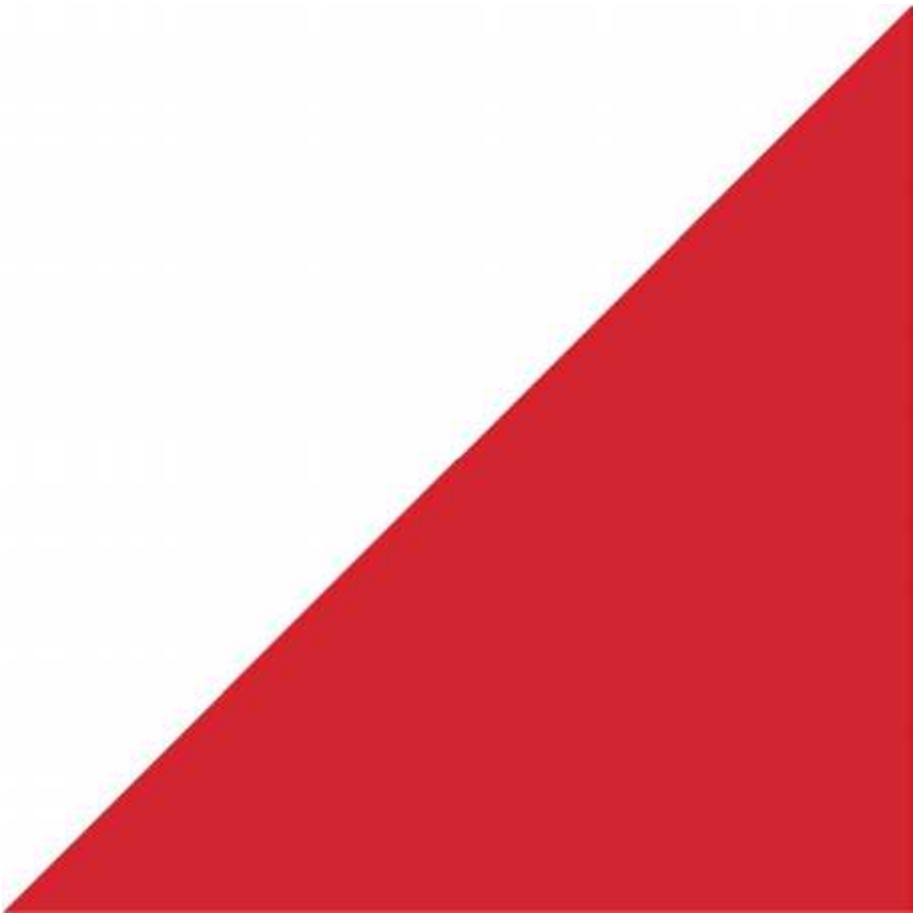
Christchurch City Council

Biddick Courts
BE 0707 EQ2

Detailed Engineering Evaluation

Quantitative Assessment Report



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Quantitative Assessment Report

14 Claydon Place, Dallington Christchurch

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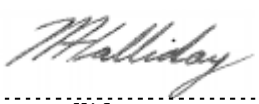

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Summary

Biddick Courts
BE 0707 EQ2

Detailed Engineering Evaluation
Quantitative Report - Summary
Final – R1

Background

This is a summary of the quantitative report for Biddick Courts located at 14 Claydon Place, Dallington, Christchurch and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This assessment covers residential units 1 to 16 plus a residents' lounge.

Key Damage Observed

The identified damage sustained by the above-ground structure buildings on site was largely superficial and is not considered to affect the structural performance of the buildings. The damage was limited mostly to the stepping of block masonry veneers, the cracking of wall linings around window frame corners and the cracking/separating of ceilings at their interface with the walls. Some spalling at the top of the precast panels in the walls of the residents' lounge was also noted. It is important to note that, due to the nature of the expected failure mechanism, damage to the critical element in the part two storey buildings could remain hidden behind wall linings.

The level survey showed significant residual differential displacements in the foundations of the buildings. This was likely caused by sand boils and lateral spreading towards the Avon River.

Critical Structural Weaknesses

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

Indicative Building Strength

The part two storey buildings, Blocks A and B, on the site were rated at 19%NBS in July 2013 and were considered to be earthquake prone. Following a strengthening scheme completed in 2015 these buildings are now rated at 40%NBS and are no longer considered earthquake prone.

The standalone single storey building, Block C, is considered to be greater than 100%NBS and is therefore deemed to be a "low risk" building.

Recommendations

The following recommendations have been made for the site:

- A strengthening works scheme be developed to increase the seismic capacity of Blocks A and B to at least 67% NBS in particular this should address the known poor seismic performance of Terrier inserts.
- Geotechnical site investigations be carried out including at least six Cone Penetrometer Tests to a target depth of 20m and four scalas to a 4-5m depth.
- The flooding risk at the site be reviewed.

- Floor slabs to have some intrusive investigation.

2014/15 Strengthening Work

In November 2014 a Building Act Exemption was approved by Christchurch City Council (CCC) for an interim strengthening scheme to Biddick Courts which was designed by Opus International Consultants.

The scheme is considered interim because the slopes on the floor are not being addressed. The strengthening which has now been undertaken removes the brittle failure mechanism in Blocks A and B and increased the capacity of the structures to 40%NBS.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by Christchurch City Council to undertake a detailed engineering evaluation of the Biddick Courts residential housing complex, located at 14 Claydon Place, Dallington, Christchurch, following the Canterbury Earthquake Sequence since September 2010.

The purpose of the assessment is to determine if the buildings on the site 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	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

Biddick Courts comprises three buildings (refer Figure 2); Block C is single storey and Blocks A and B have a part first floor level. The development was constructed circa 1987 to a design by Spencer Meikle Associates Architects and Tyndall and Hanham Civil and Structural Engineers.

Block C contains units 12 to 16 and is predominantly a timber framed structure with a timber trussed rafter roof. Pre-cast concrete tilt panels aligned in the transverse direction form common walls between the units.

Blocks A and B are similar in their configuration; the two storey portions comprise of units 2 to 5 and 8 to 11 and are formed with pre-cast concrete tilt panels aligned in the transverse direction. The first floors are formed with pre-cast floor units overlain with a structural topping. The pre-cast concrete tilt panels project vertically beyond the first floor to support a timber trussed rafter roof. The single storey portions comprise of units 1, 6, 7 and the residents' lounge and are predominantly timber framed structures with pre-cast concrete tilt panels forming common walls lines.

The buildings are supported at ground level by reinforced concrete foundation walls and reinforced concrete pad footings.

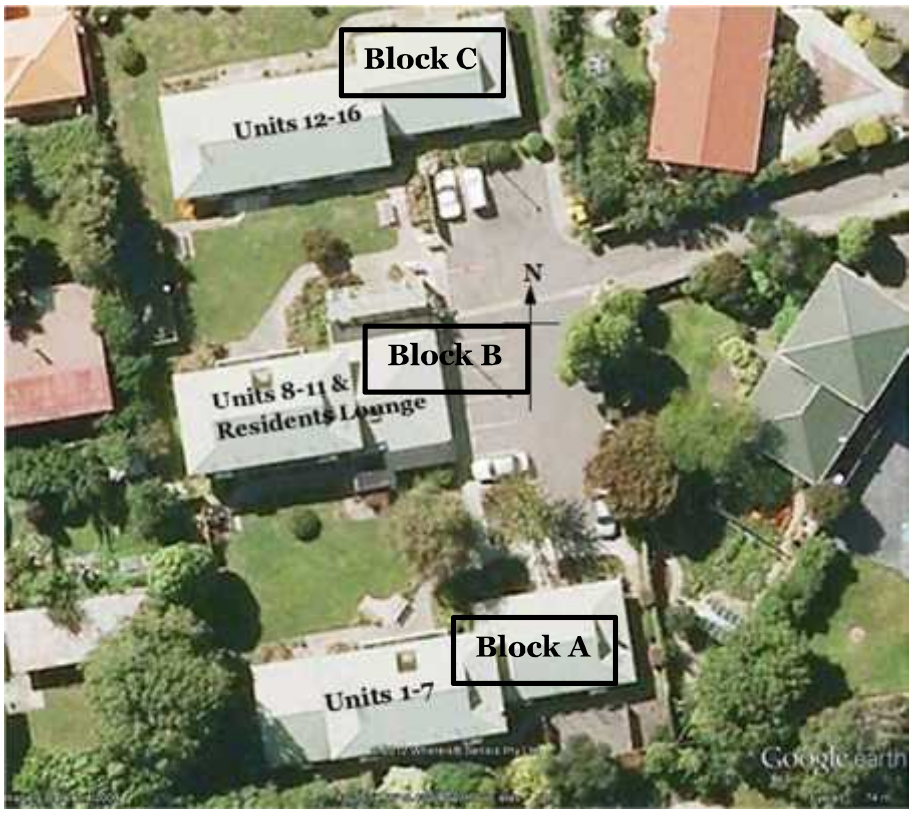

Figure 2: Site location plan of Biddick Courts Residential Housing.

Figure 3: circa 1987 foundation plan for units 1 – 7, typical across the site (original).

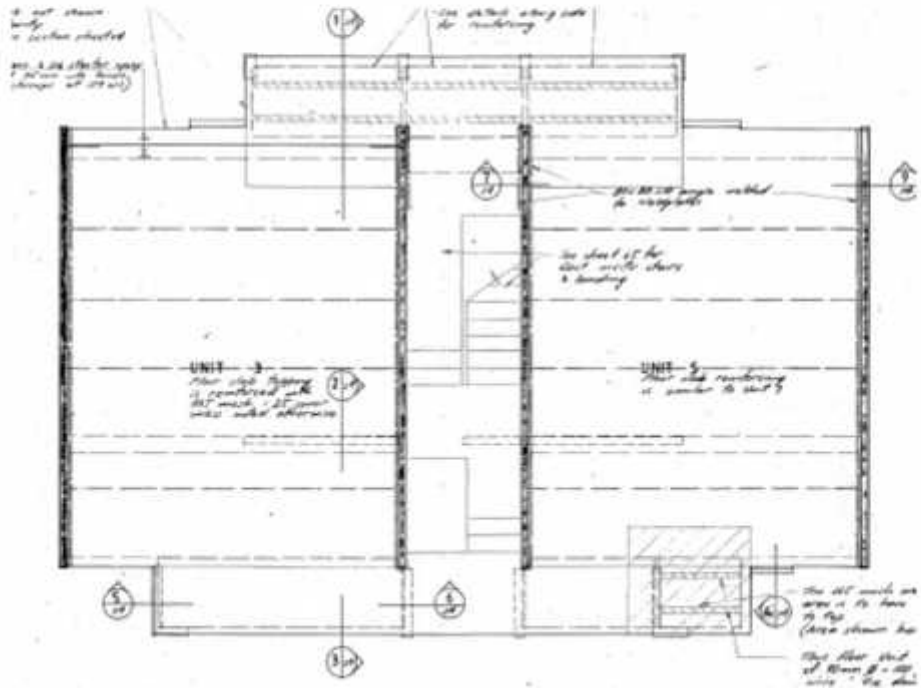

Figure 4: circa 1987 first floor plan for units 3, 5, 9 & 11 (original).

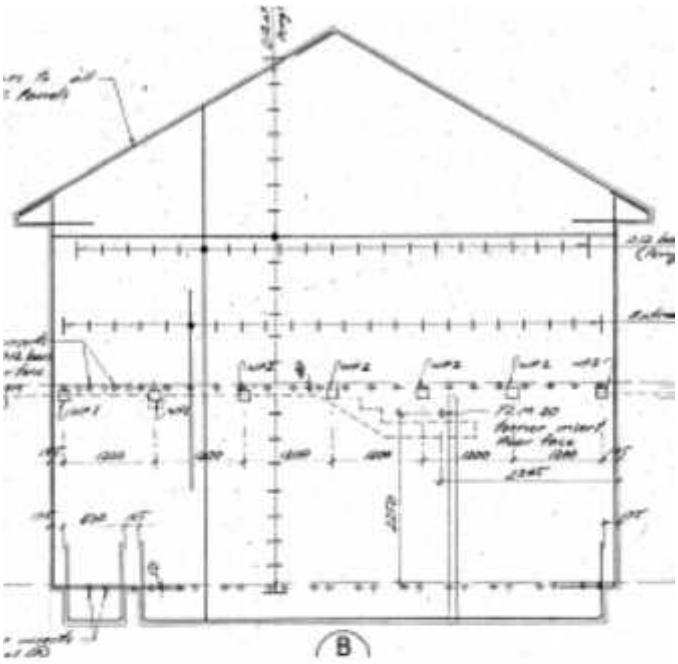

Figure 5: circa 1987 typical pre-cast concrete common wall tilt panel (original).

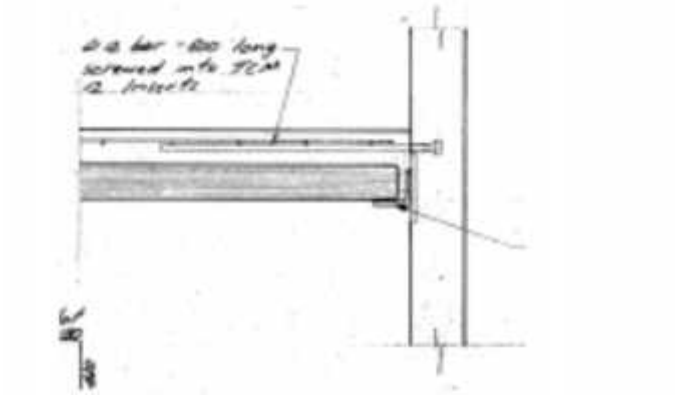

Figure 6: circa 1987 typical pre-cast concrete floor unit bearing and structural topping detail (original).

4.2 Survey

4.2.1 Post 22 February 2011 Rapid Assessment

A structural (Level 1) assessment of the property and buildings was undertaken on March 3rd, 2011 by Opus International Consultants. Minor cracking to building veneers was observed. 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 significant 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 November 2012. The results of this are outlined and discussed in Section 7.

4.2.4 Geotechnical Survey

A geotechnical site walkover was conducted on 12 October 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:

- Copies of original Spencer Meikle Associates Architects drawings
- Copies of original Tyndall and Hanham Civil and Structural Consultants drawings.

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 earthquake damage sustained by the buildings as some forms of damage may not be noticeable during a visual inspection.

5.1 Residual Displacements

The results of the level survey indicate the magnitude of residual displacements in the foundations of the buildings. These results are addressed in Section 7.

5.2 Foundations

No noticeable foundation damage to the three buildings was observed. However, the investigation consisted of visual inspection of the exterior of the foundations only. Damage to foundations below ground will not have been able to be identified.

5.3 Primary Gravity Structure

No noticeable damage to the gravity structure of the buildings was observed.

5.4 Primary Lateral-Resistance Structure

Minor cracking of the ceiling-wall interface was noticed in some areas of most units. Minor cracking in plasterboard linings around window-frame corners was also observed in at least one window of most units. Where the removal of linings allowed, the Terrier inserts (shown in figure 6) were inspected. There were no visible signs that these had been damaged.

5.5 Non Structural Elements

Some minor stepping of block masonry veneers was observed around the buildings. Spalling at the ceiling level of the northern pre-cast concrete panels was observed in the residents lounge.

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 or relative rigidity for walls connected by rigid diaphragms. The capacities of the walls were calculated and used to estimate the % NBS.

6.3 Limitations and Assumptions in Results

The observed level of damage suffered by the buildings was deemed low enough to not affect their capacity. Therefore the analysis and assessment of the buildings was based on them being in an undamaged state. There may have been damage to the buildings that was unable to be observed that could cause the capacity of the buildings to be reduced; therefore the current capacity of the buildings 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 Gravity Load Resisting System

Single storey units: timber stud walls lined with 10mm thick gib board (inside face) support a light weight timber trussed rafter roof. Pre-cast tilt panels are cantilevered from reinforced concrete foundation walls.

Two storey units: pre-cast concrete floor units at first floor level span between ledger angles welded to plates cast into the two storey pre-cast tilt panels. Timber stud walls built off the first floor slab provide support to a light weight trussed rafter roof over.

6.5 Seismic Load Resisting System

6.5.1 Longitudinal

Single storey units: seismic force is resisted by timber walls lined with 10mm gib board. Force is transmitted by the ceiling level gib board lining which provides diaphragm action between the bracing lines on a tributary area basis.

Two storey units: seismic force is resisted and taken down to first floor level by the cantilevered pre-cast concrete tilt panels acting out-of-plane in flexure. From first level to ground the walls are contained by a rigid diaphragm and therefore resist force in shear according to their in-plane stiffness.

6.5.2 Transverse

Single storey units: seismic force is transferred to in-plane pre-cast concrete walls through the ceiling level gib board lining which provides diaphragm action on a tributary area basis.

Two storey units: seismic force is resisted and taken down to first floor level by the pre-cast concrete tilt panels acting in shear. From first level to ground level the walls are contained by a rigid diaphragm and therefore resist force in shear according to their in-plane stiffness.

6.6 Assessment

A summary of the structural performance of the buildings is shown in the following table. Note that the values given represent the worst performing elements in the building, as these effectively define the building's capacity. Other elements within the building may have significantly greater capacity when compared with the governing elements.

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.
Block A (Units 1 - 7)		
Longitudinal		
Two storey pre-cast tilt panels (units: 2,3,4 & 5)	Out-of-plane, Flexure	>100%
Lower storey pre-cast tilt panels (units: 2 & 4)	In-plane, Shear	19%*
		40%
Lower storey pre-cast tilt panels (units: 2 & 4)	Pre-cast panel to first floor slab anchorage, Shear	52%

Timber bracing walls (units: 1,6 & 7)	In-plane, Bracing	>100%
Two storey pre-cast tilt panels (units: 2,3,4 & 5)	In-plane, Shear	>100%
Transverse		
Two storey pre-cast tilt panels (units: 2,3,4 & 5)	Pre-cast panel to first floor slab anchorage, Shear	>100%
Single storey pre-cast tilt panels (units: 6 & 7)	In-plane, Shear	>100%
Timber bracing walls (units: 1,6 & 7)	In-plane, Bracing	>100%
Block B (Units 8 – 11 and Residents Lounge)		
Longitudinal		
Two storey pre-cast tilt panels (units: 8,9,10 & 11)	Out-of-plane, Flexure	>100%
Lower storey pre-cast tilt panels (units: 8 & 10)	In-plane, Shear	19%*
		40%
Lower storey pre-cast tilt panels (units: 8 & 10)	Pre-cast panel to first floor slab anchorage, Shear	52%
Residents Lounge, pre-cast feature fin columns	Overturning	>100%
Two storey pre-cast tilt panels (units: 8,9,10 & 11)	In-plane, Shear	>100%
Transverse		
Two storey pre-cast tilt panels (units: 8,9,10 & 11)	Pre-cast panel to first floor slab anchorage, Shear	>100%

Residents Lounge, pre-cast feature fin columns	Overturning	>100%
Block C (Units 12 – 16)		
Longitudinal		
Timber bracing walls (units: 12,14,15 & 16)	In-plane, Bracing	>100%
Transverse		
Single storey pre-cast tilt panels (units: 12,13,14,15 & 16)	In-plane, Shear	>100%
Timber bracing walls (units: 12,14,15 & 16)	In-plane, Bracing	>100%

*Prior to 2015 Strengthening Scheme

6.7 Discussion of results

The 19%NBS rating of Blocks A and B is governed by the shear capacity of the ground floor level pre-cast tilt panels oriented parallel to the longitudinal direction (shown on Figure 7). This is primarily due to the limited number of bracing walls providing resistance to lateral force in the longitudinal direction. Shear failure of pre-cast tilt panels of this nature is considered to be a brittle failure. This means that the failure will be sudden and with little warning. Further, the structure does not have redundancy built into the lateral load resisting system, meaning that once a bracing element fails, there are few other elements available to take the load that was being resisted by the element.

The rating of the ground floor level pre-cast tilt panels to underside of first floor slab connection within the part two storey building is 52%NBS. This is governed by a combination of the length of wall available to form an in-situ construction joint between the top of the panel and the underside of the structural topping; and the number and type of reinforcement bars cast into the first floor level structural topping. It is important to note that, due to the nature of the expected failure mechanism, damage to the critical element in the part two storey buildings could remain hidden behind wall linings.

Blocks A and B (units 1-11 and residents lounge) are therefore classified as earthquake prone in accordance with NZSEE guidelines. Block C (units 12-16) has been assessed to be 100%NBS and is therefore classified as a low risk building.

7 Summary of Geotechnical Appraisal

7.1 General

No subsurface investigations undertaken within the property boundary of Biddick Courts have been recovered from the CCC property file. Nevertheless, there are a number of available boreholes and CPT's in the greater vicinity of the site that can be used for preliminary geotechnical evaluation. The available borehole and CPT data are shown in the Geotechnical Desk Study included in Appendix B.

The published geological map of the area, (Brown, L. J. Weeber, J.H. 1992: Geology of the Canterbury Plains. NZGS misc map 23) indicates the site is underlain predominantly by Alluvial sand and silt of overbank deposits.

A groundwater table depth of approximately 2-3 m has been shown on the December 2011 Groundwater surface Depth Map, Project Orbit.

Material logs available from the surrounding site investigations, have been used to infer the ground conditions at the site as shown in Table 3 below.

Table 3: Inferred ground conditions

Geological Unit	Stratigraphy	Depth (m)	Average SPT (N)	Average q_c (MPa)	Density	Relative density (%)	Average groundwater level (m) below ground
Springston Formation (Yaldhurst Member)	Interbedded layers of **Sand** and **Silt**	0.0-6.6	21 (min* 2)	4	Medium dense	51.5	2.4m
Christchurch Formation	**SAND**, fine, grey	6.6-15.5	35 (min 21)	16	Dense	70	
	SAND, fine to medium, with some silt, grey	15.5-28.3	21 (min 1)	20	Medium dense	51.5	
Riccarton Gravels	**GRAVEL**, sandy fine to coarse, very dense	28.3-30.5	50 (min 50)	22	Very dense	>85	

The level survey undertaken by Opus suggests that the Biddick Courts units have undergone:

- Local movement at the north building with differential settlement of up to 44mm with slope up to 6.6mm/m. The sand boil at the southeast corner of the building may have triggered the local movement.
- Global tilting for the whole of the south building with differential settlement of up to 104 mm in the east-west direction.
- Local areas on the south building that exceed building guidelines and differential settlements with maximum slopes of up to 8mm/m. This pattern of differential settlement is consistent with the observed cracking locations south of the site and may be associated with lateral spreading towards Avon River.

7.2 Potential for Future Land Damage

A preliminary assessment for future probable liquefaction is based on the inferred ground conditions and surrounding CPT results, with the assessment results being summarised in Table 4.

Table 4: Preliminary liquefaction assessment

Stratigraphy	Depth (m)	Average SPT (N)	Average q_c (MPa)	Density	Relative density (%)	Probability for liquefaction for earthquake acceleration 0.20g and groundwater 1.5m BGL (**)
Interbedded layers of **Sand** and **Silt**	0.0-6.6	21 (min* 2)	4	Medium dense	51.5	HIGH
SAND, fine, grey	6.6-15.5	35 (min 21)	16	Dense	70	MEDIUM
SAND, fine to medium, with some silt, grey	15.5-28.3	21 (min 1)	20	Medium dense	51.5	LOW
GRAVEL, sandy fine to coarse, very dense	28.3-30.5	50 (min 50)	22	Very dense	>85	LOW
(*): Minimum SPT N blow count encountered at some depth within the layer (**): After Seed and Idriss, 1971 (Bowles, 1997)						

Brief evaluation of surrounding site investigation data indicates that the Biddick Courts site is likely to undergo significant liquefaction ground damage during future seismic events. Observations of cracks at the buildings confirm that some liquefaction induced subsidence has occurred at the site.

The property at Biddick Courts has been zoned as Green TC 3 "Blue Zone" with moderate land deformations possible in a future small to medium sized earthquake and significant land damage in a future moderate to large earthquake. However, the neighbouring residential properties from 70 m south of the site have been zoned as "Red" which is evaluated by CERA as not being practical to rebuild, repair or reoccupy as the required improvements would be too difficult or costly to implement.

By examining the post-earthquake aerial photos taken by New Zealand Aerial Mapping (Project Orbit, 2012) the following has been observed:

- 4th September 2010: Minor ground cracking but no observed liquefaction ejecta within Biddick Courts. Minor to moderate liquefaction ejecta was observed south of the site.
- 22nd February 2011: The site suffered moderate to major lateral spreading and ejected material as reported in Project Orbit. To the south and to the east towards Avon River, lateral spreading has also been observed.
- 13th June 2011: No lateral spreading was observed at the site but evidence of minor to moderate quantities of ejected material.

Ground cracking of up to 200mm wide has been recorded by the Canterbury Geotechnical Database 2012 to the west and south of the site, with up to 50mm wide cracks observed

within the boundary. Cracks from 10mm to 50mm wide were observed from 35m to 200m east from the Avon River.

A preliminary assessment for future probable lateral spreading is based on the inferred ground conditions (and the corresponding test results), with the results being summarised in Table 5.

Table 5: Preliminary lateral spreading assessment

Stratigraphy	Depth (m)	Average SPT (N)	Average q_c (MPa)	State of packing	Relative density (%)	Probability for lateral spreading for earthquake acceleration 0.20g and groundwater 1.5m BGL (**)
Interbedded layers of Sand and Silt	0.00-6.60	21 (min* 2)	4	Medium dense	51.5	HIGH
SAND, fine, grey	6.60-15.50	35 (min 21)	16	Dense	70	MEDIUM
SAND, fine to medium, with some silt, grey	15.50-28.30	21 (min 1)	20	Medium dense	51.5	LOW
GRAVEL, sandy fine to coarse, very dense	28.30-30.50	50 (min 50)	22	Very dense	>85	None
(*): Minimum SPT N blow count encountered at some depth within the layer (**): After Seed and Idriss, 1971 (Bowles, 1997)						

Due to the close proximity of the Avon River to Biddick Courts and the liquefaction potential of the soil profile the site is considered to have a high lateral spreading potential.

At present there is insufficient data to make a quantified assessment of the liquefaction and lateral spreading potential at Biddick Courts. Site specific investigations comprising of at least six cone penetrometer tests to a target depth of 20m and four scalas to 4-5m depth near building foundations are recommended to enable site wide liquefaction and lateral spreading assessment.

7.3 Summary

As a result of the recent seismic activity in Christchurch, cracking with some differential settlement has occurred at Biddick Courts. Some surface expressions of liquefaction occurred within the site as well as some cracks to the south of the site due to lateral spreading.

The foundations of the buildings generally appear to have performed well in the recent seismic events. Stone paved areas, footpaths and car park areas surrounding Biddick Courts buildings have undergone heave or subsidence with evidence of ejected liquefied material from sand boils. Some minor and moderate cracks in claddings and evidence of settlement at some walls were observed on the site visit of 12 October 2012. No internal inspection of floor slabs was undertaken during the site visit.

The differential settlement recorded in the level survey may be attributed to liquefaction induced subsidence.

Deep and shallow site wide investigations including CPT's and scalas should be undertaken to assess the liquefaction and lateral spreading potential as well for assessing the static bearing capacity of the underlying material of the units.

It is recommended that the following be carried out:

- A deep site investigation scheme comprising of at least six Cone Penetrometer Tests to a target depth of 20 m;
- Four scalas to 4-5 m depth located near building foundations;
- Review of the flood risk to the site based on updated topographic surveys of the area and predicted flooding river levels;
- Floor slab inspection at isolated locations, may be required to assess floor slab damage.

8 Conclusions

8.1 Part two storey buildings

- Blocks A and B (units 1-11 and residents lounge) have been assessed to be 19%NBS are therefore deemed to be Earthquake Prone, a "high risk" building in a design seismic event according to NZSEE guidelines.

8.2 Single storey building

- Block C (units 12-16) has been assessed to be greater than 100%NBS and is therefore deemed to be a "low risk" building in a design seismic event according to NZSEE guidelines. Its level of risk is less than that of a building rated at 100%NBS (Figure 1).

9 Recommendations

The following recommendations have been made for the site:

- A strengthening works scheme be developed to increase the seismic capacity of Blocks A and B to at least 67% NBS in particular this should address the known poor seismic performance of Terrier inserts.
- Geotechnical site investigations be carried out including at least six Cone Penetrometer Tests to a target depth of 20m and four scalas to a 4-5m depth.
- The flooding risk at the site be reviewed.
- Floor slabs to have some intrusive investigation.

10 2014/15 Strengthening Work

10.1 General

In November 2014 a Building Act Exemption was approved by Christchurch City Council (CCC) for an interim strengthening scheme to Biddick Courts which was designed by Opus International Consultants. The scheme consisted of fixing new steel angle brackets to the underside of the first floor slabs in blocks A and B to effectively connect these slabs to the pre-cast concrete shear walls below, as shown in Figure 7 and Figure 8 below. The strengthening scheme is attached in Appendix F. Photos of the strengthening scheme works are included in Appendix A.

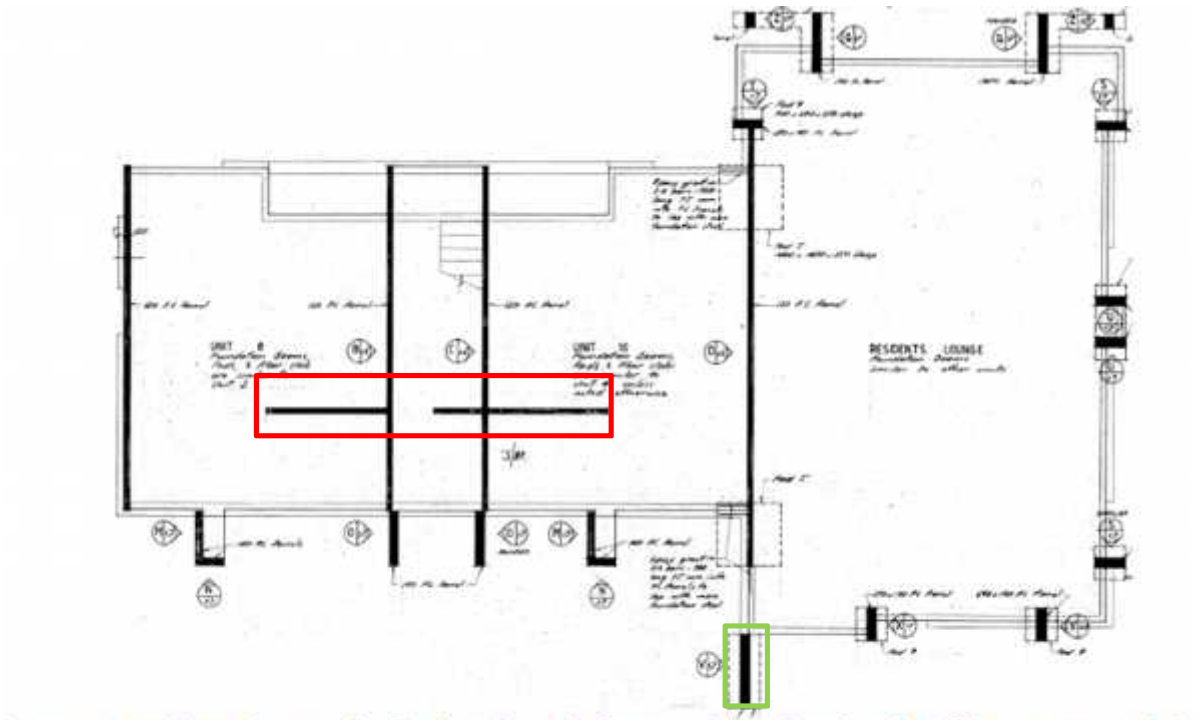

Figure 7 - Locations of strengthening brackets (red rectangle) and replaced wall (green rectangle) in Block B.

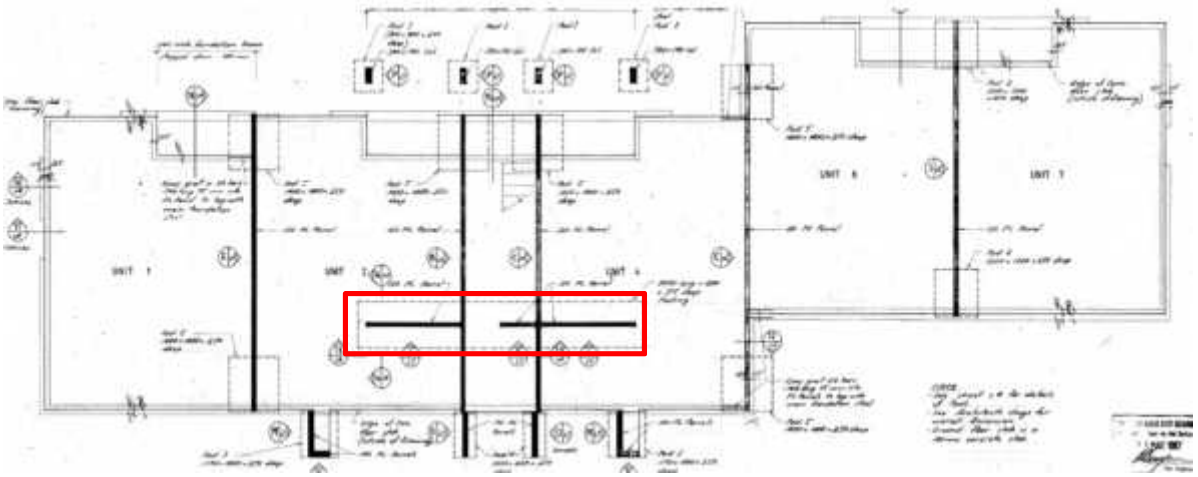

Figure 8 - Locations of strengthening brackets (red rectangle) in Block A.

The purpose of this scheme was to improve the %NBS of the structure to above 33% NBS and remove the brittle failure mechanism in the concrete panels. The slopes on the floor have not been addressed so the strengthening is considered interim.

During the construction a reinforced concrete wall near the Block B residents lounge was removed and replaced with a timber framed wall as it had tilted. This wall did not impact the capacity of the structure as the %NBS in the transverse direction was over 100%NBS.

10.2 Results of Strengthening Scheme

The strengthening stage of the construction was completed on 9th June 2015 and a PS4 was signed by Opus International Consultants on 29th June 2015.

This interim strengthening scheme successfully removed the brittle failure mechanism in Blocks A and B and increased the capacity of the structure to above 33%NBS as shown in Table 2.

10.3 Recommendations for Future Works

As the completed strengthening is considered an interim scheme it is recommended that the strengthening scheme is reviewed within five years and a permanent solution is developed to permanently strengthen the structures. At this time use of the 'Terrier inserts' should be considered for repair as it has been observed that these inserts have not performed well under seismic loads.

11 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.

12 References

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[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 A - Photographs

Block A, units 1 to 7.		
1	View on north elevation	
2	View on south elevation	

3	Cracking at unit 1	
4	Cracking at unit 3	

5	Cracking at unit 3	
6	Cracking at window in unit 2	

7	Cracking at unit 6	
8	Cracking inside unit 6	

Block B, units 8 to 11 plus residents lounge.		
1	View on north elevation	
2	View on south elevation	

3	Cracking at residents lounge.	
4	Spalling at top of precast panels in residents lounge.	

5	Cracking at unit 8	
6	Cracking in unit 8	
7	Cracking at unit 11	

Block C, units 12 to 16.		
1	View on south elevation	
2	View on north elevation	
3	Cracking at unit 12	

4	Door frame in unit 13	
5	Cracking at unit 14	

6	Cracking at unit 15	
7	Cracking in unit 16	

Interim Strengthening Scheme to Blocks A and B and Wall Replacement		
1	Brackets installed in bathroom ceilings.	
2	Reverse side of connections.	

3	Installation of the new wall outside of the residents lounge	

Appendix B - Geotechnical Appraisal

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12 February 2013

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Job number: 6-QUCC1.98

Geotechnical Desk Study- Biddick Courts, Claydon Place, Dallington

1. Introduction

The Christchurch City Council (CCC) has requested OPUS International Consultants (OPUS) to provide a geotechnical desk study and walkover inspection of the Biddick Courts, Claydon Place, Dallington following the Canterbury Earthquake Sequence initiated by the 4th September 2010 earthquake.

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

The Geotechnical Desk Study has been undertaken without the benefit of any site specific investigations and is therefore preliminary in its nature.

2. Desktop Study

2.1 Site Description

The **Biddick Courts** residential complex is situated 3.5 km north east of Christchurch City at Claydon Place, Dallington. It is a relatively flat site, approximately 60m east of the Avon River at its closest point (refer Appendix A, Figure 1).

The housing development was constructed in 1988 and comprises three buildings which include one single storey building and two 2 storey buildings. The three buildings comprising Biddick Courts are predominantly timber framed construction with tilt slab concrete panels. The cladding comprises unreinforced concrete blocks with lightweight Hardie planks in some areas. The first floor of the buildings are suspended pre-cast concrete.

For the purpose of this report the three Biddick Courts buildings have been defined as the North; Middle and South buildings (refer Appendix A, Figure 1). The three buildings

are considered to be equivalent to type C2; timber framed dwelling on concrete floor, as defined in Table 2.1 of MBIE guidance document.

2.2 Available Structural Drawings

Construction drawings prepared by Architect Spencer Meikle Associates dated 1986 were sourced from the CCC property file (refer to extracts in Appendix C). The structural drawings by Tyndal and Hanham are incorporated in this set.

Drawings indicate the buildings foundations are reinforced concrete perimeter strip footings combined with pad foundations founded at approximately 925mm below ground level. The thickness of the pads and perimeter strip footings range from 250mm to 600mm. The reinforced concrete floor slab is 100mm thick (including 665 mesh and 25mm cover) on compacted hard fill.

2.3 Regional Geology and Hydrogeology

The published geological map of the area, (Brown, L. J. Weeber, J.H. 1992: Geology of the Canterbury Plains. NZGS misc map 23) indicates the site is underlain predominantly by **Alluvial sand and silt of overbank deposits.**

A groundwater table depth of approximately 2-3 m has been shown on the December 2011 Groundwater surface Depth Map, Project Orbit.

2.4 Earthquake Commission Subsurface Investigations

No subsurface investigations undertaken within the property boundary of Biddick Courts have been recovered from the CCC property file. Nevertheless, there are a number of available boreholes and CPT's in the greater vicinity of the site that can be used for preliminary geotechnical evaluation. The available borehole and CPT data have been summarised in Table 1 below.

Table 1: Available site investigation data in the vicinity of Biddick Courts

SI reference	Distance from nearest point of Biddick Courts	Depth of SI (m)
CPT 1094 (CPT-DAL-17)	66m southwest from South building	30.20
CPT 1115 (CPT-DAL-38)	200m northwest from North building	30.20
CPT 1095 (CPT-DAL-18)	197m southeast from South building	23.95
CPT 528 (CPT-RCH-16)	228m northwest from North building	5.50
CPT 544 (CPT-RCH-32)	227m from North building	5.60
Borehole 1696 (AVS-04)	137m west from South building	15.45
Borehole 1702 (AVS-SAA)	136m southwest from South building	30.34
Borehole 1837 (RCH-03)	360m northwest from North building	15.00
ECan Borehole M35_12645 (M35/12645)	340m southwest from South building	6.57
ECan Borehole M35_2282 (M35/2282)	571m northwest from North building	139.3

The groundwater level as reported from CPT's is located 2 to 3 m below ground level. This may fluctuate during the year. The groundwater level measurements of the CPT's are consistent with Project Orbit published maps.

The locations of the CPT's, boreholes and ECan wells are shown in the surrounding site investigation plan, Figure 3- Appendix A.

2.5 Expected Ground Conditions

Material logs available from the surrounding site investigations summarised in Table 1 have been used to infer the ground conditions at the site as shown in Table 2 below.

A copy of the CPT plots and borehole logs are included in Appendix D.

Table 2: Inferred Ground Conditions

Geological Unit	Stratigraphy	Thickness (m)	Depth (m) encounter below ground level	Average groundwater level (m) below ground
Springston Formation (Yaldhurst Member)	**Interbedded layers of Sand and Silt**	6.6	0.0	2.4m
Christchurch Formation	**SAND**, fine, grey	8.9	6.6	
	SAND, fine to medium, with some silt, grey	12.8	15.5	
Riccarton Gravels	**GRAVEL**, sandy fine to coarse, very dense	-	28.3-30.5	

2.6 Liquefaction Hazard

For the development of liquefaction phenomena (ejecta), three main conditions must be met (Day, 2000):

- Soil types susceptible to liquefaction (e.g. sands in a loose state);
- Groundwater table near the ground surface or at the surface level;
- Earthquake intensity and duration;

In the case of Biddick Courts all three of these conditions have been satisfied and thus the potential for future liquefaction from an earthquake event.

The 2004 Environment Canterbury Solid Facts Liquefaction Study indicates Biddick Courts site is in the border of no liquefaction ground damage potential and moderate liquefaction ground damage potential. According to this study, based on a low groundwater table, ground damage from liquefaction is expected to be moderate and may be affected by 100 mm to 300 mm of ground subsidence.

By examining the post-earthquake aerial photos taken by New Zealand Aerial Mapping (Project Orbit, 2012) the following has been observed:

- 4th September 2010: minor ground cracking but no observed liquefaction ejecta within Biddick Courts. Minor to moderate liquefaction ejecta was observed south of the site.
- 22nd February 2011: the site suffered moderate to major lateral spreading and ejected material as reported in Project Orbit. To the south and to the east towards Avon River, lateral spreading has also been observed.

- 13th June 2011: No lateral spreading was observed at the site but evidence of minor to moderate quantities of ejected material.

Based on communication with residents at Biddick Courts, no liquefaction ejecta were observed following the 23 December 2011 earthquakes.

From the EQC vertical ground movement Aerial Mapping, the elevation changes are between -0.4 m to -0.2 m subsided for Biddick Courts. These elevation changes can also be seen in Appendix B, site photographs.

Conditional Peak Ground Accelerations (PGA) have been developed for conventional liquefaction assessments by Bradley Seismic Ltd and the University of Canterbury (Project Orbit, Conditional PGA's, 2012). Inferred PGA's for Biddick Courts site are shown in Table 3.

Table 3: Conditional Peak Ground Accelerations (PGA) for Biddick Courts according to information from Project Orbit *

Date of earthquake event	Magnitude	Peak Ground Acceleration (g) corrected for M_W=7.5
4th September 2010	7.1 (M_W)	0.19 to 0.20
22nd February 2011	6.3 (M_L)	0.44
13th June 2011	6.3 (M_L)	0.27 to 0.35
23 December 2011	5.3-6.0 (M_L)	No available data from Project Orbit

Notes:

M_W: Moment Magnitude Scale

M_L: Richter Magnitude Scale

*Bradley Seismic Ltd. and the University of Canterbury

A preliminary assessment for future probable liquefaction is based on the inferred ground conditions and surrounding CPT results, with the results being summarised in Table 4.

Table 4: In situ results and probability for liquefaction

Stratigraphy	Depth (m)	Average SPT (N)	Average q_c (MPa)	Density	Relative density (%)	Probability for liquefaction for earthquake acceleration 0.20g and groundwater 1.5m BGL (**)
Interbedded layers of Sand and Silt	0.0-6.6	21 (min* 2)	4	Medium dense	51.5	HIGH
SAND, fine, grey	6.6-15.5	35 (min 21)	16	Dense	70	MEDIUM
SAND, fine to medium, with some silt, grey	15.5-28.3	21 (min 1)	20	Medium dense	51.5	LOW
GRAVEL, sandy fine to coarse, very dense	28.3-30.5	50 (min 50)	22	Very dense	>85	LOW
(*): Minimum SPT N blow count encountered at some depth within the layer (**): After Seed and Idriss, 1971 (Bowles, 1997)						

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

The Department of Building and Housing has sub-divided the CERA "Green" residential recovery zone land on the flat in Christchurch into technical categories. The three technical categories are summarised in Table 5 which has been adapted from the Department of Building and Housing guidance document (DBH, November 2011).

Table 5: Technical Categories based on Expected Land Performance

Foundation Technical Category	Future land performance expected from liquefaction	Expected SLS land settlement	Expected ULS land settlement
TC 1	Negligible land deformations expected in a future small to medium sized earthquake and up to minor land deformations in a future moderate to large earthquake.	0-15 mm	0-25 mm
TC 2	Minor land deformations possible in a future small to medium sized earthquake and up to moderate land deformations in a future moderate to large earthquake.	0-50 mm	0-100 mm
TC 3	Moderate land deformations possible in a future small to medium sized earthquake and significant land deformations in a future moderate to large earthquake.	>50 mm	>100 mm

The property at Biddick Courts has been zoned as Green TC 3 "Blue Zone" with moderate land deformations possible in a future small to medium sized earthquake and significant land damage in a future moderate to large earthquake (refer Appendix A). However, the neighbouring residential properties from 70 m south of the site have been zoned as "Red" which is evaluated by CERA as not being practical to rebuild, repair or reoccupy as the required improvements would be too difficult or costly to implement. The extent of red zone is shown in Figure 2.

2.7 Lateral Spreading Hazard

Ground cracking of up to 200mm wide has been recorded by Canterbury Geotechnical Database 2012 to the west and south of the site, with up to 50mm wide cracking within the boundary (refer to Figure 4, Appendix A).

10mm to 50mm wide cracks are observed 35 up to 200 meters east from the Avon River.

A preliminary assessment for future probable lateral spreading is based on the inferred ground conditions (and the corresponding test results), with the results being summarised in Table 6.

Table 6: In situ results and probability for lateral spreading

Stratigraphy	Depth (m)	Average SPT (N)	Average q_c (MPa)	State of packing	Relative density (%)	Probability for lateral spreading for earthquake acceleration 0.20g and groundwater 1.5m BGL (**)
Interbedded layers of Sand and Silt	0.00-6.60	21 (min* 2)	4	Medium dense	51.5	HIGH
SAND, fine, grey	6.60-15.50	35 (min 21)	16	Dense	70	MEDIUM
SAND, fine to medium, with some silt, grey	15.50-28.30	21 (min 1)	20	Medium dense	51.5	LOW
GRAVEL, sandy fine to coarse, very dense	28.30-30.50	50 (min 50)	22	Very dense	>85	None
(*): Minimum SPT N blow count encountered at some depth within the layer (**): After Seed and Idriss, 1971 (Bowles, 1997)						

3. Site Walkover Inspection

A walkover inspection of the exterior of the Biddick Courts buildings and surrounding land was carried out by an Opus Geotechnical Engineer on 12 October 2012. The following observations were made (refer to Site Photographs and photo location plan in Appendix B):

- Up to 50 mm of heaving has occurred surrounding the storm water sewer in the entrance area (refer Figure 1);
- An area of paved parking (of approximately 6.5 m X 7.0 m) of the South car park has undergone heave and settlement, (Figure 2);
- A detached external wall on the south side of the Middle building appears to have subsided resulting in a crack 20 mm wide (refer Figures 3 & 4);
- Settlement of up to 70 mm of footpath along the east elevation of the Middle building (refer Figure 5) ;
- Several longitudinal and transverse cracks on stoned paved areas and footpaths of the three buildings. The widths of these cracks are generally less than 10 mm (refer Figures 6 and 7);
- Evidence of ejected liquefied material from sand boils surrounding the Middle and South buildings (Figure 8);
- Undulating ground surface in the clothes drying area in between the Middle and North buildings and the Middle and South buildings (refer Figure 9);
- The wooden fence tilts towards the West along the western boundary (Figure 10);
- Minor and moderate cracks in claddings of the North building (Figure 13);
- A sand boil has caused an area of 4.5 m X 3.0 m to heave; 4 m south of the southeast corner of the North building (refer Figure 17). Communications with residents suggest the heaving was triggered during the 13th June 2011 earthquake. The ground heave is approximately 100 mm at the crest.
- Stepped crack pattern <5 mm wide on the southwest corner of the South building (Figure 14).
- Stepped crack pattern 3-5 mm wide caused from settlement at the South building (Figure 15);
- Settlement crack below the corner of a window at the South building (Figure 16). The crack is 5 mm wide and possibly penetrates through the wall. Some movement may have taken place towards the southwest.

An internal levels survey of all units at Biddick Courts was undertaken by Opus surveyors dated November 2012. The annotated level survey results have been attached in Appendix F.

The level survey undertaken by Opus suggests that Biddick Courts units have undergone:

- Local movement at the North building with differential settlement of up to 44mm with slope up to 6.6mm/m. The sand boil at the southeast corner of the building may have triggered the local movement (refer Site Photographs, Figure 17).
- Global tilting for the whole of the South building with differential settlement of up to 104 mm in the east-west direction.

- Local areas on South building that exceed building guidelines and differential settlements with maximums slope of up 8mm/m. This pattern of differential settlement is consistent with the observed cracking locations south of the site and may be associated with lateral spreading towards Avon River.

4. Discussion

Foundations of the buildings at Biddick Courts generally appear to have performed well in the recent seismic events.

Step cracking, the level survey results and tilting of walls indicate some differential settlement of the foundations has occurred.

Residential properties 75 m from the southern boundary have been zoned "Red", indicating that the land is not practical to rebuild, repair or reoccupy, as the required improvements would be too difficult or costly to implement.

Brief evaluation of surrounding site investigation data indicates that the Biddick Courts site is likely to undergo significant liquefaction ground damage during future seismic events. Observations of cracks at the buildings confirm that some liquefaction induced subsidence has occurred at the site.

Due to the close proximity of the Avon River to Biddick Courts and the liquefaction potential of the soil profile the site is considered to have a high lateral spreading potential. A detailed investigation and assessment of the liquefaction and the lateral spreading potential for this site is recommended to more accurately assess and quantify the risk. The site may also be at risk from flooding of the Avon River, as has been identified in the CCC Flood Management Area.

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, 2012) indicates there is 12% probability of another Magnitude 6 or greater earthquakes occurring in the next 12 months in the Canterbury region (21 January 2013-20 January 2014). Such events may cause liquefaction induced land damage and lateral spreading; dependent on the location of the earthquakes epicentre. This confirms that there is currently a significant risk of liquefaction ground settlements and lateral spreading occurring at the site. It is expected that the probability of occurrence is likely to decrease with time following periods of reduced seismic activity.

5. Recommendations

Deep site investigation scheme comprising of at least 6 Cone Penetrometer Tests (CPT's) to a depth of 20 m and four scalas to 4-5 m depth to enable a site wide liquefaction and lateral spreading assessment is recommended. Case studies have shown that the possible liquefaction zone usually extends from the ground surface to a maximum of 15 m (Day, 2000). Deeper soils generally do not liquefy because of higher confining pressures. Thus the 20 m target depth for the CPT's is considered sufficient. In the case of very loose ground conditions, the depth may increase according to the nature of the findings. The proposed locations of the six CPT's are shown in Appendix E. Liquefaction analysis shall be performed on the data collected from the six CPT's.

It is recommended that;

- A deep site investigation scheme comprising of at least six Cone Penetrometer Tests to a target depth of 20 m;
- Four scalas to 4-5 m depth located near building foundations;
- Review of the flood risk to the site based on updated topographic surveys of the area and predicted flooding river levels;
- Floor slab inspection at isolated locations, may be required to assess floor slab damage.

6. Limitations

This report has been prepared solely for the benefit of the Christchurch City Council as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

It is recognised that the passage of time affects the information and assessment provided in this Document. The recommendations formed in this report are based upon information that existed at the time of production of the 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.

For the interpretation of the level survey it was assumed that the floor slabs in any one building were cast at the same initial level.

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List of Appendices:

Appendix A (Figures 1 to 4):

1: Site Location Plan

2: DBH Residential Foundation Technical Categories

3: Surrounding Site Investigations layout plan

4: Ground Cracking

Appendix B: Site photographs including location plan

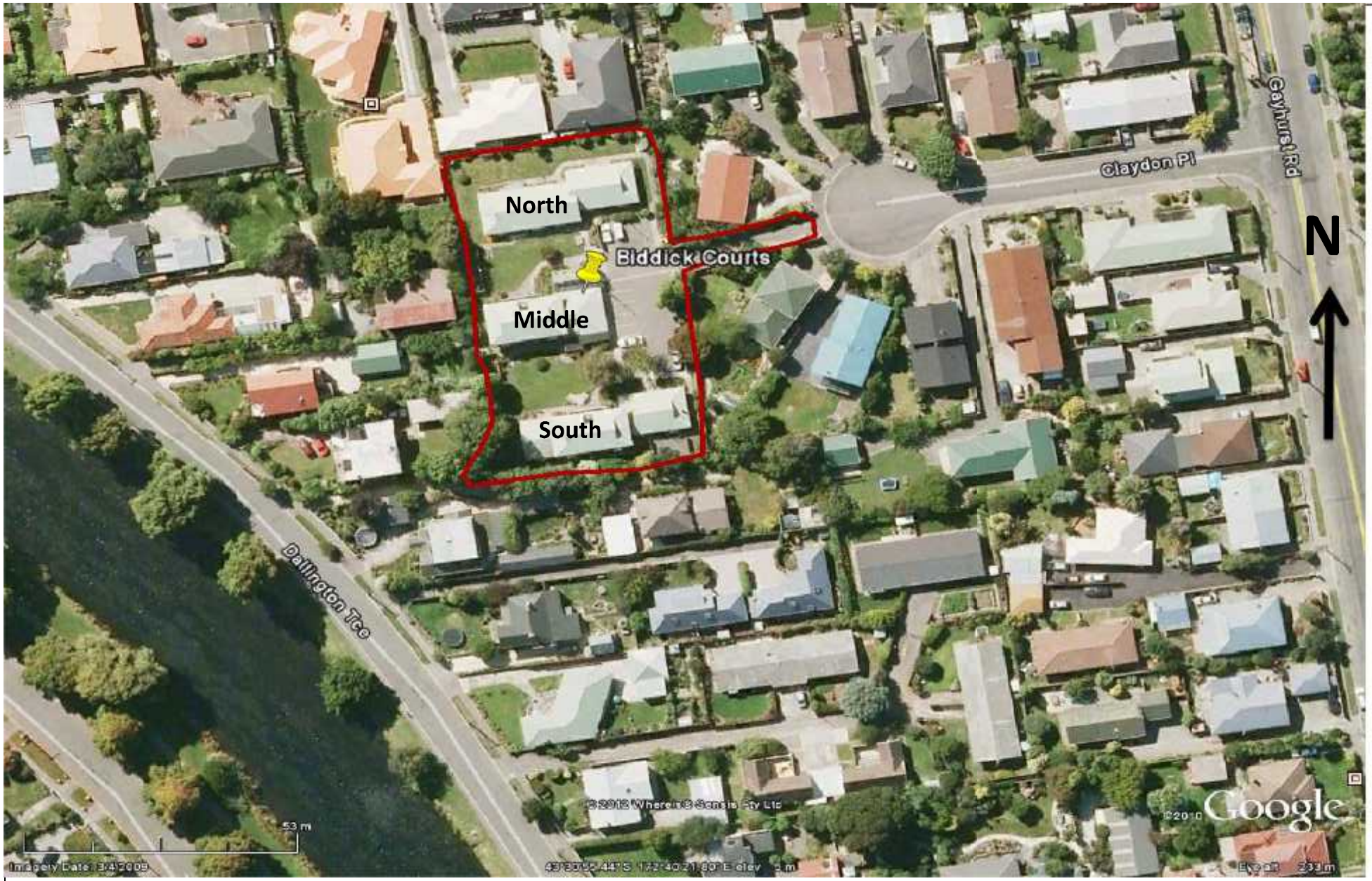
Appendix C: Available structural drawings

Appendix D: CPT's, borehole logs and ECan borehole logs

Appendix E: Proposed Site Investigations

Appendix F: Opus Level Survey

Appendix A



OPUS

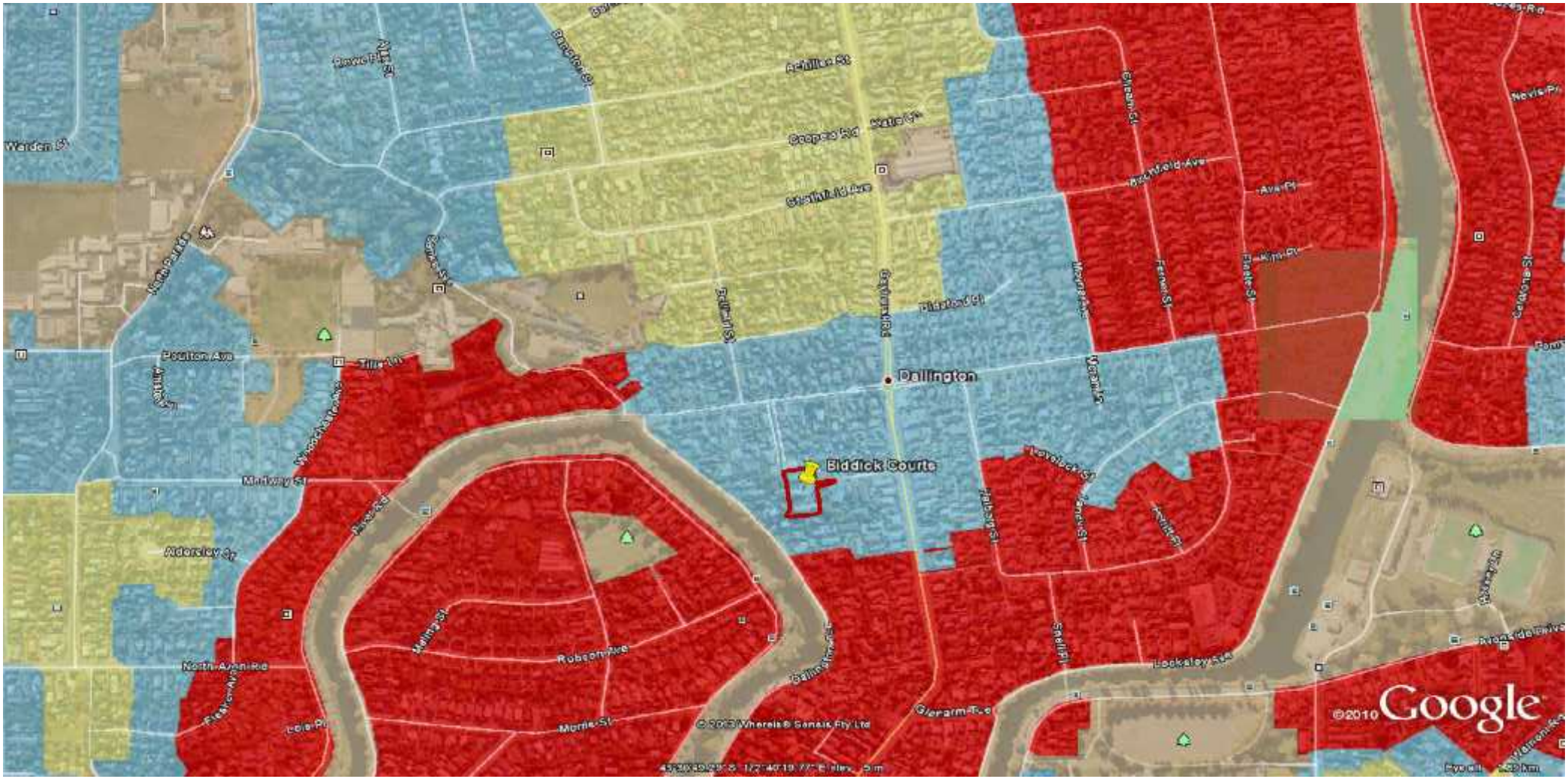
Opus International Consultants Ltd
Christchurch Office
20 Moorhouse Ave
PO Box 1482
Christchurch, New Zealand
Tel: +64 3 363 5400 Fax: +64 3 365 7857

Project:	Biddick Courts, Claydon Place, Dallington
Project No.:	6-QUCC1.98 005SC
Client:	Christchurch City Council

Figure 1: Site Location Plan

Drawn: Opus Geotechnical Engineer

Date: 19-Oct-12



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:** Biddick Courts, Claydon Place, Dallington **Project No.:** 6-QUCC1.98 005SC **Client:** Christchurch City Council	**Figure 2: DBH Residential Foundation Technical Categories** **Drawn:** Opus Geotechnical Engineer **Date:** 19-Oct-12

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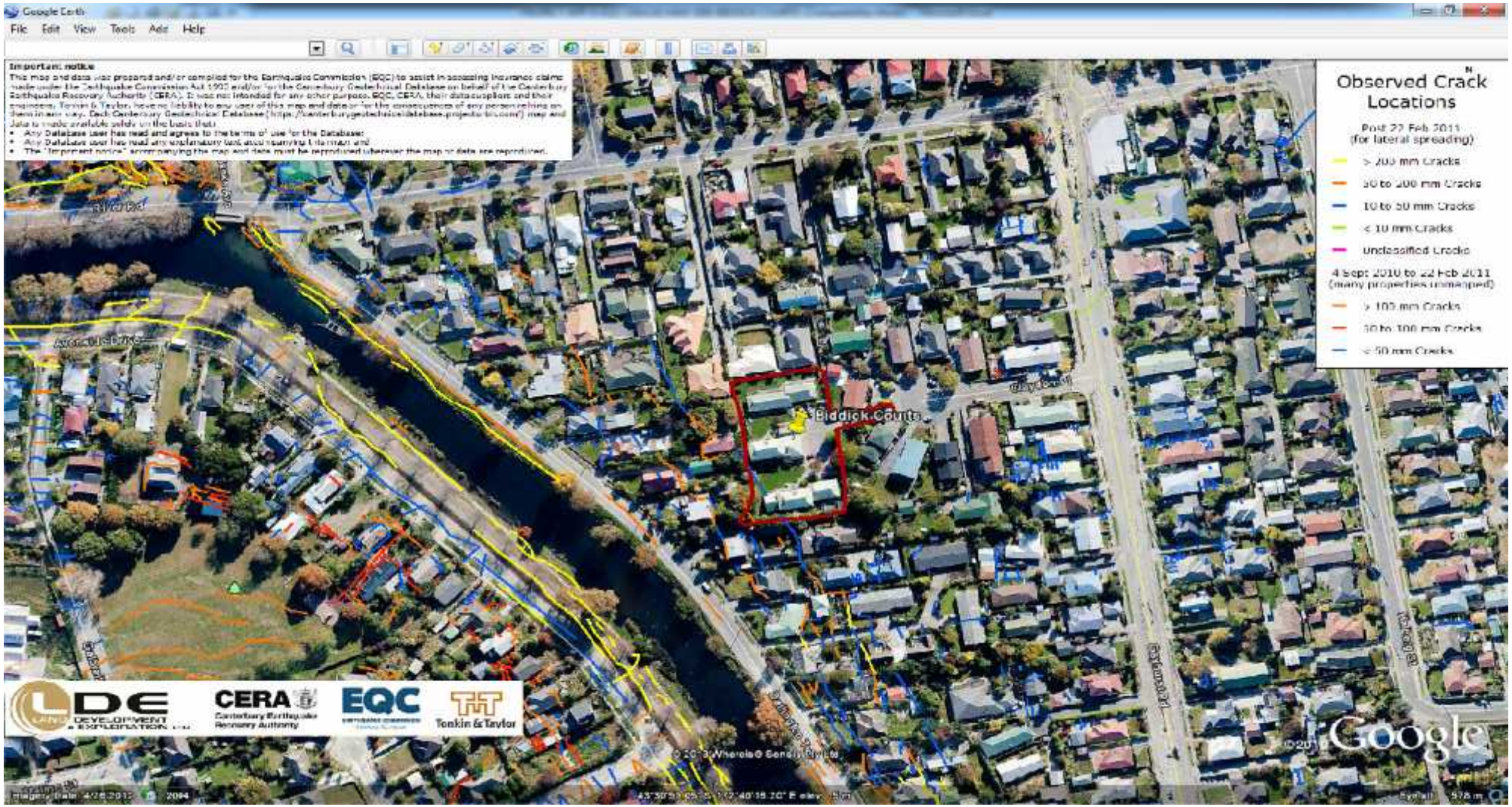
Project: Biddick Courts, Claydon Place, Dallington
Project No.: 6-QUCC1.98 005SC
Client: Christchurch City Council

Figure 3: Surrounding Site Investigations layout plan

Drawn: Opus Geotechnical Engineer

Date: 19-Oct-12



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Project: Biddick Courts, Claydon Place, Dallington
Project No.: 6-QUCC1.98 005SC
Client: Christchurch City Council

Figure 4: Ground Cracking

Drawn: Opus Geotechnical Engineer

Date: 19-Oct-12

Appendix B:
Site Photographs

Figure 1: Up to 50 mm of heaving has occurred surrounding the storm water sewer in the entrance area.

Figure 2: An area of the south car park (approximately 6.5 m X 7.0 m) has undergone heaving and settlement.

Figure 3: A 20mm crack at the Middle building that detaches the walling from the cladding.

Figure 4: Adjacent panel to that shown in Figure 7, indicating similar movement.

Figure 5: The foundation of the middle building is exposed by 70 mm from its initial position due to possible settlement of the surrounding ground. (Middle building, east side).

Figure 6: Longitudinal 5 mm wide cracks outside the residents' lounge, Middle building on stone paved entrance.

Figure 7: A 5 mm diagonal crack developed at the concrete footpath, Middle building. There are no signs of damage on the cladding.

Figure 8: Liquefied material ejected (grey silt with some fine sand) from sand boils that surrounded the Middle building.

Figure 9: Undulating surface of the residents clothes drying areas. Some minor cracking up to 5 mm wide.

Figure 10: A wooden fence at the West side of Biddick Courts that leans outwards towards the adjacent property. The tilt is estimated as 10°.

Figure 11: External claddings of North building.

Figure 12: A general view of the west side of the South building. The building has no signs of significant damage.

Figure 13: A minor crack at the joint of the cladding. Width: 5-10mm. The crack does not appear to penetrate through the cladding in the North side of the North building.

Figure 14: Stepped pattern of crack <5mm just below the window of flat 3, South building.

Figure 15: Stepped settlement crack at flat 1, South building, 3-5mm wide.

Figure 16: Settlement crack below the corner of the window, South building. The crack has width <5mm and possibly penetrates through the wall. Movement may have taken place towards the South west.

Figure 17: South side of the North building, as a result of liquefaction during 13th June 2011 earthquake. The dimensions of the bulge are 4.50 m X 3 m and the ground heave is 100 mm. Ejected Silty material (grey, non-plastic) is deposited.

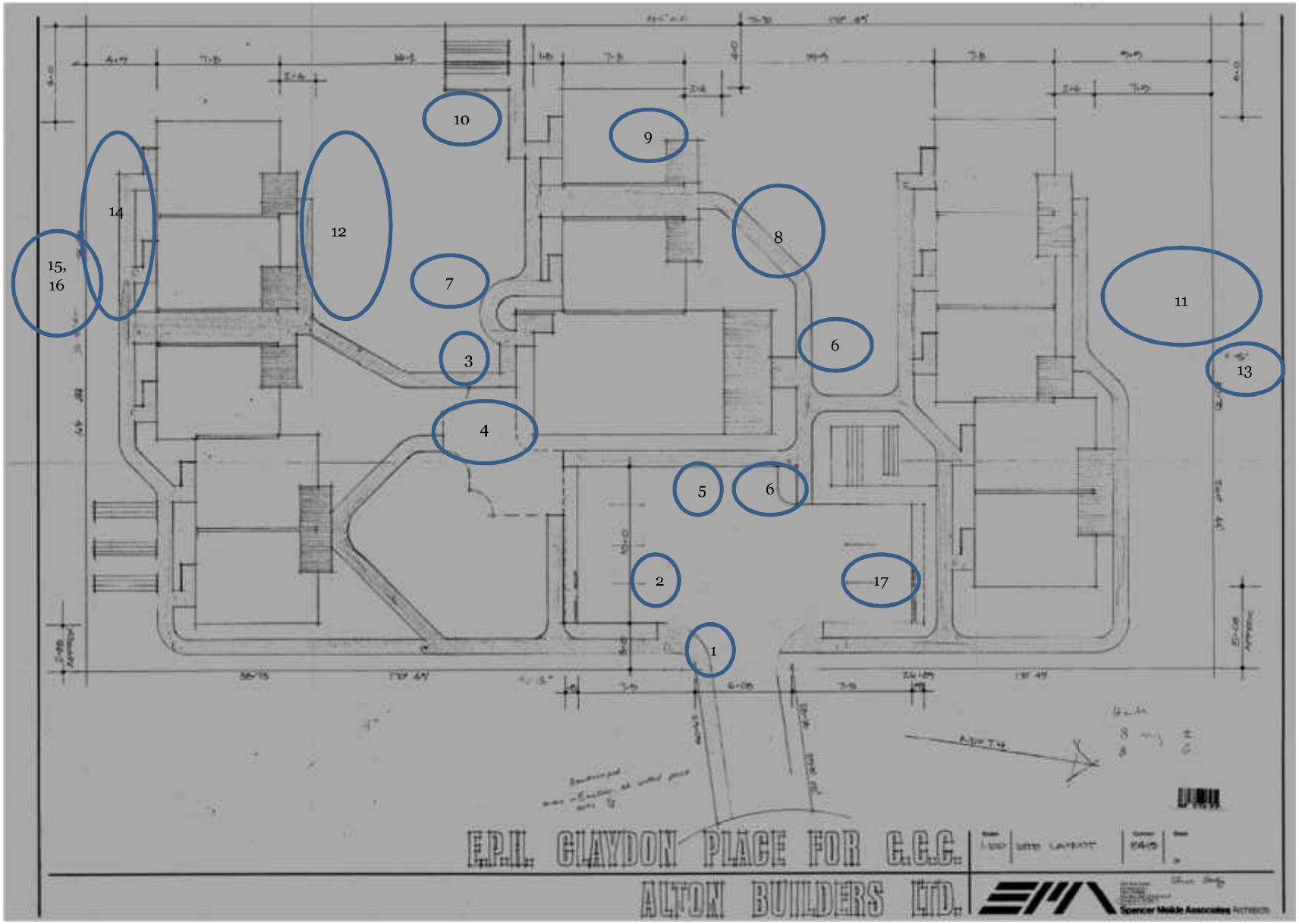
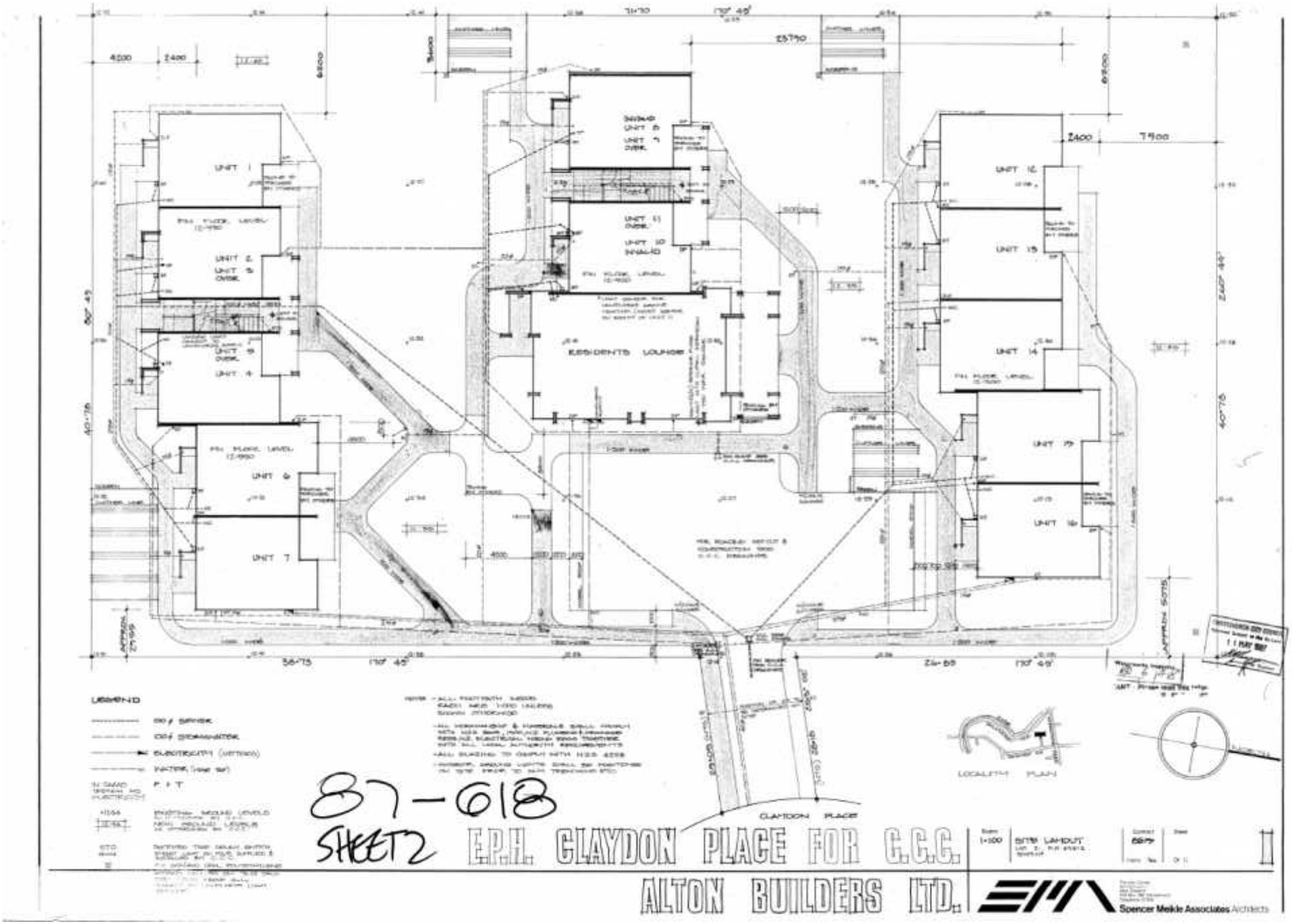
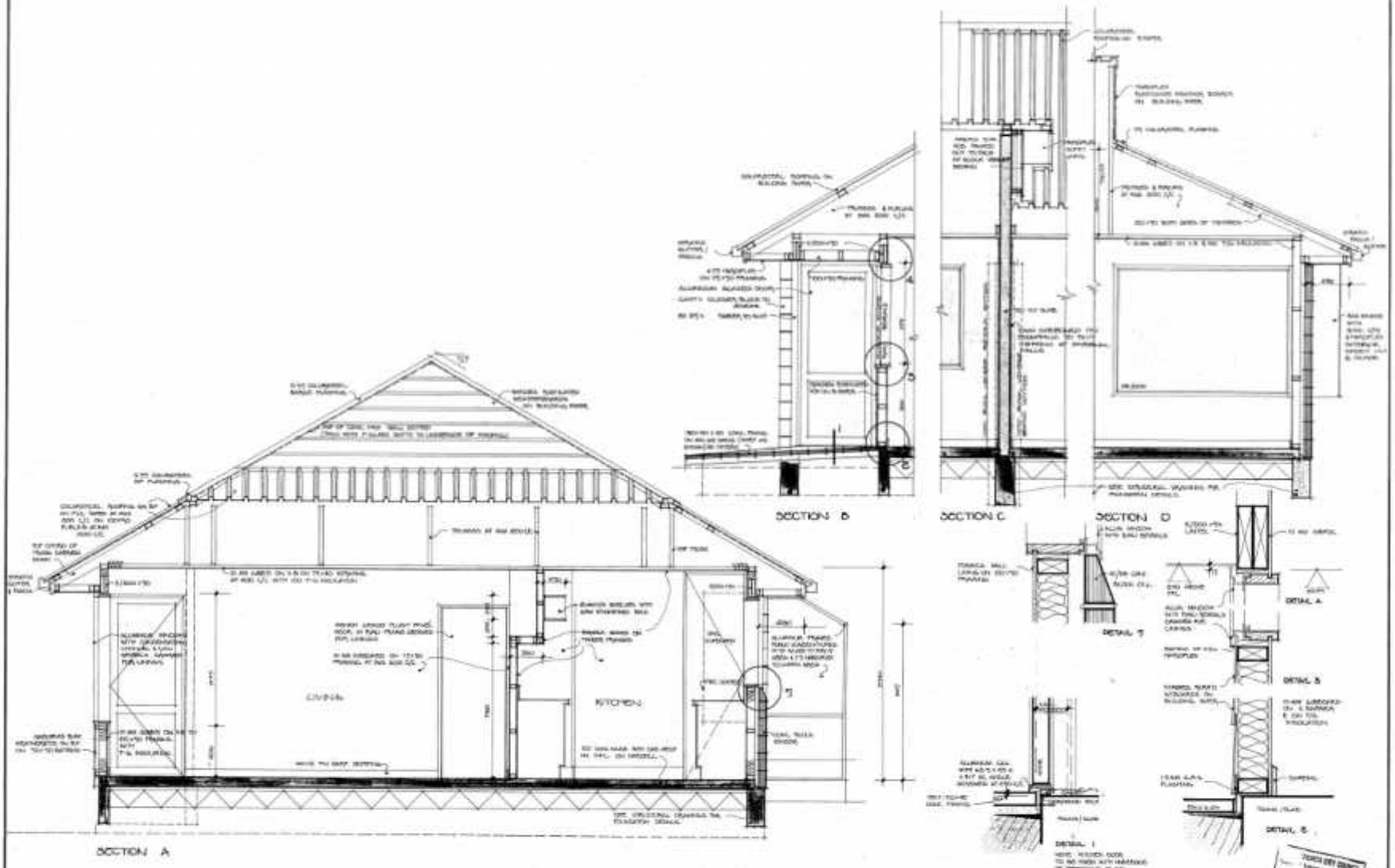


Figure 18: Location of photos 1 to 17

Appendix C:
Available Structural Drawings


UNIT 1
UNIT 2
UNIT 3
UNIT 4
UNIT 5
UNIT 6
UNIT 7
UNIT 8
UNIT 9
UNIT 10
UNIT 11
UNIT 12
UNIT 13
UNIT 14
UNIT 15
UNIT 16
UNIT 17
RESIDENTS LOUNGE
CLAYDON PLACE
LOCALITY PLAN
LEGEND
87-618
SHEET 2
E.P.H. CLAYDON PLACE FOR C.C.C.
ALTON BUILDERS LTD.
SITE LAYOUT
Spencer Meikle Associates Architects



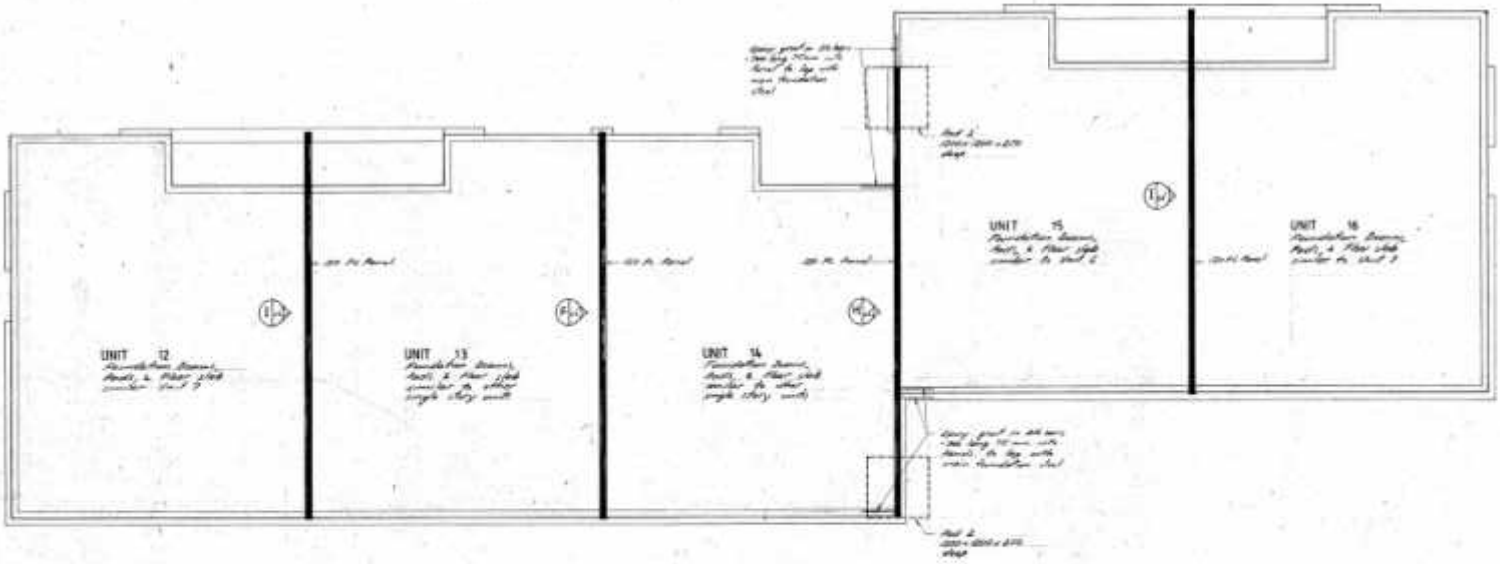
E.P.H. CLAYDON PLACE FOR C.C.C.

ALTON BUILDERS LTD.

SECTION A,B,C,D DETAILS

Spencer Meikle Associates Architects

6



Foundation Floor Slab & P.C. Panel Plan

1:50

CHRISTCHURCH CITY COUNCIL
1 MAY 1987

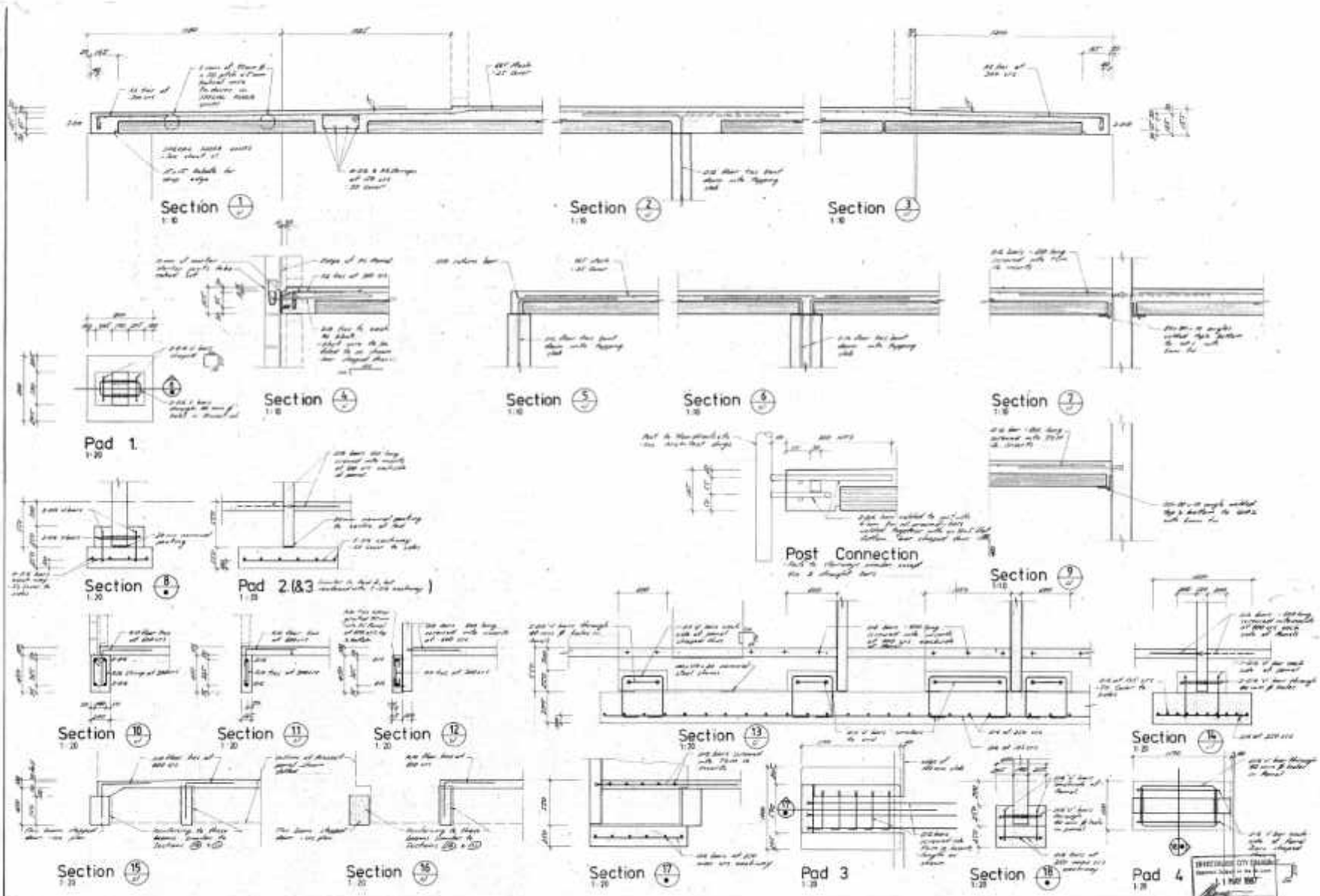
Spencer Meikle Associates Architects

E.P.H. CLAYDON PLACE FOR G.C.G. Alton Builders Ltd

TYNDALL AND HANHAM

S3

1532-13



Spencer Mekin Associates Architects

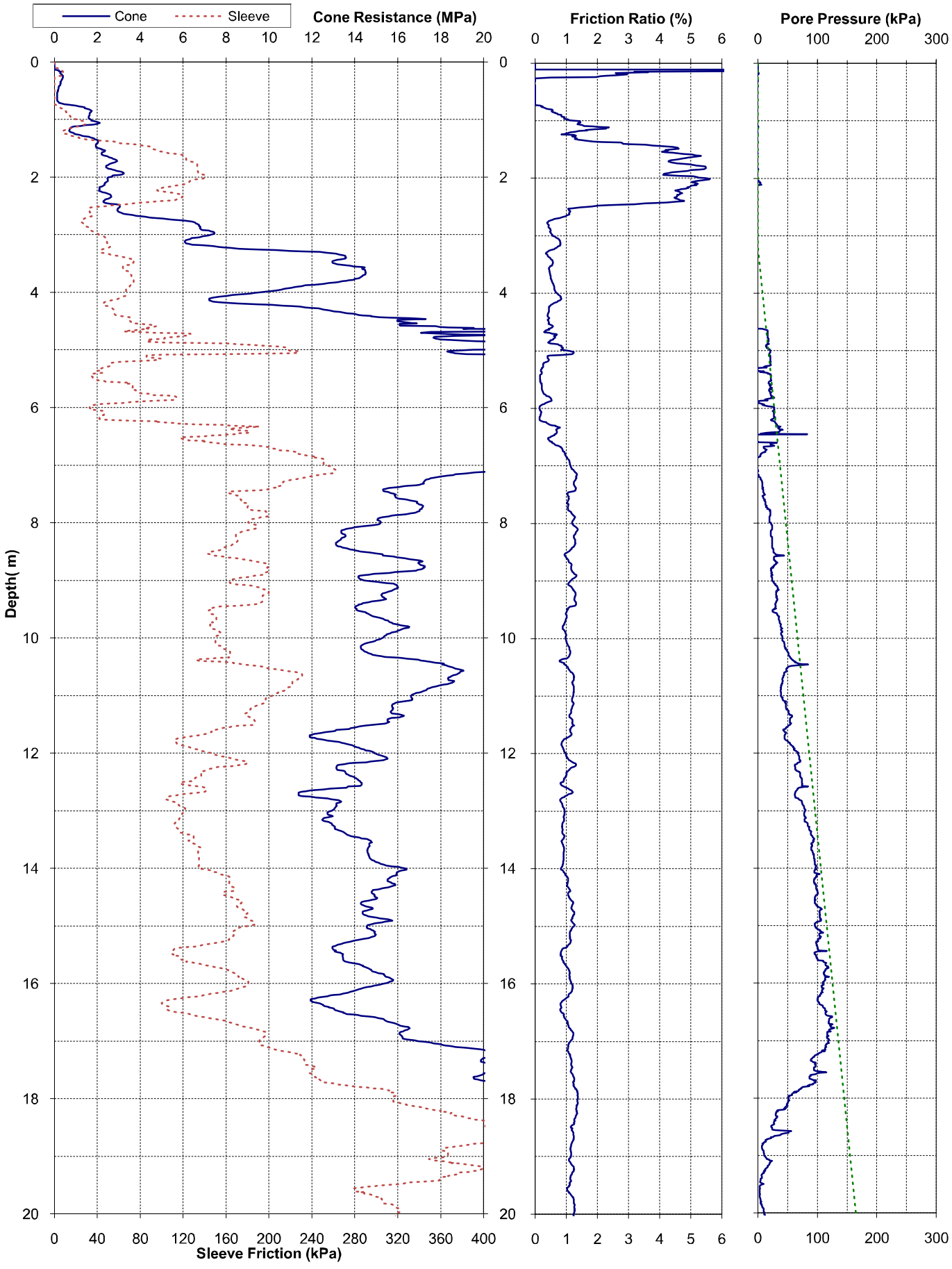
E.P.H. CLAYDON PLACE FOR C.C.C.

Alton Builders Ltd

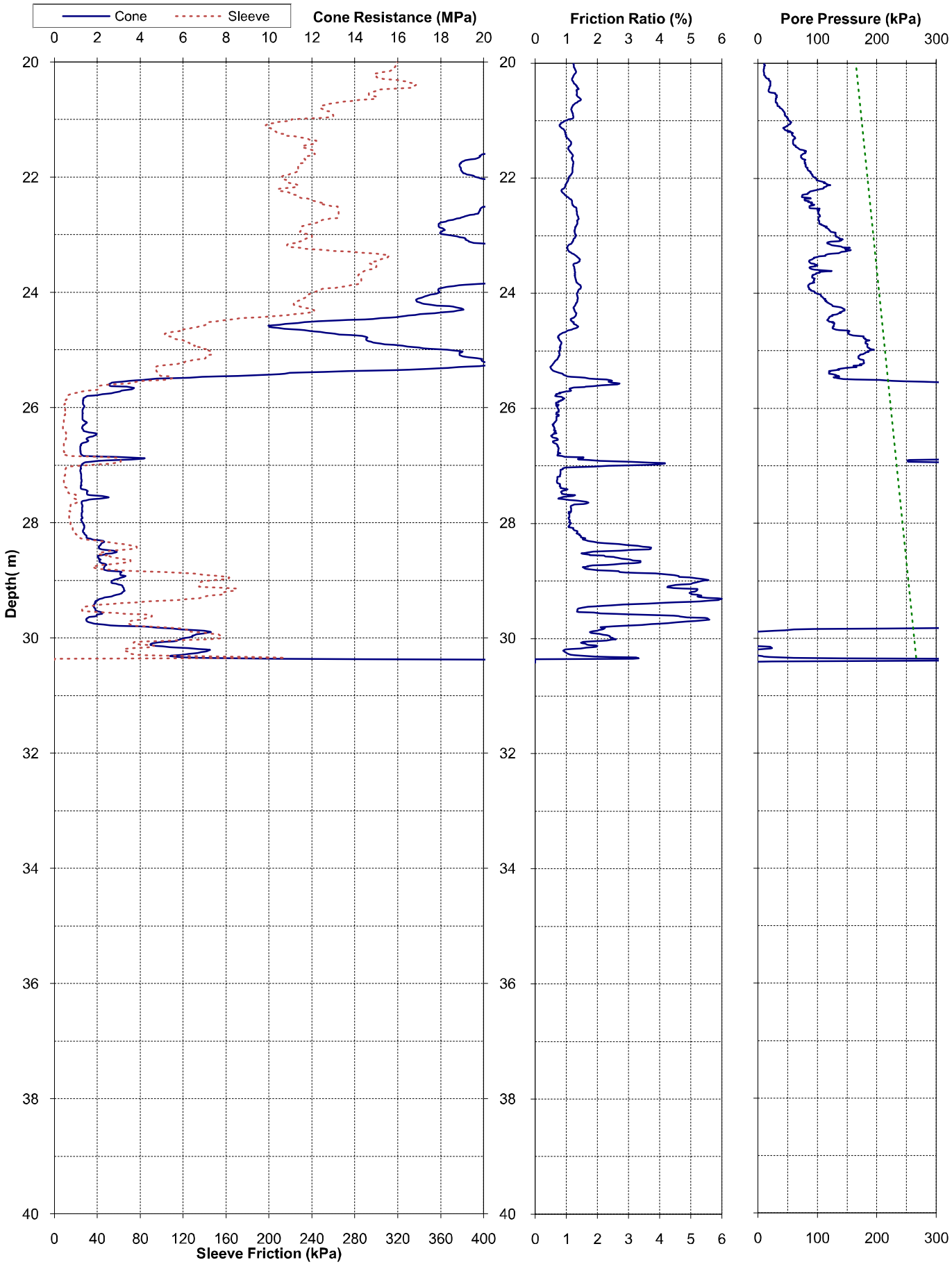
TYNDALL AND HANHAM

Appendix D:
CPT's, borehole logs and ECan borehole logs

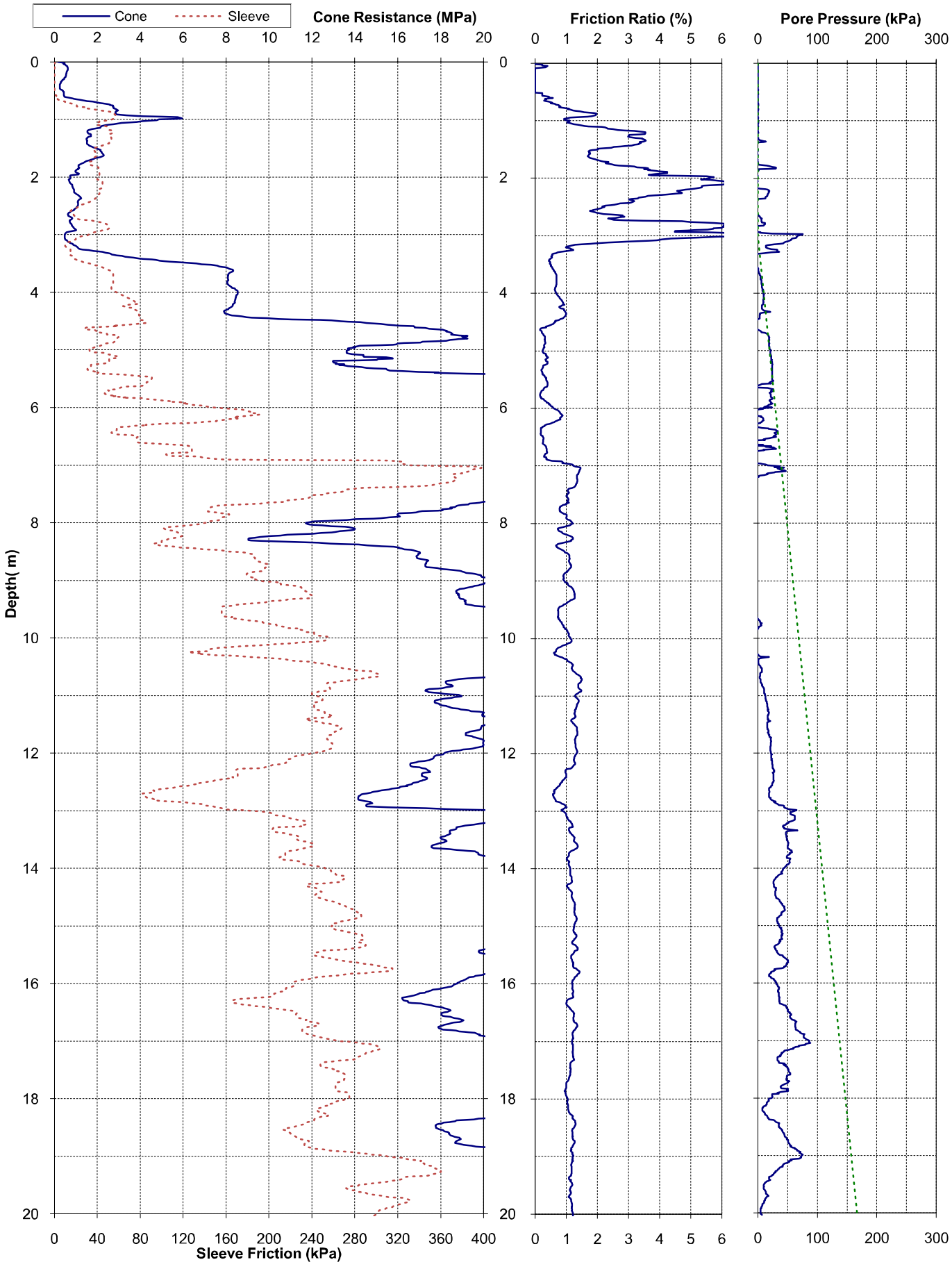
Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 1 of 2	CPT-DAL-17
Test Date:	19-Nov-2010	Location:	Dallington	Operator:	Perry
Pre-Drill:	0.8m	Assumed GWL:	3.2mBGL	Located By:	Survey GPS
Position:	2483496.7mE	5743447mN	3.3mRL	Coord. System:	NZMG & MSL
Other Tests:				Comments:	



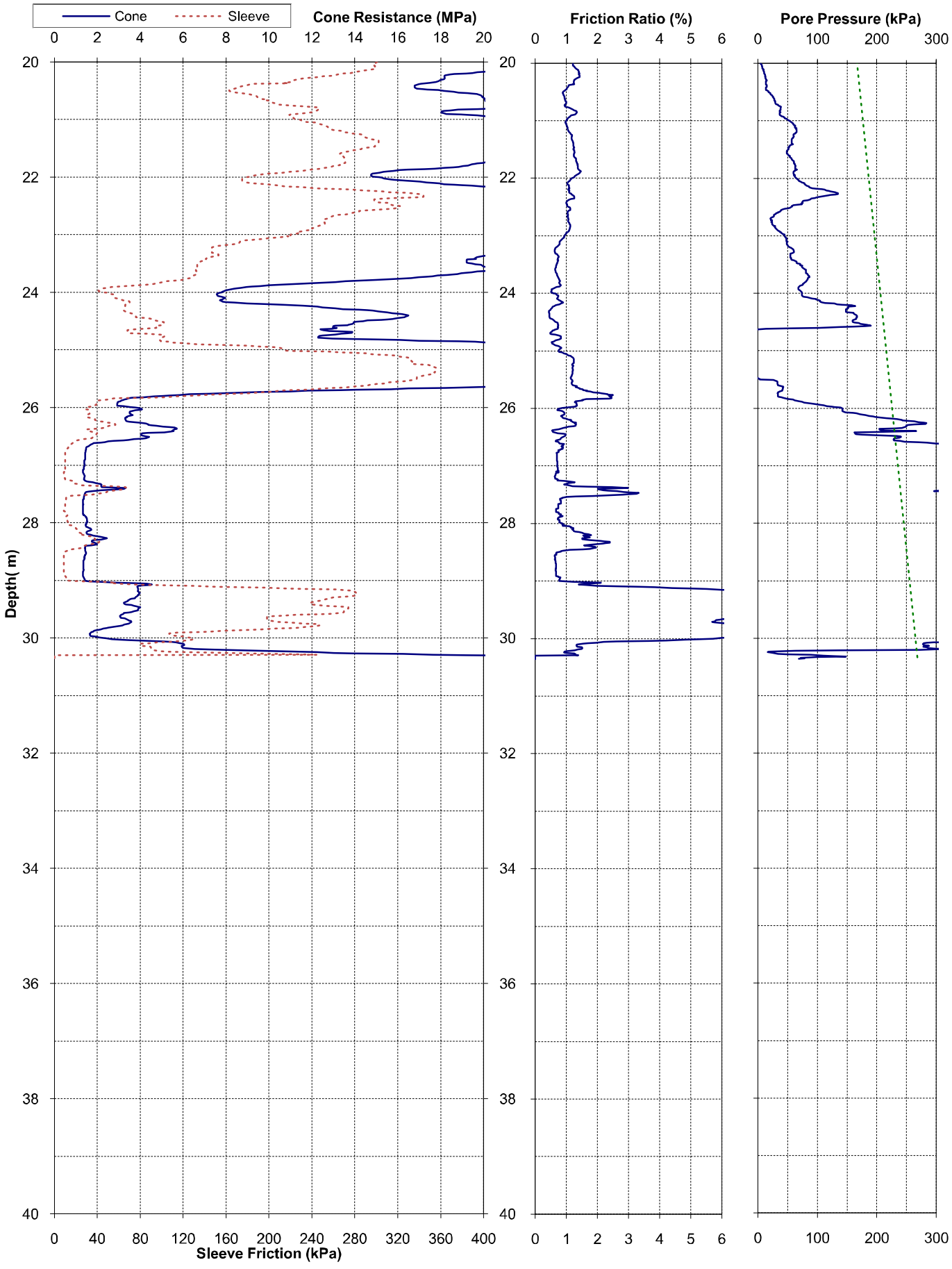
Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 2 of 2	CPT-DAL-17
Test Date:	19-Nov-2010	Location:	Dallington	Operator:	Perry
Pre-Drill:	0.8m	Assumed GWL:	3.2mBGL	Located By:	Survey GPS
Position:	2483496.7mE	5743447mN	3.3mRL	Coord. System:	NZMG & MSL
Other Tests:				Comments:	



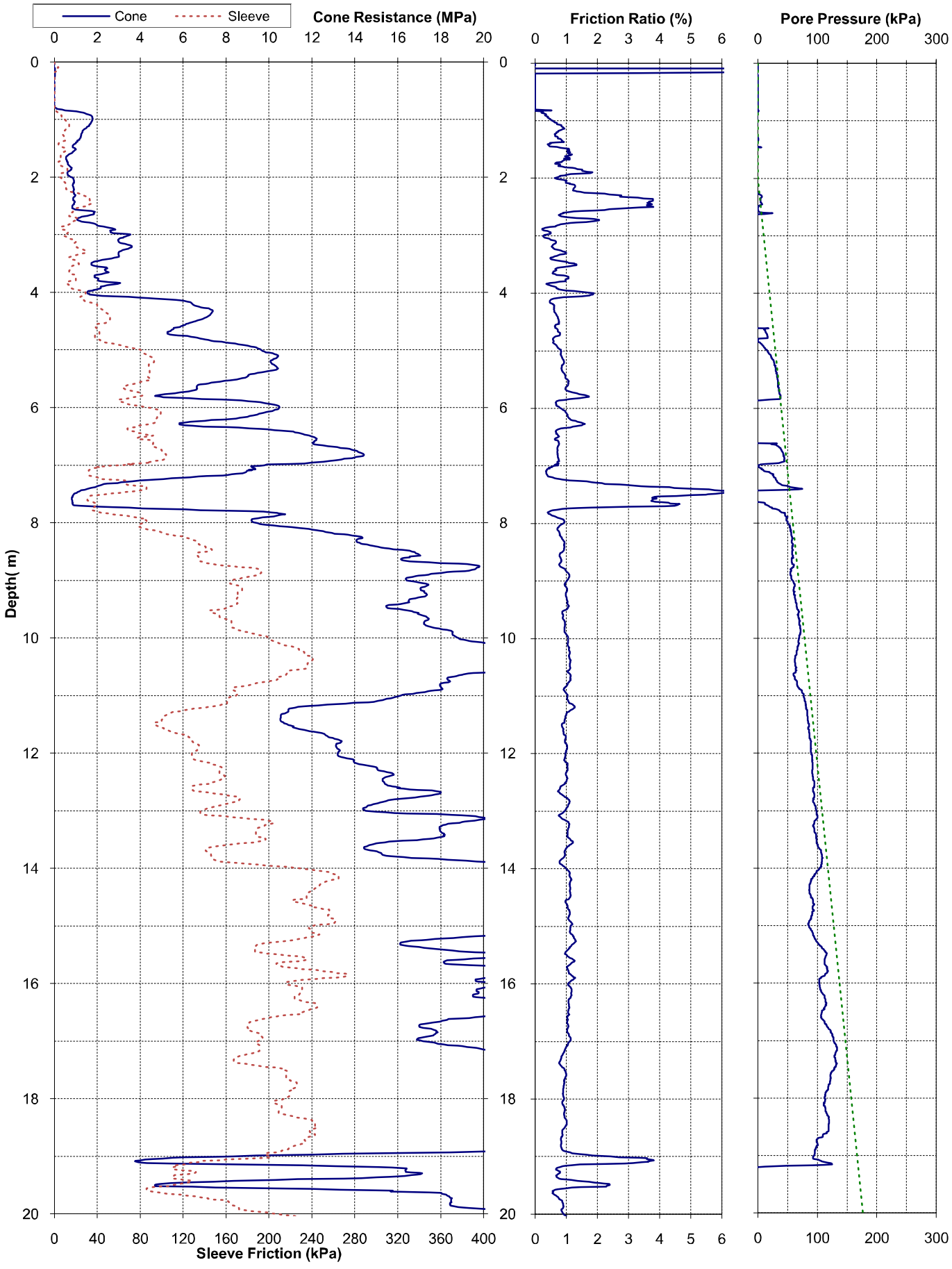
Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 1 of 2	CPT-DAL-38
Test Date:	19-Nov-2010	Location:	Dallington	Operator:	Perry
Pre-Drill:	0.8m	Assumed GWL:	3mBGL	Located By:	Survey GPS
Position:	2483321.1mE	5743615.5mN	3.52mRL	Coord. System:	NZMG & MSL
Other Tests:				Comments:	



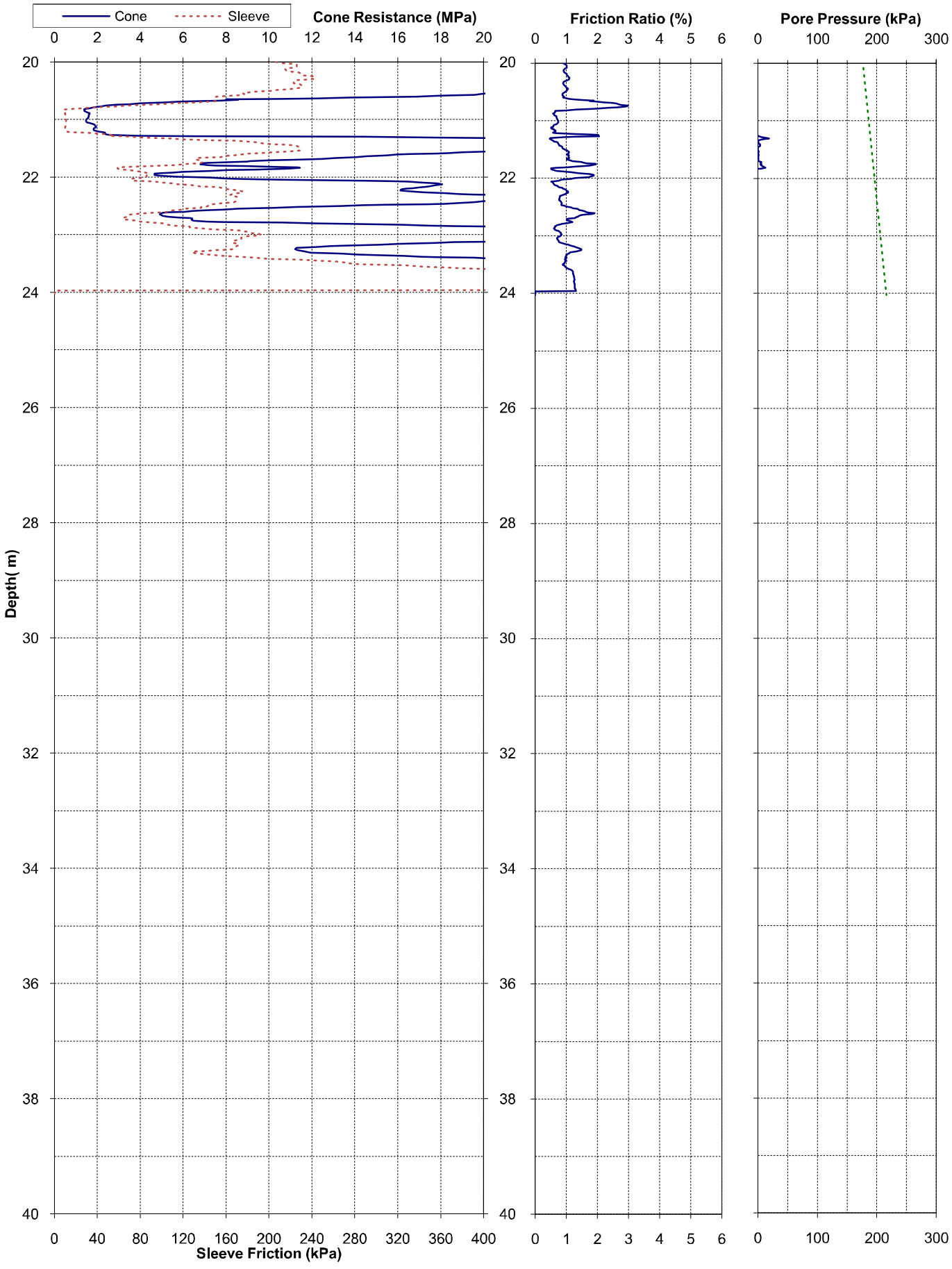
Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 2 of 2	CPT-DAL-38
Test Date:	19-Nov-2010	Location:	Dallington	Operator:	Perry
Pre-Drill:	0.8m	Assumed GWL:	3mBGL	Located By:	Survey GPS
Position:	2483321.1mE	5743615.5mN	3.52mRL	Coord. System:	NZMG & MSL
Other Tests:				Comments:	



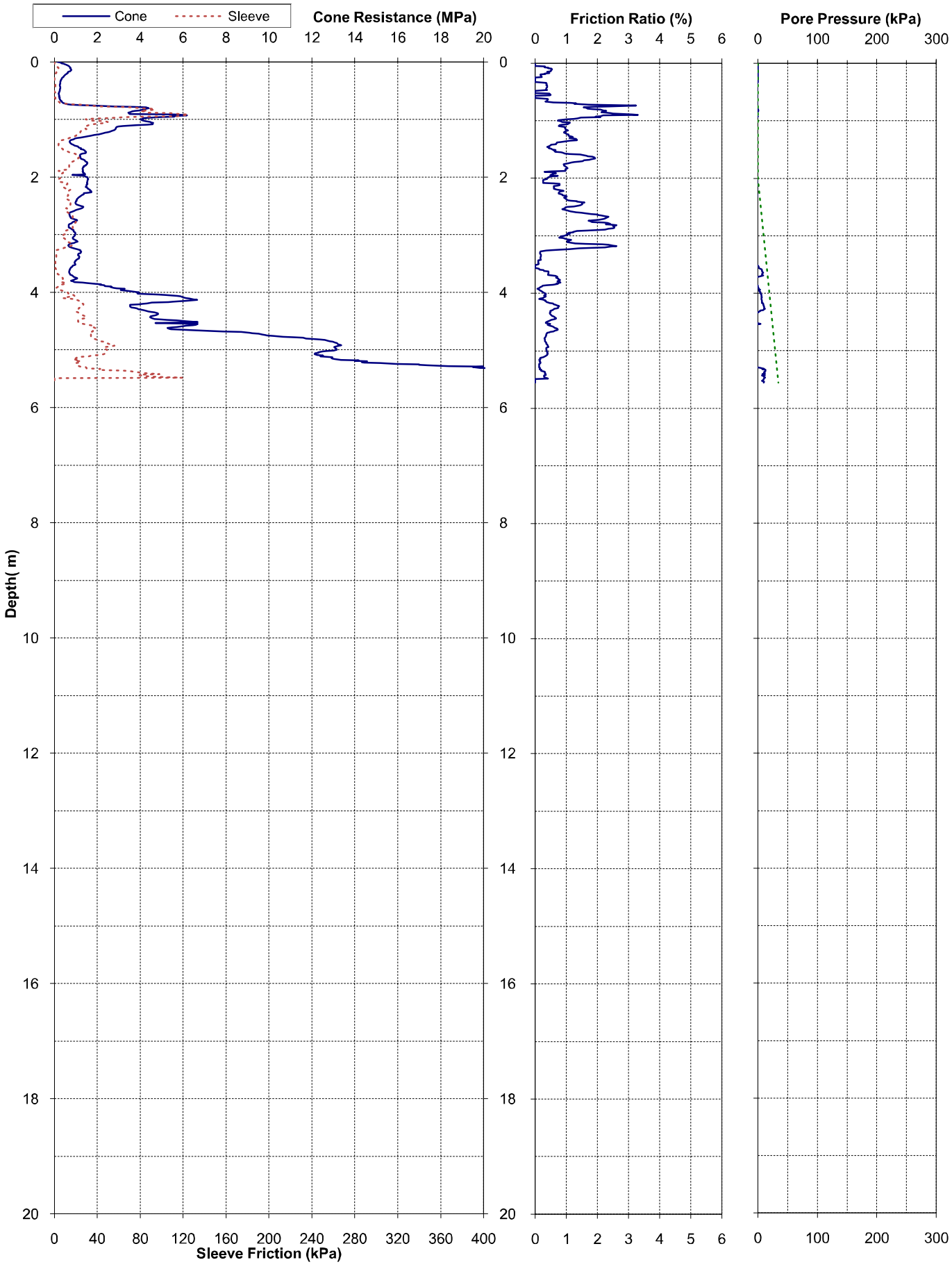
Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 1 of 2	CPT-DAL-18
Test Date:	18-Nov-2010	Location:	Dallington	Operator:	Perry
Pre-Drill:	0.8m	Assumed GWL:	2mBGL	Located By:	Survey GPS
Position:	2483688.9mE	5743389.7mN	2.96mRL	Coord. System:	NZMG & MSL
Other Tests:				Comments:	



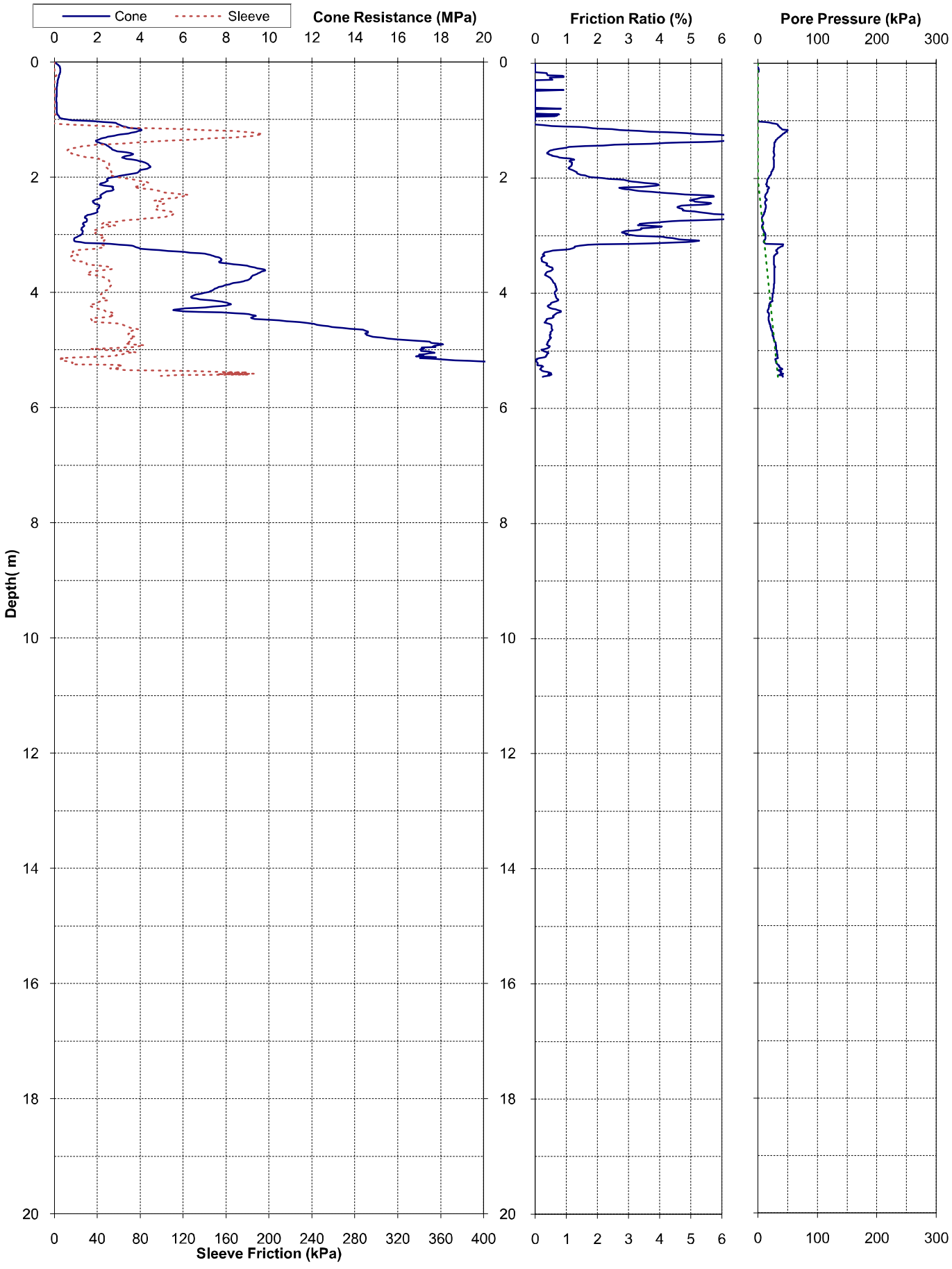
Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 2 of 2	CPT-DAL-18
Test Date:	18-Nov-2010	Location:	Dallington	Operator:	Perry
Pre-Drill:	0.8m	Assumed GWL:	2mBGL	Located By:	Survey GPS
Position:	2483688.9mE	5743389.7mN	2.96mRL	Coord. System:	NZMG & MSL
Other Tests:				Comments:	



Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 1 of 1		CPT-RCH-16
Test Date:	24-Nov-2010	Location:	Richmond	Operator:	Opus	
Pre-Drill:	0.8m	Assumed GWL:	2mBGL	Located By:	Survey GPS	
Position:	2483299.4mE	5743648.4mN	3.85mRL	Coord. System:	NZMG & MSL	
Other Tests:	Seismic downhole			Comments:		



Project:	Darfield 2010 Earthquake - EQC Ground Investigations			Page: 1 of 1		CPT-RCH-32
Test Date:	7-Dec-2010	Location:	Richmond	Operator:	McMillan	
Pre-Drill:	1.2m	Assumed GWL:	2mBGL	Located By:	Survey GPS	
Position:	2483299.5mE	5743648.5mN	3.84mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-04
Hole Location:
BH-AVS-04-Avonside
SHEET 1 OF 4

PROJECT: Darfield 2010 Earthquake - EQC Ground Investigations		LOCATION: Avonside	JOB No: 51731.001
CO-ORDINATES	5743505.15 2483383.73	DRILL TYPE:	HOLE STARTED: 22/11/10
		DRILL METHOD: Open barrel/Concentrix	HOLE FINISHED: 25/11/10
R.L.	1.65 m		DRILLED BY: CW Drilling
DATUM	Lyttleton 1937	DRILL FLUID: N/A	LOGGED BY: ZDP CHECKED: BMcD

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
HAND DIG FILL?			75					1.5	0.5		SM	D					FILL: Silty, fine SAND with some gravel, brown. Dry, poorly graded. Gravel is fine.
								1.0	0.5								0.5
YALDHURST FORMATION			66					0.5	1.0		SM	D					Silty, fine SAND, brown. Dry, poorly graded.
								0.0	1.5			W					1.0
								-0.5	2.0								- becomes more silty and wet
			100	OPEN BARREL		1/1/1 *N=2 FC	B	-1.0	2.5		MLS	W					Sandy SILT, grey. Wet, low plasticity, cohesive. Sand is fine. 1.5
						*PSD		-1.5	3.0		SW	S					Fine to medium SAND, grey. Saturated, well graded. 2.0
			100					-2.0	3.5								2.5
			50			*FC 2/4/4 N=8	B	-2.5	4.0		SW	S					Fine to medium SAND, grey. Saturated, well graded. 3.0
			63					-3.0	4.5								3.5
			100			*FC 6/8/8 N=16	B		5								4.0
			100														4.5

T+T DATATEMPLATE.GDT eek

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-04
Hole Location:
BH-AVS-04-Avonside
SHEET 2 OF 4

PROJECT: Darfield 2010 Earthquake - EQC Ground Investigations		LOCATION: Avonside	JOB No: 51731.001
CO-ORDINATES	5743505.15 2483383.73	DRILL TYPE:	HOLE STARTED: 22/11/10 HOLE FINISHED: 25/11/10
R.L.	1.65 m	DRILL METHOD: Open barrel/Concentrix	DRILLED BY: CW Drilling
DATUM	Lyttleton 1937	DRILL FLUID: N/A	LOGGED BY: ZDP CHECKED: BMcD

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
YALDHURST FORMATION			100	OPEN BARREL				-3.5	5.5		SW	S					Fine to medium SAND, grey. Saturated, well graded.
			83			✱PSD ✱FC 4/12/11 N=23	B B	-4.0	6.0		GP	S					5.5 Medium GRAVEL with some sand, grey. Saturated, poorly graded, subrounded. Sand is fine to medium.
			40					-4.5	6.5								6.0 6.5
								-5.0	7.0		SP	S					7.0 Fine SAND, grey. Saturated, poorly graded.
								-5.5	7.5		SP	S					Medium SAND, grey. Saturated, poorly graded.
			100			10/15/16 ✱N=31 FC	B	-6.0	8.0		SP	S					7.5 Gravelly, fine SAND, grey. Saturated, poorly graded. Gravel is medium, subrounded.
			100					-6.5	8.5		SP	S					8.0 Fine SAND, grey. Saturated, poorly graded.
			100			✱FC 8/17/18 N=35	B	-7.0	9.0		GP SP	S S					8.5 - very thin bed of fine, rounded gravel 9.0 Fine GRAVEL with some sand, grey. Saturated, poorly graded, rounded. Sand is fine.
CHRISTCHURCH FORMATION (Marine/Coastal)			100			✱FC		-7.5	9.5								Fine SAND, grey. Saturated, poorly graded. 9.5
								-8.0	10								

T+T DATATEMPLATE.GDT eek

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-04
Hole Location:
BH-AVS-04-Avonside
SHEET 3 OF 4

PROJECT: Darfield 2010 Earthquake - EQC Ground Investigations | LOCATION: Avonside | JOB No: 51731.001

CO-ORDINATES 5743505.15
2483383.73

R.L. 1.65 m

DATUM Lyttleton 1937

DRILL TYPE:

DRILL METHOD: Open barrel/Concentrix

DRILL FLUID: N/A

HOLE STARTED: 22/11/10
HOLE FINISHED: 25/11/10
DRILLED BY: CW Drilling
LOGGED BY: ZDP CHECKED: BMcD

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
CHRISTCHURCH FORMATION (Marine)			65	OPEN BARREL		*FC 7/19/31 N=50	B	-8.5	10.5		SP	S					Fine SAND, grey. Saturated, poorly graded, homogeneous.
			100					-9.0			SP	S					Fine SAND, grey. Saturated, poorly graded, homogeneous. - thin bed of fine, rounded gravel
			100					-9.5	11.0								
			100			12/18/32 N=50		-10.0	11.5								
			100					-10.5	12.0								
			100					-11.0	12.5								
			100					-11.5	13.0								
			87			7/10/22 N=32		-12.0	13.5								
								-12.5	14.0								
								-13.0	14.5								
									15								

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

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

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-04
Hole Location:
BH-AVS-04-Avonside
SHEET 4 OF 4

PROJECT: Darfield 2010 Earthquake - EQC Ground Investigations | LOCATION: Avonside | JOB No: 51731.001

CO-ORDINATES 5743505.15
2483383.73

R.L. 1.65 m

DATUM Lyttleton 1937

DRILL TYPE:

DRILL METHOD: Open barrel/Concentrix

DRILL FLUID: N/A

HOLE STARTED: 22/11/10
HOLE FINISHED: 25/11/10
DRILLED BY: CW Drilling
LOGGED BY: ZDP CHECKED: BMcD

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT,
GENERIC NAME,
ORIGIN,
MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 60 100 250 | DEFECT SPACING (mm) 60 250 600 2000

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

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

10/19/29
N=48

-13.5

15.5 -14.0 16.0 -14.5 16.5 -15.0 17.0 -15.5 17.5 -16.0 18.0 -16.5 18.5 -17.0 19.0 -17.5 19.5 -18.0 20

End of recovered borehole at 15.45mbgl.

T+T DATATEMPLATE.GDT eek

BORELOG AVONSIDE.GPJ 12/1/11

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-SAA
Hole Location: West cnr Avonside Dr & Robson Ave
SHEET 1 OF 7

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE		LOCATION: AVONSIDE	JOB No: 52000.3200
CO-ORDINATES	5743387.69 mN 2483458.71 mE	DRILL TYPE: Rotary	HOLE STARTED: 23/10/11 HOLE FINISHED: 25/10/11
R.L.	1.49 m	DRILL METHOD: HQTT	DRILLED BY: Pro-Drill
DATUM	NZMG	DRILL FLUID: Mud	LOGGED BY: CP CHECKED: RAP

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
TOPSOIL											ML	S	VS				SILT with minor sand and some roots, dark brown. Very soft, saturated, low plasticity. Sand is fine to medium.
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)			87	HQTT				1.0	0.5		ML	W	S				SILT with minor sand, orange mottled brown. Soft, wet, low plasticity. Sand is fine. 0.5
								0.5	1.0		SP	W	MD				Fine SAND with minor silt, orange brown. Medium dense, wet. 1.0 1.3 to 1.5m no recovery
				SPT		2/2/3/ 2/3/2 N=10		0.0	1.5		SW	W	MD				Fine to medium SAND with minor silt, grey. Medium dense, wet. 1.5
			67	HQTT				-0.5	2.0								2.0
								-1.0	2.5								2.5 2.65 to 3.0m no recovery
				SPT		2/4/4/ 4/5/7 N=20		-1.5	3.0		SW	W	MD				Fine to medium SAND, dark grey. Medium dense, wet. 3.0
								-2.0	3.5								3.5
			100	HQTT				-2.5	4.0		SW	W	MD				Fine to coarse SAND with minor gravel and trace silt, dark grey. Medium dense, wet. Gravel is fine to medium, subrounded. 4.0
											GW	W	D				Sandy, fine to coarse GRAVEL, grey. Dense, wet. Gravel is subrounded. Sand is fine to coarse. - becoming sandy, contains trace gravel. Gravel is coarse, subrounded. - contains trace cobbles 4.5
				SPT		3/4/5/ 8/9/12 N=34		-3.0	4.5								
									5								

T+T DATATEMPLATE.GDT dlm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-SAA
Hole Location: West cnr Avonside Dr & Robson Ave
SHEET 2 OF 7

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE		LOCATION: AVONSIDE	JOB No: 52000.3200
CO-ORDINATES	5743387.69 mN 2483458.71 mE	DRILL TYPE: Rotary	HOLE STARTED: 23/10/11
		DRILL METHOD: HQTT	HOLE FINISHED: 25/10/11
R.L.	1.49 m		DRILLED BY: Pro-Drill
DATUM	NZMG	DRILL FLUID: Mud	LOGGED BY: CP CHECKED: RAP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) | COMPRESSIVE STRENGTH (MPa) | DEFECT SPACING (mm)

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

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

YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)			0	HQTT				-4.0	5.5							4.95 to 6.0m no recovery
CHRISTCHURCH FORMATION (MARINE & ESTUARINE)				SPT		5/6/6/ 6/6/7 N=25		-4.5	6.0		SP	W	MD			Fine SAND, grey. Medium dense, wet.
			81	HQTT				-5.0	6.5							7.7 to 8.0m no recovery
				SPT		2/3/4/ 5/5/7 N=21		-5.5	7.0							
			86	HQTT				-6.0	7.5							9.35 to 9.5m no recovery
				SPT		2/4/4/ 5/5/7 N=21		-6.5	8.0							
								-7.0	8.5							
								-7.5	9.0							
								-8.0	9.5							
									10							

T+T DATATEMPLATE.GDT dlm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-SAA
Hole Location: West cnr Avonside Dr & Robson Ave
SHEET 3 OF 7

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE		LOCATION: AVONSIDE	JOB No: 52000.3200
CO-ORDINATES	5743387.69 mN 2483458.71 mE	DRILL TYPE: Rotary	HOLE STARTED: 23/10/11 HOLE FINISHED: 25/10/11
R.L.	1.49 m	DRILL METHOD: HQTT	DRILLED BY: Pro-Drill
DATUM	NZMG	DRILL FLUID: Mud	LOGGED BY: CP CHECKED: RAP

GEOLOGICAL									ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)
CHRISTCHURCH FORMATION (MARINE & ESTUARINE)			100	HQTT				-9.0 10.5		SP	W	MD			
				SPT		2/5/5/ 6/5/8 N=24		-9.5 11.0							
			86	HQTT				-10.0 11.5							
								-10.5 12.0							
								-11.0 12.5							
				SPT		2/2/4/ 5/6/6 N=21									
			86	HQTT				-11.5 13.0							
								-12.0 13.5							
								-12.5 14.0							
				SPT		1/3/3/ 4/6/9 N=22									
			71	HQTT				-13.0 14.5							
								15							

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

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

Fine SAND, grey. Medium dense, wet.

12.35 to 12.5m no recovery

13.85 to 14.0m no recovery

10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-SAA
Hole Location: West cnr Avonside Dr & Robson Ave
SHEET 4 OF 7

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE		LOCATION: AVONSIDE	JOB No: 52000.3200
CO-ORDINATES	5743387.69 mN 2483458.71 mE	DRILL TYPE: Rotary	HOLE STARTED: 23/10/11
		DRILL METHOD: HQTT	HOLE FINISHED: 25/10/11
R.L.	1.49 m		DRILLED BY: Pro-Drill
DATUM	NZMG	DRILL FLUID: Mud	LOGGED BY: CP CHECKED: RAP

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
CHRISTCHURCH FORMATION (MARINE & ESTUARINE)			29	HQTT				-14.0 15.5		SP	W	MD				Fine SAND, grey. Medium dense, wet.
						2/6/6/ 8/10/12 N=36						D				15.2 to 15.5 no recovery
				SPT				-14.5 16.0								- becoming dense
								-15.0 16.5								16.25 to 17.0m no recovery
								-15.5 17.0				MD				- becoming medium dense
			76	HQTT		1/2/3/ 5/6/10 N=24		-16.0 17.5								- sand becoming fine to medium
								-16.5 18.0								18.25 to 18.5m no recovery
				SPT				-17.0 18.5								
						2/2/4/ 7/9/9 N=29		-17.5 19.0								
			67	HQTT				-18.0 19.5								19.7 to 20.0m no recovery
								20								

T+T DATATEMPLATE.GDT dlm

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BOREHOLE LOG

BOREHOLE No: AVS-SAA
Hole Location: West cnr Avonside Dr & Robson Ave

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE		LOCATION: AVONSIDE	JOB No: 52000.3200
CO-ORDINATES	5743387.69 mN 2483458.71 mE	DRILL TYPE: Rotary	HOLE STARTED: 23/10/11
		DRILL METHOD: HQTT	HOLE FINISHED: 25/10/11
R.L.	1.49 m		DRILLED BY: Pro-Drill
DATUM	NZMG	DRILL FLUID: Mud	LOGGED BY: CP CHECKED: RAP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
CHRISTCHURCH FORMATION (MARINE & ESTUARINE)				SPT		1/2/3/ 5/5/6 N=19		-19.0	20.5		SW	W	MD				Fine to medium SAND, grey. Medium dense, wet.
			81	HQTT				-19.5	21.0								20.5 21.0 21.3 to 21.5m no recovery
				SPT		1/1/3/ 4/6/6 N=19		-20.0	21.5								21.5
			90	HQTT				-20.5	22.0								22.0 - contains some shells - contains trace buried wood
											SP	W	MD				Fine SAND with some silt, grey. Medium dense, wet.
								-21.0	22.5								22.5 - contains trace shells - shells absent 22.9 to 23.0m no recovery
				SPT		3/4/2/ 2/1/0 N=5		-21.5	23.0		ML	W	F				23.0 SILT, bluish grey. Firm, wet, low plasticity.
			76	HQTT				-22.0	23.5								- contains some fine sand 23.5 - sand is absent
								-22.5	24.0								24.0 24.25 to 24.5m no recovery
				SPT		0/0/0/ 0/1/0 N=1		-23.0	24.5				VS				24.5 - becoming very soft
									25								

T+T DATATEMPLATE.GDT dlm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-SAA
Hole Location: West cnr Avonside Dr & Robson Ave

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE		LOCATION: AVONSIDE	JOB No: 52000.3200
CO-ORDINATES	5743387.69 mN 2483458.71 mE	DRILL TYPE: Rotary	HOLE STARTED: 23/10/11
		DRILL METHOD: HQTT	HOLE FINISHED: 25/10/11
R.L.	1.49 m		DRILLED BY: Pro-Drill
DATUM	NZMG	DRILL FLUID: Mud	LOGGED BY: CP CHECKED: RAP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
CHRISTCHURCH FORMATION (MARINE & ESTUARINE)			100	HQTT				-24.0	25.5		ML	W	VS				- 50mm layer of fibrous peat - 250mm moderately thick bed of fine to medium sand with some silt, dark grey
				SPT		3/5/5/ 5/6/8 N=24		-24.5	26.0				VSt				- contains some fine sand. Becoming non plastic. - contains some fibrous peat, black. Becoming very stiff.
			100	HQTT				-25.0	26.5								- peat absent. 100mm layer of organic silt, brownish grey, low plasticity.
				SPT		5/10/12/ 11/9/11 N=33		-25.5	27.0								
			90	HQTT				-26.0	27.5								
RICCARTON GRAVELS								-26.5	28.0		GW	S	VD				Sandy, fine to coarse GRAVEL with minor silt, grey. Very dense, saturated. Gravel is subrounded. Sand is fine to coarse.
								-27.0	28.5								28.9 to 29.4m no recovery
			60	HQTT				-27.5	29.0								
								-28.0	29.5								
									30								

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: AVS-SAA
Hole Location: West cnr Avonside Dr & Robson Ave

PROJECT: CHRISTCHURCH 2011 EARTHQUAKE | LOCATION: AVONSIDE | JOB No: 52000.3200

CO-ORDINATES 5743387.69 mN, 2483458.71 mE | DRILL TYPE: Rotary | HOLE STARTED: 23/10/11

DRILL METHOD: HQTT | HOLE FINISHED: 25/10/11

R.L. 1.49 m | DRILLED BY: Pro-Drill

DATUM NZMG | DRILL FLUID: Mud | LOGGED BY: CP | CHECKED: RAP

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
RICCARTON GRAVELS				SPT		3/6/11/ 16/17/6 for 110mm N>50		-29.0 30.5		GW	S	VD				Sandy, fine to coarse GRAVEL with minor silt, grey. Very dense, saturated. Gravel is subrounded. Sand is fine to coarse.
								-29.5 31.0								
								-30.0 31.5								
								-30.5 32.0								
								-31.0 32.5								
								-31.5 33.0								
								-32.0 33.5								
								-32.5 34.0								
								-33.0 34.5								
								35								**End of borehole at 30.385mbgl.** Shape Accelaray installed.

30.5 31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5

T+T DATATEMPLATE.GDT dlm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: RCH-03
Hole Location:
BH-RCH-03-Richmond
SHEET 1 OF 3

PROJECT: Darfield 2010 Earthquake - EQC Ground Investigations		LOCATION: Richmond	JOB No: 51731.001
CO-ORDINATES	5743640.62 248315.9	DRILL TYPE:	HOLE STARTED: 11/11/10
		DRILL METHOD: DT	HOLE FINISHED: 12/11/10
R.L.	2.05 m		DRILLED BY: McMillan
DATUM	Lyttleton 1937	DRILL FLUID: N/A	LOGGED BY: ZDP CHECKED: BMcD

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
HAND DIG FILL. (Potholed for services check and backfilled.)			42	DT		1/1/1 N=2	B	2.0 1.5 1.0 0.5	0.5		SW	D	VL				FILL. (Borehole drilled through pre-dug and backfilled.) 0.5 Fine to medium SAND, light brown/grey. Dry, well graded.
YALDHURST FORMATION (Overbank silt & sand, gravel & sand alluvium)			75	DT	50mm	✱FC ✱PSD		0.0 -0.5	1.0 1.5 2.0 2.5		ML ML SW SP GW SP	W S	? L				SILT, grey with rust mottling. Wet, low plasticity. 1.0 - 1.2m to 1.5m no recovery 1.5 SILT with some organics, grey/brown. Saturated, low plasticity. 2.0 Gravelly, medium to coarse SAND with minor silt, grey. Saturated, well graded. Gravel is fine, subrounded. Silty, fine SAND, grey. Saturated, poorly graded. 2.5 Sandy, fine to coarse GRAVEL, grey/brown. Saturated, well graded, subrounded. Sand is medium to coarse.
			92	DT		4/4/4 N=8 ✱FC	B	-1.0	3.0		GP SP						Medium SAND, grey. Saturated, poorly graded. Sandy, medium GRAVEL, grey. Saturated, poorly graded, rounded. Sand is medium to coarse. 3.0 Medium SAND, grey. Saturated, poorly graded. 3.5 - 3.5m to 4.1m no recovery 4.0
			58	DT		5/2/3 N=5		-1.5 -2.0 -2.5	3.5 4.0 4.5		GW GP GW GP		D				Medium to coarse GRAVEL with some sand, grey. Saturated, well graded. Sand is medium. Sandy, medium GRAVEL, grey. Saturated, poorly graded. Sand is medium. Fine to medium GRAVEL, grey. Saturated, well graded, subrounded. 4.5 Sandy, medium GRAVEL, grey. Saturated, poorly graded, subrounded. Sand is medium.
CHRISTCHURCH FORMATION						11/15/17 N=32		-3.0	5		SP						

T+T DATATEMPLATE.GDT eek

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BOREHOLE LOG

BOREHOLE No: RCH-03
Hole Location:
BH-RCH-03-Richmond

PROJECT: Darfield 2010 Earthquake - EQC Ground Investigations		LOCATION: Richmond	JOB No: 51731.001
CO-ORDINATES	5743640.62 248315.9	DRILL TYPE:	HOLE STARTED: 11/11/10 HOLE FINISHED: 12/11/10
R.L.	2.05 m	DRILL METHOD: DT	DRILLED BY: McMillan
DATUM	Lyttleton 1937	DRILL FLUID: N/A	LOGGED BY: ZDP CHECKED: BMcD

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) | COMPRESSIVE STRENGTH (MPa) | DEFECT SPACING (mm)

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

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

Depth	Geological unit	Core recovery (%)	Method	Tests	Samples	R.L. (m)	Classification symbol	Moisture condition / weathering	Strength/density classification	Description
5.5	(Coastal sand)					-3.0		S	D	Fine SAND, grey. Saturated, poorly graded.
										- 4.75m to 4.85m no recovery
										Fine SAND with trace gravel, grey. Saturated, poorly graded. Gravel is fine, rounded.
		92	DT	*FC	B	-3.5				
				*PSD	B					
6.0				15/18/18 N=36		-4.0	SP			5.5
										- 5.95m to 6m no recovery
6.5										6.0 Fine SAND with trace gravel, grey. Saturated, poorly graded. Gravel is fine, rounded.
		75	DT	*FC	B	-4.5				
7.0						-5.0				6.5
				15/17/20 N=37						- 6.9m to 7.3m no recovery
7.5						-5.5	SP			7.0
							SP			Fine SAND with trace gravel, grey. Saturated, poorly graded. Gravel is fine, rounded.
8.0		67	DT			-6.0				7.5
										Medium SAND with trace gravel, dark grey. Saturated, poorly graded. Gravel is fine, subrounded.
										- 8.1m to 8.4m no recovery
8.5				13/17/20 N=37		-6.5	SP			8.0
										Medium SAND with trace gravel, grey. Saturated, poorly graded. Gravel is fine, subrounded.
9.0							GP			8.5
							SP			Sandy, fine GRAVEL, grey. Saturated, poorly graded, subrounded. Sand is medium.
		75	DT	*FC	B	-7.0	SP			9.0
										Fine SAND, grey. Saturated, poorly graded.
9.5										Medium SAND with trace gravel, grey. Saturated, poorly graded. Gravel is fine, subrounded.
				13/15/17 N=32		-7.5				9.5
10										

50mm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: RCH-03
Hole Location:
BH-RCH-03-Richmond
SHEET 3 OF 3

PROJECT: Darfield 2010 Earthquake - EQC Ground Investigations		LOCATION: Richmond	JOB No: 51731.001
CO-ORDINATES	5743640.62 248315.9	DRILL TYPE:	HOLE STARTED: 11/11/10 HOLE FINISHED: 12/11/10
R.L.	2.05 m	DRILL METHOD: DT	DRILLED BY: McMillan
DATUM	Lyttleton 1937	DRILL FLUID: N/A	LOGGED BY: ZDP CHECKED: BMcD

GEOLOGICAL	ENGINEERING DESCRIPTION

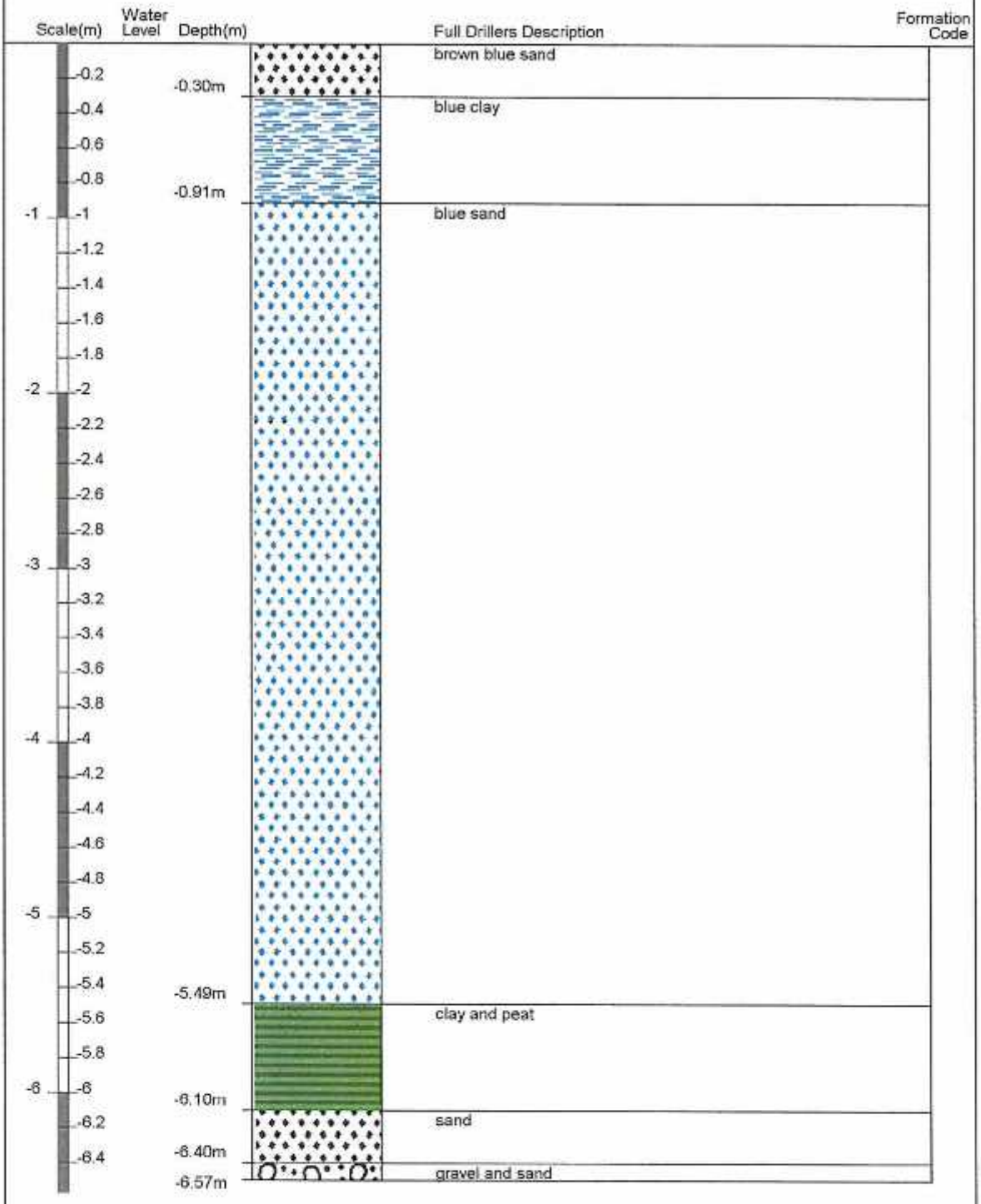
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
CHRISTCHURCH FORMATION (Coastal sand)			33	DT	50mm	✱FC	B	-8.0			SP	S	D				- 9.3m to 10.4m no recovery
								-8.5	10.5		SP						Fine SAND, grey. Saturated, poorly graded. 10.5
						14/17/17 N=34											- 10.8m to 11m no recovery
			63	DT				-9.0	11.0		SW						Fine to medium SAND, grey. Saturated, well graded. 11.0
								-9.5	11.5								11.5
						22/20/25 N=45		-10.0	12.0								- 11.75m to 12.2m no recovery 12.0
											SW						Fine to medium SAND, grey. Saturated, well graded.
			42	DT		✱FC	0.05	-10.5	12.5		SP						Medium SAND, grey. Saturated, poorly graded. Becomes coarser towards bottom. 12.5
								-11.0	13.0								- 12.7m to 13.4m no recovery 13.0
						10/14/19 N=33											
			50	DT		✱FC	0.05	-11.5	13.5		SP						Medium SAND, grey. Saturated, poorly graded. 13.5
								-12.0	14.0								- 14m to 14.45m no recovery 14.0
			92	DT		16/19/23 N=42		-12.5	14.5		SP						Medium SAND, grey. Saturated, poorly graded. 14.5
						13/19/25 N=44			15								**End of borehole at 15mbgl.**

T+T DATATEMPLATE.GDT eek

Borelog for well M35/12645

Gridref: M35:83382-43200 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 6.18 +MSD
Well name : CCC BorelogID 771
Drill Method : Not Recorded
Drill Depth : -6.5m Drill Date : 1/01/1930

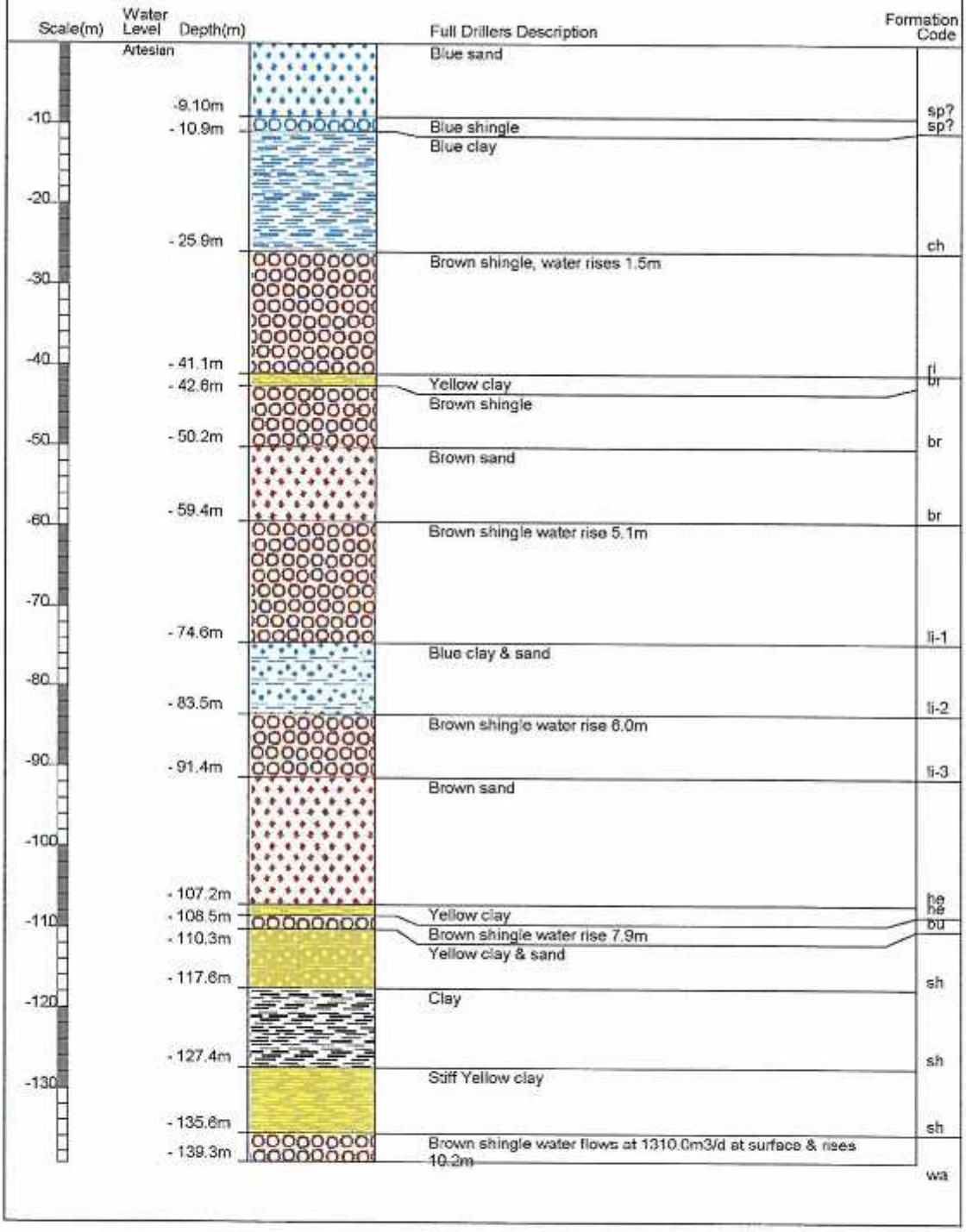
Environment Canterbury Regional Council



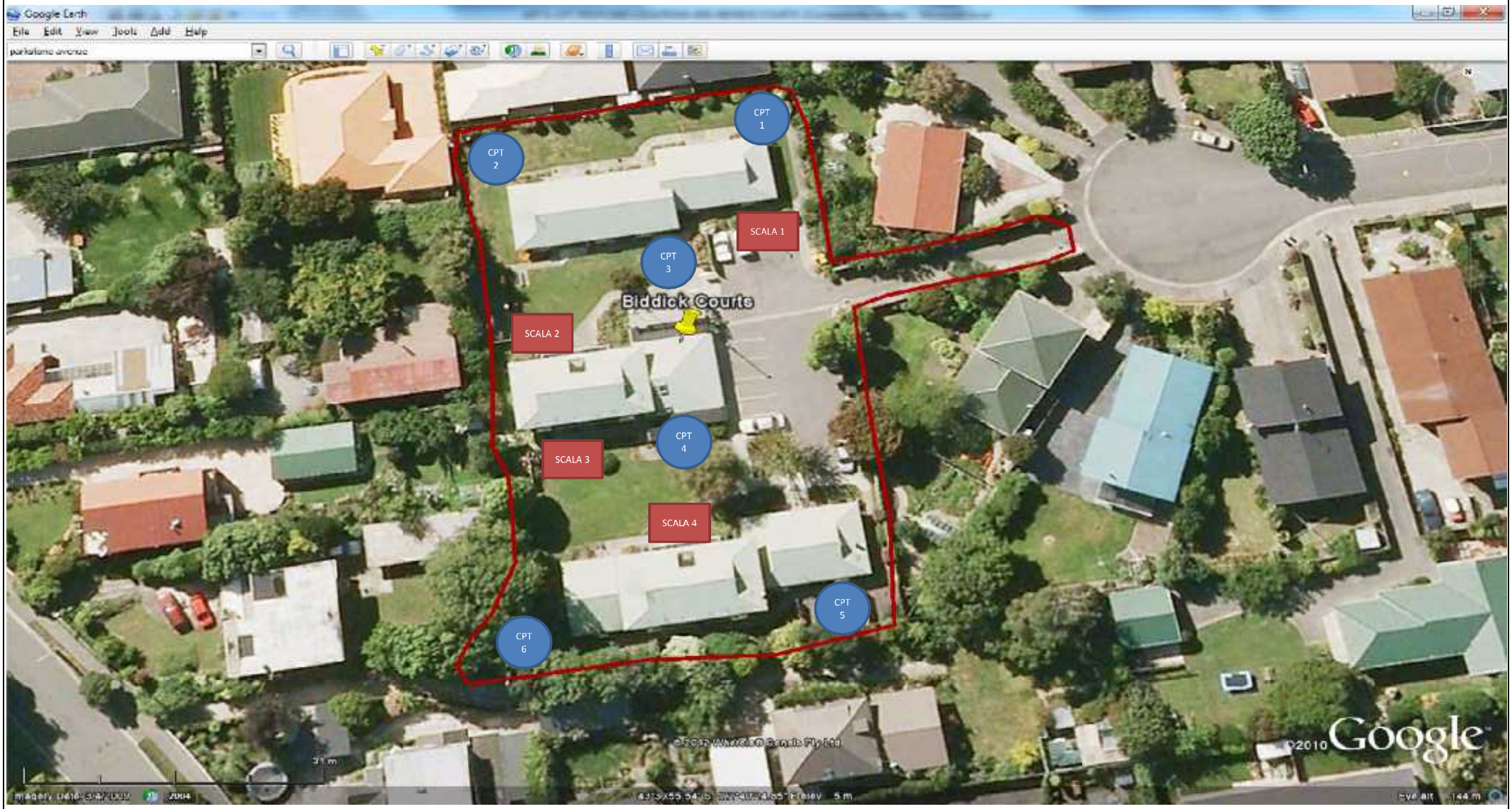
Borelog for well M35/2282

Gridref: M35:830-438 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 4.3 +MSD
Driller : not known
Drill Method : Unknown
Drill Depth : -139.2m Drill Date :

Environment Canterbury Regional Council



Appendix E:
Proposed Site Investigations



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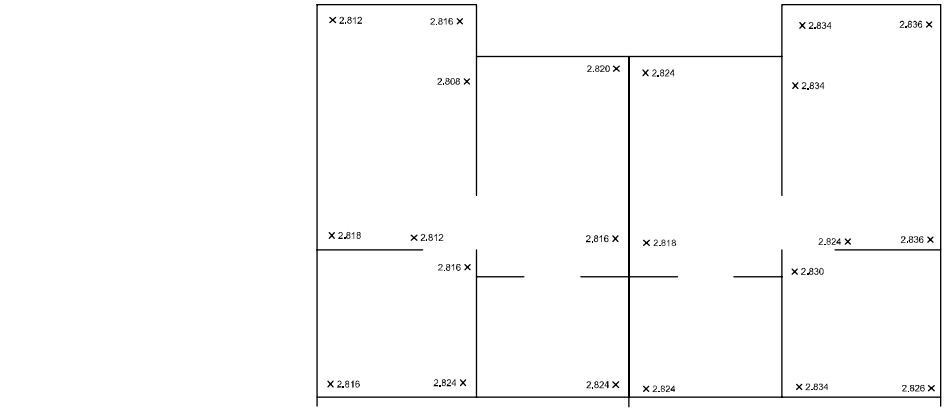
Project: Biddick Courts, Claydon Place, Dallington
Project No.: 6-QUCC1.98 005SC
Client: Christchurch City Council

Proposed Site Investigations

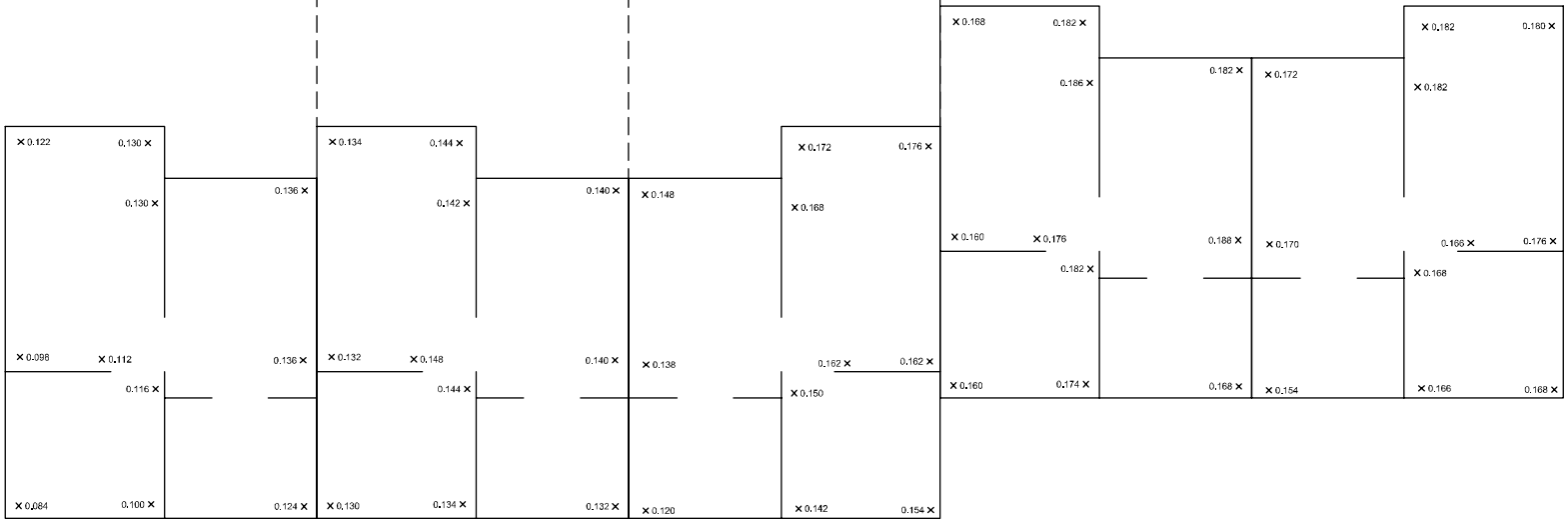
Drawn: Opus Geotechnical Engineer

Date: 19-Oct-12

Appendix F:
Opus Level Survey



UNITS 3 & 5 (FIRST FLOOR)



UNITS 1,2,4,6 & 7 (GROUND FLOOR)

ALL HEIGHTS RELATE TO THE SITE BENCHMARK.
POSITIVE VALUES ARE ABOVE THE BENCHMARK.

1:50 @ A1
1:100 @ A3
0 1 2 3 4 5 m

Revision	Amendment	Approved	Revision Date

OPUS
Christchurch Office
+64 3 363 5400
PO Box 1482
Christchurch 8140
New Zealand

Drawn	Designed	Approved	Revision Date
B JARRATT		S BECKER	

Project
CHRISTCHURCH CITY COUNCIL
BIDDICK COURTS

Sheet
FLOOR LEVEL SURVEY
UNITS 1 TO 7

Project No.	Scale	Drawing No.	Sheet No.	Revision
6QUCC1.98	1:50 @ A1 & 1:100 @ A3	6/1366/314/2604	1/3	R0

Original Sheet Size A1 [841x594] Plot Date 02/11/12 @ 09:12 p:\projects\6-quake,01\ccc_residential units\biddick courts - dayton place\survey\c3d\6qucc1.98_biddick_courts.dwg - Units 1 to 7

UNITS 9 & 11 (FIRST FLOOR)

UNITS 8 & 10 (GROUND FLOOR)

RESIDENTS LOUNGE

ALL HEIGHTS RELATE TO THE SITE BENCHMARK.
POSITIVE VALUES ARE ABOVE THE BENCHMARK.

1:50 @ A1
1:100 @ A3
0 1 2 3 4 5 m

Revision	Amendment	Approved	Revision Date

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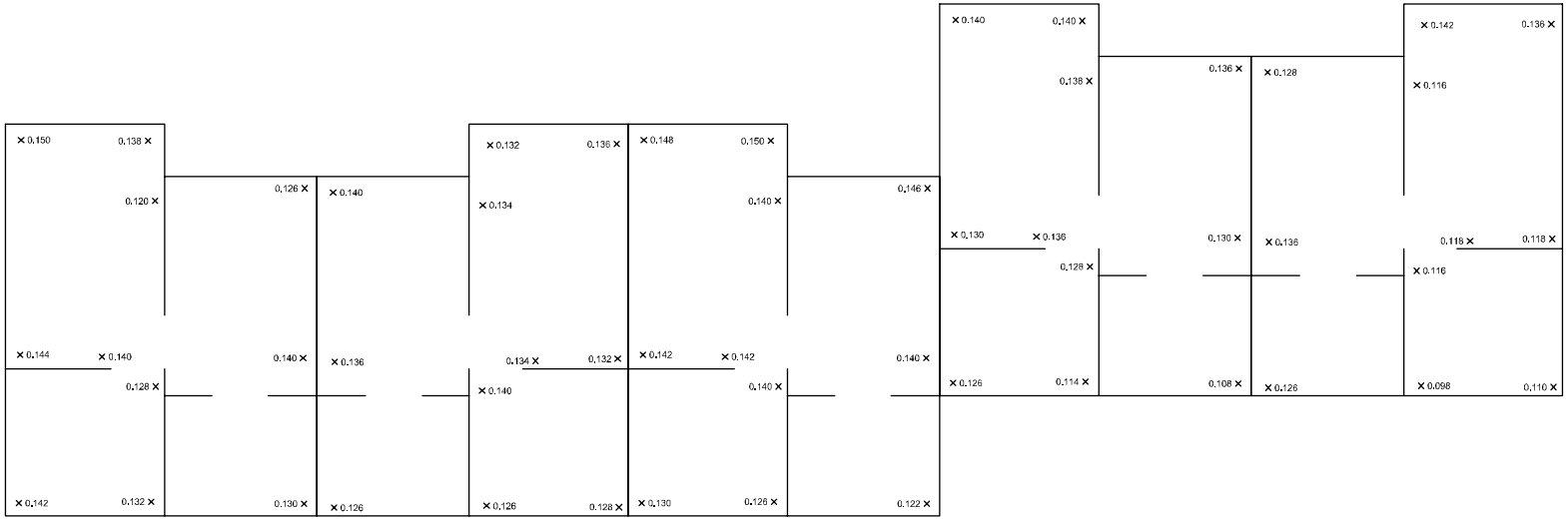
Drawn	Designed	Approved	Revision Date
B JARRATT		S BECKER	

Project
CHRISTCHURCH CITY COUNCIL
BIDDICK COURTS

Sheet
FLOOR LEVEL SURVEY
RESIDENTS LOUNGE & UNITS 8 TO 11

Project No.	Scale	Drawing No.	Sheet No.	Revision
6QUCC1.98	1:50 @ A1 & 1:100 @ A3	6/1366/314/2604	2/3	R0

Original Sheet Size A1 [841x594] Plot Date 02/11/12 @ 09:12 p:\projects\6-quake,01\ccc_residential units\biddick courts - dayton place\survey\c3d\6qucc1.98_biddick_courts.dwg - Units 8 to 11



UNITS 12 TO 16

ALL HEIGHTS RELATE TO THE SITE BENCHMARK.
POSITIVE VALUES ARE ABOVE THE BENCHMARK.

1:50 @ A1
1:100 @ A3
0 1 2 3 4 5 m

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New Zealand

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B JARRATT		S BECKER	

Project: CHRISTCHURCH CITY COUNCIL
BIDDICK COURTS

Sheet: FLOOR LEVEL SURVEY
UNITS 12 TO 16

Project No.	Scale	Drawing No.	Sheet No.	Revision
6QUCC1.98	1:50 @ A1 & 1:100 @ A3	6/1366/314/2604	3/3	R0

Original Sheet Size A1 [841x594] Plot Date 02/11/12 @ 09:12 p:\projects\6-quake,01\ccc_residential units\biddick courts - dayton place\survey\c3d\6cucc1.98_biddick_courts.dwg - Units 12 to 16

Appendix C - 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 utilised for the in-plane shear response of the pre-cast concrete tilt panels while a μ of 3 was utilised for the in-plane bracing capacity of the timber stud walls.

Analysis Procedure

Storey forces where calculated using ESM.

Block C was analysed in each orthogonal direction based on the tributary area of weight associated with each bracing/ wall line due to the limited strength and stiffness of the ceiling level gib board diaphragms. Transversely, the ceiling level diaphragms distribute force to the pre-cast panels positioned on the common walls lines. Longitudinally, the ceiling level diaphragms distribute force to timber stud gib board lined perimeter walls.

At first floor level Blocks A and B were formed with pre-cast floor units with a structural topping providing a rigid diaphragm to distribute storey shears to the pre-cast concrete tilt panels contained within. Between first floor level and the roof, in the longitudinal direction, the pre-cast tilt panels cantilever out-of-plane in turn supporting their self-weight, roof weight and in-plane weight of the perpendicular timber walls. Between first floor level and the roof, in the transverse direction, the ceiling level diaphragms distribute force to the pre-cast tilt panels acting in shear.

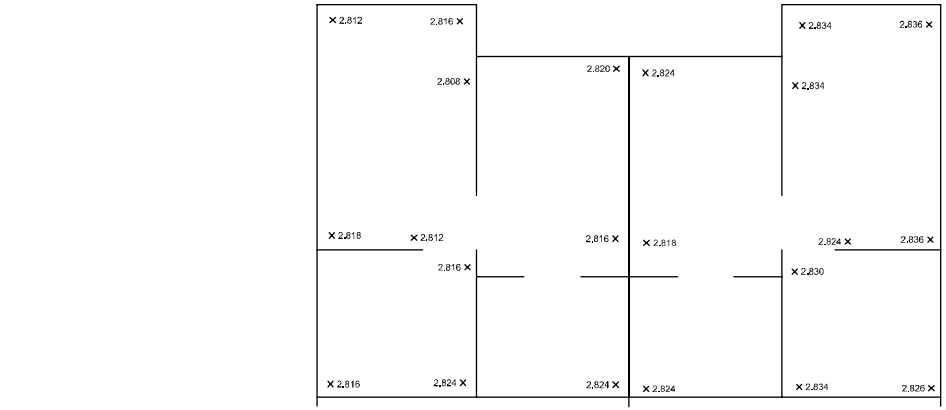
Timber stud wall capacities were based on the NZS 3604 approach where base shears are converted to bracing units (1 kN = 20 BU's) and the bracing capacities were found by assuming a certain BU/m rating for the walls along each line. Due to the unknown nature of the walls, the BU/m rating was taken as 42 BU/m for all timber walls lined with 10mm thick gib board on one side only.

Additional Assumptions

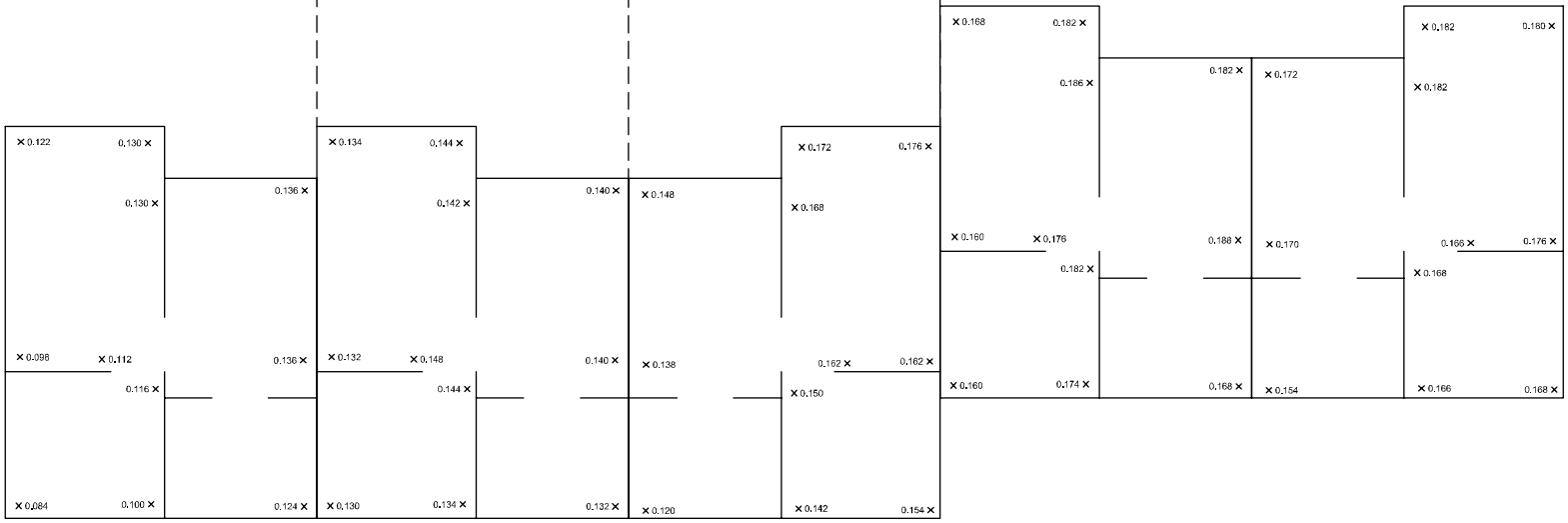
Further assumptions about the seismic performance of the buildings were:

- 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 D – Level Survey



UNITS 3 & 5 (FIRST FLOOR)



UNITS 1,2,4,6 & 7 (GROUND FLOOR)

ALL HEIGHTS RELATE TO THE SITE BENCHMARK.
POSITIVE VALUES ARE ABOVE THE BENCHMARK.

1:50 @ A1
1:100 @ A3
0 1 2 3 4 5 m

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B JARRATT		S BECKER	

Project
CHRISTCHURCH CITY COUNCIL
BIDDICK COURTS

Sheet
FLOOR LEVEL SURVEY
UNITS 1 TO 7

Project No.	Scale	Drawing No.	Sheet No.	Revision
6QUCC1.98	1:50 @ A1 & 1:100 @ A3	6/1366/314/2604	1/3	R0

Original Sheet Size A1 [841x594] Plot Date 02/11/12 @ 09:12 p:\projects\6-quake,01\ccc_residential units\biddick courts - dayton place\survey\c3d\6qucc1.98_biddick_courts.dwg - Units 1 to 7

UNITS 9 & 11 (FIRST FLOOR)

UNITS 8 & 10 (GROUND FLOOR)

RESIDENTS LOUNGE

ALL HEIGHTS RELATE TO THE SITE BENCHMARK.
POSITIVE VALUES ARE ABOVE THE BENCHMARK.

1:50 @ A1
1:100 @ A3
0 1 2 3 4 5 m

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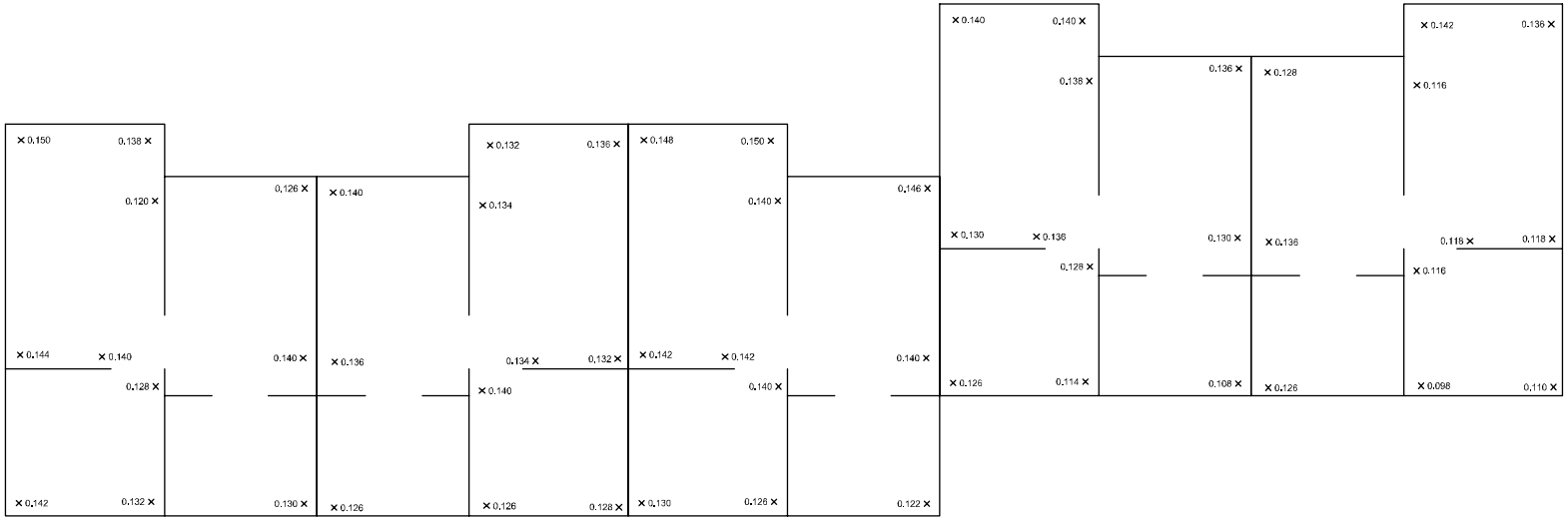
Project
CHRISTCHURCH CITY COUNCIL
BIDDICK COURTS

Sheet
FLOOR LEVEL SURVEY
RESIDENTS LOUNGE & UNITS 8 TO 11

Project No.	Scale	Drawing No.	Sheet No.	Revision
6QUCC1.98	1:50 @ A1 & 1:100 @ A3	6/1366/314/2604	2/3	R0

Original Sheet Size A1 [841x594] Plot Date 02/11/12 @ 09:12 p:\projects\6-quake,01\ccc_residential units\biddick courts - dayton place\survey\c3d\6qucc1.98_biddick_courts.dwg - Units 8 to 11



UNITS 12 TO 16

ALL HEIGHTS RELATE TO THE SITE BENCHMARK.
POSITIVE VALUES ARE ABOVE THE BENCHMARK.

1:50 @ A1
1:100 @ A3
0 1 2 3 4 5 m

Revision	Amendment	Approved	Revision Date

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Project: CHRISTCHURCH CITY COUNCIL
BIDDICK COURTS

Sheet: FLOOR LEVEL SURVEY
UNITS 12 TO 16

Project No.	Scale	Drawing No.	Sheet No.	Revision
6QUCC1.98	1:50 @ A1 & 1:100 @ A3	6/1366/314/2604	3/3	R0

Original Sheet Size A1 [841x594] Plot Date 02/11/12 @ 09:12 p:\projects\6-quake,01\ccc_residential units\biddick courts - dayton place\survey\c3d\6cucc1.98_biddick_courts.dwg - Units 12 to 16

Appendix E – CERA Spreadsheets

Detailed Engineering Evaluation Summary Data V1.14

Location

Building Name:	Biddick Courts - Block A			Reviewer:	Mary Ann Halliday
	Unit	No:	Street	CPEng No:	67073
Building Address:		14	Claydon Place	Company:	Opus
Legal Description:				Company project number:	6-QUCC1.98
				Company phone number:	36 3635400
	Degrees	Min	Sec		
GPS south:	43	30	53.53	Date of submission:	1/08/2015
GPS east:	172	40	21.13	Inspection Date:	
				Revision:	Final
Building Unique Identifier (CCC):	BE 0707 EQ2			Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	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:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground	0			
Foundation type:	mat slab		if Foundation type is other, describe:	
Building height (m):	5.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	240			
Age of Building (years):	26		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):	multi-unit residential			
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	
Floors:	precast concrete with topping	unit type and depth (mm), topping	
Beams:	none	overall depth x width (mm x mm)	
Columns:			
Walls:	load bearing concrete	#N/A	

Lateral load resisting structure

Lateral system along:	concrete shear wall	**Note: Define along and across in detailed report!**	enter wall data in "IEP period calcs" worksheet for period calculation	
Ductility assumed, μ:	1.25			
Period along:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	concrete shear wall		enter wall data in "IEP period calcs" worksheet for period calculation	
Ductility assumed, μ:	1.25			
Period across:	0.40	##### enter height above at H31	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:	precast, full flight	describe supports	
Wall cladding:	other light	describe	Gib lining
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	
Structural	partial	original designer name/date	
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report	partial	original designer name/date	

Damage

Site:	Site performance:		Describe damage:
(refer DEE Table 4-2)			
	Settlement:		notes (if applicable):
	Differential settlement:	1:150 or more	notes (if applicable):
	Liquefaction:	0-2 m³/100m²	notes (if applicable):
	Lateral Spread:	0-50mm	notes (if applicable):
	Differential lateral spread:		notes (if applicable):
	Ground cracks:		notes (if applicable):
	Damage to area:	slight	notes (if applicable):

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%	$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$	
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	veneer and lining cracking.

Recommendations

	Level of repair/strengthening required:	significant structural	Describe:	relevelling of structurue required
	Building Consent required:	yes	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	34%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: DEE
	Assessed %NBS after e'quakes:	34%		
Across	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	100%		

Detailed Engineering Evaluation Summary Data V1.14

Location

Building Name:	Biddick Courts - Block B			Reviewer:	Mary Ann Halliday
	Unit	No:	Street	CPEng No:	67073
Building Address:		14	Claydon Place	Company:	Opus
Legal Description:				Company project number:	6-QUCC1.98
				Company phone number:	36 3635400
	Degrees	Min	Sec		
GPS south:	43	30	53.53	Date of submission:	1/08/2015
GPS east:	172	40	21.13	Inspection Date:	
				Revision:	Final
Building Unique Identifier (CCC):	BE 0707 EQ2			Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	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:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground	0			
Foundation type:	mat slab		if Foundation type is other, describe:	
Building height (m):	5.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	240			
Age of Building (years):	26		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):	multi-unit residential			
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	
Floors:	precast concrete with topping	unit type and depth (mm), topping	
Beams:	none	overall depth x width (mm x mm)	
Columns:			
Walls:	load bearing concrete	#N/A	

Lateral load resisting structure

Lateral system along:	concrete shear wall	**Note: Define along and across in detailed report!**	enter wall data in "IEP period calcs"	
Ductility assumed, μ:	1.25		worksheet for period calculation	
Period along:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	concrete shear wall		enter wall data in "IEP period calcs"	
Ductility assumed, μ:	1.25		worksheet for period calculation	
Period across:	0.40	##### enter height above at H31	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:	precast, full flight	describe supports	
Wall cladding:	other light	describe	Gib lining
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	
Structural	partial	original designer name/date	
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report	partial	original designer name/date	

Damage

Site: (refer DEE Table 4-2)	Site performance:		Describe damage:
	Settlement:		notes (if applicable):
	Differential settlement:	1:150 or more	notes (if applicable):
	Liquefaction:	0-2 m³/100m²	notes (if applicable):
	Lateral Spread:	0-50mm	notes (if applicable):
	Differential lateral spread:		notes (if applicable):
	Ground cracks:		notes (if applicable):
	Damage to area:	slight	notes (if applicable):

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%	$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$	
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	veneer and lining cracking.

Recommendations

	Level of repair/strengthening required:	significant structural		Describe:	relevelling of structurue required
	Building Consent required:	yes		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	40%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	DEE
	Assessed %NBS after e'quakes:	40%			
Across	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	100%			

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Biddick Courts - Block C			Reviewer:	John Mitchell
	Unit	No:	Street	CPEng No:	1006738
Building Address:		14	Claydon Place	Company:	Opus
Legal Description:				Company project number:	6-QUCC1.98
				Company phone number:	03 3835400
	Degrees	Min	Sec		
GPS south:				Date of submission:	4-Mar-13
GPS east:				Inspection Date:	
				Revision:	Final
Building Unique Identifier (CCC):	BE 0707 EQ2			Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	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):	0.00
Storeys below ground	0			
Foundation type:	mat slab		If Foundation type is other, describe:	
Building height (m):	5.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	240			
Age of Building (years):	26		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):	multi-unit residential			
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	
Floors:	precast concrete with topping	unit type and depth (mm), topping	
Beams:	none	overall depth x width (mm x mm)	
Columns:			
Walls:	load bearing concrete	#N/A	

Lateral load resisting structure

Lateral system along:	concrete shear wall	**Note: Define along and across in**	enter wall data in "IEP period calcs"	
Ductility assumed, μ:	1.25	**detailed report!**	worksheet for period calculation	
Period along:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	concrete shear wall		enter wall data in "IEP period calcs"	
Ductility assumed, μ:	1.25		worksheet for period calculation	
Period across:	0.40	##### enter height above at H31	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:	precast, full flight	describe supports	
Wall cladding:	other light	describe	Gib lining
Roof Cladding:	Metal	describe	
Glazing:			
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	
Structural	partial	original designer name/date	
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report	partial	original designer name/date	

Damage

Site: (refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:		notes (if applicable):	
Differential settlement:	1:150 or more	notes (if applicable):	
Liquefaction:	0-2 m³/100m²	notes (if applicable):	
Lateral Spread:	0-50mm	notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:	slight	notes (if applicable):	

Building:

Current Placard Status:	green			
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%	$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$	
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	veneer and lining cracking.

Recommendations

Level of repair/strengthening required:	minor non-structural		Describe:	repair cracking
Building Consent required:	yes		Describe:	foundation work may be needed
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:	100%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	100%		

Appendix F – Interim Strengthening Scheme

26 November 2014

Opus International Consultants Ltd
PO Box 1482
Christchurch
Christchurch 8140

Dear Sir/Madam

Building Act Exemption: BCN/2014/10913
1/14 Claydon Place, Dallington
Strengthening to 34% NBS

Building Act Exemption Approved

We have considered your application, under Schedule 1, clause 2(a) of the Building Act 2004, for exemption from the requirement to obtain building consent.

We are satisfied that the completed work is likely to comply with the building code, provided it is carried out in accordance with your proposal. Therefore, your application has been approved.

You can download stamped copies of your proposal documents from onlineservices.ccc.govt.nz. Please forward copies to the building owner.

Advice

- All building work must comply with the Building Act, building code, and all other applicable laws.
- This letter does not provide any approval that may be required, other than that stated.
- This approval is valid if the work is completed within two years of **26 November 2014.**

You are not required to provide verification to the Council that the work has been completed. However, any documentation that you do supply will be placed on the file for the property, and may prove beneficial for future enquiries (for example, land information memoranda (LIMs) or property file requests).

Yours sincerely

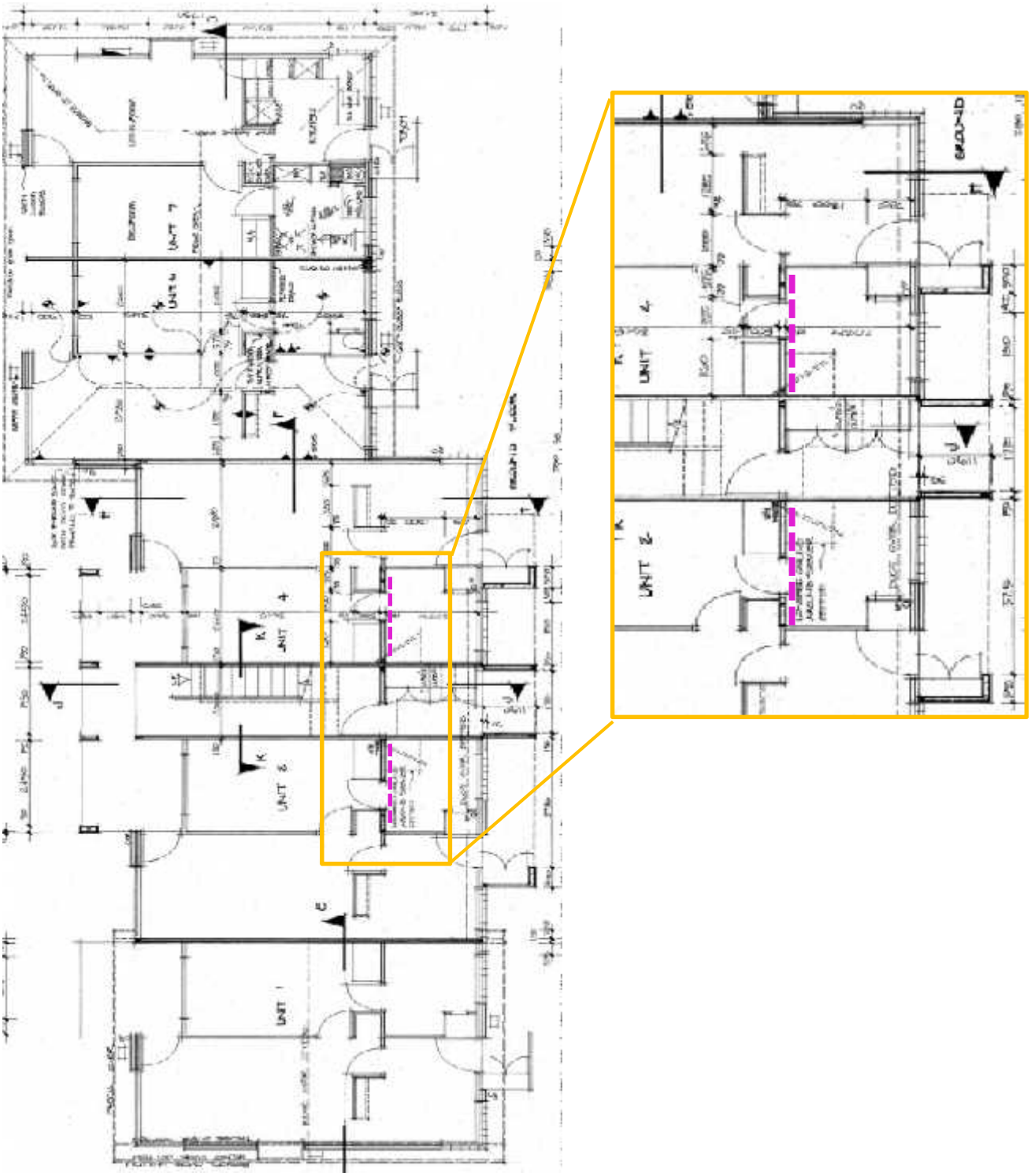
Phill Carr
Senior Building Consent Officer
Building Certification & Exemption Team
Building Control & City Rebuild Group

Civic Offices, 53 Hereford Street, Christchurch 8011
PO Box 73013, Christchurch 8154
Phone: (03) 941-8999, Fax: (03) 941-8792
www.ccc.govt.nz

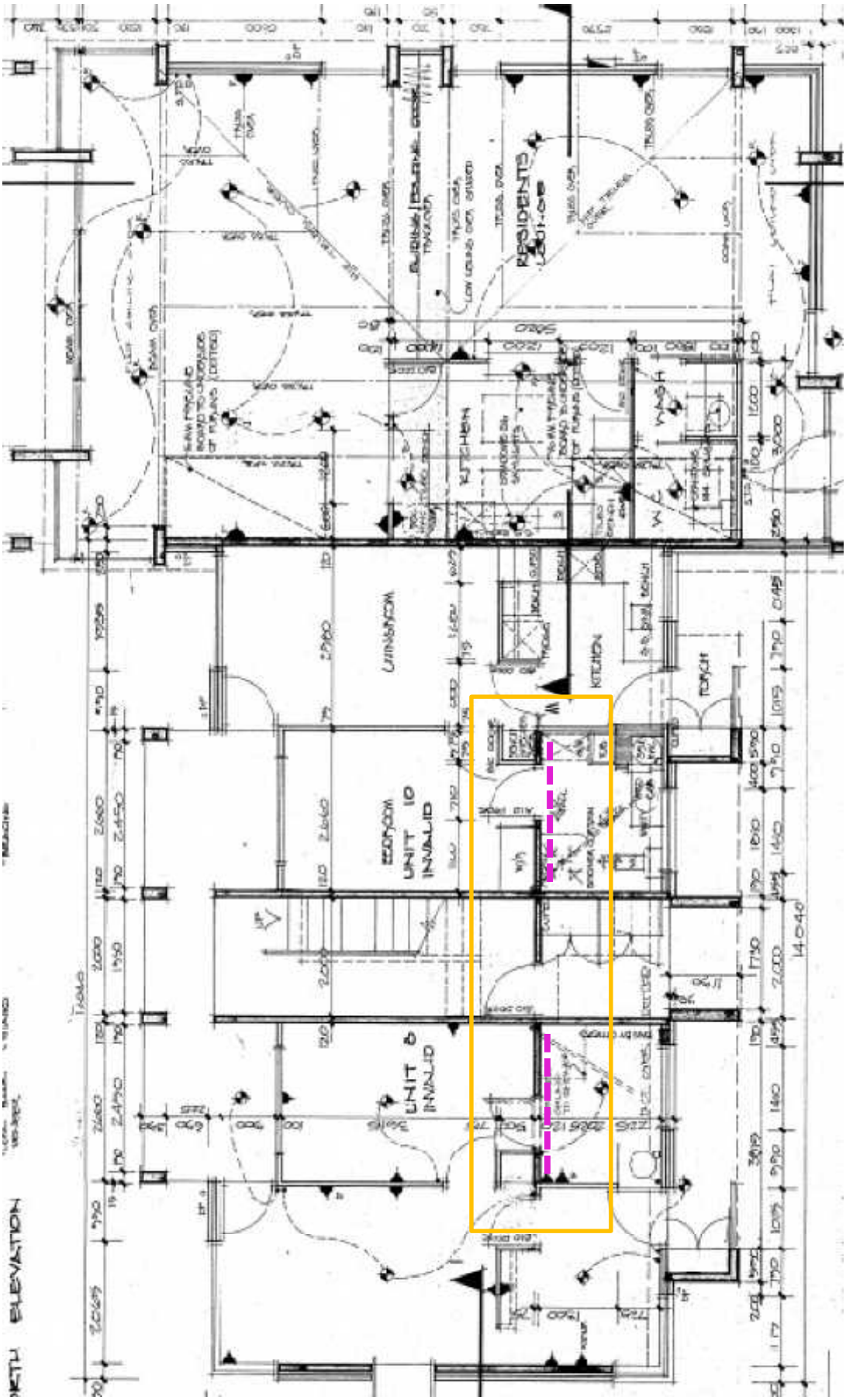
8 July 2014

Strengthening Plan

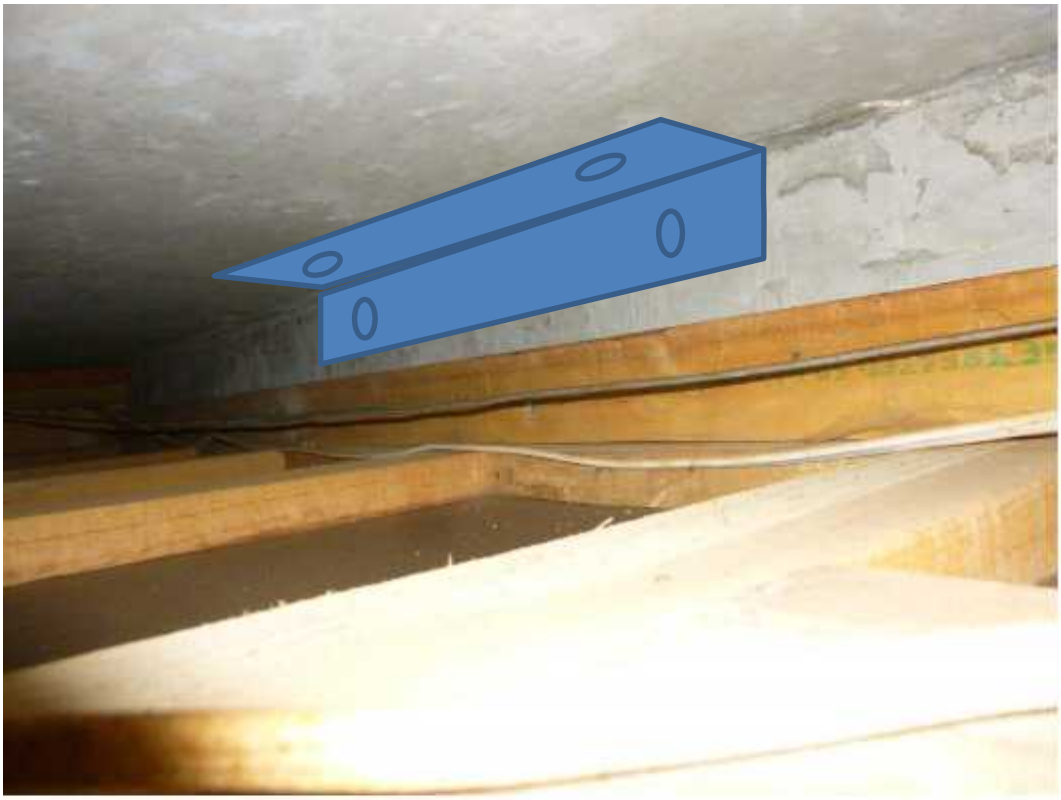
- - - - - - location of strengthening between first floor slab and wall panel. Angles are to be located above the ceiling in the bathroom.

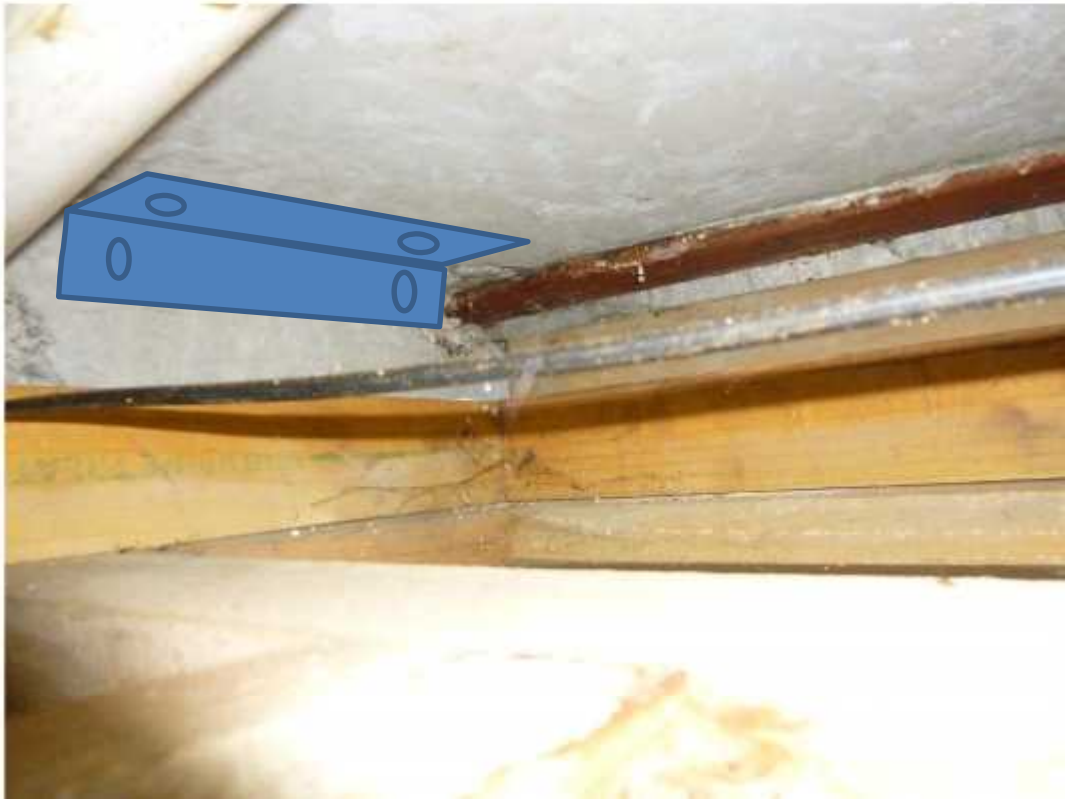


Block A – Ground Floor Plan



Block B – Ground Floor Plan





Indicative location of angles above bathroom ceiling.

CALCULATION SHEET

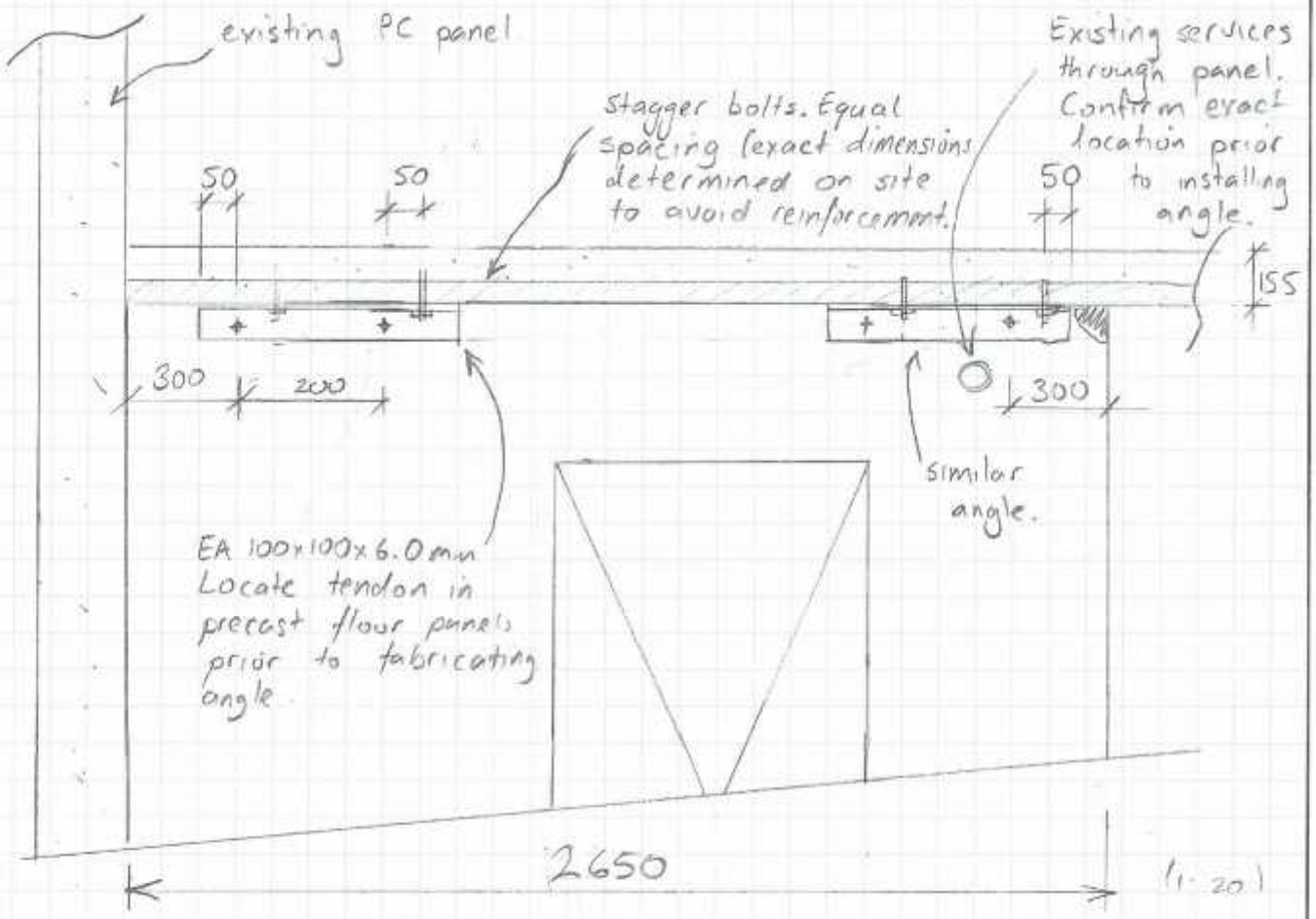
Project/Task/File No: Biddick Courts | Sheet No C 1 of 1

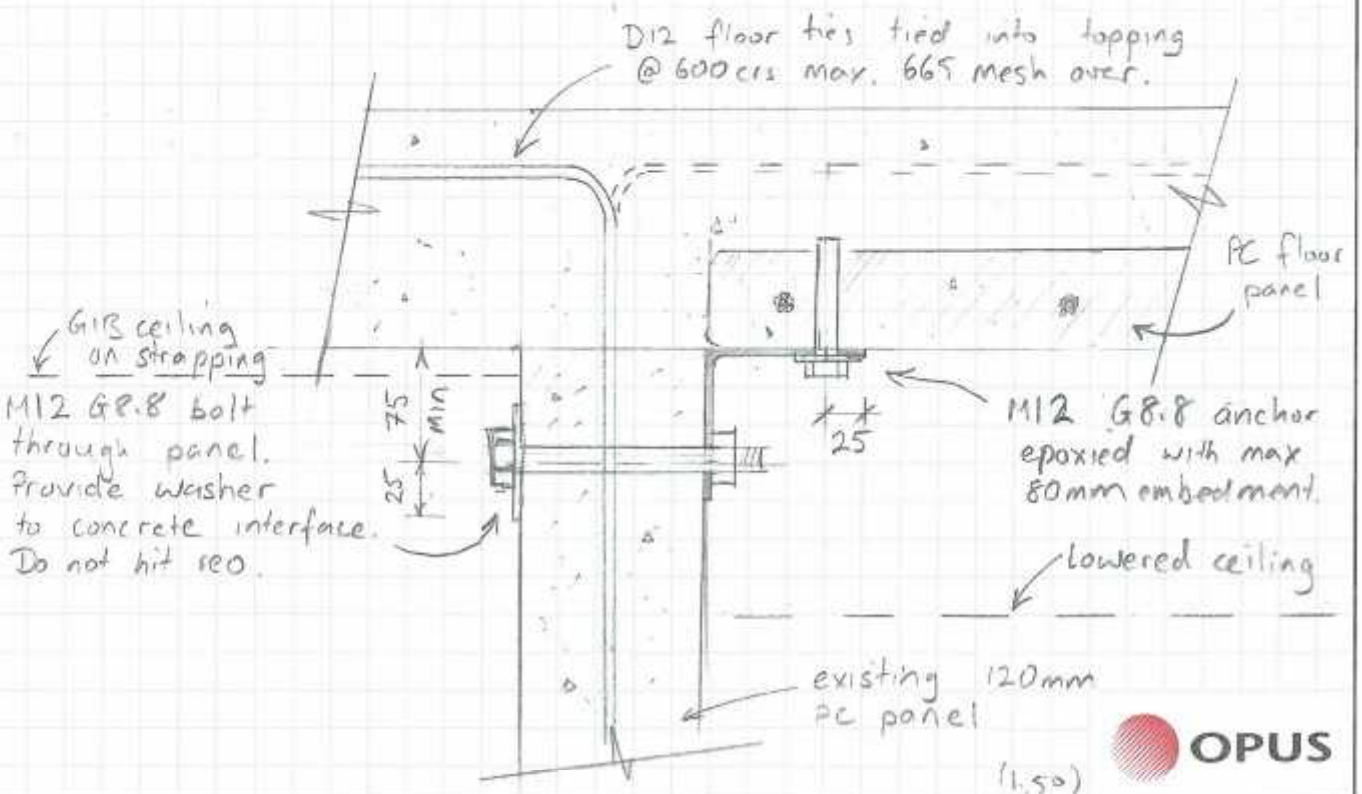
Project Description: Strengthening of first floor slab to panel connection Sketch 1 | Office: Chch TMT

Computed: 03/07/14

Check: / /

STRENGTHENING





OPUS

Building Code Clause(s)B1 & B2.....

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance notes on the use of this form are printed on page 2)

ISSUED BY: Opus International Consultants.....
(Design Firm)

TO: Christchurch City Council .....
(Owner/Developer)

TO BE SUPPLIED TO: Christchurch City Council .....
(Building Consent Authority)

IN RESPECT OF: Interim strengthening to 34% NBS.....
(Description of Building Work)

AT: Biddick Courts Housing Complex, 14 Claydon place, Christchurch.....
(Address)
..... **LOT**..... **DP** ..... **SO** .....

We have been engaged by the owner/developer referred to above to provide To provide a temporary strengthening scheme to above 34%NBS. services in respect of the requirements of
(Extent of Engagement)
Clause(s) B1 and B2.....of the Building Code for
All ☐ or Part only ☒ (as specified in the attachment to this statement), of the proposed building work.

The design carried out by us has been prepared in accordance with:

☒ Compliance Documents issued by the Ministry of Business, Innovation & EmploymentB1 & B2, NZS3604.... or
(verification method / acceptable solution)

☐ Alternative solution as per the attached schedule.....

The proposed building work covered by this producer statement is described on the drawings titled Biddick Courts Interim Strengthening to 34% Sketches 1-4.....

and numbered N/A.....;
together with the specification, and other documents set out in the schedule attached to this statement.
On behalf of the Design Firm, and subject to:
(i) Site verification of the following design assumptions ...Existing structure is built as per drawings and good practice at the time.....
(ii) All proprietary products meeting their performance specification requirements;

I believe on reasonable grounds that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:
☒CM1 ☐CM2 ☐CM3 ☐CM4 ☐CM5 (Engineering Categories) or ☐ as per agreement with owner/developer (Architectural)

I, Mary Ann Halliday..... am:
(Name of Design Professional)

☒CPEng 67073.....#

☐Reg Arch ..... .#

I am a Member of : ☒ IPENZ ☐NZIA and hold the following qualifications:CPEng, ME (Civil).....
The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than $200,000*.
The Design Firm is a member of ACENZ: ☐

SIGNED BY Mary Ann Halliday ..... ON BEHALF OF **Opus International Consultants** .....
(Design Firm)

Date31/10/2014..... (signature).....

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000.*

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