CHRISTCHURCH CITY COUNCIL
PRK_0966_BLDG_001 EQ2
Huntsbury Community Building
30F & G Huntsbury Ave

QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 14 February 2013

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1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on the building, PRK_0966_BLDG_001 EQ2, located at 30F & G Huntsbury Ave. This building is used as a community centre by the public. The building is a split level timber framed structure supported by a combination of timber columns and concrete block walls. The building appears to be founded on a combination of concrete strip footings and concrete slab and timber piles. The structure is clad with light Hardiboard panels to the walls and corrugated metal sheets on the roof. An aerial photograph illustrating the location of this 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 PRK_0966_BLDG_001 EQ2 Located on Huntsbury Ave**

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 our visual inspection on 21May 2012. Limited structural drawings along with a copy of an earlier damage inspection report for the building were provided by the manager of the community centre.

1.2. Key Damage Observed

Key damage observed includes:-

- Minor crack to concrete blockwork on the northwest corner of the basement wall.
- Hairline cracking to the internal plasterboard wall linings.
- Construction joints on the basement floor had opened up approximately 0.8mm.
- A 12mm gap was present between the floor and wall base along the east side of the corridor towards the south entrance. This appears to be a result of settlement of the floor slab.

1.3. Critical Structural Weaknesses

No critical structural weakness was observed during our visual inspection.

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 23%NBS. No significant structural damage that will diminish the structural integrity of the building was observed during our site investigation, and as a result the post earthquake capacity is also in the order of 23%NBS. This assessment has been made using partial structural drawings and is accordingly limited.

As noted above the building has been assessed to have a seismic capacity in the order of 23% NBS and is therefore potentially earthquake prone. Therefore, we recommend a quantitative assessment is carried out due to the uncertainty of the seismic capacity provided by the IEP. This will allow us to confirm our findings and develop possible strengthening concepts if necessary. Any quantitative assessment carried out will most likely require intrusive investigations unless full set of structural drawings can be provided.

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) A quantitative assessment of the building, supported by intrusive investigations if required, be undertaken to determine the seismic capacity and to develop potential strengthening concepts. As part of this assessment, further geotechnical review should be undertaken to confirm the site sub-soil category (improving the assumed classification from Category C to Category B would not change the earthquake prone result in the IEP completed for this report, but could make a significant difference to the quantitative analysis).

b) A verticality and level survey is carried out on the building, to cover all areas but with particular attention to the apparent settlement of the ramp and floors around the extension near the southern entrance of the building.

c) Minor earthquake damage to building is repaired, but only after the results of the site survey and quantitative analysis are obtained.

d) 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 30 F & G Huntsbury Avenue 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 7.2.

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].

A site inspection report from Connor Consulting dated 25th November 2011 has been provided. The damage observed in the report was still present during our inspection, except for the pinex ceiling tiles slumping off the roof/ceiling framing.

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

[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_0966_BLDG_001 EQ2, located at 30 F & G Huntsbury Avenue is a split level timber structure. The building is used primarily as a community centre but is also used as preschool centre in the morning during weekdays. The upper level or ground floor contains the main hall, kitchen, and toilets. It is accessed from the east where the ground level is higher. The ground floor building superstructure is constructed from timber portal frames, supported by a combination of timber piles, concrete piles, masonry walls, and concrete slab in various areas. The lower level is a basement which is being used for storage. The basement is accessed from the west where the ground level is lower, and is constructed from masonry concrete blocks with concrete slab flooring. The east and south sides of the basement walls serves as a retaining wall for the higher ground level in front and left side of the building. These walls partly support the framings on the ground floor. Outside the basement on the north, timber piles extend upward to the upper ground level to support the suspended timber flooring. Drawings indicate that this part of the building has been added to the original structure around 1995. The south end on the building where the toilets and kitchen are located and ground elevation is higher, is supported on grade with concrete slab. An extension was also added on the southwest corner of the building for storage and bar. The date of extension is believed to be before 1995 since this modification has been shown as existing on the alteration drawings dated 1995. This extension is supported by concrete masonry blocks and strip footings. It is also notable that basement area seems wider than what was shown on the original drawings.

The original building was constructed around 1971

5.2. Gravity Load Resisting system

The gravity load resisting structure of the building is made up of timber portal frames in the upper storey. Areas of suspended timber floor are supported by timber piles, concrete piles, & masonry walls. The southern end of the building is supported on grade with concrete slabs. A new veranda type extension is supported on timber piles.

5.3. Seismic Load Resisting system

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

At the upper level lateral loads acting across the building are resisted by the timber upper level portal frames and walls in the north-south direction. Lateral loads acting along the building are most likely to be resisted by the timber wall linings at first floor level, which may have limited capacity because of the significant door and window openings along the north and south elevations of the hall. At the lower (basement) level, the loads acting along the building are transferred into a combination of concrete block walls and braced timber piles. Lateral loads acting across the building are solely transferred into the concrete block walls. Note that the 2”x4” diagonal bracing for the transverse direction specified on the original drawings were not found during the inspection.

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 C or B. The used of C is recommended until further investigations are carried out.
- No evidence of liquefaction was noted during the site walkover or from the aerial photography taken after the February 2011 earthquake. Liquefaction risk is negligible on this site.
- A ground investigation to determine the subsoil class is recommended as part of a quantitative DEE.

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

6. Damage Summary

SKM undertook an inspection of the building on the 21th May 2012. The following areas of damage were observed during the time of inspection. Photos of the damage can be found in Appendix 1.

1) Crack at concrete masonry pilaster column on the North West corner of the basement wall (Photos 3-4).
2) About 12mm gap between the floor and wall base along the east side of the corridor towards the south access door (photos 9-10). No apparent movement or damage was observed on the wall. This indicates that a small amount of settlement has occurred, although it could not be determined from visual inspection whether this is earthquake related or not. Extent of damage and scope of repairs to be confirmed after level survey.
3) Apparent settlement of the concrete ramp on the building access on the south side (photos 7-8). It is not clear from visual inspection whether this is earthquake related. Extent of damage and scope of repairs to be confirmed after level survey.
4) Hairline cracks on some walls of all three toilets on the southeast side of the building (photos 11-18)
5) Opening of construction joints (about 0.8mm) at the basement floor (photo 6). It is not clear whether this is earthquake related, and could well be the result of drying shrinkage. No repairs are recommended for this item.

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

[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 21th May 2012, SKM carried out a preliminary structural review. The structural review was undertaken using the available information which was as follows:

- SKM site inspection findings of the building. Please note no intrusive investigations were undertaken.
- Limited drawings were made available during the preparation of the report.

The design criteria used to undertake the assessment include:

- Standard design criteria for 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, 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 and a review of the available 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

Due to the visible settlement of the floor around the south entrance we recommend that a verticality and level survey be conducted on the entire building.

7.4. Critical Structural Weaknesses

No critical structural weaknesses for the building were observed during our visual inspection

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 is expressed as a percentage of new building standard (%NBS) and is in the order of that shown below in Table 3. This capacity is subject to confirmation by a quantitative analysis.

Table 3: Qualitative Assessment Summary

Item	%NBS
Buildings likely Seismic Capacity	23

Our qualitative assessment found that the building is likely to be classed as a 'High Risk Building' (capacity less than 33% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.

Further investigation is required to confirm our initial findings and establish possible strengthening concepts.

The Council regulations state that if the %NBS of the building is less than 34%, this building is considered earthquake prone and is required to be strengthened.

8. Further Investigation

Due to the lack of structural drawings and the likely seismic capacity of the building being less than 34% NBS we recommend that a quantitative assessment is carried out due to the potential margin of error that may be inherent in the initial IEP assessment. This investigation will entail looking at the characteristics of each area of structural bracing in more detail to determine if there is sufficient capacity in the structural elements to resist the required earthquake demand. Further geotechnical investigation is also required to complete the quantitative assessment. This additional work is outlined in our desktop study detailed in Appendix 4. If the building is confirmed to be earthquake prone, a seismic strengthening concept design should be prepared so that a pre-feasibility cost estimate can be prepared. The pre-feasibility strengthening cost estimate should then be compared with an estimate to demolish and rebuild the building so that the cost-effectiveness of repairing the building can be determined. Due to the limited information provided on the available structural drawings intrusive investigations may be required to confirm the following structural details:

- Foundations
- Sizes of the structural members
- Connection sizes and layouts
- Reinforcing details to existing concrete block walls

A level and verticality survey is required to confirm the extent of movement that has occurred to the building in practically around the south entrance.

It is believed that a building consent is not likely to be required for the repair of the damage noted in Section 6. However a building consent may be required for repairing the floor area around the south entrance if the movement is outside the acceptable level tolerances, and for upgrading the building to achieve an acceptable %NBS capacity.

9. Conclusion

A qualitative assessment was carried out on building PRK_0966_BLDG_006 EQ2 located at 30 G & F Huntsbury Ave. The building has sustained minor damage to internal linings, floor settlement on a small area of the building hairline cracking to concrete elements. The building has been assessed to have a seismic capacity in the order of 23% NBS due to this the building is likely to be classified as a ‘High Risk Building’ (seismic capacity less than 33% of NBS).

A quantitative assessment of the building, supported by intrusive investigations is recommended due to the potential margin of error inherent in the initial assessment. This will enable us to confirm the seismic capacity of the building and to develop any potential strengthening concepts.

It is recommended that:

a) A quantitative assessment of the building, supported by intrusive investigations if required, be undertaken to determine the seismic capacity and to develop potential strengthening concepts. As part of this assessment, further geotechnical review should be undertaken to confirm the site sub-soil category (improving the assumed classification from Category B to Category C would not change the earthquake prone result in the IEP completed for this report, but could make a significant difference to the quantitative analysis).
b) A verticality and level survey is carried out on the building, to cover all areas but with particular attention to the apparent settlement of the ramp and floors around the extension near the southern entrance of the building.
c) Minor earthquake damage to building is repaired, but only after the results of the site survey and quantitative analysis are obtained.
d) Barriers are not required around the building.

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: View of the building looking west.	Photo 2: View of the building from south showing alternate access.
	
Photo 3: Photo showing cracks on the masonry column on the north west side corner of the retaining wall.	Photo 4: Aerial photo showing location of cracks in Photo 3.

Photo 5: View on the northern side of the buidling showing tha basement walls and timber piles supporting the timber flooring on the ground floor.

Photo 6: Construction joint on the basement floor opening slightly by about 0.8mm.

Photo 7: Photo of the buidling access on the south side of building.

Photo 8:View as pointed by the arrow in photo 7 showing the concrete ramp and masonry wall interface were apparent settlement is observed

	
Photo 9: Photo showing increased gap between floor and wall base on the along the corridor of the building access on its south.	Photo 10: Zoomed out view where the cracks along the corridor shown in Photo 9 were found.
	
Photo 11: Plaster board cracks found on toilet walls.	Photo 12: Plaster board cracks found on toilet walls.

	
Photo 13: Plaster board cracks found on toilet walls.	Photo 14: Plaster board cracks found on toilet walls.
	
Photo 15: Plaster board cracks found on toilet walls.	Photo 16: Plaster board cracks found on toilet walls.

	
Photo 17: Plaster board cracks found on toilet walls.	Photo 18: Plaster board cracks found on toilet walls.

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)

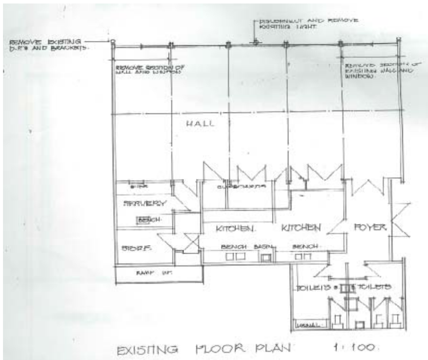
Building Name:	**PRK_0966_BLDG_001 EQ2 Huntsbury Community Center**	Ref.	**ZB01276.147**
Location:	30F&G Huntsbury Avenue	By	NER
		Date	22/05/2012

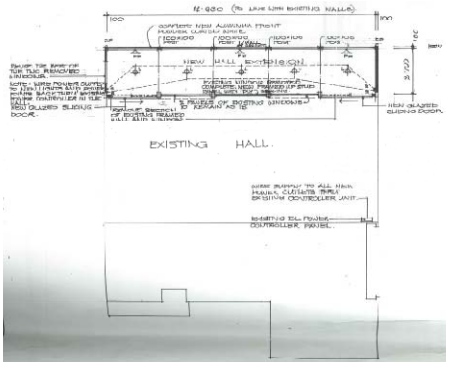
Step 1 - General Information

1.1 Photos (attach sufficient to describe building)




1.2 Sketch of building plan





1.3 List relevant features

This building is a split level timber structure that is constructed in mid 70s on a sloping ground. The upper level or ground floor contains the main hall, kitchen, and toilets. It is accessed from the east where the ground level is higher. It is constructed from timber portal frames supported by a combination of timber piles, concrete piles, masonry walls, and concrete slab. The lower level is a basement which is being used for storage and is constructed from masonry concrete blocks with concrete slab flooring..

It partly supports the ground level timber flooring above. Outside the basement on the north, timber piles extend upward to the upper ground level to support the suspended timber flooring. The south end on the building where the toilets and kitchen are located and ground elevation is higher, is supported by concrete slabs. The roof structure consists of timber framing and steel corrugated sheets.

1.4 Note information sources

	Tick as appropriate	
Visual Inspection of Exterior	✓	
Visual Inspection of Interior	✓	
Drawings (note type)	✓	partial structural
Specifications	☐	
Geotechnical Reports	☐	
Other (list)	✓	

Site Inspection report, Connor Consulting dated 25 November 2011

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:	**PRK_0966_BLDG_001 EQ2 Huntsbury Community Center**	Ref.	**ZB01276.147**
Location:	30F&G Huntsbury Avenue	By	NER
Direction Considered:	**Longitudinal & Transverse**	Date	22/05/2012

(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 = 5 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 <= 0.4sec	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 = 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	
0.2	0.2	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	6.4	$(\%NBS)_{nom}$
Transverse	6.4	$(\%NBS)_{nom}$

		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	6.4	$(\%NBS)_{nom}$
Transverse	6.4	$(\%NBS)_{nom}$

Continued over page

Building Name:	PRK_0966_BLDG_001 EQ2 Huntsbury Community Center	Ref.	ZB01276.147
Location:	30F&G Huntsbury Avenue	By	NER
Direction Considered:	Longitudinal & Transverse	Date	22/05/2012

(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 = 2
Transverse	**1.25**	μ Maximum = 2

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**	1.14
Transverse	**Factor D**	1.14

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	0.93
Transverse	Sp	0.93

b) Structural Performance Scaling Factor

Longitudinal	$1/S_p$	**Factor E**	1.08
Transverse	$1/S_p$	**Factor E**	1.08

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

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

Longitudinal	26.4	(%NBS)b
Transverse	26.4	(%NBS)b

Building Name:	PRK_0966_BLDG_001 EQ2 Huntsbury Community Center	Ref.	ZB01276.147
Location:	30F&G Huntsbury Avenue	By	NER
Direction Considered:	**a) Longitudinal**	Date	22/05/2012

(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

	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	Refer to comments for F-factor below				

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:

Split level nature of building will mean some differential movement between 2 storeyed section and slab on grade section under EQ in longitudinal direction, possibly worsened by seismic mass of verandah extension. But singificant masonry shear wall supporting 2nd storey along northern elevation means performance appears OK.

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:	**PRK_0966_BLDG_001 EQ2 Huntsbury Community Center**	Ref.	**ZB01276.147**
Location:	30F&G Huntsbury Avenue	By	NER
Direction Considered:	**b) Transverse**	Date	22/05/2012

(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

	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** 0.9

Record rationale for choice of Factor F:

The diagonal bracing to timber piles at basement levels indicated on the design drawings were not visible on site.
This may represent a construction defect, or a subsequent modification of the structure.
Lateral resistance still provided by masonry walls and slab on grade.

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F) **PAR** 0.9

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)

SKM

Building Name:	**PRK_0966_BLDG_001 EQ2 Huntsbury Community Center**	Ref.	**ZB01276.147**
Location:	30F&G Huntsbury Avenue	By	NER
Direction Considered:	**Longitudinal & Transverse**	Date	22/05/2012
	(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)	26	26
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	1.00	0.90
4.3 PAR x Baseline (%NBS)$_b$	26	23

4.4 Percentage New Building Standard (%NBS) (Use lower of two values from Step 4.3) — **23**

Step 5 - Potentially Earthquake Prone? (Mark as appropriate)

%NBS ≤ 33 — YES

Step 6 - Potentially Earthquake Risk?

%NBS < 67 — YES

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade — **D**

Evaluation Confirmed by

Signature

BRENDAN DONNELL Name

246971 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

Location

Building Name:	PRK_0966_BLDG_001 EQ2
Building Address:	Unit: No: 30F&G; Street: Hunstbury Ave; Huntsbury Community Centre
Legal Description:	
GPS south: (Degrees / Min / Sec)	
GPS east: (Degrees / Min / Sec)	
Building Unique Identifier (CCC):	
Reviewer:	B. Donnell
CPEng No:	246971
Company:	Sinclair Knight Merz
Company project number:	ZP01276.147
Company phone number:	03 940 4900
Date of submission:	14/02/2013
Inspection Date:	21/05/2012
Revision:	B
Is there a full report with this summary?	yes

Site

Site slope:	slope >1 in 5
Soil type:	silt (upper 6m fill)
Site Class (to NZS1170.5):	C
Proximity to waterway (m, if <100m):	
Proximity to clifftop (m, if < 100m):	
Proximity to cliff base (m,if <100m):	
Max retaining height (m):	3
Soil Profile (if available):	
If Ground improvement on site, describe:	
Approx site elevation (m):	

Building

No. of storeys above ground:	2 (single storey = 1)
Ground floor split?	yes
Storeys below ground	0
Foundation type:	strip footings
Building height (m):	5.00
Floor footprint area (approx)	185
Age of Building (years):	41
Ground floor elevation (Absolute) (m):	
Ground floor elevation above ground (m):	
if Foundation type is other, describe:	Also timber piles and slab on grade
height from ground to level of uppermost seismic mass (for IEP only) (m):	5
Date of design:	1965-1976
Strengthening present?	no
If so, when (year)?	
And what load level (%g)?	
Brief strengthening description:	
Use (ground floor):	public
Use (upper floors):	public
Use notes (if required):	Community Center / preschool (lower floor is for storage only)
Importance level (to NZS1170.5):	IL2

Gravity Structure

Gravity System:	frame system
Roof:	timber framed
rafter type, purlin type and cladding	Combined timber portals & timber framing
Floors:	timber
joist depth and spacing (mm)	Suspended timber floors on ground floor / concrete slabs on basement
Beams:	
Columns:	timber
typical dimensions (mm x mm)	
Walls:	Walls are timber frame

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	other (note)
describe system	timber portals
Ductility assumed, μ:	1.00
Period along:	0.20 (0.00)
estimate or calculation?	estimated
Total deflection (ULS) (mm):	100
estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	100
estimate or calculation?	
Lateral system across:	other (note)
describe system	bracing, timber framed walls with linings
Ductility assumed, μ:	1.00
Period across:	0.20 (0.00)
estimate or calculation?	estimated
Total deflection (ULS) (mm):	100
estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	100
estimate or calculation?	estimated

Separations:

leave blank if not relevant

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

Non-structural elements

		Describe
Stairs:		n/a
Wall cladding:	other light	flexiboard
Roof Cladding:	Metal	corrugated steel
Glazing:	timber frames	
Ceilings:	light tiles	
Services(list):	Lighting	

Available documentation

		original designer name/date
Architectural	none	
Structural	partial	christchurch city council
Mechanical	none	
Electrical	none	
Geotech report	none	

Damage

Site: (refer DEE Table 4-2)

		notes (if applicable)
Site performance:		Describe damage:
Settlement:	0-25mm	building extension at south entrance
Differential settlement:	0-1:350	approximately
Liquefaction:	none apparent	
Lateral Spread:	none apparent	
Differential lateral spread:	none apparent	
Ground cracks:	none apparent	
Damage to area:	slight	

Building:

Current Placard Status:	green
Along – Damage ratio:	0%
Along – Describe (summary):	
Describe how damage ratio arrived at:	damage observed does not deminish the capacity of the structure
Across – Damage ratio:	0%
Across – Describe (summary):	

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

	Damage?	Describe
Diaphragms	no	
CSWs:	no	
Pounding:	no	
Non-structural:	yes	

Recommendations

		Describe
Level of repair/strengthening required:	minor structural	
Building Consent required:	no	
Interim occupancy recommendations:	full occupancy	Occupants may elect to move out, but assumed not appropriate to evacuate based on IEP only and there is no significant damage. Expect that quantitative assessment will improve %NBS

Along	Assessed %NBS before:	23%	%NBS from IEP below
	Assessed %NBS after:	23%	
Across	Assessed %NBS before:	23%	%NBS from IEP below
	Assessed %NBS after:	23%	

If IEP not used, please detail assessment methodology: Qualitative Assesment carried out includes NZSEE IEP (refer to SKM report)

14. Appendix 4 – Geotechnical Desktop Study

Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	147
Address	30F & G Huntsbury Avenue
Report date	10 July 2012
Author	Chris Ritchie / Hannah Hadley
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 for 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

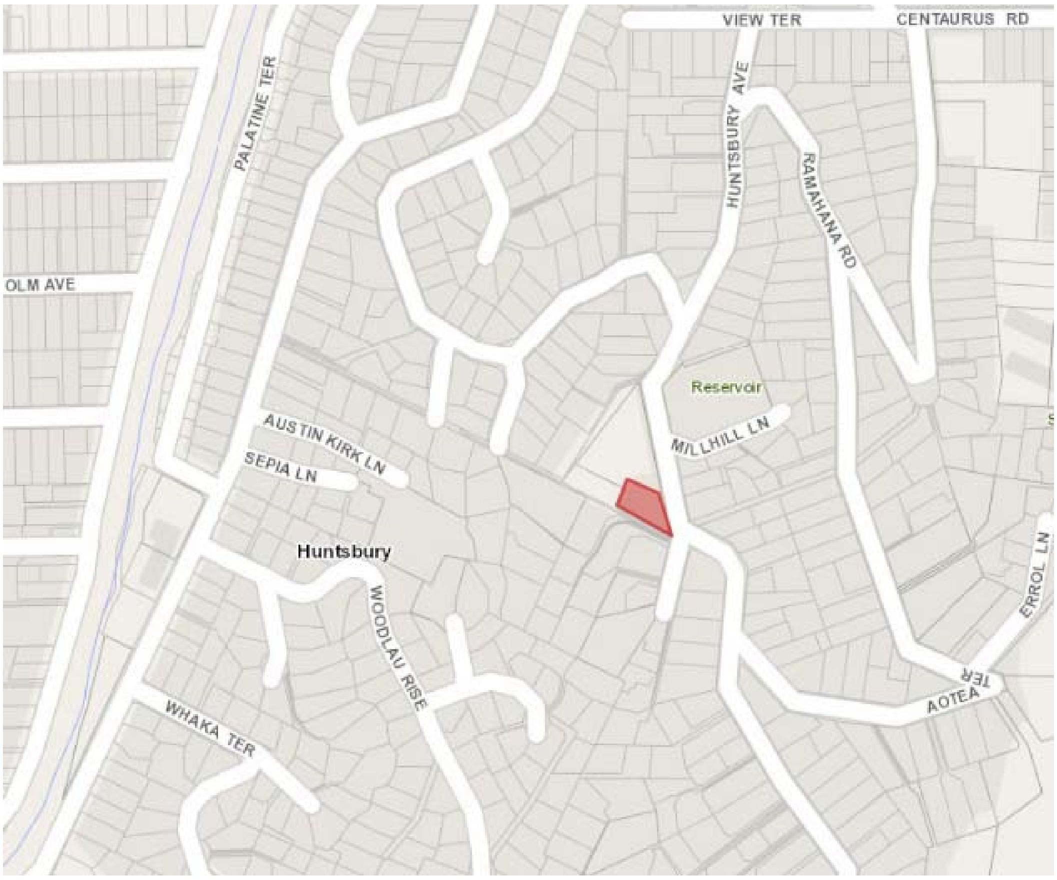
3. Limitations

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

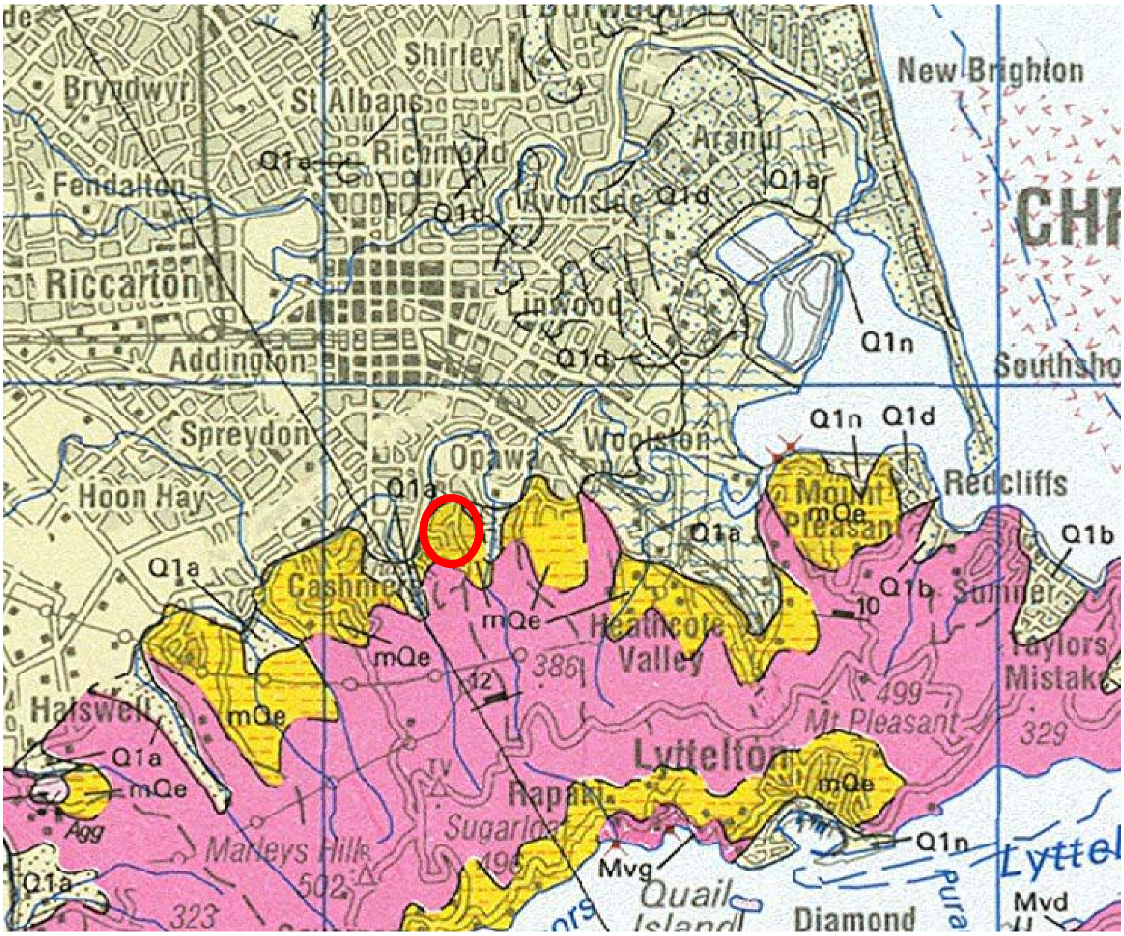


- **Figure 1 – Site location (courtesy of LINZ http://viewers.geospatial.govt.nz)**

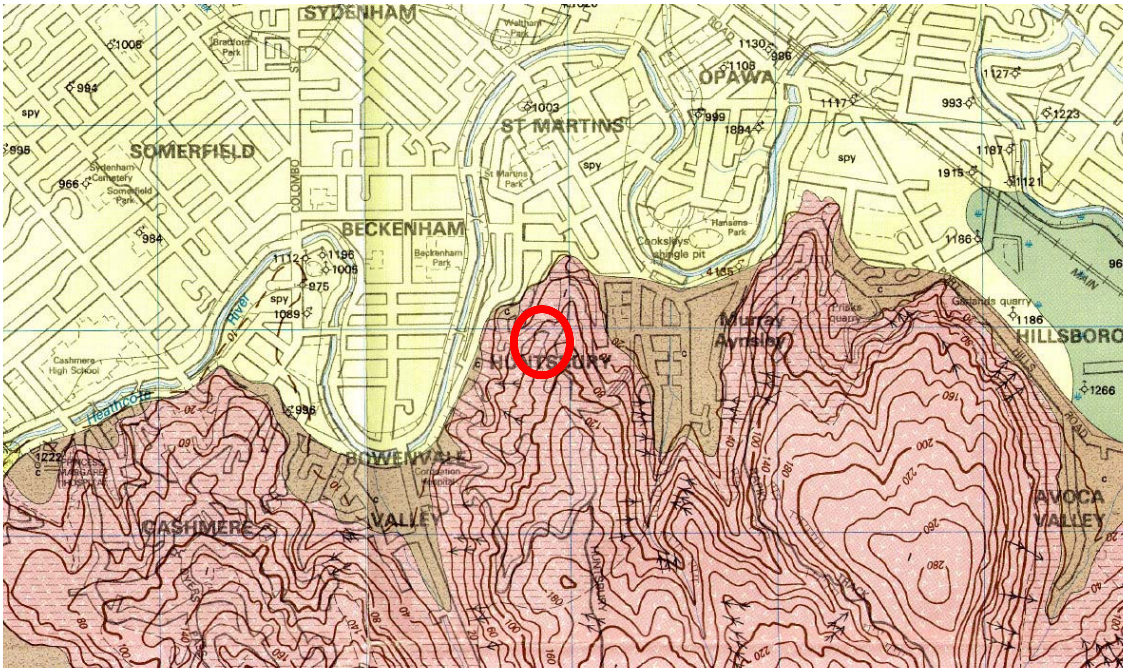
The structure is located on at 30F and G Huntsbury Avenue grid reference 1571910E 5176180 N (NZTM).

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 Quaternary deposits consisting of wind blown loess, and possible Miocene basalt flows at shallow depths.

5.2 Aerial photography

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

There is no evidence of land damage noted from the aerial photography on the site or neighbouring properties.

5.3 CERA classification

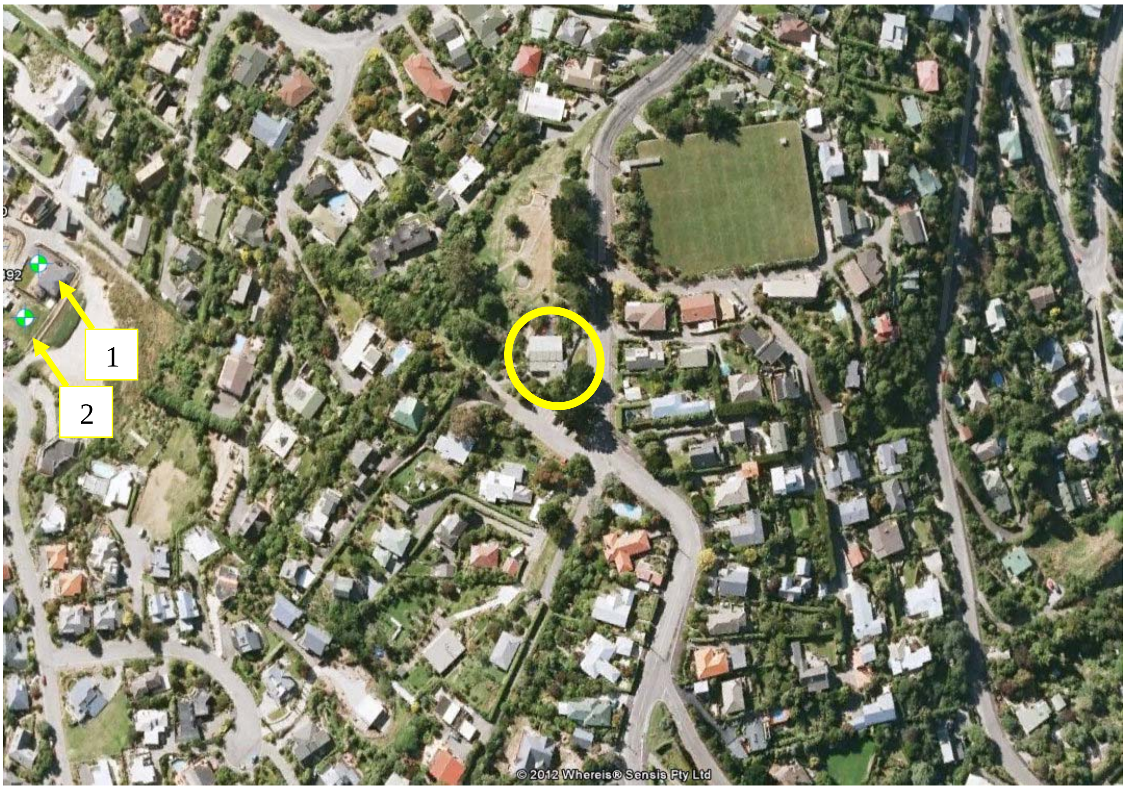
A review of the LINZ website (http://viewers.geospatial.govt.nz/) shows that the site is:

- Zone: Green
- DBH Technical Category: N/A (Port Hills and Banks Peninsula)

5.4 Historical land use

Reference to historical documents (eg Appendix A) no specific historical land use of the site in 1856. However, tunnel gullies were noted during the external site walkover. Therefore, as loess layers were inferred to be present at shallow depths beneath the site, it is likely that tunnel gullies may have formed on site or in adjacent area due to run off of water down the hill slope in the past.

5.5 Existing ground investigation data



- **Figure 5 – Local boreholes from Project Orbit and SKM files (https://canterburygeotechnicaldatabase.projectorbit.com/)**

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

5.6 Council property files

The available council records for the site are limited to documents relating to the landscape gardening occurring at the park. There is no relevant geotechnical or structural information included.

5.7 Site walkover

An external site walkover was conducted by an SKM engineer on 13 June 2012.

The building is a two storey building located on a cut to level footprint, with the hill sloping at approximately 20-30 degrees. The building was noted to be a timber structure (frame and clad), with a corrugated sheet metal roof. The structure comprised a combination of masonry walls and columns, and timber columns. The foundation appeared to be a concrete perimeter strip footing with a slab on grade flooring system on compacted hardfill. There was cracking in the masonry column head on the north west corner of the building; otherwise no significant structural damage was noted from the external site inspection.

There was evidence of tunnel-gully erosion, but this is not believed to be as a result of earthquake damage. No visual evidence of tension cracks was noted within the site; however, a minor gap was observed between the concrete ramp and wall base to the south side of the building, likely as a result of settlement.

No liquefaction would be expected at this site.

- **Figure 6 Overview of structures**

- **Figure 7 Observed tunnel gully**

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 (mBGL)	Soil type
0 – 6	Fill
6+	Loess

However, it should be noted that the available investigations are approximately 270 m from the site and are located near the bottom of the hill side. Therefore, it is possible that the geology indicated by the available investigation is not an accurate reflection of the underlying geology on site.

6.2 Seismic site subsoil class

The site has been assessed as NZS1170.5 Class C OR B; the use of Class C is recommended until further investigations are carried out.

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 absence of deep boreholes near the site has resulted in the use of the least preferred method. 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 is negligible at this site. It should be noted that the site is on a hill side sloping at approximately 20 to 30 degrees. However, risk of slope failure occurring on site is expected to be low. No tension cracks were noted during the external site walkover or on aerial photographs taken shortly after the 22 February 2011 earthquakes. Additional investigations would be required to confirm this assessment.

As all available ground investigation data was greater than 50 m away from the site, an estimation of the ground properties has not been provided in this report. Additional, investigations closer to the site would be required to perform a full quantitative DEE.

6.5 Further investigations

A ground investigation to determine the subsoil class is recommended as part of a quantitative DEE. This would require one borehole into 2 m of competent rock.

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.

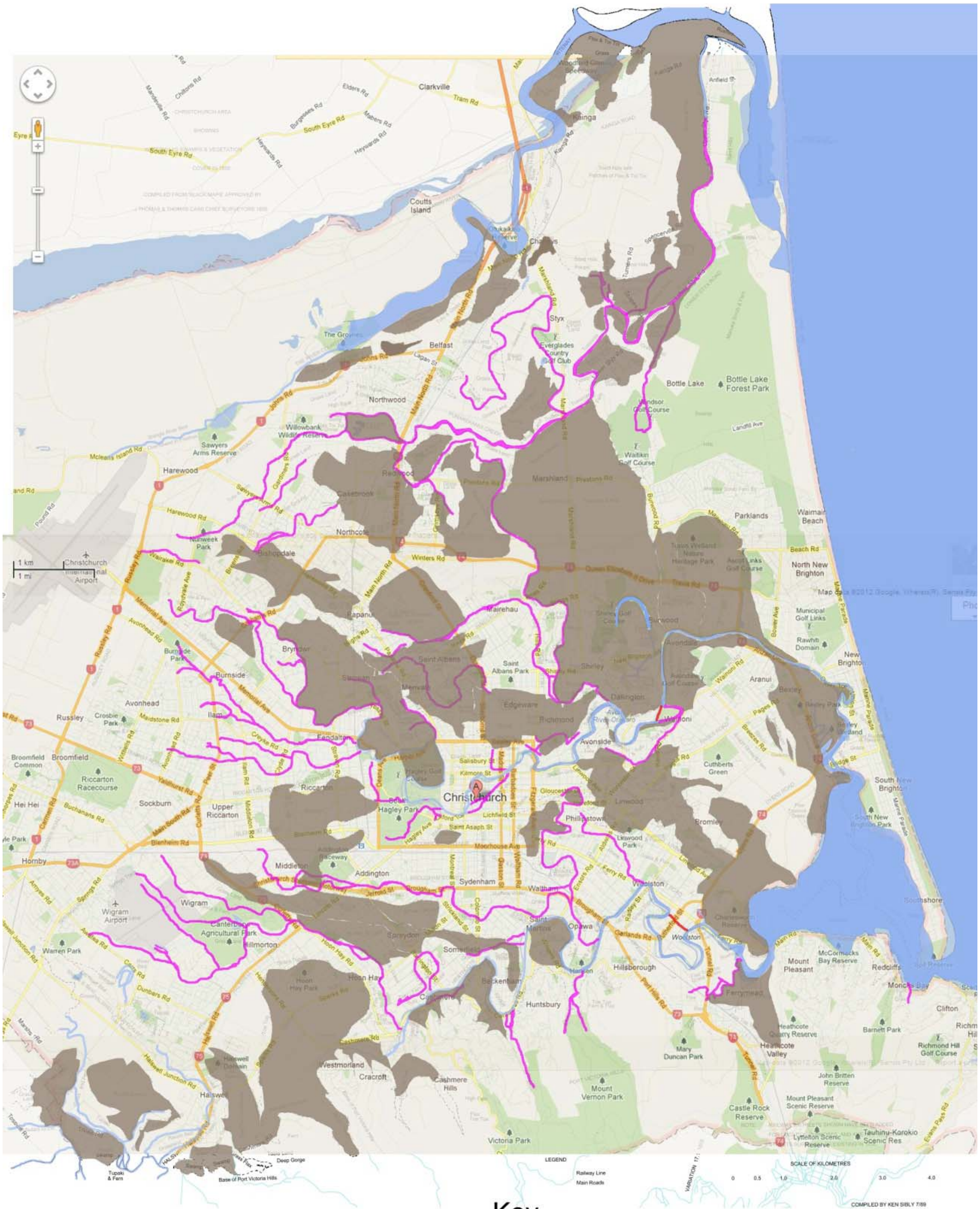
Cubrinovski & Taylor, 2011. Liquefaction map summarising preliminary assessment of liquefaction in urban areas following the 2010 Darfield Earthquake.

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

Borelog for well M36/10492

Gridref: M36:81645-37796 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 5.2 +MSD
Well name : CCC BorelogID 7512
Drill Method : Not Recorded
Drill Depth : -6.9m Drill Date : 19/07/2004

Environment Canterbury Regional Council

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
0 to -2		-2.00m	brown silt fill / minor rounded grey gravels	
-2 to -3		-3.00m	grey silt fill / timber / demolition debris	
-3 to -5.25		-5.25m	grey silt fill	
-5.25 to -6		-6.00m	greyish brown silt fill / grey rounded gravels	
-6 to -6.5		-6.50m	grey silt fill / rounded gravels	
-6.5 to -6.9		-6.90m	yellow / brown loess silt	

Scale: -0.2, -0.4, -0.6, -0.8, -1, -1.2, -1.4, -1.6, -1.8, -2, -2.2, -2.4, -2.6, -2.8, -3, -3.2, -3.4, -3.6, -3.8, -4, -4.2, -4.4, -4.6, -4.8, -5, -5.2, -5.4, -5.6, -5.8, -6, -6.2, -6.4, -6.6, -6.8

Borelog for well M36/10493

Gridref: M36:81646-37768 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 5.2 +MSD
Well name : CCC BorelogID 7513
Drill Method : Not Recorded
Drill Depth : -6.5m Drill Date : 19/07/2004

Environment Canterbury Regional Council

Depth(m)	Full Drillers Description	Formation Code
-1.50m	brown sandy silt / red brick fragments / greywacke	
-2.00m	grey sandy silt fill / gravels / red brick fragments	
-3.00m	grey silt fill / occasional greywacke gravels	
-4.25m	light & darker grey silt fill / minor brick fragments / ceramic pipe	
-5.50m	dark grey silt fill / red brick fragmetns	
-6.00m	sandy silt fill / red brick fragments	
-6.50m	brown loess silt	

Scale(m): -0.2, -0.4, -0.6, -0.8, -1, -1.2, -1.4, -1.6, -1.8, -2, -2.2, -2.4, -2.6, -2.8, -3, -3.2, -3.4, -3.6, -3.8, -4, -4.2, -4.4, -4.6, -4.8, -5, -5.2, -5.4, -5.6, -5.8, -6, -6.2, -6.4

Water Level

Appendix C – Geotechnical Investigation Summary

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

WW		1	2
Type *		WW	WW
Ref		M36/10492	M36-10493
Depth (m)		6.9	5.7
Distance from site (m)		284	170
Ground water level (mBGL)			
Simplified recorded geological profile (depth below ground level to top of stratum, m)	0	Fill	Fill
	1	Fill	Fill
	2	Fill	Fill
	3	Fill	Fill
	4	Fill	Fill
	5	Fill	Fill
	6		
	7		
	8		
	9		
	10		

*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

Loess; 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