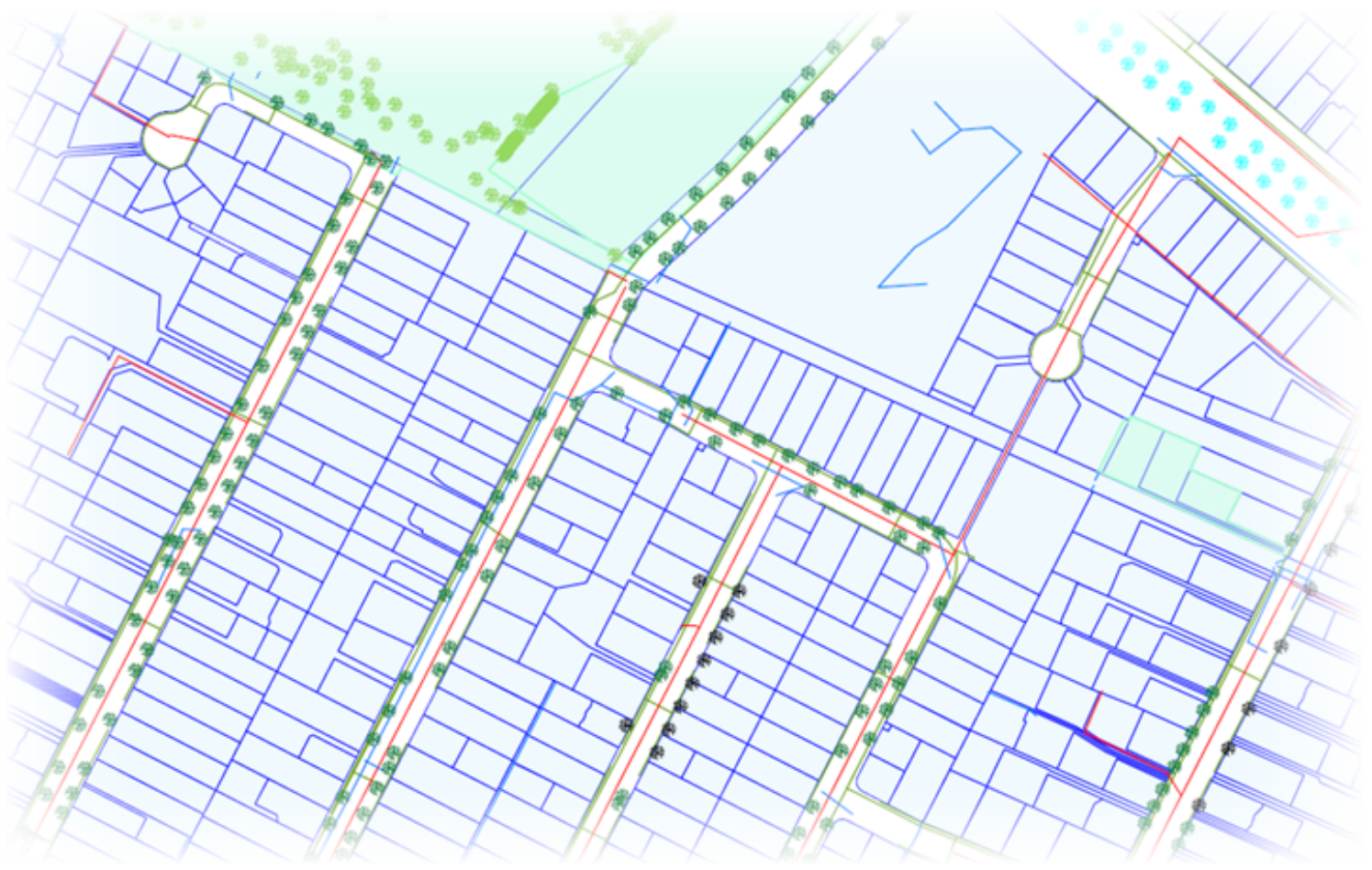


Land Information Memorandum



Property address:
80 Byron Street

LIM number: 70247257
Page 1

Christchurch City Council
53 Hereford Street, PO Box 73015
Christchurch 8154, New Zealand
Tel 64 3 941 8999
Fax 64 3 941 8984
www.ccc.govt.nz

Application details

Please supply to BAYLEYS REAL ESTATE - HAREWOOD
PO BOX 36533
CHRISTCHURCH 8146

Client reference

Phone number (03) 358 5566

Fax number (03) 357 2111

Date issued 21 June 2021

Date received 9 June 2021

Property details

Property address 80 Byron Street

Valuation roll number 22560 53901

Valuation information Capital Value: \$1260000
Land Value: \$630000
Improvements Value: \$630000
Please note: these values are intended for Rating purposes

Legal description Lot 1 DP 449853

Existing owner Spaghetti Junction Limited
210 Huntsbury Avenue
Christchurch 8022

Council references

Debtor number 3189236

Rate account ID 73173933

LIM number 70247257

Property ID 1171794

Document information

This Land Information Memorandum (LIM) has been prepared for the purpose of section 44A of the Local Government Official Information and Meetings Act 1987 (LGOIMA). It is a summary of the information that we hold on the property. Each heading or "clause" in this LIM corresponds to a part of section 44A.

Sections 1 to 10 contain all of the information known to the Christchurch City Council that must be included under section 44A(2) LGOIMA. Any other information concerning the land as the Council considers, at its discretion, to be relevant is included at section 11 of this LIM (section 44A(3) LGOIMA). If there are no comments or information provided in these sections this means that the Council does not hold information on the property that corresponds to that part of section 44A.

The information included in this LIM is based on a search of Council records only and there may be other information relating to the land which is unknown to the Council. Please note that other agencies may also hold information relevant to the property, or administer legislation relevant to the use of the land, for example, the Regional Council (Ecan), Heritage New Zealand Pouhere Taonga, and Land Information New Zealand.

Council records may not show illegal or unauthorised building or works on the property. The applicant is solely responsible for ensuring that the land is suitable for a particular purpose.

A LIM is only valid at the date of issue as information is based only upon information the Council held at the time of that LIM request being made.

Property file service

This Land Information Memorandum does not contain all information held on a property file. Customers may request property files by phoning the Council's Customer Call Centre on (03) 941 8999, or visiting any of the Council Service Centres. For further information please visit www.ccc.govt.nz.

To enable the Council to measure the accuracy of this LIM document based on our current records, we would appreciate your response should you find any information contained therein which may be considered to be incorrect or omitted. Please telephone the Customer Call Centre on (03) 941 8999.

A search of records held by the Council has revealed the following information:

1. Special features and characteristics of the land

Section 44A(2)(a) LGOIMA. This is information known to the Council but not apparent from the district scheme under the Town and Country Planning Act 1977 or a district plan under the Resource Management Act 1991. It identifies each (if any) special feature or characteristic of the land concerned, including but not limited to potential erosion, avulsion, falling debris, subsidence, slippage, alluvion, or inundation, or likely presence of hazardous contaminants.

(For enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

┆ **Borelog/Engineer Report Image Available**

Borelog/Engineer Report Image Available

┆ **Consultant Report Available**

Land Information New Zealand (LINZ) engaged Tonkin and Taylor to provide a Geotechnical Report on Ground Movements that occurred as a result of the Canterbury Earthquake Sequence. The report indicates this property may have been effected by a degree of earthquake induced subsidence. The report obtained by LINZ can be accessed on their website at <https://www.linz.govt.nz/land/surveying/earthquakes/canterbury-earthquakes/information-for-canterbury-surveyors>

┆ **Predicted 1 in 50 Year Flood Extent**

This property, or parts of this property are predicted to be within the extent of a 1 in 50 year flood event. For new developments a minimum finished floor level may be required for flood limitation purposes under the Building Code. For more information please refer to (<https://ccc.govt.nz/floorlevelmap>) or phone 941 8999.

┆ **Liquefaction Vulnerability**

Christchurch City Council holds indicative information on liquefaction hazard for Christchurch. Information on liquefaction, including an interactive web tool, can be found on the Council website at ccc.govt.nz/liquefaction. Depending on the liquefaction potential of the area that the property is in, the Council may require site-specific investigations before granting future subdivision or building consent for the property.

Related information

┆ There is attached a soil investigation report for this property.

2. Private and public stormwater and sewerage drains

Section 44A(2)(b) LGOIMA. This is information about private and public stormwater and sewerage drains as shown in the Council's records.

(For stormwater and sewerage enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

Related information

- | The drainage works associated with this property has been partially plotted on the Council's drainage plan. A copy of the field Inspectors pickup/approved site plan showing the drains and buildings/house outline is attached.
- | The dwelling/building is shown to be served by a sewer drain and a stormwater drain.
- | Council Trade Waste Bylaw regulates the use of the sewer system for sources other than domestic sewage. A trade waste consent must be obtained by the new owner or occupier before any wastewater from an industrial or commercial processes including but not limited to wash down grease traps and cooling systems may be discharged to Council sewer system.

3. Drinking Water Supply

Section 44A(2)(ba) and (bb) LGOIMA. This is information notified to the Council about whether the land is supplied with drinking water, whether the supplier is the owner of the land or a networked supplier, any conditions that are applicable, and any information the Council has about the supply.

Please note the council does not guarantee a particular water quality to its customers. If you require information on current water quality at this property please contact the Three Waters & Waste Unit.

(For water supply queries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

Water Supply

Christchurch City Council is the networked supplier of water to this property. This property is connected to the Christchurch City Council Water Supply. The conditions of supply are set out in the Christchurch City Council Water Supply, Wastewater & Stormwater Bylaw (2014), refer to www.ccc.govt.nz.

Related information

- † All commercial and industrial properties are to have a minimum of medium-hazard backflow prevention device at the boundary to protect the main water supply. The installation of this device is a condition of supply and is the responsibility of the property owner in accordance with Christchurch City Council Water Supply, Wastewater and Stormwater Bylaw 2014. To learn more visit our website <https://ccc.govt.nz/services/water-and-drainage/water-supply/backflow-prevention/> or to speak to someone call 03 941 8999 and ask to speak to the water supply team.

4. Rates

Section 44A(2)(c) LGOIMA. This is information on any rates owing in relation to the land.

(For rates enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

(a) Annual rates

Annual rates to 30/06/2021: \$ 5,227.60

	Instalment Amount	Date Due
Instalment 1	\$ 1,306.84	15/08/2020
Instalment 2	\$ 1,306.84	15/11/2020
Instalment 3	\$ 1,306.84	15/02/2021
Instalment 4	\$ 1,307.08	15/05/2021

Rates owing as at 21/06/2021: \$ 0.00

(b) Excess water charges

\$ 0.00

(For water charge enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

(c) Final water meter reading required?

Reading is Required

(To arrange a final water meter reading, please phone (03) 941 8999 or visit www.ccc.govt.nz.

5. Consents, certificates, notices, orders, or requisitions affecting the land and buildings

Section 44A(2)(d) LGOIMA. This is information concerning any consent, certificate, notice, order, or requisition, affecting the land or any building on the land, previously issued by the Council. The information in this section may also cover building consent and/or code compliance information issued by building certifiers under the Building Act 1991 and building consent authorities that are not the Council under the Building Act 2004.

You can check the property file to identify whether any consent or certificate was issued by a building certifier under the Building Act 1991.

Section 44A(2)(da) LGOIMA. The information required to be provided to a territorial authority under section 362T(2) of the Building Act 2004. There is currently no information required to be provided by a building contractor to a territorial authority under section 362T(2) of the Building Act 2004. The Building (Residential Consumer Rights and Remedies) Regulations 2014 only prescribed the information that must be given to the clients of a building contractor.

(For building enquiries, please phone (03) 941 8999, email EPADutyBCO@ccc.govt.nz or visit www.ccc.govt.nz.

(a) Consents

- | BCN/1959/3222 Applied: 31/07/1959 Status: Completed
80 Byron Street Sydenham
Permit issued 11/08/1959
REPAIRS TO SHED- Historical Reference PER59900617 - No information/plans held on property file
- | BCN/1960/3038 Applied: 07/06/1960 Status: Completed
80 Byron Street Sydenham
Permit issued 25/08/1960
FACTORY- Historical Reference PER60100689 - No information/plans held on property file
- | BCN/1964/1982 Applied: 15/04/1964 Status: Completed
80 Byron Street Sydenham
Permit issued 22/05/1964
ADDITIONS- Historical Reference PER64400376 - No information/plans held on property file
- | BCN/1969/957 Applied: 28/02/1969 Status: Completed
80 Byron Street Sydenham
Permit granted 11/03/1969
Permit issued 12/03/1969
OFFICE ALTERATIONS & MEZZANINE EXT.- Historical Reference PER68900213
- | BCN/1971/655 Applied: 12/02/1971 Status: Completed
80 Byron Street Sydenham
Permit issued 27/09/1971
STORAGE BUILDING- Historical Reference PER71200448
- | BCN/1986/785 Applied: 20/02/1986 Status: Completed
80 Byron Street Sydenham
Permit issued 26/03/1986
WAREHOUSE ADDITIONS- Historical Reference PER85604153
- | BCN/1988/5288 Applied: 29/07/1988 Status: Completed
80 Byron Street Sydenham
Permit issued 01/09/1988
FACTORY- Historical Reference PER88901646

- | BCN/1990/5558 Applied: 11/07/1990 Status: Completed
80 Byron Street Sydenham
Permit granted 11/07/1990
Permit issued 11/07/1990
DRAINAGE: STORMWATER TO SIDECHANNEL- Historical Reference PER90154146
- | BCN/1990/5627 Applied: 13/07/1990 Status: Completed
80 Byron Street Sydenham
Permit granted 13/07/1990
Permit issued 13/07/1990
DRAINAGE: STORMWATER - TO SIDECHANNEL- Historical Reference PER90154182
- | BCN/1994/3440 Applied: 06/05/1994 Status: Completed
80 Byron Street Sydenham
Accepted for processing 06/05/1994
Building consent granted 16/05/1994
Building consent issued 02/06/1994
Code Compliance Certificate Granted 09/08/1996
Code Compliance Certificate Issued 09/08/1996
Sign (hall shopfitting) miscellaneous freestanding sign (hall shopfitting)- Historical Reference CON94003859
- | BCN/2010/8559 Applied: 04/11/2010 Status: Completed
80 Byron Street Sydenham
Accepted for processing 04/11/2010
PIM Granted 11/11/2010
PIM Issued 11/11/2010
Building consent granted 21/12/2010
Building consent issued 26/01/2011
Code Compliance Certificate Issued 16/10/2013
REPLACE ROLLER DOOR WITH FIRE WALL- Historical Reference ABA10107578
- | BCN/2017/2013 Applied: 22/03/2017 Status: Building consent issued
80 Byron Street Sydenham
Accepted for processing 23/03/2017
Building consent granted 15/08/2017
Building consent issued 22/08/2017
Council refused to issue a Code Compliance Certificate, s95 Building Act 2004 10/02/2021
Addition to Factory - New Offices, Meeting and Store Room
- | BCN/2017/2013 Applied: 25/10/2019 Status: Completed
80 Byron Street Sydenham
Accepted for processing 29/10/2019
Building consent granted 14/11/2019
Building consent issued 14/11/2019
Amendment 1 - Addition of concrete wall, store room replaced with office space, office partition walls removed, 1 skylight location change, addition of heat pumps, drainage plumbed to sink wastes, hallway extended, interior office windows added, perimeter strip drains reduced to entry doors only, cladding change
- | BCN/2017/2013 Applied: 29/06/2020 Status: Completed
80 Byron Street Sydenham
Accepted for processing 30/06/2020
Building consent granted 13/04/2021
Building consent issued 15/04/2021
Amendment 2 - change to floor plan, emergency lighting and backflow prevention device

(b) Certificates

Note: Code Compliance Certificates were only issued by the Christchurch City Council since January 1993.

(c) Notices

Property address:
80 Byron Street

- | Placards issued under the Civil Defence Emergency Management Act 2002 as a result of the 4 September 2010 and 22 February 2011 earthquakes have now expired (by 12 July 2011 if not before). Some civil defence placards were replaced with dangerous building notices issued under section 124 Building Act 2004, and where this has happened the section 124 notice is separately recorded. Many other buildings, although not issued with a section 124 notice, may require structural work or other repairs before they can be occupied again. It is the building owners responsibility to make sure the building is safe for any occupier or visitor. Detailed structural engineering assessments may still be required to be carried out.
- | CDB75083798 09/03/2011
Building Evaluation - Sock Spacific : Building Inspected Under Civil Defence Emergency , Green Placard Issued (a deemed Building Act notice)
- | WOF/2020/5827 Expires:
Compliance schedule issued

(d) Orders

(e) Requisitions

Related information

- | In the property file there is an electrical and/or gas fitters certificate relating to works that have been carried out on the current building at this address. If you require a copy of the certificate/s please order a property file through the Council website www.ccc.govt.nz or phone 03 941 8999.

6. Certificates issued by a building certifier

Section 44A(2)(e) LGOIMA. This is information notified to the Council concerning any certificate issued by a building certifier pursuant to the Building Act 1991 or the Building Act 2004.

(For building enquiries, please phone (03) 941 8999, email EPADutyBCO@ccc.govt.nz or visit www.ccc.govt.nz.

7. Weathertightness

Section 44A(2)(ea) LGOIMA. This is information notified to the Council under section 124 of the Weathertight Homes Resolution Services Act 2006.

(For weathertight homes enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

If there is no information below this means Council is unaware of any formal Weathertight Homes Resolution Services claim lodged against this property.

8. Land use and conditions

Section 44A(2)(f) LGOIMA. This is information relating to the use to which the land may be put and conditions attached to that use. The planning information provided below is not exhaustive and reference to the Christchurch District Plan and any notified proposed changes to that plan is recommended: <https://ccc.govt.nz/the-council/plans-strategies-policies-and-bylaws/plans/christchurch-district-plan/>.

There maybe some provisions of the Christchurch City Plan or Banks Peninsula District Plan that affect this property that are still operative.

(For planning queries, please phone (03) 941 8999, email DutyPlanner@ccc.govt.nz or visit www.ccc.govt.nz.

Regional plan or bylaw

There may be objectives, policies or rules in a regional plan or a regional bylaw that regulate land use and activities on this site. Please direct enquiries to Canterbury Regional Council (Environment Canterbury).

(a)(i) Christchurch City Plan & Banks Peninsula District Plan

(ii) Christchurch District Plan

Christchurch International Airport Protection Surfaces

Property or part of property within the Christchurch International Airport Protection Surfaces overlay which is operative.

Liquefaction Management Area (LMA)

Property or part of property within the Liquefaction Management Area (LMA) Overlay which is operative.

Flood Management Area

Property or part of property within the Flood Management Area (FMA) Overlay which is operative.

District Plan Zone

Property or part of property within the Industrial General Zone which is operative.

(b) Resource consents

If there are any land use resource consents issued for this property the Council recommends that you check those resource consents on the property file. There may be conditions attached to those resource consents for the property that are still required to be complied with.

RMA/1985/436 - Resource consents

80 Byron Street Sydenham

Consent to inclusion of parking space where the vehicle needs to reverse in - ind 3 zone - interim measure only -

Historical Reference RES9207692

Status: Processing complete

Applied 04/12/1985

Decision issued 01/01/1999

Declined 01/01/1999

- I RMA/1986/390 - Resource consents
80 Byron Street Sydenham
Dispensation from provision of on site turning for two carparks - Historical Reference RES9207688
Status: Processing complete
Applied 20/02/1986
Decision issued 24/03/1986
Granted 24/03/1986

- I RMA/2011/615 - Subdivision Consent
BOUNDARY ADJUSTMENT Sec223 issued 25/1/13 Sec224 issued 8/9/14 Lt 449853 - Historical Reference RMA92018158
Status: Processing complete
Applied 26/05/2011
Granted 08/06/2011
Decision issued 08/06/2011

9. Other land and building classifications

Section 44A(2)(g) LGOIMA. This is information notified to the Council by any statutory organisation having the power to classify land or buildings for any purpose.

(For land and building enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

Please refer to Section 1 for details

10. Network utility information

Section 44A(2)(h) LGOIMA. This is information notified to the Council by any network utility operator pursuant to the Building Act 1991 or the Building Act 2004.

(For network enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

! **None recorded for this property**

11. Other information

Section 44A(3) LGOIMA. This is information concerning the land that the Council has the discretion to include if it considers it to be relevant.

(For any enquiries, please phone (03) 941 8999 or visit www.ccc.govt.nz.

(a) Kerbside waste collection

- | Your recycling is collected Fortnightly on the Week 2 collection cycle on a Tuesday. Please leave your recycling at the Kerbside by 6:00 a.m. Your nearest recycling depot is the Metro Place EcoDrop.
- | Your refuse is collected Fortnightly on the Week 2 collection cycle on a Tuesday. Please leave your rubbish at the Kerbside by 6:00 a.m. Your nearest rubbish depot is the Metro Place EcoDrop.
- | Your organics are collected Weekly on Tuesday. Please leave your organics at the Kerbside by 6:00 a.m.

(b) Other

| Floor Levels Information

Christchurch City Council holds a variety of information relevant to building/property development across the city. This includes minimum finished floor levels that need to be set to meet the surface water requirements in clause E1.3.2 of the building code (where this applies), and the requirements of the Christchurch District Plan (where a property is in the Flood Management Area). Where this information has been processed for your site, it can be viewed at <https://ccc.govt.nz/floorlevelmap/>, otherwise site specific advice can be obtained by emailing floorlevels@ccc.govt.nz.

| Community Board

Property located in Linwood-Central-Heathcote Community Board.

| Tsunami Evacuation Zone

This property is not in a tsunami evacuation zone. It is not necessary to evacuate in a long or strong earthquake or during an official Civil Defence tsunami warning. Residents may wish to offer to open their home to family or friends who need to evacuate from a tsunami zone, and should plan with potential guests to do so in advance. More information can be found at <https://ccc.govt.nz/services/civil-defence/hazards/tsunami-evacuation-zones-and-routes/>

| Electoral Ward

Property located in Central Electoral Ward

| Listed Land Use Register

Hazardous activities and industries involve the use, storage or disposal of hazardous substances. These substances can sometimes contaminate the soil. Environment Canterbury identifies land that is used or has been used for hazardous activities and industries. This information is held on a publically available database called the Listed Land Use Register (LLUR). The Christchurch City Council may not hold information that is held

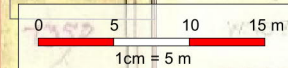
on the LLUR Therefore, it is recommended that you check Environment Canterbury's online database at www.llur.ecan.govt.nz

┆ **Spatial Query Report**

A copy of the spatial query report is attached at the end of this LIM. The spatial query report lists land use resource consents that have been granted within 100 metres of this property.

Related information

- ┆ Please see attached a copy of the Detailed Engineering Evaluation (DEE) assessment report.
- ┆ Dangerous Goods Licences have been replaced with Location Test Certificates/ Location Compliance Certificates administered by Worksafe. You can contact a local Test Certifier to advise you or to issue the type of test certificate you need.



1 : 500 on A4
21/06/2021 9:34:26 AM



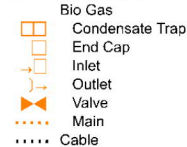
ph: 941-8300 fax: 941-8385

Accuracy not guaranteed. Onsite verification required. Display of data scale dependent, full detail available at 1:500.

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Private Drainage

Standard Infrastructure



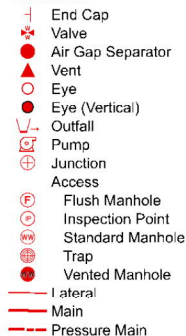
Water Intake/Supply



Water Intake/Supply



Wastewater



Wastewater



Stormwater



Stormwater



Stormwater



03/04/2017

RFI's Issue 2

existing stormwater pipe to be disconnected and removed at time of slab excavation

15mm Dia @ 1:40 through ceiling space & down through wall to connect to sink drain

cleaners sink
65Ø @ 1:40

100Ø @ 1:60

15/10/2019 Minor Variation of Consented Plans Issue 5

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

IB

Stormwater

Roof area + Gutter area = 105.23m²

Rain intensity 50

MRA factor 50/100=.5

105.23x.5= 52.61m²

MRA= 52.61m²

Cross sectional gutter area required = 26,000mm²

Cross sectional gutter area achieved 132x600 = 79,200mm²

Down pipe 100Ø

Stormwater mains pipe

Total existing & proposed roof areas 806.7464m²

plus half hardstand 257.5205m²

multiply by modification factor .55

= 585.2m²

Required pipe & gradient 150Ø @ 1:120

compliant with E1/AS1 fig.3

NOTE: Confirm on site that existing 150Ø storm water pipe is at 1:120 gradient prior to any drainage work commencing, if pipe is found to have insufficient fall reset to comply

Roof & Gutter Area

105.2331 m²

Figure 16: Cross-sectional Area of Internal Gutter
Paragraphs 5.1.2 and 5.1.3

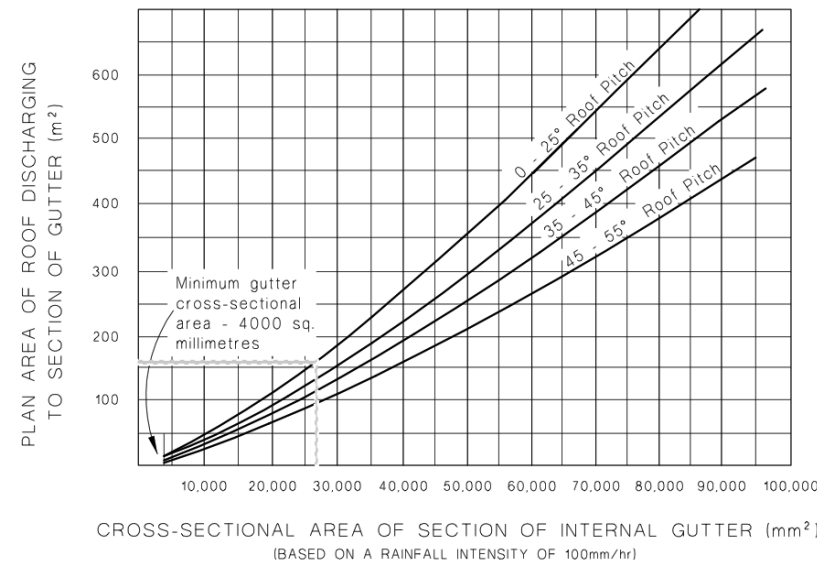


Table 5: Downpipe Sizes for Given Roof Pitch and Area Paragraph 4.2.1	Roof pitch			
	0-25°	25-35°	35-45°	45-55°
Downpipe size (mm) (minimum internal sizes)	Plan area of roof served by the downpipe (m²)			
63 mm diameter	60	50	40	35
74 mm diameter	85	70	60	50
100 mm diameter	155	130	110	90
150 mm diameter	350	290	250	200
65 x 50 rectangular	60	50	40	35
100 x 50 rectangular	100	80	70	60
75 x 75 rectangular	110	90	80	65
100 x 75 rectangular	150	120	105	90

Sewer

SS	Sanitary sewer
DU	Discharge units
AB	Access bend
AJ	Access junction
FWG	Floor waste gully
ORG	Overflow relief gully
TV	Terminal vent
DS	Discharge stack
FF	First floor fitting
IP	Existing inspection point
IB	Existing inspection bend

Sanitary sewer waste pipe minimum falls unless shown otherwise

100Ø	1:60
80Ø	1:60
65Ø	1:40
50Ø	1:40
40Ø	1:40

Sanitary sewer designed to AS/NZS3500.2.2003

Pipe gradients minimum, may be increased to suit site levels

Stormwater

DP	Downpipe, uPVC
SW	Stormwater
MCA	Modified catchment area
MRA	Modified roof area
CP	Cesspit

Roof areas modified for 126mm/hour rainfall intensity, 10 percent probability of occurring with a 10 minute duration

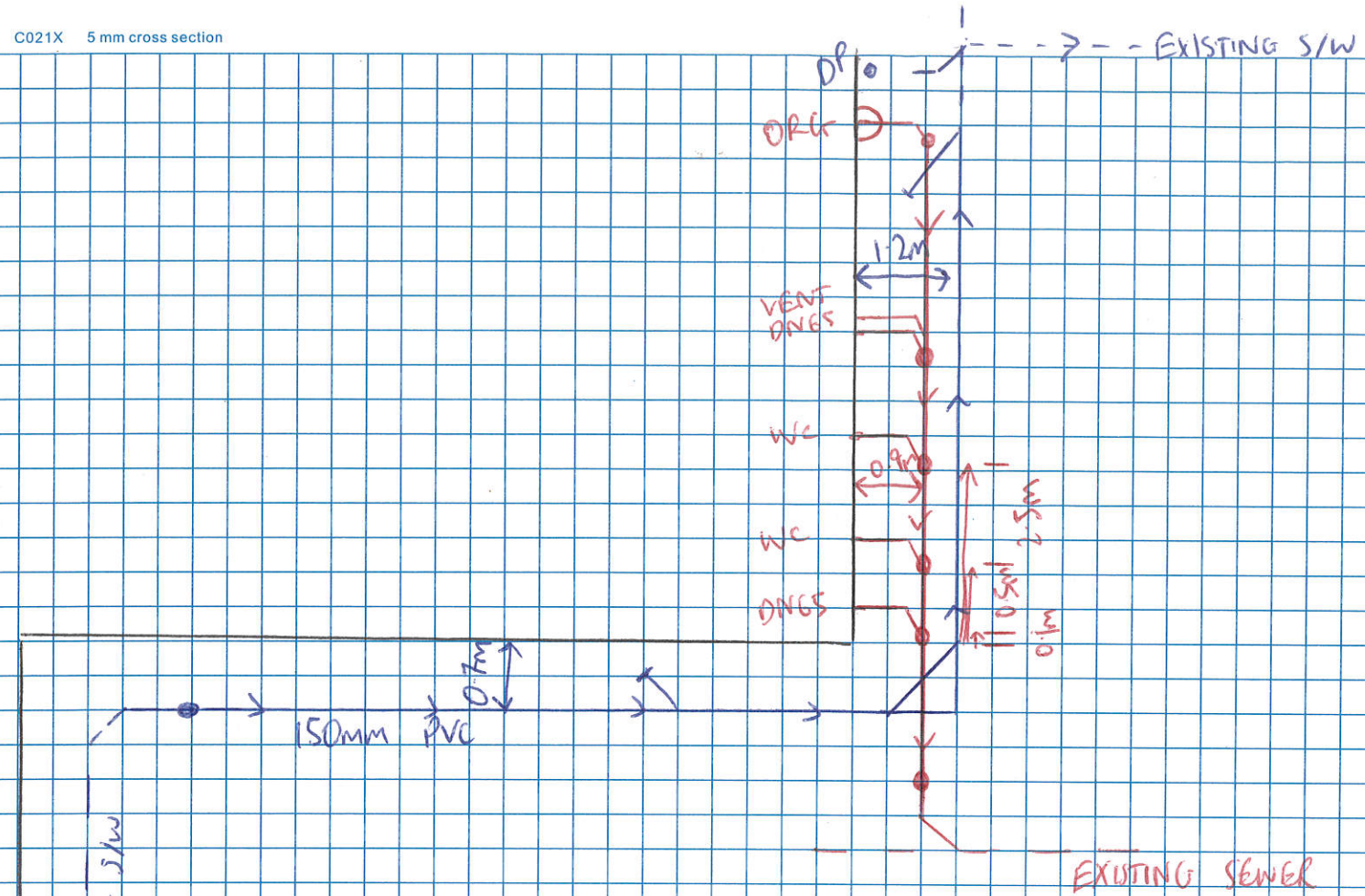
All pipework to be uPVC unless stated otherwise

Pipe gradients minimum, may be increased to suit site levels

NOTE:
Drains in close proximity to building must comply with Clause 7.2.9 of AS/NZS 3500:2003.

A Wilkins double check valve 950XLT Series 20-50mm or equivalent, medium risk Back Flow Device shall be fitted to potable water supply.

Amendment #1



80 Byron st, Christchurch
 Josh Eady Reg. 22552

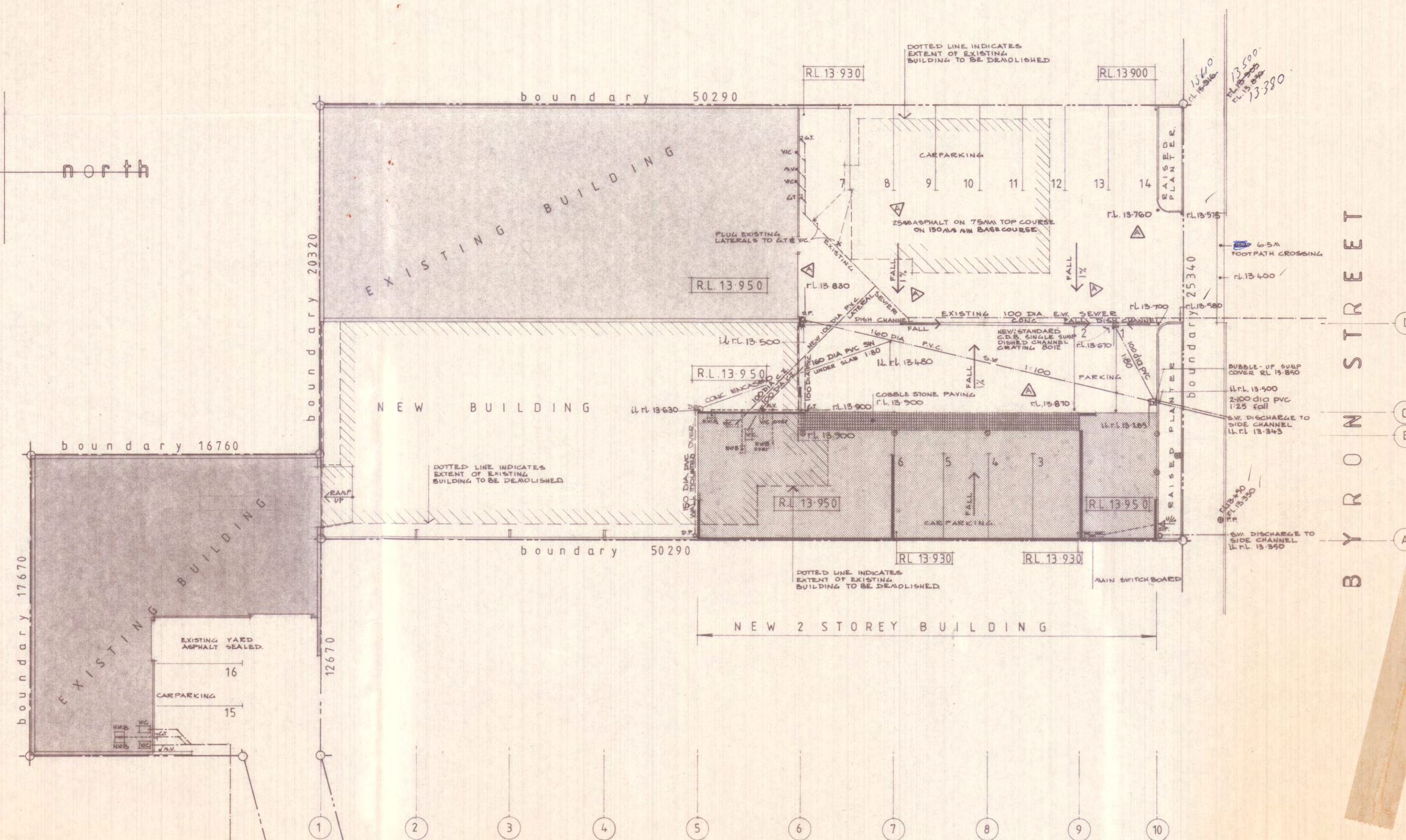
100mm PVC AT 1:60 MIN GRADE TO EXISTING DRAIN
 150mm PVC AT 1:100 MIN GRADE TO EXISTING DRAIN.

GROUND LEVEL	13.950	13.950
INVERT LEVEL	13.950	13.950
OUT TO INVERT	0.40	0.40
DISTANCE	0.00	2.10
GRADIENT	1:100	

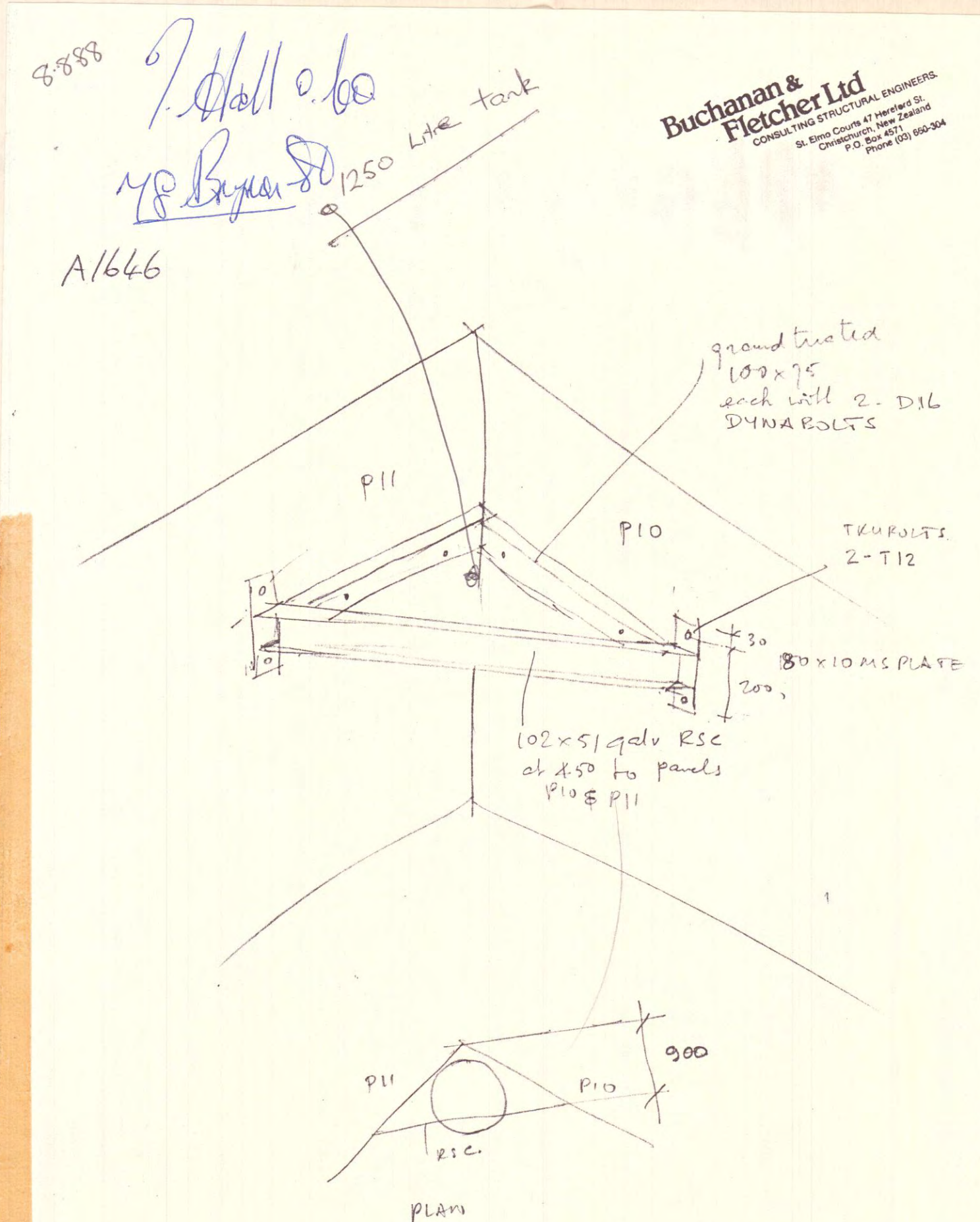
ELEVATION 160 DIA SW V=1:50 H=1:500

GROUND LEVEL	13.950	13.950
INVERT LEVEL	13.950	13.950
OUT TO INVERT	0.42	0.42
DISTANCE	0.00	12.00
GRADIENT	1:20	

ELEVATION 160 DIA SW LATERAL V=1:50 H=1:500



LAND DESCRIPTION
 D.P. 2 PART LOT 215
 D.P. 2 PART LOT 214, 215, 216
 D.P. 50440 PART # 213, 214, 215, 216



CHRISTCHURCH CITY COUNCIL
 Approved Subject to the By-Laws
 1 SEP 1988
 W. Drake
 For Engineer

CHRISTCHURCH CITY COUNCIL
 Approved Subject to the By-Laws
 1 SEP 1988
 W. Drake
 For Engineer

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK

88-1833
 sheet 3

A 03 08 88 rls altered as indicated
 REVISIONS

NEW CONCRETE
 TWO STOREY UNIT
 AND NEW TIMBER
 FRAMED STRUCTURE
 78 BYRON STREET

Buchanan & Fletcher Ltd
 CONSULTING STRUCTURAL ENGINEERS
 51 New Cornish Street, Christchurch, New Zealand
 Phone (03) 600 500 Fax (03) 600 501

DRAWN G.J.H. DATE 18 07 88
 APPROVED SCALE 1:200

site and drainage plan

JOB 620 A&B DRAWING S1 REV. A

REPORT

STRUCTURAL AND CIVIL ENGINEERS

78- 82 BYRON ST

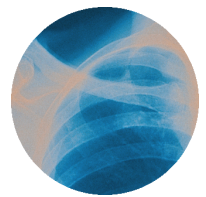
BUILDING A

PREPARED FOR

STEWART FAMILY TRUST

111702

JUNE 2014





78 BYRON ST – DETAILED SEISMIC ASSESSMENT REPORT
BUILDING A – SHEER ADVENTURE WORKSHOP

Prepared For:
STEWART FAMILY TRUST

Date: 27 June 2014
Project No: 111702
Revision No: 1

Prepared By:

David J Herman
DESIGN ENGINEER

Reviewed By:

Richard Seville
PROJECT DIRECTOR

Holmes Consulting Group LP
Christchurch Office



REPORT ISSUE REGISTER

DATE	REV. NO.	REASON FOR ISSUE
27 June 2014	1	Information



CONTENTS

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EXECUTIVE SUMMARY

This report covers the structural damage sustained by the Sheer Adventure Workshop building at 78 Byron St, as a result of the series of earthquakes including the Darfield Earthquake that struck at 4:36am on 4th September, 2010 and the Lyttelton Earthquake that struck at 12.51 pm on the 22nd of February, 2011. The Sheer Adventure Workshop building consists of the original western warehouse structure and the eastern lean-to addition.

The lateral capacity of the building in the east-west direction prior to the earthquakes was found to be approximately 35% of current code. The capacity in the east-west direction was limited by the combined axial loading and bending capacity of the steel portal frames. The lateral capacity of the building in the north-south direction was found to be approximately 70% of current code and was limited by shear in the central ungrouted concrete block infill walls. The external wing-wall extension in the northwest corner of the original structure was found to be 15% of current code and was limited by the out-of-plane capacity of the wall at its base.

The level of shaking experienced at the site is estimated from the Geonet strong motion data recorded at monitoring sites around Christchurch and is related to the fundamental periods of the building for the Lyttelton Earthquake. Given the strong motion data available, it is likely that this earthquake produced accelerations significantly in excess of the design spectra for this building.

Preliminary and detailed observations have been made of the damage sustained as a result of the earthquakes. This report summarises the findings of these detailed observations and provides recommendations regarding the repair work required.

General damage observed consists of cracking and differential settlement of the concrete slab, diagonal cracking along the mortar joints of the concrete masonry unit block walls throughout the original western structure, and failure of a roof bracing strap.

As a result of the earthquakes the building's capacity has likely been reduced in the north-south direction due to diagonal cracking along mortar joints in some of the infill wall panels. The remaining uncracked panels provide the residual lateral capacity in the north-south direction and we estimate the remaining capacity to be greater than 33% of current code. The building's capacity in the east-west direction remains at approximately 35% of current code. The wing-wall extension in the northwest corner of the original structure remains at 15% of current code.

Repairs are recommended in the report and include repairing and repointing of the concrete blockwork and infill wall mortar joints, repair of spalled concrete at portal column bases and beam joints, removing and replacing the slab-on-grade in approximately 40% of the building, and replacing the failed roof bracing tension strap. Note that replacement of slab sections and wall repairs may require the tenants to relocate equipment and operations to the unaffected areas of the building. The northwest wing wall extension should be deconstructed. A fire engineer should be engaged to determine if the wall needs to be replaced. If so, the new wall should be designed for 100% of current loading standard.

Following the repairs recommended herein, the lateral load resisting performance of the building will be restored to its pre-earthquake condition. As noted above, this capacity is

limited by the capacity of the steel portal frames in the east-west direction (35% DBE) and the capacity of the infill walls in the north-south direction (70% DBE).

The following further investigations are recommended to confirm analysis assumptions and complete observations of areas of potential damage:

- To confirm foundation assumptions, a geotechnical report should be completed for the site.
- One location of the slab should be broken up along the internal north-south running block wall to confirm block wall foundation and steel portal frame column foundation assumptions.
- The concrete encasement around the steel portal frame column should be broken out at the slab level and the beam-column joint level at several locations to determine if any damage has occurred to the steel portal frames.

All locations should be confirmed with the engineer prior to implementation of any destructive investigations.

This report is considered a live document and will be updated throughout the course of the project with the final report issued once the repairs have been completed.



1. INTRODUCTION

Holmes Consulting Group has been engaged by the Stewart Family Trust to complete a structural review following the Canterbury Earthquakes.

The Darfield Earthquake of 4:36am on 4th September, 2010 and the Lyttelton Earthquake of 12.51 pm on 22nd of February, 2011 have subjected the building to strong ground motions which significantly exceed the full design earthquake load for buildings of this nature. Consequently it is important that a full evaluation is performed.

1.1 PURPOSE

The purpose of this study was to:

- review the impact of the earthquakes on the building
- determine the seismic capacity of the building
- map typical damage around the building
- identify those items requiring repairs or replacement
- specify concept repairs to comply with Christchurch City Council regulations

The overall objective is to ensure that the building is repaired and opened for tenants in as timely and smooth a fashion as possible.

1.2 SCOPE OF WORK

The CERA detailed engineering evaluation procedure is currently in draft form and specific requirements for re-occupation of buildings or applications for Building Consents are not yet certain. As such, this report covers the following scope:-

- Review the available structural drawings to determine the building structural systems and predict areas of likely damage.
- Inspect a sufficient amount of the building structure to be able to make a determination of the behaviour of the building in the earthquake, and to map damage to the structure.
- Repair of damage caused directly by the earthquake.
- Adoption of the new loadings standard ($Z=0.3$).
- Assessment of Critical Collapse Hazards.
- Prepare a report detailing the proposed repairs required including extent and details.

The likely extent of repairs outlined herein is based on our observations described herein and does not consider any potential changes to the minimum design load levels other than those described above. Further repairs may also be identified during the course of conducting detailed observations.

It should be noted that even after the detailed observations and analysis outlined above, it is difficult to accurately quantify the residual capacity remaining in the structure following this significant earthquake. As such, it is likely that we may never be able to categorically state that the building is as good as it was before the earthquake.

1.3 LIMITATIONS

Findings presented as a part of this project are for the sole use of the Stewart Family Trust, its insurer, and the Christchurch City Council in its evaluation of the subject property. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses.

Our observations have been visual only and limited to representative samples, as described in our record of observations. Our observations have been restricted to structural aspects only. Waterproofing elements, electrical and mechanical equipment, fire protection and safety systems, service connections, water supplies and sanitary fittings have not been inspected or reviewed, and secondary elements such as windows and fittings have not generally been reviewed.

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. No other warranty, expressed or implied, is made as to the professional advice presented in this report.



2. STATUTORY REQUIREMENTS

2.1 BUILDING ACT

When dealing with existing buildings there are a number of relevant sections of the Building Act [1] that need to be considered in relation to the building's structure and strength.

Section 112 - Alterations to Existing Buildings

Section 112 of the Building Act requires that a building subject to an alteration continue to comply with the relevant provisions of the Building Code to at least the same extent as before the alteration.

Essentially this section means that the building may not be made any weaker than it was, as a result of any alteration.

Section 122 – Meaning of Earthquake Prone Building

Section 122 of the Building Act 2004 deems a building to be earthquake prone if its ultimate capacity (strength) would be exceeded in a “moderate earthquake” and it would be likely to collapse causing injury or death, or damage to other property.

The Building Regulations (2005) define a moderate earthquake as one that would generate loads 33% as strong as those used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

If a building is found to be earthquake prone, the territorial authority has the power under section 124 of the Building Act to require strengthening work to be carried out, or to close the building and prevent occupancy.

Section 131 – Earthquake Prone Building Policy

Section 131 of the Building Act requires all territorial authorities to adopt a specific policy on dangerous, earthquake prone, and unsanitary buildings.

2.2 BUILDING CODE

The Building Act requires all new building work to comply with the New Zealand Building Code [2] which outlines the performance standards required for new building work. The Department of Building and Housing also publishes Compliance Documents which may be used to establish compliance with the Building Code.

Following the Lyttelton Earthquake, an amendment to the Compliance Document B1 Structure was published on the 19th May, 2011. This amendment contained changes to the seismic design loads for Canterbury including:-

- 36% increase in the basic seismic design load (Z) for Christchurch (new Z=0.3)
- 85% increase in the basic seismic design load (Z) for Akaroa (new Z=0.3)
- Increased serviceability limitations for new buildings

As a result, a building constructed last year to comply with the Building Code could now have a capacity of just 73% of the new load levels.

2.3 CHRISTCHURCH CITY COUNCIL POLICY

In 2006 the Christchurch City Council (CCC) adopted their Earthquake-Prone, Dangerous and Insanitary Building Policy [3], which was subsequently amended (under urgency) following the 4th September 2010 Darfield Earthquake.

The 2010 amendment outlines a process of identifying Earthquake Prone Buildings due to commence from 1 July 2012. Owners of Earthquake Prone Buildings identified through this process would have between 15-30 years to strengthen the building to a target of 67% of current code as outlined in Section 2.3.3.

Section 2.3.3 – Taking Action on Earthquake-prone Buildings

... As noted in section 2.3.1 of this Policy, the Council will determine the level of strengthening required to reduce or remove the danger on a building-by-building basis. It will be guided by the Recommendations of the New Zealand Society of Earthquake Engineers that 67% of Full Code Levels is a reasonable target level of strengthening to reduce the risk posed by existing buildings...

The CCC's 2010 policy also includes the following section covering the repair of buildings damaged by an earthquake:

Section 2.3.6 – Buildings Damaged by an Earthquake

Buildings may suffer damage in a seismic event. Applications for a building consent for repairs will be required to ensure structural strength. The Council will follow sections 2.3.1 and 2.3.3 of this Policy in determining the level of strengthening required for each building.

If a building consent application for repairs is not made and/or the repair work is not completed within a timeframe that the Council considers reasonable the Council reserves the right to serve notice under section 124(1) of the Building Act 2004 to require the work to be done.

The judgement of a recent case before the High Court of New Zealand (CIV 2012-409-2444 [2013] NZHC 51) states that "...territorial authorities may not use section 124 notices to advance a policy of increasing building capacity to a level above 34% of the NBS. However, they are not prevented from requiring work to reduce or remove specific vulnerabilities capable of causing injury, death or property damage where the subject building is also under 34% of the NBS"

While strengthening earthquake prone buildings to levels above 34% is desirable and recommended, this judgement indicates that the Christchurch City Council does not have the authority to require earthquake prone buildings to be strengthened beyond 34% of the NBS.

2.4 CANTERBURY EARTHQUAKE RECOVERY AUTHORITY (CERA)

The Canterbury Earthquake Recovery Authority (CERA) was established on 28th March, 2011 to take responsibility for the recovery of Christchurch by means of the Canterbury Earthquake Recovery Act 2011 [4] which was passed on 18 April, 2011. Under this act, the CEO (of the Canterbury Earthquake Recovery Agency, CERA) has wide powers in respect of verifying building safety and requiring demolition or repairs. Particularly relevant sections are;

Section 38 – Works

- (4) If the chief executive gives written notice to an owner of a building, structure, or other erection on or under land that demolition work is to be carried out there, -
 - (a) the owner must give notice to the chief executive within 10 days after the chief executive's notice is given stating whether or not the owner intends to carry out the works and, if the owner intends to do so, specifying a time within which the works will be carried out; and
 - (b) if the owner fails to give notice under paragraph (a) or the chief executive is not satisfied with the time specified, or the works are not carried out in the time specified or otherwise agreed, then –
 - (i) the chief executive may commission the carrying out of the works; and
 - (ii) in the case of the demolition of a building to which section 40(1) or (2) refers, the chief executive may recover the costs of carrying out the work from the owner of the dangerous building in question; and
 - (iii) the amount recoverable becomes a charge on the land on which the work was carried out.

Section 51 – Requiring Structural Survey

The chief executive may require any owner, insurer, or mortgagee of a building that he or she considers has or may have experienced structural change in the Canterbury earthquakes to carry out a full structural survey of the building before it is re-occupied for business or accommodation by the owner, a tenant, or any member of the public.

With regard to Section 51, we understand that it is likely that CERA will require a detailed engineering evaluation to be carried out for all buildings not exempt from the Earthquake Prone Building Legislation. At this stage it is not clear whether the detailed evaluation will be required prior to re-occupation.

CERA has recently published a draft procedure for the detailed engineering evaluation. Depending on the outcome of an initial qualitative assessment for a building, a further detailed quantitative assessment may be required. In addition to repair of earthquake damage, strengthening may be required in order to achieve compliance with the performance levels outlined in this evaluation procedure.

Typically the evaluation procedure defaults to achieving the minimum standard set out by the Earthquake Prone Building legislation, which has generally been accepted as achieving an ultimate limit state capacity equivalent to at least 33% current code.

3. PRE-EARTHQUAKE BUILDING CONDITION



This section discusses the form and capacity of the building prior to the Canterbury Earthquakes. The Sheer Adventures Workshop building at 78 Byron Street was constructed in two different time periods. The main structure was constructed in the 1960's with an addition along the eastern side of the building constructed in 1988. The original structural design for the 1988 addition was completed by Buchanan and Fletcher Ltd. Designers of the 1960's section are unknown. The street facing side of the structure is shown in Figure 3-1.

The information available for the review included the structural drawings for the eastern addition. Construction documents for the original warehouse structure were not available. A geotechnical assessment has not been conducted for this site at the time of this report.



Figure 3-1: Sheer Adventure Workshop – 78 Byron St

3.1 BUILDING FORM

The Sheer Adventure Workshop overall building footprint is approximately 28 m by 26 m. The building is composed of two sections built in separate time periods. The building is located adjacent to buildings on its eastern and southern elevations. The building is structurally separate from the neighbouring buildings. There may be some small separation gap between the buildings, however existing external façade elements and internal linings prevented the

direct observation of the gap. There was originally a link (door opening) between the eastern addition and the building to the south. This has since been filled in with a fire rated concrete block wall. The block wall appears to be attached to the southern building and separated from this building. The overall building footprint is illustrated in Figure 3-2.

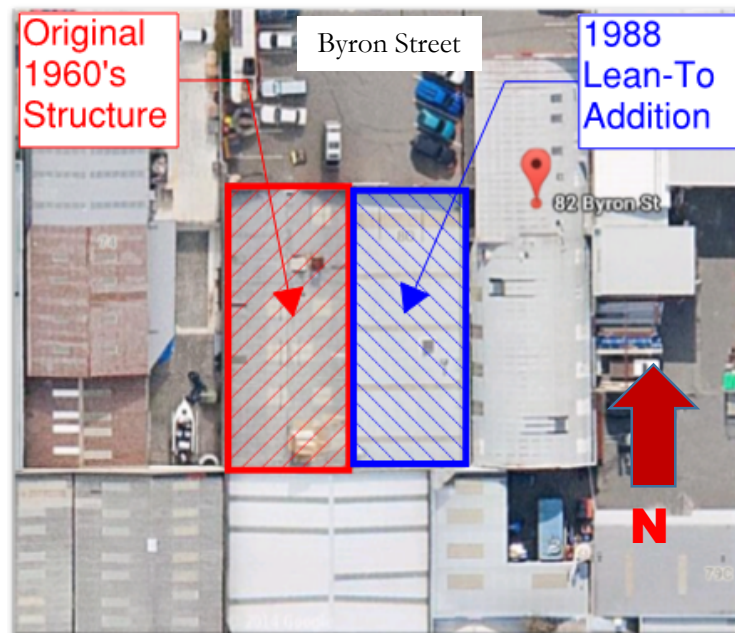


Figure 3-2: Sheer Adventure Workshop – Original Structure and Eastern Addition

The original structure, the western section, was designed and constructed in the 1960's (Figures 3-3 and 3-4). The building was likely designed to predecessor standards of the current NZ Building Code, comprising principally NZS1900:1965. The building is a single story structure, with an internal timber framed mezzanine at the north end of the building. The structure is an open warehouse with steel portal frames running across the building in the east-west direction. The portal frames are composed of I-sections with the columns encased in concrete. Infill walls around the west, south, and original 1960's eastern perimeter of the building are constructed of ungrouted concrete blockwork. There is a solid bond beam along the top of these walls that appears to be reinforced concrete. The roof is composed of diagonal sarking on timber framing with numerous skylights. There is no foundation information available to review however given the type of building and damage observed, the likely construction is concrete slab on grade with shallow pads under portal legs and shallow strip foundations under the walls.

The lean-to addition, the eastern section, was designed and constructed in 1988 (Figures 3-3 and 3-5). This addition was likely designed to the NZS4203 (1984) loadings standard. The structure consists of glulam cantilevered L-shaped frames which span in the east-west direction and are pinned to the original structure's reinforced concrete bond beam. The roof is composed of light gage metal roofing and insulation supported by timber purlins. The south, north, and east walls are composed of light timber framing. A connection doorway to the building adjacent to the south wall has been in-filled with a grout filled concrete block wall. The wall appears to be tied into the structural concrete blockwork walls of the adjacent structure, and are therefore not a part of this building. There is a short height timber framed mezzanine at the north end.

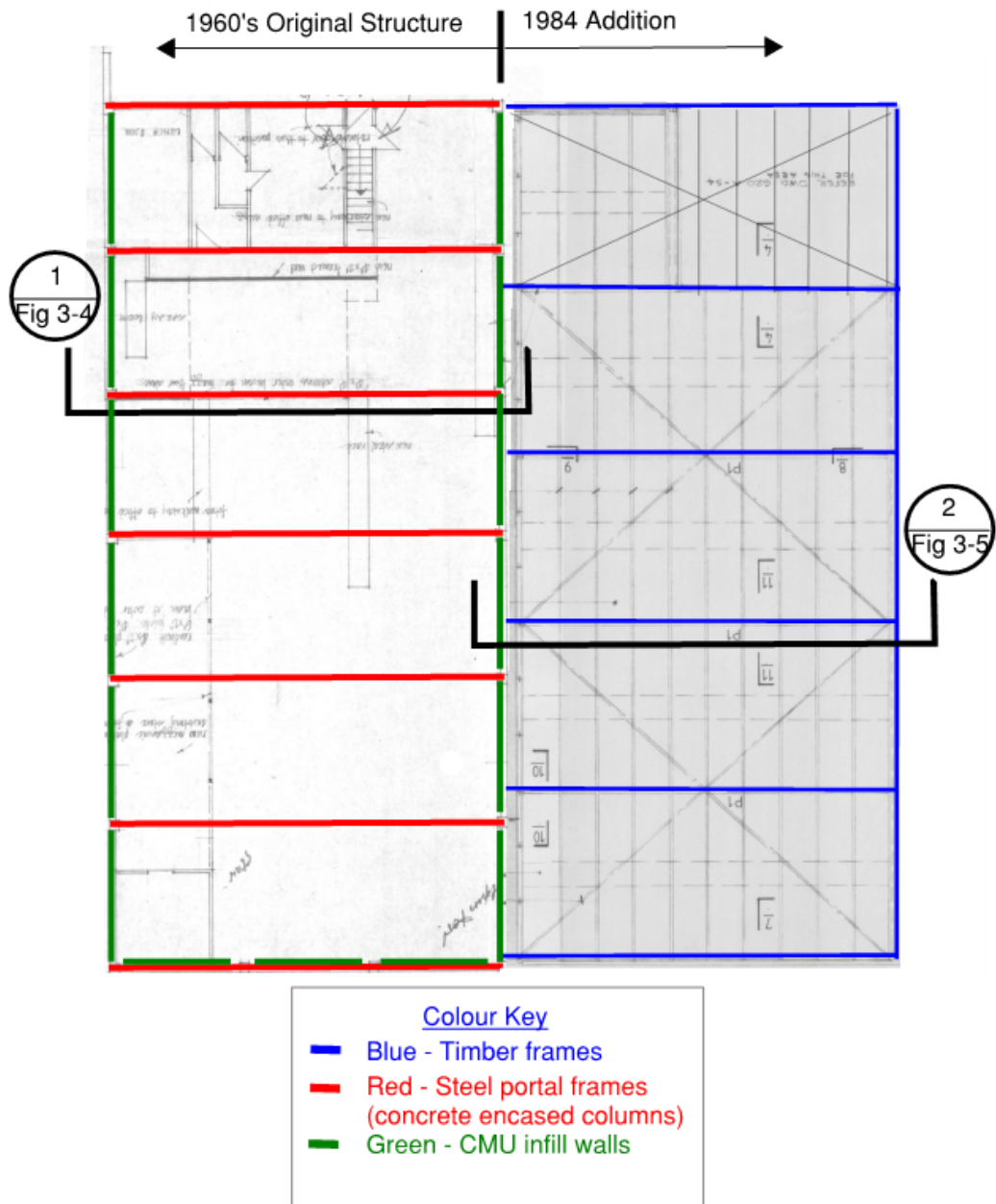


Figure 3-3: Sheer Adventure Workshop – Plan View of Building

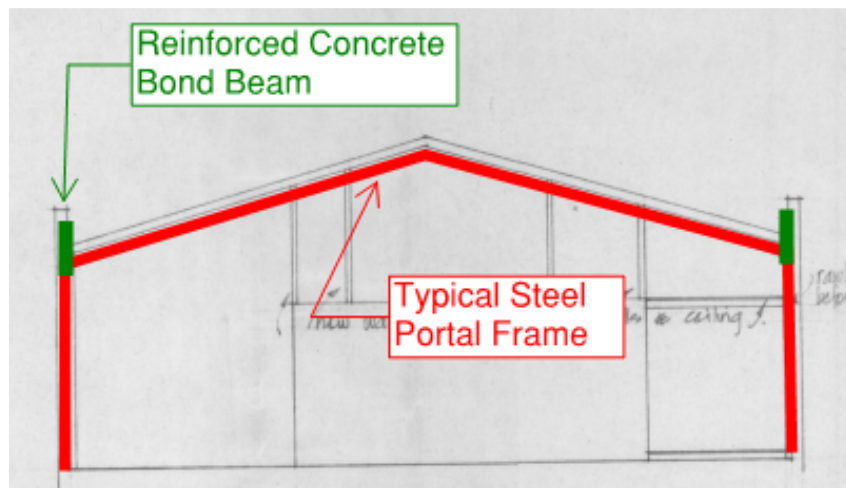


Figure 3-4: Section 1 - 1960's Original Steel Building Cross Section

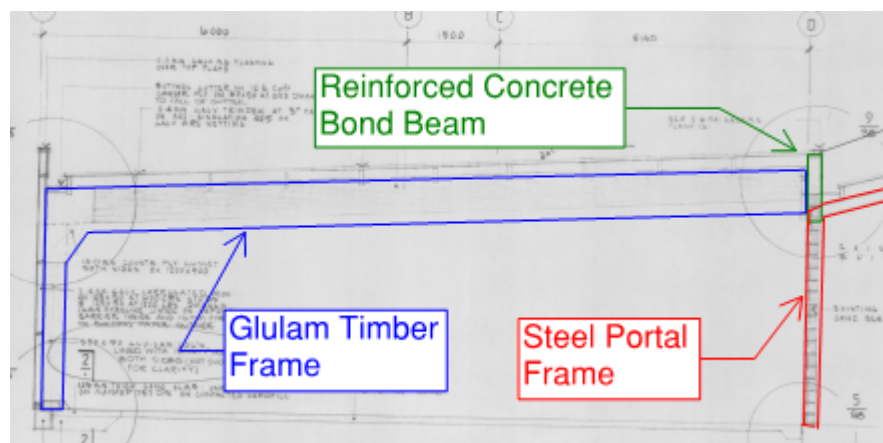


Figure 3-5: Section 2 - 1980's Eastern Addition

3.2 LATERAL LOAD RESISTING SYSTEM

In the east-west (across) direction lateral loads for the original structure at the roof level are distributed by the diagonal timber sarking and are resisted, typically, by the steel portal frames. Lateral loads at the roof level from the eastern lean-to addition are distributed to the timber glulam frames via the purlins. The lateral loads from the walls are transferred directly to the timber glulam frames. The timber glulam frames in the addition and the original steel portal frames are connected by the concrete bond beam of the original structure. The timber glulam frames and original steel portal frames are offset, as shown in Figure 3-3. Lateral loads are resisted by a combination of frame action in the glulam frame and the steel portal frames.

In the north-south direction in the original structure, lateral loads at the roof level are distributed by diagonal timber sarking to the reinforced concrete bond beam and resisted by the ungrouted concrete block infill walls between the portal frames. Lateral loads at the roof level of the lean-to addition are distributed by tension only steel strap bracing to the gib lined timber wall along the western edge of the building and to the reinforced concrete bond beam in the centre of the building. Lateral loads are resisted by the gib lined timber perimeter wall and the ungrouted concrete block infill walls below the reinforced concrete bond beam.

3.3 PRE-EARTHQUAKE BUILDING CAPACITY – DIRECT CODE COMPARISON

The original structure, the western building, was likely designed to the NZS1900:1965 loadings standard. The eastern addition, constructed in 1988, was likely designed to the NZS4203 (1984) loadings standard. Both standards have been replaced by NZS1170.5:2004 [8]. The recent amendment to the Building Code has further increased the load levels defined in NZS1170.

Based upon building occupancy, the Sheer Adventures Workshop has been considered as an Importance Level 2 (IL2) building in accordance with NZS1170.5:2004 [8]. For a building design life of 50 years, the associated return period of the Design Base Earthquake (DBE) is 500 years. Per the loadings standard for a warehouse structure as prescribed in this code (no post-disaster or special function), the risk factor for design is taken as $R=1.0$. The sub soil for the entire site has been assumed to be Soil Type D in accordance with NZS1170, which is typical of this location in Christchurch. The fundamental period of the structure was assumed to be 0.4s for out-of-plane and in-plane ungrouted concrete block walls. The fundamental period of the steel portal frame with lean-to frame addition was estimated with the Raleigh method to be approximately 1.0s.

Based upon the information available, we have assumed the following levels of ductility:

- in-plane lateral loads for frames – nominally ductile, $\mu=1.25$
- in-plane lateral loads for ungrouted concrete block walls – elastic, $\mu=1.0$
- Out-of-plane lateral loads for ungrouted concrete block walls – elastic, $\mu=1.0$

Comparisons of the load levels represented by the original loading standards to the current loading standard are plotted below for a building fundamental period of 0.4s. The seismic design loads from NZS1900:1965 are approximately 15% of current design loads. Seismic loads from NZS4203(1984) are approximately 35% of current design loads.

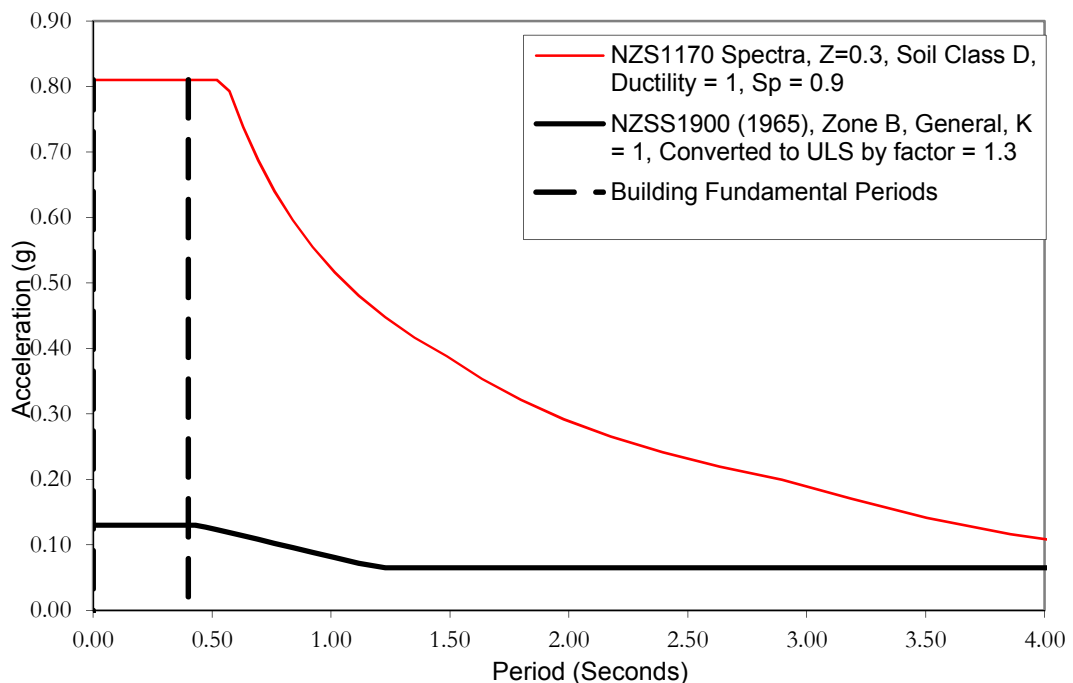


Figure 3-6: Comparison of Design Codes (NZSS1900 to NZS1170)

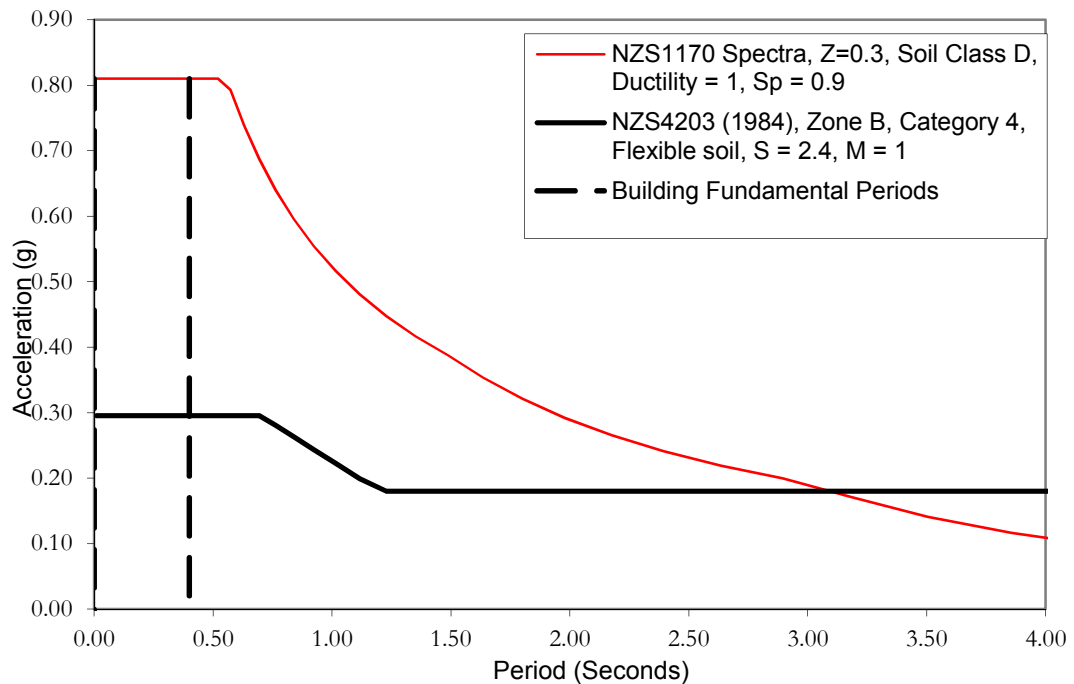


Figure 3-7: Comparison of Design Codes (NZS4203 to NZS1170)

3.4 PRE-EARTHQUAKE BUILDING CAPACITY – EQUIVALENT STATIC ANALYSIS TO NZS1170.5 (2004)

In addition to the direct code comparison provided above, an equivalent static analysis to NZS1170.5:2004 has been carried out to gain a better understanding of the buildings capacity when compared to current loading standards. The equivalent static analysis was carried out based upon the original construction documents available, incorporating on-site measurements and as-built observations.

The probable capacities have been calculated using the *New Zealand Society for Earthquake Engineering Guidelines for the Assessment of the Structural Performance of Buildings in Earthquakes* – NZSEE 2006 [13]. The guidelines allow some relaxation of the requirements for existing buildings when compared to what would be required for a new building. As a result existing buildings shown to achieve 100% of current code loading may not achieve the same level of seismic performance as a new building designed to achieve minimum compliance with the building code.

Account is also made of critical structural weaknesses. Critical structural weaknesses (CSW) are details, configurations, and building or site characteristics that could lead to increased damage levels in a building or the premature failure or collapse of all or part of a building.

To provide a comparison for each of the primary lateral components, the relative capacity of the elements have been assessed as a percentage of the demand imposed by the current loading code Design Basis Earthquake, and have been expressed as a %DBE. This includes checks for both strength and deflection requirements.

The demand on the various structural elements of the system were determined by performing a three dimensional analysis on the main framing elements. A three-dimensional model was constructed and analysed in an analysis program based on information contained on the available construction drawings and from on-site measurements. Based on the time period and

type of building construction, some fixity in the portal frame foundations was assumed in the model.

To determine the design loads imposed by the current loading standard, the building natural periods were estimated to be 0.4s in the north-south direction and approximately 1.0s in the east-west direction. The fundamental period in the east-west direction was determined using the Raleigh Method described in the loading standard. From the structure's natural period and ductility, as listed in Section 3.3, the loading demand imposed by the current standard was determined and applied to the analysis model. The demand on the various structural components was obtained from the analysis results and compared to the calculated capacities to determine the %DBE of each element.

The calculated seismic capacity in the east-west direction of the Sheer Adventures Workshop is approximately 35% DBE. The limiting elements in the structure are the east-west steel and glulam portal frames. The table below outlines the capacities of various elements in the structure.

The limiting factor in the north-south direction for the capacity of the Sheer Adventures workshop is the central ungrouted concrete block work infill walls which are at 70% DBE and limited by sliding shear of the infill walls.

Due to the flexible nature of the portal frames, large deflections are likely to occur, especially in at the western edge of the building. If the seismic gap with the adjacent building is insufficient, pounding is likely to occur.

To the north of the western concrete masonry wall of the original warehouse structure there is an extension of the concrete masonry block wall that appears to cantilever from the ground. There does not appear to be any dowel connection between the original wall and the extension. Assuming the wall is fully grouted with minimum reinforcement, the wall is at approximately 15% DBE and limited by out-of-plane loading.

Table 3-1: 78 Sheer Adventure Workshop – Seismic Assessment %DBE

Building Element	%DBE (IL2)	Comments
Ceiling Diaphragm – NS - EW	100 100	Diagonal sheathing in west side of building
Ceiling Tension Strap Bracing	95	Bracing is limited by tensile capacity
GluLam Portal Frames	35	Glulam frame is limited by combined bending and axial loading in the column
Steel Portal Frames	35	Steel portal frame is limited by combined bending and axial loading in beam element
Gib lined timber framed wall	70	Capacity limited by nail slip
Concrete Bond Beam	50	Capacity limited by out-of-plane flexural capacity due to assumed reinforcement layout.
UngROUTED concrete masonry block infill walls – in plane	70	Capacity limited by sliding shear
UngROUTED Concrete masonry block infill walls – face loading.	65	Capacity is limited by south wall block wall spanning between ground and roof
External Concrete Masonry Block wall – face loading	15	Capacity is limited by moment capacity at base of cantilevered wall



4. EARTHQUAKE EVALUATION

4.1 EARTHQUAKE SHAKING EXPERIENCED AT THE SITE

The Geonet Project, run by EQC and GNS Science, maintains the New Zealand National Seismograph Network which consists of a series of strong motion seismometers set up around New Zealand. The following image shows the location of the four closest monitoring stations to the building.

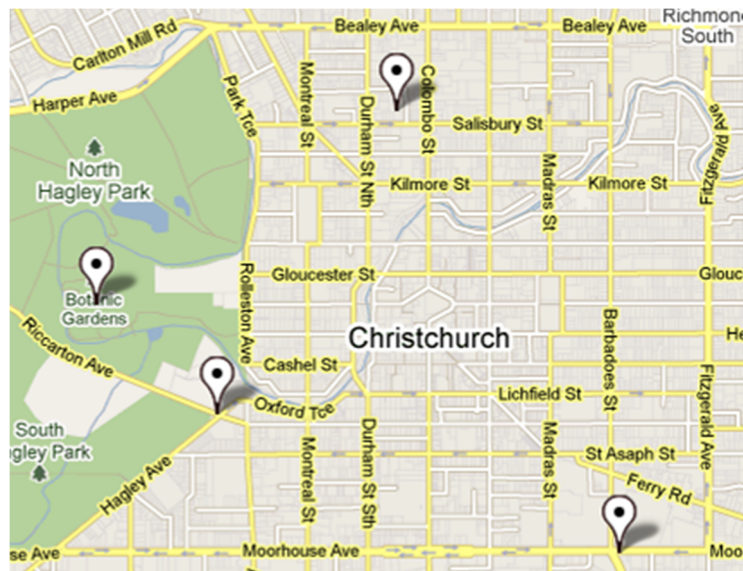


Figure 4-1: Location of Nearby Monitoring Stations

The strong motion shaking data resulting from the Darfield and the Lyttelton Earthquakes has been downloaded from these monitoring stations and processed to obtain acceleration response spectra (a response spectra essentially defines the peak response for a building subjected to the ground shaking, as a function of its fundamental period).

The accelerations recorded from the Lyttelton Earthquake are generally larger than those from the Darfield Earthquake, therefore these are presented and discussed in this section.

The following graphs plot the acceleration response spectra processed from the Geonet monitoring stations for the initial main shock of the Lyttelton Earthquake at 12:51pm on the 22nd February, as well as the elastic design spectra (NZS1170) for a new building constructed on the site. For reference the fundamental period of the building has been plotted on the graphs of the North-South and West-East directions respectively.

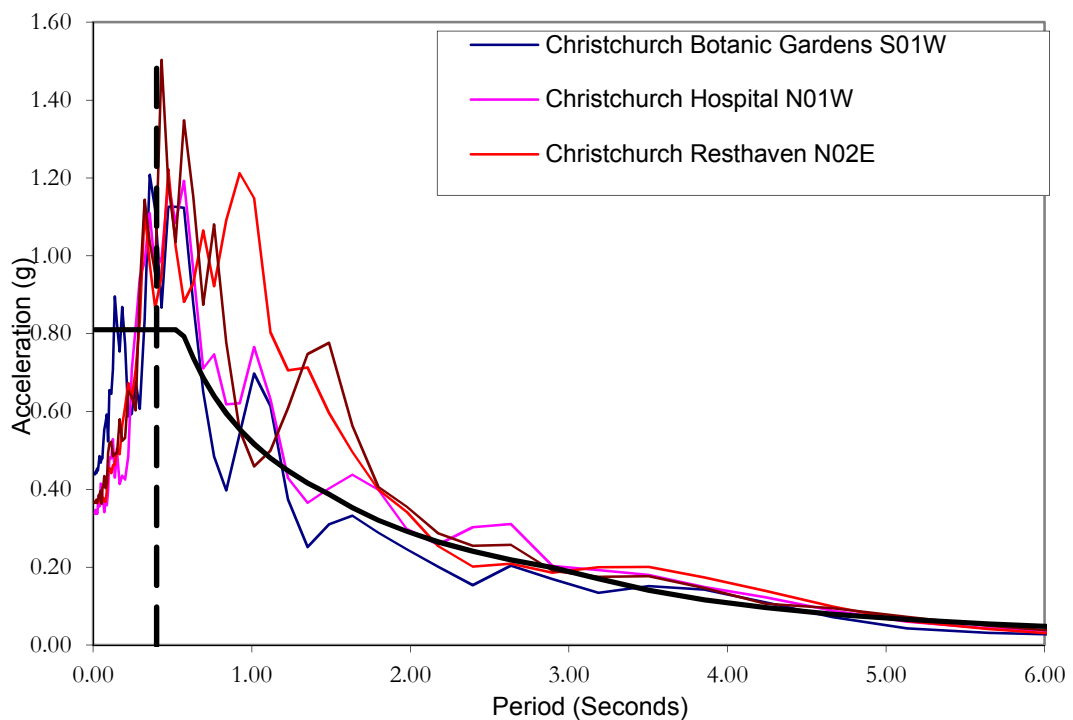


Figure 4-2: 5% Damped Spectra – North-South

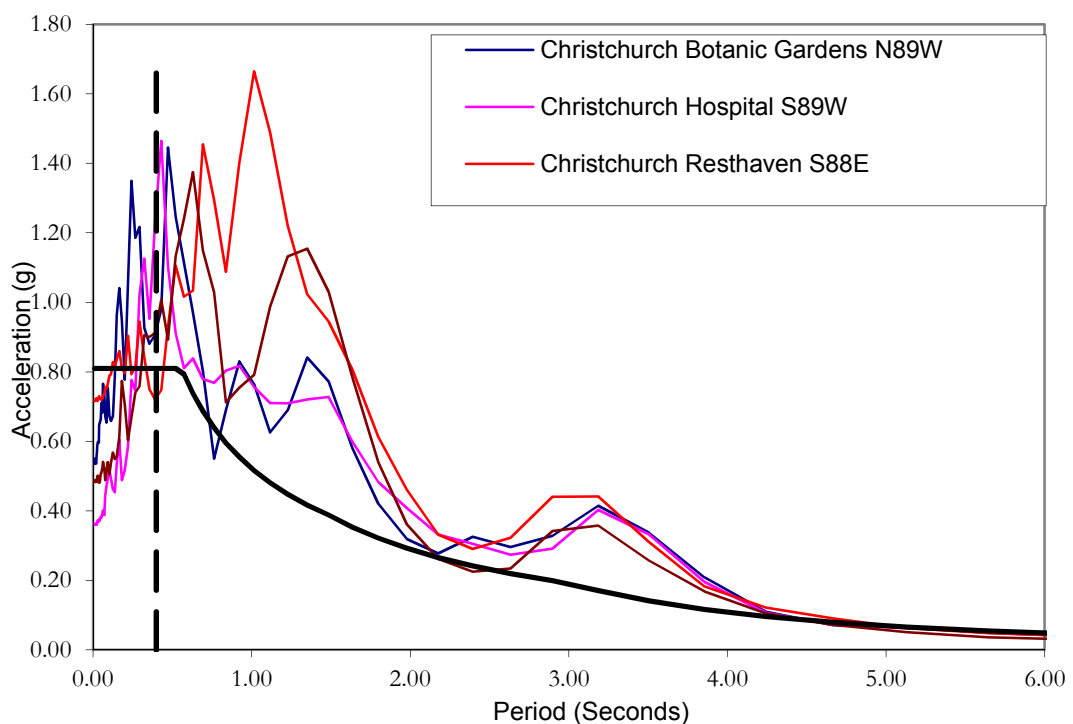


Figure 4-3: 5% Damped Spectra – East-West

It is apparent that in both directions there is significant variation in the shaking experienced at the different monitoring sites. This is due to the highly variable ground conditions around Christchurch.

The Shear Adventure Workshop building has been determined to have a fundamental period to less than 0.4 seconds (north-south) and (east-west). Based on the strong motion data downloaded, it is likely that the earthquake produced accelerations significantly in excess of the design spectra for this building.

Modern office buildings, typically designed to an importance level of 2 (IL2), are designed to resist an earthquake with a return period of 500 years at the Ultimate Limit State (ULS). The magnitude of the ground accelerations recorded in the CBD are in the order of 150% to 200% of the current design code at the time of the earthquake, and are some of the strongest ever recorded in the world. This intensity of shaking is roughly equivalent to an earthquake in Christchurch having a return period of 2500 years, deemed to be the Maximum Credible Event (MCE). At this level of shaking, modern buildings designed to the current codes in place at the time are expected to be at the point of collapse.

However it should also be noted that this earthquake was relatively short in terms of the strong shaking produced. The following plot of the earthquake record from the Christchurch Hospital monitoring station at 12:51 pm on the 22nd of February shows that the strong motion only lasted for a duration of approximately 5-10 seconds.

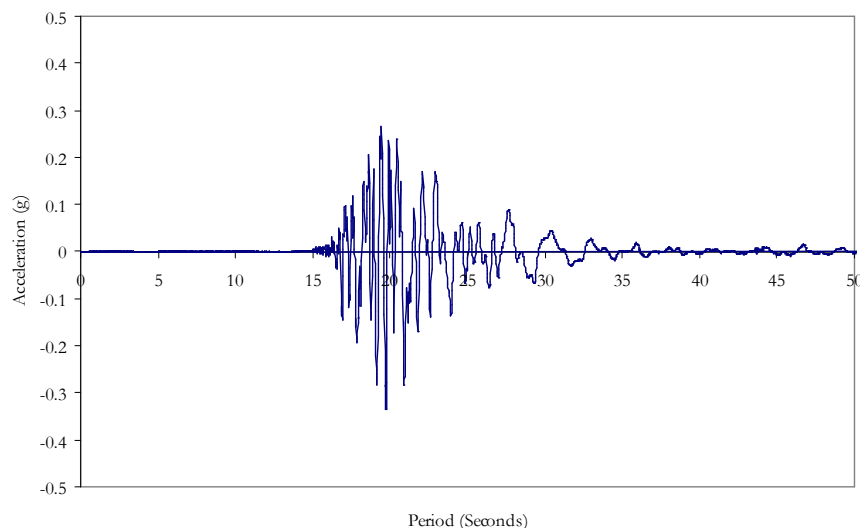


Figure 4-4: Earthquake Record from Christchurch Hospital Site

Because of this the building has only gone through a limited number of inelastic cycles. A full design earthquake for Christchurch (eg rupture of the Alpine Fault) is expected to have a significantly longer record of shaking, although the accelerations are not expected to be as strong. As an indication, rupture of the Alpine Fault is expected to contain in excess of 60 seconds of strong motion.

Due to the highly variable ground conditions around Christchurch, it is impossible to determine what the actual shaking experienced at the site was. However, based on the data described above it is likely that the shaking experienced by the building could have exceeded the current code design spectra for the building

4.2 PRELIMINARY INVESTIGATIONS

Preliminary investigations have been undertaken to ascertain areas of the building likely to be subject to damage, and therefore requiring specific attention during the detailed assessment. The areas identified for detailed inspection have been selected based on:-

- typical damage expected for buildings of this form;
- a review of the original drawings [6];
- review work undertaken to date;
- damage observed following the earthquakes.

In conjunction with a review of the structural drawings and previous damage review associated with this building the following areas were identified for potential damage:-

- Cracking of concrete block work wall mortar joints
- Distress at portal frame moment connections
- Differential settlement and lateral spreading of slab on grade
- Differential settlement and lateral spreading of walls and foundations

4.3 SUMMARY OF BUILDING DAMAGE

The following is a summary of the structural damage observed.

- In plane diagonal cracking along concrete block wall mortar joints
- Cracking along slab construction joints
- Differential settlement and lateral spreading of slab on grade
- Out of vertical walls at central block work wall and southern wall of eastern structure
- Broken tension only strap cross bracing in eastern structure

4.4 FURTHER INVESTIGATIONS REQUIRED

No geotechnical information is available for the building site. A geotechnical report should be completed to assess the ground conditions at the site.

Destructive investigations should be conducted to examine the condition of the steel portal frame beam to column connections ensure no damage occurred.

The connection between the reinforced bond beam and the steel portal frames as well as the steel portal frame foundations should be exposed and observed to confirm analysis assumptions.



5. DAMAGE OBSERVED & REPAIRS REQUIRED

5.1 TYPICAL DAMAGE OBSERVED & REPAIRS REQUIRED

Table 5-1 provides a photographic summary of the observed damage and typical repairs required. The table should be read in conjunction with Appendix A – Damage Photo Location Map and Appendix B – Record of Observations. The Repair Specification is attached in Appendix D.

Generally the aim of the repair work indicated is to restore the structure to its pre-earthquake state as far as practicable. Specifically the repair work described herein does not include the strengthening required to comply with the relevant regulations outlined in Section 2. It should be noted that more damage may be identified during the repair works and (if required) additional repair details will be specified accordingly.

The damage outlined herein does not include the necessary repair or replacement of architectural items, services, etc, or the removal of such items necessary to carry out structural observations. We recommend appropriate professionals be engaged to carry out scoping of these non-structural works.

Table 5-1: 78 Sheer Adventure Workshop - Photographic Summary of Primary Damage Observed & Repairs Required

Damaged Item	Location	Example	Recommended Repair
1. Slab on Grade			
1.1. Cracking and spreading at slab construction joints	South section of eastern structure		Chase channels each side of crack and install dowels across crack to prevent future lateral spreading of slab.
1.2. Differential settlement of slab	South section of eastern structure		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.

Damaged Item	Location	Example	Recommended Repair
1.3. Differential settlement of slab	Southern wall at internal wall junction with slab in eastern structure.		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.
2. Concrete Block Infill Walls			
2.1. Diagonal cracking along mortar joints in concrete block infill walls	Occurs along the west, south, and east walls of the original factory building (west structure)		Repair and repoint all mortar joint cracks from both the inside and outer faces.

Damaged Item	Location	Example	Recommended Repair
2.2. Vertical cracking in concrete block work wall	Occurs in north section of west wall		Remove and replace cracked concrete blocks. Repair and repoint cracked mortar joints.
2.3. External concrete block wing wall extension has moved creating a gap in the upper portion	External concrete wing wall at northwest corner of building		Remove wing-wall extension or strengthen for face loads. Provide temporary propping while the fire requirements are confirmed and the solution for the wall is determined.

Damaged Item	Location	Example	Recommended Repair
3. Western structure portal frames			
3.1. Cracking and spalling of concrete column to steel beam connection	Top of west portal frame column at west boundary wall		Remove concrete and observe beam to column connection to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
3.2. Cracking and spalling of concrete column at slab level	Occurs at several locations in the western structure		Remove concrete and observe column at base to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
4. Roof			
4.1. Broken roof tension strap	Eastern structure		Replace broken strapping. Refer to Section 5.2.

5.2 ROOF TENSION STRAP CROSS BRACING

In the eastern lean-to addition, a roof tension strap cross bracing member has failed in tension and snapped apart. This is likely due to the difference in stiffness of the eastern gib lined timber framed wall and the internal concrete blockwork infill walls. As determined in section 3, the capacity of the tension strap bracing is at 95% DBE.

The strap brace should be replaced. To improve the performance of the structure in future seismic events, the gib wall along the eastern boundary should be stiffened with additional bracing or additional strap bracing should be installed.

5.3 NORTHWEST WING WALL

In the northwest corner of the original 1960's warehouse structure, a concrete masonry block wall wing wall extension has, at some point, been added along the western boundary wall. This wall does not appear to be tied to the original wall or concrete bond beam and cantilevers from ground level. The out-of-plane capacity of the wall is 15% DBE. There are signs of lateral movement at the base of the wall and along the joint with the original wing wall end.

The wall extension may have been installed due to fire requirements. Temporarily prop the wall until the fire requirements are investigated and a strengthening solution can be determined.

5.4 DIFFERENTIAL SETTLEMENT REMEDIATION

In addition to the damage and repairs outlined in Table 5-1, differential settlement of the slab and foundations was identified onsite and in the levels survey. From the levels survey, the slab-on-grade and walls appear to have settled in the earthquake. The general pattern of settlement inside the western half of the building is settlement of the external wall foundations relative to the internal slab causing bowing in the slab. This is likely due to the heavier loads carried by the perimeter walls. The differential settlement along the wall foundations is typically less than 20mm. The differential settlement between the slab and the wall foundations is generally 35 mm or less. There is a high spot in the centre of the western half of the building.

In the eastern half of the building, settlement was generally relatively even throughout the interior with low spots at the south and north ends of the building. This is likely due to the light weight timber construction of the addition.

Slopes, throughout the building, are typically around 0.50% (1:200). In a localised area towards the south of the eastern lean-to addition, the slope is approximately 0.8% (1:130). Near this location, the slab has cracked along a construction joint. The differential settlement across the construction joint is approximately 10 mm.

5.4.1 Repair Work to Return the Building to Original Level

Based on these observations, the settlements affecting the foundations and walls may be acceptable and not require re-levelling. The bowing in the ground floor slab can be addressed by locally demolishing and replacing the existing slab-on-grade. The areas of slab to be replaced include the southern end of both the western and eastern parts of the building as well as the northern area of the eastern half of the building. Refer to Appendix C for the extent of slab replacement.

The existing slab-on-grade to be demolished should be replaced with a new 125mm slab on DPM on sand binding on 150 mm of compacted hard fill. Allow for reinforcing in the slab of 12mm diameter deformed reinforcing bars at 300mm centres each way. The demolition is to

be such that the dowels connecting the foundation beam to the slab remain in place and are cast into the new slab. Allow to epoxy inject D12 starters at 300 mm into the existing slab and foundations around the perimeter of the new slab.

Note that this option will return the structure to its pre-earthquake level and lateral capacity, but does not address the mitigation or prevention of differential settlements occurring in future seismic events. Differential settlements could reduce the lateral capacity of the structure. However, as indicated above, there has not been significant differential settlement between existing foundations in recent events. The mitigation of future differential settlement should be considered in any future strengthening scheme.



6. POST-EARTHQUAKE BUILDING CAPACITY

6.1 POST-EARTHQUAKE BUILDING CAPACITY

In its damaged state following the earthquakes, we consider the Sheer Adventures workshop to have no reduction in gravity load resistance. The overall lateral load resisting capacity of the building in the north-south direction has been affected due to the snapping of the eastern roof tension strap bracing and due to diagonal cracking along the mortar joints of the ungrouted concrete blockwork infill walls. The roof tension strap bracing that has snapped has reduced the roof bracing capacity from 95% to 75% DBE. Diagonal cracking along the mortar joints of the concrete blockwork walls has reduced the lateral load resisting capacity of the walls to approximately 35% DBE. This has been determined by considering the blockwork infill wall panels that remain uncracked as well as accounting for some contributions to capacity from the damaged walls per NZSEE 2006. Distribution via the reinforced concrete bond beam of the lateral loads to undamaged infill wall segments is likely to occur.

The overall lateral load resisting capacity of the building in the east-west direction has not been significantly reduced due to the damage observed after the earthquakes.

Following the recommended repair of the structural damage, the lateral load resisting performance of the structure will be restored. The capacity of the primary structural system in the east-west direction will be approximately 35% of DBE and in the north-south direction will be 75% DBE.

Following the recommended repair of the consequential damage the durability performance of the structure should be restored. However this should continue to be monitored throughout the life of the building to ensure that the sealants are maintained to prevent moisture penetration, and that any future cracking is repaired.



7. REFERENCES

- 1 *Building Act 2004*, New Zealand Government
- 2 *New Zealand Building Code*, New Zealand Government
- 3 *Earthquake-Prone Dangerous and Insanitary Buildings Policy 2010*, Christchurch City Council, 2010
- 4 *The Canterbury Earthquake Recovery Act 2011*
- 5 78-82 Byron Street – EQ Damage and Repair, Structex, September 2013
- 6 Temporary Warehouse 82 Byron St Christchurch, Holmes, Wood & Poole, April 1975
- 7 Survey Report for Building Survey at 78 & 82 Byron St, Christchurch, Staig & Smith, August 2013
- 8 *Structural Design Actions part 5: Earthquake Actions – New Zealand*, NZS 1170.5:2004, Standards New Zealand, 2004
- 9 *Timber Framed Buildings*, NZS 3604:2011, Standards New Zealand, 2011
- 10 *Steel Structures Standard*, NZS 3404:1997, Standards New Zealand, 1997
- 11 *Timber Structures Standard*, NZS 3603:1993, Standards New Zealand 1993
- 12 *Design of Reinforced Concrete Masonry Structures*, NZS 4230:2004, Standards New Zealand, 2004
- 13 *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, NZSEE-2006, New Zealand Society for Earthquake engineering, 2006



APPENDIX A

Damage Map



Project Name: **78 Byron Street DEE Building A**

Project No: **111702**

Calcs By: **DJH**

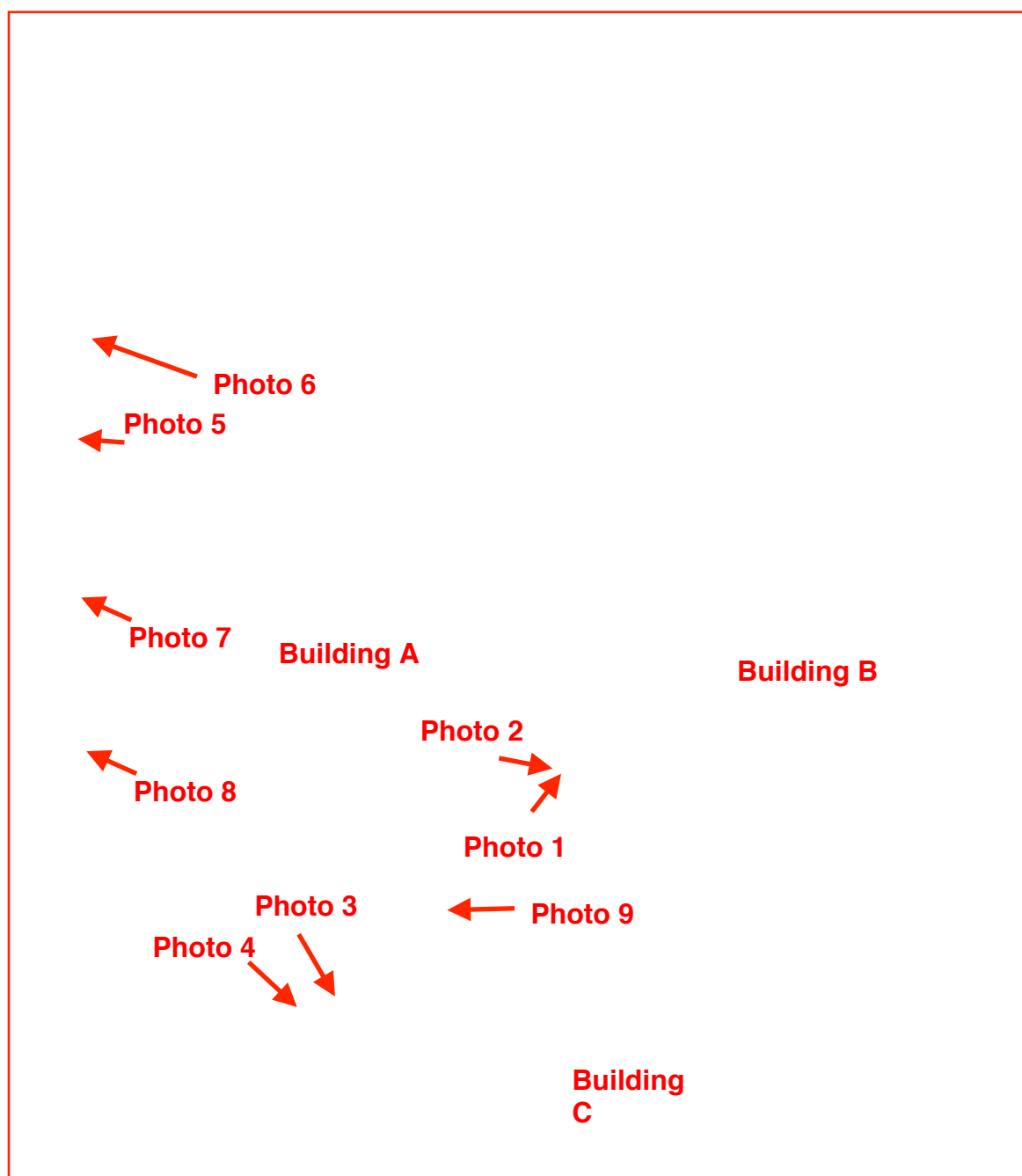
Date: **24/06/14**

Sketch No: **APA-SK01**

Page No: **1**

Revision: **1**

CALCS / SKETCHES



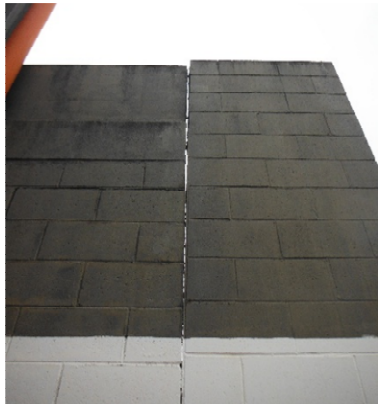


APPENDIX B

Record of Observations

Damaged Item	Location	Example	Recommended Repair
1. Slab on Grade			
1.1. Cracking and spreading at slab construction joints	South section of eastern structure See damage map photo 1.		Chase channels each side of crack and install dowels across crack to prevent future lateral spreading of slab.
1.2. Differential settlement of slab	South section of eastern structure See damage map photo 2.		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.

Damaged Item	Location	Example	Recommended Repair
1.3. Differential settlement of slab	Southern wall at internal wall junction with slab in eastern structure. See damage map photo 3.		Remove section of slab that has lifted. Re-level ground. Install new slab with epoxy dowels into adjacent slab sections.
2. Concrete Block Infill Walls			
2.1. Diagonal cracking along mortar joints in concrete block infill walls	Occurs along the west, south, and east walls of the original factory building (west structure) See damage map photo 4.		Repair and repoint all mortar joint cracks from both the inside and outer faces.

Damaged Item	Location	Example	Recommended Repair
2.2. Vertical cracking in concrete block work wall	Occurs in north section of west wall See damage map photo 5.		Remove and replace cracked concrete blocks. Repair and repoint cracked mortar joints.
2.3. External concrete block wing wall extension has moved creating a gap in the upper portion	External concrete wing wall at northwest corner of building See damage map photo 6.		Remove wing-wall extension or strengthen for face loads. Provide temporary propping while the fire requirements are confirmed and the solution for the wall is determined.

Damaged Item	Location	Example	Recommended Repair
3. Western structure portal frames			
3.1. Cracking and spalling of concrete column to steel beam connection	Top of west portal frame column at west boundary wall See damage map photo 7.		Remove concrete and observe beam to column connection to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
3.2. Cracking and spalling of concrete column at slab level	Occurs at several locations in the western structure See damage map photo 8.		Remove concrete and observe column at base to ensure no signs of distress. If no signs of distress, repair concrete encasement of column per repair specification.
4. Roof			
4.1. Broken roof tension strap	Eastern structure See damage map photo 9.		Replace broken strapping.



APPENDIX C

Conceptual Repair Plan



Project Name: **78 Byron Street DEE - Building A**

Project No: **111702**

Calcs By: **DJH**

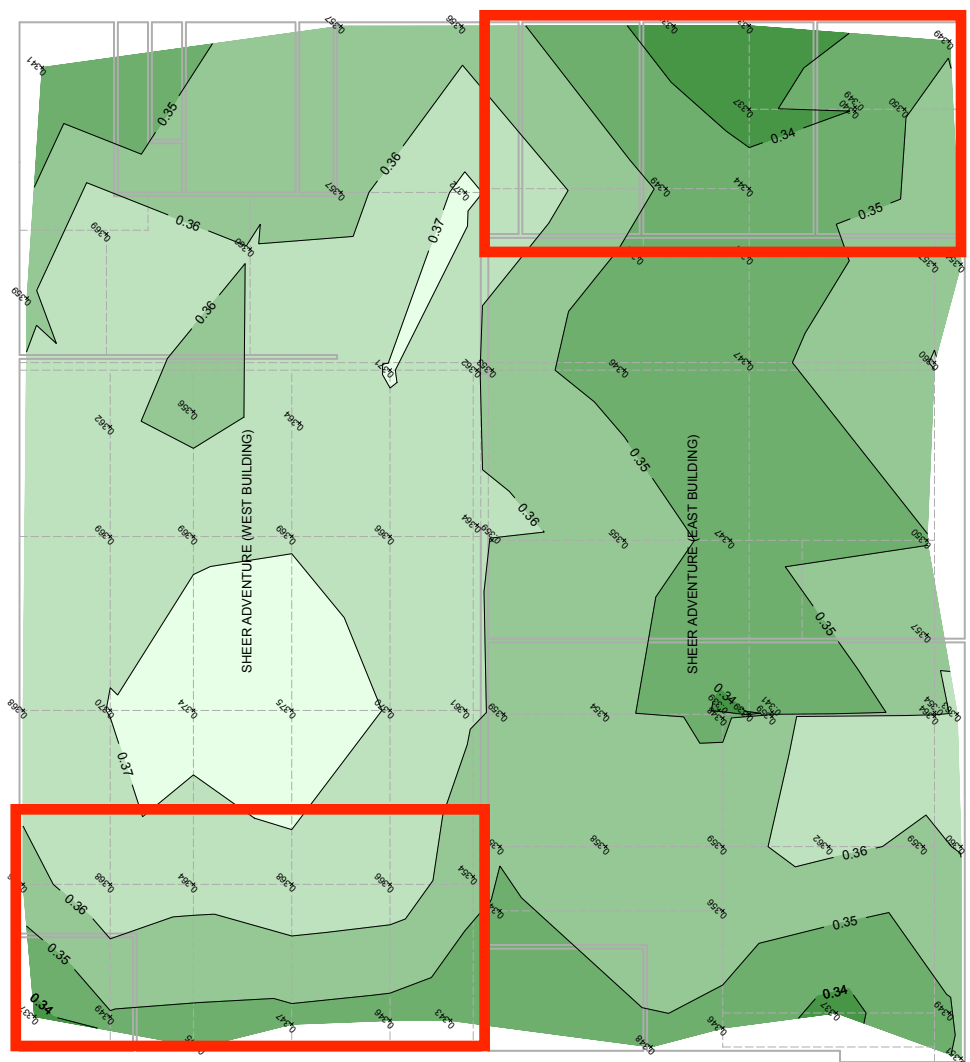
Date: **24/06/14**

Sketch No: **APC-SK01**

Page No: **1**

Revision: **1**

CALCS/SKETCHES



- Area of slab to be broken out and replaced with D12 starters epoxied into existing slab or foundations/walls to remain.



APPENDIX D

Building Alignment Survey



SURVEY REPORT FOR BUILDING SURVEY AT 78 & 82 BYRON ST, CHRISTCHURCH

Introduction

Staic and Smith Ltd were engaged to carry out a survey of the buildings at 78 & 82 Byron St. The site comprises four individual buildings; the eastern and south-eastern buildings are tenanted by Socks Pacific and the two western buildings are tenanted by Sheer Adventure.



Diagram of the buildings surveyed.

The aim of the survey was to measure the building following the recent significant earthquakes in Christchurch.

The work involved surveying the following elements:

- Floor levels and gradients
- Internal column verticality

Following the survey, a set of plans have been prepared detailing the results from the survey.

Methodology

The survey was carried out on the 28th and 29th August 2013.

Levels

Levels were surveyed with a Leica 150M Sprinter Digital Level (SN 2111297). This instrument has a measuring standard deviation of 0.6mm (electronic) and 1.2mm (optical) at 30m. Closed level loops were observed. Levels were positioned relative to the walls. In the Socks Pacific showroom the level positions were based on a grid using



the portals and concrete slabs. In the remainder of the Socks Pacific the level positions were based on a 3x3 grid on each individual concrete slab. In the Sheer Adventure buildings the level positions were based on the concrete slab edges.

Contours have been provided at 10mm (0.01m) intervals.

Assumed datums have been used for the level surveys and origin marks are shown and labelled on the plans.

Any noticeable cracks or steps in the slab were surveyed and have been shown on the plan. The thickness of the different floor coverings was measured and levels have been adjusted so that all levels are in terms of the concrete surface.

Verticality Alignment

Verticality measurements were made with a Leica TCRP 1202 Robotic Total Station (SN 227215). This instrument has measuring standard deviations of 2" for angle and 2mm+2ppm for prism distance and 3mm+2ppm for reflectorless distance.

Measurements were made directly onto the walls/columns using reflectorless EDM measurements from the total station. The top and bottom of the columns/walls were measured wherever practical.

Analysis

Socks Pacific Northern Building

The floor contours and levels indicate that the central part of the floor is generally lower than the outside of the floor, with particularly low areas seen at the central southern, central middle and central northern parts of the floor. There are noticeably high areas at the central western and central eastern parts of the floor. Note the very outer edge of the floor, which is outside the main floor slabs, drops away significantly.

The floor slope plan shows maximum slopes adjacent cracks and on the outer edge of the floor as expected. Large areas of the floor, mainly in the outer areas, have gradients of 0.5% or more.

No verticality measurements were made in this building.

Socks Pacific Southern Building

The floor contours and levels indicate that the central part of the floor is generally higher than the outside of the floor. There is a noticeably low area at the south-eastern corner of the floor.

The floor slope plan shows that the majority of the floor has gradients of 0.5% or more, particularly the southern part of the floor.

The verticality values show maximum deviations from vertical near the southeast and southwest corners of the building.

Sheer Adventure Eastern Building

The floor contours and levels indicate that the central part of the floor is generally higher than the outside of the floor, as well as low spots on the central northern and central southern edges of the floor. There is a noticeably high area near the south eastern corner of the floor.



The floor slope plan shows maximum slopes adjacent cracks as expected. Isolated areas of the floor, mainly in the outer areas, have gradients of 0.5% or more.

The verticality values show significant deviations from vertical on the eastern wall of the building. Note that this wall, including the columns, is lined so measurements have not been made directly to the structural elements.

Sheer Adventure Western Building

The floor contours and levels indicate that the central part of the floor is generally lower than the outside of the floor. The southern edge and north-western corner of the floor are noticeably lower than the rest of the floor.

The floor slope plan shows maximum slopes at the interface to the adjacent building to the east. The southern and northern areas of the floor generally have gradients of 0.5% or more.

The verticality values show significant deviations from vertical on the southern end of the eastern wall and along the southern wall.

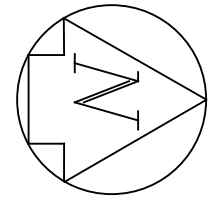
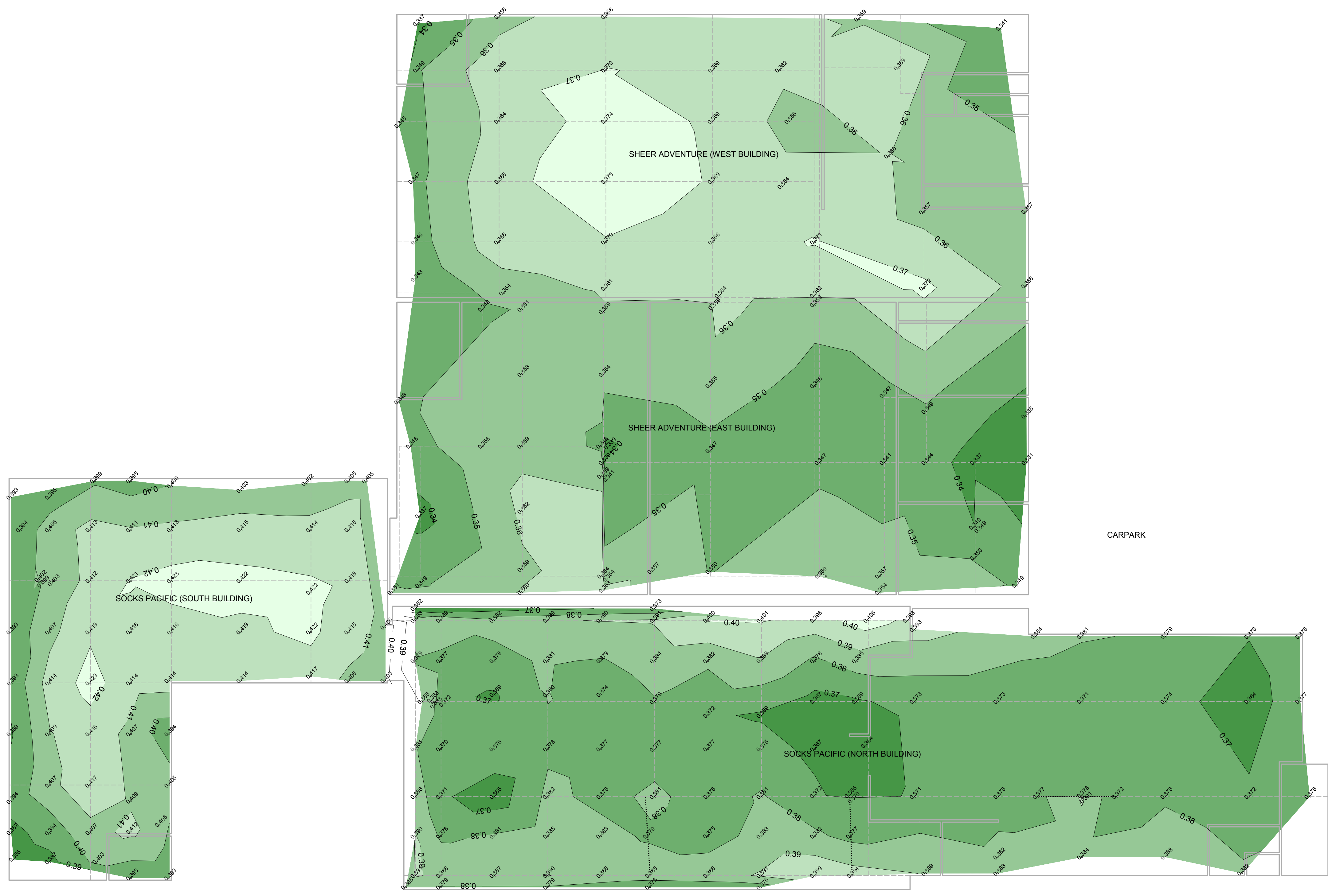
Conclusion

The survey was successfully carried out and plans drafted showing graphically the results of the survey. The plans show areas that deviated from level and verticality. The plans and report can be used to assist further structural analysis of the building.

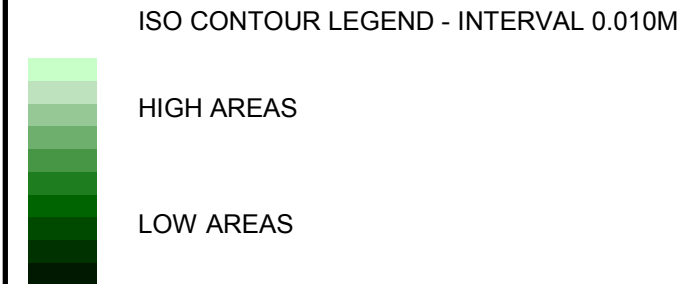
Report Prepared by
STAIG AND SMITH LTD

Ephraim Jacobsen
Licensed Cadastral Surveyor

ORIGINAL SIZE A1 0 10 20 30 40 50 60 70 80 90 100 150 200 DO NOT SCALE



- Notes**
- (1) VERIFY ALL DIMENSIONS ON SITE.
 - (2) DO NOT SCALE FROM DRAWING.
 - (3) LEVELS IN TERMS OF: ASSUMED DATUM
ORIGIN OF LEVELS: SURVEY BENCHMARK NAIL 1
(IN ASPHALT ON WEST SIDE OF EASTERN ENTRANCE)
RL 0.000m
 - (4) ORIENTATION IS APPROXIMATE ONLY AND IS NOT IN TERMS OF TRUE NORTH.
 - (5) THE FLOOR PLAN HAS BEEN OBTAINED FROM ON-SITE MEASUREUP. THE WALL LAYOUT IS INDICATIVE ONLY AND MUST NOT BE USED FOR STRUCTURAL ANALYSIS.
 - (6) LEVELS WERE TAKEN ON THE CONCRETE FLOOR SURFACE. WHERE A CARPET OR VINYL SURFACE WAS PRESENT, LEVELS WERE ADJUSTED FOR THE COVERING THICKNESS.
 - (7) THE COLUMN/WALL VERTICALITY ARROWS SHOW THE DIRECTION OF THE TOP OF THE COLUMN/WALL RELATIVE TO THE BOTTOM.
 - (8) THE COLUMN/WALL VERTICALITY ARROWS SHOW THE DIRECTION OF THE TOP OF THE COLUMN/WALL RELATIVE TO THE BOTTOM.
 - (9) VERTICALITY DEVIATIONS ARE FOR CONCRETE WALLS, UNLESS STATED OTHERWISE.
 - (10) FIELDWORK CARRIED OUT ON 28TH-29TH AUGUST 2013.



- KEY**
- STEP/CRACK IN CONCRETE SLAB
 - EDGE OF CONCRETE SLAB
 - TOP OF BANK (TB)
 - 42.5 ----- EXISTING CONTOURS
 - BUILDING WALL
 - ⊗ TREE
 - ⊗ SPOT HEIGHT
 - ⊗ STREET LIGHT
 - ⊗ POWER BOX
 - ⊗ TELEPHONE UPSTAND
 - ⊗ HYDRANT
 - ⊗ WATER VALVE
 - ⊗ WATER METER
 - ⊗ MANHOLE
 - ⊗ SANITARY SEWER MANHOLE (SSMH)
 - ⊗ STORMWATER MANHOLE (SWMH)
 - ⊗ STANDARD SUMP
 - ⊗ YARD SUMP
 - INVERT
 - ⊗ FENCE
 - ⊗ GATE
 - V — POWER LINE

AMENDMENT	DATE
 STAIG & SMITHTM 12 Bealey Avenue Christchurch Ph: 0800 807 818 Fax: 03 548 4427 e-mail: enquiries@staigsmith.co.nz SURVEYING-PLANNING-ENGINEERING-RESOURCE MANAGEMENT	

Design:	
Drawn: EDJ	
Checked: SO	
Approved: SO	
Issue Date: 10 Sept 2013	

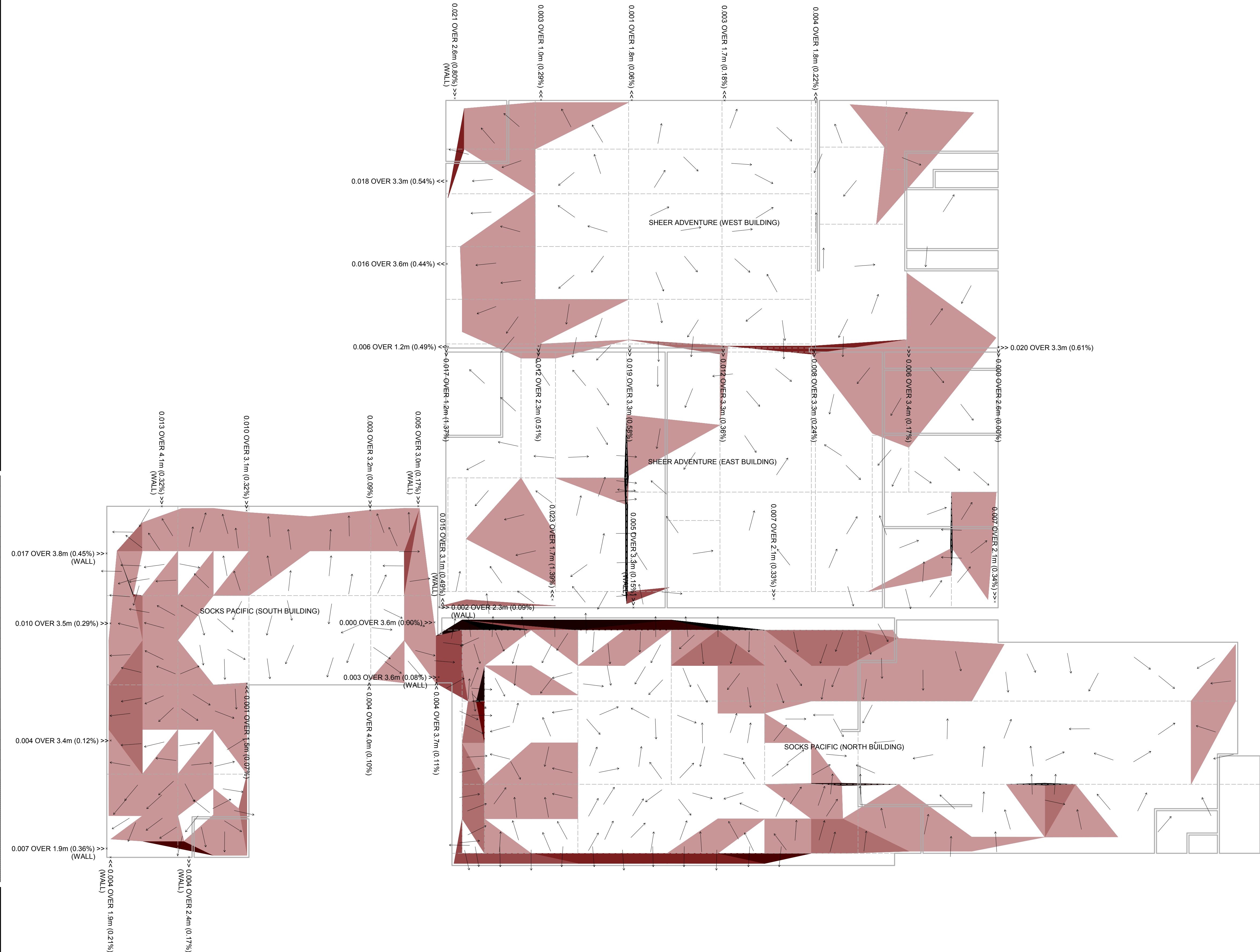
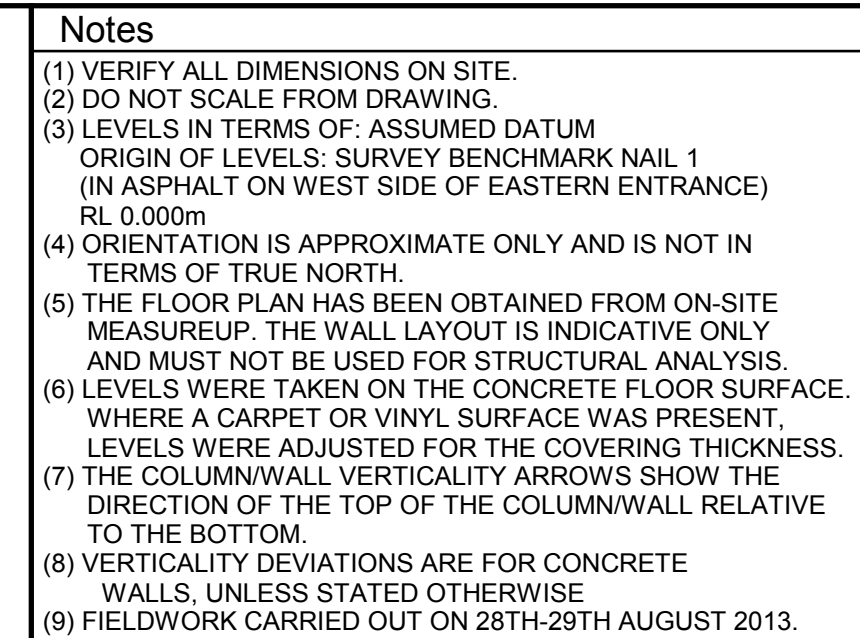
Job Title

**Structex Harvard Ltd
78 & 82 Byron St
Christchurch**

Drawing Title

Floor Level Plan

Scale: 1:100 at A1	Issue. 1
Job No: 11417	Sheet 1 of 2




STAIG & SMITHTM
12 Bealey Avenue
Christchurch
Ph: 0800 807 818
Fax: 03 548 4427
e-mail: enquiries@staigsmith.co.nz
SURVEYING-PLANNING-ENGINEERING-RESOURCE MANAGEMENT

Job Title

Structex Harvard Ltd
78 & 82 Byron St
Christchurch

Scale: 1:100 at A1	Issue. 1
Job No: 11417	Sheet 2 of 2



APPENDIX E

Repair Specification



1. POST-EARTHQUAKE DAMAGE REPAIR

1.1 PRELIMINARY

Refer to the Preliminary and General Clauses of this Specification and to the General Conditions of Contract which are equally binding on all trades. This section of the Specification shall be read in conjunction with all other sections.

1.2 SCOPE

This Section consists of:-

1. Damage surveys.
2. Repair of cracks in reinforced concrete and blockwork.
3. Repair of concrete spalling.
4. Repair of cracks in unreinforced masonry.
5. Grouting of reinforcing bars and anchors into unreinforced masonry.

1.3 RELATED DOCUMENTS

In this section of the Specification reference is made to the latest revisions of the following documents:

The New Zealand Building Code		(BIA)
NZS 3103:1991	Specification for sands for mortars and plasters	(SCNZ)
NZS 3104:2003	Specification for Concrete Production	(SCNZ)
NZS 3109:1997	Specification for Concrete Construction	(SCNZ)
NZS 3112.4:1986	Methods of test for concrete Tests relating to grout	(SCNZ)
NZS 3121:1986	Specification for water and aggregate for concrete	(SANZ)
NZS 4210:2001	Code of Practice for Masonry Construction: Materials and Workmanship	(SANZ)
BS EN 459-1:2010	Building Limes Part 1: Definitions, Specifications and Conformity Criteria	(BS EN)
BS EN 1052-3:2002	Determination of Initial Shear Strength	(BS EN)
BS EN 459-2:2010	Building Limes Part 2: Test Methods	(BS EN)
NZSEE	Assessment & Improvement of the Structural Performance of Buildings in Earthquakes.	(NZSEE)

ASTM C 109-08	Standard Test Methods for Compressive Strength of Hydraulic Cement Mortars.	(ASTM)
ASTM C 1314-10	Standard Test Methods for Compressive Strength of Masonry Prisms.	(ASTM)
ASTM E488-90	Standard Test Methods for Strength of Anchors In Concrete and Masonry Elements.	(ASTM)

1.4 QUALITY ASSURANCE

1.4.1 General

It is the Contractor's responsibility to ensure that all work associated with this part of the contract is performed in accordance with the plans and specifications.

The Contractor's quality assurance procedures should encompass, but are not limited to, the following items:

1. Photographic record of damage observed
2. Recording of repairs completed
3. Daily recording of materials used
4. Mixing of epoxy/mortar/grout
5. Substrate surface preparation
6. Application of repair systems
7. Anchor hole location and embedment depth
8. Anchor and reinforcing steel placement
9. Testing frequency and reporting

The Contractor shall advise the Engineer in writing of the name of a suitably qualified and experienced representative to be responsible for ensuring that quality assurance procedures are being followed, prior to commencement on site.

Masonry shall be erected only under the direction of a Registered Mason specialising in the laying of masonry units. Before work commences on site, the Contractor shall advise the Engineer, in writing, the name of the Registered Mason who will be responsible for the masonry construction.

From time to time the Engineer may elect to audit the quality records. They shall be kept up to date and be made available for audit by the Engineer at all times during the construction of this project.

If so instructed, the Contractor shall forward copies of all or part of the records to the Engineer.

1.4.2 Inspection

The Engineer will review construction. Prior to grouting of anchor holes, the Engineer or his representative shall be notified and a reasonable opportunity given him to inspect prepared anchor holes.

Where necessary, the Engineer's instructions shall be carried out before grouting commences.

1.4.3 Producer Statement – Construction (PS3)

When the works are sufficiently complete that they are ready for application to the Territorial Authority for a Code Compliance Certificate, or otherwise at key handover dates for particular sections of the works, the nominated representative responsible for the quality assurance procedures for the Damage Repair will be required to certify to the main Contractor that all Damage Repair work has been carried out in full accordance with all Contract Documents and Contract Instructions in the form of a Producer Statement - Construction. This statement will be required to be completed prior to the issue of the Producer Statement – Construction Review by the Engineer for the whole or sections of the works as appropriate.

No Practical Completion Certificate shall be issued until such time as all the Producer Statements for the relevant section of the works have been received.

1.5 TESTING

The Contractor shall provide evidence of material compliance with the required testing as defined in this section of the Specification.

1.5.1 Mortar for Reinforced Concrete Blockwork

The Contractor shall provide evidence of testing for the following:

1. Mortar Compression Strength

Allow to test mortar compressive strength in accordance with NZS 4210:2001. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Test to be carried out for every 450 sq.m of wall constructed (measured on one face only) to be tested at an age of 28 days.

2. Masonry to Mortar Bond Strength

Allow to test masonry to mortar bond strength in accordance with NZS 4210:2001. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Test to be carried out for every 450 sq.m of wall constructed (measured on one face only) to be tested at an age of 7 days.

1.5.2 Unreinforced Masonry with Lime Mortar

The Contractor shall provide evidence of testing for the following:

1. Lime Chemical Requirements

Prior to the commencement of work allow to test the carbon dioxide content of the lime in accordance with Section 5.5 or 5.4 of BS EN 459-2:2010.

2. Soundness of Slaked Lime

Prior to the commencement of work allow to test soundness of slaked lime in accordance with Section 6.4.4 of BS EN 459-2:2010. Each test shall consist of a minimum of 3 specimens.

3. Mortar Compression Strength

Allow to test mortar compressive strength in accordance with ASTM C 109-08 (2008) except that the samples shall be left to cure at a temperature of 24 ± 8 deg C and a relative humidity of less than 80%. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (ii) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 7, 28, 90, 180 and 360 days (total 15 specimens to be prepared).
- (iii) Specimens prepared for every 50 sq.m of wall constructed (measured on one face only) to be tested at an age of 7 and 28 days.

4. Masonry Compression Strength

Prior to the commencement of work allow to test masonry compressive strength in accordance with ASTM C 1314-10 (2010) except that the samples shall be left to cure at a temperature of 24 ± 8 deg C and a relative humidity of less than 80%. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 7, 28, 90, 180 and 360 days (total 15 specimens to be prepared).

5. Masonry Bed-Joint Shear Strength

Prior to the commencement of work allow to test initial masonry shear strength in accordance with BS EN 1052-3:2002. Each test shall consist of a minimum of 9 specimens as detailed in BS EN 1052-3:2002. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 28, 90, 180 and 360 days (total 12 specimens to be prepared).

Variation of Materials

If the repair works consist of structural elements with more than one type of masonry unit (i.e. red brick and Halswell Stone) the testing detailed above for masonry compressive strength and bed-joint shear strength shall be repeated for each masonry unit type.

Further tests shall be carried out if, and immediately when, the supply of the constituent materials varies during construction with at least three specimens per test. Tests shall also be conducted when requested by the Engineer.

The results of all tests shall be submitted upon request to the Engineer for review.

1.5.3 Unreinforced Masonry with Cement-Lime Mortar

The Contractor shall provide evidence of testing for the following:

1. Mortar Compression Strength

Allow to test mortar compressive strength in accordance with Appendix 2.A of NZS 4210. Each test shall consist of a minimum of 3 specimens. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 7, 28 and 90 days (total 9 specimens to be prepared).
- (ii) Specimens prepared for every 50 sq.m of wall constructed (measured on one face only) to be tested at an age of 7 and 28 days (6 specimens to be prepared for every 50 sq.m).

2. Masonry Bed-Joint Shear Strength

Prior to the commencement of work allow to test initial masonry shear strength in accordance with BS EN 1052-3:2002. Each test shall consist of a minimum of 9 specimens. Testing frequency shall be as follows:

- (i) Specimens prepared for testing prior to the commencement of works, to be tested at an age of 28 and 90 days (total 18 specimens to be prepared).

Variation of Materials

If the repair works consist of structural elements with more than one type of masonry unit (i.e. red brick and Halswell Stone) the testing detailed above for masonry compressive strength and bed-joint shear strength shall be repeated for each masonry unit type.

Further tests shall be carried out if, and immediately when, the supply of the constituent materials varies during construction with at least three specimens per test. Tests shall also be conducted when requested by the Engineer.

The results of all tests shall be submitted upon request to the Engineer for review.

1.6 SAFETY

The Contractor shall conform fully both on and off site with the provisions of the New Zealand Building Code in all matters related to construction safety, in particular with approved documents F1 (Hazardous Agents on Site), F2 (Hazardous Building Materials), F4 (Safety from Falling) and F5 (Construction and Demolition Hazards).

1.7 MATERIALS AND WORKMANSHIP

1.7.1 Materials

The Contractor shall adhere to all requirements of NZS 3104, NZS 3109 and NZS 4210, except where specified otherwise herein or instructed otherwise by the Engineer. A copy of this standard shall be kept on the site and relevant parts read with the following Clauses of this Specification.

Materials to be used in conjunction with brick or stone masonry shall be selected to minimise the effects of efflorescence.

The Engineer may approve equivalent products that satisfy all of the requirements and show equality to the systems specified herein. Approval for the equivalent system shall be sought prior to submission of tender, refer also to the Submittals section below

1.7.2 Workmanship

All work shall be carried out by licensed applicators of the material manufacturer's.

Undertake all preparatory work necessary prior to application of the specified system to ensure proper bond and clean, true surfaces in the finished work.

All materials shall be mixed and applied in accordance with best trade practice and applied by skilled applicators to the manufacturer's recommendations.

All adjoining work shall be adequately protected during mixing and application and utmost care shall be taken not to damage surrounding fixtures and fittings. All damage consequent upon this operation shall be completely made good.

Remove debris at regular intervals and leave the completed work free from defects of all kinds.

1.7.3 Completion

Clean all adjoining surfaces and fittings of any paint contamination. Replace all hardware without damage to it or the adjoining surface. Take away from the site all painting materials, equipment and rubbish leaving the surrounding area clean, tidy and undamaged.

1.8 DAMAGE SURVEYS

We have undertaken an initial assessment that has identified general forms of damage and repairs required. We have not been able to expose all critical elements for observation, nor have we conducted a detailed survey identifying each individual crack. At the request of the engineer the Contractor shall expose areas of the structure, in order to enable detailed observations to be made of critical areas.

The Drawings provide specific details of the primary structural repairs required. Repairs of more minor damage (such as cracking and spalling of concrete) shall be undertaken by the Contractor in accordance with this Specification, under the direction of the Engineer.

1.8.1 Crack Damage

The Contractor shall identify cracks to be repaired following the methodologies outlined in the following sections of this Specification. Following preparation but prior to epoxy injection or grouting, the Contractor shall contact the Engineer to arrange an inspection of the area to be repaired.

Cracks are to be repaired in various elements as identified in site reports or on structural drawings.

Records should be kept of repaired cracks and should include details of:-

1. Location
2. Crack width
3. Crack length
4. Volume of material (epoxy/grout) used

1.8.2 Spalling Damage

The Contractor shall identify areas of spalled concrete to be repaired following the methodologies outlined in the following sections of this Specification. Following preparation but prior to application of the repair mortar, the Contractor shall contact the Engineer to arrange an inspection of the area to be repaired.

Spalled concrete is to be repaired in various elements as identified in site reports or on structural drawings.

Records should be kept of repaired spalling and should include details of:-

1. Location
2. Approximate spalled area
3. Volume of material (repair mortar) used

1.8.3 Verticality Survey

At the request of the Engineer, the Contractor shall undertake a verticality survey of the target building. The verticality survey shall ascertain whether there is any residual displacement or twist of the building. The Contractor shall submit their proposed methodology to the Engineer for approval prior to undertaking the survey.

1.9 REPAIR OF CRACKS IN REINFORCED CONCRETE AND BLOCKWORK

The following sections of the Specification detail the procedures to be followed when repairing cracks in reinforced concrete and reinforced concrete blockwork.

Cracks less than 0.2mm wide are considered to be superficial and do not require specific structural repair.

1.9.1 Repair of Hairline Cracks (< 2mm)

Where possible at the direction of the Engineer, cracks between 0.2mm and 2mm shall be repaired by injection of epoxy resin.

Where access to seal around the element being repaired is possible, repair the crack using a low viscosity epoxy resin such as Sikadur Injectokit – LV or Sikadur 52.

Where access is not possible to prevent grout loss, repair the crack with a thixotropic epoxy resin such as Sikadur Injectokit – TH.

Seal and prepare the surface being repaired and inject the epoxy resin in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.9.2 Repair of Large Cracks (< 5mm)

Where possible at the direction of the Engineer, cracks between 2mm and 5mm shall be repaired by injection of Sikadur 52.

Seal and prepare the surface being repaired and inject the epoxy resin in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.9.3 Repair of Very Large Cracks (> 5mm)

Advise the Engineer of any cracks larger than 5mm in width.

If the Engineer does not require any specific repair detail, cracks larger than 5mm shall be repaired by injection of Sikadur 42 / Sika Grout 212.

Seal and prepare the surface being repaired and inject the epoxy resin / cementitious grout in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.9.4 Repair of Reinforced Concrete Blockwork Mortar Joints

Repair mortar shall conform to NZS 4210, clause 2.2. Mortar shall have a 28 day compressive strength of at least 12.5 MPa. The 7 day masonry to mortar bond strength shall not be less than 200kPa. Sand shall comply with NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand. Appearance of new mortar shall match the existing. The contractor shall submit to the Engineer a mix design for the mortar prior to commencing work.

Damaged mortar beds shall be raked out to a minimum depth of 25 mm and re-pointed. Pointing shall be undertaken to match existing.

The Contractor shall carry out material testing as required in Section 1.5.

1.10 REPAIR OF CONCRETE SPALLING

The following sections of the Specification detail the procedures to be followed when repairing spalled concrete.

1.10.1 Repair of Shallow Spalling (<40mm thick)

At the direction of the Engineer break back to sound concrete. The depth of breakout on the edge of any repair area shall be a minimum of 10 mm and feather edges will not be accepted. To achieve this, the perimeter of the area to be repaired shall first be cut to a depth of 10 mm using a suitable tool.

Clean any exposed reinforcing using a wire brush. Prepare the exposed concrete surface and reinforcing in accordance with the manufacturers instructions, applying a primer such as Sika Monotop Primer as required.

Build up the required concrete profile using a high strength repair mortar, such as Sika Monotop Structural Mortar, and finish in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.10.2 Repair of Moderate Spalling (<80mm thick)

At the direction of the Engineer break back to sound concrete. The depth of breakout on the edge of any repair area shall be a minimum of 10 mm and feather edges will not be accepted. To achieve this, the perimeter of the area to be repaired shall first be cut to a depth of 10 mm using a suitable tool.

Clean any exposed reinforcing using a wire brush. Prepare the exposed concrete surface and reinforcing in accordance with the manufacturers instructions, applying a primer such as Sika Monotop Primer as required.

Build up the required concrete profile using a high build repair mortar, such as Sika Monotop High Build Mortar, and finish in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.10.3 Repair of Deep Spalling (>80mm thick)

At the direction of the Engineer break back to sound concrete. The depth of breakout on the edge of any repair area shall be a minimum of 10 mm and feather edges will not be accepted. To achieve this, the perimeter of the area to be repaired shall first be cut to a depth of 10 mm using a suitable tool.

Clean any exposed reinforcing using a wire brush. Prepare the exposed concrete surface and reinforcing in accordance with the manufacturers instructions.

Box and pour to the required concrete profile using a flowable repair mortar, such as Sika Monotop Microconcrete, and finish in accordance with the manufacturers instructions.

Alternative products of equivalent properties may be acceptable but must be submitted to the Engineer for approval at the time of tender.

1.11 REPAIR OF CRACKS IN UNREINFORCED MASONRY

The following sections of the Specification detail the procedures to be followed when repairing cracks in unreinforced masonry. The Contractor shall adhere to all requirements of NZS 4210, except where specified otherwise herein or instructed otherwise by the Engineer.

1.11.1 Unreinforced Masonry with Lime Mortar

At the direction of the Engineer, replace or repair cracked masonry units. New brick or stone masonry units shall be selected to match colour, density and texture of the existing.

Repair mortar shall be lime mortar to match the existing. Lime mortar shall be composed of aged slacked lime (lime putty), sand and water. The prescribed ratio of lime to sand shall be 1:3. Alternate mix designs may be used with the approval of the Engineer. Repair mortar should be batch mixed.

Lime used shall meet the requirements of BS 890:1995 and shall be slaked for a minimum of 3 months. Acceptable suppliers include:

1. Historic Building Conservation
18 Soper Road
Wingatui
Dunedin
03 489 0930

Alternate suppliers may be used with the approval of the Engineer.

Sand shall be Class A sand as defined in NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand.

Alkaline resistant mineral oxides can be added to enable colour matching. Dosage rates of mineral oxides shall limited such that they do not cause a reduction in mortar strength.

No cement products, modern additives or plasticisers are to be added to the mix unless approved by the Engineer.

The contractor shall submit to the Engineer a mix design for lime mortar prior to commencing work.

Masonry repairs shall be cured in accordance with NZS 4210, Sections 2.18 and 2.19.

The Contractor shall carry out material testing as required in Section 1.5.

1.11.2 Unreinforced Masonry with Cement-Lime Mortar

Repair of unreinforced masonry with cement-lime mortar shall be undertaken in accordance with NZS 4210.

At the direction of the Engineer, replace or repair cracked masonry units. New brick or stone masonry units shall be selected to match existing. Damaged mortar beds shall be raked out to a minimum depth of 25 mm and re-pointed. Pointing shall be undertaken to match existing.

Repair mortar shall be cement-lime mortar to match the existing. Mortar shall be composed of Portland cement, hydrated lime, sand and water, and shall be Durability Class M2 mortar as defined in Table 2.1 of NZS 4210.

Mortar shall have a 28 day compressive strength of at least 5 MPa. The 28 day masonry to mortar bond strength shall not be less than 200kPa.

Building lime shall comply with BS EN 459-1:20101 and shall be slaked with water to form hydrated lime before use in mortar. Sand shall be Class A sand as defined in NZS 3103 with chloride levels not exceeding 0.04% by dry weight of sand.

Repair mortar should be batch mixed. Hydrated lime shall not be omitted from the mix unless approved by the Engineer. Alkaline resistant mineral oxides can be added in accordance with NZS 4210 to enable colour matching.

The contractor shall submit to the Engineer a mix design for the mortar prior to commencing work.

Masonry repairs shall be cured in accordance with NZS 4210, Sections 2.18 and 2.19.

The Contractor shall carry out material testing as required in Section 1.5.

1.12 GROUT INJECTION OF CRACKS AND OPEN JOINTS IN UNREINFORCED MASONRY

The following sections of the Specification detail the procedures to be followed when repairing cracks in unreinforced masonry.

At the direction of the Engineer, replace or repair cracked masonry units. New brick or stone masonry units shall be selected to match colour, density and texture of the existing.

1.12.1 Materials

Grout shall be Centricrete MV or approved alternative.

Repair mortar shall be as specified in Section 1.10.

1.12.2 Methodology

Rake open joint to adequate depth to remove any loose mortar, but no less than 25 mm.

Flush joint, surfaces and cracks with clean water. Loose bricks shall be removed and reset with mortar

Injection holes are to be drilled at header joints or cracked brick, through to the inner wythe in each course. Bleed tubes shall be provided as required to ensure that any trapped air can escape. Flush bleed holes with water. Pressure inject grout to bond cracks in accordance with the manufacturers recommendations.

Re-point holes and open joints. Pointing shall be undertaken to match existing.

1.13 GROUTING OF BARS INTO UNREINFORCED MASONRY

The following sections of the Specification detail the procedures to be followed when grouting threaded rod and reinforcing bars into unreinforced masonry.

1.13.1 Shallow Embedment (< 750mm)

Grout shall be either non-shrink cement or epoxy based and shall be prepared in accordance with the manufacturers specifications. Acceptable products include:

1. Hilti HY150
2. Hilti CM 651
3. Sika Sikadur 52
4. Sika Grout 212
5. Ramset Epcon C6 (brick masonry only)
6. Ramset Premier Grout MP

The Contractor shall submit details of the proposed grout and grouting procedure to the Engineer for approval prior to the start of construction.

Anchor hole diameters are detailed in Table 1.

Table 1 Hole Diameters

Anchor Size (mm)	Hole Diameter (mm)	
	Hilti HY150 / Sikadur 52 / Epcon C6	Hilti CM 651 / Sika Grout 212/ Premier Grout MP
10	12	20
12	14	24
16	18	32
20	22	40
25	27	50

Holes shall be drilled using hammer drills and must be dry prior to filling with grout.

All holes shall be cleaned out using a stiff bristled wire bottlebrush and a compressed air source (with no oil bottle in the line) so that all dust and debris are removed from the side of the hole.

When this has been completed the Contractor is to notify the Engineer for inspection of the holes prior to placement of bars and grout.

The holes shall be partially filled with grout prior to inserting the reinforcing bar. Holes shall be filled from the bottom up (rather than pouring from the top). When a wall cavity is encountered, use a proprietary mesh anchor sleeve to bridge the cavity.

Bars shall be placed in the holes, given one turn to expel air voids and shall be fully supported (if necessary) and left undisturbed for at least 24 hours. After 24 hours horizontal bars installed at 15 degree slope can be bent horizontal.

After the bars have been placed in position, ensure that the grout fills the hole to the surface of the substrate. Top up holes if necessary.

The grouts shall be used strictly in accordance with the manufacturer's instructions.

When it is intended that the anchor be concealed in the completed state the bar shall be recessed a minimum of 35 mm beyond the exposed face of the masonry. Close the hole by mixing dust salvaged from the drill hole with a weakly cementitious mortar (eg Sika 212) and plug the hole to match existing.

1.13.2 Deep Embedment (> 750mm Vertical)

This section of the Specification details the procedure to be followed when grouting vertical bars into masonry walls. Grout shall be either non-shrink cement or epoxy based and shall be prepared in accordance with the manufactures specifications. Acceptable products for grouting include:

1. Hilti RE500
2. Sika Sikadur 52
3. Sika Grout 212
4. Ramset Epcon C6
5. Ramset Premier Grout MP

The Contractor shall submit details of the proposed grout and grouting procedure to the Engineer for approval prior to the start of construction.

Anchor hole diameters are detailed in Table 2.

Table 2 Hole Diameters

Anchor Size (mm)	Hole Diameter (mm)	
	Hilti RE500 / Sikadur 52/ Epcon C6	Sika Grout 212/ Premier Grout MP
10	12	20
12	14	24
16	18	32
20	22	40
25	27	50

Holes may be drilled using hammer or core drills and must be dry prior to filling with grout.

If the brick wall is suspected to contain cavities that might cause significant grout loss the hole can be filled with expandable builders filler and re-drilled at 2mm oversize to remove the filler from the walls of the hole.

All holes shall be cleaned out using a stiff bristled wire bottlebrush and a compressed air source (with no oil bottle in the line) so that all dust and debris are removed from the side of the hole.

When this has been completed the Contractor is to notify the Engineer for inspection of the holes prior to placement of bars and grout.

The holes shall be partially filled with grout prior to inserting the reinforcing bar. Holes shall be filled from the bottom up (rather than pouring from the top). Grouting shall be conducted with a maximum lift height of 1.5m.

Bars shall be placed in the holes, given one turn to expel air voids and shall be fully supported (if necessary) and left undisturbed for at least 24 hours.

After the bars have been placed in position, ensure that the grout fills the hole to the surface of the substrate. Top up holes if necessary.

The grouts shall be used strictly in accordance with the manufacturer's instructions.

1.13.3 Control Tests – Grouted Anchors & Reinforcing Bars

Shallow embedment anchors installed in accordance with Section 1.11.1 above shall be tested in accordance with the following:

Torque Testing

One quarter of all new tension anchor bolts and reinforcing bars embedded in unreinforced masonry walls shall be tested using a torque calibrated wrench to the following minimum torques,

12mm diameter anchors or bars	54Nm
16mm diameter anchors or bars	68Nm
20mm diameter anchors or bars	100Nm

No slippage shall occur under the above torques.

Direct Tension Testing

A minimum of five direct tension tests shall be undertaken for each anchor size specified on the Structural Drawings. The load testing shall be undertaken as follows:

The masonry wall should support the test apparatus. The distance between the anchor and the test apparatus support should not be less than the wall thickness.

The tension test load reported should be the load recorded at 3 mm relative movement of the anchor and the adjacent masonry surface. For the testing of existing anchors, a preload of 1.5 kN shall be applied prior to establishing a datum for recording elongation.

Reports

Results of all tests shall be reported. The report shall include the test results as related to anchor size and type, location, embedment depth, wall thickness and joist orientation.

14 March 2017

Our Ref: 47003 - Rev 1

Julius Long
Structex Harvard Ltd
248 Montreal Street,
Christchurch, NZ
Email: JLong@structex.co.nz

**RE: 80 BYRON STREET, SYDENHAM
GEOTECHNICAL LETTER FOR PROPOSED EXTENSION**

Dear Mr Julius Long

1.0 INTRODUCTION

Engineering Design Consultants Ltd (EDC) has been engaged to provide a brief geotechnical investigation and soil bearing assessment for the proposed extension of the western warehouse building at 80 Byron Street in Sydenham, henceforth referred to as 'the site'. The new single storey extension will be used as offices.

1.1 Site Identification

The site's legal description is Lot 1 DP 449853. The property is rectangular, covers an area of 1280m² and is located on the south side of Byron Street in Sydenham, as shown below on Figure 1:



Figure 1: Site Location

1.2 Proposed Extension

The client has provided an extension drawing set, drafted by Architectural Design Group (ADG) Ltd (Ref: 5996; January 2017) for the proposed offices.

These drawings indicate that the proposed extension is to be situated near the northwest corner of the existing west building, as shown on Figure 1 above. The drawings also indicate that the extension is approximately 13m long (north-south), 7.8m wide (east-west) and one-storey. The foundation is proposed to be a concrete slab and is to be tied into the existing buildings concrete slab.

A copy of the proposed extension drawings is attached in Appendix A.

2.0 NEARBY GEOTECHNICAL INVESTIGATION

The site owner has supplied a geotechnical report completed for the property at 83 Byron Street (approx. 40m northeast of extension; see Figure 1) by Engco Consulting Engineers (Ref: 16363) in January 2017. The following is a summary of relevant information:

- Engco undertook 2 No. Cone Penetration Tests (CPT') and 2 No. Hand Augers (HA's) across the site. The HA's indicated that the shallow ground profile consists gravel fill to 0.3m below ground level (bgl), underlain by clayey silt to 2.0m bgl.
- Groundwater was not encountered during the HA's.
- Estimated '*Free-Field*' index (upper 10m) ground settlements, based on the on-site CPT's, range between 60mm and 90mm under SLS 2 (0.19g 6.0Mw) earthquake conditions and 90mm to 115mm under ULS earthquake conditions. Very little settlement is anticipated in the upper 4.5m under SLS or ULS conditions.
- The risk of lateral spreading as a result of liquefaction is considered low and the risk of lateral stretch is considered to within the MBIE minor to moderate category (less than 200mm).
- Due to the liquefaction risk, conventional shallow foundations are not recommended.
- A piled foundation is considered a viable solution for a single-storey warehouse building. It is anticipated that piles would need to be founded at 12.5m bgl. The CPT's indicated that the soil layer between 12m and 16m bgl has sufficient bearing capacity (>15MPa) and thickness for deep piles.

Based on the level of estimated settlement from the Engco on-site CPT's, the ground performance in a future earthquake event would be considered equivalent of CERA Technical Category 3 (TC3) if the site were residential.

The Engco geotechnical report is available upon request.

3.0 DESK BASED INFORMATION

3.1 Historical Imagery

Historical aerial imagery indicates that the site was residential in 1941, with two dwellings located in the northern half of the property (not covering location of the current building). Between 1941 and 1994 the site was subject to several developments, none of which were in the area of the proposed extension. By 1994 the site appeared as it does currently (March 2017).

3.2 Historical Land Use

The Environment Canterbury (ECan) Listed Land Use Register (LLUR) holds all known information about Hazardous Activities or Industries (HAIL) that have historically (and/or currently) taken place on the site or within the vicinity of the site.

The ECan LLUR indicates that a known HAIL activity has not occurred on the site, however there are two properties identified on the LLUR within 50m as follows:

- 71 Byron Street, located approximately 45m northwest of the site. This portion of land has been listed for 'F4 – Motor Vehicle Workshops'. The impacts of this HAIL activity have not been investigated as the activity is on-going.
- A small portion of land in the northeast corner of 83 Byron Street, located approximately 45m northeast of the site has been listed for 'A17 – Storage tanks or drums for fuel, chemicals or liquid waste'. This HAIL activity was investigated in 2011 during decommissioning and soil testing results indicated that hydrocarbons were present in the soil, though the level of contamination was below industrial/commercial guideline values.

These nearby HAIL activities are considered unlikely to present a geotechnical constraint for the proposed extension.

The ECan LLUR is attached in Appendix B.

3.3 New Zealand Geotechnical Database

3.3.1 CERA Technical Classification

The site is located in an un-zoned CERA area as it is non-residential.

3.3.2 Geology and Hydrology

The GNS Geological QMap shows the site as being located on '*Modern river floodplain/low-level degradation terrace. Un-weathered, variably sorted, gravel/sand/silt/clay*'. Nearby geological investigation data suggests that the ground profile in vicinity of site (~50m northwest) consists 0.8m of fill, underlain by silt with occasional sand to 4.5m bgl and fine to medium sand from 4.5m to at least 15.0m bgl.

The GNS 'Depths to Water Table' maps indicate that the mean depth of groundwater is generally 0.0m – 2.0m bgl in the area of the site. The EQC 'Event Specific Depths to

Water Table' maps indicate that the depth to groundwater was generally closer to 1.0m – 2.0m bgl for each of the major 2010/2011 earthquakes.

3.3.3 Seismic

The EQC 'Vertical Ground Movements' map indicates that the area of the might have subsided between 100mm and 200mm following the 2010/2011 Canterbury Earthquake Sequence.

The EQC 'Horizontal Ground Movements' map indicates that the area of the site may have experienced 170mm of lateral movement in a south-westerly direction. However this amount of movement is highly consistent for the surrounding area.

EDC has reviewed post-earthquake aerial photos taken for the 2010/2011 Canterbury Earthquake sequence. No liquefaction ejecta was evident on-site or on surrounding areas following any of the major earthquakes during the 2010/2011 Canterbury Earthquake Sequence. Additionally, EQC did not observe any ground cracks on-site or within the surrounding area following the 2010/2011 earthquakes.

Estimated Peak Ground Accelerations (PGA's) for the site, based on a model by Bradley et al, indicate that the site experienced a median PGA of 0.33g during the February 2011 event (greatest shaking at the site) and therefore, the site can be considered 'sufficiently tested' to a Serviceability Limit State (SLS) earthquake event, but not to an Ultimate Limit State (ULS) earthquake. It is noted that the site was not 'sufficiently tested' during any of the other 2010/2011 earthquakes.

Important Notice

This section (Section 3.3) and information where NZGD has been referenced in this document was created from maps and/or data extracted from the Canterbury Geotechnical Database (<https://canterburygeotechnicaldatabase.projectorbit.com>), which were prepared and/or compiled for the Earthquake Commission (EQC) to assist in assessing insurance claims made under the Earthquake Commission Act 1993. The source maps and data were not intended for any other purpose. EQC and its engineers, Tonkin & Taylor, have no liability for any use of the maps and data or for the consequences of any person relying on them in any way. This "Important notice" must be reproduced wherever this information or any derivatives are reproduced.

It is understood that damage to the existing building from the earthquakes was light and limited.

3.4 Seismic Subsoil Classification

Based on the above, a seismic subsoil classification 'Class D –Deep or Soft Soil', as defined in NZS 1170.5 is considered appropriate for the site.

3.5 Flooding

The Christchurch City Council (CCC) has indicated that the site is located within a District Plan Flood Management Area (FMA) and therefore a Finished Floor Level (FFL) of 14.39m RL is required for new building at the site. LiDAR information indicates that the average ground level at the site is 13.82m RL, approximately 0.6m below the required FFL.

4.0 INTRUSIVE WORKS

4.1 Rational

Due to the relatively small footprint of the proposed extension and the lack of earthquake related ground damage at and within vicinity of the site, it was considered that two shallow intrusive holes would be adequate to gain an understanding of the ground conditions and that deep investigation/liquefaction analysis was not necessary.

4.2 Investigation

EDC visited the site on 03 March 2017 to undertake the shallow intrusive investigation to determine the subsoil conditions.

Two exploratory holes comprising a Hand Auger (HA) and Scala Penetrometer (SC) were undertaken at either end of the proposed extension footprint, as indicated below on Figure 2:

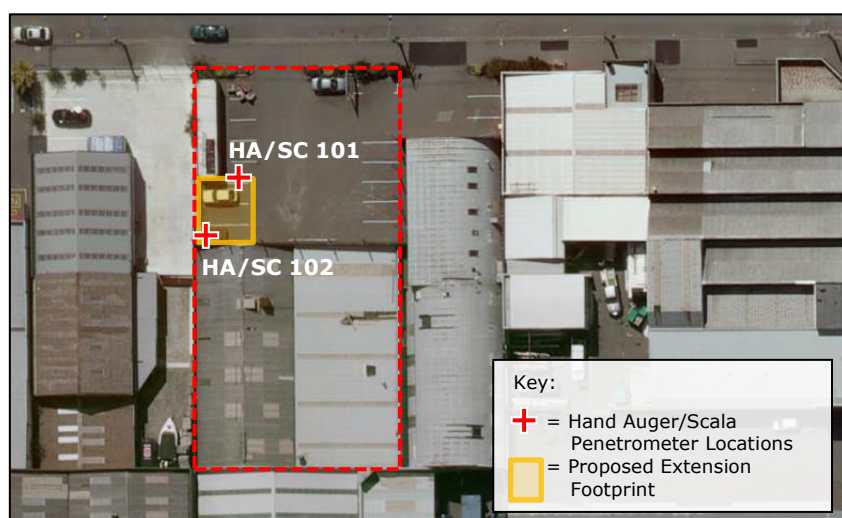


Figure 2: Intrusive Investigation and Extension Locations

Both HA's were drilled to the target depth of 3.2m below existing ground level (begl). SC 101 extended to its target depth of 3.9m begl and SC 102 extended to its target depth of 2.9m begl.

4.3 Ground Summary

Table 1 below is a summary of the ground profile encountered during EDC's HA's:

General Range (begl)	Depth	Ground Description	Density/ Consistency	Water Content
Surface to 0.025m		Asphalt	-	-
0.025m to 0.40m/0.50m		FILL - Fine to coarse sandy gravel with occasional cobbles (hardfill)	Medium dense	-
0.4m to 0.65m/0.75m		FILL - Dark grey organic silt with occasional ash and fine sand	Soft to firm	Moist to wet

General Range (begl)	Depth	Ground Description	Density/ Consistency	Water Content
0.65m to 2.50m		Light grey mottled orange clayey SILT	Firm to stiff	Moist to wet. Saturated from 1.8m/1.9m
2.50m to at least 3.20m		Bluish grey fine to medium sandy SILT	Firm	Saturated

Table 1: Summary of Ground Profile

Groundwater was encountered at 1.8m begl in HA 101, rising to 1.6m begl after one hour. Groundwater was encountered at 1.9m begl in HA 102.

A 150mm diameter plastic pipe was encountered at 0.9m depth in HA 102. Additionally, the natural soil below 1.0m at the location of HA 102 had a greenish colour and produced a slight hydrocarbon smell. It was not clear if the two changes in the soil are related.

A copy of the exploratory hole logs are attached in Appendix C.

4.4 Geotechnical Ultimate Bearing Capacity

The Scala Penetrometer results have been assessed for the approved bearing strata using a correlation between Scala blowcount and allowable bearing capacity by Stockwell, 1977. Using this correlation, the Scala Penetrometer results indicate that the Geotechnical Ultimate Bearing Capacities (UBC) shown in Table 2 can be assumed:

Soil Type	UBC (kPa)
Fill	150
Natural Silt (upper 3.0m)	300

Table 2: Available UBC

A copy of the Geotechnical UBC graph is attached in Appendix D.

5.0 CONCLUSIONS & RECOMMENDATIONS

No historical activities have been identified that are likely to present geotechnical constraints for the proposed extension.

It is understood that damage to the existing building from the earthquakes was light and limited.

A geotechnical report for the adjacent land to the north indicates estimated '*Free-Field*' index ground settlements of between 60mm and 90mm under 'worst case' SLS earthquake conditions and 90mm to 115mm under ULS earthquake conditions.

The risk of lateral spreading as a result of liquefaction is considered low and the risk of lateral stretch is considered to within the MBIE minor to moderate category (less than 200mm).

Notwithstanding the above, estimated Peak Ground Accelerations (PGA's) for the site, indicate that during the February 2011 event (greatest shaking at the site) the site was considered 'sufficiently tested' to a Serviceability Limit State (SLS) earthquake event. Following this event no liquefaction ejecta was evident on-site or on surrounding areas.

The liquefaction analysis for the adjacent site indicates that little settlement is anticipated in an SLS or ULS event in the upper 4.5m despite a groundwater of 0.5m being used in the analysis. Based on this and the lack of significant earthquake damage from the Canterbury Earthquake Sequence it is considered that shallow foundation types are suitable for the proposed lightweight building extension.

The GNS 'Depths to Water Table' maps indicate that the mean depth of groundwater is generally 0.0m – 2.0m bgl in the area of the site. The EDC HA's indicated groundwater to be at approximately 1.6m depth.

EDC's HA's encountered a consistent soil profile comprising: 25mm asphalt, hardfill to approximately 0.45m depth, fill comprising dark grey organic silt to approximately 0.7m depth, firm to stiff silt to at least 3.2m depth.

The Scala Penetrometer results indicate the following Geotechnical Ultimate Bearing Capacities (UBC) can be assumed:

Soil Type	UBC (kPa)
Fill	150
Natural Silt (upper 3.0m)	300

The Christchurch City Council (CCC) has indicated that the site is located within a District Plan Flood Management Area (FMA) and therefore a Finished Floor Level (FFL) of 14.39m RL is required for new building at the site. LiDAR information indicates that the average ground level at the site is 13.82m RL, approximately 0.6m below the required FFL.

6.0 RECOMMENDATIONS

Based on the CCC floor level requirements to mitigate flood risk it is recommended that an assessment of the design implications for the extension is undertaken by the architect and structural engineer for the project.

It is understood that the preferred foundation for the proposed extension is a slab on grade. This is considered a suitable foundation type. The proposed extension is understood to be light weight (distributed load of less than 15kPa). The fill encountered on the site is hardfill to 0.5m over 0.25m thick organic silt fill. Settlement of the topsoil is considered unlikely to be significant (<10mm) if the foundation loads were above the organic fill. In view of this it is considered that the slab foundation can be founded above the organic fill, on the basis that the assumed distributed load of <15kPa is correct. A UBC of 150kPa should be assumed for design. A 300mm thick layer of compacted AP65 should be placed beneath the concrete slab. A layer of geotextile (Bidim A19 or equal) should be placed on the base and sides of the excavation. A layer of geogrid (Cirtex Duragrid 30/30 or equal) should be placed over the geotextile.

The foundation should be designed by a Chartered Professional Engineer.

The gravel hardfill should extend laterally a distance beyond the building footprint that is equal to the depth of gravel. Over excavation will not be possible along the southern and western sides of the excavation due to the site boundary and the existing building. As such, a Chartered Structural Engineer should design the new section of slab to suitably tie into the existing slab and cantilever along the western side.

It is recommended that services (particularly drainage) are not located below the new foundation. All services in the area of the new foundation should therefore be identified (such as the pipe identified at HA 102) and re-aligned (if required) as part of the final design.

It is not likely that dewatering of the excavation will be required.

Advice from a suitably qualified Geotechnical Engineer should be sought if ground conditions different to those encountered in the intrusive investigation are observed during foundation construction works.

Any filling work should be undertaken in accordance with NZS 4431:1989 Code of Practice for Earthfill for Residential Development and MBIE Module 5A: Specification of ground improvement for residential properties in the Canterbury region (MBIE & NZGS, 2015). Validation testing of the compacted gravel should be undertaken and signed off by a suitably experienced Geotechnical Engineer.

PREPARED BY:



Blair Griffiths

Dip Civil Eng GIPENZ
Geotechnical/Geoenvironmental Technician

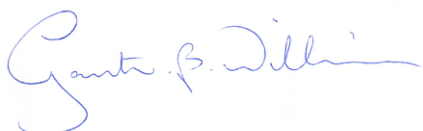
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AUTHORISED BY:



Gareth B Williams

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Snr Geotechnical Engineer, Director

LIMITATIONS

Except where required by law, the findings presented as part of this report are for the sole use of our client, as noted above. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses. No third party (excluding the local authority) may use or rely upon this report unless authorised by EDC in writing.

To the extent permitted by law, EDC expressly disclaims and excludes liability for any loss, damage, cost or expense suffered by any third party relating to or resulting from the use of, or reliance upon any information contained in this letter. It is the responsibility of third parties to independently make enquiries or seek advice in relation to their particular requirements.

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. No other warranty, expressed or implied, is made as to the professional advice presented in this report, in regard to its accuracy or completeness. Our opinions and recommendations are based on our comprehension of the current regulatory standards and must not be considered legal opinions. For legal advice, please consult your solicitor. This opinion is not intended to be advice that is covered by the Financial Advisors Act 2010.

The recommendations and opinions contained in this letter are based on our visual reconnaissance of the site, information from geological maps and upon data from the field investigation as well as the results of in situ testing of soil. Inferences are made about the nature and continuity of subsoils away from and beyond the exploratory holes which cannot be guaranteed. The descriptions detailed on the exploratory hole logs are based on the field descriptions of the soils encountered.

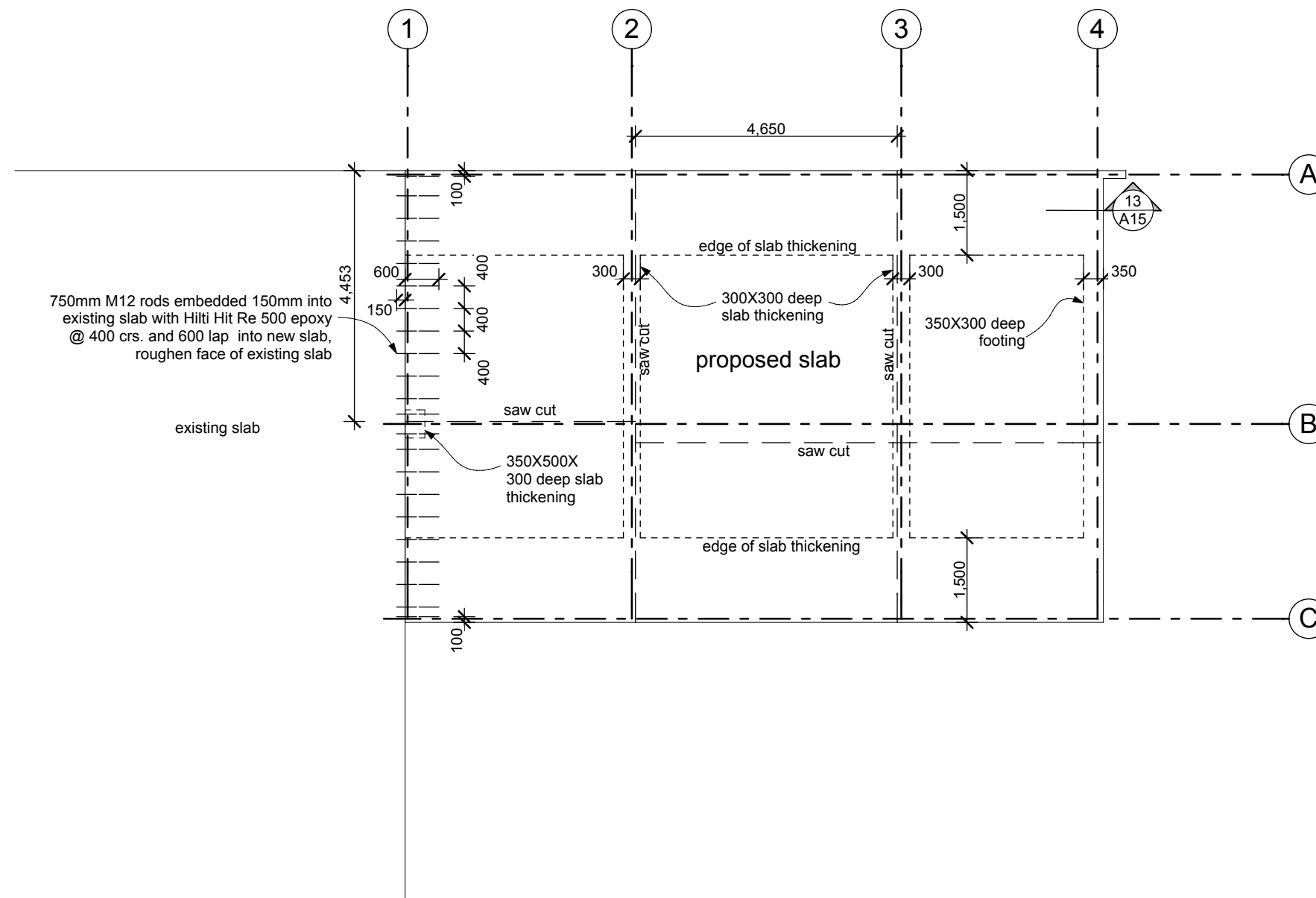
Appendices:

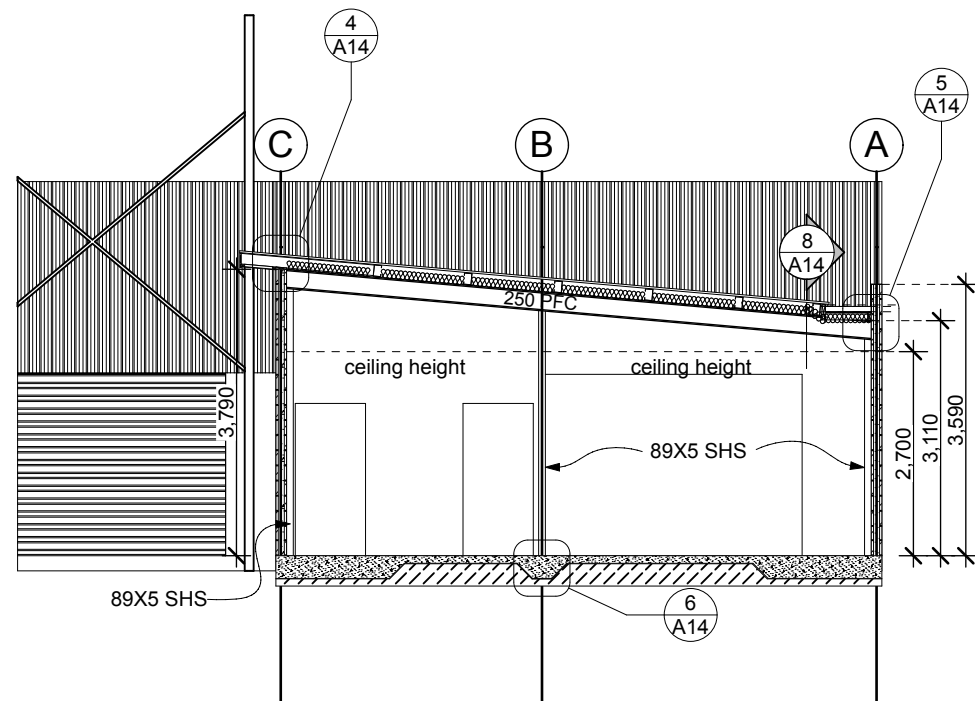
- Appendix A – Proposed Extension Drawing Set by Architectural Design Group (ADG) Ltd (Ref: 5996)
- Appendix B – Environment Canterbury Listed Land Use Register
- Appendix C – Exploratory Hole Logs
- Appendix D – Geotechnical Ultimate Bearing Capacity Graph

Appendices should be read in conjunction with letter and this letter should not be considered complete without them.

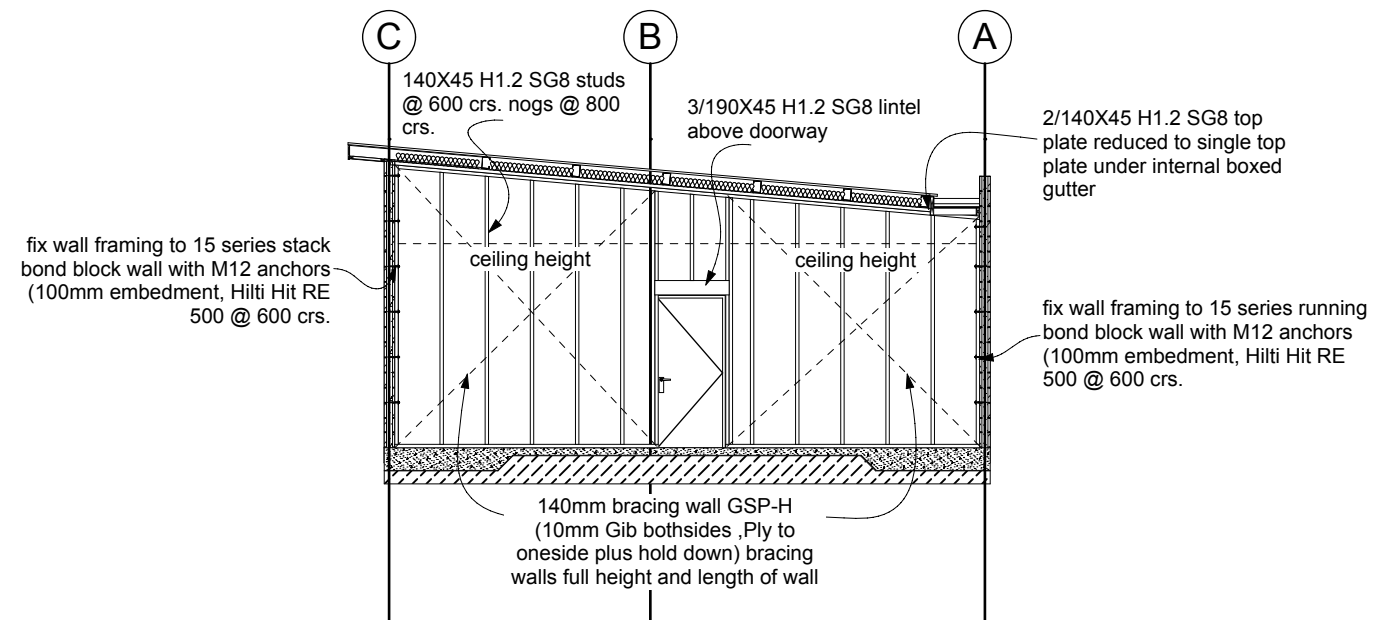
APPENDIX A

Proposed Extension Drawing Set by Architectural Design Group (ADG) Ltd (Ref: 5996)

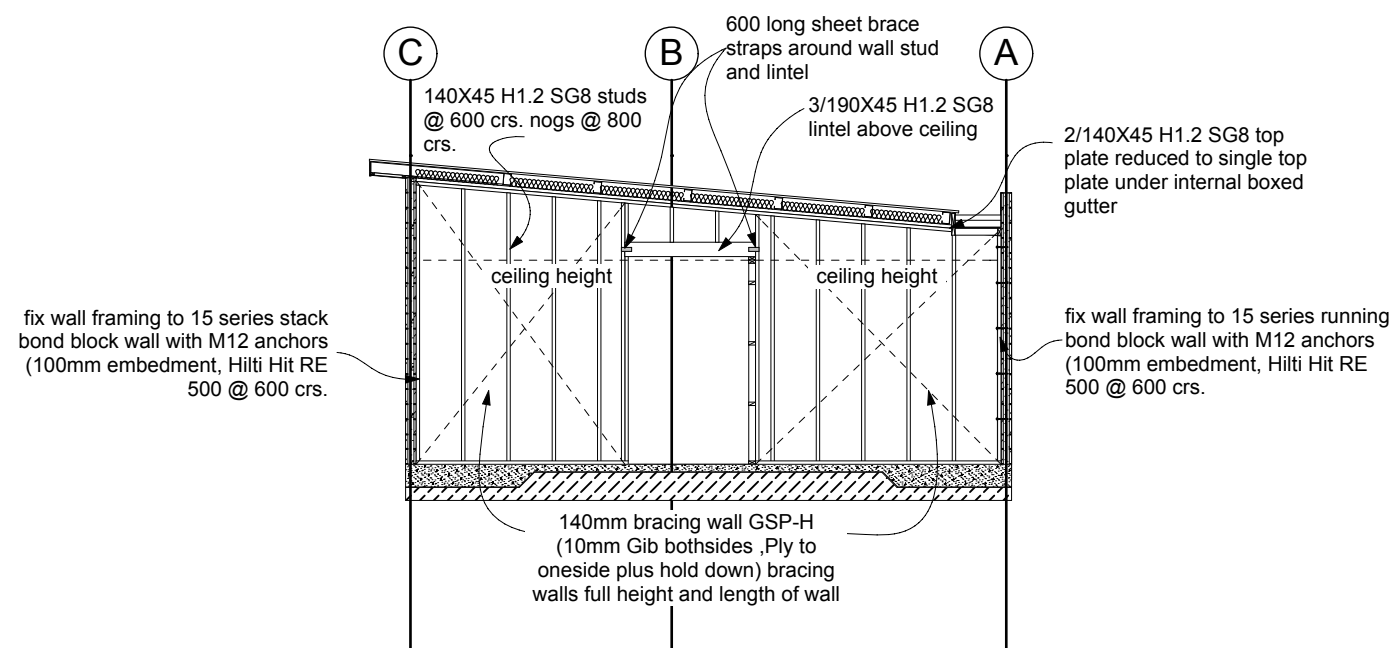




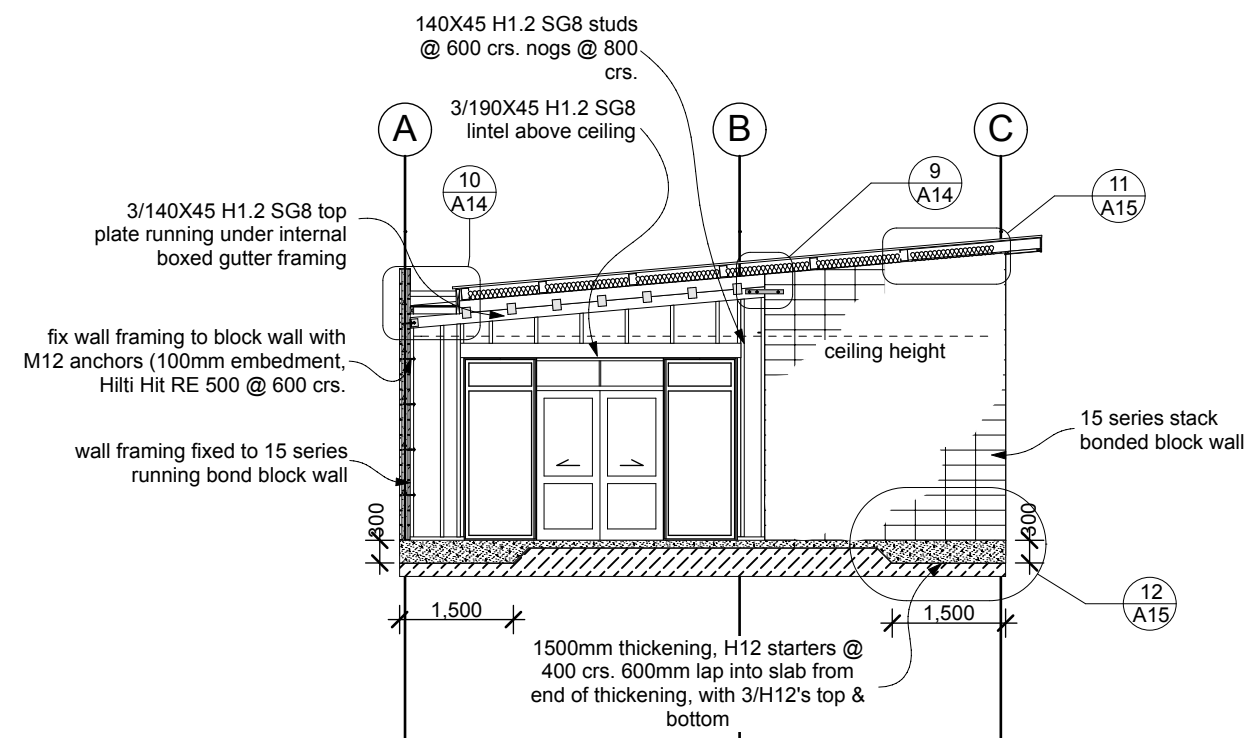
Gridline 1 Cross Section



Gridline 2 Cross Section



Gridline 3 Cross Section

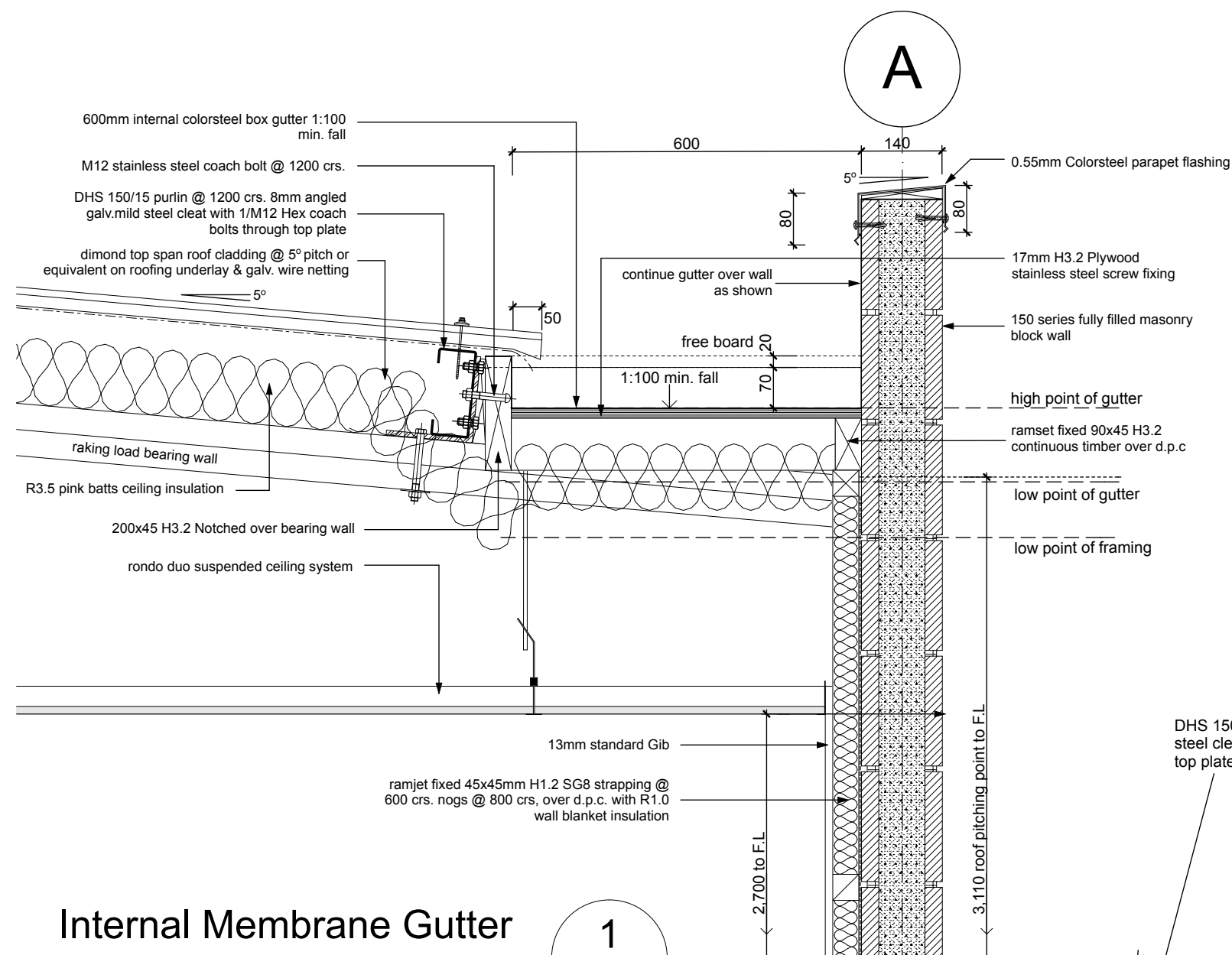


Gridline 4 Cross Section

NOTE:
15 series block walls on grids A & C

- H12's @ 400 crs. verticals
- D16's @ 200 crs. horizontal in 3 courses by roof connection.
- H12's @ 400 crs. horizontal rest of wall.

wall framing to NZS 3604:2011

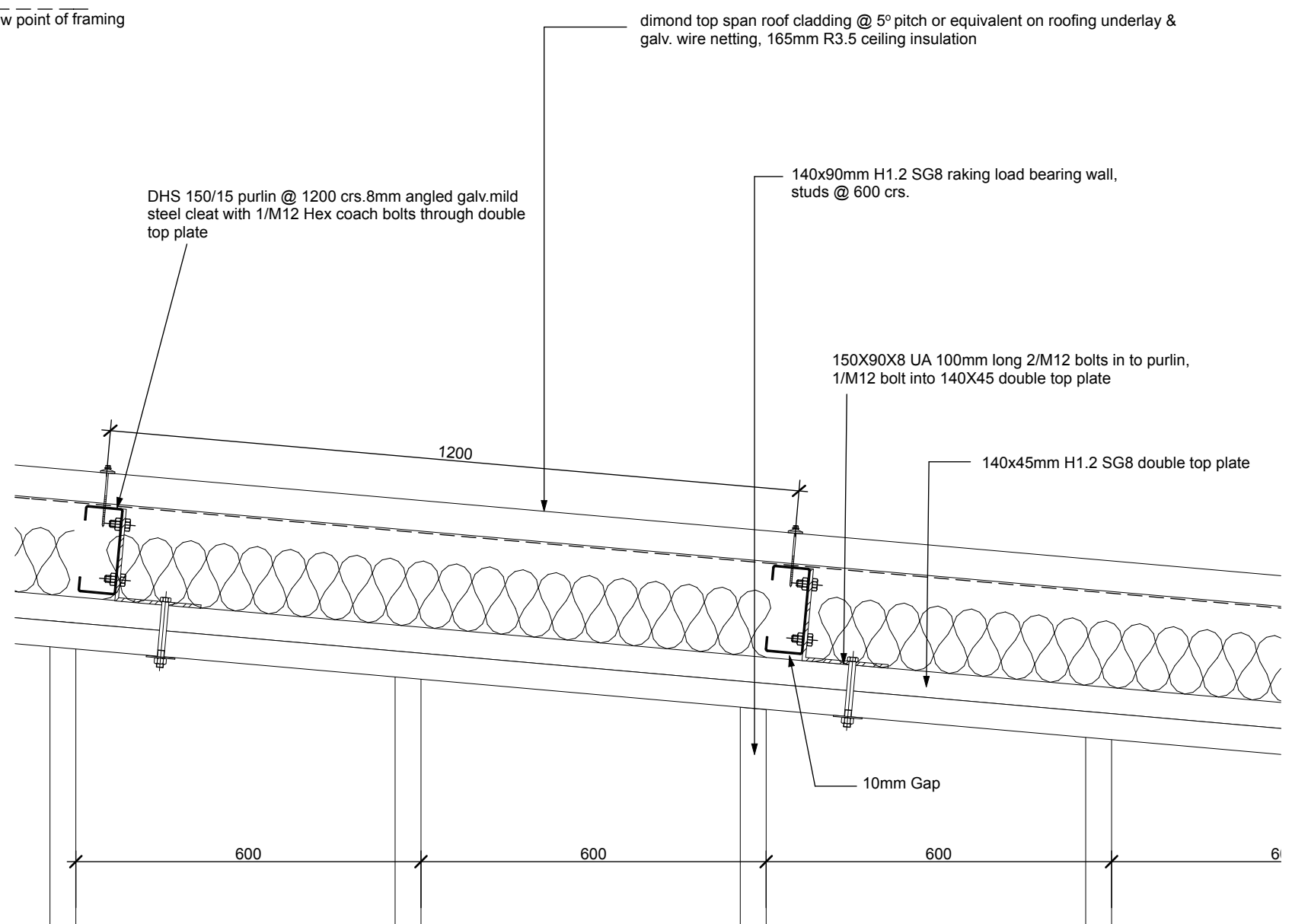


Internal Membrane Gutter
Cross Sectional Detail

1
A11

150 DHS Purlin Connection
Cross Sectional Detail

2
A11



Architectural Design Group
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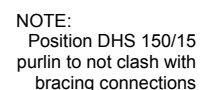
ADG

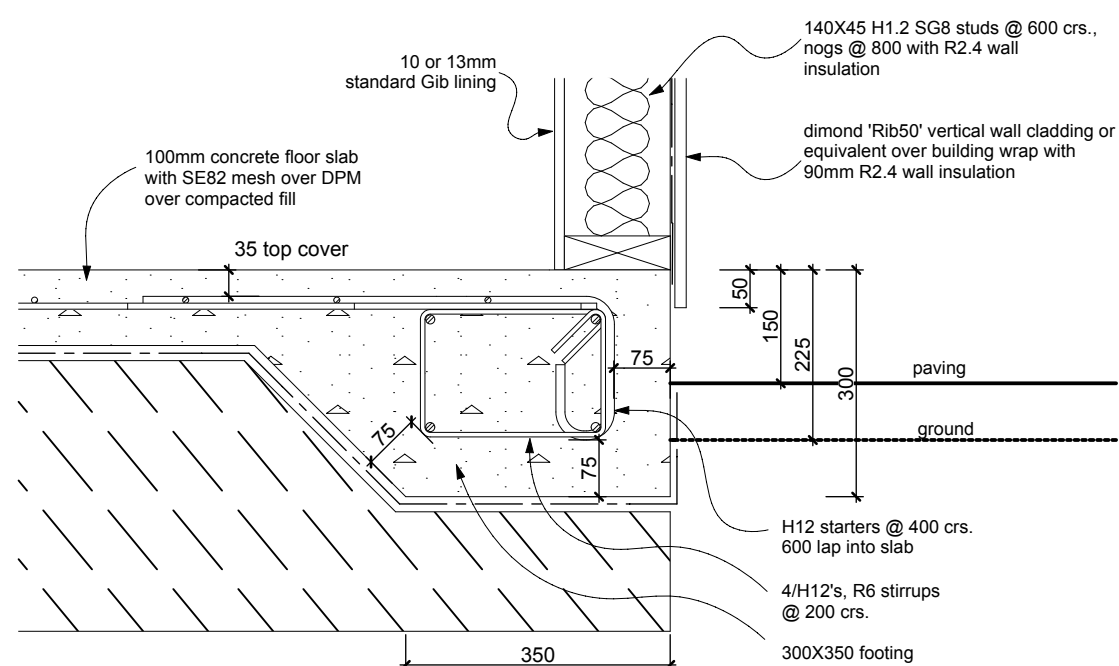
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Proposed Additions
80 Byron Street
Christchurch
For Clip & Climb

Drawing: Architectural Details
Scale at A3: 1:10
Date: January 2017
Job no: 5996
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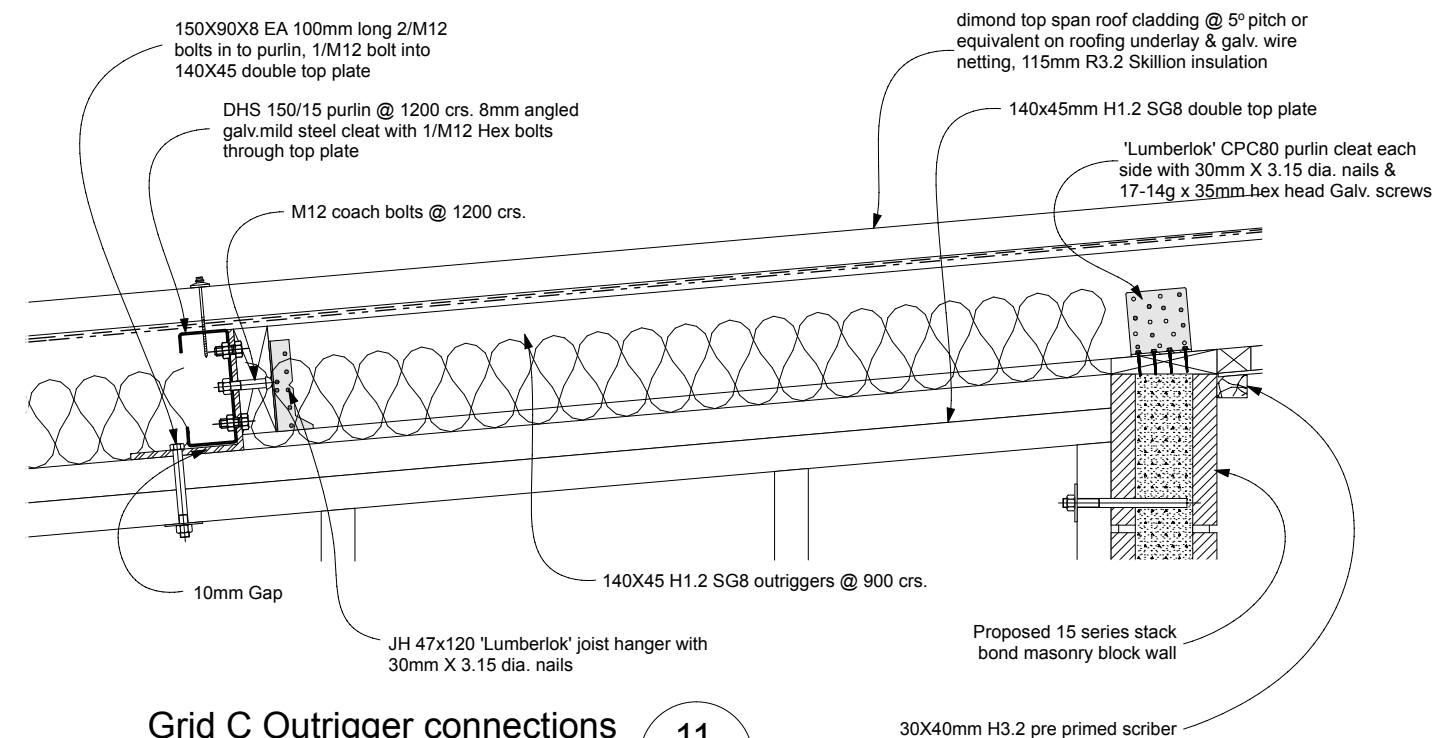
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Sheet no.
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of sheets





Grid 4 Slab Foundation Section Detail

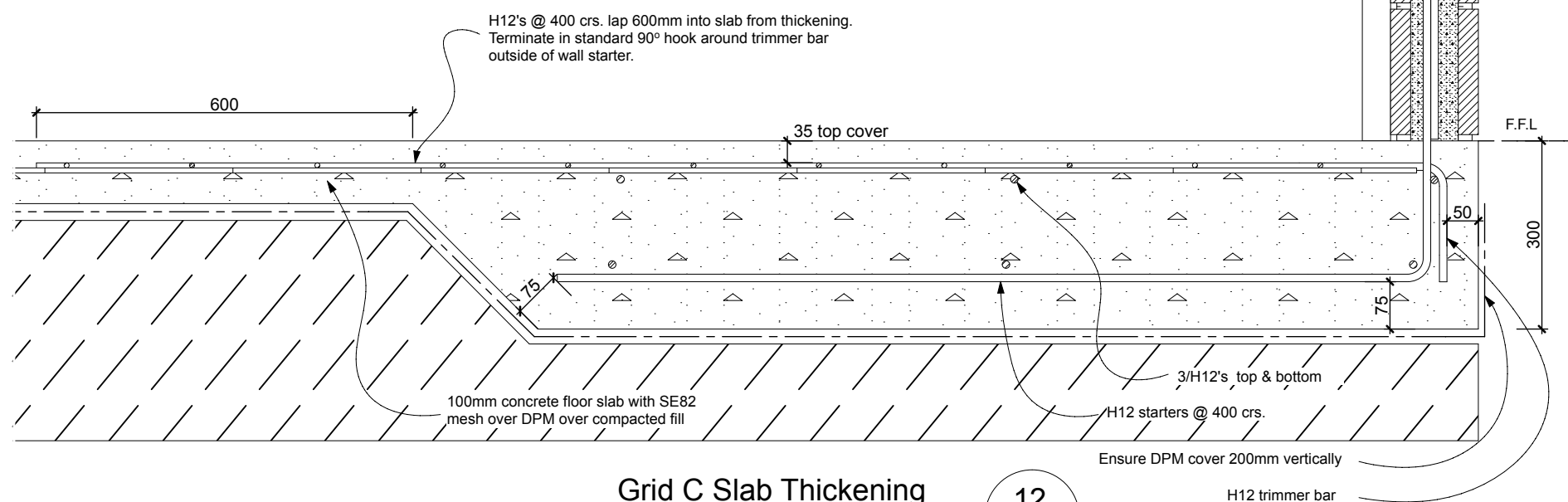
13
A9



Grid C Outrigger connections

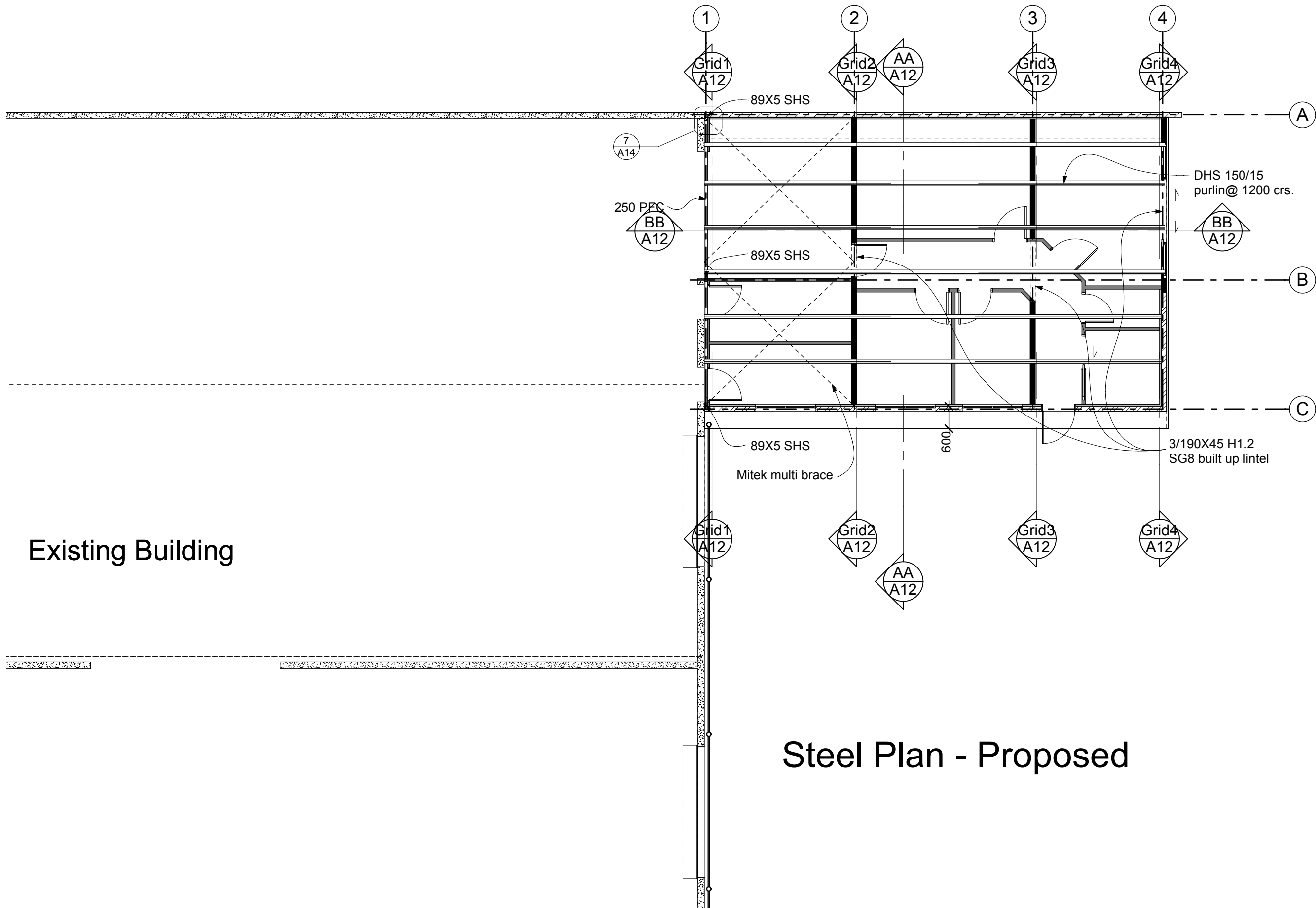
Section Detail

11
A12

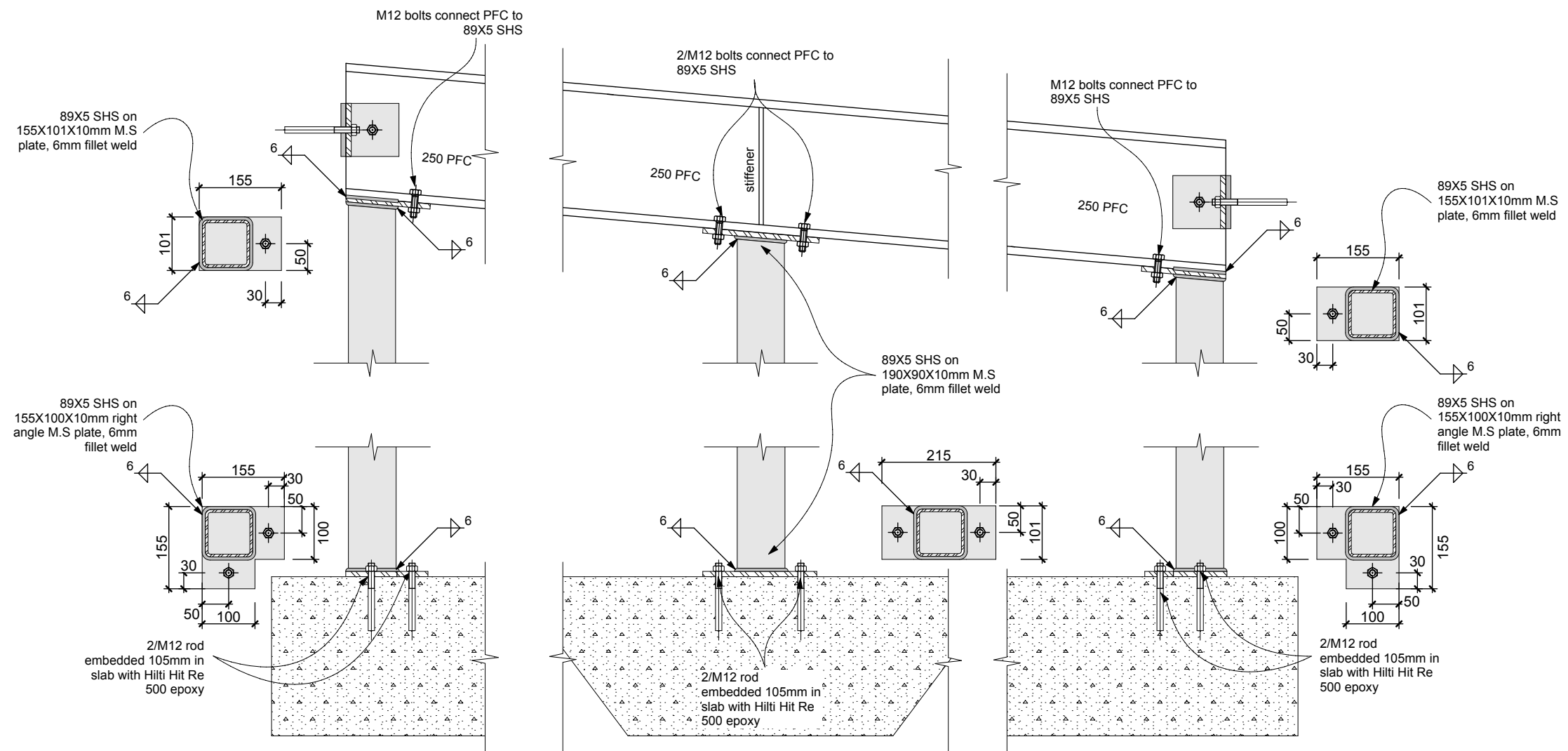


Grid C Slab Thickening Section Detail

12
A12



Steel Plan - Proposed



Gridline 1 Steel Details



Architectural Design Group

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Proposed Additions
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Drawing: Grid 1 Steel Details
Scale at A3: 1:10
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Issue: 1
Sheet no.

A18

of sheets

APPENDIX B

Environment Canterbury Listed Land Use Register



ENGCO
Consulting Engineers

**GEOTECHNICAL REPORT FOR PROPOSED COMMERCIAL BUILDING
83 BYRON ST, SYDENHAM, CHRISTCHURCH**



Project Reference No: I6363

Prepared for: Spaghetti Junction Ltd

Date: 11/11/2016

Project Summary				
Report Title		Geotechnical Report		
ENGCO Project No		16363		
Client		Spaghetti Junction Ltd		
Rev	Date	Details	Prepared by	Approver
0	25/11/2016	Draft for review	Ragulan Kanapathippillai	
1	30.01.2017	For Consent	Ragulan Kanapathippillai	AL

Approval			
Action	Name	Title	Signature
Prepared by	Ragulan Kanapathippillai	Geotechnical Engineer	
Reviewed by	Dave Brierley	Technical Director CPEng No 225268	
Authorised by	Andrew Lind	Director CPEng No. 1019507	

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Appendix 2- Liquefaction Assessment Results

Appendix 3- Shallow Geotechnical Investigation Results

I INTRODUCTION

The Engineering Company Limited (ENGCO) was requested by Spaghetti Junction Ltd, to undertake a geotechnical assessment for the proposed warehouse building with offices at 83 Byron Street, Sydenham, Christchurch. Refer to Figure I for a plan of the proposed development area. This report evaluates the surface and subsurface conditions of the site and provides preliminary geotechnical recommendations for the proposed building foundations, with reference to Ministry of Business, Innovation and Employment (MBIE) Guidance, and building codes, as appropriate.

Our scope of works included the following:

- Desktop study of relevant, publicly available geotechnical and geological publications;
- Organizing deep geotechnical investigation, comprising Piezocone Penetration Tests (CPTu), Dynamic Cone Penetrometers (DCP) and Hand Augers (HA);
- An assessment of liquefaction potential for the site;
- Preparation of this report, outlining our findings on the ground conditions and including geotechnical advice on foundation conditions and ground remediation if necessary;
- Preliminary foundation recommendations for the proposed warehouse building;

2 SITE DETAILS

2.1 Site description

The site 83 Byron Street, Sydenham is located approximately 1.5k southeast of Christchurch city centre. The vacant site is surrounded by commercial buildings. At the time of our investigation, the site was cleared, the contour was generally flat and the site was occupied by a number of containers.

2.2 MBIE land zoning

The site is classified as a non-residential site and the current liquefaction severity land classification for this site, according to Canterbury Earthquake Recovery Authority (CERA) maps, is “N/A-Urban Non-Residential”. A plan of the site location is provided in Figure 2.

2.3 Regional Geology and Seismicity

The geological map of the area indicates that the site has surface geology consisting of “*Dominantly alluvial sand and silt overbank deposits*”.

2.4 Flood hazard

Ground levels have changed across Christchurch as a result of the Canterbury earthquake sequence. Minimum floor elevation requirements for any rebuild at the site should be confirmed with the Christchurch City

Council to inform the design and construction processes. At the time of writing this report, there was no publically available information regarding the final floor level for the commercial building development proposed.

2.5 Hazardous Activities and Industries List

The ECAN contaminated land registry indicates that the site contained an underground storage tank which was removed in 2011. It should be noted that contaminated land assessment is outside the scope of this report.

2.6 Liquefaction and Lateral Spreading

2.6.1 Observed performance

A site walkover was performed by ENGCO on 31st October 2016. During the inspection, there was no evidence of any earthquake-induced land deformation remaining onsite. A summary of our desktop assessment and site walkover is provided below;

The “EQC Liquefaction Interpreted from Aerial Photography” map layers indicate that the property is located within an area where moderate to severe liquefaction was observed, following the June 2011 earthquake, and minor liquefaction was observed following the December 2011 earthquake. No liquefaction was observed following the September 2010 or February 2011 Earthquake.

The “EQC Liquefaction and Lateral Spreading Observations” map indicates no ground cracking or ejected liquefied material were reported at the site, following the February 2011 earthquake event. The road observation indicates no ejected liquefied material observed, after the June 2011 earthquake.

The “EQC Observed Ground Crack Locations” map indicates there were no ground cracks observed near the site, following the February 2011 earthquake.

3 FIELDWORK SUMMARY

3.1 Site Investigation

On behalf of ENGCO, Land Test Ltd carried out two Piezocone Penetration Tests (CPTu), four Dynamic Cone Penetrometer Tests (DCPs) and two Hand Augur Tests (HAs) on 31st October 2016. In addition, another CPT test was carried out on 15th November 2016. These deep investigations were carried out under the supervision of ENGCO's Engineer. The results of both deep and shallow investigations are summarized in Table 1.

Table 1: Location and Depth of Investigations

Test No	Investigations Type	Depth (m)
1	Piezocone Penetration Tests (CPTu 1)	15m bgl
2	Piezocone Penetration Tests (CPTu 2)	15m bgl
3	Dynamic Cone Penetrometer (DCP1 & HA1)	2.0m bgl
4	Dynamic Cone Penetrometer (DCP2 & HA2)	2.0m bgl
5	Dynamic Cone Penetrometer (DCP3)	2.0m bgl
6	Dynamic Cone Penetrometer (DCP4)	2.0m bgl

The locations of the DCP, HA and CPTu tests are shown on Figure 3, and the results are attached in Appendix 2.

3.2 Shallow Ground Condition

The shallow ground conditions encountered during the investigation have been interpreted from the HAs and DCPs. The subsurface conditions encountered are considered to be generally consistent with published geological information.

The inferred shallow ground condition from specific Hand Augers (HA) are provided in Table 2.

Table 2: Inferred soil profile from Test Pits

HA1	HA2	Summary of Soil Type
0 to 0.3m bgl	0 to 0.3m bgl	Sandy GRAVEL (FILL)
0.3 to 2.0m bgl	0.3 to 2.0m bgl	Clayey SILT

3.3 Groundwater Regime

Groundwater was not encountered during the shallow investigation at this site, in October 2016. The GNS ground water elevation model indicates that the water table may vary between 0.0m and 1.0m bgl at this site. It should be noted that the ground water level may vary, seasonally.

For liquefaction analysis purposes, an in-situ groundwater depth of 2.0m bgl and a design groundwater level of 0.5m bgl were adopted.

3.4 Site subsoil class

In accordance with NZS1170.5, Section 3.1.3, site subsoil classification “*Class D – Deep or soft soil sites*” may be assumed for this site.

3.6 Deep Ground Condition

Based on the existing geotechnical information, the site-specific geotechnical investigation undertaken by ENGCO and the review of published information, the following ground model for the site has been inferred, as outlined in Table 3.

Table 3: Inferred geological model

Soil Layer	Depth range(m bgl)	Soil Description
Layer 1	0.0 to 6.0	Clay & silty clay
Layer 2	0.6 to 16.5	Sand & silty sand
Layer 3	16.5 to 24.5	Clay & silty clay, Silty sand & sandy silt
Layer 4	24.5 to 24.7	Silty sand & sandy silt, Gravel

4 EARTHQUAKE- INDUCED GROUND DEFORMATION

4.1 Predicted vertical deformation

Assessment of earthquake-induced ground deformation at the site has been carried out in accordance with MBIE Guidance, using proprietary liquefaction assessment software. The derivation of the procedures has been based on a conservative approach to give estimates of deformation that may be experienced in the earthquake scenarios at a free-field site, i.e. one with no building present, and not subject to lateral spreading. The results of this analysis are summarized in Table 4.

Table 4: Estimated Total "Free-Field "Ground Surface Settlement from CPT and BH results

Earthquake Scenario	Moment Magnitude (Mw)	Peak Ground Acceleration(PGA,(m/s ²))	Settlement to tested depth (mm)	MBIE "Index Value"(settlement in Upper 10m) (mm)
SLS1	7.5	0.13	65 - 90	55 - 80
SLS2	6.0	0.19	75 - 100	60 - 90
ULS	7.5	0.35	155 - 165	90 - 115

The liquefaction assessment results are provided in Appendix 2.

The analysis results indicates that a non-liquefiable soil layer is located between 3.0m bgl and 7.0m bgl, under ULS conditions.

4.2 Assessed lateral deformation

Following the procedure outlined in Section 12.2 of the MBIE Guidance, an assessment of the global lateral movement of the site and lateral stretch across the site has been undertaken and the results are outlined in Table 5.

Table 5: Assessed lateral deformation at the site

Assessed global lateral movement category of the site	Minor to moderate (less than 300mm)
Assessed lateral stretch category of the site	Minor to moderate (less than 200mm)

Based on the Canterbury Geotechnical database (CGD) horizontal ground movement data, the site is categorized as being subject to minor to moderate global lateral movement. Site observations and subsequent analyses show that the site has been 'sufficiently tested at SLS' to a significant degree, and that a minor global lateral movement category is appropriate for this site.

We consider the risk of lateral spreading, as a result of liquefaction at this site, to be low, as there are no major cracks due to earthquake events (based on desktop studies). We consider that the risk of lateral stretch is in the minor to moderate category as there were no significant ground cracks identified at the site.

5 FOUNDATION RECOMMENDATION FOR THE DEVELOPMENT

5.1 Design considerations

At the time of preparation of this report, the anticipated foundation loads from the proposed structures were not known to ENGCO, but have been assumed to be based on a single level, heavyweight warehouse building. Due to the liquefaction risk at this site, conventional shallow foundations are not recommended.

A specifically designed, piled foundations is a viable solution for the proposed building. The piles would need to be founded at a depth of 12.5m bgl. It should be noted that pile driving operations can cause vibration to adjacent buildings and suitable pile installation methods should be considered for the pile driving, including the potential use of screw piles. The piled foundation solution would require minimal excavation, as the structural loads would be transferred through the piles. It should be noted that the soil layer between 12m and 16m bgl has sufficient bearing capacity (>15MPa) and thickness, to resist superstructure loads, under SLS earthquake conditions.

The design of the building structure and foundations must be carried out to ensure that, as a minimum, SLS and ULS Building Code performance requirement are fulfilled (e.g. low probability of causing loss of amenity through undue deformation, for SLS events, and low probability of rupturing, becoming unstable, losing equilibrium or collapsing, for ULS events).

6. Construction Observation

6.1 Pavement Areas

It is generally advisable that any un-engineered fill or unsuitable material be removed from under any pavement areas, prior to construction, and replaced with compacted granular fill. However, based upon our assessment, the density of existing soils may be adequate for the support of access ways.

6.2 Underground Services

Flexible connections should be constructed where all service drains and ducts enter/exit the concrete floor slabs. Service trench backfill within 1.5m of the buildings is to comprise well graded crushed stone aggregate (i.e. CAP 20), compacted from the surface only.

6.3 Storm water

Concentrated storm water flows from all impermeable areas must be collected and carried in sealed pipes to the Council system. Uncontrolled storm water flows must not be allowed to run onto or saturate the ground so as to adversely affect foundation performance, both statically and during future seismic activity (liquefaction potential and liquefaction induced settlement are both increased with a higher groundwater table, resulting from uncontrolled disposal of storm water).

7 Limitations and Restrictions on Building Consents

7.1 Construction of building on land subject to natural hazards

In terms of Section 71 of the Building Act 2004, Christchurch City Council has an obligation to consider the following matters, and to refuse consent unless satisfied that measures have been or will be taken to remedy identified hazards:

- Erosion, including surface and subsurface erosion, associated with water and wind;
- Falling debris, including rockfall that could impact the site from upslope sources;
- Subsidence, which involves the removal of underlying support by natural or artificial means;
- Slippage, which is defined as the downslope transfer of materials by sliding and/or flowage;
- Inundation, including flooding, overland flow, storm surge, tidal effects, and ponding.

Provided adequate stormwater drainage is in place, erosion is not considered an issue at this site.

As the site is situated on the flat, falling debris is not an issue. Due to the moderate to high potential for soils to liquefy at ULS levels of seismic shaking beneath the site, minor to moderate subsidence could occur during an earthquake event. Provided a foundation system per the recommendations of this report (Section 5.0) is constructed, we consider the proposed foundation system will comply with MBIE industrial building guidance performance criteria. There are no other potential subsidence and/or settlement processes that could

adversely affect the foundation system. The site is far removed from any free edge or major waterway. In terms of slippage, lateral movement is considered to be consistent with the minor category during a ULS seismic event. ENGCO is satisfied that there are no geotechnical issues pertaining to Section 71 of the Building Act 2004 that cannot be addressed by appropriate foundation design and drainage on the site.

8 REFERENCES

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- 7) Canterbury Geotechnical Database. EQC Observed Ground Crack Locations. Map layer CGD0400 – 23 Jul 2012
- 8) van Ballegooy, S., Wentz, F. J. & Boulanger, R. W. 2015c. Evaluation of a CPT-based liquefaction procedure at regional scale. Soil Dynamics and Earthquake Engineering, Special Issue: Liquefaction in New Zealand and Japan
- 9) Boulanger, R. W. & Idriss, I. M. 2014. CPT and SPT based liquefaction triggering procedures. (Report No. UCD/CGM-14/01). Center for Geotechnical Modelling, Department of Civil and Environmental Engineering, University of California, Davis, CA
- 10) Robertson and Wride, 1998. Evaluating cyclic liquefaction potential using the cone penetration test. Canadian Geotechnical Journal, Vol. 35, pp. 442 – 459
- 11) Zhang, G., Robertson, P. K., & Brachman, R. W. I. (2002). Estimating liquefaction induced ground

settlements from CPT for level ground, Canadian Geotechnical Journal, 39, 1168–80

12) Ministry of Business, Innovation and Employment (MBIE) 2015. Repairing and rebuilding houses affected by the Canterbury earthquakes - Section 15.3 Updated guidance on site ground improvement, Christchurch.

9 LIMITATIONS

9.1 General

This report, prepared by ENGCO, at the request of our Client, is exclusively for our Client's use, is not to be relied upon by any other person, and is strictly limited to the matters herein.

No responsibility or liability to any third party is accepted for any loss or damages whatsoever arising out of the use of or reliance on this report by any third party, outside of our Client. Nor may the report be used for any other property than the one specified.

The report and its contents are not to be quoted or published without ENGCO's consent.

9.2 Geotechnical

The conclusions of the report are based on the interpretation of a limited number of tests at specific locations, and information gathered from nearby sites and other sources. It shall not be relied upon for any other purpose. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk. ENGCO will not accept liability for global stability issues on this site where investigation on a single lot could not reasonably assess the global stability issues.

During excavation and construction, the site should be examined by a Geotechnical Engineer to judge whether the exposed subsoils are compatible with the inferred conditions. It is possible that the nature of the exposed subsoils may require further investigation and the modification of the design based on this report. In any event, it is essential that ENGCO is notified if there is any variation in subsoil conditions from those described in the report, as it may affect the design parameters recommended in the report. There is no investigation, which is thorough enough to preclude the presence of materials at the site, which presently, or in the future, may be considered hazardous.

Should you require any further information, please contact the ENGCO office on 03 366 7955



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Appendix I

Figure 1- Site location plan

Figure 2- Site Location plan Showing MBIE Technical Category Map

Figure 3- Field Investigation Location

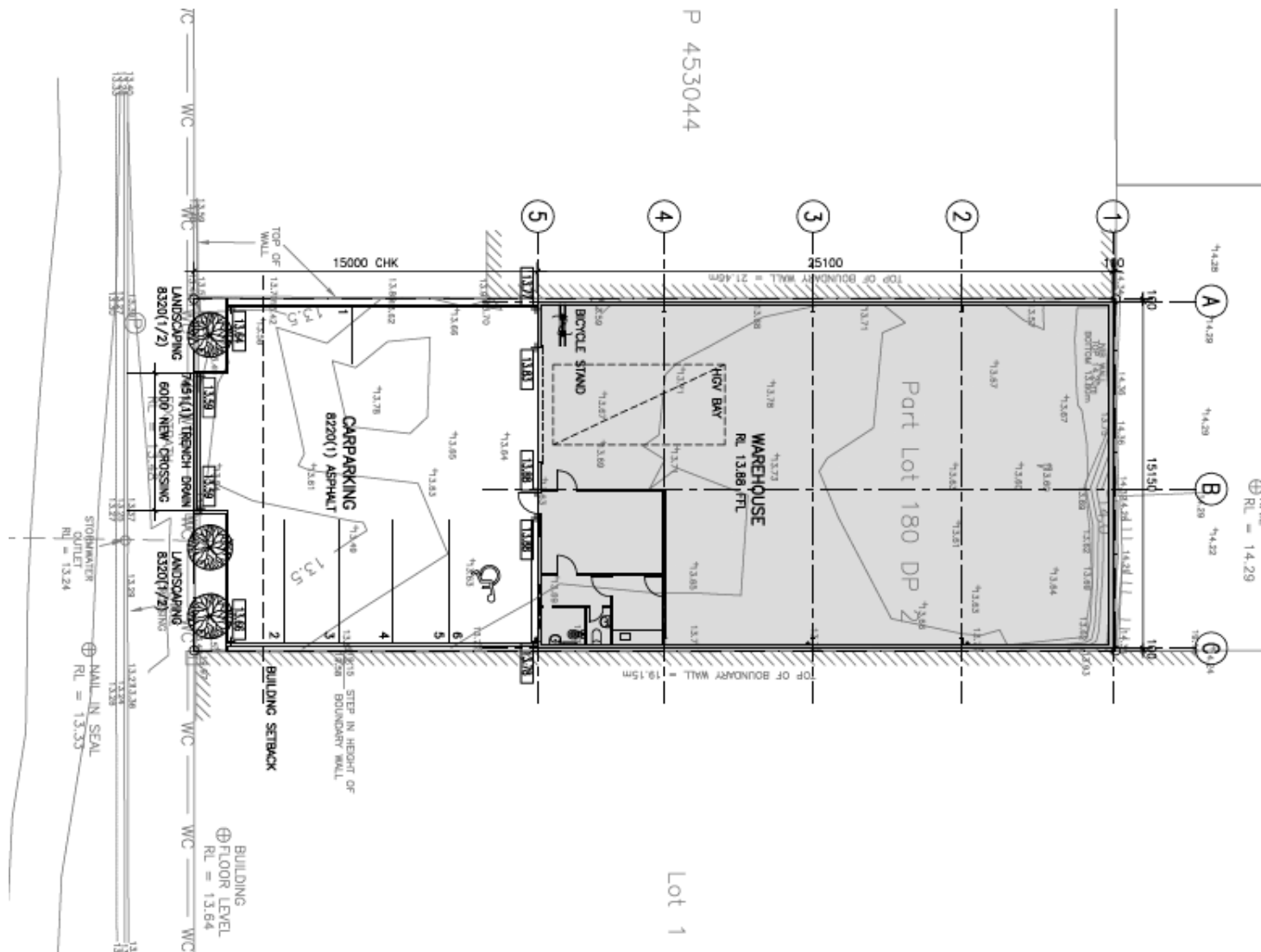


	Figure	I	Date	23/11/2016	Title	Site boundary & Development Area
	Project No	I6363			Reference	N/A

FOR RESIDENTIAL PURPOSES ONLY

Foundation Technical Category 1 (TC1):

Future land damage from liquefaction is unlikely, and ground settlements are expected to be within normally accepted tolerances. Standard foundations (NZS 3604) are acceptable subject to shallow geotechnical investigation.

Foundation Technical Category 2 (TC2):

Minor to moderate land damage from liquefaction is possible in future large earthquakes. Lightweight construction or enhanced foundations are likely to be required such as enhanced concrete raft foundations (ie, stiffer floor slabs that tie the structure together).

Foundation Technical Category 3 (TC3):

Moderate to significant land damage from liquefaction is possible in future large earthquakes. Foundation solutions should be based on site-specific geotechnical investigation and specific engineering foundation design.

Foundation Technical Category map not applicable (N/A):

Normal consenting procedures apply in these areas. This applies to non-residential properties in urban areas, properties in rural areas or beyond the extent of land damage mapping, and properties in the Port Hills and Banks Peninsula.

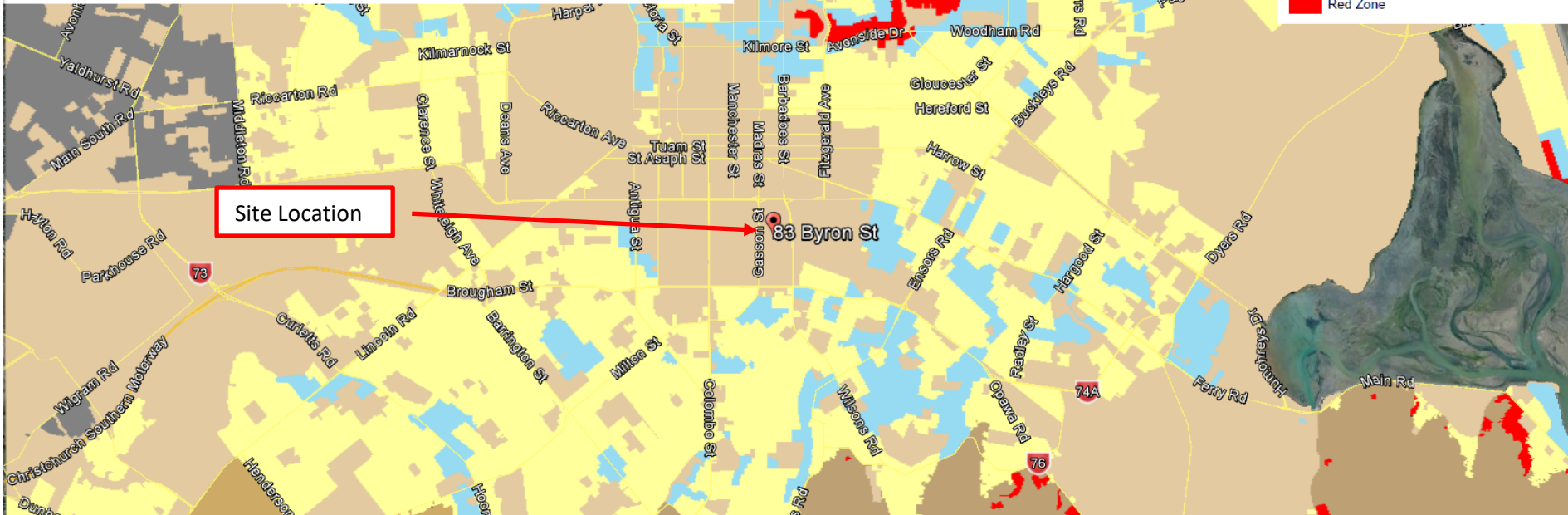


Figure	2	Date	23/11/2016	Title	Site Location Plan showing MBIE Technical Categories
Project No	16363			Reference	Canterbury Geotechnical Database.

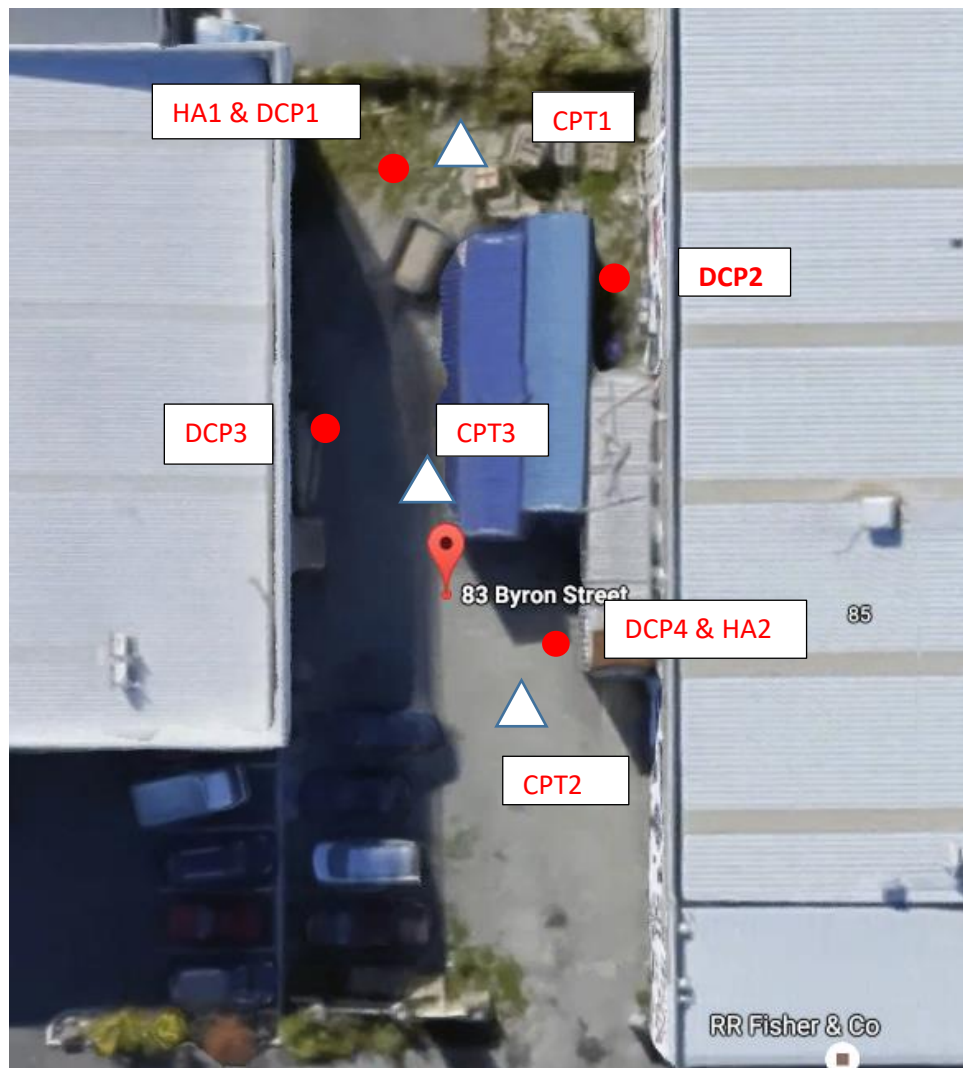


	Figure	3	Date	23/11/2016	Title	Field Investigation Locations
	Project No	16363			Reference	N/A

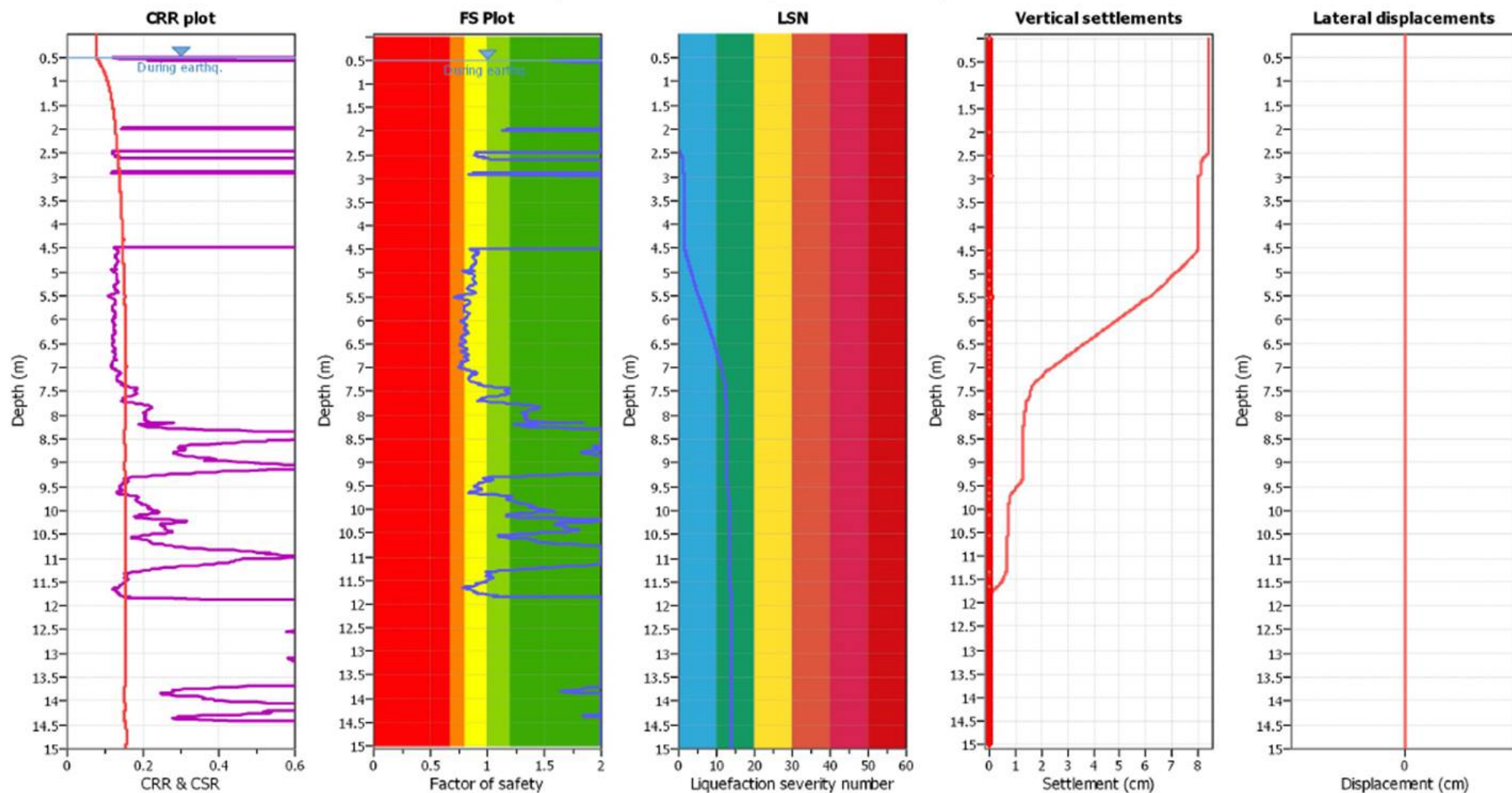


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Appendix 2

Liquefaction Assessment Results

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_0 applied:	Yes
Earthquake magnitude M_w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

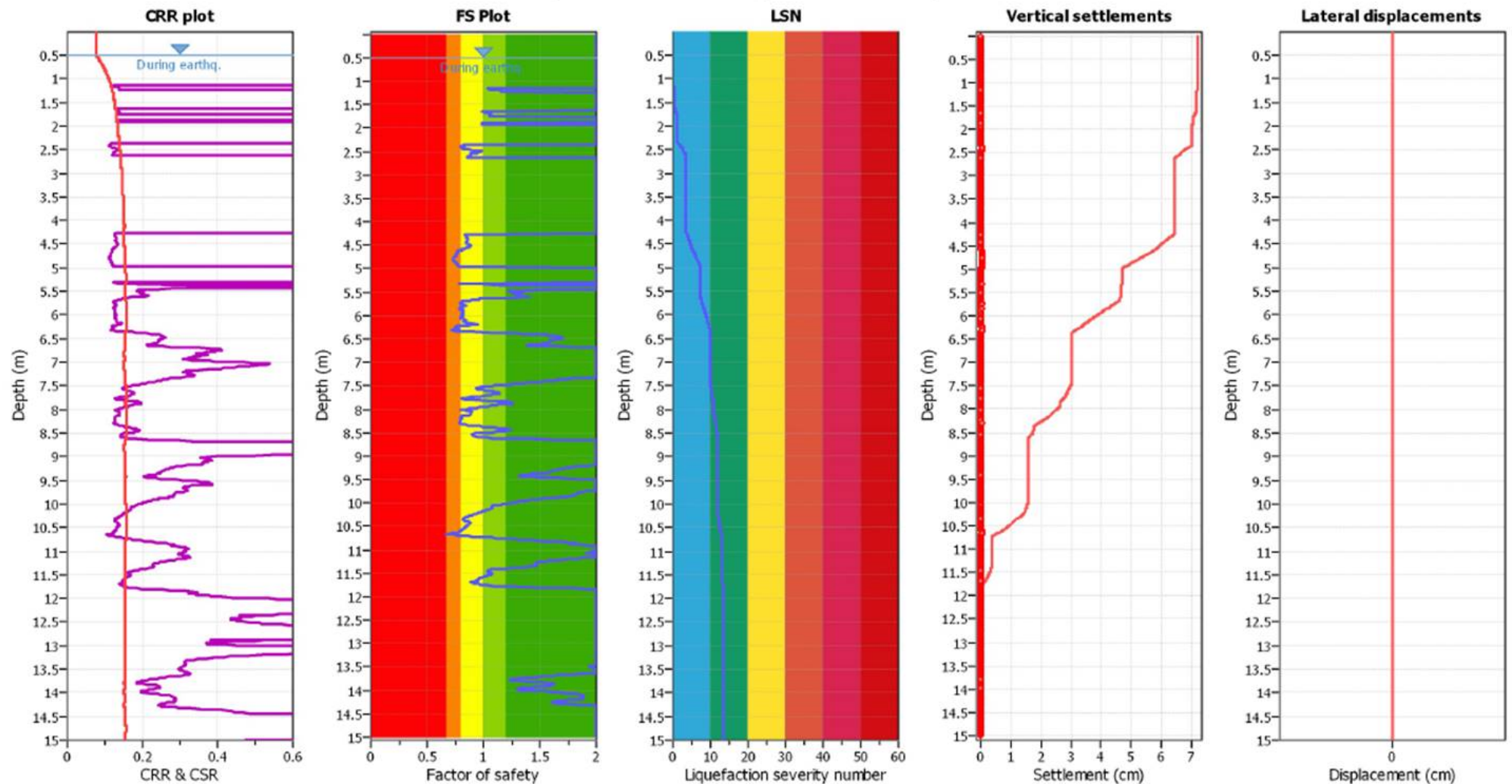
LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Dark Green	Little to no expression of liquefaction

CLiQ v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:11:57 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiQ with pour water pressure correction.clq

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 7.50
 Peak ground acceleration: 0.13
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

F.S. color scheme

Red: Almost certain it will liquefy
 Orange: Very likely to liquefy
 Yellow: Liquefaction and no liq. are equally likely
 Green: Unlike to liquefy
 Blue: Almost certain it will not liquefy

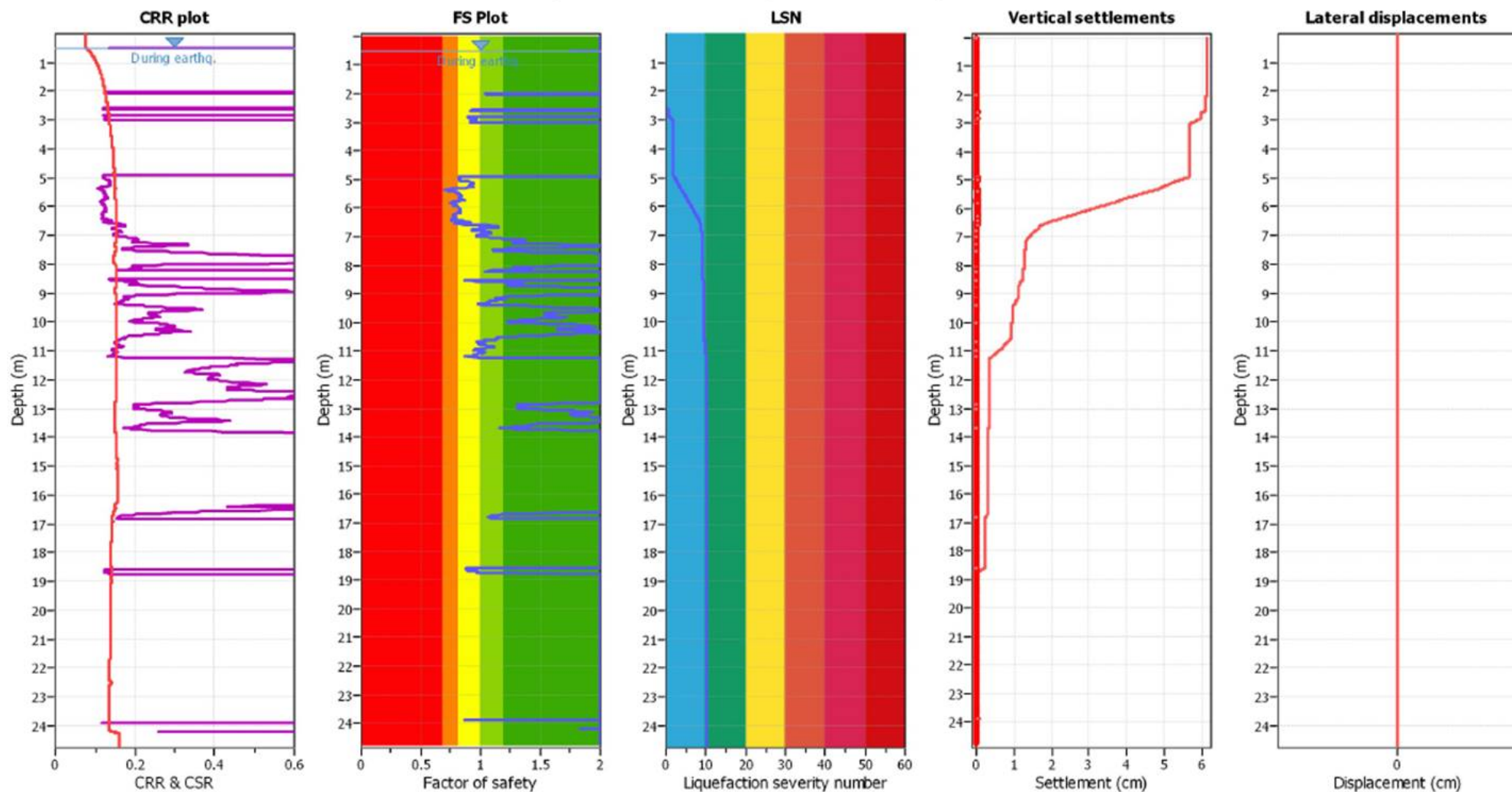
LSN color scheme

Red: Severe damage
 Orange: Major expression of liquefaction
 Yellow: Moderate to severe exp. of liquefaction
 Green: Moderate expression of liquefaction
 Blue: Minor expression of liquefaction
 Light Blue: Little to no expression of liquefaction

CLiq v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:11:58 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiq with pour water pressure correction.cliq

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_0 applied:	Yes
Earthquake magnitude M_w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

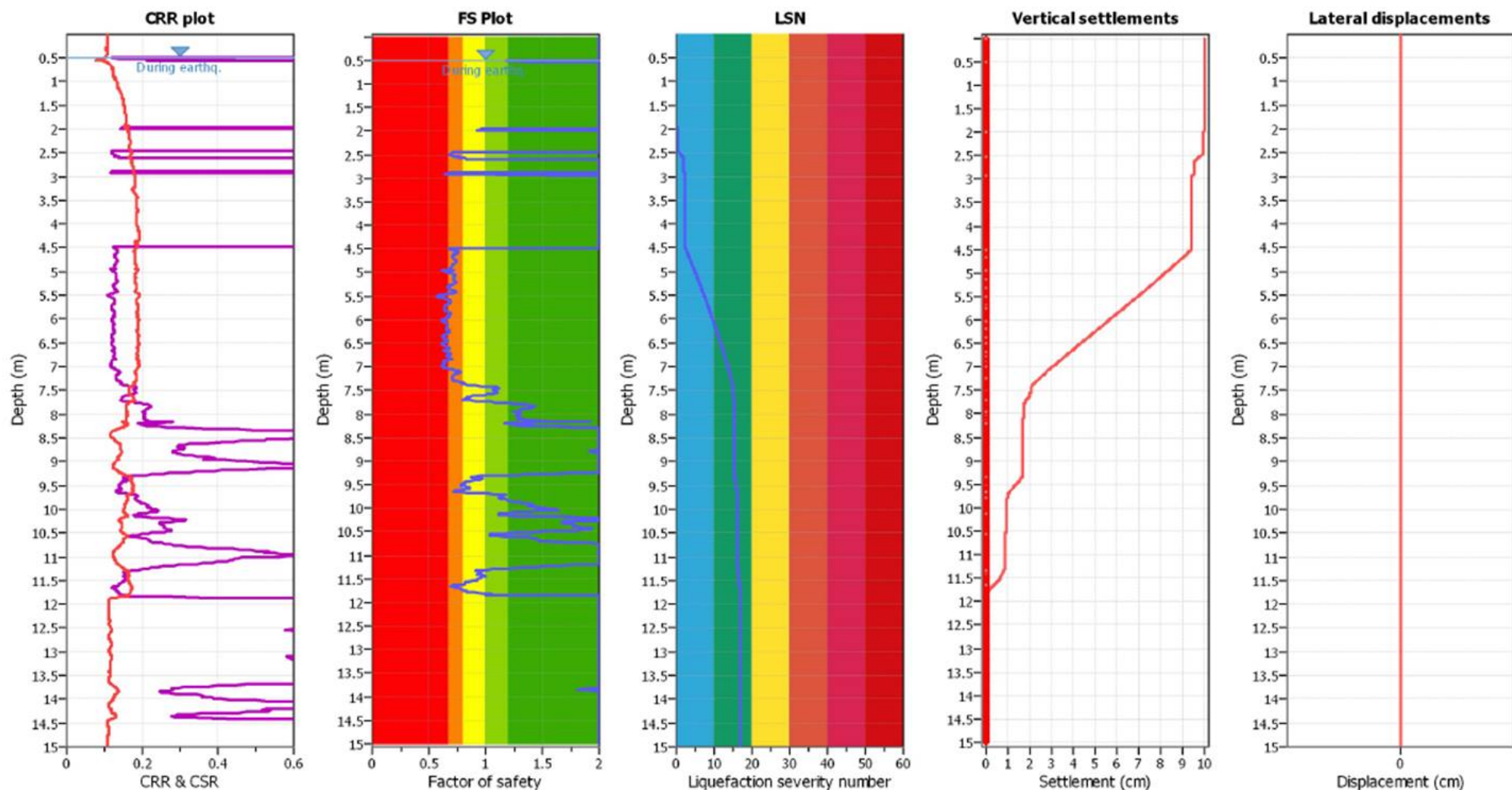
LSN color scheme

Red	Severe damage
Orange	Major expression of liquefaction
Yellow	Moderate to severe exp. of liquefaction
Green	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

CLiq v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:11:59 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiq with pour water pressure correction.clg

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.19
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

F.S. color scheme

■ Almost certain it will liquefy
■ Very likely to liquefy
■ Liquefaction and no liq. are equally likely
■ Unlike to liquefy
■ Almost certain it will not liquefy

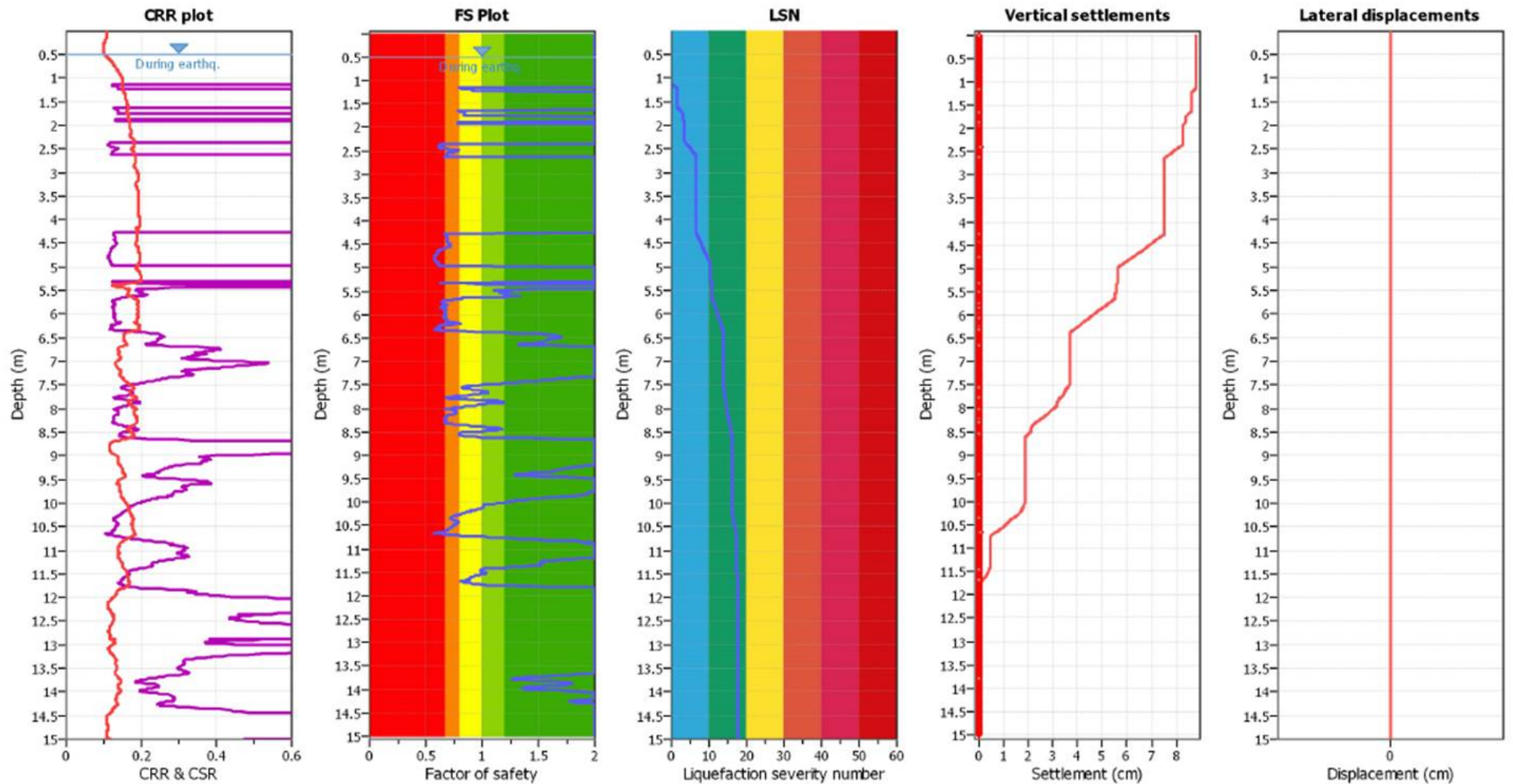
LSN color scheme

■ Severe damage
■ Major expression of liquefaction
■ Moderate to severe exp. of liquefaction
■ Moderate expression of liquefaction
■ Minor expression of liquefaction
■ Little to no expression of liquefaction

CLiq v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:12:00 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiq with pour water pressure correction.ciq

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.19
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

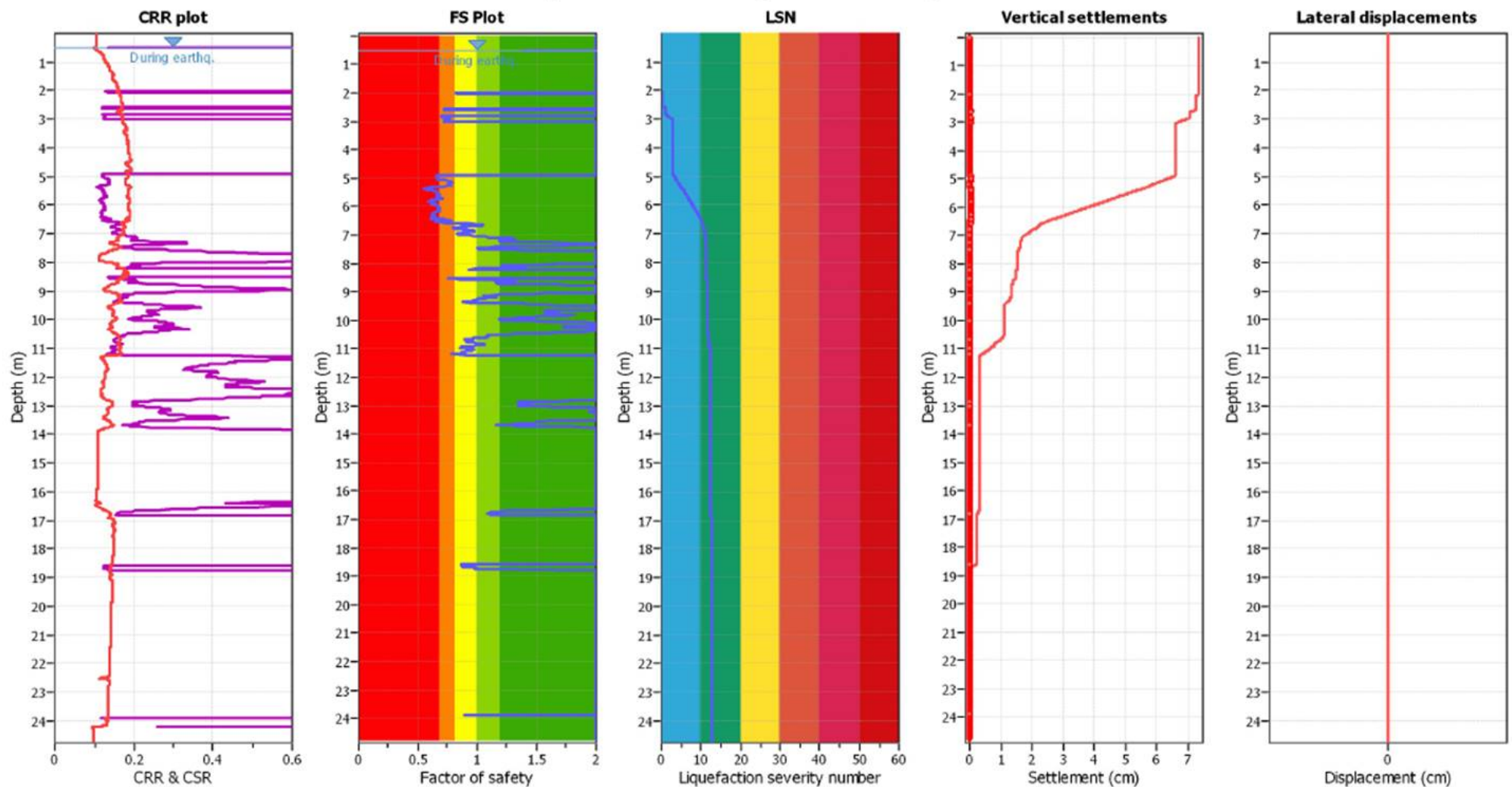
F.S. color scheme

Almost certain it will liquefy
 Very likely to liquefy
 Liquefaction and no liq. are equally likely
 Unlike to liquefy
 Almost certain it will not liquefy

LSN color scheme

Severe damage
 Major expression of liquefaction
 Moderate to severe exp. of liquefaction
 Moderate expression of liquefaction
 Minor expression of liquefaction
 Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 6.00
 Peak ground acceleration: 0.19
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

F.S. color scheme

Red: Almost certain it will liquefy
 Orange: Very likely to liquefy
 Yellow: Liquefaction and no liq. are equally likely
 Green: Unlike to liquefy
 Dark Green: Almost certain it will not liquefy

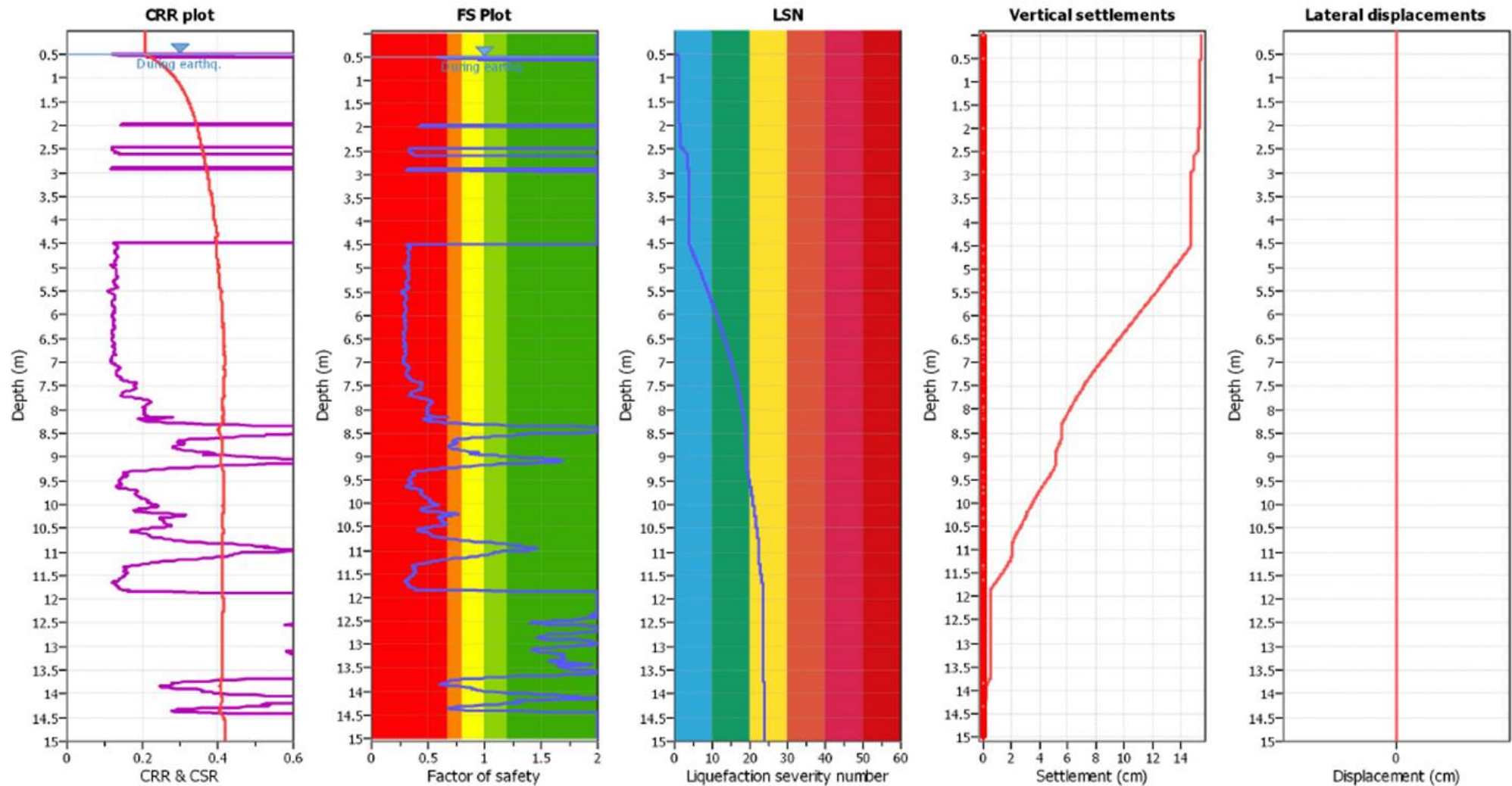
LSN color scheme

Red: Severe damage
 Dark Red: Major expression of liquefaction
 Orange: Moderate to severe exp. of liquefaction
 Yellow: Moderate expression of liquefaction
 Green: Minor expression of liquefaction
 Blue: Little to no expression of liquefaction

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Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiq with pour water pressure correction.ciq

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_o applied:	Yes
Earthquake magnitude M_w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.35	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

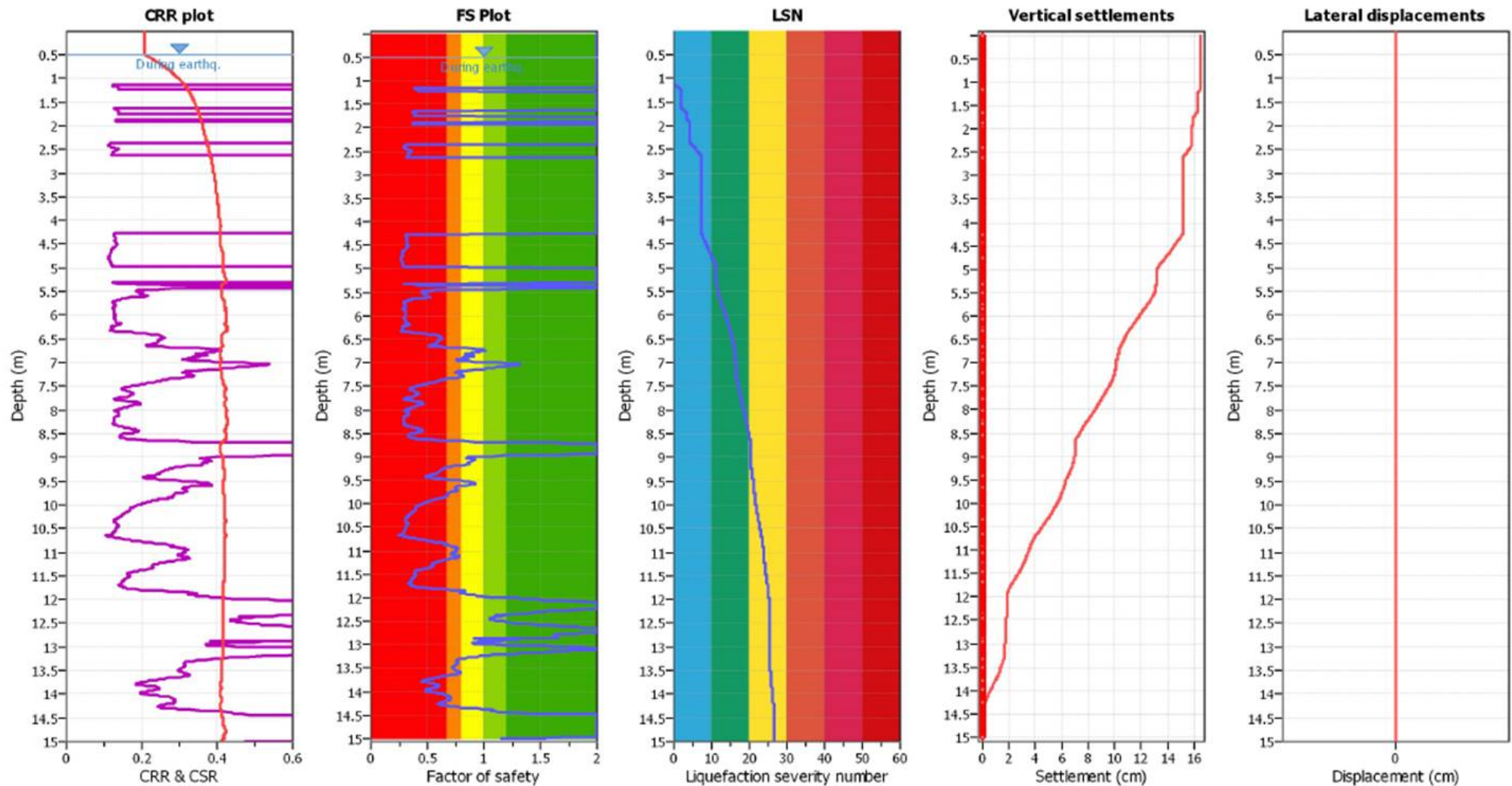
LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Dark Green	Little to no expression of liquefaction

CLiq v.1.7.6.49 - CPT Liquefaction Assessment Software - Report created on: 25/11/2016, 12:12:07 p.m.

Project file: C:\Users\Ragulan\Dropbox (Engco)\The Engineering Company Ltd\Jobs 2016\16301-16400\16363 Clip n Climb warehouse\04 - Geotechnical Report\CLiq with pour water pressure correction.clg

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 7.50
 Peak ground acceleration: 0.35
 Depth to water table (insitu): 2.00 m

Depth to GWT (erthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_o applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

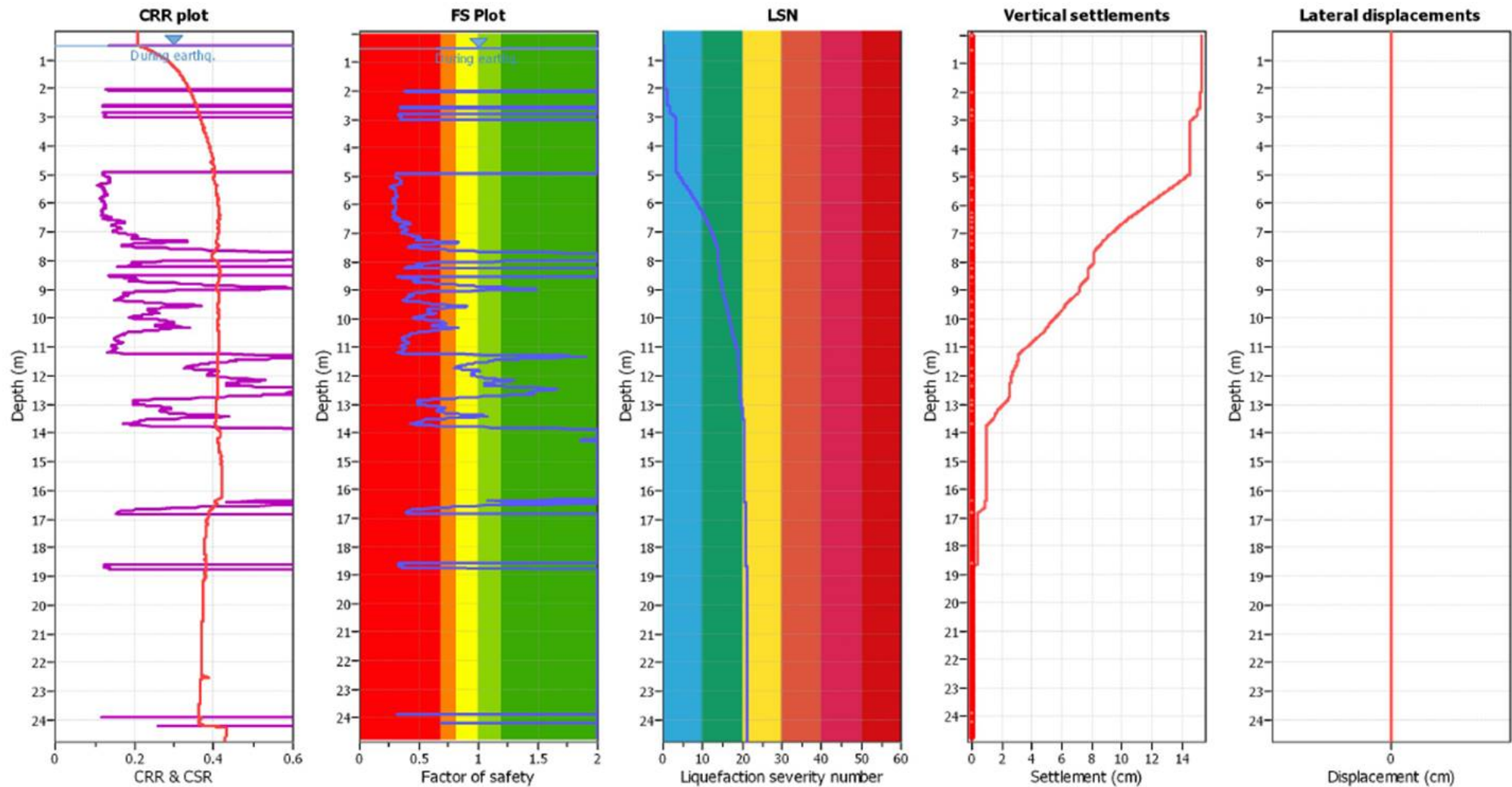
F.S. color scheme

Almost certain it will liquefy
 Very likely to liquefy
 Liquefaction and no liq. are equally likely
 Unlike to liquefy
 Almost certain it will not liquefy

LSN color scheme

Severe damage
 Major expression of liquefaction
 Moderate to severe exp. of liquefaction
 Moderate expression of liquefaction
 Minor expression of liquefaction
 Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 7.50
 Peak ground acceleration: 0.35
 Depth to water table (insitu): 2.00 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 3
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

F.S. color scheme

Red: Almost certain it will liquefy
 Orange: Very likely to liquefy
 Yellow: Liquefaction and no liq. are equally likely
 Green: Unlike to liquefy
 Dark Green: Almost certain it will not liquefy

LSN color scheme

Red: Severe damage
 Dark Red: Major expression of liquefaction
 Orange: Moderate to severe exp. of liquefaction
 Yellow: Moderate expression of liquefaction
 Green: Minor expression of liquefaction
 Blue: Little to no expression of liquefaction



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Appendix 3

Shallow Geotechnical Investigation Results

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: DCP02

Site Location: 83 Byron Street, Christchurch

Test Date: 31/10/2016

Coordinates: -43.542160, 172.644481 (WGS84)

Groundwater Level: Not encountered

Operator: Logan Allan

Logger: Jozef Knottenbelt

Hole Depth: 2m

Surface Conditions: Grass

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)														
				2	4	6	8	10	12	14	16	18						
		Groundwater Not Encountered				7												
				2														
				2														
						6												
					4													
			0.5		3													
				2														
					4													
						7												
						6												
			1.0			8												
							11											
									15									
										18								
											20							
			1.5															
										18								
											20							
												19						
													16					
																	20	

Remarks

Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: DCP03

Site Location: 83 Byron Street, Christchurch

Test Date: 31/10/2016

Coordinates: -43.542241, 172.644351 (WGS84)

Groundwater Level: Not encountered

Operator: Logan Allan

Logger: Jozef Knottenbelt

Hole Depth: 2m

Surface Conditions: Gravel

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)											
				2	4	6	8	10	12	14	16	18			
		Groundwater Not Encountered													
						6									
												17			
							8								
			0.5	2											
					5										
					4										
					4										
					4										
			1.0				7								
						6									
								10							
									11						
									11						
			1.5							12					
										12					
											13				
												11			
													8		

Remarks

Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: HA01/SP01

Site Location: 83 Byron Street, Christchurch
Test Date: 31/10/2016
Coordinates: -43.542137, 172.644341 (WGS84)
Groundwater Level: Not encountered

Operator: Logan Allan
Logger: Jozef Knottenbelt
Hole Depth: 2m
Surface Conditions: Grass

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)									
				2	4	6	8	10	12	14	16	18	
Sandy Gravelly SILT; with minor tiles and trace brick, dark brown/black, medium dense to very dense, damp, grey clasts(rounded)		Groundwater Not Encountered				6							
							8						
Sandy SILT; blue/grey with orange mottles, dense, damp, low plasticity													28 >>
								9					
SILT; black with orange mottles, loose, damp, moderate plasticity					3								
			0.5		3								
clayey SILT; green/blue, medium dense, damp, high plasticity						6							
						6							
clayey SILT; grey/blue with orange mottles, medium dense, damp, high plasticity						6							
						5							
clayey SILT; grey/blue with orange mottles, medium dense to dense, wet, high plasticity			1.0			6							
						6							
								10					
								9					
							7						
			1.5				7						
clayey SILT; grey/blue, medium dense, wet, high plasticity							7						
						6							
						6							
clayey SILT; grey/blue, medium dense, saturated, high plasticity,							7						

Remarks

Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

HAND AUGER & SCALA LOG

Job Number: 16412

Client: ENGCO
Project: 83 Byron Street

Test Label: HA02/DCP04

Site Location: 83 Byron Street, Christchurch
Test Date: 31/10/2016
Coordinates: -43.542315, 172.644489 (WGS84)
Groundwater Level: Not encountered

Operator: Jozef Knottenbelt
Logger: Logan Allan
Hole Depth: 2m
Surface Conditions: Gravel

Hand Auger Geological Interpretation	Legend	Water	Depth (m)	Scala Penetrometer (Blows / 100mm)									
				2	4	6	8	10	12	14	16	18	
Sandy GRAVEL; Grey clasts brown matrix, very dense, damp, rounded clasts, well graded		Groundwater Not Encountered											
SILT; dark brown/black, medium dense, moist, plastic													19
					4								
			0.5		4								
SILT; blue/grey, medium dense, moist, high plasticity					3								
					5								
					6								
					6								
SILT; light brown, dense, moist, high plasticity			1.0			7							
						7							
						7							
						7							
			1.5					10					
						8							
					6								
SILT; light brown, dense, wet, high plasticity					6								
					6								
					6								
					6								

Remarks

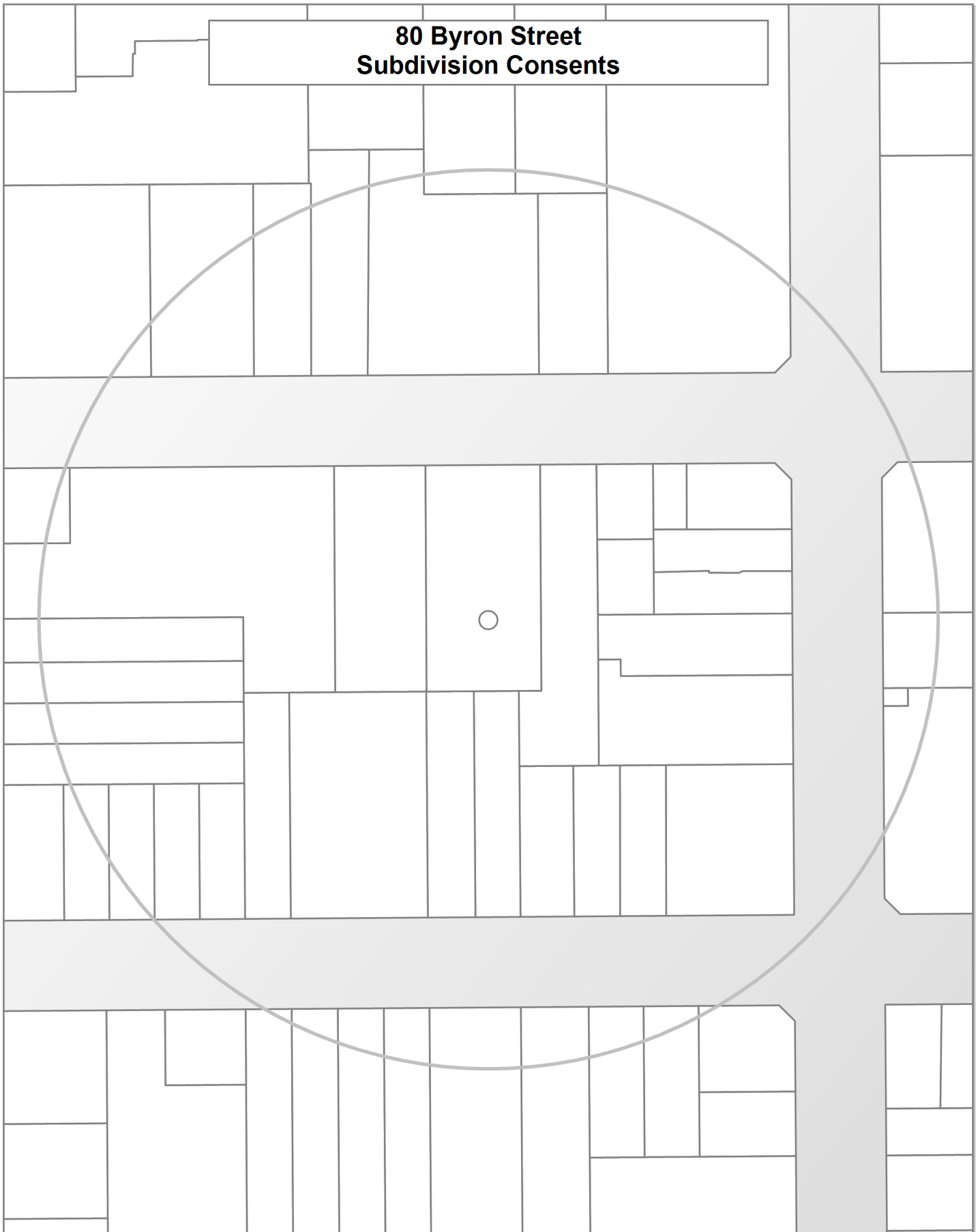
Testing carried out to New Zealand Standard 4402:1986 (Test 6.5.2.1988)

Scalar prehole to 0.3m





**80 Byron Street
Subdivision Consents**



Land Use Resource Consents within 100 metres of 80 Byron Street

Note: This list does not include subdivision Consents and Certificates of Compliance issued under the Resource Management Act.

1/72 Byron Street

RMA/1986/652

Dispensation for reverse manoeuvring for 5 carparking spaces (2 on Gasson St and 3 on Byron St) - Historical Reference RES9212013

Processing complete

Applied 23/07/1986

Decision issued 05/08/1986

Granted 05/08/1986

RMA/1987/359

Consent to waiver 2 carparks for Mezzanine floor addition - Historical Reference RES9207676

Processing complete

Applied 30/09/1987

Decision issued 15/10/1987

Granted 15/10/1987

RMA/1999/4617

To extend a mezzanine floor into the 3 metre set back. - Historical Reference RMA1362

Processing complete

Applied 08/11/1999

Decision issued 06/12/1999

Granted 06/12/1999

RMA/1999/577

Consent to a dispensation from maximum limit for vehicle crossings - Historical Reference RES9207678

Processing complete

Applied 01/01/1999

Decision issued 17/11/1982

Declined 17/11/1982

184 Carlyle Street

RMA/2007/2703

Construct 36 storage units - Historical Reference RMA92010045

Processing complete

Applied 03/10/2007

Decision issued 20/02/2008

Granted 20/02/2008

2/72 Byron Street

RMA/1996/1907

To waive the one additional carpark required due to the increase in GFA, resulting from the proposed internal alterations
- Historical Reference RES962232

Processing complete

Applied 27/08/1996

Decision issued 06/09/1996

Granted 06/09/1996

69 Brisbane Street

RMA/1992/230

Consent to erect an industrial building with dispensation from - 1.5m landscaping opposite corner splay - crossing 18m
not 20m from intersection and crossing 6m not 5m - Historical Reference RES9207067

Processing complete

Applied 16/03/1992

Decision issued 01/01/1999

Granted 01/01/1999

70 Kingsley Street

RMA/2001/2563

MVD Certificate - Historical Reference RMA20008479

Processing complete

Applied 18/10/2001

Decision issued 31/10/2001

Granted 31/10/2001

RMA/2021/629

Seismic strengthening of existing workshop with associated earthworks

Processing complete

Applied 16/03/2021

Decision issued 31/03/2021

Granted 31/03/2021

71 Byron Street

RMA/2020/706

Earthworks associated with site upgrade

Processing complete

Applied 03/04/2020

Decision issued 06/05/2020

Granted 06/05/2020

75 Kingsley Street

RMA/2019/1192

Signage for commercial activity

Processing complete

Applied 30/05/2019

Decision issued 20/06/2019

Granted 20/06/2019

76 Kingsley Street

RMA/1985/655

Dispensation from providing on site turning - narrow site - Historical Reference RES9212415

Processing complete

Applied 09/12/1985

Decision issued 31/12/1985

Granted 31/12/1985

78 Brisbane Street

RMA/1996/2575

To erect a general advertising hoarding. - Historical Reference RES962973

Processing complete

Applied 19/11/1996

Decision issued 02/12/1996

Granted 02/12/1996

RMA/1996/2916

No Desc - Historical Reference RES970105

Processing complete

Applied 18/12/1996

RMA/1997/301

Change of use for existing building which does not meet the required 3m set back from the road boundary, and carparking numbers. - Historical Reference RES970230

Processing complete

Applied 28/01/1997

Decision issued 14/02/1997

Granted 14/02/1997

RMA/2009/590

Land use non-compliances resulting from the subdivision of the site to two lots - Historical Reference RMA92014021

Processing complete

Applied 06/05/2009

Decision issued 03/06/2009

Granted 03/06/2009

79 Kingsley Street

RMA/2000/1686

Warehouse redevelopment; reduction of floor area to provide car parking, but still does not meet parking requirement - Historical Reference RMA20002410

Processing complete

Applied 05/07/2000

81 Byron Street

RMA/2011/1716

warehouse to replace earthquake damaged warehouse - Historical Reference RMA92019295

Processing complete

Applied 15/12/2011

Decision issued 02/02/2012

Granted 02/02/2012

83 Byron Street

RMA/1996/1723

To have retail display of floorcoverings in I3 and B3 zone, does not comply with zone Rules. - Historical Reference RES962011

Processing complete

Applied 05/08/1996

Decision issued 25/11/1996

Granted 25/11/1996

RMA/2018/110

To construct a new warehouse

Processing complete

Applied 18/01/2018

Decision issued 16/02/2018

Granted 16/02/2018

83 Kingsley Street

RMA/2002/1212

Construct an office/showroom to an existing warehouse. Fails to comply with landscaping/carparking - Historical Reference RMA20010209

Processing complete

Applied 24/05/2002

Decision issued 21/06/2002

Granted 21/06/2002

RMA/2003/420

Application for reduction in landscaping. - Historical Reference RMA20012679

Processing complete

Applied 12/02/2003

Decision issued 03/03/2003

Granted 03/03/2003

86 Gasson Street

RMA/2008/759

Upgrade of existing commercial building - Historical Reference RMA92011566

Cancelled

Applied 10/04/2008

94 Byron Street

RMA/2000/1810

To extend an existing industrial building. - Historical Reference RMA20002536

Processing complete

Applied 19/07/2000

Decision issued 07/08/2000

Granted 04/08/2000

94 Gasson Street

RMA/2016/720

Signage - Retrospective - Historical Reference RMA92032814

Processing complete

Applied 22/03/2016

Decision issued 17/05/2016

Granted 17/05/2016

96 Gasson Street

RMA/1993/345

Consent to erect a sky sign longer than the 2.4m permitted - 3.6m sought - Historical Reference RES9216788

Processing complete

Applied 15/09/1993

Decision issued 17/09/1993

Granted 17/09/1993

Data Quality Statement

Land Use Consents

All resource consents are shown for sites that have been labelled with an address. For sites that have been labelled with a cross (+) no resource consents have been found. Sites that have no label have not been checked for resource consents. This will be particularly noticeable on the margins of the search radius. If there are such sites and you would like them included in the check, please ask for the LIM spatial query to be rerun accordingly. This will be done free of charge although there may be a short delay. Resource consents which are on land occupied by roads, railways or rivers are not, and currently cannot be displayed, either on the map or in the list. Resource consents that relate to land that has since been subdivided, will be shown in the list, but not on the map. They will be under the address of the land as it was at the time the resource consent was applied for. Resource consents that are listed as Non-notified and are current, may in fact be notified resource consents that have not yet been through the notification process. If in doubt. Please phone (03)941 8999.

The term “resource consents” in this context means land use consents. Subdivision consents and certificates of compliance are excluded.

Subdivision Consents

All subdivision consents are shown for the sites that have been labelled with consent details. For Sites that have been labelled with a cross (+) no records have been found. Sites that have no label have not been checked for subdivision consents. This will be particularly noticeable on the margins of the search radius. If there are such sites and you would like them included in the check, please ask for the LIM spatial query to be rerun accordingly. This will be done free of charge although there may be a short delay.

The term “subdivision consents” in this context means a resource consent application to subdivide land. Non subdivision land use resource consents and certificates of compliance are excluded.

This report will only record those subdivision applications which have not been completed i.e once a subdivision has been given effect to and the new lots/properties have been established the application which created those lots will not be shown

All subdivision consent information is contained on the map and no separate list is supplied