Hawke's Bay CDEM Risk Register July 2021

High level Risk Overview

Likelihood	Negligible	Minor	Moderate	Major	Extreme
Almost Certain		Drought Coastal Inundation Coastal Erosion Frost Landslide-small Hazardous substances event	Average Flood (50 yr) Earthquake (MMI 6) Strong Wind	Rural Fire	
Likely		Trace Volcanic Ash (<1mm)	Large Landslide Lifeline failure- electric Lifeline failure – waste water & sewage	Earthquake (MMI 7) Human Pandemic Animal epidemic- plant and animal pests	
Possible		Snow Hail Major transport accident – road/rail	Urban fire- multiple Pollution over unconfined aquifer	Large Flood Moderate Tsunami (100 Yr.) Light Volcanic Lifeline failure – water Major transport accident- Marine	
Unlikely		Civil unrest/terrorism	Extreme temperature Lifeline failure – Gas Major transport accident - Air	Heavy Volcanic Ash	Very Large Tsunami (500 Yr) Large Tsunami (500 Yr) Earthquake (MMI 8)
Rare		Dam failure		Very Large Landslide Lifeline failure - telecommunications	Earthquake (MMI 9)

Consequence

Hawke's Bay CDEM Risk Register July 2021

Ref ID N=National response R=Regional response	Risk	Return period (year)	Scenario description and consequences	Likelihood	Consequence	Risk Rating	Risk Score	Links to science https://hbmaps.hbrc.govt.nz/hazards/	Links to relevant hazard response plans or SOPs	Risk last exercised Next exercise due
Natural risks										
1N	**Very large tsunami**	500*	A magnitude 8.9 earthquake on the Hikurangi subduction zone producing a tsunami, which has an offshore wave height of approximately 10 m. Arrives within 40 minutes without any time for an official evacuation warning. ▯ 1000s of fatalities and 10,000s injuries ▯ International and domestic assistance required to supplement the response ▯ 1000s of homes damaged requiring repair ▯ Significant damage to infrastructure including power, telecommunications, and three waters, with long restoration times ▯ Severe environmental damage ▯ Complex and long-term recovery process *GNS calculate a recurrence interval of 500 yr (335–655 yr, 95% confidence interval) and a coefficient of variation of 0.27 (0.0–0.47, 95% confidence interval). The probability of a large subduction earthquake on the southern Hikurangi subduction zone is 26% within the next 50 yr.	Unlikely	Extreme	Very High	**16.5**	Click here for tsunami science	Hikurangi Response Planning Toolbox July 2020 HB CDEM Group Initial Response Plan Version 1.3 Hawke's Bay CDEM Group Tsunami Response Plan Hawkes Bay fuel plan v3	Exercise Tangaroa 2010 (Tier 4) 2024 - Tier 4 proposed
2N	**Earthquake (MMI 9)**	740	A magnitude 7.1 earthquake on the Poukawa Fault near Bridge Pa causing extreme shaking (MMI 9). Substantial ground shaking throughout Hawke's Bay ▯ 10-15 deaths, 250-350 injuries, some serious. ▯ $400m heavy damage to buildings. Damage to bridges and roads. Large cracks in ground. ▯ Landslides on steep slopes. Liquefaction effects intensify. ▯ Substantial damage to lifelines including power, water & waste water and transportation routes. Telecommunications also badly affected.	Rare	Extreme	High	**15.8**	Click here for earthquake science	HB CDEM Group Initial Response Plan Version 1.3 Hawkes Bay fuel plan v3	Exercise Ruaumoko 2019 (Tier 2) Alpine Fault Exercise 2020 (Tier 4)

Hawke's Bay CDEM Risk Register July 2021

3N	**Large tsunami**	500	A distance source event, caused by a M8.5 earthquake on the coast of Peru resulting in a 1000-year return period tsunami, which has an offshore wave height of approximately 5m. Arrives on high tide with 10 hours advance warning with time for evacuation. ▯ 2 deaths, 140 injuries. ▯ $800m damage to buildings, homes and coastal infrastructure. Many coastal private dwellings uninhabitable. ▯ Severe environmental damage along the coastline.	Unlikely	Extreme Very High	**14.3**	Click here for tsunami science	HB CDEM Group Initial Response Plan Version 1.3 Hawkes Bay fuel plan v3	Exercise Tangaroa 2010 (Tier 4) 2024 - Tier 4 proposed
4N	**Earthquake (MMI 8)**	130	A magnitude 6.4 earthquake on the Mohaka Fault line near Willowflat causing extreme shaking throughout Hawke's Bay. ▯ 3-5 deaths & 90-150 injuries. ▯ $130m building damage with some damage to earthquake resistant buildings. Cracks in ground. Heavy furniture overturned. ▯ Damage to lifelines including power, water & waste water and transportation routes. Telecommunications also affected.	Unlikely	Extreme Very high	**13.5**	Click here for earthquake science	HB CDEM Group Initial Response Plan Version 1.3 Hawkes Bay fuel plan v3	Exercise Ruaumoko 2019 (Tier 3) 2024
5N	**Heavy volcanic ash**	1,000	Mount Ruapehu erupts with wind directing ash over Hawke's Bay. All the cities and towns are affected, with region covered with between 50-100 mm of ask over the course of 3 weeks. Wet weather exacerbates problems. ▯ 700 affected with bad health from ash which is irritant to lungs and eyes. ▯ Burial of pasture and low plants and foliage stripped off some trees. Most pasture will be killed by over 50mm of ash. ▯ Livestock may suffer from lack of feed, wear on teeth, and contamination of water supplies. ▯ Major ash removal in urban areas. ▯ Weaker roof structures may collapse at 100mm ash thickness if the ash is wet. ▯ Airports closed. ▯ Road transport badly affected. ▯ Electricity cuts due to ash shorting at substations. Water supplied limited due to failure of power to pumps.	Unlikely	Major High	**13.3**	Click here for volcanic science	HB CDEM Group Initial Response Plan Version 1.3 Hawkes Bay fuel plan v3	Exercise Ashbay 2006 (Tier 2) 2021

Hawke's Bay CDEM Risk Register July 2021

5aN	**Extreme Event^- Very heavy volcanic ash**	N/A*	A very large eruption in the Taupo Volcanic Centre producing over 1 cubic km of material. Vent open for months to years. Ash thickness 100-2000 mm with between 50-100mm being deposited in the Hawke's Bay ☐ Distal airfall issues ☐ Sedimentation/remobilisations ☐ Transport/airways not operable ☐ Supply chain impacts *Over the last 30,000 years, there have been three extremely large eruptions in the TVC, all producing over 1 cubic km of material. This scenario represents an extreme event, defined as a statistical outlier which cannot be predicted. ^This scenario has been included as an example of an extreme event for the Hawke's Bay. Because of the rare likelihood of this event occurring, a risk rating will not be calculated.				Click here for volcanic science	HB CDEM Group Initial Response Plan Version 1.3 Hawkes Bay fuel plan v3	Exercise Ashbay 2006 (Tier 2) 2021
6R	**Large flood**	101	A cyclone brings high rainfall to Hawke's Bay with considerable damage to Hastings, Napier and Central HB. Rainfall at Rissington is 510mm in 10 hours, and there is substantial flooding on the Heretaunga Plains caused by a breach in the stopbank on the Ngaruroro River. ☐ 2 deaths, 35 serious injuries. ☐ Clean up, production loss, and damage to homes and businesses in millions. ☐ Health impacts if sewage & water supplies affected.	Possible	Major	Very High	**13.3**	Click here for flood science	HB CDEM Group Initial Response Plan Version 1.3 Hawkes Bay fuel plan v3	Exercise BayVac 2009 (Tier 2) 2021
7N	**Moderate tsunami**	100	A regional source event from a magnitude 7.9 earthquake at the Kermadec Islands produces an offshore wave height of approximately 1-2. Arrives on high tide with 2 hours advance warning. ☐ 28 injuries ☐ $7m damage to coastal infrastructure and boats including at the Port of Napier. *NB: a 100 year return period event from a local source on the subduction zone or from off -shore faults is estimated to produce larger waves up to 5m – refer to Figure 6.19 Napier tsunami hazard curve GNS Science Client report 2013/131*	Possible	Major	Very High	**13.1**	Click here for tsunami science	HB CDEM Group Initial Response Plan Version 1.3	Exercise Tangaroa 2010 (Tier 4) 2024 - Tier 4 proposed
8R	**Earthquake (MMI 7)**	26	A magnitude 6.9 earthquake centred south of Wairoa causing severe earthquake shaking. ☐ 1 death & 15 injuries ☐ $7m building damage. Tiles, water tanks, walls damaged. Some chimneys broken. Furniture movement. ☐ Lifelines including power, water & waste water and transportation routes al report some damage.	Likely	Major	Very High	**11.0**	Click here for earthquake science	HB CDEM Group Initial Response Plan Version 1.3	Exercise Ruaumoko 2019 (Tier 3) 2024

Hawke's Bay CDEM Risk Register July 2021

			Telecommunications affected.						
9R	**Rural Fire**	N/A*	Major fire in extreme drought conditions on rural-urban interface and threatening urban areas. ▯ Fire-fighters and residents killed and injured ▯ Widespread evacuations required and extensive destruction of property and vegetation. ▯ National and international assistance required. ▯ Airspace restrictions ▯ Loss of income to rural sector with significant losses to forestry *Return period not available. Each year rural fire authorities control approx. 500 fires which burn about 400 hectares of land.	Almost Certain	Major Extreme	**10.8**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme
10N	**Light volcanic**	100	Mount Taranaki erupts with wind directing ash over Hawke's Bay. Some of the cities and towns are affected, with region covered with between 1-5mm of ash over the course of 4 weeks. Weather stays reasonably dry. ▯ 100 affected with bad health from ash which is an irritant to lungs and eyes. ▯ Airports closed ▯ Livestock may suffer from lack of feed; wear on teeth, and possible contamination of water supplies. ▯ Minor damage to houses if ash enters buildings, soiling & blocking air con filters, etc. ▯ Road transport may need to be cleared. Electricity may be cut due to ash shorting at substations. High water use from ash clean up. Water supplies may be limited.	Possible	Major Very High	**10.4**	Click here for volcanic science	HB CDEM Group Initial Response Plan Version 1.3	Exercise Ashbay 2006 (Tier 2) 2021
11R	**Average flood**	50	A chain of thunderstorms formed up the eastern coast of NZ which results in downpours in HB. In Napier & Hastings 50mm of rain falls in 1 hour – close to the	Almost certain	Moderate	**10.1**	Click here for flood science/reports	HB CDEM Group Initial Response Plan Version 1.3	Exercise BayVac 2009 (Tier 2)

Hawke's Bay CDEM Risk Register July 2021

			average for an entire month. ▯ Millions of dollars damage from water and surface water flooding and damage to some roofs and shop stock. ▯ Clean-up, production loss, and damage to homes and businesses.	Very High				2021
12R	**Earthquake (MMI 6)**	6	An earthquake measuring 6.1 on the Richter scale with its epicentre near Lake Poukawa. Shaking throughout HB causing strong shaking ▯ $1.5m slight damage to poorly constructed buildings. Objects fall from shelves ▯ Slight damage to lifelines including power and water supplies. Telecommunications overloads and cellphones affected.	Almost Certain / Moderate Very High	**8.4**	Click here for earthquake science	HB CDEM Group Initial Response Plan Version 1.3	Exercise Ruaumoko 2019 (Tier 3) 2024
13R	**Drought**	3*	A prolonged and severe drought similar to that experienced in 1982. ▯ Small streams dry up, trees die, and stock numbers are greatly reduced. ▯ Increased likelihood of extensive rural fires ▯ Loss of water impacts on production and economic activity in the region and there is a general economic decline. *Based on the current historical record, drought affects the region on average once every 3 years.	Almost Certain / Minor High	**7.8**	Click here for science about meteorological hazards	HB CDEM Group Initial Response Plan Version 1.3	N/A
14R	**Coastal inundation**	N/A*	A severe coastal storm swell event inundates land adjacent to the coast, as seawater is driven over beach crests. ▯ Evacuations required. Some injuries ▯ Building damage including sea water and loss of roofs from wind. ▯ Storm water networks overwhelmed. Blocked and damaged culverts. Interruption of power. Road disruptions and temporary isolation of parts of the region due to access problems. *Return period not available. Risk predicted to increase	Almost Certain / Minor High	**7.8**	Click here for coastal science	HB CDEM Group Initial Response Plan Version 1.3 Cape Coast Initial Response Plan	N/A
15R	**Very large landslide**	100+	After several weeks of wet weather in the region a large landslide occurs in the Esk Valley blocking SH5. ▯ A number of casualties from an associated	Rare / Major	**7.8**	Click here for landslide science	HB CDEM Group Initial Response Plan Version 1.3	N/A

Hawke's Bay CDEM Risk Register July 2021

			vehicle accident. A number of properties badly damaged. People are unable to return to their homes. - Transportation redirects required. Severe infrastructure damage with SH 5 closed for over 8 weeks given the size of the landslide and rebuild required which results in high business & economic losses.	Medium				
16R	**Coastal erosion**	N/A*	Storm leads to the removal of beach front and private coastal land adjacent to the beach. - Destruction of several private houses on the coast. - Loss of land, distress. - Loss of utilities in the area - Damage to wetlands, riverbank and river mouth ecosystems. *Return period not available. Risk predicted to increase	Almost Certain / Minor High	**7.3**	Click here for coastal science	HB CDEM Group Initial Response Plan Version 1.3	N/A
17R	**Large landslide**	10	Numerous small rainfall induced landslides in all parts of the region. A small number block essential roads such as SH 2 & 5 for a period of 3-4 days. - Some people are unable to return to their homes. - SH Infrastructure damage. Transportation delays - Property damage - Economic losses	Likely / Moderate Very High	**7.3**	Click here for landslide science	HB CDEM Group Initial Response Plan Version 1.3	N/A
18R	**Strong wind**	142	Ex-tropical cyclone affects entire region bringing winds of 200 km/hr - Power supplies disrupted with power poles damaged by winds. - Roofing materials torn off roofs, trees blown down, transport accidents and injuries. - Some people unable to return to homes	Almost certain / Moderate Very High	**7.1**	Click here for science about meteorological hazards	HB CDEM Group Initial Response Plan Version 1.3	N/A
19R	**Extreme temperature**	N/A*	Following a period of drought, a high establishes over Hawke's Bay bringing extreme temperatures of 32°C for 2 days - A death(s) of urban-dwelling elderly without access to an air-conditioned environment. - Highways and roads are damaged by excessive heat - Livestock, such as poultry, are severely impacted. Increased demand for water. *Return period not available. Risk predicted to increase.	Unlikely / Moderate Medium	**6.3**	Click here for science about meteorological hazards	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme

Hawke's Bay CDEM Risk Register July 2021

20N	**Trace volcanic - <1mm ash fall**	20	Mount Ruapehu erupts with wind directing some ash over HB. Wairoa mainly affected, with region covered with less than 1 mm of ash over 1 week. - Irritant to lungs and eyes. - Airports will close due to potential damage to aircraft. - Possible minor damage to vehicles, houses and equipment caused by abrasive ash - Dust affects road visibility and possible contamination of roof-fed water supplies	Likely	Minor High	**6.1**	Click here for volcanic science	HB CDEM Group Initial Response Plan Version 1.3	Exercise Ashbay 2006 (Tier 2) 2021/22
21R	**Snow**	N/A*	A prolonged period of cold moist air produces heavy snowfall that closes all road into and out of HB - The cold weather freezes the snow, producing icy roads, which remain closed for a few days. Transportation delays. - Stock losses occur in CHB due to the cold and snow. - Some damage and disruption to power and telecommunication lines. *Return period not available.	Possible	Minor Medium	**6.1**	Click here for science about meteorological hazards	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme
22R	**Hail**	N/A*	Severe and widespread hail storm over the Heretaunga Plains in mid-summer. - Damage affects most of the export crop apples, estimated to be $50million - Loss of family income for affected properties. Distress. - Minor damage to homes, broken windows, and damaged air con units. *Return period not available.	Possible	Minor Medium	**5.8**	Click here for science about meteorological hazards	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme
23R	**Frost**	N/A*	A severe frost covers the Heretaunga Plains at the end of summer. - Major crop losses, including tomatoes for Heinz Wattie's estimate to be in the millions - Major economic losses to families *Return period not available.	Almost Certain	Minor High	**4.6**	Click here for science about meteorological hazards	HB CDEM Group Initial Response Plan Version 1.3	N/A
24R	**Landslide-Small**	1-2	A number of small rainfall induced landslides across SH 5 from Napier to Wairoa for a period of 1-2 days - Some people are unable to return to their homes - SH Infrastructure damage - Transportation delays.	Almost Certain	Minor High	**4.3**	Click here for landslide science	HB CDEM Group Initial Response Plan Version 1.3	N/A
Technological risks									

Hawke's Bay CDEM Risk Register July 2021

25R	**Urban fire-Multiple**	N/A*	After a long hot summer, on a hot windy day a large number of fires occur in a short period over a wide suburban areas ▯ All fire service resources are fully committed. ▯ There are many casualties and one fatality. ▯ Several of the fires spread destroying several homes. ▯ Welfare provision is necessary. *Return period not available. 250 urban fires annually	Possible	Moderate High	**10.4**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme
26R	**Lifeline failure – Electric**	N/A*	An MMVII earthquake with an epicentre near to Redclyffe unearths a hidden fault covered by river gravels. Widespread damage to the Redclyffe Grid Exit Point renders the whole substation inoperable. Contingency options are very limited with a potential small capacity supply available from the Fernhill GXP. The majority of Hawke's Bay is without power for up to a week before urgent repairs to be made. ▯ The power cut affects hundreds of homes and is estimated to cost the region's industry hundreds of thousands of dollars. ▯ Distress and communities affected *Return period not available although MMVII shaking on average every 26 years.	Likely	Moderate Very High	**10.1**	Click here for lifeline reports	HB CDEM Group Initial Response Plan Version 1.3 Critical Lifeline Sites-Hawke's Bay	Click here to view the interagency National Exercise Programme
27R	**Lifeline failure – Water**	N/A*	A water pipe attached to a bridge ruptures after a bridge collapse close to the epicentre of a small earthquake. ▯ Water supply to a small HB community fails and access is limited. ▯ Distress and communities affected ▯ Alternative supplies required. *Return period not available.	Possible	Major Very High	**9.8**	Click here for lifeline reports	HB CDEM Group Initial Response Plan Version 1.3 Critical Lifeline Sites-Hawke's Bay	Click here to view the interagency National Exercise Programme
28R	**Hazardous substances event**	10	A large explosion at an industrial site in Hastings, causes a huge fire and sends black ▯ Injuries including burns and effects from toxic fumes	Almost Certain	Minor	**9.3**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise

Hawke's Bay CDEM Risk Register July 2021

			▯ 150 homes require evacuation ▯ Significant residential and central business district disterution from smoke/toxic cloud. ▯ Runoff of toxic materials into inland water, air pollution, on-site contamination of soil and groundwater ▯ Economic losses	High				Programme
29R	**Pollution over unconfined aquifer**	N/A*	A major truck accident on SH 50 causes a significant chemical spill which leaks into the surrounding land at Roys Hill ▯ The major pollutant spill threatens the groundwater systems which provides 85% of the water needs of the local population. *Return period not available.	Possible / Moderate High	**9.1**	Click here for a science report	HB CDEM Group Initial Response Plan Version 1.3	N/A
30R	**Lifeline failure – Telecommunications**	N/A*	A telecommunications line attached to a ridge to a coastal community breaks after a bridge collapse close to the epicentre of a small earthquake (?) ▯ Coastal community loses telecommunications and access to 111 calls, putting lives at risk ▯ Telecommunications in the region experience overloading due to earthquake *Return period not available.	Rare / Major Medium	**8.6**	Click here for lifeline reports	HB CDEM Group Initial Response Plan Version 1.3 Critical Lifeline Sites-Hawke's Bay	Click here to view the interagency National Exercise Programme
31N	**Civil unrest/terrorism**	N/A*	Terrorism targets include political & economic interests, critical infrastructure, mass gatherings of people & events that capture media attention ▯ Violent acts, protest and civil unrest can all impact severely on normal life and operations. *Return period not available.	Unlikely / Minor Low	**7.8**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme
32R	**Major transport accident – Marine**	N/A*	A ship goes aground on Pania Reef, leaking tonnes of heavy fuel oil into the Bay. ▯ Port of Napier operations affected. Marine industry affected and economic losses. ▯ Black oil on HB beaches requires months of clean up. ▯ Distress and effects from fumes from those living close to the beaches ▯ Significant economic impact, businesses affected. *Return period not available.	Possible / Major Very High	**7.3**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme

Hawke's Bay CDEM Risk Register July 2021

33R	**Lifeline failure – Gas**	N/A*	A bridge collapse breaks the gas supply to Napier - Significant economic impact - Businesses affected - *Return period not available.	Unlikely	Moderate Medium	**6.8**	Click here for lifeline reports	HB CDEM Group Initial Response Plan Version 1.3 Critical Lifeline Sites-Hawke's Bay	Click here to view the interagency National Exercise Programme
34R	**Lifeline failure – Waste Water & Sewage**	N/A*	After 3 weeks of wet weather, the failure of a pump station causes the back up of sewage in a Napier community. - Public health issues - Risk of contamination from sewerage systems *Return period not available.	Likely	Moderate High	**6.6**	Click here for lifeline reports	HB CDEM Group Initial Response Plan Version 1.3 Critical Lifeline Sites-Hawke's Bay	Click here to view the interagency National Exercise Programme
35R	**Major transport accident - Air**	N/A*	A fully laden airplane crashes near to a residential area - Deaths & injuries - Transportation systems disrupted - Damage to infrastructure in the area - Large cost of response and investigation - Business disruption *Return period not available.	Unlikely	Moderate Medium	**6.6**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme
36R	**Dam failure**	N/A*	A dam on Te Mata peak breaks following heavy rain - The broken dam sends a wall of water down through the residential area of Havelock North. - Many houses are destroyed and there are many severe injuries *Return period not available.	Rare	Minor Low	**6.2**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme
37R	**Major transport accident-Road/rail**	N/A*	A train derails between Napier and Hastings - Injuries - Transportation systems disrupted - Damage to infrastructure in the area - Large cost of response and investigation - Business disruption *Return period not available.	Possible	Minor Medium	**6.1**	N/A	HB CDEM Group Initial Response Plan Version 1.3 Supporting Plan-Closure of State Highways	Click here to view the interagency National Exercise Programme
Biological risks									
38N	**Human Pandemic**	30	Scenario – a novel virus spreads around the world and arrives in HB. Consequences	Likely	Major	**14.2**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National

Hawke's Bay CDEM Risk Register July 2021

			▯ Up to 200 deaths and 62,000 clinically unwell over a 2-3 month period. ▯ Widespread illness in the community will increase the likelihood of sudden and potentially significant shortages of personnel who provide critical community services. ▯ Significant economic impact as businesses close to prevent spread of infection. ▯ Increase in social isolation for vulnerable people. Likelihood – pandemics average out at every 30 years.	Very High					Exercise Programme
39R	**Animal Epidemic, plant and animal pests**	N/A*	A number of cases of anthrax are detected on the banks of the Tukituki River. It affects animals and humans, and can be fatal, so is considered a serious public health risk. ▯ Large number of illness in Central HB and 1 death. ▯ Public health officials overwhelmed with demand for information ▯ Trade is severely affected ▯ Significant economic losses ▯ Food safety issues ▯ Other public health priorities compromised *Return period not available.	Likely / Major Very High		**10.5**	N/A	HB CDEM Group Initial Response Plan Version 1.3	Click here to view the interagency National Exercise Programme

Links to Science	
Hazard	**Research Title/Link**
Earthquake	• The Shock of '31: The Hawke's Bay Earthquake (1980)
	• Pre-A.D. 1931 tectonic subsidence of Ahuriri lagoon, Napier, Hawke's Bay, New Zealand.(1986)
	• Normal faulting through subducted oceanic crust: the 19 July 1985 earthquake of Hawkes Bay, New Zealand (1989)
	• Estimation of Earthquake Strong Ground Motions: Napier and Hastings Hospital Sites (1991)
	• A comparison of seismic sources used for High Resolution Onshore Seismic Surveys in New Zealand (1991)
	• A seismic reflection survey near Takapau, Southern Hawke's Bay (1993)
	• Seismic Reflection Investigations near Tollemache Road and St George Road, Hastings (1993)
	• Earthquakes, active fault displacement and associated Vertical Deformation near Lake Taupo, Taupo Volcanic Zone (1994)
	• Earthquake hazards in Hawke's Bay: initial assessment (1994)
	• Earthquake Hazard Analysis- Hawke's Bay (1996)
	• Damage Ratios for Houses and microzoning effects in Napier in the magnitude7.8 Hawke's Bay New Zealand earthquake of 1931 (1995)
	• Earthquake Hazards analysis – Stage 1. Recurrence of large earthquakes determined from geological and seismological studies in Hawke's Bay area (1996)
	• Disaster damage risk management review (1996)
	• Hawke's Bay Region Earthquake Hazard Analysis Programme Stage II – Part 1. A numerical assessment of the Earthquake Hazard in the HB Region (1997)
	• Hawke's Bay Region Earthquake Hazard Analysis Programme Stage 2 –A numerical assessment of the Earthquake Hazard in the HB Region (1997)
	• Hawke's Bay earthquake hazard analysis stage 2 (1997)
	• Executive Summary Report Geological Hazards in the Gisborne District (1997)
	• The Hawke's Bay Earthquake: New Zealand's Greatest Natural Disaster (1998)

Hawke's Bay CDEM Risk Register July 2021

	• Hawke's Bay Regional Council earthquake hazard analysis programme stage 3 evaluation of ground shaking amplification potential (1998), (Appendix)
	• Hawke's Bay Regional Council Earthquake Hazard Analysis Program Stage III, Volume 2 Appendices (1998)
	• Fault kinetic adjustments during the last 2 Myr in the transition area between continental collision and Hikurangi Margin subduction (1998)
	• Paleoseismology of an active reverse fault in a forearc setting: the Poukawa Fault zone, Hikurangi forearc, New Zealand (1998)
	• Strong motion modelling of the 1993 Tikokino earthquake, southern Hawke's Bay, New Zealand (1998)
	• Damage and Intensities in the Magnitude 7.8 1931 Earthquake Hawke's Bay, New Zealand (1998)
	• Post-Earthquake Building Safety Evaluation Procedures (1998)
	• Attenuation of Modified Mercalli intensity in NZ Earthquakes (1999)
	• Earthquake Hazard Analysis Program – Stage II: Part II Evaluation of Liquefaction Potential in the Hawke's Bay Region (1999)
	• A new probabilistic seismic hazard model for New Zealand (2000)
	• Hawkes Bay Regional Council Infrastructural Assets Seismic Risk Assessment (2001)
	• Communities' understanding of earthquake risk in the Hawke's Bay and Manawatu/Wanganui regions (2001)
	• Subduction earthquake Geology in Northern Hawke's Bay, New Zealand (2003)
	• Micropaleontological evidence of large earthquakes in the past 7200 years in southern Hawke's Bay, New Zealand (2006).
	• Fault avoidance zone mapping- Wairoa District, Napier City and Surrounds (2011)
	• Active fault mapping and fault avoidance zones for CHB (2013)
	• Exploring the "second soul" of Napier (2014)
	• Active fault mapping and fault avoidance zones for Hastings district (2016)
	• Mapping of active faults and fault avoidance zones for Wairoa district: 2016 update
Tsunami	• New Zealand Tsunamis 1840-1982 (1986)
	• Hawke's Bay tsunami inundation by attenuation rule
	• Tsunami hazard study for the Hawke's Bay Region (1994)
	• The 26 March and 17 May 1947 Gisborne Earthquakes and Tsunami: Implication for Tsunami Hazard for East Coast (2000)
	• Tsunami Impacts in Hawke's Bay (2000)
	• A Tsunami (ca. 6300) and other Holocene environmental changes, Northern Hawke's Bay (2002)
	• Subduction earthquake Geology in Northern Hawke's Bay, New Zealand (2003)
	• Towards a record of Holocene Tsunami and Storms for northern Hawke's Bay (2005)
	• Community Understanding and Preparedness for Tsunami Risk in the Eastern North Island, New Zealand (2007)
	• Tsunami Hazard Assessment for Hawke's Bay Region (2008)
	• Tsunami Hazard posed by earthquakes on the Hikurangi subduction zone interface (2008)
	• Chile Tsunami Event Impacts in Hawke's Bay February 2010
	• Scoping Study for evaluating the Tsunami Vulnerability of New Zealand Buildings for us as evacuation structures (2011)
	• Tsunami Evacuation: Lessons from the Great East Japan earthquake and tsunami of March 11th 2011 (2012)
	• Hikurangi Response Plan- Developing a scenario for an Mw8.9 Hikurangi earthquake, including tsunami modelling and a preliminary description of impacts (2018)
	• Exercise injects for a Hikurangi Subduction Zone earthquake aftershock sequence (2019)
	• Paleoseismology of an active reverse fault in a forearc setting: the Poukawa Fault zone, Hikurangi forearc, New Zealand (1998)
	• Fault kinetic adjustments during the last 2 Myr in the transition area between continental collision and Hikurangi Margin subduction (1998)
	• Review of Tsunami Hazard in New Zealand 2013/131 GNS Science
	• 1931 Waikari River Tsunami: New Zealand's largest historical tsunami (2016)
	• Paleotsunamis on the southern Hikurangi Subduction Zone, New Zealand, show regular recurrence of large subduction earthquakes (2021).
Volcanic Ash	• Four communities under ash. After Mount St. Helens. Program on Technology, Environment and Man Monograph #34 (1981)
	• Active Volcanoes and Geothermal Systems, Taupo Volcanic Zone (1987)
	• Earthquakes, Active Fault Displacement and associated Vertical Deformation near Lake Taupo, Taupo Volcanic Zone (1984)
	• Volcanic Impacts in the Hawke's Bay region (1988)
	• Physical and Social Impacts of Past and Future Volcanic Eruptions in New Zealand (1997)
	• A Scenario of Geophysical Events Inferred to have Proceeded the 1300AD Kaharoa Eruption (2001)
	• Environmental response to a large, explosive Rhyolite eruption (2001)

Hawke's Bay CDEM Risk Register July 2021

	• Risk Analysis of Ash Fall Hazards in the Hawke's Bay Region, North Island, New Zealand (2002) A Monte Carlo methodology for modelling ashfall hazards (2004)
Flooding	• Report on Storm of 26-28 July 1985 (1985) • SH38 Waiau River Flooding (1987) • The Climate and Weather of Hawkes Bay- Third Edition (1987) • Cyclone Bola 7-10 March 1988 (1989) • Floods and Drought: the New Zealand experience (1997) • Towards a record of Holocene Tsunami and Storms for northern Hawke's Bay (2005) • Te Ngaru Catchment Flood Hazard Study (2005) • Wairoa River: Flood hazard study (2006) • Wairoa Catchments Flood Report: Labour Weekend, 20-21 October 2005 (2006) • Whareranga Flood Risk Assessment (2007) • Waipatiki Catchment Flood Hazard Analysis (2008) • Wairoa River Bank Stability Assessment (2009) • Wairoa River Bank Erosion Risk (2009) • Kopuawhara Opoutama Flood Hazard Analysis (2010)
Drought	• Floods and Drought: the New Zealand experience (1997) • Meteorological hazards to Hawke's Bay Engineering Lifelines (1999)
Coastal Inundation and Erosion	• Aokautere; An assessment of storm damage at Otoi in Northern Hawke's Bay • Sea Inundation: Heavy Swells Wave Run-up (2000) • Review of the 1996 Coastal Hazard Zone between Ahuriri Entrance and Esk River Mouth (2002) • Hawke's Bay Regional Coastal Hazard Assessment (2004) (Vol. 1 of 3) • Hawke's Bay Regional Coastal Hazard Assessment (2004) (Vol. 2 of 3) • Hawke's Bay Regional Coastal Hazard Assessment (2004) (Vol. 3 of 3) • Coastal Hazard Assessment for Hardinge Rd, Napier (2005) • Cliff hazard zone delineation (2005) • Summary report on site specific coastal hazard determination for Southern Beaches (2005) • Summary report: The Coast of Hawkes Bay: Processes and Erosion Problems (2007) • Summary Report: The Coast of Hawke's Bay: Processes and Erosion Problems (2007) • Hawke's bay Regional Coastal Environment Plan: Coastal hazards – additional information (2008) • Hawke's Bay Climate Change and Gravel-Beach Responses Conference Proceedings, 2015 • Hawke Bay coastal Strategy – Coastal Hazard Assessment (Draft) (2015) • Clifton to Tangoio Coastal Hazards Strategy 2120, Coastal Hazard Assessment (Draft) (2015) • Clifton to Tangoio Coastal Hazards Strategy 2120, Coastal Risk Assessment (Draft) (2016)
Landslides	• Hydrological behaviour of pastoral hill country modified by extensive landsliding, Northern Hawke's Bay, New Zealand (1988) • Slope Instability and Mud Volcano Hazard Assessment, Gisborne District Countil (1997)
Meteorological hazards	• Meteorological Hazards to Hawke's Bay Engineering Lifelines (1999) • Extreme winds in the Hawke's Bay (2000)
Lifelines	• Report of the Hawke's Bay Engineering Lifelines Project: Facing the risks (2001) • Hawkes Bay Gas Supply Disruption Crisis Management in Action (2004)
Other	• Hawke's Bay joint hazard strategy for local authority land-use planning (2012) • A review of natural physical hazards research in Hawke's Bay (2003) • Awesome forces - how plate tectonics, earthquakes, volcanic eruptions and erosion have shaped NZ. • Hazards in Hawke's Bay (2007) • Plate tectonics for curious kiwis (1996)

Hawke’s Bay CDEM Risk Register July 2021

	• The modified Mercalli earthquake intensity scale; revisions arising from recent studies of New Zealand earthquakes (1996)
	• Civil Defence in New Zealand
	• Disasters and Social Science (1994)
	• Caught in the Crunch (1996)
	• After words (2004)
	• Napier City Council Hazard Analysis Research Project - part 1
	• Napier City Council Hazard Analysis Research Project - Part 2
	• Disaster damage risk management review (1996)
	Report on Two Shallow Seismic Surveys in the Roys Hill Recharge Area (1992)
	• Large Earthquakes in New Zealand. Anticipation. Precaution. Reconstruction. (1981)
	• Report on the Relief Organisation in Hastings arising out of the Earthquake in Hawke's Bay on February 3, 1931 (1999)