Bromley Community Centre

BU 0897-001 EQ2

Detailed Engineering Evaluation

Quantitative Report

Christchurch City Council

Christchurch City Council

Bromley Community Centre

Detailed Engineering Evaluation Quantitative Report

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Date: October 2012
Reference: 6-QUCCC.89
Status: Final

Bromley Community Centre
BU 0897-001 EQ2

Detailed Engineering Evaluation
Quantitative Report - SUMMARY
Final

Background

This is a summary of the quantitative report for the Bromley Community Centre building, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspections on 29 February 2012, available drawings and calculations.

Damage Observed

Damage observed includes:-

- There appears to be some floor heaving in front of the kitchen area.
- There are cracks present in the timber rafter support in the hall.
- There is minor cracking in the access ramp and pathways, also some separation between the building and the path is evident.
- The chimney has been removed to a lower level and is no longer a falling hazard.

Critical Structural Weaknesses

No potential critical structural weaknesses have been identified.

Indicative Building Strength

Based on the information available, and from undertaking a quantitative assessment, the building's original capacity has been assessed to be greater than 33% NBS in both the longitudinal (east-west) and transverse directions (north-south). The building's post-earthquake capacity excluding critical structural weaknesses is in the order of 50% NBS in the longitudinal direction the building and 52 % NBS in the transverse direction of the building.

The building has been assessed to have a seismic capacity greater than 33% NBS but less than 67% NBS and is therefore considered a potential earthquake risk. No further strengthening action is required by law, however strengthening to at least 67% NBS (where it would be considered to pose no potential earthquake risk) is recommended and could be achieved by strategically reinforcing internal linings with specific structural bracing elements.

The building is founded on deep sands typical of the Bromley area, and the peak ground accelerations from the February earthquake were high near this site, especially in the vertical direction. However the building has sustained little structural damage, this could be due to the relatively lightweight nature of the structure.

Recommendations

We recommend that the minor repair work remedying the above observed damage be carried out. We also recommend that the building be strengthened to at least 67% NBS.

From our observations we conclude that the building has performed well in recent seismic event with only minor superficial damage, and our calculations also indicate that the building is not likely to be a seismic risk.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by Christchurch City Council (CCC) to undertake a detailed seismic assessment of the Bromley Community Centre building. The building is located at 45 Bromley Road, Bromley in Christchurch, on the CCC local recreation reserve. This report has been commissioned following the M6.3 Christchurch earthquake on 22 February 2011.

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

The seismic assessment and reporting have been undertaken based on the qualitative and quantitative procedures in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011.

2 Compliance

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

2.1 Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

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

We understand that CERA require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). CERA have adopted the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011. This document sets out a methodology for both initial qualitative and detailed quantitative assessments.

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

1. The importance level and occupancy of the building.

2. The placard status and amount of damage.

3. The age and structural type of the building.

4. Consideration of any critical structural weaknesses.

Any building with a capacity of less than 34% of new building standard (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67% as required by the CCC Earthquake Prone Building Policy.

2.2 Building Act

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

Section 112 - Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to the alteration.

This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) is satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'.

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

Section 121 – Dangerous Buildings

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

1. In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
2. In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
3. There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
4. There is a risk that other property could collapse or otherwise cause injury or death; or
5. A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone (EPB) if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property.

A moderate earthquake is defined by the building regulations as one that would generate loads 33% of those used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake on 4 September 2010.

The 2010 amendment includes the following:

1. A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
2. A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
3. A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
4. Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply 'as near as is reasonably practicable' with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

2.4 Building Code

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

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

- 36% increase in the basic seismic design load for Christchurch (Z factor increased from 0.22 to 0.3);
- Increased serviceability requirements.

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

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

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

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

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

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

3 Earthquake Resistance Standards

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

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

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

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

Table 1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Table 1: %NBS compared to relative risk of failure

Percentage of New Building Standard (%NBS)	Relative Risk (Approximate)
>100	<1 time
80-100	1-2 times
67-80	2-5 times
33-67	5-10 times
20-33	10-25 times
<20	>25 times

3.1 Minimum and Recommended Standards

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

3.1.1 Occupancy

– The Canterbury Earthquake Order[1] in Council 16 September 2010, modified the meaning of “dangerous building” to include buildings that were identified as being

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

EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the Territorial Authority, or CERA acting on their behalf, once they are made aware of our assessment. Based on information received from CERA to date, this notice is likely to prohibit occupancy of the building (or parts thereof), until its seismic capacity is improved to the point that it is no longer considered an EPB.

3.1.2 Cordoning

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

3.1.3 Strengthening

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

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

3.1.4 Our Ethical Obligation

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

4 Building Description

4.1 General

The Bromley Community Centre building is a single storey timber framed structure with timber weatherboard cladding and lightweight corrugated iron roof cladding (refer to Appendix A, Photographs 1, 2, and 3). The age of the original building is unknown, however from its construction type we estimate that it was built between 1920 and 1950. Following its original construction, the building has subsequently had two extensions carried out on it. In 1980 the toilet and kitchen areas were added to the southern side of the building. In 2003 Meeting Rooms 2 and 3 and the office area was added to the south west side of the building. The original portion of the building has shallow pile foundations under the floor and short foundation walls under the external walls. In the newer sections of the building the foundations consist of cast insitu concrete slab on grade floors with thickenings under the walls.

The building is situated on a flat section of land section in the Bromley Community Park and there are no other buildings immediately adjacent. There is an asphalt recreation court to the north of the building, and an asphalt car park to the east. The building is approximately 27.3m in the east-west direction and 17.1m in the north-south direction. The building consists of weatherboard external cladding. The internal wall lining in the original part of the building consists of lathe and plaster. The wall linings in the newer additions consist of gib lining, which we have assumed is equivalent to standard gib lining. The apex of the roof in the original section is approximately 7.1m above the ground and has an internal wall stud height of approximately 3.9m. The later additions have a maximum roof height of approximately 3.3m, with an internal stud height of 2.4m.

The original structure had an unreinforced masonry chimney on its northern side, however due to damage resulting from the recent shaking. The chimney has been removed to a height of approximately 2.0m above ground level.

4.2 Gravity Load Resisting System

The roof of the original structure is of robust timber framed construction, with timber sarking and lightweight corrugated cladding. Due to the robust roof structure, we assume that it has previously supported heavy roof cladding.

The roof of the later additions consists of a timber framed structure with lightweight corrugated cladding.

The walls of the original structure are timber framed with a stud height of approximately 3.9m in the main hall area. The stud size is stud size of 100mm x 50mm and stud spacing of 600mm (assumed).

The floor of the original section consists of varnished MDF particle board (or similar) on suspended timber framing. The spacing between the ground level and the top of the piles is approximately 250mm. The walls are supported on concrete strip footings and it is anticipated that the floor is supported internally on shallow piles.

The floor in the later additions consists of a cast insitu concrete slab on grade with reinforced concrete external perimeter thickenings.

4.3 Seismic Load Resisting System

Lateral support for the roof in the original section is provided through its diagonal rafter truss design in one direction and timber sarking in the other direction.

The roof lateral support in the later additions consists of diagonal timber truss members, and collar ties in one direction and the ridge beam and underpin purlins in the other direction.

The main lateral support for the original section of the building is provided through the internal lathe and plaster linings. The main form of lateral bracing in the later additions consists of internal gib linings. The external weatherboard cladding could also be providing some lateral bracing capacity, however this has not been considered in our calculations.

No subfloor bracing appears to have been installed, or pile bearer hold down connections.

5 Survey

The Bromley Community Centre building currently has a green placard (not issued as part of this inspection).

Copies of the following drawings were referred to as part of the assessment (Appendix 2):

- Eleven pages consisting of submitted applications for building consent for the proposed additions to the original structure
- An Architectural Drawing outlining the proposed addition to the southern side of the building in 1980.
- Four architectural drawings that outline the proposed addition to the south west side of the building in 2003.
- Aerial photographs from Google earth that show the current plan view of the building

No copies of the design calculations or structural drawings have been obtained for this building.

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

Opus has previously carried out a level 1 Rapid assessment on the building on 10 March 2011, where a restricted yellow placard was assigned, due to movement of the chimney. On 17 August 2011 Opus carried out a level 2 rapid assessment on the building, with a green G1 placard being assigned after work was carried out partially removing the chimney to a lower level.

We have carried out a site visit on 29 February 2012 to identify the structural systems of the building, note any critical structural weaknesses and any damage resulting from the February 2011 earthquake.

6 Damage Assessment

The building appears to have suffered only minor damage as a result of the recent earthquake events. The following damage has been noted:

6.1 Chimney

The chimney has been deconstructed to a lower height, and is no longer presenting a falling hazard.

6.2 Floor Heaving

We observed evidence of floor heaving in front of the kitchen area and in the toilet at the northwest corner of the building (Appendix 1: Photograph 4).

6.3 Cracking in Concrete, Separation and Distortion

There is some minor cracking of the concrete around the support column in the north west corner porch.

There are some non-structural cracks present in the footpaths and access ramp (Appendix 1: Photograph 5).

There is some separation present between the external footings on the northern side of the building and the adjacent asphalt seal/footpath.

There is some minor distortion present in the external door step away from the building and door frame.

There are cracks present in the timber rafter near its support in the hall area (Appendix 1: Photograph 6).

7 General Observations

Overall the building has performed well under the recent seismic conditions. The building has sustained little damage and continues to be fully operational.

Due to the non-intrusive nature of the original survey, many connection details could not be inspected

8 Detailed Seismic Assessment

8.1 Critical Structural Weaknesses

As outlined in the Critical Structural Weakness and Collapse Hazards draft briefing document, issued by the Structural Engineering Society (SESOC) on 7 May 2011, the term

'Critical Structural Weakness' (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of the building.

We have not identified any critical structural weaknesses in the building.

8.2 Seismic Coefficient Parameters

The seismic design parameters based on current design requirements from NZS1170.5:2004 and the NZBC clause B1 for this building are:

- Site soil class D, clause 3.1.3 NZS 1170.5:2004
- Site hazard factor, Z=0.3, B1/VM1 clause 2.2.14B
- Return period factor R_u = 1.0 from Table 3.5, NZS 1170.5:2004, for an Importance Level 2 structure with a 50 year design life.
- Ductility factor μ_{max} = 1.25 for the lathe and plaster lined timber-framed building.

8.3 Detailed Seismic Assessment Results

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

Assumptions made

- The bracing capacity for lathe and plaster lined walls is 4 kN/m for single side and both sides lined. The strength reduction factor Φ is 0.7. This gives a bracing capacity of 56 BUs/m, for one and both sides lined (reference: Assessment and Improvement of the Structural Performance of Buildings in Earthquakes, June 2006, Section 11).
- Standard Gib linings (GS1-N), one side only = 55 BUs/m (0.4m<L<1.2m), 60 BUs/m (L>1.2m). Both sides 65 BUs/m (0.4m<L<1.2m), 85 BUs/m (L>1.2m). From: GIB EzyBrace Systems Design, June 2011.
- The few architectural/structural drawings that were available did not show the connection details between the original and additional timber frame walls. We have however assumed that these connections are adequate to allow transfer of lateral loads of at least those associated with the assessed %NBS lateral loading for the structure. This assumption is based on site visits carried out and the performance of the building in recent seismic events.
- There were no architectural/structural drawings available and therefore we were not able to assess the connection details between the timber frame walls and the foundation walls and piles. We have however assumed that these connections are adequate to allow transfer of lateral loads of at least those associated with the

assessed %NBS lateral loading for the structure. This assumption is based on site visits carried out and the performance of the building in recent seismic events.

Table 2: Summary of Seismic Performance

Structural Element/System	Failure mode and description of limiting criteria	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Walls in the east west direction i.e. longitudinal direction	Bracing capacity of the wall linings in the longitudinal direction of the building	No	50
Walls in the north south direction i.e. transverse direction	Bracing capacity of the wall linings in the transverse direction of the building	No	52
Roof diaphragm	Capacity of the roof plane sarking.	No	>100%
Pile foundations	Subfloor bracing capacity of the concrete wall foundations	No	>100%

8.4 Discussion of Results

The building has a calculated seismic capacity of approximately 50% NBS in both the longitudinal (east-west) and transverse (north-south) directions. This is above the threshold limit for buildings classified as “Earthquake Prone” which is effectively one third (33%) of the seismic performance specified in the current loading standard for new buildings (New Building Standard, or NBS). The building falls under the category of being “Potentially an earthquake risk”, with a medium risk profile.

This %NBS for the building is above 33% NBS as required by the CCC Earthquake Prone Building Policy and Industry guidelines (NZSEE 2006 [2]). No further action is therefore required. However as the building is currently below 67% NBS it is still potentially an earthquake risk. The building should therefore be upgraded to above 67% (i.e. “No potential earthquake risk”) by strategically reinforcing linings with structural bracing elements.

8.5 Limitations and Assumptions in Results

Our analysis and assessment is based on an assessment of the building in its undamaged state. However we haven’t observed any significant structural damage to the building.

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

- Simplifications made in the analysis, including boundary conditions such as foundation fixity;
- Assessments of material strengths based on limited drawings, specifications and site inspections;

- The normal variation in material properties which change from batch to batch;
- Approximations made in the assessment of the capacity of each element, especially when considering the post-yield behaviour.

9 Geotechnical Assessment

(Refer to Appendix C: Geotechnical Desktop Study for the Bromley Community Centre Building, Opus, March 2012)

9.1 Regional Geology

The published geological map of the area, (Geology of the Christchurch Urban Area 1:25,000, Brown and Webber, 1992) indicates the site is underlain by surficial geological soil of sand of fixed and semi-fixed dunes and beaches of the Christchurch Formation. Peat Swamp deposits belonging to the Yaldhurst member of the Springston Formation outcrop almost immediately to the west of the building.

According to the Environment Canterbury Regional Council records, the groundwater table is shown to be approximately 1.0 m below the ground level.

9.2 Peak Ground Acceleration

Interpolation of United States Geological Survey (USGS) Shakemap: South Island of New Zealand (22 Feb, 2011) indicates that this location has likely experienced a Horizontal Peak Ground Acceleration (PGA) during the 22nd February 2011 Earthquake of approximately 0.66g, and a peak vertical acceleration of 1.63g. These recorded values come from the Pages Road Pumping Station site (PRPC), which is located 1.7km from the Bromley Community Centre building. The duration of strong shaking was approximately 10-15 seconds. Estimated PGA's have been cross checked with Geonets' Modified Mercalli intensity scale observations.

9.3 Expected Ground Conditions

Subsurface investigations have been completed by Tonkin and Taylor on behalf of the Earthquake Commission around Christchurch. Cone Penetration test result CPT-BRY-10, complete in the Cypress Garden Reserve, approximately 120m west of the site, indicated the presence of suspected dense sand to approximately 24m below the ground level. Cone penetration test locations CPT-BRY-11 and CPT-BRY-12 located 350 m, and 325 m to the west of the site indicated similar ground conditions in the surrounding area.

9.4 Site Observations

The building was inspected by Opus Structural Engineers on the 29th February 2012. The following observations were made from site notes and photographs.

- The building is located on flat land in Bromley approximately 1.6 km from the estuary and 4.2 km from the coast (South Brighton Beach).

- Apart from minor superficial damage the building has sustained little damage.

9.5 Conclusions and Discussion of Geotechnical assessment

The building does not appear to have suffered from differential settlement or lateral movement, therefore it could be assumed that the current foundations are adequate. The surrounding court and car park has sustained relatively little damage and there is little risk of lateral spreading. From the aerial photographs, it appears that liquefaction has not occurred in the immediate vicinity of the building. Based on site observations, no further geotechnical investigations are recommended.

10 Conclusions

The building is founded on deep sands, and we have assumed soil class D (deep or soft soil) for our calculations. The building has experienced a number of significant seismic events over the past 18 months, with high peak ground accelerations in both horizontal and vertical directions. However from inspections there appears to be very little structural damage to the building, indicating that it has performed well in these events. This could be due to the building being of single level light weight timber frame construction, with light weight roof cladding.

We have calculated the bracing capacity of the building to be approximately 50% in both directions, which is above 33% and no further action is required. However it is still below the 67% (the recommended minimum by NZSEE), and is therefore considered a potential earthquake risk. If the building was upgraded to achieve 67% NBS, this could be achieved by the strategic reinforcement of internal linings with structural bracing elements.

11 Recommendations

a) Repair work to remedying the observed damage be carried out

b) The building be strengthened to at least 67% NBS.

12 Limitations

(a) This report is based on an inspection of the structure with a focus on the damage sustained from the 22 February 2011 Canterbury Earthquake and aftershocks only. Some non-structural damage is mentioned but this is not intended to be a comprehensive list of non-structural items.

(b) 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 the time.

(c) This report is prepared for the CCC to assist with assessing remedial works required for council buildings and facilities. It is not intended for any other party or purpose.

Appendix A – Photographs

Photograph 1: North west facing corner

Photograph 2: South east facing corner

Photograph 3: View inside the hall

Photograph 4: Floor heaving outside the kitchen

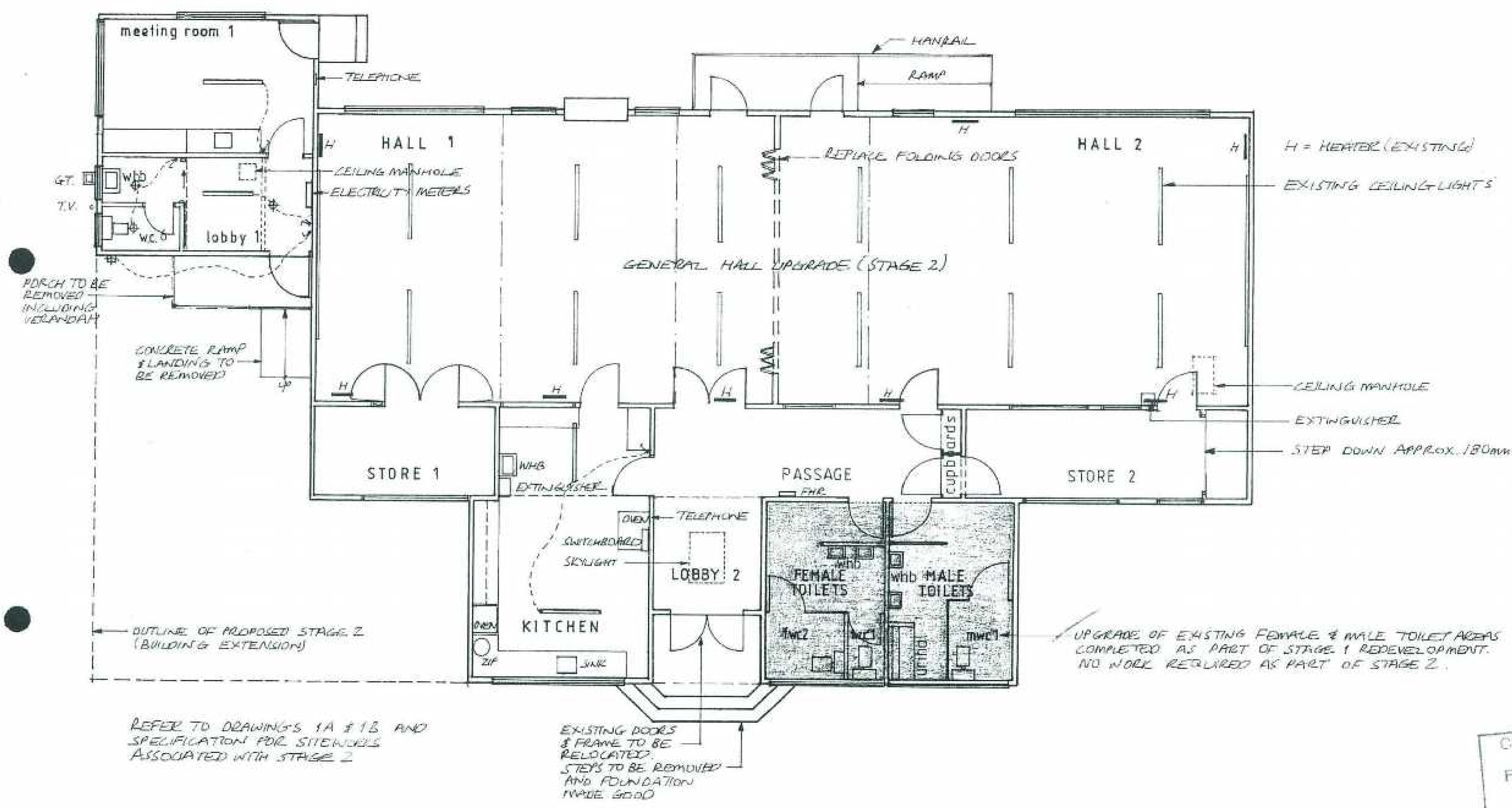
Photograph 5: Cracks in the concrete access ramp

Photograph 6: Cracks in the timber rafter support

Appendix B – Drawings and Plans

Chris Hadlee, Architect
3 Tillman Avenue, CHCH 8005
Phone/Fax (03) 352 7149

approx. North

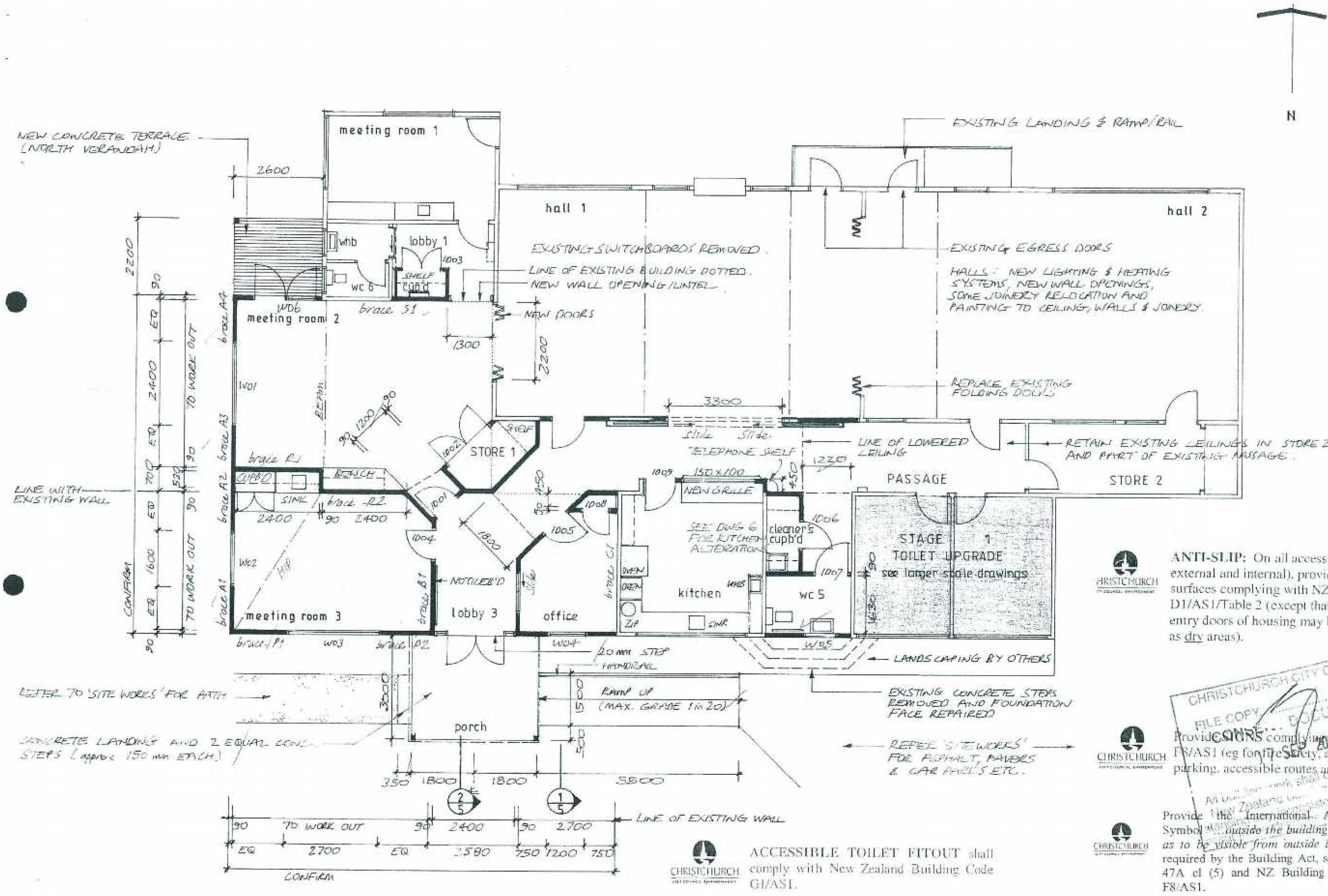


0 1 2 3 4 5 6 7 8 9 10m

PROPOSED ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE : EXISTING FLOOR PLAN

1:100 2304 (2)

Chris Hadlee, Architect
3 Tillman Avenue, CHCH 8005
Phone/Fax (03) 352 7149



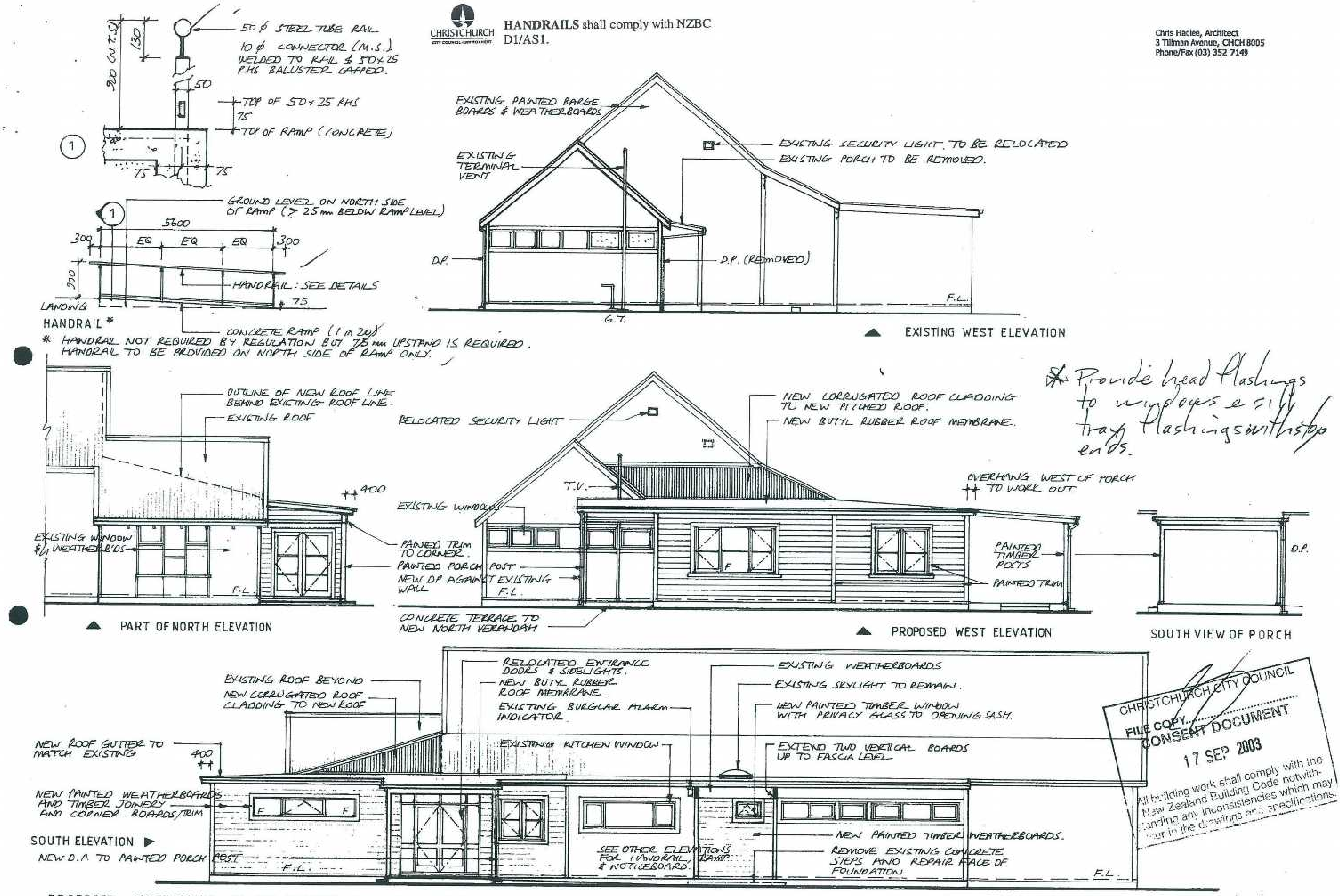
ANTI-SLIP: On all access routes (both external and internal), provide anti-slip surfaces complying with NZBC D1/AS1/Table 2 (except that surfaces inside entry doors of housing may be considered as dry areas).

Provide SIGNS complying with NZBC F8/AS1 (eg for fire safety, accessible parking, accessible routes and facilities).

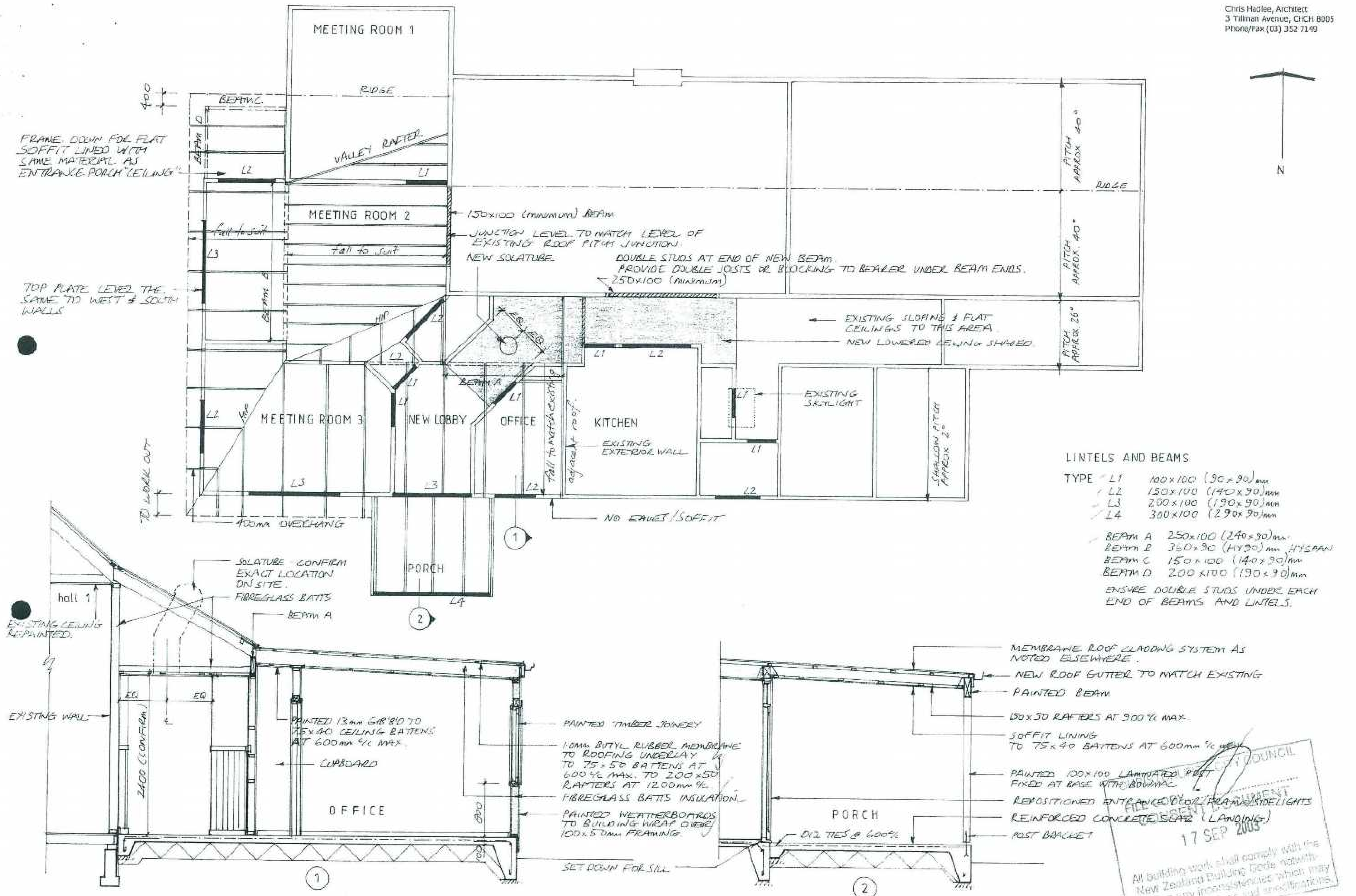
Provide the International Access Symbol "inside the building or so as to be visible from outside it", as required by the Building Act, section 47A cl (5) and NZ Building Code F8/AS1.

ACCESSIBLE TOILET FITOUT shall comply with New Zealand Building Code G1/AS1.

ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE | NEW FLOOR PLAN | 14·5·2003 | 1:100 | 2304 | (3)



PROPOSED ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE — ELEVATIONS — 7-5-2003 — 1:100 — 2304 (4)



ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE   FRAMING PLAN and CROSS SECTIONS   14-5-2003   1:100, 1:50   2304   5

GENERAL FEATURES SUMMARY

BUILDING PERMIT APPLICATION

DESCRIPTION OF WORK: Addition to existing building

Bromley Community Centre

PROPOSED USE:

SITE AND LEGAL DESCRIPTION

FLOOR AREA

OWNER OF SITE

BUILDER

EMPLOYER FOR WHOM WORK IS BEING CARRIED OUT

DESIGNER

Existing Built

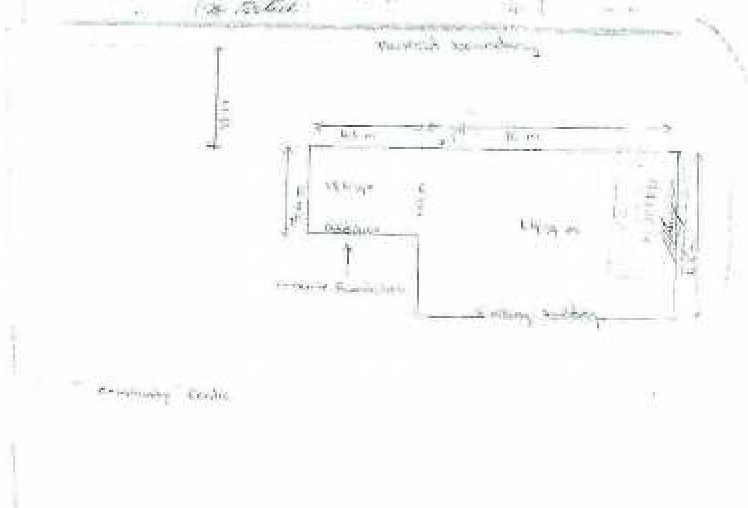
WATER CONTRACT

CITY OF CHRISTCHURCH

87-2404

CHRISTCHURCH DRAINAGE BOARD

Bromley Community Centre



Bromley Rd

CHRISTCHURCH CITY COUNCIL

261

17-12-85

Additions to Community Centre
16 Bowey Rd
Bowey Community Centre

Return to
B. SCANLEY

CHRISTCHURCH
DRAINAGE
BOARD
BOX 13096

Foul Water Drainage	✓	Bank Plan	
Stormwater Drainage	✓		
Sanitary Plumbing	✓		

No 7

V C.C.C. Rd
Bowey Community Centre
Bowey Rd.

Addition to Centre.

Plumbing and drainage to comply with regulations and C.D.B. By-laws.

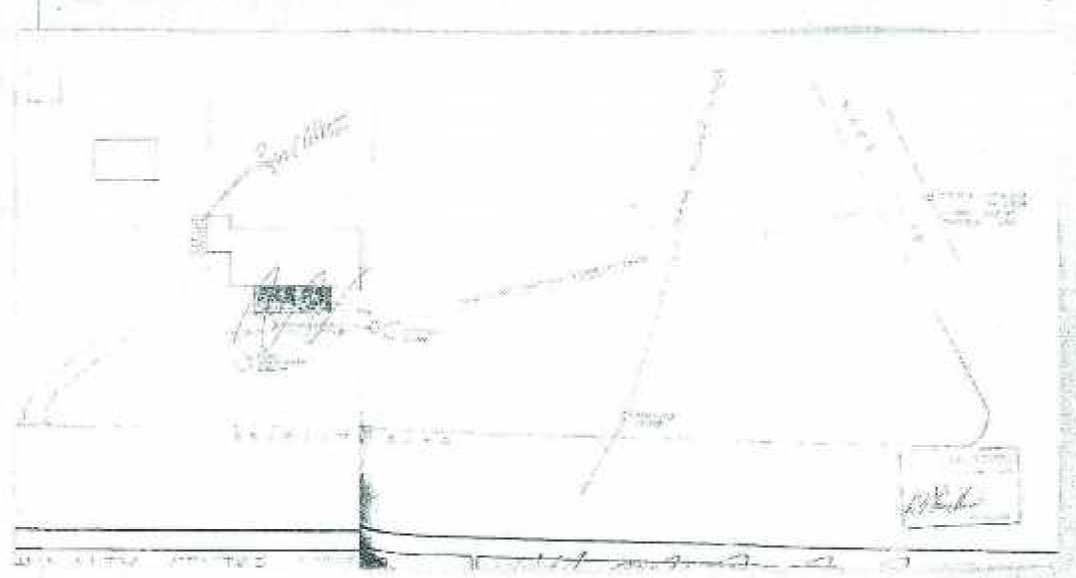
CITY OF CHRISTCHURCH

85-597
Sheet 1

BUILDING PERMIT

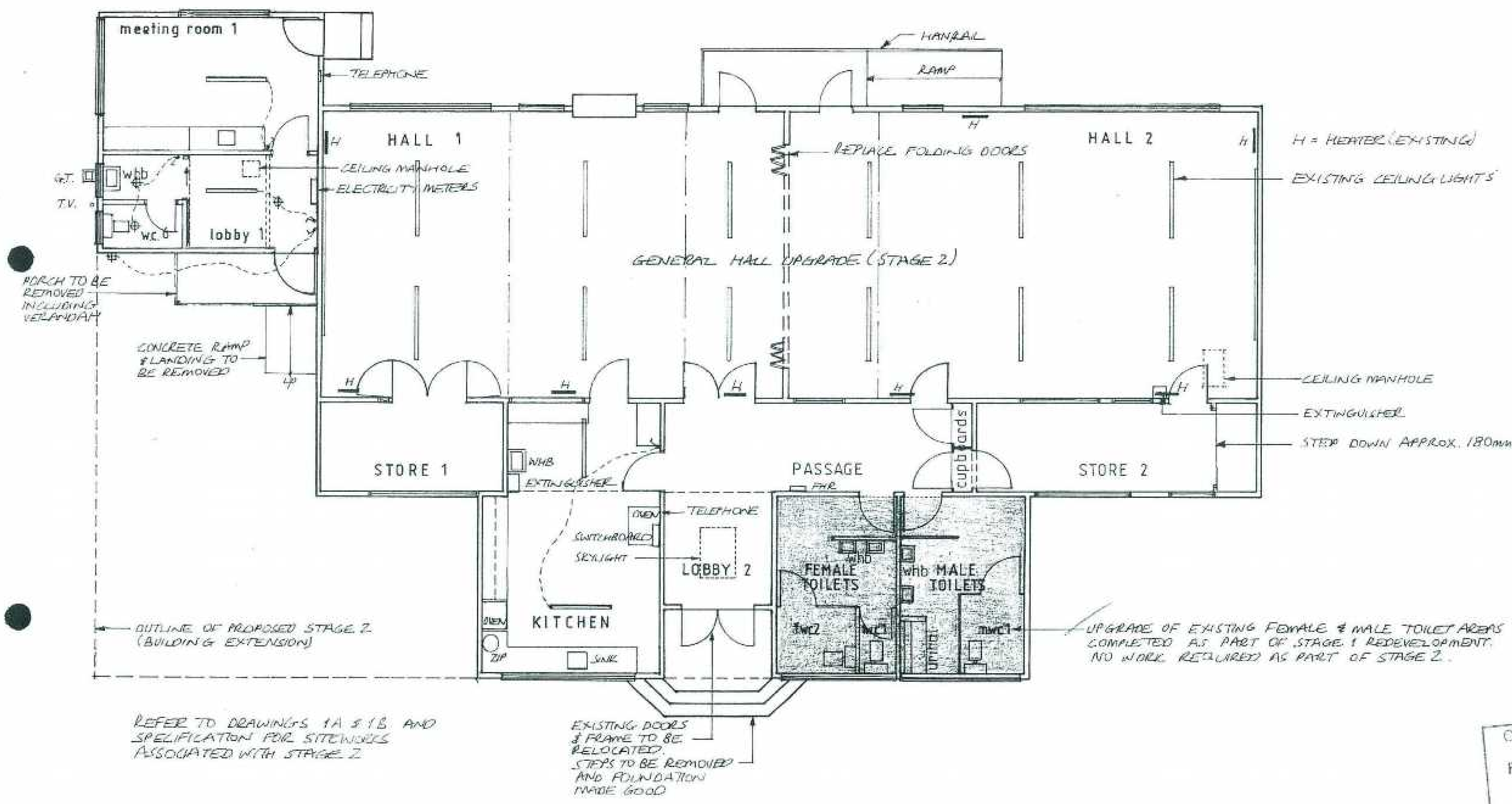
CHRISTCHURCH CITY COUNCIL

CITY WORKS & PLANNING DEPARTMENT



Chris Hadlee, Architect
3 Tillman Avenue, CHCH 8005
Phone/Fax (03) 352 7149

approx. North



0 1 2 3 4 5 6 7 8 9 10m

PROPOSED ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE : EXISTING FLOOR PLAN

1:100 2304 (2)

HANDRAILS shall comply with NZBC D1/AS1.

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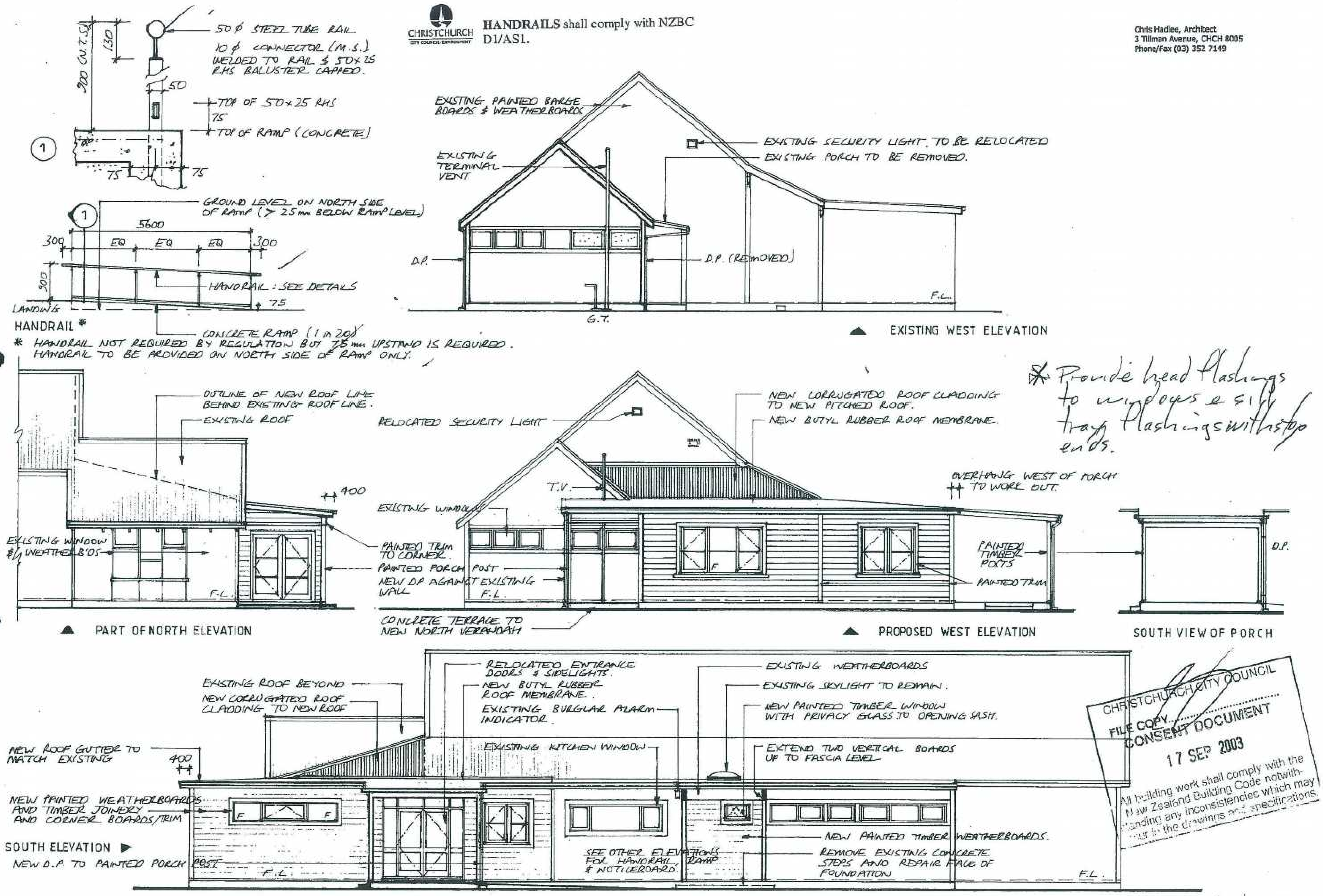
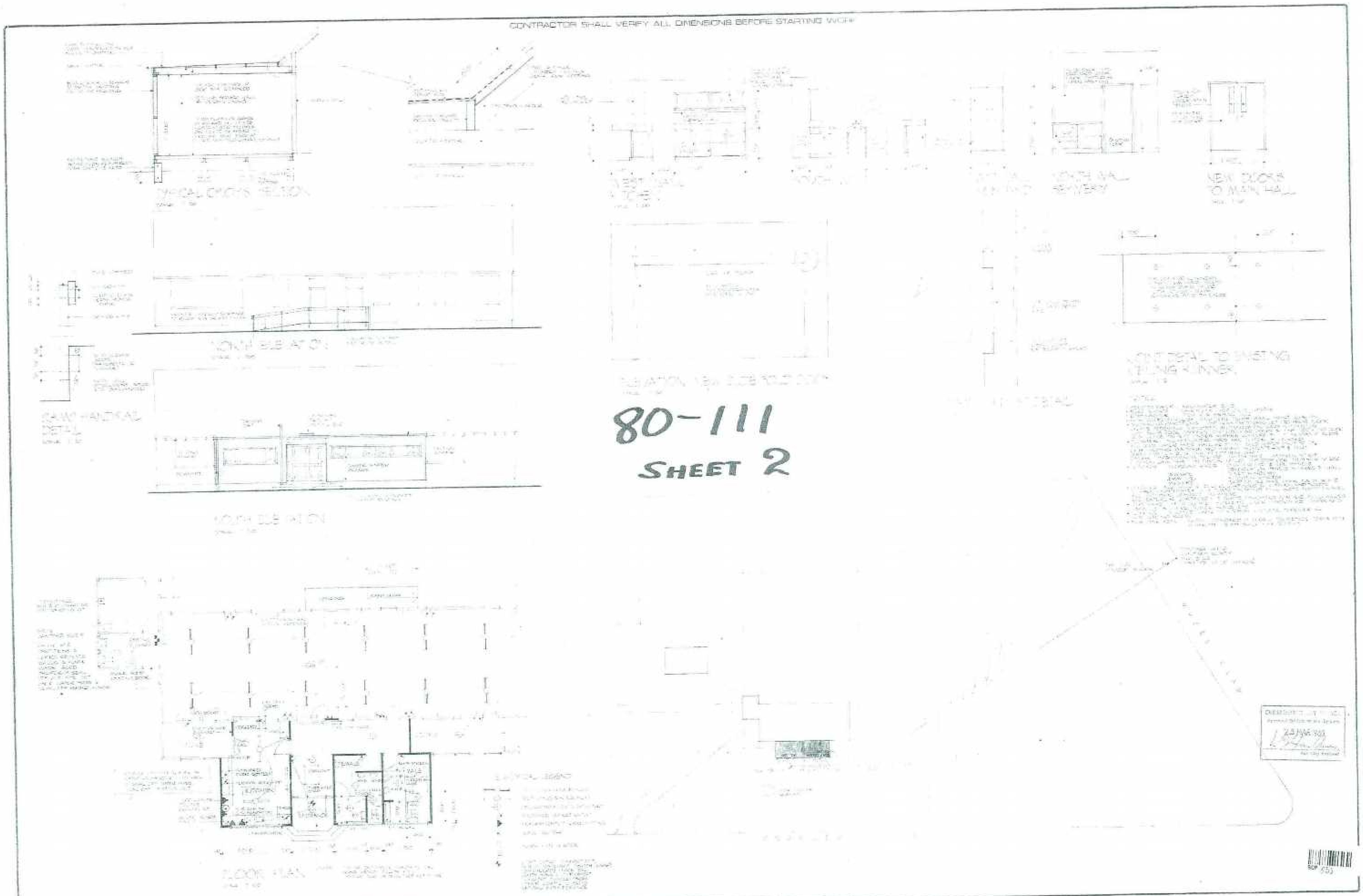


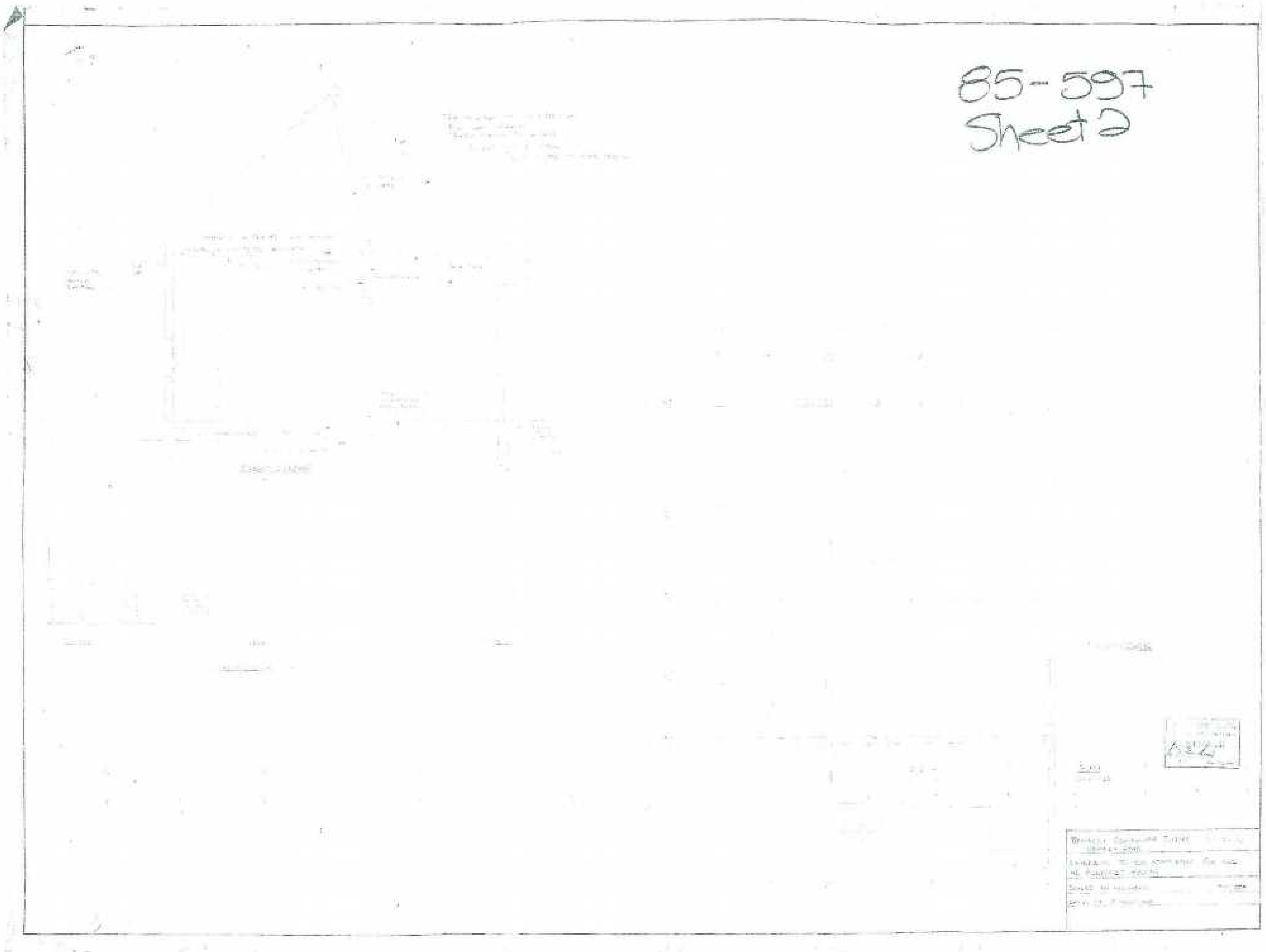
PROPOSED ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE | ELEVATIONS | 7-5-2003 | 1:100 | 2304 (4)



CHRISTCHURCH CITY COUNCIL
CITY ARCHITECTS DIVISION | CITY ENGINEERS DEPARTMENT

COMMUNITY CENTRE

SCALE | DESIGN | DRAWN | TRACED | APPRVD | DATE | JOB NO | SHEET NO | FILE NO | CONT NO


85-597
Sheet 2

Appendix C – Geotechnical Desktop Study

29 March 2012

Micheal Shefield
Property Asset Manager
Christchurch City Council
PO Box 237
CHRISTCHURCH 8140

6-QUCCC.89/025SC

Dear Lindsay

Geotechnical Desktop Study – Bromley Community Centre

1. Introduction

This report summarises the findings of a geotechnical desktop study and site walkover completed by Opus International Consultants (Opus) for the Christchurch City Council at the above property on 27 March 2012. The Geotechnical desk study follows the Canterbury Earthquake Sequence initiated by the 4 September 2010 earthquake.

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

It is our understanding this is the first inspection by a Geotechnical Engineer of this property following the Canterbury Earthquake Sequence. Rapid structural inspections have been undertaken by Opus on 23 March 2011 and 17 August 2011.

2. Desktop Study

2.1 Site Description

The Bromley Community Centre is located in the Cypress Garden Reserve, approximately 100m east of the Bromley Rd/Raymond Rd intersection. The site is relatively flat.

The building is a single storey structure with timber framed walls clad in various light materials. We understand that an extension was added to the southwest corner of the building sometime between 2003 and 2004.

2.2 Structural Drawings

We have received extracts from building consent drawings prepared by C W Hadlee Architects dated September 2003 (refer Appendix A) which detail the foundations to the existing building and subsequent additions.

The drawings indicate the foundations of the existing original structure comprise concrete strip footings approximately 200mm wide. It is anticipated that the timber floor is supported internally on short piles. The extension is supported on a reinforced concrete slab on grade, connected into a shallow reinforced concrete perimeter strip footing.

No geotechnical report or record of a ground conditions assessment associated with the construction of the original building or additions have been provided by the Christchurch City Council.

2.4 Regional Geology

The published geological map of the area, (Geology of the Christchurch Urban Area 1:25,000, Brown and Weeber, 1992) indicates the site is underlain by surficial geological soil of sand of fixed and semi-fixed dunes and beaches of the Christchurch Formation. Peat swamp deposits belonging to the Yaldhurst member of the Springston Formation outcrop almost immediately to the west of the building.

According to Environment Canterbury Regional Council records, groundwater is shown to be approximately 1.0m below ground level.

2.5 Expected Ground Conditions

Subsurface investigations have been completed by Tonkin and Taylor on behalf of the Earthquake Commission around Christchurch. Cone penetration test result CPT-BRY-10 (refer to the Site Location Plan and Appendix B), completed in the Cypress Garden Reserve, approximately 120m west of the site, indicated the presence of suspected dense sand to approximately 24m below ground level. CPT-BRY-11 located approximately 350m to the west of the site, and CPT-BRY-12 located approximately 325m to the southeast of the site indicate similar ground conditions in the surrounding area.

2.6 Liquefaction Hazard

Examination of post-earthquake aerial photos did not identify any evidence of significant quantities of liquefied soils ejected at the ground surface after the Magnitude 7.1 September 2010, Magnitude 6.3 February 2011 event or recent aftershocks. It appears soils ejected resultant from liquefaction occurred in the Cypress Garden Reserve, approximately 240m to the north west of the Bromley Community Centre, but no material was ejected at the property.

Tonkin and Taylor Ltd (T&T Ltd) have been engaged as the Earthquake Commission's (EQC) geotechnical consultants and have prepared maps showing areas of liquefaction interpreted from high resolution aerial photos for the 4th September earthquake, and the aftershocks of 22 February and 13 June 2011. An interpretation of these maps indicates the area suffered from liquefaction in both the 22 February 2011 and 13 June 2011 earthquakes.

The University of Canterbury drive-through reconnaissance 23 February – 1 March (Cubrinovski & Taylor, 2011) indicated that there was moderate to severe liquefaction at the Bromley Rd/Raymond Rd intersection.

The 2004 Environment Canterbury Solid Facts Liquefaction Study indicates the site is in an area designated as 'moderate liquefaction ground damage potential'. According to this study, based on a low groundwater table, ground damage is expected to be moderate and may be affected by 100-300mm of ground subsidence.

The Christchurch Earthquake Recovery Authority (CERA) last updated 11 December, 2011 has classified 31 Bromley Road and surrounding residential properties as Green Zone, indicating repair and rebuilding process can begin.

The maps that were released by the Department of Building and Housing (DBH) on 9 February 2012 indicate that the area immediately to the south of the site is classified as Technical Category 2 (yellow), which indicates that minor to moderate land damage from liquefaction is possible in future significant earthquakes.

3. Site Walkover Inspection

A walkover inspection of the interior of the building and surrounding land was carried out by John Garvey, Opus Geotechnical Engineer on 27 March 2012.

The following observations were made (refer to the Walkover Inspection Plan and Site Photographs attached to this report):

- Some heaving of flooring observed in front of the kitchen area (Photograph 6) and toilet in the northwest corner of building;
- 2mm wide crack present in footpath at south west corner of building (Photograph 7);
- Minor cracking around support column to porch area on north west corner of building (Photograph 8);
- Minor distortion to door frame, and separation of door step away from footings/building frame (Photographs 9 & 10);
- 2mm wide cracks observed in access ramp at rear (north face) of building (Photographs 12 & 13);
- Separation of footpaths/asphalt seal away from footings on north, east and south facing sides of building. Up to 50mm of separation observed along east face (Photograph 14);
- Minor crack observed at base of access ramp to front (south face) of the building (Photograph 16).

4. Discussion

Minor damage has occurred to the building at 31 Bromley Rd due to the Canterbury Earthquake Sequence following the 4 September 2010 earthquake.

No obvious evidence of surface rupture or lateral spreading due to the recent earthquakes was observed on the property or adjoining properties.

While liquefaction has occurred in the local area surrounding the site, it appears the existing shallow foundations have performed adequately in recent earthquakes.

The foundations of the existing original structure comprise concrete strip footings approximately 200mm wide, while the extension is supported on a reinforced concrete slab on grade, connected into a shallow reinforced concrete perimeter strip footing. There is evidence of heaving of the floor at two locations. The magnitude of heave has not been measured by level survey, but it is estimated that this heave is less than 50mm. The existing foundations have performed satisfactorily and do not appear to have sustained damage from cracking from differential settlement. The existing foundations are considered appropriate for the building with CCC acceptance of potential differential subsidence damage.

GNS Science indicates an elevated risk of seismic activity is expected in the Canterbury region as a result of the earthquake sequence following the 4 September 2010 earthquake. Recent advice[1] indicates there is an 18% probability of another Magnitude 6 or greater earthquake occurring in the next 12 months in the Canterbury region. This event may cause liquefaction induced land damage at the site similar to that experienced, however it is dependent on the location of the earthquakes epicentre. This confirms that there is currently a significant risk of liquefaction and differential settlements occurring. It is expected that the probability of occurrence is likely to decrease with time following periods of reduced seismic activity.

5. Recommendations

- Based on the building performance in recent earthquakes, the existing foundations should be acceptable in terms of future ultimate limit state (ULS) and serviceability limit state (SLS) loadings, although CCC will have to accept the risk for potential differential settlement in the order of 0 to 50mm in a future seismic event;

- Further geotechnical investigations are currently not considered necessary. However, if Christchurch City Council wish to further evaluate and quantify the liquefaction potential at this specific site, additional site testing comprising x2 CPT's and associated analysis would be required.

6. Limitation

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

Prepared By:	Reviewed By:
John Garvey	Graham Brown
Senior Engineering Geologist	Senior Geotechnical Engineer

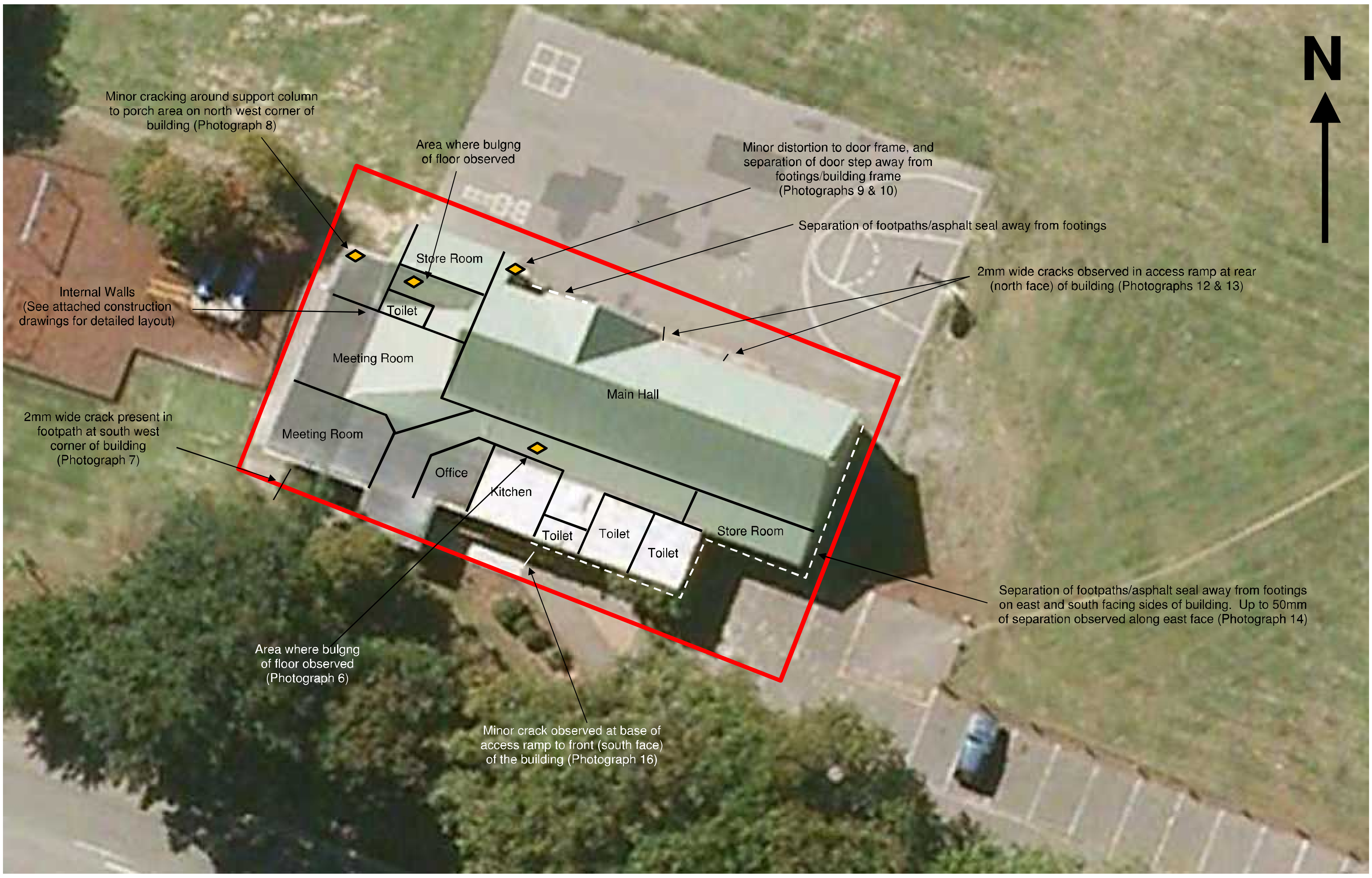
Figures:
Site Photographs
Site Location Plan
Walkover Inspection Plan

Appendices:
Appendix A: Building Consent Drawings
Appendix B: CPT Reports

[1] GNS Science reporting on Geonet Website: http://www.geonet.org.nz/canterbury-quakes/aftershocks/ updated on 3 February 2012.

SOURCE: canterburyrecovery.projectorbit.com (Accessed on 28/03/12)

Opus International Consultants Ltd Christchurch Office 20 Moorhouse Ave PO Box 1482 Christchurch, New Zealand Tel: +64 3 363 5400 Fax: +64 3 365 7857	**Project:** **Project No.:** **Client:**	Bromley Community Centre Geotechnical Desktop Study 6-QUCCC.89/025SC Christchurch City Council	**Site Location Plan** **Drawn:** John Garvey on 28/03/2012 Senior Engineering Geologist **Date:** 28/03/2012



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

Project:	Bromley Community Centre Geotechnical Desktop Study	**Walkover Inspection Plan**	
Project No.:	6-QUCCC.89/025SC	**Completed by:**	John Garvey on 27/03/2012 Senior Engineering Geologist
Client:	Christchurch City Council	**Date Drawn:**	28/03/2012

Photograph 1: View of south west corner of Community Centre

Photograph 2: View of north west corner of Community Centre

Photograph 3: View of north east corner of Community Centre

Photograph 4: View of south east corner of Community Centre

Photograph 5: view of main hall, looking west.

Photograph 6: View of bulging in floor to the front of the kitchen area.

Photograph 7: cracking in footpath, south west corner.

Photograph 8: cracking around support column to porch, northwest corner.

Photograph 9: Rear door way, northwest corner. Minor distortion to door frame.

Photograph 10: Separation between rear door step and building frame/facing.

Photograph 11: Possible separation of asphalt seal away from footings (north face).

Photograph 12: 2mm wide cracking in rear access ramp (north face).

Photograph 13: 2mm wide cracking in rear access ramp (north face).

Photograph 14: Up to 50mm separation of asphalt seal away from footings (east face).

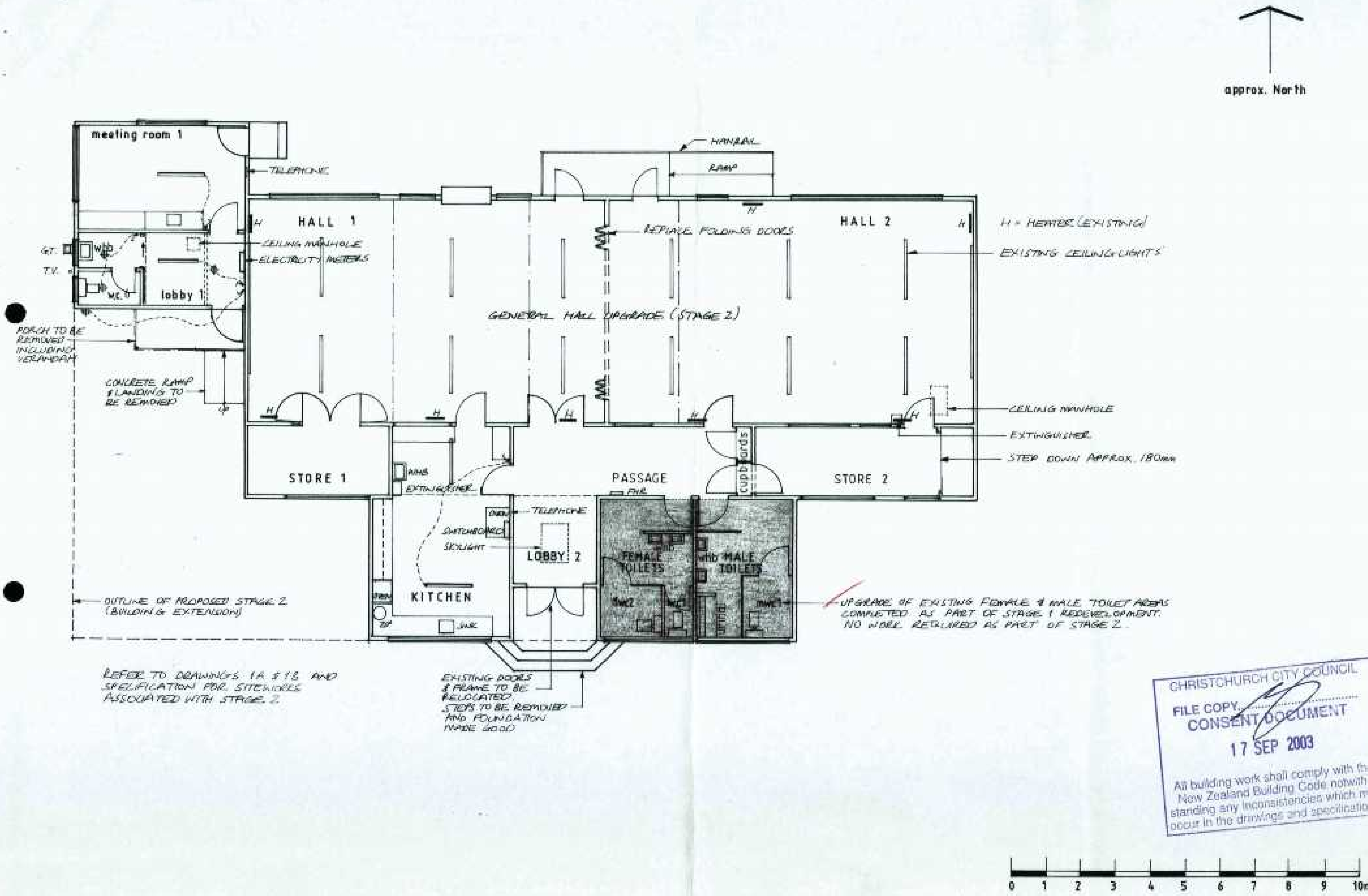
Photograph 15: Possible separation of asphalt seal away from footings (south face).

Photograph 16: Cracking in access ramp (south face).

Appendix A:

Building Consent Drawings

Chris Hadlee, Architect
3 Tillman Avenue, CHCH 8005
Phone/Fax (03) 352 7149



PROPOSED ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE : EXISTING FLOOR PLAN

1:100 2304 (2)

Chris Hadlee, Architect
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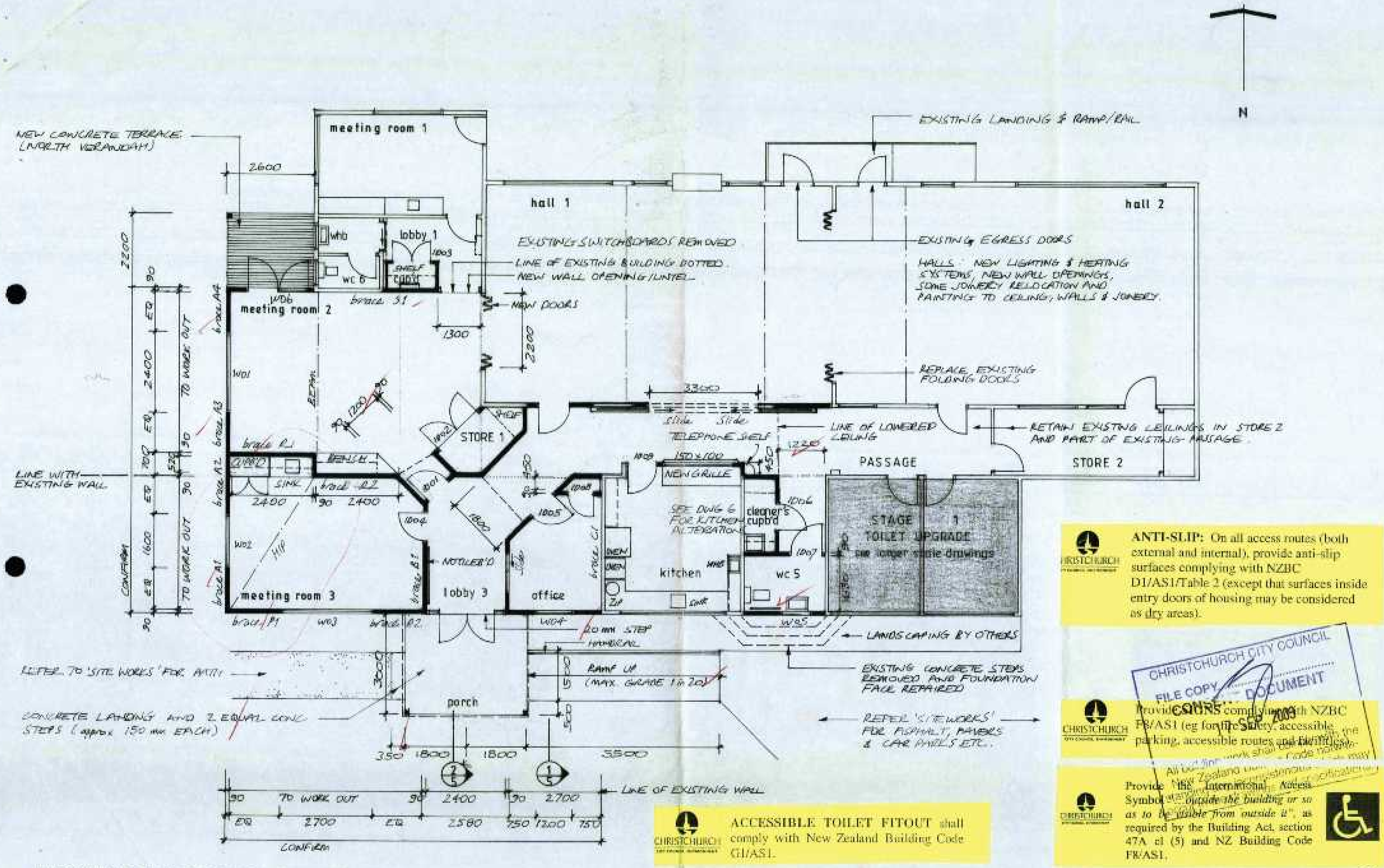
Phone/Fax (03) 352 7149



ANTI-SLIP: On all access routes (both external and internal), provide anti-slip surfaces complying with NZBC D1/AS1/Table 2 (except that surfaces inside entry doors of housing may be considered as dry areas).

Provide SIGNS complying with NZBC F8/AS1 (eg for fire safety, accessible parking, accessible routes and facilities).

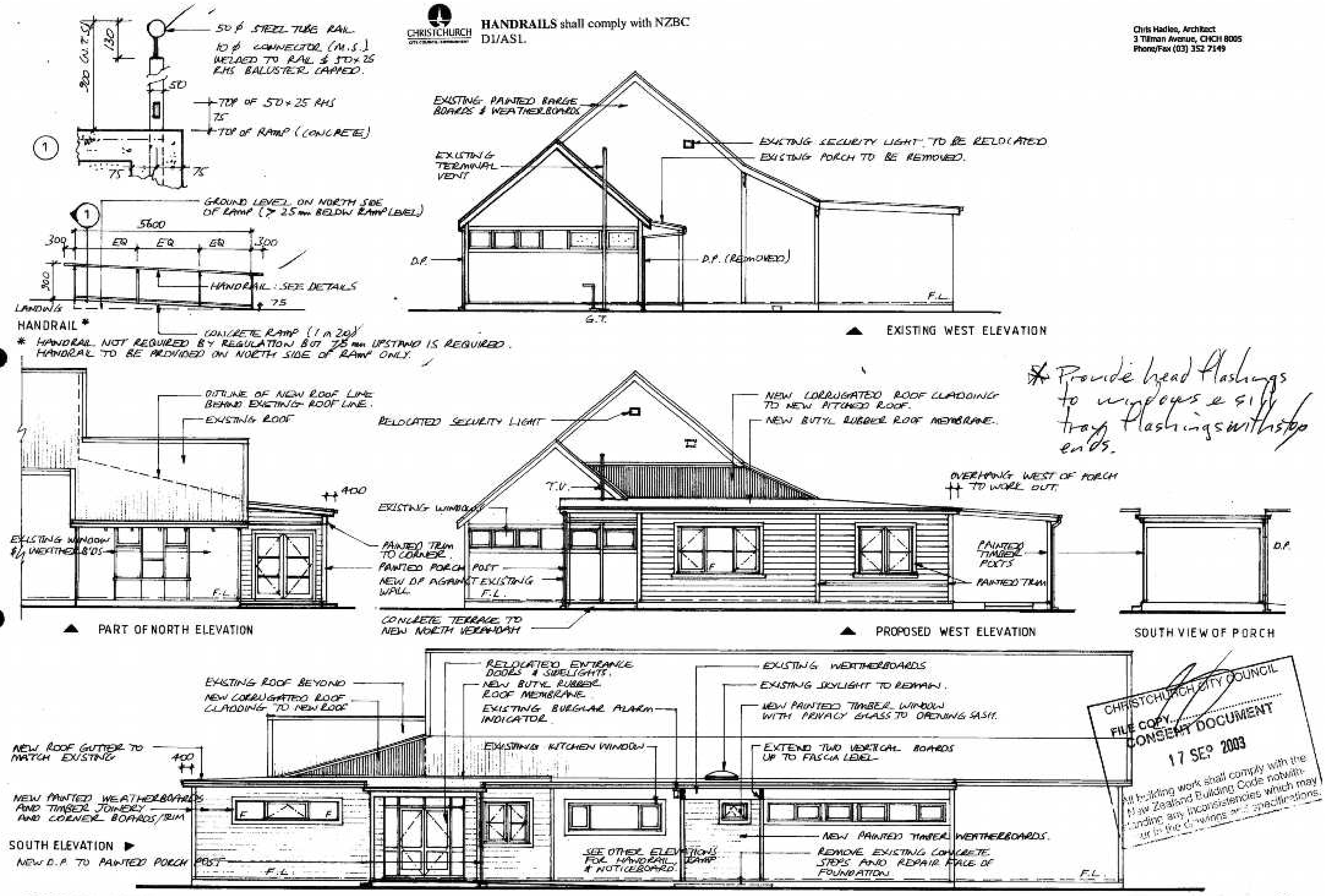
Provide the International Access Symbol "outside the building or so as to be visible from outside it", as required by the Building Act, section 47A cl (5) and NZ Building Code F8/AS1.

ACCESSIBLE TOILET FITOUT shall comply with New Zealand Building Code G1/AS1.

ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE — NEW FLOOR PLAN — 14·5·2003 — 1:100 — 2304 (3)

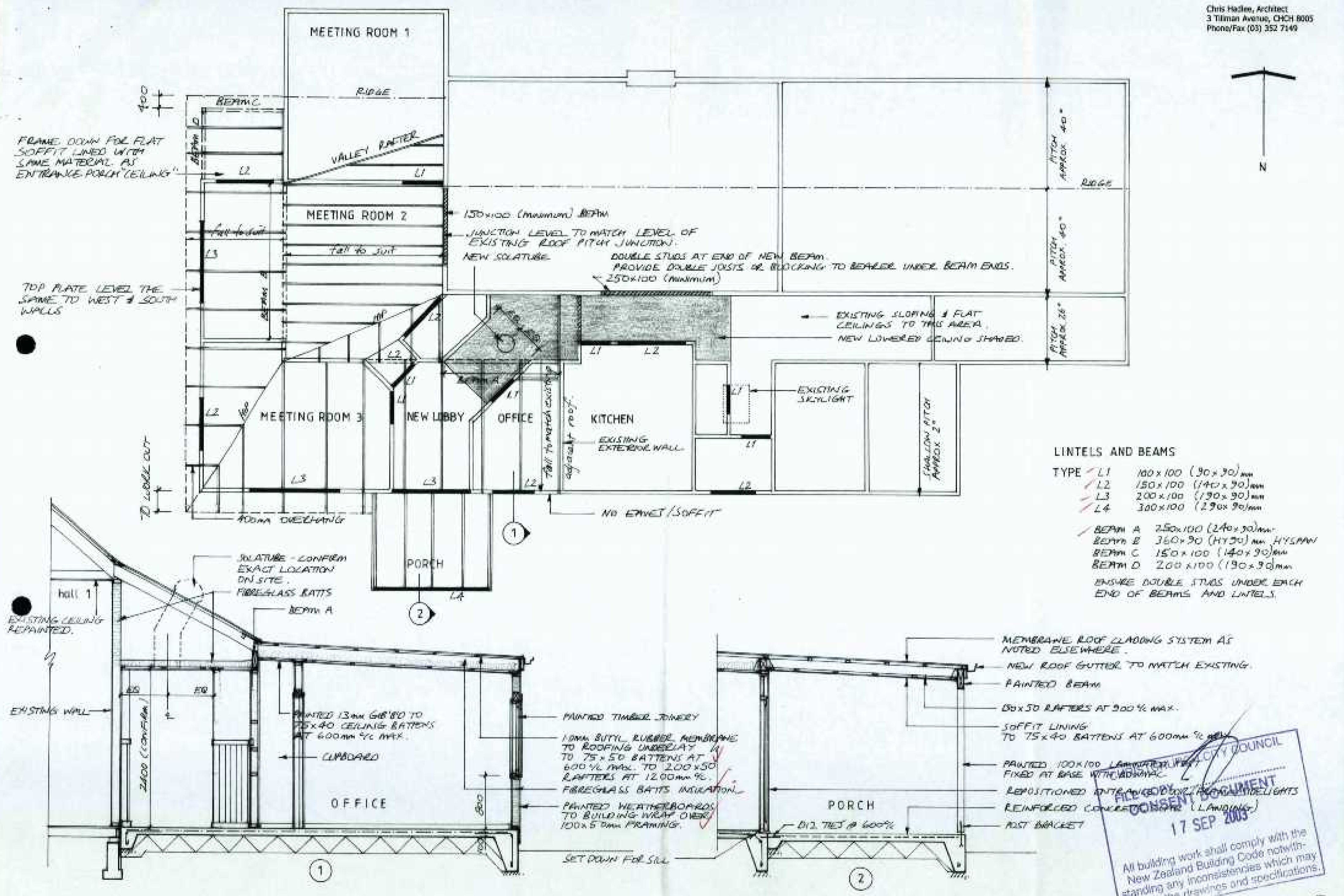
HANDRAILS shall comply with NZBC D1/AS1.

Chris Hadlee, Architect
3 Tillman Avenue, CHCH 8005
Phone/Fax (03) 352 7149



PROPOSED ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE | ELEVATIONS | 7-5-2003 | 1:100 | 2304 | 4

Chris Hadlee, Architect
3 Tillman Avenue, CHCH 8005
Phone/Fax (03) 352 7149

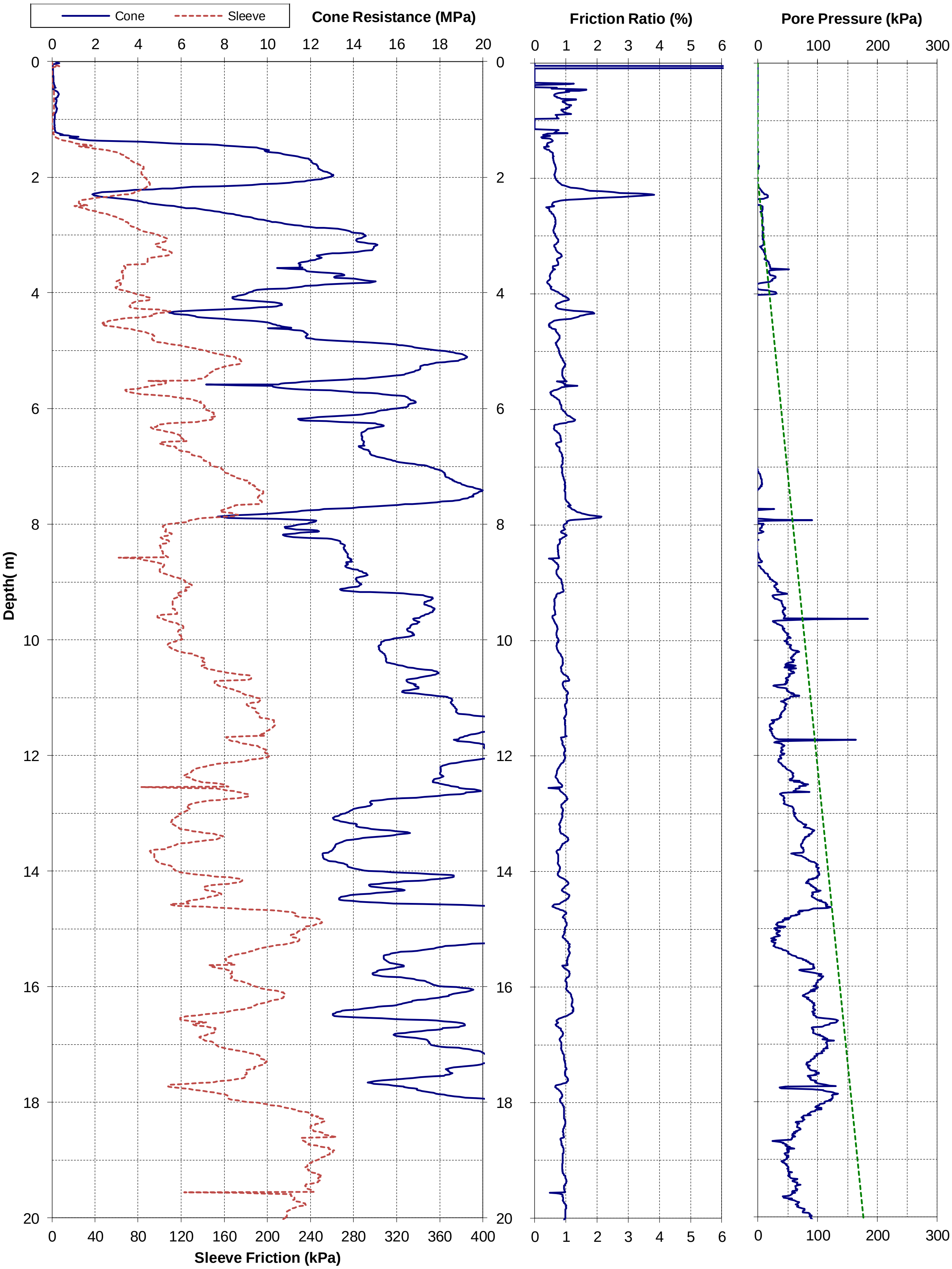


ALTERATIONS TO THE BROMLEY COMMUNITY CENTRE — FRAMING PLAN and CROSS SECTIONS — 14·5·2003 — 1:100, 1:50 — 2304 (5)

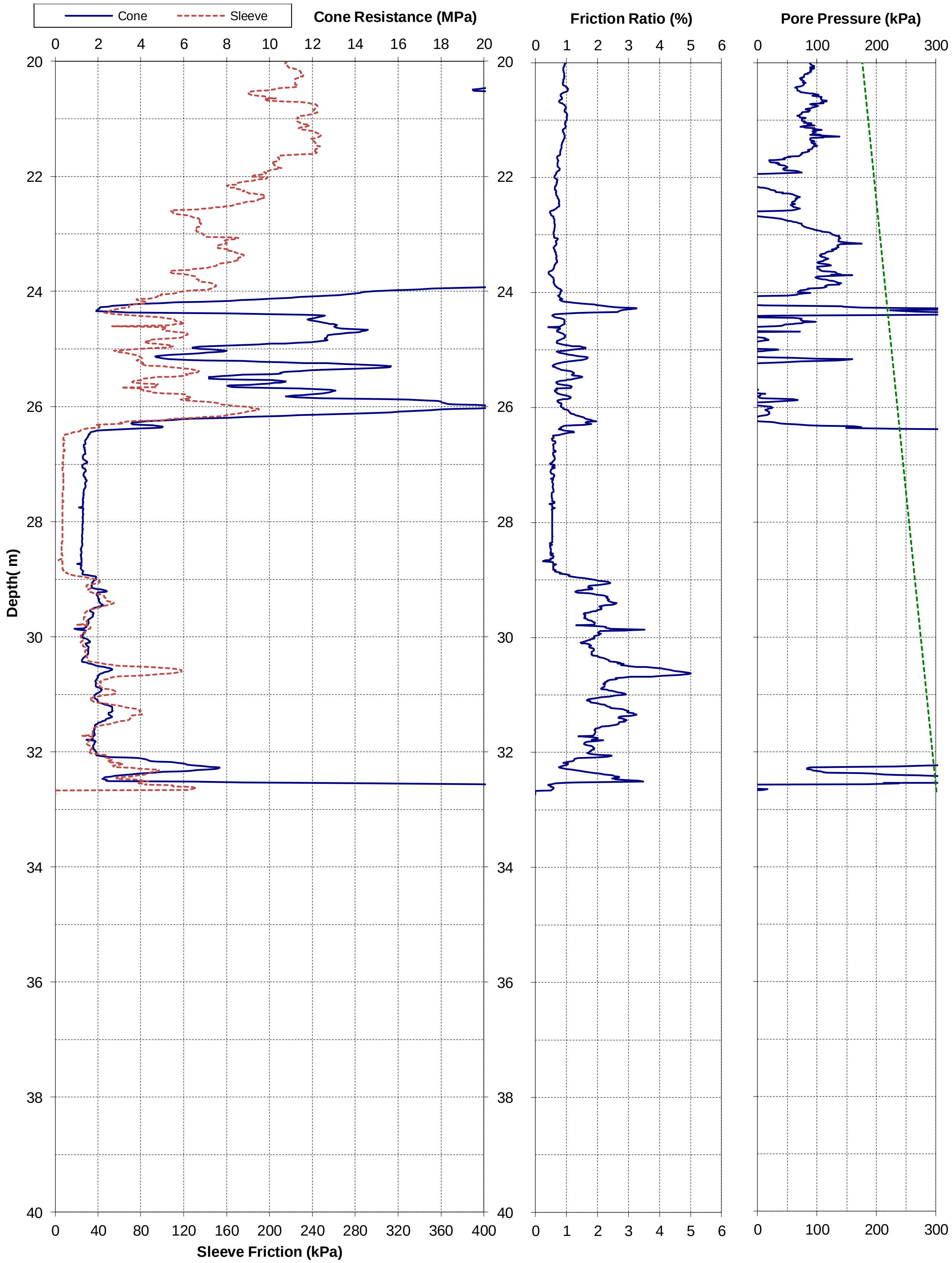
Appendix B:

CPT Reports

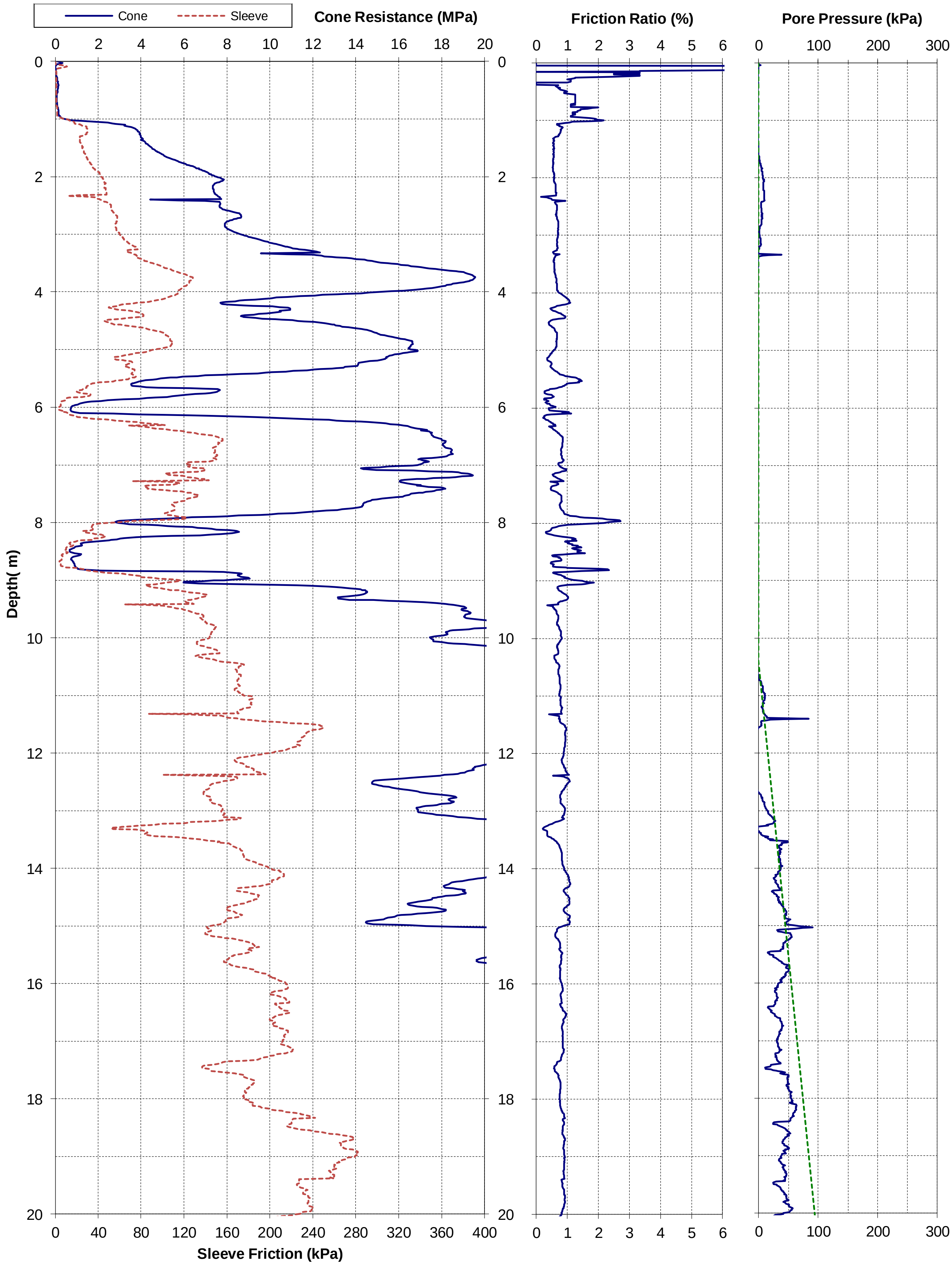
Project:	Christchurch 2011 Earthquake - EQC Ground Investigations				**Page:** 1 of 2	**CPT-BRY-10**
Test Date:	21-Jun-2011	**Location:**	Bromley	**Operator:**	Perry	
Pre-Drill:	1.2m	**Assumed GWL:**	2mBGL	**Located By:**	Survey GPS	
Position:	2484864.2mE	5740968.4mN	3.51mRL	**Coord. System:**	NZMG & MSL	
Other Tests:				**Comments:**		



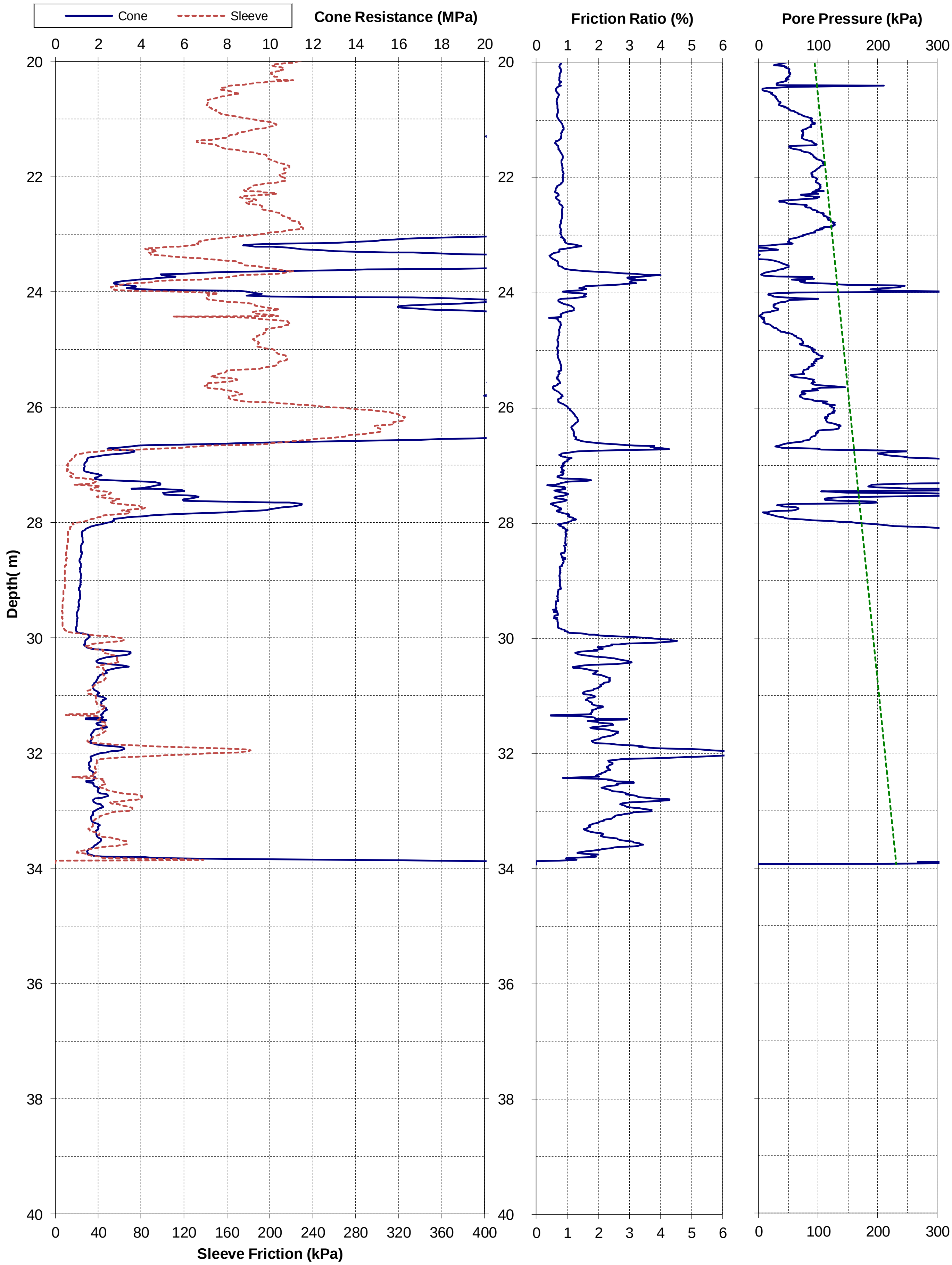
Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			Page:	2 of 2	CPT-BRY-10
Test Date:	21-Jun-2011	Location:	Bromley	Operator:	Perry	
Pre-Drill:	1.2m	Assumed GWL:	2mBGL	Located By:	Survey GPS	
Position:	2484864.2mE	5740968.4mN	3.51mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



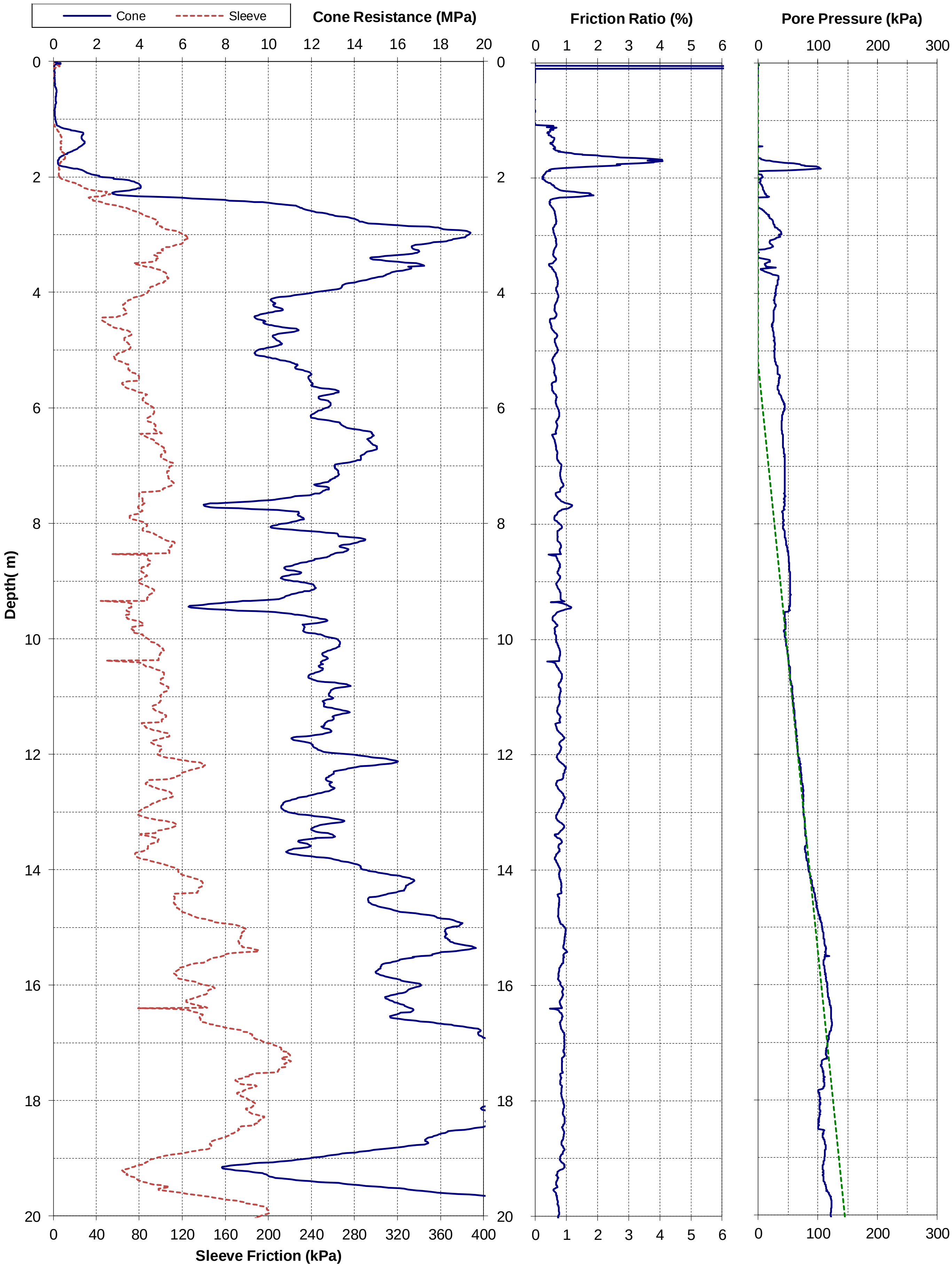
Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			**Page:** 1 of 2		**CPT-BRY-11**
Test Date:	16-Jun-2011	**Location:**	Bromley	**Operator:**	Perry	
Pre-Drill:	1.2m	**Assumed GWL:**	10.4mBGL	**Located By:**	Survey GPS	
Position:	2484763.1mE	5740899.8mN	4.88mRL	**Coord. System:**	NZMG & MSL	
Other Tests:				**Comments:**		



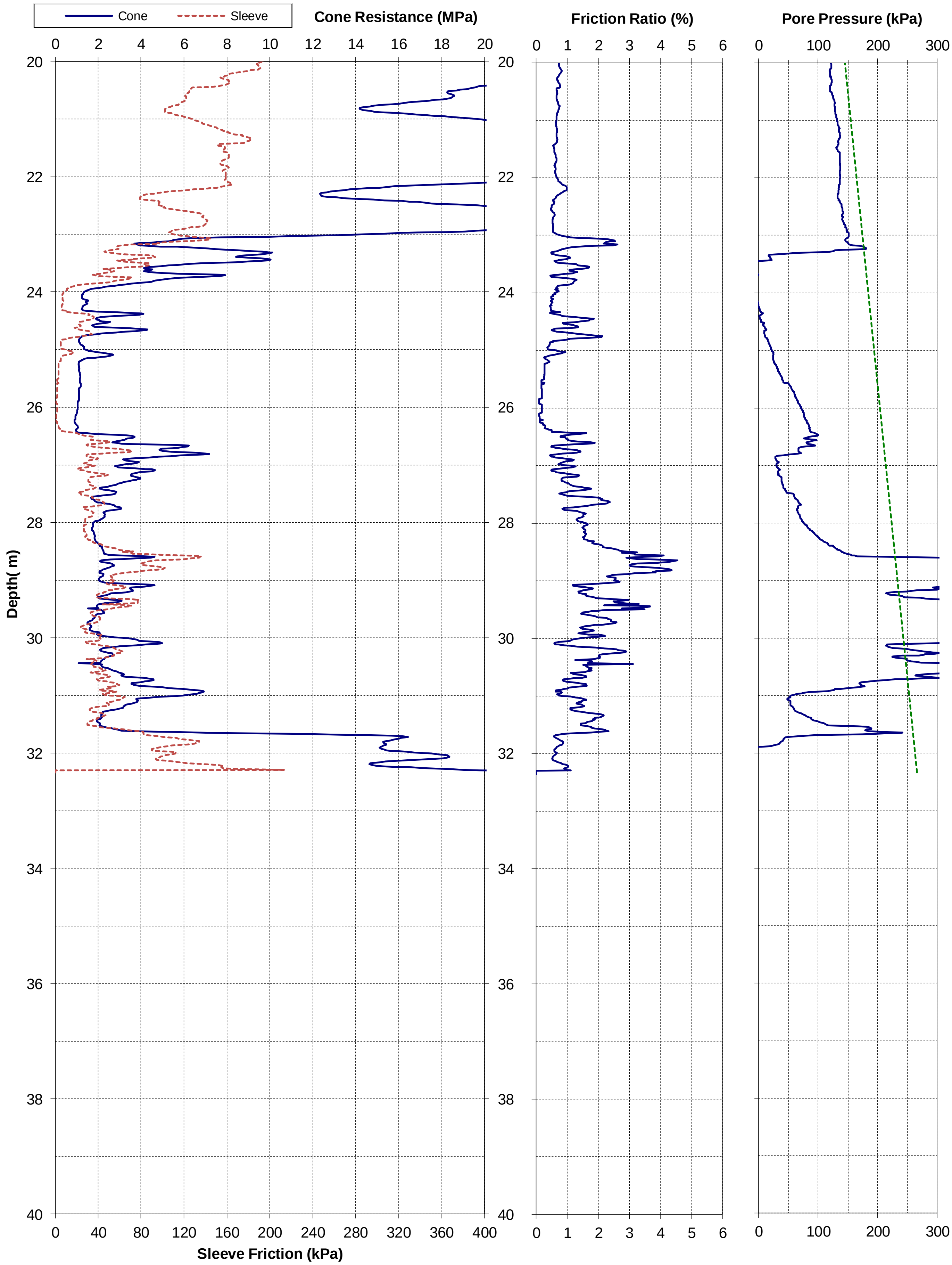
Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			Page:	2 of 2	CPT-BRY-11
Test Date:	16-Jun-2011	Location:	Bromley	Operator:	Perry	
Pre-Drill:	1.2m	Assumed GWL:	10.4mBGL	Located By:	Survey GPS	
Position:	2484763.1mE	5740899.8mN	4.88mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			Page:	1 of 2	CPT-BRY-12
Test Date:	16-Jun-2011	Location:	Bromley	Operator:	Perry	
Pre-Drill:	1.2m	Assumed GWL:	5.2mBGL	Located By:	Survey GPS	
Position:	2485272.2mE	5740670.2mN	3.54mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			Page: 2 of 2		CPT-BRY-12
Test Date:	16-Jun-2011	Location:	Bromley	Operator:	Perry	
Pre-Drill:	1.2m	Assumed GWL:	5.2mBGL	Located By:	Survey GPS	
Position:	2485272.2mE	5740670.2mN	3.54mRL	Coord. System:	NZMG & MSL	
Other Tests:				Comments:		



Appendix D – CERA DEE Data Sheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Bromley Community Centre
Unit / No: / Street
Building Address: Bromley , Christchurch / 45 Bromley Road
Legal Description: RS 41428, CCC Local Purpose Recreation Reserve 22480-38501, 22480-34700
Degrees / Min / Sec
GPS south:
GPS east:
Building Unique Identifier (CCC): BU 0897-001 EQ2

Reviewer: Dave Dekker
CPEng No:
Company: Opus International Consultants Ltd
Company project number: 6-QUCCC.89
Company phone number: ph +64 7 8389344
Date of submission: 4/10/2012
Inspection Date: 29/2/20012
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: silty sand
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available): sand of fixed and semi-fixed dunes and beaches of the Chris
If Ground improvement on site, describe: Minor seperation between path and building
Approx site elevation (m): 10.00

Building

No. of storeys above ground: 1 — single storey = 1
Ground floor split? no
Storeys below ground: 0
Foundation type: timber piles
Building height (m): 7.10
Floor footprint area (approx): 350
Age of Building (years): 60

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m): 0.25
if Foundation type is other, describe: Assuming timber piles (no access was possible)
height from ground to level of uppermost seismic mass (for IEP only) (m):
Date of design: 1935-1965

Strengthening present? no
If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Use (ground floor): public
Use (upper floors):
Use notes (if required): Council owned community centre
Importance level (to NZS1170.5): IL2

Gravity Structure

Gravity System: load bearing walls
Roof: timber framed — rafter type, purlin type and cladding: Timber framed building. Timber framed roof, walls and floor.
Floors: other (note) — describe sytem:
Beams: timber — type:
Columns:
Walls:

Lateral load resisting structure

Lateral system along: lightweight timber framed walls — **Note: Define along and across in detailed report!**
Ductility assumed, μ: 1.25
Period along: 0.40 — 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):
note typical wall length (m):
estimate or calculation?
estimate or calculation?
estimate or calculation?

Lateral system across: lightweight timber framed walls
Ductility assumed, μ: 1.25
Period across: 0.40 — 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):
note typical wall length (m):
estimate or calculation?
estimate or calculation?
estimate or calculation?

Separations:

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

Non-structural elements

Stairs:
Wall cladding: other light — describe: weatherboads external, lathe and plaster and gib internally
Roof Cladding: Other (specify) — describe: lightweight corrugated steel
Glazing: timber frames
Ceilings: plaster, fixed
Services(list): Standard building services

Available documentation

Architectural: partial — original designer name/date:
Structural: none — original designer name/date:
Mechanical: none — original designer name/date:
Electrical: none — original designer name/date:
Geotech report: none — original designer name/date:

Damage

Site: (refer DEE Table 4-2)
Site performance: Very good performance during the recent seismic event
Describe damage: Chimney damage, minor floor heaving, minor cracking

Settlement: none observed — notes (if applicable):
Differential settlement: none observed — notes (if applicable):
Liquefaction: none apparent — notes (if applicable): None apparent on site but some on nearby fields
Lateral Spread: none apparent — notes (if applicable):
Differential lateral spread: none apparent — notes (if applicable):
Ground cracks: none apparent — notes (if applicable):
Damage to area: none apparent — notes (if applicable):

Building:

Current Placard Status: green

Along — Damage ratio: 0% — Describe how damage ratio arrived at:
Describe (summary): No reduction in capacity

Across — Damage ratio: 0%
Describe (summary): No reduction in capacity

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

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

Recommendations

Level of repair/strengthening required: minor non-structural — Describe: No strengthening required by law, however we recommend s
Building Consent required: no — Describe:
Interim occupancy recommendations: full occupancy — Describe:

Along — Assessed %NBS before: 50% — ##### %NBS from IEP below
Assessed %NBS after: 50%

Across — Assessed %NBS before: 52% — ##### %NBS from IEP below
Assessed %NBS after: 52%

IEP

Period of design of building (from above): 1935-1965
h_n from above: m

Seismic Zone, if designed between 1965 and 1992:
not required for this age of building
not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		

Note:1 for buildings designed prior to 1976 as public buildings, to code at time, use 1.25: 1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2: 1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0): 1.0

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6: 1.00

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B**: #DIV/0!

2.4 Return Period Scaling Factor

Building Importance level (from above): 2
Return Period Scaling factor from Table 3.1, **Factor C**:

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.00	1.00
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	1.000	1.000
Structural Performance Scaling Factor **Factor E**:	1	1

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom} \times A \times B \times C \times D \times E$

	along	across
$\%NBS_b$:	**#DIV/0!**	**#DIV/0!**

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A: 1
3.2. Vertical irregularity, Factor B: 1
3.3. Short columns, Factor C: 1
3.4. Pounding potential
Pounding effect D1, from Table to right: 1.0
Height Difference effect D2, from Table to right: 1.0
Therefore, Factor D: 1
3.5. Site Characteristics 1

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

3.6. Other factors, Factor F

	Along	Across
For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum		
Rationale for choice of F factor, if not 1		

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: — Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

	along	across
3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

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