Mount Taranaki is closely monitored for signs of eruption.

Geological hazards

Agricultural and pastoral producers can thank Mount Taranaki's historical eruptions for the region's fertile soils. However, a volcanic eruption today has the potential to affect the region for a long period of time.

Volcanic eruption is the region's key geological hazard and the mountain is monitored closely to ensure timely and appropriate action can be taken if there is any threat of an event. Taranaki is less likely to experience earthquakes and liquefaction than other regions because of the geographical distance from New Zealand's major fault lines and the types of soil in the region. However, being on the coast means the region could be affected by storm surges or earthquake-created tsunami. The Taranaki coastline has high rates of erosion.

A number of national and regional agencies and organisations are responsible for monitoring and preparing for potential geological hazards in the region.

'Volcanic eruption is the region's key geological hazard.'

Volcanic eruption

At 2,518 metres high, Mount Taranaki is the second highest peak in the North Island and one of the most symmetrical volcanic cones in the world. The mountain is the youngest and only remaining active volcano in a chain that includes the Kaitake and Pouakai ranges, Paritūtū, and the Sugar Loaf Islands.

The Institute of Geological and Nuclear Sciences Limited (GNS) undertakes volcanic monitoring through the nationwide GeoNet network. GNS has nine regional seismometers that detect any local earthquakes or magma movement that would indicate the beginning of an eruption. Because volcanic tremors have a signature different from common earthquakes, scientists can analyse the information recorded by the GeoNet seismic network and determine whether or not the earthquake is of a volcanic nature.

What's the story?

Since the GeoNet network was commissioned in 1994, no volcanic activity or earthquake of volcanic significance has been recorded in Taranaki.

However, an eruption of Mount Taranaki is potentially the most significant geological hazard the region faces. In 2008, GNS forecast the probability of an explosive eruption over the next 50 years to be 49% (a 1.5% chance in any one year).

In 2013, following further research, GNS estimated the probability that Mount Taranaki will have at least one eruption in the next 50 years to be about 81% or 3% in any one year, which equates to about a 50:50 chance within 23 years. This is double the former annual probability estimates and significantly increases the risk of potential eruption. The estimated risk is also cumulative and will increase each year.

No volcanic activity has been recorded since monitoring began in 1994.

The *Taranaki CDEM Volcanic Unrest Response Plan* is intended for the use of agencies and operational staff. It identifies roles and responsibilities across New Zealand's Volcanic Alert Level system, and the effects of the many hazards that may arise during an eruption of Mount Taranaki. The 2013 forecast of volcanic eruption has resulted in a CDEM Group review of procedures in 2015.

National comparison

GNS monitors 12 volcanoes or volcanic fields in New Zealand. This includes the Auckland volcanic field (which includes no fewer than 50 small volcanoes) and the Northland volcanic field. It also includes cone volcanoes like Mount Taranaki, Mount Ruapehu and Mount Ngauruhoe, calderas such as Taupō and Tarawera (within the Okataina Volcanic centre) and the Kermadec Islands, Mayor Island, Rotorua, Tongariro and White Island. At the time of publishing, three volcanoes (Ruapehu, White Island and Tongariro) had an alert at level one indicating minor volcanic unrest. The others, including Taranaki, had zero alert levels indicating no volcanic unrest.

Find out more

Developing an eruption forecast for dormant volcanoes: Mt Taranaki case study (Bulletin of Volcanology, 2008) tinyurl.com/TRC9d

Shhh! Mt Taranaki is sleeping: Quantifying the Hazard from Re-awakening Volcanoes (GNS website) tinyurl.com/TRC9c

Studying past eruptions and monitoring active volcanoes (GNS website) tinyurl.com/TRC9a

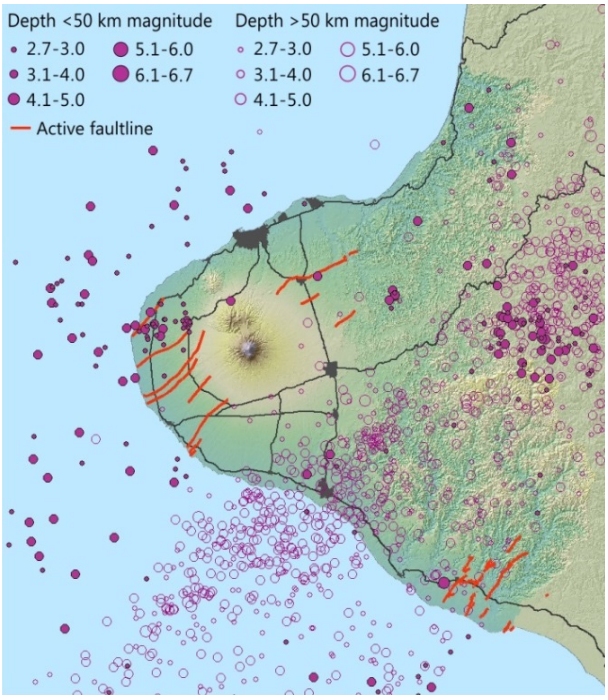
Green R M, Bebbington M S, Cronin S J and Jopnes G (2013) Geochemical precursors for eruption repose length; Geophysical Journal International, 193(2), 855-973

Turner M B, Bebington M S, Cronin SW and Stewart R B (2009); Merging eruption datasets: building an integrated Holocene eruption record for Mt Taranaki, New Zealand; Bulletin of Volcanology, 71(8) 903-91.

Earthquakes

Since the Christchurch earthquakes of 2010 and 2011, people know a lot more about earthquakes than they did before. Although a number of active fault lines run underneath Taranaki, the region is not as earthquake-prone as other areas of the country. Less than 2% of New Zealand's earthquakes recorded annually are located in Taranaki. Only a handful of that number are felt by people in the region and reported.

Nine GeoNet seismometers are installed at carefully chosen sites in the region to detect the arrival time and strength of pressure waves generated by an earthquake as they travel through the ground. The information is transmitted by radio and telephone line to a computer system which calculates (by triangulation) the location and size of the earthquake within a few minutes. The Ministry of Civil Defence and Emergency Management 'Get ready, Get Thru' website and the Taranaki Civil Defence website both provide information on how to prepare for and respond to an earthquake.



Between 2008 and 2013, a number of magnitude 2.7 earthquakes and above occurred across the Taranaki region.

What's the story?

Taranaki typically experiences 250 to 300 measurable earthquakes every year. Up to ten of those might be large enough to be felt by residents. The depth and distribution of earthquakes has remained stable since measurements began in 1994.

Most of the shallow earthquakes in Taranaki are centred west of Mount Taranaki, with only a few events beneath or close to the mountain. Deep earthquakes are mainly located in the Hāwera area, in the south-east and east of Taranaki. GNS calculates the annual likelihood of a magnitude 6.0 earthquake (large enough to damage buildings and move furniture) to be 5% in South Taranaki and 3% in the north.

GNS studies of over 3000 records of seismic activity in Taranaki between 2000 and 2011 have found no correlation between hydraulic fracturing (fracking) activities at hydrocarbon sites and earthquakes—both within five kilometres and three months of fracking activity and in deep-well injection sites.

National comparison

Taranaki is not considered a high risk area for earthquakes. Nationally, earthquakes occur within a 100 kilometre-wide zone running along the plate boundary from offshore East Cape to Fiordland, including Gisborne, Hawke's Bay, Wairarapa, Wellington, Marlborough, North Canterbury, and Buller, Southern Alps, and Fiordland. The earthquake hazard in this zone of New Zealand is comparable with that of California.

Find out more

An assessment of the effects of hydraulic fracturing on seismicity in the Taranaki region (GNS website) tinyurl.com/TRC9h

Seismicity in Taranaki annual report 2009-2014 (GNS Science) tinyurl.com/TRC9f

Understanding and monitoring seismic activity (GNS website) tinyurl.com/TRC9g

A G Hull and G D Dellow, Earthquake Hazards in the Taranaki Region, GNS Science Report 1993/03

The Taranaki Emergency Management Office is a hive of activity during Exercise Pahū in November 2013.

PAHŪ EXERCISE

CASE STUDY

Pahū tests eruption response

Mount Taranaki started erupting about 130,000 years ago, and large eruptions have occurred on average every 500 years, with smaller eruptions about 90 years apart.

While the mountain is considered today to be dormant or 'sleeping', the best expert advice is that another eruption is a matter of 'when', not 'if'—and it is likely the younger generation in Taranaki today will see it happen. In November 2013, an eruption scenario was the basis of Taranaki CDEM Group's Exercise Pahū (the name translates as 'to explode' or 'to pop'), the largest civil defence emergency management exercise ever run in the region. Exercise Pahū was a Tier 3 (inter-group) exercise in the National Exercise Programme and its purpose was to test the emergency response arrangements and readiness, both within the Taranaki CDEM Group and between nearby CDEM Groups, in the context of a Taranaki volcanic event.

The exercise involved emergency services, the Taranaki District Health Board, councils, utility companies and other critical industries, the Department of Conservation, GNS Science, Civil Defence groups from Waikato, Hawke's Bay and Manawatū/Wanganui, the Ministry of Civil Defence and Emergency Management, and other government agencies. More than 200 people were involved.

The exercise scenario envisaged a developing major volcanic eruption following a period of seismic unrest. Three weeks of lead-in information, based on fictitious but realistic seismic activity, preceded the main exercise and helped to prepare those involved in the exercise for what they might face in a real event.

A significant amount of planning went into the development of the exercise, starting in early 2013 and continuing right up to and beyond exercise day.

"A lot of work went into making the scenario as realistic as possible," says Senior Emergency Management Officer Shane Briggs. "So it was a good 'pressure-test' for Civil Defence people and systems in Taranaki and elsewhere, as well as being a chance for teams to practice working together in a response scenario."

After the exercise, a formal report was presented to the Taranaki CDEM Group and its Coordinating Executive Group. From this, an action plan has been developed with recommendations for particular changes in resourcing, operating procedures, and training and exercising. These actions have been prioritised and are being implemented.

Findings from the exercise have also fed into development of a *Taranaki Volcanic Unrest Response Plan*, an update of the *2004 Volcanic Strategy* and the *2010 Volcanic Contingency Plan*. The Plan will set out the high-level roles and responsibilities of various groups during a volcanic event for each of the five volcanic alert levels.

Exercise Pahū included a staged 'media briefing' with journalism students from WITT playing the role of reporters. Here they are being addressed by the Controller, Mike Langford (in red jacket) and GNS Science volcanologist Brad Scott.

Liquefaction

As witnessed in Christchurch, liquefaction is the process whereby certain types of soil suddenly lose strength. If the shaking is strong enough, as in a large earthquake, the pressure of the water against the soil causes the sand and grains to 'float' in the water, and the soil becomes liquefied.

Not all soil types will liquefy following a large earthquake. Soils at risk are geologically young, fine-grained and sandy and saturated, which means they are below the water table. If one of these preconditions is not met then soils are not liquefiable. The areas in Canterbury that experienced liquefaction during the 2010 and 2011 quakes had all of the necessary soil preconditions. Fortunately, this is not the case for most of Taranaki. If liquefaction did occur in the region, it is expected to be of low impact, nothing like that experienced in Christchurch.

What's the story?

Historically, there have either been no earthquakes of sufficient intensity in Taranaki to cause liquefaction, or where earthquakes of sufficient intensity have occurred, there has been no liquefaction.

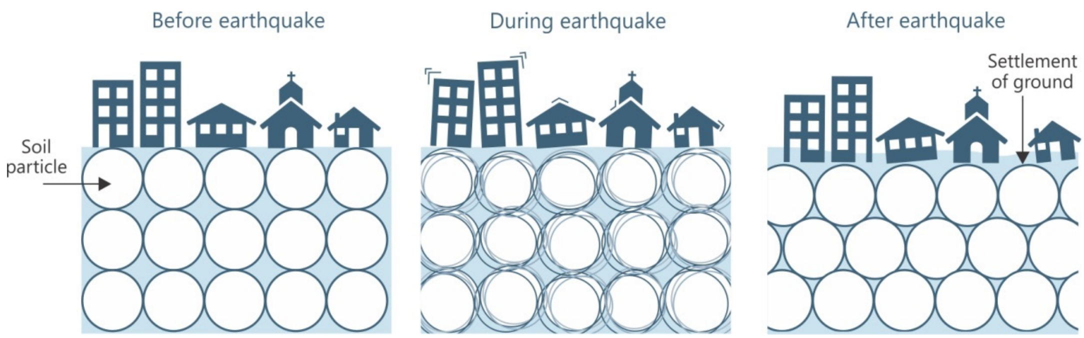
In 2013, a GNS investigation found that, due in part to the region's geology and low earthquake risk, and the fact that only a few coastal areas have the types of soil that might liquefy, the probability of liquefaction in Taranaki is low and restricted to a few areas.

'The probability of liquefaction in Taranaki is low.'

Those areas identified as having potential to liquefy include Port Taranaki; the lower reaches and tributaries of the Mōhakatino, Rapanui, Tongaporutu, Mimitangiatua (Mimi), Urenui, Onaero and Waitara rivers (in New Plymouth district); and the lower reaches and tributaries of the Waitōtara, Whenuakura and Pātea rivers (in South Taranaki).

Liquefaction at Port Taranaki would damage freight handling areas and thus impact on imports and exports in the region with significant economic effects. However, on average, earthquakes strong enough to cause liquefaction would only be expected every 150 years at Port Taranaki and between 980 and 1,070 years at the river areas.

The New Plymouth District Council is currently considering whether a detailed district survey of the potential for liquefaction is necessary, or whether a case-by-case approach is more appropriate.



Liquefaction of soil as the result of an earthquake is unlikely to occur in Taranaki.

Find out more

Liquefaction Hazard in the Taranaki Region (GNS Science, 2013) tinyurl.com/TRC9k

Looking Closer: Liquefaction (Science Learning website) tinyurl.com/TRC9i

Tsunami

A tsunami is a series of water surges caused when a large volume of water in the sea, or in a lake, is rapidly moved by earthquakes, seabed slips, or volcanic eruptions. The tsunami that hit the Thailand coast in December 2004 and Japan in 2011 demonstrated vividly the loss of life and property damage they can cause. While a tsunami is not identified as a significant hazard in the Taranaki region, some degree of tsunami risk exists for New Zealand's entire coastline. Tsunami information for New Zealand comes from the Pacific Tsunami Warning Centre and goes directly to the Ministry for Civil Defence and Emergency Management. It also comes from many media sources. The Taranaki Civil Defence issues regional advice and warnings based on this information.

What's the story?

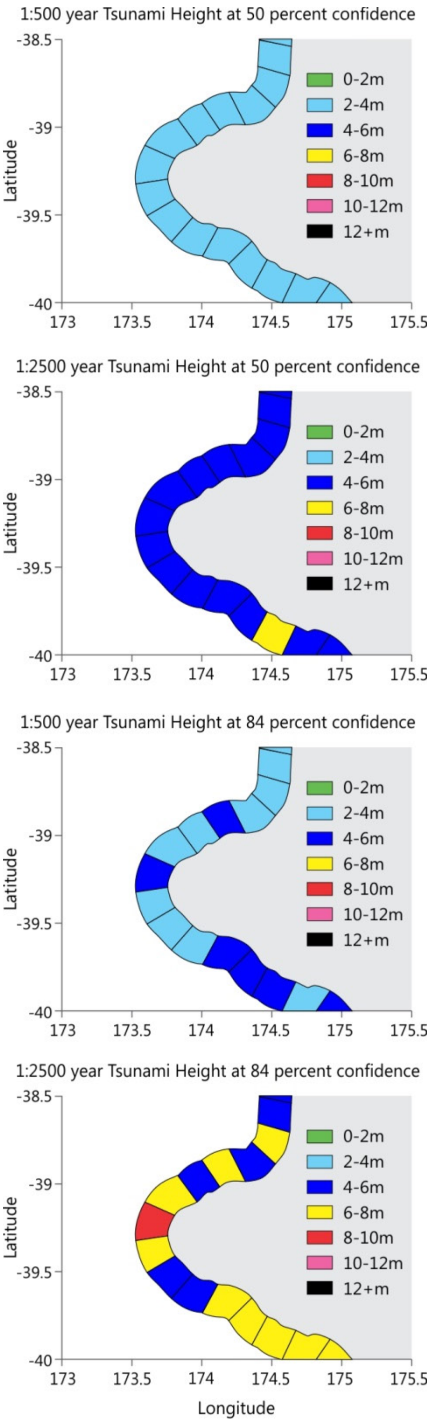
In 2012, the Council and other local authorities contracted a GNS report on Taranaki's tsunami inundation risk. Partially updated in 2013, the report found that most of Taranaki's steep coastline is not susceptible to tsunami. However, some low-lying communities on the coast or in river estuaries do have a higher risk. Those communities include Tongaporutu, Urenui, Onaero, Waitara, Bell Block, New Plymouth, Oākura, Opunake and Pātea.

The time it would take a tsunami to reach Taranaki's shores is dependent on the proximity of the tsunami source—far away or close to home. A locally sourced tsunami may have a travel time of less than 30 minutes. A distant tsunami (for example, sourced in South America) may have a travel time of up to 18 hours. Tsunami activity can continue for 25 hours after the first wave event.

The 2013 GNS report considered the potential for tsunami to be generated by faults around New Zealand and the Pacific for different time frames 1:500 years and 1:2500 years, (or 0.2% chance and a 0.04% chance of such an event in any year). It also estimated the expected maximum tsunami heights at the coast, taking into account the range of uncertainties in any given scenario (such as location of source, storm surges and so on).

Although the 2013 report indicated a slight increase in predicted wave heights for Taranaki over the long term, compared with previous estimates, most results estimate tsunami heights at no more than eight metres—even in worst case scenario conditions such as a locally sourced tsunami, occurring in storm conditions at high tide. A full and updated GNS report due in 2015 and evacuation zones for the region will be updated.

Storm surges experienced around the Taranaki coast can result in wave heights of eight metres or more, which is higher than most tsunami wave predictions for Taranaki. However, the energy and volume of a tsunami may mean a tsunami surge could reach further inland or higher than a storm surge.



Estimated tsunami heights for different time frames and levels of confidence: 50% confidence results are a best estimate of the tsunami heights, while 84% confidence results assume a pessimistic 'worst-case' scenario.

Taranaki's coast is exposed to the west and subject to weather coming in from the Tasman Sea.

On land, run-up heights can sometimes be higher than expected tsunami heights, in very rare cases up to twice as high (where the tsunami is channelled into steep narrow gullies).

The tsunami risk for Port Taranaki is moderate. A large tsunami damaging the port (as occurred at Lyttleton in the Christchurch earthquake) would have significant local and national impact, preventing imports and exports of oil and gas-related products. A small tsunami might disrupt shipping movements, on a precautionary basis, for a few hours.

National comparison

In New Zealand, the zone at greatest risk of any tsunami hazard (local or distant-sourced) is the east coast of the North Island and the Chatham Islands.

The risk to community infrastructure as a result of tsunami inundation is lower in Taranaki than in other regions because of the many high coastal areas and cliffs. Although predicted potential wave heights have recently been increased for Taranaki, these predictions are still lower than the 10–12 metres predicted for other parts of New Zealand and tsunami are likely to occur with less frequency here. Parts of the region's coastal communities could still be seriously affected by tsunami. A tsunami event combined with bad weather, high tides and coastal surges could increase that risk.

> *'The time it would take a tsunami to reach Taranaki's shores is dependent on the proximity of the tsunami source—far away or close to home.'*

Find out more

National Tsunami Hazard Model (GNS Science, 2014) tinyurl.com/TRC9q

Review of Tsunami Hazard in New Zealand-2013 update (GNS Science) tinyurl.com/TRC9p

Taranaki Tsunami Inundation Analysis (Hawke's Bay Regional Council, 2012) tinyurl.com/TRC9m

☎ *Taranaki Civil Defence Emergency Management Group: Tsunami Initial Action Plan May 2010*

CASE STUDY

Grassroots preparedness

The first step in developing what's planned to be a series of community emergency plans in Taranaki started with a public meeting in Oākura in February 2013.

The meeting, organised by Taranaki Civil Defence Emergency Management and New Plymouth District Council, attracted 28 people keen to hear how they could help their community be better prepared for an emergency. From this meeting the Oākura Community Emergency Committee (OCC) was developed and a *Community Emergency Plan* was born.

Of these, 24 put their names down to participate in establishing a plan for Oākura, and they have since held further meetings to define how the local community can best help itself.

Communities throughout Taranaki will be encouraged to develop their own emergency plans, and the process trialled in Oākura will be rolled out to other communities across the region, including Waverley, Pātea and Whangamōmona. Also keen to have an emergency plan are Manaia and Opunake.

Tsunami alert

The Taranaki Emergency Operations Centre was partially activated on Wednesday 6 February 2014 in response to advice from the Ministry of Civil Defence and Emergency Management that a scale 8.0 earthquake in the Solomon Islands had triggered a tsunami that might affect New Zealand.

Later information identified that the Taranaki region was in the centre of the coastline of New Zealand that could experience highest amplitude waves of up to 0.9 metres, together with unusual surges and other water movement.

Taranaki CDEM focused on identifying those stretches of coastline that would be at greatest risk, preparing and distributing warnings to key organisations, agencies, and the public, and enlisting the help of surf lifesaving clubs and members, the Fire Service and individual fire brigades, police, and District Council staff to get the message out in vulnerable coastal areas.

A feature was the use of social media. The first warning 'tweet' from Taranaki CDEM was retweeted 30 times and reached a total potential readership of more than 24,000 people, although this would have included double-ups and people out of the region.

While the tsunami brought no large surges or waves, its effects were detected at Port Taranaki, with wave fluctuations of up to 15 cm continuing for more than 12 hours after first arrival.