FLOOD RESILIENT INFRASTRUCTURE

A Design Framework

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Overview

- The network concept
- Examples of actual and potential catastrophic infrastructure failure
- Estimating direct, indirect and intangible costs of infrastructure loss
- Critical interdependencies between infrastructure types
- A suggested flood design framework.

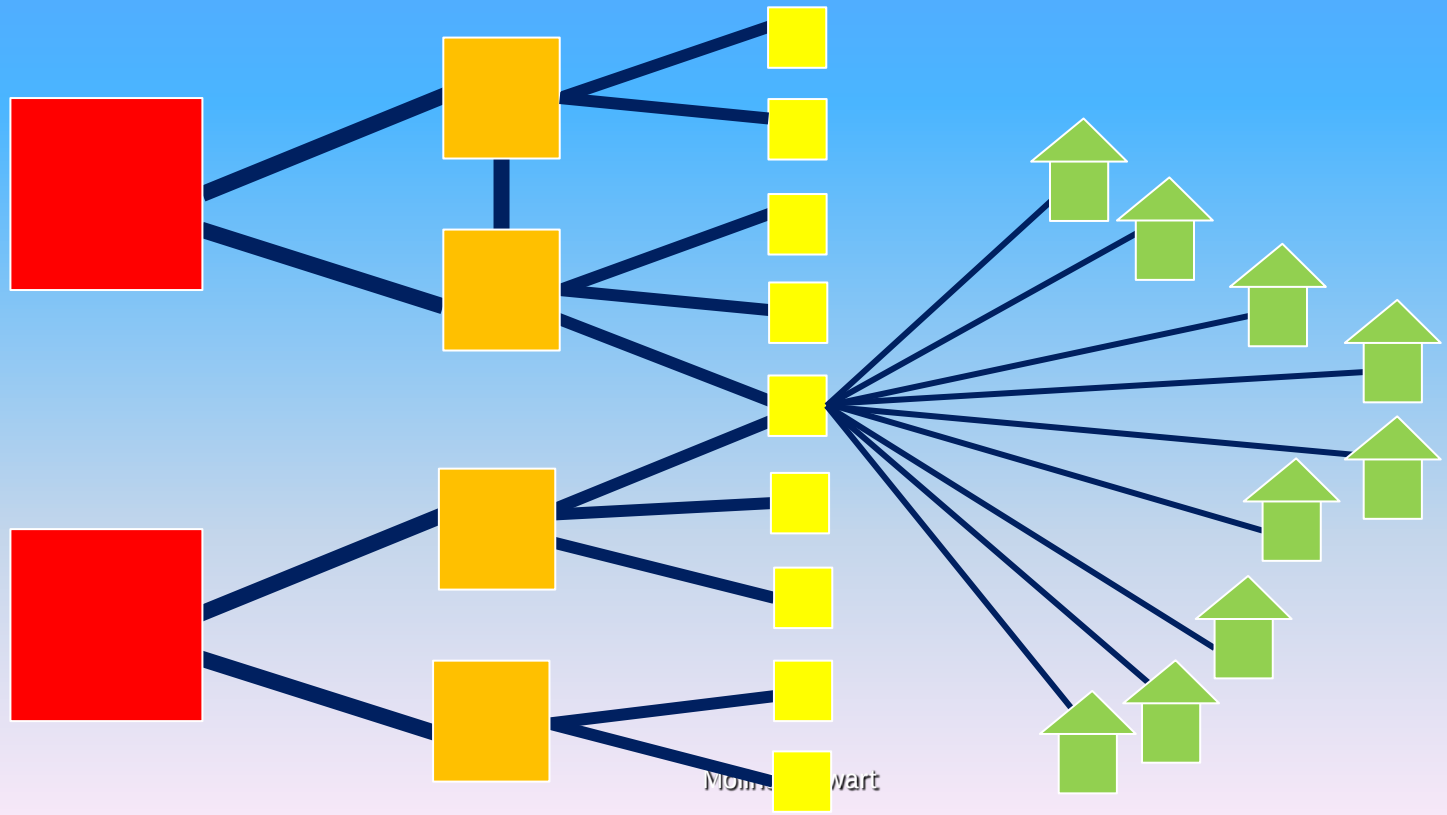
“Infrastructure providers need to consider design standards that enable continuity of use or ready re-establishment of services after a flood, as appropriate. These standards may involve reducing the likelihood of infrastructure flooding or the vulnerability of the infrastructure to the impacts of flooding when it occurs, and using readily available components to re-establish services easily after a flood. “

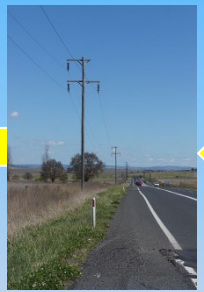
A Guide to Best Practice in Flood Risk Management in Australia’ (Australian Institute for Disaster Resilience 2017, page 86)

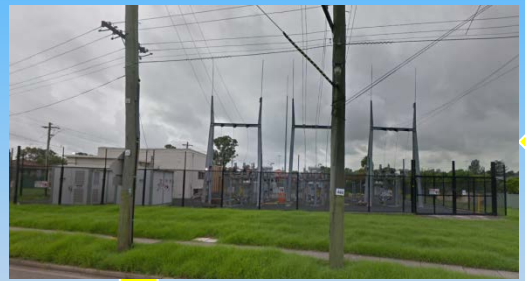
Types of Infrastructure

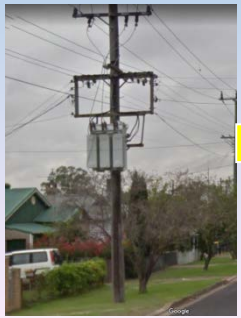
- Electricity
- Gas
- Telecommunications
- Road
- Rail
- Water
- Sewerage
- Health
- Emergency Service

Infrastructure Networks



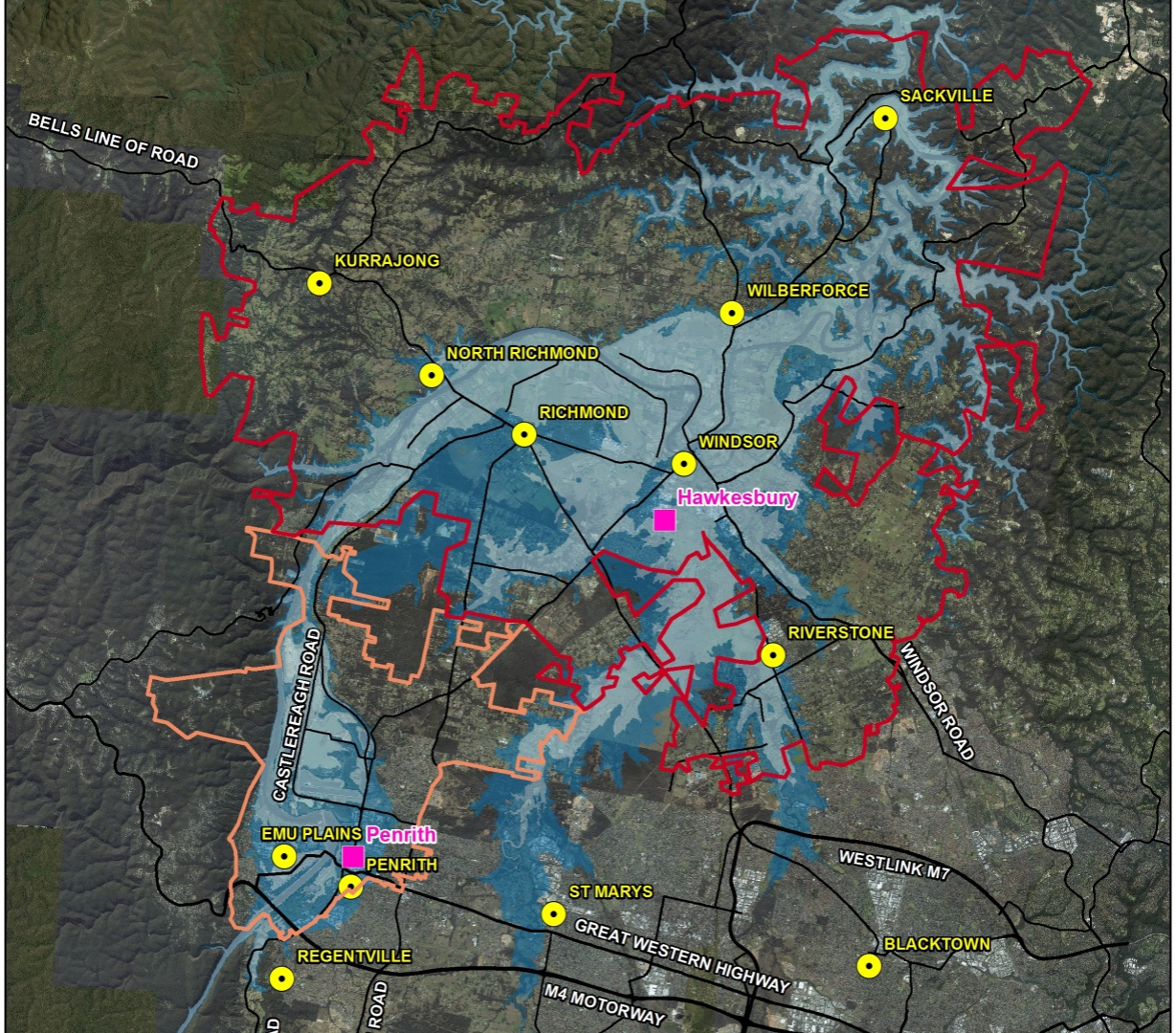


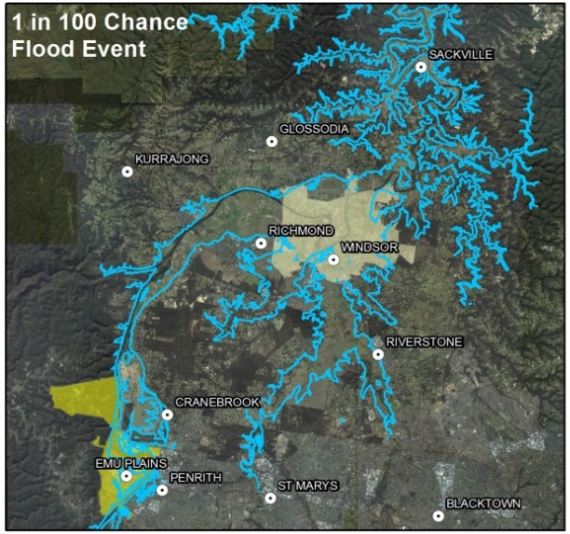


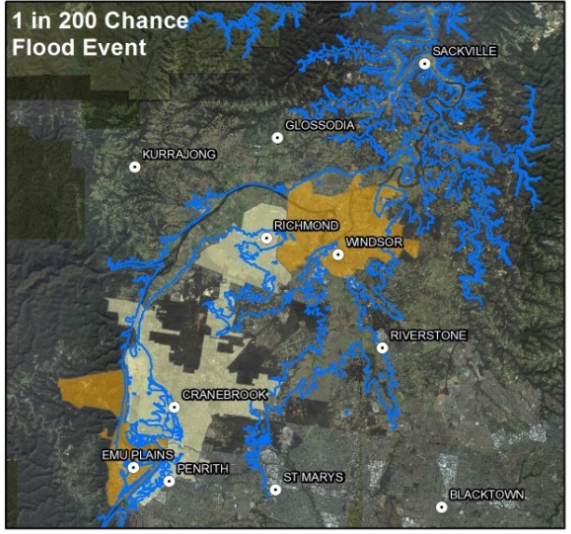


2011 Qld Floods

- 150,000 customers lost power
- 6 zone substations flood damaged
- 25 zone substations switched off due to inundation or supply loss
- 95 poles had to be replaced
- 98 kilometres of overhead conductors replaced
- 120 pad mount transformers removed and replaced
- 10 major substations in Brisbane's CBD were impacted
- Loss of supply to 21 CBD buildings

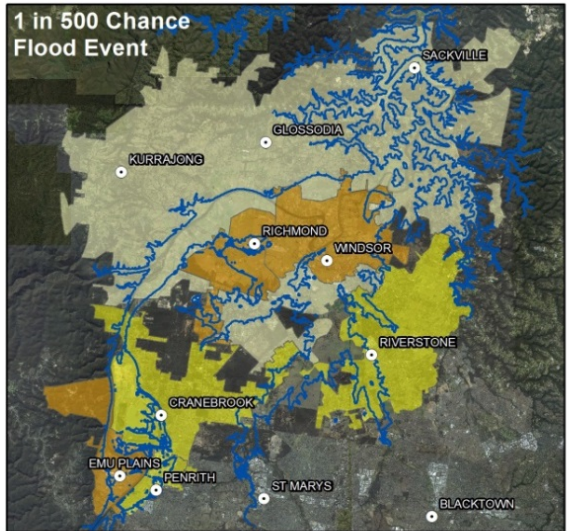

SACKVILLE
BELLS LINE OF ROAD
KURRAJONG
WILBERFORCE
NORTH RICHMOND
RICHMOND
WINDSOR
Hawkesbury
RIVERSTONE
WINDSOR ROAD
CASTLEREAGH ROAD
EMU PLAINS
Penrith
PENRITH
WESTLINK M7
ST MARYS
GREAT WESTERN HIGHWAY
BLACKTOWN
REGENTVILLE
M4 MOTORWAY

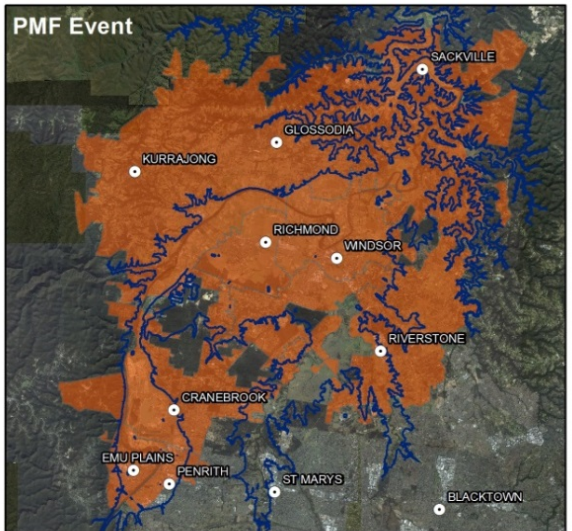




Electricity Outages

Existing Scenario





Legend

- Locality

Length of time

- 2 days
- 2 weeks
- 3 months
- 6 months

Flood event

- 1 in 100 chance
- 1 in 200 chance
- 1 in 500 chance
- PMF

0 5 10

Kilometres

N

Costs

- Direct – repair, replace, clean-up
- Indirect – loss of profits to utility owner
- Intangible – loss of power supply – value of unsupplied electricity vs cost per kWh
  - Residential – 26:1
  - Large C&I – 310:1
  - Small C&I – 2,757:1

  https://www.utilitydive.com/news/what-electric-reliability-is-actually-worth-and-what-it-means-for-utilities/367506/

Solutions

Solutions

Flood Risk Management Approaches

- 1% AEP
- AAD and BCR
- Acceptable Risk thresholds based on probability and consequence

Infrastructure Type	Within infrastructure categorisation						
Water Supply	Local water supply network	Trunk mains	Reservoirs/Towers	Water Treatment Plant processing infrastructure	Water Treatment Plant throughput pumps and pipes and mains leading out of WTP		Source (e.g. Dam) and main trunk
Electricity	11 kV distribution system	33 kV power cables	33/11 kV substation	110 kV power cables	110/33 kV substation		275/110 kV substation & 275kV and higher voltage power cables
Telecommunications	Cables connecting mini exchanges	Mini exchanges	Other mobile phone towers cables connecting terminal exchanges and mobile phone towers to switching centres and each other	Terminal Exchanges And critical mobile phone (cellular) transmission towers	intercity cables and cables between switching centres		Radio transmission infrastructure used by emergency services. Telephone switching centres
Emergency Services				Minor Evacuation Centre	Station (Police/Fire brigade/Ambulance/SES)		Major Evacuation Centre or Control Centre (Police/Fire brigade/Ambulance/SES)
Sewage and waste			Gravity Pipes	Sewage pumps and waste tips or landfill	Sewage Water Treatment Plant		
Health services			Medical Centres	Private Hospitals and aged care facilities	Local Public Hospitals		Regional Public Hospitals
Duration **Event Range**					<24hrs	>24hrs	
1,000 - PMF					2 or 3	2 or 3	2 and 3
100-1,000				2 or 3	2 or 3	3	2 and 3
50 to <100		1, 2 or 3	2 or 3	2 or 3	3	3	2 and 3
>10 to <50	1 or 3	2 or 3	3	3	3	3	2 and 3
10	1 or 3	3	3	3	3	3	2 and 3

Potential Risk Mitigation Options

1. Means of restoring basic service within 48 hours.
2. Provide backup/alternative system/service to provide adequate service for more than 48hrs. This includes power, telecommunications, access and consumables required to provide critical services
3. Relocation of infrastructure.

Thank you