Christchurch City Council
PRK_1482_BLDG_002 EQ2
Taylors Mistake Bay -Toilets
Taylors Mistake Foreshore

QUALITATIVE ASSESSMENT REPORT
FINAL

- Rev B
- 08 November 2012

Christchurch City Council

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Taylors Mistake Bay – Toilets
Taylors Mistake Foreshore

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Contents

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1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on the building PRK_1482_BLDG_002 EQ2 located on Taylors Mistake Foreshore. The building located on this site comprises of changing rooms, toilets and a services and storage room. The roof structure consists of polycarbonate roofing supported on a steel CHS framed roof. The framed roof is supported by CHS columns bolted to the top of the masonry shear walls which make up the lateral resistance of the building. The building appears to be less than 20 years of age. An aerial photograph illustrating the building is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type are given in Section 5 of this report.

- **Figure 1: Aerial Photograph of PRK_1482_BLDG_002 EQ2 Taylors Mistake Toilet**

The qualitative assessment includes a summary of the building 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 and visual inspection on 27th of June 2012. No structural drawings were available.

1.2. Key Damage Observed

Key damage observed includes:-Separation between vertical masonry blocks.

1.3. Critical Structural Weaknesses

- The building has no critical structural weaknesses

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 98%NBS and post earthquake capacity in the order of 98%NBS. The buildings post earthquake capacity excluding critical structural weaknesses is in the order of 98%NBS. This assessment has been made without structural drawings and is accordingly limited.

The building has been assessed to have a seismic capacity in the order of 98% NBS and is therefore not potentially earthquake prone.

Please note that structural strengthening is 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 of green 1 remain as is.
b) We consider that barriers around the building are not necessary.

2. Introduction

Sinclair Knight Merz was engaged by Christchurch City Council to prepare a qualitative assessment report for the building located at Taylors Mistake Foreshore public toilets 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" (part 2 revision 5 dated 19/07/2011 and part 3 draft revision dated 13/12/2011). The qualitative assessment includes a summary of the building damage as well as an initial assessment of the likely current Seismic Capacity compared with current seismic code 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 the 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 had been carried out. The building description below is based on a review of the drawings and our visual inspections.

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

3. Compliance

This section contains a 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 34%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	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

The building is located on Taylors Mistake Foreshore. There is only one building on this site. The building is a public toilet and changing rooms servicing Taylors Mistake Bay. The building is predominantly constructed of concrete masonry block work around the perimeter and separating the changing rooms and storage with light timber internal partitions separating the individual toilets and family rooms. The roof of the structure is constructed of a steel frame of CHS welded sections supported on short columns bolted to the top of the masonry walls. The building is supported on concrete strip foundations beneath the masonry walls and has a concrete slab on grade floor throughout.

Our evaluation was based on the site inspection on the 27th of June 2012.

As no drawings were available the building has been assumed to have been constructed between 1992 and 2004 and is likely less than 20 years old based on construction and site observations of the building.

5.2. Gravity Load Resisting system

The gravity load resisting structure of the building is made up of structural steel roof frames supported on short CHS columns which in return are supported by the fully filled masonry walls. Masonry walls are founded on concrete strip footings. A reinforced concrete slab on grade creates the ground floor area.

5.3. Seismic Load Resisting system

For the purposes of this report the longitudinal direction of the building is defined as being the long north-south direction and the transverse direction is defined as being in the east-west direction. See Figure 1 for clarification.

Lateral load on the buildings are carried from the roof frame to the masonry shear walls through bending and shear of the short CHS roof supports welded to the roof frame. The masonry shear walls transfer lateral loading to the foundations which offer resistance through overturning and bearing. The roof structure is also connected to a central roof column at the roof supports by tension members this may be an architectural feature or provide limited restraint for the short support columns in bending.

5.4. Geotechnical Conditions

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

Liquefaction risk is low at this site. As mentioned above no evidence of liquefaction was observed at the site or around the Taylor's Mistake flat land area. The geological conditions at the sand i.e. sands of beach origin are not typically susceptible to liquefaction.

For the purposes of carrying out a Quantitative Detailed Engineering Evaluation the engineer can assume this site is 'good ground' (as defined in NZS3604:2011) and therefore the following parameters are recommended for the shallow materials:

Parameter	Estimated value
Effective angle of friction	34 degrees
Apparent cohesion	0 kPa
Unit weight	18 kPa
Ultimate bearing capacity of a shallow square pad footing	300 kPa

NOTE: These figures are based on geological data from outside the site for the purposes of preliminary structural assessment. These parameters should not be relied upon for any design work. Site specific investigations are required to confirm that these assumed values are correct. Additionally, further geotechnical investigation could potentially increase the ultimate bearing capacity stated above.

Unless a change of use is intended for the site we do not believe that any further geotechnical investigations are required. Specific ground investigation should be undertaken if significant alterations or new structures are proposed. If any excavations are required on the site further investigation of the potential for contamination should be undertaken. The full geotechnical desktop study can be found in Appendix 4 – Geotechnical Desktop Study

6. Damage Summary

SKM undertook inspections on the following dates 27th of June 2012. The following areas of damage were observed during the time of inspection:

1) Separation of the stacked masonry block work from adjacent stacks
   See photos : 9-12
2) Separation of the concrete footpaths from the masonry strip footings.
   See photos: 13-16
3) Hairline cracking to concrete drainage unit on north west corner
   See photos: 17-18

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].

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[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 collapse or other forms of 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.

The NZ Building Code describes that the relevant codes for determining %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
- NZS 3604:2011 Timber Framed Buildings

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

7.2. Design Criteria and Limitations

Following our inspection on the 27th of June 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. Please note no intrusive investigations were undertaken.
- Structural drawings were not available

The design criteria used to undertake the assessment include:

- Standard design assumptions for typical office and factory 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. The ductility of 1.25 has been used for both the steel framed roof structure and masonry walls based on the steel ratios of the assumed design period.
  - Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011

This IEP was based on our visual inspection of the building. 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 was there any significant ground movement issues around the building. The building is adjacent to land which is zoned TC1 under the CERA Residential Technical Categories Map. The combination of these factors means that we do not recommend that any survey be undertaken at this point.

7.4. Critical Structural Weaknesses

The building has no critical structural weaknesses:

7.5. Qualitative Assessment Results

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

Table 3: Qualitative Assessment Summary

Item	%NBS
Building excluding CSW's	98%

Our qualitative assessment found that the building is likely to be classed as a grade A 'Low Risk Building' (capacity greater than 67% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.

Based on this assessment and the limited damage that the building has sustained, further investigation is not required.

As the building has been assessed to have a capacity greater than 67% NBS, there is no legal requirement for strengthening the building and no further investigation work is required.

8. Further Investigation

No further work is required.

9. Conclusion

A qualitative assessment was carried out on the building PRK_1482_BLDG_002 EQ2 located at Taylors Mistake Bay foreshore. The building has sustained minor damage to block work with separations between stacked masonry units through the mortar and to the surrounding paths with the paths having separated from the base of the masonry wall foundations.

The building has been assessed to have a seismic capacity in the order of 98% NBS and is therefore not potentially earthquake prone and is likely to be classified as a grade A ‘Low risk Building’ (capacity greater than 67% of NBS).

No critical structural weaknesses were found and no further investigation is required

Due to the low level of damage sustained by the building and the assessment of the building as being a “Low risk building” the building may continue to be used under full occupancy.

It is recommended that:

a) The current placard status of the building of green 1 remain as is .

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

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: Taylors Mistake Bay toilets and changing rooms

Photo 2: Structure consists of steel framed roof support by masonry shear walls via CHS columns

Photo 3: View along east support lines. Roof supports along west, centre and east lines with three supports per line, corner four supports also connected to central mast as shown in photo 3.

Photo 4: Support columns bolted to top of masonry walls via a base plate.

Photo 5: Base plate for roof support columns

Photo 6: Concrete strip foundations supporting the masonry shear walls

Photo 7: Footpath cast up to foundations with a concrete slab on grade cast within the structure

Photo 8: Typical corner detail with short blocks used to create a curve. Note blocks are stacked as opposed to staggered.

Photo 9: Separation of masonry along the mortar joint

Photo 10: Cracking of approximately 1mm on north east corner

Photo 11: Separation of masonry along mortar joint approximately 0.3mm

Photo 12: Separation of stacked masonry along mortar joint of approximately0.4mm

Photo 13: Corner of masonry structural walls

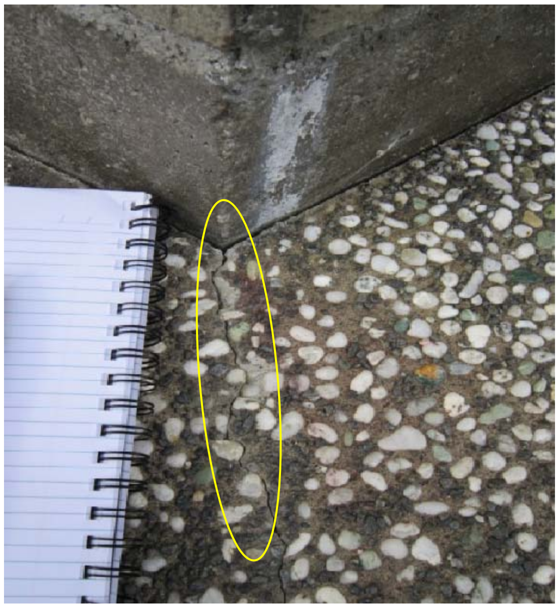


Photo 14: Separation of footpaths from the structure along join lines and cracking from structural corners

Photo 15: Separation of floor slabs from surrounding footpaths

Photo 16: Separation of internal floor and adjacent footpath of approximately 3mm in places with spalled area of concrete

	
Photo 17: Concrete drain.	**Photo 18:** Hairline cracking through drainage pit.

12. Appendix 2 – IEP Reports

Table IEP-1 Initial Evaluation Procedure – Step 1

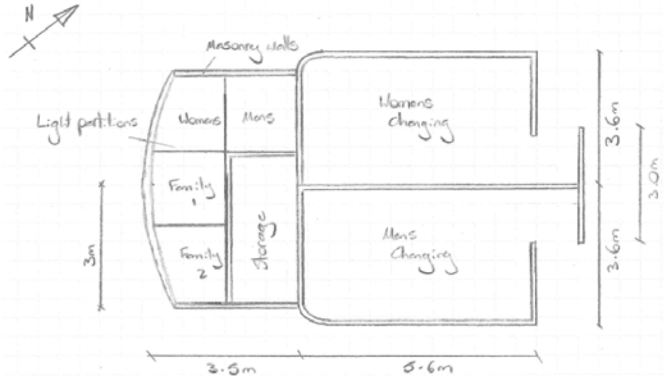
(Refer Table IEP - 2 for Step 2; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	**PRK_1482_BLDG_002 EQ2 Taylors Mistake Bay-Toilets**	Ref.	**ZB01276.177**
Location:	Taylors Mistake Bay foreshore	By	AFL
	Christchurch	Date	18/07/2012

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)

1.2 Sketch of building plan



1.3 List relevant features

The building is located on Taylors Mistake Foreshore approximately 90m from the waters edge. The structure consists of a suspended steel latice of welded Circular hollow sections supported by CHS columns bolted to the top of the masonry block walls. The support columns are also tied back to a central column. The structural shear walls are fully filled 200 series stacked concrete masonry blocks. The block work showed hairline cracking along the joints of the block in a number of loacations. The masonry walls are founded on perimeter concrete strip footings with slab on grade floors cast between these.

1.4 Note information sources

Tick as appropriate

Visual Inspection of Exterior	✓
Visual Inspection of Interior	✓
Drawings (note type)	
Specifications	
Geotechical Reports	✓
Other (list)	

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_1482_BLDG_002 EQ2 Taylors Mistake Bay-Toilets**	Ref.	**ZB01276.177**
Location:	Taylors Mistake Bay foreshore	By	AFL
Direction Considered:	**Longitudinal & Transverse**	Date	18/07/2012

(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 = 3 meters

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	
0.4	**0.4**	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	22.2	$(\%NBS)_{nom}$
Transverse	22.2	$(\%NBS)_{nom}$

			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	22.2	$(\%NBS)_{nom}$
Transverse	22.2	$(\%NBS)_{nom}$

Continued over page

Building Name:	PRK_1482_BLDG_002 EQ2 Taylors Mistake Bay-Toilets	Ref.	ZB01276.177
Location:	Taylors Mistake Bay foreshore	By	AFL
Direction Considered:	Longitudinal & Transverse	Date	18/07/2012

(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
Type Z 1992 above

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 2.67

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 Masonry Block
Transverse Masonry Block

a) **Structural Performance Factor, S_p**
from accompanying Figure 3.4

Longitudinal	Sp	0.90
Transverse	Sp	0.90

b) **Structural Performance Scaling Factor**

Longitudinal	$1/S_p$	**Factor E**	1.11
Transverse	$1/S_p$	**Factor E**	1.11

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

Longitudinal	65.8	(%NBS)b
Transverse	65.8	(%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)

Building Name:	**PRK_1482_BLDG_002 EQ2 Taylors Mistake Bay-Toilets**	Ref.	**ZB01276.177**
Location:	Taylors Mistake Bay foreshore	By	AFL
Direction Considered:	**a) Longitudinal**	Date	18/07/2012

(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

Separation	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant 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

Separation	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant 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	Factor E
	○ 0.5	○ 0.7	◉ 1	1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

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

Record rationale for choice of Factor F:

The factor of 1.5 has been chosen based on the size of the structure the good arrangement of return walls and cellular layout of the masonry walls.

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

PAR 1.5

(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_1482_BLDG_002 EQ2 Taylors Mistake Bay-Toilets	Ref.	ZB01276.177
Location:	Taylors Mistake Bay foreshore	By	AFL
Direction Considered:	**b) Transverse**	Date	18/07/2012

(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	Building Score
Effect on Structural Performance	○	○	◉	**Factor A** 1
Comment				

3.2 Vertical Irregularity

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

3.3 Short Columns

	Severe	Significant	Insignificant	Building Score
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	Building Score
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** 1.5

Record rationale for choice of Factor F:

The factor of 1.5 has been chosen based on the size of the structure the good arrangement of return walls and cellular layout of the masonry walls.

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

PAR 1.5

Table IEP-4 **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)

Building Name:	**PRK_1482_BLDG_002 EQ2 Taylors Mistake Bay-Toilets**	Ref.	**ZB01276.177**
Location:	Taylors Mistake Bay foreshore	By	AFL
Direction Considered:	**Longitudinal & Transverse**	Date	18/07/2012

(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)	65	65
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	1.50	1.50
4.3 PAR x Baseline (%NBS)$_b$	98	98
4.4 Percentage New Building Standard (%NBS) (Use lower of two values from Step 4.3)		98

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

%NBS ≤ 33 — NO

Step 6 - Potentially Earthquake Risk?

%NBS < 67 — NO

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade — **A**

Evaluation Confirmed by

Signature

JAMES CARTER Name

1017618 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

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	PRK_1482_BLDG_002 EQ2		Reviewer:	JAMES CARTER
	Unit	No: Street	CPEng No:	1017618
Building Address:	Taylors Mistake Bay Toilets	47 Taylors Mistake Bay Foreshore R	Company:	Sinclair Knight Merz
Legal Description:			Company project number:	ZB01276.177
			Company phone number:	027 320 7967
	Degrees	Min Sec		
GPS south:			Date of submission:	
GPS east:			Inspection Date:	27/06/2012
			Revision:	A
Building Unique Identifier (CCC):			Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	silty sand	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):	90	If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	2.00

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	2.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground				
Foundation type:	strip footings		if Foundation type is other, describe:	with slab on grade floors
Building height (m):	4.00		height from ground to level of uppermost seismic mass (for IEP only) (m):	3.5
Floor footprint area (approx):	65			
Age of Building (years):	15		Date of design:	1992-2004
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	public		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	steel framed	rafter type, purlin type and cladding	CHS purlins and rafters opaque plastic roofing
Floors:	concrete flat slab	slab thickness (mm)	125
Beams:	none	overall depth x width (mm x mm)	
Columns:	structural steel	typical dimensions (mm x mm)	76 mm diameter CHS
Walls:	fully filled concrete masonry	#N/A	

Lateral load resisting structure

Lateral system along:	fully filled CMU	**Note: Define along and across in detailed report!**	note total length of wall at ground (m):	6
Ductility assumed, μ:	1.25		wall thickness (m):	0.19
Period along:	0.40	0.11 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	60		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	60		estimate or calculation?	estimated
Lateral system across:	fully filled CMU		note total length of wall at ground (m):	7.2
Ductility assumed, μ:	1.25		wall thickness (m):	0.19
Period across:	0.40	0.09 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):	60		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):	60		estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:			no stairs
Wall cladding:			no wall cladding
Roof Cladding:	Other (specify)	describe	white corrugated polycarbonite
Glazing:			no glazing
Ceilings:			no ceilings within stalls or bathrooms
Services(list):			

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:
(refer DEE Table 4-2)

Site performance:		Describe damage:	Cracking to masonry joints
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	Separation of blockwork but not reducing in plane shear strength
	Describe (summary):	separation of stacked masonry		
Across	Damage ratio:	0%		
	Describe (summary):	separation of stacked masonry		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	Separation from surrounding paths

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

Recommendations

	Level of repair/strengthening required:	minor non-structural	Describe:	Re pointing of masonry
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	Low risk of collapse
Along	Assessed %NBS before:	98%	%NBS from IEP below	If IEP not used, please detail assessment methodology:
	Assessed %NBS after:	98%		
Across	Assessed %NBS before:	98%	%NBS from IEP below	
	Assessed %NBS after:	98%		

14. Appendix 4 – Geotechnical Desktop Study

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Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	177
Address	Taylors Mistake Foreshore
Report date	16 July 2012
Author	Dominic Hollands/ Ananth Balachandra
Reviewer	Ross Kendrick
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 DEE, 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
- 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.

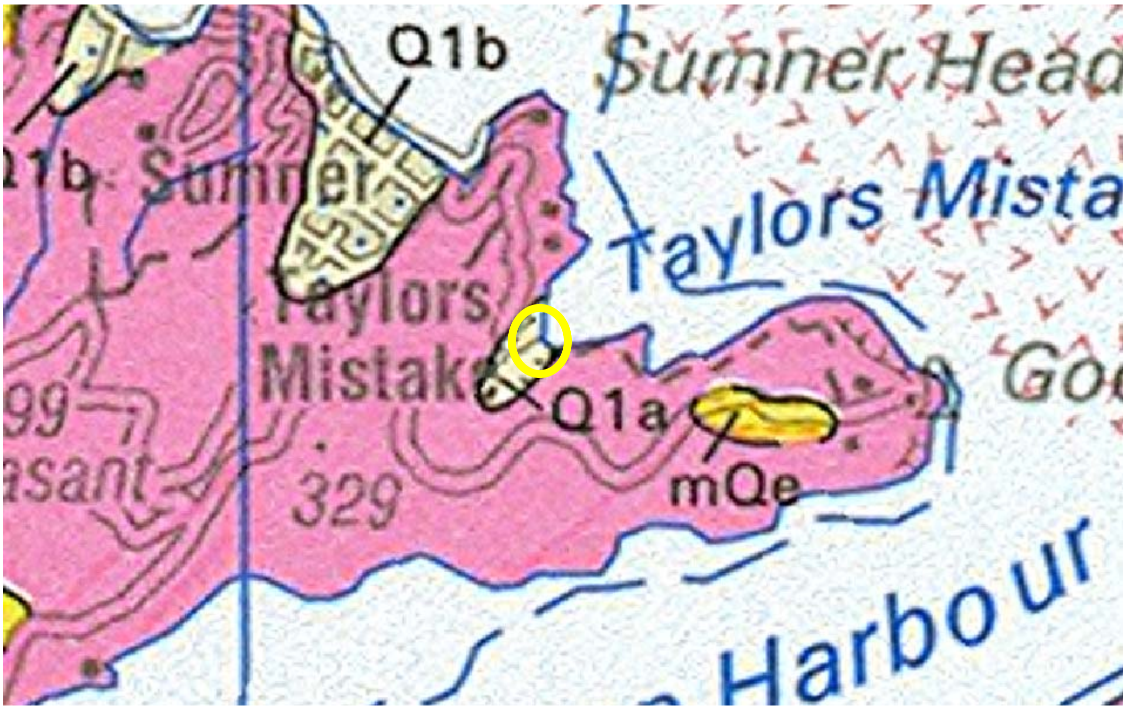
4. Site location

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

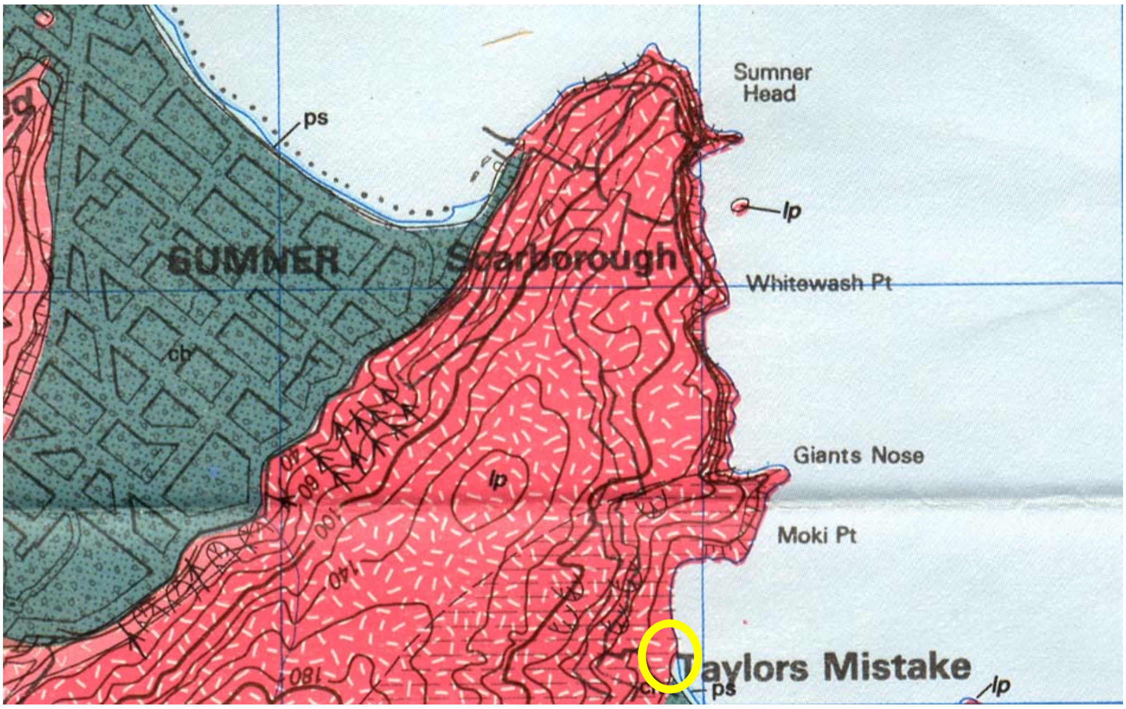
These structures are located on the corner of Linwood Avenue and Smith Street at grid reference 1581925 E, 5174296 N (NZTM).

5. Review of available information

5.1 Geological maps



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



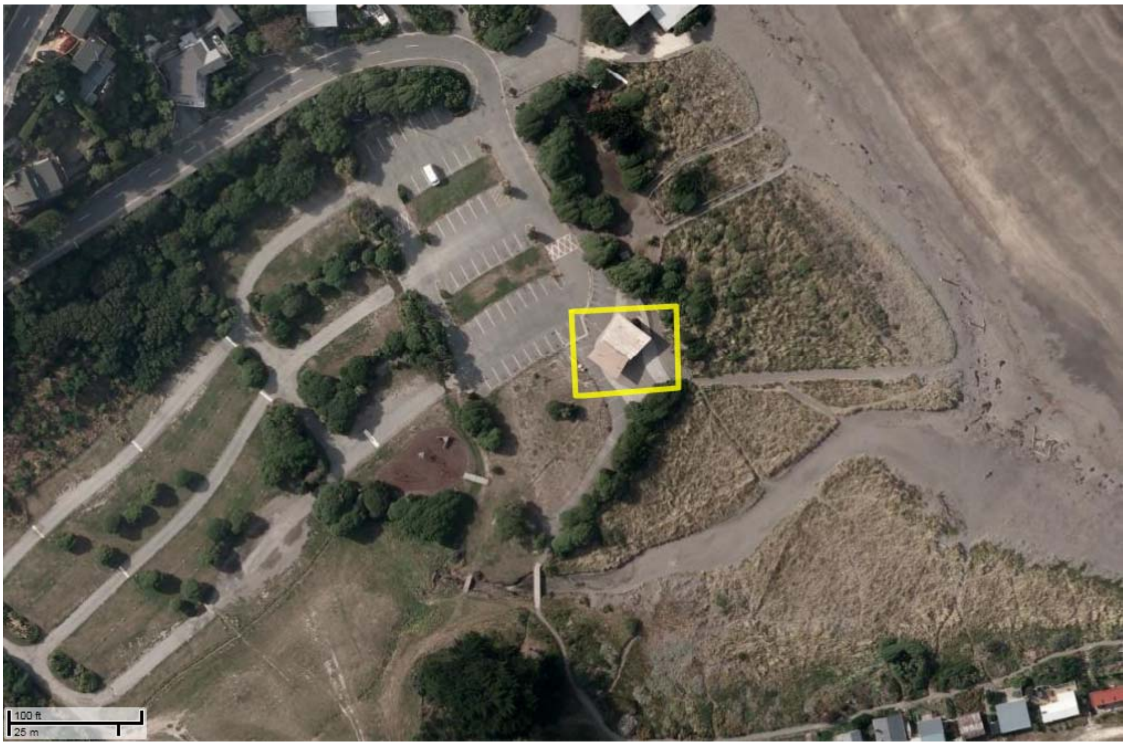
- **Figure 3 – Local geological map (Brown et al, 1992). Site marked in yellow.**

The site is shown to be underlain by Holocene deposits comprising sands of fixed dunes and semi-fixed dunes and beaches of the Christchurch Formation.

5.2 Liquefaction map

Following the 22 February 2011 event drive through reconnaissance was undertaken from 23 February until 1 March by M Cubrinovsko and M Taylor of Canterbury University. However the survey did not include the area of Taylor's Mistake.

5.3 Aerial photography



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

Aerial photography shows relatively no land damage after the 22 Feb 2011 event. The area of grey wet ground located approximately 75m south west of the toilets/changing shed is likely to historical, not sand and silt ejecta.

5.4 CERA classification

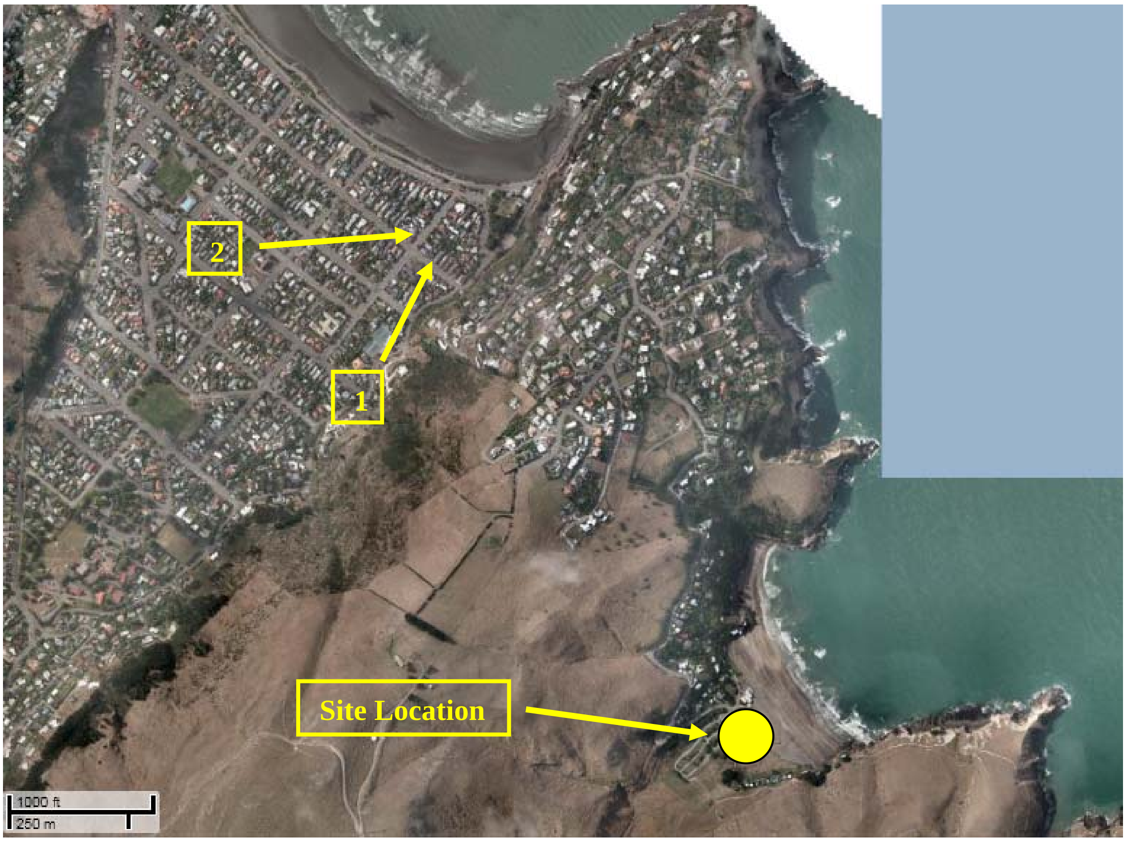
A review of the LINZ website (http://viewers.geospatial.govt.nz/) shows that the site is:

- Zone: Green
- DBH Technical Category: Banks Peninsula/Port Hills Area.

5.5 Historical land use

Historical documents indicating historical site use and waterways did not extend to Taylor's Mistake area.

5.6 Existing ground investigation data



- **Figure 45 – Local boreholes from Project Orbit and SKM files (https://canterburygeotechnicaldatabase.projectorbit.com/)**

The closest available borehole data is approximately 600m to the north of the site. These boreholes are located elevated hill sites and comprise loess which would not represent the ground conditions of the investigation site.

It is most likely that ground conditions are similar to that of the flat land in the Sumner area where the geology and depositional environment are comparable.

Where available logs from these investigation locations are attached to this report (Appendix A), and the results are summarised in Appendix B.

5.7 Council property files

Council property files were not available for the site at the time of writing this report.

5.8 Site walkover

An external site walkover was conducted by an SKM engineer on 12 July 2012.

The building was noted to be a masonry block structure with light weight sheet metal roof supported on slab on grade foundation. No cracks were noted in the block work or in the floors of the toilets in the southwest half of the building. A crack less than 1mm wide is through the concrete floor in the mens and womens changing rooms, leading to the drain in the centre of the room.

There is a 1-5mm crack between the building foundation and the concrete around the southwest corner of the building. There are multiple cracks, less than 1mm wide, in the concrete paths around the southwest corner of the building.

There were no signs of liquefaction around the site including no undulations in the asphalt surrounding the building which can be an indication of liquefaction. It is possible that beach sands underlying the building were porous enough that water pressures were not able to rise quickly enough to cause liquefaction.

- **Figure 5 - Overview of the building (northwest wall).**

- **Figure 6 - 1 - 2mm crack between building foundation and concrete pathway around the building.**

6. Conclusions and recommendations

6.1 Site geology

An interpretation of the most relevant local investigation suggests that the site is underlain by:

Depth	Soil type
0 - 6	Sand (Christchurch Formation)

Note that no investigations were present near the site. However, due to proximity of the site to the coastal beach area and as similar ground conditions to that noted in the Sumner area are expected in the area, approximated site geology has been provided in this report.

6.2 Seismic site subsoil class

The site has been assessed as NZS 1170.5 Class C (shallow soil) from the geological setting and estimation of the depth to underlying rock. Dune sands have been inferred to be present at shallow depths beneath the site. However, it is likely that volcanic rocks that form the hill sides will profile beneath the site. Therefore, it is likely that the volcanic rock would be present at depths shallower than the maximum allowable depth of soil noted in NZS 1170.5 for a Class C site. It should, however, be noted that no investigation data were available to confirm this assessment. Therefore, future site specific study may revise the specified site subsoil class.

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. It is possible that site specific investigation could revise the site class.

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

Liquefaction risk is low at this site. As mentioned above no evidence of liquefaction was observed at the site or around the Taylor's Mistake flat land area from aerial photographs taken shortly after the 22 February 2011 earthquake event or during the external site walkover undertaken. The geological conditions at the sand i.e. sands of beach origin are not typically susceptible to liquefaction. It should be noted that due to the steep hills either side of the site, there is a potential rock fall risk in the area. However, we expect the rock fall risk for the site to be low, as it is located approximately 160 m from the hill side. Additionally, no significant evidence of any rock fall caused by the recent earthquake events was noted in the immediate area during the external site walkover undertaken by an SKM engineer.

For the purposes of carrying out a Quantitative Detailed Engineering Evaluation the engineer can assume this site is 'good ground' (as defined in NZS3604:2011) and therefore the following parameters are recommended for the shallow materials:

Parameter	Estimated value
Effective angle of friction	35 degrees
Apparent cohesion	0 kPa
Unit weight	18 kPa
Ultimate bearing capacity of a shallow square pad footing	300 kPa

NOTE: These figures are based on geological data from outside the site for the purposes of preliminary structural assessment. These parameters should not be relied upon for any design work. Site specific investigations are required to confirm that these assumed values are correct. Additionally, further geotechnical investigation could potentially increase the ultimate bearing capacity stated above.

6.5 Further investigations

If consent is required for the structure or significant alterations to the structure are proposed, additional tests on site is likely to be required to confirm recommended properties:

- As beach sands are generally inferred to be present beneath the site, two CPTs to refusal on site are recommended
- If gravel layers or other dense material that causes refusal of the CPT at a depth below 15 m is encountered, one borehole on site to a minimum depth of 20 m with SPT at intervals of 1.5 m would be required
- It should be noted that if significant changes to the structure is proposed, a more extensive set of intrusive investigations, than recommended above, may be required

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 – Existing ground investigation logs

Borelog for well N36/0168

Gridref: N36:91100-37072 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 3 +MSD
Well name : CCC BorelogID 4034
Drill Method : Not Recorded
Drill Depth : -6m Drill Date : 2/03/1989

Environment Canterbury Regional Council

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.20m	light brown non-cohesive dry road metal	
		-4.30m	light brown non-cohesive moist dune sand	
		-6.00m	grey non-cohesive wet dune sand with some shells	

Scale: -0.2, -0.4, -0.6, -0.8, -1, -1.2, -1.4, -1.6, -1.8, -2, -2.2, -2.4, -2.6, -2.8, -3, -3.2, -3.4, -3.6, -3.8, -4, -4.2, -4.4, -4.6, -4.8, -5, -5.2, -5.4, -5.6, -5.8

Borelog for well N36/0172

Gridref: N36:91359-37038 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 3 +MSD
Well name : CCC BorelogID 4038
Drill Method : Not Recorded
Drill Depth : -6m Drill Date : 2/02/1989

Depth(m)	Full Drillers Description	Formation Code
-0.30m	grey brown non-cohesive dry road metal	
-2.40m	brown non-cohesive moist dune sand	
-3.90m	grey non-cohesive wet dune sand	
-6.00m	grey non-cohesive saturated dune sand with some shells	

Appendix B– Geotechnical Investigation Summary

■ Table 1 Summary of most relevant investigation data

ID	1	2
Type *	BH	BH
Ref	N36/0172	N36/68
Depth (m)	6.0	6.0
Distance from site (m)	1200	1280
Ground water level (mBGL)	N/A	N/A
Simplified recorded geological profile (depth below ground level to top of stratum, m)		
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
Greater depths		

*BH: Borehole, HA: Hand Auger, WW: Water Well, CPT: Cone Penetration Test

Sensitive or organic clay/silt; Clay to silty clay; Clayey silt to silt; Silty sand to silt
Clayey sand; Sand; Gravelly sand or gravel

VL = very loose, L = loose, MD = medium dense, D = dense, VD = very dense
VS = very soft, So = soft, F = firm, St = stiff, VS = very stiff, H = hard