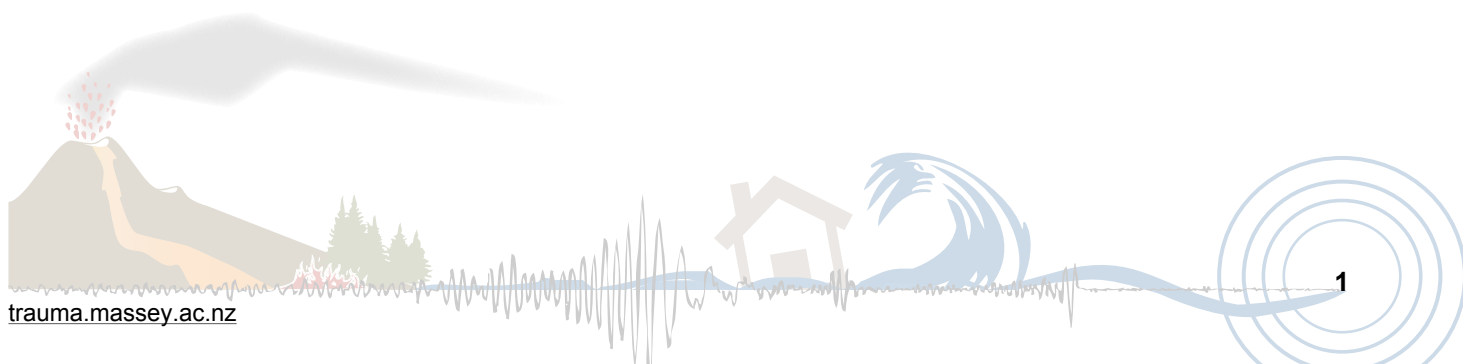
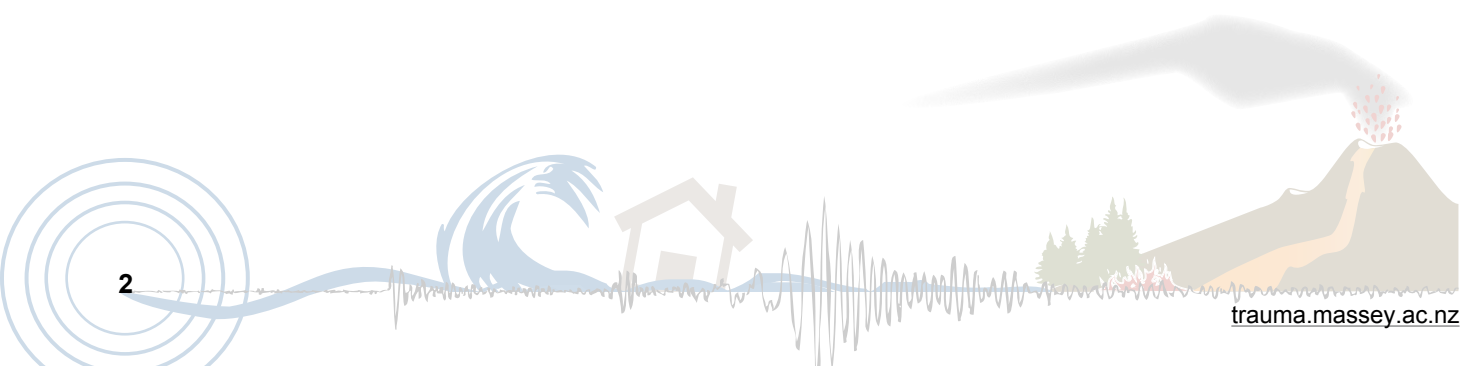


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# How the 2010 Canterbury (Darfield) earthquake affected earthquake risk perception: Comparing citizens inside and outside the earthquake region

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## Abstract

*This study examined changes in the judgments of the risk of earthquakes before and after the 2010 Darfield, Canterbury earthquake in three cities: Christchurch (Canterbury), Wellington and Palmerston North. Christchurch citizens were chosen because of their direct experience of the earthquake, whereas Wellington and Palmerston North were chosen because their citizens were likely to have different earthquake expectations. Whereas many citizens in Wellington have long expected an earthquake, this is less likely in Palmerston North. Palmerston North therefore provides a comparable sample to Christchurch before the Darfield earthquake. Participants judged the likelihood of an earthquake in different locations before and after the Darfield earthquake. Participants judged earthquake likelihoods for their own city, for the rest of New Zealand, and with participants in Wellington and Palmerston North, the likelihood of another major earthquake in*

*Canterbury. Christchurch participants also reported damage suffered in the earthquake. Expectations of an earthquake occurring in Canterbury were low before the Darfield earthquake in all three samples and rose significantly after that earthquake. Palmerston North expectancies of an earthquake in their own city also rose after the earthquake. In contrast, Wellingtonians' expectancies of an earthquake in Wellington were higher before the Darfield earthquake and did not rise after that earthquake. These findings clarify the effects of earthquakes and prior expectancies on risk judgments about earthquakes inside and outside the directly affected region.*

**Keywords:** earthquakes, Canterbury earthquakes, risk perception, perceived earthquake likelihood

## Introduction

For people to prepare for natural disasters such as earthquakes, they need to recognize the risk they are exposed to from the hazard. Thus it is important to understand what factors influence citizens' judgments of risk from these hazards. One factor is people's experience of those hazards, either directly or at a distance. When a natural disaster occurs, does it affect the risk judgments of those who live in the disaster region differently to people who live outside the region and are vulnerable to the same types of disaster?

Research has shown that judgments of the probability of negative events such as disasters are subject to a range of factors, including optimistic biases in people's judgments about different sorts of events, and people's personal experience of these events.

## Optimistic bias

Research on risk perception has shown that people often make biased appraisals about their own risk relative to others. Specifically, many people display an optimistic bias where they view themselves as less likely to be harmed by future risks than other citizens (e.g., Weinstein, 1980). This unrealistic optimism can lead people to underestimate the likelihood that they will experience a negative event, such as an illness or a car accident.

Several studies have demonstrated this optimistic bias in relation to natural disasters. Jackson (1981) found that the majority of respondents in cities that were prone to earthquakes believed they would not experience an earthquake, or that if they did, they would not suffer personal harm. Mileti and Darlington (1995) found that whereas 80% of respondents in an earthquake risk zone believed an earthquake would occur where they lived in the next five years, most judged that they would not suffer injuries or loss to their property. A similar optimism has been found in relation to hurricanes (Sattler, Kaiser, & Hittner, 2000), and volcanic eruptions (Johnston, Bebbington, Lai, Houghton, & Paton, 1999). Spittal, McClure, Siegert and Walkey (2005) asked New Zealand citizens not only about their own prospects in an earthquake, but also about the prospects of an acquaintance and an 'average other' person. Participants judged the likelihood of both personal harm and property damage across the three target persons. Consistent with previous research, respondents judged themselves to be less likely to suffer harm than an acquaintance. Interestingly, on the damage to property measure, they rated themselves *more* likely to experience damage than either an acquaintance or an 'average other', which suggests that financial loss is less susceptible to optimistic bias. These findings show that people tend to underestimate the likelihood that they will be personally harmed by natural disasters.

Optimistic bias may be compounded by citizens' beliefs about the different levels of risk that particular hazards pose in different regions. For example, in New Zealand, prior to the recent Canterbury earthquakes, citizens' estimates of the probability of an earthquake in Canterbury were likely to have been lower than for Wellington (Becker, 2010), which is widely known to be vulnerable to earthquakes. However, the objective risk of an earthquake in Christchurch was still serious, as has been borne out by recent events in 2010 and 2011 - two large earthquakes occurring in the region that caused huge damage and loss. Similarly, before the Kobe earthquake, the estimated probability of an earthquake in the Kobe region was significantly lower than for Tokyo (Nakashima & Chusilp, 2003). Yet it was Kobe that experienced the earthquake and its damaging consequences.

A key problem in citizens' risk judgment is that people in regions that are objectively deemed a lower risk than other regions appear to think that they are not at risk at

all – they think that the hazard will strike the higher risk region first. This pattern may be analogous to people's tendency to edit low frequency events as having zero probability (Slovic, Fischhoff, & Lichtenstein, 1982; Stone, Yates, & Parker, 1994). This inferential leap has been shown to be an inaccurate extrapolation from the risk probabilities in both Kobe and Christchurch, as well as many other examples. This line of reasoning can have disastrous consequences, because people think they do not need to prepare.

## The effect of experiencing a disaster

Personal experience of a natural disaster can reduce optimistic bias. Burger and Palmer (1992) showed that with students who experienced the 1989 Loma Prieta earthquake, optimistic bias about negative events was absent directly after the earthquake, but returned three months later. Following the 1994 Northridge earthquake, Helweg-Larsen (1999) similarly found a lack of optimistic bias in respondents; however, unlike Burger and Palmer's sample, optimistic bias in regard to earthquakes did not return five months later, when the respondents were surveyed again. This suggests that there was a longer reduction in optimistic bias as a result of the earthquake experience. This difference may reflect the fact that Burger and Palmer's items did not focus specifically on optimism about earthquakes.

Although experience of an earthquake does increase many citizens' judgments of risk, the outcome of a person's experience is also an important factor. Mileti and O'Brien (1992) found that in comparison with those who suffered loss, people who suffered no personal losses or injuries were more optimistic about possible consequences of a future earthquake and were less likely to take warnings of aftershocks seriously. Mileti and O'Brien claimed that these participants showed a 'normalization bias', in that when they experienced no negative impacts from the first event, they thought they would not be affected by subsequent impacts.

## The present article

The aforementioned studies examined the effect of personal experience on risk perception following a major earthquake in a single geographical area – usually the area that is vulnerable to or hit by an earthquake. To our knowledge, no studies have systematically compared the judgments of earthquake probability for people who have experienced an earthquake with the judgments

of others outside the region. Thus there is a gap in the understanding of the effects of personal experience on risk judgments for those inside and outside the affected area. Yet these effects are likely. For example, the Chernobyl disaster affected American citizens' perceptions of risks of nuclear energy (Reve, 2011), and the recent Japanese nuclear disaster triggered by a tsunami had similar effects on German citizens (Spiegel online, 2011).

The present study directly addresses this issue. The research was carried out shortly after the 2010 earthquake in September 2010 that occurred in Darfield, Canterbury, near Christchurch (magnitude 7.1 on the Richter scale). The study compared the judgments of participants in the city of Christchurch, New Zealand, the largest urban area affected by the earthquake, with those located in two other cities in New Zealand: Wellington and Palmerston North. The location of the two latter cities was distant from the earthquake and citizens in these two cities did not experience the earthquake first hand. Whereas many citizens in Wellington have long expected an earthquake, due to civil defence warning and commentaries in the mass media that focus specifically on Wellington (e.g., Aftershock, 2008), this is less likely in Palmerston North. The Palmerston North sample may therefore be comparable to Christchurch before the Darfield earthquake, where many citizens had not strongly expected an earthquake before the Darfield earthquake (Becker, 2010). Seismologists knew that there was a serious possibility that a major earthquake could occur in or near to the Christchurch region, and newer buildings had been built to earthquake building code standards.

Using a questionnaire format, participants judged their recall of earthquake likelihoods prior to the 2010 Darfield Canterbury earthquake and following the same earthquake. They made these judgments for their own city, for the rest of New Zealand, and in the case of participants in Wellington and Palmerston North, for Canterbury. The study assessed whether judgments of earthquake likelihood following the Canterbury earthquake differed across the three regions. We predicted: first, that for all three participant groups, expectancies of another earthquake in Canterbury would be higher following the Darfield earthquake than before the event; second, that the expectancies of another earthquake in Canterbury would be higher for Christchurch citizens than the other two groups; and third, that expectancies of the probability of a local

earthquake would rise in Palmerston North but not in Wellington. We made no predictions about an increase in judged likelihood of an earthquake in another part of New Zealand.

The study also assessed whether Wellington and Palmerston North participants who knew people in Christchurch judged the future earthquake risk higher than those who did not- an issue where there is little previous research. We also assessed whether participants who suffered damage in the earthquake perceived the future risk as higher than those who did not, as found by Mileti and O'Brien (1992).

## Method

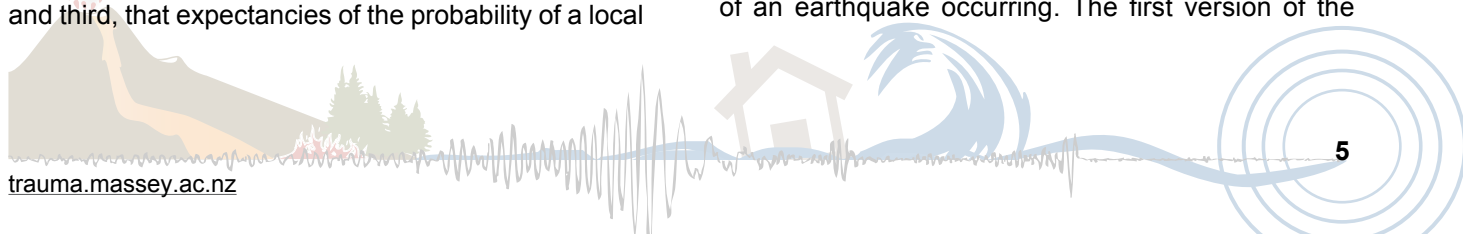
### Participants

The participants completing the questionnaire were 380 residents from three cities in New Zealand: Christchurch, Wellington and Palmerston North. For the Christchurch sample, to gain a sample of the general population, participants were recruited at a popular market in Riccarton, central Christchurch on a Sunday, five weeks after the Darfield earthquake. This sample consisted of 200 participants (gender: male = 49, female = 139, not stated = 12), with a median age of 41-50 years, and a mean of 0.76 children per household.

The Wellington sample consisted of 100 participants (male = 33, female = 48, not stated = 19), whose median age was 21-30, with a mean of 0.57 children per household. Data was again collected at the food market in downtown Wellington, and at lunchtimes in a popular urban park over three days, twelve weeks after the Darfield earthquake. For the Palmerston North sample, 80 participants were recruited (male = 35, female = 36, not stated = 9), with a median age of 41-50, and a mean of 0.63 children per household. In Palmerston North, researchers were denied permission to survey participants in most public spaces, and the sample comprised some passers-by on a major street ( $n = 20$ ), staff members from the Palmerston North City Library ( $n = 21$ ), and staff members from the Palmerston North City Council ( $n = 39$ ), thirteen weeks after the Darfield earthquake. In all three cities, participation was voluntary and anonymous, and a chocolate bar was offered in appreciation of their participation.

### Materials/Procedure

The questionnaires measured the perceived likelihood of an earthquake occurring. The first version of the



questionnaire was constructed for Christchurch, and took account of the fact that this sample had recently experienced a major earthquake. The second version of the questionnaire, designed for Wellington and Palmerston North, was adapted from the Christchurch questionnaire. Questions that were not appropriate for those cities, such as 'Did you incur a lot of damage in the earthquake?' were excluded, and additional questions such as 'Has the risk of an earthquake become more real or plausible to you since the Canterbury earthquake?' were added. The questions in the Wellington and Palmerston North version of the questionnaire were identical, except that in questions that specifically referred to the city where the participants lived, the name of the city was changed to that of the resident.

The Christchurch questionnaire had three earthquake likelihood items, two of which asked how likely participants thought it was that a big earthquake would occur in or near Christchurch *before* the Darfield Earthquake and *after* the Darfield earthquake. The third item assessed the likelihood of an earthquake happening in another part of New Zealand. In the Wellington / Palmerston North questionnaire, three further likelihood items were added. Two items elicited the perceived likelihood of an earthquake occurring in the participants' city (i.e., Wellington or Palmerston North), *before* and *after* the earthquake. A further item assessed recall of the likelihood that a serious earthquake would occur in another part of New Zealand *before* the Darfield earthquake. Responses were given on a 5 point Likert Scale, with endpoints labelled 'Not at all likely' and 'Very likely'. Related questions asked: 'Did you expect an event such as the Canterbury [i.e., Darfield] earthquake to happen in your lifetime?' 'No/not sure/yes'; and 'If you previously thought an earthquake in or near Christchurch was unlikely, why was that?' with a blank line for comments.

In addition to these earthquake likelihood items, the Christchurch survey asked: 'Did you incur a lot of damage in the earthquake?' (Yes/no) Because of the sensitive nature of the questionnaire, a question asked if answering the questions made the participant feel uncomfortable (or upset), to be answered with yes/a little/ not at all, followed by a blank space for comments. These questions were only appropriate for the Christchurch sample.

The Wellington and Palmerston North questionnaires also asked: 'Has the risk of an earthquake become more real or plausible to you since the Canterbury

earthquake?' and 'Did you know anyone close to you who lives in Christchurch?'; with Yes and No response options.

All versions of the questionnaire asked 'Before the earthquake, were you aware of any information about how to prepare for a possible earthquake in [Participant's city]?' The response options were: Yes, not sure, no. 'If you were aware of this information, and did you regard it as relevant to you?' The response options were: Yes, some relevance, no. A question asked if there were any other comments participants would like to make, followed by optional questions about demographic information: gender, age, number of dependent children in the household, and for Wellington and Palmerston North, their suburb. Other questions dealing with preparation are reported elsewhere.

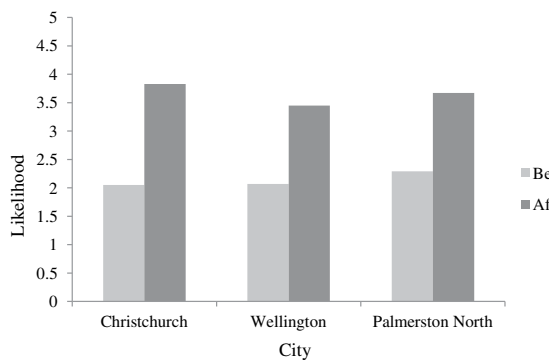
## Results

### Judged likelihood of an earthquake before and after the earthquake

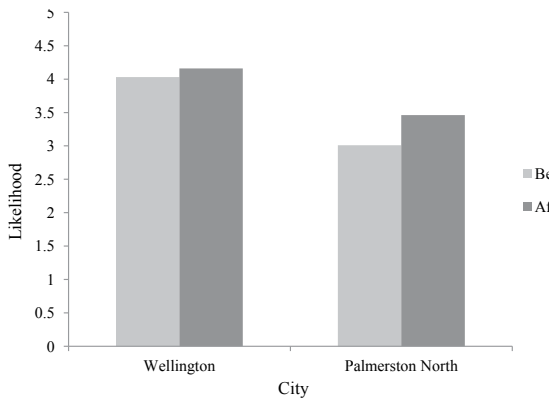
Figure 1 shows the data for expectancy of an earthquake in occurring in or near Christchurch. These data were analysed with a 3 (Participant City: Christchurch, Wellington, Palmerston North) x 2 (Time: before, after the earthquake) mixed design analysis. This showed a main effect for Time,  $F(1, 375) = 334.29, p < .001, \eta^2 = .47$ , in that participants' expectancies of an earthquake near Christchurch were higher after the Darfield earthquake ( $M = 3.61$ ) than before the earthquake ( $M = 2.13$ ). There was also a significant interaction between City and Time,  $F(2, 375) = 4.64, p < .01, \eta^2 = .02$ , so separate analyses were preferred for each time. In recall of their expectancy of an earthquake around Christchurch before the Darfield earthquake, participants from the three cities did not differ,  $F(2, 375) = 1.22, ns$ , whereas after the earthquake, they did differ,  $F(2, 375) = 4.88, p < .01, \eta^2 = .02$ , with Christchurch participants ( $M = 3.83, SD = 1.12$ ) rating the likelihood of a future earthquake near Christchurch higher than participants from Wellington ( $M = 3.45, SD = 0.98$ ) and Palmerston North ( $M = 3.67, SD = 0.99$ ).

Figure 2 shows the data for expectancy of an earthquake in the participant's own city. These data were analysed by a 3 (Participant City: Christchurch, Wellington, Palmerston North) x 2 (Time: before, after the earthquake) mixed design analysis. There were main effects for Time,  $F(1, 375) = 122.88, p < .001, \eta^2 = .25$ , and City,  $F(2, 375) = 50.86, p < .001, \eta^2 = .25$ . These

main effects were qualified by an interaction between City and Time,  $F(2, 375) = 66.42, p < .01, \eta^2 = .26$ . Both Palmerston North and Christchurch participants rated a future earthquake in their own region more likely after the earthquake, ( $M = 3.46, SD = 0.99; M = 3.83, SD = 1.12$ , respectively), than before the earthquake, ( $M = 3.01, SD = 1.11; M = 2.05, SD = 1.36$ ), whereas Wellington participants rated a future earthquake in Wellington equally likely after ( $M = 4.16, SD = 0.83$ ) and before the earthquake ( $M = 4.03, SD = 1.01$ ).



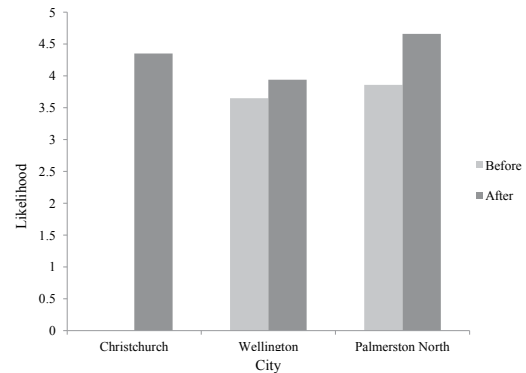
**Figure 1.** The perceived likelihood of an earthquake occurring in or near Christchurch before and after the Canterbury Earthquake. (1= not at all likely, 5 = very likely)



**Figure 2.** The perceived likelihood of an earthquake in participants' own city before and after the Canterbury Earthquake in Wellington and Palmerston North. (1= not at all likely, 5 = very likely)

Figure 3 shows the data for expectancy of an earthquake in another part of New Zealand. These data were analysed with a 2 (Participant City: Wellington, Palmerston North) x 2 (Time: before, after the earthquake) mixed design analysis. This showed a main effect for Time,  $F(1, 178) = 5.47, p < .02, \eta^2 = .03$ , in that this expectancy was higher after the Darfield earthquake ( $M = 4.30$ ) than before the earthquake ( $M = 3.76$ ). A marginal main effect for City,  $F(1, 178) = 3.55, p < .06, \eta^2 = .02$ , showed that Palmerston North participants judged

an earthquake in another part of New Zealand more likely ( $M = 4.26$ ) than Wellington participants ( $M = 3.79$ ). There was no interaction between City and Time. A 3 (Participant City: Christchurch, Wellington, Palmerston North) between subjects ANOVA on expectancy of an earthquake in another part of New Zealand after the Darfield earthquake showed no difference between Christchurch and the other two cities,  $F(2, 376) = 2.53, ns$ .



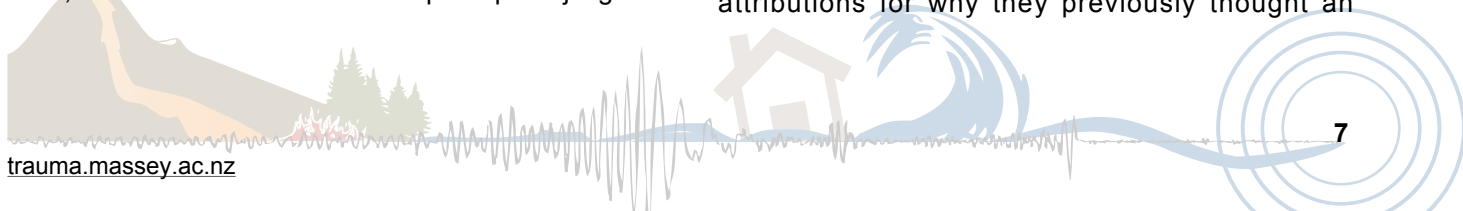
**Figure 3.** The perceived likelihood of an earthquake in another part of New Zealand before and after the Canterbury Earthquake. Note: The 'before' question was not given to Christchurch participants. (1= not at all likely, 5 = very likely)

**Lifetime Expectancy and reality of risk**

On the question of whether participants thought before the Darfield earthquake that an event such as the Darfield earthquake would occur in their lifetime, there was a significant association between participant city and expectancy,  $\chi^2(4) = 59.34, p < .001$ . Over half of people in Wellington (56%) and Palmerston North (59%) believed such an event would happen in their lifetime, whereas the percentage was much lower for Christchurch (22%) (See Table 1). This shows that the City variable has a moderate relationship ( $V = .28$ ) with lifetime expectancy of a disaster. The proportion of participants who felt that the risk of an earthquake had become more real or plausible since the Darfield Earthquake did not differ significantly by city (Wellington and Palmerston North),  $\chi^2(2) = 2.07, p = .36$ . The majority of participants in both cities, Wellington (74%) and Palmerston North (74%), indicated that the risk had become more real for them (See Table 1)..

**Attributions for risk judgments about an earthquake near Christchurch**

Two researchers established inter-response reliability for the open-ended question eliciting participants' attributions for why they previously thought an



earthquake in Christchurch was unlikely. One researcher examined all responses to find emerging themes, and developed categories and subcategories that reflected those themes. All responses were then allocated to one or more subcategories. If a participant’s response matched more than one category (for example when a participant said that they gained information about a possible earthquake from television and mailers), all relevant categories were coded. All categories contained two or more items, and responses that did not fit were coded as ‘other’.

**Table 1.** Whether respondents expected an event such as the Canterbury Earthquake in their lifetime, and whether the risk of an earthquake had since become more real/ plausible. Data in percentages

	Yes	No	Not sure
<b>Expect in your lifetime?</b>			
Christchurch	22	60	17
Wellington	56	27	17
Palmerston North	59	20	27
<b>Risk is more real/ plausible?</b>			
Wellington	74	21	5
Palmerston North	74	16	10

Once this stage was completed, the second researcher checked the categorisation of all responses. If there was disagreement on individual items, the re-categorisation of these items was discussed with the first coder. At this point, new categories were developed between the two researchers and existing categories were also renamed or combined. The purpose of this process was that the researchers agreed on the categories as well as the allocation of all answers to these categories.

The outcome was shown to a third researcher, who suggested final changes to the categorisation. The results are shown in Table 2. The most common attributions were: they did not know that Christchurch was near a fault-line; they thought an earthquake in Canterbury was unlikely and that the next major earthquake was going to happen elsewhere; and there had been no major earthquakes near a populated area in recent New Zealand history (See Table 2).

**Earthquake Information:**

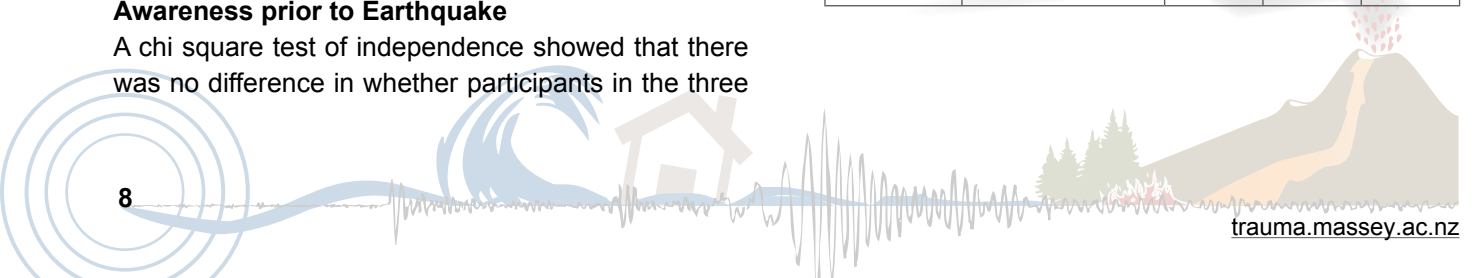
**Awareness prior to Earthquake**

A chi square test of independence showed that there was no difference in whether participants in the three

cities were aware of information about earthquakes, before the Darfield earthquake,  $\chi^2 (4) = 6.81, p = .15$ . There was, however, a significant difference in whether participants perceived this information to be relevant to them,  $\chi^2 (4) = 17.72, p < .005$ . Wellington (68%) and Palmerston North (66%) participants saw this information as more relevant to them than Christchurch (51%) participants. This suggests that although participants from all cities were equally conscious of information about earthquake preparedness, people in Christchurch viewed it as less relevant to them personally. ( $V = .159$ )

**Table 2.** Attributions for why participants thought an earthquake in Canterbury was unlikely (Percentages). Note: Wgtn = Wellington; ChCh = Christchurch; P North = Palmerston North

<i>If you previously thought an earthquake in or near Christchurch was unlikely, why was that?</i>				
Category	Sub-category	Chch	Wgtn	P. North
<i>Earthquake Expectancy</i>	Unlikely/Not going to Happen	11.5	1.0	2.5
	Happen elsewhere	5.5	0.0	2.5
	Wellington/North Island a bigger risk	6.5	12.0	5.0
	Flat/Stable land	4.0	0.0	1.3
	ChCh is Safe/Not earthquake prone	4.5	0.0	5.0
<i>Past Experience</i>	No personal earthquake experience	4.0	2.0	1.3
	None in recent NZ history	13.5	7.0	8.8
	Hadn't thought about it	7.5	9.0	8.8
<i>Personality Trait</i>	Complacency	1.5	0.0	0.0
<i>Lack of Knowledge/ Information</i>	No media reports/ not told about it	4.0	3.0	1.3
	Didn't know about faultline near ChCh/ thought ChCh not near/ on faultline e.g. alpine	25.5	31.0	21.3
<i>Other</i>	Because happened in Napier already	0.0	0.0	3.8
	I thought earthquake WAS likely	3.0	1.0	3.8
	Other	5.5	1.0	5.0





**Did citizens who incurred damage see the risk differently?**

The proportion of Christchurch citizens who incurred damage is shown in Table 3. A one way ANOVA showed that those who incurred damage saw the risk of another earthquake in Canterbury as only marginally higher than those who did not,  $F(1, 185) = 3.04, p < .08, \eta^2 = .016$ .

**Table 3:** The percentage of respondents who incurred damage from the earthquake in Christchurch, and those that knew someone close to them living in Christchurch. (Percentages)

	Yes	No
<b>Incurred Damage</b>		
Christchurch	34.0	65.0
Wellington	-	-
Palmerston North	-	-
<b>Knew someone close in Christchurch?</b>		
Christchurch	-	-
Wellington	51.5	48.5
Palmerston North	57.5	42.5

**The effect of knowing persons in Christchurch**

The proportion of participants who knew someone close in Christchurch was 51.5% in Wellington and 57.5% in Palmerston North. A chi square test found no difference in these proportions in Wellington and Palmerston North,  $\chi^2(1) = 0.60, p = .44$ . A one way ANOVA showed that those who knew people in Christchurch saw the risk of another earthquake in Canterbury as higher ( $M = 3.64$ ) than those who did not ( $M = 3.33$ ),  $F(1, 167) = 3.80, p < .05, \eta^2 = .022$ , but did not see the risk of another earthquake in their own city as higher than those who did not know anybody in Christchurch,  $F(1, 167) = 0.67, ns$ .

**Discussion**

**Perceived likelihood of an earthquake**

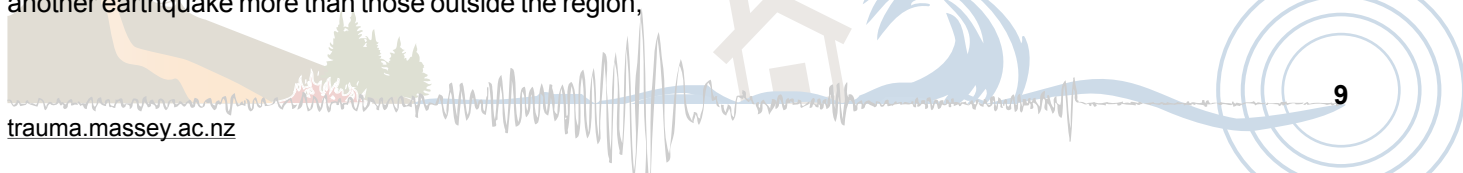
There are several interesting findings in changes in perceived earthquake likelihood after the Darfield earthquake inside and outside the affected region. As predicted, judgments of the likelihood of a further earthquake in Canterbury were low before the earthquake and rose significantly after the earthquake. This increase in the perceived likelihood of an earthquake was higher in the affected city (Christchurch) than in other cities, suggesting that direct experience of the earthquake affected local citizens' expectancy of another earthquake more than those outside the region,

suggesting that identification with an affected group may influence judgments of risk.

In judgments of the likelihood of a further earthquake in their own city, there were interesting differences across the three cities. Whereas both Palmerston North and Christchurch citizens rate the likelihood of an earthquake in their own city higher after the Darfield earthquake, Wellington citizens did not. However, the baseline level of judged earthquake likelihood for Wellingtonians was high before the earthquake. This result suggests that these risk judgments depend not only on experience of an earthquake but the effect of communications about earthquake risk. Wellingtonians have been told frequently by both civic agencies and the news media that an earthquake is likely in their city, but this has not been the case for citizens of Palmerston North and Christchurch. The findings suggest the importance of civic agencies communicating risk not only to citizens in cities thought to be at highest risk but also citizens in cities thought to have a lower (but still significant) probability of an earthquake. As in the case of this event and the Kobe earthquake, earthquakes do not always happen in the zone that is seen as the most vulnerable.

The analyses on expectancies of an earthquake in another part of New Zealand show that for Wellington and Palmerston North citizens, these expectancies changed after the earthquake. The message for citizens from this earthquake is that earthquakes happen not only in known vulnerable cities like Wellington; they may happen elsewhere in New Zealand. This recognition of the risk may not be sufficient on its own to motivate citizens to undertake preparedness activities, but it is one likely prerequisite of this preparation. Consistent with this interpretation, the data show that the Christchurch citizens were aware of the civil defence messages about preparedness but thought that these messages applied to others, not themselves. This is a vivid illustration of the optimism bias.

Other findings showed that Christchurch participants who suffered loss in the earthquake saw the probability of another earthquake in the region as only marginally higher than those who did not suffer loss, a finding that contrasts with that of Mileti and O'Brien (2002). Interestingly, citizens living outside Christchurch who had acquaintances in Christchurch judged the likelihood of another earthquake in the Canterbury region higher than those who had no acquaintances there, but did not judge an earthquake in their own region as more likely. This is a novel finding



A possible limitation in these findings is that the judgments of earthquake risk before the Darfield earthquake were recalled judgments that could be subject to memory biases. In particular, people may revise their recall judgments in line with current expectancies in a form of the hindsight bias. However, other data suggest that these judgments were consistent with risk judgments for the region collected before the Darfield earthquake (Becker, 2010). In addition revising recalled judgements in line with current judgments would diminish rather than augment the difference between the before and after judgments of earthquake likelihood shown here.

Previous research has shown that communications about damage from earthquakes and other hazards can reduce or increase people's fatalism about earthquakes and their belief in the value of preparations (e.g., Cowan, McClure, & Wilson, 2002; McClure, Sutton, & Sibley, 2007; Spittal, Siegert, McClure, & Walkey, 2002). The way messages are framed influences people's attributions about the cause of events (McClure & Hilton, 1998; McClure, White, & Sibley, 2009), and these attributions in turn affect people's perception that the causes can be prevented. Unrealistic optimism can be countered by messages that communicate that people in similar circumstances have taken steps to prepare for a hazard (Weinstein 1980). A key implication of the present findings about risk judgments is the need to get people to understand that even if they are objectively at a lower risk than others in terms of probabilities, they should *not* use this comparison as a basis for their risk judgments. Instead, they should base their actions on the actual level of risk in their own region, even if that risk is judged lower in probabilistic terms than other regions. Even when the probabilities are low, the consequences when an earthquake does occur can be devastating.

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# Sleeplessness, Stress, Cognitive Disruption and Academic Performance Following the September 4, 2010, Christchurch Earthquake

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## Abstract

*Two studies investigated psychological effects of the September 4, 2010 Christchurch earthquake. Study 1 found self-reported sleeplessness, cognitive dysfunction, and heightened stress, depression and anxiety in members of the general public who had experienced the earthquake and aftershocks, but many also reported positive experiences. The self-reported effects were much stronger for women than men. Those scoring higher on neuroticism were worse affected, but otherwise effects varied little with personality. Study 2 examined academic performance by over 9000 University of Canterbury undergraduate students in the second semester (July-October) of 2010 and found no performance decrement for either men or women.*

**Keywords:** disaster, earthquake, mental health, cognitive disruption, academic performance

## Introduction

The city of Christchurch, New Zealand and the adjacent Canterbury region has a population of about 500,000. At 4.35 a.m. on September 4, 2010, the city and

region were struck by a 7.1 magnitude earthquake. Remarkably, no one was killed and only a handful of people injured, but there was major property and infrastructure damage. In the following weeks and months, there were numerous aftershocks with over 100 quakes of at least magnitude 2.0 on September 4 alone. By September 30, over 1800 had been recorded, and by October 31 over 2400. Depending on strength, depth, and position, some of these were widely felt and caused further damage (Quigley, Villamor, Furlong, Bevan, Van Dissen, Litchfield, Stahl., Duffy, Bilderback, Noble, Barrell, Jongens, & Cox, 2010). In this paper we examine some psychological effects on people who experienced the earthquake and its aftermath. The first instrument we used was a questionnaire survey, and the vast majority of responses to it were collected in the week 23 to 30 September.

That natural disasters in general, and earthquakes in particular, have detrimental effects on psychological functioning is well-known (Bergiannaki, Psarros, Varsou, Paparrigopoulos, & Soldatos, 2003; Cardena & Spiegel, 1993; Neria, Nandi, & Galea, 2008; Sahin, Batigün, & Yilmaz, 2007). Most studied has probably been the incidence and severity of post-traumatic stress disorder (Neria et al., 2008), but there have also been studies of more immediate or short-term effects. For example, Bergiannaki et al. (2003) examined acute and post-acute stress from 48 hours after an earthquake in the Greek town of Egion.

The present study had a different focus to most previous research. We concentrated on a range of less serious and more short-term complaints than post-traumatic stress disorder. Thus, we investigated not only depression, anxiety and stress effects but also reports of cognitive impairment and sleeplessness. Indeed, our second study focussed on cognitive effects, specifically in academic performance. One reason for looking at the effects on cognition and sleep is that these may have consequences for such activities as driving performance (Su, Tran, Wirtz, Langteau, & Rothman, 2009).

When a natural disaster such as an earthquake strikes, not all members of the community are equally affected, either physically or psychologically. Do people of

particular personality types or people whose homes were more damaged suffer more (e.g. Kendler, Kuhn, & Prescott, 2004)? Is there a difference between the reactions of men and women (as reported by Potangaroa, 2006; Potangaroa, Wang, and Chan, 2010)?

The Depression Anxiety Stress Scales (DASS) provide useful brief measures of depression, anxiety, and stress (e.g. Potangaroa *et al.*, 2010). The three scales are separate but correlated, with intercorrelations ranging from .54 to .65, and have good psychometric properties (Lovibond & Lovibond, 1995a, b). A 21-item version of the scales (7 items per scale), the DASS21, produces comparable results to the longer (42 item) version (Henry & Crawford, 2005; Lovibond & Lovibond, 1995a, b; Ng, Trauer, Dodd, Callaly, Campbell, & Berk, 2007).

Immediately following the Christchurch earthquake people often reported not thinking clearly. We included a simple five-item self-report measure of cognitive disruption. Validation for this ad hoc measure comes from another post-earthquake study by Helton, Head and Kemp (2011), which found that variability on two Sustained Attention to Response Tasks (e.g. Chan, 2001) was well predicted ( $\beta = .78$ ) by performance on this cognitive disruption measure.

Many people reported losing sleep for weeks after the major event. The most obvious cause was the frequent aftershocks, although psychological disturbance might also play a role. We introduced two measures. One directly asked people how many hours of sleep they had per night. The other was a three-item scale of sleep disturbance.

Finally, many people received help from others, friends and family phoned or emailed to express sympathy and concern, and communities in New Zealand and overseas sent sympathetic messages and material aid. We attempted to measure whether people also had positive experiences of the earthquake

## Study 1

### Method

**Questionnaire.** The questionnaire asked about people's experiences following the September 4 Christchurch earthquake. Further information about uses of the data and organisations to contact for help were given on the introductory page and in a separate information sheet.

At the beginning of p. 2, respondents were asked to read and indicate how much each of a series of 33 statements "applied to you over the whole period since September 4". These statements consisted of the 21 statements included in the DASS-21 scale, with 7 each from scales measuring depression (e.g. "I couldn't seem to experience any positive feelings at all"), anxiety (e.g. "I was aware of dryness of my mouth"), and stress (e.g. "I tended to overreact to situations"). Statements from the DASS were haphazardly ordered, and interspersed with 12 other statements measuring sleep disruption, cognitive disruption, and mostly positive statements about reactions to the earthquake.

The three sleep disruption questions were: "I was often woken up from sleep"; "I found it difficult to sleep through the night"; and "I was tired during the day". Five statements related to respondents' perceptions of their own cognitive disruption: "I found it difficult to remember things"; "I felt it was very difficult to make decisions"; "I felt my brain was working more slowly than usual"; "I thought about the earthquake a lot"; and "I was frustrated by not being able to think clearly". The four positive statements were included partly to lighten the tone of the questionnaire for the respondents, and partly to see if there were positive aspects to the experience. They were: "I found my local community and neighbours helpful"; "I was cheered up by sympathy from people outside the city"; "I felt official New Zealand helped ordinary people"; and "I talked to other people about my experiences". (Note that the latter is not necessarily a positive experience, although we expected most people to find it helpful.)

All these statements were responded to on the four-point scale normally used with the DASS-21. This scale is: (0) Did not apply to me at all; (1) Applied to me to some degree, or some of the time; (2) Applied to me to a considerable degree, or a good part of the time; (3) Applied to me very much, or most of the time.

The following page presented brief measures of the Big Five personality traits. There were two word or phrase pairs for extraversion (extraverted, enthusiastic and reserved, quiet); agreeableness (sympathetic, warm and critical, quarrelsome); conscientiousness (dependable, self-disciplined and disorganised, careless); neuroticism (anxious, easily upset and calm, emotionally stable); and openness (open to new experiences, complex and conventional, uncreative). For all these traits, the second pair was reverse-scored. Each pair was followed by a seven-point scale from 1

(disagree strongly that these words or phrases apply to you) to 7 (agree strongly that these words or phrases apply to you). Respondents were asked to consider each pair as “a description of what you are **normally** like”, and to “rate the extent to which each pair of words applies to you, even if one word or phrase applies more strongly than the other”.

The personality measures were followed by requests for mostly factual information, namely whether the respondent was in Christchurch or the greater area on September 4, whether they owned a house or flat and what condition their accommodation was now in (uninhabitable; it's badly damaged but I can live in it; some but no really major damage; no apparent damage of any kind). They were asked to estimate how many hours sleep they had had on average since the earthquake, and whether they had contacted a welfare centre/emergency services/or official agency for help; helped someone else; seen a doctor or counsellor about your response to the earthquake; taken sleeping pills; considered moving to another city or country; considered moving to another part of town; and stocked up with a lot of groceries. The questionnaire concluded with gender and age group questions, detail about where they were at the time of the earthquake and the date of questionnaire completion. A slightly shortened version of the questionnaire that omitted some requests for factual information was used for most of the non-Christchurch respondents.

**Respondents and procedure.** A total of 299 people completed questionnaires. Two hundred and two of them were recruited by paid psychology graduates at the University of Canterbury, all of whom were asked to recruit non-student members of their acquaintance. Thirty-two respondents were themselves psychology students. Recruitment of these 234 respondents focussed on respondents who had experienced the earthquake and aftershocks although a few other respondents were obtained. A further 34 respondents were then recruited by again asking paid graduates to find respondents who had not experienced the earthquake or aftershocks. The final 31 respondents were obtained from an online version of the questionnaire which was made available both locally and outside of Christchurch.

The total sample contained 240 people who were in Christchurch on September 4 and for most of the following periods. Of this sample, 219 completed their questionnaires in the period 23-30 September, 17 between 1 and 6 October, and the remaining 4 later in

October, the latest on 27 October. Thus, most of the earthquake sample responded between 19 and 26 days after the main earthquake. The 59 respondents who did not experience the earthquake were mostly recruited in October, the latest on 17 October.

Overall, the sample contained 143 males and 153 females (no information for 3 respondents). Thirty-four percent were between the ages of 15 and 24; 28% between 25 and 24; 11% between 35 and 44; 13% between 45 and 54; 9 % between 55 and 64; and 4% were 65 or over. One hundred and thirty-eight owned a house or a flat in Christchurch. No respondent reported that their house in Christchurch was uninhabitable following the earthquake; 7 that their house was badly damaged but liveable; 97 reported some damage; and 132 no apparent damage.

## Results

The DASS-21 scales all proved to have good internal consistency reliability (Depression, Cronbach  $\alpha = .80$ ; Anxiety,  $\alpha = .85$ ; Stress,  $\alpha = .89$ ). The three sleep disruption items ( $\alpha = .89$ ) and the five cognitive dysfunction items ( $\alpha = .84$ ) also had high internal consistency. The four positive experience items had lower although still respectable reliability ( $\alpha = .72$ ). Inspection of the item-total correlations indicated that this reliability would not be improved by omitting any of the four items so they were all retained. The measures of sleep disruption, cognitive disruption and positive experience were composed by averaging the relevant items (producing possible scores between 0 and 3). DASS scale measures were composed by adding the relevant seven items and then multiplying by two. This is a standard procedure as it enables comparison with both previous DASS results and the full 42-item DASS scale (e.g. Henry & Crawford, 2005).

The three DASS scales, the sleep disturbance measure and the cognitive disruption scale correlated quite highly with one another, with Pearson correlations ranging from .61 (sleep disturbance and anxiety) to .83 (anxiety and cognitive disruption).

Table 1 shows comparisons on each of the scales between the earthquake and the non-Christchurch samples. Also shown are the average number of hours sleep per night reported by the samples, a measure which correlated moderately well with rated sleep disruption ( $r = .48$ ,  $p < .05$ ). In order to enable some comparison between the different measures employed,

and especially to investigate which of the measures were most affected by the earthquake, we also include a standardised measure (*d*) of the difference between the samples.

**Table 1.** Rated sleeplessness, cognitive dysfunction, positive experiences, reported average hours of sleep, and DASS depression, anxiety, and stress scores for those who did (*n* = 240) and did not (*n* = 59) experience the earthquake and aftermath.

Measure	Earthquake sample	non-Christchurch	<i>d</i>
Sleep disruption	1.57 (0.97)	0.47 (0.77)***	1.06
Positive experiences	1.44 (0.69)	0.64 (0.62)***	1.18
Average Stress	11.7 (9.6)	5.0 (8.0)***	.73
Cognitive disruption	0.84 (0.68)	0.39 (0.52)***	.69
Average Depression	5.8 (6.3)	2.4 (4.6)***	.57
Average Anxiety	6.4 (8.1)	2.9 (5.3)**	.46
Average hours sleep	6.7 (1.5)	7.1 (1.0)*	.30

Results of two-tailed t-test shown:

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .

*d* is a standardized measure of difference between the samples (equal to the difference in sample means divided by the overall sample deviation)

The results are straightforward to interpret. Those who experienced the earthquake and its aftershocks reported a substantial increase in sleep disruption and related problems. They also reported positive experiences (although note that the control, non-earthquake sample had little opportunity to have these particular experiences). There were also significant effects of the earthquake on stress, depression, anxiety, and cognitive disruption. However, the average member of the earthquake sample recorded levels of depression, stress, and anxiety that remained (just) within the DASS normal range (Lovibond & Lovibond, 1995a). A number of analyses focussed only on respondents who were in Christchurch for the earthquake and its aftermath. Measures of the five personality traits were constructed and correlations between them and the seven earthquake effects measures calculated. Neither openness nor extraversion correlated with any of the measures. More agreeable people reported slightly more sleep disruption ( $r = .16$ ,  $p < .05$ ) but also more positive experiences ( $r = .21$ ,  $p < .05$ ). More conscientious people also reported more positive experiences ( $r = .16$ ,  $p < .05$ ). Those scoring higher on neuroticism had more sleep disruption ( $r = .28$ ,  $p < .05$ ), more cognitive disruption ( $r = .35$ ,  $p < .05$ ), and more depression ( $r = .36$ ,  $p < .05$ ), anxiety ( $r = .35$ ,  $p <$

$.05$ ) and stress ( $r = .36$ ,  $p < .05$ ). Older people reported sleeping fewer hours ( $r = -.26$ ,  $p < .05$ ).

Women reported substantially more serious effects than men. Table 2 shows comparisons for the seven measures for just those who had been in Christchurch for the earthquake. The differences seem earthquake related: The non-Christchurch group showed no significant gender differences on any measure, and when two-way analyses of variance were conducted using gender and being present for the earthquake or not as factors, all measures except for positive experiences showed significant ( $p < .05$ ) interactive effects. Compared to DASS norms (Lovibond & Lovibond, 1995a), the average male scores were all well within the normal range; the average woman produced normal depression scores but moderate anxiety and mild stress.

**Table 2.** Rated sleeplessness, cognitive dysfunction, positive experiences, reported average hours of sleep, and DASS depression, anxiety, and stress scores for men (*n* = 118) and women (*n* = 119) who experienced the earthquake and aftermath.

Measure	Men	Women	<i>d</i>
Average Stress	6.9 (7.0)	16.6 (9.3)***	1.17
Cognitive disruption	0.51 (0.48)	1.16 (0.69)***	1.10
Sleep disruption	1.12 (.89)	2.01 (0.82)***	1.03
Average Anxiety	3.0 (5.0)	10.0 (9.1)***	.95
Average Depression	3.2 (4.8)	8.4 (6.5)***	.91
Average hours sleep	7.2 (1.3)	6.3 (1.5)***	.60
Positive experiences	1.28 (0.70)	1.60 (0.64)***	.48

Results of two-tailed t-test shown:

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .

*d* is a standardized measure of difference between the samples (equal to the difference in sample means divided by the overall sample deviation)

Table 3 shows differences in the six measures between those whose homes received either serious or some damage (pooled because only 7 respondents lived in homes with serious damage) and those whose homes had received no damage. In general, those with some damage were worse affected. With the Table 2 results in mind, we also investigated interactive effects of gender and damage on each of the seven measures. Significant interactive effects were found for cognitive disruption, depression and stress. Men's scores showed little effect of damage to the home on these three measures, whereas women's scores were increased. However, women's scores were higher than men's even for those in undamaged homes.

**Table 3.** Rated sleeplessness, cognitive dysfunction, positive experiences, reported average hours of sleep, and DASS depression, anxiety, and stress scores for those who reported some or severe damage (n = 104) or no damage (n = 132) to their homes from the earthquake or aftershocks.

Measure	Damage	No damage	<i>d</i>
Cognitive disruption	0.99 (0.74)	0.72 (0.60)**	.40
Positive experiences	1.55 (0.69)	1.34 (0.68)*	.30
Average Stress	13.3 (10.2)	10.6 (9.0)*	.28
Average Depression	6.6 (6.9)	5.2 (5.7)	.22
Average Anxiety	7.4 (8.5)	5.7 (7.7)	.21
Average hours sleep	6.8 (1.4)	6.6 (1.5)	.13
Sleep disruption	1.62 (0.96)	1.53 (0.97)	.09

Results of two-tailed t-test shown:

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .

*d* is a standardized measure of difference between the samples (equal to the difference in sample means divided by the overall sample deviation)

The relationships shown in Tables 1, 2 and 3 were also investigated in a series of analyses of covariance using the five personality measures as covariates. When this was done, the difference in positive experiences between men and women (see Table 2) achieved significance at only the  $p < .01$  (instead of .001) level of significance. The difference in positive experiences and the difference in stress between those who had or had not suffered damage now failed to achieve significance (instead of the .05 level of significance). For all eighteen other differences examined the level of statistical significance (or not) was unchanged under analysis of covariance. In no case, including those where the level of significance was changed did inspection of the corrected means suggest major changes from those obtained with the simple *t*-test analyses. Thus, effects of experiencing the earthquake, gender or damage sustained to one's home could mostly not be subsumed under personality differences.

The most frequently reported reaction to the earthquake and its aftermath was helping others (62 % of the earthquake sample). Next most frequent was stocking up on groceries (33%), followed by taking sleeping pills (18 %), contacting a welfare centre, emergency services or official agency for help (12 %), considering moving to another city or country (12 %), considering moving to another part of Christchurch (9 %), and seeing a doctor or counsellor (5 %). Taking any of the steps (including helping others) were associated with higher levels of sleep and cognitive disruption, lower average numbers

of hours slept, higher scores on all three DASS scales, but also a higher incidence of positive experiences.

## Study 2

Study 1 indicated that the earthquake had produced substantial cognitive disruption, especially in women. An obvious issue arises as to whether the gender effect reflects differences in readiness to self-report or differences in actual cognitive disruption. Linked to this is the issue of whether reported cognitive disruption relates to actual cognitive performance, and, if so, which aspects of cognitive performance. As remarked earlier, Helton *et al.* (2011) found a strong relationship between performance on the cognitive disruption scale and performance on a vigilance task, but it is not clear that real-world thinking or performance would necessarily be affected. Previous research has often found that sleep deprivation has a substantial effect on vigilance but not on other cognitive performance (Altena, van der Werf, Strijers, & van Someren, 2008).

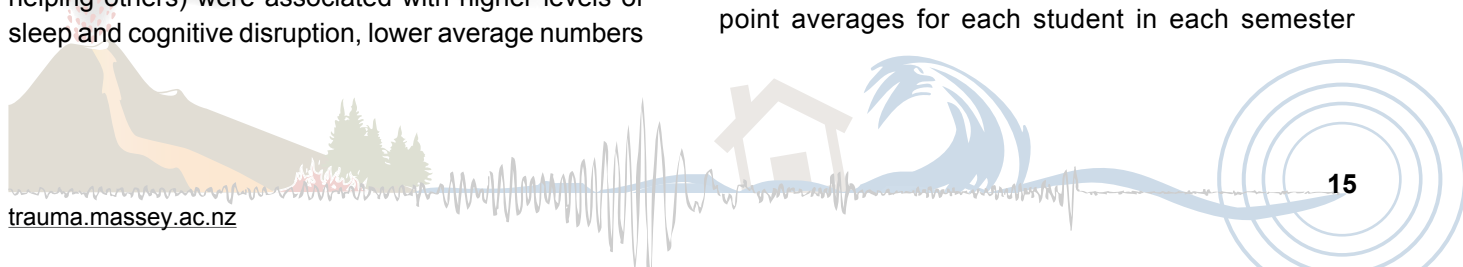
In Study 2 we looked at the academic performance of undergraduates enrolled in the University of Canterbury.

## Method

Ethical and administrative consent was obtained to access edited academic performance information from the University of Canterbury student records. We were permitted to access the grade point averages of all undergraduate students enrolled in 2010 and 2009. We also obtained information about individual students' gender, faculty of enrolment, and level (first, second, third, or, for four-year undergraduate degrees, fourth year of study).

In 2010, the University of Canterbury's first teaching semester extended from 22 February to 4 June, with all examinations ending by 26 June. The second teaching semester extended from 12 July to 22 October, with all assessment completed by 11 November. We averaged grade points only over courses taught wholly in either the first or second semester. Almost all undergraduate courses had a proportion (and frequently *all*) of their assessment due before teaching ended (*i.e.*, 22 October), although in the second semester of 2010 many extensions were allowed.

Grade points for all courses ranged from 9 (A+) through to 0 (D) and -1 (E). Both D and E are fail grades. Grade point averages for each student in each semester

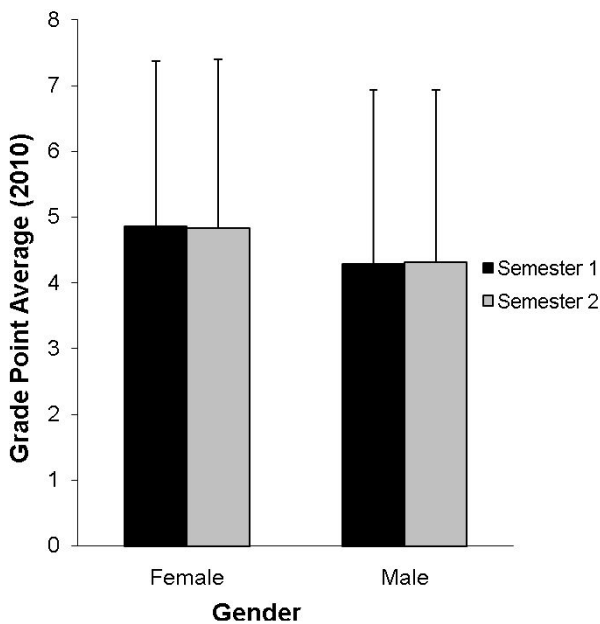


were obtained by averaging these numbers taking into account the course weighting. (Some courses carry greater course weights.)

A total of 9313 students (4435 female and 4878 male) completed at least one undergraduate course in each semester of 2010. Of these, 3577 completed their most advanced paper at first, 2768 at second, 2591 at third, and 377 at fourth-year level. In 2009, 9107 students (4343 female and 4764 male) completed at least one undergraduate course in each semester.

### Results and Discussion

The key result, comparing first and second semester grades for male and female students in 2010, is shown in Figure 1. Analysis of variance showed a statistically significant effect of gender ( $F(1, 9311) = 124.9, p < .001$ ), but not of semester ( $F < 1$ ), or the interaction ( $F(1, 9311) = 3.06, p = .08$ ).

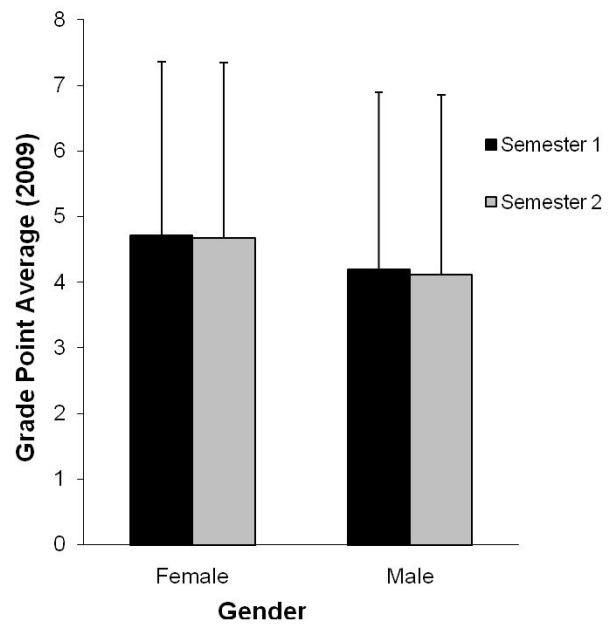


**Figure 1.** Grade Point Average of Semester 1 and Semester 2 courses for all undergraduate students at the University of Canterbury in 2010. Bars above the boxes indicate standard deviations.

Figure 2 shows comparable results from 2009, a year unmarked by any major natural disaster in Canterbury. Analysis of variance showed statistically significant effects of gender ( $F(1, 9105) = 112.5, p < .001$ ), semester ( $F(1, 9105) = 9.25, p = .002$ ), but not of the interaction ( $F(1, 9105) = 1.28, p = .26$ ).

Taken together, these results indicate that the earthquake had no negative effect on the grade obtained in the second semester of 2010. Indeed, a

slight but significant deterioration of average grades between Semester 1 and Semester 2 in 2009 (also found in 2008 and 2007) did not occur in 2010, raising the possibility that the earthquake might even have produced slightly better performance. On the other hand, assessment may have been more generous than normal in 2010 as markers consciously or unconsciously allowed for potential earthquake effects.



**Figure 2.** Grade Point Average of Semester 1 and Semester 2 courses for all undergraduate students at the University of Canterbury in 2009. Bars above the boxes indicate standard deviations.

Nor do the data support the hypothesis that the grades of female students were particularly badly affected by the earthquake. Thus, the gender differences in self-reported cognitive disruption found in Study 1 were not mirrored in university performance.

Overall withdrawal rates in 2010 were 2.6 % in Semester 1 and 2.0 % in Semester 2; corresponding figures for 2009 were 2.6 % and 1.8 %. Thus, the earthquake did not produce a much greater withdrawal rate than normal, although it is likely that some individuals did withdraw for that reason. We conducted other analyses comparing across different faculties and years of study, but these shed no light on any earthquake effects, so we do not report them.

### Discussion

Although most previous research on psychological effects of natural disasters has focussed on negative emotional effects, especially post-traumatic stress, the



present research also indicated marked effects on sleep and thinking. Indeed, our strength of effects measure indicated greater effects on sleep disruption than on any other measure, and the reported effects indicated cognitive disruption was more widespread than depression or anxiety. These results do not necessarily mean that, say, having disrupted sleep was worse than having more stress, and they certainly should not be taken to imply that the problems of the many people reporting disrupted sleep are of more consequence than the problems of the relatively few who may develop a post-traumatic stress disorder. Moreover, although sleep was disrupted following the earthquake, it is not clear whether the effect arose from being awakened by aftershocks or as a result of heightened stress (cf. Bernert, Merrill, Braithwaite, Van Orden, & Joiner, 2007).

Interestingly, those who had experienced the earthquake often reported positive as well as negative experiences. This tendency correlated positively with reporting negative experiences, possibly because those who were worse affected also received more sympathy and help from others, and possibly because those who report negative experiences are more likely to report experiences of any kind.

Four of the five personality variables proved poor predictors of who was most affected by the earthquake. However, those who scored high on neuroticism were worse affected on a variety of measures. This result replicates earlier findings that neurotic people generally appear to suffer, or are at least more willing to report, more adverse effects of stressful events than other people (Feldman, Cohen, Doyle, Skoner, & Gwaltney, 1999; Kendler et al., 2004). Older people reported sleeping fewer hours, but the elderly often report poorer sleep (Floyd, Medler, Ager, & Janisse, 2000; Vitiello, 2009) so this may not be earthquake-specific. Those now living in damaged homes were more likely to have negative experiences than those living in undamaged homes.

The most noticeable predictor variable in Study 1, however, was gender. Females overall reported stronger effects than males. There are a number of different possible explanations. One is simply that women are generally (for example) more stressed or slept fewer hours, but this explanation is unlikely in view of finding no gender differences in the non-earthquake sample and interactions of gender with whether or not the respondents were present for the earthquake and aftermath.

Study 2 investigated whether the gender differences in self-reported cognitive disruption were reflected in a more behavioural measure. They were not. Indeed, there was no evidence that this earthquake had any effect on academic performance at all. Three possible reasons for the apparent discrepancies between Studies 1 and 2, by no means mutually exclusive, occur to us.

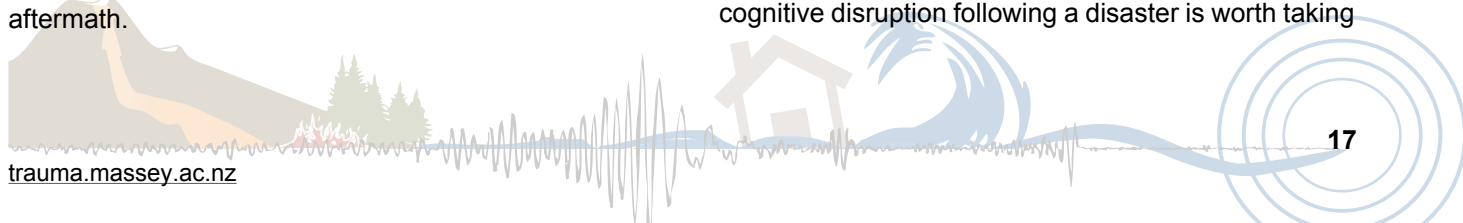
Firstly, it is possible that the University of Canterbury students showed resilience and recovered quickly, and because half the scheduled classes had already taken place before the earthquake and much post-earthquake assessment was not completed until October, they may have been able to escape the effects of the disruption.

Secondly, suppose that the reported cognitive disruption was closely linked to sleep deprivation. Sleep deprivation is unpleasant, and produces poorer performance on vigilance tasks, such as the Sustained Attention to Response Tasks. However, people who have endured even prolonged sleeplessness usually show little impairment of most cognitive abilities (Fulda & Schultz, 2001). Perhaps real cognitive disruption was produced by the mechanism of sleep deprivation, and these effects persisted and were worse in women, but the disruption simply did not affect academic assessment.

Thirdly, the gender differences of Study 1 may reflect only gender differences in self report. New Zealand women may be more likely to self report cognitive disruption, sleeplessness, depression, anxiety, or stress. Overall, some but not all previous studies have found gender effects (Chou, Huang, Lee, Tsai, Tsay, Chen and Chou, 2003; Potangaroa et al., 2010; Sahin et al., 2001).

The present studies have obvious limitations. Study 1 was a cross-sectional study that looked at the effects only over a limited time-span. However, the unpredictability of earthquakes makes it impractical to take pre-earthquake measures. It is quite possible that Study 2 was influenced by academic grading changes following the earthquake (although it is unlikely that these changes would have masked a real gender effect in response to the earthquake). We should perhaps also admit the possibility of cognitive disruption to our own research capabilities.

Further studies underway, following the earthquake on February 22, 2011, may help resolve these issues. Regardless of their outcome, however, the possibility of cognitive disruption following a disaster is worth taking



seriously. The situation is one in which people are forced to think and make important decisions, as well as to perform everyday tasks, such as driving, which impose a cognitive load.

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# Early Disaster Recovery: A Guide for Communities

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## Abstract

*On September the 4<sup>th</sup> 2010 and February 22<sup>nd</sup> 2011 the Canterbury region of New Zealand was shaken by two massive earthquakes. This paper is set broadly within the civil defence and emergency management literature and informed by recent work on community participation and social capital in the building of resilient cities. Work in this area indicates a need to recognise both the formal institutional response to the earthquakes as well as the substantive role communities play in their own recovery. The range of factors that facilitate or hinder community involvement also needs to be better understood. This paper interrogates the assumption that recovery agencies and officials are both willing and able to engage communities who are themselves willing and able to be engaged in accordance with recovery best practice. Case studies of three community groups – CanCERN, Greening the Rubble and Gap Filler – illustrate some of the difficulties associated with becoming a community during the disaster recovery phase. Based on my own observations and experiences, combined with data from approximately 50 in-depth interviews with Christchurch residents and representatives from community groups, the Christchurch City Council, the Earthquake Commission and so on, this paper outlines some practical strategies emerging communities may use in the early disaster recovery phase that then strengthens their ability to ‘participate’ in the recovery process.*

**Keywords:** community development; community participation; urban resilience; social capital

## Introduction

On September 4<sup>th</sup> 2010, at 4.36 am, the Canterbury region was rocked by a large 7.1 magnitude earthquake. We later learned that there had been no casualties and that the damage was largely confined to particular areas of the city of Christchurch and parts of Kaiapoi in the neighbouring Waimakariri District. For the people living in those areas, life became a constant battle. In contrast, most of Christchurch city’s residents and the Christchurch City Council tried to move back to ‘business as usual’; they had almost succeeded when a ‘smaller’ though more devastating earthquake occurred almost directly under the city.<sup>1</sup> This time, 181 people were killed (most of them in the collapse of two large inner city buildings), and many more were injured. An as yet unconfirmed number of people have lost their homes though it is estimated to be between 8000-12000. Some of these (again, numbers are not yet known) will not be rebuilt because the land damage underneath them is so extensive.

This provides some background for a paper which presents the findings of an exploration of the strategies three particular community groups in Christchurch used in their collective response to the first of the major earthquake. Whilst the initial research project aimed to explore community-recovery authority relationships and interactions in broad terms, the project later crystallised around the formation and development of three community groups: the Canterbury Communities Earthquake Recovery Network (CanCERN) who advocate for the inclusion of communities in recovery processes, and Gap Filler and Greening the Rubble who both focus on temporary installations on sites made vacant by the earthquake. Greening the Rubble promotes bio-diversity through the development of pocket parks, whilst Gap Filler celebrates the development of places that serve ‘creative, people-centred purposes’ such as mobile cafes, movie theatres, and even a bowling alley.

<sup>1</sup> The peak ground acceleration of the second quake was 2.2 times that of gravity and was one of the highest recording taken anywhere. According to Professor Yeats, professor emeritus of geology at Oregon State University in Corvallis, this would have ‘flattened’ most world cities (<http://www.stuff.co.nz/national/christchurch-earthquake/4711189/Tuesday-quake-no-aftershock>).

<sup>2</sup> This term, like ‘engagement’, ‘participation’ and ‘empowerment’, is problematic and subject to extensive debate as to its meaning conceptually and in practice.

<sup>3</sup> See Aldrich, 2011 or French, 2011 for recent summaries of a general nature.

## Disaster recovery and community involvement

Much of the recovery literature recognises both difficulties and advantages associated with involving<sup>2</sup> the local community in disaster recovery efforts.<sup>3</sup> Kweit and Kweit (2004), for example, compared recovery processes in Grand Forks and East Grand Forks following severe floods in 1997. After the disaster, East Grand Forks engaged in extensive citizen participation initiatives and subsequently reported high levels of political stability and citizen satisfaction. In contrast, Grand Forks instigated a more top-down, bureaucratic approach and has since experienced changes to their government structure, a high turnover of elected and appointed officials, and more negative citizens' evaluations. Besides this, Etye (2004) argues that 'getting involved' after a disaster can be cathartic and notes that taking positive action can make victims feel empowered; this helps recovery. Other studies report on stalled recoveries that were facilitated, or resurrected, by a turn to citizen engagement and more deliberative democratic models (Coghlan, 2004; Coles and Buckle, 2004; Waugh and Streib, 2006; Murphy, 2007; Hauser, Sherry and Swartz, 2008; Wilson, 2009; Vallance, 2011). In such literature, the benefits of effective community engagement are variously represented as identifying workable solutions to the range of problems recovery presents, sharing and delegation of duties, securing community 'buy-in' to the process, and building trust. As Norman (2004, p. 40) has succinctly argued, 'While consensus may not be possible, recovery cannot succeed if the aims, priorities and processes do not have community support'.

Another strand of literature that addresses the role of the community in disaster recovery comes under the rubric of social capital, which is often referred to as the mix of 'strong and weak ties' that bind different elements of society both vertically and horizontally (Putnam, 1995; but also Manyena et al., 2011; Lorenz, 2010; Norris, 2008; Murphy, 2007; Walker and Salt, 2006; Pelling and High, 2005; Boettke et al, 2007). Social capital may be used to *bond* a group together; *bridge* groups with similar interests; *link* groups vertically in formal institutional arrangements; or *brace* between public and private sectors.

Social capital is thought to contribute to general resilience which is variously defined as the ability of a system to 'bounce back' from, 'cope with' or 'bounce

forward' from a disturbance (see Vallance, 2011; Cutter, Barnes and Berry, 2008; Norris, et al., 2008). Given the right conditions, such as having an enabling local government and/or adaptive capacity, some scholars are even optimistic about the ways a strong civil society with good social capital can turn a disaster into an opportunity (Solnit, 2009).

The problem at the core of this paper is that despite a broad consensus regarding the benefits of strong social capital<sup>4</sup> and community involvement, it is not always easy to follow engagement best practice in the post-disaster recovery scramble. Much of the scholarship outlining the benefits of public engagement seems to assume that the state will be both willing and able to accept post-disaster input from communities who are themselves willing and able to participate in the recovery process. My research here in Christchurch suggests recovery authorities here (including, but not limited to, the Earthquake Commission, Canterbury Earthquake Recovery Commission and the Christchurch City Council) struggled to connect adequately with affected communities for quite some time.

This is a controversial claim, though it is well-supported in interview data with both residents and representatives from recovery authorities. A Community Board representative told me she had encountered strong resistance to her idea of holding a local meeting a week after the first earthquake and was informed that the Council wouldn't pay out for the tea and coffee, nor help with the table and chairs. When she suggested driving around the affected areas with a megaphone to inform residents without electricity of what to do a City Councillor 'snapped' at her 'that is EQC's job'. It took until mid-November (*approximately 9 weeks*) for the first Christchurch City Council 'Community Meetings' to be held and even then, places were limited. This was quite a lengthy wait for residents desperate to understand what was going to happen to their homes. Numerous Letters to the Editor in *the Press* and on-line discussions, blogs and posts document a litany of complaints about poor information flows and a general lack of communication; the recovery effort was even described as a 'bureaucratic, spin-doctored disaster, [a] cock-up like New Orleans' Hurricane Katrina' (McCrone, 2011).

This struggle to engage adequately with the public after a disaster is not entirely without precedent in New Zealand: Using the IAP2 spectrum of participation<sup>5</sup> in an analysis of New Zealand's Ohura floods, for

<sup>4</sup> Though see Aldrich (2008) and Rydin and Holman (2004) for a critique.

<sup>5</sup> [www.iap2.org/associations/4748/files/IAP2%20Spectrum\\_vertical.pdf](http://www.iap2.org/associations/4748/files/IAP2%20Spectrum_vertical.pdf)

example, Ward, Becker and Johnston (2008) suggested the official state response barely moved beyond the 'consultation' stage. Consulting is some distance away from the deliberative and participatory models that are more likely to foster social capital and facilitate the development of holistic solutions (see, for example, Agyeman and Briony, 2003).

In their discussion of recovery lessons learned in Kobe and Northridge, Olshansky, Johnson and Topping (2006, p. 368-9) noted that citizen engagement is key but 'to work most effectively after disasters, community organizations should already be in place and have working relationships with the city [officials]. It is difficult to invent participatory processes in the intensity of a post-disaster situation'. This 'invention of participatory processes' is the primary concern of this paper, though it is addressed here largely from several communities' perspectives. It speaks to a comment Daryl Taylor<sup>6</sup> made about a difference between *engaging* communities and engaging *with* communities. The distinction is subtle but draws attention to pre-existing communities that can be engaged with, and emergent communities that may need to be engaged. It raises interesting questions about the actions community groups can take, or strategies they can use, to come together after a disaster, and then build and use social capital 'on the fly' so as to take advantage of the opportunities disaster recovery provides. This paper seeks to inform answers to these questions.

## Methodology

The findings outlined below are part of an evolving research project which, in more general terms, seeks to explore communities' attempts to create particular senses of place. This focus on the 'informal' aspects of urban management after disasters demands a suitable methodology, one that acknowledges dynamic complexity, relationality and contingency. Mindful of concerns about the conduct of research and the 'deadening' effect that orthodox research approaches visit upon that which should be most lively (Lorrimer, 2005), I adopted an iterative mix of qualitative research and analytic approaches which, following Wolch (2007, p. 382), involved getting out there and 'wading around in the muck'. From a very different research tradition, but offering similar advice (Seyfang and Smith, 2007; Escobar 2007) systems theorists have developed a particular 'orientation to enquiry' which aims to make

sense of a situation through experimental action. Research in this tradition expects that a range of opportunities to gather data will be presented over the course of the project, only some of which will be deliberate (e.g. formal interviews and focus groups). Other opportunities will be a spontaneous part of a process involving doing, learning through reflection, and 'being in it' (Burns, 2007). This orientation brings the benefits of enhanced understanding of the various components contributing to the issue at hand, and the ways in which they interact.

The contrived or deliberate research methods used here included observations of numerous public meetings, and 37 in-depth (usually on-site) interviews with individual residents and members of various community groups including, but not limited to, CanCERN, Greening the Rubble and Gap Filler. These data were augmented with semi-structured interviews with representatives from various recovery authorities, including Christchurch City Council (elected and non-elected), Environment Canterbury, the Earthquake Commission, the District Health Board, two insurance companies, Fletchers construction, and Citycare.

## Strategies for Communities

### Beware geography:

The social scientific literature is replete with problematic references to 'community' (for an overview, see Chamberlain, Vallance and Perkins, 2010) with a central concern being 'propinquity without community' and 'community without propinquity'. Yet, the earthquakes rather forcefully demonstrated the continued importance of geography and the prospects of geography-based communities. Suddenly, people with little in common had a collective problem that was, literally, very grounded. As but one example, the earthquake damaged or destroyed 100s of kilometres of sewers. Neighbours that may or may not have known each other before the earthquake were suddenly united in a rather intimate ways through these sewerage laterals that made flushing the toilet a very communal problem. As one interviewee told me:

They [the Christchurch City Council (CCC)] keep telling me I've got 'low' flow [flush] but that's not right...I've got 'no flow' really because when I flush it bubbles up in my neighbour's back yard...Now I'm not about to... take a dump on my neighbour's lawn am I?

<sup>6</sup> Member of the Kinglake Community Recovery Committee.

The earthquake's exposure of 'hidden' geographies like this led to the formation of CanCERN. This network was very explicitly based on particular geographies where *street* co-ordinators fed information through to a *neighbourhood* representative. The collective of neighbourhood representatives then met to discuss 'global' or region-wide issues, and negotiated on residents' behalf with government and non-governmental organisations. This initially worked well because some of the damage – like pockets of liquefaction or failed sewerage systems – could be resolved more quickly and more effectively when addressed holistically rather than on an individual household basis. It also manages to 'capture' people who might otherwise be left out (such as those without telephone or internet), and it provides a forum whereby all those people who suddenly have issues (and who may not be familiar with existing political processes, assuming they still exist) can be heard. Later, however, as residents left the area and became more dispersed, emails held the 'affected' community together.

Though geography is an obvious starting point for community formation, communities of interest also formed after the earthquake. Gap Filler and Greening the Rubble are held together by their enthusiasm for, respectively, people-arts-creativity and bio-diversity. They used facebook, websites, and other social media to good affect.

## Having dedicated people

CanCERN, Gap Filler and Greening the Rubble all developed a core team of people that initially drove the process. They spent huge amounts of time building support for their organisation, and they also had to invest 'days and days' developing an understanding of the wider situation, including entitlements, formal process of government and governance, regulations, funding opportunities, and legal requirements. There is an extraordinary range of unusual and often alarming issues to consider, many of which take time and energy to work through. It is not entirely unexpected, then, that some of the more durable and influential community groups can attribute their success, in part, to the fact that at least some of the leaders do not have full-time jobs (in a number of cases this is actually because their own or their employers' businesses were destroyed in the earthquake). This has allowed them the time to invest in this extended sense-making project.

## Connecting with existing organisations

In the immediate aftermath of a disaster there is a need for resources and information to flow but, unfortunately, many of the pre-disaster mechanisms for doing this may be inoperable or slow. The emergent community may need time to establish more enduring governance and financial structures, such as becoming an Incorporated Society or setting up their own charitable trusts. Under these circumstances, appropriate resourcing is really important but, even if a group or organisation can secure some financial aid, it can be difficult to find a suitable repository because donors are understandably reluctant to put money into personal bank accounts. Gapfiller, Greening the Rubble and CanCERN addressed this problem by connecting with pre-existing NGOs; Canterbury Arts and Heritage Trust, Living Streets Aotearoa, and Delta Community House. Using a Memorandum of Understanding, these NGOs acted as both a funding repository and (loosely) 'overseer' until long-term structural, governance and accountability issues could be resolved.

Pre-existing community groups, including Residents' Associations, Neighbourhood Support, and a diverse range of garden clubs, drama societies and the like have proved useful in terms of information provision, labour, and general encouragement.

## Finding a Patron

One of the possible steps towards establishing credibility and 'gaining access' to decision-making fora and processes is to find a patron. Church groups and other pre-existing civil society groups offer good prospects as they tend to have a philanthropic disposition. It helps if the patron has a high public profile, good relationships with the media and other networks, and is not controversial or overtly political.

## Connect in many ways

Social media, like facebook, and the internet more generally have given extra nuance to community-based recovery here in Christchurch. Some of the community initiatives I have followed over the course of this research are, at least to date, solely web-based. Other groups have shown the benefits of using various communication methods to access a range of potential members and diversity of media also allows the group to connect their messages with the means of delivery. Devastating or controversial news ('like your house is munted', for example) was thought to be best delivered face-to-face, whilst 'information' of a more factual nature

or less important updates (such as dates of meetings) could be broadcast through the mass media. Developing some expertise across a full range of media is part of a successful recovery communication strategy for both state and community groups.

#### **Identify easy victories and share the good news.**

Almost everyone interviewed for this research commented on the complexity and enormity of the recovery process. There was not only a huge range of problems, many of the issues were interconnected, and this gave the sense that the overall recovery was an intractable mess. Some of the more successful community groups dealt with this by identifying and seizing easy victories. Some examples were securing funding, finding a site, connecting with another organisation or key figure in the recovery effort, having the Christchurch City Council review an unpopular decision, having the Earthquake Commission review a procedure, and so on. It may have done little to address the overall 'earthquake problem', but these were achievements that consolidated membership, legitimised their approach, and helped in some way.

#### **Solid core**

Several of the more successful earthquake groups have a core of 3 - 5 people, a steering group, who others often look to for direction. To the best of my knowledge only two of these 'leaders' actually knew each other well prior to the earthquake. Others may have been acquaintances but, in most cases, no previous relationships of note existed. Nonetheless, over the last 6 months they have come together as a team which then guides the extended membership. This arrangement means they rarely act alone (thus they have become quite competent at collective decision-making) but they are still capable of moving quickly should the need arise. An observation is each of the three steering groups has both male and female members.

#### **Collaborate**

The enormity of recovery can be overwhelming for all involved and there is a risk that while waiting for the larger tasks to be completed the small issues are overlooked. In conditions of uncertainty, and when there is a lack of pre-existing links between the recovery authorities and the affected public, a good strategy may be to undertake a small project to build trust and develop a good functional relationship that will also work

for the larger recovery process. This is really important in light of observations (Ward, Becker, Johnston, 2008; Olshansky, Johnson and Topping, 2006) about the difficulties of inventing participatory processes in the aftermath of a disaster. The projects need not be huge, and may actually seem insignificant in the face of the overall recovery process, but these small projects might be a useful step; without them the larger undertaking may be compromised or even impossible. These collaborative projects may be the provision of a family fun day, or it may be the temporary repair of a bridge that enables children to walk to school more easily. Small projects demonstrate the effectiveness and trustworthiness of all involved and set the scene for later developments.

#### **Positive action**

Many of the groups observed during the course of this research emphasised a 'solutions-based' approach to their activities. A recurrent theme from the interviews and observations was the need to avoid being seen as 'a bunch of whingers' and instead offer positive strategies that were seen, at least by the residents, as desirable and achievable. This appears to be accord with some of the literature emerging from developing countries where some NGOs have moved from 'expose-oppose' or revolutionary strategies to 'expose-oppose-propose' models (Etemadi, 2004).

## **Conclusions**

This research provides some good (though contextual, situated and partial) strategies that communities and grassroots movements may use to develop and promote their cause in the post-disaster 'scramble'. Communities here in Christchurch were not always 'engaged'; indeed, at times over the course of this research they were not even adequately 'informed'<sup>7</sup> (IAP2's lowest order of participation). This raises the prospect of looking beyond the civil defence and emergency management literature to scholarship on, for example, insurgent/radical/informal planning for lessons about facilitating genuine community empowerment, and the pitfalls that may lie ahead for the Christchurch community organisations and citizens' initiatives studied here. Etemadi (2004), for example, in a summary of strategies adopted by NGOs in developing countries has verified the utility of many of the strategies described above. In addition, Etemadi warns against becoming beholden to a particular

<sup>7</sup> There are numerous examples but for brevity I cite the 'septic tanks affair' where residents were approached one by one and asked to give their consent to the installation of sewage holding tanks. Some were told that if they didn't sign they would be denying their neighbours a toilet. At least some people who signed were not aware the tanks would be permanent.

official, and suggests keeping officials at a distance during elections. Others have highlighted the dangers of focussing only on consensus-oriented, collaborative approaches that almost necessarily imply the dilution of one's ambitions (Rutherford, 2007; Swyngedouw; 2009). Hence, the development or preservation of a radical wing that preserves the original language, sentiments and intent of the community or grassroots movement may be necessary in extreme cases. Indeed, this may be a desirable step if the frequent observation (Clarke, 2008; Anderson and Woodrow, 1998; Coles and Buckle, 2004; Mitchell, 2004; Solnit, 2009) that disasters exacerbate existing inequalities holds true. We have seen the beginnings of more radical developments in Christchurch with two protest marches having taken place already, with more planned.

It is also important to note that some of the onus of participation lies with communities themselves. Participation at the IAP2's higher levels demand collective effort on their part. This suggests a need for communities themselves to do some work, to become citizens rather than 'residents', 'consumers' or 'clients', and get ready to be *engaged with*. That said, it is important to note that authorities can facilitate this process by providing funding and other resources.

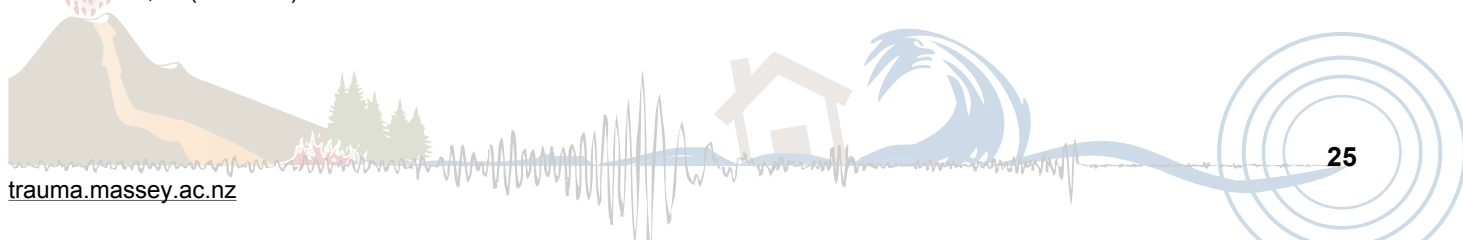
In conclusion, this research shows that we cannot assume the state is willing or able to effectively engage a public who is also willing and able to participate. This suggests that in spite of a robust literature outlining the benefits of community engagement, and even in a country with established democratic traditions like New Zealand, the early disaster recovery phase challenges ideals of 'best practice'. While it is easy to blame the state for failing to live up to the best practice model, communities must also take some responsibility for becoming something the state can engage with. As I heard a Canterbury Earthquake Recovery Commission official telling a CanCERN representative, 'I'm glad you're here; if you didn't exist we would have to invent you'. This paper therefore outlines a number of strategies that provide a useful starting point for communities that might face a similar struggle to be heard in a post-disaster clamour, and a number of pointers for officials who would like to see their efforts move beyond token consultation to more empowering forms of engagement.

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## Rapid response research in Christchurch: Providing evidence for recovery decisions and for future theoretical research

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### Abstract

*During the immediate response phase after a disaster event, decision-makers need urgent insight into the impacts of the disaster on affected communities so that support and policy attention are directed to those communities in most need. For researchers to assist decision-making in this vital period, there is a need to adapt their customary research approach in order to provide helpful information in a timely, inexpensive, and non-invasive manner. Traditional research techniques can be applied at a later date when recovery processes are well underway.*

*Using a case study approach, this paper reports on two research projects commenced after the Canterbury earthquake of 4 September 2010. This research, of necessity, took an applied approach, and, in one instance, employed remote datasets to reveal the impacts of the earthquake during the immediate response phase. In the light of these accounts, the modifications required of researchers to undertake rapid response research after a major hazard event are discussed. Provided the research process engaged in is technically rigorous, there is an opportunity to shift from applied, operational research to improve theoretical knowledge of the recovery phase.*

**Key words:** disaster recovery research, Canterbury earthquake, research dissemination, rapid response research, recovery indicators

### Introduction

Recovery after a natural hazard event is increasingly viewed as a dynamic and complex process with no

clear endpoint (Johnson 2010; Nigg 1995). Recovery is also often cited as the least understood phases of the disaster cycle with most current knowledge built on individual case studies of disasters (Chang 2010; Olshansky & Chang 2009). Over the last 20 years progress has been achieved in developing a multi-disciplinary understanding of the recovery process. Indeed in New Zealand, researchers have previously examined recovery from hazard events that include floods, volcanic eruptions and earthquakes (e.g. Becker & Richardson 2000; Becker *et al.* 2001; Johnston *et al.* 2000; Powell 2010). However, there is still no theory of recovery, no consistent definition of what recovery means, and no consensus on how it should be modelled, measured or tracked over time (Johnson 2010; Miles & Chang 2006). To address part of this knowledge gap, attention has been paid recently to identifying potential indicators of recovery (e.g. Brown *et al.* 2008; Chang 2010; Johnson 2010; Miles & Chang 2006).

One goal of research into recovery from hazard events is to provide well-grounded explanations of a range of social and behavioural phenomena across a range of different hazards. With generally no previous experience to go on, a community hit by a large disaster is dependent on researchers to synthesise lessons and provide guidance from what is already known about recovery processes (Olshansky & Chang 2009). Information can also be gleaned from new applied research of the disaster-hit community itself to ascertain impacts and to record people's experiences (King 2002). The immediacy and uncertainty after a disaster event leaves little option other than rapid fieldwork as a means of collecting perishable data on key disaster-related topics (King 2002; Myers 1993).

Adopting a case study approach, this paper reports on two research projects commenced after the Canterbury earthquake of 4 September 2010. These projects incorporate novel ways of conducting rapid, non-invasive research of relevance to the recovery effort. Following a brief review of the literature that relates to researching in the immediate aftermath of a major disaster, there is a description of the two projects. The opportunities and challenges experienced in undertaking research in the early recovery phase are outlined. Conclusions are drawn about the ways in which researchers must modify

their customary approach to deliver rapid response research, providing evidence for recovery practitioners that will later form the basis for theoretical research into the recovery process.

## Researching disaster recovery in the immediate aftermath of an event

Though recovery is the least understood phase of the disaster cycle, there is a growing body of evidence on disaster recovery. Several studies have looked at the impacts of different hazard events on small businesses<sup>1</sup>, allowing comparisons to be made between different hazards and different communities. In the first study to take a comprehensive view of the recovery process, Haas *et al.* (1977) examined four disasters<sup>2</sup> to extract common lessons on the rebuilding of cities after a disaster and to develop a conceptual framework of recovery. They recommended that post-disaster planners make quick decisions to reduce uncertainty amongst private decision-makers. Yet Olshansky and Chang (2009) observe that 'recovery is a fast-paced, information poor environment' (p.206), and that the central issue for post-disaster recovery is the tension between speed and deliberation. In this time compressed phase, there are two key influences of decisions: vision and resources, with the latter including financial, manpower and information resources (Johnson & Olshansky 2011).

Natural hazards researchers are able to play an important role by providing practitioners with guidance about what is already known about recovery from previous research and with information on the current hazard event based on new applied research. For those researchers who previously examined other disaster phases (that is emergency preparedness or emergency response), recovery research may entail engaging with a new audience (Quarantelli 1993). This may present a challenge for some researchers as different audiences have different timeframes, and material for each audience needs to be presented in different ways.

In addition to engaging with a new audience, a further shift is required from researchers in terms of the means used to disseminate their findings. Usually academic researchers favour peer-reviewed journals and conference proceedings to disseminate their findings

as their performance is judged primarily in terms of publications in well-regarded journals (Druckman 2000; Fothergill 2000). The urgency of the post-disaster situation requires the use of alternative means of dissemination as these more customary means will not meet the timeframes of potential end-users. Myers (1993) recommends that researchers succinctly present their material, and recognize the context in which their results may be applied to assist the end-user in interpreting results and applying them.

Aware that researchers may need to comply with funding institution's and university's requirements for academic publications, Fothergill (2000) suggests that researchers try to create results that are both theoretical and practical. Furthermore, the information flow must be two-way as end-users need to clearly define their problems so that researchers can address these needs (Myers 1993). This transition from theory-driven to applied research represents a further adjustment for researchers more accustomed to research programmes in which findings typically stimulate further investigation rather than having as an end point improved analysis of or solutions for particular problems (Druckman 2000).

The most frequently discussed risk of conducting research with affected communities is emotional distress (Collogan *et al.* 2004). Thus, it is important that research involving interaction with and data collection about participants is conducted in an ethical manner. Key aspects of 'ethical research' include the right to privacy, informed consent, protection of each participant's welfare, and research that does not involve deception (Barron Ausbrooks *et al.* 2009; Collogan *et al.* 2004; Dodds & Nuehring 1996; Richardson *et al.* 2009). Ideally, post-disaster research should address the needs of practitioners and communities within the disaster area. It is important to protect human research participants, but at the same time, researchers have a responsibility to undertake research to answer relevant questions and to disseminate any knowledge gained so it can be applied to benefit current and/or future disaster victims (Barron Ausbrooks *et al.* 2009; Collogan *et al.* 2004; Kilpatrick 2004; Richardson *et al.* 2009).

This background information on researching disaster recovery illustrates some of the modifications that researchers need to make to their approach to research when they commence investigations in the immediate aftermath of a hazard event. These modifications can be summarised as follows:

<sup>1</sup> Examples from the U.S.A. include Chang and Falit-Baiamont (2002) on the 2001 Nisqually earthquake; Kroll *et al.* (1991) on the 1989 Loma Prieta earthquake; Webb, Tierney and Dahlhamer (2000) on the Loma Prieta earthquake, Hurricane Andrew in 1992, the 1994 Northridge earthquake and the 1993 floods in Des Moines; and from New Zealand, Powell and Harding (2010) on the 2007 Gisborne earthquake.

<sup>2</sup> 1972 Rapid City flood; 1972 Managua, Nicaragua, earthquake; 1964 Alaska earthquake; 1906 San Francisco earthquake.

- 1) **Rapid fieldwork:** Because information is a vital part of the recovery process, rapid fieldwork is required to inform the quick decisions required of policy-makers. A further reason is the capture of perishable data;
- 2) **End-user engagement:** Researching recovery is likely to mean engaging with a new audience of end-users with different timeframes and different information needs from other end-users of disaster research. For researchers to address end-user's needs, end-users may become more involved in formulating research studies;
- 3) **Applied research:** The types of studies undertaken are liable to be applied projects which *analyse or solve operational problems* rather than more theory-driven work that seeks to *explain behaviour or processes*;
- 4) **Ethical considerations:** The need to collect and disseminate knowledge that will benefit affected communities should be balanced with ethical considerations;
- 5) **Dissemination of findings:** The presentation of research findings is likely to be different both in terms of its succinctness and the means of dissemination; and
- 6) **Rigorous and practical research:** Research should deliver results that are practical and rigorous, and that will add to the theoretical knowledge.

## Responding to the 2010 Canterbury earthquake

Immediately following the 4 September 2010 Canterbury earthquake, succinct advice notes for policy-makers were compiled and circulated to local and central government. These advice notes contained key learnings from (a) earlier business recovery research undertaken in Gisborne, New Zealand, following the 2007 earthquake (Powell 2010; Powell & Harding 2010), and (b) psychosocial considerations with regards to billeting and temporary accommodation for displaced populations. Over October and November 2010, findings and advice arising from the earlier research were presented to end-users from local and central government, and recovery managers in Christchurch.

Rather than move into completely different research directions, studies were developed that were aligned to previous and intended research. Two research

projects were initiated after the earthquake and these are described in more detail below:

- a) An investigation of pedestrian footfall counts in the Christchurch CBD as a potential indicator of recovery and/or decline; and,
- b) A longitudinal study of population migration within the Canterbury region resulting from the earthquake.

### A. Feasibility study of pedestrian traffic as a recovery indicator

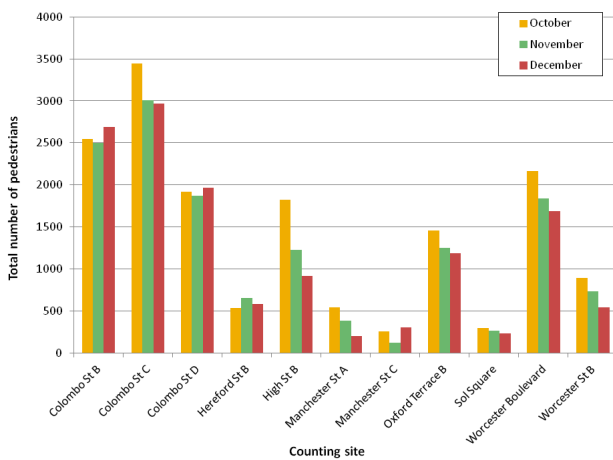
Comments received when surveying businesses in Gisborne suggested that after its 2007 earthquake, pedestrian avoidance of seemingly damaged areas negatively affected businesses remaining open nearby. Road, building and footpath closures, as well as perceptions of personal risk, can reduce pedestrian traffic and thus business viability even when individual businesses escape direct damage themselves. Certainly under normal (non-disaster) circumstances, empirical evidence links retail store performance and pedestrian route-choice behaviour (Timmermans & Van der Waerden 1992). The 2010 Canterbury earthquake, therefore, provided the opportunity to investigate the feasibility of pedestrian footfall as an urban recovery indicator that could contribute in some way to the growing body of knowledge of such indicators (Brown *et al.* 2008; Johnson 2010). The reliability of the footfall data as a proxy measure of business recovery would be later authenticated by an intended survey of businesses located in the centre of Christchurch.

Student observers conducted manual pedestrian counts using tally counters at 12 sites throughout the CBD on a midweek day in each of October, November, December 2010 and February 2011 (see Figure 2). The sites were chosen based on the patterns of earthquake damage within the CBD, and to be comparable with sites used in an assessment of urban vitality in 2008 undertaken for the Christchurch City Council (Gehl Architects 2009). Pedestrian counts were recorded every quarter hour during two hours in the morning and two hours mid-afternoon. At the request of Christchurch City Council, in December and February, additional counts were undertaken for a further two hours covering the evening commute, and an alternative site was used in place of one of the original sites.

The study was to be replicated a number of times for a year to monitor progress towards recovery and to reveal areas likely to be at risk of decline due to fewer

potential customers. After each survey, short reports were circulated to end-users in Christchurch, including the City Council, a business association representing city centre businesses, and Canterbury Development Corporation, the organisation responsible for economic development in the city. Feedback from end-users was positive, and the researchers were invited to make an in-house presentation to the Council in November 2010. The reports were also posted on the website of the New Zealand Society for Earthquake Engineering's research clearing house and therefore made available to other researchers.

The total number of pedestrians recorded at each site on each counting days is shown in Figure 1. Between October and December, the total number of pedestrians recorded at all sites fell each month, with 12.8% fewer pedestrians overall in November, and a further fall of 4.1% by December. In February, the total number of pedestrians counted almost recovered to the October totals, being only 0.8% lower than the earlier number. At two of the sites (Colombo St D and Sol Square) pedestrian numbers altered little over the study period. Pedestrian numbers fell each month to December in 7 of the 11 sites, but numbers rebounded in February in all but two of these (High St and Worcester St B).



**Figure 1:** Total number of pedestrians recorded (10.30a.m.-12.30p.m. and 1.00p.m.-3.00p.m.)

There are a number of possible explanations for the observed decrease in pedestrian numbers over the first three months. The higher total number of pedestrians observed in October may have been artificially high because this was the only survey undertaken during school holidays. For the December count, being three weeks before Christmas, more pedestrians were anticipated but the low numbers observed may

be attributable to the unpleasant weather deterring shoppers. Similarly, the increase recorded in February may be in part due to fine weather. The full reopening of Manchester Street, part of which had been closed since September due to an unsafe building that had to be demolished, led to temporarily closed businesses in that area reopening by February, and this is likely to have resulted in more workers being in the CBD than in the preceding months.

A clear pattern of areas in the CBD at risk of decline due to low patronage emerged from the survey data (see Figure 2). The southern and eastern sides of the CBD experienced declining footfalls that may threaten the viability of businesses that remained open after the earthquake (Timmermans & Van der Waerden 1992). These findings supported anecdotal accounts of businesses in the south and eastern parts of the city experiencing hardship since the earthquake. At the same time, other sites to the north and west of the CBD appeared to be experiencing reasonable and even high pedestrian numbers. This part of the city contained the cultural quarter running from Cathedral Square to the Arts Centre and Gallery. With less damage to buildings in this area than to the east, this part of the CBD had fewer road closures that might deter pedestrians. Retail was dominated by chain stores, and this area seems to have maintained its popularity with shoppers and tourists after the earthquake. The relocation of the civic offices to this part of the CBD in September 2010 is also likely to be manifest in the higher pedestrian numbers.



**Figure 2:** Map of Christchurch CBD, showing counting sites and possible risk of decline.

From the results to date, it is concluded that by providing quantitative evidence regular pedestrian counts could potentially be a useful indicator of business recovery after a shock event so long as adequate contextual

information is also known (Harding & Powell 2011; Powell & Harding 2011). Pedestrian counting is a relatively simple and cost-effective complement to anecdotal evidence and more thorough surveys. It is a non-intrusive means of observational study that allows for the quick survey of sites and prompt analysis of data. Whilst the protocol for counting is simple, data collection must be rigorous to be comparable over time.

The reliability of this possible indicator was to be authenticated using data collected from a survey of CBD businesses, but that survey is on hold at the time of writing as the CBD remains cordoned off due to the devastating February 2011 earthquake. The relationship between footfall and turnover will now be verified using the value of credit and debit card transactions provided by Paymark, a major EFTPOS provider in New Zealand.

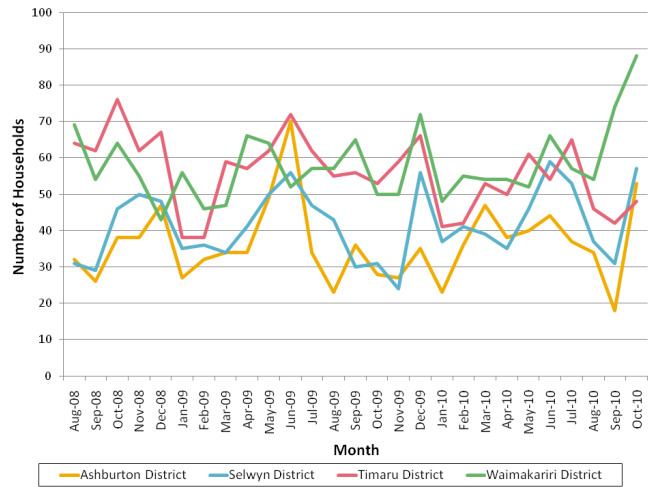
**B. Post-earthquake migration within the Canterbury region**

The postal service provider, New Zealand Post (NZ Post), has a mail redirection database in which people can register their change of address. Following the September 2010 earthquake, this database was analysed to provide an indication of household migration within the Canterbury region. This analysis was to achieve two aims; in the short term, to provide prompt migration information for recovery managers, while in the longer term to explore changes in migration patterns over time as an indicator of recovery.

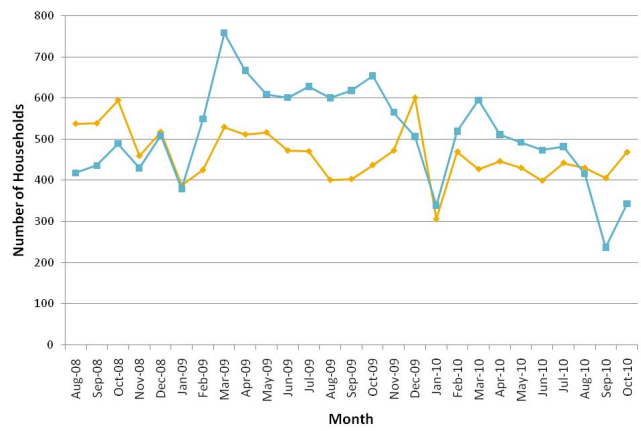
Of those that register their change of address with NZ Post, 65% agree to have their details included in the publicly available relocation database. Each record can be purchased, with recent records being more expensive to acquire than older registrations. Data was purchased for September and October 2010 with the intention of continuing to purchase the data over at least a 12 month period following the earthquake.

To allow a baseline comparison, historic records from August 2008-August 2010 were also purchased. As a first stage, Statistical Chi-Square analyses were carried out, comparing relocations in September and October 2010 to relocations in the same months of 2008 and 2009. Census files were merged with the dataset to include the Area Unit, Ward, Territorial Local Authority (TLAs) and Regional Council areas of the listings. In addition, data from the Real Estate Institute of New Zealand (REINZ) on the number of house sales per month (which is publicly available on the Internet) was accessed for the same period to enable comparisons with house sales.

The numbers of relocations from August 2008 in Hurunui, Kaikoura, Mackenzie, Waitaki and Waimate districts are typically low, being often in single figures per month. The focus of analysis was therefore on household relocations for the TLAs of Ashburton, Christchurch, Selwyn, Timaru and Waimakariri (see Figures 3 and 4).



**Figure 3:** Frequency of household relocations in Ashburton, Selwyn, Timaru and Waimakariri districts, August 2008 – October 2010



**Figure 4:** Frequency of household relocations and residential property sales in Christchurch City, August 2008 – October 2010

The number of household relocations in September 2010 was generally lower than usual in all but one of the TLAs in the Canterbury region; the exception was the Waimakariri district where more households relocated than normal, possibly due to this area being worst affected by the earthquake. Numbers rebounded in October with both Waimakariri and Selwyn districts showing significantly higher rates of relocation

than would be anticipated from the baseline data. Comparisons with house sales data in Christchurch and Kaiapoi were made that revealed there were more household relocations than house sales in both areas, suggesting that a greater number of people moved to rented accommodation than into newly purchased properties.

In the weeks following the September earthquake, there were a wide range of estimates of the number of people leaving the Canterbury region, many of which were not based on analysis of any data. Over time, a number of other datasets became available (e.g. school and electoral enrolments, electronic payment transactions), but the agencies responsible for these were reluctant to provide researchers access to the data, primarily due to privacy concerns. Comparisons with other secondary datasets can also be difficult due to different measurement units (e.g. the REINZ data was difficult to match to Census boundaries), but all can be used to form an overall picture of migration.

While datasets such as the NZ Post data are not without limitations, they provide a quick insight into changes in the number of household relocations around the Canterbury region, and the statistical analyses performed gave a scientific basis to migration estimates. The primary limitation of the dataset was that not every person that changes address notifies NZ Post, and of those that do, not all allow their details to be made available to others. In response to the more severe earthquake in February 2011, NZ Post made all of the records available to the government as this data was requested by recovery managers and policy-makers to inform migration estimates from and within Christchurch City for the prioritisation of resource allocation. The uptake of this research technique following the second earthquake is testament to its usefulness as a remote and non-invasive means of determining patterns of internal migration following a disaster event.

## The transition to rapid response research

The literature on researching disaster recovery illustrated some of the modifications required by natural hazards researchers when they commence investigations into post-disaster recovery in the immediate aftermath of an event. Based on these likely modifications and following Richardson *et al.* (2009), a brief review of the key opportunities and challenges that arose during these two research projects is provided.

## Opportunities

### 1. Undertaking rapid fieldwork

Following a disaster, it is essential that decision-makers quickly receive accurate information in order that they can make swift decisions to reduce uncertainty and facilitate recovery (Johnson & Olshansky 2011; Olshansky & Chang 2009). Both research projects were initiated within a few weeks of the earthquake. The pedestrian footfall study involved the application of a well-established technique to a new research context. Being simple and quick to operationalise, this study allowed the capture of perishable data on a monthly basis to provide timely trend information. It was identified that for findings to be robust, contextual knowledge is required, and that a clear protocol for data collection is essential for data to be comparable.

The internal migration study involved the novel application of an existing remote dataset. The benefits and limitations of using secondary data sources are well-known (Kiecolt & Nathan 1985). The primary advantages in the context of the internal migration study were time and resource savings. The acquisition of data for NZ Post was relatively easy to do quickly, as the data was set up for a commercial nature and so could be purchased (whereas other datasets can require lengthy access arrangements). The limitations of secondary data analysis are intrinsic to the original survey method (Kiecolt & Nathan 1985), and the key limitations of the NZ Post database were discussed earlier. The advantages of prompt data provision to inform the recovery effort far outweigh the limitations associated with the dataset.

### 2. Engaging a new audience of end-users

In the event of a disaster, researchers are likely to have to develop a new audience of end-users to whom they disseminate knowledge arising from previous research and information on the current event based on new research (Quarantelli 1993). The utilisation of existing relationships to encourage trust (for example, the use of local contacts if the research team is not based locally), and evidence of the ability to help the recovery effort (such as the use of easily digestible advice notes or targeted presentations) both help engagement with new end-users. For researchers to deliver the information that end-users require, it is important that end-users are given the opportunity to define the problems, so that there is a two-way flow of information (Myers 1993). An instance of this is evident

in the modification of the pedestrian footfall survey after feedback from Christchurch City Council indicated that an additional survey period and alternative survey site would be helpful.

### 3. Commencing applied research projects

In order that researchers can promptly provide the information required by end-users, researchers need to shift their approach from being theory-driven to delivering solutions to distinct problems (Druckman 2000). Both of these studies represent this necessary transition to applied research. First, the pedestrian footfall study sought to identify which parts of the CBD were vulnerable to a loss in business vitality due to a decline in the number of potential customers that would be more accurate than the anecdotal accounts of businesses. Second, the purpose of the migration study was to deliver more accurate information on the nature of population movements from an information source that was readily available, relatively reliable, and up-to-date. Alternative sources of information on population movements were either not accessible to researchers and policy-makers due to confidentiality or would entail a substantial lag in the delivery of such information, for example updates to the electoral roll, that would not meet end-users' desired timeframes.

## Challenges

### 1. Complying with ethical considerations

It is important that researchers respect the needs of human research participants, and at the same time gather information that will deliver research to assist their recovery (Barron Ausbrooks *et al.* 2009; Kilpatrick 2004). Studies were therefore purposefully developed that avoided the requirement to interact directly with potentially traumatised people via the use of an observational technique (pedestrian footfall survey), and the analysis of existing remote datasets (migration study).

### 2. Modifying the dissemination of research findings

For various reasons, academic researchers favour peer-reviewed journals and conference proceedings to disseminate knowledge arising from their research (Druckman 2000; Fothergill 2000). The urgency of the recovery situation requires that alternative means of dissemination are used that will facilitate end-user uptake and meet their desired timeframes (Myers 1993). For these reasons, new reporting formats were adopted

in the studies outlined in this paper, including the preparation of advice notes circulated to policy-makers in the first days after the earthquake. Furthermore as each phase of the two studies was completed, short reports were released to end-users. Whilst this prompt and regular reporting was time-consuming, it facilitated communication with and feedback from end-users. Research findings were also presented to end-users in Christchurch, and made available to other researchers on the Internet. At the same time as this additional direct contact with end-users and regular reporting, preparation of conference papers and journal articles continued (Harding & Powell 2011; Powell & Harding 2011).

### 3. Delivering rapid response research that is both practical and rigorous

To comply with institutional requirements for academic publications, it is recommended that recovery researchers deliver research that is both practical and rigorous (Fothergill 2000). In the immediate aftermath of the 2010 earthquake, resources were initially directed to providing relevant knowledge from earlier research. Then, new research projects were developed that would promptly deliver information to practitioners.

The challenges in terms of the new research were two-fold: first, the research had to be rigorous and scientific to ensure accurate reporting in the short term, and to provide robust evidence for the more theoretical work to follow afterwards; and second, with resources re-directed to aid recovery, there was a risk that existing funding would be quickly depleted, leaving little for theoretical work once the urgency for information had passed.

Addressing the first of these, proven techniques of data collection and analysis were used in both studies. For the pedestrian footfall study, it was essential that data collected across the different sites and on different occasions were comparable. Therefore the student observers received training in the observational technique to be used and were closely monitored by an experienced researcher. In the migration study, the remote datasets were scrutinised before analysis to check for discrepancies and the limitations of the datasets were understood. Analysis of the datasets used a well-established and appropriate statistical technique, Chi-Square analysis, and was undertaken by experienced statisticians. In both studies, data analysis and reporting accuracy were verified by independent reviewers prior to the release of reports.



To meet the challenge of delivering theoretical research after the emergency had passed, studies were purposefully aligned to intended research. Furthermore, it was planned that data captured should provide the evidence for scientific investigations into the recovery phase of the disaster cycle. The footfall study entailed the capture of perishable data on the number of people frequenting different parts of the CBD. In the short term, the benefit of this data for end-users was a more accurate understanding of pedestrian avoidance and its potential impact on business vitality. The longer term benefit of the research is the subsequent testing of pedestrian footfall as a reliable recovery indicator that would add to the academic knowledge on this topic. Furthermore, the footfall data would be reconciled with the intended business survey, adding a level of richness to that later study as the effect of the earthquake's impacts on potential customers would be known.

As with the footfall study, the immediate benefit of the migration study was to deliver timely information on population movements due to the earthquake to provide an evidence base to appropriately allocate resources to provide for the welfare of communities and mitigate community abandonment. The NZ Post data was found to be the best indicator of movements available that met the urgent timeframe of recovery managers. The intention was to monitor movements over a longer period, identifying when people who left the region due to the earthquake returned. With the database revealing identities and contact details, people's motivations and migration patterns could be investigated at a later date through surveys and/or interviews, establishing a more scientific investigation of people's behaviour.

## Conclusions

Severe seismic events are fortunately infrequent in New Zealand, and rarely affect its major urban centres. The 2010 earthquake in Canterbury presented researchers with a relatively unique opportunity to investigate the post-disaster recovery of the country's second largest city, and to provide useful knowledge to practitioners that would assist recovery.

There is a potential danger that evidence-based decision-making is missing from the recovery phase because researchers do not provide a fast enough response. In order to provide helpful information on post-disaster recovery in a timely, inexpensive and non-invasive manner, it is essential that customary approaches to research and its dissemination are

modified and that potential challenges are overcome.

In the longer term, data captured during rapid response research can become an essential element of more theory-driven and scientific research that will explain recovery behaviour or processes, and will improve understanding of this phase of the disaster cycle. For this reason, it is essential that data collection techniques used by researchers undertaking rapid response research are as scientific and rigorous as they would ordinarily employ.

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# The Management of Portable Toilets in the Eastern Suburbs of Christchurch after the February 22, 2011 Earthquake.

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## Abstract.

*The extent of liquefaction in the eastern suburbs of Christchurch (Aranui, Bexley, Avonside, Avonhead and Dallington) from the February 22 2011 Earthquake resulted in extensive damage to in-ground waste water pipe systems. This caused a huge demand for portable toilets (or port-a-loos) and companies were importing them from outside Canterbury and in some instances from Australia. However, because they were deemed “assets of importance” under legislation, their allocation had to be coordinated by Civil Defence and Emergency Management (CDEM). Consequently, companies supplying them had to ignore requests from residents, businesses and rest homes; and commitments to large events outside of the city such as the Hamilton 400 V8 Supercars and the Pasifika Festival in Auckland were impacted. Frustrations started to show as neighbourhoods questioned the equity of the port-a-loos distribution. The Prime Minister was reported as reassuring citizens in the eastern suburbs in the first week of March that<sup>1</sup> “a report about the distribution of port-a-loos and chemical toilets shows allocation has been fair. Key said he has asked Civil Defence about the distribution process and where the toilets been sent. He said there aren’t enough for the scale of the event but that is quickly being rectified and the need for toilets is being reassessed all the time.” Nonetheless, there still remained a deep*

*sense of frustration and exclusion over the equity of the port-a-loos distribution.*

*This study took the simple approach of mapping where those port-a-loos were on 11-12 March for several areas in the eastern suburbs and this suggested that their distribution was not equitable and was not well done. It reviews the predictive tools available for estimating damage to waste water pipes and asks the question could this situation have been better planned so that pot-a-loo locations could have been better prioritised? And finally it reviews the integral roles of communication and monitoring as part of disaster management strategy.*

*The impression from this study is that other New Zealand urban centres could or would also be at risk and that work is need to developed more rational management approaches for disaster planning.*



Figure 1: Examples of Port-a-loos in the Eastern Suburbs of Christchurch

## Background

Christchurch had earlier undergone a major earthquake of magnitude 7.1 on September 4 2010 and hence was in recovery when the February 22 event occurred. Despite being a “smaller” magnitude 6.3, it was shallow with a depth of 2 kilometres and centred only 10 kilometres south east of the city centre and this resulted in much higher shaking intensity than the September event. This shaking intensity and the time of day 12.51pm resulted in the deaths of 181 people<sup>2</sup> (134 in just two sites) and extensive damage to buildings and infrastructure in the city centre and eastern suburbs that had been weakened by the earlier event. The cost

<sup>1</sup> Reported on National Television ONE NEWS 7 March 2011 downloaded on 1/4/11 from <http://tvnz.co.nz/national-news/key-says-toilet-distribution-nothing-but-fair>

<sup>2</sup> “List of deceased - Christchurch earthquake”. New Zealand Police. 7 April 2011. <http://www.police.govt.nz/list-deceased> Retrieved 8 April 2011

<sup>3</sup> [http://en.wikipedia.org/wiki/February\\_2011\\_Christchurch\\_earthquake#cite\\_note-austcost-12](http://en.wikipedia.org/wiki/February_2011_Christchurch_earthquake#cite_note-austcost-12) retrieved on 20 June 2011

for the reconstruction was provisional put at \$NZ15-16<sup>3</sup> billion making it New Zealand's costliest natural disaster and nominally the 3<sup>rd</sup> costliest seismic disaster worldwide.<sup>4</sup>

The resulting liquefaction in the eastern suburbs caused bridge approaches to settle, water pipes to fracture, waste water pipes and access points to surface, roads to sink, land to shift laterally, houses and buildings to tilt and blanketed the area with foul smelling silt. The apparent need for port-a-loos was recognised on Day 1 and certainly by Day 8 (and probably sooner) they had been deemed "assets of importance" to be distributed by order of CDEM (refer to Appendix 1: The Port-a-loo Timeline). By Day 6 port-a-loos were being positioned throughout Christchurch but even by day 15, much of Aranui did not have any despite earlier assures from the CDEM controller and the Prime Minister on Day 10. Port-a-loos became sought after "luxury" items with suburbs being warned that it could be weeks before they have a "business as usual" flushing toilet. The situation did not appear to have improved by Day 13 and the CDEM controller and the Prime Minister hold public meetings to assure people that all that can be done is being done. However, by day 15-16 it seemed that the shortage of port-a-loos remained and Christchurch reportedly buys out all chemical toilets worldwide. Tempers and frustrations are now being openly expressed and the gap between the apparent policy/protocol of decision makers and the on ground reality is "uncomfortably" acknowledged. On day 23 (despite port-a-loos being assets of importance) the Member of Parliament for Christchurch Central Brendan Burns reports that he brought and distributed 9 from outside Christchurch? Two days later CDEM are reporting that they still do not have sufficient toilets and that 3,000 are on order while suppliers are reporting surplus in their yards? By now the coordination appears to be in "free fall" and by Day 90 there remain significant parts of Bexley and Aranui without flushing toilets: were the eastern suburbs "forgotten" as suggested in the media and what could or should be the management implications?

## Methodology and Results

CDEM had put in place a ban on all "social research" which was not operational required<sup>5</sup>. This was apparently done to prevent a potential flood of researchers into the area and consequently any methodology could not

involve interviews of those affected and needed to be based in the "public domain". Hence, by default (and by necessity), the management "success" of port-a-loos studied was largely spatially based with community inputs being taken from media reports. On the one hand this is perhaps acceptable given the emergency response nature of port-a-loos and their common design features while on the other it would have been useful to relate the number of port-a-loos to the number of people in the areas and get more detailed feed back from those affected. However, the overall migration numbers from Christchurch remains contestable and any breakdown by suburb was and seems to be still unavailable. But as a first feasible step (and as a marker for later independent review of this aspect of the operational response) the field approach adopted was to map the port-a-loos in these selected areas of the suburbs and from that and the theoretical review of what was possible in terms of disaster "readiness" draw out relevant management implications. It should be noted that while this may now seem straight forward, its development and implementation at the time was not. Moreover, there was concern by the authors that the above ban by CDEM could "skew" any post disaster "lessons learnt" and hence the need to record what could be accessed nonetheless. Thus, there was a social advocacy component to this work in addition to the operational aspects.

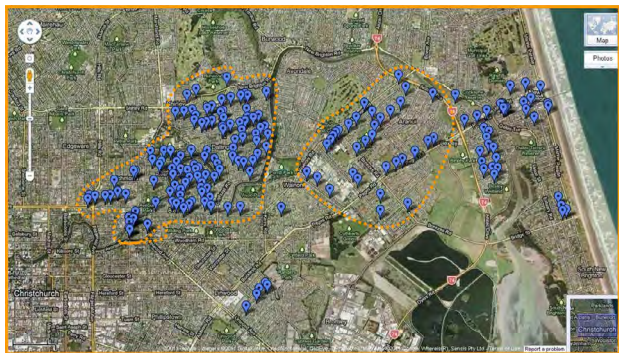
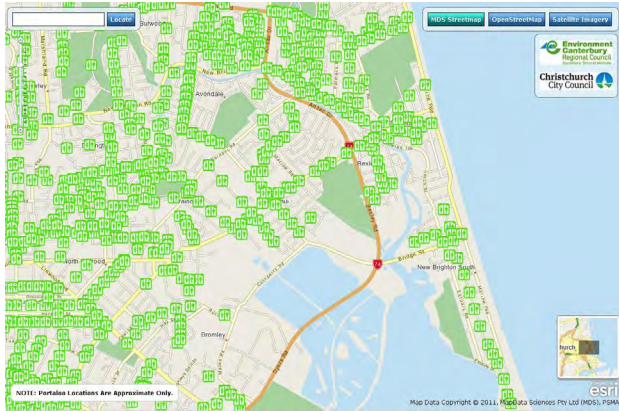
The emergency response had the appearance of being in control and port-a-loos were being shown as mapped on the CDEM/ Environment Canterbury Regional Council (ECRC)/ Christchurch City Council (CCC) web site <http://eqviewer.co.nz/index-port-a-loos.html>. These were checked in selected areas of the eastern suburbs and in particular Aranui, Bexley and Dallington by Dr Paul Steinfort on March 11-12 (Day 17-18) with further checking field work on March 13 (Day 19). These port-a-loos were easily identifiable in the field as can be seen in figure 1 above. The peer review of this paper posed the question of how distributed and non distributed port-a-loos were distinguished in the field. This did not seem to be an issue as all port-a-loos became assets of importance and port-a-loo companies had to withdraw them from local service and supply solely as directed by CDEM. In addition, some streets in Avondale and Avonside were "residents only" and were not mapped; and it was difficult to maintain suburban boundaries when in the field and consequently typical

<sup>4</sup> Scott Murdoch and Andrew Fraser (24 February 2011). "Disaster could cost insurance sector \$12bn". The Australian retrieved 20 June 2011.

<sup>5</sup> Personal communication from Peter Wood CDEM July 14. But also outlined by David Johnston GNS at the July meeting of the social research group as being for all research.

<sup>6</sup> Acknowledgement of Des Brosnahan for the drafting and map construction of the fieldwork

areas within suburbs (rather than full suburbs) were used for comparisons. The mapping was completed and is shown in figure 2<sup>6</sup> together with the CDEM/ECRC/CCC map retrieved on the 15 March (Day 21).



**Figure 2:** Port-a-loo Mapping by CDEM/ECRC/CCC (left) and actual as at 11-12 March (right)

Despite claims to the contrary, the distribution of port-a-loos had not been “fair”. There are apparent visual differences in the “port-a-loo’s per sq metre” between Bexley/Aranui (who are low) compared to Dallington and Avonside (who are high). These are estimated at around 1 port-a-loo/80,000m<sup>2</sup> for Aranui/Bexley compared to 31,000m<sup>2</sup> for Dallington/Avonside. Moreover, within each “suburb”, distribution has not been even and streets such as Gayhurst Rd in Dallington appear to have no port loos and parts/most of the badly hit Waitaki Street in Bexley have also been missed. This is also apparent in other areas outside these suburbs and for example Jolie Street in North Linwood/Bromley and Hargood Street and Cuminor Tce in the Woolston area all have many port-a-loos while the surrounding streets have none. The “asset of importance” tag does not appear to have been reflected in their distribution. Some could/would have been adjusted (based on comments in Appendix 1) but not to the extent suggested by the mapping. This would have required the moving of every

2<sup>nd</sup> port-a-loo from Aranui/Bexley to Dallington/Avonside if equity had been achieved at distribution.

It is also interesting when the “actual” are compared to the CDEM/ECRC/CCC map and it would seem that the sorts of “inequities” measured in the field are also apparent on the CDEM map. Moreover, the unevenness within each area as noted in the field is also apparent in the CDEM map. Thus, the earlier impression from people in the Eastern suburbs that there were inequities in the distribution of port-a-loos (and their sense that they may have been forgotten) does appear to be supported by both the field work and the CDEM mapping.

## The Christchurch Response

What can be learned and how can the disaster management community in New Zealand move forward from this point? Risk is often described using the relationship below<sup>7</sup>:

$$\text{RISK} = \text{HAZARD} \times \text{VULNERABILITY}$$

Which in recent years been suggested should more accurately be<sup>8</sup>:

$$\text{RISK} = \text{HAZARD} \times \text{VULNERABILITY/RESILIENCE}$$

Risk= Is the probability of an event occurring, it can be calculated and results from the combination of a hazard and a vulnerability (but not normally resilience)

Hazard= Is a potential threat of an event to a community.

Vulnerability= Is a condition or predisposition; it is a set of prevailing or consequential conditions, which adversely affect the community’s/individual’s ability to prevent, mitigate, prepare for or respond to an event.

Resilience= The capacity of a community/individual to not only adjust, recover and adapt but to thrive despite its hazard or vulnerabilities. It usually involves access to resources, skills, networks or beliefs and is difficult to assess.

NB: inherent in this analysis will be the expectations of the communities/individuals or “stakeholders” (as there could/will be others beyond solely communities and individuals)

Disaster responses and management approaches generally address these 3 aspects of hazard, vulnerability or resilience. The provision of port-a-loos (and soon after chemical toilets) was a vulnerability response. Hazard response such as abandonment of certain areas is presently underway and hence the note on stakeholder

<sup>7</sup> United Nations (2004): Living with Risk: A global Review of Disaster Reduction Initiatives. United Nations International Strategy for disaster Reduction, Geneva, Switzerland.

<sup>8</sup> White, P., Pelling, M., Sen, K., Seddon, D., Russell, S., Few, R. (2005): Disaster Risk Reduction. A Development Concern. DFID.

expectations. Resilience (the most difficult) was evident by those that moved out of the Eastern suburbs estimated at around 60% for Aranui<sup>9</sup>. It was perhaps apparent in <http://www.showusyourlongdrop.co.nz/> “set up to showcase all the creative Long Drops that are popping up around Christchurch”<sup>10</sup> and also in figure 3 below of a port-a-loo, before and after.



Figure 3: Qualitative Evidence of Resilience in Christchurch

### A disaster manager’s tool box

What can be learned will be summarised later but moving on with the discussion and as a counter point to the analysis above is the risk management process codified for New Zealand and outlined in figure 4<sup>11</sup> below. It suggests and represents a rational and thoughtful process with the key steps highlighted in the middle column linked on one side by the need to communicate<sup>12</sup> and on the other by the need to monitor; presumably at all stages of the process. Communication and monitoring are important not only to make sure that those affected are firstly informed and consulted but also that any intended outcomes do actually occur at

all levels. This didn’t seem to happen with the port-a-loos but moreover, there did not seem to be the need to communicate directly with the field or with those affected an impression gained from Appendix 1 but also from being in the field. While it is not possible to communicate with all, the assurances given on Day 13 should not have been questioned so readily by simple mapping?

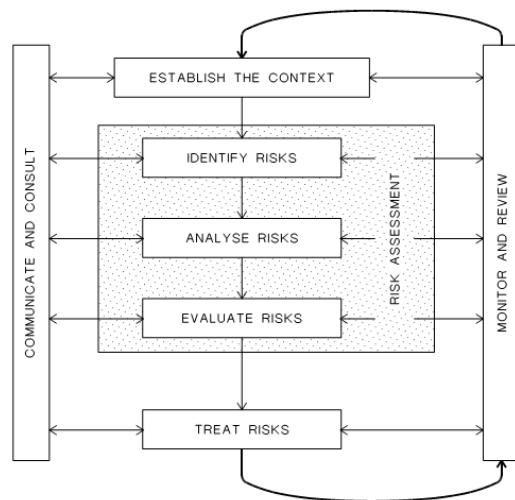


Figure 4: The risk management process

Moreover, disaster responses are phase dependent and these are most commonly expressed as the 4R model which can also come in a 3R and a 5R form<sup>13</sup>. The “R”s represent the different phases of Reduction, Readiness before the disaster; and Response and Recovery after with sometimes a 5<sup>th</sup> R for Reconstruction. It is usually expressed as a linear model with one phase linking into the next but has been also depicted as a circle (linking back on itself) or as a spiral suggesting a new reduced vulnerability in future disasters cycles. The port-a-loo response took 15-16 days to realise that it was not filling the gap left by the failure of the wastewater water system in several of the eastern suburbs and it would appear by Day 23 that the process was in free fall. This does happen in humanitarian responses where recovery phase solutions are inappropriately used for the response/emergency phase. Unfortunately as was the case in Christchurch it took too long to implement despite experiences from the earlier September

<sup>9</sup> Unpublished work An Analysis of the Door Knocking Data for Nga Hau e Wha National Marae, Aranui Christchurch. What does it suggest for the way forward? Potangaroa R 26 April 2011

<sup>10</sup> <http://www.showusyourlongdrop.co.nz/> retrieved 20 June 2011.

<sup>11</sup> SNZ HB 4360:2000 New Zealand Handbook Risk Management for Local Government NZ Standards Association pg 9.

<sup>12</sup> T. Schacher Good Engineering without Appropriate Communication doesn’t lead to Seismic Risk Reduction: some thoughts about appropriate knowledge transfer tools 14<sup>th</sup> World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China

<sup>13</sup> Ministry of Civil Defence Emergency Management (MCDEM) (2004). National CDEM Strategy 2003-2006 pub. by the NZ Govt pp14-16

earthquake. Future emergency responses on the scale of Christchurch should perhaps use the example of the long drop (as is the standard in humanitarian responses<sup>14</sup>) and promote and distribute plans and present workshops on their construction.

Up to this point, the tool box has focused on the seemingly separate disaster phases. Stephenson et al study<sup>15</sup> on the resilience of businesses in Auckland New Zealand however have managed to link both the before (readiness phase) to the disaster (response and early recovery phase). Their study, based on survey responses from 249 individuals from 68 different organizations, suggests that there are two distinct phases; a planning dimension that happens prior to the disaster and an adaptive capacity dimension that occurs once the disaster happens. Private organizations were more adaptive than public ones, and larger companies tended to have higher planning than smaller ones, however almost all sectors (except communications) scored higher on the adaptive dimension rather than planning. Unfortunately no public utilities companies were involved. Nonetheless, the study and the apparent response in Christchurch suggest there was minimal adaptive capacity in as far as the waste water systems.

**Table 1:** Dimensions of Planning and Adaptive Capacity

Planning Dimension (before)	Adaptive Capacity Dimension (after)
Planning strategies	Leadership
Participation in exercises	Staff involvement
External resources	Situation monitoring and reporting
Recovery priorities	Minimisation of silos
Proactive posture	Internal resources
	Decision making
	Innovation and creativity
	Information and knowledge

## Waste water pipeline management in New Zealand

Zare et al<sup>16</sup> would probably go further and their work suggests that if public wastewater companies in New Zealand had been involved that they would have scored low values in both the planning and adaptive capacity dimensions. Breaks in pressurised water supply pipes can be readily identified while those in essentially gravity waste water pipes cannot and the approach used by

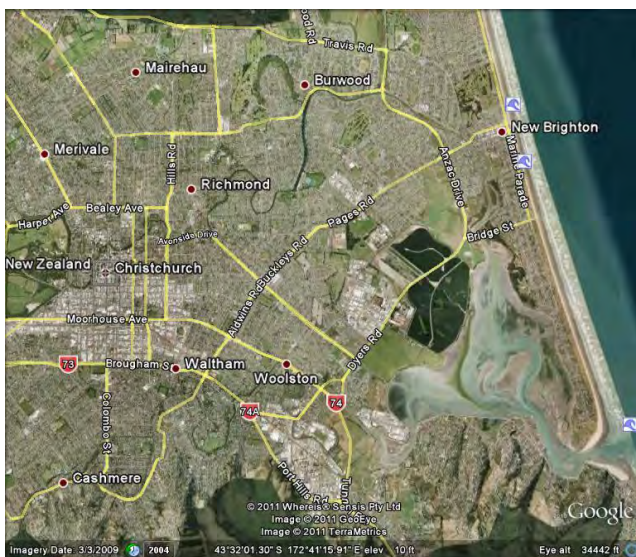
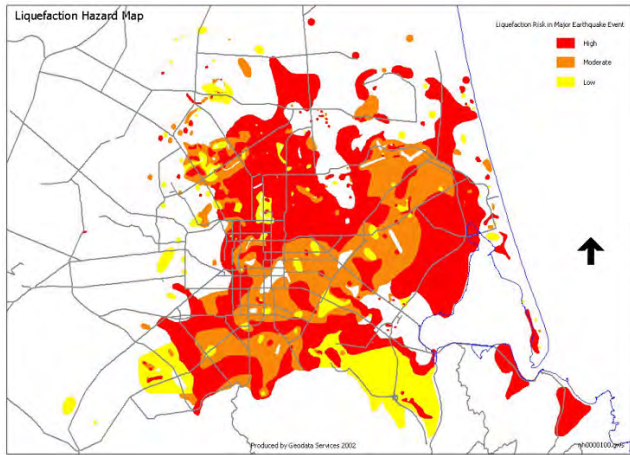
the 4 New Zealand case studies was to wait till there was a problem. And while there are fragility or f-curves for water pipes there are apparently none for waste water pipes. Such curves give the expected damage rates for pipes of different types, sizes, age and soil condition under different peak ground accelerations or more commonly velocities that can be expected in a seismic event. Consequently, there is presently no clear engineering basis for pipe network management and planning and given the apparent lifeline status of at least main waste water lines should be disturbing. The CDEM Act 2002 section 60 stipulates that "...every lifeline utility must:

- (a) ensure that it is able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency;
- (b) make available to the Director in writing, on request, its plan for functioning during and after an emergency;
- (c) participate in the development of the national civil defence emergency management strategy and civil defence emergency management plans;
- (d) provide, free of charge, any technical advice to any Civil Defence Emergency Management Group or the Director that may be reasonably required by that Group or the Director;
- (e) ensure that any information that is disclosed to the lifeline utility is used by the lifeline utility, or disclosed to another person, only for the purposes of this Act." None of these were seemingly achieved following the February 22 event. The lack of any engineering basis to predict the extent (and possibly the location) of damage to waste water lines probably means that alternative solutions needed to be incorporated into a response plan; port-a-loos at the scale of the Christchurch earthquake did not work.

<sup>14</sup> UNHCR 2004. *Handbook for Emergencies* 3rd Ed 2004 Published by The United Nations High Commissioner for Refugees

<sup>15</sup> Stephenson, A; Vargo, J, Seville, E. Measuring and Comparing Organisational Resilience in Auckland. *Australian Journal of Emergency Management, The*, Vol. 25, No. 2, Apr 2010: 27-32

<sup>16</sup> Zare M Wilkinson S, Potangaroa R, Resilience of Wastewater Pipelines to Earthquakes: New Zealand case study COBRA Conf. Paris 2010



**Figure 5:** The extent of Liquefaction in Christchurch<sup>17</sup> (right) and an aerial view (right). \*(Aranui shown in dashed circle)

Pit latrines (or what are called longdrops in New Zealand) are recognized as one of the few emergency/ response phase approaches that work<sup>18</sup> and these probably need to be included in future emergency response plans. However, it is not clear at what scale of disaster and what level of port-a-loo supply would trigger this approach? It is clear that in an urban setting with minimal open spaces and multi-storey (residential) buildings would probably make such an approach impractical. And given the extent of potential liquefaction in Christchurch (red areas in figure 5 above) would have required extensive evacuation.

## Conclusion

Disaster management still seems to be a developing area of research and understanding. Significant difficulties included the “perishable” nature of disaster data, difficulties of measuring (what to measure) and metrics (how to measure), isolating cause and effects (especially where the “causes” may have been in place well before the disaster), the difficulty to test systems and procedures without a disaster and the various assumptions or “myths” (the social context) that seeming surround such work. Perhaps one of the myths is that we are prepared and it has been surprising to the authors that a simple port-a-loo mapping exercise pulled together various research strands. It seems that the following management experiences can be carried over:

- Port-a-loos are not a timely emergency response for large scale disasters such as Christchurch post February 22 and other possibly “long drop” options need to be agreed upon.
- Nonetheless, in larger urban situations with high rise buildings and minimal open space, evacuation maybe the only option
- There is a need to better communicate the protocols and criteria for port-a-loos and in particular their allocation to specific areas such as retirement homes.
- In field monitoring is required and in particular feedback from those affected needs to be sought.
- The risks of failure of waste water systems need to be researched and in particular f-curves developed
- Unfortunately, the waste water practices in New Zealand probably mean that the experiences in Christchurch will be repeated in other urban centres.

Thus, there is the need for better assessment systems on which to base a focused management system.

<sup>17</sup> Christchurch Liquefaction Study - Stage II ECan Report No. U02/22 Prepared for Environment Canterbury by Beca Carter Hollings & Ferner Ltd May 2002

<sup>18</sup> UNHCR Handbook for Emergencies chapter 15



## APPENDIX 1: The Port-a-loo Timeline

Feb 22 2011 6.3 Earthquake

23 February <http://www.scoop.co.nz/stories/AK1102/S00823/request-for-portable-toilets-and-petrol-in-christchurch.htm>

Day 1 **Request for Portable Toilets and Petrol in Christchurch Press Release: Rural Women New Zealand**

### Urgent request for portable toilets and petrol to support elderly and disabled Cantabrians

In the wake of yesterday's earthquake, there is an urgent need for portable toilets at the Christchurch offices of homecare company Access Homehealth Ltd, so that it can begin operating again.

The company supports elderly and disabled clients in Christchurch and the wider Canterbury area with daily care needs. The offices of the two other Christchurch home healthcare companies (Nurse Maud and Healthcare New Zealand) are out of action. Access has offered to share its premises with to these two companies so that urgent services can be co-ordinated for all their vulnerable clients, including the urgent distribution of water. If anyone can help with this request, the toilets should be delivered to Access' offices at 100 Carlisle Street, Christchurch. This is outside the restricted zone. At least six toilets are required.

Port-a-loos: 780 port-a-loos are distributed around the city. Another 250 port-a-loos are in transit nationally, and a further 963 in transit from the United States of America. Christchurch City Council has requested 30,000 chemical toilets. This is being actioned by the National Crisis Management Centre.  
[http://www.facebook.com/note.php?note\\_id=196767083685402](http://www.facebook.com/note.php?note_id=196767083685402)

1-9 March  
Day 7-15 Residents in the Christchurch suburb of Aranui say they have been overlooked in the rush to help other victims of the quake. <http://www.3news.co.nz/Aranui-residents-feel-ignored-by-council-in-quake-cleanup/tabid/423/articleID/200403/Default.aspx>

But others don't have that choice, without water, power or sewerage they're beginning to feel fed up. Resident Christopher Murphy says he is "pissed off" at how slow progress is.

"We want toilets, we want port-a-loos you know," he says. Mr Falomalo says port-a-loos have come through but haven't been for Aranui residents. 3 News took their request directly to the mayor. "Well I think it's an outstanding response to a very difficult situation, and you know is it good enough that we had a 6.3 earthquake that's taken potentially hundreds of lives," says Christchurch Mayor Bob Parker.

### COMMENTS

**AM** 09 Mar 2011 7:54p.m.... No one from any department or organisation has knocked on my door more than two weeks after the fact, and not having a single port-a-loo on the block for a week and a half -while being told that you should dig a hole in your yard (which you no longer have)

**Floss** 08 Mar 2011 8:06a.m.Loosers let things happen, winners make things happen. Other areas haven't got power, water, and port-a-loos, at least all the ones in Housing Corporation Houses are getting a Holiday from their rent,

**Georgie** 03 Mar 2011 9:46a.m.Cashmere and Huntsbury had no port-a-loos. And we have seen no one. I mean no one.

**Dallington Resident** 01 Mar 2011 11:57p.m.This is an ongoing feeling that people all over Christchurch are all feeling. I live in a street in Dallington, the same applies to the treatment we have had there, many people have moved out, but again we have a strong group willing to stick it out. We have no power, no water, or sewage either, no port-a-loo's and from the start I felt that this time was going to be different. We have police presents and local groups watching out for one another, but as we all get sick and tired of waiting for something to happen we have nothing to do but vent or do it yourself. Our street has pulled together to clean our street for pickup, but 3 days since contact we have still not seen a truck to collect it. I back the comments made by the people in this story. I could list many of a problem with what is not happening, but I hope in time it does. I've noticed that streets like hills road have 5 pot-a-loo's with 300 meters of each other and then around 5 scattered either side of the road, you can understand how we get a little peeved.

**Dene** 01 Mar 2011 9:50p.m. I would say that 90% of the city has seen no one. Until this morning Cashmere and Huntsbury had no port-a-loos. And we have seen no one. I mean no one. No student army. No food drops. We have no water or sewers either. Aranui is no worse, it is just full of moaners.

2 March **NZ Herald Residents unable to hire temporary toilets**

Day 8  
Assets of importance By Yvonne Tahana and Bernard Orsman Demand for temporary toilets in Christchurch is so high that one company is importing them from Australia - but private households won't be allowed to hire them. Hirepool operates Port-A-Loo and so far it had sent 500 to the city, chief executive Mark Powell said. It is one of a number of businesses servicing residents. Under legislation - because the units are deemed **assets of importance** - Civil Defence has to co-ordinate where the toilets go.

Staff were having a hard time explaining the company's legislative obligations to residents, rest homes and businesses who just wanted to sort sanitation problems themselves, Mr Powell said.

"We're not actually able to hire out to private citizens. Our guys are driving past people and they're being waved down by people who are yelling 'stop I need a toilet.'"It's really hard saying 'I'm sorry I can't help.'" Mr Powell advised residents to call authorities and tell them how many people were in their street so their needs could be addressed faster. In the meantime, the company was in the process of sourcing 300 more toilets from Australia.



- 3 March  
Day 9 [http://www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=10709835](http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10709835)
- On the eighth day, there was wind and dust. In Dallington there is plenty of both, but Port-a-loos are much harder to find... She uses the description used by many others in the same situation: "It's like camping." The optimistic attempt to view it as an adventure is always delivered with the same fed-up shaky smile. There is little fun in "camping" with six children, aged 3 to 10, in such conditions. People don't complain about their own plights when they know that in the CBD people lie dead. "We're fine, we're alive," is a constant refrain, followed by a plaintive "but a Port-a-loo would be nice." Eight days on, the Port-a-loo wars are intensifying. In suburbs such as Bexley, Aranui, Avonside, and New Brighton, where the sludge was at its worst and power and electricity are distant memories, there are only a few Port-a-loos, some serving more than four streets.
- Port-a-loos are the new currency and reports emerge of stealth raids on Port-a-loos in other neighbourhoods and of people hiding them away on their own sections rather than sharing.
- People hear news of 900 Port-a-loos on the way, another 500 on order. But they never seem to arrive.
- Ms McFarlane knows Sumner has a good supply of Port-a-loos - and that they got them early, as did Lyttelton. "The rich people seem to get them," she says, resigned. In Bexley there is at least one consolation to living near the sewage ponds - they were among the first to have the big piles of silt on their streets carted away, reducing their dust. There are still no Port-a-loos but the bills are still getting through - it's the postie's first day back at work.
- 
- 3 March  
Day 9 [http://www.nzherald.co.nz/social-issues/news/article.cfm?c\\_id=87&objectid=10709998](http://www.nzherald.co.nz/social-issues/news/article.cfm?c_id=87&objectid=10709998)
- "We've had WINZ (Work and Income) and the Red Cross coming every day to see people yet you couldn't go to the toilet," said community nurse Jenny Herring. "I was piddling behind the garage. We felt very neglected in that area."
- [http://www.nzherald.co.nz/social-issues/news/article.cfm?c\\_id=87&objectid=10709998](http://www.nzherald.co.nz/social-issues/news/article.cfm?c_id=87&objectid=10709998)
- A mother of six, Mrs. Manuleleua flagged down the toilet truck yesterday and begged the crew to position one of the 10 port-a-loos allocated to Hampshire St outside her front door. Even then, for little Rosemary, aged three, relief was not immediate - she locked herself in the unfamiliar contraption before a tearful extrication. Mrs. Manuleleua said Rosemary had had sanitary issues since last week's quake. "I had to force her to go outside in a hole in the garden."
- 
- 4 March  
Day 10  
Assistance slow to eastern suburbs [http://www.campusdaily.co.nz/read\\_university\\_news.php?title=christchurch\\_earthquake\\_relief\\_at\\_hand\\_for\\_the\\_eastern\\_suburbs\\_3881](http://www.campusdaily.co.nz/read_university_news.php?title=christchurch_earthquake_relief_at_hand_for_the_eastern_suburbs_3881)
- Christchurch earthquake: Relief at hand for the eastern suburbs**
- With the rescue phase over in Christchurch's central city, authorities were yesterday working to restore vital services to the city's badly hit eastern suburbs as the Government acknowledged help had been slow coming. Labour's Christchurch East MP, Lianne Dalziel, bloggers and residents of the eastern suburbs themselves have raised concerns about a lack of toilets, water and power in the wake of last week's quake. Residents of some areas had reportedly taken matters into their own hands by stealing Port-a-loos from other suburbs. While national Civil Defence controller John Hamilton yesterday said the eastern suburbs had not been forgotten and everything possible was being done to provide help, a spokesman for Earthquake Recovery Minister Gerry Brownlee acknowledged, "It is apparent, given the scale out there, that there just wasn't sufficient hardware out there, loos and the like." Early yesterday, Mr Brownlee made it clear at a Civil Defence meeting that relief for the eastern suburbs "had to be a priority." "It was agreed and they're working on it," the spokesman said.
- Prime Minister John Key said that given the significant loss of life in the central city, "it's been appropriate to prioritise that area" However, he had seen the eastern suburbs soon after the quake, and "obviously it sustained a lot more damage" than in last September's jolt. He would visit the area again today. "I understand the issues and I understand the stress completely ... The process has been slow. I think we accept that but it's not for the want of trying. I'll have a look tomorrow and ask more questions." He had sought assurances from authorities that every effort was going into helping the residents of the badly affected areas. "On the advice we've had they've been doing the best that they can." "I'm confident that the resources will be applied to the east of Christchurch as rapidly as they physically can be." At Avonside, some relief had filtered in. Yesterday, power returned to many houses and the roads were largely cleared of the mountains of silt collected from the roads and gardens. However, even the arrival of 80 more Port-a-loos in Avonside and neighbouring Dallington meant residents were still relying on sparsely placed Port-a-loos along the main roads, far away from the back streets. Local resident Amie Wagenvoord said having power would make a massive difference but she was angered at reports that other suburbs got more help, faster. "They promised us that all the hardest-hit areas would be treated the same, that no one else was getting more help than others in similar situations." Two Port-a-loos had mysteriously appeared further along the road, reportedly stolen from other suburbs which had plenty. "Vigilantes! We are creating anarchy. People are driving down the roads stealing Port-a-loos - that's what it's got down to." Her husband, Scott Wagenvoord, said a friend who lived in Spreydon had told him they now had water and could use their toilets, but still had Port-a-loos on most streets. However, he felt most for Bexley and was delighted to hear they were getting individual chemical toilets. "For the last six months, they've lived what we're only just living now." He conceded there was some suburb envy and a perception the wealthier suburbs got more help, faster. "I drive home through Fendalton and they've already got spray paint on the roads indicating where potholes need fixing. "But let's not be bitter."
- AID TO THE EAST\* 400 welfare and 50 search-and-rescue staff are visiting homes in the area.\* 86 extra Port-a-loos were to be delivered to Avonside and Dallington yesterday.\* 1200 more are due by the weekend.\* 2000 chemical toilets were due to be delivered by the army tomorrow.\* 30,000 more were due to arrive by Sunday.\* 87 per cent of Christchurch homes had power on by yesterday.\* 67 per cent had water.

5 March  
Day 11

With parts of Christchurch's wastewater network still some way from repair, residents in many areas of the city will be faced with using port-a-loos and chemical toilets for the next few weeks at least.

Several thousand of these temporary toilets are being distributed around the city in the affected areas. While the Council acknowledges that sharing ablution facilities with strangers is not easy, it has some tips on toilet etiquette to help ease the situation.

- Be tolerant.
- Think of your neighbours – leave the loo how you would like to find it.
- Be patient – Council staff are working around the clock to remedy the situation.
- Be scrupulous about hygiene – wash hands thoroughly and have plenty of hand sanitiser available.

The Council also has concerns about how waste is being disposed of. Remember to follow these simple rules:

- For those without any toilet services, well-wrapped solid waste can be disposed of in the red bin. Liquid waste should not be put in the bin but rather buried on-site.
- Do not dump plastic bags of waste into port-a-loos. This blocks the suction pipes and can take several hours to repair.
- If you are using a chemical toilet, dispose of waste at specified dump sites that are being delivered into neighbourhoods.

The Council has asked that residents do not dump liquid waste in the red bin as these are emptied into compactor trucks which will burst the bags and create a significant health risk.

Port-a-loos will remain on site for some days after water is restored in case the sewer pipes are not usable. It may take a while for this damage to show.

5 March  
Day 11

The lack of a toilet is the worst of it, she says. "I get up twice a night and in the morning take a bucket down to the Port-a-Loo. It's a bucket parade but I get down there early," she says as we watch a neighbour with a red bucket heading in that direction....Last stop of the night is the disaster zone of Bracken St in Avonside which leads straight down to the Avon River. The street has huge holes and no power, water or Port-a-Loos....About 4pm and we are back at Pages Rd with the army which is using 10 trucks to deliver 4500 chemical toilets to households. The boxes come with the happy slogan: "Companion, you're never alone". ...For Shayne Wheble, whose two-bedroom house, which is without water and power, is hosting three adults and four children, the toilet is a welcome addition. Likewise for Aranui amputee Brian Mckay, who gets his chemical toilet delivered personally by Tim Cronin, from the Fellowship Baptist Church in Kelston, Auckland. "Christchurch's eastern suburbs 'mobilising' after earthquake" MARTIN VAN BEYNEN [stuff.co.nz](http://stuff.co.nz)

7 March  
Day 13

<http://tvnz.co.nz/national-news/key-says-toilet-distribution-nothing-but-fair-4047445/video>

Prime Minister assures Christchurch



**Toilets still a talking point in quake-hit Christchurch**

Published: 10:18AM Monday March 07, 2011

Source: ONE News

Authorities are still scrambling to get 30,000 chemical toilets to residents in the worst-hit suburbs of Christchurch.

The lack of working toilets is upsetting many residents while others are having difficulty with the unfamiliar portable loos. At this morning's media briefing, Mayor Bob Parker gave a theoretical **demonstration** of how to operate a chemical toilet. Prime Minister John Key said a report about the distribution of port-a-loos and chemical toilets shows allocation has been fair.

Key said he has asked Civil Defence about the distribution process and where the toilets been sent. He said there aren't enough for the scale of the event but that is quickly being rectified and the need for toilets is being reassessed all the time. A shortage of port-a-loos and chemical toilets was the top concern expressed by residents at community meetings in the eastern suburbs yesterday. Residents said they did not have enough of the toilets, and those that were available were too far away from their homes and were filled to overflowing. Authorities said the huge amount of damage underground was hampering their efforts to repair water and sewerage systems and no time could be set for completion of this. Civil Defence director John Hamilton today responded to reports of port-a-loos overflowing in the eastern suburbs, saying more will be provided from areas where they're no longer needed. "I have asked to have a review of where the port-a-loos are currently located and we will redistribute those which are no longer required because water and sewerage have returned to those properties. I suspect port-a-loos in southern and western parts of the city may be able to be relocated to the east," he said. Hamilton said officials are also looking at whether the arrangements for servicing the toilets are adequate. Mayor Bob Parker said there is no point in having all the port-a-loos out in the suburbs if they're not being looked after properly. "There's nothing worse than being confronted with a port-a-loo that needs a really good clean."

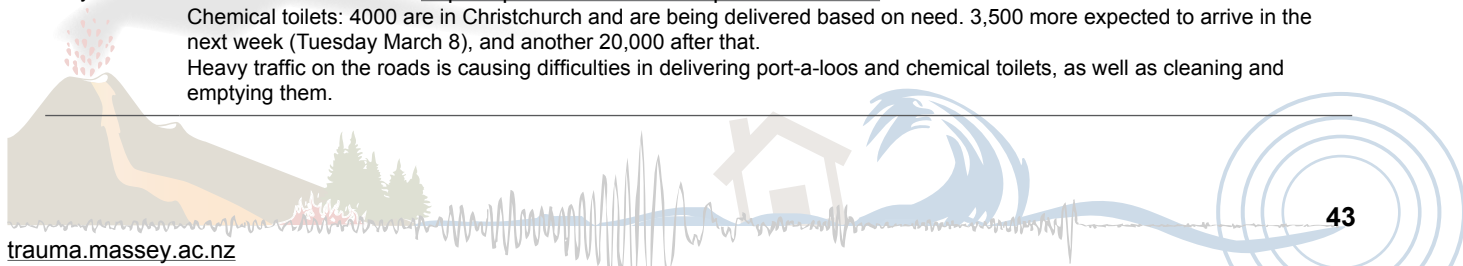
Parker also denied reports that yesterday's community meetings were angry. He said he was at four of the five meetings held across the eastern suburbs and they were "tremendously positive" meetings.

He said there are frustrations in the community around the number of port-a-loos and chemical toilets, and quake recovery arrangements, and that is completely understandable. Last week an Air New Zealand engineer even decided to show people how to make their own portable toilet if they were desperate.

9 March  
Day 15

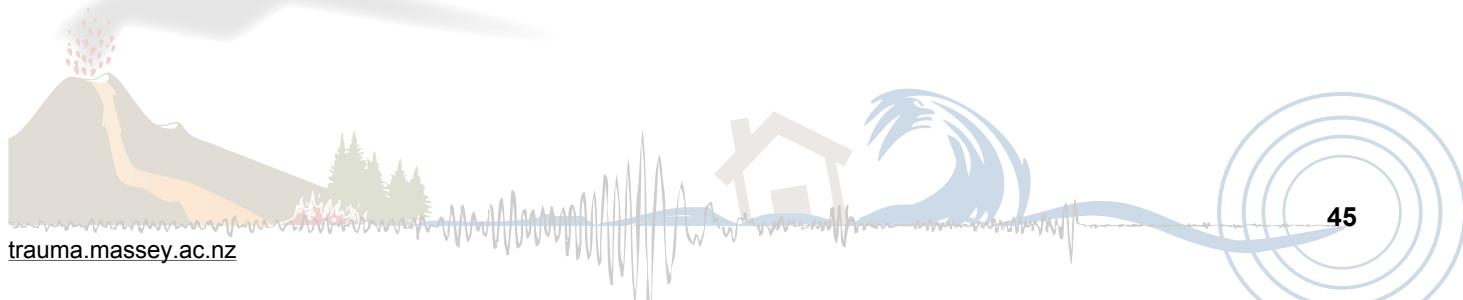
CDEM Update #CHRISTCHURCH #EQNZ Quake Update 110  
Pot-a-loo toilet locations <http://eqviewer.co.nz/index-port-a-loos.html>

Chemical toilets: 4000 are in Christchurch and are being delivered based on need. 3,500 more expected to arrive in the next week (Tuesday March 8), and another 20,000 after that.  
Heavy traffic on the roads is causing difficulties in delivering port-a-loos and chemical toilets, as well as cleaning and emptying them.



9 March Day 15	<a href="http://www.prmatters.co.nz/tag/christchurch-earthquake/">http://www.prmatters.co.nz/tag/christchurch-earthquake/</a> However, even now I sense that the tendency to stray into the realm of un-realism is irresistible to some media, and in the process distorting the bigger picture. Possibly because of perceived injustices, port-a-loos are emerging as a symbol of this tendency. In no way do I underestimate the disappointment, discomfort and unpleasantness of not having a flush loo. However, the reality is that in a number of areas the waste system that has served so many for so long, and so faithfully, has been destroyed. A replacement system cannot be conjured up, so holes in ground, plastic bags and chemical toilets, where there is no escaping one's own waste, are the new reality. As important as toileting facilities are, are they really the major concern of the majority of quake-affected Cantabrians at this time?
9 March Day 15 Long drops	<a href="http://www.stuff.co.nz/national/christchurch-earthquake/4747675/Christchurch-earthquake-World-out-of-chemical-toilets">http://www.stuff.co.nz/national/christchurch-earthquake/4747675/Christchurch-earthquake-World-out-of-chemical-toilets</a> Christchurch has exhausted the world's supply of chemical toilets after the devastating February 22 earthquake wreaked havoc on the city's eastern suburbs. More than 500 people from quake hit suburbs gathered in Richmond this morning, looking for answers. In silt-ridden Richmond Park, Civil Defence spokesman John Lovell told the crowd port-a-loos and chemical toilets were being distributed as quickly as possible. "We've exhausted the world's supply of chemical toilets." Lovell said 96 port-a-loos would arrive from the United States to be distributed in Christchurch's eastern suburbs this week. The focus had also shifted, from rescue and recovery in the central city, to the well-being of quake-affected communities. The website, Show Us Your Longdrop ( <a href="http://www.showusyourlongdrop.co.nz/">http://www.showusyourlongdrop.co.nz/</a> ), features photos and descriptions of long drops which are adorned with decoration and practical Kiwi ingenuity.
9 March Day 15	<b>Help on Hand from Hirepool for Christchurch Residents</b> Wednesday, 9 March 2011, 2:26 pm Press Release: Hirepool Limited Help on Hand from Hirepool for Christchurch Residents Seeking Some Relief – Relief is on its way for Christchurch residents still without sanitation and toilet facilities following last month's devastating earthquake with Hirepool Limited increasing its commitment to the region by a further 200 portable toilets due to arrive from Australia next week. New Zealand's equipment solutions leader has sourced the additional Port-A-Loos from Onsite, its sister company in Australia, in response to an urgent request from Christchurch City Council (CCC), with whom Hirepool has established a close working relationship since the original quake first struck the Canterbury region back in September 2010.
10 March Day 16	<a href="http://www.lastwordonnothing.com/2011/03/10/christchurch-hardtack-and-the-myth-of-earthquake-preparedness/">http://www.lastwordonnothing.com/2011/03/10/christchurch-hardtack-and-the-myth-of-earthquake-preparedness/</a> "Only half of those who remain [in the eastern suburbs]... have power, and almost NONE have running water ... Their houses may or may not be intact. Their streets may be clear, broken, or full of silt. Or sewage. There are no showers. Or ways to wash clothes. Or to wash dishes. Or to heat the "must boil" water that is available — assuming they can make it to the nearest water truck, day after day. No refrigeration. No working toilets, and precious few port-a-loos ... The media flies over, drives past and dips into Refugee City, usually at the main welfare or water points. But they don't cover it that much. From my observations, the officials – those who are making decisions about the relief effort – seem to do likewise." Again, not the vision of hell we often see after major disasters — something closer to a really lousy camping trip, perhaps — but still a long way from what residents of a wealthy, educated country with a small population, impressive social cohesion and a great deal of technological and logistical know-how might have expected. Above all, it seems to be a vision of missing or missed communication—and that seems to be the common thread in virtually all disaster response efforts. ...Hyde writes, "they all know they have a major job on their hands out east, and are finally starting to do simple/obvious thing like redistribute port-a-loos in line with the most acute need." This makes me feel rather smug about the latrine seat I have that can snap on to a five-gallon pail—and really, really bad about the deep, abiding lack of civic-mindedness that surrounds us.
10 March Day 16	More toilets on way to Christchurch. Meanwhile, more than 40,000 temporary toilets are on their way to Christchurch as officials struggle to repair the city's heavily earthquake damaged waste water network. Civil Defence minister John Carter said 40 per cent of the city's houses are still without a working toilet, 16 days after the devastating February 22 earthquake. He said 40,131 port-a-loos and chemical toilets had been sourced, with about 5000 expected to arrive today. Suburbs in desperate need had already been delivered 1471 port-a-loos and 4800 chemical toilets, he said. "I know that for those households who cannot use their toilet there is considerable anxiety. I want to assure those people that Civil Defence is getting temporary toilets into Christchurch and out to affected people as quickly as possible." Silt build-up has caused widespread blockages in wastewater pipes in the wake of the Christchurch earthquake. It needs to be jet blasted out of pipes before damage can be fully assessed, said Mr Carter. Christchurch City Council and Defence Force staff were working to find ways to reconnect waste water to the thousands of houses in need, he said. "The earthquake on 22 February did significant damage to the waste water network throughout Christchurch. Civil Defence and Christchurch City Council staff are working as quickly as possible to assess the damage and develop both short and long-term solutions." <a href="http://www.nzherald.co.nz/christchurch-earthquake/news/article.cfm?c_id=1502981&amp;objectid=10711449">http://www.nzherald.co.nz/christchurch-earthquake/news/article.cfm?c_id=1502981&amp;objectid=10711449</a>

- 
- 10 March  
Day 16
- While New Zealand Prime Minister John Key continues to insist that “everything that can be done is being done” to help victims of the devastating February 22 earthquake in Christchurch, thousands of people have received hardly any assistance. The *World Socialist Web Site* spoke to residents from the severely damaged eastern suburbs, where hundreds of homes remain without water, sewage or water. <http://www.wsws.org/articles/2011/mar2011/nzin-m10.shtml>
- Brian Dooley**, a self-employed web technician from Dallington, said his street had been given just two portable toilets. “Nobody in this area has water or sewage,” he said, “and the council says it’s going to take months to restore [the services].” Dooley felt that “the city is doing the best that can be done under the circumstances, but the further east you go the more people feel that they’ve been ignored”. On Sunday Dooley attended one of several community information forums held by Civil Defence—the first local meetings since the quake hit. “About 100 to 200 people attended. People had a lot of bottled up anger,” he said. “They were concerned about [the lack of] basic services. One person mentioned the servicing problems with port-a-loos, with 40 people using the same pot-a-loo.”
- Magnus Koldau** said that although power had been restored to his Dallington home six days after the earthquake, his family was still living without sewage and water.
- “There was lots of chaos over the distribution of portable toilets,” he said. “Some roads have port-a-loos that are not being used but other streets don’t have any. We have dug a hole in the back yard.”
- “There has been no recovery from the two earthquakes in September and December. It is our third run,” she said. “After the September quake, there were just two badly-hit suburbs without power and water 10 days afterwards. Two weeks after this quake, very few people in eastern Christchurch have power, water or toilet facilities.”
- Steve Hill**, a plumber from Bexley, ...voiced his immense frustration over the “lack of information and direction” provided to survivors. “No one out there is making decisions,” Hill said. “No one knows where we are going. This has been going on since the September quake.” He explained that “basic services are still missing from whole areas. Half of Avonside is still using portable toilets.” His street had finally received port-a-loos three days before he spoke to the WSWs.
- “The biggest problem is the land slump [that has occurred], which means there are no drains, sewage or power,” he explained. This had made it almost impossible for him to do his job as a plumber effectively. “The water table sits just centimetres below the land surface. Every time I dig into it, a new spurt of water immediately surfaces,” he said.
- 
- 10 March  
Day 16
- <http://www.nzdoctor.co.nz/un-doctored/2011/march-2011/10/temporary-toilets-delivered-as-fast-as-possible.aspx>
- Thursday 10 March 2011, 3:45pm *Media release from Civil Defence minister John Carter* Providing temporary toilet facilities for earthquake affected Christchurch residents is being worked on urgently, Civil Defence Minister John Carter said today. “There are 40,131 temporary toilets (both port-a-loos and chemical toilets) that have been sourced to meet demand,” Mr Carter said.
- “Sixteen days after the earthquake, approximately 60 percent of households in Christchurch can use their toilets. I know that for those households who cannot use their toilet there is considerable anxiety. I want to assure those people that Civil Defence is getting temporary toilets into Christchurch and out to affected people as quickly as possible.”The latest information I have is that by the end of today, 1471 port-a-loos will have been delivered to the suburbs that need them. A total of 4800 chemical toilets have been delivered and are in people’s houses. A further 5000 chemical toilets are expected into Christchurch today.”The earthquake on 22 February did significant damage to the waste water network throughout Christchurch. Civil Defence and Christchurch City Council staff are working as quickly as possible to assess the damage and develop both short and long-term solutions. “Residents will be given information as their water is connected on how to find out if their toilet can be used. It is important to follow the instructions and advice of Civil Defence.”
- 
- 16 March  
Day 22
- Life in the “New Normal” also has given us a new found appreciation of the basic necessities in life. Power, water from the tap and a working flushable toilet are the new luxuries now. A pot-a-loo is now a popular kerbside fixture that your neighbouring streets will envy; it has now replaced swimming pools as the new chic. <http://www.brands4tomorrow.com.au/the-%E2%80%9Cnew-normal%E2%80%9D-in-our-life-in-christchurch/>
- 
- 17 March  
Day 23
- <http://www.brendonburns.co.nz/?p=487>
- Brendon Burns** Today I will be helping deliver port-a-loos I have sourced from a friend in Marlborough who has rounded them up from Marlborough vineyards. Nine have arrived in Christchurch so far. I am getting them delivered to Avonside, one of the worst-hit neighbourhoods in my electorate. They arrived on Tuesday and have now been cleansed etc, and are ready for Avonside
- The spur for the story was the Prime Minister saying 10,000 homes may have to be bowled, a figure he later said was not an official estimate. The figure itself is not a huge surprise when you consider more than 3000 were in that category after September 4 and that quake was a tiddler compared to February 22. But the process for communicating such information – and the geo-tech reports which fed it – is with the communities involved and their representatives; not a post-Cabinet news conference which then leads to unacceptable extrapolation that has pole-axed some of my constituents. It’s not as if there aren’t enough stresses here already.
- 
- 18 March  
Day 24
- A k19** Mar 2011 12:31p.m. Perhaps if they put the port-a-loo’s where they are actually most needed then they may get used. We had them on our street, but out pipes weren’t damaged so we could use rain water to flush, which meant not needing to use the port-a-loo. Give them to the area’s they need them the most!! <http://www.3news.co.nz/Many-of-Christchurch-port-a-loos-going-unused/tabid/423/articleID/203047/Default.aspx>
- 



19-20 Marc  
Day 25-26

Civil Defence has ordered nearly 3000 portable toilets for the streets following the damage done to the sewage system in the February 22 earthquake. Mayor Bob Parker said the supply of portable toilets was still stretched. Port-a-loo's Auckland branch manager Steve Coulter said a big effort was made to truck 644 of his company's port-a-loos, plus 300 it brought in from Australia, to the quake-stricken city. But Diane Dakin, from Dakin Group, the only manufacturer of the toilets in New Zealand, said that while they were extremely busy, there was not really a shortage of portable toilets as they still had some in their yard. "We have a lot out on the street and they are not getting used." She said people were using the smaller chemical toilets -- Civil Defence has delivered nearly 17,000 of the 41,000 ordered -- but dumping the waste in the portable toilets in the street, rather than the designated chemical toilet waste dump points. "We have to put up with it," she said. The "worst nightmare" was people pulling the toilets up to their driveways or back yards.

<http://www.stuff.co.nz/the-press/news/christchurch-earthquake-2011/4788095/Port-a-loos-go-unused>

#### Comments

**Az #8** 09:45 pm Mar 20 2011 When we finally got our power back on in Aranui not so long ago... we saw a news item regarding the trauma a lady in Redcliffs had experienced when her nice marble benchtop had broken. While I'm sure it might have been important to her... along with other damage sustained to her property it seems that pot-a-loo's have served one very odd function other than the one they were designed for.

They have been a good marker for how many services have been allocated to different areas of Christchurch post quake. It felt like help (and port-a-loos) were distributed according to the perceived value (and socio-economic status) of the area and the kind of people who live there.

I'm sure the relief centre out in Burnside had awesome toilets... it was just strange driving through there toward the airport to flee up north that we passed dozens of port-a-loos in areas with no damage ...and no queues to use them. Send them to Aranui/Wainoni. THEY STILL NEED THEM - unless of course unaffected areas would like to keep them up their driveways just in case

**Mike #7** 11:18 am Mar 20 2011 This is misleading. When port-a-loos were dropped off in the early days they were dropped at the easiest places to leave them (for example the SW), not necessarily where they were needed. People didn't use them because they had sewerage. At the same time people on East side did not have anything like enough. There has been little sign of sensible coordination and this just goes to show that port-a-loos are in the wrong places. It does not mean that they are not needed elsewhere.

**Kevin #5** 10:13 am Mar 20 2011 I would like to know where all these port-a-loos are driving around the brighton area haven't seen them.

**tj #2** 10:29 pm Mar 19 2011 go on! civil defence / council management style in aotearoa! having have to sh^^ in a bucket for nearly ten days I bought a chem dunny from placemakers in desperation - sewage was not going to work. terse phone calls to brenden "pinkoe" burns finally delivered a result: a chem toilet arrived two days after he and his babushkas had handed these things out in the "forgotten suburbs". finally, we got one too (and the rest of our street). we had to sign for them (unlike what happened in these so-called forgotten suburbs) including a declaration we would return the chem toilet once it no longer was needed. finally, today, the port-a-loos were placed in our street..... why? We are all now shi\*\*\*\*\*g in a chem toilet? sorry, this entire "civil defence emergency" and subsequent management is joke. utter imbecilic nonsense. there is no co-ordination - no management - no rationale.

21 March  
Day 27

<http://www.minpac.govt.nz/christchurch-earthquake-week-four/>

**Toilets:** 960 Port-a-loos arrived from the United States on Saturday and are currently being assembled. Another 200 are coming on Tuesday and will be distributed as soon as possible.

More chemical toilets were distributed over the weekend, with a focus on Avondale, Bromley and Avonside. 17,000 toilets are expected to have been delivered by Monday 14 March.

If you are not home when chemical toilets are being delivered a note will be left in your letter box detailing how you can obtain one. Civil Defence is working with the manufacturers to provide affected residents with information about correct use of chemical toilets and will make this available as soon as possible.

An estimated 60 percent of households can use toilets. If you have running water you can flush the toilet sparingly. Also, please check whether the flushing of your toilet is causing any blocking or issue either on your own property or within your immediate neighbourhood - this is because, although toilets may flush, there may be breaks in the system which could cause sewage to leak into the ground or flow in to the streets. Instructions on how to use chemical toilets and how to dispose of chemical toilet waste are available at:

<http://canterburyearthquake.org.nz/2011/03/07/how-to-use-your-chemical-toilet/>

14 April  
Day 51

There has been a sewer collapse on Ferry Road between Charlesworth St and the Ferry Road roundabout. Crews are on site to fix the line, and the road has been closed and traffic diverted.

Civil Defence says the collapse was caused by ground subsidence due to the 22 February earthquake. It could take several weeks to put a temporary fix in place because it is a large sewer approximately four metres deep. Permanent fixes will be part of a programme of work planned as part of the whole city's response to the quake. The collapse has occurred in an area that was already fragile, and raw sewage from the area was being pumped directly into the Heathcote River.

<http://canterburyearthquake.org.nz/2011/04/14/ferry-road-sewer-collapse/#more-7346>

22 April  
Day 59

<http://www.starcanterbury.co.nz/local/news/christchurch-two-months-after-quake/3949239/>

**Major infrastructure breakthroughs:**

\* A temporary sewerage system is in place. It is made up of 2800 port-a-loos and 31,000 chemical toilets with 525 disposal tanks and support for the 20 per cent of users experiencing sewerage issues. Civil Defence still needs everyone else in the city not directly affected to conserve water and flush sparingly to minimise their impact on the fragile infrastructure.

\* 97% of sewer mains are flowing to some degree.

\* Major progress has been made on the Christchurch Wastewater Treatment Plant, which is processing 85% of the city's wastewater.

Treatment capacity is now 40%, up one third from a month ago. Six of the plant's seven primary tanks are operating; although there is less silt entering the plant, it remains fragile.

6 May  
Day 73

<http://www.ccc.govt.nz/homeliving/civildefence/Christchurchearthquake/Toilets.aspx>



Toilets have been distributed to the area indicated on the map because the sewers are damaged and/or full of silt. They may also be more prone to flooding in wet weather.

If you have been given a chemical toilet, please use it, even if your toilet appears to be working.

Chemical toilets offer privacy, security, and better hygiene. Also, because they are used inside your home, they are unaffected by the weather as winter approaches. The number of chemical toilets and disposal tanks is continually being reviewed to ensure they are in the right place and that there are enough of them.

How to get a chemical toilet: If you are in the chemical toilet distribution area but have not received a chemical toilet, call 941 8999. Please don't call for a chemical toilet if you are outside this area.

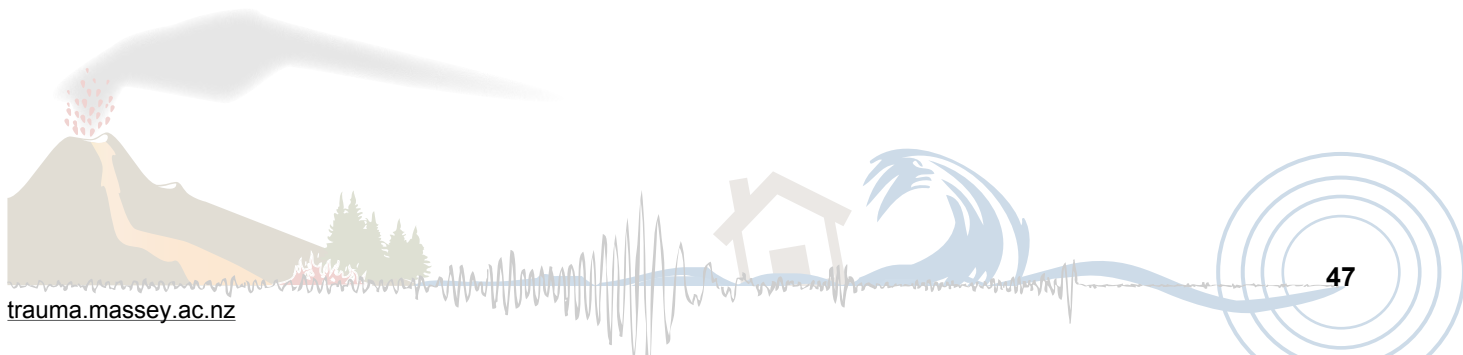
**Emptying your chemical toilet**

Empty your chemical toilet into one of the 400 disposal tanks (see **distribution map**). Do not empty it into a portable (street) toilet. If a full chemical toilet is too heavy or difficult to empty, you do not have to wait until it is full. Alternatively, you can ask a friend or neighbour to help you

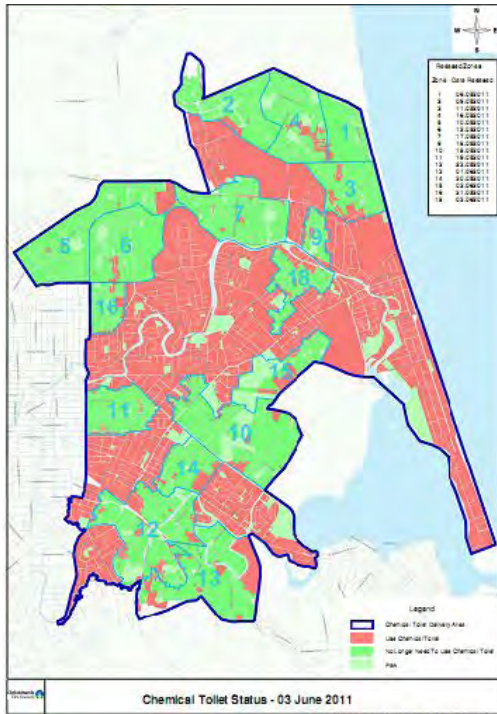
23 May  
Day 90

Three months after the February 22 earthquake devastated Christchurch and nothing much has changed for some residents in the eastern suburbs of the city. When Prime Minister John Key visited the suburb of Bexley 10 days after the quake, Waitaki Street resident Tracey Bolton's biggest criticism was the lack of port-a-loos in the eastern suburbs. Today, Mrs. Bolton says not a lot has changed. "We still haven't got any sewer," she says. "We are still using a chemical toilet, but we're over it. Absolutely over having to go empty it all the time. The closest pot-a-loo to our place is probably 20 metres down the road. And the same with the container..." [http://www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=10727561](http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10727561)

When Prime Minister John Key visited the suburb of Bexley 10 days after the quake, Waitaki Street resident Tracey Bolton's biggest criticism was the lack of port-a-loos in the eastern suburbs. Today, Mrs. Bolton says not a lot has changed. "We still haven't got any sewer," she says. "We are still using a chemical toilet, but we're over it. Absolutely over having to go empty it all the time. The closest pot-a-loo to our place is probably 20 metres down the road. And the same with the container that you empty the chemical toilet as well. She says the family chemical toilet needs to be emptied every second day. Mrs. Bolton lives with her husband and three kids, aged four, nine and 12. Her biggest concern is her nine-year-old daughter, who has type-1 diabetes, getting sick. "We can't really use port-a-loos around the community because I can't risk her getting any infections. She was in hospital last week with really bad tummy pains and a virus. That's not a good start, considering winter has not kicked in yet.



3 June  
Day 101



7 June  
Day 105

<http://www.watoday.com.au/breaking-news-world/effluent-for-nzs-lady-of-affluence-20110607-1fpvq.html>  
The local city council announced last week that the port-a-loos would be collected as Christchurch slowly returns to a semblance of normality following the disaster. Scientists said last week that there was an almost one-in-four chance of another quake measuring 6.0 to 7.0 in the next year

13 June  
Day 111

**Another earthquake** <http://www.kanes.co.nz/2action/1Ev/earthquake.htm>  
Reports coming in are indicating the more liquefaction than as the Feb event. There are more broken buildings in the fenced off CBD and more rocks are falling from the Sumner cliffs. No serious injuries or fatalities reported. Buildings at risk have been closed or removed so not expecting many injuries. The reports are saying many roads are again closed, bent, broken and flooding. The Avon River is flooding its banks in places (that makes me wonder if the whole city has tilted a little yet the tide is high). Streets are jammed as 100s of thousands of people creep home. Power was off to 54,000 homes but this will improve quickly. There is more damage to water and drain systems. The airport is open and operating and it's a warm sunny winter day.

25 June  
Day 123

The Kelly's' Landy St house is coated in dust, they have sand volcanoes in their backyard and have had to shovel silt from their property three times this year. They have not had proper sewerage since September and have lost power and water several times this year. <http://www.stuff.co.nz/the-press/news/christchurch-earthquake-2011/5191894/Earthquake-report-deals-soul-destroying-blow>



# Animal welfare impact following the 4 September 2010 Canterbury (Darfield) earthquake

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## Abstract

*At 4.35am on Saturday 4 September 2010, a magnitude 7.1 earthquake struck near the township of Darfield in Canterbury leading to widespread damage in Christchurch and the wider central Canterbury region. Though it was reported no lives were lost, that was not entirely correct. Over 3,000 animals perished as a result of the earthquake and 99% of these deaths would have been avoidable if appropriate mitigation measures had been in place. Deaths were predominantly due to zoological vulnerability of birds in captive production farms. Other problems included lack of provision of animal welfare at evacuation centres, issues associated with multiple lost and found pet services, evacuation failure due to pet separation and stress impact on dairy herds and associated milk production. The Canterbury Earthquake has highlighted concerns over a lack of animal emergency welfare planning and capacity in New Zealand, an issue that is being progressed by the National Animal Welfare Emergency Management Group. As animal emergency management becomes better understood by emergency management and veterinary professionals, it is more likely that both sectors will have greater demands placed upon them by national guidelines and community expectations to ensure provisions are made to afford protection of animals in times of disaster. A subsequent and more devastating earthquake struck the region on Monday 22 February 2011; this article however is primarily focused on the events pertaining to the September 4 event.*

**Key words:** Canterbury, Darfield, earthquake, emergency, pets, animals, welfare, disaster, New Zealand.

## Introduction

Animal welfare during a disaster has emerged as a critical component of modern emergency management. Many companion animals are considered part of the family and livestock are a primary source of income for many rural businesses. The strong emotional and financial bonds to these animals can result in humans endangering their own safety to save their animals during disaster events. Endangering actions include refusing to evacuate and leave their animals and/or trying to re-enter an unsafe area to rescue or tend to their animals (Glassey, 2010; Heath, 1999; Irvine, 2009). The impact of losing valued animals can also lead to psychosocial effects on humans following the disaster, reducing or delaying their ability to cope and ultimately recover (Hall, et al., 2004; Hunt, et al., 2008). In an online survey of Taranaki and Wellington pet owners, Glassey (2010)<sup>1</sup> reported that more than 63% of respondents (n=92) identified their pet as an important coping mechanism during times of stress and that 99% of the respondents also identified their pet as part of the family. Ninety one percent of respondents also wanted to be involved in the continued care of their pet if evacuated. Reputations could suffer if an individual, company or nation is perceived to be mistreating animals following a disaster, which could extend to financial impact. Thus, the treatment of animals during a disaster is also a significant issue for emergency management, which goes beyond basic animal rights.

This paper seeks to provide a preliminary analysis of impacts on animal welfare following the 4 September 2010 Canterbury earthquake. The scene is set with a brief review of relevant planning for animal welfare during disasters in New Zealand. Several key international case studies are analysed to identify lessons on relevant issues and give insight to potential problems which may develop during future disasters. Lessons for veterinarians and other relevant stakeholders are then presented. This paper does not consider the 22 February 2011 Christchurch earthquake. However, many more people were displaced and homes destroyed. Media

<sup>1</sup> This survey was part of a Master of Emergency Management research report to develop recommendations to enhance companion animal emergency management in New Zealand.

and anecdotal reports at the time indicated the loss of companion animals was a significant issue. Analysis of this event will provide rich data for future research into animal emergency welfare.

## Animal emergency management arrangements in New Zealand

The framework for Civil Defence Emergency Management (CDEM) in New Zealand is established in the Civil Defence Emergency Management Act 2002. The act is based on Norton's<sup>2</sup> dispersed accountability model (Figure 1) that places emphasis for local government to facilitate community level disaster resilience, rather than provide a top down *command and control* environment. Local government is responsible for establishing a Civil Defence Emergency Management Group that is comprised of the regional council and respective local territorial authorities (Section 12, New Zealand Parliament, 2002). Regional CDEM Groups are responsible for the application of comprehensive emergency management, that being reduction of risk (mitigation), readiness, response and recovery – also known as the four R's. CDEM Groups are also required to develop an emergency management plan that is consistent with the National Civil Defence Emergency Management Plan. Group plans provide information on hazards as well as roles and responsibilities of local partners to the plan. Together with the associated guide outline (Glasse, 2010), plans identify that local territorial authorities are responsible for companion animals during an emergency supported by the Society for the Prevention of Cruelty to Animals (SPCA). Large and small animals are the responsibility of their respective owners; obligations under the Animal Welfare Act 1999 to afford appropriate care and attention remains during a declared state of emergency (Glasse, 2010). In the National Civil Defence Emergency Management Plan and Guide, the Ministry of Agriculture and Forestry (MAF) provides overall coordination and monitoring of issues relating to domestic animals at a national level. In 2006 the National Animal Welfare Emergency Management Liaison Group (NAWEM) was established as a cluster of agencies for the purpose of providing advice on animal welfare issues during emergencies through individual and multi-agency action. NAWEM was formed in response to adverse events that highlighted significant

regional variation in local community's ability to cope, and the need for heightened national coordination among relevant agencies<sup>3</sup> (H. Squance personnel communication 2010). The NAWEM Liaison Group is co-chaired by the New Zealand Veterinary Association and the World Society for the Protection of Animals. The group also includes representatives of MAF, Federated Farmers, SPCA, Massey University, Ministry of Civil Defence and Emergency Management (MCDEM); New Zealand Companion Animal Council (NZCAC) and Local Government (through the New Zealand Institute of Animal Control Officers). NAWEM operates on minimal funding, with all agencies providing in-kind support to progress the NAWEM mandate. One of the current projects being undertaken by NAWEM is the publication of a Companion Animal Emergency Planning Guideline which is due for release in 2011. Currently, there is no statutory requirement for CDEM Groups to ensure animal welfare is considered in their emergency plans and the Groups are only slowly accepting the consensus of scholars that protecting companion animals, in turn protects their human guardians. Authorities in Taranaki, Taupo, Rotorua and Wellington are now championing efforts in this area – however other areas' progress is limited or non-existent, as is not seen as a priority to decision makers or insufficient resources hinder further development. Without a statutory mandate such as a Directors Guideline, it is difficult to expect local authorities to expend ratepayer funds to establish adequate plans and capabilities to manage animal welfare during emergencies.

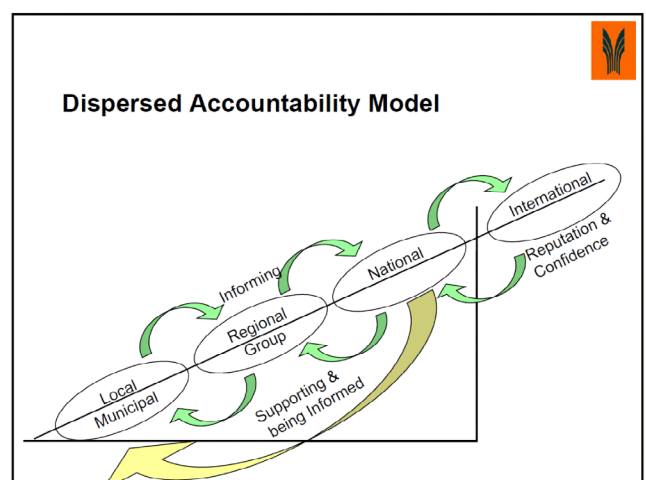


Figure 1: Norton's Dispersed Accountability Model (Angus, 2005).

<sup>2</sup> John Norton was the Director of Civil Defence, Ministry of Civil Defence & Emergency Management, New Zealand for eight years ending in June 2006.

<sup>3</sup> NAWEM was founded Dr. Ian Dacre (H. Squance, personal communication, 2011)

## Experience From Elsewhere

### Hurricane Katrina

In 2005 the impact of Hurricane Katrina on New Orleans and the Gulf Coast led to the largest natural disaster to affect a developed country. During the disaster, one of the largest organised human evacuations in history occurred, with over 1 million people evacuating from New Orleans before the arrival of Katrina. However, a large number of people (estimated over 100,000) did not evacuate resulting in significant societal consequences.

Federal government policy at that time did not require state and local emergency management agencies to have operational plans (including evacuation plans) to “take into account the needs of individuals with household pets and service animals prior to, during, and following a major disaster or emergency” (Congressional Research Service, 2006). There is a need for clearly mandated emergency management practices to be adopted that go beyond the issuing of voluntary codes or guidelines.

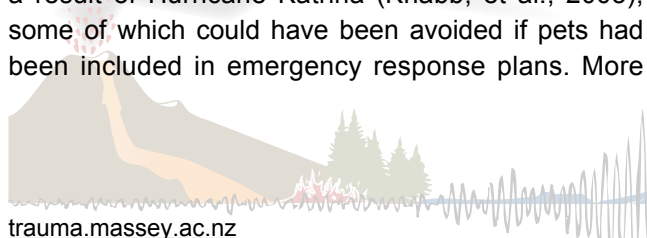
Subsequent research revealed that 44% of those who chose not to evacuate did so in part because they did not want to leave behind their pets (Fritz Institute, 2006). This was the second highest causal factor in this group for evacuation non-compliance (n=430). In addition, over 50,000 companion animals died during and after Hurricane Katrina, mainly due to forced or circumstantial abandonment (Shiley, 2006; Woodard, 2005). Factory and laboratory animals were the most zoologically vulnerable. There were over 635 million farm animals in the area affected by the hurricane (Irvine, 2009). Sanderson Farms had 1,874 broiler houses in the Mississippi region and an estimated three million broiler chickens died in affected facilities (Irvine, 2009).

Following Hurricane Katrina specific legislation known as the Pet Evacuation Transportation and Standards (PETS) Act 2006 was passed by the United States Congress. The PETS Act placed requirements on local and state emergency management to ensure companion and service animals were included in their emergency plans, provided funding for related preparedness activities, and required emergency management authorities to ensure these animals were to be rescued, cared for and sheltered during emergencies (Edmonds & Cutter, 2008). Over 1,833 human lives were lost as a result of Hurricane Katrina (Knabb, et al., 2005), some of which could have been avoided if pets had been included in emergency response plans. More

broadly, there is consensus within academic emergency management literature that saving pets, saves people through increased evacuation compliance and reduced psychosocial impact (Anderson & Anderson, 2006; Edmonds & Cutter, 2008; Heath, 1999; Irvine, 2009; Leonard & Scammon, 2007). However, the New Zealand Ministry of Civil Defence & Emergency Management has declined to seek a review of legislation in this area, in distinct contrast to the actions taken by their American counterpart, the Federal Emergency Management Agency. A further issue that will be later discussed is the importance of micro-chipping and a central micro-chip register and reunification database. Following Hurricane Katrina over 50,000 pets were stranded in New Orleans. Eighty to ninety percent of these stranded pets died. Ten to fifteen thousand pets were rescued and only one fifth of these were reunified with owners (Anderson & Anderson, 2006; Shiley, 2006). Pets were relocated outside of their respective States and there was no central database for lost and found pets. Pet collars with associated identification discs became separated, or in some cases thrown away purposefully by spontaneous animal rescue volunteers who felt their owners did not deserve them (Shiley, 2006).

### 2008 Chaitén Eruption

In May 2008 the largest volcanic eruption in nearly 20 years occurred at Chaitén volcano in southern Chile. Volcanic ash was erupted over 20 km into the atmosphere for up to 5 days and eventually over 1 km<sup>3</sup> of volcanic ash was deposited over 100,000 km<sup>2</sup> of Chile and neighbouring Argentina (Lara, 2009). Chaitén town was located 10 km to the south of the volcano and was evacuated within 36 hours of the eruption's onset due to fears of a pyroclastic flow (fast moving cloud of hot gas and ash) from the volcano (Lara, 2009). Over 4,500 people were evacuated to other regional centres, such as Puerto Mont and due to the haste arrived with little more than the clothes on their back (Lara, 2009). Due to time and space requirements, pets were forbidden from evacuation transport (Leonard, et al., 2010). In Puerto Mont, senior emergency management officials reported that within days psychosocial impacts began to develop within the evacuated population, with families often devastated from leaving their pets behind. Observing televised images of their pets roaming the ash covered streets scavenging for food was particularly distressing. This prompted strict media controls by the Chilean government (Leonard, et al., 2010). Lobbying from evacuees and NGOs such as People for the



Ethical Treatment of Animals (PETA) also resulted in an extraordinary decision to deploy the army to rescue as many pet as possible from Chaitén, despite the continuing threat of a pyroclastic flow engulfing the town from the on-going eruption (Leonard, et al., 2010). A senior emergency manager reflected that significant social harm and political influence would have been avoided had the pets been allowed to evacuate with their owners (Leonard, et al., 2010). In rural areas over 10,000 cattle were evacuated from ash covered farmland (Wilson, et al., 2009). Farmers decided not to evacuate in favour of trying to tend to their livestock. Hundreds to thousands of sheep and cattle were estimated to have perished from starvation due to thick ash covering pastures. As livestock meat, wool and milk represent farmers' main source of income, the eruption has had a significant economic impact on individuals and the local economy (Wilson, et al., 2009).

#### The 4 September Canterbury earthquake

At 04:36 on 4 September 2010, a M7.1 earthquake struck near the township of Darfield, located south east of Christchurch. The earthquake was relatively shallow at a depth of approximately 11 kilometres. The earthquake caused significant damage in the Canterbury Region and was felt as far away as Auckland (GNS Science, 2010). The previously unmapped Greendale fault ruptured along a 29 km trace through high intensity arable and pastoral (mainly dairy) farmland in central Canterbury. The earthquake was the most damaging earthquake since the 1931 Napier earthquake, which claimed 256 lives (Department of Prime Minister and Cabinet, 2007). In contrast, it has been reported there were no lives lost in the Canterbury earthquake. However over 3,000 animals died. Most of these were avoidable deaths. A brief review of media reports and limited assessment of 10 farms on the Greendale fault indicated at least 3,000 chickens (Fox, 2010), 8 cows (T. Wilson, et al., 2010), 1 lemur (NZPA, 2010), 1 dog (Bellis, 2010) and 150 tanked fish died as a result of the earthquake.

The Canterbury earthquake caused significant damage in Christchurch and the wider central Canterbury region. As of 22 August 2011, the Earthquake Commission (EQC) had received 156,935 insurance claims relating to the 4 September 2011 earthquake (Earthquake Commission, 2011). The scale of damage included over severely damaged 12,000 homes and some 300 resident evacuations to civil defence welfare centres immediately after the earthquake, while others affected

stayed in their homes or relocated elsewhere. One of the key characteristics of this event was the low number of displaced persons, given the severity of the earthquake, which has been attributed to the time of day and strict building codes. With no mass evacuation, there were few problems of companion animal related, evacuation non-compliance and therefore, animal issues were not a serious operational issue for emergency coordinators for this event. The Canterbury Branch of the SPCA were also a member of the local Welfare Management Committee (Christchurch City Council, 2008), which benefited the response through establishing a mandated role and forming pre-event relationships.

## Animal welfare impact

### Companion Animals

Under the local Christchurch City Council emergency management arrangements, the Animal Control division of the Council assumes the lead for companion animal emergency management, which is consistent with the National Civil Defence Emergency Management Plan responsibilities. Under these arrangements, evacuated animals are sent to an animal control facility (including species other than dogs) with any overflow accommodated at the local SPCA shelter.

There were numerous anecdotal accounts of companion animals being deeply scared or 'spooked' by the earthquake event and running away from home. This caused stress for owners, but in most cases the companion animals returned on their own within several days. The local SPCA took a lead role in reunification of lost and found pets through their existing user pays *track-a-pet* service and they also launched a disaster appeal to provide financial support to those affected with pets. The Canterbury SPCA had 460 pets registered as lost for the month following the earthquake, in comparison to only 77 for the same period the previous year (G. Sutton, personal communication, 5 October 2010). The SPCA effort was supported by local veterinary clinics and hospitals providing advice on reunification of animals.

Several companion animals are known to have died, with one dog left behind by its owners, found dead from a heart attack when the owners returned (Bellis, 2010). Another dog was also treated for poisoning after contact with contaminated flood water (J. Mitchell, personal communication, 15 November 2010). Numerous animals were injured as they fled houses or buildings

during the earthquake, including cuts from broken glass and other bruises and abrasions (Muir, 2010). In the days to weeks after the event, many companion animals were exhibiting symptoms of on-going anxiety and stress which prompted veterinarians to advise how to deal with traumatised companion animals as advice included keeping pets indoors for several days and trying to maintain their normal routines (RadioNZ, 2010).

To cater for affected residents following the earthquake, "six welfare centres were established throughout the three affected Territorial Authorities. The maximum number presenting on any one day at a welfare centre was >250, with a total of approximately 4,000 individual visits to welfare centres occurring during the response phase" (Canterbury CDEM Coordinating Executive Group, 2010). One of the issues raised in the debrief report was the lack of provision for companion animal care at welfare centres (Canterbury CDEM Coordinating Executive Group, 2010). This included an allegation that an evacuee reliant on her disability support dog was refused entry to a civil defence welfare centre and attempts were made by staff to separate the dog from its owner (confidential personal communication, 2010), in contrary to Section 75 of the Dog Control Act 2002 that makes for the provision of disability assistance dogs to be given access to public places.

*"Christchurch didn't go smoothly from what I saw and heard. More animals than resources. People turned up to the welfare centre with animals and were told to take them to SPCA, but had no transport to get them there, and were more or less just turned away. At one stage when I was manager at a welfare centre I had to do battle as there was a woman with a hearing dog, not only that the woman had mental health issues. I had to fight to get the staff to let them in, then the other staff kept trying to remove her. They had all never heard of a hearing dog before, great learning for them, however extremely traumatic for the woman who spent hours in tears"* (confidential personal communication, 2010).

Although another firsthand account challenge the circumstances of this event (confidential personal communication, 2011), the issue over status, access and identification of disability support dogs in emergencies remains unclear. Additionally, as evacuated families sought new rental accommodation due to their homes being uninhabitable, there was a lack of empathy by landlords to allow dogs and a shortage of pet-friendly rental accommodation which created more stress on pet owners (J. Mitchell, personal communication, 2010).

## Livestock

The greatest number of animal fatalities in the Canterbury earthquake was at the Weedons Poultry farm where two out of the three stands collapsed, killing 3,000 chickens from the total stock of 26,000 (Fox, 2010). There were few other reports of direct livestock fatalities due to the earthquake (A. Baird, Rural Recovery Coordinator, personal communication, 2010); and typically these only occurred close to the fault where strong shaking led to peak ground accelerations in excess of 0.5 g (acceleration due to Earth's gravity). For example, eight cows waiting to be milked on a concrete pad in Hororata less than 1 km from the fault were knocked over, resulting in broken legs and pelvises. These had to be destroyed (Wilson, et al., 2010). Other cows only several metres away from the concrete pad on a (softer) gravel and soil track did not suffer any injuries.

Numerous farmers reported their livestock were spooked (stressed) by the earthquake and the continuing aftershocks. This was exacerbated by the number of dairy sheds that were unable to milk cows due to structural damage from ground shaking or fault rupture beneath the shed itself, or the loss of electricity due to outage across a large part of the Selwyn district. This required herds to use neighbouring milking sheds and often required a reduction in milking from twice to once a day. This perpetuated stress amongst dairy herds led to significant increases in milk somatic cell counts. In an effort to assist farmers, Fonterra and Synlait milk companies waived high somatic cell count and temperature gradient standards penalties for over a week following the earthquake. In the central section of the 29 km rupture zone where horizontal and vertical displacement was greatest, the land surface was broken with fractures up to 1 m deep and 0.5 m wide across a 5-20 m wide zone (Figure 2). Some farmers were concerned that livestock may injure themselves in the ground fissures, particularly if spooked. However, farmers simply removed livestock from paddocks impacted by the surface fault rupture if they had not been able to flatten or close fractures with a heavy roller or cultivator (see Almond P, et al., 2010 for further information). This became particularly important for roadside paddocks, where strong interest in viewing the surface fault rupture meant some properties were at times visited by hundreds of people per day, creating an additional risk that livestock would be spooked (A. Baird, Rural Recovery Coordinator, personal communication, 2010). Another concern was that livestock were exposed to the increased risk of infectious disease transference if

the general public were allowed to go from farm to farm (H. Squance personnel communication 2010). The fault rupture also severed buried water pipes for supplying livestock, damaged pumps and affected the ground water table. Whilst there were not significantly hot or dry conditions immediately following the earthquake (such as would be expected in January or February), restoration of livestock water was still a high priority for farmers to ensure animal welfare. Most farms had repaired pipes or shifted livestock to paddocks with reliable water supplies within hours to days of the earthquake.



**Figure 2:** Surface rupture of the Greendale fault, close to Highfield Road, North Canterbury viewed from the air and ground (inset). At this point there was about 4 m horizontal movement and over 1 m vertical movement on the fault (Main photo: Russel Green, GEER; Inset: University of Canterbury).

**Laboratory Animals**

The University of Canterbury maintains a range of animals and arthropods for teaching and experimental purposes. Their welfare was an immediate concern for staff, however controlled access to buildings was required by the university’s incident management team until structural stability of buildings could be checked. Electricity was disrupted at the University for 12 hours and when restored it was only to some buildings due to structural and non-structural damage. Those with animal welfare requirements were made a priority. Immediate welfare concerns were ensuring animals had access to food, water and a safe living environment. In rat laboratories, water bottles tipped over in cages, but these were replaced within 6-12 hours. The strong shaking created large oscillating waves in laboratory fish tanks which in an extreme case lead to a small number of freshwater fish dying after they were washed over the side of one tank. In a tank of snapper (*Lutjanidae*) the excessive wave motion caused the fish to vomit. Heating was lost for the tropical fish which require a regulated temperature (25°C), however, there were no deaths or

mortality related to this. Fruit fly breeding was also set back by the loss of heating.

Where tanks and inhabited containers were physically tied down, on shelves with a lip, or on a braked trolley there were few instances of damage. However, unsecured tanks and containers fell from selves but fortunately resulted in surprisingly few deaths. The worst instance was a tank containing ~2,000 cockroaches that fell and smashed within the arthropod laboratory. Whilst most cockroaches survived the fall, retrieving them was deemed too difficult. After other valuable insects were removed from the room, it was fumigated and cleaned.

On-going aftershocks continued to stress animals. For example, rat breeding was reported to be reduced by less than 10% in the following weeks and snapper ceased eating for up to a week, despite a change in water within 12 hours of the main earthquake. The stress to animals delayed various experiments for up to several weeks or halted them completely in extreme cases.

The loss of electrical power increased the difficulty of providing the animals with automated feed and water, and environmental control processes, such as changing fish water, had to be laboriously done by hand (Prof. W. Davison personnel communication 2010).

The university also maintains a number of secure facilities in accordance with New Zealand Biosecurity legislation. Communication was made with Biosecurity New Zealand on the day of the earthquake to assure them that facilities were still secure. Several days later a structural engineering assessment was also delivered to assure the regulatory body of laboratory integrity.

**Discussion**

The events that unfolded after the Canterbury earthquake highlight the value of effective planning and offer a glimpse of what impacts emergency managers may need to cope with regarding animals following a disaster where large numbers of people are displaced, such as after Hurricane Katrina. It is clear that despite the considerable damage and lack of human casualties; there are areas for improvement that require the attention of emergency managers, pet owners and animal welfare professionals. The improvements are not unique to this event, but add to our collective knowledge. The highlighted lack of capacity in animal emergency management in New Zealand compounds progress to protect animals and ultimately, people.

From anecdotal evidence following the Canterbury earthquake, supplemented by existing literature, the following key lessons can be drawn:

## Key Lessons

### Veterinary Professionals

Veterinary professionals are likely to be become involved in response operations during disasters and need to ensure they are prepared for operating in a civil defence emergency management environment. Each Civil Defence Emergency Management Group convenes a Welfare Advisory Group (WAG), on which animal welfare should be represented. Likewise, Rural Support Trusts will be heavily involved in any disaster affecting rural communities, so should also have provisions within their structures and systems for inclusion of veterinary and animal welfare expertise. Veterinary professionals should liaise with these representatives to ensure they can be effectively integrated into emergency plans, training and exercises (Lovern, 2003). Micro-chipping is an important tool for the effective identification and reunification of lost companion animals, in particular following mass displacement during emergencies. Veterinary professionals should continue to actively promote micro-chipping of pets and could consider offering discounts during *Get Ready* (disaster preparedness) week, as well as reminding pet owners to ensure their animals are included in household emergency plans during consultations. Pet owners should also be strongly encouraged to ensure they have a pet carrier for each animal, and a muzzle and lead for each dog – as lack of pet carriers is a casual factor for evacuation failure (Heath, 2001). Following hazard events such as flooding, earthquake, volcanic eruption and hazardous materials incidents, it is likely that veterinary professionals may be presented with contaminated animals. Veterinary professionals should familiarise themselves with decontamination procedures such as those offered by Soric et al (2008). Key competencies for animal emergency responders are currently being compiled by H. Squance (personal communication, 2010) and this research will be of interest to many veterinary professionals. Veterinary practices also need to ensure they have sufficient business continuity arrangements to continue to provide services, not only to animals in hospital care, but to any potential surge of injured animals (Wingfield & Palmer, 2009), including development of evacuation plans and identification of alternate facilities. Further research is

needed to analyse whether any companion animals attended veterinary clinic consultations following the Canterbury earthquake due to stress (H. Squance, personal communication, 2010).

### Emergency Management

Emergency management organisations need to ensure that pets and service animals are included in emergency plans and that staff and volunteers are familiar with the protocols for handling pets and their owners. Operational personnel need to understand that it is not appropriate to evacuate people without their pets, as this may create significant repercussions including evacuation non-compliance, illegal re-entry to evacuated areas by pets owners to retrieve their pets, psychosocial impacts from forced abandonment of pets or pet loss, refusal of medical treatment by pet owners until the needs of pets are met, as well as potential criminal liabilities (Glassey, 2010). The lead agency approach of having the local authority animal control coordinate the companion animal emergency welfare function, with support from the local SPCA appeared effective in Canterbury. There needs to be greater recognition that local authorities as a whole take responsibility for this mandate and not assume that generally under-resourced charities will fill the void. Following the response phase, it is likely during recovery that welfare agencies supporting displaced families will encounter a demand for medium term accommodation that is able to cater for pets and this may well be in short supply. Recovery plans should consider this issue and encourage family units (pets and their owners) to be accommodated together. There is an opportunity for the MCDEM Consistent Messaging programme to also ensure information is included on dealing with traumatised pets.

### Legislation

The importance of specific animal welfare emergency management legislation has not been realised in New Zealand, in contrast to the passage of the Pet Emergency Transportation and Standards (PETS) Act 2006 by US lawmakers to address major lessons learned following Hurricane Katrina (Glassey, 2010). The PETS Act 2006 required local and state emergency management plans to include arrangements for pets and service (disability assistance) animals; funding for state and local pet and service animal emergency preparedness; and lastly, requirements that pets were rescued, cared and sheltered during emergencies (Edmonds & Cutter, 2008).

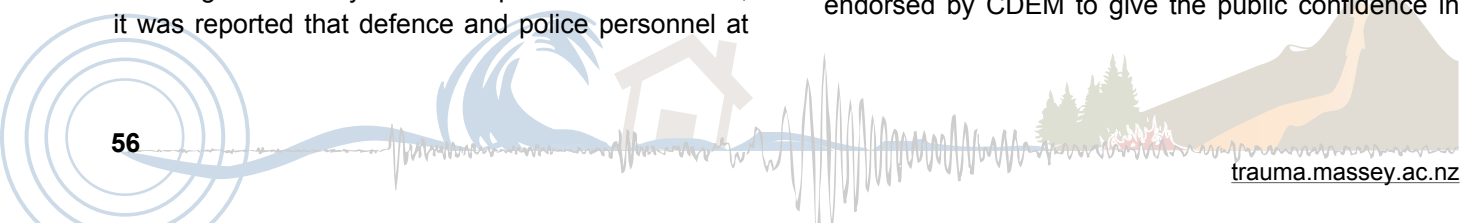
An outdated and fragmented regulatory framework for animal welfare emergency management is spread across the Animal Welfare Act 1999, Civil Defence Emergency Management Act 2002 and Dog Control Act 1996. The issue around disability assist dog status, access and identification has been highlighted by the September earthquake event. Under the Dog Control Act 1996 a “disability assist dog means a dog certified by one of the following organisations as being a dog trained to assist (or as being a dog in training to assist) a person with a disability” including Hearing Dogs for Deaf People New Zealand, Mobility Assistance Dogs Trust, New Zealand Epilepsy Assist Dogs Trust, Royal New Zealand Foundation of the Blind, and Top Dog Companion Trust. With no nationally required external identification of dogs, it is difficult for welfare centre staff during emergencies to ascertain whether an accompanying dog is a genuine disability assist dog or not. *Bona fide* disability assist dogs are eligible to be registered as such, which provides a right to access and remain in public places with such legal provisions overriding any other enactment or bylaw (Section 75, Dog Control Act 1996). This legitimises the right for those with disability assist dogs to access and remain in welfare centres, whether a state of emergency is in effect or not. Although the laws around disability assist dogs are clear and appropriate; it would appear these are not well understood by the emergency management sector.

The Civil Defence Emergency Management Act 2002 however is not so clear in its application to animal welfare during a state of emergency. Under Section 86, powers to evacuate may only be executed for the preservation of human life, and such evacuations only provide for the exclusion of persons or vehicles – not animals. Similarly, the power to requisition (Section 90) only applies for the preservation of human life. In the scenario of a poultry farm being flooded during a state of emergency, it appears that the powers outlined in the act, may not be able to be applied for the preservation of animal life. One of the provisions of the Civil Defence Emergency Management Act 2002 is that it shall not affect the functions, duties, and powers under other acts or general law (Section 6). This means the powers of the Chief Fire Officer (or delegated Officer in Charge) under the Fire Service Act 1975 and an Inspector and Auxiliary Officer appointed pursuant to the Animal Welfare Act 1999 remain largely unaffected. During the following 22 February 2011 earthquake in Christchurch, it was reported that defence and police personnel at

cordons did not permit access by SPCA Inspectors (R. Dawson, Chief Inspector, personal communication, 2011), contrary to the SPCA Inspectors’ power to do so under the Animal Welfare Act 1999 and the provision of Section 6 of the Civil Defence Emergency Management Act 2002. This again highlights the lack of legislative knowledge by officials which needs to be addressed. Finally, micro- chipping of pets is a proven mitigation tool according to the American Microchip Advisory Council for Animals (2007). Although New Zealand is fortunate to require all newly registered dogs to be micro- chipped under the Dog Control Act 1996 (Section 36A), other pets such as cats are not required to be micro- chipped. Counter productively, disability assist dogs are excluded from the requirement to be micro- chipped due to their classification as working dogs (Section 36(2A)). With the massive surge in displaced pets found following the 4 September 2011 earthquake, having the wider population of pets being micro- chipped would have significantly increased rates of reunification with their owners. Local authorities in their dual role for animal control and civil defence emergency management as well as animal welfare and veterinary professionals should encourage wider adoption of micro- chipping for all pets and disability assist dogs.

**Animal Welfare Organisations**

Currently, the New Zealand civil defence emergency management arrangements do not designate a lead agency for the management of lost and found pets following an emergency, or an agency responsible for pet/owner reunification. During the response to the 2010 Canterbury earthquake, the local SPCA (Canterbury SPCA) operated their independent track-a-pet service that incurs a \$10 fee to register lost animals and no charge to register found animals (Canterbury SPCA, 2010). Online newspapers and trading sites (e.g. [www.trademe.co.nz](http://www.trademe.co.nz)) also advertised lost pets. This created some confusion about where to search for information on a lost pet. Evidence from the Canterbury earthquake and other disasters indicates coordination of lost and found pet information services is essential. For example, following Hurricane Katrina there was no single missing pet database which resulted in some owners visiting over fifty animal shelters in an attempt to locate their pet (Shiley, 2006). There would be considerable value, both in terms of time and resource, for one official lost and found database which is used by all current animal welfare providers, and information providers and is endorsed by CDEM to give the public confidence in





pet reunification. The current options are limited. For example, the free national online lost and found pets service “[petsonthenet.co.nz](http://petsonthenet.co.nz)” database has limited search capability, and “track-a-pet” is only a local service. Consideration needs to be given for a comprehensive system that meets the needs of all users. Related costs associated with the surge of lost and found notifications should be considered claimable under central government financial assistance arrangements.

In a wider sense, the Canterbury earthquake experience also highlighted the value of a single consolidated micro-chip database for companion animals, which would allow rapid searching of or identification of lost pets following a disaster. Currently, there are two commonly used databases: the National Dog Control Database operated by the Department of Internal Affairs and the New Zealand Companion Animal Register. The former only provides coverage to dogs, which automatically creates multiple systems to be searched. Again a lesson following Hurricane Katrina was the problems created through multiple lost and found databases of companion animals. An integrated national micro-chip database that covers all species and is accessible by all legitimate users would be of considerable value (Animal Control, SPCA, and Veterinary Clinics).

### Other considerations

More than 99% of the known animal fatalities associated with the Canterbury earthquake occurred on a poultry farm. It is well established that caged production animals are zoologically vulnerable (Irvine 2009). The nature of the damage would suggest that such facilities would benefit from ensuring buildings and cage fittings are seismically restrained, as well as appropriate emergency plans being in place to protect these vulnerable animals. According to Irvine (2009), over a million hens were trapped in damaged cages following tornados at the Buckeye Egg farm in Ohio. Despite rescue efforts, tens of thousands of birds died of starvation, dehydration and exposure due to building damage as well as automated feeding, watering and waste systems being destroyed (Irvine, 2009). In committing to the philosophy of comprehensive emergency management, farm operators, public officials and the wider community have a responsibility to ensure such vulnerable animal groups are afforded appropriate mitigation, preparedness, response and recovery in a disaster management context. Compliance requirements for factory farms should include provision of emergency animal welfare planning.

## Conclusion

The 2010 Canterbury earthquake provides valuable lessons for future emergency management in New Zealand. It highlights that animal emergency management is an important component of wider civil defence and emergency management.

Animals were vulnerable to a range of physical and psychological impacts, with some specific groups more acutely vulnerable, such as captive species, including factory farmed and laboratory animals. Large numbers of pets were reported lost, commonly traumatised by earthquake shaking. This put significant pressure on lost pet databases, and raised issues about how this is best managed. Feedback relationships were exposed, in that trauma to companion animals, and even farmed animals, can have serious knock-on psychosocial impacts on their human owners.

The 2010 Canterbury earthquake caused considerable distress and disruption to people or animals. However, the timing of the main earthquake was extremely fortuitous (early in the morning) and the relatively low number of displaced or injured persons did not put significant pressure on management of displaced companion animals. Nor were farms seriously impacted by feed damage or extended loss of essential services (such as electricity), mitigating any farmer desire to evacuate livestock, access significant supplementary feed supplies to maintain livestock, or destroy livestock on a large-scale. In contrast to companion animal emergency management, there is limited literature available on livestock emergency management practice and further research is required to ensure emergency management approaches in New Zealand are evidence based.

It is clear from the Canterbury earthquake that the integration of animal welfare organisations and veterinary professionals with wider civil defence emergency management will be essential for managing future disasters. As guardians of these animals, the human population has a moral obligation to afford protection to them in times of disaster. Veterinary professionals in New Zealand need to be proactive and engage in local civil defence emergency management arrangements before disaster strikes, as they will provide important services during major emergencies that affect people and their animals.

As new guidelines are published by NAWEM, further uptake of animal emergency planning is likely to occur

and this will see an increased demand for contributions by veterinary professionals to local civil defence emergency management. The uptake of companion animal emergency management by CDEM Groups would be strengthened if statutory mandate gave effect to the new NAWEM guidelines.

Whatever the future New Zealand disaster; pet owners, farmers, veterinarians, animal welfare officers and emergency managers need to collaborate to create resilient communities, with the understanding that animals too, are part of these communities.

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## Resources

An animal emergency management special interest group has been established by the International Association of Emergency Managers. A group wiki to share information and resources is available from <http://animalemergency.wikispaces.com>

## Postscript Note

While this paper was written to focus on the Sept 4 earthquake event, many more people were displaced and homes destroyed during the 22 February 2011 Christchurch earthquake. Media and anecdotal reports at the time indicated the loss of animals was a significant issue for displaced persons and an issue for the CBD cordon management, as people attempted to breach the cordon to rescue lost pets. Analysis of this event will provide rich data for future research into animal emergency welfare.

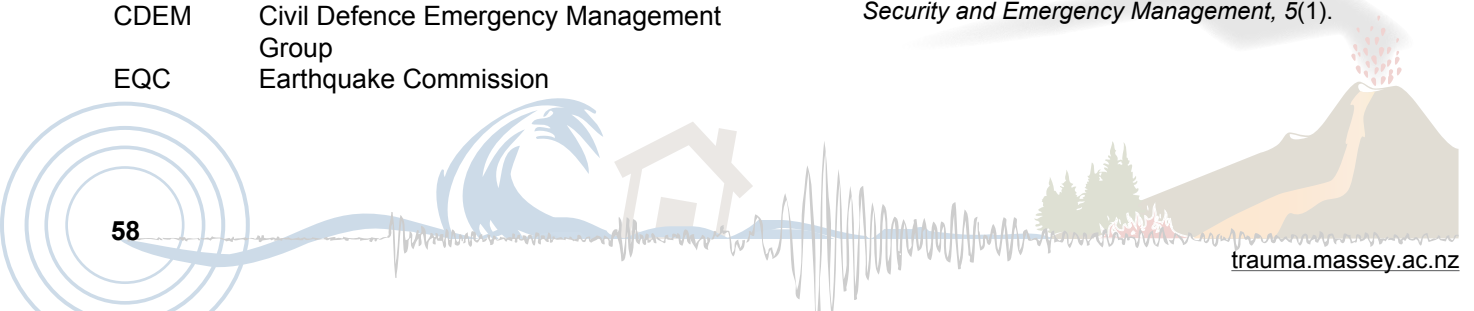
## Abbreviations

CDEM	Civil Defence Emergency Management Group
EQC	Earthquake Commission

MAF	Ministry of Agriculture and Forestry
MCDEM	Ministry of Civil Defence & Emergency Management
NAWEM	National Animal Welfare Emergency Management Liaison Group
NZCAC	New Zealand Companion Animal Council
PETA	People for the Ethical Treatment of Animals
PETS	Pet Evacuation and Transportation Standards
SPCA	Society for the Prevention of Cruelty to Animals
WAG	Welfare Advisory Group
WSPA	World Society for the Protection of Animals

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**Commentary Article**

# Caring for the Carers: the emotional effects of disasters on health care professionals

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**Key Words:** compassion fatigue, vicarious traumatisation, burnout, self-care

Ellen Zimmer and Mary Beth Williams, in their book “When a Community Weeps” (1999) talk about the way in which a tragedy can shatter ones world-view and long-held meaning – our daily existence is no longer predictable nor invulnerable to harm, and questions such as ‘why has this happened to us?’ get asked. Of course our lives have risk, but when catastrophic events, such as natural disasters occur that resulting in death and destruction and mass suffering, our belief frameworks can be challenged in ways we have not previously experienced. Not only is this an individual experience, but one experienced by communities, who face the resulting impact of these tragedies in the life of the community and their far-reaching social networks. Depending on the nature of the disaster, people may need to be able to cope with the consequences for some time without being able to access their usual resources and services.

Health professionals, by the very nature of their work, can be exposed to the suffering of others on a daily basis. This is part of the role. However, the sadness felt, and response to this suffering can in part, be offset and mitigated by the rewards of caring. When the health professional is also involved in the disaster at a personal level, the distress felt may be overwhelming. This can be related to the degree of destruction and death, as well as the often difficult circumstances of continuing to provide a medical response, and therefore special attention needs to be placed on providing support and care for those health care professionals.

Ehrenreich (2002), in *Caring for Others, Caring for Yourself*, gives the following characteristics of extraordinary traumatic events such as natural disasters:

- The characteristics and magnitude of the events mean that it is impossible for one individual to control them
- The events create feelings of intense fear, helplessness and horror
- The events can threaten individuals or their loved ones with the possibility of death or severe injury

Immediately following the disaster, emotional responses in those directly affected by the disaster can include numbing, heightened arousal, a diffuse anxiety – particularly a loss of a sense of safety, and sometimes “survivor guilt”. There may be differences in nurturance – some people may need close contact while others emotionally distance themselves, and emotional and cognitive instability. In addition to having to provide care for others, health professionals may themselves be experiencing these emotional responses.

The USA-based Centre for the Study of Traumatic Stress (CSTS), as an organisation, brings together military and disaster psychiatry with an integration of disaster mental health and public health. Their *Health Care Providers* document (CSTS, 2011) describes some of the challenges for health care professionals in the post-disaster environment (see Table 1).

Table 1: Challenges for the Health Care Provider in the Post-Disaster Environment

Disaster areas are often physically ruined and socially unstable
The magnitude of suffering
Providing support as well as medical care
Unfamiliar and unexpected conditions
Poor conditions that are often substandard

When tragic events occur, one’s usual ability to cope can be disrupted. Even if not physically harmed by the disaster, almost immediately afterwards health professionals may be involved with those who are. One’s own additional vulnerability at this time may result in experiencing the effects of being vicariously

traumatised by witnessing this suffering of others. This vicarious trauma, also known as compassion fatigue, has been acknowledged as a normal consequence of caring for others (Figley, 1995; Stamm, 1995). Current thinking (Stamm, 2009) is that compassion fatigue is a combination of the effects of burnout and those of secondary traumatic stress (STS). STS, the result of being secondarily traumatised by witnessing the trauma of others, is less common than burnout, although often has a higher consequence impact, and is frequently driven by fear – fear of a threat to one’s personal safety or the safety of significant others, and usually associated with one’s workplace. This work-related trauma can result in a direct effect (primarily traumatised), indirect (secondarily traumatised) or a combination of the two (Huggard, Stamm, & Pearlman, 2011). Not only are these effects experienced by the individual health professional, but can “spill over” to those closest to them and impact on the health professional’s immediate family. Sometimes compassion fatigue can occur in specific circumstances, such as being exposed to the death or severe injury of children, or of patients similar to ourselves or those closest to us. It can result in feeling completely overwhelmed and not able to see another patient.

The signs and symptoms of compassion fatigue are many and varied and can be a combination of physical (exhaustion, headaches, insomnia), behavioural (increase in alcohol use, anger, avoidance of certain clients, impaired ability to make certain decisions) and psychological (emotional exhaustion, distancing, negative self image, depression, reduced ability to feel empathy, feeling professional helplessness, fear, disruption of world view, heightened anxiety or irrational fears, increased sense of personal vulnerability). These responses are often those seen early on following the traumatic event. What must not be forgotten, are the possible long term consequences. A small number of people, both health professionals and others affected by a disaster, may go on to develop post traumatic stress disorder. The cluster of symptoms experienced can include intrusive imagery (nightmares, flashbacks), avoidance behaviour (inability to carry out our professional roles) and hypervigilance and hyperarousal (constantly scanning for threats and danger and being “on guard”). The spectrum of symptoms is broad, and in addition to those mentioned above can include depression and grief responses, dissociative experiences, somatic disorders, spiritual discontent,

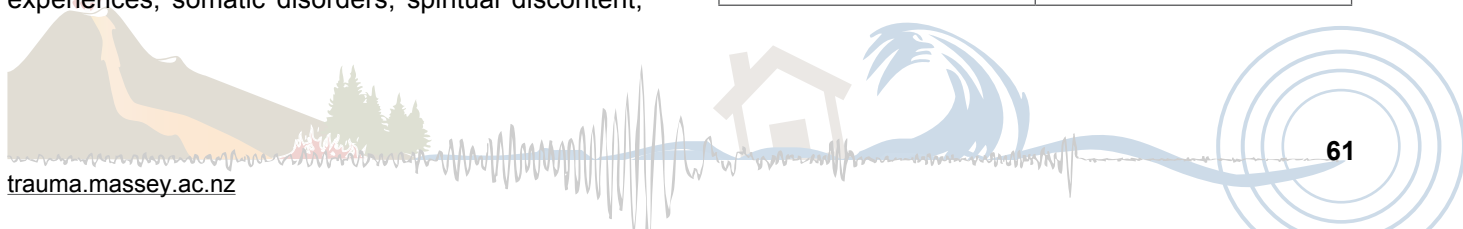
anxiety, and interpersonal difficulties. Single seemingly unrelated events can cause flashbacks, sometimes many years after the initial event. The triggers can be words, smells, a particular scene, re-experiencing certain emotions that were felt at the time, and re-experiencing similar conditions and events as before. Long term post-disaster mental health consequences are well summarised by Watts and Wilson (1999).

These experiences can be seen as opportunities that remind one of personal vulnerability and give a message that these feelings must be given attention and processed in appropriate and helpful ways. Ways of processing these feelings include talking to those closest to you or to a trusted colleague, talking in peer, professional, or supervision groups, or to another health professional skilled in this area. These processes contribute to building and strengthening our communities – communities where we live, and where we work. This strengthening process has been observed in the growth that can occur when health professionals experience prolonged exposure to traumatised patients (Arnold, Calhoun, Tedeschi & Cann, 2005; Hernandez, Gangsei & Engstrom, 2007). In the same way that vicarious traumatisation can disrupt our world view and sense of self, vicarious transformation can lead to enhanced and deeper understandings of self and our world. This vicarious posttraumatic growth, or vicarious resilience, has been shown to lead to a reframing of negative events and enhanced coping skills (Hernandez, Gangsei, & Engstrom, 2007).

The Centre for the Study of Traumatic Stress (CSTS, 2011) recommends the following strategies for mitigating psychological distress in health care providers (Table 2).

**Table 2:** Strategies for Mitigating Psychological Distress in Health Care Providers

Communicate with colleagues clearly and in an optimistic manner.	Reach out and contact your loved ones, if possible.
Be sure to eat, drink and sleep regularly.	Acknowledge the different ways in which people respond - some people need to talk while others need to be alone. Recognize and respect these differences in yourself, your patients and your colleagues.
Give yourself a rest from tending to patients. Allow yourself to do something unrelated to the traumatic event and which you find comforting, fun or relaxing.	Stay updated by keeping informed of the situation, plans and events.



Connect with others by talking to your colleagues and receiving support from one another.	Check in with yourself by monitoring yourself over time for any symptoms of depression or stress disorder, prolonged sadness, difficulty sleeping, intrusive memories, hopelessness. Seek professional help if needed.
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One of the most effective means of coping with a disaster, and in a healthy way, relates to the preparation carried out prior to the disaster. This includes knowing about such issues as vicarious trauma, compassion fatigue and burnout, and the way in which they may affect us, and in particular, acknowledging the possibility of delayed responses. Of importance is the setting of appropriate boundaries – particularly those between one's professional and private lives – and practicing good self-care. Additionally, an understanding and insight into the way in which one responds to stressors assists in developing one's self-care toolkit (Huggard, 2011). Health professionals involved in a disaster, are not immune to the experiences of their patients. Post-disaster, continual self-monitoring of personal responses and monitoring of those of colleagues, is important. An understanding of responses to stressors assists those involved in disasters to manage the effects of those stressors, and to actively work to rebuild and strengthen both professional and personal communities.

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