REPORT

Tonkin+Taylor

Review of buildings deemed "dangerous" as defined in Section 121 of the Building Act 2004, in Kaikoura District, as at July 2018

Prepared for
Kaikoura District Council
Prepared by
Tonkin & Taylor Ltd
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1 Background

In the days following the 7.8 Magnitude Kaikoura Earthquake (KE) on 14 November 2016, a number of buildings received placards (white – can be used, yellow – restricted access, or red - entry prohibited) relating to the management of buildings under the Civil Defence and Emergency Management (CDEM) Act 2002.

These building management powers were to cease at the end of the state of emergency. The options then open to the Kaikoura District Council (KDC) were to allow the placards to lapse, and allow normal unrestricted access to these buildings, or continue to manage building access under the Building Act 2004.

During June, July and August 2017, the red and yellow placarded properties (among others) were assessed for life risk, and recommendations were made either for the placement or retention of s124 notices on properties that were deemed "dangerous". That process was led by Golders and included internal and external review by Don McFarlane and Ian Wright. KDC then reviewed these recommendations, and as a result 16 properties still have s124 notices in place as of July 2018.

Given that a year had passed since the assessments that led to the s124 notices being placed, or remaining in place, KDC requested a review of the "dangerous" buildings to assess the current situation (July 2018), before taking a case to Central Government for financial assistance. The locations of the properties on which these buildings are located are shown on Figures 1, 2, 3 and 4.

2 Legislative Requirements

The purpose of the various pieces of legislation that govern the safety of people in buildings, and from unsafe buildings, and the requirements of Councils, are well documented in various MBIE documents, in particular the Building Act Emergency Management Proposals Consultation Document (2015) and the Regulatory impact statement, Managing buildings after an emergency event (2016). The Policy Guidance for Territorial Authorities on Dangerous and Insanitary Building Provisions of the Building Act (DBH 2005) is also instructive.

The issues around transitioning are also covered extensively in those documents and will not be repeated in this report.

The placarding of buildings in Kaikoura under the CDEM Act is not also part of this review. It is worth noting, however, that placarding, which naturally expires at the end of the emergency, often leads to notification via the Building Act Dangerous Building notice, which endures. A process that starts as a response to a natural disaster, therefore often leads to a process that can be problematic for recovery.

An effective recovery requires as many people as possible to be able to remain in their homes, and for accommodation (e.g. motels) to be available wherever possible both for displaced residents and to accommodate outside recovery assisters.

In Christchurch the recovery was undertaken within the context of the CER Act 2011, including the acquisition of properties by the Crown. On the flat land the Crown offered to purchase properties based on the time it would take to effect a meaningful recovery. Very few of the properties in the residential red zone flat land were unoccupied because they were considered to be "dangerous".

In the Port Hills both the Crown and Council made decisions largely around life safety, using policy criteria specifically developed to deal with the particular situation. That decision making was also informed by the GNS Seismic Hazard Model of post-earthquake seismicity, in particular that significantly elevated levels of seismicity would likely extend for some 30 to 50 years which could lead to similar levels of land and building damage. It is noted the process was resource and cost

intensive and had the advantage of a lot of data to calibrate the models that informed policy decisions.

3 Processes

The placarding and notification processes that were applied to buildings in Kaikoura appear to have mirrored those that were applied to the Port Hills in Christchurch following the Canterbury earthquakes of 2010 and 2011. Indeed, the flow charts developed by the Port Hills Geotechnical Group have been utilised for the s124 notification process in Kaikoura.

However, whilst the initial stages of the response and recovery appear to have been informed by the experience from Christchurch, the situation in Kaikoura has since proved to be very different. It was initially considered that the aftershock sequence would follow a typical decay, and be not dissimilar to Christchurch. The placarding, and initial s124 notifications, were placed with the expectation of further earthquakes or ground shaking that would result in rock fall and land slippage that would threaten particular houses. Rainfall induced land movement was also considered. These two trigger mechanisms need to be considered separately given the specific wording of s121 of the Building Act, which excludes earthquake.

4 Seismic Hazard Model

Earthquakes are described in terms of the size, or Magnitude, of the energy they release. The shaking that results from earthquakes is described quantitatively as peak ground accelerations (PGA) and qualitatively as intensity. The level of shaking intensity uses a Modified Mercalli (MM) scale, where 0 is the lowest and 12 is the greatest. A MM level of 7 is where small scale rock fall and landslips on steep slopes can occur. MM levels of 6 or less are unlikely to experience ground movement.

In December 2016 GNS assigned a probability of MM7 shaking in the next year of around 90%. This advice informed the CDEM placarding. By May 2017 the probability had reduced to around 40%. That advice informed the s124 notifications.

GNS now (July 2018) assign a probability of MM7 levels of shaking over the next year to be about 10% (see Appendix B). Overall the rate of seismic activity in the Kaikoura region is almost back to the level (now roughly around two times) that is was prior to the KE in November 2016.

It is also now recognised, by both GNS and other seismological experts, that the aftershock sequence from active faults is very different, and considerably less severe, than for faults with much longer return periods of rupture, such as the faults hidden beneath the Canterbury Plains.

Accordingly, the current assessment of the s124 notifications as part of this review is informed by a much lower level of seismic hazard now compared to that which was thought to exist both at the time of the placarding, and then at the time of the initial s124 notifications.

There still exists a seismic hazard over the longer term in the region (over decadal timescales)…the Hope Fault for example….but this should be considered in the context of an overall natural hazard management plan, not in the aftermath of a natural disaster event where recovery is the focus.

5 Dangerous Building

This review is also informed by the definition of a "dangerous" building, and the application of s124 notices. While s124 is far from an ideal tool to manage this process, it is currently the only one available.

Under s121, the meaning of relevance to this review is that "*a building is dangerous for the purposes of this Act if in the ordinary course of events (excluding the occurrence of an earthquake), the*

building is likely to cause injury or death (whether by collapse or otherwise) to any persons in it or to persons on other property".

Note that earthquake is excluded from the "*ordinary course of events*". For the 16 buildings with s124 notices, most of these building are not considered to be dangerous because of structural weakness, but because of an external threat from land upslope, movement of which could be triggered by earthquake shaking or rainfall.

What these words in the "meaning" actually mean in practical terms was the subject of a Determination by the Department of Building and Housing (Determination 2006/116) which found that a s124 notice is justifiable only if the risk of injury or death for people living in the houses is so high that, *in the public interest*, the building owner cannot be allowed to take that risk, and that injury or death is likely in the ordinary course of events. The details of that determination are outlined in Appendix A.

Like the Determinations Manager, the Royal Commission into the Canterbury earthquakes was also very concerned about the potential impact on property rights from the process of managing dangerous buildings.

Precedent has been mentioned as a test for notification. At the time of the placarding, there was considerable uncertainty on just what the performance of the soils and rock masses on the hillslopes would be during future levels of earthquake shaking and intensity/depth/duration of rainfall. Of particular concern was the deformation that the soils and rocks had undergone as a result of the KE.

We also now know that the aftershock sequence drops off rapidly following active fault rupture.

Prior to the Kaikoura Earthquake, the most severe rainfall event to hit Kaikoura was from Cyclone Alison in 1975, the 6 hour and 12 hour rainfall intensities from which had a return period of around 200 years. Some 191 mm fell in 12 hours, and 212 mm fell in 24 hours.

The properties on which the subject buildings are located have also been tested by significant rainfall events post November 2016.

During 4-5 April 2017, the remnants of Cyclone Debbie produced rainfall that resulted in landslips and rock falls in Kaikoura. More than 100 mm fell in 36 hours, with up to 200 mm falling over a 4 day period. Less than 10 days later, during 13-14 April 2017, the remnants of Cyclone Cook produced rainfall that resulted in further landslips and rockfalls. Although the rainfall intensities were not in themselves particularly high, the antecedent rainfall from Cyclone Debbie resulted in landslips and rockfalls that probably had a lower frequency of occurrence.

During 20 February 2018, the remnants of Cyclone Gita produced more significant rainfall that resulted in major landslips and rockfalls in Kaikoura. GNS considered the rainfall return period to be about 150 years. NIWA analyses show the 6 hour rainfall accumulation to be on the order of a 1 in 80 to 1 in 100 year event. !2 hour accumulations averaged about a 50 year return period, with one site well in excess of 100 year return period. 24 hour accumulations averaged about a 30 to 40 year return period.

No further damage occurred to the subject buildings during these rainfall events. Accordingly, since November 2016, the subject buildings have not sustained any damage that could in any way be considered to be life threatening, despite experiencing a 7.8 Magnitude earthquake and three cyclonic rainfall events. Of all the rainfall events, Cyclone Gita was by far the most severe. This rainfall event occurred some 6 months after the notifications.

6 Review Process

In undertaking this review, we have:

- Reviewed the hazard assessments and reports prepared for KDC by Golder Associates;
- Reviewed the reports on the properties (where claims for natural disaster damage were made) prepared by T+T for EQC;
- Reviewed vertical and oblique aerial photographs of the sites taken from November 2016 to February 2018;
- Inspected all 16 "dangerous" buildings and the immediate environs, as well as 15 other properties and/or buildings that were considered to be at an elevated risk, but not "dangerous"; and
- Discussed our broad findings with Golder Associates.

The properties reviewed are shown on Figures 1, 2, 3 and 4. Those previously considered to be at elevated risk but not dangerous were reviewed and confirmed. As such, those properties are not discussed further in this review.

7 Findings

The buildings have mostly been considered to be "dangerous" because of the potential for impact from upslope instability which could result in impact and/or inundation of the buildings. For ease of presentation, we have firstly considered those buildings that occur in clusters. Some of these wider areas have been subject to a hazard assessment, and many of the properties have also been subject to assessments under the EQC Act 1993.

In the case of the buildings assessed it is clear in our view that based on precedent (earthquake and rainfall induced land slippage or rock fall) the houses are not considered "dangerous", as defined by s121 and as determined by 2006/116.

7.1 Potential relic cliff collapse, 270, 272 and 280 The Esplanade (3)

These commercial properties (belonging to the University of Canterbury and the Youth Hostel Association (YHA)) had been assessed prior to the KE, and the building owners had elected not to occupy the buildings due to their concern about the cliff behind the buildings.

The buildings were therefore not occupied at the time of the KE. Interestingly, the cliffs remained largely intact, and the building sustained little or no damage from rock fall or land slippage. Even though the building owners voluntarily prevented access, placards and notices were placed on the buildings. These are the only buildings along the relic cliff section of The Esplanade with s124 notices.

The motel immediately adjacent to the YHA building remains open and fully operational. Domestic dwellings further south along the Esplanade remain fully accessible.

Given the performance of the cliffs, albeit around SLS levels of earthquake shaking and lower than ULS levels of earthquake shaking, and under significant rainfall of around the 100 year return period, it appears that the cliffs are not at risk of failure in the ordinary course of events. It follows, therefore, that occupants are not likely to sustain injury of death, and therefore the buildings are not "dangerous" as defined in s121 of the Building Act.

We consider the s124 notices could now be removed. Removal does not mean that there is no risk associated with occupation of the buildings. The owners can still elect to not occupy the buildings, as they did before the KE.

We recommend that, given the importance of the buildings (under NZS 1170), the building owners seek a reassessment of the risk to determine whether collapse of the buildings is likely under ULS levels of earthquake shaking, and to get a reassessment of whether the cliffs are likely to collapse under various, but greater, levels of earthquake shaking than that which was experienced in the KE. This would provide them with the information that they need to decide whether or not to reoccupy the buildings. Under rainfall of around 100 year return period levels, the slopes behind these buildings remained intact.

7.2 Potential rock fall and debris avalanche, 1800 and 1802 SH 1, Boat Harbour, Oaru (2)

We assessed these two properties, as well as the six adjacent properties 1810, 1812, 1814, 1816, 1824a and 1824b SH 1. All these properties are separated from the upslope rock source area by the railway line. Large angular, slabby rocks have impacted the lower slopes above the railway line and some have impacted the line itself. A few, smaller rocks have impacted the properties, but none presented a life risk. These slopes have also recently experienced rainfall at levels around 100 year return period. The buildings are not, in our opinion, dangerous. We consider the s124 notice could now be removed.

We understand that the fence that Kiwirail have installed upslope of the rail line is a hazard identification fence, not a barrier or containment fence. If the fence is broken a warning is provided to allow trains to stop safely before the hazard. However, we understand that rocks are still impacting the land immediately upslope of the railway line in the ordinary course of events, and have also come onto the track without triggering the alarm, including during “blue sky” events (which occur unrelated to rainfall or earthquake events). Accordingly we recommend that the building owners talk to Kiwirail to look at the installation of an upslope catch fence, to mutual risk reduction advantage.

7.3 Potential rock fall and debris avalanche, Rakautara, 2021, 2023, 2025, 2027 and 2029 SH 1 (5)

We assessed these five properties, as well as 2011 and 2015 SH 1. The properties have been impacted to a relatively minor extent by angular, slabby, rock fall. Most of the buildings have not received any significant impact damage. Only one building was moderately impacted, and the weatherboards and timber studs had restrained the rock. The minor building damage has not compromised the building safety. The slopes above the buildings have recently experienced rainfall at levels around 100 year return period. Based on precedent, we would not expect further similar land slippage to occur in the ordinary course events, Even if similar land slippage were to occur, based on precedent it is not likely to result in injury or death.

The buildings are therefore not, in our opinion, “dangerous”. We consider the s124 notices could now be removed.

7.4 Potential debris flow, 188 Torquay Street (1).

We assessed this property, as well as 194 and 198. A narrow gully was created, or further incised, into the relic coastal cliff, by a landslip about 70 years ago. The building is located on the debris at the foot of the slope.

Although some (probably co-seismic) land displacement occurred upslope, there is insufficient debris within the gully to pose a significant threat to the downslope buildings. We would therefore not expect a debris flow of sufficient size that would be likely to cause injury or death to occur in *the ordinary course of events.*

The hillslope has recently experienced rainfall levels with a return period of around 100 years.

Accordingly, the building is not, in our opinion, "dangerous". We consider that the s124 notice could now be removed.

7.5 Potential rock fall, 18 Moana Road, Goose Bay Camping Ground (1)

A tiny building is located at the southern end of the camping ground. An upslope medium sized rock, and a source area of smaller rocks, present a potential threat of damage to the building. The building was not impacted by any rocks during the KE. It is our opinion that the rocks are not likely to become dislodged in the ordinary course of events.

Even if such dislodgement were to occur, we do not believe that this would be likely to cause injury or death to someone in the building. Accordingly, we do not believe that the building is dangerous, and we consider that the s124 notice could now be removed.

However, we recommend that the owner eliminates or reduces the potential threat of damage to the building by either removal or in-situ restraint of the rock(s), or relocation of the tiny building.

7.6 Potential rock fall, rock avalanche, 93 Waitane Road, Oaru (1)

A building is located at the northern end of the road. The road parallels the railway line. A large rock fall has occurred immediately to the south of the building due to fault rupture and intense shaking. Some rocks have also come down to land immediately adjacent to the western side of the building. The building itself was not impacted by rock fall. The hillslope has recently experienced rainfall levels with a return period of about 100 years.

Based on the precedent of what occurred under extreme ground movement, we do not believe that further rock fall would occur in the ordinary course of events that would be sufficient to be likely to cause death or injury. Accordingly, we do not believe that the building is "dangerous", and consider that the s124 notice could now be removed.

There is, however, still a risk of building damage, albeit low. Access to the building is now compromised because of severe scouring of the road. A practical option that the owner could consider would be to relocate the building onto other land with better vehicular access. Council could then also disestablish the terminal section of Waitene Road. This road does, however, also provide access to the main overhead transmission line pylons from Christchurch to Kaikoura.

7.7 Fault rupture, 247 Kekerengu Road (1)

The building was partially destroyed when the fault, over which the building was located, ruptured. The building was occupied at the time by a farm worker. The remaining part of the building is to be relocated away from the fault rupture area. Had the building remained structurally sound, we consider that the fact that the fault rupture had occurred should not have, of itself, required notification. There is no post fault rupture hazard to the building that could result in injury of death.

This is now a moot point however as, with the demolition of part, and removal of the remaining, building, the removal of the s124 notice has in effect already occurred. All that remains is for this to be formalised.

7.8 Fault rupture, 3059 SH 1 (1)

The building was immediately adjacent to a fault rupture which damaged the rear entry to the building. The remaining part of the building is not considered to constitute a life risk to the occupants. We do not consider that the building is dangerous due to land movement, and as such the s124 notice could now be removed. Given the proximity to a relatively steep bank, the owner of the building might want to consider relocating the building elsewhere on site with level ground all around the building. Being a single level timber frame and weatherboard structure with an iron roof, the building should be able to be relatively easily relocated elsewhere on site, given the rural setting.

7.9 Land slippage, 335 East Lane (1)

A substantial building, located on an elevated cut and fill platform, has sustained considerable damage due to co-seismic ground rupture and displacement of the building platform. Based on our assessment we do not consider that, in the ordinary course of events, the building is likely to undergo further movement and sustain damage which would be likely to result in injury or death to the building occupants. The hillslope has recently experienced rainfall at levels with a return period of about 100 years, with no further movement. Accordingly, we consider that the s124 notice could now be removed, subject to a structural assessment confirming that the building is not dangerous because of structural deficiencies.

As with 247 Kekerengu, however, we understand that the building has sustained considerable damage to its foundations, floor and internal walls and linings to the extent that it is most likely a total constructive loss. The most likely outcome is that the building will be demolished.

8 Summary of buildings, risk of damage and risk reduction costs

Building Location	Remedial work and costs
270, 274 and 280 The Esplanade	No practical risk reduction works.
1800, 1802 SH 1.	A protection fence would further reduce risk to very low. Cost estimate $90,000 -$140,000
2121, 2023, 2025, 2027, 2029 SH 1.	Relocation seaward would reduce risk further to very low. Cost estimate $60,000 to $90,000 per property ($300,000 to $450,000 total).
188 Torquay Street	Deflection wall (and using driveway as runout) would reduce risk further to very low. Cost estimate $25,000 to $50,000
8 Moana Road	Risk could be reduced considerably to very low by removing the hazard. Cost estimate $25,000 to $40,000
93 Waitane Road	Building can be relocated off site to mitigate risk. Cost estimate $40,000 to $80,000 excluding land acquisition (if required).
247 Kekerengu Road	Demolition in progress. Risk will be mitigated by rebuilding elsewhere on site.

Building Location	Remedial work and costs
3059 SH.	Can be relocated on site to mitigate risk, but already very low. Cost estimate $40,000 to $80,000.
335 East Lane	Likely demolition. Risk likely to be mitigated elsewhere on site.

The total cost of disaster risk reduction for the s124 properties is therefore estimated to be $840,000 (excl GST, or $966,000 incl GST).

9 Conclusions

With the seismic hazard now back to a level that is not significantly above where it was prior to the Kaikoura earthquake, and the hillslopes having been subject to rainfall events with return periods up to about 100 years, we consider that the s124 notices could now be removed from the affected properties. This is because, in our opinion, in the ordinary course of events the occupants of the buildings are not likely to sustain injury or death.

This does not mean that there is no longer any risk from natural hazards to the buildings on the subject properties, rather that the risks are not significantly greater than those affecting similarly located properties throughout New Zealand that are currently occupied. We recommend that the building owners be made aware of the hazard.

Low frequency (i.e. unusual) events in future could result in damage to some of these properties. In this regard the owners and occupiers should be aware of the possibility of building damage should severe rainfall or earthquake shaking occur in future. For some properties there are works that could be practically undertaken to reduce the risk of natural disaster damage.

We recommend that the building owners should be informed of the hazards and the risks and consulted on possible remedial and preventative works options that appear to be available to mitigate or manage those risks. We understand that this approach has already been adopted for those properties where the placards have been removed but did not require notifications. We understand that, for those buildings, ongoing monitoring of the slopes and not sleeping in the rear parts of the buildings was recommended until the slopes had been tested through a severe weather event. We believe that Cyclone Gita was a sufficiently severe weather event so that normal practice can now resume.

10 Applicability

This report has been prepared for the exclusive use of our client Kaikoura District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Nick Rogers and Roger Sutton	John Leeves

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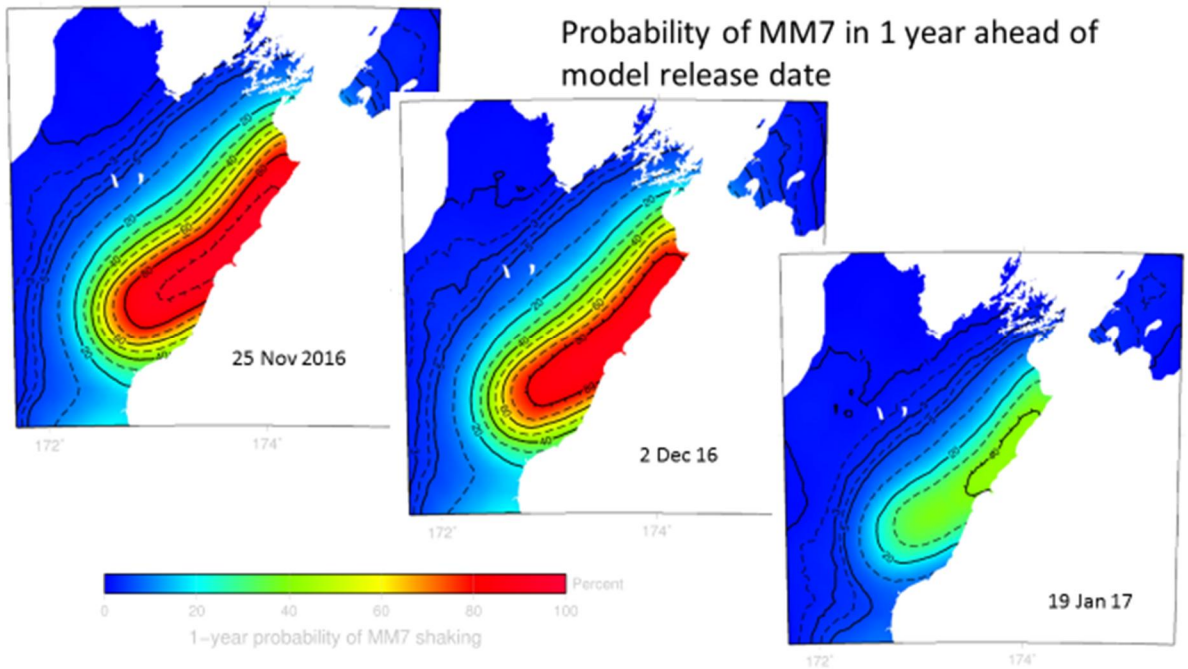
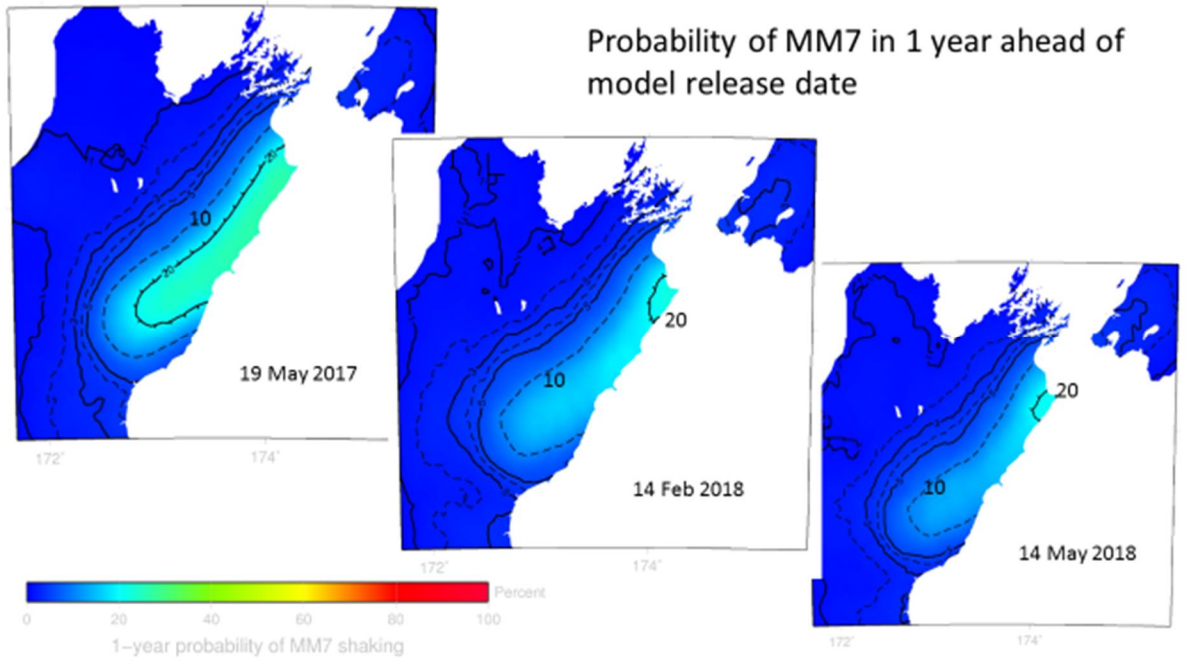
Appendix A: *Dangerous* Building Determination

- The application for the Determination arose from eight houses with s124 notices that were affected by landslips and associated flooding in the Awatarariki catchment, Matata, Whakatane District. That determination was essentially about whether the owners should continue to be prevented from occupying their houses. That would amount to a severe restriction of property rights.
- The determinations manager took the view that such a restriction is justifiable only if the risk of injury or death for people living in the houses is so high that, in the public interest, the building owner cannot be allowed to take that risk (bearing in mind that not only the owners but also their families, and perhaps other people can also be expected to live in the houses).
- The determinations manager also took the view that the Act provides that the owners may be prevented from living in their houses only if that risk is as defined in s121, namely that injury or death is likely in the ordinary course of events.
- As with Kaikoura, the buildings in Matata were not considered unsafe because of any unrepaired structural damage, but rather they were considered to be unsafe because they could be impacted by debris from upslope.
- As with Kaikoura, the situation in Matata required both the event to occur in the ordinary course of events, and the consequences to be likely to cause injury or death.
- The word likely was considered to mean less that probable but more than a mere possibility. The evidence for Matata suggested that a 10 year return period event would be unlikely to result in injury or death, but a 200 year to 500 year event would be likely to cause injury or death. The ordinary course of events had been interpreted as “the usual gamut of climatic occurrences likely to be encountered in this country, and would include dry and wet spells, heavy downpours, winter storms, equinoctial gales but would exclude not normally occurring such as 50 year flood and cyclones”.
- The determinations manager concluded that the houses were not dangerous in terms of s121, and further concluded that the territorial authority should not require the houses to remain unoccupied, reversing the territorial authorities decision not to remove the s124 notices.

Appendix B: Seismic hazard

- Short Term Seismic hazard. Source, GNS.





NZ definition of Modified Mercalli Intensity 7

People

- General alarm
- Difficulty experienced in standing
- Noticed by motorcar drivers who may stop

Fittings

- Furniture moves on smooth floors, may move on carpeted floors
- Substantial damage to fragile contents of buildings

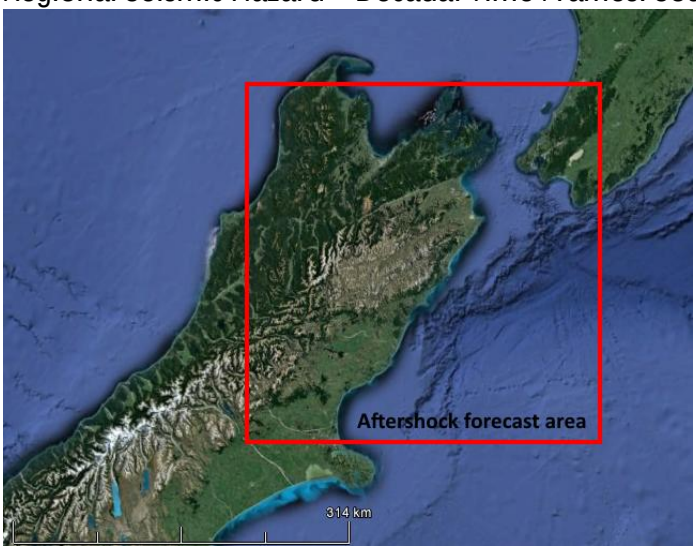
Structures

- Unreinforced stone and brick walls cracked
- Unbraced parapets, unbraced brick gables, and architectural ornaments fall
- Roofing tiles, especially ridge tiles may be dislodged
- Many unreinforced domestic chimneys damaged, often falling from roof-line

Environment

- Water made turbid by stirred up mud
- Small slides such as falls of sand and gravel banks, and small rock-falls from steep slopes and cuttings
- Instances of settlement of unconsolidated or wet, or wear soils
- Some fine cracks appear in sloping ground
- A few instances of liquefaction (i.e. small water and sand ejections)

Regional Seismic Hazard – Decadal Time Frames. Source. GNS



	No events M6.0-6.9	Probability of 1 or more M6.0-6.9
23 Nov 2016	1-10	99%
19 Dec 2016	0-7	95%
19 Jan 2017	0-4	77%
19 April 2017	0-3	64%
14 Feb 2018	0-3	49%
14 May 2018	0-3	47%

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