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Hawke's Bay Regional Alerting Systems Review

December 2021

Executive Summary

The project's purpose is to conduct a gap analysis and review of the current suite of public alerting tools in the Hawke's Bay region. This project also assesses the suitability of other alerting options for use across the region.

Public alerting systems should deliver the best timely information so that people can make an informed decision during a warning with as much time as possible for protective action. Two of the critical considerations for alerting are providing (1) *heads-up* and (2) *instructions*. *Heads-up* is the ability to inform people ahead of the threat. *Instruction* is the ability to provide details: what is happening, where, when, and what action is required to respond to the threat. This review recommends a system of public alerting options.

Recommendations

Emphasis on natural warnings. The public must be aware that an official warning may not be possible for certain events, and natural warnings may be the only source of warning. For local source tsunami, natural warnings are the fastest warnings. The public must be able to know and recognise these warnings and be ready to respond without hesitation. An enhanced alerting system may cause a risk of people waiting for an official alert before taking appropriate actions. This risk of overreliance on alerting systems must be mitigated with public education. Aligned with developing warning systems, it is recommended that warning systems MUST be accompanied by public education and with annual drills and exercises. Public education is needed to emphasise the overriding importance of responding to natural warnings.

Backbone. Emergency Mobile Alerts (EMA) through cell broadcasting, supported by mobile apps, should be considered the backbone of public alerting in Hawke's Bay. These systems can reach the vast majority of the population and give heads-up and instructions. During the 2019 nationwide EMA test, 77% of New Zealanders had access to the alert. EMAs rely on mobile coverage; to ensure broader coverage to areas with blackspots, we recommend the support of mobile apps. Mobile apps can ingest and replicate EMA using the internet (e.g., through fixed-line networks). Public education should also support the backbone to remind people about natural warnings and limits of EMA and mobile app systems.

Infill options. Additional layers of regionally coordinated alerting are needed to cover groups and pockets. An alternative option where cellular coverage is lacking is the voice-over-internet-protocol (VOIP) auto dialler system. Engagements, public education, and coordinated warning arrangements should be pursued with self-maintaining networks and agencies with people in their care.

Mobile coverage mapping. Further assessment is needed to investigate the available telemetry and alerting options to cover blackspots. An extensive regional study for network coverage should be commissioned. Information from the coverage mapping can be used to lobby for better coverage from providers.

Multi-end-point platform and one-stop-shop. Reinforcement messages should also be distributed through the web and social media to cover redundancy in various channels. A multi-end-point platform is encouraged to distribute alert information to different end-points (e.g. EMA, mobile app, social media, CAP RSS, etc.). The existing webpage on Hawke's Bay public warning system (https://www.hbemergency.govt.nz/get-ready/public-warning-systems/) should be maintained to be act as the one-stop-shop that provides clear explanation and access to various warning services.

Existing systems: Napier siren system. The current signal-only siren system in Napier is not fit-for-purpose in the context of current-day alerting. Although it provides a *heads-up,* it cannot provide detailed *instructions*. The rise-and-fall signal only intends to communicate the need to seek more information. The public might not know what the siren signal means unless this system is accompanied by extensive education on the appropriate actions to take when the signal is heard. Upgrading the current system to a PA loudspeaker system can be considered, so *instructions* can also be provided. However, a PA loudspeaker system has a high start-up cost and will have substantial ongoing maintenance costs. Its coverage is also restricted to narrow geographical areas. Therefore, the costs may not outweigh effectiveness in areas with already existing or alternative alerting options. Napier City, as an urban area, already has good coverage with EMA and mobile apps. Inclusion of an extensive plan for public education and exercises on sirens in Napier should take place, if it is decided the system be maintained or upgraded. Costs for maintenance or upgrade are likely to be better spent on public education on natural warnings, increasing network coverage, and strengthening the backbone.

Staff resourcing must be increased to enhance education on natural warnings and public alerting awareness, including recognizing and responding to warnings. Higher levels of community engagement, education, and exercise are needed throughout the region. The costs for these should be sustained on an annual basis.

Method

This review uses the national Public Alerting Options Assessment methods by Wright et al. (2014) and the updated Excel decision support tool. The methods were streamlined and used for regional-level review in Waikato (Wright et al., 2015) and Bay of Plenty (Leonard et al., 2017). The Public Alerting Options Assessment uses an evidence-based scoring system. The effectiveness of each alerting option was determined using a range of criteria developed from information from international and national cases studies and theory-based research (Leonard et al., 2017; Wright et al., 2014, 2015). An indicative solution with cost estimates is given in this report. However, the values are utilised only to compare the cost-effectiveness of systems. A caveat on the approximations, the costs will most likely have increased from the past studies' estimates.

The project team worked with the Hawke's Bay CDEM Group to source and compile information that is pertinent to alerting. This Hawke's Bay review looks at identifying alerting options that could alert the majority of the people. The review also focuses on finding gaps in the coverage of current alerting options. This review identifies 'pockets' – spatial gaps and special demographic groups – that would need alternative or additional alerting channels because of gaps in the current coverage. Recommendations for covering these gaps focus on available national and regional alerting options and identifying additional 'infill' options – potential solutions to fill these pockets.

Context

Hawke's Bay key demographics. Relative to some other regions, there is a sizeable Māori population in Hawke's Bay Region. Māori represents over a quarter of the region's population with 11 iwi groups, 91 hapū, and 79 marae throughout Hawke's Bay. Based on the 2018 census (Stats NZ, n.d.), the majority of the population (81%) reside in urban areas. Hawke's Bay population is older than the national average, with a median age of 40.6 years. Eighteen per cent of Hawke's Bay population is over 65, with Napier City and Central Hawke's Bay District having the highest proportion of people over 65 (at 20% each).

Hawke's Bay CDEM. The Hawke's Bay CDEM Group covers the four territorial authorities in the region: Central Hawke's Bay, Hastings, Napier, and Wairoa. Hawke's Bay CDEM manages multiple hazards,

including hazards requiring rapid warnings for life safety. Rapid onset hazard events include tsunami from local or regional sources, serious chemical hazard incidents, heavy rainfall, surface flooding, wildfire, lifelines failure, and multiple urban fires. The Hawke's Bay CDEM Group provides the coordinated and integrated approach to how significant risks and hazards are managed in Hawke's Bay across the 4R's of emergency management: Reduction, Readiness, Response, and Recovery.

Regional and national alerting. Current arrangements for alerting in the region include using the following: EMA, social media, website, mobile app (Red Cross Hazard app), land-based sirens, helicopter public address system (PA), and door-knocking and outbound calling. Hawke's Bay regional alerting aligns with national initiatives for alerting, including EMA, Red Cross Hazard App, Common Alerting Protocol, and the National Geohazard Monitoring Centre.

Keywords

Public alerting, hazards, options, warning systems

Bibliographic Reference

Tan, ML, Leonard, GS, Johnston, DM. 2021. Hawke's Bay Regional Alerting Systems Review. Wellington (NZ): Joint Centre for Disaster Research – Massey University. 1-50p. (Disaster Research Science Report 2021:4)

Contents

1 Introduction

1.1 Purpose and context

The project's purpose is to conduct a gap analysis and review of the current suite of public alerting tools in the Hawke's Bay region. This project also assesses the suitability of other alerting options for use across the region.

The Sendai Framework for Disaster Risk Reduction (UNDRR, 2015) has emphasised developing people-centred multi-hazard warning systems and strong research and risk-based approaches to mitigation. New Zealand's National Disaster Resilience Strategy (Ministry of Civil Defence & Emergency Management, 2019) aligns with the Sendai Framework to gradually implement risk reduction efforts.

While at an overarching national level, various warnings are provided (e.g. Emergency Mobile Alerts (EMA), the Hawke's Bay Civil Defence Emergency Management (CDEM) Group and its Group members manage, maintain, and operate warning systems for the region. Communications and warning systems should have the components for effective alerting (Leonard et al., 2017). Ideally, the suite of alerting tool options for Hawke's Bay should:

- Reach Target Audience – The system should be able to alert or communicate with target groups effectively.
- Be Resilient – Individual systems should be resilient, and the comprehensive suite of systems should have redundancies. In addition, provisions should exist for backup systems and capabilities.
- Be Easy to Operate – Any system should be user-friendly and easy to operate for all the staff required to use it.
- Be Cost-Effective – Maintaining and managing systems should be cost-effective. The management of systems should consider ongoing and future costs for maintenance and operations.
- Use Multiple Channels – The comprehensive suite of systems should use different channels to ensure coverage.
- Operate Remotely – The systems should be accessible and operable remotely to guarantee warnings issuance and communication maintenance does not rely on fixed locations.
- Interoperable – Different warning systems, where possible, should be able to exchange information with each other.

1.1.1 Out of scope

Several areas will not be within the scope of the review:

- Public communication is an integral part of public warnings. However, the focus of this assessment will be on Hawke's Bay CDEM Group's alerting capability.
- The assessment will look at the set of available and existing tools and protocols of the Hawke's Bay CDEM Group. However, it will not assess or make recommendations on National Warning Systems-related alerting options.
- The assessment estimates costs for the alerting options, but these costs are indicative only based on the costs used in the Bay of Plenty Warning Alerting Systems review (Leonard et al., 2017). It is not within this project's scope to reassess these costs; however, it can be safely assumed that costs will have risen at least by the consumers' price index.
- The assessment will focus on the region-wide alerting options. The project will touch on Napier-specific issues and assess the Napier City Siren System's suitability against other options now available.

- The project will focus on public alerting and communication during an event and not assess the internal agency alerting and communication tools and protocols used within the Hawke's Bay CDEM Group and partners. Detailed assessments of the standard operating procedures to operate end-to-end warning systems are beyond this project's scope.
- The project provides recommendations to the Hawke's Bay CDEM group to consider but will not seek to identify any implementation plans for new alerting options.
- An overview of mobile coverage blackspots will be given in this report. However, detailed mapping for mobile coverage blackspots is beyond the scope of this project.

1.1.2 Current situation

The Hawke's Bay CDEM Group Plan indicates that the Group 'maintains an interagency warning and communication system, with the assistance of the administrative authority […and] territorial local authorities maintain warning systems to alert their residents' (Hawke's Bay Emergency Management Group, 2014, p. 65) While the Hawke's Bay region has an adequate existing warning system, there is an opportunity to improve public alerting across the region. The Hawke's Bay region currently operates a suite of alerting tools as outlined in Section 2.4.

Tsunami warnings

The National Tsunami Warning and Advisory Plan by the National Emergency Management Agency (NEMA) states that:

> *'New Zealand is a member of the Pacific Tsunami Warning System (an international system under the auspices of the Intergovernmental Oceanographic Commission of UNESCO), that is designed to provide timely and effective information about tsunami or potential tsunami generated in the Pacific Basin. In New Zealand, the system is complemented by GeoNet geological hazards and sea level monitoring. The National Emergency Management Agency (NEMA) is the agency responsible for initiating national tsunami advisories and warnings to the communities of New Zealand'* (NEMA, 2020, p. i).
>
> *'NEMA uses the National Warning System (NWS) to disseminate official tsunami notifications in the form of national advisories and warnings on a 24/7 basis. Section 25 of the Guide to the National CDEM Plan describes the NWS'* (NEMA, 2020, p. 3).
>
> *'CDEM Groups and CDEM Group members are responsible for the planning, development, and maintenance of appropriate public alerting and tsunami response systems, including public education and evacuation zone identification for their areas'* (NEMA, 2020, p. 5).
>
> *'All CDEM Groups and CDEM Group members receive official national tsunami advisories and warnings via the NWS. When time and expertise is available, CDEM Groups are responsible for further local threat assessment and deciding on appropriate local public alerting and response for regional and distant-source tsunami. For example, designating which evacuation zones are relevant to evacuate, dependent on the threat'* (NEMA, 2020, p. 5).

CDEM Groups and CDEM Group members have responsibility for evacuations. The Tsunami Warning and Advisory Plan covers the three different categories of tsunami (distant-source, regional-source, and local-source). NEMA and GeoNet work to provide threat advice for all tsunami. However, an official warning may not be possible for local-source tsunami. Indeed, the National Tsunami Warning and Advisory Plan clarifies that official warnings are unlikely and should not be relied upon to take action. Natural felt signs are the primary warning for local-source tsunami.

'CDEM Groups, agencies, and the public should not wait for an official warning if long or strong shaking is felt ("Long or Strong, Get Gone"). They must take immediate action to evacuate predetermined evacuation zones, or in the absence of predetermined evacuation zones, go to high ground or go inland' (NEMA, 2020, p. 7).

Weather, flood, and volcanic warnings

The Meteorological Service of New Zealand Ltd. (MetService) is the Official Alerting Authority that provides information about potential severe weather. It provides information to the individuals and agencies through a suite of different tools for issuing warnings and watches, including its website, app, the Common Alerting Protocol (CAP), social media, via media, email, and other communication channels (MetService, n.d.-a). GNS Science, through GeoNet, provides information on volcanic hazards; official volcano status information is given through the Volcanic Alert Bulletins, which summarises volcanic status, recent activities, forecasts, and any developing or expected problems (GeoNet, n.d.). The information is provided through several channels, including website, app, social media, media, and via email. For volcanic ash, the MetService operates the Wellington Volcanic Ash Advisory Centre (VAAC) and provides ash cloud forecast – ash suspended in atmosphere affecting aviation – for New Zealand and surrounding areas of responsibility (MetService, n.d.-b).

The Hawke's Bay CDEM Group runs the Hawke's Bay Regional Warning System (RWS) within the region using the Whispir Platform via SMS and email. A Hawke's Bay CDEM duty manager receives all warnings and alerts for the region, and seeks additional regional interpretation as appropriate, usually from the Hawke's Bay Regional Council, before disseminating using the RWS. The additional interpretation usually includes communication of severe weather impact (including flood warnings) and other hazards, aim at identifying potential risks and target areas

Fire warnings and hazardous substances

The Fire and Emergency New Zealand Act 2017 combined urban and rural fire services into a unified organisation: Fire and Emergency New Zealand (FENZ). FENZ has the mandate to cover urban and rural fire incidents and provide a range of emergency management functions, including events involving hazardous substances (FENZ, 2020). In addition, FENZ provides public alerting for fire and hazardous substances to directly affected people and, more broadly, via the media. The FENZ regional teams work closely with CDEM Groups' where alerting can be via regional public alerting channels as well. There is some shared responsibility with the Ministry of Health and regional health agencies on communication for hazardous substances, including warnings regarding smoke from fire.

1.2 Related documents

There are key references available for public alerting in New Zealand:

1. An updated review of public alerting options (Wright et al., 2014),
2. Hawke's Bay CDEM Group Plan (Hawke's Bay Emergency Management Group, 2014),
3. Emergency Mobile Alert: Protocol for user agencies (Ministry of Civil Defence and Emergency Management, 2017),
4. Technical standard Common Alerting Protocol: CAP-NZ (Ministry of Civil Defence and Emergency Management, 2018),
5. Tsunami advisory and warning plan: supporting plan (NEMA, 2020), and
6. An analysis of public alerting options for Bay of Plenty Regional Alerting System (Leonard et al., 2017).

1.3 Structure of this review

The project uses streamlined versions of the methods used in past alerting reviews like that conducted for the Bay of Plenty and Waikato regions (Leonard et al., 2017; Wright et al., 2015). This review uses tools and lessons from the past reviews. The review process is outlined below.

- The project team worked with the Hawke's Bay CDEM Group to source and compile information that is pertinent to alerting. This Hawke's Bay review looks at identifying alerting options that could alert the majority of the people.
- The review focuses on finding gaps in the coverage of current alerting options. This review identifies 'pockets' – spatial gaps and special demographic groups – that would need alternative or additional alerting channels because of gaps in the current coverage. Recommendations for covering these gaps focus on available national and regional alerting options and identifying additional 'infill' options – potential solutions to fill these pockets.
- The review also looks at special considerations for Napier, considering its denser urban population and specific hazards to tsunami.

Stage 1 – Analysis

We assessed the cost, reliability, reach functionality, and effectiveness of each alerting tool utilised by the Hawke's Bay CDEM Group.

1. The Joint Centre for Disaster Research (Massey University) team analysed the 2018 Census data(Stats NZ, n.d.).
2. The Hawke's Bay CDEM Group provided specific contexts, needs, and options (summarised in Sections 2 and 3) to ensure local knowledge was considered for the review.

The following specific topics were analysed:

- population data (high and low density),
- elderly populations (used as an indicator for hearing, sight, and mobility impaired populations),
- hazards that need a specific alerting focus (e.g., tsunami for coastal areas),
- rural and urban population composition of the region,
- telecommunications coverage,
- approximate mobile phone coverage,
- transient populations, and
- pockets that need infill options:
    - spatial gaps,
    - specific demographic groups (e.g. ethnic, language, special needs), and
    - agencies with people in care.

Stage 2 – Draft review

The draft review was subjected to feedback from the Hawke's Bay CDEM Group and was peer-reviewed by JCDR experts. As a result, further recommendations were made for improvements, modifications, and changes to the alerting suite.

Stage 3 – Review finalisation

Comments from Hawke's Bay CDEM Group on the draft review contributed towards the final recommendations presented in this report.

1.4 Capacity and relationship building

Data collection, partner agency contacts, and price indications were undertaken with consultation with the Hawke's Bay CDEM Group, wherever possible.

2 Context for alerting in the Hawke's Bay

2.1 Overview of the Hawke's Bay CDEM structure

The Hawke's Bay CDEM Group's role is to provide a coordinated and integrated approach to how significant risks and hazards are managed in Hawke's Bay across the 4R's of emergency management: Reduction, Readiness, Response, and Recovery. The Hawke's Bay CDEM Group covers the four territorial authorities (Figure 1): Central Hawke's Bay, Hastings, Napier, and Wairoa.

Figure 1. Hawke's Bay Territorial Authorities. Source: Hawke's Bay Emergency Management Group Plan 2014-2019

The Hawke's Bay CDEM Group is comprised of the following local authorities:

- Central Hawke's Bay District Council,
- Hastings District Council,
- Hawke's Bay Regional Council,
- Napier City Council, and
- Wairoa District Council.

The Joint Committee oversees the governance of the Group. The Joint Committee comprises the Chair of the Regional Council and elected representatives of each territorial authority in the region. The Coordinating Executive Group (CEG) oversees the management of the CDEM Group, membership to the CEG comprises of statutory or co-opted members. The Hawke's Bay CEG members include CEOs from the local authorities, representatives from the Fire Service Eastern Region, Police Eastern District, and Hawke's Bay District Health Board, CDEM Group Controllers, Group Recovery Manager, Chair of

the Welfare Coordination Group, Medical Officer of Health, and the Chair of the Hawke's Bay Engineering Lifeline Group (Hawke's Bay Emergency Management Group, 2014).

Responsibilities for public alerting fall to members of CDEM Groups under the National CDEM Plan Order 2015. The order states:

'CDEM Groups;

- - must maintain arrangements to respond to warnings (s60(5));
- - Are responsible for (s62(6)):
    a. Disseminating national warnings to local communities; and
    b. Maintaining local warning systems. '

2.2 Hawke's Bay warnable hazards

The Hawke's Bay CDEM Group Plan describes the hazards managed by the Group. Table 1 summarises the hazards based on the need to disseminate rapid warnings from a life safety perspective. Rapid warnings require faster and more effective systems. In general, public alerting systems should have capabilities to warn the public of these rapid-onset hazards effectively. If alerts work for rapid warnings, they can also be expected to be effective for less time-critical events.

Table 1. Hazards applicable to the Hawke's Bay CDEM group (as per Part 1 of the Group Plan, 2014-2019) and the requirements for rapid warnings for life safety

Hazards requiring rapid warnings for life safety (short-onset, less than 3 hours)	**Hazards NOT requiring rapid warnings for life safety but are still appropriate for alerting**	**Hazards that currently cannot be warned for**
Tsunami – local source[1] Tsunami – regional source Serious Hazchem incident Heavy rainfall (Severe Thunderstorm/Flash flooding/debris flow) Stormwater surface flooding Wildfire/Rural fire Large-scale lifelines failure (Major air accident, electrical failure, telecommunications failure, dam break, etc.) Urban fire multiple	Flooding Tsunami – distal source Coastal storm Volcanic eruption with precursor (local or distal) Animal disease epidemic Human disease pandemic Biological pests and new organisms Drought Coastal erosion Windstorms Snow Hail Pollution over unconfined aquifer	Earthquakes[2] Extreme geothermal events or unheralded small volcanic eruptions Landslides Localised subsidence

[1]NEMA and GeoNet will seek to monitor, detect, and provide threat advice for all tsunami (including local-source). However, it may not be possible to issue warnings within sufficient time or accuracy. Natural warnings are still the best possible warnings in the immediate time. Groups, agencies, and the public should not wait for an official warning from NEMA (NEMA, 2020).

[2]The Android Earthquake Alerts System was initiated in New Zealand starting April 2021 and has issued a few earthquake early warning alerts to Android users. This alerting system was deployed without officials' involvement and should not be confused with alerts issued by civil defence authorities (McDonald, 2021).

2.3 Key demographic characteristics

This section describes the variation in demographics across the region that require consideration for different public alerting options. Agencies with people in their care are considered in Section 3.3.5 but not under specific demographic analysis.

2.3.1 Rural vs urban populations

The majority of the population (81%) reside in urban areas (based on the 2018 census). However, the range of effective and feasible alerting measures differs for high-density and low-density populations. Table 2 shows the distribution of urban-rural populations in Hawke's Bay.

Table 2. 2018 Census population summary giving total population and percentage in urban vs rural areas.

2018 Census Data	Population	Percentage
Urban Wairoa	4,527	54%
Rural Wairoa	3,840	46%
Urban Hastings	61,521	75%
Rural Hastings	20,016	25%
Urban Napier	62,241	100%
Urban Central Hawke's Bay	6,468	46%
Rural Central Hawke's Bay	7,674	54%
Region Total	166,287	
Region Urban	134,757	81%
Region Rural	31,530	19%

2.3.2 Ethnic group self-maintaining networks

Specific iwi communication channels provide an opportunity to reach a substantial part of the regional population. 6.8% of 2018 census respondents report speaking Māori (Stats NZ, n.d.). Relative to some other regions, there is a sizeable Māori population in Hawke's Bay Region. The Hawke's Bay Regional Council (2021) describes the culturally rich landscape of the region:

> *Hawke's Bay has a diverse and culturally rich landscape. Māori are Treaty partners as mana whenua and key members of our community.*
>
> - *Māori represent over a quarter of the region's population*
> - *There are 11 iwi groups, 91 hapū and 79 marae throughout Hawke's Bay*
> - *Eight iwi groups are represented post-settlement governance entities (PSGEs) on the Hawkes Bay Regional Planning Committee*
> - *Ngāti Kahungunu with Rongomaiwahine, coastal area is said to be from Paritū north of Mahia to Tūrakirae on the south Wellington Coast. Ngāti Kahungunu Iwi Inc composes six Taiwhenua with governance entities and operations on the ground, 4 of which are within the region*
> - *6.8% of Hawke's Bay speak Te Reo Māori*
>
> *Māori make a significant contribution to our region both as mana whenua and treaty partners and also through their ownership of assets; to economic development; participation in co-governance and their growing influence as kaitiaki in the conservation, preservation and management of our natural resources.*

Hawke's Bay CDEM Group needs to continue engaging with iwi group representatives to develop approaches to deliver alerts and collaborate with existing communication channels and community organisations. Hawke's Bay CDEM Group also needs to identify and follow up with other ethnic groups and communities for potential alerting.

2.3.3 Language barriers

According to the 2018 Census (Stats NZ, n.d.), 96.7% of the Hawke's Bay region population speak English. Two per cent (2.0%) do not speak a language (e.g., they are too young), leaving 1.3% – about 2,100 people – who may not speak English. Given the overall low proportion of the region who do not speak English and the diversity of other languages spoken, it is most effective to tie warnings directly into existing communication structures within these communities. Coordinating with self-maintaining networks is more effective than creating a regional system that warns in all languages.

Table 3. Spoken languages in Hawke's Bay as indicated in the 2018 Census

	Number of people	Of those who stated a language
English	160,908	96.70%
Maori	11,361	6.80%
Samoan	2,604	1.60%
Northern Chinese	435	0.30%
Hindi	696	0.40%
French	1,452	0.90%
Yue	525	0.30%
Sinitic not further defined	309	0.20%
Tagalog	633	0.40%
German	1,152	0.70%
Spanish	750	0.50%
Afrikaans	855	0.50%
Tongan	435	0.30%
Panjabi	1,125	0.70%
New Zealand Sign Language	948	0.60%
Other	5,436	3.30%
None (e.g., too young to talk)	3,357	2.00%
Total people stated	**166,365**	**100.00%**

2.3.4 Age

Hawke's Bay population is older than the national average, with a median age of 40.6 years. Eighteen per cent of Hawke's Bay population is over the age of 65. Napier City and Central Hawke's Bay District have the highest proportion of people over 65 (both at 20%), whereas Wairoa District and Hastings District have a slightly lower proportion of people over 65 (at 17%). See Table 4 for a summary of the district's age distribution of the region's population.

Table 4. Summary of Hawke's Bay population's age by district, based on the 2018 Census

	Wairoa		Hastings		Napier		Central Hawke's Bay	
	Count	% over total district pop.	Count	% over total district pop.	Count	% over total district pop.	Count	% over total district pop.
Under 15 years	1,965	23%	17,700	22%	12,321	20%	2,940	21%
15-29 years	1,503	18%	14,961	18%	10,740	17%	1,974	14%
30-64 years	3,465	41%	35,199	43%	26,712	43%	6,423	45%
65 years over	1,431	17%	13,689	17%	12,465	20%	2,799	20%

In terms of infill alerting demand, it should be noted that some rural parts of Hawke's Bay have a higher proportion of people over 65 years of age than the regional average; and these locations may also have mobile blackspots. Table 5 summarises the population counts of people aged over 65 in rural areas in Hawke's Bay using 2018 census data (Stats NZ, n.d.).

Table 5. Count and % population of people 65 years and over in rural Hawke's Bay

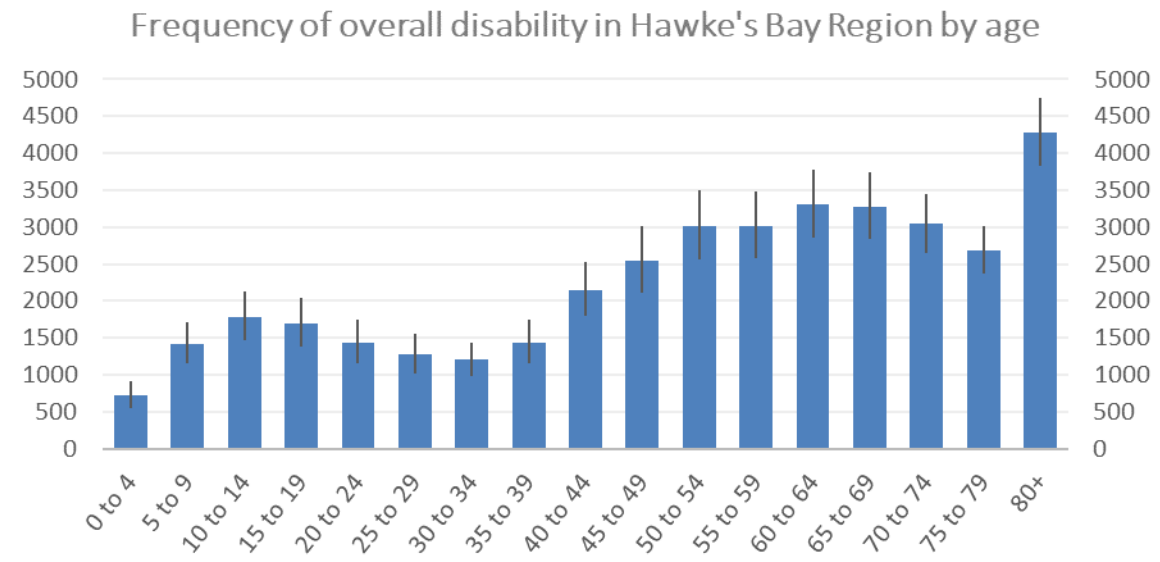
	People 65 years and over	
Rural areas	Count	% of the total area population
Tuai	27	12.50%
Other rural Wairoa District	477	15.96%
Frasertown	57	22.35%
Nuhaka	42	21.21%
Mahia Beach	60	32.79%
Other rural Hastings District	2331	13.84%
Whirinaki	87	22.48%
Whakatu	66	10.33%
Haumoana	150	12.95%
Te Awanga	150	19.53%
Waimarama	48	22.22%
Tikokino	27	14.06%
Ongaonga	45	26.79%
Takapau	102	17.17%
Otane	111	16.74%
Other rural Central Hawke's Bay District	939	15.87%
Porangahau	30	21.28%

**highlighted cells indicate % higher than the regional average of 18%*

Furthermore, there are many elderly communities and retirement villages in Napier, Hastings, and Havelock North. Several of the elderly care facilities in Napier are also in identified tsunami evacuation zones.

2.3.5 People with disabilities

Age also correlates with the proportion of people with disabilities. Figure 2 summarises people with overall disabilities (hearing, vision, physical, or psychological) based on the 2013 National Disability Survey (Stats NZ, 2014). People's disabilities may inhibit their ability to receive and respond to a warning. Infill considerations should be given on reaching people with disabilities through solutions with supporting agencies for the respective communities.



Note: The numbers and rates provided estimates of the true value. The lines represent error bars at 95% confidence intervals, representing the range where the true value will likely fall.

Figure 2. Frequency of people with disabilities in the Hawke's Bay Region by age. Data from the 2013 Disability Survey.

2.4 Existing regional systems and arrangements

Table 6 summarises existing alerting systems in use in Hawke's Bay region. Arrangements with media (usually via phone call, email, or fax) and uptake of press releases also provide widespread alerting.

Table 6. Existing systems summary. Costs are met by the CDEM Group.

	EMA	Social media & website	Red Cross Hazard App	Land-Based Sirens[1]	Stinger Siren[2]	Helicopter PA[2]	Door knocking and outbound calling
Capital/ purchase cost ($NZ)	N/A	0	0	$51,000 (including purchase and install for standalone and fire service setups)	$1,500	$20,000	N/A
Annual Maintenance cost ($NZ)	Costs included in council staff time	$9,000[4]	0	<$3,400	N/A	Ongoing cost estimated at $1,000/hr during event	Already included in council staff time
Annual Contract cost ($NZ)	N/A	0	0	N/A	N/A	N/A	N/A
Annual Testing Cost ($NZ)	NEMA is the operational custodian and responsible for testing	0	0	N/A (the only cost associated with the siren test is for advertising/ publicity)	N/A	N/A	Already included in council staff time
Number of Units	N/A	N/A	N/A	17 (in Napier)	1 remaining	1	N/A

	EMA	Social media & website	Red Cross Hazard App	Land-Based Sirens[1]	Stinger Siren[2]	Helicopter PA[2]	Door knocking and outbound calling
Locations	N/A	N/A	N/A	Eskdale School Bayview Fire Station – Shared Hawke's Bay airport Westshore School Napier Port – Shared Battery Road Napier Fire Station – Shared McLean Park Napier Library building Napier Awatoto site Maraenui Shop site Meeanee Sports Hall site Waverley/Tannery Road EIT Building Taradale Fire Station – Shared Anderson Park NCC Depot	Hastings District	Wairoa District	Region-wide
Number of subscribers	All mobile phone users in the region (non-opt out option)	36,602 Facebook 225 Twitter	Unknown	N/A	N/A	N/A	N/A

[1] Land-based siren capital cost and annual maintenance cost are approximated only; using proportional costs as estimated on the Bay of Plenty report by Leonard et al. (2017)

[2] Stringer sirens estimated capital cost was $15,000 for ten units. Hastings District Council previously owned these, but most have been gifted to Manawatu-Wanganui. Only one remained in the region but has been decommissioned.

[3] Helicopter PA costs based on minimum estimates per assessment tool Wright et al. (2014) review of public alerting options in New Zealand

[4] $9,000 is the estimated cost to maintain the entire Hawke's Bay CDEM website, not just the warning system-related pages.

2.5 National initiatives

2.5.1 Emergency Mobile Alert (EMA)

Emergency Mobile Alert (EMA) is a cell broadcast system used by authorised agencies 'to send alerts about actual or suspected threats, risks, hazards, or emergencies to mobile phones in selected area(s) via a dedicated cell broadcast channel' (Ministry of Civil Defence and Emergency Management, 2017, p. 3). The system works on a push basis, meaning the public does need to subscribe and cannot opt out of receiving the alerts. Mobile phones may show settings to opt-out from EMAs, as used in other countries, but New Zealand authorities use a special broadcast channel that is permanently on (National Emergency Management Agency, n.d.).

EMA is delivered over 3G and 4G on the three mobile networks (2degrees, Spark, and Vodafone). The specific mobile network will deliver to any mobile phone in coverage on any other network. Individual authorised agencies, including CDEM Groups, can distribute EMA to selected area(s). NEMA is the custodian of the EMA System and sets the restrictions on who and how it can be used. Since the nationwide launch test in November 2017, the EMA has been tested and used in actual events in New Zealand.

2.5.2 Red Cross Hazard App

The Red Cross Hazards App is a multi-hazard app that can receive alerts from participating alerting authorities via the app (New Zealand Red Cross, n.d.). The Red Cross Hazards app has been rolled out to the 16 Regional CDEM Groups. The Red Cross Hazards App complements the EMA system for areas without mobile coverage as it uses internet from various sources, including fixed-line broadband, Wi-Fi, and cell phone data. The Red Cross Hazard App can replicate EMA information and deliver the notification via the app through internet service. It is Common Alerting Protocol (CAP) compliant; it can read CAP feeds and provide a CAP origination form. The app is free of charge for the public to download. However, as for all apps, people need to download and install them to be effective. It is an 'opt-in' option, thus reducing effectiveness. A widespread and ongoing campaign is needed to keep the app installation rates high.

2.5.3 Common Alerting Protocol (CAP)

'Common Alerting Protocol (CAP) is an international XML1-based open, non-proprietary digital message format for exchanging all-hazard emergency alerts. It supports consistency in applying public warnings across Alerting Authorities and the dissemination of warnings over many channels simultaneously. The net result is increased effectiveness of warnings' (Ministry of Civil Defence and Emergency Management, 2018, p. 1)

CAP is used in New Zealand, where the CAP-NZ Working Group guides its implementation. NEMA leads the CAP-NZ Working Group. A technical standard for implementing CAP is available on the NEMA website[1].

CAP uses a consistent formalised structure for alerts; which means that CAP messages, once authored, can sit on a feed and be picked up immediately and automatically at the same time by all CAP compliant and compatible alerting end-points (e.g., Red Cross Hazard App and other alerting platforms).

[1] https://www.civildefence.govt.nz/assets/Uploads/publications/Common-Alerting-Protocol/Common-Alerting-Protocol-CAP-NZ-Technical-Standard-TS04-18-FINAL.pdf

2.5.4 National Geohazard Monitoring Centre

Starting December 2018, New Zealand started enhanced monitoring of geohazards (earthquake, landslide, tsunami, volcano) on a 24/7 basis through the National Geohazards Monitoring Centre (NGMC). NGMC received live data feeds from GeoNet supported monitoring equipment located around New Zealand and from international stations. The NGMC is supported by the GeoNet programme and is part of GNS Science; the Geohazards Analysts staffing the centre are in contact with NEMA through which data, information, and advice is provided (NEMA, 2020).

3 Needs and options analysis

This section describes the multi-hazard public alerting needs and potential options for the Hawke's Bay region within the context given in Sections 1 and 2. The options discussed are in terms of alert channels that may reach each type of need, primarily dependent on the available telemetry (the telecommunication path).

3.1 Available alerting options

The alerting options considered in this review are listed here. Details on their effectiveness and cost basis are given in Section 3.5.2 and Appendix B.

1. Natural warnings
2. Independently self-maintained networks
3. System reliant on third-party hardware or staff
    - Aircraft banners
    - Helicopter PA loudspeaker
    - Billboards – static
    - Billboards – electronic telemetered
    - Break-in broadcasting*
    - Call-in telephone line
    - Emails
    - Emergency mobile alert (cell broadcast)
    - GPS receiver messaging*
    - Marine radio
    - Mobile PA loudspeaker (Police/Fire)
    - Mobile apps
    - Newspaper content
    - Pagers (triggering group of 200 people)
    - Power mains messaging
    - Radio announcements
    - Route alert (door-to-door)
    - Social media
    - SMS-PP text messaging
    - Telephone auto-diallers
    - Telephone trees
    - Television announcements
    - Tourist radio
    - Websites
    - Website banners
4. Systems using dedicated hardware
    - Fixed PA loudspeakers
    - Mobile PA loudspeakers
    - Bells, airhorns
    - Flares, explosives
    - Radio data systems*
    - Radio (UHF, VHF, or HF)
    - Sirens (signal-only) – Mobile
    - Sirens (signal-only) – Fixed
    - Tone-activated alert radio*

**Not currently available in New Zealand*

3.1.1 The importance of available telemetry

The available telemetry channels and the pockets of isolated areas govern the options available for alerting; these include:

- Mobile networks
    - Wireless broadband – also known as Fixed Wireless Access (FWA), does not rely on a physical connection (e.g., fibre cable or copper line). Instead, it enables users to have access to high-speed data through radio waves. However, it still requires a modem to be installed. It uses radio waves and typically connects to cellular networks.
    - Mobile – text messaging, voice calls, and mobile data are provided through the three companies (2degrees, Spark, Vodafone) through their network of cell towers using different technologies available (3G, 4G, 5G, etc.).
- Fixed-line networks
    - Copper – copper lines are used for traditional telephone lines and copper broadband (ADSL and VDSL), but copper connections are being replaced by fibre and wireless and ultimately will be phased out in areas in New Zealand.
    - Fibre – fibre-optic cables deliver ultra-fast broadband speeds to users. 87% of New Zealanders will be able to connect to a fibre connection by the end of 2022 (NZ Telecommunications Forum, 2021).
- Satellite – accessed through a satellite dish, particularly useful in remote areas where fixed and mobile solutions are unavailable or of poor quality
- Radio – both as broadcast stations and as signals to alerting receivers on these frequencies
- TV broadcast stations
- VHF radios
- Audio-frequency signals through the electricity network – also known as ripple control – are used by New Zealand's Electricity Distribution Businesses; can be used to reduce the load in grid emergencies (EECA, 2020).
- Electric power -- Electric power supporting these networks is also a factor as Hawke's Bay is limited by the capacity of single main transmission routes. Alternative supply routes for electricity could maintain only a very restricted supply. Some channels may become dependent on limited alternative supplies such as batteries.

3.2 District specific needs

In general, most hazards will require wide coverage alerting throughout the region. However, some cases as listed below may require specific local attention:

- rural and urban fire risk
- flood plains and urban flood basins
- sites for hazardous chemicals
- large facilities such as stadium, airport, and seaport
- critical points in lifeline services
- tsunami inundation areas.

3.3 Regional needs

The multi-hazard alerting needs are assessed at a regional level given the scope outlined in Section 1.1, except for location-specific needs as highlighted in Section 3.2. In addition, some of the available alerting options rely heavily on mobile phone coverage; we discuss coverage in specific areas in this section.

3.3.1 Urban populations

Urban populations in the Hawke's Bay region concentrate on the following areas: Hastings and Napier as the two main large urban areas, Havelock North as a medium urban area, and Wairoa, Clive, Waipawa, and Waipukurau as small urban areas. The majority of the populations in the urban centres have mobile coverage; however, there may be blackspots on the hills and in outlying dwellings.

As mobile phones appear to cover most urban populations, options that utilise mobile networks are therefore a high priority in those locations.

3.3.2 Rural populations

Rural and smaller settlements exist throughout the region. The main exception would be in forested land in plantation or native forests. Plantation areas include those highlighted in Figure 3. In these plantation areas, rural fire alerting should be a priority.

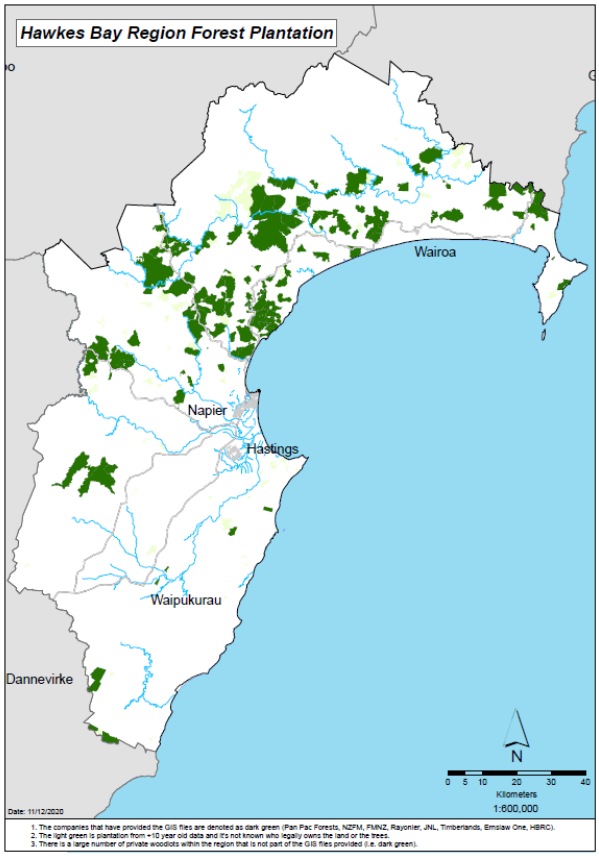


Figure 3. Hawke's Bay Region Forest Plantations Location map by the Hawke's Bay Forestry Group. Original image accessible at https://hbforestrygroup.co.nz/wp-content/uploads/2020/12/HBRC_Forest_Location_Map_122020_v4.pdf

The remaining settlement areas are related to non-forestry agriculture. These have distributed small communities and dwellings throughout and, therefore, low-density. Mobile phone coverage over farming agricultural areas is variable depending on topography, but in many cases can be found at least somewhere on many farms.

In contrast, forested areas have many locations with minimal or no mobile coverage. Maps are provided by mobile phone companies (Figure 4 to Figure 6) to give a broad view of the level of coverage, but the exact coverage experience across any one square kilometre can vary from the coverage shown in these maps.

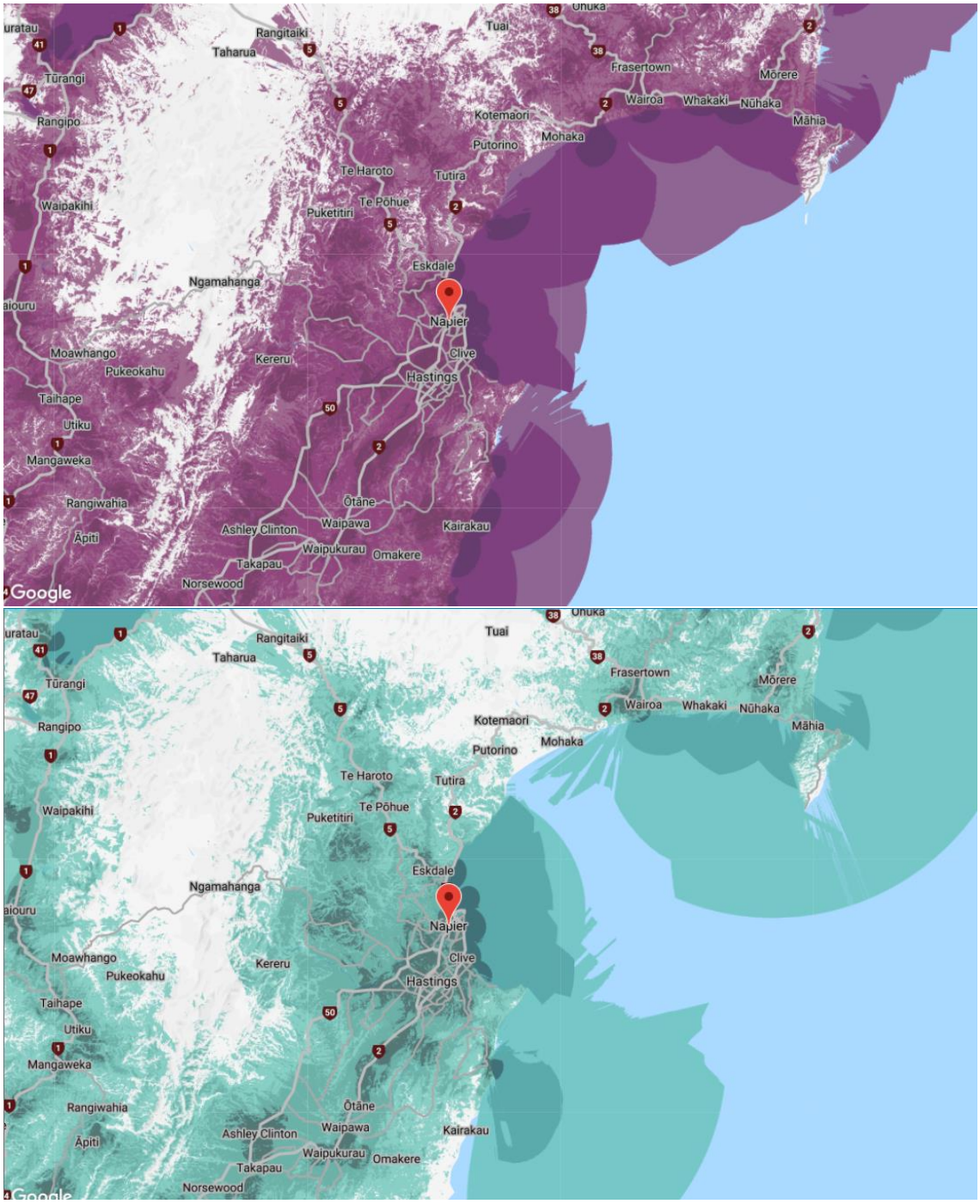


Figure 4. Two-Degrees Coverage maps of Hawke's Bay. Top image shows 4G coverage, and the bottom image shows 3G-Boosted coverage. Snapshots taken from https://www.2degrees.nz/coverage/, accessed on 8 September 2021.

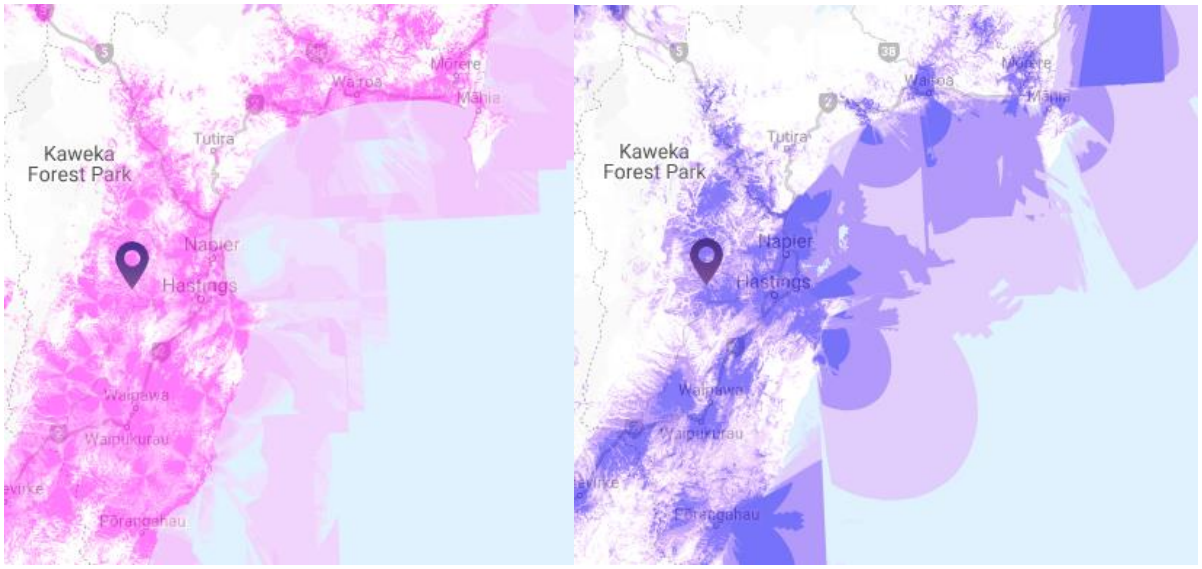


Figure 5. Spark coverage map for Hawke's Bay. Left image shows 4G coverage, and right image shows 3G coverage. Snapshots are taken from https://www.spark.co.nz/shop/mobile/network.html accessed on 8 September 2021.

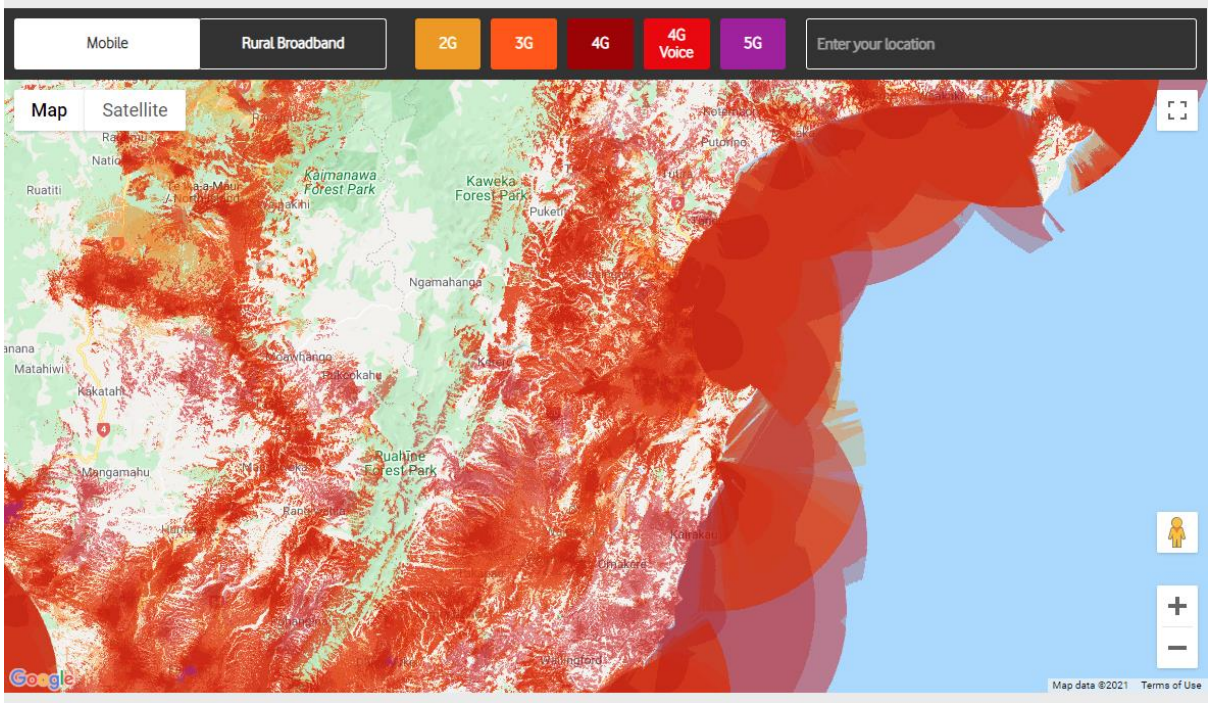


Figure 6. Vodafone coverage map in Hawke's Bay, including overlapping layers for 2G, 3G, 4G, 4G Voice, and 5G. Snapshot taken from http://www.vodafone.co.nz/network/coverage/, accessed on 8 September 2021

3.3.3 Isolated pockets

Isolated areas are referred to here as 'pockets', and the nature of the main pockets is discussed in terms of their common characteristics for public alerting needs.

Areas without mobile coverage

The urban areas, which contains 81% of the regional population, have mobile coverage. However, mobile coverage in rural areas may be highly varied. The maps provided in Figures 4 to 6 provide an overview of potential blackspots, but granular details on these blackspots are not within this report's scope. A project to conduct detailed mapping is recommended.

Beaches

The Hawke's Bay Region includes four Surf Lifesaving clubs, each with a patrolled beach (variable daytime and seasonal hours): Westshore Beach, Napier's Marine Parade, Ocean Beach, and Waimarama Beach). Alerting options to reach these beaches include mobile phones, dedicated hardware at the locations, and existing communications to the Surf Lifesaving facilities in these locations. In addition, each of the surf clubs has phones and radios. The clubs also have active social media pages. The Hawke's Bay CDEM Group needs to agree to harmonise the approach and messaging with these groups.

Most of the popular beaches in Hawke's Bay have good mobile coverage, with some exceptions on Mahia Peninsula. People visiting beaches in the region would be reached through widespread alerting (particularly mobile-phone-based).

3.3.4 Specific groups

This section discusses some key groups that need alerting. It also refers to other sections of the report (e.g., for ethnic groups, seasonal workers, and children via schools).

English as a second language

No notable spatial clusters with English as a second language are apparent from the 2018 census data. The overall number of people for whom English is not spoken appears to be approximately 2,100 people. There remains an opportunity for additional alerting via ethnic groups' self-maintaining networks (Section 2.3.3) and into agencies with people in their care (e.g., seasonal workers, Section 3.3.5), potentially reaching most dispersed non-English speakers.

Elderly

Hawke's Bay population is older than the national average. There are areas with a high proportion of older populations (Section 2.2.4). The most significant impact of age is likely to be a decreased access to technology, which is relevant to internet and mobile phone-based alerting. In aged-care facilities, the elderly will have reliance on carers to disseminate information or take action. If alerting requires access to these technologies, other means may be needed to ensure notifications reach areas with older populations, especially in rural areas.

Limited access to technology

It is recognised that access to technology, particularly to mobile phones, is a factor in alerting coverage. Most people in New Zealand have access to smartphones. Although on average, people in New Zealand have more than 1.3 smartphones per person (Statista, 2021), this does not imply everyone has a smartphone. In fact, digital inclusion varies based on demographics. Older populations may have less digital access (Digital Government, 2019). The scope of the review is limited to approximating issues through known associations, such as an inverse correlation between mobile phone and internet use to the age (e.g., 65 and older).

People with disability

A proportion of the Hawke's Bay population may be affected by disability (hearing, vision, physical, or psychological). See Section 2.3.5 for a summary of people with disabilities in the region. People with disabilities may have an inhibited ability to receive and respond to a warning.

Most alerting solutions under consideration are audible; therefore, receiving the initial alert may not be an issue for the sight-impaired. However, receiving content details from a warning may rely on the

accessibility and availability of assistive/adaptive technologies for the sight-impaired population. Therefore, their ability to respond to the warning needs to be considered in broader community response planning. Reaching the hearing-impaired community through existing channels must also be considered (e.g., voice to text solutions). Considerations must be provided for other disabilities, including physical and psychological. The Hawke's Bay CDEM group needs to explore solutions for people with disabilities with the supporting agencies for the respective communities.

Transient populations

Transient populations are comprised of tourists in the Hawke's Bay region and people travelling on state highways and docking through Napier Port. Tourists can be in larger numbers in accommodation and attraction locations (assuming a return to pre-COVID-19 pandemic levels). This includes urban areas such as Napier and Hastings in terms of accommodation, where standard urban warnings may cover transient populations. However, remote attractions may need specific coverage. Special attention may need to be given to international tourists travelling to remote locations, as they may not have the same access to mobile coverage as domestic tourists.

3.3.5 Agencies with people in their care

Many agencies have substantial numbers of people in their care because they reside, visit, or work there. These agencies may include schools, the Department of Conservation, the Hawke's Bay Regional Prison, hospitals, aged care facilities, large employers (e.g., primary production and manufacturing sectors) and large sites (e.g., ports, stadiums, etc.).

Connecting with these agencies is an effective additional alerting channel to reach people in their care. Especially important for sites or areas where there are people who may not have access to regional public alerting options. The agency provides an additional opportunity to get an alert message to people in their care via their existing communication structures, reinforcing and providing redundancy to regional options.

As part of enhancing coverage, Hawke's Bay CDEM Group is already connected or needs to connect with agencies with people under their care, including

- Hawke’s Bay District Health Board – may also be able to liaise with via their networks Mental Health Social Service providers
- Ministry of Education – to liaise with alerting Oranga Tamariki and Young People Social Service providers
- Ministry of Social Development (MSD) – may be able to liaise with via their networks for Older People, Homeless and Family Social Services providers
- Ministry for Primary Industries (MPI) – may be able to liaise with the Forestry Group, also horticulture, agriculture, and viticulture sector - via the Rural Advisory Group (Rural Network)
- Eastern Institute of Technology (EIT)
- Te Puni Kōkiri – for alerting marae
- Hawke’ Bay Tourism
- Department of Conservation (DOC)
- Department of Corrections
- NZ Transport Agency (NZTA)
- Hawke’s Bay Airport
- Port of Napier
- Camper van providers
- Campgrounds

- Surf Lifesaving
- Large commercial entities (e.g., supermarkets and large format retailers)
- Regional Sport Park.

3.3.6 Cross border issues

Hazards can be shared across regional borders. Harmonisation of warning systems between neighbouring CDEM groups is essential to share consistent warning messages in impacted areas. Harmonisation will reduce confusion and improve responses to take protective action.

3.4 Napier specific considerations

Napier City is particularly vulnerable to earthquake and tsunami impacts due to its exposure to the Hikurangi Subduction Zone and other local faults (Payne et al., 2019). Around 62,000 people live in Napier as of the 2018 census (Stats NZ, n.d.). Napier's population mostly lives in low-lying land within tsunami evacuation zones. See Figure 7 for an overview of Napier City's tsunami evacuation zones. Populations north of the city will likely evacuate to Napier Hill. It is estimated that 20,000 people live in this area (Power et al., 2019). People west of the drainage channel separating Onekawa from Pirimai would evacuate to the Taradale Hills (Power et al., 2019).

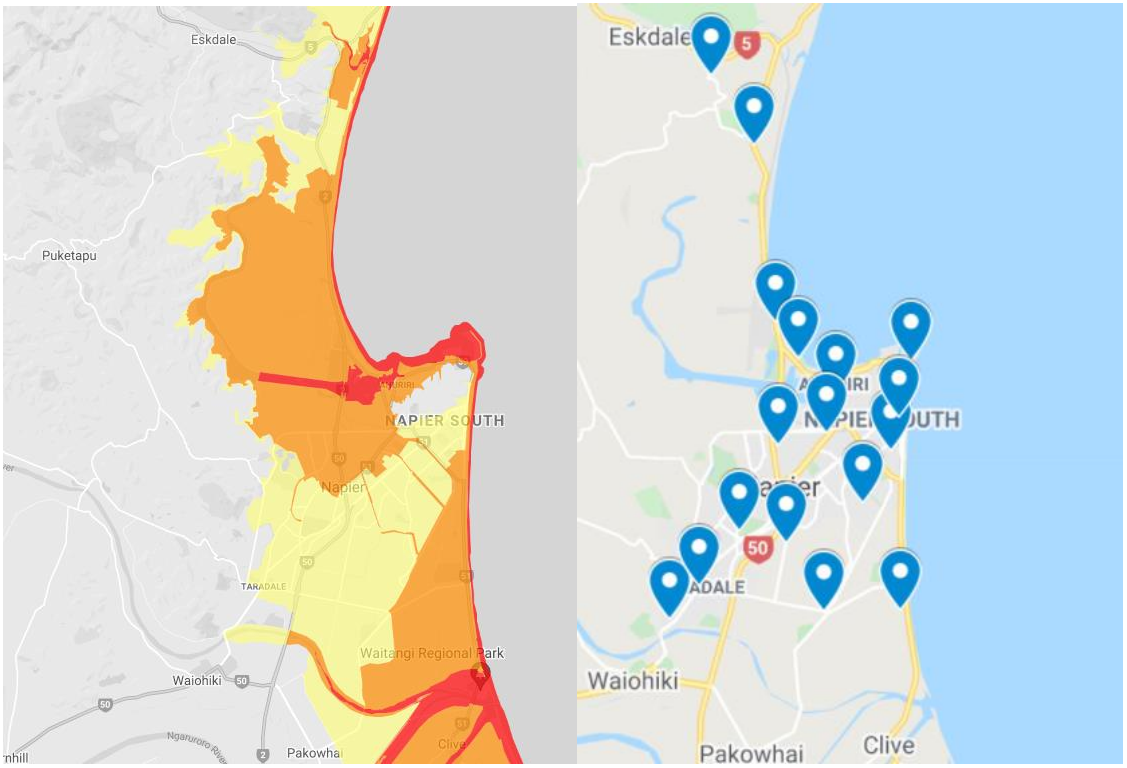


Figure 7. Overview of Napier City's Tsunami Evacuation Zones and Locations of Napier Siren System. The left figure shows three coloured zones in Napier per NEMA guidance on tsunami evacuation zones (2016)*. Red – shore exclusion zone, Orange – area evacuated in distant and regional-source official warnings, Yellow – coverage for all maximum credible tsunami events. The right figure shows the location of sirens in Napier. Images sourced from Hawke's Bay Emergency Management Group.*

Systems are in place for public alerting to tsunami hazards in Napier. Napier has a siren system installed since the late 1960s and upgraded in about 2002 (Morris & Leonard, 2013). The initial development of tsunami sirens followed reviews after the unwarned damaging May 1960 tsunami (Johnston et al., 2008). The Napier Siren System is mechanical. They are fixed sirens mounted on establishments. Previously, tsunami sirens were mounted on fire stations around Napier. But according to Hawke's Bay CDEM, these have been disabled following FENZ's organisational directive across New Zealand that no tsunami sirens be located at fire stations.

Napier's siren coverage is from Eskdale to Taradale with 17 sensors (see Figure 7 for a summary of the siren locations). The sirens use a rise and fall signal. The signal means that an emergency is imminent, and the public is advised to listen to the radio for more information (Morris & Leonard, 2013). NEMA has national guidance for tsunami warnings (Ministry of Civil Defence & Emergency Management, 2014). In addition, tsunami warning must employ a multi-channel system where sirens could be one of many public alerting options. Appendix A lists the key principles for tsunami warning systems.

It must be noted that the Emergency Mobile Alerts (EMA) system is used for public tsunami notifications in New Zealand. NEMA and CDEM Group Controllers may issue EMA for local, regional, and distant source tsunami where there is significant life-safety risk (NEMA, 2020).

However, for local tsunami sources, there is very little or no time to send official warnings; people will need to respond and make decisions based on natural warnings (NEMA, 2020). People in all three zones (in Figure 7) will need to self-evacuate immediately on feeling a long or strong earthquake to avoid the impacts of tsunami that could arrive within 15-40 minutes from the initial ground shaking (Hawke's Bay Emergency Management Group, 2021). Public awareness is vital, so people can recognise and respond to natural warnings. Local agencies such as the Hawke's Bay CDEM Group and Napier City Council work to enhance community readiness and resilience as an ongoing and critical focus (Payne et al., 2019).

3.5 Needs compared to options

3.5.1 Methods

This review uses the national Public Alerting Options Assessment by Wright et al. (2014) and the updated Excel decision support tool. The methods used were streamlined and applied for regional-level review in Waikato (Wright et al., 2015) and Bay of Plenty (Leonard et al., 2017). This assessment has been updated with developments in emerging options, including EMA, CAP, and other evolving capabilities available in New Zealand.

3.5.2 Scoring and basis

A Public Alerting Options Assessment was developed using an evidence-based scoring system. The effectiveness of each alerting option was determined using a range of criteria developed from information from international and national cases studies and theory-based research (Leonard et al., 2017; Wright et al., 2014, 2015). The tool contains base effectiveness scores, which are modified based on local and contextualised information added to the tool. The alerting options and the effectiveness evaluation tool are discussed more in Appendix B.

The tool used for this assessment used approximated costs for each alerting system based on the estimates from the Bay of Plenty review (Leonard et al., 2017). These values provide a way to compare the cost-effectiveness of systems. A caveat on the approximations, the costs will most likely have increased from the 2017 estimates. The range of criteria used to determine the effectiveness of each alerting system is shown in Table 7.

Table 7. Evaluation Criteria for Determining Effectiveness in the Public Alerting Decision Support Tool, taken from Leonard et al. (2017)

Evaluation Criteria	**Explanation, implications**
Activation time – Fast or nothing	Alerting and action time available
For fast onset, localised	Hazard, alerting and action time available
For fast onset, widespread	Hazard, alerting and action time, cost
For slow onset, localised	Hazard, alerting and action time available
For slow onset, widespread	Hazard, alerting and action time available, cost
Heads-up	Reach people whatever they are doing
Hearing-impaired	Vulnerable groups, receipt of message
High pop density	Cost, economy of scale, reach of system
Immobile	Vulnerable groups, action esp. evacuation
Institutions	Vulnerable groups, dependent
Instruction	Provides appropriate action information
Language	Vulnerable groups, understanding of message
Low pop density	Cost, economy of scale, reach of system
Mental capacity	Vulnerable groups, understanding of message
Ongoing effect (ability to update message)	Change in at-risk area or required action
Opt-in required	At-risk population must subscribe and cannot unsubscribe
Relies on (landline) telephony	Potential point of failure
Relies on electricity	Potential point of failure
Relies on internet connection	Potential point of failure
Robustness/resilience	Maintenance required, hazard resistant
Sight impaired	Vulnerable groups, receipt of message
Terrain	Topographic constraints on alert delivery
Time to reach all	Congestion of networks, delivery time
Transients/Visitors	Unfamiliar with local hazards, alerting systems, and required actions

Highlighted cells indicate showstoppers – most critical considerations

3.5.3 Showstoppers

The most critical considerations (i.e., 'showstoppers') for the evaluation are (1) *heads-up*, (2) *instruction*, (3) *opt-in required*, and (4) *time to reach all*. These are highlighted in Table 7 and discussed in more detail below.

- *Heads-up* and *instruction* are necessary for alerting to produce the appropriate response from the at-risk public during emergency events. *Heads-up* is the ability to inform people regardless of where they are and what they are doing. It needs to be attention-grabbing.
- *Instruction* is the content information of the alert for the recipient. It should contain *heads-up* information that indicates that something is happening. It should provide the following details: what is happening, where, when, and what action is required to respond to the threat.
    - For example, a severe Hazchem incident and a regional tsunami event may require different responses (e.g., staying indoors and sealing doors and windows vs evacuating tsunami hazard zone). *Instruction* is a critical part of alerting.

- *Opt-in* criterion captures the need to subscribe or install components to be part of the alerting system. Examples for *opt-in* subscriptions include signing up to an email list, telephone-tree, telephone auto-dialler, SMS-text alert distribution list. Examples of *opt-in* systems that require installation include mobile applications (apps), audio-frequency signals through the electricity network (ripple control), and tone-activated alert radio. The need to subscribe or install to be part of the alerting system creates a potential barrier for uptake, especially if it involves costs or technological proficiency. An *opt-in* system most likely also allows people to opt-out. This would give capability and option for citizens to modify when they would receive alerts and can also turn off completely. Therefore, alerting opt-in options have lower effectiveness.
- *Time to reach all* is essential to maximise appropriate responses to warnings. Timeliness must be considered, including system activation time and the time to create and deliver the alert to all at risk.

3.5.4 Initial indicative cost comparison

Table 8 provides relative effectiveness scores for selected alerting options, with indicative costs if implemented across the Hawke's Bay CDEM Group. See the Public Alerting Options Assessment (Wright et al., 2014) for details on how the effectiveness scores were calculated. The costs in the table are not intended as a quote but rather an indication of relative cost based on the per-unit costs used in computation in past reports (Leonard et al., 2017).

Table 8. Effectiveness scores and indicative costs for alerting options to reach 100% of the region's population. Sorted by effectiveness score under different coverage categories

	Effectiveness score	Low Density Population. 31,530		High Density Population: 135,000		
		Start Cost	Cost/ year	Start Cost	Cost/ year	
		$k	$k	$k	$k	
Rapid widespread coverage:						
EMA Cell Broadcast	84%	6	6	25	25	Already funded centrally
Mobile device apps	82%	14	14	58	58	Opt-in
Fixed PA loud-speakers	68%	NA	NA	2979	279	Maintenance, telemetry and testing
Coverage can reach 70%						
High effectiveness:						
Radio announcements	82%	1	1	4	4	No heads up, slow to reach 70%
Route alert (door-to-door)	71%	2049	2049	8775	8775	# staff available and time to walk/drive
Moderate effectiveness:						
Power mains messaging	66%	631	0	2701	1	Heads up only – slow response
Natural warnings	66%	114	114	486	486	Only for a few hazards **Good for coasts**
Telephone trees	65%	82	82	352	352	Slow to reach 70%
Telephone auto-dialler	64%	8	8	36	36	Slow to reach 70% **Good for pockets**
SMS-PP text messaging	63%	11	6	31	26	Slow to reach 70% **Good for pockets**
Pagers (triggering 200 people)	62%	99	49	422	211	Slow to reach 70%, phasing out
Lower effectiveness:						
Call-in telephone line	47%	669	649	2801	2781	Very slow to reach 70%
Sirens (signal-only) - Fixed	44%	3825	262	4226	314	Heads up only – slow response
Coverage cannot reach 70%						
Mobile PA loud-speakers	74%	316	0	139	1	Cannot reach 70% **Good for pockets**
Television announcements	73%	1	1	4	4	Cannot reach 70% **Good backup**
Website banners	66%	159	1	679	4	Cannot reach 70%
Independent self-maintaining networks	66%	6	6	24	24	Cannot reach 70% **Good for pockets**
Mobile PA loudspeaker (Police / Fire)	66%	1	1	4	4	# vehicles & staff; time required
E-mails	59%	20	5	38	23	Cannot reach 70%
Newspaper content	58%	0	0	1	1	Cannot reach 70%
Websites	56%	162	4	693	18	Cannot reach 70%
Marine radio	53%	1	1	4	4	Cannot reach 70%
Tourist/Iwi radio	49%	1	1	4	4	Cannot reach 70%
Billboards - static	47%	114	51	122	55	Cannot reach 70%
Billboards - electronic telemetered	45%	0	0	1	1	Cannot reach 70% **Good for pockets**

4 Recommendations

Public alerting systems should deliver the best timely information so that people can make an informed decision during a warning with as much time as possible for protective action. This review recommends a system of public alerting options. Following the scope outlined in Section 1.1, the recommendations focus on public alerting. It must be noted that public alerting occurs in broader contexts of risk management, community engagement, planning, public education and exercises, and evaluation.

Recommendations discussed in this section:

4.1 Public alerting system to support response to natural warnings
4.2 Backbone of EMA supported by mobile apps
4.3 Infill options to cover pockets
4.4 Other considerations include multi-end point platform, one-stop-shop, low-cost reinforcement channels, and technologies to watch
4.5 Suggestions for existing systems
4.6 Example indicative solutions
4.7 Prioritisation of the recommendations.

4.1 Public alerting system must support response to natural warnings

The public must be aware that for certain events, an official warning may not be possible. For example, natural warnings are the fastest warnings for local source tsunami, and the public must be ready to act on these without hesitation.

If an earthquake is LONG or STRONG: GET GONE – is a natural warning message for tsunami. It is an important warning for people in Hawke's Bay and the rest of New Zealand, and people must know how to respond and do so without any hesitation. They must move immediately to the nearest high ground or as far inland as possible upon experiencing an earthquake that lasts more than a minute or makes it hard to stand up. People should not wait for an official warning. This is in addition to DROP, COVER and HOLD during the earthquake itself. Knowing the natural warning, the corresponding message, and appropriate action is important as it will give the maximum time and may be the only warning before impact.

An enhanced alerting system may cause a risk of people waiting for an official alert before taking appropriate actions. Over-reliance on official announcements and technical systems may have fatal consequences, as seen in the 2011 Tohoku earthquake and tsunami in Japan (Ishida & Ando, 2014). This was also seen following the 2005 Crescent City earthquake and tsunami warning in the USA, where a technical error led to the failure of the alerting system (Biever & Hecht, 2005; NOAA, 2005). In recent surveys in New Zealand, many people still indicated that they would wait for an official public warning before evacuating after a large earthquake (Dhellemmes et al., 2021).

This risk of over-reliance on alerting systems must be mitigated with public education. Regular exercises (e.g., annual tsunami hīkoi for all schools) can be an effective way to educate about correct actions for different warnings and regulate expectations on alerting systems. Resourcing adequate levels of public education and exercises requires substantial ongoing investment for staff resourcing. There is still a gap in educating the New Zealand public about natural warnings for tsunami. Aligned with developing warning systems, it is recommended that warning systems MUST be accompanied by public education and with annual physical evacuation exercises. Public education is needed to emphasise the overriding importance of responding to natural warnings.

Public education campaigns around natural warnings, EMA, and supporting public alerting tools with evacuation exercises, require staff resourcing. Section 4.6 shows indicative costing for staffing support that includes community response plans, education campaigns, engagement with the whole community, and annual exercises. Note that the staff ratios are indicative only using estimates from more densely populated urban areas. For Hawke's Bay, staffing must consider the local context, including the geographical spread and risk exposure needs.

4.2 Backbone

EMA, supported by mobile apps, should be considered the backbone of public alerting in Hawke's Bay as the systems can reach the vast majority of the population whether they are at home or work. EMA and mobile apps are cost-effective and have high effectiveness scores. All EMA-compatible phones[2] can receive an alert if issued within the broadcast network. EMAs do not need to be installed and cannot be uninstalled.

However, FTE staff costs must be allocated to reinforce public education of these systems. Since its implementation in 2017, EMA has been tested nationwide annually (in 2017, 2018, and 2019). No tests were conducted in 2020 in consideration of the COVID-19 pandemic. However, the EMA system has been widely used in response to the pandemic, and notifications have been sent out to communicate about Alert Level changes. The New Zealand public is now well acquainted with the EMA. However, there is a risk that the public will over-rely on the EMA and may not respond to natural warnings. Public education should continue to remind people of natural warnings and the limits of the EMA system (especially to warn for local source tsunami). The cost for FTE should be accounted as part of the job of staffing to support response to natural warnings.

Mobile apps should be promoted to areas where there is limited mobile coverage but may have internet connectivity. The Hawke's Bay CDEM Group is promoting the Red Cross Hazard App. The Red Cross Hazard App is an app that is CAP-ready. In recent developments, the Hazard App can replicate the EMA in the app. This app alerting option will suit people whose phones cannot receive EMAs and those outside mobile coverage areas but are connected to the internet by other means. Apps have a lower penetration rate to the New Zealand public as substantial effort needs to promote the installation, educate about the correct configuration, test its effectiveness, and evaluate its uptake. There should be regular promotion, education, testing, and physical exercises (e.g., during annual ShakeOut/Tsunami Hīkoi) for the public. The cost for FTE staffing is indicatively costed in Section 4.12 for the support staff to support response to natural warnings.

The Red Cross Hazard App is currently in use for the region and has three substantial issues that need addressing before it achieves the high theoretical effectiveness of apps, besides the needs mentioned above:

1. Poor reviews in the app stores are contributing to people not installing the app.
2. Past performance on the volume of weather-related alerts may have contributed to alerting fatigue, causing people to uninstall the app. Too many alerts may dilute the likelihood that users will notice the important and less frequent life-safety alerts when they come through. Users may need to configure the app to the appropriate level of warnings they may want to receive.

[2] List of EMA Capable phones: https://getready.govt.nz/prepared/stay-informed/emergency-mobile-alert/capable-phones/

3. The app does not effectively wake people up because alerts come through as a regular push notification (as with other apps). Therefore, the sound and vibration may be minimal. However, future enhancements to the app may include a loud alarm.

Because of the availability of Wi-Fi provided by non-cellular Internet Service Providers at most homes and workplaces, the mobile app support to the EMA backbone can be considered a partial redundancy in terms of channel.

4.3 Infill options

Additional layers of regionally coordinated alerting are needed to cover groups and pockets (as identified in Section 3.3). The layers for coverage will depend on the costs and the number of people that the backbone cannot reach.

4.3.1 Possible alerting options for infill

The following alerting options score high on effectivity while having relatively low-cost that can be considered:

- Voice-Over-Internet-Protocol (VOIP) auto-dialler system – should be investigated as an alternative option where cellular coverage is lacking. VOIP uses technology to allow high rates of simultaneous calling. It allows for multiple simultaneous callers, where many lines can call a single server to receive information.
- SMS can deliver messages to a list of people in areas with cell cover but with phones that are not EMA capable. However, more handsets are becoming capable of receiving EMA.

An effective and more expensive option is PA loudspeakers:

- Fixed PA loudspeakers allow alerts to be telemetered in areas that have no cell or internet cover. However, this option is costly.

4.3.2 Linking alerting options to pockets

Applying alerting options solutions for infill coverage should consider the following pockets and their intersections:

- places where there is no mobile coverage or internet
- places where there are people, and
- groups of distributed people (specific groups 3.3.4) that the backbone may not reach.

4.3.3 Determining areas that lack mobile coverage

Further work is needed to map the mobile coverage for the region fully (indicative maps in Figures 4 to 6). Different providers have different blackspots. Mapping will help identify which blackspots may not receive EMAs and for apps that will require mobile internet. These can be cross-analysed with the available telemetry and risk profiles to determine what alerting options will be best suited. This information can be used to lobby for better coverage from providers.

4.3.4 Population centres' mobile coverage and other telemetry

To understand appropriate infill options, further assessment is needed to investigate the population centres and their available telemetry and mobile coverage. For example, there may be areas with mobile blackspots, but they may have access to fixed-line systems (e.g., copper wire or fibre optic); in such cases, these areas can be covered by VOIP auto-dialler using a landline or mobile apps.

4.3.5 Specific groups

Further work is needed to fill in alerting options to specific groups:

- **Iwi groups**. Relative to some other regions, there is a sizeable Māori population in Hawke's Bay Region. Specific Iwi communication channels provide an opportunity to reach a substantial part of the regional population. Hawke's Bay CDEM Group needs to continue engaging with Iwi group representatives to develop approaches to deliver alerts and collaborate with existing communication channels and community organisations.
- **Non-English speakers** – there is a need to enhance engagements with ethnic groups and support their self-maintaining networks. It is recommended to identify groups and ensure that their networks would have access to public alerting.
- **Elderly** – Access to technologies for the older population, especially in rural areas, must be considered. Using and installing mobile apps may be a problematic alternative for the elderly that EMA can't reach. However, access to landlines may allow for the use of auto-diallers. In aged-care facilities, the elderly will have reliance on carers to disseminate information or take action.
- **People with disabilities** – Access and availability to assistive/adaptive technologies may be a barrier for people with disabilities. It is recommended that Hawke's Bay CDEM explore solutions for people with disabilities with the supporting agencies for the respective communities.
- **Transient populations**
    - To cover people travelling on highways, specific warning arrangements may be needed with NZTA. Future CAP compliant public alerting endpoints could be used as an integrated system (e.g., digital signboards).
    - To cover tourists, additional mobile alerting options should be explored. Most domestic tourists will have EMA-capable mobile phones. However, there may be potential variability with foreign handsets. Mobile apps (e.g., New Zealand Red Cross Hazard App) may be an alerting option for foreign tourists. It must be explored how to get tourists to install the apps on their phones. Blackspots may be an issue with tourists as both EMA and apps have reliance on mobile coverage.
- **Agencies with people in their care** – The list in Section 3.3.5 identifies the agencies that Hawke's Bay CDEM Group must connect with to ensure coverage. Hawke's Bay CDEM Group should coordinate specific warning arrangements into the internal and broader communication channels of these agencies.

4.4 Other considerations

4.4.1 Multi-end-point platform

We suggest considering using an alerting end-point platform to ingest alerts and distribute to other end-points, including but not limited to:

- EMA
- Red Cross Hazard App
- VOIP auto-dialler
- SMS lists (for groups within cell coverage but are not capable of receiving EMA)
- social media
- website
- CAP RSS feed for all other alerting end-points.

4.4.2 One-stop-shop

The Hawke's Bay CDEM Group currently has a web page where a list of public alerting channels is available: https://www.hbemergency.govt.nz/get-ready/public-warning-systems/. We encourage

using this page as a one-stop-shop portal to provide a clear explanation and access to warning services. It must be noted that the webpage in itself is not intended to be a warning system but a pre-warning portal of information. The page can be enhanced further to include what channels are available where, for whom, and what hazards. The current content is tsunami heavy for appropriate reasons, but the one-stop-shop must be balanced to include other hazards.

4.4.3 Additional Low-Cost Reinforcement Channels

The following should be enhanced and maintained at a regional level as they provide reinforcement to Hawke's Bay public alerting:

- Media arrangements
- Connection to self-maintaining networks
- Connection to large agencies with people in their care
- Social media
- Websites
- Other CDEM Group members alerting capacity.

4.4.4 Other technology to watch

More **CAP-compliant public alerting endpoints** will be available in the coming years. A public alerting endpoint is any piece of technology that can read CAP messages and deliver those messages to the public in a human-readable format (e.g., SMS, digital road signs, etc.). The Hawke's Bay CDEM Group should continue to work with the NZ CAP Working Group, where CDEM can originate CAP warnings that can be ingested and distributed to various end-points.

The **Android earthquake alerts system from Google** was initiated in New Zealand starting April 2021 and has issued out a few Earthquake Early Warning (EEW) alerts (which is intended to provide advanced notification of incoming earthquake shaking) to Android users. This alerting system was deployed without officials' involvement and should not be confused with alerts issued by civil defence authorities (McDonald, 2021). EEW is not an alerting option accessible for Hawke's Bay CDEM Group as this warning system is automated and run by Google. However, alerts coming from Android phones may confuse the public, and the Hawke's Bay CDEM Group must respond. It is recommended that the Group, with guidance and in coordination with NEMA, provide public education on the EEW alert and communicate its advice to the public about what they should do upon receiving the alert (e.g., include this in the one-stop-shop).

4.5 Existing systems

Existing systems should be maintained until consideration and implementation of installing new systems or decommissioning of old systems has taken place. The following are recommendations for the existing systems:

- Consider a **multi-end-point platform** that could deliver to multiple existing platforms at once. The platforms could integrate delivering consistent messaging to the existing end-points such as EMA, social media (Facebook and Twitter), the Hawke's Bay CDEM website, and the Red Cross Hazard App. The platform could integrate with future alerting options, including auto-diallers, etc.
- Consider **EMA** and **mobile apps** as a backbone to the alerting system. This should be accompanied by public education and exercises.
- **Social media** and **one-stop-shop webpage** should be maintained and enhanced for reinforcement alert messages and the public alerting system
- **Land-based siren**

- The current signal-only siren system in Napier is not fit-for-purpose in the context of current-day alerting. Although it provides a *heads-up,* it cannot provide detailed *instructions*. The rise-and-fall signal only intends to communicate the need to seek more information. The current Napier system does not comply with the NZ Standard for Tsunami Sirens and should not be used for this purpose.
- The public might not know what the siren signal means unless this system is accompanied by extensive education on the siren signal meaning and the appropriate actions to take when the signal is heard. The public may not respond because they are unsure of the meaning (Fraser et al., 2013). Especially for tone-only sirens, there may be a disconnect between the intended message and what the people's perception of the message. In Napier, the siren signal means that the public should seek further information through radio, and not necessarily indicating of threat of tsunami (Fraser et al., 2013). However, staff report that in their previous education campaigns, they have struggled to change community perceptions that these fixed sirens are 'tsunami sirens.' For tone-only sirens to work, a public education component is needed to enhance awareness and understanding of the system (Fraser et al., 2013). Staff resourcing for public education must be budgeted with the use of the current siren system.
- The existence of the siren system may increase the risk of over-reliance on the system and cause people to wait to hear the signal before acting on natural warnings. Potential earthquake damage itself can make the sirens fail. In a survey after the 2011 earthquake and tsunami in Japan, 17 out of 27 affected municipalities responded that their fixed tsunami alert transmission system failed from power cuts or earthquake damage and did not function properly at the time of the disaster (Hasegawa, 2013).
- Public education and exercises must reinforce natural warnings and the LONG or STRONG: GET GONE message. Staffing costs must be budgeted for public education.
- The costs of upgrading the current siren system to a PA loudspeaker system may not outweigh effectiveness in areas with already existing or alternative alerting options (i.e. good EMA or mobile app coverage). Although, a PA loudspeaker system has high effectiveness score, because it provides both *heads-up* and *instruction*, it has a high start-up cost and substantial ongoing maintenance costs (Wright et al., 2014). It is also considered to be prohibitive in low-density areas. Its coverage is restricted to narrow geographical areas and has audibility issues, especially in strong winds.
- Napier City, as an urban area, already has good coverage with the high-reliability backbone of EMA and mobile apps. EMA and mobile apps provide both *heads-up* and *instructions.* Capital and maintenance costs are likely to be better spent on public education and strengthening the backbone, rather than maintenance or upgrading of the land-based Napier Siren System.

- One **Stinger Siren** exists in the region but is currently decommissioned. Careful consideration should be given if it will be used as an infill alerting option. Effectiveness is questionable due to deployment time, the added exposure of the operator to the hazard, and the rate of warning delivery.
- **Helicopter PA** (currently in Wairoa) should be maintained if it is an appropriate infill alerting option to areas where the backbone is ineffective. However, use with caution, as media reports on helicopter PA testing in Wellington showed that a significant number of the population could not hear the address message clearly and caused confusion (Leonard et al., 2017). Main issues include service level, availability, speed for deployment, and speed to reach the populations at risk.

- **Door-to-door and outbound calling** should be maintained and integrated with public education and annual exercises. The effectiveness of the option is dependent on the availability and proportion of staff on duty and per per-person rate of visits. This option will not reach the majority of the population when peril is imminent but would be good as infill options for pockets. Appropriate staffing resources must be budgeted this option.

4.5.1 Requests for Proposals (RfP) and Implementation Process

Before implementing changes in the alerting system, the balance between the backbone and infill options will need to be agreed upon. After which, further specifications will be needed for RfPs from vendors. Points of clarity and alignment will be needed on national initiatives around EMA, CAP, mobile apps, and other technological trends.

4.6 Example indicative solution

Table 9 shows an indicative solution to implement the above recommendations. Table 9 is not a quote, and the costs are indicative only. The exact costs will be dependent on detailed proposals from vendors.

Note the following points for Table 9:

- The backbone of EMA and mobile apps is cost-effective as these alerting options will have rapid widespread coverage. However, the annual cost of staff time must be budgeted to account for the substantial amount of work to train, maintain procedures, and provide education and exercises around these options.
- Note that detailed pocket analysis was not in the scope of this report, so areas without access to EMA and mobile apps are indicative via population density only. This estimate must therefore be treated as speculative until Hawke's Bay has conducted a detailed pocket analysis.
- The infill via a telephone auto-dialler system and targeted SMS messaging has an annualised direct and staff cost. Charges per message will also be incurred.
- Upgrade of 17 Fixed PA loudspeakers are included as an example. These fixed PA systems could be targeted at the highest use beaches and tourist locations with limited cell coverage. The cost basis needs to be confirmed with RfP.
- It is necessary to budget staff time for additional redundancy and reinforcement systems. These must be annually sustained, and important to consider further infill options to reinforce warning messages.

Table 9. Example indicative approach to determining costs for alerting options for the Hawke's Bay region. Sorted by effectiveness score under the categories of rapid widespread coverage, can reach 70%, and cannot reach 70%. Costs are in proportion to the targeted reach (in terms of percentage population) of each alerting option.

	Effectiveness score	LOW Density (100 ppl/sq.km) Population: 31,530 people				HIGH Density (2500 ppl/sq.km) Population: 135,000 people				
		Reach	Start-up Cost	Annual Cost	Annual direct cost	Reach	Start-up Cost	Annual Cost	Annual direct cost	
Rapid Widespread Coverage:			**$k**	**$k**	**$k**		**$k**	**$k**	**$k**	
EMA	84%	60%	6	6	5	90%	35	35	29	Training, maintenance, education, and testing
Mobile apps	82%	90%	12	12	15	90%	52	52	58	Training, maintenance, education, and testing
Rapid targeted coverage:										
Fixed PA loud-speakers (17 units)	68%		NA	NA		10%	850	85	43	Maintenance, telemetry, and testing
Coverage can reach 70%										
High effectiveness:										
Radio announcements	82%	70%	1	1	0	70%	3	3	0	No heads up, slow to reach 70%
Moderate effectiveness:										
Natural warnings	66%	70%	79	79	22	70%	340	340	94	Required for tsunami. Cost = full plans, education, and exercises supported.
Slow to reach 70%										
Telephone trees	65%	10%	53	53	0	5%	18	18	0	
Telephone auto-dialler	64%	10%	1	1	1	5%	2	2	2	Good for pockets
SMS-PP text messaging	63%	10%	6	1	1	10%	9	4	3	Good for pockets
Cannot reach 70%:										
Mobile PA loud-speakers	74%	0%	0	0	0	5%	7	0	0	Good for pockets
Television announcements	73%	50%	1	1	0	50%	2	2	0	Good backup
Website banners	66%	50%				50%				Provided with CAP uptake
Independent self-maintaining networks	66%	10%	1	1	0	10%	2	2	1	Good for pockets
Mobile PA loudspeaker (Police / Fire)	66%	1%	0	0	0	10%	1	1	0	# vehicles & staff
E-mails	59%	10%	16	1	0	10%	17	2	0	
Newspaper content	58%	50%	0	0	0	50%	0	0	0	
Websites	56%	2%	3	0	0	2%	14	0	0	
Marine radio	53%	2%	0	0	0	2%	0	0	0	
Tourist/Iwi radio	49%	5%	0	0	0	5%	0	0	0	
Billboards – static	47%	10%	11	5	5	10%	12	5	5	
Billboards - electronic telemetered	45%	15%	0	0	0	15%	0	0	0	Good for pockets
TOTALS ($k)			**190**	**161**	**49**		**1364**	**551**	**235**	

Start-up total (year 1)	**1554**
Annual (Year 2 onwards)	**712**
Annual Direct Costs (no FTE) only	**284**

4.7 Prioritisation

1. We recommend that backbone options (both of which are currently in use) are costed in detail and implemented first.
2. Staff resourcing must be increased to enhance education on natural warnings awareness, including knowing how to act. Higher levels of community engagement, education, and exercise are needed throughout the region. The cost for this should be sustained on an annual basis. These programmes need to be appropriately evaluated.
3. A comprehensive regional study of network coverage should be commissioned. This mapping exercise should be cross-analysed with fixed-network systems, geographical risks, and an assessment for suitable infill alerting options for blackspots, recognising that different providers probably have different blackspots.
4. Ongoing research should be conducted or commissioned into infill needs to use the end-point platform options (particularly VOIP auto-dialler).
5. The system should be reviewed every three to five years
6. **IF** it be decided that the Napier siren system be maintained or upgraded, there should be inclusion of an extensive plan for public education and exercises. An RfP for enhancing the Napier Siren System with PA loudspeakers to match the above need (if any) should also be released.

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Appendix A: Principles for Tsunami Warning Sirens

From the Tsunami Warning Sirens Technical standard [03/14] (civildefence.govt.nz)

The following principles emerged as a part of consultation, and provide fundamental guidance to the use of sirens in tsunami warnings:

1. The term 'sirens' refers to a public alerting option only. The ability to detect earthquakes and tsunami, interpret that data, and trigger public alerting options (e.g. sirens) is a separate concept that should not be confused with activating siren hardware.
2. The use of sirens is a subset of CDEM Group/territorial authority warning systems, and is one public alerting option among many.
3. The use of sirens should be attuned with the national warning system and NEMA tsunami guidance.
4. The use of sirens must be risk based – that is, based on an understanding of CDEM Group/territorial authority tsunami hazards and risks.
5. Tsunami warning systems will employ the use of multiple alerting channels – one of which may be sirens.
6. Responsibility for activating sirens and the basis for activation must be clarified within CDEM Groups.
7. The use of sirens must be linked to continuous public education programmes and evacuation planning activities.
8. There should be national consistency in the signal and meaning of sirens.
9. Sirens should be used as an all-hazards alerting mechanism, and not only for tsunami warnings.
10. Sirens may be used for distant source tsunami events, and where possible, for regional source tsunami events, depending upon the policies of the CDEM Group and/or territorial authority. Activation of sirens must not be expected for local source tsunami events – the strong earthquake is the only reliable warning.
11. Communities should be involved in awareness raising, testing, and decisions on expanding or decommissioning siren systems, where possible. Testing must be done on a regular basis.
12. A realistic and achievable programme and budget must be developed for ongoing maintenance and operations.
13. Ongoing consideration of public alerting options by CDEM Groups is recommended – for both reach and cost effectiveness purposes.
14. Ideally, sirens should be public address (PA) capable to allow for direct, event-related messaging to be given. The use of sirens in tsunami warnings should not be inconsistent with the above principles.

Appendix B: Available Alerting Options

From the GNS Science Report: Bay of Plenty Regional Alerting Systems Review. https://doi.org/10.21420/G28043

Table B1. below shows the available alerting option, their costs-basis and effectiveness as per Public Alerting Options Assessment (Wright et al., 2014, 2015) and Leonard et al. (2017).

Table B1. Cost basis summary for alerting options

		Additional start-up	cost start-up / 1000 people	FTE / 100,000 people	cost annual / 1000 people (minimum - includes training, exercises etc.)	cost start-up / 1000 people	FTE / 100,000 people	cost annual / 1000 people (minimum - includes training, exercises etc.)	
	SCORE		**LOW density**			**HIGH density**			**NOTES regarding cost basis**
Natural warnings	66%			4.00	1,000		4.00	1,000	Based on education pre-event. Heads-up time depends on hazard. 1 FTE per 25,000 people, or four 6000 person communities or neighbourhoods. Estimated from effort over 6 years in Wellington region across 70,000 people. Provides wider benefit for resilience building and multi-hazard preparedness.
Independently self-maintained networks	66%			0.20	50		0.20	50	Based on staff effort to maintain relationships and testing.
Reliant on third party hardware and/or staff									
Aircraft banners	48%	5,000	400	0.01	200	100	0.01	50	Based on equipment purchase, flight time costs.
Helicopter PA loudspeaker	64%	20,000	1,600	0.01	8,000	400	0.01	100	Based on equipment purchase, flight time costs. 2 minute hover, 1 minute flight. 1000 per hover HD, 10 per LD
Billboards - static	47%	3,500	2,000	0.01	1,600	500	0.01	400	Based on monthly rental, reaching 10k people per board
Billboards - electronic telemetered	45%		unknown	0.01	unknown	unknown	0.01	unknown	
Break in broadcasting*	77%	large cost	not costed		not costed	not costed		not costed	LIKELY TO NEED NATIONAL ARRANGEMENT
Call-in telephone line	47%	20,000	20	0.01	20,592	20	0.01	20,592	Based on auto-dialler costs. Passive mechanism.
E-mails	59%	15,000	1	0.25	10	1	0.25	10	Database build (partially source from platforms, subscribers), using infinite size, rate of emailing limit? End user cap?
GPS receiver messaging*	57%		unknown		unknown	unknown		unknown	Needs INTERNATIONAL work to cover New Zealand, receivers must be changed to receive.

		Additional start-up	cost start-up / 1000 people	FTE / 100,000 people	cost annual / 1000 people (minimum - includes training, exercises etc.)	cost start-up / 1000 people	FTE / 100,000 people	cost annual / 1000 people (minimum - includes training, exercises etc.)	
	SCORE		**LOW density**			**HIGH density**			**NOTES regarding cost basis**
Marine radio	53%			0.05			0.05		Only reaches boats. Assumes exist in all boats, already have transmitter. Effort to maintain and exercise.
Mobile PA loud speaker (Police / Fire)	66%			0.05			0.05		Effort to maintain and exercise. Limited by number of units and speed.
Mobile device apps	83%		-	0.20	300	-	0.20	300	Rough estimate based on general 2016 experience
Cell broadcast	84%	-	-	0.05	150	-	0.05	150	Assumed scaled to 2016 mobile device apps. NO DATA
Newspaper content	58%			0.01			0.01		Press release
Pagers (triggering group of 200 people)	62%	312	1,560	0.01	1,560	1,560	0.01	1,560	One pager reaches200 people, up to 100 pages per month. + effort to coordinate.
Power mains messaging	66%	250,000	20,000	0.01		20,000	0.01		$50 per house, 2.5 ppl/dwelling (2006 census)
Radio announcements	82%			0.05			0.05		Effort to maintain and exercise
Route alert (door-to-door)	71%			100.00			100.00		Limited by avg. proportion of staff on duty and per person rate of visits. Won't reach the majority if widespread diffuse areas
Social Media									
SMS-PP text messaging	63%	5,000		0.10	130		0.10	130	BULLETIN - Annual licence for web-based system. Cost to send message 13c per SMS. Cost is based on two tests. Subscribers must sign up.
Telephone auto-dialler	64%			0.10	200		0.10	200	TNZ - VOIP based system - no subscription but must create and upload database - 0.5 FTE to create and 0.25 FTE for maintenance. Capacity 700 calls per minute. Can be increased by request for emergency or' burst' calls Broadly consistent with informal indication (1c per second) of 2017 cost for platform multi-endpoint option in place for another region (ongoing discussion with BOP CDEM Group)
Telephone trees	65%			4.00	10		4.00	10	High effort required. Likely cap on completeness and accuracy of list
Television announcements	73%			0.05			0.05		
Tourist radio	49%			0.05			0.05		Reaches only maximum number of people listening to this station
Websites	56%		5,000	0.05	100	5,000	0.05	100	Price of one website and hosting, but limited to people viewing
Website banners	66%		5,000	0.05		5,000	0.05		Not currently in use. Cost basis would need investigation with ISPs.

		Additional start-up	cost start-up / 1000 people	FTE / 100,000 people	cost annual / 1000 people (minimum - includes training, exercises etc.)	cost start-up / 1000 people	FTE / 100,000 people	cost annual / 1000 people (minimum - includes training, exercises etc.)	
	SCORE		**LOW density**			**HIGH density**			**NOTES regarding cost basis**
Dedicated hardware									
Fixed PA loud-speakers	68%	20,000	80,000	0.10	8,000	20,000	0.10	2,000	Limited by proportion of people who know meaning.
Mobile PA loud-speakers	74%	1,000	10,000	0.05	-	1,000	0.01	-	TAUPO - Wellington build your own. $50k for 12, reaches 400 ppl/sq km dense, 1/4 of that diffuse. 10% annual maintenance
Bells, air horns	50%			0.01			0.01		
Flares, explosives	43%		10,000	10.00	2,000	200	10.00	40	Pack of 30 = $3k, flare reaches a few people in diffuse areas and a few hundred dense. Replace 20% every year
Radio Data Systems*	52%	5,000	25,000	0.50	100	25,000	0.50	100	Cost to reach 200 people + effort to coordinate response groups and exercise
Radio (UHF, VHF or HF)	64%	5,000	25,000	0.50	100	25,000	0.50	100	Cost to reach 200 people ($5,000) + effort to coordinate response groups and exercise - Gisborne costs?
Sirens (signal-only) - Mobile	56%								
Sirens (signal-only) - Fixed	44%	28,000	112,000	2.00	8,000	28,000	0.50	2,000	Based on $1,130,000 for 45 towers (varying siren numbers per tower)
Tone-activated alert radio*	82%	120,000	50,000	0.10	1	50,000	0.10	1	E60 per unit - unlikely to have high uptake unless paid-for and supplied

Effectiveness evaluation and public alerting options decision support tool

There is a wealth of information on the effectiveness of public alerting systems based on case studies from a range of hazard types and locations both national and international, as well as theory-based research applying psychology principles. The evidence for what constitutes an effective alerting system has been summarised and used to develop an effectiveness evaluation methodology for alerting systems in New Zealand (Leonard et al., 2005, 2006, 2008; Wright et al., 2014). The effectiveness of each option is determined using a range of criteria, with an evidence-based scoring system. This scoring system forms the basis for a Public Alerting Decision Support Tool. The tool contains base effectiveness scores and these are modified as more detailed information on local hazards and demographics are input to the tool.

The tool also applies an estimated cost for each alerting system, which provides for cost effectiveness comparisons of systems. The range of criteria used to determine effectiveness of each alerting system is shown in Section 3.4.2. The 'showstoppers' (most critical considerations for effectiveness) are highlighted in red and explained in Section 2.5.1.

Information required to populate the decision support tool

The Public Alerting Decision Support Tool requires information to be input to determine the effectiveness of each system for specific communities, such as towns, cities, districts or regions. Some of the information is available from the NZ Census on the Statistics NZ website. Other information is best sought from local CDEM practitioners or local authority and community representatives. The following information is necessary to apply the tool:

- Population count – low and high density population counts for the area of interest; high density = >200 people/km2).
- Demographics – information about groups of citizens who might have increased barriers to receiving certain types of alerts (e.g., communities with many elderly people, possibly having higher levels of sight or hearing impairment and lower rates of mobile device ownership). The tool asks for information on groups with sight, hearing, mobility or intellectual impairments, and those with English as a second language.
- Telephone coverage; mobile and fixed – many alerting systems require telecommunications through either mobile or landline networks.
- Transient populations – this includes the number of visitors to the area (tourists and others from outside the location such as seasonal workers) who may be unfamiliar with the local hazards and the local alerting systems.
- Those in the care of institutions – this includes the number of citizens who are housed in institutions such as hospitals; those who are temporarily in care such as pre-school, school and tertiary students; and those working in large campuses or workplaces. These people are likely to require an alert to be delivered to them via the institution in which they are housed.
- Hazards of interest – hazards are grouped into four classes based on the lead-in time from hazard trigger to impact and the range or extent of impact. Classes are as follows: short lead-in time localised impact, short lead-in time widespread impact, long lead-in time localised impact and long lead-in time widespread impact.
- Budget – each alerting system requires some budget resource, which could be in the form of staff time for education and exercises, resources for education, financial input for purchase, installation and maintenance of dedicated systems, and/or licenses or charges to use third party systems. Costs are determined on a per-thousand population basis and are separated into start-up (establishment) and ongoing.

- Nearly forty alerting options are included in the decision support tool, including some options not yet readily available in NZ that are used overseas. These are categorised into third-party systems, dedicated hardware, natural warnings and independent self-maintained networks.
- Third-party systems are owned and operated by non CDEM agencies but can be used for alerting, e.g., TV, radio, mobile phone networks.
- Dedicated hardware is owned and operated by the CDEM agency e.g., PA systems or sirens.
- Natural warnings are those phenomena which are produced by the event that could indicate a hazard threat (e.g., strong or long shaking near the coast could indicate tsunami; heavy rainfall could indicate landslides or flooding).
- Independent self-maintained networks are non-CDEM agencies in contact with the public that could deliver an alert message to the public if agreements and arrangements are in place (e.g., surf-lifesaving groups, park rangers, neighbourhood watch). The decision support tool allows users to select which alerting options to include and exclude in any evaluation.