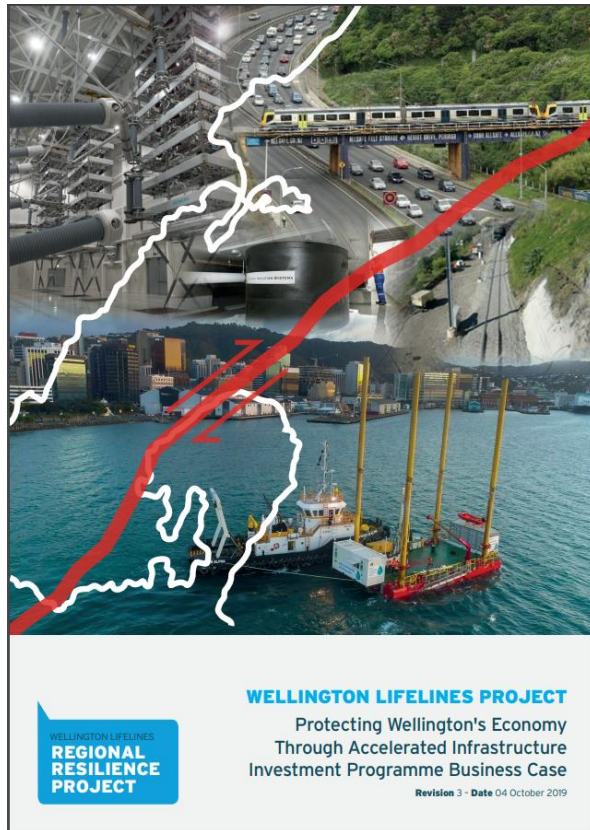


Improving Urban Food Supply Chain Resilience using Discrete-Event Simulations of Local Supply Chains

Joshua Wight

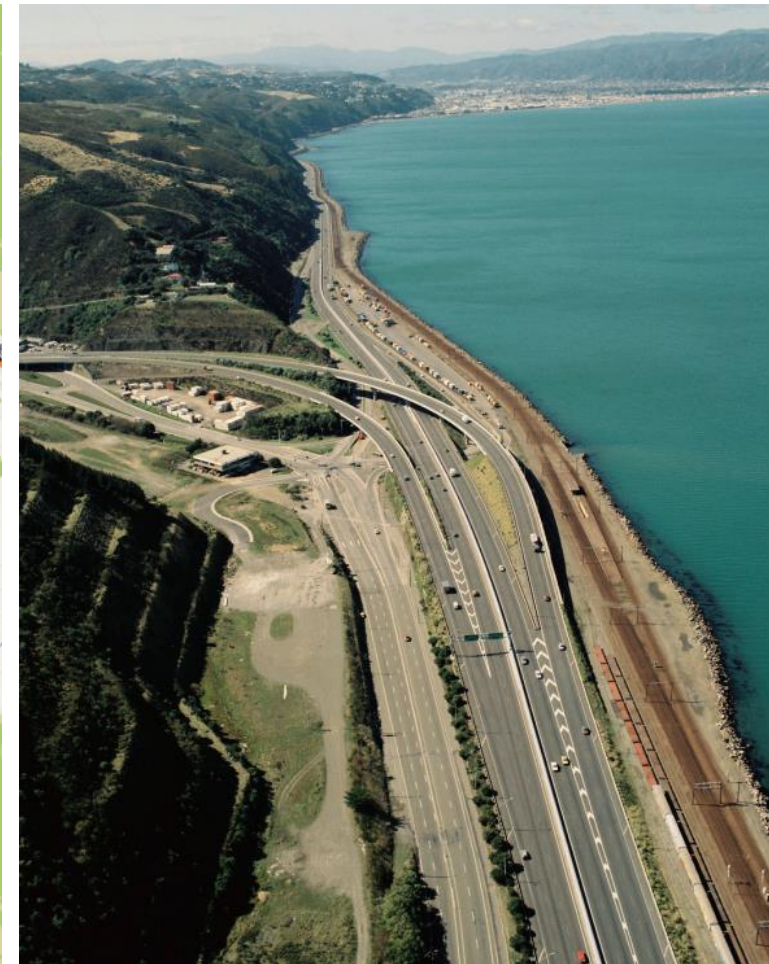
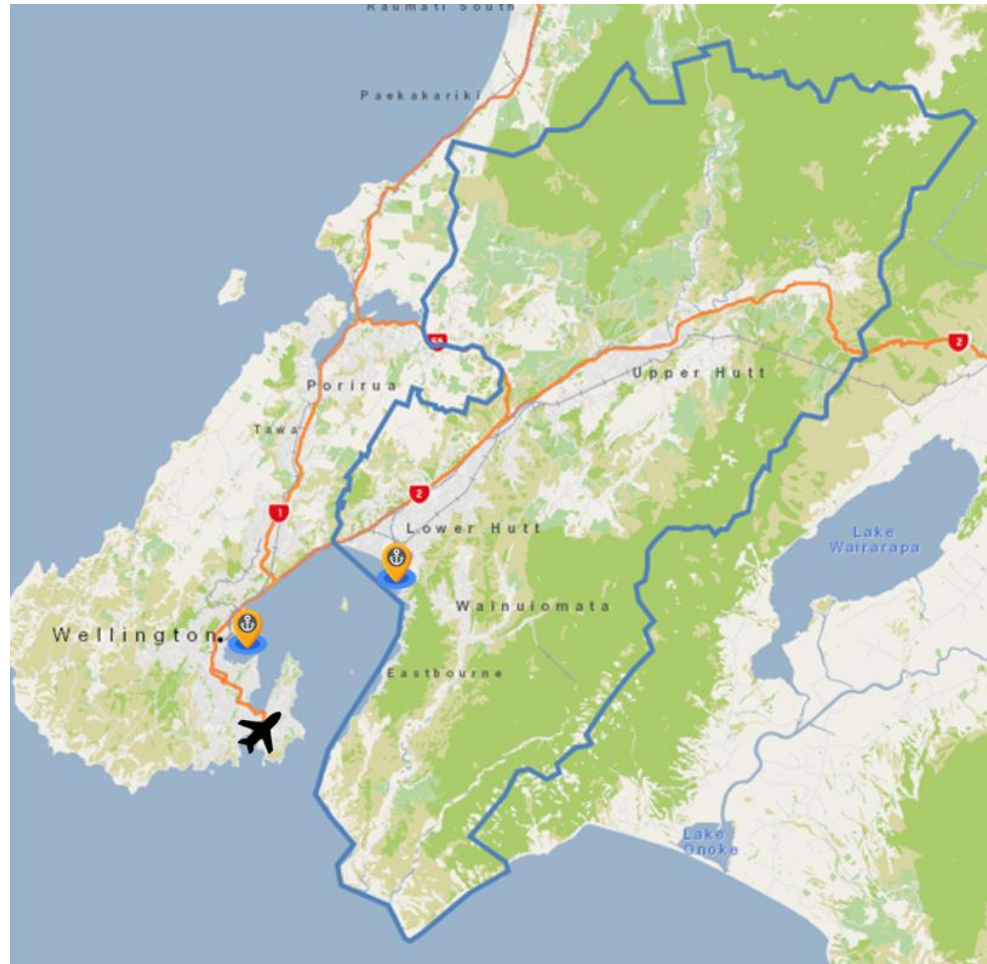
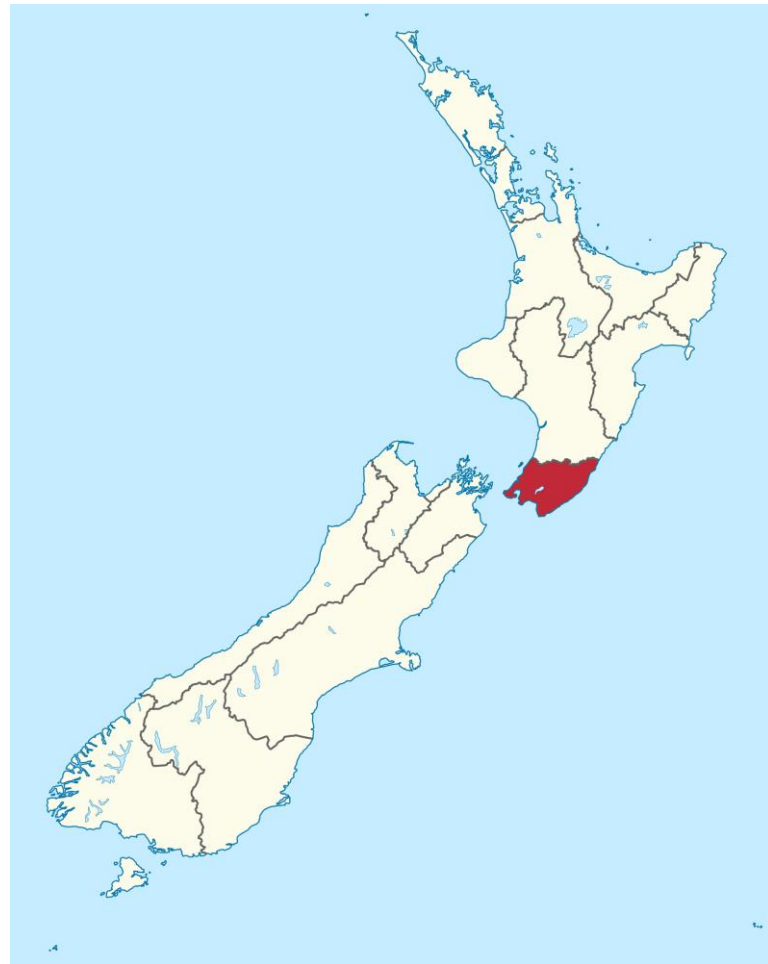
Supervisors: Dr Tom Logan, Professor Diane Mollenkopf, &
Dr Charlotte Brown

Key Reports

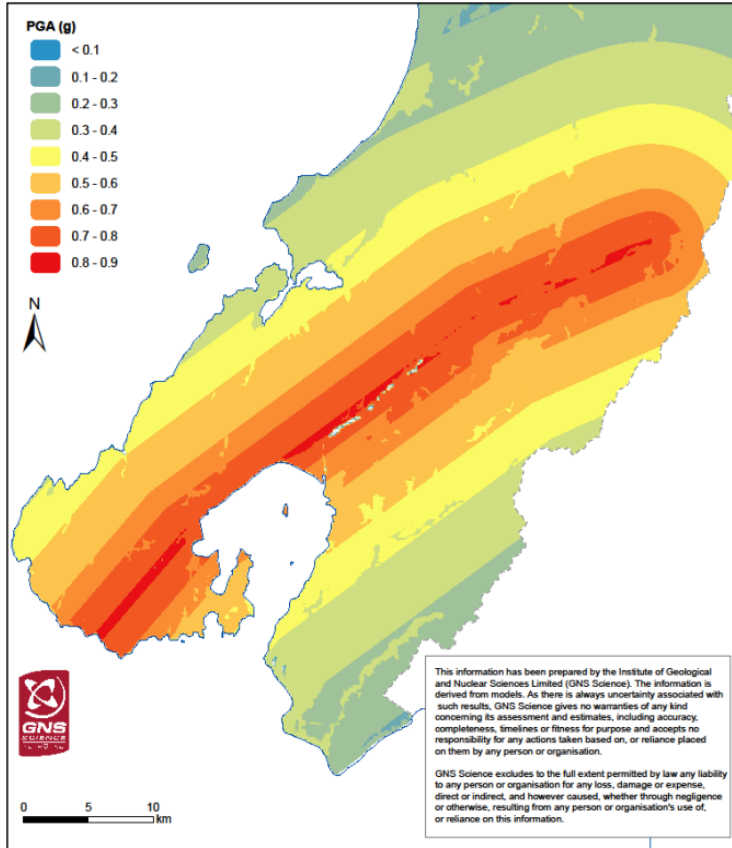


- Wellington Lifelines Project, 2019
- Wellington Resilience Programming Business Case: Lifelines Outage Modelling, 2017

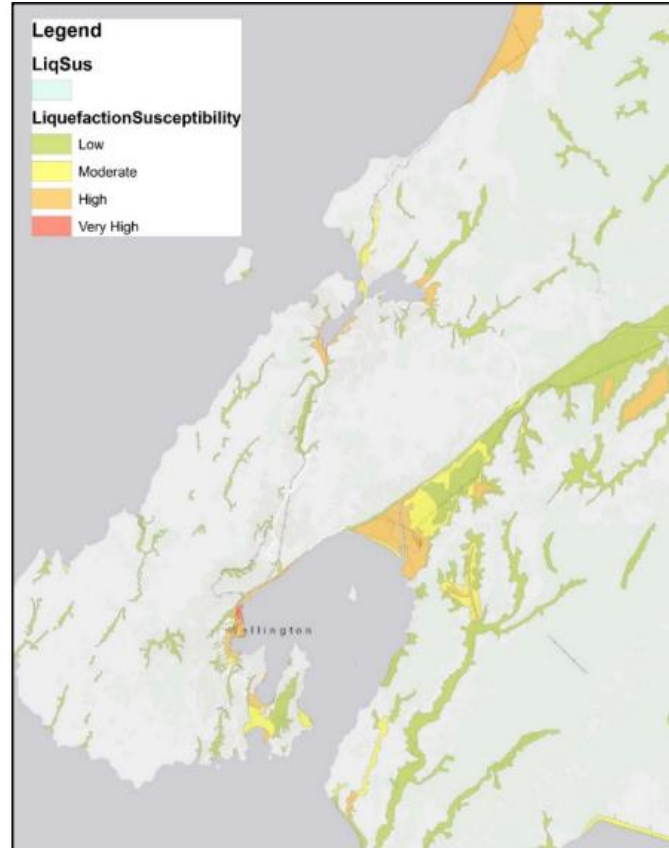
Context



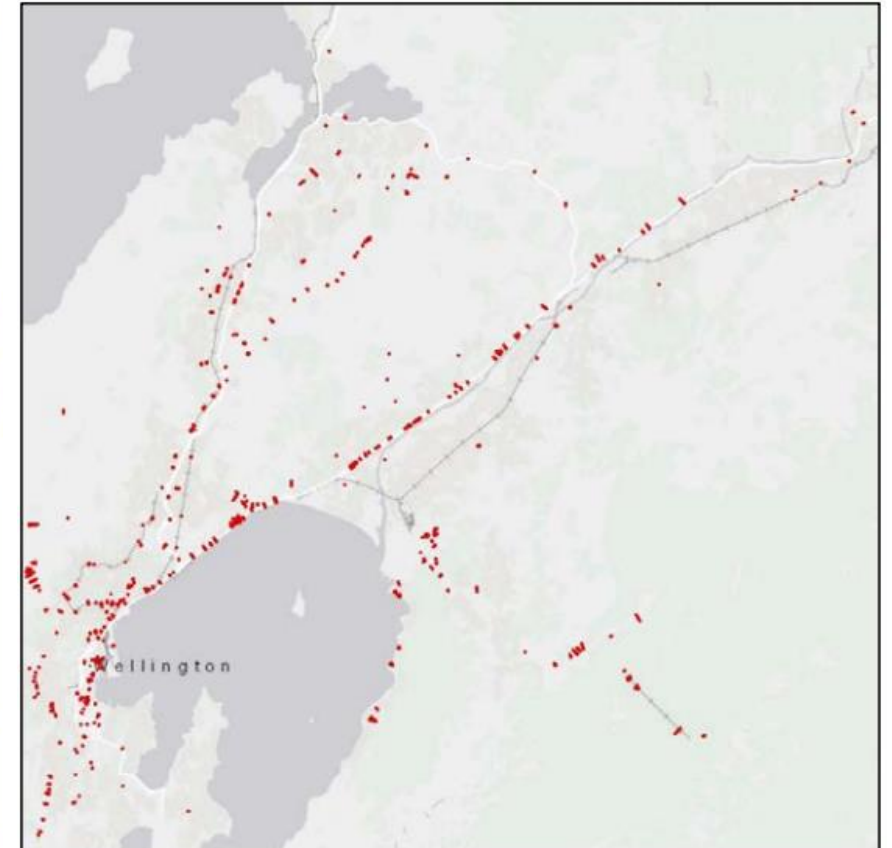
WARNING HAZARDS!



PGA



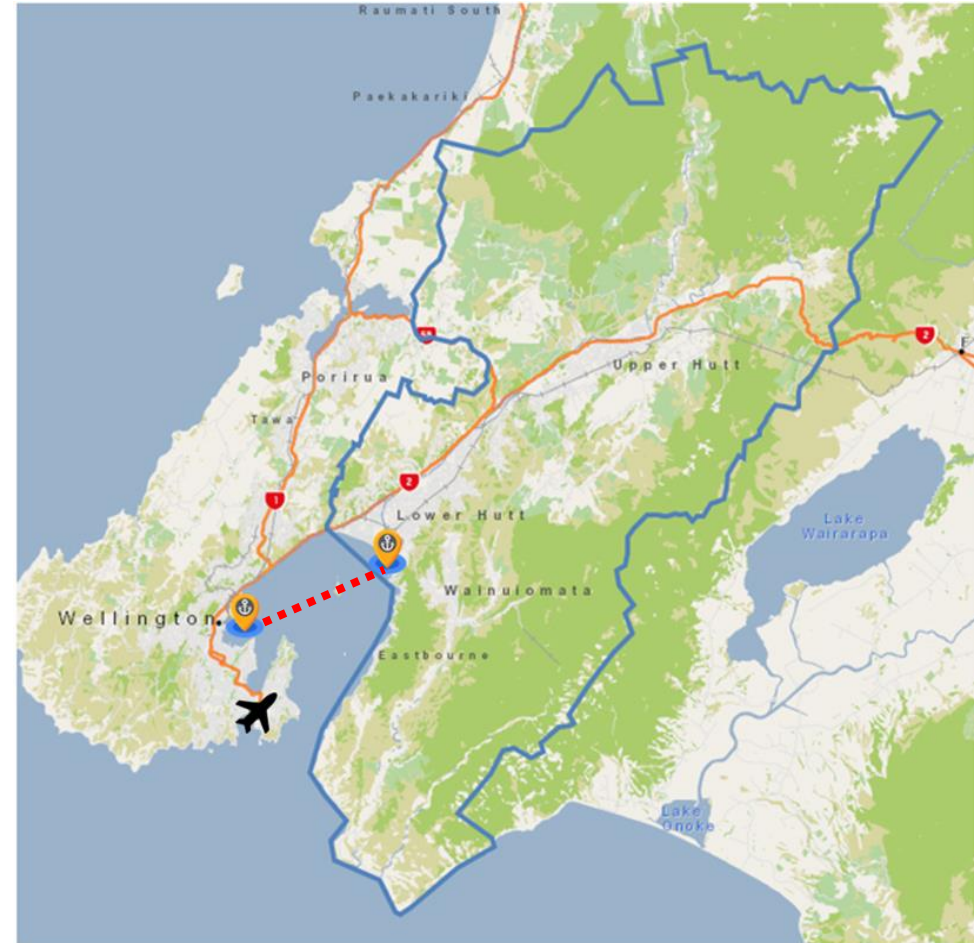
Liquefaction



Landslips

Intervention Options

- Options identified by emergency managers
- **Roads** (upgrading or building new)
- **Barging** (across the harbour)
- **Pre-Positioned Stock**



Uncertainty, Weather, and Climate Change

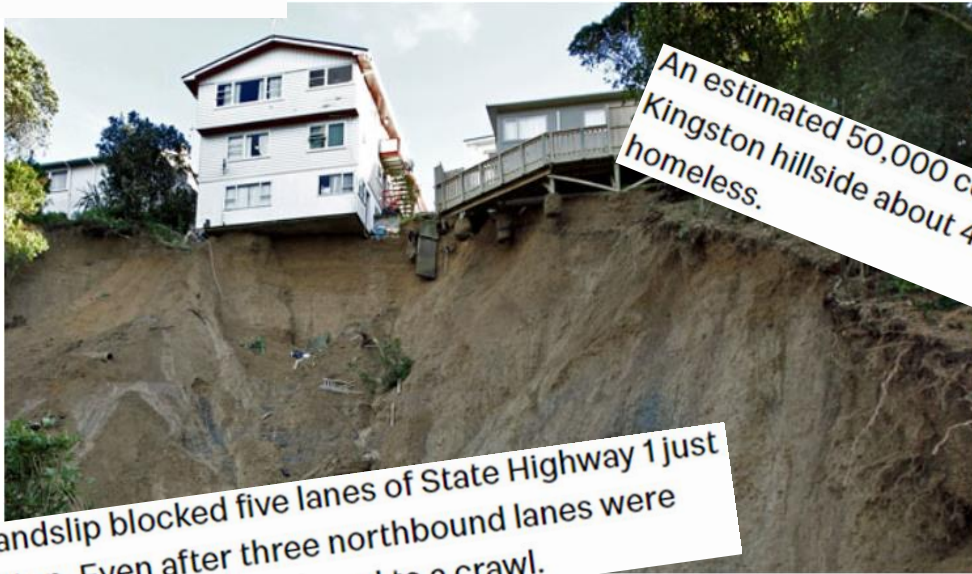
Welcome to Wellington, the windiest city in the world



Bad weather hits Wellington region with huge waves, high winds and snow forecast



Landslide blocks part of Wellington CBD road, 12 homes evacuated

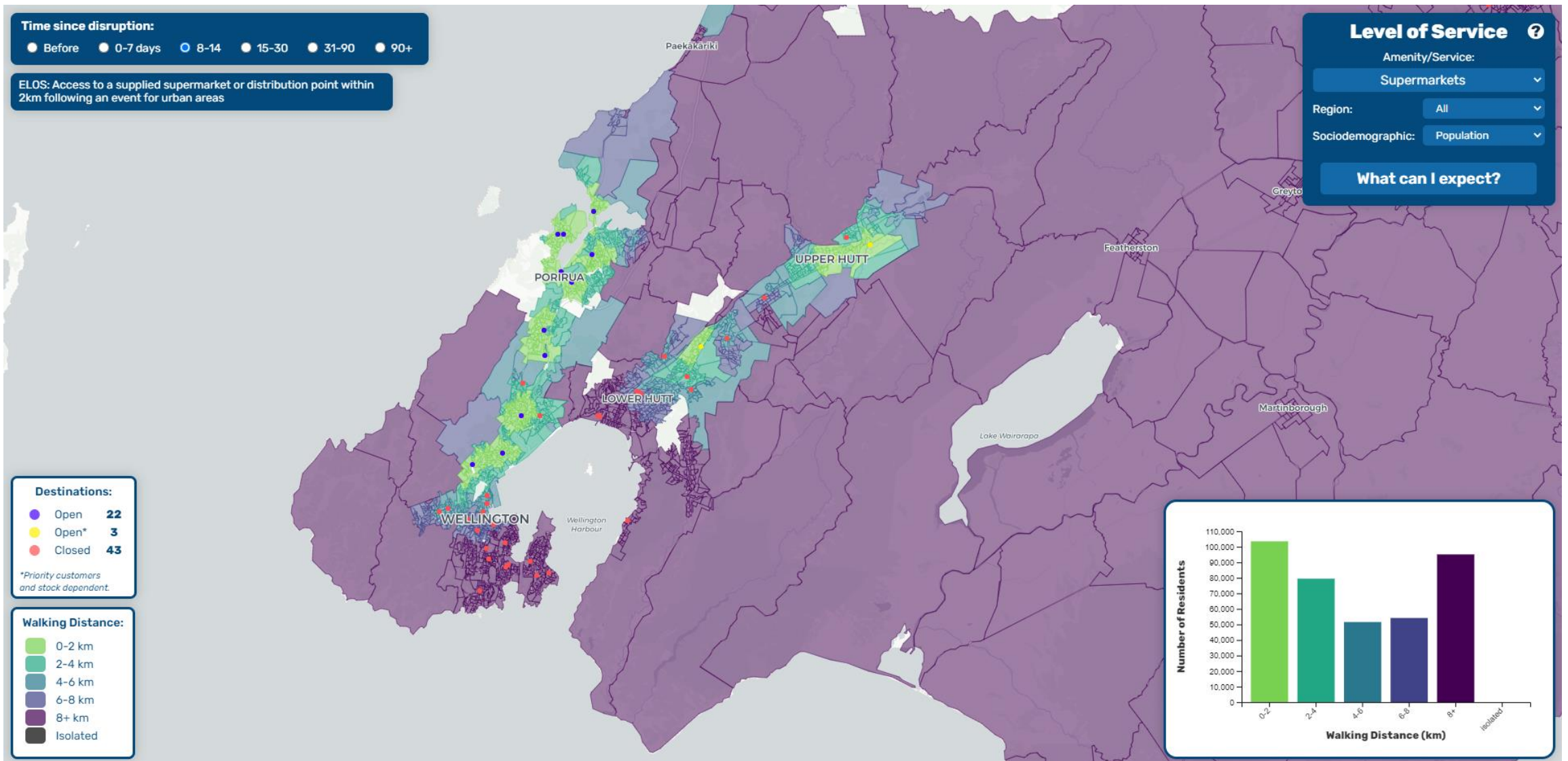


An estimated 50,000 cubic metres of earth slipped down a Kingston hillside about 4.30am on Saturday, leaving 35 people homeless.

On Tuesday, a landslip blocked five lanes of State Highway 1 just north of Wellington. Even after three northbound lanes were reopened, rush hour traffic was reduced to a crawl.



Accessing Supermarkets



Literature Review

- **“No Roads, No Gasoline, No Delivery”**, a catchphrase heard after the March **2011 Japan Earthquake and Tsunami**. The number of food supplies following the disaster proved sufficient for the Japan earthquake. However, distribution of food supplies and dealing with hoarding proved difficult (Palin, 2017)
- Logistics and supply chain challenges were an issue after the **2015 Nepal earthquake**. Again, despite a sufficient supply of food resources in many regions, a lack of coordination and understanding of where and who needs food leads to a lacklustre distribution of food (Hall et al., 2017)
- Providing ‘business-as-usual’ access after a disaster through a resilient transport network is critical to improving a community’s resilience (Anderson et al., 2022)

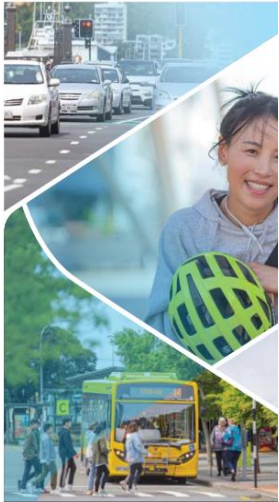
Literature Review

- “...little work has been done on the resilience of supply chain with a particular emphasis on food supply chains in disaster events” (Umar et al., 2017)
- “Despite growing attention, traditional urban food system resilience and relief planning still fails to adequately address urban food supply chain vulnerabilities and food insecurity” (Masterson, 2020)
- Within the humanitarian sector of supply chain analysis – modelling the fair allocation of limited resources in situations of severe disasters is also lacking (Katsaliaki et al., 2021)

Strategies which support investment in resilience

THE THIRD
NEW ZEALAND
INFRASTRUCTURE

Te Kāwanatanga o Aotearoa New Zealand Government
September 2020
Government Policy Statement
LAND TRANSPORT
2021/22-2030/31



Ver...
as at 12 A

Local Govern...
Public Act
Date of assent
Commencement

Cont...

1	Title
2	Commencement
Part 3	
Preliminary	
3	Purpose
4	Treaty of Waitangi
5	Interpretation
5A	Temporary definition of public no...
6	Meaning of council-controlled org...
7	Exempted organisations
8	Act binds the Crown
8A	Provisions affecting application o...

Note
The Parliamentary Counsel Office has made editorial...
under subpart 2 of Part 3 of the Legislation Act 2019.
Note 4 at the end of this version provides a list of the...
This Act is administered by the Department of Inter...

Wellington
Resilience

March 2017



New Zealand Government

The Guide to the
National Civil Defence
Emergency Management Plan
2015

The guide to the National Civil Defence Emergency Management Plan (MoCD)

National Infrastructure Plan 2015
(National Infrastructure Unit,
Treasury)

Government Policy Statement
(2021/22 – 2030/31) (MoT)

Wellington Resilience Strategy, 2017
(Local Councils)

Local Government Act 2002, DoIA

Research Objectives

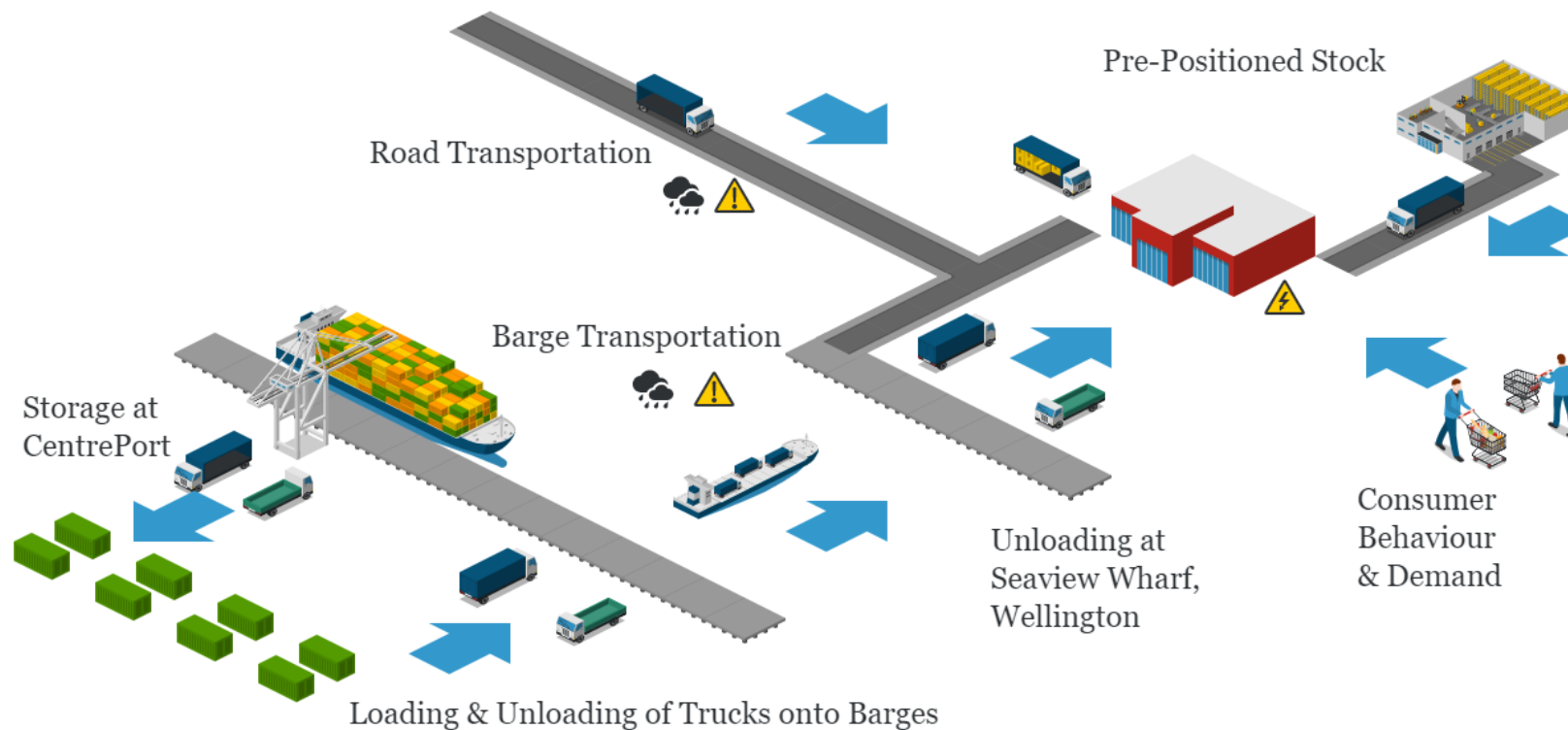
This research aims to investigate the role of local supply chains in achieving urban food resilience following a natural hazard and evaluate potential interventions. Specifically:

What aspects of the local supply chain (e.g., transport links, retail facilities, distribution centres) impact local food resilience?

What impacts would climate and weather uncertainty have on community food resilience?

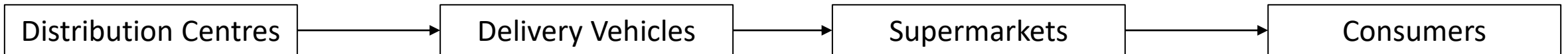
Supply Chains

A supply chain is a “set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and information from a source to a consumer” (Mentzer et al., 2001)



Discrete-Event Simulation (DES)

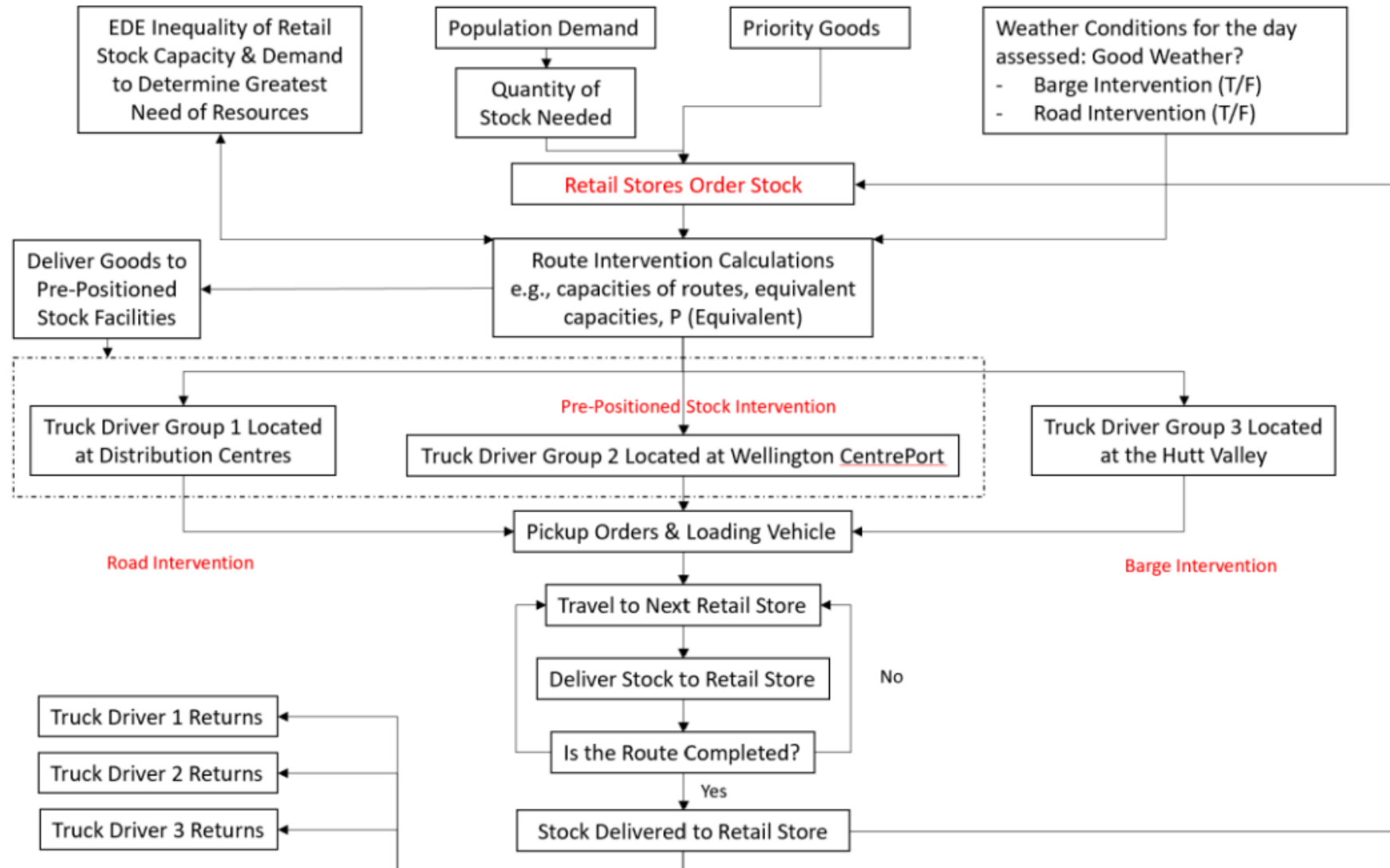
- DES models the operation of a system as a sequence of events in time
- DES useful for problems that consist of queuing simulations or a complex network of queues



Model Parameters

- Consumer demand
- Weather and climate impacts
- Transportation/Road Status
- Prioritisation of goods to certain supermarkets
- Prioritisation of specific goods
 - Food
 - Electricity Generators
 - Fuel

Model Flow Diagram for DES



Validation and Sensitivity Analysis

01

Expert
Validation

02

Validation
of historical
data

03

Predictive
Validation

04

Changing
input
parameters

Questions?