Karehana Park Stormwater Catchment Improvements

August/September 2021

Wellington Water

Our water, our future.

Agenda

Project Background (what we're trying to achieve)

Purpose (what we need from you)

Catchment Challenges (what we're up against)

Where Are We Now?

Defence vs Retreat

Hydraulic Modelling & Flood Damage Analysis

Options Assessment (how we reached our recommendations)

Recommendations

Other Options

Cost Estimates

Project Background

- The residents of Karehana Bay have faced significant flooding three times in the past five years; 2015, 2016 and most recently on 29 November 2020
- Porirua City Council and Wellington Water have agreed to undertake investigations to develop mitigation options

Porirua City Council Consultation

We sought Council's direction in two matters:

1. **What is an acceptable (and affordable) Level of Service?**
2. **To what degree are we comfortable with Defence vs Retreat (i.e. raising houses)?**

Stormwater Level of Service

Wellington Water

Wellington Water's aspirations are:

1. **Shelter* from the '1 in 100 year' flood, including Climate Change**

*specifically: keeping floodwater below *habitable floors*

This may be economically un-achievable with network upgrades alone.

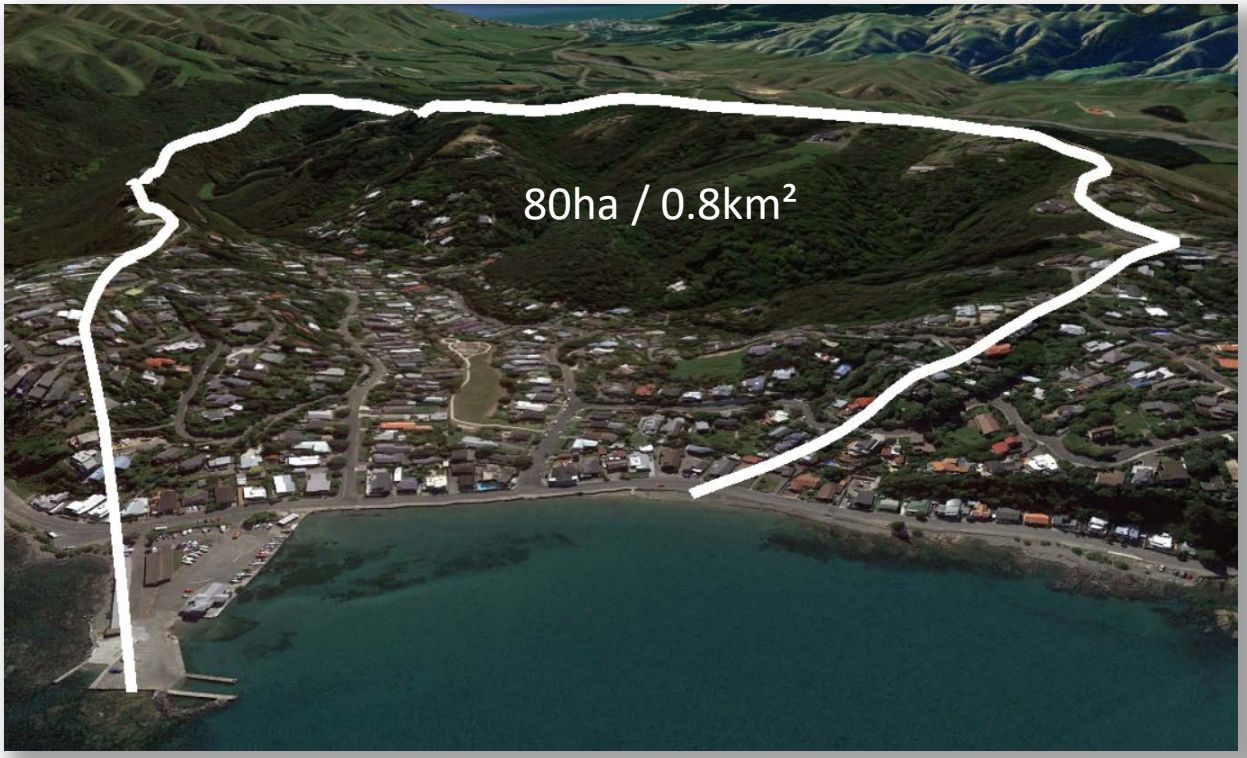
2. Safe access / protection for business in the '1 in 10 year' flood event
3. Attenuate increased runoff from new developments

Project Service Goals

Primary		**We minimise the impact of flooding on people's lives and proactively plan for the impacts of climate change** We are seeking a solution to reduce the number of habitable floors effected by flooding.
Secondary		**We minimise public health risks associated with wastewater and stormwater** We are seeking a solution to reduce the number of wet weather overflows onto land.
Secondary		**We operate and manage assets that are safe for our suppliers, people and customers** The solution should ensure that all public stormwater assets (existing and new) meet the Wellington Water health and safety requirements. Any existing operational risks are identified and changes to the assets are included in the design.

Catchment Challenges

1. The catchment is a relatively small and steep sided valley. It responds quickly to rainfall, and is therefore most vulnerable to short, high intensity rainfall events

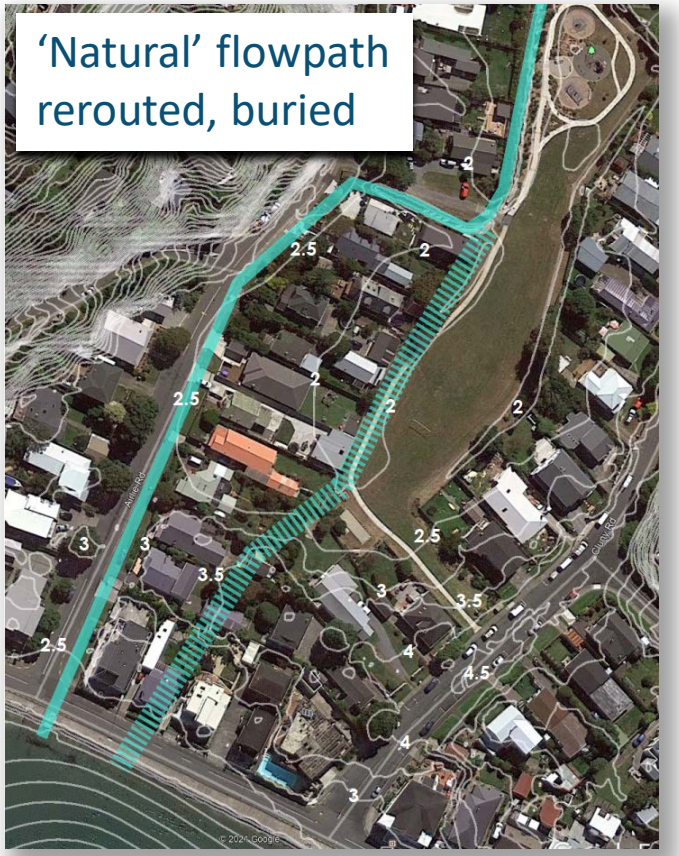


Catchment Challenges

2. The colluvial soils are unstable, and easily prone to water erosion

Catchment Challenges

3. Residential development has impacted stormwater drainage



Catchment Challenges

South Coast, Wellington

4. Climate Change
   - Worse storms, more frequently
   - Sea levels are rising

Where are we now?

We have completed a **feasibility investigation**, including…

- Community consultation
- Identification of wider catchment and network issues
- Options Long List
- Options Short List
  - Hydraulic modelling
  - Cost estimating
  - Specialist assessment
  - Multi-criteria analysis

…and we can now recommend next steps. However, we have sought ***direction*** on those steps:

1. **What is an acceptable (and affordable) Level of Service?**
2. **To what degree are we comfortable with Defence vs Retreat (i.e. raising houses)?**

Defence vs Retreat

- Network upgrades are a **defence** strategy: i.e. keep floods away from people & property
- **Retreat** strategies move people & property away from floods (in this case, *above* the flood)

- Our work to date has focussed on defence strategies, and has found them likely to cost more and/or be contentious
- We seek your direction on retreat options (specifically: lifting houses), at least in part
- Advantage of retreat: raising a house by a marginal increase increases Level of Service significantly
- Main disadvantage: poor control, high risks, clean-up costs

Defend

Control the flood everywhere

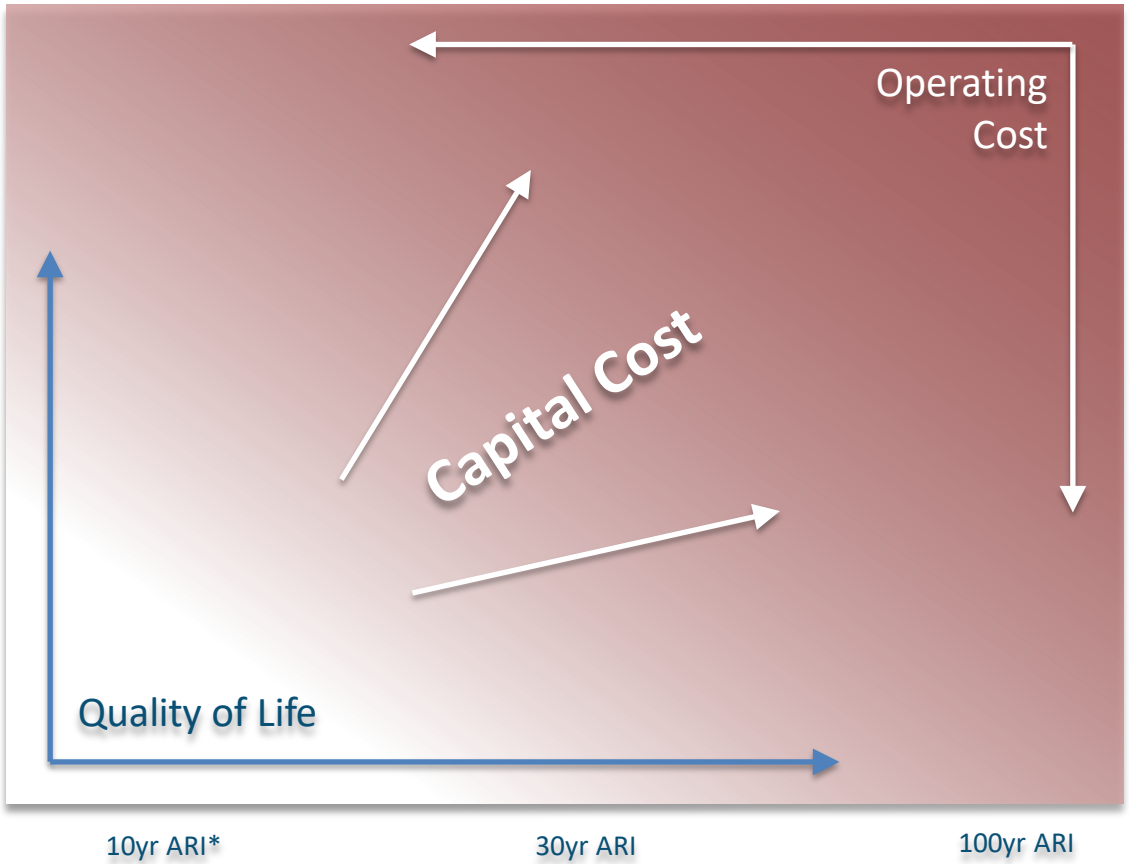
Raise no houses

Control the flood only in specific locations

Raise houses elsewhere

Raise all flood prone houses

Retreat



Level of Service

(Manageable Storm Event)

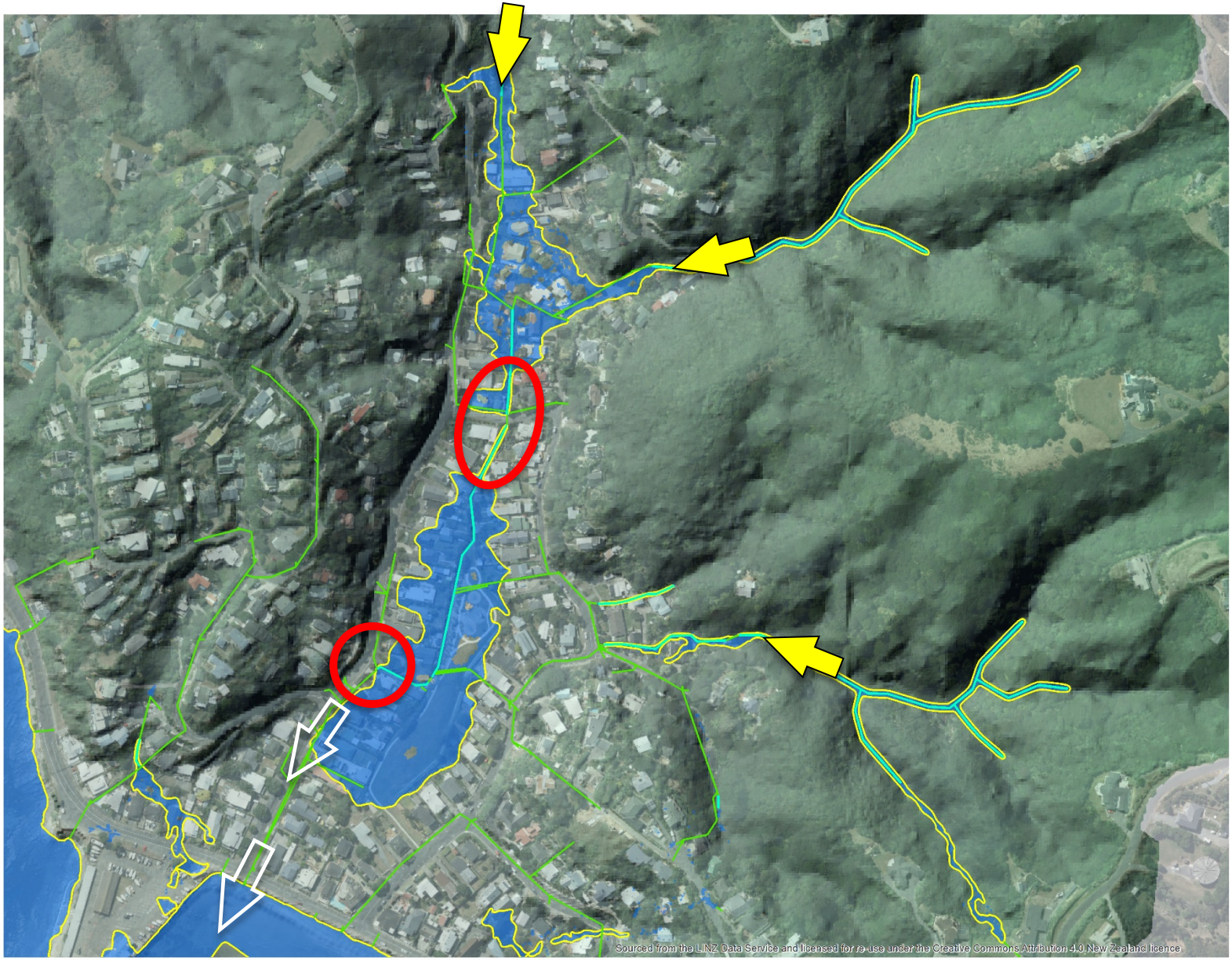
*Average Recurrence Interval

Predicted Flooding in the Existing Network

Updated computer model of this catchment:

- Verified against recorded rainfall & estimated peak flood level, Nov 2020
- Predicts the extents of the 10yr, 30yr, and 100yr ARI ‘standard’ events

1 in 10yr ARI Event in the Existing Network



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For: Wellington Water Ltd

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Date: 12/08/2021

50 Meters

LEGEND

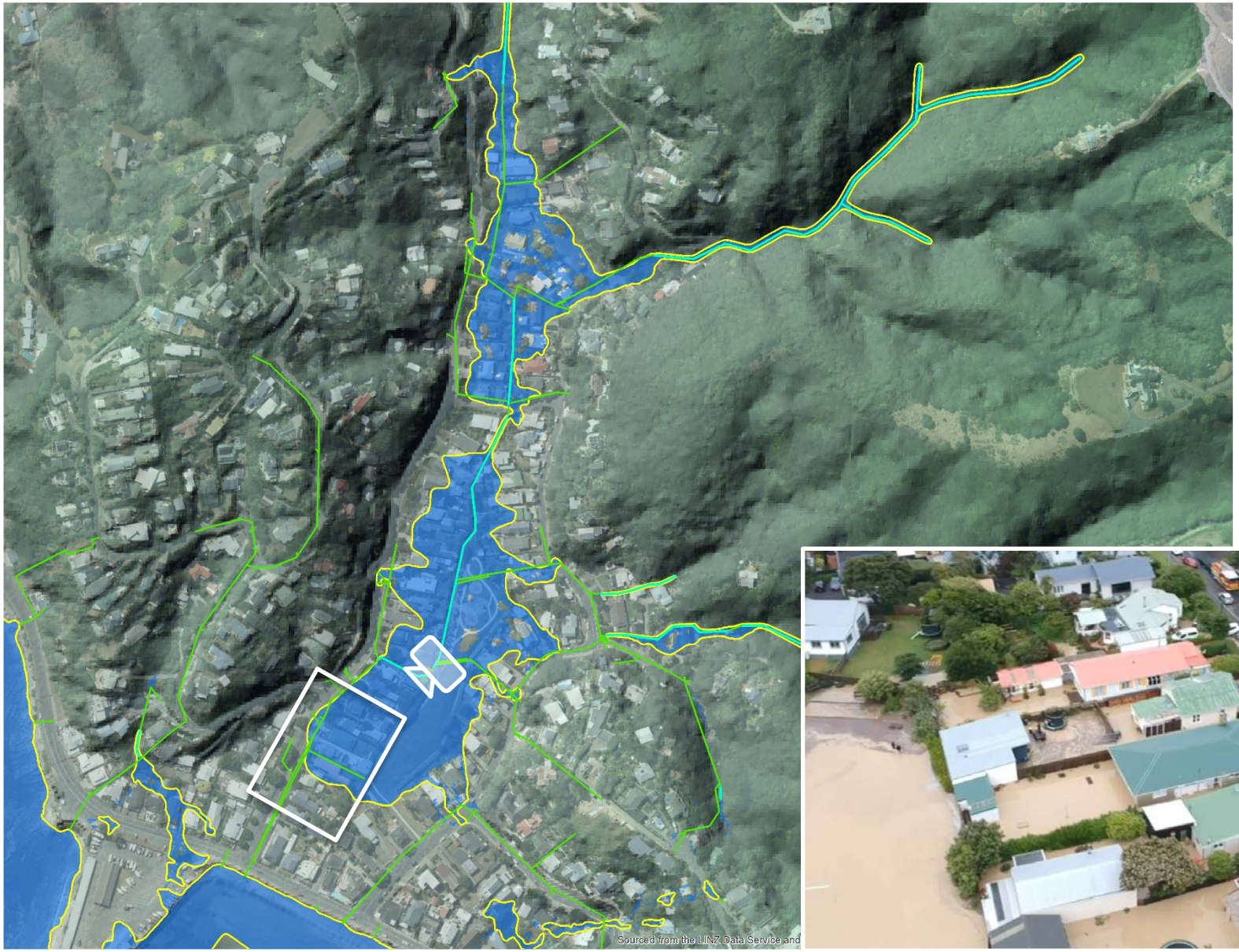
- Open Channels
- Stormwater Pipes
- Base Flooding
- Existing Flooding Extent

Major Subcatchments

Major Constrictions

Outlet

1 in 30yr ARI Event in the Existing Network



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LEGEND

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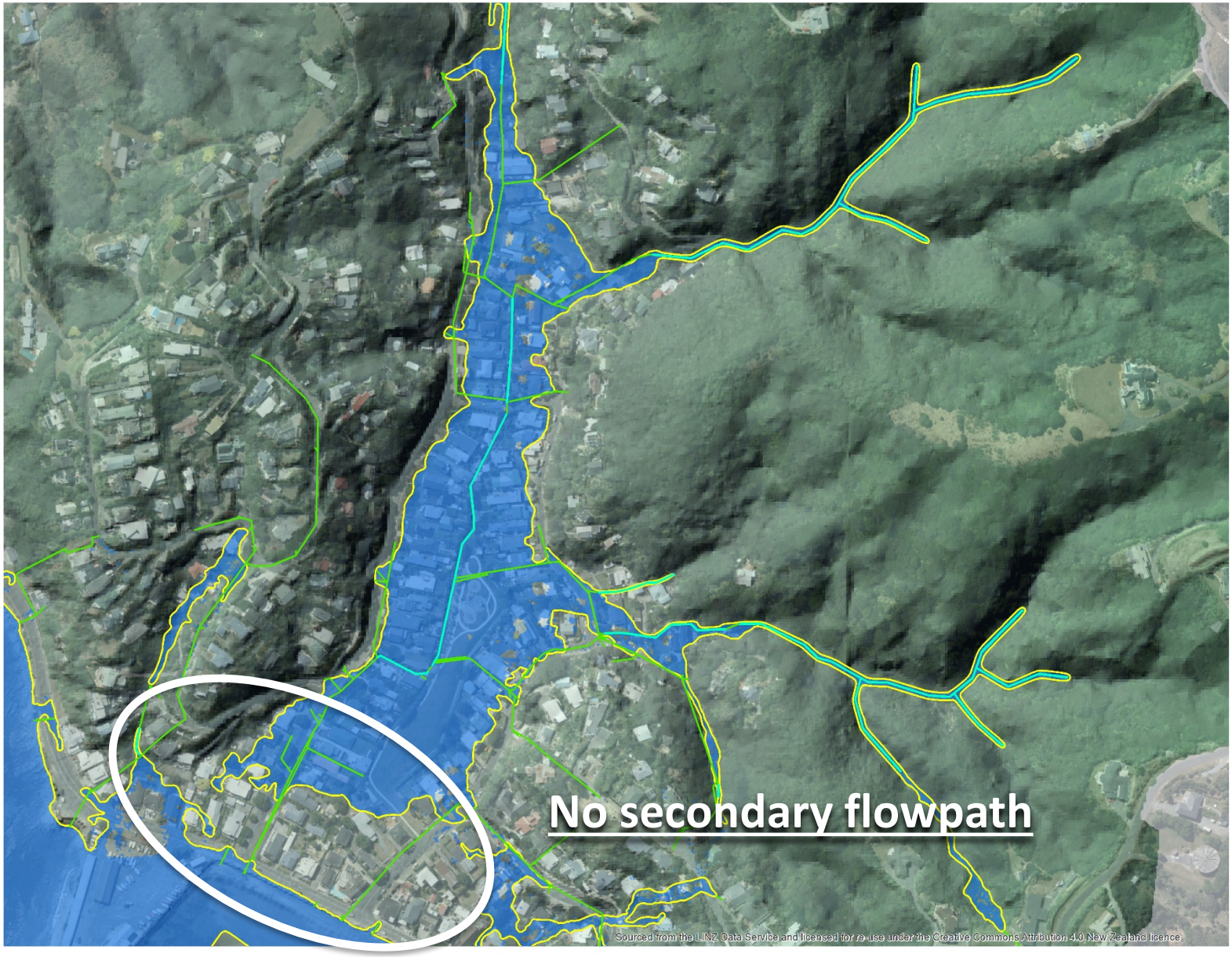
- Existing Flooding Extent

1 in 100yr ARI Event in the Existing Network



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LEGEND

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Flood Damage Analysis

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Estimates of flood damage repair costs with existing network

Storm Event	Habitable Floors Flooded	FDA Private Property Damage Estimate	Public Property & Clean Up Costs*
10yr ARI	20 – 25	$2.8M	$1.4M
30yr ARI	30 – 40	$5.5M	$2.8M
100yr ARI	60 – 90	$11.2M	$5.6M
Long Term Damage Risk *(50yr Net Present Value)*		**$14.1M**	

*Studies suggest additional (public) damage accounts for 1/3 of total damage, or a 50% increase on private property damage

Multi Criteria Analysis

- A ‘Long List’ of Options, i.e. ‘everything we *could* do’, was developed initially and assessed
- Process evolved to identify the combination approach for short list assessment
- The ‘Short List’ assessment identified improvements as
  - Primary Options, i.e. those with the primary purpose of increasing the flow from lower Karehana Park to the sea
  - Secondary Options, i.e. those that address network incapacity in the upper and mid catchment
  - Tertiary Options, i.e. those with the potential to enhance items 2 and 3

  Tertiary Options have been deferred for further investigation during concept design


Relief channel
(common to 6, 7, 8 & 9)
10: Culvert
Upgrades
6a: Box culvert
6b: Open channel
7: Box Culvert
8: Pump Station
9: Vacuum Siphon
Short List Primary Options

MCA Outcome/Recommendation

Mostly Defence

Primary Option

1 — A Pump Station in Karehana Park, a 'feeder' channel in the park, a discharge main in Cluny Road, and a new outfall in Moana Road.

Secondary Options

2 — Stream Upgrades between nos. 42 and 64 Airlie Rd.

3 — Improved Inlet Protection at key network entry points.

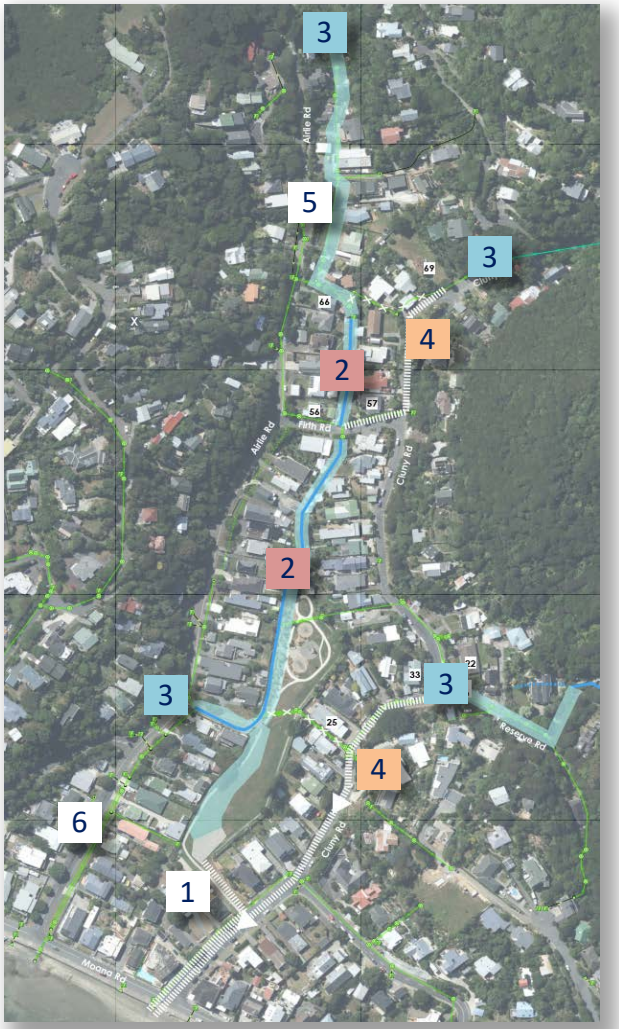
4 — Network Diversions to free up system capacity

5 — Secondary Flow Path Improvements where upgrades & diversions are impracticable

6 — Improvements to the Airlie Road Culverts

Tertiary Option

Residual House Raising (not shown)



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Mitigation Modelling

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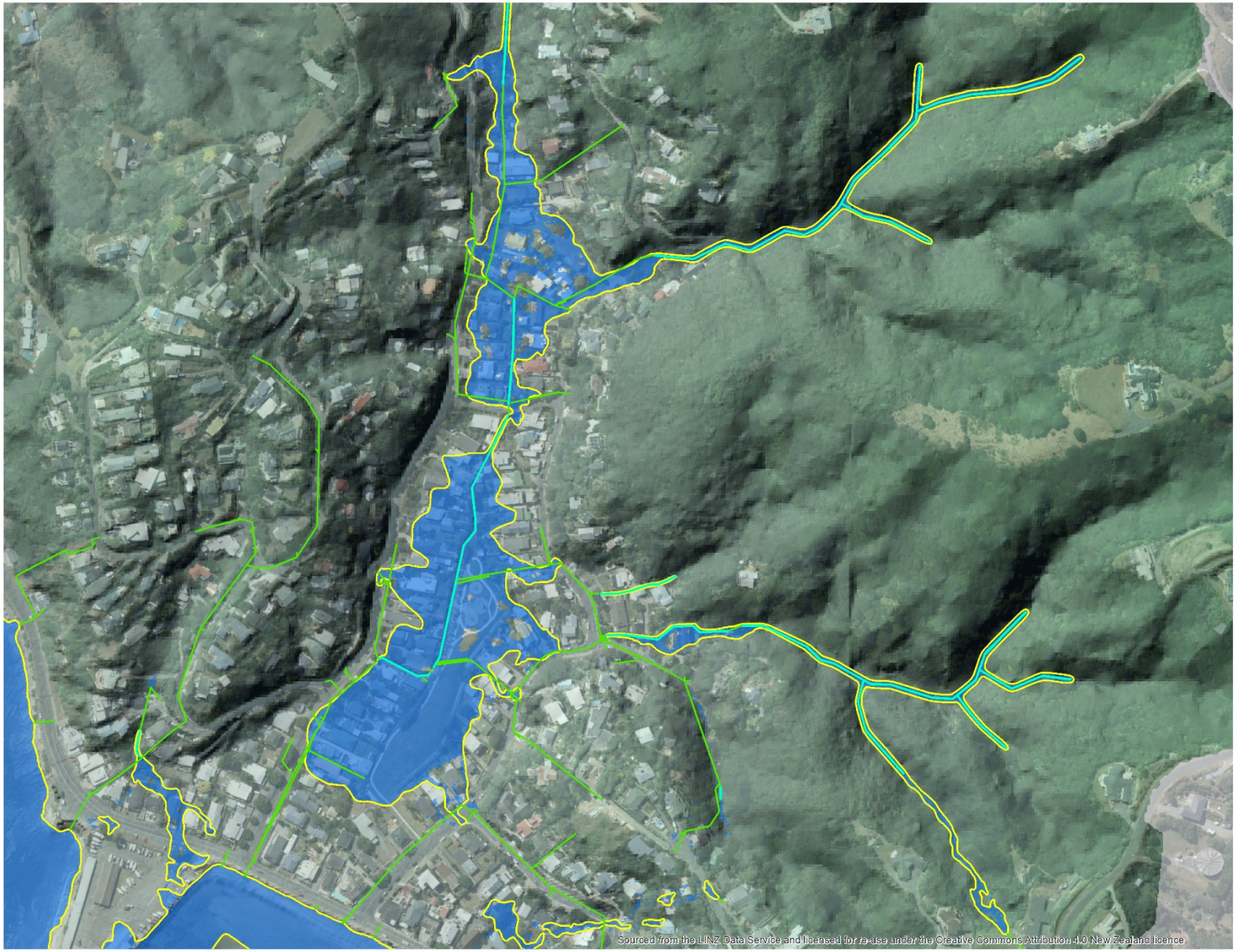
Model Limitations

- All models have fundamental limitations. No model can ever be 100% accurate in its predictions of existing flooding, or proposed mitigations
- The optimal mix of mitigation strategies is not yet identified, but we know where to find it and will do so in Concept Design
- The model clearly demonstrates that if we are to continue with a defence strategy then a comprehensive catchment-wide approach is necessary

Existing Network, 30yr Event



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LEGEND

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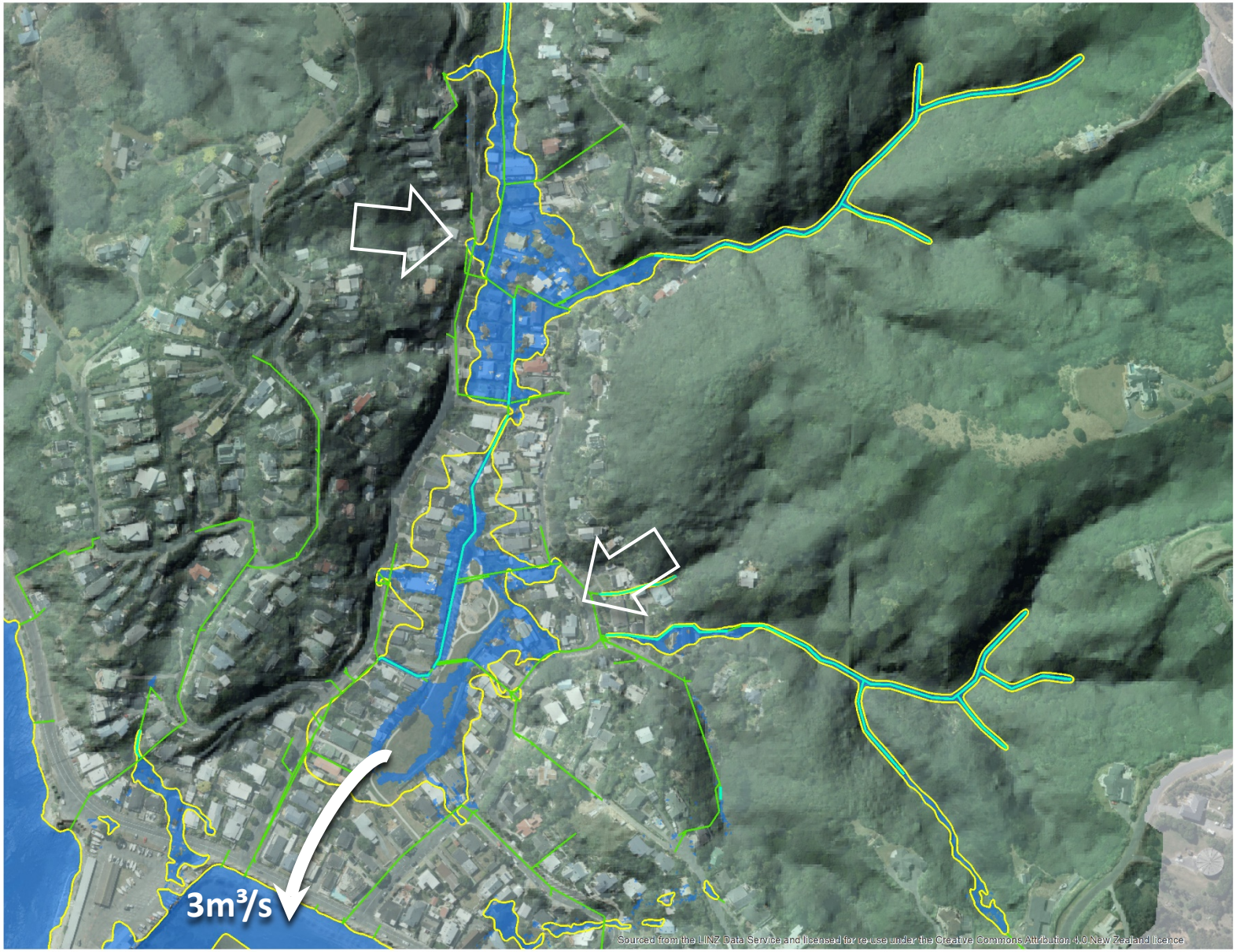
- Base Flooding
- Existing Flooding Extent

Pump, *Improved Inlets*, 30yr Event



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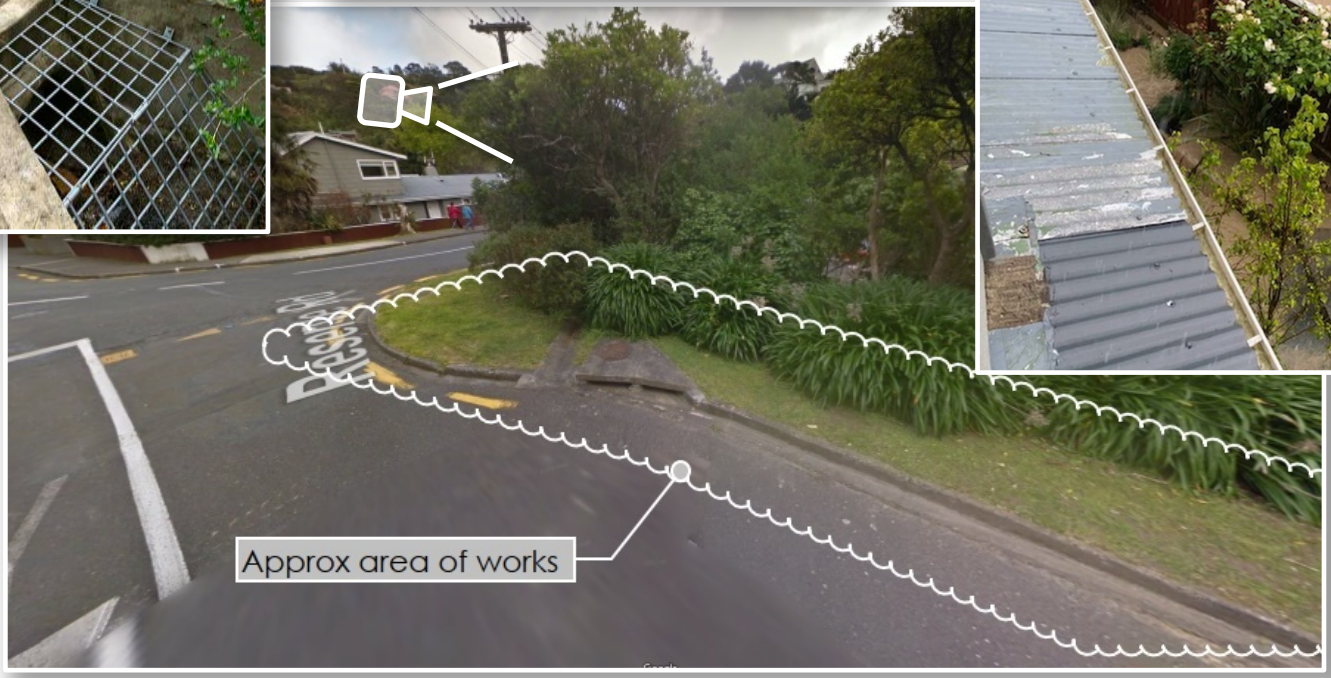
LEGEND

- Open Channels
- Stormwater Pipes
- Option Flooding Extent
- Existing Flooding Extent

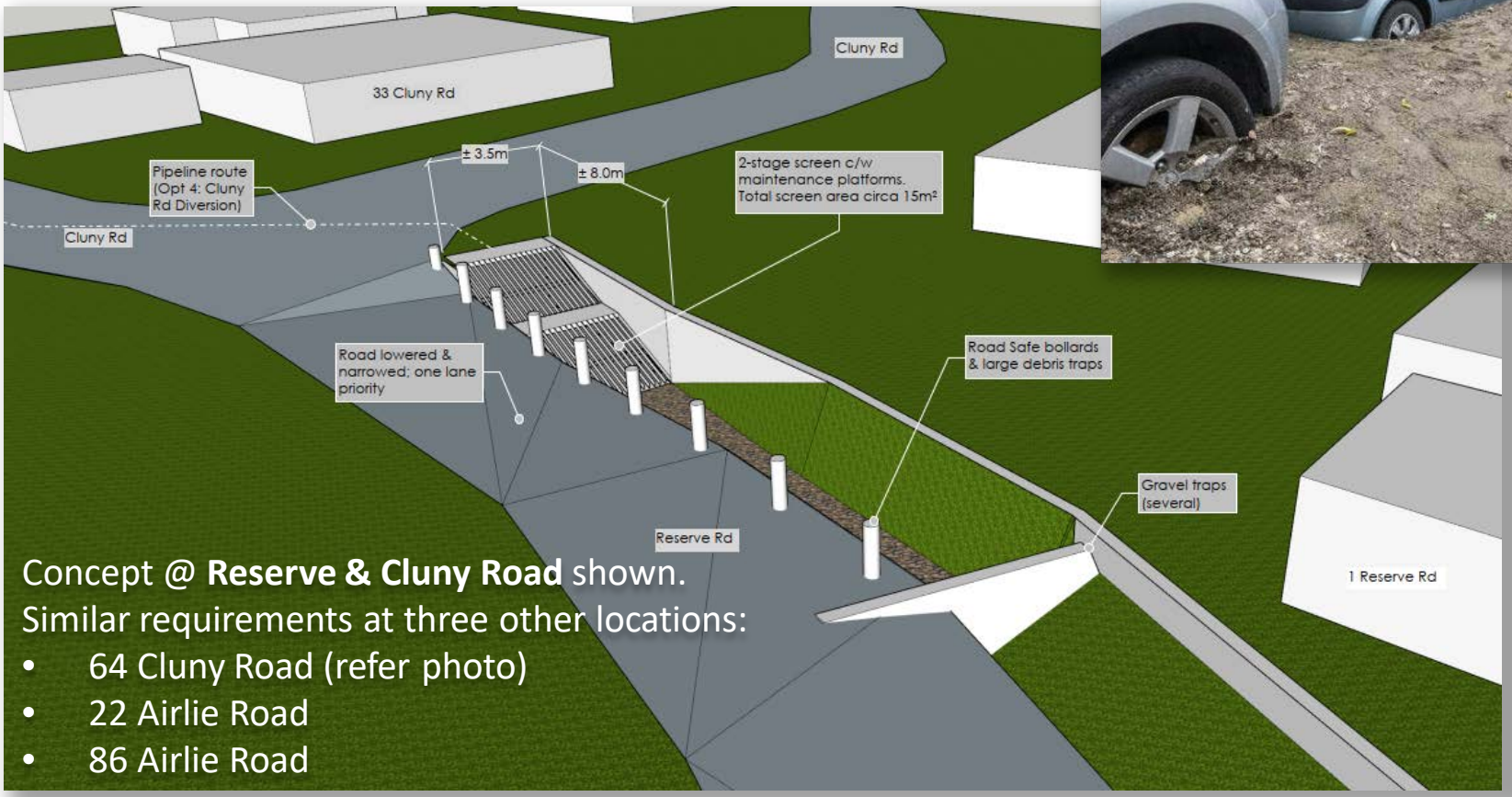
Existing Inlets

Wellington Water



Improved Inlets

Recommended Absolute Minimum Defence Strategy

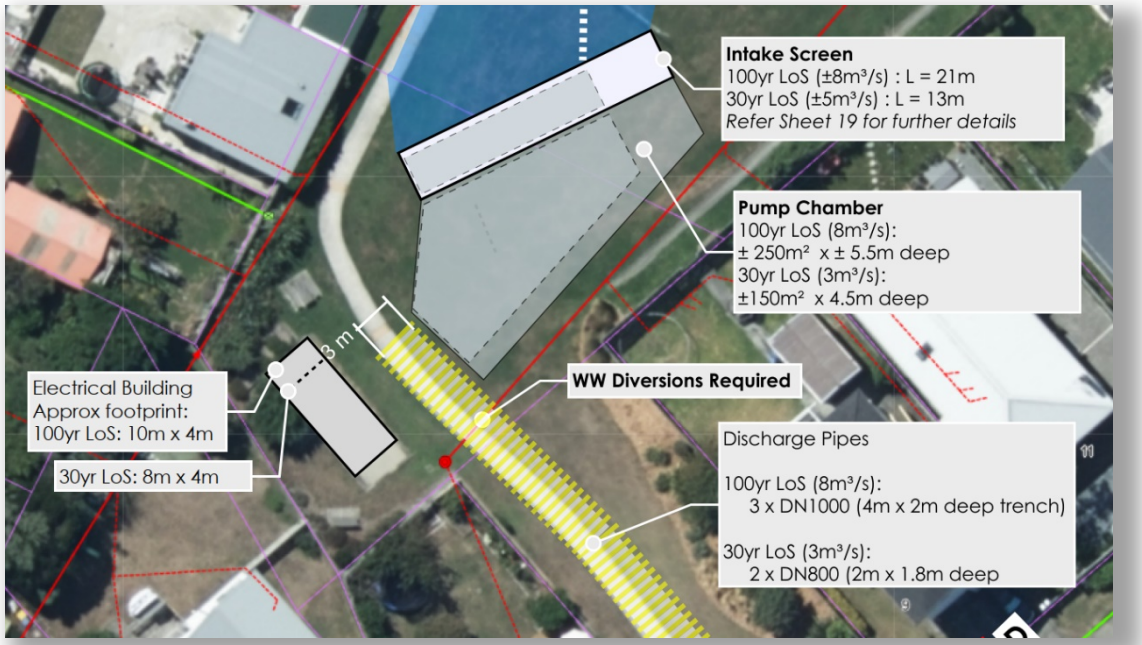


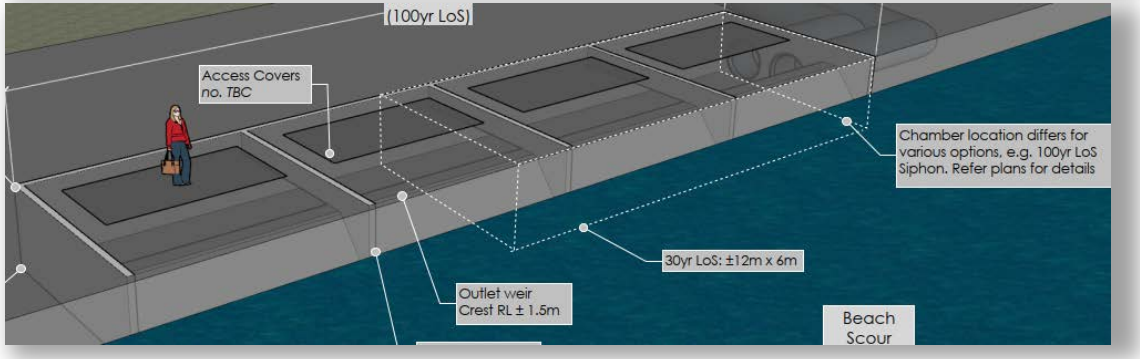
Concept @ **Reserve & Cluny Road** shown.

Similar requirements at three other locations:

- 64 Cluny Road (refer photo)
- 22 Airlie Road
- 86 Airlie Road

Park Pump Station (indicative)





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Improved Inlets, Pump, Improved Stream, 30yr Event

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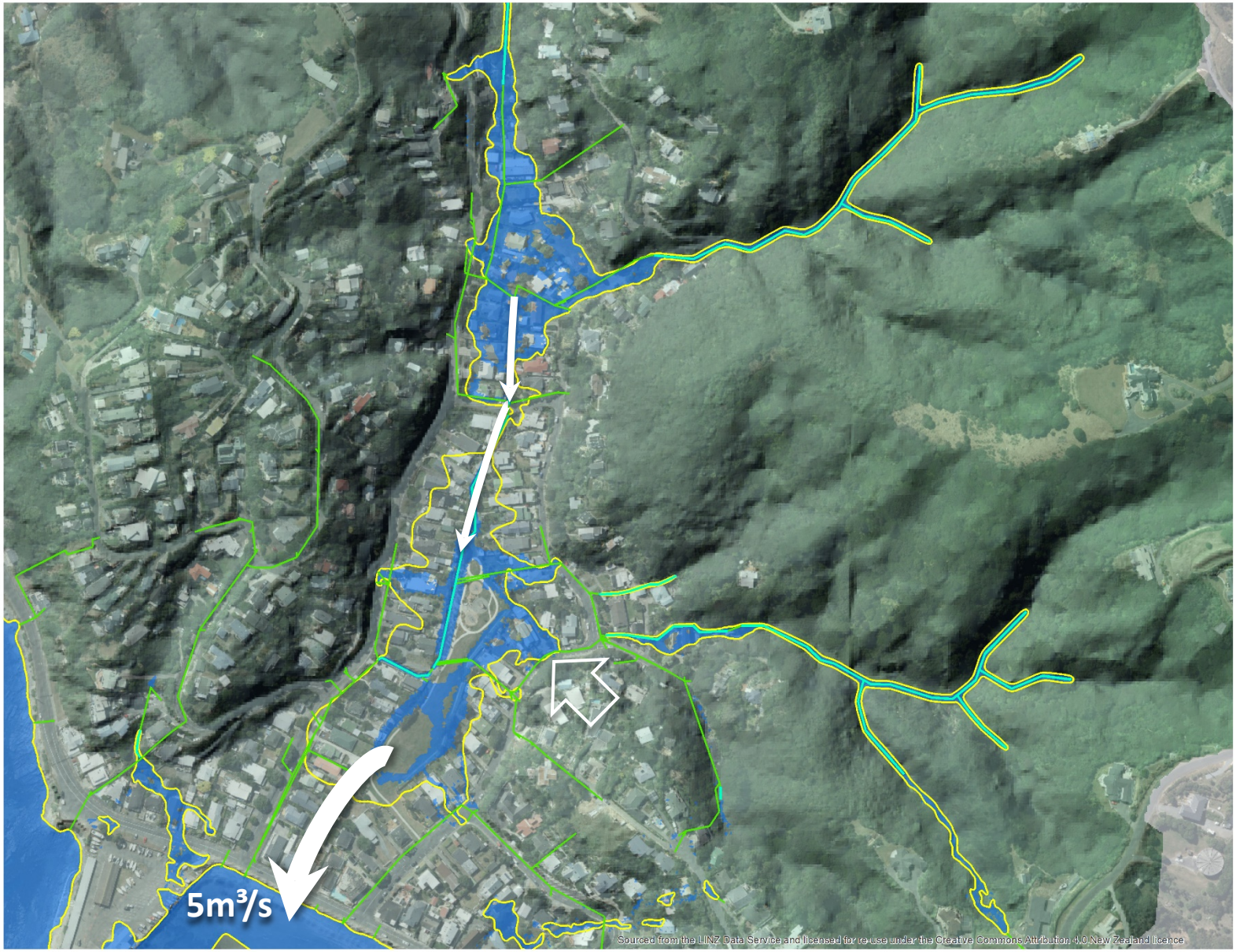
LEGEND

- Open Channels
- Stormwater Pipes
- Option Flooding Extent
- Existing Flooding Extent

Bigger Pump, Improved Stream, 30yr Event



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Meters

LEGEND

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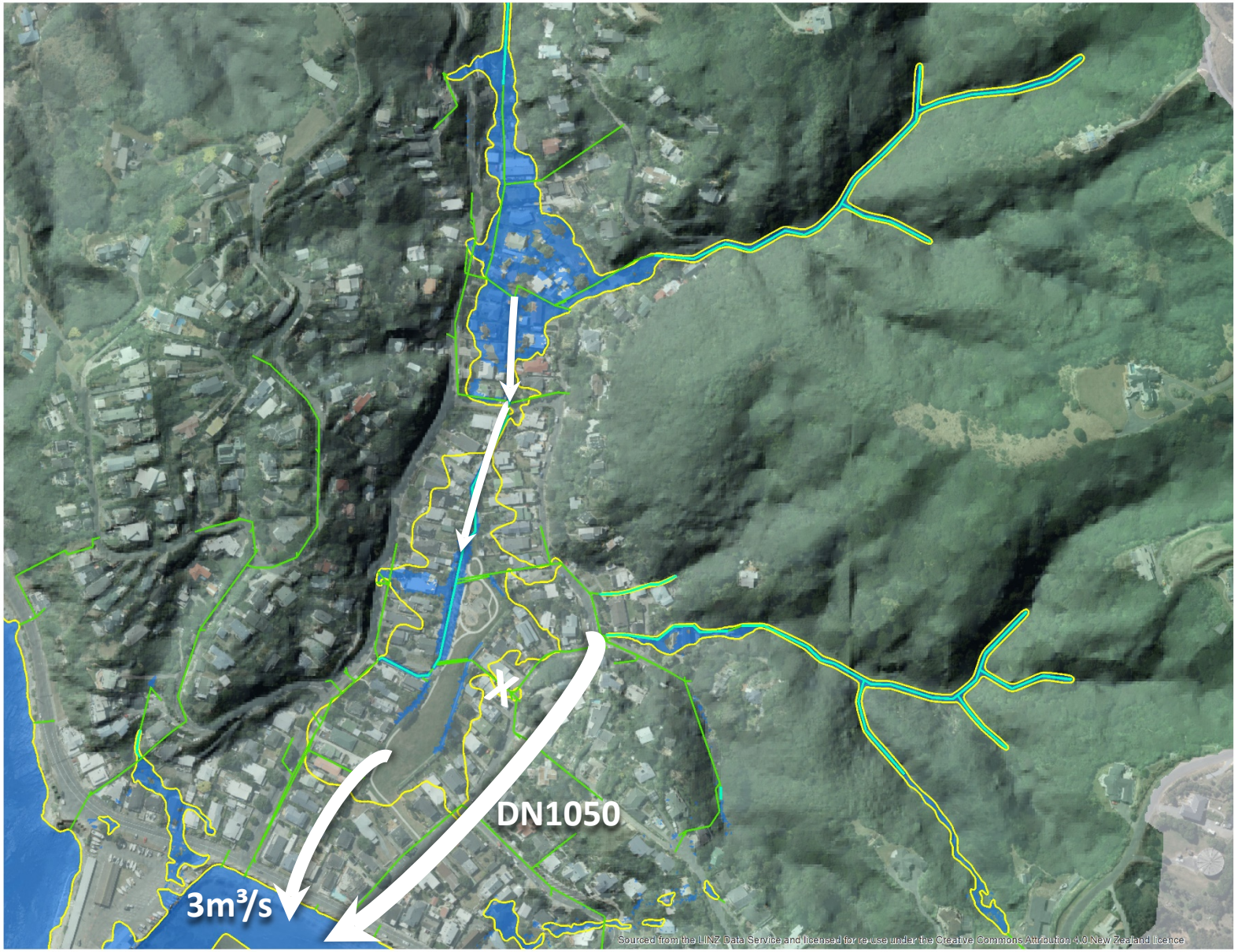
- Stormwater Pipes
- Option Flooding Extent
- Existing Flooding Extent

Pump, Improved Stream, Diversion, 30yr Event



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LEGEND

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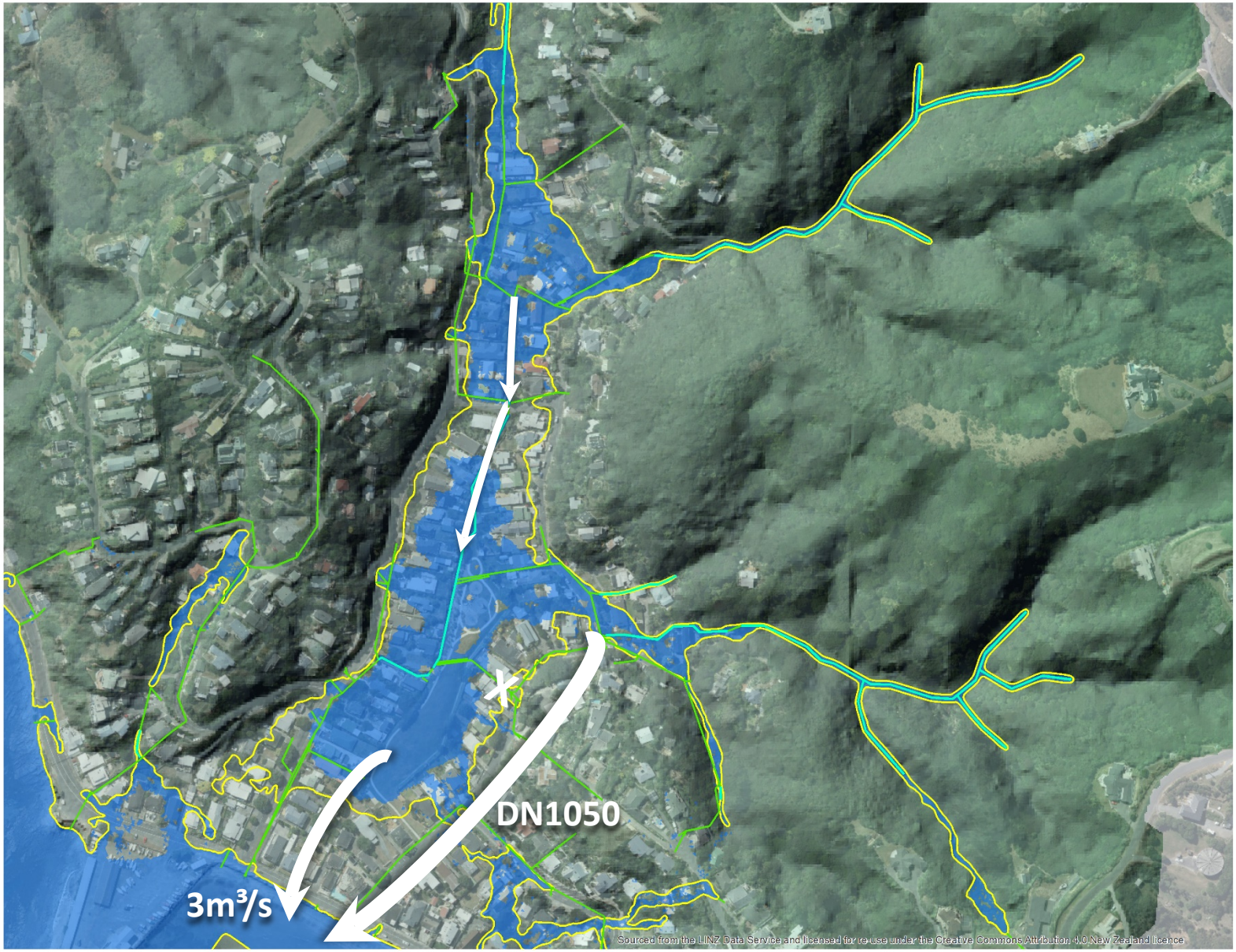
- Stormwater Pipes
- Option Flooding Extent
- Existing Flooding Extent

Pump, Improved Stream, Diversion, 100yr Event



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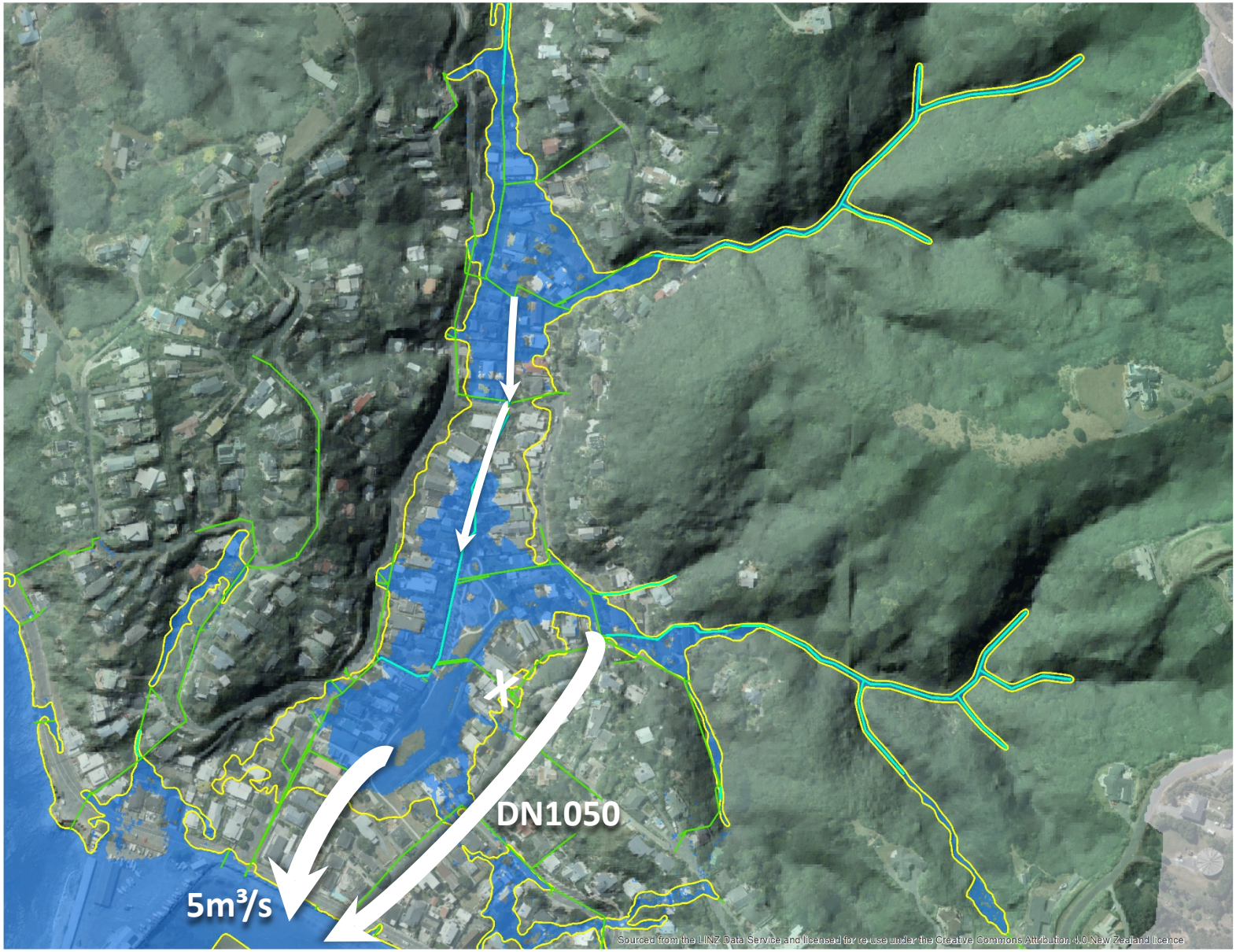
LEGEND

- Open Channels
- Stormwater Pipes
- Option Flooding Extent
- Existing Flooding Extent

Bigger Pump, Improved Stream, Diversion, 100yr Event



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LEGEND

- Open Channels
- Stormwater Pipes
- Option Flooding Extent
- Existing Flooding Extent

MCA Outcome/Recommendation

Mostly Defence

Primary Option

1 — A Pump Station in Karehana Park, a 'feeder' channel in the park, a discharge main in Cluny Road, and a new outfall in Moana Road.

Secondary Options

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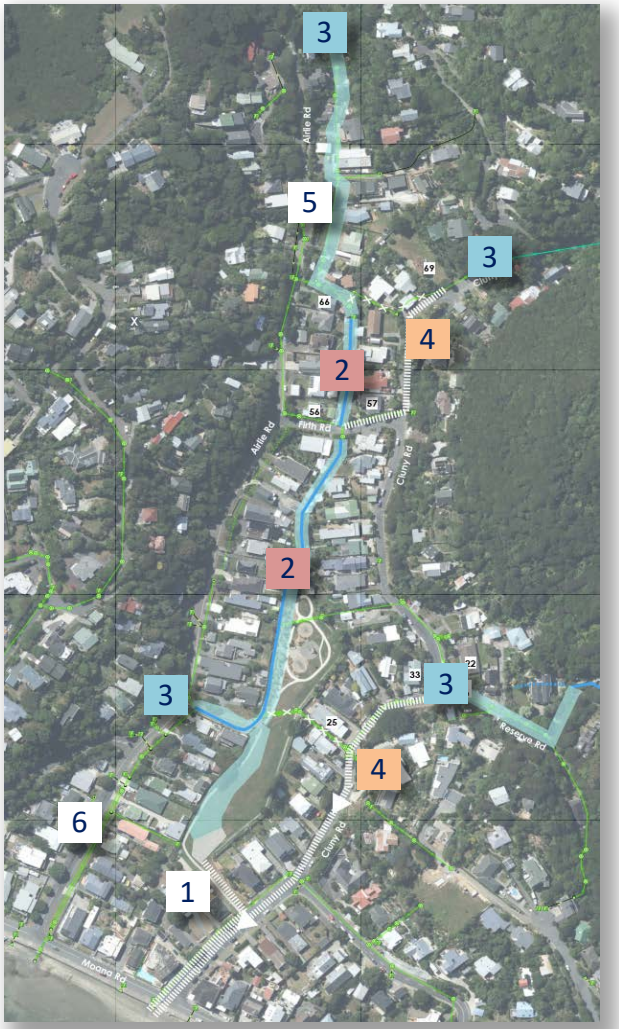
Tertiary Option

Residual House Raising (not shown)



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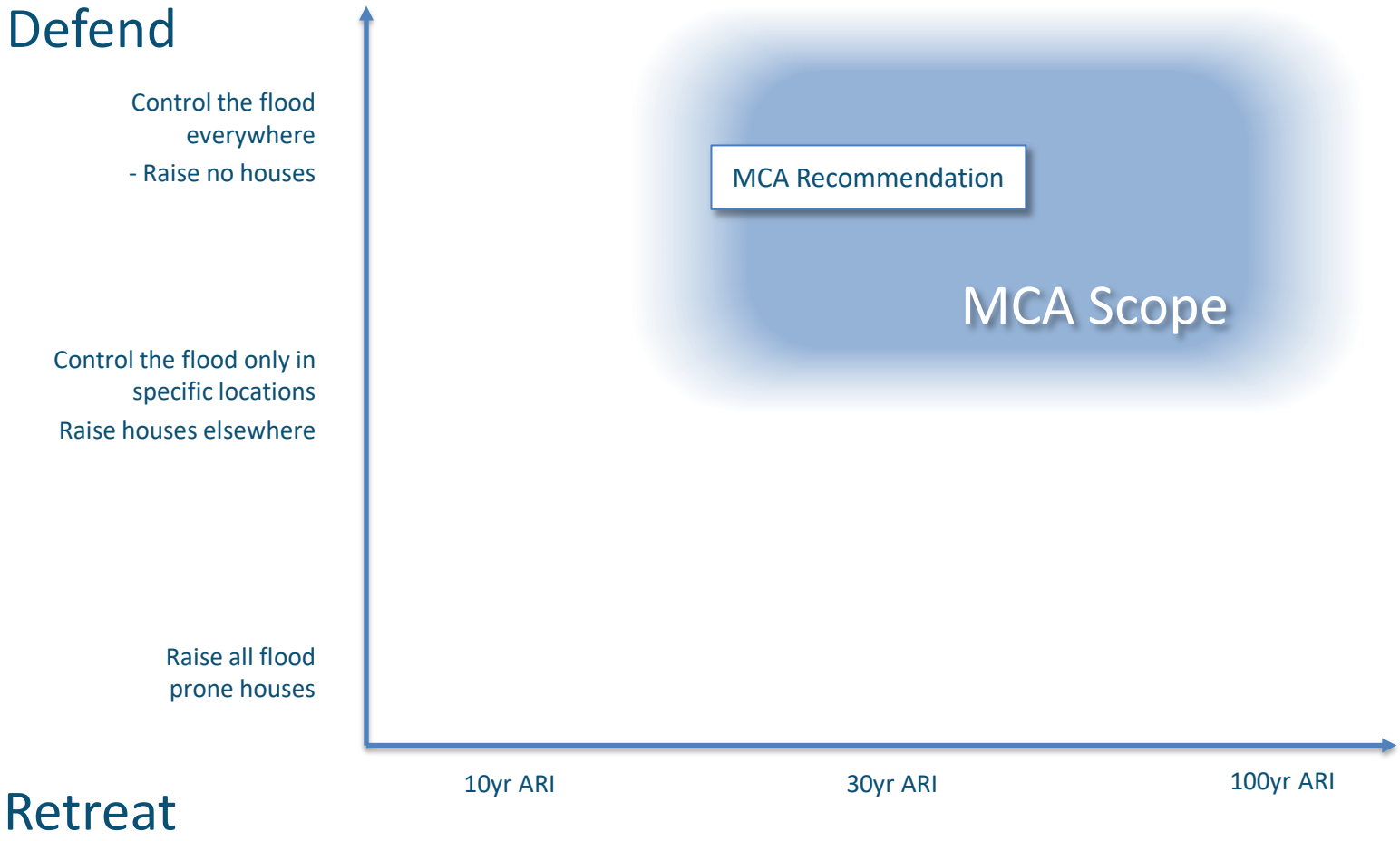

Defend
Control the flood everywhere
- Raise no houses
Control the flood only in specific locations
Raise houses elsewhere
Raise all flood prone houses
Retreat
MCA Recommendation
MCA Scope
10yr ARI
30yr ARI
100yr ARI
Level of Service

Alternative 1:

Less Defence, More Retreat

Primary Option

1 A Pump Station in Karehana Park, a 'feeder' channel in the park, a discharge main in Cluny Road, and a new outfall in Moana Road.

Secondary Options

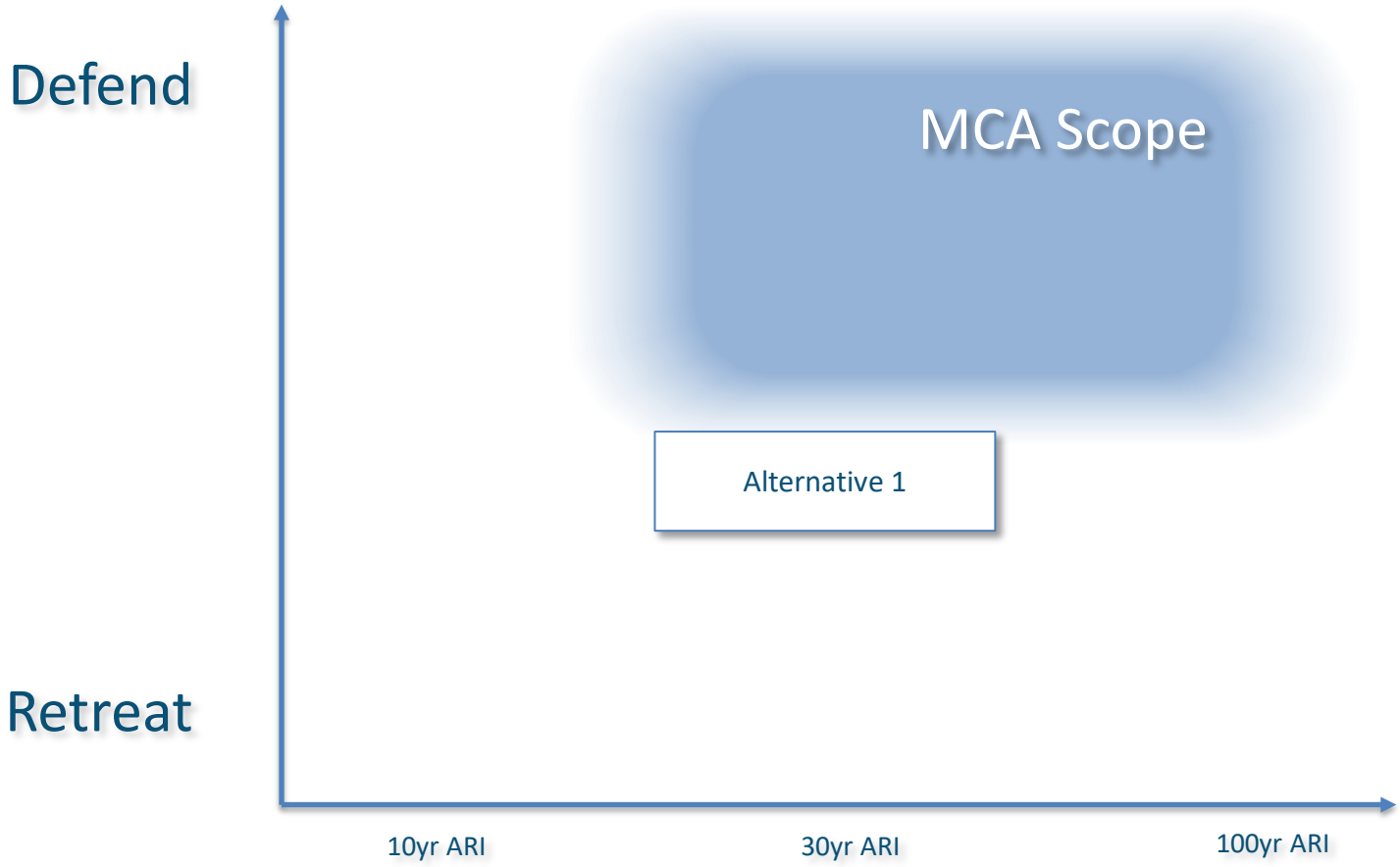
2 Stream Upgrades between nos. 42 and 64 Airlie Rd.

3 Improved Inlet Protection at key network entry points.

Tertiary Option

Residual House Raising (not shown)

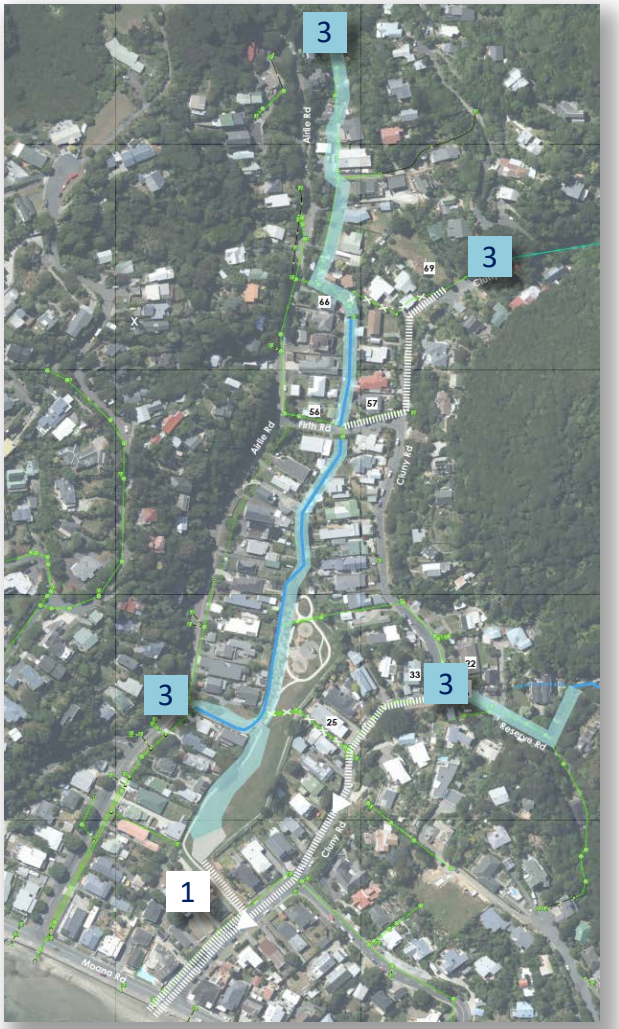
Our water, our future.


Defend
Retreat
MCA Scope
Alternative 1
10yr ARI
30yr ARI
100yr ARI

Alternative 2:

Even More Retreat

Primary Option	1	A Pump Station in Karehana Park, a 'feeder' channel in the park, a discharge main in Cluny Road, and a new outfall in Moana Road.
Secondary Option	3	Improved Inlet Protection at key network entry points.
Tertiary Option		Residual House Raising (not shown)



Wellington Water

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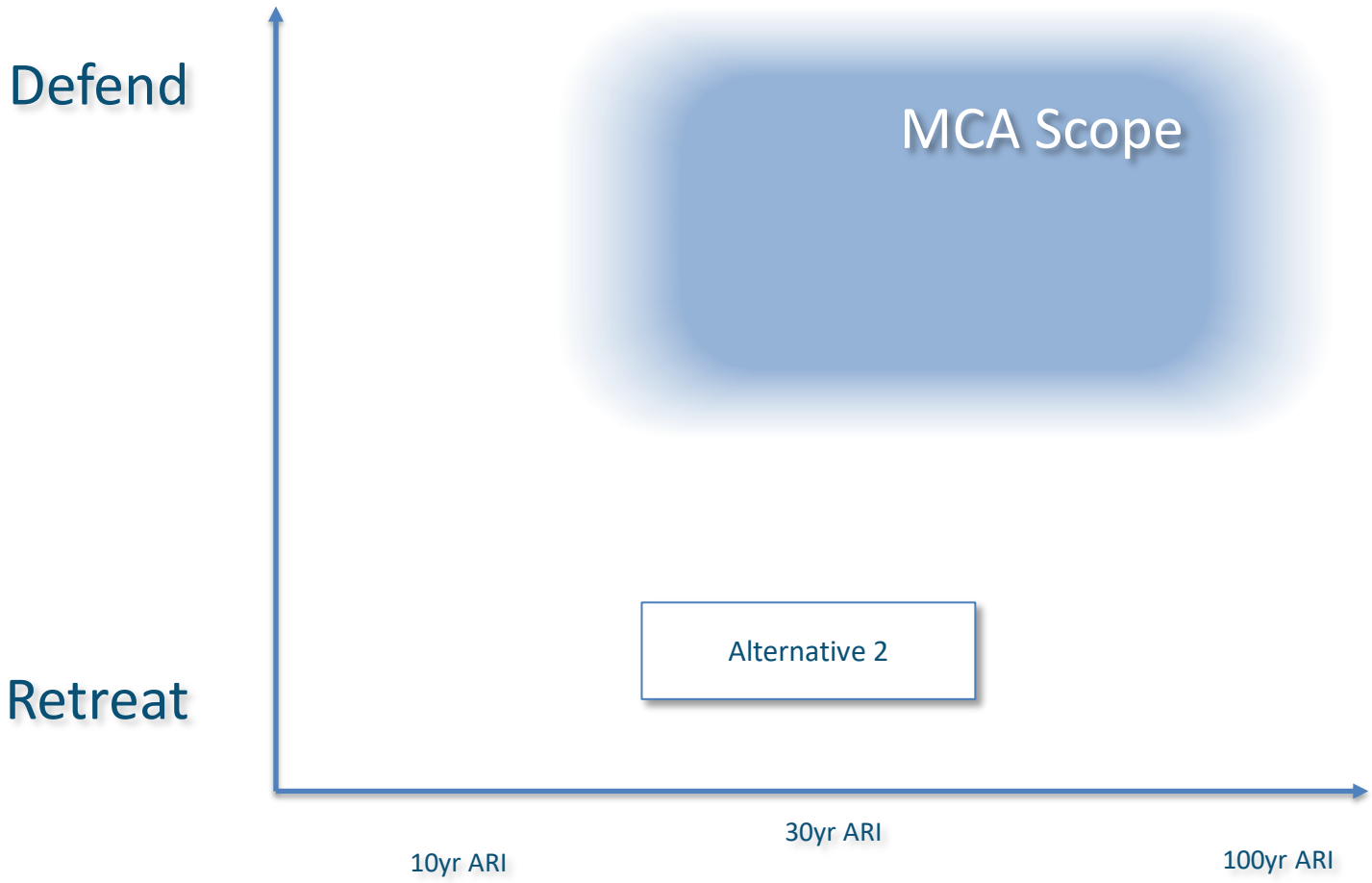

Defend
MCA Scope
Alternative 2
Retreat
10yr ARI
30yr ARI
100yr ARI
Level of Service

Cost Estimates

Wellington Water

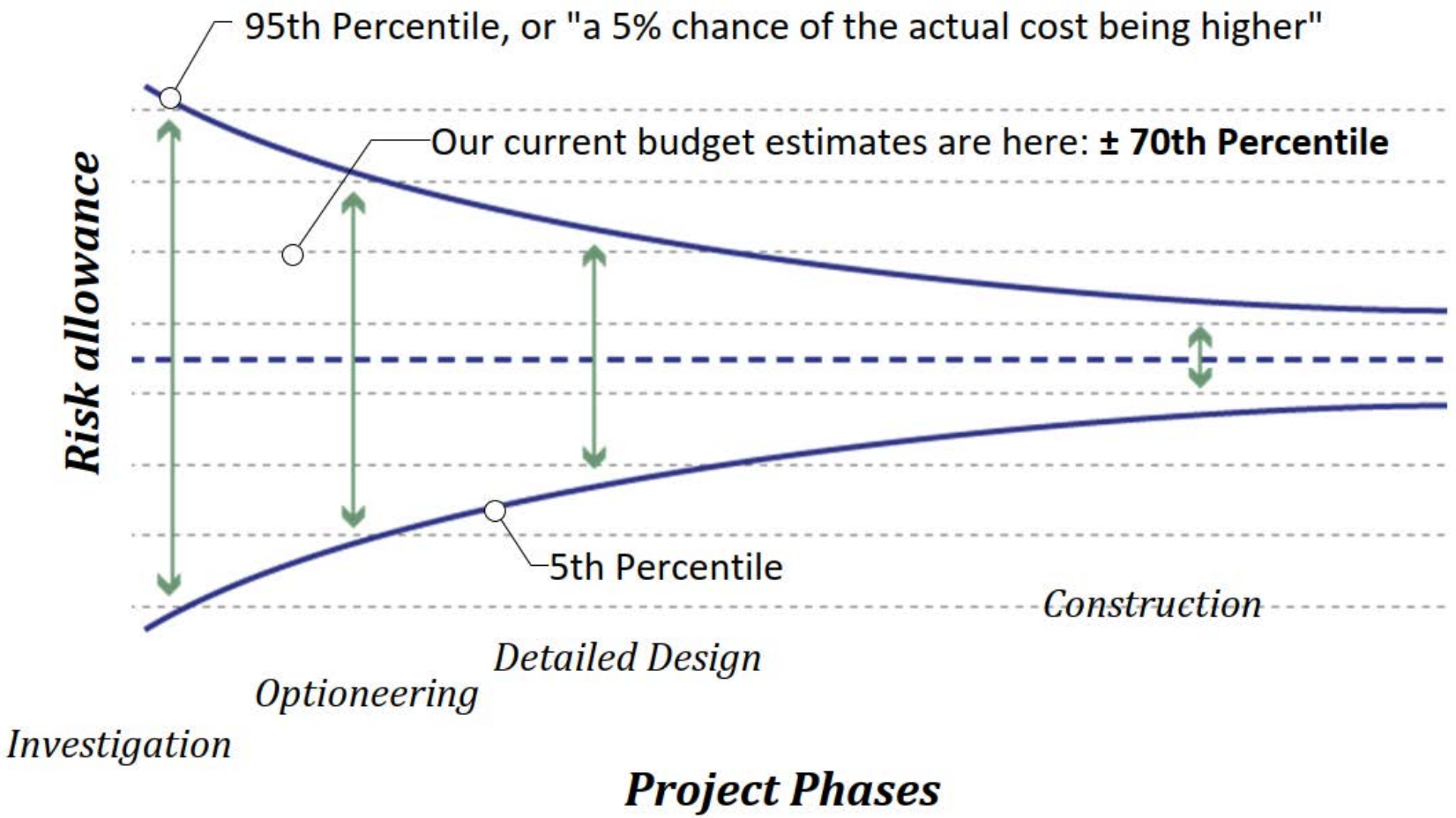
	MCA Recc.	Alt 1	Alt 2
Level of Service	30yr ARI event		
Pump Station (3 m^3/s)	$7.0M		
Inlet Protection	$1.5M		
Debris Flow Control (by others)	*$1.0M*		
Stream Upgrades	$3.2M		
Network Diversions	$3.5M		
Overland Flow Path Improvements	$1.0M		
Airlie Rd Improvements	$1.7M		
Subtotal (excl. house raising)	$17.9M	$12.7M	$9.5M
Buildings protected	20-25	15-25	15-20
Buildings raised	± 10	10-15	15-20
(+ cost)	$3.0M	$4.2M	$5.1M
TOTAL COST ESTIMATE (WWL CEM Lvl 2)	**$21.9M**	**$16.9M**	**$14.6M**

House Raising

- ***Pre feasibility and not included in the MCA***
- ***Only keeps indoor areas habitable***
- 'Uncontrolled' flow remains
- Access issues remain
- Cleanup still required
- 'Ballpark' estimate at $100k - $500k per property.
- May not always be possible

Storm Event	Habitable Bdgs Flooded	Est. Cost of '100% Retreat'
10yr ARI	20 – 25	$6–10M
30yr ARI	30 – 40	$9–16M
100yr ARI	60 – 90	$18–36M

Cost Certainty vs Time



Risks

Defence	Retreat
Operational Failure	
Cost	
Ground Conditions	
Private Property	
Planning, Law	
	H&S, Quality of Life
	Access
	Control
	Equity of service
	Case by case / practicability
	Precedent

Project Service Goals

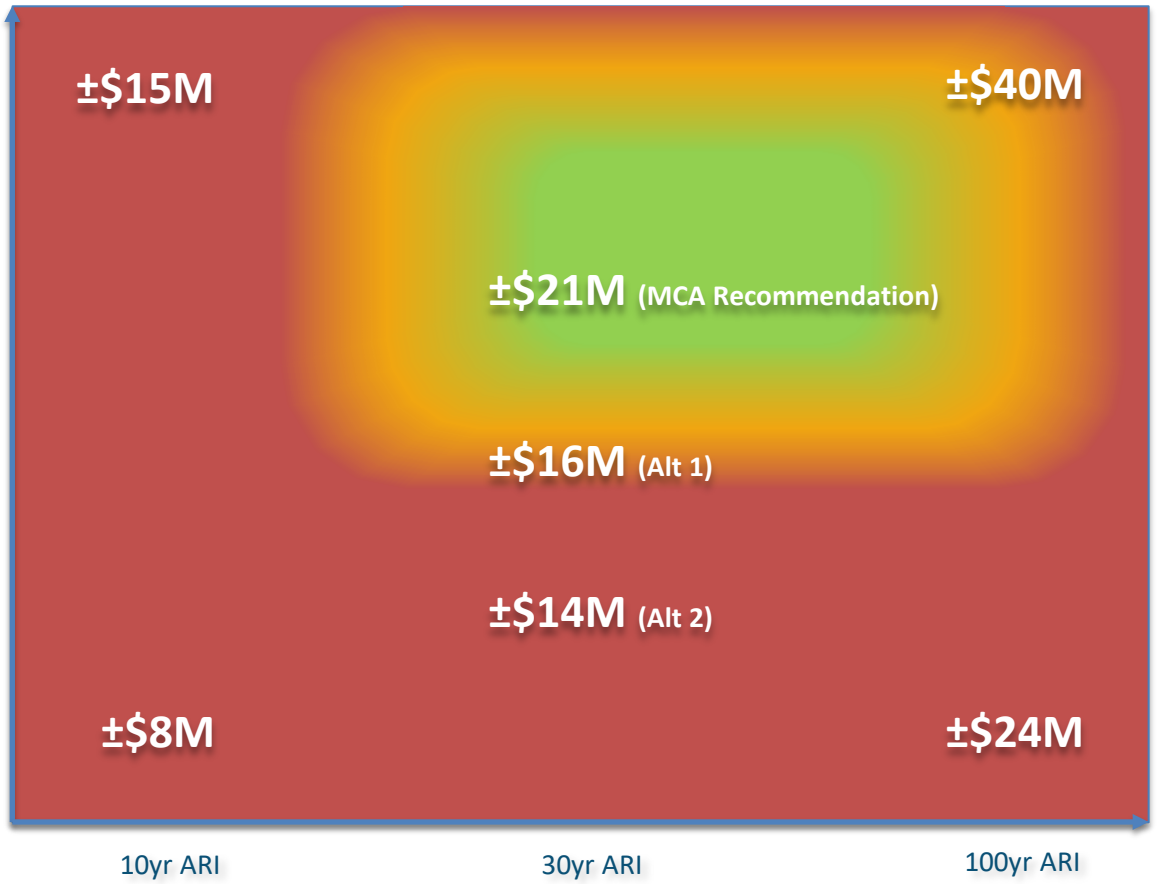
Primary		**We minimise the impact of flooding on people's lives and proactively plan for the impacts of climate change** We are seeking a solution to reduce the number of habitable floors effected by flooding.
Secondary		**We minimise public health risks associated with wastewater and stormwater** We are seeking a solution to reduce the number of wet weather overflows onto land.
Secondary		**We operate and manage assets that are safe for our suppliers, people and customers** The solution should ensure that all public stormwater assets (existing and new) meet the Wellington Water health and safety requirements. Any existing operational risks are identified and changes to the assets are included in the design.

To what degree are we comfortable with…?

Defend

vs.

Retreat



What is an acceptable (and affordable) Level of Service

Confidence

PCC LTP CAPEX allocations

Area	2022/23	2023/24	2024/25	2025/26
Porirua	$10M	$10M		
Takapuwahia		$1M	$1M	$1M

Questions?

Wellington Water