



**KAIKŌURA EARTHQUAKE
WATER RESOURCE IMPACTS
PROJECT UPDATE**

Ministry for Primary Industries
Manatū Ahu Matua

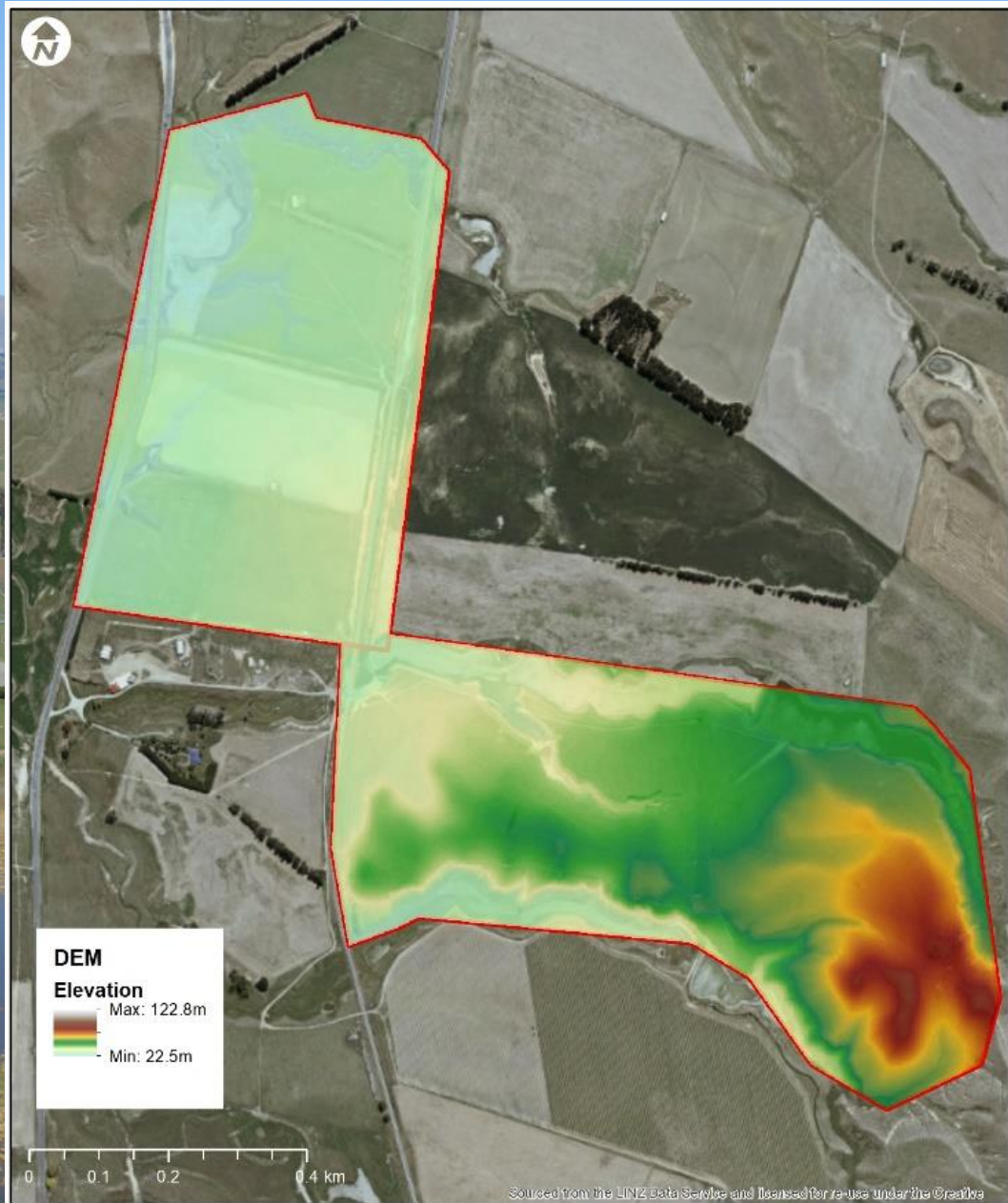


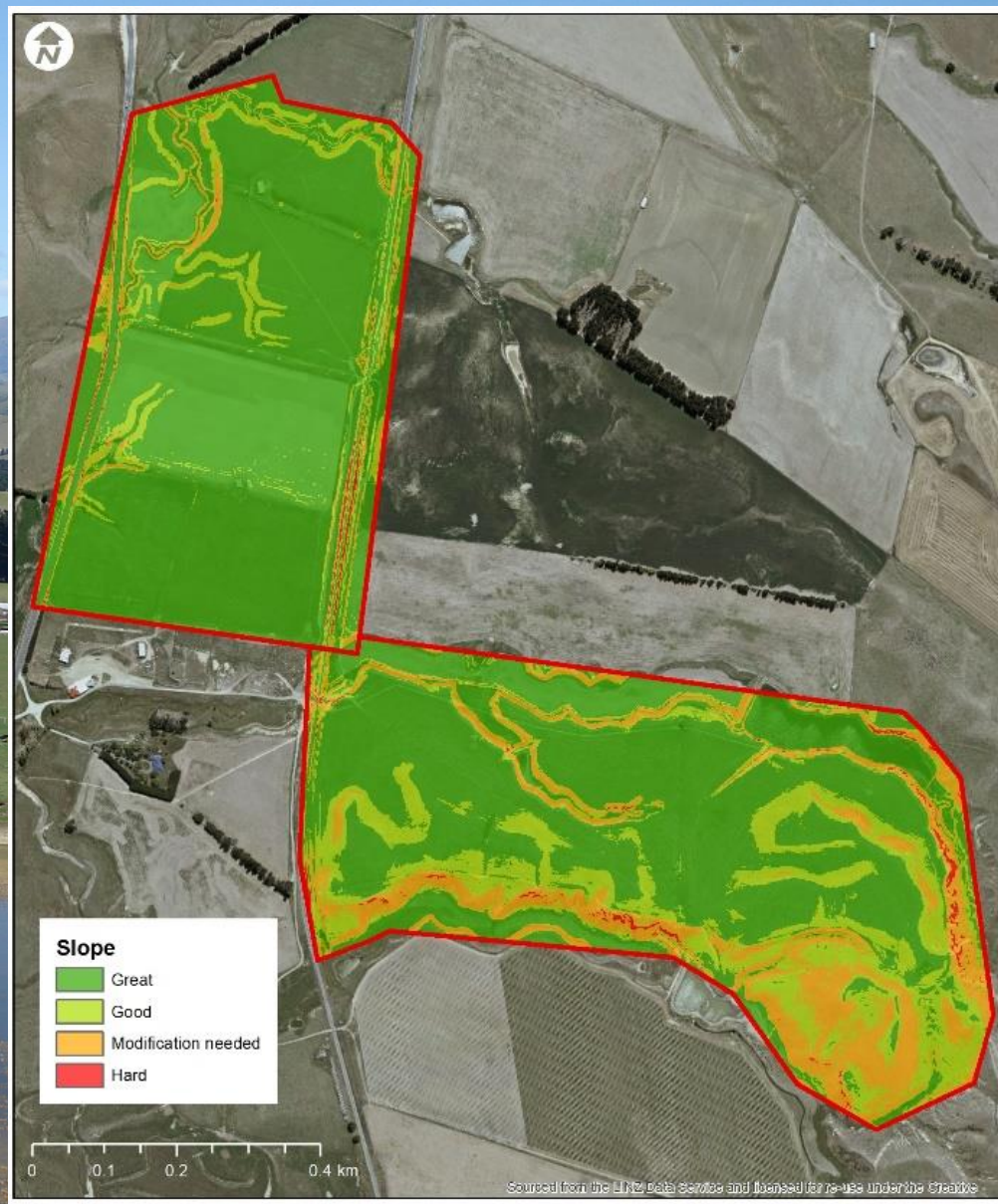
WSP | **OPUS**

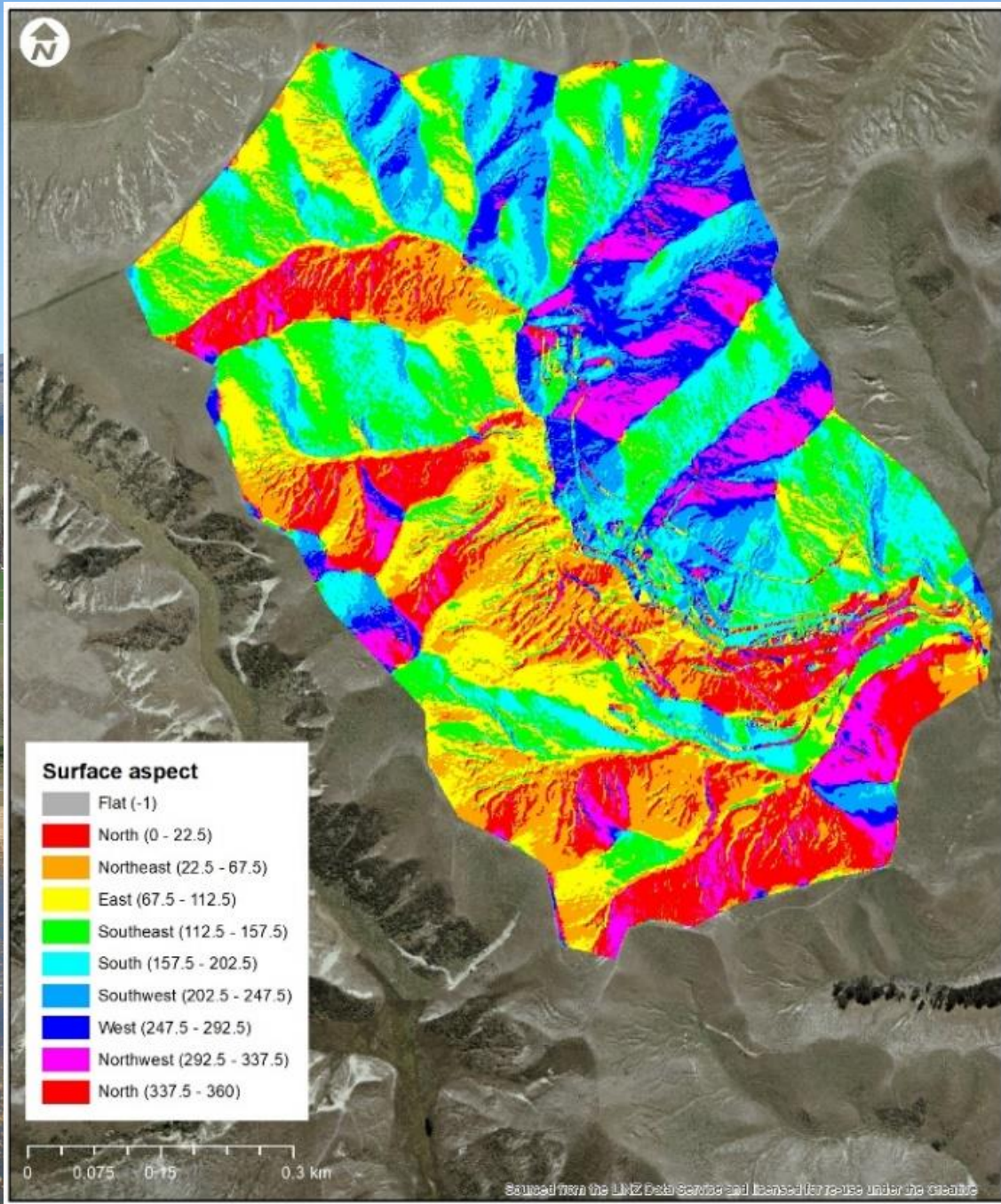
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- The Kaikōura Earthquake caused massive changes in the Waima/Flaxbourne/Mirza catchments
 - These changes have affected the water resources of these catchments
 - Changes to the distribution and dynamics of the water resources have implications for both the Ward Community and land use

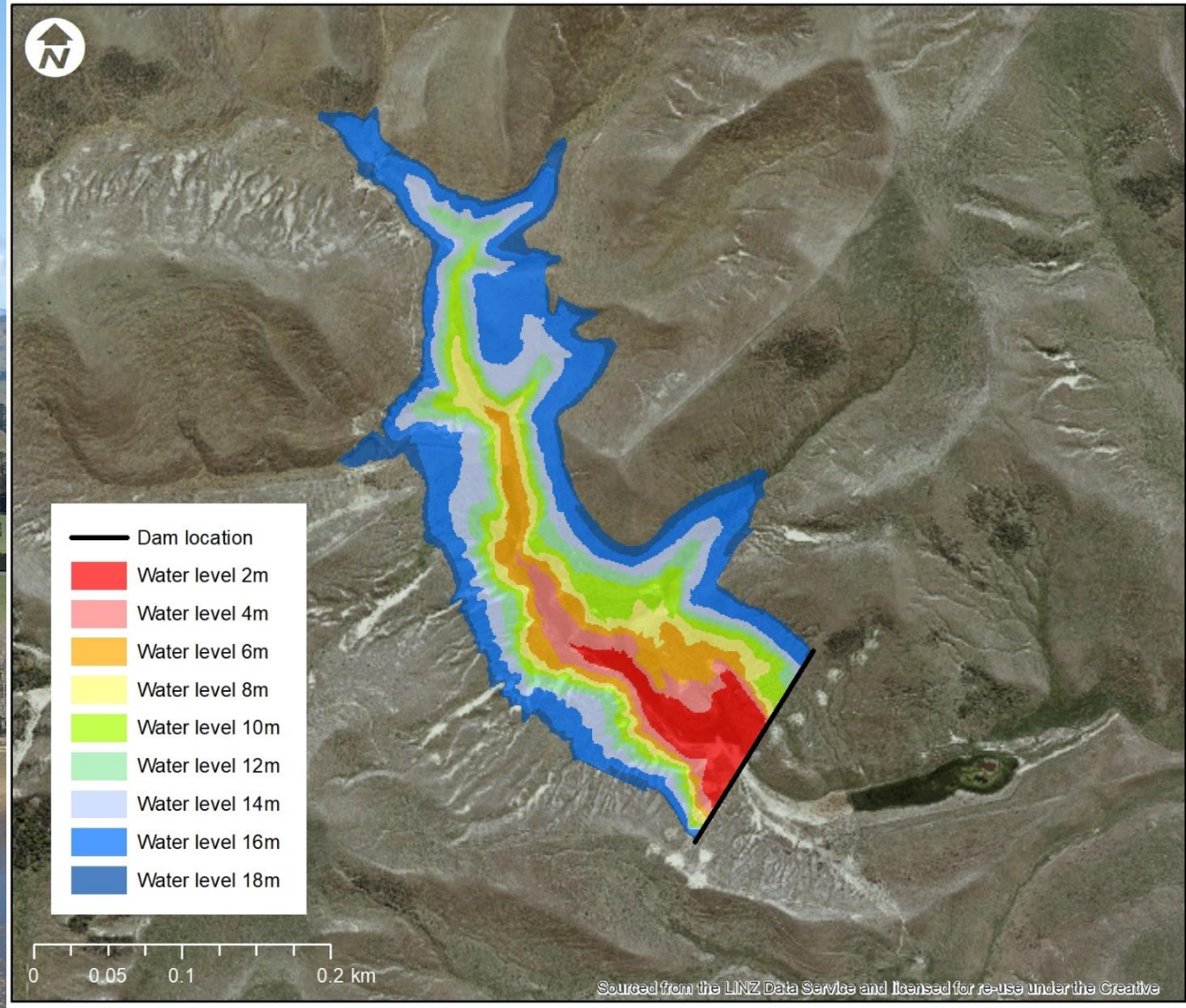
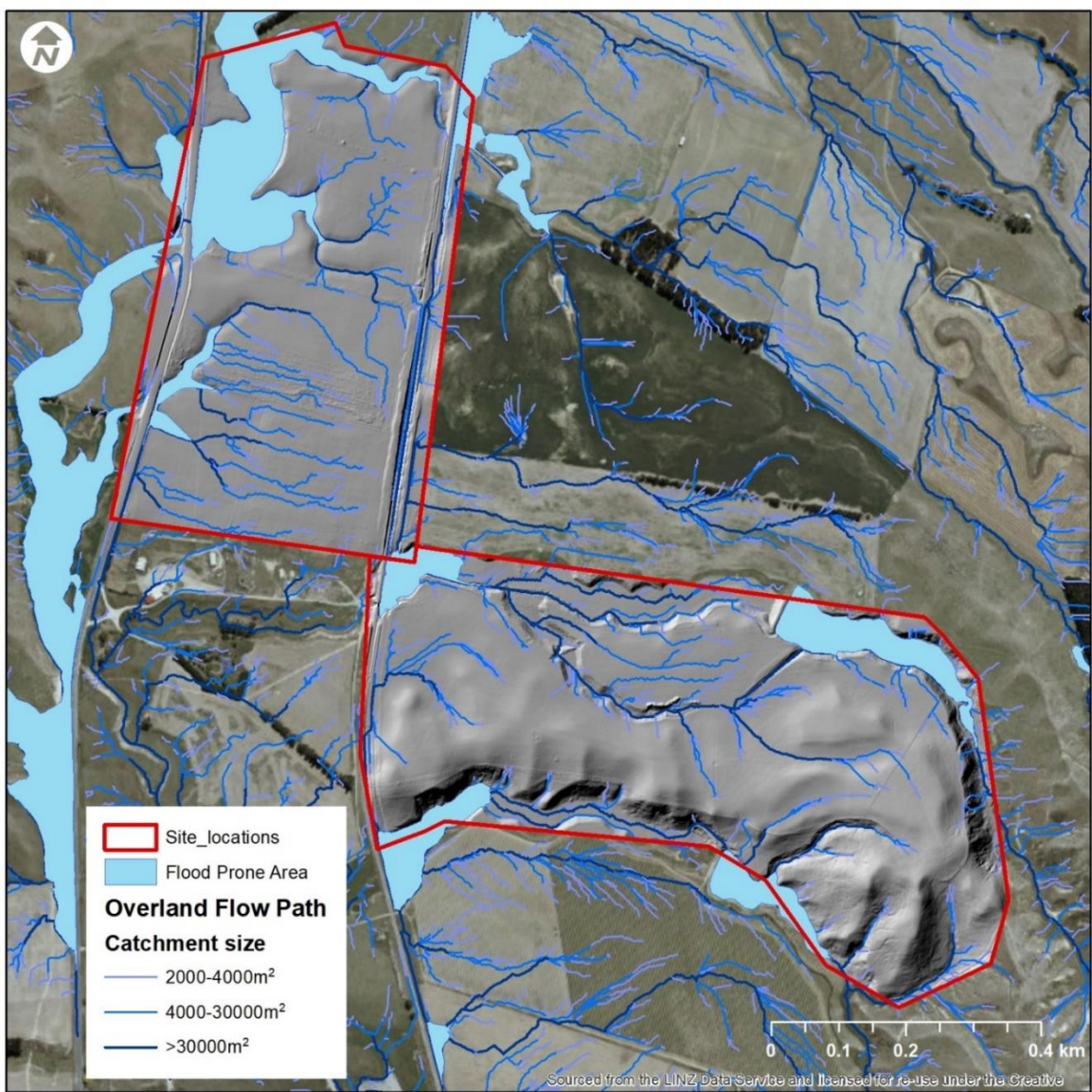
PRACTICAL USE OF LiDAR

- The Flaxbourne Settlers' Group (FSG) obtained high resolution LiDAR which was used to produce a Digital Terrain Model (DTM) of the Waima/Ure, Mizra and Flaxbourne catchments
- The data can be obtained free from the Marlborough District Council:
<https://maps.marlborough.govt.nz/smmaps/?map=9590cd3c520c4f7e82cdcd5a208b8466>
- DTMs can be used to assist land use decisions on both a large and small scale. For example, slope and aspect can be used to highlight possible irrigable areas, and flow paths can be used to assess options for drainage and water storage
- When used in with information on soils and land cover, DTMs can also be used to better understand nutrient loss and erosion rates etc.





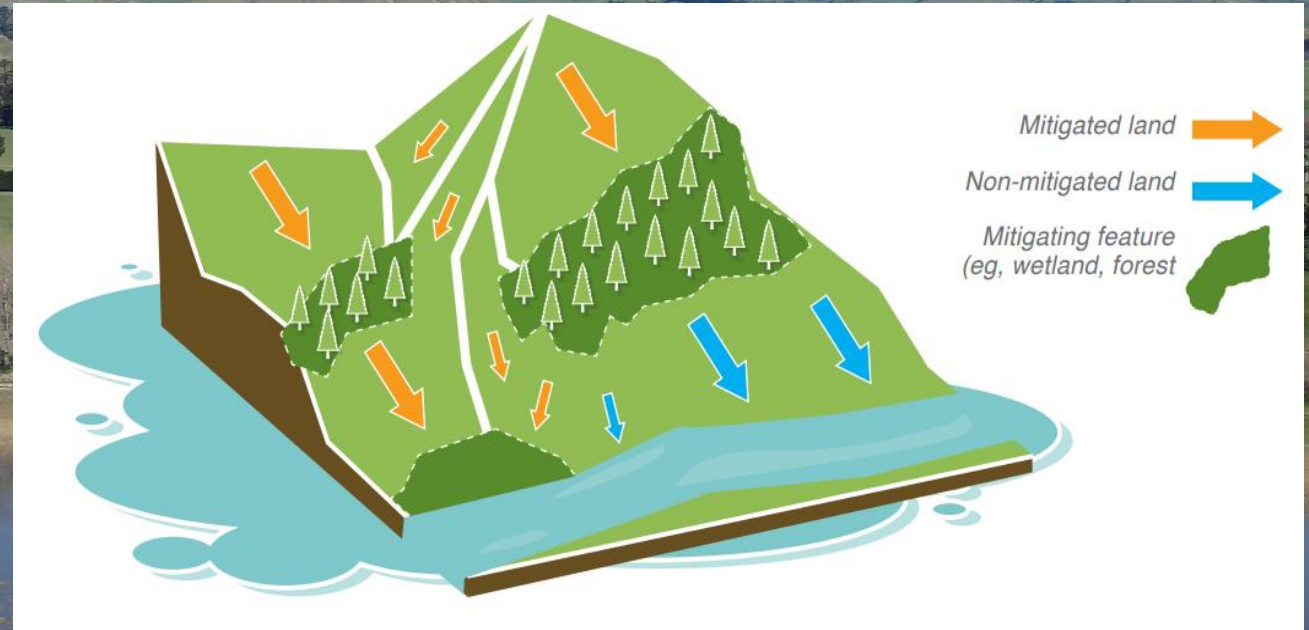




Water level (m)	2m	4m	6m	8m	10m	12m	14m	16m	18m
Volume (m ³)	4329	15261	34857	64328	103916	156062	222551	356905	417136

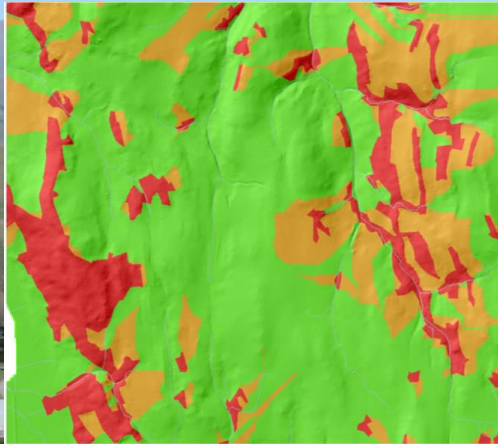
LUCI – Land Utilization & Capability Indicator

- LUCI allows testing of different scenarios and options
- Looks at trade-offs and searches for “win-win” solutions

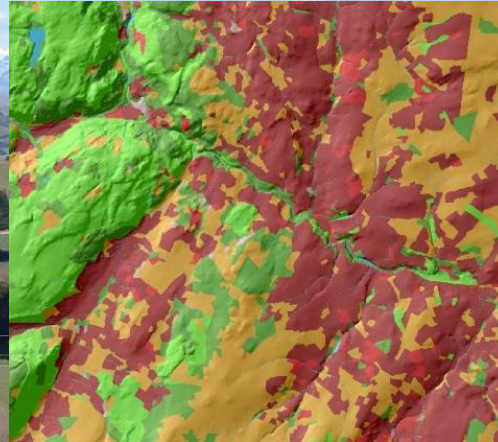


Flooding and agricultural productivity

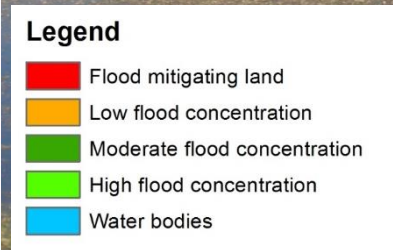
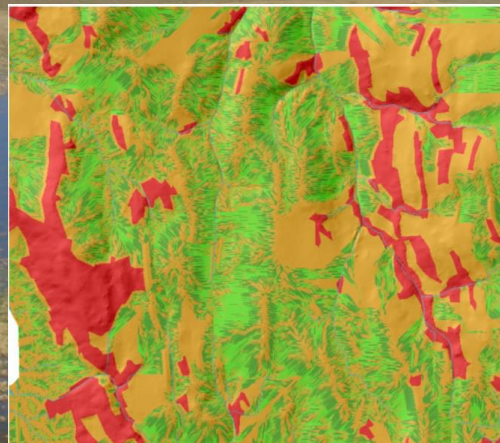
Flood mitigation



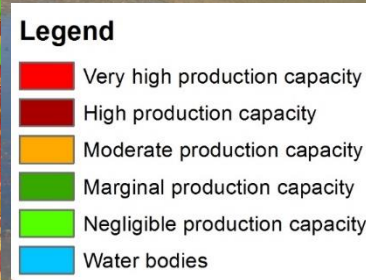
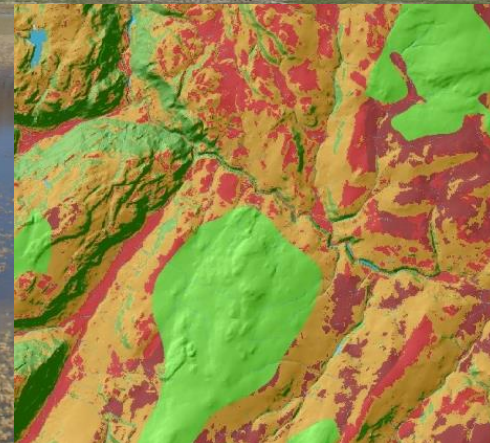
Current production



Flood interception



Optimal production



Other Services

Agricultural production

C stock/emissions

CH₄/N₂O emissions

Water supply and floods/ droughts

Erosion

Sediment delivery

Water quality

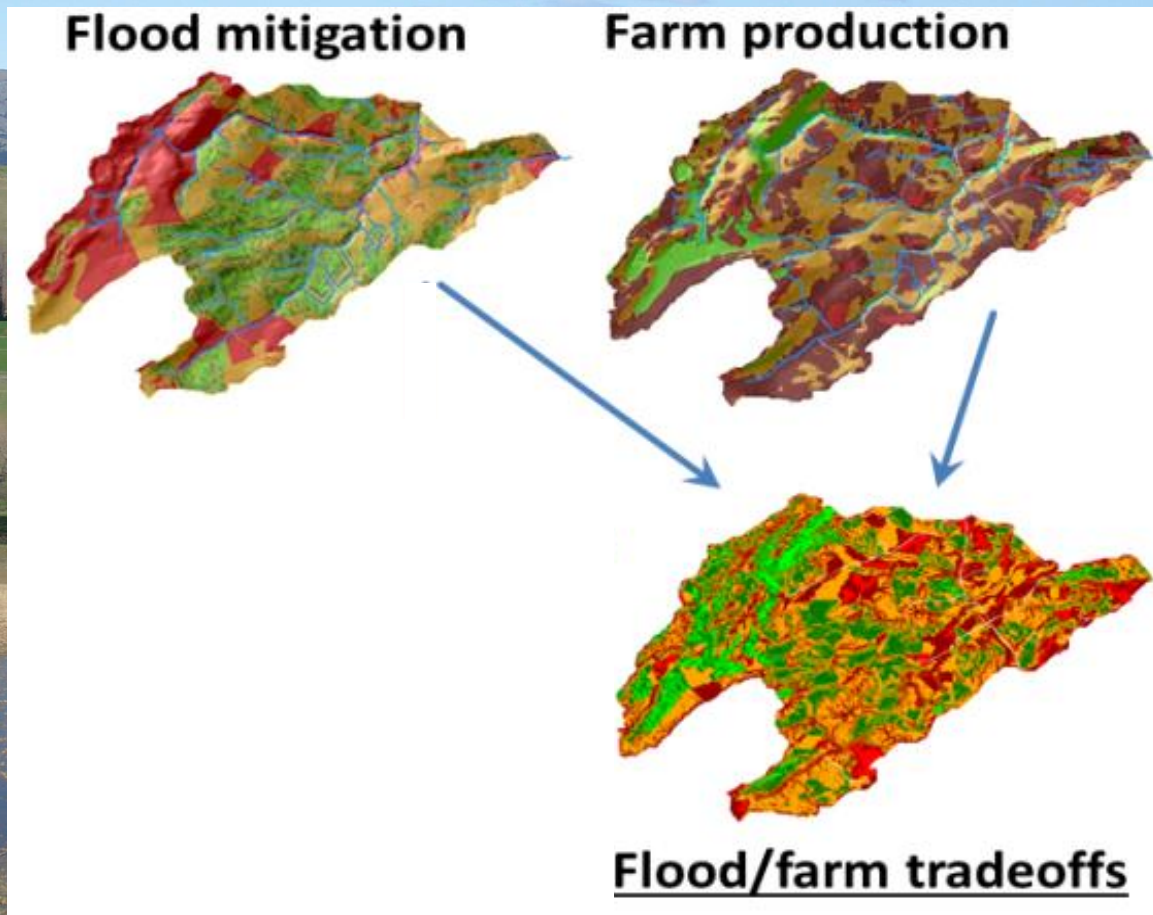
Habitat Approaches

Coast/ floodplain inundation risk

Trade-offs/synergy identification

Trade-off analysis

- Where should you target planting to improve water quality and provide flood protection while having a minimal impact on productivity.



Key to single service maps

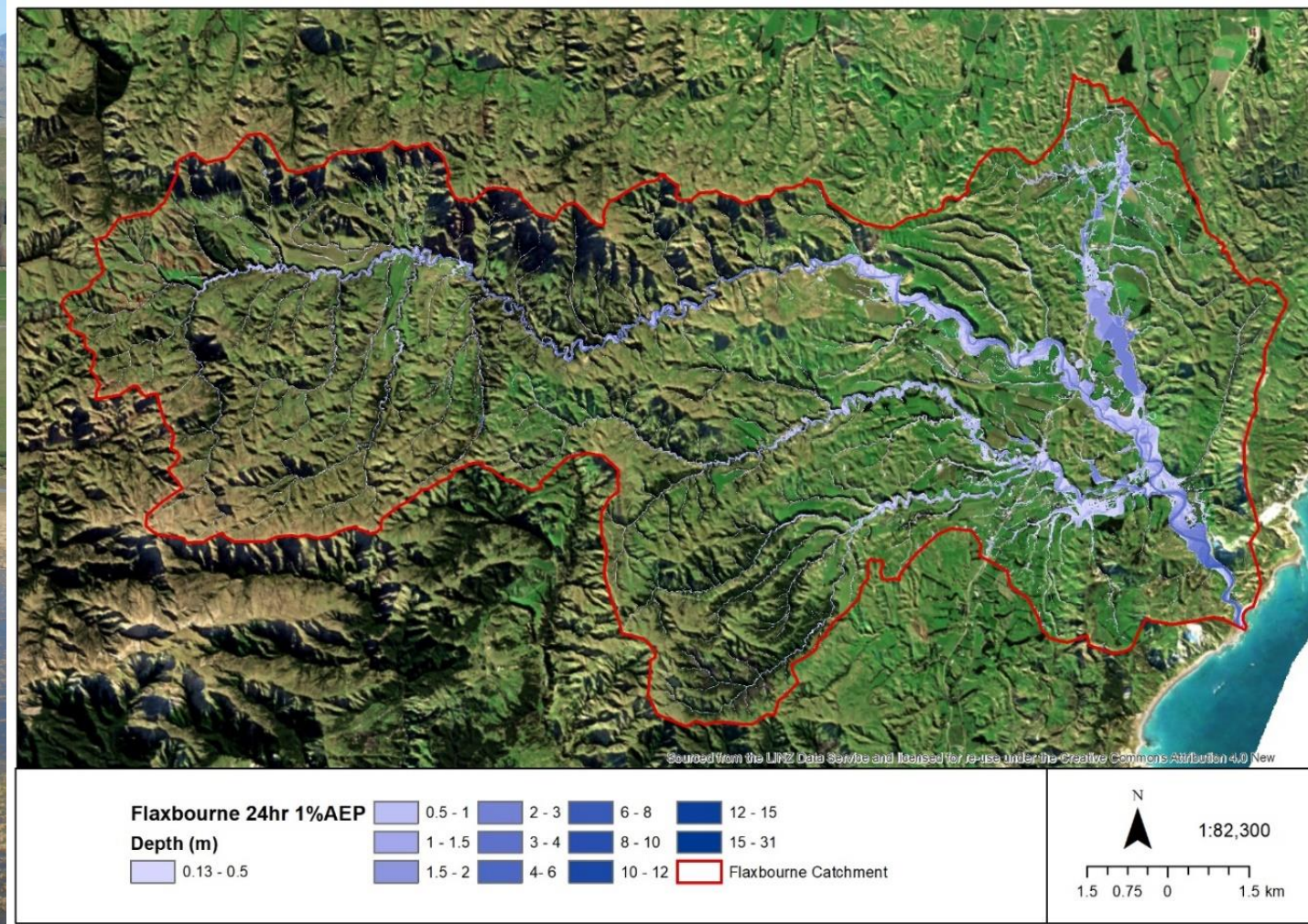
Red	High existing value
Dark red	Existing value
Orange	Marginal value
Green	Opportunity to improve service
Bright green	High opportunity to improve

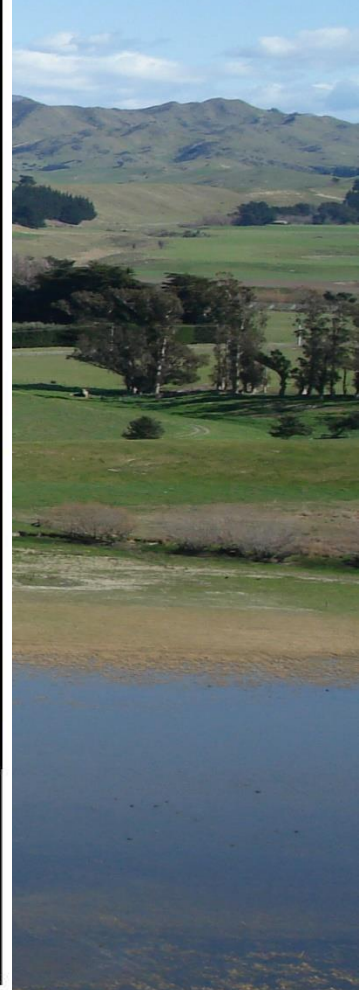
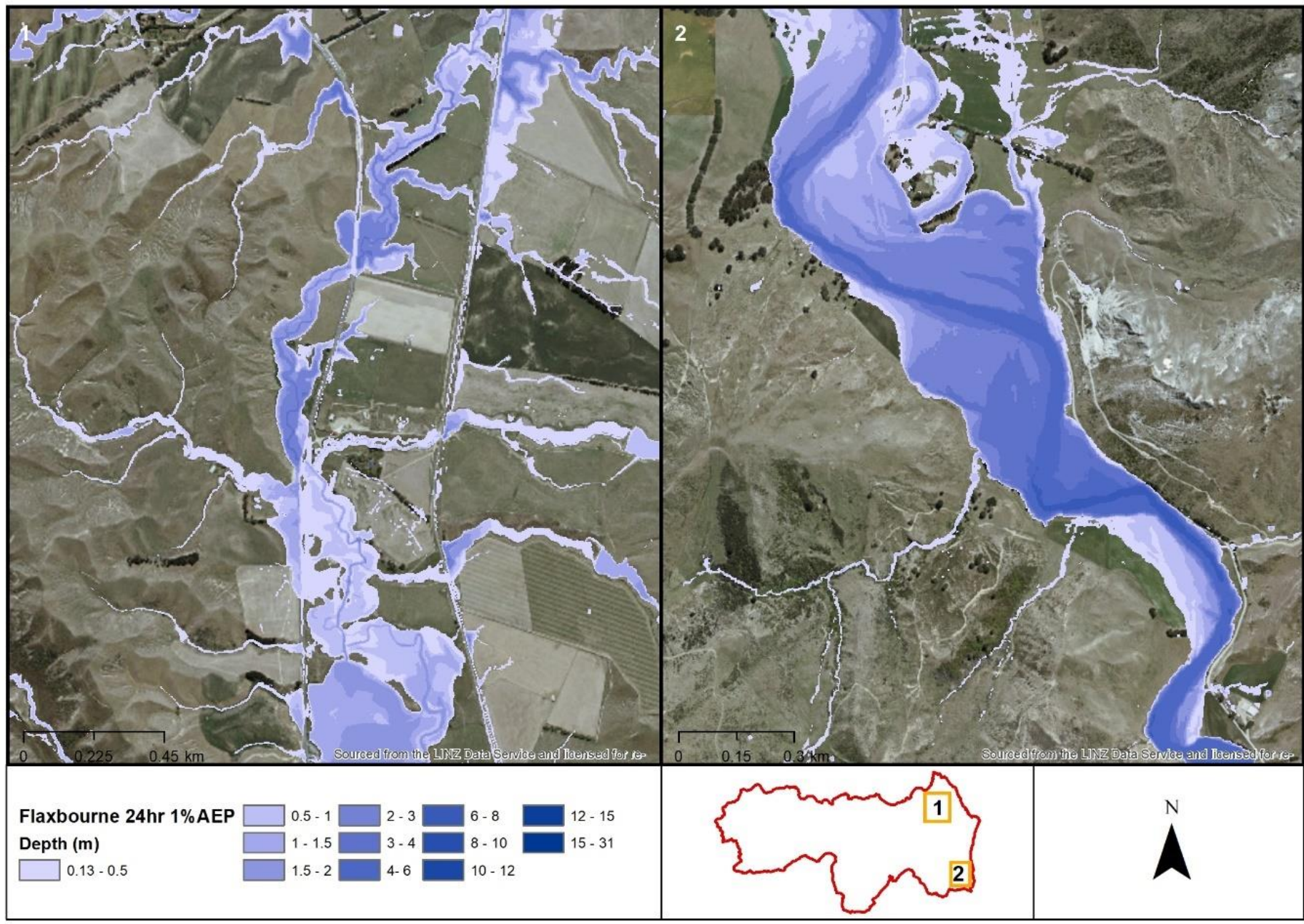
Key to trade-off maps

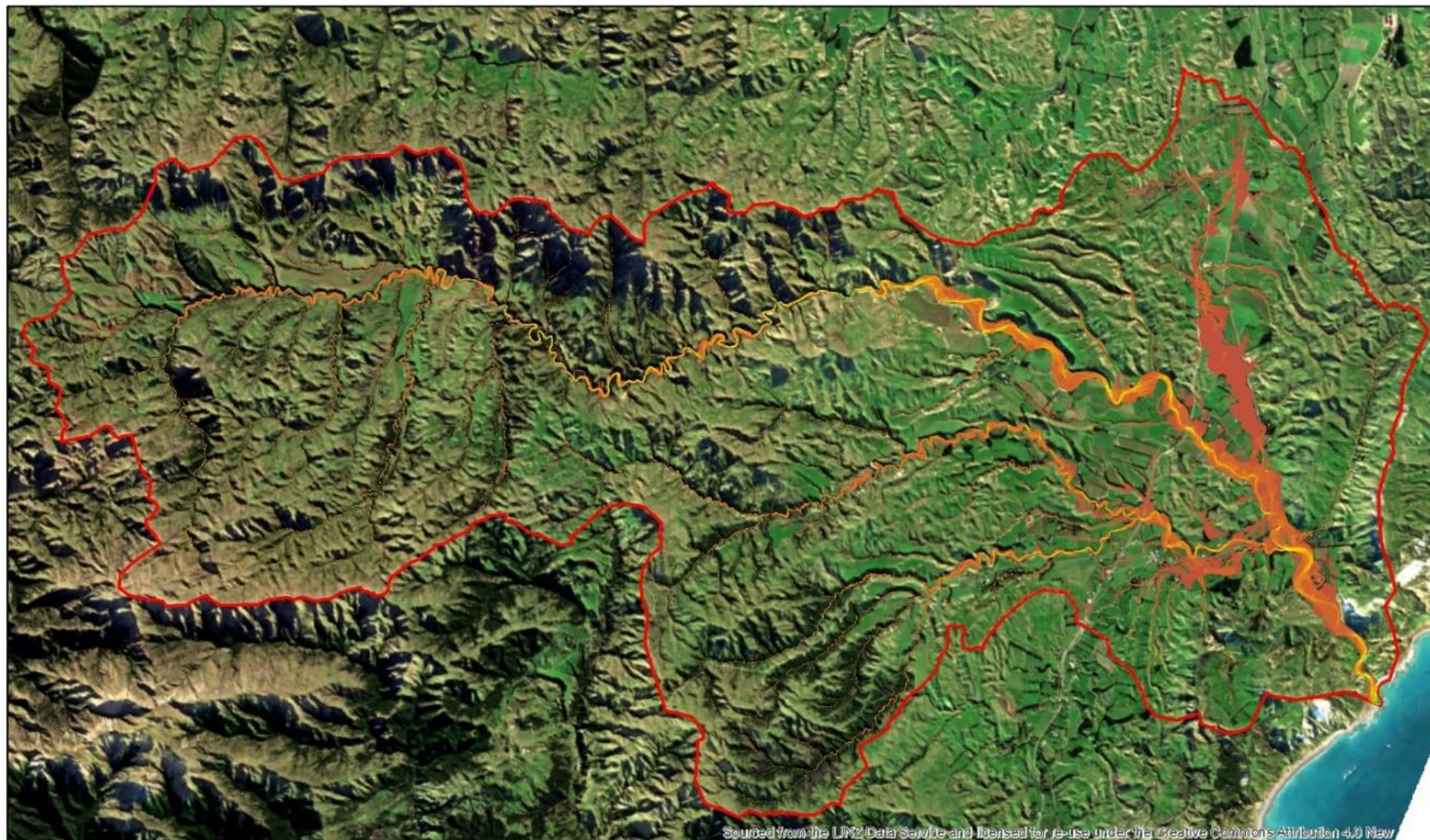
Red	Multiple existing services
Dark red	Some service(s) provided
Orange	Tradeoffs in service provision
Green	Opportunity to improve some service(s)
Bright green	Opportunity to improve multiple services

FLOOD MODELLING

The flood hazard within the Flaxbourne, Waima/Ure and Mirza catchments was investigated using a 2-D model








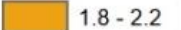
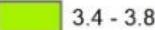



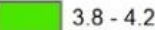






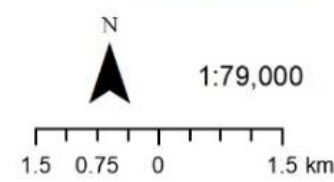


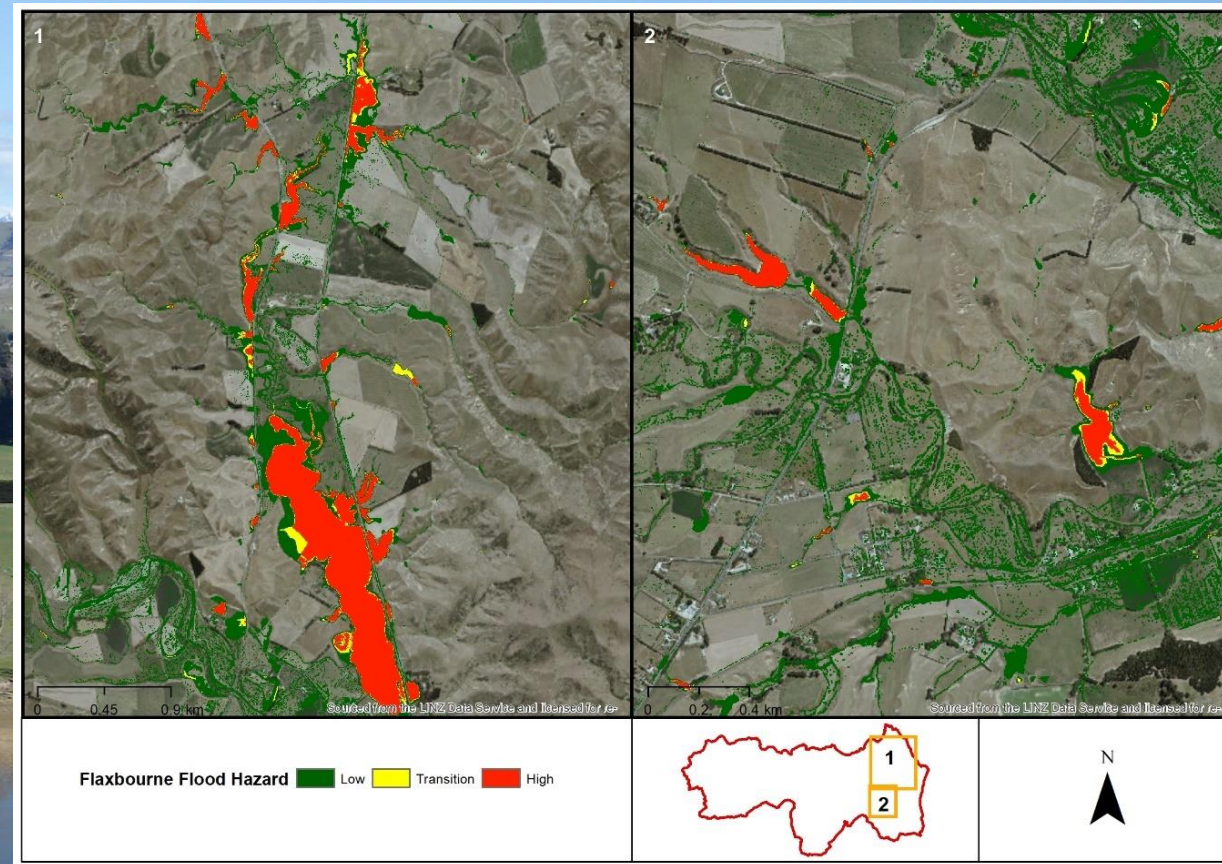
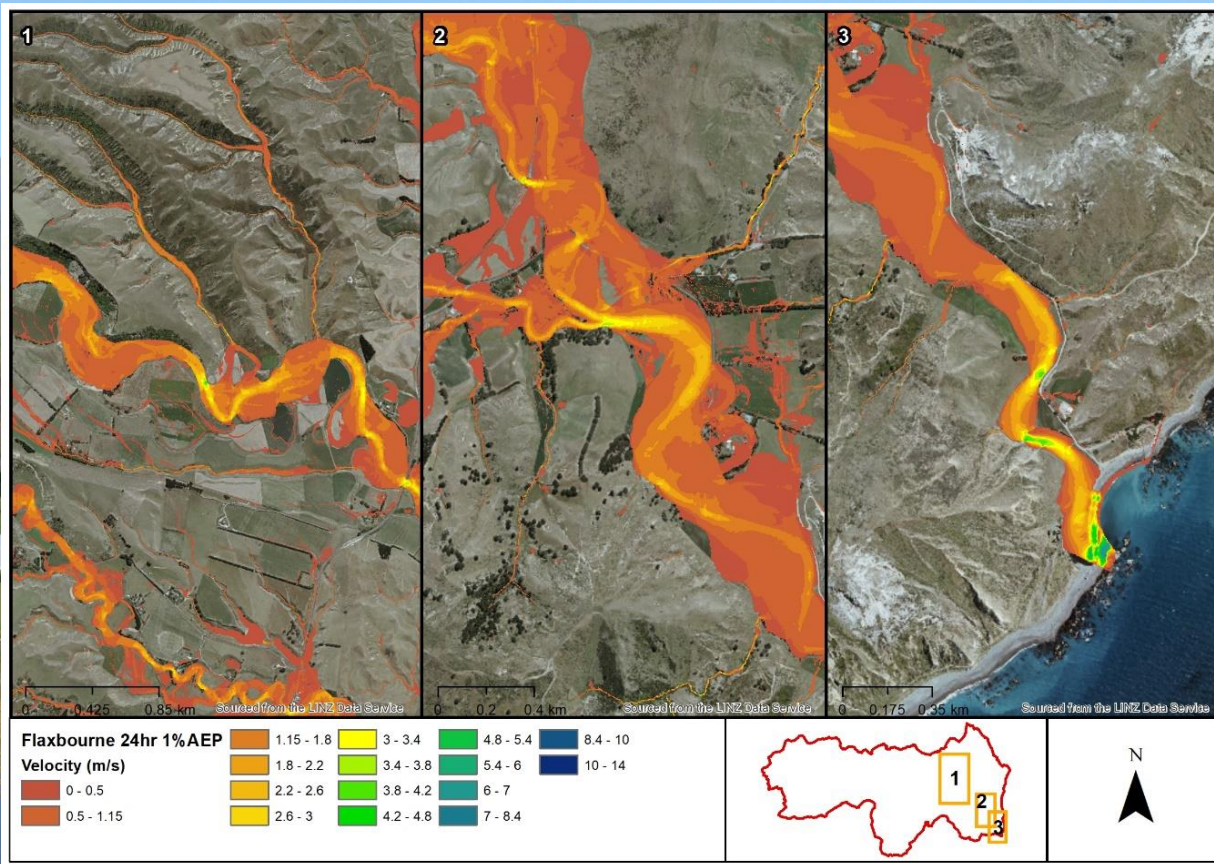
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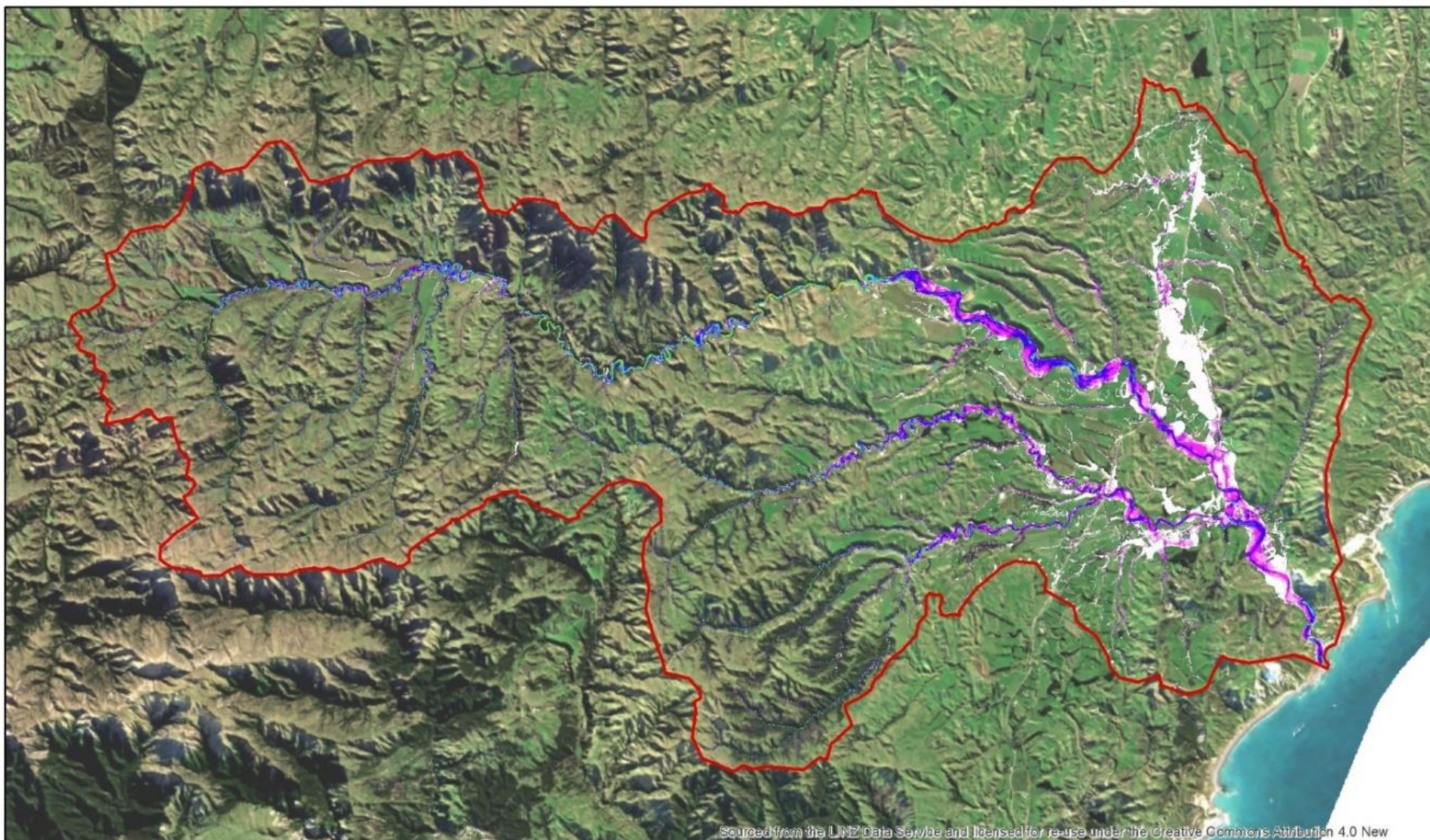
Flaxbourne 24hr 1%AEP

Velocity (m/s)

	0 - 0.5		1.15 - 1.8		3 - 3.4		4.8 - 5.4		8.4 - 10
	0.5 - 1.15		1.8 - 2.2		3.4 - 3.8		5.4 - 6		10 - 14
			2.2 - 2.6		3.8 - 4.2		6 - 7		Flaxbourne Catchment
			2.6 - 3		4.2 - 4.8		7 - 8.4		







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Flaxbourne 24hr 1%AEP

Bed shear stress

0 - 10

10 - 20

20 - 40

40 - 50

50 - 100

100 - 150

150 - 200

200 - 250

250 - 300

300 - 400

400 - 500

500 - 800

800 - 1,000

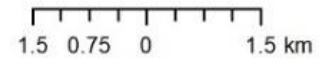
1,000 - 1,500

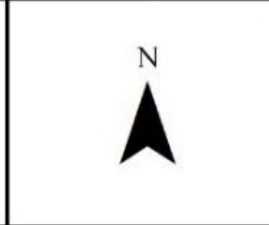
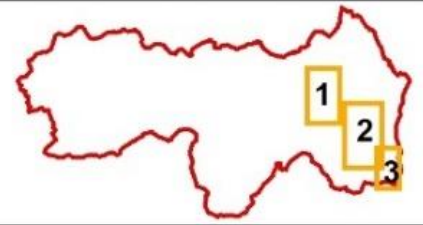
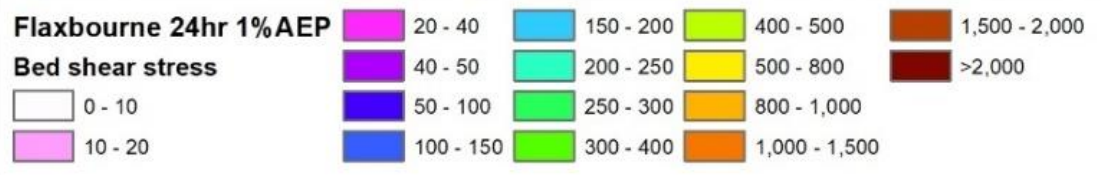
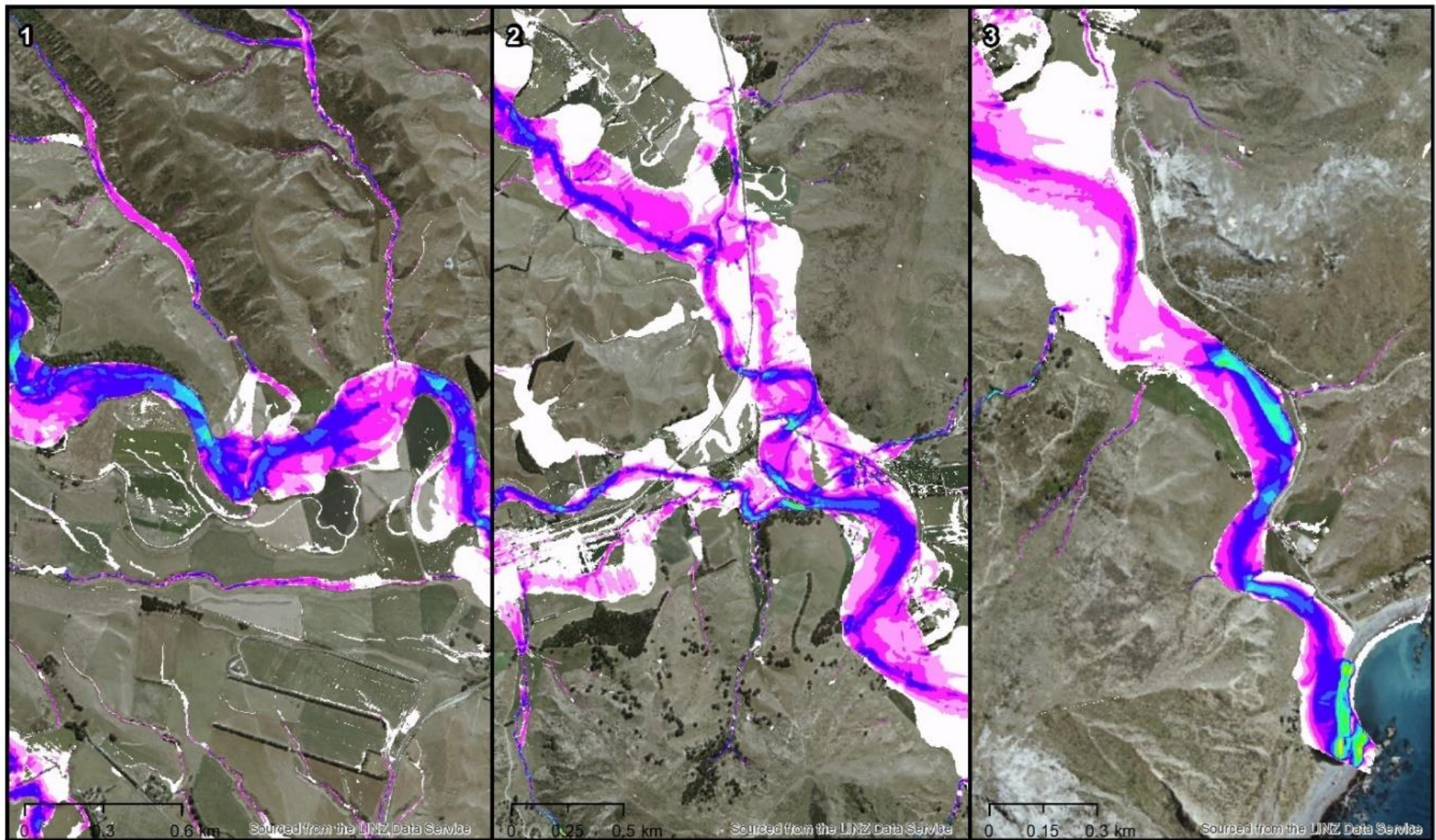
1,500 - 2,000

>2,000

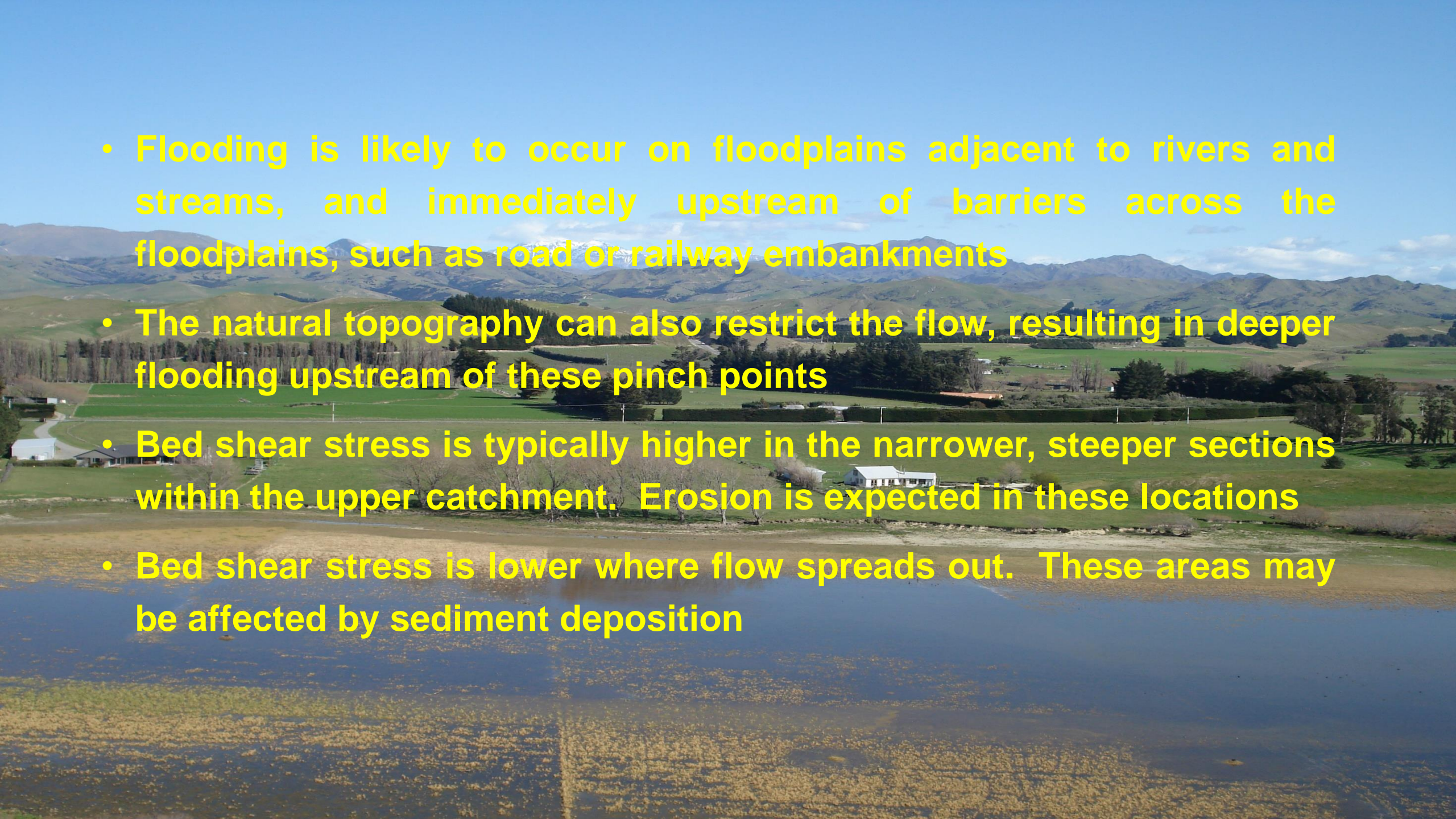
Flaxbourne Catchment

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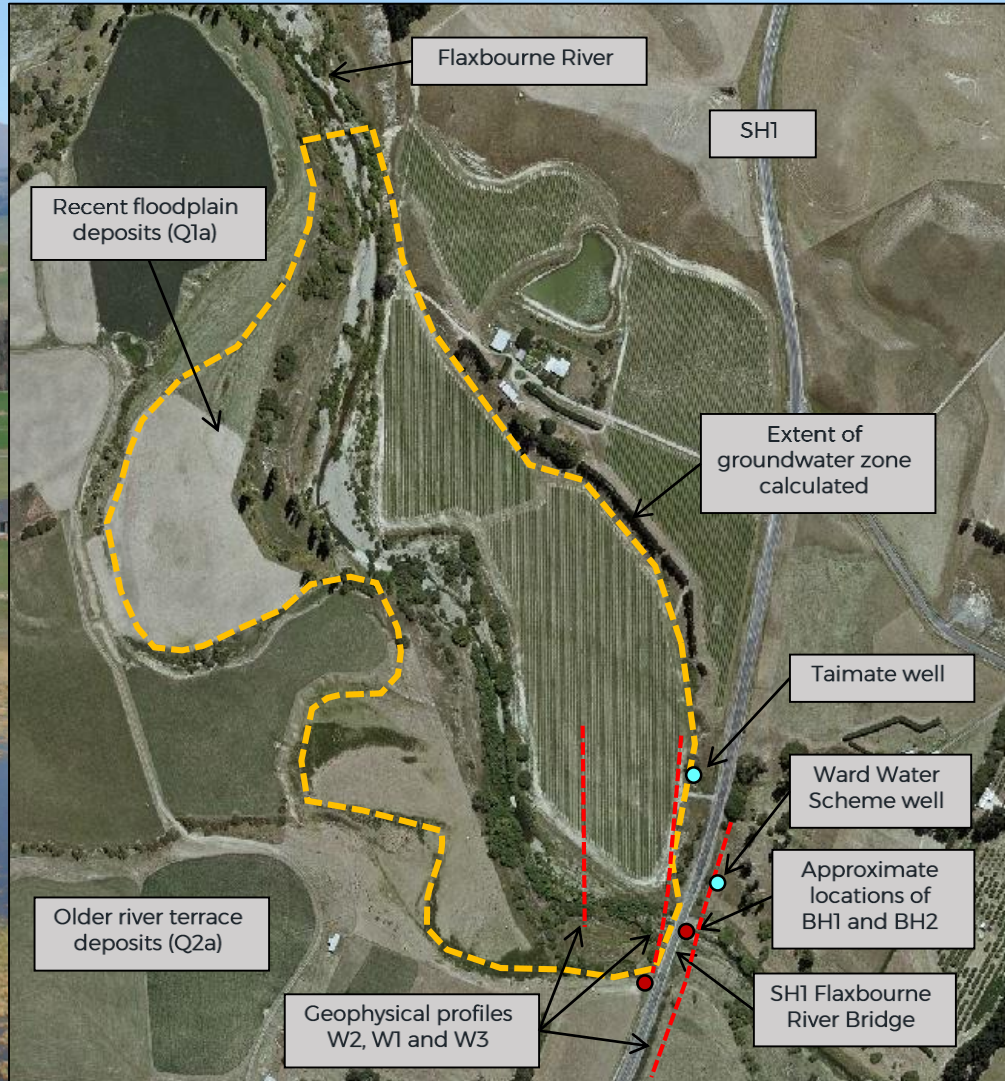


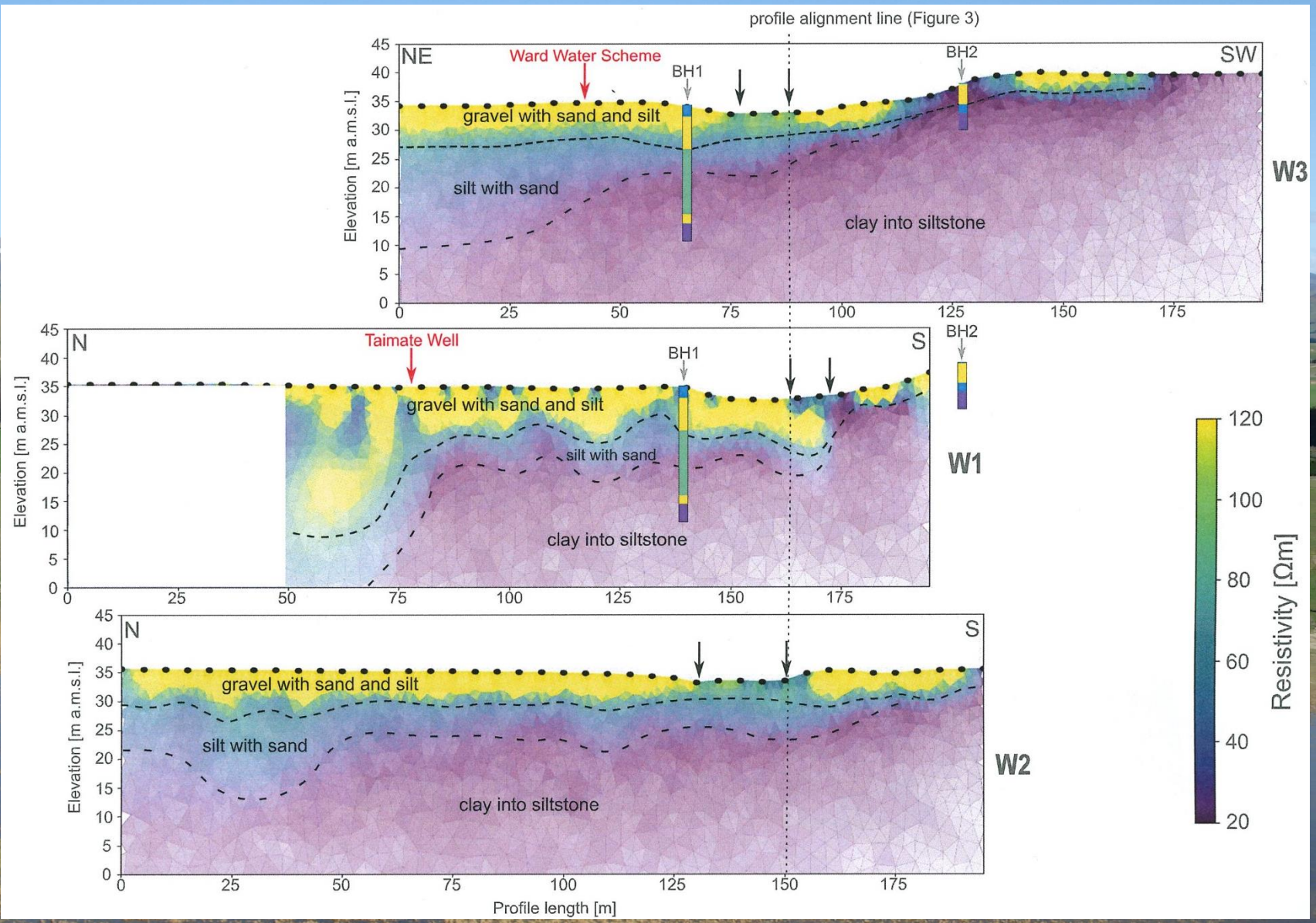


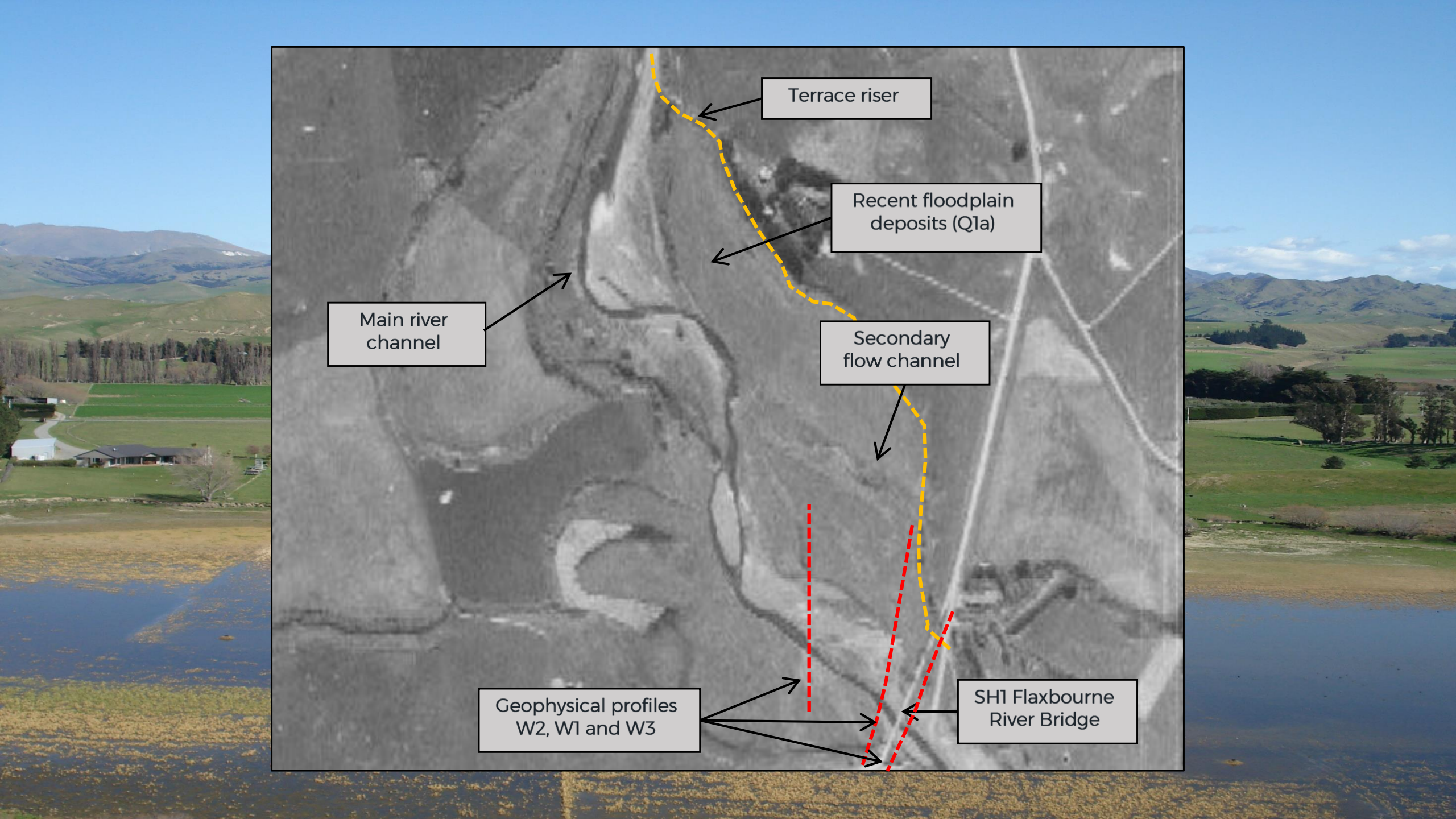


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- An aerial photograph showing a wide expanse of flooded agricultural land. The water is a deep blue-grey color, reflecting the sky. In the background, there are rolling green hills and mountains under a clear blue sky. The foreground shows the flooded fields, with some yellowish-brown patches of sediment or submerged vegetation. The text is overlaid in yellow on the image.
- Flooding is likely to occur on floodplains adjacent to rivers and streams, and immediately upstream of barriers across the floodplains, such as road or railway embankments
 - The natural topography can also restrict the flow, resulting in deeper flooding upstream of these pinch points
 - Bed shear stress is typically higher in the narrower, steeper sections within the upper catchment. Erosion is expected in these locations
 - Bed shear stress is lower where flow spreads out. These areas may be affected by sediment deposition

Ward Water Supply







Terrace riser

Recent floodplain deposits (Q1a)

Main river channel

Secondary flow channel

Geophysical profiles W2, W1 and W3

SH1 Flaxbourne River Bridge

Findings

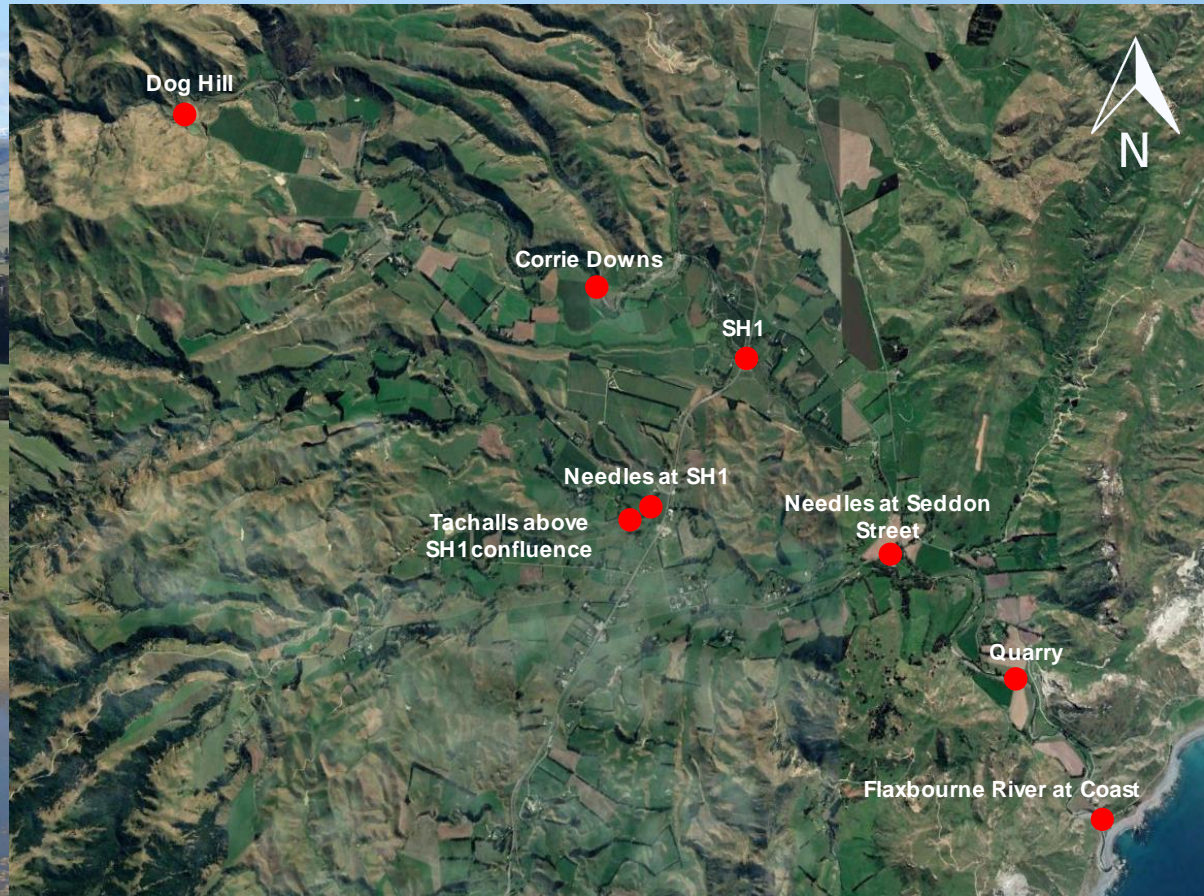
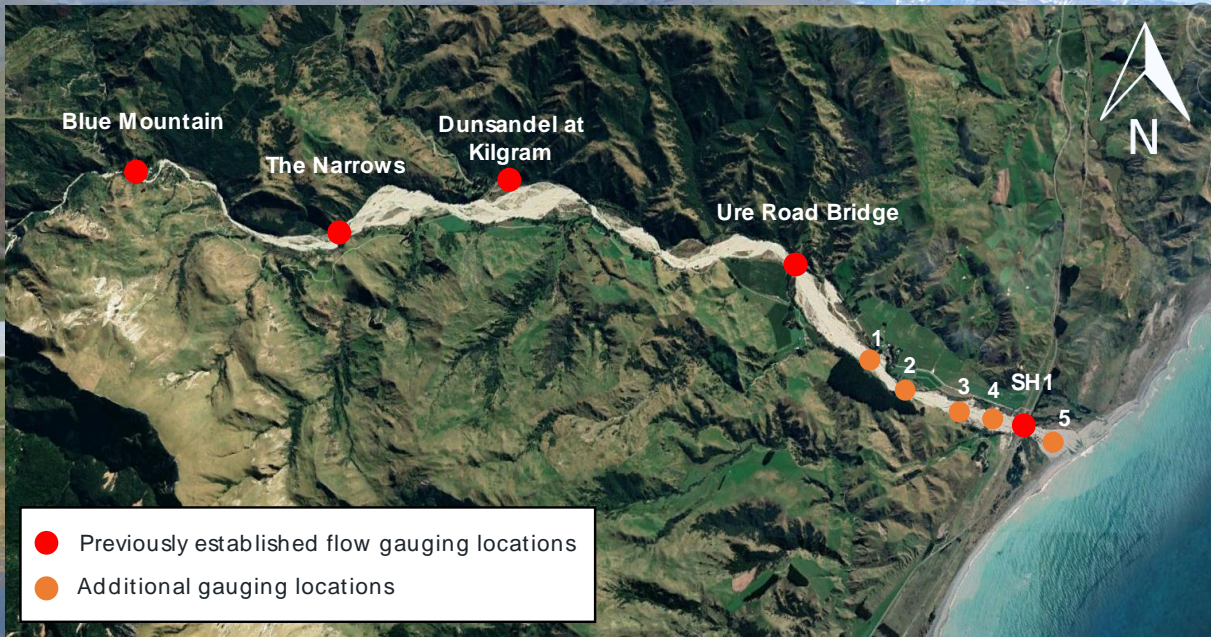
- Gravel deposits are 5m to 8m thick, but thicker 100m north of the river. This may indicate a larger groundwater resource
- Implications for water resource management include:
 - A direct hydraulic connection between the Flaxbourne River and the groundwater resource
 - Limited availability of groundwater
 - Rapid recharge during periods of higher flow in the Flaxbourne River
 - Limited storage potential to buffer periods of sustained low flow in the Flaxbourne River
 - No buffer to prevent contamination of the groundwater from the ground surface

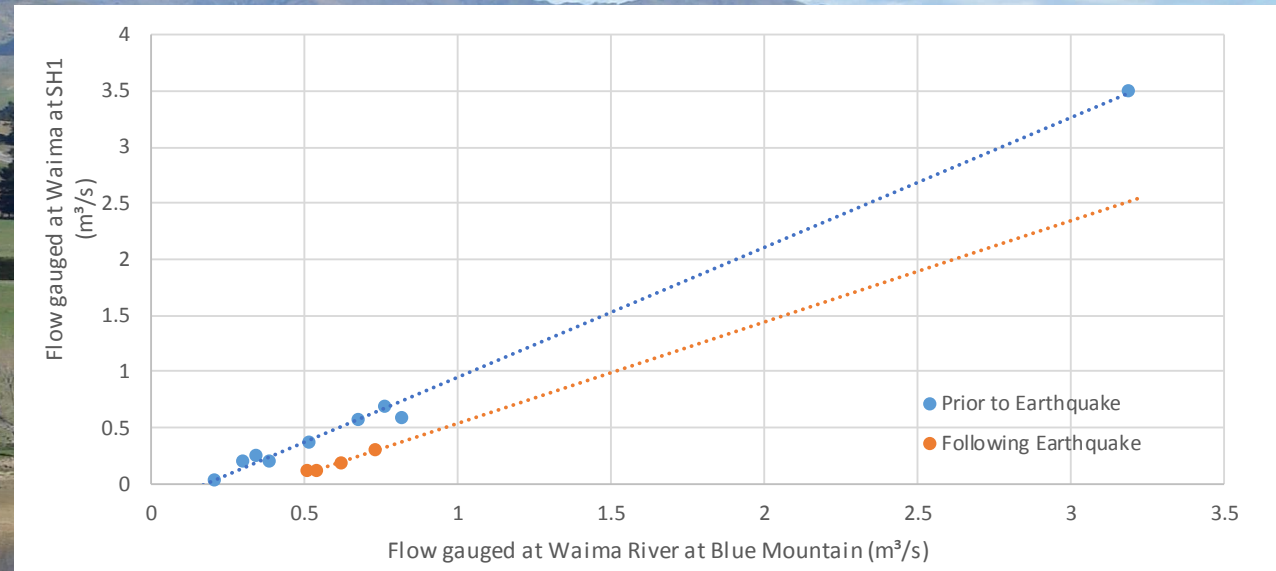
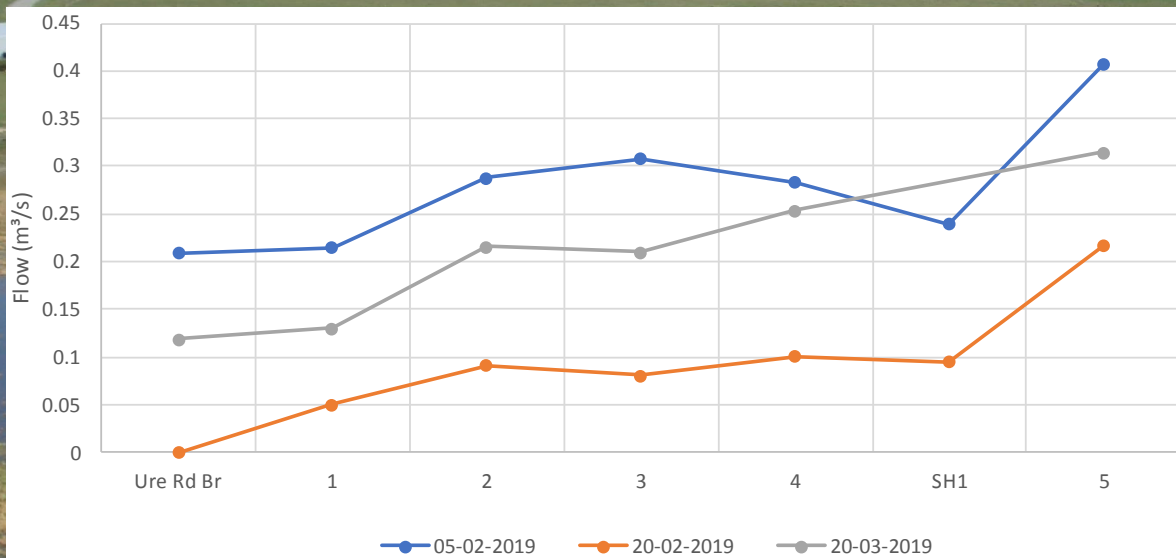
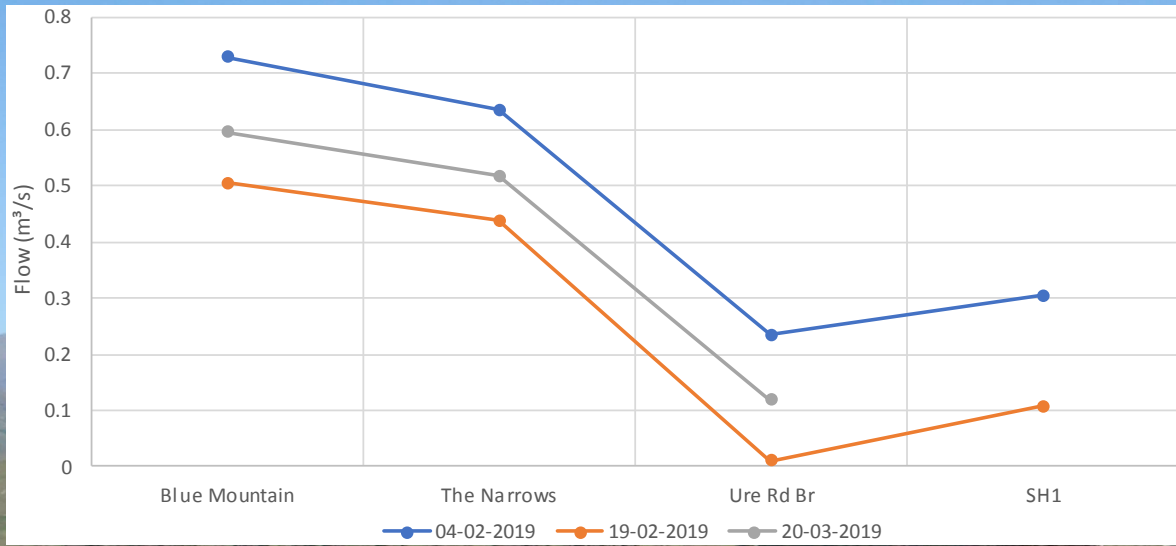
Recommendations

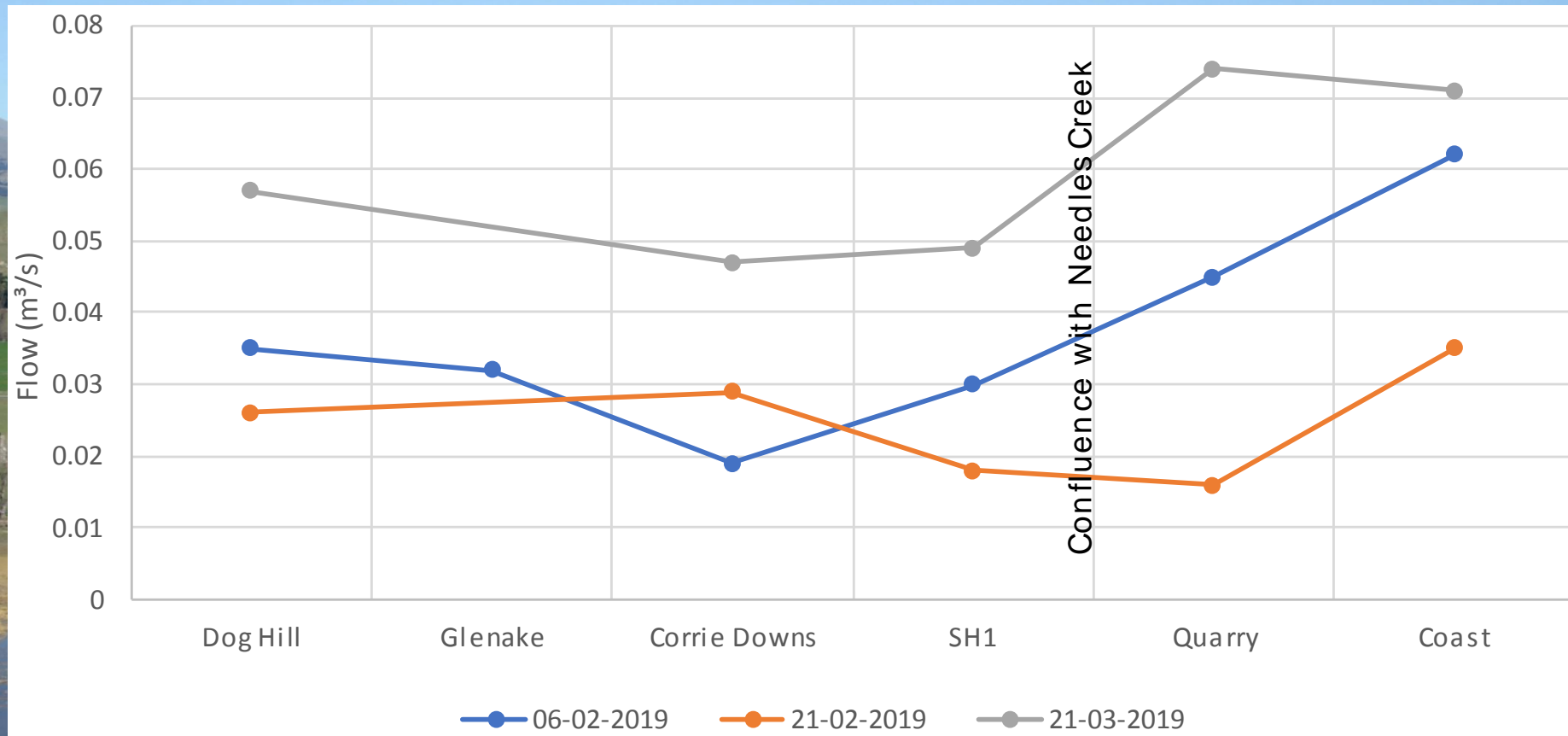
- The potential of this paleochannel, and the associated gravel deposit, to provide a resilient groundwater supply should be investigated further. This could include:
 - Additional resistivity profiles to better define the boundaries of the paleochannel
 - Exploratory drilling
 - Pump testing if a significant groundwater resource is located in this area

LOW FLOW GAUGINGS

- Water resources most stressed during summer and prolonged low-flows. Reaches of the Waima/Ure and Flaxbourne Rivers go dry for extended periods, although this has not occurred since the Kaikōura Earthquake
- A low-flow monitoring programme to:
 - Characterise the low-flow regimes of these rivers
 - Identify gaining and losing reaches
 - Identify the location of groundwater recharge zones
 - Identify how the dynamics of the rivers have changed since the earthquake







Findings

- No relationship between flows in the Waima/Ure and the Flaxbourne, therefore a need for a flow recorder most likely at Blue Mountain
- Significantly less surface flow at SH1 relative to Blue Mountain since the earthquake. This has implications for:
 - The management and maintenance of surface flows
 - The connectivity between surface water and groundwater
 - Nature of the groundwater resource
 - Further changes over the coming years

Recommendations

- More gauging runs over the next summer to confirm the preliminary results
- Target localities with significant water resource implications
- Further investigation of the changes to the flow regime between Blue Mountain and SH1
- Regular LiDAR surveys between SH1 and the coast to monitor bed levels
- Review the implications of bed level change for the shallow unconfined aquifer and surface water – groundwater interactions

FUTURE WORK

- Low Flow Gaugings
- Ward Water Supply
 - Improved monitoring;
 - Additional resistivity lines; and
 - Potential alternative supply
- LUCI
- Other Suggestions