DISRUPTION OF CRITICAL INFRASTRUCTURE DURING PROLONGED NATURAL DISASTERS

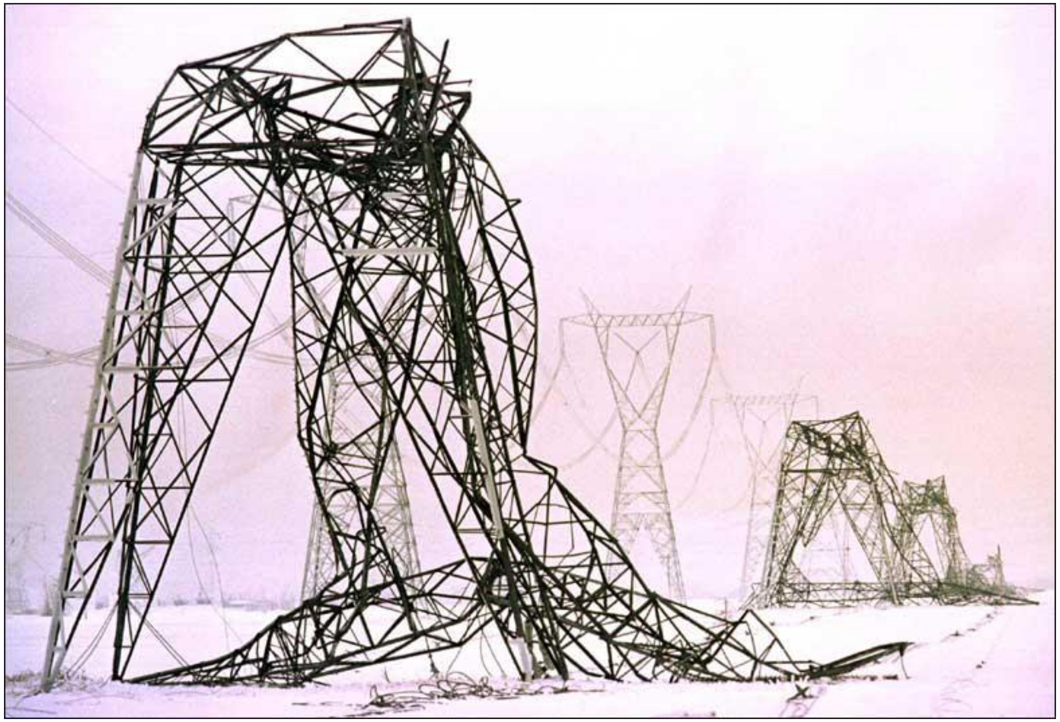
A research outline

Emma Phillips
BNHCRC PhD Scholarship Holder, PhD Candidate, Risk Frontiers, Macquarie University, NSW

An Australian Government Initiative

PRESENTATION OUTLINE

- Research background
- Project aims
- Preliminary work
- Future work



North American ice storm of 1998. Crumpled transition tower.

RESEARCH BACKGROUND

Mount Pinatubo eruption, 1991. DC-10 jumbo jet on the ground at Cubi Point Naval Air Station.

- Reliance on infrastructure and technology (lifeline networks) is growing
- Coupled with strong interdependencies
- Vulnerable to disruption from natural hazard events

RECENT EVENTS

- June 2014 - severe storm impacted the North Island of New Zealand
- ~90,000 power outages across Auckland
- ~30,000 residential and business customers lost power in Tauranga, South Waikato and Coromandel
- Some residents without hot water for up to a week

June 2014 Northland Storm, New Zealand.

RECENT EVENTS

Flights cancelled at Darwin Airport due to volcanic ash, May 2014.

- May 2014 - ash from Sangeang Api volcano, Indonesia blew over the Northern Territory
- Darwin airport closed for 24 hours
- Flights around Australia bound for Bali were also disrupted

PROLONGED AND MULTI-HAZARD EVENTS

- **Prolonged event –** event with a long duration or a series of events that occur in quick succession
- **Multi-hazard event –** where the initial hazard is associated with additional hazards
- These events can cause vast and on-going disruption to lifeline networks, critical services for rescue and recovery.

PROJECT AIMS

- Define and quantify the impacts of prolonged and multi-hazard events on lifeline networks

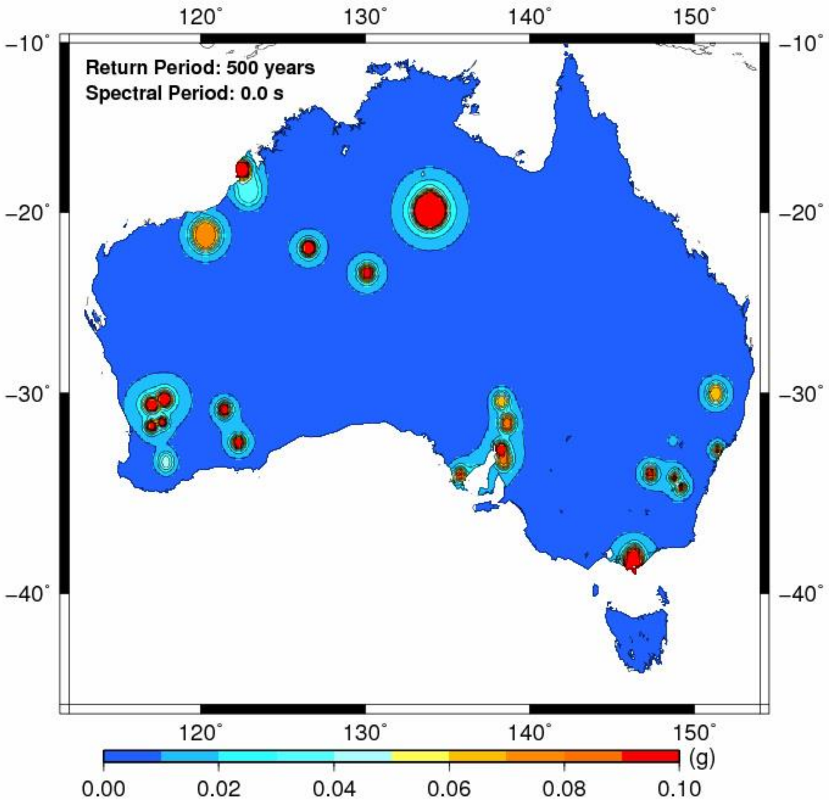
- Understand the interconnectedness of these critical services.

RESEARCH QUESTIONS

- How does the interconnectedness of critical services lead to a cascade of failures?
- What influences network recovery and how long can it take to rebuild?
- How long can impacts of a natural hazard event last and what is the cost of long term network disruption?
- What combination of factors could generate catastrophic disruption in the future?

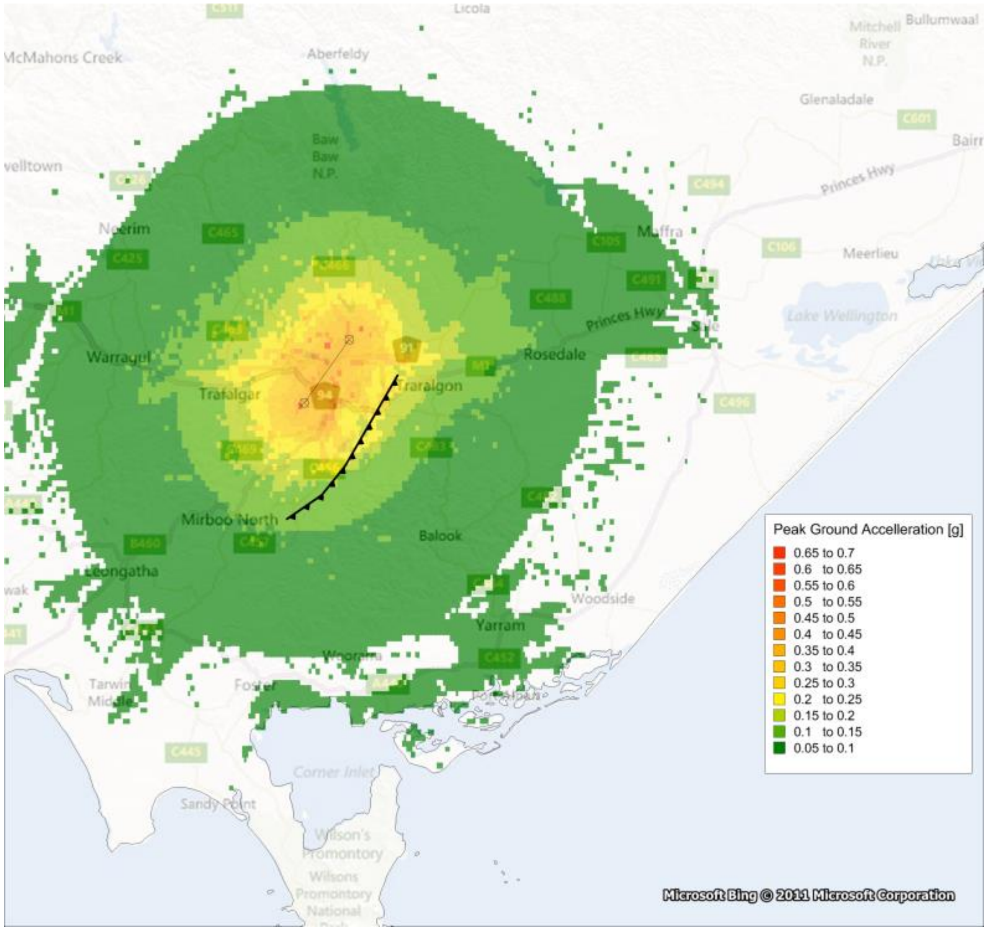
PRELIMINARY STUDY – LATROBE VALLEY EARTHQUAKE SCENARIO

- The Latrobe Valley is located in Morwell Hotspot earthquake zone (Burbidge and Leonard, 2011)
- Last event - M5.4 Moe earthquake June 2012
- Most likely scenario for a damaging earthquake in the Latrobe Valley would be a magnitude 6 earthquake in the Morwell Hotspot



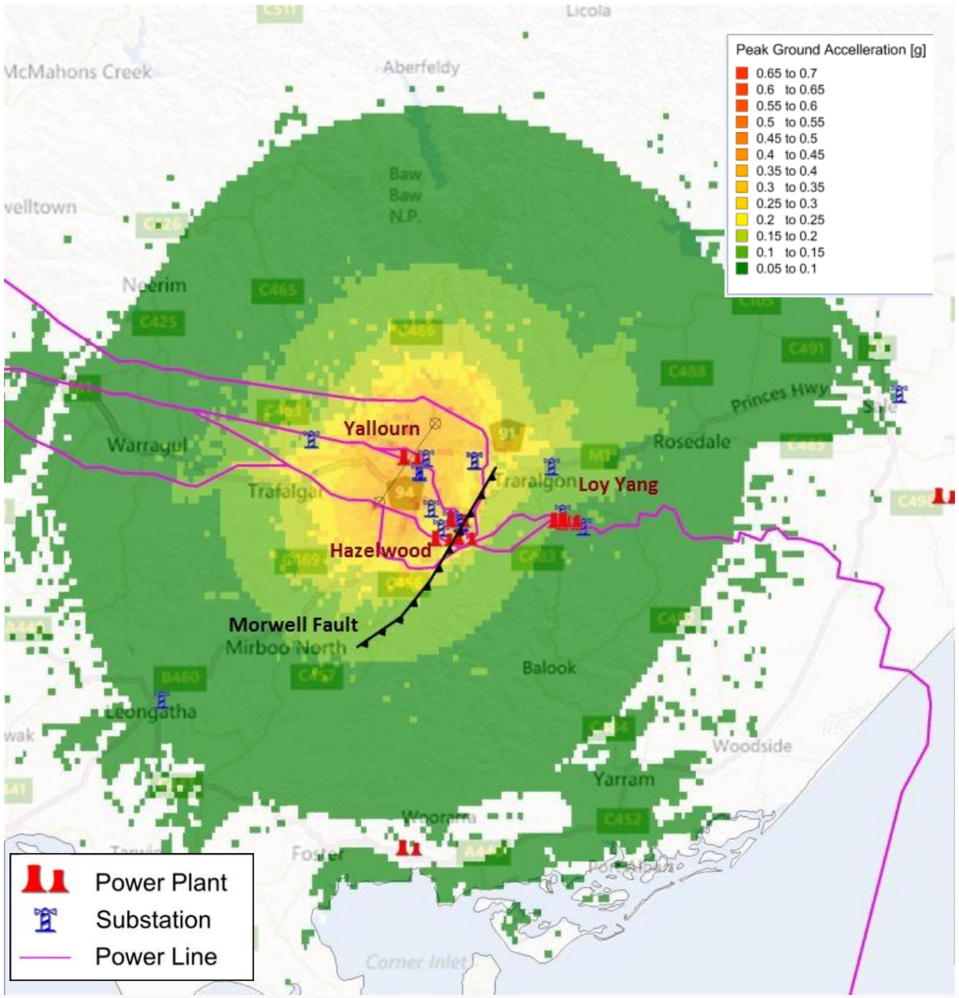
The 500 year return period hotspot zone PGA hazard map with a 60 km Gaussian spatial filter. Values above 0.1 g are shown in red (Burbidge and Leonard, 2011).

LATROBE VALLEY EARTHQUAKE SCENARIO



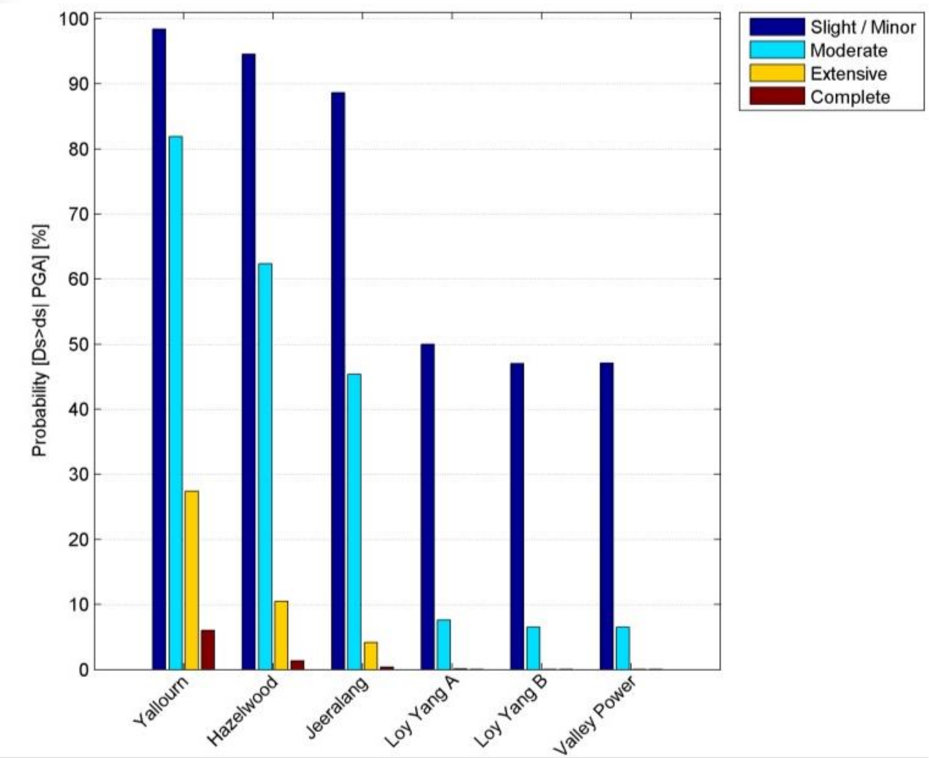
- Scenario: M6.0 earthquake on the Morwell Fault
- Output: ground shaking map
- Damage to property and infrastructure calculated using FEMA HAZUS model methodologies

LATROBE VALLEY EARTHQUAKE SCENARIO



Damage state	Damage to generation plants
Slight/Minor Damage (ds_2)	- Turbine tripping - Light damage to diesel generator - Minor damage to building
Moderate Damage (ds_3)	- Chattering of instrument panels and racks - considerable damage to boilers and pressure vessels - Moderate damage to building
Extensive Damage (ds_4)	- Considerable damage to motor driven pumps - Considerable damage to large vertical pumps - Extensive damage to building
Complete Damage (ds_5)	- Extensive damage to large horizontal vessels beyond repair - Extensive damage to large motor operated valves - Building completely damaged

LATROBE VALLEY EARTHQUAKE SCENARIO



Probability of damage to power stations during at M6.0 earthquake on the Morwell Fault.

Power station	PGA (g)	Power generation
Yallourn	0.36	supplies approximately 22 percent of Victoria's electricity needs and approximately eight percent of the National Electricity Market (NEM) (EnergyAustralia, 2014).
Hazelwood	0.26	supplies between 20 and 25 percent of Victoria's energy requirements and 5.4 percent of Australia's energy demand (GDF SVEZ Australian Energy, 2014a).
Jeeralang	0.21	The station is a peaking facility which is utilised only during periods of peak demand, it is also used as a black start facility to restore power to the grid in the event of major system failure.
Loy Yang A	0.1	Supplies approximately 30 percent of Victoria's power requirements (AGL, 2014).
Loy Yang B	0.09	supplies about 17 per cent of Victoria's energy needs (GDF SVEZ Australian Energy, 2014b).
Valley Power	0.09	Peaking facility

FUTURE WORK

- Collection of data describing infrastructure networks
- Modelling as a connected network considering the interactions between different lifeline elements
- Overlaying this modelling with event hazard layers
- Analysing the post-event network to establish its efficiency, possible bottlenecks and impact to hubs

PHD OUTPUTS

- Review key historical natural disasters and the impact they had on essential infrastructure and critical services.
- Review existing network vulnerability models
- Development of new approaches to quantify network disruption

Contact: emma.phillips@mq.edu.au

QUESTIONS?

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