Christchurch City Council

Technical Guideline for Rockfall Protection Structures

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CONTENTS

1 INTRODUCTION

The installation of Rockfall Protection Structures (RPS) for the mitigation[1] of risk may be permitted in areas where the risk of rockfall is judged to be unacceptable for residential activities, and where properly engineered RPS can be demonstrated to **reduce the risk** to an acceptable level. Rockfall Protection Structures cannot be relied upon to eliminate risk; there will remain a level of residual risk regardless of how well they are designed and constructed.

The purpose of this Technical Guideline is to provide guidance to property owners, engineers, planners, consultants, contractors and others who may wish to engage in the evaluation, design, consenting and/or construction and ongoing maintenance of RPS.

This document is not a construction standard but sets out some, though not necessarily all, of the matters to be considered in planning, design and construction of Rockfall Protection Structures, specifically RPS for protection against rock (boulder) roll.

1 Mitigation refers to lessening the effect of rockfall or boulder roll by constructing various man-made protection works to protect vulnerable dwellings or structures

2 TYPES OF ROCKFALL PROTECTION STRUCTURES

Rockfall Protection Structures may include treatment at source, the installation of rock fences, earth bunds, benching of slopes and secondary treatments, such as revegetation, that can provide additional protection in the longer term. The following table outlines RPS options that may be suitable for use in the Port Hills or Banks Peninsula.

Category	Types of RPS	Comments
At-source (prevention of rockfall)	Scaling, anchors, cables, mesh, buttress/support	These types of treatment reduce the potential for rockfall to occur
Barrier and attenuation systems (control of rockfall)	Rockfall fence; proprietary rockfall barrier system; reinforced earth bunds and walls; structural walls; attenuator fences; hybrid systems; draped mesh; catch benches	These types of systems are designed to intercept and control rockfall. The type of system should be selected with care and should include careful consideration of boulder flux issues that have been observed as a result of local seismic activity.
Secondary Protection	Dense vegetation; shelter belts.	This type of system serves to reduce rock energies and is effective up to a certain boulder size that is dependent on the nature of the secondary protection. This type of RPS is not considered appropriate as the sole or primary means of rockfall protection. It shall be used in conjunction with other types of RPS.

3 DESIGN OF ROCKFALL PROTECTION STRUCTURES [2]

In all cases, site-specific assessments and a detailed engineering design will need to be undertaken to determine the viability of a protection work for long term rockfall hazard management.

A deterministic approach shall be used to demonstrate the effectiveness or otherwise of the proposed Rockfall Protection Structure(s). The GNS report on Boulder Roll[3] shall be used as the source of base modelling parameters for the Port Hills

Areas subject to rockfall hazards that may be suitable for RPS are defined in the *City Plan* which recognises distinct Hazard Management Zones for rockfall risk management. However, the guidelines may also be relevant to other areas and it is not intended that RPS necessarily be limited to the defined Hazard Management Zones. Whether or not an RPS could be used to reduce risk to an acceptable level should be determined by an Approved Geoprofessional, and confirmed through Peer Review by another Approved Geoprofessional.

The design of RPS structures shall be undertaken by or under the direction of an Approved Geoprofessional in accordance with current best practice, which is evolving rapidly. It is the responsibility of the Approved Geoprofessional to keep appraised of developments and current good practice in the field of RPS.

3.1 Approved Geoprofessionals

Christchurch City Council's *Infrastructure Design Standard* requires that certain design related certifications can only be completed by Approved Geoprofessionals.

An Approved Geoprofessional is a Chartered Professional Engineer with specific experience in the investigation, design and/or construction of rockfall protection structures who is acknowledged by the Council as possessing the appropriate qualifications, skills and relevant experience to provide advice on RPS issues within Council's area.

The designer of the protection systems (including foundations and tie back anchors) shall be an Approved Geoprofessional, who shall provide a Producer Statement PS1 - Design, as set out in Appendix I - Producer Statement PS1 – Design.

The design shall be reviewed by an Approved Geoprofessional, who shall provide a Producer Statement PS2a – Design Review, as set out in Appendix II - Producer Statement PS2a – Design Review.

2 Text derived in part from IDS Part 4: Geotechnical Requirements 2013, clause 4.7
3 GNS CR2012-311: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Pilot study for assessing life-safety risk from rockfalls (boulder rolls)*

Design amendments shall also be reviewed by the Approved Geoprofessional, who shall provide a Producer Statement PS2b – Design Review Amendment, as set out in Appendix III - Producer Statement PS2a – Design Review Amendment.

A list of Approved Geoprofessionals is available on the Council's web page at www.ccc.govt.nz/business/constructiondevelopment/approvedcontractors.aspx

3.2 Design Considerations

There is no single document that provides a comprehensive guide to the design of Rockfall Protection Structures. Clause 8 List of References & Useful Documents identifies a collection of papers or chapters in publications that provide examples of good current practice in rockfall engineering, as well as selected planning and policy documents that may be useful.

This Technical Guideline does not list design criteria, but outlines factors that need to be considered in design, as follows:

1. Council requires that any RPS demonstrably reduces the Annual Individual Fatality Risk (AIFR) at the dwelling or structure to be protected to below the adopted tolerable risk limit of 10-4 announced by the Minister for CER on 29 June 2012. The reduction to the AIFR is to be determined in accordance with the Australian Geomechanics Society *Landslide Risk Management* guidelines[4].
2. To determine possible protection and/or remedial measures to mitigate the assessed risk for any site, it is necessary to assess the rock source(s) and appraise bounce height and energy for the likely rock sizes. The bounce height and energy appraisals shall be calibrated against previous rockfall behaviour at the specific or similar locations if suitable data is available. The Council database will be made available to Approved Geoprofessionals.
3. Barrier systems must be designed to withstand multiple impacts from boulders (more than 2 impacts of the 95th percentile boulder for the site without significant loss of capacity or height). The design must also address environmental effects including erosion potential, any impact on natural surface water flow and the potential for deflection of rocks into nearby properties.
4. Seismic loading must be considered in the design of bunds (for stability) and at-source restraint systems such as cables, rock anchors and mesh. Seismic loads should also be considered for tie backs on rock fences and attenuators.
5. The design seismic loads should be based on the 22 February 2011 earthquake.
6. Corrosion protection must be considered as for many RPS it controls the design life.

4 Australian Geomechanics, Volume 42 No 1 March 2007

7. Any rockfall protection system shall:

   > be legally and physically accessible for walkover inspection, rock removal and repair without compromising the safety of downhill property or life; and

   > not have its protection effectiveness compromised where gates or access ways are included; and

   > be and remain effective over its design life.

3.3 Design Approach

The suggested design approach for determining a suitable location and type of Rockfall Protection Structure is outlined in Table 1. Council's objective is to ensure that a consistent approach is followed and documented such that consent applications are in a standardised form that makes them easier to assess.

Table 1 – Design Approach

Task	Requirements/Intention	Recommendations/Comments
Site Specific Assessment	> Site mapping: location and type of rock sources (boulder/bluff); location of fallen boulders; slope surface cover characteristics; location and type of vegetation. > Source assessment: characterize boulder sizes; rock jointing in bluffs > Inspect trees (if present) for bounce-mark scars > Identify areas where boulder flux concentrations may be an issue (e.g. gullies or immediately below rock bluffs)	Information available from Council should be obtained by the Approved Geoprofessional for use in the site assessment. This includes: > aerial photos > detailed LIDAR contours > boulder data from Council database
Selection of Site Specific Design Parameters	> Boulder size, including maximum and 95% sizes > Slope surface material types > Slope surface cover (vegetation) characteristics	> Council requires that the design considers the site-specific 95% boulder size **at a minimum**.[1] > Site specific design boulder should be compared to GNS suburb model boulder as a verification check.

Rockfall analyses	> Perform 2D rockfall analysis; multiple cross sections may be needed > Back analyse fallen boulders where observed > Output should include plots of energy and bounce height along slope, and boulder end points > 2D models should be run with and without vegetation	> 2D rockfall modelling should be undertaken using the approach described by GNS in CR2012-311. > 2D rockfall model parameters developed by GNS (eg. coefficients of restitution) should be used as a base case. > Consideration of existing 3D analysis may be warranted where topography is complex. > The Designer should use recognised, commercially available software for analyses.
Selection of Rockfall protection structures	Identify RPS types and locations NOTE: Council recommend using MEL approach only for low frequency rockfall events; SEL approach is recommended where multiple hits are likely or for sites with difficult access where frequent maintenance is not desirable	> May involve a combination of structures or stabilisation of the rock source. > Need to consider boulder flux (depends on source characteristics) > Dynamic barriers (fences) should be designed for Service Energy Level (SEL). > MEL (Maximum Energy Level) generally not considered appropriate in Canterbury given seismic-induced swarms of rockfall and the potential for multiple hits
Confirmation of selected RPS	Re-run the model with RPS incorporated.	> RPS should be shown to stop 95% or better of the design boulder

Note 1: Designing for the 95th percentile boulder will reduce the AIFR by approximately one order of magnitude. Where it is necessary to reduce the AIFR by two orders of magnitude it may be necessary to design for the 98th percentile boulder.

3.4 In-situ Anchorage and Hybrid Solutions

In-situ anchorage solutions such as rock bolts, cables, mesh, nets and drape systems may be used for protective works in rock source areas. In some cases, break up, removal or stabilisation of rocks may be sufficient.

Hybrid rockfall protection barriers (attenuators), which are a combination of rockfall protection drapes/rockfall nettings and flexible rockfall protection barriers without bottom supporting ropes, are used as passive protection measures below the rock source areas.

3.5 Low Energy Dynamic Rockfall Protection Systems (Fences)

For Christchurch City Rockfall Protection Structures a low energy system is one required to handle impact energies of less than or equal to 100kJ.

3.6 Proprietary Dynamic Rockfall Barrier Systems

Council strongly recommends the use of a proprietary system for all dynamic structures where the estimated impact energy is greater than 100 kJ. Dynamic rockfall barrier systems are not considered an appropriate protection measure against falling rock masses with very high (>1500 kJ) energy levels.

Design Considerations

Anchorage solutions (such as grouted steel ground anchors, rock bolts, rock mesh etc) and anchors for dynamic rockfall barriers should be designed to the following codes of practice:

- *Eurocode 7 - Geotechnical Design*
- Anchor requirements of the NZTA *Bridge Manual*

Above-ground structures and easily replaced components (such as posts and mesh but excluding components such as anchors or bolts) shall have a design life of at least 15 years.

Proprietary rockfall protection systems shall have a design life of not less than 15 years, when maintained in accordance with the manufacturer's requirements. The manufacture of any proprietary rockfall fence protection system shall comply with Table 2.

Table 2 – Minimum standards for proprietary rockfall fence protection systems

Expected Impact Energy[1]	Minimum Standard Applicable	Comment
100 – 500 kJ	Manufacturer certification including full scale testing in accordance with *ETAG 27 – Falling Rock Protection Kits*	Manufacturer shall both certify and warrant the performance of the protection system to the required impact energy and for the design life of the structure.
> 500 kJ	Manufacturer certification including full scale testing in accordance with *ETAG 27 – Falling Rock Protection Kits*	Full scale testing shall be in accordance with the provisions of ETAG 27 – *Falling Rock Protection Kits*.

Note 1: Maximum energy level (MEL) as defined by ETAG27 for 95th percentile boulder

The required capacity of the foundation and tie back systems for rock fences shall be provided by the manufacturer of the rockfall protection system. The foundations and tie backs shall be designed in accordance with the manufacturer's requirements, and shall comply with the conditions of the building consent.

3.7 Reinforced Earth Embankment Barriers

Reinforced Earth Embankment Barriers are able to withstand extremely high energy levels without any appreciable deformation or requiring extraordinary maintenance. Current experience of the manufacturers of proprietary Reinforced Earth Embankment Barrier systems allows the design and construction of embankments up to 20m high, with a resistance of not less than 20,000 kJ.

Because Reinforced Earth Embankment Barriers permit both high energy levels and multiple impacts to be controlled, and the maintenance requirements are relatively minor, Council prefers that a Reinforced Earth Embankment Barrier is the first choice rockfall protection system in all situations where the total kinetic (impact) energy is > 1500kJ.

Design Considerations

Ronco et al (2009) note that, for design purposes, apart from the static analysis of the embankment and the slope (bearing capacity of the foundations, sliding and tilting) and the internal stability of the embankment (tensile and pull-out strength of the reinforcing elements), it is necessary to check that the structure can sustain the dynamic impact without launching fragments during the impact, without being passed over by rolling blocks and without collapsing due to block penetration and/or sliding of the soil layers.

Some unstable rocks may require the installation of temporary fencing or cable ties before permanent stabilisation can be undertaken. Temporary protection shall be specified by the designer when considered necessary.

4 CONSENTS

Rockfall Protection Structures (attenuators, rock fences, earth embankments) will require both a Building Consent and a Resource Consent.

5 REPORTING REQUIREMENTS

As a **minimum** the following key Geotechnical components are required with any consent application for a Rockfall Protection Structure:

5.1 Site Specific Geotechnical Assessment

The site specific geotechnical assessment must include:

- An assessment of rockfall and cliff collapse hazards, including those resulting from seismic activity.
- A full geological description of the potential hazard sources;
- Details of source areas of rockfall or cliff collapse;
- Assessment of likely boulder runout distances and level of damage that a rockfall may induce
- Assessment of the likely kinetic energy of boulders at the site
- Recommendations proposing measures to avoid, remedy or mitigate any geotechnical hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.
- Details of any subsurface investigations at the site of the proposed RPS
- The extent of further geotechnical engineering services required at the design stage (including further geotechnical and geological investigations).

5.2 Design Report

The Design Report shall detail the key achievement criteria and assumptions, such as the chosen factors of safety, for the geotechnical aspects of the engineering design. It is required to include:

- Assessment of the feasibility and/or suitability of possible protection measures.
- Map showing location and type(s) of proposed protection measures
- Design parameters, quantities, description of selected arrangement(s) for protection and/or mitigation
- An explanation of the rationale for adopting the proposed measures
- Identification of other options that were considered for protection and/or mitigation measures
- Modelling summary output from 2D analysis, including a list of model assumptions and uncertainties
- Constructability assessment, including comments on potential impacts on drainage and erosion

- Statement on the design life, including description of corrosion protection for mechanical elements, design loads and the manufacturer's testing certificates for material properties, to substantiate the design life.
- Design drawings
- Methods and frequency of construction control tests to be carried out.
- Construction and Maintenance Specification
- Producer Statement (PS1) signed by the Designer of the proposed works who must be an Approved Geoprofessional
- Independent review report by a suitably qualified independent Approved Geoprofessional including Producer Statement for Design Review (PS2)

6 CONSTRUCTION

The contractor shall verify the completed construction complies with the manufacturer's requirements and with the design by providing a Completion Certificate.

The Designer (the Approved Geoprofessional who designed the mitigation) shall monitor and review the construction and provide a Producer Statement PS4 – Construction Review, as set out in Appendix IV - Producer Statement PS4 – Construction Review. The minimum construction monitoring requirement shall be CM4[5].

The constructor is required to submit a construction report and as-built drawings.

7 COMPLIANCE MONITORING

Once constructed, Rockfall Protection Structures will require ongoing compliance checks to ensure that they are still performing in accordance with their intended design. Checks will be the responsibility of the owner of the dwelling or structure being protected and will include an annual rock/damage check, post-trigger event engineering checks and engineering certification at specified intervals. A summary of the required compliance checks is attached as Appendix V.

5 Defined by IPENZ as: Review, at a frequency agreed with the client, **regular samples** of work procedures, materials of construction and components for compliance with the requirements of the plans and specifications and review the **majority** of completed work prior to the enclosure or on completion as appropriate.

8 LIST OF REFERENCES & USEFUL DOCUMENTS

Planning and Policy

- *The Christchurch City District Plan (City Plan)* www.cityplan.ccc.govt.nz/NXT/gateway.dll?f=templates&fn=default.htm
- Resource Management Act (1991) Section 106
- Building Act (2004) Section 36
- Chartered Professional Engineers Act of New Zealand (2002)
- Department of Building and Housing *Guidelines for the investigation and assessment of subdivisions* (2011) www.dbh.govt.nz/subdivisions-assessment-guide

GNS Reports

- GNS Science Report CR2012/15: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Geomorphology mapping for rockfall risk assessment*
- GNS Science Report CR2011/319: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Principles and criteria for the assessment of risk from slope instability in the Port Hills, Christchurch*
- GNS Science Report CR2011/311: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Pilot study for assessing life-safety risk from rockfalls (boulder rolls)*
- GNS Science Report CR2012/123: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Life-safety risk from rockfalls (boulder roll) in the Port Hills*
- GNS Science Report CR2012/214: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Additional assessment of the life-safety risk from rockfalls (boulder rolls)*
- GNS Science Report CR2012/57: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Pilot study for assessing life-safety risk from cliff collapse*
- GNS Science Report CR2012/124: Canterbury Earthquakes 2010/11 Port Hills Slope Stability: *Life-safety risk from cliff collapse in the Port Hills*

General Rockfall References

- Andrew, R.; Bartingale, R, Hume, H. (2011). *Context Sensitive Rock Slope Design Solutions*. Report FHWA-CFL/TD-11-002. Federal Highway Administration. January 2011.
- Transportation Research Board. *Landslides: Analysis and control*. Special Report No. 176, National Academy of Sciences, 1978.
- Transportation Research Board. *Rockfalls: Characterisation and control*. National Academy of Sciences. Due for publication late 2012.
- Lambert, S; Nicot, F. (2011). *Rockfall engineering*. Wiley, July 2011.
- Volkwein, A et al. (2008). *Interdisciplinary workshop on rockfall protection*. Switzerland 2008.

- Rockfall Modelling Software
- Rocscience. *Rocfall™* Version 4.0. www.rocscience.com
- Colorado Rockfall Simulation Program, Version 4.0. 2000. http://geosurveystore.state.co.us/p-676-colorado-rockfall-simulation-program-version-40.aspx

Design

- Christchurch City Council *Infrasturcture Design Standard* www.ccc.govt.nz/business/constructiondevelopment/infrastructuredesignstandard.aspx
- Australian Geomechanics Society Practice Note 2007 (and commentary) *Landslide Risk Management*, Australian Geomechanics Volume 42 No 1 (March 2007) www.australiangeomechanics.org
- Piela, D. and Ronco, C (2009): *Technical Note: Design of rockfall net fences and the new ETAG 027 European Guideline*, Nat. Hazards Earth Syst. Sci., 9, 1291-1298 www.nat-hazards-earth-syst-sci.net/9/1291/2009
- Ronco, C., Oggeri, C. and Peila, D. (2009). *Design of reinforced ground embankments used for rockfall protection*. Nat. Hazards Earth Syst. Sci., 9, 1189-1199 www.nat-hazards-earth-syst-sci.net/9/1189/2009
- New Zealand Transport Agency (2003). *Bridge Manual, 2nd Edition* (July 2005 amendment). www.nzta.govt.nz/resources/bridge-manual/bridge-manual.html
- European Organisation for Technical Approvals ETAG 27 – *Falling Rock Protection Kits*
- BS EN 1997 *Eurocode 7 - Geotechnical Design*
- AS/NZS 2312:2002. *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings*

Construction Monitoring

- IPENZ. Construction Monitoring Services. www.ipenz.org.nz/ipenz/practicesupport/endorsedinfo/codes/

APPENDIX 1. Producer Statement PS1 – Design [6]

This Producer Statement is for the design of support or protection devices for the rockfall and boulder roll hazards on and near to the Port Hills, Christchurch. It applies to construction consented by the Christchurch City Council under the Building Act 2004 and its amendments.

DESIGNED BY: _____

(Approved Geoprofessional)

ISSUED BY: _____

(Design Firm)

TO: _____

(Purchaser)

OWNERS: _____

(Registered owners shown on the Certificate of Title. Individuals, trusts, Trustees, Company Directors)

Consenting Authority – Christchurch City Council

Appointed Peer Reviewer _____

(Approved Geoprofessional and signatory to a Producer Statement PS2- Peer Review)

Description of Work _____

_____

(Describe the work covered by this Producer Statement in detail)

At _____ (Address)

Lot Number _____ **DP**_____ **C/T Number**_____

Description of Design Services Undertaken _____

_____

Inputs to the Design _____

(Standards and codes used)

_____

(Rockfall Energy used and its derivation/supply)

_____

(other)

6 from IDS Part 4: Geotechnical Requirements 2013

Design Life _____ **Expected Service Life** _____

(To take account of the environmental setting)

Name any Proprietary System _____

Test Level for Proprietary System Used _____ **Certificate Number** _____

(Current test level certificate)

The works covered by this Producer Statement are **described** in calculations titled

_____

All details are given on drawings **titled** _____

I _____

(the designer)

being a Chartered Civil Engineer under the Chartered Engineers Act of New Zealand and an Approved Geoprofessional (see note 2) **believe** on reasonable grounds the works designed by me, if constructed according to the details shown on the drawings, in the specification and any other accompanying documents will perform to the design intent as set down by the Christchurch City Council in a consent to construct. The work covered by this Statement will be observed as it is constructed according to:

CM4 ◯ CM5 ◯ Other_____

This statement is endorsed by_____

(Director and/share holder)

of_____

(Design Firm)

and the employer of the Designer.

I/we are member(s) of ACENZ **YES** ◯ **NO** ◯, hold Professional Indemnity insurance of no less than $5,000,000.00 and accept that liability under this statement accrues to the Design Firm only.

Signed by the Designer _____ (Signature)

_____ (Date)

Signed on behalf of the Design Firm _____ (Signature)

_____ (Date)

NOTES AND REQUIREMENTS FOR PS1 - DESIGN

1. This Producer Statement shall provide the Christchurch City Council with reasonable grounds to issue a consent for construction of the work without the need for duplicate and independent design checking.

2. PS1 - Design is required from an Approved Geoprofessional, as defined on www.ccc.govt.nz/business/constructiondevelopment/approvedcontractors.aspx.

3. The Designer shall have signing authority delegated by the Design Firm. By signing the PS1 – Design the Designer warrants that she/he has:

    a. delegated authority from a Director of the Design Firm to undertake the design and develop the construction details;

    b. a directory role in the gathering of site data, establishing the design inputs overseeing the design process, checking the outputs from design, arranging and signing off internal verification, developing the work specification, overseeing the drawing of details and shall be fully satisfied that the documents accompanying the PS1 – Design are completed and relevant to the stabilisation of rockfall or protection of life and/or property from rockfall or boulder roll.

4. The Designer shall employ an Approved Geoprofessional, as defined on www.ccc.govt.nz/business/constructiondevelopment/approvedcontractors.aspx, to independently review the design and to provide a Producer Statement PS2a – Design Review. The costs associated with the design review shall be borne in full by the Design Firm. Issues of disputed design shall be resolved by the Designer and Design Reviewer to enable the PS1 – Design to be signed unconditionally. Council will not accept a PS1 with conditions.

5. The PI Insurance minimum stated on the PS1 shall be current at the time of submission to Christchurch City Council. A certificate of currency shall be appended by the Design firm to the Statement.

6. In the case where a Design Firm ceases to trade within 10 years of the construction of the designed work, the Director(s) shall maintain “run-on” insurance to the full value of $5,000,000 for the balance of time to 10 years from completion of construction.

APPENDIX 2. Producer Statement PS2a – Design Review [7]

This Producer Statement is for the design review of support or protection devices for the rockfall and boulder roll hazards on and near to the Port Hills, Christchurch. It applies to construction consented by the Christchurch City Council under the Building Act 2004 and its amendments.

APPOINTED DESIGN REVIEWER: _____

(Approved Geoprofessional named on the Producer Statement PS1 - Design)

ISSUED BY: _____

(Design Reviewer Firm)

TO: _____

(Designer)

OF: _____

(Design Firm)

OWNERS: _____

(Registered owners shown on the Certificate of Title. Individuals, trusts, Trustees, Company Directors)

Consenting Authority – Christchurch City Council

Description of Work _____

_____

(Describe the work covered by this Producer Statement in detail)

At _____ (Address)

Lot Number _____ **DP**_____ **C/T Number**_____

I _____ (Design Reviewer) have been engaged

by _____ (Design Firm)
to review all of the work included by the design calculations, specification and drawings

7 from IDS Part 4: Geotechnical Requirements 2013

Calculations titled _____ dated _____

Specification titled _____ dated _____

Drawings titled _____ dated _____

Drawing number _____ Revision numbers _____

I _____

(the Design Reviewer)

being an Approved Geoprofessional (see note 2) **have** reviewed the design and construction documents supplied by the Designer and agree all matters of difference between the Designer and myself are satisfactorily resolved.

I believe on reasonable grounds the design work reviewed by me, if constructed according to the details shown on the drawings, in the specification and any other accompanying documents will perform to the design intent determined by the Designer as set down by the Christchurch City Council in the consent to construct.

I have sighted the signed Producer Statement PS1 and confirm that the Statement is complete and correct.

This statement is endorsed by _____

(Director and/share holder)

of _____

(Design Firm)

and the employer of the Designer Reviewer.

I/we are member(s) of ACENZ **YES** ◯ **NO** ◯ , hold Professional Indemnity insurance of no less than $5,000,000.00 and accept that liability under this statement accrues to the Design Firm only.

Signed by the Designer _____ (Signature)

_____ (Date)

Signed on behalf of the Design Review Firm _____ (Signature)

_____ (Date)

Notes And Requirements For PS2a – Design Review

1. This Producer Statement shall provide the Christchurch City Council reasonable grounds to issue consent for construction of the work. It shall be based on an independent review of the design covered by PS1 – Design.

2. PS2a - Design Review is required from the Design Reviewer who shall be an Approved Geoprofessional, as defined on www.ccc.govt.nz/business/constructiondevelopment/approvedcontractors.aspx.

3. The Design Reviewer shall be a person and not a Firm and shall have signing authority delegated to him/her from a Director of the Design Reviewer's Firm to undertake the review and sign the PS2a.

4. The Design Reviewer is engaged by the Design Firm to undertake a review of the documents representing the design work. Christchurch City Council is not responsible in any part for the commercial arrangements between the Design Firm and the Design Reviewer.

5. From time to time differences of opinion will arise between the Design Reviewer and Designer of the work. Both parties are expected to work together to resolve any difference so that the PS1 and PS2 Statements are submitted to Christchurch City Council without conditions.

6. The PI Insurance minimum stated on the PS2a shall be current at the time of submission to Christchurch City Council. A certificate of currency shall be appended by the Design Reviewer Firm to the Statement.

7. In the case where a Design Reviewer Firm ceases to trade within 10 years of the construction of the designed work, the Director(s) shall maintain "run-on" insurance to the full value of $5,000,000 for the balance of time to 10 years from completion of construction.

APPENDIX 3. Producer Statement PS2b – Design Review Amendment [8]

Producer Statement PS2b – Design Review Amendment

This Producer Statement is a variation to PS2a to cover variation to the design content arising out of construction of rockfall support or protection devices for rockfall and boulder roll hazards on and near to the Port Hills, Christchurch. It applies to construction consented by the Christchurch City Council under the Building Act 2004 and its amendments.

APPOINTED DESIGN REVIEWER: _____

(Approved Geoprofessional named on the Producer Statement PS1 - Design)

ISSUED BY: _____

(Design Reviewer Firm)

TO: _____

(Designer)

OF: _____

(Design Firm)

OWNERS: _____

(Registered owners shown on the Certificate of Title. Individuals, trusts, Trustees, Company Directors)

Consenting Authority – Christchurch City Council

The amendment to the work _____

_____

(Describe the work covered by this Producer Statement in detail)

At _____ (Address)

Lot Number _____ **DP**_____ **C/T Number**_____

I _____ (Design Reviewer) have been engaged

by _____ (Design Firm)
to review all of the work included by the design calculations, specification and drawings

8 from IDS Part 4: Geotechnical Requirements 2013

VARIATION TO DESIGN CONTENT

> Variation No_____ Description_____Date_____

> Variation No_____ Description_____Date_____

> Variation No_____ Description_____Date_____

> Variation No_____ Description_____Date_____

I _____

(the Design Reviewer)

being an Approved Geoprofessional (see note 2) have reviewed the amendments to the design reviewed under PS2a and viewed the variations at the place of construction.

I believe on reasonable grounds the amendments to the design work reviewed by me, as constructed, will perform to the design intent determined by the Designer as set down by the Christchurch City Council in the consent to construct.

I have sighted the signed Producer Statement PS1 and PS4 and confirm that the Statements are complete and correct.

This statement is endorsed by_____

(Director and/share holder)

of_____

(Design Review Firm)

and the employer of the Designer Reviewer.

I/we are member(s) of ACENZ **YES** ◯ **NO** ◯, hold Professional Indemnity insurance of no less than $5,000,000.00 and accept that liability under this statement accrues to the Design Firm only.

Signed by the Design Reviewer _____ (Signature)

_____ (Date)

Signed on behalf of the Design Review Firm _____ (Signature)

_____ (Date)

Notes And Requirements For PS2b – Design Review

1. This Producer Statement shall show the Christchurch City Council that variation to the content of the design work which arises out of its construction does not alter the design intent and the basis of the design review. It shall be based on an independent check of the variation to the design covered by the PS2a – Design Review.

2. PS2b - Design Review Amendment is required from the Design Amendment Reviewer and signatory to the PS2a, who shall be an Approved Geoprofessional, as defined on www.ccc.govt.nz/business/constructiondevelopment/approvedcontractors.aspx.

3. The Design Amendment Reviewer shall be a person and not a Firm and shall have signing authority delegated to him/her from a Director of the Design Reviewer's Firm to undertake the review and sign the PS2b.

4. The Design Amendment Reviewer is engaged by the Design Firm to undertake a review of the documents representing the design work. Christchurch City Council is not responsible in any part for the commercial arrangements between the Design Firm and the Design Amendment Reviewer.

5. The PI Insurance minimum stated on the PS2b shall be current at the time of submission to Christchurch City Council. A certificate of currency shall be appended by the Design Amendment Reviewer Firm to the Statement.

6. In the case where a Design Amendment Reviewer Firm ceases to trade within 10 years of the construction of the designed work, the Director(s) shall maintain "run-on" insurance to the full value of $5,000,000 for the balance of time to 10 years from completion of construction

APPENDIX 4. Producer Statement PS4 – Construction Review [9]

This Producer Statement is for the construction compliance of design for support or protection devices for the rockfall and boulder roll hazards on and near to the Port Hills, Christchurch. It applies to construction consented by the Christchurch City Council under the Building Act 2004 and its amendments.

ISSUED BY: _____
(Design Firm)

TO: _____
(Purchaser)

OWNERS: _____
(Registered owners shown on the Certificate of Title. Individuals, trusts, Trustees, Company Directors)

Consenting Authority – Christchurch City Council

Description of Work _____

_____
(Describe the work covered by this Producer Statement in detail)

At _____ (Address)

Lot Number _____ **DP**_____ **C/T Number**_____

Designed by _____ (Designer)

Construction observations made by _____

Qualifications of Construction Observer NZCE ◯ REA ◯ TIPENZ ◯ CPEng ◯ Other ◯

Construction observations to CM4 ◯ CM5 ◯ Other_____
(Categories given by IPENZ)

Description of construction observations _____

_____

Authorised variations to design details that are covered by PS1 and PS2a for construction

_____
(attach all documentation to vary content of construction)

9 from IDS Part 4: Geotechnical Requirements 2013

Endorsement of variation to vary content of construction by the Design Reviewer Producer Statement PS2b is attached YES ◯ NO ◯

(Include copies of the communication with the Design Reviewer)

I _____ (the designer)

being a Chartered Civil Engineer under the Chartered Engineers Act of New Zealand and an Approved Geoprofessional (see note 2) **have** monitored the construction of the work and **believe** on reasonable grounds the works are constructed according to my design.

I am satisfied that variation to the work as detailed made at time of construction has not altered its expected performance and durability.

I confirm that the conditions of Consent issued by Christchurch City Council are satisfied in full by the construction.

This statement is endorsed by_____

(Director and/share holder)

of_____

(Design Firm)

and the employer of the Designer and Construction Observer.

I/we are member(s) of ACENZ **YES** ◯ **NO** ◯, hold Professional Indemnity insurance of no less than $5,000,000.00 and accept that liability under this statement accrues to the Design Firm only.

Signed by the Designer _____ (Signature)

_____ (Date)

Signed on behalf of the Design Firm _____ (Signature)

_____ (Date)

Notes And Requirements For PS4 – Construction Review

1. This Producer Statement shall provide the Christchurch City Council with assurance that the work as designed and amended at time of construction has been built according to the documents to which PS1, PS2a and PS2b apply and any conditions of consent to construct.

2. PS4 – Construction Review is required from an Approved Geoprofessional, as defined on www.ccc.govt.nz/business/constructiondevelopment/approvedcontractors.aspx.

3. The Designer shall be a person and not a Firm and shall have signing authority delegated to him/her from a Director of the Design Firm to undertake the Construction Review and sign the PS4.

4. The Designer shall establish the frequency for inspections and shall adopt CM4 and CM5 as specified by the consent to construct. The day-to-day inspections of construction can be undertaken by other professional or sub-professional engineers who are under the direct supervision of the Designer.

5. The PI Insurance minimum stated on the PS4 shall be current at the time of submission to Christchurch City Council. A certificate of currency shall be appended by the Design Firm to the Statement.

6. In the case where a Design Firm ceases to trade within 10 years of the construction of the designed work, the Director(s) shall maintain "run-on" insurance to the full value of $5,000,000 for the balance of time to 10 years from completion of construction.

APPENDIX 5. Compliance Monitoring Requirements for Rockfall Protection Structures

STRUCTURE	Maintenance Inspection	Trigger3 Event	Engineering Inspection
Bund	Annual check, rock clearance and certificate – by Engineer[1]	Inspection required post trigger event - by Engineer[1]	10 yearly check with cert signed by Engineer[1] unless otherwise specified by the Designer
Fence	Annual check, rock clearance and certificate – by Engineer[1]	Inspection required post trigger event - by Engineer[1]	5 yearly check with cert signed by Engineer[1] unless otherwise specified by the Designer
Source Rock Fixing (e.g. cable, bolt, mesh)	Annual check, rock clearance and certificate – by Engineer[1]	Inspection required post trigger event - by Engineer[1]	5 yearly check with cert signed by Engineer[1] unless otherwise specified by the Designer
Source Rock Zone	As advised by Geoprofessional or if rockfall has been observed in the immediate area	Inspection required post trigger event - by Engineer[1]	5 yearly check with cert signed by Engineer[1] unless otherwise specified by the Designer

Notes:

1. Engineer must be a qualified approved Geoprofessional (with required specified insurances). A list of Approved Geoprofessionals is available on the Council's web page at www.ccc.govt.nz/business/constructiondevelopment/approvedcontractors.aspx

2. Responsibility for all compliance checks, submission of documentation and the costs associated with these, rests with the owner of the RPS.

3. Trigger events will be defined in conjunction with GNS. Trigger events will include non-seismic factors e.g. rainfall, fire