



THE TREASURY

Kaitohutohu Kaupapa Rawa

# National Infrastructure & Resilience

National Lifelines Forum

*7 November 2013*



NATIONAL INFRASTRUCTURE UNIT

# Agenda

- “ Context
- “ The Plan
- “ Direction of travel
- “ Evidence base
- “ 2014
- “ ÷ Resilience





## NATIONAL INFRASTRUCTURE UNIT

- “ Established 2009 . Infrastructure identified as one of six key drivers of economic growth
- “ Located within NZ Treasury
- “ Works across specialist sector policy agencies eg. Ministry of Transport, Ministry for the Environment etc
- “ We are about:
  - High performing infrastructure supporting higher living standards+
- “ Involving a lot of: Oversight . Facilitation - Coordination
- “ National Infrastructure Advisory Board

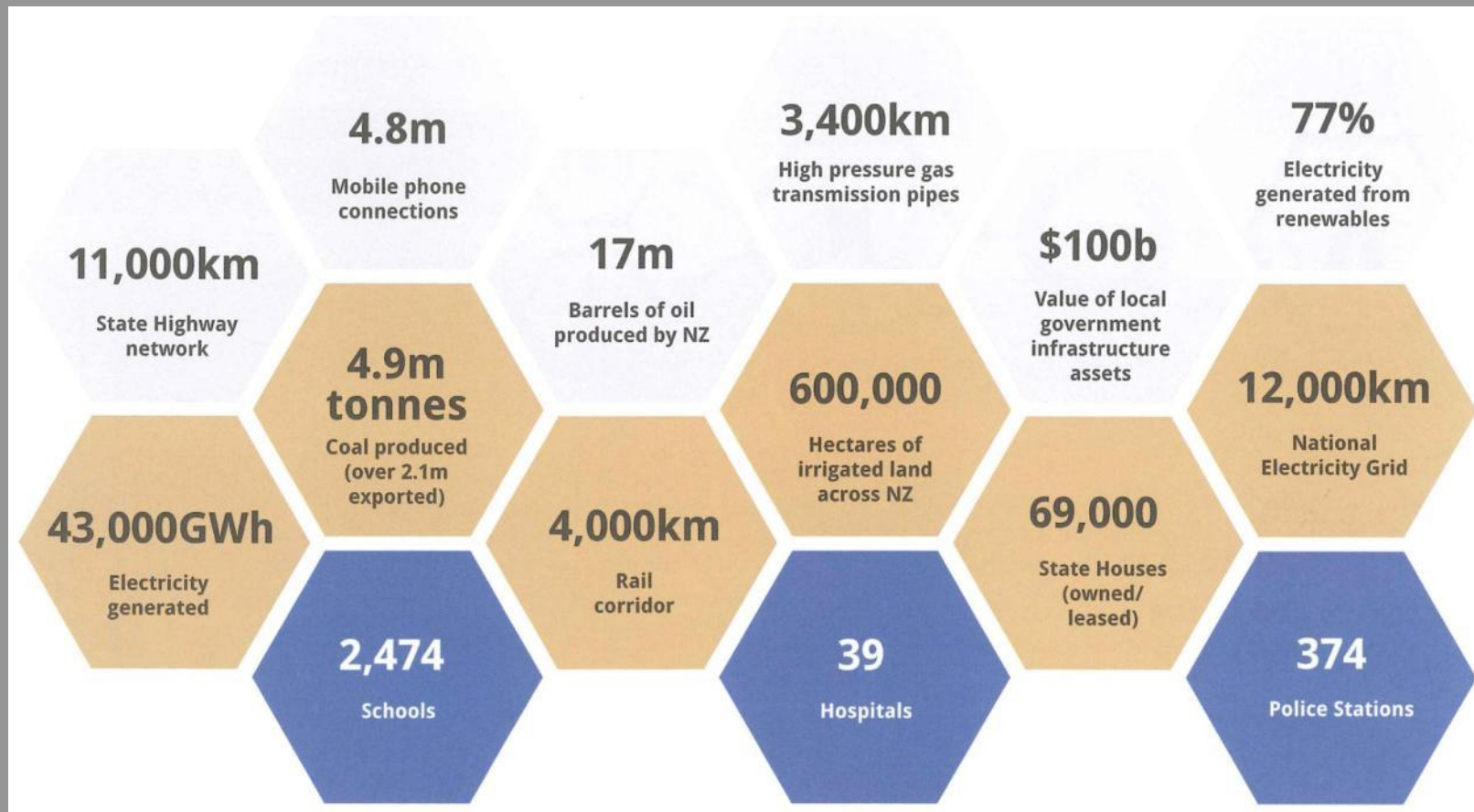


# Infrastructure

- the fixed, long-lived structures that facilitate the production of goods and services and underpin many aspects of quality of life.
- physical networks, principally transport, water, energy, communications and social assets.



# A diverse business ÷





# ... current investment ...

Our investments and commitments: 2012/13 & 2013/14



# National Infrastructure Plan



- “ Released in July 2011
- “ Strategic future focused document
- “ A common direction for how we plan, fund, build and use economic and social infrastructure





## *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*

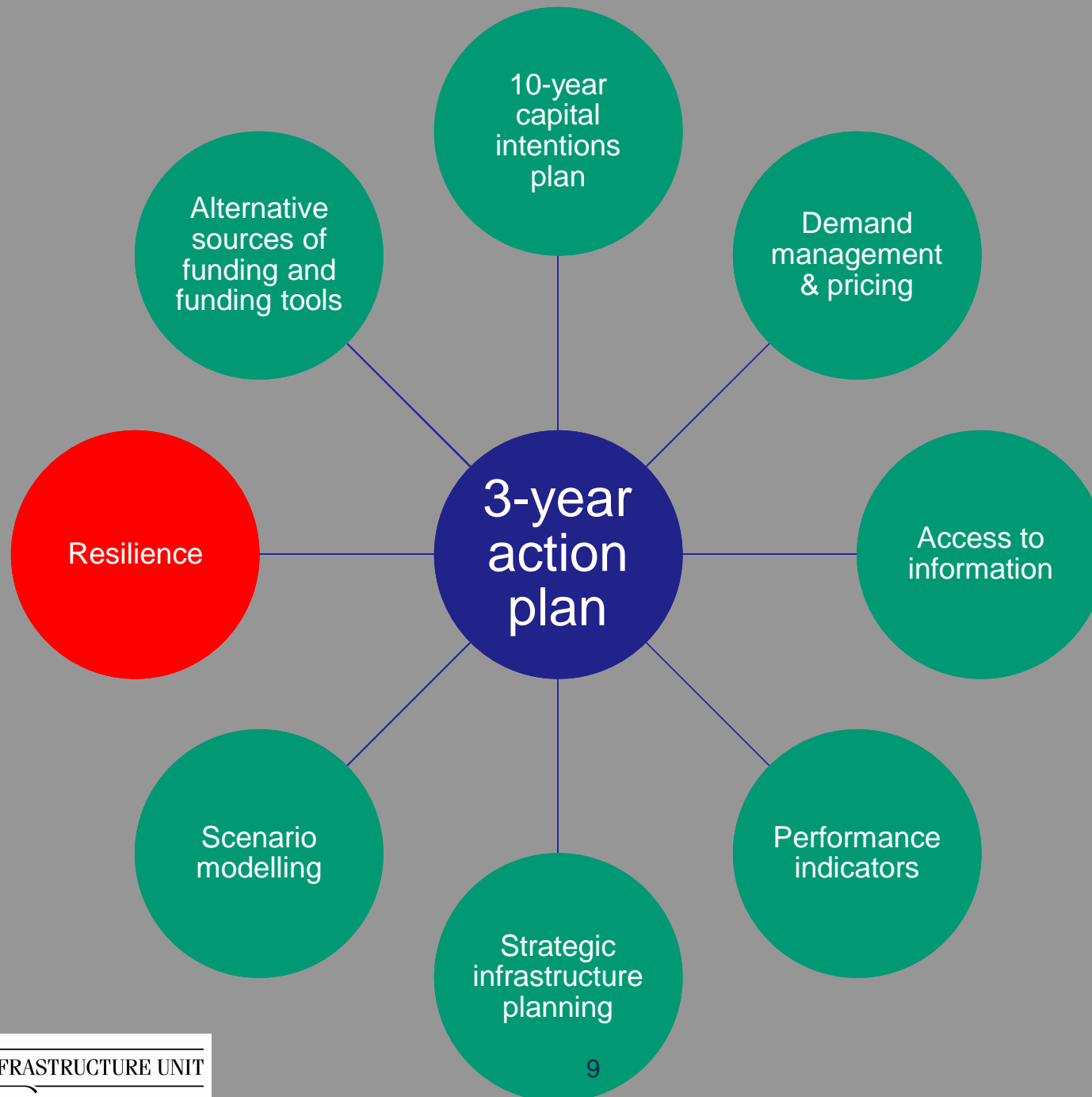
*Accountability  
/ Performance*

*Regulation*

*Coordination*







# Recent reports . Oct 2013

**DEMAND MANAGEMENT**  
A Think Piece by National Infrastructure Advisory Board  
September 2013

Infrastructure in New Zealand is an important asset – one of the most important – and as such we must make sure we manage it properly. But we must also make sure we don't build it for the sake of it – infrastructure projects are expensive, time consuming, adversely impact on the environment, and are not always the best response to increasing demand.

As the National Infrastructure Advisory Board (NIAB) our role is to consider the big issues facing New Zealand infrastructure, now and into the future, and to provide advice on these to Ministers and the National Infrastructure Unit.

It is our view that supply side solutions are no longer sufficient to respond to increasing demand in New Zealand, and that other options must be considered.

We know that demand for services in New Zealand is increasing, and it will continue to do so: the population is increasing and moving, and it is getting more demanding – as services improve in quality and availability, peoples' expectations increase, and so a trajectory of ever increasing demand is created.

We also know that input costs will increase over time, and that many New Zealand infrastructure providers have reducing funding for infrastructure, so we cannot assume that supply side options will be enough to meet the continuing increase in demand. There is not enough money, there is not enough space, and it is not economically efficient to do so. We must look at other options.

Demand management is one of the most appropriate and effective options, but it is widely misunderstood and underutilised. Demand management is often thought of as pricing to reduce end user demand – such as road tolls or water meters – and these are good uses of demand management in the right circumstances, but it is also a lot more than this.

The National Infrastructure Unit today publishes a document that highlights the breadth of demand management tools and techniques available to infrastructure managers, and a series of case studies designed to highlight already successful applications in New Zealand. This is a good start in raising awareness of the positive application of demand management, but NIAB believes we need to go further to drive this across New Zealand. We believe demand management must be taken seriously as an option to manage and meet demand in a sustainable way, and we would like to see decision makers being bold in its use.

NIAB believes a twin track approach which considers demand management and supply side options together must be adopted to optimise both existing and future investment, and we would like to see demand management as a component of every infrastructure business case across New Zealand. It should be considered as a substitute for supply side options before any commitment is made to build new infrastructure, and we strongly urge central and local government, as well as the private sector, to ensure that it has been considered before any new projects are approved.

We also encourage the Treasury to make this requirement more explicit in the Better Business Case model, and we suggest Ministers request evidence of demand management options before approving any new government spend on infrastructure.

In addition to this, we believe demand management needs to be factored into new projects as a complement to supply side options to ensure we are making the best use of our infrastructure investments, and we urge every infrastructure manager to ensure they have a plan in place to manage demand to the most efficient level for their infrastructure.

Finally, we would like to see more analysis on the benefits of demand management to support decision makers. We know the infrastructure landscape is changing, we are no longer in an environment where assets are managed independently of each other and new capital is spent in isolation, so understanding the interdependence between assets and managing the demand across the whole system is crucial to driving the full benefits from them. We need to ensure we are measuring these benefits, and sharing best practice throughout the country.

There are already some great examples of demand management across New Zealand, but now we need to go further if we are to meet our challenges, and we want this document to be the start of that process.

The National Infrastructure Advisory Board  
Treasury 27/10/13v1  
For more information visit: [www.infrastructure.govt.nz](http://www.infrastructure.govt.nz)

**DEMAND MANAGEMENT**  
A Discussion Document by National Infrastructure Unit  
September 2013

The 2011 National Infrastructure Plan committed to "increase understanding of and encourage debate on the use of demand management and pricing in infrastructure sectors".

This outcome is important to the success of infrastructure in NZ, as managing demand to the most effective and efficient level is crucial for ensuring NZ continues to grow and living standards continue to improve, and this cannot be achieved by supply side options alone. Demand side options must also be utilised, but in many cases they are discounted as understanding of the real benefits and options available is limited.

This publication is designed to illustrate the variety of tools available within Demand Management (DM) and to highlight and promote good practice across New Zealand. Government wants to ensure demand side options are considered both as a substitute and a complementary tool to supply side options in all areas of infrastructure. This discussion document is the first step in encouraging debate and sharing best practice to enable this.

**What is demand?**

The National Infrastructure Unit (NIU) defines demand as the needs and expectations of users of infrastructure (users), as well as their hopes and aspirations. Users of infrastructure include the community, government, business, and sector users.

Demand from users is motivated by a variety of factors, including need, but also a sense of fairness and expectation. For example if one town had a set of services, other towns are likely to expect the same services at the same quality. Users also tend to demand a service, which may require an asset, rather than demanding the asset directly. For example, users might demand a certain level of healthcare, rather than demanding a specific hospital be built. It is up to local and central government to determine the best way to meet the requirement and what assets may be needed to deliver it.

As a general trend, once users' needs and expectations are met, new expectations will arise, as part of continuously improving living standards.

**What is demand management?**

Demand management is defined by NIU as active intervention to influence demand for something. It is used in order to best match current and future resources to requirements and to ensure delivery in the best value for money way.

Demand Management may be used to increase, decrease, or maintain demand. It may also be used to change the level of demand over a time period, rather than change the overall level of demand. It may be used for a variety of reasons, such as:

- increasing demand for a service deemed beneficial to society (e.g. childhood education or preventative healthcare);
- increasing demand for a service deemed beneficial to the economy (e.g. faster connectivity);
- managing demand at the most efficient level for value for money of an asset (e.g. capacity of public transport);
- smoothing demand over time to avoid peaks and troughs (e.g. energy usage);
- redirecting demand to a substitute (e.g. teleconferencing instead of travel);
- decreasing demand where continuing rises will outstrip supply (e.g. road usage);
- decreasing demand in the short term (e.g. water restrictions during a drought).

The National Infrastructure Unit  
Treasury 27/10/13v1  
For more information visit: [www.infrastructure.govt.nz](http://www.infrastructure.govt.nz)



The six key areas in the Business Growth Agenda are:



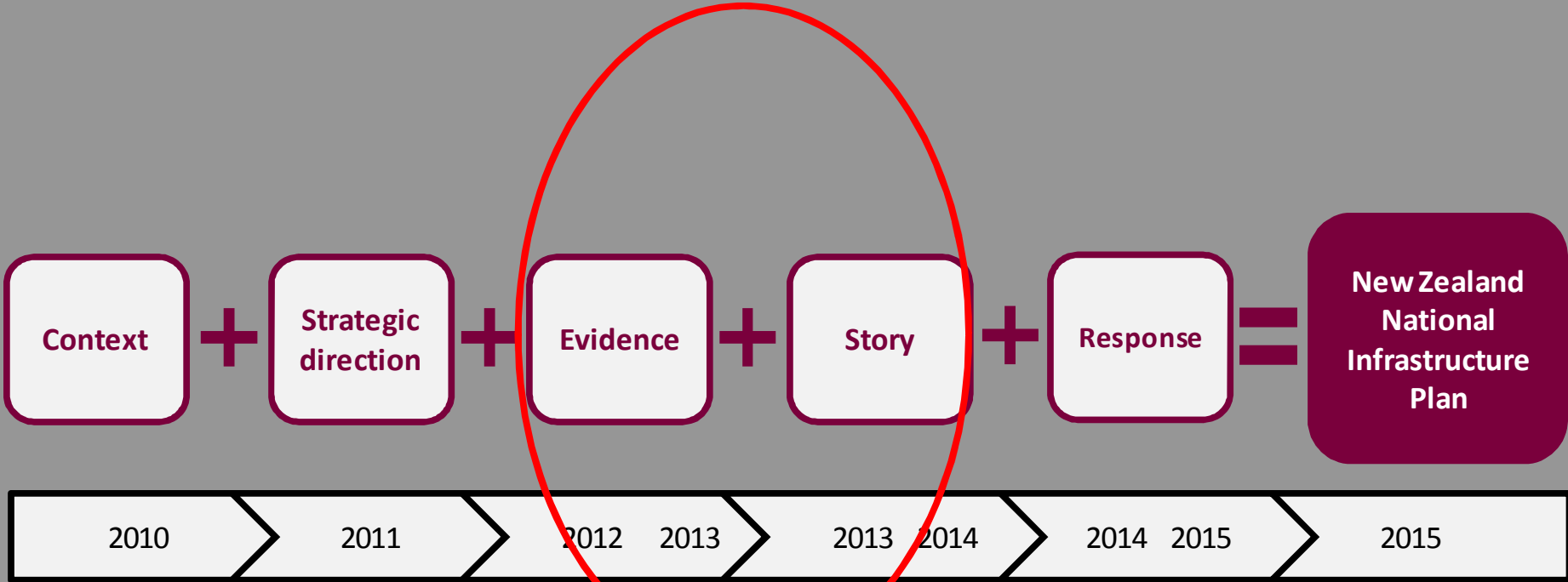
# Where are we heading

Five key expectations the next iteration of the Plan needs to deliver on:

- “ Reinforce the current strategic direction (the vision and outcomes)
- “ Mature the debate around future needs and responses
- “ Be a collective infrastructure plan by NZ Inc across the private sector, central and local government
- “ Have increased specificity about the action plan and future investment programme required to achieve the strategic direction
- “ **Be underpinned by a more robust evidence base of future need and current performance**



# Direction of travel



Framework	Focus	Key questions	Work programme (Action Plan)
<b>Pressure</b>	Future Infrastructure demands – drivers of demand	<ul style="list-style-type: none"> <li>• What are the future drivers of demand?</li> <li>• How consistent is this view across the sectors?</li> <li>• Where are the most significant forecast deficits and the relative priorities of these?</li> </ul>	<ul style="list-style-type: none"> <li>• Scenario modelling</li> <li>• Macro-regional planning</li> <li>• Resilience framework and issues</li> </ul>
<b>State</b>	Current state and performance of infrastructure	<ul style="list-style-type: none"> <li>• What quantity/volume of infrastructure do we have?</li> <li>• Where is it located?</li> <li>• What is the quality?</li> <li>• Does it deliver the appropriate level of resiliency?</li> <li>• What capacity do we have, how well is it utilised?</li> <li>• What is it costing? The price?</li> </ul>	<ul style="list-style-type: none"> <li>• Performance Indicators framework</li> <li>• Resilience framework and issues</li> </ul>
<b>Response</b>	Regulatory setting Funding arrangements	<ul style="list-style-type: none"> <li>• How is it funded?</li> <li>• Who should be making the investment?</li> <li>• Are the regulatory settings optimised to facilitate the required level of investment?</li> </ul>	<ul style="list-style-type: none"> <li>• Capital Intentions Plan</li> <li>• Demand management</li> <li>• Alternative sources of funding</li> <li>• Regulatory settings analysis</li> </ul>





# Evidence base . January 2014



# Performance indicators

Objective data  
+  
Subjective knowledge



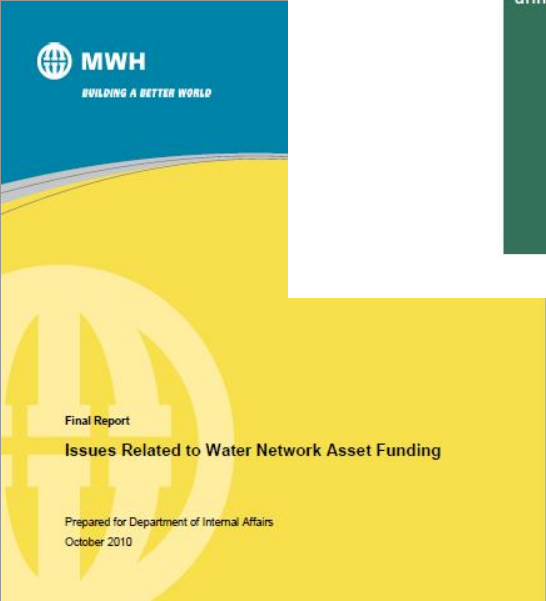
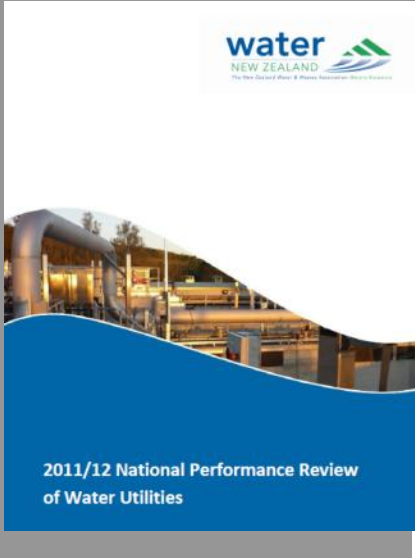
Asset Condition	Asset condition generally reflects the need to make future investments in maintenance and renewals. Better asset condition therefore is associated with greater welfare, to the extent this translates to future cost savings.
Quality / Reliability of Service	Quality and reliability of services provided using infrastructure are attributes that are generally valued by infrastructure users. Improvements in these dimensions will increase welfare, everything else equal.
Service Availability	Broader service availability (both across space and time) increases the options to use infrastructure services. Greater options are generally valued by infrastructure users.
Capacity Utilisation	
Environmental Performance	Negative environmental effects associated with infrastructure can reduce welfare either through effects on human health or people's intrinsic value of the environment. To the extent these are not offset by policies such as the Emissions Trading Scheme, an improvement in environmental performance increases welfare, everything else equal.



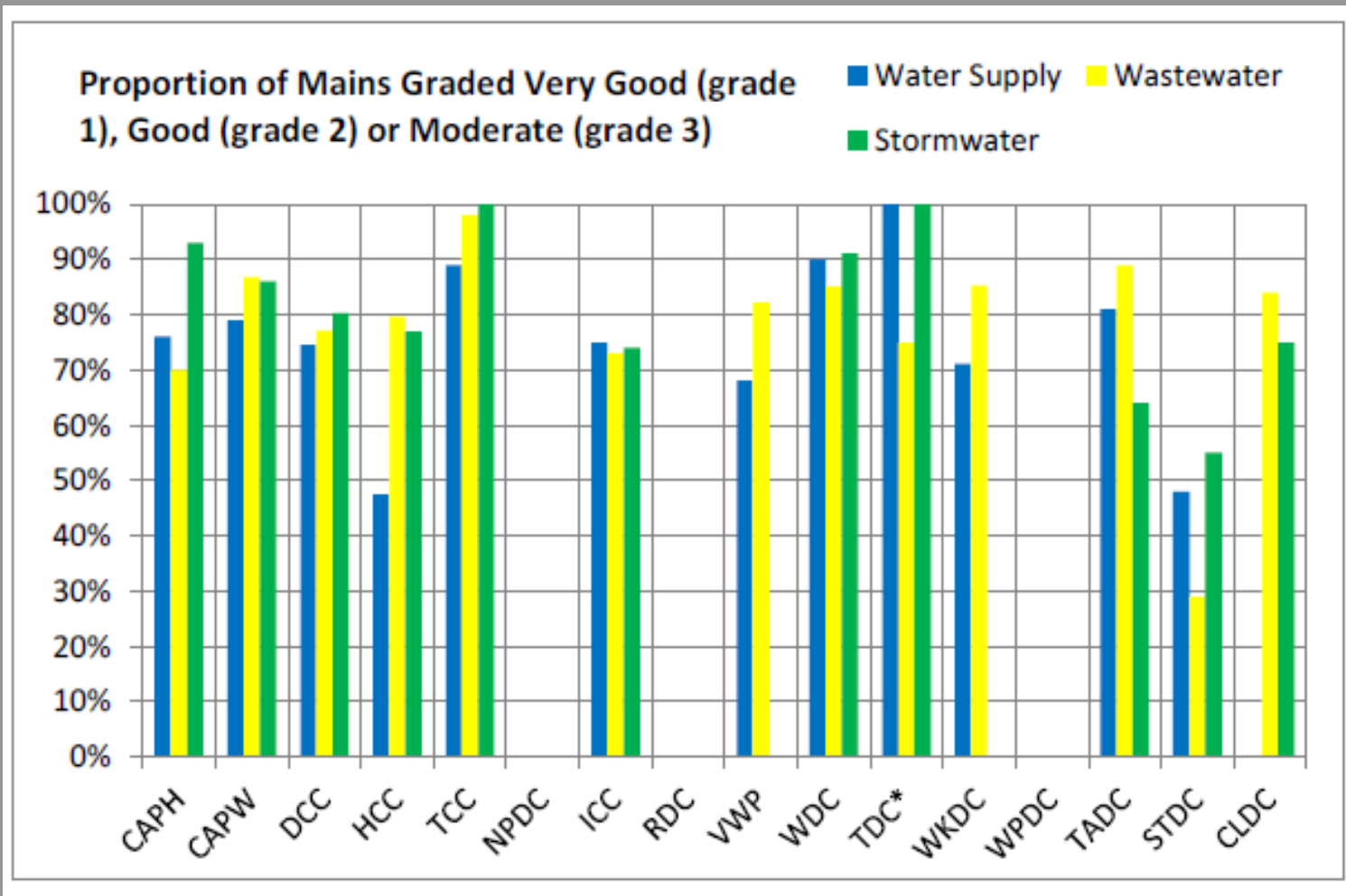
Level of Competition	The intensity of competition (in sectors such as electricity and telecommunications where infrastructure services are provided in markets) affects the prices that users face relative to costs and thus the efficiency of use of existing infrastructure.
Productivity	Productivity (ideally measured as total factor productivity reflecting the value of all inputs) reflects the output produced per unit of input. Greater productivity translates to greater welfare, as fewer scarce resources are used and can be put to alternative use.
Investment evaluation processes	Higher quality investment evaluation processes will lead to better investment decisions and therefore greater welfare generated by new investment.
ROI	Return on investment is an alternative measure of (capital) productivity that is easier to calculate in some cases as it does not require valuing all inputs. Greater return on investment should reflect higher productivity and welfare, provided it is not associated with excessive margins between prices for infrastructure services and costs of provision.
Accuracy of forecasts	Forecasts are crucial for investment decisions involving long-lived assets. Forecasts can be improved by reducing error, and most importantly by eliminating systematic biases.



# Urban water . key sources



# Water . asset condition





But ...

*“On average, less than 60% of local government and 40% of central government decision-makers were receiving regular asset condition information.”*

OAG 2013, 5.10



# Water . resilience

**Table 7. Scores against each metric for the Resilience principle, for pilot study operators**

<b>Metrics for Resilience</b>	<b>Waikato</b>	<b>Hamilton</b>	<b>Waipa</b>	<b>Taupo</b>	<b>Watercare</b>	<b>P</b>
<b>Overall score for principle</b>	Yellow	Yellow	Yellow	Yellow	Green	Green
<b>Design &amp; construction standards</b>	Green	Green	Green	Green	Green	Green
<b>Natural hazard risk assessments</b>	Red	Yellow	Red	Green	Green	Green
<b>Vulnerability assessments</b>	Red	Yellow	Red	Yellow	Green	Green
<b>Key risks: understand &amp; mitigation</b>	Red	Yellow	Yellow	Yellow	Green	Green
<b>Network resilience consideration *</b>	Yellow	Yellow	Green	Yellow	Green	Green
<b>Power outage contingency plan</b>	Green	Green	Yellow	Yellow	Green	Yellow

Note: (\*) The score for this metric was derived from scores for sub-metrics. The scores for each sub-metric are shown in Appendix C.



WSA4 - Pump Stations	13	33	29	6	11
WSA5 - Water Supply Reservoirs	24	81	58	7	21
WSA6 - Capacity of Water Reservoirs (m <sup>3</sup> )	71,577	126,502	151,000	88,200	82,076
<i>Reservoir Days of Supply</i>	<i>2.0</i>	<i>1.7</i>	<i>3.4</i>	<i>1.7</i>	<i>2.4</i>



- “ January: publish evidence base
- “ Feb/March: engagement/discussions/refining
- “ April . Dec: What does it mean  
Developing response options
- “ Bring together into 2015 National Infrastructure Plan





## *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*



# NZ features

- “ Isolated . long way from markets
- “ Heavily dependent on primary products
- “ More urbanised than France and Germany
- “ Challenging geography
- “ Hazardous





# In the face of:

- rapid changes
- hazards

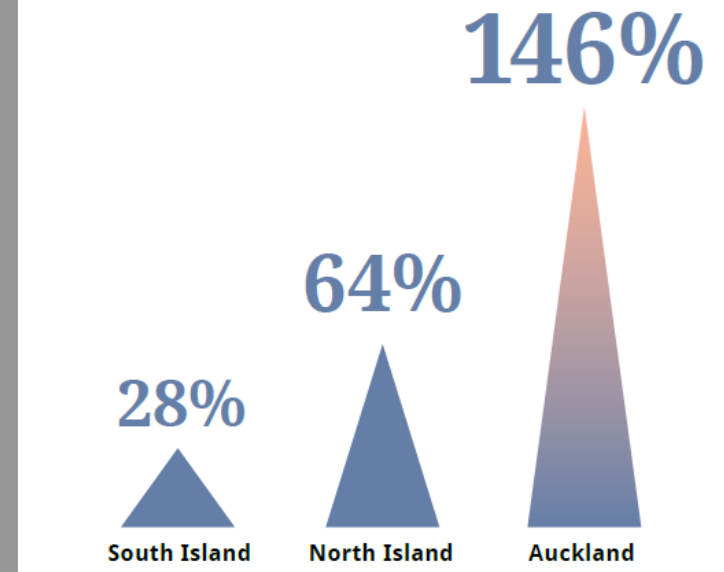
## Hazards to infrastructure:

- natural,
- socio-natural, or
- technological

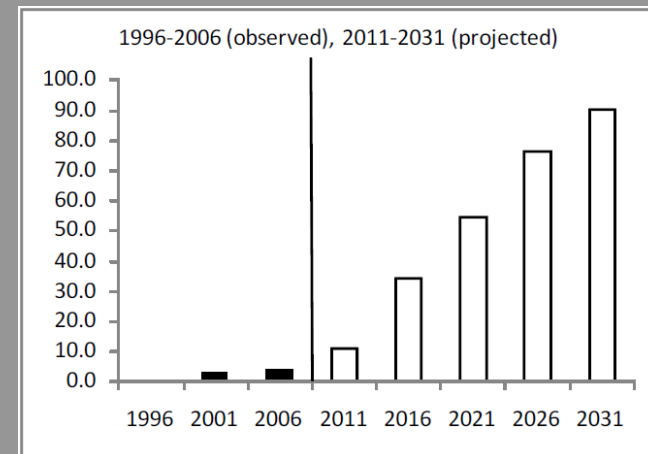
## Viewed against:

- short term change (shock, unexpected events), and
- long term, more gradual change or stresses.

New Zealand population increase 1971-2011



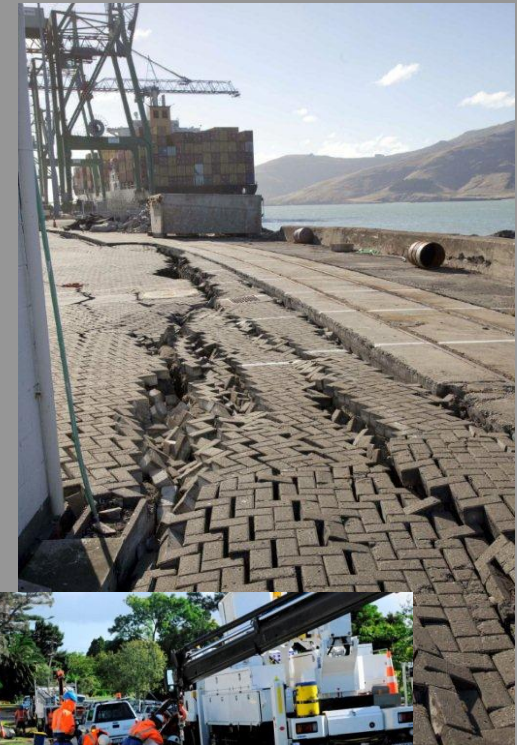
Percentage of territorial authorities with more elderly than children



Source: Jackson, Natalie, *The demographic forces shaping New Zealand's future. What population ageing [really] means*

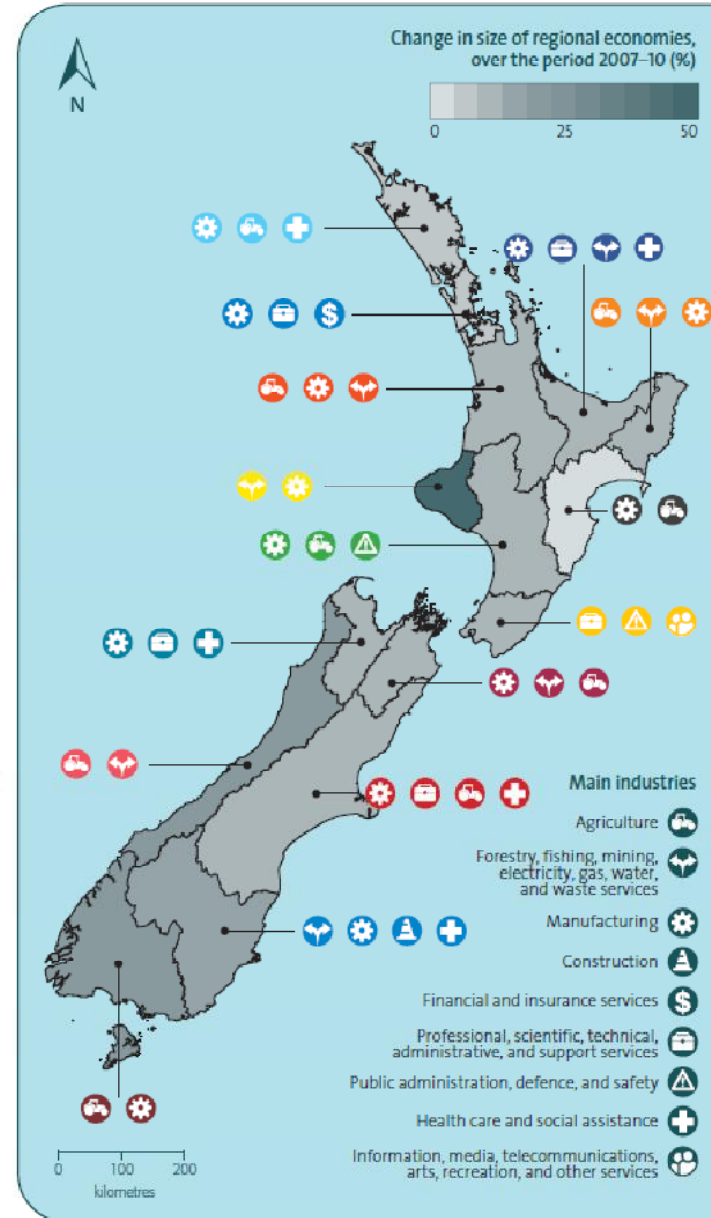
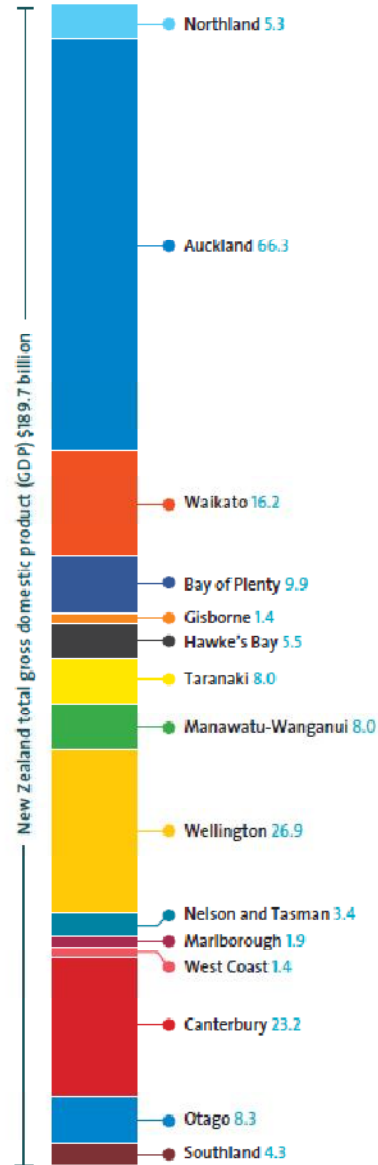
# Home Truths ÷

- “ Infrastructure fails
- “ New Zealand is hazardous
- “ 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



# New Zealand's regional economies

GDP by region for the year ended March 2010, \$(billion)



# National Risk Matrix – Summary for NZ

Relative Likelihood

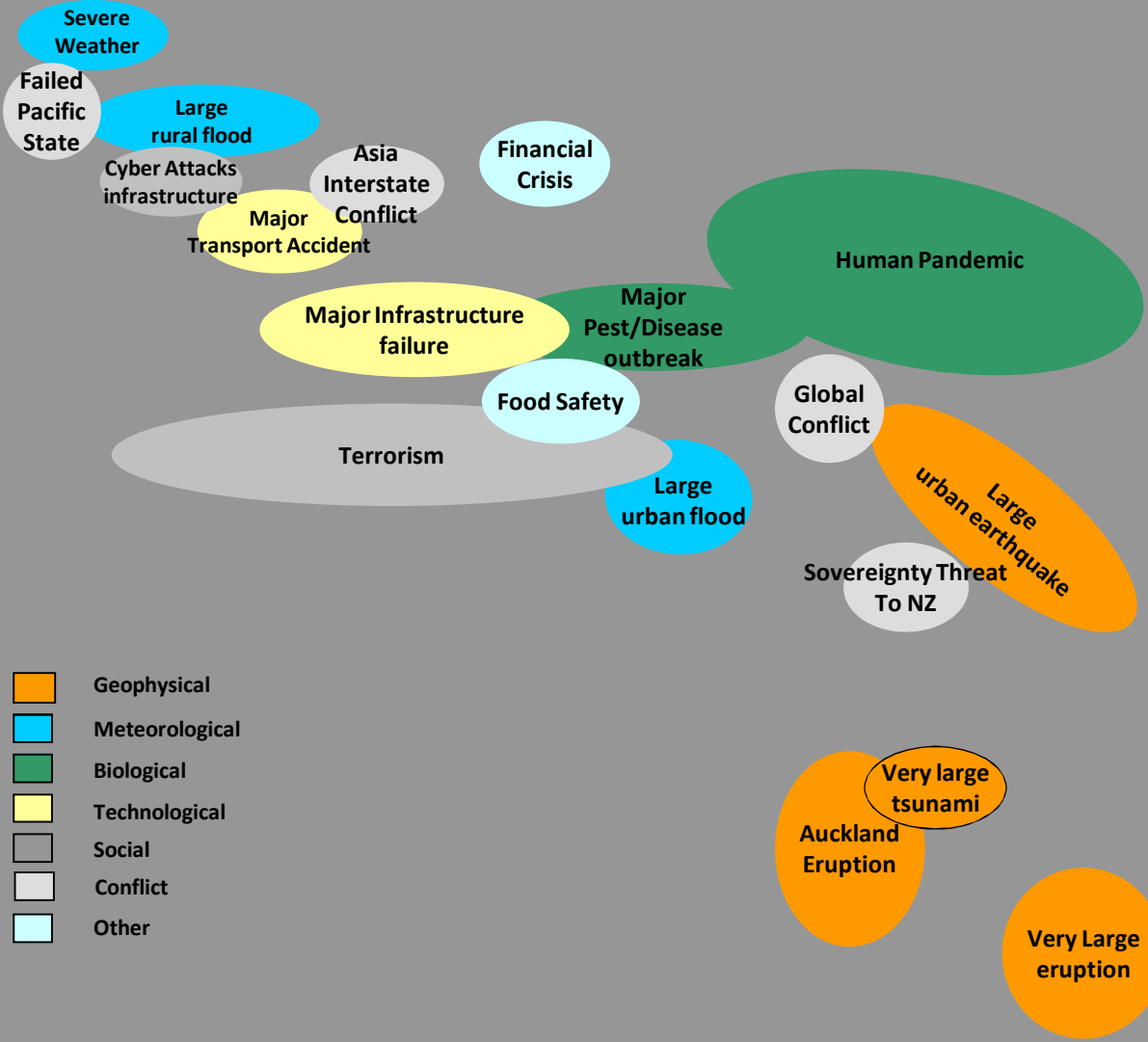
At least once a Year

At least once a Decade

At least once a Century

At least once a Millennia

Cyber Attacks Data Confidentiality



- Geophysical
- Meteorological
- Biological
- Technological
- Social
- Conflict
- Other

Minor

Moderate

Major

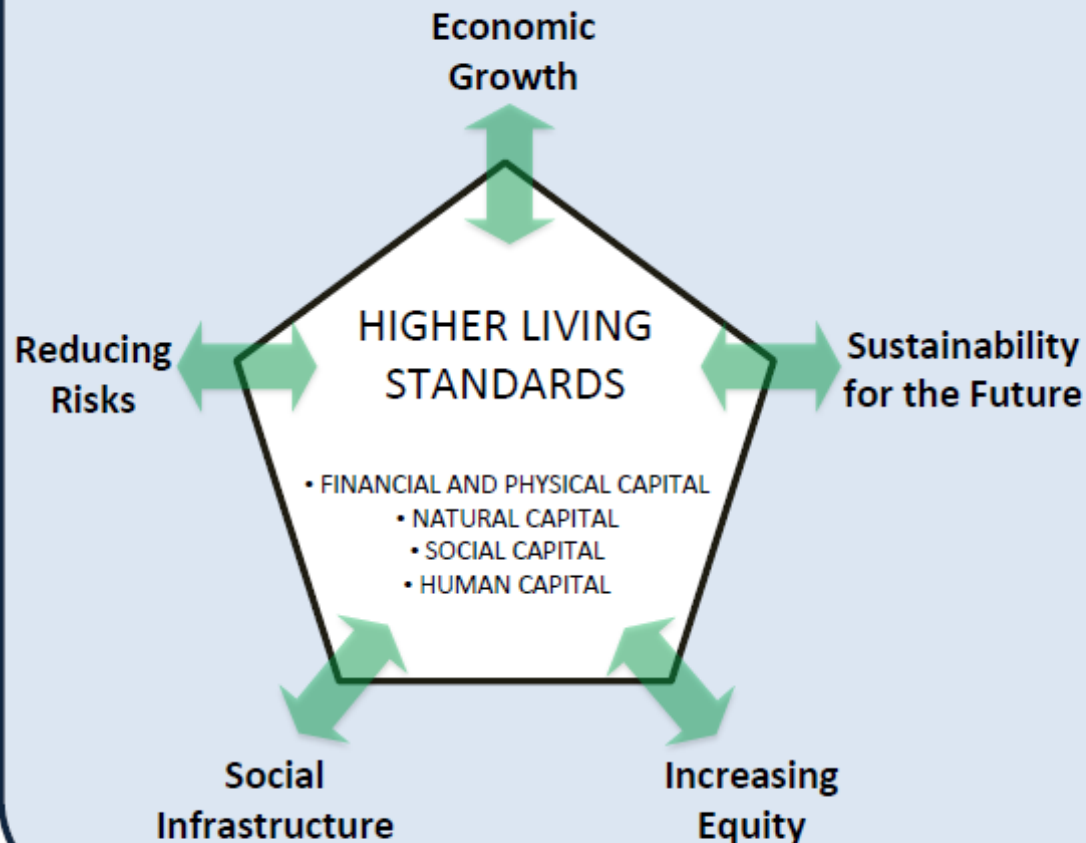
Catastrophic

Relative Consequences



# LIVING STANDARDS: THE HEART OF OUR POLICY ADVICE

Assess the impact of policy across key living standards dimensions



## Economic Growth

- Does this improve the opportunities or incentives for higher incomes or greater economic growth?
- Does this remove obstacles that hinder resources moving to their most efficient use, or enhance the ability of people to take up new opportunities?

## Sustainability for the Future

- Does this impact on the capital stocks for future use (e.g. physical capital, human capital, or the sustainability of the environment)?

## Increasing Equity

- Does this impact on the distribution across society (both intra and intergenerational)?
- Does this improve opportunities for people to improve their position?

## Social Infrastructure

- Does this impact on core institutions that underpin our society (e.g. trust in the rule of law, democracy, Crown-Māori relationship, cultural identity)?
- Does this impact on the trust and connections between people?

## Reducing Risks

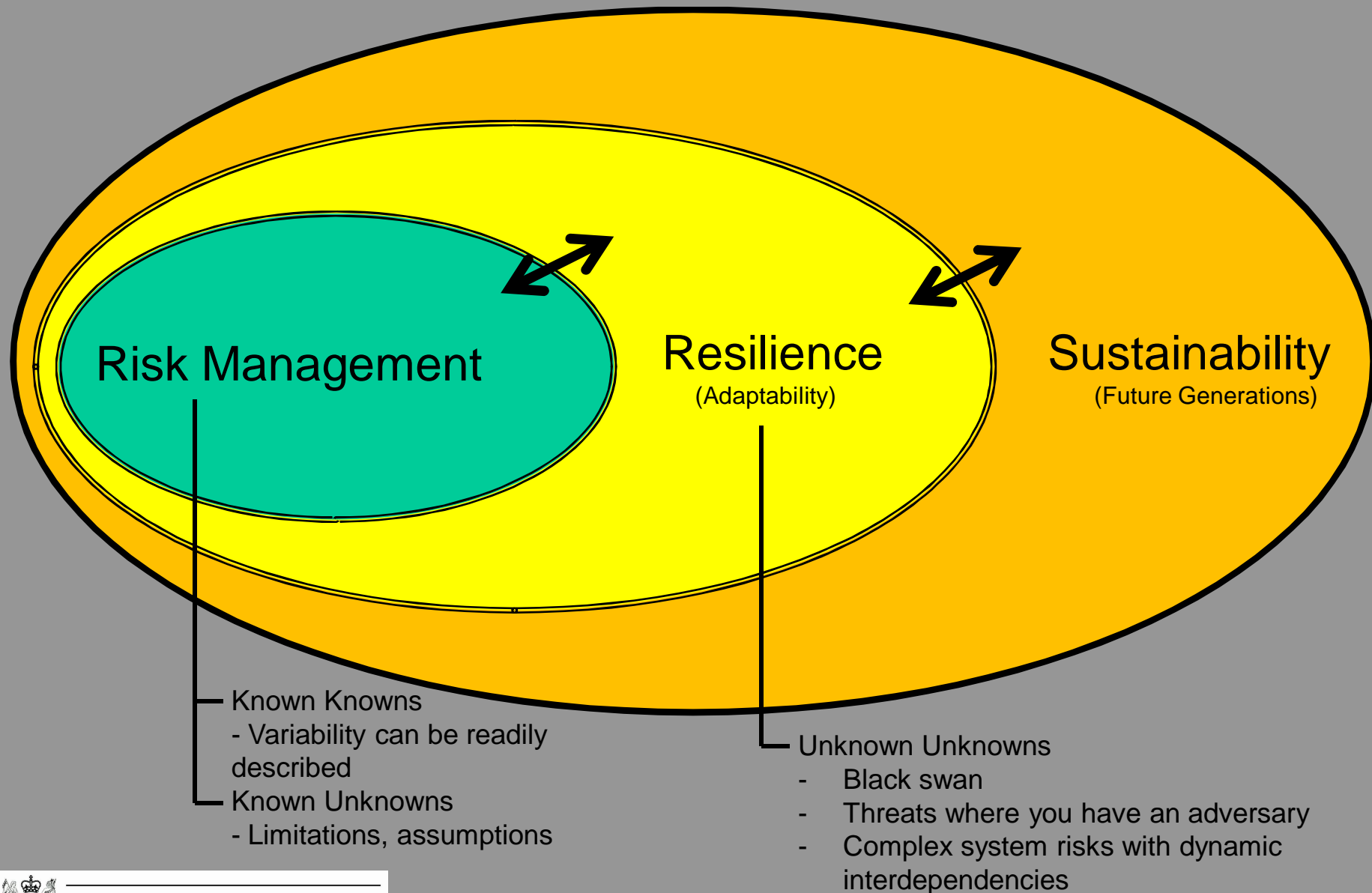
- Does this impact on NZ's ability to withstand unexpected shocks?
- In particular, does this impact on our macro-economic position (debt, deficits, inflation etc)?

Considering these five key aspects when developing your policy advice will ensure that Treasury consistently embeds Living Standards in our advice. It is an adjunct to, not a replacement for, a good evidenced-based process for developing free and frank advice. Need help or more information? See Girol Karacaoglu.



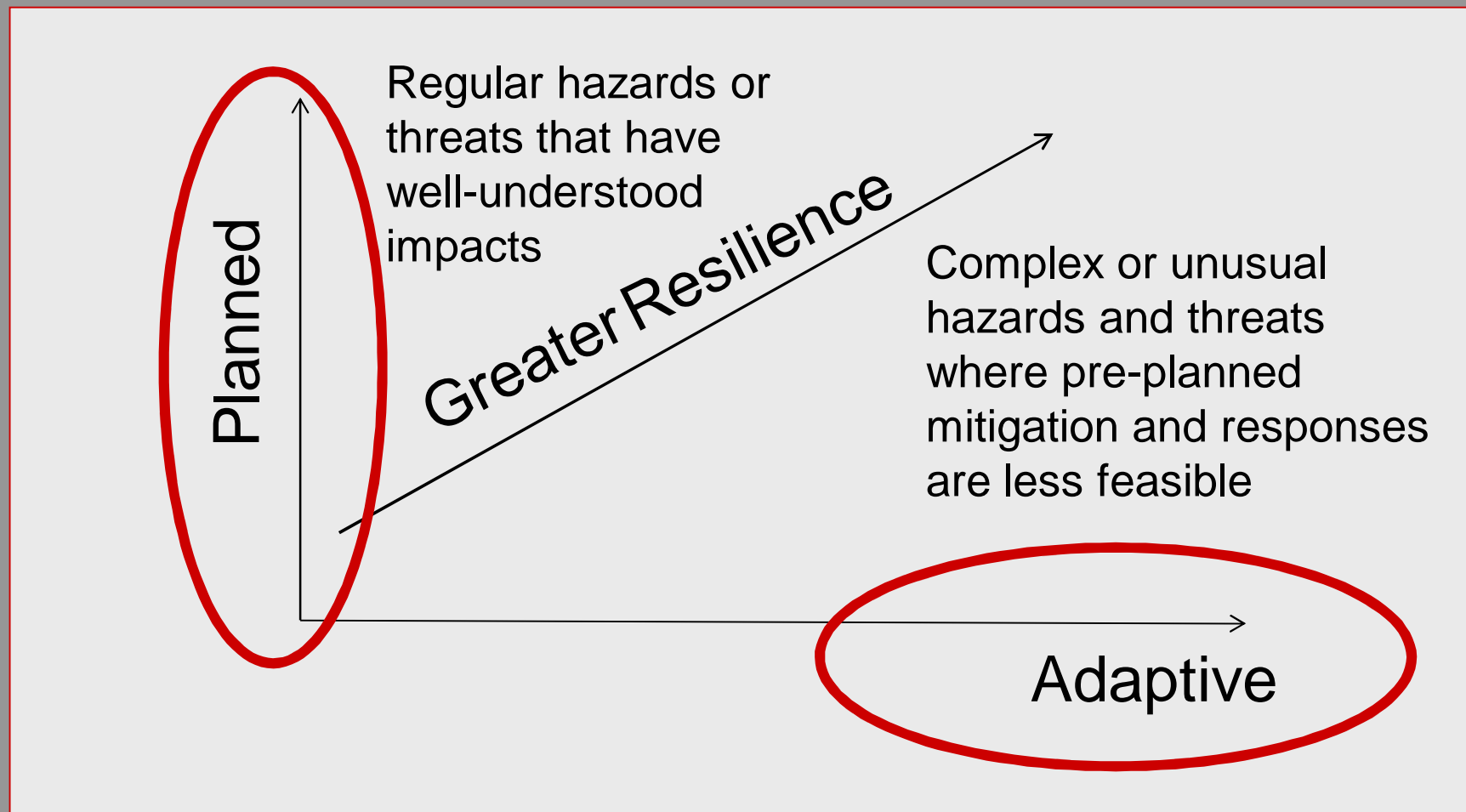
# Risk, Resilience and Sustainability ÷ ..

(Linking to Treasury's Living Standards Framework)





# Planned and adaptive capacities ÷ .





# The Quest for Resilience

- “ Strategic resilience is not about responding to a onetime crisis. It's not about rebounding from a setback.
- “ It's about continuously anticipating and adjusting to deep, secular trends that can permanently impair the earning power of a core business.
- “ It's about having the capacity to change before the case for change becomes desperately obvious.

(Hamel & Välikangas, 2003)





# 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 ò ò

Not all elements of infrastructure require high resilience

All infrastructure sectors have vulnerabilities

Infrastructure systems can not guarantee supply of services at all times

Indicators, Pinchpoints and Hotspots



(<http://www.infrastructure.govt.nz/>)

# Transport

Resilience Expectation

Assessed Resilience



		Resilience Expectations	Assessed Resilience	Desired Movement	Indicator Sources/Points of Assurance Transport global : Transport Monitoring Indicator Framework (TMIF) Best Practice Asset Management Plans eg. PAS 55 or IIMM 2011 Business Continuity Management eg. Standards NZ BCM Annual Financial Reports Resilient Organisations Practices
Local Roads	Suburban	Low	Low		Desired Movement
	Main arterial with alternate	Medium	Medium		
	Main arterial . no alternate	Medium	Medium		
	Strategic freight routes	High	Medium	↑	
National Roads	National with alternate	Medium	Medium		
	National . no alternate	High	Medium	↑	
Road/Rail Link Span	Cook Straight ferries & terminals	Medium	Medium		
Rail	Suburban (incl .rolling stock)	Medium	Low	↑	
	National (incl. rolling stock)	High	Medium		
	National Train Control Centre	High	Low	↑	
Ports	Individual Ports	Medium	Medium		Compliance International Ship and Port Security Code
	Ports with specialist facilities	High	Medium	↑	Compliance International Ship and Port Security Code
	Ports Network	High	Medium	↑	Compliance International Ship and Port Security Code
Airports	Regional airports	Medium	Medium		
	Airways NZ	High	High		
	International airports	Medium	Medium		



## **Pinchpoints** (Nationally Significant)

- “ **Northland**
  - . New Zealand Refining Company (NZRC)
- “ **Auckland**
  - . Ports of Auckland
  - . Auckland International Airport
- “ **Wellington**
  - . Avalon Tower, Lower Hutt
  - . Wilton Substation
  - . Central Park Substation
- “ **Canterbury**
  - . Wastewater Treatment Plant & ocean outfall
  - . Cass Peak air traffic control radar installation
- “ **Otago**
  - . Dunedin Fuel Terminal

## **Hotspots** (Nationally Significant)

- “ **Auckland**
  - . Wiri Oil Terminal
  - . Auckland Harbour Bridge
  - . Greenlane Roundabout
  - . Newmarket viaduct
  - . Grafton Gully
- “ **Wellington**
  - . Thorndon / Kaiwharawhara
  - . Seaview
  - . Haywards
  - . Paekakariki / Pukerua Bay
- “ **Canterbury**
  - . Lyttelton Road Tunnel and control centre
  - . Ferrymead Bridge
  - . Timaru Port & Tank Farm



# Work Programme

## “ Coordination

- . Cross government agency
- . Climate change adaptation
- . Best practice guidelines

## “ Economic/Financial

- . Banks, financiers, insurers
- . Seeking exemplars
- . Economic modelling

## “ Indicators

- . Develop evidence base; MoT, MBIE et al
- . Hotspots & Pinchpoints
- . Sector priorities

## “ Regional/Community

- . Lifelines
- . Regional vulnerability mapping
- . Service restoration times

## “ Research

- . Encourage resilience related research
- . Interdependencies, economics, water, ports
- . Some parts of infrastructure more important

## “ Outreach

- . LGNZ, Lifelines, Resilience conferences
- . Engage with private sector, consultants
- . NIU newsletter

## Examples of recent activities

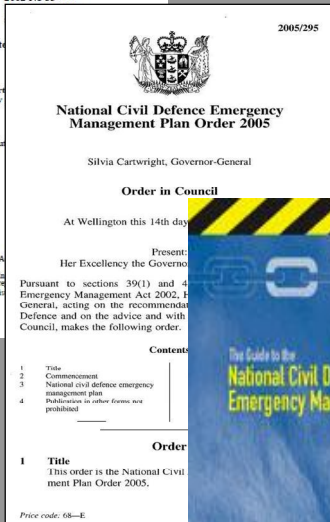
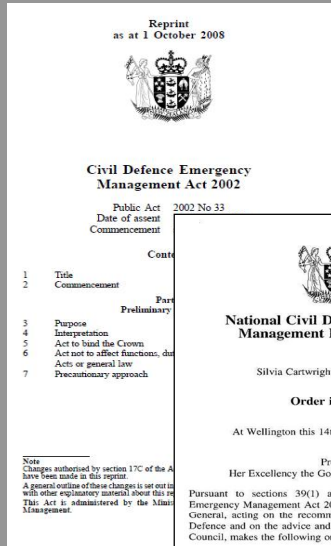
- ó Joint Resilience Operating Framework (KiwiRail, Transpower and NZTA)
- ó Measuring resilience of transport (NZTA lead)
- ó Oil security (MBIE lead)
- ó Gas security (MBIE lead)
- ó Lyttelton Recovery Plan (CERA lead)
- ó Update of CDEM Directors Guide (MCDEM lead)
- ó International cables (MBIE lead)
- ó TA Emergency Management Offices and Lifelines (Auckland, Wellington, Canterbury, Bay of Plenty, Otago, Southland, ō .)
- ó Joint NIU, Natural Hazards Research Platform, Lifelines and University of Canterbury Interdependencies workshops planning for early December





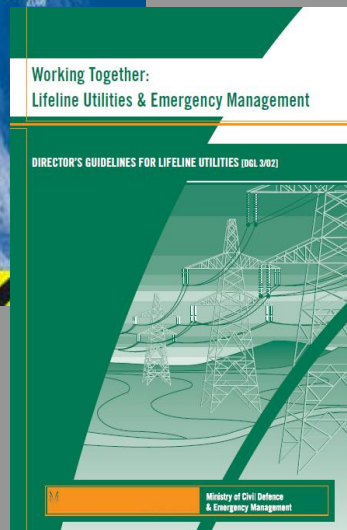
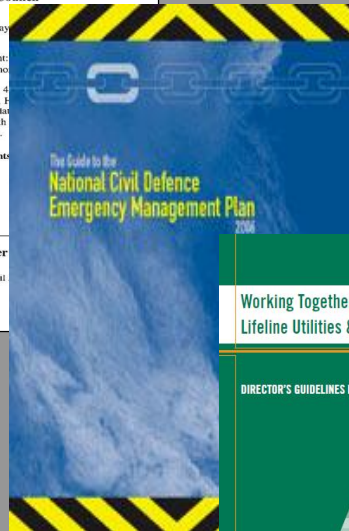
# Advancing Interdependencies: CDEM & Lifelines

CDEM Act 2002



National CDEM Plan Order 2002

Guide to the National CDEM Plan

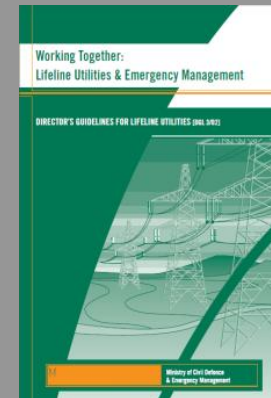


Director's Guideline for Lifeline Utilities



# Civil Defence Emergency Management Act 2002

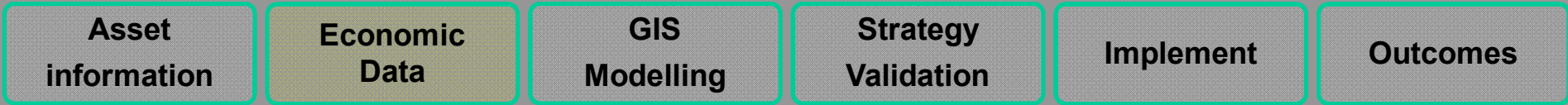
- “ Schedule 1 Lifeline utilities,
  - Part A specific entities (airports, ports, radio, television),
  - Part B certain businesses (gas, electricity, water, waste water, stormwater, roads, fuel, rail)
  
- “ Section 59 Every department, Civil Defence Emergency Group, local authority, emergency service, and lifeline utility, and
  
- “ Section 60 Duties of lifeline utilities; ability to function, participate, provide technical advice



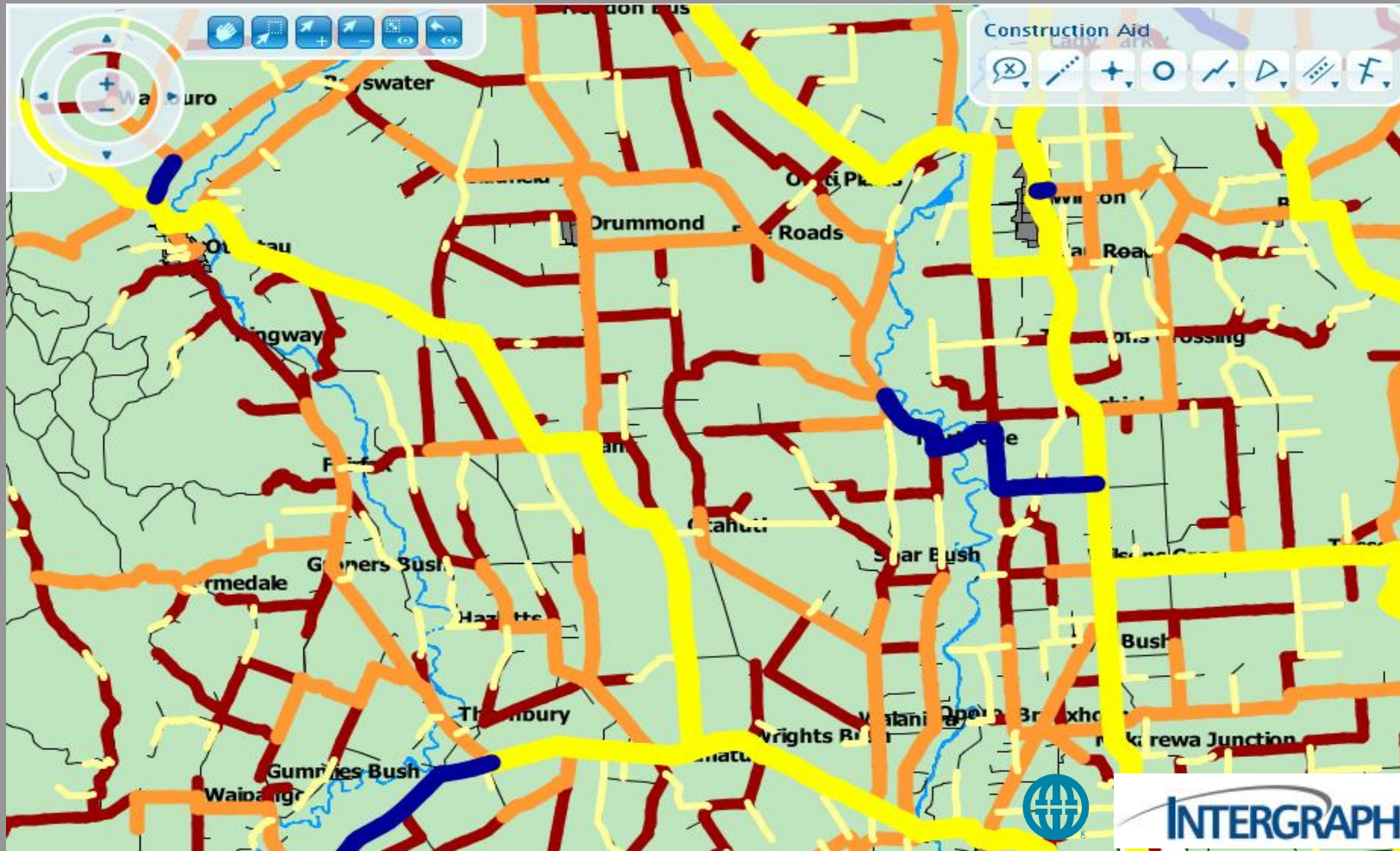
Guideline issued by the Director of CDEM. Provides guidance to LU's on how to meet their obligations under the CDEM Act



# Financial resilience: Southland

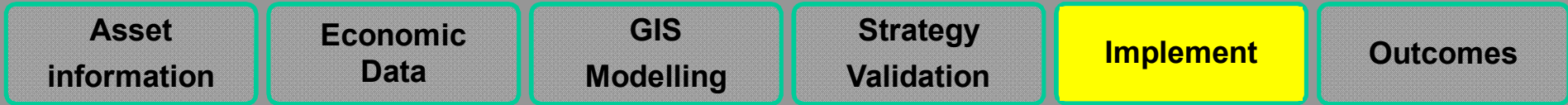


Export flow





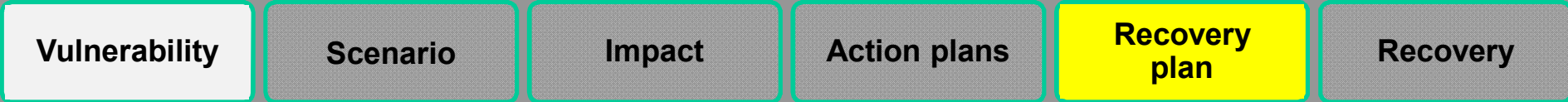
# Financial resilience: Southland



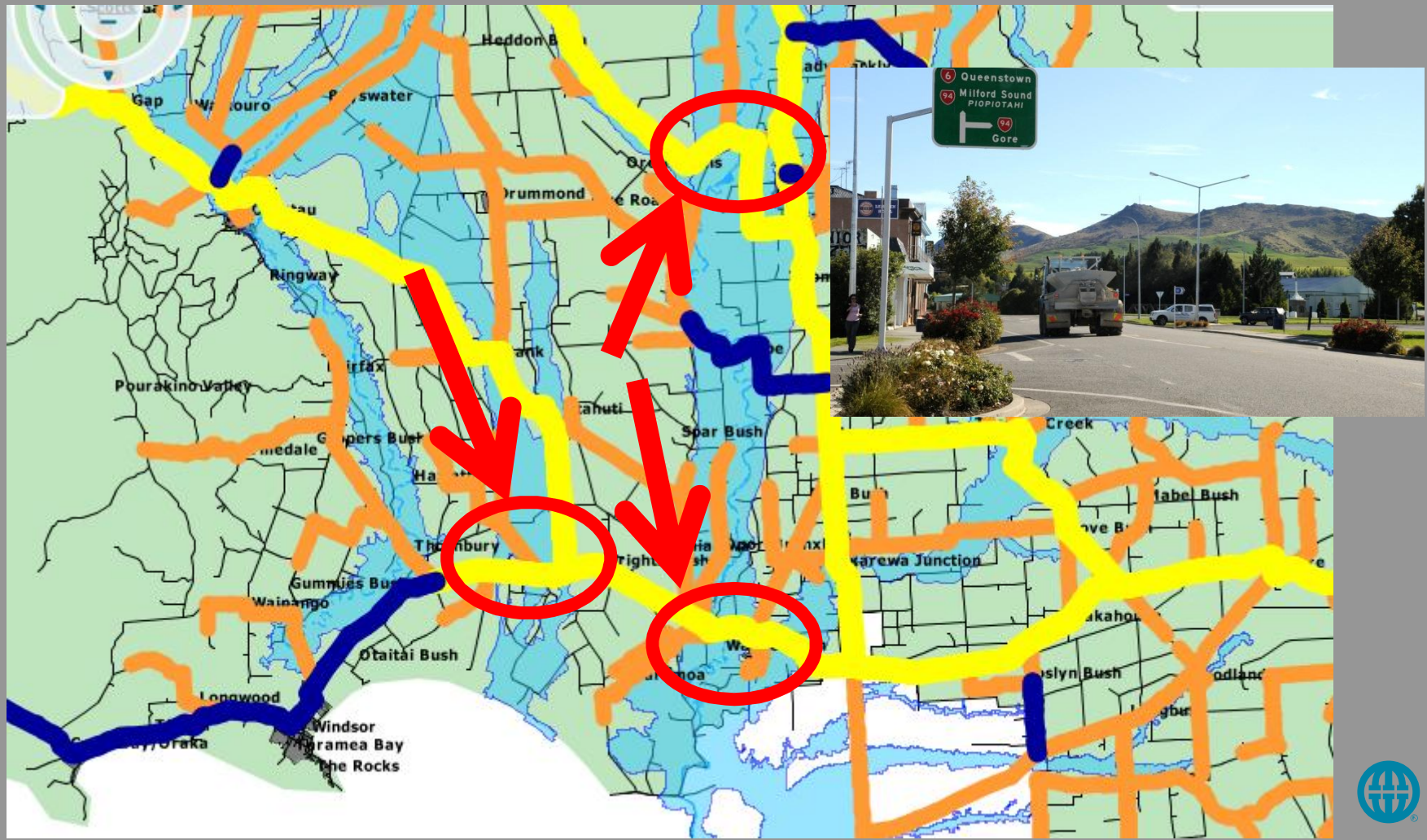
Opportunities



# Event resilience: Southland



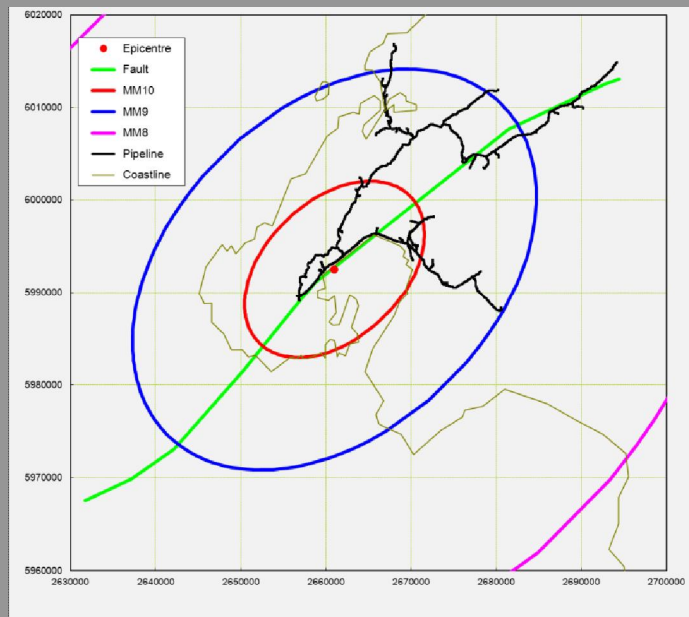
Re-route tankers







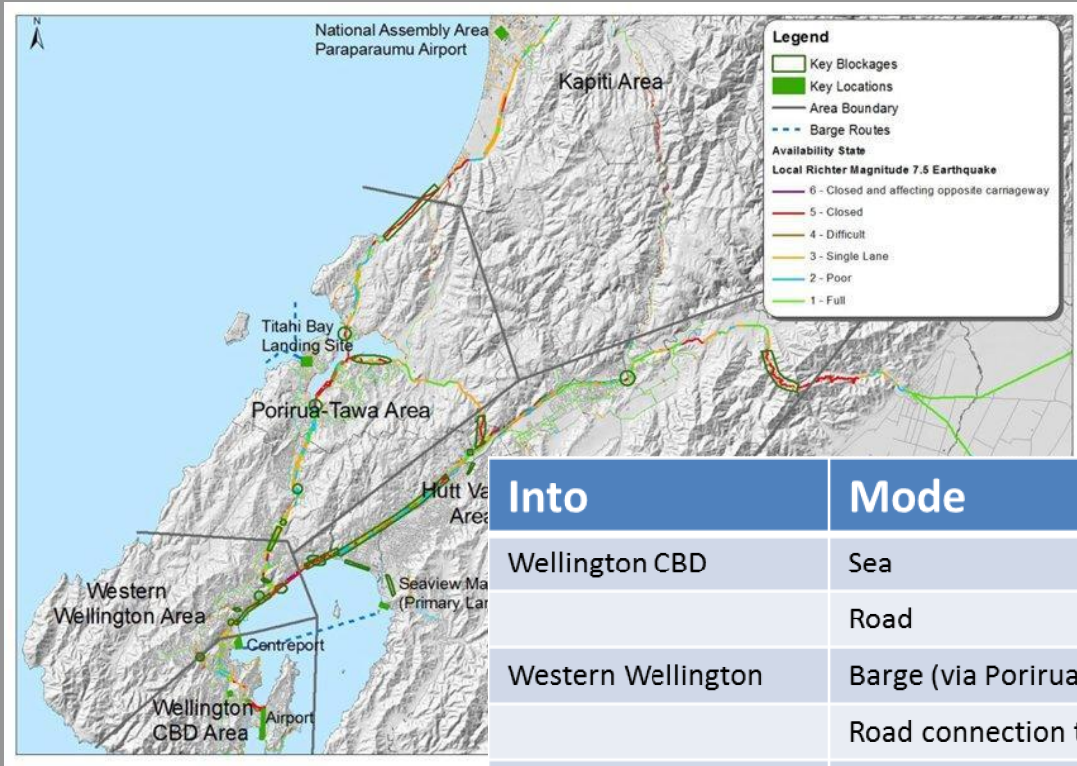
# Lifeline Utilities Restoration Times



	Gas restoration time (days)	Power restoration time (days)	Water restoration time (days)
Hutt Central and Western Hills	80	60	25/40
Porirua, Mana, Plimmerton and Pukerua Bay	60	40	75
Northern /Western Wellington suburbs	60	60	45/55
Wellington CBD	80	95	55
Airport and Eastern Wellington suburbs	80	60	70



# Restoring Wellington's transport links



Into	Mode	Time
Wellington CBD	Sea	4-5 days
	Road	120 days
Western Wellington	Barge (via Porirua)	5-7 days
	Road connection to Porirua and Tawa	3 weeks
Porirua	Barge	5-7 days
	Road connection to the Wellington CBD area	3 weeks
Lower Hutt	Barge	5-7 days
	Road connection to the Wellington CBD area	8-10 weeks
Upper Hutt	Road connection to Lower Hutt	3 days to 2 weeks
Kapiti	Road connection to the Upper North Island	1-4 days





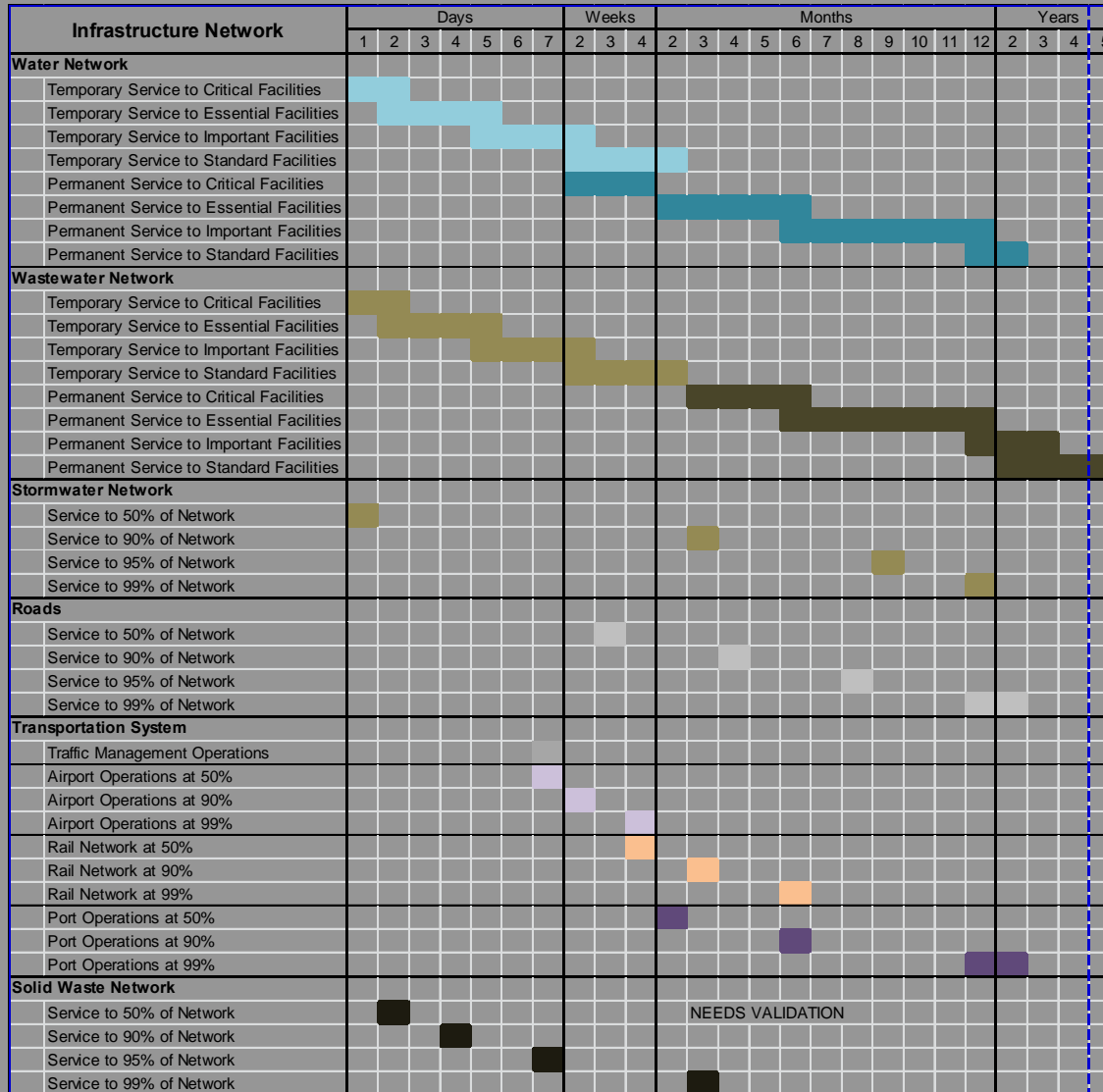


**Damaged:**  
 528 km of waste water network  
 Need to rebuild or replace 100+  
 sewer pumping stations

Hazard	Probability	Magnitude
Seismic	See next page	Varies
Flood	1:50 yr (Building Act) 1:200 yr (Local) 1:500 yr (Regional)	As modelled
Tsunami	1:100yr 1:500yr	~2 m ~4 m
Coastal Erosion & Storm Surge	1:10-15 yrs	Significant
Landslide & Rockfall	Exposure to seismic activity, rainfall etc.	n/a
Wind	1:150 yr	130 km/h (gusts to 200 km/h)
Snow	Low	n/a
Changing Sea Level	~ next 80-90 yrs	0.5 m (0.8 m)
Volcanic	Very Low	n/a
Drought	n/a	n/a
Other (Natural or Man-made, instant or gradual)	n/a	n/a

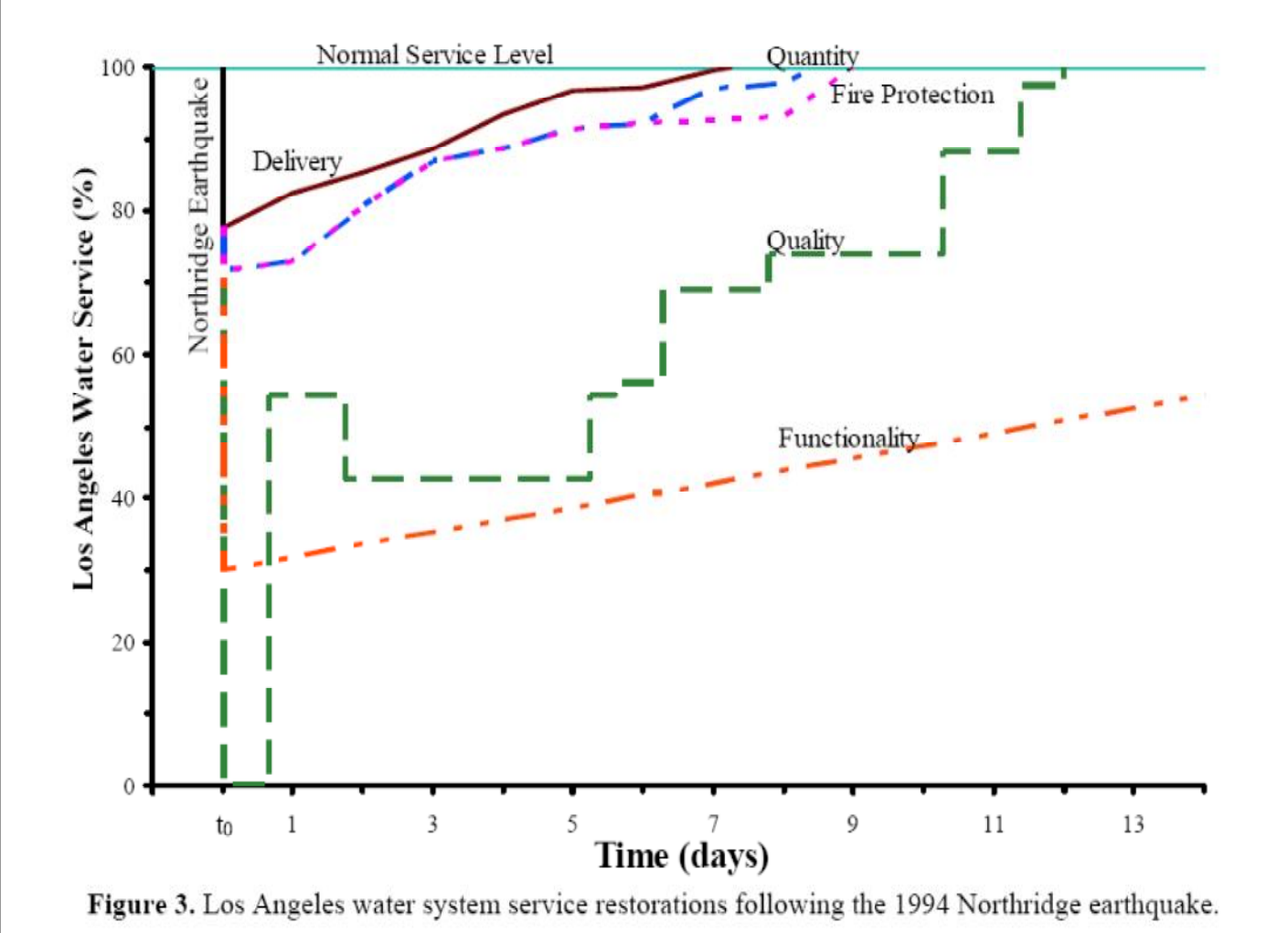


# Service Restoration Times



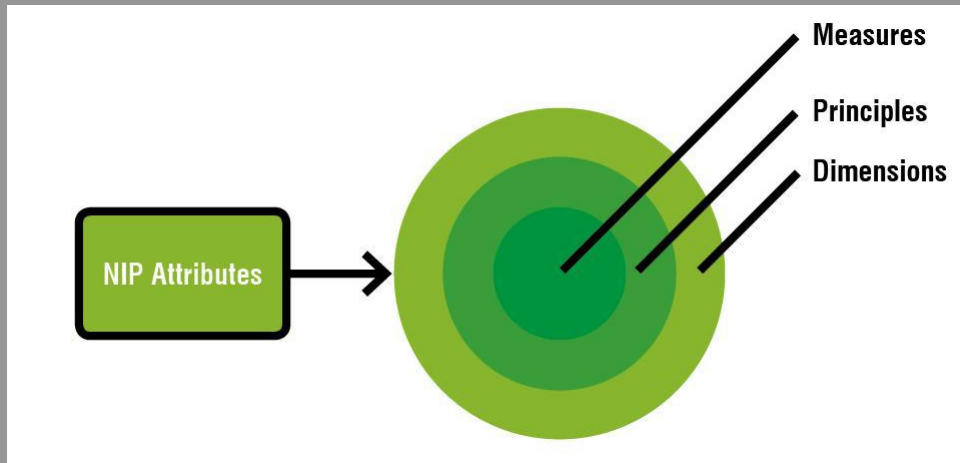
- “ **Critical Facilities**
  - “ includes emergency response
- “ **Essential Facilities**
  - “ includes lifelines infrastructure (MESHT)
- “ **Important Facilities**
  - “ includes high priority facilities and infrastructure
- “ **Standard Facilities**
  - “ includes everything else,
  - “ including residential dwellings.

# Service Restoration Times



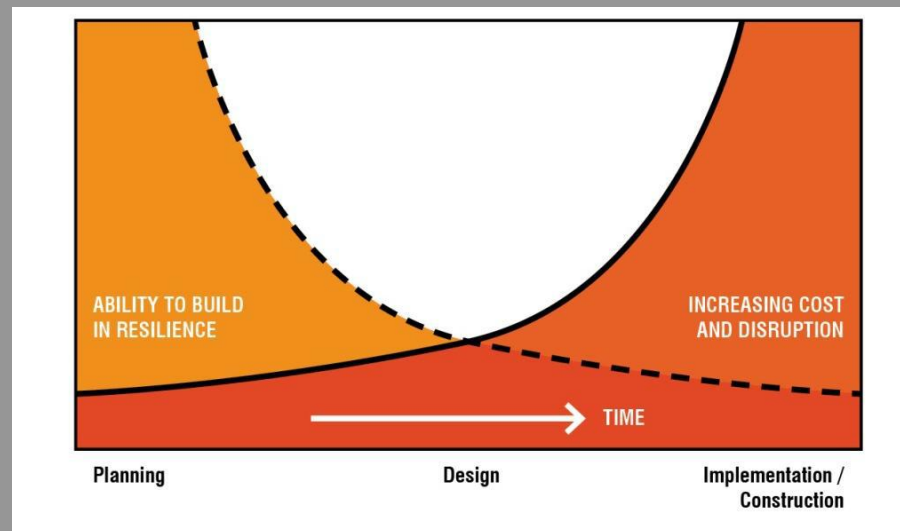
# Measuring Resilience

Relationship between NIP Attributes, and Dimensions, Principles and Measures of Resilience



Ability to build in resilience into planning and design

NZTA Research Project: Measuring the Resilience of Transport Infrastructure, AECOM 2013 (Work in progress)



# Game Changers ÷ .

- “ Regional Vulnerability Assessments (TA~~s~~ and Lifelines)
- “ Community engagement
- “ Champions of resilience; business leaders, political leaders, ÷ .
- “ International thought leaders
- “ Resilient organisations ([www.resorgs.org.nz](http://www.resorgs.org.nz) )
- “ Lead global thinking (theory & practice)
- “ Create/maintain options (option value)
- “ Vulnerability awareness (National Security System, global supply chains)
- “ Interdependencies (opportunities, cascade failures, multi-hazards, ÷ )



# Game Changers ÷

- “ Re-mobilise lifeline utility operators (responsibilities under CDEM Act)
- “ Challenging current paradigms (why networks?, safe-to-fail, low damage, ÷ )
- “ Outreach
- “ Denser urban forms (distributed cells)
- “ Targeted base & applied research
- “ Research translators (research to practice)
- “ Opportunities through policy



# From you

- “ Engage with us
- “ Articles/exemplars of good practice/innovation . share the news!
- “ Recognise the threat . advocate and work together - take the opportunity



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