

CHRISTCHURCH CITY COUNCIL

PRK_2347_BLDG_005 EQ2

Travis Wetlands – Bird Hide

280 Beach Road, Parklands



QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 23 November 2012



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Travis Wetlands – Bird Hide
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1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on building PRK_2347_BLDG_005 EQ2 located at 280 Beach Road, Parklands. This building is a single story timber framed structure that is used as a bird hide at Travis Wetlands. 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_2347_BLDG_005 EQ2 Located at 280 Beach Road

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 and our visual inspection carried out on the 19 April 2012.

1.2. Key Damage Observed

Key damage observed includes:-

- No damage seismic damage was observed during our inspection.



1.3. Critical Structural Weaknesses

This structure contains 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 greater than 100%NBS. No damage was observed during our site investigation. Due to this the post earthquake capacity is also greater than 100%NBS.

As noted above our analysis indicates that the current seismic capacity of the building is over 100% NBS and therefore is not a potentially earthquake prone building.

1.5. Recommendations

It is recommended that:

- a) No current placard was displayed on the building however we believe that the status of the building shall be Green 1.
- b) We consider that barriers around the building are not necessary.

2. Introduction

Sinclair Knight Merz was engaged by the Christchurch City Council to prepare a qualitative assessment report for building PRK_2347_BLDG_005 EQ2 located at 280 Beach Road, Parklands 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 0.3¹.

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure have been carried out. No structural drawings were available for this structure and as a result the buildings description outlined in Section 5 is based only on our visual inspection carried out on the 19 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	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_2347_BLDG_005 EQ2 is a single storey timber framed building that is used as a bird hide at Travis Wetlands. The roof is constructed from timber framing and supports a light weight profiled steel cladding. The walls are also constructed from timber framing and are clad with a light weight steel cladding. The building is supported on timber piles. The footprint of this building is approximately 4.0m x4.0m and is only 3.0m high.

5.2. Gravity Load Resisting System

Our evaluation was based on our site investigation conducted on the 19 April 2012.

The roof structure consists of timber framing which is supported on round timber columns and the timber framed walls. The ground floor is timber framed and is supported on timber piles. The round timber columns extend through the floor and form part of the pile systems. Based on condition of this structure and the information provided inside the information kiosk located on site this structure is believed to have been constructed after 1994.

5.3. Seismic Load Resisting System

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 diaphragm that is formed by the timber framing. The loads can then be picked up the round timber columns which will resist the loads by acting as cantilevers with fixity at the base.

5.4. Geotechnical Conditions

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

- The site has been assessed as NZS 1170.5 Class D (soft or deep soil, including gravel exceeding 100 m in depth) using nearby borehole investigation data
- The liquefaction risk for the site is likely to be low. The gravel layers inferred to be underlying the site are not liquefiable and no evidence of land damage or liquefaction was observed during the external inspection of the site. However, there may be lenses of sand present in the sandy gravel layers are potentially liquefiable.

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. The full geotechnical desktop study can be found in Appendix 4 – Geotechnical Desk Study



6. Damage Summary

SKM undertook inspections on the 19 April 2012. The following was observed during the time of inspection:

- 1) No external or internal damage due to the earthquake was noted.
- 2) No visual evidence of settlement was noted at this site. Therefore a level survey is not required at this stage of assessment.
- 3) It appears that someone has tried to set fire to the timber floor boards. This has resulted in charring of the floor boards in a localised area. However this will have no effect on the structural capacity of the structure

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 buildings².

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. Earthquake prone buildings are defined as having less than 33 %NBS strength which correlates to an increased risk of approximately 10 times that 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 prone⁴.

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

² <http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf>

³ NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p 2-2

⁴ <http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf>



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 building⁵. 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
- NZS 3604:2011 Timber Framed Buildings

7.2. Available Information, Assumptions and Limitations

Following our inspection on the 19 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.
- No structural drawings were available for this building.

The assumptions and design criteria were used during our assessment:

- The building was built according to good practices at the time.
- Standard design assumptions as described in AS/NZS1170.0:2002
 - 50 year design life, which is the default NZ Building Code design life.
 - Structure Importance Level 1 since the total floor area is <30m² and represents structures presenting a low degree of hazard to life and other property.
- Ductility level of 1, based on our assessment and code requirements at the time of design.

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

- 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 were there any significant ground movement issues around the building. The building is zoned as either TC2 or TC3 on the CERA Technical Categories Map. However due to the importance level of this structure and the lack of any structural damage or visible settlement 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.

Table 3: Qualitative Assessment Summary

<u>Item</u>	<u>%NBS</u>
Buildings likely Seismic Capacity	>100

Our qualitative assessment found that the building is likely to be classed as a 'Low Risk Building' (capacity between 67% and 100% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Report.



8. Further Investigation

Due to the likely seismic rating of this building being greater than 67% and the lack of any structural damage no further investigation is required.



9. Conclusion

A qualitative assessment was carried out on building PRK_2347_BLDG_005 EQ2, located at 280 Beach Road, Parklands. This building has been assessed to have a likely seismic capacity greater than 100% NBS and is therefore a 'Low Risk Building' (capacity greater than 67% of NBS).

Due to the likely seismic rating of this building and the lack of any structural damage no further investigation is required.

It is recommended that:

- a) No current placard was displayed on the building however we believe that the status of the building shall be Green 1.
- 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: Bird Hide – Eastern Elevation



Photo 2: Foundation Details



Photo 3: Typical Wall Cladding



Photo 4: Internal View



Photo 5: Internal Column



Photo 6: Roof Structure



12. Appendix 2 – IEP Report

Building Name:	CCC_PRK_2347_005 - Bird Hide	Ref.	ZB01276.58
Location:	Travis Wetlands - 280 Beach Road, Parklands	By	KW
		Date	21/03/2012

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 2347-005 is a single storey timber framed building that is used as a bird hide at Travis Wetlands. The roof is constructed from timber framing and supports a light weight profiled steel cladding. The walls are also constructed from timber framing and are clad with a light weight steel cladding. The building is supported on timber piles. The footprint of this building is approximately 4.0m x4.0m and it is only 3.0m high. Lateral loads acting across and along the building will be resisted by the roof diaphragm that is formed by the timber framing. The loads can then be picked up the round timber columns which will resist the loads by acting as cantilevers with fixity at the base.

1.4 Note information sources

Tick as appropriate

- Visual Inspection of Exterior
- Visual Inspection of Interior
- Drawings (note type)
- Specifications
- Geotechnical Reports
- Other (list)

<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

Inspection Date - 19/04/2012

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)



Page 2

Building Name:	CCC_PRK_2347_005 - Bird Hide	Ref.	ZB01276.58
Location:	Travis Wetlands - 280 Beach Road, Parklands	By	KW
Direction Considered:	Longitudinal & Transverse	Date	21/03/2012
(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
 1935-1965
 1965-1976 Seismic Zone; A
 B
 C
 1976-1992 Seismic Zone; A
 B
 C
 1992-2004

<input type="radio"/>
See also notes 1, 3
<input type="radio"/>
<input type="radio"/>
<input type="radio"/>
<input type="radio"/>
See also note 2
<input type="radio"/>
<input type="radio"/>
<input type="radio"/>
<input checked="" type="radio"/>

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

<input type="radio"/>
<input type="radio"/>
<input checked="" type="radio"/>
<input type="radio"/>

From NZS4203:1992, Cl 4.6.2.2
 (for 1992 to 2004 only and only if known)
 a) Rigid
 b) Intermediate

<input checked="" type="radio"/>
N-A
<input type="radio"/>

c) Estimate Period, T

building Ht = 3 meters

Can use following:

$T = 0.09h_n^{0.75}$ for moment-resisting concrete frames
 $T = 0.14h_n^{0.75}$ for moment-resisting steel frames
 $T = 0.08h_n^{0.75}$ for eccentrically braced steel frames
 $T = 0.06h_n^{0.75}$ for all other frame structures
 $T = 0.09h_n^{0.75}/A_c^{0.5}$ for concrete shear walls
 $T \leq 0.4\text{sec}$ for masonry shear walls

Where h_n = height in m from the base of the structure to the uppermost seismic weight or mass.
 $A_c = \sum A_i(0.2 + L_{wi}/h_n)^2$
 A_i = cross-sectional shear area of shear wall i in the first storey of the building, in m²
 L_{wi} = length of shear wall i in the first storey in the direction parallel to the applied forces, in m
 with the restriction that L_{wi}/h_n shall not exceed 0.9

Longitudinal	Transverse
Ac = 4	4
<input type="radio"/> MRCF	<input type="radio"/> MRCF
<input type="radio"/> MRSF	<input type="radio"/> MRSF
<input type="radio"/> EBSF	<input type="radio"/> EBSF
<input checked="" type="radio"/> Others	<input checked="" type="radio"/> Others
<input type="radio"/> CSW	<input type="radio"/> CSW
<input type="radio"/> MSW	<input type="radio"/> MSW

Longitudinal	Transverse
0.1	0.1

Seconds

d) (%NBS)nom determined from Figure 3.3

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.

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

Note 2: For reinforced concrete buildings designed between 1976 -1984 (%NBS)nom by 1.2

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.

Factor
 No ☐ 1

No ☐ 1

No ☐ 1

No ☐ 1

Longitudinal	22.2	(%NBS)nom
Transverse	22.2	(%NBS)nom

Longitudinal	22.2	(%NBS)nom
Transverse	22.2	(%NBS)nom

Continued over page

Building Name:	CCC_PRK_2347_005 - Bird Hide	Ref.	ZB01276.58
Location:	Travis Wetlands - 280 Beach Road, Parklands	By	KW
Direction Considered:	Longitudinal & Transverse	Date	21/03/2012
(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 $T < 1.5\text{sec}$, Factor A = 1

a) Near Fault Factor, $N(T,D)$

(from NZS1170.5:2004, Cl 3.1.6)

1

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

b) Hazard Scaling Factor

For pre 1992 = $1/Z$

For 1992 onwards = Z_{1992}/Z

Type Z 1992 above

Wellington 1.2 Dunedin 0.6

Christchurch 0.8 Hamilton 0.67

#

(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

(from NZS1170.0:2004, Table 3.1 and 3.2)

1

b) Return Period Scaling Factor from accompanying Table 3.1

Factor C	2.00
----------	------

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

μ Maximum = 6

Transverse 1

μ Maximum = 6

b) Ductility Scaling Factor

For pre 1976

$$= k_{\mu}$$

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

Transverse

Timber	▼
Timber	▼

a) Structural Performance Factor, S_p

from accompanying Figure 3.4

Longitudinal

S_p

1.00

Transverse

S_p

1.00

b) Structural Performance Scaling Factor

Longitudinal

$1/S_p$

Factor E

1.00

Transverse

$1/S_p$

Factor E

1.00

2.7 Baseline %NBS for Building, $(\%NBS)_b$

(equals $(\%NSB)_{nom} \times A \times B \times C \times D \times E$)

Longitudinal	118.4	$(\%NBS)_b$
Transverse	118.4	$(\%NBS)_b$

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: CCC_PRK_2347_005 - Bird Hide	Ref. ZB01276.58
Location: Travis Wetlands - 280 Beach Road, Parklands	By KW
Direction Considered: a) Longitudinal	Date 21/03/2012
(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

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor A **3.2 Vertical Irregularity**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor B **3.3 Short Columns**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor C **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 <input type="text" value="1"/>		
		Severe	Significant	Insignificant
Separation		0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height		<input type="radio"/> 0.7	<input type="radio"/> 0.8	<input checked="" type="radio"/> 1
Alignment of Floors not within 20% of Storey Height		<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

		Factor D2 <input type="text" value="1"/>		
		Severe	Significant	Insignificant
Separation		0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Height Difference > 4 Storeys		<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 1
Height Difference 2 to 4 Storeys		<input type="radio"/> 0.7	<input type="radio"/> 0.9	<input type="radio"/> 1
Height Difference < 2 Storeys		<input type="radio"/> 1	<input type="radio"/> 1	<input checked="" type="radio"/> 1

Factor D

(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
<input type="radio"/> 0.5	<input type="radio"/> 0.7	<input checked="" type="radio"/> 1

Factor E **3.6 Other Factors**

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum.

Factor F **Record rationale for choice of Factor F:**

Since the structure is a small light weight timber structure a F factor > 1 could be rationalised. However since the NBS is already over 100% we have left this factor as 1.

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

Building Name:	CCC_PRK_2347_005 - Bird Hide	Ref.	ZB01276.58
Location:	Travis Wetlands - 280 Beach Road, Parklands	By	KW
Direction Considered:	b) Transverse	Date	21/03/2012
(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

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor A **1****3.2 Vertical Irregularity**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor B **1****3.3 Short Columns**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor C **1****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		<input type="radio"/> 0.7	<input type="radio"/> 0.8	<input checked="" type="radio"/> 1
Alignment of Floors not within 20% of Storey Height		<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 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		<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 1
Height Difference 2 to 4 Storeys		<input type="radio"/> 0.7	<input type="radio"/> 0.9	<input type="radio"/> 1
Height Difference < 2 Storeys		<input type="radio"/> 1	<input type="radio"/> 1	<input checked="" type="radio"/> 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
<input type="radio"/> 0.5	<input type="radio"/> 0.7	<input checked="" type="radio"/> 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**

Record rationale for choice of Factor F:

Since the structure is a small light weight timber structure a F factor > 1 could be rationalised. However since the NBS is already over 100% we have left this factor as 1.

3.7 Performance Achievement Ratio (PAR)
 (equals A x B x C x D x E x F)
PAR **1**

Building Name:	CCC_PRK_2347_005 - Bird Hide	Ref.	ZB01276.58
Location:	Travis Wetlands - 280 Beach Road, Parklands	By	KW
Direction Considered:	Longitudinal & Transverse	Date	21/03/2012

(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)	118	118
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	1.00	1.00
4.3 PAR x Baseline (%NBS)_b	118	118
4.4 Percentage New Building Standard (%NBS) (Use lower of two values from Step 4.3)		118

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

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: CC_PRK_2347_005	Unit: No: Street	Reviewer: Nick Calvert
Building Address: Bird Hide - Travis Wetlands		280 Beach Road, Parklands		CPEng No: 242062
Legal Description:				Company: SKM
				Company project number: ZB01276.57
				Company phone number: 09 940 4900
GPS south: Degrees Min Sec				Date of submission:
GPS east:				Inspection Date: 19/04/2012
Building Unique Identifier (CCC):				Revision: A
				Is there a full report with this summary? yes

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

Building		No. of storeys above ground: 1	single storey = 1	Ground floor elevation (Absolute) (m): 0.00
Ground floor split? no		Stores below ground: 0		Ground floor elevation above ground (m): 0.00
Foundation type: timber piles				if Foundation type is other, describe:
Building height (m): 5.50				height from ground to level of uppermost seismic mass (for IEP only) (m): 5.50
Floor footprint area (approx): 50				Date of design: 1992-2004
Age of Building (years): 18				
Strengthening present? no				If so, when (year)?
Use (ground floor): other (specify)				And what load level (%g)?
Use (upper floors):				Brief strengthening description:
Use notes (if required): Bird Hide				
Importance level (to NZS1170.5): IL1				

Gravity Structure		Gravity System: frame system	rafter type, purlin type and cladding: timber rafters supporting light weight
Roof: timber framed		Floors: timber	profiled steel cladding
Beams: none		Columns: other (note)	joist depth and spacing (mm): unknown
Walls:			overall depth x width (mm x mm):
			typical dimensions (mm x mm): Timber rounds - 300 diameter

Lateral load resisting structure		Lateral system along: other (note)	Ductility assumed, μ: 1.00	Period along: 0.10	Total deflection (ULS) (mm): 20	maximum interstorey deflection (ULS) (mm): 0	describe system: cantilevering timber round columns
		Lateral system across: other (note)	Ductility assumed, μ: 1.00	Period across: 0.10	Total deflection (ULS) (mm): 20	maximum interstorey deflection (ULS) (mm): 0	estimate or calculation? estimated
							estimate or calculation? estimated
							estimate or calculation? estimated
							describe system: cantilevering timber round columns
							estimate or calculation? estimated
							estimate or calculation? estimated
							estimate or calculation? estimated

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

Non-structural elements		Stairs: n/a	describe: Light weight steel sheets
Wall cladding: profiled metal		Roof Cladding: Metal	describe: Light weight profiled steel cladding
Glazing: none		Ceilings: none	no windows present
Services(list):			n/a

Available documentation		Architectural: none	original designer name/date:
Structural: none		Mechanical: none	original designer name/date:
Electrical: none		Geotech report: none	original designer name/date:
			original designer name/date:

Damage		Site performance: 1	Describe damage:
Settlement: none observed		Differential settlement: none observed	notes (if applicable):
Liquefaction: none apparent		Lateral Spread: none apparent	notes (if applicable):
Differential lateral spread: none apparent		Ground cracks: none apparent	notes (if applicable):
Damage to area: moderate to substantial (1 in 5)			notes (if applicable):

Building:		Current Placard Status: green	Describe how damage ratio arrived at: no damage observed
Along	Damage ratio: 0%	Describe (summary):	
Across	Damage ratio: 0%	Describe (summary):	
Diaphragms	Damage?: no	Describe:	
CSWs:	Damage?: no	Describe:	
Pounding:	Damage?: no	Describe:	
Non-structural:	Damage?: yes	Describe:	

Recommendations		Level of repair/strengthening required: none	Describe:
Building Consent required: yes		Interim occupancy recommendations: full occupancy	Describe:
Along	Assessed %NBS before: 100%	Assessed %NBS after: 100%	%NBS from IEP
Across	Assessed %NBS before: 100%	Assessed %NBS after: 100%	%NBS from IEP
			Qualitative Assessment carried out includes NZSEE IEP - refer to SKM report

Official Use only:	Accepted By:	Date:



14. Appendix 4 – Geotechnical Desk Study



Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	57 and 58 inclusive
Address	Travis Wetland
Report date	28 May 2012
Author	Dominic Hollands
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 (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
- Council files
- A preliminary site walkover

3. Limitations

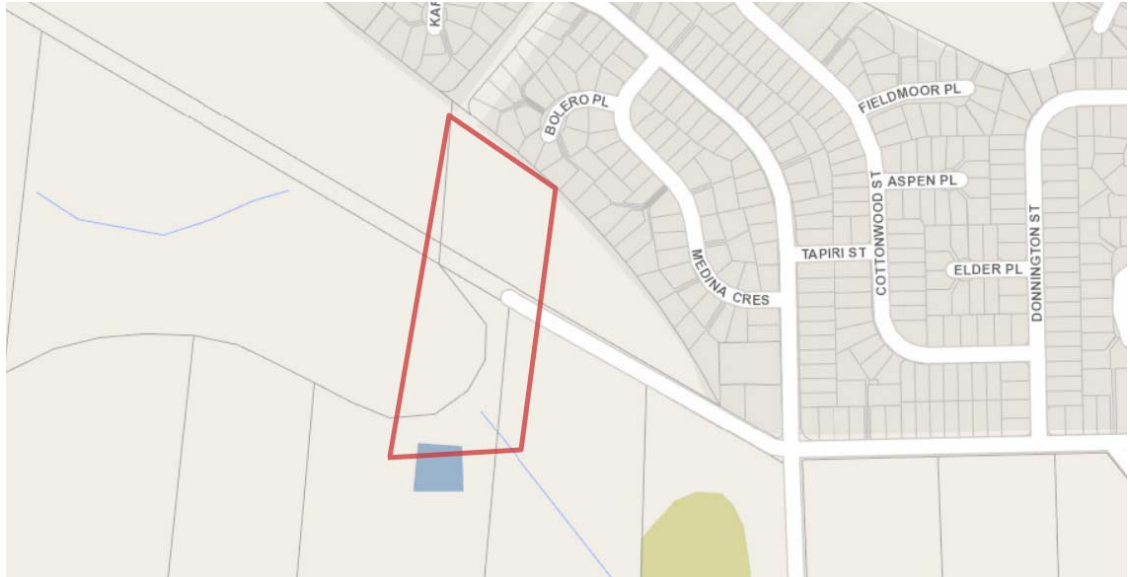
This report was prepared to address geotechnical issues relating to the specific site in accordance with the scope of works as defined in the contract between SKM and our Client. This report has been prepared on behalf of, and for the exclusive use of, our Client, and is subject to, and issued in accordance 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



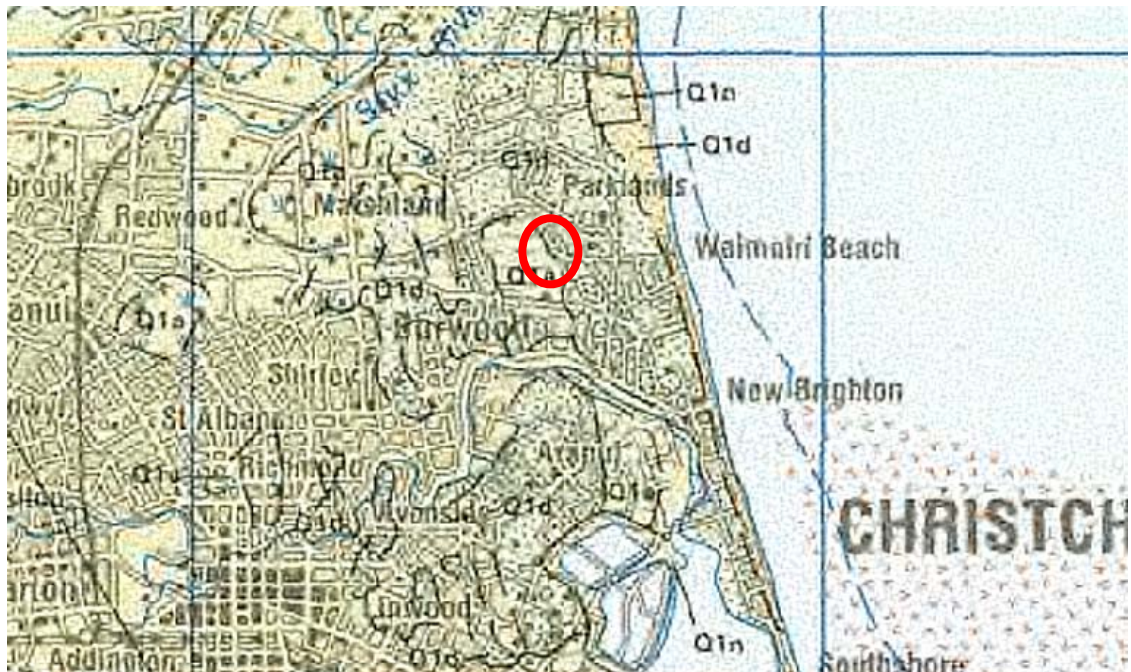
■ Figure 1 – Site location (courtesy of LINZ <http://viewers.geospatial.govt.nz>)

These structures are located on 280 Beach Road at grid reference 1575565 E, 5185267 N (NZTM).

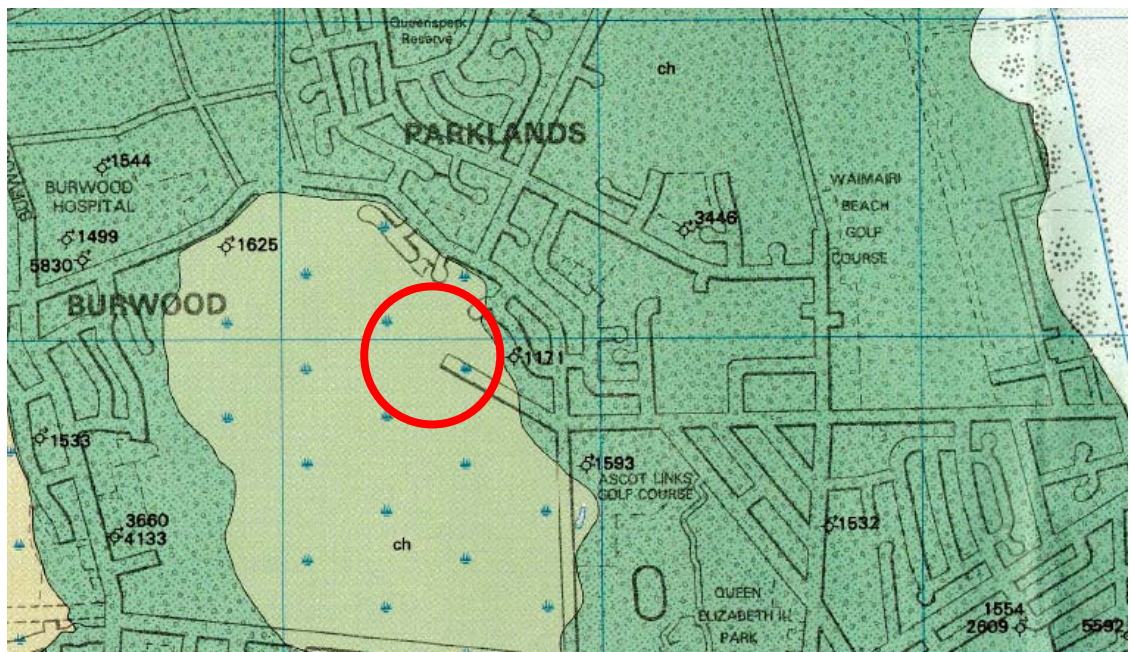


5. Review of available information

5.1 Geological maps



■ Figure 2 – Regional geological map (Forsyth et al, 2008). Site marked in red.

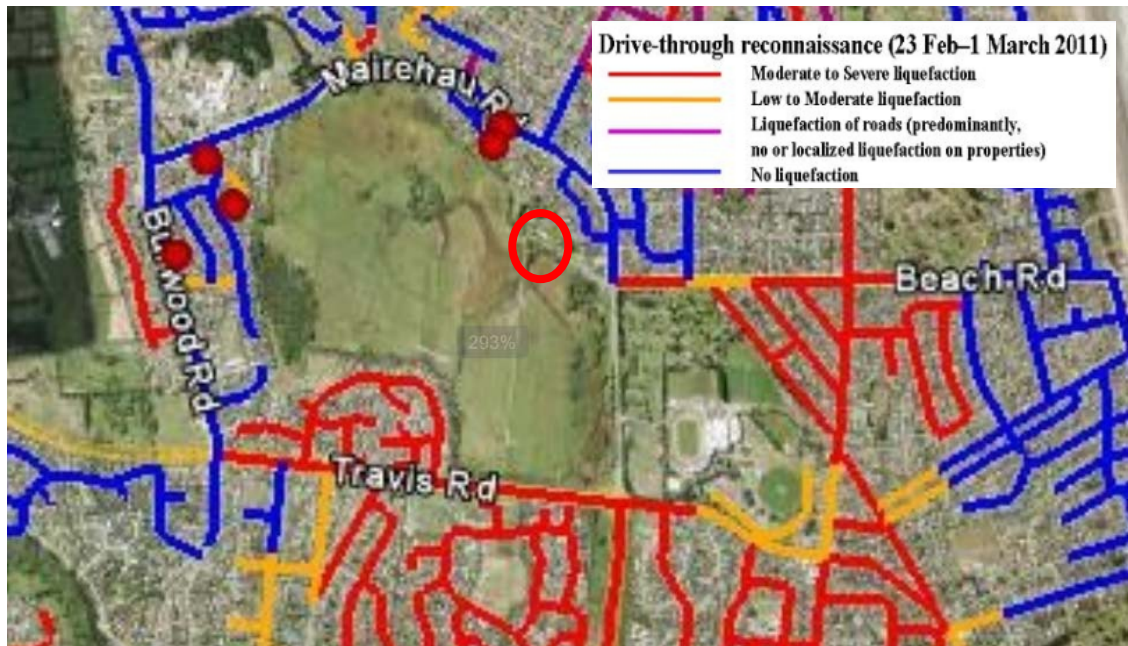


■ Figure 3 – Local geological map (Brown et al, 1992). Site marked in red.



The local geological map shows the area to be underlain by sand, silt and peat of drained lagoons and estuaries. Immediately east of the site the area is shown to be underlain by sand of fixed and semi-fixed dunes and beached.

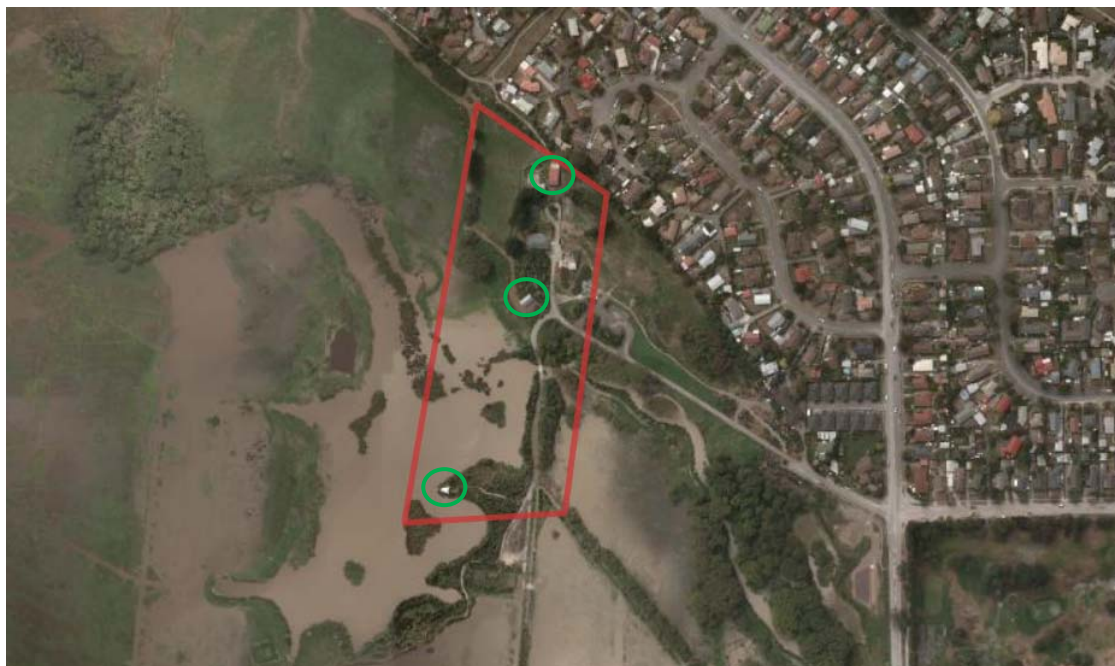
5.2 Liquefaction map



■ **Figure 4 – Liquefaction map (Cubrinovski & Taylor, 2011). Site marked in red.**

Following the 22 February 2011 event drive through reconnaissance was undertaken from 23 February until 1 March by M Cubrinovski and M Taylor of Canterbury University. Their findings show no liquefaction on Mairehau Road and Medina Crescent to the north east and moderate to severe liquefaction on Beach Road to the east.

5.3 Aerial photography



■ Figure 5 – Aerial photography from 24 Feb 2011 (<http://viewers.geospatial.govt.nz/>)



■ Figure 6 - Aerial photography from 24 Feb 2011 (<http://viewers.geospatial.govt.nz/>)



■ Figure 7 - Aerial photography from 24 Feb 2011 (<http://viewers.geospatial.govt.nz/>)



■ Figure 8 - Aerial photography from 24 Feb 2011 (<http://viewers.geospatial.govt.nz/>)



Aerial photography shows significant liquefaction in the area after the 22 Feb 2011 event in particular the elevated water table within the site and surrounding the site.

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 – N/A – Urban Non residential - in general residential properties around the site are classed as TC3

5.5 Historical land use

In reference to historical documents (e.g. Appendix A) it is shown that the site lies within land that was recorded as marshland or swamp in 1856 which is not too dissimilar to what is present today. It is therefore possible that soft or liquefiable ground would be present at the site. Some of the land area however has likely been built up since then including roads and paths on the site.



5.6 Existing ground investigation data



■ **Figure 9 - Local Boreholes from project orbit**
(<https://canterburygeotechnicaldatabase.projectorbit.com/>)

Where available logs from these investigation locations are attached to this report (Appendix B), and the results are summarised in Section 6.1 and Appendix C. Only investigations within 350m have been summarised however our existing knowledge of the area and wider boreholes have been used to draw conclusions regarding ground condition

5.7 Council property files

No council property files were available for the structures on site.

5.8 Site walkover

An external site walkover was conducted by an SKM engineer on 2 May 2012 for the information kiosk and Bird Hide structures and on 29 May 2012 for the dairy shed and barn structures.

The site housing the dairy shed and barn was noted to be located in a low lying grassed area. There was a 20-30 degree slope at the northern side of the barn sloping up to adjacent houses. There was evidence of liquefaction having occurred at the site with sand ejecta still present more than a year after the earthquake event. It is expected that the water table will be within 0.5 below ground level due to nearby water ways.



The Barn was noted to be a timber structure (frame and clad), with a corrugated iron lean to on the northern side. The roof was also noted to be an iron construction. The structure appears to be supported on a slab foundation at the western end only. There appears to be some significant cracks in the concrete but this could be not confirmed during the external site walkover.

The dairy shed appears to be a masonry block construction at the eastern end with poured in situ concrete walls for the remaining parts of the structure. The roof was an iron sheet construction. Gapping, some cracking and differential movement of slabs was noted in the concrete paving outside. However, it is not clear how much of this damage is due to the earthquake event. No other significant cracking of blocks or any differential settlement of the structure was noted during the site walkover.

The information kiosk and bird hide buildings are a single storey timber framed building with timber pile foundations.



■ **Figure 10 – Exterior front view of the information kiosk (eastern elevation)**



■ **Figure 11 - Overview of the information kiosk (western elevation)**



■ **Figure 12 - Exterior front view of the bird hide (eastern elevation)**



■ **Figure 13 – Foundation details of the bird hide**



■ **Figure 14 - Overview of the barn structure**



■ **Figure 15 - Overview of the Dairy shed**



■ **Figure 16 - Noted damage to the concrete paving**



■ **Figure 17 - Ejected sand**



6. Conclusions and recommendations

6.1 Site geology

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

Depth range (mBGL)	Soil type
0 - 1	Top soil
1 - 29	Sand (Springston Formation)
29 - 40	Gravel (Riccarton Gravels)

A shallow water table within 0.5m BGL is expected due to nearby water ways.

6.2 Seismic site subsoil class

The site has been assessed as NZS 1170.5 Class D (soft or deep soil, including gravel exceeding 100 m in depth) using nearby borehole investigation data. As no information regarding the composition of the top soil layer is available, Class D is recommended as a conservative estimate of the seismic 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.

The third preferred method has been used in the assessment of site subsoil class. It should be noted that only one borehole near the site was available however we are relatively confident of ground conditions in this area.

6.3 Building Performance

The performance to date suggests that in general the existing foundations are adequate for their current purpose. However some damage to the concrete slab supporting the barn structure was noted. From the site walkover it was noted that the shallow piled foundations in general performed better than the slab foundations.

It should be noted that no significant evidence of lateral spreading was noted during the external site walkover but, as waterways are present nearby lateral spread could occur on site. This could mean that the current foundations may be unsuitable if lateral spreading occurs during a future event. As surrounding residential properties are classed as TC3, for buildings that are frequently used or open to public a specialised foundation solution in accordance with the TC3 residential guidelines would be recommended if the foundations are to be remediated.



6.4 Ground performance and properties

Liquefaction risk is expected to be moderate to severe for this site. Significant surface evidence of liquefaction on site as well as elevated water table could be seen from the aerial photographs. No evidence of liquefaction was noted during the site visit; however, this is most likely due to the significant lapse of time between the seismic event and the external site walkover undertaken. The density of the sand layer inferred to underlay the site is not known. However, it is likely that the sand layers, in particular the shallow layers, are susceptible to liquefaction. Even though there was no evidence of lateral spreading noted during the site walkover, there is future risk of lateral spreading on site due to the significant potential for liquefaction to occur on site and the presence of free faces caused by nearby waterways.

As no information for the first 5m below ground level is available from the borehole log, an estimation of ground properties, which can be reliably used in a quantitative DEE, has not been made in this desk study.

6.5 Further investigations

If a quantitative DEE is to be undertaken further site specific investigation are required to confirm the liquefaction assessment and to estimate likely ground properties on site. Additional investigations recommended are:

- Two hand augers near each structure to a depth of 3m to assess the composition of the shallow soil layer
- Two CPTs to refusal on site

7. References

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

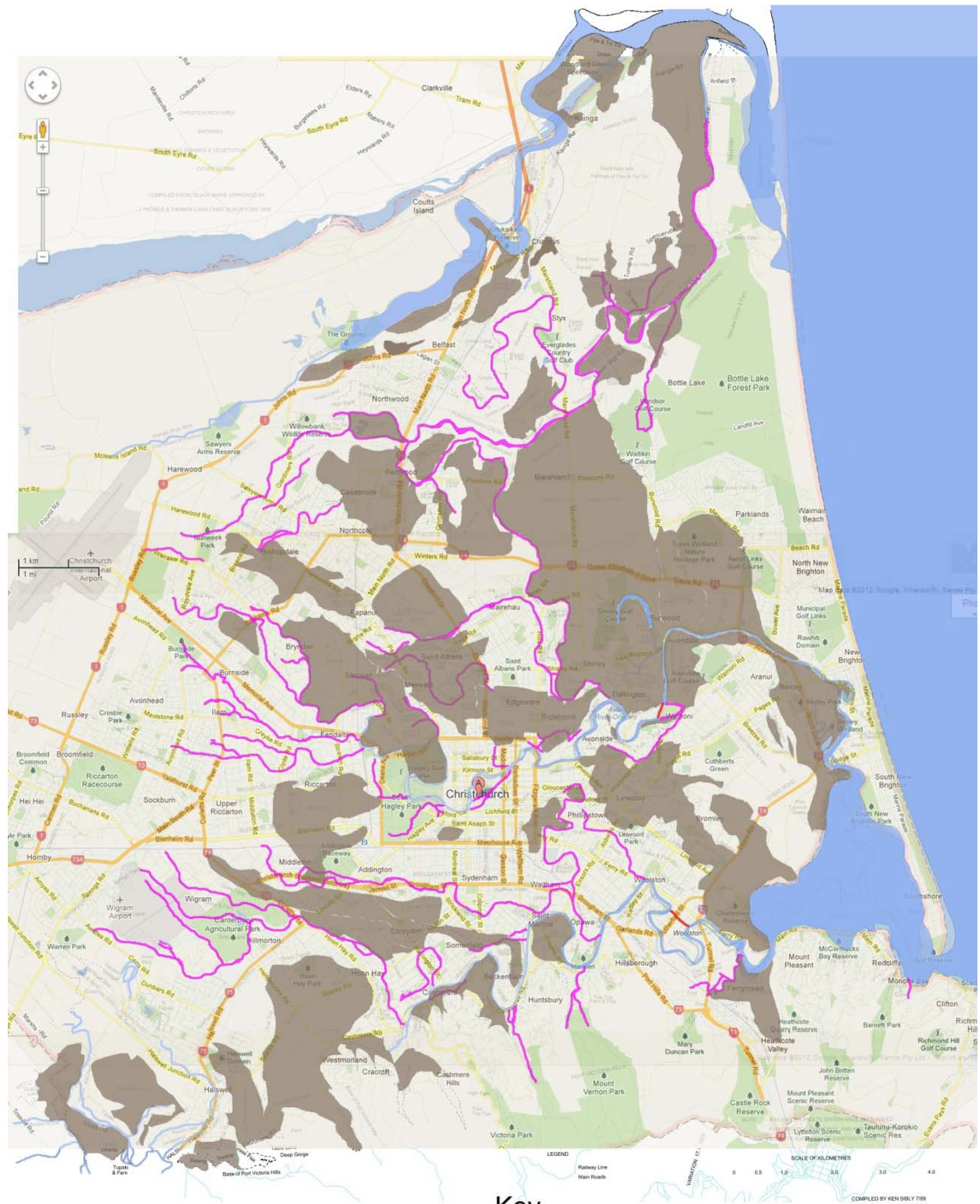
Forsyth PJ, Barrell DJA, Jongens R, 2008. Geology of the Christchurch area. Institute of Geological & Nuclear Sciences geological map 16.

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/ivers from 1856 have been overlaid onto a map of Christchurch in 2012

- Key**
- Previous creeks/ivers
 - Existing creeks/ivers
 - New creeks/ivers
 - Swamp/Marshland



Appendix B – Existing ground investigation logs

Borelog for well M35/1171

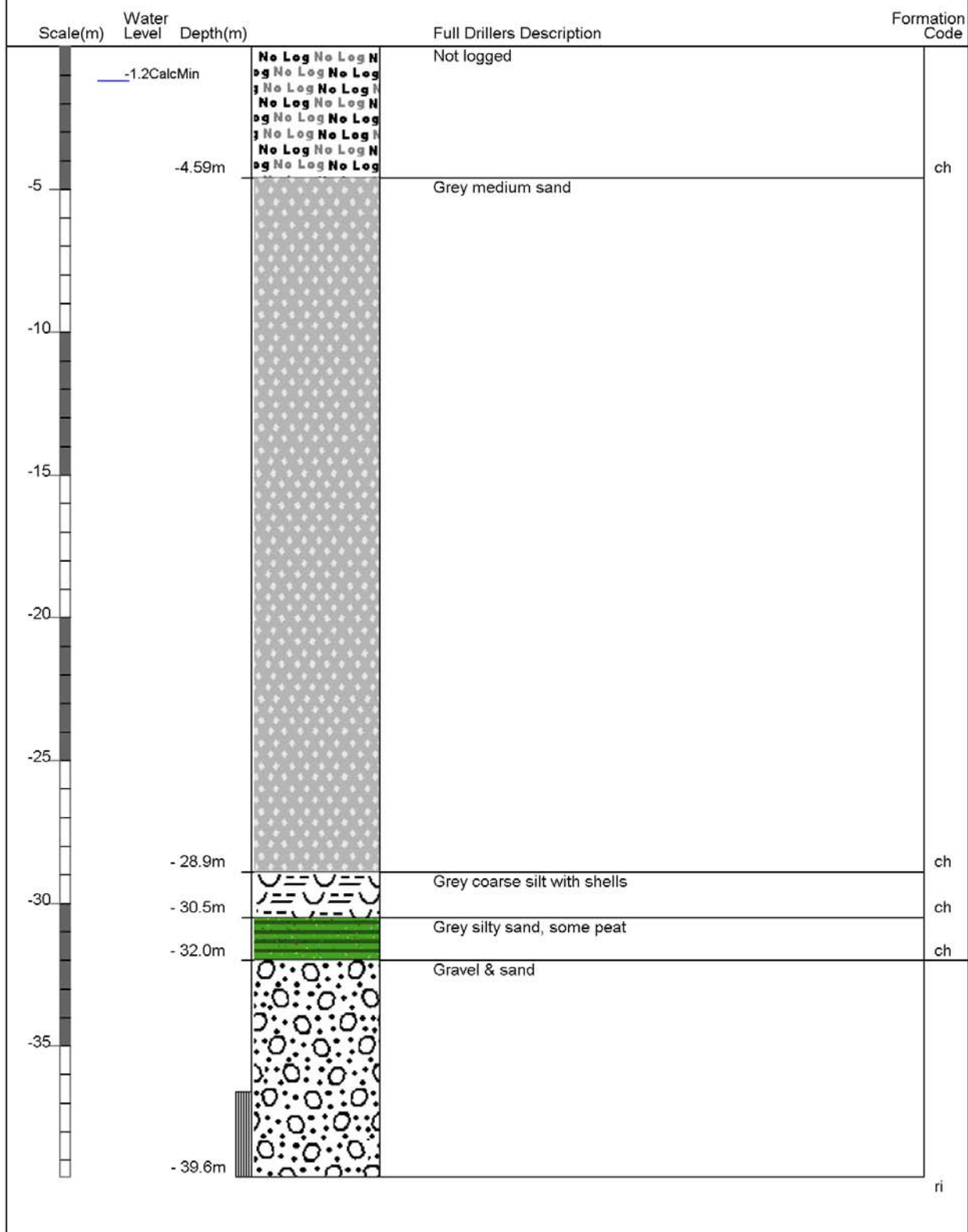
Gridref: M35:8560-4690 Accuracy : 4 (1=high, 5=low)

Ground Level Altitude : 5.6 +MSD

Driller : McMillan Water Wells Ltd

Drill Method : Cable Tool

Drill Depth : -39.59m Drill Date : 1/09/1976





Appendix C – Geotechnical Investigation Summary



■ **Table 1 Summary of most relevant investigation data**

ID	1
Type *	BH**
Ref	M35 - 1171
Depth (m)	40
Distance from site (m)	0
Ground water level (mBGL)	1.2
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

** 0-5m not logged

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