National Reports will be posted to the ICG/PTWS-XXXI website without TWFP contact details

NATIONAL REPORT

Submitted by New Zealand

BASIC INFORMATION

(FILL IN SECTIONS 1-3 ONLY IF THERE IS A NEED TO COMMUNICATE OFFICIAL UPDATES.)

1. ICG/PTWS Tsunami National Contact (TNC)

The person designated by a Member State to an Intergovernmental Coordination Group (ICG) to represent his/her country in the coordination of international tsunami warning and mitigation activities. The person is part of the main stakeholders of the national tsunami warning and mitigation system. The person may be the Tsunami Warning Focal Point, from the national disaster management organization, from a technical or scientific institution, or from another agency with tsunami warning and mitigation responsibilities.

Name: Wendy Wright
Title: National Operations Manager and National Controller
Department: National Operations
Organization: National Emergency Management Agency (NEMA)
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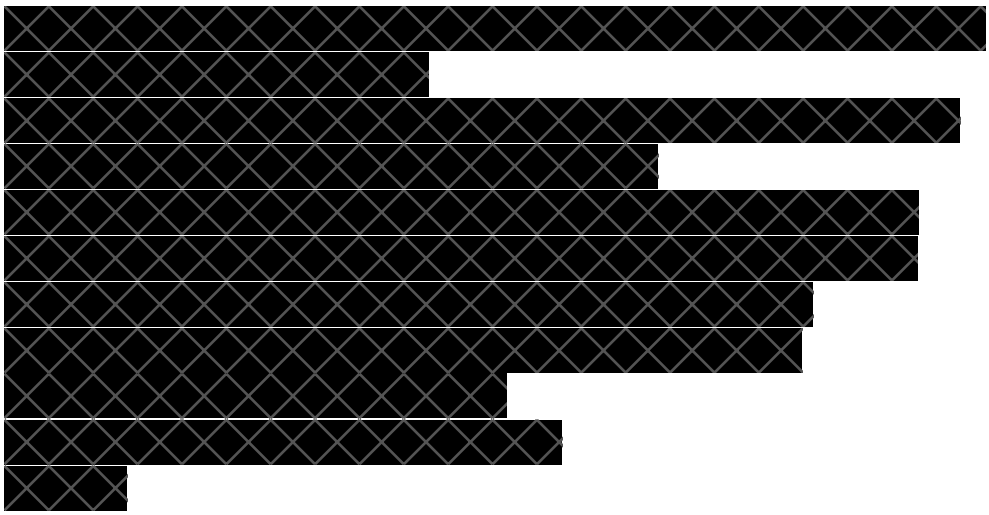
E-mail Address: wendy.wright@nema.govt.nz, ashleigh.fromont@nema.govt.nz, international@nema.govt.nz
[redacted]

2. ICG/PTWS Tsunami Warning Focal Point (TWFP)

A 24 x 7 point of contact (office, operational unit or position, not a person) officially designated by the NTWC or the government to receive and disseminate tsunami information from an ICG Tsunami Service Provider according to established National Standard Operating Procedures. The TWFP may or not be the NTWC.

[redacted]

TWFP (and NTWC) 24x7 point of contact (office, operational unit or position**, not a person**):



National Tsunami Warning Centre (if different from the above)
A centre officially designated by the government to monitor and issue tsunami warnings and other related statements within their country according to established National Standard Operating Procedures

NTWC Agency Name: As per TWFP
NTWC Agency Contact or Officer in Charge (person): As per TWFP

3. Tsunami Advisor(s), if applicable
(Person, Committee or Agency managing Tsunami Mitigation in country)
Name: National Emergency Management Agency (NEMA)
Postal Address: PO Box 5010, Wellington 6140, NEW ZEALAND
E-mail Address: emergency.management@nema.govt.nz, MAR@nema.govt.nz

4. Tsunami Standard Operating Procedures for a Local Tsunami (when a local tsunami hazard exists)

New Zealand is exposed to several local tsunami sources that offer very little, if any, time for official warnings. In this case, public awareness to be able to recognise and individually respond to natural warnings is vital. The 'Long or Strong, Get Gone' message is a key component of New Zealand's tsunami public education at local, regional and national level. It encourages people on the coast to evacuate if they feel an earthquake that lasts longer than a minute, or is strong enough that it is hard to stand up – and not to wait for official warnings.

The National Tsunami Advisory and Warning Plan (https://www.civildefence.govt.nz/cdem-sector/guidelines/national-tsunami-advisory-and-warning-plan) describes natural warnings and how they should be used:

Natural Warnings

'Natural warnings' are personal observations. They can include any of the following:

- Strong earthquakes (it's hard to stand up), or long earthquakes (including weak shaking) lasting for a minute or more; or
- Strange sea behaviour, such as the sea level suddenly rising and falling; or
- Hearing the sea making loud and unusual noises or roaring like a jet engine.

When any of the above observations apply, a Land Threat should be anticipated.

Public education about tsunami awareness, tailored to the specific community is critical in this regard.

Official warnings will still be sent wherever possible. To assist the rapid dissemination of these warnings, simple, conservative 'Action Maps' are initially issued for earthquakes in specific areas. The maps indicate areas within 90 minutes' travel time of first waves; these areas should evacuate without waiting for further assessment. Efforts are underway to expand the use of similar, pre-calculated maps to all local source subduction zones, which would enable faster official warnings.

Official warnings are sent through multiple channels; the most timely and direct of which is a broadcast alert to all cell phones in the target area (Emergency Mobile Alert). However, such local source tsunami warnings may not include assessments of wave amplitude, and do not replace the natural warning which remains the primary warning for local source events.

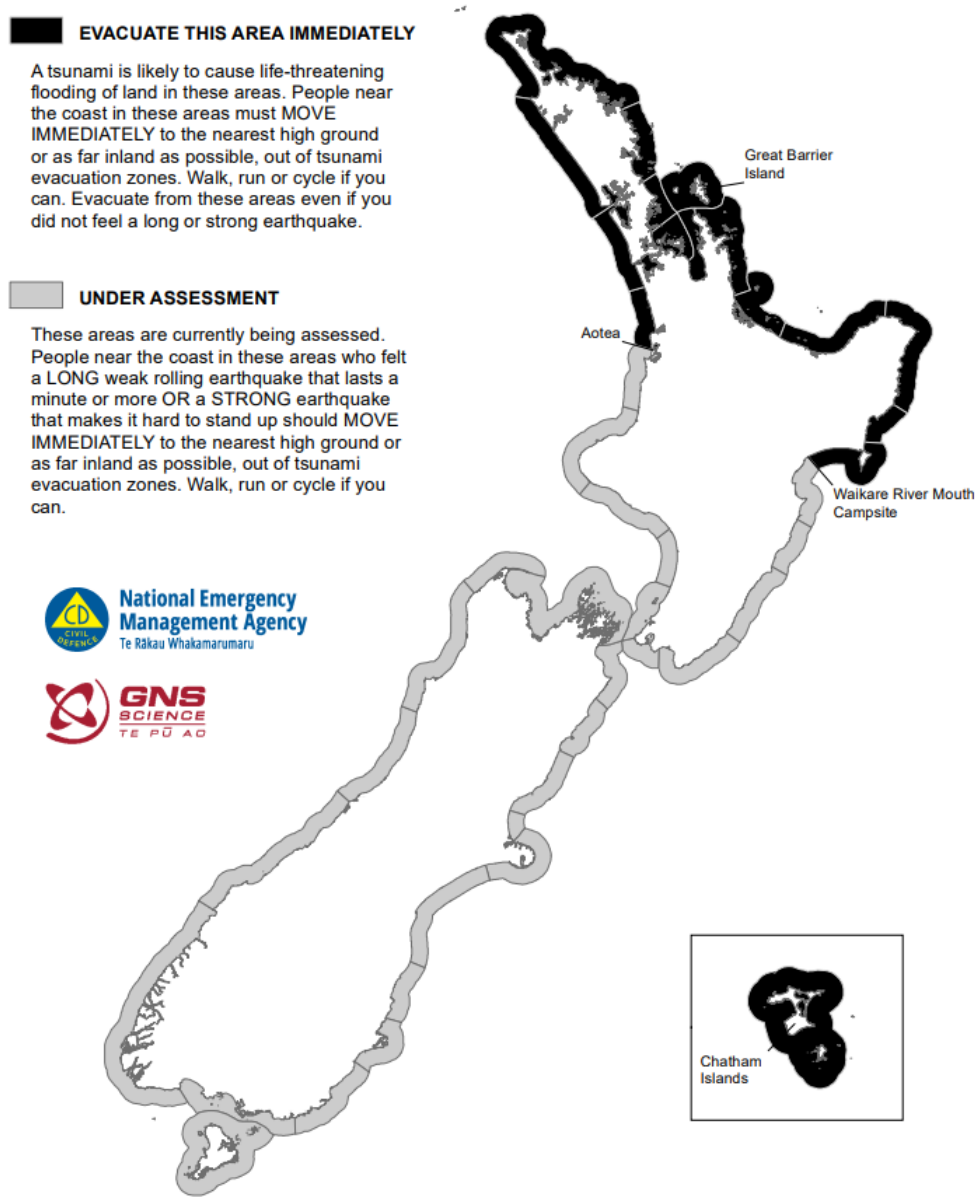


Figure 1: An example of an initial 'Action Map' used for local tsunami threats

5. Tsunami Standard Operating Procedures for a Distant Tsunami (when a distant tsunami hazard exists)

5.1 Responsible organizations

In New Zealand, the primary science/monitoring agency (GNS Science) and the NDMO (NEMA) work closely together to assess and warn for tsunami threats. Initial monitoring, detection, and assessment of threats is conducted by GNS Science, who relays this to NEMA so that it can issue public warnings and trigger evacuation processes. Both agencies operate 24/7 centres to assist this. In regional and distant events, the 'local' Emergency Management Groups from each province may also become involved in evacuations.

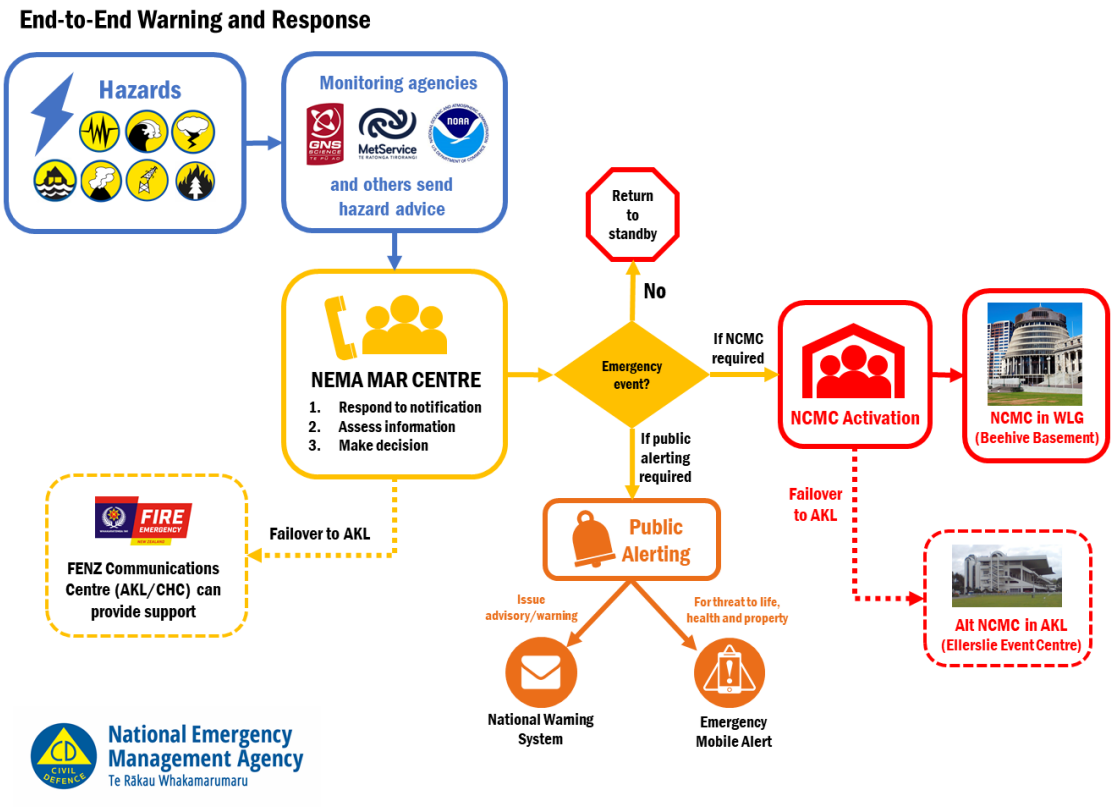


Figure 2: A high level overview of the New Zealand warning process, including for tsunamis.

GNS Science/GeoNet

GeoNet is a national geological hazards monitoring and data collection system operated by GNS Science. It collects and provides real-time data to monitor and assess earthquake, volcano, tsunami and landslide hazards in New Zealand. This functionality is augmented by its National Geohazards Monitoring Centre (NGMC), a 24/7 staffed facility for rapid detection and assessment of events. Any potential tsunami threat is assessed immediately and escalated to tsunami experts. GNS Science oversees experts on call, and a Tsunami Experts Panel (TEP) for this purpose. Earthquake parameters, tsunami threat advice, and tsunami forecasts are produced using GeoNet data, modelling tools, and local expertise, and conveyed to NEMA via the NGMC.

National Emergency Management Agency (NEMA)

The NEMA Monitoring, Alerting and Reporting (MAR) Centre is a 24/7 capability with a core role of liaising with GNS to assess threats and issuing warnings/advisories. NEMA maintains the National Warning System (NWS) for disseminating national warnings to local authorities, government departments, lifeline utilities, the media, and the public. NEMA also maintains the Emergency Mobile Alert (EMA) system and portal for public alerting. Escalation mechanisms include specific coordination centres (eg National Crisis Management Centre) and roles (eg National Controller, Director of Emergency Management) to coordinate the response to an emergency.

5.2 Thresholds and Criteria

Tsunami assessment advisories are issued by the NEMA MAR when earthquake parameters meet or exceed thresholds, or when an event is considered to hold a potential threat for New

Zealand, based on expert advice. Once assessed, depending on the initial threat NEMA will send a tsunami warning (land threat >1m), tsunami advisory for beach and marine threat (30cm<1m), or tsunami advisory for no threat. Assessment by the TEP continues and maps issued until there is no threat determined, following which the NEMA MAR issues a cancellation message.

The thresholds for issuing default initial national tsunami advisories and warnings by NEMA are outlined in the National Tsunami Advisory and Warning Plan. Thresholds are determined for Region 1 - New Zealand (local source, < 1 hour), Region 2 – South-west Pacific (regional source, 1-3 hours) and Region 3 (wider Pacific, 3+ hours).

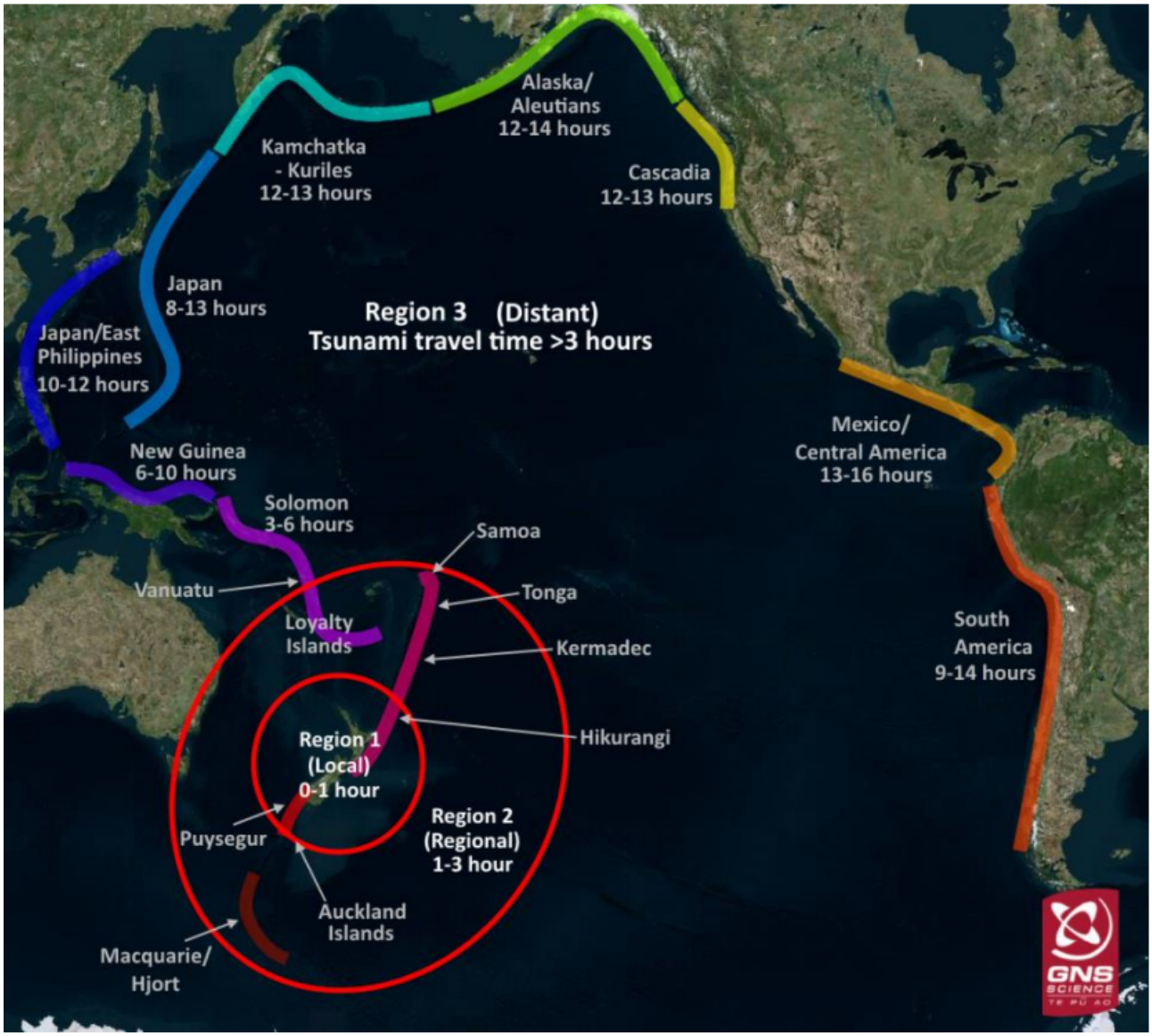


Figure 3: Local, regional, and distant source regions based on minimal tsunami travel time to New Zealand shores

The thresholds for advisories and warnings are as follows:

Region	Location	Thresholds	Possible notification issued via the National Warning System
1	New Zealand (0-1 hour to nearest coast Local source)	M≥6.5 and <100km depth	**Natural, felt signs are the primary warning for local source tsunami (Region 1).** **If possible and as appropriate,** NEMA will issue one or a sequence of the following Advisories and Warnings: • *National Advisory: Earthquake Being Assessed* ("Long or Strong, Get Gone" holding message) • *National Advisory: Tsunami Activity – Strong Unusual Currents* • *National Warning: Tsunami Threat* • *Emergency Mobile Alert* (to areas where land inundation is forecast) • *National Advisory: No Tsunami Threat* • *National Advisory: Earthquake – No Tsunami Threat*
	Southern Kermadec (<1 hour to nearest coast Local source)	M≥7.9 and <150km depth	**Natural, felt signs are the primary warning for local source tsunami (Region 1), however Southern Kermadec earthquakes located between 25°S and 33°S may not be widely felt in New Zealand.** **If possible and as appropriate,** NEMA will issue one or a sequence of the following Advisories and Warnings: • *National Advisory: Earthquake Being Assessed* (local/regional boundary holding message) • *National Advisory: Tsunami Activity – Strong Unusual Currents* • *National Warning: Tsunami Threat* • *Emergency Mobile Alert* (to areas where land inundation is forecast) • *National Advisory: No Tsunami Threat*
2	South-West Pacific (1-3 hours Regional source)	M≥7.5 and <100km depth	**Initial message:** • *National Advisory: Large Pacific Earthquake Being Assessed* (holding message) **Followed by (as appropriate, once confirmed data and advice received from GNS Science):** • *National Advisory: Tsunami Activity – Strong Unusual Currents* • *National Warning: Tsunami Threat* • *National Advisory: No Tsunami Threat to New Zealand* • *Emergency Mobile Alert* (to areas where land inundation is forecast)
3	Wider Pacific (>3 hours Distant source)	M≥8.0 and <100km depth	

Table 1: Thresholds for evaluation and messaging for local, regional and distant earthquakes

Subsequent national advisories or warnings are issued by NEMA based on the assessment provided by GNS Science and the Tsunami Experts Panel.

Information about expected arrival times is derived from modelling conducted by the PTWC and moderated by GNS Science/the TEP. The information is expressed as the estimated time of arrival (ETA) of the first (lead) wave at a given coastal point.

Supplementing PTWC forecasts, the TEP regularly updates its modelling of the maximum expected water elevation (amplitude) around the NZ coast. This information is provided to NEMA via Threat Forecast Maps, with water heights assigned to each of the country's 43 designated 'coastal zones'. The amplitude at shore and corresponding threat categories are as follows:

Maximum expected amplitude at shore		Threat definition
	<0.3m	No threat
	0.3-1m	Beach & Marine Tsunami Activity (incl. harbours, estuaries & small boats)
	1-3m	Land & Marine Threat
	3-5m	
	5-8m	
	>8m	

Table 2: Tsunami Threat Categories

Figure 4: An example Threat Forecast Map, showing the 43 coastal zones.

5.3 Other Agencies' Response

Following the issue of a national tsunami advisory or warning, local authorities are responsible for local threat assessment and for activating local public alerting mechanisms, following their own procedures, while national agencies activate response plans relevant to their area of business. NEMA maintains a Memorandum of Understanding with key media (radio and TV) for the public broadcasting of warnings.

5.4 Dissemination

National tsunami advisories and warnings are disseminated to all local authorities, key national agencies, the media, and the public. Information is communicated through the National Warning System (NWS) to text, email, phone call, NEMA website, Twitter and Facebook. The processes applied for the NWS are outlined in The Guide to the National CDEM Plan 2015. National warnings for tsunami are followed by an Emergency Mobile Alert (EMA) to areas under land threat instructing people to evacuate. The processes applied for the use of EMA are outlined in the National Tsunami Advisory and Warning Plan.

5.5 Termination

All national tsunami advisories or warnings (except National Advisory – No Threat) are followed up by continuous subsequent advisories/warnings until a formal cancellation is issued via the NWS. Termination is determined by observations from the National Sea Level Network, DART buoys, and expert advice from GNS (and the TEP).

6. National Sea Level Network

GeoNet (GNS Science) operates a network of real-time tsunami gauges around the New Zealand coasts and on nearby offshore islands. These are owned, designed and operated as part of the LINZ-GNS Science partnership. At each New Zealand station, sea level is measured by two pressure sensors submerged in the ocean. Sea level measurements, sampled at 10 Hz, are transmitted to the GeoNet Data Centres. Data is available to tsunami warning centres in real-time via the GTS as well as over the Internet via Seedlink (a seismic data exchange protocol). An additional two Australian stations at Norfolk Island and Macquarie Island complement the NZ network.

NAME	CODE	LATITUDE	LONGITUDE
Wellington	WLGT	-41.2846	174.7791
Napier	NAPT	-39.4757	176.9201
Chatham Island	CHIT	-44.0240	-176.3675
Gisborne	GIST	-38.6754	178.0229
Tauranga	TAUT	-37.6411	176.1812
East Cape	LOTT	-37.5504	178.1590
North Cape	NCPT	-34.4148	173.0487
Auckland	AUCT	-36.8314	174.7865
Boat Cove, Raoul Island	RBCT	-29.2800	-177.8944
Fishing Rock, Raoul Island	RFRT	-29.2511	-177.9038
Castlepoint	CPIT	-40.8993	176.2317
Puysegur	PUYT	-46.0848	166.5894
Dunedin	OTAT	-45.8143	170.6294
Kaikoura	KAIT	-42.4129	173.7028
Manukau	MNKT	-37.0466	174.5117
Great Barrier Isl	GBIT	-36.1890	175.4889
Christchurch	SUMT	-43.5701	172.7738
Charleston	CHST	-41.9083	171.4333

Table 3 : New Zealand Tsunami Monitoring Network: site names, codes, locations, date opened and deployed sensors. Stations are ordered according to date opened.

NZ also owns and operates an array of 12 deep ocean DART buoys positioned around the southwest Pacific (Table 2). The data provide real-time detection and monitoring capabilities to the NGMC and Tsunami Experts Panel. DART data is also used to augment tsunami forecasts as the event progresses.

NAME	*LATITUDE*	*LONGITUDE*
NZA	*-42.3707*	*176.9109*
NZB	*-40.6003*	*179.0996*
NZC	*-38.2001*	*-179.7978*
NZD	*-36.0998*	*178.6037*
NZE	*-36.0493*	*-177.708*
NZF	*-29.6843*	*-175.0126*
NZG	*-23.3516*	*-173.4012*
NZH	*-20.0896*	*-171.8599*
NZI	*-16.8921*	*-171.1904*
NZJ	*-26.6672*	*163.9549*
NZK	*-24.3093*	*169.4988*
NZL	*-19.3096*	*166.782*

Table 4: New Zealand DART Network: Sit Name, Latitude and Longitude

Real-time raw and de-tided time series are displayed on the GeoNet website: http://www.geonet.org.nz/tsunami/gauges and freely available for download via the GeoNet ftp site: ftp://ftp.geonet.org.nz/tsunami.

The National Institute of Water and Atmospheric Research (NIWA), port companies, regional and district councils also operate various sea-level gauges which complement the operational near real-time monitoring undertaken by GeoNet.

7. Information on Tsunami occurrences

During the intersessional period (September 2023 – February 2025):

National Advisory – Tsunami: No Threat to NZ notifications were issued by NEMA for the following events

08/09/2023	Kermadec Islands	M6.6

National Advisory – Tsunami activity: Expect Strong and Unusual currents and unpredictable surges at the shore notifications were issued by NEMA for the following events:

17/12/2025	Vanuatu	M7.3 (with bespoke messaging)
25/03/2025	New Zealand (Puysegur)	M6.8

National Warning – Tsunami Threat to NZ notifications were issued by NEMA for the following events:

NIL		

8. Web sites (URLs) of national tsunami-related web sites

- www.civildefence.govt.nz
- https://getready.govt.nz/emergency/tsunami/tsunami-evacuation-zones
- www.getready.govt.nz
- www.gns.cri.nz
- www.geonet.org.nz/tsunami
- www.niwa.govt.nz
- https://www.naturalhazardsportal.govt.nz/s/

9. Summary plans of future tsunami warning and mitigation system improvements.

- National Tsunami Strategy planned for 2025/26 – to coordinate and direct investment and resources
- Formalisation of failover arrangements, including with Geoscience Australia (science inputs) and Fire services (messaging and warnings) – to provide additional redundancy in national warnings
- Satellite EMAs – Providing Emergency Mobile Alerts via satellite, expanding the reach of these warnings to coastal areas without cell phone coverage
- Rapid maps – implementation of precalculated threat maps for local earthquakes, to enable faster initial assessment and warnings for local source tsunamis
- Updates to the National Tsunami Advisory and Warning Plan to document and formalise these and other system changes
- Expanding public education efforts to include lake tsunami – to increase awareness of the potential hazard at our large lakes
- Moving towards a single (public-facing) evacuation zone for local earthquakes, simplifying guidance for the public so that when there is no time for official warnings, their evacuation actions are faster and more effective
- Exploring Vertical Evacuation further to make it a realistic option in areas of New Zealand where timely evacuation to high ground is not feasible.
- Scoping and implementing a targeted programme of warning improvements (long and short term). The programme is still being scoped but is likely to include
    - Managing uncertainty and the requirement for speed vs accuracy
    - Aligning systems, processes, and requirements with our science advice agency (GNS Science) to enable faster handover
    - Options to uplift public understanding and evacuation
    - Supporting structures and governance of the system
    - Improved clarity and documentation of agency processes and roles
- Stage Two of the National Tsunami Model, creating probabilistic inundation and risk models for several at-risk coastal centres.
- Incorporating social science findings into warnings, to ensure warning messaging is easily understood and actioned (especially for the marine community)
- Automation and optimisation of RCET programme advances in tsunami forecasting. Where possible, these expert tools and products will be automated and/or fully integrated to take full advantage of the improvements they bring to tsunami forecasting.

- Research into the design and delivery of impact-based forecasting and warning systems, to aid understanding and action by all parts of society (e.g., the public, vulnerable groups, infrastructure managers, emergency managers).

NATIONAL PROGRAMMES AND ACTIVITIES INFORMATION

10. EXECUTIVE SUMMARY

New Zealand has continued its efforts to increase its resilience to tsunami hazards in the intersessional period. These efforts have spanned understanding risk, community and system readiness, and forecasting, warning and response capabilities. In addition, a programme has recently been launched to review the tsunami warning system and its supporting arrangements, and identify any areas for improvement. This will incorporate lessons from the December 2024 Vanuatu earthquake and tsunami.

Due to the high exposure of our population to tsunami hazards, and the proximity of major subduction zones, significant effort is directed at public readiness, and the ability to recognise and respond to the natural warning signs of an impending local tsunami. NEMA's annual 'Shake Out' earthquake and tsunami drill was successfully conducted in October 2024; this was supplemented by participation in the Communications Test of Exercise Pacific Wave in November. Encouragingly, we recorded an increase in public awareness of tsunami evacuation practices in our annual Preparedness Survey in 2024 compared to 2023 – 86% of respondents knew to evacuate to higher ground.

Exercising and public information campaigns have been complemented by work to simplify public facing evacuation zones – namely, moving from multiple zones to one. This new approach is designed to make it easier for the public to understand which areas to evacuate when there is a local source tsunami and respond to natural warnings without official guidance.

The design and publication of NEMA's Catastrophic Planning Handbook significantly improved central government awareness of the threat of a major Hikurangi Subduction Zone earthquake/tsunami – one of our most serious hazards. The project created stronger links and planning across government agencies and produced the handbook to guide the response to this kind of major event.

Through the RCET research programme, the capability to forecast tsunami has been lifted in several areas. Some of these are currently for expert use, but others have been included into 24/7 centre SOPs during the earthquake analysis stage. Our ability to rapidly recognise slow 'tsunami' earthquakes has improved with the adoption of Early-Est analysis and the ability to quickly calculate Mwpd, both of which utilise rupture duration.

There have also been advances in forecasting, improving the accuracy and resolution of advice. The TiDeTEW tool, which forecasts the evolution of the threat over time, has been adopted for expert use, as has ensemble forecasting, creating more precise threat maps and reducing the conservatism needed. It is hoped that both tools can be more automated in the future. Regional and Distant tsunami forecasting abilities have also improved with the use of a new operational

inversion of DART data (SIFT); we are now approaching the ODTP targets for a fully constrained source (45 mins).

Finally, new ground is being explored in both social science and new technologies. Findings from the combined effects of the Hunga Tonga Hunga Ha'apai eruption and a coinciding cyclone in 2022 on local mariners have reinforced the need for multi-hazard, impact-based warnings. We are also exploring cabled technologies – we have begun testing high-resolution interferometry on the Southern Cross NEXT cable stretching between New Zealand, Australia and Fiji, and we are preparing for integration of TAMTAM SMART Cable data should it become available.

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11. NARRATIVE

Detailed description of innovations or modifications to National tsunami warnings procedures or operations since last National Report, tsunami research projects, tsunami mitigation activities and best practices (especially in preparedness and emergency management), tsunami exercises, as well as public education programmes or other measures taken to heighten awareness of the tsunami hazard and risk.

Exercises

The annual 'ShakeOut' drill was held in October 2024. This is a nationwide, 'opt in' earthquake and tsunami exercise. Schools, communities, businesses and agencies can sign up to participate, practising both their earthquake actions and their tsunami evacuations (hikoi). The exercise is used to promote and practise the 'Drop, Cover, Hold' guidance for earthquakes and 'Long or Strong, Get Gone' natural warning guidance for tsunami self-evacuation. 675, 000 people took part around New Zealand. NEMA also participated in the Communications Test of PacWave in November 2024; this included testing the preferred arrangement for TSP warnings to also go directly to NAVAREA providers, and not via the NTWC.

Annual Preparedness Survey

NEMA conducted its annual preparedness survey in 2024. This is run each year to measure the level of emergency preparedness in New Zealand. The survey was run online with a random sample of 1700 people across the country. While the survey covers all types of emergencies, a key finding for tsunami preparedness was that 86% of respondents knew to move to high ground if they experienced strong/long earthquake shaking at the coast. This is a significant improvement on the 2023 rate of 75% and a return to the 2022 levels. Overall, we have continued to see that emergencies in New Zealand are a key trigger for preparedness actions.

Simplified evacuation guidance

The National Emergency Management Agency has updated its national tsunami evacuation guidelines. They recommend that public-facing information now use one tsunami evacuation zone (called the Blue Zone) instead of the three zones currently in use. The guideline states all regions of New Zealand should update their evacuation zones to the Blue Zone on websites, printed media and sign boards. This new approach is designed to make it easier for the public to understand which areas to evacuate when there is a local source tsunami where no official warning can be issued. The Blue Zone also makes a stronger link to our national education campaign of 'Long or Strong, Get Gone' which means if people feel a long or strong earthquake, they should immediately evacuate the Blue Zone. The guideline, expected to be published in April 2025, has

been developed through a collaborative effort with tsunami and social science experts across New Zealand.

Catastrophic Planning Handbook
NEMA has launched its first version of a Catastrophic Event Handbook, intended to guide a response to the most severe emergencies that could affect New Zealand. It outlines roles and responsibilities across Government agencies to manage an All-of-Government response to a catastrophic level event. The initial development of the handbook was based on the scenario of a Magnitude 9.1 local earthquake and ensuing tsunami (the 'maximum credible' Hikurangi Subduction zone event). The scenario highlighted the extreme intensity and geographic extent of the likely impacts of such an earthquake and tsunami, and drew significant interest from central and local government agencies. Consequently, the project has contributed to greater tsunami awareness and improved planning by several agencies, as well as to the handbook itself.

Lessons from the Vanuatu earthquake and tsunami (December 2024)
While New Zealand was not impacted by the Vanuatu earthquake and tsunami, the event presented several challenges for our initial assessment and advice mechanisms as it unfolded. This was partially due to the magnitude assessment being very close to our SOP thresholds, crossing into different categories as it was refined. The event has been debriefed and several lessons regarding SOPs and roles are being incorporated into our arrangements.

We also expect further lessons to be identified from the **Puysegur Trench Earthquake** on March 25th 2025. At time of writing the response to this event has just ended.

Improved local-source earthquake analysis
New Zealand is prone to local tsunami generated by both large, fast tsunamigenic earthquakes and slow "tsunami" earthquakes (e.g. March 1947 with 9m tsunami runup and May 1947 with 6m tsunami runup). To support analysis of both of these types of locally generated events, we have implemented the Early-Est analysis procedures currently in use in the NEAMTWS. This analysis provides a metric (TdT50ex) that can be directly used to triage the tsunamigenic potential of both fast and slow earthquakes by providing information about the earthquake rupture duration. Rupture duration is one of the most powerful diagnostic metrics for analysing the tsunamigenic potential of an earthquake. We further use duration information to calculate Mwpd in real-time. It is promising that the time to Mwpd estimates is approaching the ODTIP goal of 3 minutes for detection of earthquake sourced tsunamis. This analysis has recently been included in SOP as an escalation tool for use by our NGMC and a science analysis tool for the national Tsunami Experts Panel. This will be especially helpful in recognising slow 'tsunami earthquakes' during analysis.

Regional/distant-source SOP improvements:
New Zealand's response to large regional and distant events is primarily based on an initial forecast derived from precalculated scenarios that is subsequently updated through an expert deliberation process drawing on available observations and bespoke hydrodynamic modelling. We have made operational advances in both of these areas.

To improve the use of precalculated scenarios, we have implemented RCET TL Mapper. This is a tool to generate a tsunami threat level map derived from a linear combination of precalculated scenarios close in space and magnitude to real-time event metadata. The automated tool is

informed by automated wphase and DART inversions and produces an ensemble map product that is identical in appearance to the previous generation of threat level maps. The produced maps are currently generated for expert consideration, but a clear pathway to automated use exists. We are hopeful that the resulting maps will be more accurate and reduce the need for conservatism and over-evacuation.

To improve our forecasting capability for regional and distant events, we have implemented an operational inversion of DART data (SIFT). Supported by the dense NZ DART network, SIFT inversion results and forecasts based on subsequent hydrodynamic modelling are approaching the ODTP target of 45 minutes for fully constraining the source of earthquake generated tsunami. Resulting forecasts are currently provided for expert consideration in the Tsunami Experts Panel.

Incorporating social science findings:
We have made advances in social science research around impact-based tsunami warnings. Of significance are learnings from mariners' experiences during the coinciding 15 January 2022 Cyclone Cody and Hunga Tonga volcanic tsunami events. This work highlights the need for integrated thinking about the combined impacts of these rare but possible events. Doing so could have helped the mariners become more of aware of, and better prepared for, the heightened wave activity. Our findings align with current international trends toward integrated multi-hazard impact-based forecasts and warnings.

Operational Forecasting:
We have implemented an interactive tool to generate time-dependent threat level forecasts (TiDeTEW) based on analysis of ocean observations from DART data. This allows forecasts to show threat evolution over time, a key planning input for emergency managers. The current operational products require intensive interaction of experts with in-depth knowledge of both ocean data inversion and threat forecasting. Future efforts will be aimed at making TiDeTEW forecasts more automated and closer to operational production, requiring minimal human intervention.

We have an extensive programme of exploring new data technologies including seafloor telecommunications cables. We have begun preparation for integration of TAMTAM SMART Cable data if and when it becomes available to our real-time forecasting systems. We have also begun testing high-resolution interferometry on the Southern Cross NEXT cable stretching between New Zealand, Australia and Fiji. Analysis of recorded events suggest the data can be used to both improve earthquake metadata for forecasting and augment DART-based forecasting through approaches such as data assimilation.

National Tsunami Model
We have recently completed Stage 1 of a 3 Stage, multi year project to create a national tsunami model. Significantly, we are using physics-based source models that allow inclusion of coseismic vertical motion of the coastlines because of complex earthquake sources. Recent work has shown us that most large (M8+) subduction earthquakes commonly involve secondary movement on crustal faults, having significant impact on land inundation.

The completed Stage 1 included generation of probabilistic inundation and risk models for two regions of New Zealand. Stage 2 will include the expansion of modelled areas to many of our

prone coastal centres. It is intended that the project will deliver nationally consistent products including: 1) a probabilistic coastal hazard model (PTHM), 2) a probabilistic tsunami inundation model (PTIM), 3) a probabilistic tsunami risk model (PTRM) and 4) a scenario database of events that can be used to test response systems.

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Wendy Wright
New Zealand Tsunami National Contact of the ICG/PTWS
New Zealand National Emergency Management Agency
February 2025