

Infrastructure Resilience

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Key messages ...

... current infrastructure
resilience projects

... why is it important

... relationship to natural
hazards

... gap filling



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Projects:

- considerable breadth
- number of collaborations

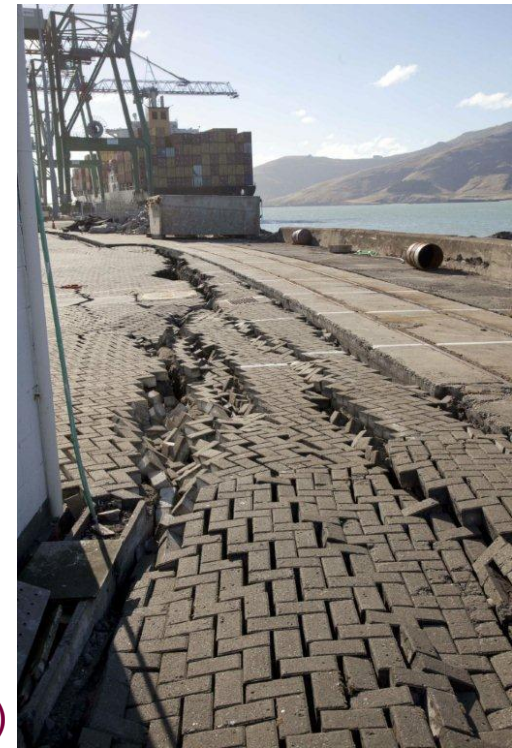
- Bridge performance (Eng)
- Resilient urban futures
- Economics of resilient infrastructure
- Liquefaction impacts on pipe networks (Geotech)
- New Zealand climate changes, impacts and implications
- Seismic response of underground services
- Resilient Infrastructure through effective organisations
- Tsunami impacts on ports & harbours (Geol Haz / Eng)
- Faster rebuilds following volcanic event (Social)
- Wind speed hill shape multiplier (Eng)



Projects (Cont):

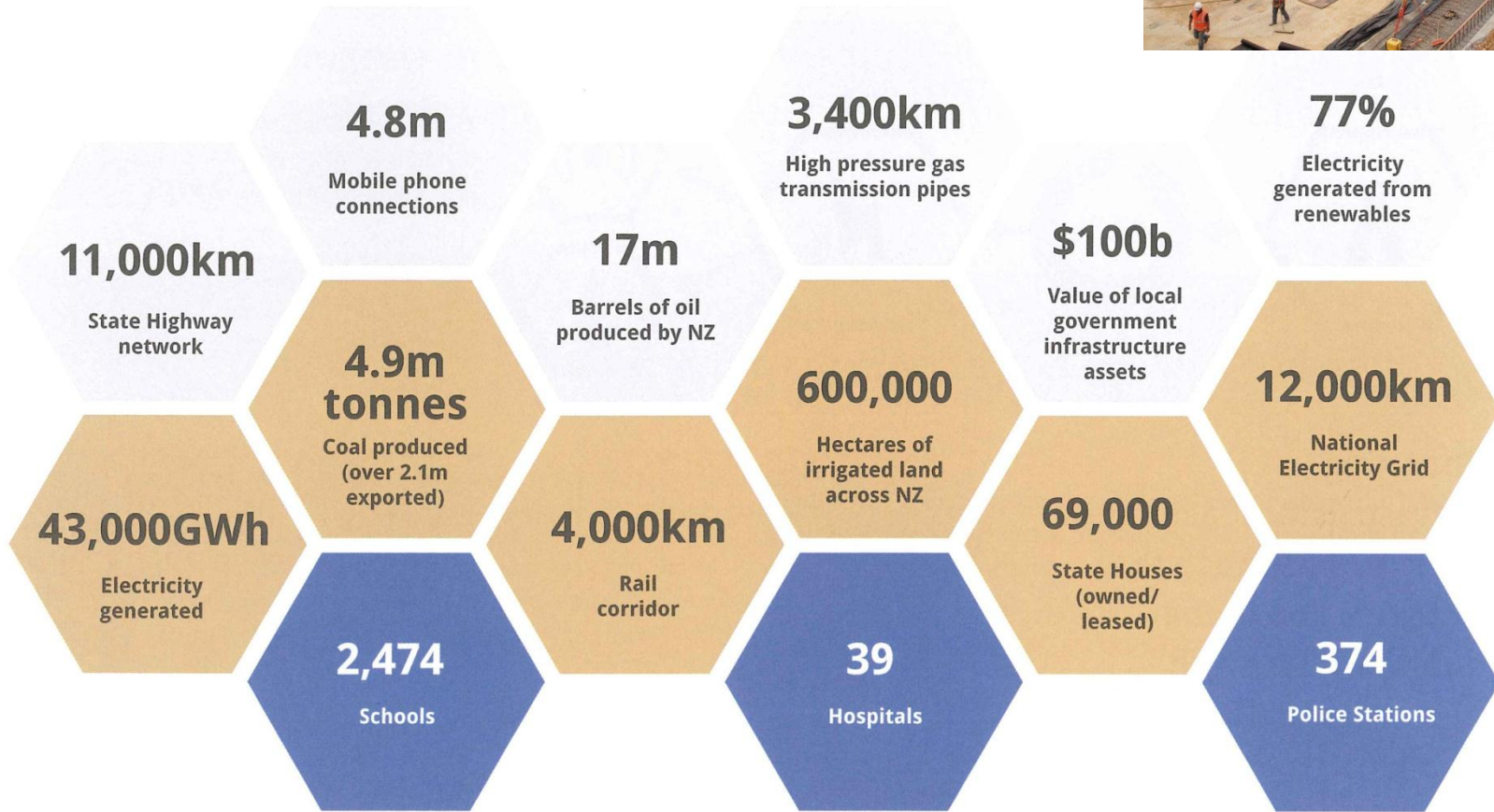
- considerable breadth
- number of collaborations

- Coastal processes & forecasting (Weather)
- Riskscape (Risk)
- Hazards exposure, impacts and vulnerability (Risk)
- Interdependencies of critical lifelines and infrastructure (Eng)
- Impacts of infrastructural damage (Eng / Social)
- Resilience of NZ coastal infrastructure to natural hazards (Eng)
- Seismic Response of NZ bridges (Eng)
- Advanced Bridge Construction & Design (Eng)
- Volcanic impacts ... disruption to critical infrastructure (Social)
- Organisational Resilience (Social / Res Orgs)



Why is it important?

- New Zealand's infrastructure



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NATIONAL INFRASTRUCTURE UNIT ⁿ



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.

146%

28%

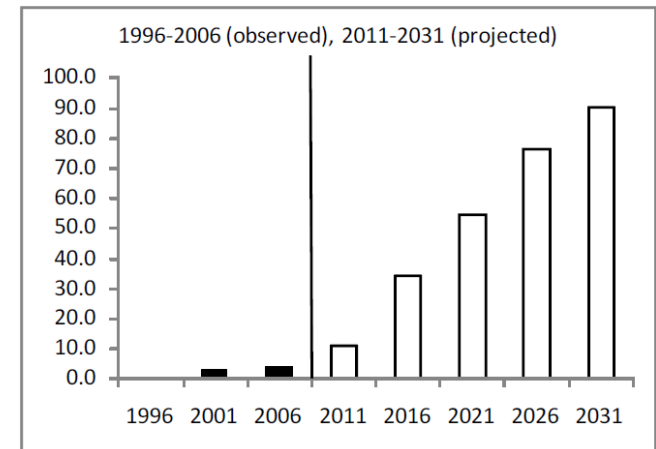
64%

South Island

North Island

Auckland

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*

National Infrastructure Plan 2011



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

Better use of existing infrastructure

... Getting more from the current stock of infrastructure is about looking at how assets are used, identifying opportunities for improved management, finding better ways of managing demand and ensuring users' expectations are understood.

Higher Living Standards Framework
Better Business Cases
National Security System

(<http://www.treasury.govt.nz/abouttreasury/higherlivingstandards>)
(<http://www.infrastructure.govt.nz/publications/betterbusinesscases>)
(<http://www.dpmc.govt.nz/node/930>)

Better allocation of new investment

New Zealand needs to be smarter about investing in new infrastructure. The Government will prioritise investment where there are adequate returns and these are underpinned by robust analysis through a well understood and transparent process.

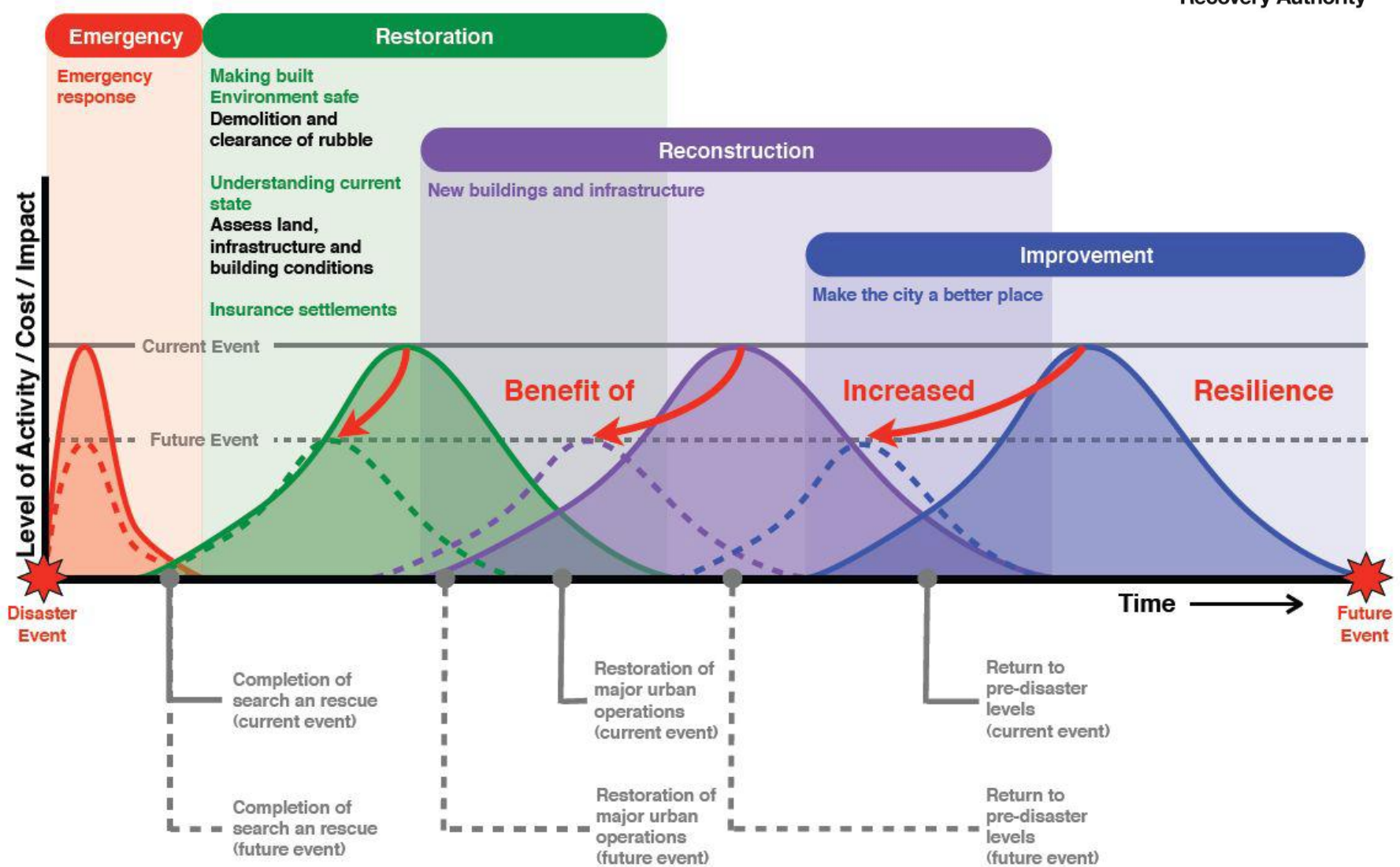
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Benefit of Increased Resilience



Not all elements of
infrastructure require high
resilience



Infrastructure systems can
not guarantee supply of
services at all times

Indicators, Pinchpoints and
Hotspots

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Example Only (<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	-	

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Water



		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
	Lakes	Low	Low	-	
	Rivers	Medium	Medium	-	
Rural Water	Irrigation	Low	Medium	-	
	Reticulation	Medium	Low	↑	
Urban Water	Private laterals	Low	Low	-	
	Street	Medium	Medium	-	
	City mains	High	Medium	↑	
	Reservoirs	High	Medium	↑	
Urban Wastewater	Private laterals	Low	Low	-	
	Street	Medium	Medium	-	
	City mains	High	Medium	↑	
	Treatment facilities	High	Medium	↑	
Urban Stormwater	Private laterals	Low	Low	-	
	Street	Medium	Medium	-	
	City mains	High	Medium	↑	
	Discharge	High	Medium	↑	

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

Interdependencies



		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
Transport	Telco	High	High	-	
	Energy	Medium	High	↑	
	Water	Low	High	-	
	Social	Low	High	-	
Telco	Transport	Medium	High	↑	
	Energy	High	Low	↑	
	Water	Low	High	-	
	Social	Low	High	-	
Energy	Transport	High	High	-	
	Telco	Medium	High	↑	
	Water	High	High	-	
	Social	Low	High	-	
Water	Transport	High	High	-	
	Telco	Medium	High	↑	
	Energy	Medium	High	↑	
	Social	Low	High	-	
Social	Transport	High	High	-	
	Telco	Medium	High	↑	Health only
	Energy	Medium	High	↑	Health only
	Water	Medium	High	↑	Health only

Pinchpoints – Nationally Significant

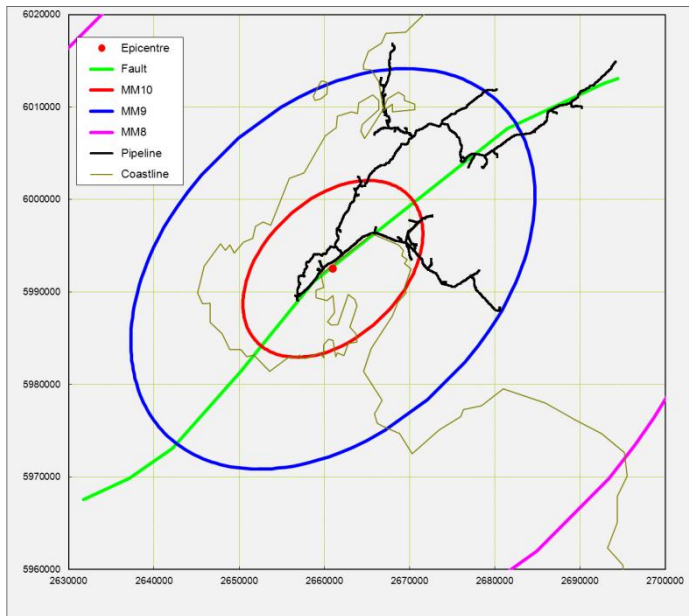
- **Northland**
 - New Zealand Refining Company (NZRC)
- **Auckland**
 - Ports of Auckland
 - Auckland International Airport
- **Wellington**
 - Avalon Tower, Lower Hutt
 - Wilton Substation
 - Central Park Substation
- **Canterbury**
 - Wastewater Treatment Plant & ocean outfall
 - Cass Peak air traffic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

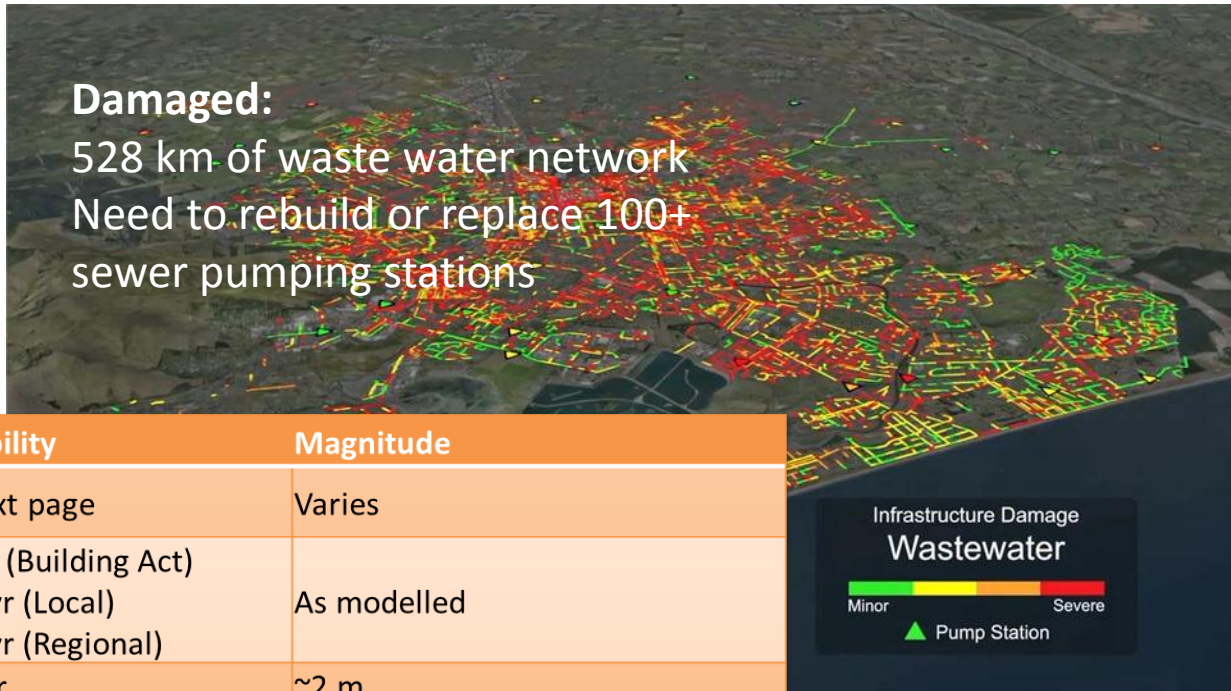


Lifeline Utilities Restoration Times



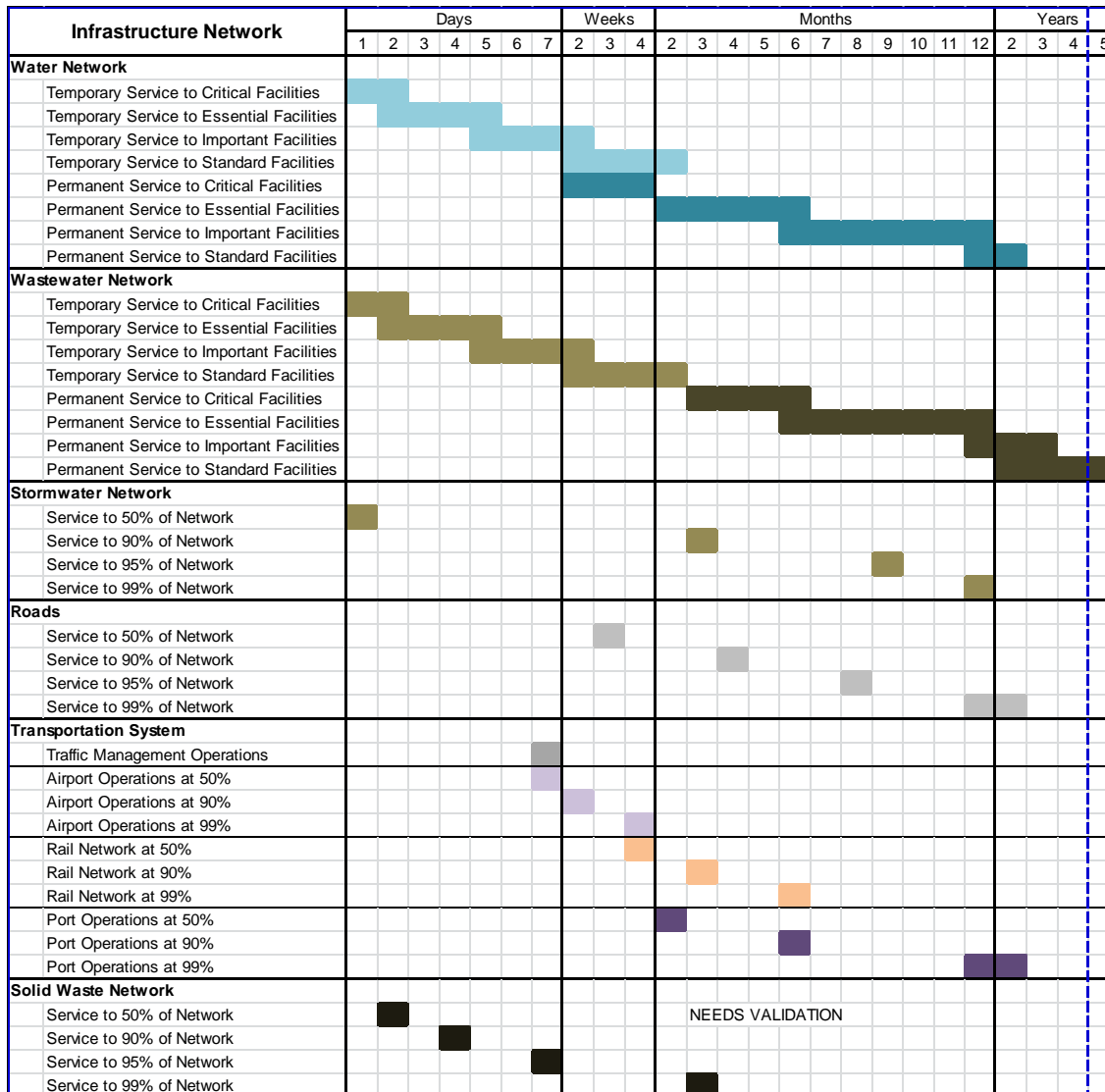
	Gas restoration time (days)	Power restoration time (days)	Water restoration time (days)
Hutt Central and Western Hills	80	60	25/40
Porirua, Mana, Plimmerton and Pukerua Bay	60	40	75
Northern /Western Wellington suburbs	60	60	45/55
Wellington CBD	80	95	55
Airport and Eastern Wellington suburbs	80	60	70

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

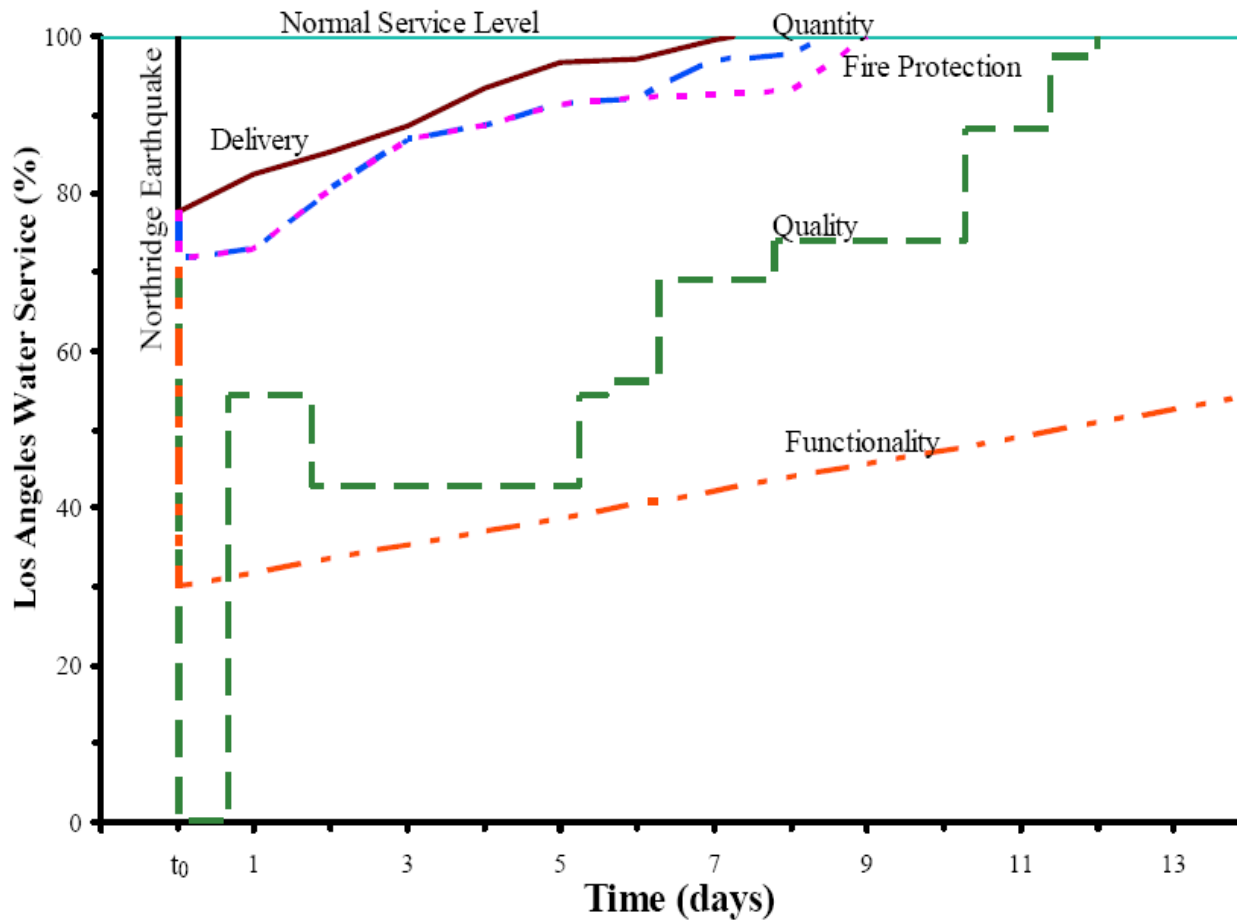
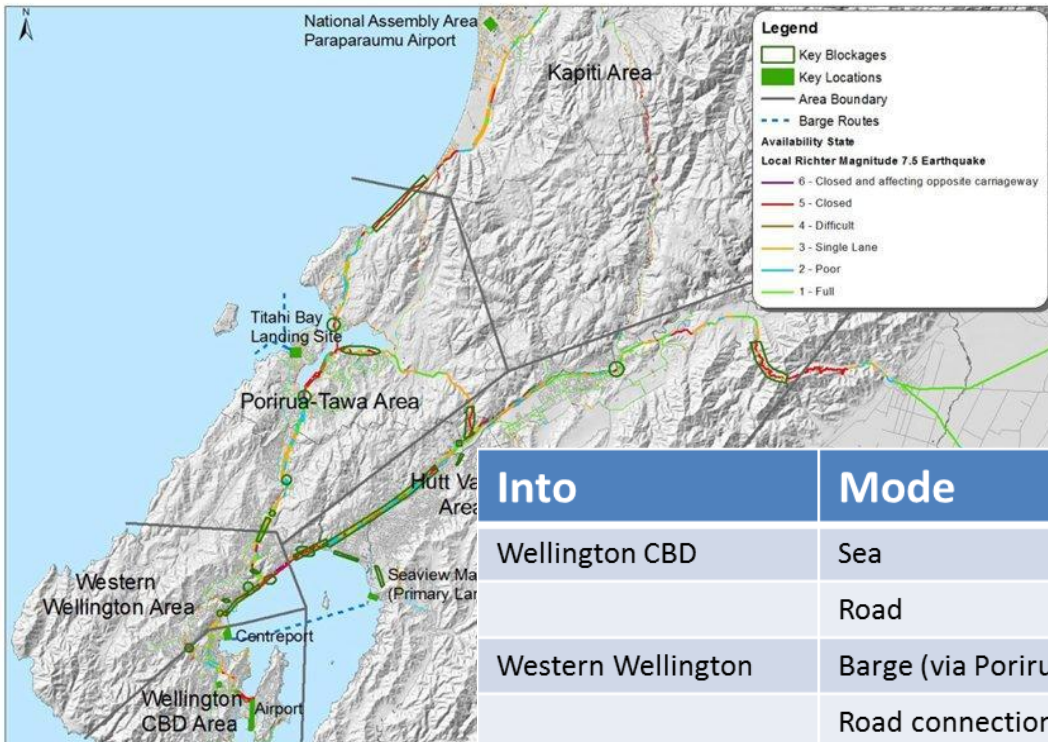


Figure 3. Los Angeles water system service restorations following the 1994 Northridge earthquake.

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

E+14

- Lower and Upper Hutt probably linked
- Port partially functioning
- Landing sites for Hutt and Porirua operating
- Airport partially functioning (military and turbo-prop)
- Major road operations ongoing
- No road access into region
- Region fragmented into three main areas. Suburb-sized parts of these areas may be cut off



E+56 to E+120

- Wellington CBD and Hutt probably linked
- Port functioning
- Landing site for Hutt closes
- Airport partially functioning (military and turbo-prop)
- Major road operations ongoing
- No road access into region
- One large area cut off from the rest of the region



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Gap Filling



- Priorities
- Making relevant
- Parts of sectors requiring resilience improvement
- Linkages to infrastructure providers
- Linkages to communities, including businesses
- Organisational resilience
- Interdependencies
- Cost of resilience
- Increased coordination and discussion

Thank you

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