Wellington Water

Prince of Wales Reservoir

Summary Document

Our water, our future.

Background

From day to day, the network must balance supply with demand through a combination of just-in-time supply and stored reserves. the key asset that maintains this delicate balance is the reservoir.

If a pipe breaks; if a water main is severed, if a flood event occurs, a water treatment plant stops, water quality is compromised or the power fails; the network must maintain supply. Our customers should not notice any service interruption - the tap stays on.

This is Operational Resilience.

However, every once in a while mother nature will throw us a curve ball; a cyclone, a forest fire, a tsunami, a drought, an ash cloud or an earthquake. Each of these events affects the water network in a different way. We don't know what damage will occur, we don't know where, we don't know on what scale; but we know we can be prepared.

This is Disaster Resilience.

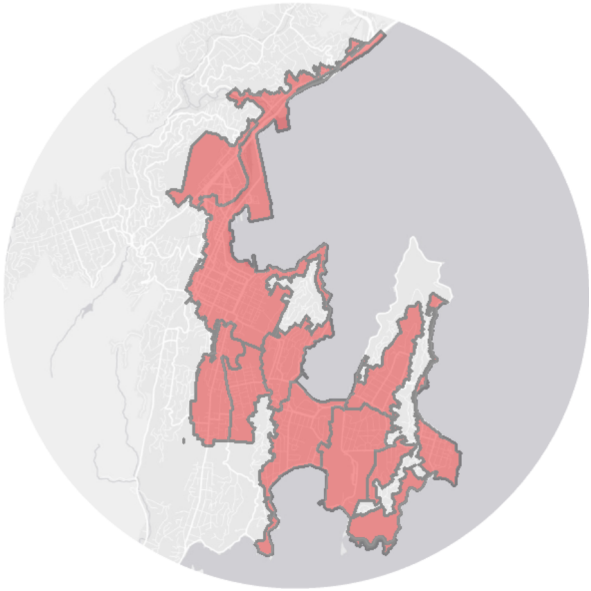
To guide our long term investment strategy in resilience, we have developed and agreed that our network should be sufficiently prepared to provide the following Levels of Service against the most significant event - a large earthquake affecting the Wellington region.

OUR LEVELS OF SERVICE

Days 1 to 7	Days 8 to 30	From Day 30
Emergency State	**Survival & Stability**	**Restoration & Recovery**
People and businesses will be self-sufficient, relying their own stored water supplies, their communities, and Civil Defence centres.	Residents collect up to 20 litres per person per day from Distribution Points while Critical Customers begin to receive water to their boundary.	The region moves toward restoration of normal service through provision of reliable reticulated supplies.

If we can achieve these levels of service then the network is likely to be resilient, both in Operation and Disaster recovery. This defines our need for investment.

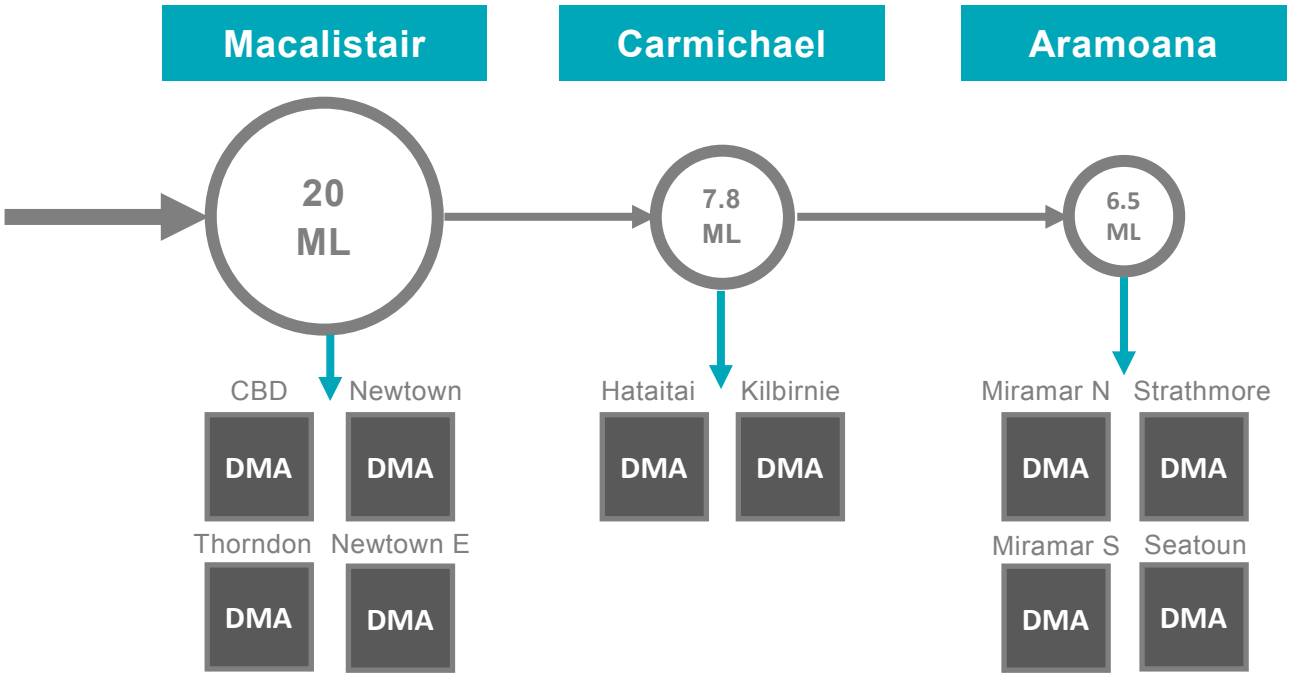
ZONE SUPPLY AND DEMAND



The Wellington Low Level Zone is the largest single supply zone in Wellington. It serves nearly 70,000 residents as well significant commercial, and some industrial activities.

Every day this zone consumes an average of 32 million litres of water, but during times of peak demand, consumption may exceed 50 million litres a day.

Three key reservoirs feed the Low Level Zone, the largest being Macalistair which is fed directly from the Bulk Supply system. On any given day, there is **currently less than one day's storage in-zone** to manage a significant network event.



Key critical customers in this zone consist of:

13	Civil Defence Centres
4	Hospitals
7	Medical Centres
32	Schools
8	Aged Care Facilities
4	University Facilities
16	Lifelines Facilities

Everyday supply with Prince of Wales Reservoir

Key supply risks are currently mitigated through Macalistair Reservoir in combination with one of the other links in the supply chain.

Macalistair reservoir is the largest reservoir in the zone. Its primary function is to supplement peak demand as the Bulk Supply cannot meet peak demand in the zone. There is insufficient additional storage without Macalistair.

Without this reservoir, water rationing would be required on a daily basis to manage demand and supply.

The Thorndon PRV's directly connect a portion of the Bulk Supply to the Low Level Zone reticulation network. They must be open to boost zone supply and pressure near the Thorndon area due to the geographical distance and hydraulic loss between Macalistair and this part of the zone.

Key issues include:

- PRV's are vulnerable to failure, thereby introducing high pressures to the reticulation system.
- Without these PRV's upper parts of Thorndon will not receive sufficient pressure.
- These PRV's bypass storage, meaning there is a risk that any contamination in the Bulk Supply network cannot be isolated and managed before reaching the customer.
- Fine sediments can enter the system (as opposed to settling in the reservoir) slowly clogging

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State Highway 2 via Hutt Road and lower Thorndon provides the primary supply into Wellington. The pipeline traverses liquefiable land, complex CBD environments and shares the road with many buried services.

This section of pipeline cannot be out service for more than 18 hours otherwise there will be insufficient water in-zone to meet demand.

Prince of Wales Reservoir:

- Reduces system flows into CBD area from Thorndon; in turn reducing supply and contamination risk - Better management of water quality.
- Allows Macalistair Reservoir to be taken out of service for maintenance for the first time since commissioning.
- Improves 'buffer' storage levels through which pump stations around Wellington rely on for supply to other DMA Zones.

At a size of **31 million litres**, Price of Wales Reservoir would increase in-zone Operational storage to two days, providing a 100% increase in the ability of the water network to manage network events while maintaining uninterrupted supply at the customers tap.

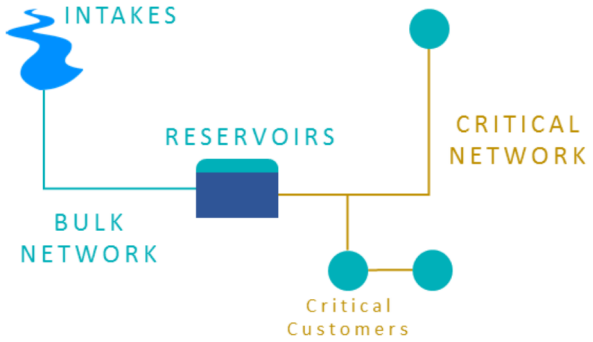
GETTING THROUGH A DISASTER

Wellington Water

Maintaining a supply of generally potable water to residents and Critical Customers is the primary function of the Survival & Stability State (Days 8 to 30).

In this state, our basic minimum level of service consists of:

- Provision of 20l litres per person per day to residents via distribution points.
- Providing major hospitals and CD centres with a basic water supply from Day 8. (Category 1)
- Providing Aged Care and Medical Services with a basic water supply from Day 14. (Category 2)
- Providing Education facilities with a basic water supply from Day 21. (Category 3)



Our only source of water to provide this basic level of service is currently via reservoirs in-zone.

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19 The number of days until current in-zone storage is depleted.

26 Million litres of new storage is required via Prince of Wales Reservoir to meet our basic minimum level of service to Day 30.

Demand **during the Survival & Stability** state consists of:

23%	Wellington Hospital
4%	Other Major Hospitals
7%	Category 1 Critical Customers
2%	Category 2 Critical Customers
1%	Category 3 Critical Customers
2%	Universities
61%	Residents

Wellington Hospital requires an additional 2.9 million litres of storage for self-sufficiency from Days 1 to 7.

29 Million litres of new storage is the total requirement when provision is made to hold Wellington Hospital's self-sufficiency requirements in Prince of Wales Reservoir.

THE NEED FOR INVESTMENT

Against our Base Case for Operational and Disaster resilience, we must test key variables that may challenge our thinking. These variables include:

- Development of distributed sources such as low flow greywacke bores or use of mobile Containerised Desalination.
- Development of an alternative water source supplying Wellington.
- Development of a larger, resilient Bulk Supply route between Haywards, via Porirua, into Wellington.

X ML Denotes Operational resilience requirement to manage day-day operation of the reservoir. (NC denotes No Change).

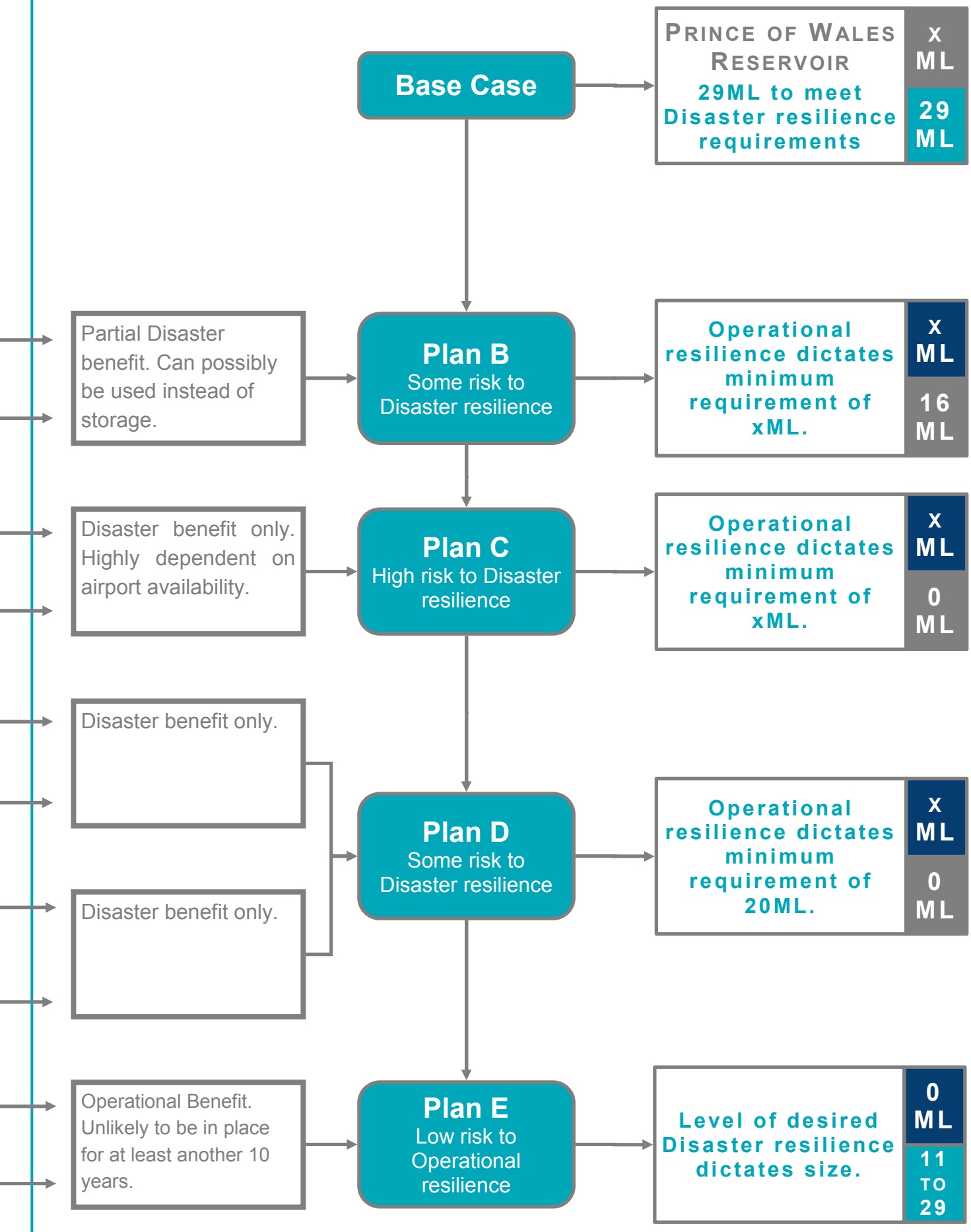
X ML Denotes Disaster resilience requirement (with provision made to hold Wellington Hospital's self-sufficiency requirements in Prince of Wales Reservoir).

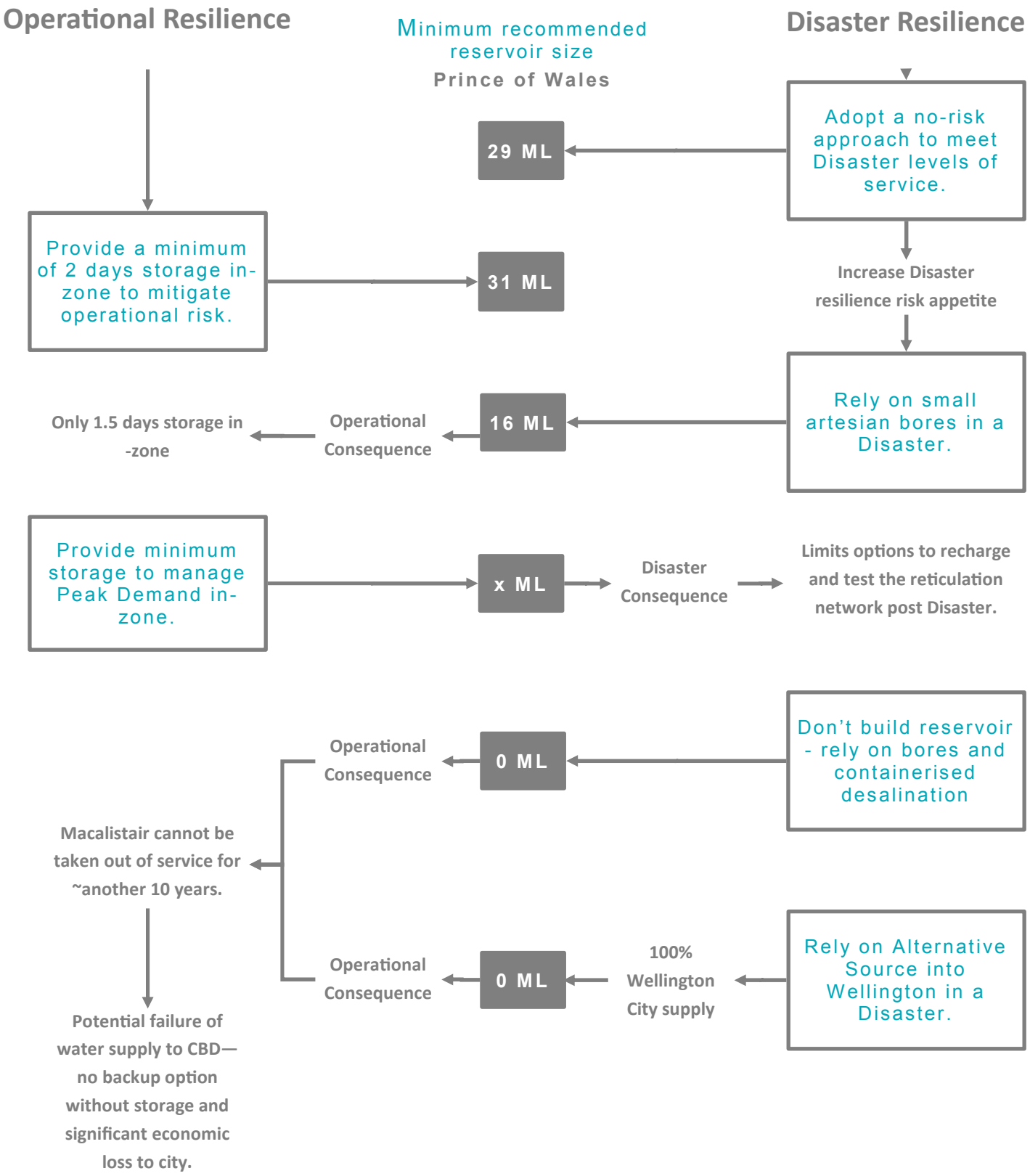
VARIABLES

GREYWACKE BORES SUPPLY OF 0.5 ML PER DAY	NC	These Bores are too small to make a difference to day-day operation in the zone.
	16 ML	If these bores are used to directly supply the Hospital then only **11 ML** of new Disaster storage is required.
CONTAINERISED DESALINATION SUPPLY OF 1 ML PER DAY	NC	This emergency solution is too small to make a difference to day-day operation in the zone.
	0 ML	This is only an option if the Airport is operational.
CROSS HARBOUR PIPELINE SUPPLY OF 80 ML PER DAY	NC	Waterloo is run at full capacity in summer and is not capable of providing any "new" supply into CHP. CHP does not mitigate peak storage requirements
	0 ML	Supply via CHP is sufficient to eliminate the need for additional in-zone storage after a significant Disaster - provided it is available.
WELLINGTON BORES SUPPLY OF 8 ML PER DAY	NC	Waterloo is run at full capacity in summer. The Bores draw from the same aquifer and therefore do not mitigate peak storage requirements
	0 ML	Supply via the Wellington Bores is sufficient to eliminate the need for additional in-zone storage after a significant Disaster - provided
WESTERN RING MAIN SUPPLY CAPABILITY INCREASES	X ML	Increased supply via a new main from Ngauranga would provide additional capacity from Te Marua to meet peak demand while Macalistair was out of service.
	NC	Supply after a disaster is unlikely before day 15 to 20 hence a reservoir is still required to

Wellington Water

The following summarises how these variables can be combined depending on appetite for risk against scale of the potential investment.




Operational Resilience
Minimum recommended reservoir size
Prince of Wales
Disaster Resilience
Adopt a no-risk approach to meet Disaster levels of service.
29 ML
Provide a minimum of 2 days storage in-zone to mitigate operational risk.
31 ML
Increase Disaster resilience risk appetite
Rely on small artesian bores in a Disaster.
16 ML
Operational Consequence
Only 1.5 days storage in -zone
Provide minimum storage to manage Peak Demand in-zone.
x ML
Disaster Consequence
Limits options to recharge and test the reticulation network post Disaster.
Don't build reservoir - rely on bores and containerised desalination
0 ML
Operational Consequence
Macalistair cannot be taken out of service for ~another 10 years.
Rely on Alternative Source into Wellington in a Disaster.
100% Wellington City supply
0 ML
Operational Consequence
Potential failure of water supply to CBD— no backup option without storage and significant economic loss to city.