Otago Lifelines Project

A Vulnerability and Interdependency Assessment of Otago's Lifelines Infrastructure

Alex Sims | Otago Regional Council | Natural Hazards Analyst

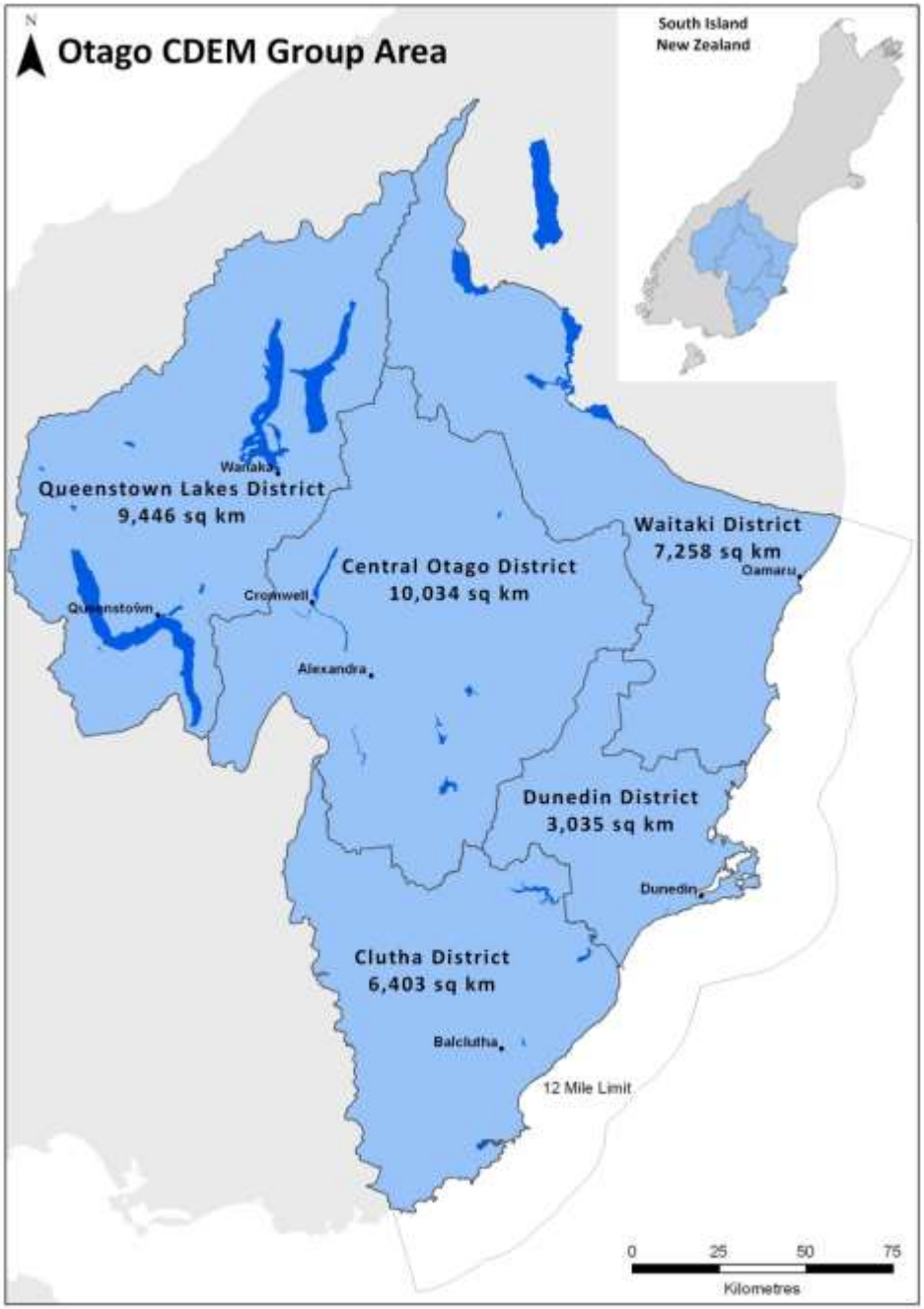
Otago Regional Council

www.orc.govt.nz

CD CIVIL DEFENCE OTAGO REGION EMERGENCY MANAGEMENT GROUP

Otago CDEM Group Area

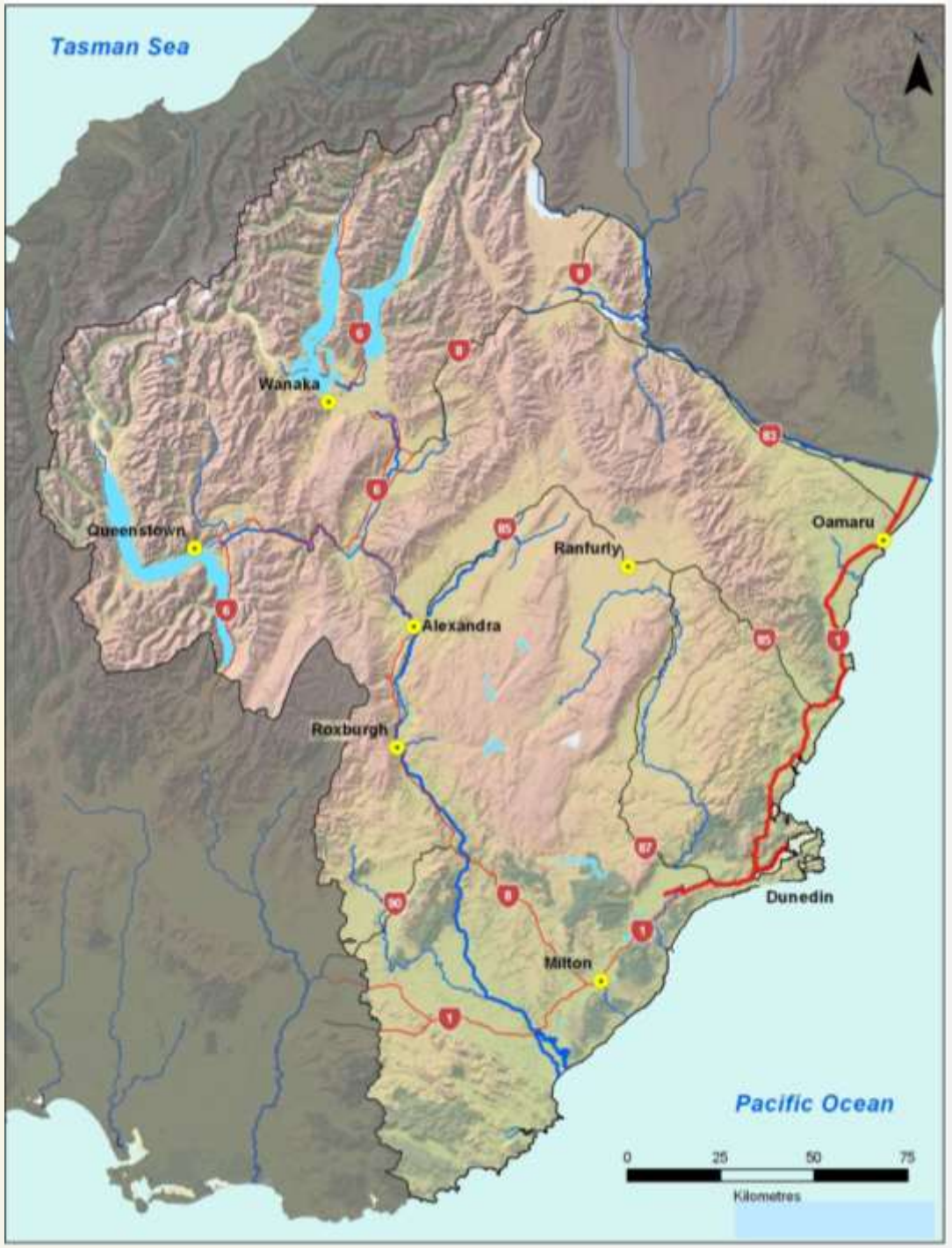
- 36,446 Km^2
- Population: 230,800
  - Dunedin: 127,900
  - Queenstown: 11,800 (and ~ 1.8 **million** visitors in 2013)



Otago Regional Council

www.orc.govt.nz

- Widely distributed population and assets
- Open coast, plains, rivers, valleys and basins, mountains and lakes
- Every hazard except volcanoes

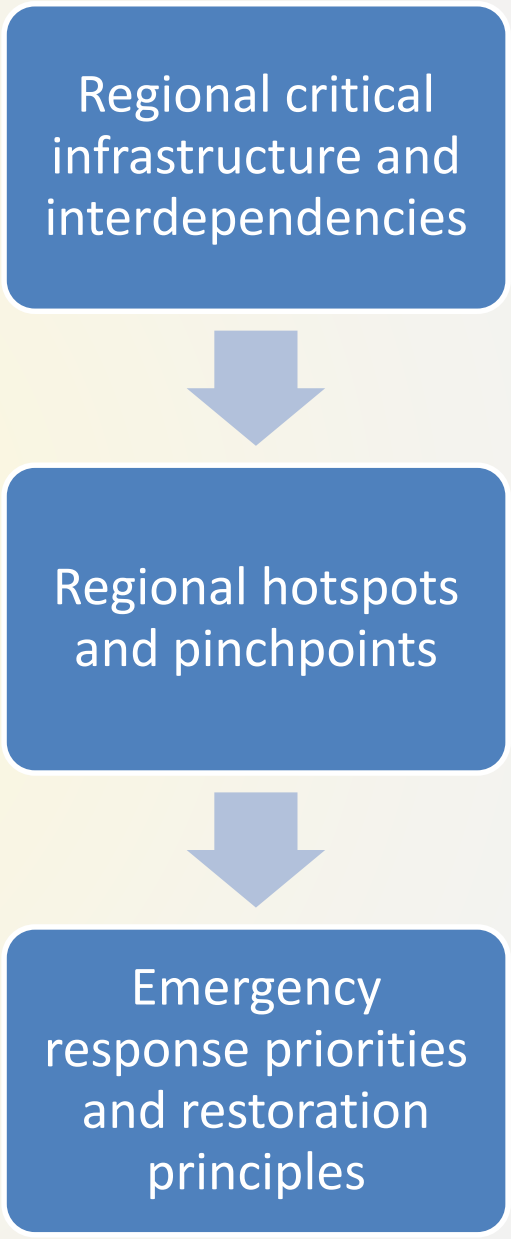


Otago Regional Council

www.orc.govt.nz

Otago Lifelines Project

- A Vulnerability and Interdependency Assessment of Otago's Lifelines Infrastructure
- 'assess the potential impacts of hazards on the region's lifelines infrastructure and identify mitigation strategies to reduce that risk.'



Project Summary

- Funding:
  - 60% sourced from MCDEM Resilience Fund
  - 40% from Otago CDEM Group
- Duration: October 2013 – September 2014
- Parties:
  - Otago Regional Council/Otago CDEM Group
  - Infrastructure Decisions Ltd
  - Otago Lifeline Utilities

Regional critical infrastructure and interdependencies

Criticality 1: Nationally Significant

- Failure would have national significance or cause loss of utility supply to most of region or loss of supply to another nationally significant site that depends on its service.
- Eg: State Highway 1, Benmore Power Station, Mt Cargill Broadcasting Transmission Site, South Dunedin Electricity Sub-Station.

Criticality 2: Regionally Significant

- Failure would cause loss of supply to more than 20,000 customers or reduction in service across the region or loss of supply to a regionally significant site.
- Eg: Other State Highways, Vodafone's Balclutha POI site, Port Otago Oil Tanker Berth, Dunedin's main sewer interceptor.

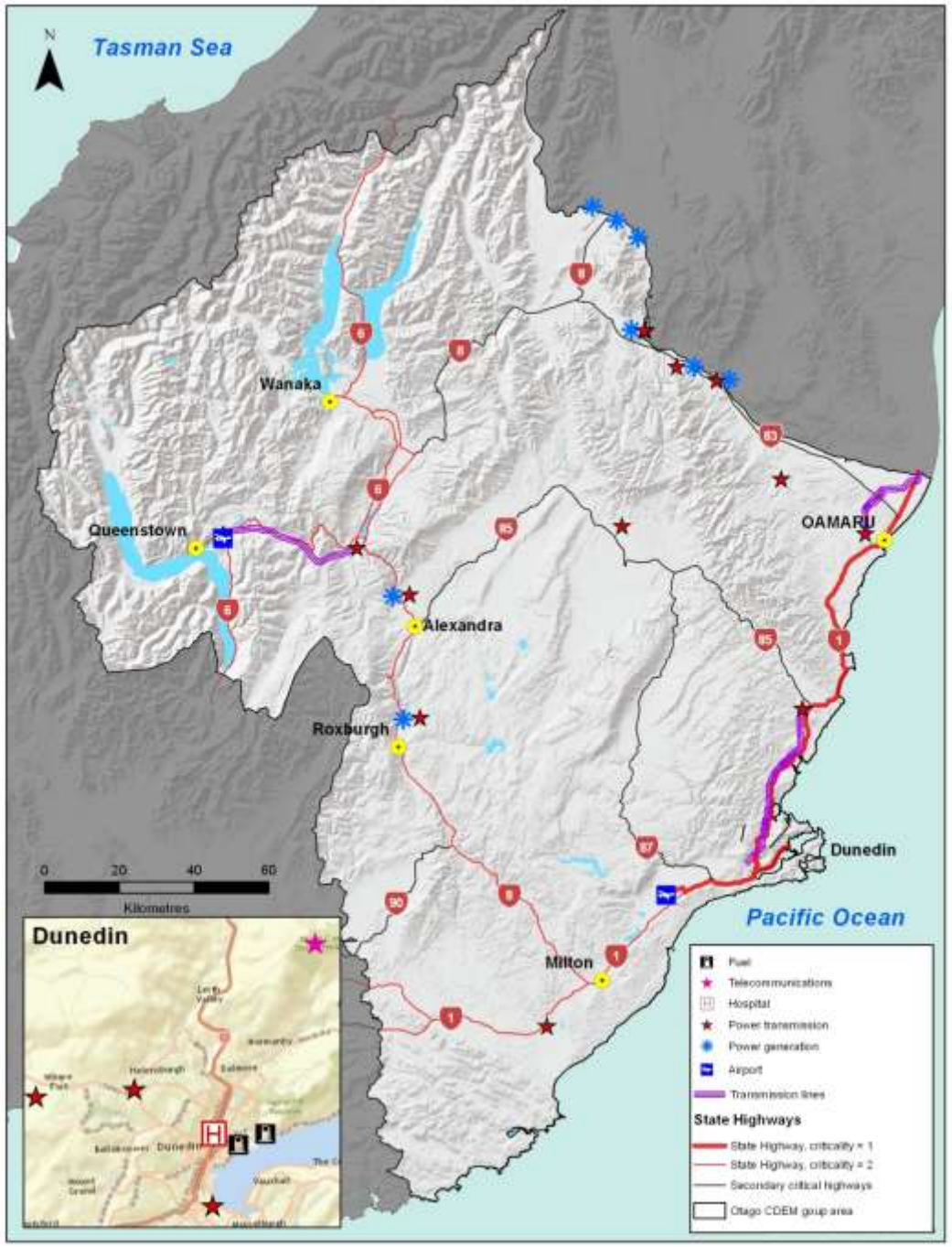
Criticality 3: Locally Significant

- Failure would cause loss of supply to more than 2,000 customers or reduction in service across part the region or loss of supply to a locally significant customer.
- Eg: Queenstown's main water supply intakes and reservoirs, King George Park (Oamaru) water pump station, arterial roads.

Lifeline Utilities

- Main challenges
  - Criticality; think from a regional/CDEM (not a business) perspective
  - Perceived vs. actual redundancy
  - Redundancy dependant on duration/impact of event; business as usual scenario assumed
  - Group discussion key

critical assets



Otago Regional Council

www.orc.govt.nz

interdependencies

Lifelines Sector	Dependant on	Airport	Broadcasting	Electricity	Fuel	Gas	Ports	Rail	Roads	Telecomms	Wastewater	Water Supply
Airport		0	3	2	2	3	3	3	1	3	2	2
Broadcasting		2	0	2	3	3	3	3	2	3	3	3
Electricity		2	3	1	2	3	3	3	2	2	3	3
Fuel		3	3	1	1	3	1	3	1	2	3	2
Gas		3	3	2	3	3	1	2	1	2	3	1
Ports		3	3	1	2	3	0	1	1	2	3	2
Rail		3	3	2	1	3	3	0	1	3	3	3
Roads		2	3	3	2	3	3	3	1	2	3	3
Telecomms		2	3	2	3	3	3	3	2	1	3	3
Wastewater		3	3	1	3	3	3	3	2	2	0	2
Water Supply		2	3	1	3	3	3	3	2	2	3	0

1 = Critical for Service to Function

2 = Critical for service to function but some backup or part function.

3 = Not required for service to function.

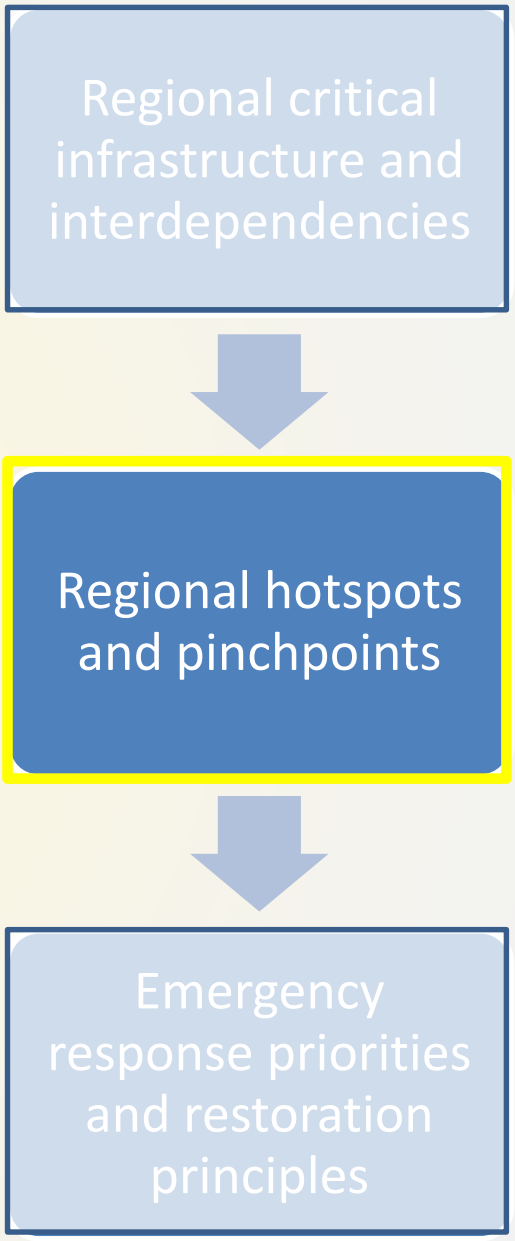
0 = Not Applicable

Note: This figure illustrates the impact on lifelines services following 1 week of outage of another lifelines service, in an emergency response situation. Dependence levels may be different in business-as-usual or shorter/longer duration outages.

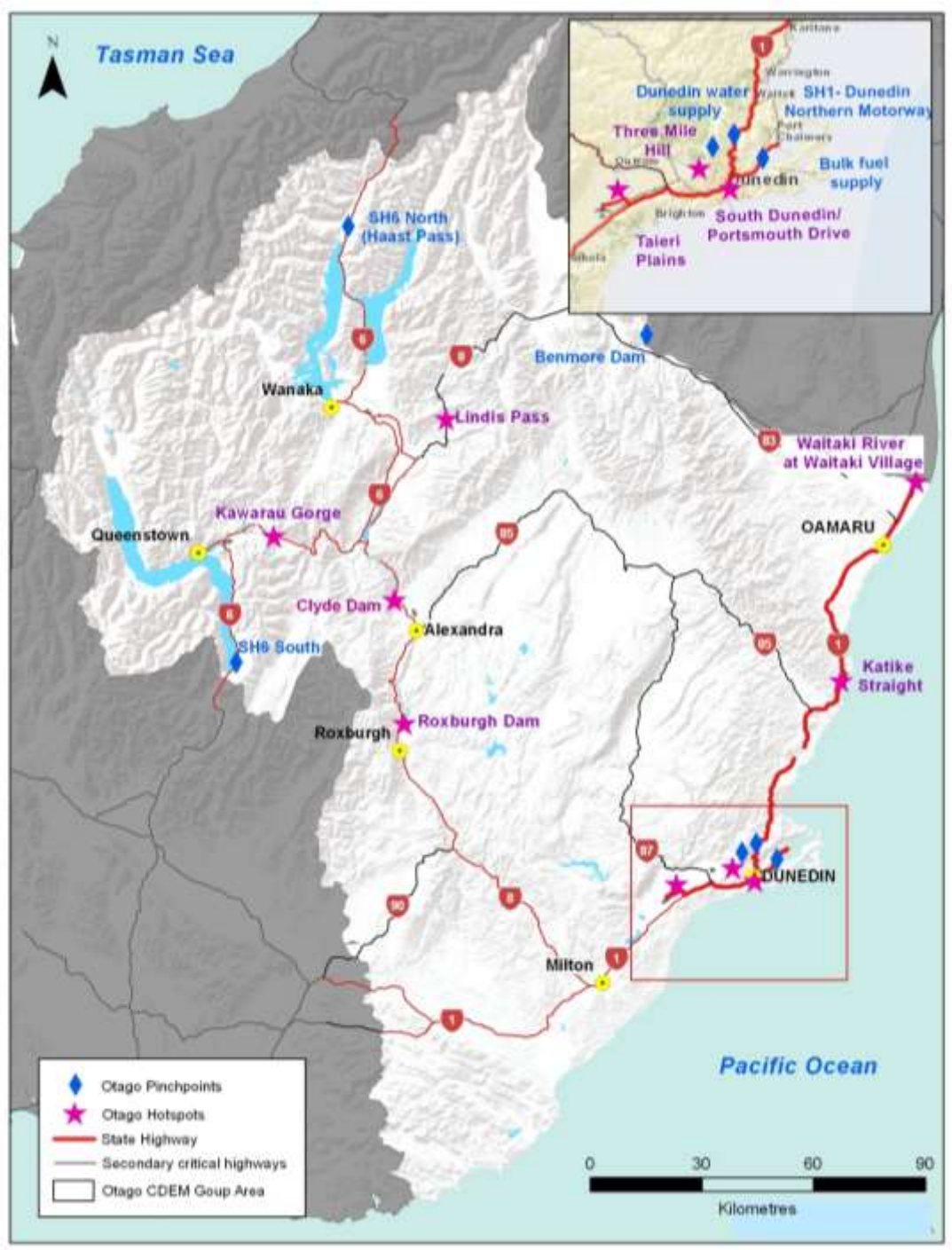
Hotspots & pinchpoints

- **Hotspots:** where a number of critical infrastructure assets from different sectors converge in a single area.

- **Pinchpoint:** significant single points of failure for a network or organisation



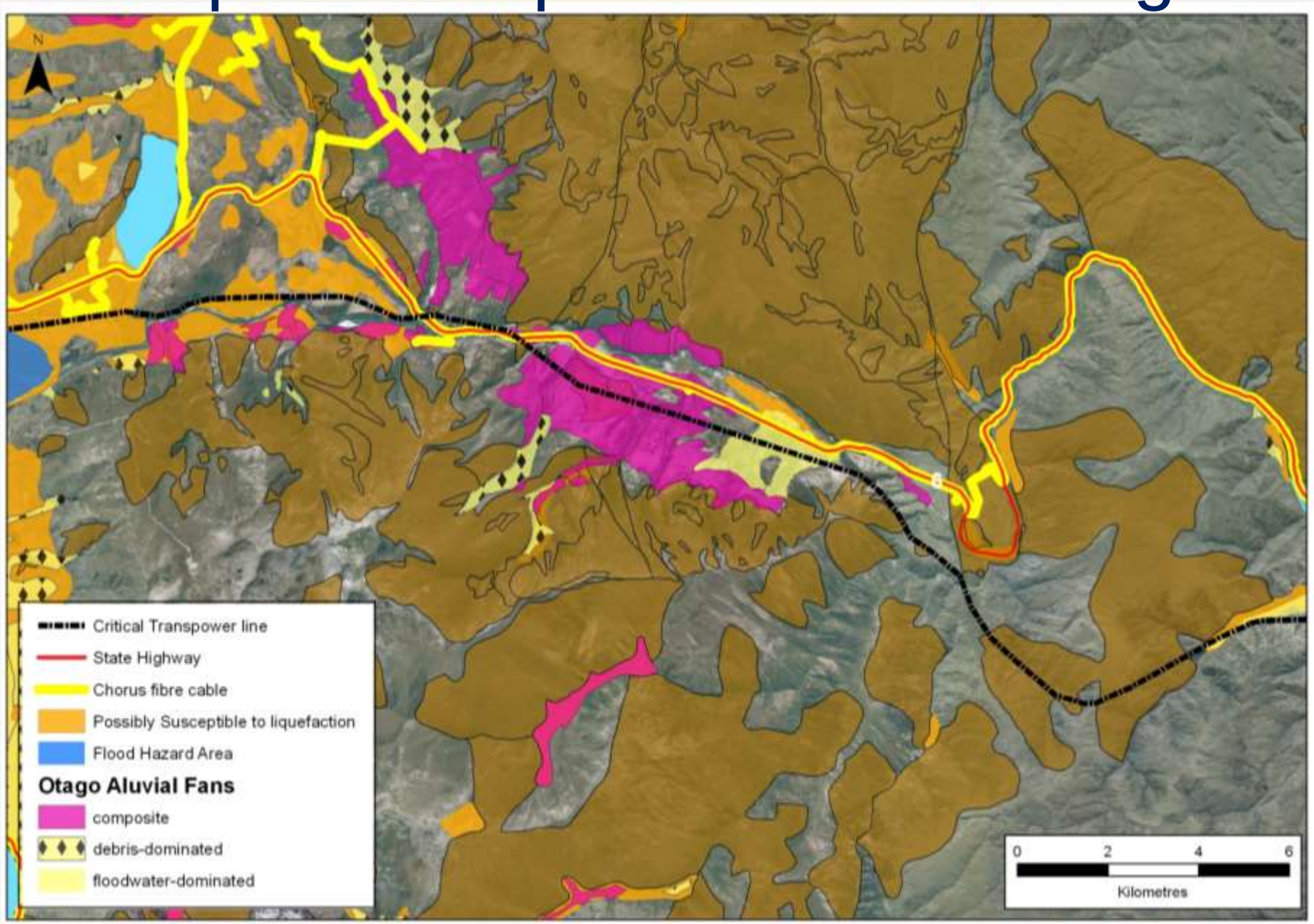
- 9 hotspots
- 6 pinchpoints
- **Made possible by the Otago Natural Hazards Database**



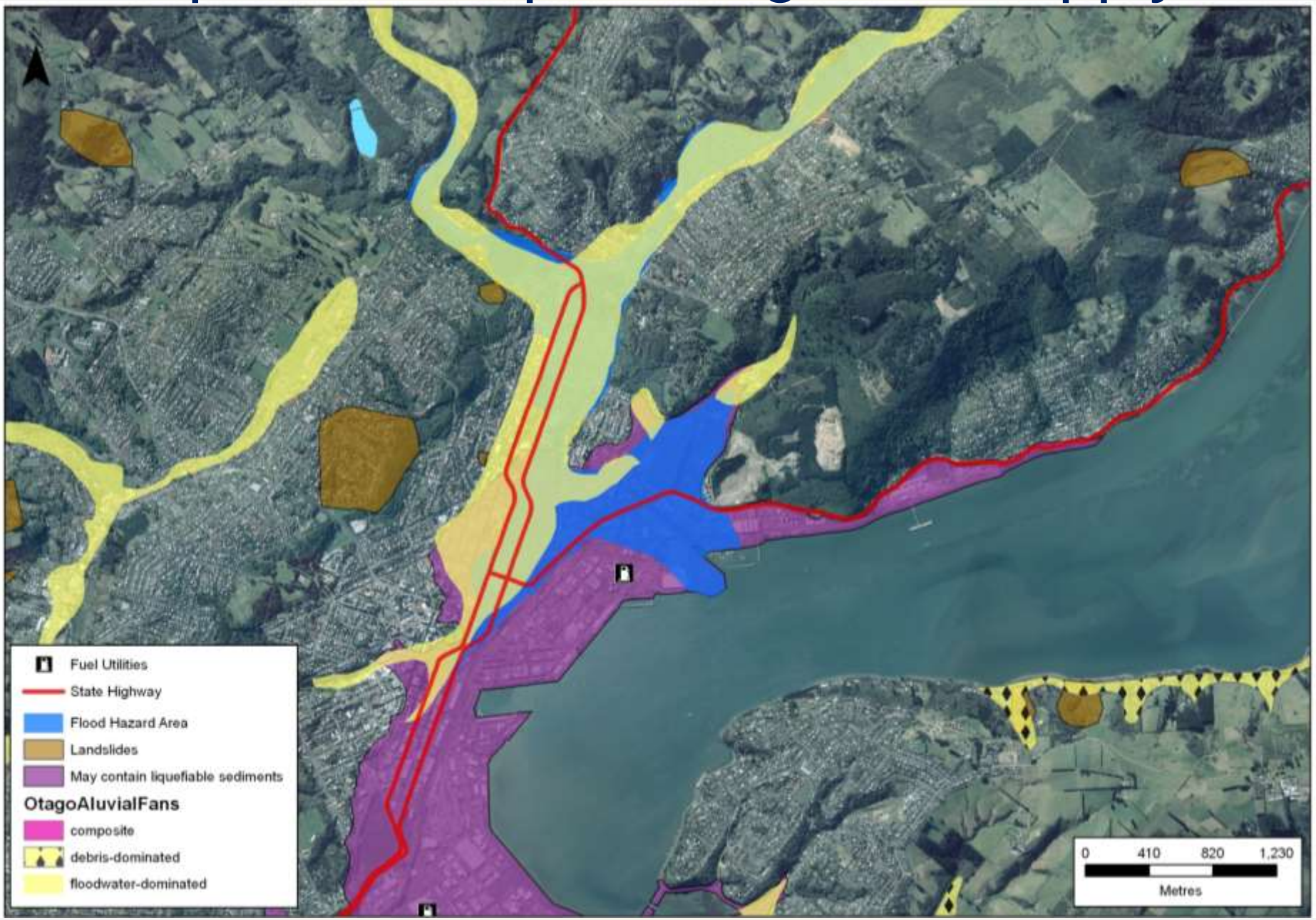
Otago Regional Council

www.orc.govt.nz

Hotspot Example: Kawarau Gorge



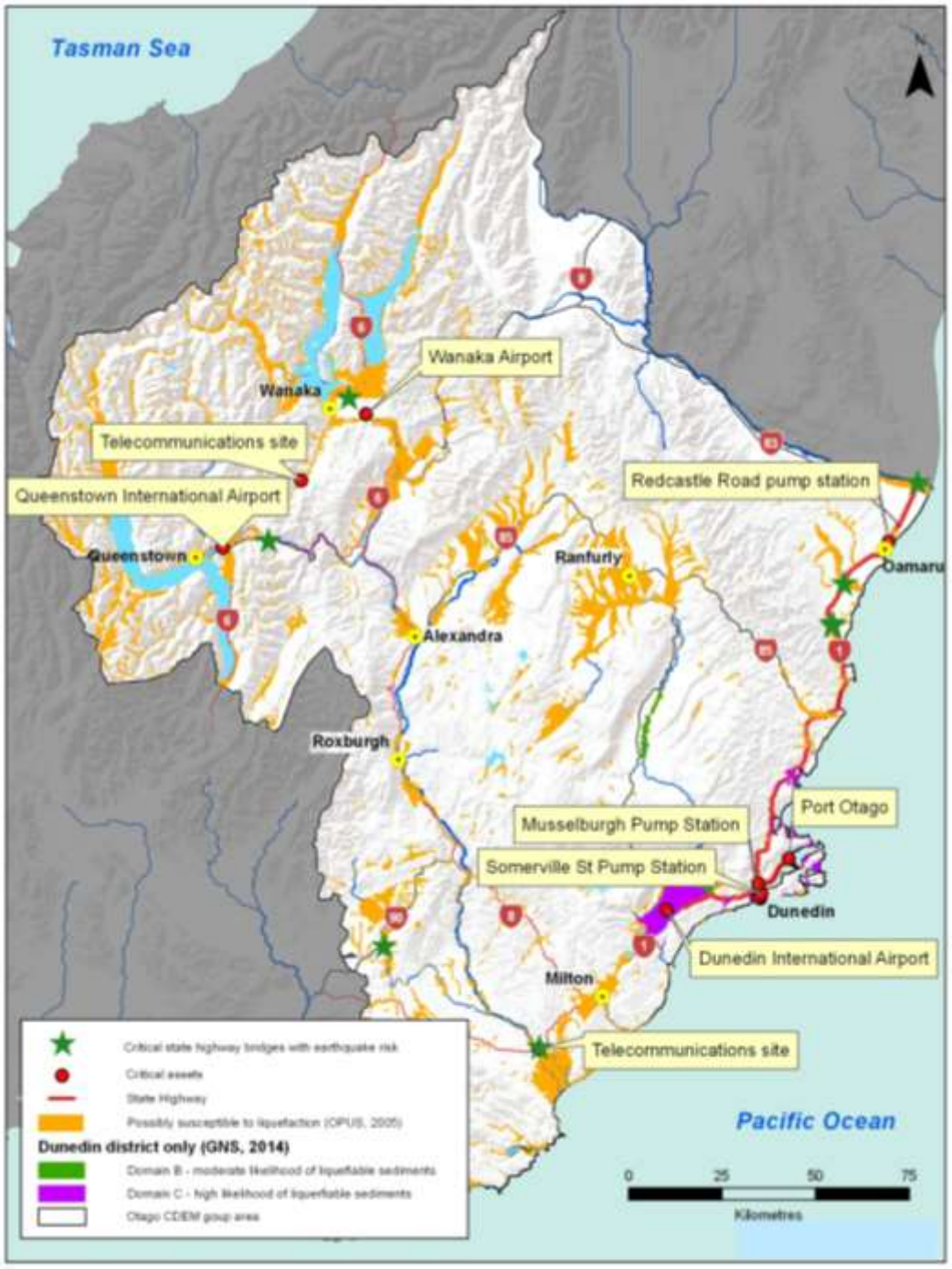
Pinchpoint example: Otago fuel supply



Infrastructure hazard risk assessment

1	*Unlikely to cause damage post event*
2	*Possible damage, short term repair (days)*
3	*Possible damage, long term repair (weeks/months)*
4	*Complete failure - full reconstruction required.*

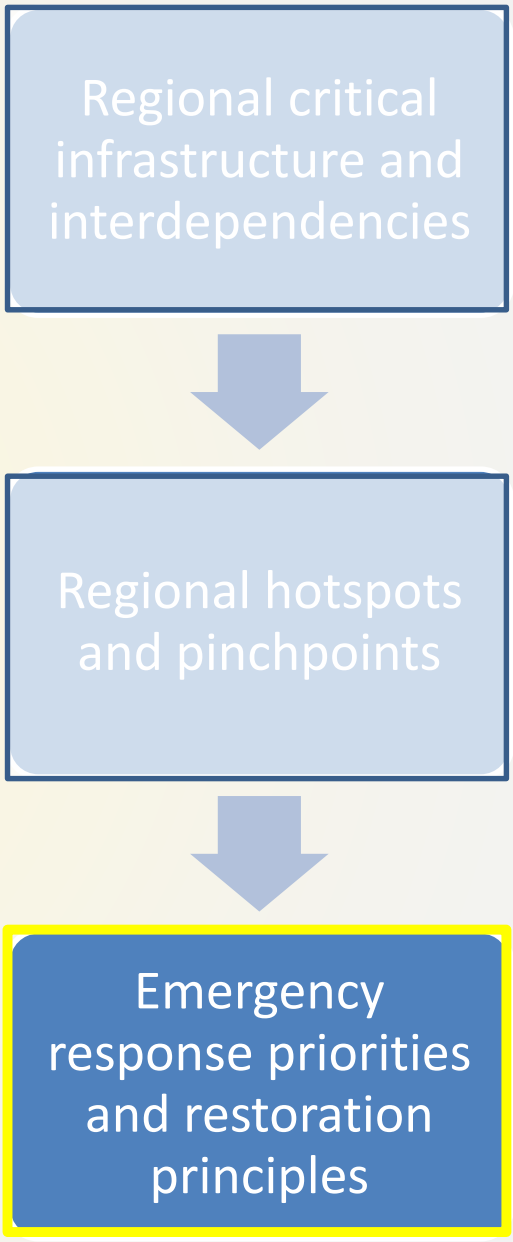
	Flooding	Landslip	Winds	Equake	Tsunami	Snow
Electricity						
Electricity transmission lines - overhead	1	3	2	2	1	2
Electricity distribution lines - overhead	2	2	3	3	3	3
Electricity Substations / Switchyards	3	3	1	2	3	1
Underground electricity cables	1	3	1	3	1	1
Fuel						
Storage Tanks	2	1	1	3	2	1
Pipelines	1	1	1	3	2	1
Transport						
Roads	2	3	1	3	2	1
Bridges	2	4	1	4	3	1
Wharves	1	1	1	3	3	1
Airport	3	1	1	3	2	1
Rail lines	3	4	1	3	3	2
Water Supply						
Pipelines	1	4	1	3	1	1
Pump stations	1	4	1	3	3	1
Water treatment plant	1	1	1	3	4	1
Wastewater						
Pipelines	2	4	1	3	1	1
Pump stations	3	4	1	3	3	1
Water treatment plant	3	1	1	3	4	1
Gas						
Pipelines	1	2	1	2	1	1
Storage Tanks	2	1	1	3	2	1
Telecommunications						
Transmission tower	2	3	3	3	3	3
Cell sites	2	2	2	2	2	2
Roadside cabinets	2	2	2	2	2	1
Exchanges	2	2	3	3	2	3
Fibre cable	2	2	1	2	2	1



Otago Regional Council

Emergency response priorities and restoration principles

- **Prioritise**: Emergency/health services, CDEM agencies, welfare agencies and lifeline organisations
- **Critical resources**:
  - Helicopters
  - People
  - Spare Parts
  - Fuel
  - Generators



Additional benefits

- Able to identify assets that may be in hazard-prone areas for each utility
- Enable lifeline utilities to understand one-another and what they do, ‘get to know your neighbours’
- Build relationships;
  - between different lifeline utilities
  - between lifeline utilities and CDEM agencies

Future actions

- Regional Fuel Contingency Plan
- Regional Reconnaissance Plan
- Regional Emergency Generator Management Plan
- Lifelines – CDEM Sector Communication Protocols
- Lifelines – CDEM Sector Communication Systems

Otago Lifelines Group

- Supported by participating lifelines utilities
- Recommendation endorsed by
  - Risk Reduction Committee
  - Readiness and Response Committee
  - Expected to be endorsed by CEG
- To be driven by lifelines utilities, support provided by Otago CDEM Group (resource, some coordination and meeting facilities)
- No agenda for work plan yet; but once organised could apply for funding/support from Otago CDEM Group

Resilience and the Otago Regional Policy Statement

- **Building resilience into our environment** (section 7)
- **Objective 3.1:** People and communities are safe from, and resilient to, the effects of natural hazards
- **Objective 3.2:** The community is prepared and able to adapt to climate change
- **Objective 3.3:** Our energy supplies are secure and sustainable
- Widespread factors that affect our long term resilience;
  - Climate change
  - Reliance on fossil fuels
  - Known and unknown natural hazards
  - Inappropriate land use, development or hazard mitigation
- Robust economy especially important where Otago relies on infrastructure located in other regions and vice versa.

Otago Regional Council
70 Stafford Street
Private Bag 1954
Dunedin

Phone: 03 474-0827

Free: 0800 474 082

Fax: 03 477-9837

Otago Regional Council

www.orc.govt.nz

aurecon

Leading. Vibrant. Global.

BoP Lifelines Vulnerability Study

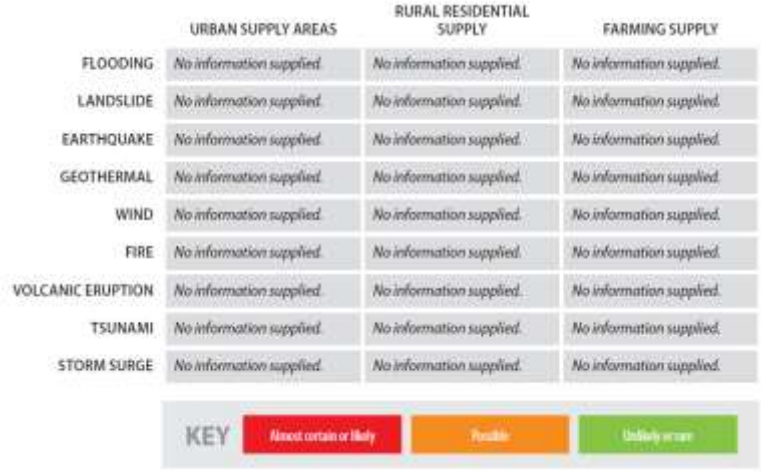
Bay of Plenty Lifelines Group

Lessons Learnt from Version One

- **Data Gaps**
  - Simply put a lot of information was missing
- **Data Consistency**
  - Each lifeline was asked to assess the risk to their assets without detailed guidelines.
  - The level of information provided varied and was open to interpretation
- **Data Format**
  - The information was presented in a report format in Lifeline order that did not display the interdependencies

	MOUNT MAUNGANUI TERMINAL	WBOP RETAIL OUTLETS	ROTORUA/EBOP RETAIL OUTLETS
FLOODING	Almost certain or likely	Possible	Possible
LANDSLIDE			
EARTHQUAKE	Possible	Possible	Possible
GEOTHERMAL			
WIND			
FIRE	Possible	Possible	Possible
VOLCANIC ERUPTION			
TSUNAMI	Almost certain or likely		
STORM SURGE			

KEY



	URBAN SUPPLY AREAS	RURAL RESIDENTIAL SUPPLY	FARMING SUPPLY
FLOODING	No information supplied.	No information supplied.	No information supplied.
LANDSLIDE	No information supplied.	No information supplied.	No information supplied.
EARTHQUAKE	No information supplied.	No information supplied.	No information supplied.
GEOTHERMAL	No information supplied.	No information supplied.	No information supplied.
WIND	No information supplied.	No information supplied.	No information supplied.
FIRE	No information supplied.	No information supplied.	No information supplied.
VOLCANIC ERUPTION	No information supplied.	No information supplied.	No information supplied.
TSUNAMI	No information supplied.	No information supplied.	No information supplied.
STORM SURGE	No information supplied.	No information supplied.	No information supplied.

KEY

What did the Lifeline Groups want

- **We held a initiation collaborative workshop with Executive Committee Members and asked them what they wanted:**
  - A better understanding of their vulnerability
  - A useable tool that was not going to sit on a shelf
    - To be used for planning and infrastructure development and replacement programmes
    - To be used during events
  - A better understanding of the other Lifelines and their interdependencies
  - Justification for future works/funding/research/investigations
  - Identification of priorities – high risk, high impact items
  - Identification of hotspots

Interesting information presented

- Tsunami could lead to 50,000 empty containers and 500,000 tonnes of logs floating around downtown Tauranga
- Planes can land at Tauranga Airport without anyone there
- MoUs with hire companies to access generators – who gets priority
- Patients can be transported out of the bay through the Kaimai Tunnel via Rail
- A fuel tank fire could shut down the site and may be left to burn out in a controlled manner
- A replacement telecom cable can be in place within 8hrs of a bridge washout
- A replacement temporary power transmission tower takes 24hrs to erect (once access is established)
- Kaimai tunnel closure would have significant impact on Port and Road networks

Asset condition rating defined

Asset condition rating	Descriptor
1. Fit for purpose	Asset is performing to current design standard and requires no capital spend within the next 5-10 years for physical assets and 1-4 years for technology based assets; based on the predicted level of use and growth.
2. Requires repairs and or maintenance	Asset has been identified to need repairs and/or maintenance to restore the asset's design capability and Level of Service; or extend the design capability to provide higher LOS.
3. Requires replacement	Asset has been identified as un-economic to continue to maintain or it cannot meet the expected LOS. Typically asset is planned to be replaced 5-10 years out.

Asset priority rating defined

Asset priority rating	Descriptor
1. Vital/Critical for network	Essential for the preservation of life. Serves critical customers and or risks to health.
2. Important to network	Efficient function of network from economic, social, and environmental perspective. This is business as usual. Affects a significant geographical area or large customer area but not critical infrastructure.
3. Local influence	Disruption of the asset poses no great risk to life, health, property, and effects economy, social, and environment, are localised. Non-essential minor customers – low financial rewards

Currently in information gathering stage

- **Challenges**
  - Finding the right person – champion - not necessarily the Lifelines rep
  - Getting asset managers and GIS staff together (**attribute tables**)
  - GIS capabilities and systems compatibility
  - Fitting into already packed work programmes
  - Organisation restructures
  - Timeliness – how long does it take
- **Important**
  - Making sure we get this part right
  - Reducing/eliminating the need to revisit the data collection
  - Making it easy for the lifeline groups

How is the information being gathered

- Decision made that each Lifeline Group would retain ‘ownership’ and maintenance of their data
- Infrastructure data is published as ArcGIS map services on their external ArcGIS server
- The map services REST URLs are sent to Regional Council and added to the web viewer
- The map services are linked to the live database. So whenever any changes are made, the viewer is updater as well.
- Result a live tool accessible to all our Lifelines

Key benefits to the Lifelines Groups - Objectives

- Awareness of own lifeline
- Awareness of interdependencies with other lifelines
- Planning
- Live tool
- Identification of hotspots/priorities
- Provides justification for funding/work programme
- Greater awareness of critical Lifelines and impacts across CDEM and communities

"Plan for the Possible not the Probable"

Professor Thomas D. O'Rourke, Civil & Environmental Engineering at the Sibley College of Engineering, Cornell University

TERMS OF REFERENCE:

LIFELINES VULNERABILITY STUDY

New Zealand Lifelines Committee

Purpose

To assess the vulnerably of lifelines to natural hazards.

- Community services that have main emergency response roles may be added. Examples: emergency services, CDEM ECCs and EOCs, health facilities, corrections facilities, and welfare centres.

Deliverable: Comprehensive Report

- Descriptions of lifeline infrastructure including criticality (importance) ratings (infrastructure that serves other regions / New Zealand as a whole to be identified)
- Maps (GIS) showing lifeline layouts
- Descriptions of the major natural hazards including location
- Development of a lifelines interdependency analysis
- An assessment of the vulnerability of infrastructure to the hazards and interdependencies including estimates of recovery times
- Identification of lifeline Hotspots and Pinchpoints
- Mitigation options and suggested ongoing work programme for the Lifelines Group

A PowerPoint suited to presentation at a CEG meeting is to be prepared summarising the comprehensive report.

- The report and PowerPoint to be consistent with *AS/NZS ISO 31000:2009*

New Zealand Lifelines Committee

Other Terms of Reference Features

- Audience: CDEM and Lifelines Group, utilities, others
- Personnel: Project Manager, working with utilities and hazard experts
- Governance: Small project management group
- Resourcing: Funding, in-kind contributions

THE TREASURY

Kaitohutohu Kaupapa Rawa

Infrastructure Resilience Toolkit

DEVELOPMENT DRAFT

2014 National Lifelines Forum

5 November *2014*

NATIONAL INFRASTRUCTURE UNIT

Vision

By 2030 New Zealand's infrastructure is resilient, coordinated and contributes to economic growth and increased quality of life

Outcomes

- *Better use of existing infrastructure*
- *Better allocation of new investment*

Principles

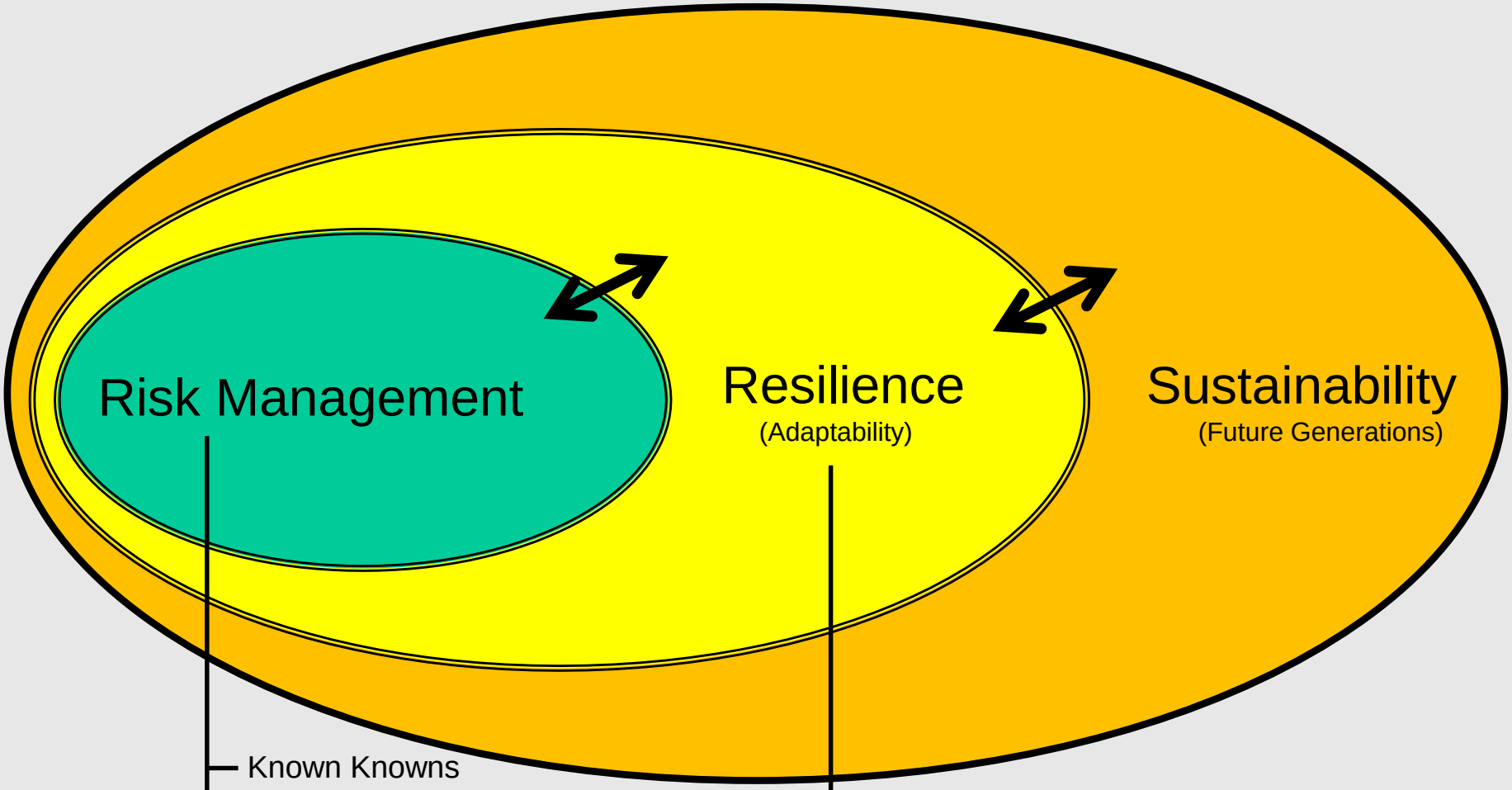
- *Investment analysis*
- *Resilience*
- *Funding mechanisms*
- *Accountability / Performance*
- *Regulation*
- *Coordination*

Home Truths ….

- Infrastructure fails
- Resilience:
  - something you are not something you do
  - not necessarily more expensive
  - emergent as well as shock events
  - natural hazards and beyond
  - not always about making things stronger
  - includes decommissioning infrastructure
  - often achieved by operational changes
- Equilibrium is never constant
- Our diverse regional economies are valuable

Risk, Resilience and Sustainability …..

(Linking to Treasury's Living Standards Framework)



Known Knowns
- Variability can be readily described

Known Unknowns
- Limitations, assumptions

Unknown Unknowns
- Black swan
- Threats where you have an adversary
- Complex system risks with dynamic interdependencies

NATIONAL INFRASTRUCTURE UNIT

Resilience Attributes …

- Service Delivery
  - Focus on national, business and community needs in the immediate and longer term
- Adaptation
  - National infrastructure has capacity to withstand disruption, absorb disturbance, act effectively in a crisis, and recognises changing conditions over time
- Community Preparedness
  - Infrastructure providers and users understand the infrastructure outage risks they face and take steps to mitigate these. Aspects of timing, duration, regularity, intensity, and impact tolerance differ over time and between communities
- Responsibility
  - Individual and collaborative responsibilities are clear between owners, operators, users, policy-makers and regulators. Responsibility gaps are addressed
- Interdependencies
  - A systems approach applies to identification and management of risk (including consideration of interdependencies, supply chain and weakest link vulnerabilities
- Financial Strength
  - Financial capacity to deal with investment, significant disruption and changing circumstances
- Continuous
  - On-going resilience activities provide assurance and draws attention to emerging issues, recognising that infrastructure resilience will always be a work in progress
- Organisational Performance
  - Leadership and culture are conducive to resilience, including: Leadership & Culture, Networks & Change Ready. Future skills requirements are being addressed

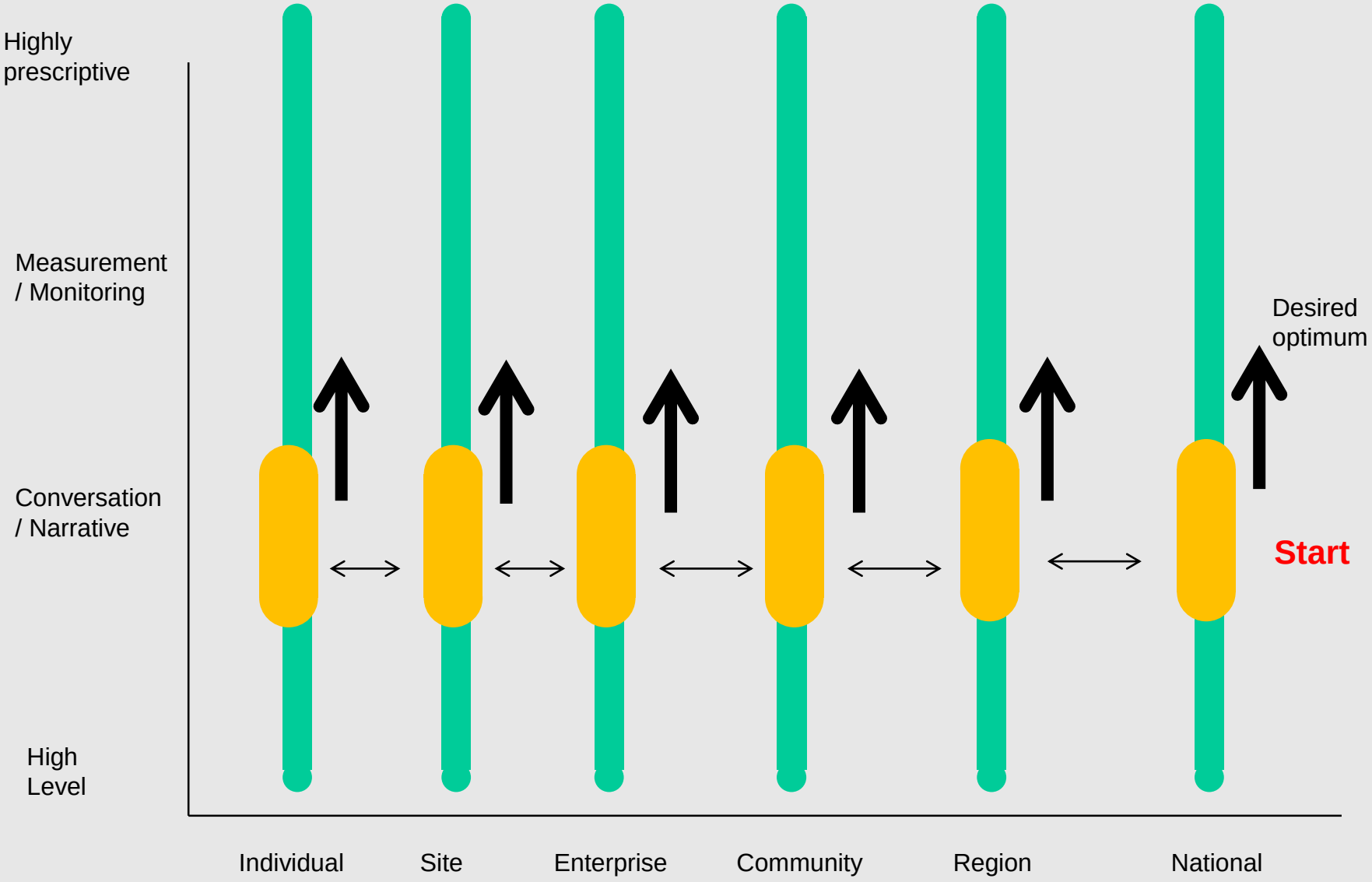
Resilience Toolkit objectives …

- Operationalise the resilience framework
- Mobilise research and practitioner resources to develop further
- Target in the first instance:
  - Conversations / narratives
- Target in the second instance:
  - Reporting / monitoring / diagnostics

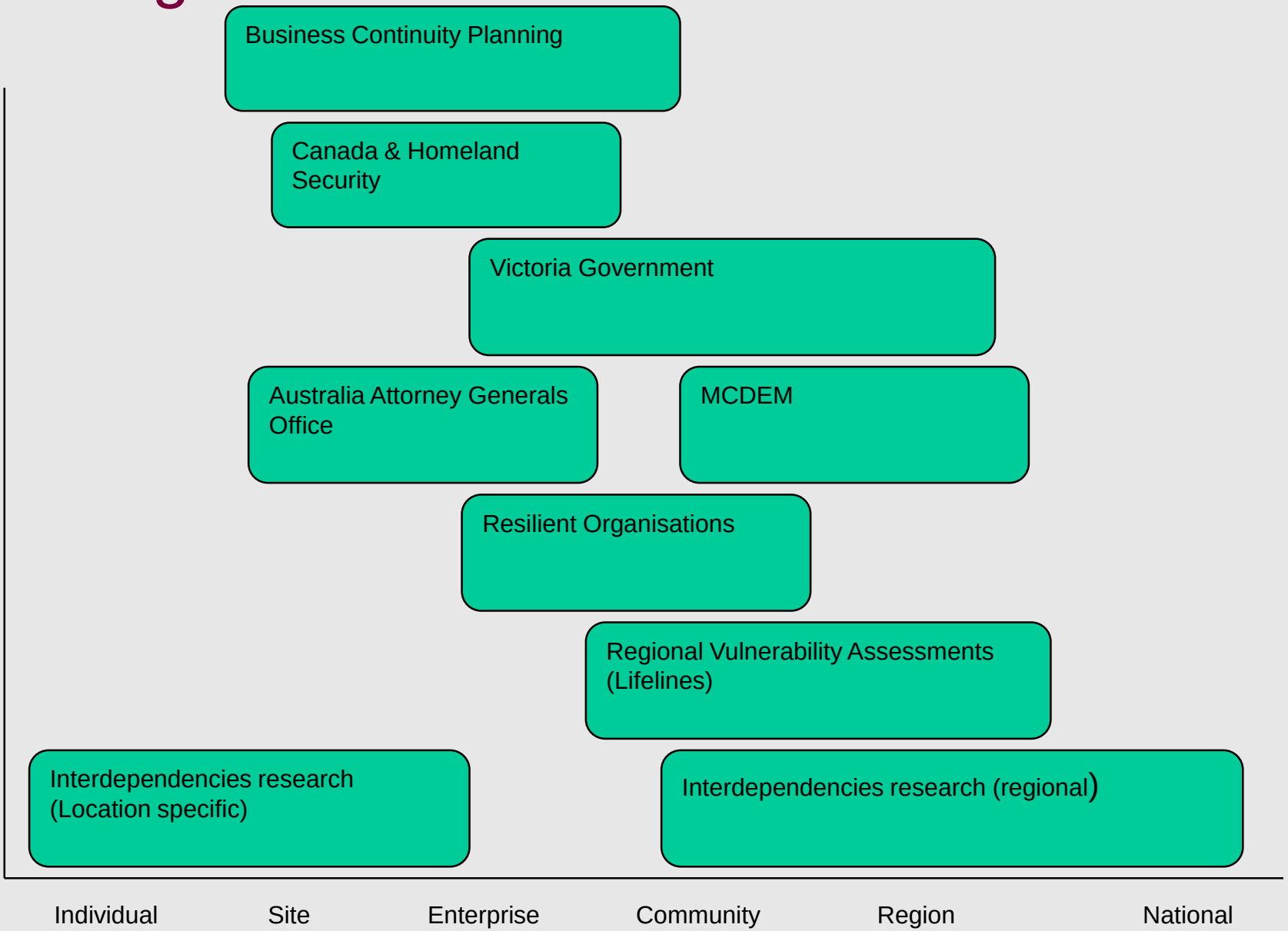
Resilience Toolkit approach …

- NIU is facilitator / influencer / coordinator
- Regulation is a last resort
- Seek to use existing tools
- Recognise that resilience depends on perspective
- Need an iterative process to integrate perspectives within and between (interdependencies)
- Open source “non-proprietary” preferred
- (Very) low barriers to entry (better that tools are being applied)
- Staged increasingly detailed tools
- Enable preliminary self assessment
- Encourage private sector application of detailed tools
- Develop over time (address research and practice gaps progressively)

Resilience Toolkit approach …



Existing Resilience Tools …



Concept of National Resilience

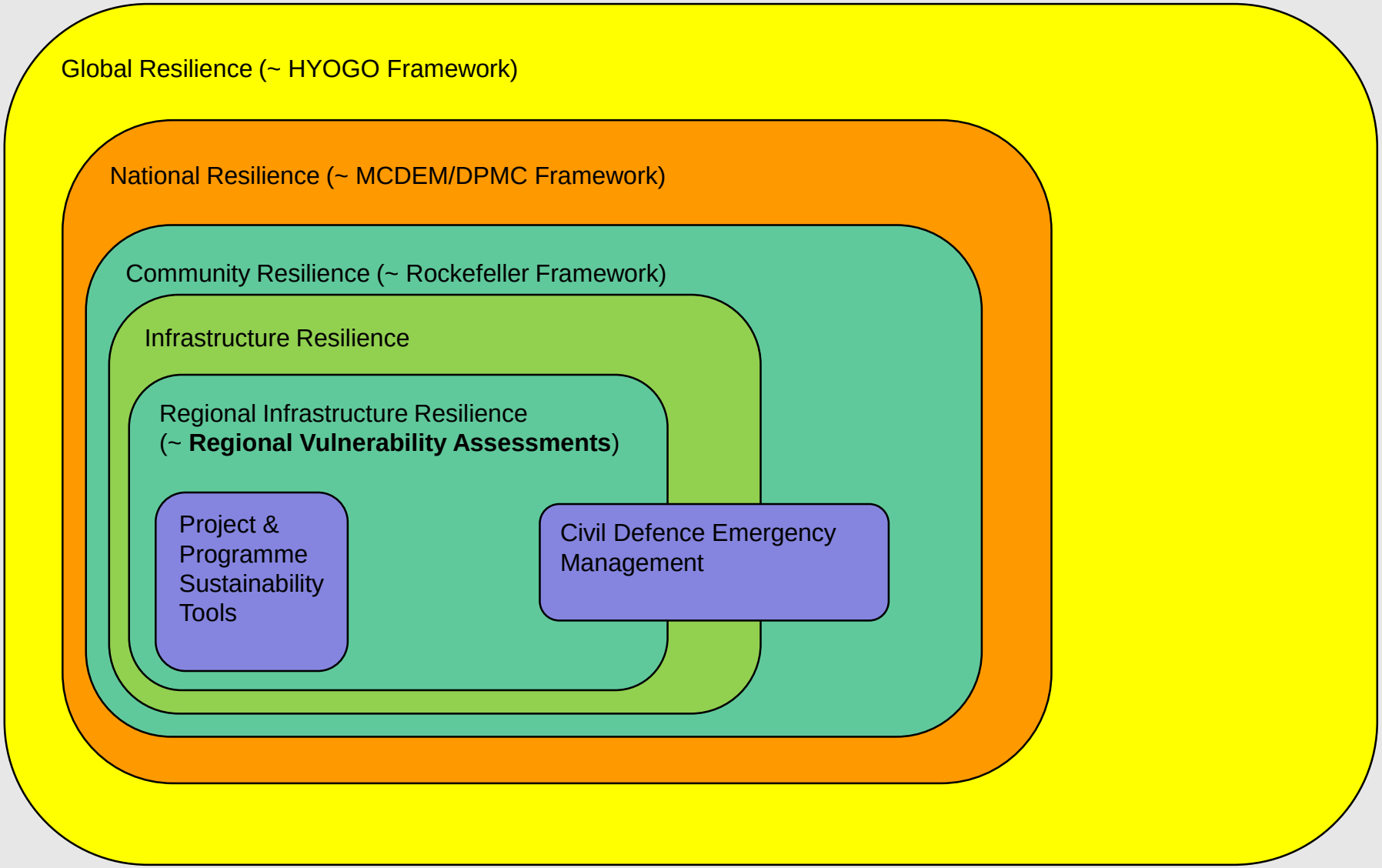
Source: MCDEM

This diagram is designed to illustrate that:

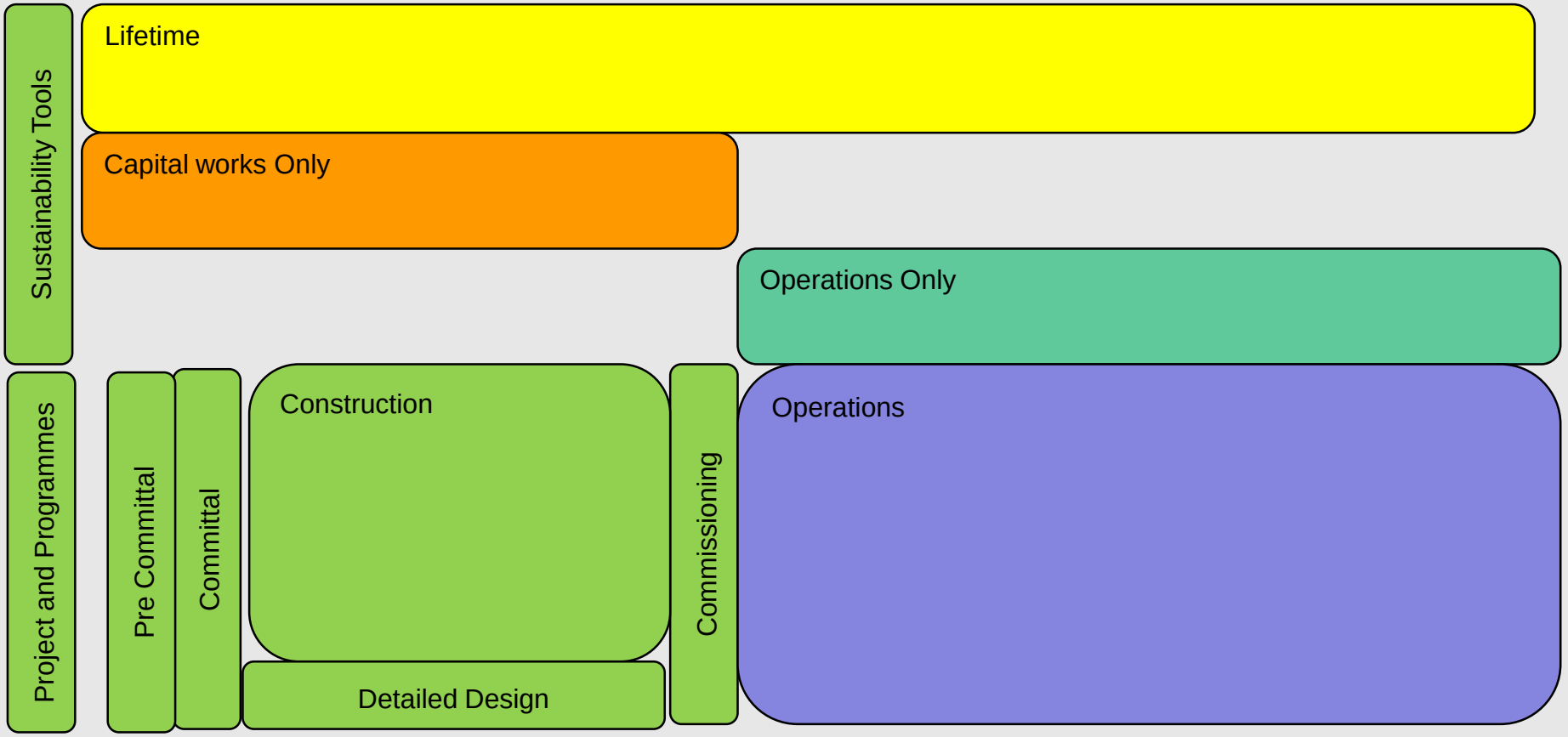
1) **resilience crosses a range of portfolios**; your team or organisation's work might contribute to a particular aspect of resilience, but it is important to look at things holistically and to put what we do in the wider context of what makes communities – and the nation – resilient. This also illustrates the range and breadth of potential partners in your resilience work – there is no need to work in isolation, there will be synergies to working with others who have similar goals.

2) **resilience acts on a range of scales**, from individual to societal, and it follows that interventions and initiatives should be on a range of scales, and include "bottom up" and "top down" efforts.

National Resilience



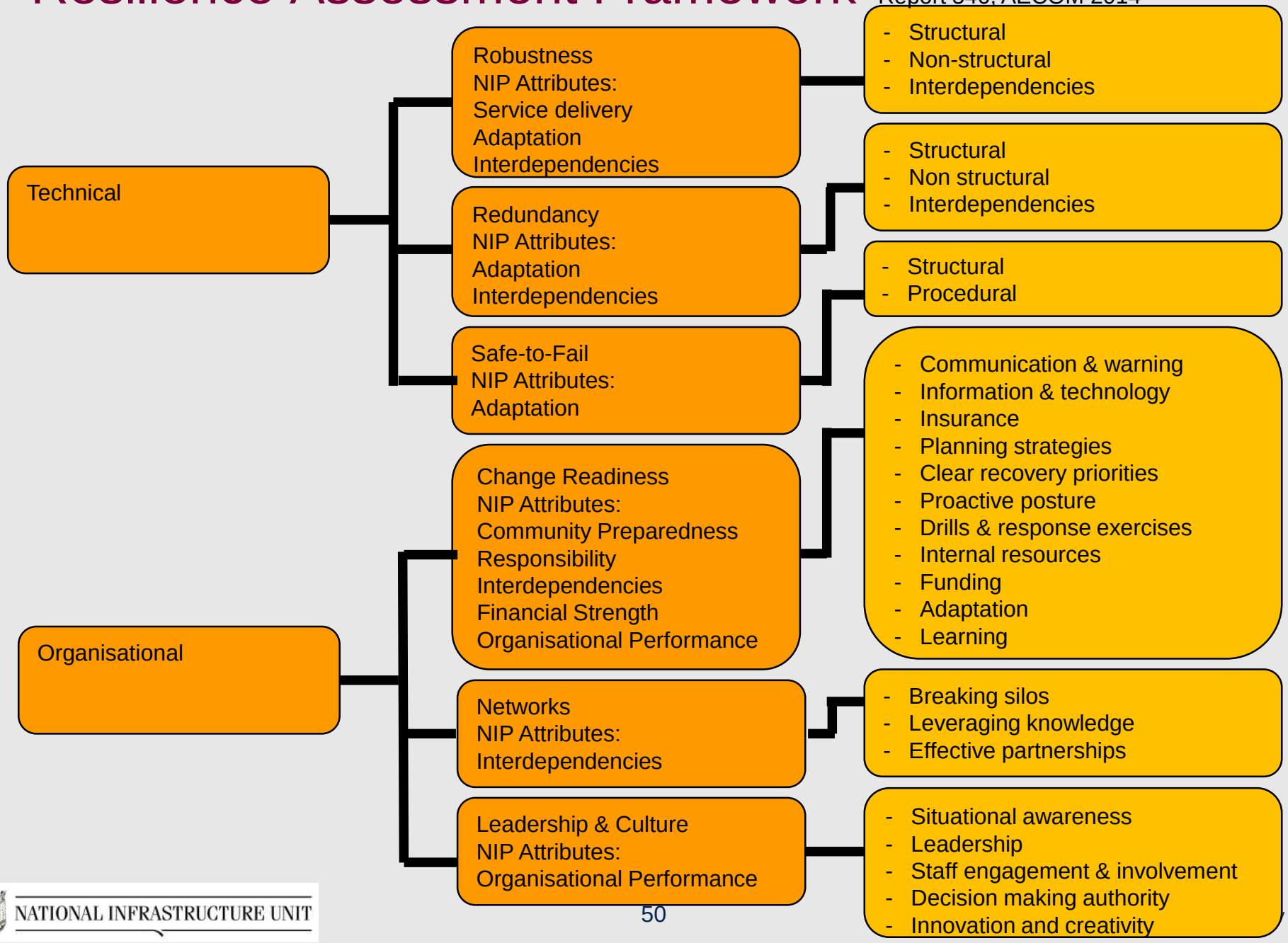
Projects and Programmes – Sustainability Tools



Reference: Kerry Griffiths, URS New Zealand, is currently undertaking in-depth research into the use of infrastructure sustainability rating tools as a means of delivering business value and improving social and environmental outcomes. Tools under consideration: **Infrastructure Sustainability Council of Australia (ISCA)** rating tool, **US based Greenroads™** framework, the **UK CEEQUAL™** rating tool.

Resilience Assessment Framework

Source: Measuring the Resilience of Transport Infrastructure, NZTA Research Report 546, AECOM 2014



Organisational Resilience - Released August 2014

Australian Government
Attorney-General's Department

www.organisationalresilience.gov.au

What is **Organisational Resilience**?

Organisational resilience refers to a business's ability to adapt and evolve as the global market is evolving, to respond to short term shocks—be they natural disasters or significant changes in market dynamics—and to shape itself to respond to long term challenges.

Discover your **organisation's resilience potential** now

1

Respond to the HealthCheck indicators

All you need is a basic awareness of your organisation.

2

You get immediate insights into your current organisational resilience capability

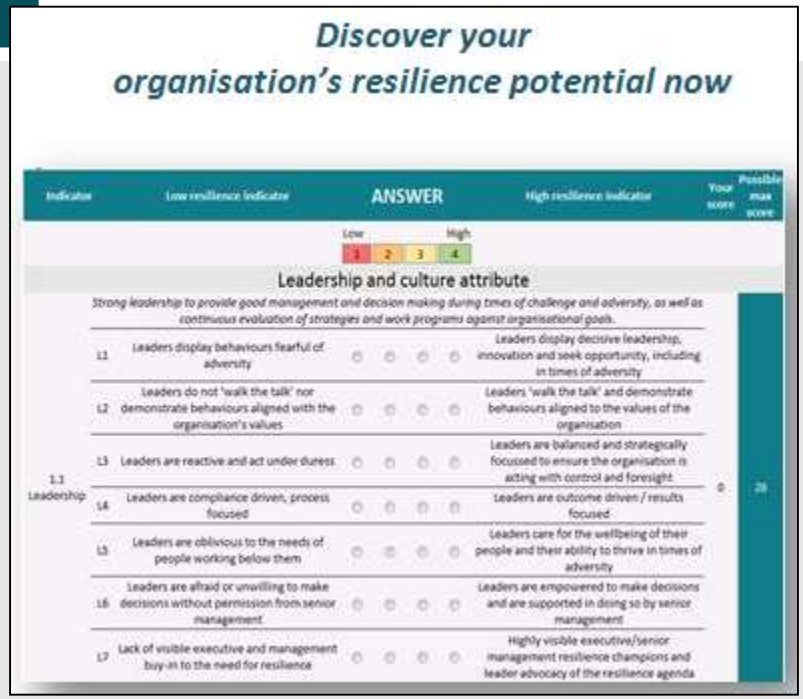
This process will help you become more aware.

3

You receive potential treatment options

Practical ways to respond and grow your organisational resilience capability.

Take the free organisational resilience HealthCheck now



NATIONAL INFRASTRUCTURE UNIT

Organisational Resilience - Released August 2014

- Respond to short term shocks and take advantage of long term trends and challenges.
- Help critical infrastructure organisations better manage unforeseen or unexpected risk and threats to the continuity of essential services.
- Businesses and individuals
- Free tool
- Assist you and your team develop a shared understanding of your organisation’s progress towards resilience, and identify possible treatment actions.

Organisational Resilience - Released August 2014

- Organisations rate where their organisations sit for each question.
- The tool is designed as a conversation starter within organisations, rather than a measurement or benchmark.
- As such, but there is a direct flow onto Res Orgs tools as it uses the same 13 resilience indicators as its basis.
- The spider diagram for presenting the results looks the same as Res Orgs.
- This leads to: use the Healthcheck tool to start the conversation within organisation, and then advance to measurement and benchmarking.
- Highly recommended for the infrastructure sector.

Your feedback is most welcome.

Resilient is something you are not something you do

National Infrastructure Unit
www.infrastructure.govt.nz
roger.fairclough@treasury.govt.nz