Bay of Plenty and Waikato Lifelines Forum 2018

BAY OF PLENTY LIFELINES GROUP

Waikato Lifelines Utilities Group

Kevin Biggar

Trans-Atlantic rower and Polar explorer

Presentation available at https://www.kevinbiggar.co.nz/bopllg

Morning Tea – Resume at 10:20AM

Lifelines Forum 2018

BAY OF PLENTY LIFELINES GROUP

Waikato Lifelines Utilities Group

Todd Muller

MP for Bay of Plenty and Opposition Spokesperson for Climate Change

No presentation available

Dr Rob Bell, NIWA

Principal Scientist - Coastal and Estuarine Physical Processes

Programme Leader - Risk Impacts of Weather Related Hazards

Presentation available as separate pdf

Thank you

Rob Bell (CPEng)
+64 27 2332324
rob.bell@niwa.co.nz

Andrew Renton

Senior Principal Engineer
Transpower New Zealand Ltd

Presentation available as separate pdf

Blackstart

WBOP Lifelines Aug 2018

Andrew Renton Senior Principal Engineer

Lunch – Resume at 12:45PM

Prof Colin Wilson
Dr Graham Leonard

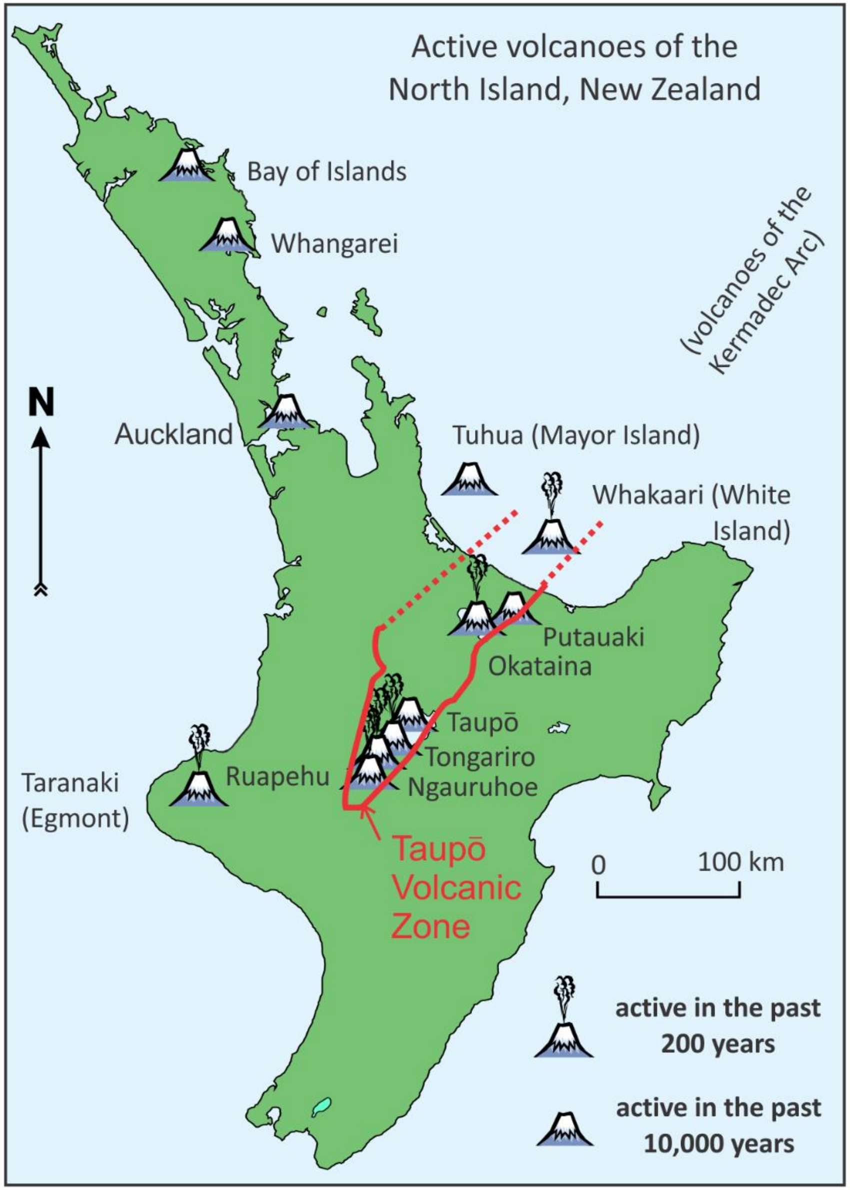
Victoria University,
GNS Science

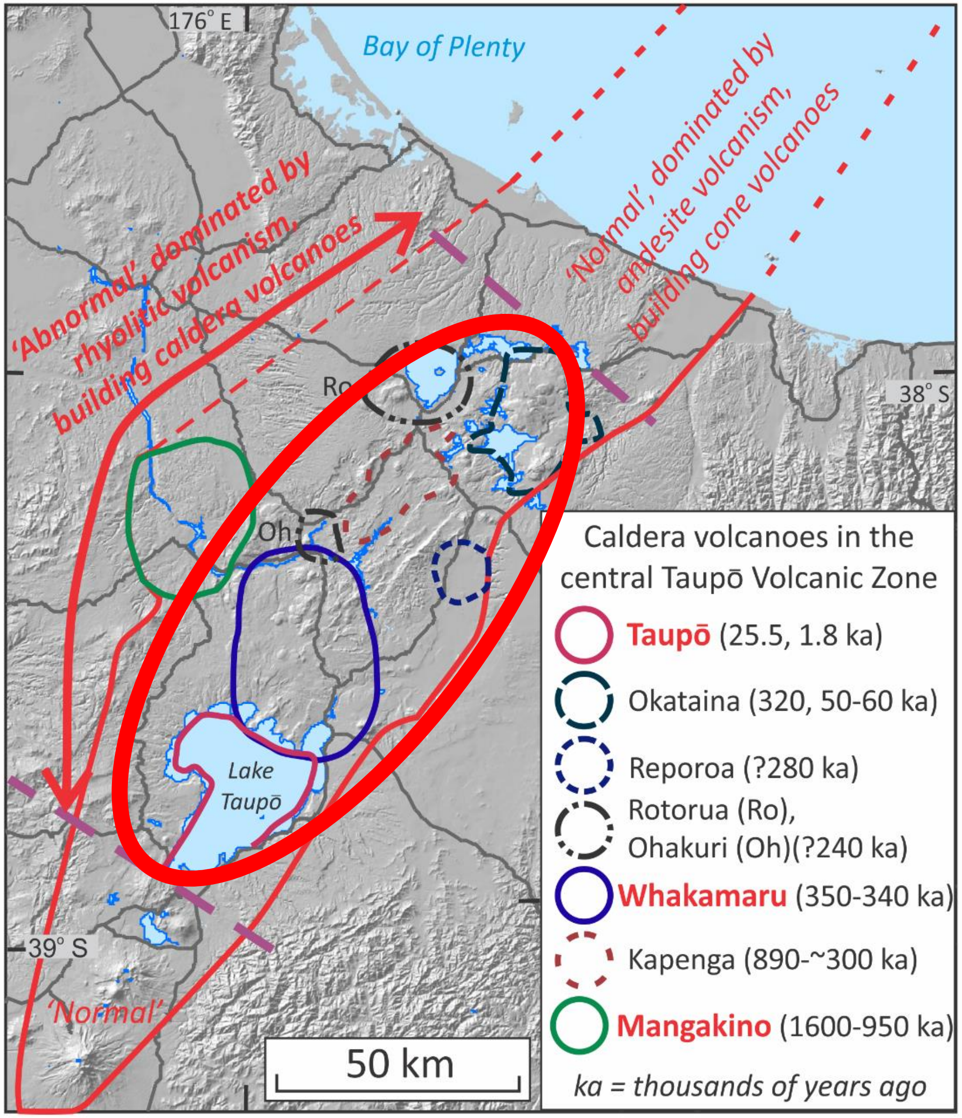
ECLIPSE:
Eruption or Catastrophe: Learning to Implement Preparedness for Supervolcano Eruptions

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA UNIVERSITY OF WELLINGTON

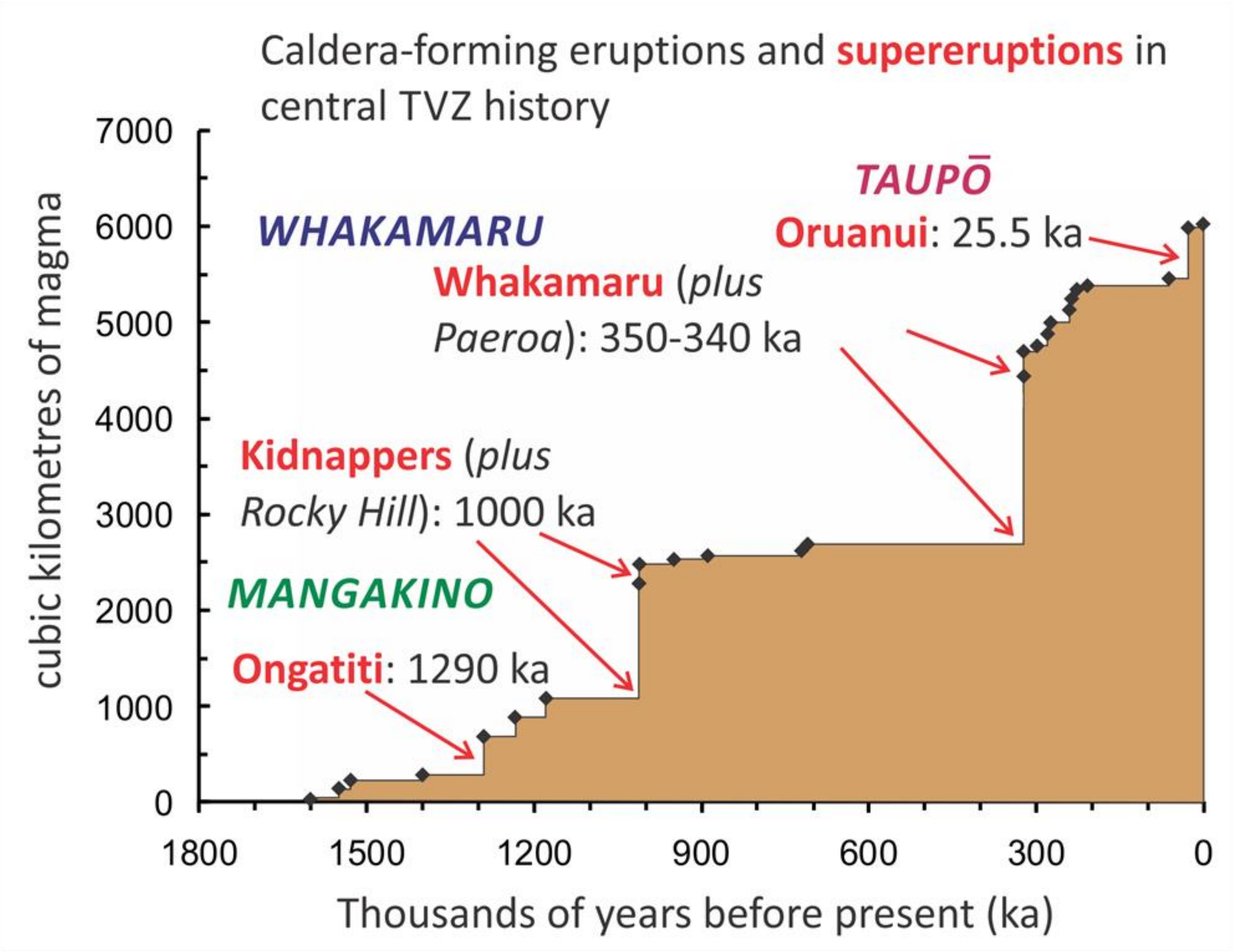
GNS SCIENCE
TE PŪ AO

The central North Island supervolcano system

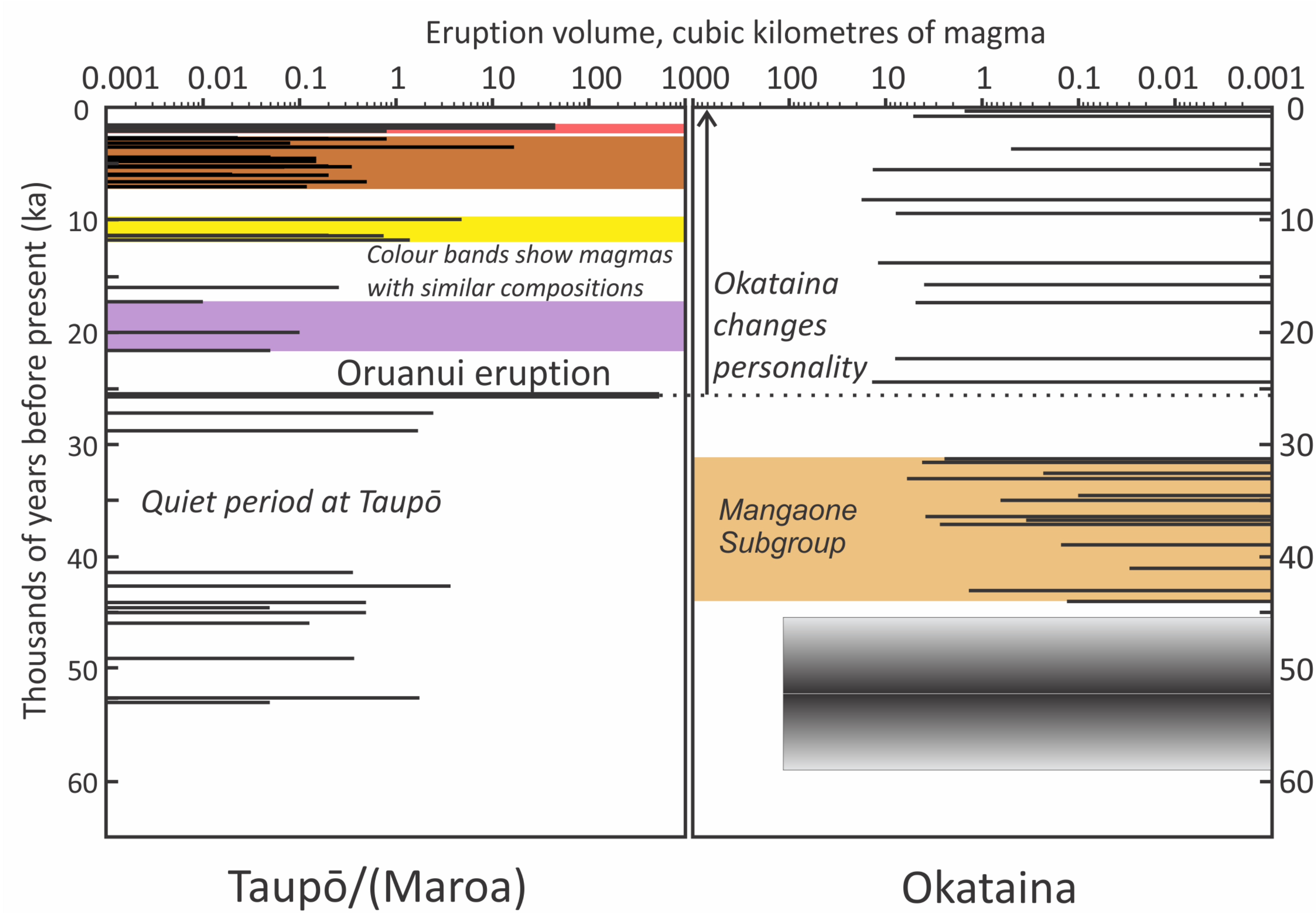




The largest eruptions: thousands of years apart

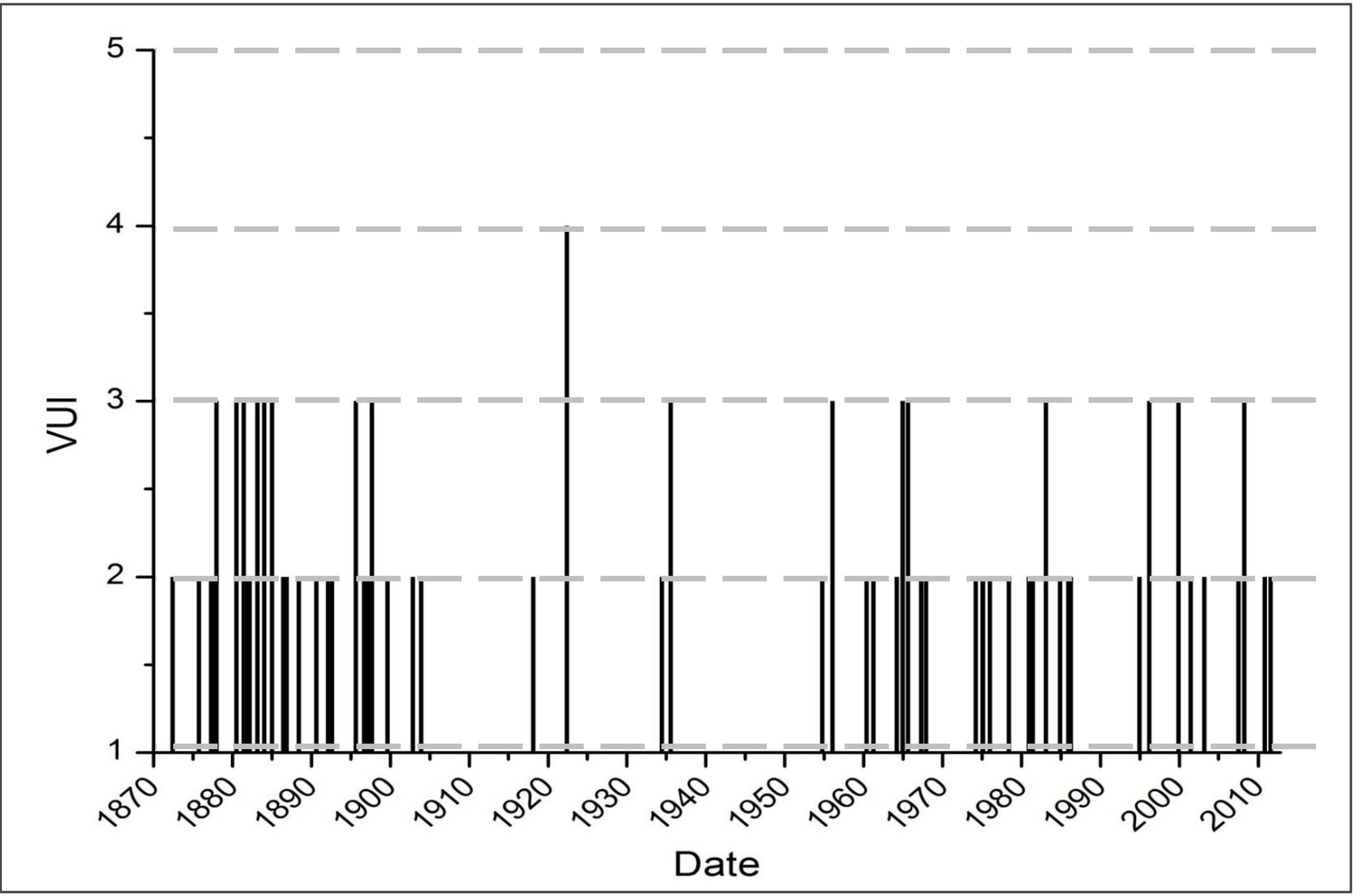


Eruptions of any size: hundreds of years apart



Unrest events: years apart

Relative intensity of unrest episodes at Taupō volcano using a Volcanic Unrest Index (VUI: from Sally Potter, GNS Science)



Heightened unrest

Moderate unrest

Minor unrest

Dynamic volcanic system, no unrest

Inactive volcanic system, no unrest

In summary:

The central Taupo Volcanic Zone can be considered in terms of its overall evolution as a single rhyolitic caldera complex, with comparable longevity and scale to Yellowstone

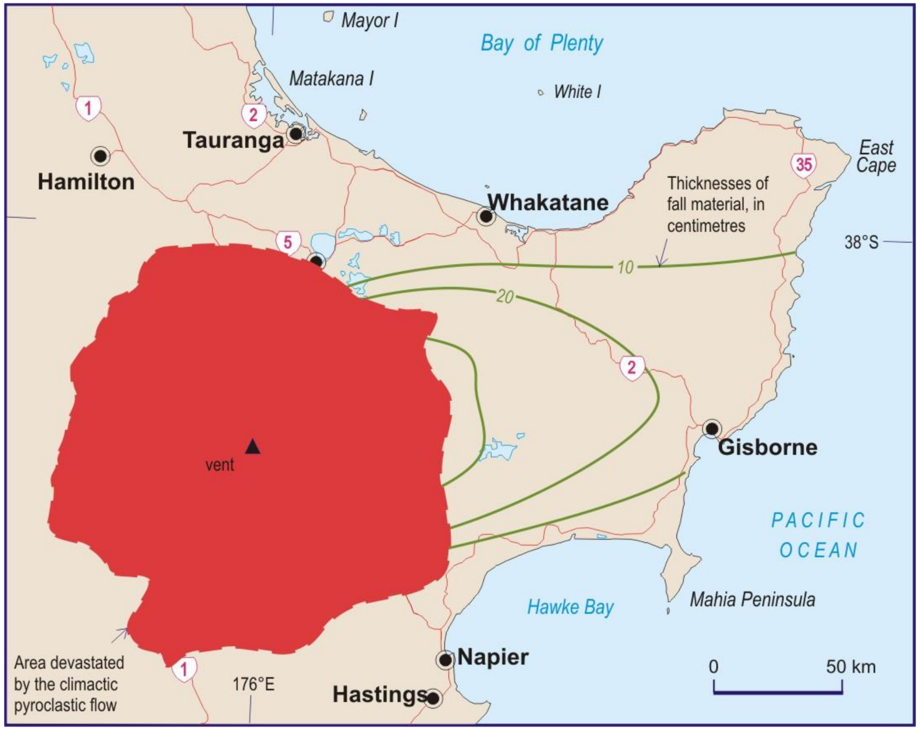
The largest events are episodic and spaced at thousands of years, but the smaller events and rifting occur throughout the zone at timescales of relevance to modern society

The main hazard we are expecting in our lifetime is unrest, and dealing with concern as to how to decide if it's hinting at something more…

Taupo Caldera – Latest eruption 1800 years ago

D. Townsend

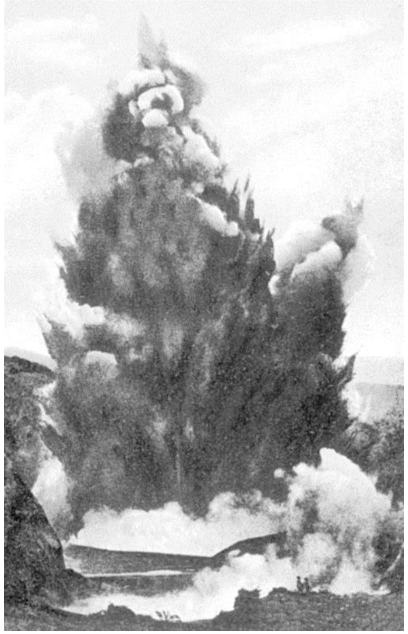
232 AD eruption at Taupo: Widespread fall deposits and major pyroclastic flow deposits



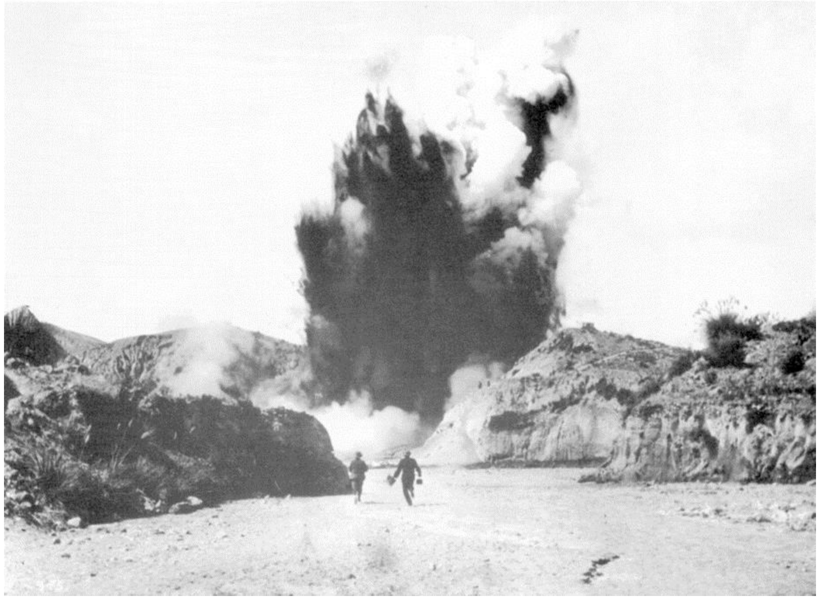
Okataina caldera and Mt Tarawera (700 years old)

The majority of eruptions are non caldera-forming (compare with Chaiten, 2008)

Historic eruptions and unrest



1886
Tarawera
eruption &
aftermath

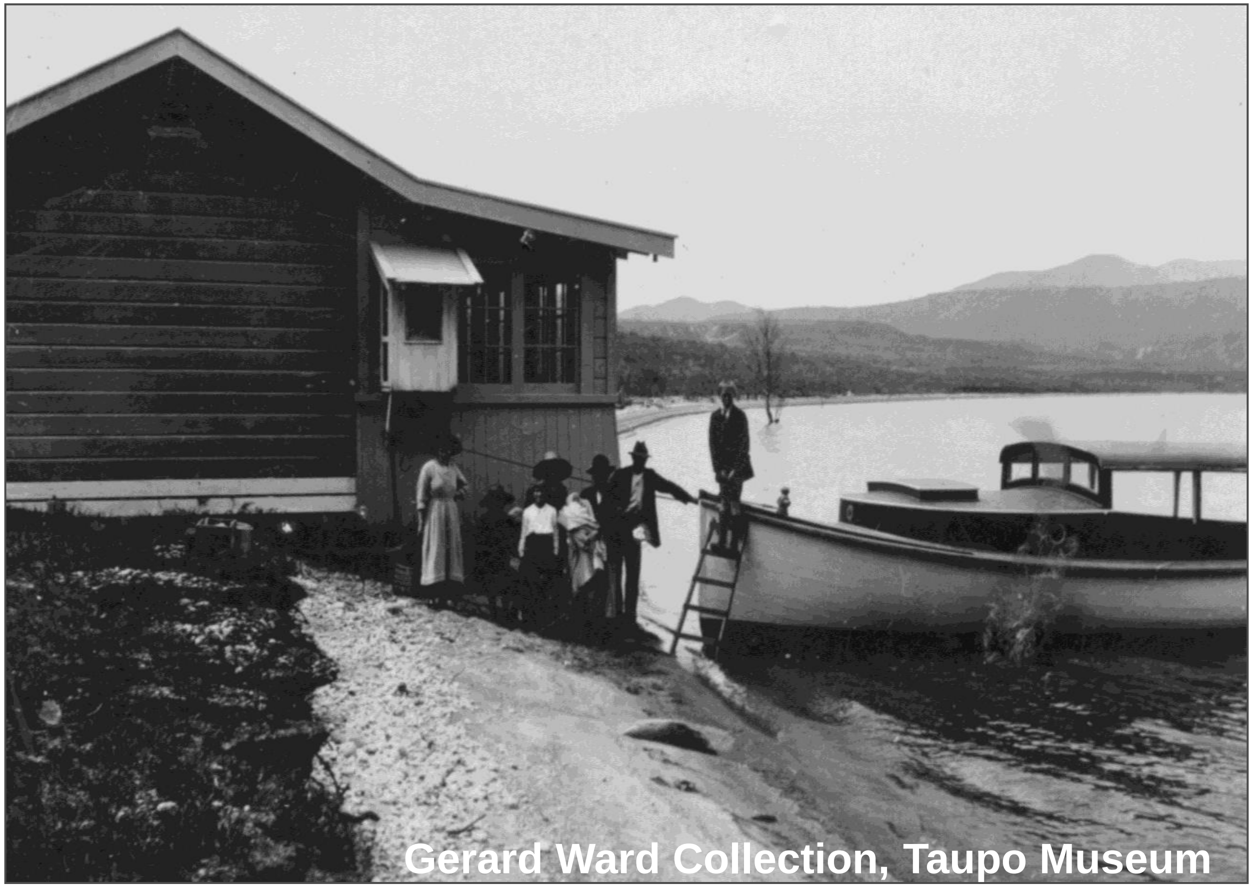


‘Moderate’ unrest at Taupo: 1922-23

Deformation

- 1 m of uplift, then 3.7 m of subsidence on the north shore of Lake Taupo
- Hundreds of 1 m high ‘water spouts’ seen

Flooding caused by subsidence at Whakaipo Bay.



Hydrothermal eruptions as another expression of unrest

Rotorua 2001

ECLIPSE - Eruption or Catastrophe: Learning to Implement Preparedness for future Supervolcano Eruptions

2017-2022 MBIE Endeavour programme

Statement of intent

Co-produced research (with GeoNet, Iwi and CDEM) to provide a sound science basis for the interpretation and response to unrest and possible eruption (or not) at New Zealand’s caldera volcanoes.

Research Participants

Victoria University, GNS Science, Massey University, Auckland University, Canterbury University, Waikato University, Local Iwi researchers, CDEM Group members (Caldera Advisory Group)

Eruption or Catastrophe: Learning to Implement Preparedness for future Supervolcano Eruptions

2017-2022 MBIE Endeavour programme

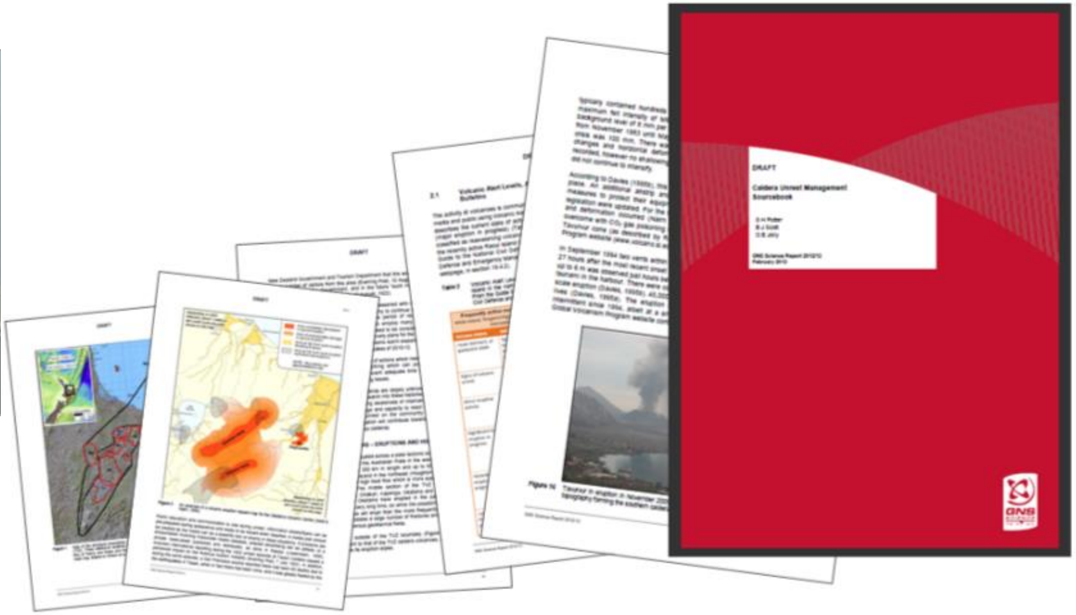
AIM: Using information from the past (geological studies), merging this with knowledge of the present (geophysical studies and GeoNet Monitoring) to inform the future

Caldera Advisory Group (CAG)

The Caldera Advisory Group is an interagency collaboration focusing on increasing the understanding of caldera unrest episodes, risks and potential consequences.

Caldera Advisory Group

Potter, S. H.; Scott, B. J.; Jolly, G. E. (2012). Caldera Unrest Management Sourcebook, *GNS Science Report* 2012/12. 74 p.



Summary

- Volcanic unrest is complex, has multiple parameters and high uncertainty
- Unrest at caldera volcanoes is physically hazardous, and can cause negative social impacts including:
  - Rumours and exaggeration
  - Public anxiety
  - Economic impact
  - Mistrust of scientists and public officials
- Nearly 100 episodes of heightened activity identified at Taupo Caldera, wide range in intensity across multiple parameters
- It is unknown how much unrest has occurred at NZ's other calderas
- The Caldera Advisory Group (CAG) is a multi-agency strategic planning group focussing on caldera unrest in the Waikato and Bay of Plenty.

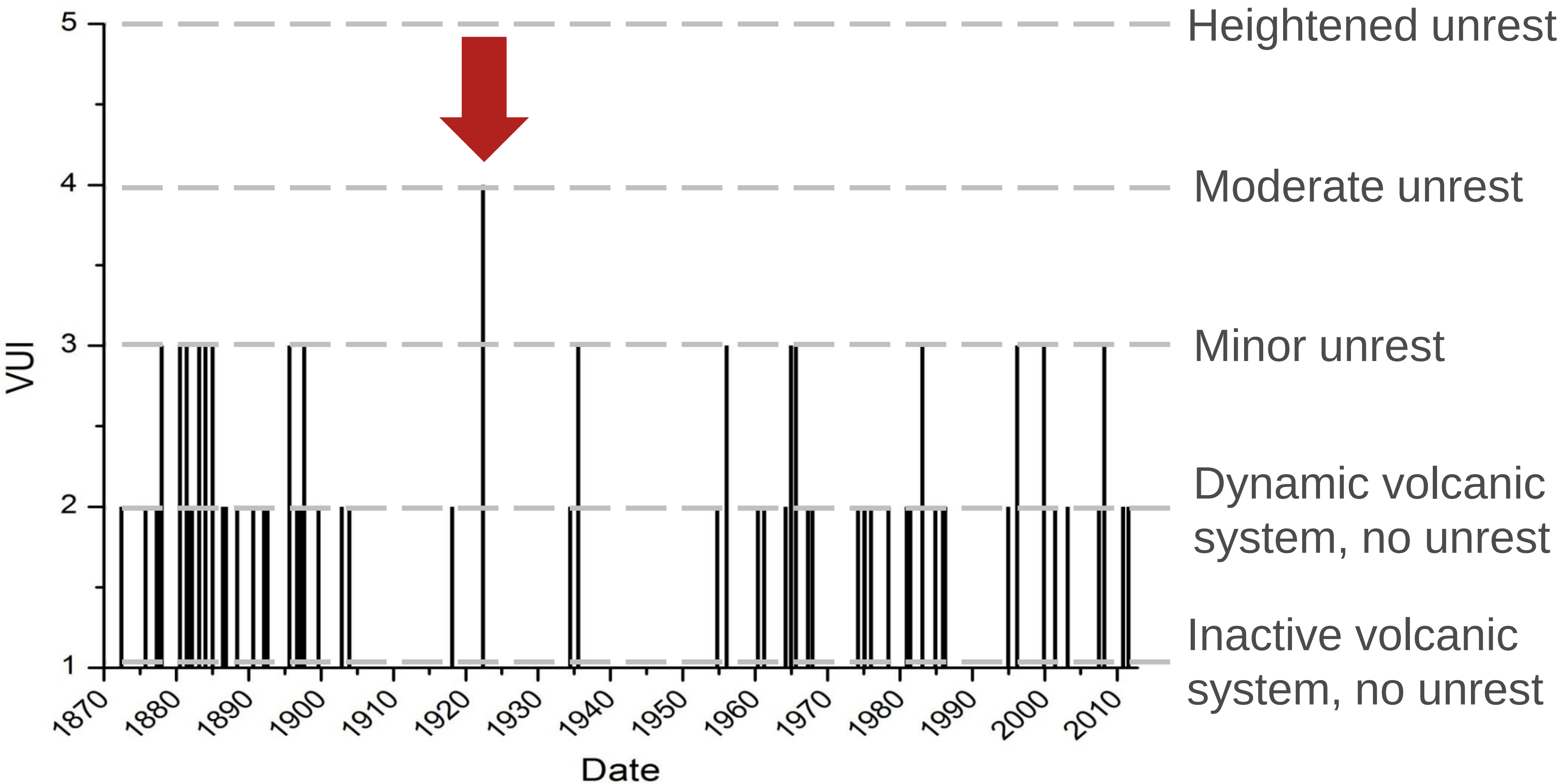
Unrest impacts and mitigation

From global case studies (e.g. 1970, Naples, 1980s onwards Long Valley), Taupo 1923, and theoretical:

- **Ground deformation (up or down), cracking**
- **Earthquake shaking (discrete earthquakes and tremor)**
- **Hydrothermal and geothermal changes**
    - Temperature
    - Chemistry
    - Style and output (increase, decrease, change)

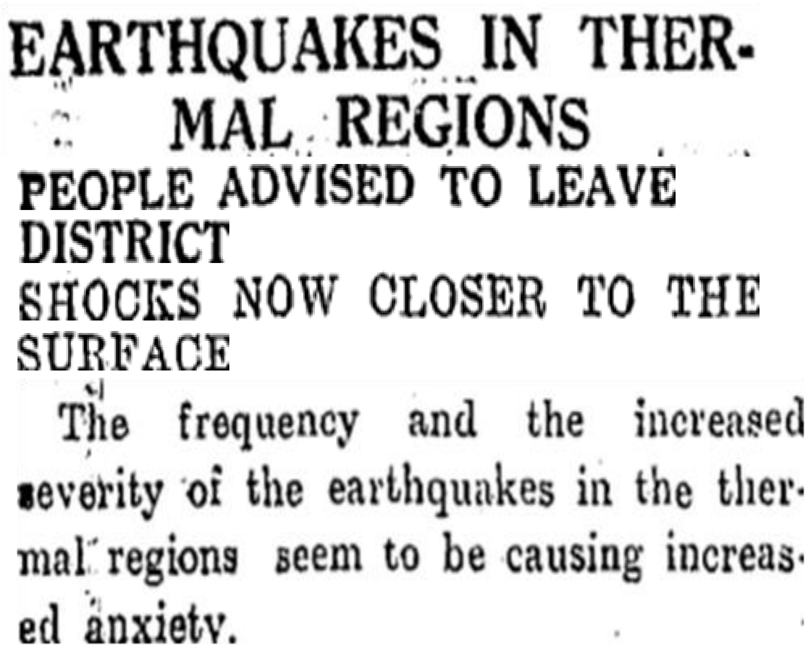
Taupo Caldera unrest

Relative intensity of unrest episodes at Taupo Caldera using the Volcanic Unrest Index



Taupo Caldera unrest: 1922

Evening Post, 19 June 1922

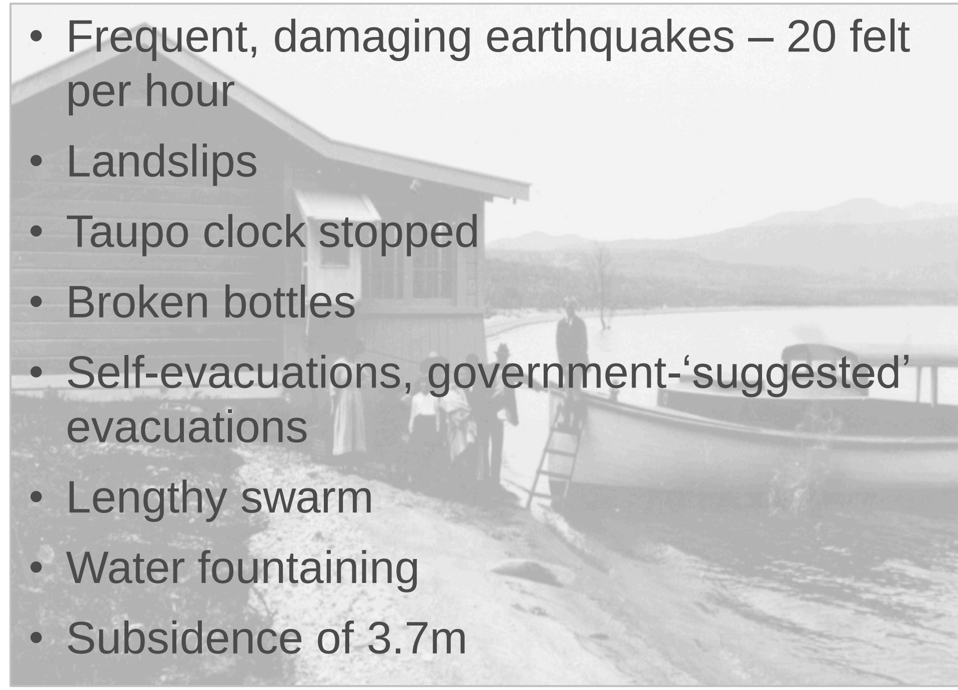


EARTHQUAKES IN THERMAL REGIONS

PEOPLE ADVISED TO LEAVE DISTRICT

SHOCKS NOW CLOSER TO THE SURFACE

The frequency and the increased severity of the earthquakes in the thermal regions seem to be causing increased anxiety.



- Frequent, damaging earthquakes – 20 felt per hour
- Landslips
- Taupo clock stopped
- Broken bottles
- Self-evacuations, government-‘suggested’ evacuations
- Lengthy swarm
- Water fountaining
- Subsidence of 3.7m

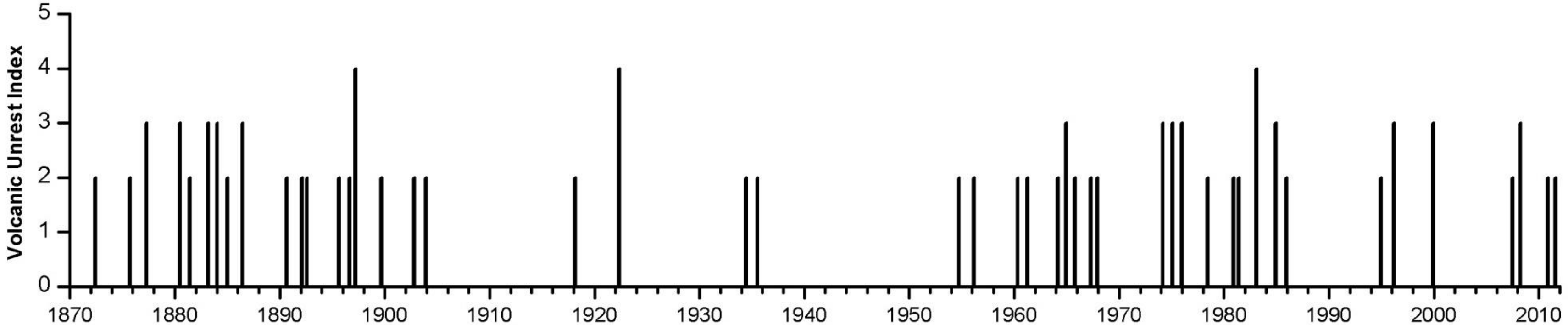
Duration	Seismicity	Hydrothermal	Deformation
10 months	High rate, <MM7	Change in activity of springs (?)	Subsidence of 3.7m

Summary of Taupo Caldera Unrest

Taupo Volcanic Centre has had:

- **Fluctuating 'background' activity**
- **16 episodes of unrest at TVC in 140 years (average of one per 8.8 years)**
    - 13 episodes of 'minor unrest'
    - 3 episodes of 'moderate unrest'
- **No episodes of 'heightened unrest' or eruptions (yet)**

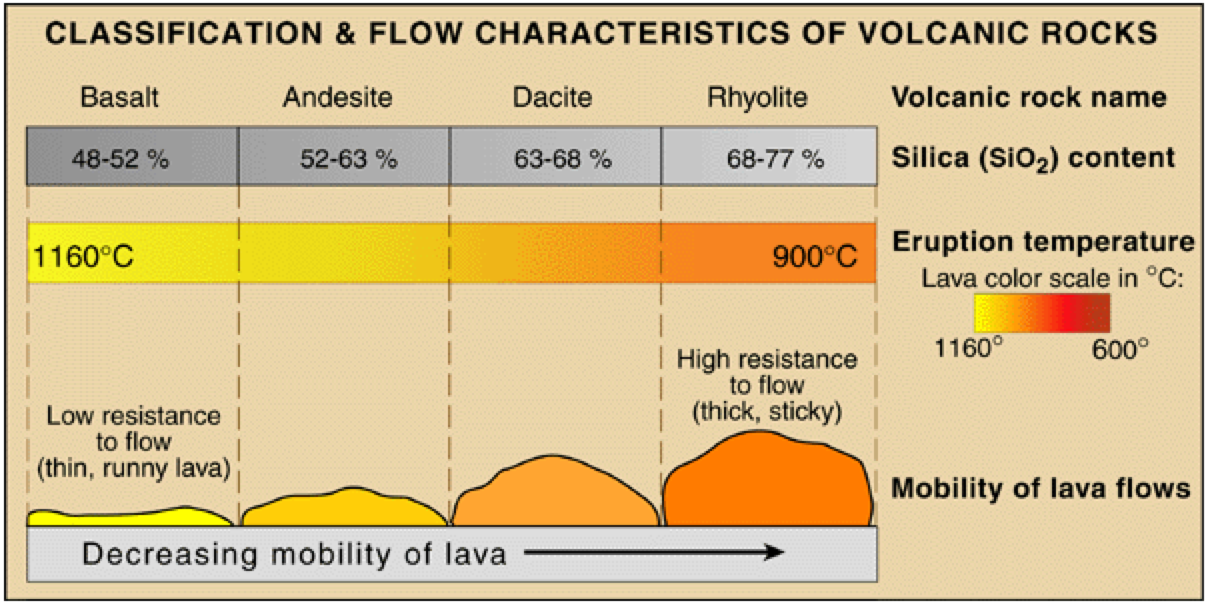
Caldera unrest caused impacts on built, social and economic environments



Eruption impacts

- **The case studies of Chaiten (2008-2011) and Cordón Caulle (2012), comparative (to andesite and basalt), and theoretical**
  - Lava domes
  - Ballistics
  - Ashfall, and resuspension
  - Gas and acid rain
  - Lahars (remobilization)
  - Pyroclastic Density Currents (surges, Pflows)
  - (and the unrest hazards too)

Volcanic rock types



Less explosive
Flows as lava

More explosive

Eruption impact examples:

Rhyolitic Eruption of Vulcan Chaiten, Chile

Tom Wilson
University of Canterbury

Graham Leonard
GNS Science

Carol Stewart
Wellington

David Johnston
Massey University/GNS Science

EQC EARTHQUAKE COMMISSION

Massey University

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

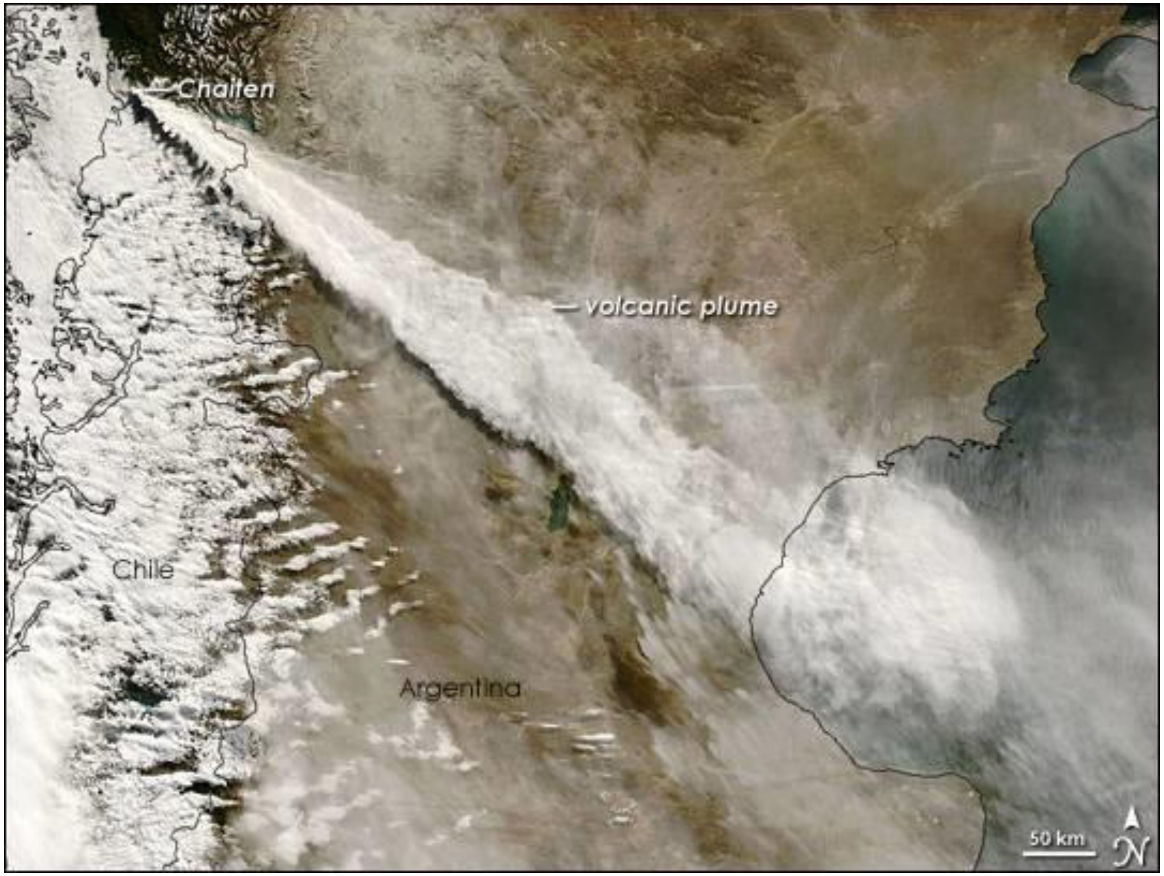
Statistics

2 May – first eruption (plinian) to 20 km height

6 May – second plinian eruption to 30 km height

175,000 km^2 affected by ashfall

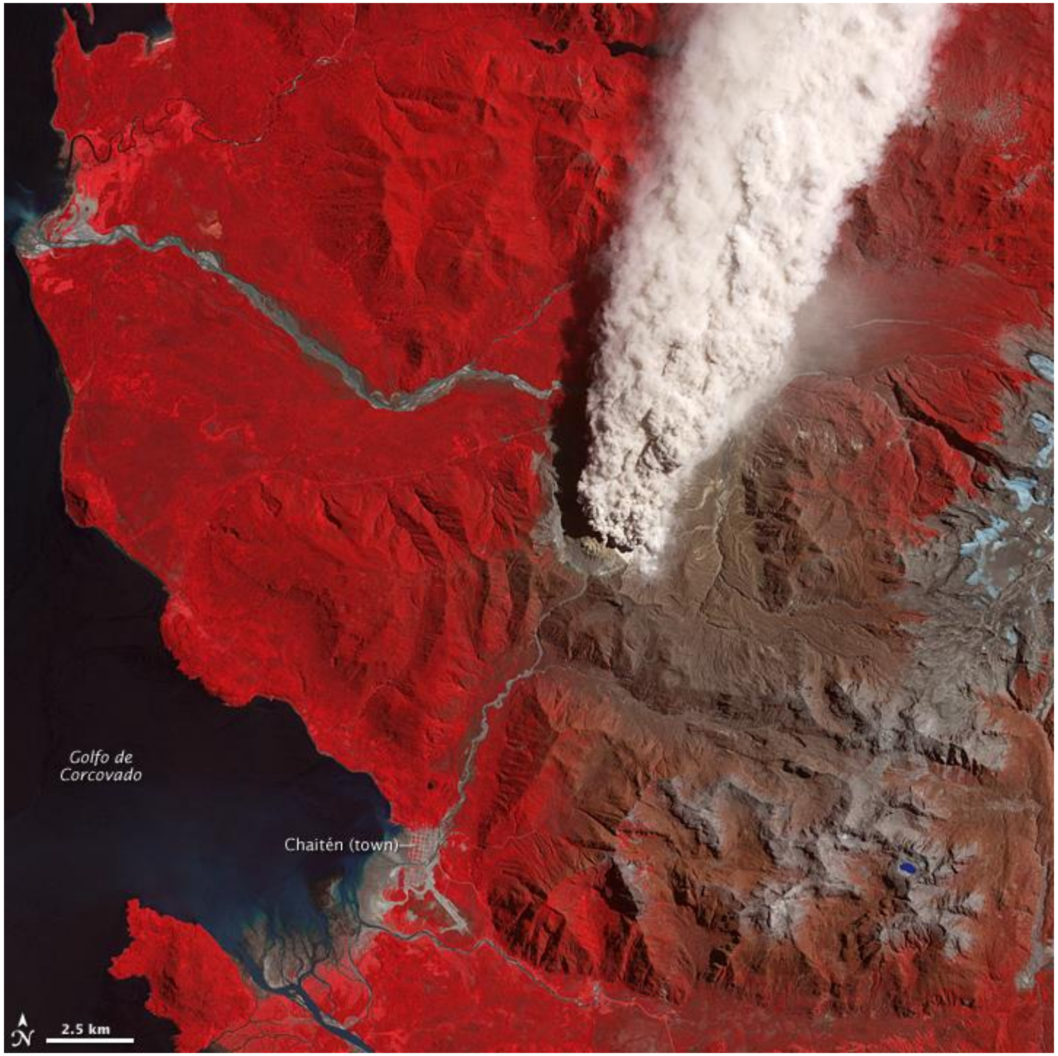
6,000 people evacuated (Chaiten and Futaleufu)



On-going eruption - lava dome growth with light ashfalls

The importance of wind direction

19 Jan, 2009

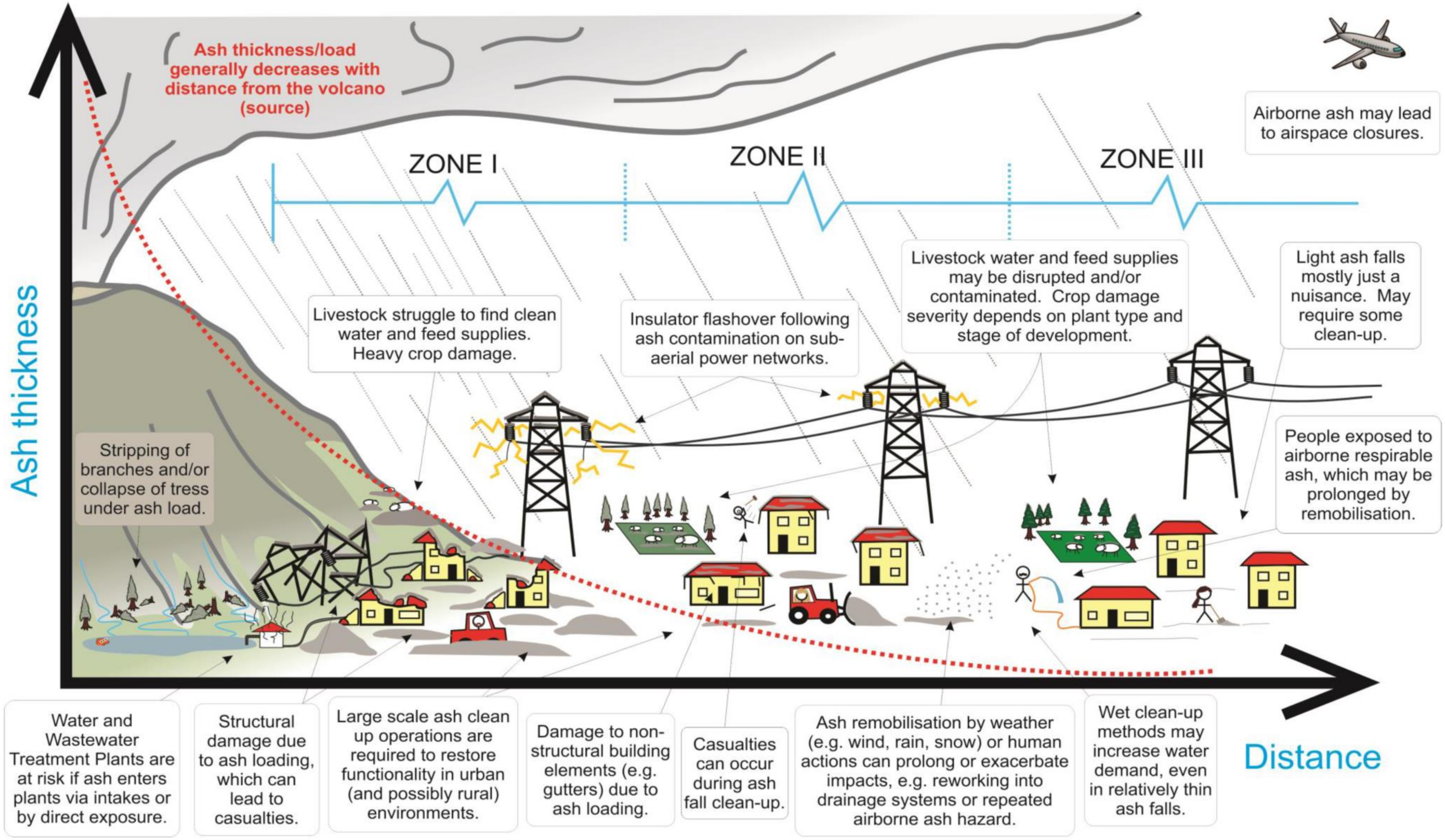


Chaiten town – evacuated because of lahar and pyroclastic flow threat

Lahars and ashfall: Chaiten Airport - after

Futaleufú, Chile

- Town of approx. 2000 located ~ 70 km SE of Volcan Chaitén
- Received approx 15 cm ashfall in total (2-3 cm at first)
- Evacuation of vulnerable on 6 May



Three main zones of tephra fall impacts

1. **Proximal: Destructive and immediately life-threatening**
2. **Medial: Damaging/disruptive**
3. **Distal: Mildly disruptive/nuisance**

Buried Pastures

1) Futaleufu – Puerto Rameq (Chile): 33 kV line FLASHOVER

- Heavy falls (up to and over 100 mm) of fine grained ash caused flashover to 68 km of 33 kV line
- 10-20% of insulators estimated to be affected by flashovers
- Occurred following light rain on 6-9 May
- Heavy rain washed off most of the ash, but ash remained underneath insulator (flash-over occurred damage here)
- Total replacement of insulators on line – took too much time to clean or assess damage to each insulator.

Telecommunications

Very high level of resiliency, evening from within the plume

No reports of transmission disruption <u>anywhere</u>

- cellular phones were heavily relied on for emergency communication
- satellite phones = no problems
- UHF radio transmission = no problems
- telemetered sites = no problems

Transportation

Dry, fine ash

- Easily remobilised = visibility problems for other drivers (roads closed in Esquel due to this)
- Few reported traction problems
- Some older-cars (20 years) reported engines failures from ash ingestion

Wet, fine ash

- Caused traction problems
- (soupy mud in places)

Futaleufu clean up: 200 mm of ashfall (+ snow)

Municipal clean-up

Municipal clean up was a significant undertaking in towns

- Restoration of roads
- Reduce re-mobilisation hazards (wind and water)

1) Began with clean up of public areas (built community spirit)

2) Personal property clean up

- Required everyone to clean up at the same time so on-going contamination wouldn't occur...
- Difficult to achieve with staggered return from evacuation


6 1:30PM


6 10:15AM


IRIBUS LTDA
TURIBUS
6 10:08AM

Esquel's water supply

150km downwind

- Esquel's water supply comes from both a surface canal and groundwater
- Water supply authority concerned as ash entered the Canal de Faldeo
- Esquel residents noticed a 'strong metallic taste'
- Water authority immediately initiated a monitoring programme targeted at establishing risks of ashfall for drinking water

Canal de Faldeo, Esquel

Value in a timely, well-designed monitoring programme and clear communication of results to the public – effective in allaying concerns and fears

Dome formation continued for more than 2 years with intermittent ashfall to 10s of km. Ongoing pyroclastic flow risk 10+km+.

USGS/GNS/NZ Volcanic Impacts Website

- Updated and revised with an expanded knowledge base
- http://volcanoes.usgs.gov/volcanic_ash/

VISG Ash Poster Series

- Developed for lifeline sector
- Fact- and advice-rich resources for a <u>specialised</u> audience
- Sector specific terminology
- Minimise volcano jargon
- Address uncertainty
- ➢ Accurate, authentic, credible

http://www.gns.cri.nz/Home/Learning/Science-Topics/Volcanoes/Eruption-What-to-do/Ash-Impact-Posters

VISG Ash Poster Series
Sector specific posters

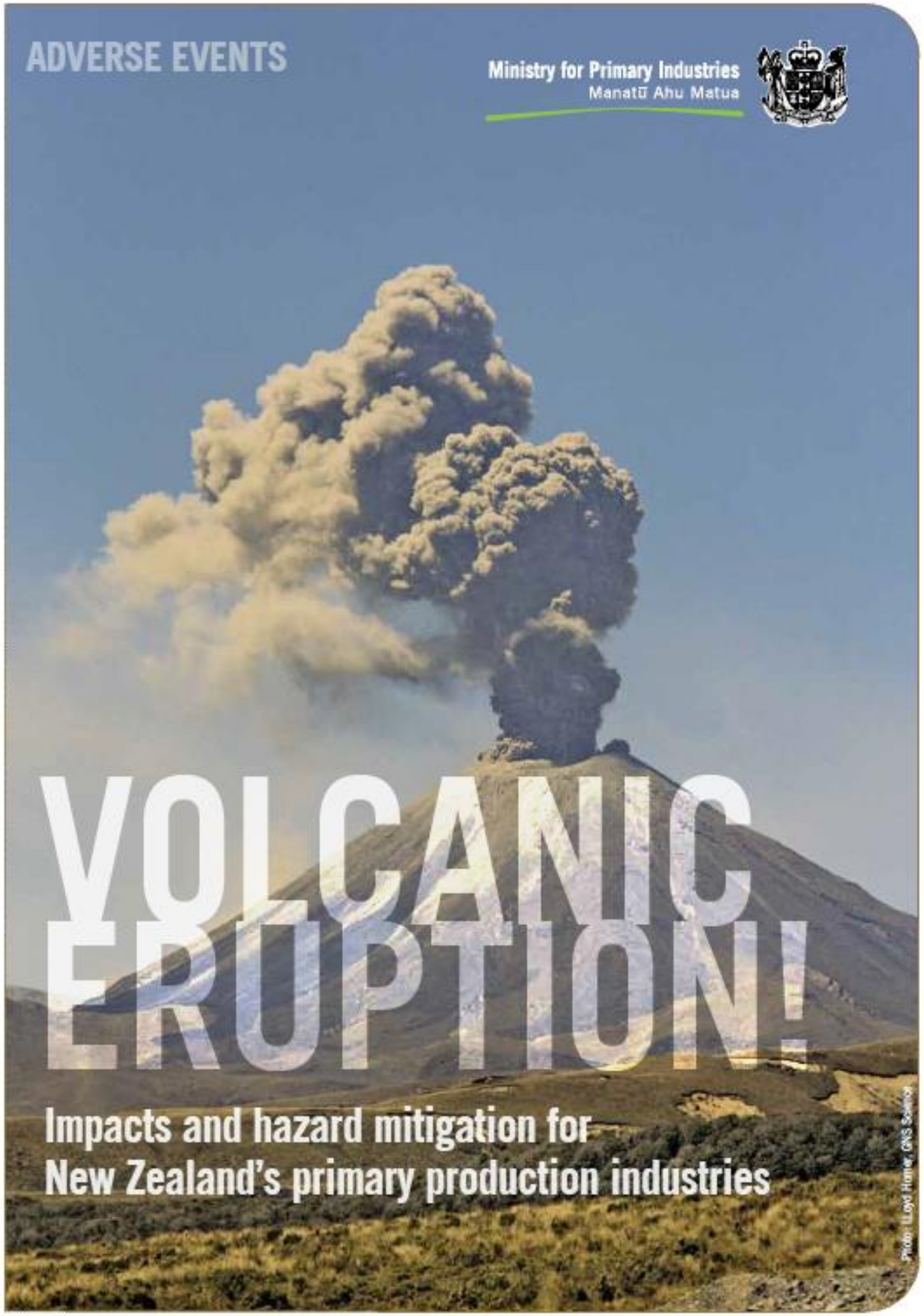
- Electricity – distribution & transmission
- Electricity – generation
- Water supply
- Wastewater
- Airport
- Road Managers

VISG Ash Poster Series
Cross-cutting posters

- Management of Buildings
- GenSets/HVAC,
- Computers + Electronics
- Urban Clean Up

Agriculture resource

- **Likely impacts**
  - People
  - Livestock
  - Water supplies
  - Horticulture
  - Forestry
- **Contains case studies**
- **Provides mitigation options**

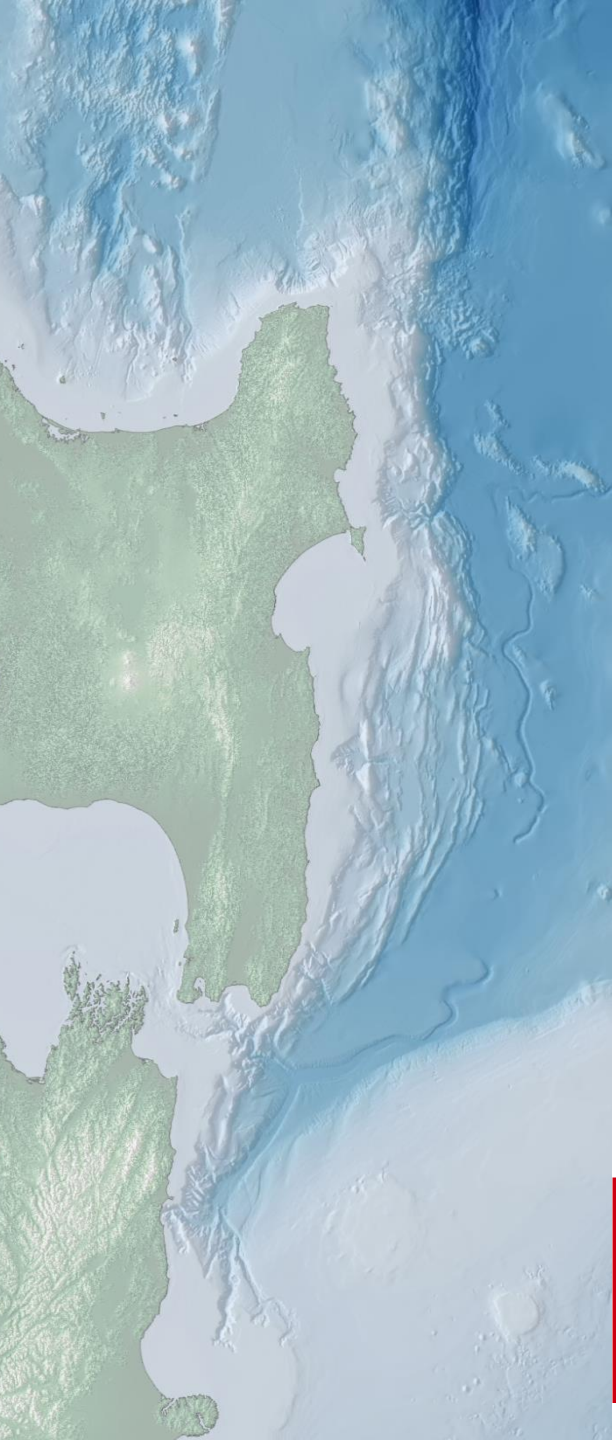


<u>Things for us all to design as a team</u> (many are aligned Caldera Advisory Group deliverables)

- Volcano Health Status - **dashboard**
- Incl. environmental monitoring solution
- **Probabilistic** analysis of volcanic hazards
- **Impact** metrics for unrest and volcanic hazards
- **Vulnerability** functions determined for six hazards (<u>supports hotspots and risk</u>)
- Decision support, CDEM planning and capability tools
- **Lifelines preparedness products (with lifelines)**
- CDEM, Iwi, GeoNet and NZVSAP **response plans**, **exercised**
- **Interagency plan**, tested in an exercise
- **Citizen science** module
- Risk perception **survey**
- Mitigation and **communication** toolkit
- **Schools** research partnership - new education approaches and Materials
- **Web** portal
- IAVCEI 2021: THE 4-yearly **world volcano conference** in Rotorua!

Dr Kate Clark

Earthquake Geologist
GNS Science



Slip behaviour at the Hikurangi subduction margin – NZ’s largest fault

Kate Clark & Laura Wallace & many others

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

EQC
EARTHQUAKE COMMISSION
Kōmihana Rūwhenua

NATURAL HAZARDS
RESEARCH PLATFORM

EAST COAST LAB
LIFE AT THE BOUNDARY

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

MASSEY UNIVERSITY

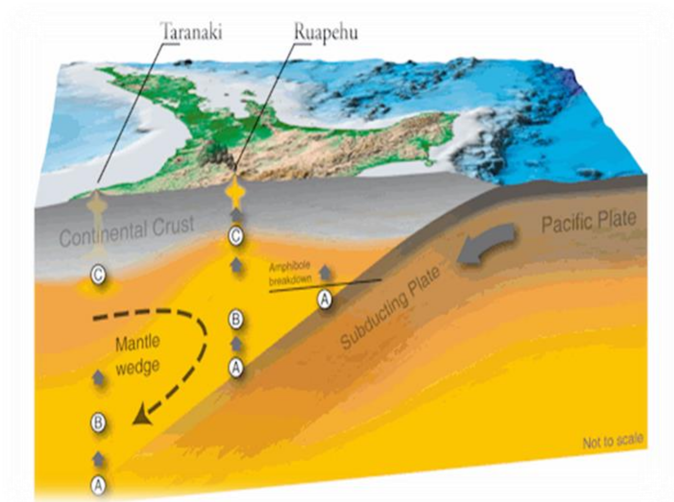
NIWA
Taihoro Nukurangi

GNS SCIENCE
TE PŪ AO

Subduction of the Pacific Plate occurs beneath the eastern North Island at the Hikurangi Trough

Subduction is where one tectonic plate dives or "subducts" beneath another

The Hikurangi subduction zone links up to the Kermadec and Tonga Trenches further north



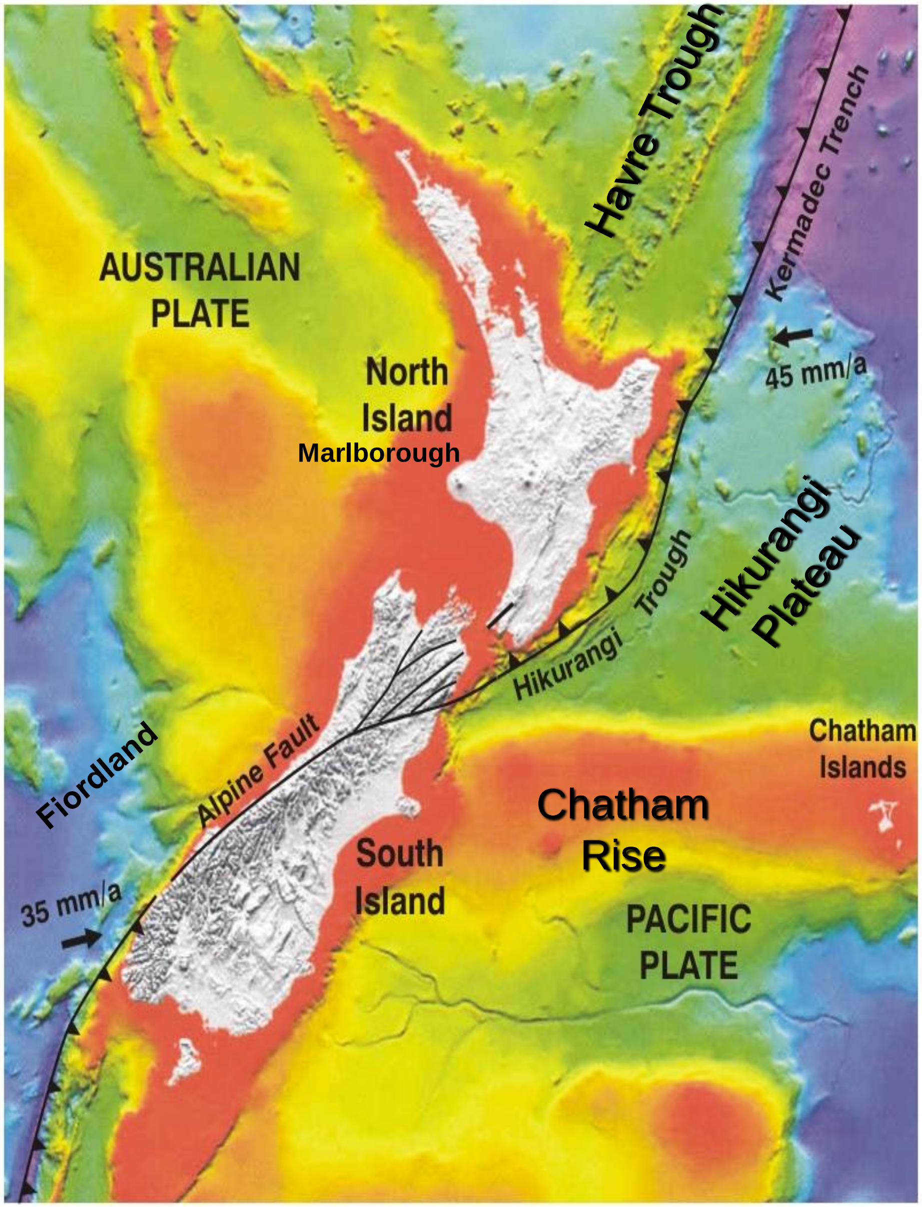
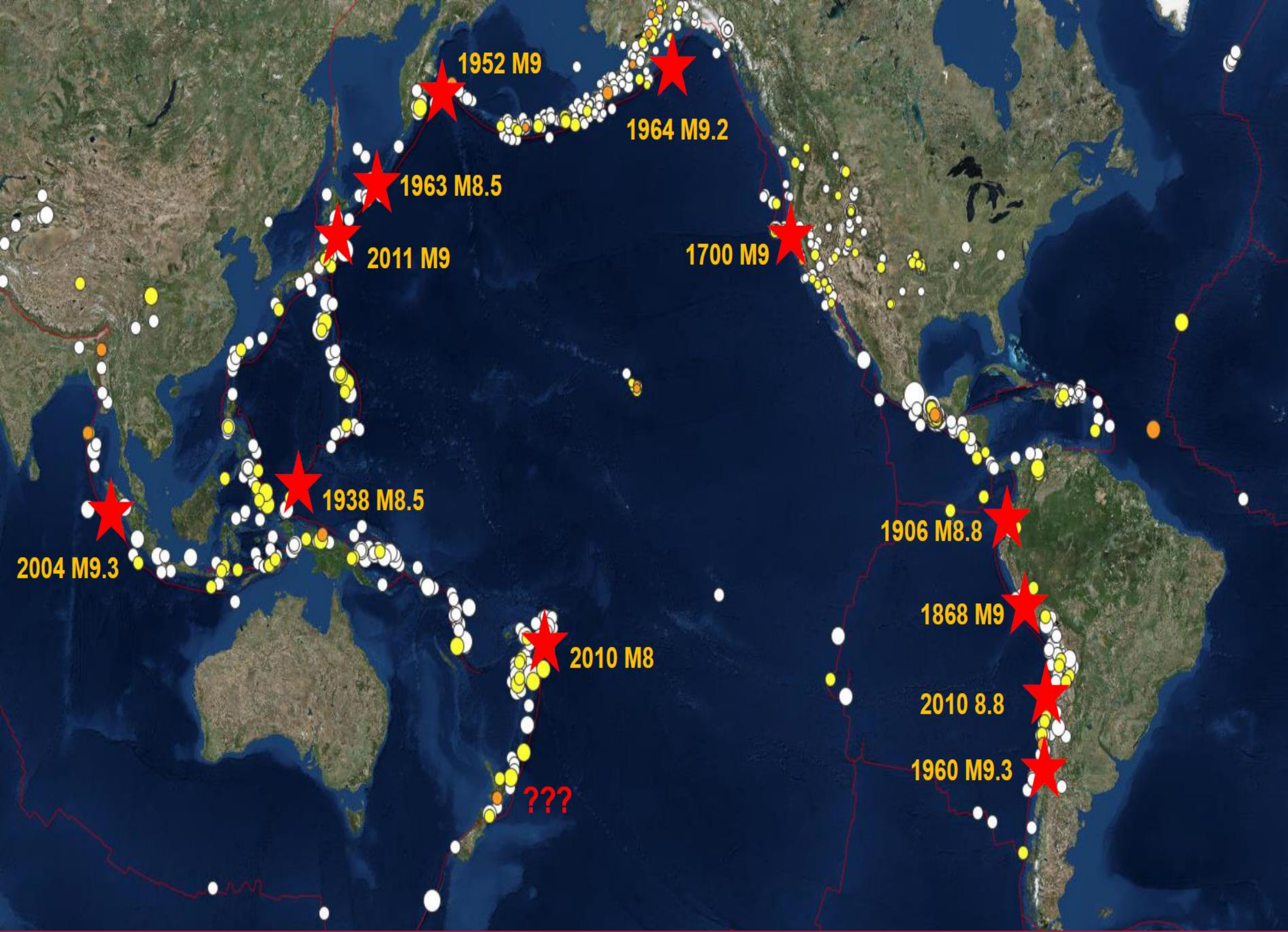
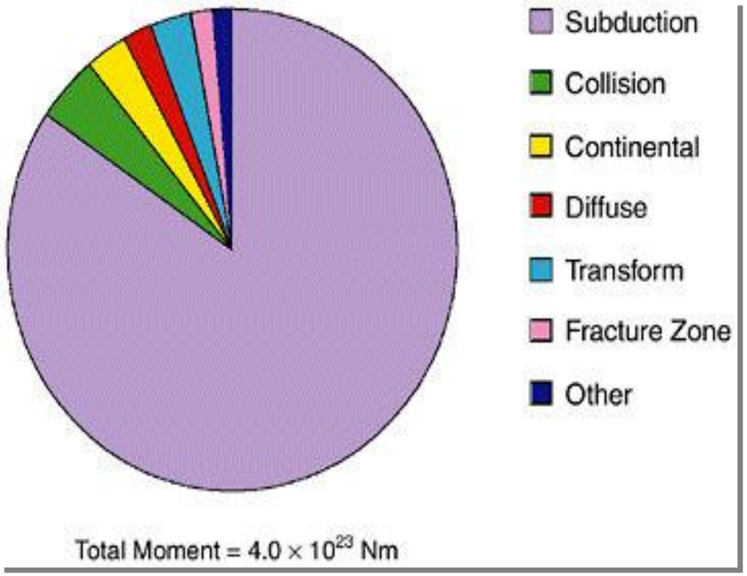


Image from NIWA


1952 M9
1964 M9.2
1963 M8.5
2011 M9
1700 M9
1938 M8.5
2004 M9.3
1906 M8.8
1868 M9
2010 M8
2010 8.8
1960 M9.3
???

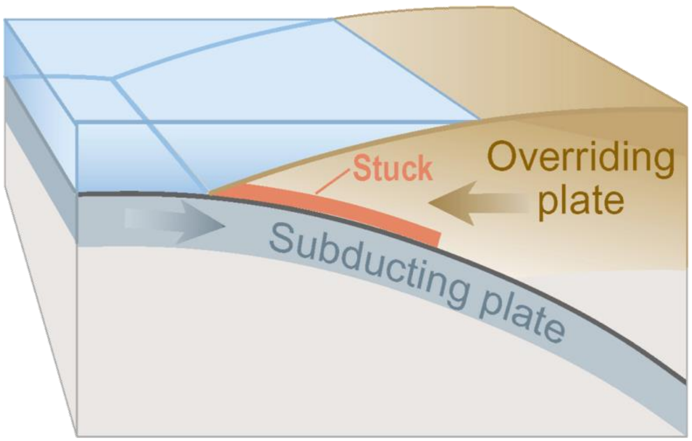
Why do we care? Subduction zones cause the world's largest earthquakes and generate devastating tsunami



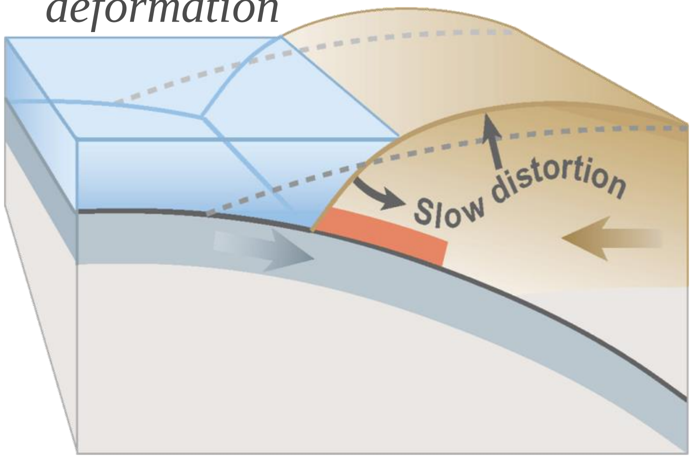
Subduction Zone Earthquakes account for the majority of earthquake energy release worldwide

We currently have little understanding of the tsunami and earthquake hazard posed to NZ by our Hikurangi subduction zone. **<u>More knowledge=better preparedness</u>**

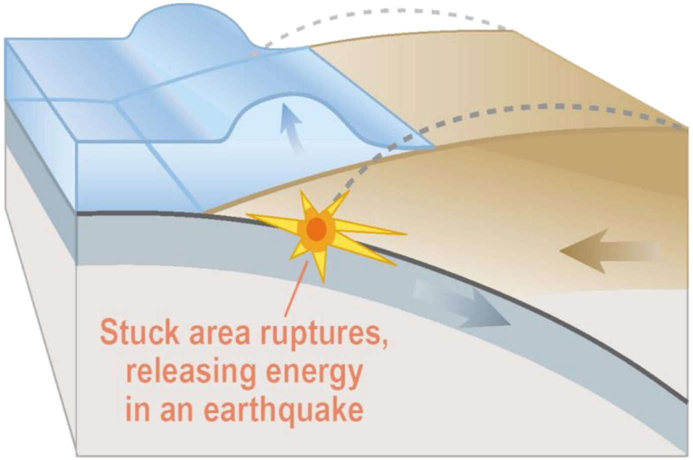
Subduction Interface Earthquake Cycle



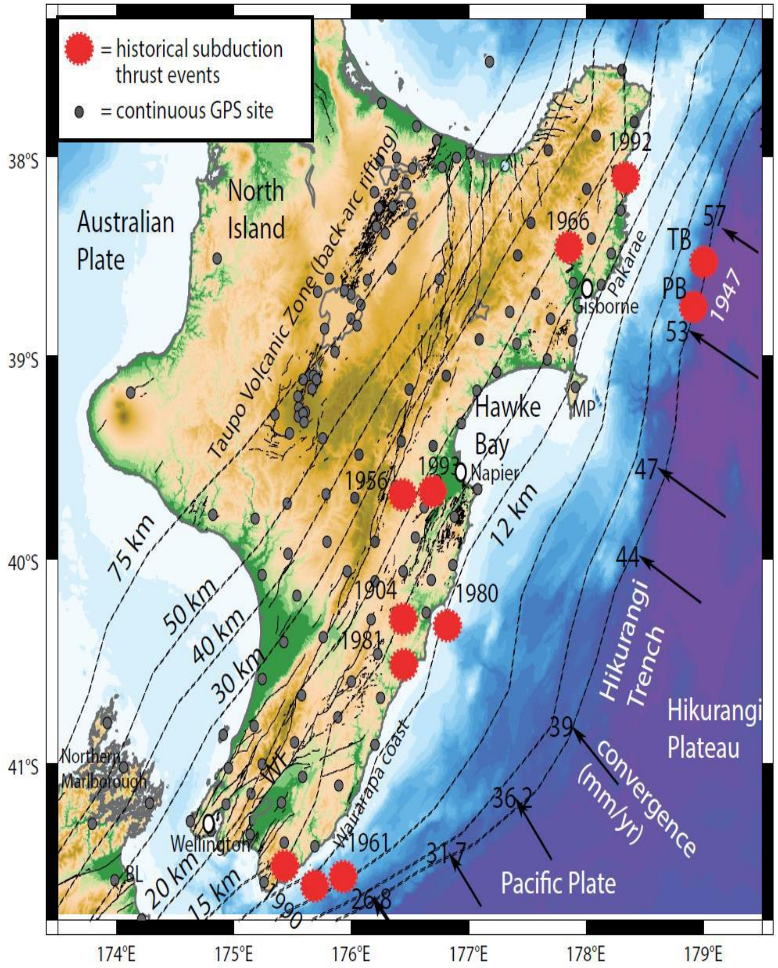
Interseismic period of deformation



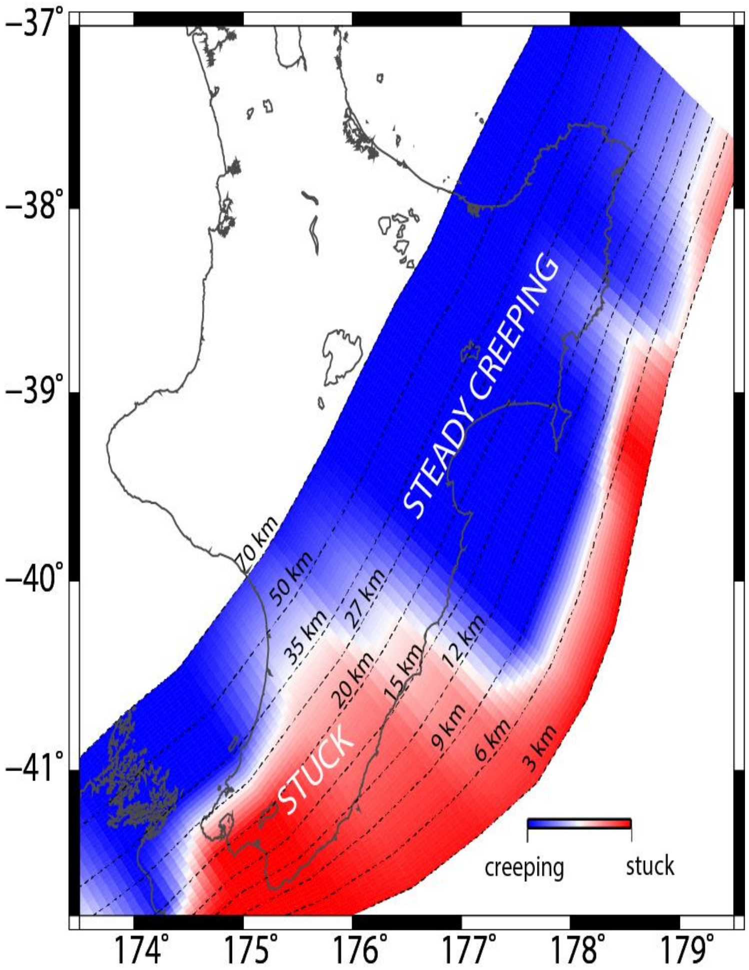
Sudden deformation; possible tsunami



Historic earthquakes & contemporary deformation at the Hikurangi margin

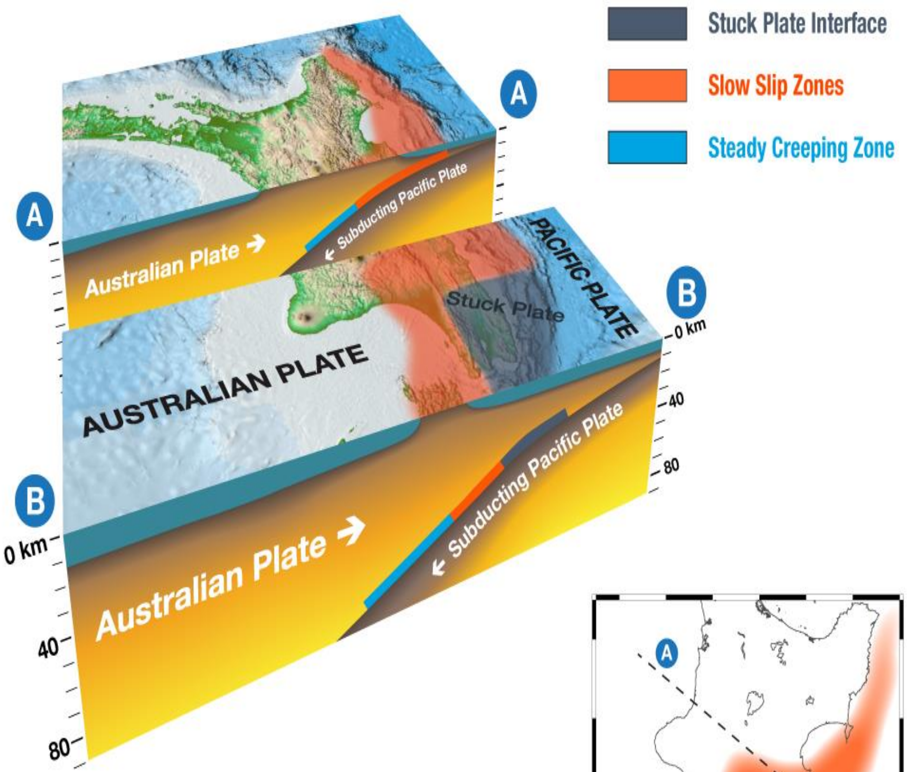


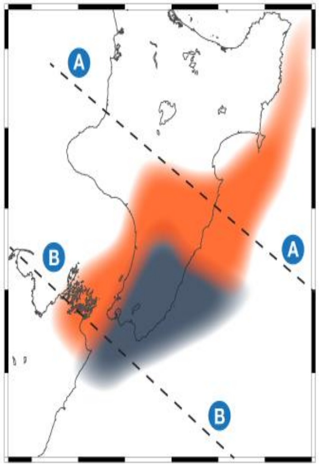
Interseismic coupling



No Great (Mw > 8.0) subduction thrust events have occurred on the Hikurangi interface in historical times (e.g., last 170 years)

Slow slip events

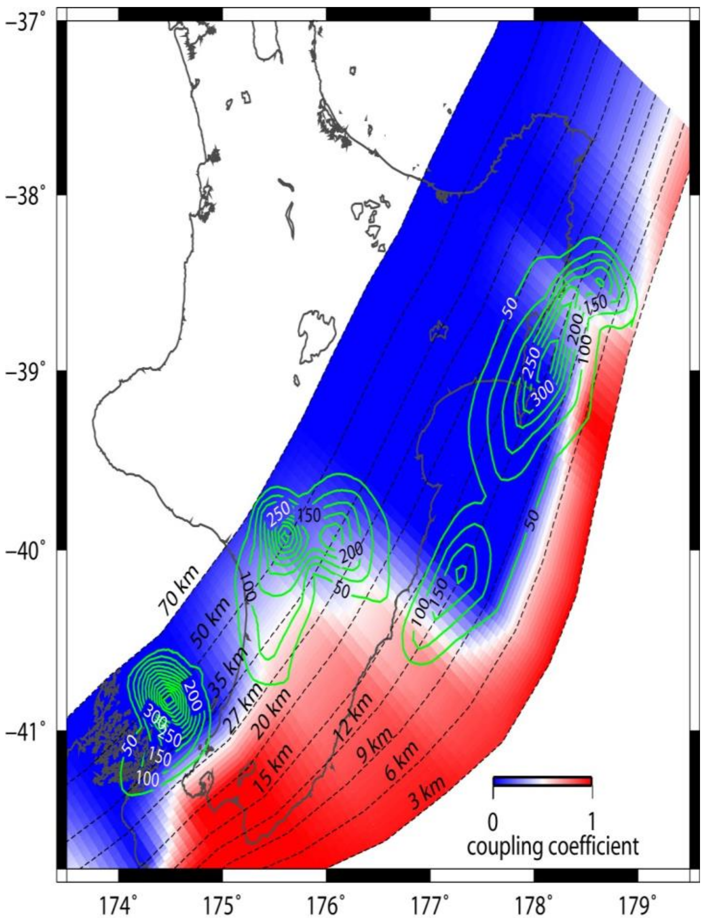




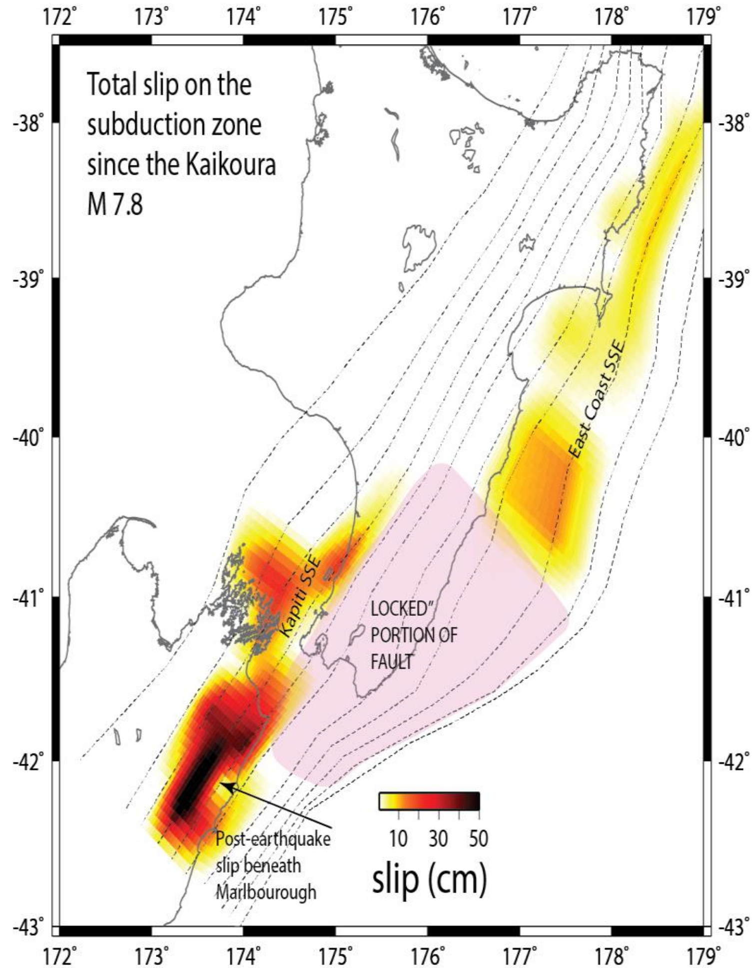
- Slow-slip events accommodate a large proportion plate motion.
- Slow-slip events don't pose any risk to people, but they are a major part of how the tectonic plates move in a subduction zone. The other major part is earthquakes.
- So if we better understand the slow-slip events, we should better understand the earthquake potential of subduction zones.

Figure from Geonet,
https://www.geonet.org.nz/about/earthquake/sse

Slow slip at Hikurangi outlines the areas of plate boundary locking



Most NZ slow slip events follow along the transition zone from the locked to steadily creeping portion of the subduction interface fault. Slow slip takes a huge amount of plate motion budget in the North Island (40%)



Slip on the subduction zone beneath the northern South Island was clearly observed for the first time following the 2016 Kaikoura earthquake

Research projects underway to understand Hikurangi SZ megathrust earthquakes and SSEs:

New Zealand's MBIE Endeavour fund project - $6.5M NZD (NZ research time, paleoseismology, numerical modeling, rolling seafloor geodesy, science and support for drilling and active source surveys); many NZ, US, Japan, European participants

2D seismic integrated with numerical modeling and paleoseismic studies to investigate the physical controls on megathrust behavior (**SHIRE project**; NSF, NZ, and Japan)

3D seismic investigation of **physical properties and structure of the source of shallow slow slip**: US (NSF), UK (NERC), Japan, NZ; Jan/Feb 2018; R/V Langseth (3D seismic) and R/V Tangaroa (for OBS deployments during active source acquisition)

Offshore deformation and seismicity (NZ, NSF, Japan) - Rolling deployments of Seafloor Pressure Sensors, OBS, and GPS-A

IODP drilling: sample sediment input section, thrust, upper plate, downhole logs, install NSF-funded observatories [Exp. 372, 375; Nov-Dec, 2017; March-May 2018]

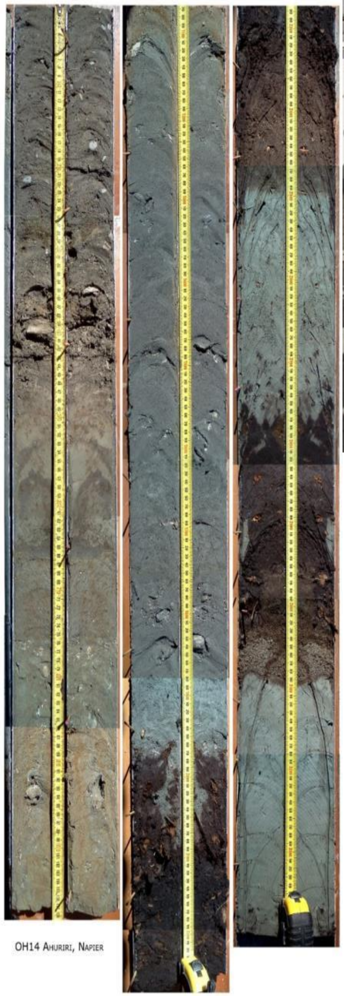
UNDERSTANDING THE HIKURANGI SUBDUCTION ZONE

MBIE Endeavour project will reveal the past and present behaviour of the subduction zone, and tell us why earthquakes and slow slip occur

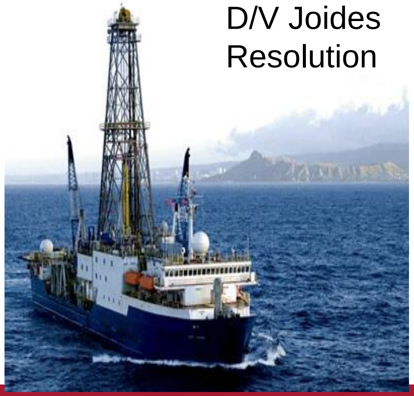
Four main components:

- **Matauranga Maori, education and outreach in east coast communities to increase understanding of Hikurangi subduction zone geohazards**
- **Modern-day subduction zone behavior**
- **Prehistoric earthquakes**
- **Reveal the physical processes controlling earthquakes and slow slip -- seismic imaging and scientific drilling**

Many NZ Universities, CRIs, and international scientists are involved in the project

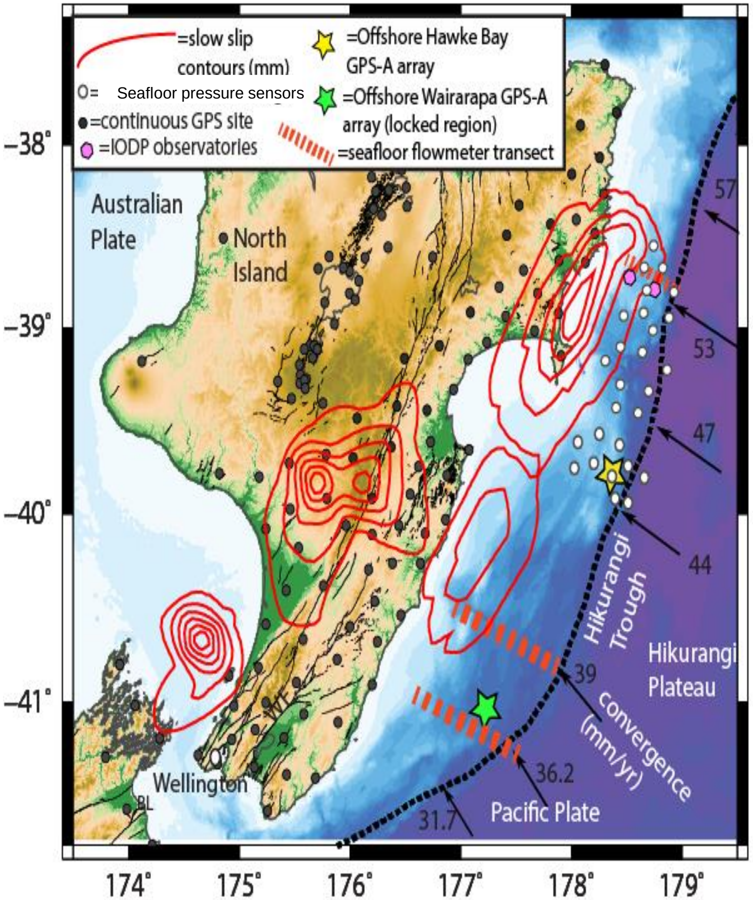


D/V Joides Resolution



What is the modern-day offshore deformation and seismicity?

NZ, U.S. NSF, and Japanese funded rolling deployments over the next few years of: Seafloor pressure sensors; OBS; and GPS-Acoustic.

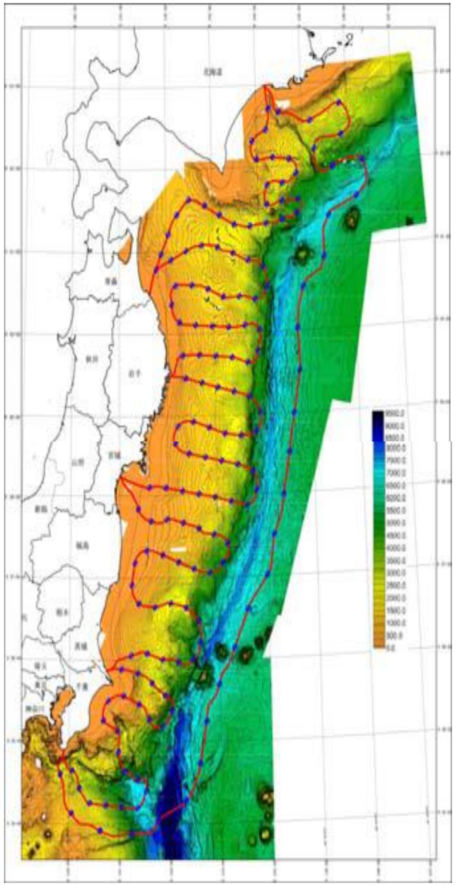


Seafloor pressure sensors measure cm-level vertical movement of the seafloor during slow slip events and earthquakes, and can also detect passing tsunami waves

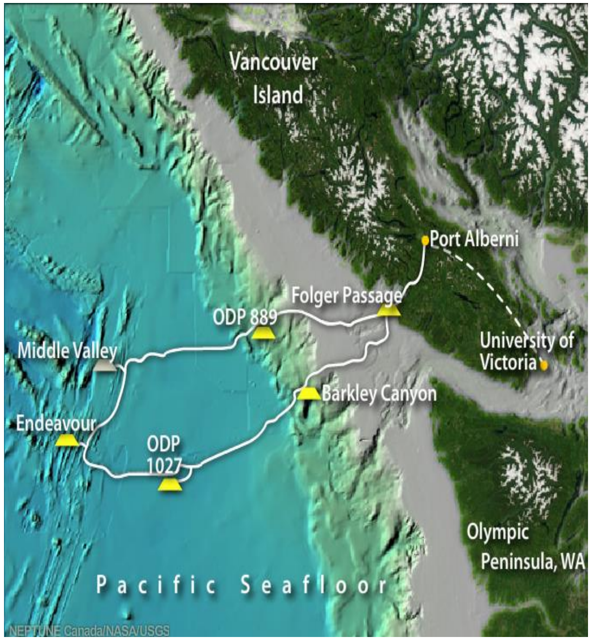
Seafloor transponders enable tracking of horizontal motions of the seafloor over time (at mm to cm level)

GNS Science is building 10 seafloor pressure sensors and purchasing GPS-A transponders to develop New Zealand-based capability in seafloor geodesy.

Offshore monitoring using permanent, cabled networks: the future of subduction zone monitoring for earthquake and tsunami early warning



This is already being done offshore Japan and Canada



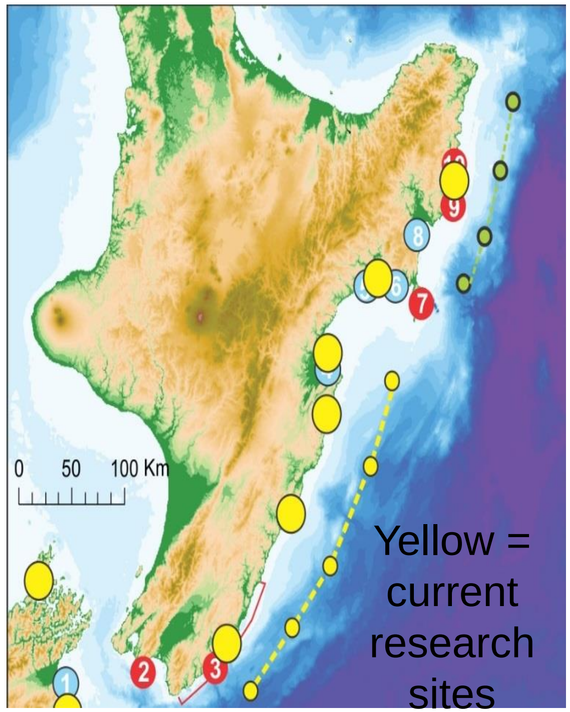
This project will help with developing NZ-based expertise in deep sea instrumentation and monitoring for earthquakes and tsunami

Earthquakes like the September M7.1 Te Araroa earthquake and the 1947 Gisborne quakes and tsunami demonstrate a need for offshore monitoring

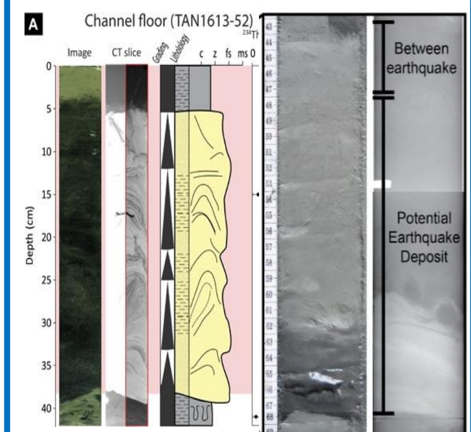
Prehistoric earthquakes: Does the Hikurangi megathrust rupture in great (M >8) or giant (M >9) earthquakes, and if so, how often?

Aim: Identify the past earthquake behaviour over a timespan of many thousands of years along the length of the Hikurangi SZ, using paleoseismic approaches.

Onshore:
- marine terrace trenching
- estuary sediment cores
- focus on high-precision dating of past coseismic coastal deformation



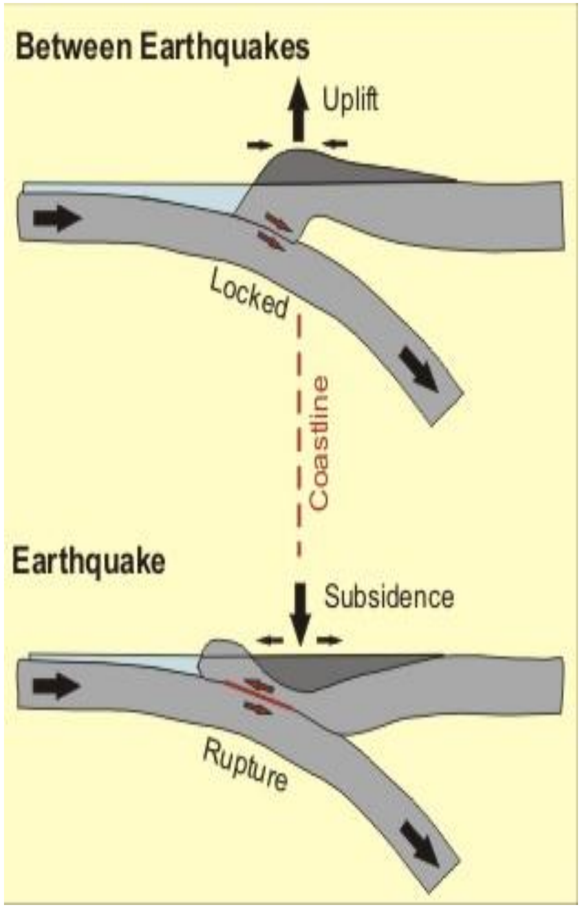
Offshore:
- shelf and slope sediment cores
- calibrated by observations of the Kaikōura EQ turbidite

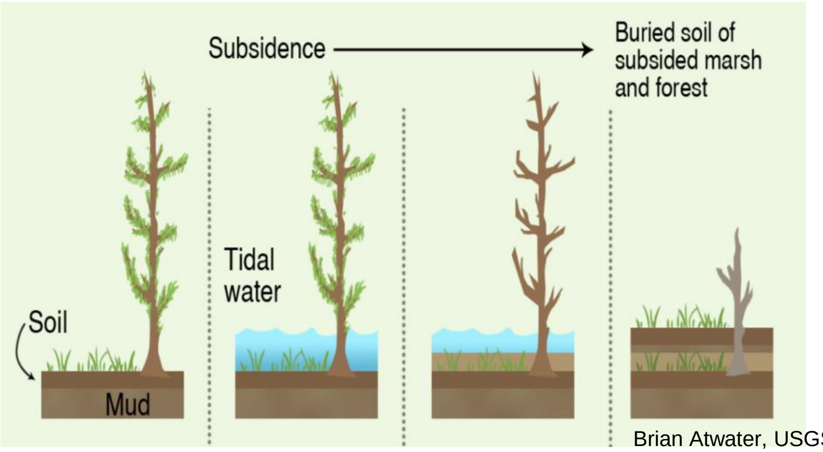


Integrate onshore/offshore to obtain a high resolution record

How do we find out whether we have great subduction earthquakes on the Hikurangi margin?

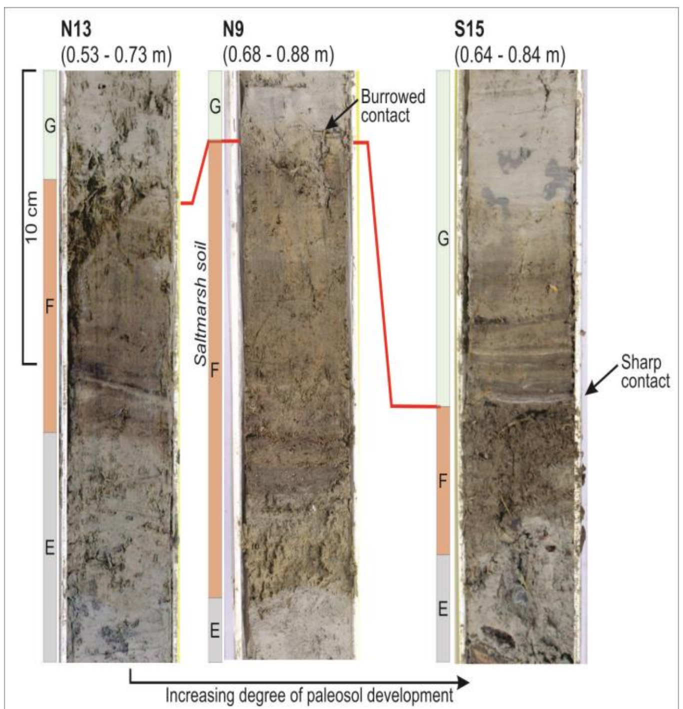
Great Earthquakes Leave Geological Evidence

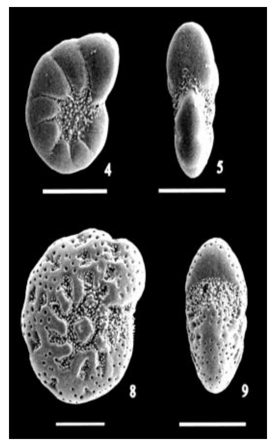


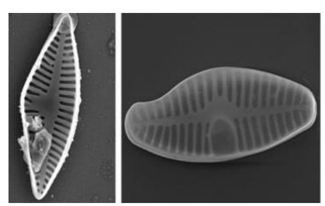


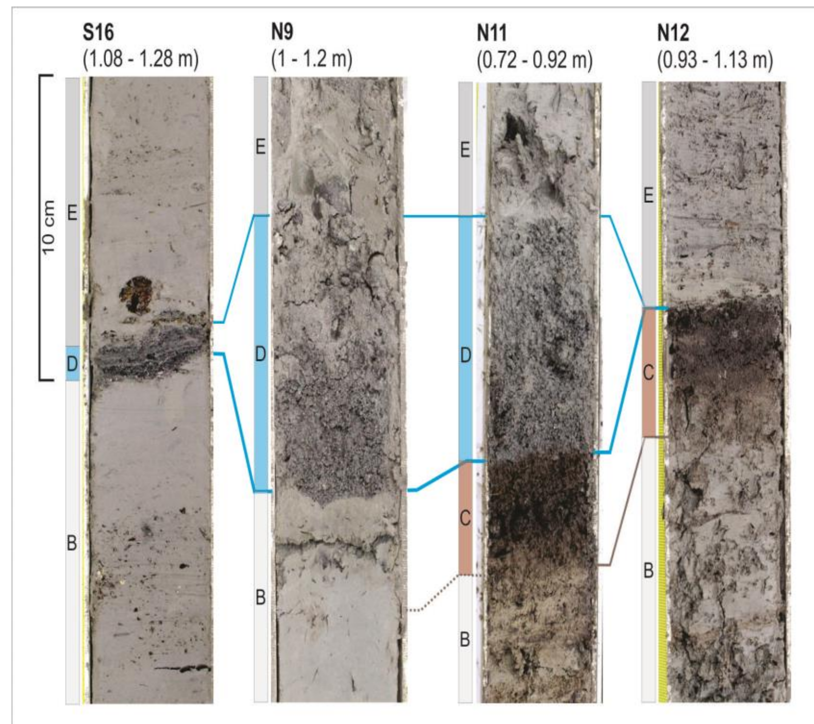
Brian Atwater, USGS

Example: Big Lagoon









Earthquake: 0.25 m subsidence 470 – 520 yrs ago

Earthquake & tsunami: 0.5 m subsidence 800 – 880 yrs ago

Coastal uplift

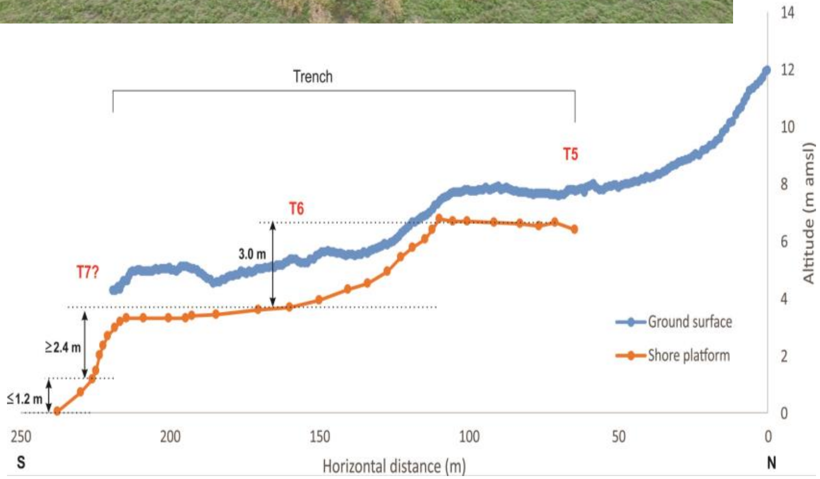
- Uplift also can occur in subduction earthquakes – more common with upper plate fault ruptures though.
- Current projects north of Gisborne & Wairarapa.
- Sudden coastal uplift produces a marine terrace, e.g. Kaikoura 2016.

Waipapa, Papatea Fault popup block, 4 days post-EQ, 4.5 m uplift.

Paparoa Point, 1 week post-EQ, 2.5 – 4.5 m uplift
Photo: Steve Lawson

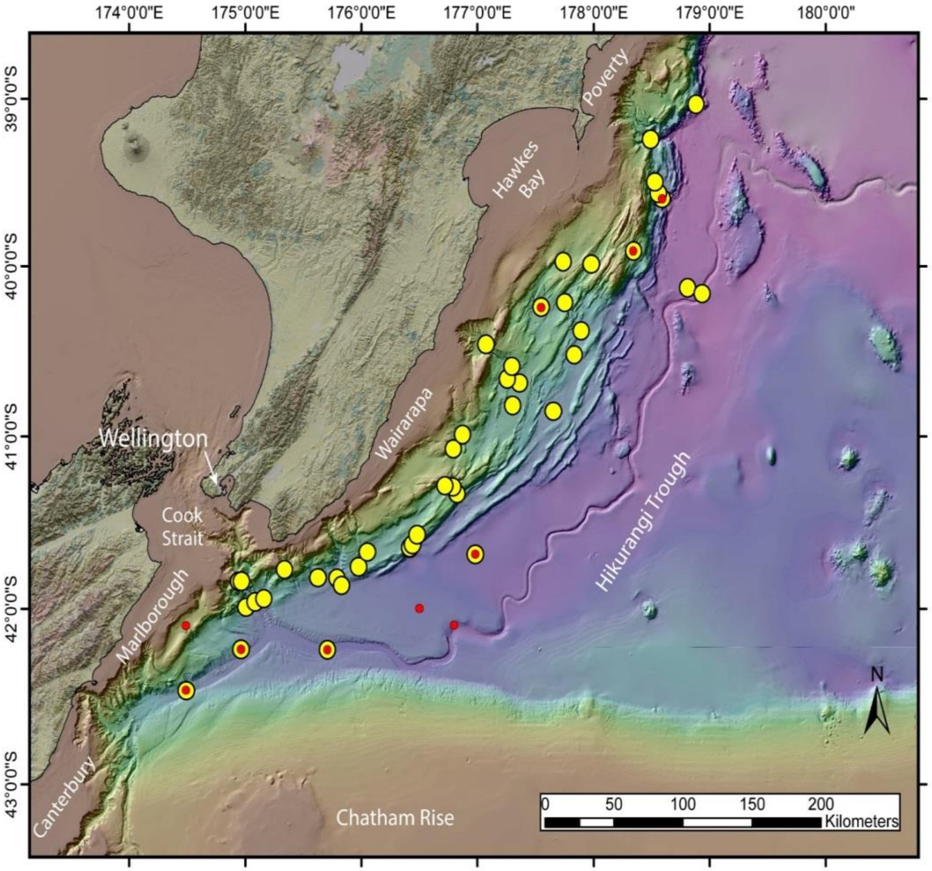
Pakarae River mouth

Platform topography indicates uplift of <1.2, 2.4, 3 m per event

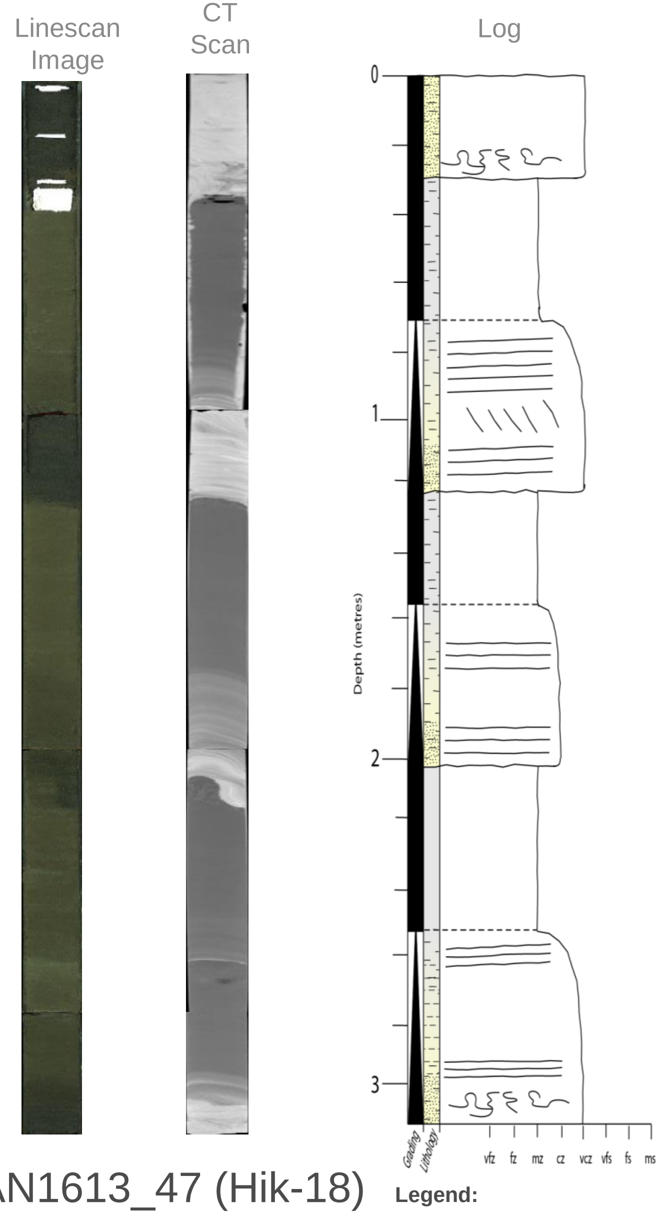


- Contributes to a better understanding of the timing & impact of past upper plate fault ruptures.
- Gable End Fault may rupture synchronously with plate interface or rupture independently.

Offshore paleoseismology



- 61 sediment cores between Marlborough and Poverty Bay
- Will record numbers of earthquakes & timing along the margin
- To integrate with onshore record



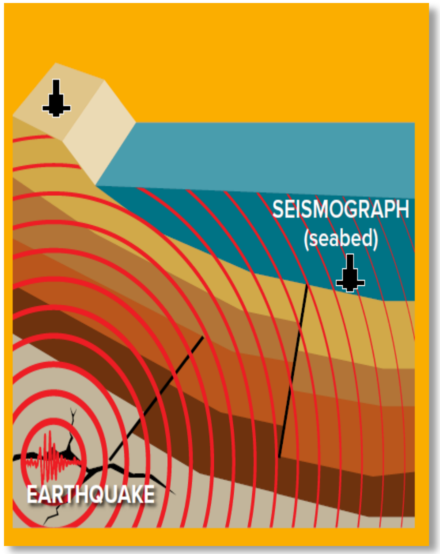
TAN1613_47 (Hik-18)

Reveal the physical processes controlling earthquakes and slow slip -- seismic imaging and scientific drilling

Joides Resolution

Scientific drilling:
Two IODP Expeditions to investigate slow slip offshore Gisborne:
Expedition 372: November/December 2017
Expedition 375: March-May 2018

Seismic imaging: Provides detailed geological structural information and physical properties



The International Ocean Discovery Program is an international, 26-country government funded research project using scientific drilling to investigate the history of the Earth, past climate change, and plate boundary processes

Two IODP Expeditions to investigate slow slip offshore Gisborne:
<u>Expedition 372</u>: November/December 2017
<u>Expedition 375</u>: March-May 2018

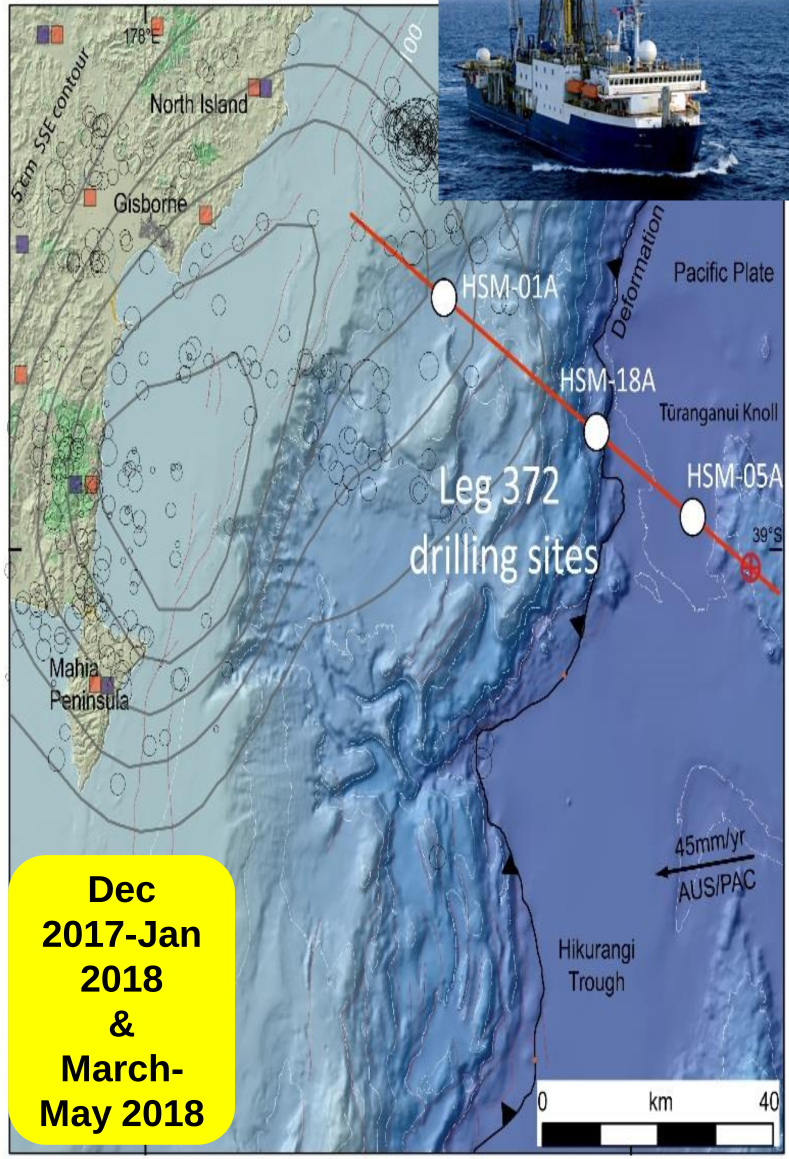
- Downhole logging
- Coring
- Observatory installation

1. Characterise SSE area properties

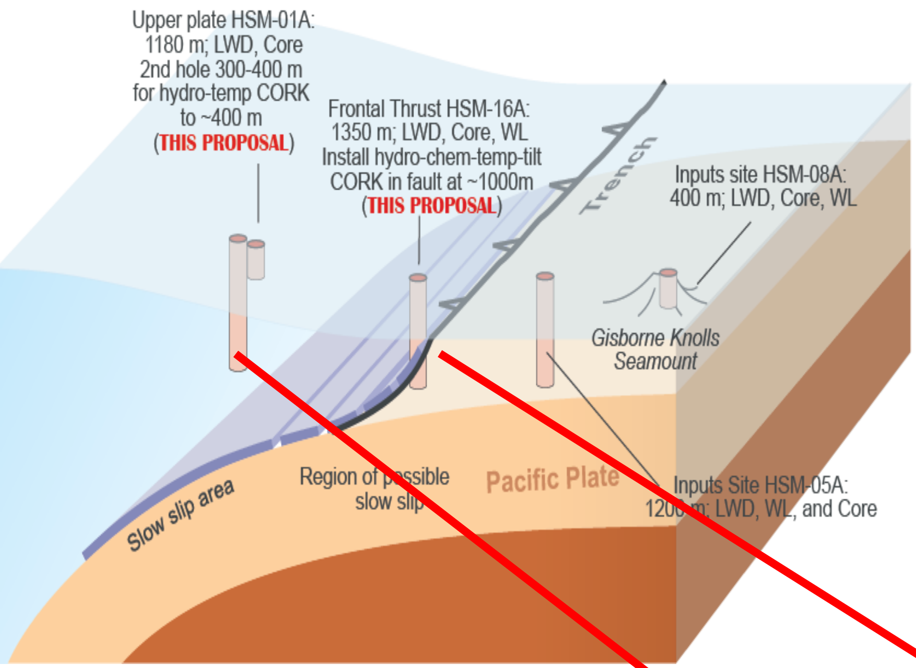
2. Characterise overlying plate properties

3. Monitor deformation, hydrology and chemistry, Instruments installed in the boreholes to monitor changes during slow slip for 10 years or more


Joides Resolution



Dec 2017-Jan 2018 & March-May 2018

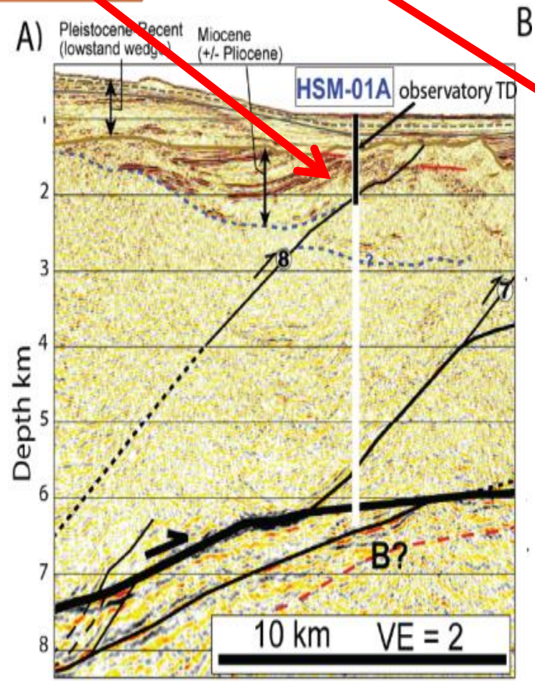


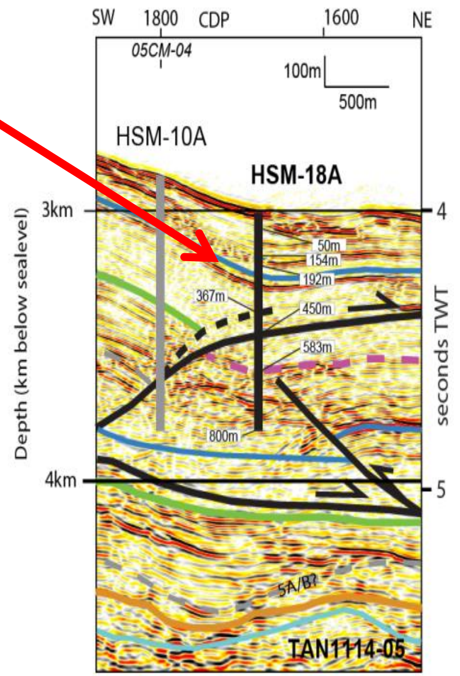
IODP drilling

Coring and geophysical logging of subducting and overriding plates surrounding the slow slip area

World's first scientific drilling project to target slow slip events

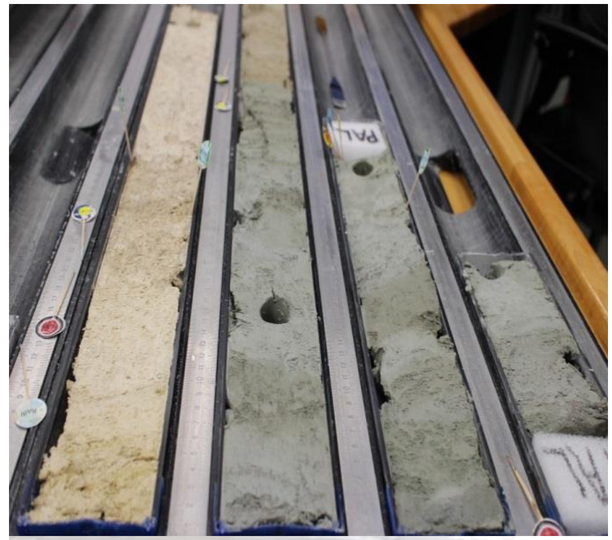
Long-term borehole observatories (US NSF-funded) were installed at two of the sites to measure changes due to slow slip events and earthquakes NEAR THE SOURCE OF SLOW SLIP





IODP expeditions collected over 1 km of cores at four different locations—these give us our first-ever view of the types of rocks that host slow slip events

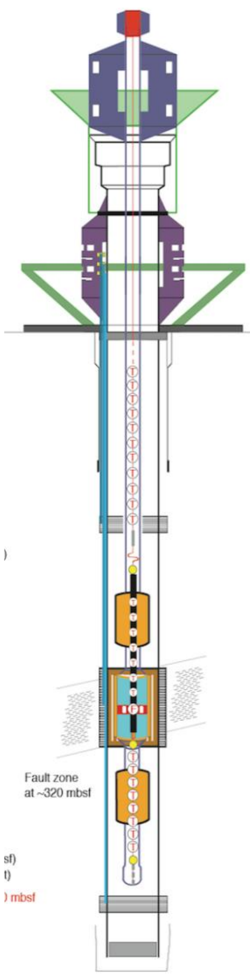
Site U1518



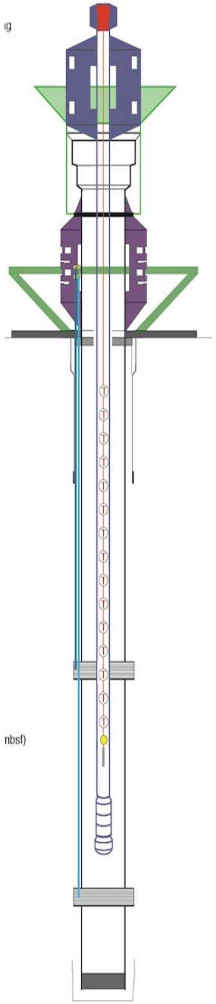
Site U1520

Two observatories installed at up to half a kilometer deep beneath the seafloor--these will give us an unprecedented view of slow slip events

“Te Matakite”

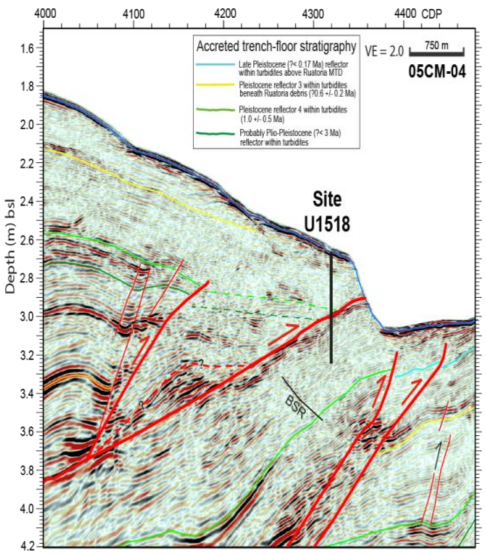


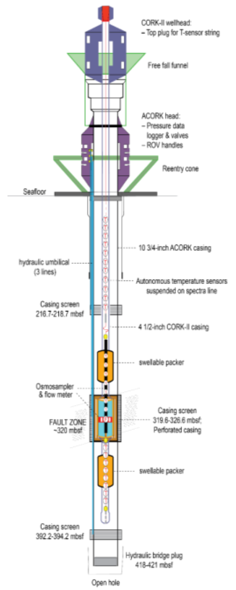
“Athena”

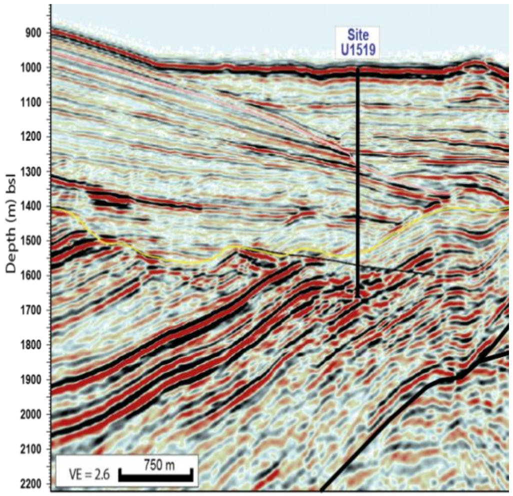


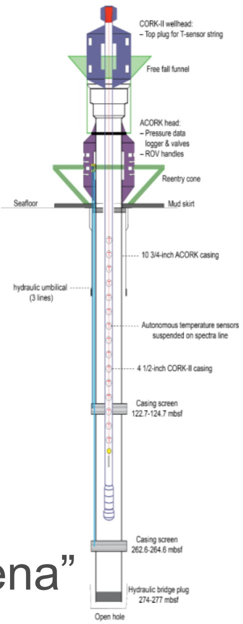
Observatory science objectives

“Te Matakite”









“Athena”

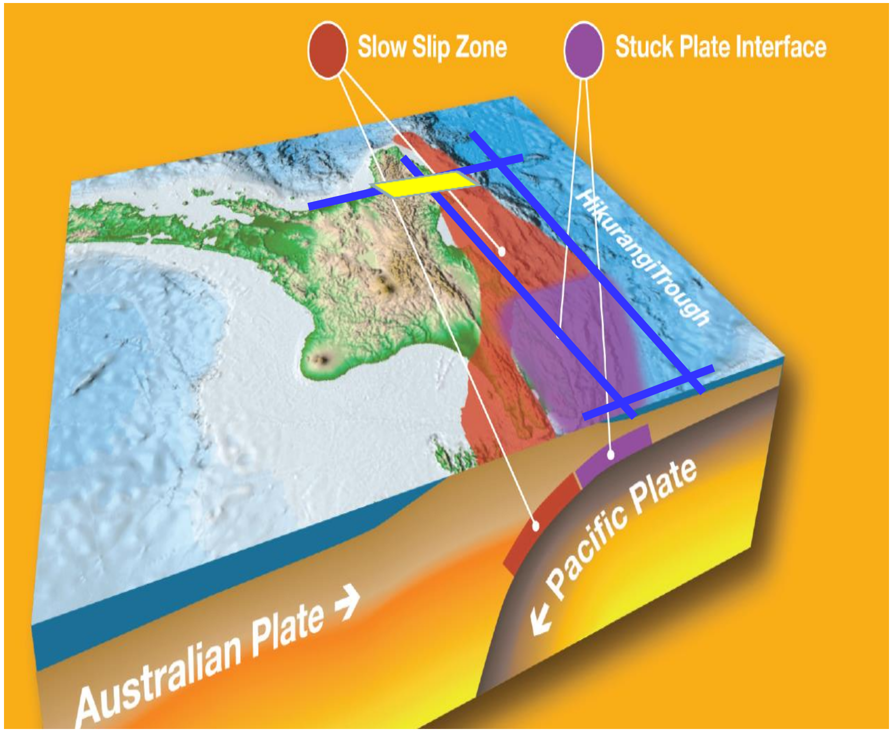
- **In situ pore pressure, fluid flow rates, temperature, and fluid geochemistry throughout the SSE cycle**
- **Ambient temperatures to establish the thermal and metamorphic/diagenetic regime of slow slip**
- **Pore pressure as a proxy for volumetric strain - to define location, magnitude and timing of SSE slip.**

We should be able to resolve SSEs ~10x’s smaller than those we can currently see with GPS

Major north to south changes in Hikurangi subduction zone behaviour make it a globally unique natural laboratory to resolve the processes that control the occurrence of subduction zone earthquakes and tsunami

Goals of the Seismic Experiments

- Provide images of the plate boundary zone to investigate north to south changes of plate coupling
- Provide images the deeper structure to of the Hikurangi subduction zone to investigate processes occurring beneath the Raukumara Peninsula
- Investigate rock properties along the plate interface, offshore Gisborne, to help determine what controls plate coupling



SHIRE

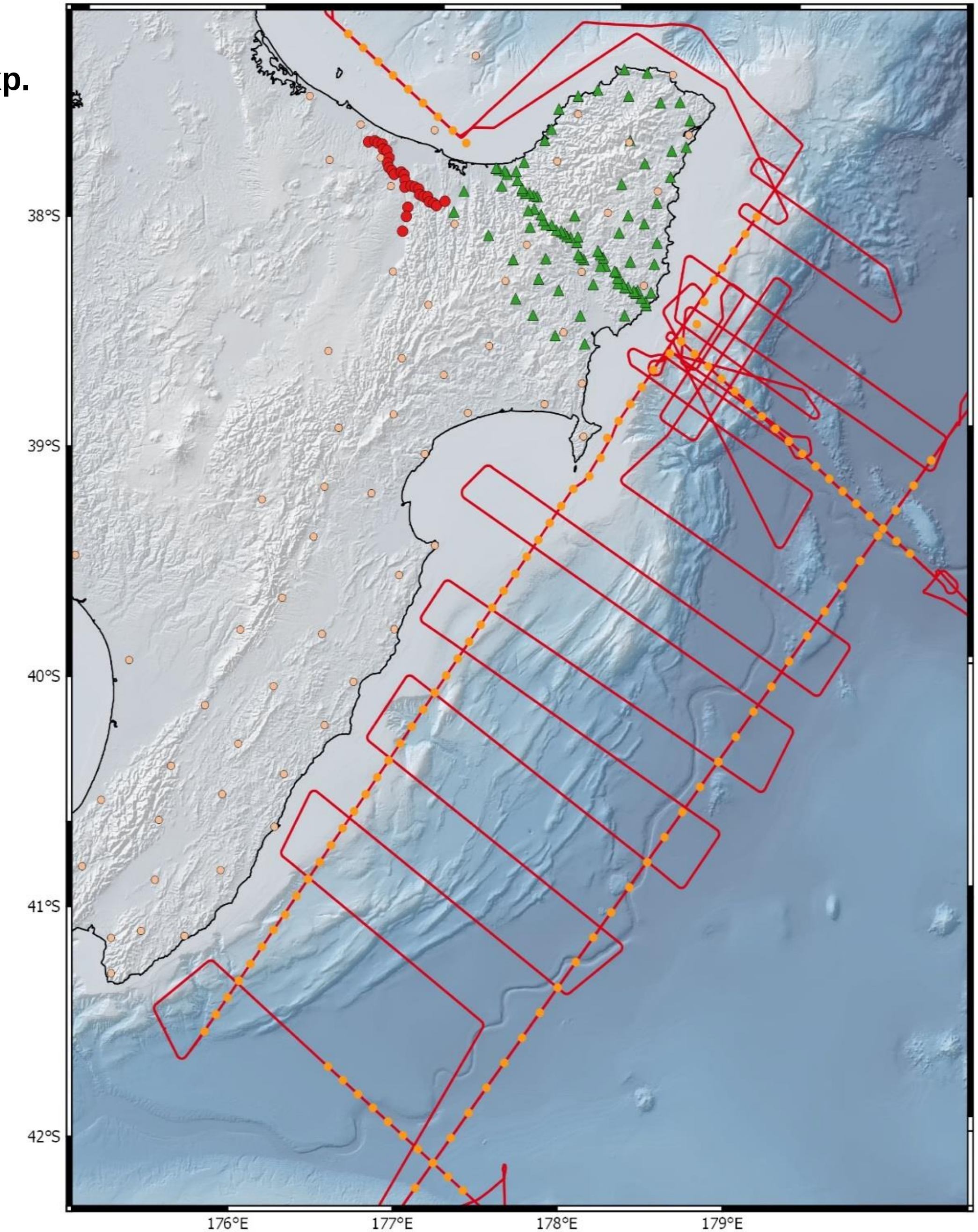
Seismogeneis at Hikurangi Integrated Research Exp.

(1) 118 Onshore deployments
- **47 along the SHIRE transect**
- **43 in Raukumara array**
- **28 GSXs in BOP array by ERI**

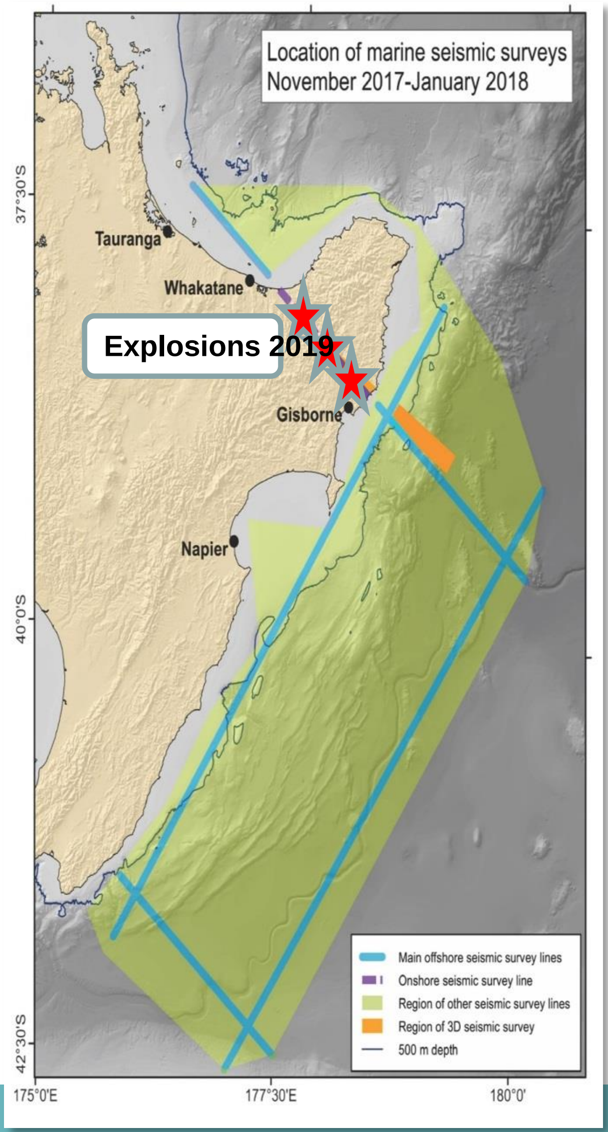
(2) 114 Offshore deployments
- **RV Tangaroa**
- **100 JAMSTEC OBSs**

(3) SHIRE Active Source Voyage
- **RV Marcus G. Langseth**
- **>1500 km of 2-D seismic**
- **12.5 km streamer, *** L source**
- **>4000 O-O receiver gathers**

(4) Onshore transect shots
- **2019 – Okaya/Henrys**



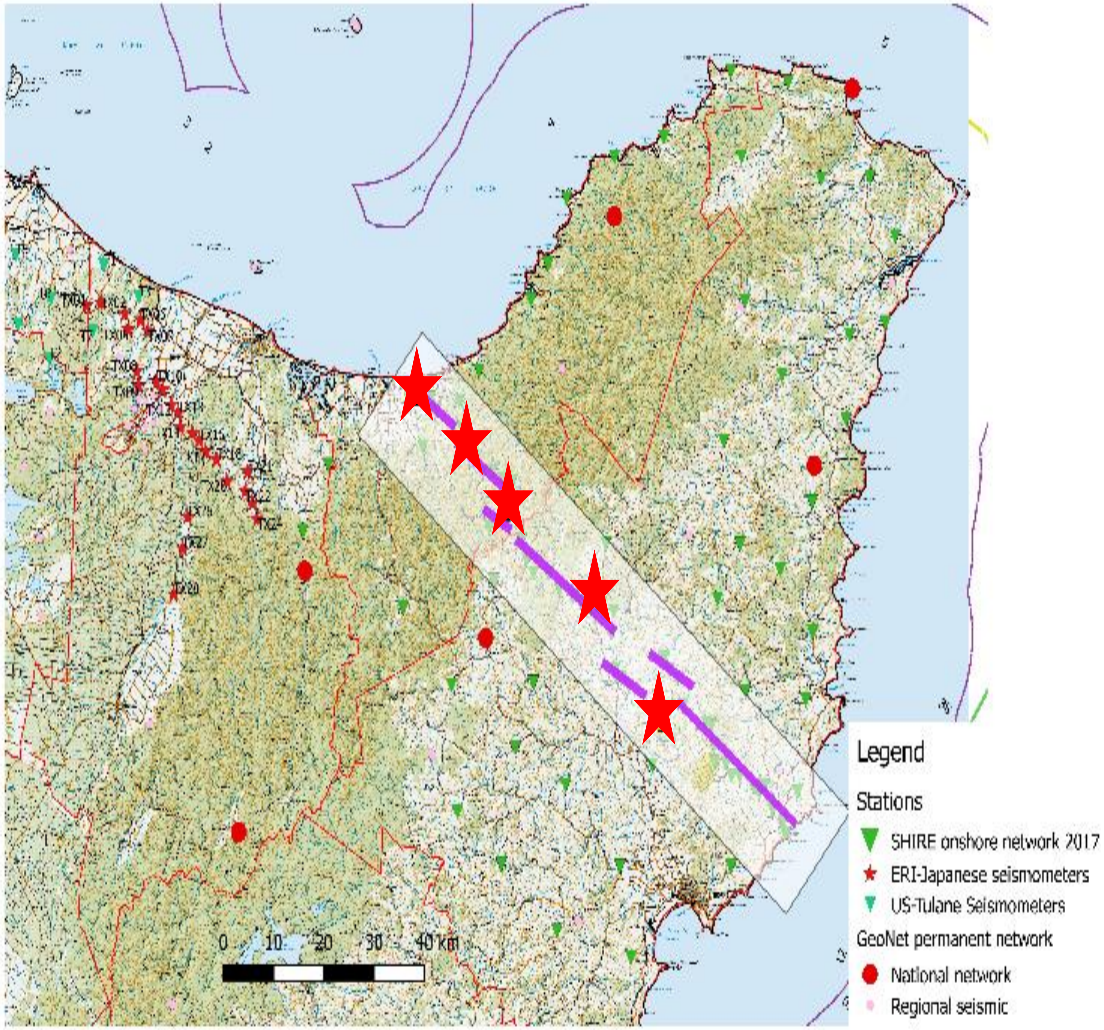
Determining the physical properties of the subduction zone: Seismic surveys are the best remote sensing tool available



Seismic waves are also generated onshore from explosions in shallow bore holes. The energy that bounce back from layers in the earth are recorded on seismographs

Feb or March 2019

SHIRE 2 - Transect



- **February 2019**
  - Currently preparing consent information for BOPRC and GDC

Summary

- We currently have little understanding of the tsunami and earthquake hazard posed to NZ by the Hikurangi subduction zone.

- Multiple NZ-based and international projects are underway to better understand the Hikurangi subduction zone.

- Recent MBIE Endeavour fund project will constrain past and present behaviour of the megathrust, and reveal the physical controls on this.

- Major focus areas include:
  - Understanding the distribution and mechanisms of shallow Slow Slip Events using seafloor geodesy & scientific drilling. IODP observatories installed to monitor conditions in the plate above regions of slow slip.
  - Studies of past earthquakes using onshore and offshore datasets – will help to answer “Does the Hikurangi megathrust rupture in great (M >8) or giant (M >9) earthquakes, and if so, how often?”.
  - Seismic experiments to provide images of the plate boundary zone, to investigate the physical properties along the plate interface and better understand changes along the margin.

Dr Graham Leonard

Senior Scientist (Volcanic Geologist)
GNS Science

Communicating in an Emergency: including effective warnings deep dive

Sally Potter, Graham Leonard, Julia Becker

GNS Science

New Zealand

Bay of Plenty Lifelines Forum 2018

GNS SCIENCE
TE PŪ AO

Wider communications research and best practice

Risk communication (quiet times)

- Risk-perception/ Information-education/ Decision-making
  D Johnston, J Becker, S Potter
- Public earthquake preparedness communication before the Canterbury Earthquake Sequence – S. McBride
- Information-decisions on the Tongariro crossing (weather, volcano) - A. Dhellemes
- Spatial communication – map design and hazard map process – MA Thompson
- Communication of uncertainty/probabilities - E. Hudson Doyle, S. Potter.
- Use of mobile apps before and during disasters – M. Tan

Crisis communication (often in the form of warnings)

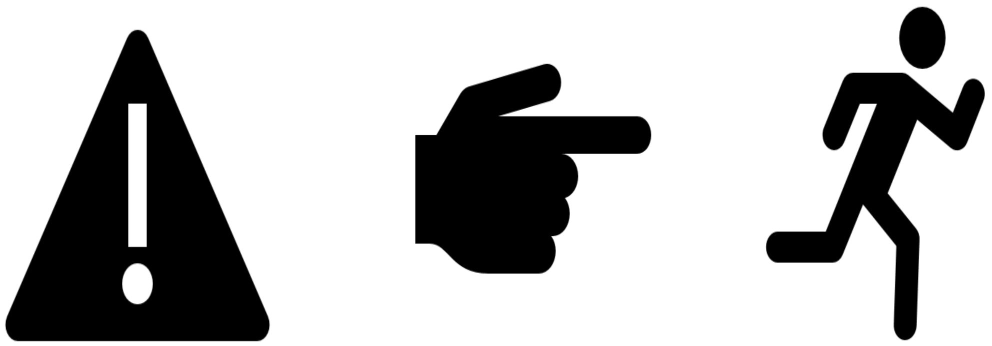
- Patton/Lindell-Perry – cognitive warning-decision models
- Social media – use, monitoring/scraping – A Beatson, S Harrison
- Consistent messages – MCDEM resource being updated – D Miletti
- Public discourses and decisions on safety and authority – L Taito
- Operational Earthquake Forecasting and Aftershock communication (J Becker, A Wein, S Potter)
- Response to tsunami warnings – delay, don't go, confusion, driving cars – intended (A Dhellemes), Actual (D Blake)
- Warnings studies – volcano, landslide, earthquakes, tsunami, weather, alerting (case study = this presentation)

What is the purpose of a warning?

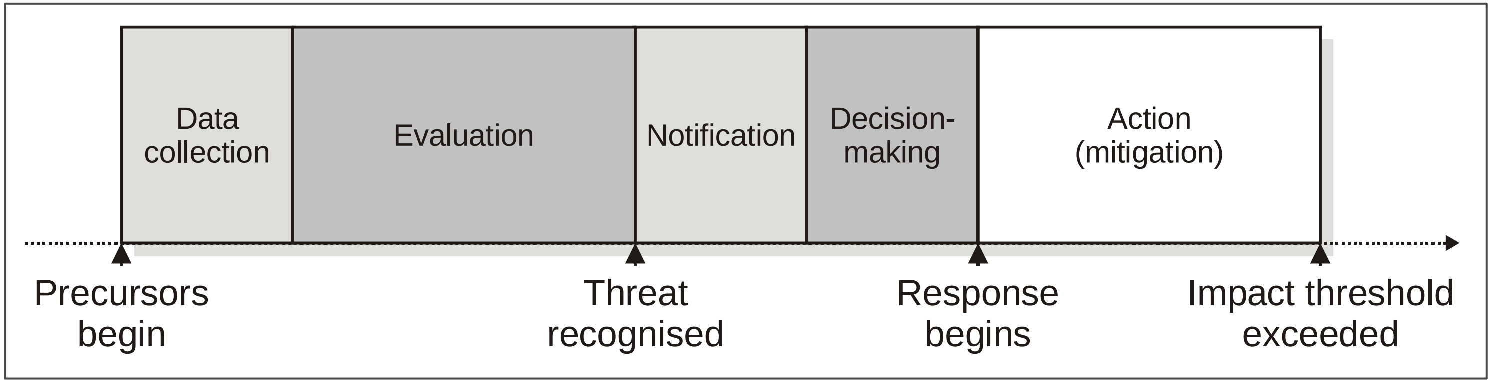
A warning should

> *“Empower individuals, communities, and businesses to respond to hazards in a* ***timely*** *and* ***appropriate*** *manner that will reduce the risk of death, injury, property loss, and damage”*

Rogers & Tsirkunov 2013 p. 74



Understanding response to warnings



Key issues

- **Differing end-user groups**
  - Institutional populations
  - Elderly and disabled
  - Gender and ethnicity
  - Schools
  - Tourisms and transient populations

Warning effectiveness depends on:

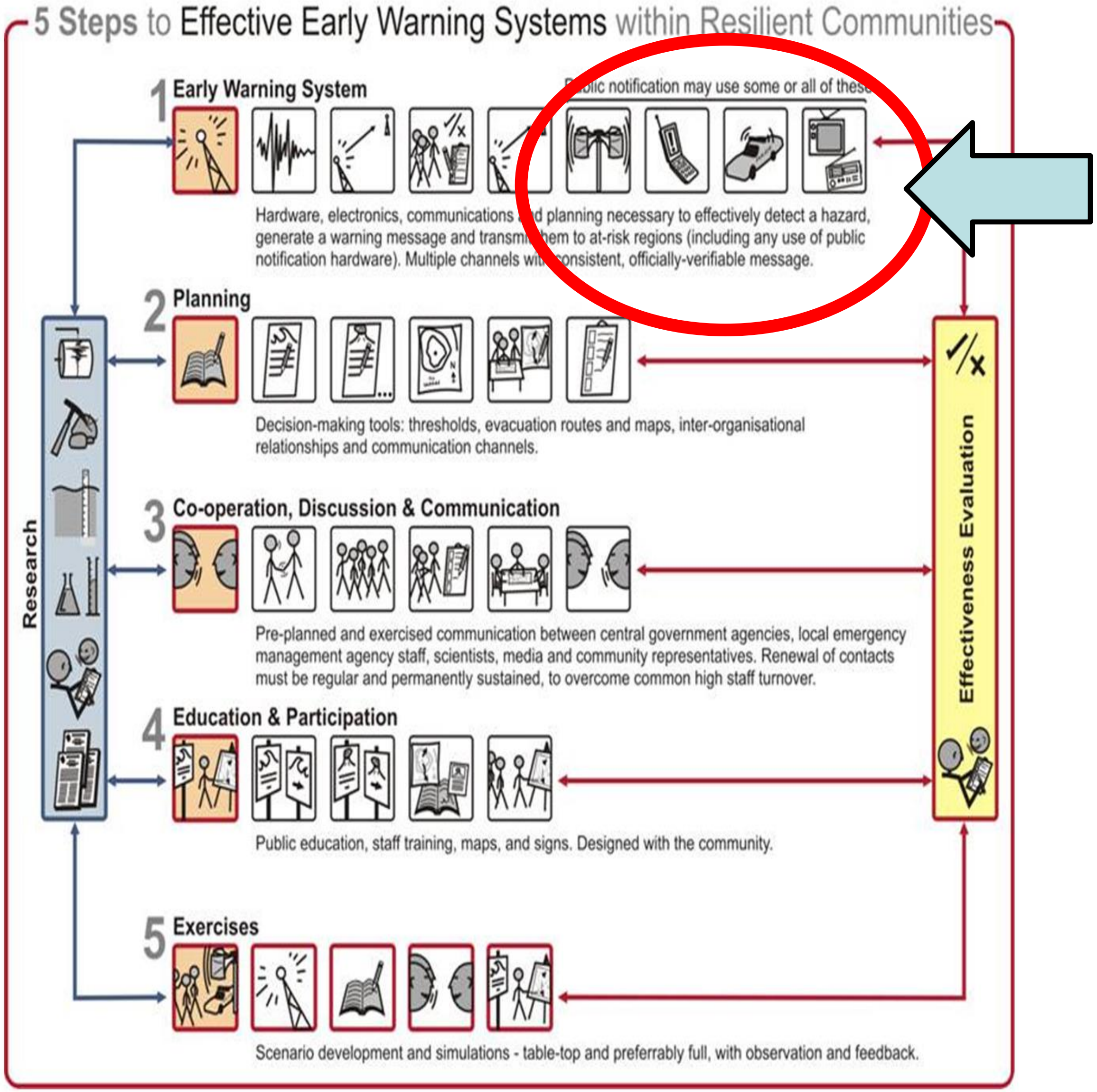
The nature of the warning information

- consistency
- certainty
- accuracy
- clarity
- media
- frequency

The Partnership for Public Warning in the USA concludes that an <u>effective</u> warning system should:

- Be focused on people at risk
- Be able to be understood by all in the same way
- Be capable of reaching people irrespective of what they are doing
- Be easy to access and use
- Not create added risk
- Be reliable
- Provide appropriate lead time so people can have a chance to protect themselves
- Generate authenticated messages

Public alerting is just one part of an effective warning system



The importance of planning and regular exercises

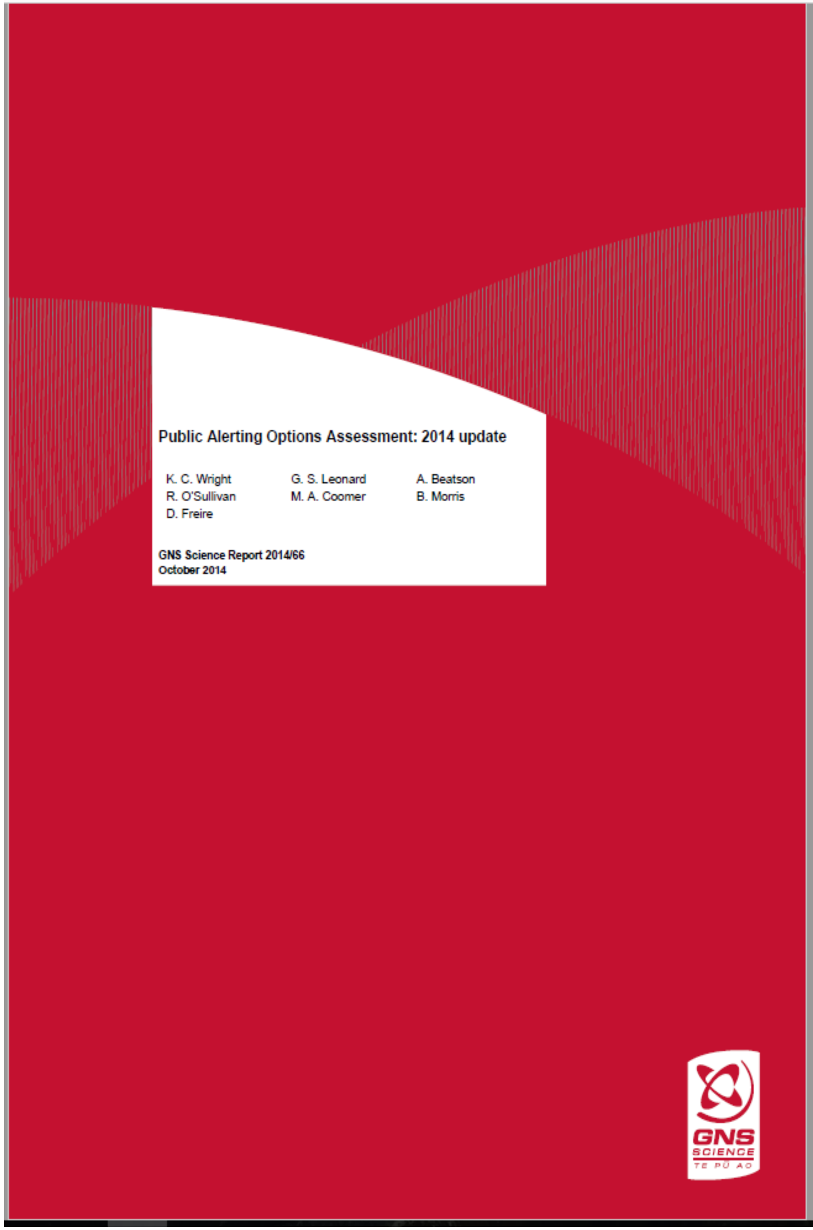
- **The process of making the plan is critical – it must be made by those who will then later apply it (not an external consultant).**
- **Plans need regular updates.**
- **Plans need to be regularly exercised – this some of the best education, and acts to test plans so they can be improved.**

This applies to both risk communication (quiet times), and crisis communication equally.

National public alerting options assessment

2009, 2014 update

- Considerations when planning or reviewing warning systems
- Evaluating the effectiveness of public alerting mechanisms currently used as part of warning systems
- Considering the effectiveness and advantages of one public alerting mechanism against another
- Deciding on the most appropriate public alerting mechanism (or suite of mechanisms) in relation to their budget and target areas' unique features like hazards and demographics.


Public Alerting Options Assessment: 2014 update

K. C. Wright, G. S. Leonard, A. Beatson, R. O'Sullivan, M. A. Coomer, B. Morris, D. Freire

GNS Science Report 2014/66
October 2014

NZ Public alerting options review
General findings - Effectiveness

Most effective systems

+ Mobile Apps
+ Cell broadcasting (EMA)
+ Radio announcements#
+ Tone activated alert radios*
+ Break-in broadcasting*
+ Mobile PA (Public Address)
+ TV Announcements#
+ Door-to-door knocking
+ Fixed PA Systems

Least effective systems

– Flares or explosives#
– Fixed Sirens (signal only)
– Electronic billboards#
– Call-in phone lines#
– Static billboards#
– Aircraft banners#
– Tourist radio#
– Bells or air horns#

* Not currently available in NZ
# May not be able to reach 70% of the population

Evaluation criteria used for determining effectiveness

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
On-going effect (ability to update message)	Change in at-risk area or required action
Opt-in required	**At risk population must subscribe**
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, travel time**
Transients/ Visitors	Unfamiliar with local hazards, alerting systems and required actions

Methods for BOP and Waikato reviews:

- International and domestic systems review
- Effectiveness scoring (25 criteria)
- 4 critical criteria: Heads-up, Instruction, Opt-in need, Time to reach all
- Warnable hazards (fast onset compared to others)
- Geographic variability of hazards and population
- System coverage (e.g. mobile networks)
- Back bone options and in-fill needs (pockets and groups)

Warnable hazards (BOP Example)

Hazards requiring rapid warnings for life safety (short-onset, less than 3 hours)	Hazards NOT requiring rapid warnings for life safety but still appropriate for alerting	Hazards which currently cannot be warned for
Tsunami – local source[1]* Tsunami – regional source[1] Serious Hazchem incident[2] Heavy rainfall (Severe Thunderstorm/Flash flooding/debris flow)[3] Stormwater surface flooding Wildfire/Rural fire[4] Large-scale lifelines failure (Major air accident, electrical failure, telecommunications failure, dam break, etc.)	River 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	Earthquakes Extreme geothermal events[5] or unheralded small volcanic eruptions Landslides Localised subsidence

Community preparedness for warnings

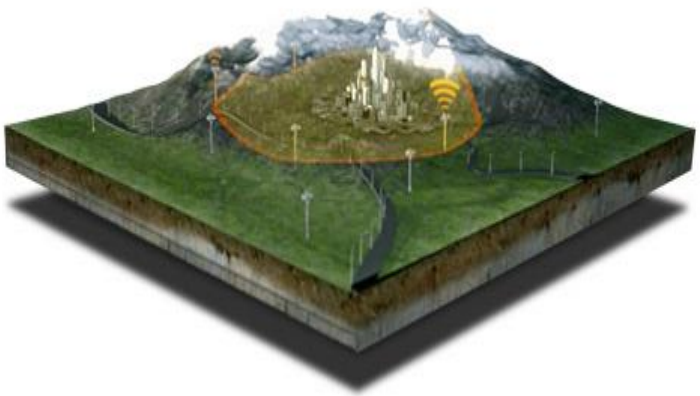
- As part of rapid response to all warnings, including not delaying in natural warning
- Supports wider community preparedness activities
- Requires regular, sustained, widespread engagement at neighbourhood/township level
- Needs regular (annual) exercising
- For high (e.g. 95% such as Japan 2011) evacuation effectiveness estimated to need one FTE per 25,000 people (4 communities at 6000 people, 8 communities at 3000 people)

National systems

Emergency Mobile Alerts (EMA)

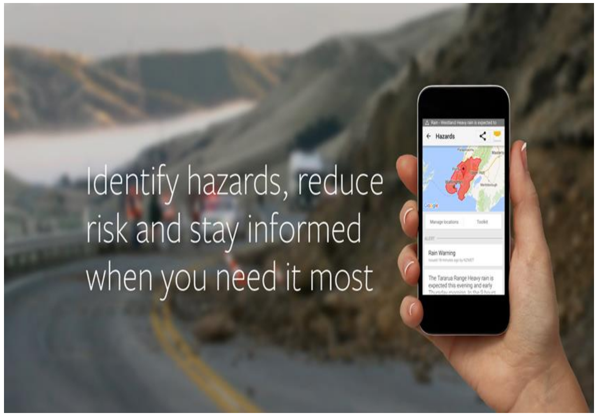
(Cell Broadcast)

- December 2017 now live
- All compatible phones at once
- Geotargeted



Red Cross Hazard App

- In operation
- Works over wifi
- Includes preparedness info



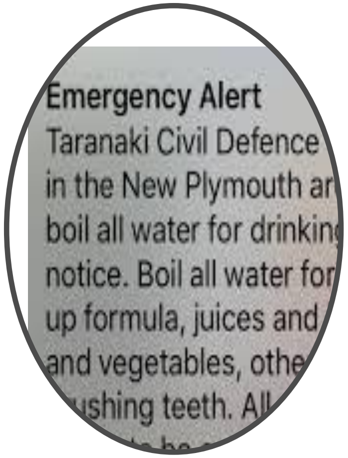
Alerting end-point platform

- Includes autodialler which can reach people over copper/fibre
- Originate alert once, reach social media, email, SMS, web
- Maintains contact lists

Fixed PA Loudspeaker

- Tone and message – high effectiveness
- High cost
- Ongoing maintenance cost
- As infill may be needed for areas not reached by backbones or telephone

How can a warning message that goes out to thousands/millions of people at once achieve an appropriate and timely response?



Project outline

Literature review:
- Global best practice for warnings
- Human behavior & response

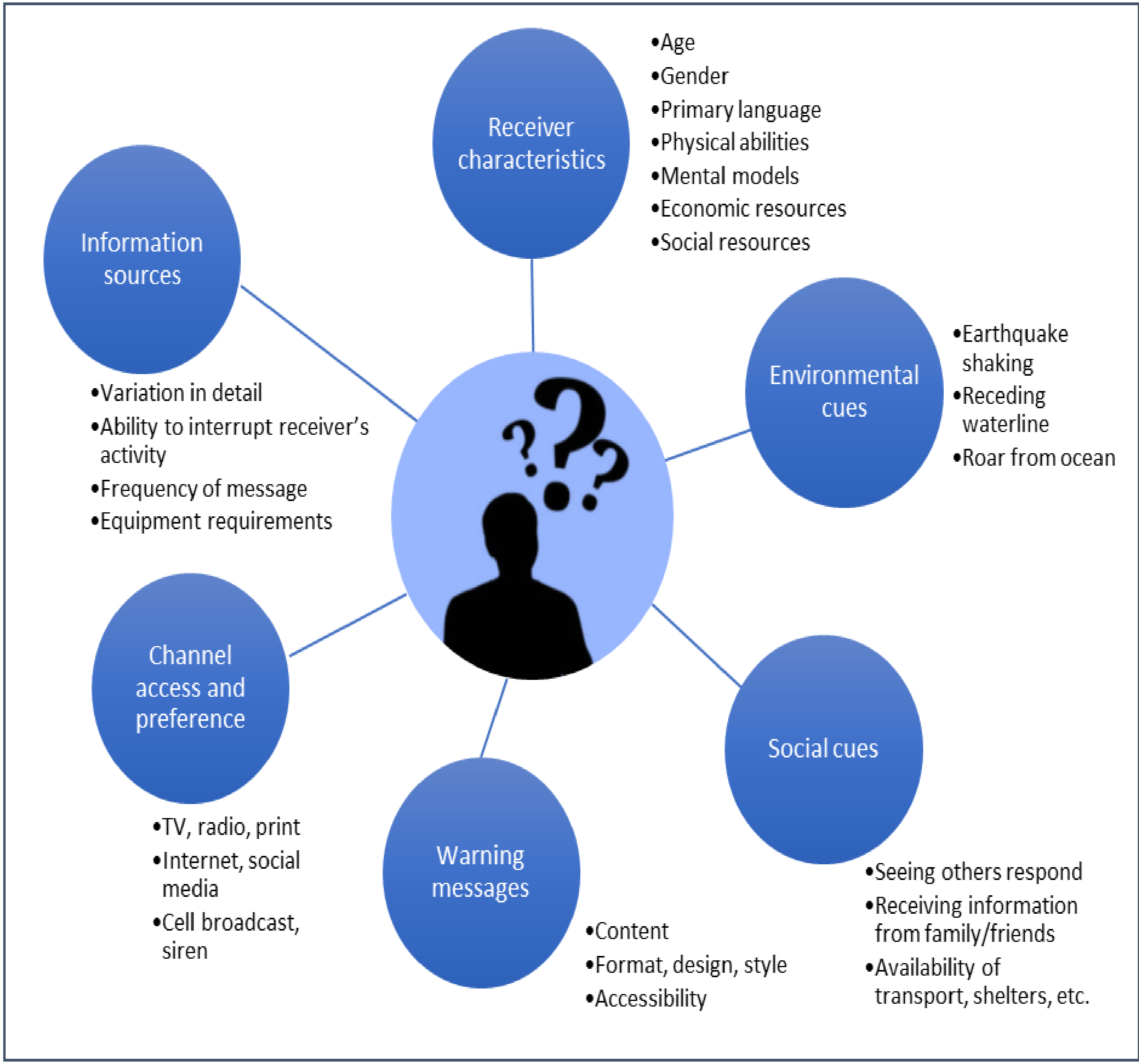
NZ research:
- Tested best practice
- Intended tsunami evacuation survey of the public

Recommendations for short warning messages:
- Content
- Style

Findings applied to NZ Emergency Mobile Alerts:
- Templates reflect evidence-based best practice

Dr Sally Potter
s.potter@gns.cri.nz
@sallyhpotter

Some of the reasons people respond differently to warnings



From Potter (2018a), pg. 4.

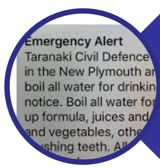
Based on the Protective Action Decision Model (Lindell & Perry, 2012)

Influences on responding to warnings


Receiver characteristics


Environmental cues


Social cues



Warning messages


Channel access & preference

Information sources

Exposure

Attention

Comprehension

Perceptions

Threat

Protective action

Stakeholder

Decision to respond

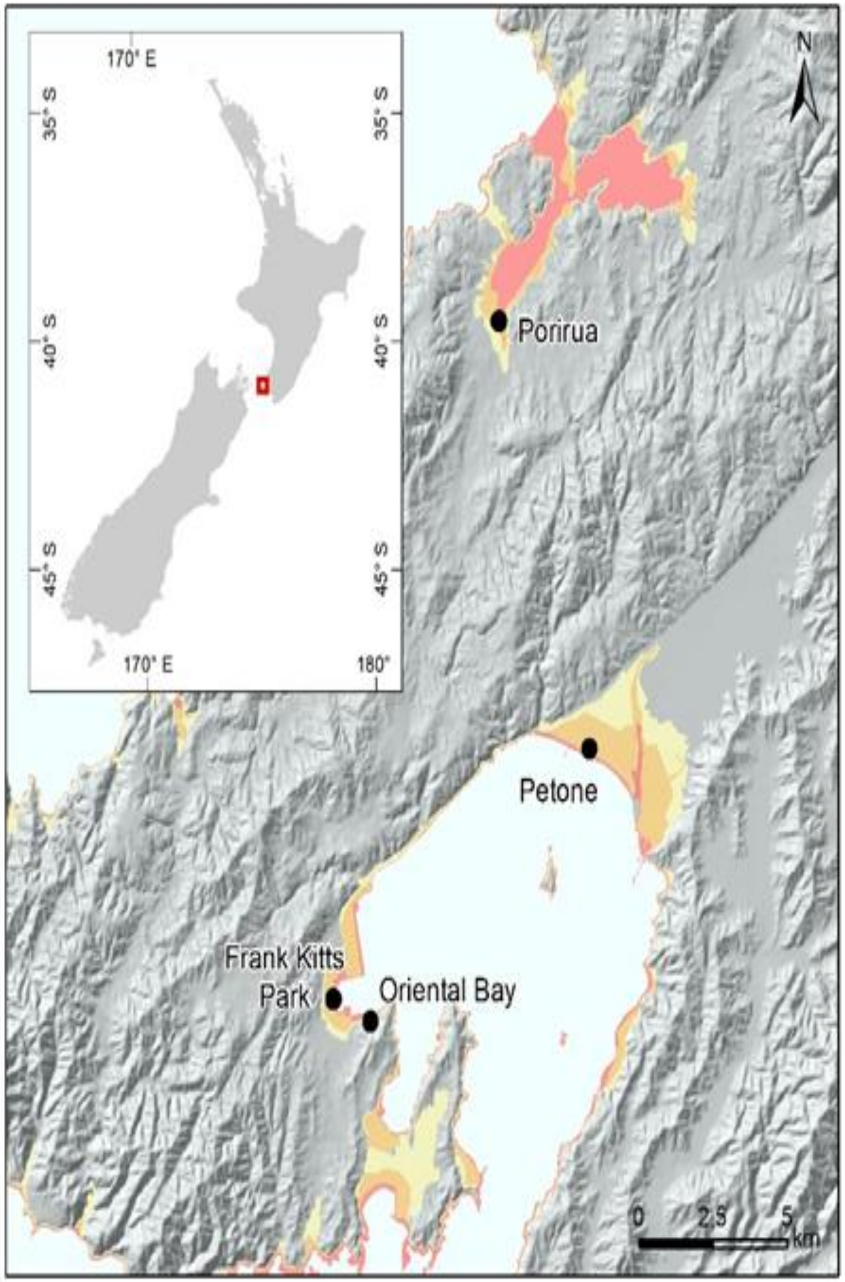
Based on Lindell & Perry (2012)

Tsunami warning research

Aim:

To test the literature review findings in a New Zealand context for tsunami warnings using Emergency Mobile Alerts

- 28 interviews with the public
- November 2017
- Wellington Region

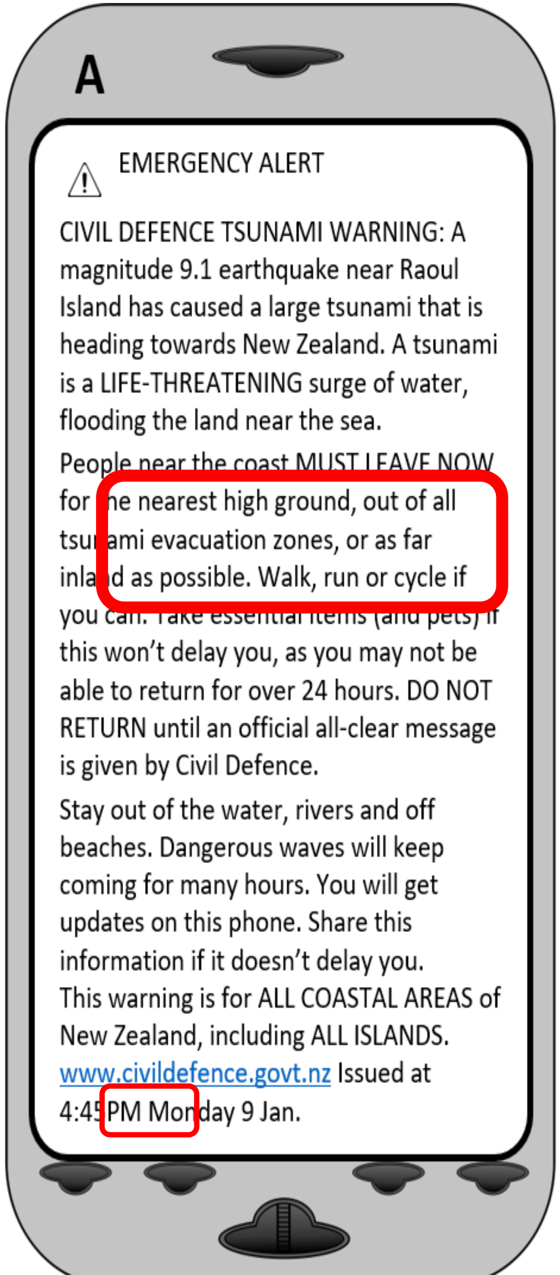


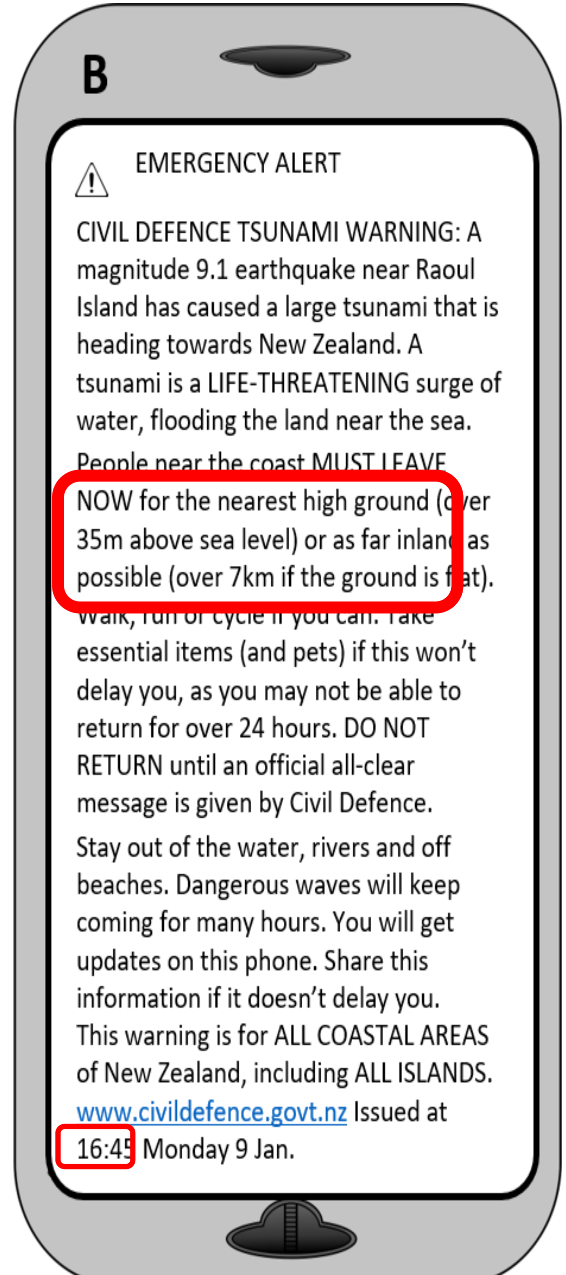
From Potter (2018b), pg. 4

Warning messages provided

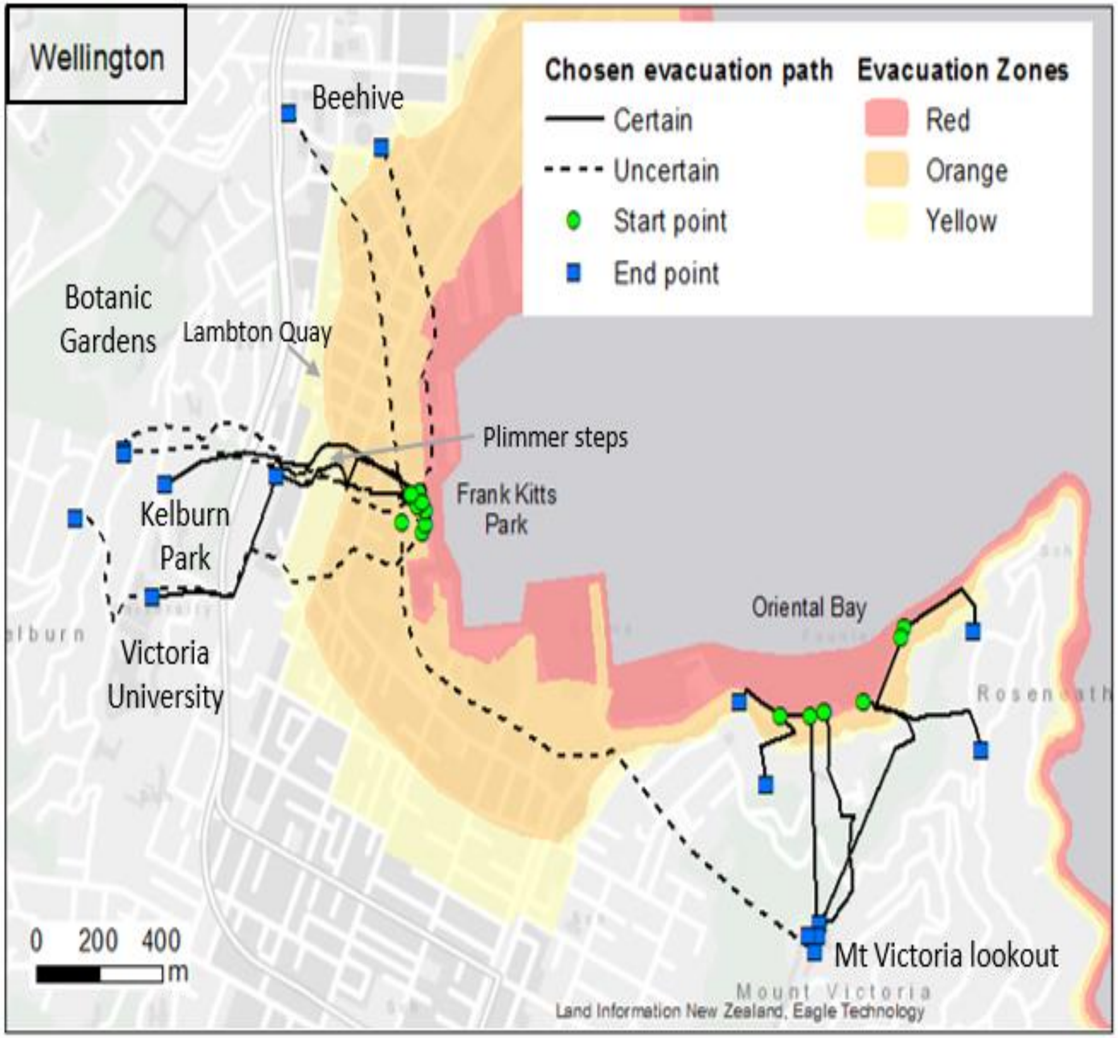
Survey questions:

- Evacuation intentions (timing, location)
- How easy it would be to do
- General thoughts on the message (content, style)
- Understanding of time format

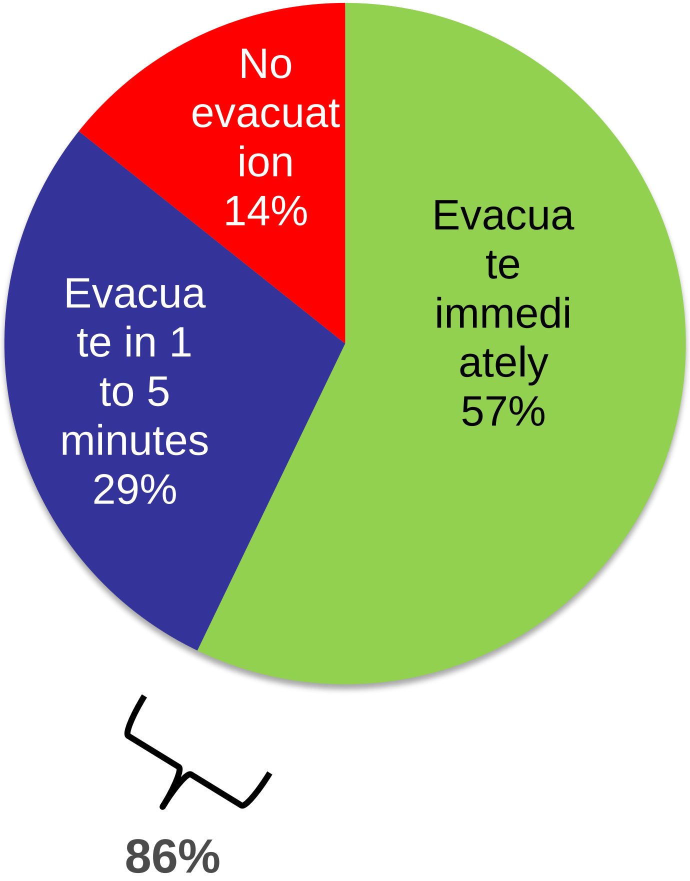




Tsunami warning research findings



From Potter (2018b) pg. 17



Content to include in a warning message

Source	• Agency issuing the message
Hazard	• Hazard characteristics and location
Impacts	• What might happen to people and property
Guidance	• Suggested actions to decrease the impacts
Location	• Who the warning applies to
Time	• Time of issue; time to have responded by
Link	• Link to more information to reduce delays

Style and length

Strategic and minimum use of ALL CAPS

Message tone should be formal, but empathetic messaging may be well received

The message length should be long enough to be informative and specific

Best practice for constructing effective short warnings

Specific	• Personalise the message as much as possible • Include specific location names
Clear	• Simple and clear, with no acronyms
Effective	• Achievable, affordable and effective actions given to reduce the risk
Accurate	• No spelling or grammatical mistakes

Example message
(Prepare to evacuate, tsunami 6-9 hour arrival time, 930 characters)

EMERGENCY ALERT

CIVIL DEFENCE TSUNAMI WARNING: An earthquake near Chile has caused a large tsunami that is heading towards NZ. A tsunami is a DANGEROUS surge of sea water lasting many hours.

People in low-lying coastal areas SHOULD LEAVE by 10am for high ground (35m+) or as far inland as possible. Take essential items (and pets) with you and share this information if it doesn't delay you. Stay out of the water, rivers, and off beaches. DO NOT RETURN until all-clear message given by Civil Defence. You will get updates on this phone.

This warning is for the East Coast of the North Island from CAPE REINGA to MAKARA, including WHANGAREI, AUCKLAND, TAURANGA, WHAKATANE, GISBORNE, NAPIER, LOWER HUTT & WELLINGTON, and the East Coast of the South Island from FAREWELL SPIT to TAIERI RIVER, including NELSON, KAIKOURA, CHRISTCHURCH, TIMARU, OAMARU and DUNEDIN. Also ALL ISLANDS to the east of NZ. www.civildefence.govt.nz Issued 5:05AM Tues 14 Feb

Future research

- Investigate perceptions and understandings about tsunami evacuation zones
- Effectiveness of including time of impact in the warning
- Optimal message length with a NZ audience
- Effectiveness of having a more detailed and longer title with key message
- How best to communicate location information (e.g. with maps)

More information

Potter, S. H. (2018a). Recommendations for New Zealand agencies in writing effective short warning messages. GNS Science Report 2018-02 (pp. 28): GNS Science, Lower Hutt (NZ).

Potter, S. H. (2018b). Intended responses to a tsunami evacuation message using Emergency Mobile Alerts in New Zealand. GNS Science Report 2018/14 (pp. 34). Lower Hutt, N.Z.: GNS Science.

5-minute YouTube clip: https://youtu.be/TILHN1-Mx0k

Sally Potter is on 12 months of parental leave from Monday, so for further questions, talk to me!

g.leonard@gns.cri.nz

Kate Waterhouse

GIS Analyst
Bay of Plenty Regional Council Toi Moana

Contact Kate.Waterhouse@boprc.govt.nz directly for presentation

Donna Llewell

In-House Legal Counsel
Bay of Plenty Regional Council Toi Moana

LEGAL ASPECTS OF LIFELINES IN A STATE OF EMERGENCY?

Donna Llewell, In-House Legal Counsel

Bay of Plenty / Waikato Lifeline Utilities Forum
23 August 2018

OUTLINE

- Legal authority & framework
  - CDEM 2002 – The Act: Purpose & Principles
  - CDEM Section 60: Duties
  - NCDEMPO 2015 – The Order: Roles & Responsibilities

- What does it really mean for your lifeline utility?
- CDEM Controller & Powers
- How does a State of Emergency change things?
- Compliance

Legal authority & framework

CDEM 2002 – The Act

- **Section 3 - Purpose**
- Sustainable management of hazards
- Four well-beings & safety of public and protection of property
- Acceptable levels of risk
- Planning & preparation emergencies / response & recovery
- Co-operation / educate / joint action
- Integrate & align national and local strategy & plans
- Co-ordination with 11 other statues

CDEM 2002 continued… Principles

- **Section 6**
- Subject to CDEM - other functions, duties, powers of persons under other Acts or general law not affected

- **Section 7**
- Precautionary approach – all persons … be cautious in managing risks even if scientific and technical uncertainty about those risks

CDEM 2002 continued…

- **Lifeline Utilities**
- S2 - Entity named or business described in Schedule 1
- S2 - Part of "emergency" definition / failure or disruption
- S10(3)(c) - Director issue guidelines, codes or technical standards
- S59 – General duty to perform
- S60 – Specific duties of lifeline utilities

CDEM 2002 – Section 60 – Duties of lifeline utilities

- **Every lifeline utility must…**
- Ensure functioning to fullest possible extent, may be at reduced level, during and after an emergency
- Make available the plan for such functioning
- Participate in development of civil national strategy & plans
- Provide free technical advice as reasonably required
- Disclosure of information limited to purposes of CDEM

NCDEMPO 2015 – The Order

- **Overview**
- Order of the Governor-General in Council
- Schedule = National civil defence emergency management plan
- Operative 1 December 2015 and ends 30 November 2020
- Definitions / linkages to the Act
- Before, during or after state of national emergency or transition
- Provides the mechanics and how to carry out section 60 duties under the Act

NCDEMPO 2015 – The Order continued…

- **Lifeline utilities**
- S2 – Key mention 4 R's is "readiness"
- S10(5)(b) – Loss of lifeline utility services recognised as possible consequence of hazards and risks
- S19 – Roles and responsibilities / links to S59 of the Act
- S33 – Recognised current "cluster" / group of agencies interacting to achieve common civil defence outcomes

- S47(4) – Recognition where staff cannot work or utilities fail or services reduced or relocated = may endanger community health and safety
- S50(4)(c) – Entitled to advice about public health aspects of an agency and its business continuity planning
- S57 – Explanatory note … lifeline utilities provide essential and enabling infrastructure and services that support commercial and domestic activity

- S58 – Objective – Main Duty / links to S60 of the Act
- S59 – Principles underlying the role of lifeline utilities
- ➢ Identify and understand hazards and risks and reduction strategy
- ➢ Prioritise continuity of operations and supply of services
- ➢ Plan co-operatively with others and provide information
- ➢ Procedures and best practice, share and apply
- ➢ Facilitate sector specific solutions without government assistance
- ➢ Service restoration following an emergency

- S60 – Roles during reduction and readiness
- S61 – Roles during response and recovery
- S77 – Recognition to minimise loss or disruption of lifeline utility services in building management objectives during emergency
- S78(g)(iii) – Territorial authority building information to include critical lifeline utility services located in or near them
- S80(1)(d) – Building consent authorities have regard to priority for preservation and restoration of lifeline utility services

- S92 – Readiness
- S97 – Requirement for business continuity planning
- S104 – National exercises, testing and monitoring
- S114(3) – Response / expectations
- S120 – National warning system
- S156 & 157 – National and Group recovery activities

What does it really mean?

- Understand the breadth and scope of your CDEM responsibilities / links between the Act and the Order
- Private verse public obligations and accountability
- Expertise and resourcing
- Complimentary to business as usual
- Prepare, prepare, prepare…
- Co-ordinate, co-operate, consolidate, collaborate

CDEM Controller & Powers

- National / Group / Local Controllers
- Direct and co-ordinate … use of personnel, material, information, services and other resources made available
- Authorise (delegate) any suitably qualified and experienced person to perform any CDEM function, duty or power
- CDEM S86 – 94 – Specific powers of Controllers in State of Emergency

CDEM Sections 86 – 94 Controller Powers

- Evacuation of premises and places
- Entry on premises
- Closure of roads and public places
- Removal of aircraft, vessels, vehicles etc.
- Requisitioning
- Directions – stop an activity, take any actions
- Carry out inspections
- Urgent contracts for CDEM purposes

State of Emergency

- National and Local States of Emergency
- Declaration by authorised and appointed person
- Parameters – time, date and area(s)
- Statutory duration 7 days after coming into force
- Can be extended before expiry otherwise terminates
- Prescribed form for declaration
- Fundamental = Controller’s powers are in play (mandatory)

Compliance

- CDEM 2002 S110 – Protection from liability
- The Order has no specific offences or penalties provisions
- CDEM 2002 Part 6 paramount
- Failure to comply with plan, withholding information, obstruction, intentional failure to comply Controller's specific powers, failure to comply with Controller's directions, personation
- Individual penalty – imprisonment 3 months or fine $5,000 or both
- Body Corporate penalty – fine not exceeding $50,000

Whakatauākī - Proverb

Kia kaha	Be strong
Kia maia	Be brave
Kia manawanui	Be of open heart & mind

???   QUESTIONS ???

Afternoon Tea – Resume at 3:10PM

Craig Campbell-Smart

CDEM Regional Manager
Taranaki Emergency Management Office

BAY OF PLENTY LIFELINES GROUP

Waikato Lifelines Utilities Group

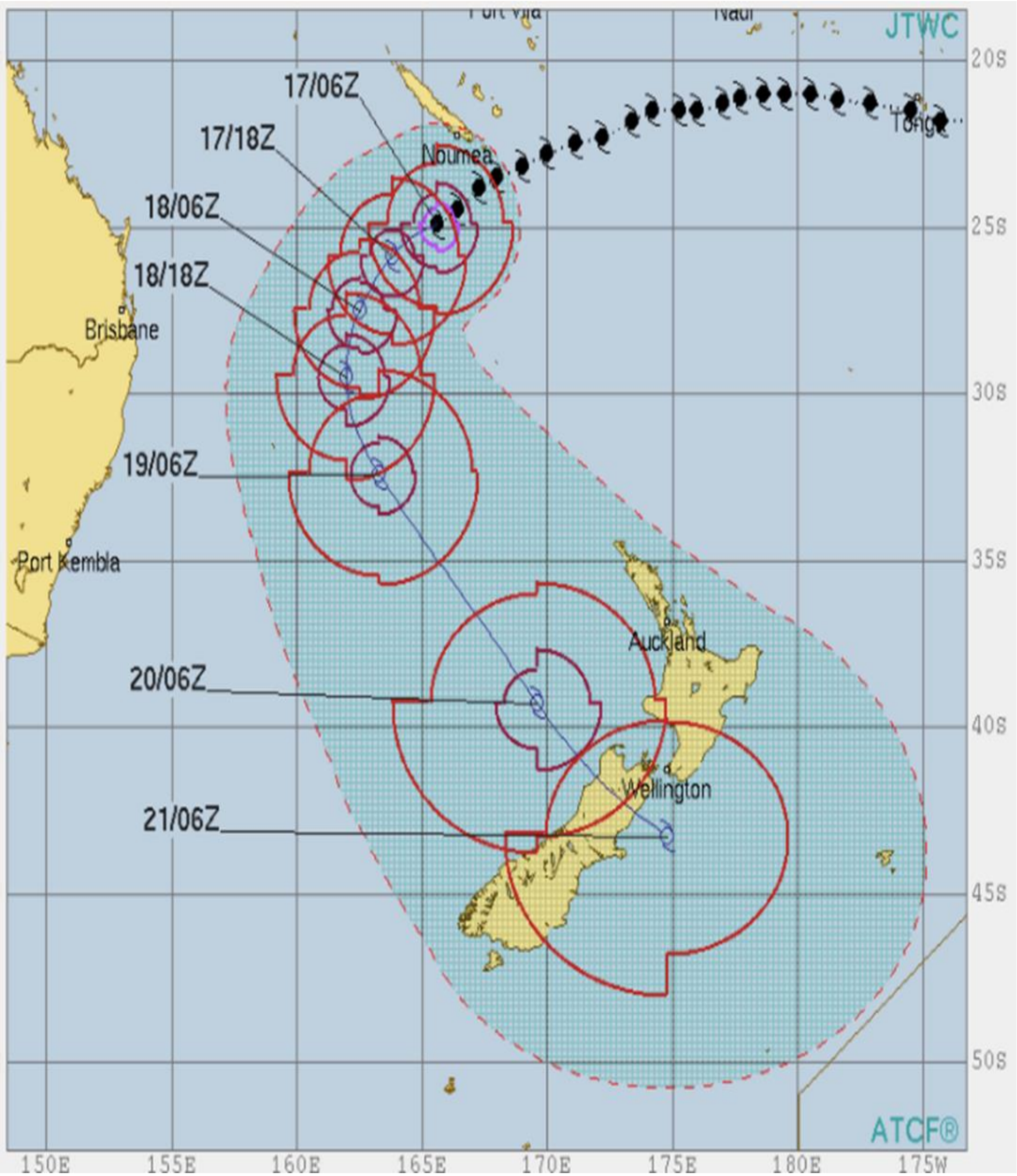
Lifelines response to Ex-cyclone Gita

TARANAKI EMERGENCY MANAGEMENT

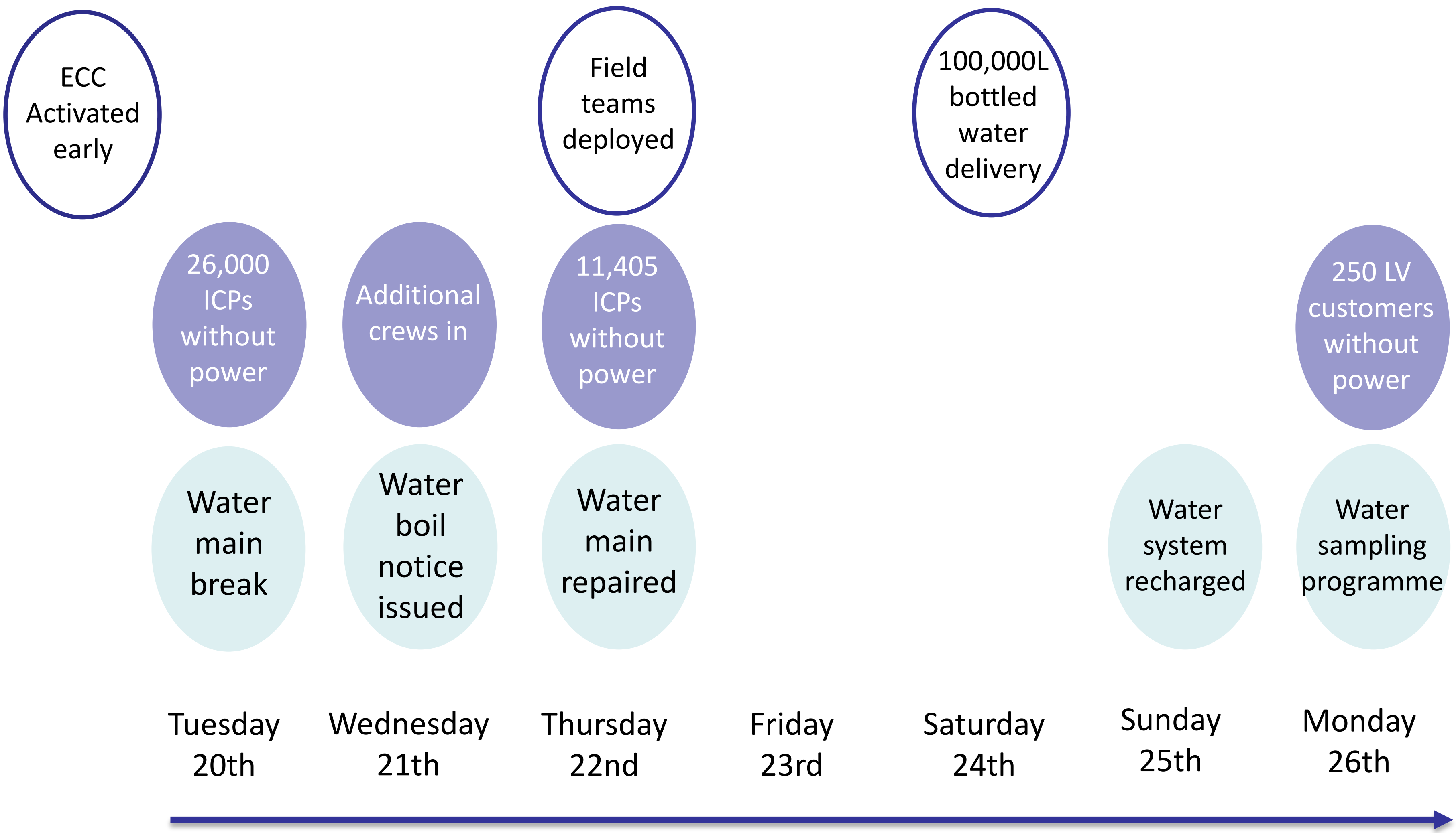
CIVIL DEFENCE

Overview

- Two emergencies within one event
- Prolonged power outages
- Water reticulation outage & boil water notice
- Lifeline interdependency issues



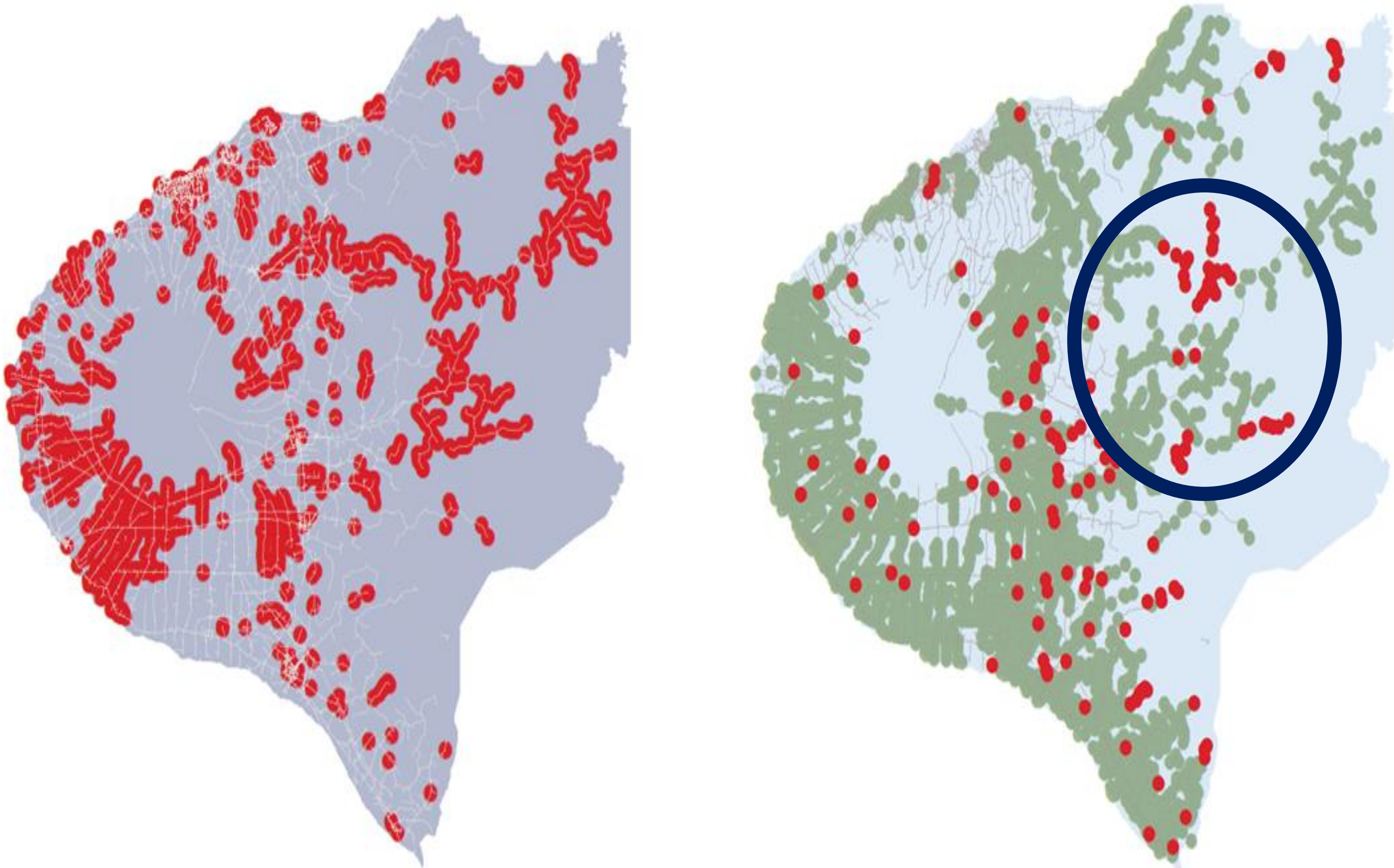
Event Progression



Prolonged power outages

- 26,000 customers without power
- 7 day restoration (95%)
- 250 LV customers with ongoing impacts

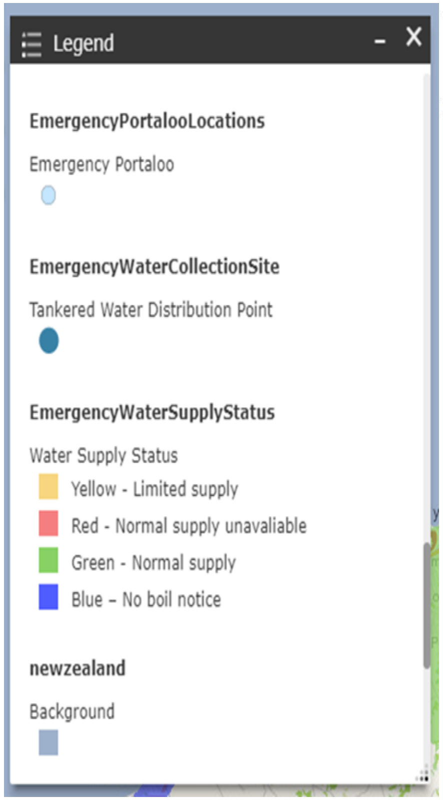
Initial impact 6 days later

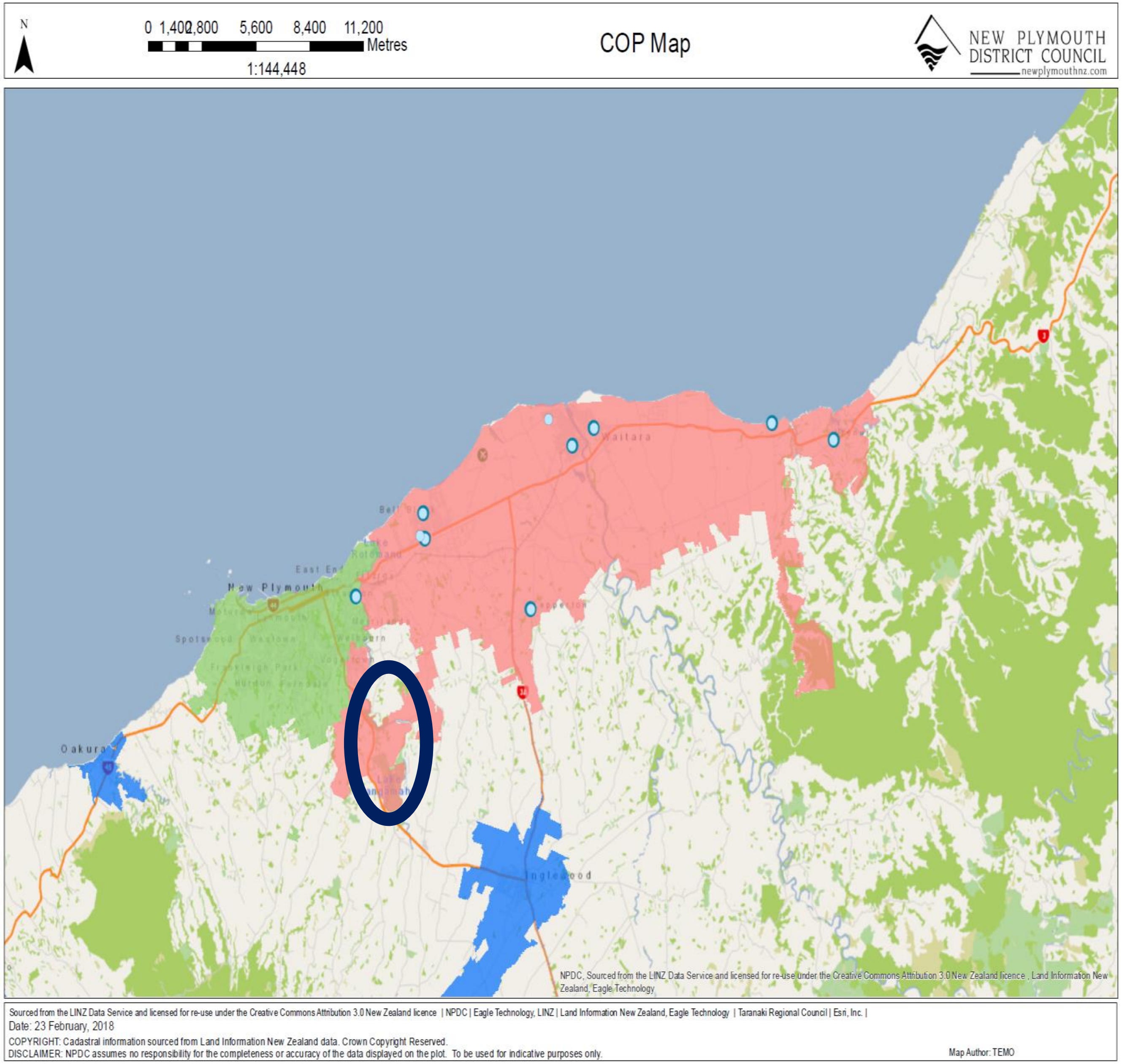


Water reticulation outage

- 16,500 households impacted (25,000 people est.)
- Water boil notice to remaining customers (45,000)

- Disruption to business and industry


Legend
EmergencyPortalooLocations
Emergency Portaloo
EmergencyWaterCollectionSite
Tankered Water Distribution Point
EmergencyWaterSupplyStatus
Water Supply Status
Yellow - Limited supply
Red - Normal supply unavaliable
Green - Normal supply
Blue – No boil notice
newzealand
Background


N
0 1,400 2,800 5,600 8,400 11,200
Metres
1:144,448
COP Map
NEW PLYMOUTH DISTRICT COUNCIL
newplymouthnz.com
Waitara
New Plymouth
Oakura
Inglewood
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Date: 23 February, 2018
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DISCLAIMER: NPDC assumes no responsibility for the completeness or accuracy of the data displayed on the plot. To be used for indicative purposes only.
Map Author: TEMO


SAVER
NZ Natural Mineral Water Sparkling 1L
1.79 ea
Disclaimer


Symons BULK Transport Services


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HOOKER PACIFIC
www.hookers.co.nz

Interdependencies

Issue	Interdependencies
Water reticulation loss	Loss of fire fighting; Loss of potable water; People supply chain issues; Loss of sanitation; Water back flow risk; School Closures; Industry & Business Closures
Power loss	Comms site failures; Oil & Gas production impacts; Ability to boil water; Sewage Pump failures

TaranakiCivilDefence

@TaranakiCD

www.cdemtaranaki.govt.nz

Daniel Blake, PhD

RNC/QuakeCoRE Postdoctoral Fellow

Volcanic impacts: Transportation

Daniel Blake
Postdoctoral Fellow, Resilience to Nature's Challenges, University of Canterbury

daniel.blake@canterbury.ac.nz

Overview

- Direct impacts of multiple volcanic hazards
- Laboratory studies for volcanic ash impact quantification
- Secondary impacts & ash remobilisation
- Mitigation options
- Application of findings using a scenario.

Cotopaxi eruption, Ecuador, 2015 (AFP)

Calbuco eruption, 2015, Chile (EPA)

Context

"Volcanic eruptions are associated with increasingly large economic impacts" (GAR 2015)

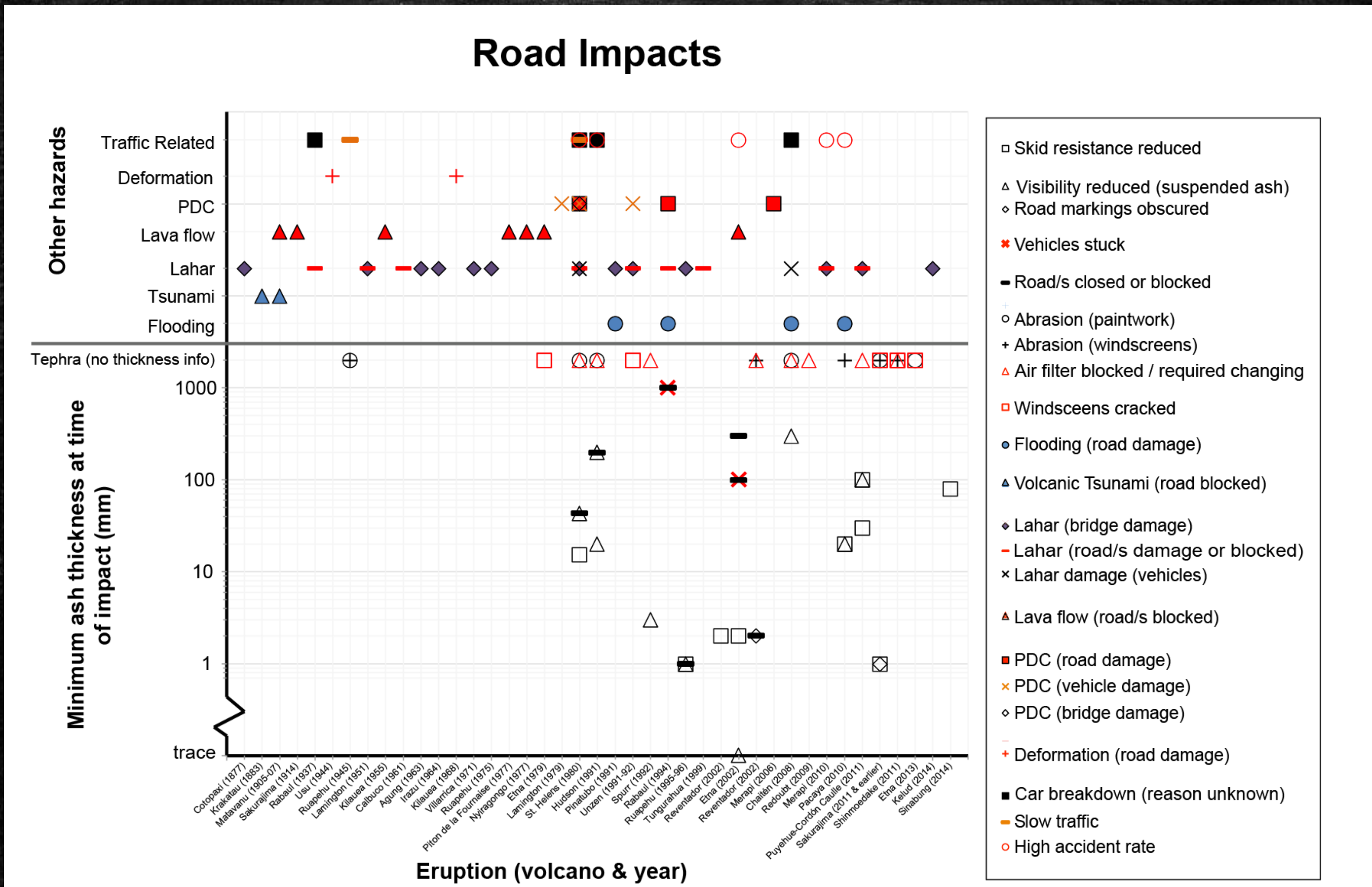
Many observations of ground transportation impacts following ashfall.

- vulnerability data largely qualitative
- lack of quantitative data to assess functionality.

Advance understanding of volcanic ash vulnerability to improve risk assessments:

"To substantially reduce disaster damage to critical infrastructure & disruption of basic services through developing their resilience"

Direct impacts



Direct impacts

Extreme physical damage to transport from:

- **Lava flows, base surges, edifice formation, ballistics, lahars**
  - vehicle destruction / damage
  - route destruction / blockage

All close to volcanic vents

Lava flow across road and vehicle in Hawaii (2018)

Bridge destruction from lahar in Indonesia, 2014 (JakartaGlobe)

Direct impacts

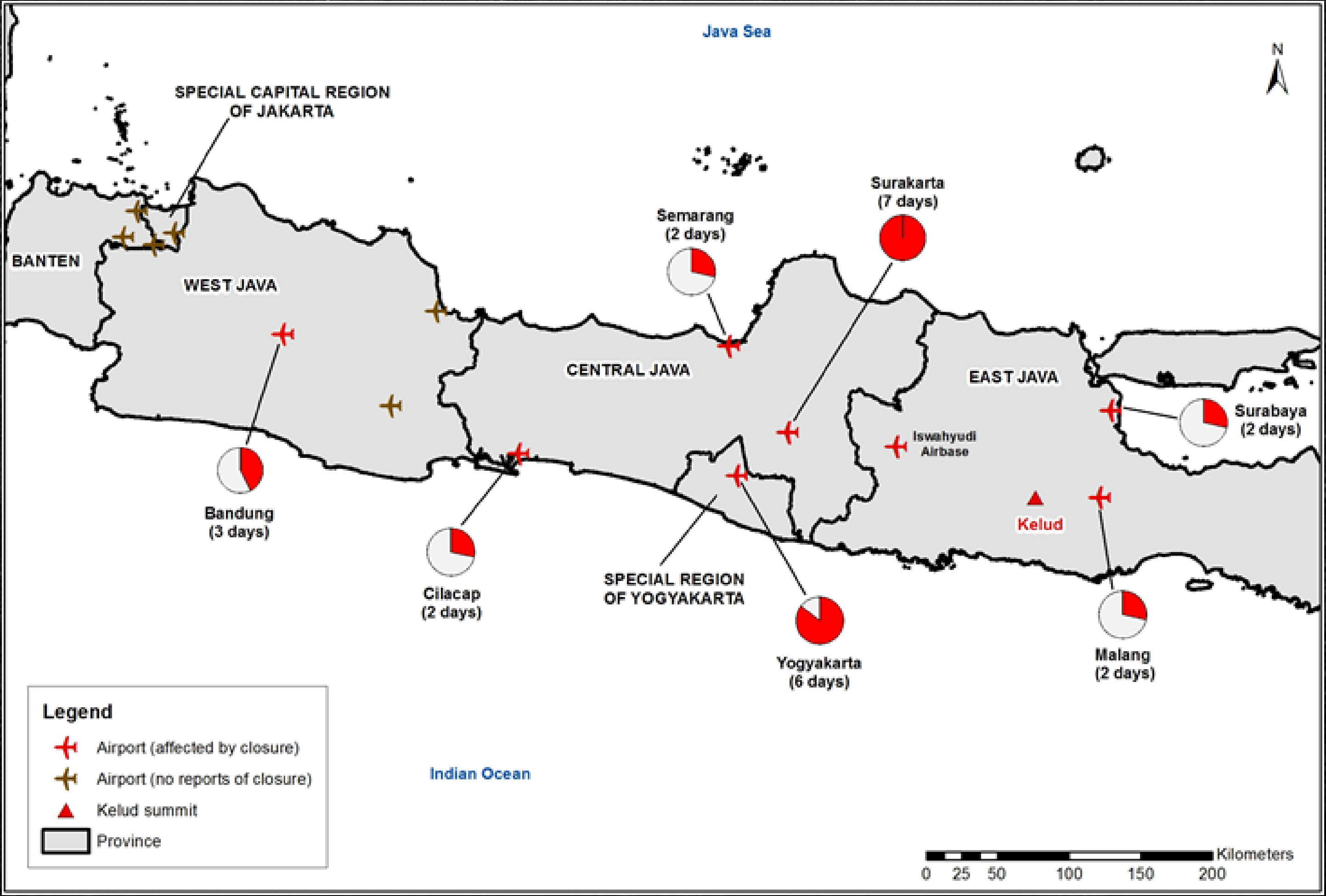
Compounding disruption from:

- **Volcanic ash**
  - line marking coverage
  - surface traction
  - visibility (*important for all transport modes)*
  - vehicle damage

Persistent & far-reaching!

Ash in Kagoshima, Japan (Minami Nippon Shimbun)

Far-reaching ash example

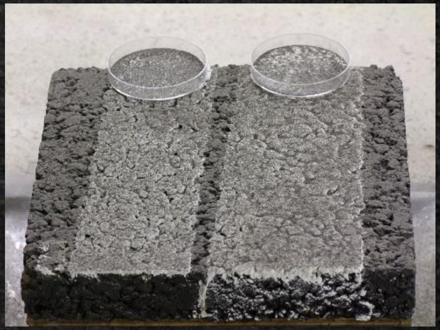


Airport closures in Java, Indonesia after the 2014 Kelud volcanic eruption (Blake et al. 2015)

VAT LAB
VOLCANIC ASH TESTING LABORATORY

Lab impact studies

- Frequently occurring impacts:
    1. Surface traction reduction
    2. Line marking coverage
    3. Visibility impairment



- Quantitative empirical evidence could inform transport management strategies.

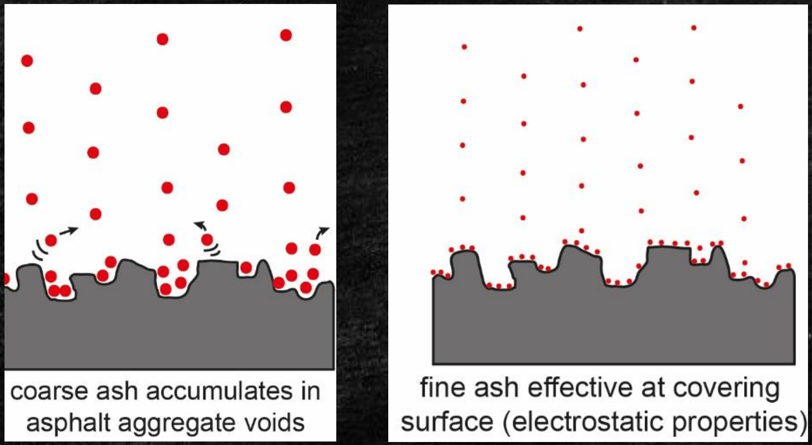
- Various ash characteristics can be isolated and their effects investigated.

Lab impact studies

1. Line marking coverage

- As little as 0.1 mm ash thickness!
- Fine ash covers markings easily

Road markings covered by ash in Kagoshima, Japan (Kagoshima City Office)



Line marking coverage testing - diagram exerts

Thresholds for cleaning initiation

(Blake et al. 2016)

Lab impact studies

2. Surface traction reduction

- dry & wet ash slippery
- various ash properties important – not just thickness
- surface properties also important

Pendulum skid resistance testing

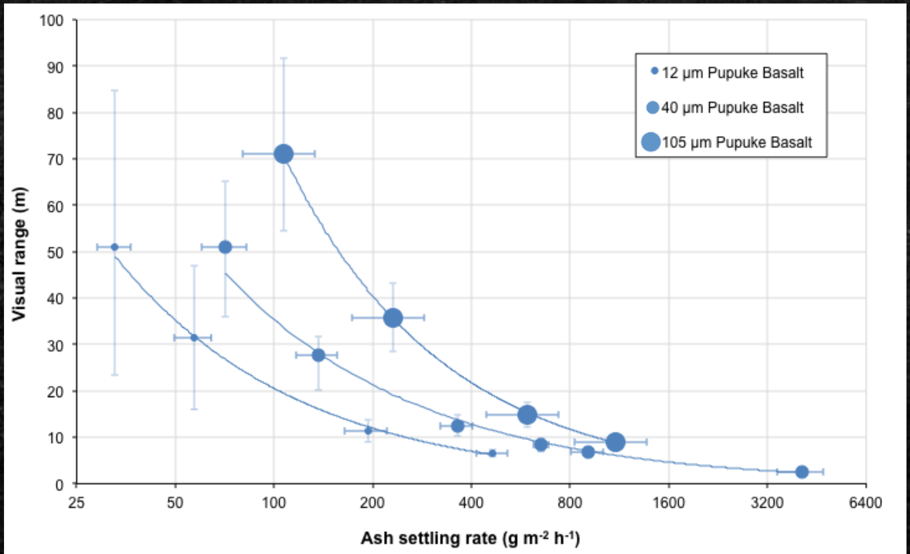
Van accident following Merapi ash fall, Indonesia
(Andersen Oystein, 2010)

(Blake et al. 2017)

Lab impact studies

3. Visibility in airborne ash

- low visibility for fine-grained ash
- also low for light-coloured & elongated particles



(Blake et al. 2018)

Low visibility in ash from Kelud volcano, Indonesia (2014) *(The Guardian, 2014)*

Secondary impacts

Airspace affected before, during & after eruptions

Air traffic restoration in Europe following the Eyjafjallajökull eruption, 2010

Secondary impacts

Closures on the ground before, during & after eruptions from:

- ash & other volcanic hazard impacts
- evacuation zoning & safety regulations / precautions

Airport closure in Ecuador, 2002 (Ecuador Geophysical Institute)

Ash fall from Mt. Tongariro, New Zealand, 2012

Secondary impacts

Accidents and traffic congestion

- multiple vehicles with higher injuries & fatalities
- still unknowns around behaviour in Auckland

Accident damage in Argentina, 2016 *(JLA Fire Department)*

Multiple vehicle accident in Oklahoma, 2012 *(Wall Street Journal)*

Ash remobilisation

Ash remobilisation from traffic in Yogyakarta, Indonesia (2014)

Persistent impacts due to:

- wind
- water
- traffic

and/or

- other human activities

Maybe for months to years

Mitigation options

(Besides clean-up)

- increase vehicle maintenance (air filters & oil changes etc.)
- lower speed limits
- one-way systems
- spacing of vehicles
- dampen surfaces
- inform / educate end-users

Ash remobilisation from train nr Yogyakarta, Indonesia (2014)

Māngere Bridge scenario, Auckland

Damage metrics

Road impact

- Destroyed
- Severe damage / complete blockage
- Some damage / major blockages
- Minor accumulation of deposits (no damage)
- Minor blockages and damage possible
- No impact

Level of service metrics

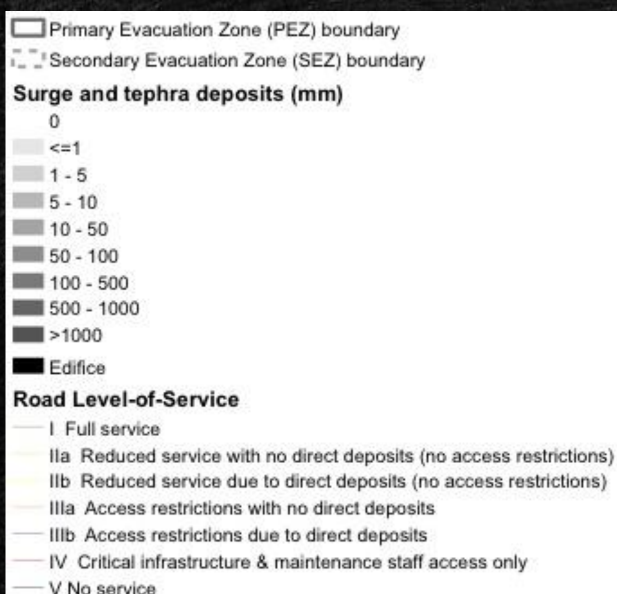
Conveys 'end-user experience
(informed by consultataion)

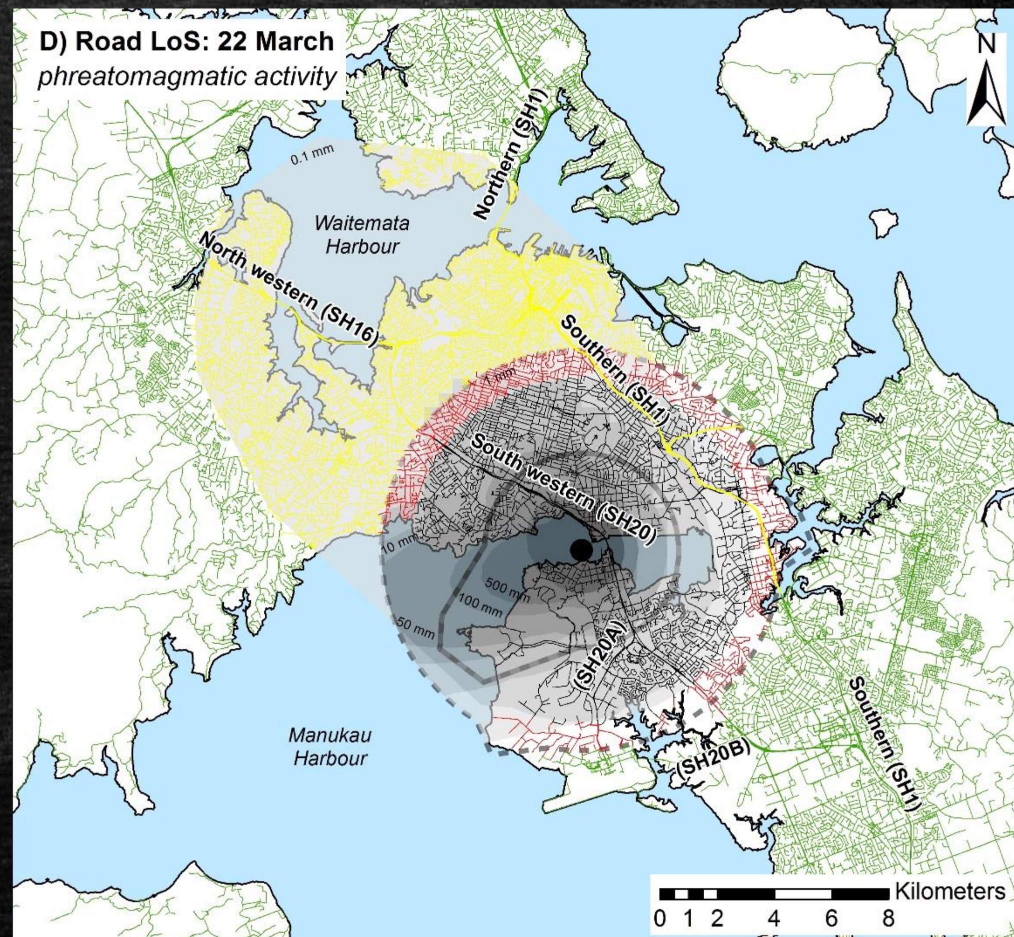
Road Level of Service

- 1 Full service
- 0.7 Reduced traction and visibility
- 0.2 Very limited access due to blockage and damage
- 0.1 No access except critical staff
- 0 No service

Māngere Bridge scenario, Auckland

Level of service example map:





(Blake et al. 2018)

Summary

- Extreme physical damage to transportation infrastructure close to vents
- Disruption from volcanic ash widespread and persistent
  - depends on a variety of properties (not just ash thickness)
- Impacts to level of service from closures, evacuation zoning, and safety precautions are very important
  - disruptive & costly

Ash in Kagoshima, Japan *(Minami Nippon Shimbun)*

Skid resistance – ash covered roads & airfields

Pendulum Skid Resistance Tester

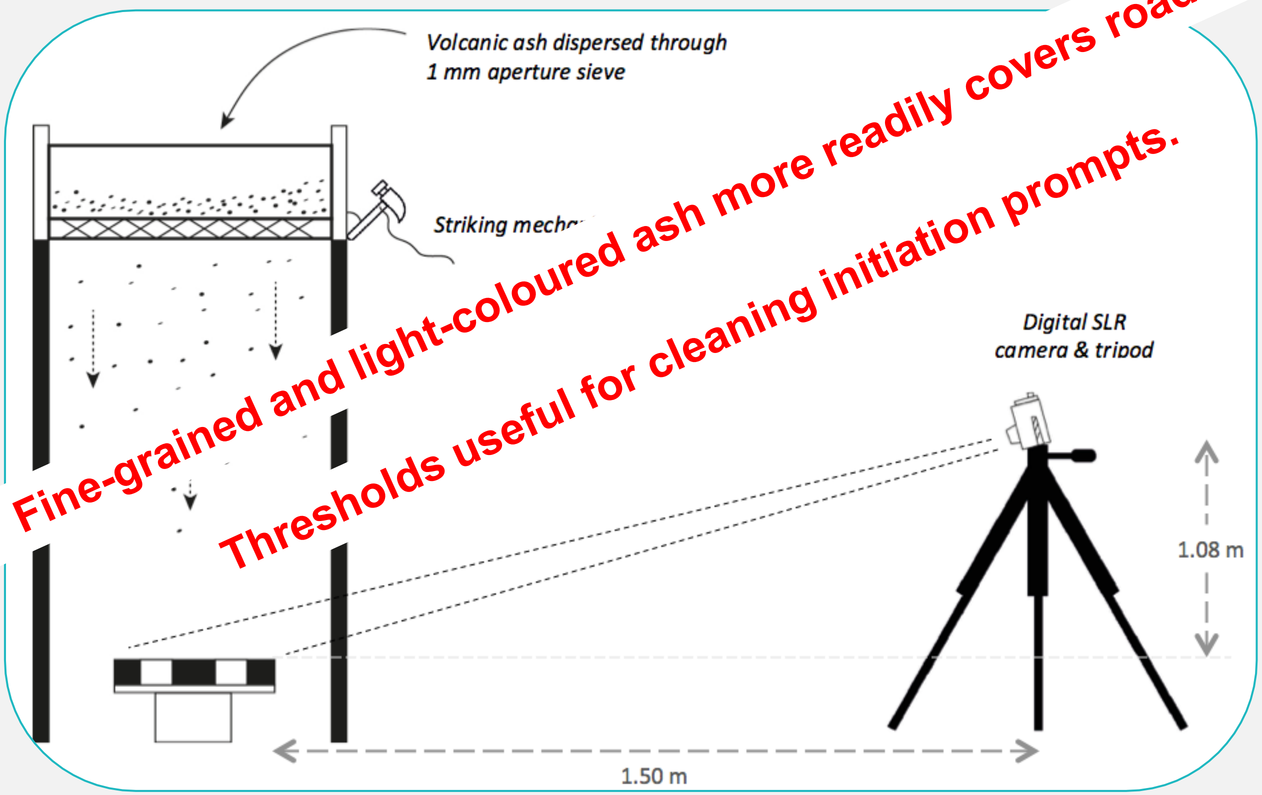
- Skid Resistance Values (SRVs) calculated
- Comparable to Coefficient of Friction
- Multiple characteristics tested

Thin (~1 mm) ash responsible for slippery surfaces.

Largest change in skid resistance occurs during dry conditions.

Road marking coverage

Experimental set-up:

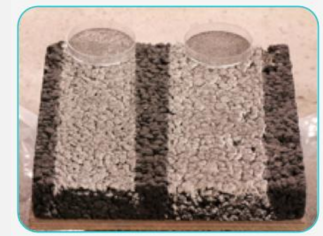


Fine-grained and light-coloured ash more readily covers road markings.

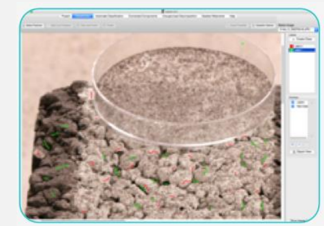
Thresholds useful for cleaning initiation prompts.

Visible markings calc on:

1. Photograph y

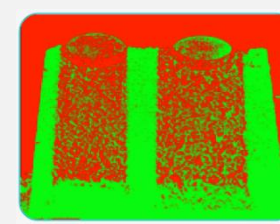


2. Classification



3. Pixel segmentation

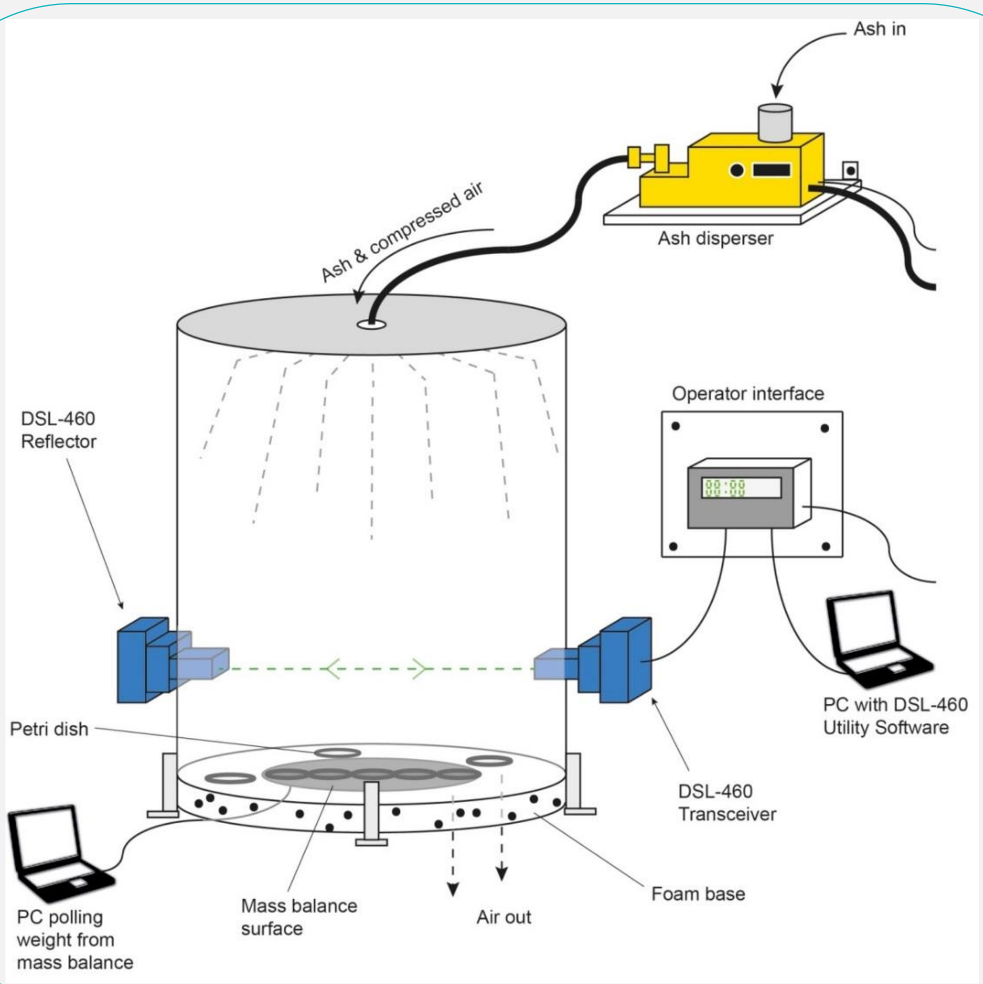
4. Image processing



Visibility through airborne ash

- Illogical to associate an atmospheric-related impact to a ground-based measurement.
- Contemporary ash dispersion and fallout models can provide forecasts of atmospheric conc… **opportunities!**

Visual range:
$VR = 3912 / (b_{ext} + 10)$



Ajay Makhija

Senior Emergency Management Advisor, National Planning | Analysis & Planning MCDEM

MCDEM Update

23 August 2018

Ministry of Civil Defence
& Emergency Management
Te Rākau Whakamarumaru

Ajay Makhija
Senior Emergency Management Advisor

Today

- Introduction
- National Planning Team
- National CDEM Strategy
- National CDEM Fuel Plan
- Other Stuff

Intro

- Ajay Makhija
- Lifeline Utilities & Infrastructure Resilience – National Planning
- Previously
  - Wellington Airport
  - Capital & Coast DHB
  - Hospitality

MCDEM National Planning Team

- Three work streams
  - Lifeline Utilities
    - Planning – Director's guidelines
    - Sector engagement/support – CDEM Groups & Lifelines
    - NLUC @ NCMC
  - Welfare
  - Hazard Specific planning
    - WENIRP
    - AF8

National CDEM Strategy Review

NATIONAL DISASTER RESILIENCE STRATEGY

We all have a role in a disaster resilient nation

NATIONAL DISASTER RESILIENCE STRATEGY

Working together to manage risk and build resilience

a National CDEM Strategy under the CDEM Act 2002

OUR VISION

New Zealand is a disaster resilient nation that acts proactively to manage risks and build resilience in a way that contributes to the wellbeing and prosperity of all New Zealanders

RISKS TO, AND OPPORTUNITIES FOR, ATTAINING OUR VISION

Risks

New Zealand is subject to a variety of risks that threaten our wellbeing and prosperity. Examples include: natural hazards (e.g. volcanoes, earthquakes), biological hazards (e.g. plant and animal pests and diseases), technological hazards (e.g. industrial accidents, infrastructure failure), malicious acts (e.g. armed conflict, maritime security, terrorism), and economic crises (e.g. commodity or oil price shocks, financial crisis).

Societal Trends

Broader societal trends also have potential to change the way we live and work. These can represent either a risk or an opportunity for attaining our desired outcomes. These include: climate change and environmental degradation, population trends, economic growth and productivity, technological change, and challenges to the rules-based international order

OUR GOAL

To strengthen the resilience of the nation by managing risks, being ready to respond to and recover from emergencies, and by empowering and supporting individuals, organisations, and communities to act for themselves and others, for the safety and wellbeing of all.

We will do this through:

1 Managing Risks

2 Effective Response to and Recovery From Emergencies

3 Strengthening Societal Resilience

OUR OBJECTIVES:

1 Managing Risks

1 Identify and understand risk scenarios (including the components of hazard, exposure, vulnerability, and capacity), and use this knowledge to inform decision-making

2 Put in place organisational structures and identify necessary processes to understand and act on reducing risks

3 Build risk awareness, risk literacy, and risk management capability, including the ability to assess risk

4 Address gaps in risk reduction policy (particularly in the light of climate change adaptation)

5 Ensure development and investment practices, particularly in the built environment, are risk-sensitive, taking care not create any unnecessary or unacceptable new risk

6 Understand the economic impact of disaster and disruption, and the need for investment in resilience. Identify and develop financial mechanisms that support resilience activities.

2 Effective Response to and Recovery From Emergencies

7 Implement measures to ensure that the safety and wellbeing of people is at the heart of the emergency management system

8 Strengthen the national leadership of the emergency management system

9 Improve policy and planning to ensure it is clear who is responsible for what, nationally, regionally, and locally, in response and recovery

10 Build the capability and capacity of the emergency management workforce for response and recovery

11 Improve the information and intelligence system that supports decision-making in emergencies

12 Embed a strategic approach to recovery planning that takes account of risks identified, recognises long-term priorities, and ensures the needs of the affected are at the centre of recovery processes

3 Strengthening Societal Resilience

13 Build a culture of resilience, including a 'future-ready' ethos, through promotion, advocacy, and education

14 Promote and support prepared individuals, households, organisations, and businesses

15 Cultivate an environment for social connectedness which promotes a culture of mutual help; embed a collective impact approach to building community resilience

16 Take a whole of city/district/region approach to resilience, including to embed strategic objectives for resilience in key plans and strategies

17 Recognise the importance of culture to resilience, including to support the continuity of cultural places and institutions, and to enable to the participation of different cultures in resilience

18 Address the capacity and adequacy of critical infrastructure systems, and upgrade them as practicable, according to risks identified

Key dates

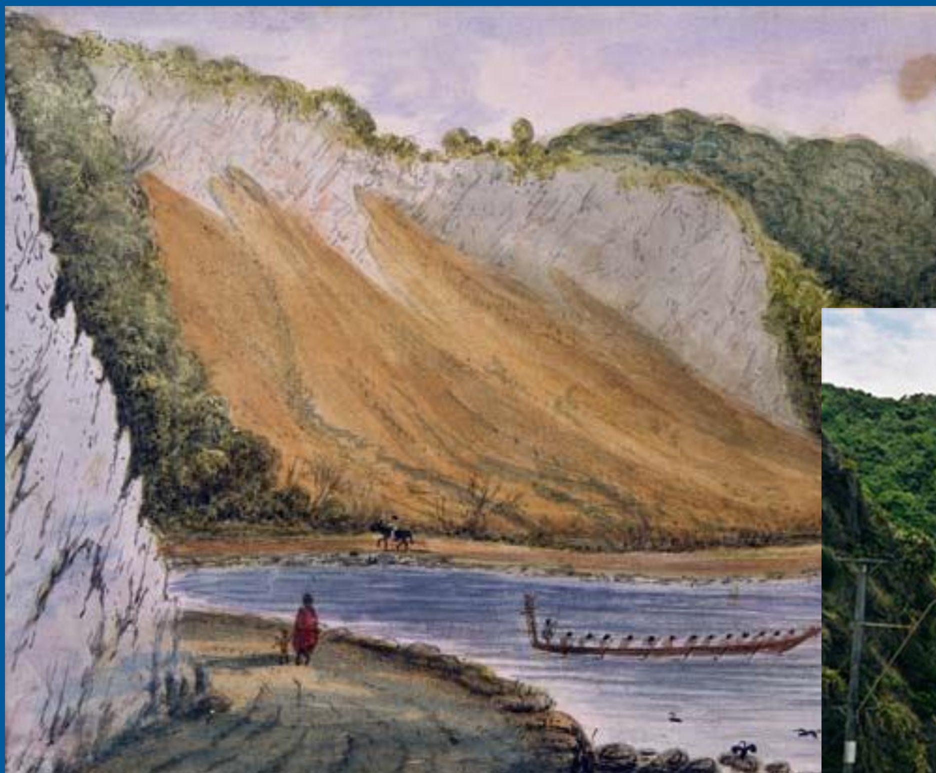
Date	Activity
Tues 21-Tues 28 August	First consultation draft to Government Agencies
Late August	Draft to the Minister of Civil Defence
Early September	Consultation with Ministers
Weds 26 September	Consultation draft to Cabinet Committee
Monday 8 October	Cabinet confirms (hopefully) decisions
Early-Oct to early-Dec	Public consultation (incl. further engagement with agencies)
January 2019	Final draft to the Minister of Civil Defence
Feb 2019	Agency consultation on final draft Strategy and accompanying Cabinet paper; Consultation with Ministers
Feb-March 2019	Cabinet; Select Committee; House sitting period (Strategy to tabled in House)
9 April 2019	Strategy comes into effect

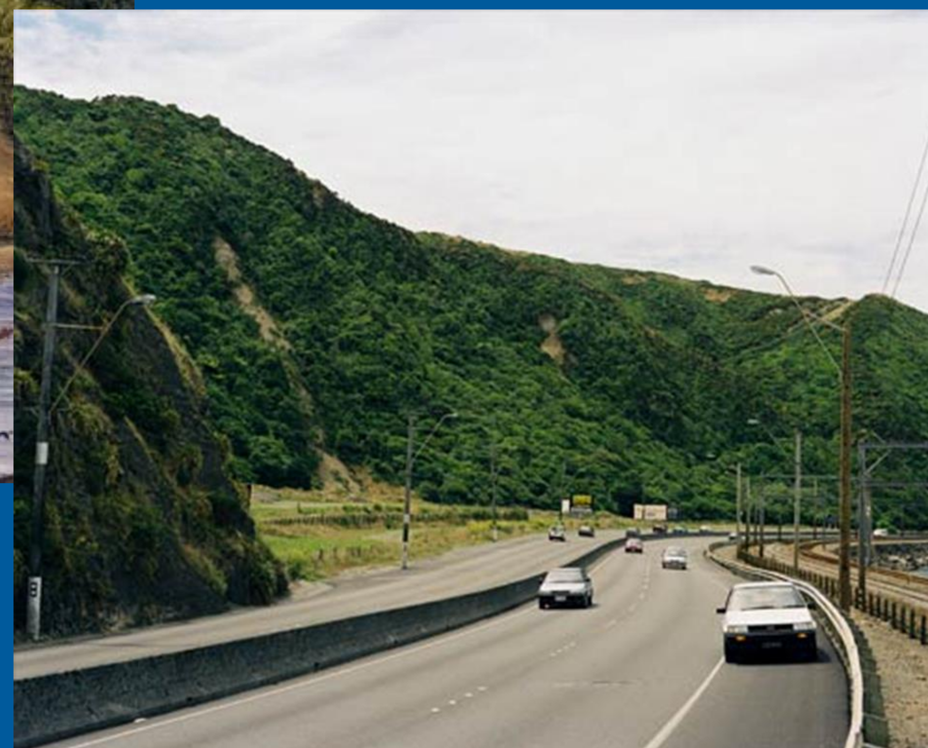
National Fuel Plan Review

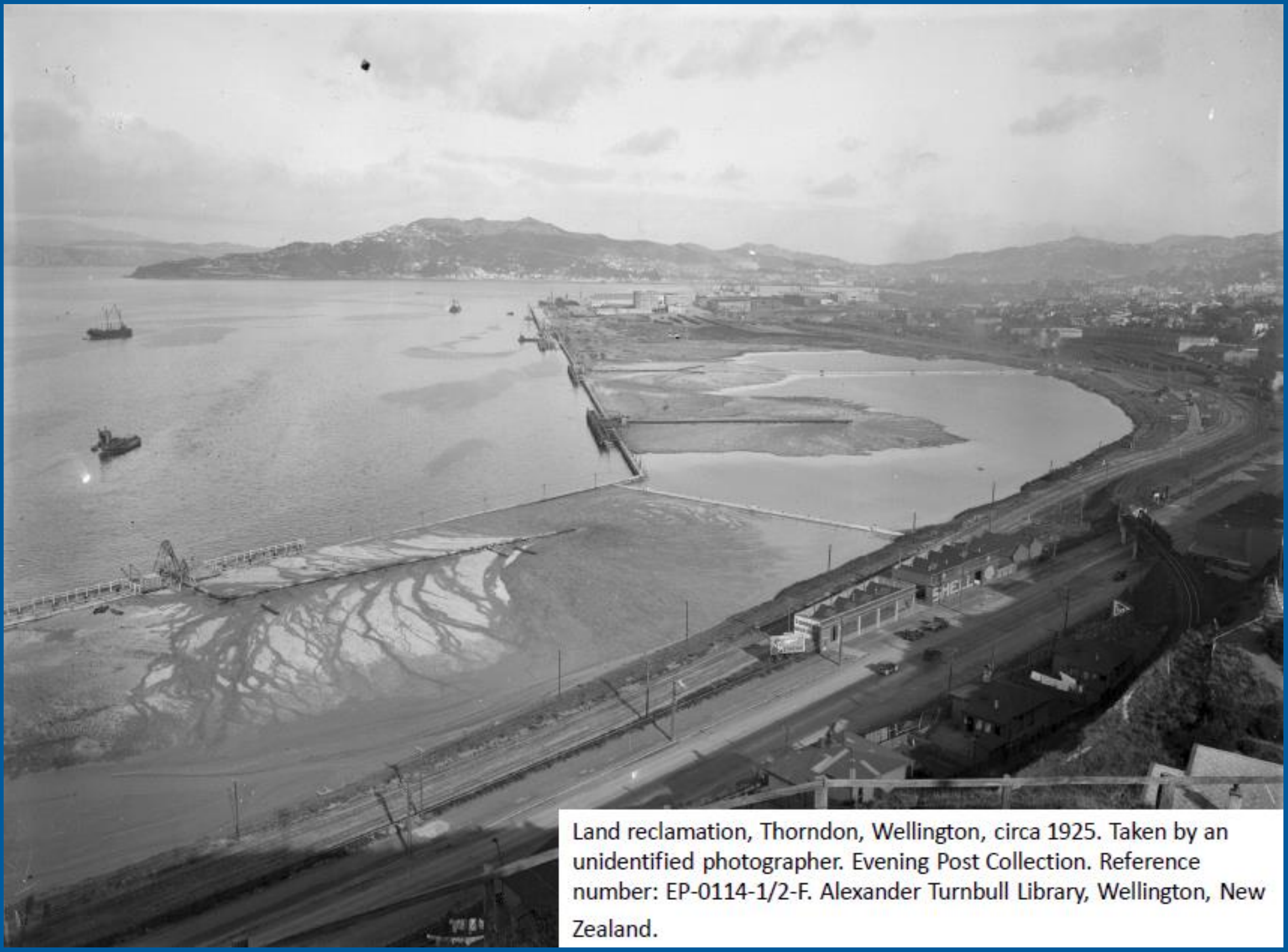
- National Fuel Plan due for review
- MBIE Oil Emergency Response Strategy (OERS) due for review
- Opportunity to align into a single document
- Joint review
- Timeframe
  - Initial Draft – Sep/Oct 2018
  - Sector Consultation – Oct/Nov 2018
  - Implementation – Mid 2019

Other updates

- Lifeline Utilities Coordinator (LUC) Capability and training
- CIMS Review
- National Lifeline Utilities Forum
  - 15/16 October, Te Papa – Wellington
- Geospatial Development







Land reclamation, Thorndon, Wellington, circa 1925. Taken by an unidentified photographer. Evening Post Collection. Reference number: EP-0114-1/2-F. Alexander Turnbull Library, Wellington, New Zealand.

Fraser Toulmin
Lifeline Utilities Coordinator
Bay of Plenty CDEM Group
Mobile +64 27 705 7296

BAY OF PLENTY EMERGENCY MANAGEMENT GROUP

Irving Young Group Welfare Manager | CDEM Group Services, Community and Services
Waikato CDEM Group | Group Emergency Management Office
P: +6478592743
M: +6421308058

IN AN EMERGENCY STAY SAFE STAY INFORMED

Lifelines Forum 2018

BAY OF PLENTY LIFELINES GROUP

Waikato Lifelines Utilities Group