GeoNet Landslide Response: New-Zealand-wide storm August 16–20, 2022

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ABSTRACT

From August 16th to 20th 2022, an atmospheric river bringing moisture down from the tropics led to a sustained five-day period of heavy rainfall for much of New Zealand. In particular, prolonged and heavy rain fell over Northland, Taranaki, Wellington and the Marlborough and Tasman regions. Taranaki Maunga and some areas at the top of the South Island experienced up to 1.2 m of rain, and large areas in the Nelson and Tasman districts experienced rainfall totals with annual return intervals of >250 years (https://hirds.niwa.co.nz/). NIWA reported that this was the strongest atmospheric river for August since records began in 1959 (https://niwa.co.nz/news/). A GeoNet landslide rapid response (LRR) for this event was activated on the 19th of August, as several of the criteria for activating a rapid response were met. The GeoNet LRR for this event included: (1) August 19 – September 7: desktop study and formal collection of all available landslide reports for later incorporation into a national landslide database. Local Territorial Authorities were contacted to collate available local knowledge on the impacts of the event. This information was used to determine whether an escalation was warranted, and, if so, what the appropriate actions would involve. Following these activities, the main areas of concern were: Northland, Taranaki, Wellington, Marlborough, Nelson/Tasman and the West Coast; (2) August 19–24: aerial and field reconnaissance in the Nelson/Tasman region, reported on by Massey et al. (2022); (3) September 7: aerial reconnaissance of Marlborough Sounds, reported on by Rosser and Townsend (forthcoming 2022). This report covers the New-Zealand-wide landslide impacts of the August 16–20 rainfall event.

KEYWORDS

Landslides, Nelson rain event, rainfall-induced landslides

1.0 INTRODUCTION

From August 16th to 20th 2022, an atmospheric river bringing moisture down from the tropics led to a sustained five-day period of heavy rainfall for much of New Zealand. In particular, prolonged and heavy rain fell over Northland, Taranaki, Wellington and the Marlborough and Tasman regions. Taranaki Maunga and some areas at the top of the South Island experienced up to 1.2 m of rain, and large areas in the Nelson and Tasman districts experienced rainfall totals with annual return intervals of >250 years (https://hirds.niwa.co.nz/). NIWA reported that this was the strongest atmospheric river for August since records began in 1959 (https://niwa.co.nz/news/). The storm occurred at the end of a long, wet winter, and much of this rain fell onto already saturated ground, causing widespread flooding and landslides across the country. Prior to the storm, over 340 landslides occurred in the Wellington region due to sustained wet weather between July and August (Rosser 2022).

The National Emergency Management Agency (NEMA) classified the event as N1 = A minor national-level response (NEMA/NCC 2022) and States of Emergency were declared for the:

- West Coast region on 16th August
- Nelson/Tasman region on 17th August, and
- Marlborough region on 19th August.

The GNS Science Landslide Duty Officer, in consultation with other landslide experts at GNS Science, activated a GeoNet landslide rapid response (LRR) for this event on the 19th of August, as several of the criteria for activating a rapid response were met. As a result, the GNS Science Incident Management Team (IMT) was set up and a Controller was established.

1.1 GeoNet Landslide Rapid Response Criteria

GeoNet maintains a rapid-response capability for landslides in New Zealand.[1] The rapid-response team consists mainly of landslide experts (Engineering Geologists and Geomorphologists).
The aim is to have team members mobilised within 24 hours of a major event. The criteria for activating a rapid response are landslides that cause any of the following:

1. Death or serious injury.
2. Subsequent catastrophic events (such as the breach of a landslide dam).
3. Damage of greater than NZ$1 million.
4. Economic loss greater than NZ$10 million.
5. Potential to threaten public health (such as contaminated or threatened water supplies).
6. Significant research interest.

The event met criterion 3–6 for triggering a landslide response. A GeoNet Landslide Response was initiated on 20th August to determine the extent and severity of landslides triggered by this event and to collect reliable and consistent landslide information.

1 https://www.geonet.org.nz/landslide/how

2.0 LANDSLIDE RESPONSE

Initial response activities were limited to a desktop study and formal collection of all available landslide reports for later incorporation into a national landslide database. This included all traditional media and social media reports of landslides throughout New Zealand, and each of these reports were assigned a geospatial location. Local Territorial Authorities were contacted to collate available local knowledge on the impacts of the event. This information was used to determine whether an escalation was warranted, and, if so, what the appropriate actions would involve. Following these activities, the main areas of concern were:

- Northland
- Taranaki
- Wellington
- Marlborough
- Nelson/Tasman
- West Coast.

A State of Emergency was declared on 17th August for Nelson City and Tasman District due to the impacts of the flooding and landslides. This was followed by a similar State of Emergency being declared on 19th August in the Marlborough District. Due to the scale of impacts in these regions, a separate GeoNet Landslide Response was initiated to focus on the Nelson/Tasman / Marlborough Districts. An aerial reconnaissance of affected areas in Nelson/Tasman was carried out by Chris Massey, Kerry Leith and Dougal Townsend of GNS Science on August 22nd and 23rd. The aerial reconnaissance allowed the field team to:

- Systematically document (photograph) the extents and types of landslides and ground deformation caused by the rain.
- Verify the landslide locations and identify any additional areas of landslides and ground deformation, as well as potential impacts on buildings and infrastructure.
- Provide rapid information on landslides and areas of ground deformation to Land Information New Zealand (LINZ) to inform aerial photograph and LiDAR surveys of the most affected areas, and to the geotechnical engineers / engineering geologists working on the ground inspecting the damage to buildings and infrastructure on behalf of Nelson City Council and others.

The observations from the Nelson/Tasman aerial reconnaissance flight and additional ground investigations are presented in Massey et al. (2022).

On 20th August, Marlborough District Council (MDC) requested assistance from GNS Science with respect to the landslides triggered around the Marlborough Sounds and surrounding hill country. MDC advised that at least 88 houses had been affected by landslides in the Marlborough Sounds, which included 30 red-stickered and 58 yellow-stickered houses. Many of the roads in the Marlborough Sounds were closed due to landslides, and communities were only accessible by boat. An aerial reconnaissance was undertaken by GNS Science and MDC staff on September 7th in the Marlborough Sounds (co-funded by GNS Science and MDC). The observations and results of the aerial reconnaissance will be presented in a separate report (Rosser and Townsend, forthcoming 2022).

An existing GeoNet Landslide Response was already in progress in the Wellington region since August 12th due to landslides triggered by the wet weather during July and August. Consequently, landslide monitoring continued throughout the storm but landslides triggered over this period were incorporated into the existing response.

For the Northland, Taranaki and West Coast regions, landslides were compiled and documented from all known sources and, where possible, spatially located. Due to the smaller number of landslides in these regions, it was decided that that no field reconnaissance and landslide mapping from remote-sensing data was warranted. The distribution and severity of these landslides are documented in Section 3 of this report.

2.1 August 2022 New-Zealand-Wide Storm Event Details

Rainfall totals in many areas of the country were extreme, with several areas recording more than 1 m of rain over the four days. Figure 2.1 illustrates the rainfall distribution for (a) the storm total (16th to 20th August), (b) the 24-hour maximum rainfall and (c) the maximum rainfall intensity (1-hour maximum) based on rain gauge data from MetService. The highest rainfall totals were recorded on Taranaki Maunga, where 1332 mm of rain fell over five days, and a maximum 24-hour total of 634 mm was recorded. Despite the large rainfall totals at Taranaki Maunga, the Annual Return Intervals (ARIs) from the National Institute of Water & Atmospheric Research (NIWA)'s HIRDS system (https://hirds.niwa.co.nz/) were relatively modest, with the five-day total having an ARI of ~100 years and the 24-hour total an ARI of ~70 years.

High rainfall totals were recorded on rain gauges throughout much of the country (data from MetService):

- In the Nelson/Tasman and Marlborough districts, four-day totals of >1000 mm were recorded at Paradise Peak in Kahurangi National Park and in the Rai Valley (Tunikino).
- Rainfall totals of >700 mm were recorded in the Bryant Ranges behind Nelson, including in the Maitai and Roding River catchments.
- In the Able Tasman National Park, 827 mm was recorded over four days, and 511 mm was recorded at Takaka.
- Large areas in the Nelson/Tasman and Marlborough districts experienced rainfall totals over the four-day period from August 16th to 19th that had 96-hour ARIs of >250 years.
- In Northland, up to 259 mm of rain fell over 48 hours at Kerikeri, with rainfall intensities of up to 15 mm/hour.
- In Taranaki and South Waikato, high 24-hour rainfall totals were experienced from Eltham to Kawhia, where the maximum 24-hour totals ranged from 200 mm at Inglewood to 123 mm near Kawhia.
- In Wellington, a maximum 151 mm was recorded at Tawa over two days. The rainfall totals in Wellington were not particularly high, but, due to the wet July and August, the ground was already saturated. Around 80–120 mm fell in Wellington City over the five-day period from August 16th to 20th.

On the West Coast, forecast rainfall totals were not reached, and a total of 276 mm was recorded for the event at Westport and 168 mm at Hokitika. Around 300 mm fell on the main divide.

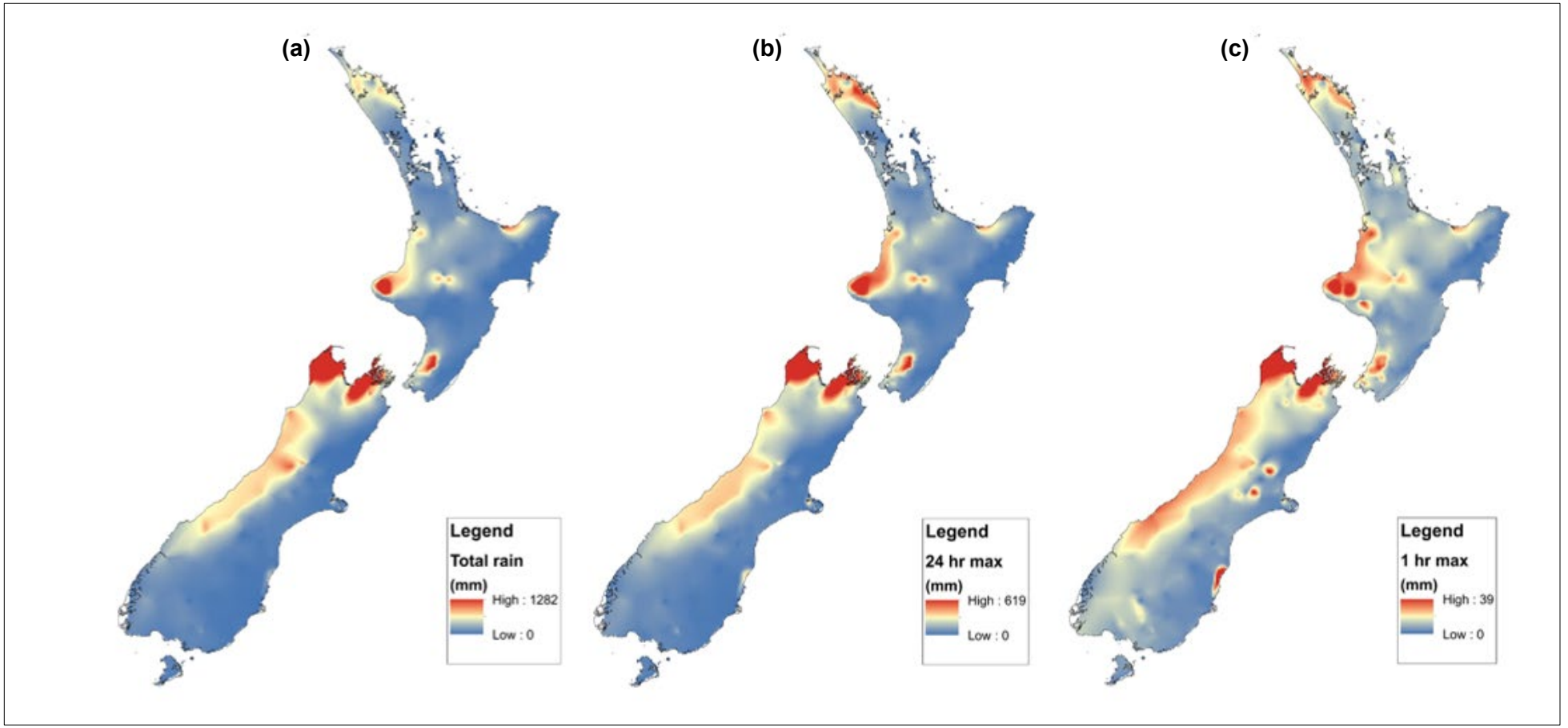

Figure 2.1 Rainfall distribution for August 16–20 2022, showing (a) total rainfall for the storm event, (b) the 24-hour maximum over the storm event and (c) the maximum rainfall intensity recorded by the rain gauge network across New Zealand. Rainfall data was provided by MetService.

3.0 LANDSLIDE DISTRIBUTION AND SEVERITY

The location of all landslides known to have been triggered by the August 16–20 storm are shown on Figure 3.1. Additional landslides may have occurred but have not been captured by traditional media, social media or territorial authorities. Each of the regions are discussed in the sections below.

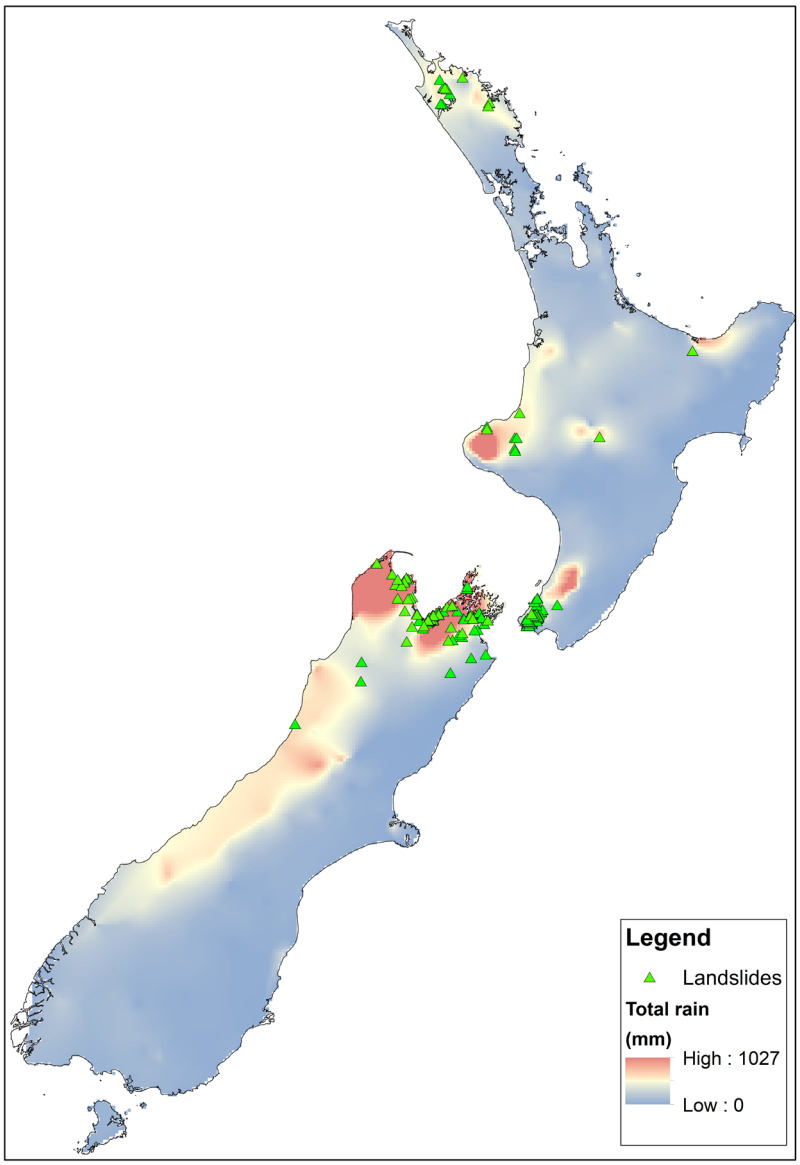

Figure 3.1 Locations of all known landslides to have been triggered by the August 16–20 heavy rainfall event, shown in relation to the total rainfall recorded over the same period (rainfall data from MetService).

3.1 Northland

The heavy rain in Northland caused extensive flooding that cut off Kaitāia, forced people to evacuate their homes and closed State Highway (SH) 10 at Kāeo. Multiple landslides were triggered in Mangamuka Gorge, closing SH 1 indefinitely. Waka Kotahi reported that there were about 18 landslides in Mangamuka Gorge – three landslides, where material fell onto the road; and 15 dropouts, where a landslide occurred beneath the road (Figure 3.2), six of which were serious. Minor landslides and dropouts were reported near Opua, and a large landslide at Lemon Hill (from 2018) was re-activated. In total, 28 landslides are known to have occurred during this event in Northland.

Further south, there were also small landslides or washouts reported in Waimana Gorge, near Whakatāne, and on the Desert Rd.

Figure 3.2 One of the landslides (drop-out) affecting State Highway 1 through Mangamuka Gorge (Photo: Waka Kotahi).

3.2 Taranaki

Two small landslides were reported by Waka Kotahi; one was on the outskirts of New Plymouth near Manorei and the other closed SH 3 near the tunnel on Mt Messenger. Stratford District Council reported that several roads were closed due to landslides, including Mangaorapa Road, Mangaotuku Road, Soldiers Road and Matau Road.

3.3 Wellington

Wellington City Council reported 271 landslides in Wellington City from the August 16th to 20th storm event. This included 209 landslides that occurred during the rainfall event and a further 62 in the week following. A total of 89 landslides occurred on August 19th. Three residential properties were evacuated from Onslow Road in Khandallah due to a landslide causing road subsidence. Another landslide that occurred earlier in August on Woodhouse Avenue in Karori also re-activated during the storm. Other notable landslides included a large landslide on the Wainuiomata Hill Rd, a retaining wall collapsed onto parked cars on Sutherland Crescent in Melrose (Figure 3.4) and a landslide that closed SH 59 at Paekākāriki (Figure 3.5). Most of these landslides occurred between August 18th and 21st.

The locations of landslides triggered during the storm event are shown in Figure 3.3. The majority of these landslide locations (271) were supplied from the Wellington City Council RAMM database, and a further 84 landslides were mapped from our own observations and media / social media sources (Figure 3.3). We are still awaiting data from Hutt City Council on the locations of landslides triggered during this storm event. GNS Science had already initiated a Landslide Response in the Wellington region on August 12th due to the hundreds of landslides triggered in the city during the the sustained period of wet weather over July and August. The landslides mapped as part of the New-Zealand-wide landslide response will be incorporated in and reported on under the existing Wellington July–August 2022 Landslide Response.

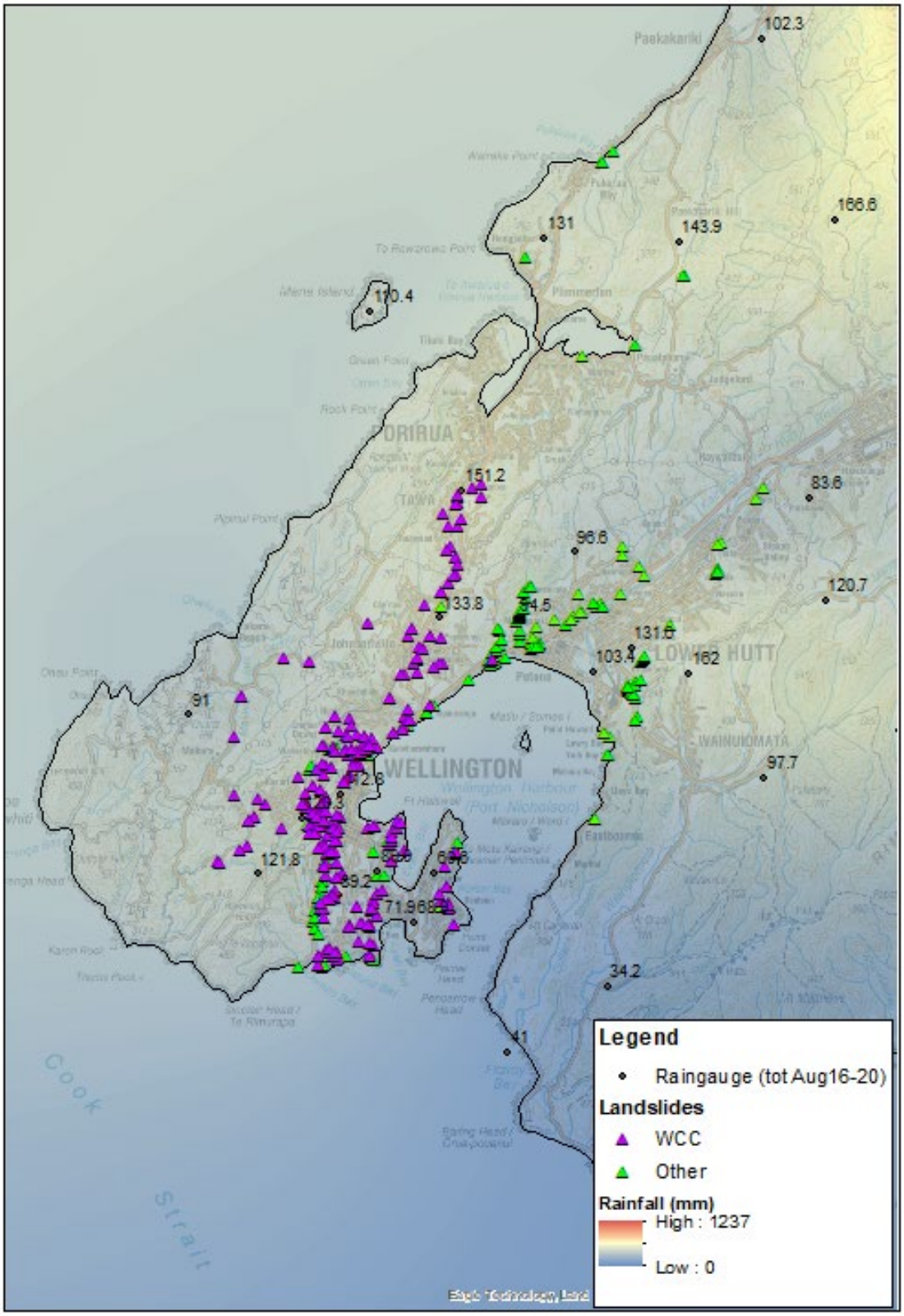

Figure 3.3 Locations of known landslides triggered by the August 16–20 rainfall event shown in relation to the rainfall total from August 16th to 20th. (Note: does not include data from Hutt City Council.)

Figure 3.4 A retaining wall collapsed onto cars on Sutherland Crescent in Melrose. (Photo: Mark Remfrey / Wellington Region Emergency Management Office (WREMO) Facebook page).

Figure 3.5 State Highway 59 at Paekākāriki; photo taken on August 26th by Margaret Keane (Traffic Updates – Horowhenua Kapiti Wellington / Facebook).

3.4 Marlborough

Extensive landsliding occurred in the Marlborough Sounds and surrounding hill country, closing most of the roads in the Sounds and damaging numerous properties. Consequently, many properties in the region could only be accessed by helicopter or boat for a sustained period following the storm. To date, 30 properties have been red-stickered, and 58 properties have been yellow-stickered.[2] An aerial reconnaissance was conducted by GNS Science staff on 7th September together with staff from MDC. Data from the aerial reconnaissance is currently being compiled and will be presented in a separate report (Rosser and Townsend, forthcoming 2022).

3.5 Nelson/Tasman

In Nelson, multiple landslides occurred within the city, affecting ~350 homes; of those, 134 houses were deemed unsafe (red-stickered) by Nelson City Council. This included damage from slippage, where a landslide undermined a house, and damage from houses being impacted by landslide debris. The main water-supply pipeline from the Maitai Reservoir to Nelson City failed on 17th August, as it was impacted by landslide debris, resulting in a reduced flow rate of drinking water to the city. Many of the region's roads were closed due to landslides and flooding, including SH 6 and SH 63.

An aerial reconnaissance of the impacted areas was conducted by GNS Science staff on August 22nd and 23rd. The observations and results from the aerial reconnaissance are presented in Massey et al. (2022).

3.6 West Coast

Despite as much as 300 mm being recorded at some rain gauges on the West Coast, there was only one report of a landslide that occurred close to Blackball and damaged a road.

2 https://www.marlborough.govt.nz/civil-defence-emergency-management/august-storm-event-2022

4.0 SUMMARY

From August 16th to 20th 2022, an extreme rainfall event affected much of New Zealand. NIWA referred to this event as the "strongest August atmospheric river (AR) on record" and classified it as a 1-in-120-year rain event for Nelson City. NEMA classified the event as N1, as it required a minor national-level response. The rain triggered hundreds of landslides and caused flooding across much of New Zealand. The main areas affected by landsliding during this storm event were Northland, Taranaki, Wellington, Marlborough and Nelson/Tasman.

This report has summarised the national impacts of the landslides from the storm event. More detailed observations from the two aerial reconnaissance responses in the Marlborough and Nelson/Tasman regions are provided in separate reports (e.g. Massey et al. 2022; Rosser and Townsend, forthcoming 2022) A further detailed analysis of the landslide distribution in Wellington following the prolonged wet-winter period is currently being finalised under a separate landslide response and report.

5.0 ACKNOWLEDGMENTS

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