

Photo: Volcanologists driving towards Eyjafjallajökull, Iceland, during 2010 eruption

Volcanic Impacts to Critical Infrastructure

Update on current research and VISG



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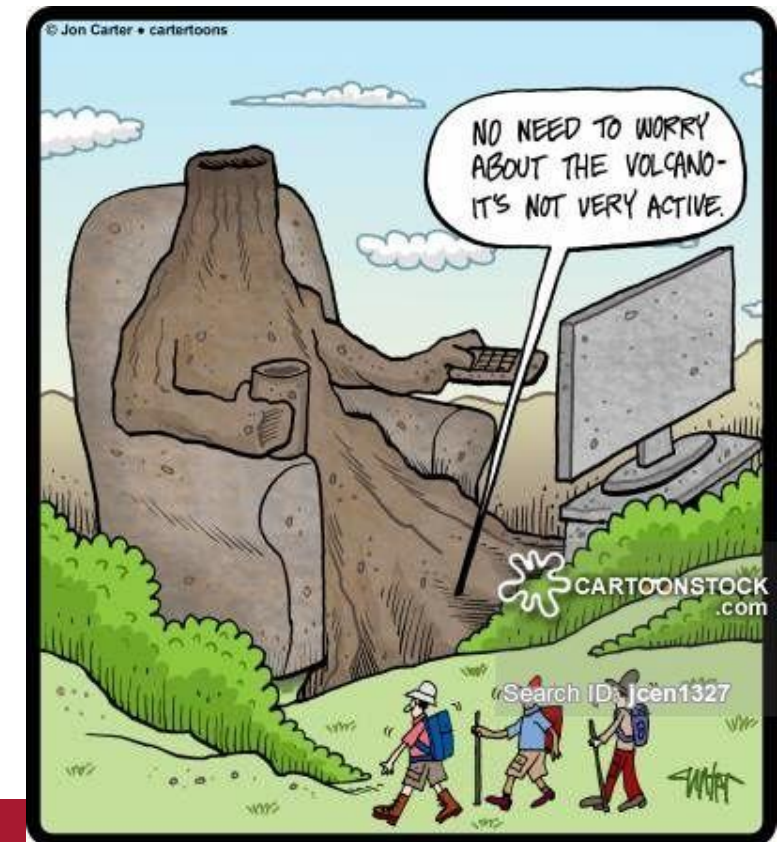
**Why care...? We haven't had an eruption in NZ in ages...
2019 eruption of Stromboli – Italy**

**Elements of
this could
happen at:**

- Auckland**
- Whakaari
(White Island)**
- Taranaki**
- Tongariro**
- Ruapehu**

Why should you care about volcanoes?

- Proximately lethal, distally a major headache and pain to deal with
 - Ash will go where the wind blows
- We (as a society) and our infrastructure are exposed
- An eruption/episode can last anywhere from minutes to decades
 - Open-ended crisis
- NZ volcanoes have been pretty quiet last 20 years – we have been given an opportunity to prepare



Ash impact research context & current programmes

- **Past 20+ years: sustained & systematic approach to volcanic impact assessment**
 - Critical infrastructure
 - Ash clean-up & disposal
 - Primary industries, e.g. agriculture
 - Social impacts
 - Emergency management
- **Reconnaissance trips to impacted areas to bring lessons home**
- **Laboratory testing of critical infrastructure components**

RESILIENCE
TO NATURE'S
CHALLENGES

Kia manawaroa
– Ngā Ākina o
Te Ao Tūroa

National
SCIENCE
Challenges



ECLIPSE

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

**Transitioning Taranaki
to a Volcanic Future
(MBIE Endeavour)**



VISG Objectives

- To **collate and advocate existing knowledge** about the impacts of volcanic hazards (e.g., volcanic ash) on, and mitigation measures for, **lifeline infrastructure**.
- To **facilitate and support research** on the impacts of volcanic hazards on lifeline infrastructure and the development of appropriate mitigation measures.
- To provide a **vehicle for two-way exchange** of relevant research information between the research and lifeline infrastructure community.
- To **facilitate reconnaissance investigations**, and/or advocate lifeline representation on reconnaissance investigations, to active volcanic areas where this would add to our knowledge about volcanic impacts on infrastructure.
- To provide a **national focal point** for volcanic impacts work on lifeline infrastructure



CLEAN-UP OF URBAN AREAS AFTER VOLCANIC ERUPTIONS

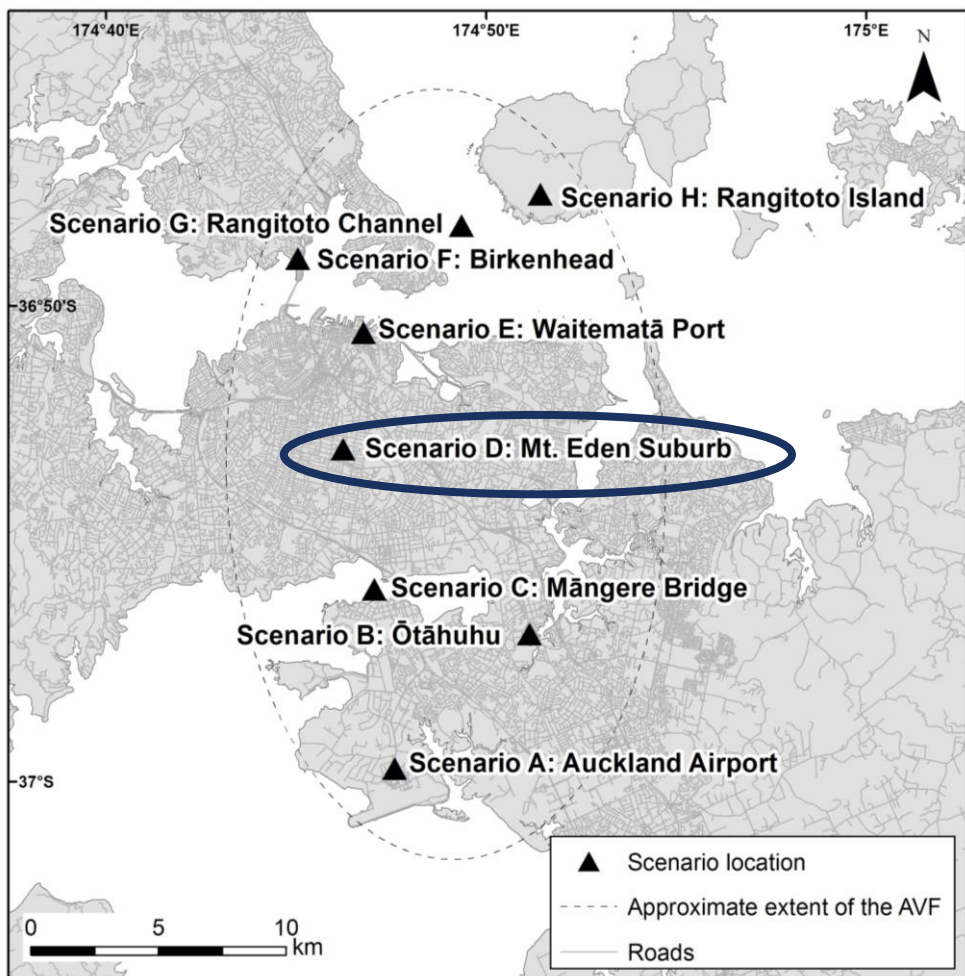
JOSH L. HAYES – PhD Candidate: Disaster Risk and Resilience, University of
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LEONARD, JIM COLE

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THE DEVORA SCENARIOS



Scenario	Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
A	1						..■						
B	1							..■	■				
C	1		■	■								
D	1			.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
D	2	■	■										
E	1									■	■		
F	1											.....	■
F	2	■	■	■	■	■	■	■	■	■	■	■	■
G	1												.....
G	2	■											
H	1						■						
H	2						■						
H	3		.....	■	■	■	■	■	■	■	■	■	■

Legend:

- Precursory unrest
- Wet eruption dominant
- Dry eruption dominant

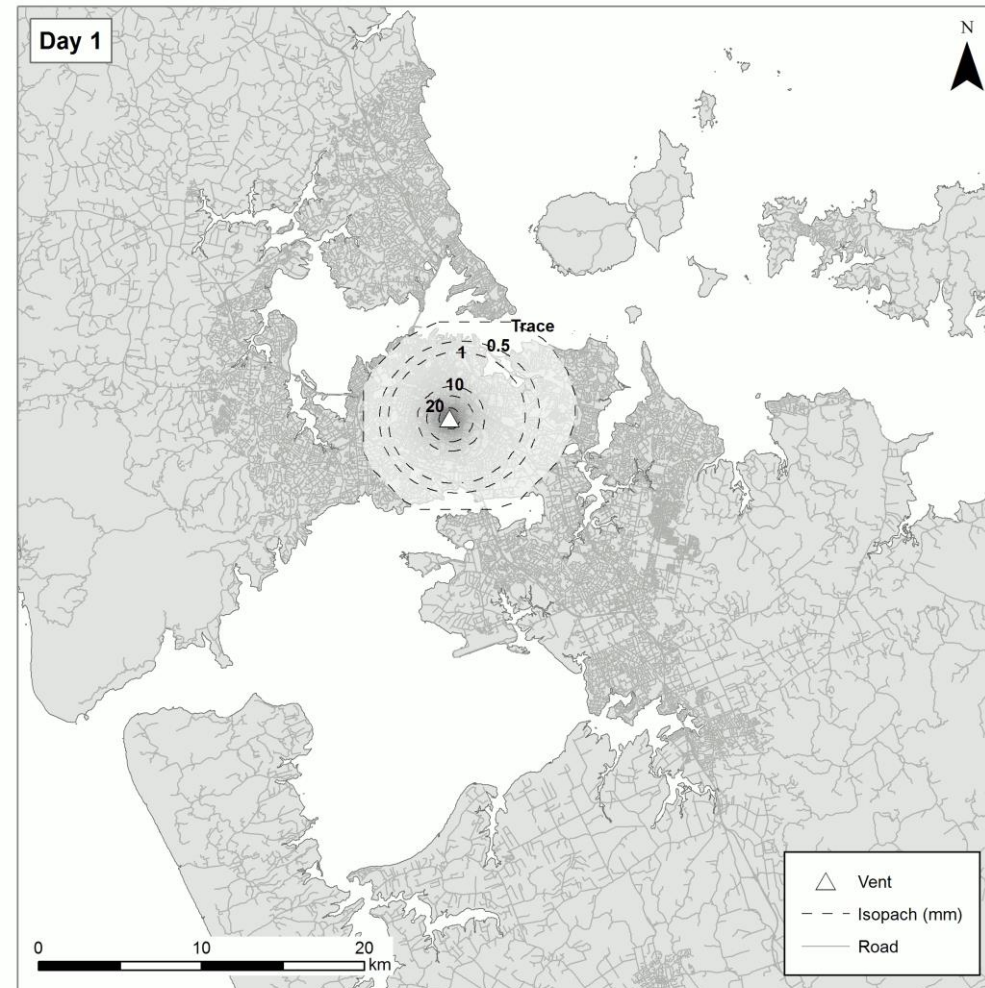
- Time-stamped shapefiles available for each scenario for 5 volcanic perils

Hayes, J.L., Tsang, S.W., Fitzgerald, R.H., Blake, D.M., Deligne, N.I., Doherty, A., Hopkins, J.L., Hurst, A.W., Le Corvec, N., Leonard, G.S., Lindsay, J.M., Miller, C.A., Németh, K., Smid, E., White, J.D.L., Wilson, T.M. (2018). The DEVORA scenarios: multi-hazard eruption scenarios for the Auckland Volcanic Field. Lower Hutt (NZ): GNS Science. 138 p. (GNS Science report; 2018/29). doi:10.21420/G20652

AN EXAMPLE SCENARIO

Scenario D – Mt. Eden Suburb

- **Relatively long-lived**
 - 45 days unrest
 - 320 days eruption duration
- **“Dry” eruption**
 - Similar to the Heimaey eruption in Iceland
- **Volcanic hazards**
 - Earthquakes
 - Edifice formation
 - Ballistics
 - Tephra fall
 - Lava flow

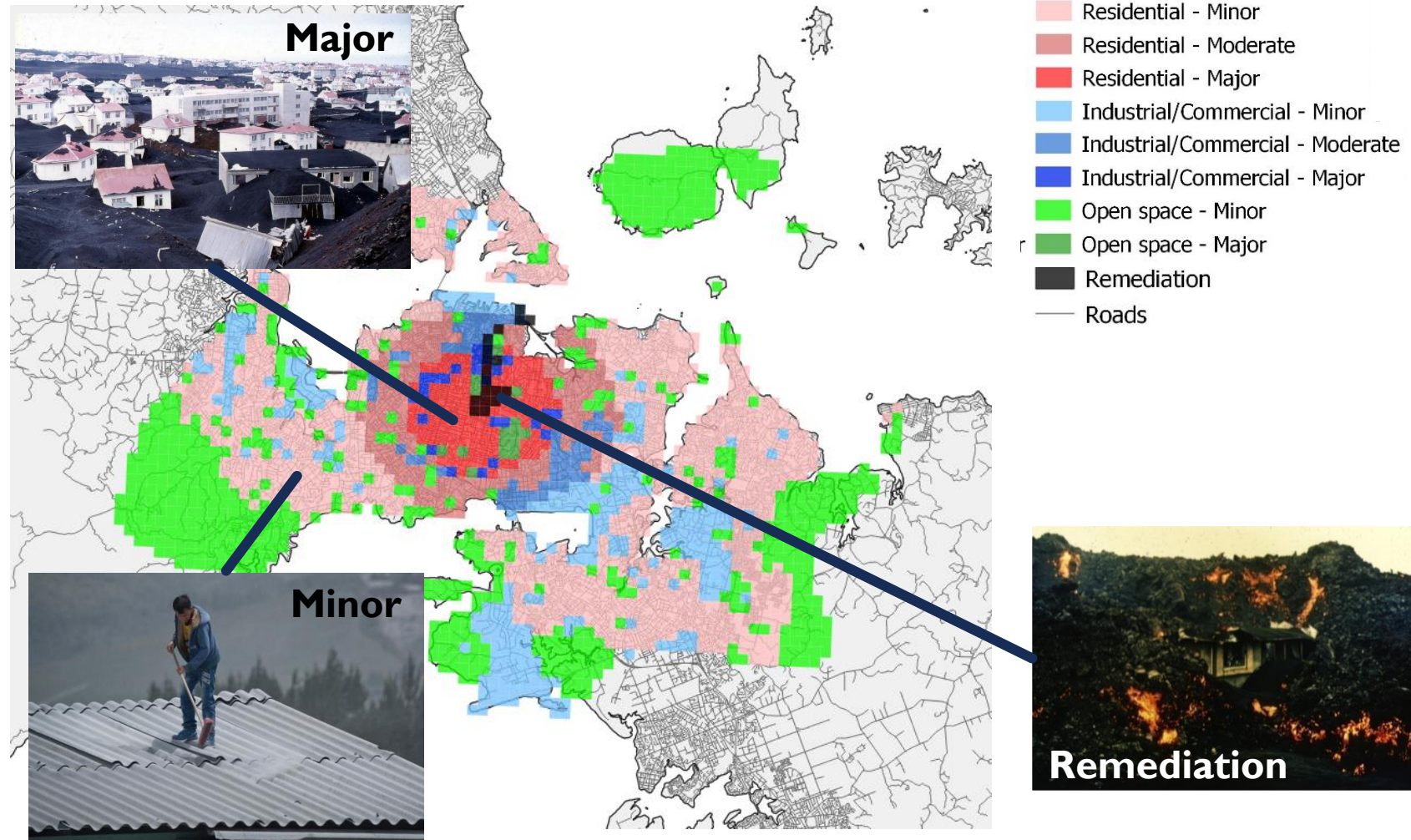


MT. EDEN SUBURB – ESTIMATED CLEAN UP REQUIREMENTS

- ~6 million tonnes of building debris (complex mixed waste)
- ~10-15 million tonnes of volcanic products (ash, lava, etc)
- TOTAL: 25-30 million tonnes

Comparison:

- Canty EQ Sequence: ~7.5 million t
- Tohoku EQ/tsunami: ~30 million t



Alec Wild (UC/UA): Taranaki Eruption direct & indirect impacts to farms from ash fall

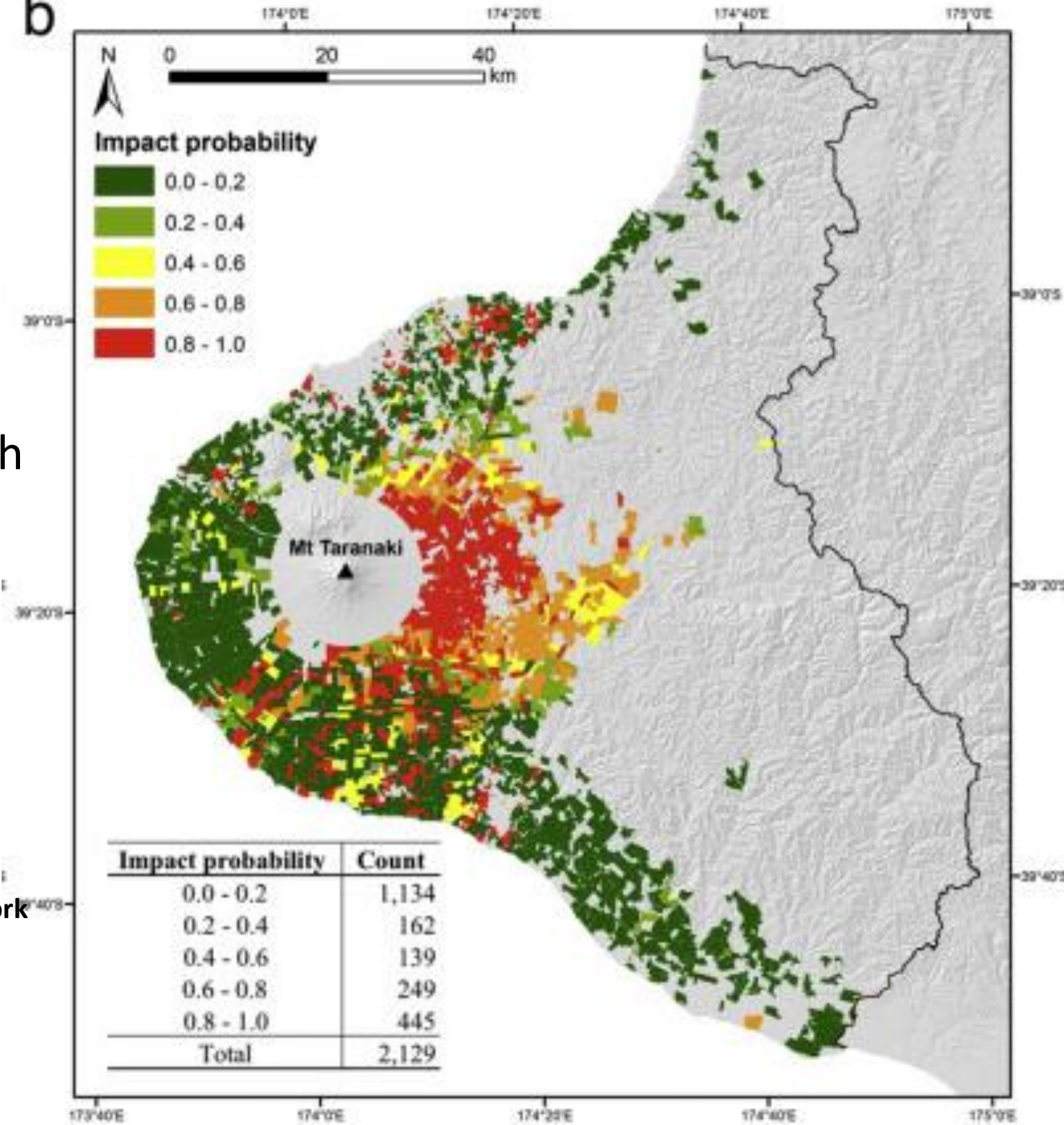
- Moderate-large Taranaki eruption (subplinian), with westerly wind
- ~600 farms severely impacted* by direct ash fall
- ~150 farms severely impacted* by indirect disruption of lifelines (water, power, road) due to ash fall

**Loss of production for >12 months and likely require substantial de-stocking and/or pasture rehabilitation*

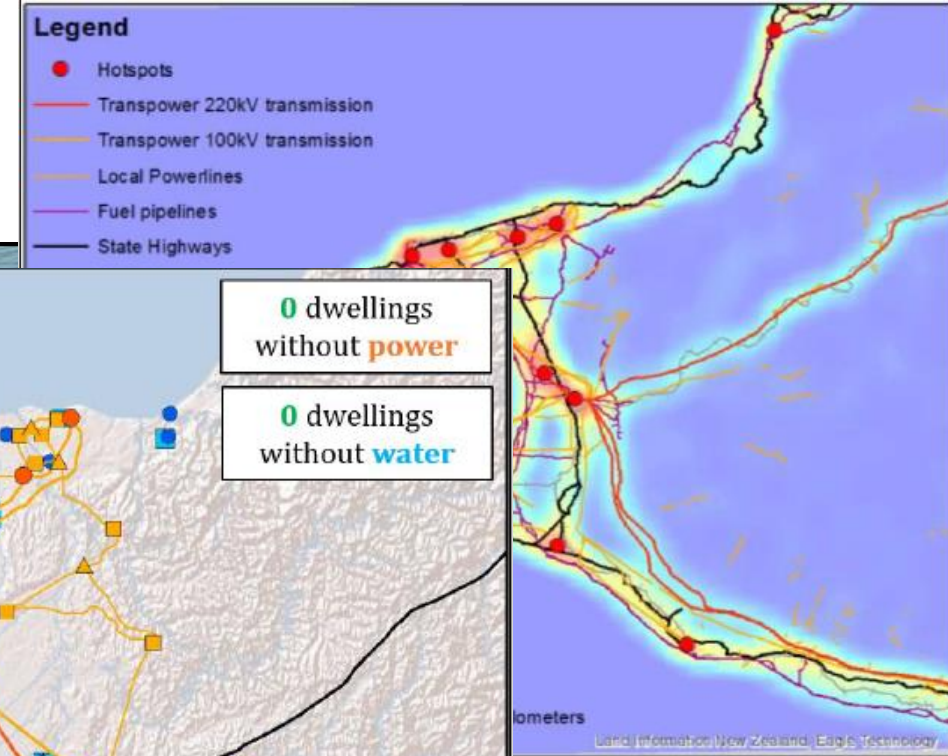
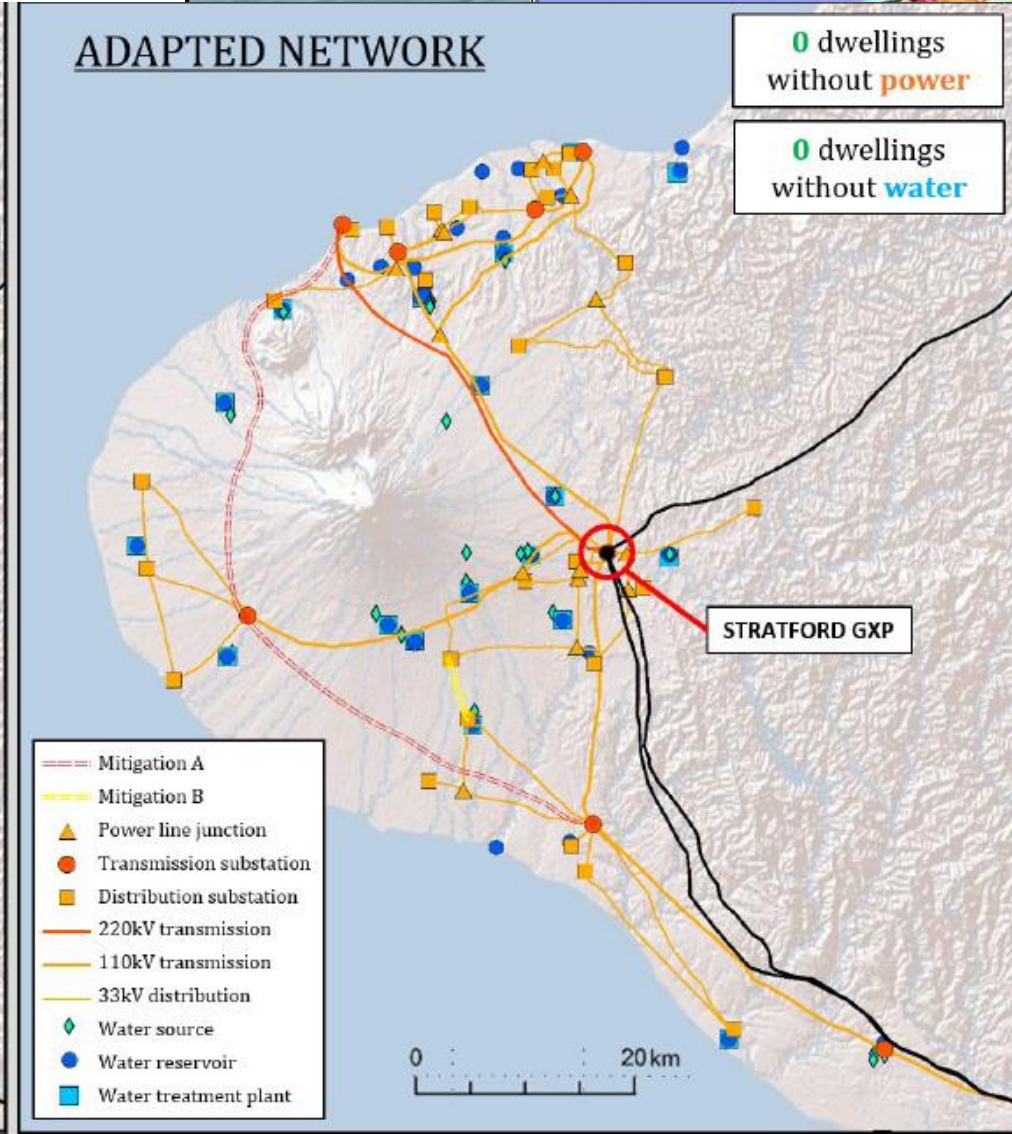
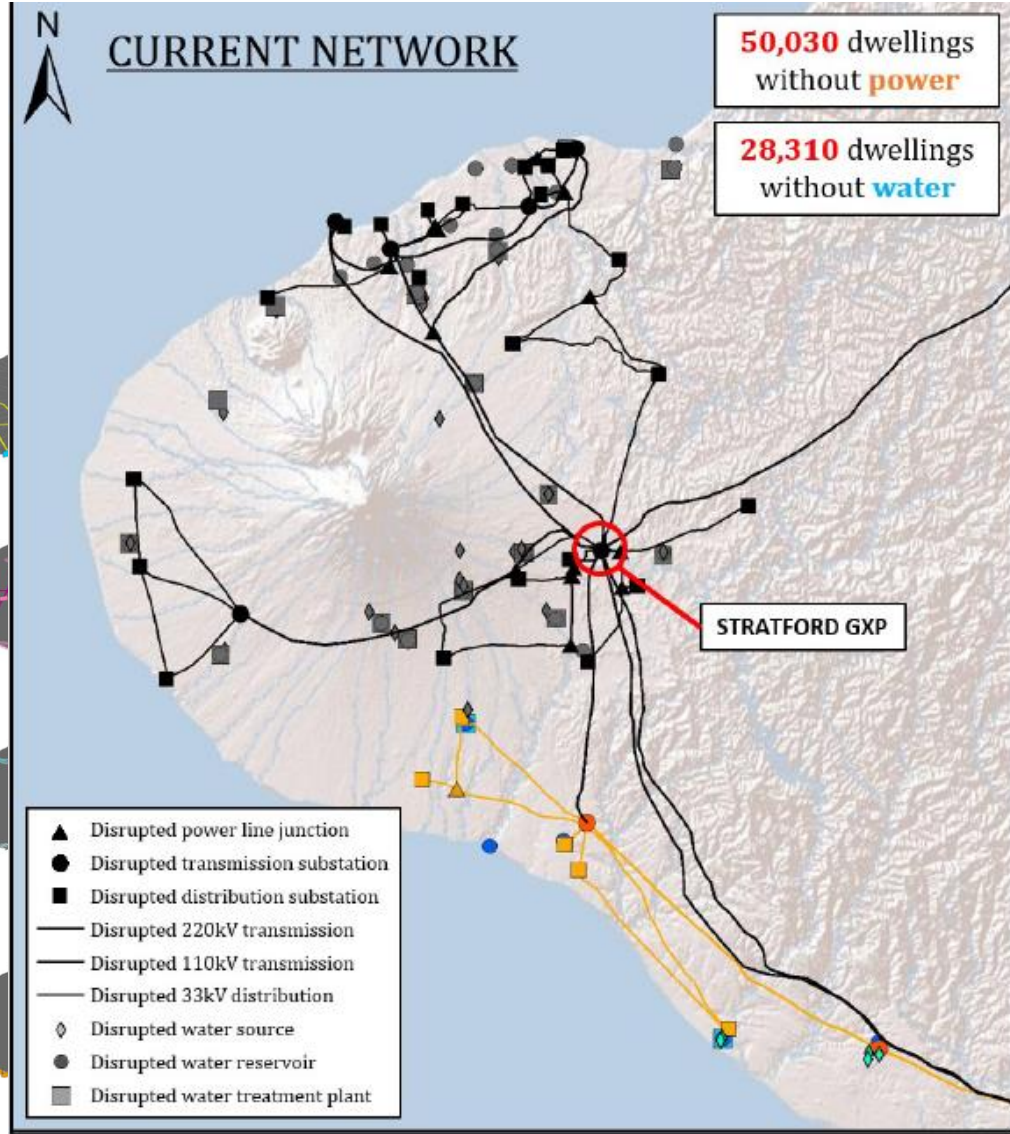
Wild, A. J., Wilson, T. M., Bebbington, M. S., Cole, J. W., & Craig, H. M. (2019). **Probabilistic volcanic impact assessment and cost-benefit analysis on network infrastructure for secondary evacuation of farm livestock: A case study from the dairy industry, Taranaki, New Zealand.** *Journal of Volcanology and Geothermal Research*, 387, 106670. OPEN ACCESS

<https://www.sciencedirect.com/science/article/pii/S0377027319302379>

b



Alana Weir (UC) Systemic vulnerability of critical infrastructure networks to volcanic multi-hazards



Nicole Allen (UC) - Multi-Volcanic Hazard Impact Assessment for Residential buildings in the Auckland Volcanic Field, New Zealand



Funded by
Building Research Levy



Waitematā Port Scenario

- 286,436 buildings exposed (2014 dataset).
- 87.7% residential,
- 39.6% are impacted by more than 1 hazard.
- Waitematā Port destroyed
- Airport disrupted

Habitability

- Residential buildings are required to protect residents from inclement weather, structural hazards and disease.
- The impacts of volcanic hazards can influence the habitability of residential buildings.
- It is possible that the order and timing of hazards has a direct relationship with habitability.
- Structural integrity of the building will be the focus of this research.



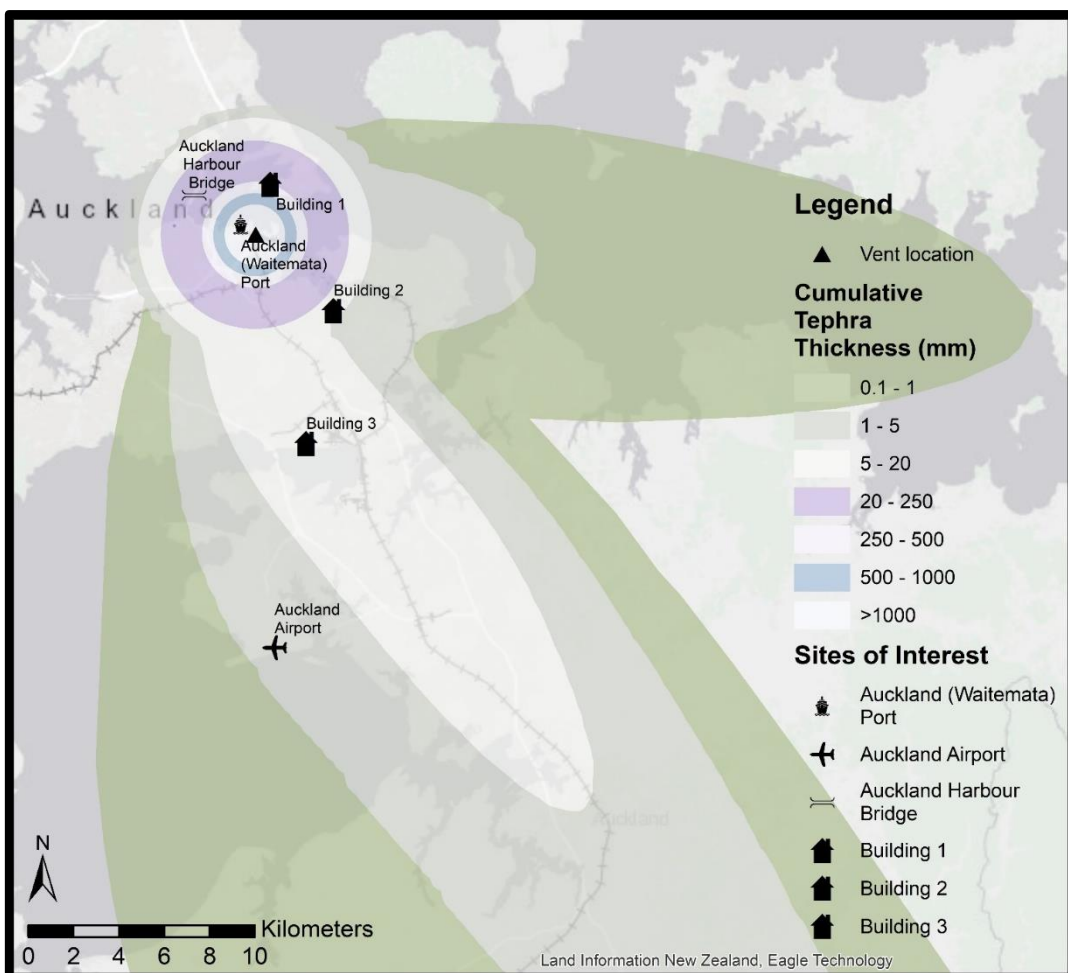
Roof, with wind protection boulders, covered in ash <500m from 2014 Mt Ontake eruption, Japan. Credit Kae Tsunematsu.



Fire damage from low momentum PDC, 1997 eruption of Soufrière Hills, Montserrat. Credit Baxter, P., (2005), Bul. Volc.



Manual cleaning of tephra in Jacobacci, Argentina, Cordón-Caulle, eruption, 2011. Credit: Aileen Rodriguez.



Sophia Tsang (UoA): Lava flow impacts to critical infrastructure in urban environments



- Challenging localised urban volcanism issue
- Buried Infrastructure – focus on electricity cables
 - Thermal diffusion modelling for Auckland soils
 - Transpower and Vector support
- Case-study analysis on complex lava flow crises e.g. Hawaii

Resources

- **Volcano Short Course**
 - 11-12 November in Auckland, optional field trip on 13 November
- **Open research forums**
- **NZ-specific VISG ash impacts posters**
 - ALG website (under Document Library)
 - GNS website (Eruption What to Do)
- **USGS-hosted Ash Impacts and Mitigation website**
 - Majority of content provided by VISG researchers
 - https://volcanoes.usgs.gov/volcanic_ash/
 - Google Search 'ash impacts' (on the first page)



VOLCANIC ASHFALL
ADVICE FOR ROAD NETWORK OPERATORS

Ash Impacts On Road Networks

GENERAL IMPACTS

- Visibility can be low with rain and fog and after an eruption due to suspended ash in the air.
- Tracked and off-road roads (used in both dry and wet conditions).
- Road markings and signage can be obscured by ash less than 1mm thick.
- Asbestos release if they increase.
- Vehicles can experience other types of wear, corrosion of metal surfaces, and abrasion damage to windshields, plastic and other components.
- Road surface may become slippery due to the dust that is blown up from the ground and/or 100 km/h.

RECOMMENDED ACTIONS

WHERE TO FIND MORE INFORMATION

See the links provided on the right hand side of the poster.

HOW TO PREPARE

Operational plans should be developed for the volcanic event, including:

- Coordinating plans with emergency management agencies.
- Identifying road blocks and other problems.
- Identifying the safety of the road network.
- Identifying equipment and labour requirements for cleanup.
- Identifying guidelines for disposal.

HOW TO RESPOND

VEHICLE AND MACHINE OPERATIONS

- Avoid long trips to clear ash from roads as the ash can cause slip and slide events. Stop ash from accumulating on the road surface.
- Clean or replace air and oil filters regularly.
- Apply lubricant to gears more frequently and check for wear.

ROAD NETWORK MANAGEMENT

- Advise the public to avoid unnecessary travel.
- Implement safety measures. These may include:
 - Ash falls to road side.
 - Warning information and road signs (e.g. through variable message signs).
 - Implement road closures and one-way systems.
 - Ensure that road closures are based on road type, road width, road condition and proximity to the road.
- If the road is closed, ensure that the road is clear of ash before reopening.
- Coordinate cleanup schedules with other agencies.
- See the poster for more information on cleanup.

ROAD CLEAN-UP

- An assessment of the road should be made, including the size and type of the road, the location of the road, and the type of road.
- Clean up high priority roads before opening to traffic.
- Remove ash from roads before opening to traffic.
- Clean up roads that are used for public transport, heavy trucks, and private roads.
- If the road is closed, ensure that the road is clear of ash before reopening.
- Coordinate cleanup schedules with other agencies.
- See the poster for more information on cleanup.

FURTHER RESOURCES

<https://www.govt.nz/for-science-researchers/>
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DESIGNED BY DANIEL DICKSON
Version 1, June 2018

VOLCANIC ASHFALL IMPACTS WORKING GROUP

Volcanic Ash Impacts & Mitigation Choose Topic - For Scientists About Us References Resources What can I do? Multimedia

Select Language Powered by Google Translate

Volcanic Ash Impacts & Mitigation

Volcanic-ash hazards are far reaching and disruptive, affecting more people, infrastructure, and daily activities than any other eruptive phenomena.

This web encyclopedia provides information on the impacts of volcanic ash and mitigation strategies for dealing with them. Content is summarized from expert and peer-reviewed sources.

- Use 'Choose Topic' in the header or the left menu to find information categorized by affected sector.
- Posters and booklets in a range of languages are available in **Resources**.
- Technical guidance for scientists undertaking ash studies is presented in the **For Scientists** section.
- Do you have technical information or images you'd like to contribute to this Web site? New case studies and well documented experiences are valuable, and we welcome your contributions. Please **Contact Us** if you have information to add or questions.

DO YOU NEED URGENT INFORMATION?

If a volcanic eruption is forecast or ash has fallen in your area, follow the advice of your local Civil Defense or Emergency Management officials.

Resources

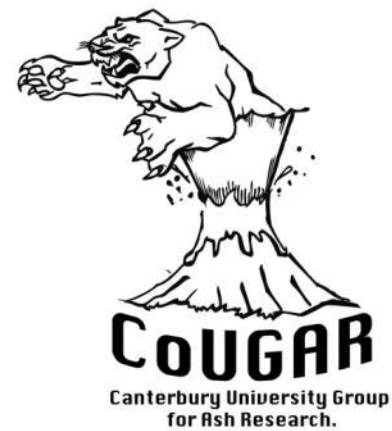
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Working together

- **Our best projects have been driven by stakeholder needs and engagement**
 - Transpower supporting PhD on ash impacts to grid
 - ALG member engagement on Mangere Bridge scenario
 - Taranaki CDEM hosting and deep support for PhD student for several years
 - VISG posters
- **While we approach partners, we also value partners approaching us with questions they want answered**

Ash Impact Research Context

- **Over past 20 years our New Zealand research group (& international collaborators) have aimed to undertake a sustained & systematic approach to volcanic impact assessment**
 - Critical infrastructure: electricity, water supplies, wastewater, land & air transport, telecommunications
 - Ash clean-up & disposal
 - Primary industries, e.g. agriculture
 - Social impacts
 - Emergency management
- **Reconnaissance trips to impacted areas to bring lessons home**
- **Followed by laboratory testing of critical infrastructure components...VAT Lab**



Current Volcano + Lifelines Research Programmes

- **Resilience to Natures Challenge (MBIE NSC) - *Volcano + Infrastructure***
 - Cone volcano focus, with national coordination
 - Central North Island and national focus, including vulnerability/resilience
- **ECLIPSE (MBIE Endeavour) – *Caldera Volcanoes***
 - Key focus on volcano unrest → Infrastructure
- **DEVORA (EQC, AC, GNS) – *Auckland Volcanic Field***
 - Volcanic disaster waste management + reuse of eruption products
 - Probabilistic analysis of infrastructure impacts and recovery scenarios
- **Transitioning Taranaki to a Volcanic Future (MBIE Endeavour)**
 - Major new investment, looking at detailed economic modelling for recovery pathways



Upcoming Events

	Volcano Short Course	DEVORA Forum	RNC2 Urban Theme Forum
Why	Learn / refresh about New Zealand's volcanoes, hazards, impacts, mitigation, GeoNet messaging, eruption response	Learn about latest research on Auckland Volcanic Field and contribute to future research directions	Receive updates on Smart Resilient Cities, Resilient Urban Communities, and Pathways to Governing for Resilience research workstreams and contribute to future research directions
What	2 day classroom learning, 1 day optional field trip	1 day forum	1 day forum
Where	Auckland	Auckland	Auckland
When	11-13 November	21 November	22 November
Cost	\$500 + \$100 (field trip) + GST	Free	Free
More information / RSVP	Fiona Buxton (f.buxton@gns.cri.nz)	Elaine Smid (e.smid@auckland.ac.nz)	Kate Kenedi (katek@auckland.ac.nz)