

# Distributed Infrastructure RNC/QuakeCoRE

Monthly Meeting  
12/3/2018

# Summary

- Introductions
- Infrastructure program update and new project summaries.
- Presentation: "Quantification of the resilience of electric power distribution systems" Leo Liu
- Presentation: "Operational resilience assessment of a rural road network – South Island" Mohammad Aghababaei
- RNC-NHRP Updates
- Advisory Group Updates
- Discussion

# Infrastructure Program Updates

- New projects
- Ongoing projects

# Presentations

- Presentation: "Quantification of the resilience of electric power distribution systems" Leo Liu
- Presentation: "Operational resilience assessment of a rural road network – South Island" Mohammad Aghababaei

# RNC-NHRP Merger

- 1<sup>st</sup> March – International Science Review
  - Assessment of RNC1 and RNC2 plans
  - Presentation on Infrastructure
  - Lack of visibility of infrastructure in RNC2 noted
  - Review comments still in progress

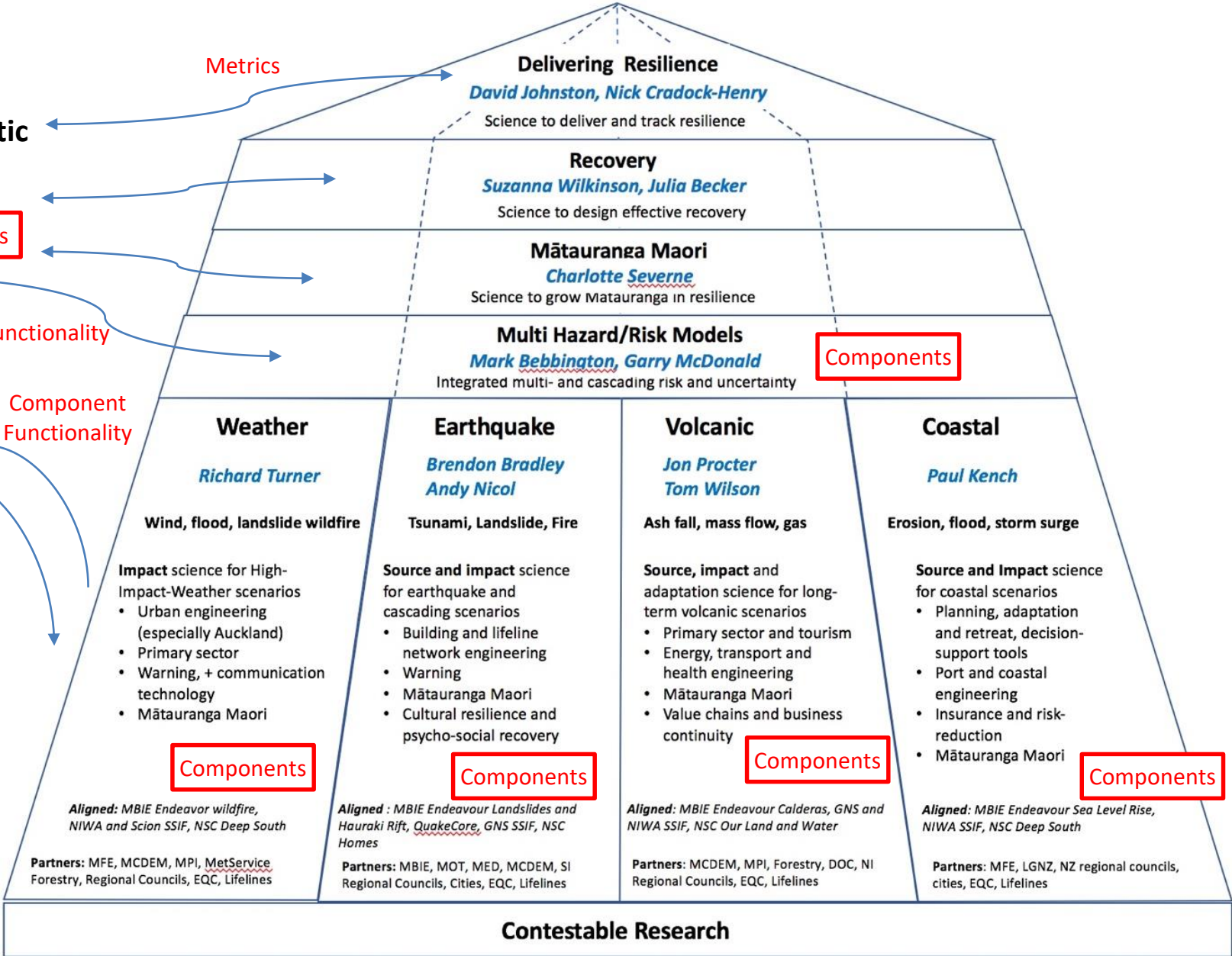
**Hazard agnostic**

- Networks
- Interdependencies

Functionality  
Component Functionality

Feed back into scenarios and metrics

Metrics



**Delivering Resilience**  
*David Johnston, Nick Cradock-Henry*  
Science to deliver and track resilience

**Recovery**  
*Suzanna Wilkinson, Julia Becker*  
Science to design effective recovery

**Mātauranga Maori**  
*Charlotte Severne*  
Science to grow Mātauranga in resilience

**Multi Hazard/Risk Models**  
*Mark Bebbington, Garry McDonald*  
Integrated multi- and cascading risk and uncertainty

**Weather**  
*Richard Turner*  
**Wind, flood, landslide wildfire**  
  
**Impact science for High-Impact-Weather scenarios**  

- Urban engineering (especially Auckland)
- Primary sector
- Warning, + communication technology
- Mātauranga Maori

**Components**  
  
*Aligned: MBIE Endeavor wildfire, NIWA and Scion SSIF, NSC Deep South*  
  
**Partners:** MFE, MCDEM, MPI, MetService, Forestry, Regional Councils, EQC, Lifelines

**Earthquake**  
*Brendon Bradley, Andy Nicol*  
**Tsunami, Landslide, Fire**  
  
**Source and impact science for earthquake and cascading scenarios**  

- Building and lifeline network engineering
- Warning
- Mātauranga Maori
- Cultural resilience and psycho-social recovery

**Components**  
  
*Aligned: MBIE Endeavour Landslides and Hauraki Rift, QuakeCore, GNS SSIF, NSC Homes*  
  
**Partners:** MBIE, MOT, MED, MCDEM, SI Regional Councils, Cities, EQC, Lifelines

**Volcanic**  
*Jon Procter, Tom Wilson*  
**Ash fall, mass flow, gas**  
  
**Source, impact and adaptation science for long-term volcanic scenarios**  

- Primary sector and tourism
- Energy, transport and health engineering
- Mātauranga Maori
- Value chains and business continuity

**Components**  
  
*Aligned: MBIE Endeavour Calderas, GNS and NIWA SSIF, NSC Our Land and Water*  
  
**Partners:** MCDEM, MPI, Forestry, DOC, NI Regional Councils, EQC, Lifelines

**Coastal**  
*Paul Kench*  
**Erosion, flood, storm surge**  
  
**Source and Impact science for coastal scenarios**  

- Planning, adaptation and retreat, decision-support tools
- Port and coastal engineering
- Insurance and risk-reduction
- Mātauranga Maori

**Components**  
  
*Aligned: MBIE Endeavour Sea Level Rise, NIWA SSIF, NSC Deep South*  
  
**Partners:** MFE, LGNZ, NZ regional councils, cities, EQC, Lifelines

**Contestable Research**



**QuakeCoRE**  
NZ Centre for Earthquake Resilience



**National SCIENCE Challenges**

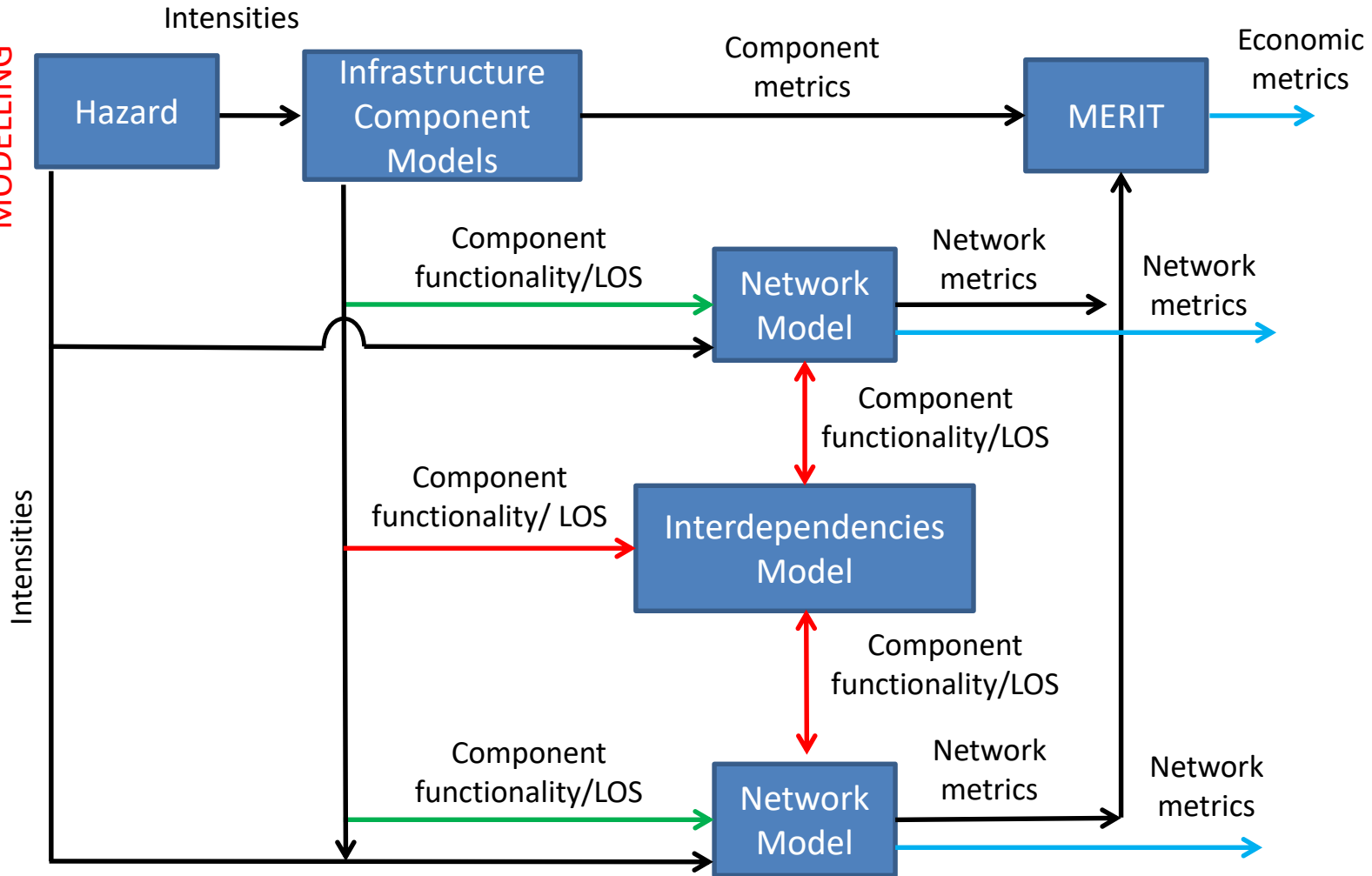
**RESILIENCE TO NATURE'S CHALLENGES**

Kia manawarao  
– Ngā Ākina o Te Ao Tūroa

# Distributed Infrastructure

## QUALITATIVE TO QUANTITATIVE

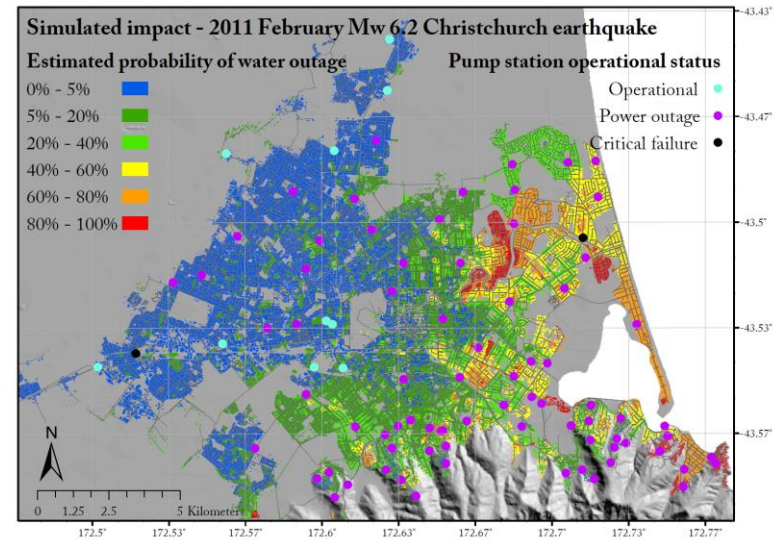
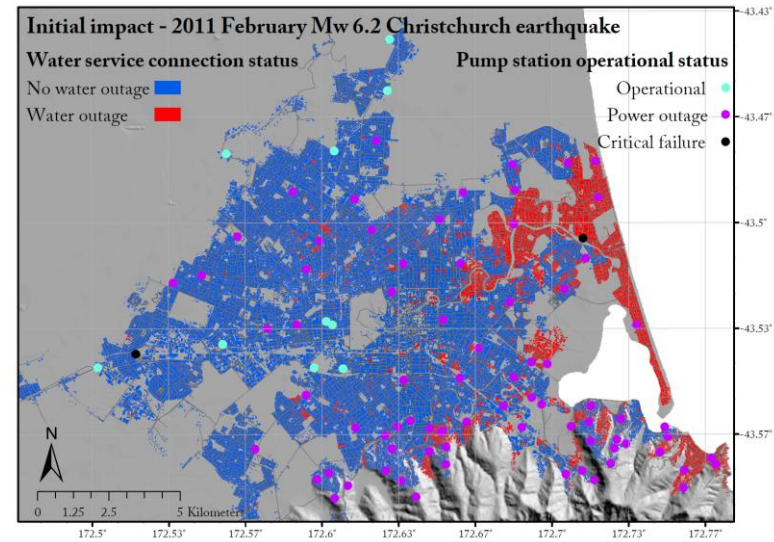
REGIONAL SEISMIC AND  
CO-SEISMIC HAZARD  
MODELLING



CRITICALITY FRAMEWORKS  
INFRASTRUCTURE FAILURE ADAPTATIONS

# Components

1. Improve characterisation of infrastructure component fragility/vulnerability
2. Build on case history and physical/computation modelling
3. NZ infrastructure
  - Potable water – CES
  - Wastewater – CES
  - Buried electric power – CES
  - Telecommunications – CES and Kaikoura
  - Tsunami fragility/vulnerability functions
  - Flooding vulnerability functions

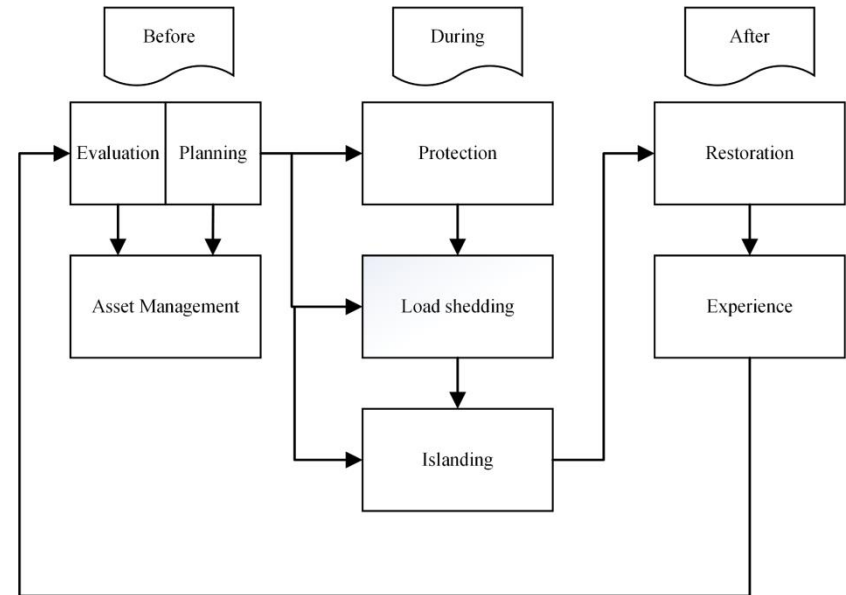


**Potable water outage – actual vs simulated**



# Networks

1. **Development of network process models for infrastructure: expertise across sectors**
  2. **Development of resilience and criticality frameworks**
  3. **Quantify effect of physical and management based resilience strategies**
- Seismic resilience of the potable water network
  - Electric Power Systems resilience
    - Quantifying resilience
    - Microgrid management
    - Re-energisation strategies
  - Operational resilience assessment of rural road networks
  - Framework for dynamic configuration of communications systems post-disaster
  - New Zealand Stopbank Database
  - Technical Resilience of Stormwater networks
  - Understanding evacuation and travel behaviour - Auckland volcanic field
  - Criticality frameworks development for networks – road, electricity

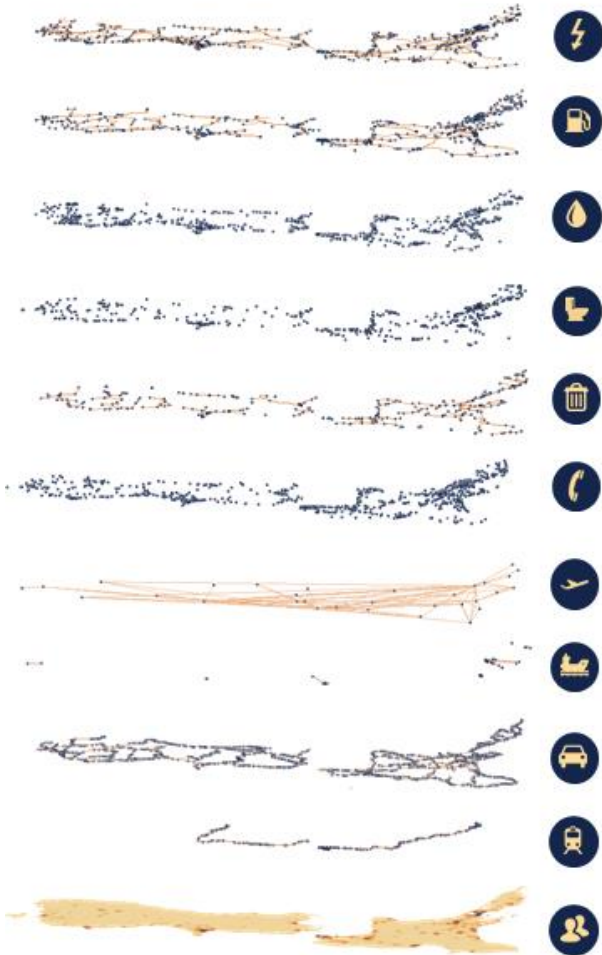


**Electric Power resilience framework**

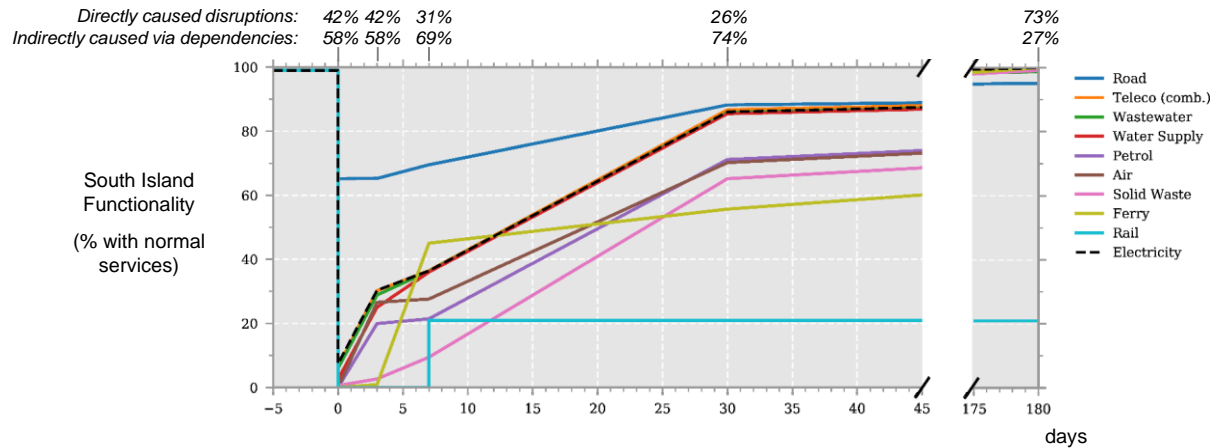
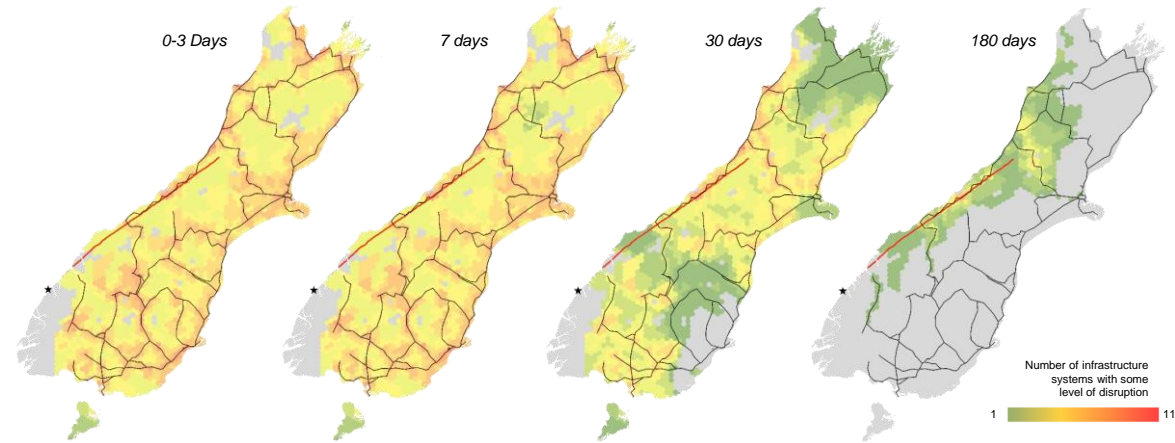
# Interdependencies + Case Studies

- West Coast, Canterbury, Auckland, Nelson-Tasman, Christchurch

## Alpine Fault Impacts and Recovery



**Interdependent National Infrastructure Model**



**Quantification of direct and indirect disruptions**



# Outputs

- **Mapping and alignment of wider NZ infrastructure research**

- 4 Journal Papers Accepted

- Kaikoura earthquake Infrastructure Network performance

**Co-authored with stakeholders**

- 6 Journal Papers Submitted

- Development of fragility functions for buried pipelines based on New Zealand data
- Vulnerability of New Zealand utility poles to tsunami bore impacts
- Quantifying the seismic resilience for electric power distribution systems
- Criticality of Road Networks in Auckland, New Zealand
- Quantification of the hydraulic dimension of stormwater system resilience to flooding
- Evaluating the magnitude and spatial extent of disruptions across interdependent national infrastructure networks

- **By mid-2019**

- National infrastructure seismic and co-seismic exposure 2 papers
- Potable water seismic resilience and recovery 2 papers
- Electric power resilience 3 papers
- Transportation model development and operational resilience 2 papers
- NZ stopbank database, hazard exposure, regional flooding 2 papers
- Infrastructure component tsunami fragility functions 2 papers
- Telecommunications resilience –component and system 2 papers
- Technical stormwater resilience methods
- Small town adaptations during infrastructure outages
- Electric power criticality framework
- Alpine Fault infrastructure outage propagation
- ?

# Infrastructure Advisory

- Meeting 22<sup>nd</sup> February
- RNC-NHRP Update
  - Highlighted lack of visibility of infrastructure
- Advice fed into specific projects
- Key actions
  - Feed information to new infrastructure minister
  - Link into NIU infrastructure plan
  - What info can be translated/disseminated now?

# Other Items?

- Wiki:

<https://wiki.canterbury.ac.nz/display/QuakeCore/Special+Project+1%3A+Spatially-distributed+Infrastructure>