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CANTERBURY Civil Defence Emergency Management Group

Environment Canterbury
Your regional council

DEFINING MOMENTS IN NATURE



THE Q FILES

- NATURAL EVENTS, NATURAL DISASTERS, NATURAL HAZARDS AND RISK
- WHAT ARE THEY?
- WHAT DO THEY MEAN?

CANTERBURY Civil Defence Emergency Management Group

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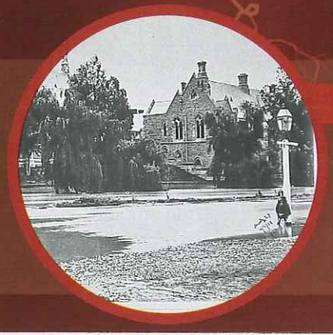
1. Flooding in Pleasant Point, 1986.
2. Damage from the Cheviot earthquake, 1901.
3. Power poles brought down by the weight of snow, June 2006. *Source: Electricity Ashburton*

DEFINING MOMENTS IN NATURE

Straddling a tectonic plate boundary, on floodplains between high mountains and the coast, Canterbury is vulnerable to many natural hazards. Floods, earthquakes, snow, high winds, tsunamis, landslides, erosion and droughts have affected us in the past, and will continue to affect us in the future.

The effects of these hazards can be significant, not only on life, property and business, but also in the emotional scars that often remain long after material damage has been repaired.

Our actions, and where we choose to live, work and play, determine these impacts. The Q Files reveal our risky situation and how we can make ourselves less vulnerable…



Canterbury floods, 1868

Heavy rain in February 1868 caused widespread flooding throughout Canterbury. "The damage to property was enormous, and when the flood abated a desolate picture met the eye – houses levelled to the ground, crops silted over and buried, fences washed away…" – *R M Burdon.* In Christchurch, the Waimakariri River overflowed into old channels near Halkett and flowed through Avonhead and Fendalton to the Avon River.

1865

1870

1875

1880

CANTERBURY'S HAZARDSCAPE

FLOODS

Floods are the most common and, for many areas, the most significant natural hazard in Canterbury. Many settlements are built on floodplains, including Christchurch. Northwesterly rainfall in the Southern Alps can cause large alpine rivers like the Waimakariri, Rakaia and Rangitata to flood. Rivers rising in the foothills and on the plains can flood, often quickly, during rain from the south or east. Today, monitoring, warning systems and structural works like stopbanks mean that floods in Canterbury claim few lives but they still regularly cause millions of dollars of damage to buildings, infrastructure and agriculture.

EARTHQUAKES

Canterbury lies in a zone of active land deformation along the boundary between the Australian and Pacific tectonic plates. Several large earthquakes caused deaths, injuries and damage to buildings and infrastructure in the early years of European settlement. In contrast, the last 80 years have been unusually quiet with no earthquakes larger than magnitude 7 in the region. However, it is likely that we will experience a large, damaging earthquake within the next 100 years. You can find out more about Canterbury's earthquake hazard in *The Q Files: Earthquakes.*

TSUNAMIS

Source: Christchurch Star

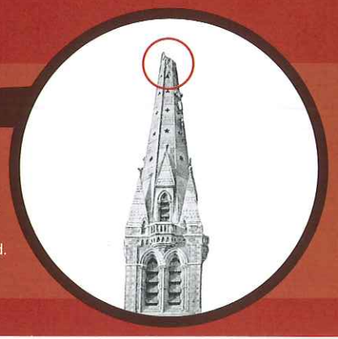
The entire Canterbury coast is exposed to distant source tsunamis, particularly those generated off the coast of South America. Banks Peninsula is particularly vulnerable because the long narrow harbours and bays channel and amplify tsunami waves. The North Canterbury coast, especially around Kaikoura, is also exposed to local source tsunamis generated by offshore faults or undersea landslides. To find out more information on tsunamis along the Canterbury coast, check out *The Q Files: Tsunamis.*

DROUGHTS

In the rain shadow of the Southern Alps and commonly experiencing dry northwesterly winds, Canterbury is particularly susceptible to drought – over the last 100 years there has been a significant drought at least once per decade. Climate change is likely to increase this susceptibility.

1885
1890
1895
1900

North Canterbury earthquake, 1888
This magnitude 7-7.3 earthquake occurred in the early hours of 1 September, damaging buildings and contents throughout North Canterbury and Buller. Land was displaced up to 2.6 metres across the fault through Glynn Wye Station, and liquefaction produced large pits and sandblows. In Christchurch, the top of the Cathedral spire collapsed.



LANDSLIDES

Landslides are common in the fractured rock of the Southern Alps. They are usually triggered by strong earthquakes but can also happen with no obvious trigger. The steep volcanic rock slopes and faces of Banks Peninsula are also susceptible to rock falls and there are many landslides in the overlying, thick wind-blown silty soil, which are often triggered by rainfall. Activities on slopes, such as clearing vegetation and constructing roads and buildings, can increase the likelihood of landslides.

SNOW AND WIND

Source: Waimate District Council

While snowfalls are common in the Southern Alps and foothills during winter, heavy snowfalls on the plains and downlands are uncommon. Major snowstorms, which damaged buildings and power infrastructure and seriously disrupted transport and communications, have happened in 1945, 1967, 1973, 1992, 1996 and 2006. High winds are also a hazard for Canterbury, the most severe being the northwesterly 'downslope winds' that blow across the Southern Alps and over the plains. These can damage forestry, crops and buildings, and disrupt infrastructure.

COASTAL EROSION AND FLOODING

Most of the Canterbury coast is undergoing long-term erosion, the only exceptions being the rocky shoreline of Banks Peninsula, Kaitorete Spit, southern Pegasus Bay and the Kaikoura coastline. Many low-lying coastal areas, particularly at river mouths and along the South Canterbury coast, are vulnerable to seawater inundation during coastal storms. In many places, people have significantly altered natural coastal processes, and some development has happened in areas where the coast is eroding or land may be flooded.

Cheviot earthquake, 1901
"A terrible earthquake [magnitude 6.5-6.7] this morning at a quarter to eight. There is a mass of ruins at Cheviot…shook a traction engine over, and a man out of his coffin." – *Diary entry, Harry Richard Willis, 16 November 1901.*

1900
1905
1910
1915

WHAT'S IN A WORD?

'Natural events', 'natural hazards', 'natural disasters' and 'risk' are a few of the terms used in natural hazard management and they can be confusing. However, we need to make sure we are all talking the same language so that we can work together to get the best results for Canterbury's communities.

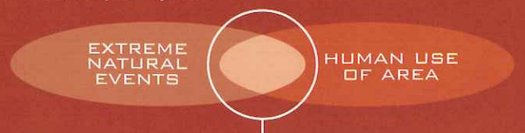
NATURAL EVENTS

Natural processes are happening around us all the time – rain falls, rivers flow, tectonic plates move, the sea builds up and erodes coasts. These processes, day-to-day, generally do not concern us too much. Sometimes though, extremes of these processes occur – heavy rainfall or snow, no rainfall, large earthquakes, tsunamis or strong winds. These are often called 'natural events' as they are significantly different from everyday processes.

NATURAL HAZARDS AND NATURAL DISASTERS

A natural process, or extreme natural event, becomes a hazard when we choose to live, work or play in an area where it has the potential to affect us.

The effects of a natural process or event can range from being a nuisance to a catastrophe. We often use the term 'disaster' when the effects overwhelm the ability of a community to respond – a situation that can include deaths and injuries, extensive damage to property, infrastructure or the environment, and disruption to normal day-to-day life.



A NATURAL HAZARD IS THE POSSIBILITY OF...

an avalanche	at a	ski resort
a tsunami	at a	port
a flood	in a	town
a drought	in a	farming district
an earthquake	near a	city
a wind storm	through	crops

1925
1930
1935
1940

Arthur's Pass earthquake, 1929
This magnitude 7 earthquake was felt across New Zealand and triggered many large landslides in the Southern Alps between Arthur's Pass and Lake Sumner, including the Falling Mountain rock avalanche. This large rock in this photograph fell onto and blocked the road in Otira Gorge.

WHAT ARE THE CHANCES

We often 'measure' hazards by describing the likelihood, or probability, that an event will occur.

The likelihood of a certain size event happening can be estimated by counting how many events of that size have occurred over a given period of time. For example, there have been 20 earthquakes bigger than magnitude 7 in or near New Zealand in the last 170 years. So, on average, a magnitude 7 or bigger earthquake has happened approximately every 8.5 years. The chance of another magnitude 7 or bigger earthquake happening in any one year is 1 in 8.5, or a 12% chance. However, large earthquakes are not evenly spaced and often occur in clusters.

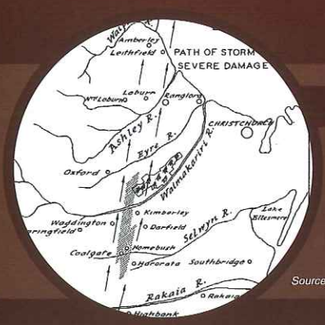
There are different ways of describing probability. A flood in the Ashburton River with a flow of 1,960 cubic metres per second can be described as a 1 in 200 year flood. This means a flood of this size or larger is likely to occur on average about once every 200 years. But it does not mean that if a 1 in 200 year flood occurs, that it will not occur again for another 200 years. There is a 1 in 200 or 0.5% chance there will be a flood of 1,960 cubic metres per second, or larger, in any one year. This way of expressing probability as a percentage chance each year is called Annual Exceedance Probability (AEP) and is often used instead of return period because it gives a better indication of how likely something is in any year.

With time, the probability of experiencing a natural event changes. For example, the chance of a 1 in 200 year (0.5% AEP) flood occurring in any one location...

in any 1 year is 1 in 200	0.5% chance
in a 10 year period is 1 in 20	5% chance
in a 30 year period is 1 in 7	14% chance
in a 70 year period is 1 in 3	33% chance

We only have a short written record of natural events in New Zealand – about 170 years. Because large events are infrequent, our written records and experiences sometimes do not give a good indication of the sorts of things that could happen in future. We can, however, use the data we do hold or evidence of large events in the geological record to predict the likelihood of something happening in the future.

Human activities can change the likelihood of some natural hazards occurring. Cutting into slopes to create roads and building platforms can increase the likelihood of landslides. Removing vegetation from river catchments and urbanisation can increase the likelihood of heavy rain creating a large flood.



Source: New Zealand Journal of Forestry

1955
1960
1965
1970

Canterbury hailstorm, 1956
In December 1956 a hailstorm, with hail stones up to 5cm in diameter, damaged forestry plantations, orchards and crops along a narrow, 100km long belt from Mt Somers to Loburn. Windows were broken, iron roofs dented, and many trees in plantations and shelter belts died in the months following the storm.

RISK

Risk is the combination of the likelihood of an event occurring and the potential consequences of that event.

RISK = LIKELIHOOD X POTENTIAL CONSEQUENCES/ VULNERABILITY

Understanding risk is important for two reasons. Firstly, by understanding the factors that contribute to risk (i.e. the likelihood of something happening and a community's vulnerability to it), we can develop ways to reduce risk. Secondly, by determining risk, we can compare levels of risk across different types of hazards and set priorities for reducing that risk.

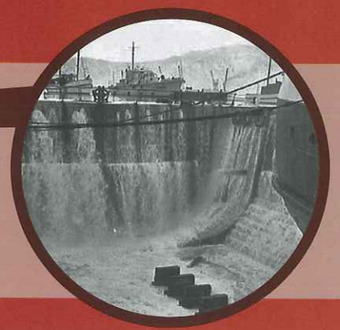
While in many cases we cannot influence the likelihood of natural events occurring, we can often avoid or reduce the potential consequences. We make ourselves more vulnerable to natural hazards by choosing to live, work and play in areas where natural events are likely to occur.

ASSESSING RISK

Once we understand our risk factors – likelihood and consequences or vulnerability – we can then analyse the level of risk. For example, two areas of coast may have the same long-term erosion rate, but one area is undeveloped while the other has a subdivision of new homes adjacent to it. The coastal erosion hazard is the same for each area of coastline but we would determine that the coastal erosion risk is higher on the developed coast than the undeveloped coast because the potential damage from coastal erosion is higher.

1955
1960
1965
1970

Chilean tsunami, 1960
The 1960 Chilean tsunami flooded Lyttelton Harbour damaging boats and electrical equipment at the Port of Lyttelton, and pouring into the dry dock. Further up the harbour, water inundated a hotel and several houses and drowned 200 sheep.

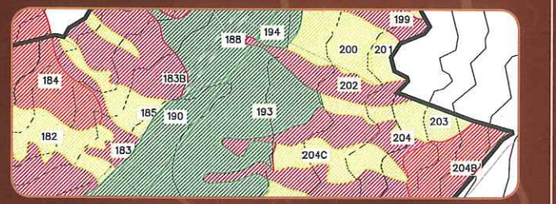


MANAGING RISK

Managing risk in New Zealand involves activities across the '4Rs': risk reduction, readiness, response and recovery.

RISK REDUCTION

After identifying and analysing risks, risk reduction involves taking steps to eliminate or reduce risk by reducing an event's likelihood or potential effects. This includes measures that reduce vulnerability to hazards such as land-use planning, building design and construction, minimum floor levels, and planting or retaining vegetation. It also includes measures that modify the natural event, such as structural measures like stopbanks or seawalls.



Hazard maps can be used to determine areas that are less suitable for development because they are more prone to hazards, or that need site specific investigation and mitigation measures before development.

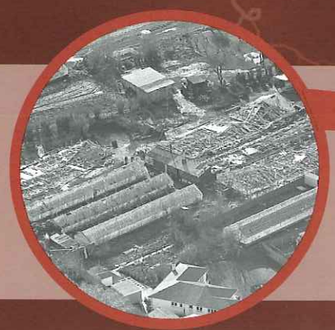
Source: Christchurch City Council.

Structural measures can be expensive to maintain and can sometimes affect the natural environment or transfer flooding or erosion problems to adjacent areas. Sometimes, structural measures such as stopbanks can actually increase risk by encouraging development behind them and increasing the potential damage if the stopbank is overtopped by a flood larger than it is designed to contain. Although stopbanks are necessary in some areas to reduce risk to existing settlements, risk reduction now focuses more on avoiding intensive development in high hazard areas, using those areas for other activities such as agriculture or recreation, which are likely to be more sustainable in the long-term.

RESIDUAL RISK

Risk from natural hazards cannot be completely eliminated. Despite constructing strong and flexible buildings, wherever you are in Canterbury you may still be affected by a strong earthquake. Also a stopbank may be overtopped by a flood larger than what it was designed to hold back. Taking steps to reduce risk costs – not just in dollars to build stopbanks or strengthen buildings, but also in lost development opportunities. These costs need to be weighed up against the level of risk.

Residual risk is the level of risk that remains after we have implemented risk reduction measures. Ideally, the level of residual risk is low enough to be acceptable to the community.



Canterbury windstorm, 1975
A northwesterly windstorm hit Canterbury in August 1975, with a peak wind speed of 195km/hr recorded in Kaikoura. The winds caused millions of dollars worth of damage to forest plantations and 12,600 insurance claims were made for damage to structures.

1970
1975
1980
1985

READINESS

Readiness involves preparing and developing systems to cope with and minimise the effects of a natural hazard event. This includes being prepared at home and at work by having adequate emergency supplies, as well as communities and organisations having systems like evacuation plans, warning systems and response plans in place.

RESPONSE AND RECOVERY

Response is the action taken immediately before, during or directly after a natural hazard event to save lives and property, and to help communities recover. Response involves the whole community but is usually coordinated by emergency services, local government and health organisations.

Recovery is the phase of community regeneration after the immediate response to a natural hazard event and can take many months or even years. Hopefully, following recovery, a community will be much more resilient to future natural events than it was before. This may include taking steps such as relocating people away from flood-prone areas after a flood, rather than simply rebuilding in the same place and still being vulnerable.

Emergency management teams in South Canterbury after the 2006 snow storm.

1985
1990
1995
2000

South Canterbury flood, 1986
Large areas of South Canterbury flooded in March 1986, including Temuka, the Levels Plain from Pleasant Point to the coast, and areas adjacent to the Pareora and Waihao rivers. Two thousand people were evacuated and one person died. Damage to property, roads, bridges and river engineering works, and loss of crops and livestock were estimated at $60million (1986 dollars).

MANAGING CANTERBURY'S RISK – SOME EXAMPLES

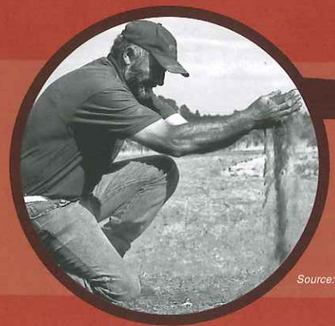
REDUCING FLASH FLOOD RISK – BLANDSWOOD, SOUTH CANTERBURY

The lower part of Blandswood has been affected by at least four flash floods from Kowhai Stream in the last 250 years. In 1975, four lives were lost when some baches were washed away, and evidence suggests that the previous floods could have been even larger. Environment Canterbury, in consultation with the local community, has put a series of flood warning initiatives in place, including flood warning signs and notices.

REDUCING FLOOD RISK – LYELL CREEK, KAIKOURA

Kaikoura has flooded more than a dozen times in the last 150 years. The last major flood in 1993 caused $10million worth of damage and prompted a floodplain management strategy. One measure to come from this strategy was the 400 metre-long Lyell Creek floodwall, which was completed in 2006. The floodwall is designed not only to keep floodwaters out of Kaikoura, but also to be opened to allow water entering the town from the State Highway 1 bridge to pass back into the river quickly. The award-winning works included planting the creek banks and constructing bridges, a walkway and an amphitheatre for the community to use.

Source: SquareCircle



Source: The Press

Canterbury drought, 1988-1989
The 1988-1989 drought cost Canterbury several tens of millions of dollars in lost productivity. In addtion to the drought, thousands of tonnes of dry topsoil was blown away by strong northwesterly winds.

1985
1990
1995
2000

REDUCING FAULT RUPTURE RISK – HANMER SPRINGS

The active Hanmer Fault runs through Hanmer Springs township in Hurunui District. The fault is thought to be relatively active, moving at least once every 2000 years, generating a large earthquake and displacing the ground across the fault by up to one metre. The location of the fault is included in the Hurunui District Plan and geotechnical investigations are required within 20m of the fault, so that new buildings are located and designed to reduce the effects of displacement of land across the fault.

definite active fault trace
possible minor or propagating trace
Hanmer fault ground hazard zone

TSUNAMI READINESS – COASTAL CHRISTCHURCH

Christchurch City Council has developed a plan to evacuate residents from coastal parts of Christchurch if a tsunami warning is received from the Pacific Tsunami Warning Center in Hawaii. The Council distributed a brochure to residents in 2007 which shows areas that will be evacuated if a warning is received, along with recommended evacuation routes and advice on where to go, what to take, what to do with pets and which radio stations to listen to. The brochure gives background information on Christchurch's tsunami risk and detailed advice on what people can do to reduce their own risk.

Source: Christchurch City Council

1985
1990
1995
2000

Canterbury snowstorm, 1992
The August 1992 snowfall was one of the largest recorded in Christchurch, with around 25cm falling in the city, damaging buildings and disrupting transport. The snowstorm killed over one million livestock in Canterbury and the economic impact was estimated at between $50million and $100million.

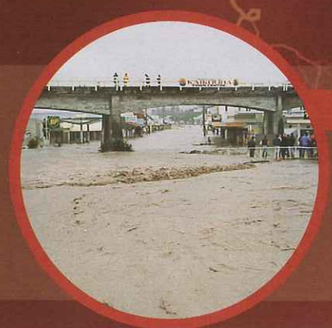
READINESS – EMERGENCY MANAGEMENT EXERCISES

The Canterbury Civil Defence Emergency Management Group holds regular emergency management exercises, which are a practical, efficient and cost-effective way to prepare. Exercises improve community preparedness and test the operational capability of emergency management organisations, the interaction and coordination between emergency services, and the effectiveness of response plans and procedures. The usefulness of exercises relies on accurate and up-to-date hazard and risk information.

ASSET MANAGEMENT PLANS – ORION

Earthquake, tsunami, flood, snow, and wind hazard information has been used to develop risk reduction and readiness measures within Orion's asset management plans. These measures aim to reduce disruption to electricity supply in an emergency. Equipment spares are stored in a secure location and an emergency contractor is engaged to respond to emergency events. Infrastructure is checked regularly to make sure it is robust and bunding has been installed at some sites to reduce the possibility of an oil spill. Bridges that carry Orion cables have had their approaches checked for liquefaction potential and have been reinforced if necessary.

Source: Orion New Zealand Ltd



Kaikoura flood, 1993
On 23 December 1993, the Kowhai River changed its course and flowed through Kaikoura township and into Lyell Creek. Thirty-five houses and 44 businesses were flooded, and damage was estimated at $10million.

1990
1995
2000
2005

ENVIRONMENT CANTERBURY'S ROLE

Environment Canterbury, along with city and district councils in the region, is responsible for helping reduce the potential effects of natural events in Canterbury. This includes identifying hazards and risks as part of broader environmental management, thus helping work towards a sustainable and resilient community.

Our work spans risk reduction, readiness, response and recovery, and includes hazard investigations and monitoring, planning and regulation, river engineering, flood warning, emergency management, and providing advice and education.

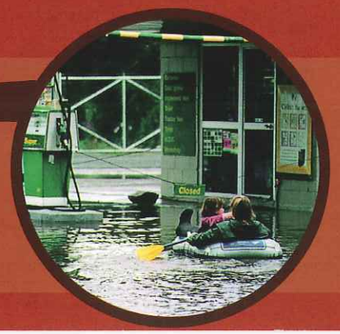
Environment Canterbury is also a member of the Canterbury Civil Defence Emergency Management (CDEM) Group, a partnership of local councils, emergency services, district health boards and other emergency response organisations in Canterbury. The members of the CDEM Group work together to identify and analyse hazards and risks in Canterbury, and to plan how to reduce risk, be ready for, respond to and recover from hazard events.

WHERE CAN YOU GET MORE INFORMATION ABOUT NATURAL HAZARDS?

- Environment Canterbury: www.ecan.govt.nz/naturalhazards or your city or district council
- Canterbury Civil Defence Emergency Management Group: www.cdemcanterbury.govt.nz
- Ministry of Civil Defence and Emergency Management: www.civildefence.govt.nz
- Institute of Geological and Nuclear Sciences (GNS Science): www.gns.cri.nz
- National Institute of Water and Atmospheric Science (NIWA): www.niwascience.co.nz
- MetService Learning Centre: www.metservice.co.nz
- Te Ara: The Encyclopaedia of New Zealand: www.teara.govt.nz

1990
1995
2000
2005

South Canterbury flood, 1994
On 19 March 1994, 179mm of rain fell in 24 hours on the town of Fairlie. The bridge over the Opihi River was destroyed and the river swept through a timber business on the river bank taking tractors, trucks, timber and sawmilling buildings with it.



ARE YOU READY?

Everyone has a part to play in managing natural hazard risk. Emergency services, local government and other organisations do their bit to reduce risk and be ready – are you doing yours?

Being prepared means reducing the impact of an event, in addition to coping with it as well as we possibly can when it does happen. Household emergency plans and emergency survival supplies help make communities self-sufficient in an event. Remember, in a disaster, many people will need help and the emergency services will not be able to get to everyone immediately. You need to be able to look after your family and neighbours without help.

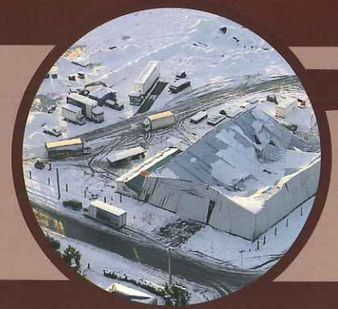
HOUSEHOLD EMERGENCY PLAN

- Discuss ways to get in touch with other family members during an emergency (bearing in mind communications may be limited).
- Arrange for people to collect children from school and provide the school with a list of these people.
- Establish a meeting place in case you cannot stay in your house or if family members are separated.
- Allocate tasks for those at home when a disaster occurs, like turning off power and water, and checking on neighbours.
- Do a first aid course.
- Locate your nearest civil defence centre.

EMERGENCY SURVIVAL SUPPLIES

The following items are useful to have easily accessible at home:

- water – at least 10 litres per person, more is better
- food – at least three days' supply
- alternative cooking source and utensils – BBQ or gas cooker, can opener, knives
- warm, waterproof clothing and sturdy shoes
- emergency blankets
- important family documents
- first aid kit, medications, baby supplies
- soap, wet wipes, toilet paper
- torch with spare batteries
- radio with spare batteries



Canterbury snowstorm, 2006
Snow fell across almost all of Canterbury on 12 June 2006. Snow depths of up to 30cm were recorded at sea level between Temuka and Rakaia, and up to 80cm on the upper Canterbury Plain. Ashburton experienced its greatest snowfall on record – 38cm. Several buildings in South Canterbury collapsed and large areas were without power for up to four weeks.

Source: Timaru Herald

2005
2010
2015
2020