Christchurch City Council

Concord Place Housing Complex BE 1063

Detailed Engineering Evaluation

Quantitative Assessment Report

Christchurch City Council

Concord Place Housing Complex

Quantitative Assessment Report

Burwood, Christchurch

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Summary

Concord Place Housing Complex
BE 1063

Detailed Engineering Evaluation
Quantitative Report - Summary
Final

Background
This is a summary of the quantitative report for the Concord Place Housing Complex, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This assessment covers the 52 residential units, the residents lounge and the block of 10 storage garages.

Key Damage Observed
No damage was observed to have been sustained by the garages or the residents lounge.

The residential units suffered minor-to-moderate damage to non-structural elements. This included cracking of foundation slabs and footpaths and cracking of brick and block veneers.

Structural damage to the residential units was generally minor and was limited to the cracking of the wall and ceiling linings and concrete ground slabs in some of the residential units. One unit required propping of a roof beam that was in danger of becoming unseated due to wall movement.

Critical Structural Weaknesses
No critical structural weaknesses were found in any of the buildings.

Indicative Building Strength
No buildings on the site are considered to be earthquake prone.

The storage garages have a capacity of 61% NBS as limited by the in-plane capacity of their front wall. The residents lounge has a capacity of 97% NBS. The residential units have capacities ranging from 49% to 65% NBS and are limited by the in-plane shear capacity of the lined timber-framed shear walls.

Recommendations
It is recommended that all buildings with an assessed capacity less than 67% NBS be strengthened to at least 67% NBS.

A geotechnical site investigation be carried out to determine the liquefaction potential of the site and the shallow bearing capacities of the soils, if this information is required for future construction on the site.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by Christchurch City Council to undertake a detailed seismic assessment of the Concord Place Housing Complex, located at Concord Place, Burwood, Christchurch following the Canterbury Earthquake Sequence since September 2010.

The purpose of the assessment is to determine if the buildings in the village are classed as being earthquake prone in accordance with the Building Act 2004.

The seismic assessment and reporting have been undertaken based on the qualitative and quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) [3] [4].

2 Compliance

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

2.1 Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

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

We understand that CERA 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). CERA have adopted the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011. This document sets out a methodology for both initial qualitative and detailed quantitative assessments.

It is anticipated that a number of factors, including the following, will determine the extent of evaluation and strengthening level required:

1. The importance level and occupancy of the building.

2. The placard status and amount of damage.
3. The age and structural type of the building.
4. Consideration of any critical structural weaknesses.

Christchurch City Council requires any building with a capacity of less than 34% of New Building Standard (including consideration of critical structural weaknesses) to be strengthened to a target of 67% as required under the CCC Earthquake Prone Building Policy.

2.2 Building Act

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

Section 112 - Alterations

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

The Earthquake Prone Building policy for the territorial authority shall apply as outlined in Section 2.3 of this report.

Section 115 – Change of Use

This section requires that the territorial authority is satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'.

This is typically interpreted by territorial authorities as being 67% of the strength of an equivalent new building or as near as practicable. This is also the minimum level recommended by the New Zealand Society for Earthquake Engineering (NZSEE).

Section 121 – Dangerous Buildings

This section was extended by the Canterbury Earthquake (Building Act) Order 2010, and defines a building as dangerous if:

1. 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
2. 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
3. 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
4. There is a risk that other property could collapse or otherwise cause injury or death; or

5. A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone (EPB) 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 loads 33% of those used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in October 2011 following the Darfield Earthquake on 4 September 2010.

1. The policy includes the following:
2. A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
3. A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
4. A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
5. 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.

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.

Where an application for a change of use of a building is made to Council, the building will be required to be strengthened to 67% of New Building Standard or as near as is reasonably practicable.

2.4 Building Code

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

On 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- increase in the basic seismic design load for the Canterbury earthquake region (Z factor increased to 0.3 equating to an increase of 36 – 47% depending on location within the region);
- Increased serviceability requirements.

2.5 Institution of Professional Engineers New Zealand (IPENZ) Code of Ethics

One of the core ethical values of professional engineers in New Zealand is the protection of life and safeguarding of people. The IPENZ Code of Ethics requires that:

Members shall recognise the need to protect life and to safeguard people, and in their engineering activities shall act to address this need.

1.1 Giving Priority to the safety and well-being of the community and having regard to this principle in assessing obligations to clients, employers and colleagues.

1.2 Ensuring that responsible steps are taken to minimise the risk of loss of life, injury or suffering which may result from your engineering activities, either directly or indirectly.

All recommendations on building occupancy and access must be made with these fundamental obligations in mind.

3 Earthquake Resistance Standards

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The loadings are in accordance with the current earthquake loading standard NZS1170.5 [1].

A generally accepted classification of earthquake risk for existing buildings in terms of %NBS that has been proposed by the NZSEE 2006 [2] is presented in Figure 1 below.

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

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

Table 1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year).

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

3.1 Minimum and Recommended Standards

Based on governing policy and recent observations, Opus makes the following general recommendations:

3.1.1 Occupancy

The Canterbury Earthquake Order[1] in Council 16 September 2010, modified the meaning of "dangerous building" to include buildings that were identified as being EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the

[1] This Order only applies to buildings within the Christchurch City, Selwyn District and Waimakariri District Councils authority.

Territorial Authority, or CERA acting on their behalf, once they are made aware of our assessment. Based on information received from CERA to date and from the DBH guidance document dated 12 June 2012 [6], this notice is likely to prohibit occupancy of the building (or parts thereof), until its seismic capacity is improved to the point that it is no longer considered an EPB.

3.1.2 Cordoning

Where there is an overhead falling hazard, or potential collapse hazard of the building, the areas of concern should be cordoned off in accordance with current CERA/territorial authority guidelines.

3.1.3 Strengthening

Industry guidelines (NZSEE 2006 [2]) strongly recommend that every effort be made to achieve improvement to at least 67%NBS. A strengthening solution to anything less than 67%NBS would not provide an adequate reduction to the level of risk.

It should be noted that full compliance with the current building code requires building strength of 100%NBS.

3.1.4 Our Ethical Obligation

In accordance with the IPENZ code of ethics, we have a duty of care to the public. This obligation requires us to identify and inform CERA of potentially dangerous buildings; this would include earthquake prone buildings.

4 Background Information

4.1 Building Descriptions

The site contains 52 residential units, a residents lounge and a block of 10 storage garages. The units are numbered 1 to 53 (there is no unit 13). A site plan showing the locations of the units, residents lounge and garages is shown in Figure 3. Figure 2 shows the location of the site in Christchurch City. The units are grouped together in twos to form 'sub-blocks' with groups of 1, 2 or 3 sub-blocks forming blocks of 2, 4 or 6 units respectively.

The units and sub-blocks are separated by ungrouted, 190mm block masonry fire walls which (based on information available for other similar blocks of the same era) are partially filled with reinforcement to their perimeters. We note that the screen walls, in line with the block party walls, are likely to be two wythes of veneer tied together.

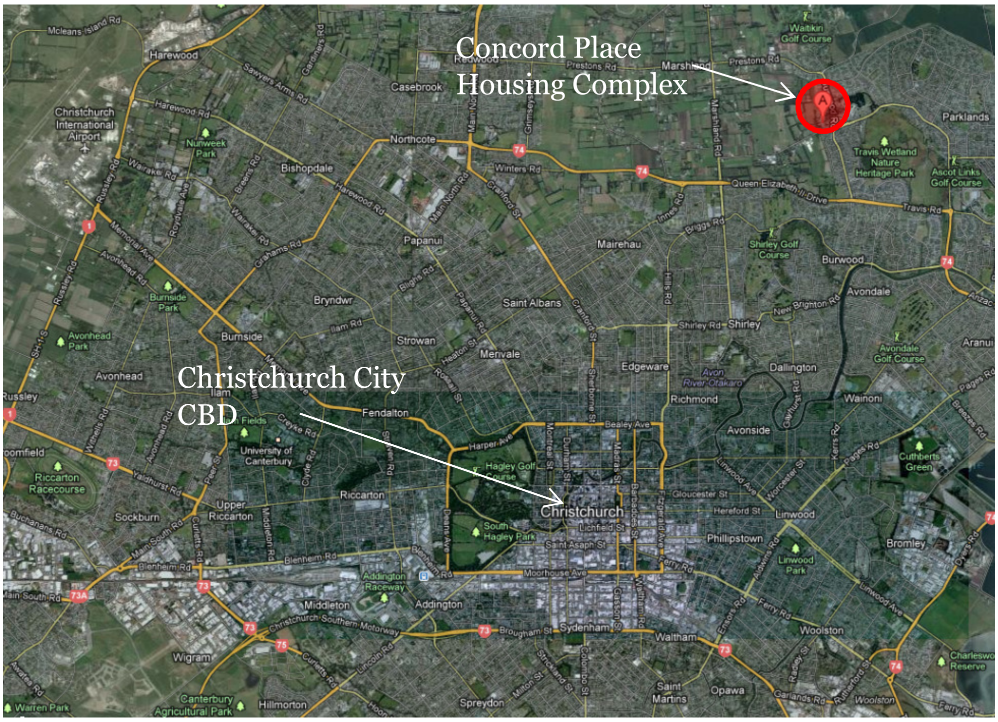


Figure 2: Location of site relative to Christchurch City CBD.

Figure 3: Site plan of Concord Place Housing Complex.

The residential units and the residents lounge are timber-framed buildings with timber roof trusses supporting light-weight metal roofs. Walls and ceilings are lined with GIB and GIB/pinex respectively. Cladding above and below windows is light-weight harditex-type cladding with the remaining wall areas clad with either brick veneer or block veneer. Foundations are concrete pads. Figure 4 shows the floor plan of the residents lounge produced from site measurements by Opus. Figure 5 shows a typical floor plan of a block of residential units produced from site measurements by Opus.

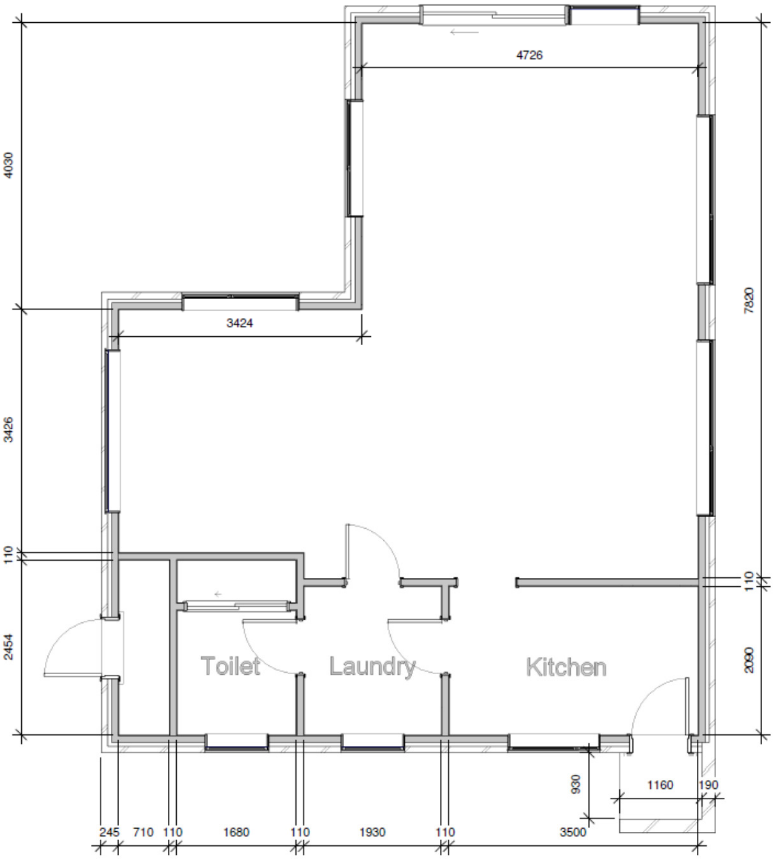


Figure 4: Floor plan of the residents lounge.

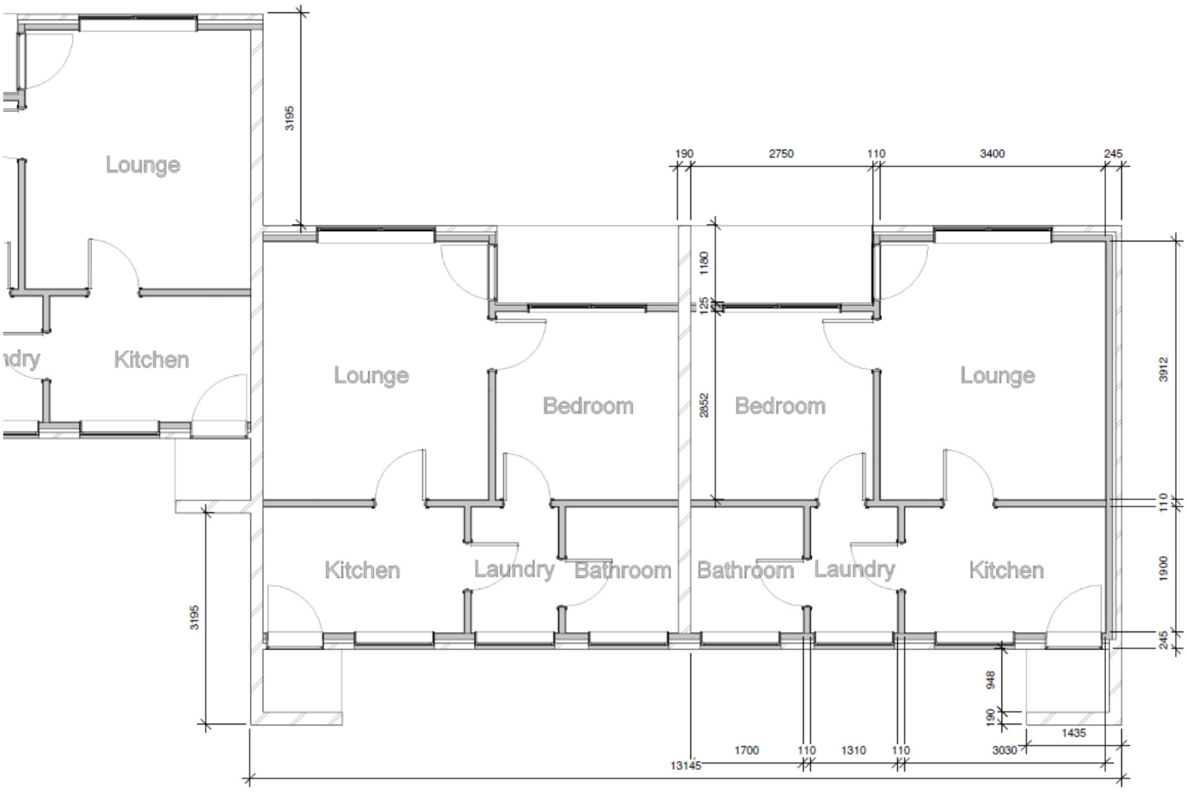


Figure 5: Partial floor plan of residential unit blocks.

The storage garages are made from pre-cast concrete panels bolted into a concrete pad foundation. The roof is a light-weight metal roof supported on timber framing spanning between the garage walls. Figure 6 shows a typical cross-section through the garages.

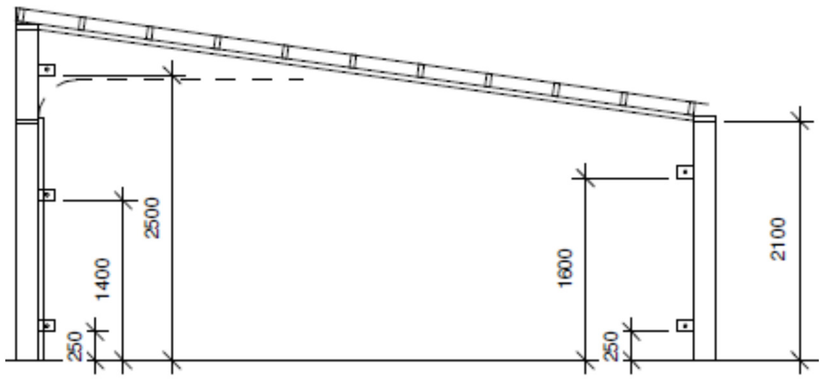


Figure 6: Cross-section through the storage garages.

A definitive date for the construction of the residential units and the garages is unknown. It is anticipated that they were constructed in the 1970's and 1990's respectively. The residents lounge was constructed in the early 1980's.

4.2 Survey

4.2.1 Post 22 February 2011 Rapid Assessment

A structural (Level 1) assessment of the buildings/property was undertaken on March 3rd, 2011 by Opus International Consultants. Minor cracking to building veneers was observed as well as cracks in the footpaths and driveways. A summary of the damage to the buildings is provided in section 5.

4.2.2 Further Inspections

A structural (Level 2) assessment of units 12 and 14 was undertaken on May 27th, 2011 by Opus International Consultants. These units were observed during the Level 1 assessment to have suffered the greatest damage and so further investigation was deemed necessary. A summary of the damage to the units is provided in section 5.

4.2.3 Level Survey

A level survey of the buildings was undertaken in August/September 2012. For the results refer to Opus letter report dated 5 December 2012, "Concord Place CCC Social Housing insurance settlement claim with EQC Report and Costings".

4.2.4 Geotechnical Survey

Geotechnical site walkovers were conducted on August 20th 2012 and September 9th 2012 to supplement a geotechnical desktop study. A summary of the geotechnical findings is given in section 7.

4.3 Original Documentation

Copies of the following construction drawings were provided by CCC:

- Plans, elevations, sections and details for the construction of the residents lounge. It is noted that the residents lounge appears to have had an extension added after its original construction; no drawings were provided for this extension.

The drawings have been used to confirm the structural systems, investigate potential critical structural weaknesses (CSW) and identify details which required particular attention.

Copies of the design calculations were not provided.

5 Structural Damage

This section outlines the damage to the buildings that was observed during site visits. It is not intended to be a complete summary of the damage sustained by the buildings due to the earthquakes. Some forms of damage may not be noticeable during a visual inspection due to being 'hidden' behind cladding, interior linings, etc.

For a summary of damage, refer also to Opus letter report dated 5 December 2012, "Concord Place CCC Social Housing insurance settlement claim with EQC Report and Costings".

Overall, Units 12 and 14 appeared to have suffered the highest levels of damage with noticeable damage also observed around the units in the centre of the village (Units 28-45).

5.1 Residual Displacements

The results of the level survey indicate the possibility of ground settlement due to the earthquakes.

5.2 Foundations

The floor slab of Unit 14 has an approximately 20mm wide crack. A 1-5mm wide crack is present in the slab between units 40 and 41. Foundation damage was not observed in the other buildings.

5.3 Primary Gravity Structure

A roof beam in Unit 14 required propping as it had shifted approximately 25mm, causing seating to become an issue.

5.4 Primary Lateral-Resistance Structure

Some cracking of ceiling diaphragms was observed in Units 12 and 14. Cracking of GIB-lined walls was observed in Units 7, 8, 10, 12 and 32.

5.5 Non Structural Elements

A 40mm deformation in the footpath at a corner of Unit 5 and Unit 11 was observed. The pavement at Unit 39 has displaced from the floor slab by around 20mm.

A broken clay stormwater drain was observed outside of Unit 39.

The external wall joint between Units 12 and 14 appears to have separated about 10mm. This separation was also noticed on the interior of the units where the ceiling has come away from the masonry block firewalls. It is anticipated that there was no fixing across this joint prior to the earthquakes. Similar cracking was observed between Units 43 and 44.

Cracking of the mortar in the brick/block cladding of Units 13, 15, 34, 37, 38, 40, 41, 42 and 43 was observed.

6 Detailed Seismic Assessment

The detailed seismic assessment has been based on the NZSEE 2006 [2] guidelines for the "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes" together with the "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure" [3] draft document prepared by the Engineering Advisory Group on 19 July 2011, and the SESOC guidelines "Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes" [5] issued on 21 December 2011.

As the majority of the residential units (all but Units 1 and 2) have the same floor plan, the analysis was simplified by conducting the analysis of each multi-unit block once for each cladding type (brick veneer or block veneer).

6.1 Critical Structural Weaknesses

The term Critical Structural Weakness (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of a building. During the initial qualitative stage of the assessment the following potential CSW's were identified for each of the buildings and have been considered in the quantitative analysis.

No critical structural weaknesses were identified in the buildings.

6.2 Quantitative Assessment Methodology

The assessment assumptions and methodology have been included in Appendix 3. A brief summary follows:

Hand calculations were performed to determine seismic forces from the current building codes. These forces were distributed to walls by tributary area and relative rigidity. The capacities of the walls were calculated and used to estimate the % NBS. Where sections within the same block were constructed at separate times (such as the extension to the residents lounge), they were analysed as separate structures.

6.3 Limitations and Assumptions in Results

Our analysis and assessment is based on an assessment of the building in its undamaged state. Therefore the current capacity of the building may be lower than that stated.

The results have been reported as a %NBS and the stated value is that obtained from our analysis and assessment. Despite the use of best national and international practice in this analysis and assessment, this value contains uncertainty due to the many assumptions and simplifications which are made during the assessment. These include:

- Simplifications made in the analysis, including boundary conditions such as foundation fixity.
- Assessments of material strengths based on limited drawings, specifications and site inspections
- The normal variation in material properties which change from batch to batch.
- Approximations made in the assessment of the capacity of each element, especially when considering the post-yield behaviour.

6.4 Assessment

A summary of the structural performance of the buildings is shown in the following tables. Note that the values given represent the worst performing elements in the building, where these effectively define the building's capacity. Other elements within the building may have significantly greater capacity when compared with the governing elements. This will be considered further when developing the strengthening options.

Table 2: Summary of Seismic Performance

Structural Element/System	Failure Mode, or description of limiting criteria based on displacement capacity of critical element.	% NBS based on calculated capacity.
Storage Garages	Bracing capacity of front shear walls in longitudinal direction.	61%
Residents Lounge	Bracing capacity of shear walls in E-W direction.	97%
Units 1-2	Bracing capacity of internal shear wall between the bedroom and the lounge.	65%
Units 3-6	Bracing capacity of shear walls in the front of the bedroom and the lounge.	49%
Units 7-10	Bracing capacity of shear walls in the front of the bedroom and the lounge.	54%

Units 11-12 & 14-15	Bracing capacity of shear walls in the front of the bedroom and the lounge.	49%
Units 16-19	Bracing capacity of shear walls in the front of the bedroom and the lounge.	54%
Units 20-23	Bracing capacity of shear walls in the front of the bedroom and the lounge.	49%
Units 24-27	Bracing capacity of shear walls in the front of the bedroom and the lounge.	54%
Units 28-33	Bracing capacity of shear walls in the front of the bedroom and the lounge.	54%
Units 34-39	Bracing capacity of shear walls in the front of the bedroom and the lounge.	49%
Units 40-45	Bracing capacity of shear walls in the front of the bedroom and the lounge.	54%
Units 46-49	Bracing capacity of shear walls in the front of the bedroom and the lounge.	54%
Units 50-53	Bracing capacity of shear walls in the front of the bedroom and the lounge.	54%

Figure 7 and Figure 8 show the locations of the critical walls in the residential units.

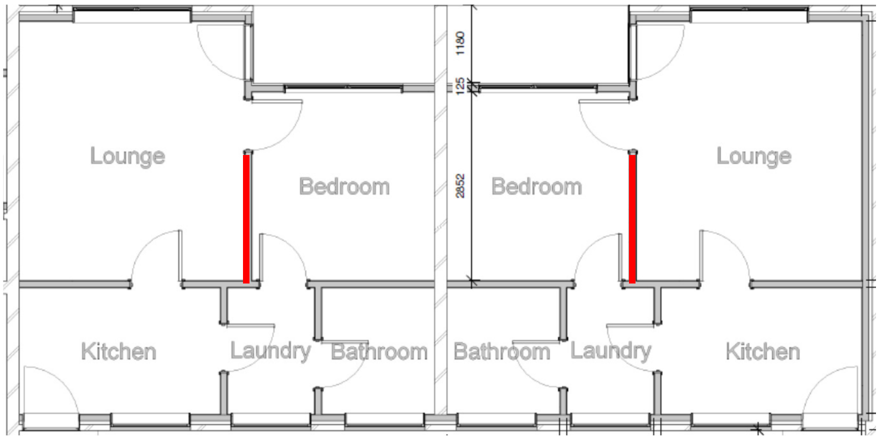


Figure 7: Critical wall for lateral capacity (shown in red) - Units 1 & 2.

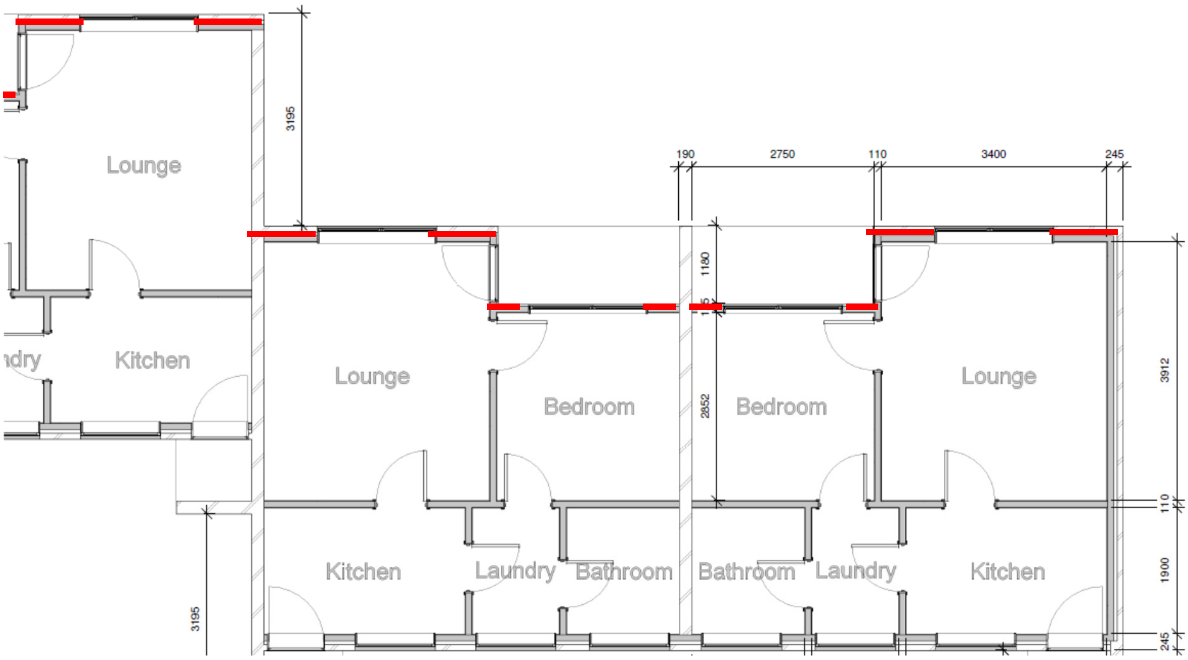


Figure 8: Critical wall for lateral capacity (shown in red) - Units 3 to 53.

7 Summary of Geotechnical Appraisal

7.1 General

The nearest Cone Penetrometer Test (CPT) reference no. CPT-BUR-104 was undertaken 200m south of the site on behalf of the Earthquake Commission (EQC). The CPT is likely to be located on different geological strata to the site.

Well records are also available from Environment Canterbury (ECan) for two wells in the Burwood Hospital; M35/5830 and M35/1499 which are both located approximately 285 m east of the site. According to the geological map the well records are located on the same geology as the site and indicate the presence of sand to 30 m depth, which overlay 'blue clay' and peat to 32 m depth which in turn lie on gravels to 43 to 45 m.

Groundwater was encountered in the wells between 4.6 and 5.84 m below ground level (BGL). The well record from M35/1499 drilled in 1903 and M35/5830 drilled in 1988 both note the wells tap a 'flowing artesian' aquifer type, expected to be the Riccarton Gravel Formation.

The well records from M35/1499 and M35/5830, as well as the information from the Geology of Christchurch by Brown and Weeber (1992) have been used to infer the anticipated ground conditions at the site, are shown in Table 3.

Table 3: Inferred Ground Conditions.

Stratigraphy	Thickness (m)	Depth Encountered from (m) below ground, based on well M35/1499
TOPSOIL	0.2-0.5	0
BROWN SAND	8.00	0.2-
Grey SAND with traces of peat	8.2	8.
Grey SAND with some shells	13.8	16.4
Blue CLAY	4.0	30.4
PEAT	1.0	34.4
GRAVEL (Riccarton)	10	35.4

The groundwater level was initially recorded as 4.6 to 5.84 BGL in well records. On the basis of the topography a similar level could be anticipated at Concord Place.

7.2 Liquefaction Potential

Examination of post-earthquake aerial photos taken from aerial mapping (Project Orbit) did not show any evidence of liquefaction ejected material on the site. This concurs with anecdotal information offered from residents, who did not observe any liquefaction ejected material during any of the earthquake events between 4 September 2010 and 23 December 2011.

Following the recent strong earthquakes in Canterbury, CERA has zoned land in the greater Christchurch area according to its ground performance in future large earthquakes. The residential properties surrounding Concord Place to the east south and north, facing onto Burwood Road, Mairehau Road and Serama Place, are zoned "Yellow" (TC2) which are evaluated as having minor to moderate land damage from liquefaction in future large earthquakes.

Concord Place has not been zoned by the MBIE as they are not privately owned residences. The nearest CPT tests (CPT-BUR-104, CPT-BUR-101 and CPTBUR-97) were all undertaken in deposits of the Christchurch Formation 'sand silt and peat of drained lagoons' or Yaldhurst Member of the Springston Formation 'peat swamps now drained'. Properties at these locations have been categorised as being in the "Blue Zone" (TC3).

At present there is insufficient data to make a quantified assessment of the liquefaction potential at Concord Place. Site specific investigations comprising of approximately 6 CPT's to a depth of 20m are recommended to be undertaken to enable a site wide liquefaction assessment.

7.3 Summary

As a result of the 4th September 2010 Canterbury Earthquake and the following aftershocks; cracking, with possible settlement had occurred in some Units in Concord Place. No surface expression of liquefaction occurred within the site.

Ground damage to the Units appears to be limited mainly to a central zone which includes Unit blocks 11 to 15, 34 to 39 and 40 to 45.

Evidence of cracking in the floor slabs was observed inside Unit 12 on a visit on 20/8/12. No evidence of cracking of the externally exposed floor slabs was observed on the site visit of 13/9/12. No internal inspection of floor slabs was undertaken on the site visit of 13/9/12.

The differential settlement recorded in the level survey may be attributed to a temporary loss of bearing capacity during the seismic shaking. Shallow investigations including Hand Augers and Scalas should be undertaken to confirm the static bearing capacity of the underlying material around the perimeter of the affected Units.

In general the existing shallow foundations have performed well in the recent seismic events, and would appear to be suitable for the site subject to confirmation of the density of the underlying soil strata.

7.4 Further Work

It is recommended that the ground conditions at the site are confirmed by a ground investigation, as a consequence of the distance of Concord Place to existing CPTs and boreholes. To provide information on the ground conditions, which focuses specifically on the observed area of concern in the centre of the site, it is recommended that the following investigation is undertaken:

- Four hand auger/Scala probes are undertaken surrounding the block of Units 11 to 15 to assess the bearing capacity of the underlying material.
- Six Cone Penetrometer Tests to a depth of 20 m be undertaken to confirm the overall ground conditions of the site.
- Four Localised hand excavations to inspect the conditions of the footings in the central area of the site.

8 Conclusions

- None of the buildings on site are considered to be Earthquake Prone.
- The Residents Lounge has a capacity of 97% NBS and is therefore deemed to be a 'low risk' building in a design seismic event according to NZSEE guidelines. It's level of risk is 1-2 times that of a 100% NBS building (Figure 1)

- The storage garages have a capacity of 61% NBS, as limited by the in-plane capacity of the front wall of the building. They are deemed to be a 'moderate risk' in a design seismic event according to NZSEE guidelines. Their level of risk is 5-10 times that of a 100% NBS building (Figure 1).

- The residential units have capacities ranging from 49% - 65% NBS, as limited by the in-plane shear capacity lined shear walls. They are deemed to be a 'moderate risk' in a design seismic event according to NZSEE guidelines. Their level of risk is 5-10 times that of a 100% NBS building (Figure 1).

- Based on the geotechnical appraisal, differential settlement as a result of liquefaction could result in further damage, similar in nature to that which has occurred in the recent earthquake sequence. However, based on the nature of construction, this is unlikely to result in the collapse of concrete ground beams beneath the blockwork and masonry walls.

9 Recommendations

- A strengthening works scheme be developed to increase the seismic capacity of all buildings rated less than 67% NBS to at least 67% NBS, this will need to consider compliance with accessibility and fire requirements.

- A geotechnical site investigation be carried out to determine the liquefaction potential of the site and the shallow bearing capacities of the soils if this information is required for future construction on the site.

10 Limitations

- This report is based on an inspection of the buildings and focuses on the structural damage resulting from the 22nd February Canterbury Earthquake and its subsequent aftershocks only. Some non-structural damage may be described but this is not intended to be a complete list of damage to non-structural items.

- Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time.

- This report is prepared for the Christchurch City Council to assist in the assessment of any remedial works required for the Concord Place retirement village. It is not intended for any other party or purpose.

11 References

[1] NZS 1170.5: 2004, Structural design actions, Part 5 Earthquake actions, Standards New Zealand.

[2] NZSEE (2006), Assessment and improvement of the structural performance of buildings in earthquakes, New Zealand Society for Earthquake Engineering.

[3] Engineering Advisory Group, Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure, Draft Prepared by the Engineering Advisory Group, Revision 5, 19 July 2011.

[4] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Non-residential buildings, Part 3 Technical Guidance*, Draft Prepared by the Engineering Advisory Group, 13 December 2011.

[5] SESOC (2011), Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes, Structural Engineering Society of New Zealand, 21 December 2011.

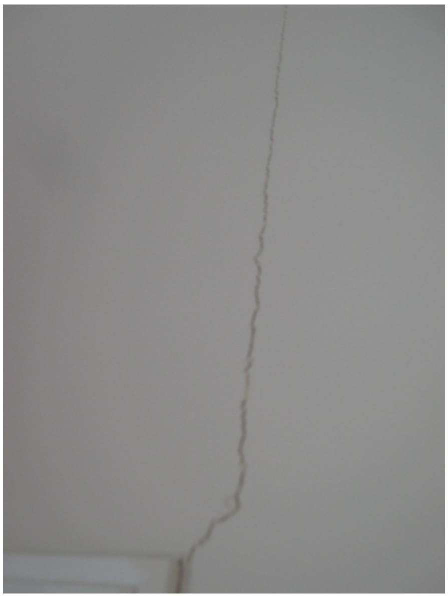
[6] DBH (2012), Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch, Department of Building and Housing, June 2012.

Appendix 1 - Photographs

Site Name		
No.	Item description	Photo
Garage Block		
1	Front Wall	
2	Interior	

Residents Lounge		
3	Western Side	
4	Eastern Side	
5	Southern Side	

Residental Units		
6	Units 1-2	
7	Units 3-6	
8	Units 7-10	

9	Unit 7; damage to wall lining around door frame.	
10	Units 11-12 and 13-14	
11	Unit 12; damage to floor slab.	

12	Units 12 and 14; separation.	
13	Units 16-19	
14	Units 20-23	

15	Units 24-27	
16	Units 28-33	
17	Units 34-39	

18	Unit 38; damage to block veneer.	
19	Units 40-45	
20	Units 50-53	

Appendix 2 - Geotechnical Appraisal

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30 November 2012

Matt Cummins
Project Manager
Capital Programme Group
Christchurch City Council
PO Box 2522
Christchurch

6-QUCC1.76 005SC

Dear Matt

Concord Place Burwood - Geotechnical Desk Study

1 Introduction

Christchurch City Council (CCC) has requested Opus International Consultants (Opus) to provide a geotechnical desk study and walkover inspection of Concord Place Residential Housing Units following the Canterbury Earthquake Sequence initiated by the 4 September 2010 earthquake.

The purpose of the geotechnical study is to assess the current ground conditions, the potential geotechnical hazards that may be present at the site, and determine whether further subsurface geotechnical investigations are necessary.

This Geotechnical Desk Study forms part of a Detailed Engineering Evaluation prepared by Opus, and has been undertaken without the benefit of any site specific investigations and is therefore preliminary in nature.

2 Desktop Study

2.1 Site Description

The Concord Place Residential Housing Units are situated approximately 5 km north-east of Christchurch City 50 m to the west of the Burwood Road / Mairehau Road intersection, on the north side of Mairehau Road, in the suburb of Burwood. It is a relatively flat site, although the ground rises up at the northern boundary, north of house Units 24 to 27. A retaining wall approximately 1 m high is located at the northern part of the site (Figure 1). The ground slopes away from the site on the western boundary.

The housing development was constructed in the late 1960s / early 1970s and comprises 53 units of a single storey configuration. The Units are joined together in blocks of 4 or 6 units (Figure 1). The site also contains a single storey resident's lounge which was added in the 1980s, and a block of 10 single garages. The units are timber framed with either concrete block (e.g. Units 34-39 and 28-33) or brick veneer (e.g. Units 34-39 and 40-45) walls with a concrete floor slab on grade. The glazing has metal frames. The roof construction is steel sheeting.

The units are open without boundary fences. The communal garden is grassed, with concrete paths joining the flats. The flats have small gardens beneath the windows.

2.2 Available Building Drawings

Plan drawings of the Units showing external and internal walls, were provided by Opus (Drawing Nos. 6/1366/287/2604 sheets 1 to 57). The drawings have floor spot levels and verticality of the firewalls. The difference in spot levels within each room was noted as a possible indication of potential liquefaction induced differential settlement and subsidence. The condition of the units prior to the earthquakes is unknown. No drawings showing the construction details of the units were available.

2.3 Regional Geology

The published geological map of the area, (Geology of the Christchurch Urban Area 1:25,000, Brown and Weeber, Map 1, 1992) indicates the site is predominantly located on sand of fixed and semi-fixed dunes and beaches belonging to the Christchurch Formation. The geological map shows that the north western extremity of the site may extend to peat swamps (now drained) belonging to the Yaldhurst member of the Springston Formation. An extract of the geological map is shown on Figure 3 in Appendix B.

2.4 Expected Ground Conditions

The nearest Cone Penetrometer Test (CPT) reference no. CPT-HIS-0496 and CPT-HIS-0502 was undertaken within 200m on behalf of the Earthquake Commission (EQC) shown on Figure 2, Appendix B. The CPT is likely to be located on different geological strata to the site.

Well records are also available from Environment Canterbury (ECan) for two wells in the Burwood Hospital; M35/5830 and M35/1499 which are both located approximately 285 m east of the site (Figure 2). According to the geological map (Figure 3) the well records are located on the same geology as the site and indicate the presence of sand to 30 m depth, which overly 'blue clay' and peat to 32 m depth which in turn lie on gravels to 43 to 45 m.

Groundwater was encountered in the wells between 4.6 and 5.84 m below ground level. The well record from M35/1499 drilled in 1903 and M35/5830 drilled in 1988 both note the wells tap a 'flowing artesian' aquifer type, expected to be the Riccarton Gravel Formation.

The well records from M35/1499 and M35/5830, as well as the information from the Geology of Christchurch by Brown and Weeber (1992) have been used to infer the anticipated ground conditions at the site, are shown in Table 1 below:

Table 1: Inferred Ground Conditions

Stratigraphy	Thickness (m)	Depth Encountered from (m) below ground,
TOPSOIL	0.2-0.5	0
BROWN SAND	8.00	0.2
Grey SAND with traces of peat	8.2	8.0
Grey SAND with some shells	13.8	16.4
Blue CLAY	4.0	30.4
PEAT	1.0	34.4
GRAVEL (Riccarton)	-	32 - 35

The groundwater level was initially recorded as 4.6 to 5.84 bgl in well records. On the basis of the topography a similar level could be anticipated at Concord Place.

2.5 Liquefaction Hazard

Examination of post-earthquake aerial photos taken by New Zealand Aerial Mapping (Project Orbit) did not show any evidence of liquefaction ejected material on the site. This concurs with anecdotal information offered from residents, who did not observe any liquefaction ejected material during any of the earthquake events between 4 September 2010 and 23 December 2011.

Following the recent strong earthquakes in Canterbury, the Canterbury Earthquake Recovery Authority (CERA, 2012) has zoned land in the greater Christchurch area according to its ground performance in future large earthquakes.

The residential properties surrounding Concord Place to the east, south and north, facing onto Burwood Road, Mairehau Road and Serama Place, are zoned "Yellow" (TC2) which are evaluated as having minor to moderate land damage from liquefaction in future large earthquakes. Figure 2 summarises the Technical Category Zones defined by the Department of Building and Housing (Now part of the Ministry of Business Innovation and Employment (MBIE)).

Concord Place has not been zoned by the MBIE as they are not privately owned residences. The nearest CPT tests (CPT-BUR-104, CPT-BUR-101 and CPT-BUR-97) were all undertaken in deposits of the Christchurch Formation 'sand silt and peat of drained lagoons' or Yaldhurst Member of the Springston Formation 'peat swamps now drained'. Properties at these locations have been categorised as being in the "Blue Zone" (TC3). (see Figure 2).

At present there is insufficient site specific data to make a quantified assessment of the liquefaction potential at Concord Place.

3 Site Walkover Inspection

A walkover inspection of the exterior of the buildings and surrounding land at Concord Place was carried out by an Opus Geotechnical Engineer on 13 September 2012. The following observations were made (refer to the annotated Site Plan and Site Photographs attached to this report):

- **Units 1 to 10** had no notable signs of deformation on the external walls. Footpath showed displacement of 40mm at corner of Unit 5. (photo 1)

- **Unit No 9** was inspected inside. No evidence of significant displacement of the floor slab was noted, despite a level survey showing up to 1.8% gradient. There was no evidence of cracking on the exterior walls or floor slab.

- **Unit 11 to 15:** At Unit 12 an internal wall was displaced by up to an estimated 40 mm(viewed through the window only).The external wall join between Units 12 and 14 had a vertical crack of approximately 10 mm. (photo 2). The floor slab in Unit No. 12 had cracked, with a crack width of approximately 20 mm (photo 3 - from a visit on 29/8/12). The rear wall of Units 14 and 15 had a crack running through mortar down to the floor slab which itself appeared to have no cracking (photo 4). The footpath pavement was displaced by 40 mm adjacent to Unit 11 (photo 5).

- **Units 16 to 33** had no notable signs of deformation on the external walls or floor slabs**.** Horizontal displacement of a concrete footpath away from the floor slab at Unit 28. Was noted (photo 6).

- **Units 34 to 39:** The west wall of Unit 34 had cracks running through mortar. Symmetrical cracks were noted which run up from the centre of the wall from floor slab level to the low point of the roof on both sides. Cracks were noted in mortar below the window at Units 37 and 38 (photo 7). No cracks were observed in the floor slab. The concrete pavement had displaced from the floor slab at Unit 39 by about 20 mm (photo 8). A broken clay stormwater drain was observed outside 39 (photo 9).

- **Units 40 to 45:** Between Units 40 and 41 a 1 to 5mm wide crack runs from the floor slab (which appears not to be cracked) through bricks and mortar for 1 m.(photo 10). A crack was noted in the wall join between Units 44 and 43. Between Units 42 and 43 a crack runs from floor slab (which does not appear to be cracked) through bricks and mortar up to a window (photo 11). At Unit 41 severe cracks (up to 20 mm wide) are present in mortar at porch (photo 12 and 12a).

- **Units 46 to 53** had no visible signs of deformation on the external walls or floor slabs

- **Resident's Lounge** had no visible signs of deformation on the external walls or floor slabs

- **Garage Block** was only subject to a cursory examination where no visible defects were recorded (photo 13).

- **Retaining wall:** A concrete block retaining wall approximately 1 m high at the north end of the site, supporting higher ground to the north was examined for any movement. The wall appeared sound with no apparent cracks or displacement (photo 14).

4 Level Survey

A Level survey was undertaken by Opus Surveyors in late August / early September 2012. Maximum gradients measured were up to 1.8% recorded at Unit 9. Gradients greater than 0.5% were recorded in Units 8, 9, 12, 14, 43, 50, 51 and 53.

5 Discussion

As a result of the 4th September 2010 Canterbury Earthquake and the following aftershocks; cracking, with possible differential settlement has occurred in some Units at Concord Place. No surface expression of liquefaction occurred within the site.

Ground damage to the Units appears to be limited mainly to a central zone which includes Units 11 to 15, 34 to 39 and 40 to 45.

The buildings at the site are single storey and timber framed, with either concrete block or brick veneer walls.

Evidence of cracking in the floor slabs was observed inside Unit 12 on a previous visit on 20/8/12. No evidence of cracking of the externally exposed floor slabs was observed on the site visit of 13/9/12. No internal inspection of floor slabs was undertaken on the site visit of 13/9/12.

GNS Science indicates an elevated risk of seismic activity is expected in the Canterbury region as a result of the earthquake sequence following the 4 September 2010 earthquake. Recent advice (Geonet) indicates there is currently a 13% probability that a magnitude 6 or greater earthquake may occur in the next 12 months in the Canterbury region. Ground damage may occur in such an event, dependent on the location of the epicentre. It is expected that the probability of occurrence is likely to decrease with time, following periods of reduced seismic activity.

The differential settlement recorded in the level survey may be attributed to a temporary loss of bearing capacity during the seismic shaking. Shallow investigations including Hand Augers and Scalas should be undertaken to confirm the static bearing capacity of the underlying material around the perimeter of the affected Units.

In general the existing shallow foundations have performed well in the recent seismic events, and would appear to be suitable for the site, subject to confirmation of the density of the underlying soil strata.

If the existing affected Units are to be retained, a building consent will be necessary for remedial works. Remedial works may include re-levelling of Units 11 to 15, 34 to 39 and 40 to 45. Site specific investigations comprising of approximately 6 Cone Penetrometer Tests (CPT's) to a depth of 20m are recommended to be undertaken to enable a site wide liquefaction assessment (refer to Figure 4 in Appendix D) and combined with shallow investigations to identify the shallow bearing capacity of underlying soils.

6 Recommendations

It is recommended that in order to comply with the requirements of a building consent for the remedial works, a site specific investigation is undertaken including CPTs, test pits, hand augers and Scalas. The site investigation data will enable a liquefaction assessment to be undertaken. The investigation should focus on the observed area of ground damage in the centre of the site. The information obtained from the liquefaction assessment will help Christchurch City Council understand the future risk of liquefaction and potential ground damage. It is recommended that the following investigation is undertaken:

- Four hand auger/Scala probes are undertaken surrounding the block of Units 34 to 45 to assess the bearing capacity of the underlying material.

- Six Cone Penetrometer Tests to a depth of 20 m be undertaken to confirm the overall ground conditions of the site.

- Four localised test pits to inspect the condition of footings in the central area of the site.

7 Limitation

This report has been prepared solely for the benefit of Christchurch City Council as our client with respect to the particular brief given to us. Data or opinions in this desk study may not be used in other contexts, by any other party or for any other purpose.

It is recognised that the passage of time affects the information and assessment provided in this document. Opus's opinions are based upon information that existed at the time of the production of this Desk Study. It is understood that the Services provided allowed Opus to form no more than an opinion on the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings or any laws or regulations.

8 References

Brown, LJ; Webber, JH 1992: Geology of the Christchurch Urban Area. Scale 1:25,000. Institute of Geological and Nuclear Sciences geological map, 1 sheet + 104p.

http://ecan.govt.nz/services/online-services/tools-calculators/Pages/well-card.aspx

Project Orbit, 2011: Interagency/organisation collaboration portal for Christchurch recovery effort. https://canterburyrecovery.projectorbit.com/SitePages/Home.aspx

GNS Science reporting on Geonet Website: http://www.geonet.org.nz/canterbury-quakes/aftershocks/ updated on 9 September 2012.

Revised Guidance on repairing and rebuilding houses affected by the Canterbury earthquake sequence. Dept. of Building and Housing November 2011.

Appendices:

Appendix A: Site Photographs
Appendix B: Figure 1 Site Plan, Figure 2 Existing Borehole Locations, Figure 3 Site Geology
Appendix C: Surrounding Site Investigations
Appendix D: Figure 4 Site Investigation Plan

Yours sincerely

Opus Geotechnical Team

Appendix A:
Site Photographs

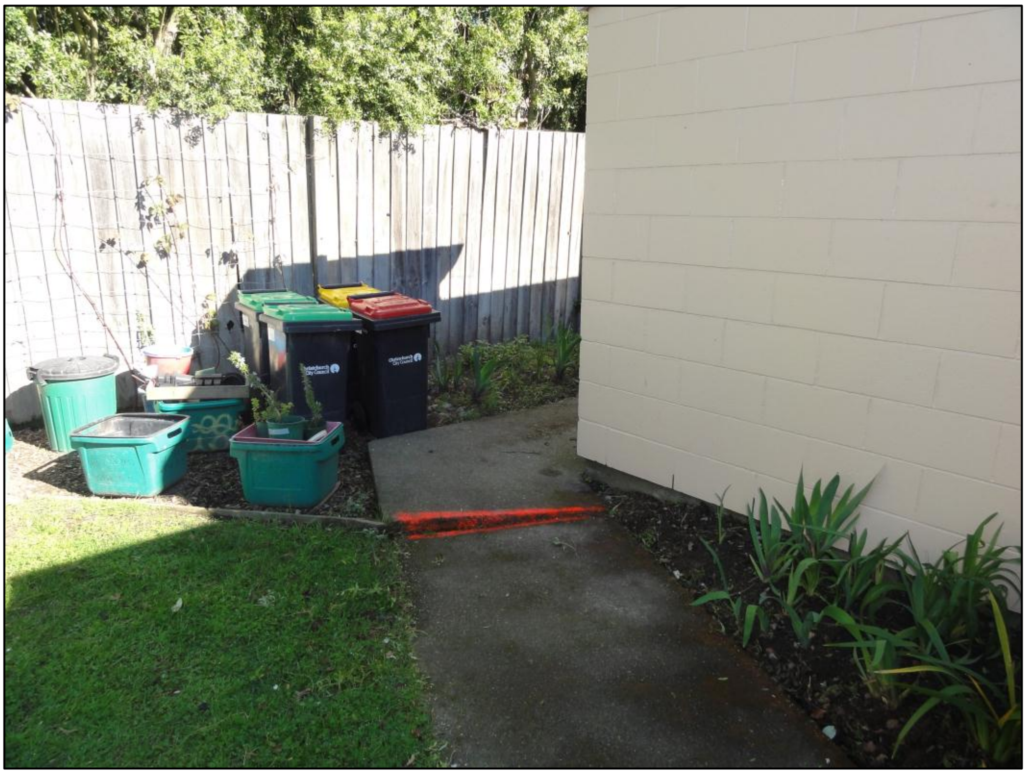

Photo 1 – Footpath displacement at SE corner of Unit No. 5

Photo 2 Vertical crack between No. 12 on left and No. 14 on right

Photo 3 Cracked floor slab inside Unit No. 12 (20 mm wide)

Photo 4 Step crack in the mortar of concrete masonry wall between Unit No. 15 (left) and Unit No. 14 (right)

Photo 5 Footpath displacement of approx. 40 mm to the south of No. 11

Photo 6 Footpath pulling away from Unit floor slab at No. 28 of 20 mm

Photo 7 Step crack in mortar, south side of No. 38

Photo 8 Footpath pulling away from Unit 39 floor slab. About 20 mm displacement horizontal and vertical (footpath up).

Photo 9 Broken 100 mm diameter clay drainage pipe east of Unit No. 39

Photo 10 Crack through mortar and bricks. Note intact floor slab. Unit No. 40 Left, Unit No. 41 Right.

Photo 11 Crack through mortar and bricks from floor slab to window. No cracking observed in floor slab. (South wall of No. 42).

Photo 12 and 12a Cracking in mortar from downpipe to doorway on the right. Unit No. 41 porch (Unit No 42 door on right).


Photo 13 Garage Block No obvious visible indication of movement


Photo 14 Retaining wall at north of site. No obvious visual indication of movement

Photo 15 View into Concord Place looking north from Mairehau Road

Appendix B:
Figure 1 Site Plan
Figure 2 Existing Borehole Locations
Figure 3 Site Geology

P1-15→ Photographs (with direction indicated by arrow) from Site walk over 13/9/12

0m 200m

SOURCE: CCC

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Project:	Concord Place Geotechnical Desktop Study
Project No.:	6-QUCC1.76
Client:	Christchurch City Council

Figure 1 Site Plan

Drawn: Opus Geotechnical Engineer

Date: 5/11/2012

CPT Borehole

Water well

EQC Borehole

TC3 Technical Category for residential areas

0 250 m

Scale: NTS

SOURCE: canterburyrecovery.projectorbit.com (Accessed on 19/09/12)

OPUS

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Project: Concord Place
Geotechnical Desktop Study

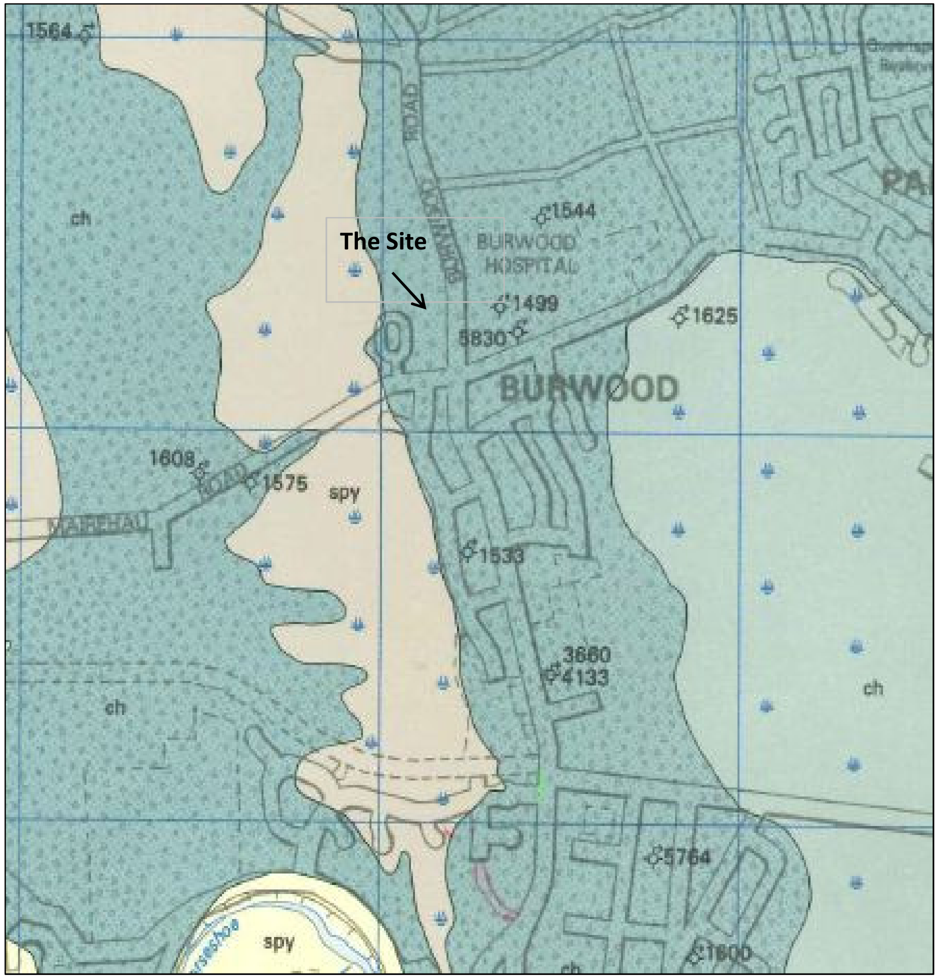
Project No.: 6-QUCC1.76

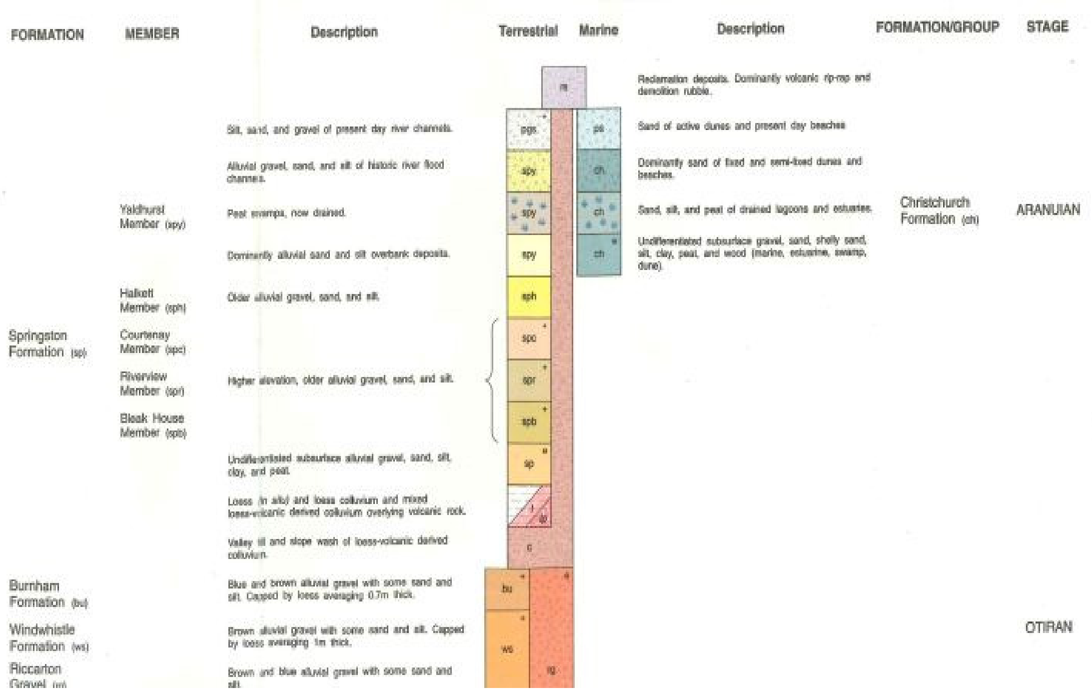
Client: Christchurch City Council

Figure 2 Existing Borehole Locations

Drawn: Opus Geotechnical Engineer

Date: 5/11/2012





Scale: **Not to scale**

SOURCE: NZGNI

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Project:	Concord Place Geotechnical Desktop Study
Project No.:	6-QUCC1.76
Client:	Christchurch City Council

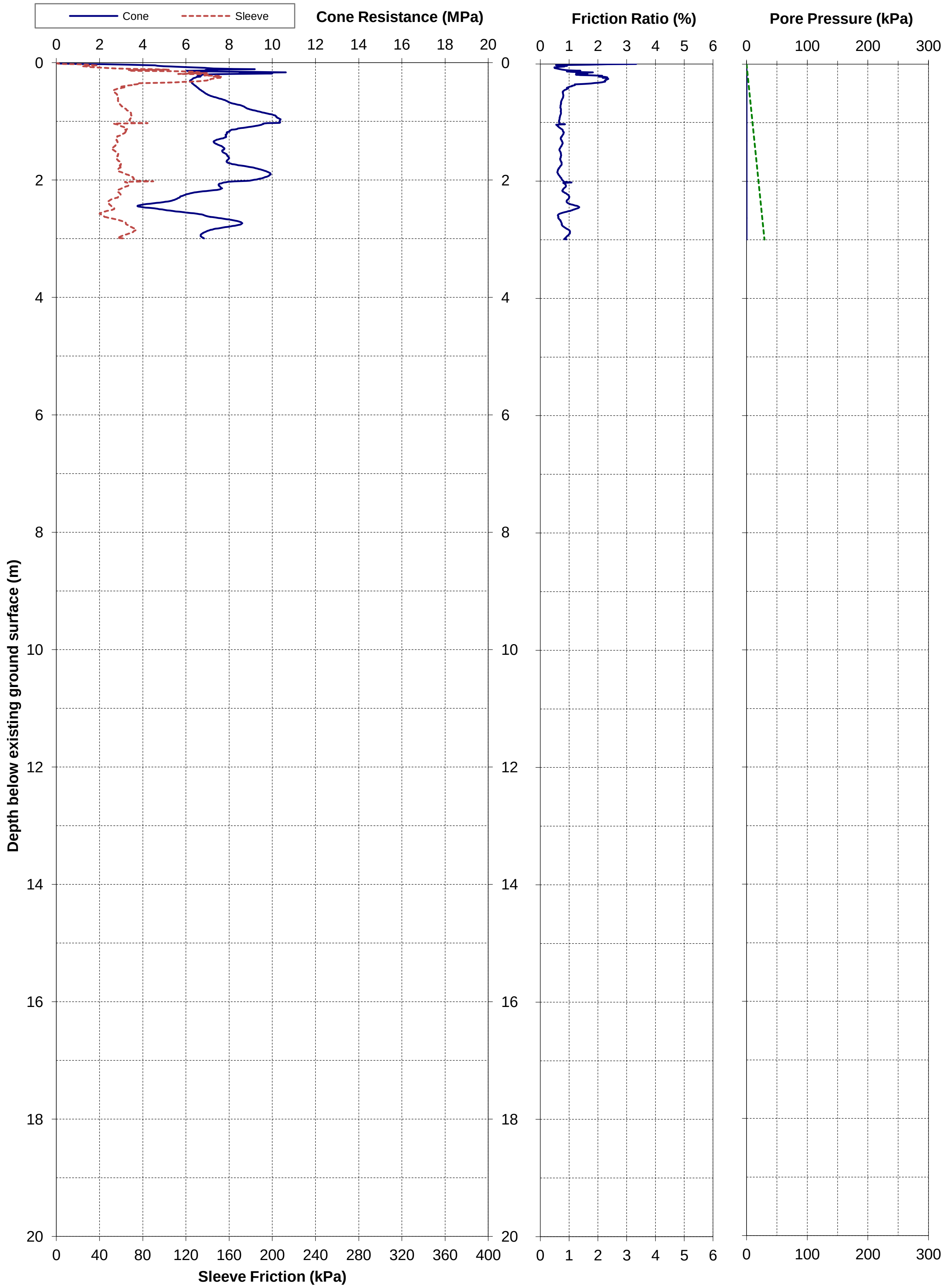
Figure 3 Site Geology

Drawn: Opus Geotechnical Engineer

Date: 5/11/2012

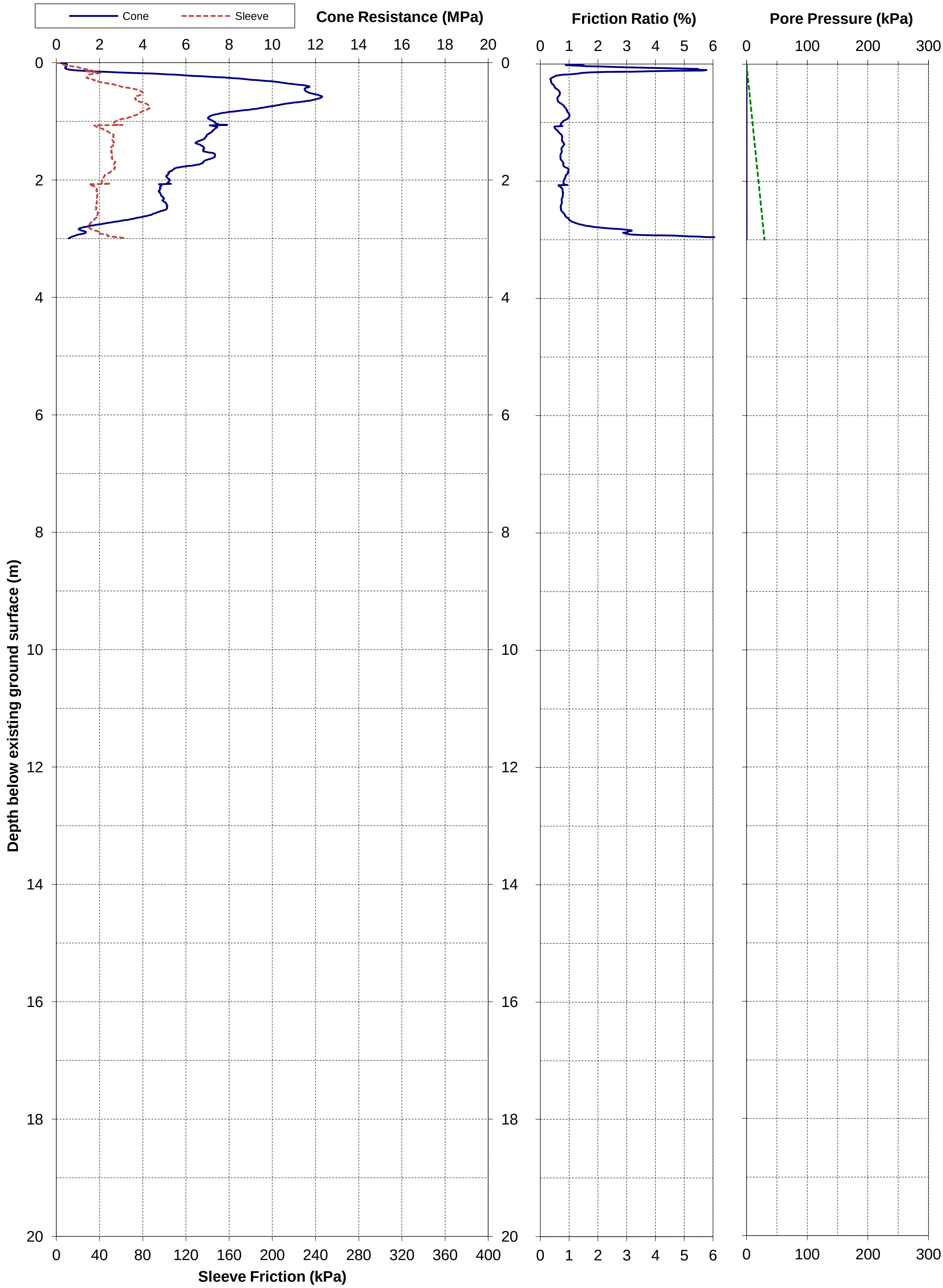
Appendix C:
Environment Canterbury Well Records

Project:	Historical Geotechnical CPT Investigations			Page:	1 of 1	CPT-HIS-0496
Test Date:	10-Nov-2000	Suburb:	Burwood			Locations based on supplied address
Pre-Drill:	0 m			Located By:	Google Earth	
Position:	5747172 mE	2484323 mN	5.3 mRL	Coord. System:	NZMG	
Address:	242 Mairehau Rd			Datum Reference:	Lyttelton Vertical Datum (MSL 1937)	



Plotted: 6/11/2012 6:17 p.m.

Project:	Historical Geotechnical CPT Investigations			Page:	1 of 1	CPT-HIS-0502
Test Date:	10-Nov-2000	Suburb:	Burwood			Locations based on supplied address
Pre-Drill:	0 m			Located By:	Google Earth	
Position:	5746977 mE	2484115 mN	3.3 mRL	Coord. System:	NZMG	
Address:	88 Greenhaven Dr			Datum Reference:	Lyttelton Vertical Datum (MSL 1937)	



Plotted: 6/11/2012 6:17 p.m.

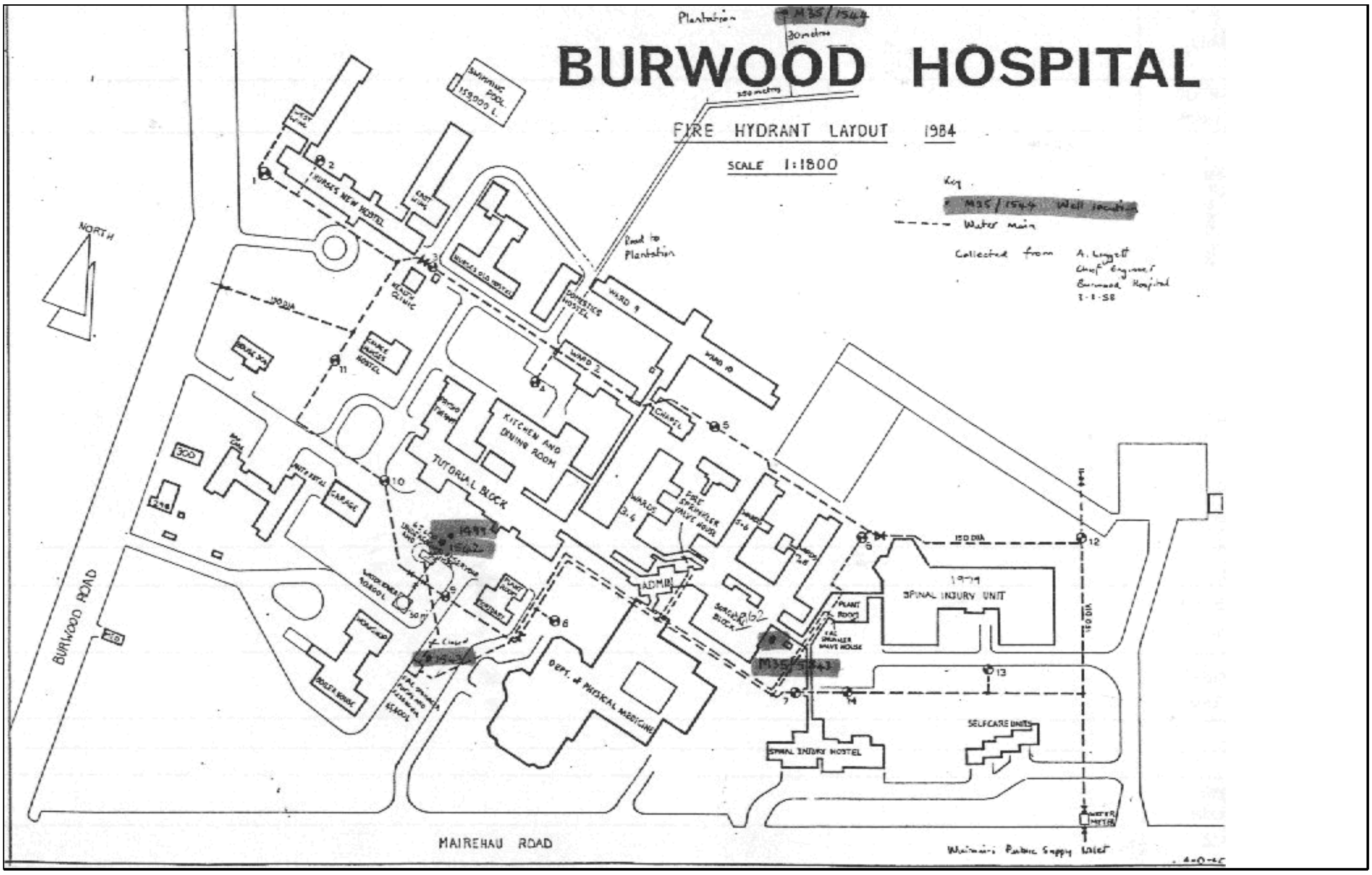
Bore or Well No:	M35/1499
Well Name:	
Owner:	BURWOOD HOSPITAL

Environment Canterbury
Your regional council

Street of Well:	MAIREHAU RD	**File No:**	
Locality:	BURWOOD	**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:8435-4732 QAR 3		
NZGM X-Y:	2484350 - 5747320		
Location Description:		**Uses:**	
ECan Monitoring:			
Well Status:	Not Used		

Drill Date:	01 Jul 1903	**Water Level Count:**	0
Well Depth:	97.50m -GL	**Strata Layers:**	15
Initial Water Depth:	4.60m -MP	**Aquifer Tests:**	0
Diameter:	51mm	**Isotope Data:**	0
		Yield/Drawdown Tests:	0
Measuring Point Ait:	6.30m MSD QAR 2	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:	not known	**Calc. Min. GWL:**	2.70m -MP
Drilling Method:	Unknown	**Last Updated:**	29 Jan 2002
Casing Material:		**Last Field Check:**	
Pump Type:	None Installed		
Yield:		**Screens:**	
Drawdown:		**Screen Type:**	
Specific Capacity:		**Top GL:**	
		Bottom GL:	
Aquifer Type:	Flowing Artesian		
Aquifer Name:	Linwood Gravel		

Date	Comments
29 Jan 2002	Also wells at 79.2m +3m and 36.6m +0.9m. Was mains supply well from 1903, now unused.
29 Jan 2002	Gridref changed from: M35:843-473


BURWOOD HOSPITAL
FIRE HYDRANT LAYOUT 1984
SCALE 1:1800
Plantation
M35/1544
30 metres
Key
M35/1544 Well location
Water main
Collected from A. Leggett
Chief Engineer
Burwood Hospital
3-1-58
NORTH
Road to Plantation
SWIMMING POOL 159000 L
WEST WING
EAST WING
NURSES NEW HOSTEL
NURSES OLD HOSTEL
HEALTH CLINIC
DOMESTICS HOSTEL
WARD 9
WARD 10
WARD 2
CHAPEL
CHARGE NURSES HOSTEL
100 DIA
KITCHEN AND DINING ROOM
TUTORIAL BLOCK
GARAGE
300
WARDS 3.4
FIRE SPRINKLER VALVE HOUSE
ADMIN
1999
1562
WASTEWATER POOL
50 m³
PLANT ROOM
1543
DEPT. of PHYSICAL MEDICINE
BOILER HOUSE
MAIREHAU ROAD
BURWOOD ROAD
150 DIA
1979
SPINAL INJURY UNIT
PLANT ROOM
SPRINKLER VALVE HOUSE
M35/1543
SURGICAL BLOCK
SPINAL INJURY HOSTEL
SELFCARE UNITS
WATER METER
Waimairi Public Supply Inlet
1
2
3
4
5
6
7
8
9
10
11
12
13
14

Borelog for well M35/1499

Gridref: M35:8435-4732 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 6.3 +MSD
Driller : not known
Drill Method : Unknown
Drill Depth : -98.09m Drill Date : 1/07/1903

Water Level: Artesian

Depth(m)	Full Drillers Description	Formation Code
- 29.0m	Sand	ch
- 32.0m	Clay	ch
- 42.7m	Gravel	ri
- 51.2m	Clay	ri
- 51.8m	Sand	ri
- 53.9m	Gravel	ri
- 58.8m	Sand	br
- 59.4m	Gravel	br
- 61.9m	Sand	br
- 64.6m	Clay	br
- 68.9m	Sand	li-1
- 70.4m	Clay	li-2
- 88.4m	Gravel - water	li-2
- 93.6m	Clay	li-2
- 98.1m	Gravel + 4.6m	li-3

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

Bore or Well No:	M35/5830
Well Name:	MAIREHAU WELL 1
Owner:	Christchurch City Council

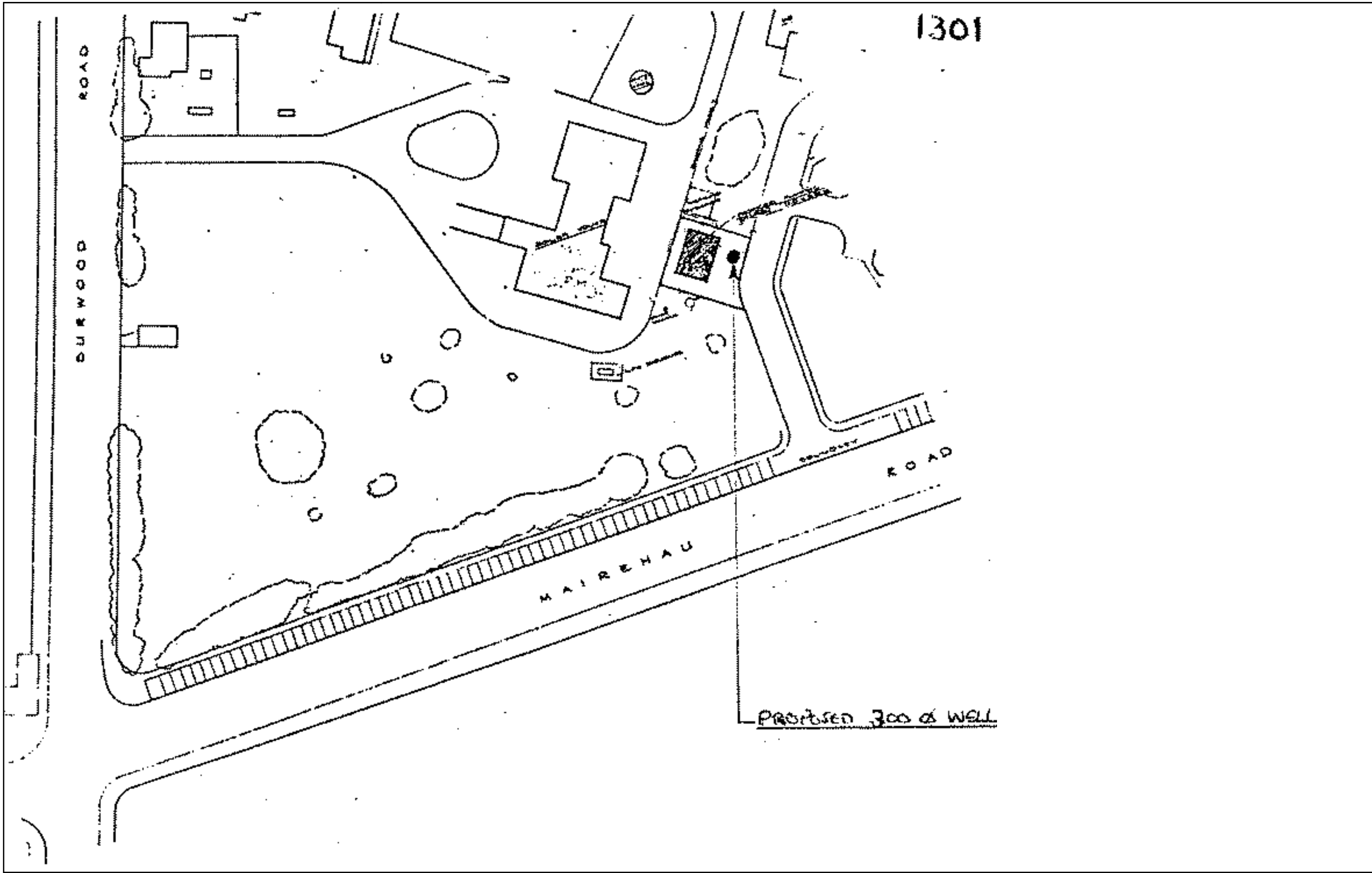
Environment Canterbury
Your regional council

Street of Well:	Cne Mairehau rd & Burwood Rd	**File No:**	CO6C/08672
Locality:	BURWOOD	**Allocation Zone:**	Christchurch/West Melton
NZGM Grid Reference:	M35:84363-47252 QAR 2		
NZGM X-Y:	2484363 - 5747252		
Location Description:	BURWOOD HOSPITAL	**Uses:**	Public Water Supply
ECan Monitoring:			
Well Status:	Active (exist, present)		

Drill Date:	01 May 1988	**Water Level Count:**	0
Well Depth:	154.00m -GL	**Strata Layers:**	34
Initial Water Depth:	5.84m -MP	**Aquifer Tests:**	1
Diameter:	305mm	**Isotope Data:**	0
		Yield/Drawdown Tests:	2
Measuring Point Ait:	6.00m MSD QAR 2	**Highest GW Level:**	
GL Around Well:	0.00m -MP	**Lowest GW Level:**	
MP Description:		**First Reading:**	
		Last Reading:	
Driller:	McMillan Water Wells Ltd	**Calc. Min. GWL:**	
Drilling Method:	Cable Tool	**Last Updated:**	05 May 2010
Casing Material:		**Last Field Check:**	15 Jan 2003
Pump Type:	Unknown		
Yield:	74 l/s	**Screens:**	
Drawdown:	10 m	**Screen Type:**	Stainless steel
Specific Capacity:	13.18 l/s/m	**Top GL:**	147.80m
		Bottom GL:	153.80m
Aquifer Type:	Flowing Artesian		
Aquifer Name:	Wainoni Gravel		

Date	Comments
	NCCB FREE FLOW TEST. Unpublished IGNS palynology report (DCM 113/89) by D C Mildenhall 1989 (see file IN6C-332-1/18, M35/f42).
01 May 1988	Fossil analysis data available for this bore.
02 Oct 1998	Formerly Waimairi C.C.
15 Oct 1998	Parklands pressure zone.
15 Jan 2003	Manhole into well padlocked. Left of driveway into Burwood hospital from Mairehau rd.
15 Jan 2003	Well checked by Lincoln Environmental for Piezometric contour map 2003
03 Dec 2007	Free flow rate 205.00 m3/h, information form CCC
05 May 2010	MfE source code added

1301



Borelog for well M35/5830 page 1 of 2

Gridref: M35:84363-47252 Accuracy : 2 (1=best, 4=worst)
Ground Level Altitude : 6 +MSD
Driller : McMillan Water Wells Ltd
Drill Method : Cable Tool
Drill Depth : -153.8m Drill Date : 1/05/1988

Depth(m)	Full Drillers Description	Formation Code
-8.00m	Brown sand	ch
- 16.2m	Traces of peat mostly Grey sand	ch
- 30.0m	Grey sand with some shells	ch
- 32.0m	Blue sand & some Blue clay	ch
- 34.0m	Blue clay	ch
- 35.0m	Peat	ch
- 38.0m	Small free gravels	ri
- 45.0m	Free medium sized gravels	ri
- 51.0m	Grey clay & some gravels	br
- 62.0m	Fine Brown running sands	br
- 63.5m	Yellow clay	br
- 66.0m	Brown sand & some gravel	li-1
- 73.0m	Free medium sized gravels	li-1
- 74.5m	Hard Yellow clay	li-2
- 81.0m	Blue clay & wood	li-2

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

Borelog for well M35/5830 page 2 of 2

Gridref: M35:84363-47252 Accuracy : 2 (1=best, 4=worst)
Ground Level Altitude : 6 +MSD
Driller : McMillan Water Wells Ltd
Drill Method : Cable Tool
Drill Depth : -153.8m Drill Date : 1/05/1988

Environment Canterbury
Your regional council

Depth(m)	Full Drillers Description	Formation Code
- 81.0m	Blue clay & wood	li-2
- 87.0m	Free gravels & sand	li-2
- 91.6m	Blue clay	li-2
- 91.7m	Brown peat	li-2
- 92.5m	Hard Brown clay	
- 101.4m	Free Brown stained gravels	li-3
- 110.6m	Brown sand	he
- 113.7m	Very sandy Grey gravels	he
- 119.4m	Brown clay	he
- 120.9m	Free Grey sandy gravels	bu
- 125.3m	Brown claybound gravels &sand	bu
- 131.6m	Brown very coarse sand & pea gravels, traces of soft Yellow clay	bu
- 138.0m	Free Brown gravel	bu
- 138.5m	Hard whitish claypan	sh
- 140.8m	Grey pug	sh
- 142.7m	Whitish/Yellow clay pan	sh
- 145.9m	Hard Or clay	sh
- 146.2m	Whitish silty clay	wa
- 146.5m	Brown claybound gravels	
- 153.8m	Free Grey & Brown sandy gravels traces of Or clay	wa

Scale(m): -80, -90, -100, -110, -120, -130, -140, -150

Appendix C:
Surrounding Site Investigations

Proposed Scala / Hand Auger S1

Proposed CPT Boreholes CPT1

Hand Dug Pit P1

0m 50m

SOURCE: CCC

OPUS
Opus International Consultants Ltd
Christchurch Office
20 Moorhouse Ave
PO Box 1482
Christchurch, New Zealand
Tel: +64 3 363 5400 Fax: +64 3 365 7857

Project: Concord Place
Geotechnical Desktop Study

Project No.: 6-QUCC1.76

Client: Christchurch City Council

Figure 4 Site investigation Plan

Drawn: Opus Geotechnical Engineer

Date: 5/11/2012

Appendix 3 - Methodology and Assumptions

Seismic Parameters

As per NZS 1170.5:

- T < 0.4s (assumed)
- Soil: Category D
- Z = 0.3
- R = 1.0 (IL2, 50 year)
- N(T,D) = 1.0

For the analyses, a μ of 1.25 was assumed for the garages while a μ of 2 was assumed for the residents lounge and the residential units.

Analysis Procedure

The age and/or structural layout of the buildings meant that a rigid diaphragm assumption would be invalid for the ceiling diaphragms of all of the buildings. Base shears and capacities were therefore calculated based on tributary areas.

Capacities were based on the NZS 3604 approach where base shears are converted to bracing units (1 kN = 20 BU's) and the bracing capacities were found by assuming a certain BU/m rating for the walls along each line. Due to the unknown nature of the walls, the BU/m rating was taken as 60 BU/m for all timber walls with an aspect ratio (height : length) of less than 2:1. This was scaled down to 0 BU/m at an aspect ratio of 3.5:1 as per NZSEE guidelines. %NBS values were then found through the ratio of bracing demand to bracing capacity along each line; with the worst %NBS for each block being reported.

Additional Assumptions

Further assumptions about the seismic performance of the buildings were:

- Foundations and foundation connections had adequate capacity to resist and transfer earthquake loads.
- Connections between all elements of the lateral load resisting systems are detailed to adequately transfer their loads sufficiently and are strong enough so as to not fail before the lateral load resisting elements.

Appendix 4 – CERA DEE Spreadsheets

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Concord Place - Residential Units 3-6, 11-15, 20-23, 34-39	Reviewer:	John Newall
	Unit / No: / Street	CPEng No:	1018146
Building Address:	Concord Place, Burwood, Christchur	Company:	Opus International Consultants Ltd.
Legal Description:		Company project number:	6-QUCC1.95
		Company phone number:	03 363 5400
	Degrees / Min / Sec		
GPS south:		Date of submission:	24/01/2013
GPS east:		Inspection Date:	
		Revision:	Final
Building Unique Identifier (CCC):	BE 1063	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	sandy silt	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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):			height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	212			
Age of Building (years):	40		Date of design:	1965-1976
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	(unknown)
Floors:	timber	joist depth and spacing (mm)	(unknown)
Beams:			
Columns:			
Walls:			

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Opus site measurements.
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

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:	Cracking of linings, veneer and firewalls.

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

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	Reline walls, epoxy masonry cracks.
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	49%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: DEE
	Assessed %NBS after e'quakes:	49%		
Across	Assessed %NBS before e'quakes:	90%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	90%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Concord Place - Residential Units 1-2	Reviewer:	John Newall
	Unit / No: / Street	CPEng No:	1018146
Building Address:	Concord Place, Burwood, Christchur	Company:	Opus International Consultants Ltd.
Legal Description:		Company project number:	6-QUCC1.95
		Company phone number:	03 363 5400
	Degrees / Min / Sec		
GPS south:		Date of submission:	24/01/2013
GPS east:		Inspection Date:	
		Revision:	Final
Building Unique Identifier (CCC):	BE 1063	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	sandy silt	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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):			height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	85			
Age of Building (years):	40		Date of design:	1965-1976
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	(unknown)
Floors:	timber	joist depth and spacing (mm)	(unknown)
Beams:			
Columns:			
Walls:			

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Opus site measurements.
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

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:	Cracking of linings, veneer and firewalls.

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

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	Reline walls, epoxy masonry cracks.
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	65%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: DEE
	Assessed %NBS after e'quakes:	65%		
Across	Assessed %NBS before e'quakes:	84%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	84%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Concord Place - Residential Units 7-10, 16-19, 24-33, 40-53	Reviewer:	John Newall
	Unit No: Street	CPEng No:	1018146
Building Address:	Concord Place, Burwood, Christchur	Company:	Opus International Consultants Ltd.
Legal Description:		Company project number:	6-QUCC1.95
		Company phone number:	03 363 5400
	Degrees Min Sec		
GPS south:		Date of submission:	24/01/2013
GPS east:		Inspection Date:	
		Revision:	Final
Building Unique Identifier (CCC):	BE 1063	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	sandy silt	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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):
Ground floor split?	no		Ground floor elevation above ground (m):
Storeys below ground	0		
Foundation type:	strip footings		if Foundation type is other, describe:
Building height (m):			height from ground to level of uppermost seismic mass (for IEP only) (m):
Floor footprint area (approx):	212		
Age of Building (years):	40		Date of design: 1965-1976
Strengthening present?	no		If so, when (year)?
			And what load level (%g)?
Use (ground floor):	multi-unit residential		Brief strengthening description:
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	(unknown)
Floors:	timber	joist depth and spacing (mm)	(unknown)
Beams:			
Columns:			
Walls:			

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Opus site measurements.
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

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:	Cracking of linings, veneer and firewalls.

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

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	Reline walls, epoxy masonry cracks.
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	54%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: DEE
	Assessed %NBS after e'quakes:	54%		
Across	Assessed %NBS before e'quakes:	94%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	94%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Concord Place - Residents Lounge		Reviewer:	John Newall
	Unit / No: / Street		CPEng No:	1018146
Building Address:		Concord Place, Burwood, Christchur	Company:	Opus International Consultants Ltd.
Legal Description:			Company project number:	6-QUCC1.95
			Company phone number:	03 363 5400
	Degrees / Min / Sec			
GPS south:			Date of submission:	24/01/2013
GPS east:			Inspection Date:	
			Revision:	Final
Building Unique Identifier (CCC):	BE 1063		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	sandy silt	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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):			height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	212			
Age of Building (years):	40		Date of design:	1965-1976
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	(unknown)
Floors:	timber	joist depth and spacing (mm)	(unknown)
Beams:			
Columns:			
Walls:			

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	lightweight timber framed walls			
Ductility assumed, μ:	2.00		note typical wall length (m)	
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	brick or tile	describe (note cavity if exists)	
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Opus site measurements.
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

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:	Cracking of linings and veneer

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

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	Reline walls, epoxy masonry cracks.
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: DEE
	Assessed %NBS after e'quakes:	100%		
Across	Assessed %NBS before e'quakes:	97%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	97%		

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Concord Place - Garages	Reviewer:	John Newall
	Unit / No: / Street	CPEng No:	1018146
Building Address:	Concord Place, Burwood, Christchur	Company:	Opus International Consultants Ltd.
Legal Description:		Company project number:	6-QUCC1.95
		Company phone number:	03 363 5400
	Degrees / Min / Sec		
GPS south:		Date of submission:	24/01/2013
GPS east:		Inspection Date:	
		Revision:	Final
Building Unique Identifier (CCC):	BE 1063	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	sandy silt	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):	

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):
Ground floor split?	no		Ground floor elevation above ground (m):
Storeys below ground	0		
Foundation type:	strip footings		if Foundation type is other, describe:
Building height (m):			height from ground to level of uppermost seismic mass (for IEP only) (m):
Floor footprint area (approx):	180		
Age of Building (years):	40		Date of design: 1965-1976
Strengthening present?	no		If so, when (year)?
			And what load level (%g)?
Use (ground floor):	multi-unit residential		Brief strengthening description:
Use (upper floors):			
Use notes (if required):			
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	(unknown)
Floors:	concrete flat slab	slab thickness (mm)	(unknown)
Beams:			
Columns:			
Walls:			

Lateral load resisting structure

Lateral system along:	single level tilt panel		**Note: Define along and across in detailed report!**	
Ductility assumed, μ:	1.25		note total length of wall at ground (m):	
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	single level tilt panel			
Ductility assumed, μ:	1.25		note total length of wall at ground (m):	
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	none
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	none		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Opus site measurements.
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	none	original designer name/date	

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:	Cracking of linings and firewalls.

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

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	Reline walls, epoxy masonry cracks.
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	100% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	DEE
	Assessed %NBS after e'quakes:	100%		
Across	Assessed %NBS before e'quakes:	61% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	61%		

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