

Resilience to Nature's Challenges: Distributed Infrastructure**Three Waters Research: Summary as at April 2019**1. Background

Resilience to Nature's Challenges Kia manawaroa - Ngā Ākina o Te Ao Tūroa (RNC) aims to partner researchers with stakeholders, including communities, to build shared understandings of natural hazards and risks, and to work together to develop practical risk reduction solutions. The RNC framework is intended to promote collaboration between infrastructure stakeholders and the New Zealand research community.

The resilience of lifeline networks like electricity, transportation and water is critical in enabling society to recover rapidly after a major disaster. The Distributed Infrastructure programme is developing tools to assess the performance of spatially-distributed infrastructure networks subject to extreme natural hazards. Working closely with relevant stakeholders, the programme is developing methodologies to quantify system-level performance of infrastructure networks when subject to natural hazards and cascading impacts, leading to improved resilience of communities through identification of multi-hazard related vulnerabilities in infrastructure critical for NZ society. More about this programme can be found here [link](#).

2. RNC-supported three waters research to date

Research title: Impacts of the Kaikoura EQ on Three Waters (2016-2017)

Research partners: Marlborough District Council, Kaikoura District Council, Wellington Water

Principal outcomes: Summary of preliminary observations of performance of three waters networks across affected regions and adaptations that were made to enable the provision of services.

Status: Complete.

Outputs: Journal paper - [link](#)

Research title: Development of fragility functions for potable water pipelines (2016-2018)

Research partners: Christchurch City Council.

Principal outcomes: Development of fragility functions for potable water pipes based on data from the Canterbury earthquake sequence. Functions are developed to enable wide application, from situations where little is known about the pipes and soil conditions, through to situations where there is more knowledge of the conditions.

Status: Complete.

Outputs: Journal paper and suite of fragility functions - [link](#)

Research title: Decision support algorithm for post-earthquake water service recovery (2016-2018)

Research partners: Christchurch City Council.

Principal outcomes: Development of detailed geospatial overview of the performance the potable water network following the 22nd February 2011 Christchurch earthquake and the recovery of different facilities. Development of recovery model of this system based on both pipe inspection and repair.

Status: Complete.

Outputs: Journal paper and decision support tool for CCC - [link](#)

Research title: Development of an assessment method for seismic damage to gravity waste water pipes (2017-2019).

Research partners: Christchurch City Council.

Principal outcomes: Using data from the Canterbury earthquake sequence, assessment of the relationships between CCTV footage of earthquake damage to the wastewater network with pipe characteristics and ground deformation. This evidence base was used to inform the development of an assessment method for damage of this type.

Status: Complete

Outputs: ME thesis under review.

Research title: Technical resilience of stormwater management systems (2017-2020).

Research partners: Auckland Council.

Principal outcomes: Development of a framework to quantify resilience of stormwater management systems to flooding by categorising the stormwater system to three main dimensions, namely hydrology characteristics, network structure and hydraulic capacity. Framework can be used to assess the influence of management strategies and physical interventions on the resilience of the network.

Status: Underway. - [link](#)

Research title: Quantification of the hydraulic dimension of stormwater system resilience (2017-2019).

Research partners: Auckland Council

Principal outcomes: Development of an index based approach to quantify the hydraulic dimension of urban stormwater system resilience. Hydraulic performance capacity metric is defined to quantify the resilience of both subcatchments and overall systems, based on the temporal variation in capacity and flow depth of piped networks.

Status: Complete

Outputs: Conference papers and Journal paper submitted. - [link](#)