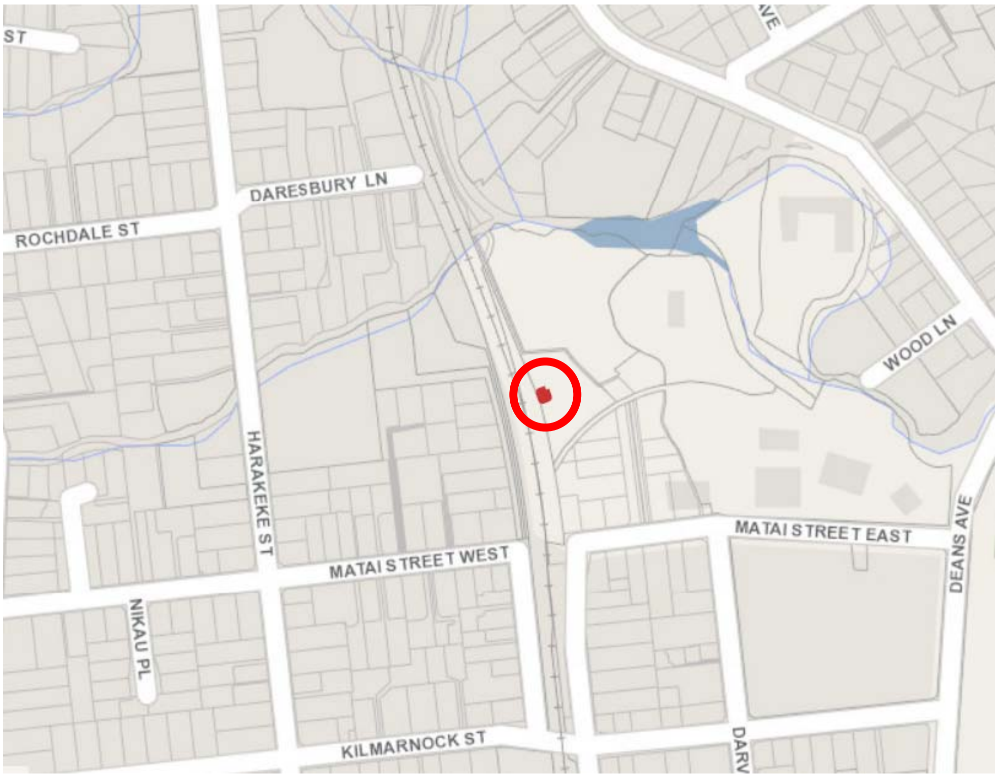
- Published geology
- Publically available borehole records
- Liquefaction records
- Aerial photography
- Council files
- A preliminary site walkover

3. Limitations

This report was prepared to address geotechnical issues relating to the specific site in accordance with the scope of works as defined in the contract between SKM and our Client. This report has been prepared on behalf of, and for the exclusive use of, our Client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and our Client. The findings presented in this report should not be applied to another site or another development within the same site without consulting SKM.

The assessment undertaken by SKM was limited to a desktop review of the data described in this report. SKM has not undertaken any subsurface investigations, measurement or testing of materials from the site. In preparing this report, SKM has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by our Client, and from other sources as described in the report. Except as otherwise stated in this report, SKM has not attempted to verify the accuracy or completeness of any such information.

4. Site location

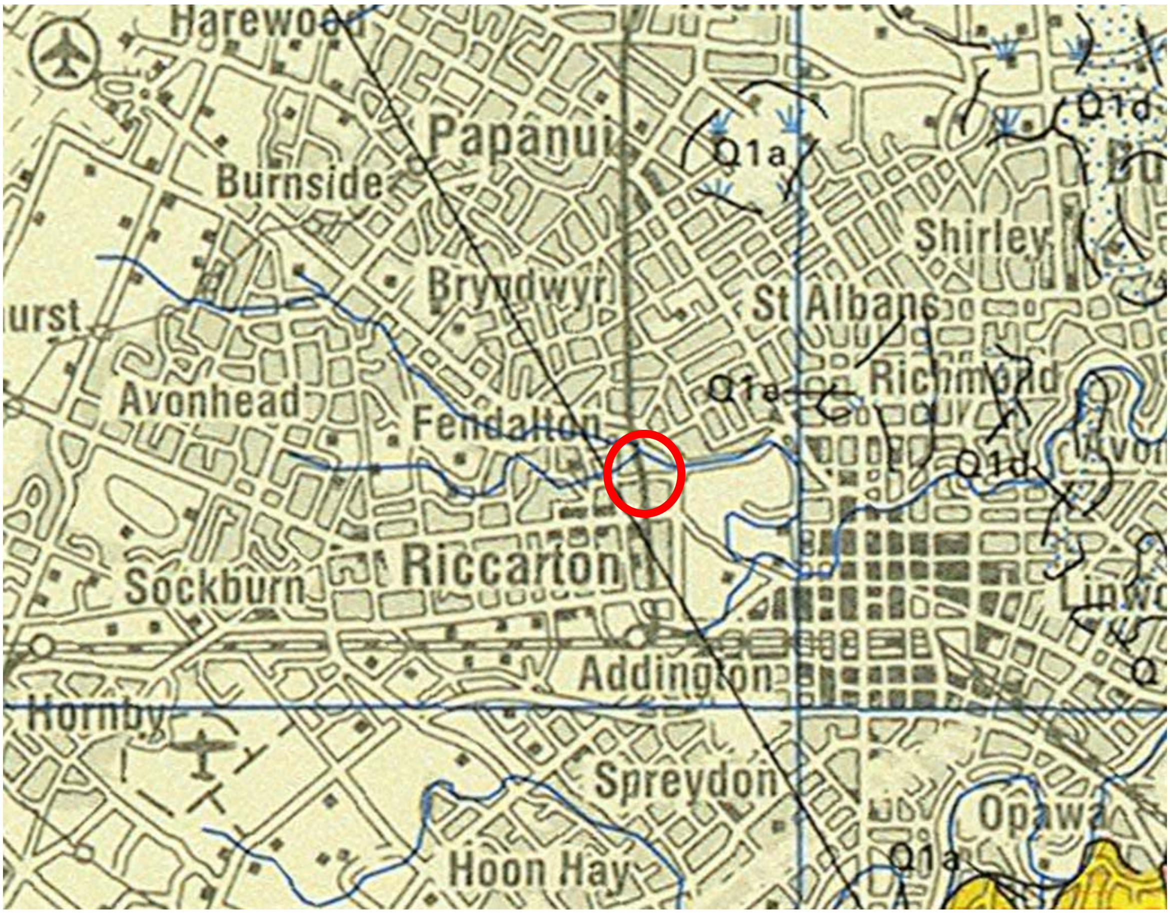


- **Figure 1 – Site location (courtesy of LINZ http://viewers.geospatial.govt.nz)**

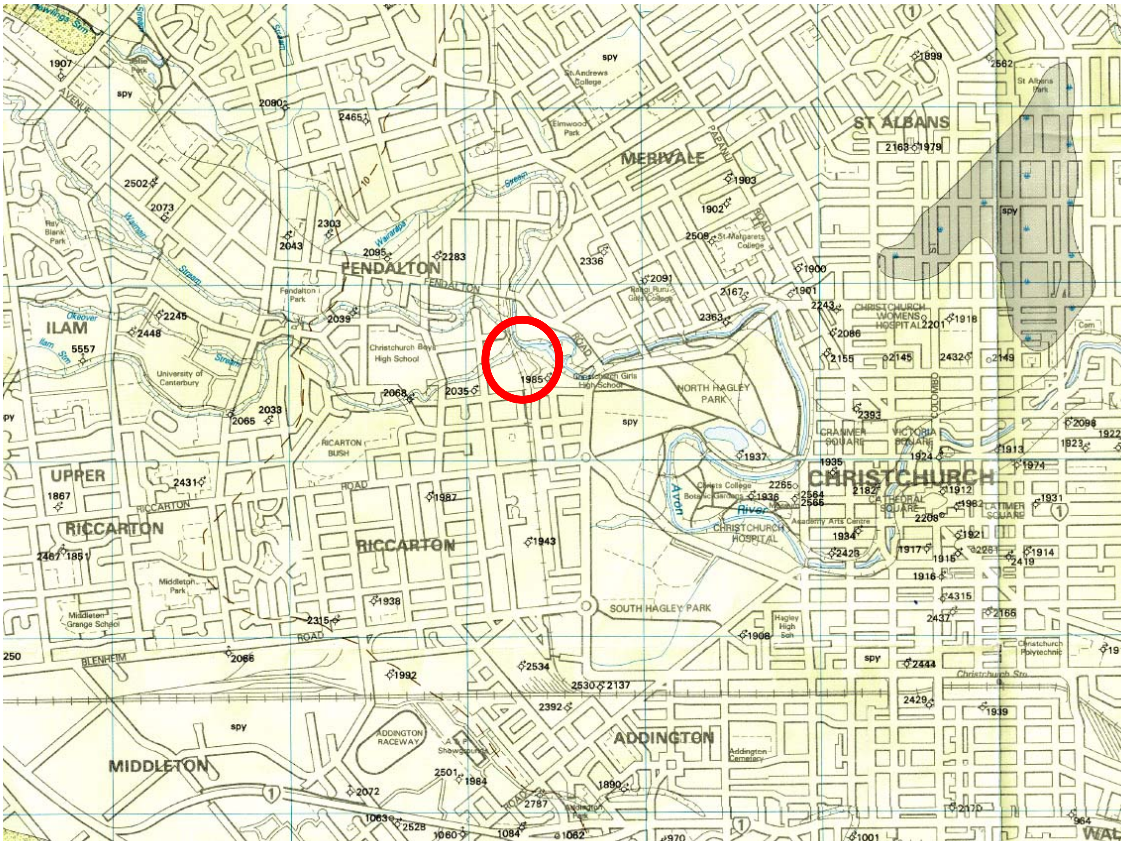
The structure is located in Monavale, 65 Fendalton Road, 1568334 E, 5180896 N (NZTM).

5. Review of available information

5.1 Geological maps



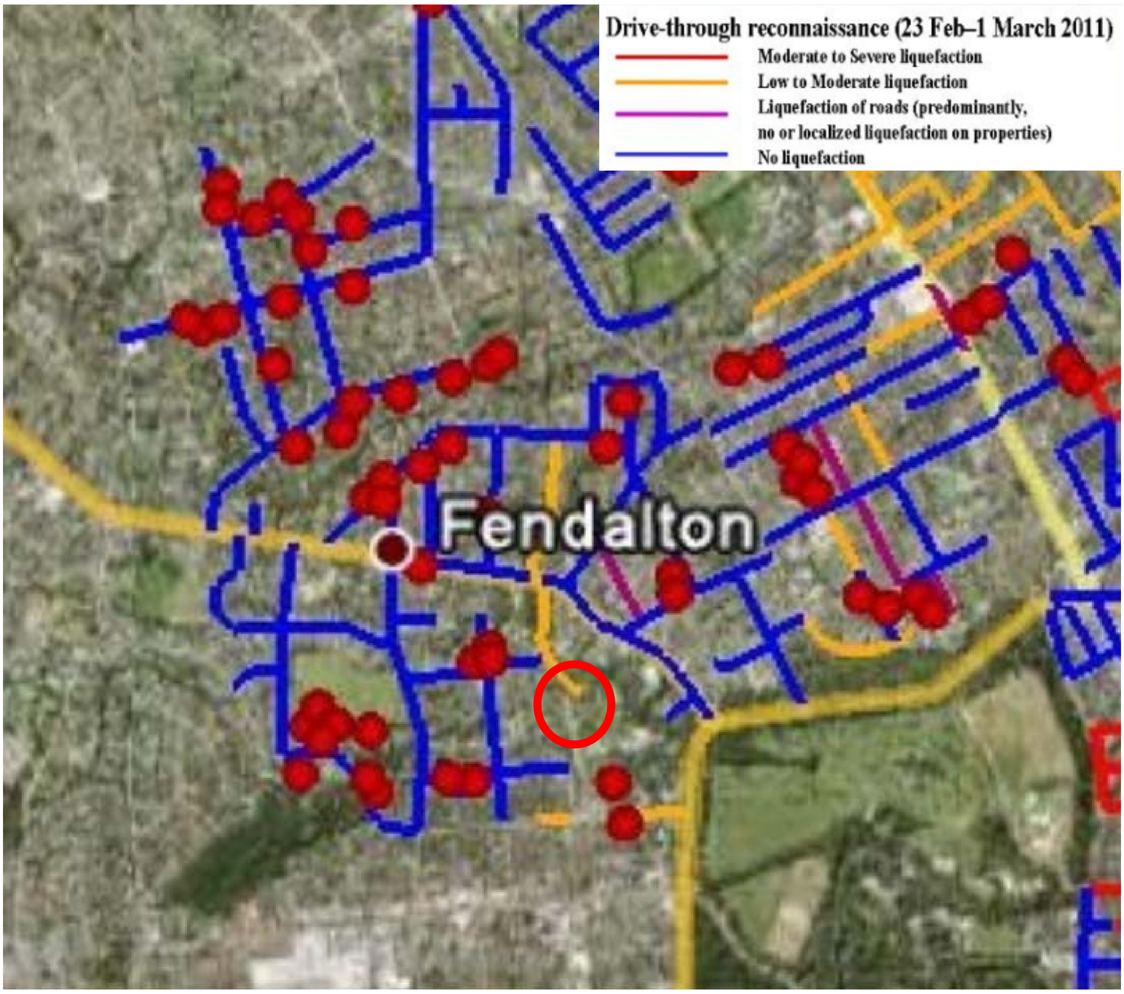
- **Figure 2 – Regional geological map (Forsyth et al, 2008). Site marked in red.**



- **Figure 3 – Local geological map (Brown et al, 1992). Site marked in red.**

The site is shown to be underlain by Yaldhurst member compromising dominantly alluvial sand and silt overbank deposits of the Christchurch formation. The Avon River approaches to the North of the site.

5.2 Liquefaction map



- **Figure 4 – Liquefaction map (Cubrinovski & Taylor, 2011). Site marked in red.**

Following the 22 February 2011 event drive through reconnaissance was undertaken from 23 February until 1 March by M Cubrinovsko and M Taylor of Canterbury University. Their findings show low to moderate liquefaction was noted near the site.

5.3 Aerial photography

- **Figure 5 – Aerial photography from 24 Feb 2011 (http://viewers.geospatial.govt.nz/)**

The location of the site is marked in red. Aerial photography shows no evidence of liquefaction at the site but an evidence of liquefaction approximately 100 m to the east of the site which coincides with the existing ground investigation data.

5.4 CERA classification

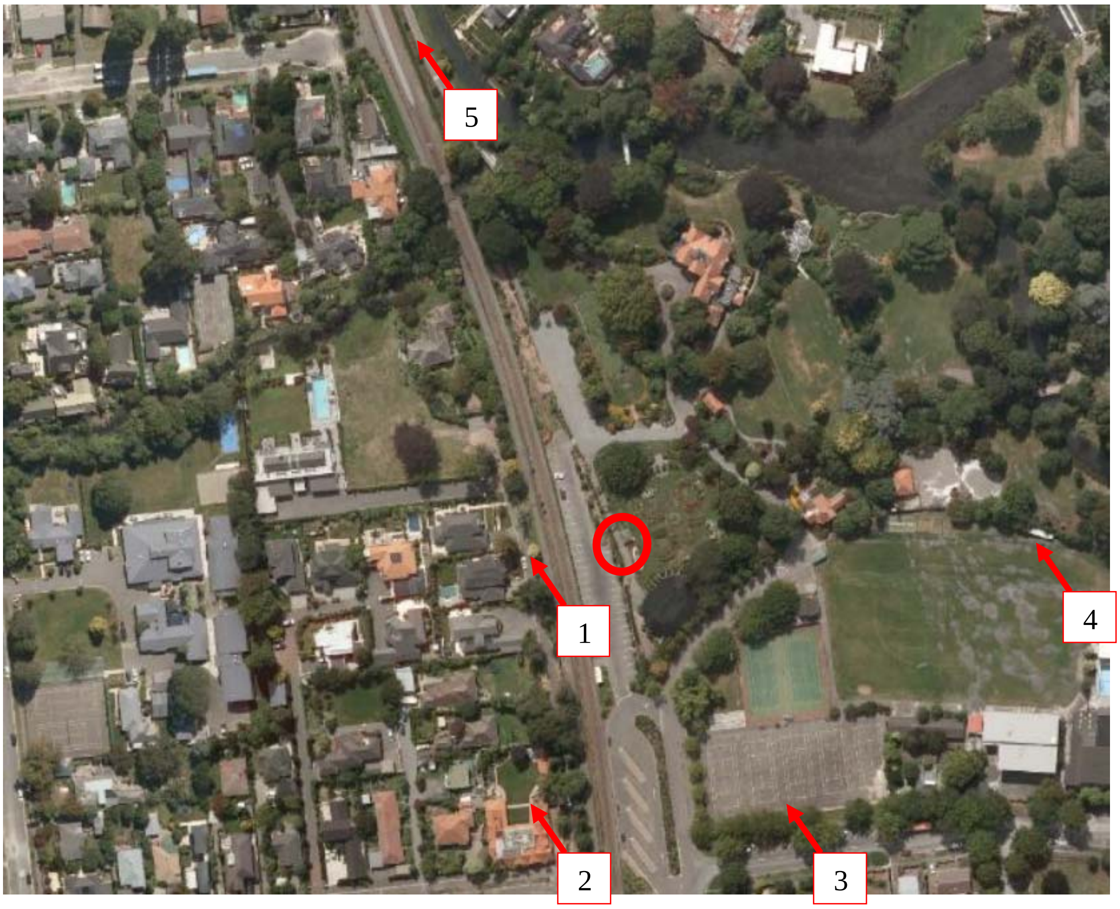
A review of the LINZ website (http://viewers.geospatial.govt.nz/) shows that the site is:

- Zone: Green
- DBH Technical Category N/A. Adjacent properties to the Northeast are TC3 and to the Southwest are TC2.

5.5 Historical land use

Reference to historical documents (e.g. Appendix A) show that the site lies approximately 150 m south and west of land that was recorded as marshland or swamp in 1856. It is therefore possible that soft or liquefiable ground would be present near the site. Given the relatively low accuracy of these historical documents, it should be considered possible that old swamp deposits are present on the site.

5.6 Existing ground investigation data



- **Figure 6 – Local boreholes from Project Orbit and SKM files (https://canterburyrecovery.projectorbit.com/)**

Where available logs from these investigation locations are attached to this report (Appendix B), and the results are summarised in Appendix C.

5.7 Council property files

Council files were not available at the time of writing this report.

5.8 Site walkover

An external site walkover was conducted by an SKM engineer on 31 July 2012.

The building was a timber structure (frame and clad) with a timber framed roof that is used as a garden shelter at Mona Vale. The foundation appeared to be a concrete perimeter strip footing with a slab on grade flooring system. There was no obvious structural damage to the building, and no apparent evidence of liquefaction or settlement of the structure was observed.

The brick wall surrounding the rose garden and homestead has sustained significant damage due to the earthquake event, and found to be partially collapsed at a number of locations. The nearby car park and driveway appeared relatively undamaged; however, there was significant evidence of liquefaction having occurred at a school ground approximately 100 m to the east of the site.

- Figure 7 - Overview of the building (north east elevation)

- Figure 8 - No visible liquefied material on the Rose Garden next to the building

6. Conclusions and recommendations

6.1 Site geology

An interpretation of the most relevant local investigation suggests that the site is underlain by:

Depth range (mBLG)	Soil type
0 – 16 m	Clay, Sand and Gravel
16 – 20 m	Clay and Peat
20 m+	Brown Shingle

6.2 Seismic site subsoil class

The site has been assessed as NZS1170.5 Class D (deep or soft soil) from adjacent borehole logs.

As described in NZS1170, the preferred site classification method is from site periods based on four times the shear wave travel time through material from the surface to the underlying rock. The next preferred methods are from borelogs including measurement of geotechnical properties or by evaluation of site periods from Nakamura ratios or from recorded earthquake motions. Lacking this information, classification may be based on boreholes with descriptors but no geotechnical measurements. The least preferred method is from surface geology and estimates of the depth to underlying rock.

In this case the second preferred method has been used to make the assessment, the distance to the nearest ground investigation information is 35 m and it is considered unlikely that site specific investigation could revise the site class.

6.3 Building Performance

Although detailed records of the existing foundations are not available, the performance to date suggests that they are adequate for their current purpose.

6.4 Ground performance and properties

The liquefaction risk for the site is likely to be low to medium. The clay, sand and gravel layers inferred to be underlying the site are unlikely to be liquefiable and no evidence of liquefaction near the site was observed during the reconnaissance undertaken shortly after the 22 February earthquake or during the site walkover undertaken by a SKM engineer. The area of extensive silt and sand ejecta located 100 m to the east appears to have a highly define western boundary striking in a north south direction, with no evidence of sand and silt to the west towards the site. However, there may be lenses of sand present in the clay, sandy gravel layers that are potentially liquefiable.

6.5 Further investigations

As nearby existing borehole information did not include geotechnical descriptions we cannot at this stage recommend ground properties to perform a full quantitative DEE we therefore recommend the following investigation:

- One cone penetrometer test on site to refusal.

Existing borehole indicate the material present comprises clay and sand with some grit, we therefore believe the CPT will be an appropriate testing methodology.

7. References

Brown LJ, Weeber JH, 1992. Geology of the Christchurch urban area. Scale 1:25,000. Institute of Geological & Nuclear Sciences geological map 1.

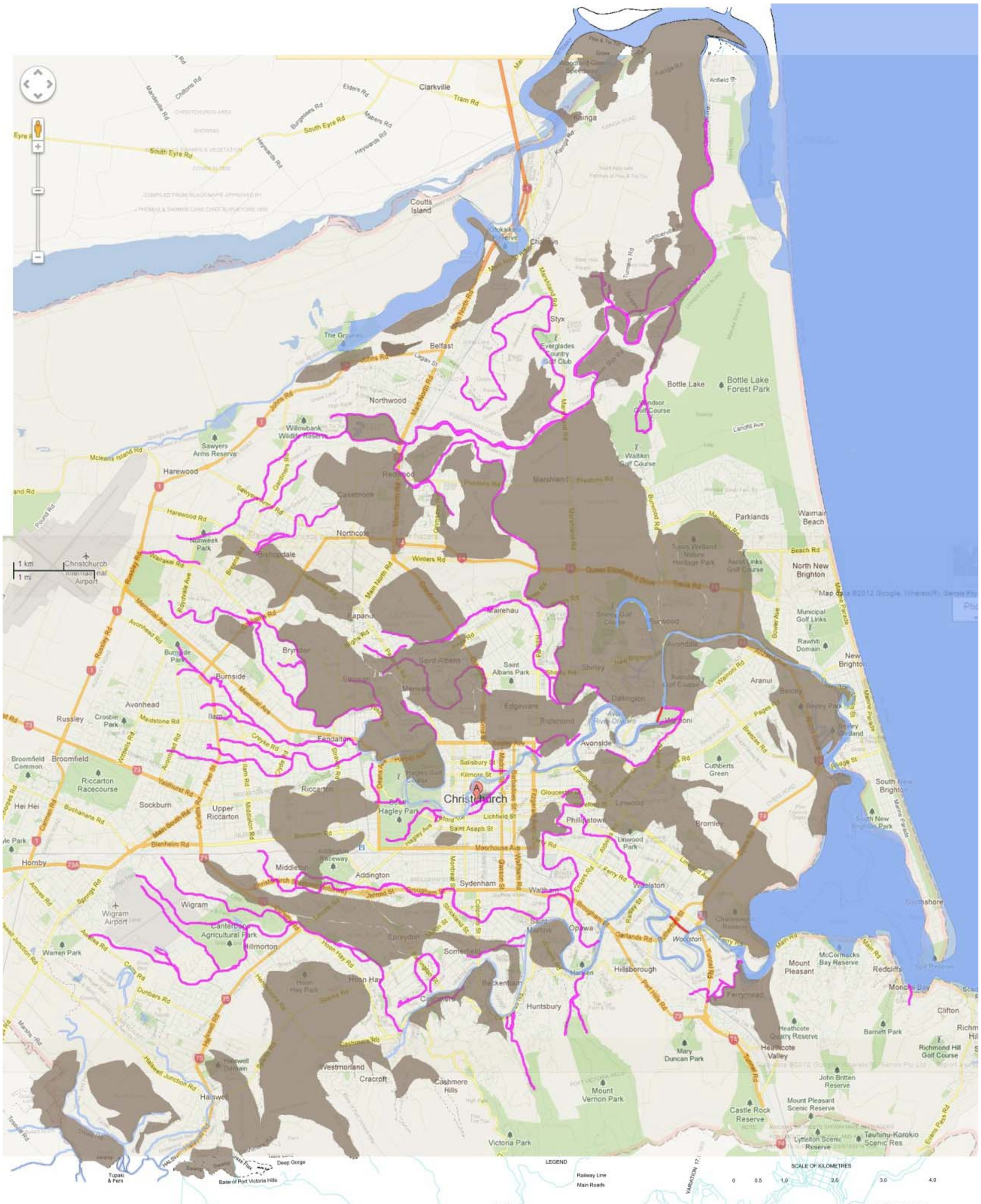
Cubrinovski & Taylor, 2011. Liquefaction map summarising preliminary assessment of liquefaction in urban areas following the 2010 Darfield Earthquake.

Forsyth PJ, Barrell DJA, Jongens R, 2008. Geology of the Christchurch area. Institute of Geological & Nuclear Sciences geological map 16.

Land Information New Zealand (LINZ) geospatial viewer (http://viewers.geospatial.govt.nz/)

EQC Project Orbit geotechnical viewer (https://canterburyrecovery.projectorbit.com/)

Appendix A – Christchurch 1856 land use



The swamps and previous creeks/rivers from 1856 have been overlayed onto a map of Christchurch in 2012

Key

■ Previous creeks/rivers
■ Existing creeks/rivers
■ New creeks/rivers
■ Swamp/Marshland

Appendix B – Existing ground investigation logs

Bore or Well No: M35/2096
Well Name:
Owner: Christchurch Drainage Board

Environment Canterbury
Your regional council

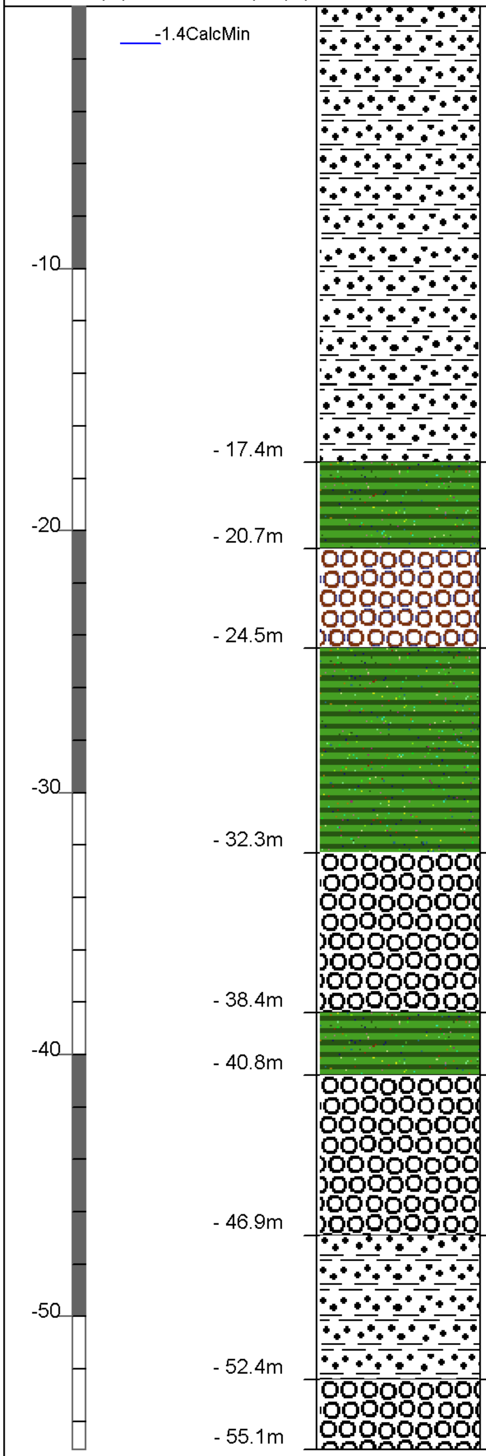
Street of Well: MATAI ST
File No:
Locality: RICCARTON
Allocation Zone: Christchurch/West Melton
NZGM Grid Reference: M35:783-425 QAR 4
NZGM X-Y: 2478300 - 5742500
Location Description:
Uses:
ECan Monitoring:
Well Status: Not Used

Drill Date: 26 Jan 1932
Water Level Count: 0
Well Depth: 55.10m -GL
Strata Layers: 9
Initial Water Depth: 0.90m -MP
Aquifer Tests: 0
Diameter: 51mm
Isotope Data: 0
Yield/Drawdown Tests: 0

Measuring Point Ait: 9.90m MSD QAR 3
Highest GW Level:
GL Around Well: 0.00m -MP
Lowest GW Level:
MP Description:
First Reading:
Last Reading:
Driller: Job Osborne (& Co/Ltd)
Calc. Min. GWL: -1.40m -MP
Drilling Method: Hydraulic/Percussion
Last Updated: 21 Sep 2006
Casing Material:
Last Field Check:
Pump Type: Unknown
Yield: 0 l/s
Screens:
Drawdown: 0 m
Screen Type:
Specific Capacity:
Top GL:
Bottom GL:
Aquifer Type: Flowing Artesian
Aquifer Name: Linwood Gravel

Borelog for well M35/2096

Gridref: M35:783-425 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 9.9 +MSD
Driller : Job Osborne (& Co/Ltd)
Drill Method : Hydraulic/Percussion
Drill Depth : -55.09m Drill Date : 26/01/1932



Depth(m)	Full Drillers Description	Formation Code
- 17.4m	Clay, sand & grit	sp?
- 20.7m	Clay & peat	ch
- 24.5m	Brown gravel	ri
- 32.3m	Clay & peat	ri
- 38.4m	Gravel	ri
- 40.8m	Clay & peat & sand	br
- 46.9m	Gravel	br
- 52.4m	Sand & clay	br
- 55.1m	Gravel	li-1

Bore or Well No: M35/2430

Well Name:

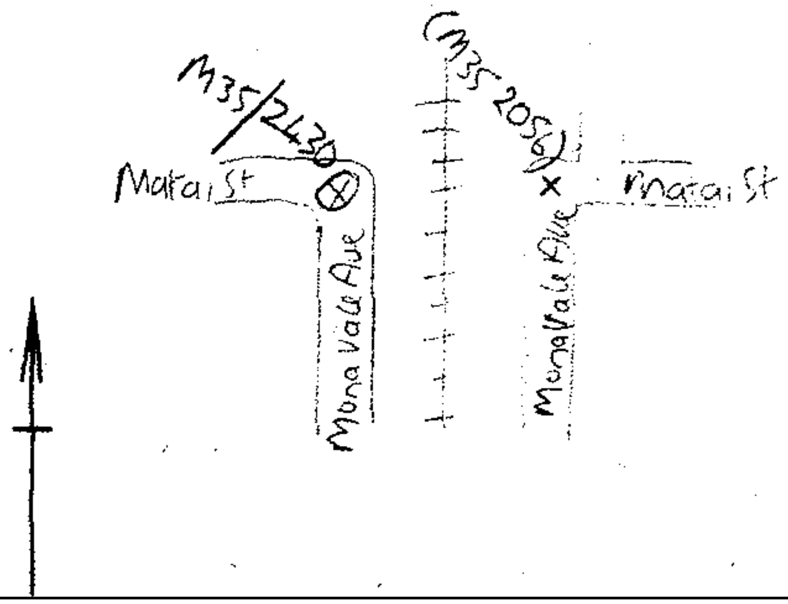
Owner: Christchurch Drainage Board

Street of Well:	CNR MATAI ST & MONAVALE AVE	**File No:**	
Locality:	RICCARTON	**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:783-424 QAR 4		
NZGM X-Y:	2478300 - 5742400		
Location Description:	UNDER ROAD	**Uses:**	Sewage Flushing
ECan Monitoring:			
Well Status:	Active (exist, present)		

Drill Date:	02 Nov 1927	**Water Level Count:**	0
Well Depth:	55.40m -GL	**Strata Layers:**	8
Initial Water Depth:	1.06m -MP	**Aquifer Tests:**	0
Diameter:	51mm	**Isotope Data:**	0
		Yield/Drawdown Tests:	0
Measuring Point Ait:	9.30m MSD QAR 3	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:	Job Osborne (& Co/Ltd)	**Calc. Min. GWL:**	-1.60m -MP
Drilling Method:	Hydraulic/Percussion	**Last Updated:**	21 Sep 2006
Casing Material:		**Last Field Check:**	
Pump Type:	Unknown		
Yield:	0 l/s	**Screens:**	
Drawdown:	0 m	**Screen Type:**	
Specific Capacity:		**Top GL:**	
		Bottom GL:	
Aquifer Type:	Flowing Artesian		
Aquifer Name:	Linwood Gravel		

Date	Comments
	Used for Sewer Flushing

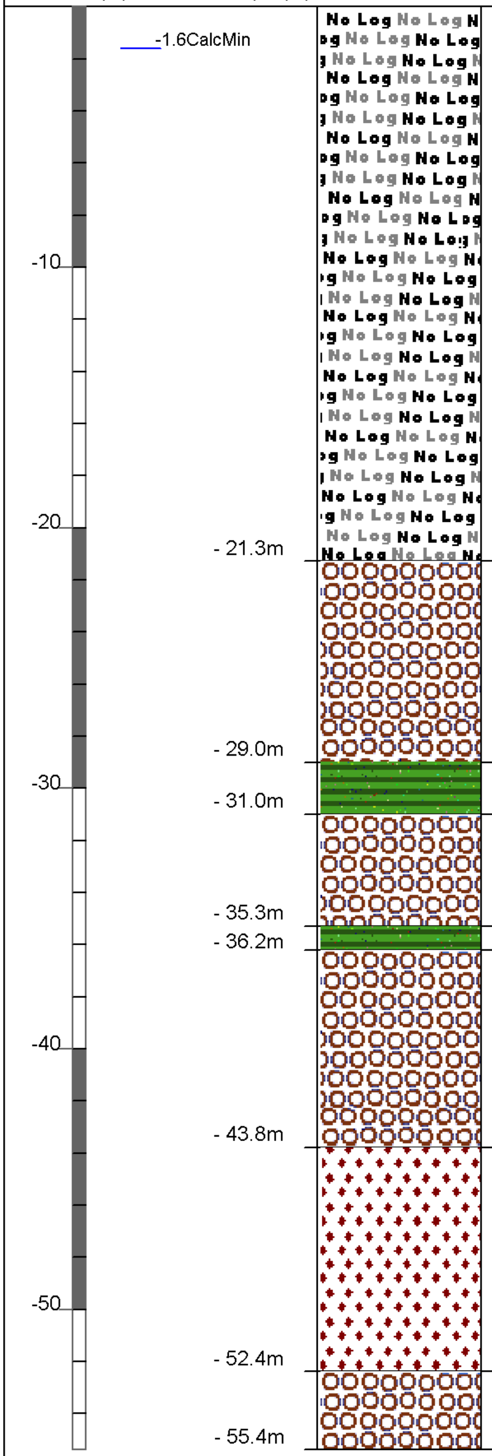
LOCATION SKETCH



Borelog for well M35/2430

Gridref: M35:783-424 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 9.3 +MSD
Driller : Job Osborne (& Co/Ltd)
Drill Method : Hydraulic/Percussion
Drill Depth : -55.4m Drill Date : 2/11/1927

Water Level: -1.6CalcMin



Depth(m)	Full Drillers Description	Formation Code
- 21.3m	Sunk by Eade Bros	sp?
- 29.0m	Brown shingle	ri
- 31.0m	Clay & peat	ri
- 35.3m	Brown shingle	ri
- 36.2m	Clay & peat	br
- 43.8m	Brown shingle	br
- 52.4m	Brown sand	br
- 55.4m	Brown shingle	li-1

Bore or Well No: M35/2056

Well Name:

Owner: Christchurch Drainage Board

Environment Canterbury
Your regional council

Street of Well: CNR MATAI & MONA VALE AVE

Locality: RICCARTON

NZGM Grid Reference: M35:784-424 QAR 4

NZGM X-Y: 2478400 - 5742400

Location Description: UNDER ROAD @ CNR MATAI ST & MONA VALE AV

ECan Monitoring:

Well Status: Active (exist, present)

File No:

Allocation Zone: Christchurch/West Melton

Uses: Sewage Flushing

Drill Date: 27 Oct 1927

Well Depth: 55.70m -GL

Initial Water Depth: 0.90m -MP

Diameter: 51mm

Measuring Point Ait: 9.40m MSD QAR 3

GL Around Well: 0.00m -MP

MP Description:

Driller: Job Osborne (& Co/Ltd)

Drilling Method: Hydraulic/Percussion

Casing Material:

Pump Type: Unknown

Yield: 0 l/s

Drawdown: 0 m

Specific Capacity:

Aquifer Type: Flowing Artesian

Aquifer Name: Linwood Gravel

Water Level Count: 0

Strata Layers: 8

Aquifer Tests: 0

Isotope Data: 0

Yield/Drawdown Tests: 0

Highest GW Level:

Lowest GW Level:

First Reading:

Last Reading:

Calc. Min. GWL: -1.90m -MP

Last Updated: 21 Sep 2006

Last Field Check:

Screens:

Screen Type:

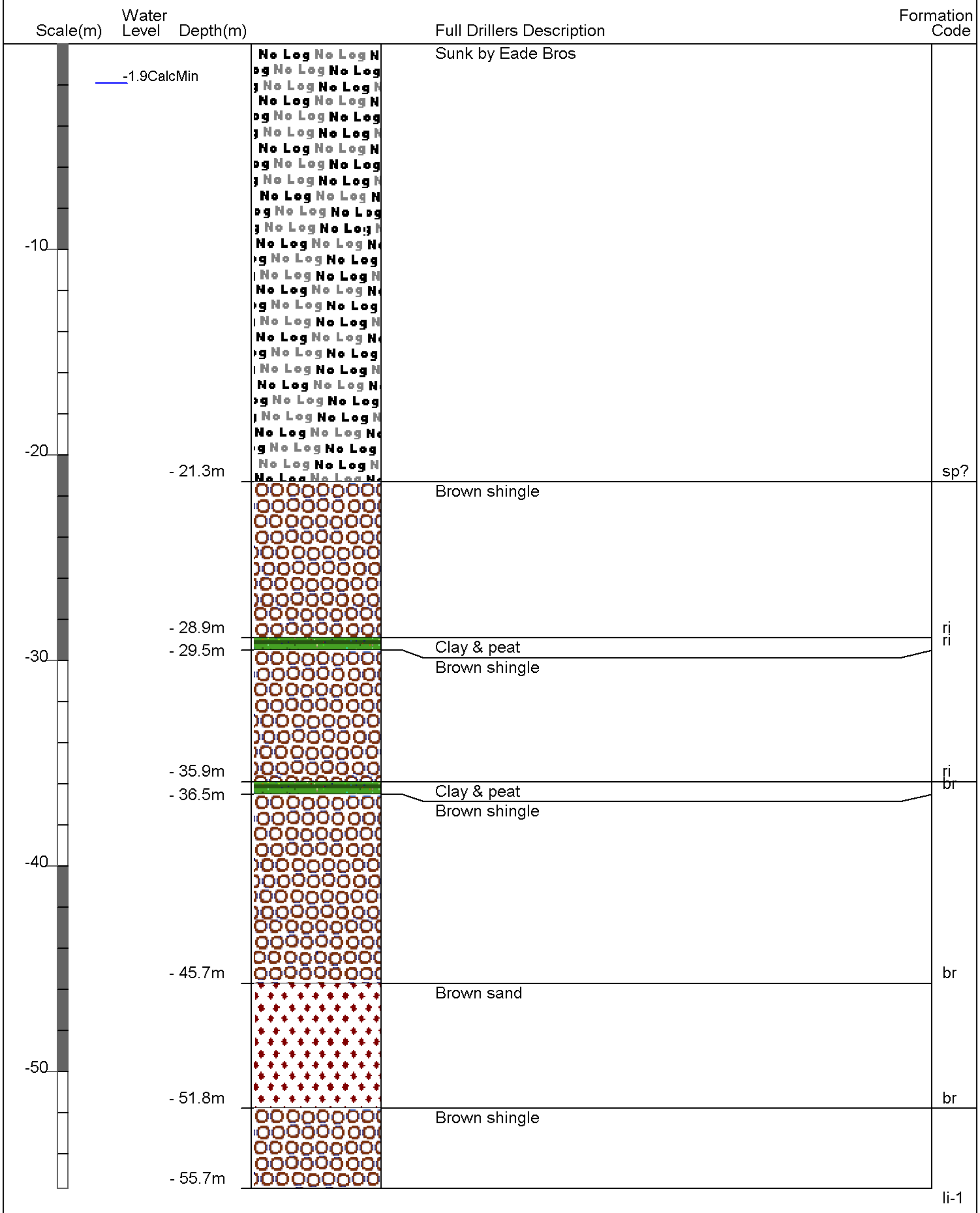
Top GL:

Bottom GL:

Date	Comments
	Used for Sewer Flushing

Borelog for well M35/2056

Gridref: M35:784-424 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 9.4 +MSD
Driller : Job Osborne (& Co/Ltd)
Drill Method : Hydraulic/Percussion
Drill Depth : -55.7m Drill Date : 27/10/1927



Depth(m)	Full Drillers Description	Formation Code
- 21.3m	Sunk by Eade Bros	sp?
- 28.9m	Brown shingle	ri
- 29.5m	Clay & peat	ri
- 35.9m	Brown shingle	ri
- 36.5m	Clay & peat	br
- 45.7m	Brown shingle	br
- 51.8m	Brown sand	br
- 55.7m	Brown shingle	li-1

Bore or Well No: M35/1985
Well Name:
Owner: FLEMING & CO.

Environment Canterbury
Your regional council

Street of Well: MATAI STREET
Locality: RICCARTON
NZGM Grid Reference: M35:785-425 QAR 4
NZGM X-Y: 2478500 - 5742500
Location Description:
ECan Monitoring:
Well Status: Sealed / Grouted up

File No:
Allocation Zone: Christchurch/West Melton
Uses:

Drill Date: 14 Jun 1910
Well Depth: 99.30m -GL
Initial Water Depth: 3.70m -MP
Diameter: 51mm

Measuring Point Ait: 9.70m MSD QAR 3
GL Around Well: 0.00m -MP
MP Description:

Driller: Job Osborne (& Co/Ltd)
Drilling Method: Hydraulic/Percussion
Casing Material:
Pump Type: Unknown
Yield: 0 l/s
Drawdown: 0 m
Specific Capacity:

Aquifer Type: Flowing Artesian
Aquifer Name: Burwood Gravel

Water Level Count: 0
Strata Layers: 20
Aquifer Tests: 0
Isotope Data: 0
Yield/Drawdown Tests: 0

Highest GW Level:
Lowest GW Level:
First Reading:
Last Reading:
Calc. Min. GWL: -1.80m -MP
Last Updated: 21 Sep 2006
Last Field Check:

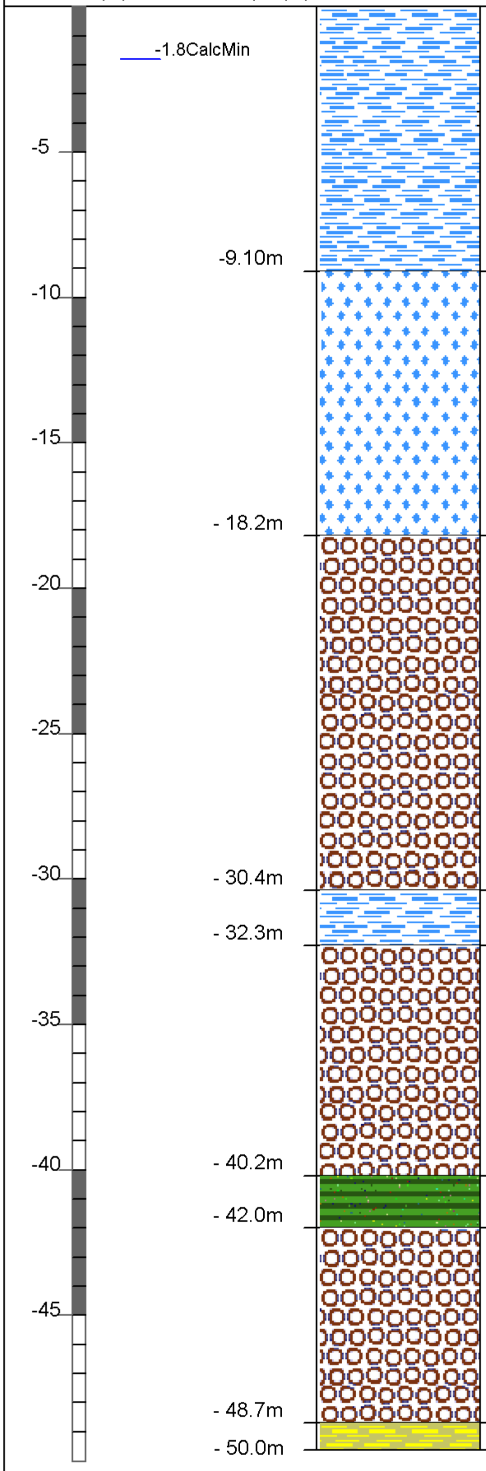
Screens:
Screen Type:
Top GL:
Bottom GL:

Date	Comments
	WELL COVERED OVER/SEALED DURING CONSTRUCTION OF GIRLS HIGH SCHOOL

Borelog for well M35/1985 page 1 of 2

Gridref: M35:785-425 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 9.7 +MSD
Driller : Job Osborne (& Co/Ltd)
Drill Method : Hydraulic/Percussion
Drill Depth : -99.3m Drill Date : 14/06/1910

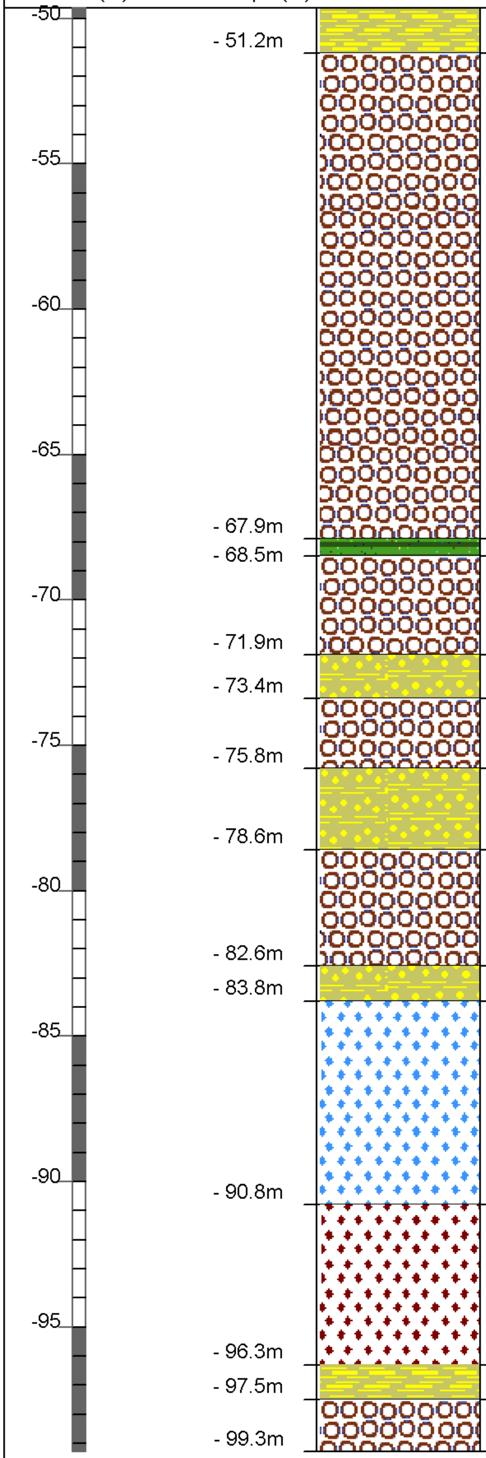
Environment Canterbury Regional Council



Depth(m)	Full Drillers Description	Formation Code
-9.10m	Blue clay	sp?
- 18.2m	Blue sand	ch
- 30.4m	Brown shingle	ri
- 32.3m	Blue clay	ri
- 40.2m	Brown shingle	ri
- 42.0m	Blue clay & peat	br
- 48.7m	Brown shingle	br
- 50.0m	Yellow clay	br

Borelog for well M35/1985 page 2 of 2

Gridref: M35:785-425 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 9.7 +MSD
Driller : Job Osborne (& Co/Ltd)
Drill Method : Hydraulic/Percussion
Drill Depth : -99.3m Drill Date : 14/06/1910



Depth(m)	Full Drillers Description	Formation Code
- 51.2m	Yellow clay	br
- 67.9m	Brown shingle	li-1
- 68.5m	Blue clay & peat	li-2
- 71.9m	Brown shingle	li-2
- 73.4m	Yellow clay & sand	li-2
- 75.8m	Brown shingle	li-2
- 78.6m	Yellow clay & sand	li-2
- 82.6m	Brown shingle	li-3
- 83.8m	Yellow clay & sand	he
- 90.8m	Blue sand	he
- 96.3m	Brown sand	he
- 97.5m	Yellow clay	he
- 99.3m	Brown shingle	bu

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: FND 07
Hole Location: Mona Vale Walkway
SHEET 1 OF 4

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE
LOCATION: FENDALTON
JOB No: 52000.3200

CO-ORDINATES 5742694.13 mN
2478255.37 mE
R.L. 9.28 m
DATUM NZMG

DRILL TYPE: Rotary
DRILL METHOD: HQTT/OB
DRILL FLUID: Mud

HOLE STARTED: 16/10/11
HOLE FINISHED: 19/10/11
DRILLED BY: Pro-Drill
LOGGED BY: CP
CHECKED: RAP

GEOLOGICAL — ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION \ WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 1000 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

Geological	Core recovery (%)	Method	Tests	Samples	Classification symbol	Moisture condition	Strength/density	Description
HAND DIG FILL. (Potholed for services check and backfilled.)	0	PRE-DUG						FILL: Borehole drilled through pre-dug and backfilled pothole.
	38	OB						
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)			✱FC	B	SW	M	MD	Fine to medium SAND with minor interbedded silt, yellowish brown. Medium dense, moist.
					SW	M	D	Gravelly, fine to coarse SAND with some silt, yellowish brown. Dense, moist. Gravel is fine to coarse, subangular to subrounded.
		SPT	✱PSD WS 5/10/10/ 13/11/10 N=44	B				
	29	HQTT						2.45 to 3.2m no recovery
					GP	W	MD	Coarse GRAVEL, grey. Medium dense, wet. Gravel is subangular to subrounded. Fines washed away during drilling process.
								- contains minor fine to coarse sand. Gravel becoming fine to coarse. 3.55 to 4.55m no recovery
		SPT	7/6/6/ 6/6/6 N=24					
	43	HQTT						- Sand absent. Gravel is coarse.

R.L. (m): 9.0, 8.5, 8.0, 7.5, 7.0, 6.5, 6.0, 5.5, 5.0, 4.5

DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5

T+T DATATEMPLATE.GDT dlm

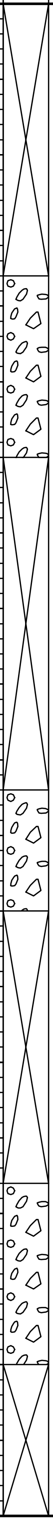
TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: FND 07
Hole Location: Mona Vale Walkway
SHEET 2 OF 4

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE	LOCATION: FENDALTON	JOB No: 52000.3200
CO-ORDINATES 5742694.13 mN 2478255.37 mE	DRILL TYPE: Rotary	HOLE STARTED: 16/10/11 HOLE FINISHED: 19/10/11
R.L. 9.28 m	DRILL METHOD: HQTT/OB	DRILLED BY: Pro-Drill
DATUM NZMG	DRILL FLUID: Mud	LOGGED BY: CP CHECKED: RAP

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	CORE RECOVERY (%)	METHOD	TESTS	R.L. (m)	DEPTH (m)	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)		SPT	20/28/ 25/25 for 50mm N>50	4.0		VD	5.0 to 5.9m no recovery. Becoming very dense.
					5.5		
	49	HQTT		3.5			
					6.0		
				3.0			
		SPT	4/5/5/ 6/6/5 N=22		6.5	MD	6.5 to 8.6m no recovery. Becoming medium dense.
				2.5			
					7.0		
	38	HQTT		2.0			
					7.5		- contains trace cobbles
				1.5			
		SPT	3/5/5/ 5/6/6 N=22		8.0		8.0 to 8.9m no recovery
				1.0			
					8.5		
	57	HQTT		-0.5			
					9.0		
				-0.0			
		SPT	4/4/5/ 5/5/7 N=22		9.5		9.5 to 10.4m no recovery
				-0.5	10		



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: FND 07
Hole Location: Mona Vale Walkway

SHEET 3 OF 4

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE
LOCATION: FENDALTON
JOB No: 52000.3200

CO-ORDINATES 5742694.13 mN
2478255.37 mE
R.L. 9.28 m
DATUM NZMG

DRILL TYPE: Rotary
DRILL METHOD: HQTT/OB
DRILL FLUID: Mud

HOLE STARTED: 16/10/11
HOLE FINISHED: 19/10/11
DRILLED BY: Pro-Drill
LOGGED BY: CP
CHECKED: RAP

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	CORE RECOVERY (%)	METHOD	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)	57	HQTT	✱PSD WS	B	-1.0	10.5		9.5 to 10.4m no recovery
		SPT	5/5/8/ 9/7/6 N=30		-1.5 -2.0	11.0	D	11.0 to 13.55m no recovery. Becoming dense.
	24	HQTT			-2.5 -3.0	11.5 12.0	VD	- becoming very dense
		SPT	5/10/15/ 17/18 for 75mm N>50		-3.5	12.5		
	40	HQTT			-4.0 -4.5	13.0 13.5		
		SPT	4/4/4/ 5/5/10 N=24		-5.0	14.0	MD	14.0 to 15.0m no recovery. Becoming medium dense.
	48	HQTT			-5.5	14.5 15		

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: FND 07
Hole Location: Mona Vale Walkway

SHEET 4 OF 4

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE
LOCATION: FENDALTON
JOB No: 52000.3200

CO-ORDINATES 5742694.13 mN
2478255.37 mE
R.L. 9.28 m
DATUM NZMG

DRILL TYPE: Rotary
DRILL METHOD: HQTT/OB
DRILL FLUID: Mud

HOLE STARTED: 16/10/11
HOLE FINISHED: 19/10/11
DRILLED BY: Pro-Drill
LOGGED BY: CP
CHECKED: RAP

GEOLOGICAL										ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)								-6.0	15.5		GW	W	MD				Fine to coarse GRAVEL with minor sand, grey. Medium dense, wet. Gravel is subangular to subrounded. Sand is medium to coarse.
				SPT		10/8/7/ 7/10/10 N=34	■ ■	-6.5									15.5 to 15.95m no recovery
								-7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0 -10.5	16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5 20								**End of borehole at 15.95mbgl.** No piezometer installed - backfilled with grout.

T+T DATATEMPLATE.GDT dlm

Appendix C – Geotechnical Investigation Summary

- **Table 1 Summary of most relevant investigation data**

ID		**1**	**2**	**3**	**4**	**5**
Type *		WW	WW	WW	WW	BH
Ref		M35/2096	M35/2430	M35/2056	M35/1985	FND 07
Depth (m)		55.1	55.4	55.7	99.3	15.95
Distance from site (m)		35	112	125	166	204
Ground water level (mBGL)		0.9	1.06	0.9	3.7	Unknown
Simplified recorded geological profile (depth below ground level to top of stratum, m)	0	Clay, Sand, Gravel	N/A	N/A	Blue Clay	Fill
	1					Fill
	2					Gravelly Sand
	3					Coarse Gravel
	4					N=24
	5					N>50
	6					N=22
	7					
	8					N=22
	9					N=22
	10				Blue Sand	
	11					N=30
	12					N>50
	13					
	14					N=24
	15					N=34
	16					
	17	Clay and Peat				
	18					
	19				Brown Shingle	
	20	Brown Shingle				
	21		Brown Shingle	Brown Shingle		
	22					
	23					
	24					
	25					
Greater depths						

*BH: Borehole, HA: Hand Auger, WW: Water Well, CPT: Cone Penetration Test

🟪 Sensitive or organic clay/silt	🟦 Clay to silty clay	▨ Clayey silt to silt	🟩 Silty sand to silt
🟩 Clayey sand	🟨 Sand	🟧 Gravelly sand or gravel	

VL = very loose, L = loose, MD = medium dense, D = dense, VD = very dense

VS = very soft, So = soft, F = firm, St = stiff, VS = very stiff, H = hard