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# **BUILDING A RESILIENT NATION**

## **Proceedings of the 7th Australasian Natural Hazards Management Conference**

**GNS Science Miscellaneous Series 74**

**Te Papa, Wellington, New Zealand  
22–25 September 2014**

**(Optional Workshops 22, 25 and 26 September 2014)**



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# THE NATURE OF CROSS-BOUNDARY INFORMATION SHARING BY KNOWLEDGE BROKERS DURING DISASTERS

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During disasters, cross-boundary information sharing is seen as significant. It requires extensive information sharing flow between different groups and individuals in the community as well as among the different response teams. The impact on the affected community may also be reduced by having a good information sharing plan.

Boundaries exist between multiple groups involved in a disaster. Knowledge brokers in this study are individuals who receive and hold critical information that might be relevant across their group's boundaries during a disaster. The importance of cross-boundary information sharing during a disaster has been discussed in both academic and practitioner circles. However, they focus on either the organisation or at the system level. Very little attention has been paid to the individual level. This study intends to fill the gap by exploring the nature of cross-boundary information sharing by knowledge brokers during disasters.

The objective of this study is to identify how knowledge brokers assess and decide to whom the information they receive might be relevant during a disaster. This study also argues that during the golden hour of a disaster, the stress knowledge brokers are under might affect their judgment of the reliability and accuracy of the information they receive. Therefore, the second objective of this study is to identify how knowledge brokers assess the reliability of the information they obtain during a disaster.

Using an interpretivist epistemology, a qualitative multiple case research method is used. Critical incident method interviews were conducted as the method of inquiry and data collection technique. The unit of analysis is the knowledge brokers.

Based on the interim findings, temporary group structure formation during a disaster was found to be an important factor for a manageable information flow. However, individuals' training and experience were the enablers for knowledge brokers to identify to whom the critical information they hold is relevant. Trust in the information source, social relationships and personal experience were found to contribute to the judgment process regarding the reliability of the information that the knowledge brokers received.

The findings of this study are expected to be useful both for IS academics – as new theories may emerge for future knowledge development and may shed light on information sharing and knowledge broker theories – and practitioners, as it may assist relevant organisations and communities to prepare a stronger community resilience plan.

# **POST-DISASTER HOUSING RECONSTRUCTION: POLICY AND PRACTICE GAPS IN SRI LANKA**

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The 2004 Boxing Day tsunami, which was a result of the fifth largest earthquake of the last century, caused great devastation in Sri Lanka, making more than 1,000,000 people homeless. The task of reconstruction after the 2004 tsunami was an onerous challenge to a developing country like Sri Lanka, which required the deliberate and coordinated efforts of all stakeholders for effective and efficient recovery of the affected community. This resulted in a large number of post-disaster housing reconstruction projects. Two main types of housing projects namely owner driven and donor driven emerged in Sri Lanka. Varying types of policy decisions were executed in order to meet the objectives including time, cost, and quality of post-disaster housing reconstruction. However, gaps between the policy decisions, practice and the existing literature were observed. This paper tries to uncover these gaps after an extensive review of literature and case study interviews in Sri Lanka.

# GLACIER LAKE OUTBURST FLOOD (GLOF) HAZARD ASSESSMENT AND GLOF RISK MANAGEMENT IN THE CHILEAN PATAGONIA

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GLOFs are one of the most frequent and damaging processes that originate from glaciated areas worldwide. GLOFs can release  $10 \times 10^6 \text{ m}^3$  of water in a short time (hours to days) affecting distant communities (located dozens of kilometres from lakes). GLOFs damaging capacity has been dramatically demonstrated in the Peruvian Andes where GLOFs have caused thousands of victims. In Patagonia, dozens of GLOFs have been documented with some affecting inhabited areas. However, data about GLOFs conditioning and triggering factors are limited. With power schemes being planned in Patagonian basins that have historically been affected by GLOFs it is urgent that we gain a better understanding of GLOFs hazards. In this work we study the conditioning factors of GLOFs from moraine-dammed lakes that occurred in historical time in Patagonia and developed a methodological scheme (based on remote sensing techniques, GIS modelling and the Analytical Hierarchy Process) to classify the lake's outburst susceptibility. We also reviewed the procedures that are followed when facing GLOF hazards in this region.

At least 16 moraine-dammed lakes have failed in Patagonia. Failed lakes range in size from 0.01 to 1.82 km<sup>2</sup>, had moderate ( $\geq 8^\circ$ ) to steep ( $\geq 15^\circ$ ) outlet slopes (which favours dam's erosion if overtopping occurs) and were commonly in contact with glaciers at the time of failure (and thus were affected by calving and/or rapid changes in volume after glacier variations). Prolonged and intense precipitation and the impact of mass movements caused some of the GLOFs. These data were integrated in the proposed outburst susceptibility scheme which was applied in the Baker Basin Chilean, Patagonia. The scheme allowed categorising the outburst susceptibility of hundreds of lakes in a short time in a qualitative but objective way.

Until now, GLOF hazard assessments in Patagonia were based exclusively on statistical analysis of short series (<50 years) of flood data and no attempts were made to identify hazardous lakes. Emergency management procedures mainly consisted of spontaneous responses by communities during GLOFs (e.g., ringing a chapel bell as an alert). Nevertheless, after major GLOFs, official responses have also been developed, including the relocation of a village and the implementation of a monitoring and early warning system (e.g., telemetering data of the level of a hazardous lake to declare GLOF alerts). These emergency procedures have been reactive and have not been systematised. The proposed outburst susceptibility scheme can be used in first-order regional GLOF hazard assessments and might contribute to future GLOF emergency management plans.

# **CULTURAL TOURISM SERVICE PROVIDERS: SURVIVING IN THE POST-DISASTER CONTEXT**

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In recent years tourism has been one of the fastest growing sectors of the New Zealand economy. As a tourist destination, cultural attractions are significant along with many of New Zealand's outdoor experiences, especially in Christchurch, the garden city. However, Christchurch lost many of its unique defining features after the series of devastating earthquakes. Culture and heritage are suddenly no longer part of the attraction for visitors. Instead, the demolition of buildings and the vast empty spaces, which give the city an almost post-apocalyptic look in certain areas, have now become one of the key features for tourists. This situation is a critical issue for Christchurch's cultural tourism and its providers.

The current study explores how tourism can survive after a natural disaster. Using semi-structured interviews to gather the data, this research uses six case studies to look at the different tourist industries in Christchurch. The research aims to determine the impact of the disaster on cultural tourism, including the post-disaster representation of tourism sites, features and activities, site preservation and implementation of substitute tourism attractions. In particular, it explains Christchurch local service providers' experiences and disaster management strategies.

The research indicates that adopting and ensuring the actual reality of the situation goes into planning for the service providers and managers. They should modify and adapt their skills for the actual situation along with collaborative practice and new innovative product creation in disaster-affected tourism.

# **BUILD BACK BETTER – APPLICATION TO THE CHRISTCHURCH WATER INFRASTRUCTURE RECONSTRUCTION**

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“Build Back Better” (BBB) is a term that is becoming more commonly used during post-disaster reconstruction efforts. In addition to being an increasingly commonly used phase, BBB is a specific concept that uses the opportunity of reconstruction to improve the pre-disaster situation and resilience of infrastructure prior to future disasters in a holistic manner.

This paper uses an established BBB model and has applied it to the reconstruction of water (stormwater, water supply and wastewater) infrastructure in Christchurch following the 2010 and 2011 earthquakes. In doing so, the key principles including Risk Reduction, Community Recovery and Implementation have been considered to ensure the on-going resilient and sustainable development of the Christchurch water infrastructure into the future.

A series of semi-structured interviews have been conducted to date speaking with those involved at various stages of the city’s water infrastructure reconstruction. This includes designers, delivery team representatives and programme coordinators within the Stronger Christchurch Infrastructure Rebuild Team (SCIRT). Data collected during these interviews have been used to identify successes and shortcomings of BBB principles related directly to the case of Christchurch rebuilding its water infrastructure.

## **AFTERSHOCK COMMUNICATION DURING THE CANTERBURY EARTHQUAKES, NEW ZEALAND**

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On 4 September 2010 a Mw7.1 earthquake struck Canterbury, New Zealand. It initiated an aftershock sequence that included more than 3,500 events (over Mw 3.0) by the end of 2012. Amongst the aftershocks was a Mw 6.3 earthquake in February 2011 which caused significant impacts to the city of Christchurch and 185 fatalities. During the aftershock sequence it became evident that the effective communication of aftershock information was imperative to assist with subsequent decision making and overall community wellbeing. As a consequence a joint USGS-JCDR research project was initiated to investigate:

- How aftershock information was communicated to organisations and the public;
- How people interpreted that information;
- What people did in response to receiving that information; and
- What decision-making challenges relating to aftershocks were encountered.

To investigate these questions, a series of focus groups and interviews were conducted with a range of information users. These users included scientists and science advisors, local and national emergency managers and responders, engineers, communication officers, critical infrastructure operators, elected officials and the public. The interviews and focus groups were transcribed, and the data is currently being coded and analysed thematically using the software package NVivo. Preliminary results indicate that people were exposed to information about aftershocks ranging from experiencing actual aftershocks themselves, to basic media descriptions, through to aftershock forecast products (e.g., probability tables, forecast maps). People used such aftershock information for a variety of purposes including response (e.g., deciding when to enter a damaged building); recovery (e.g., making decisions about when to instigate insurance-related repairs; reassurance about what to expect in terms of future earthquakes); readiness (e.g., emergency managers balancing aftershock forecasts with messages about staying prepared); and reduction (e.g., new building standards). This research has found aftershock communication to be highly contextual and thought must be given to the needs of different user groups ahead of time, so that information can be provided in the format and nature that each group requires.

Lessons from this research have subsequently been used by GNS Science and GeoNet to enhance aftershock risk communication after the M6.2 Eketahuna (New Zealand) earthquake in January 2014. The US Geological Survey is also integrating an aftershock sequence with earthquake forecasts and cumulative damage assessments into a Bay Area scenario in California.

# THE LONG TERM SOCIAL RECOVERY PROCESSES POST-1931 NAPIER EARTHQUAKE

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In 1931, a magnitude 7.8 earthquake hit the city of Napier and the Hawke's Bay, New Zealand. This had a major effect on the communities of Napier with the loss of lives and resources, including homes and infrastructure. Research suggests that, in face of a disaster, people are not helpless victims but rather utilise an array of enmeshed capacities such as their endogenous knowledge, skills and resources to respond, recover and re-establish their lives after a disaster event. This poster explores the long-term social recovery processes and capacities of local community's post-1931 Napier earthquake. It specifically focuses on the capacities various local communities used to re-establish their lives, the long term effectiveness of various capacities/coping strategies used by communities in attempt to re-establish their lives and the ways in which various stakeholders assisted local communities in re-establishing their lives. The study involves a literature review and interviews with individuals who experienced the hardship of 1931 Napier earthquake, or have knowledge of the social situation in Napier post-earthquake and analysis of historical documents from the Napier Museum archives, Archives New Zealand and private collections. These methods provide an understanding of community needs after the earthquake, how their needs were met/if they were met, the appropriateness of the response from stakeholders and where and what assistance would have been more beneficial in terms of recovery.

## WEATHER HISTORY WEBSITE

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MetService is developing a website ([iwonderweather.co.nz](http://iwonderweather.co.nz)) dedicated to the history of weather and forecasting in New Zealand. One aim is to heighten awareness of the havoc bad weather can create by documenting the effects New Zealand's worst storms, such as the cyclone of 1936, the widespread snow of 1939 or the wind-driven wildfires of 1878 and 1918.

Stories are being told that highlight the way in which weather hazards depend not just on the extremity of the weather but also on what activity people attempt. For instance, strong winds in Wellington became a near lethal hazard in 1914 when Will Scotland took off from Athletic Park in his Caudron bi-plane. Walking through deep mud is unpleasant in normal circumstances but on a battlefield it can be lethal, as New Zealanders found to their cost at Passchendaele in 1917. Yet, benign weather can mitigate hazards as we see in the story about the steamer *Wimmera* that struck a mine and sank north of New Zealand in 1918. Fortunately moderate northerly winds blew most of the survivor's lifeboats safely to land.

We hope that more weather history information is shared on the website and that the ongoing collaboration between the MetService and its stakeholders, such as the New Zealand public enables [iwonderwether.co.nz](http://iwonderwether.co.nz) represent the truly rich and deep history of New Zealand weather. Further entries to the website are being written as time allows and feedback is always welcome.



## GETTING THE MESSAGE OUT

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The weather has always been a talking point. Over the last few years, the growth of social media has raised the profile of the "weather discussion" in the public arena. Discussion on social media can yield significant benefits: individuals can ask questions and have them answered knowledgeably, information about weather- and weather-related events can become available more rapidly than via conventional observing networks, and so on.

There are challenges in making best use of the opportunities offered by social media. Occasionally, information about forecast weather events "goes viral", for better or worse. The result can be a rapid spread of misinformation and a corresponding backlash when this does not match with reality.

A notable recent example is the passage of ex-tropical cyclone Lusi through the New Zealand area in March 2014. Many people seemed to expect that they "were going to be hit by a cyclone" that weekend and there was significant discussion in the broadcast and social media when this expectation was not met. Forecasts and warnings issued for most New Zealand places verified well.

This presentation will discuss the type of messaging used, both in social and broadcast media, during the lead-up to the passage of ex-tropical cyclone Lusi through the New Zealand area and reflect on the importance of the "single official voice."

# RISK AND RESILIENCE APPROACHES TO CATASTROPHE MANAGEMENT IN SOCIETY

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Recent natural and man-made catastrophes, such as the Fukushima nuclear power plant, flooding caused by Hurricane Katrina, the *Deepwater Horizon* oil spill, the Canterbury earthquakes and the mortgage derivatives crisis, have renewed interest in the concept of *resilience* in the context of complex societal systems vulnerable to multiple or cascading failures. Although the meaning of resilience is contested in different contexts, it can usefully be understood as *the capacity of a system to adapt to changing conditions without catastrophic loss of form or function*. In the context of societal systems, this has sometimes been interpreted in terms of the probability that system conditions might exceed an irrevocable tipping point. However, expressing resilience exclusively in terms of probability in this way confuses the resilience and risk perspectives. In addition, the use of probabilistic risk as a factor in disaster risk reduction is intrinsically unreliable because the numbers of hazard events that occur in a locality in a reasonable planning time-frame is too small to be described in this way. In contrast, resilience is an *emergent property* of what a system *does*, rather than a *static* property the system *has*. Thus resilience cannot be measured at the system scale solely from examination of component parts. Instead, resilience is better understood as the outcome of a recursive system process that comprises *sensing, anticipation, learning, and adaptation*. From this perspective, resilience analysis is able to address risks that are unknown and/or unquantifiable, whereas risk analysis and risk management can by definition address only those risks that are identified and adequately quantified. Society needs to recognise that some of its current governing principles, such as centralisation and short-term economic efficiency, are intrinsically counter-resilient, and purposefully develop strategies that incorporate the resilient behaviours that long-lived natural systems exhibit.

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# **PRACTISING RESILIENCE: WOMEN'S STORIES OF THE CHRISTCHURCH QUAKES**

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Resilient individuals, households and communities are defined as crucial to disaster response and recovery. But what contributes to this imagined 'resilience' and how is it created and sustained? This paper draws on the stories of over 150 Christchurch women interviewed about their earthquake experiences in a community-based oral history project organised by the Christchurch Branch of the National Council of Women of New Zealand. It highlights the different ways in which women practiced resilience, and identifies how primary emotional bonds, existing social networks, social media and spontaneous individual and collective initiatives were important during and after the quakes. The emotional toll of the exercise of living in an ongoing disaster situation is also noted, especially among women with limited financial resources in eastern Christchurch, many of them in damaged rental homes.

The findings of this project indicate how agency, responsibility for others in crisis situations and ingenuity in difficult circumstances are interwoven with vulnerability and the need for support and care. A case is made for attention to the disaster assistance dynamic in planning for, and responding to, natural disasters, especially in a context where the consequences persist over several years. Resilience can manifest itself differently in the context of the shock of particular quakes as opposed to the ongoing stresses of living in damaged homes, struggling with bureaucratic processes and experiencing financial insecurity. Women's stories illustrate this complexity.

See: NCWNZ Women's Voices: Recording Women's Experiences of the Canterbury Earthquakes archive of interview summaries, audio recordings, photographs of participants, research reports and information about the research process at <https://quakestudies.canterbury.ac.nz/store/collection/228>

# DISASTER RESILIENCE: AN INTEGRATED APPROACH FOR DISASTER PREPAREDNESS AND RESPONSE

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The devastating impact of disasters have emphasised the need for an integrated process for improving disaster preparedness and response in disaster-prone communities. While community-based approach to resilience and disaster planning has been widely promoted in the last decade, ability to sustain initiated community-based measures, challenges in synchronising the measures with national framework as well as ensuring the effectiveness of these arrangements during response to devastating disasters has been challenging. Thus, this research examines existing functions within disaster-prone communities which can be utilised for disaster preparedness and response thereby promoting resilience to future disasters. The aim of this research is not to initiate new disaster preparedness and response measures, it aims to examine the functions which can be integrated into the existing framework for disaster preparedness and response as set up the Civil Defence and local authorities. Thus, the research will:

- identify existing functions within disaster-prone communities (using Lyttelton and Greater Riccarton area in Christchurch as a case study)
- examine the appropriateness of identified functions for improved disaster preparedness and response.

This approach to improving preparedness and response level to future disasters will simultaneously enhance resilience of disaster-prone communities. The research builds on the researches of Cutter et al. (2008), Paton and Johnston (2006), Tierney and Bruneau (2007) among others, by adapting their models to compliment the concepts of Integrated Emergency Management (IEM) as examined by Alexander (2005), Waugh and Tierney (2007), Sylves (1991).

Secondary data such as disaster reports and community profile developed by Christchurch City Council, previous researches on target communities, academic articles, and video documentaries relating to the research objectives are analysed. Primary data collected through focus group interviews and ethnography will determine the appropriateness of the function(s) identified. These combined methods will generate reliable, valid and repeatable data which can inform disaster resilience in the case study communities and any disaster-prone communities.

The research addresses the need to develop a disaster resilience framework which integrates community functions and disaster preparedness and response activities undertaken by the local authority and the emergency organisations. The framework will ensure that disaster-prone communities are involved in the planning and response process to catastrophic events which are likely to occur but difficult to predict with certainty. By adapting the principle of integration as embedded in IEM ensures that communities are formally involved in the disaster planning/reduction phase of disaster management continuum. It also makes this research a major contribution to knowledge.

## **MANAGING COMMUNITY LANDSLIDE AND DEBRIS FLOW RISK – WHAKATĀNE EXPERIENCE**

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Although provided for already in the Resource Management Act, proposed changes to the Act will increase the emphasis on regional and local authorities' management of natural hazard risk to communities. Whakatāne is a naturally active district where residents and visitors are exposed to many natural hazards including volcanic eruptions, earthquakes, coastal processes, tsunami, tornados, flooding, landslides, and debris flows.

The 2005 debris flow events at Matatā highlighted the devastating consequences of this hazard. The Council responded by planning a series of engineered mitigation projects.

In response to an increasing frequency of high intensity rainfall events between 2004 and 2012 that resulted in damaging and fatal landslides throughout the District, the Council initiated a programme to develop a planning response to manage the consequences of landslides. The project started with a quantitative hazard assessment of landslides along the Whakatāne and Ōhope escarpments.

When it became clear that a viable and sustainable engineering solution to manage the debris flow hazard from the Awatarariki catchment at Matatā was not available, the Council resolved to extend the landslide hazard programme to include landslide and debris flow hazards at Matatā. Due to the unique and devastating nature of debris flows and the number of properties likely to be adversely impacted, the Council progressed the debris flow hazard component through to a quantitative debris flow risk assessment to better understand the potential loss of life risk posed by the hazard.

This paper will examine some of the challenges the Council has faced in its development of a proposed variation to the natural hazards provisions of its District Plan. The focus of the paper will be on landslide and debris flow hazards and risks. Due to an absence of central or regional government policy direction on how natural hazards should be assessed and what levels of risk are deemed acceptable, tolerable, or intolerable to New Zealand communities, the Council was forced down an exploratory pathway to identify an appropriate risk framework and then implement it. Following international and national research that looked at natural hazard work carried out in the UK, Hong Kong, Canada, Australia, and Christchurch (NZ), the Australian Geomechanics Society risk framework for landslides was adopted.

In the course of carrying out the work, other challenges such as community engagement, making the engineering science credible to elected representatives to allow life safety policy decisions to occur, application of the information to resource consents and building consents for development on high hazard and high risk land, application of the information to land information memoranda, and managing a hazard affected community that is disenchanted with the Council, have all had to be positively managed.

# **BUILD BACK BETTER IN WAIMAKARIRI DISTRICT COUNCIL EARTHQUAKE RECOVERY AND REBUILD: BEST PRACTICES**

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Disasters can provide opportunities to build back the existing environment in a better, more resilient way. Hence, the restoration process is complex and requires close attention. The phrase 'modified Build Back Better', established after the Victorian Bushfires, encompass all key elements in post disaster recovery and reconstruction. It aims for better resilience by prioritising risk reduction, community recovery and implementation aspects.

This paper aims to identify the best practises in recovery and reconstruction in Waimakariri district, which was worst affected by Christchurch earthquake in 2010 and how they relate to the modified 'Build Back Better' concept. The analysis will be undertaken through literature review and interviews, and will attempt to bridge potential gaps in the Build Back Better framework.

# PARTICIPATORY MAPPING FOR DISASTER RISK REDUCTION: A REVIEW

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In theory, disaster risk reduction (DRR) must be inclusive of a large array of stakeholders in order to integrate actions from the bottom up and the top down and address both the root causes of people's vulnerability and enhance their intrinsic capacities to face natural and other hazards. In practice, however, this is rarely the case, reflecting difficulties in appraising and integrating different forms of knowledge and resources, the dominance of technocratic institutional frameworks, and a scarcity of appropriate tools to foster dialogue amongst all stakeholders.

Maps constitute a powerful tool which gives visual expression to realities which are perceived, desired, or considered useful, thus often providing means for conveying ideas beyond the realms of those who produce maps. Unfortunately, maps used in DRR often require particular skill to decipher. They are crafted after Western guidelines and semiologies, e.g., language, technical jargon, colour coding of the legend, orientation towards the North, which frequently make little sense to people threatened by the same hazards. They are therefore of limited use when fostering community-based DRR that integrates top down and bottom up knowledge and actions. Participatory mapping has emerged as an alternative to better encompass the diversity of local communities' views on natural hazards and disasters. Participatory maps enable local communities, assisted by Non-Government Organisations (NGO), to draw very insightful picture of their territory which feature people's perception of natural hazards as well as their vulnerability and capacities. In the process, the most marginalised people can discuss DRR with scientists, government representatives, and other key stakeholders to foster sustainable assessment and solutions to DRR that reflect local needs and resources.

Different forms of participatory mapping are currently being used for DRR. These include ground mapping, 'stone mapping', sketch mapping. While these methods have proven successful in identifying knowledge and issues, they remain poorly capable of integrating local and scientific knowledge as they are typically not scaled or geo-referenced so are dismissed by officials who are unable to overlap their own hazard and land use information. Alternative forms of mapping have emerged to address this shortcoming, such as mapping on aerial photos or satellite images, balloon mapping, GPS mapping, drone mapping, and Web-based and interoperable mapping, and participatory three dimensional mapping. Drawing upon an array of concrete examples from Asia and the Pacific, this presentation provides an overview of these forms of participatory mapping, and the strengths and weaknesses of their processes and outputs when applied to DRR.

# **PARTICIPATORY 3-DIMENSIONAL MAPPING FOR DISASTER RISK REDUCTION**

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Participatory 3-Dimensional Mapping (P3DM) consists of building stand-alone large-scale relief maps made of locally available and cheap materials (e.g., carton, paper, cork) over people overlap thematic layers of geographic information. P3DM enables the mapping of landforms and topographic landmarks, including volcanoes, land cover and use, and anthropogenic features, which are depicted by push-pins (points), yarn (lines), and paint (polygons). Participants plot land use and other geo-referenced features threatened by natural and other hazards and differentiate them according to their vulnerability. Pins of different shapes, sizes and colours enable differentiating building materials and locating the most vulnerable people in the community. It is also possible to identify different resources which form the household livelihoods, land tenure and power relationships within the community. Members of the community eventually delineate hazard-prone areas and locate local resources to face these threats. It is then easy and quick to evaluate disaster risk based on hazards, threatened assets, vulnerabilities and capacities. P3DM then enables the planning of disaster risk reduction measures based on multi-stakeholder group discussions over the map, helping to find consensus among participants.

Therefore, P3DM fosters the participation of a large range of stakeholders, especially the collaboration amongst scientists, government officials, and local communities, thus enabling the integration of bottom-up and top-down risk reduction initiatives. P3DM provides a tangible tool where the most marginalised people, including the illiterate who may have a poor understanding of scientific concepts, can discuss disaster risk reduction with scientists, who on the other hand may have a poor understanding of the local context. All stakeholders can contribute their knowledge on the same tool and in the same forum. P3DM is credible to both locals, who build the map and plot most of the information, and to scientists as well as local government representatives who can easily overlap their own data and plans on scaled and geo-referenced maps. In the process, NGO partners serve as facilitators and moderators. The integration of bottom-up and top-down actions is further facilitated when P3DM data are integrated into Geographic Information Systems (GIS) to make use of people's knowledge beyond the community which built the map.



# STOP DISASTERS 2.0: VIDEO GAMES AS TOOLS FOR DISASTER RISK REDUCTION

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Increasingly, international organisations (e.g., UNISDR), governments (e.g., Canada), NGOs (e.g., Save the Children) and researchers use video games to raise disaster and disaster risk reduction (DRR) awareness. Existing research suggests, video games in general, may attribute toward an individual's thinking, attitude and behaviour. It particularly points to video games as a stimulus, focusing upon game users' exposure to game content and features. However, literature surrounding how the game content, design and outcomes experienced by users is lacking, especially in the context of disasters. With disaster themed video games becoming increasingly prevalent, a significant gap is present in the research area. A typology designed to specifically deconstruct disaster awareness building video games, identifies how games like Stop Disasters, Disaster Watch, Inside Haiti, Earthquake Response and SimCity instil disaster awareness, portray hazards, vulnerabilities, capacities, disasters and DRR. This typology will be used to assess disaster and DRR awareness in video game users.

## **HISTORICAL ECOLOGY FOR RISK MANAGEMENT: YOUTH SUSTAINABILITY (HERMYS)**

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Current team consists of the following researchers and community partners: Anne Garland (DHS CREATE, ARIES, University of Maryland, Historical Ecology/Archaeology), Kathleen Fischer (ARIES, Oceanographer), Michael Brady (Doctoral Candidate, Geography, Rutgers University) Glenn Sheehan (Barrow Arctic Science Consortium), Hollis Yenna (PolarTREC High School Teacher), Sian Proctor (PolarTREC Community College Faculty), Anne Jensen (UIC Senior Scientist for Cultural Resources), Fredrick Brower, Robin Smith, and James Kilioni (North Slope Borough Risk Managers and Disaster Coordinator), Laura Thomas (Ilisagvik Community College Cooperative Extension), and David Ongley (Tuzzy Consortium Library Director).

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Applied Research in Environmental Sciences Nonprofit, Inc. (ARIES), Barrow Arctic Science Consortium (BASC), North Slope Borough (NSB) Risk Management, Tuzzy Consortium Library, and Cooperative Extension of Ilisagvik Community College are collaborating to implement a historical ecology model for the North Slope Coastal Region of Alaska.

Historical ecology is an applied research program that focuses on interactions of people and their environments (social-ecological systems) in both time and space to study its accumulated effects. The research can be applied to community landscapes that assist management strategies including environmental conservation, ecosystem services, and hazard mitigations.

The emphases align with the ARIES mission that combines research, education and community outreach, the Inupiaq Learning Framework, and the eco-heritage indicator of the CRIOS model (Cumulative Regional Integrated Operability Score. <http://www.ariesnonprofit.com/ARIESprojects.php>). The Inupiaq Learning Framework (<http://www.inupiatheritage.org/our-culture>) and the HERMYS model align. Traditional knowledge of the Inupiaq includes the integration of historical, social and natural sciences.

The project emphases are:

- compile a bibliographic database of historical resources of both social and natural sciences,
- conduct a historical examination of the shoreline for a time-series baseline,
- develop simulation models to demonstrate socio-natural cycles of change for the North Slope shorelines,
- study historical ecology of the shoreline with interactive mapping and a web based database to assist academia, industry, regional government, and local communities for socio-cultural and environmental management purposes, (in collaboration with Barrow Area Information Database, BAID, <http://prodgis02.utep.edu/baidutep/>)
- assemble an integrated team with interested researchers, industry, community planners, Native corporations for risk mitigation, community decision making, community participation in research, educational products, age-level activities, and community service learning such as PolarTREC (<http://www.polar trec.com/expeditions/historical-ecology-for-risk-management-2014>) and Teen CERT(<http://www.fema.gov/community-emergency-response-teams/teen-community-emergency-response-team>).

## LEARNINGS FROM EMBEDDING METEOROLOGY INTO CIVIL DEFENCE DECISION-MAKING

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One third of all New Zealanders reside in Auckland, within only 2% of the country's total landmass. Under the Civil Defence and Emergency Management National Plan, MetService are recognised as the official supplier of weather warnings, and Civil Defence as the lead organisation during significant adverse events. Having both organisations working closely together in our largest city is essential, ensuring the public are well informed with accurate and timely information through a single-voice.

For the last year and a half, MetService has had an embedded meteorologist working within Auckland Council Civil Defence and Emergency Management. This qualified forecaster offers a 5-day Auckland-region daily weather briefing to Hazards staff, and is available on station if the Emergency Coordination Centre activates. In addition, the MetService forecast room is available 24/7 for updates during significant weather, and computer modelling and real time weather observations are available to Council through the MetService MetConnect product.

Both MetService and Council now have increased knowledge of the other's day-to-day operations, with subsequent improvement in communication (focusing on what is likely to be important to Council). The benefits in having a qualified forecaster on site compliments the planning and intelligence phase of natural hazard events (such as the lead-up to Cyclones Lusi and Ita), as well as improved real-time response to non-weather-related events (for example, wildfires or major maritime oil spills).

# THE WINDING ROAD TO BUSINESS RECOVERY

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On February 22, 2011, life for Christchurch business owners and managers changed dramatically. Whether they were in the less affected west of the city, or the devastated central business district, the operation of their businesses was immediately threatened. In the short term, this threat was predominantly about staff welfare, access to premises, stock and equipment and in the longer term about a city whose patterns of travel, employment and consumption have changed enormously. Businesses, the majority of whom had taken no actions to prepare for disruption, faced the immensely difficult task of making quick decisions in an uncertain and rapidly evolving environment.

It has long been appreciated that recovery from a major disaster is a process, not an event. Extensive study has shown that the recovery period is long and progress does not necessarily occur in neat linear stages. We know that disasters create winning and losing sectors but little is known about the intricacies of these processes other than an overall balancing out when recovery is considered from a macroeconomic regional unit of analysis.

This study examines the intricacies of the recovery process for 24 Christchurch organisations, finding a journey with many twists and turns, some unexpected detours and in many cases, still very uncertain outcomes. Organisations in this study include those who worked with others in collaborative endeavours to recover, those who resumed alone and those who have not yet resumed trading. The very different journeys to recovery will be discussed, along with the many silver linings that have emerged from these businesses' goal to simply survive. Key points from these journeys that are relevant for those tasked with assisting business recovery will be highlighted including: issue framing, innovation enablement, providing the right space and problem-sharing.

Organisational recovery from disaster is often cited as one of the least researched areas of disaster recovery, yet also acknowledged as fundamental to overall community recovery. The more we understand with regard to the disaster recovery process, the more actions can be taken by individuals, organisations and governments to hasten the process.

# **PYROCLASTIC FALL AND FLOW CLEAN-UP IN AUCKLAND CITY, NEW ZEALAND: QUANTITATIVE IMPACT ASSESSMENT AND RESPONSE PLANNING**

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Pyroclastic falls and flows can potentially affect urban functionality by disrupting transport, damaging infrastructure, and causing a health hazard. Consequently, efficient clean-up operations are a fundamental component of the response for impacted communities during and following a pyroclastic fall and/or flow event. We present a review of tephra clean-up operational processes around the world and identify best practices to apply to clean-up of a possible future pyroclastic falls and flows affecting Auckland, New Zealand. Our global survey indicates there are many challenges with pyroclastic fall and flow clean-up operations. Interestingly, there is poor relationship between pyroclastic fall intensity (e.g., deposit depth and extent) and the time it takes to complete clean-up operations. We holistically attribute variability in clean-up duration to interactions between volcanic (e.g., particle grain size, and eruption duration), engineering (e.g., road surface type and width), and social (e.g., existence of clean-up plan, and clean-up priorities) characteristics. Steps common to all documented clean-up operations are: (1) identification of priority areas for clean up, (2) deposit collection, (3) disposal site selection, and (4) deposit stabilisation. We present results from our quantitative impact assessment for multiple scenarios of pyroclastic fall and flows affecting Auckland undertaken to evaluate the geospatial extent and losses for clean-up. We end with initial findings of a source to disposal site network analysis for the Auckland road network, considering time and cost estimates for disposal.

# WHO REALLY COUNTS? PARTICIPATORY NUMBERS IN DISASTER RISK REDUCTION

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Participatory numbers are quantitative research data produced by those at the forefront of everyday development struggle, i.e. the poor and marginalised who are usually excluded from mainstream research initiatives supposed to assist in lifting their wellbeing. Tools involved in collecting these data include scoring and ranking, proportional pilling, Venn diagrams, participatory mapping, etc. This alternative data set has emerged as a response to the need for participatory methods and tools to be tangible to those outside of local communities who are involved in participatory learning and action activities. Participatory numbers are therefore meant to provide a platform for dialogue across a large array of stakeholders involved in development work. Disaster risk reduction is a subfield of development where participatory numbers are being increasingly used for identifying and assessing the vulnerabilities and capacities of those most affected by natural hazards. Nonetheless, there has not been much critical reflection to date upon the relevance, purpose, practice and outcomes of such tools for better appraising the risk of disaster amongst marginalised communities and making this assessment tangible to outside stakeholders such as government officials, scientists and NGOs. This presentation contributes to bridging this gap by providing some empirical and theoretical thoughts on the use of participatory numbers for disaster risk reduction based upon activities conducted in the Philippines and Samoa between 2010 and 2013.

# RESEARCH CONTRIBUTIONS TO MONITORING AND EVALUATING COMMUNITY DISASTER RESILIENCE: POLITICAL CONSIDERATIONS AND TECHNICAL SOLUTIONS

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Community disaster resilience exists because of interactions between a range of social and physical systems. It can be very complicated to plan, monitor and evaluate resilience interventions, especially where a wide range of collaborating professionals and organisations are involved. Our research aimed to disentangle some of the strong, and very different, opinions held by collaborating professionals, to help facilitate the improvement of community disaster resilience programmes in the field.

Five researchers and five practitioners from the Wellington-based International Centre of Excellence: Community Resilience ranked a set of opinion statements (about monitoring and evaluating community disaster resilience) by levels of agreement or disagreement. Patterns amongst these rankings identified three substantial opinion factors, including certain political tensions between the two groups. Practitioners supported an approach to building knowledge from community development practice in the field, on up. Researchers were focused on knowledge which was much more removed, for informing strategic management and policy. One factor was shared by all participants. This factor supported technical analysis to help meet a range of pragmatic, post-disaster objectives.

Our analysis helped us adapt Duignan's Visual Monitoring and Evaluation Planning, to promote a dialogue between researchers and practitioners who were party to the new International Centre of Excellence. Duignan's approach is pragmatically focused. It involves drawing connections between projects and their intended outcomes, to form an 'outcomes model'. Our initial outcomes model drew on pre-existing strategic documents and meetings with the manager of the practitioner team. The model included information about current priorities and existing data being gathered by the practitioners. A set of principles, which had been documented elsewhere, were added to the resulting outcomes model.

The model of priority community disaster resilience activities produced through our research engagement highlighted the importance of knowledge being built at a very operational level. Clear references to intended outcomes and guiding principles supported researchers' focus on strategic insights. All content was combined into a high resolution A3 sized image. We then convened a workshop drawing researchers, practitioners and community representatives together to focus on the model and questions related to it. The workshop successfully identified unmet research needs and produced 35 draft research questions. These questions are now available to students, researchers, and practitioner-researchers wanting to contribute to the International Centre of Excellence: Community Resilience.

## TOOLS FOR RESILIENT COMMUNITIES

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By 2050, 1 million of New Zealand's 1.35 million older people will live in settlements at risk of natural hazards. This paper will briefly outline tools developed as part of the public good funded research programme *Community Resilience and Good Ageing*. The paper will focus particularly on the Flood Experience Tool. The purpose of the tool is to identify ways that policy, planning and operational responses and recovery can be improved for older people; and address the 'secondary impacts' caused by poor organisational responses. The tool is interactive, taking participants through a range of real flood experiences of older people living independently in the community and the issues they face. It shows the impacts of flood events, and the supports needed for recovery, which can last for an extended period. The tool is targeted to a range of organisations including government agencies, emergency services, community organisations, services for older people, councils, insurers, utilities providers and building and construction.

This paper discusses the evidence base for the tool. The tool is then described. The paper also details how the tool was tested in workshops with a range of organisations.



# IMPACT ON HEALTH SERVICES FOLLOWING THE CANTERBURY EARTHQUAKES: COMPARISON OF GP AND NURSE EXPERIENCES

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This research aims to explore the impact on health care professionals and delivery of health services of the 2010/2011 Canterbury earthquakes in New Zealand. Both GPs and nurses played a significant role in the Christchurch health care system during both the earthquakes and recovery process. This qualitative research sought to explore their experiences of providing care whilst also being personally affected by the disaster.

Semi-structured open-ended interviews took place with eight GPs (November 2012–February 2013) and eleven nurses (September–October 2013) from across Christchurch. The transcripts were analysed using a grounded theory approach to derive themes from the data rather than drawing on pre-existing conceptualisations. The results indicated that there were similarities in the GP and nurse experiences such as significant impact to living arrangements and increased workload both immediately following the earthquakes and into the recovery process. As a direct or indirect result of the earthquake some of the participants had changed roles or reduced their working hours. The GPs demonstrated greater awareness of their personal stress and self-care behaviours with both groups acknowledging the risk of empathy exhaustion. The GPs and nurses identified a number of sources of support both formal and informal that they had found beneficial. The GPs and nurses commented on the longer term implications for their patients and for Christchurch.

The earthquakes impacted significantly on both the professional and personal lives of GPs and nurses and the research provides insights into how GPs and nurses are coping with the dual challenge of personal and work demands. This valuable information can support the development of disaster education, preparation and planning resources for health care professionals.

# **DOWN BUT NOT OUT: VULNERABILITY AND RESILIENCE AMONG ELDERLY AND/OR DISABLED MĀORI LIVING IN CHRISTCHURCH DURING THE CANTERBURY EARTHQUAKE SEQUENCE**

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There is limited research on the experiences of elderly and/or disabled Māori following a major disaster. This paper combines findings from two research projects, one that focus upon the experiences of disabled people and one that relates to Māori who were living in Christchurch over the extended period in which the earthquakes occurred. Findings: Vulnerability was discussed by participants in relation to personal safety, communication, social isolation, housing, transport and financial hardship. A lack of emergency service preparedness alongside insufficient structures to assist people during the disaster response phase increased exposure to risk. Resilience was strengthened through the implementation of cultural attributes that enhanced disaster preparedness planning and response. Support networks situated within extended whanau and/or iwi facilitated the provision of assistance. Cultural infrastructure such as marae provided opportunities for spontaneous volunteering to support the wider disaster impacted community as well as connectedness within the Māori community. Implications: Individuals, communities and responding agencies could learn from the experiences of elderly and/or disabled Māori in order to improve preparation and response to disasters for diverse groups.

## RISK PERCEPTION AND THE ORIGINS OF CIVIL DEFENCE

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Natural hazards have played a major role in shaping society in New Zealand, but an organised central government response is only a very recent phenomena. Until the mid-1900s New Zealand had no formal or national policy for disasters and little by way of dialogue on risk management and responsibilities among stakeholders. The rationale, philosophy, and institutions of civil defence have been influenced by factors ranging from earthquakes to riots and war but the real stimulus to a permanent nationwide civil defence system was the perceived threat of nuclear war in the late 1950s. Almost immediately divergent policy interpretations, incongruent messages, and a general lack of support from the government posed major barriers to implementation. With the realisation that nuclear war was unlikely, and that New Zealand was an even unlikelier candidate as a direct target, civil defence was refocused onto natural hazards as the Cold War lingered and other countries continued to develop their civil defence plans based on the assumption of nuclear war. But, in terms of public perception and political will considerable damage had been done which presented barriers to policy implementation and lead to confusion about the purpose of civil defence and even doubts about its necessity. The way that risk and responsibilities were communicated – both within the government and with external partners and citizens in the first few decades of civil defence had considerable impact on the success, or otherwise, of civil defence during emergencies. The proposed poster will explain the roots of the modern institutions, policies, and philosophies of civil defence and emergency management by exploring its Cold War origins and critical events which shaped public perception and political will for developing a nationwide system of hazard management. Comparison is made with Australia, Canada, and the US and their civil defence (and subsequent emergency management) systems.

The information in this poster draws on research being carried out for a dissertation on the evolution of civil defence and emergency management law in New Zealand by Robert Kipp in the School of Law at the University of Canterbury.

# EFFECTIVE WILDFIRE COMMUNICATION IN NEW ZEALAND: TARGET THE AUDIENCE, TAILOR THE MESSAGE AND TUNE THE METHOD

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Effective communication is the key to minimising human-caused rural fires and hence the impact wildfires hold for New Zealand communities. It is essential that fire agencies target their audience, tailor the messages and tune the methods of communication to be most effective.

The Scion Rural Fire Research Group has analysed communication strategies within three New Zealand rural and rural-urban interface communities as part of the Bushfire Cooperative Research Centre's Effective Communication: Communities and Bushfire project. This research has shown that a universal approach is not effective in communicating rural fire messages. Instead communication needs to target both the audience (type of fire user) and the message (awareness, information, fire prevention or preparedness). Communication needs to be tailored to make a difference to potential fire users – rural and semi-rural, recreational users/visitors and cultural users, as well as non-fire users.

The largest group of fire users are those who light fires for vegetation clearance on their rural and semi-rural properties. They generally have good levels of awareness and knowledge around fire practice, which they term 'common sense', and primarily want information around fire restrictions. However they need to be kept aware of fire risk, prevention and preparedness requirements. Recreational users of fire, such as those lighting campfires and using fireworks, tend to be visitors to rural areas and pose considerable risk as they often lack awareness or knowledge. Often overlooked currently, this group require tailored communication messages concentrating on fire awareness and prevention.

Most New Zealanders do not use fire or pose any risk of starting a fire; hence communication with this group needs to focus on increasing levels of awareness and preparedness should a wildfire occur. It is important to optimise the use of limited resources and not dilute or waste effort by aiming to provide information on fire prevention to non-fire users in addition to fire users.

The research has shown that fire agencies should carefully consider their method of communication. Current wildfire communication methods range from one way communication using traditional approaches and no face to face contact, to two-way dialogue with one-on-one personal communication with individuals and communities engaged in FireSmart and Red Zone activities. Our research recommends the best methods of tuning specific fire messages to each of the four broad audiences.

# REMITTANCES IN THE FACE OF DISASTER: A CASE STUDY OF THE SAMOAN COMMUNITY IN NEW ZEALAND

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A growing number of studies recognise the importance of remittances in time of disaster. However, very few researches focus on migrants' perspectives, nor investigate the implications that this mechanism has on their livelihood. This article draws on participatory activities and interviews done with Samoan households in New Zealand. It uses the tsunami of 2009 as case study and explores the role of Samoan migrants in supporting their community of origin during this event. It is found that remittances had a great influence on the capability of disaster-affected people to respond and recover from the tsunami. The act of remitting in time of disaster reinforced the social ties with the affected community, contributed to their wellbeing and may have increased the community's resilience to face natural hazards. At the same time, it is found that remittances have negative effects on the livelihood of the senders, such as limiting their expenses, spending their savings, and reallocating bank loans. We conclude that governments and NGOs involved in disaster risk reduction and disaster management should build on this community-based mechanism. Ultimately, more research is required on remittances and their implications for the senders.

# HOW NEWS MEDIA REPORTS SHAPE JUDGMENTS THAT EARTHQUAKE DAMAGE CAN BE PREVENTED: MIXED MESSAGES ABOUT THE CANTERBURY EARTHQUAKE

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Previous research has shown that different types of news media reports have contrasting effects on citizens' perceptions about different risks and hazards. For example, messages that portrayed earthquake damage as distinctive led people to see the damage as more preventable than messages portraying the damage as universal. The present research examined the effects of two different types of message appearing simultaneously in the news media in the weeks following the February 2011, Canterbury New Zealand earthquake: fatalistic and analytical messages. Fatalistic messages portrayed widespread, generalised damage and made little reference to the contrasting performance of different types of buildings. In contrast, analytical messages conveyed the distinctiveness of damage and the flawed design of buildings that were damaged. The study examined the effects of these different messages on judgments of the cause of the damage and the preventability of the damage, fatalism about earthquakes in general, and estimates of the percentage of buildings that were damaged. Participants who were already familiar with reports about the earthquake read either the fatalistic messages or the analytical messages. Participants reading the analytical reports attributed the damage to controllable causes and saw it as preventable more than those reading fatalistic reports. The reports had no effect however, on overall fatalism about earthquakes. These findings show that the different messages in the news media have contrasting effects on judgments about damage in a recent, local, earthquake, despite competing real world information. These results clarify which messages are likely to facilitate preparedness for earthquakes and other hazards, and have several implications for risk communication strategies.

## “GETTING OUR COLLECTIVE GROOVE ON”

### **Elizabeth McNaughton**

Principal Advisor to the Secretary General Strategy and Planning New Zealand Red Cross

### **Duncan Gibb**

General Manager of the Stronger Christchurch Infrastructure Rebuild Team (SCIRT)

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The presentation draws on the findings from a Winston Churchill fellowship that explored *Leadership, Wisdom and the Post-disaster Recovery Process* which reflects on key themes in post-disaster recovery leadership such as articulating a vision, crisis as a leadership crucible, balancing multiple agenda, communicating in recovery and the importance of broad leadership models. These themes will be further explored through a case study of an internationally award winning post-disaster collaborative recovery model [The Stronger Christchurch Infrastructure Rebuild Team – SCIRT]. This model was designed by engineers, community engagement and organisational specialists to meet the massive horizontal infrastructure challenges of the Christchurch rebuild. The experiences of SCIRT offer lessons for establishing post-disaster collaborative models that are transferable to other contexts and sectors and offer insights into the prearrangements, skills and relationships that engineers need to build prior to a disaster that will enhance their leadership post-disaster.

# **SUSTAINABLE METHODS FOR SUSTAINABLE ISLANDS: INTEGRATING COMMUNITY PARTICIPATION INTO DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION IN THE PACIFIC ISLANDS**

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The Pacific region is highly vulnerable to many different hazards, all of which have varying magnitude and effects upon the natural, environmental, socio-cultural and economic resources communities rely upon. Traditionally, however, the way in which Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) has been administered is through government-led top-down command and control tactics, which leave the local communities at the heart of such policy decisions voiceless and disempowered. In light of this, the development and facilitation of new methods to integrate community participation into the process is essential. This poster shows one particular pathway to community-based DRR and CCA that has recently been, and is currently being, adapted for the specific context of the Pacific Islands. The tools and methods explored in the poster are based upon a series of workshops conducted within small island communities in the Republic of the Marshall Islands (RMI), and Kiribati. The tools have been developed with the intention to facilitate dialogue sharing between a variety of stakeholders involved in DRR and CCA in the Pacific. They focus upon multi-stakeholder participation with emphasis placed upon the process of community discussion, consensus and planning for DRR and CCA, thus encouraging all stakeholders to feel accountable and empowered by the decisions made, thus rendering them sustainable for future DRR and CCA planning. The methods outlined, however, are not designed to be set in stone. Instead, they are created as guidelines, which rely upon stakeholder creativity and adaptability for the formulation of their own sets of culturally sensitive, context-specific and sustainable DRR and CCA frameworks.



## USING REAL-TIME HAZARD INFORMATION TO TRIGGER RISK REDUCTION ACTIONS

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A key component of natural hazard management and disaster risk reduction is a situational awareness that allows the ability to react rapidly when an event occurs.

Today there is a plethora of RSS (real simple syndication) feeds from national and international scientific organisations that provide real-time hazard event information with geospatial extents and event intensity. With the internet and mobile technology these feeds can provide immediate alerts and situation awareness allowing rapid response, but there often is a disconnect between the hazard information and an immediate understanding of the risk. The real-time feeds provide hazard information, but not the vulnerability or consequence to the assets of concern and more importantly they do not provide advice on risk reduction actions.

We present a system where real-time multi-hazard information is aggregated and assessed with asset specific triggers in a risk context (hazard x vulnerability x consequence). If a trigger is exceeded, an alert is sent out via SMS or email containing information on the hazard and risk reduction actions specific to that event trigger following risk management plans. The pre-defined asset risk trigger levels are established based on knowledge of the asset vulnerability and the consequence to the asset owners. Examples are presented linking real-time hazard alerts to risk reduction actions.

Assessing real-time hazard feeds with knowledge of asset vulnerability and consequence provides a situational awareness and an immediate understanding of risk to enhance rapid disaster risk reduction actions.

# **THE LONG-LASTING ECONOMIC CONSEQUENCES OF NATURAL DISASTERS: COMPARING SAN FRANCISCO (1906), KOBE (1995) AND CHRISTCHURCH (2011)**

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This project empirically examines the long-term economic consequences of urban earthquakes on the economies of the affected regions. We compare the San Francisco earthquake (18/4/1906), the Kobe earthquake (17/1/1995) and the Christchurch earthquake (22/2/2011), and their impacts. This comparison points to some sobering possibilities that ought to be considered with respect to post-disaster recovery forecasting in general, and planning in particular. Some of the key channels of impact and bottlenecks that inhibit full recovery are discussed and examined for these three case studies. We also identify and discuss policies that may improve long-term recovery after a future event.

## THE DECEMBER 2011 DEBRIS FLOWS IN THE POHARA-LIGAR BAY AREA, GOLDEN BAY

M. J. Page, R. M. Langridge, K. E. Jones (GNS Science) and G. J. Stevens (Tasman District Council)

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In December 2011 the Tasman District experienced an extreme rainfall event which caused severe flooding, land sliding and a number of debris flows which affected homes and properties. In the Pohara-Ligar Bay area in eastern Golden Bay, where 450mm of rain fell in 24 hours, a number of properties were severely impacted and several houses destroyed by debris flows and debris floods.

A debris flow is a very rapid to extremely rapid flow of water-saturated sediment and debris that travel down a steep channel. Material is contributed from landslides on the surrounding hill slopes and from sediment and vegetation scoured from the channel as the debris flow travels downstream. It is capable of carrying large boulders and logs which are particularly destructive when they reach a fan or other depositional surface. A debris flood is a very rapid surging flow of water, heavily charged with debris, in a steep channel.



*Debris flow and flood – Nvhane Drive, Ligar*

Subsequent investigation of the geologic record of the fans in the Pohara-Ligar Bay area has found evidence of historic debris flows. The estimated return period for the 24 hour rainfall that generated the debris flows is ~200 years, which is similar to the interval between two dated debris flow deposits in the Pohara-Ligar Bay area.

Only some of the catchments in the Pohara-Ligar Bay area generated debris flows and debris floods. An analysis of catchment parameters indicate that there are threshold values for catchment length and catchment ruggedness which, when combined identify those catchments capable of generating debris flows and those capable of debris floods. These thresholds are specific to the investigated catchments which are dominated by deeply weathered and highly erodible Separation Point Granite geology.

Knowledge of the debris flow hazard has since been used in Councils' planning processes. The exotic forestry areas in the upper catchments are due to be harvested. A detailed and comprehensive forestry management plan has been developed specifically for this area taking into account the debris flow hazard.

## **COST-EFFECTIVE COMMUNITY RESILIENCE: EARTHQUAKE HAZARD CLASS MAPPING AT THE PARCEL SCALE**

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A significant challenge for engineers and urban planners is to promote community resilience to earthquakes, while not making the community's total cost of compliance impossibly expensive. Neither property owners nor local authorities can bear the cost of individualised engineering studies of every block and every building. At the same time, no economy can bear the cost of building and retrofitting to mitigate earthquake risks when guided solely by the currently available, interpolated, extrapolated, and over-generalised hazard maps. Current earthquake hazard maps miss the details of localised safer hard spots, and dangerous unknown soft spots that sparse geological and geotechnical data cannot predict, and only detailed direct measurements can find. Two local authorities with a population of 2 million in southern Nevada (USA) addressed this challenge with a comprehensive Earthquake Parcel Mapping program. Clark County and the City of Henderson completed the USA's first effort to map earthquake hazard class with systematic measurements through an entire urban area. Urban development, disaster response planning, and especially building code implementation and enforcement motivated the mapping project, carried out by Optim and the University of Nevada. The project classified an area of ~1500 square kilometers, including urban Las Vegas Valley, and exurban areas of future development. The resulting "Parcel Map" includes over 10,000 surface-wave array measurements completed within three years. Optim's SeisOpt® ReMi™ refraction microtremor measurement and processing technology, adapted for large-scale data collection, obtained shear-wave velocity profiles at the 10,000 sites, along with average shear-wave velocities to 30 m depth. The noisy urban setting necessitated use of microtremor as the seismic source. With the required density of measurements, ReMi™ was the only method able to cost-effectively produce the desired accurately detailed Parcel Map within three years. Nevada's Clark County found two-thirds of the 1500 square km area to be stiffer and safer than assessed in the previous generalised hazard maps provided by the US Geological Survey. The Parcel Map will thus save property owners and Nevada's economy billions of dollars in unneeded, and unjustified, over-strengthening. In the wake of the Christchurch earthquakes and the degree of liquefaction that occurred, the need to characterise shallow (<30 m) and deep shear-wave velocities in urbanised areas is evident. Standardised large-scale shallow shear-wave velocity hazard mapping of earthquake-prone cities is long overdue. Maps generated using a consistent data acquisition and processing technique across an entire city avoid bias, and result in a more reliable hazard evaluation with all the detail needed at the parcel, block, and building scale. The Parcel Map benefits the entire community, including engineering companies, builders, owners, planners, emergency.

# **FUTURE TSUNAMI RISK AT OMAHA BEACH, AUCKLAND**

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Over the last 20 years many coastal communities in New Zealand have experienced significant urban growth. Recent improvements in our knowledge and capacity to model hazardous coastal processes, such as tsunami, show this development upsurge has increased asset exposure to hazards. Although advancements in research often come after land use planning decisions to intensify development in coastal communities, opportunities exist to utilise local hazard exposure models and asset information to estimate risk for future development in vulnerable areas.

This presentation estimates tsunami risk for future development at Omaha Beach, Auckland. Omaha Beach is typical of many coastal settlements on the North Islands east coast that have experienced considerable urban growth. Regional source tsunami inundation modelling by Lane et al. (2013) indicates the urban area is highly vulnerable to inundation from in a 1 in 2,500 year event, including land subdivided for future residential development.

A suite of 100 regional source tsunami inundation scenarios produced by Lane et al. (2013) for Omaha Beach is used in RiskScape (multi-hazard impact and loss modelling software) to estimate building impacts and losses for '2012' and 'future' Omaha Beach building inventories. The '2012' inventory represents assets exposed to regional source tsunami hazards at the time the inundation models were produced. The 'future' inventory expands this dataset by allocating residential buildings within empty 2014 land parcels, which incorporate structural and non-structural attributes statistically derived from buildings constructed since 2005. Building damage and reinstatement costs (asset replacement, content replacement and clean-up) are calculated for each tsunami inundation event and building inventory. The method presented offers an approach to derive tsunami risk information for application in coastal settlement urban growth and community emergency response plans.

## **'FLOCKTON BASIN' BUILDING IMPACT AND LOSS ESTIMATES FOR THE 5TH MARCH 2014 CHRISTCHURCH FLOOD EVENT**

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On 5th March 2014, a significant rainfall event caused surface and riverine flooding throughout Christchurch City. When flood waters receded, NIWA staff from Wellington and Christchurch conducted a field survey of water levels and building damage for the purpose of improving RiskScape flood damage functions for buildings. A total of 125 flood inundated residential and commercial buildings were surveyed over a three day period. At each building site water levels were measured and damage estimated for the structure, contents and in case of some commercial buildings, stock and equipment. Structural and non-structural building attributes were also assessed and used to update RiskScape's national building inventory. From surveyed water levels a flood inundation model for the event was developed for Mairehau, the worst affected suburb in the 'Flockton Basin'. This model was imported into RiskScape which estimated building, content and clean-up costs of NZD\$2.2m for 47 residential buildings inundated within Mairehau. RiskScape's asset mitigation tool was then used to estimate the potential loss reduction for the flood event by raising floor levels of inundated buildings. If all floor levels were raised 0.1m, 20 fewer buildings will be inundated and estimated losses will be halved. RiskScape indicates that raising all remaining floor levels by a further 0.3m results in no flood related residential building losses in Mairehau from the flood event.

# INTRODUCTION TO NEW ZEALAND'S REVISED VOLCANIC ALERT LEVEL SYSTEM

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New Zealand's Volcanic Alert Level (VAL) system was revised between 2010 and 2014, with the new system being introduced in mid-2014. The VAL system is a communication tool used by the scientists at GNS Science to enable end-users to quickly understand the current state of activity and the potential hazards at the volcanoes, from which they can decide their response. End-users of the VAL system in New Zealand include emergency managers and the civil defence sector, all levels of government, major land managers, civil aviation, tourist operators, the media, and the public. The VAL system that was used in New Zealand between 1995 and 2014 was explored in recent research using qualitative methodologies, including interviews with end-users and scientists. A revised system was developed that can more effectively meet the needs of the users.

The revised VAL system will be introduced in this presentation. Key changes that were made (and the underlying reasoning) will be highlighted, including the use of one system for all of New Zealand's volcanoes, the addition of an extra level reflecting heightened volcanic unrest, and the inclusion of volcanic hazard information. The number of levels in the revised VAL system remains the same, ranging from 0 ('no volcanic unrest') to 5 ('major volcanic eruption'). Examples of volcanic activity that might be seen for each level will be described.

# ANIMAL RESCUE AND SHELTER FOLLOWING THE CHRISTCHURCH EARTHQUAKES

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In this paper I present on research conducted over the past three years on the plight of Christchurch's nonhuman residents in the aftermath of the devastating quakes of 2010 and 2011. Using transcript material from interviews undertaken with rescue, shelter and advocacy professionals and volunteers (including SPCA Canterbury, Massey University's Veterinary Response Team, Wellington SPCA's Animal Rescue Unit, Christchurch City Council's Animal Control Unit, Dogwatch, HUHA Animal Sanctuary, community cat rescuers and others), I report on the experiences of these agencies dedicated to ensuring animal welfare in emergencies. The personal stories of people whose animals were helped by these organisations are also included. Importantly, this paper outlines some of the key issues and concerns facing animals – and the people who care for them – during earthquakes and other disasters. This paper is based on an illustrated book called *Animals in Emergencies: Lessons Learnt from the Christchurch Earthquakes*, which will be published by Canterbury University Press in October 2014.



## WHO IN THE WORLD CARES ABOUT THE CANTERBURY EARTHQUAKES?

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The 2010-2011 earthquake sequence that devastated Christchurch, New Zealand, provides valuable lessons about earthquake risk in other areas of the world subject to “Low Probability, High Risk” earthquakes. Christchurch was considered seismically quiet compared to other parts of New Zealand, leading to a perception of relative safety from seismic events. The damage to Christchurch from the 2011 magnitude 6.3 earthquake, however, demonstrated that large earthquakes are not required to cause extensive damage if buildings are vulnerable. The central and eastern US also is an area with a relatively low probability of large earthquakes, likewise leading to a perception of relative safety and understandably resulting in emergency planning efforts to be focused on more common floods, tornados, ice storms and hurricanes. The M5.8 Virginia earthquake of 2011, however, shattered this perception by damaging iconic buildings and monuments 130 km away in Washington, DC, and damaging schools and homes in the epicentral area. In the past, the 1886 M~7 earthquake near Charleston, South Carolina, also showed the potential threat caused by the combination of an earthquake, liquefiable ground, and unreinforced buildings.

The relatively modest-magnitude Christchurch and Virginia earthquakes of 2011 raise several issues regarding preparedness for low-probability, high-risk earthquakes. Many cities with low seismic hazard have numerous unreinforced masonry and other buildings vulnerable to damage or collapse during earthquakes. Many of these “heritage” buildings have historic value and a charm that draws tourists to the city, but they can be expensive to retrofit. How many of our resources should be spent to reinforce these buildings to prevent damage from earthquakes that rarely occur, and what are the minimum levels of acceptable safety? In contrast to other disasters, earthquakes can strike a large area with no warning, can cause secondary effects such as landslides, liquefaction and fires, and sometimes have no clear end as persistent aftershocks can hamper recovery efforts for months or years. Planning efforts need to account for these factors. Finally, an education component is needed to encourage citizens and businesses to make an appropriate level of effort to prepare for earthquakes, even if they are infrequent. For this purpose, the USGS recently helped sponsor New Zealanders involved with the Christchurch earthquake recovery give talks in key areas of the US about their experiences and lessons learned. Their message emphasised that some minor planning and some inexpensive modifications to buildings can make a large difference in the risks to individuals and businesses during an earthquake, and to the rate of recovery afterwards.

# COMMUNICATING NATURAL HAZARDS AND RISK WITHIN AUCKLAND COUNCIL

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Auckland is built on a narrow isthmus covering only 2% of New Zealand's total land area, containing approximately one third of the population and contributing 35% of the total GDP for the country. The landscape of the region is undulating, with many streams and rivers, steep gully's, coastal cliffs and high energy beaches. An active volcanic field lies beneath the city with an active tectonic plate boundary 300km off shore. It is these characteristics that create a unique natural environment where people want to live, however, these factors also introduce a broad range of natural hazards that must be managed.

Natural hazard risk is currently managed by over 55 teams within Auckland Council through public education, planning, asset management, emergency management, provision of hazard information, risk treatment/mitigation and community programmes. Evaluation of Auckland Council's current approach to natural hazard risk management has identified that different teams deal with different aspects of risk, therefore introducing potential for inconsistency and variable understanding of fundamental concepts. For example, many of the terms used for natural hazard risk management are technical and abstract, making common understanding and exchange of information challenging. Additionally, different audiences have varying levels of understanding and personal experiences regarding natural hazards, which influence their comprehension of new information.

To support communication internally and externally Auckland Council, in conjunction with GNS Science, has developed a risk communication toolbox. This toolbox contains a suite of materials that can be used to communicate natural hazard risk concepts, which caters to the wide range of audiences Auckland Council deals with on a daily basis, for example, businesses, landowners and community groups.

The 13 concepts within the toolbox include:

1. Hazard and risk
2. Resilience
3. Levels of risk
4. Consequences
5. Likelihood
6. Vulnerability
7. Changes in risk over time
8. Residual risk
9. Risk treatment
10. The risk management process
11. Cumulative and cascading hazards
12. Estimating risk using modelling
13. Types of maps for showing hazard information

To effectively communicate these concepts, the toolbox includes a dynamic range of definitions, explanations, graphic illustrations, descriptive tables/graphs, and Auckland-based examples to demonstrate all concepts. The toolbox has been produced to support the development of the Natural Hazard Risk Management Action Plan which is currently underway within Council. This presentation will discuss the benefits of developing a consistent approach to risk and natural hazard communication and outline the supporting methodology towards the development of the risk communications toolbox.

## RESILIENT CITY: SOME LESSONS FROM QUAKE AFFECTED CITIES

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Disaster studies need to pay more attention to multidisciplinary approaches. One important area in disaster studies is urban planning. It is necessary to be more sensitive about looking at industrial, commercial and residential areas in cities as a complicated system not just a physical area.

Studies show that existing high levels of physical resilience in a city may make cities less vulnerable to natural disasters. However, these studies have also indicated that physical resilience in and of itself may mean a city is still vulnerable in the event of a natural disaster. It could be that other forms of resilience, other than physical, could benefit cities. For example, existing social resilience and economical resilience may be as important as physical resilience.

In this new context, researchers are finding out important relationships between several types of resilience, but it seems more studies are necessary. It is important to find out how the various types of resilience could affect each other, directly or indirectly. Such interactions may worsen or improve overall disaster resilience.

Disaster affected cities have a lot of lessons to teach us. In this research we studied a quake prone area closely. We tried to find out how several types of resilience interact and what the advantages and disadvantages of such interactions were on the city resilience.

## HOMELESSNESS, HAZARDS AND DISASTER

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There is an unequal exposure to risk in relation to hazards, within societies and between societies, due to the differing vulnerabilities and capacities of individuals or groups of individuals. Therefore when a hazard occurs, not everyone will be equally impacted and affected and the possibility of disaster will be more pronounced in some groups than others. Homeless individuals are often seen to be one of the most marginalised groups in society, with the state of homelessness impacting them physically, socially and economically in day to day life. Despite this, the fate of these individuals in relation to disasters has stirred very little attention from both scholars and policy makers. It is therefore largely unknown the linkages between homelessness and hazards in relation to their specific vulnerabilities and capacities, and potential ways to reduce their disaster risk. Homelessness is a pressing societal concern in New Zealand and more specifically Auckland with estimated 180-300 rough sleepers in the central business district (Gravitas Research and Strategy Ltd., 2005, cited in Groot et al., 2008). This research will therefore seek to raise the issue of home and homelessness in relation to disaster through case studies in both Auckland and Wellington and will look specifically at individuals in the state of absolute homelessness, living on the streets or in emergency shelters. This study will also attempt to understand the role of homelessness service organisations such as the Auckland City Mission in everyday life and in times of disaster as well as Civil Defence policies in relation to this specific group.

## FROM UNDERSTANDING HAZARD TO REDUCING RISK .... AND BEYOND

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*“Natural hazards are a part of life. But hazards only become disasters when people’s lives and livelihoods are swept away”*

– Kofi Anan, former UN Secretary General, International Day for Disaster Reduction;  
30 September, 2003

This paper highlights methods for quantifying the consequences of natural hazards relating to excess water such as floods, tsunamis or sea level rise. It provides a summary of a detailed literature review carried out for Auckland Council relating to the assessment of flood damage based on the principle of ‘asset’ vulnerability. The ‘asset’ can be buildings, vehicles, infrastructure, agriculture, economy, society and people.

There are approaches presented in the paper that provide pragmatic approaches to the communication of risk and determining tolerance to risk. The approaches are relevant to asset management, civil defence planning, catchment planning and community consultation. The approaches quantify risk in monetary terms and can be used as the basis for economic assessment and cost benefit analysis.

# **BUILDING ORGANISATIONAL RESILIENCE FOR THE CONSTRUCTION INDUSTRY: NEW ZEALAND PRACTITIONERS' POINT OF VIEW**

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Christchurch experienced a number of natural disasters in recent years, resulting in considerable disruption. The government sees building organisational resilience as contributing to the speed and success of reconstruction activities and community recovery. Despite government investment in enhancing the resilience of businesses, many organisations from the construction sector remain at high risk should a natural disaster occur, especially Small and Medium-sized Enterprises (SME's). Improving the resilience of construction organisations to such events not only minimises the negative consequences to their organisations, but also helps to improve community resilience as well as post-disaster recovery. However, little research has been undertaken on how resilient construction organisations to natural disasters. This study explores New Zealand construction sector practitioners' opinions to organisational resilience practice within the construction industry.

# A RISK-BASED APPROACH TO LAND USE PLANNING FOR NATURAL HAZARDS

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The discussion document released on 28 February 2013 for the Phase Two changes to the Resource Management Act 1991 (RMA) have identified the need for land-use planning to account for the risks associated with natural hazards. This is a move away from the traditional planning approach where the consideration of natural hazards has been largely focussed on the likelihood of occurrence, with little consideration of the potential consequences. However, how do you include risk in land-use planning and how do you communicate this risk to the public, politicians and stakeholders?

This poster demonstrates a methodology that can be used to incorporate risk into land-use planning. This methodology can be used to formulate objectives and policies as well as to set consent categories. This methodology is based on the following five steps:

- Step 1 – Know your hazard;
- Step 2 – Determine the severity of consequences;
- Step 3 – Evaluate the likelihood of the event;
- Step 4 – Take a risk-based approach; and
- Step 5 – Monitor and evaluate.

Each of these steps involves a series of planning and risk-communication actions that work together to assist with the implementation of a risk-based approach. By attending this presentation, planners will gain detailed understanding of how risk-based planning can be applied when developing their own risk-based plans, as required under proposed changes to the RMA.

The approach and an associated report is available online at <http://www.gns.cri.nz/Home/RBP/Risk-based-planning/A-toolbox>

# **DEVELOPING AN ECOLOGICAL UNDERSTANDING OF HEALTHCARE DISASTER PERFORMANCE OF RESIDENTIAL BASED NURSES: REVEALING THE INVISIBLE**

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Supervisors: Lindsay Smith and Douglas Paton

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This mixed method research is exploring, from a social-ecological perspective, how hazard event characteristics interact with personal, team and organisational factors to influence the development and maintenance of adaptive capacity of residential healthcare nurses. It discusses the relative contributions of these factors to nurse and nurse agency ability to anticipate, prepare for, cope with, adapt to, respond to, and learn from disasters. Phase 1, of a two phase research plan, has received human ethics approval.

Phase 1 is a qualitative study of nurses' experiences working in residential health care facilities during and after disaster (impacts on them; their families, their communities; and agency). Thematic analysis will identify the adaptive demands on nursing staff and how it interacts with interpretive processes to account for differences in levels of preparedness, how preparedness is enacted, and how it develops (and identify preparedness and adaptive resources and strategies). The qualitative study findings will subsequently be used to develop a nurse-focused model of adaptive capacity that will be tested in Phase 2. Once developed, the validity of the model that arises from Phase 1 and its utility as a predictor of resilience in nurses operating in disaster contexts will be tested in Phase 2.

The research will contribute to the substantive development of resilience theory by contributing towards an ecological model of health care disaster performance and inform practical training and organisational development strategies (at nurse, team and hospital levels) to increase the resilience (performance and well-being) in nurses working in the Asia Pacific region.

This presentation will expand on the utility of an ecological lens to study and interpret interrelationships and processes during hazardous events and discusses the findings to date from the integrative review completed. The integrative review has identified that nurses working in hospitals and residential healthcare facilities during a natural disaster appear invisible within the highly visible event.



## CHRONIC UNDERESTIMATION OF NEW ZEALAND FLOOD HAZARD?

**Graeme Smart**  
NIWA

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The talk will discuss the ethos, ethics and effectiveness of New Zealand flood protection works. Municipal flood protection works are usually described in terms of a design protection level, expressed in terms of a return interval (e.g., 100 year flood protection) or annual exceedance probability (1% AEP flood). Different New Zealand towns and cities have different levels of protection. Is this discriminatory?

The perceived levels of protection are usually based on hydraulic model studies and/or historic flood measurements. But is the perceived level of protection realistic and is it accurate? Many different sizes for a 100 year flood can be determined depending on calculation methodology. Many failures of New Zealand flood defences have occurred below their supposed design flood level. Are the levels of protection provided against flooding comparable with our levels of protection against other natural and un-natural hazards?

A study has been made of New Zealand flood protection schemes and the engineers responsible for these schemes have been asked to estimate the probability of failure of the protection works during floods different from the supposed protection level. By considering likelihood of failure at levels other than the design flood, an overall probability of protection work breaching can be estimated. The talk will present the results of this analysis and offer a more realistic estimate of the efficacy of flood hazard risk mitigation measures in New Zealand.

# EVALUATING THE EFFICIENCY AND EFFECTIVENESS OF NATURAL HAZARD RESOURCE MANAGEMENT PLANS

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Councils have a strong mandate to manage natural hazard risk, and the RMA provides one mechanism for achieving risk reduction. Often when it comes to plan review, time is not taken to evaluate the efficiency and effectiveness of current provisions. The lessons learnt from Gisborne District Council undertaking such a review for natural hazards, highlighted its benefits as a reduction tool.

Evaluating plan effectiveness allowed an opportunity to explore the extent to which Council has implemented its natural hazard policies and methods, and the extent to which outcomes have been achieved through implementation. Effectiveness was also evaluated in terms of plan 'appropriateness'; whether the plans focussed on the right issues and were well designed. Results of the evaluation were mixed. However, the process highlighted a number of areas for improvement, which may be similar for other Councils.

For the efficiency evaluation one topic was considered: minimum floor level rules imposed on new dwellings for mitigating the risk of flooding. The evaluation focused on those costs and benefits that were thought likely to be most significant (construction costs, consenting costs and benefit in reduction in damage to building and consents). On the basis of the evaluation, it was considered that the benefits were likely to outweigh the costs on most sites. Overall, it is believed that the efficiency and effectiveness of the evaluation process, and the learnings from completing the assessment, could be useful for other Councils.

# WESTERN AUSTRALIAN STATE RISK PROJECT

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Western Australia (WA) composes one third of the Australian continent, spanning 23 degrees of latitude and 2.5 million km<sup>2</sup>. This spread encompasses several climatic zones including tropical in the far North, moving through grassland, desert, subtropical and on to temperate regions in the South West. On a world-wide scale, the broad climatic variation and diversity are considered rare. In addition to its numerous climate zones, intraplate seismic activity, coastal exposure to the Sunda trench and increasing forest fuel loads pose significant threats to WA communities. The enhanced risks of climate change, with rising sea levels and the prediction of more severe cyclone and storm events have caused the State to focus serious attention to its ability to understand its actual risks.

In 2012, the State Emergency Management Committee (SEMC), which strategises, organises and oversees the coordination and continuous improvement of emergency management in the state, endorsed the State Risk Project. The State Risk Project has the ambitious goal to assess 27 natural and anthropogenic hazards prescribed in legislation at a state, district and local level in a consistent and comprehensive manner. The aim of the project is to inform decision-making regarding the prioritisation of resource allocations for treatment and mitigation strategies. The recent restructuring of emergency management in WA has placed the State in a unique position to re-orient and reshape its future direction with the full support of the political establishment.

The sheer size, remoteness and diversity of the State present a broad range of challenges for the project. The risk assessment process needs to be operationalised in 13 districts and 140 local government areas within a three year period. A comprehensive communications strategy will form the backbone of the project, along with an online knowledge hub that will inform and update the 160 organisations involved in the project. Significant efforts will be required to gather scientific, historical and spatial data for the hazards and vulnerabilities as much of this information is not yet consolidated. A suitable geospatial database to host this data and the generated risk information is also being pursued. The risk assessment methodology will require refinement in order to produce comparable results for the natural and anthropogenic hazards. Finally, the mitigation and treatment strategies and supporting policy frameworks are being developed with the intent of establishing measurable emergency management capabilities across the prevention, preparedness, response and recovery cycle to lower the State's risk profile.

## **AN OVERVIEW OF THE BUSHFIRE AND NATURAL HAZARDS CRC**

**Richard Thornton**

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The Bushfire and Natural Hazards Co-operative Research Centre (BNHCRC) was established in July 2013 following an announcement, by the Australian Prime Minister of funding in February 2013. It is a research centre comprising around 50 partners from the federal, state government, and not for profit sectors, as well as research partners from universities and state research bodies, the Bureau of Meteorology and Geoscience Australia. The centre is funded by a core grant of \$47M over eight years from the Commonwealth Department of Industry, with supplementary funding coming from state and territory state governments, and their agencies, as well as substantial in-kind funding from research partners. The total funds amount to around \$130M over the eight years.

The centre has three main themes of works, these are: Economics, Policy and Decision Making; Resilience of People, Infrastructure and Institutions, and Bushfire and Natural Hazard Risks. The work program is multi-disciplinary and where possible multi-hazard, with around 60% of the program being truly all-hazard in focus. The centre also has a substantial education program with funding for around 50 funded PhD students at any one time.

This talk will highlight the role that the BNHCRC plays in the research arena in Australia and will provide an overview of the around 40 projects it funds. It will provide an introduction to the work and possible linkages with activities in New Zealand.

## **SEVERE WEATHER FORECASTING AND DISASTER RISK REDUCTION DEMONSTRATION PROJECT (SWFDDP)**

**Jon Tunster**

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The Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project (SWFDDP) is a World Meteorological Organization (WMO) project aimed at improving severe weather forecasting and building closer relations between meteorological offices, disaster risk reduction (DRR) services and media in the South-West Pacific.

MetService has created “MetConnect Pacific”, a website that makes available guidance, numerical weather prediction (NWP) products and observations critical to the forecasting of severe weather in the region. The Project commenced in 2009 and now involves nine Pacific Island Countries (Fiji, Samoa, Vanuatu, Solomon Islands, Kiribati, Tuvalu, Tonga, Niue and Cook Islands).

With financial aid from the New Zealand Ministry for the Environment, MetService conducted in-country training for all participants during 2012. Two to four-day training for meteorologists focused on tropical meteorology, the Project’s MetConnect Pacific website, warning verification, writing reports and case-study generation.

Half to one-day DRR workshops were conducted for relevant weather warning stakeholders such as: local meteorologists, disaster management staff, the police, fire service, tourist operators and government departments. The DRR workshops provided an excellent opportunity for information exchange and highlighted areas for improvement and closer collaboration.

# THE RESILIENCE OF ORGANISATIONS: WHAT WE HAVE LEARNED FROM 10 YEARS OF RESEARCH

**John Vargo and Erica Seville**

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Nothing is more certain than change, and sometimes those changes come suddenly in the form of disasters. Effective planning and preparedness can help mitigate disasters and their effects that are foreseeable; however the complex changes that seem to be coming our way are increasingly poorly aligned with our planning. Resilience is the key to both surviving these unforeseen (and sometimes unforeseeable) challenges and thriving in the aftermath.

In 2004 Organisational Resilience was a very new concept, with limited research to back the concept. That was the year that the Resilient Organisations Research Programme (ResOrgs) was founded. In the ensuing 10 years a wide ranging programme of research has been carried out by ResOrgs covering: the Resilience of Organisations, Post-disaster Reconstruction, Organisations facing Crisis, Leading and Managing Resilient Organisations, and The Economics of Resilient Infrastructure. Outcomes of this programme of research have included many international refereed articles, keynote presentations, PhD Thesis completions, research reports and invitations for international collaborative research.

This presentation will provide a synthesis of our first 10 years of discovery from this broad programme of research, highlighting the implications for organisations and how they can improve their ability to both survive a crisis and thrive in a world of uncertainty.

# RESILIENCE, HAZARD AWARENESS AND THE BENEFITS OF PREPAREDNESS – THE VIEWS OF PEOPLE IN RECOVERY MODE IN CANTERBURY, NEW ZEALAND

**Julie Warren**

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This paper reports on the experiences of people in Canterbury who are coping with, and adapting to, the aftermath of a series of earthquakes and aftershocks over a prolonged period of recovery. They tell us their 'before' and 'after' stories about hazard awareness and about their disaster-related 'conversations' about preparedness. They also tell us about any benefits they now expect from taking action and preparing for future disasters. Often people surprised themselves in their expectations – and how they reflect their past experiences and the way they look at the world generally. The findings are part of a larger research programme: *Understanding factors that build resilience in New Zealand*, funded by New Zealand's Ministry of Business, Innovation, and Employment.

# HOW DO WE SUPPORT THOSE LIVING AND WORKING IN DISASTER RECOVERY?

**Jolie Wills**

Psychosocial Knowledge Sharing and Research Advisor, NZRC

Exhaustion of community workers, volunteers, recovery and social sector workers, and community leaders has been a common theme since the 2011 and 2012 Canterbury earthquakes. With the relentless grind of long term recovery, little opportunity for relief and demands which do not seem to abate, this concern is not only still present but, if anything, only becoming more urgent.

The road to recovery is paved with seemingly incongruous tensions:

ON THE ONE HAND...	ON THE OTHER HAND...
Recognising the importance of recovery from disasters being a community-led process, not something which is <i>done to</i> a community.	Avoiding foisting responsibility for recovery onto already overwhelmed, tired and stretched community members without considering capacity and with scant regard for their wellbeing.
Promoting the importance of self-care for those working in their own communities, acknowledging that even under conditions where so much is out of their control, community members still have agency.	Acknowledging that however well someone applies focus to their own wellbeing, when the pressures become overwhelming this may be a reflection on the load carried, not the coping ability of the person carrying it.

Balancing these tensions involves recognising both the valuable role that those who work at the coalface have whilst they are living their own recovery and the need to provide additional support to these key individuals and organisations.

How do we support the critical people at the heart of recovery – those who are juggling both living their own recovery journey and supporting others in their communities? Reflections, strategies and insights are shared from Canterbury and from international recovery experiences (the latter gathered as part of a Winston Churchill fellowship).



# PLANNING FOR THE RECOVERY OF THE NATURAL ENVIRONMENT FOLLOWING THE CANTERBURY EARTHQUAKES

**Chrissie Williams**

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Disasters resulting from extreme natural events affect people and the ecosystems in which they live, including the ecosystem services ecosystems provide. Yet, emergency management tends to focus more on the recovery of the social and built environments than on the natural environment. If the impacts on the natural environment are not addressed, however, they may compound over time. Actions taken to tackle humanitarian and economic needs can have unforeseen negative effects on the environment that could compromise long-term recovery. This may be through relaxation of environmental regulation, pollution from waste, habitat destruction, overexploitation of resources or the introduction of invasive species. Natural hazard and disaster planning should consider ways to anticipate and avoid these impacts. Key to successful recovery is the integration and management of the environment in both the immediate response after the disaster, and in the longer-term restoration of human well-being and livelihoods.

*The Recovery Strategy for Greater Christchurch, Mahere Haumanutanga o Waitaha* requires a Natural Environment Recovery Programme (NERP) as part of the recovery from Canterbury 2010-11 earthquakes. The NERP has been developed using a collaborative process involving key and strategic partners. Two stakeholder workshops provided valuable input to identifying issues and options, and to prioritising actions and responses.

Throughout the development and subsequent implementation of the NERP, the effects of the earthquake on the natural environment have been considered and the appropriate responses identified. A range of scientific, technical, managerial and legislative methods has been determined to prevent, mitigate, respond to and support recovery. In some cases, doing nothing is an option – given space and time the affected ecosystem will continue to function, although in a different condition. In other cases, intervention may be required to rehabilitate the ecosystem or to prevent further damage. During recovery and reconstruction, opportunities are available to enhance the natural environment on which people rely, and to decrease vulnerability and increase resilience to future disasters and the effects of climate change. The time frame for including ecosystem recovery in reconstruction efforts is long.

This presentation describes how the NERP is contributing to the rehabilitation of the natural environment and to community well-being through the rebuild of greater Christchurch, and how the programme is now being implemented.

# REDUCING COMMUNITY RISK TO COASTAL INUNDATION EVENTS IN AUCKLAND

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While only containing 2% of New Zealand's total land area, the Auckland region is home to approximately 3,100km of coastline. This abundance of coast provides substantial challenges for managing coastal hazard risks presented to the community, city and infrastructure.

In January 2011, Cyclone Wilma passed to the east of Auckland city bringing rainfall, strong winds and unusually high storm surges resulting in extensive flooding. To reduce the community's exposure to such events, Auckland Council in collaboration with the National Institute of Weather and Atmospheric Research Ltd (NIWA), undertook a study to site specifically model storm surge events across the entire coastal margin and subsequently map credible inundation extents. The results of this study provide a high resolution suite of information and maps which identifies Auckland's coastal inundation risk profile.

To reduce community risk to such events, Auckland Council has subsequently developed land use planning policies which restrict development activities in susceptible locations. In addition, sea level rise scenarios, developed in conjunction with NIWA, have been adopted to further reduce this risk into the future. Arguably, this is the most substantial coastal inundation risk reduction initiative ever undertaken in New Zealand.

While providing a baseline of information to inform communities of their risk, the results of this investigation also contribute to operational decision making to identify imminent threats. This value was proven on 24 September 2013, where exposed northern communities of Auckland experienced a storm surge event in the order of a 1:50 year event. At risk communities were identified by Civil Defence and Emergency Management staff and in collaboration with Emergency Services affected members of the community were informed and able to effectively respond to their properties being inundated.

This presentation will discuss the project's journey from conception to implementation while showcasing the extensive risk reduction benefits Aucklanders are receiving.

# ONLINE SOCIAL NETWORKS IN EMERGENCY MANAGEMENT: OPTIONS FOR PUBLIC AND NONPROFIT OFFICIALS

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This article synthesises and analyses the body of knowledge on the use of online social networks in emergency management. It examines approaches available to public and nonprofit officials to:

1. disseminate information,
2. monitor open source data to accrue situational awareness, and
3. engage organisations and constituents directly in the co-production of knowledge and public services.

These three strategies – if implemented successfully – contribute to the protection of life and property and the maintenance of operational continuity across levels of government and geographic location. Content analysis of academic research, newspaper articles, and other documents generates findings relevant to practitioners and researchers.

# POST-DISASTER GEOTECHNICAL RESPONSE FOR HILLY TERRAIN: A CASE STUDY FROM THE CANTERBURY EARTHQUAKE SEQUENCE

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The 2010–2012 Canterbury Earthquake sequence has highlighted the value of standardised, practical and co-ordinated guidelines for geotechnical risk assessment for inhabited structures in the aftermath of a geotechnical disaster. The lack of guidelines and provisions to manage the assessment of geotechnical hazards post-earthquake, hindered co-ordinated, timely and transparent management of geotechnical risk in the hilly suburbs of Christchurch.

The Canterbury Earthquake sequence triggered rockfall, landslide and cliff collapse events throughout the Port Hills which damaged thousands of houses and critical infrastructure, and created a life risk issue for people inhabiting the area. Given the high seismic hazard in New Zealand and the location of significant active faults near populated centres, it is beneficial to identify lessons learnt from the response undertaken following the Christchurch earthquake sequence to inform geotechnical risk assessment guidelines for future events.

Our research into the event sequence has enabled a post-disaster timeframe to be developed outlining the evolution of information needed as the response progressed. The basis for geotechnical risk assessment guidelines have been derived from analysing the experiences from key municipal, management and operational stakeholders who were involved in the geotechnical risk assessment during the Canterbury earthquake sequence.

# CRISIS LEADERSHIP IN THE INTENSIVE CARE UNIT FOLLOWING CHRISTCHURCH EARTHQUAKE

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On Tuesday, February 22, 2011, at 12:51 pm local time, a 6.3 magnitude earthquake struck Christchurch. This study explored the Intensive Care Unit's (ICU) staff experiences and adopted leadership approaches to manage large scale crisis resulting from the city-wide disaster.

The objective of this study was to investigate approaches to leadership in a crisis situation, through an exploration of both specialists and nursing leadership in the ICU of Christchurch Hospital within the first seventy two hours of the earthquake. This study adopted a qualitative approach. A semi-structured, audio taped personal interview method was chosen as a single data collection method. Thematic analysis was employed to analyse data.

Three core formal crisis leadership themes were identified in the transcripts: decision making, ability to remain calm and effective communication. Formal team leadership refers to the actions undertaken by a team leader to ensure the needs of the team are met.

Four core informal crisis leadership themes were identified in the transcripts: motivation to lead, autonomy and self-reliance, emotional leadership, and crisis as opportunity. Informal leaders are those individuals who exert significant influence over other members in the group to which they belong, although no formal authority has been assigned to them.

Two core shared leadership themes were identified in the transcripts: shared leadership within formal medical and nursing leadership groups and shared leadership between formal and informal leaders in the Intensive Care Unit. Shared leadership can be defined as a dynamic, interactive influence process among individuals in groups for which the objective is to lead one another to the achievement of group or organisational goals.

While in many ways the research on leadership in crisis is still in its early stages of development, there are some clear benefits from adopting this leadership approach in the management of complex crises.



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