

# NZ GEOMECHANICS NEWS

Bulletin of the New Zealand Geotechnical Society Inc.

ISSN 0111-6851

**NZGS  
WINS  
ISSMGE  
Outstanding Member  
Society Award**

## Tui Mine Remediation

Liquefaction Severity  
Number

Pike River Report Review

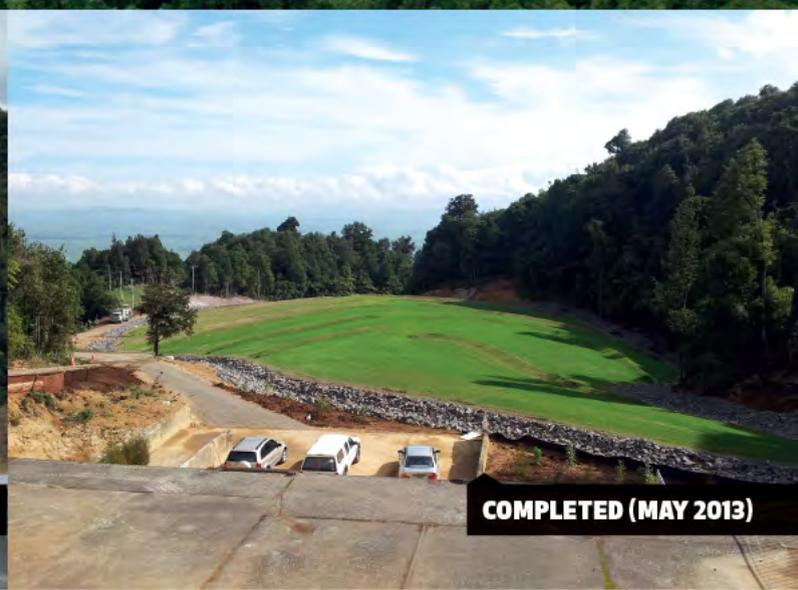
Plato on Engineering

1000th NZGS Member

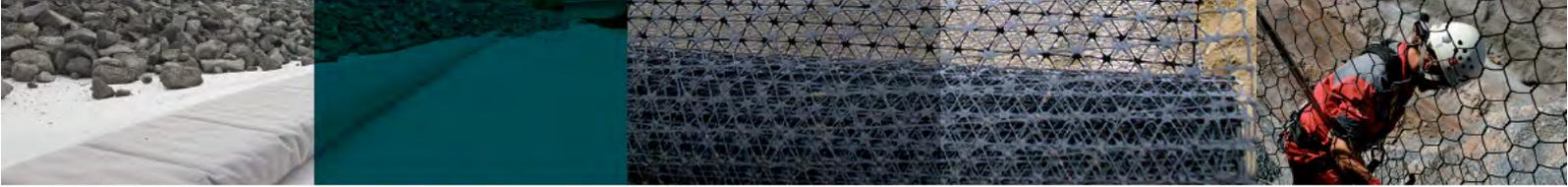
**TUI MINE BEFORE (FEBRUARY 2011)**



**DURING WORKS (MARCH 2012)**



**COMPLETED (MAY 2013)**

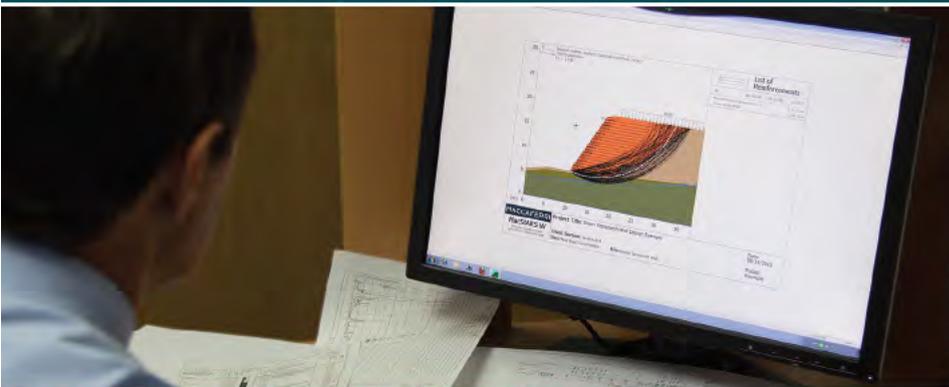


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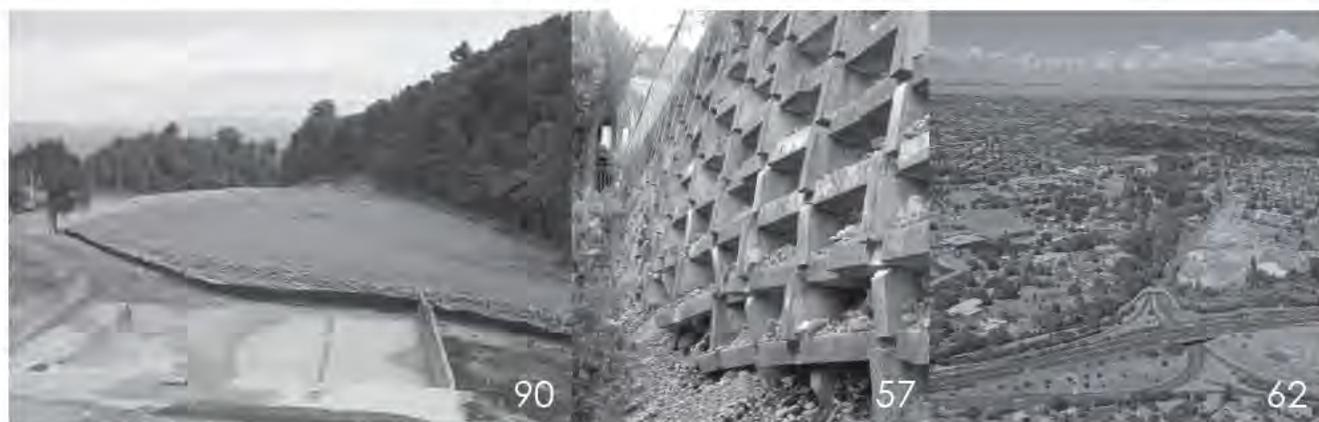
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# NEW ZEALAND GEOMECHANICS NEWS

CONTENTS

JUNE 2013, ISSUE 85



<b>Chairman's Corner</b> .....	2
<b>Editorial</b> .....	4
<b>Editorial Policy</b> .....	5
<b>Letters to the Editors</b> .....	6
<b>The Secretary's News</b> .....	7
<b>International Society Reports</b>	
ISSMGE .....	8
ISRM .....	10
IAEG .....	12
<b>NZGS Branch Activities</b> .....	15
<b>Standards, Law and Industry News</b>	
NZGS Young Geotechnical Professionals.....	23
Academic news .....	24
NZGS response to MBIE – Building Seismic Performance .....	26
The Pike River Royal Commission Report: Lessons for the Geotechnical Profession.....	38
Register of Professional Engineering Geologists (PEngGeol) .....	41
NZGS linkedin networking.....	43
<b>Awards</b>	
NZGS Wins ISSMGE Outstanding Member Society Award.....	44
IPENZ Fellows and Achievers.....	48
New Year Honours Awards .....	50
2012 NZGS Student Presentation Awards – Poster Competition.....	51
Student Posters .....	52
<b>Conference Reports</b>	
19th NZGS Symposium, 20-23 November 2013 Hanging by a Thread.....	54

## Project News

Retaining Walls and Ground Improvement in Christchurch .....	57
Waterview Connection Motorway Project.....	62
The Use of CFA Piling Technology for Ground Improvement at Waterview.....	66

## General Article

Plato and the Engineering Dilemma.....	67
--	----

## Technical Articles

Liquefaction Vulnerability in Canterbury – the Liquefaction Severity Number.....	77
Tui Mine Tailings Remediation Project – Geotechnical, Environmental and Construction Challenges .....	90

<b>Photo Competition</b> .....	89
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## Technical Note

Implausibly Low Readings with the Geonor Vane Investigated and Explained.....	102
--	-----

## Book Review

A Photographic Guide to Fossils of NZ.....	104
Craig's Soil Mechanics (Eighth Edition) .....	105

## Member Profile

Guy Cassidy, Geoscience Consulting (NZ) Ltd..	111
Kevin Anderson, AECOM .....	113
Aristomenis Magnis, MWH New Zealand Ltd..	114

Geotech Teaser **108**; December Crossword answers **108**;  
Notice Boards **110**; Events Diary **115**; Information **116**;  
Advertisers Directory **117**; Membership **118**;  
Advertising Information **120**.

## CHAIRMAN'S CORNER

WELCOME TO THIS 85th edition of Geomechanics News, my first as Chair. I would like to thank our Immediate Past Chair, David Burns for his contributions and guidance over the last two years. Our current process of having the Vice-Chair and Treasurer roles combined, and the holder moving into the Chair role after two years, provides valuable continuity and insights into the workings and needs of our Society. It does require a big commitment from the successful candidates (and their home organisations), and I sincerely hope that we are able to maintain this approach. I would also like to acknowledge Simon Woodward's contribution to the Management Committee over the last few years. He valiantly attempted to bring some of us into the high tech world of social media, and I encourage you all to join our LinkedIn discussion group (see article page 43).

I am pleased to have Charlie Price as the new Vice-Chair and Treasurer. Charlie has been leading our visiting speakers programme for the past few years and brings a wealth of experience and wisdom to his new role. Kevin Anderson and Guy Cassidy have joined the Management Committee and are impressing us all with their enthusiasm. Kevin has taken on the visiting speaker coordination role, while Guy is chairing the organising committee for the 2015 ANZ conference. Both roles are vital to our ongoing success as a learned society.

The Management Committee would like to welcome a new Branch – Hawke's Bay. Riley Gerbrandt is our inaugural branch coordinator and we applaud this initiative.

On an equally positive note, I was delighted to hear that the NZGS has been selected by the ISSMGE as its Outstanding Member Society for 2013. You will have already seen an announcement about this, and may even have taken the opportunity to read our submission. When everything we do is listed in one place, it really is quite impressive.

### Conferences

Our 19th Geotechnical Symposium is fast approaching, with papers being reviewed and finalised and registrations open. Tony Fairclough and his committee have been working hard to make this a success, and the large number of abstracts submitted is a measure of the interest. This promises to be a great event, and I look forward to meeting many of you in Queenstown in November.

The next joint ANZ conference will be held in Wellington in early 2015. A committee has been formed to organise this high profile event, and has started work. Guy Cassidy has generously accepted the leadership mantle for this event. Melbourne 2012 set a very high standard, and I'm confident we will put on a good show.

Later in 2015, Christchurch is to be the venue for the 6th International Conference in Earthquake Geotechnical



*Gavin has specialized in geotechnical engineering since graduating from Auckland University in the mid 1980's. Following graduation, he spent seven years with Arup Geotechnics in the UK and Australia working on large building and infrastructure projects. In that period Gavin spent a year at*

*Imperial College, London and was awarded an MSc and DIC in Soil Mechanics and Engineering Seismology.*

*He joined Beca on his return to NZ in 1993 and has led its Geotechnical group in Auckland, and geotechnical and multi-disciplinary teams on projects throughout New Zealand and in Australia and through South East Asia. Gavin's current focus is on the technical direction and review of projects, and his current challenges include highway embankments on peat, mine infrastructure in Indonesia, and deep basements in Singapore. Variety is the spice of life, and is what attracted Gavin to geotechnical engineering.*

Engineering. Misko Cubrinovski is spearheading this event, and you can expect to see much more about it over the coming months.

Before any of these events, the 18th International Conference on Soil Mechanics and Geotechnical Engineering, and its associated YGP event, is to be held in Paris in September. Our members are presenting seven papers at the ICSMGE and we have two delegates attending the 5th International Young Geotechnical Engineers Conference.

### Registration of Engineering Geologists

Well, we're there at last! The PEngGeol register is now live and can be accessed through the IPENZ website. Congratulations to the first registrants; we encourage all other engineering geologists with the requisite experience to start preparing your applications. Momentum is needed now to get this "quality mark" recognised and accepted by clients and territorial authorities alike as a CPEng equivalent. The Society is indebted to Ann Williams and Geoff Farquhar for their tireless championing of this initiative. The initial batch of "volunteers" and their referees are also worthy of mention – a lot of effort went into their applications and their assessment of each other.

### NZGS Short Courses

Following the flurry of activity last year, the first half of this year has been quiet on the short course front. We have Professor Vaughn Griffiths presenting a short course on Quantitative Risk Assessment in July (Auckland only, sorry, that was all he could manage). Our 2013 Symposium in

November will be preceded by several valuable workshops and I encourage you to visit the Symposium website to see what is planned.

### Seismic Guidelines

Work on the first three modules of the Geotechnical Earthquake Engineering Practice continues. You will be familiar with Module 1. Module 2 will cover foundations and Module 3 covers retaining walls. A seminar series launching an updated Module 1 of the Seismic Guidelines, revising the seismic hazard section and incorporating lessons from Christchurch and a new Module 2, covering shallow and deep foundations, is tentatively planned to be held in Auckland, Wellington and Christchurch in August. Kevin McManus, Misko Cubrinovski and CY Chin are to be commended for the effort they are putting into these essential documents.

### ISRM Local Liason

I am pleased to announce that Stuart Read has agreed to take on the role of ISRM liason for our Society. Stuart is well known to many of us, having been involved with both the NZGS and NZSOLD in a range of capacities. He will work closely with Dr David Beck, the Australasian VP, to represent our rock mechanics practitioners on the international stage.

### Industry Engagement

One of the important roles of a Society like ours is to contribute to the development of public policy and to help implement the lessons learnt from extreme events and failures. As geotechnical practitioners, our working environment has changed as a result of the Canterbury earthquake sequence. That change continues, and we have

to be a part of it. To this end, your Society has been active in the following areas:

Submission to MBIE on earthquake seismic performance (March 2013). This comprised our own submission, together with contribution to a joint IPENZ/NZSEE/SESOC/NZGS document.

Representation on the Engineering Reference Group established by MBIE to overview building and construction policy and operational developments. I am currently the NZGS representative on the ERG.

Participation in the review of the NZSEE document "Assessment and improvement of the structural performance of buildings in earthquakes". Nick Harwood is representing our Society on the governance group for this review.

I'm sure that there will be many more initiatives and calls on our time, as our professions endeavour to respond to our changed environment – or at least to changed perceptions and sensitivities. The effort required is much greater than that which can be provided by even the most well intentioned voluntary committee. We will no doubt need assistance, and I encourage all of you to offer support when given the opportunity. You will find it a very rewarding experience.

In summary, our Society is going from strength to strength, and it's fantastic to have this recognised on the world stage. This success is largely the result of the voluntary efforts of many of you. It does not come easily, but we do need to keep it up. There is much that still needs to be done.

### Gavin Alexander

Chair, Management Committee

[gavin.alexander@beca.com](mailto:gavin.alexander@beca.com)



NEW ZEALAND  
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## Nominations are invited from NZGS members for papers to be considered for the 2013 NZGS Geomechanics Award.

The Geomechanics Award is presented to the author(s) of papers that are distinguished contributions to the development of geotechnical engineering and/or geology in New Zealand.

The Award is for a paper published in the three-year period to 31 July 2013. The paper may have multiple authors, but at least one must be a Society member. Judging will be by a panel appointed by the Management Committee. The decision to award a prize for best paper will be at the discretion of the Committee.

Nominations must be in writing by an NZGS member and be submitted by 30 August 2013.

# AWARD VALUE: \$2000 plus certificate

**Nominations must be in writing and close 30 August 2013. Please provide author details along with a hard copy of the paper and a brief commentary on the contribution the paper makes to New Zealand geotechnical engineering or engineering geology, to the NZGS Management Secretary.**

Amanda Blakey, Management Secretary email: [secretary@nzgs.org](mailto:secretary@nzgs.org)

## EDITORIAL

THE YEAR IS flying by and this issue of Geomechanics News suggests it is because we are busy working on interesting projects around the country. Our cover features the Tui Mine tailings dam remediation which was very recently completed in May 2013. This issue introduces a new liquefaction vulnerability indicator known as the ‘Liquefaction Severity Number’ (LSN). This vulnerability indicator has been developed in New Zealand with the help of both local and international peer review and is shown to provide a better fit to observed liquefaction induced damage in Christchurch than existing parameters such as the Liquefaction Potential Index (LPI) or calculated settlement.

Some significant milestones for NZGS are reported. These include:

- ISSMGE selecting NZGS for the ‘Outstanding Member Society’ Award
- The PEngGeol register is now live
- Investiture ceremonies for people named in the 2013 New Year honours list recognised four NZGS members
- A number of our members won IPENZ awards or were elected as Fellows
- NZGS now has over 1000 members

The Editors recommend the very concise and informative review of the Pike River Royal Commission Report prepared by John St George and the interesting technical note is a must read for all who use a Geonor shear vane.

This year’s photo competition is up and running so don’t forget to send us those ‘interesting’ moments you capture while out on the job.

As this issue goes to print my Co-Editor Camilla is enjoying a well earned break so we look forward to seeing her back for the next issue.

**Hamish Maclean**, NZ Geomechanics News Co-editor  
HMaclean@tonkin.co.nz



*Hamish is a Geotechnical Engineer with Tonkin & Taylor Ltd in Auckland. He completed his Civil Engineering degree at The University of Auckland. Following valuable construction experience working for Fletcher Construction on the later stages of the second Manapouri tailrace tunnel, he has spent the past seven years working as a geotechnical engineer in the Tonkin & Taylor Auckland office. This has included a wide variety of projects with a focus on retaining wall design and landslip assessment and remediation.*

---



*Camilla is an Engineering Geologist with Aurecon in Christchurch. Originally from the UK, she completed her Geology degree at The University of Bristol and her Masters in Engineering Geology at The University of Leeds, graduating in 2004. She worked for Mott MacDonald in the UK for three years before coming to New Zealand at the start of 2008. She has been involved in many large and small projects all over NZ and Australia and since the earthquakes in 2010/2011 she has been heavily involved in mapping, assessing and mitigating rockfall and landslide hazards in the Port Hills around Christchurch. Camilla was awarded the New Zealand Engineering Excellence Awards, Young Engineer of the Year in 2011 for her work on rockfall following the earthquakes in Christchurch.*

**Camilla Gibbons**, NZ Geomechanics News Co-editor  
camilla.gibbons@aurecongroup.com

## EDITORIAL POLICY

*NZ Geomechanics News* is a biannual bulletin issued to members of the NZ Geotechnical Society Inc. It is designed to keep members in touch with matters of interest within the geo-professions both locally and internationally. The statements made or opinions expressed do not necessarily reflect the views of the New Zealand Geotechnical Society Inc. The editorial team are happy to receive submissions of any sort for future editions of *NZ Geomechanics News*. The following comments are offered to assist potential contributors. Technical contributions can include any of the following:

- technical papers which may, but need not necessarily be, of a standard which would be required by international journals and conferences
- technical notes
- comments on papers published in *NZ Geomechanics News*
- descriptions of geotechnical projects of special interest

### General articles for publication may include:

- letters to the NZ Geotechnical Society
- letters to the Editor
- articles and news of personalities
- news of current projects
- industry news

Submission of text material in Microsoft Word is encouraged, particularly via email to the editor or on CD. We can receive and handle file types in most formats. Contact us if you have a query about format or content.

Diagrams and tables should be of a size and quality appropriate for direct reproduction. Photographs should be good contrast, black and white gloss prints or high resolution digital images. Diagrams and photos should be supplied with the article, but also saved separately as 300 dpi .jpps. Articles need to be set up so that they can be reproduced in black and white, as colour is limited.

*NZ Geomechanics News* is a bulletin for Society members and articles and papers are not necessarily refereed. Authors and other contributors must be responsible for the integrity of their material and for permission to publish. Letters to the Editor about articles and papers submitted by members will be forwarded to the contributing member for a right of reply.

Persons interested in applying for membership of the Society are invited to complete the application form in the back of the newsletter. Members of the Society are required to affiliate to at least one International Society and the rates are included with the membership information details.



**NEW ZEALAND  
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## SCHOLARSHIP

The NZGS Management Committee has agreed to provide funding for a scholarship that would enable a member of the Society to undertake postgraduate study in New Zealand that would advance the objectives of the Society. Through this scholarship, the Society hopes to encourage members to enrol for post-graduate study or research.

The fields of study or research would be in Engineering Geology and/or Geotechnical Engineering. The award of such a scholarship would include agreed milestones and deliverables including a publication or thesis. A nominated representative from the NZGS will act as a liaison with the scholar and the supervisor (where applicable).

The NZGS Management Committee has agreed on the following Terms of Reference for the NZGS Scholarship:

1. A scholarship termed the "New Zealand Geotechnical Society Scholarship" wholly funded by the New Zealand Geotechnical Society (NZGS) and administered by the NZGS Management Committee is available for members (defined to be either a Student Member or Normal Member) of the NZGS.
2. The scholarship is provided to enable the member to undertake postgraduate study or research work in the fields of Engineering Geology and/or Geotechnical Engineering in New Zealand.
3. This study or research work can lead to the award of a post-graduate degree but is not necessarily restricted to such an award. It is expected that the study or research work will be undertaken at a post-graduate level and not an undergraduate level.
4. A publication at the end of the study or research work in the form of a thesis or report is a requirement of the award of the scholarship.
5. The scholarship is awarded on an ad-hoc basis at the sole discretion of the NZGS Management Committee. This is dependent on proposals submitted for consideration by the Committee.
6. Applications for consideration by the Committee should be submitted to the Management Secretary by 31st October of each year.
7. The period of research work is to be agreed with the NZGS Management Committee.
8. The value of the scholarship is up to a sum of NZ\$10,000.

Please go to the NZGS website for an application form or send any queries to [secretary@nzgs.org](mailto:secretary@nzgs.org)



## LETTERS TO THE EDITOR

To the Editor  
NZ Geomechanics News  
February 2013

### **A Plea to Save the Humble Scala – A Discussion of “A Review of Shallow Foundation Design Practice in New Zealand” (Geomechanics News, December 2012, Issue 84)**

The Scala penetrometer is widely used (and some think abused) in New Zealand engineering practice as a convenient tool for shallow ground investigations mostly for domestic and light commercial and industrial buildings. In recent times, there has been a growing trend to drop the name “Scala penetrometer” in favour of the acronym “DCP” for dynamic cone penetrometer, or to assume that the two terms are interchangeable, as in the above recent article.

### **In recent times, there has been a growing trend to drop the name “Scala penetrometer” in favour of the acronym “DCP” for dynamic cone penetrometer**

The reason for this seemingly spontaneous name change is uncertain but may be due to the influx in recent years of many overseas trained geotechnical engineers who are unfamiliar with our local Scala penetrometer. Also, the authors of the “Scala standard” NZS4402.6.5.2.1988 have contributed to confusion by dropping the Scala name from the standard (although the term “Scala” is referenced as a footnote).

This change in terminology is regrettable because the term DCP is generic and is used worldwide for a variety of quite different instruments. Even in New Zealand the term DCP is being applied not only to the Scala but also to some other mechanised dynamic penetrometers with quite different characteristics. Whereas the term “Scala” is instantly identified (at least in New Zealand) as a specific design of penetrometer and is available in probably every engineering office in the country (even though as pointed out in the above paper citing CETANZ this design may not be exactly the same as Mr Scala’s original).

A quick search on the internet reveals at least two other instruments each called DCP: The oldest reference to a DCP is for a device developed by late Professor George Sowers and still available for sale in the Durham Geo Slope Indicator catalogue (see <http://www.durhamgeo.com/testing/soils/field-testing-dynconeopen.html>). More recently, the ASTM has released a standard ASTM D6951 “Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications” that is quite different from

Sowers’ device. Neither of these instruments are the same as our Scala penetrometer. Both of these DCPs are promoted for use in roading design (as was the Scala penetrometer originally) although there is no reason why they should be any less suitable for use in building foundation design than say the widely used SPT (standard penetration test), also a type of dynamic penetrometer.

All dynamic penetrometers have certain drawbacks including:

- Hammer efficiency varies according to mechanical condition and operator
- Energy transfer to cone varies according to soil conditions (i.e. radiation losses and rebound)
- Certain soils susceptible to shock loading (e.g. loose sands, sensitive silts and clays)

For these reasons, static penetrometers (such as the CPT and Dilatometer) are preferred in most situations but have their own limitations including inability to penetrate hard ground (often) and the need for more complex machinery to drive them. But more simply, there is no static penetrometer (or other investigation tool) that is as portable, adaptable, or widely available as the Scala in New Zealand.

While the Scala shares all of the drawbacks common to dynamic penetrometers in general, there seems to be no reason why it should be any worse than any other dynamic penetrometer, including the SPT – probably the most widely used tool for foundation investigations worldwide. In fact, the Scala is more standardised (within New Zealand) than the SPT which is very poorly standardised with all manner of different hammers, efficiencies, and practices.

The greatest drawback for the Scala, as pointed out in the article, is the lack of direct correlations with engineering properties of soils. Most practice revolves around the very dated Stockwell paper based on indirect correlations to  $q_a$  via CBR. The best way to overcome this drawback is not to throw away a perfectly good tool (the Scala) but to carry out additional testing and research to establish better correlations, preferably for local soils relevant to our own practices.

The great practicality of the Scala penetrometer and its entrenchment in current routine practice means that it will continue to be widely used as the basis for shallow foundation design in New Zealand for the foreseeable future. The best way to improve current practice would be for the NZGS to promote a research campaign to replace the dated Stockwell paper with better guidance based on local testing and correlations.

And please, let’s avoid future confusion by keeping our most familiar name – “Scala” penetrometer.

**Kevin McManus**  
NZGS Member

## THE SECRETARY'S NEWS

MANY OF YOU will have noticed that we carry advertisements in each issue of Geomechanics News. Most advertisers are companies with employees, and employers that are members of NZGS. From big companies to small one-man-bands, up and down the breadth of New Zealand. Many have been members of NZGS for a long time, and subsequently have been advertising in Geomechanics News for a long time too. They are part of the family. They receive all the emails, and invitations, check the website, bump into each other at Branch events and know each other really well.

However, some advertisers are not members of NZGS, or part of the immediate family, the software companies, testing laboratories, contractors or recruitment specialists. These businesses support the main family; they are the aunts and uncles, attending family functions and special events. Like advertising in the Bulletin and sponsoring conferences and seminars.

I don't think we should get too carried away with this family scenario – I haven't worked out who the 'godfather' would be (or the wicked stepmother). But as a Society we sometimes need to acknowledge and thank those that support the others. Like the advertisers supporting this publication. Without the advertisers, we wouldn't be able to publish Geomechanics News.

So, thank you to all the advertisers, big and small, that provide the funds to make our NZGS publication possible. I have been co-ordinating the advertisements for almost five years and have always found everyone cheerful, amiable, honest and reliable. I think I have grasped which of you enjoy the challenge of a tight timeframe and which advertisers need a phone call rather than an email. And that is fine. We are a flexible editorial team and try to accommodate everyone.

Recently, one of our dependable advertisers retired and closed their business. Thank you to HRS (Hoare Research Software) for their continued support of Geomechanics News. We wish you all well and wanted to say thanks for all your help over the years and it was a pleasure working with you, from our family to yours.

In other news, NZGS celebrates its 1,000th member in this issue. Aristomenis Magnis has kindly prepared a brief personal profile from which you will gain a snapshot insight of one of our new members. Since December's Bulletin, we have welcomed a further 70 new members.



*Amanda has been the NZGS Secretary since 2008. She works from home in Glendowie, Auckland, whilst juggling family (two children and husband) and an international ice skating career. OK, perhaps just the family. She enjoys the Game of Thrones books, cooking and sailing.*

*In the distant past she worked as a planner at the now deceased Waitakere City Council, and even further back for URS.*

### New Members

Welcome to the following 70 new members since December 2012:

**Auckland:** Samuel Lujang, James Brokenshire, Adam Smith, Dave Brodie, Alan Thorp, Johan Laas, Jason Abraham, Mark Lyndon, Peter Bone, Simon Walkley, Helene Higham, Robert Pirrie, David Chiswell, Shaun Vemuri, Stuart Cartwright, Hannah Hadley, Trent Waterman, Mike Abbott

**Waikato:** Daryll Pinfold, Matt Prescott

**Hawke's Bay:** Leighton Gillespie

**Wellington:** Hamish Wells (Otaki), Razel Ramilo, Matthew Steer, Audi Putra

**West Coast:** Luke Matheson, Mark Stephens

**Canterbury:** Raymond Su, Chamath Nanayakkara, Andy Walsh, Joe Wise, Adam Irvine, Gareth Hickey, Kelly Robinson, Marie-Claude Hebert, Ferry Haryono, Alistair Green, Luci Swatton, Zoe Pletz, Adrian Short, David Sullivan, Charles McDermott, Jenna Crisp, Andreas Giannakogiorgos, James Myles, Andrei Cotiga, Ben Yeunk, Dan Jones, Tim New, Matthew Jefferd, Jonathan Mukhtar, Setareh Arvanaghian, Kit Lawrence, Hamish Nelson, Scott McDonald, John Harris, Matt Jackson, Gordon Ashby, Jethro Neeson, Aristomenis Magnis, Ben Anderton, Luke Challies, Victoria Anderson

**Otago:** Colin Macdiarmid, Chris Guertin, Ioannis Antonopoulos

**Australia:** Darren Rokesky, Gabriele Chiaro

**Singapore:** Senthuran Arulanantham

**Canada:** Daniel Bruton

**Amanda Blakey**

Management Secretary

secretary@nzgs.org

## INTERNATIONAL SOCIETY REPORTS

### International Society of Soil Mechanics and Geotechnical Engineering

Australasia VP Report: March 2013

AS I WRITE we are now well into the last of the four years that make the term of the current presidency and Board of the ISSMGE. Professor Jean-Louis Briaud has been a most innovative President of the Society and during his period of office he has instituted many new initiatives. The first and, perhaps, most important of these for the effective running of the ISSMGE has been the establishment of seven Board Level Committees<sup>1</sup>. Not only have these committees enabled strategies developed by the President and the Board to be enacted effectively, but they have brought a greater number of members – from students to senior practitioners and academics – into the running of the Society and with them a richness of experience and new ideas. At its September meeting in Rosario, Argentina, the Board agreed that, whilst an incoming president and Board might wish to vary the number or activities to be covered by Board Level Committees, provision for their establishment and operation should be included in the ISSMGE statutes and bylaws. The Board agreed that the wording of the statutes and bylaws should be reviewed also and revised so that the language is gender neutral. The ISSMGE Secretary General is currently drafting the required changes to the statutes and bylaws for approval first by the Board at then Council at its meeting in Paris during September.

If you have visited the ISSMGE website<sup>2</sup> in the last few months you will have noticed that it has been updated and refreshed. This has been the result of the work of the Innovation and Development Board Level Committee. The site has been redesigned – but keeping much of the ISSMGE identity of the former website – by Geoengineer.org who have also been contracted to maintain the site. In its redesign the functionality of the site has been improved and the range of content enhanced. For example, the site now includes an improved (and significantly easier to find!) database of upcoming geotechnical conferences. The site also provides access to all previous ISSMGE webinars – another initiative from the President – as recordings of the slides and presentations by the speakers so that they can be listened to and viewed at leisure. This is particularly beneficial to ISSMGE members in Australasia as the live

webinars tend to take place during the early hours of the morning in our region. The ISSMGE website will continue to evolve and I would be grateful to receive any comments you might have for improvements or additions to the site that I can pass on to the website design team.

Organisation for the 18th ICSMGE, which will be taking place in Paris later this year (2 to 6 September), is proceeding well. The organisers received some 850 abstracts from 70 Member Societies which were informed of the papers that had been accepted at the end of January. To allow a greater role for the ISSMGE Technical Committees the format for the conference will be varied slightly from previous quadrennial international conferences. The two first days will be devoted to plenary sessions that will include the Terzaghi Oration (as I indicated in my last report this is to be presented by Dr Suzanne Lacasse) together with seven ISSMGE Honour Lectures proposed by the Technical Committees – another innovation of the current President and Board. In the remaining days of the conference there will be 28 parallel discussion sessions and 15 workshops. The content and format of the sessions and workshops are being managed by the Technical Committees.

The series of ICSMGE were established to allow ISSMGE members from around the world to meet in order to discuss the latest developments in research and practice in soil mechanics and geotechnical engineering. The conference also provides the opportunity for the ISSMGE to recognise the significant achievements of its individual members through the award of three Young Member Awards, the Terzaghi Oration and the Kevin Nash Gold Medal. At the 18th ICSMGE the President will also be making seven “Outstanding Achievement” awards that have been introduced as another of the new initiatives that has been managed by the Awards Board Level Committee. These are:

- Outstanding Technical Committee
- Outstanding Geotechnical Project
- Outstanding Innovator
- Outstanding Member Society
- Outstanding paper published in the International Journal of Geo-Engineering Case Histories
- Outstanding Young Geotechnical Engineer Award
- Outstanding Public Relation Award

I am aware of nominations for some of these awards from the Austrasia region and I hope very much that these will be successful.

A meeting of the ISSMGE Council is always held

1 Board Level Committees: Membership, Practitioners and Academicians Committee; Awards Committee; Corporate Associates Presidential Group; Innovation and Development Committee; Public Relations Committee, Student and Young Member Presidential Group; Technical Oversight Committee.

2 <http://www.issmge.org>

in conjunction with the ICSMGE. The agenda for this Council meeting includes the election of the new President as well as the selection of the venue for the next ICSMGE. Although the region is not represented in the list of three currently declared candidates for the Presidency (who are: Gabriel Auvinet, Mexico; Roger Frank, France; Askar Zhussupbekov, Kazakhstan), as I am sure readers will be well aware the AGS is making a bid for the 19th ICSMGE to be held in Sydney during 2017. At the end of the 18th ICSMGE this September the new President and Board will assume responsibility for the running of the ISSMGE. Whilst the Vice-Presidents for some regions are yet to be selected, I am delighted that it has been announced that Professor Mark Jaksa, of the University of Adelaide, will be succeeding me as Vice-President for Australasia. I am sure that you will join me in congratulating Professor Jaksa and wishing him every success in this post.

**Professor Michael C.R. Davies**

Vice-President for Australasia and First Vice-President

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## International Society for Rock Mechanics

Australasia VP Report: September 2011

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THIS REPORT DESCRIBES ISRM related activities in Australia and New Zealand for the period to June 2013.

### New NZGS ISRM Representative

In April, the NZGS board appointed Mr Stuart Read as the new ISRM representative, replacing Marc Andre Brideau, who has returned to Vancouver. We wish Marc-Andre the best in his new role.

Stuart's roles as ISRM representative will include:

- Liaising with the NZGS members affiliated with ISRM;
- Attending NZGS Management Committee meetings (expenses will be reimbursed for travel);
- Representing NZGS matters to the wider ISRM community at conferences or other international meetings as required;
- Liaising with the current ISRM Vice President for Australasia, Dr David Beck; and
- Preparing quarterly reports for the Management Committee meetings and reports for Geomechanics News.

### 2<sup>nd</sup> ISRM Online Lecture

ISRM online lectures are an initiative of the Young Members Presidential Group. The 2<sup>nd</sup> online lecture was held on 28 May 2013, titled 'Solving the unsolved problems in rock mechanics and rock engineering', presented by Emeritus Professor John Hudson.

The 1 hour lecture was recorded and can be viewed at [www.isrm.net](http://www.isrm.net).

### EUROCK 2014

Eurock will be held in Vigo, Spain, 27-29 May 2014. The is now available <http://www.eurock2014.com>

### ISRM Presidential elections

The election for the next ISRM President for the term of office 2015-2019 will take place at the ISRM Council Meeting held in association with the EUROCK 2013 Symposium in Wroclaw, Poland, on 22 September 2013, whereupon the successful candidate will become the President-elect for the two years until 2015.

One nomination was received by the deadline of 22 March 2013. The presidential candidate is Dr. Eda Quadros from Brazil.

As part of the current ISRM Board's modernisation programme, the potential candidates were asked to provide videos of their background and intentions. The video of Dr Quadros can be viewed via the link below together with the candidate's nomination documents.

### Former ISRM Vice President Dr François Huezé passed away 2012-11-20

Dr François Huezé, former ISRM Vice-President for North America (2003-2007), passed away on 8 October 2012 after fighting a long illness, at the age of 70.

He was born in Algeria in 1941 and started his career in the long-wall coal mines of eastern France in 1962. He moved to the United States at 25, where he graduated from UC Berkeley with a PhD in Civil Engineering. As an educator, researcher and consultant, he worked and published in all areas of Rock Mechanics: in-situ testing and monitoring, numerical and physical modelling and laboratory testing. He was acknowledged as a world-renowned expert in Rock Mechanics and Geological Engineering, and his last position was as Leader of Geotechnical Programs at Lawrence Livermore Laboratory.

Dr Heuzé was President of the ISRM National Group of the USA, ARMA, a most active ISRM Vice-President for North America during the term 2003-2007 and a candidate to the ISRM Presidency.

The Rock Mechanics fraternity is poorer for his loss and, at this time, our thoughts are with his family and close friends.

### First bulletin of the ISRM 2014 International Symposium - ARMS8, in Japan

The first bulletin of the 2014 Asian Rock Mechanics Symposium, ARMS8, is now available for download.

ARMS8 is the 2014 ISRM International Symposium and will take place 15-17 October in Sapporo, Japan.

The theme of the symposium is 'Rock Mechanics for Global Issues – Natural Disasters, Environment and Energy'. The goal of the symposium is to respond to those issues and to promote the exchange of knowledge and experiences in various areas of the rock mechanics and rock engineering.

More details are available at <http://www.rocknet-japan.org/ARMS8/index.htm>

### Keynote lectures of the New Delhi 2010 ARMS online

The videos and presentations of the keynote lectures of the 2010 ARMS held in New Delhi, India are now online. ISRM members can watch the full length lectures, which are accompanied by the powerpoint presentations:

- Rocha Medal Winner – Dr. Jan Christer Andersson from Sweden
- Dr. John A. Hudson, Imperial College, UK – Underground Radioactive Waste Disposal – The Rock Mechanics Contribution

- Prof. Maurice Dusseault, University of Waterloo, Canada – Deep Injection Disposal: Environmental and Petroleum Geomechanics
- Dr. Shinichi Akutagawa, Kobe University, Japan – On Site Visualization as a New Paradigm for Field Measurement in Rock Engineering
- Prof. Herb Wang, University of Wisconsin, USA – Deep Underground Instrumentation and Monitoring
- Prof. Giovanni Barla, Politecnico di Torino, Italy – Progress in the Understanding of Deep-Seated Landslides from Massive Rock Slope Failure
- Prof. Yossef H. Hatzor, Ben-Gurion University of Neger, Israel – Modelling Dynamic Deformation in Natural Rock Slopes and Underground Openings with Numerical DDA Method
- Dr. C. Erichsen, WBI, Germany – Challenges in the Design and Construction of Tunnels in Jointed Rock
- Prof. Guowei Ma and Prof. Yingxin Zhou, Singapore – Rock Dynamics Research in Singapore: Fundamentals and Practices
- Prof. Xia-Ting Feng, Institute of Rock and Soil Mechanics, China – Application of Intelligent Rock Mechanics Methodology to Rock Engineering
- Dr. John Read, CSIRO LOP Project, Australia – The Large Open Pit Project

### Upcoming meetings

- 18-20 June 2013**, Shanghai, China – SINOROCK 2013 – Rock Characterization, Modelling and Engineering Design Methods – an ISRM Specialized Conference
- 20-22 August 2013**, Sendai, Japan – The 6th International Symposium on Rock Stress – an ISRM Specialized Conference
- 21-26 September 2013**, Wrocław, Poland – EUROCK 2013 – Rock Mechanics for Resources, Energy and Environment – the 2013 ISRM International Symposium
- 26-28 May 2014**, Vigo, Spain – EUROCK 2014 – Rock Engineering and Rock Mechanics: Structures in and on Rock Masses – an ISRM Regional Symposium
- 15-17 October 2014**, Sapporo, Japan – ARMS 8 – 8th Asian Rock Mechanics Symposium – The 2014 ISRM International Symposium
- 10-13 May 2015**, Montréal, Canada – ISRM 13th International Congress on Rock Mechanics
- 7-9 October 2015**, Salzburg, Austria – EUROCK 2015 – Geomechanics Colloquy – an ISRM Regional Symposium

**Dr David Beck**

Vice President Australasia



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## International Association for Engineering Geology and the Environment

Australasia VP Report: May 2013

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### Membership

New Zealand membership of IAEG now exceeds that of Australia. Representation of NZ on the IAEG has traditionally been divided between Australia and New Zealand on a 2:1 basis (2 terms Australia: 1 term New Zealand). This was because the number of Australian members was significantly greater than the number of New Zealand members. Given that this balance has now altered, should NZ consider lobbying Australia to change this to 1 for 1 representation?

### 50th Anniversary

A sub-committee has been established to prepare a book that celebrates the history and future of Engineering Geology as part of IAEG's 50 year celebrations at Torino in 2014 that will be provided to delegates of IAEG2014 and be available for purchase by others. The sub-committee is actively seeking photographs and short articles that give an Australasian view of transforming incidents or persons in the development of Engineering Geology in New Zealand and Australia. Please send submissions to [ann.williams@beca.com](mailto:ann.williams@beca.com) or Amanda Blakey at [secretary@nzgs.org](mailto:secretary@nzgs.org). Thank you to those that have already submitted material.

### Hans Cloos Medal

The 2012 recipient of the Hans Cloos medal is Professor Victor Osipov, chairman of the Russian National Group of IAEG and Director of the Sergeev Institute of Environmental Geoscience RAS. In order to further raise the profile of this prestigious award and of IAEG he has been asked to present a Hans Cloos lecture, and can be approached to present this internationally.

### Richard Wolters Prize

The procedure for the Richard Wolters prize that was trialled in Auckland and Banff has been accepted and a proposal has been submitted for alteration of the Bylaws to address this. The new procedure spreads the opportunity to contest the prize to non-academics, reduces the maximum age of applicants to 35 and includes a presentation to be given at the conference at which the award is made.

### Commission-Led Awards

In order to encourage increased activity and productivity among the Commissions, two types of awards are being proposed. The first is an International Research programme (IRP-IAEG) and the second, Science and Technology awards (STA-IAEG). Both award types are aimed at encouraging research, innovation and collaboration among our members.

### Newsletter

The new secretariat has reinstated a regular (6 monthly) newsletter. Newsletters can be viewed on the IAEG ([www.iaeg.info](http://www.iaeg.info)) and NZGS websites.

### IAEG Sponsored Conferences

The next IAEG Council meeting will be held in conjunction with the Asia Regional meeting in Beijing "Global View of Engineering Geology and the Environment" September 24 – 25, 2013. See [www.iaegasia2013.com](http://www.iaegasia2013.com).

The submission of abstracts to the next IAEG Congress to be held on the 50th Anniversary of IAEG in Torino, Italy, closed on 15 May 2013. Register on [www.iaeg2014.com](http://www.iaeg2014.com) to receive updates.

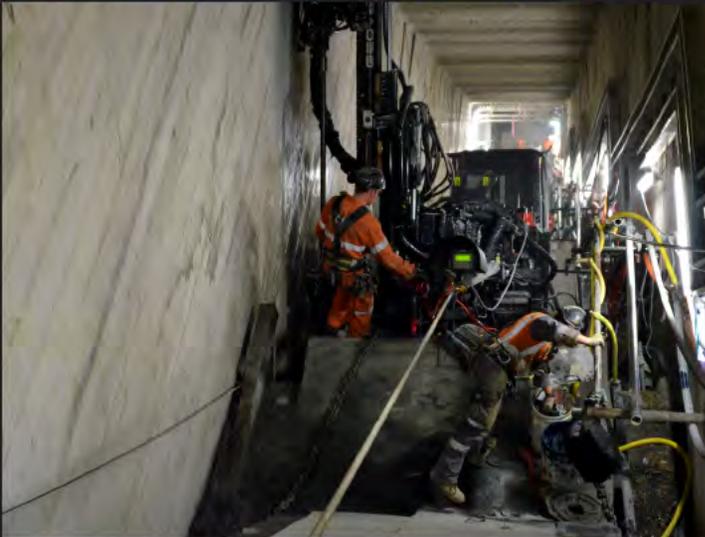
### New Zealand

As you will be aware, New Zealand has been working towards professional recognition of engineering geologists through IPENZ (PEngGeol). Guidelines and competency standards have been established and approved by IPENZ following consultation and the Register of Professional Engineering Geologists is now live. This is an outstanding achievement for the profession and I would like to acknowledge in particular the roles of Philip Robins (past Chair of NZGS, who was determined that this would be achieved), Geoff Farquhar (many time committee member of NZGS and staff assessor for CPEng who has provided guidance throughout the process and facilitated the interface IPENZ), to Jeff Wastney of IPENZ who represented us to the IPENZ Board, responded to submissions and facilitated training as well as contributing to our many sub-committee meetings, and to David Burns (immediate past Chair of NZGS) and Warwick Prebble (formerly University of Auckland) who energetically participated in the sub-committee meetings and provided robust debate in the drafting of the guidelines and competency standards. IPENZ is now waiting to receive your PEngGeol application! <http://www.ipenz.org.nz/IPENZ/finding/PEngGeol/>

### Ann Williams

IAEG Vice President, Australasia

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## NZGS BRANCH ACTIVITIES

### Auckland Branch Activity Report

AUCKLAND BRANCH HAVE had another busy period over the past six months and have hosted a wide range of interesting presentations. Attendances have been strong through 2013, following a drop-off towards the end of 2012. The Civil Engineering department at the University of Auckland have also hosted a number of geotechnical talks, and are included in the

**30 October 2012** – Professor Jonathan Bray has been visiting New Zealand to work with colleagues at the University of Canterbury on projects related to the Canterbury Earthquakes and has been able to present a number of talks in Auckland. For this first talk he presented the 2012 Joyner Lecture on ‘Building Near Faults’. This included some interesting data on the performance of new and existing faults and the consequences for buildings, particularly those in California.

**1 November 2012** – Professor Jonathan Bray (hosted by The University of Auckland) presented his second lecture on liquefaction induced building movements. This talk presented interesting findings Prof. Bray has made from earthquake events around the world as well as recommendations for accounting for liquefaction in design, which initiated some good discussion on challenges faced in Christchurch from those who attended.

**15 November 2012** – Brian Simpson (the former Rankine lecturer) presented a summary of lessons learned during his career. This was an interesting introduction to aspects of modelling and geomechanics that was both engaging and informative.

**27 November 2012** – Professor Michael Davies presented his farewell lecture on plant root reinforcement. This lecture coincided with the display of student posters as part of the NZGS Student Awards and the announcement of the prize for this competition. The event included linking of multiple centres for audience voting results as well as streaming of Prof. Davies presentation.

**12 February 2013** – Professor Scott Sloane presented the 51st Rankine Lecture on Geotechnical Stability Analysis. This event was arranged with ICE and provided a technical exploration of aspects of stability modelling.

**19 March 2013** – Peter Millar presented an expanded version of the liquefaction blasting trials carried out in Canterbury. This talk was well attended and provided insights into the performance of various options for ground improvements and the performance of residential foundations.

**17 April 2013** – Professor Jonathan Bray (hosted by The University of Auckland) presented a talk on simplified



**Pierre Malan**  
Auckland Branch Coordinator  
Tonkin & Taylor Ltd  
Work: 09 355 0759  
Email: pmalan@tonkin.co.nz

*Pierre is a Geotechnical Engineer with Tonkin & Taylor Auckland. Pierre graduated from the University of Canterbury with a M.Eng and has subsequently worked around Auckland and throughout the United Kingdom and Ireland. He has worked on major infrastructure work, design and build contracts as well as a range of small to medium projects.*



**Luke Storie**  
PhD Candidate  
Faculty of Engineering  
The University of Auckland  
Email: luke.storie@gmail.com

*Luke is currently undertaking a PhD at the University of Auckland on the earthquake resistant design of foundations. He is investigating the response of a number of buildings in the Christchurch CBD following the 2010/2011 earthquakes and is following on from research that has been undertaken under the supervision of Professor Michael Pender. Previously, following his graduation from the University of Auckland with a BE(hons) and BA conjoint degree in 2009, Luke was a Geotechnical Engineer at Coffey Geotechnics (NZ) Limited where he worked on a range of small to large scale projects in New Zealand and Australia.*



**Aidan Thorp**  
Auckland Branch Coordinator  
Beca Infrastructure Ltd  
Work: 09 300 9371  
Email: aidan.thorp@beca.com

*Aidan is a Geotechnical Engineer with Beca Infrastructure Ltd, based in Auckland. He graduated from the University of Auckland in 2009 with a BE (Hons) and has a passion for slope stability and river engineering. Aidan joined Beca in 2010 and has worked in Auckland, Tauranga and Wellington on large infrastructure projects, as well as a variety of other projects throughout the country.*



Rock drilling, Mt Pleasant, 2012. Photo: Neil MacBeth



Installing rockfall protection, Reids Falls, SH73

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procedures for estimated earthquake induced slope displacements. As with Prof. Bray's other presentations, he has provided us with relevant papers for this talk and has also included analysis spreadsheets. These will be made available on the website, where the recording of this and most of our presentations are available.

### General Auckland Branch News

The live streaming has been extremely successful over the past few years and we thank Auckland University for their

continued support. Members should note that while we do our best to provide live streaming, this can sometimes fail due to technical problems outside our control. Wherever possible we will let people know, but please be aware that this service should not be assumed to be 100% reliable at all times.

Aidan Thorpe will be travelling overseas in the next few months and standing down as branch coordinator. We would like to thank him for his work over the last year and wish him well in the future.

## Hawke's Bay Branch Start-up

THE HAWKE'S BAY Branch of NZGS is starting up! Riley Gerbrandt of Opus International Consultants Ltd in Napier has enjoyed being active in other technical groups, and he is keen to start up the new Branch and seeks interest from other Hawke's Bay geo-professionals. His desire is to connect local professionals to engage vibrant discussion on issues affecting the profession, provide a platform for members to enhance their knowledge and understanding of the industry and geotechnical design issues, and to present opportunities for networking and fun.

With the establishment of the new Branch, there is opportunity for local firms to volunteer a venue for branch meetings or to sponsor event refreshments. Riley would like to line up presentations about interesting local projects, technical news or advancements in the industry. One idea is to discuss how the effects of the Canterbury Earthquakes are influencing the industry in the Hawke's Bay. Riley would love to hear other good ideas for field trips or presentations, so please feel free to contact him if you would like to offer up an idea, suggestion or advice. He is excited to organise the first Branch meeting and looks forward to meeting you all soon. If you are interested in being involved in co-ordinating the Branch, feel free to contact Riley.



### Riley Gerbrandt

Hawke's Bay Branch Coordinator  
Opus International Consultants Ltd  
Work: 06 833 5108  
Email: Riley.Gerbrandt@opus.co.nz

*Riley is a Chartered Professional Engineer (CPEng) and Geotechnical Engineer with Opus International Consultants Ltd in Napier. He has been serving his clients in the geotechnical engineering industry in both New Zealand and California. He strives to provide practical, timely, and cost-effective engineering solutions. Riley earned BSc and MSc in Civil and Environmental Engineering in California, where he practiced geotechnical engineering and gained his PE (Civil) license. In 2011 Riley and his family moved to New Zealand with both an eagerness to further his geotechnical career and a desire for a better lifestyle for his young family.*

*Riley's experience incorporates geotechnical investigations and design for land development, structures, roading and infrastructure projects; geotechnical construction observation and quality assurance testing; and design for on-site stormwater and wastewater disposal. He particularly enjoys sub-surface interpretation, earthquake hazard assessments, seismic design and slope stability assessments.*

## Waikato Branch Activity Report

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IT'S BEEN A flat-out summer in the Waikato with the "drought" being a joy for earthworks contractors and keeping the geotechs scrambling to keep up. As a result there hasn't been much activity within the Branch. The rains (and fog) have now well and truly set in, but project work still seems to be continuing at a good pace.

The local IPENZ Branch committee is improving linkages with the technical societies. The SESOC and NZGS groups are now coordinating to organise more joint events in the near future.

A site visit to the new State Highway 1 Atiamuri bridge construction project was coordinated by the local SESOC group on 23 February 2013, which was also of interest to NZGS members locally involves roading, earthworks and piling. HEB Construction Project Manager for the Atiamuri Bridge Replacement Project gave a brief presentation on the project and was guide around the site and across the bridge. The Atiamuri Bridge Replacement project involved the construction of a new bridge about 75 metres upstream of where the previous bridge was on State Highway 1 (SH1), South Waikato. The new bridge opened to traffic in March 2013.

The Waikato IPENZ branch organised a Ngaruawahia Bypass – Site Visit and Presentation that was held on 19 March at the River Road, Horotiu site. A representative from Fletcher Construction, responsible for the design and construction of this significant section of the Waikato Expressway, gave a presentation on the work involved in designing and constructing an eight kilometre section from Taupiri to Horotiu, inclusive of a new bridge across the mighty Waikato River. This event was informally combined with the IPENZ Transportation Group and SESOC, on account of the interest to civil, structural and transportation engineers as the new bridge arises from each river bank.

On 25 September, a meeting was held to discuss local and national practice in relation to the assessment of liquefaction. Liquefaction has been shot into the public eye by the recent Christchurch earthquakes. Previously it was not widely understood what liquefaction was, where it could occur or what its potential impacts were. There is now an increased general awareness of the risk and, as the focus moves from Christchurch to practice in other regions; national guidance or legislation is on its way. The Waikato and Bay of Plenty region has areas of recognised liquefaction risk. However locally, liquefaction assessment is not always carried out or even recognised as necessary. In light of this, it was felt that a local round table type discussion was due to widen the understanding of local liquefaction risk and assessment. Rolando Orense of the University of Auckland kindly attended and gave a lightening quick tour through liquefaction assessment, lessons from Christchurch and



**Kori Lentfer**

Waikato Branch Coordinator  
Coffey Geotechnics (NZ) Ltd

Work: 07 571 6081

Email: kori\_lentfer@coffey.com

*Kori took over the role of joint Waikato/Bay of Plenty Branch Co-ordinator in June 2009.*

*Kori is a consulting Engineering Geologist who works for Coffey Geotechnics. He graduated in 1998 with a BSc(Tech) in Geology, followed by Masters study at Waikato University and an MSc thesis in Engineering Geology from Auckland University in 2007. Kori has worked for consultants based in the UK, Europe and the Middle East. On return to the homeland he joined Foundation Engineering in Orewa, which was acquired by Coffey Geotechnics in 2007. In April 2008 Kori transferred to the Tauranga office for the lifestyle and diverse geotechnical challenges.*



**Andrew Holland**

Waikato Branch Coordinator

Principal Geotechnical Engineer

– Ground Engineering & Sciences

Work: 07 834 8991

Email: Andrew.Holland@aecom.com

*Andrew is a Principal Geotechnical Engineer at AECOM. He studied engineering at the University of Auckland, graduating in 2002. Since then, Andrew has worked in geotechnical consultancy in New Zealand and England and has worked on projects around the world including in London, Morocco and Saudi Arabia.*

*Andrew's experience includes geotechnical investigation, assessment and design for infrastructure, buildings and development. Andrew is a Chartered Professional Engineer (CPEng) and is the geotechnical team leader in AECOM's Hamilton office.*

some interesting research from local Waikato soils. Andrew Holland of AECOM then followed with a few examples of assessments of Waikato sites that showed liquefaction risk. A good discussion followed which highlighted the variation in liquefaction practice in the local industry, the differences in requirements from local authorities and gave some good information on sources of information and guidance.

Planning is underway on several technical presentation topics for the Waikato Branch and there is also hoped to be follow on events from Rolly Orense's great presentation to keep everyone up to date with local and national practice in liquefaction assessment, as lessons from Christchurch are disseminated and as regulatory bodies begin to roll out requirements and standards of assessment for development.

## Wellington Branch Activity Report

THE WELLINGTON BRANCH activities are organised by a committee of people from local organisations. This has undergone significant change in the last few months; previously the committee consisted of 7 people, 6 of whom have stood aside to let new people take over in organising the local activities. The new-look branch committee consists of Doug Mason, David Molnar and Andy Hope, and we'd like to take the opportunity to acknowledge all the hard work that the previous committee members put in, particularly David Stewart and Beverley Curley.

### Meetings Held:

The Wellington branch hasn't run any meetings in the first part of 2013, due to the changeover in the organising committee.

The New Zealand Society for Earthquake Engineering held its annual conference in Wellington at the end of April. The conference was advertised with the banner "Same risks – new realities", with the theme of better understanding and communicating earthquake risk, bringing the lessons of the Canterbury and other recent earthquakes into current engineering practice.

### Upcoming Activities:

**2 October:** Performance based design in geotechnical engineering (Rankine Lecture), by Prof. Malcolm Bolton. Venue tbc.

A programme of potential meetings/events is currently being worked through by the committee, so please bear with us while we finalise this. If you have any suggestions please contact one of the committee members.



**Andy Hope**  
Wellington Branch Coordinator  
Tonkin and Taylor Ltd  
Work: 04 381 8560  
Email: ARHope@tonkin.co.nz

*He joined the Wellington office following completion of a bachelor degree in civil engineering at the University of Canterbury and has since been involved in a wide range of projects in both the North and South Island. Andy's particular areas of interest include the analysis and design for complex engineering problems, with a particular interest in numerical modelling.*



**Doug Mason**  
Wellington Branch Coordinator  
Opus  
Work: 04 471 7017  
Email: Doug.Mason@opus.co.nz

*Doug is an engineering geologist and team leader with Opus in Wellington. Doug completed bachelor degrees in geology and history and an MSc (Hons) in geology at Victoria University, carrying out an EQC-sponsored research project into active faulting in Marlborough. He worked for GNS prior to joining Opus in 2004, and has been involved in geotechnical investigations and assessment of hazards and risks for infrastructure and land development projects around central New Zealand. He moved to the UK in 2007 and spent 3 years working on geotechnical and geoenvironmental projects around Wales and southwest England, before returning to Wellington a month before the 2011 Christchurch Earthquake. Doug's particular interests include geomorphology, rock slope stability, and earthquake and landslide hazards.*



**David Molnar**  
Wellington Branch Coordinator  
Aurecon  
Work: 04 439 0311  
Email: david.molnar@aurecongroup.com

*David is an engineering geologist at Aurecon Wellington. He has 5 years of geotechnical experience following graduating at Victoria University in Wellington.*

*During his professional career he has been involved in a wide range of projects throughout New Zealand, notably including the NZTA SH16 Causeway Upgrade Project and SH2 Muldoon's Corner Improvements, also KiwiRail's North to South Junction which won the 2012 Railway Technical Society of Australia (RTSA) Biennial Railway Project Award.*

*His areas of specialisation include carrying out geological hazard assessments and site investigations, retaining wall design, construction observation and contract management (NZS 3910).*

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## Canterbury Branch Activity Report

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THE CHRISTCHURCH BRANCH has enjoyed a slightly quieter period over the first few months of 2013, following on from a very busy last couple of years. A well-attended presentation (standing room only) was provided by Ian McCahon on 5th March. Ian provided some thought provoking personal observations and opinions on the geotechnical aspects of the Canterbury Earthquakes. This meeting was held directly after the NZGS AGM, which followed the Management Committee meeting held earlier in the day. Gavin presented flowers to Joyce Searle, who stood down as a Canterbury Branch Co-ordinator after several years of service. Such was Joyce's commitment that she was roped in to organise tables for the food at the last minute.

Looking into the future, we have a number of irons in the fire. We may hold information seminars and meetings on different ground investigation techniques in use in Christchurch, along with a session to provide some insight into some of the observations of those members that have been working on the Port Hills, since the earthquakes occurred.

We will keep you informed of upcoming events. Please don't hesitate to contact us if you have an idea regarding a possible topic/presenter.

*Shamus and Ed.*



**Edwyn Ladley**  
Canterbury Branch Coordinator  
Riley Consultants Ltd  
Work: 027 704 8565  
Email: eladley@riley.co.nz

*Edwyn is an engineering geologist with 11 years geotechnical experience in New Zealand, United Kingdom, Caribbean, Algeria and Bulgaria, with skills in the following areas:*

*Geotechnical investigations for civil engineering works (dams, roads, land development, buildings, landfills etc); Geological hazard assessments for major projects; Engineering geological mapping and aerial photo interpretation; Assessment of risks associated with natural hazards; Groundwater investigations; Peer review and expert witness.*

*Edwyn's has developed expertise in feasibility studies and geotechnical investigations for infrastructure projects, ranging from dams and reservoirs to roads, wind power developments, buildings, and land stability assessments.*



**Shamus Wallace**  
Canterbury Branch Coordinator  
Tonkin & Taylor Ltd  
Work: 021 512 041  
Email: SWallace@tonkin.co.nz

*Shamus is an Engineering Geologist who works for Tonkin & Taylor in Christchurch. Passionate about maps and landforms from an early age, Shamus graduated from Canterbury with a BSc Honours in Eng Geol in 2002 and has worked on a variety of geotechnical projects throughout New Zealand, as well as working in London, and travelling around the world, before repatriating to Christchurch. Faced with the aftermath of the 2010/11 Canterbury earthquakes, Shamus has been intricately involved with the land damage assessment team, working for EQC, and looks forward to helping Christchurch emerge from the rubble.*

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## Nelson Branch Activity Report

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HAVING BEEN BROUGHT up in the Nelson and worked here for the majority of my career, I am proud to call our little sunshine haven home. I am keen to kick start local activities like field trips, evening presentations and local knowledge sharing. Hopefully we can build on the connectivity from the December 2011 storm event where most of us got to know each other well.

In the coming month I will send out an invite to the Nelson NZGS members for the first of this year's gatherings.

If you have any ideas please contact me on [grant.j.maxwell@mwhglobal.com](mailto:grant.j.maxwell@mwhglobal.com)



**Grant Maxwell**

Nelson Branch Coordinator  
Asia Pacific Geotechnical Discipline  
Leader, MWH Global  
Work: 03 546 0576  
Email: [grant.j.maxwell@mwhglobal.com](mailto:grant.j.maxwell@mwhglobal.com)

*David's current role involves setting strategy and managing technical development for the geotechnical team across the Asia Pacific region. He is also acting as the manager for the New Zealand Structural team (a fair amount of 'acting' from a geotech!). He has 15 years experience working across NZ, Australia, Pacific nations and the UK on a variety of projects.*

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## Otago Branch Activity Report

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NO ACTIVITY TO report from the Otago Branch. An email invitation sent out to members in mid-February, inviting proposals for talk(s) to provide impetus for branch meeting(s), elicited no replies. As it seems highly unlikely that nothing of interest is happening in Otago, presumably everyone is thoroughly snowed under with interesting work. As soon as they get a chance, members are most welcome to send in offers to present short talk(s), there is currently an infinite number of slots available.



**David Barrell**

Otago Branch Coordinator  
GNS  
Work: 03 479 9687  
Email: [d.barrell@gns.cri.nz](mailto:d.barrell@gns.cri.nz)

*David is a geologist and geomorphologist at GNS Science in Dunedin. South Island born and bred, David's early professional experience included work as a coal geologist in Buller, and as an engineering geologist on the Clyde Power Project. Since joining GNS Science in 1993, he has specialised in Quaternary geology, landform evolution and landscape processes. David very much enjoys the mix of scientific research and applied geoscience that his work entails. He contributes extensively to regional geological and geomorphological mapping, as well as to a range of other disciplines including earthquake geology, groundwater geology, and engineering geology.*

# NZGS 2013 STUDENT PRESENTATION AWARDS POSTER COMPETITION

## INVITATION TO PARTICIPATE

The New Zealand Geotechnical Society wishes to recognise and encourage student participation in the fields of rock mechanics, soil mechanics, geotechnical engineering and engineering geology.

The 2013 Student Presentation Awards will be a Poster Competition and is open to all students.

Posters will be displayed and awarded at the NZGS Symposium in November.

## REGISTRATION CRITERIA

- Applicants must be enrolled as a student at an appropriate University/Institution
- The topic of the poster should be relevant to geotechnical engineering or engineering geology
- There should be one registration form per poster and one co-author is allowed per submission
- The abstract must be no longer than 300 words
- Submission of the abstract should be made on the registration form or an attached Microsoft Word or pdf document
- One figure/image may be included with the abstract but it must have a caption and be referred to in the abstract

Registration forms will be available online and from the NZGS Secretary at [secretary@nzgs.org](mailto:secretary@nzgs.org) in June and are to be submitted by

**Friday 30 August 2013**

## POSTER CRITERIA

- Standard A1 size.
- Should be submitted in Microsoft Powerpoint or pdf format.

Completed posters should be submitted to the NZGS Secretary via email at [secretary@nzgs.org](mailto:secretary@nzgs.org) by

**Friday 15 November 2013**

## JUDGING

- Judging will be conducted for all entries across the country
- A panel of three judges will be formed to make the final decision
- Posters will be displayed at the NZGS Symposium in Queenstown from 21 to 22 November
- Attendees of the NZGS Symposium will be able to vote for their top 3 posters for the judging panel to consider (applicants cannot vote)
- The awards will be presented at the NZGS Symposium

## PRIZE MONEY

- \$1000 first
- \$500 second
- \$300 third
- The top posters will be displayed in the June 2014 issue of the Geomechanics Bulletin.

## Judging will be based on the following criteria:

- Quality and clarity of the abstract
- Academic content – appropriate introduction, sound methodology, clear results and conclusion
- Poster layout – appropriate use of figures, clear and coherent text, structure and creativity
- Overall poster appeal – concepts are easy to understand, poster engages the viewer and the quality of presentation

For further information or to join the Society (membership is free for students) please visit our website [www.nzgs.org](http://www.nzgs.org) or contact the Society Management Secretary at [secretary@nzgs.org](mailto:secretary@nzgs.org)

## STANDARDS, LAW AND INDUSTRY NEWS

### NZGS Young Geotechnical Professionals

THE YOUNG GEOTECHNICAL PROFESSIONALS (YGP) group has been formed to represent, support and provide a voice for the young professionals in the NZ Geotechnical Society. We represent a lively, increasingly influential and rapidly growing section of Geotechnical Engineers and Engineering Geologists nationwide. Through a social culture of innovation, integrity, networking and the pursuit of excellence, we anticipate facilitating in the professional and personal development of the young professionals.

#### Latest Activities:

##### Student Awards

The New Zealand Geotechnical Society Student Awards are presented to recognise and encourage student participation in the fields of geotechnical engineering and engineering geology. As reported in the December 2012 NZ Geomechanics News, last year it was decided to run a poster competition in an effort to increase participation. A summary of the poster competition and end of year event, where the posters were displayed across the three student centres of Auckland, Waikato, and Canterbury, is given in this issue of the Geomechanics News.

Congratulations to all of the students who participated in the event and especially those that won prizes. The quality of the posters was outstanding. Also, a big thank you is given to all of those members who encouraged students to participate in the event. In particular I would like to thank Dr. Vicky Moon at the University of Waikato for encouraging 10 of her students to get involved.

Please visit the website to see updated text regarding the student awards as it is planned to continue the poster competition into the future - <http://nzgs.org/awards/new-zealand-geotechnical-society-student-awards.htm>

##### YGP Liaison Group

In 2013 a YGP Liaison Group has started to be formed. The idea of the Liaison Group is to gather a group of young professionals from different centres around the country and from different companies to share ideas about what YGP and NZGS can do for young members and to organise events in different locations. Frances Neeson and Kelly Walker from Opus in Christchurch form the start of this group and have agreed to help organise YGP themed events at the NZGS Symposium this year. Frances has been attending the symposium committee meetings and has begun implementing a few ideas, as discussed in the next section. Thank you very much to Frances and Kelly for agreeing to be involved and all the hard work they have already put in.

If anyone else from other centres would like to get involved in this Liaison Group please get in touch.

#### YGP Events at the NZGS Symposium

Discussion and collaboration has begun with the NZGS Symposium organising committee about having YGP events at the symposium in November. The committee has indicated that best student paper and poster awards have already been discussed. It is intended to hold the 2013 NZGS Student Awards Poster Competition at the symposium and have the awards announced there. This will be finalised before the call for abstracts for the Student Awards and details given out to students at that stage.

Frances Neeson has been attending the symposium committee meetings in Christchurch on behalf of YGP and had a great idea to have a distinguished Geotechnical Engineering/Engineering Geology professional/s give a YGP themed presentation at the symposium. This presentation would focus on technical and career tips for young professionals. Details for this are in the process of being finalised and a big thank you goes to Frances for her hard work in organising this and being involved in the committee.

Other ideas, such as a YGP social event, are also being discussed and if anyone has any thoughts please get in touch.

#### Upcoming Activities and Ideas:

- Promotion of the NZGS at Universities;
- 2013 Student Award Poster Competition;
- Expansion of the YGP liaison group of interested young professionals throughout the country;
- Liaison with other young professional groups such as Engenerate - the IPENZ young professionals group;
- Part time work opportunities for students on the NZGS website;
- AYGP forum on the NZGS website with involvement from senior members;
- Social media groups;
- Social events - quiz night, rock climbing.

#### Reported by: Luke Storie

YGP Representative

Email: [luke.storie@gmail.com](mailto:luke.storie@gmail.com)

## Academic News – Canterbury University Update

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### Current ME and PhD Research Underway at the University of Canterbury,

**Catherine Tatarniuk** (PhD started March 2010): *Deep Soil Mixing as Slope Stabilization Technique in Northland Allochthon Residual Clay Soil*. This study involves the investigation into the influence of soil structure on the properties of Northland Allochthon residual clay soil, and the behaviour of Deep Soil Mixed (DSM) columns as used for road slip repair in this problematic soil type. Numerical modelling has been used to examine the effects of soil property changes that occur in the soil surrounding DSM columns, as well as soil arching and the group behaviour of the columns. Three dimensional numerical modelling is being used to examine how the columns can be modelled effectively in two dimensions.

**Muhamad Yusa** (PhD started June 2010): *Ageing and Creep of Silty Sand*. A number of field and lab evidence suggest that mechanical properties of freshly disturbed or deposited sand containing fines (e.g. silty sand) are time-dependent. This study aims to investigate the effects of creep induced ageing to macro-mechanical properties (e.g. stiffness and strength) of silty sand utilizing advanced triaxial testing with local LVDT measurements. Micro structural changes are examined using advanced image analysis to understand ageing mechanism of silty sands.

**Kelly Robinson** (PhD started July 2010): *Liquefaction-induced lateral spreading in Christchurch urban areas during the 2010 Darfield/2011 Christchurch Earthquakes*. The lateral spreading triggered by the extensive liquefaction in the 2010-2011 earthquakes caused significant damage to structures and lifelines in proximity to the streams and rivers throughout Christchurch and surrounding suburbs. Current methods used in practice for predicting such failures are limited. This project aims to document the lateral spreading that occurred during the 2010/2011 events (at over 100 locations), characterize the site and seismic demand conditions in the areas investigated, and analyse the results in order to provide a better understanding of the observed displacements and to improve the ability to model/predict lateral spreading.

**Anna Winkley** (ME started February 2011): *Impacts of liquefaction and lateral spreading on bridge pile foundations in the February 22nd Earthquake*. The purpose of this research is to document and analyse the performance of several case study bridges with pile foundations in the February 2011 (Christchurch) earthquake. In particular, typical modes of bridge/pile deformation associated with liquefaction and lateral spreading are identified. Pseudo-static analyses including parametric variations are carried out on two of the bridges in order to assess the relevance of pseudo-static analysis as a simplified seismic modelling tool.

**Kelvin Loh** (ME started February 2011): *Seismic performance and progressive failure mechanism of geosynthetic reinforced soil walls*. This project involves shake table tests on scaled-down models of geosynthetic reinforced soil walls. The study investigates the effects of reinforcement configuration, backfill densities and backfill surcharge on key parameters of the seismic response such as wall displacement, development of shear strain localization, reinforcement loads and acceleration amplification. The results will provide an in-depth understanding of the deformation characteristics of GRS walls, and insights for the seismic design of reinforced soil walls.

#### Reported by: Misko Cubrinovski

Department of Civil and Natural Resources Engineering  
University of Canterbury

Email: misko.cubrinovski@canterbury.ac.nz



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## NZGS response to MBIE – Building Seismic Performance

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### **BUILDING SEISMIC PERFORMANCE**

#### **SUBMISSION TO THE MINISTRY OF BUSINESS, INNOVATION AND EMPLOYMENT**

**8 MARCH 2013**

##### **Executive Summary**

The New Zealand Geotechnical Society (NZGS) represents over 950 geotechnical professionals. We consider that improving society's understanding of earthquake risk is critical. Desktop methods are commonly used in geotechnical engineering, and the NZGS considers that such methods would allow a rapid assessment of NZ's building stock provided that a rigorous risk assessment process is used. Geotechnical engineers should be involved in any assessment of the seismic capacity of buildings, working alongside our structural engineer colleagues as part of a multi-disciplinary team.

The NZGS is concerned that the existing EPB system does not consider geological hazards such as fault rupture, liquefaction and rockfall, all of which have the potential to damage or destroy buildings. It is also concerned that other geotechnical engineering aspects of earthquake risk may not be considered, for example foundation performance. NZGS considers the existing system to be too narrow and limited. Furthermore, the advice of geotechnical engineers on basic items such as site subsoil class is not always sought in the assessment of earthquake-prone buildings. A multi-disciplinary approach is, in our view, essential.

##### **Introduction**

The New Zealand Geotechnical Society (NZGS) is the affiliated organisation in New Zealand of the International Societies representing practitioners in Soil Mechanics (ISSMGE), Rock Mechanics (ISRM) and Engineering Geology (IAEG). The NZGS is also affiliated to the Institution of Professional Engineers NZ (IPENZ) as one of its Collaborating Technical Societies and currently has over 950 members.

The aims of the Society are:

1. To advance the education and application of soil mechanics, rock mechanics and engineering geology among engineers and scientists
2. To advance the practice and application of these disciplines in engineering
3. To implement the statutes of the respective International Societies in so far as they are applicable in New Zealand



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4. To ensure that the learning achieved through the above objectives is passed on to the public as is appropriate

The NZGS is very interested in earthquake hazards and the risk they pose to society, and in the performance of the ground and of structures that may be affected by it. The NZGS considers the Earthquake Prone Building (EPB) legislation a very important part of managing earthquake risk to society. In addition to preparing its own submission, the NZGS has contributed to and supports the submission made by IPENZ.

The NZGS believes that the EPB system needs to consider a broader context of earthquake risk. Whilst the Building Act, Building Code, national standards, and guidelines exist to control the design and construction of new buildings, the NZGS considers that the evaluation process for existing buildings is too narrow. We consider that the proposed EPB system should be broader and follow a clearly defined risk process.

Risk is a well understood concept in engineering. Risk is simply the product of the probability and consequences of an event. However, it is sometimes poorly understood by the general public and affected lay people such as building owners and occupiers. The NZGS believes that if the risk assessment process is clearly defined and described, then any interested party will be able to understand the risk posed to or by a particular building in an earthquake. There are established risk assessment processes already in use in engineering, for example in the safety of large dams, assessment of land instability and assessment methods used in complex engineering facilities.

Life safety is a fundamental principle to engineering and underpins the Building Act. Life safety must be the most important aspect of the EPB system. The NZGS believes there needs to be a minimum level of expected earthquake performance to protect life safety. There may be benefit in having a debate about what this minimum level should be, however, the existing minimum level is well established and based on sound engineering and scientific theory. It is also comparable to tolerable levels internationally.

The NZGS is concerned that earthquake risk is poorly understood. The risk posed by large earthquakes is low probability and high consequence. This means that they are rare but have the potential to cause many fatalities. Comparison to risks such as driving is, perhaps, unhelpful, as this is a higher risk tolerated by society. More useful comparison could be made to acceptance of risk associated with travel by bus or plane, or from fire or other natural hazards such as flooding.

Earthquake life safety risk is borne by the occupants of the building. Often, this is not the owner of the structure or the business. Therefore, the economic benefits are gained by those who are not exposed



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to the risk. It is necessary and assumed by society that adequate protection is provided by the engineering profession and the wider regulatory framework. Discussion of aspects such as cost and heritage, whilst important, may dilute or confuse the main issue.

As part of the EPB system, geological hazards need to be considered in conjunction with structural performance. Geological hazards include rockfall, liquefaction, and ground rupture. These can cause damage to buildings and result in fatalities. All of these geological hazards were significant in the Christchurch earthquakes. NZGS notes that the Royal Commission did not cover the rockfall hazard to buildings.

### **Definition and Approach**

An earthquake prone building should be defined as a building at high risk of catastrophic failure during a ULS earthquake likely to result in loss of life. NZGS considers that “%NBS” and “moderate earthquake” definitions lack basis in seismology or earthquake engineering principles.

Earthquake life safety risk needs to be evaluated using several factors, not just %NBS. Factors including seismicity; importance and use of building; structure type susceptibility and lack of redundancy/resilience; and pounding or impact from adjacent structures are more appropriately discussed by our structural and earthquake engineering colleagues at SESOC and the NZSEE. These aspects are addressed to varying degrees in the current EPB procedure.

Geological hazards (rockfall, liquefaction, and ground rupture) and severe foundation displacement resulting from liquefaction and ground rupture are not addressed in any way. The NZGS is concerned that the current and proposed processes do not account for these factors and that the assessment may miss potential hazards that may lead to collapse of all or part of a structure and loss of life in an earthquake. Furthermore, many current EPB assessments are based on a cursory assessment of the site subsoil category, which is a critical input into the size of the earthquake loads determined for a structure, and often the subsoil category is assessed by an engineer not experienced in geotechnical engineering. We consider it essential that EPB assessments, in whatever form they are undertaken, are made with input from a suitably experienced geotechnical engineer.

It is also important to note that the onset of liquefaction can result in a marked change in the response of a building, and in its risk of collapse. This step-change in performance may occur beneath or above any arbitrary %NBS or %ULS threshold, and in liquefaction susceptible areas needs to be assessed as part of any EPB process.

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Drill Force would like to take this opportunity to thank its clients and suppliers who have supported them over the past 5 years and welcome all to visit us at our new Auckland Office, Warehouse and Maintenance Facility which is a purpose built complex at 9 Rawson Way, Takanini, South Auckland.

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- Municipal supply
- De-watering

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### **Exploration**

- Wire line coring (BQ to PQ)
- Formation testing
- Instrumentation installation
- De watering wells
- Coal Exploration
- Coal Quality

#### **Bruce Mc Keown**

Director

Email: [bruce@drillforce.co.nz](mailto:bruce@drillforce.co.nz)

Office: +64 9 267 9100

Fax: +64 9 267 8100

Mob: +64 21 274 2404

#### **Zane Brown**

Director

Email: [zane@drillforce.co.nz](mailto:zane@drillforce.co.nz)

Office: +64 9 267 9100

Fax: +64 9 267 8100

Mob: +64 21 842 475



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The NZGS also considers that reference to particular building types or locations may miss some readily identifiable high risk buildings. For example, a wooden school building at the base of a high cliff with potential for rockfall is likely to have an unacceptable earthquake risk in the same way an unreinforced masonry (URM) building may have an unacceptable earthquake risk.

Our responses to the specific questions posed in the MBIE document are as follows:

1. Should local authorities be required to assess the seismic capacity of all buildings covered by the earthquake-prone building system in their areas, and to issue seismic capacity rating to owners?  
*Yes. The NZGS considers that improving the understanding of earthquake risk is critical. Desktop methods are commonly used in geotechnical engineering. We consider that such methods would allow a rapid assessment of NZ's building stock provided that a rigorous risk assessment process is used. Geotechnical engineers should be involved in any assessment of the seismic capacity of buildings. Furthermore, it is not clear that local authorities have the capacity to undertake such an assessment. A more timely and consistent assessment may result from a more centralised approach, utilising an experienced team.*
2. Do you think five years is a reasonable and practical time to require local authorities to carry out assessments in their districts?  
*Yes in part. The NZGS considers that it would be feasible to complete an initial risk assessment which would identify the high risk buildings. Following completion of this stage, there would sufficient data to allow a programme for detailed assessment to be prepared. Lower risk buildings should not be a priority to complete within the 5 year period.*
3. Should unreinforced masonry buildings be assessed faster than other buildings?  
*Possibly. Priority should be based on risk assessed including several factors (occupancy, seismology, structure type, geological hazard etc.). If URM buildings are likely to be high risk irrespective of the other factors, then they should be assessed as a priority.*
4. What costs and other implications do you see with these proposals to assess the seismic capacity of buildings?  
*No comment.*
5. Do you agree that local authorities should be required to enter information on the seismic capacity of buildings into a publicly accessible, central register to be managed by MBIE?  
*The NZGS supports the publication of risk information. Similar information is already available (for example flood risk). We note the recent development of databases in Christchurch for a wide range of data types. The NZGS believes that it is vital that people exposed to a risk be allowed to know what the risk is.*



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6. Should information other than a building's seismic capacity rating be entered into the register – for example, agreed strengthening actions or information from an agreed building ratings system?  
*The information should summarise the factors used in the risk assessment. Geological hazards, for example, should be presented.*
7. Rather than a central register, should local authorities be responsible for both collecting and publishing this information?  
*The NZGS considers that a centrally held register should be maintained, to allow fast and easy access to the public and to emergency agencies in the event of an earthquake or other natural disaster.*
8. Should there be any other information disclosure requirements – for example, should building owners be legally required to display information on the building itself about the building's seismic capacity?  
*The NZGS supports the disclosure of risk information.*
9. What costs and other implications do you see resulting from the proposal to put seismic capacity information in a register?  
*Hosting a database of risk information should be a relatively small cost. Some of the information may be contentious and will have commercial implications, which may lead to disputes.*
10. Does the current earthquake-prone building threshold (33 per cent of the requirement for new buildings) strike a reasonable balance between protecting people from harm and the costs of upgrading or removing the estimated 15,000-25,000 buildings likely to be below this line?  
*NZGS is concerned that the 33% NBS threshold is obscure and poorly understood. A risk rating would be preferable. The risk assessment needs to include more factors than just the above ground part of the building (such as building importance, occupancy, seismicity, geological hazards, foundation performance, pounding). The minimum tolerable risk requires further debate. Furthermore, in some cases (eg liquefaction), a step change in site and hence building performance can occur, and this may be missed by an arbitrary % value.*
11. Should the requirement for earthquake-prone buildings to be strengthened or demolished take precedence over all other legal, regulatory and planning requirements, such as those designed to protect buildings of heritage or local character?  
*The NZGS does not have a view.*
12. Should the local authorities have the power to require higher levels of strengthening than the earthquake-prone building threshold, or strengthening within shorter timeframes than the legally defined period?  
*The NZGS does not have a view.*



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13. Should certain features of unreinforced masonry buildings, such as chimneys and parapets, be required to be strengthened to a higher level?  
*If such building elements are more vulnerable, a risk assessment would highlight their higher risk.*
14. Is it reasonable and practical for owners of earthquake-prone buildings to meet the following timeframes:
- 12 months to submit plans for either strengthening or demolishing the building?
  - 10 years from the date of the seismic capacity rating to strengthen or demolish?
- The NZGS consider that the timeframes should be based on the level of risk. The higher the risk, the faster it should be upgraded.*
15. What additional powers would local authorities require to enforce the proposed requirements?  
*The NZGS does not have a view.*
16. Should local authorities be able to require faster action on buildings of strategic importance, such as those:
- located on transport routes identified as critical in an emergency
  - with important public, social and economic functions, such as schools and police stations
  - with post-earthquake recovery functions, such as civil defence centres and hospitals.
- A rigorous risk assessment process would identify such buildings as higher risk due to their higher consequences.*
17. Should all unreinforced masonry buildings require strengthening more quickly than other earthquake-prone buildings?  
*Not necessarily. Priority should be established based on risk.*
18. Should the owners of certain specified types of earthquake-prone buildings be able to apply to local authorities for exemptions or time extensions to the requirement to strengthen or demolish?  
*Possibly, however, this should be established based on risk.*
19. If yes, what are your views on the following possible criteria:
- the building is used only by the owner, or by persons directly employed by the owner, on an occasional or infrequent basis
  - the building is used only occasionally (less than eight hours per week), and by less than 50 people at any one time
- AND in each circumstance above
- all users are notified that the building is likely to collapse in a moderate earthquake
  - the building is not a dwelling
  - the building is not a school or hospital and does not have a post-disaster recovery function

# GROUND INVESTIGATION

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- there is no risk of the building partially or fully collapsing onto a public walkway, transport route or a neighbouring building or public amenity
- effective mitigation measures have been put in place to protect building users from the risk of collapse in a moderate earthquake?

*These factors should be included in the risk assessment process. Note that some are already considered in legislation and design standards.*

20. Are the advice, information and education activities proposed for central and local government agencies sufficient to help ensure effective implementation of the new earthquake-prone building system?

*Yes, provided the risk assessment process is sufficiently broad and includes geological hazards.*

21. Are current requirements to upgrade buildings to “as nearly as reasonably practicable” to Building Code fire and disabled access requirements a disincentive or barrier to owners planning to earthquake-strengthen existing buildings?

*The NZGS does not have a view.*

22. Should local authorities be able to grant building consents for earthquake strengthening without triggering the requirement to upgrade the building towards Building Code fire escape and disabled access and facilities requirements?

*The NZGS does not have a view.*

23. Should any change apply to both fire escape and disabled access and facilities requirements, or to disabled access and facilities requirements only, ie, retain the current fire escape upgrade requirements?

*The NZGS does not have a view.*

24. What would the costs and other implications of de-linking earthquake strengthening from current Building Code fire and disabled access requirements?

*The NZGS does not have a view.*

25. When considering listing heritage buildings on district plans, what factors should local authorities consider when balancing heritage values with safety concerns?

*The NZGS does not have a view.*

26. What assistance or guidance will be required for owners, local authorities and communities to make informed decisions on strengthening heritage buildings in their districts?

*The NZGS does not have a view.*

27. What barriers deter heritage building owners from strengthening their buildings?

*The NZGS does not have a view.*



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28. Do heritage rules (for example, those in district plans) deter owners from strengthening heritage buildings?

*The NZGS does not have a view.*

29. What are the costs and benefits of setting consistent rules across the country for strengthening heritage buildings?

*The NZGS does not have a view.*

30. Should local authorities have the power, following consultation with their communities, to adopt and enforce policies to require specific hazardous elements on residential buildings to be dealt with within a specific timeframe?

*The NZGS considers that residential buildings should be evaluated following a similar risk assessment process to other buildings. Given the lower life safety risk posed by these buildings (except perhaps from falling chimneys and rockfall), their assessment is likely to be relatively straightforward.*

31. What would the proposed changes mean for you?

*The NZGS represents the geotechnical engineering and engineering geology professions. Many of its members are involved in the design of buildings and in risk assessment. To date, many EPB assessments have been carried out without adequate input from geotechnical engineers. Both the assessment of site subsoil class and consideration of external geotechnical hazards that may affect life safety are undertaken to widely varying levels.*

32. Are you aware of any problems with current policy and practice around earthquake-prone buildings, other than those identified in this document?

*The NZGS is concerned that the existing EPB system does not consider geological hazards such as ground rupture, liquefaction and rockfall. It also is concerned that other geotechnical engineering aspects of earthquake risk may not be considered, for example foundation performance. NZGS considers the existing system to be too narrow and limited. A multi-disciplinary approach is, in our view, essential.*

33. Do you agree with the following objectives for changes to the existing earthquake-prone buildings system:

- reduce the risk – to an acceptable level – of people dying and being injured in or by buildings that are likely to collapse in moderate to large earthquakes.
- ensure that building owners and users have access to good information on the strength of buildings they own and use, to help them make good decisions about building resilience and their use of the building.



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*Yes. However, the terms “likely to collapse” and “moderate to large earthquakes” lack definition in engineering practice. The second bullet correctly references building resilience, but should be expressed in risk terms rather than building strength.*

Please feel free to contact the undersigned if you require any clarification of this submission.

Yours faithfully

A handwritten signature in blue ink, appearing to read "Gavin Alexander".

Gavin Alexander  
Chair – Management Committee

Email: [gavin.alexander@beca.com](mailto:gavin.alexander@beca.com)

An advertisement for McMILLAN Drilling GROUP. On the left, a vertical yellow ruler is placed next to a soil sample, with the ruler showing measurements from 0 to 90. The text "McMILLAN Drilling GROUP" is prominently displayed in white on a dark blue background. Below the name, it states "We provide a comprehensive range of drilling, sampling &amp; testing" and lists services: geotechnical &amp; environmental, ground improvement solutions, foundation system design &amp; construction, and water well drilling, monitoring &amp; testing. Logos for the Institution of Professional Engineers and NZDF are shown. The website "www.drilling.co.nz" and address "120 High St, Southbridge, Ph 03 324 2571" are provided. On the right, a photograph shows two pieces of drilling equipment, one on a tracked base and one on a wheeled base, in an outdoor setting.

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## The Pike River Royal Commission Report: Lessons for the Geotechnical Profession

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ON THE 19TH November 2010 there was an explosion at the Pike River underground coal mine on the West Coast of the South Island. Twenty nine men underground died while two men in the stone drive managed to walk out of the drift. In the days following the first explosion further explosions occurred and an underground fire developed. The Royal Commission of Inquiry<sup>1</sup> was established in December 2010 to report on the causes of the tragedy and determine what should be done to prevent future occurrences.

The intentions of this review are to highlight some of the issues relevant to the geotechnical profession and discuss interactions with the geo-disciplines in relation to the findings of the commission.

The terms of reference for the Royal Commission were wide ranging including the cause of the explosion and loss of life, the practices at the mine in relation to compliance and safe working conditions, the search, rescue and recovery operation as well as the regulatory framework and Government agencies involved – formerly the Department of Labour (DoL) and the Ministry of Economic Development (MED), now both part of the Ministry of Business, Innovation and Employment (MBIE). The Royal Commission produced a final report consisting of two volumes; Volume 1 is an overview with Volume 2 containing the detailed information. Volume 2 is divided into two parts, the first part deals with what happened at Pike River while the second part looks at proposals for reform.

For background information, the Pike River Mine is located in the remote country 45km north-east of Greymouth. The coal seam lies mainly within the Paparoa National Park and to develop the surface infrastructure for the mine, a 7km road was constructed from the processing plant through Department of Conservation (DoC) estate to the mine site. It should be noted that the Pike River Mine is unconventional in that the access to the underground mine is via a 2.3km inclined stone drive, with the portal at the mine site and driven uphill to intercept the coal seam through the Hawera fault. The ventilation circuit is completed by a shaft excavated from surface in rugged terrain above the coal seam. The construction of the stone drive and ventilation shaft were challenging projects on their own and had strong geotechnical inputs. The mine was developed up-dip with panels set out to allow for hydro monitoring of coal with flumes taking the coal to pit bottom where it was pumped as a slurry down to the processing plant. The roadways were developed using ABM machines (continuous miners). The mine was in the early development phase with the first small hydro panel being extracted at the time of the explosion. A

further complication was that the main ventilation fan was situated underground close to the ventilation shaft. This is apparently, according to one expert witness, the only coal mine in the world where the main fan was underground. One of the factors influencing the decision to locate the fan underground rather than surface was the concern over environmental issues and permitting. Due to delays (mainly from geological factors such as faulting) and lack of finance, the mine was behind schedule and in urgent need of production to generate capital.

Geological consultants presented evidence to the commission that the level of exploration was insufficient to fully delineate the coal seam, particularly in an area close to major faults. They concluded that the mining company should have carried out more drilling before progressing to development. The initial reserve estimation was carried out by an Australian company and was more concerned with the volume, ash and sulphur content of the coal rather than the amount of displacement within the seam.

In investigating what happened at Pike River the Royal Commission reviewed the organisational factors, mine systems and likely cause of the first explosion. Under the organisational factors there are a number of issues which are of interest. The percentage of inexperienced personnel working underground (known as 'cleanskins' in the mining industry) was considered to be very high at Pike River, some 40-50% although this figure might be higher if the contractors were included.

Pike River set out to create and implement good training programmes for its novice workforce and induction training for new employees was considered to be comprehensive. However they struggled to maintain this due to under-resourcing and work pressures preventing the release of miners from their crews to attend follow-up training sessions.

The management of contractors was seen as a real area of concern. No one from Pike was responsible for their management. The quality of contractor induction was inadequate and in some cases non-existent. Also safety performance audits of contractors were required under the H&S management plans however these were not carried out. The Commissioners found these shortcomings to be unacceptable since the contract workers were exposed to the same hazards and should have received the same level of induction training as the miners.

In looking at the role of the Board of Directors, the Commission took the view that corporate governance encompasses setting the strategic direction of the company and appointing and monitoring capable management to achieve this. It is clear from this view that the directors must not only lead but also monitor management and

hold it to account. The Board of Pike was heavily focussed on meeting production targets and financing. Two independent reports in 2010, a comprehensive risk survey by the company's insurers and a review of legislative compliance conducted by a NZ mining consultancy, expressed concerns over safety issues. When questioned by the Royal Commission on these reports, the Chairman of the Board expressed the view, that health and safety were the responsibility of the health and safety manager, who was in charge of the corporate safety management plan, and the mine manager. He felt the Board did not need to be actively involved in these matters. His general attitude was that things were under control, unless told otherwise.

The Commission stance was that this approach is not in accordance with the good governance responsibilities and they made three recommendations:

- The statutory responsibilities of directors for health and safety in the workplace should be reviewed to better reflect their governance responsibilities.
- The health and safety regulator should issue an approved code of practice to guide directors on how good governance practices can be used to manage health and safety risks.
- Directors should rigorously review and monitor their organisation's compliance with health and safety law and best practice.

It is clear from these recommendations that directors of organisations which are involved in hazardous activities must be proactive in respect to Health and Safety.

Without access to the mine after the explosions and fire, the Royal Commission can only speculate on the cause of the first explosion. They put forward the most likely scenario that a plug of methane gas from a fall in the hydro panel flooded the roadways and was ignited. The source of the ignition is likely to be electrical as the pumping system had been turned off for maintenance and was switched on seconds before the explosion.

The Royal Commission reviewed the factors that contributed to the event with particular attention to the ventilation, location of main fan and gas monitoring. The decision to move the main fan from surface to underground in the stone drive, then with the relocation of the ventilation shaft, to pit bottom in coal was seen as a case of incremental decision making without completing a full risk assessment of the system at each stage and revisiting previous decisions. The commission concluded that the placement of the main fan underground was a major error, aggravated by the failure to adequately protect the fan motor against methane ingress.

There had been a number of incidents of roof falls within the hydro panel and potentially explosive levels of methane had been detected by gas monitors near the ventilation shaft. One on 30th October 2010 was significant, the fall damaged the hydro monitor and the wind blast knocked

over a stopping in a cross cut. The stopping prevents intake (fresh) air short-circuiting to the return airway. After this event there was no risk assessment of further roof falls and mining continued in the hydro panel, with methane spikes reporting to the gas monitors at the ventilation shaft.

Consultants had been commissioned by the mine to give advice on technical issues in the period before the first explosion. Ventilation was of particular importance and the ventilation consultant gave evidence to the Royal Commission. The mine employed a geotechnical engineer and used consultants to advise on such matters as strata control, caving and subsidence. The consultants were not called by the Commission to give evidence directly, however their reports are referred to by the commissioners to flag concern over the various issues addressed, such as potential for caving and methane release to mine air and wind blast from caving. The geotechnical factors along with many other issues which were related to health and safety deficiencies were well documented and recognised but not acted upon by the mine.

The Royal Commission's criticism of the Department of Labour (DoL) and Ministry of Economic Development (MED) precipitated the CEO of the new government organisation to commission a report<sup>2</sup> on the role played by both departments. This investigation found in respect to the DoL, that there was no individual culpability but systemic failures at an organisational level. They comment "the DoL's performance as a Health and Safety regulator was dysfunctional and ineffective."

On reflection it is difficult to see what more: individuals employed by the mine, contractors and consultants could do to change events when faced with:

- A Government agency tasked with regulating to the industry, which was woefully under-resourced and lacking in trained inspectors.
- A regulatory system which relied on self regulation and 'best practice' as opposed to the highly prescriptive approaches employed in NSW and Queensland.
- A mining company under extreme financial pressure to produce coal in challenging mining conditions.
- A workforce with a high management staff turnover and a large proportion of inexperienced miners.

As the Royal Commission notes this is not the first mining disaster in New Zealand and it is evident that lessons from past failures have not been heeded. The Commission proposed many reforms and an implementation plan has been set up under the MBIE with an expert reference group for support. In 2011 a High Hazards Unit was established to monitor and control the mining and petroleum sectors.

As a legacy to the 29 men who lost their lives at Pike River, the Industry must improve health and safety in the workplace. Everyone working in the industry in whatever

role should be proactive when it comes to health and safety. The Royal Commission report Volume 1 – Overview is a very concise document (about 40 pages) explaining the main factors around the disaster and recommendations. It is well worth taking a look at, albeit a sobering read.

As a footnote the mine PRC Ltd (in receivership) was found guilty of 9 health and safety failures on 17th April 2013 and is currently awaiting sentence, former Pike River CEO has denied 12 charges and has applied for the case to be heard in Wellington. VLI Drilling admitted 3 charges of health and safety failures and was fined \$46,800 in October 2012.

### References

- 1 Royal Commission on the Pike River Coal Mine Tragedy, Volumes 1 and 2, 2012
- 2 Shanks D. and Meares J. Pike River Tragedy, Report of the Independent Investigation to the Chief Executive of the Ministry of Business, Innovation and Employment, March, 2013, MBIE-MAKO-3983458

**Reported by: John St George**

Department of Civil and Environmental Engineering  
University of Auckland



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## Register of Professional Engineering Geologists (PEngGeol)

THE STATUTES OF the International Association for Engineering Geology and the Environment (IAEG, 1992) define Engineering Geology as “the science devoted to the investigation, study and solution of engineering and environmental problems which may arise as a result of the interaction between geology and the works and activities of man as well as to the prediction and development of measures for prevention or remediation of geological hazards.”

On 3 April 2013, the register for professional engineering geologists was established with the assessment of a small crowd of engineering geologists from around the country, each with well over 20 years’ experience in the field. This group has undertaken training to act as practice area assessors for applications received by IPENZ in engineering geology. The register recognizes the important benefits engineering geologists provide to the engineering profession. Already, some regulators are looking to use the PEngGeol quality mark as a benchmark of current competence.

Geotechnical practice encompasses the general fields of both geology and civil engineering. Specialisation within both disciplines has led to the recognition of “engineering geology” and “geotechnical engineering” as distinct fields of professional practice. The engineering geologist is responsible for predicting the nature of the ground, while the geotechnical engineer is responsible for analysing how it will respond to changes brought about by physical engineering works.

Engineering geologists and geotechnical engineers are not interchangeable, although their skill sets might overlap, as each has separate skills, functions and responsibilities. Only with close collaboration between the two can site conditions be adequately assessed to arrive at an economical and stable design.

Registrants on the Professional Engineering Geologist register are able to use the ‘PEngGeol’ postnominal. Guidelines for Professional Engineering Geologists can be found at [www.ipenz.org.nz/IPENZ/finding/PEngGeol/](http://www.ipenz.org.nz/IPENZ/finding/PEngGeol/).

The need for a register of Engineering Geologists in New Zealand was recognised at the enquiry into the Abbotsford landslide that occurred in 1979 – its establishment, albeit some 34 years later, is cause for celebration!

**Reported by: Ann Williams**  
NZGS PEngGeol working group



**Above:** Assessment of the first small crowd of engineering geologists for PEngGeol. Left to right: Debbie Fellows, Ann Williams, Warwick Prebble, David Burns, Bernard Hegan, John Underhill, Doug Johnson, Dick Beetham, David Bell, Stuart Reed, Don MacFarlane, Geoff Farquhar (some 375 years' experience in engineering geology)



**Above:** Assessor training: Warwick Prebble, Don McFarlane and David Burns



**Above:** Celebrating the birthday of PEngGeol



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## NZGS linkedin networking

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### What is LinkedIn for NZGS?

LinkedIn is a business-related social networking site. Founded in December 2002 and launched in May 2003, it is mainly used for professional networking. As of 9 February 2012, LinkedIn reports more than 150 million registered users in more than 200 countries and territories. The site is available in English, French, German, Italian, Portuguese, Spanish, Swedish, Romanian, Russian, Turkish, Japanese, Czech and Polish. [ref: <http://en.wikipedia.org/wiki/LinkedIn> ]

### What does it cost to join?

It can cost nothing for a Basic membership, but if you want to, you can 'upgrade' for more features & benefits. We won't promote those here, but rather, let you find your way to the upgrade options later if they interest you.

### How safe are my personal and professional details?

You'll always have control over how much information other LinkedIn members can see about you when you've viewed their profile.

### Why should I join?

For the purposes of Professional Networking, which can provide you with an ongoing flow of Continual Professional Development, usually in the form of clever insights shared in technical discussions, job opportunities, and updates of new innovations.

### Does NZGS have a page?

Yes, NZGS recently sanctioned the creation of its own group, which can be found with the following LinkedIn tag:

NZGS - New Zealand Geotechnical Society

### What types of topics will I see?

We hope there will be a wide range of topics with a local interest. But more importantly, if there is NOT a geotechnical topic of interest to you, you can freely start a discussion, or seek advice from the on-line community. For a more precise taste, why not explore some of the links given below. Here is a current discussion that might light a fire in the belly of any respectable geotechnical engineer:

Why is so difficult to find a Geotechnical Engineer who can tell you what is the solution?

[http://www.linkedin.com/groupItem?view=&gid=142423&type=member&item=112884214&qid=564589c1-67d5-4891-9152-b477254bd349&trk=group\\_most\\_popular-0-b-ttl&goback=%2Egmp\\_142423](http://www.linkedin.com/groupItem?view=&gid=142423&type=member&item=112884214&qid=564589c1-67d5-4891-9152-b477254bd349&trk=group_most_popular-0-b-ttl&goback=%2Egmp_142423)

### What sort of other groups are on LinkedIn?

LinkedIn offers a multitude of Groups and sub-groups, focused on a multitude of subjects, and often, many of those are very similar. For example, here is an incomplete sample of the many geotechnical orientated groups:

- Geotechnical Engineering Experts
- Geotechnical Engineer
- ASCE: Geotechnical Engineering
- CETANZ - Civil Engineering Testing Association of New Zealand
- Civil Engineering & Land Development Professionals
- CPT Cone Penetration Testing
- Earthquake Engineering and Soil Liquefaction
- Geotechnical Data Hub
- Seismic Cone Penetration Testing (SCPT)
- Geotechnical Designers
- Geotechnique Letters
- International Society for Geotechnical Engineers

### Can I be a LinkedIn tourist? (Watch but not participate)

You sure can, but you won't be able to participate without firstly joining LinkedIn, and then joining the Group hosting the discussion

### Are projects discussed?

Most projects that get discussed, are referred to only in general terms, without specific details being given. Any responsible Professional would readily observe this level of etiquette.

### Can I find a new job on LinkedIn?

Yes you can. But Group protocols are that anything job related should be confined to the Jobs page. Just below the Group title heading, are tabs for Discussions, Members, Promotions, Jobs, and more. Many Groups get bombed by Employment Agents listing jobs in the Discussions section. This seemingly innocent but often deliberate tactic of surreptitious ambushing of the Discussions board usually only serves to alienate the Group members who are often too busy to be bothered with filtering out such background noise.

### Reported by:

Simon Woodward  
NZGS Member

## AWARDS

### NZGS Wins ISSMGE Outstanding Member Society Award

THE NEW ZEALAND GEOTECHNICAL SOCIETY has been selected as the 2013 recipient of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) ‘Outstanding Member Society’ award. This is a significant achievement and congratulations go to all members of the NZGS who work to make us such a vibrant and active society.

The ISSMGE is a professional body which represents the interests and activities of engineers, academics and contractors all over the world. It is a global organisation with more than 80 member societies and over 18,000 individual members.

Jean-Louis Briaud, the President of ISSMGE notes that the award recognizes an outstanding and active ISSMGE member society and that NZGS was selected from a short list of the very best ISSMGE member societies from around the world. He notes that the outstanding work of the NZGS was appreciated by the Awards Committee and by

the ISSMGE Board. Our success has now been announced worldwide in the most recent President’s report to all ISSMGE members from Jean-Louis Briaud.

Professor Michael Davies, the current Vice President for Australasia and First Vice President of the ISSMGE, also sends his congratulations:

*“Many congratulations to you all! This is an exceptionally well deserved award for the work of the NZGS across all of its activities. I am very proud to be a member of such an exemplary ISSMGE member society.”*

Professor Michael C.R. Davies

We should all be very proud of this achievement.

A copy of our submission has been included and is available on our website: <http://www.nzgs.org/>

**Reported by: Hamish Maclean**  
NZ Geomechanics News Editor

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of The Institution of Professional  
Engineers New Zealand

29 September 2012

Professor R N Taylor  
ISSMGE Secretariat  
Geotechnical Engineering Research Centre  
City University  
Northampton Square  
London EC1V 0HB  
United Kingdom

Dear Sir,

**NEW ZEALAND NOMINATION FOR 2013 ISSMGE AWARD FOR OUTSTANDING MEMBER SOCIETY – New Zealand Geotechnical Society**

The New Zealand Geotechnical Society (NZGS) wishes to be considered for the 2013 ISSMGE Award for Outstanding Member Society.

Our Society has a comparatively large and active membership and there is close cooperation and cross fertilisation between the sister groups ISSMGE, IAEG and ISRM. Of the combined group, ISSMGE members comprise 57% (519 members), which is a significant number for New Zealand's population. We have active programmes of conferences, seminars, workshops, visiting international speakers and publishing technical practice guidelines. We publish a Society bulletin twice-yearly.

Please find attached our submission and supporting documentation for consideration.

Sincerely,

A handwritten signature in blue ink, appearing to read "David Burns". The signature is fluid and cursive, with a large initial "D" and "B".

David Burns  
Chair, New Zealand Geotechnical Society Inc

Supporting Documentation:

1. Brief History
2. NZGS Awards and Honours
3. Canterbury Earthquake Fact Sheet

158 THE TERRACE  
PO BOX 12-241, WELLINGTON  
NEW ZEALAND  
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f +64 4 474 8933  
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## NOMINATION FOR 2013 ISSMGE AWARD FOR OUTSTANDING MEMBER SOCIETY



### *NZGS is a vibrant society that:*

- has the highest number of ISSMGE members of any national society (116 members per million population compared to the worldwide average of 11);
- has a membership of 907 (geotechnical engineers and engineering geologists from a range of organisations including consultants, technicians, contractors and academia), 519 of which are affiliated to ISSMGE representing 57% of our society;
- contributes at a high level to ISSMGE affairs with the current (2009 - 2013) Vice President of Australasia [Professor Michael Davies] and our representative on the Student and Young Member Presidential Group [Lucy Coe];
- represents the breadth of specialism's in the geo-engineering profession (i.e. it is the national society for ISSMGE, ISRM and IAEG) and thus adds additional benefits for New Zealand ISSMGE members by incorporating ISSMGE's activities with those of its two sister societies (ISRM and IAEG);
- participates actively in international activities as part of the ISSMGE (including hosting conferences and taking leading roles in Technical Committees);
- actively communicates ISSMGE presidential updates, webcasts and bulletins to ISSMGE members in a timely manner via direct emails, links to ISSMGE website and NZGS website;
- facilitates lectures, symposia, conferences and educational programmes for its members, non-members and the public (i.e. it acts as a learned society);
- provides technical guidelines for the profession and related professions;
- interprets technical issues for the public;
- advocates to government on behalf of the profession;
- supports and recognises its members and encourages them to participate and contribute to the advancement of engineering through geotechnical communities and society;
- has seven active branches throughout New Zealand (4.4m population); Auckland, Bay of Plenty, Christchurch, Nelson, Otago, Waikato and Wellington

### *Conferences and workshops during past 4 years*

- 18<sup>th</sup> New Zealand Geotechnical Society Symposium – Soil-Structure Interaction, Auckland, 2008
- 8<sup>th</sup> ANZ Young Geotechnical Professionals Conference, Wellington, November 2008
- 11<sup>th</sup> IAEG Congress – Geologically Active, Auckland, September 2010
- 9<sup>th</sup> ANZ Young Geotechnical Professionals Conference, Melbourne, July 2012
- 11<sup>th</sup> ANZ Conference on Geomechanics – Ground Engineering in a Changing World, Melbourne, July 2012 (**finale of ISSMGE 75<sup>th</sup> Anniversary Celebration** at which Professor Michael Davies (VP Australasia) presented a talk on the state of play (Present) for ISSMGE and Lucy Coe (Young Professional) on the Future of ISSMGE).

### **Future ISSMGE conferences**

- 5<sup>th</sup> International Conference on Earthquake Geotechnical Engineering (ISSMGE TC203), Christchurch, 2015
- 12<sup>th</sup> ANZ Conference on Geomechanics, New Zealand, 2015 (regional ISSMGE conference)

NZGS has very active branches where branch meetings are live streamed so those in other locations in New Zealand can participate. This is becoming popular with our members who reside in areas not serviced by local branches. NZGS also provides the opportunity for its members to attend regular workshops and short courses. Some of our recent activities are included below. For the full range of courses and branch meetings information see our website <http://www.nzgs.org/category/branch-news>.

- In-situ testing and CPT analysis workshop - Professor Peter Robinson, Diego Marchetti and Ernst Wassenaar; Auckland, Wellington, Christchurch, August 2012
- Seismic stability of deep excavations in dense urban - Professor Nick O'Riordan; July 2012
- ISSMGE Presidential address to NZGS - Professor Jean-Louis Briaud; July 2012
- NZGS Field mapping course - Dr Warwick Prebble; May 2012, December 2009
- 49<sup>th</sup> Rankine Lecture 2009 - Professor Tom O'Rourke; October 2011
- Basics of Ground behaviour - Professor John Atkinson; December 2010

## NOMINATION FOR 2013 ISSMGE AWARD FOR OUTSTANDING MEMBER SOCIETY



- Earthquake experiences in Christchurch - David Dobbie; November 2010
- NZGS and NZSEE Earthquake Engineering in Canterbury: A forum to discuss and communicate geotechnical observations, ideas, concerns, solutions and opinions; Christchurch, Nov 2010
- 50<sup>th</sup> Rankine Lecture 2010 - Professor Chris Clayton; October 2010
- Design and Analysis of Deep Excavation short course - Professor Won Kai Sin; Auckland, Wellington, Christchurch, November 2009
- 45<sup>th</sup> Terzaghi Lecture 'Uncertain geotechnical truths and cost effective high rise foundations' - Clyde Baker; November 2009

### **Awards and honours**

NZGS supports and encourages our members through various awards and honours for all ranges of members, from our young up and coming members to our experienced and retired members.

### **Contributions to ISSMGE Technical Societies (Current membership)**

TC104, Physical Modelling;	Elisabeth Bowman
TC105, Geo-Mechanics;	Haran Arampamoorthy, Rolando Orense
TC203, Earthquakes;	Misko Cubrinovski, Michael Pender
TC208, Slope Stability;	Elisabeth Bowman (TC Secretary)
TC211, Ground Improvement;	Nidhal Al-Alusi
TC212, Deep Foundations;	Tim Sinclair
TC213, Soil Erosion;	Bruce Melville
TC302, Forensic Geotechnical Engineering;	Grant Murray

### **Contributions to the advancement of science and technology**

NZGS prides itself on the technical work of its members who actively submit papers for publication and attend conferences around the world to present papers. NZGS provides professional and industry guidelines for geotechnical practice as geotechnical standards are sparse. Recently NZGS has published the following guidelines:

1. NZGS Seismic Design Guidelines – “**Geotechnical earthquake engineering practice**” Module 1: Identification, assessment and mitigation of liquefaction hazards [*This document is now under review following research being undertaken following the devastating Canterbury earthquakes*]  
Module 2: Retaining Walls [*In Preparation*]  
Module 3: Foundations [*In Preparation*]
2. Electronic transfer of geotechnical and geoenvironmental data , AGS4 NZ v1.0 (AGS edition 4.0.3 – New Zealand localisation)

NZGS publishes a biannual bulletin in June and December, “New Zealand Geomechanics News”, for its members and sent to a number of other overseas professional societies, academic institutions, libraries and industrial groups. The bulletin has grown in size in the last four years. The bulletin includes society news, project news, profiles and technical articles from members. For the contents of past issues see our website at: <http://www.nzgs.org/publications/geo-news-past-issues>.

### **Community welfare and safety**

All activities the society runs are open to all members of the community. In recent years with the earthquake disasters in Canterbury NZGS in association with IPENZ provided “Canterbury Earthquake Fact Sheets”. These fact sheets were written in layman’s terms and made available to the communities affected by the earthquakes. The public and media elsewhere in New Zealand made use of them to better understand the effects and damage caused to land and buildings and the community at large.

## IPENZ Fellows and Achievers

THE IPENZ FELLOWS' and Achievers' Dinner was held in March 2013 at the Amora Hotel in Wellington. During the dinner Members of the Institution were recognised for their commitment to IPENZ and the engineering profession. The Freyssinet Award and the Turner Award were awarded to members of the NZ Geotechnical Society. In addition, another two of our members were elected to the class of Fellow of IPENZ. Fellowship acknowledges a Members significant contribution to the development of the engineering profession, its practices or IPENZ itself.

Congratulations go to the following members of the Geotechnical society:

### Freyssinet Award Building and Construction



**Pathmanathan  
(Brabha) Brabhadaran  
FIPENZ**

Brabha has had a prominent career in geotechnical and seismic engineering in New Zealand.

He has written over 40 technical papers on practice and research related to geotechnical and earthquake engineering, and infrastructure resilience. He twice received the New Zealand Society for Earthquake Engineering (NZSEE) Award for Best Practice Paper. He was the principal organiser for two national NZSEE conferences and has been a technical reviewer, session chair and awards' judge at other conferences. His work has led to knowledge sharing with building and construction professionals locally and internationally.

He has developed unique and innovative solutions, especially for providing resilience against natural disasters, and has made significant contributions to understanding natural hazard risks such as liquefaction caused by earthquakes. In 2008 he joined NZSEE reconnaissance to China following the Wenchuan earthquake. In New Zealand he has developed leading-edge resilience plans for the Government and several city councils.

His service to the profession through NZSEE and the New Zealand Geotechnical Society has been extensive;. He has also undertaken work on IPENZ Investigating Committees. To all aspects of his work Brabha brings a high level of dedication, professionalism and a strong understanding of engineers' public service role.

### Turner Award for Professional Commitment

The Turner Award, sponsored by SEISMIC MA, is presented in recognition of a continuing contribution to the engineering profession by demonstrating commitment to the ideals of a self-regulating profession.



**Peter Millar FIPENZ**

Peter receives the 2013 Turner Award for his contribution to the development of geotechnical engineering in New Zealand, Australia and Asia, especially with geotechnical investigations, design and site development.

His wider professional contributions have included input into several working groups (particularly the New Zealand Geotechnical Society) and roading and earthquake research groups. Since 2011 he has been a member of the Engineering Advisory Group, which was established to formulate design recommendations for residential and commercial structures following the Canterbury earthquakes. He has frequently acted as an expert witness and presented technical papers on foundation, roading and tunnelling projects.

During his tenure as Tonkin and Taylor's Managing Director, he was a founding advisory Committee member of The University of Auckland's Geosciences Institute. He has encouraged young engineers at university and through his consultancy to strive for technical excellence, uphold ethical values and recognize the variety, complexity and demands of engineering.

From 2009 to 2011, he and his work colleagues volunteered in the reconstruction of the Kohukohuni Track in the Hunua Regional Park. Peter is also a keen squash player, skier and swimmer. As a member of the Tamaki College Board as part of the Business in Schools Initiative, he encourages the school trustees to examine their actions and governance strategically. His efforts are assisted by his naturally calm, reassuring and humble manner.

**Fellows of the Institution  
of Professional Engineers New Zealand**



**Brian Duncan** is elected a Fellow of IPENZ for his contribution to the advancement of engineering practice. He is recognized for his contribution to treatment technologies for municipal waste, with emphasis on natural systems. He was an early innovator in using facultative aerated lagoons to accommodate high peak loads at beach resorts. He also applied forest irrigation and root zone marsh treatment to provide low cost solutions for communities with small permanent populations. He shares his knowledge through a variety of technical society activities.



Photos courtesy IPENZ

**John Wood** is elected a Fellow of IPENZ for his contribution to the advancement of engineering practice and innovation in creating engineering works. He has contributed to resolving seismic issues and has published many papers on testing, design, performance and strengthening of various structural types. His early thesis on soil structure interaction under seismic conditions, which he wrote early in his career, is still regarded as a standard reference. He played an important role in New Zealand by developing field and laboratory methods for structural testing. He has also served IPENZ and the New Zealand Society for Earthquake Engineering in various roles.

**Editors Note:**

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## New Year Honours Awards

FOUR NZGS MEMBERS were recognised at investiture ceremonies for people named in the 2013 New Year honours lists. The Governor-General, Lt Gen The Rt Hon Sir Jerry Mateparae, presented insignia to four Tonkin & Taylor geotechnical engineers at the investiture ceremonies at Government House in Wellington and Auckland in May. New Year honours have recognised the contributions of engineers Nick Rogers, Dr Sjoerd Van Ballegooy, Mike Jacka and Kate Williams for their work with the Government and EQC, and commitment to communities following the Canterbury earthquakes.

Attending the formal ceremony with work colleagues and family was “an amazing honour and proud experience” said Kate Williams, T&T Wellington operations manager. “We are very proud of the multiple awards and acknowledge all our hard working staff,” says T&T Managing Director and NZGS member Doug Johnson.

### THE QUEEN’S SERVICE ORDER



**Honorary Companion:** Nick Rogers, for services as a land damage assessor



**Honorary Companion:** Dr Sjoerd Van Ballegooy, for services to geotechnical science

### THE QUEEN’S SERVICE MEDAL



Mike Jacka, for services as a geotechnical engineer



Kate Williams, for services as a geotechnical engineer

Photos: Government House (May 2013)

## 2012 NZGS Student Presentation Awards – Poster Competition

IN 2012 a new initiative was started for the NZGS Student Awards. A poster competition was undertaken rather than the traditional written synopsis and presentation in order to revitalise the award and reinvigorate interest and participation from students. Students were required to submit an abstract for their poster as part of their registration for the award and then prepare a poster that would clearly and concisely present their work in geotechnical engineering or engineering geology.

A record number of students registered for the 2012 Student Awards and produced posters of a very high standard. A wide range of topics were covered by the 25 student submissions from the University of Auckland, University of Waikato, and University of Canterbury.

Three prizes were available – 1st, 2nd and 3rd place with monetary values of \$1000, \$500 and \$300 respectively. The posters were displayed at an event run in Auckland on 27 November coinciding with a presentation by Professor Michael Davies. The posters were also displayed at events on the same evening in Hamilton and Christchurch and Professor Davies presentation was live streamed to those events. Attendees on the night were able to vote for their top three posters and these votes were considered by the judging panel of CY Chin, Ann Williams and Pierre Malan in making their final decision.

The award winners were announced on the night and the judges noted that the quality of the posters was outstanding and made their final decision very difficult. They decided that due to the high quality of posters they would award 5 additional merit prizes with a monetary value of \$50 for the students that just missed out on a top three spots.

### The winners were:

**Xiaoyang (Gary) Qin** [Co-author: Wai Man Cheung] – A numerical and experimental study of SSI using a lamina box on a shake table, University of Auckland.

**Julian Lees** [Co-author: Rowan Ballagh] – CPT Analysis of Liquefaction and Re-liquefaction, University of Auckland.

**Michael Cunningham** – Geotechnical changes inherent in the breakdown in structure of sensitive rhyolitic soils in the Tauranga/Bay of Plenty region, University of Waikato.



### Merit prizes:

**David Chiswell** [Co-author: Benjamin Probett] – Numerical Analysis of the Victoria Park Tunnel, University of Auckland.

**Catherine Tatarniuk** – Numerical Modelling of Laterally Loaded Deep Soil Mixed Columns, University of Canterbury.

**Josh Bird** – The Internal Mechanics of Debris Flows, University of Canterbury.

**Merrick Taylor** – Assessment of Liquefaction Hazard using Effective Stress Analysis, University of Canterbury.

**Oliver Deutschle** [Co-author: Marc-Andre Brideau] – Characterisation of Geotechnical Units on Mt Taranaki and Influence of Ediface Stability, University of Auckland.

Congratulations to all the 2012 NZGS Student Award winners and a big thank you to all the students that got involved in this successful event. The winning posters are included in this issue of NZ Geomechanics News.

The 2013 NZGS Student Awards will be run as a poster competition again. It is planned to display the posters at the NZGS Symposium in Queenstown in November. Judging will be undertaken and the winners announced at the Symposium. Students, start preparing ideas for your poster this year and members, encourage students to get involved.

**Reported by: Luke Storie**  
NZGS YGP Representative

Student Posters

A numerical and experimental study of seismic SSI using a laminar box on a shake table

X. Qin and W.M. Cheung

### Introduction

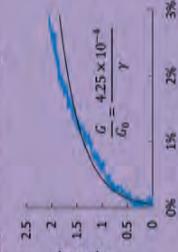
During an earthquake, the soil changes in density resulting in a change of soil shear stiffness. This change can affect the performance of structures founded in or on sand. This project investigates the dynamic response of sand during earthquake motion, by placing sand in a laminar box and shaking the assembly on a shake table. A laminar box (in the figure below) is a soil container that is flexible in terms of allowing shear deformation of specimen while providing the confinement. A numerical model was developed to simulate the response of the sand. In addition, the performance of a structure with a shallow foundation with soil-structure interaction (SSI) and soil shear deformation is investigated.



### Methodology and Findings



**Figure 1: Push over test** Figure 1 was performed on the laminar box filled with sand to obtain the shear modulus (G) of the soil (Fig. 2). The lateral stiffness of the soil was estimated and implemented into a lumped mass model based on the assumption of uniformly distributed stiffness. The model was used to simulate free-field soil response in earthquakes, and the performance is demonstrated in the graph below. A good performance of the model in simulating the soil response is revealed.



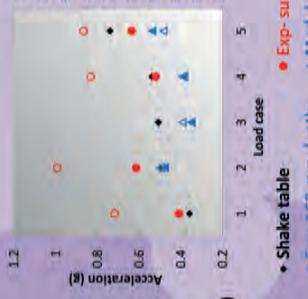
**Figure 2: Shear stress ( $\tau$ ) against shear strain ( $\gamma$ )**

### Conclusions

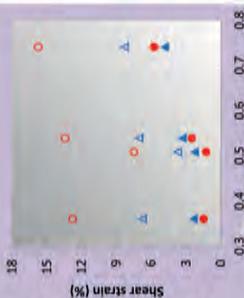
The numerical model achieved reliable accuracy for estimating the response of sand under earthquake loading.

- The lack of consideration of soil shear deformation will underestimate the rotational rocking behaviour of the structural footing.
- Without considering the shear deformation of soil, the footing settlement is overestimated. The soil shear behaviour should be incorporated in the structural seismic design.

The figure on the left summarises the maximum acceleration in the soil from both experimental and numerical model results. For soil at 160 mm depth, the maximum accelerations simulated by the model were well matched to the experimental findings. In contrast, at the sand surface, the level of accuracy was significantly reduced.



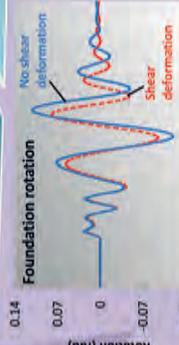
The figure on the right illustrates the performance of the numerical model in simulating the soil shear strain. The comparison suggests that using a constant soil stiffness is inappropriate. The equation for obtaining the strain dependence shear modulus (Fig. 2) should be considered to improve the accuracy of the model.



### Future Work

- Using this laminar box, soil liquefaction can be investigated.
- The numerical model can be improved by incorporating the strain dependence of soil stiffness.

The figure below shows a significant difference between the footing settlement and residual rotation when different soil boundary conditions were considered. With soil shear deformation permitted the settlement of the footing due to earthquake reduced.



**Foundation rotation**

The figure above shows the comparison of footing rotation on the soil with different boundary conditions. It is observed that when the shear deformation of the soil is eliminated, the peak maximum rotation of the structure increases. Also, the rocking period of the footing is lengthened.

Extend the study to include SSI

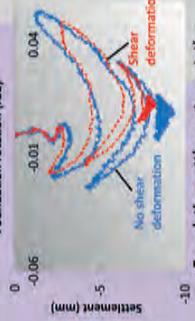
### Conclusions

The numerical model achieved reliable accuracy for estimating the response of sand under earthquake loading.

- The lack of consideration of soil shear deformation will underestimate the rotational rocking behaviour of the structural footing.
- Without considering the shear deformation of soil, the footing settlement is overestimated. The soil shear behaviour should be incorporated in the structural seismic design.

Propose a numerical model

The figure below shows a significant difference between the footing settlement and residual rotation when different soil boundary conditions were considered. With soil shear deformation permitted the settlement of the footing due to earthquake reduced.



**Foundation settlement vs rotation**

Extend the study to include SSI

### Future Work

- Using this laminar box, soil liquefaction can be investigated.
- The numerical model can be improved by incorporating the strain dependence of soil stiffness.

Above: Xiaoyang (Gary) Qin's (Co-author: Wai Man Cheung) poster which took first prize at the Student Presentation Awards

52

Bulletin of the New Zealand Geotechnical Society Inc.

# CPT Analysis of Liquefaction and Re-liquefaction in Christchurch

Julian Lees and Rowan Ballagh

Supervised by:

Dr Rolando Orense



Project 35  
Group: Geotechnical

## Introduction

Liquefaction and re-liquefaction has been observed in Christchurch due to the 4<sup>th</sup> September 2010 Darfield earthquake and the aftershocks that followed. The aftershock sequence was punctuated by three major events: 22<sup>nd</sup> February 2011, 13<sup>th</sup> June 2011 and 23<sup>rd</sup> December 2011.

## Objectives

This project had dual objectives:  
 • To determine the applicability of existing CPT liquefaction assessment methods to the soils in Christchurch  
 • To establish changes in the CPT data which may explain the re-liquefaction process in Christchurch

## Methodology

### 1) Liquefaction Analysis

Comparison Between

**Analysed Liquefaction Potential**  
(3 CPT-based methods)

Using:  
 • Liquefaction Potential Index (LPI) to represent ground surface damage potential, for all three methods

**Observed Liquefaction**  
(Land Damage Maps)

Using:  
 • Land damage grading developed by Tonkin & Taylor Ltd  
 • Liquefaction maps based on aerial photography

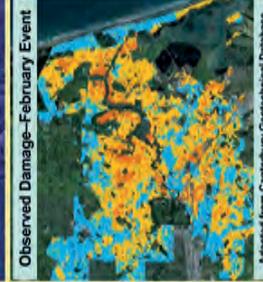
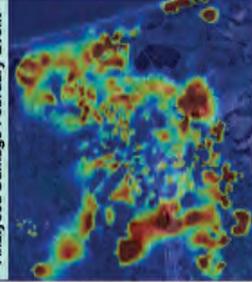
### 2) Re-liquefaction Analysis

• 30 pairs of raw CPT data were compared on the basis of three criteria:  
 a) They were performed at sites where re-liquefaction had occurred  
 b) They were carried out before different major aftershock events  
 c) They were within 50m of each other in order to have minimal geological variation

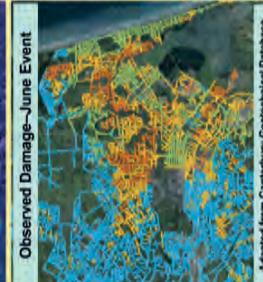
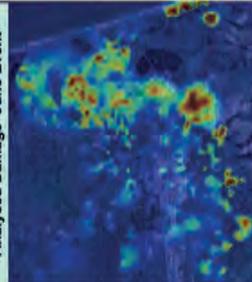
• Comparisons were made both for the entire CPT population and on an individual basis

## Maps of Analysed Liquefaction Potential and Observed Land Damage

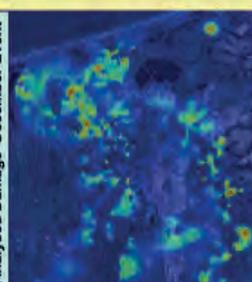
(Refer to legend, below left)



Analysed Damage—June Event



Analysed Damage—December Event



## Re-liquefaction Analysis



• The roughly 1:1 gradient of the scatter plot indicates that (in general) Christchurch soils have not undergone a significant densification



• 80% of individual comparisons indicated equivalent or reduced tip resistance profiles  
 • In future earthquakes of similar magnitude further liquefaction is likely

## Conclusions

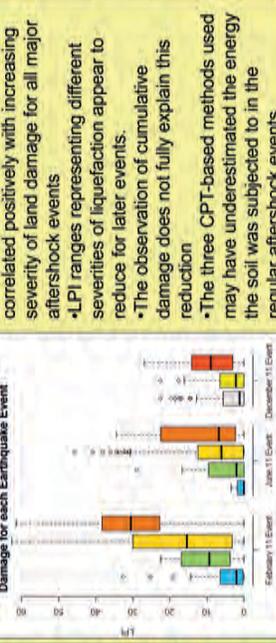
- Analysed liquefaction severity (LPis) correlated positively with observed damage for all methods tested across all aftershock events
- Analysed liquefaction severity (LPis) for the June and December 2011 events underestimated the damage observed
- No noticeable soil densification has occurred from the earthquake events in Christchurch and therefore there is future risk of liquefaction unless the ground is improved

## Acknowledgements

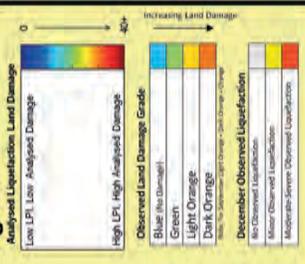
Particular thanks is extended towards Dr Orense and Dr Abuel-Naga for the contribution of their time and knowledge

## Liquefaction Analysis

(Refer to legend, left)



## Legend



Special thanks to Tonkin & Taylor Ltd for access to the Canterbury Geotechnical Database



Above: Julian Lees's (Co-author Rowan Ballagh) poster which took second prize at the Student Presentation Awards

## CONFERENCE REPORTS

### 19th NZGS Symposium, 20-23 November 2013, Hanging by a Thread – Lifelines, Infrastructure and Natural Disasters

THE 19TH GEOTECHNICAL SOCIETY SYMPOSIUM in November is shaping up to be an outstanding event in a great location. Early bird registrations are open via the symposium website and close on 31 August, so now is the time to lock in a space and accommodation at the best rates.

Planning for this symposium has been on-going for several years, which has enabled us to secure an excellent venue, a diverse cast of renowned keynote and invited speakers and an interesting mix of workshop, social and field trip options.

The programme has been designed to provide a good balance between geotechnical engineering and engineering geology topics, and includes a focus on application and practice so attendees can leave armed with increased knowledge and tools to apply this understanding. There will also be a focus on lessons learned from earthquake-induced land and building movements, providing an opportunity to assess current analysis and design methods against previous practice.

Headlining the symposium programme are Keynote Speakers Prof. Harry Poulos and Dr. Lelio Mejia:

**Prof. Poulos** will be presenting a keynote address on practical approaches to seismic design of deep foundations, including a simplified but systematic approach by which the practical foundation designer can undertake calculations to satisfy the requirements for deep foundation design in seismic areas.

**Dr. Mejia** will be presenting a keynote address on the analysis and design of embankment dams with regard to foundation fault rupture, and will also be leading a pre-symposium workshop on liquefaction and cyclic softening of soils.

Other invited symposium speakers include: Dr. Kelvin Berryman, Don Macfarlane, Mark Yetton and Prof. Jarg Pettinga. Pre-symposium workshop presenters include; Dr. J.P Giroud, Prof. Mick Pender, Dr. Chris Massey and Prof. Misko Cubrinovski.

The response to the call for abstracts from the wider geotechnical community has been excellent, and with a variety of industry-leading firms committed to sponsoring the symposium, it promises to be a high quality and enjoyable event. A few of the key event details are listed on the Ad on page 65 – The Symposium website ([www.nzgs.2013](http://www.nzgs.2013)) has the full programme, current information and information of any changes or updates.

The organising committee looks forward to meeting all of you who can make it to Queenstown this coming November.

Best Regards,

**Symposium Convenor:** Tony Fairclough

**Symposium Organising Committee:** Paul Salter, Aaron George, Nick Harwood, Kirsti Murahidy, Andi Fear-Ross

**Proceedings Editor:** C Y Chin

**HANGING BY A THREAD?**

Lifelines, infrastructure and natural disasters

[www.nzgs13.co.nz](http://www.nzgs13.co.nz)

NEW ZEALAND GEOTECHNICAL SOCIETY INC  
19th Symposium

20-23 NOVEMBER 2013 QUEENSTOWN

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Symposium THURSDAY 21 & FRIDAY 22 NOVEMBER  
Fieldtrips SATURDAY 23 NOVEMBER

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### TECCO® mesh

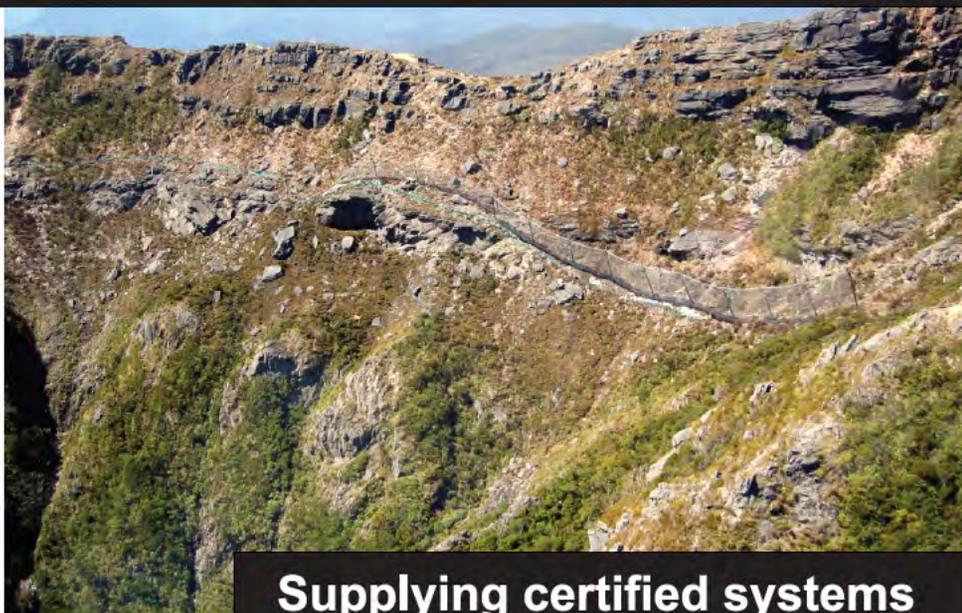
TECCO® mesh is used in the GBE barriers for impact energies of 100, 500 and 1,000 kJ, is made from robust, high-tensile steel wire with a diameter of 4 mm and nominal tensile strength of 1,770 N/mm<sup>2</sup> (conventional meshes have a strength of only 500 N/mm<sup>2</sup>). Thanks to the small opening size of 80 mm, no secondary mesh is necessary: a considerable benefit for a simplified installation.

### The SPIDER® spiral rope net

SPIDER® S4/130 spiral rope nets are used as the main net in the GBE barriers for impact energies of 2,000 and 3,000 kJ. Like TECCO® mesh, it is made from robust strand of high-tensile steel wire with a diameter of 4 mm and nominal tensile strength of 1,770 N/mm<sup>2</sup>. The 3,000 kJ barrier is further reinforced with TECCO® mesh.

### ROCCO® ring net

ROCCO® ring nets are used in the GBE barriers for impact energies of 5,000 and 8,000 kJ. They are made from steel wire with a diameter of 3 mm and nominal tensile strength of at least 1,770 N/mm<sup>2</sup>. Depending on the amount of energy to be absorbed, between 16 and 19 wire coils are bundled in each ring. Here too, a secondary mesh provides additional protection.



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## PROJECT NEWS

### Retaining Walls and Ground Improvement in Christchurch – General

#### Observations and Findings

#### 1.0 Introduction

This article briefly discusses some key observations made by engineers working on retaining wall and ground improvement projects in Christchurch. The first section discusses the behaviour of old stone block walls, crib walls and cantilever timber walls. The second section discusses more complicated anchored walls, focussing on anchor behaviour. The last section describes a ground improvement case study.

#### 2.0 Stone block walls, concrete crib walls and cantilever timber pole walls – general behaviour and performance

##### 2.1 Stone Block Walls

Most stone block walls in Christchurch were constructed in the early 1900's. The extent of mortaring is highly variable

with some walls appearing to consist of “dry stacked stones” only. Seismic design or resilience considerations would not have been a consideration at that time. The majority of the walls have been built in front of largely free-standing loess or volcanic cut faces with weather protection and provision of an aesthetic facing being the prime considerations.

Photographs 1 and 2 show two examples of contrasting behaviour exhibited by these stone walls during the recent seismic events.

Photograph 1 shows a stone wall which has suffered collapse over the majority of its length, with a short section remaining virtually undamaged for some reason. This wall initially had very little mortar placed between the blocks. Significantly variable behaviour such as this is a common feature of these walls. It is difficult to provide conclusive explanations for this variance in behaviour, but factors such as vegetation, the direction and severity of accelerations,



Photograph 1: Collapsed Stone Block Wall



**Photograph 2:** Stone block wall with cracked “panels”

wall backslope, and the method of construction are all likely to have played a part in determining whether any given section of a stone wall has collapsed or not.

Photograph 2 shows another example of a stone wall but in contrast to that in Photograph 1, mortar has been placed between the blocks at some point. It can be seen that the recent earthquakes have caused the wall to crack into discrete “panels” but the wall has not suffered complete collapse.

It appears from the above two examples that a cost effective measure of reducing the risk of complete collapse of stone block facing walls would be to point them.

### 2.2 Concrete Crib Walls

Similar to stone walls, the general performance of concrete crib walls has been extremely variable. Although the factors listed above all probably play a part in determining the degree of damage suffered, it appears from recent inspections that a key factor governing the resilience of concrete cribs is the degree of face vegetation which, crucially, seems to have held the infill stones in place. It is conceded that formal research testing this observation, has not been carried out and this is an impression based on a few inspections only. Nevertheless, it does appear to the authors that highly vegetated concrete crib walls have fared better. Photographs 3 and 4 below show examples of these two types of behaviour.



**Photograph 3:** Unvegetated Crib – fill loss and collapse.



**Photograph 4:** Vegetated crib – fill intact & in good condition.

### 2.3 Timber Pole Walls

Generally, timber pole walls appear to have been among the most resilient in the recent earthquakes. Relatively few appear to have suffered completed collapse but two key observations coming from the recent inspections in Christchurch are:

Timber pole walls have not fared well on outside corners (see Photograph 5)

The flexibility of timber pole walls appears to have reduced damage to the wall itself but the footway and road behind have suffered subsidence and cracking due to the high degree of seismic movement.



**Photograph 5:** Timber pole wall – damaged corner section

### 3.0 Anchored King Post Retaining Walls – Performance of Anchors

The Cunningham Terrace Retaining Wall and Maffey's Road Retaining Wall were both concrete crib walls and both failed during the February 2011 Christchurch Earthquake. Maffey's Road Retaining Wall is in Mt Pleasant, a suburb on the edge of the Port Hills and reaches about 7.5m in height. Cunningham Terrace has an average height of about 4 m and is located within the steep residential



**Photograph 6:** Intact timber pole wall with cracked road behind



**Photograph 7:** Anchor Installation at Maffey's Road

streets of the port town of Lyttelton.

Cunningham Terrace Retaining Wall and Maffey's Road Retaining Wall are being rebuilt as anchored king post walls. The design working load for the anchors of both walls was 100kN. These are distal plate anchors, comprising of a plate secured at the end of a 32mm bar, grouted within a 110mm diameter novacoil sheath. The bar is debonded from the grout to transfer the load to the distal plate. These prefabricated units were installed in 165mm diameter drill holes and grouted.

All the anchors for Maffey's Road Retaining Wall were installed and bonded 5m in rock. The distance to rock varied across the site and anchors were installed through Loess or soft organic silt soils for a distance of between zero and 15m.

At Cunningham Terrace Retaining Wall rock was not encountered and all anchors were installed in Loess. The strength of Loess was variable across the site and the anchor lengths ranged from 6m to 15m.

All anchors were subject to acceptance testing to 150% of the design working load. At Maffey's Road, where the anchors were bonded about 5m into rock, the measured extension was typically between 2mm and 8mm, with all the anchors fixed directly into rock generally not extending more than about 3mm. All anchors at Maffey's Road passed acceptance testing.

At Cunningham Terrace initial testing cycles typically gave rise to extension of between 2mm and 15mm. The apparent free length was calculated for each load test and where the apparent free length was outside of acceptable



**Photograph 8:** Grouted Anchors at Cunningham Terrace



**Photograph 9:** Maffeys Road RW as at end of March 2013



**Photograph 10:** Installed anchors and Waling at Cunningham Terrace

limits, as described in BS8081, further load cycles were carried out in order to ensure the anchor response was elastic. Approximately 30% of the anchors installed required retesting to ensure they were acceptable with 6% of anchors being replaced.

Unexpected poor ground conditions meant that a number of anchors had to be drilled further than initially planned at Maffeys Road in order to create the desired bond in basalt. At Cunningham Terrace, installation was significantly easier in the loess but a longer bond length was required than for the Maffeys wall.

#### 4.0 Pump Station 15 Ground Improvement Works – Geotechnical Aspects

In this section, geotechnical aspects of the repair works at Pump Station 15 (PS15) in the suburb of Woolston are discussed. The ground investigation, the general site geology and key considerations for the ground improvement are all covered.

##### 4.1 The Pump Station

PS15 is a terminal wastewater pumping station located in the eastern Christchurch suburb of Woolston. The station sits on a 12m diameter, 9m deep concrete caisson. The caisson houses pumps and receives flow from a main trunk sewer line. It was knocked out of service by both February and June 2011 earthquakes (see photos below of the damage). Surveys after the February earthquake showed the caisson to have floated up to 400mm in relation to the surrounding ground. Emergency repairs quickly brought the station back into operation, but because of its key role, there was a need for more permanent repairs or a rebuild at another site. The pump station services a broad area including hill suburbs from Hillsborough to Taylors Mistake and residential and industrial areas in Bromley and Woolston. In total it pumps wastewater for the equivalent of 40,000 people and when out of service for extended

periods, raw sewage can overflow into the Heathcote River.

##### 4.2 Ground Investigation

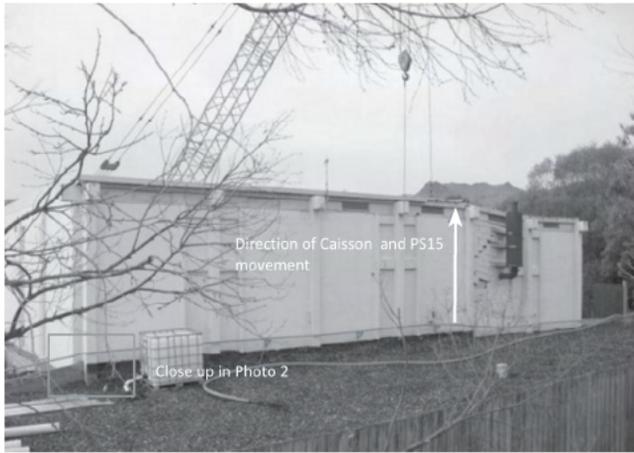
Piezoecone Penetration Testing (CPTu) was carried out on the pump station site and an adjoining block of land was investigated using boreholes and additional CPTu tests. Once a repair option had been chosen, further testing on the existing site was carried out which included Seismic Dilatometers (SDMT), boreholes and testpits. Parameters derived included shear wave velocity, grading (with particle size distribution curves), undrained shear strength, and friction angles.

##### 4.3 Geology

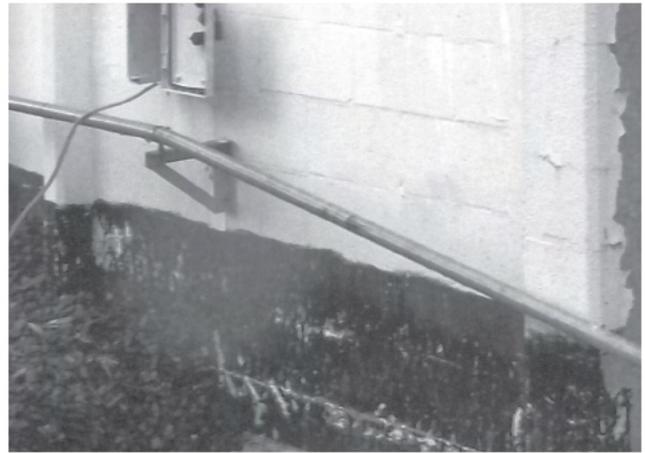
The ground investigation showed the geology of the site to be fill in the top 2 metres overlying potentially liquefiable sands with silt lenses to 14-15m below ground level (mbgl). Dense marine sands were encountered at 15 to 18mbgl and these overlaid 3m of softer materials before the dense Riccarton gravels were encountered below 21m. The Riccarton Gravels at the site are an artesian aquifer with the softer layer at 18-21m acting as an aquiclude. The artesian head measured was 1m.

##### 4.4 Ground improvement

The behaviour of the ground during the sequence of earthquakes since September 2010 and an analysis of the ground investigation data necessitated ground improvement to mitigate against future land damage. To prevent liquefaction on the site poses specific challenges in and around the caisson which is founded at 9mbgl. The need to prevent further floatation of the caisson and differential movement relative to pipes entering and exiting the pump station was a main consideration. The sequencing of the ground improvement to allow continued operation of the pump station and allow other repair work to continue, such as replacing pipes, will require



**Photograph 11a:** Pump station 15, note damage at right hand side of structure



**Photograph 11b:** Damage due to floatation of Caisson



**Photograph 11c:** Damage to pipe connected to PS15 caisson



**Photograph 11d:** Floatation of manhole on street outside PS15

co-operation between all the contractors. The ground improvement work is currently being completed under a design-build contract and at the time of writing was in the detailed design phase. The proposed design will see a grid of deep soil mixing (DSM) piles across the site with a ring around the caisson and particular focus being put on the prevention of floatation.

#### 4.5 Quality assurance

As part of the Quality Assurance process, verification of the ground improvement works will consist of CPTu's and SDMT testing after the completion of site work.

**Reported by: P.Aynsley, I.Froggatt, L.Kendal Riches,  
and M.Lazzaro**

Aurecon

## Waterview Connection Motorway Project

THE WELL CONNECTED ALLIANCE consisting of Fletcher Construction, MacDow Constructors, Beca Infrastructure, Tonkin & Taylor, Parsons Brinkerhoff, SICE and Obayashi Corporation won the contract to deliver NZTA's Waterview Connection motorway project in August 2011. The \$2.4b project will complete Auckland's Western Ring Route between SH20 and SH16, with approximately 4.8km of 3 lane motorway between Maioro Street and the SH16 Waterview Interchange, including twin, 2.4km, 13.3m diameter bored tunnels by the world's tenth largest tunnel boring machine (TBM). The project is due for completion in 2017.

Due to the size of the TBM and a tunnelling requirement to have approximately 8m of cover over the top of the TBM at launch and retrieval, two significant sized portal structures are required at the southern and northern approach trenches (SAT & NAT) of the bored twin tunnels. Approximately 7m of additional temporary excavation below the final road surface is also required at both the portals to accommodate the circular shape of the TBM. This space will accommodate the portal drainage sumps which will collect surface stormwater and subsurface groundwater before being pumped into treatment ponds

and then into Oakley Creek.

The southern portal trench (SAT) will extend to a depth of 29m in the temporary case and 22m in the permanent situation below the surrounding ground surface while the northern portal is slightly shallower at approximately 25m in the temporary case and 18m permanently. The SAT is approximately 45m wide and the NAT approximately 40m.

The geology across the project varies substantially and has dictated the construction methodology at both portals. At the SAT, the geology consists of approximately 10m of basalt overlying Tauranga Group (TG) alluvial deposits overlying East Coast Bays Formation (ECBF). The SAT location and depth required careful selection due to a number of constraints, including an overlying basalt aquifer, which the TBM needed to pass under, the 5.6% motorway gradient, Oakley creek stream to the immediate west and local residents to the immediate east.

The SAT design requires the basalt to be bolted and shotcreted, with a Reinforced Concrete (RC) bored piled wall with multiple rows of ground anchors to support the TG, weathered ECBF and ECBF rock, forming a fully drained portal structure. The tunnels required the TG below the basalt to be stabilised. This necessitated



Photograph 1: Southern Approach Trench Aerial, April 2013



**Photograph 2:** Southern Approach Trench Headwall, April 2013

the removal of the basalt along the face and construction of a 7m wide stabilised block, extending down into unweathered ECBF rock. The stabilised block was formed using continuous flight auger (CFA) piles. The ground between the tunnels is retained using RC bored piled walls. The stabilised block forms two main functions; it prevents soft ground from being drawn into the TBM face chamber close to the portal face where earth pressure balance (EPB) pressures are limited and it forms an unreinforced gravity block retaining wall to allow the TBM to tunnel through the headwall face without the need to break out steel reinforced piles. The ground is reformed over the stabilised block with the construction of a Mechanically Stabilised Earth (MSE) wall using precast facing panels to reinstate the tunnelling requirement for a minimum of 8m overburden at launch and retrieval.

Photo 1 shows an aerial view of the SAT with the relocated Oakley creek stream to the west and local residents to the east. Photo 2 shows progress of the SAT headwall in April 2013.

The geology at the NAT is quite different to the SAT consisting of approximately 15m of firm to stiff TG alluvium overlying ECBF, with the groundwater level approximately 2m below existing ground surface. Due to the softer ground and high groundwater table, the NAT retention consists of 1m wide diaphragm walls with

multiple levels of structural RC props. The portal will be constructed in a top down method with the roof props installed after the D-Walls have been completed and excavation then proceeding below the roof beams. The first sub-level props are installed at approximately 7m below ground level and excavation then proceeds below the props. The sequence is repeated until the base of the portal is reached. The TBM will start at the SAT and be driven to the north where it will be turned around and driven back to the SAT. To accommodate the turn around, a 40m x 24m opening in the roof is required to remain open during the construction stage to allow crane access. Anchors through the D-Wall will be used in this location where internal propping is not possible.

The NAT headwall face requires similar stabilised gravity block retention as formed at the SAT. However, due to the depth to rock at the NAT, the stabilised block has been formed using conventional interconnecting bored piles filled with flowable fill. The front face comprises a row of piles with fibre reinforcement to mitigate against the concrete cracking and spalling under stress.

The NAT design is further complicated by the need for an 11m wide x 8m deep vent tunnel to be formed through the eastern D-Wall. The vent tunnel will cross Great North Road to a vent stack on the opposite side of the road.

The headwall face between the bored tunnels will be



Photograph 3: Northern Approach Trench Aerial (looking south), Feb 2013

retained by steel reinforced D-Walls. To avoid the need for anchors this portion of the headwall face is buttressed by two perpendicular 7m long D-Wall panels.

The NAT also has severe space constraints, with Great North Road to the east, Waterview School to the immediate west and the Waterview interchange to the north.

Each portal is required to have a vent building which accommodates the vent fans for exhaust fume extraction. Both the SAT and NAT will accommodate these buildings below ground surface within the portal space.

Photo 3 shows the location of the NAT in relation to SH16, Great North Road and the Waterview interchange.

Photo 4 shows the D-Wall construction in February 2013.



Photograph 4: Northern Approach Trench Diaphragm Wall Grab, Feb 2013

**Reported By: Neil Korte**  
Geotechnical Design Manager  
Well Connected Alliance

# 19th Symposium



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- » Keynote and invited speaker addresses
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- » Welcome Reception – Millennium Hotel
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- » Poster Presentation Cocktail Function
- » Young Professionals Networking

### Post Symposium Field Trip Options

- » Clyde Dam
- » SH6 Network
- » Developments around Queenstown

### INVITED SPEAKERS

Kelvin Berryman, Don Macfarlane, Mark Yetton, Jarg Pettinga

### KEYNOTE SPEAKERS



#### DR. LELIO MEJIA

Dr. Mejia is a Vice President and Earthquake Engineering leader at URS in Oakland, California where he has been involved in geotechnical, dam and foundation engineering projects for over 30 years. His experience in the design of large earth dams, including assessing seismic stability and liquefaction issues for these structures, is particularly relevant as he has worked on a number of dam projects in New Zealand.



#### PROF. HARRY POULOS

Prof. Poulos is a Senior Principal at Coffey Geotechnics in Australia and Emeritus Professor at the University of Sydney. Harry is a recognized international authority in geotechnics, particularly pile foundation design and research into soil-structure interaction. In his close to 50 years' in the geotechnical industry he has worked on major projects throughout the world, including tall buildings, bridges, tunnels, and offshore structures.

# HANGING BY A THREAD?

Lifelines, infrastructure and natural disasters

For detailed information regarding this symposium and the associated workshops, and abstract submission. [www.nzgs13.co.nz](http://www.nzgs13.co.nz)



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## GENERAL ARTICLES

### Plato and the Engineering Dilemma

#### Introduction

Most people are familiar with the names: Socrates, Plato, Aristotle and Archimedes. This may seem surprising given that these Greek philosophers lived two and a half thousand years ago. However, we know the names because these giants of ideas have played a significant role in shaping Western thought and their legacy continues to influence culture today.

Discussions along this line with a workmate led us to question what perception of engineering we may have inherited from the ancient Greeks. The answer is a little alarming.

#### The Classical Greek Perception of Engineering

The Greek philosopher's view of engineering is not flattering.

"I cannot think of any study as making the mind look upwards except one which has to do with *unseen reality*."

*Socrates, Republic (529 A)*

"But as more arts were invented, and some were directed to the necessities of life, others to recreation, the inventors of the latter were naturally always regarded as wiser than the inventors of the former, because their branches of knowledge did not aim at utility."

*Aristotle, Metaphysics (981B)*

**"...regarding the work of an engineer and every art that ministers to the needs of life as ignoble and vulgar"**

*Plutarch, Parallel Lives, Marcellus (17:3-4)*



**Left:** A close-up of Plato and Aristotle in Raphael's masterpiece 'The School of Athens'

Plutarch gives an interesting assessment of Archimedes who among other things equipped Syracuse with many war machines. He also notes the worthlessness of engineers (using the common title of mechanic) while criticising the

stoics for failing to observe the doctrine of their founder Zeno:

"And yet, Archimedes possessed such a lofty spirit, so profound a soul, and such a wealth of scientific theory, that although his inventions had won for him a name and fame for super human sagacity, he would not consent to leave a treatise on the subject, but regarding the work of an engineer and every art that ministers to the needs of life as ignoble and vulgar, he devoted his earnest efforts only to those studies the subtlety and charm of which are not affected by the claims of necessity."

*Plutarch, Parallel Lives, Marcellus (17:3-4)*

"Moreover it is a doctrine of Zeno's not to build temples of the gods, because a temple not worth much is also not sacred, and no work of builders or mechanics ['engineers'] is worth much."

*Plutarch, Stoic. Rep. (1034B)*

"Socrates challenged the experimental point of view... [and] had in turn a pupil, Plato, who was even more vehemently opposed to practical testing of hypotheses by mechanical devices... Practical manipulation was vulgar, banal and fit for slaves."<sup>1</sup>

*W. H. G. Armytage, 'A Social History of Engineering'*

The philosopher's dislike of engineering is an outworking of the ideology which shaped their entire culture and society. 'Dualism' was the legacy left to those living in the first century by Greek philosophers living in the preceding seven centuries and this ideology persists in culture today. It is the belief that an 'ideal reality' exists somewhere other than everyday life. Plato's 'forms' are an expression of this truer reality which lies beyond the corruption and change of earthly human experience and 'matter.'

Access to the ideal or primary reality was through reason, which Plato identified as an activity of the soul and thus implied that any form of physical, bodily perception was inadequate for this purpose. Access to the perfect, eternal reality was via the mind alone and the head was therefore the most important member of the body. All other bodily members served the head and their relative importance depended upon their relation to the head. This cosmology and anthropology justifies the priority of abstract ideas over the activities of everyday life, engineering or otherwise.<sup>2</sup>

<sup>1</sup> W. H. G. Armytage, *A Social History of Engineering* (London: Faber and Faber, 1961), 24

<sup>2</sup> Mark Strom, *Reframing Paul: Conversations in Grace & Community* (Downers Grove: InterVarsity Press, 2000), 23-33.

Against this background it becomes apparent why Aristotle can write (see earlier quote) that those who work at something useful for serving the necessities of life (a reasonable definition of engineering) are less wise than those who pursue recreation. Similarly, Plutarch regards the work of an engineer, which “*ministers to the needs of life*” as “*ignoble*” and “*vulgar*” and considered their work to be of very little worth.

We certainly owe the Greeks for much work in mathematics and science.<sup>3</sup> However, the physical outworking of the discoveries made in these fields in the form of engineering and technology was limited by comparison. Judge argues that first century philosophy and science were “often locked into an abstract cycle of debate in general terms, driven more by the sheer rationality of the tradition than by reference to any actual social situation.”<sup>4</sup>

For the Greeks life was primarily to be understood, not changed. The perfect man sought to live the best life by escaping the world through abstract reason and this tension between a higher reality and physical matter gave rise to a dichotomy between intellect and skill. Engineering was a skill that lay within the ‘everyday reality’ which most would have preferred to leave behind in favour of the transcendent truer reality.<sup>5</sup> Engineering was not considered valuable as it requires engagement with the physical world, with soil, steel, timber, rock and water.

### Social Perception of Engineering Today

Today the perception of engineering is quite different. Garry Macdonald, a past president of The Institution of Professional Engineers New Zealand (IPENZ), makes the following comment about the social perception of engineering;

“From time to time, public surveys of favourable occupations are published. Very often, such surveys place firemen, police officers, teachers, nurses and doctors and the like in the ‘most trusted’ occupations. When engineers are included, we normally fare reasonably well, often not far below these groups.”<sup>6</sup>

*Garry Macdonald, Past President IPENZ*

Engineers within the profession certainly value their work because it benefits a broad cross section of society. Another former president of IPENZ, Anthony Wilson conveys this self understanding in his own assertion of the worth of the profession;

“When was the last time you stepped back and thought about what our society would be like if we could not rely on the built environment? How many generations is it in your family since you could not take for granted safe, readily available food, a water supply in your home, urban sanitation, energy (electricity and gas) on tap, reliable travel (by land, sea and air), just-in-time freight delivery, and instant communication? The answer, perhaps surprisingly, is three generations at most. Your grandparents could take none of these for granted, yet we (and I include many engineers with whom I talk) have forgotten just how far we have come in only a few decades.”<sup>7</sup>

*Anthony Wilson, Past President IPENZ*

The classical Greek tradition has arguably shaped Western culture more than any other. However, a shift in the social perception of engineering has occurred since the first century which means that engineering is commonly viewed positively as a profession critical to enabling our society to function well. So, what caused this shift?

### Two Great Traditions Shaping the Western Mindset and Culture

Two founding traditions predominantly shape Western thought and society. These traditions are the classical Greek world and perhaps surprisingly, a world view derived from Jewish origins.<sup>8</sup> As discussed above, the philosophers show us that the classical Greek view of engineering is not flattering. However, what of the second world view which shapes modern western thought? This is best conveyed through the interesting story of Saul of Tarsus, who brought both traditions starkly into contrast for the first time and ultimately undermined the dominant Greek culture.

---

3 Euclid's Elements (300 BC) is a rigorous and systematic presentation of mathematical theorems. Archimedes (287-212 BC) and Apollonius explored new areas of mathematical knowledge. Archimedes had a wide ranging talent which possibly brings him closest to work in an ‘engineering’ field, in addition to his contributions to astronomy and mathematics. He along with Ctesibius of Alexandria (270BC), Philo of Byzantine (200BC) and Hero of Alexandria (60BC) invented water clocks, mechanical puppets, fire pumps, steam toys and many military machines. Jonathan Barnes, “Hellenistic Philosophy and Science,” in *The Oxford History of the Classical World: Greece and the Hellenistic World* (Oxford: Oxford University Press, 1988), 375–378.

4 E. A. Judge, “St. Paul as a Radical Critic of Society,” *Interchange* 16 (1975): 191.

5 Most philosophers held sufficient rank and social esteem that they could avoid work and peruse this goal by indulging in rounds of intrigue and dialogue that marked men of leisure. Their desire for a transcendent reality reflects popular Greco-Roman thought in the first century.

6 Garry MacDonald, “An Engineer's Dilemma - Being Trusted or Valued!,” *Engineering Dimension*, August 2010, 2.

7 Anthony Wilson, “The Importance of Engineering to Our Society,” *Engineering Dimension*, May 2009, 2.

8 Mark Strom, *Arts of the Wise Leader* (Sydney; Auckland: Sophos Publications, 2007), 182.

# Seismic investigations and analysis



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Central Laboratories  
138 Hutt Park Rd  
Lower Hutt 5610  
Ph. 04 587 0600  
Gary.Bentley@opus.  
co.nz

Sarah Amore  
Hamilton Laboratory  
Fox Street  
Hamilton 3216  
Ph. 07 856 2870  
Sarah.Amore@opus.  
co.nz

Daniel Grebenar  
Auckland Laboratory  
Unit A, 7 Ride Way  
Albany 0632  
Ph. 09 415 4660  
Daniel.Grebenar@  
opus.co.nz

Denys Searls  
Dunedin Laboratory  
131 Main South Rd  
Dunedin 9018  
Ph. 03 488 0580  
Denys.Searls@opus.  
co.nz

Geoff Jones  
Christchurch  
Laboratory  
52c Hayton Rd  
Wigram  
Christchurch 8042  
Ph. 03 343 0739  
Geoff.Jones@opus.  
co.nz

Saul knew how to work the system so that he could operate in two very different camps. He was a staunch Jew living in the Roman city of Tarsus (south-eastern Turkey today) during the first century. Palestine, his beloved homeland, was heavily influenced by Greek Culture and occupied by oppressive Roman rule. Saul was a competent lawyer and importantly a Roman Citizen. However, he was also schooled in his Jewish history and a member of Jewish political party which condoned terrorist activity against the Roman occupation of Palestine. Saul was both the slick, educated, classical professional and the zealous, influential Jewish agitator.<sup>9</sup>

This position, background and skill set gave Saul a unique understanding of *both* the Greek and Jewish traditions and mindsets. He was able to recognise historical events during his lifetime as fulfilment of his Jewish traditions in an unexpected manner which demanded a thoughtful yet radical shift in his thinking to an entirely new mindset. He was also able to insightfully determine what this new mindset and the story behind it meant for life in his first century Greco-Roman world.

Contrary to the traditional, dominant Greek mindset, Saul's new story asserted that physical reality and earthly experiences are good and not something to be escaped in favour of abstract ideas of perfection. It also gave prominence to grace, freedom and equality of all people. Saul is famously noted for asserting that "there is neither Jew nor Greek, slave nor free, male nor female, for you are all one." This claim contradicted the basis for the very hierarchical social structure operating in the first century Greco-Roman world. A social structure which consigned a large proportion of society to the worthless 'lower classes' for life. Slavery was common practise and all were expected to know their place and stay in it.

Saul became known by the new name Paul and he initially shared his story with groups of around ten people at dinner parties. This new story and the counter cultural practise of living it out was so attractive that people gravitated to it in exceedingly large numbers. Not even fifty years later, history tells us that Pliny, the Roman governor of what is now north-western Turkey, writes to the Roman Emperor asking what should be done about the significant number of people subscribing to Paul's new story and the person at the centre of it.<sup>10</sup> This radical new story with its newly innovated patterns of thought and social relations was at risk of destabilising long standing (but not necessarily good) social behaviour and conventions of the first century Greco-Roman world.<sup>11</sup>

Mark Strom explains how Paul's story played out in history as follows:

"To subscribe to Paul's story in the wrong part of the empire in the first century could lead to an untimely demise under imperial decree. Three hundred years later, if you didn't, you couldn't be emperor. The shift was



Above: An engraving depicting Paul talking with Greek Philosophers in Athens

complete. Well, almost.

Paul's original vision was sustained, plagiarized, corrupted and creatively adapted. There is no simple picture to what happened in the fusion of church and empire in the centuries that followed. I have no doubt Paul would be dismayed at so much that has been said and done in his name. And yet his influence extended beyond what he could have ever imagined. Political systems, jurisprudence, public health and education as we know them in the Western world, every humanitarian institution and every domain of social reform—owes its existence and character to a very large degree to Paul's radical story and his example of grace and freedom, equality and gifting."<sup>12</sup>

Mark Strom, 'Arts of the Wise Leader'

### Reframing Engineering as Gift for Service

Paul's story is a radical advocate of engineers and the engineering profession, elevating it from the scrap heap in first century Greek thinking to an activity of God given significance.

Paul's positive view of the physical world and earthly human experience ennobles work with soil, steel, timber, water and rock. Likewise his understanding of the equality and worth of all people at every level of society endorses the use of engineering for the good of humanity. It is good to build hospitals, houses and infrastructure and to ensure that all society has adequate water, food, sanitation and means of communication.

9 Ibid., 183.

10 Ibid., 193.

11 Strom, Reframing Paul, 103-04.

12 Strom, Arts of the Wise Leader, 193-94.

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Engineers engage with both humanity and nature to provide the needs of humanity and steward nature in a manner which amplifies both spheres.

Paul's story reminds us that our engineering efforts should be on behalf of both humanity and nature and that both are worthy of our engagement and effort. Paul would agree that engineers engage with both humanity and nature to provide the needs of humanity and steward nature in a manner which amplifies both spheres. The work we do means that we are uniquely placed and trusted to engage with, and on behalf of, both entities.

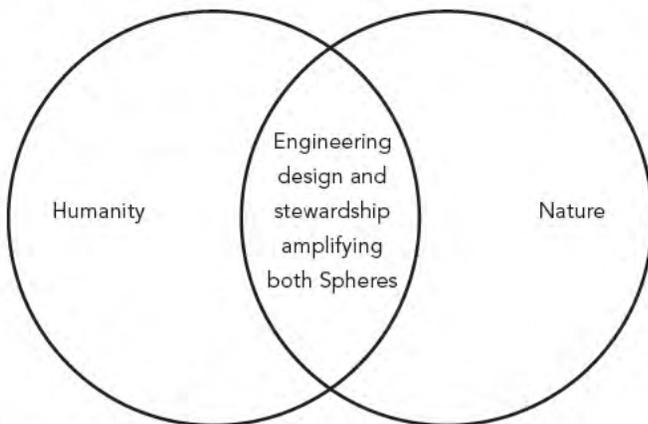


Figure 1: Engineering at the interface between humanity and the physical world

### Concluding Thoughts

The influence of Paul's story and the man at the centre of it has contributed massively to the current cultural climate in the Western world which, contrary to the dominant first century Greek mindset, values engineering.

Paul's story elevates engineering from work of minimal worth in abstract classical Greek thinking to an activity of vital importance. Paul's assertions that the physical world and earthly human experience are good and that all humanity should be allowed equality and freedom has created a cultural climate which frees us to engage in design, innovation and construction as a valued and vitally necessary pursuit.

Paul's exciting invitation and challenge is to see our work as part of a bigger story and to reframe our skill as engineers as 'gift for service.' What can we create given that we are uniquely placed to engage with both humanity and nature for the benefit of both?

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## Geotechnical Data Processes

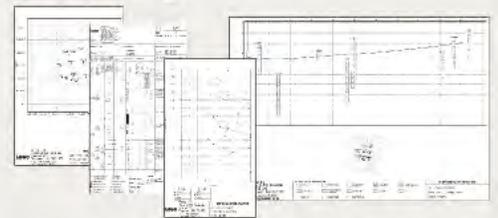
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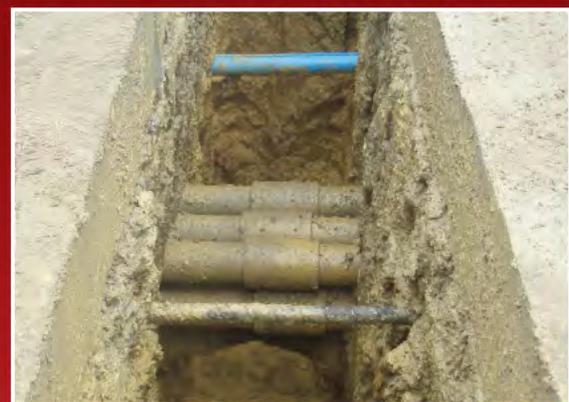


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**TECHNICAL ARTICLES**

**Liquefaction Vulnerability in Canterbury –the Liquefaction Severity**

**Number** – Tonkin & Taylor: Pierre Malan; Dr. Sjoerd van Ballegooy; Virginie Lacrosse; Mike Jacka

**Introduction**

The 2010–2011 Canterbury Earthquake Series has affected Christchurch City and the Canterbury region and caused widespread liquefaction, lateral spreading and ground surface subsidence. Areas believed to be affected by

liquefaction exhibited varying levels of damage. To better understand the effect of liquefaction at residential sites, a liquefaction vulnerability study was carried out by Tonkin & Taylor Ltd for the Earthquake Commission. The study considered liquefaction vulnerability parameters and how

Land Damage Categories		Dwelling Foundation Damage Categories			
Category	Criteria / Description	Type of Damage	Minor	Moderate	Major
1 Blue	No observed ground cracking or ejected liquefied material	Stretching 	0 to 5mm	5 to 30mm	>30mm
2 Green	Minor ground cracking but no observed ejected liquefied material	Hogging 	0 to 20mm	20 to 50mm	>50mm
3 Light Orange	No lateral spreading but minor to moderate quantities of ejected material	Dishing 	0 to 20mm	20 to 50mm	>50mm
4 Dark Orange	No lateral spreading but large quantities of ejected material	Racking/Twisting 	0 to 10mm	10 to 30mm	>30mm
5 Red	Moderate to major lateral spreading; ejected material often observed	Tilting 	0 to 20mm	20 to 50mm	>50mm
6 Dark Red	Severe lateral spreading; ejected material often observed	Abrupt Differential Movement 	0 to 10mm	10 to 20mm	>20mm
		Global Settlement 	0 to 50mm	50 to 100mm	>100mm

Figure 1: Land damage and dwelling foundation damage inspection criteria

they related to the liquefaction and lateral spreading damage observations made around Canterbury. It also introduced a new liquefaction vulnerability indicator, the Liquefaction Severity Number (LSN). This paper summarises a more extensive, publicly available, report on the liquefaction vulnerability study that is referenced below.

Tonkin & Taylor (2013) *Liquefaction Vulnerability Study* for the Earthquake Commission, February 2013 Ref 52020.0200 v1.0

<https://canterburygeotechnicaldatabase.projectorbit.com/Maps/EQC/TT-LiquefactionVulnerabilityStudy.htm>

The liquefaction vulnerability study compares datasets of land and dwelling related damage observations from the Canterbury Earthquake Series with three parameters representing liquefaction vulnerability. The report demonstrates that a new liquefaction vulnerability parameter, the Liquefaction Severity Number (LSN) provides a better fit to observed liquefaction-induced damage than existing parameters such as the Liquefaction Potential Index (LPI) or calculated settlement (S).

**Background**

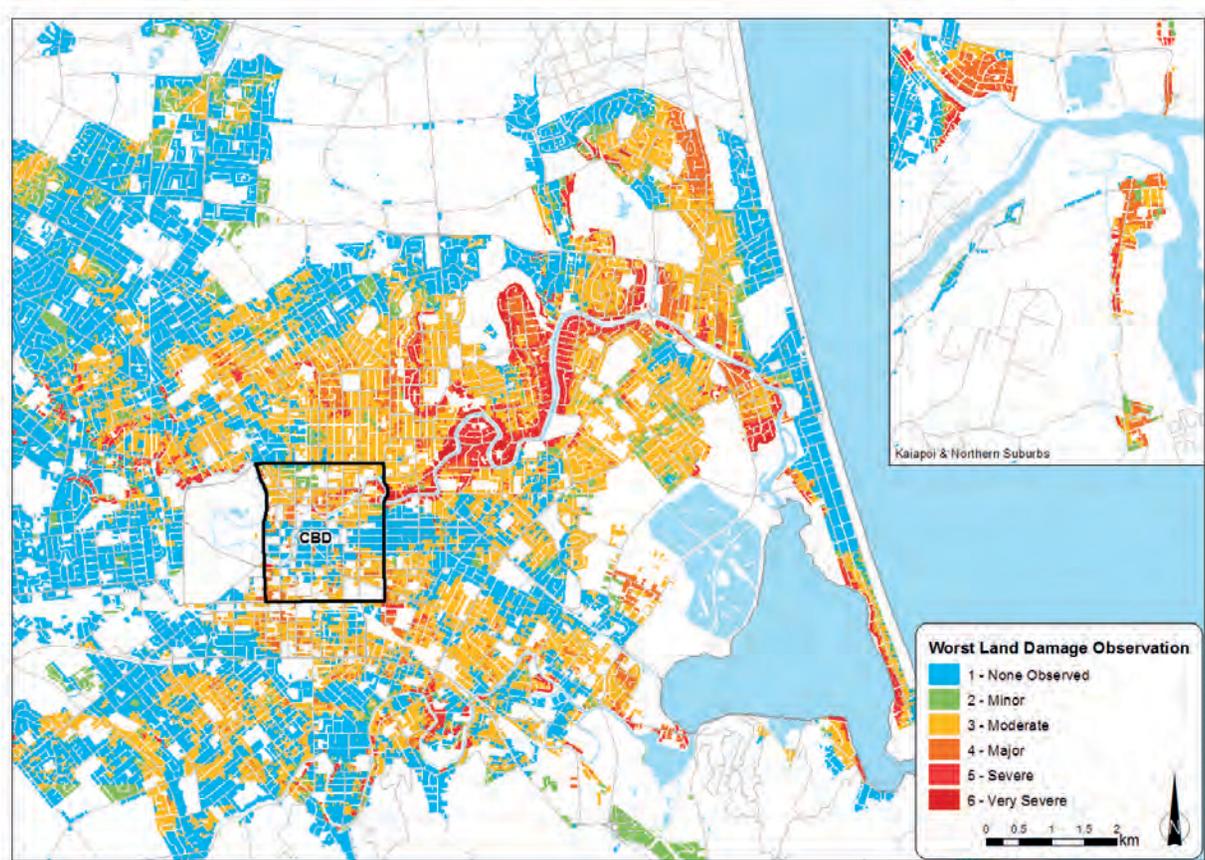
The four most significant earthquakes in the 2010-2011 series were the 04 September 2010, 22 February 2011,

13 June 2011 and 23 December 2011 events. Following these earthquakes, land damage mapping was undertaken, based on the criteria in Figure 1, to assess the extent and severity of surface liquefaction manifestation. The land damage mapping was carried out by a team of geotechnical engineers who cross-checked observations to ensure broad consistency across their assessments. Figure 2 shows the most severe observation made for each property during the earthquake series.

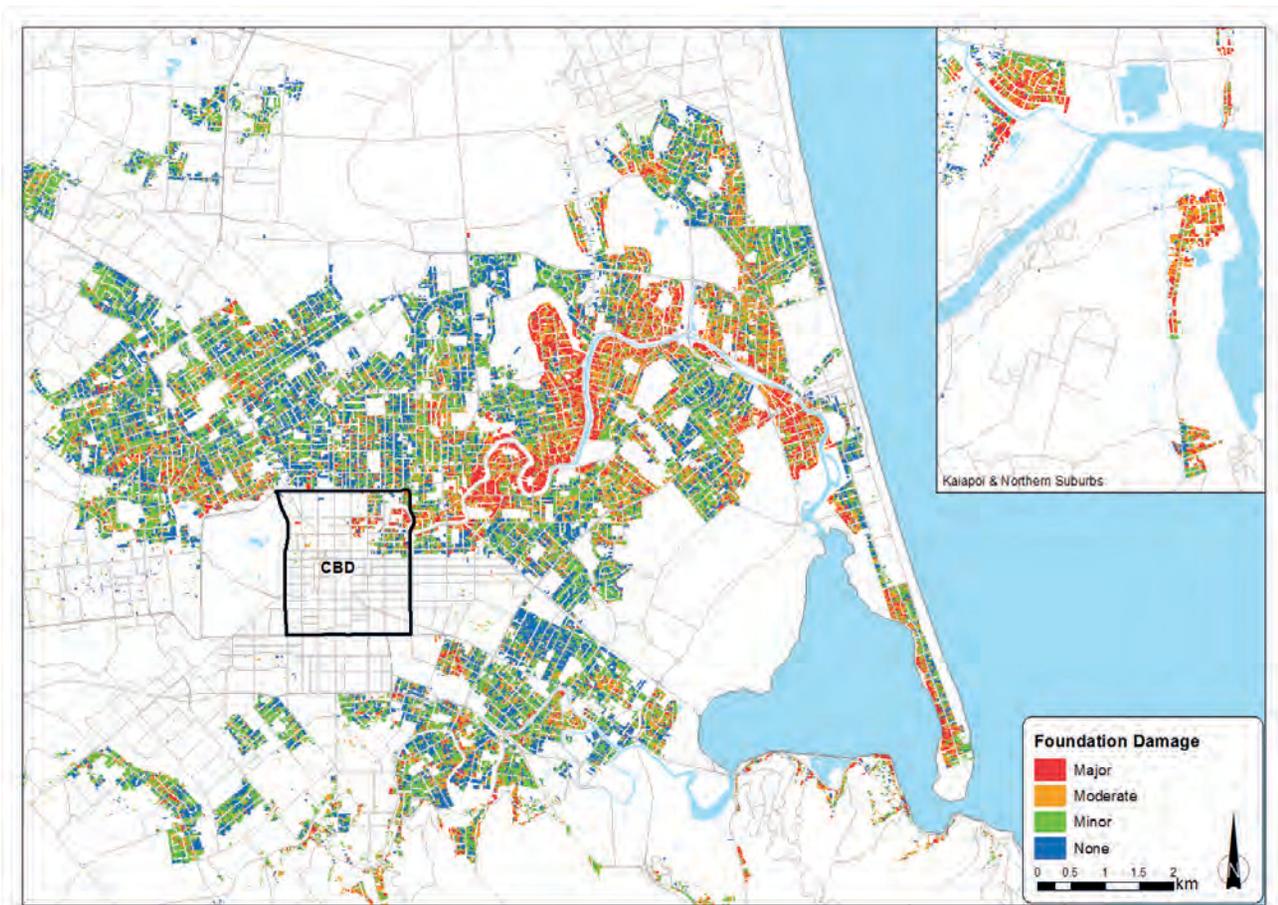
In addition to the land damage mapping, a more detailed damage inspection programme was undertaken on residential properties with Earthquake Commission claims for land damage. The visually observed damage to the foundations of residential houses was recorded based on set criteria Figure 1. Approximately 75,000 inspections were undertaken on around 60,000 properties (i.e. some properties were re-inspected).

The foundation damage to dwellings (defined in Figure 1) has been compiled into a database and the worst mapped foundation damage severity of the seven types plotted on a map on Figure 3. If more than one inspection was undertaken for the property, then the inspection with the worst foundation damage was plotted on Figure 3. White areas on Figures 2 and 3 are properties where no observations were made.

Flown survey measurements (LiDAR) were undertaken



**Figure 2:** Distribution of worst earthquake induced observed liquefaction and lateral spreading surface observations in Canterbury for the earthquake series



**Figure 3:** Distribution of worst earthquake induced foundation damage observations in Canterbury for the earthquake series

over the affected areas of Canterbury after each of the major earthquakes. From the data, bare earth surfaces were developed and compared to prepare models of vertical changes in elevation. These models were corrected for the estimated tectonic deformation (Beavan et al, 2012). The resulting models represent the change in ground elevation mainly due to liquefaction related subsidence effects including volumetric densification of the soil deposits, vertical subsidence resulting from liquefaction induced lateral spreading and removal of ejected material from the ground surface. A map showing the total liquefaction related subsidence from the earthquake series is shown in Figure 4.

As a result of the damage caused by the Canterbury Earthquake Series, the New Zealand Government has classified residential land in Canterbury into various zones and categories, shown in Figure 5. The classification into technical categories includes the consideration of calculated settlements based on methods stated in guidance documents (MBIE, 2013). The calculated settlement has therefore been investigated as a liquefaction vulnerability indicator in this report.

As of March 2013, the land damage mapping was supplemented by an extensive geotechnical site investigation program that included approximately 7,500 CPT, 1,000 boreholes with SPTs, geophysical testing, and piezometers.

The number of investigations will continue to increase as the rebuilding of Christchurch progresses. Subsurface data are available through the CERA geotechnical database: <https://canterburygeotechnicaldatabase.projectorbit.com>. The CPT soundings in conjunction with conventional liquefaction triggering methods have been used as the primary tools to assess the depth of the critical layer for liquefaction triggering and to derive parameters representing liquefaction vulnerability. The CPT locations in Christchurch of all CPT greater than 5m depth are shown in Figure 5. It is noted that the spatial distribution of geotechnical investigation data (including CPT) are concentrated in the TC3 areas where ground investigations are required for foundation design purposes (MBIE, 2012).

### Literature Review

Ishihara (1985) published observations on the protective effect of an upper layer of non-liquefied material against the effects of liquefaction at the ground surface. He plotted material observations of sand ejection for sites using the thickness of the underlying liquefied layer (H2) and the thickness of the overlying non-liquefied surface layer (H1), often referred to as the crust. Ishihara's work was based on observations from two earthquakes with limited ranges of ground accelerations. Boundary curves were defined that separated those sites which had

manifestations of liquefaction at the ground surface from those sites that did not.

Youd & Garris (1995) added data to the Ishihara (1985) plot and showed that it captured their dataset from 13 additional earthquakes. Their conclusions were that the Ishihara bounds for sites not susceptible to liquefaction-induced ground damage appear to be valid but that these bounds were not always reliable for predicting ground surface deformation for sites prone to liquefaction. Both studies indicated that the crust typically had a critical thickness beyond which surface manifestations of liquefaction were unlikely regardless of the thickness of underlying liquefied material (H2). These studies did not directly measure damage to structures, but instead considered only whether evidence of liquefaction was observed at the ground surface. The conclusion drawn was that an upper crust of non-liquefiable material has a beneficial effect in mitigating the damaging effects of liquefaction at the ground surface.

The vulnerability of sites to liquefaction was also considered by Iwasaki (1982) and subsequently by Juang (2005). Iwasaki's Liquefaction Potential Index (LPI) is a measure of the vulnerability of sites to liquefaction effects. LPI is the summation of liquefaction severity in each soil layer, which in turn is a function of the Factor of Safety for liquefaction triggering (FoS), weighted by a depth factor that decreases linearly from 10 to 0 over the top 20 m. The resulting LPI varies between 0 and 100 (representing negligible to high vulnerability to liquefaction-induced ground damage). The LPI uses a liquefaction triggering methodology, which incorporates the soil density and soil profile (which is inferred from the CPT in this study), depth to groundwater, and shaking severity represented by the Cyclic Stress Ratio (CSR) (Idriss & Boulanger 2008). It addresses a multi-variate problem in terms of a single parameter.

### Liquefaction vulnerability parameters

For each CPT, the following three liquefaction vulnerability parameters were calculated:

1. Liquefaction Potential Index (LPI) calculated in accordance with Iwasaki (1982):

$$LPI = \int_0^{20} F_1 W(z) dz \quad (1)$$

where  $W(z)=10-0.5z$ ,  $F_1=1-FoS$  for  $FoS < 1.0$ ,  $F_1=0$  for  $FoS \geq 1.0$ ,  $FoS$  is the factor of safety calculated from the Idriss & Boulanger (2008) liquefaction triggering evaluation procedure and  $z$  is the depth below the ground surface in meters.

2. Calculated Settlement (S) calculated in accordance with MBIE (2012):

$$S = \int \epsilon_v dz \quad (2)$$

where  $\epsilon_v$  is the calculated post-liquefaction volumetric reconsolidation strain based on the Zhang et al (2002) strain equations which are a function of the factor of safety calculated from the Idriss & Boulanger (2008) liquefaction triggering evaluation procedure and the relative density of the soil determined from the CPT tip resistance and  $z$  is the depth below the ground surface in meters.

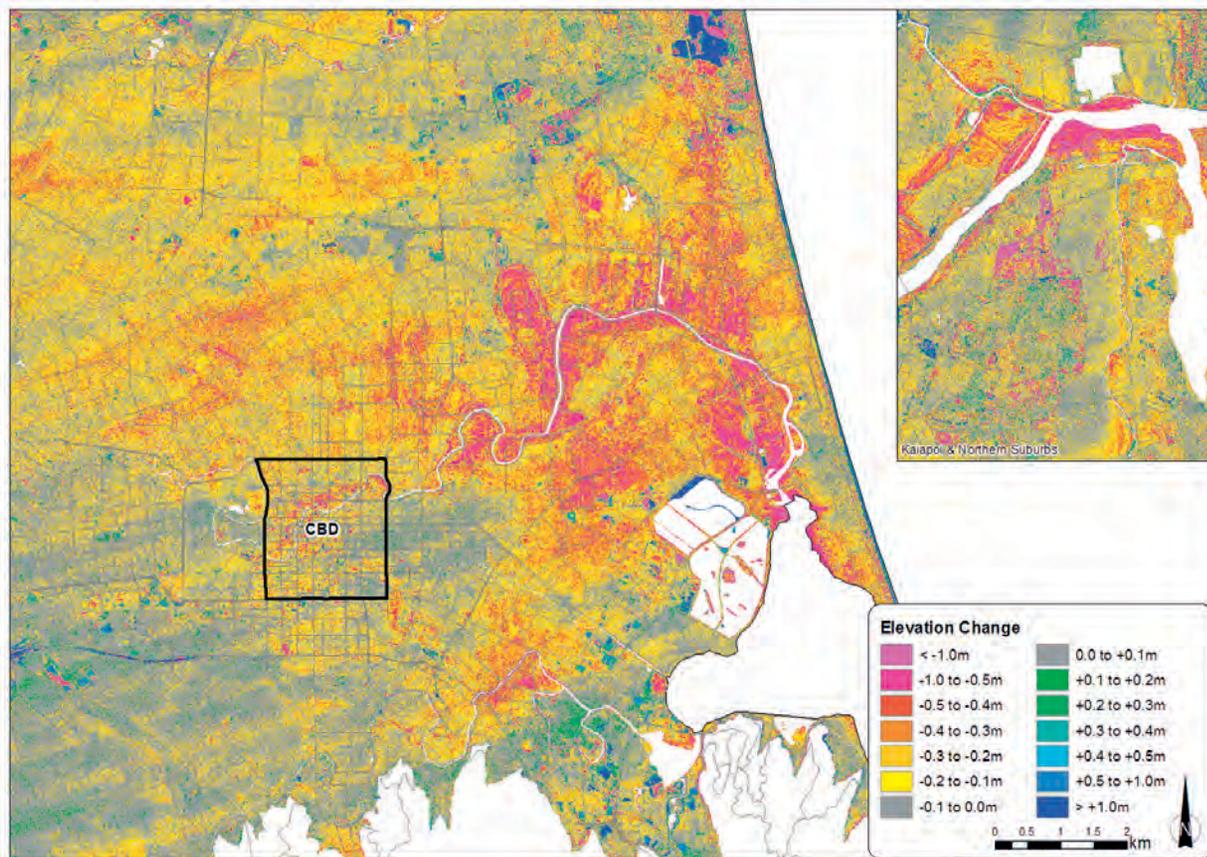
3. Liquefaction Severity Number (LSN), a new parameter calculated in accordance with Tonkin & Taylor (2013) to evaluate liquefaction-induced land damage, is defined as:

$$LSN = 1000 \int \frac{\epsilon_v}{z} dz \quad (3)$$

where  $\epsilon_v$  is the calculated post-liquefaction volumetric reconsolidation strain entered as a decimal, and  $z$  is the depth below the ground surface in meters for depths greater than zero. In practice, LSN is calculated as the summation of the post-liquefaction volumetric reconsolidation strains, each calculated for an underlying soil layer divided by the depth to the midpoint of that layer.

Iwasaki's LPI represents an early attempt to develop an index for assessing the vulnerability of land subjected to liquefaction. Its value is between 0 (representing no liquefaction vulnerability) and 100 (representing extreme liquefaction vulnerability). LPI provides a straightforward method for assessing the vulnerability of sites, with published ranges of values indicating the severity of liquefaction. Sites with an LPI of more than 5 have a high liquefaction risk, and sites with LPI greater than 15 indicate very high risk (Iwasaki, 1982). While the LPI is a useful parameter that captures important aspects of liquefaction vulnerability, this study identified some limitations of LPI, which are discussed later.

The calculated settlement (S) has been compared with the measured ground surface subsidence (corrected for vertical tectonic displacement) for each earthquake event (Tonkin & Taylor, 2013). This showed there is no apparent direct relationship between the calculated settlement (S) and the measured liquefaction induced ground settlement. However, there is a weak correlation between the calculated S and the liquefaction and lateral spread observations discussed below. The S parameter can be better considered as a proxy for the likelihood of liquefaction related damage at the ground surface, rather than a calculation of predicted settlement. Similarly, MBIE (2012) describe the calculated settlement (S) parameter as an index value (rather than an absolute settlement value) for the purpose of indexing the



**Figure 4:** Liquefaction related subsidence from a change in ground elevation from before the September 2010 earthquake to after the December 2011 earthquake

predicted land performance for technical categorisation and foundation design purposes.

The theoretical value of LSN varies from 0 (representing no liquefaction vulnerability) to more than 100 (representing very high liquefaction vulnerability). Very large LSN values can only be calculated when the groundwater table is very close to the ground surface and soil layers immediately below the ground surface are assessed as being at risk of liquefaction.

LSN is an extension of the LPI philosophy. It attempts to quantify the effects of liquefaction and consequent land damage using volumetric strains (adopted in conventional settlement calculations recommended by MBIE (2012)) in conjunction with depth weighting by a hyperbolic function ( $1/z$ ) rather than a linear reduction. The hyperbolic function gives much greater weight to liquefaction at shallow depths. LPI considers a linear reduction with depth, while S which gives equal weighting to all liquefying soil layers irrespective of depth. The LSN calculation weights shallow liquefaction as the key contributor to land and foundation damage. This inference was supported by general observations during the liquefaction-induced land damage mapping, particularly the observation that ejection of liquefied material and loss of crust integrity tended to result in significant differential settlements, with various forms of severe ground distortion, cracking, and fissuring.

The important differences between the proposed LSN

parameter and the existing LPI and S parameters are:

- Because S and LSN are based on volumetric strains, they are continuously calculated even for FoS of greater than one. Thus, S and LSN values start to increase as excess pore water pressures rise when  $FoS < 2.0$ , and include a continuous smooth transition when  $FoS < 1.0$ . Conversely, LPI accounts for the effects of layers only with  $FoS < 1.0$ . It will be seen later that S and LSN start to increase at lower accelerations than LPI, because S and LSN reflect the weakening effect of soil layers where FoS is falling towards, but not yet below unity.
- The maximum damage contribution of any soil layer within the deposit is limited by the initial relative density of the soil as represented by CPT tip resistance. This is implied by the Zhang et al (2002) volumetric strain relationships used in the S and LSN calculations. In these relationships a limiting volumetric strain is eventually reached, which is a function of the soil's relative density and not a function of the seismic demand. Conversely, the LPI parameter continues to increase with increasing PGA because it is a direct function of FoS, which continues to decrease as the seismic demand increases.
- Liquefying layers with a lower relative density are expected to develop larger strains which in turn will result in larger damage at the ground surface as

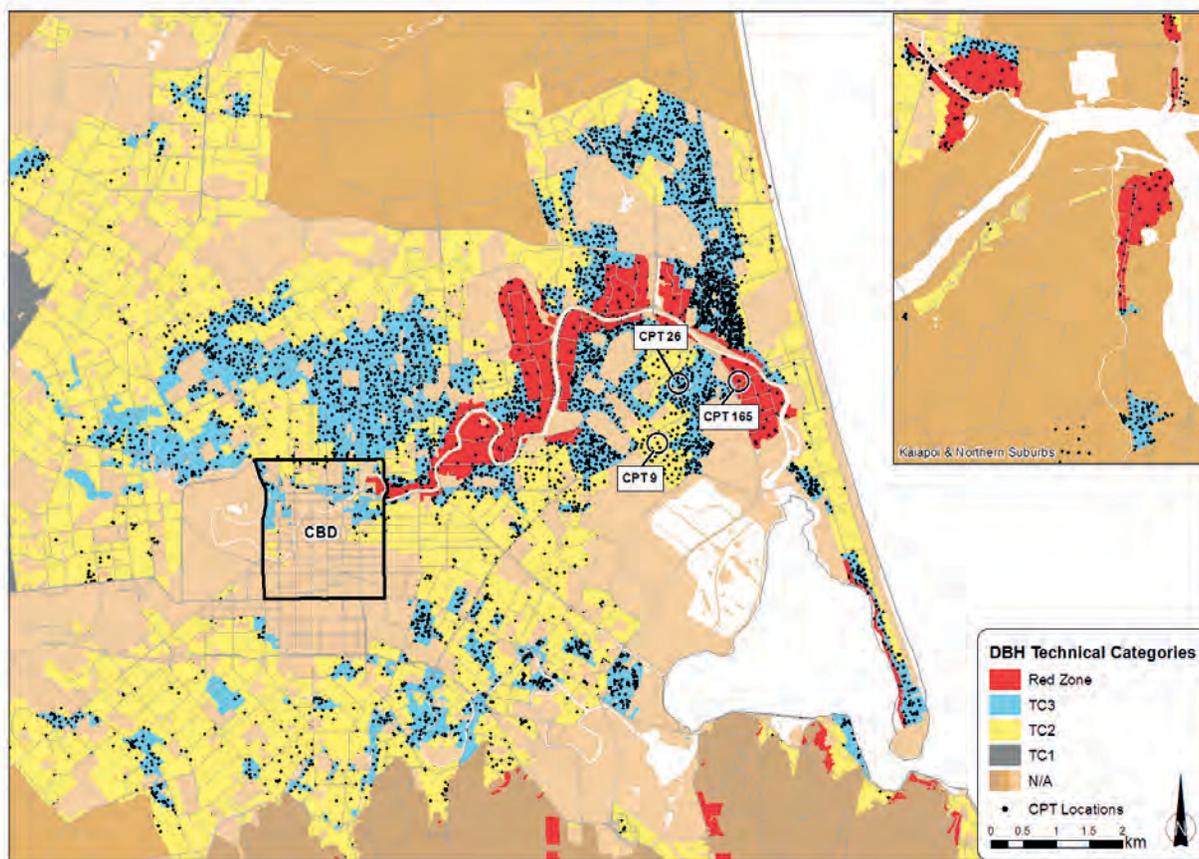


Figure 5: – Technical categories and CPT investigations available on the Canterbury Geotechnical Database in March 2013

compared to the effects of liquefaction from a layer with higher relative density. With S and LSN the calculated strain value is used as a damage index that includes the effects of strength loss and the potential for soil ejecta rather than as an index purely for settlement calculation (discussed above). By contrast, for a calculated FoS, LPI provides the same value irrespective of the relative density of the soil. This approach erroneously indicates that the consequences of liquefaction are not related to the relative density of the liquefied soils for a given FoS. Because LPI does not explicitly address the relationship between relative density and FoS, it should be less successful in differentiating between the damage potentials of sites with different densities of soil.

- Complementary to the work of Ishihara (1985), LSN places greater importance on the thickness of the non-liquefied crust when the groundwater table is close to the ground surface through the use of the hyperbolic depth weighting function. LSN suggests that shallow liquefaction is significantly more damaging for land and surface structures than deep liquefaction relative to the contribution of shallow and deep layers in LPI. By contrast the S parameter places equal contribution of potential ground surface damage for both shallow and deep liquefying soil layers and therefore does not place any importance on the thickness of the non-liquefying crust.

### Response of liquefaction vulnerability indicators to PGA

The response to PGA of these vulnerability indicators calculated from three sample CPT (locations shown on Figure 5) is shown in Figure 6 based on the post-December 2011 depth to groundwater. The CPT in the Red Zone shows that below 0.1 g for S and LSN, and below 0.15 g for LPI, the indicators do not respond to PGA. Similar trends are also observed for the TC2 and TC3 CPT, but the threshold PGAs are higher for the TC3 CPT and higher again for the TC2 CPT. This is consistent with the observed and expected land performance for the respective Technical Categories. LPI continues to increase with increasing PGA, but the rate of increase in S and LSN steadily decreases with increasing PGA. This is because the contribution to S and LSN is strain-limited with respect to the initial relative density of the soil. This strain limiting response is a characteristic that is generally consistent with field observations over the various earthquakes of the Canterbury Earthquake Series. The S parameter does not differentiate significantly for the three CPT, which is inconsistent with the observed land performance. In contrast, the LSN better differentiates the three sites. This is because the S parameter does not include the beneficial effects of the non-liquefying crust, whereas the LSN parameter does.

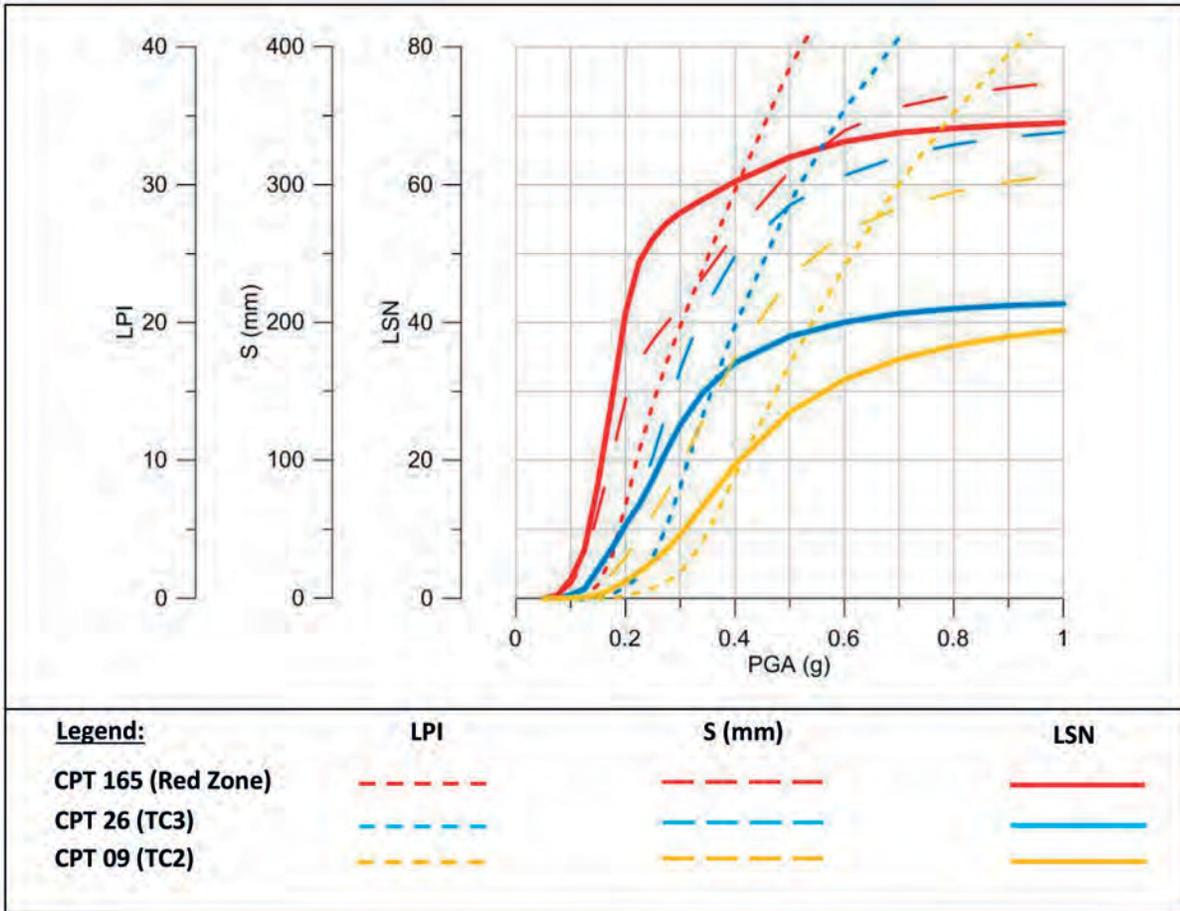


Figure 6: Sensitivity of LPI, S and LSN to PGA (M7.5) for selected TC2, TC3 and Red Zone CPT

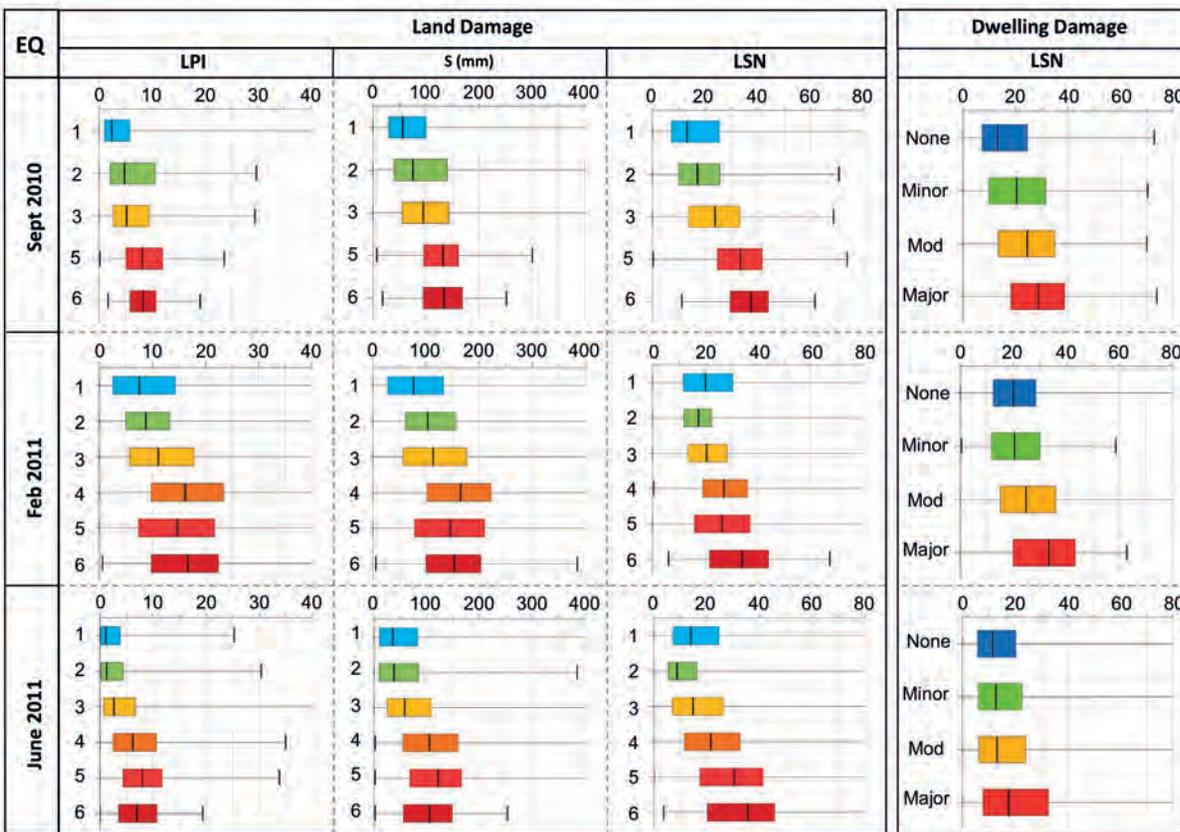


Figure 7: Box and whisker plots of LPI, S and LSN correlated with observed land damage and dwelling damage for the 4 September 2010, 22 February and 13 June 2011 earthquakes

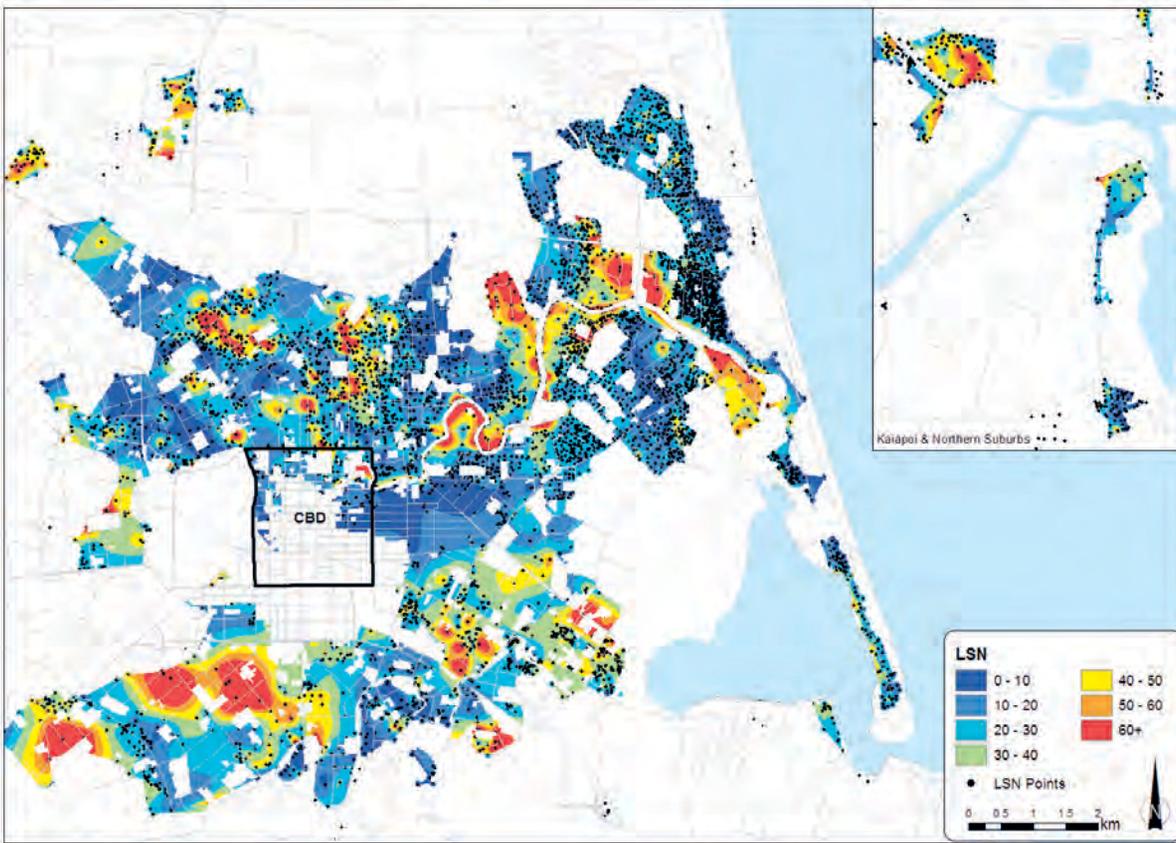


Figure 8: Distribution of highest calculated Liquefaction Severity Number (LSN) across Christchurch for all modeled earthquakes

**Correlation of damage data with LPI, S and LSN**

Figure 7 shows a comparison of the observed land damage and residential dwelling foundation deformation damage, plotted against the vulnerability indicators *LPI*, *S* and *LSN* for the September 2010, February 2011 and June 2011 earthquakes as a series of box and whisker plots. The liquefaction parameters were calculated for the entire CPT data set based on the ground water levels immediately prior to each earthquake event (Tonkin & Taylor, 2013) and the spatially varying seismic demand (Bradley and Hughes, 2012). The range in calculated values is denoted by the horizontal line showing the minimum and maximum data points. The box shows the median, upper quartile and lower quartile values. The criteria for the damage categories are defined in Figure 1. Following the September 2010 earthquake the land damage mapping combined categories 3 and 4, and they are presented below as a combined category 3.

An analysis of the data indicates that *LPI*, *S* and *LSN* all broadly correlate with measured damage to land and dwelling foundations. For the *LPI* parameter however, the relationship between the *LPI* value and the observed damage is different for each event. This indicates that the *LPI* correlation with land damage and foundation damage is event specific and produces inconsistent responses to the three events. The *S* parameter has substantial overlap between damage categories and is inconsistent between events. This lack of repeatability in the damage trend for *LPI* and *S* limits their usefulness as vulnerability indicators

to assess future land performance. Of the three parameters considered, the *LSN* provides the best and most consistent fit to the data sets, and provides most value as a tool for the prediction of future performance.

The spatial distribution of the highest calculated *LSN* values for each property based on the groundwater levels and seismic loadings from each event are presented in Figure 8. This can be compared directly with the damage data shown in Figures 2, 3 and 4. The comparison shows that there are generally strong correlations between areas of observed land and foundation damage and subsidence due to liquefaction effects with areas with high *LSN*. A review of maps of *LPI* and *S* show that *LSN* provides a more consistent spatial fit to the mapped land damage through the earthquake series.

There is substantial scatter within the correlations due to variations in crust quality, geological conditions, the actual PGA experienced at the site, the actual depth to groundwater at the time of earthquakes, the presence of lateral spreading and the probabilistic nature of liquefaction triggering calculations, including the assumptions for estimating fines content or cut-off values for materials too fine grained to liquefy.

It is noted that *LSN* is not intended to be an indicator of vulnerability to lateral spreading hazard. Therefore, not all the areas with land damage have been identified because of the occurrence of superimposed damage from lateral spreading.

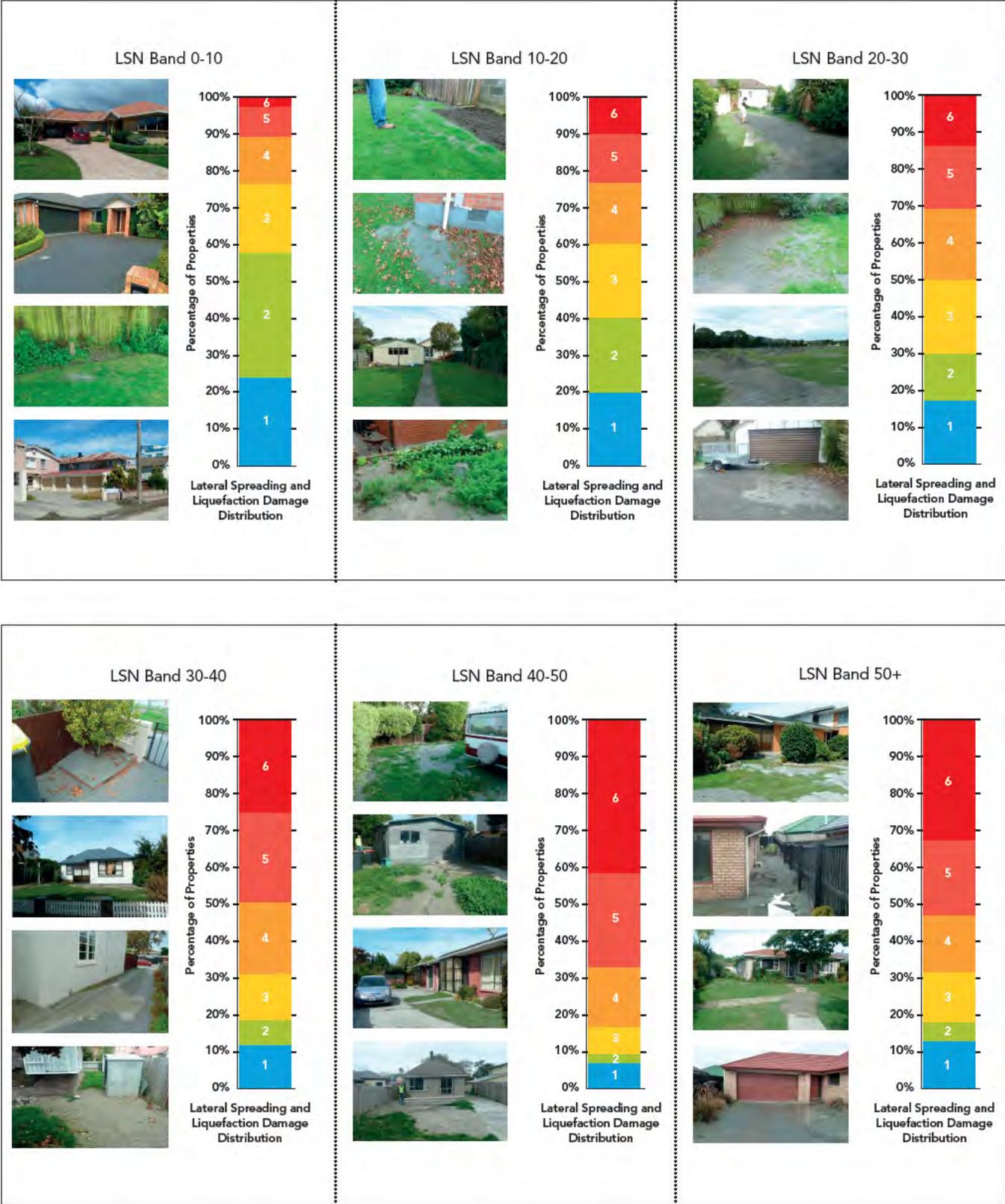


Figure 9: – Photographs of Typical Land Damage for LSN Ranges (Based on UoC PGA Distribution)

## Example of LSN

Photographs have been reviewed which show damage at sites with calculated *LSN*. These have been collated into various *LSN* ranges (e.g. *LSN* of 0–10, 10–20 etc.). A summary of these photos is presented on Figure 9. The photos visually show that sites with higher *LSN* values are more likely to experience damage compared to sites with lower *LSN* values.

The typical behaviour of sites with a given *LSN* are summarised in Table 1 below. It is important to reiterate that due to natural variations, the *LSN* describes a range of possible damage and the information below represents only a typical behaviour. The actual site performance may sometimes vary from this due to the influence of many other factors that can affect site performance. It is important to note that the correlations are based on the performance of Canterbury soils in the recent earthquake series and represent local site conditions and construction types as well as the local ground motion characteristics. Careful assessment and consideration should be undertaken before relying on these conclusions in other areas.

**Table 1** *LSN* Ranges and observed land effects

<i>LSN</i> Range	Predominant performance
0 – 10	Little to no expression of liquefaction, minor effects
10 – 20	Minor expression of liquefaction, some sand boils
20 – 30	Moderate expression of liquefaction, with sand boils and some structural damage
30 – 40	Moderate to severe expression of liquefaction, settlement can cause structural damage
40 – 50	Major expression of liquefaction, undulations and damage to ground surface, severe total and differential settlement of structures
50+	Severe damage, extensive evidence of liquefaction at surface, severe total and differential settlements affecting structures

## Summary and conclusions

This summary paper presents the results of a comparison of various vulnerability indicators with observed damage datasets for the Canterbury Earthquake Series. The damage datasets comprise land damage, dwelling foundation damage and flown LiDAR settlement survey. The Liquefaction Potential Index (*LPI*), calculated settlement (*S*) and Liquefaction Severity Number (*LSN*) were calculated using a regional groundwater model, spatial distributions of seismic loading and geological data from a regional investigation.

*LPI* produced correlations that show clear trends within each earthquake dataset, but not consistently between earthquakes. This limits the usefulness of *LPI* as a predictive tool as the ranges indicating damage vary depending on the magnitude and location of the earthquakes that may occur.

The range of calculated *LPI* values is not consistent with the published indications of damage category.

There is no apparent direct relationship between the calculated settlement (*S*) and the measured liquefaction induced ground settlement. However, there is a correlation between the calculated settlement and the liquefaction and lateral spread observations. Therefore, the calculated settlement can be considered as a proxy for predicting the likelihood of liquefaction related damage, albeit with a significant amount of overlap between the observed damage categories.

The *LSN* analyses show that there is a more consistent correlation, both within each earthquake and between various earthquakes for the different categories of liquefaction and lateral spreading observations. The *LSN* differentiates the most severely damaged land from the least severely damaged and represents the risk of adverse liquefaction related damage occurring at the ground surface.

Of the three vulnerability indicators considered, *LSN* provides the best correlations with the liquefaction land damage observations and is therefore considered to be most suitable parameter for predicting future land performance in Canterbury.

## Acknowledgements

We acknowledge and recognise the significant contribution made by Hugh Cowan (Earthquake Commission) and the peer reviewers Tom O'Rourke (Cornell University), Jonathan Bray (University of Berkeley) and Misko Cubrinovsky (University of Canterbury). This work would not have been possible without the data supplied by the New Zealand Government through its agencies the Earthquake Commission, the Ministry of Civil Defence and Emergency Management and Land Information New Zealand.

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in under 20 minutes, with the use of specially modified drag bits and 800cfm compressors to remove the tailings out of the holes. Staff following the drill crews quickly installed the bars and grout completing the demanding project in record time. This may all sound like a rather typical civil engineering stabilising day's work, but throw in continuous rain, rope access teams involvement to roll out rock fall prevention mesh and a couple of unidentified ongoing landslides and you will appreciate the quality and efficiency of these professionals.

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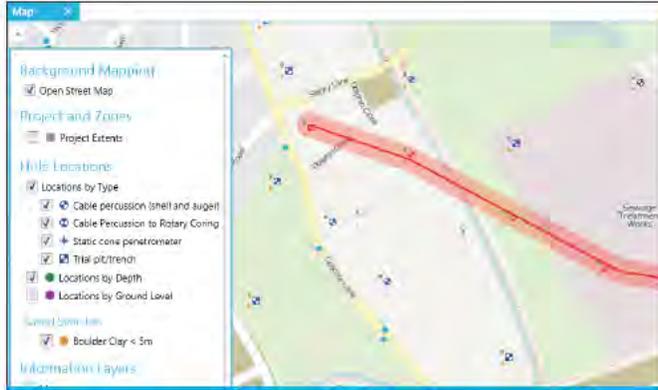
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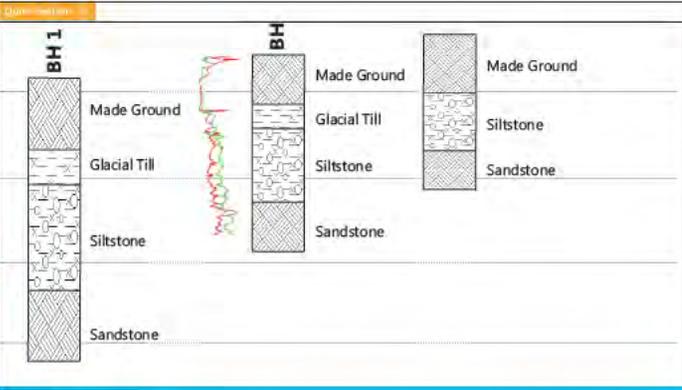
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## Tui Mine Tailings Remediation Project – Geotechnical, Environmental and Construction Challenges

– Project case study of the recently completed, largest contaminated site remediation in New Zealand. **G.P Quickfall**, Hiway Environmental Ltd, Auckland, **G. Basheer**, Environment Waikato, Hamilton, **B. Croucher**, Ministry for Environment, Wellington, **I. R. Jenkins, D.L Fellows**, URS New Zealand Ltd, Auckland, **T. Willson**, Tonkin and Taylor, Hamilton

### Introduction

THE TUI MINE is an abandoned mine site on the western flanks of Mt Te Aroha. The mine produced a range of base metals, including copper, lead and zinc from 1966 to 1973, when it was abandoned by Norpac Mining Co. The mine produced 13,159 tonnes of zinc concentrate, 7,755 tonnes of copper lead concentrate, 3,050 kg of silver and 69 kg of gold from 163,000 tonnes of ore.

The site is located within the catchments of the Tui and Tunakohoa Streams, both of which flow into the Waihou River at the base of Mt Te Aroha, in the Waikato.

The site consisted of a tailing dam and impoundment containing some 100,000 m<sup>3</sup> of tailings, a number of mine adits, waste rock and ore dumps and stockpiles. There are various water discharges from the site including adit drainage, natural catchment drainage and contaminated under drainage (low pH, high dissolved metals concentrations) from waste rock and tailings.

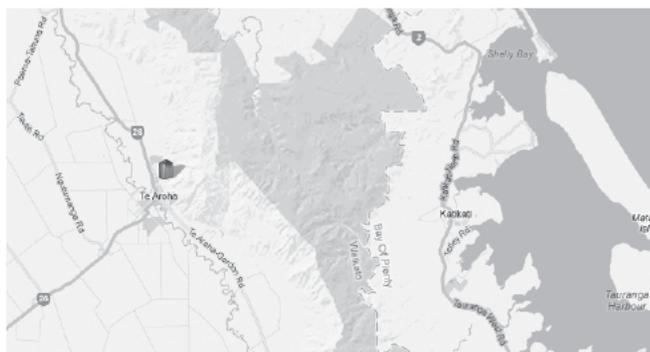


Figure 1: Tui mine location

There have been a number of previous rehabilitation initiatives at the site, but none have resulted in any effective improvement in water quality discharging from the site and hence improvements in the receiving water quality. During the 1970's, buttressing of the tailings embankment was completed as a temporary measure.

Over the last 20 years, concerns increased regarding adverse effects arising from the site, including water contamination due to acid rock drainage, the threat of tailings impoundment failure and the lack of effective rehabilitation of the site. Given the nature of the site, the Local and Regional Authorities, Department of Conservation (DOC) and Ministry for the Environment (MfE) initiated the review of site remediation options.

During the period from 1974 to 2009, a number

of site investigations, geochemical and geotechnical characterisation testing and reporting was carried out on the Tui mine site primarily by URS and Tonkin and Taylor Consultants. An assessment of various remedial options was also completed. The options were assessed and assigned a ranking based on long term effectiveness, risk assessment, constructability and cost. The favoured option to stabilise the tailings on site and to create a regraded landform was selected in 2009.

The remediation aimed to provide a sustainable solution for the long term environmental security, provide geochemical and geotechnical improvement, consider cultural and social implications and preserve the mining heritage.

In 2009, Hiway Environmental (HE) provided advice and potential methodologies for achieving the preferred stabilisation option. A full scale field trial was necessary to prove the Geotechnical and Geochemical performance, constructability and to enable design refinement. A field trial of both Insitu Mass Stabilising (IMS) and Exsitu Mass Stabilising (EMS) and blending of approximately 3000 m<sup>3</sup> volume, was carried out by HE in 2009. The results of this were reported by URS (2009d) and published by Fellows and Jenkins (2010). The results of the trial proved satisfactory and lead to the tendering of the Tui Mine tailings remediation contract in 2011.

This paper presents a case study summary of the phase 2 construction works undertaken to remediate the tailings dam and other sources of surface acid rock drainage on site. The phase one contact works which involved acid rock drainage from the underground workings and the design work and field trial which preceded the phase 2 works are not discussed in this paper.

### 2 Key Construction Risks and Challenges

The Tui tailings dam comprised of 100,000 m<sup>3</sup> of tailings contained within a dam which had been constructed using waste rock and tailings. The tailing impoundment was contained by a steep sided valley to the north, the dam structure to the west and a low dam to the south (refer to figure 2 and the dam cross section figure 3).

The two key construction issues facing the remediation project were the very low strength nature of the contaminated tailings, and the significant depth of tailing which was up to 14 metres deep.

The remediation works required both IMS and EMS to

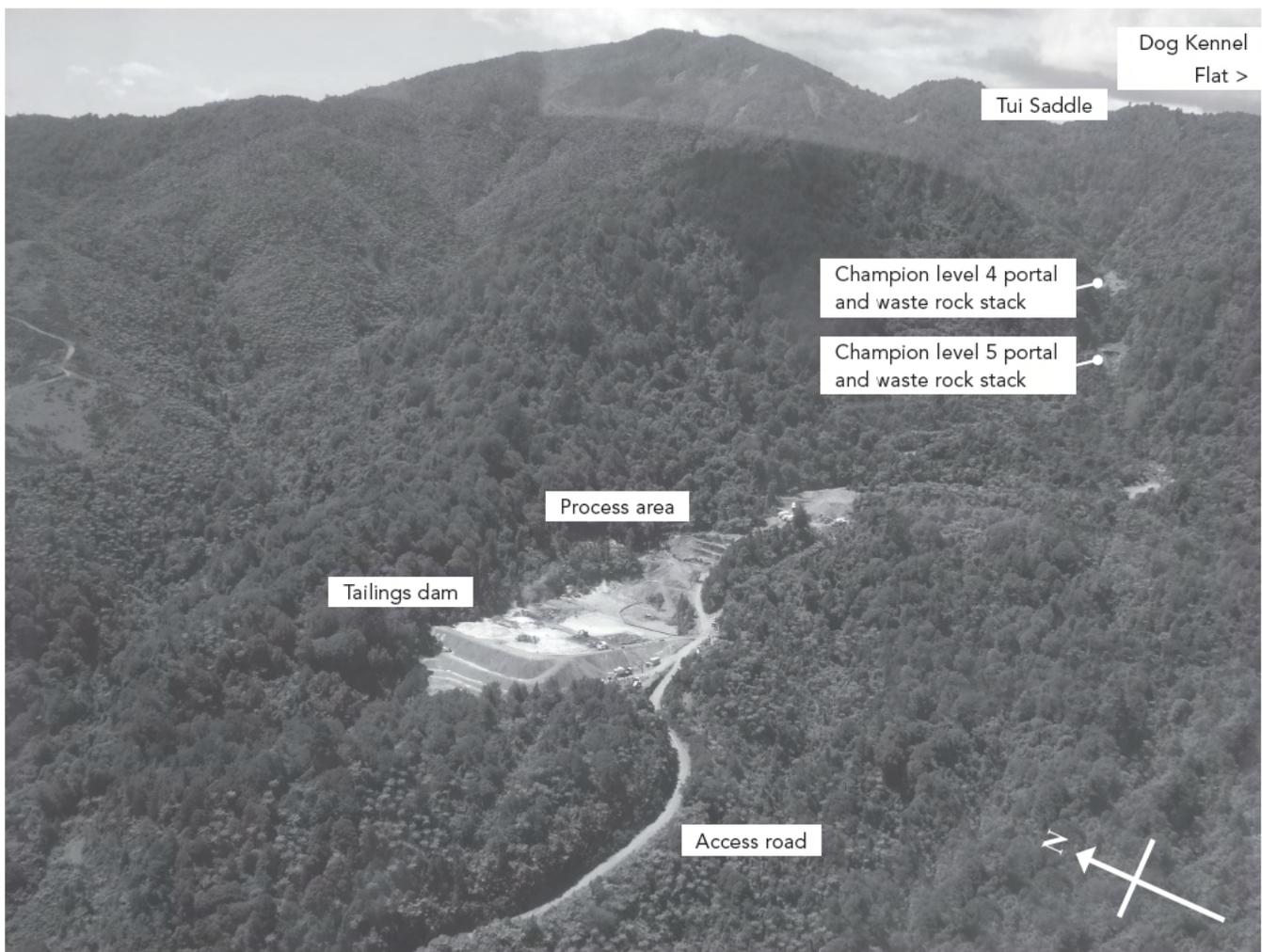


Figure 2: Tui Mine Site

achieve a regraded landform. This would require a wedge shape excavation of the tailings which became progressively deeper towards the western dam end of the tailings. Using IMS, the shallower tailings up to 5 m deep in the eastern end could be mixed in situ as well as the 5 m depth of tailing at the base of the deeper tailings. A wedge of overlying tailings required excavation and EMS treatment and placement into the eastern fill zone (refer to figure 4).

The Tui Mine tailings impoundment posed two significant risks – geotechnical instability and environmental pollution through acid rock drainage. The key geotechnical and environmental challenges in constructing the remedial design included :

- Geotechnical instability. The tailings dam had a factor of safety of about 1. Thus careful staging and management of the construction works was required to prevent dam failure. The potential cost of dam failure was assessed as \$ 170 million cost associated with the immediate and long term damage and remediation costs.
- The impoundment tailings were deposited as a slurry and had extremely low strength. The tailings

were saturated and would quickly liquefy under the loads of construction equipment. The planning and sequencing of works were critical to the remediation construction. The work was programmed to commence from the shallow eastern end and work towards the dam. This method allowed to unload the embankment and essentially create a more stable structure as the tailings were progressively stabilised from east to west.

- Unforeseen ground conditions were likely to be encountered despite the large amount of investigations which had been carried out.
- Accurate determination of quantities and types of materials was difficult. This represented potential for cost uncertainty.
- There was potential to expose buried cyanide drums on site which would require careful excavation, testing, H & S controls and potential for disposal.
- The site received high rainfall with annual total of 1600mm in 2012. Weather conditions were unfavourable during winter months. The highest recorded rainfall during construction works was 300

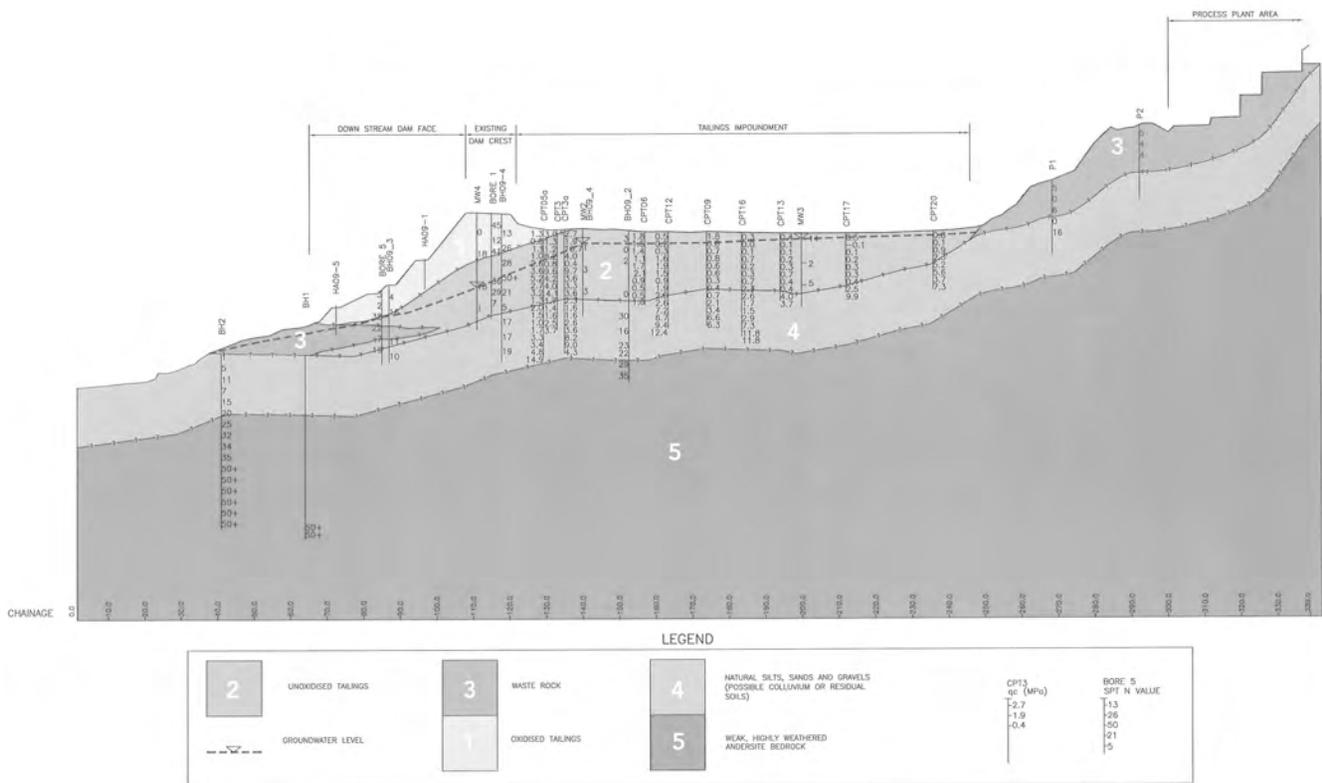


Figure 3: Interpretation of the tailings impoundment geology before stabilising works

mm in a 24 hr period on 3rd September 2012.

- Site security and safety of public required consideration. A number of DOC tracks crossed through historical mine sites.
- Site conditions and steep terrain posed challenges in the restricted and tight available construction space.
- The site access road was steep and narrow and insufficient width to allow two heavy vehicles to pass. The effective management of road and maintaining access for three landowners on the lower sections plus DOC and Kordia access for the Mt Te Aroha transmission tower was required at all times. Detailed Traffic Management planning, one way traffic movements and procedures were required with truck volumes up to 60 per day on a one way access road.
- Contamination exposure to workers was a significant hazard. A detailed site specific safety plan was implemented. There are always challenges in training staff to adhere to stringent contaminated site protocols and procedures.
- Site communications were limited and cell phone coverage was poor and unreliable on site.
- Management of stakeholder expectations was important. There were a number of stakeholders including local Iwi, DOC, MfE, Client, (Environment Waikato), district council. The project structure consisted of a Governance group, Steering

group and Project team working to an agreed project plan and project controls and requiring. The project was subjected to high levels of auditability.

- IMS was a relatively new method to HE and had been implemented on several small projects. The project required significant investment into plant and fabrication of mixing components. The IMS project was to be the largest ever undertaken in New Zealand. The requirement to accurately mix to the profile of the highly undulating base of tails was difficult. The control of binder flow and survey control required a high degree skill from the mass mixing excavator operator.

### 3 Tender Process – Alternatives, Contingencies

The Regional Council, Environment Waikato (EW), received the bulk of their funding from the Ministry for the Environment (MfE) for the Tui Mine Remediation project. EW was the sponsor and Project Managers, Tonkin and Taylor were the Engineer to the Contract and URS the project Designers.

Three contractors were prequalified and tendered for the work in June 2011.

HE submitted a tender which featured comprehensive attributes and focus on construction methodologies, detailed programme, contingencies and risk mitigation measures. Several alternative options outlined potential cost savings and risk mitigation measures.



It was a requirement to ensure that binder was injected consistently throughout the depth and laterally throughout the tailings. A computer was used to record and control binder flow rates and rate of mixing. This QA requirement was therefore extremely challenging. However the investment in GPS control, significant planning, training and execution proved invaluable.

Binder blend was injected and mixed at an application rate of 160 kg per m<sup>3</sup>.

The initial stages of the project proved slower than anticipated and took some time to gain traction. This was due to limited space on site for construction plant, meeting stakeholder expectations with regard to vegetation clearance and resultant design changes, more detailed classification of material types being required, a large number of variations, some unexpected ground conditions and slower than anticipated mixing production.

The project was hampered throughout the entire duration due to lack of room being available to effectively and efficiently stockpile and manage earthworks excavations and stockpile areas. This required a large degree of material double handling.

A new purpose built, track mounted cement pressure pod was delivered to the site in February 2012 which speedup the IMS production to some degree. However by April, the project was some 2 months behind programme due to a combination of site issues.

By April 2012, the works had progressed towards the western end which had become increasingly coarser and sandier and with better drainage characteristics than finer tailings. The coarse tailings had also become very dense and firm due to consolidation. The coarse dense tailings proved more difficult to mix in situ and required additional mixing effort to achieve a homogeneous mixed state. Some layers of in situ material were cohesive and very stiff in nature. An alternative option to excavate all the remaining tailings and treat ex situ (rather than insitu mix the 5 metre depth of base tailings) was proposed by HE and was considered to provide a number of advantages. This option was one of the risk mitigation contingencies allowed for in the tender. The construction method for deep excavation of tailings was assessed and considered in detail. Ex situ excavation also presented an opportunity to achieve increased production rates. This alternative was accepted and the contract rates for ex situ mixing were applied.

The excavation to base of tailings depth was also beneficial in ensuring that the entire tailings were excavated. Updated changes to tailings volumes predictions during the construction were monitored by URS to ensure that a stable engineered landform could be developed. The landform final levels were redesigned several times as the works progressed, accounting for the surveyed quantities and impact of bulking. This had some impact on the

location and detailing of the toe of the landform and it was necessary to re-evaluate the best for stability placement of the shear key. The redesign also enabled the removal of the upper two rows of deep soil mixing columns. Excavation to the base of tails and into the colluvial materials for the shear key construction also enabled the designer to re-evaluate the strength of the colluvial material. The slope stability models and landform design were updated three times during the construction with as-built data to ensure that all design criteria were met.

A total of 25,000 m<sup>3</sup> of IMS was completed.



**Figure 5:** 35 Tonne In situ mass stabilising rig with Pressure Pod in the background

#### 4.2 Ex situ Mass Stabilising (EMS)

As the project proceeded and a stabilised platform became available, the excavation of the upper tailings (ie the zone deeper than 5 m depth) commenced in January 2012. This material was excavated and trucked to the placement area and EMS stabilised using tracked spreader and tracked stabilizer. The EMS material was compacted in place in layers to achieve compaction criteria strength, and geochemical amendment.

The EMS typically used the IMS cement blend at 146 kg / m<sup>3</sup> plus an additional 60 kg/m<sup>3</sup> of CaOH.

In total, 17,000m<sup>3</sup> was stabilised using this method. This was an accepted alternative method which proved beneficial to the project as it overcame the problems associated with the blending of tailings and rock whereby there was a shortfall of a suitable blend rock on site, or otherwise imported rock for blending was required.

In addition to EMS of the excavated tailings, a 1.5 m thick layer of blended tailings was also completed. The blended EMS comprised of two main blend components - a Rock blend mixed with tailings at a ratio of 2 parts tailings to 1 part rock. Binder for the tails blending comprised 4 parts CaO and 5 parts CaOH and was added at 135 / kg/m<sup>3</sup>.

Several other binder blend recipes and application rates were implemented in consultation between HE, the Engineer and URS.

The “rock” was won from the various rock stacks on site. The nature of the rock was highly variable and poorer quality than anticipated requiring quite considerable characterisation testing and some blend mix designs to confirm its suitability as a rock blend. Careful management and identification of various stockpile and earthworks sources was required to both confirm acceptability and to maximise the various materials “value” and end use. It was important to avoid cross contamination of soils which could be used as capping clean fill or as a separation layer. This involved stockpiling and in many cases double handling of materials given the restriction of available space.

A total of 38,000m<sup>3</sup> of rock was blended with 47,000m<sup>3</sup> of tailings resulting in a total EMS volume of 85,000m<sup>3</sup>.

The excavation works on site uncovered significant amounts of unforeseen organic material and trees. It was understood that during the mining work the original vegetation was pushed into the valley prior to the tailings deposition. At the toe of the tailings dam the excavations revealed that the logs had been carefully stacked to bridge the narrow valley base and form part of a starter dam complex. All of these materials were excavated, tested for contaminants and appropriately reused on site, with amendment if needed.



**Figure 6:** Ex situ mass stabilising operation

### 4.3 Earthworks

The requirement for more detailed assessment and characterisation testing of the various tailings and material types on site caused some delays to the earthmoving operation.

The requirement to carefully manage the various types of materials was identified by HE in the tender methodology. The high “salvage value” of some types of materials and the associated cost savings methodologies were implemented into the project works.

The final earthworks volumes consisted of:

- Onsite Rock for Stabilising – 12,000m<sup>3</sup> excavated and Crushed

- Oxidised tailings – 4,500m<sup>3</sup> Cut
- Unoxidised Tailings – 85,700m<sup>3</sup> Cut
- Ore Chip – 4,000m<sup>3</sup> Cut
- Rock for Swale Drains – 3,000m<sup>3</sup> Imported
- Clay – 5000m<sup>3</sup> Imported Fill for Capping
- GAP40 Rock – 3000m<sup>3</sup> Imported Fill for Capping
- Topsoil – 6500m<sup>3</sup> Imported Fill for Capping and Contour Drains

This created a total volume of 115,000m<sup>3</sup> of Earthworks. Note that all materials were stabilised and used on site.

### 4.4 Drainage

The design required the construction of 5m wide open swale drains around the perimeter of the stabilised landform consisting of rock riprap 300mm to 600mm in size. These were designed to reroute surface water off and around the tailings earth fill.

A fordable drain was placed above the impoundment area to divert water away from the landform and south towards the Tunakohoa Stream. The drain consisted of rock swale catch drains which flowed into 450mm Pipes. The Ford drain also allowed for a diversion spillway in flood conditions.

A cut-off drain at the head of the impoundment was constructed to collect and redirect any groundwater before it came in contact with the tailings. A collection drain at the toe of the stabilised landform was constructed to pick up both ground water and possible leachate and at the interface between the natural material and the stabilised material.

### 4.5 Geometric Design

A requirement of the contract was to complete several progressive asbuilt surveys and review of quantities in order to determine the final profile of the stabilised landform. The design drawings made provision for a lower, average and upper finished level profile which accounted for bulking of the stabilised materials.

The uncertainty of the final quantities required consideration to be given that the final shape was not overfilled. Despite the ongoing assessment of the finished design levels, there was one section of the landform which required some minor rework, redesign and releveling of placed materials.

The finished levels needed to take into account the predicted final volumes, amount of material in various stockpiles, and impact of bulking. The finished landform levels were completely redesigned once during the construction and the toe area of the landform amended again when further tailings volume predictions became available towards the completion of the project.

### 4.6 Landfill Capping

The capping consisted of four layers of material. Figure 7

below displays the thickness and structure of the capping layers. The Separation layer was able to utilise stabilised oxidised tailings mixed with excess organic material or excess rock material and stabilised with 60kg/m<sup>3</sup> of both CaCO<sub>3</sub> and cement blend (OPC, CaO and CaOH). This ensured that the best use was made of on site materials. Clay was sourced from Hyndmans Quarry 40km south of the site. GAP40 was sourced as the drainage layer from Taotaoroa Quarry 70km south of the site. Topsoil was sourced from a farm only 8km north of the site. A total of 50,000 tonnes of soils were imported to site.

Topsoil	300mm
GAP40 Drainage Layer	150mm
Clay	300mm
Seperation Layer	250mm

Figure 7: Landfill capping layers

#### 4.7 Programme

The programme was broken down into several critical stages. The critical path followed the initial enabling works and then IMS and EMS works followed by the capping layers. Other work items such as drainage were programmed around critical path.

The first key milestone was to complete the shallow in situ stabilising (up to 5 m depth) in the eastern end on the impoundment. Due to some compounding delays, this milestone was achieved in December 2011, some 6 weeks behind programme.

The commencement of EMS works started in late December once a sufficiently large “pad” of in situ stabilising had been completed. A reasonably wet summer of 2012 also impacted on programme, with 17.5 days time extension wet days approved.

The next key milestone was completing the stabilising works to chainage 150. The area below chainage 150 was considered a critical zone. In this zone the designers wanted to achieve better geotechnical and chemical results as this material essentially buttressed the up slope stabilised tailings. Stability of temporary works whilst the dam still existed and had the potential to pond water was also important.

By the end of the programmed winter shutdown at the end of April 2012 the programme was 2 months behind schedule. However a winter exemption was applied for and granted and work continued through until the end of May. The fine weather in autumn enabled the programme to be caught up and put back on track by the winter shutdown period on 1 June 2012.

An early recommencement of work in the second week of September 2012 enabled some work to recommence with full production ramped up by October.

All stabilising works were completed by February 2013. A focus on project completion programme and tight programme and construction works enabled the entire project to be completed by May 2013 with practical completion granted on 10 May. This completion date fell within the revised due date for completion allowing for time extensions related to variations and wet weather.

The project certainly benefited from the summer 2013 drought. Surprising to note was the heavy rainfalls encountered immediately after the final capping layers were constructed.

#### 4.8 Quality Control

The quality control requirements for the project were stringent. GPS was used to set out the target base of tailings profile, confirm quantities and provide as built data.

Quality control methods were implemented to control the mix design blends. At the project commencement, HE provided input with Holcim Cement and McDonalds Lime to ensure that the correct binder blend ratios were achieved. This involved blending CaO and CaOH at the Otorohanga lime works and the secondary blending with cement at the Holcim Onehunga wharf depot. Loss on ignition testing and XRF testing, use of load cells and the control of screw conveyor feed rates for lime and cement ensured that the blends achieved the correct mix ratios. This was not an easy process and required a high degree of initial testing and trialling of the blending process.

HE engaged the services of GHD consultants to undertake quality control testing and reporting for the project. A full time Environmental Engineer was seconded to the project and was further supported by GHD head office personnel to prepare results and report on an ongoing basis. The Quality control testing was self performing six specified performance criteria. HE had identified the large quantum of QA work and the importance to the project. GHDs support, involvement and commitment to the project was a factor in the project success.

Throughout construction GHD consistently monitored the performance of the material being placed by completing NDM, Scala and Clegg Testing at intervals of 500mm lift per material. Geochemical and Geotechnical testing was carried out for all materials at a frequency of one sample per 2000m<sup>3</sup>.

At the time of publishing this paper (10 May 2013), the site works had just been completed and the validation reporting for the project was not completed. As a result, it was not appropriate to include the quality control data in this article. However, all quality control and acceptance testing for Geochemical and Geotechnical criteria had been completed.

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Figure 8: Tui Mine tailings dam 2009



Figure 9: Tui Mine tailings remediation completed May 2013

## 5 Project Statistics

- Final contract claim \$ 13.2 million (delivered within the total project budget)
- Total Man hours on site: approximately 100,000 man-hours
- Total LTI's (Lost time injuries): 2 minor reported incidents
- Total FAI's (First aid injury): 1 minor incident
- Total OFI's (Opportunity for improvements): 46
- Total truck movements to site calculated as: 3,500 trucks
- Cement use: 12,000 tonnes
- Lime use: 6,000 tonnes
- IMS: 25,000 m<sup>3</sup>
- EMS: 85,000 m<sup>3</sup>
- Earthworks: 115,000 m<sup>3</sup>
- Imported Material: 50,000 tonnes
- Total wet day time extensions: 32 days
- Public complaints 3 related to truck traffic movements.

## 6 Conclusion

Despite the numerous construction challenges, the Tui Mine Phase 2 Remediation Contract was completed on time and within the project budget. Over a period of 20 years, this project had progressed through numerous phases of assessment, option review, funding review and engineering design. To several "project veterans" associated with the design and construction works since inception, the project completion represents a personal fulfilment and achievement.

The project has achieved the design objectives. Throughout the project, numerous challenges have presented themselves, from unforeseen ground conditions, redesign assessment and design changes, construction methods, weather and logistics to name a few. From the outset, it was accepted and acknowledged that a collaborative and partnership approach between Contractor, Client, Engineer, Designer and Stakeholders was essential to the success of the project. This approach was adopted by all parties at the outset and was effectively maintained throughout the project to deal with issues as and when they occurred. An excellent working relationship was developed between Contractor, Engineer and Client, with all parties willing to work collaboratively to address and action issues as they arose. The Governance and Steering groups proved effective in providing the necessary project support, controls, approvals and direction. The project partnership philosophy went beyond any words written into the contract and this successful partnership has largely attributed to the overall success of the project.

Aside from achieving the design objectives, perhaps the project success can also be measured by the community's general support for the project and stakeholder endorsement



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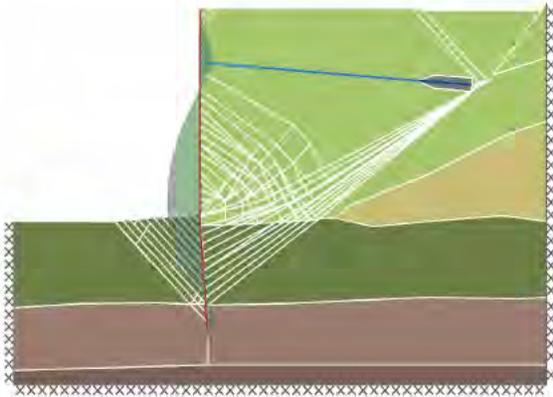
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## New Zealand Geomechanics News

of a job well done. A project completion ceremony was held on site on 1 May 2013 attended by various dignitaries, stakeholders and the Minister for Environment, the Honourable Amy Adams who paid tribute to all those associated with the project.

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## TECHNICAL NOTES

### Implausibly Low Readings with the Geonor Vane Investigated and Explained

DURING A RECENT project in New Zealand a number of shear vane tests were undertaken using a Geonor vane in partially pre-drilled boreholes. A number of the results appeared to be erroneous. In many cases the results were implausibly low, and in some the peak strength measured was lower than the residual strength. Many of the results for the peak shear strength were around 5 kPa.

In order to investigate this, two local providers of Geonor vanes (including the one involved on site) were invited to undertake a controlled test. Modelling clay was compacted in a laboratory into a large plastic box approximately 500 mm by 300 mm, and 300 mm deep. Two Proctor moulds were also filled with the same material compacted with the same number of blows per layer. Each of the vanes was set up on a workbench in a manner to directly replicate the field set up.

Each vane was operated in turn by their usual operator twice, and the results recorded. A standard Pilcon hand vane was also used, and the samples in the Proctor moulds tested (one by undrained triaxial testing and one by uniaxial compression).

All the testing methods gave the peak undrained shear strength of the modelling clay in the range of 17 to 21 kPa. However, the first tests undertaken by both of the Geonor shear vanes recorded peak strengths of 4 kPa and 5 kPa.

During the test the methodology was carefully observed. Because of the open nature of the test with all parts visible in the laboratory it was possible to observe the full apparatus, and it quickly became clear that the test was not progressing correctly. The reported strength quickly rose to approximately 5 kPa and then levelled off with no peak in strength noted. Continuing the tests it became apparent that the reaction from the outer tubes was deficient. The Geonor vane applies torque to the vane head via rods which are housed within outer tubes. The outer tubes provide the reaction, and thus it is essential that these cannot move. During the test, rather than remaining fixed so that the torque was transferred to the inner rods, the top outer tube was very slowly unscrewing. The 'peak strength' being measured was actually the friction on the threads between the first and second outer tubes. This occurred on both the instruments being tested during their first test.

Following this failure on both tests the residual tests were set up by rotating each instrument clockwise ten times. This tightened up the outer tubes, and the residual tests were performed satisfactorily and gave comparable and realistic results which were higher than the 5 kPa peak previously recorded.

Subsequent tests were undertaken by manually rotating the instrument. This method does not rely on a reaction from the outer tubes. One peak and residual strength test was undertaken with each of the vanes, and both gave results in the expected range.

Following this controlled test the work recommenced on site with two mitigation measures in place. A clamp was used on the first outer tube to minimise the likelihood of it rotating, and where appropriate (i.e. in softer material) the instrument was rotated by hand. None of the subsequent tests had unexpectedly low or suspicious results.

Our experience showed that the field Geonor vane is a valuable test which can quickly and accurately collect a significant amount of shear strength data in soft to firm clays and silts. We also showed that, when operated carefully, the results were repeatable and correlated well with good quality laboratory testing on identically prepared samples. However, there is an issue with the design which can result in false low readings if the outer tubes are not held firmly in place.

As a result of this experience it is recommended that:

- The Geonor shear vane should be considered as a useful technique for ground investigations in soft to firm clay and silt.
- The tests should be observed by personnel with experience in this form of testing, and the results carefully screened for anomalies.
- The upper outer tube should be held in a clamp to prevent rotating (for example, by resting against a drill rig). Normally the rig jaws will already be used to hold the borehole casing in place; if these are not in use then they may be appropriate for this task.
- If any unexpectedly low results are obtained then the test should be repeated a small distance below the original test with the instrument rotated by hand.

**Reported by: Ross Roberts**

Engineering Geology Team Leader  
Sinclair Knight Merz  
Auckland



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## BOOK REVIEW

### A Photographic Guide to Fossils of New Zealand – Hamish Campbell, Alan Beu, Dr. James Crampton, Liz Kennedy

AS A BRITISH palaeontology enthusiast that grew up just a few miles from where Gideon Mantell controversially discovered the first Iguanodon tooth, and later studied on the same Jurassic Coast where Mary Anning earlier found the first Ichthyosaur, I was extremely pleased when asked to review “*A Photographic Guide to Fossils of New Zealand*” by the editors of NZ Geomechanics News.

When I decided to follow Gideon Mantell’s Iguanodon tooth to New Zealand (it was carried by his son Walter, who lends his surname to the North Island Brown Kiwi, *Apteryx mantelli*, and the extinct North Island Takahē, *Porhyrio mantelli*), my search for guides to New Zealand geology and palaeontology began. I soon managed to find some quality books about geoscience and natural history, including Geological & Nuclear Science’s *In Search of Ancient New Zealand*, authored by Te papa’s Hamish Campbell, also one of the authors of this photographic guide. Having been spoiled by the rich choice of comprehensive palaeontological literature available in the UK, I was, however, disappointed to find that much of New Zealand’s palaeontology library was limited to books with children on the cover pages.

To my relief, *A Photographic Guide to Fossils of New Zealand*, the latest in a series of New Holland Publishers’ natural history photographic guides, arrived on New Zealand bookshelves earlier this year. In addition to the aforementioned author, Hamish Campbell (who happens to work in the same building as Mantell’s *Iguanodon* tooth), the book is co-authored by GNS palaeontologists and principal scientists Alan Beu and James Crampton, palaeobotanist Liz Kennedy and photographer Marianna Terezow.

Those familiar with New Holland’s photographic guides, which with this addition become a 13 strong series, will instantly recognise the simple, tried and tested format of individual subject entries with superb photographs and descriptions. In a similar style to other guides in the series, this book is conveniently organised into several concise sections. These include an explanation of how, where and why fossils occur; how different types of fossils are preserved; a brief history of New Zealand from 520 ma Gondwanaland



through Zealandia to today’s modern layout; and finally the main portion, the photographic guide.

The photographic guide presents the more common New Zealand macrofossils, organised by geological time period (and epoch), from the Cambrian through to the Quaternary’s Pleistocene. Within each of these sections, fossils are usefully ordered by phylum and class name. In addition to the photographs, each with an accurate scale bar and detailed description, each fossil entry includes useful information such as geological units, habitat and other brief but relevant notes.

Although organisation by time period is a logical and generally accepted format in fossil guides, it does mean that the user needs to know the age of the strata they are visiting. This requires the assistance of a geological map, also identifying geological units, which is not included in the guide. However, the guide does have a good *How to use this book* section, which defines the scope and recommends appropriate sources to be used in accompaniment.

When compared with palaeontological heavyweights such as the Natural History Museum’s *British Palaeozoic, Mesozoic and Caenozoic Fossils*, which detail nearly 1200 fossil species, this guide’s mere 200 species might seem a bit light to the international palaeontologist. However, like its namesake country this book punches above its weight and more than delivers on the fossil front. Although it lacks microfossils and Joan Wiffen’s Cretaceous theropod, sauropods and pterosaurs, it more than makes up with mosasaurs, sharks, ammonites, echinoids and plants as well as and the more usual bivalves, brachiopods and gastropods. Perhaps the most attractive feature of this guide is the fact that it fits perfectly in my back pocket, which is where it’s going now as I head off to Motunau Beach to find myself some arthropods!

Reviewed by: James Codd  
Aurecon, Christchurch

Author	Hamish Campbell, Alan Beu, Dr. James Crampton, Liz Kennedy
Publisher	New Holland Publishers (NZ) Ltd
Year Published	2013
Hardback	144 pp
ISBN	1869663667
Price	NZ \$25.99

## Craig's Soil Mechanics (Eighth Edition) – J.A. Knappett and R.F. Craig

I BROUGHT MY first copy of Craig's Soil Mechanics when I was in my second year at university and like many others around our office have continued to refer to it ever since. My first copy was the fifth edition of the text which is now up to its eighth edition and is authored by J. A. Knappett and R.F. Craig.

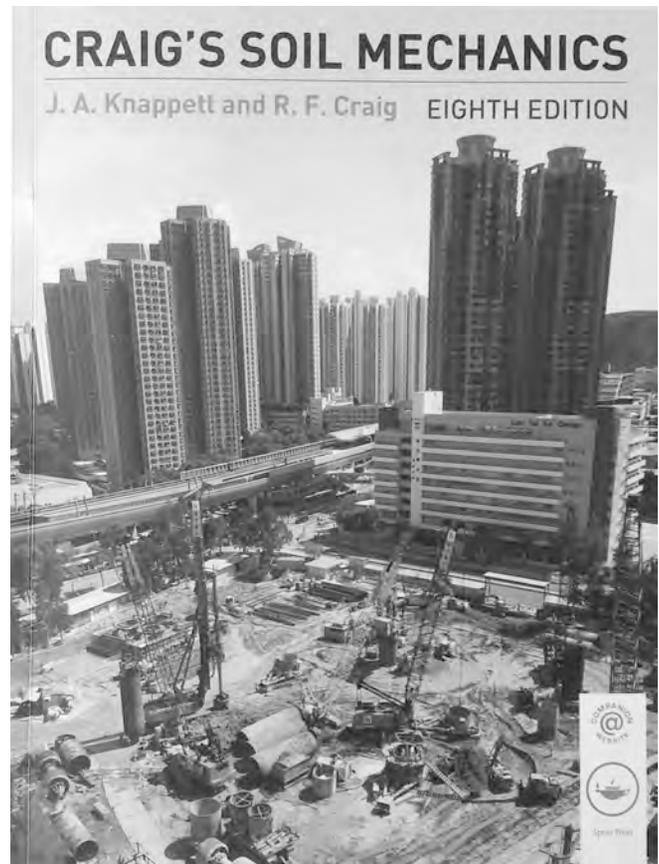
**“Initially published in 1974, I felt that the time was right for a major update as the book approaches its fortieth year, though I have tried to maintain the clarity and depth of explanation which has been a core feature of previous editions.” J.A. Knappett**

The five hundred page text is intended to meet the needs of the undergraduate civil engineering student and to be a useful reference during the transition into engineering practise. This latest edition includes some more advanced topics with the intention of also making it suitable for many post-graduate level courses.

Previous editions of this text are recognisable in this latest edition which includes many of the same subject headings and similar material. However, J.A Knappett (University of Dundee) notes the following: “Initially published in 1974, I felt that the time was right for a major update as the book approaches its fortieth year, though I have tried to maintain the clarity and depth of explanation which has been a core feature of previous editions.”

Immediately obvious is the separation of material into two major sections. The first section is titled, ‘Part 1 Development of a mechanical model for soil,’ deals with basic concepts and theories in soil mechanics. Part 2, titled ‘Applications in geotechnical engineering,’ deals with geotechnical design. A new chapter has been added on in-situ testing and covers both the basics about testing methods available and parameters which can be determined from various tests. This provides essential information for young engineers fresh out of university who often find themselves out in the field next to a drilling rig with limited knowledge of the testing they are required to carry out!

J.A. Knappett has added discussion of limit analysis techniques to the text with the aim that students will enter the workplace with knowledge of the underlying theory. This addition is timely as advanced computer software and modelling is fast becoming common place in geotechnical engineering.



It is noted that the chapters on geotechnical design are discussed within the context of limit state design to Eurocode 7 and more extensive background is provided on Eurocode 7. For example, in Chapter 11 the ultimate and serviceability limit states to be considered for retaining wall design are included for various forms of retaining walls (gravity, embedded, anchored or propped). The focus on limit state design includes numerical examples and the end-of-chapter problems. The priority of limit state design in the text is no doubt due to the widespread use of this design approach in many countries but may be less appropriate in the New Zealand context where limit state design is not widely used in geotechnical engineering. However, it will be helpful for students to be exposed to this design approach as many will work in other countries where it is the norm and it may be that geotechnical design in New Zealand heads this way in the future. If this is the case then the text may also prove to be a useful reference for more experienced engineers picking up this design approach.

The beauty of this edition, as with previous editions, is its simplicity and clarity which is entirely appropriate for the intended purpose as an undergraduate text. This allows

a wide range of essential topics to be covered without getting lost in the detail. I suspect this may be why I see engineering practitioners with over ten years experience still flicking quickly through their trusty copy of Craig's Soil Mechanics for concise information on a particular topic. It is highly recommended to the undergraduate student and the professional engineer in the early years of their career.

**Reviewed by: Hamish Maclean**  
Editor NZ Geomechanics News  
Tonkin & Taylor, Auckland

Author	J.A. Knappett and R.F. Craig
Publisher	Spon Press, London and New York
Year Published	2012
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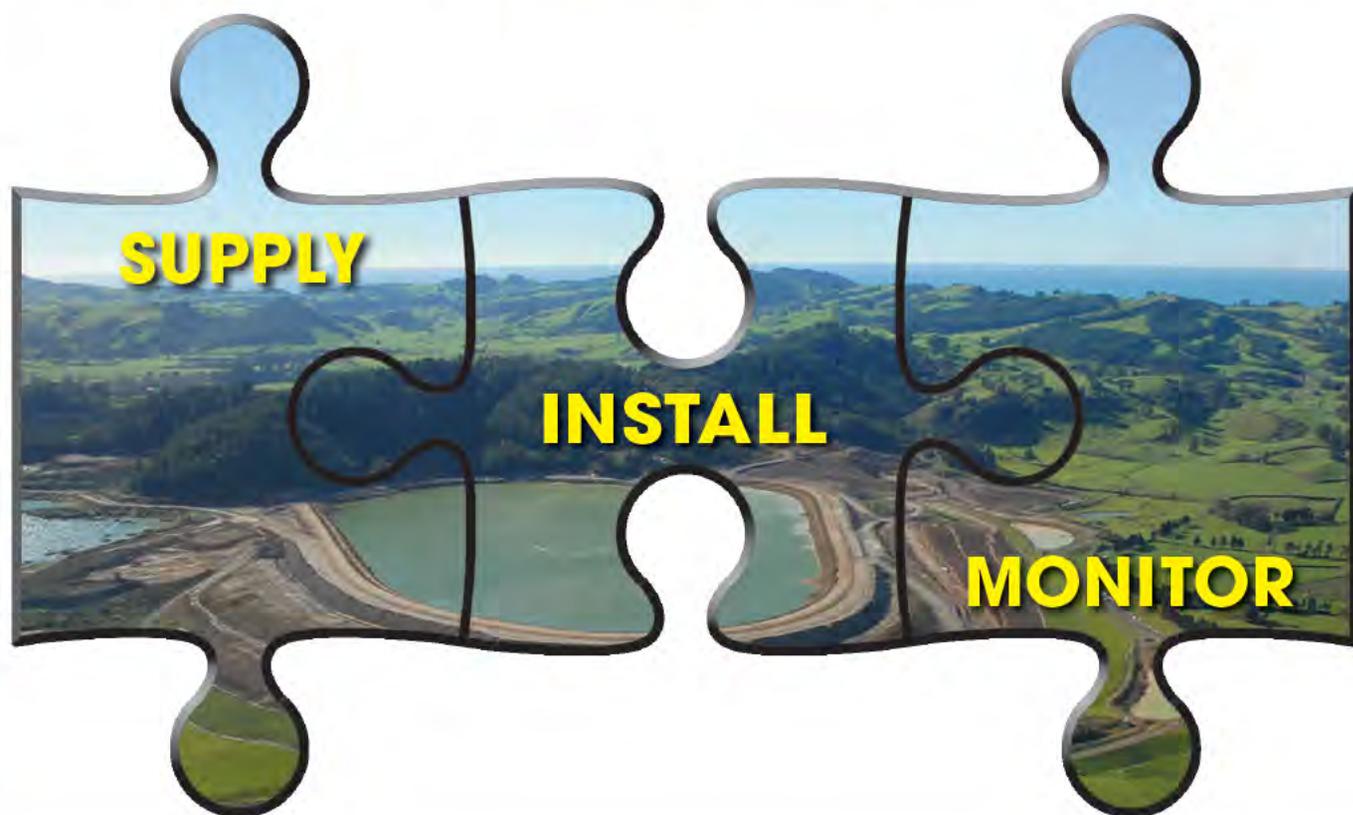
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## ANSWER

Answer to December 2012 Issue 84 Crossword

### Across

- 5 Fissures
- 10 Foundations
- 13 Rudolph
- 16 Terzaghi
- 17 Tunnel
- 18 Star
- 21 Optimum
- 22 Landslide
- 26 Vinson Massif
- 29 Chimney
- 30 Carols
- 32 Turkey
- 33 Petrography
- 34 Bridge
- 38 Stocking
- 39 Consolidation
- 41 Engineer
- 42 Geotextile
- 43 Metamorphic
- 45 Gravity Wall
- 46 Meteorite
- 48 Water
- 49 Pseudo
- 50 Peak Ground Acceleration

### Down

- 1 Geological Hazards
- 3 Effective Stress
- 4 Liquid Limit
- 5 Cut And Cover
- 6 Hydrostatic
- 7 Concrete
- 8 Liquefaction
- 9 Coal
- 11 Sinkhole
- 12 Montmorillonite
- 14 Excavation
- 15 Anisotropic
- 19 Alpine Fault
- 20 Negative Skin Friction
- 23 Darcys Law
- 24 Base Isolation
- 25 Pipers Piping
- 27 Fumarole
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- 31 Bedrock
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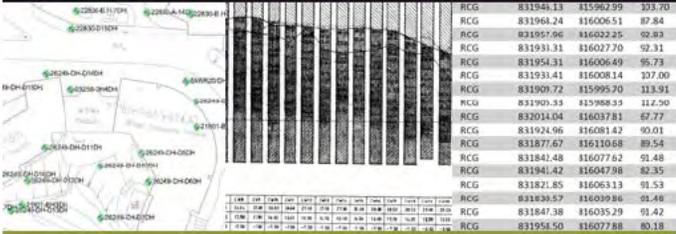
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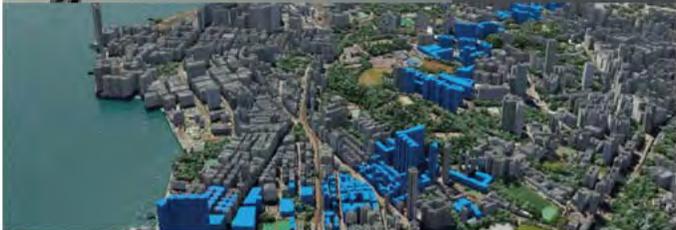
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### Around the Office

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Unexplained ‘liquefaction’ observed in the Auckland Domain



A member spotted this unique traffic control signage outside a local wine store

## MEMBER PROFILE




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**Guy Cassidy**


---

**Occupation**

Associate Engineering Geologist  
Geoscience Consulting (NZ) Ltd,  
Wellington

NZGS Management Committee, Elected Member  
ANZ 2015, Conference Chair

**RUGBY, WIDE OPEN** countryside and sheep...! No, not New Zealand; That's what my friends said I must be passionate about when I informed them of my impending move to study at Cardiff, The University of Wales, UK. Instead, I would insist, it was the compelling mix of learning geology in the oldest UK university school of earth sciences, the ample choice of reasonably priced accommodation and the healthy ratio of female to male students (heavy on the female side I might add). With this in mind I was off to Wales, a far cry from the sleepy Sussex town where I grew up, and got my first taste for geology. This initial geological tasting event was at secondary school, taught by the most enthusiastic and eclectic teacher I have ever met. It was she who set me on this journey into the unknown...The University of Geology.

It would be fair to say that Cardiff treated me very well indeed. I thoroughly enjoyed my time in the Welsh capital city and left with an honours degree in Exploration Geology and a Master of Science in Applied Geology. Not bad, you might agree, given two out of my three main motives to study here were not academically orientated. Now what...?

I first dipped my big toe into what my parents called the 'real world' as a graduate engineering geologist in a small office of a relatively large consultancy firm called Parkman Ltd (later to be taken over by Mouchel Ltd). The office was located in Newmarket, a suburb and village on the outskirts of Cambridge, famous for horse racing and nothing much else. Being young and carefree I chose to live in Cambridge and commute out to Newmarket each day, leaving the weekends free to explore the great city of Cambridge in all its seasons. Being the latest recruit and a graduate, I got my fill of field work and staying away from home – which was ideal for me, being single at the time and eager to learn everything about everything. I packed a fair amount of experience in my first eighteen months living and working in the real world and it only took me about six months to realise that I didn't know everything about engineering geology: And probably never would!

It was about this time in my career that London called... the big smoke and the shiny lights, where the streets were almost certainly paved in gold. Well, not quite gold... while my salary was adjusted to take into account the 'London weighting', it didn't really account for much at that time. I recall walking past happy people eating Sunday brunch at cafes on the fashionable streets of Clapham and Balham with jealousy and regret while carrying my groceries home. Mainly regret that I had drunk my weekend's allowance the previous night with friends and had beans on toast to look forward to later. The choices we make.

Working in London was a blessing in disguise. At least in the sense I met some really interesting people, many of whom I stay in touch with today. I recall working with a couple of Kiwi geotechnical engineers (as London is where many Kiwi's actually reside), hearing stories of how great New Zealand was and how much there was to learn in such a geologically active island. Volcanoes, earthquakes and landslides: My eyes widened and I may have drooled a little on my desk. I went back to my project report on London Clay and Cretaceous Chalk, temporarily loosing focus and enthusiasm for what I was doing. Eighteen months after moving down to the big smoke I had a one way ticket in my hand to Wellington, New Zealand... Bring on the Rugby, wide open countryside and sheep...!

I had heard of the expression 'work hard, play hard' but had not properly gotten to grips with it until I joined the Wellington office of Connell Wagner Ltd. The office social club was fiercely active and, being a newbie, I was encouraged to join... Which I am glad I did. It was a great way to get to know a great bunch of people in a new city. The geotechnical team also worked very hard and I soon learnt that I STILL didn't know everything about engineering geology, far from it. It took me many months to get up to speed with the local geology, the seismic aspect of what we do and the geography of the local area – add to that the place names which, by being mispronounced in a splendid English accent, only served to entertain most people in the office. It is not an accent, by the way, it's just the noise words make when they are pronounced properly.

During my early years in Wellington, I was fortunate to work on some very technically challenging and interesting projects. You know, the type of project where you have to actually pinch your arm and remind yourself that this is what you do for a living and are getting paid to do this. In fact, all bar two of my 'pinch yourself' career moments to date have been in NZ... Thank goodness for the choices made earlier in my career.

Did I mention the office social club at Connell Wagner was active? It was. So much so, I met my wife at a work function. She wasn't my wife at the time of course, in

fact we had just met, but she later agreed to my proposal of marriage on a windy Wellington day... in September 2009 if I recall correctly. Very romantic but a challenge in itself as she was the Personal Assistant to the head of civil engineering in Connell Wagner at the time who was a relatively scary man who shall remain nameless. So many thoughts ran through my head at night... Was this a career limiting move, will it last, how much was that social club deduction really costing me. With relief, the good old Kiwi gene kicked in and Hayley decided she wanted to live and work in London... The big smoke. Take two.

I mentioned ‘pinch yourself’ career moments earlier, well, the two that have happened outside of NZ were in fact back to back during this latest stint working in London and in the midst of the global financial crisis. The first was a senior geologist role on the Third Forth Bridge marine investigation in Edinburgh, Scotland – this was an amazing project and my first over-water investigation. I spent a little over six months working a mixture of day and night shifts, spread across two jack-up barges and only got caught driving the contractors speed boat once... Little did the project manager know I was actually qualified to drive it. Back in London, the opportunity arose to act as Engineers Representative on the massive Thames Tideway ground investigation project – a 24km long new pipeline, 13m in internal diameter running beneath the River Thames. I will never forget the day we were working on a jack-up barge outside the Houses of Parliament and, during their lunch

break, I was close enough to see what they were eating. Suffice to say they weren’t very chatty... so we instructed more SPT’s immediately.

Two years and back in NZ, I headed straight for the familiar surroundings of Connell Wagner... Only to find the name had changed to Aurecon. Not content with a challenging geotechnical career, I chose to build a house and get married all in the same year. I am pleased to report that both marriage and home are still intact. I enjoyed a further two years working with the team at Aurecon before turning another chapter in my ‘real world’ career and joining Geoscience Consulting Ltd. Here my brief was simple: Start up a new Wellington office from scratch and make sure it’s successful. Gulp. As you can imagine this was a logistical challenge to say the least. Luckily, I wasn’t alone in this exercise and we now have a team of five talented individuals and are enjoying the challenges of growing a new business, supported by our friendly colleagues in Christchurch, Auckland and now California USA. One year in, things are looking great.

In March 2013 I was proud to be elected onto the NZGS Management Committee after serving around three years on the Wellington branch team and I am looking forward to the challenges this new role will bring. Even more recently, I have been asked to act as the Organising Committee Chair for the ANZ 2015 Geomechanics Conference to be held in Wellington.... Watch this space, I feel another ‘pinch yourself’ career moment may be close!



Photo 1: Wearing the correct PPE boarding a jack-up barge in Scotland.



## Kevin Anderson

### Occupation

Principal Geotechnical Engineer  
AECOM  
Auckland

I ARRIVED IN New Zealand 12 years ago with just a backpack and an adventure in mind. I quickly realised there was much more to the country, and especially the people, than I thought. I soon started working on the Central Motorway Junction with SKM. The project was an amazing challenge of undertaking geotechnical investigations on very busy roads and fitting even more spaghetti into the junction. We were tasked with adding capacity and links between the motorways within the existing designation. More interesting projects followed, such as leading the geotechnical design on North Shore City's wastewater network upgrade, Victoria Park Tunnel and the East Taupo Arterial. Work took me around the country where I learnt to fully appreciate the variety in geology and landscape. Floods and landslides led to me travelling the whole North Island from Wellington to Northland, including memorable days of remote roads in East Cape and the Wairarapa.

I joined AECOM in 2010 and have worked on major tunnel projects, such as Waterview Connection, Additional Waitemata Harbour Crossing and Wellington's Terrace and Mt Victoria Tunnels. I have also helped out in the Christchurch recovery in my own small way, through assessing and designing repairs to the many damaged retaining walls in Lyttleton and Governor's Bay. Whilst investigating the earthquake damage was very interesting, experiencing the 13 June M6 earthquake was a scare, and a sobering reflection of what the locals have been subjected to in the last few years. I certainly hope that the recovery accelerates and Christchurch can return to normal life in the near future.

When not working, I explored the country on land and water. I discovered sailing in Auckland's wonderful harbour and quickly progressed to racing around the Hauraki Gulf and beyond. I also travelled widely to tramp the tracks in the mountains, forests and beaches; and ski the fields north and south. Recently, such exploration has slowed following the arrival of our baby daughter.

Tunnels, rockfall and retaining walls take me back to my roots. I grew up in Inverness in the north of Scotland and from a very young age was tramping and climbing all over the country. My rock climbing and mountaineering took me as far as the Alps as well as an intimate encounter with geology. Ducking rockfall on a snowy ridge in Scotland and being hit on the head by rocks on another rock climb helps you appreciate the danger they pose.

I was interested in civil engineering from a young age. I remember being told off when a toddler for tunnelling into sand banks and damming a stream at the beach. Supervising rough road maintenance contractors on remote Scottish roads and working on a German tunnel construction site when a student gave me an early taste of life as a civil engineer. After graduating from the University of Strathclyde in 1996, I joined the Babbie Group in Glasgow as a geotechnical engineer. They were the biggest Scottish consultant at that time, with about 2,000 employees. I was fortunate to work on a wide variety of projects of all sizes.

I am delighted to join the NZGS management committee. I have lots of ideas and enthusiasm to put into the society, having enjoyed the benefits of being a member since arriving in New Zealand. We live in exciting, but changing times.



## Aristomenis Magnis

### Occupation

Geotechnical Engineer  
MWH New Zealand Ltd  
(Christchurch)



I JOINED MWH New Zealand Ltd as an Intermediate Geotechnical Engineer on 12 November 2012. My role includes conducting site surveys, field investigations and feasibility studies for proposed projects, modeling and design of geotechnical engineering works such foundations, retaining structures, slope stability analysis, landslide remediation and soil improvement.

I have 9 years of experience in the geotechnical engineering consulting industry in Greece and have a civil engineering academic background (M.Sc. in Geotechnical Eng., UMIST, UK – BEng in Civil Eng., UMIST, UK – Diploma in Civil & Infrastructure Eng., Technological Educational Institute of Athens, Greece).

Outside of work I enjoy basketball, chess and playing piano.

A Selection of recent major projects includes:

- Waikato Expressway, Rangiriri Section, Fill Embankment Design, 2012-2013
- 64 Cashel St., Christchurch, Liquefaction Assessment, MWH Recovery, 2013
- Construction of Pier III and Restoration and upgrade of Pier II in Piraeus Port, Greece, COSCO Pacific Ltd. and Piraeus Port Authority S.A., 2010 to 2012.
- AL ALFIYA Hotel, Conference and Residential Suite Development in Doha, Qatar, Qatar Industrial Services Est., 2011.
- Landslides' Restoration of Rematia-Malthi Road in Messinia, Greece, Prefecture of Messinia, 2011
- Design of Agios Konstantinos Port, Prefecture of Fthiotida, Greece, 2010

- Petroleum Products Storage Terminal in Beira, Mozambique, REFCON S.A., 2009
- COSTA NAVARINO Luxury Resort and Housing Development in Peloponnese, Greece, TEMES S.A., 2005 to 2008
- Improvement of the road network Tavronitis-Kandanos-Paleochora in Chania, Crete, Prefecture of Chania, 2004 to 2007
- Wind Farm Panachaiko in Peloponnese, Greece, AIOLIKI PANACHAIKOU S.A., 2004 to 2005
- Development of a multi-storey building in land Lot 817 in Beirut, Lebanon, THEMELIOSI S.A., 2004 to 2005

I came to New Zealand directly from Athens, Greece, which is my home town. Although I studied in the UK, I selected New Zealand as it offers great job opportunities, a healthy work life balance, a safe and secure living environment and an incredible amount of natural beauty.

Kiwis are very warm, friendly and open-minded people. Christchurch is a garden city with a unique blend of city life and beautiful landscape. As a geotechnical engineer I am sure that it will be a great experience and challenge for me to be part of rebuilding Christchurch. I am thankful to my company and the people that have trusted me and given me this unique opportunity.

Joining NZGS will not only help me in my career but also makes me feel an integrated member of the geotechnical industry of this country. I am very happy that I am the 1000th member of a rapidly growing society.

## EVENTS DIARY

Links are available from the NZ Geotechnical Society website – [www.nzgs.org](http://www.nzgs.org)

### 2013

#### 16-22 June 2013

Bulgaria

13th International Multidisciplinary Scientific  
Geoconference and Expo – SGEM 2013  
<http://www.sgem.org/>

#### 16-19 June 2013

Norway

Strait Crossings 2013 – Extreme Crossings  
and New Technologies  
<http://www.SC2013.no>

#### 23-26 June 2013 San Francisco, USA

47th US Rock Mechanics/Geomechanics  
Symposium  
<http://www.armasyposium.org/>

#### 1-3 July 2013

Torino, Italy

TC215 Symposium on Coupled Phenomena  
in Environmental Geotechnics  
<http://www.tc215-cpeg-torino.org>

#### 11-12 July 2013

Griffith University, Gold Coast  
Campus, Australia

Applied Course on Engineering Geology  
and Rock Engineering  
[http://www.griffith.edu.au/conference/  
geology-rock-engineering-workshop2013](http://www.griffith.edu.au/conference/geology-rock-engineering-workshop2013)

#### 31 August – 1 September 2013

Paris, France

5th International Young Geotechnical  
Engineers' Conference  
[http://www.lepublicsystemepco.com/  
events.php?IDManif=696](http://www.lepublicsystemepco.com/events.php?IDManif=696)

#### 2-5 September 2013

Paris, France

18th International Conference for Soil  
Mechanics and Geotechnical Engineering  
[www.issmge2013.org](http://www.issmge2013.org)

#### 21-26 September 2013

Wrocław, Poland

EUROCK 2013 ISRM International  
Symposium  
<http://www.eurock2013.pwr.wroc.pl>

#### 25-27 September 2013

Sofitel Brisbane Central Hotel,  
Brisbane, Qld

ACG Instrumentation and Slope  
Monitoring Workshop  
<http://www.slopestability2013.com/>

#### 24-25 September 2013

Beijing, China

International Symposium & 9th Asian  
Regional Conference of IAEG

#### 19-22 November 2013

Queenstown, New Zealand

19th NZGS Symposium – Infrastructure  
and Lifelines  
<http://www.nzgs13.co.nz>

#### 20-22 November 2013

Hokitika, New Zealand

New Zealand Coastal Society Annual  
Conference 2013 – Hokitika – “The Coast:  
Rough around the Edges”

#### 26-28 November 2013

Lausanne (Switzerland)

International Workshop on Geomechanics  
and Energy  
[http://eage.org/events/index.  
php?eventid=890&Opendivs=s3](http://eage.org/events/index.php?eventid=890&Opendivs=s3)

### 2014

#### Date to be confirmed (March 2014)

Sunshine Coast, Queensland,  
Australia  
10th ANZ YGP

#### 28-30 March 2014

Sofia, Bulgaria

Balkan Speleological Conference  
[www.balkan-speleo-2014.eu/eng/home.html](http://www.balkan-speleo-2014.eu/eng/home.html)

#### 7-9 May 2014

Afyonkarahisar, Turkey

ROCKMEC'2014-XIth Regional Rock  
Mechanics Symposium  
<http://www.kayamek.org/>

#### 12-14 May 2014

Las Vegas

CPT'14 International Symposium on Cone  
Penetration Testing  
<http://www.cpt14.com/>

#### 2-6 June 2014

Beijing, China

World Landslide Forum 3 (WLF3)  
<http://www.wlf3.org/>

#### 9-11 July Sky City Auckland

12 July in Christchurch

Second Australasian Structural Conference  
on Earthquake Engineering  
<http://www.asec2014.org.nz/>

#### 25-27 August 2014

Seoul, Korea

Eighth International Symposium on  
Geotechnical Aspects of Underground  
Construction in Soft Ground  
<http://www.is-seoul2014.org/main.asp>

#### 9-11 September 2014

Vienna, Austria

XV Danube-European Conference  
on Geotechnical Engineering  
<http://www.decge2014.at/>

#### 15-19 September 2014

Turin, Italy

XII IAEG Congress 2014 – Addressing  
Geological Uncertainties in Major  
Engineering Projects  
<http://www.iaeg2014.com/>

#### 9-14 November 2014

Melbourne, Australia

7th International Conference on  
Environmental Geotechnics

### 2015

#### 13-16 September 2015

Christchurch, New Zealand

6th Intl. Conference on Earthquake  
Geotechnical Engineering

#### 13-17 September 2015

Edinburgh, Scotland

XVI European Conference on Soil  
Mechanics and Geotechnical Engineering  
[www.xvi-ecsmge-2015.org.uk](http://www.xvi-ecsmge-2015.org.uk)

## NEW ZEALAND GEOTECHNICAL SOCIETY INC.

### Management Committee Address List April 2013

NAME	POSITION	ADDRESS, EMAIL	PHONE, FAX
Alexander, G (Gavin) *	Chair (Elected Member)	Beca Infrastructure Ltd 21 Pitt Street P O Box 6345 Auckland 1141 gavin.alexander@beca.com	09 300 9205 DDI 09 300 9300 Fax 0274 924 492 Mob
Anderson, K (Kevin) *	Committee Member (Elected Member) Overseas Speaker Coordinator	AECOM AECOM House PO Box 4241 Shortland St Auckland 1140 Kevin.Anderson2@aecom.com	09 967 9212 DDI 021 679 196 Mob
Burns, D (David)	Immediate Past Chair	AECOM AECOM House PO Box 4241 Shortland St Auckland 1140 David.Burns@aecom.com	09 336 5374 DDI 09 379 1201 Fax 021 999 019 Mob
Blakey, A (Amanda) +	Management Secretary (Appointed Member)	P O Box 12 241 Wellington secretary@nzgs.org Hours: 10am – 2pm Mon, Wed, Thurs.	09 575 2744 Ph 09 575 2744 Fax 021 025 11628 Mob
Cassidy, G (Guy) *	Committee Member (Elected Member)	Geoscience Consulting PO Box 25-047 Wellington 6146 guy@nzgeoscience.co.nz	04 4720820 Work 021 320 769 Mob
Gibbons, C (Camilla) •	Co-Editor, Geomechanics News (Co-Opted Member)	Aurecon PO Box 1061 Christchurch 8140 New Zealand Camilla.Gibbons@aurecongroup.com	03 375 1346 DDI 021 936 546 Mob
Fairclough, T (Tony) *	Committee Member (Elected Member)	Tonkin & Taylor Ltd 33 Parkhouse Road Sockburn TFairclough@tonkin.co.nz	03 363 2445 DDI 021 378 385 Mob
Harwood, N (Nick) *	Committee Member (Elected Member)	Coffey Geotechnics PO Box 1872 Christchurch Nick_Harwood@coffey.com	3 374 9600 Work 021 896 360 Mob
Maclean, H (Hamish) •	Co-Editor Geomechanics News (Co-Opted Member)	Tonkin & Taylor Ltd PO Box 5271 Wellesley Street Auckland 1036 hmaclean@tonkin.co.nz	09 355 0777 DDI 021 469 215 Mob 09 307 0265 Fax
Price, C (Charlie) *	Committee Member (Elected Member)	MWH Global PO Box 13 249 Christchurch 8141 Charlie.H.Price@nz.mwhglobal.com	03 345 6637 DDI 021 240 9388 Mob
Storie, L (Luke) •	YGP Representative (Co-Opted Member)	PhD Candidate Faculty of Engineering The University of Auckland Private Bag 92019 Auckland Mail Centre, Auckland 1142 luke.storie@gmail.com	021 666 118 Mob

Williams, A (Ann)	IAEG Australasian Vice President	Beca Infrastructure Ltd 21 Pitt Street P O Box 6345 Auckland 1141 ann.williams@beca.com	09 300 9172 Ph 021-809-162 Mob 09 300-9300 Fax
Davies, M (Prof. Michael)	ISSMGE Australasian Vice President	Pro-Vice-Chancellor University of Sussex Sussex House Brighton BN1 9RH United Kingdom michael.davies@sussex.ac.uk	+44 1273 678212
Beck, D (Dr. David)	ISRM Australasian Vice President	General Manager Beck Engineering Pty Ltd 9 Reid Drive Chatswood West 2067 NSW Australia dbeck@beckengineering.com.au	+61 412 135 782 Cell
Read, S (Stuart)	NZ ISRM Representative	GNS Science P O Box 30368 Lower Hutt 5040 New Zealand s.read@gns.cri.nz	+64 04 570 4728 Ph
Williams, A (Ann)	IAEG Australasian Vice President	Beca Infrastructure 132 Vincent Street P O Box 6345 Auckland 1141 ann.williams@beca.com	09 300 9172 Ph 09 300-9300 Fax 021-809-162 Mob
Rohin (IPENZ)	NZGS Web Manager	Contact: webmanager@nzgs.org	Website: www.nzgs.org

• Co-opted position

+ Appointed position

\* Elected members of committee

## ADVERTISERS DIRECTORY

Abseil Access Ltd.....	16	Geovert Ltd .....	13
Avalon.....	37,42	Griffiths Drilling.....	74,75
Beca.....	40	Grouting Services NZ Ltd.....	71
Browns Bros (NZ) LTD.....	72	Hiway Geotechnical.....	44
Contract Landscaping Ltd.....	87	LimitState Limited .....	100
Cirtex.....	101	Maccaferri NZ .....	inside front cover
Civil Services (HB) Ltd .....	49	McMillan Specialist Drilling Services .....	36
Datatan.....	73	Opus International Consultants .....	69
DCN Drilling Ltd.....	103	Perry Geotech.....	14
Drill Force NZ Ltd.....	29	Prodrill .....	97
Enzdata.....	88,108	Reinforced Earth Limited.....	9
Ground Investigation.....	33	Rock Control.....	back cover
Geobrugg .....	56	Stonestrone Infrastructure .....	108
Geoscience Consulting (NZ) Ltd.....	109	Techsoft Australasia Pty Ltd .....	inside back cover, 11
Geotech Drilling.....	99	Tonkin & Taylor.....	106
Geotechnics Ltd.....	25,55,76,107		

## **NEW ZEALAND GEOTECHNICAL SOCIETY INC.**

### **Objects**

- a) To advance the education and application of soil mechanics, rock mechanics and engineering geology among engineers and scientists.
- b) To advance the practice and application of these disciplines in engineering.
- c) To implement the statutes of the respective international societies in so far as they are applicable in New Zealand.
- d) To ensure that the learning achieved through the above objectives is passed on to the public as is appropriate.

### **Membership**

Engineers, scientists, technicians, contractors, students and others who are interested in the practice and application of soil mechanics, rock mechanics and engineering geology.

Members are required to affiliate to at least one of the International Societies.

Students are encouraged to affiliate to at least one of the International Societies.

### **Annual Subscription**

Subscriptions are paid on an annual basis with the start of the Society's financial year being 1st October. A 50% discount is offered to members joining the society for the first time. This offer excludes the IAEG bulletin option and student membership. No reduction of the first year's subscription is made for joining the Society part way through the financial year.

### **Basic membership subscriptions (inclusive of GST), which include the magazine, NZ Geomechanics News, are:**

Members	\$100
Students	Free
Annual IPENZ service centre fee applies to all NZGS members who are not members of IPENZ	\$43.70

### **Affiliation fees for International Societies are in addition to the basic membership fee:**

International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)	\$35.00
International Society for Rock Mechanics (ISRM)	\$35.00
International Association of Engineering Geology & the Environment (IAEG)	\$35.00
(with bulletin)	\$80.00

All correspondence should be addressed to the Management Secretary. The postal address is:

NZ Geotechnical Society Inc, P O Box 12 241, WELLINGTON 6144

The Secretary  
NZ Geotechnical Society Inc.  
The Institution of Professional Engineers New Zealand (Inc)  
P.O. Box 12-241, WELLINGTON 6144



## NEW ZEALAND GEOTECHNICAL SOCIETY INC. APPLICATION FOR MEMBERSHIP

(A Technical Group of the Institution of Professional Engineers New Zealand (Inc))

FULL NAME Dr/Mr/Mrs/Ms/Miss (Underline Family Name): .....

HOME POSTAL ADDRESS: .....

Phone No: ( )..... Cell Ph: ( )..... Fax No: ( ).....

E-MAIL: Home..... E-MAIL: Work.....

DATE OF BIRTH .....

ACADEMIC QUALIFICATIONS: .....

PROFESSIONAL MEMBERSHIPS: ..... Year Elected.....

PRESENT EMPLOYER: .....

WORK POSTAL ADDRESS: .....

OCCUPATION: .....

EXPERIENCE IN GEOMECHANICS: .....

STUDENT MEMBERS: .....

TERTIARY INSTITUTION: ..... SUPERVISOR: .....

SUPERVISORS SIGNATURE: .....

Preferred email (please circle): home/work

Preferred address: home/work

**Note** that the Society's Rules require that in the case of student members "the application must also be countersigned by the student's Supervisor of Studies who thereby certifies that the applicant is indeed a bona-fide full time student of that Tertiary Institution". . . ; Applications will not be considered without this information.

**Affiliation to International Societies:** All full members are required to be affiliated to at least one society, and student members are encouraged to affiliate to at least one Society. Applicants are to indicate below the Society/ies to which they wish to affiliate.

### I wish to affiliate to:

International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)	Yes/No
International Society for Rock Mechanics (ISRM)	Yes/No
International Association of Engineering Geology (IAEG)	Yes/No
& the Environment (with Bulletin)	Yes/No

**DECLARATION:** If admitted to membership, I agree to abide by the rules of the New Zealand Geotechnical Society

Signed ..... Date ...../...../.....

**ANNUAL SUBSCRIPTION:** Due on notification of acceptance for membership, thereafter on 1st of October. Please do not send subscriptions with this application form. You will be notified and invoiced on acceptance into the Society

**PRIVACY CONDITIONS:** Under the provisions of the Privacy Act 1993, an applicant's authorisation is required for use of their personal information for Society administrative purposes and membership lists. I agree to the above use of this information:

Signed ..... Date ...../...../.....

(for office use only)

Received by the Society .....

Recommended by the Management Committee of the Society .....

## ADVERTISING INFORMATION

NZ *Geomechanics News* is published twice a year and distributed to the Society's 800 plus members throughout New Zealand and overseas.

The magazine is issued to society members who comprise professional geotechnical and civil engineers and engineering geologists from a wide range of consulting, contracting and university organisations, as well as those involved in laboratory and instrumentation services.

BLACK AND WHITE	COST	SIZE
Full page	\$310/issue	210mm x 297mm high
Half page	\$240/issue	90mm wide x 265mm high
Quarter page	\$210/issue	90mm wide x 130mm high

### COLOUR

Full page A4	\$550/issue	210mm x 297mm high
A3 position	\$1035/issue	420mm wide x 297mm high
Half page (vertical)	\$275/issue	90mm wide x 265mm high
Half page (horizontal)	\$275/issue	210mm wide x 148mm high

### COVER PLACEMENTS

Inside front & back and outside back cover	\$830/issue	210mm x 297mm high
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### FLYERS/INSERTS

Insert to be posted with magazine \$275/ for A4 single page flyer

(For other size inserts the price is dependent on weight of insert. Price provided on request)

(advertiser to provide the insert at their own cost)

### NOTE

1. All rates exclude GST
2. Space is subject to availability
3. A 3mm bleed is required on all ads that bleed off the page.
4. Advertiser to provide all flyers

If you are interested in advertising in the next issue of NZ *Geomechanics News* please contact:

Management Secretary, Amanda Blakey

email: [secretary@nzgs.org](mailto:secretary@nzgs.org)