

Paper, seismic, rock - Paper beats rock. A review of how earthquake hazards are recognised and addressed in council plans and policies for the Wellington Region

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ABSTRACT: Earthquake hazards in New Zealand are addressed under a variety of pieces of legislation, including the Resource Management Act 1991, Building Act 2004, Earthquake Commission Act 1993, Civil Defence Emergency Management Act 2002, and the Local Government Act 2002. A number of these pieces of legislation require councils to produce plans and policies that identify how they are going to address the risks due to natural hazards in their respective jurisdiction. Such plans and policies play an important role in the management of natural hazards; however, there is little research that examines how well natural hazards are identified and recognised in councils' plans and policies. This paper presents the findings from two projects completed under the Wellington, "It's Our Fault" programme which explore this topic. First, the results from a 2001 content analysis are presented that assessed how earthquake hazards are recognised and addressed in the Regional Policy Statement and district plans of city and district councils in the Wellington Region. The second part of the paper presents the results from a 2011 longitudinal review of the Wellington Regional Policy Statement, district plans, annual plans, long term plans, spatial development plans and earthquake prone building policies to see whether earthquake hazards are better recognised since 2001. The two sets of analyses show that land use planning for earthquake hazards in the Wellington Region has improved from 2001-2011, with more of a focus being given on planning for fault rupture. However, opportunities exist for improvements in planning for other earthquake-related hazards such as liquefaction and earthquake-induced landslides. Better integration between planning and policy documents that address earthquake-related matters would also assist in effective risk reduction for earthquakes.

1 INTRODUCTION

1.1 Earthquake hazards in Wellington, New Zealand

New Zealand straddles a plate boundary with the Australian Plate to the west, and the Pacific Plate to the east. The country's placement on such a boundary means it is subject to seismic activity. The Wellington Region lies within the deforming zone of the plate boundary, with the subduction interface underlying the region, and the surface traces of numerous active faults crossing the region (Figure 1) (Pondard and Barnes 2010; Stirling et al., 2012). One of the most well-known faults is the Wellington Fault, which bisects Wellington, Lower Hutt and Upper Hutt cities, and has a 10-15 % likelihood of rupturing within the next 100 years (Rhoades et al. 2011). However, there are also many other active faults which impact upon urban areas in the region. Any large earthquake in the region has the potential to produce a wide variety of earthquake-related hazards such as strong ground shaking, surface fault rupture, uplift and/or subsidence, liquefaction, landslides and tsunamis. Given that the Wellington Region is significantly urbanised, the occurrence of such hazards has the potential to cause severe damage and disruption. Ideally, ways of addressing the risks from these hazards need to be considered and mitigated for in advance of an earthquake occurring.

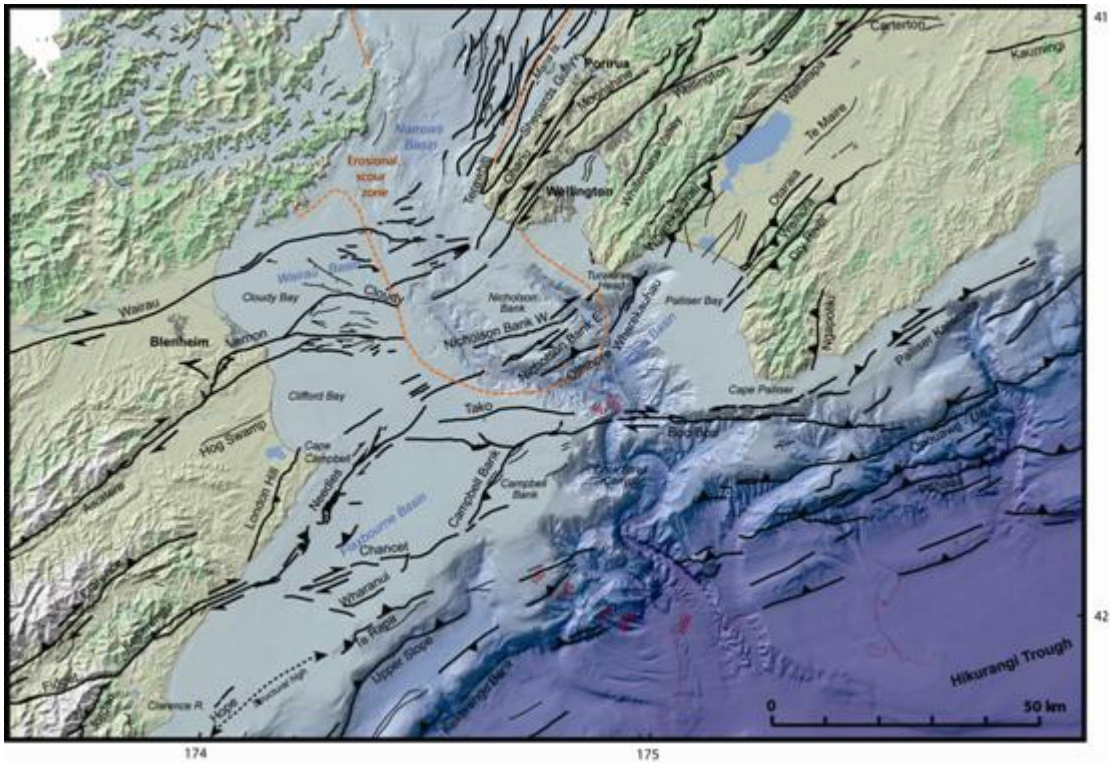


Figure 1. Location of the Wellington Region, showing the major earthquake faultlines.

1.2 Mitigating earthquake hazards

Earthquake hazards are addressed under a variety of pieces of legislation, including the Resource Management Act 1991 (RMA), Building Act 2004, Earthquake Commission Act 1993, Civil Defence Emergency Management Act 2002, and the Local Government Act 2002. A number of these pieces of legislation require councils to produce plans and policies that identify how they are going to address the risks from natural hazards in their respective jurisdiction. Mitigation for earthquake hazards can be managed in a number of ways including engineering earthquake-resistant structures, strengthening or demolishing ‘earthquake prone buildings’, implementing community and individual preparedness measures, developing response plans and undertaking land use planning. Land use planning can be a very effective way of reducing risk but is often not done well, with many land use planning documents only having weak policies, objectives and methods of dealing with natural hazards such as earthquakes (Berke and Smith 2009).

1.3 Focus of this paper

This paper presents the findings from two projects completed under the Wellington, ‘It’s Our Fault’ programme. The projects investigated how earthquake hazards are dealt with via land use planning, using the Wellington Region as a case study. In 2001 a content analysis of the Wellington Regional Policy Statement and all of the local city and district plans was undertaken to identify if (and how) earthquake hazards are acknowledged and incorporated into land use planning. This was followed up by a review of planning documents 10 years later to see whether land use planning in the region for earthquake hazards has improved over time. The paper first presents the results of the 2001 content analysis, then discusses earthquake land use planning changes over time to 2011, and finally draws some recommendations on where land use planning should be focussing in future to ensure a reduction of earthquake risk.

2 ANALYSIS OF WELLINGTON LAND USE PLANNING DOCUMENTS IN 2001

2.1 Outline of the analysis

In 2001 a content analysis was undertaken of Wellington land use planning documents to see if (and how) earthquake hazards were acknowledged and incorporated into such planning. Nine planning documents were reviewed including the Wellington Regional Policy Statement and eight city and district plans (referred to henceforth as “district” plans). Figure 2 shows the location of the Greater Wellington Region which the policy statement covers, as well as the location of city and district councils within the region.



Figure 1. Location of the Greater Wellington Region, and associated city and district councils.

2.2 Methodology

The content analysis of the Wellington land use planning documents followed a methodology similar to that used in an earlier study of earthquake planning and policy in three other regions of New Zealand (Becker and Johnston, 2000; 2002). Briefly this analysis involved:

- Defining what aspects of earthquake hazards to identify in policy statements and plans, and converting these into categories;
- Reading each policy statement or plan, and coding whether or not a category was present in a plan (yes; no; and not applicable);
- Undertaking statistical analysis of the coding.

2.3 Results

The Wellington Regional Policy Statement and district plans had a strong acknowledgement of earthquakes, with all of the planning documents stating that earthquakes could affect the region or district, and all but one identifying the location of active faults and outlining the potential impacts of an earthquake. Three quarters of the district plan maps identified earthquake-related hazards such as active faults or seismic hazards areas. Half of the planning documents included a disclaimer that there was a lack of seismic hazard information to inform effective land use planning or that seismic information needed to be updated (Becker et al., 2013).

All planning documents include objectives, policies and rules to provide structure and guidance on the

way that planning should be carried out. When looking at earthquake related objectives and policies in the Wellington planning documents, the majority (~80%) tended to take an “all hazards” approach rather than an earthquake specific one. Lower Hutt, Porirua and Kapiti Coast councils were the only districts to have specific earthquake objectives and policies and these were quite generic in nature (i.e. objectives stating the necessity of avoiding or minimising risk from earthquakes; and general policies related to appropriate development, engineering, and management of ground shaking effects). In terms of methods, 87% of district plans had rules specifically targeting the mitigation of earthquake hazards. Most rules were related to building near an active fault including making construction of a new building near a fault a discretionary activity, imposing standards for buildings and requiring a setback for new buildings (Becker et al., 2013).

All Wellington planning documents acknowledged the role of the Building Act 2004 in ensuring that buildings were built or retrofitted to be strong enough to withstand the effects of earthquake shaking (Becker et al., 2013).

When compared with three other regions in New Zealand (Hawke’s Bay, Bay of Plenty and Waikato) (Becker and Johnston, 2000; 2002), the Wellington Region was found to be more advanced in terms of land use planning for earthquakes. Wellington Region plans and its policy statement had a wider acknowledgement of earthquake hazards, and fault lines in particular were more likely to be depicted on planning maps (Becker et al., 2013).

3 LAND USE PLANNING FOR EARTHQUAKES IN WELLINGTON - TEN YEARS ON

3.1 Outline of analysis and methodology

A content analysis of current Wellington policy statements and plans was undertaken in 2011 (Beban et al., 2012) and compared with the findings of the 2001 review. Some extra planning documents were analysed in addition to the original policy statement and plans, including local annual plans, long-term plans, spatial development plans, earthquake prone building strategies and the Civil Defence Emergency Management Group Plan. The methodology used was the same as outlined in Section 2.2, with additional descriptive data also collected (e.g. information about particular plan changes) to identify the nature of the evolution in planning documents. Because of the different number of planning documents analysed the total percentages calculated for the 2011 study are not directly comparable with the 2001 study, and these are not reported in this paper. It is the changes in the nature of the plans that provide the most valuable information about the evolution of earthquake land use planning over time, and the results section (3.2) discusses the nature of these changes.

3.2 Results

It was found that, in general, since 2001 improvements had begun to occur with respect to land use planning for earthquakes in Wellington.

Levels of the recognition of earthquake hazards in the 2011 Regional Policy Statement and plans remained high, as well as interest in ensuring safe buildings via the Building Act 2004. However, other planning documents (in particular, annual plans, long-term plans and spatial development plans) did not recognise and incorporate earthquake hazards to the same degree.

Several councils had made specific progress on improving their district plans. In 2001 Wellington City Council commissioned a study to better define the location of the Wellington Fault (Perrin and Wood, 2002). Based on the new information they decided a district plan change was necessary to achieve their intended outcomes of reducing earthquake risk. Plan change 22 was approved in 2004 and included the following key changes (Wellington City Council 2004, Becker et al., 2013):-

- Clarification of the explanation of earthquake hazard policies;
- Changes to wording, highlighting the importance of building to the Building Code and focussing on the need for lighter building materials;
- Reduction of the number of permitted residential units per site to one;

- New assessment criteria for discretionary activities, including the requirement to provide geotechnical and engineering reports;
- New rules (i.e. for assessing multi-unit developments; and for the Suburban Centre Zone, because the Wellington Fault hazard area did not previously pass through this zone);
- Changes to other hazard rules to maintain consistency across the Plan; and
- Updated planning maps to include a more accurate location of the Wellington Fault.

Kapiti Coast District Council also made changes to their district plan over a ten year period. The first attempt at a plan change began in 2000, but was thwarted by the need for more detailed information about where fault traces in their district were located. Research was commissioned to gather more information about the faults, and provide planning recommendations on what to do next (Van Disen and Heron, 2003). Following the study, a period of community consultation occurred, and new content was drafted for the district plan. Plan change 61 became operative on 14 October 2011 and included the following changes (Kapiti Coast District Council, 2007):

- An update of district plan maps with revised fault traces;
- New objectives and policies for faults;
- Using a risk-based planning approach to developing near faults, including:
 - o New rules and standards to ensure building sites are clear of the fault trace
 - o New assessment criteria (e.g. which may include requirement for geotechnical assessment);
- Changes in rules and standards to new buildings (i.e. allowing non-habitable buildings over the fault trace but not habitable ones; and new assessment criteria).

A third major change to district planning documents occurred for the Wairarapa district councils (Masterton, Carterton and South Wairarapa). In 2003 and 2004 the three aforementioned councils prepared a combined district plan which included updated information related to earthquake hazards and how they will be treated. The district plan maps were updated with the location of the fault traces. New objectives and policies were created to address the councils' new approach to active faults. New rules and standards were also created for subdivision (i.e. new subdivision must avoid natural hazards) and new buildings (i.e. allowing non-habitable buildings in a "Faultline Hazard Area", but encouraging habitable buildings to be located outside the Area).

In summing up the changes to the above plans, advances in land use planning for earthquakes in Wellington from 2001-2011 were largely directed at a number of particular amendments including (Becker et al., 2013):

- More detail added to clarify fault traces on planning maps;
- Changes to objectives and policies to improve mitigation of earthquake hazards mainly related to fault rupture;
- New improved rules and standards related to setback, subdividing and types of buildings allowed in fault zones; and
- Requirements for geotechnical reports if a development is located in a fault hazard area.

Figure 3 summarises some of the main changes in land use planning for earthquakes in Wellington from 2001-2011 within the context of other influences in the overall planning environment.

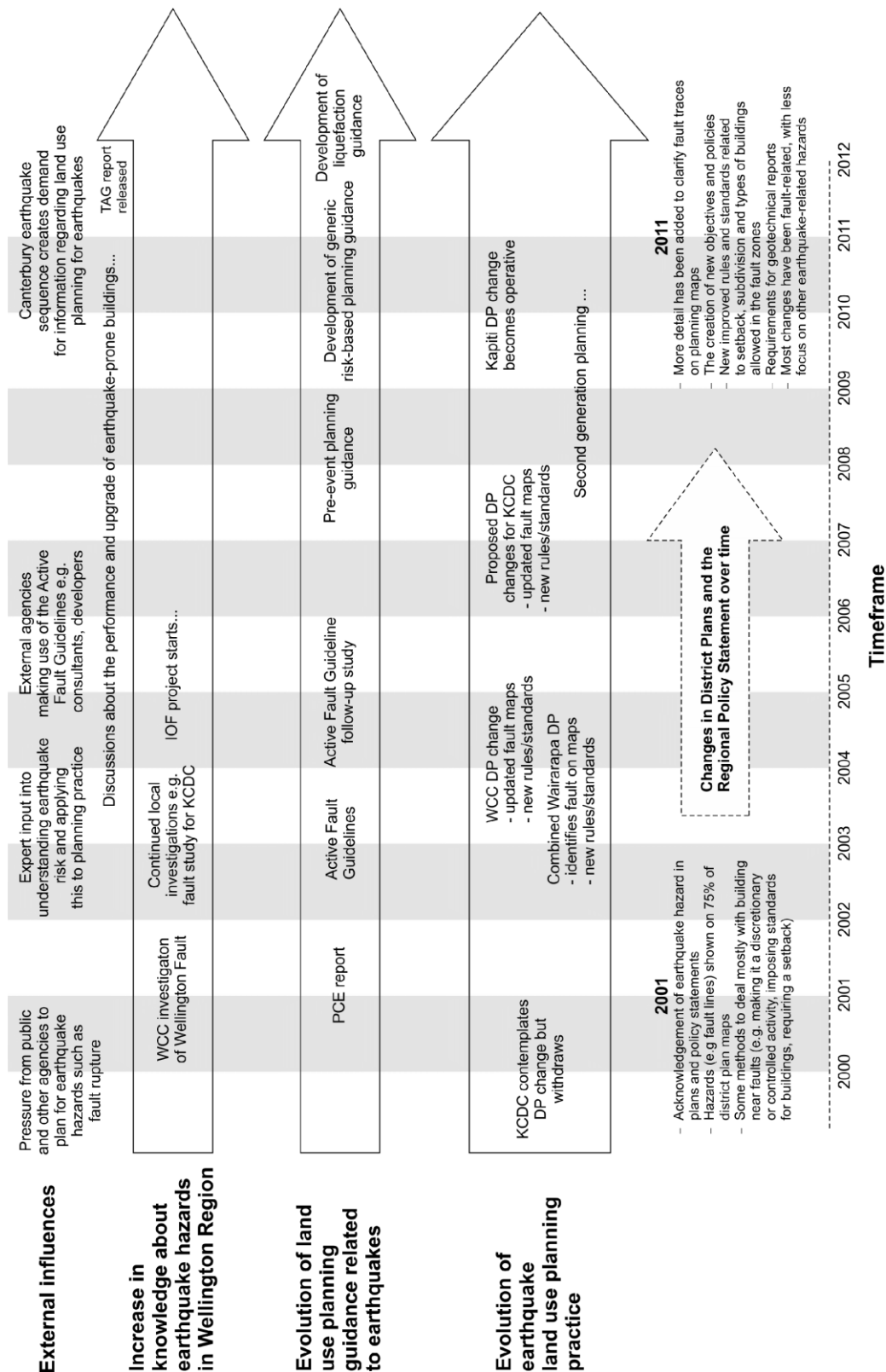


Figure 3. Land use planning for earthquakes in Wellington Region 2001-2011 (Becker et al., 2013). Abbreviations: WCC=Wellington City Council; KCDC=Kapiti Coast District Council; IOF=It's Our Fault; TAG=Technical Advisory Group; PCE=Parliamentary Commissioner for the Environment; DP=District Plan. Relevant studies cited: (Perrin and Wood, 2002; TAG 2012; Van Dissen and Heron, 2003). Relevant guidance cited: (Becker et al., 2005, 2008; PCE, 2001; Kerr et al., 2003; Saunders and Beban, 2011; Saunders and Berryman, 2012).

4 DISCUSSION

While progress has occurred with regard to land use planning for earthquakes in Wellington, there are still many gaps. In particular, changes in the past ten years have been largely directed at understanding and planning for identified active faults. This is in part due to pressure from external sources who have advocated for the fault issue to be addressed (e.g. the public, agencies, experts) (Parliamentary Commissioner for the Environment, 2001), and the development of guidance to assist planners with how to deal with the issue in a practical planning sense (Kerr et al., 2003; Van Dissen and Heron, 2003; Van Dissen et al. 2006). Other earthquake-related hazards (e.g. liquefaction and lateral spread, landslides, etc.) have been largely ignored in terms of land use planning and are not accounted for specifically in planning documents. The Canterbury earthquake sequence (e.g. NZSEE 2010, 2011; Kaiser et al. 2012) has proved a timely reminder that a wide variety of earthquake hazards should be considered and accounted for in the land use planning environment. Additionally, plans still appear to place a heavy emphasis on ensuring the safety of buildings as per the Building Act and associated standards/code. While important, this needs to be balanced with appropriate land use planning, as safe buildings are but one part of the earthquake risk reduction equation.

While the Regional Policy Statement and district plans have been dealing with aspects of land use planning for earthquake hazard, this is often not integrated with other plans relevant to the region (e.g. annual plans, long-term plans and development plans, and to a lesser degree, earthquake prone building strategies and the Civil Defence Emergency Management Group Plan). For example annual plans, long-term plans, and spatial development plans, had low levels of recognition of earthquake hazard, which raises questions that if such plans do not allocate funding or provide complementary direction on the management of earthquake hazards, the earthquake policies in district plans may not be able to be supported. Better integration of planning documents is required to achieve holistic land use risk reduction for earthquakes.

National legislation and policy guidance needs to support local land use planning. At present there are a number of Acts that play a direct role in addressing earthquake hazards including the Resource Management Act 1991, Building Act 2004, Earthquake Commission Act 1993, Civil Defence Emergency Management Act 2002, and the Local Government Act 2002. Integration between these pieces of legislation has not always been effective in the past and more thought needs to be given to how laws and policies could be better aligned to facilitate a more holistic approach that effectively supports local hazard planning (Glavovic et al 2010). Recent recommended changes to natural hazard provisions in the RMA will, in some part, address these issues by including natural hazard risk as a matter of national importance, and elevating it's consideration in local planning (Saunders & Beban, 2012). If integration is achieved, effective risk reduction for earthquakes will be made easier.

REFERENCES:

- Beban, J.G., Coomer, M.A., McBride, S. 2012. Addressing earthquake hazards – a review of council policies and plans within the Wellington Region. *GNS Science Report 2012/31*. GNS Science, Lower Hutt.
- Becker, J., Johnston, D. 2000. Planning and Policy for Earthquake Hazards in New Zealand, *Institute of Geological and Nuclear Sciences Report 2000/28*. Institute of Geological and Nuclear Sciences, Lower Hutt
- Becker, J., Johnston, D. 2002. Planning for earthquake hazards in New Zealand: a study of four regions. *Australian Journal of Emergency Management*. Autumn 2002 p. 2-8.
- Becker, J., Saunders, W., Van Dissen, R., 2005. Planning for the development of land on or close to active faults: A study of the adoption and use of the Active Fault Guidelines. *Institute of Geological and Nuclear Sciences Science Report 2005/16*. Institute of Geological and Nuclear Sciences.
- Becker, J., Saunders, W., Hopkins, L., Wright, K., Kerr, J., 2008. Pre-event recovery planning for land-use in New Zealand: An updated methodology. *GNS Science Report 2008/11*, GNS Science, Lower Hutt.
- Becker, J.S., Beban, J., Saunders, W.S.A., Van Dissen, R., King, A. 2013. Land Use Planning and Policy for Earthquakes in the Wellington Region, NZ, 2001-2011. *Australasian Journal of Disaster and Trauma Studies*.
- Berke, P., Smith, G., 2009. Hazard Mitigation, Planning and Disaster Resiliency: Challenges and Strategic Choices for the 21st Century. In U.f Paleo (Ed), *Building Safer Communities. Risk Governance, Spatial*

- Planning and Responses to Natural Hazards* (pp 1 -20). University of Santiago de Compostela, Spain. IOS.
- Glavovic, B.C., Saunders, W.S.A., Becker, J.S., 2010. Land-use planning for natural hazards in New Zealand: the setting, barriers, 'burning issues' and priority actions. *Natural Hazards* 54(3), 679-706.
- Kapiti Coast District Council, 2007. *Meeting notes: KCDC Environment & Regulatory Committee, 30 Aug 2007*.
- Kerr J., Nathan, S., Van Dissen, R., Webb, P., Brunson, D., King, A., 2003. *Planning for Development of Land on or Close to Active Faults: A guideline to assist resource management planners in New Zealand*. GNS Client Report 2002.124, prepared for the Ministry for the Environment (ME Report 483).
- Kaiser, A., Holden, C., Beavan, J., Beetham, D., Benites, R., Celentano, A., Collett, D., Cousins, J., Cubrinovski, M., Dellow, D., Denys, P., Fielding, E., Fry, B., Gerstenberger, M., Langridge, R., Massey, C., Motagh, M., Pondard, N., McVerry, G., Ristau, J., Stirling, M., Thomas, J., Uma, S.R., and Zhao, J., 2012. The M_w 6.2 Christchurch earthquake of February 2011: preliminary report, *New Zealand Journal of Geology and Geophysics* 55, 67-90.
- NZSEE, 2010. Special Issue: Preliminary observations of the September 2010 Darfield (Canterbury) earthquake sequence, *Bulletin of the New Zealand Society for Earthquake Engineering* 43, 215-439.
- NZSEE, 2011. Special Issue: Effects of the 22 February 2011 Christchurch earthquake and its aftershocks, *Bulletin of the New Zealand Society for Earthquake Engineering* 44, 181-430.
- Parliamentary Commissioner for the Environment (PCE). 2001. *Building on the edge: the use and development of land on or close to fault lines*. March 2001. Office of the Parliamentary Commissioner for the Environment. Te Kaitiaki Taiao a Te Whare Pāremata.
- Perrin, N.D., Wood, P.R., 2002. Defining the Wellington Fault within the urban area of Wellington City. *Institute of Geological & Nuclear Sciences Client Report 202/151. Project No. 430W0510*. Institute of Geological & Nuclear Sciences, Lower Hutt.
- Pondard, N., Barnes, P.M. 2010., Structure and paleoearthquake records of active submarine faults, Cook Strait, New Zealand: Implications for fault interactions, stress loading, and seismic hazard. *Journal of Geophysical Research*, 115, B12320. doi:10.1029/2010JB007781.
- Rhoades, D.A., Van Dissen, R.J., Langridge, R.M., Little, T.A., Ninis, D., Smith, E.G.C., Robinson, R., 2011. Re-evaluation of conditional probability of rupture of the Wellington-Hutt Valley segment of the Wellington Fault. *Bulletin of the New Zealand Society for Earthquake Engineering*, 44 (2): 77-86.
- Saunders, W. S. A., Beban, J. G. 2011. Risk-based approach to natural hazards. *Planning Quarterly*, 183, 18-21.
- Saunders, W. S. A., Beban, J. G. 2012. *Putting R(isk) in the RMA: Technical Advisory Group recommendations on the Resource Management Act 1991 and implications for natural hazards planning*. GNS Science.
- Saunders, W. S. A., Berryman, K. R. 2012. Just add water: when should liquefaction be considered in land use planning? (GNS Science Miscellaneous Series 47 ed.). GNS Science, Lower Hutt.
- Stirling, M., McVerry, G., Gerstenberger, M., Litchfield, N., Van Dissen, R., Berryman, K., Barnes, P., Wallace, L., Bradley, B., Villamor, P., Langridge, R., Lamarche, G., Noder, S., Reyners, M., Rhoades, D., Smith, W., Nicol, A., Pettinga, J., Clark, K., Jacobs, K. 2012. National seismic hazard model for New Zealand: 2010 update. *Bulletin of the Seismological Society of America* 102 (4): 1514-1542. doi: 10.1785/0120110170.
- TAG, 2012. *Report of the Minister for the Environment's Resource Management Act 1991 Principles Technical Advisory Group*. Technical Advisory Group.
- Van Dissen, R., Heron, D., Becker, J., King, A., Kerr, J., 2006. Mitigating active fault surface rupture hazard in New Zealand: development of national guidelines, and assessment of their implementation. *in proceedings*, 8th U.S. National Conference on Earthquake Engineering, San Francisco, California, 18-22 April, 2006. Paper No. 633, 10 p.
- Van Dissen, R.J., Heron, D.W. 2003. Earthquake Fault Trace Survey, Kapiti Coast District. *Institute of Geological & Nuclear Sciences Client Report 2003/77*. Inst. of Geological & Nuclear Sciences, Lower Hutt.
- Wellington City Council, 2004. *Approval of District Plan Change 22: Hazard (Fault Line) Areas Re-alignment and rules, Council Committee, April 2004*. Wellington City Council.

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