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# Sep 23 2010 - Darfield earthquake damages Canterbury

The magnitude 7.1 Darfield earthquake struck early on Saturday morning, and caused significant damage in Christchurch city and the Canterbury region.

*Last update October 18, 1:00 pm*

- [Receive notification of all website updates on your mobile via Twitter](#)
- [View our map of the latest aftershocks in the area](#)
- [Follow the shaking at the nearby McQueen's Valley seismograph](#)
- [Read the list of the recent larger aftershocks](#)
- [See the real-time shaking plots on the home page](#)
- [Make your personal earthquake report for the magnitude 7.1 Darfield mainshock](#)
- [Historic quakes: background to the Darfield earthquake](#)
- [Read the Canterbury Civil Defence Emergency Management earthquake factsheet](#)

## Frequently asked questions

- **Q: Why do you call this the *Darfield* earthquake? Why don't you mention other localities when you report the aftershocks?**
- **A:** Although this earthquake has impacted much further afield than just Darfield, the scientific community named the earthquake after the nearest locality to the epicentre soon after the earthquake happened. It can now be argued that other communities or localities were in fact closer, but that is what was chosen on the day. We chose a unique name so that no confusion can arise with any previous earthquakes. In the past regional names were used, such as the [Wairarapa earthquakes of 1942](#), but this forced us to number those earthquakes, leading to possible mix-ups if the numbers were left off. To the people of New Zealand, though, this is indeed the *Canterbury* earthquake.

We have been specifically asked to send out the locations of aftershocks with reference to a single place, so that is easier for people to visualise where they are occurring in relation to each other; it made sense to choose Darfield for this. There is no intended slight to other communities that may indeed be closer to the epicentre of these aftershocks. Where aftershocks are significantly closer to Christchurch city centre, we are using Christchurch as the reference locality.

- **Q: I felt this earthquake, why is it not on your website! Are you recording all the earthquakes? Are your instruments broken?**
- **A:** We are recording all the earthquakes, but due to the sheer number of aftershocks, we are unable to post them all on the [Recent Earthquakes](#) page. This page is reserved for the bigger and more widely felt events; generally these are magnitude 3.5 or larger. We apologise if there's a particular quake you're looking for but isn't yet listed. You can [submit a felt report](#)

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[anyway](#), and this will alert us to the fact that an earthquake has been felt at that time. The more accurate you can be with your date and time, the easier it is for us to allocate them to the correct earthquake.

The [Quake Search function](#) lets you extract a file or display a map of earthquake locations in New Zealand. The search can be modified by date, geographic location, depth or magnitude. This will let you search for earthquakes you may have felt that are not listed on the Recent Quakes page. Note that Quake Search uses [Coordinated Universal Time](#) (UTC) which is 12 hours behind New Zealand Standard Time (NZST), 13 hours behind New Zealand Daylight Time (NZDT).

- **Q: Can I get traces of the drums for the 7.1 mainshock?**
- **A:** The accompanying image shows the Darfield earthquake and some of its early aftershocks recorded at *McQueen's Valley* (MQZ) seismograph on Banks Peninsula. The seismogram is coloured red if it is clipped, i.e. the largest parts of the signal are not shown. If this was not done, then a large earthquake would obscure much of the seismogram from view - so if the signal is red, the real size is larger than shown. Lots of aftershocks can be seen on this image, with some of the biggest ones appearing out of the *coda* (dying away of shaking) of the mainshock.
  
- **Q: How long was the earthquake? Why don't you tell us the duration of it?**
- **A:** Defining the length of shaking is not routinely calculated. Seismometers are very sensitive instruments that will detect shaking for a much longer time than the human perception of shaking. How long shaking may be detected by a person will depend on (but is not limited to) several criteria:

1. The type of building you are in and what floor you're on
2. Your local geology
3. The earthquake magnitude
4. The distance from where you are to where the earthquake is located
5. The depth of the earthquake

Especially in earthquakes of this size, where aftershocks become so closely spaced in time (see image), the shaking appears to last a lot longer. It's not just one earthquake, but many strung together. So there is no single answer to, "How long did the earthquake last?".

- **Q: How many aftershocks have there been? When will they stop?**
- **A:** It depends! The numbers of magnitude fives and fours are tabulated below, but we're still working through our data to locate all the magnitude threes; this will take some months. As the numbers of earthquakes go up by roughly a factor of ten for each of the ranges, we expect to locate one to two thousand magnitude threes over the course of the entire aftershock sequence. So that means there are probably up to 20,000 magnitude twos! We have to strike a balance between the people we have to do the work and what gives us the best scientific outcome. As we already locate 15,000 earthquakes in a typical year without a Darfield-type aftershock sequence, we are setting the bar at locating magnitudes 3.0 and above. Bear in mind also that prising out individual earthquakes from very busy looking seismograms makes the job even slower than normal.

You can download a spreadsheet of the locations so far using [Quake Search](#), limiting your search region to the Canterbury area, and entering **Sep 3** into the start time of the date search boxes; note that the Quake Search uses [Coordinated Universal Time](#) (UTC) which is 12 hours behind New Zealand Standard Time (NZST), 13 hours behind New Zealand Daylight Time (NZDT). Also note that these data have not undergone final processing, so magnitudes and locations are subject to change.

GNS scientists have modelled the aftershock sequence. You can see their forecasts in the table below. The frequency of aftershocks will continue to diminish, but they will occur for many weeks after a large earthquake such as this.

- **Q: I heard a loud rumble, but felt no shaking.**
- **A:** When a small earthquake is very shallow and very close, people can sometimes hear them without feeling them. The first wave arriving from an earthquake is a [compressional wave \(P-wave\)](#). When this wave hits the ground surface, it can produce a sound wave in the air which people hear. This effect is more pronounced when hills are around where the sound can reverberate. For larger, close earthquakes, this same effect accounts for people sometimes hearing earthquakes coming before feeling them. In this case, the P-wave causes the noise, and the slower [shear wave \(S-wave\)](#), which carries more energy, causes the shaking.

## Mainshock ("Darfield" earthquake)

Saturday, September 4 at **4:35 am**, magnitude **7.1**

The [magnitude 7.1 earthquake occurred at 4:35 am on September 4](#), the epicentre was 40 km west of Christchurch city and the depth of the quake was at 10 km. The epicentre was close to the town of Darfield. There was no tsunami resulting from this earthquake as it had occurred on land. It is the most damaging earthquake in New Zealand since the [Hawke's Bay earthquake in 1931](#), but there has been no loss of life. It was fortunate the earthquake occurred when the central city streets were deserted, as there would almost certainly have been many deaths and serious injuries had it happened during a busy time of the day.

*The magnitude, depth and epicentral location were revised in the first few hours upon receipt of further data, so two notifications were sent out for this earthquake. In particular, the magnitude of 7.1 was revised down from 7.4, and the location was put slightly further to the west and the depth refined to 10 km.*

## Other New Zealand earthquakes recorded after September 3

The sheer volume of earthquakes produced by the Darfield event has stretched our resources keeping up with minor seismicity in the rest of New Zealand during the same time. They have not stopped or taken a break in the meantime! We just haven't been able to locate them all yet. In due course as we unscramble the various individual earthquakes, especially in the early days of the sequence, you will again see a more normal pattern of seismicity around the country for that time period.

## Aftershocks

### Aftershock forecast

There have been numerous aftershocks so far and we expect that they may continue for some months to come; however, through the remainder of the aftershock sequence they will occur with decreasing frequency. Below is a table that shows the number of

aftershocks that have occurred in the first month, and how many we expect for the following four weeks:

Dates	Expected number of aftershocks of magnitude 4.0-4.9	Observed	Expected number of aftershocks of magnitude 5.0 and above	Observed
Sep 4	43 - 73	34	2 - 12	4
Sep 5	11 - 29	18	0 - 5	1
Sep 6 - Sep 12	28 - 53	35	1 - 9	4
Sep 13 - Sep 19	8 - 23	17	0 - 5	0
Sep 20 - Sep 26	4 - 16	9	0 - 3	0
Sep 27 - Oct 3	2 - 13	3	0 - 3	0
Oct 4 - Oct 17	4 - 17	9	0 - 4	2
<b>4 week forecast</b>		<b>Average</b>		<b>Average</b>
Oct 4 - Oct 31	10 - 26	17	0 - 5	2

## Aftershock felt reports

We invite you to fill in felt earthquake reports for the aftershocks by clicking on the "felt it?" button [next to each quake that you felt](#). We'd really appreciate it if you could try and select the earthquake nearest to the time you felt it. More information about this is found in our [Earthquake](#) section.

## Aftershock animation

You can view your own animation of the Darfield sequence, or any set of New Zealand quakes, in [Google Earth](#). You can control the events for selection, the speed of animation, and both area and time of interest. Just go to [QuakeSearch](#), set your search criteria, then select KML output and press *submit*. The default on the time is just right at the moment to view the Darfield sequence quakes so no other form fields need to be completed, but as days pass you will have to adjust the start date accordingly (N.B. Time are in Universal Time, currently 12 hours behind New Zealand Standard Time).

[Or here's one we prepared earlier!](#) It shows the earthquakes from September 3 to the morning of September 9.

If you have Google Earth installed you will be prompted to open the results. You may need to fine tune the animation speed and window size in Google Earth - mouseover the time bar and click on the spanner icon.

## What should I do in an earthquake?