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ABSTRACT

The need for a collaborative project to establish a nationally consistent approach to tsunami signage was identified by the Civil Defence Emergency Management Group Managers' Forum in March 2007. A Tsunami Signage Subcommittee was consequently established by the Ministry of Civil Defence Emergency Management Tsunami Working Group to consider and make recommendations for a national standard for tsunami signage.

Signs are grouped under five categories for the purposes of this report:

1. Evacuation zone
2. Information board
3. Evacuation route
4. Evacuation safe-location (optional, only use those which highlight risk)
5. Previous event (impact/elevation; optional).

Categories 1 through 3 are considered high priority signs and should be developed together as a package. The following rollout process is recommended:

1. Convene a local planning group of agencies with a role in tsunami risk reduction and community representatives (ideal to use existing structures)
2. Customise evacuation maps as a team
3. Map out as a team a draft placement of all sign types
4. Draft evacuation, warning response, all-clear and welfare plans
5. Check that maps, plans and signs make sense on-the-ground
6. Conduct wider community education and engagement and collect feedback
7. Revise evacuation maps and sign placement map
8. Obtain signs
9. Place signs (with supporting education to community)
10. Exercise evacuation plans, maps and signs
11. Survey public awareness and response to maps and signs
12. Review evacuation map and sign placement.

The report makes brief comment regarding constructing and situating signs, and avoiding theft and vandalism. Summary discussion is provided of tsunami hazard including local, regional and distant source tsunami. Components of effective warning systems are given under the headings of early warning, planning and evacuation, cooperation and discussion, education, exercising and community engagement. Barriers and concerns are discussed, along with the potential for signs to exacerbate risk in certain cases if certain considerations are not made.

International and national sign examples reviewed for this report are summarised in text with representative examples given as an appendix. The majority are blue and white, incorporating a common tsunami design.

Recommended content for tsunami information boards is given under the following components: tsunami process and characteristics, tsunami evacuation, warnings and response, local information or previous tsunami event information and images, and evacuation zone maps. Regulations and standards for New Zealand district/city and Transit roads are reviewed as well as international tsunami sign standard initiatives.

KEYWORDS

Tsunami, sign, evacuation, review, recommendations

1.0 INTRODUCTION

The Joint Centre for Disaster Research, GNS Science – Massey University was commissioned to work with the Ministry of Civil Defence Emergency Management (MCDEM) Tsunami Working Group's (TWG) Signage Subcommittee in May 2007 to consider and make recommendations for a national standard for tsunami signage.

The objectives of this report are to:

1. Agree a set of national tsunami signs
2. Recommend these to Civil Defence Emergency Management (CDEM) Groups
3. Report back to the TWG.

1.1 Background

Prior to 2004, several CDEM Groups had listed tsunami as a high priority hazard. Following the December 26th, 2004 Indian Ocean tsunami New Zealand political and public awareness of tsunami risk rose. A national tsunami risk and preparedness review was instigated by a request from the Minister for CDEM and commissioned by MCDEM. A national tsunami risk and preparedness review was instigated by a request from the Minister for CDEM, and commissioned by MCDEM. Two GNS Client Reports were prepared, one on Tsunami Hazard and Risk in New Zealand (Berryman (compiler), 2005), and the other on New Zealand's preparedness for tsunami hazard (Webb (compiler), 2005), respectively referred to in this report as the MCDEM Tsunami Risk report and MCDEM Tsunami Preparedness report. The latter report made a number of recommendations to improve preparedness, including several related to signage and to the setting up of a working group to develop national guidelines. These were:

At national level

Recommendation 4.3: Components of an effective warning system beyond early warnings require support at national level. We recommend resource material (content for education material, signage methodology, evacuation planning tools, etc.) and consistency guidelines; a national education strategy; exercising; research in support of improved warning; and evaluation.

At regional level

Recommendation 7.1: CDEM Groups participate in identifying where national guidelines would be beneficial, and in developing and implementing national guidelines where appropriate for regional effective warning system components, via a national working group. This working group should include representation by (but not restricted to) MCDEM, CDEM Groups, scientific organisations, and key individual scientists.

Some tsunami signage exists in New Zealand. That is in Western Bay of Plenty district (temporary, for use in emergency evacuations only), Masterton District (fixed, east Wairarapa coast), Tararua District (fixed), and Manawatu district (fixed, Himatangi beach) – see Appendix A1.

1.2 Process

The signage sub-committee has developed its recommendations based on its own review and extra external input.

Sub-committee:

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David Johnston, Joint Centre for Disaster Research: Massey University – GNS Science
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Stanley Chesterfield, Transit New Zealand
Bill Hutchinson, Far North District Council
Lamorna Cooper, Otago Regional Council and Neil Brown, Dunedin City Council
Perla Delos Reyes, Philippine Institute for Volcanology and Seismology
Bob Gibson, Land Transport New Zealand

1.3 Associated projects

- The MCDEM Tsunami Working Group is addressing a range of tsunami preparedness projects within the wider context of effective tsunami warnings (see Section 3).
- Tsunami evacuation mapping and planning projects are underway in 2007 in Wellington and Northland regions. Authors of this report are also members of the working group emerging for these regional projects.

2.0 RECOMMENDATIONS

Signs are grouped under five categories for the purposes of this report:

1. Evacuation zone
2. Information board
3. Evacuation route
4. Evacuation safe-location
5. Previous event (impact/elevation)

Explanation as to the background for these signs, including the review of existing examples, is given in Section 4.0 with supporting examples shown in Appendices. The Ministry of Civil Defence and Emergency Management has released the National Tsunami Signage, Technical Standard for the CDEM Sector [TS 01/08], in response to these recommendations. This standard contains the specific details of signs as they should be installed.

2.1 Rollout process

The recommended process for establishing tsunami signs within a region, district/city or community is as follows:

1. Convene a local planning group of agencies with a role in tsunami risk reduction and community representatives (ideal to use existing structures)
2. Customise evacuation maps as a team
3. Map out as a team a draft placement of all sign types
4. Draft evacuation, warning response, all-clear and welfare plans
5. Check that maps, plans and signs make sense on-the-ground
6. Conduct wider community education and engagement and collect feedback
7. Revise evacuation maps and sign placement map
8. Obtain signs
9. Place signs (with supporting education to community)
10. Exercise evacuation plans, maps and signs
11. Survey public awareness and response to maps and signs
12. Review evacuation map and sign placement.

2.2 High priority signs

There are three types of signs that are collectively considered essential to achieve effective tsunami signage education: evacuation zone, information board and evacuation route. Two optional signs that can be added to this set are evacuation safe locations and signage that highlights previous events, given in Section 2.3.

All signs should contain the logos of both "Civil Defence" and the local emergency management agency that is maintaining the signs (e.g. district council, regional council or CDEM Group).

The colour should be blue as defined in AS/NZS 1906. Please refer to Sections 2.4 and 6.0 for reference to pertinent regulations.

2.2.1 Priority one - Evacuation zones

Content: (1) "Tsunami Evacuation Zone [identifier - .e.g. Orange] (2) symbol, (3) direction: "In case of strong earthquake shaking, unusual ocean behaviour or noise, move to high ground and/or inland ["follow evacuation routes" where present]". Wait for official all-clear (Fig. 1).

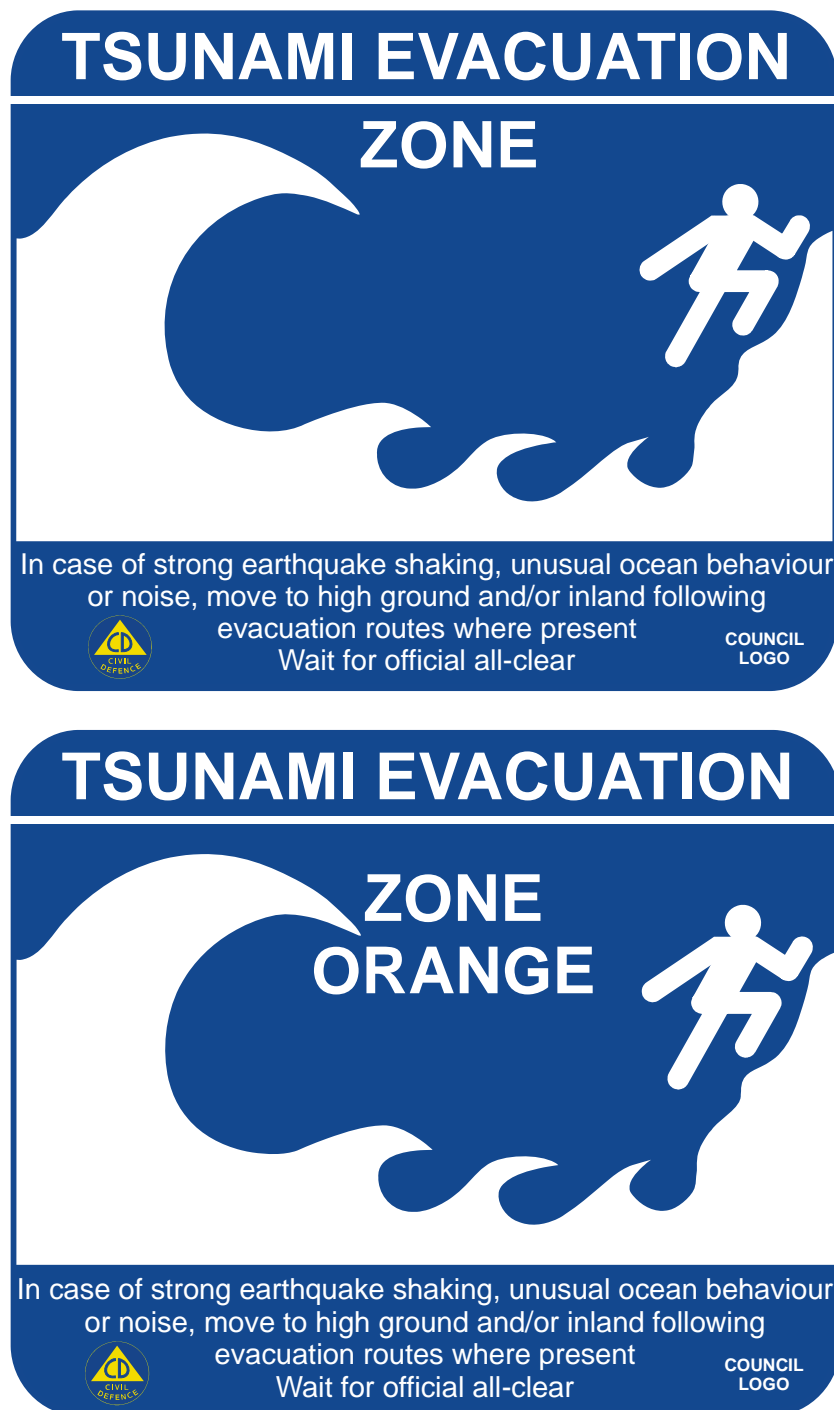


Figure 1 Recommended 'tsunami evacuation zone' signs. Generic one-zone sign above; Sign annotated to refer to specific (orange) evacuation zone below (where more than one zone is used, 'orange' is one of two zones in the Appendix 3 example). Both are 400 mm wide.

Tsunami information boards (Fig. 2) present awareness and action messages, assisting the community to understand the risk and empowering them to respond effectively to a tsunami warning or a tsunami event.

It is recommended that tsunami information boards have the following content:

- The specific text and resources for developing information boards with this content are given in Section 5.0.



2.2.3 Priority three - Evacuation routes

Content: (1) arrow (flexible angle), (2) [text], (3) symbol

Three available types:

Road, text = "Tsunami Evacuation Route"

Walking, text ="Walking Tsunami Evacuation Route"; symbol includes walker(s).

In place/vertical, text ="Vertical Tsunami Evacuation Route"; symbol includes person climbing stairs.

All of the below signs (Figs. 3-5) are 400mm wide unless otherwise stated.

Generic:



The arrow may be affixed pointing in one of five directions:



Figure 3 Recommended generic 'evacuation route' sign (arrows permanently affixed after printing).

Walking, Driving and 'in-place':

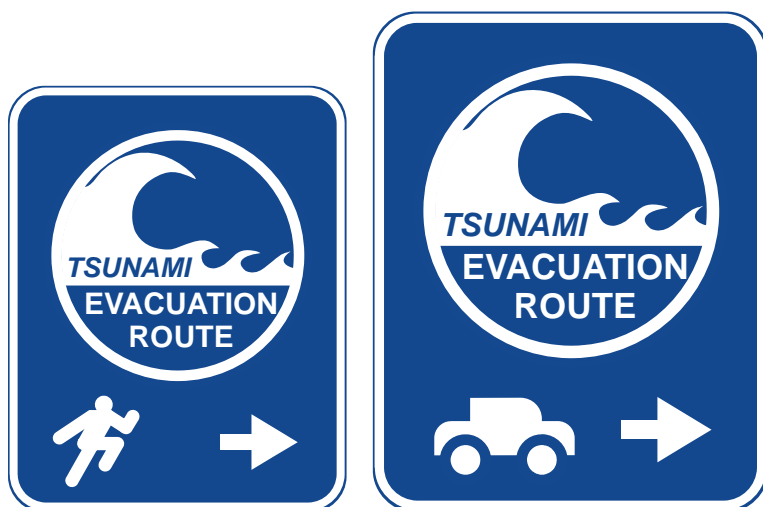


Figure 4 Recommended walking (350mm wide) and driving 'evacuation route' sign (arrows permanently affixed after printing).

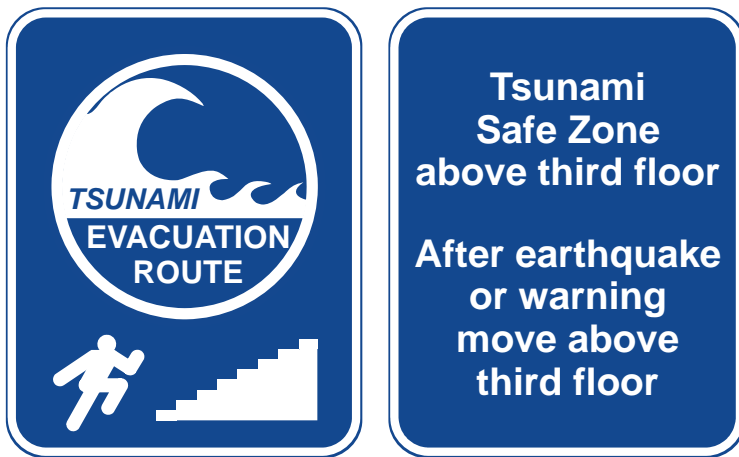


Figure 5 Recommended in-place 'evacuation route' sign (arrows permanently affixed after printing). Requires additional information sign explaining the safe location. 350mm wide.

2.3 Optional signs

There are two categories of optional signs recommended for consideration. There are pros and cons associated with using each, as stated below.

2.3.1 Evacuation safe locations

These are strongly suggested for walking evacuation routes only (Figure 6). Avoid routes with a possibility of people driving as stopped vehicles will block others behind.

(1) "Evacuation Safe Location", (2) symbol, (3) directive text: "Stay here until official 'all-clear' comes from [agency]"



Figure 6 Recommended 'safe location' sign. Sign is 400mm wide.

2.3.2 Previous events that highlight risk

Only use those which highlight risk (there is a potential to make people feel the risk is lower than in reality by using these signs). The message on the sign should be simple, clearly stating what case is represented (historic, maximum credible, etc.). See Figure 7.



Figure 7 Recommended 'previous event' sign. Sign is 280mm wide.

2.4 Constructing signs

2.4.1 Manufacture and reflectorisation

In order to provide for manufacture consistency, based on the recommendations of this report the Ministry of Civil Defence and Emergency Management has released the National Tsunami Signage, Technical Standard for the CDEM Sector [TS 01/08]. This standard contains the specific details of signs as they should be manufactured and installed.

Evacuation route signs are under consideration as 'traffic signs' and as such may in future be approved as reflectorised. There may be little point in making the evacuation in-place route signs to be used inside buildings reflectorised. The other four sign types may not be reflectorised and placement must conform to regulations for information signs that are not formal traffic signs.

Signs can be printed allowing for arrows to be permanently affixed after printing it-situ which will make printing and placement of signs easier, although the possibility of peeling with weathering will need to be evaluated.

As most councils have preferred suppliers and contractors for the manufacture of signs, this report does not provide detailed costs analysis on construction.

If guidance is required on manufacture, there are general recommendations available in Woods' (2005) report "Development of Tsunami Information Boards for Installation at Public Beaches" on the construction of signs including design parameters, assembly, installation and costs.

2.4.2 Situating signs

Consider:

- Ensure any signs do not obscure any traffic signs.
- Place any sign in such a position that an approaching driver can see it and react appropriately and safely to the information provided.
- Impact/interpretation – Select a location and orientation that will be noticed and which will give the right impression of the location of the hazard and of safety.
- Location - Will the majority of beach users notice the sign?
- Ground Conditions – Is the ground firm enough to support the sign?
- Access – Is the location easy to get to when installing and maintaining the sign?
- Shelter – Is the location sheltered? Will people want to stop and read the sign on a windy day?
- Visual pollution – Achieve optimum balance of effectiveness without adverse impact.
- Avoid the impression that a lack of a sign at one location indicates safety from tsunami
- Vandalism – Is the location prone to being vandalised due to isolation?
- Use existing poles only where strong and secure.

Evacuation route signs if adopted as traffic signs will need to comply with placement requirements in the TCD Rule and MOTSAM (see Section 6.0).

The tsunami signs at Masterton were placed at locations in an attempt to gain as much exposure as possible. These included shops, adjacent to a surf club, fixed to a regularly used gate, marker posts including and on the side of beach access roads, etc.

2.5 Avoiding theft and vandalism

2.5.1 Pacific Northwest, USA

Theft and vandalism is a constant problem for all signage and was a major problem in the initial rollout of tsunami signs in the Pacific Northwest of the USA. In that case, several strategies were developed to limit the impacts (Darienzo et al., 2005; Dengler, 2005):

- Copies of signs were mass-produced on paper as free handout.
- Signs should be placed “out of reach” on lampposts where possible.
- The use of tamper proof screws.
- Where metal posts were used it was found that greasing the poles made them less attractive to steal.
- Signs were designated as “Life Safety” signs under US Federal Law, increasing the punishment for their theft.

The rate of signage theft in Washington has decreased over time.

3.0 THE CONTEXT OF SIGNAGE

Signage is one component of an effective tsunami warning system. This report follows the definition used in the MCDEM Tsunami Risk Report for an “effective warning system” namely:

The term ‘effective tsunami warning system’ refers to all of the components required to detect a tsunami and effectively remove people from harm’s way, including all of the linkages and steps in between. This goes beyond the early warning system itself and additionally includes: supporting research; planning; cooperation, discussion, and communication; education; exercising; and evaluation.

Signage is integral to the effective response to early warning messages and signals, and at least some signage should educate the public regarding notification (warning) procedures, warning messages and signs, and basic tsunami facts. Conversely, warning and evacuation procedures and educational material, including websites, need to take into account the recommended content of the signage.

Community awareness of the locations and salience of tsunami hazards are expected to be increased by placing tsunami hazard and evacuation signage in partnership with those communities. Signage, discussions and planning that precede it, and the exercising that tests response are all strong public education tools. With increased public awareness of the location and nature of local tsunami hazards comes an increased potential for buy-in to modification of human behaviours, especially through land-use planning and building codes.

In essence, signage may also positively influence the public acceptability of other tsunami risk reduction actions, especially land-use planning.

In developing signage, issues related to the tsunami impact and likely warnings (official, natural, and unofficial, defined in the Section 3.2) for each source type (defined in Section 3.1) were considered. Key issues only are outlined here. More detail on warning systems and tsunami sources and effects can be found in the 2005 MCDEM tsunami risk and preparedness reports.

3.1 Distant-, regional- and local- source tsunami

Prior to and particularly since the 2005 MCDEM Risk and Preparedness reports (Berryman (compiler), 2005; Webb (compiler), 2005) it has become practice to distinguish between distant-, regional-, and local-source tsunami. These terms were defined in the 2005 reports, principally for emergency management purposes, to reflect the availability of time for warning notifications to be issued at national level by MCDEM and the appropriate response initiated and implemented at regional level. Definitions for the different sources of tsunami are:

- **NZ Local sources:** less than 1 hour tsunami travel time to the nearest New Zealand coastline, noting that many travel times are less than 30 minutes and some travel times are as short as a few minutes.

- **NZ Regional sources:** 1–3 hours tsunami travel time to the nearest New Zealand coastline.
- **NZ Distant sources:** more than 3 hours of tsunami travel time to the nearest New Zealand coastline.

CDEM Groups, their member local authorities and partner agencies are now using similar terms preceded by a district or place name to refer to response times specific to their district or place. For example, a “Mercury Bay area regional source tsunami” refers to those events that are 1–3 hours tsunami travel time from the Mercury Bay area. These may be local source events somewhere else, e.g. a local source tsunami as far as Gisborne is concerned and as far as response at national level is concerned. Prefixes should be used consistently to prevent confusion.

3.2 Warning messages and signals

Warning messages and signals to the public can come from several sources — official, natural, or unofficial.

3.2.1 Official warnings

Official warnings to the public fall into two categories:

- those disseminated via the MCDEM National Warning System to the national media and CDEM Groups and other key organisations that might be involved in response; and in response to these or independently:
- those disseminated via CDEM Groups, local authorities, and partner response organisations, which may include Police, Fire, related networks, and local media.

At present, official warning messages are:

- **expected for NZ distant source tsunami.**
There is, in theory, adequate time to evaluate the potential of distant source tsunami and provide timely notification to CDEM Groups and to the public for physical evacuation to be achieved.
- **not expected for the nearest coast affected by NZ local source tsunami**
A warning system for New Zealand that delivers informed warnings within 3–5 minutes of a large local earthquake would take considerable development of infrastructure and scientific knowledge (a database of 1000s of scenario events), and it is unlikely that this will be available for at least the next few years. Hence, natural warnings are currently the only warning possible for those on the coast nearest to the source.
- **possible for NZ regional source tsunami and for areas 1-3 hours travel time from the source of local source tsunami**
While only possible at present, the availability and content of official warnings is expected to improve in coming years as detection, analysis and notification systems are upgraded.

3.2.2 Natural warning signals

Natural warning signals are of key importance in response to local source tsunami.

The key natural warning signal is **strong earthquake shaking**. Masterton district guidelines adopt MM6-MM7 (Modified Mercalli, Table 1) as the threshold level. Shaking at MM6 would be considered by most people as strong, and is the threshold for causing difficulty in standing or walking steadily, significant household contents damage, and building damage. This seems a reasonable threshold and a lower intensity would possibly produce too many false alarms. However, the appropriate level and duration of shaking to initiate evacuation close to the source and at more distant locations (in large subduction interface events for example) has not been investigated rigorously.

Table 1 New Zealand Modified Mercalli Intensity Scale

MM 6: Slightly damaging	Felt by all. People and animals are alarmed, and many run outside. Walking steadily is difficult. Furniture and appliances may move on smooth surfaces, and objects fall from walls and shelves. Glassware and crockery break. Slight non-structural damage to buildings may occur.
MM 7: Damaging	People experience difficulty standing. Furniture and appliances are shifted. Substantial damage to fragile or unsecured objects. A few weak buildings are damaged.

The other key natural warning signals relate to **strange sea behaviour** (appearance and noises). These are:

- unusual and sudden ocean recession or rise;
- loud and unusual noise or roaring that can occur some minutes before the tsunami arrives. Whether the noise is the result of recession, or a disturbance that is still a long way offshore is uncertain, but it nevertheless allows a little time for people to escape.

The sea behaviour signs are not always included on international evacuation zone signage, but it is considered important for New Zealand because:

- there are many isolated parts of the coast which may not be reached by official warnings;
- natural warning signals may currently be the only warnings possible for regional source tsunami [see above];
- tsunami may be generated by submarine or coastal landslides that are spontaneous or triggered by mild shaking earthquakes only;
- special type of earthquakes called “slow tsunami” earthquakes often cause mild shaking only on the nearest coast. The key characteristic of these earthquakes is that they cause greater than expected tsunami for their magnitude;
- a large earthquake and tsunami in one part of the country can propagate to places further away where shaking has been moderate.

The latter two cases emphasise that the public should be wary after any earthquake, and public inquiry into the source of long and/or moderate shaking should be encouraged, i.e. people should be encouraged to find out from some official source where the earthquake was (inland or near the coast) and if a tsunami may have been generated, as for unofficial warnings.

3.2.3 Unofficial warnings

There are several paths by which people may receive unofficial (which have also been called informal) warnings of an impending tsunami, for example:

- media coverage, following release of a watch/warning bulletin from PTWC. People may receive unofficial warnings either directly through local or international media, or from friends in New Zealand or overseas that have heard their broadcasts;
- from people (e.g. by phone) who have already experienced the arrival of the tsunami on coastline closer to the source, or observed a natural warning sign.

Unofficial warnings may or may not be correct. The signage recommends several actions that people should take to respond appropriately.

3.3 Characteristics of tsunami impact: distribution, variability and all-clear notification

3.3.1 Distribution

While some parts of New Zealand are clearly more at risk from tsunami than others in terms of frequency and size, because of their proximity to high seismic areas (local and regional source) and their exposure to distant source events, it is considered that information on signage about natural, official or unofficial warning signals and tsunami basic facts is appropriate throughout the country.

3.3.2 Variability of duration and characteristics

The duration of significant waves and characteristics of tsunami can be highly variable, with durations ranging from as little as 2-12 hours for a local source tsunami to 12-72 hours for the largest distant source tsunami. Heights and characteristics vary in time and along the coast because of interactions with local bathymetry and coastline, interactions with tidal levels, aftershocks, and so on.

The most important of the issues related to variability in wave heights in time and space, late arrivals, etc have been included on the information boards so that people can understand a little about tsunami characteristics, can make informed decisions about their safety if necessary, and can understand the need to follow instructions from authorities.

3.4 All-clear notification

Because of the variability in duration in local source events in particular it was considered advisable to include the “Wait for official all-clear” message on the evacuation zone signage

in association with the strong earthquake shaking message, rather than specify a time for people to wait before returning to the shore (as appears on Wairarapa signage, for example). It is also consistent with procedures for regional and distant source tsunami. Nevertheless, the inclusion of some indication of duration (many hours) on the information boards was also seen as important.

National guidelines on how to determine the “all clear”, whose responsibility it is to determine or to propagate the all clear (national or regional CDEM) and whether a reducing alert level is feasible will probably need to be developed.

4.0 REVIEW OF SIGNS BY CATEGORY

This section gives more detail as to the background (including other signs reviewed) and content of signs recommended in Section 2.0.

If signs are to be placed on road reserve, these must be designed in partnership with district consenting agencies (district roads) and Transit (State Highways), see Section 6.0 regarding regulations. A 'traffic sign' on a road reserve may only be installed by the road controlling authority.

Appendices 1 and 2 show signs previously in use in New Zealand and internationally at the publication of this report. Note that the majority of reviewed signs in New Zealand and around the Pacific Rim are blue and white using the common ITSU tsunami design (Section 6.1.3).

4.1 Evacuation zone

Evacuation zone signs are used in various annotated and/or slightly modified forms (Section 5.1.5 and Appendix 3) in Washington, Oregon and California States, USA; British Columbia, Canada; Manawatu district; and Far North district. They are compatible with the international 'standard' according to ITIC website (Section 6.1.3). These signs show people that they are within an evacuation zone.

We recommend that it is best to have signs delineating 'evacuation' zones only. 'Evacuation' Zone allows for: (a) zone boundaries to move as hazard understanding improves, (b) implicit meaning as to required action (evacuate), (c) distinction that signs do not necessarily set final hazard zone boundaries (which may have more of a specific implication to properties within the zone).

We recommend that New Zealand maintains the three components seen in the evacuation zone signs reviewed:

1. Nature of hazard at this location (i.e. 'tsunami evacuation zone')
2. Symbol(s)
3. Direction

In most of the reviewed cases evacuation zone signs are complemented by information boards/evacuation maps, and evacuation route signs (below).

4.2 Information boards

Most of the reviewed cases combine information boards/evacuation maps with evacuation zone and evacuation route signs (above and below). One study, Woods (2005), states that the major benefits of using information boards in tsunami hazard public education are:

- They will increase public awareness of New Zealand's tsunami risk.
- They will increase the public's ability to respond effectively in a tsunami event.
- They have MCDEM support and provide a consistent set of messages.

- The use of multiple media increases public education effectiveness.
- Their location on the coast aids retention of risk knowledge.
- They provide a reminder of tsunami risk every time someone visits the beach.
- Their reach includes transitory public.
- The board content is already designed and recommended here.
- Compared to other public education methods they are low cost.
- They are easy to install.

While Woods (2005) recommended some signs could give hazard and warning response information only, we strongly recommend development of tsunami signage with evacuation planning and mapping and thus inclusion of those maps in the information board.

Recommended content for information boards is given in Section 5.0.

4.3 Evacuation route

Evacuation route signs direct people along a pre-defined 'best' route out of the evacuation zone(s).

With respect to evacuation route signage, overseas examples reviewed are based around the following three components:

1. An arrow
2. Symbol(s)
3. Directing text (most commonly 'tsunami evacuation route')

In most reviewed cases these are combined with information boards/evacuation maps and evacuation zone signs.

A single type of sign could be used for all modes of transport, or distinct signs could be available for each, e.g.:

- Driving
- Walking
- In-place evacuation (indoor or outdoor)

4.4 Evacuation safe-location

These signs denote that a person is in a safe location from tsunami. They may be associated with, for example, a shelter and/or a store of evacuation rations and supplies.

Safe-location signs may not be appropriate on routes with any chance of vehicle evacuation, because vehicles reaching that point may stop and block the advance of those evacuating behind them. This has been seen at past events in New Zealand, Australia and the USA. This issue may be able to be overcome by placing the safe location signs well inland of the boundary of the evacuation zone; care must then be taken that the safe location is not so far inland that people feel it is not possible to reach and therefore give up on evacuating, even if safe locations also exist very close to the coast.

Small community evacuation routes, especially those on-foot-only, may best be directed to a sign-posted safe location. Evacuation safe locations may have shelter, store resources for evacuees, etc.

Naming some safe locations as 'tsunami viewing locations' may attract some suitable evacuees, but it may also attract those from outside risk areas into risk areas to get to these locations and so is therefore is not recommended.

4.5 Previous event (impact/elevation)

This category refers only to simple poles or other markers of elevation inundated in an event. Other previous event information, including more detailed text, images, etc. are discussed under Section 5.0 Information Boards.

Appendix 2 presents examples of this type of sign from several overseas locations.

This type of sign intends to raise awareness of the existence and magnitude of past events, hopefully motivating preparedness. However, these signs may give a false sense of security inland of the point where they have been placed, if the event denoted is anything other than the maximum credible from all sources.

Historical event markers are only available in areas where there has previously been an inundation. This type of sign has been based in other countries on historical events, but could be based on modelled events or other pre-historic or theoretical events.

5.0 TSUNAMI INFORMATION BOARDS RECOMMENDED CONTENT

It is recommended that tsunami information boards and supporting pamphlets/posters have the following content:

1. Tsunami process and characteristics
2. Tsunami evacuation
3. Warnings and response
4. Local information and images
5. Local tsunami histories (if available) or comment on risk (plain language) and images
6. Evacuation map

The following is suggested detail, based on the above content headings that could be included within information boards.

5.1.1 Tsunami process and characteristics

What is a tsunami?

Tsunami are a series of waves most commonly generated by major disturbances of the sea floor, usually caused by undersea earthquakes, landslides, or volcanic eruption. Tsunami can occur at any season of the year and at any time, day or night. Some tsunami can be very large and can rapidly and violently inundate coastlines, causing loss of life and property damage. Others can be small but still dangerous to those near or in the water.

Tsunami Facts

- New Zealand's entire coast is at risk of tsunami.
- The biggest tsunami in New Zealand are likely to be caused by events close to our shore and can arrive within just a few minutes.
- Some tsunami can travel thousands of kilometres and still be big enough when they arrive here to cause loss of life and damage.
- The first waves may not be the largest.
- Large waves may come after a series of small waves. The largest waves from distant sources may take many hours to arrive.
- There may be many waves separated by up to an hour, or more.
- Tsunami can travel around corners, up coastal rivers and streams.
- When they flow over land, tsunami pick up debris and can knock down houses. The force of tsunami is enormous.
- Harbours, bays and inlets often increase the size of tsunami waves.

5.1.2 Tsunami evacuation

- Evacuate via the routes drawn on evacuation maps.
- Walk quickly if possible, drive only if essential. If driving, keep going once you are well outside of all evacuation zones, to allow room for others behind you.
- Stay out of the evacuated area for many hours after the first waves, or until given the "all-clear" from local authorities. Continue to listen to your radio.

- Stay away from coastal water, tidal estuaries, rivers and streams for at least 24 hours after any tsunami warning, as even small waves create dangerous currents.
- Boats are generally safer in water deeper than 20 metres than if they are close to the shore. It is not safe to try to move a boat if a tsunami is imminent.

5.1.3 Warnings and response

Natural warnings

In the case of strong earthquake shaking (i.e. it is hard to stand up), unusual noises from the ocean, or changes in the ocean (e.g. the ocean rushing in or out):

- **Go immediately to high ground and/or inland**, evacuating all zones; Zones red and orange are especially high risk (– if colour zones are used locally).
- **The first wave may arrive within minutes**, or take more than an hour to arrive.

Official warnings

- Civil Defence Emergency Management will issue the official warning. The warnings may come to you via NZ TV/Radio broadcasts or other authorities [insert other channels where present]".
- [Insert local arrangements as they exist].
- You may receive warnings from one, or several sources. Respond to the first source; do not wait for more messages before you act.
- Official warnings are currently expected to come for sources that are more than three hours of tsunami travel time away from you.
- Listen carefully to official instructions and follow them.
- Evacuate from the zone(s) stated in the warning.
- Stay out until the official 'all-clear' is given.
- Take your 'Getaway Kit' with you if possible (but do not travel into the evacuation zone to collect your kit or other belongings).
- Continue listening for further messages while you respond.

Informal warnings

- Warnings from friends, other members of the public, international media, internet, etc. may be correct. Informal communication may be your only warning especially for tsunami from less than three hours tsunami travel time away from you.
- Verify the warning only if you can do so quickly (via NZ TV/Radio broadcasts, Civil Defence Emergency Management, Police, Fire) or if you feel the threat is imminent then consider evacuating from all zones. [multi-zone text as for the example in Appendix 3 – "Zones red and orange are especially high risk"].
- The first or largest wave may not arrive for 6 hours after the forecast arrival time.
- If New Zealand Civil Defence Emergency Management warnings are available, trust their message over informal warnings.

5.1.4 Local information or previous tsunami event information and images

Local information and image(s) will make the boards more-obviously relevant to a local area and increase public uptake of the information on the board. Add information and images as deemed appropriate by local Civil Defence Emergency Management and community groups.

Generic local information may be supplemented or replaced by 'past event information' (below) for areas where information on historic tsunami events exists.

The following text is an example of previous event information (from several selected events and geographic locations) and images that can be used.

Tsunami history

- 1 At least three tsunami with run-up heights (elevation inundated at maximum distance from the shore along a given line) of 10 m or more have occurred in the last 165 years. Two of these tsunami were generated by local earthquakes (1855 and 1947), the other by a large South American earthquake (1868). Tsunami with run-up heights of 30 m or more have been found in the geological (prehistoric) record of the last 6,000 years. New Zealand also has a big plate-boundary faultline offshore east of the North Island, similar to the boundary offshore of Indonesia which caused the Indian Ocean tsunami in 2004.
- 2 The 1855 earthquake, which ruptured the Wairarapa fault, generated a tsunami with a maximum known run-up of 10 m in eastern Palliser Bay and up to 45 m in several locations in Wellington and along the northern Marlborough coast.
- 3 On 26 March 1947 tsunami were experienced on the coast north of Gisborne, where the waves reached 10 m above sea-level (Figure 8), a small part of Hawke's Bay north of Mahia Peninsula was also affected.
- 4 In May 1960 a massive magnitude 9.5 earthquake in southern Chile generated a Pacific-wide tsunami that caused the deaths of thousands in Chile and several hundreds in Hawaii, Japan and the Philippines. It also resulted in damage throughout New Zealand. Water levels possibly reached over 4 m above high tide mark, even though this tsunami occurred at low tide (Figure 9). It would have been far more damaging if it had occurred at high tide.



Figure 8 Remains of a 4-room cottage, in which three people survived three large tsunami surges on 26 March 1947. In the distance, the tsunami reached 10 m vertically above sea-level, wrenching a bridge from its foundations, and driving it 500 m upstream. (*NZ Weekly News*, 2 April 1947).



Figure 9 In Napier 50 m of the footbridge to West Shore was torn away and the power and gas lines along it were broken; 17000 m³ of sand were scoured from the boat harbour. (*Daily Telegraph*, date unknown, prob. 24 May 1960).

5.1.5 Evacuation zone maps

Evacuation zone maps are intimately associated with signage. They should form part of information boards, and evacuation zone and route signs should be designed in parallel with zone maps. It is likely that at least two zones will be suitable/desirable for most regions. Signage should, therefore allow for more than one zone if required. See Appendix 3 for examples of tsunami evacuation maps being piloted in Northland and planned for Wellington.

6.0 REGULATIONS AND STANDARDS

The Ministry of Civil Defence and Emergency Management has released the National Tsunami Signage, Technical Standard for the CDEM Sector [TS 01/08], in response to these recommendations. This standard contains the specific details of signs as they should be installed.

6.1.1 District/city roads

Territorial Authorities (TA) as [Roading Controlling Authorities](#) generally follow the Manual of Traffic Signs and Markings in principal. Existing tsunami signs placed by TA emergency managers on district roads have received no opposition from the TA consenting arm to date.

6.1.2 Transit Roads

The 'Land Transport Rule: Traffic Control Devices' (TCD Rule) and 'Manual of Traffic Signs and Markings' (MOTSAM) are released under the auspices of Transit New Zealand and Land Transport New Zealand and governs road sign standards in New Zealand. The current versions can be accessed at the websites:

<http://www.landtransport.govt.nz/rules/traffic-control-devices-amendment-2006.html>
http://transit.govt.nz/technical/view_manual.jsp?content_type=manual&=edit&primary_key=1&action=edit#download

The sheetings approved for use on traffic signs are described in Traffic Note 12 at <http://www.landtransport.govt.nz/roads/traffic-notes/index.html>. The relevant gazette notices are also included there. On 1 July 2008 Land Transport NZ and Transit NZ combine to form the NZ Transport Agency: website www.nzta.govt.nz

A Principal Engineer at Land Transport has written the following in response to our enquiries: "A Signs Working Group, containing representatives of local authorities, sign manufacturers, Transit NZ and Land Transport NZ, is undertaking a major review of MOTSAM. This will see the development of a series of guidelines one of which will relate to the signing of traffic routes. The draft document will be widely consulted on and we aim for it to be adopted by all road controlling authorities. We would anticipate this document would include tsunami evacuation routes and other requirements. The target completion date for the guideline is July 2009. In the meantime MOTSAM provides the best guidance on the issue."

For signs to be reflectorised and to be placed on Transit roads as 'traffic signs' they need to be approved as 'traffic signs' by the Director of Land Transport (and by notice in the *NZ Gazette*). Their placement would then be governed by the TCD Rule and MOTSAM.

Signs that are not official 'traffic signs' can be placed beside Transit roads in accordance with the regulations for billboards, 'advertising signs' etc. They would need to be placed outside of the road reserve (5 – 10 m from the road edge usually), on their own poles, and not be reflectorised. They would need to have their face other than perpendicular to the road.

For formal 'traffic signs' on Transit roads a typically 100 mm minimum letter height would apply. The words 'evacuation route' as part of the wave symbol may be able to be considered elements of an 'emblem' and thus remain less than 100 mm high.

6.1.3 ITSU – ITIC and ISO standards

'Hazard Zones' (yellow & black) that ITSU have been promoting were put to the ISO for approval. They were not successful as Japan countered with a different (also yellow & black) sign that is now up for approval. These are not widely used, whereas blue and white are frequently used. ITSU now appears to be leaving it open for individual countries to decide what they prefer. The ITSU ITIC site displays the following (Figure 10) blue and white signs as their standard.



Figure 10 Tsunami signs adopted by the 19th Session of ITSU (2003). Downloaded 25 May 2007

Source: http://ioc3.unesco.org/itic/categories.php?category_no=168

The Japanese signs being considered by ISO include:

Water safety sign WSE002: Tsunami evacuation area

Water safety sign WSE003: Tsunami evacuation building

Water safety sign WSW014: Warning; Tsunami hazard zone

These can be found by viewing: <http://www.iso.org/iso/home.htm>

Search for standards under development (ISO, 2007).

7.0 ACKNOWLEDGEMENTS

Paul Walker, Masterton District Council (Paul thanks Dr. James Goff AIB, FACR, NIWA for advice in developing their signage content). Trevor Auld and Jim Mestyanek, Manawatu District Council. Noel Mingins, Tararua district. David Coetzee, MCDEM for ISO and Chilean sign information. Linda Sjogren and Hugo Gorziglia for ISO help. Stanley Chesterfield, Transit and Bob Gibson, Land Transport, provided input regarding national standards and regulations.

8.0 REFERENCES

- Berryman (compiler), K., 2005. Review of Tsunami Hazard and Risk in New Zealand, Institute of Geological and Nuclear Sciences client report CR2005-104, Lower Hutt.
- Darienzo, M., Aya, A.L., Crawford, G.L., Gibbs, D., Whitmore, P.M., Wilde, T. and Yanagi, B.S., 2005. Local tsunami warning in the pacific coastal United States. *Natural Hazards*, 35(1): 111-119.
- Dengler, L., 2005. The role of education in the National Tsunami Hazard Mitigation Program. *Natural Hazards*, 35(1): 141-153.
- ISO, 2007. Standards Under Development, International Organisation for Standards (ISO). Accessed 20 September, 2007.
http://www.iso.org/iso/iso_catalogue/catalogue_tc.htm?development=true
- MOTSAM, 2007. Manual of Traffic Signs and Markings: Part I - Traffic Signs. Edition 4. November 2007. Transit New Zealand and Land Transport New Zealand, Accessed 23 November 2007, 439 p.
http://www.transit.govt.nz/technical/view_manual.jsp?content_type=manual&=edit&primary_key=1&action=edit
- Webb (compiler), T.H., 2005. Review of New Zealand's preparedness for tsunami hazard, comparison to risk and recommendations for treatment, 2005/162, 104 p. plus appendices.
- Woods, L., 2005. Development of tsunami information boards for installation at public beaches, Resilient Organisations Student Research Report 2005/02, Christchurch, 48 pp.

APPENDICES

A1 Signage in New Zealand through to 2007

A1.1 Western Bay of Plenty District

Temporary traffic management signs (red on white) prepared in Tauranga and Western Bay were designed in conjunction with a panel of roading managers from local government, Transit, private contracting concerns and the New Zealand Police. They require a suitable affixed logo and the international tsunami logo.

There is a Traffic Managements Plan (TMP) for each that will include a detailed diagram as to where they are to be affixed. Each TMP is part of the evacuation plan. In the packs there will be emergency ribbon, either Police or CD, plus sufficient duct tape to enable the signs to be overlaid on existing road signs. There are zones in the evacuation plan, each having several packs to be applied at strategic intersections. These have been prioritised. The critical intersections are described as block actions, they are intended to deny access into the Western Bay as soon as a warning is acted upon. This evacuation plan is based on a 4 hour lead in time. The tsunami working group was supplied a draft copy of the evacuation plan in 2006.

A1.2 Manawatu District - Himatangi

Signs and evacuation map brochures have been developed for Himatangi Beech. The consultation process is described in the consultation section of the report. There are reported to be a number of matters still under discussion among council staff, e.g. the appropriateness of fixing the signs to existing road sign posts, the means of fixing the signs, the height of the signs.

A1.3 Tararua and South Wairarapa District Councils

In 1996 as part of the ongoing civil defence public education programme, the tsunami risk to the Masterton District eastern coastal settlements was highlighted. Ministry of Civil Defence brochures and a flyer produced by this office was distributed to residents of Castlepoint and Riversdale Beach highlighting the tsunami risk.

This was followed in 1998 with tsunami warning signage erected at eleven locations from Mataikona (northern boundary) to Uriti (near southern boundary) (Fig. 11). The signage is designed to bring to the attention of the visitor to the beach that there is risk from tsunami and what you should do if you feel a strong earthquake. The signage deals only with locally generated tsunami. The signage was later adopted by the Tararua (Fig. 11), South Wairarapa District Council and Manawatu District Councils.

Hazard signs have been placed at locations to gain as much exposure as possible. Locations included shops, adjacent to a surf club, fixed to a gate, and marker posts including one on the side of road, etc. Eleven signs have been installed at Castlepoint, Riversdale, Beach, and Mataikona.

An informative A3 tsunami poster was created in 2001. The poster deals with locally generated and long distant tsunami. It was requested to be displayed in a prominent place, such as behind the toilet door.

Masterton have drafted a fridge magnet, are currently working on evacuation route (Figure 12) planning, and reproducing the coloured poster.



Figure 11 Tsunami hazard zone signs in Masterton District (left) and Tararua District (right), 500 x 500 mm. Both districts have recently amended the “do not return” time from one hour to two hours.



Figure 12 Draft evacuation route signs for Masterton District. Some may include “evacuation shelter” wording. Masterton District Council and Civil Defence logos are to be included; probably 400 x 400 mm.

The Tsunami Sign being used in the Tararua District was developed from the original which the Masterton district council use, to keep uniformity on the coast of the lower eastern side of the North Island.

A2 Representative examples of overseas signs

A2.1 Australia

Gordon Hall (Project Director, Western Australian Tsunami Warning System, Fire and Emergency Services Authority) informally commented that initial focus groups with Western Australian public have shown a preference for similar white on blue signs to those recommended by this report.

A2.2 USA

The NOAA standard (Figure 13) applies to USA States including Alaska and Hawaii.
<http://www.dot.ca.gov/hq/traffops/signtech/signdel/tsunami.htm>



Figure 13 Signs installed by local agencies in California, USA

A2.3 Canada

At right bottom (Fig 14 p. 29) is the sign for British Columbia disaster response routes: A network of pre-identified municipal and provincial roads that can best move emergency services and supplies to where they are needed in the event of a major disaster. Emergency planners and transportation engineers from all levels of government have cooperated to identify these routes. Public awareness and cooperation is necessary to keep these Disaster Response Routes clear following an earthquake or other disaster, in the interest of saving lives and protecting property.

http://www.th.gov.bc.ca/popular-topics/driver_info/route-info/disroute/disaster_response_routes.htm



Figure 14 British Columbia Tsunami signage

http://www.th.gov.bc.ca/publications/Circulars/Current/T_Circ/2006/t18-06.pdf



Figure 14 continued British Columbia Tsunami signage

A2.4 Chile

The 'Hazard Zone' (yellow & black) sign (Fig. 15) is that which that ITSU had put to the ISO for approval – that process has apparently since been discontinued.



Figure 15 Left two images courtesy of D. Coetzee. Right image shows a tsunami warning sign in the city of Antofagasta in northern Chile, which was shaken by a magnitude 8.0 earthquake on July 30, 1995 (image courtesy of Mark Simons).

http://nasadaacs.eos.nasa.gov/articles/2005/2005_earthquake.html

A2.5 Thailand



Figure 16 Left: Khao Lak, Koh Lanta, Phi-Phi and Patong. Right: Ko Lanta, Thailand, <http://www.travelblog.org/Asia/Thailand/Phuket/Patong-Beach/blog-56846.html>; <http://worldunfurled.com/category/asia/>

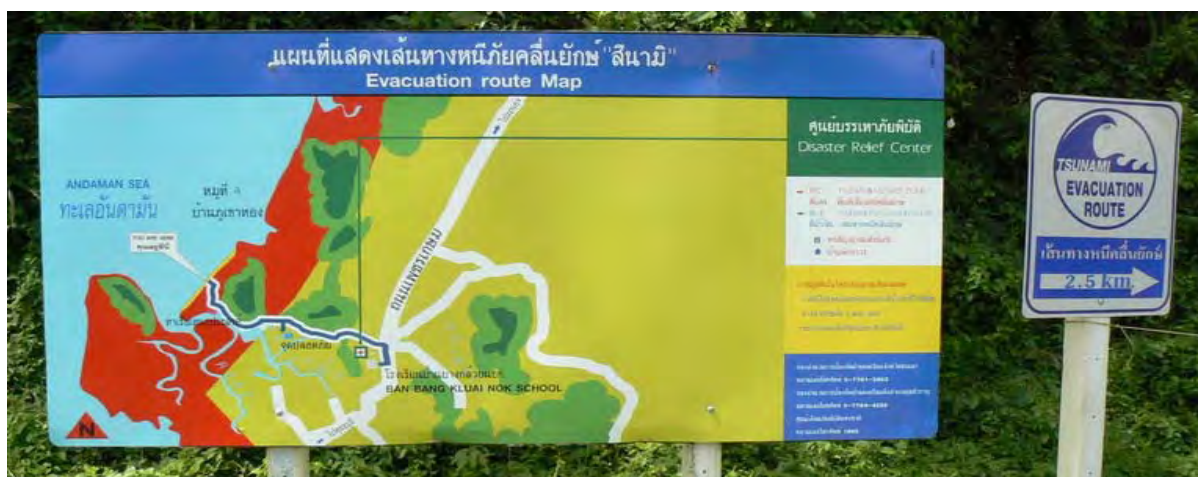


Figure 17 Thai tsunami evacuation map and evacuation route signs, respectively (G. Leonard, 2007).

A2.6 Indonesia



Figure 18 Tsunami hazard zone (left) and evacuation route (right) signs from Banda Aceh, 2007 (photos courtesy of Hannah Brackley, GNS Science).

A2.7 Philippines



Figure 19 Philippines tsunami hazard zone sign on display at the Philippine Institute of Volcanology and Seismology, Manila (G. Leonard, 2007).

A2.8 Japan



Figure 20 Example signs illustrate the situation in Japan where tsunami sign standardisation has not occurred.

From <http://sio.ucsd.edu/japan/journal/0719/m>, Mike Page, GNS Science, (<http://www.juliantrubin.com/encyclopedia/earthsciences/tsunami.html>) and <http://www.bo-sai.co.jp/tunamiyoujiban.htm> retrieved on 28 May 2007.

A3 Evacuation mapping for Northland and Wellington regions

Standardised maps are being piloted with Northland (Figure 21) and Wellington regions. The maps are designed to be a single consistent format used by (a) emergency managers deciding on evacuation, (b) those conducting official evacuations and (c) the public responding to all warnings or evacuation messages. A Tsunami Evacuation Mapping Sub-Committee has been established and an initial workshop in March 2008 has produced a working document that will progress towards recommendations for a standard.

Northland's base maps have the following components:

- Local topographic and cultural (roads etc.) features
- Evacuation zone (name considerations see Table 2) boundaries
- Tsunami evacuation information
- Information on the correct response to official, informal and natural warnings

Maps are completed by the community, and then local Civil Defence Emergency Management:

- Check for computational errors, make sure flat coastal land is coloured orange
- Add reference to cultural features and location names
- Add emergency services, hospitals, public transport, welfare centres, etc.
- Expand boundaries as needed (schools, suburban blocks, match existing roads)
- Add evacuation routes and transport
- Add safe locations for non-car evacuation
- Set revision timeframes
- Map the location of signs
- Develop evacuation and warning plans

For the public they are intended to be available as:

- Posters and brochures.
- Information boards with further tsunami process and local history information added.
- Part of information boards that contain extra local information and photographs, outside of the borders of the map. In this case, tsunami and warning information can also sit outside the border of the map if space on the map does not accommodate.

Table 2 Some evacuation zone name options considered when deciding on coloured zones:

Only one zone			USA	Washington has found this doesn't provide flexibility for local/regional vs. distance source.
Orange	Yellow	Etc.	Northland	Has inherent meaning as to coloured zone on map to evacuate.
Zone 1	Zone 2	etc.	Pacific Wave ex. Trial	Independent of source, warning type. But no inherent meaning related to when it is activated.
Primary	Secondary	etc.		Suggests priority of zones, doesn't tie to type of zone or source of warning.
Local-source	Distant-source (+/- regional-source)	etc.		Tied to time-frame for evacuation, but doesn't relate directly to type of warning expected.
Natural/informal	Official	etc.		Indicates the sources of the warning on which zones should be evacuated.
Voluntary	Mandatory	etc.	Canada	Suggests official vs. un-official.
Self-evacuation	Directed-evacuation	etc.		

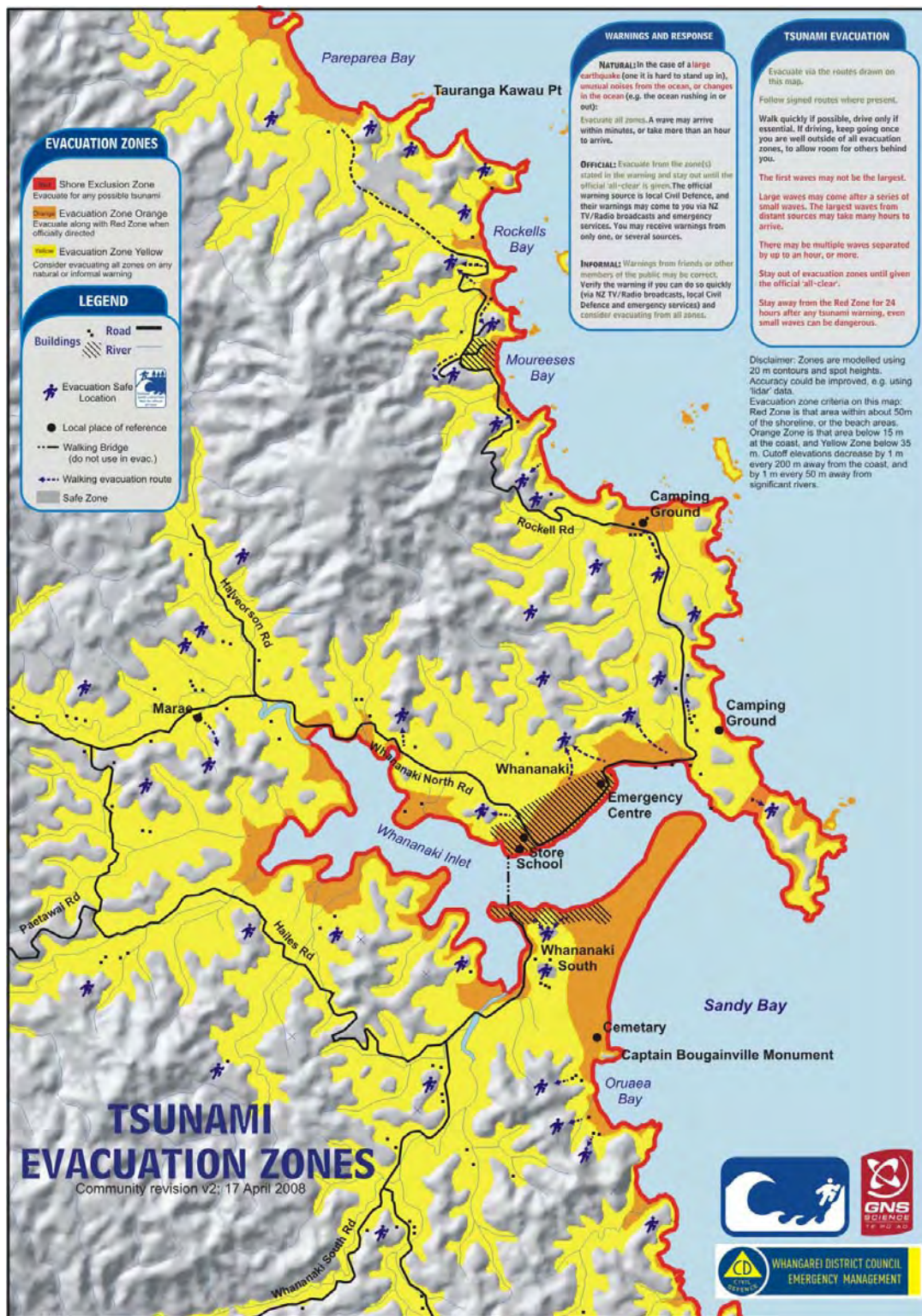


Figure 21 A draft tsunami evacuation map for Northland. Once this map has local photograph(s), evacuation routes and annotation added, it can stand alone as a tsunami information board.



www.gns.cri.nz

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