Chapter 14: Natural Hazards

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Natural Hazards

Briefly ....

The nature of Marlborough's climate, topography and geology combine to create the potential for significant natural hazards. Flooding, land instability, earthquakes, storm surges, fire and drought have all been experienced in living memory. Some natural hazards, such as flooding, create localised risks while others could affect the whole area e.g. earthquakes. In many cases, natural hazards cannot be controlled or contained by humans and the impacts of a hazard can be made worse because of the pattern of settlement and development.

ISSUES

- Protecting the Wairau Plain from flooding (including maintaining the drainage network) and dealing with floods where there are no flood protection works.
- Earthquake risks for public safety, buildings and infrastructure.
- Building on unstable land.
- Uncertainty about the risks from hazards such as tsunami and storm surge

PRESENT AND FUTURE MANAGEMENT OF NATURAL HAZARDS

Research and investigations

To help the Council identify and assess the range of hazards affecting Marlborough, a study has looked at significant hazard risks for Marlborough. The study describes the degree, the level of risk and the likely impact posed by natural hazards affecting or posing a threat to Marlborough. Gaps in current knowledge are also identified. The three major hazards identified for Marlborough are earthquakes, rainstorm/floods and drought.

Some preliminary assessments have been carried out on the risks from tsunami and from liquefaction. However, with seismic hazard being rated as a top ranked hazard, some detailed investigations have been undertaken. Initially information was gathered on the main known active faults in Marlborough. The Wairau section of the Alpine Fault was identified as presenting the highest risk for Marlborough and that with a large earthquake occurring on this fault, there would be very serious impacts felt all over the district.

The second stage of investigations looked at establishing reliable estimates of the timing of the most recent earthquake rupture on the Wairau section of the Alpine Fault. From these investigations, there is radiocarbon evidence of the most recent rupture occurring in the last 500 years. This was unexpected because other paleoseismic investigations near Wairau Valley township indicated there had been no rupture of the Wairau section of the fault in that area for at least 1,000 years, and probably longer. There is some thought that this work suggests that both the amount of elastic strain stored at the fault, and the likelihood of the next earthquake rupture, may be lower than was previously thought. More investigations will be needed to provide a better understanding of the future level of risks.

Flood protection works and drainage network

There has been a significant history of constructing flood protection works on the Wairau Plain, dating back to the late 19th century. Most of these works have involved stop banks to contain flood waters. The total length of stop banks associated with the Wairau River floodway is 98 kilometres; a further 45 kilometres of stopbank follow the Upper Opawa and Roses overflow floodway; with an additional 44 kilometres following the Lower Opawa and Taylor floodway. Recent work has been undertaken to upgrade existing flood protection works to a one in one hundred year standard. Floods have had a dramatic effect on the social and economic wellbeing of Marlborough in the past and it is essential for existing flood protection works to be retained and maintained to ensure public safety and the protection of property.

There are flood risks in other parts of Marlborough but these areas aren't physically protected because of the costs of constructing flood protection works. In some cases new development may be limited where it can go because the known flood risks are too high.

The Council operates a River and Flood Infoline answer phone system that gives up-to-date river levels and recent rainfall from the Council's recorders throughout Marlborough. This provides warnings of possible flooding.

The Council also operates and maintains an extensive drainage network of 160 kilometres of modified streams and constructed drains on the lower Wairau Plain. The drainage network reduces water table levels over what is now some of the most productive land in Marlborough and is important to our economic wellbeing. The expansion of viticulture has seen demand to expand or enhance this network so grapes can be planted in areas where high groundwater tables have been experienced. However, some of these streams and drains provide habitat for indigenous fish and invertebrates. Removing vegetation and sediment from the streams and drains can affect the habitat for these indigenous species.

Civil Defence and Engineering Lifelines Group

Much of the responsibility for civil defence planning and response is carried out by the Marlborough Civil Defence Emergency Management Group, which includes the Council, the Nelson/Marlborough District Health Board, the Police and Fire Services. An Emergency Management Plan has been prepared to manage hazards and risks in accordance with the principles of reduction, readiness, response and recovery.

The Marlborough Engineering Lifelines Group has been set up to reduce damage following a major disaster and reduce the time lifeline utilities (roads, water supply, power supply, communications etc), will take to restore their usual level of service after an event.

Resource management plans

Both the Wairau/Awatere and Marlborough Sounds resource management plans have a range of rules and other methods to limit the impact of natural hazards on certain land uses. Development (including building), in areas of unstable land and within flood hazard areas are the two main activities that are controlled.

Making earthquake prone buildings safe

The Building Act requires local authorities to develop a policy for those local buildings most vulnerable in a moderate earthquake. The Council's policy requires the earthquake risk of mostly non-residential buildings to be evaluated and require earthquake prone buildings to be strengthened. An assessment of buildings at risk has been carried out and property owners notified of the need for the buildings to be strengthened.

Flood waters overtopping flood bank, 1983

Natural Hazards

In depth ....

The nature of Marlborough's climate, topography and geology combine to create the potential for significant natural hazards. Flooding, land instability, earthquakes, storm surges, fire and drought have all been experienced in living memory. This includes events such as the 1983 Wairau River flood, which inundated large parts of the Wairau Plain, the devastating droughts of 1973 and 1997/1998, and the Boxing Day fire on the Wither Hills in 2000. These hazards were experienced over quite a wide area, but hazards can also be experienced at quite a different scale at the local level such as land instability on individual properties.

Some natural hazards, although not experienced by many of us, have gained a heightened sense of awareness over the past few years. Who can forget the graphic images of the 2004 Boxing Day tsunamis in the Indian Ocean and the almost unbelievable loss of human life and destruction of whole towns and ways of life? These images remind us all how vulnerable our coastal settlements are, especially as New Zealanders have a real affiliation for living and playing by the sea.

Seismic activity in Marlborough is probably the most significant hazard in terms of its potential to cause serious loss of human life and damage to property. However, the infrequency of high magnitude events lulls us into believing that a damaging earthquake will not occur in our lifetime. The reality though of living in an area that is the most seismically active in New Zealand, means a significant and damaging event is possible.

Irrespective of scale, natural hazards create a risk of the loss of life or personal injury. They can also damage or destroy property and community infrastructure (such as sewerage, water supply, telecommunications, road and rail links). The fact that Marlborough is still thriving is indicative of the resilience of our community. Irrespective of this resilience, it is clearly preferable to avoid the effects of natural hazards or, where this is not possible, mitigate the effects to an acceptable level.

One of the functions of the Council under the Resource Management Act 1991 is to avoid or mitigate natural hazards. This is reflected in the existing provisions of the Marlborough Regional Policy Statement and the resource management plans. In some cases, works have also been undertaken over the past 10 years to reduce the risk of certain hazards occurring (e.g. upgrading of the flood defences along or near the Wairau River have reduced the risk of flooding on the Wairau Plain). However, the risk of many hazards remains unchanged or may have even increased with the expansion of activities or as a result of climate change.

NATURAL HAZARD ISSUES

Protecting the Wairau Plain from flooding

The Wairau River catchment has historically had at least one damaging flood every decade since the time of European settlement. Flood events have also occurred in the Omaka and Taylor Rivers. In fact, floods were so frequent in the early days that Blenheim was known as Beavertown. In spite of the obvious flood hazard from these rivers, the Wairau Plain is the most intensively used land area in the district.

Perhaps not surprisingly, there has also been quite a history of constructing flood protection works on the Wairau Plain, dating back to the late 19th century. Most of these works have involved stop banks to contain flood waters. Over the 100 years or so since river works were commenced on the Wairau floodplain, vast amounts of money have been spent to create the present river system for the prime purpose of flood control.

William Budge's survey map of the Wairau Plain in 1848 clearly shows the Opawa River as a secondary flood channel of the Wairau River. During flood events water from the Wairau River regularly flowed into the Opawa River flooding much of the lower Wairau Plain. Attempts were made as early as 1862 to close the Opawa outlet just west of the State Highway 6 Wairau River Bridge at Conder's Bend.

In 1911 river works by the Wairau River Board resulted in reduced groundwater recharge and the substantial drying up of springs and streams in the Renwick and Rapaura areas. In 1913 the Opawa River was finally blocked as a secondary flood channel from the Wairau River. The Wairau River Diversion was built in 1963 to reduce the effect of flooding in the lower reaches of the Wairau River.

The siting of Blenheim on the banks of the Taylor River led to regular flooding of the town. The diversion of the Fairhall, Omaka and Opawa rivers, and the blocking of the Opawa loop, changed the flow regime of the Lower Opawa River reducing the effects of flooding in Blenheim.

The construction of the Taylor Dam (the largest earth flood retention dam of its type in New Zealand) was also instrumental in the reduction of flooding in Blenheim. The dam limits the amount of water that flows down the Taylor River and therefore reduces the height of the flood levels in the town.

The total length of stop banks associated with the Wairau River floodway is 98 kilometres; a further 45 kilometres of stopbank follow the Upper Opawa and Roses overflow floodway; with an additional 44 kilometres following the Lower Opawa and Taylor floodway. Recent work has been undertaken to upgrade existing flood protection works to a one in one hundred year standard (i.e. the flood flows from an event that has a 1% probability of occurring in any year can be contained).

The location of rivers on the Wairau Plain has been changed with construction of diversions, or by blocking off alternative outlet channels. These diversions and blockages have meant that every river channel or floodway on the Wairau floodplain below the confluence of the Wairau and Waihopai Rivers, is carrying a different flow regime or in a different position (or both), from what it did prior to European settlement.

These flood protection works have also dramatically changed the natural character of the Wairau, Opawa, Omaka and Taylor Rivers, particularly as the river channels flow in a confined channel. The urban and rural development that this infrastructure seeks to protect makes the process irreversible.

Floods have had a dramatic effect on the social and economic wellbeing of Marlborough in the past. The impact of the 1983 Wairau Flood is a reminder of this. It is therefore essential that existing flood protection works be retained and maintained to ensure public safety and the protection of property.

Most of the land adjacent to stop banks is privately owned and there is also privately owned land within floodways, although the majority of the land inside the flood banks is owned by the Council and leased for cropping and grazing. Land use activities on this land such as excavations close to stop banks or fences and larger structures, could jeopardise the integrity of stop banks or create obstacles to flood flows.

The Wairau River carries a significant bed load of gravel. The gravel can accumulate and create significant deposits within the bed of the river. These deposits have had to be actively managed to ensure that they do not also prevent an efficient floodway channel. The main form of management is to allow the periodic removal of gravel from strategic areas. This has been a win-win situation given the demand for aggregate.

Tuamarina - 1983 flood

Doctors Creek flooding, August 2008

Flood threats where there are no flood protection works

Flood works have not been undertaken in other parts of Marlborough because of the lack of a flood hazard (e.g. Awatere River) or the fact that the costs of the necessary works outweigh the public benefits. The latter especially applies in the case of sparsely populated areas. This means that there are areas of Marlborough where there is still a very real flood hazard. This is especially so in the Marlborough Sounds and Rai/Pelorus areas where there is higher rainfall and the potential for intense rainfall. The Picton/Waikawa floods of 2004 were the result of 133 millimetres of rainfall in two hours! See the box 'February 2004 flood event' for more about this.

It is important that the risk to public safety and property is minimised where there are known flood hazards (due to past flood events). This may require taking a more cautious approach to locating new buildings in these areas. For example, a resource consent is currently required to build in known flood hazard areas. This allows the risk to the homeowner and their property to be assessed and a resource consent is granted when there is an acceptable level of risk.

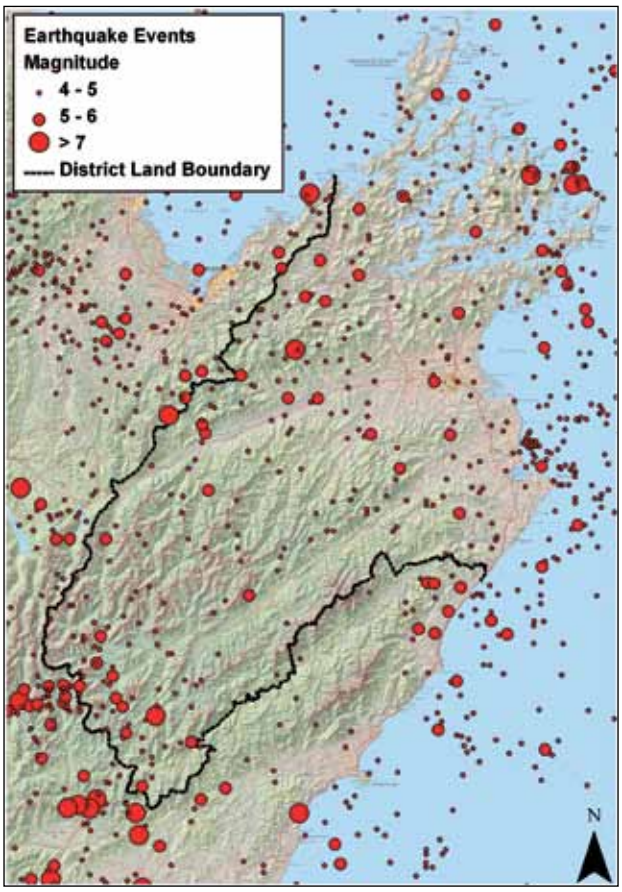
There has been growth in the number of people living in rural areas in Marlborough, which may mean that new flood protection works might become financially feasible. Another response, and one which seems to be increasing in popularity, is for local residents to develop their own flood protection works. However, if not appropriately designed and constructed, such works may make worse the flood hazard for neighbouring or downstream properties.

Even with protection properties can still be subject to extreme flood events. It is therefore important that the Council and the community are able to respond in the event of any emergency situation.

Earthquake risks for public safety, buildings and infrastructure

All of Marlborough lies within the zone of highest earthquake risk in New Zealand. This is because the district is crossed by a series of fault lines associated with the relative movements of the tectonic plates that New Zealand sits across. These fault lines are an extension of the Alpine fault, being the Wairau, Awatere and Clarence faults, as well as a number of other active faults of limited extent. There are also several important faults offshore to the east of Marlborough. Ground shaking will occur from ruptures on these faultlines. The northern area of Marlborough (mainly the Sounds) is over or adjacent to the subducting Pacific tectonic plate. This feature can generate severe shaking without necessarily showing surface faulting.

FIGURE 14.1: EARTHQUAKE EVENTS GREATER THAN MAGNITUDE 4, 1930 - 2008



FEBRUARY 2004 FLOOD EVENT

On the morning of 17 February 2004, an extremely large, very localised and totally unpredicted rainfall event, struck the catchments of the Waitohi and Waikawa Streams in Picton and the Graham River in nearby Whatamango Bay. Extreme rainfall fell over an intense two hour period. The resulting flood flows were the largest ever recorded in the Picton area and were far in excess of the design estimates for the three main waterways affected. Over a one hour period 62 millimetres of rain was recorded, which is amongst the highest ever recorded in the South Island (even for areas like Milford Sound and Haast), and only bettered in New Zealand by occasional tropical downpours in Northland. This deluge caused 'flash flooding' in Waitohi and Waikawa Streams and in the Graham River.

Waitohi Stream

The Waitohi Stream, carrying a lot of logs and debris from the steep Essons Valley catchment, overtopped at Alexander's Holiday Park affecting the camp and some houses in Canterbury Street. Major culverts running underground from Waitohi Domain to the Edwin Fox area could not handle the flow produced.

Initially the Kent Street drain, and then the purpose-designed overflow area within Waitohi Domain, coped with the flood flows but very quickly the 50 year return period design storage volume was exceeded. Floodwaters then inundated the area bounded by Broadway, Kent Street, Market Street and Dublin Street. Floodwater became ponded up to 0.7 metres deep in the commercial/industrial area surrounding Dublin Street.

The main sewer pump station in Dublin Street failed, when the floodwater level rose above the main electrical switches within the station. Sewage overflows then occurred in that area and upstream.

Water Supply Dams

Further up the catchment the two water supply dams (Barnes and Humphries) were also significantly overtopped during the rainfall event because the normal spillway capacity was exceeded. There were some concerns about the possibility of dam failure because of scour around dam abutments or from a sudden landslide into the full reservoirs. This resulted in a precautionary evacuation of low-lying areas in Picton. The dams have since undergone engineering investigation and have been deemed to be safe.

Waikawa Stream

The Waikawa Steam catchment experienced some of the highest rainfall intensities of the event. Most of the flood flow passed through the lower parts of the system without overtopping significantly. The remaining floodwaters flowed over the Beach Road reserve and then down Beach Road to discharge into the marina area. The Beach Road Reserve and Beach Road had been specifically designed to act as an emergency overflow path.

Graham River

The Graham River, in Whatamango Bay, experienced extreme flooding and debris flows during the event. The River is not protected by floodworks and escaped its banks across a wide floodplain and overtopped the road. A caravan parked within the floodway was washed away but the only dwelling within the floodway was raised high enough to avoid being damaged.

Waitohi Stream at Alexander's Holiday Park

Waikawa Stream

Civil Defence Emergency

When emergency managers evaluated the risk of dam failure, the resulting evacuation of people from homes, schools, a motor camp and businesses and associated roadblocks, along with security measures, etc, led to a State of Civil Defence Emergency being declared. At the height of the emergency, and largely in response to the evacuation of people from the floodplain downstream of the water supply dams, approximately 1,000 people had been evacuated.

Once concerns about the safety of the dams had been addressed, the majority of those who had been evacuated were allowed to return home. Evacuees whose properties had been inundated by floodwaters and possibly contaminated by sewage in the area bordered by Broadway, Market Street, Dublin Street and Kent Street, were not allowed to return home until the Council's building inspectors had assessed the sanitary condition of their homes.

The largest historical earthquake experienced in Marlborough generating ground fracture occurred on the Awatere Fault in 1848. It had an estimated magnitude of 7.5. Earthquakes occurring in other areas can also affect Marlborough with severe ground shaking, notably the Wairarapa earthquake of 1855 with a magnitude of 8.2. The lack of recent significant earthquakes can lead to a false sense of security.

In addition to the obvious effects that earthquakes can have on buildings and infrastructure, and the consequent threat to public safety, there are secondary hazards associated with earthquakes. These include fires in urban areas and liquefaction. Liquefaction occurs during shaking when the soil becomes like a liquid and loses its ability to support buildings and other structures. Some types of soils are more susceptible than others to liquefaction and shallow groundwater also increases the potential for liquefaction. There are indications that soils susceptible to liquefaction can be found along the coastal margin of the Wairau Plain, especially in the Riverlands area.

Given the number of active faults that exist in Marlborough, earthquakes are a very real hazard. Although nothing can be done to prevent an earthquake from occurring, there are various ways in which the impact of earthquakes can be reduced. These can include trying to minimise the impact of earthquakes on buildings and ensuring new buildings are not located on active faults. Buildings constructed in close proximity to active faults face a much greater risk because of the potential for differential horizontal and vertical movement and for soil disturbance.

Building on unstable land

The geology, soils, topography and climate in some parts of Marlborough combine to create the potential for land instability. The two most obvious examples are land in the Marlborough Sounds and hill country along the southern margin of the Wairau Plain. In the Sounds, much of the geology is fractured schist with limited topsoil. This type of land is naturally unstable where it occurs on steep slopes and especially in times of intense rainfall.

Past slips and areas susceptible to instability have already been mapped and are included in the Marlborough Sounds Resource Management Plan. Similar to flood hazard areas a cautious approach to development in areas of instability is also taken: a resource consent is required to construct buildings to assess the level of risk. The Council also requires that all engineering work related to the construction of a building has to be carried out by a geo-technical engineer accredited by the Council.

Dense network of pipes that are exposed in the shallow head scarp of an earth (loess) slide/flow in dispersive loess, Wither Hills, south of Blenheim

One of the difficulties with this approach has been determining what is an acceptable level of risk. There are also probably areas that have a similar geology and topography to those that are mapped, and to which arguably a similar level of risk could apply, but development in these areas is not subject to the same level of scrutiny.

The soils on the hill country to the south of the Wairau Plain also create a land instability hazard, but for quite different reasons. The dominant material in these hills is loessial soils, which are susceptible to erosion. When wet they tend to dissolve away through extensive sub surface tunnels. In severe cases, the tunnels cave in to form gully erosion. Unlike the Sounds, no specific provision is given to the potential for instability in the Wairau/Awatere Resource Management Plan when considering development on these hills.

Drainage network on the Wairau Plain

The Council operates and maintains an extensive drainage network on the Lower Wairau Plain. Much of the Wairau Plain was wetland prior to European settlement. The drainage network, consisting of 160 kilometres of modified streams and constructed drains, was created to bring this wetland into productive agricultural use. The drainage network still acts in much the same way today, reducing water table levels over what is now some of the most productive land in Marlborough.

The drainage network is actively maintained to ensure that the streams and drains efficiently and effectively convey water. The maintenance work can involve the removal of vegetation by mechanical or chemical means and the removal of accumulated sediment from the bed. Given the importance of the various use of the Wairau Plain to the economic wellbeing of Marlborough, it is important that the function of the drainage network is maintained. The loss of the drainage network, or an impairment of its function, would jeopardise these productive uses.

The dramatic expansion of viticulture on the Wairau Plain has started to put pressure on the drainage network. For example, there has been some demand to expand or enhance the drainage network to provide for recent viticulture conversions in areas where high groundwater tables have been encountered. There has also been anecdotal evidence of increased runoff from land used for viticulture. This could possibly be caused by soil compaction from the high vehicle movements between rows.

Wairau Plain drainage channel

An ecological assessment of the drainage network has identified that some of the streams and drains provide habitat to indigenous fish and invertebrates. For example, four of the last five recorded sightings of the very rare giant kokopu on the Wairau Plain were in the drainage network. The removal of vegetation and sediment from the streams and drains can have an effect on the habitat of indigenous fish and invertebrates. There is therefore a potential conflict between maintaining the drainage function and maintaining habitat for indigenous flora and fauna.

Uncertainty about tsunami and storm surge hazards

A tsunami is a series of waves created when a body of water, such as an ocean, is rapidly displaced on a massive scale. Tsunamis usually result from earthquakes at sea or undersea landslides. The Boxing Day tsunami of 2004, and the loss of life and destruction it caused around the Indian Ocean, demonstrated how devastating tsunamis can be to coastal communities and provided a global wake up call about the hazard posed by tsunamis.

It is estimated that New Zealand has been affected by more than 40 tsunamis in the past 165 years, with at least three having run up heights of 10 metres or more. It is known that Marlborough has been affected by tsunamis in the past: an 1855 earthquake, which ruptured the Wairarapa fault east of Wellington, generated a tsunami with a wave height of 4-5 metres along the Marlborough coast.

Storm surges can also cause the inundation of land. They are a temporary elevation of sea level usually associated with low pressure weather systems. Storm surges allow swells and local wind waves to penetrate inland further than under "normal" storm conditions.

The Marlborough coast is becoming an increasingly desirable place to live. Residential properties exist and are still being developed along the coastal margin of the Marlborough Sounds and at Rarangi. That development might be at risk of inundation from either tsunami or storm surge. Such inundation would damage property and create a threat public safety.

There are many variables that determine the magnitude of tsunami and storm surge and the extent of land inundation. However, these variables have not been investigated in the Marlborough context. This means that little is known about the nature of the tsunami or storm surge hazard along the Marlborough coastline or the risk of it occurring.

Other hazards

Drought is the least spectacular but often the most persistent natural hazard to affect Marlborough. It develops relatively slowly, is long lasting and often widely dispersed in extent. Drought may be defined in many different ways. Easiest of all is by applying the concept of "lack of rainfall". If agriculture is the primary concern then "soil moisture deficit" might be a more appropriate measure. Drought costs the community through lost economic productivity and social stress, while the environmental consequences often go unmeasured. This hazard has been more fully reported in both the Freshwater and Climate Change chapters of this report.

Extreme drought conditions can also create a high risk environment for fire, even though the fire itself may not arise through natural causes. An example of this occurred in 2000 when Marlborough recorded the highest ever national fire index level. The extreme drought conditions at the time culminated in the Boxing Day fires near Ward and on the Wither Hills near Blenheim. Some 600 hectares of farmland were burnt in the Ward fire. The Wither Hills fire was much more extensive burning some 6100 hectares and at the time was the largest grass fire recorded in New Zealand for the preceding 17 years. See more about these fires in the box 'Wither Hills and Ward fires on Boxing Day 2000'.

There has been no collection of data about frost by the Council historically although some data is available from the Marlborough Research Centre. It has become evident there is a gap in what is known about the statistical incidence of frost events in Marlborough. The importance of this has been highlighted in the expansion of vineyard plantings into areas known generally to be frost prone. Crop loss from these vineyards has seen a significant number of frost fans installed in the last 3 or 4 years. More about this can be found in the Land chapter.

Lake Elterwater was dry for two unprecedented consecutive summers in 2002 and 2003. The area being grazed by cows is the lake bed.

Boxing Day fires - Wither Hills overview

By world standards, the frequency of thunderstorms in New Zealand is low. Marlborough has 5 to 10 days of thunderstorm activity per year with Blenheim having 3 thunderstorm days per year on average. Once in 50 years the district can expect up to 15 days of thunderstorm activity.

There is very limited information on lightning strikes in Marlborough, although Marlborough Lines keeps records of faults caused by lightning. Generally there is just one major lightning storm per year with most of the damage causing only temporary power disruption.

Hail in Marlborough is generally confined to low lying and coastal areas. Between 1924 and 1973 there were nine severe hailstorms reported in Marlborough. In these storms, stone size varied from 0.5 centimetres to greater than 3.0 centimetres, with the majority of storms having stones between 1 centimetres and 3 centimetres diameter. However, compared to the rest of New Zealand, Marlborough has a relatively low incidence of hailstorms.

Wind records for Marlborough indicate that in an average year most of the district experiences fewer than 10 days when mean wind speeds are over 51 kilometres per hour. Much higher frequencies occur at the coast; for example Cape Campbell has an average of 21 days with mean wind speeds greater than 51 kilometres per hour. Wind gusts over 180 kilometres per hour can be expected at least once every 50 years over most of the Wairau Valley and Marlborough Sounds.

RESPONDING TO NATURAL HAZARD ISSUES

Natural hazard and risk study

To help the Council meet its natural hazard management responsibilities, the School of Earth Sciences at Victoria University was commissioned to identify and assess the range of hazards affecting Marlborough.

The project sought to classify and rank natural hazards relative to the Marlborough district and discuss hazards within the 'Marlborough Context'. This included how the hazards affect Marlborough and also how natural hazards in Marlborough relate to the rest of New Zealand.

Assessment of the information available on hazards has identified gaps in current knowledge and this will allow work to be implemented to remedy these gaps. The study provides an objective statement of the degree of hazard, the level of risk and the likely impact posed by natural hazards affecting or posing a threat to Marlborough. The three major hazards identified in the study are earthquakes, rainstorm/floods and drought.

Liquefaction

An initial assessment of the risks of liquefaction was undertaken for the Council in 2000. Liquefaction occurs when sediments lose their strength and turn from a solid state into a liquefied state during strong earthquakes.

The assessment carried out for the Council looked to identify areas potentially susceptible to liquefaction. The report prepared noted that liquefaction events were recorded in Marlborough, in the lower Wairau Valley, in 1848 and 1855, although historic records do not provide much information on how severe, or exactly where, these events took place. By combining information on groundwater, soils, subsurface geology and historic data, a liquefaction susceptibility map of the Wairau Valley was created. The map is divided into five different zones of susceptibility. However, the report states that while high susceptibility zones have been shown, there is no certainty that liquefaction will occur due to an earthquake of any size.

In general, the lower end of the Wairau Valley has a geological structure in which liquefaction can occur readily. This is because of the soil type found there with the finer sediments being associated with marine and river processes. This has been borne out in the Riverlands area, where investigations for the Council's infrastructure and the rezoning of land for industrial purposes, required sub-surface investigations.

WITHER HILLS AND WARD FIRES ON BOXING DAY 2000

The Wither Hills and Ward fires both started on Boxing Day 2000. The Ward fire, started by a spark from a mower on private property, spread to 545 hectares of steep hill country north west of Ward.

The Wither Hills fire started mid afternoon, beside the road in the grass berm along Taylor Pass Road, near the old entrance to the Wither Hills carpark. With very dry conditions, plenty of pasture grass to fuel the fire and helped by very strong north west winds, the fire quickly spread. In the early stages the fire came very close to dwellings before spreading out in a wide arc, racing up the slopes of the Wither Hills Farm Park. At its widest point the fire was some 5 kilometres across.

In addition to burning much of the Wither Hills Farm Park, the fire also burnt significant areas of private land holdings between Taylor Pass Road, Maxwell Pass, State Highway One and Redwood Pass. State Highway One was closed to through traffic for a period of time as the fire burnt from one side of the highway to the other.

No human lives were lost nor were houses lost from either of the two fires. However, hundreds of sheep and cattle perished and pine plantations and grapevines were destroyed. A few outbuildings on farms were also lost as well as significant damage to fencing, irrigation systems, pasture and amenity plantings. Many of the extensive plantings lost on the Wither Hills included those in the Queen Elizabeth II National Trust covenant area along Sutherland Stream. This covenanted area, which comprised some 41 hectares of dryland forest remnant and riparian habitat, was largely devastated in the fire, with only a little of the kanuka forest and ecological plantings of cabbage trees and flaxes surviving.

Since the fire, recovery has been significant in many gully plantings. Although a large number of trees were destroyed, many have recovered through resprouting, coppicing or seed germination. Post fire aerial oversowing and fertilizer application, followed by significant rain have also restored vegetative cover over most areas. Ongoing planting has occurred, with approximately 6,000 mixed species planted in three areas within the Farm Park. Nine schools were involved with planting 3,000 mixed species throughout 2002 and 2003 along the lower Quail Stream, with two other areas being planted with the assistance of Rotary Clubs.

For the covenanted area the Council put a detailed vegetation recovery-monitoring programme in place, in conjunction with the Department of Conservation and the Landcare Trust, to assess natural recovery rates and to determine the future viability of the covenant area as a protected site. An internal fence was installed post fire within the covenanted area to enable controlled grazing. This was to potentially assist with the anticipated significant weed regrowth. However, none of the covenant area was grazed as on-going weed control measures using knapsack and helicopter spraying has proved successful. Ongoing annual weed control is required, however broom and gorse seedling growth is low and now at manageable levels.

2,300 eco-sourced native species were planted within the covenant area by the Blenheim Rotary Club during 2002 and 2003. A further 1,200 ecosourced native plants were planted within the covenant area along Sutherland Stream during 2004 and these plantings have thrived.

Queen Elizabeth II National Trust Covenant Area, Sutherland Stream, following the Boxing Day Fire, 2000

Currently, the Council places a statement about liquefaction on Land Information Memorandum or Project Information Memorandum sought for properties in the Riverlands area. This points out the characteristics of the area are indicators of possible compaction and/or liquefaction if subjected to seismic shaking. The statement also points out that where an application for building consent is made, then this needs to show how the potential for compaction and/or liquefaction has been considered in the design of the structure.

Elsewhere, in the Blenheim urban area there are soft soils evident, but no specific investigations have been made of soil properties for their susceptibility to liquefaction.

Tsunami

A preliminary assessment of the risks of tsunami hazard to Marlborough, also undertaken in 2000, notes that given the location of New Zealand in the south west Pacific and the active tectonic setting of the country, that Marlborough's entire coastline is vulnerable to tsunami. While historic records show only one record of inundation from a tsunami, (in 1855), there is likely to have been at least nine tsunami inundating the coastline in the last 5,000 years.

There are several geological structures in the Cook Strait area that have the potential to generate tsunami. Tsunamis originating from faults around this area are more likely to have a devastating effect than tsunami originating from distant sources. This is because there would be limited, if any, time to warn people to move away from the coast. If a significant enough earthquake event triggered a tsunami offshore from Marlborough then the residential development that has occurred in and around Rarangi in recent years would be susceptible to inundation.

Distant source tsunamis in recent times have had a lower wave height, but are still able to cause considerable damage with salt water contamination of soils and buildings.

Since the initial report in 2000, there have been no specific attempts to update the state of knowledge particular to Marlborough. However, considerable work on tsunami risk has been carried out for the adjoining Wellington and Canterbury regions. The Council is currently looking to build on this work to provide a risk profile for Marlborough.

Seismic investigations

With seismic hazard being rated as a top ranked hazard, some investigations on seismic hazards have been undertaken.

The first phase of the Council's seismic hazard investigations had seen information gathered on the main known active faults in Marlborough, including the Wairau section of the Alpine Fault. The Wairau section of the Alpine Fault was identified as presenting the highest potential seismic hazard risk for Marlborough. (This information was reported in the State of the Environment Report Update 2003-2004)

The initial investigations had concluded that an earthquake on the Wairau section of the Alpine Fault would have very serious consequences including direct ground rupture at the fault trace, strong earthquake shaking, with impacts all over the district, liquefaction in areas such as the lower Wairau valley, and other secondary effects such as landslides. The hazard presented by this fault was considered higher than any other in the district because:

View during trench excavation, looking north across the fault zone (grey brown clay) to the abrupt change to blue grey unfaulted gravel

- The active fault trace is located in the middle of the densely populated, and rapidly developing, lower and middle Wairau Valley. The fault trace passes through parts of west Renwick, and is projected to pass at depth under Blenheim.
- Ground displacement at the fault trace in the next earthquake is expected to be 3.4 to 6.6 metres, and will be associated with a large earthquake with widespread shaking effects.
- Previous research suggests that there may be a relatively high likelihood of a future fault rupture within the next 50 to 100 years.

The next stage of the investigations, was aimed at establishing reliable estimates of the timing of the most recent earthquake rupture on the Wairau section of the Alpine Fault. Paleoseismic trench investigations were consequently undertaken on a section of the fault at a site 4 kilometres west of Renwick. From these investigations, there is radiocarbon evidence of one rupture event prior to 1000 AD but the most recent rupture has occurred in the last 500 years.

This result was unexpected because the closest previous paleoseismic investigations near Wairau Valley township concluded that there had been no rupture of the Wairau section of the fault in that area for at least 1,000 years, and probably longer. The new results suggest that the earthquake rupture event in the last 500 years near Renwick, has either been missed in the previous trenches, or that the Wairau section of the Alpine Fault may have a more complex rupture segmentation pattern than has been previously recognized. The new result also suggests that both the amount of elastic strain stored at the fault, and the likelihood of the next earthquake rupture, may be lower than was previously thought.

Further paleoseismic work was recommended from this study to provide a better understanding of the level of future earthquake hazard associated with the Wairau section of the Alpine Fault. To date no further investigations have occurred.

Making earthquake prone buildings safe

The Building Act requires local authorities to develop a policy for those local buildings most vulnerable in a moderate earthquake. The Council's policy was adopted in August 2006. The policy requires the earthquake risk of mostly non-residential buildings to be evaluated and require earthquake prone buildings to be strengthened. (Where residential buildings are two or more stories and contain three or more household units, the policy also applies.)

Previous legislation had required earthquake risk buildings to be identified and the former Blenheim Borough and Picton Borough Councils classified a number of buildings as such. These buildings were essentially given a timeframe within which they had to be strengthened or demolished. Over time a considerable number of these buildings have been demolished or upgraded but some have not had any work undertaken on them to make them secure.

While the initial focus was on unreinforced masonry structures, the new focus has targeted buildings that are either multi-storey or have high density occupations (for example theatres, churches and halls). The higher risk buildings tend to be located in the commercial areas and therefore ensuring these buildings are safe (either structurally or through demolition) will considerably enhance the overall safety and well being of the public.

An assessment of buildings at risk has been carried out and property owners notified of the need for the buildings to be strengthened.

Resource management plans

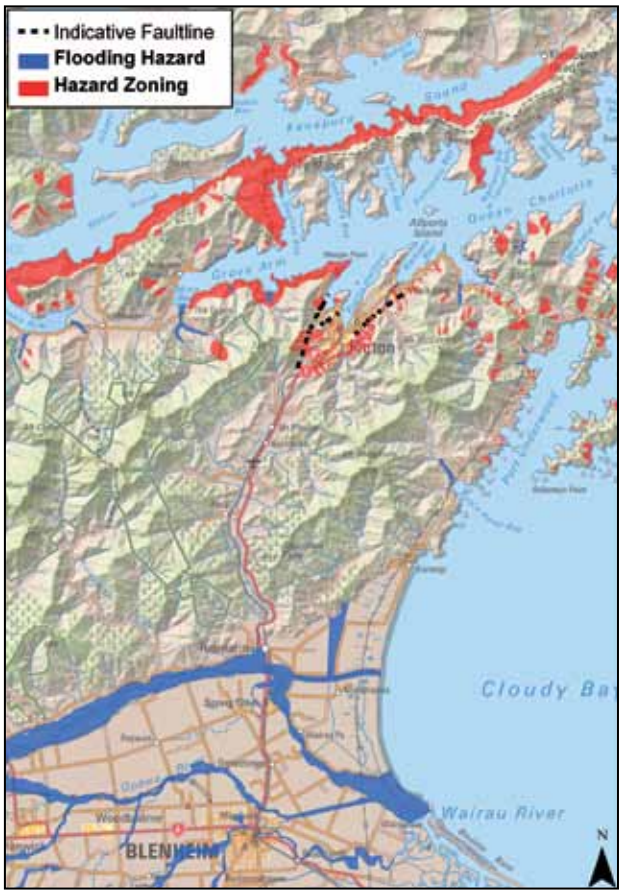
The Marlborough Sounds Resource Management Plan identifies the various hazards likely to be experienced in the Marlborough Sounds including earthquakes, slope instability, coastal inundation and tsunami, flooding, fire and climatic hazards.

Unlike the Wairau/Awatere Resource Management Plan, which has separate provisions for each of the hazards, the provisions of the Marlborough Sounds Plan are generic in that they apply to all of the identified hazards. This picks up the direction provided by the Marlborough Regional Policy Statement in terms of managing land uses in areas prone to natural hazards and managing land uses that would increase the risk of natural hazards in order to avoid, loss of life and avoid, remedy and mitigate damage to property and infrastructure.

The main method of management is controlling the location and design of activities and structures in areas known to be prone to hazards. Flood and instability hazards are identified on planning maps - see Figure 14.2 for an example of this.

Given the considerable history of flooding in the Wairau River catchment, it is probably not surprising that much of the focus in the Wairau/Awatere Resource Management Plan is on managing the effects of flooding, particularly on the Wairau Plain. Maintaining and upgrading existing flood defences is identified as the main method of mitigating the flood hazard, although the

FIGURE 14.2: HAZARD MAP



potential for exceptional flood events to breach these defences is also recognised. The Wairau/Awatere Plan seeks to avoid intensive development in areas likely to be susceptible to such extreme events. Maps are used to define the extent of the flood hazard.

In areas not protected by flood defences, the emphasis is on locating or constructing structures (e.g. minimum floor levels) in such a way so as to avoid any flood hazard. This policy of avoidance is also adopted in terms of constructing structures in areas that could experience slope instability.

The Wairau/Awatere Plan identifies that there are limited coastal hazards and what hazards there are (e.g. tsunami), are not well understood.

Marlborough Civil Defence Emergency Management Group

The Ministry of Civil Defence co-ordinates emergency management at a national level. However, much of the responsibility for civil defence planning and response is devolved to Civil Defence Emergency Management Groups established under the Civil Defence Emergency Management Act 2002.

The Marlborough Civil Defence Emergency Management Group involves the Council, the Nelson/Marlborough District Health Board, the Police and Fire Services. The Group has prepared the Marlborough Civil Defence Emergency Management Plan, which was adopted in February 2005. The core of the Plan is to manage hazards and risks in accordance with the principles of reduction, readiness, response and recovery.

The readiness, response and recovery aspects of the Marlborough Civil Defence Emergency Management Plan are mainly operational, although provisions relating to risk reduction have a strong link with the Marlborough Regional Policy Statement in seeking to avoid and mitigate natural hazards.

Marlborough Engineering Lifelines Group

The essential infrastructure and services that support the life of our community are called lifelines; this includes utility services such as water, wastewater and stormwater, power, gas, telecommunications, and transportation networks including road, rail, airports and ports. Lifelines engineering is a process where people from the various infrastructure and service providers work with scientists, engineers and emergency managers to identify what is vulnerable in regional scale emergencies. The purpose of this is to reduce damage following a major disaster and reduce the time lifeline utilities will take to restore their usual level of service after an event.

The Marlborough Engineering Lifelines Group's initial objective has been to identify significant lifeline sites and routes throughout Marlborough. Once these have been mapped it will be possible to focus on critical 'hotspots' where many services may come together (e.g. a major road bridge with other services attached). Then the group will assess and co-ordinate the combined planning or engineering works needed to mitigate the risk. The latest outputs of lifeline groups throughout New Zealand has shown this approach will focus attention on an essential priority list of regionally critical sites that may not be immediately apparent from the individual asset owners' asset management plans.

There are four principles of emergency planning the group are using to develop a mitigation strategy for Marlborough.

- Remove - Wherever possible relocate the utility away from the potential hazard.

- Reduce - If it is not possible to relocate the utilities, consider engineering solutions to reduce the consequences of the hazard threat.
- Respond - Plan for an emergency event to ensure the response it timely and appropriate.
- Recover - Ensure the facilities and resources are available to restore the usual level of service in the shortest possible time.

Future projects for the Marlborough Engineering Lifelines Group are likely to include fuel and resource planning, improved contact and communication, identifying hazard vulnerability for further research and looking at things such as maps of safe routes, priorities for disaster restoration and emergency communications arrangements for lifeline utilities.

As well as further developing the preparedness of lifelines operators for major hazard events, one of the key areas of emphasis is to create and maintain awareness of the importance of lifelines to the Marlborough community at large. Lifelines work helps to show a wider view of what major hazard events will mean for the community. For example, people react to the thought of being without water or sewage facilities for a week far more consciously than the threat of being injured by a damaged building in an earthquake.

Real-Time On-line Flood Information

The current river levels at the Council's recorders and the recent rainfall amounts can be accessed on the Council's website. The river levels are shown compared to normal and rainfall is shown for the previous 3 days. The rainfall data is collected as the rain is falling and river level data as the rivers rise. This is done at several sites throughout Marlborough and sent to the Council office. During floods this data is collected every few hours.

A summary of the data is also recorded on the Council's River and Flood Infoline answer phone system, phone: +64 (0)3 520 7488. The InfoLine gives up-to-date river levels and recent rainfall from the Council's recorders throughout Marlborough, so as to warn of probable flooding.

Wither Hills fire control