



WAIKATO REGION  
EMERGENCY MANAGEMENT

GROUP



Image credit: Mark Taylor / Stuff (Te Aroha, 2023)

Waikato Civil Defence Emergency Management Group

# Hazard Risk Assessment

## Regional Hazard Summary

December 2024



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## Very high level risks – Hazard summaries

### Extreme weather event – cyclone

#### Context

#### Hazard definition

A cyclone consists of high winds and heavy rainfall and is normally associated to a significant low pressure system moving from the tropics southwards to New Zealand in Late spring and summer. These events can result in large accumulations of rain, causing flooding, surface ponding and landslides. They can also result in damage to trees and infrastructure from high wind speeds. Often these events are also accompanied by storm surges, increasing the risk to low-lying coastal areas.

#### Magnitude and frequency

The magnitude and frequency of storm events within New Zealand is increasing, with a noticeable increase in the severity and magnitude of storms over the past 20 years. On average, New Zealand is impacted by one ex-tropical cyclone each year, however, the location of impact and severity can vary greatly. With climate change the magnitude and frequency of cyclones is likely to increase. Most recently New Zealand experienced Cyclone Gabrielle, which had record rainfall and wind speeds, and was NZ's largest cyclone event to date. The likelihood of a significant cyclone impacting the Waikato region is possible.

#### Exposure

The region is exposed to cyclones moving onto land from both the northwest and the northeast. Areas such as Coromandel are particularly exposed to cyclone events.

#### Vulnerability

The region is extremely vulnerable to these types of events, with moderate to major impacts likely across all four of the environments. In particular, the built environment is extremely vulnerable, in particular low-lying and coastal areas prone to flooding and landslides.

#### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

#### Potential Impacts

#### Social Environment

A severe cyclone event has the potential to result in significant impacts to the social environment, including injury, psychological impacts and potentially deaths. In addition, there would likely be significant impacts to housing, requiring emergency shelter and displacing people from communities, and impacts upon the provision of services and access to consumer goods. Overall wellbeing is also likely to be significantly impacted.

#### Built Environment

The built environment would be significantly impacted in a major cyclone event, with damage likely to residential housing, commercial and industrial properties and community facilities. Critical infrastructure, including roads, telecommunications, electricity and 3 waters would likely be heavily impacted with potential loss of services for extended periods of time.

## Economic Environment

The economic environment would potentially be significantly impacted by a severe cyclone, including significant losses to individuals, businesses and local / central government. It would be highly likely that significant regional economic drivers, such as agricultural production, aquaculture and tourism would be heavily impacted by an event of this scale.

## Natural Environment

The main impacts to the natural environment would likely be seen in freshwater ecosystems and the marine environment due to significant silt deposition. In addition, soil quality may be impacted by both silt deposition and coastal inundation of salt water. Some significant environments may be impacted by slips, flooding and wind damage, resulting in some loss of species or iconic landforms.

## Risk Rating

This hazard has been rated as a very high risk for the Waikato region.

## Human pandemic

### Context

### Hazard definition

A pandemic is an epidemic of infectious disease that spreads through populations across a large region.

The most recent pandemic to impact New Zealand is COVID-19. Several other events have impacted New Zealand in the past, including the 1918 Spanish Flu epidemic.

### Magnitude and frequency

New Zealand has experienced two major pandemics in the past 100 years and several minor events. The likelihood of a human pandemic event is 2% AEP (possible occurrence).

### Exposure

Human pandemic events can occur anywhere in the region and can impact people of all ages.

### Vulnerability

The most vulnerable from human pandemic events are the elderly or those with weaker immune systems and other pre-existing health issues. In addition, human pandemic events can have a significant impact on the regional economy due to the inability of people to work.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field who had a recent event directly comparable, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

An event of this magnitude is likely to have a range of impacts across the social environment within the region. It is anticipated injuries and illness, and psychosocial impacts will be majorly impacted. Moderate impacts would be expected to welfare and community services and the access to essential consumer products. Social and cultural wellbeing would also likely experience moderate impacts.

### Built Environment

The built environment is expected to mostly have insignificant impacts from this event.

### Economic Environment

The scenario presented would have moderate to major impacts regarding direct losses to individuals, businesses, commercial entities & industries, Local Government, Central Government, and local and regional economic drivers.

### Natural Environment

The natural environment would experience minor impacts from this event, with potential impacts to terrestrial environments from inability to manage invasive species due to movement restrictions.

### Risk Rating

This hazard is currently assessed as a very high risk to the Waikato region.

## High level risks – Hazard summaries

### Animal pest / disease

#### Context

#### Hazard definition

Animal pest or disease outbreak is when a virus or pest spreads throughout an animal population across a large region.

Many of the major animal diseases are not present in New Zealand due to its strict biosecurity. However, in recent times the dairy industry has dealt with M-Bovis outbreaks in cattle and there have been several other minor outbreaks since 2000 (Parrot Pox (birds), Brucella suis (Pigs) and Postweaning Multisystemic Wasting Syndrome (pigs)).

#### Magnitude and frequency

New Zealand is free from the main animal diseases that have devastated other countries such as avian influenza (H5N1) and Foot and Mouth Disease. The likelihood of a significant animal disease outbreak is 1% AEP (possible occurrence).

#### Exposure

The Waikato region's agricultural production sector would be exposed to an animal pest/disease outbreak.

#### Vulnerability

The main vulnerability from animal pest and disease is the economic environment, in particular jobs and businesses related to cattle and sheep farming. This may also have some impacts in the social environment, including health and wellbeing and requirement for welfare support.

#### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

#### Potential Impacts

##### Social Environment

An event of this magnitude is likely to have moderate impacts across the social environment within the region. The most likely impacts are to the wellbeing of people psychologically, requirement for welfare support and ability to connect within rural communities.

##### Built Environment

The built environment is likely to experience insignificant impacts from this type of event.

##### Economic Environment

The scenario presented would have major impacts to the economic environment. Agriculture is a major contributor to the regional GDP and would be heavily impacted. Many businesses associated to the agricultural sector would experience losses, impacting upon individual's financial stability.

##### Natural Environment

The natural environment would experience minimal localised impacts from this event. There may be minor impacts to freshwater quality (and associated ecosystems) as a result of mass burials.

#### Risk Rating

This hazard has been rated as a high risk for the Waikato region.



## Aquatic pest / disease

### Context

#### Hazard definition

An aquatic pest / disease outbreak is when a virus or pest spreads throughout an aquaculture or marine species across a large region.

There are a number of invasive species already present within New Zealand that threaten existing eco-systems, but many that are not currently present, but would cause significant damage to the aquaculture industry.

#### Magnitude and frequency

The likelihood of a significant aquatic pest or disease event is rated as 'possible'.

#### Exposure

The majority of the region's aquaculture industry is based within the Coromandel, where significant mussel and oyster farms exist within the Firth of Thames. An outbreak of a pest or disease that impacts shellfish would significantly impact communities in this area.

#### Vulnerability

The main vulnerability from aquaculture and marine pest outbreak events is the economic environment, in particular jobs and businesses related to the fishing and aquaculture industries. This may also have some impacts in the social environment, including health and wellbeing and requirement for welfare support.

### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have minor to moderate impacts across the social environment within the region. The most likely impacts are to the health and wellbeing of people, mainly psychosocial wellbeing. There may be some requirement for financial support.

#### Built Environment

This hazard is likely to have insignificant impacts to the built environment.

#### Economic Environment

This hazard is likely to have moderate impacts to the economic environment. This includes impacts to aquaculture businesses and supporting industries and potential loss to individuals linked to the industry.

#### Natural Environment

This hazard is likely to have minor to moderate impacts to the natural environments, with potentially major impacts to the marine environment and freshwater environments, depending upon the type of pest or disease.

#### Risk Rating

This hazard is currently assessed as a high risk to the Waikato region.

## Coastal flooding - storm surge / erosion

### Context

### Hazard definition

Storm surge is the result of an offshore rise in sea level as the result of low barometric air pressure and strong, persistent winds. This creates temporary increases in water levels along the coast and in estuaries. Storm surges are usually associated with large storms and increase the risk of coastal flooding when combined with a King tide or large swells.

### Magnitude and frequency

Waikato is exposed to large storms frequently and has experienced a number of storm surge events in recent times. When these have coincided with a King Tide, severe coastal flooding has been seen in low-lying parts of the region, impacting key infrastructure and damaging homes. It is highly likely that the frequency and magnitude of these events will increase with climate change. The likelihood of a significant storm surge event is rated as possible.

### Exposure

Storm surge and erosion occurs along both coasts of the region. Significant erosion has been seen in the west around Port Waikato and Raglan. In the east, the Coromandel has experienced several events with inundation and erosion occurring within the past decade.

### Vulnerability

The main vulnerabilities to this hazard exist within the built and economic environments, particularly marine infrastructure and roading. In addition, low-lying areas may be inundated, impacting housing and businesses.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

Impacts to the social environment are largely access to key services and the need for temporary accommodation for anyone impacted by the event. Some psychosocial impacts may also be seen.

### Built Environment

The built environment is likely to see moderate impacts to key infrastructure, including key arterial roads and marine infrastructure. It is also likely that impacts would be seen to residential housing and commercial properties in low-lying areas.

### Economic Environment

Impacts to the economic environment are most likely to be seen through losses to individuals, commercial entities and local government.

### Natural Environment

The natural environment would experience mostly moderate impacts to the terrestrial environment and the marine environment from erosion of foreshores and saltwater intrusion in low-lying land.

### Risk Rating

This hazard is currently assessed as a high risk to the Waikato region.

## Cyberattack

### Context

#### Hazard definition

A cyber-attack is an assault launched by cybercriminals using one or more computers against a single or multiple computers or networks. A cyber-attack can maliciously disable computers, steal data, or use a breached computer as a launch point for other attacks. Cybercriminals use a variety of methods to launch a cyber-attack, including malware, phishing, ransomware, and denial of service.

#### Magnitude and frequency

Global estimates suggest there is a cyber-attack every 44 seconds throughout the day. Cyber-attacks that successfully attack large organisations or businesses happen less frequently. In mid-May 2021, Waikato DHB hospital computer systems and phone lines were affected by a ransomware attack causing significant disruption to the DHBs services.

The likelihood of a significant cyber-attack or technology infrastructure failure in the Waikato region is rated as possible.

#### Exposure

All individuals, businesses and organisations in the Waikato region are exposed to potential cyber-attack (or technology infrastructure failure).

#### Vulnerability

The main vulnerability from a cyber-attack (or technology infrastructure failure) is to the social, economic and built environments.

Cyber-attacks or technology infrastructure failures have the ability to impact individuals, businesses and organisations, especially as computer-based systems are increasingly used over hardcopy paperwork to manage data. Sensitive data may be lost or equipment/assets unable to be used following the attack.

#### Risk Analysis Confidence

##### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

#### Potential Impacts

##### Social Environment

An event of this magnitude is likely to have moderate impacts to the social environment. The main impacts would be to the health system, welfare support services, education services and community services.

##### Built Environment

The built environment is likely to mostly experience moderate impacts from this event. Major impacts to electricity supply and fuel distribution, and moderate impacts to telecommunications, broadcasting & mass communications could occur.

##### Economic Environment

The economic environment is likely to experience moderate impacts from this event. These would mainly be to businesses and local government.

##### Natural Environment

The natural environment is likely to experience minimal impacts from this event.

#### Risk Rating

This hazard is currently assessed as a high risk to the Waikato region.

## Drought

### Context

### Hazard definition

Drought occurs due to significant periods without rainfall and sustained warm temperatures. This results in reduced river and groundwater levels and impacts to plant growth and services that utilise water.

### Magnitude and frequency

The Waikato recorded its driest decade from 2011 to 2021. Historically, water shortage and drought within the Waikato region has not been as severe as in others. However, drought events have impacted communities and the Waikato region's economy in the recent past. Areas typically most affected by water shortage and drought conditions are in the north: the Hauraki Plains, lower Waikato Basin, Thames-Coromandel and Pukekohe.

There have been a number of drought events since 2007/08. Six of the seven driest three-month periods on record (1905 to present) have occurred since 2007/08.

### Exposure

All of Waikato is exposed to the consequences of drought. Climate change is likely to bring warmer temperatures, more extreme weather patterns, and rising sea levels. Drought and water security issues are expected to become more intense and frequent in the region (and across New Zealand) with widespread environmental, social, economic, and cultural impacts.

### Vulnerability

Any significant drought in the Waikato region poses a threat to regional water security and will severely impact the primary industries including agricultural production and forestry. Both industries are extremely susceptible to the impacts of drought and when affected may also result in job losses, impacts to social wellbeing, and impacts to the natural environment. Additionally, they also can impact the energy and transportation assets resulting in power outages.

### Modelling, mapping, and Geospatial analysis



'Drought in a changing climate' - NIWA

### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

### Potential Impacts

#### Social Environment

In this scenario it is anticipated there would be moderate impacts to the social environment. Major impacts would be likely to occur across the welfare support sector and with the psychosocial wellbeing of those in impacted communities.

#### Built Environment

The built environment is likely to experience minor to moderate impacts. Moderate to major impacts are expected for potable and wastewater services. Some moderate impacts to electricity supply may occur.

#### Economic Environment

The scenario presented would have major impacts on the region's economy, particularly within the agricultural sector and associated businesses. An event of this scale could have significant impacts upon the regional GDP.

#### Natural Environment

The natural environment would potentially experience some major impacts to surface freshwater quality and soil quality and terrestrial ecosystems.

### Risk Rating

This hazard has been rated as a high risk for the Waikato region.

## Earthquake

### Context

### Hazard definition

Earthquakes are caused by ruptures in faults in the earth's surface, resulting in shaking and ground acceleration as energy is released. In addition, earthquakes can also result in significant land deformation and liquefaction, along with other co-seismic events such as landslides and tsunamis. On average, around 250 earthquakes are felt in Aotearoa New Zealand each year and thousands more are measured

### Magnitude and frequency

Waikato is generally considered a seismically quiet part of New Zealand, although earthquakes have occurred within the region in the past. The Waikato region lies upon a small number of active faults, with the most likely sources of strong earthquake shaking from the Kerepehi Fault (Hauraki plains) and the Hikurangi subduction zone (located off the east coast of the North Island).

A rupture of the Te Poi, Waitoa and Awaiti / Kerepehi fault segments could produce a magnitude 7.4 earthquake resulting in MMI 8-10 (Severe to extreme) shaking in eastern Waikato and MMI 6-8 in the west. Average fault rupture recurrence intervals are 5ka or less on the central segments and 10ka or more on low slip rate segments to the north and south.

The maximum credible scenario for the Hikurangi subduction zone equates to a magnitude 8.9 earthquake which results in minutes of intense MMI 8-9 shaking (severe to extreme shaking) for the southern Waikato region. MMI 6-8 would be experienced across the wider region.

### Exposure

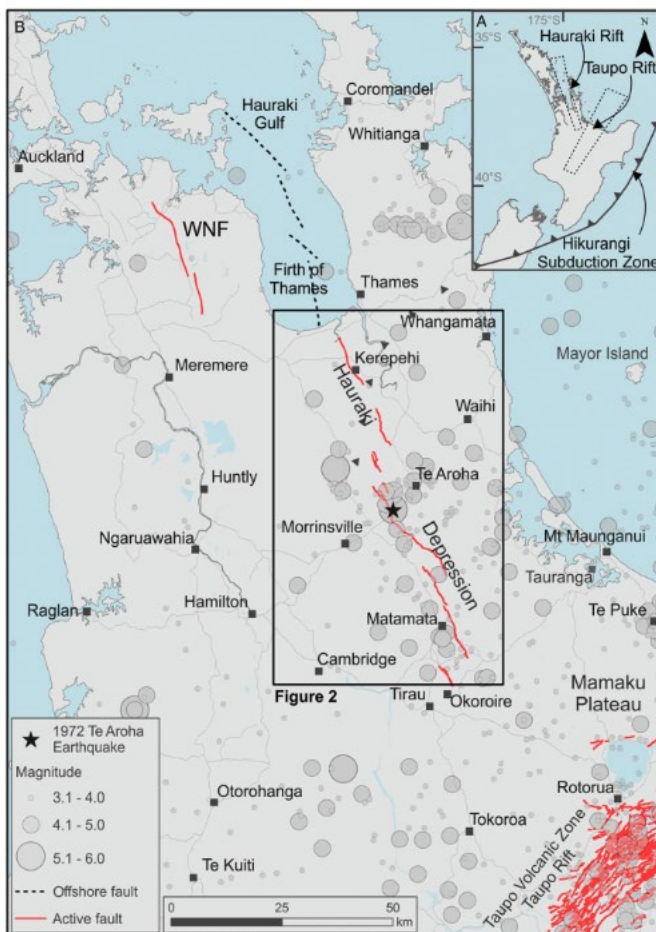
The Waikato region has exposure to significant earthquake shaking from a Kerepehi Fault or Hikurangi subduction zone event. In one of these scenarios, all of Waikato would feel the shaking, however, the strongest shaking is likely to be felt in the east of the region for the Kerepehi fault and the south of the region for a Hikurangi subduction earthquake.

### Vulnerability

A large earthquake is likely to damage weak residential and commercial buildings throughout the region. Utilities are also likely to be impacted with widespread short to medium term service disruptions. Earthquake shaking is likely to trigger landslides, rockfall, lateral spreading, and liquefaction in vulnerable soils which experience an excess of MMI 7 shaking.

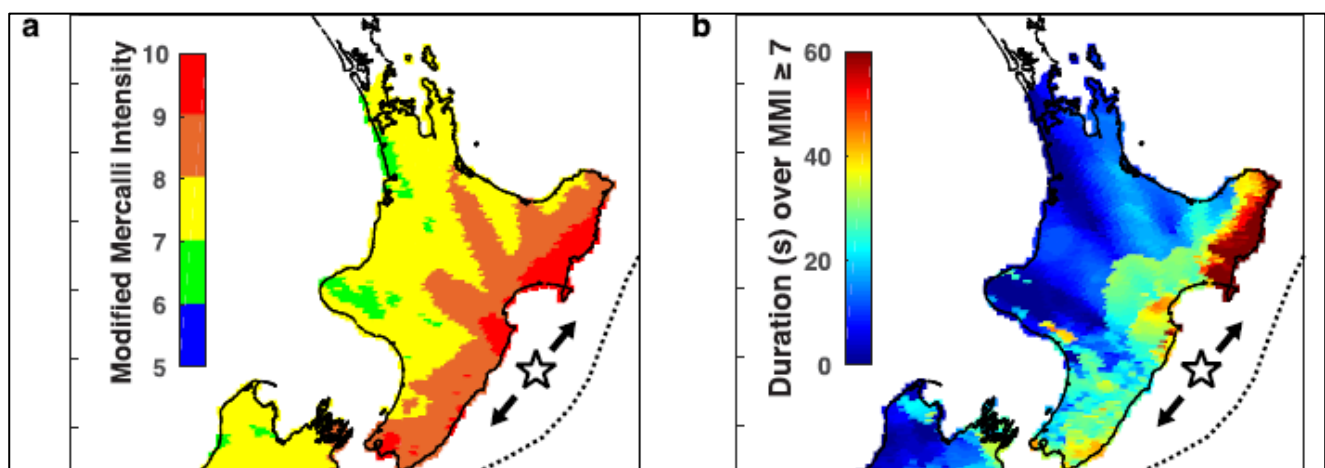
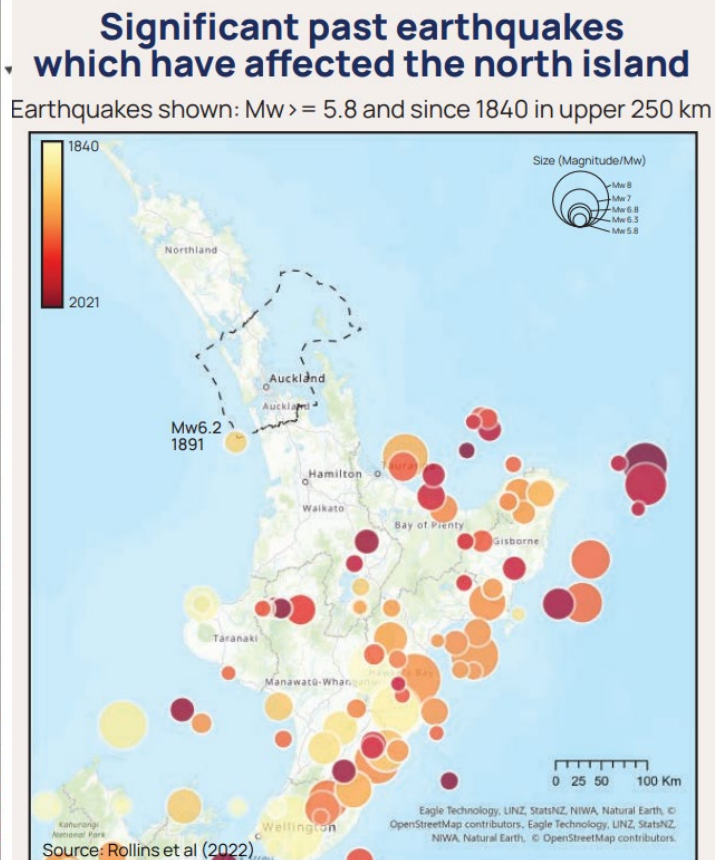


## Modelling, mapping, and Geospatial analysis



**Figure (left):** Location of the Hauraki Rift including the Kerepehi Fault, the Hikurangi subduction zone and the Wairoa North Fault (Figure from 2016)

**Figure (right):** Significant past earthquakes which have affected the north island (Source: Rollins et al. (2002) in the NSHM Waikato factsheet)



**Figure:** Synthetic ground motions (a) and durations (b) from a potential M8.9 Hikurangi subduction earthquake with the hypocentre located at the central portion of the zone (Power et al., 2018)

### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have major to extreme impacts in the social environment, especially to the health and wellbeing of those nearest the epicentre. Displaced populations in the worst impacted parts of the region would require emergency shelter and accommodation. It is anticipated that community support services will be stretched due to need, availability of goods and services (supply chain disruption), and availability of volunteers. Extreme psychosocial impacts are expected because of this event.

#### Built Environment

The built environment would, on the most part, experience major impacts. Buildings which have been identified as earthquake prone and are yet to undergo strengthening are likely to be significantly damaged in areas near to the epicentre. Damage to some health facilities, rest homes, and care facilities is expected alongside disruption to utility services.

#### Economic Environment

The economic environment would potentially suffer extreme impacts because of this event. Local and central government are anticipated to have extreme losses due to damage to three waters water and transportation assets (local roads, SH network and potentially rail). No- or under-insurance is anticipated to result in significant losses to individuals in Waikato. It is anticipated businesses, and the agriculture sector would face significant challenges following this event impacting the region's economy.

#### Natural Environment

Moderate to major impacts are expected to occur to terrestrial ecosystems and to surface freshwater and groundwater quality with this event. Damaged wastewater and stormwater networks have the potential to impact the marine environment.

### Risk Rating

This hazard has been rated as a high risk for the Waikato region.



## Earthquake and tsunami – local source

### Context

#### Hazard definition

The Hikurangi Subduction Zone is the undersea boundary between the Pacific and Australasian tectonic plates and lies within close proximity to the east coast of the North Island of New Zealand. This major plate boundary is capable of creating significant earthquakes and tsunami.

The Hikurangi subduction zone presents one of the largest hazards to New Zealand. Research on the zone has increased over the past five years to further understand the likelihood and potential consequences of an event. Current research suggests that the lower half of the zone is currently 'locked', increasing the potential for a significant quake in the southern half of the zone. This is similar to the conditions on the Tōhoku fault prior to the 2010 Japan earthquake and tsunami. The Hikurangi Subduction Zone has the potential to create the largest earthquake and tsunami experienced in New Zealand in recorded times.

#### Magnitude and frequency

The exact magnitude of quake that the subduction zone is capable of is still unknown, however, it is currently thought that the maximum plausible magnitude is Mw 9.0. A quake of this magnitude on the subduction zone would create significant shaking across the North Island of New Zealand, particularly on the east coast, with areas closest to the zone experiencing shaking intensities of MM8-10 for several 10's of seconds. Any earthquake of this magnitude is likely to cause significant disturbance to the sea floor and create tsunami, with waves exceeding 10m along parts of the coast. The exact location of the earthquake on the subduction zone will greatly affect the scale of tsunami event seen on the eastern coast on the Waikato region, with earthquakes located in the northern part of the zone having more significant impacts than those further south.

It is believed that 8-10 major subduction zone quakes have occurred over the past 10,000 years from evidence collected during recent research. The most recent major quake and tsunami is thought to have occurred in the past 500 years. This hazard is rated as unlikely to occur.

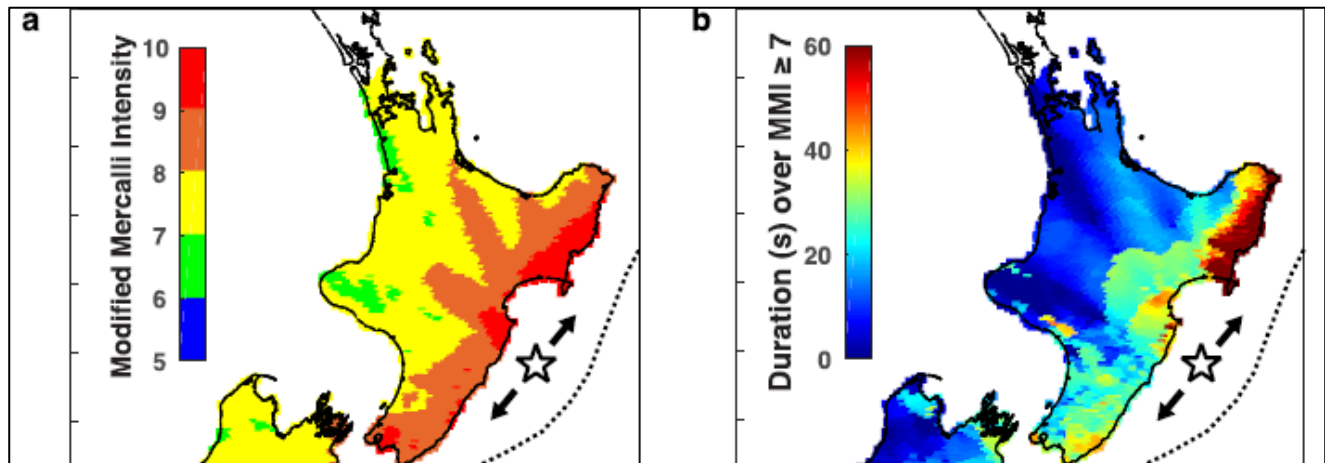
#### Exposure

The Waikato region has exposure to both the earthquake and tsunami. In particular, the towns on the Coromandel coast would be exposed to tsunami from a subduction zone earthquake in the northern portion of the fault. All the major towns of the region would be exposed to the violent shaking as a result of the earthquake, in particular Taupō, which would experience significant shaking in an earthquake on the southern part of the subduction zone.

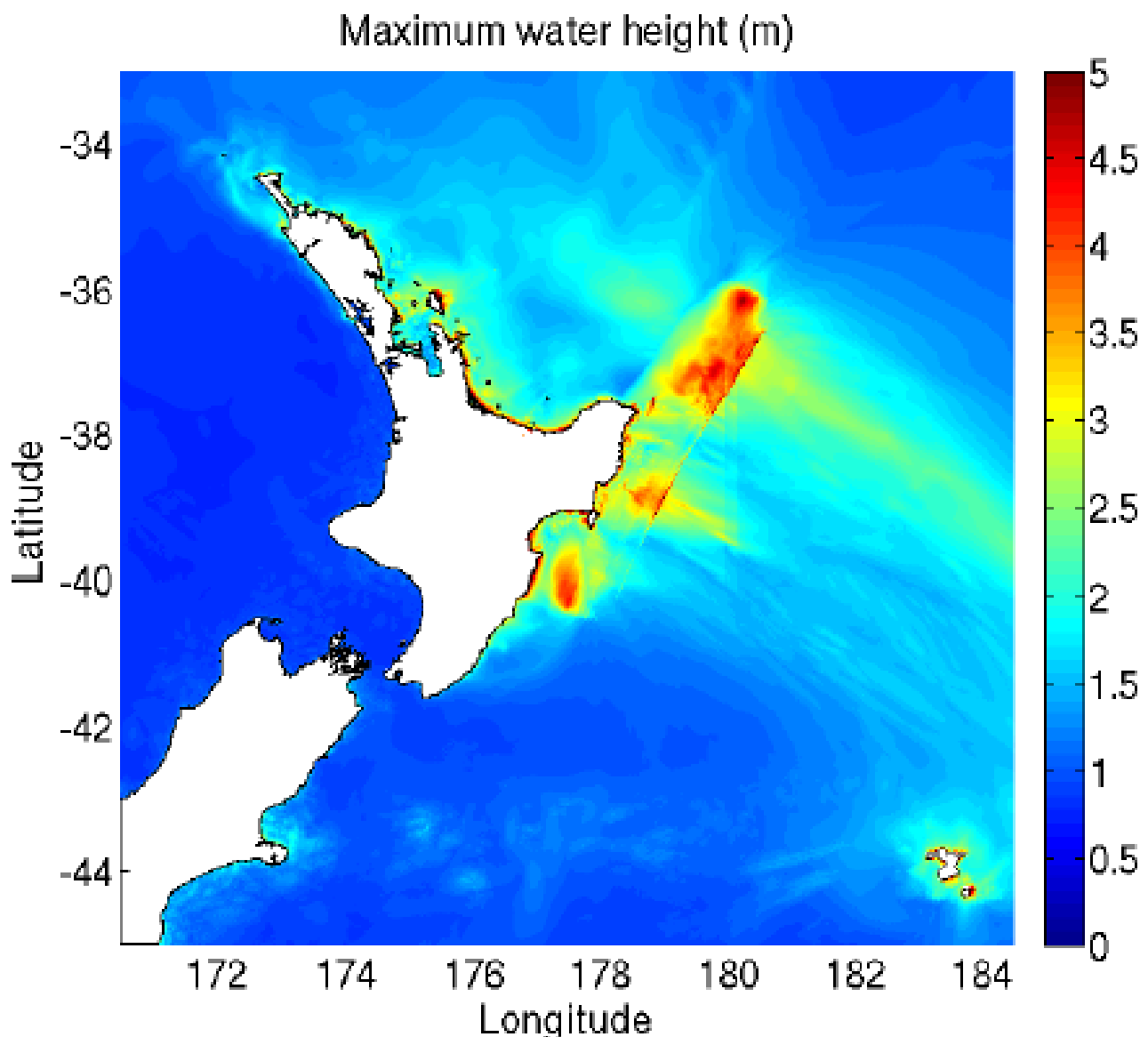
#### Vulnerability

All of Waikato is exposed to any earthquake shaking associated with a Hikurangi subduction event from any portion of the zone. Eastern coast areas are vulnerable to tsunami inundation, particularly from a northern rupture.

## Modelling, mapping, and Geospatial analysis



**Figure:** Projected shaking for an earthquake in the central portion of the subduction zone



**Figure:** Projected tsunami heights for an earthquake on the northern portion of the subduction zone. Water heights above 5m appear as 5m due to the limitations of the scale.

### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have major to extreme consequences across the social environment especially for southern and eastern parts of the region. Extreme consequences are expected to individual's health and wellbeing, including potential deaths and injuries, households in need of accommodation, access to welfare support services and social wellbeing and connectedness.

#### Built Environment

The built environment is likely to experience major consequences to residential and commercial businesses in the Coromandel from the impact of tsunami. Additionally, many parts of the region will experience damage to homes and commercial sites from the significant shaking, particularly in the east and south. Key infrastructure, including highways may be damaged and electricity and communications may be significantly impacted. Three waters infrastructure in parts of the region may be significantly impacted by the shaking and by the tsunami in coastal areas.

#### Economic Environment

The scenario presented would have extreme impacts for businesses, commercial entities & industries and Local and Central Government. The event would likely have wide ranging impacts upon the region's economy and main economic drivers, resulting in a reduction to regional GDP.

#### Natural Environment

The natural environment would experience moderate damage to coastal ecosystems and may also see some moderate impacts to terrestrial ecosystems from silt deposition and debris mobilised by tsunami. Wastewater and hydrocarbons may be released into the marine and freshwater environments due to damaged infrastructure.

### Risk Rating

This hazard has been rated as a high risk for the Waikato region.

## Fire – wildfire

### Context

### Hazard definition

Wildfire can occur in forestry, agricultural production land and areas of scrub. Fires can be started naturally, by lightning strike, or by arcing from electricity supply lines and acts of arson. Fire is most common when ground moisture levels are low and relative humidity in the air is also low, providing perfect conditions for ignition. High winds can also result in larger fires, providing mobilisation for hot embers and fanning flames.

### Magnitude and frequency

The risk of wildfire is at the highest in summer months within New Zealand when ground conditions are at their driest. The Waikato region has large areas of pine forestry that are susceptible to fire in dry conditions. In addition, numerous grass fires can occur in very dry summers.

Among the many consequences of climate change, wildfires are growing in intensity and spreading in range across Earth's ecosystems. FENZ have already seen wildfires occur earlier during the warmer months.

### Exposure

Areas in Waikato exposed to wildfire risk include rural areas, native or plantation forest, shrub lands and grasslands. In addition, wildfires can also travel across the rural-urban divide, exposing buildings and infrastructure to this risk.

### Vulnerability

Any significant wildfire could have a significant impact on the forestry industry within the region and some key lifeline utilities, such as electricity distribution and transportation networks. It may also have potentially significant impacts to the natural environment, in particular regional parks, forests and bush reserves and significant flora and fauna.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a workshop where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

### Potential Impacts

### Social Environment

An event of this magnitude is likely to have moderate impacts across the social environment, with potential psychosocial impacts and moderate consequences to households in need of emergency/temporary accommodation. This scenario was also assessed to have moderate consequences to welfare services and social wellbeing of impacted communities.

### Built Environment

The built environment is likely to experience minor to moderate impacts from this type of event, including potential damage to buildings (residential, commercial & industrial, non-commercial & community facilities), electricity supply and telecommunications.

### Economic Environment

The scenario presented would have moderate impacts to the economic environment, in particular there may be localised losses to individuals and businesses associated to forestry and the rural sector. There may also be impacts to local government costs and assets.



## Natural Environment

The natural environment would experience moderate impacts, with moderate impacts to regional parks, forests & bush reserves, iconic flora and fauna and other terrestrial ecosystems expected.

## Risk Rating

This hazard has not been given a final risk rating due to the minimal assessment of the consequences across the four environments.

## Land Instability - landslides

### Context

### Hazard definition

Landslides can occur as the result of significant rainfall, extended dry periods or earthquakes. The Waikato region has mainly experienced significant landslides as a result of heavy rainfall events in the past. Parts of the region have been isolated by landslides previously, such as the Coromandel Peninsula, following the January 2023 cyclone event, which created a number of significant slips throughout the region and resulted in significant damage to SH 25. Areas on the West Coast, including Port Waikato and Raglan have also been impacted by significant slips.

### Magnitude and frequency

Landslides can occur at any time but are most often related to periods of severe weather. These can have widespread and significant impacts on lifeline utilities throughout the region.

### Exposure

The region has a number of areas prone to landslides and debris flows. Predominantly these are on the west coast south of Port Waikato, the King Country, Coromandel Peninsula and other areas of hill country.

### Vulnerability

Any significant landslides are likely to impact lifeline utilities, mainly regional transportation routes. They may also have impacts on other aspects of the built environment, including residential and commercial buildings. The impacts of a landslide event may also result in isolated populations and impact key sectors, such as agriculture. That natural environment may also see impacts to freshwater ecosystems and areas of forestry and native bush.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

This hazard is likely to have moderate impacts to the social environment, specifically in the need for emergency accommodation and access to key services.

### Built Environment

The built environment is likely to experience minor to moderate impacts from this type of event. The worst impacts would likely be seen in residential properties impacted by slips and the impacts to key regional transportation links.

### Economic Environment

The scenario presented would have moderate impacts to the economic environment, largely as a result of transportation disruptions and impacts to key sectors, such as agriculture and tourism.



## Natural Environment

The natural environment would experience moderate impacts from this event. These would largely be seen in freshwater ecosystems and terrestrial environments, including forest and bush, impacts to iconic flora and fauna potentially loss of iconic landforms.

## Risk Rating

This hazard is currently assessed as a high risk to the Waikato region.

## Major Maritime pollution (provisional)

### Context

#### Hazard definition

Maritime pollution events can occur from a range of sources, vessel groundings or accidents, loss of oil from drilling operations at sea, loss of cargo or deliberate discharge of waste products from shipping.

While there have been several more minor to moderate spills within the region in the past, major spills like the Jody F Millenium (Gisborne) and the Rena (Bay of Plenty) are relatively rare.

#### Magnitude and frequency

Over the past 20 years there have been three major spills within New Zealand's territorial waters and several moderate spills around the country. Accidents involving large container ships or cruise ships coming into the Port have the potential to result in large oil spills. Smaller oil spills in the region can occur during bunkering operations or because of pumping bilges contaminated with oil.

#### Exposure

The Waikato region has a significant number of large vessels transiting between Tauranga and Auckland and passing near the eastern coast, and from New Plymouth on the West Coast. Any spill in neighbouring regions waters could also impact either coastline.

#### Vulnerability

The main vulnerability from major maritime pollution events is the natural environment, in particular the impacts to coastal ecosystems, significant flora and fauna and landforms. There is also some risk to the economic environment, with potential impacts to tourism in areas impacted by the event.

### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

This was assessed as a high risk to the Waikato is previous Group Plan assessment, no assessment has been undertaken, this hazard has a provisional high risk rating. This rating may change during the life of the next Group Plan following a full risk assessment for this hazard.

As assessment not undertaken, there is the lowest level of confidence.

### Potential Impacts

#### Social Environment

This hazard has not had potential impacts assessed.

#### Built Environment

This hazard has not had potential impacts assessed.

#### Economic Environment

This hazard has not had potential impacts assessed.

#### Natural Environment

This hazard has not had potential impacts assessed.

### Risk Rating

This was assessed as a high risk to the Waikato is previous Group Plan assessment, no assessment has been undertaken, this hazard has a provisional high risk rating.

This rating may change during the life of the next Group Plan following a full risk assessment for this hazard.



## Plant pest / disease

### Context

### Hazard definition

Plant pest or disease outbreak is when a virus or pest spreads throughout plant species across a large region.

In recent years several plant pests and diseases have occurred within New Zealand. These include Kauri Die Back disease, PSA in Kiwi fruit and Didymo outbreaks in rivers and streams.

### Magnitude and frequency

The likelihood of a significant plant pest or disease event is 1% AEP (possible occurrence).

### Exposure

All of the Waikato region is exposed to plant pest / disease - this hazard therefore could have widespread impacts across the entire region.

### Vulnerability

The main vulnerability from plant pest and disease events is the economic environment, in particular jobs and businesses related to horticultural production and forestry. This may also have some impacts in the social environment, including health and wellbeing and requirement for welfare support.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

An event of this magnitude is likely to have minor to moderate impacts across the social environment. This includes potential psychosocial impacts, requirement for welfare support services and social wellbeing & connectedness.

### Built Environment

The built environment is likely to experience insignificant impacts from this type of event.

### Economic Environment

The scenario presented would have major impacts to the economic environment, specifically to businesses associated to the rural sector and individuals working within this sector, given this is one of the biggest contributors to the regional GDP.

### Natural Environment

The natural environment would experience moderate to major impacts to terrestrial ecosystems, regional parks, forests & bush reserves and potentially iconic flora and fauna.

### Risk Rating

This hazard is currently assessed as a high risk to the Waikato region.

## River flooding

### Context

### Hazard definition

Flooding is Waikato's most common natural hazard and occurs when rainfall events within river catchments exceed the capacity of the system. This results in excess water breaking out of river channels and flowing over adjacent land until the amount of water in the system no longer exceeds capacity of the channel.

The Waikato region has numerous rivers and small streams. The major river within the region is the Waikato River, which is fed by Lake Taupō and several smaller rivers and flows north through Hamilton to Port Waikato. In addition, there are several rivers capable of widespread flooding across the Hauraki Plains, threatening townships including Paeroa and Te Aroha.

### Magnitude and frequency

Several severe flooding events have occurred in the Waikato region resulting in widespread consequences. Most recently in February 2023, Cyclone Gabrielle caused widespread flooding across parts of the region, including Coromandel, Matamata-Piako and the Waikato District. Other significant floods have occurred on an almost annual basis within the region, with several declarations of emergency made for flooding within the past 20 years.

### Exposure

Large parts of Waikato are prone or sensitive to flooding:

**Coromandel** - due to its short steep catchments (where rain quickly runs into the rivers) and susceptibility to tropical storms. The Coromandel has frequent severe flooding when water levels rise very quickly, with little time for warning and preparation.

**Hauraki Plains** - low lying farmland and towns are vulnerable to flooding along the Waihou and Piako river systems.

**Farmland adjacent to the Waipā River** – vulnerable to flooding, especially since the river is uncontrolled by dams.

**Lower Waikato River (from Ngāruawāhia north)** - properties on low lying land near the Waikato River are at risk. The river carries large volumes of water where the Waipā River joins the Waikato River.

**Flooding at the southern end of Lake Taupō** - where the Tongariro and Tauranga-Taupō rivers enter the Lake.

### Vulnerability

Any high magnitude flood event is likely to cause significant damage to residential and commercial buildings. However, widespread flooding is unlikely to impact highly populated areas within the region and is likely to impact largely rural areas. Utilities are also likely to be impacted in the short to medium term, particularly roading, and access to key services limited. There is also likely to be significant silting and debris in areas that have flooded. Some settlements may also be disconnected from the rest of the region due to significant impacts to roading networks.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

### Potential Impacts

### Social Environment

An event of this magnitude is likely to have minor consequences given it is likely to impact less populated areas, and many would be able to move back into areas once access is re-established. Access to services may be impacted in the short terms and there may be some psychosocial impacts.

## Built Environment

In this scenario moderate impacts to residential and commercial buildings are expected. Damage is also expected to occur to three waters services and transportation networks.

## Economic Environment

The scenario presented would have moderate consequences in regard to losses for individuals, Local and Central Government, and business, commercial entities and industries. Where individuals do not have insurance or are underinsured, significant individual losses could occur.

## Natural Environment

In this scenario it is anticipated the natural environment would experience some moderate impacts to soil quality and surface freshwater quality.

## Risk Rating

This hazard has been rated as a high risk for the Waikato region.

## Tornadoes

### Context

### Hazard definition

Tornadoes are violently rotating columns of air, extending from a thunderstorm, which are in contact with the ground. The winds inside a tornado spiral inward and upward. For a thunderstorm to produce a tornado it requires warm humid air near the surface with cold, dry air above.

### Magnitude and frequency

The Waikato region has experienced several tornadoes in the past, with several passing through urban areas of Hamilton and Cambridge. While tornadoes in New Zealand are not of a magnitude seen in places such as the United States of America, they are still capable of causing significant damage and can have sustained winds up to 150km/h+.

### Exposure

All of Waikato is exposed to tornadoes, there is no way of predicting where the next tornado may occur.

### Vulnerability

Tornadoes are destructive and can lead to injuries and fatalities. Depending on the path they take, they may also damage buildings, infrastructure and utility services resulting in power outages.

### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have moderate to major impacts to the social environment, with potential for death and injuries, households in need of emergency accommodation, psychosocial impacts and access to emergency finance. Impacts are highly dependent on the path of the tornado.

#### Built Environment

Localised damage to the built environment is anticipated for this scenario. Depending on where the tornado tracks, this may result in moderate to major damage to residential and commercial properties and critical infrastructure.

#### Economic Environment

The scenario presented would have moderate impacts in regard to direct losses for individuals, particularly where those affected are under insured or have no insurance. Localised losses to businesses, commercial entities and industries may occur depending on where the tornado tracks.

#### Natural Environment

The natural environment would experience minor impacts depending upon where it tracks. This would mostly be due to debris associated to the event.

### Risk Rating

This hazard is currently assessed as a high risk to the Waikato region.

## Medium level risks – Hazard summaries

### Civil unrest

#### Context

#### Hazard definition

Civil disturbance events are incidents that disrupt communities and require intervention to maintain public safety. This includes major demonstrations, riots, and strikes.

#### Magnitude and frequency

Major civil unrest events are infrequent in New Zealand. While protest events are common, these rarely result in major civil unrest and are generally located within the major cities. The likelihood of a civil unrest event in the Waikato region is rated as unlikely.

#### Exposure

Civil unrest can occur anywhere within the region, but is most likely to occur in urbanised areas, such as the Hamilton CBD.

#### Vulnerability

The main vulnerability from major civil unrest events are the social and economic environments, in particular the impacts to health, and commercial businesses.

#### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

#### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have moderate impacts to the social environment with potential psychosocial impacts and access to services compromised.

#### Built Environment

The built environment is likely to experience minimal impacts from this event.

#### Economic Environment

The economic environment is likely to experience minor to moderate impacts from this event. Moderate impacts to businesses, commercial entities & industries may occur, with the potential for major impacts to local and central government.

#### Natural Environment

The natural environment would potentially experience minimal impacts from this event.

#### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Dam break / failure

### Context

### Hazard definition

Dam failures (power generation or water supply) can occur as the result of structural failures, either as the result of on-going degradation, or as a direct consequence of another event, such as an earthquake or flood. Dam breaks can result in large volumes of water rapidly entering river and stream catchments, resulting in flooding of surrounding land.

### Magnitude and frequency

Dam breaks are very rare in New Zealand. Most dams that are of a significant size are built to withstand events such as earthquakes. The likelihood of a significant dam failure event is rare in the Waikato region.

### Exposure

The Waikato region is home to several large dams along the Waikato River providing significant power generation to the North Island. There are also a number of drinking water reservoirs and numerous smaller earthen farm dams.

### Vulnerability

The main vulnerability from dam failure events is the social and built environment, in particular the risk to life safety and potential for damage to housing and infrastructure. Freshwater ecosystems may also be impacted by the sudden influx of water into the system.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have moderate impacts across the social environment, particularly the threat to life, households in need of accommodation and welfare support for those affected by the event.

#### Built Environment

The built environment is anticipated to mostly experience moderate impacts from this type of event. Major impacts to electricity supply are expected should a power generation dam collapse.

#### Economic Environment

The scenario presented would have moderate impacts to the economic environment, mostly from disruption to business and local government.

#### Natural Environment

The natural environment would experience moderate impacts from this event, specifically within the terrestrial and freshwater environments.

### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Extreme temperatures

### Context

### Hazard definition

Heatwaves occur during late spring to early Autumn and generally consist of more than three days where temperatures exceed 5°C above average temperatures, although there is no recognised definition within New Zealand. Significant heatwaves can occur over several weeks and even modest increases in seasonal temperatures can have significant impacts.

### Magnitude and frequency

Severe heatwaves are not a common occurrence in New Zealand; however, increased temperatures are being observed regularly throughout the country and within the Waikato Region. The past two years have seen record temperatures set and it is highly likely that increased summer temperatures will be experienced as the impacts of climate change begin to impact our weather systems. The likelihood of a significant heatwave impacting the Waikato region is rated as possible.

### Exposure

The entire Waikato region could be exposed to this hazard.

### The Vulnerability

The main vulnerabilities to this hazard exist within the social and natural environments, in particular the health of the aged population and the impacts to marine, terrestrial and freshwater environments. There is some risk to the economic and built environments, particularly agricultural production and water supply.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

An event of this magnitude is likely to have minor to moderate impacts across the social environment with moderate impacts to injuries & illness for the aged population.

### Built Environment

The built environment is likely to experience minimal impacts from this event, with some minor impacts to three waters infrastructure.

### Economic Environment

The scenario presented would have mostly minor impacts to the economic environment within the region – the largest impacts would likely be to the rural sector.

### Natural Environment

The natural environment is expected to experience minor impacts to terrestrial ecosystems, surface freshwater quality & associated ecosystems and minor impacts to the marine environments & associated ecosystems as a result of this event.

### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Fire – structure

### Context

#### Hazard definition

Urban fire events occur primarily in cities and towns, impacting structures and posing the risk of spreading to adjoining buildings. These can be started accidentally, or deliberately. They can impact homes, schools, and commercial and industrial buildings. The type of structure impacted, and the construction materials used may also result in additional impacts, such as harmful substance release.

#### Magnitude and frequency

Urban fires occur on an almost daily basis. Major urban fires that impact larger structures and pose serious risk to surrounding buildings are much less frequent. The likelihood of a major urban fire event in the Waikato region is possible (1-2% AEP).

#### Exposure

The potential for a major urban fire that has significant impacts is largely in CBD and industrial areas.

#### Vulnerability

The main vulnerability from major urban fire events are the social and natural environments, in particular the impacts to health, freshwater ecosystems, and air quality.

#### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a workshop where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

#### Potential Impacts

##### Social Environment

An event of this magnitude is likely to have moderate impacts across the social environment within the region. The main impacts are likely to be the potential for deaths, injuries and accommodation required for displaced persons.

##### Built Environment

The built environment is likely to experience minimal impacts from this event.

##### Economic Environment

The economic environment is likely to experience minimal impacts from this event, although the direct losses to businesses was assessed to be of moderate consequence.

##### Natural Environment

The natural environment is likely to experience minor impacts from this event.

#### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.



## Fuel supply failure

### Context

### Hazard definition

Fuel supply failures can occur when there is damage to the network infrastructure, or when supply of fuel into New Zealand is restricted. The last major fuel crisis occurred in the 1970's. In more recent times air travel was severely disrupted by a break in the pipeline from the Marsden Point Oil refinery.

### Magnitude and frequency

The likelihood of a significant fuel supply failure event is 1% AEP (possible occurrence).

### Exposure

Fuel within the Waikato region is largely supplied by road transport from other regions, Taranaki, Hawke's Bay, Bay of Plenty and Auckland. This makes it particularly susceptible to the impacts of fuel shortage, with minimal in-region storage.

### Vulnerability

The main vulnerability from fuel supply failure events is the economic environment, in particular businesses reliant upon fuel for production and transportation.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

### Potential Impacts

### Social Environment

An event of this magnitude is likely to have minor to moderate impacts across the social environment within the region. The most likely impacts are access to essential consumer products, delivery of community services and social wellbeing & connectedness.

### Built Environment

The built environment is likely to have to experience minor to moderate impacts from this event. The main impacts would be seen to transportation and electricity supply.

### Economic Environment

The scenario presented would have minor impacts to the economic environment within the region. Direct losses to individuals would potentially be experienced through an inability to work, particularly for those involved in transportation, or businesses reliant upon motorised transportation.

### Natural Environment

The natural environment would experience minimal impacts from this event.

### Risk Rating

This hazard has been rated as a medium risk for the Waikato region.

## Hazardous substance event

### Context

#### Hazard definition

Hazardous substance events can occur when there is an accidental, or deliberate release of a substance that is potentially harmful to people or the environment. Depending upon the substance, or substances, involved, these can have potentially widespread impacts.

#### Magnitude and frequency

Hazardous substances can be stored for use in industry or manufacturing or may be transported. The likelihood of a significant hazardous substance event occurring in the region is rated as unlikely.

#### Exposure

There is the potential for a significant hazardous substance event to occur anywhere within the region. This could be due to an accident during the transportation of hazardous substances or a leak at a premise which stores and utilises hazardous substances for production purposes and are located close to residential areas.

#### The Vulnerability

The main vulnerability from hazardous substance events are the social and natural environments, in particular the impacts to health, freshwater and terrestrial ecosystems, air quality and flora and fauna.

### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a workshop where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have minor impacts across the social environment.

#### Built Environment

The built environment is likely to experience minor impacts from this event, with the biggest impacts to the transportation network.

#### Economic Environment

The scenario presented would have mostly minor impacts to the economic environment within the region. Businesses, commercial entities and industries directly affected may experience some minor financial impacts.

#### Natural Environment

The natural environment is expected to experience minor impacts to surface freshwater quality & associated ecosystem and terrestrial ecosystems as a result of this event.

### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Land instability – subsidence / long term deformation

### Context

### Hazard definition

Subsidence and long term deformation can be caused by both natural and man-made processes. In the south of the region, the processes within the Taupō Volcanic Centre (TVC) can result in deformation of the land. In other parts of the region, historical and current mining operations have resulted in subsidence impacting properties. In other parts, the karst landscape can also result in subsidence occurring.

### Magnitude and frequency

Long term deformation of land as a result of the TVC is an on-going issue. However, the magnitude of this movement is often of a fairly low level and occurs over long periods of time. Subsidence as a result of man-made activity, such as mining, or in the Karst landscapes is less frequent, but may impact more significantly upon populated areas.

### Exposure

Natural subsidence and deformation are not widespread and are largely confined to the south and west of the region. Lake Taupō has seen a number of deformation events as a result of processes within the TVC, most notably in 1922 and 1983, where the lake shore subsided in the south. Historic mining operations in the east and north of the region may result in some subsidence occurring. A swarm of earthquakes occurring in Lake Taupō over several months leads to subsidence along the shore of the lake in a short period. Along the northern shore the subsidence impacts lower-lying parts of Taupō, particularly around the Two, Three and Four Mile Bay areas, where up to 0.5m is observed. In the eastern and southern parts of the lake the subsidence is more severe, resulting in increased flood risk and erosion of lower-lying areas surrounding Turangi, Tauranga Taupō Bay, Motutere and Waitahanui.

### Vulnerability

The main impacts of this hazard are to the built environment, largely impacts to buildings and structures and key lifelines. There may be some economic and social impacts linked to impacts to the built environment.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, with historical comparable event, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

This hazard would have minor impacts in the social environment, with potentially moderate impacts for alternative accommodation, depending upon where it occurs.

### Built Environment

The built environment is likely to experience minor impacts from this event, with isolated impacts to homes and infrastructure.

### Economic Environment

The scenario presented would potentially have moderate impacts to the economic environment, as a result of damage to businesses and losses to individuals, depending upon where the impacts occur.

## Natural Environment

The natural environment would experience moderate impacts from this event, with potential loss of terrestrial environments and iconic landforms. In addition, freshwater ecosystems may be impacted by this hazard.

## Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Severe weather – short duration

### Context

### Hazard definition

Short duration severe weather events can be caused by high levels of convection, resulting in thunderstorms, hail and strong winds, or by fast moving low pressure systems. These can result in the depositing of high levels of rainfall in short periods of time, causing surface flooding and landslides.

### Magnitude and frequency

Numerous short duration severe weather events have occurred in recent times, and these are likely to increase with the impacts of climate change. Several events have previously occurred, including the Hamilton storms of 2018 and 2020 and the 2021 Te Awamutu storms that caused significant surface flooding.

### Exposure

All of the region is exposed to this hazard.

### Vulnerability

This type of event can have impacts across all four environments, resulting in impacts to housing, businesses and key infrastructure. This then has knock-on effects in the social and economic environments. The natural environment can be impacted as a result of impacts to terrestrial and freshwater ecosystems.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment, with a comparable event, in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

This hazard would have moderate impacts to the social environment, mainly impacts to the need for alternate accommodation and access to key welfare services. There may also be some risk to the wellbeing of people in impacted areas.

### Built Environment

The built environment is likely to experience moderate impacts from this type of event. These would largely be seen in residential and commercial buildings and across lifelines infrastructure.

### Economic Environment

The scenario presented would have moderate impacts to the economic environment, with disruption to key sectors, and potential losses for local government, businesses and commercial entities and individuals.

### Natural Environment

The natural environment would experience moderate impacts from this event, largely from impacts to freshwater ecosystems and iconic landforms as a result of landslides associated with the heavy rainfall.

### Risk Rating

This hazard is currently assessed as a low risk to the Waikato region.

## Snowfall

### Context

### Hazard definition

During winter extreme snowfall can occur due to significant low pressure systems moving up from the south. These can result in heavy snowfall in high country areas of the region, particularly around the Central volcanic plateau in the south.

### Magnitude and frequency

The likelihood of a significant snowfall event is 2% AEP (possible occurrence). The Desert Road (SH1) is closed several times each year as a result of snow fall.

### Exposure

Snowfall events are mostly confined to the high country in the south of the region. It is rare to experience snowfall at sea level.

### Vulnerability

The main vulnerability from snowfall events are lifeline utilities, in particular roading and electricity supplies.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

This hazard would likely have minor to moderate impacts to the social environment, largely as a result of reduced access to key services.

### Built Environment

The built environment is likely to experience minor to moderate impacts. Moderate impacts would largely be seen to key infrastructure, such as transportation networks and electricity supply.

### Economic Environment

The scenario presented would have moderate impacts to the economic environment as a result of impacts to key transportation networks and disruption to key sectors, such as agriculture.

### Natural Environment

The natural environment would experience minimal impacts from this event.

### Risk Rating

This hazard is currently assessed as a low risk to the Waikato region.

## Terrorism

### Context

### Hazard definition

Terrorism events are incidents that involve the use of force or violence against people and property to further a cause through intimidation of governance and the general population.

### Magnitude and frequency

Terrorism incidents are very rare in New Zealand. The Christchurch Mosque shootings that occurred in 2018 are the most recent example. The likelihood of a terrorism event in the Waikato region is unlikely.

### Exposure

Terrorism events in the region are most likely to occur in urbanised areas, such as the Hamilton CBD.

### Vulnerability

The main vulnerability from terrorism events are the social and economic environments, in particular the impacts to health and wellbeing, and commercial businesses located near to the event.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

An event of this magnitude is likely to impact the social environment – the main impact would be to the health and wellbeing of those affected by the event and the ongoing psychological impacts. Social wellbeing and connectedness are likely to also be impacted along with access to some services.

### Built Environment

The built environment is likely to experience minimal impacts from this event.

### Economic Environment

The economic environment is likely to experience moderate impacts from this event, particularly to businesses and commercial entities.

### Natural Environment

The natural environment is likely to experience insignificant impacts from this event.

### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Tsunami - regional / distant source

### Context

### Hazard definition

Significant earthquakes can occur on plate margins all around the Pacific rim, resulting in distant and regional-source tsunami that can travel huge distances in short amounts of time and impact New Zealand.

Over the past 150 years New Zealand has historically been impacted by several distant source tsunami events. These include the 1960 Mw 9.4 Chile earthquake, which resulted in a tsunami with run-up of over 2m on the east coast of the region and resulted in 1-2m of run-up on the west coast. Several other events have occurred in the past 50 years that have resulted in significant tsunami elsewhere, however, the impact of these to New Zealand was reduced due to the location of the quake.

A significant regional source tsunami risk for the Waikato region comes from the Tonga-Kermadec Trench. This part of the Australian-Pacific plate boundary has the potential to trigger tsunami which can cause significant inundation along coastal areas in the Waikato region.

### Magnitude and frequency

Since 1835 New Zealand has been impacted by at least 80 tsunamis of varying sizes. The rate of tsunami events impacting New Zealand is approximately 4-5 per year but has increased since 2000 due to improved tidal gauge data collection. Of these 80, 27 were from distant sources (more than 3 hours to NZ) and 12 from regional sources (1-3 hours travel to NZ).

A significant earthquake on the Tonga-Kermadec trench could result in tsunami on the coast of the Waikato region and potentially devastating inundation. In addition, a significant quake occurring in other parts of the Pacific Ocean could also result in widespread inundation. The likelihood of occurrence is rated as 'unlikely'.

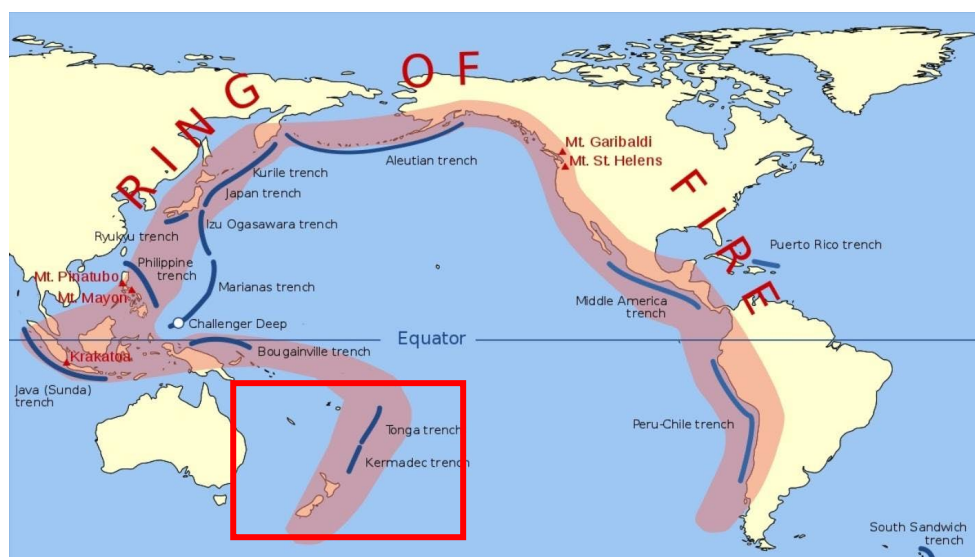
### Exposure

All of Waikato's coastline is exposed to tsunami from regional and distant sources.

### Vulnerability

Coastal low-lying areas as identified by tsunami evacuation zones are vulnerable to tsunami inundation.

### Modelling, mapping, and Geospatial analysis



**Figure:** The 'Ring of Fire' subduction zones with the Tonga-Kermadec trench highlighted as a regional source for the Waikato Region.



### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have moderate consequences across the social environment especially for eastern parts of the Coromandel Peninsula. This would include impacts to individual's health and wellbeing, households in need of accommodation, social wellbeing and connectedness and companion animals.

#### Built Environment

The built environment is likely to experience minor consequences. The majority of damage to the built environment in this scenario would be confined to the east coast of the Coromandel Peninsula, mainly to residential homes and some transportation and lifeline assets.

#### Economic Environment

The scenario presented would have moderate impacts on the economy. These would mainly be to businesses and individuals within the townships of the Coromandel Peninsula.

#### Natural Environment

The natural environment would experience damage to coastal ecosystems and may also see some impact from silt deposition and debris mobilised by tsunamis. Wastewater and hydrocarbons may be released into the marine environment due to damaged infrastructure.

### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Volcanic activity – caldera eruption

### Context

### Hazard definition

There are a number of caldera volcanoes within the region, including the Taupō Volcanic Centre (TVC) and the Maroa Volcanic Centre to the north of Taupō. Eruptions from caldera volcanoes are rare, however, their magnitude makes them potentially catastrophic events.

### Magnitude and frequency

Caldera eruptions happen millennia apart from each other. The last major caldera eruption in New Zealand was in Taupō in 180AD. This was the 3<sup>rd</sup> largest eruption in the earth's history, depositing ash and volcanic debris for hundreds of kilometres and impacting most of the North Island of New Zealand.

### Exposure

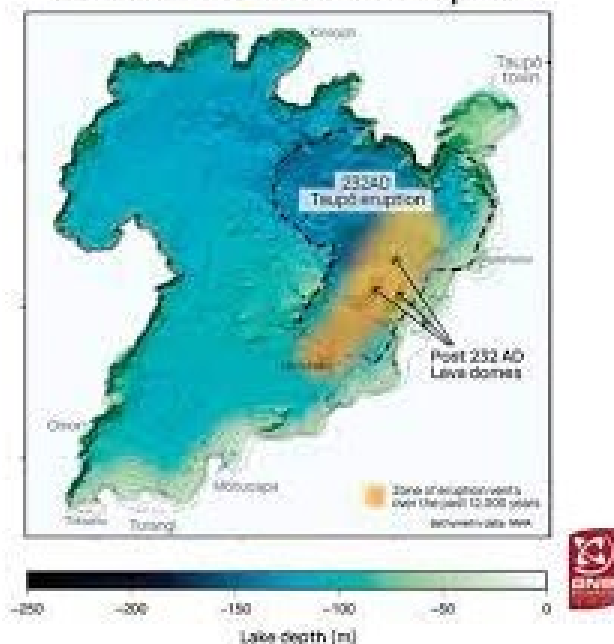
The magnitude of a caldera eruption would impact the entire region and would have far reaching impacts across the North Island. It would be a nationally significant event, many magnitudes beyond what has previously been experienced.

### Vulnerability

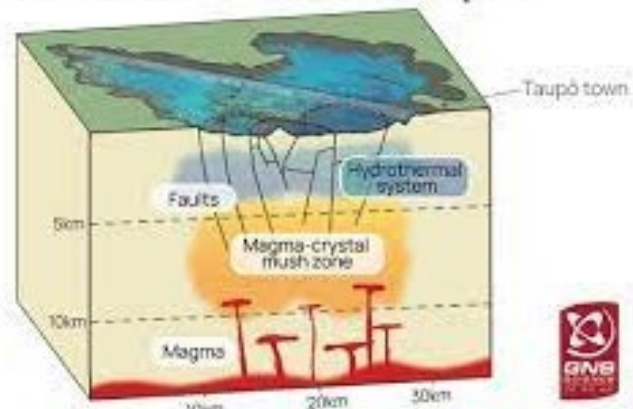
All four of the environments would be massively impacted by an event in the TVC. This would result in extreme impacts to the social environment, with widespread need for support and displaced populations. It would have significant impacts upon lifelines infrastructure of national importance and would have extreme effect upon the economy of both the region and New Zealand. The natural environment would be hugely impacted, with the loss of landforms, terrestrial and freshwater ecosystems and impacts to marine environments.

### Modelling, mapping, and Geospatial analysis

#### What is below Lake Taupō?



#### What is below Lake Taupō?



### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

#### Potential Impacts

##### Social Environment

An event of this magnitude is likely to have a range of impacts across the social environment, with some deaths and injuries and impacts to the fabric of society that would take many years to recover. Long term health consequences may occur from prolonged ash inhalation. Major psychological impacts are likely, and it is anticipated there would be major impacts to welfare services, education services and community services.

##### Built Environment

An event of this scale would have widespread extreme impacts across all areas of the built environment, with destruction and damage to buildings and critical lifelines infrastructure.

##### Economic Environment

The economic environment would experience extreme impacts from this event across all elements. This would impact New Zealand's GDP significantly.

##### Natural Environment

The natural environment would experience extreme impacts from this event, with widespread ash fall impacting air, freshwater and terrestrial ecosystems. Landscapes would be permanently changed, with the loss of iconic landforms. The marine and freshwater environments would be hugely impacted by continuing debris flows and sediment.

##### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.

## Volcanic activity – caldera unrest

### Context

### Hazard definition

There are a number of caldera volcanoes within the region, including the Taupō Volcanic Centre (TVC) and the Maroa Volcanic Centre to the north of Taupō. Eruptions from caldera volcanoes are rare, however, their magnitude makes them potentially catastrophic events. However, these can go through extended periods of unrest, resulting in earthquake swarms and land deformation.

### Magnitude and frequency

Despite the long periods of time between eruptions, calderas can still have frequent periods of unrest, with earthquakes and land deformation occurring. Significant unrest periods have occurred throughout recorded history, including in 1922 and 1983 and more recently with earthquake swarms experienced in December 2022.

### Exposure

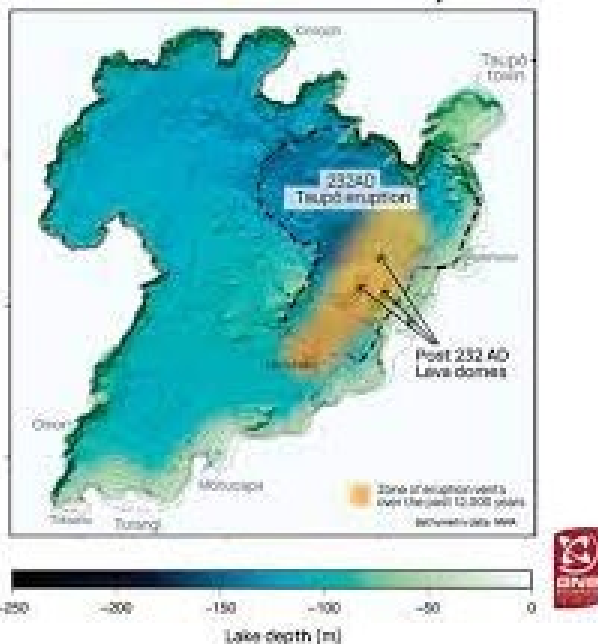
Many settlements, including Taupō itself, lie in close proximity to the region's calderas. Unrest periods would potentially impact these places, but the wider region would be largely unaffected.

### Vulnerability

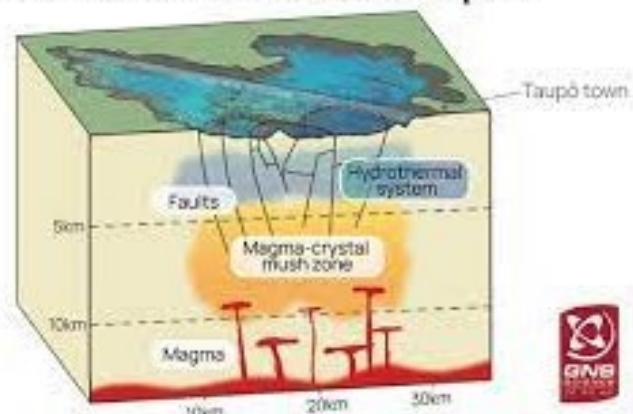
The main vulnerabilities to this hazard are in the social and built environments. It would be likely that land deformation could result in some displaced populations and some lifeline utilities may be impacted, including transportation networks.

### Modelling, mapping, and Geospatial analysis

#### What is below Lake Taupō?



#### What is below Lake Taupō?



### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard is based upon the risk assessment conducted at the risk assessment workshops and has been given a moderate level of confidence.

### Potential Impacts

#### Social Environment

It is anticipated that this event would have largely insignificant impacts on the social environment, with the main risk associated to displaced populations, which would be in low numbers.

#### Built Environment

This hazard would have minor impacts to the built environment, mainly to structures and infrastructure located near areas of deformation.

#### Economic Environment

This hazard could have minor to moderate impacts to the economic environment, largely through costs to local government for damage infrastructure and the impact to regional economic sectors, such as tourism.

#### Natural Environment

The natural environment would experience a

#### Risk Rating

This hazard has been rated as a medium risk for the Waikato region.

## Volcanic activity – local eruption

### Context

### Hazard definition

The Waikato region has several active volcanoes within its boundaries including.

- Taupō Volcano
- Ruapehu
- Ngāuruhoe
- Tongariro

Volcanic eruptions occur when magma under the earth rises to the surface and is released. This can sometimes be as violent eruptions, where pressure builds up over time and is suddenly released, or as slow-release events. Hazards associated with volcanic eruptions include ashfall, ballistics (flying rocks), lava flows, lahars (mudflows), pyroclastic flows (fast moving hot, dense ash clouds) and volcanic gases. Other potential hazards include landslides, tsunamis, electrical storms and hydrothermal eruptions.

### Magnitude and frequency

The active volcanoes of the Taupo Volcanic Zone are alive and well – Mount Tongariro has experienced over 70 eruptions from various vents since 1839 – vents include the Te Maari Crater, the Red Crater and Mount Ngauruhoe (considered as a separate volcano however is geologically a cone of Mount Tongariro). The most recent eruption came from the Te Maari Crater in 2012, sending large volcanic rock as far as two kilometres into the air.

Ngauruhoe is the most continuously active of the volcanoes in New Zealand, with Māori recording many eruptions prior to European colonisation. Until 1975, Mount Ngauruhoe was recorded to have erupted every nine years however the volcano has now been resting for over four decades. In 1974 and 1975 there were explosive eruptions of ash, and blocks of lava were thrown as far as 3 km away.

In recorded history, trends show Mt Ruapehu eruptions happened every 50 years with the most recent large eruption occurring in 1995. Since 1995, Ruapehu has had a series of smaller, sporadic eruptions as well as heightened activity. In addition to the usual volcanic hazards, the crater lake of Ruapehu ejects frequent lahars. The most recent eruption in 2007 was explosive lasting 7 minutes, during the eruption explosions spread ash, rocks and water across the summit area, producing lahars in two valleys including one in the Whakapapa ski field.

Taupō volcano first began to erupt over 300,000 years ago. Taupō volcano last erupted over 1,800 years ago and is today filled by New Zealand's largest lake – this eruption was the most violent eruption in the world in the last 5,000 years.

### Exposure

The area immediately surrounding Ruapehu, Ngauruhoe and Tongariro volcanoes is largely utilised for agriculture and forestry and is sparsely populated. Turangi, a tourist destination in the winter months, is the closest population centre in the Waikato region to these volcanos. Volcanic ash fall can be deposited hundreds to thousands of kilometres however from its source - all the Waikato region is exposed to volcanic ashfall hazard.

Most of the central North Island would be exposed to the direct impacts of a Taupo Volcano eruption – the last eruption culminated with a large and very energetic pyroclastic flow that devastated an area of about 20,000 km<sup>2</sup> and filled all the major river valleys of the central North Island with pumice and ash. The first phases of the eruption produced a series of five pumice and ash fall deposits over a wide area of the central North Island, especially east of Taupō and beyond Napier into Hawke Bay. Most of New Zealand would feel some level of impact from an event of this magnitude.

## Vulnerability

A local volcanic event could significantly impact the Waikato region. A significant event in winter months could see many more people impacted due to the use of the mountain for winter sports. Agricultural production and tourism activities in the region could also be impacted. Ash fall may impact key lifeline utilities, such as electricity distribution, communications, roading and water supply. Impacts are also likely within the social environment, especially for those with respiratory conditions. An event may also have potentially significant localised impacts to the natural environment, including freshwater ecosystems and significant flora and fauna.

## Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment, with historical comparable event, in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

## Potential Impacts

### Social Environment

The social environment would likely see minor effects overall, depending upon when an eruption occurs. If it is without warning during the busiest time for tourism on the mountain, then impacts in the social environment could be far worse.

### Built Environment

The built environment would potentially see moderate impacts from this hazard, due to ashfall. This would have impacts upon key transportation networks that run either side of the volcanoes and impacts to infrastructure in the surrounding areas.

### Economic Environment

This hazard would have moderate impacts to the economic environment, largely as a result of disruption to the regions key sectors and impacts to infrastructure. Some individual loss would be experienced, but the worst impacts would likely be seen to businesses and commercial entities and local government.

### Natural Environment

There would potentially be moderate impacts to the natural environment from ash fall and debris flows. This would see impacts occurring in both the terrestrial and freshwater ecosystems and potentially result in changes to an iconic landform.

## Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.



## Water supply failure / contamination

### Context

### Hazard definition

Water supply failures can occur when there is damage to the network infrastructure, or when contaminants enter the supply, either at source, or within the distribution network.

There have been several water supply or failure events within New Zealand in the past ten years, including the 2016 Havelock North Campylobacter outbreak and the Taranaki water supply failure in 2018 due to infrastructure damage.

### Magnitude and frequency

The likelihood of a significant water supply failure or contamination event is 1% AEP (possible occurrence).

### Exposure

The Waikato region has reticulated water supplies in Hamilton city and most towns within the region. Contamination of the supply in a large population base such as Hamilton could see a significant portion of the region's population impacted.

### Vulnerability

The main vulnerability from water supply failure events is the economic environment, in particular businesses reliant upon water for production. A water contamination event may also have additional impacts in the social environment, including health and wellbeing, particularly in the elderly or those with pre-existing medical issues.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment, with a comparable event, in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

### Social Environment

In this event, moderate impacts are expected to injuries and illness (especially to vulnerable people with medical needs), psychosocial impacts, access to welfare support services, education services, community services and social wellbeing & connectedness.

### Built Environment

Moderate impacts are anticipated to potable water services. The built environment is also likely to experience minor impacts to facilities that use a large amount of water for operations, such as health services and hospitals in the affected area.

### Economic Environment

The scenario presented would have moderate impacts to businesses, commercial entities & industries, especially those who are high water users in manufacturing, horticulture and hospitality.

### Natural Environment

The natural environment would experience insignificant to minor impacts to surface freshwater quality and associated ecosystem services.

### Risk Rating

This hazard is currently assessed as a medium risk to the Waikato region.



## Low level risks – Hazard summaries

\*Denotes hazards that have been fully assessed through workshops and given a final risk rating.

### Geothermal activity

#### Context

#### Hazard definition

Due to the complex volcanic system in the south of the region, geothermal activity is a significant part of the landscape. This is generally concentrated from the Central Plateau volcanoes through the Taupō volcanic Centre (TVC). While the majority of geothermal activity is benign and can be harnessed for power production, occasionally geothermal eruptions can occur. These are generally very localised and have minimal impacts to the region.

#### Magnitude and frequency

Geothermal eruptions have occurred on several occasions within the region, most notably around areas such as the Craters of the Moon Geothermal Park and in 2005 near Reporoa. While not a common occurrence, they have the potential to occur at any time. The impacts of a geothermal eruption are generally very localised and not more than a few hundred metres radius from the centre.

#### Exposure

The main exposure is in the south of the region, from the Volcanic Plateau through Taupō to the boundary with Bay of Plenty, south of Rotorua.

#### Vulnerability

The main vulnerabilities are to the built and the natural environments from this type of hazard. However, this is highly dependent upon where the activity occurs.

#### Risk Analysis Confidence

#### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

#### Potential Impacts

#### Social Environment

This hazard would have minor impacts to the social environment, with potential for injuries and illness and some minor displacement of people.

#### Built Environment

This hazard would have minor impacts across the built environment. There is potential for impacts to housing, commercial property, transportation, electricity and telecommunications networks depending upon where the eruption occurs.

#### Economic Environment

This hazard would have minor impacts across the economic environment with very localised impacts to individuals and businesses.



## Natural Environment

This hazard could have minor to moderate impacts to the natural environment, particularly to freshwater ecosystems, or national parks, forests and iconic landforms.

## Risk Rating

This hazard is currently assessed as a low risk to the Waikato region.

## Mass fatality transport accident

### Context

### Hazard definition

Major transport accidents can occur on any of the region's transportation routes. These involve the death and injury of many people as the result of a significant accident, such as a rail crash, bus accident or plane crash.

### Magnitude and frequency

Historically, major mass fatality incidents in New Zealand are unlikely. Many of the causes of previous major incidents have been addressed and the scale of transportation within the country is far smaller than other countries around the world.

### Exposure

The Waikato region has several major road and rail networks and two regional airports. The largest potential for a major transport accident is a plane or train crash.

### Vulnerability

The main vulnerability from major transport accident event is in the social environment, in particular the risk to life safety and psychological impacts. There is some risk to the built environment also, depending upon the circumstances of the accident.

### Risk Analysis Confidence

### Uncertainty / Confidence level in assessment data

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a moderate level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

### Potential Impacts

#### Social Environment

An event of this magnitude is likely to have mostly minor impacts across the social environment within the region. The most likely impacts are deaths and injuries and illness.

#### Built Environment

The built environment is likely to experience insignificant impacts from this event. Minor impacts to the transport asset involved (road, rail, airport) may be expected depending on the circumstances.

#### Economic Environment

The scenario presented would have minor impacts to the economic environment within the region.

#### Natural Environment

The natural environment would experience insignificant impacts from this event.

### Risk Rating

This hazard is currently assessed as a low risk to the Waikato region.

## Volcanic activity – distant (ashfall)

### Context

### Hazard definition

Volcanic eruptions occur when magma under the earth rises to the surface and is released. This can sometimes be as violent eruptions, where pressure builds up over time and is suddenly released, or as slow-release events.

During an eruption, volcanoes can produce huge columns of ash, several thousand metres high. This is made up of particulate that can travel many kilometres in the upper atmosphere before being deposited. Heavy particles will fall closer to the volcano, but lighter particulate will travel with the predominant winds at the time of eruption.

### Magnitude and frequency

The risk of a significant volcanic eruption from one of the distant source volcanoes impacting the region is very low. The likelihood for the maximum credible event from Mt. Taranaki is 0.1%AEP, or 1 in 1000 years. An eruption of Mt. Taranaki would potentially result in ash fall up to 5mm near to the Taranaki Regional boundary and decreasing as the distance from the volcano increases. This hazard is rated as unlikely.

Mt Taranaki, which could impact the Waikato Region, is considered to have the highest risk of a major eruption with a 50% chance of it occurring in the next 50 years. It is reasonable to expect that a distant volcanic eruption could deposit 1-2cm of ashfall in the Waikato Region, however, this hazard has a 'rare' likelihood.

### Exposure

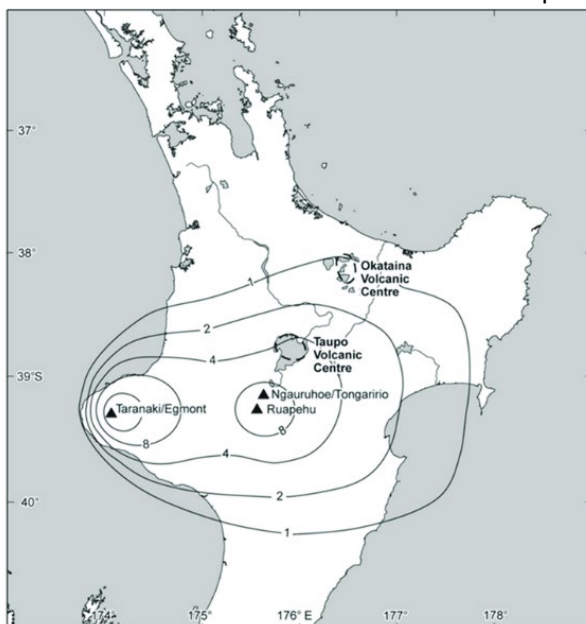
All of Waikato is exposed to a distant volcanic eruption, however, it is likely that southern and western parts of the region would experience thicker ashfall than areas in the north.

### Vulnerability

A distant volcanic eruption which deposits ashfall in the Waikato region is likely to impact all environments. People with pre-existing respiratory health conditions and electrical power lines are particularly vulnerable to ash fall.

### Modelling, mapping, and Geospatial analysis

Probabilistic volcanic ashfall hazard map for the North Island. The map shows the ashfall thickness (units of mm) expected with a 10% probability of exceedance in 50 years (equivalent to a 500 year return period). The source of the map is Hurst and Smith (2010).



### Risk Analysis Confidence

**Uncertainty / Confidence level in assessment data**

The assessment of this hazard was initially based upon the results of the hazard surveys, with survey data as the only source of assessment there is the lowest level of confidence.

Following a validation process where the survey results were reviewed, by experts within the field, this assessment in alignment with the NEMA Assessment for confidence table, is given a low level of confidence.

This rating should be taken as provisional and may change during the life of the next Group Plan following a full risk assessment for this hazard.

**Potential Impacts****Social Environment**

An event of this magnitude is likely to have minor impacts across the social environment. Those with pre-existing respiratory health conditions may be affected.

**Built Environment**

It is anticipated there would be minor impacts on utility services such as electricity, telecommunication networks and major impacts to 3 waters services.

**Economic Environment**

The scenario presented may impact businesses and industry in the Waikato region, in particular the south and western Waikato rural sector.

**Natural Environment**

The natural environment would experience some impact, particularly to the freshwater environment and air quality.

**Risk Rating**

This hazard is currently assessed as a low risk to the Waikato region.