

# Land Use Planning and Policy for Earthquakes in the Wellington Region, New Zealand (2001-2011)

Becker, J.S.<sup>1</sup>

Beban, J.<sup>1,2</sup>

Saunders, W.S.A.<sup>1</sup>

Van Dissen, R.<sup>1</sup>

King, A.<sup>1</sup>

<sup>1</sup> GNS Science, P.O. Box 30368, Lower Hutt 5040, New Zealand .

<sup>2</sup> Cuttriss Consultants Ltd, P.O. Box 30429, Lower Hutt 5040, New Zealand.

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## Author correspondence:

J. S. Becker, GNS Science,  
P.O. Box 30368,  
Lower Hutt 5040,  
New Zealand.  
Ph: +64 4 570-4795  
Email: [j.becker@gns.cri.nz](mailto:j.becker@gns.cri.nz)

URL: [http://trauma.massey.ac.nz/issues/2013-1/AJDTS\\_2013-1\\_Becker.pdf](http://trauma.massey.ac.nz/issues/2013-1/AJDTS_2013-1_Becker.pdf)

## Abstract

*Local land use plans often have poor approaches to identifying natural hazards and mitigating for their effects. This paper uses earthquake hazards in the Wellington Region, New Zealand as a case study. A project was undertaken in 2011 to see whether the earthquake hazard had been better recognised and mitigated for in Wellington Region land use planning documents since 2001. In general, it was found that councils' land use policy statements and plans better recognise the risk from the earthquake hazards today than they did a decade previously. There are still areas where land use planning for earthquakes can improve, including strengthening relationships between central government legislation, addressing a wide variety of hazards associated with earthquakes (not just fault rupture), and continued evaluation of policy to ensure earthquake risk is recognised, information is updated, and effective mitigation measures are employed.*

**Keywords:** Land use planning, Policy, Earthquakes, Wellington Region.

## 1.0 Introduction

No single approach to bringing sustainable natural hazard mitigation into existence shows more promise at this time than increased use of sound and equitable land-use management. By planning for and managing

land use to accomplish sustainable mitigation for natural hazards, disasters – though not wholly eliminated – can be reduced to a scale which can be borne by the government, communities, individuals and businesses exposed to them (Mileti 1999). Several studies have documented successful examples of how individual communities have integrated vulnerability data and natural hazard mitigation policies into local planning (Berke, Kartez and Wenger 1993, Berke and Godschalk 2009). However, in general, such practice is still not widespread with few communities having integrated mitigation provisions into their local land-use plans and development ordinances (Berke and Smith 2009). This is a common problem internationally, and arises for a number of political and economic reasons (Mileti 1999).

A project was undertaken to explore this issue in an earthquake context to see if and how earthquake hazard information and mitigation provisions have been integrated into land use plans and policies. The Wellington Region, New Zealand (which is divided into eight separate cities and districts), was used as a case study (Figure 1). A comparison was made between a 2001 desk-based study (Becker and Johnston, 2001, 2002) that documented how earthquake hazards were addressed within local planning documents, and more recent 2011 planning documents, to see whether earthquake hazard and mitigation options had been better recognised since 2001.



**Figure 1.** The Wellington Region (Greater Wellington) and local city and district councils

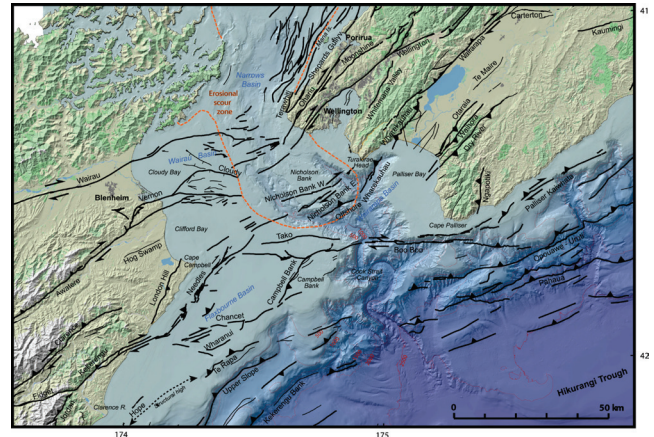
This paper first outlines the 2001 desk-based study that reviewed the incorporation of earthquake hazards into the Wellington land use planning and policy environment. It then goes on to discuss the changes that have occurred from 2001 to 2011 in terms of guidance, land use planning and policy, earthquake hazard information and environmental influences (including recent earthquake events). Finally, the paper discusses influences on the evolution of Wellington earthquake planning and policy over time, and makes recommendations for further improving land use planning and policy for earthquakes.

## 2.0 Context

### 2.1 The earthquake hazard in the Wellington Region

The Wellington Region lies within the deforming boundary zone between the Pacific and Australian plates (Figure 2), within one of the most seismically active areas of the country. The region is cut by earthquake producing active faults – both on and offshore. It is underlain by the subduction interface between the Australian and Pacific plates, and has been violently shaken by earthquakes in 1848, 1855 and 1942 (Downes 1995, Pondard and Barnes 2010, Robinson, Van Dissen and Litchfield 2011, Stirling *et al.* 2012).

Wellington City is bisected by the active Wellington Fault, with many engineered lifelines (e.g. water, electricity, roads, telecommunications) crossing this fault. Surface fault rupture and a large earthquake (approximately magnitude 7.5) on the Wellington Fault is regarded as New Zealand’s probable maximum earthquake

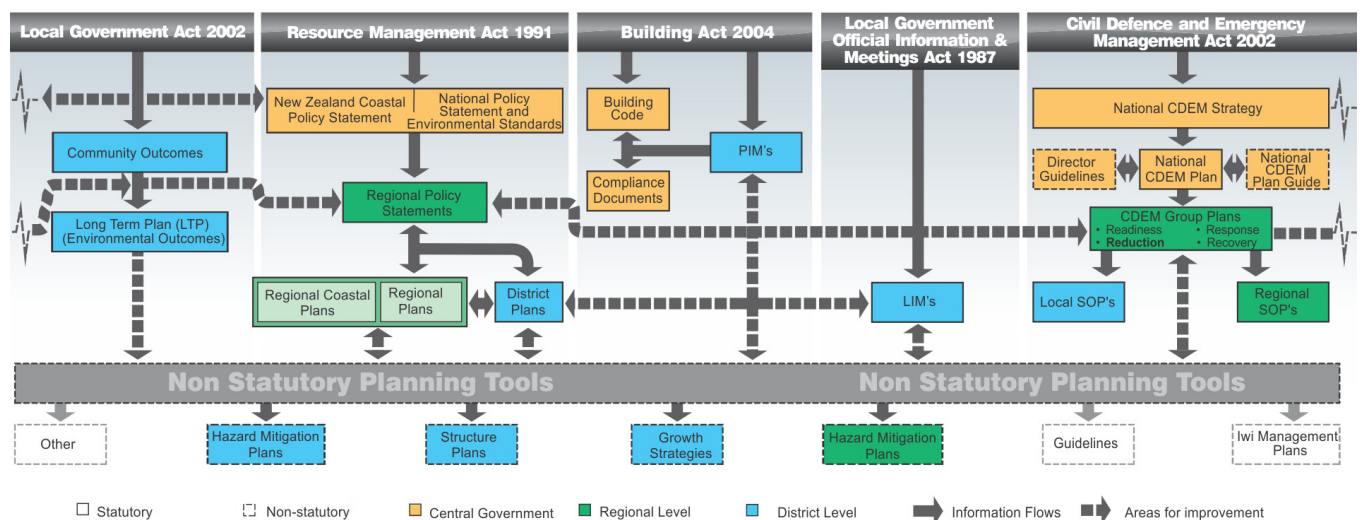


**Figure 2.** Location of the Wellington Region, showing major earthquake fault lines (NIWA image in Van Dissen *et al.*, 2010).

loss event (Cousins *et al.* 2009), and the likelihood of such an event occurring within the next 100 years is approximately 10% (Rhoades *et al.* 2011). Parts of the region are vulnerable to different earthquake hazards (strong ground shaking, surface fault rupture, liquefaction, landslides and tsunami). Characterising these hazards, and attempting to mitigate their effects, has been the focus of government and private investigation and policy over many years, and continues to this day (Grant-Taylor *et al.* 1974, Greater Wellington Regional Council 1996, Wellington City Council 2009, Van Dissen *et al.* 2010).

### 2.2 Responsibility for dealing with Earthquake Hazards

Five key pieces of legislation contribute to natural hazard management in New Zealand: the Resource Management Act 1991 (RMA), Building Act 2004, Civil



**Figure 3.** Legislative context for hazard management in New Zealand showing the hierarchy of planning provisions (Glavovic *et al.* 2010). Solid arrows show established relationships between provisions, while dashed arrows highlight relationships that ought to be improved. Relationships may be one- or two-way.

Defence Emergency Management Act 2002 (CDEM Act), Local Government Act 2002, and the Local Government Official Information and Meetings Act 1987.

Figure 3 presents the five main statutes that govern natural hazards planning at different levels of government, namely central (orange), regional (green) and district/city (blue) levels. The hierarchy of plans established under each law provide various statutory and non-statutory tools for natural hazards planning. These legislative provisions and the tools they provide constitute a robust 'toolkit' for natural hazards planning. However, many of these tools are not well known or used to their full potential to reduce hazard risk and build community resilience (Glavovic et al, 2010). Two key tools in the 'toolkit' that can be used to reduce risk from natural hazards include Regional Policy Statements and District Plans. Provision can be included in these documents (i.e. appropriate objectives, policies, and methods) to ensure that a prudent approach to land use planning is taken to mitigate earthquake effects. The following section outlines a 2001 analysis of the Wellington Regional Policy Statement and district plans which was undertaken to identify how these planning documents dealt with earthquake hazards at the time.

### 3.0 Policy and planning for earthquake hazards in Wellington

#### 3.1 Analysis of regional policy statements and district plans in 2001

##### 3.1.1 Outline of analysis.

The Wellington Regional Policy Statement and nine district plans were analysed in 2001 to identify if earthquake hazards had been acknowledged and incorporated into land use planning (Becker and

Johnston 2001, 2002). A similar analysis was conducted in the Hawke's Bay, Bay of Plenty, and Waikato regions in 2000 (Becker and Johnston 2000, 2002). The Wellington project used a similar methodology to the 2000 study.

A content analysis of the Wellington planning documents was undertaken which involved (Becker and Johnston, 2000):-

- a) "Deciding which aspects of earthquake hazards, and [natural] hazards in general, to identify as being present in plans and policy statements. These were then converted into categories for coding.
- b) Reading each plan or policy statement and using a simple coding system to denote whether or not a category was present in a plan. For each category yes=y and no=n. In some cases the question was not applicable and "-" was entered as a data figure.
- c) Statistical analysis."

Table 1 details the coding categories and the content analysis of regional policy statements and district plans in 2001. **3.1.2 Identification of earthquakes as a hazard.**

The Wellington planning documents had strong acknowledgement of earthquake hazards. All the planning documents indicated that earthquakes could affect the region or district, and all but one planning document identified the location of fault lines within the relevant area, and described the earthquake hazard and its potential effects. Three quarters of district plan maps identified natural hazards, including fault lines. Only the Masterton and Carterton district plans did not specifically mark seismic hazard areas, fault avoidance zones or fault lines on planning maps. The Masterton District Plan included maps showing fault lines, but these

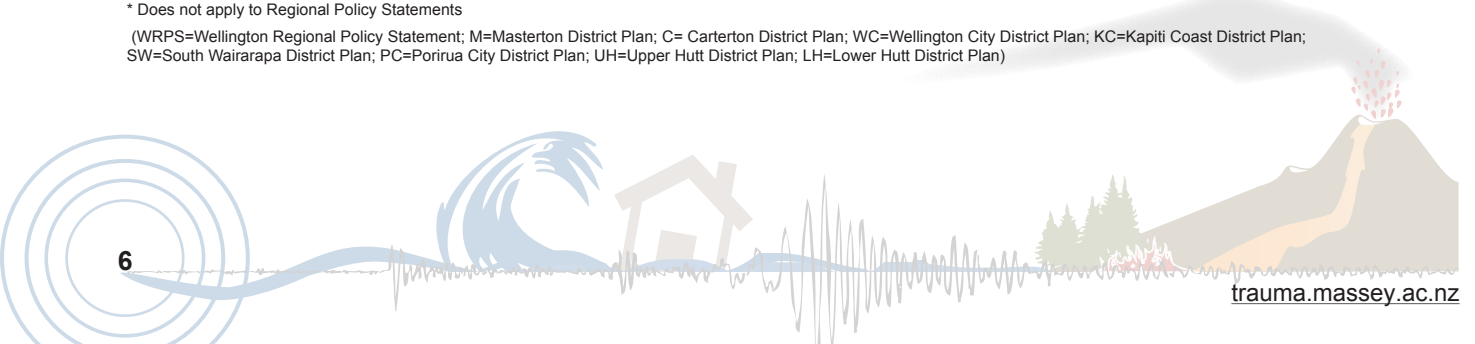
**Table 1.** Results of the planning document analysis for Wellington Region in 2001

Categories identified in plans and policy statements	Summary		WRPS	M	C	WC	KC	SW	P	UH	LH
	Yes	No									
<b>Structure of the Plan/Policy Statement</b>											
- Has a specific section on natural hazards (in contrast to hazards being mentioned throughout the document)	8 (89%)	1 (11%)	Y	Y	Y	N	Y	Y	Y	Y	Y
<b>Hazard and Earthquake Definitions</b>											
Does the plan/policy statement:											
- Have the definition of a hazard?	5 (56%)	4 (44%)	Y	Y	Y	N	N	N	Y	N	Y
- List earthquakes as hazards?	6 (67%)	3 (33%)	Y	Y	Y	N	Y	N	N	Y	Y
- Mentions earthquakes as a hazard that could affect the district or region?	9 (100%)	0 (0%)	Y	Y	Y	Y	Y	Y	Y	Y	Y
- Locate the fault lines in the district or region (in the text or on a map)?	8 (89%)	1 (11%)	N	Y	Y	Y	Y	Y	Y	Y	Y
- Describe the earthquake hazard and its effects	8 (89%)	1 (11%)	Y	Y	Y	N	Y	Y	Y	Y	Y

Categories identified in plans and policy statements	Summary		WRPS	M	C	WC	KC	SW	P	UH	LH
	Yes	No									
<b>Objectives</b>											
Does the plan/policy statement have:											
- Objectives that are 'all hazard' based?	8 (89%)	1 (11%)	Y	Y	Y	Y	Y	Y	N	Y	Y
- Specific Objectives for earthquakes?	2 (22%)	7 (78%)	N	N	N	N	N	N	Y	N	Y
- Specific Objectives for other hazards?	2 (22%)	7 (78%)	N	N	N	N	N	N	Y	N	Y
<b>Policies</b>											
Does the plan/policy statement have:											
- Policies that are 'all hazard'?	7 (78%)	2 (22%)	Y	Y	Y	Y	Y	Y	N	Y	N
- A specific policy or policies on earthquakes?	3 (33%)	6 (67%)	N	N	N	N	Y	N	Y	N	Y
- Specific policies for hazards other than earthquakes?	4 (44%)	5 (56%)	N	N	N	Y	Y	N	Y	N	Y
<b>Methods</b>											
Does the plan/policy statement have:											
- Methods that are 'all hazard'?	7 (78%)	2 (22%)	Y	Y	Y	Y	Y	Y	N	Y	N
- Methods that mention earthquakes specifically?	5 (56%)	4 (44%)	Y	N	N	N	N	Y	Y	Y	Y
- Methods that mention specific hazards but not earthquakes?	7 (78%)	2 (22%)	Y	N	Y	N	Y	Y	Y	Y	Y
<b>Rules</b>											
- 'All hazard' rules?*	3 (38%)	5 (62%)	-	Y	Y	Y	N	N	N	N	N
- Rules for earthquakes/ fault lines?*	7 (87%)	1 (13%)	-	N	Y	Y	Y	Y	Y	Y	Y
- Specific hazard rules but not for earthquakes/fault lines?*	4 (50%)	4 (50%)	-	N	Y	N	Y	Y	N	Y	N
<b>Assessment Criteria</b>											
Does the plan/policy statement have:											
- General hazard assessment criteria? *	2 (25%)	6 (75%)	-	Y	N	N	N	Y	N	N	N
- Specific assessment criteria with regards to earthquakes? *	2 (25%)	6 (75%)	-	N	N	Y	N	N	N	Y	N
<b>Performance Standards for Earthquakes</b>											
- Are there any performance standards for earthquakes?	4 (44%)	5 (56%)	N	N	Y	N	N	Y	N	Y	Y
<b>The Building Act 1991</b>											
Does the plan/policy statement refer to:											
- The Building Act 1991 regarding earthquakes?	4 (44%)	5 (56%)	N	N	Y	N	N	N	Y	Y	Y
- The Building Act 1991 regarding hazards in general?	9 (100%)	0 (0%)	Y	Y	Y	Y	Y	Y	Y	Y	Y
<b>Practicalities of Planning for Earthquakes</b>											
Does the plan/policy statement:											
- Note the limitations/practicalities of planning for earthquakes?	6 (67%)	3 (33%)	Y	N	Y	Y	N	N	Y	Y	Y
- Suggest that due to the nature of earthquakes, control is not possible through district plan/regional policy statement?	0 (0%)	9 (100%)	N	N	N	N	N	N	N	N	N
<b>Earthquake Hazard Information</b>											
Does the plan/policy statement:											
- Recognise there is a need for the council to update the local seismic hazard information, or acknowledge there is a lack of information available to the district or region?	5 (56%)	4 (44%)	Y	N	Y	N	Y	Y	N	Y	N
- Account for new hazard information come to light?	4 (44%)	5 (56%)	Y	Y	Y	Y	N	N	N	N	N
<b>Environmental Outcomes</b>											
Does the plan/policy statement have:											
- 'All hazards' based environmental outcomes/results?	8 (89%)	1 (11%)	Y	Y	Y	Y	Y	Y	N	Y	Y
- Hazard specific environmental outcomes/results?	1 (11%)	8 (89%)	N	N	N	N	N	N	Y	N	N
<b>Hazards on District Planning Maps</b>											
- Are local hazards included on land use planning maps? (as opposed to having a separate map with hazards on)*	6 (75%)	2 (25%)	-	N	N	Y	Y	Y	Y	Y	
<b>Monitoring</b>											
- Monitoring that is all 'all hazard'?	5 (56%)	4 (44%)	N	Y	Y	N	Y	N	N	Y	Y
- Monitoring specifically for earthquakes?	1 (11%)	8 (89%)	N	N	N	N	N	N	N	N	Y
- Monitoring of specific hazards but not earthquakes?	1 (11%)	8 (89%)	N	N	N	N	N	N	N	N	Y
- Monitoring only covered elsewhere in plan and does not mention natural hazards?	4 (44%)	5 (56%)	Y	N	N	Y	N	Y	Y	N	N

\* Does not apply to Regional Policy Statements

(WRPS=Wellington Regional Policy Statement; M=Masterton District Plan; C= Carterton District Plan; WC=Wellington City District Plan; KC=Kapiti Coast District Plan; SW=South Wairarapa District Plan; PC=Porirua City District Plan; UH=Upper Hutt District Plan; LH=Lower Hutt District Plan)



were not integrated with the official planning maps. While not officially linked to its Regional Policy Statement, Wellington Regional Council had also published a series of earthquake hazard maps to show the range of earthquake hazards likely to affect different areas (Greater Wellington Regional Council, 1996 a, b, c, d).

Approximately half of Wellington Region policy statements and plans recognised the need to account for new natural hazard information when it came to light, and had updated their plans accordingly. Half of Wellington Region planning documents stated there was a lack of seismic hazard information, or that their information needed to be updated.

In general, the Wellington Region planning documents supported the fact that land use planning could be a useful tool for earthquake risk reduction. None stated that land use planning for earthquakes was impossible. However, 67% did suggest there were limitations on planning for earthquakes (for example, there was suggestion that it is impossible to plan to mitigate for all the effects of ground shaking).

**3.1.3 Objectives, Policies and Methods.**

When looking specifically at objectives and policies, the majority (~80%) of Wellington Region policy statements and plans tended to take an “all hazards” approach

rather than an earthquake-specific one. Less than a third of Wellington Region planning documents had any earthquake-specific objectives or policies. Specific objectives and policies cited by district plans are included in Table 2.

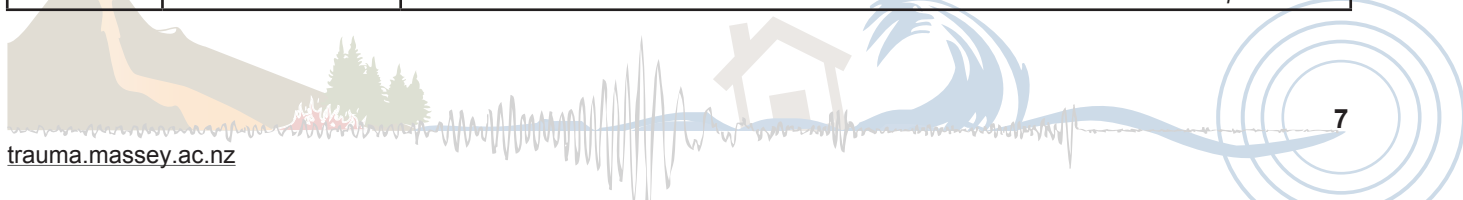
Just over half of the planning documents from the Wellington Region mentioned earthquakes when discussing methods to mitigate for natural hazards. Eighty seven percent of district plans had rules specifically targeting the mitigation of earthquake hazards. Table 3 presents examples of earthquake-specific rules found in district plans. A quarter of Wellington planning documents had assessment criteria for natural hazards in general and earthquakes in particular, while 44% had performance standards for earthquake hazards.

**3.1.4 Monitoring of effectiveness of policy statements and plans.**

In the Wellington Region, monitoring planning provisions for natural hazards was referred to in just over half (56%) of policy statements and plans. When looking at earthquake-specific monitoring, only one planning document referred specifically to monitoring for planning provisions related to earthquake hazards. The other planning documents (44%) covered monitoring in a

**Table 2.** Earthquake-specific policies and objectives found in Wellington-based district plans as of 2001.

District Plan	Objectives	Policies
Lower Hutt	<i>“ To avoid or reduce the risk to people and their property from natural hazards associated with seismic action, landslides, flooding and coastal hazards”</i>	a) <i>“That the area at risk from fault rupture causing permanent ground deformation along the Wellington Fault Line be managed by the Wellington Fault Special Study Area to address the effects of subdivision and development on the safety of people and their property.</i> b) <i>That suitable engineering and emergency management measures be adopted to safeguard people and their property from liquefaction, groundshaking and tsunami hazards...”</i>
Porirua City	<i>“To minimise the risk from earthquakes to the wellbeing and safety of the community”.</i>	Policy C12.1.1 <i>“To minimise the effect of earthquake ground shaking and amplified effects on soft ground through controls on the location and materials of pipelines and services”.</i> Policy C12.1.2 <i>“To minimise the effects of ground damage from Ohariu fault movement in rock or very stiff soil types”.</i> Policy C12.1.3 <i>“To minimise the effects of ground damage from Ohariu fault movement in intermediate and flexible, or deep soil”</i> Policy C12.1.4 <i>“To manage the effects of ground damage from earthquake induced liquefaction of soils.”</i> Policy C12.1.5 <i>“To minimise the effects of ground damage created by slope failures, earthquake induced slope instability and landslides”.</i>
Kapiti Coast	No earthquake-specific objectives	Policy 6 <i>“Promote a viable alternative access to the north of the district in the event of an earthquake”</i>



**Table 3.** Examples of Earthquake Specific rules found in Wellington-based district plans available as of 2001.

District Plan	Earthquake-specific rules
Lower Hutt	<p><i>"14H 2.1 Restricted Discretionary Activities</i></p> <p>a) <i>All structures and buildings on any site where the whole site or a portion of the site falls within the Wellington Fault Special Study Area, excluding the following:</i></p> <p>i) <i>Proposed accessory buildings which are not required for habitable or working purposes; or</i></p> <p>ii) <i>Utilities;</i></p> <p><i>which are Permitted Activities".</i></p> <p><i>"14H 2.1.1.1 Matters in which Council has Restricted its Discretion</i></p> <p>a) <i>Safe separation distance of Structures and buildings from the Wellington Fault line:</i></p> <p><i>14H 2.1.1.2 Standards and terms</i></p> <p>a) <i>Safe separation distance of Structures and buildings from the Wellington Fault line:</i></p> <p><i>For all structures and buildings, an engineering report will be required to confirm that the Wellington Fault Line is not within 20.0m of any proposed structure or building, or that the necessary engineering precautions have been taken".</i></p>
Porirua City	<p>Rural Zone rules and standards</p> <p><i>"New dwellings shall not be built within a fault avoidance zone 40m either side of the fault traces shown on the Judgeford Hills Structure Plan unless further investigation, which may include trenching, has established the exact location of the relevant fault, in which case the separation distance may be reduced to 20m".</i></p> <p>Under Policy C12.1.2 it states:</p> <p><i>"Essential activities (as defined in Part M) are a limited discretionary activity in seismic hazard areas. For other activities, any seismic hazard will be a factor in the consideration of a resource consent application".</i></p> <p>In applying discretion council says it will consider the location of the site, appropriateness of the proposed activity on the site, and the potential of seismic hazard to disrupt that activity. Further information may be required as part of a resource consent process to clarify the extent of the risk and the consequences of the hazard.</p>
Kapiti Coast	<p>Under residential and rural zone rules and standards:</p> <p><i>"The following are controlled activities, provided they comply with the controlled activity standards:...</i></p> <p><i>...Any building which is within 20 metres of an earthquake fault trace as shown on the Planning Maps. The matters over which the Council reserves control are:</i></p> <ul style="list-style-type: none"> <li>• <i>The imposition of conditions to ensure appropriate engineering design to avoid, remedy or mitigate any adverse effects resulting from ground rupture".</i></li> </ul>
Wellington City	<p>Rule 5.1.3.7</p> <p><i>"In any Hazard (Fault Line) Area, residential buildings shall have a maximum height of 8m and shall be specifically designed to the requirements of New Zealand Standard 4203:1992 'Code of Practice for General Structural Design and Design Loadings for Buildings."</i></p> <p>Rule 5.3.6 (Discretionary (Restricted) Activity)</p> <p><i>Residential buildings within a Hazard (Fault Line) Area are Discretionary Activities (Restricted) if they do not comply with the conditions for Permitted Activities in respect of:</i></p> <p>5.3.6.1 <i>building height</i></p> <p>5.3.6.2 <i>construction type.</i></p>
Carterton	<p><i>"10.6.2 Conditions for Permitted Activities:</i></p> <p><i>Setback Requirements:</i></p> <p>(a) <i>Any essential facility shall be setback at least 20 metres from any faultline identified in Appendix 10A and on the Planning Maps."</i></p> <p><i>"10.6.3 Discretionary Activities</i></p> <p>(c) <i>Any use or storage of hazardous substances within any mapped flood plain area or within 20 metres of any fault line identified in Appendix 10A and plan maps"</i></p> <p>(d) <i>Any essential facility within any floodplain area or within 20 metres of any mapped fault line".</i></p>
South Wairarapa	<p><i>Rules in the South Wairarapa District Plan were more concerned with building standards in seismic areas, rather than limiting development on or around faults.</i></p>
Upper Hutt	<p><i>"Any new habitable building or structure to be erected within the fault band identified on the Planning Maps" is considered a discretionary activity. Matters of discretion within the fault band include:</i></p> <ul style="list-style-type: none"> <li>• <i>The accuracy of information relating to the location of the fault.</i></li> <li>• <i>The potential effects of an earthquake in terms of the nature and scale of use proposed for the building.</i></li> <li>• <i>The extent to which the building complies with Clause B1 Structure of the New Zealand Building Code".</i></li> </ul>

separate section and did not relate it directly to natural hazards or earthquakes.

### 3.1.5 Reference to the Building Act.

All Wellington planning documents made some reference to linkages with The Building Act 1991 (which ensures that buildings are built to adequate earthquake standards), with 44% making direct links between earthquakes and The Act.

### 3.1.6 Comparison with other regions.

The policy and plan analysis for the Wellington Region revealed that Wellington land use planners appeared to be more advanced in terms of planning for earthquake hazards than those in the northerly regions studied in 2000 (Becker and Johnston 2000, 2002). In particular, earthquake hazards and the impacts of a potential earthquake were more widely acknowledged and there was greater location of earthquake hazards on planning maps.

## 3.2 Evolution of the planning environment since 2001

### 3.2.1 Development of Guidance for Active Faults

After the 2000 study of northerly regions and evidence from a new development on Kapiti Coast showing that limited attention was afforded to earthquake fault rupture hazards, the Parliamentary Commissioner for the Environment (PCE) directed that guidance was needed (Parliamentary Commissioner for the Environment, 2001). As a consequence MfE commissioned the development of a new guideline, entitled *Planning for the Development of Land on or Close to Active Faults*, referred to from here on as the Active Fault Guidelines (Kerr *et al.*, 2003).

The Active Fault Guidelines provide a risk-based approach for dealing with the fault rupture hazard specifically. They recommend that information about the nature of a fault rupture hazard (e.g. location, recurrence interval) and development type (e.g. use and construction type) be collected before decisions are made about if, and how, a risk will be treated. The key principles of the guidelines as stated in the Active Fault Guidelines are to:

- “Gather accurate active fault hazard information;
- Plan to avoid fault rupture before development and subdivision;
- Consider, and as appropriate, account for fault rupture hazard in areas already developed or subdivided
- Communicate risk in built up areas subject to fault rupture”.

Examples of resource consent categories are also included, to give planners guidance as to how to deal with a particular type of fault in a District Plan. It is suggested that planning permissions for activities be more permissive if the risk is low and become more restrictive as the risk rises.

### 3.2.2 Changes to land-use planning policy practice in the Wellington Region since the 2001 desk-top study: A 2011 review

#### 3.2.2.1 Wellington City Council (WCC).

In 2001, WCC commissioned a study on the impact of a Wellington Fault earthquake on properties (Perrin and Wood 2002). The study discovered that the district plan maps did not accurately reflect the fault's location, and further studies were reviewed that revealed updated information held about the fault. In light of the new

information, and because current provisions were not achieving their intention (i.e. multiple units had been built in the active fault zone), Wellington City Council decided on a district plan change (Plan Change 22). The plan change was publicly notified on 6 September 2003. In April 2004 the Council approved the recommendations of the District Plan Hearing Committee.

Key changes to the plan included (Wellington City Council 2004):-

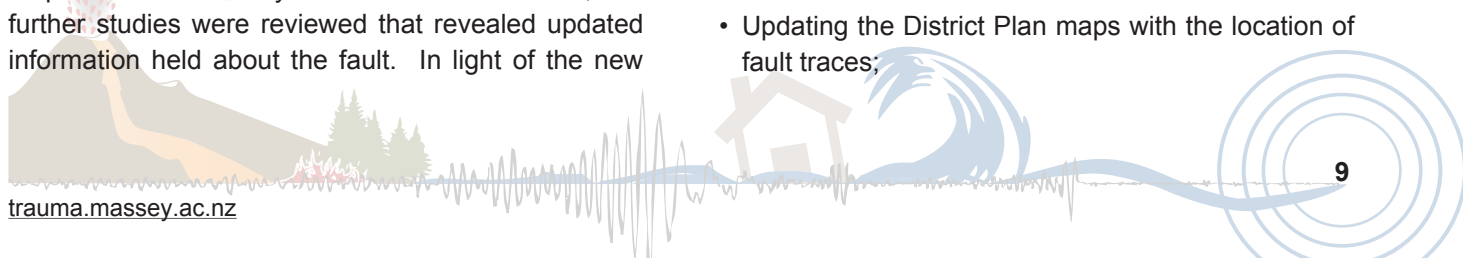
- Clarification of the explanation to policies for earthquake hazard;
- Changes to wording, highlighting the importance of building to the Building Code and focussing on the need for lighter building materials;
- Reduction of the number of permitted residential units per site to one;
- New assessment criteria for discretionary activities, including the requirement to provide geotechnical and engineering reports;
- A new rule for assessing multi-unit developments;
- A new rule for the Suburban Centre Zone, because the hazard area did not previously pass through this zone;
- Changes to other hazard rules to maintain consistency across the Plan; and
- Updated planning maps.

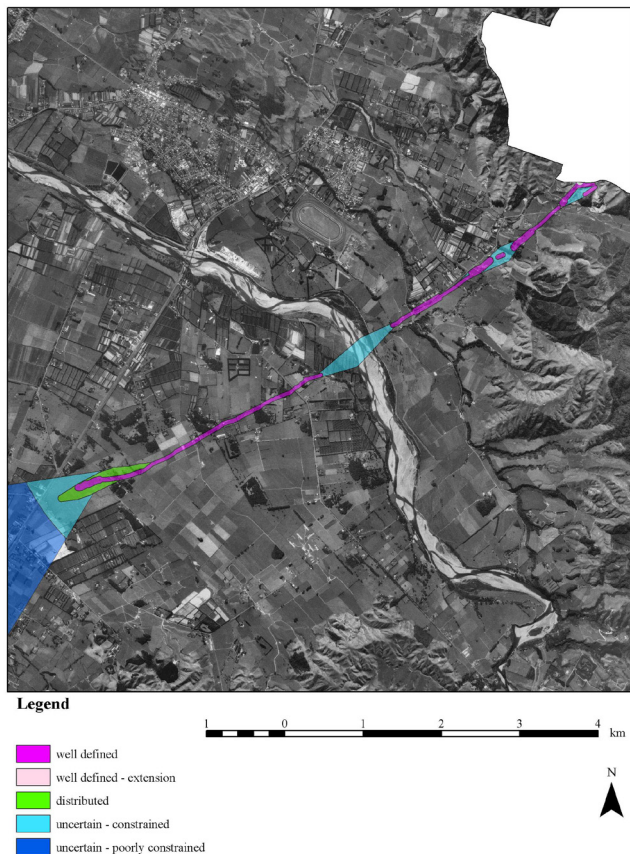
#### 3.2.2.2 Kapiti Coast District Council (KCDC).

In November 2000, KCDC notified a proposed plan change focussed on planning for active faults. However, this plan change was withdrawn after submissions suggested more information was needed to locate fault traces. In 2003, a GNS Science report for KCDC identified the fault traces (some in more detail than others depending on the accessibility of the fault) and provided planning recommendations based on the Active Fault Guidelines (Van Dissen and Heron 2003). Figure 4 shows one of the maps created to identify the location and definition of the Ohariu Fault on the Kapiti Coast.

Following the study, community consultation took place, followed by the drafting of new content for the district plan (Saunders, Becker, and Glassey 2009). In 2007, proposed changes (Plan Change 61) to the district plan included (Kapiti Coast District Council 2007):

- Updating the District Plan maps with the location of fault traces;





**Figure 4.** The Northern Ohariu Fault showing Fault Avoidance Zones (Van Dissen and Heron, 2003).

- Adding an objective and policies which reflect Council's goal and approach to development on or near fault traces;
- Promoting a risk-based planning approach to determining the status of a development based upon the Building Importance Category and the Recurrence Interval of the faultline.
  - Altering rules and standards in relation to subdivision by encouraging all new allotments created by subdivision to have building sites clear of the identified fault trace; and;
  - Setting out the matters that will be considered by Council in assessing an application if a building site cannot be clear of the fault trace, e.g. the provision of geotechnical information.
- Altering rules and standards in relation to new buildings by:
  - Allowing non-habitable buildings e.g. sheds and garages to be located over the fault trace; but
  - Encouraging all other buildings to be located away from the fault trace. Where this is not possible, it sets

out the criteria Council will consider in assessing such an application.

The plan change became operative on 14 October 2010 (Kapiti Coast District Council 2011). While this plan change took several years, there was evidence of developers using the proposed rules and the Active Fault Guidelines in the Kapiti Coast district to guide new development before the rules became operative. Symmans and Leith (2006) reported that, as part of their assessment for a new residential hillside subdivision, they had located the fault trace and assessed appropriate setbacks for development. Subdivision building lots were created to ensure building platforms were outside the potential fault ground rupture and deformation areas.

### 3.2.2.3 Wairarapa councils (Masterton, Carterton and South Wairarapa districts).

In 2003 and 2004 the Masterton, Carterton and South Wairarapa District Councils prepared a combined District Plan where a variety of natural hazards, including fault lines, were identified in the region. The specific matters relating to active faults which were identified within the District Plan are (Wairarapa Combined District Plan 2011):

- Updating the District Plan maps with the location of fault traces;
- Adding an objective and policies which reflect Councils' goals and approach to development on or near fault traces;
- Creating rules and standards in relation to subdivision by encouraging all new allotments created by subdivision to take into account natural hazard avoidance or mitigation;
- Creating rules and standards in relation to new buildings by:
  - Allowing non-habitable buildings e.g. sheds and garages to be located within the Faultline Hazard Area; but
  - Encouraging all developments involving habitual buildings to be located away from the identified Faultline Hazard Areas. Where this is not possible, the development is a discretionary activity and all relevant effects associated with the construction of a habitual building within the Faultline Hazard Area can be considered.



#### 3.2.2.4 Other changes in the Wellington Region.

Since 2001, in addition to the changes made to the district plans, other changes have occurred in planning and policy including:

- A second generation of plans and policy statements have begun to be developed, e.g. Wellington Regional Council has drafted up a proposed Regional Policy Statement for the region;
- Structure planning has taken place, guiding where and how Wellington will grow in the future (Quality Planning 2011);
- The Wellington Civil Defence Emergency Management (CDEM) Plan has been developed and implemented; and
- Attempts have been made to ensure public earthquake-prone buildings are upgraded to meet requirements under the Building Act 2004.

Research has also led to a better scientific understanding of earthquake hazards in the region, and much of the research has been through the “It’s Our Fault” programme. A better understanding of Wellington’s earthquake risk can help inform future planning and policy. The latest results for this study have indicated that the risk of a large (Magnitude 7.5) Wellington Fault earthquake has decreased from a 30% risk of rupture in the next 100 years (D. A. Rhoades, Stirling, Schweig, & Van Dissen, 2004) to approximately 10% (Rhoades et al., 2011; Rhoades, Van Dissen, Langridge, Little, Ninis, Smith, & Robinson, 2010).

#### 3.2.2.5 A change of focus – risk-based planning.

Since the release of the Active Fault Guidelines, there has been a change in focus to land use planning for active faults, with research identifying a risk-based planning approach. This approach has been described in the Active Fault Guidelines and takes into account the Building Importance Category, Fault Complexity, and Recurrence Interval (Kerr et al. 2003). This approach has been refined further within Saunders (2011), and Saunders, Prasetya and Leonard (2011). A risk-based planning approach allows for the consideration of the consequences from the fault rupture, and the likelihood of this event occurring, when determining whether a proposal should proceed. This allows for more robust planning decisions when determining what activities councils will allow within their fault hazard zones.

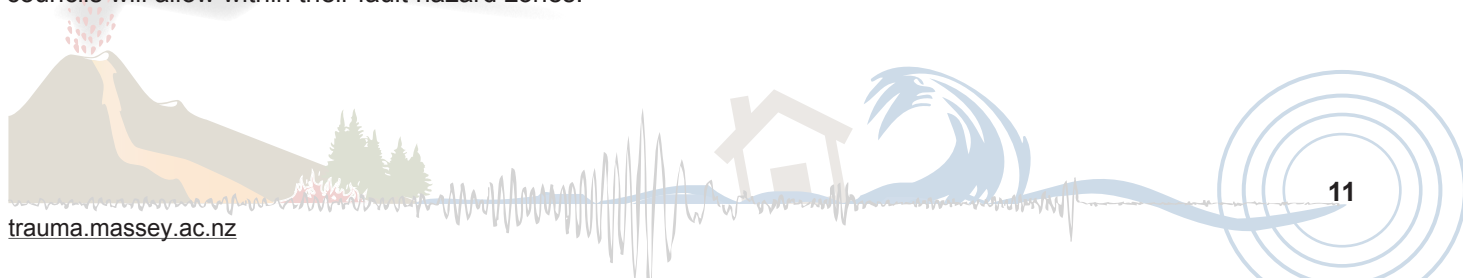
#### 3.2.2.6 Recognition of a variety of hazards associated with earthquakes.

The Darfield (4 September 2010) and Christchurch (22 February 2011) earthquakes have demonstrated the impact earthquakes can have on the urban environment. Both earthquakes caused severe damage to unreinforced masonry buildings, and in the 22 February earthquake, two multi-storey buildings collapsed. Severe liquefaction and lateral spread in both earthquakes damaged many residential and commercial buildings, and many residential areas within liquefaction zones now have to be abandoned. Landslides on the Port Hills also caused damage to houses and properties.

The Canterbury earthquakes have demonstrated that:

- Earthquakes pose a range of hazards including ground shaking, landslides, liquefaction, lateral spread, fault rupture and tsunamis. All of these hazards should be considered when reducing earthquake risk.
- Land use planning has a role in reducing risk from earthquakes.
- Policy guidance and rules need to help reduce the effects from the other earthquake hazards aside from fault rupture.

The Canterbury earthquakes have spawned the evolution of new recommendations and guidance. In particular, a review of the RMA by the Government appointed RMA Principles Technical Advisory Group (TAG) resulted in recommendations for improving natural hazard provisions (TAG, 2012), which included prioritising risk as a matter of national importance. Currently, ‘risk’ is not included in the RMA, so the recommended changes to the natural hazard provisions of the RMA to include risk is considered to be a positive response to improving the management of land use in areas susceptible to natural hazards (Saunders & Beban, 2012b). As well as possible legislative changes, non-regulatory guidance on land use planning for liquefaction has been developed (Saunders & Berryman, 2012). The Canterbury earthquakes have also sparked intensified debates about the performance of earthquake prone buildings and the actions that need to be taken to ensure buildings are up to the required performance standards for earthquakes.



## 4.0 Recent planning studies relevant to the Wellington Region

### 4.1 Active Fault Guideline Follow-up Study

In 2005, a follow-up study to the Active Fault Guidelines assessed if, and how, local authorities used the guidelines, and whether they had found them useful (Becker, Saunders and Van Dissen 2005). Planners from local authorities across New Zealand (88 regional and territorial authorities) were surveyed, followed by detailed interviews with eleven individual planners. The survey revealed there was reasonable awareness of the Active Fault Guidelines (60% awareness). However, actual use of the Active Fault Guidelines was less, with only a third of respondents reporting that they used it on a day-to-day basis. Even fewer respondents stated that long-term changes had been made to processes, such as amending district plans or regional policy statements (Becker *et al.* 2005, 2006).

Most respondents felt that the Active Fault Guidelines were easy to understand and apply but had some difficulty knowing how to apply the resource consent tables to their local fault situations and planning environments. Local authorities that made the best use of the Guidelines worked closely with physical scientists or geotechnical specialists to define fault rupture hazard and devise planning methods that fitted the local situation (making use of the consent tables). The follow-up study found that, to achieve good planning outcomes with respect to fault rupture, it is essential that strong partnerships are formed between scientists/specialists and planners, so as to accurately identify the risk posed by fault rupture and to formulate a local solution (Becker *et al.* 2005, 2006).

### 4.2 Pre-event Recovery Planning

Pre-event recovery planning is the consideration of recovery, and implementation of solutions, before a disaster occurs. By working through solutions before an event occurs, recovery can be greatly improved, resulting in better coordination, efficiency and appropriately targeted reinstatement of affected areas (Becker *et al.* 2008). The publication "Wellington after the Quake" (EQC 1995) highlights some of the planning issues that may need to be addressed before and after a big earthquake. McKay (2005) says five key tasks are part of pre-event recovery planning for Wellington, including:

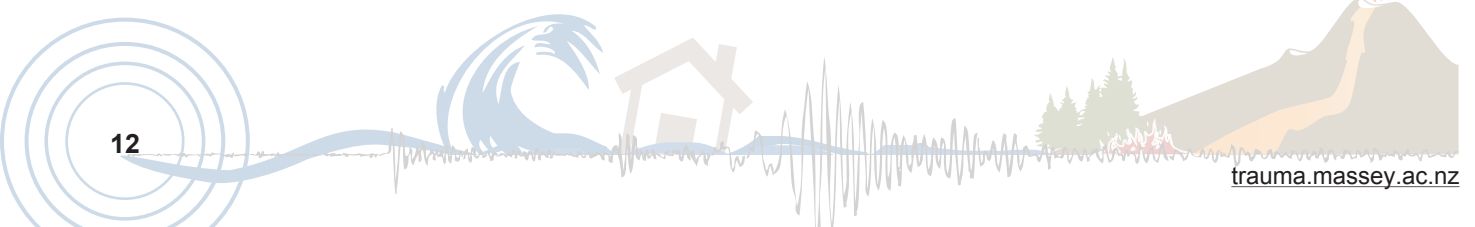
- Business continuity planning within council and other organisations;
- Ensuring the CDEM Group Plan recognises urban development as an integral part of the post disaster recovery process;
- Defining operational roles and responsibilities of planners in the recovery;
- Consideration of how information on the disaster relevant to city planning is to be gathered; and
- Consideration of how the statutory system (e.g. RMA) will work in a major disaster.

Despite recognising the need for pre-event recovery planning, the topic has been given limited attention in Wellington. In 2008, Becker, *et al.*, published a methodology on pre-event planning for land use which outlines key things that regional and district councils can put into their policies and plans to address the impacts of disasters and to aid effective recovery. A workshop was run involving central government, emergency management staff and resource management planners from the Wellington Region to analyse the methodology, provide feedback, and discuss opportunities for incorporating the methodology into future planning. Feedback from the workshop helped improve the methodology in general but did not feed directly into subsequent land use planning efforts.

## 5.0 Discussion

### 5.1 Evolution of land use policy and planning for earthquakes in the Wellington Region, 2001-2011

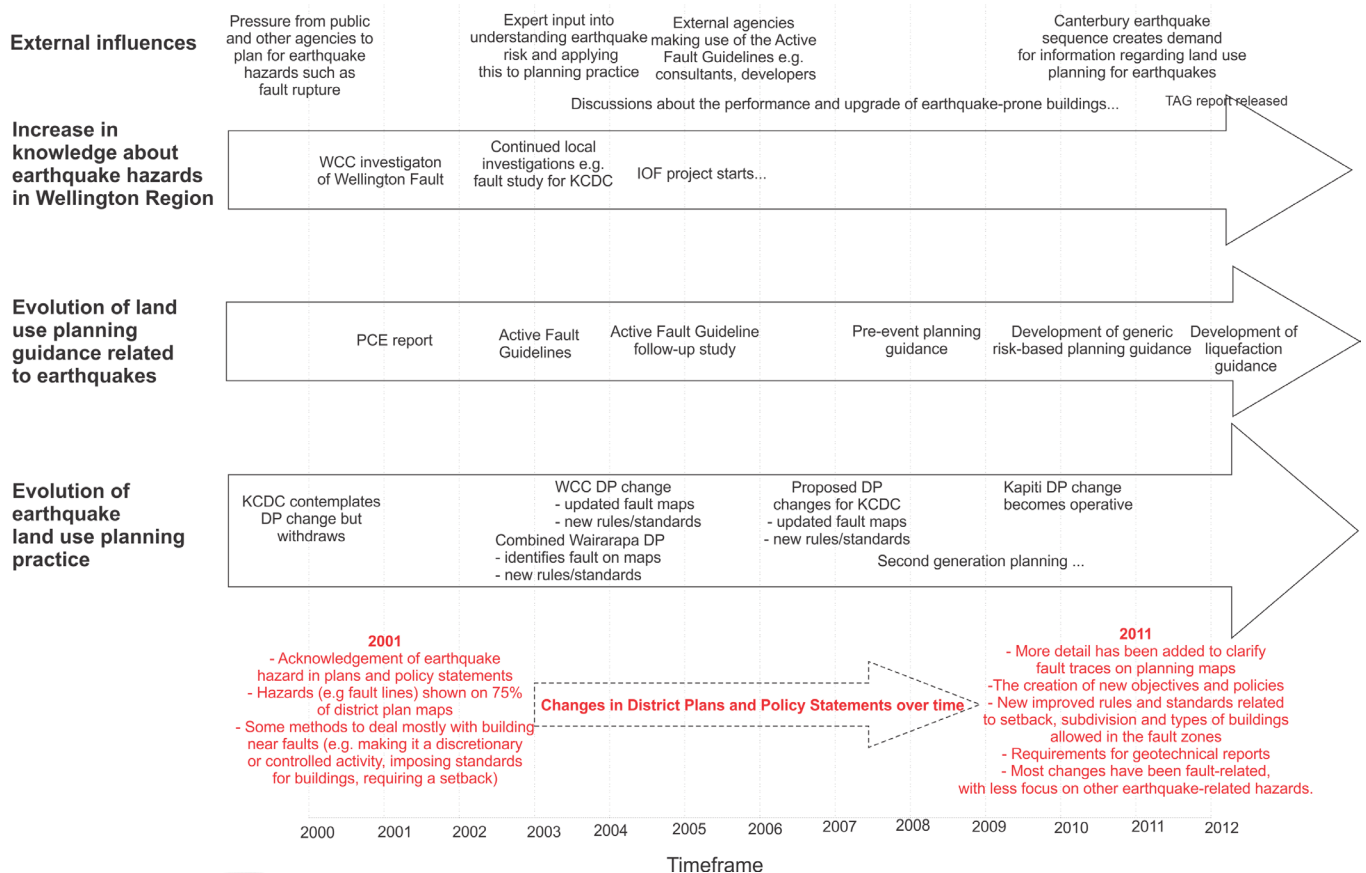
An analysis of Wellington plans and policy statements revealed that the Wellington Region was reasonably advanced in 2001 with respect to planning for earthquakes, in comparison with other regions (Becker and Johnston, 2000, 2002). Earthquake hazards and the impacts of earthquakes were widely acknowledged in planning documents, there was some attempt to address earthquake hazards through objectives, policies and methods, and earthquake hazards such as fault lines were located on planning maps. However, gaps still existed in terms of the existence of adequate and accurate information about earthquake hazards, and how this knowledge was dealt with in terms of planning practice (e.g. the accurate location of fault lines and how district plans dealt with the placement of buildings on or near these fault lines).



Since 2001, a number of drivers have caused a change in planning practice in the Wellington Region (Figure 5). External pressure exerted by the public and key organisations, coupled with research evidence on the lack of earthquake planning (Becker and Johnston, 2000, 2002) forced a re-think on how earthquake hazards were planned for at a land use level. Recommendations by the PCE to develop fault planning guidance (Parliamentary Commissioner for the Environment, 2001), led to the development of the Active Fault Guidelines (Kerr *et al.*, 2003). The external pressure and new guidance motivated a number of councils to improve their planning for earthquakes. Over the following 10 years, councils made a significant number of improvements to their plans including: commissioning expert investigations to clarify earthquake hazards (especially with regard to fault traces) and adding these to planning maps; creating clearer objectives and policies; developing improved rules and standards related to setback, subdivision and types of buildings allowed in fault zones; and requiring

geotechnical reports in earthquake hazard areas. Improvements to policy and planning have been slow (often requiring 'second generation' planning for District Plans to begin before changes have taken place), reflecting the fact that improvements take a long time to work through the planning process and that patience is required when seeking change.

Other influences have also had an impact on the planning process, the Canterbury earthquakes being a primary example of this. The Canterbury earthquakes have demonstrated the range of hazards associated with earthquakes (such as ground shaking, fault rupture, landslides, liquefaction, lateral spread and tsunami) that need to be planned for. This has led to a wider dialogue about how land use planning can contribute to reducing earthquake risk. From this dialogue has come the development of new guidance (i.e. liquefaction guidance (Saunders & Berryman, 2012)) and recommendations on how to improve the RMA by elevating natural hazard risk to a "matter of national importance" (TAG,



**Figure 5.** Changes in earthquake policy and planning in the Wellington Region, 2001-2011, and key drivers influencing that change. 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 mentioned: (Perrin and Wood, 2002; TAG 2012; Van Dissen and Heron, 2003). Relevant guidance mentioned: (Becker *et al.*, 2005, 2008; PCE, 2001; Kerr *et al.*, 2003; Saunders and Beban, 2011; Saunders and Berryman, 2012).

2012). The Canterbury earthquakes have also had an influence on building legislation and policy. While discussions in Wellington about the performance and upgrade of earthquake prone buildings have been going on for some time, the Canterbury earthquakes have heightened this debate and hastened action on building improvements.

Research has also contributed to improving policy. For example, research has helped us better understand the nature of earthquake hazards and how they can be applied in policy and practice; and research has enabled the development of new risk based planning guidance which can be used as a methodology to address earthquake-related and other natural hazards (Saunders & Beban, 2011, 2012a).

The range of influences on the evolution of earthquake policy and planning over the last 10 years illustrates that undertaking effective land use planning for earthquakes is not as simple as making a decision about what to do and then implementing that decision. Many factors have to be present for effective planning to take place including, external pressure for change (e.g. from organisations or the public), provision of appropriate advice (e.g. from earthquake research or the development of guidance), and expert input into the process (e.g. experts who understand the earthquake hazard, experts in devising planning solutions). Events such as the Canterbury earthquake sequence can drive pressure and willingness for change, but a key challenge is garnering such support in times of earthquake quiescence. Establishing conversations in the wider community about earthquake risk and how to deal with that risk is a good starting point for devising improvements to land use planning for earthquakes. These two improvements are outlined in further detail below.

## 5.2 Future improvements to policy and planning for earthquakes

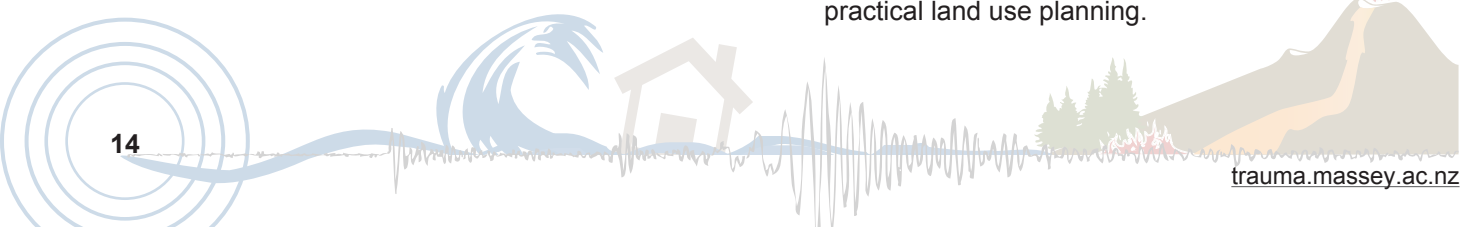
While an evolution of earthquake land use planning has occurred over time in the Wellington Region, and improvements have been made, further progress is required to ensure that the region becomes more resilient. Work is required to improve both the overarching structures that support land use planning (i.e. central government legislation and policy) and the planning practice that occurs at local government level (i.e. regional and district planning practice).

### 5.2.1 Improvements to central government legislation and policy

As identified in Figure 2, there are five key pieces of legislation which contribute to the management of natural hazards in New Zealand. This legislation provides New Zealand with a solid policy, legal, and institutional foundation to manage natural hazards (Glavovic, Saunders and Becker 2010). However, as demonstrated within Figure 2, there is the ability to improve the relationships between the various pieces of legislation to integrate these better and ensure effective natural hazard risk reduction is achieved. Currently, effective risk reduction is hampered by gaps, overlaps, redundant provisions, contradictions and perverse incentives. Once identified, these issues need to be addressed, and where appropriate, policies and laws need to be better aligned to facilitate a more holistic and cooperative government approach (Glavovic *et al* 2010). Recommended changes to natural hazard provisions of the RMA will, in some part, address these issues. Risk, recommended to be included in the RMA as a matter of national importance, will allow a consistent risk management approach to be taken across the legislation, particularly risk reduction which is required under the CDEM Act (Saunders & Beban, 2012b).

### 5.2.2 Improvements to regional and district policy and planning

The analysis of planning documents for the Wellington Region in 2001 and subsequent changes through to 2011 showed many improvements in planning for earthquakes over time. However, gaps still remain in planning practice. In particular, many of the objectives, policies and methods used in the Wellington Regional Policy Statement and district plans have tended to be focussed predominantly on the fault rupture hazard, with little attention paid to other earthquake-related hazards such as ground shaking, liquefaction, landslides, and lateral spread. Councils need to begin considering how these additional hazards can be factored into their land use planning within a risk-based approach. Given that the planning process can be drawn out, such actions need to begin now to ensure that provisions are included in plans for the future. A partnership approach between experts who understand the nature of these hazards (e.g. scientists, engineers, civil defence personnel) and planning staff is essential to ensure an accurate understanding of the effects of these hazards, and in developing ways of injecting this knowledge into practical land use planning.



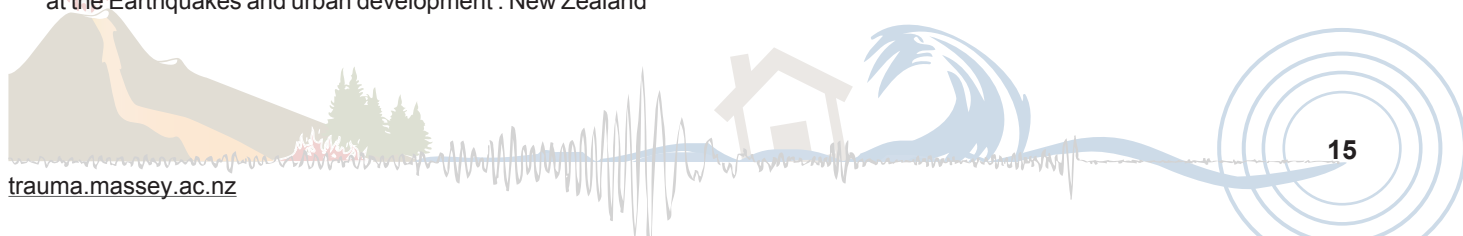
While integration of central government legislation and policy is important for effective functioning to reduce natural hazard risk, it is also important that integration occurs at a local government level. In particular, land use planning documents should be consistent and integrated with other council documents that deal with natural hazards. For example, provisions for dealing with earthquakes should be consistent between documents such as the Regional Policy Statement, District Plan, Annual Plan, Civil Defence Emergency Management Plan and local Structure Plan. Consistency can best be achieved by ensuring that regular conversations happen between different departments as relevant plans are being developed. If integration is achieved, there is an opportunity for effective risk reduction to be realised.

## 6.0 Acknowledgements

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