CHRISTCHURCH CITY COUNCIL
PRK_1474_BLDG_001 EQ2
Scarborough Lifeboat Shed
2 Scarborough Beach

QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 25 January 2013

CHRISTCHURCH CITY COUNCIL
PRK_1474_BLDG_001 EQ2
Scarborough Lifeboat Shed
2 Scarborough Beach

QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 25 January 2013

Sinclair Knight Merz
142 Sherborne Street
Saint Albans
PO Box 21011, Edgeware
Christchurch, New Zealand
Tel: +64 3 940 4900
Fax: +64 3 940 4901
Web: www.skmconsulting.com

Contents

Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
A	7 Jun. 2012	CD Paverd	NM Calvert	7 Jun. 2012	Draft for Client Approval
B	25 Jan. 2013	NM Calvert	NM Calvert	25 Jan. 2013	Final Issue

Approval

	Signature	Date	Name	Title
Author		25/01/2013	Kimberley Wylie	Structural Engineer
Approver		25/01/2013	Nick Calvert	Senior Structural Engineer

Distribution of copies

Revision	Copy no	Quantity	Issued to
A	1	1	CCC
B	1	1	CCC

Printed:	25 January 2013
Last saved:	25 January 2013 10:01 AM
File name:	ZB01276.50_CCC_PRK_1474_001_EQ2_Qualitative Assmt_B.docx
Author:	Kimberley Wylie
Project manager:	Nick Calvert
Name of organisation:	Christchurch City Council
Name of project:	Christchurch City Council Structures Panel
Name of document:	CCC – PRK_1474_BLDG_001 EQ2 – Scarborough Lifeboat Shed
Document version:	B
Project number:	ZB01276.50

1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on building PRK_1474_BLDG_001 EQ2 located at Scarborough Beach. This building is a two story timber framed structure that is used by the Scarborough Surf Lifesaving Club. It was originally constructed in 1979 however it has since undergone significant alterations to the original layout. The date and of these alterations is unknown. An aerial photograph illustrating the buildings location is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type is given in Section 5 of this report.

- **Figure 1 Aerial Photograph of Building PRK_1474_BLDG_001 EQ2 Located at Scarborough Beach**

The qualitative assessment broadly includes a summary of the buildings damage as well as an initial assessment of the current Seismic Capacity compared with current seismic code loads using the Initial Evaluation Procedure (IEP).

This Qualitative report for the building structure is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, our visual inspection carried out on the 26 April 2012 and the limited structural drawings available detailing the original construction dated 1979.

1.2. Key Damage Observed

Key damage observed includes:-

- Cracking to masonry block wall.
- Cracking and spalling to concrete foundation elements.
- Cracking to plasterboard linings.

Further details describing the level of damage are given in section 6 of this report.

1.3. Critical Structural Weaknesses

No critical structural weaknesses were observed during our site inspection.

1.4. Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the buildings original capacity has been assessed to be in the order of 59%NBS. Minor structural damage was observed during our site investigation. Without doing a full design analysis the exact affect of this damage on the structural capacity is difficult to determine. However we believe that it will be no greater than 15%. Due to this we have altered the post earthquake capacity to be in the order of 50%NBS. This assessment has been made with limited structural drawings that do not detail the significant upgrades made to the building and is therefore accordingly limited.

As noted above our analysis indicates that the current seismic capacity of the building is in the order of 50% NBS and therefore is not a potentially earthquake prone building. However since the seismic capacity of the building is less than 67% NBS it is potentially an earthquake risk building, therefore we recommend that a quantitative assessment is carried out to confirm our findings and develop possible strengthening concepts if required. Due to the lack of structural drawings detailing the alterations made to this building available any quantitative assessment carried out may require intrusive investigations.

Please note that structural strengthening is only required by law for buildings that are confirmed to have a seismic capacity of less than 34% NBS.

1.5. Recommendations

It is recommended that:

a) The current placard status of the building remain as Green 2.

b) We consider that barriers around the building are not necessary.

c) A Quantitative Assessment is carried out to confirm our findings and establish possible strengthening concepts.

2. Introduction

Sinclair Knight Merz was engaged by the Christchurch City Council to prepare a qualitative assessment report for building PRK_1474_BLDG_001 EQ2 located at Scarborough Beach following the magnitude 6.3 earthquake which occurred in the afternoon of the 22nd of February 2011 and the subsequent aftershocks.

The qualitative assessment uses the methodology recommended in the Engineering Advisory Group document "Guidance on Detailed Engineering Evaluation of Earthquake affected Non-residential Buildings in Canterbury". The qualitative assessment broadly includes a summary of the building damage as well as an initial assessment of the current likely Seismic Capacity compared with current seismic requirements.

A qualitative assessment involves inspections of the building and a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available.

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).

This report describes the structural damage observed during our inspection and indicates suggested remediation measures. The inspection was undertaken from floor levels and was a visual inspection only. Our report reflects the situation at the time of the inspection and does not take account of changes caused by any events following our inspection. A full description of the basis on which we have undertaken our visual inspection is set out in Section 7.2

The NZ Society for Earthquake Engineering (NZSEE) Initial Evaluation Procedure (IEP) was used to assess the likely performance of the building in a seismic event relative to New Building Standard (NBS). 100% NBS is equivalent to the strength of a building that fully complies with current codes. This includes a recent increase of the Christchurch seismic hazard factor from 0.22 to 0.3[1].

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure have been carried out. The structural drawings available for this building do not represent the current structure and layout of this building and as a result the descriptions outlined in Section 5 are predominately based on our visual inspection carried out on the 26 April 2012.

---

[1] http://www.dbh.govt.nz/seismicity-info

3. 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.

3.1. 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 anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications. The quantitative assessment involves analytical calculation of the buildings 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 and amount of damage
- The age and structural type of the building
- Consideration of any critical structural weaknesses
- The extent of any earthquake damage

3.2. Building Act

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

3.2.1. 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).

3.2.2. 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.

3.2.3. 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.

3.2.4. 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.

3.2.5. 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.

3.2.6. Section 131 – Earthquake Prone Building Policy

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

3.3. 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. Council recognises that it may not be practicable for some repairs to meet that target. The council will work closely with building owners to achieve sensible, safe outcomes;
- 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.

We anticipate 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.

3.4. 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.

After the February Earthquake, 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.

4. 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 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).

The likely 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 buildings 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 2 below.

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

▪ **Figure 2: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines**

Table 1 below provides an indication of the risk of failure for an existing building with a given percentage NBS, relative to the risk of failure for a new building that has been designed to meet current Building Code criteria (the annual probability of exceedance specified by current earthquake design standards for a building of 'normal' importance is 1/500, or 0.2% in the next year, which is equivalent to 10% probability of exceedance in the next 50 years).

- **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

5. Building Details

5.1. Building Description

Building PRK_1474_BLDG_001 EQ2 is a two storey timber framed building that is used by the Scarborough Surf Lifesavers Club. The roof is constructed from timber framing and light weight corrugated steel cladding that is supported on the timber framed walls. The roof structure is supported by the timber framed walls along the north and south side of the building. The wall cladding consists predominately of timber weatherboards however there are concrete blocks wall located along the north side of the building. The concrete block walls are present on the bottom storey only and also form the northern wall of the jet-ski shed that was constructed as part of the building upgrade. The finished floor level of the jet-ski shed is below ground level and therefore the concrete block walls also act as retaining walls. The level 1 suspended floor is constructed from timber framing and is supported on the timber frame walls. There is a steel portal frame that has been installed at the west end of the main boat shed. This appears to have been installed as part of the building upgrade. The south-west corner of the building is founded on concrete bearers that are supported on cantilevering concrete piles whereas the remaining parts of the building appear to be founded on concrete strip footings and a concrete slab on grade. The original construction drawings are dated November 1979 and as a result we have taken a design period of 1976-1992 for our assessment.

5.2. Gravity Load Resisting System

Our evaluation was based on our site investigation conducted on the 26 April 2012 and the limited construction drawings issued by the Christchurch City Council.

As detailed above the roof structure consists of timber framing which is supported on the timber framed walls. The level 1 suspended floor also consists of timber framing and is supported on the timber framed walls. There is a steel portal frame that has been installed in the west end of the main boat shed. This portal frame possibly helps to support the timber floor joists. The south-west corner of the building is founded on concrete bearers and concrete piles whereas the remaining parts of the building appear to be founded on concrete strip footings and a concrete slab on grade.

5.3. Seismic Load Resisting System

Our evaluation was based on our site investigation conducted on the 26 April 2012 and the limited construction drawings issued by the Christchurch City Council.

For the lateral analysis of this building the ‘across direction’ has been taken as north-south whereas the ‘along direction’ has been taken as east-west.

Lateral loads acting across and along the building will be resisted by the roof and wall linings. The steel portal frame present along the west end of the main boat shed will help to resist lateral loads acting across the building whereas the concrete block walls present along the north side of the building will help to resist lateral loads acting along the building.

5.4. Geotechnical Conditions

A geotechnical desktop study was carried out for this site. The main conclusions from this report are:

- Due to the lack of geotechnical investigation data, an estimation of the ground properties for this site has not been made in this desk study.
- No liquefaction appears to have occurred due to the 22nd February earthquakes. However, further site specific investigations would be needed to make a full liquefaction assessment of the site.

Due to a lack of existing information for the purpose of carrying out a Quantitative Assessment a conservative seismic class should be used. We recommend that seismic class D should be used. Further Geotechnical investigation will be required if design works need to be carried out or a building consent obtained The full geotechnical desktop study can be found in Appendix 4 – Geotechnical Desk Study.

6. Damage Summary

SKM undertook inspections on the 26 April 2012. The following was observed during the time of inspection:

6.1. Damage Summary

6.1.1. External Damage

1) No visual evidence of settlement was noted at this site. Therefore a level survey is not required at this stage of assessment.

North Wall

1) Vertical cracking present along the concrete block wall. These cracks span the full height of the wall and continue down through the concrete foundation. Cracks run through both the mortar joints and the face of the block. Cracking is reflected on both sides of the wall. Cracks range from 0.2mm - 1.0mm wide (PHOTO 5, 6, 7, 8, 9, 10 & 11).
2) Diagonal crack present on the northern block - eastern end. Crack width varies from 0.3mm - 0.9mm wide. Minor spalling to the block face has occurred along the edges of this crack. Cracking spans the full height of wall and continues through the concrete foundation. Cracking reflected on both sides of the wall (PHOTO 12, 13, 14, 15 & 16).
3) Various cracking present at the western end of the concrete block balustrade wall. Cracks range from 0.2mm – 1.0mm wide (PHOTO 17, 18 & 19). Cracking present along construction joint mortar where the concrete retaining wall and the northern block wall meet, crack width is approximately 5.0mm (PHOTO 20).
4) South side of Driveway: - Horizontal hairline cracking present along the concrete block and concrete foundation mortar joint, cracking continues around north-east corner (PHOTO 21 & 22).
5) South side of Driveway: - Hairline cracking present along the block wall and timber wall joint in the northern corner (PHOTO 23 & 24).

East Wall

1) Vertical weatherboards joints have opened up above the eastern door. This type of damage is typical on all weatherboard clad walls (PHOTO 25 & 26).
2) Joints in timber door frame and architrave have opened up on the northern door (PHOTO 27).
3) Cracking and splitting present to the bottom weatherboard in the south-east corner. This appears to be existing damage that has been exacerbated by the earthquake. (PHOTO 28 & 29).
4) Hairline cracking around pipe penetration in the south-east corner (PHOTO 30 & 31).

South Wall

1) Vertical weatherboards joints have opened up as noted above (PHOTO 32).

2) Minor spalling around cracking present in the middle of the 2nd concrete bearer from the east. Cracking was approximately 0.5mm wide. Note that not all bearers were checked for damage due to access and safety issues (PHOTO 34, 35 & 36).
3) Minor spalling and cracking present on the concrete pile located on the southern perimeter of the building, 2nd pile from the east. Cracking approximately 0.5mm wide. Note not all concrete piles where checked for damage (PHOTO 37 & 38).

6.1.2. Internal Damage

North-East Entrance

1) Hairline cracking present between the east wall window architrave and ceiling lining joint (PHOTO 39 & 40).
2) Hairline cracking present between the east wall window architrave and wall lining joint in the south-east corner (PHOTO 39 & 40).
3) Mitre joints on the western shower door architrave and the door leading to the stairs have opened up.
4) Hairline cracks present along the western wall ply lining and the plasterboard linings (PHOTO 41 & 42).

Jet-Ski Shed

1) Cracking to northern block wall as noted above in external damage (PHOTO 44 & 45).
2) Mitre joints in the wooden balustrade trim for the steps leading down to the jet-ski shed have opened up (PHOTO 46).

Main Boat Shed

1) The following damage was observed on the south wall: -
   - Cracking present to wall lining under the floor beam (PHOTO 47 & 48).
   - Cracking present between the wall lining around the floor beam and ceiling lining joint (PHOTO 47 &48).
   - Cracking present along ceiling lining joint radiating out from the underside of the stair (PHOTO 47 & 48).
   - Cracking in stair wall lining present near the eastern wall (PHOTO 49).
2) The following damage was observed on the east wall: -
   - Diagonal cracking in the wall lining radiating out from the top corners of the first aid room door, damage reflected on both sides of the wall (PHOTO 50).
   - Mitre joints in the first aid room door architraves have opened up (PHOTO 50). Hairline cracking also present along the door architrave and the wall lining joint.
   - Diagonal and horizontal cracks radiating out from the top corners of the northern door (PHOTO 51 & 52).

- Hairline cracking present along the lining joints in the north-east corner (PHOTO 53 & 54).

3) The following damage was observed on the north wall: -
   - Vertical hairline crack at wall lining joint above personnel door (PHOTO 55).
   - Cracking present between the floor beam lining and both the ceiling lining and wall lining joints (PHOTO 56 & 57).
   - Hairline cracking at ceiling lining joints radiating out from the underside of the stairs (PHOTO 58).
   - Hairline cracking present around the steel UB portal column and the ceiling lining joint (PHOTO 59).

First Aid Room

1) Hairline cracking at wall lining joint in the south-west and south-east corners (PHOTO 60, 61 & 62).
2) Diagonal cracking to wall lining at the stair re-entrant corner (PHOTO 63).
3) Vertical hairline crack at the wall lining joint located on the northern side of the east wall door (PHOTO 64).
4) Hairline cracking in wall linings radiating out from the top north corner of the east wall door (PHOTO 64).

Northern Stairwell

1) Cracking present along the timber stair skirting and the wall lining joint, typical (PHOTO 66).
2) Hairline cracking present between the main boat shed door architrave and the wall lining joint (PHOTO 67 & 68).
3) Severe diagonal cracking in the wall lining on the south wall (PHOTO 69, 70 &71).
4) Horizontal hairline crack along wall lining joint on the north wall (PHOTO 72 & 73).
5) Vertical crack in wall lining near the north-west corner of the mid-height stair landing (PHOTO 74).
6) Vertical hairline crack in wall lining joint on the east wall of the mid-height stair landing (PHOTO 75).
7) Hairline cracking around ceiling bulkhead and the wall lining in the south-east corner of the mid-height stair landing (PHOTO 76).

Communications Room (Level 1)

1) Vertical hairline crack at wall lining joint above the west corner of the south wall door (PHOTO 77).
2) Horizontal crack in wall lining joint spanning between the top corners of the west wall windows (PHOTO 78).
3) Mitre joints in the door architrave on the kitchen side have opened up (PHOTO 79 & 80).

Kitchen (Level 1)

1) Mitre joints on the west wall door and window architraves have opened up (PHOTO 81 & 82).
2) Vertical hairline crack in the wall lining joint above the south wall window (PHOTO 83).
3) Hairline cracking present between the ceiling lining and the manhole trim.
4) Hairline cracking in wall lining joint in the south-west corner (PHOTO 84).

Main Room (Level 1)

1) Vertical hairline crack in wall lining joint above the south wall window near the kitchen (PHOTO 85 & 86).
2) Hairline crack in wall lining joint above the north corner of the concertina door (PHOTO 87).
3) Hairline crack in wall lining joint under the central window on the northern wall (PHOTO 88).
4) Hairline crack in the wall lining joint next to the east window on the northern wall (PHOTO 89 & 90).
5) Hairline crack in the plasterboard lining near the top of the south stair (PHOTO 92 & 93).

West Stair

1) Cracking in wall lining on the south wall around the ceiling bulkhead (PHOTO 94).
2) Cracking between timber beam and timber brace joint on the east wall (located at the mid-height stair landing) (PHOTO 95 & 96).
3) Cracking present to the east wall window architrave in the south-east corner of the mid-height stair landing (PHOTO 97 & 98).
4) Cracking present in wall lining above east wall exit door at the base of the stair. Cracking radiates out from the south corner of the door and continues up to the window architrave (PHOTO 99).
5) Cracking present between the west wall exit door architrave and the wall lining joint (PHOTO 100 & 101).
6) Mitre joints on the first aid room door architrave have opened up (PHOTO 102).

Photos detailing this damage can be found in Appendix 1 – Photos

7. Initial Seismic Evaluation

7.1. The Initial Evaluation Procedure Process

This section covers the initial seismic evaluation of the building as detailed in the NZSEE 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes'. The IEP grades buildings according to their likely performance in a seismic event. The procedure is not yet recognised by the NZ Building Code but is widely used and recognised by the Christchurch City Council as the preferred method for preliminary seismic investigations of buildings[2].

The IEP is a coarse screening process designed to identify buildings that are likely to be earthquake prone. The IEP process ranks buildings according to how well they are likely to perform relative to a new building designed to current earthquake standards, as shown in Table 2. The building grade is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have.

A building is earthquake prone for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building:-

a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and
b) would be likely to collapse causing:-
    i. injury or death to persons in the building or to persons on any other property; or
    ii. damage to any other property.

A moderate earthquake is defined as 'in relation to a building, an earthquake that would generate shaking at the site of the building that is of the same duration as, but that is one-third as strong as, the earthquake shaking (determined by normal measures of acceleration, velocity and displacement) that would be used to design a new building at the site.'

An earthquake prone building will have an increased risk that its strength will be exceeded due to earthquake actions of approximately 10 times (or more) than that of a building having a capacity in excess of 100% NBS (refer Table 1)[3]. Buildings in Christchurch City that are identified as being earthquake prone are required by law to be followed up with a detailed assessment and strengthening work within 30 years of the owner being notified that the building is potentially earthquake prone[4].

---

[2] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf
[3] NZSEE June 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes,* p 2-13
[4] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

Table 2: IEP Risk classifications

Description	Grade	Risk	%NBS	Structural performance
Low risk building	A+	Low	> 100	Acceptable. Improvement may be desirable.
	A		100 to 80	
	B		80 to 67	
Moderate risk building	C	Moderate	67 to 33	Acceptable legally. Improvement recommended.
High risk building	D	High	33 to 20	Unacceptable. Improvement required.
	E		< 20	

The IEP is a simple desktop study that is useful for risk management. No detailed calculations are done and so it relies on an inspection of the building and its plans to identify the structural members and describe the likely performance of the building in a seismic event. A review of the plans is also likely to identify any critical structural weaknesses. The IEP assumes that the building was properly designed and built according to the relevant codes at the time of construction. The IEP method rates buildings based on the code used at the time of construction and some more subjective parameters associated with how the building is detailed and so it is possible that %NBS derived from different engineers may differ.

This assessment describes only the likely seismic Ultimate Limit State (ULS) performance of the building. The ULS is the level of earthquake that can be resisted by the building without catastrophic failure. The IEP does not attempt to estimate Serviceability Limit State (SLS) performance of the building, or the level of earthquake that would start to cause damage to the building[5]. This assessment concentrates on matters relating to life safety as damage to the building is a secondary consideration. SLS performance of the building can be estimated by scaling the current code levels if required.

The NZ Building Code describes that the relevant codes for NBS are primarily:

- AS/NZS 1170 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard
- NZS4230:2004 Design of Reinforced Concrete Masonry Structures
- NZS 3603:1993 Timber Structures Standard

[5] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p2-9

- NZS 3604:2011 Timber Framed Buildings

7.2. Available Information, Assumptions and Limitations

Following our inspection on the 26 April 2012, SKM carried out a preliminary structural review. The structural review was undertaken using the available information which was as follows:

- SKM site measurements and inspection findings of the building.
- Limited structural drawings were available for this building. However these drawings are out of date and do not detail any of the alterations that were made to the building after its original construction.

The following assumptions and design criteria were used during our assessment:

- The building was built according to good practices at the time.
- Standard design criteria for typical office buildings as described in AS/NZS1170.0:2002
  - 50 year design life, which is the default NZ Building Code design life.
  - Structure importance level 2. This level of importance is described as 'normal' with medium or considerable consequence of failure.
- Ductility level of 1.25, based on our assessment and code requirements at the time of design.
- Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011
- The site has been assumed as NZS1170.5 Class D (deep or soft soil).

This IEP was based on our visual inspection of the building and the limited structural drawings available. Since it is not a full design and construction review, it has the following limitations:

- It is not likely to pick up on any original design or construction errors (if they exist)
- Other possible issues that could affect the performance of the building such as corrosion and modifications to the building will not be identified
- The IEP deals only with the structural aspects of the building. Other aspects such as building services are not covered.
- The IEP does not involve a detailed analysis or an element by element code compliance check.

7.3. Survey

There was no visible settlement of the structure, nor were there any significant ground movement issues around the building. The building is zoned as TC2 on the CERA 'Land Zone Technical Categories Map' for residential properties. Due to both these factors we do not recommend that any survey be undertaken at this stage of the assessment.

7.4. Critical Structural Weaknesses

No critical structural weaknesses for the building were observed during our visual inspection.

7.5. Qualitative Assessment Results

The building has had its seismic capacity assessed using the Initial Evaluation Procedure based on the information available. The buildings capacity is expressed as a percentage of new building standard (%NBS) and are in the order of that shown below in Table 3. The capacity is subject to confirmation by a quantitative analysis.

Table 3: Qualitative Assessment Summary

Item	%NBS
Buildings likely Seismic Capacity	50

Our qualitative assessment found that the building is likely to be classed as a 'Moderate Risk Building' (capacity between 34% and 67% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.

8. Further Investigation

Due to the limited information provided on the available structural drawings and the likely seismic capacity of the building being less than 67% NBS we recommend that a quantitative assessment is carried out due the possible margin of error inherent in the IEP method. This will allow us to confirm our findings and establish possible strengthening concepts. If a quantitative assessment is carried out then intrusive investigations will be required to confirm the following structural details:

- Foundations
- Sizes of the structural roof members
- Sizes of structural floor members
- Connection sizes and layouts
- Block wall reinforcing layout and spacing

The quantitative assessment will involve preparing a quantitative report and will entail looking at the characteristics of each structural area in more detail to determine if there is sufficient capacity in the structural elements to resist the required earthquake demand. If the building is confirmed to be earthquake prone a seismic strengthening concept design should be prepared so that a pre-feasibility cost estimate can be prepared. The pre-feasibility strengthening cost estimate should then be compared with an estimate to demolish and rebuild the building so that the cost-effectiveness of repairing the building can be determined.

A building consent is likely to be required for repairing the damage noted in Section 6.

If it is determined that the building should be repaired there are a number of issues which will need to be investigated and associated documents prepared in order to submit a building consent application. These issues will need to be considered during the initial phase of strengthening works. Listed below are the likely items the council may require to be explored:

- Further Geotechnical Investigation as outlined in our Desktop Study detailed in Appendix 4 – Geotechnical Desk Study.
- A quantitative report will be required. Where the quantitative report shows the building to be earthquake prone consent issue strengthening drawings, specifications and associated calculations will be required to accompany the building consent application.
- A fire report will be required and all necessary upgrades to egress routes, emergency lighting and specified systems will need to be undertaken.
- An emergency lighting design will be required to meet the provisions noted in the fire report.
- A disabled access summary will be required including provision for disabled facilities.
- The site amenities (toilets and the like) will need to be reviewed to ensure that there are sufficient facilities for the expected number of people on site.

- Landscaping will need to be considered although we do not anticipate that any modifications will be required since you will not be adjusting the footprint area of buildings on site and will likely only be required for the new build option.

9. Conclusion

A qualitative assessment was carried out on building PRK_1474_BLDG_001 EQ2 located at Scarborough Beach. The building has sustained minor damage to internal linings and cracking to concrete elements. The building has been assessed to have a likely seismic capacity in the order of 50% NBS and is likely to be classified as a 'Moderate Risk Building' (seismic capacity between 34% and 67% of NBS).

Due to the likely seismic rating of this building being less than 67%NBS we recommend that a quantitative assessment of the building, supported by intrusive investigations is carried out due to the possible margin of error inherent in the IEP. This will enable us to confirm the seismic capacity of the building and to develop any potential strengthening concepts.

It is likely that a building consent will be required for repairing the damage detailed in section 6.

It is recommended that:

a) The current placard status of the building remain as Green 2.
b) We consider that barriers around the building are not necessary.
c) A Quantitative Assessment is carried out to confirm our findings and establish possible strengthening concepts.

10. Limitation Statement

This report has been prepared on behalf of, and for the exclusive use of, SKM's client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and the Client. It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to, and the assumptions made by, SKM. The report may not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

Without limiting any of the above, in the event of any liability, SKM's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited in as set out in the terms of the engagement with the Client.

It is not within SKM's scope or responsibility to identify the presence of asbestos, nor the responsibility of SKM to identify possible sources of asbestos. Therefore for any property pre-dating 1989, the presence of asbestos materials should be considered when costing remedial measures or possible demolition.

There is a risk of further movement and increased cracking due to subsequent aftershocks or settlement.

Should there be any further significant earthquake event, of a magnitude 5 or greater, it will be necessary to conduct a follow-up investigation, as the observations, conclusions and recommendations of this report may no longer apply Earthquake of a lower magnitude may also cause damage, and SKM should be advised immediately if further damage is visible or suspected.

11. Appendix 1 – Photos

	
Photo 1: South Elevation	Photo 2: East Elevation
	
Photo 3: North Elevation and Cracking to Block Wall	Photo 4: West Elevation

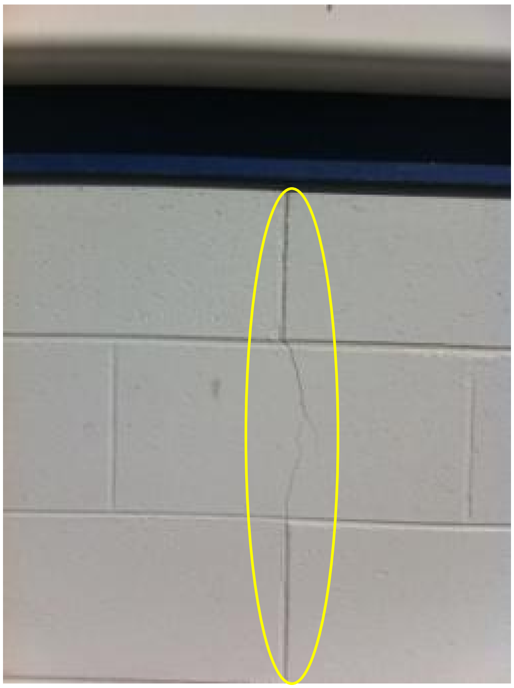


Photo 5: Vertical Cracking to North Wall Blocks

Photo 6: Cracking Continuing through Concrete Foundation

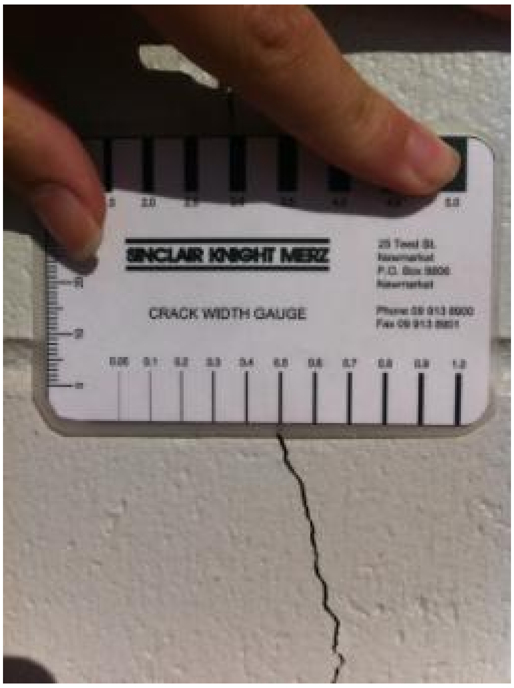


Photo 7: Close up of North Wall Crack

Photo 8: Close up of Foundation Crack

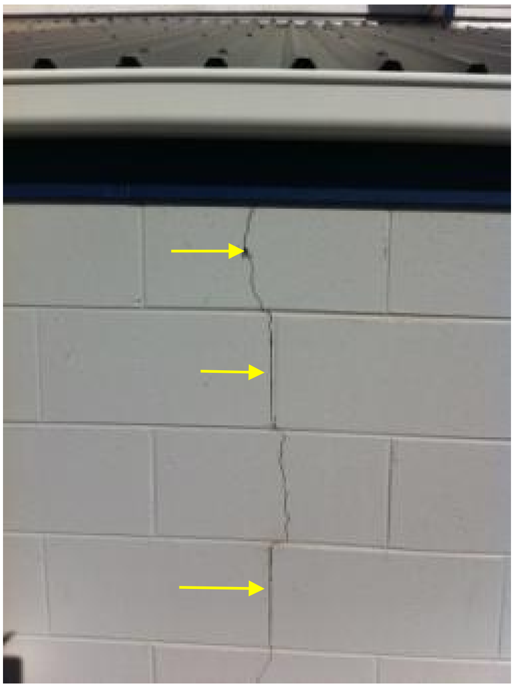


Photo 9: Further Cracking to North Wall Blocks	Photo 10: Cracking to Concrete Foundation
	
Photo 11: Close up of North Wall Cracking	Photo 12: Diagonal Cracking to North Wall Blocks

Photo 13: Close up Of Diagonal Cracking

Photo 14: Close up Of Diagonal Cracking

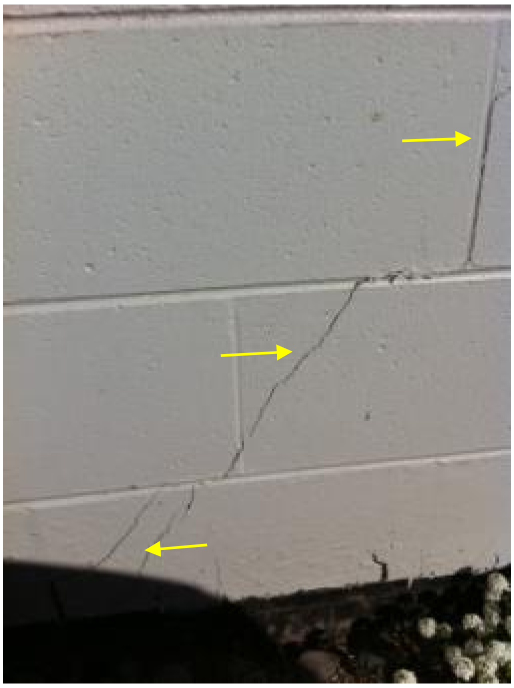


Photo 15: Lower Part of Diagonal Crack

Photo 16: Close up of Photo 17

	
Photo 17: Cracking to Block Wall Balustrade	Photo 18: Cracking to Block Wall Balustrade
	
Photo 19: Close up of Cracking to Block Wall Balustrade	Photo 20: Cracking between Concrete Retaining Wall & Masonry Wall Joint

Photo 21: Hairline Cracking Along Block Wall and Concrete wall Joint

Photo 22: Close up of Photo 21

Photo 23: Hairline Cracking Between Timber Cladding and Block Wall Joint

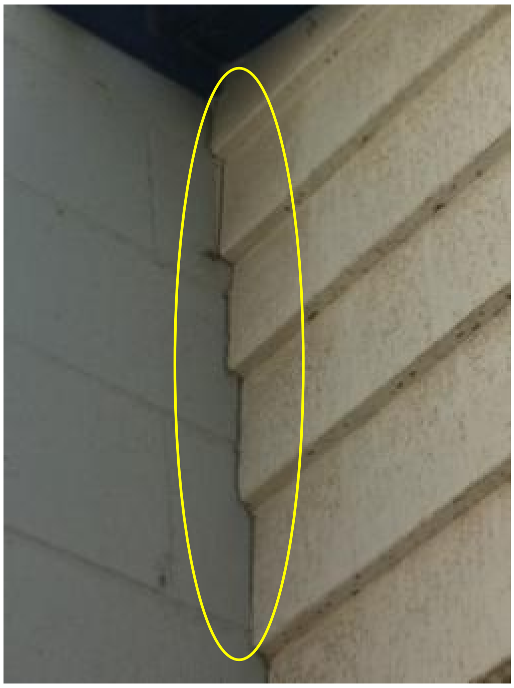


Photo 24: Close up of Photo 23

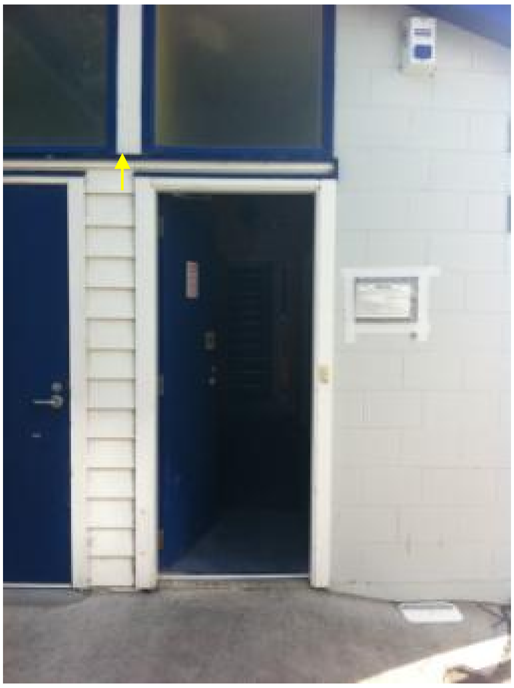


Photo 25: Opening up of Joints in Weatherboards	Photo 26: Close up of Photo 26
	
Photo 27: Timber Door Frame and Architrave Joints have Opened up	Photo 28: Cracking and Spliting of Weatherboard near SE Corner

Photo 29: Close up of Photo 28

Photo 30: Hairline Cracking around Pipe Penetration in SE Corner

Photo 31: Close up of Photo 30

Photo 32: Opening up of Weatherboard Joints (typical)

Photo 33: Foundations under Main Boat Shed

Photo 34: Cracking and Spalling to Concrete Bearer

Photo 35: Close up of Photo 34

Photo 36: Close up of Photo 35

Photo 37: Cracking and Spalling to Concrete Pile

Photo 38: Close up of Photo 37

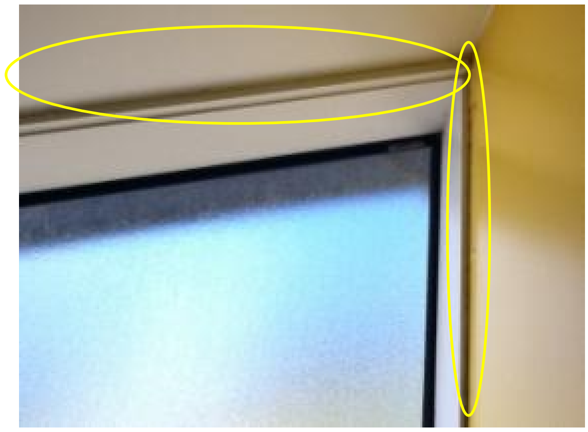
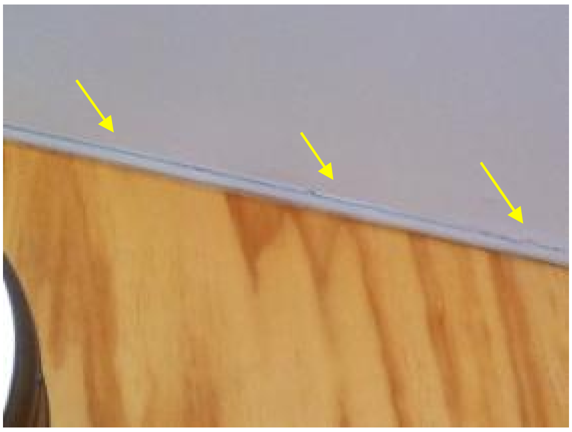
	
Photo 39: Cracking present Between South Wall Window architrave and Linings	Photo 40: Close up of Photo 39
	
Photo 41: Hairline Cracking Between Ply and Plasterboard Lining Joints	Photo 42: Close up of Photo 41

	
Photo 43: Internal View of Jet-Ski shed	Photo 44: Internal Cracking of Northern Block Wall
	
Photo 45: Internal Cracking of Northern Block Wall	Photo 46: Mitre Joints in Wooden Balustrade Trim have Opened up

	
Photo 47: Cracking to Linings on Southern Wall of Main Boat Shed	Photo 48: Close up of Cracking to Linings on Southern Wall of Main Boat Shed
	
Photo 49: Cracking to Stair Wall Lining Joints near East Wall in Main Boat Shed	Photo 50: Diagonal Cracking to Wall Lining above First Aid Room Door

	
Photo 51: Cracking in Wall Lining above Door near NE Corner of Main Boat Shed	Photo 52: Close up of Photo 51
	
Photo 53: Hairline Cracking at Lining Joints in the NE Corner of Main Boat Shed	Photo 54: Close up of Photo 53

	
Photo 55: Vertical Hairline Crack at Wall Lining Joint above Personnel Door – North Wall of Main Boat Shed	Photo 56: Cracking Between Floor Beam Lining and the Ceiling and Wall Lining Joints – North Wall of Main Boat Shed
	
Photo 57: Close up of Photo 56	Photo 58: Hairline Cracking at Ceiling Lining Joints

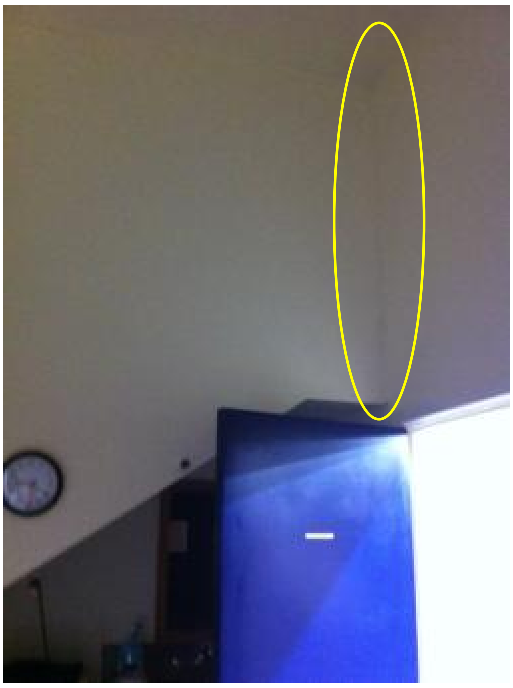
	
Photo 59: Hairline Cracking around Portal Column in Main Boat Shed	Photo 60: Hairline Cracking in SW Corner of First Aid Room
	
Photo 61: Close up of Photo 60	Photo 62: Hairline Cracking in SE Corner of First Aid Room

	
Photo 63: Diagonal Cracking at Stair Re-Entrant Corner in First aid Room	Photo 64: Vertrical hairline Crack at wall Lining Joint Next to East Wall Door and Horizontal Crack Radiating out from Corner of Door in the First Aid Room

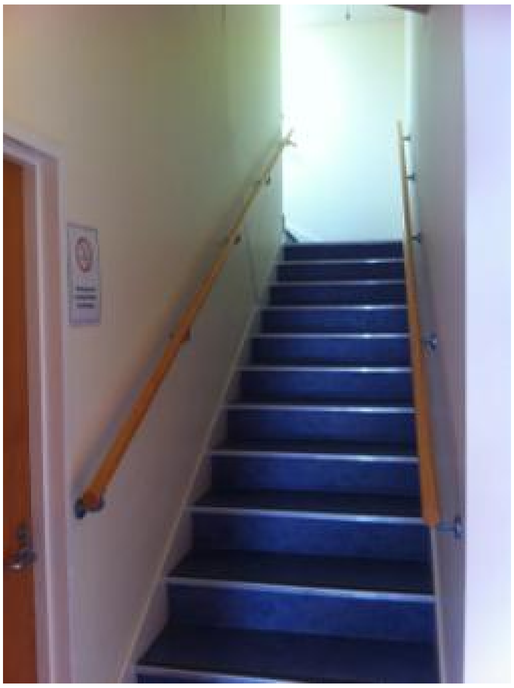


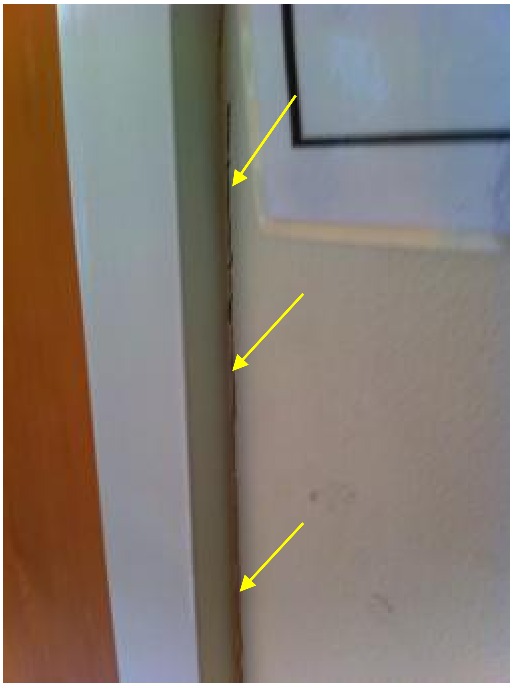
Photo 65: Northern Stairwell	Photo 66: Cracking Between Timber Stair Skirting and Wall Lining Joint in Eastern Stairwell
	
Photo 67: Cracking Between Wall Lining and Main Boat Shed Door Architraves	Photo 68: Close up of Photo 67

	
Photo 69: Severe Cracking to Wall Lining on the SouthWall (Bottom of Cracking)	Photo 70: Severe Cracking to Wall Lining on the South Wall (Top of Cracking)
	
Photo 71: Close up of Cracking on SouthWall	Photo 72: Horizontal Hairline Crack at Wall Lining Joint on North Wall

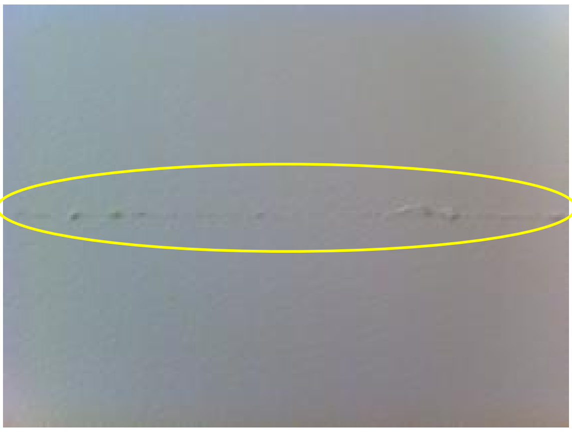
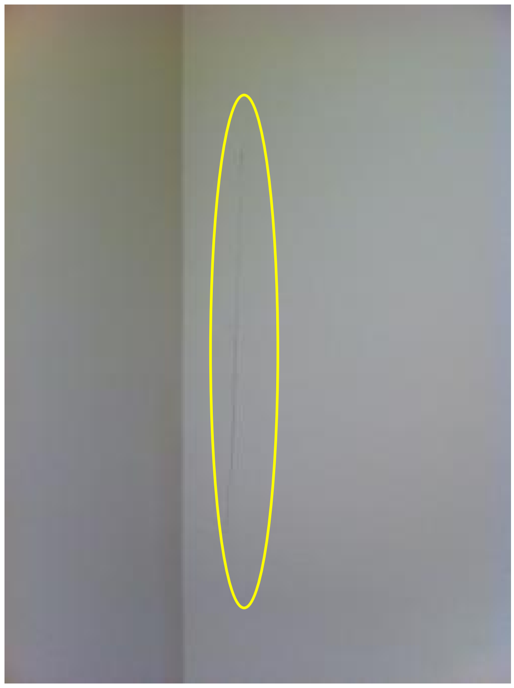
	

Photo 73: Close up of Photo 72	Photo 74: Vertical Cracking to Wall Lining in NW Corner of Mid-Height Stair Landing

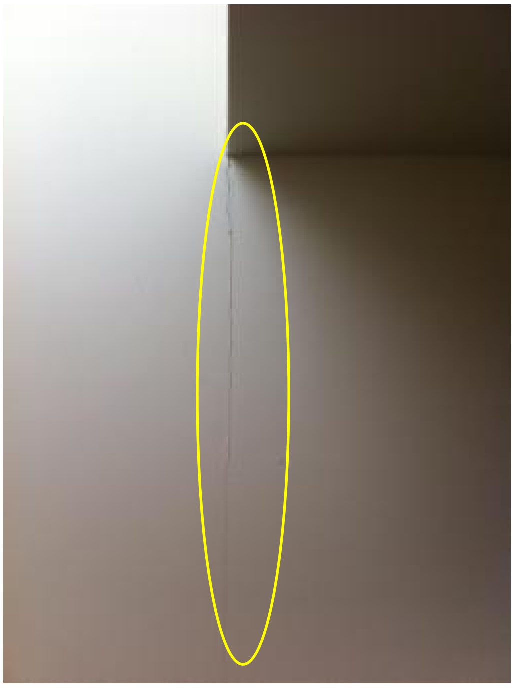



Photo 75: Vertical Crack at Wall Lining Joint on East Wall of Mid-Height Stair Landing	Photo 76: Hairline Cracking around Ceiling Bulkhead and Wall Lining Joint

	
Photo 77: Vertical Hairline Crack at Wall Lining Joint above Door in the Communications Room	Photo 78: Horizonatl Crack at Wall Lining Joint Between Windows in Communication Room

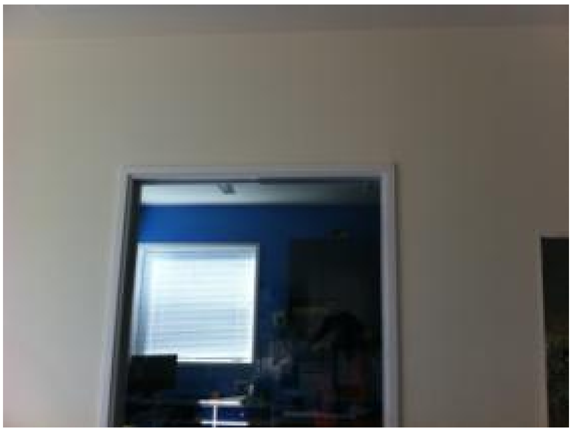
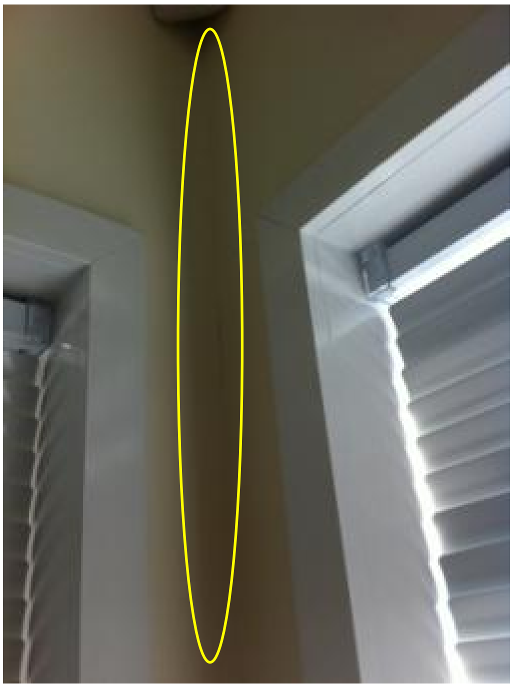



Photo 79: Mitre Joints on the Communication Room Door Architrave have Opened up	Photo 80: Close up of Photo 79

	
Photo 81: Mitre Joints on Window and Door architraves in the Kitchen have Opened up	Photo 82: Close up of Photo 81
	
Photo 83: Vertical Hairline Crack at Wall Lining Joint on South Wall of Kitchen	Photo 84: Hairline Cracking in SW Corner of Kitchen

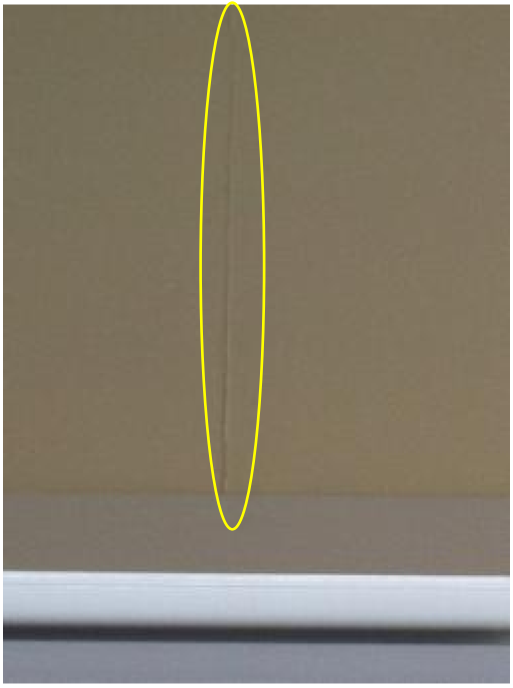
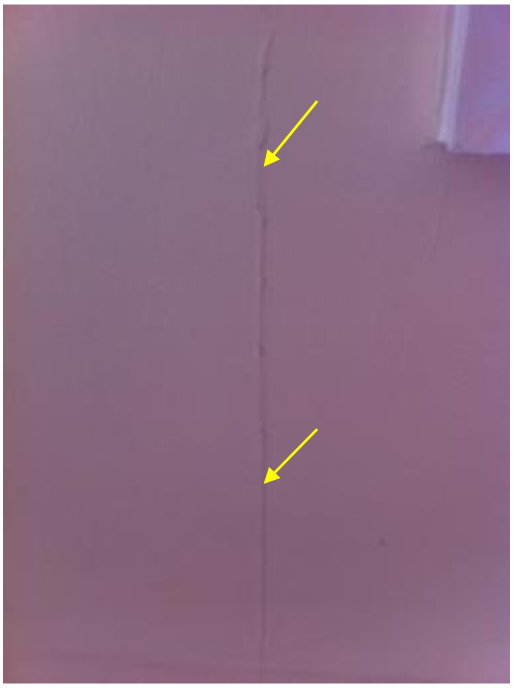
	
Photo 85: Vertical Hairline Crack at Wall Lining Joint on South Wall in L1 Main Room	Photo 86: Close up of Photo 85
	
Photo 87: Hairline Crack at wall Lining Joint above Corcertina door	Photo 88: Vertical Hairline Crack on North Wall of L1 Main Room

	
Photo 89: Vertical Hairline Crack on North Wall of L1 Main Room	Photo 90: Close up of Photo 89
	
Photo 91: Internal View of L1 Main Room	Photo 92: Vertical Hairline Crack at Wall Lining Joint Next to South Stair

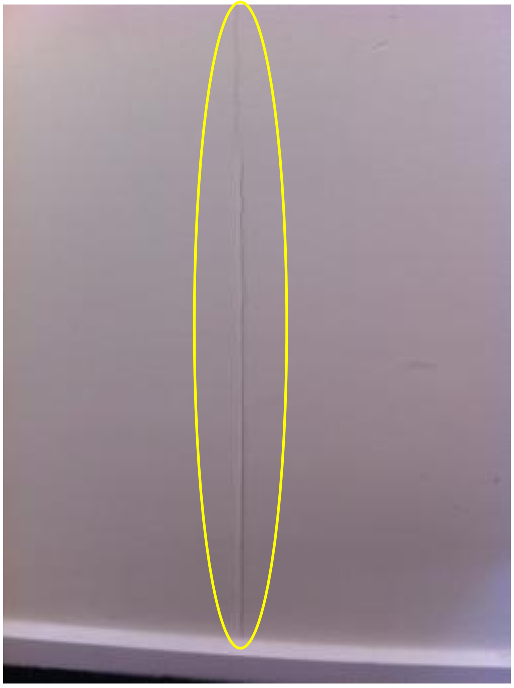


Photo 93: Close up of Photo 92

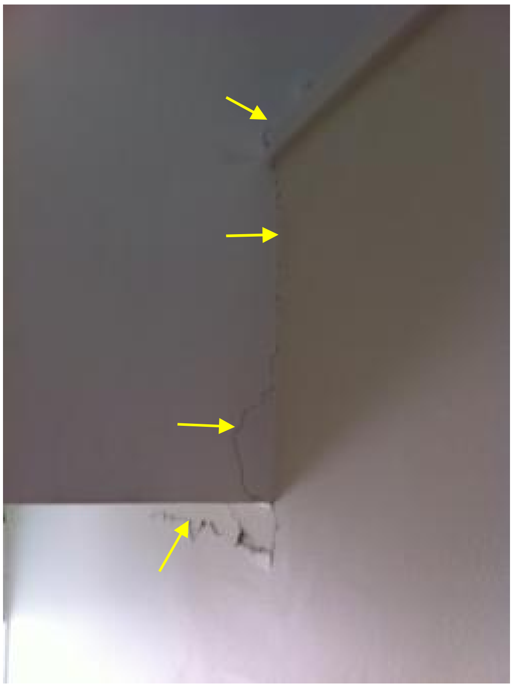


Photo 94: Cracking in Bulkhead Linings in South Stair

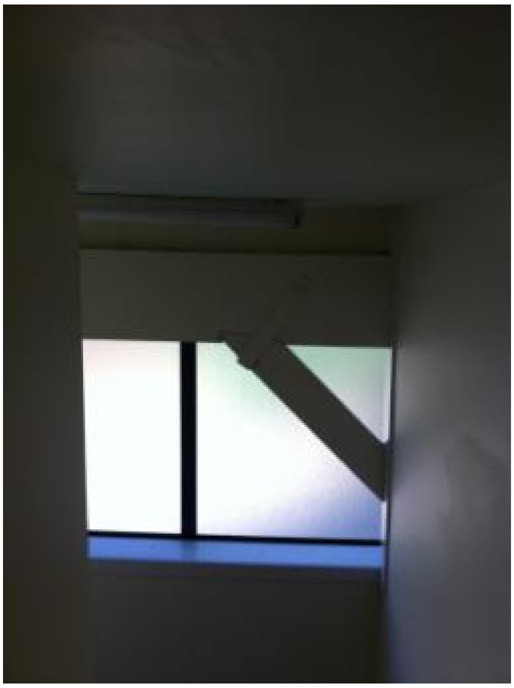


Photo 95: Cracking around Timber Brace in South Stair

Photo 96: Close up of Photo 95

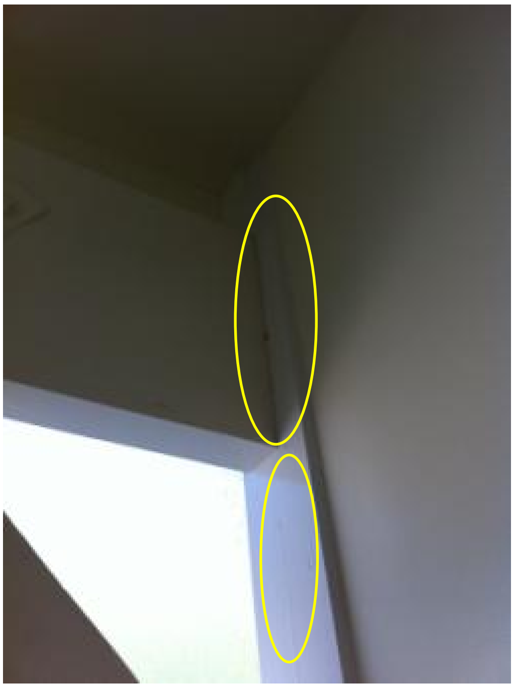
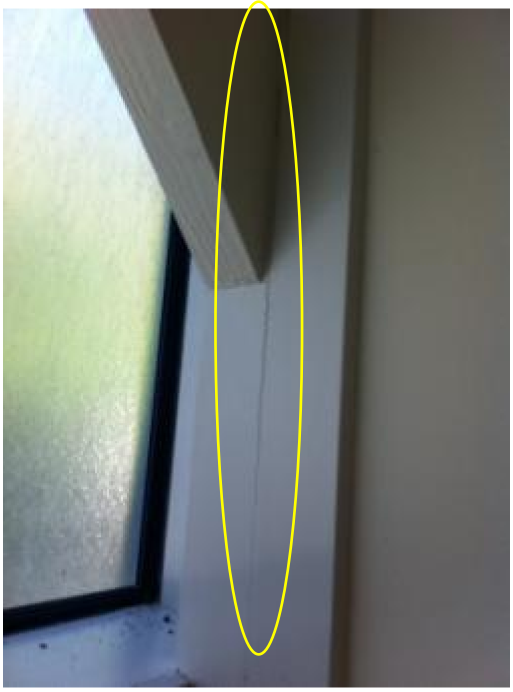
	

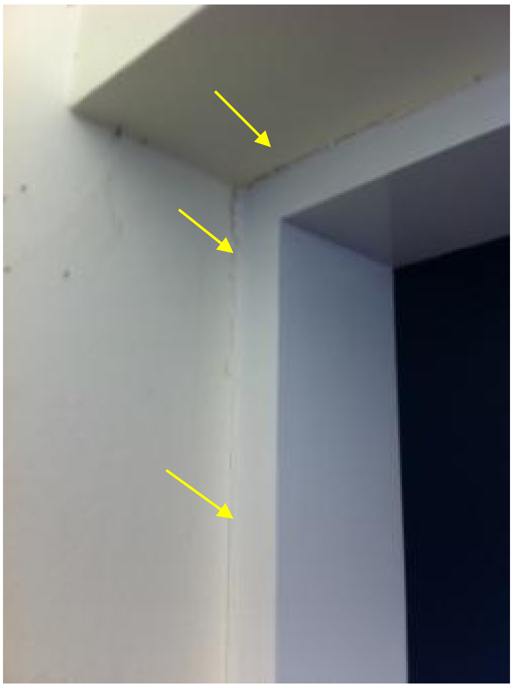
Photo 97: Cracking Present to Window Architrave in SE corner of South Stair	Photo 98: Close up of Photo 97
	
Photo 99: Cracking above East Exit Door in West Stair	Photo 100: Cracking around East Exit Door

	
Photo 101: Close up of Photo 100	Photo 102: Mitre Joints in First aid Room Door architrave have Opened up

12. Appendix 2 – IEP Report

Table IEP-1 **Initial Evaluation Procedure – Step 1**

(Refer Table IEP - 2 for Step 2; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	PRK_1474_BLDG_001 EQ2 - Scarborough Lifeboat Shed	Ref.	ZB01276.50
Location:	Scarborough Beach	By	KW
		Date	10/05/2012

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)




1.2 Sketch of building plan

1.3 List relevant features

Building CCC-PRK-1474-005 is a two storey timber framed building that is used by the Scarborough Surf Lifesavers Club. The roof is constructed from timber framing and light weight corrugated steel cladding that is supported on the timber framed walls. The roof structure is supported by the timber framed walls along the north and south side of the building. The wall cladding consists predominately of timber weatherboards however there are concrete blocks wall located along the north side of the building. The concrete block walls are present on the bottom storey only and also form the northern wall of the jet-ski shed that was constructed as part of the building upgrade. The finished floor level of the jet-ski shed is below ground level and therefore the concrete block walls also act as retaining walls. The level 1 suspended floor is constructed from timber framing and is supported on the timber frame walls. There is a steel portal frame that has been installed at the west end of the main boat shed. The south-west corner of the building is founded on concrete bearers that are supported on cantilevering concrete piles whereas the remaining parts of the building appear to be founded on concrete strip footings and a concrete slab on grade. The original construction drawings are dated November 1979 and as a result we have taken a design period of 1976-1992 for our assessment. Lateral loads acting across and along the building will be resisted by the roof and wall linings. The steel portal frame present along the west end of the main boat shed will help to resist lateral loads acting across the building whereas the concrete block walls present along the north side of the building will help to resist lateral loads acting along the building.

1.4 Note information sources

	Tick as appropriate	
Visual Inspection of Exterior	✓	
Visual Inspection of Interior	✓	
Drawings (note type)	✓	Partial Structural
Specifications	☐	
Geotechical Reports	☐	
Other (list)	☐	

Inspection Date - 26/04/2012

Note that the drawings available do not show the alterations made to this structure.

Table IEP-2 Initial Evaluation Procedure – Step 2

(Refer Table IEP - 1 for Step 1; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	PRK_1474_BLDG_001 EQ2 - Scarborough Lifeboat Shed	Ref.	ZB01276.50
Location:	Scarborough Beach	By	KW
Direction Considered:	**Longitudinal & Transverse**	Date	10/05/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 2 - Determination of (%NBS)b

2.1 Determine nominal (%NBS) = (%NBS)nom

Pre 1935			○	See also notes 1, 3
1935-1965			○	
1965-1976	Seismic Zone;	A	○	
		B	○	
		C	○	See also note 2
1976-1992	Seismic Zone;	A	○	
		B	◉	
		C	○	
1992-2004			○	

b) Soil Type

From NZS1170.5:2004, Cl 3.1.3

A or B Rock	○
C Shallow Soil	○
D Soft Soil	◉
E Very Soft Soil	○

From NZS4203:1992, Cl 4.6.2.2

(for 1992 to 2004 only and only if known)

a) Rigid	◉	N-A
b) Intermediate	○	

c) Estimate Period, T

building Ht = 6 meters

	Longitudinal	Transverse	
Ac =			m2

Can use following:

		Longitudinal	Transverse
$T = 0.09h_n^{0.75}$	for moment-resisting concrete frames	○ MRCF	○ MRCF
$T = 0.14h_n^{0.75}$	for moment-resisting steel frames	○ MRSF	○ MRSF
$T = 0.08h_n^{0.75}$	for eccentrically braced steel frames	○ EBSF	○ EBSF
$T = 0.06h_n^{0.75}$	for all other frame structures	◉ Others	◉ Others
$T = 0.09h_n^{0.75}/A_c^{0.5}$	for concrete shear walls	○ CSW	○ CSW
T <= 0.4sec	for masonry shear walls	○ MSW	○ MSW

Where hn = height in m from the base of the structure to the uppermost seismic weight or mass.

Ac = ΣAi(0.2 + Lwi/hn)2

Ai = cross-sectional shear area of shear wall i in the first storey of the building, in m2

lwi = length of shear wall i in the first storey in the direction parallel to the applied forces, in m

with the restriction that lwi/hn shall not exceed 0.9

Longitudinal	Transverse	
0.2	0.2	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	16.5	$(\%NBS)_{nom}$
Transverse	16.5	$(\%NBS)_{nom}$

		Factor
Note 1: For buildings designed prior to 1965 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.25.	No	1
For buildings designed 1965 - 1976 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.33 - Zone A or 1.2 - Zone B	No	1
Note 2: For reinforced concrete buildings designed between 1976 -1984 (%NBS)nom by 1.2	No	1
Note 3: For buildings designed prior to 1935 multiply (%NBS)nom by 0.8 except for Wellington where the factor may be taken as 1.	No	1

Longitudinal	16.5	$(\%NBS)_{nom}$
Transverse	16.5	$(\%NBS)_{nom}$

Continued over page

Building Name:	PRK_1474_BLDG_001 EQ2 - Scarborough Lifeboat Shed	Ref.	ZB01276.50
Location:	Scarborough Beach	By	KW
Direction Considered:	**Longitudinal & Transverse**	Date	10/05/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

2.2 Near Fault Scaling Factor, Factor A
If T < 1.5sec, Factor A = 1

a) Near Fault Factor, N(T,D) 1
(from NZS1170.5:2004, Cl 3.1.6)

b) Near Fault Scaling Factor = 1/N(T,D) — **Factor A** 1.00

2.3 Hazard Scaling Factor, Factor B

Select Location: Christchurch

a) Hazard Factor, Z, for site
(from NZS1170.5:2004, Table 3.3)

Z = 0.3
Z 1992 = 0.8

Auckland	0.6	Palm Nth	1.2
Wellington	1.2	Dunedin	0.6
Christchurch	0.8	Hamilton	0.67

b) Hazard Scaling Factor

For pre 1992 = 1/Z

\# For 1992 onwards = Z 1992/Z

(Where Z 1992 is the NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))

Factor B 3.33

2.4 Return Period Scaling Factor, Factor C

a) Building Importance Level 2
(from NZS1170.0:2004, Table 3.1 and 3.2)

b) Return Period Scaling Factor from accompanying Table 3.1 — **Factor C** 1.00

2.5 Ductility Scaling Factor, D

a) Assessed Ductility of Existing Structure, μ
(shall be less than maximum given in accompanying Table 3.2)

Longitudinal	1.25	μ Maximum = 6
Transverse	1.25	μ Maximum = 6

b) Ductility Scaling Factor

For pre 1976 = k_μ

For 1976 onwards = 1

(where k_μ is NZS1170.5:2005 Ductility Factor, from accompanying Table 3.3)

Longitudinal	**Factor D**	1.00
Transverse	**Factor D**	1.00

2.6 Structural Performance Scaling Factor, Factor E

Select Material of Lateral Load Resisting System

Longitudinal Timber 1

Transverse Timber

a) Structural Performance Factor, S_p
from accompanying Figure 3.4

Longitudinal	Sp	0.93
Transverse	Sp	0.93

b) Structural Performance Scaling Factor

Longitudinal	$1/S_p$	**Factor E**	1.08
Transverse	$1/S_p$	**Factor E**	1.08

2.7 Baseline %NBS for Building, $(\%NBS)_b$
(equals $(\%NSB)_{nom}$ x A x B x C x D x E)

Longitudinal	59.5	(%NBS)b
Transverse	59.5	(%NBS)b

Table IEP-3 Initial Evaluation Procedure – Step 3

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

SKM

Building Name:	PRK_1474_BLDG_001 EQ2 - Scarborough Lifeboat Shed	Ref.	ZB01276.50
Location:	Scarborough Beach	By	KW
Direction Considered:	**a) Longitudinal**	Date	10/05/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness — **Effect on Structural Performance** (Choose a value - Do not interpolate) — **Building Score**

3.1 Plan Irregularity

Effect on Structural Performance	Severe	Significant	Insignificant	
	○	○	◉	Factor A: 1
Comment				

3.2 Vertical Irregularity

Effect on Structural Performance	Severe	Significant	Insignificant	
	○	○	◉	Factor B: 1
Comment				

3.3 Short Columns

Effect on Structural Performance	Severe	Significant	Insignificant	
	○	○	◉	Factor C: 1
Comment				

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2	Severe	Significant	Insignificant
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

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

Effect on Structural Performance	Severe	Significant	Insignificant	
	○ 0.5	○ 0.7	◉ 1	Factor E: 1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum.

Factor F 0.85

Record rationale for choice of Factor F:

Limited structural damage noted during inspection

3.7 Performance Achievement Ratio (PAR)
(equals A x B x C x D x E x F)

PAR 0.85

Initial Evaluation Procedure – Step 3

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	PRK_1474_BLDG_001 EQ2 - Scarborough Lifeboat Shed	Ref.	ZB01276.50
Location:	Scarborough Beach	By	KW
Direction Considered:	**b) Transverse**	Date	10/05/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

Step 3 - Assessment of Performance Achievement Ratio (PAR)

(Refer Appendix B - Section B3.2)

Critical Structural Weakness	**Effect on Structural Performance** (Choose a value - Do not interpolate)	**Building Score**

3.1 Plan Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor A**	1
Comment					

3.2 Vertical Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor B**	1
Comment					

3.3 Short Columns

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor C**	1
Comment					

3.4 Pounding Potential

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:
Values given assume the building has a frame structure. For stiff buildings (eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1 1

Table for Selection of Factor D1

	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2

	Severe	Significant	Insignificant
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

Factor D 1

(Set D = lesser of D1 and D2 or..
set D = 1.0 if no prospect of pounding)

3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)

	Severe	Significant	Insignificant		
Effect on Structural Performance	○ 0.5	○ 0.7	◉ 1	**Factor E**	1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 0.85

Record rationale for choice of Factor F:

Limited structural damage noted during inspection

3.7 Performance Achievement Ratio (PAR)

(equals A x B x C x D x E x F)

PAR 0.85

Initial Evaluation Procedure – Steps 4, 5 and 6

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 3 for Step 3)

SKM

Building Name:	PRK_1474_BLDG_001 EQ2 - Scarborough Lifeboat Shed	Ref.	ZB01276.50
Location:	Scarborough Beach	By	KW
Direction Considered:	**Longitudinal & Transverse**	Date	10/05/2012
	(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)		

Step 4 - Percentage of New Building Standard (%NBS)

	Longitudinal	Transverse
4.1 Assessed Baseline $(\%NBS)_b$ (from Table IEP - 1)	59	59
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	0.85	0.85
4.3 PAR x Baseline $(\%NBS)_b$	50	50
4.4 Percentage New Building Standard (%NBS) (Use lower of two values from Step 4.3)		50

Step 5 - Potentially Earthquake Prone?
(Mark as appropriate)

%NBS ≤ 33 NO

Step 6 - Potentially Earthquake Risk?

%NBS < 67 YES

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade C

Evaluation Confirmed by

[signature] Signature

Nick Calvert Name

242062 CPEng. No

Relationship between Seismic Grade and % NBS :

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	80 to 67	67 to 33	33 to 20	< 20

13. Appendix 3 – CERA Standardised Report Form

Location

Building Name:	PRK_1474_BLDG_001 EQ2	Reviewer:	Nick Calvert
	Unit / No: / Street	CPEng No:	242062
Building Address:	Scarborough Lifeboat Shed / Scarborough Beach	Company:	SKM
Legal Description:		Company project number:	ZB01276.50
		Company phone number:	03 940 4900
	Degrees / Min / Sec		
GPS south:		Date of submission:	
GPS east:		Inspection Date:	26/04/2012
		Revision:	B
Building Unique Identifier (CCC):		Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	mixed	Soil Profile (if available):	(unknown) refer to geotech desktop study attached in SKM report
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	1			
Foundation type:	other (describe)		if Foundation type is other, describe:	combination of concrete piles and strip footings
Building height (m):	6.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	6
Floor footprint area (approx):	150			
Age of Building (years):	33		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description:	
Use (upper floors):	other (specify)			
Use notes (if required):	used as offices and storage for lifesaving club			
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls			
Roof:	timber framed		rafter type, purlin type and cladding	Timber trusses supporting timber purlins and light weight corrugated steel cladding
Floors:	timber		joist depth and spacing (mm)	360x50 - 400crs
Beams:	timber		type	unknown
Columns:	load bearing walls		typical dimensions (mm x mm)	timber walls - approx 150x50 stud and 190mm thick concrete block walls
Walls:		Tmber framed walls		

Lateral load resisting structure

Lateral system along:	other (note)	**Note: Define along and across in detailed report!**	describe system	linings will provide diaphragm
Ductility assumed, μ:	1.25			
Period along:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	5		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	0		estimate or calculation?	estimated
Lateral system across:	other (note)		describe system	linings will provide diaphragm
Ductility assumed, μ:	1.25			
Period across:	0.10	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):	20		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	0		estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:	timber	describe supports	unknown
Wall cladding:	other light	describe	timber weatherboards
Roof Cladding:	Metal	describe	light weight corrugate
Glazing:	aluminium frames		Gib Llinings
Ceilings:	plaster, fixed		
Services(list):	lighting, sprinklers etc		

Available documentation

Architectural	none	original designer name/date	
Structural	partial	original designer name/date	CCC - Engineers Dated 1979
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:	1	Describe damage:	hill side instability to hill behind jet boat shed
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	0-50mm	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	0-20mm/20m	notes (if applicable):	
Damage to area:	moderate to substantial (1 in 5)	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	15%	Describe how damage ratio arrived at:	minor structural damage observed
	Describe (summary):			
Across	Damage ratio:	15%		
	Describe (summary):			

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

Diaphragms	Damage?:	yes	Describe:	cracking to wall linings and concrete block walls
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	cracking to linings and minor cracking to concrete elements

Recommendations

Level of repair/strengthening required:	minor structural	Describe:	as noted above - refer to SKM Qualitative report - section 6 for detailed descriptions
Building Consent required:	yes	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	

Along	Assessed %NBS before:	59%	%NBS from IEP	If IEP not used, please detail assessment methodology:	NZSEE IEP used, refer to SKM Qualitative Report
	Assessed %NBS after:	50%			
Across	Assessed %NBS before:	59%	%NBS from IEP		
	Assessed %NBS after:	50%			

14. Appendix 4 – Geotechnical Desk Study

Sinclair Knight Merz
142 Sherborne Street
Saint Albans
PO Box 21011, Edgeware
Christchurch, New Zealand

Tel: +64 3 940 4900
Fax: +64 3 940 4901
Web: www.globalskm.com

Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	050 to 051
Address	2 Scarborough Beach
Report date	03 April 2012
Author	Ross Roberts / Ananth Balachandra / David Bae
Reviewer	Leah Bateman
Approved for issue	Yes

1. Introduction

This report outlines the geotechnical information that Sinclair Knight Merz (SKM) has been able to source from our database and other sources in relation to the property listed above. We understand that this information will be used as part of an initial qualitative Detailed Engineering Evaluation, and will be supplemented by more detailed information and investigations to allow detailed scoping of the repair or rebuild of the building.

2. Scope

This geotechnical desk top study incorporates information sourced from:

- Published geology
- Publically available borehole records
- Liquefaction records
- Aerial photography
- Council files
- A preliminary site walkover

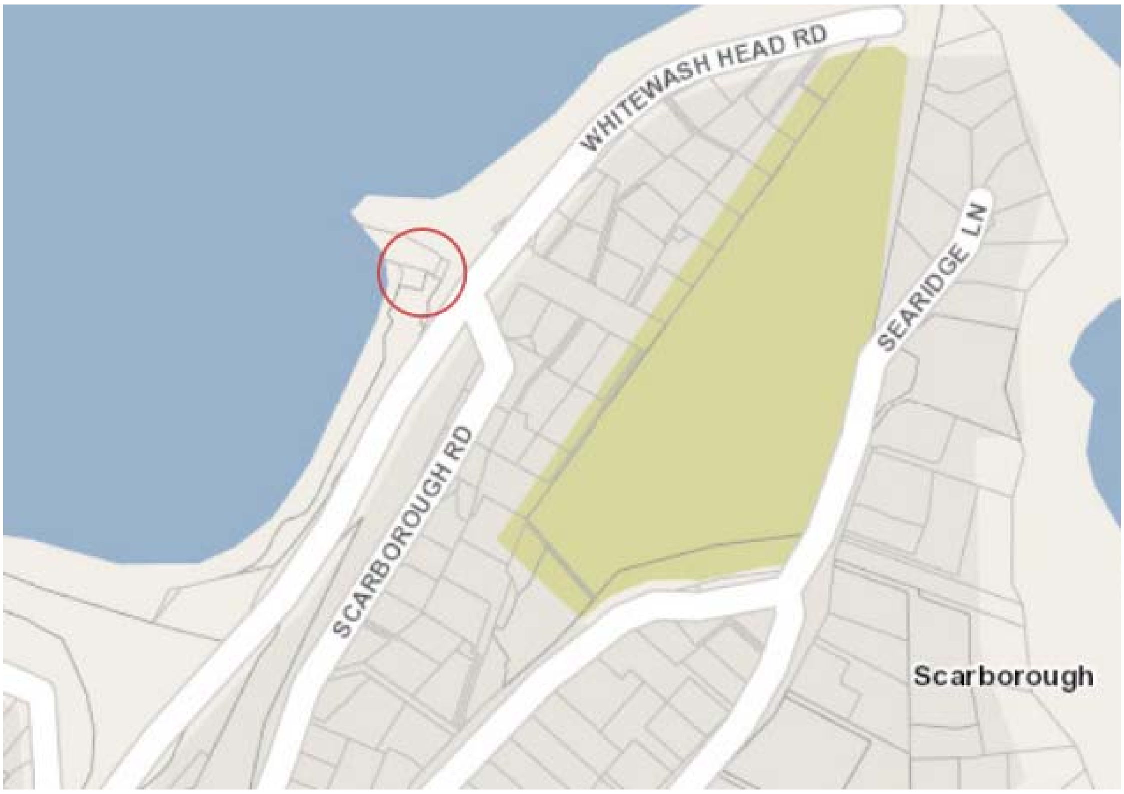
3. Limitations

This report was prepared to address geotechnical issues relating to the specific site in accordance with the scope of works as defined in the contract between SKM and our Client. This report has been prepared on behalf of, and for the exclusive use of, our Client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and our Client. The findings presented in this report should not be applied to another site or another development within the same site without consulting SKM.

The assessment undertaken by SKM was limited to a desktop review of the data described in this report. SKM has not undertaken any subsurface investigations, measurement or testing of materials from the site. In preparing this report, SKM has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by our Client, and from other sources as described in the report. Except as otherwise stated in this report, SKM has not attempted to verify the accuracy or completeness of any such information.

This report should be read in full and no excerpts are to be taken as representative of the findings. It must not be copied in parts, have parts removed, redrawn or otherwise altered without the written consent of SKM.

4. Site location

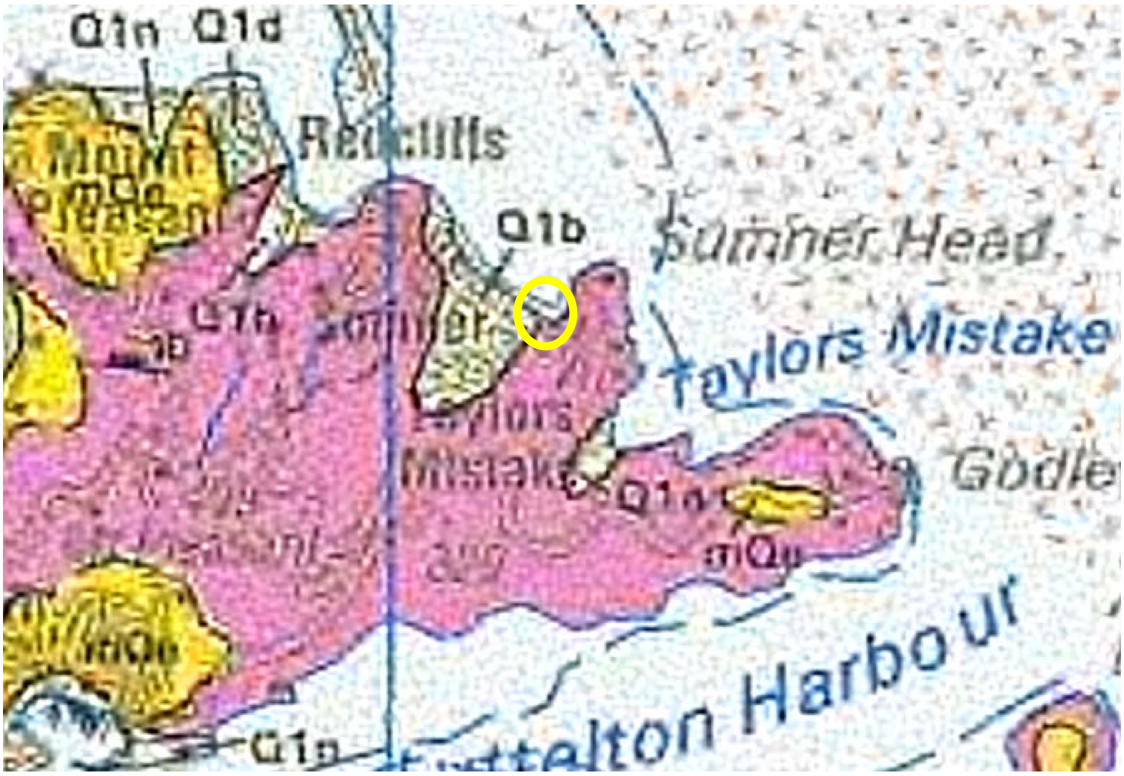


- **Figure 1 – Site location (courtesy of LINZ http://viewers.geospatial.govt.nz)**

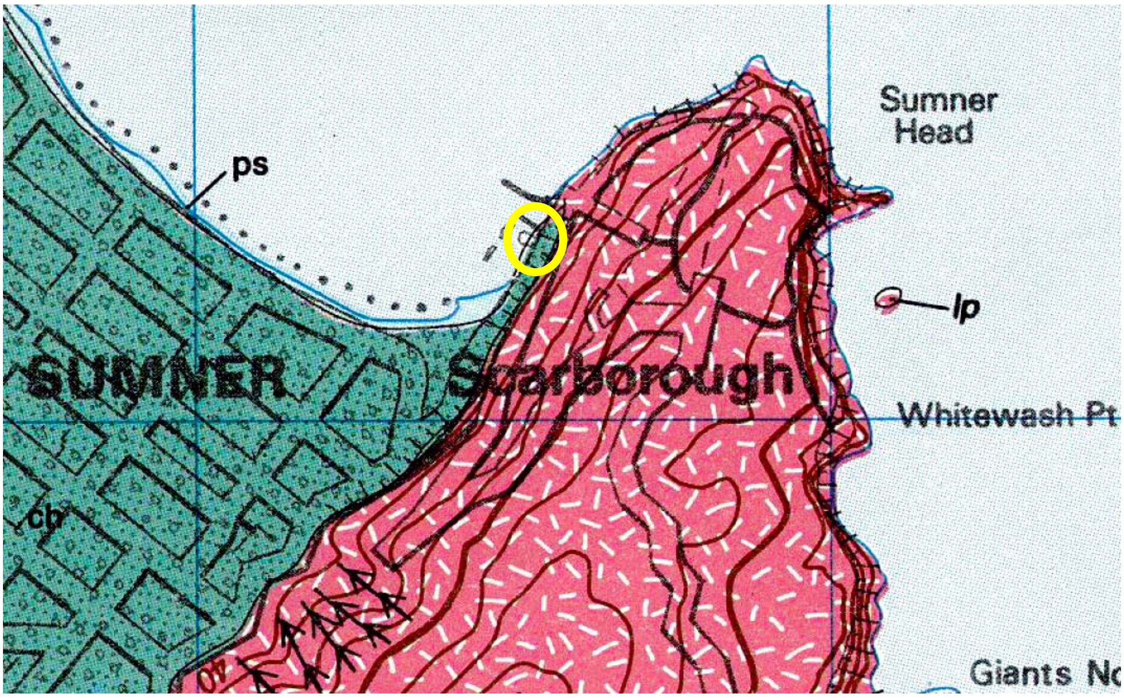
These structures are located on 2 Scarborough Beach at grid reference 1581571 E, 5175723 N (NZTM).

5. Review of available information

5.1 Geological maps



- **Figure 2 – Regional geological map (Forsyth et al, 2008). Site marked in yellow.**



- **Figure 3 – Local geological map (Brown et al, 1992). Site marked in yellow.**

The site is shown to be underlain by Holocene deposits comprising dominantly sands of fixed and semi-fixed dunes and beaches from the Christchurch formation. Immediately to the north, east and south-east of the site, the respective areas are underlain by Miocene deposits comprising dark grey, plagioclase-pyroxene-amphibole, phyric hawaiite through to grey-green trachyte with interbedded red-brown pyroclastic deposits.

5.2 Liquefaction map

The reconnaissance undertaken by M Cubrinovsko and M Taylor of Canterbury University following the 22 February 2011 earthquake did not extend to this area.

5.3 Aerial photography

- **Figure 4 – Aerial photography from 24 Feb 2011 (http://viewers.geospatial.govt.nz/)**

No damage to the structure, adjacent road and land can be observed from aerial photographs following the 22nd February 2011 earthquake event. Details of land damage are given in Section 5.8. No liquefied material is visible at the surface.

5.4 CERA classification

A review of the LINZ website (http://viewers.geospatial.govt.nz/) shows that the site is:

- Zone: No zone specified. Area surrounding the site is specified as green zone
- DBH Technical Category: On the boundary of N/A (Urban Non-residential) and N/A (Port Hills and Banks Peninsula)

5.5 Historical land use

No record of historical land use for this site was available.

5.6 Existing ground investigation data

No existing ground investigation data near the site was available.

5.7 Council property files

The available council records were limited to building consents applied for the alterations and additions to the existing lifeboat shed and other documents relating to the above construction. The council record identifies the site to be in a very high wind zone. The building is on reclaimed land and classified as being in the sea spray zone. No ground investigation was found in the council property files.

Drawings for the lifeboat shed show a slab-on-grade concrete foundation on the east side of the building. The main foundation consists of reinforced concrete piles with square section of 300 mm by 300 mm spaced along the wall (depth and spacing not recorded). Concrete piles of 600 mm diameter are provided as intermediate support for beams running through the centre of the building. Two shear walls, 1500 mm long by 200 mm wide (depth not recorded), are connected to the edge piles near the slipway. Drawings for the slipway show 600 mm diameter concrete piles were utilised with the existing 150 mm by 100 mm timber posts. The spacing between piles ranged from 1.6 m to 4.0 m.

5.8 Site walkover

A walkover inspection of the site was undertaken by a Geotechnical Engineer from SKM on 11 May 2012.

The site comprises two separate buildings located on the west side of Whitewash Head Road. The buildings are constructed using a combination of timber framed and masonry walls. One of the buildings, the lifeboat shed, is supported on combined slab-on-grade and concrete pile foundations. Damage noted from the external inspection consisted of minor cracking and spalling of the concrete floor slab and masonry wall.

The jet boat shed building has experienced pooling of water on the ground floor since the February 2011 earthquake. Excavation work is currently being undertaken on the east side of the building to prevent further flooding.

During the site walkover, there was no apparent evidence of surface expression of liquefaction. No signs of residual evidence were observed that would indicate liquefaction had occurred, such as undulating ground, ejected materials, settlement of buildings and raised manhole lids in road pavements. Minor cracks in the concrete kerb and pavement were observed during the inspection. Other evidence of land damage such as ground fissures or lateral spreading was not apparent on the site.

The slope behind the jet boat shed has been supported by Shotcrete (see Appendix B, Photos 1 and 2). The annotated aerial photo in Appendix C shows the location of the site walkover observations. The slope north and south of the jet boat shed is supported by dry stacked boulders. These appear to have performed satisfactorily with minimal movement adjacent to the boat shed, however, behind the historic boat shed to the south, the boulder wall collapsed during the 13 June event (see Appendix B, Photos 3 and 4).

The road above at hairpin looks to have moved approximately 15mm (see Appendix B, Photos 5 and 6) northwest as shown by the crack in the footpath. This is likely to be related to movement of fill or damage of underground services and not an indication of large scale rock movement.

From site observations, there does not appear to be any stability issues related to the slope behind the jet boat shed.

6. Conclusions and recommendations

6.1 Site geology

No inference on the site geology has been made in this desk study due to lack of geotechnical investigation data.

6.2 Seismic site subsoil class

Due to a lack of geotechnical information, seismic class D should be conservatively used.

As described in NZS1170, the preferred site classification method is from site periods based on four times the shear wave travel time through material from the surface to the underlying rock. The next preferred methods are from borelogs including measurement of geotechnical properties or by evaluation of site periods from Nakamura ratios or from recorded earthquake motions. Lacking this information, classification may be based on boreholes with descriptors but no geotechnical measurements. The least preferred method is from surface geology and estimates of the depth to underlying rock.

In this case with a distinct lack of intrusive investigation the least preferred method has been used. The seismic class may be changed following geotechnical investigation.

6.3 Building Performance

Although detailed records of the existing foundations are not available, the performance to date suggests that they are adequate for their current purpose.

6.4 Ground performance and properties

No liquefaction appears to have occurred due to the 22nd February earthquakes. However, further site specific investigations would be needed to make a full liquefaction assessment of the site.

Due to the lack of geotechnical investigation data, an estimation of the ground properties for this site has not been made in this desk study.

6.5 Further investigations

Due to a lack of existing information for the purpose of carrying out a Quantitative DEE then a conservative seismic class should be used. There was no liquefaction observed at the site following the February or June 2011 earthquakes, therefore we can assume that liquefaction risk is insignificant at this site.

If design works need to be carried out or a building consent obtained then a geotechnical investigation will be required as there is considerable uncertainty of where the geological boundary between the sand dunes and volcanic material occurs.. Therefore, further investigations recommended are:

- Two boreholes to a minimum depth of 20m or into 3m of competent rock

- Two dynamic cone penetration tests to estimate the properties of the surface soil if appropriate.

7. References

Brown LJ, Weeber JH, 1992. Geology of the Christchurch urban area. Scale 1:25,000. Institute of Geological & Nuclear Sciences geological map 1.

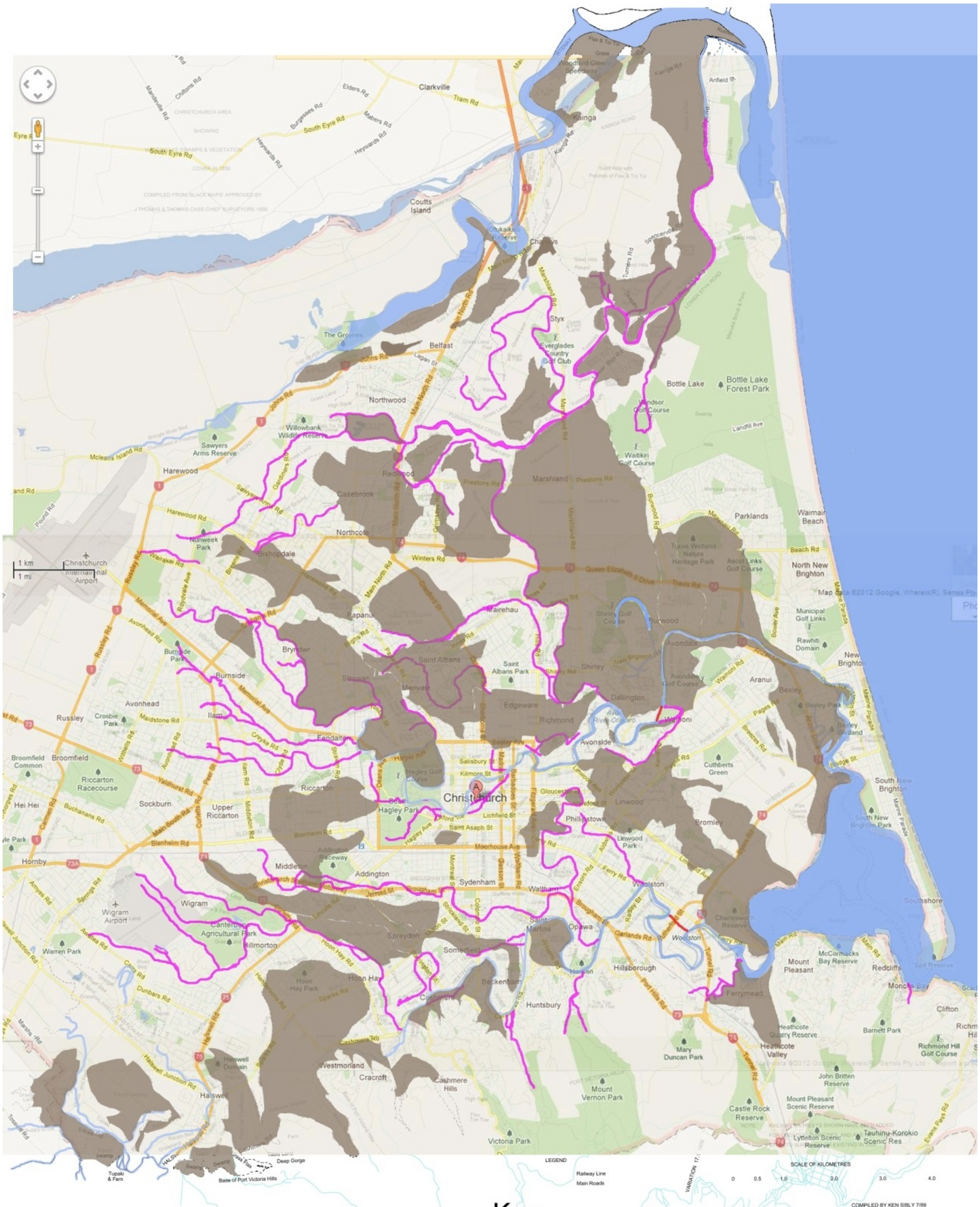
Cubrinovski & Taylor, 2011. Liquefaction map summarising preliminary assessment of liquefaction in urban areas following the 2010 Darfield Earthquake.

Forsyth PJ, Barrell DJA, Jongens R, 2008. Geology of the Christchurch area. Institute of Geological & Nuclear Sciences geological map 16.

Land Information New Zealand (LINZ) geospatial viewer (http://viewers.geospatial.govt.nz/)

EQC Project Orbit geotechnical viewer (https://canterburyrecovery.projectorbit.com/)

Appendix A – Christchurch 1856 land use



The swamps and previous creeks/rivers from 1856 have been overlayed onto a map of Christchurch in 2012

Key

- Previous creeks/rivers
- Existing creeks/rivers
- New creeks/rivers
- Swamp/Marshland

Appendix B – Site Photos

Photo 1 – Shotcrete wall behind jet boat shed.

Photo 2 – Shotcrete wall behind jet boat shed

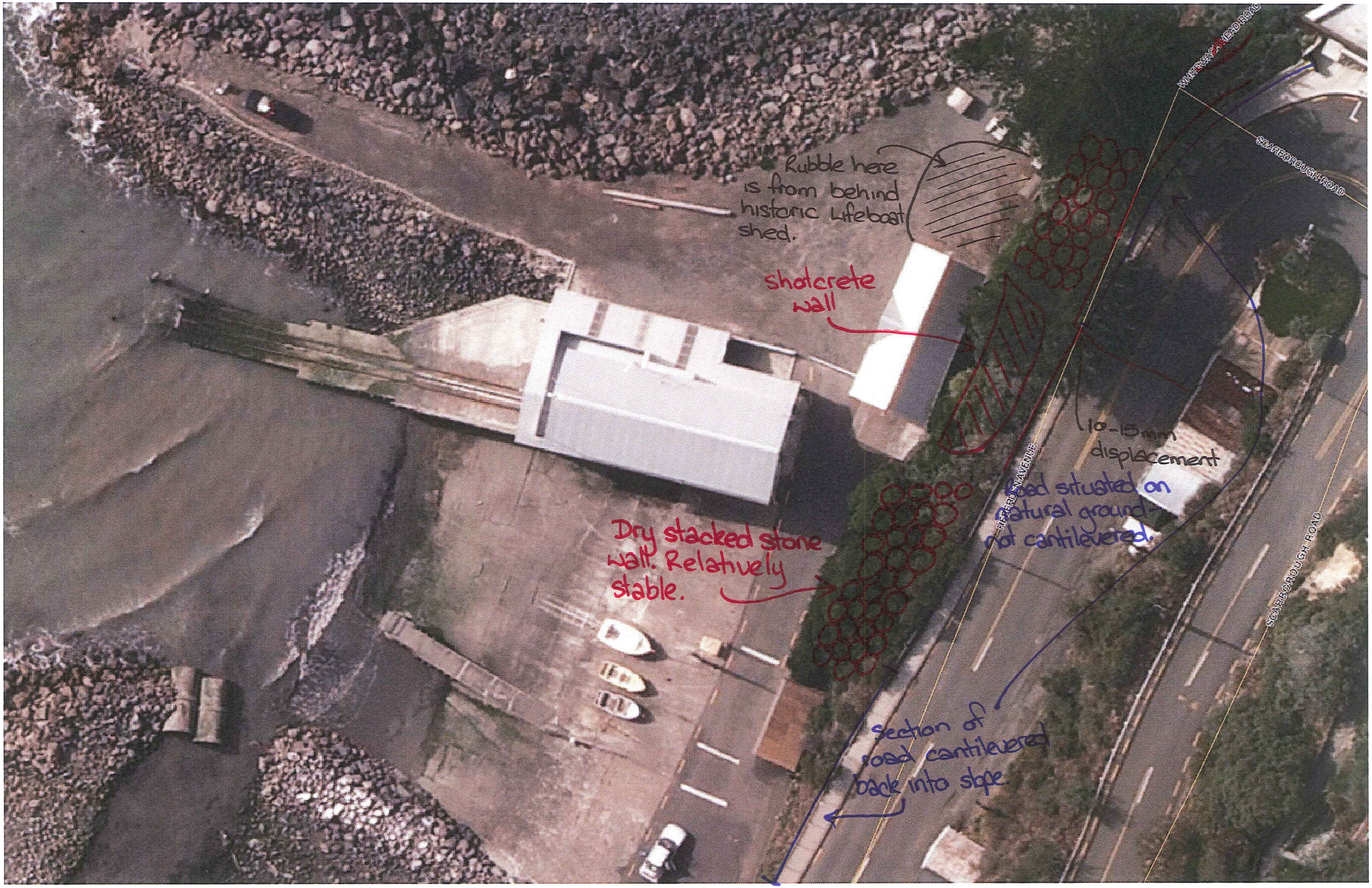
Photo 3 – Sand bags supporting dry stacked boulder wall that collapsed behind historic boat shed. Wall to right is still standing.

Photo 4 – Rubble removed from behind historic boat shed.

Photo 5 – 15mm offset in footpath due to movement of the cantilevered road section.

Photo 6 – Section of road which has moved approximately 15mm (looking north).

Appendix C – Annotated Aerial Photo



SCARBOROUGH ROAD
Rubble here is from behind historic Lifeboat shed.
Shotcrete wall
10-15mm displacement
Road situated on natural ground-not cantilevered.
Dry stacked stone wall. Relatively stable.
Section of road cantilevered back into slope.
SCARBOROUGH ROAD