Christchurch City Council

Sumner Beach Toilets
PRK 1474 BLDG 009 EQ2

Detailed Engineering Evaluation

Quantitative Assessment Report

OPUS

Christchurch City Council

Sumner Beach Toilets

Quantitative Assessment Report

Marriner Street, Sumner

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Summary

Sumner Beach Toilets
PRK 1474 BLDG 009 EQ2

Detailed Engineering Evaluation
Quantitative Report - Summary
Final

Background
This is a summary of the quantitative report for the Sumner Beach Public Toilets, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, visual inspections on 20 March 2012 and calculations.

Key Damage Observed
No seismic damage was identified at the time of inspection.

Critical Structural Weaknesses
No potential critical structural weaknesses have been identified.

Indicative Building Strength
Based on the information available, and from undertaking a quantitative assessment, the building's original capacity has been assessed to be in the order of at least 100% NBS and is therefore classified as a low risk building.

Recommendations
The building complies with current standards and no further action is required, although repairs to the cosmetic damage could be considered.

Contents

1 Introduction

Opus International Consultants Limited (Opus) has been engaged by Christchurch City Council (CCC) to undertake a detailed seismic assessment of the Sumner Beach Toilets located at Marriner Street, Sumner, Christchurch, following the M6.3 Christchurch earthquake on 22 February 2011.

The purpose of the assessment is to determine if the building is classed as being earthquake prone in accordance with the Building Act 2004.

The seismic assessment and reporting have been undertaken based on the qualitative and quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) [3] [4].

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

We understand that CERA 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). CERA have adopted the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011. This document sets out a methodology for both initial qualitative and detailed quantitative assessments.

It is anticipated that a number of factors, including the following, will determine the extent of evaluation and strengthening level required:

1. The importance level and occupancy of the building.

2. The placard status and amount of damage.

3. The age and structural type of the building.

4. Consideration of any critical structural weaknesses.

Christchurch City Council requires any building with a capacity of less than 34% of New Building Standard (including consideration of critical structural weaknesses) to be strengthened to a target of 67% as required under the CCC Earthquake Prone Building Policy.

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 the alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

The Earthquake Prone Building policy for the territorial authority shall apply as outlined in Section 2.3 of this report.

Section 115 – Change of Use

This section requires that the territorial authority is satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'.

This is typically interpreted by territorial authorities as being 67% of the strength of an equivalent new building or as near as practicable. This is also the minimum level recommended by the New Zealand Society for Earthquake Engineering (NZSEE).

Section 121 – Dangerous Buildings

This section was extended by the Canterbury Earthquake (Building Act) Order 2010, and defines a building as dangerous if:

1. 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
2. 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
3. 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
4. There is a risk that other property could collapse or otherwise cause injury or death; or

5. 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 (EPB) 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 loads 33% of those 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 on 4 September 2010.

The 2010 amendment includes the following:

1. A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
2. A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
3. A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
4. 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.

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.

Where an application for a change of use of a building is made to Council, the building will be required to be strengthened to 67% of New Building Standard or as near as is reasonably practicable.

2.4 Building Code

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

On 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- increase in the basic seismic design load for the Canterbury earthquake region (Z factor increased to 0.3 equating to an increase of 36 – 47% depending on location within the region);

- Increased serviceability requirements.

2.5 Institution of Professional Engineers New Zealand (IPENZ) Code of Ethics

One of the core ethical values of professional engineers in New Zealand is the protection of life and safeguarding of people. The IPENZ Code of Ethics requires that:

Members shall recognise the need to protect life and to safeguard people, and in their engineering activities shall act to address this need.

1.1 Giving Priority to the safety and well-being of the community and having regard to this principle in assessing obligations to clients, employers and colleagues.

1.2 Ensuring that responsible steps are taken to minimise the risk of loss of life, injury or suffering which may result from your engineering activities, either directly or indirectly.

All recommendations on building occupancy and access must be made with these fundamental obligations in mind.

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 loadings are in accordance with the current earthquake loading standard NZS1170.5 [1].

A generally accepted classification of earthquake risk for existing buildings in terms of %NBS that has been proposed by the NZSEE 2006 [2] is presented in Figure 1 below.

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

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

Table 1 below 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).

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

3.1 Minimum and Recommended Standards

Based on governing policy and recent observations, Opus makes the following general recommendations:

3.1.1 Occupancy

The Canterbury Earthquake Order[1] in Council 16 September 2010, modified the meaning of "dangerous building" to include buildings that were identified as being EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the Territorial Authority, or CERA acting on their behalf, once they are made aware of our assessment. Based on information received from CERA to date and from the DBH guidance document dated 12 June 2012 [6], this notice is likely to prohibit occupancy of the building (or parts thereof), until its seismic capacity is improved to the point that it is no longer considered an EPB.

3.1.2 Cordoning

Where there is an overhead falling hazard, or potential collapse hazard of the building, the areas of concern should be cordoned off in accordance with current CERA/territorial authority guidelines.

3.1.3 Strengthening

Industry guidelines (NZSEE 2006 [2]) strongly recommend that every effort be made to achieve improvement to at least 67%NBS. A strengthening solution to anything less than 67%NBS would not provide an adequate reduction to the level of risk.

It should be noted that full compliance with the current building code requires building strength of 100%NBS.

3.1.4 Our Ethical Obligation

In accordance with the IPENZ code of ethics, we have a duty of care to the public. This obligation requires us to identify and inform CERA of potentially dangerous buildings; this would include earthquake prone buildings.

[1] This Order only applies to buildings within the Christchurch City, Selwyn District and Waimakariri District Councils authority

4 Background Information

4.1 Building Description

The Sumner Beach Toilets are located at the corner of Marriner Street and the Esplanade, Sumner, Christchurch. The construction drawings are dated May 2003 and it is assumed construction occurred the same year. The toilets contain two similar cubicles. The walls are constructed of 20 series stacker bond reinforced masonry block, solid filled, reinforced with D12 at 600mm spacing in both directions and supported on shallow strip footings. The floor is 100mm thick concrete slab-on-grade reinforced with 665 mesh. The roof is timber framed with 21mm plywood and butynol rubber.

4.2 Inspection

An inspection of the site was completed by Opus International Consultants on 12 July 2012. The building has suffered little visible damage. The only damage visible is minor spalling of the plaster finish at the base of the wall and cracking of the mortar around the small windows.

4.3 Original Documentation

Copies of the following construction drawings were provided by CCC:

» Structural drawings 562/935 Sheets A01, A02 and A03; titled Marriner Street Public Toilets Changing Rooms & Wash Down; dated 27.05.03.

The drawings are included in Appendix 2. The assessment has been based on these drawings.

5 Detailed Seismic Assessment

The detailed seismic assessment has been based on the current codes NZS 1170 [1] and NZS 4230 [6].

5.1 Critical Structural Weaknesses

The term Critical Structural Weakness (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of a building.

No critical structural weaknesses were identified for this building.

5.2 Quantitative Assessment Methodology

Static analysis was carried out using the spectral values established from NZS1170.5, with an updated Z factor of 0.3 (B1/VM1). These analyses were used to establish the actions on the structural elements. Based on the actions determined from the analysis a comparison with the building capacities was made.

5.3 Seismic Loads

Seismic loads have been calculated in accordance with NZS1170.5 [1].

The NZS1170.5 seismic parameters for the site were as listed below.

Soil Category:	D (deep soil)
Spectral shape factor C_h:	3.0
Importance Level:	2
Return period factor R:	1.0 (500 year)
Hazard factor Z:	0.30
Near fault factor N:	1.0
Elastic site hazard spectrum for horizontal loading	0.90g

7.6 Assessment

A summary of the structural performance of the building is shown in the following table.

Table 2: Summary of Seismic Performance, $\mu = 1.25$

Structural Element/System	Comments	Critical Structural Weakness and Collapse Hazard	% NBS based on calculated capacity
Roof	The light weight timber frame and plywood will act as a diaphragm. The roof is not assumed to resist any loads except to brace to the top of the two columns.	None	>100%
Walls	The walls will act to resist the lateral seismic loads in both directions through in-plane shear. The walls must resist out-of-plane bending resulting from self-weight. The critical aspect ratio for these is 1:1.25, thus they act as two-way slabs.	None	>100%
Slab-on-grade	The slab-on-grade must resist any tension forces and bending moments transferred from the walls.	None	>100%
Columns	These must resist their own self-weight.	None	>100%

The building has a calculated seismic capacity of greater than 100%NBS and is therefore classed as a low risk building in accordance with NZSEE guidelines.

6 Summary of Geotechnical Appraisal

A site walkover by a geotechnical engineer was undertaken on 17 August 2012 and a geotechnical desktop study has been completed (refer Appendix 3). Minor land damage has occurred at this site as a result of the Canterbury Earthquake sequence following the September 2010 earthquake.

Potential for ground damage, from liquefaction, is moderate for this site, indicating that the ground may be affected by between 100 – 300mm of subsidence. The Sumner Beach Toilets site is bounded by residential properties located in the CERA "green" zone.

Some 5 – 10mm cracks were observed in the nearby asphalted footpaths, concrete walkway and wall.

7 Conclusions

Calculations confirm that the building has a capacity of over 100% NBS and is therefore classed as a low risk building. The toilets are less than ten years old, performed well in the recent earthquakes and have only very minor cosmetic damage evident.

The liquefaction ground damage potential for this site is considered moderate for future seismic events.

8 Recommendations

The building complies with current standards and no further action is required, although repairs to the cosmetic damage could be considered.

9 Limitations

a) This report is based on an inspection of the building and focuses on the structural damage resulting from the 22 February Canterbury Earthquake and aftershocks only. Some non-structural damage is noted but this is not intended to be a complete list of damage to non-structural items.
b) Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time.
c) This report is prepared for CCC to assist with assessing the remedial works required for council buildings and facilities. It is not intended for any other party or purpose.

10 References

[1] NZS 1170.5: 2004, *Structural design actions, Part 5 Earthquake actions,* Standards New Zealand.

[2] NZSEE: 2006, *Assessment and improvement of the structural performance of buildings in earthquakes,* New Zealand Society for Earthquake Engineering.

[3] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure*, Draft Prepared by the Engineering Advisory Group, Revision 5, 19 July 2011.

[4] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Non-residential buildings, Part 3 Technical Guidance*, Draft Prepared by the Engineering Advisory Group, 13 December 2011.

[5] SESOC, *Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes*, Structural Engineering Society of New Zealand, 21 December 2011.

[6] NZS 4230: 2004, *Design of Reinforced Concrete Masonry Structures*, Standards New Zealand.

Appendix 1: PHOTOGRAPHS

Photo 1: North-East view of Sumner Beach Toilets

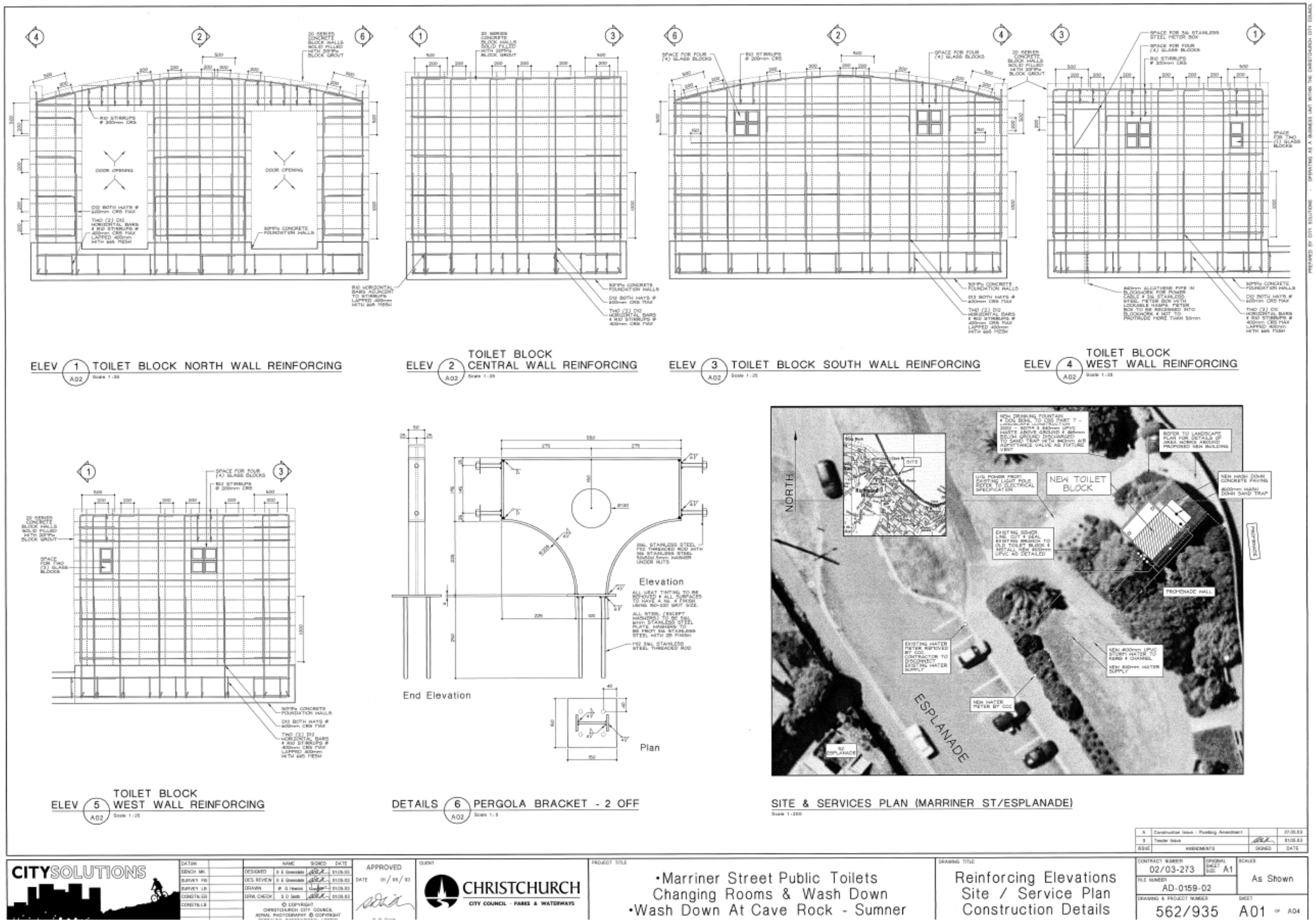
Photo 2: North Wall Elevation

Photo 3: East Wall Elevation (wash down area)

Photo 4: South Wall Elevation

Photo 5: East Toilet Cubicle (West similar)

Appendix 2: CONSTUCTION DRAWINGS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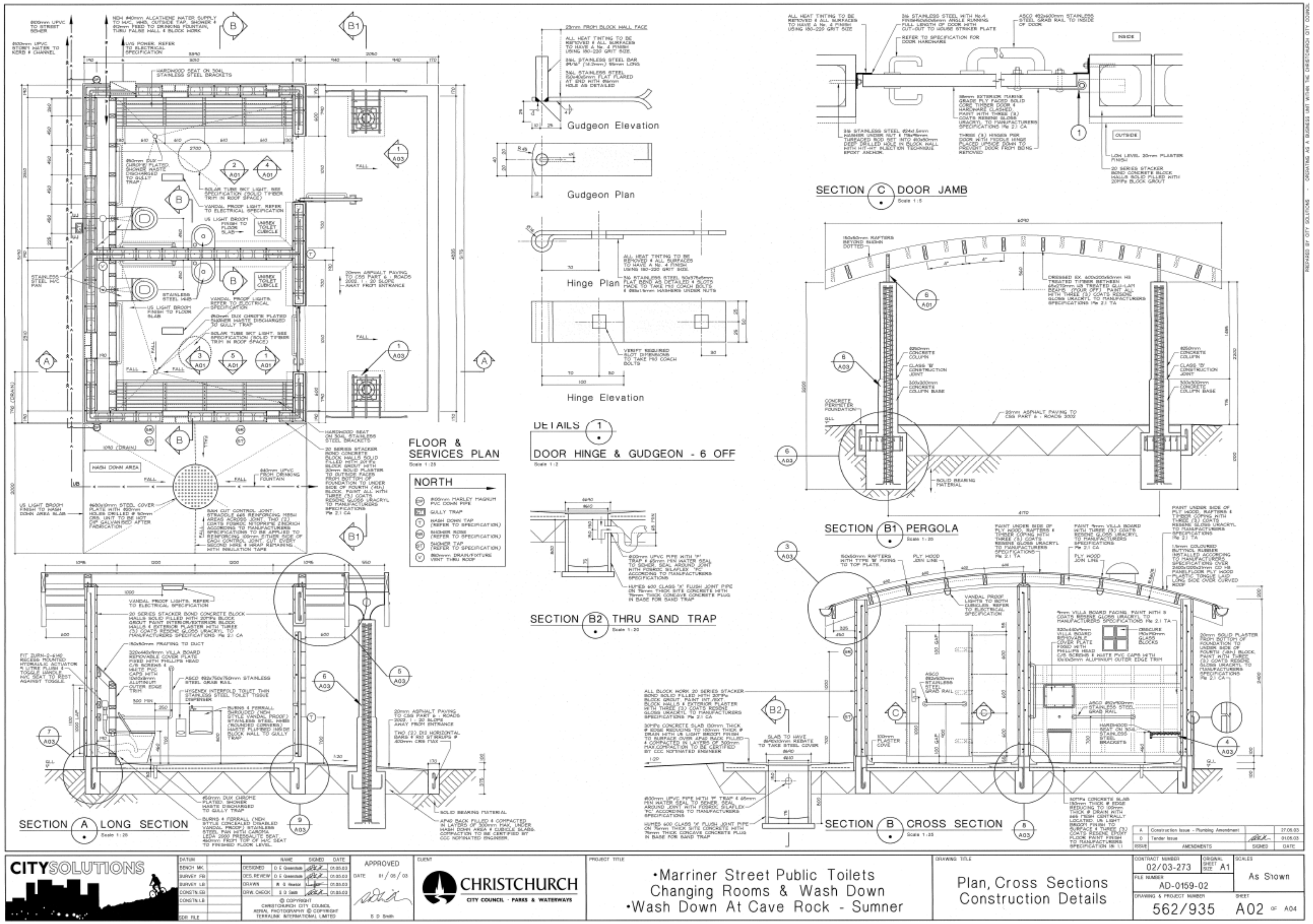
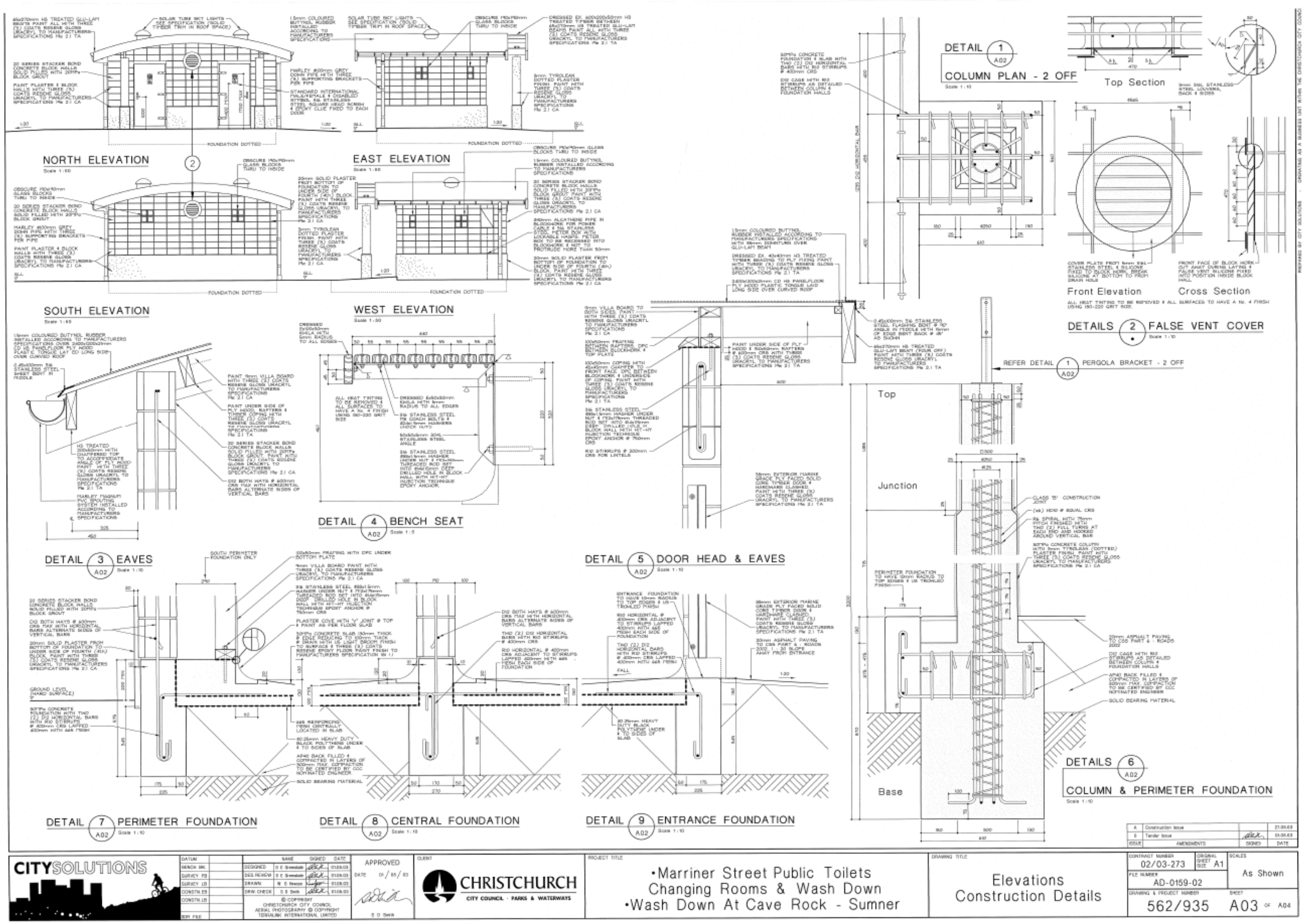
ELEV 2 TOILET BLOCK CENTRAL WALL REINFORCING
ELEV 3 TOILET BLOCK SOUTH WALL REINFORCING
ELEV 4 TOILET BLOCK WEST WALL REINFORCING
ELEV 5 TOILET BLOCK WEST WALL REINFORCING
DETAILS 6 PERGOLA BRACKET - 2 OFF
Elevation
End Elevation
Plan
SITE & SERVICES PLAN (MARRINER ST/ESPLANADE)
NORTH
NEW TOILET BLOCK
ESPLANADE
CITYSOLUTIONS
CHRISTCHURCH CITY COUNCIL · PARKS & WATERWAYS
•Marriner Street Public Toilets
Changing Rooms & Wash Down
•Wash Down At Cave Rock - Sumner
Reinforcing Elevations
Site / Service Plan
Construction Details
02/03-273
A1
As Shown
AD-0159-02
562/935
A01



FLOOR & SERVICES PLAN
NORTH
Gudgeon Elevation
Gudgeon Plan
Hinge Plan
Hinge Elevation
DETAILS 1
DOOR HINGE & GUDGEON - 6 OFF
SECTION C DOOR JAMB
SECTION B1 PERGOLA
SECTION B2 THRU SAND TRAP
SECTION A LONG SECTION
SECTION B CROSS SECTION
CITYSOLUTIONS
APPROVED
CHRISTCHURCH
CITY COUNCIL · PARKS & WATERWAYS
•Marriner Street Public Toilets
Changing Rooms & Wash Down
•Wash Down At Cave Rock - Sumner
Plan, Cross Sections
Construction Details
02/03-273
A1
As Shown
AD-0159-02
562/935
A02


NORTH ELEVATION
EAST ELEVATION
SOUTH ELEVATION
WEST ELEVATION
DETAIL 1 COLUMN PLAN - 2 OFF
Top Section
Front Elevation
Cross Section
DETAILS 2 FALSE VENT COVER
REFER DETAIL 1 PERGOLA BRACKET - 2 OFF
Top
Junction
Base
DETAILS 6 COLUMN & PERIMETER FOUNDATION
DETAIL 3 EAVES
DETAIL 4 BENCH SEAT
DETAIL 5 DOOR HEAD & EAVES
DETAIL 7 PERIMETER FOUNDATION
DETAIL 8 CENTRAL FOUNDATION
DETAIL 9 ENTRANCE FOUNDATION
FOUNDATION DOTTED
CITYSOLUTIONS
APPROVED
CHRISTCHURCH CITY COUNCIL · PARKS & WATERWAYS
•Marriner Street Public Toilets
Changing Rooms & Wash Down
•Wash Down At Cave Rock - Sumner
Elevations
Construction Details
02/03-273
A1
As Shown
AD-0159-02
562/935
A03 OF A04

Appendix 3: GEOTECHNICAL APPRAISAL

12 February 2013

Christchurch City Council
C/O:- Michael Sheffield
Property Asset Manager

6-QUCC1.75/005SC

Dear Michael

Geotechnical Desktop Study – Sumner Beach Toilets

1. Introduction

Christchurch City Council (CCC) has commissioned Opus International Consultants (Opus) to undertake a geotechnical desktop study and site walkover of the Sumner Beach Toilets located on the Esplanade, Christchurch. The purpose of this study is to collate existing subsoil information and undertake an appraisal of the potential geotechnical hazards at this site and to determine whether further investigations are required. The site walkover was completed by Opus on 17 August 2012. Refer to Appendix A for site photos.

This Geotechnical Desk Study has been prepared in accordance with the Engineering Advisory Group's Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Revision 5, 19 July 2011.

It is our understanding that this is the first geotechnical inspection of this property and forms part of a Detailed Engineering Evaluation prepared by Opus.

This geotechnical desk study has been undertaken without the benefit of any site specific investigations and is therefore preliminary in nature.

2. Desktop Study

2.1 Site Description

The Sumner Beach Toilets is located close to the intersection of Marriner St and Esplanade, Richmond, Christchurch, and surrounded with shrubs plants to the south and west elevations, asphalted/concreted paths to the north and the beach and promenade to the east. The toilet is a single storey structure and is comprised of 20 series stacker bond reinforced concrete block walls filled with 20MPa block grout, resting on 30MPa reinforced concrete foundation walls and concrete slab on compacted AP40 backfill.

The building was designed in 2003 for CCC by City Solutions.

The ground profile is relatively flat and approximately level with the road.

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2.2 Structural Drawings

Structural drawings showing plan, cross-section and elevation construction details have been available for review and are appended in Appendix D. The drawings indicated a 30MPa 130mm reinforced concrete floor slab reducing to 100mm on the edge on a 345mm AP40 hard fill, compacted in layers. The concrete perimeter foundations are a minimum of 345mm below ground level (bgl) and 225mm wide with central foundation being 270mm wide.

2.3 Regional Geology

The published geological map of the area, (Geology of the Christchurch Urban Area 1:25,000, Brown and Weeber, 1992) indicates the site is underlain by the Christchurch Formation with dominantly sand of fixed and semi-fixed dunes and beaches.

2.4 Expected Ground Conditions

A review of the Environmental Canterbury (ECan) wells database showed eleven wells located within approximately 270m of the Sumner Beach Toilets (refer to Site Location Plan in Appendix B). All ECan wells are shallow, maximum depth of only 4.2m bgl. It must be noted that the ground conditions of this area are variable; two of the eleven ECan wells indicate rock at 2m bgl and 300m to the north-west an approximately 10m high bedrock sea stack is located.

Material logs available from the wells have been used to infer the ground conditions at the site as shown in Table 1 below.

Table 1: Inferred Ground Conditions

Stratigraphy	Thickness (m)	Depth Encountered From (m)
FILL (brown sandy GRAVEL)	0.5 – 2m	Surface
SAND (grey, fine to coarse)	>4.2	Surface – 0.5m

An indication of the relative density of the sand layers has not been included in the well logs.

The Brown and Weeber “Geology of the Christchurch Urban Area” map suggests a water table less than 1m bgl.

2.5 Liquefaction Hazard

A liquefaction hazard study was conducted by the Canterbury Regional Council (ECan) in 2004 to identify areas of Christchurch susceptible to liquefaction during an earthquake. The Sumner Beach Toilets is located in an area identified as ‘moderate liquefaction ground damage potential’ for a low groundwater scenario. According to this study, the ground damage potential is moderate, indicating the ground may be affected by between 100 and 300mm of subsidence.

Tonkin and Taylor Ltd (T&T Ltd) have been engaged as the Earthquake Commission’s (EQC) geotechnical consultants and have prepared maps showing areas of liquefaction interpreted from high resolution aerial photos for the 4 September 2010 earthquake, and the aftershocks of February 2011 and June 2011. An interpretation of these maps indicates there was liquefaction in the Sumner area but none within the vicinity of the Sumner Beach Toilets.

Sumner Beach Toilets is bounded by residential properties located in the CERA “green” zone. The “green” zone has been further categorised into technical categories by the Department of Building and Housing (DBH). This site has been identified as “Technical Category 2” (TC2) released in October 2011. The DBH technical categories are guidelines for residential foundations, however are likely to be used as a guideline by the Christchurch City Council for building consent. TC2 identifies the area may be subject to minor to moderate land damage from liquefaction in future large earthquakes.

3. Site Walkover Inspection

A walkover inspection of the exterior and interior was carried out by an Opus Geotechnical Engineer on 17 August 2012. The following observations were made (refer to Appendix A for Site Photos and Appendix C for the Site Walkover Plan):

- 5mm crack on the 20mm solid plaster of concrete on south side of building. Refer to Photograph 5.

- Some minor cracking (2mm wide hairline crack) on concrete slab on the wash down area, east elevation of the building. Refer to Photograph 6 in Appendix A.

- 2mm hairline crack on the concrete floor of the toilets. Refer to Photograph 7a and 7b in Appendix A.

- An approximate 5mm wide cracks around the right most 300mm x 300mm concrete column, cracks radiating outward the 20mm asphalt paving. Asphalt ground lifted roughly 5mm. Refer to Photograph 8 in Appendix A.

- Minor 5mm wide cracks on the asphalted footpath north of the toilets. Refer to Appendix C -Site Walkover Plan, Photograph 9.

- 10mm wide cracks from the top to base of the concrete wall separating the toilets from the promenade. This is also accompanied by a lift and subsidence of approximately 10mm as indicated by the arrows. Refer to Appendix C -Site Walkover Plan, Photograph 10.

- Small ground heave within 5mm to 10mm at the bottom of the concrete wall with estimated 10mm wide cracks separating bottom of wall and paved ground. Refer to Appendix C -Site Walkover Plan, Photograph 11.

- Approximately 10mm to 15mm wide cracks on the concrete walkway, north of the toilets, leading toward the promenade. Refer to Appendix C -Site Walkover Plan, Photograph 12.

4. Discussion

Minor land damage has occurred at the Sumner Beach Toilet due to the Canterbury Earthquake Sequence following the 4 September 2010 earthquake.

The cracks in the paved areas (concreted/asphalted) outside the beach toilets, cracks on the solid plaster on the perimeter foundation and hairline cracks on the toilets’ floor slab and damaged areas on the wall separating the toilets and the promenade (e.g. cracks and lifts) are considered minor.

Cracks in the solid plaster on the east elevation of the toilet could not be observed in the perimeter footing, possibly shallow. There is no evidence of liquefaction at the site.

The hairline cracks in the toilets' floor slab appear to be negligible and have the no potential to affect the structural integrity of the building and its performance in future earthquakes.

ECan well logs indicate the building is likely to be founded on a capping of fill overlying sand to a depth of at least 4.2m bgl. The foundation system of a perimeter strip footing with a concrete slab on hard fill seem to have performed well for the majority of the building. However, CCC will have to accept that in future seismic events there is a risk of minor differential settlement.

GNS Science[1] indicates an elevated risk of seismic activity is expected in the Canterbury region as a result of the earthquake sequence following the 4 September 2010 earthquake. Recent advice (Geonet) indicates there is a 12% probability of another Magnitude 6 or greater earthquake occurring in the next 12 months in the Canterbury region. It is expected that the probability of occurrence is likely to decrease with time, following periods of reduced seismic activity. However, we would expect that similar ground damage could occur in a future earthquake, dependent on the location of the epicentre.

5. Recommendations

The existing concrete perimeter slab foundations appear to have performed reasonably well and are considered suitable.

No further geotechnical investigations are recommended.

6. Limitation

This report has been prepared solely for the benefit of CCC as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

It is recognised that the passage of time affects the information and assessment provided in this Document. The recommendations formed in this report are based upon the information that existed at the time of production of the Desktop Study. It is understood that the services provided allowed Opus to form no more than an opinion on the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings or any laws or regulations.

7. References:

Brown, LJ; Webber, JH 1992: Geology of the Christchurch Urban Area. Scale 1:25,000. Institute of Geological and Nuclear Sciences geological map, 1 sheet + 104p.

[1] GNS Science reporting on Geonet Website: http://www.geonet.org.nz/canterbury- quakes/aftershocks/ updated on 22 January 2013.

Environment Canterbury, Canterbury Regional Council (ECan) website:

ECan Well Card
http://ecan.govt.nz/services/online-services/tools-calculators/Pages/well-card.aspx

ECan 2004: The Solid Facts on Christchurch Liquefaction. Canterbury Regional Council, Christchurch, 1 sheet.

Project Orbit, 2011: interagency/organisation collaboration portal for Christchurch recovery effort. https://canterburyrecovery.projectorbit.com/SitePages/Home.aspx

<u>Appendices:</u>
Appendix A: Site Photos
Appendix B: Site Location Plan and ECan Well Logs
Appendix C: Site Walkover Plan
Appendix D: Structural Drawings

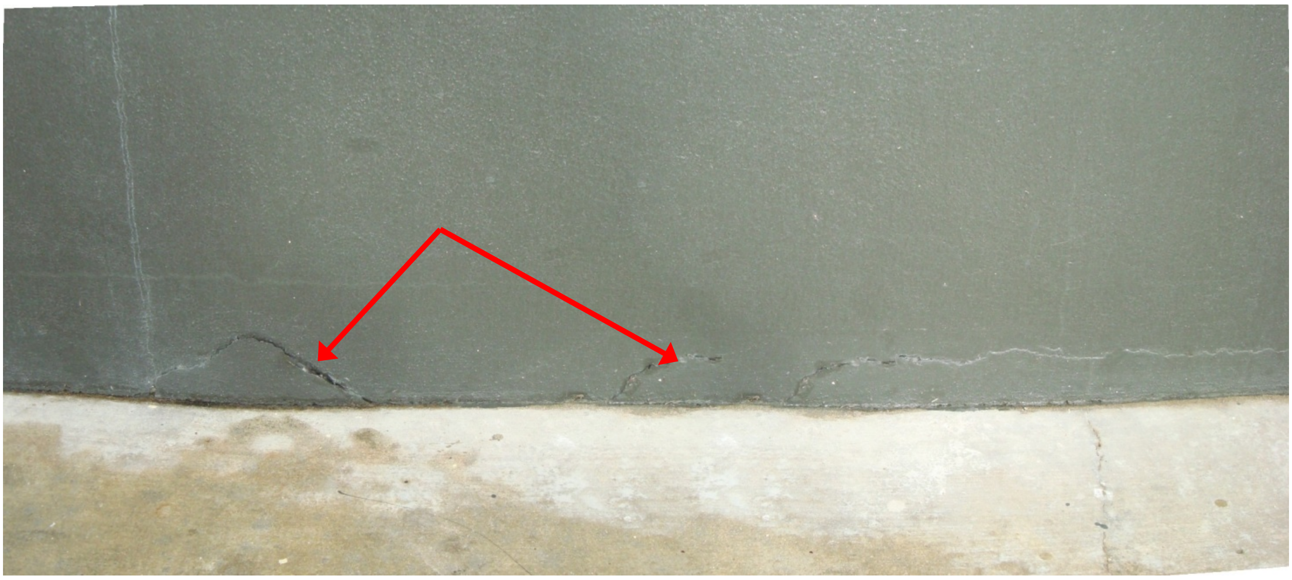
APPENDIX A:
Site Photos

Photograph 1: North Elevation of Sumner Beach Toilet.

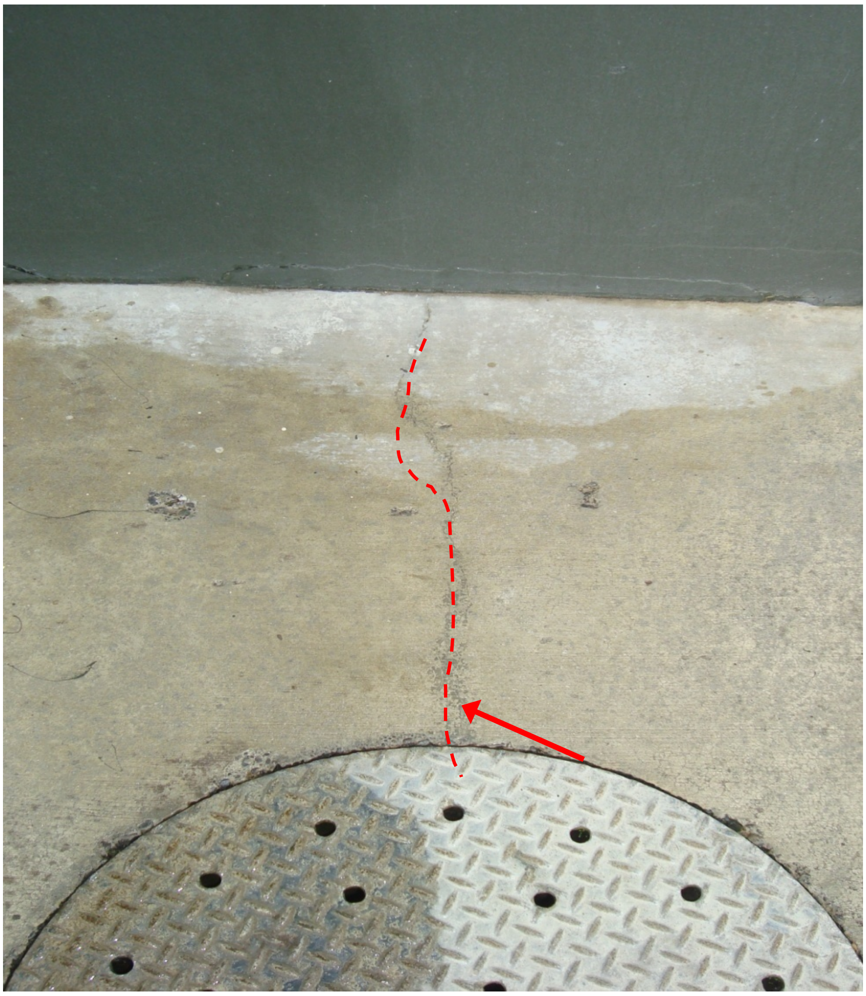
Photograph 2: South Elevation of Sumner Beach Toilet.

Photograph 3: East Elevation of Sumner Beach Toilet.

Photograph 4: West Elevation of Sumner Beach Toilet.



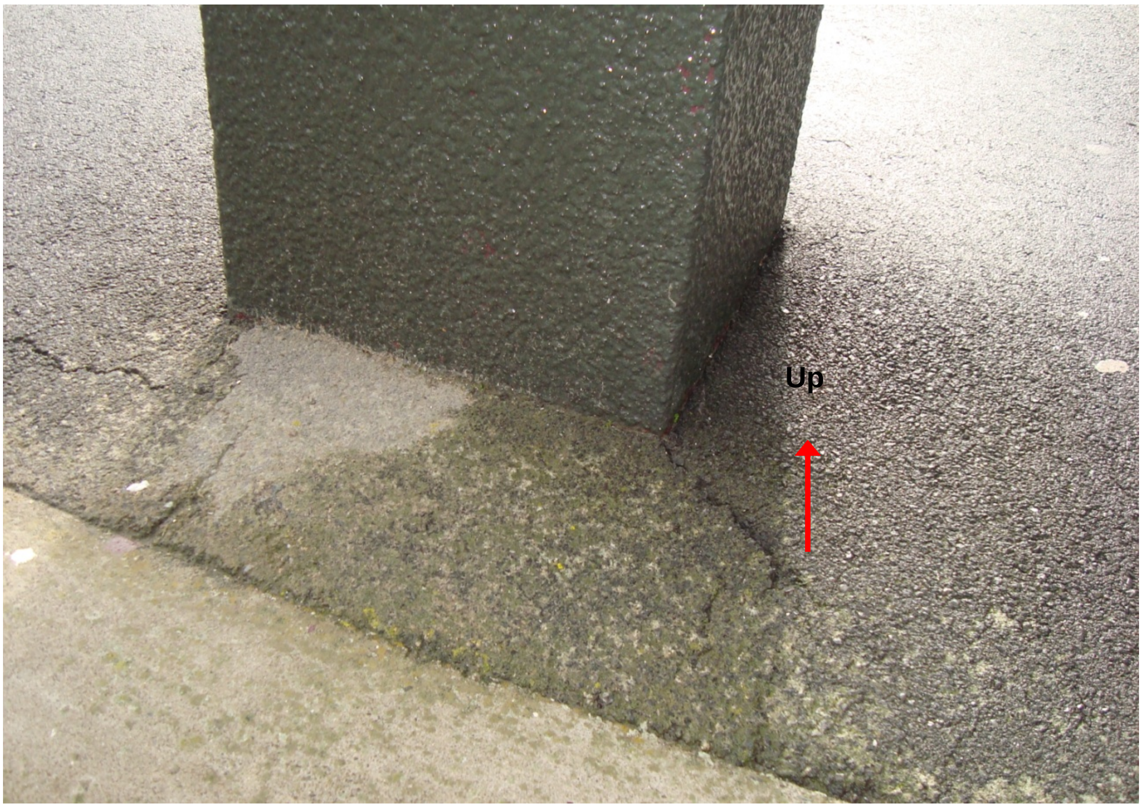
Photograph 5: 5mm crack on the 20mm solid plaster of concrete on south side of building.



Photograph 6: Some minor cracking (2mm wide hairline crack) on wash down area (east elevation).


Photograph 7a: 2mm wide cracks floor slab inside the toilets.


Photograph 7b: 2mm wide cracks floor slab inside the toilets.



Photograph 8: Approximate 5mm wide shallow cracks around the right most 300mm x 300mm concrete column, cracks radiating outward the 20mm asphalt paving. Asphalt ground lifted 5mm.

APPENDIX B:

Site Location Plan
ECan Well Logs

SOURCE: canterburyrecovery.projectorbit.com (Accessed on 17/08/12)

Opus International Consultants Ltd
Christchurch Office
20 Moorhouse Ave
PO Box 1482
Christchurch, New Zealand
Tel: +64 3 363 5400 Fax: +64 3 365 7857

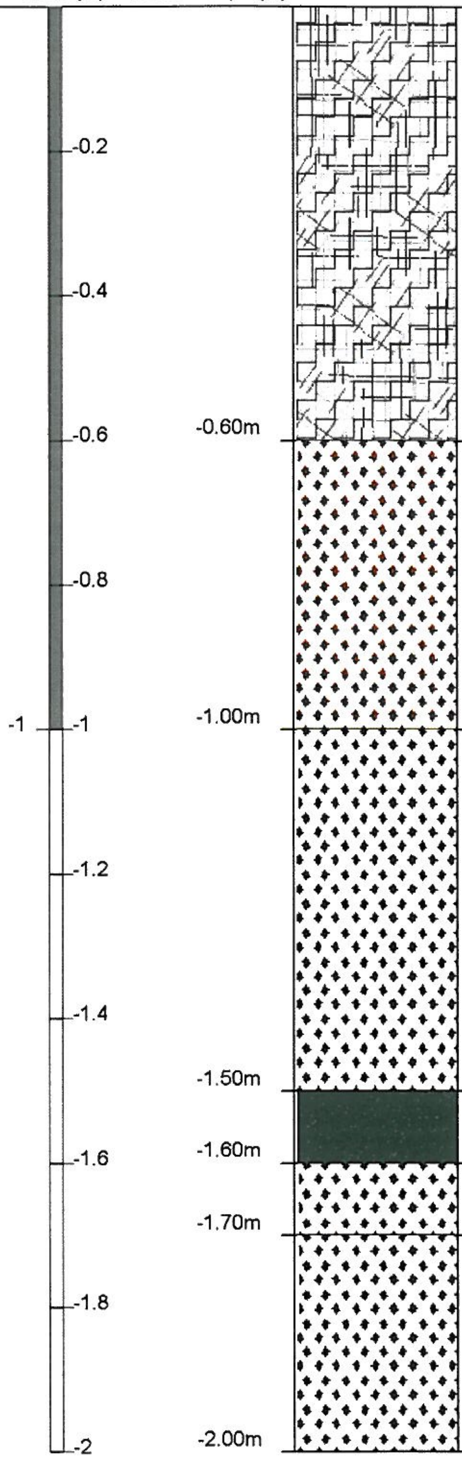
Project:	CCC- Sumner Beach Toilets Geotechnical Desktop Study
Project No.:	6-QUCC1.75
Client:	Christchurch City Council

Site Location Plan

Date: 17/09/2012
Drawn By: Opus Geotechnical Engineer

Borelog for well N36/0219

Gridref: N36:90467-37609 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 13 +MSD
Well name : CCC BorelogID 7315
Drill Method : Not Recorded
Drill Depth : -2m Drill Date : 6/12/2005



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			dark brown loosely packed dry sand fill	
		-0.60m	dark brown loosely packed slightly moist sand	
		-1.00m	greyish brown loosely packed moist sand	
		-1.50m	black peaty sand	
		-1.60m	greyish brown loosely packed very moist sand	
		-1.70m	greyish brown loosely packed wet sand	
		-2.00m		

Borelog for well N36/0218

Gridref: N36:90491-37621 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 13 +MSD
Well name : CCC BorelogID 7314
Drill Method : Not Recorded
Drill Depth : -1.9m Drill Date : 6/12/2005

Environment Canterbury Regional Council

Depth(m)	Full Drillers Description
0 to -0.50m	dark brown loosely packed dry sand fill
-0.50m to -0.60m	dark brown loosely packed dry silty sand fill
-0.60m to -0.70m	dark brown loosely packed dry silty sand fill
-0.70m to -0.80m	dark brown loosely packed dry silty sand fill / gravel
-0.80m to -1.30m	mottled grey / reddish brown medium packed moist sand
-1.30m to -1.35m	grey / blue medium packed moist sand
-1.35m to -1.50m	mottled grey / reddish brown medium packed very moist sand
-1.50m to -1.90m	mottled grey / reddish brown medium packed wet sand

Borelog for well N36/0246

Gridref: N36:90532-37533 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 1 +MSD
Driller : McMillan Water Wells Ltd
Drill Method : Rotary Rig
Drill Depth : -4.2m Drill Date : 2/04/2009

Depth(m)	Full Drillers Description	Formation Code
-0.50m	Topsoil light brown, with some subrounded gravels up to 20 mm dry	
-1.50m	Brown fine to coarse sand, moist from .85 wet from 1.2m	
-2.50m	Brown fine to coarse sand wet.	
-3.60m	Grey fine coarse sand, wet	
-4.20m	Grey fine to coarse sand, wet, with occasional white shell fragments	

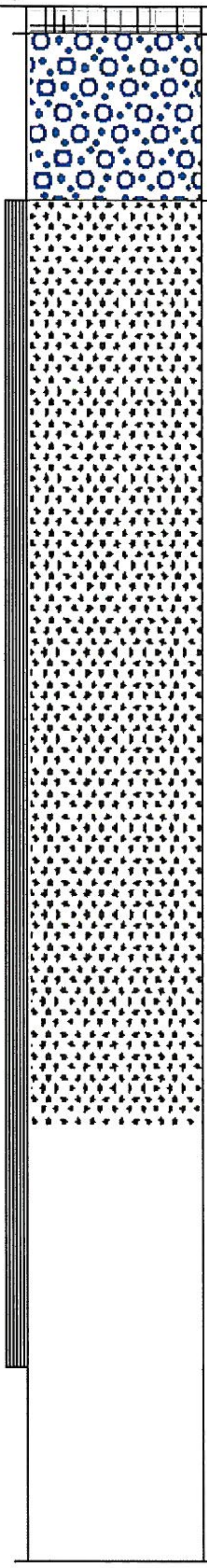
Borelog for well N36/0039

Gridref: N36:905-375 Accuracy : 4 (1=best, 4=worst)
Ground Level Altitude : 4.2 +MSD
Driller : Canterbury Drilling Company
Drill Method : Auger Rig
Drill Depth : -2m Drill Date : 17/05/1994

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			Sand, fine, Grey with some building rubble up to 500mm in size, some shell fragments below 1m	
		-1.99m		
		-2.00m	Rock	

Borelog for well N36/0040

Gridref: N36:905-375 Accuracy : 4 (1=best, 4=worst)
Ground Level Altitude : 4.2 +MSD
Driller : Canterbury Drilling Company
Drill Method : Auger Rig
Drill Depth : -4m Drill Date : 15/05/1994

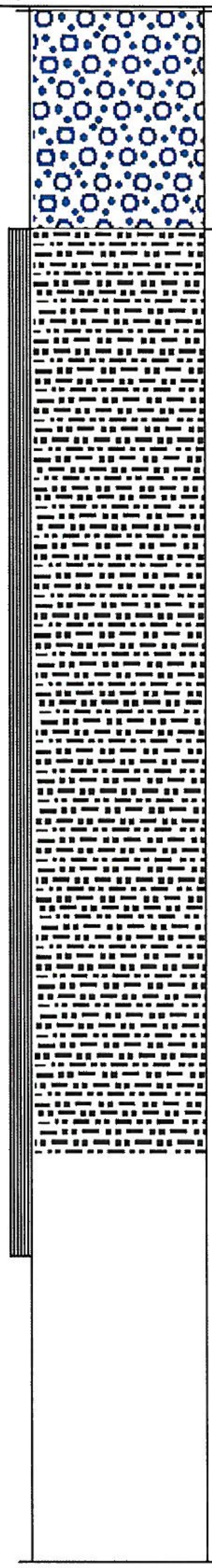


Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.07m	Asphalt	
		-0.50m	Sand, Br, fine with Grey rounded gravel up to 100mm in diameter	
		-4.00m	Sand, grey, fine	

Borelog for well N36/0041

Gridref: N36:905-375 Accuracy : 4 (1=best, 4=worst)
Ground Level Altitude : 4.2 +MSD
Driller : Canterbury Drilling Company
Drill Method : Auger Rig
Drill Depth : -3.5m Drill Date : 17/05/1994

Environment Canterbury
Your regional council

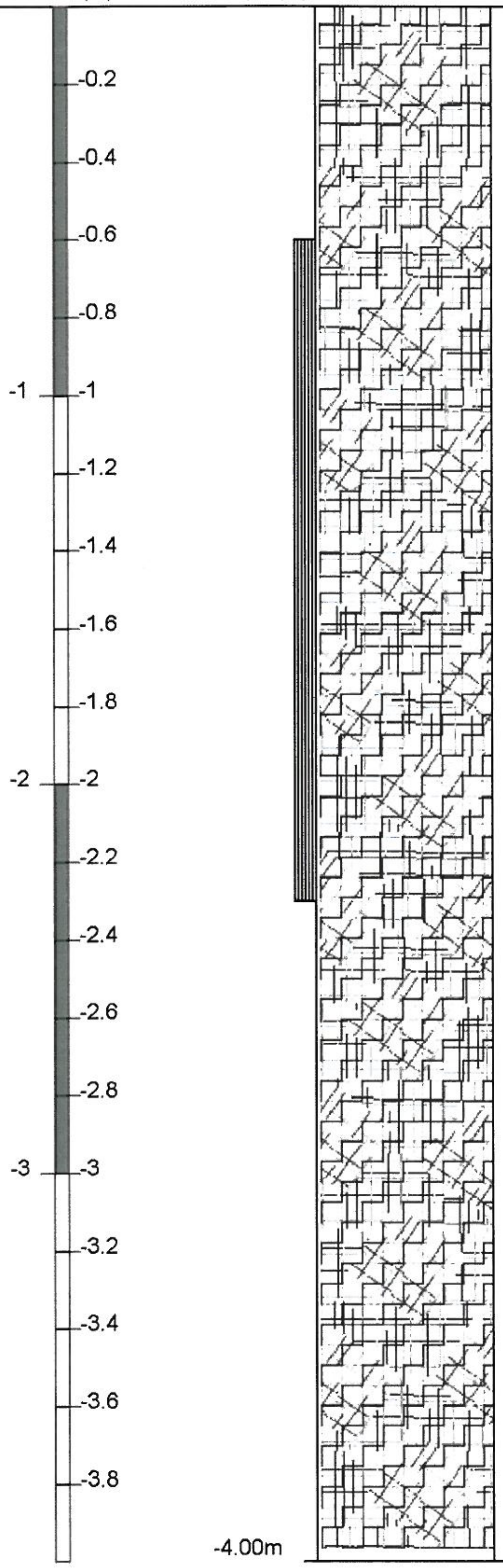


Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.01m	Concrete not reinforced	
			Sand, grey, fine with some silt and rounded, grey, gravel up to 50mm	
		-0.50m	Sand, grey, fine with some silt. Some timber pieces up to 300mm long	
		-3.50m		

Borelog for well N36/0084

Gridref: N36:90525-37488 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 11 +MSD
Driller : C W Drilling and Investigations Ltd
Drill Method : Push Tube
Drill Depth : -4m Drill Date : 20/10/2005

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			sandy gravel fill	

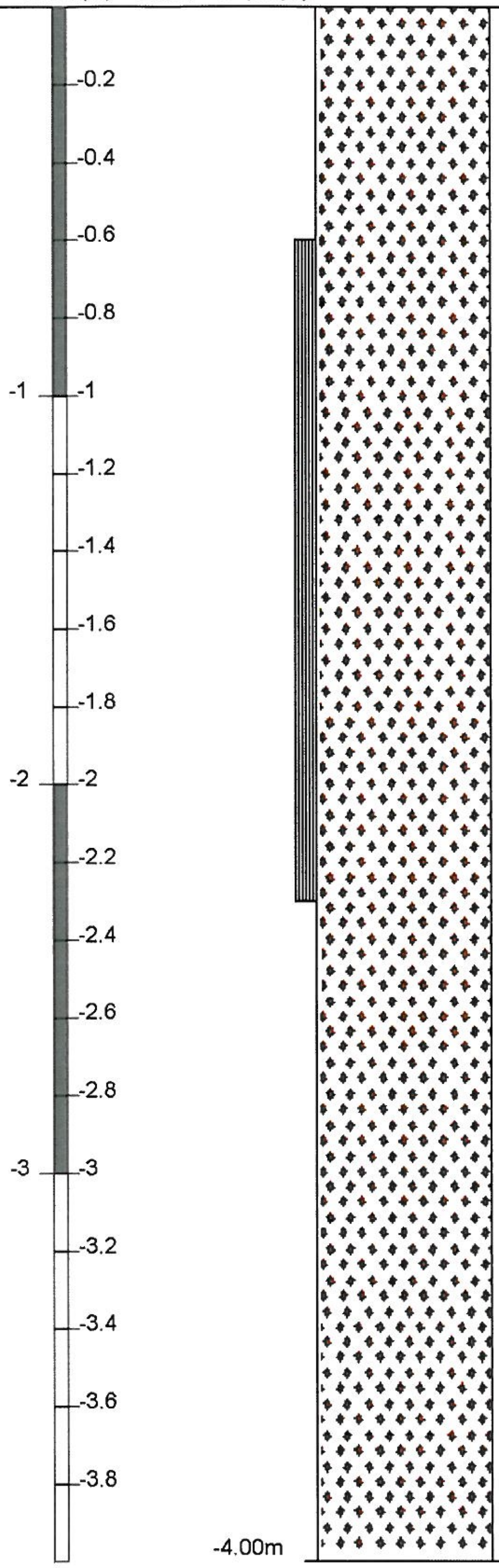


Borelog for well N36/0085

Gridref: N36:90531-37489 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 11 +MSD
Driller : C W Drilling and Investigations Ltd
Drill Method : Rotary Rig
Drill Depth : -4m Drill Date : 20/10/2005

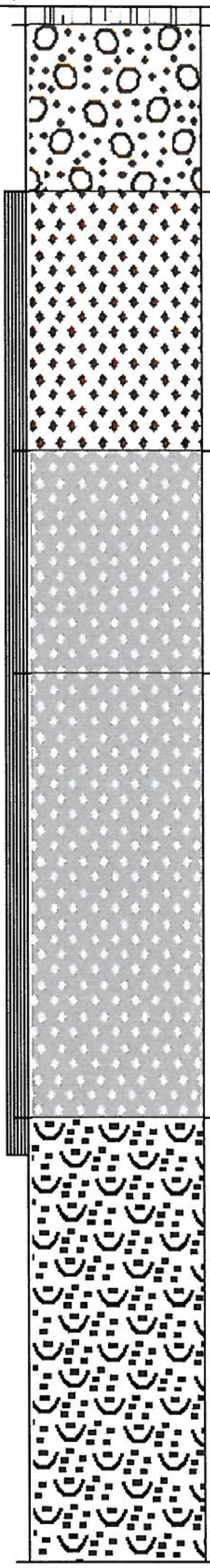
Environment Canterbury

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-4.00m	sand, medium brown	



Borelog for well N36/0247

Gridref: N36:90542-37551 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 1 +MSD
Driller : McMillan Water Wells Ltd
Drill Method : Rotary Rig
Drill Depth : -4.2m Drill Date : 3/04/2009



Depth(m)	Full Drillers Description	Formation Code
-0.05m	Ashphalt (3cm)	
-0.50m	Brown sandy gravel fill. dry	
-1.20m	Brown fine to coarse sand, dry	
-1.80m	Grey fine to coarse sand, damp. (wet from 1.3m)	
-3.00m	Grey fine to medium sand, wet	
-4.20m	Grey fine to medium sand with some silt, wet, with some white shell fragments.	

Scale(m): -0.2, -0.4, -0.6, -0.8, -1, -1.2, -1.4, -1.6, -1.8, -2, -2.2, -2.4, -2.6, -2.8, -3, -3.2, -3.4, -3.6, -3.8, -4

Borelog for well N36/0248

Gridref: N36:90552-37553 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 1 +MSD
Driller : McMillan Water Wells Ltd
Drill Method : Rotary Rig
Drill Depth : -4.2m Drill Date : 2/04/2009

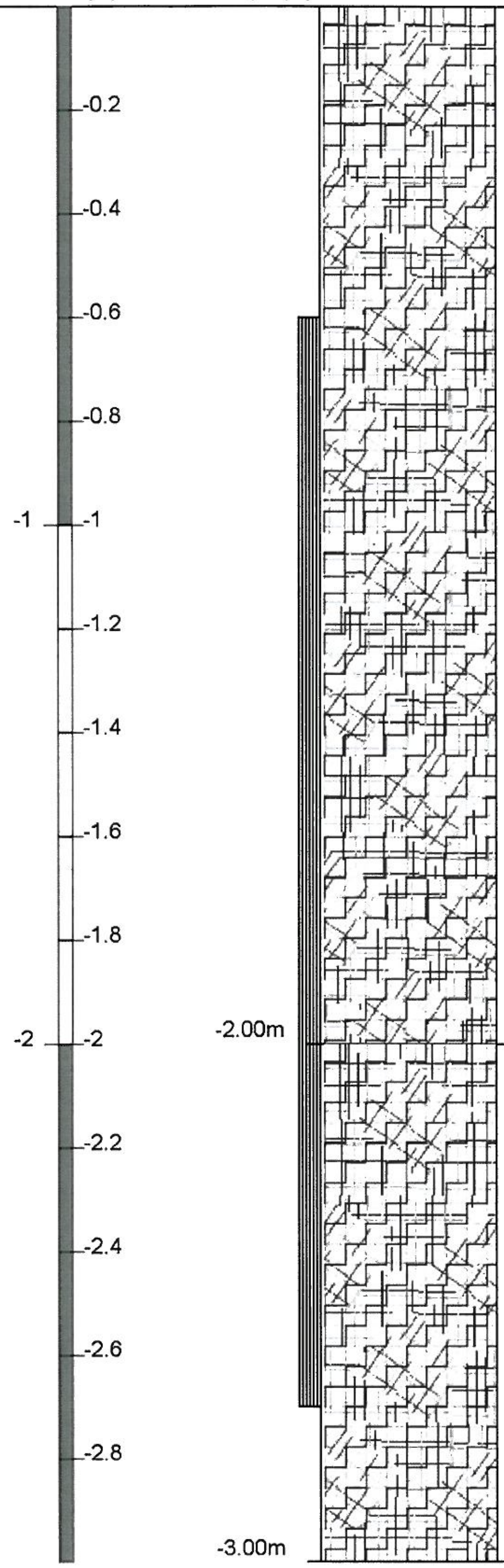
Environment Canterbury

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.20m	Ashphalt	
		-0.40m	Brown sandy silt with occasional sub-angular moderate to coarse sized gravels, dry	
		-1.20m	Brown fine to moderate sand. Moisture content increasing with depth.	
		-2.40m	Brown fine to moderate sand. Damp becoming wet from1.4 mbgl. Occasional organic material.	
		-4.20m	Grey fine sand, wet, some white shell fragments	

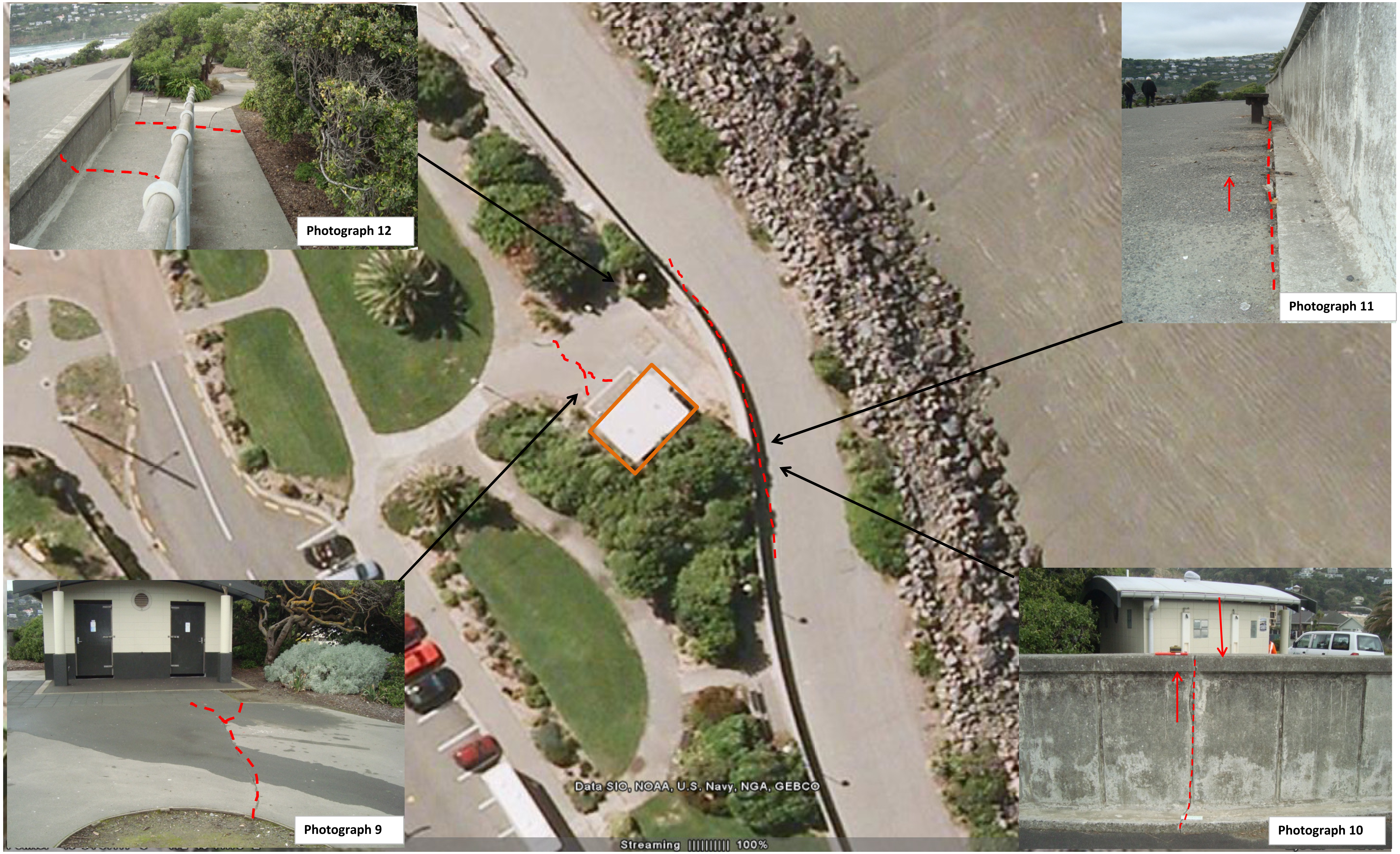
Borelog for well N36/0086

Gridref: N36:90552-37496 Accuracy : 2 (1=high, 5=low)
Ground Level Altitude : 10 +MSD
Driller : C W Drilling and Investigations Ltd
Drill Method : Rotary Rig
Drill Depth : -3m Drill Date : 20/10/2005

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			Gravel FILL	
		-2.00m	Hard/Rockfill	
		-3.00m		



APPENDIX C:
Site Walkover Plan



SOURCE: canterburyrecovery.projectorbit.com (Accessed on 17/09/12)

Opus International Consultants Ltd
Christchurch Office
20 Moorhouse Ave
PO Box 1482
Christchurch, New Zealand
Tel: +64 3 363 5400   Fax: +64 3 365 7857

Project: CCC- Sumner Bear Toilets
Geotechnical Desktop Study

Project No.: 6-QUCC1.75

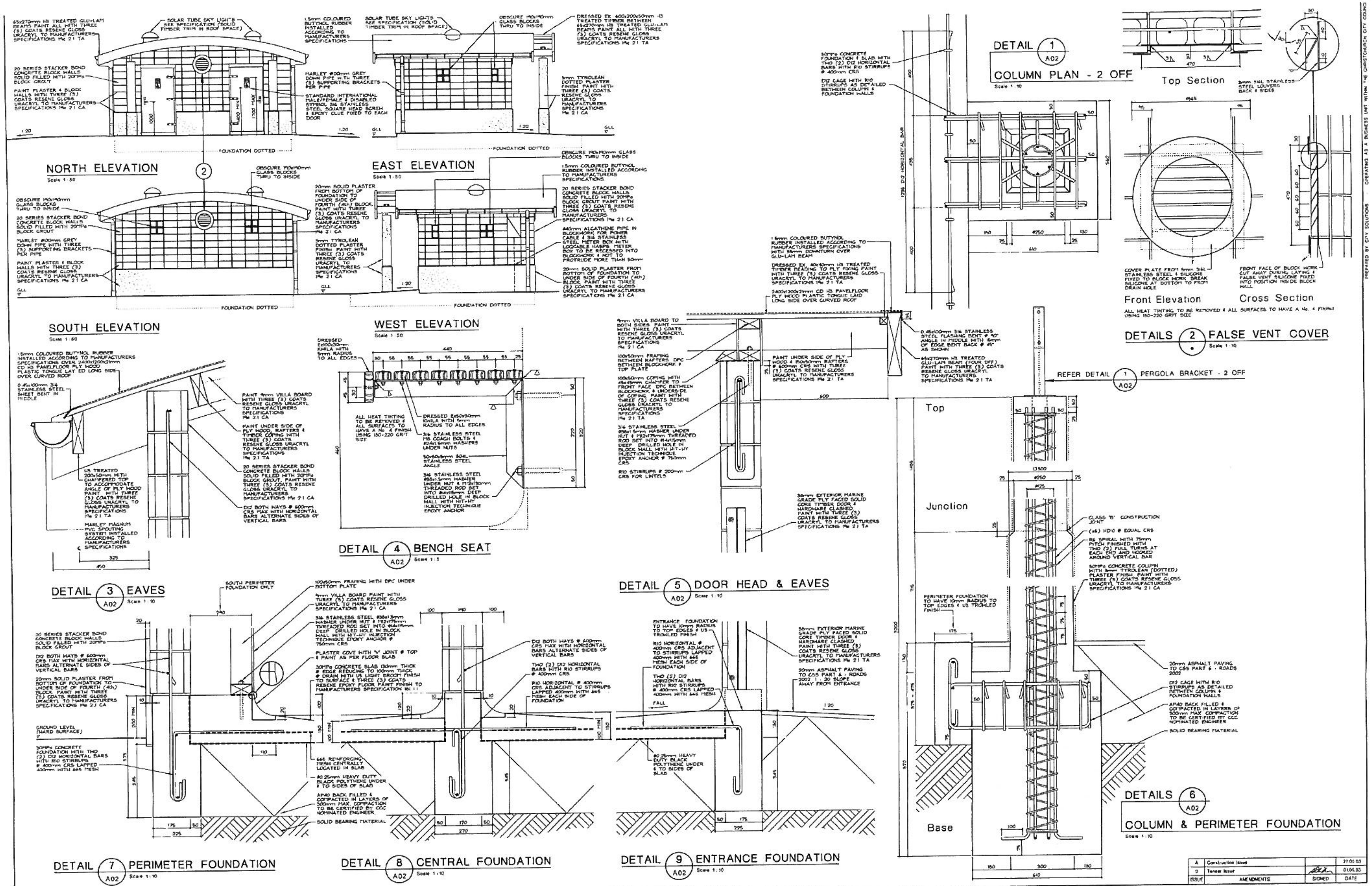
Client: Christchurch City Council

Site Walkover Plan

Date: 17/09/2012

Drawn by: Opus Geotechnical Engineer

APPENDIX D:
Structural Drawings



ISSUE	AMENDMENTS	SIGNED	DATE
A	Construction Issue		27.05.03
0	Tender Issue		01.05.03

CITYSOLUTIONS

	NAME	SIGNED	DATE
DESIGNED	S E Groendale		01.05.03
DES. REVIEW	S E Groendale		01.05.03
DRAWN	W G Hewson		01.05.03
DRW. CHECK	S D Smith		01.05.03

DATUM / BENCH MK / SURVEY FB / SURVEY LB / CONSTN.FB / CONSTN.LB / SDR FILE

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AERIAL PHOTOGRAPHY © COPYRIGHT TERRALINK INTERNATIONAL LIMITED

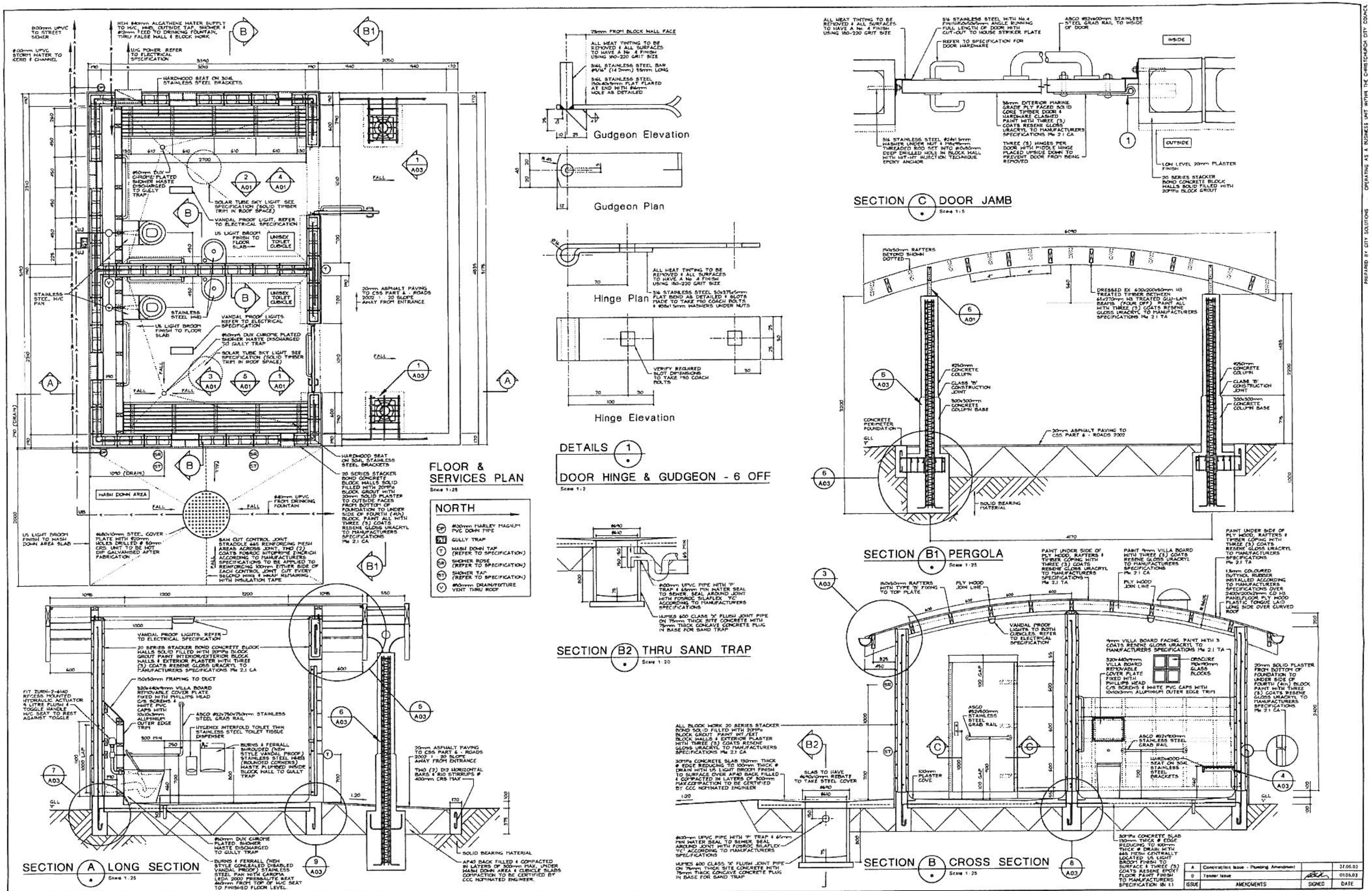
APPROVED
DATE 01/05/03
S D Smith

CLIENT: CHRISTCHURCH CITY COUNCIL · PARKS & WATERWAYS

PROJECT TITLE:
•Marriner Street Public Toilets
Changing Rooms & Wash Down
•Wash Down At Cave Rock - Sumner

DRAWING TITLE:
Elevations
Construction Details

CONTRACT NUMBER: 02/03-273
ORIGINAL SHEET SIZE: A1
SCALES: As Shown
FILE NUMBER: AD-0159-02
DRAWING & PROJECT NUMBER: 562/935
SHEET: A03 OF A04



A	Construction Issue - Plumbing Amendment — 27.05.03
0	Tender Issue — 01.05.03
ISSUE	AMENDMENTS — SIGNED — DATE

CITYSOLUTIONS

	NAME	SIGNED	DATE
DESIGNED	D E Greenslade		01.05.03
DES.REVIEW	D E Greenslade		01.05.03
DRAWN	W G Rowse		01.05.03
DRW CHECK	S D Smith		01.05.03

DATUM / BENCH MK / SURVEY FB / SURVEY LB / CONSTN FB / CONSTN LB / SOFI FILE

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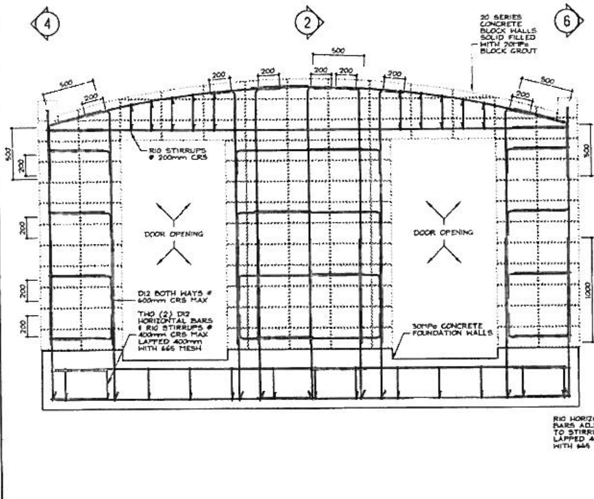
APPROVED
DATE 01/05/03
S D Smith

CLIENT: CHRISTCHURCH CITY COUNCIL · PARKS & WATERWAYS

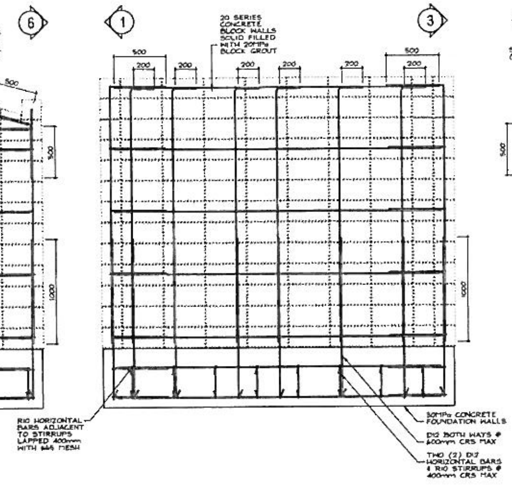
PROJECT TITLE:
•Marriner Street Public Toilets
Changing Rooms & Wash Down
•Wash Down At Cave Rock - Sumner

DRAWING TITLE:
Plan, Cross Sections
Construction Details

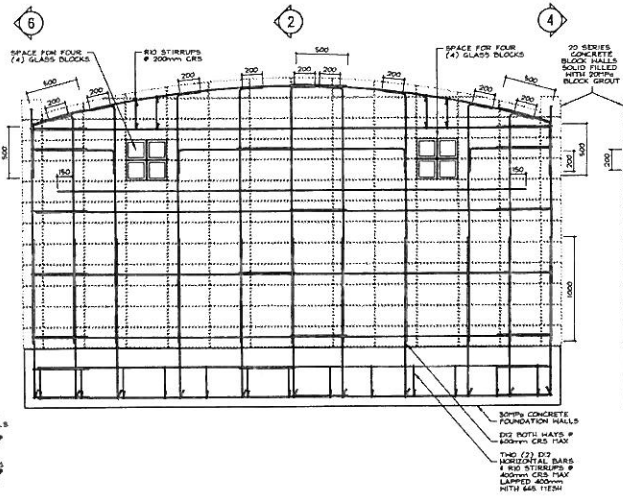
CONTRACT NUMBER 02/03-273 — ORIGINAL SHEET SIZE A1 — SCALES As Shown
FILE NUMBER AD-0159-02
DRAWING & PROJECT NUMBER 562/935 — SHEET A02 OF A04



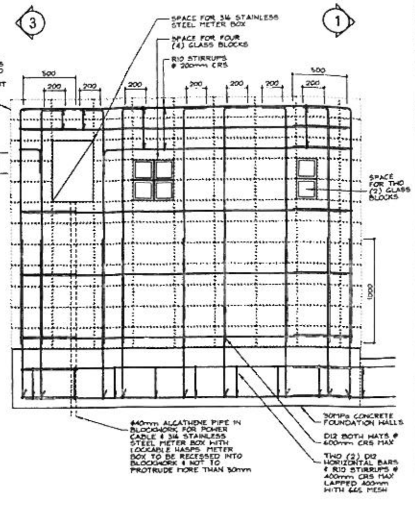
ELEV 1 A02 TOILET BLOCK NORTH WALL REINFORCING
Scale 1:25



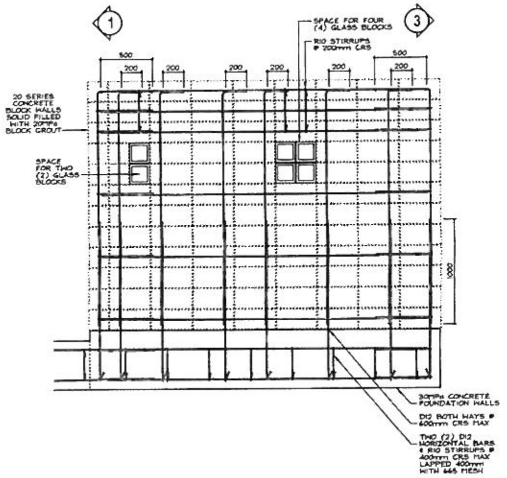
ELEV 2 A02 TOILET BLOCK CENTRAL WALL REINFORCING
Scale 1:25



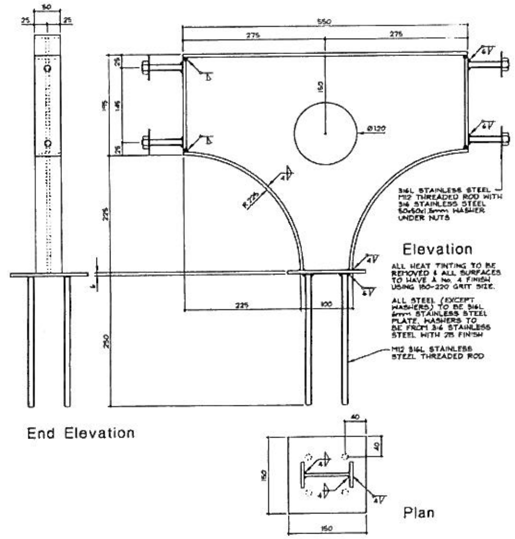
ELEV 3 A02 TOILET BLOCK SOUTH WALL REINFORCING
Scale 1:25



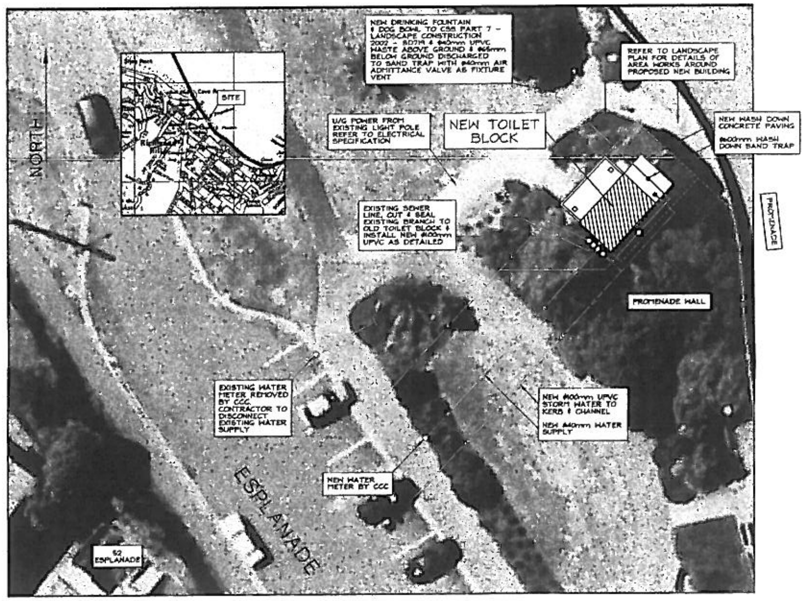
ELEV 4 A02 TOILET BLOCK WEST WALL REINFORCING
Scale 1:25



ELEV 5 A02 TOILET BLOCK WEST WALL REINFORCING
Scale 1:25



DETAILS 6 A02 PERGOLA BRACKET - 2 OFF
Scale 1:5



SITE & SERVICES PLAN (MARRINER ST/ESPLANADE)
Scale 1:200

ISSUE	AMENDMENTS	SIGNED	DATE
A	Construction Issue - Plumbing Amendment	[signature]	27.05.03
0	Tender Issue		01.05.03

CITYSOLUTIONS

DATUM	
BENCH MK	
SURVEY FB	
SURVEY LB	
CONSTN FB	
CONSTN LB	
SDR FILE	

	NAME	SIGNED	DATE
DESIGNED	D E Greenslade	[signature]	01.05.03
DES.REVIEW	D E Greenslade	[signature]	01.05.03
DRAWN	W G Newman	[signature]	01.05.03
DRW CHECK	S D Smith	[signature]	01.05.03

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APPROVED
DATE 01/05/03
S D Smith

CLIENT
CHRISTCHURCH
CITY COUNCIL · PARKS & WATERWAYS

PROJECT TITLE
•Marriner Street Public Toilets
Changing Rooms & Wash Down
•Wash Down At Cave Rock - Sumner

DRAWING TITLE
Reinforcing Elevations
Site / Service Plan
Construction Details

CONTRACT NUMBER 02/03-273
ORIGINAL SHEET SIZE A1
SCALES As Shown
FILE NUMBER AD-0159-02
DRAWING & PROJECT NUMBER 562/935
SHEET A01 OF A04

PREPARED BY CITY SOLUTIONS · OPERATING AS A BUSINESS UNIT WITHIN THE CHRISTCHURCH CITY C

Appendix 4: CERA DEE SPREADSHEET

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Sumner Beach Toilets	Reviewer:	Dave Dekker
	Unit / No: / Street	CPEng No:	1003026
Building Address:	Marriner St / Esplanade	Company:	Opus International Consultants
Legal Description:		Company project number:	6-QUCCC.75 / 25HC
		Company phone number:	03 363 5400
	Degrees / Min / Sec		
GPS south:		Date of submission:	27-Feb-13
GPS east:		Inspection Date:	12-Jul-12
		Revision:	Final
Building Unique Identifier (CCC):	PRK 1474 BLDG 009 EQ2	Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:		Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):	80	If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	10.00

Building

No. of storeys above ground:	1 (single storey = 1)	Ground floor elevation (Absolute) (m):	
Ground floor split?	no	Ground floor elevation above ground (m):	
Storeys below ground	0		
Foundation type:	mat slab	if Foundation type is other, describe:	
Building height (m):	2.60	height from ground to level of uppermost seismic mass (for IEP only) (m):	2.6
Floor footprint area (approx):	18		
Age of Building (years):	9	Date of design:	1992-2004
Strengthening present?	no	If so, when (year)?	
		And what load level (%g)?	
Use (ground floor):	public	Brief strengthening description:	
Use (upper floors):			
Use notes (if required):	Public Toilets		
Importance level (to NZS1170.5):	IL2		

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	65x75 Glulam, 150x50 rafters, 21mm ply
Floors:	concrete flat slab	slab thickness (mm)	100-130 mmm
Beams:	none	overall depth x width (mm x mm)	Not applicable
Columns:	cast-insitu concrete	typical dimensions (mm x mm)	300 sq, 250 dia
Walls:	fully filled concrete masonry	#N/A	

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	fully filled CMU		note total length of wall at ground (m):	10.38
Ductility assumed, μ:	1.25		wall thickness (m):	0.19
Period along:	0.40	0.03 from parameters in sheet	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	fully filled CMU		note total length of wall at ground (m):	10.17
Ductility assumed, μ:	1.25		wall thickness (m):	0.19
Period across:	0.40	0.03 from parameters in sheet	estimate or calculation?	
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:	
Roof Cladding:	
Glazing:	
Ceilings:	
Services(list):	

Available documentation

Architectural		original designer name/date	
Structural	full	original designer name/date	City Solutions, 2003
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report		original designer name/date	

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:		notes (if applicable):	
Differential settlement:		notes (if applicable):	
Liquefaction:		notes (if applicable):	
Lateral Spread:		notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:		notes (if applicable):	

Building:

	Current Placard Status:			
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:		Describe:	
CSWs:	Damage?:		Describe:	
Pounding:	Damage?:		Describe:	
Non-structural:	Damage?:	yes	Describe:	Cracking of grout around windows

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

Recommendations

Level of repair/strengthening required:	minor non-structural	Describe:	Cracked grout
Building Consent required:	no	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	

Along	Assessed %NBS before:	100%	0% %NBS from IEP below	If IEP not used, please detail assessment methodology:	Quantitative
	Assessed %NBS after:	100%			
Across	Assessed %NBS before:	100%	0% %NBS from IEP below		
	Assessed %NBS after:	100%			

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