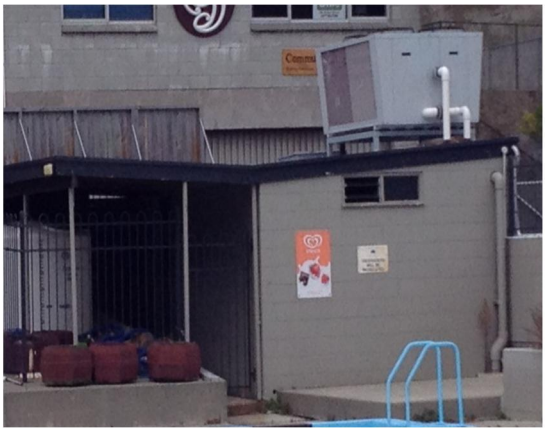
Norman Kirk Memorial Pool – Main Plant Room Detailed Engineering Evaluation
BU 3513-001 EQ2
Qualitative Report

Prepared for Christchurch City Council (CCC)

By Beca Carter Hollings & Ferner Ltd (Beca)

12 July 2013



Revision History

Revision Nº	Prepared By	Description	Date
A	Andrew Franklin	Draft for CCC review	11 October 2012
B	Andrew Franklin	Final	12 July 2013

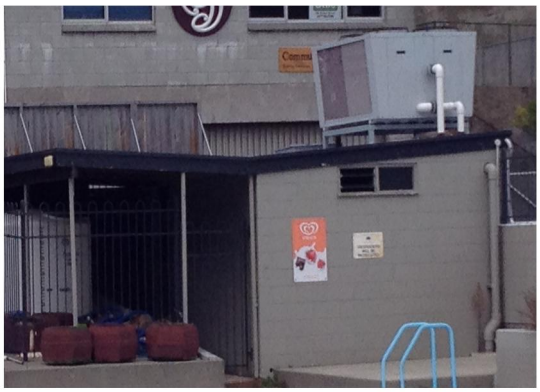
Document Acceptance

Action	Name	Signed	Date
Prepared by	Andrew Franklin		12 July 2013
Reviewed by	Nicholas Charman		12 July 2013
Approved by	David Whittaker		12 July 2013
on behalf of	Beca Carter Hollings & Ferner Ltd		

Norman Kirk Memorial Pool
Main Plant Room
BU 3513-001 EQ2

Detailed Engineering Evaluation
Qualitative Report – SUMMARY
Version 1

Address
54 Oxford St
Lyttelton



Background

This is a summary of the Qualitative report for the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

The Main Plant Room is located at the Norman Kirk Memorial Pool at 54 Oxford St, Lyttelton. It was built in 1973 and has an approximate floor area of 32m^2, including the external awning. The main structural system consists of concrete masonry block walls, with the roof consisting of timber rafters and lightweight metal sheeting. No architectural or structural drawings were available and no calculations were carried out.

The Norman Kirk Memorial Pool site has a number of concrete masonry block walls/fences and retaining walls of varying construction type.

Key Damage Observed

Visual inspections on 7 August 2012 indicate the Main Plant Room structure has suffered minor earthquake damage. The key damage observed includes:

- Minor cracking to concrete masonry block work mortar.

Our inspections also noted the following earthquake damage:

- Extensive cracking to mortar and block work of adjacent concrete masonry block wall that extends along the driveway at the south of the site (between the Main Plant Room and Lean-to Shelter).

Critical Structural Weaknesses (CSW)

No Critical Structural Weaknesses have been identified for the Main Plant Room structure during our inspection.

Indicative Building Strength (from Initial Evaluation Procedure and CSW assessment)

The building has been assessed to have a seismic capacity of 39%NBS using the NZSEE Initial Evaluation Procedure (IEP) and is therefore classified as Earthquake Risk and Seismic Grade C.

Recommendations

In order that the owner can make an informed decision about the ongoing use and occupancy of their building the following information is presented in line with the Department of Building and Housing document '*Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch*', June 2012.

The building is considered to be potentially earthquake risk, having an assessed capacity of between 34% and 67%*NBS*. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads and therefore no restrictions on use or occupancy are recommended. However, access to the Main Plant Room, if required, should be restricted to routes that do not require entering cordoned areas of the site.

It is recommended that:

- A quantitative %NBS analysis of the building should be completed.
- A verticality and level survey could be carried out to determine the extent of settlement of the building, and differential settlement across the site, for insurance purposes.
- An investigation is undertaken to determine the structural integrity of the retaining wall along the driveway at the south of the site.
- A geotechnical investigation is undertaken into the stability of the surrounding landscape and large retaining wall to the east of the site.
- An inspection of the services system located on the roof of the Main Plant Room. The connections between the services and the roof should be checked by a certified services inspector.
- Barricades be installed to cordon off access to damaged structures on the western portion of the Norman Kirk Memorial Pool site including walls/fences and buildings. No occupancy restrictions exist for the Main Plant Room or the Nursery Building and we understand the Nursery is currently occupied. Access to these two building should be restricted to routes that do not require entering cordoned areas of the site.
- Repairs that would bring the building back to an "as new" condition are typically entitled under typical replacement insurance policies. We suggest you consult with your insurance advisor as to how you wish to proceed.

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Appendices

1 Background

Beca Carter Hollings & Ferner Ltd (Beca) has been engaged by Christchurch City Council (CCC) to undertake a qualitative Detailed Engineering Evaluation (DEE) of the Main Plant Room building located at the Norman Kirk Memorial Pool at 54 Oxford St, Lyttelton.

This report is a Qualitative Assessment of the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) issued by the Engineering Advisory Group (EAG) on 19 July 2011.

A qualitative assessment involves inspections of the building, a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available and an assessment of the level of seismic capacity against current code using the Initial Evaluation Procedure (IEP).

The purpose of the assessment is to determine the likely building performance and damage patterns, to identify any potential Critical Structural Weaknesses or collapse hazards, and to make an initial assessment of the likely building strength in terms of percentage of New Building Standard (%NBS).

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure has been carried out. The building description below is based only on our visual inspection as drawings were not available.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

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 carry out a full structural survey before the building is re-occupied.

We understand that CERA will require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building

Act). It is understood that CERA is adopting the Detailed Engineering Evaluation Procedure document (draft) issued by the Engineering Advisory Group on 19 July 2011, which sets out a methodology for both qualitative and quantitative assessments. We understand this report will be used in response to CERA Section 51.

The qualitative assessment includes a thorough visual inspection of the building coupled with a desktop review of available documentation such as drawings, specifications and IEP's. The quantitative assessment involves analytical calculation of the building's strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

It is anticipated that factors determining the extent of evaluation and strengthening level required will include:

- The importance level and occupancy of the building
- The placard status that was assigned during the state of emergency following the 22 February 2011 earthquake
- The age and structural type of the building
- Consideration of any Critical Structural Weaknesses
- The extent of any earthquake damage

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 any 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)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67%NBS however where practical achieving 100%NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67%NBS.

Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

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

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

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 of the 4th September 2010.

The 2010 amendment includes the following:

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

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

It is understood that any building with a capacity of less than 33%NBS (including consideration of Critical Structural Weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

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

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

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:

a. Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)

b. Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

3 Earthquake Resistance Standards

For this assessment, the building's Ultimate Limit State earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

No consideration has been given at this stage to checking the level of compliance against the increased Serviceability Limit State requirements.

The likely ultimate capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a building's capacity based on a comparison of loading codes from when the building was designed and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown in Figure 3.1 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	Unacceptable	Unacceptable

Figure 3.1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 3.1 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. on average 0.2% in any year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Table 3.1: %NBS compared to relative risk of failure

Building Grade	Percentage of New Building Standard (*%NBS*)	Approx. Risk Relative to a New Building
A+	>100	<1
A	80-100	1-2 times
B	67-80	2-5 times
C	33-67	5-10 times
D	20-33	10-25 times
E	<20	>25 times

4 Building Description

4.1 General

Summary information about the building is given in the following table.

Table 4.1: Building Summary Information

Item	Details	Comment
Building name	Norman Kirk Memorial Pool - Main Plant Room.	
Street Address	56 Oxford St, Lyttelton.	
Age	39 years. Constructed in 1973.	Advised by CCC.
Description	Single storey concrete masonry block building with a timber framed roof & steel/timber awning. The Main Plant Room houses plant and equipment.	
Building Footprint / Floor Area	Approximately 32m^2, including the external awning. Approximately 6.5m x 4.9m.	Dimensions based on photos and site observations. No drawings available.
No. of storeys / basements	1 storey / no basement.	
Occupancy / use	Plant / Storage.	Importance Level 2.
Construction	Building has two parts, the main part is concrete masonry block, while the external awning is of timber and steel construction. Both sections have timber-framed roofs.	No drawings available. Based on visual inspection. Based on the age of the building, the block work is assumed to be lightly reinforced and partially filled.
Gravity load resisting system	The main part of the building has lightweight metal roof sheeting on timber rafters that are supported by concrete masonry block load bearing walls. The awning also has lightweight metal roof sheeting, but it is supported on a timber framed roof and steel columns.	No drawings available.

Item	Details	Comment
Seismic load resisting system	Lateral loads in both directions are resisted by concrete masonry block shear walls. Strip bracing in the roof of the main part of the building transfer seismic loads from the roof to the concrete masonry walls. Timber bracing is present in the awning roof and this is assumed to be tied back to the main structural concrete masonry walls.	No drawings available.
Foundation system	Unknown but assumed to be shallow foundations with a concrete slab on grade.	No drawings available.
Stair system	No stairs.	
Other notable features	Services system on roof.	Services system should be inspected by a certified services inspector. Connections to the Main Plant Room roof should be checked as the services pose a potential falling hazard.
External works	Concrete pavement surroundings, asphalt pavement to the east. Concrete masonry block retaining wall to the west (along the driveway and which continues to the Lean-to Shelter), adjacent to the building's southern wall. In ground concrete swimming pool located in the centre of the site.	No drawings available.
Construction information	Visual inspection only.	No drawings available.
Likely design standard	NZS 1900 Chapter 8: 1965.	Inferred from age of building.
Heritage status	No heritage status.	
Other		

4.2 Structural 'Hot-spots'

- Connections between concrete masonry walls, concrete floor and roof.
- Connections between main concrete masonry block structure and external awning structure.
- The stability and strength of the concrete masonry wall to the west (along the driveway and which continues to the Lean-to Shelter) where differential settlement is evident.
- Shear capacity of concrete masonry walls.
- Flexural capacity of concrete masonry walls.

5 Site Investigations

5.1 Previous Assessments

The building had a level 2 rapid assessment undertaken following the February 2011 and June 2011 earthquake events (refer to Appendix C).

5.2 Level 4 Damage Inspection

Visual inspections as part of the level 4 damage assessment were undertaken on 7 August 2012.

6 Damage Assessment

6.1 Damage Summary

The table below provides a summary of damage observed during our inspection. Refer to Appendix A for photographs of the observed damage.

Table 6.1: Damage Summary

Damage type	Unknown	Minor	Moderate	Major	Comment
settlement of foundations	ü				None observed during visual inspection. Level survey may be required to confirm.
tilt of building	ü				None observed during visual inspection. Verticality survey may be required to confirm.
liquefaction					None observed during visual inspection.
settlement of external ground			ü		Some differential settlement noted. Pavement slopes from the pool to the south.
lateral spread / ground cracks		ü			None observed in immediate proximity of Main Plant Room. Some ground cracks observed on southern side of pool and adjacent to Change Rooms.
frame					No damage to awning frame observed during visual inspection.
masonry walls		ü			Minor cracking to concrete masonry block work mortar.
cracking to concrete floors					No damage observed during visual inspection.
bracing					No damage observed during visual inspection.
precast flooring seating					Not applicable.
stairs					Not applicable.
cladding /envelope					No damage observed during visual inspection. Refer above for concrete masonry walls.

Damage type	Unknown	Minor	Moderate	Major	Comment
internal fit out					No damage observed during visual inspection.
building services	ü				No inspection of services was carried out.
other			ü		Cracking in blocks and mortar in concrete masonry wall to the west of the Main Plant Room building (along the driveway and which continues to the Lean-to Shelter).

6.2 Surrounding Buildings

There are no buildings in the immediate proximity of the Main Plant Room.
Close-by there is a Nursery (BU 3513-005 EQ2) and Lean-to Shelter (BU 3513-006 EQ2) that have individual Detailed Engineering Evaluation Reports.

To the west of the Main Plant Room (along the driveway to the south of the site) is a partially filled and lightly reinforced concrete masonry block wall that sustained damage to both the blocks and mortar. The cracking is vertical in nature and the damage observed suggests local differential settlement. It was identified that the likely cause for the differential settlement is the founding of the concrete masonry wall on two concrete retaining walls (refer Photo 4 in Appendix A). The differential settlement on the western side of the cracking coincides with the differential settlement and sloped pavement in the Lean-to Shelter proximity (refer BU 3513-006 EQ2 Qualitative Report).

To the north side of the pool is a concrete retaining wall approximately 2m high with a 2m high concrete masonry block fence on top that is significantly damaged (refer Photo 7 and Photo 8 in Appendix A). The block fence section appears to be very lightly reinforced and has minimal fill. It appears likely that the block fence will need to be demolished and reconstructed with an appropriately engineered replacement.

6.3 Residual Displacements and General Observations

No evidence of permanent settlement and displacements to the Main Plant Room structure was observed during our visual inspection. Some evidence of permanent settlement and displacements was observed in other areas of the site however. A global settlement survey may reveal movement that could be described as damage under insurance entitlement.

6.4 Implication of Damage

The structure has suffered only minor visible structural damage and therefore we believe the structural capacity has not been affected.

7 Generic Issues

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to the Main Plant Room:

Partially Filled Concrete Masonry

- Inadequate flexural strength.
- Inadequate shear strength.
- Connection between roof diaphragms and walls not adequate.

8 Critical Structural Weaknesses

No critical structural weaknesses were identified for the Main Plant Room.

9 Geotechnical Consideration

No geotechnical information was available for this site. During the inspection, any damage to the surrounding pavement was noted and any affect to the structure was considered.

10 Survey

There was some evidence of settlement and lateral spread across the site that was observed during our inspection however no level or vertical surveys were carried out. CCC may wish to undertake level and verticality surveys as part of insurance entitlement considerations.

11 Initial Capacity Assessment

11.1 %NBS Assessment

The building has had its seismic capacity assessed using the Initial Evaluation Procedure based on the assumed age, visually determined construction types and assumed structural systems. The building's capacity is expressed as a percentage of New Building Standard (%NBS) and is in the order of that shown in Table 11.1. These capacities are subject to confirmation by a quantitative analysis which is more detailed. The post-damage capacity is considered to be the same as the original capacity.

The seismic capacity of the masonry block wall between the Main Plant Room and Lean-to Shelter has not been assessed.

Table 11.1: Indicative Building Capacities

System	Direction	Seismic Performance in *%NBS*	Notes
Partially filled Concrete Masonry Units	Longitudinal	39%	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.
Partially filled Concrete Masonry Units	Transverse	39%	NZSEE Initial Evaluation Procedure. IL 2, Z=0.3.

11.2 Seismic Parameters

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

- Site soil class: C – NZS 1170.5:2004, Clause 3.1.3.
- Site hazard factor, Z = 0.3 – NZBC, Clause B1 Structure, Amendment 11 effective from 19 May 2011.
- Return period factor Ru = 1 – NZS 1170.5:2004, Table 3.5, Importance level 2 structure with a 50 year design life.
- Near fault factor N(T,D) = 1 – NZS 1170.5:2004, Clause 3.1.6, Distance more than 20 km from fault line.

11.3 Expected Structural Ductility Factor

The lateral load resisting system in both directions is partially filled and lightly reinforced concrete masonry shear walls which have been assumed to have a ductility factor of 1.25 for the IEP assessment.

11.4 Discussion of results

Based on the IEP results, the Main Plant Room is considered potentially Earthquake Risk and seismic grade C as the IEP result is greater than 33%NBS but less than 67%NBS. This assessment is qualitative and based on the NZSEE IEP only. The dimensions have been approximated by visual inspection and tit is assumed that the concrete masonry blocks are partially filled and lightly reinforced.

12 Initial Conclusions

- Minor earthquake damage was noted in the Main Plant Room.
- The building has been assessed to have a seismic capacity of 39% NBS and is therefore potentially Earthquake Risk.
- No Critical Structural Weaknesses have been identified.
- Damage was observed in surrounding concrete masonry block walls/fences.
- Collapse hazards have been identified at the Norman Kirk Memorial Pool site and these require cordoning off.

13 Recommendations

13.1 Occupancy

In order that the owner can make an informed decision about the ongoing use and occupancy of their building the following information is presented in line with the Department of Building and Housing document '*Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch*', June 2012.

The building is considered to be potentially earthquake risk, having an assessed capacity of between 34% and 67%*NBS*. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

No significant damage or hazards were identified to the seismic or gravity load resisting system that would reduce its ability to resist further loads and therefore no restrictions on use or occupancy are recommended. However, access to the Main Plant Room, if required, should be restricted to routes that do not require entering cordoned areas of the site.

13.2 Further Investigations, Survey or Geotechnical Work

It is recommended that:

- A quantitative %NBS analysis of the building should be completed.
- A verticality and level survey could be carried out to determine the extent of settlement of the building, and differential settlement across the site, for insurance purposes.
- An investigation is undertaken to determine the structural integrity of the retaining wall along the driveway at the south of the site.
- A geotechnical investigation is undertaken into the stability of the surrounding landscape and large retaining wall to the east of the site.
- An inspection of the services system located on the roof of the Main Plant Room. The connections between the services and the roof should be checked by a certified services inspector.
- Barricades be installed to cordon off access to damaged structures on the western portion of the Norman Kirk Memorial Pool site including walls/fences and buildings. No occupancy restrictions exist for the Main Plant Room or the Nursery Building and we understand the Nursery is currently occupied. Access to these two building should be restricted to routes that do not require entering cordoned areas of the site.

13.3 Damage Reinstatement

Repairs that would bring the building back to an 'as new' condition are typically entitled under typical replacement insurance policies. We suggest you consult with your insurance advisor as to how you wish to proceed.

14 Design Features Report

Minor repairs are required to reinstate the existing structural system. No additional load paths are expected. A repair methodology has not been prepared at this stage.

15 Limitations

The following limitations apply to this engagement:

- Beca and its employees and agents are not able to give any warranty or guarantee that all defects, damage, conditions or qualities have been identified.
- Inspections are primarily limited to visible structural components. Appropriate locations for invasive inspection, if required, will be based on damage patterns observed in visible elements, and review of the construction drawings and structural system. As such, there will be concealed structural elements that will not be directly inspected.
- The inspections are limited to building structural components only.
- Inspection of building services, pipework, pavement, and fire safety systems is excluded from the scope of this report.
- Inspection of the glazing system, linings, carpets, claddings, finishes, suspended ceilings, partitions, tenant fit-out, or the general water tightness envelope is excluded from the scope of this report.
- The preliminary assessment of the lateral load capacity of the building is limited by the completeness and accuracy of the drawings provided. Assumptions have been made in respect of the geotechnical conditions at the site and any aspects or material properties not clear on the drawings. Where these assumptions are considered material to the outcome further investigations may be recommended. It is noted the assessment has not been exhaustive, our analysis and calculations have focused on representative areas only to determine the level of provision made. At this stage we have not undertaken any checks of the gravity system, wind load capacity, or foundations.
- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

This report is of defined scope and is for reliance by CCC only, and only for this commission. Beca should be consulted where any question regarding the interpretation or completeness of our inspection or reporting arises.

Appendix A

Photographs

Figure 1: Site Layout.

Photo 1: External view of Main Plant Room.

Photo 2: External view of Main Plant Room.

Photo 3: Internal concrete masonry block work.

Damage Summary: Minor mortar joint cracking.

Photo 4: Adjacent concrete masonry block wall along driveway between Main Plant Room and Lean-to Shelter. The Main Plant Room is immediately to the right of this photo (view from south).

Damage Description: Cracking and differential settlement of concrete masonry block wall.

Photo 5: Adjacent concrete masonry block wall along driveway between Main Plant Room and Lean-to Shelter. The Main Plant Room is immediately to the left of this photo (view from north).

Damage Description: Cracking and differential settlement of concrete masonry block wall.

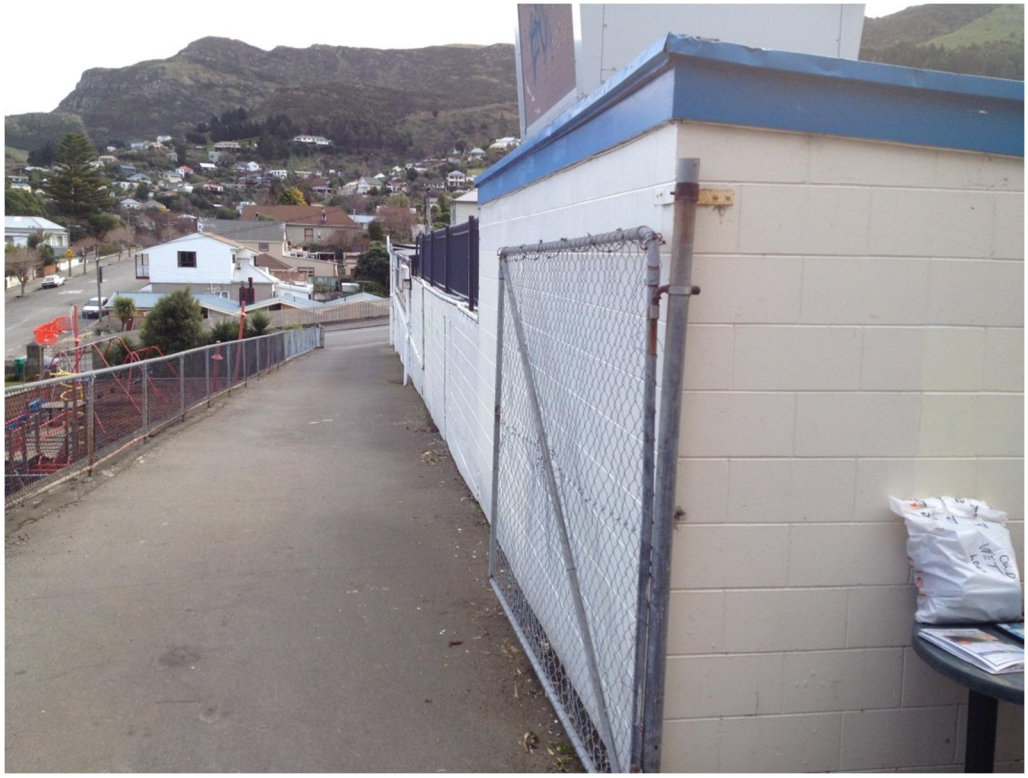


Photo 6: View along the driveway at the south of the site. The Main Plant Room is in the foreground (view from east).

Photo 7: Concrete retaining wall and concrete masonry block fence to the north of the pool (view from south-east).

Damage Description: Cracking and differential settlement of concrete masonry block wall.

Photo 8: Concrete masonry fence to the north of the pool.

Damage Description: Cracked and dislodged concrete masonry units.

Appendix B

CERA DEE Summary Data

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Main Plant Room			Reviewer:	David Whittaker
	Unit	No:	Street	CPEng No:	123089
Building Address:	Norman Kirk Memorial Pool	54	Oxford St, Lyttelton	Company:	Beca
Legal Description:				Company project number:	5323355
				Company phone number:	033663521
	Degrees	Min	Sec		
GPS south:				Date of submission:	12/07/2013
GPS east:				Inspection Date:	7/08/2012
				Revision:	
Building Unique Identifier (CCC):	BU 3513-001 EQ2			Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 5	Max retaining height (m):	0.4
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):	C		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):	30	Approx site elevation (m):	32.00

Building

No. of storeys above ground:	1	single storey = 1		Ground floor elevation (Absolute) (m):	32.00
Ground floor split?	no			Ground floor elevation above ground (m):	0.00
Storeys below ground	0				
Foundation type:	other (describe)			if Foundation type is other, describe:	Unknown. Shallow foundation assumed.
Building height (m):	2.50			height from ground to level of uppermost seismic mass (for IEP only) (m):	2.5
Floor footprint area (approx):	32				
Age of Building (years):	39			Date of design:	1965-1976
Strengthening present?	no			If so, when (year)?	
				And what load level (%g)?	
Use (ground floor):	other (specify)			Brief strengthening description:	
Use (upper floors):					
Use notes (if required):	Plant room / Storage				
Importance level (to NZS1170.5):	IL2				

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Timber purlins & rafters. Lightweight metal sheeting
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	timber	type	Timber beam supporting external awning.
Columns:	structural steel	typical dimensions (mm x mm)	Steel columns supporting external awning
Walls:	partially filled concrete masonry	thickness (mm)	190

Lateral load resisting structure

			Note: Define along and across in detailed report!		
Lateral system along:	other (note)			describe system	partially filled CMU, timber frame for external awning
Ductility assumed, μ:	1.25				
Period along:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	
Lateral system across:	other (note)			describe system	partially filled CMU, timber frame for external awning
Ductility assumed, μ:	1.25				
Period across:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	exposed structure	describe	
Roof Cladding:	Metal	describe	Lightweight metal sheeting
Glazing:			
Ceilings:			
Services(list):	Water		

Available documentation

Architectural	none	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:	Site performance:	Ground cracks and differential settlement	Describe damage:	Ground, mortar and blockwork cracking, settlement
(refer DEE Table 4-2)				
	Settlement:	none observed	notes (if applicable):	
	Differential settlement:	0-1:350	notes (if applicable):	ground around pool slopes to the south
	Liquefaction:	none apparent	notes (if applicable):	
	Lateral Spread:	none apparent	notes (if applicable):	
	Differential lateral spread:	none apparent	notes (if applicable):	
	Ground cracks:	0-20mm/20m	notes (if applicable):	pavement cracks throughout site
	Damage to area:	slight	notes (if applicable):	

Building:

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

Recommendations

	Level of repair/strengthening required:	minor structural		Describe:	Mortar cracking. Settlement. Cracked concrete masonry blockwork (adjacent).
	Building Consent required:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	Access to avoid cordoned areas of the site.
Along	Assessed %NBS before:	39%	39% %NBS from IEP below	If IEP not used, please detail assessment methodology:	
	Assessed %NBS after:	39%			
Across	Assessed %NBS before:	39%	39% %NBS from IEP below		
	Assessed %NBS after:	39%			

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1965-1976 — h_n from above: 2.5m

Seismic Zone, if designed between 1965 and 1992: B — 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:	6.3%	6.3%
Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0		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
Final (%NBS)$_{nom}$:	**6%**	**6%**

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: 0.30

Z_{1992}, from NZS4203:1992: 0.7

Hazard scaling factor, **Factor B:** 3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above): 2

Return Period Scaling factor from Table 3.1, **Factor C**: 1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.25	1.25
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:	1.14	1.14
Ductility Scaling Factor, **Factor D**:	1.14	1.14

2.6 Structural Performance Scaling Factor:

Sp:	0.925	0.925
Structural Performance Scaling Factor **Factor E**:	1.081081081	1.081081081

2.7 Baseline %NBS, (NBS%)$_b$ = (%NBS)$_{nom}$ x A x B x C x D x E — **%NBS$_b$:** **26%** | **26%**

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

3.1. Plan Irregularity, factor A: insignificant | 1

3.2. Vertical irregularity, Factor B: insignificant | 1

3.3. Short columns, Factor C: insignificant | 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 insignificant | 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	1.5	1.5
Rationale for choice of F factor, if not 1	Structure performed well, minimal damage	Structure performed well, minimal damage

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

3.7. Overall Performance Achievement ratio (PAR) — **1.50** | **1.50**

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **39%** | **39%**

4.4 Percentage New Building Standard (%NBS), (before) **39%**

Official Use only:

Accepted By:

Date:

Appendix C

Previous Reports and Assessments

(2)

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: MWF | Date: 21-6-11 | Final Posting (e.g. UNSAFE): Inspected G1
Territorial Authority: Christchurch City | Time: 11:50

Building Name: Norman Kirk Main Pool Plant Room
Short Name:
Address: 54 Oxford St, Lyttelton
GPS Co-ordinates: S° E°
Contact Name: Bruce Thompson
Contact Phone: 027 499 2037

Storeys at and above ground level: 1 | Below ground level: N/A
Total gross floor area (m²): | Year built:
No of residential Units:

Photo Taken: Yes / (No)

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☑ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☐ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☑ Other: Pool Bldgs

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☐	☐	☐	
Building or storey leaning	☐	☐	☐	
Wall or other structural damage	☐	☐	☐	No damage
Overhead falling hazard	☐	☐	☐	
Ground movement, settlement, slips	☐	☐	☐	
Neighbouring building hazard	☐	☐	☐	
Electrical, gas, sewerage, water, hazmats	☐	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED *GREEN*: ☑ G1 | G2
RESTRICTED USE *YELLOW*: Y1 | Y2
UNSAFE *RED*: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☑		
0-1 %	☐	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: MWF

Date & Time: 21-6-11 12:50

ID: Murray Frost SKM

PROP: 021 403 180

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage	Minor/None	Moderate	Severe	Comments
Foundations	☐	☐	☐	
Roofs, floors (vertical load)	☐	☐	☐	
Columns, pilasters, corbels	☐	☐	☐	
Diaphragms, horizontal bracing	☐	☐	☐	
Pre-cast connections	☐	☐	☐	
Beam	☐	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☐	☐	☐	No damage
Cladding, glazing	☐	☐	☐	
Ceilings, light fixtures	☐	☐	☐	
Interior walls, partitions	☐	☐	☐	
Elevators	☐	☐	☐	
Stairs/ Exits	☐	☐	☐	
Utilities (eg. gas, electricity, water)	☐	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☐	☐	☐	
Ground movement, fissures	☐	☐	☐	
Soil bulging, liquefaction	☐	☐	☐	

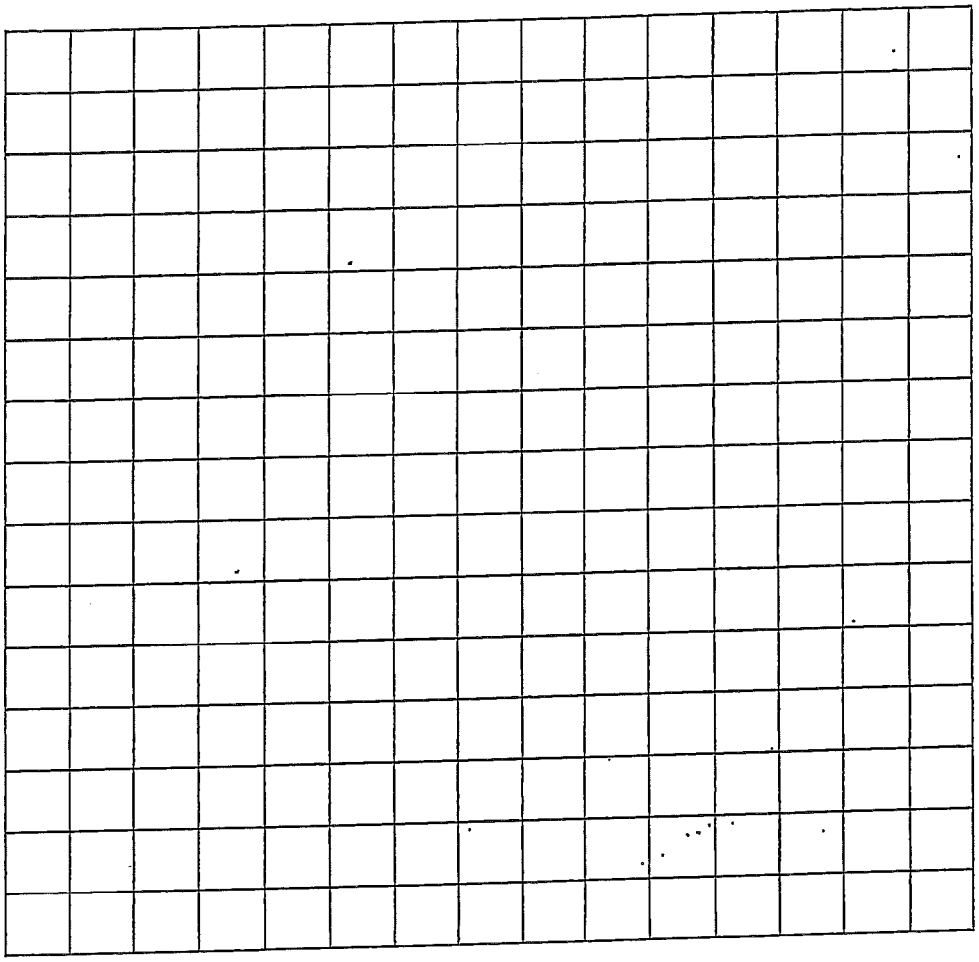
General Comment _____

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)