Christchurch City Council

BU 1564-007 EQ2
Sockburn Recreation Centre - BBQ Shelter
134 Main South Road, Sockburn

QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev C
- 17 December 2012

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Contents

Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
A	6 July 2012	J Mason	NM. Calvert	6 July 2012	Draft for Client Approval
B	23 Nov. 2012	NM Calvert	NM Calvert	23 Nov. 2012	Final Issue
C	17 Dec. 2012	NM Calvert	NM Calvert	17 Dec. 2012	Final Issue

Distribution of copies

Revision	Copy no	Quantity	Issued to
A	1	1	Christchurch City Council
B	1	1	Christchurch City Council
C	1	1	Christchurch City Council

Printed:	17 December 2012
Last saved:	17 December 2012 11:30 AM
File name:	ZB01276.140.BU 1564-007 EQ2.Qualitative.Assmt.C.docx
Author:	Nigel Chan
Project manager:	Nick Calvert
Name of organisation:	Christchurch City Council
Name of project:	Christchurch City Council Structures Panel
Name of document:	BU 1564-007 EQ2 Qualitative Assessment Report
Document version:	B
Project number:	ZB01276.140

1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on the building BU 1564-007 EQ2 located at Sockburn Recreation Centre, 132 Main South Road. The structure is a BBQ shelter constructed from steel portal frames with a timber framed roof. A masonry retaining wall is located on the southern side of the structure. An aerial photograph illustrating these areas is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type is given in Section 5 of this report.

- **Figure 1 Aerial Photograph of BU 1564-007 EQ2 BBQ Shelter , Sockburn**

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 a visual inspection on 24 May 2012.

1.2. Key Damage Observed

Key damage observed includes:-

- 1mm vertical crack in the masonry wall
- 100mm diameter hole in the masonry wall (defect which appears to have been drilled sometime in the past and not as a result of the recent earthquakes)
- Moss, cracks and loose timber joints in the roof (defect which appears to be as a result of general wear and tear and not as a result of the recent earthquakes)

1.3. Critical Structural Weaknesses

No potential critical structural weaknesses have been 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 100%NBS and post earthquake capacity in the order of 100%NBS. This assessment has been made without structural drawings and is accordingly limited.

The building has been assessed to have a seismic capacity in the order of 100% NBS and is therefore not potentially earthquake prone.

Please note that structural strengthening is required by law for buildings that are confirmed to have a seismic capacity of less than 34% NBS.

1.5. Recommendations

It is recommended that:

a) No placard was found on the building. If a placard had been issued for the building it would have likely to have been green 1. We recommend that this placard status remains for this building.
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 BU 1564-007 EQ2 located at 134 Main North Road, Sockburn Recreation Centre 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 section 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. The building description 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 BU 1564-007 EQ2 is a single storey exposed BBQ shelter located in the Sockburn Recreation Centre, 134 Main North Road. The structure is constructed from 4 steel portal frames supporting a timber frame with a translucent corrugated roof. Concrete foundation pads support the steel portal frames. The south side of the building has a 1.1m high filled masonry retaining wall.

Due to the design we believe it was built in the 1980's.

5.2. Gravity Load Resisting system

The gravity load resisting structure of the building is made up of structural steel portals frames supported on pad foundations. Pavement stones create the ground floor area.

5.3. Seismic Load Resisting system

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

Lateral load on the building are carried by portal frames in the transverse direction and by steel rod tension only bracing in the longitudinal direction. The portals are supported on pad foundations which act to hold down the braced columns by providing mass.

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 appears to be low for this site.
- No significant land damage was observed during the site walkover.

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. Our full geotechnical desktop study can be found in Appendix 4.

6. Damage Summary

SKM undertook inspections on 24th May 2012. The following areas of damage were observed during the time of inspection:

1) 1 mm vertical crack in the masonry wall
2) 100 mm diameter hole in the masonry wall. (defect which appears to have been drilled sometime in the past and not as a result of the recent earthquakes)
3) Moss, cracks and loose timber joints in the roof. (defect which appears to be as a result of general wear and tear and not as a result of the recent earthquakes)

Photos of the above damage can be found in Appendix 1 – Photos.

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].

[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

[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 on the 24th May 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. This level of importance is described as 'normal' with medium or considerable consequence of failure.
  - Ductility level of 1.25 in both directions, based on our assessment and code requirements at the time of design.
  - 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. 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 TC1 under the Residential Green Zone categories. The combination of these factors means that we do not recommend that any survey be undertaken at this point.

7.4. Critical Structural Weaknesses

No structural weaknesses have been 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	>100

Our qualitative assessment found that the building is likely to be classed as a 'Low Risk Building' (capacity greater than 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 than 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 BU 1564-007 EQ2 located at 134 Main South Road. This building has been assessed to have a likely seismic capacity greater than 100%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) No placard was found on the building. If a placard had been issued for the building it would have likely to have been green 1. We recommend that this placard status remains for this building.

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: North elevation

Photo 2: East elevation

Photo 3: South elevation

Photo 4: West elevation

Photo 5: View along east elevation

Photo 6: North elevation, close up view of west

Photo 7: North elevation, close up view middle bay

Photo 8: North elevation, close up of east bay

	
Photo 9: View along north elevation	Photo 10: View of roof framing
	
Photo 11: Steel column and rafter connection	Photo 12: Foundation pad connection

Photo 13: Close up view of foundation pad connection

Photo 14: Masonry retaining wall with 100mm diameter hole, and vertical crack alongside.

Photo 15: Close up view of 100mm diameter hole

Photo 16: Close up view of vertical crack

	
Photo 17: View of translucent roof cladding.	Photo 18: loose timber connection in roof framing

12. Appendix 2 – IEP Reports

Table IEP-1 **Initial Evaluation Procedure – Step 1**

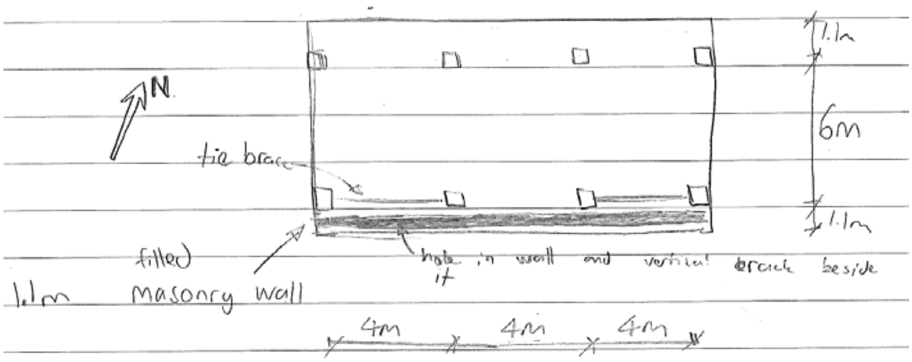
(Refer Table IEP - 2 for Step 2; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	**BU 1564-007 EQ2 Sockburn Recreation Centre - BBQ Shelter**	Ref.	**ZB01276.140**
Location:	Sockburn Recreation Centre, 134 Main South Road	By	NLC
		Date	24/05/2012

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)

1.2 Sketch of building plan



1.3 List relevant features

The structure is a BBQ shelter constructed from steel portal frames with a timber framed roof. A masonry retaining wall is located on the southern side of the structure. Due to the design we believe it was built in the 1970's.

1.4 Note information sources

Tick as appropriate

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

Inspection Date: 24/5/2012

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:	**BU 1564-007 EQ2 Sockburn Recreation Centre - BBQ Shelter**	Ref.	**ZB01276.140**
Location:	Sockburn Recreation Centre, 134 Main South Road	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	24/05/2012

(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
(for 1992 to 2004 only and only if known)

a) Rigid	◉	N-A
b) Intermediate	○	

c) Estimate Period, T

building Ht = 3 meters

	Longitudinal	Transverse	
Ac =			m2

Can use following:

		Longitudinal	Transverse
$T = 0.09h_n^{0.75}$	for moment-resisting concrete frames	○ MRCF	○ MRCF
$T = 0.14h_n^{0.75}$	for moment-resisting steel frames	○ MRSF	◉ MRSF
$T = 0.08h_n^{0.75}$	for eccentrically braced steel frames	○ EBSF	○ EBSF
$T = 0.06h_n^{0.75}$	for all other frame structures	◉ Others	○ Others
$T = 0.09h_n^{0.75}/A_c^{0.5}$	for concrete shear walls	○ CSW	○ CSW
$T \leq 0.4\text{sec}$	for masonry shear walls	○ MSW	○ MSW

Where hn = height in m from the base of the structure to the uppermost seismic weight or mass.
$Ac = \Sigma Ai(0.2 + Lwi/hn)2$
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	**0.3**	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	16.5	$(\%NBS)_{nom}$
Transverse	16.5	$(\%NBS)_{nom}$

			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	16.5	$(\%NBS)_{nom}$
Transverse	16.5	$(\%NBS)_{nom}$

Continued over page

Building Name:	**BU 1564-007 EQ2 Sockburn Recreation Centre - BBQ Shelter**	Ref.	**ZB01276.140**
Location:	Sockburn Recreation Centre, 134 Main South Road	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	24/05/2012

(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

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 3.33

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	**1.25**	μ Maximum = 6
Transverse	**1.25**	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 Steel

Transverse Steel

a) Structural Performance Factor, S_p

from accompanying Figure 3.4

Longitudinal	Sp	0.90
Transverse	Sp	0.90

b) Structural Performance Scaling Factor

Longitudinal	$1/S_p$	**Factor E**	1.11
Transverse	$1/S_p$	**Factor E**	1.11

2.7 Baseline %NBS for Building, $(\%NBS)_b$

(equals $(\%NSB)_{nom}$ x A x B x C x D x E)

Longitudinal	61.1	(%NBS)b
Transverse	61.1	(%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:	BU 1564-007 EQ2 Sockburn Recreation Centre - BBQ Shelter	Ref.	ZB01276.140
Location:	Sockburn Recreation Centre, 134 Main South Road	By	NLC
Direction Considered:	a) Longitudinal	Date	24/05/2012

(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

Effect on Structural Performance	Severe	Significant	Insignificant	Building Score
	○	○	◉	Factor A: 1
Comment				

3.2 Vertical Irregularity

Effect on Structural Performance	Severe	Significant	Insignificant	Building Score
	○	○	◉	Factor B: 1
Comment				

3.3 Short Columns

Effect on Structural Performance	Severe	Significant	Insignificant	Building Score
	○	○	◉	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

Separation	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant 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

Separation	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant 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)

Effect on Structural Performance	Severe	Significant	Insignificant	Building Score
	○ 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** 2

Record rationale for choice of Factor F:

Structure not governed by earthquake loads

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F) **PAR** 2

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

Building Name:	BU 1564-007 EQ2 Sockburn Recreation Centre - BBQ Shelter	Ref.	ZB01276.140
Location:	Sockburn Recreation Centre, 134 Main South Road	By	NLC
Direction Considered:	b) Transverse	Date	24/05/2012

(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

Effect on Structural Performance: Severe ○ / Significant ○ / Insignificant ◉ — **Factor A** 1

Comment

3.2 Vertical Irregularity

Effect on Structural Performance: Severe ○ / Significant ○ / Insignificant ◉ — **Factor B** 1

Comment

3.3 Short Columns

Effect on Structural Performance: Severe ○ / Significant ○ / Insignificant ◉ — **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

Separation	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant 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

Separation	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant 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)

Effect on Structural Performance: Severe ○ 0.5 / Significant ○ 0.7 / Insignificant ◉ 1 — **Factor E** 1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. — **Factor F** 2

Record rationale for choice of Factor F:

Structure not governed by earthquake loads

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F) — **PAR** 2

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:	**BU 1564-007 EQ2 Sockburn Recreation Centre - BBQ Shelter**	Ref.	**ZB01276.140**
Location:	Sockburn Recreation Centre, 134 Main South Road	By	NLC
Direction Considered:	**Longitudinal & Transverse**	Date	24/05/2012
	(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)	61	61
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	2.00	2.00
4.3 PAR x Baseline $(\%NBS)_b$	122	122

4.4 Percentage New Building Standard (%NBS) (Use lower of two values from Step 4.3) — **122**

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 — **A+**

Evaluation Confirmed by

[signature] Signature

NICK CALVERT Name

242062 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:	BU 1564-007 EQ2		Reviewer:	NICK CALVERT
	Unit / No: / Street		CPEng No:	242062
Building Address:	Sockburn Recreation Centre	134 Main North Road	Company:	Sinclair Knight Merz
Legal Description:			Company project number:	ZB01276.140
			Company phone number:	
	Degrees / Min / Sec			
GPS south:			Date of submission:	
GPS east:			Inspection Date:	24th May 2012
			Revision:	A
Building Unique Identifier (CCC):			Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	mixed	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	0.00

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	0.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground	0			
Foundation type:	isolated pads, no tie beams		if Foundation type is other, describe:	
Building height (m):	3.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	3
Floor footprint area (approx):	72			
Age of Building (years):	32		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description	
Use (upper floors):				
Use notes (if required):	Toilet Block			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	frame system		
Roof:	timber framed	rafter type, purlin type and cladding	200 PFC steel rafters, 200x50 timber purlins, translucent roof cladding
Floors:	concrete flat slab	slab thickness (mm)	150mm (assumed)
Beams:			
Columns:	structural steel	typical dimensions (mm x mm)	200 PFC
Walls:			

Lateral load resisting structure

Note: **Define along and across in detailed report!**

Lateral system along:	other (note)		describe system	steel brace ties on one side of the structure
Ductility assumed, μ:	1.25			
Period along:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	welded and bolted steel moment frame		note typical bay length (m)	6
Ductility assumed, μ:	1.25			
Period across:	0.30	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
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:	exposed structure	describe	no walls on structure
Roof Cladding:	Other (specify)	describe	translucent corrugated roof material
Glazing:			
Ceilings:			
Services(list):			

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 desktop report, 21 May 2012

Damage

Site: (refer DEE Table 4-2)

Site performance:		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):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	crack in nearby retaining wall

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

Recommendations

Level of repair/strengthening required:	minor non-structural	Describe:	Grouting of crack
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:	Qualitative Assessment carried out, this includes the NZSEE IEP - refer to SKM report
	Assessed %NBS after:	100%			
Across	Assessed %NBS before:	100%	%NBS from IEP below		
	Assessed %NBS after:	100%			

14. Appendix 4 – Geotechnical Desktop Study

Sinclair Knight Merz
142 Sherborne Street
Saint Albans
PO Box 21011, Edgeware
Christchurch, New Zealand

Tel: +64 3 940 4900
Fax: +64 3 940 4901
Web: www.globalskm.com

Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	140
Address	Sockburn Recreation Centre - Barbeque Shelter
Report date	21 May 2012
Author	Ain Kim
Reviewer	Ross Kendrick
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 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

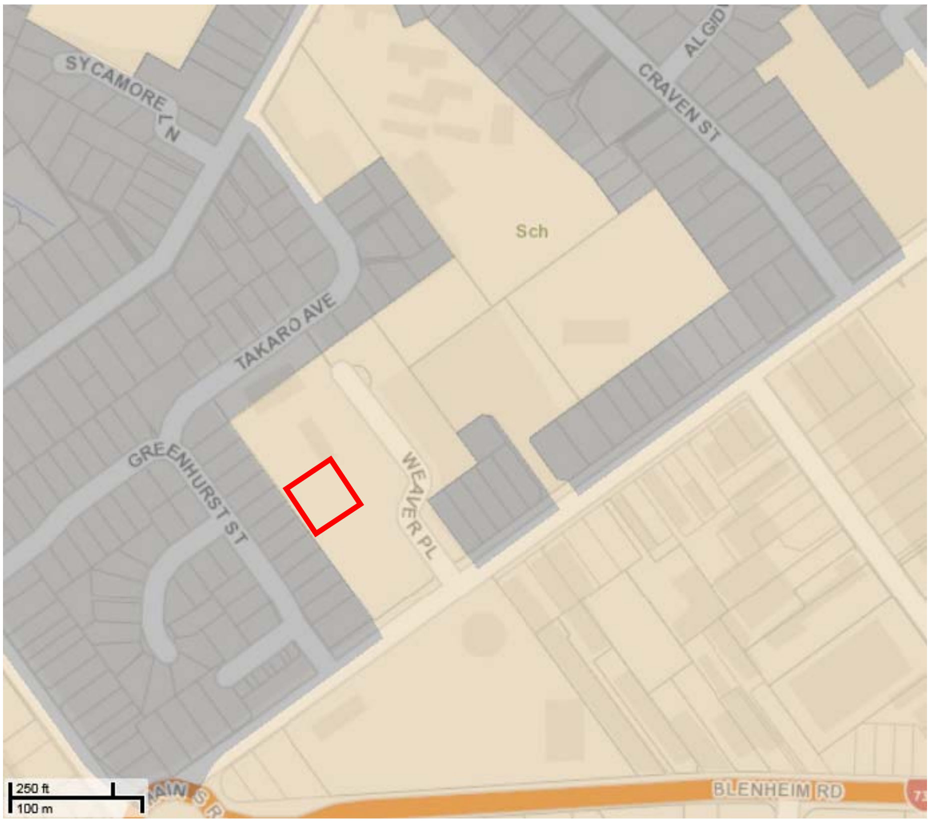
3. Limitations

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.

This report should be read in full and no excerpts are to be taken as representative of the findings. It must not be copied in parts, have parts removed, redrawn or otherwise altered without the written consent of SKM.

4. Site location



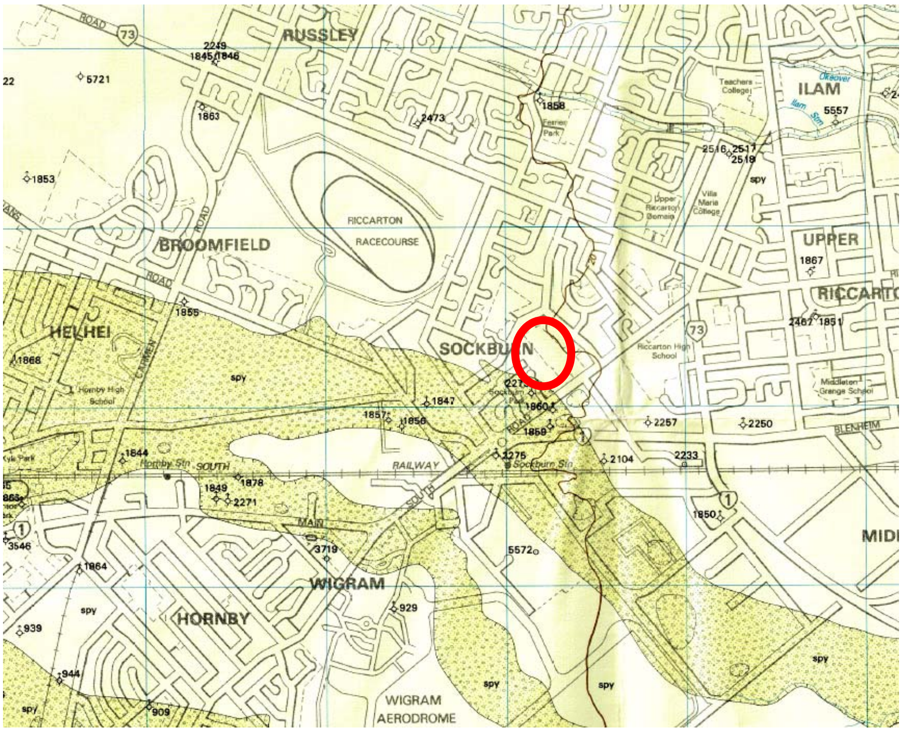
- **Figure 1 – Site location (courtesy of LINZ http://viewers.geospatial.govt.nz)**

The barbeque shelter is located in Sockburn Recreation Centre (8 Takaro Ave.) at grid reference 1564078 E, 5179466 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 deposits comprising predominantly alluvial sand and silt overbank deposits of the Springston Formation. Immediately to the South lies an area of alluvial gravel, sand and silt of historic river flood channels.

5.2 Liquefaction map

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.

However, the reconnaissance did not extend into this area.

5.3 Aerial photography

- **Figure 4 – Aerial photography from 24 Feb 2011 (http://viewers.geospatial.govt.nz/)**

From the aerial photograph above, there does not appear to be significant evidence of liquefaction occurring on. The white material on the driveway shown in the top centre in figure 3 could indicate dried silt ejecta. However, no other visible evidence of liquefied material ejected to the surface is apparent from the aerial photograph.

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 (Urban Non-residential) – adjacent properties are TC1

5.5 Historical land use

A demolished outdoor swimming pool is located immediately to the North of the structure. Available historical reference document is shown in Appendix A. However, no record for historical land use was available.

5.6 Existing ground investigation data

- **Figure 5 – Local boreholes from Environment Canterbury Regional Council (http://arcims.ecan.govt.nz/ecanmapping/)**

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

A site walkover was conducted by an SKM engineer on 25 June 2012.

The Shelter was noted to be located in a low lying grassed area with a 20-30 degree slope at the western side of the building sloping up to adjacent houses. The building was observed to comprise a 1.1 m high masonry retaining wall on the southern side and steel portal frames supporting a timber framed roof. The foundation appeared to be a slab on grade foundation. The site was surrounded by a wire mesh fence. Some cracking in the masonry wall and external concrete ground slab was noted during the external site inspection. There was slight differential settlement of external concrete slabs within the site. There was no evidence of surface expression of liquefaction or any land damage around the site. No stability issues related to the slope were noted. Site photographs are shown below:

- **Figure 6 - Overview of the structure (eastern elevation)**

- **Figure 7 - Overview of the structure (northern elevation)**

- **Figure 8 - Cracking in external concrete slab**

- **Figure 9 – Observed differential settlement of external concrete slabs**

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 - 5	Fill
5 - 8	Clay to Clayey Sand
8 - 25 +	Gravelly Sand or Gravel

6.2 Seismic site subsoil class

The site has been assessed as NZS1170.5 Class D (deep or soft soil) 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. Other preferred methods are from borehole logs 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 utilising records from sites at least 50 m from the site. It is therefore possible 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

Liquefaction risk appears to be low for this site. Little evidence of liquefied material at surface was observed from the aerial photographs taken after the 22nd February earthquake.

Clayey sand layers below 5m are susceptible to liquefaction and this would explain the liquefied material observed from the aerial photographs.

Design parameters were not provided as the top 5m ground conditions were not confirmed.

6.5 Further investigations

Due to lack of information of ground conditions in the top 5 m, ground investigations may be expected to perform a quantitative DEE:

- Two cone penetration test to refusal

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.

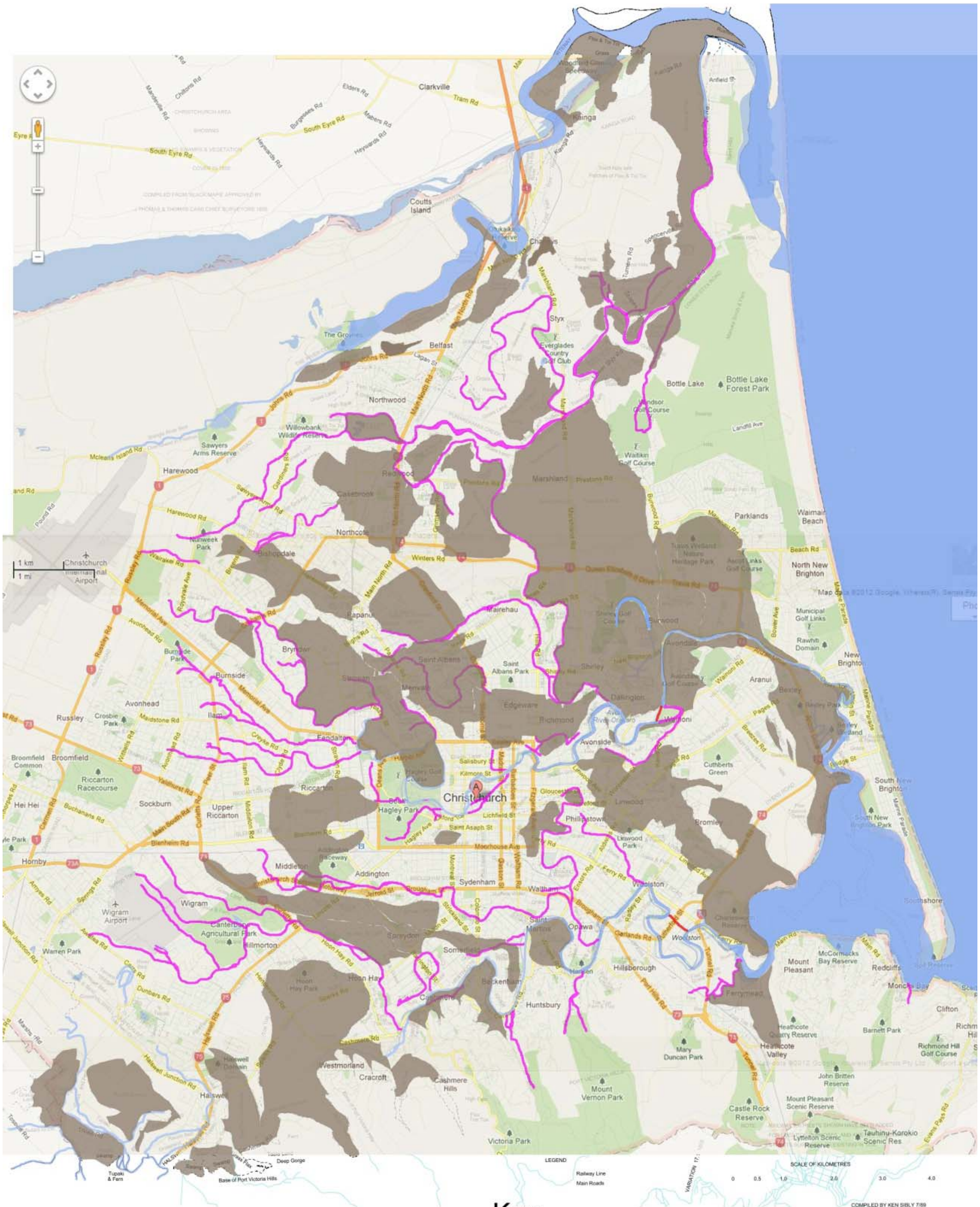
Forsyth PJ, Barrell DJA, Jongens R, 2008. Geology of the Christchurch area. Institute of Geological & Nuclear Sciences geological map 16.

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

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

Environment Canterbury Regional Council home page (http://ecan.govt.nz)

Appendix A – Christchurch 1856 land use



Key

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

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

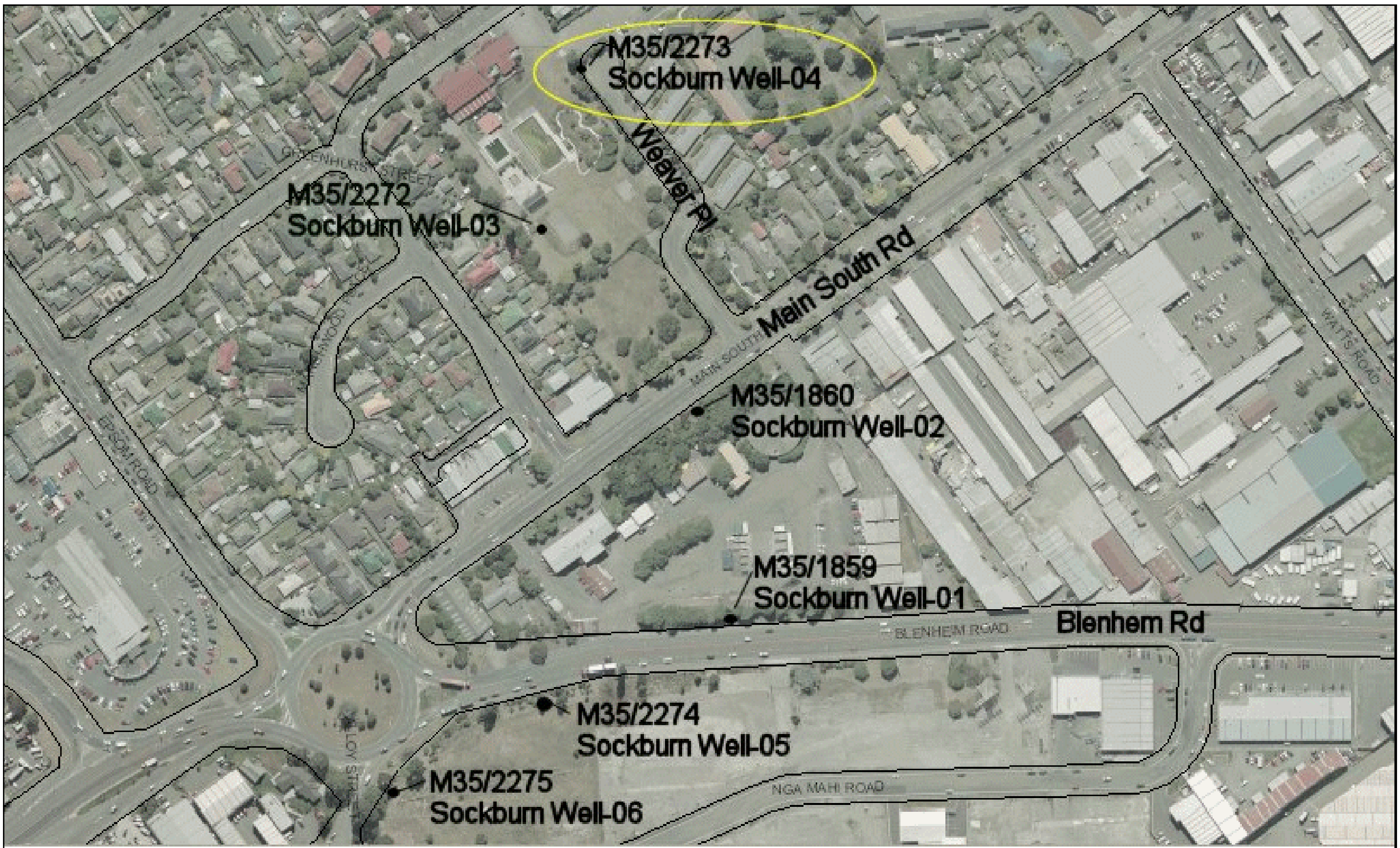
Appendix B – Existing ground investigation logs

Bore or Well No: M35/2273
Well Name: SOCKBURN WELL 4
Owner: Christchurch City Council

Street of Well:	WEAVER PLACE	**File No:**	CO6C/10597
Locality:	SOCKBURN	**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:74100-41160 QAR 2		
NZGM X-Y:	2474100 - 5741160		
Location Description:	Well down Weaver Place.	**Uses:**	Public Water Supply
ECan Monitoring:			
Well Status:	Active (exist, present)		

Drill Date:	29 Aug 1978	**Water Level Count:**	0
Well Depth:	68.40m -GL	**Strata Layers:**	19
Initial Water Depth:		**Aquifer Tests:**	0
Diameter:	305mm	**Isotope Data:**	1
		Yield/Drawdown Tests:	1
Measuring Point Ait:	22.40m MSD QAR 3	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:	A M Bisley & Co	**Calc. Min. GWL:**	-3.70m -MP
Drilling Method:	Cable Tool	**Last Updated:**	07 May 2012
Casing Material:		**Last Field Check:**	30 Jan 2008
Pump Type:	Submersible		
Yield:	26 l/s	**Screens:**	
Drawdown:	5 m	**Screen Type:**	Stainless steel
Specific Capacity:	5.06 l/s/m	**Top GL:**	62.20m
		Bottom GL:	68.40m
Aquifer Type:	Non-Flowing Artesian		
Aquifer Name:	Linwood Gravel		

Date	Comments
	SEE M35/1859
29 Aug 1978	Fossil analysis data available for this bore.
15 Oct 1998	West pressure zone.
01 Jul 2003	Pollen analysis in Brown & Wilson 1988: Stratigraphy of the late Quaternary deposits of the northern Canterbury Plains, NZ. NZJG&G 31:305-335
01 Feb 2008	Gridref changed from: M35:7410-4114
06 May 2010	MfE source code added



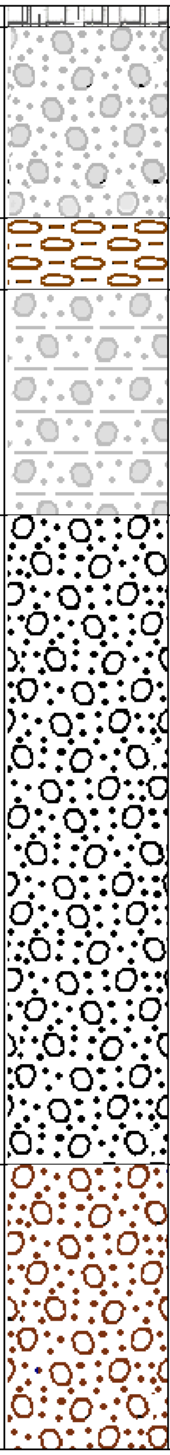
M35/2273
Sockburn Well-04
Weaver Pl
M35/2272
Sockburn Well-03
Main South Rd
M35/1860
Sockburn Well-02
M35/1859
Sockburn Well-01
Blenheim Rd
BLENHEIM ROAD
M35/2274
Sockburn Well-05
M35/2275
Sockburn Well-06
NGA MAHI ROAD
EPSOM ROAD
WATTS ROAD

Borelog for well M35/2273 page 1 of 2

Gridref: M35:74100-41160 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 22.4 +MSD
Driller : A M Bisley & Co
Drill Method : Cable Tool
Drill Depth : -68m Drill Date : 29/08/1978

Environment Canterbury Regional Council

Water Level: -3.7CalcMin



Scale(m)	Depth(m)	Full Drillers Description	Formation Code
	-0.50m	Filling	fi
-5	-5.00m	Grey gravel & sand	sp
	-6.69m	Grey clay & timber	sp
-10	- 12.0m	Grey sandy clay, timber & some gravel	sp
-15, -20, -25	- 27.3m	Grey/Brown gravel (Some dark stained) & sand	ri
-30	- 34.0m	Brown gravel, some dark stained & sand	ri

Borelog for well M35/2273

Gridref: M35:74100-41160 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 22.4 +MSD
Driller : A M Bisley & Co
Drill Method : Cable Tool
Drill Depth : -68m Drill Date : 29/08/1978

Depth(m)	Full Drillers Description	Formation Code
- 34.2m	Brown gravel, some dark stained & sand	ri
- 37.2m	Sandy Brown gravel	ri
- 38.7m	Yellow clay & some gravel	ri
- 39.0m	Brown gravel & sand	ri
- 42.0m	Sandy Grey clay	br
- 46.0m	Grey clay & timber	br
- 48.1m	Grey sand, some gravel & timber	br
- 52.2m	Grey clay	br
- 57.6m	Sandy Brown gravel & some clay	li
- 57.9m	Yellow clay & gravel	li
- 60.4m	Brown gravel & fine sand	li
- 63.5m	Sandy Brown & dark stained gravel	li
- 67.0m	Brown gravel, some dark stained & fine sand	li
- 68.0m	Sandy Brown gravel & Yellow clay	li

Scale(m): -35, -40, -45, -50, -55, -60, -65

Bore or Well No:	M35/2272
Well Name:	SOCKBURN WELL 3
Owner:	Christchurch City Council

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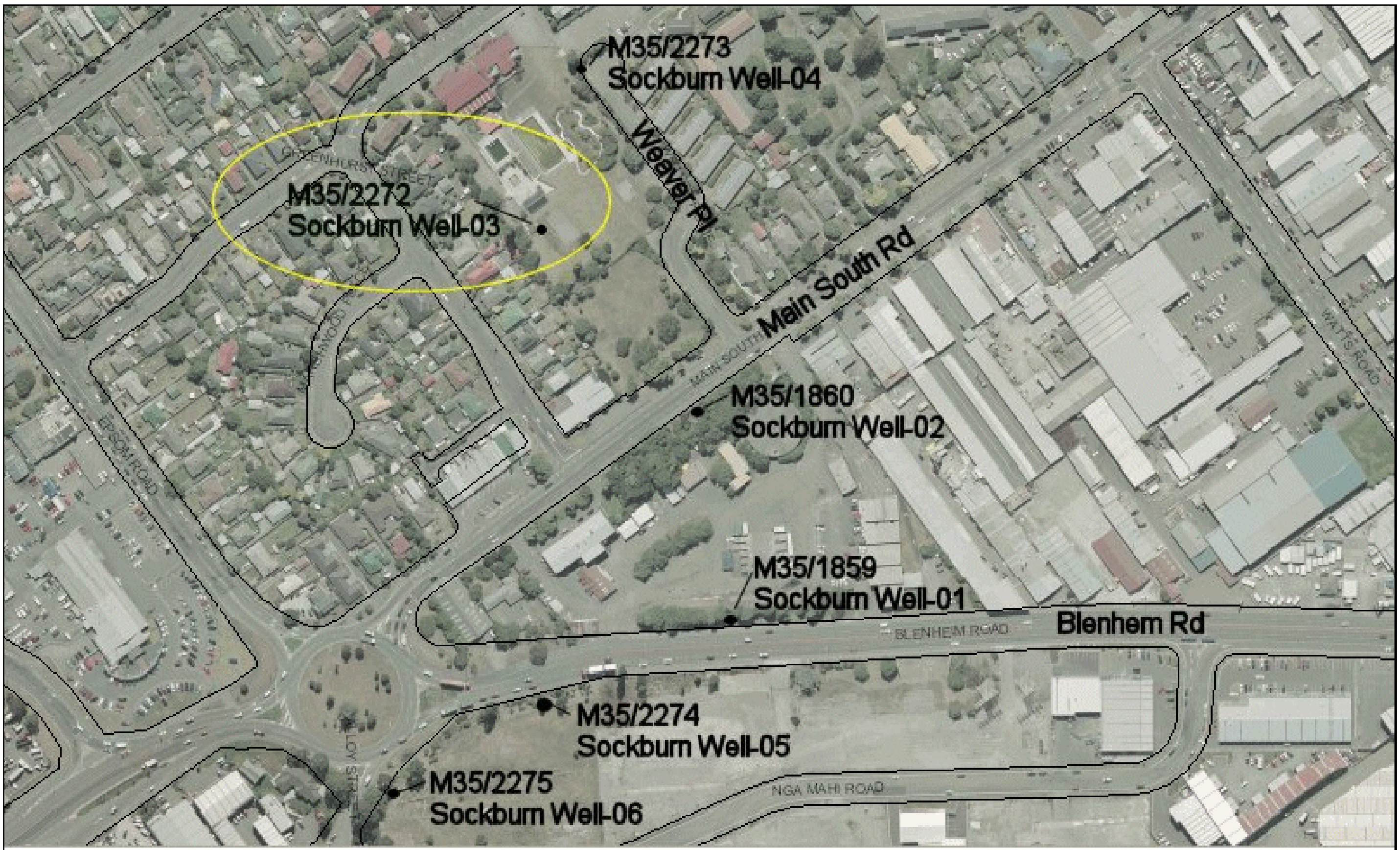
Street of Well:	WEAVER PLACE	**File No:**	CO6C/10597
Locality:	SOCKBURN	**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:74079-41064 QAR 2		
NZGM X-Y:	2474079 - 5741064		
Location Description:	Inside old sockbirn swimming pool grounds.	**Uses:**	Public Water Supply
ECan Monitoring:			
Well Status:	Active (exist, present)		

Drill Date:	18 Sep 1978	**Water Level Count:**	0
Well Depth:	77.20m -GL	**Strata Layers:**	20
Initial Water Depth:	-2.85m -MP	**Aquifer Tests:**	0
Diameter:	305mm	**Isotope Data:**	0
		Yield/Drawdown Tests:	1
Measuring Point Ait:	19.30m MSD QAR 3	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:	A M Bisley & Co	**Calc. Min. GWL:**	-3.70m -MP
Drilling Method:	Cable Tool	**Last Updated:**	11 Nov 2010
Casing Material:		**Last Field Check:**	30 Jan 2008
Pump Type:	Unknown		
Yield:	24 l/s	**Screens:**	
Drawdown:	4 m	**Screen Type:**	Stainless steel
Specific Capacity:	6.94 l/s/m	**Top GL:**	64.10m
		Bottom GL:	67.10m
Aquifer Type:	Non-Flowing Artesian	**Screen Type:**	Stainless steel
Aquifer Name:	Linwood Gravel	**Top GL:**	74.10m
		Bottom GL:	77.20m

Date	**Comments**
	SEE M35/1859
15 Oct 1998	West pressure zone.
01 Feb 2008	Gridref changed from: M35:7407-4111
06 May 2010	MfE source code added
15 Jul 2010	Gridref changed from: M35:74079-71064 to M35:74079-41064 - looks like didn't want to update the wrong map ref the 7 in the northing WRONG


M35/2273
Sockburn Well-04
Weaver Pl
M35/2272
Sockburn Well-03
Main South Rd
M35/1860
Sockburn Well-02
M35/1859
Sockburn Well-01
Blenheim Rd
BLENHEIM ROAD
M35/2274
Sockburn Well-05
M35/2275
Sockburn Well-06
NGA MAHI ROAD
EPSOM ROAD
WATTS ROAD

Borelog for well M35/2272

Gridref: M35:74079-41064 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 19.3 +MSD
Driller : A M Bisley & Co
Drill Method : Cable Tool
Drill Depth : -77m Drill Date : 18/09/1978

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Water Level: -3.7CalcMin

Depth(m)	Full Drillers Description	Formation Code
-5.00m	Rubbish dump fill	fi
-7.30m	Grey gravel & sand	sp
-8.30m	Grey clay	sp
-8.80m	Yellow clay	sp
- 28.2m	Grey/Brown gravel (Some dark stained) & sand	sp-ri
- 32.7m	Brown gravel (Some dark stained) & sand	ri
- 36.7m	Sandy Brown gravel	ri
- 37.5m	Brown gravel & Yellow clay	ri
- 38.5m	Sandy Brown gravel	ri

Scale(m): -5, -10, -15, -20, -25, -30, -35

Borelog for well M35/2272

Gridref: M35:74079-41064 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 19.3 +MSD
Driller : A M Bisley & Co
Drill Method : Cable Tool
Drill Depth : -77m Drill Date : 18/09/1978

Depth(m)	Full Drillers Description	Formation Code
- 38.7m	Sandy Brown gravel	fl
- 44.0m	Yellow clay	br
- 44.9m	Sandy Yellow clay & gravel	br
- 50.7m	Grey clay, sand, timber & some gravel	br
- 52.0m	Brown gravel & fine sand	li
- 55.6m	Tight sandy Brown gravel	li
- 64.5m	Sandy Brown & dark stained gravel	li
- 67.5m	Sandy Brown & dark stained gravel & some Yellow clay	li
- 70.3m	Very sandy Brown & dark stained gravel	li
- 71.5m	Hard Yellow clay	li-2
- 72.0m	Brown gravel, fine sand & some clay	li-2
- 77.0m	Sandy Brown gravel	li-3

Unknown No: M35/15192
Well Name: CCC BorelogID 4328
Owner: CCC borelog

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Street of Well:	Paparua Main	**File No:**	
Locality:		**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:74068-40962 QAR 3		
NZGM X-Y:	2474068 - 5740962		
Location Description:	Paparua Main Drain / Greenhurst St - west corner of #4 at M.H	**Uses:**	Foundation/Investigation Bore
ECan Monitoring:			
Well Status:	Filled in		

Drill Date:		**Water Level Count:**	0
Well Depth:	1.00m -GL	**Strata Layers:**	3
Initial Water Depth:		**Aquifer Tests:**	0
Diameter:		**Isotope Data:**	0
		Yield/Drawdown Tests:	0
Measuring Point Ait:	21.33m 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 M35/15192

Gridref: M35:74068-40962 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 21.33 +MSD
Well name : CCC BorelogID 4328
Drill Method : Not Recorded
Drill Depth : -1.1m Drill Date :

Scale(m): -0.2, -0.4, -0.6, -0.8, -1

Water Level	Depth(m)	Full Drillers Description	Formation Code
	-0.50m	topsoil and gravel	
	-1.00m	sand	
	-1.10m	gravel	

Unknown No: M35/15193
Well Name: CCC BorelogID 4329
Owner: CCC borelog

Environment Canterbury
Your regional council

Street of Well:	Paparua Main	**File No:**	
Locality:		**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:73979-41089 QAR 3		
NZGM X-Y:	2473979 - 5741089		
Location Description:	Paparua Main Drain / Greenhurst St - at M.H west side #24	**Uses:**	Foundation/Investigation Bore
ECan Monitoring:			
Well Status:	Filled in		

Drill Date:		**Water Level Count:**	0
Well Depth:	0.10m -GL	**Strata Layers:**	2
Initial Water Depth:		**Aquifer Tests:**	0
Diameter:		**Isotope Data:**	0
		Yield/Drawdown Tests:	0
Measuring Point Ait:	21.83m 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 M35/15193

Gridref: M35:73979-41089 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 21.83 +MSD
Well name : CCC BorelogID 4329
Drill Method : Not Recorded
Drill Depth : -0.2m Drill Date :

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			topsoil	
		-0.10m	gravel	
-0.2		-0.20m		

Appendix C – Geotechnical Investigation Summary

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

ID		1	2	3	4
Type *		BH	BH	BH	BH
Ref		M35/2273	M35/2272	M35/15192	M35/15193
Depth (m)		68	77	1.1	0.2
Distance from site (m)		80	20	100	120
Ground water level (mBGL)		3.7	3.7		
Simplified recorded geological profile (depth below ground level to top of stratum, m)	0	N/A	N/A		
	1		N/A		
	2		N/A		
	3		N/A		
	4		N/A		
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	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