Charteris Bay Boat Ramp Toilets
PRK 3581 BLDG 001

Detailed Engineering Evaluation

Quantitative Report

Version FINAL

Marine Road, Charteris Bay

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Marine Road, Charteris Bay

Christchurch City Council

Prepared By

Shashank Kumar

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Date

09th May 2013

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Charteris Bay Boat Ramp Toilets

PRK 3581 BLDG 001

Detailed Engineering Evaluation

Quantitative Report - SUMMARY

Version FINAL

Marine Road, Charteris Bay

Background

This is a summary of the Quantitative report for the above building structure, and is based in general on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, NZS 3604:2011, NZSEE guidelines (2006), and the visual inspection and site measure carried out on 4th April 2013.

Building Description

The Charteris Bay Boat Ramp Toilet building is located on Marine Road, Charteris Bay. The building's primary use is as a public toilet. Drawings for the building were unavailable and the exact construction date of the building is unknown.

The building is a single storey light timber framed structure on subfloor framing. The roof is pitched and is made up of timber rafters and lightweight metal cladding externally and plywood lining internally. The single storey and subfloor walls are both externally clad with light-weight timber panels. The single storey walls are lined internally by plywood boards, whereas the subfloor walls do not have any internal wall linings. The building has a timber flooring system with plywood floor boards supported by timber floor joists. The foundation system appears to be a combination of concrete slab-on-grade and driven cantilevered timber piles that are approximately 100mm, 125mm and 150mm in diameter. The exact construction details of the foundations could not be confirmed due to restricted access to the part of the foundation below ground.

The dimensions of the building are approximately 3.5m long by 2.1m wide and 4.8m tall. The overall footprint of the building is approximately 7.4m^2. A sketch of the building plan is shown in Figure 2.

Key Damage Observed

No earthquake damage was observed to the building's structural and non-structural elements.

Critical Structural Weaknesses

No critical structural weaknesses were identified for this building.

Building Seismic Capacity Assessment

Based on the quantitative analysis carried out on the structure using NZS 3604:2011 for Timber-Framed buildings and referencing the New Zealand Society for Earthquake Engineering (NZSEE) guidelines, the building's seismic capacity has been assessed as being >100% NBS in both the along and across directions. Based on this, the overall %NBS for the building is **>100%**.

Recommendations

The building has been assessed to have a %NBS greater than 100% NBS and is not considered to be an Earthquake Prone or Earthquake Risk building. Therefore no further assessment or strengthening works are required.

There are no immediate collapse hazards, or critical structural weaknesses identified for this building, therefore general occupancy of the building is permitted.

1. Background

GHD has been engaged by Christchurch City Council (CCC) to undertake a detailed engineering evaluation of Charteris Bay Boat Ramp Toilets.

This report presents the Quantitative Assessment of the building's seismic capacity, and is based in general on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011 and the New Zealand Society for Earthquake Engineering (NZSEE) guidelines.

2. Compliance

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

2.1 Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

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

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

2.2 Building Act

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

Section 112 – Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

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

2.2.1 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 other property could collapse or otherwise cause injury or death; or
- A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

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

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

2.3 Christchurch City Council Policy

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

The 2010 amendment includes the following:

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

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

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.

2.4 Building Code

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

After the February Earthquake, on 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
- Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

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

3. Earthquake Resistance Standards

For this assessment, the building's 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 1 below.

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

Figure 1 NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE

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

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

Table 1: %NBS compared to relative risk of failure

4. Building Description

4.1 General

The Charteris Bay Boat Ramp Toilet building is located on Marine Road, Charteris Bay. The building's primary use is as a public toilet. Drawings for the building were unavailable and the exact construction date of the building is unknown.

The building is a single storey light timber framed structure on subfloor framing. The roof is pitched and is made up of timber rafters and lightweight metal cladding externally and plywood lining internally. The single storey and subfloor walls are both externally clad with light-weight timber panels. The single storey walls are lined internally by plywood boards, whereas the subfloor walls do not have any internal wall linings. The building has a timber flooring system with 18mm plywood floor boards supported by timber floor joists. The foundation system appears to be a combination of concrete slab-on-grade and driven cantilevered timber piles that are approximately 100mm, 125mm and 150mm in diameter. The exact construction details of the foundations could not be confirmed due to restricted access to the part of the foundation below ground.

The dimensions of the building are approximately 3.5m long by 2.1m wide and 4.8m tall. The overall footprint of the building is approximately 7.4m^2.

4.2 Gravity Load Resisting System

The gravity loads on the structure are resisted by a timber framed system. The gravity loads from the roof rafters are transferred to the timber framed walls which are supported on timber subfloor framing. The gravity loads are then transferred by the subfloor framing into the foundations.

The gravity floor loads are transferred by the timber floor joists into the subfloor wall framing and timber piles and then to the foundations.

4.3 Lateral Load Resisting System

The lateral loads acting on the building in both the longitudinal and transverse directions are resisted by timber framed walls braced with plywood linings. Lateral loads acting on the building are expected to be distributed to the braced walls through diaphragm action of the internal plywood lining to the roof.

The timber framed subfloor walls and the cantilevered timber piles provide bracing for the subfloor structure in both the longitudinal and transverse directions. The lateral loads in the subfloor structure are expected to be distributed by diaphragm action provided by the timber flooring into the timber framed subfloor walls and the cantilevered timber piles.

5. Site Investigation and Assessment

5.1 Site Inspection

A site inspection of the building was undertaken on 4th April 2013. Both the interior and exterior of the building were inspected.

The site inspection consisted of a visual inspection of the building to determine the structural systems and likely behaviour of the building during an earthquake. The site was assessed for damage, including observing the ground conditions, checking for damage in areas where damage would be expected for the structure type observed and noting general damage observed throughout the building in both structural and non-structural elements. Some structural elements of the building were not able to be viewed due to wall and floor linings. It should be noted that inspection of the foundations of the structure was limited due to restricted access to the foundation structure below ground.

5.2 Available Drawings

No construction drawings for the building were available. A full site measure of the building was undertaken to gather required dimensions of structural elements relevant to this Quantitative Assessment of the building.

A plan sketch of the building has been produced from the site measure-up and is attached in Appendix B.

6. Damage Assessment

6.1 Surrounding Buildings

There was no damage noted to surrounding buildings.

6.2 Residual Displacements and General Observations

There was no settlement or earthquake damage identified during our visual inspection of the building.

6.3 Ground Damage

No ground damage was observed during our inspection of the site.

7. Geotechnical Consideration

7.1 Site Description

The site is situated in Charteris Bay, in Banks Peninsula. It is relatively flat at approximately 1 m above mean sea level. Behind the site is a cutting at the base of sloping hillside. The site is on the coast at Charteris Bay, and is approximately 2.3 km east of Diamond Harbour.

7.2 Published Information on Ground Conditions

7.2.1 Published Geology

Brown & Weeber, 1992[1] describes the site geology as:

- Flow-banded rhyolite and dacite domes and lava flows with rare breccia, tuff and obsidian;

7.2.2 Environment Canterbury Logs

No nearby boreholes had lithographic logs. However, wells slightly further away (1.2 km North) indicate the area to be underlain by silt and sand to 1.5 m bgl, underlain by weathered bedrock to 2.5m bgl.

Groundwater was not recorded in the borehole logs.

Table 1 ECan Borehole Summary

Bore Name	Log Depth	Groundwater	From Site	Log Summary
M36/10398	2.0m	Not recorded	1.2 km N	0.0 – 0.6 m Clayey SILT and SAND 0.6 – 1.1 m Basalt/ gravelly CLAY 1.1 – 2.0 m Mudstone
M36/10397	2.5 m	Not Recorded	1.2 km NE	0.0 – 1.5 m Clayey SILT and SAND 1.5 – 2.5 m Gravelly CLAY/ Clayey gravel

It should be noted that the logs have been written by the well driller and not a geotechnical professional or to a standard. In addition strength data is not recorded.

7.2.3 EQC Geotechnical Investigations

The Earthquake Commission has not undertaken geotechnical testing in the area of the subject site.

7.2.4 CERA Land Zoning

Canterbury Earthquake Recovery Authority (CERA) has indicated the site is situated within the Green Zone, indicating that repair and rebuild may take place.

[1] Brown, L. J. & Weeber, J.H. (1992): *Geology of the Christchurch Urban Area*. Institute of Geological and Nuclear Sciences 1:25,000 Geological Map 1. IGNS Limited: Lower Hutt.

Land in the CERA green zone has been divided into three technical categories. These categories describe how the land in expected to perform in future earthquakes.

The site has been categorised as "N/A – Port Hills and Banks Peninsula". These areas have not been given a technical category as their geology differs significantly from the Canterbury Plains.

7.2.5 Post-Earthquake Land Observations

The site is not in coverage of the aerial photography following the major earthquakes of the Canterbury earthquake sequence.

7.2.6 Summary of Ground Conditions

From the information presented above, the ground conditions underlying the site are anticipated to comprise variable thickness of clayey silt and sand underlain by weathered volcanic bedrock.

No groundwater information has been recorded near the site. However, due to the sites proximity to the coast it can be considered to be within 1 m of ground level.

7.3 Seismicity

7.3.1 Nearby Faults

There are many faults in the Canterbury region, however only those considered most likely to have an adverse effect on the site are detailed below.

Table 2 Summary of Known Active Faults[2,3]

Known Active Fault	Distance from Site	Direction from Site	Max Likely Magnitude	Avg Recurrence Interval
Alpine Fault	140 km	NW	~8.3	~300 years
Greendale Fault (2010)	30 km	W	7.1	~15,000 years
Hope Fault	120 km	N	7.2~7.5	120~200 years
Kelly Fault	120 km	NW	7.2	~150 years
Porters Pass Fault	75 km	NW	7.0	~1100 years
Port Hills Fault (2011)	*7 km*	N	6.3	Not Estimated

The recent earthquake sequence since 4 September 2010 has identified the presence of a previously unmapped active fault system underneath the Canterbury Plains; this includes the Greendale Fault and Port Hills Fault listed in Table 2 above. Research and published information on this system is in development and the average recurrence interval is yet to be established for the Port Hills Fault.

[2] Stirling, M.W, McVerry, G.H, and Berryman K.R. (2002): "A New Seismic Hazard Model for New Zealand", *Bulletin of the Seismological Society of America*, Vol. 92 No. 5, June 2002, pp. 1878-1903.

[3] GNS Active Faults Database, http://maps.gns.cri.nz/website/af/viewer

7.3.2 Ground Shaking Hazard

New Zealand Standard NZS 1170.5:2004 quantifies the Seismic Hazard factor for Christchurch as 0.30, being in a moderate to high earthquake zone. This value has been provisionally upgraded recently (from 0.22) to reflect the seismicity hazard observed in the earthquakes since 4 September 2010.

The recent seismic activity has produced earthquakes of Magnitude 6.3 with significant peak ground accelerations (PGA) across large parts of the city.

Conditional PGA's from the CGD[4] are not available for Banks Peninsula.

7.4 Slope Failure and/or Rockfall Potential

The topography surrounding the site suggests that rockfall is not a potential hazard. However, given its proximity to the coast and the small cutting behind the site has a potential for global slope instability. In addition, any retaining structures or embankments nearby should be further investigated to determine the site-specific local slope instability potential.

7.5 Liquefaction Potential

The site is considered unlikely to liquefy, due to the following reasons:

- The presence of clay is likely to reduce the development of liquefaction;
- The anticipated presence of shallow bedrock.

7.6 Summary & Recommendations

This assessment is based on a review of the geology and existing ground investigation information, and observations from the Christchurch earthquakes since 4 September 2010.

The site appears to be situated on variable thickness of clayey silt and sand underlain by weathered volcanic bedrock. Associated with this the site is unlikely to liquefy due to shallow bedrock and presence of clay.

A soil class of **C** (in accordance with NZS 1170.5:2004) should be adopted for the site.

Should a more comprehensive liquefaction and/or ground condition assessment be required, it is recommended that intrusive investigation be conducted.

[4] Canterbury Geotechnical Database (2012): "Conditional PGA for Liquefaction Assessment", Map Layer CGD5110 - 27 Sept 2012, retrieved 31/10/2012 from https://canterburygeotechnicaldatabase.projectorbit.com/

8. Seismic Capacity Assessment

8.1 Quantitative Assessment

A Quantitative Assessment of the building was carried out using the information gathered from a full site measure of the building on the 4th of April 2013. From this information, the building's seismic capacity was determined in accordance with NZS 3604:2011 and the NZSEE guidelines. The demand for the building was calculated in accordance with NZS 3604:2011 and the percentage of New Building Standard (%NBS) was assessed.

8.1.1 Building Demand

The demand on the structure was determined in accordance with Section 5 of NZS 3604:2011. The bracing unit demand per square metre was determined from Table 5.8. As per Table 5.8 of NZS 3604:2011 (for a single storey building with light roof, light single-storey cladding on light subfloor framing) a bracing demand of 17 BU/m^2 for the subfloor structure and 13BU/m^2 for the single storey walls is taken. As the building is located in Christchurch (earthquake Zone 2) on Class C soils, a multiplication factor of 0.6 is applied to reduce the demand in accordance with Table 5.8 of NZS 3604:2011. Therefore the total bracing demand for the building is;

$$\text{Single storey walls BU}_{\text{demand}} = (0.6 \text{ x } 13 \text{ BU/m}^2 \text{ x } 7.5\text{m}^2)$$

$$= 59 \text{ BU}$$

$$\text{Subfloor structure BU}_{\text{demand}} = (0.6 \text{ x } 17 \text{ BU/m}^2 \text{ x } 7.5\text{m}^2)$$

$$= 77 \text{ BU}$$

8.1.2 Wall bracing capacity

Wall bracing capacity of the plywood lining to the single storey walls is estimated in accordance with the "3604 Fix List Bracing Elements" publication by BRANZ in 1992. The BRANZ publication lists the bracing rating of 7.5 mm plywood lining to one face as being 95 BU/m.

Section 11.4 of the NZSEE guidelines states that shear panels can utilise their full bracing capacity for aspect ratios (height-to-width) up to 2:1. For aspect ratios greater than 2:1 and up to 3.5:1 a limiting factor can be applied in accordance with the NEHRP Recommended Provisions (BSSC, 2000) as follows;

$$\text{Aspect Ratio Factor} = \frac{2 \text{ x Width of Wall}}{\text{Wall Height}}$$

The walls in this building all have an aspect ratio less than 3.5:1 and therefore no reduction to the bracing capacity was applied.

Subfloor bracing capacity is provided by the timber framed sub-floor walls and the cantilevered timber piles. For the purpose of this assessment, the bracing rating of timber framed sub-floor walls were assumed to be 55 BU/m in accordance with Table 11.1 of NZSEE 2006 guidelines. The bracing rating of 150mm diameter timber piles were assumed to be 30 BU/pile as given in Table 5.11 of NZS 3604:2011.

The bracing capacities along and across the building are presented in Table 3.

Table 3 Bracing Capacity

Direction	Bracing Units Provided
Single storey walls	
Along the building	608 BUs
Across the building	399 BUs
Subfloor structure	
Along the building	269 BUs
Across the building	291 BUs

8.1.3 % NBS

The bracing capacity both along and across the building are compared to the demand to determine the critical direction, and therefore the overall %NBS for the building. The % NBS value is calculated as follows;

$$\%NBS = \frac{BU_{provided}}{BU_{demand}} \text{ x } \%100$$

The %NBS for both along and across the building is presented in Table 4.

Table 4 % NBS

Direction	%NBS
Along the building	>100%
Across the building	>100%

Following a detailed assessment the building has been assessed as having a seismic capacity of **>100% NBS**. Under the NZSEE guidelines and Building Act Section 122 the building is not considered to be an Earthquake Prone or Earthquake Risk under the NZSEE guidelines and the building Act Section 122.

8.2 Discussion of Results

The >100% NBS seismic rating obtained from the assessment is generally consistent with that expected for a small light weight timber framed building of this size and construction type, founded on Class C soils.

8.1 Occupancy

As the building has been assessed to have a %NBS greater than 100% NBS, it is not considered to be an Earthquake Prone or Earthquake Risk building. In addition there are no immediate collapse hazards, or critical structural weaknesses identified for this building. Therefore it is recommended that general occupancy of the building and its intended use as a public toilet is permitted.

9. Conclusions and Recommendations

The building has been assessed to have a %NBS greater than 100% NBS and is not considered to be an Earthquake Prone or Earthquake Risk building. Therefore no further assessment or strengthening works are required.

There are no immediate collapse hazards, or critical structural weaknesses identified for this building, therefore general occupancy of the building is permitted.

10. Limitations

10.1 General

This report has been prepared subject to the following limitations:

- The foundations of the building were unable to be inspected.
- No level or verticality surveys have been undertaken.
- No material testing has been undertaken.

It is noted that this report has been prepared at the request of Christchurch City Council and is intended to be used for their purposes only. GHD accepts no responsibility for any other party or person who relies on the information contained in this report.

10.2 Geotechnical Limitations

The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent geotechnical professional before being used for any other purpose. GHD Limited (GHD) accepts no responsibility for other use of the data by third parties.

Where drill hole or test pit logs, cone tests, laboratory tests, geophysical tests and similar work have been performed and recorded by others under a separate commission, the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

The advice tendered in this report is based on information obtained from the desk study investigation location test points and sample points. It is not warranted in respect to the conditions that may be encountered across the site other than at these locations. It is emphasised that the actual characteristics of the subsurface materials may vary significantly between adjacent test points, sample intervals and at locations other than where observations, explorations and investigations have been made. Subsurface conditions, including groundwater levels and contaminant concentrations can change in a limited time. This should be borne in mind when assessing the data.

It should be noted that because of the inherent uncertainties in subsurface evaluations, changed or unanticipated subsurface conditions may occur that could affect total project cost and/or execution. GHD does not accept responsibility for the consequences of significant variances in the conditions and the requirements for execution of the work.

The subsurface and surface earthworks, excavations and foundations should be examined by a suitably qualified and experienced Engineer who shall judge whether the revealed conditions accord with both the assumptions in this report and/or the design of the works. If they do not accord, the Engineer shall modify advice in this report and/or design of the works to accord with the circumstances that are revealed.

An understanding of the geotechnical site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances which arise from the issue of the report which have been modified in any way as outlined above.

Appendix A

Photographs

Photograph 1: West elevation

Photograph 2: East elevation

Photograph 3: South elevation

Photograph 4: Access door to subfloor space

Photograph 5: View of timber framed subfloor walls

Photograph 6: View of timber bearer and timber piles forming the subfloor structure

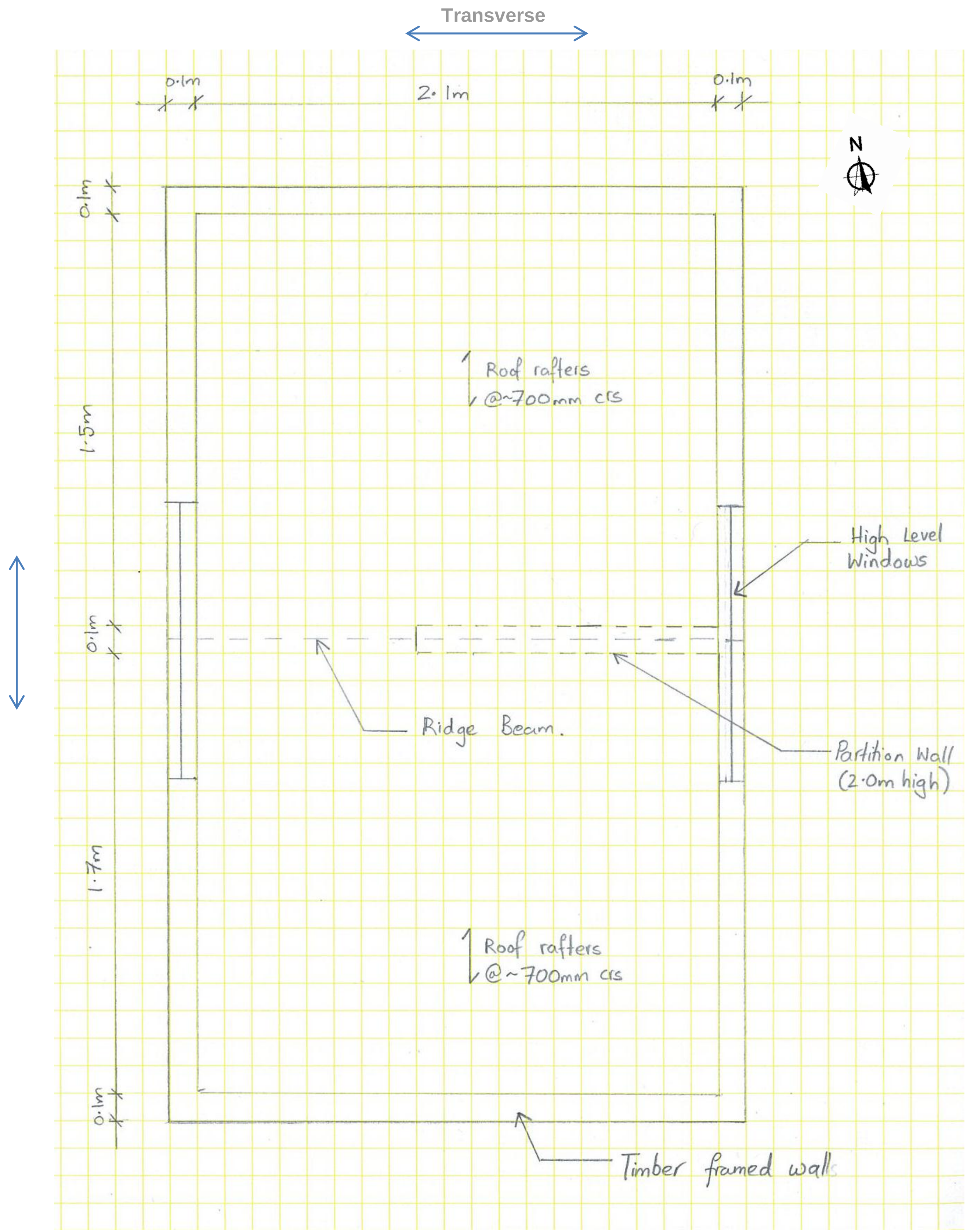
Photograph 7: Concrete slab-on-grade foundation

Photograph 8: Timber access ramp

Photograph 9: View of internal walls

Photograph 10: View of roof rafters and plywood lined ceiling

Appendix B
Drawings



Transverse
0.1m
2.1m
0.1m
N
0.1m
1.5m
Roof rafters
@~700mm crs
High Level
Windows
0.1m
Ridge Beam.
Partition Wall
(2.0m high)
1.7m
Roof rafters
@~700mm crs
0.1m
Timber framed wall

Appendix C
CERA Form

Detailed Engineering Evaluation Summary Data V1.14

Location

Building Name:	Charteris Bay Boat Ramp Toilets	Reviewer:	Hamish Mackinven
	Unit / No: / Street	CPEng No:	1003941
Building Address:	Marine Road	Company:	GHD
Legal Description:		Company project number:	513090281
		Company phone number:	33780900
	Degrees / Min / Sec		
GPS south:	43 / 38 / 44.00	Date of submission:	9/5/2013
GPS east:	172 / 42 / 34.00	Inspection Date:	4/4/2013
		Revision:	FINAL
Building Unique Identifier (CCC):	PRK 3581 BLDG 001	Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 10	Max retaining height (m):	
Soil type:	silty sand	Soil Profile (if available):	
Site Class (to NZS1170.5):	C		
Proximity to waterway (m, if <100m):	50	If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	1.00

Building

No. of storeys above ground:	1	single storey = 1 / Ground floor elevation (Absolute) (m):	2.50
Ground floor split?	no	Ground floor elevation above ground (m):	1.50
Storeys below ground	0		
Foundation type:	other (describe)	if Foundation type is other, describe:	concrete slab-on-grade & timber piles
Building height (m):	4.80	height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	7		
Age of Building (years):		Date of design:	
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	other (specify)	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):	Building houses public toilet		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	290x45 rafters with timber purlins and light metal cladding
Floors:	timber	joist depth and spacing (mm)	140x45 @ 420crs
Beams:			
Columns:			
Walls:			

Lateral load resisting structure

Lateral system along:	other (note)	Note: Define along and across in detailed report!	describe system	braced timber framed walls
Ductility assumed, μ:	3.00			
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	other (note)		describe system	braced timber framed walls
Ductility assumed, μ:	3.00			
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:			
Wall cladding:	other light	describe	timber panels
Roof Cladding:	Metal	describe	corrugated metal cladding
Glazing:	timber frames		direct fixed plywood linings
Ceilings:	strapped or direct fixed		
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:	Good	Describe damage:	
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:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before e'quakes:	100% ##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Quantitative Assessment
	Assessed %NBS after e'quakes:	100%		
Across	Assessed %NBS before e'quakes:	100% ##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	100%		

IEP

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

Period of design of building (from above): 0 — h_n from above: m

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

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		
Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0		1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2		1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)		1.0
Final (%NBS)nom:	**0%**	**0%**

2.2 Near Fault Scaling Factor

	along	across
Near Fault scaling factor, from NZS1170.5, cl 3.1.6:		1.00
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

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

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

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

2.6 Structural Performance Scaling Factor:

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

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom} \times A \times B \times C \times D \times E$ — **$\%NBS_b$:** **#DIV/0!** | **#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential — Pounding effect D1, from Table to right: 1.0; Height Difference effect D2, from Table to right: 1.0

Therefore, Factor D: 1

3.5. Site Characteristics 1

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

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

Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

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

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

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

Official Use only:

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