Upper Selwyn Huts Climate Assessment

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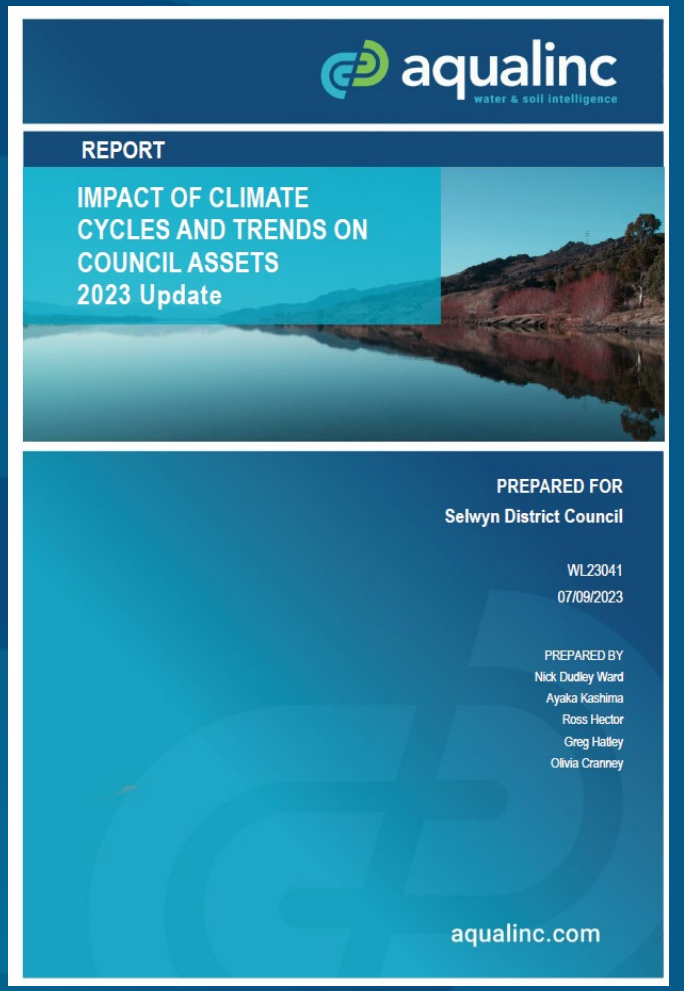
Presentation outline

- What did the assessment cover?
  - How it relates to district-scale climate assessments
- Lake Levels – method and results.
- Groundwater – method and results.

What did the assessment cover?

- Previous district-scale assessments
  - 2016, 2020, 2023
  - Identified relevant issues but limited detail due to district-wide focus
- Te Waihora / Lake Ellesmere water levels
  - Sea level rise
- Shallow groundwater and groundwater flooding
  - Future climate
  - Sea level rise
- River flooding was not specifically in scope.



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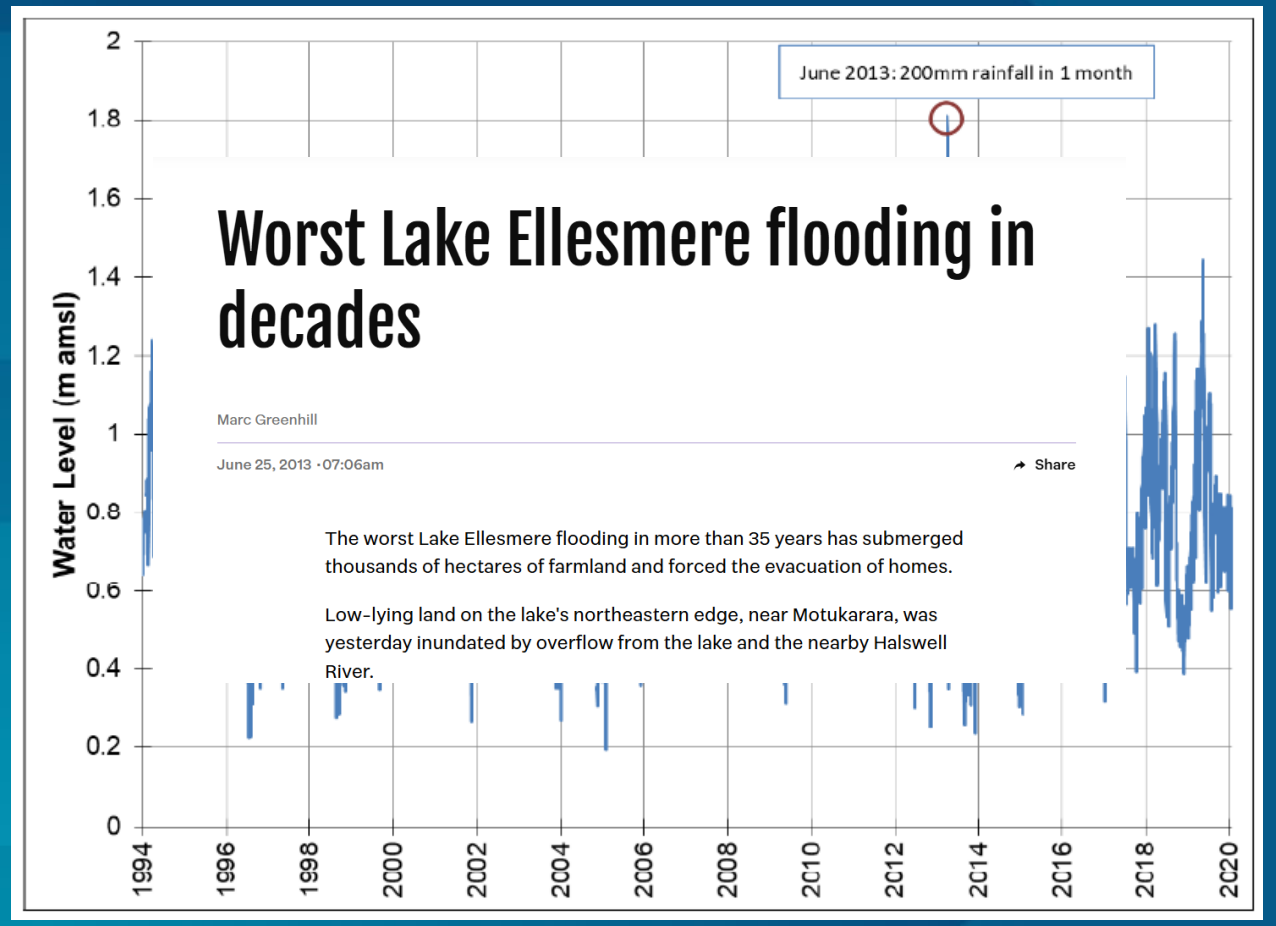
Te Waihora / Lake Ellesmere levels

- Levels are in the 0.4 – 1.2 m range 95% of the time.
- June / July 2013
  - Lake level reached 1.8 m above sea level
  - Due to high rainfall and inability to open the lake outlet
- Key assumption:
  - If this combination of events occurred again with a higher sea level, the lake level will end up higher.



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Sea level rise projections

- NZ SeaRise project (https://www.searise.nz)
  - Location-specific sea level rise projections for the whole NZ coast.
  - Includes vertical land movement
  - A range of projections:
    - Different emissions pathways
    - Confidence intervals (we've considered the *most likely* range)

Scenario	Year	Percentile		
		17th	50th	83rd
SSP2-4.5 + VLM (medium confidence)	2050	0.10 m	0.26 m	0.42 m
	2100	0.32 m	0.64 m	0.98 m
SSP5-8.5 + VLM (medium confidence)	2050	0.14 m	0.29 m	0.46 m
	2100	0.55 m	0.90 m	1.30 m

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Mapping method

- 2023 digital elevation model from LiDAR aerial survey
  - Highly accurate ground levels
- Mapped area lower than 1.8 m above sea level
- Added sea level rise and re-mapped:
  - SSP2-4.5 and SSP5-8.5
  - 2050 and 2100

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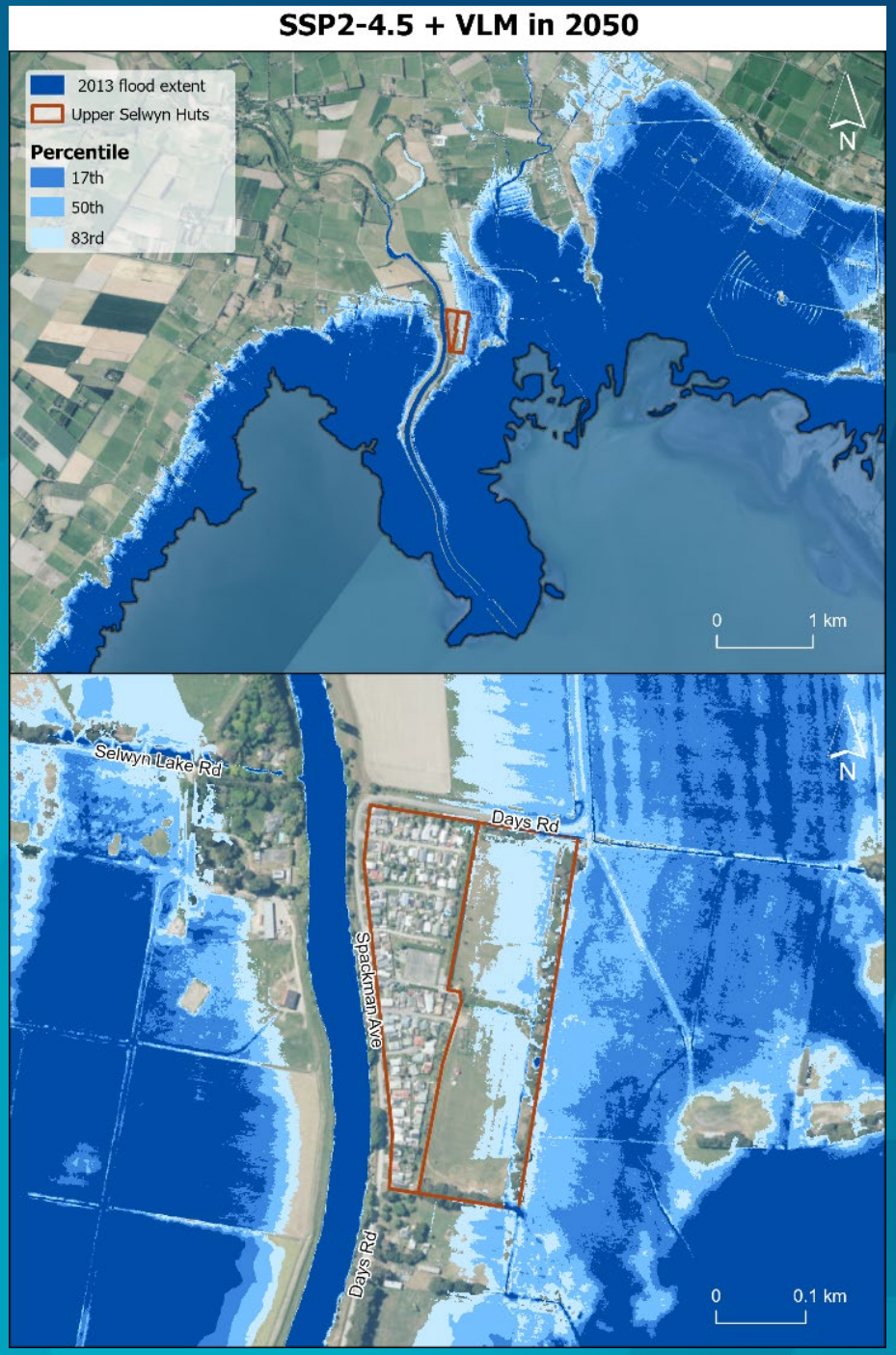
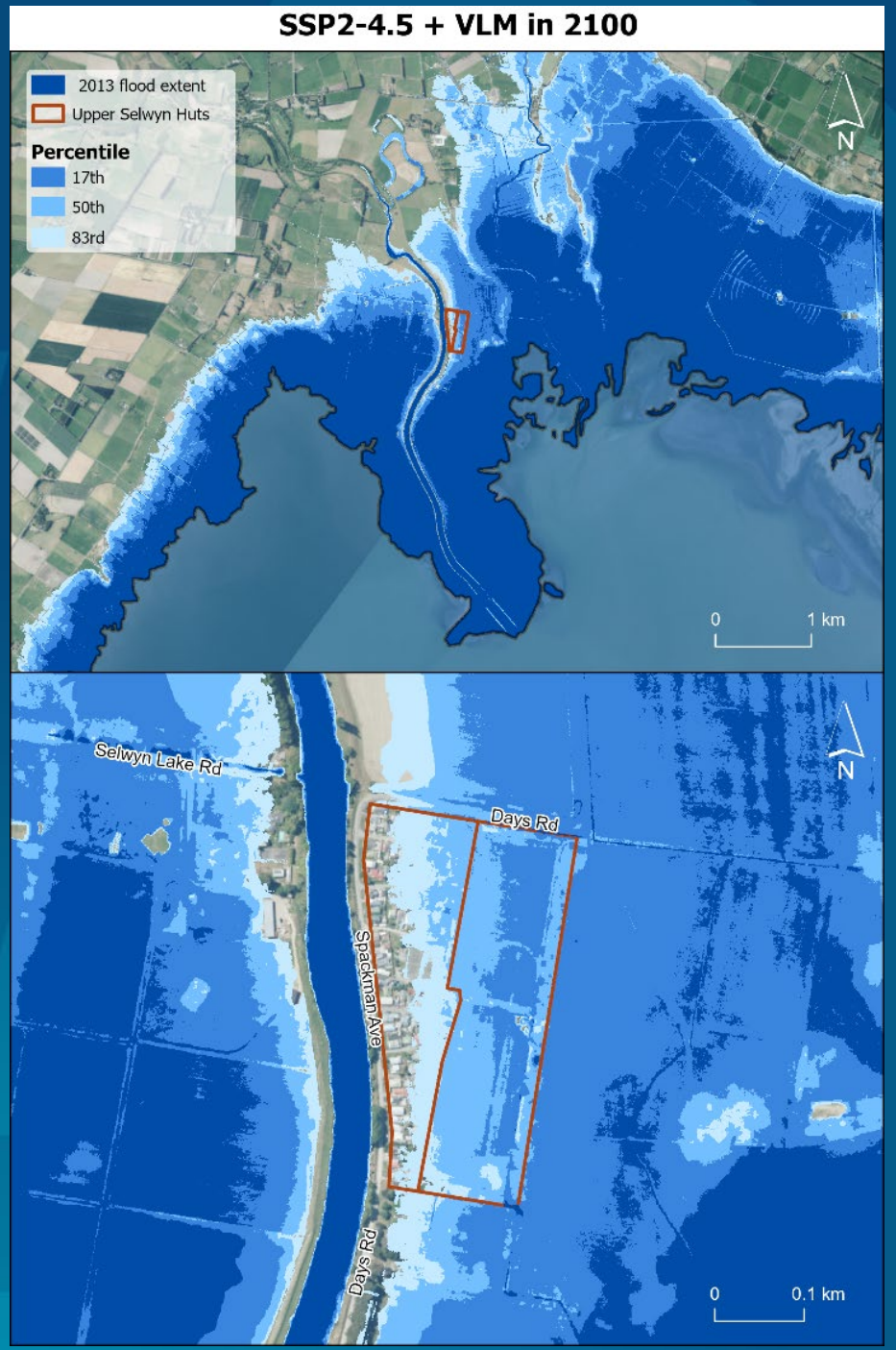
Mapping Results

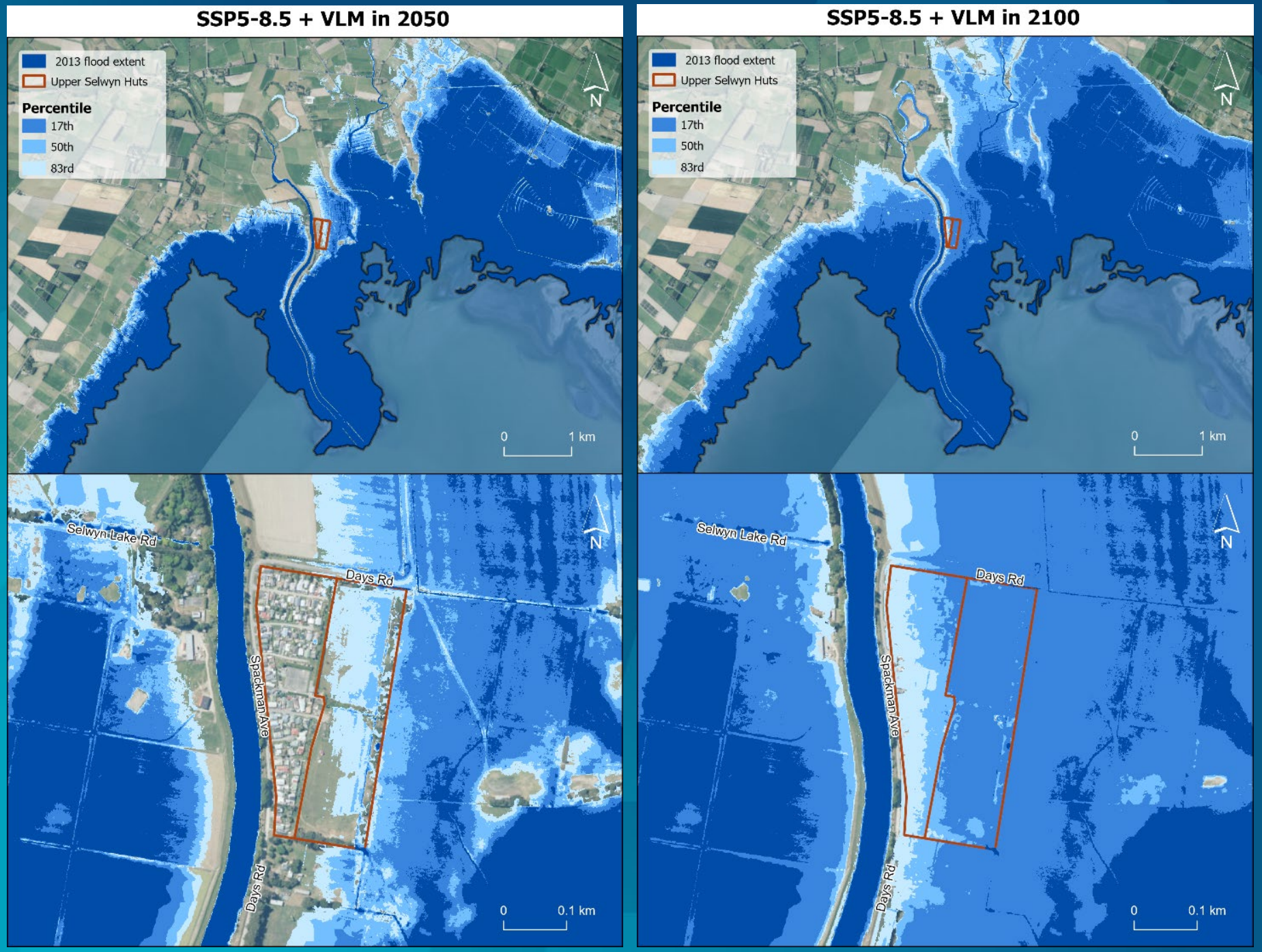
- Inundation extent for SSP2-4.5
- Mid-century:
  - Days Road access
- Late-century:
  - More widespread flooding





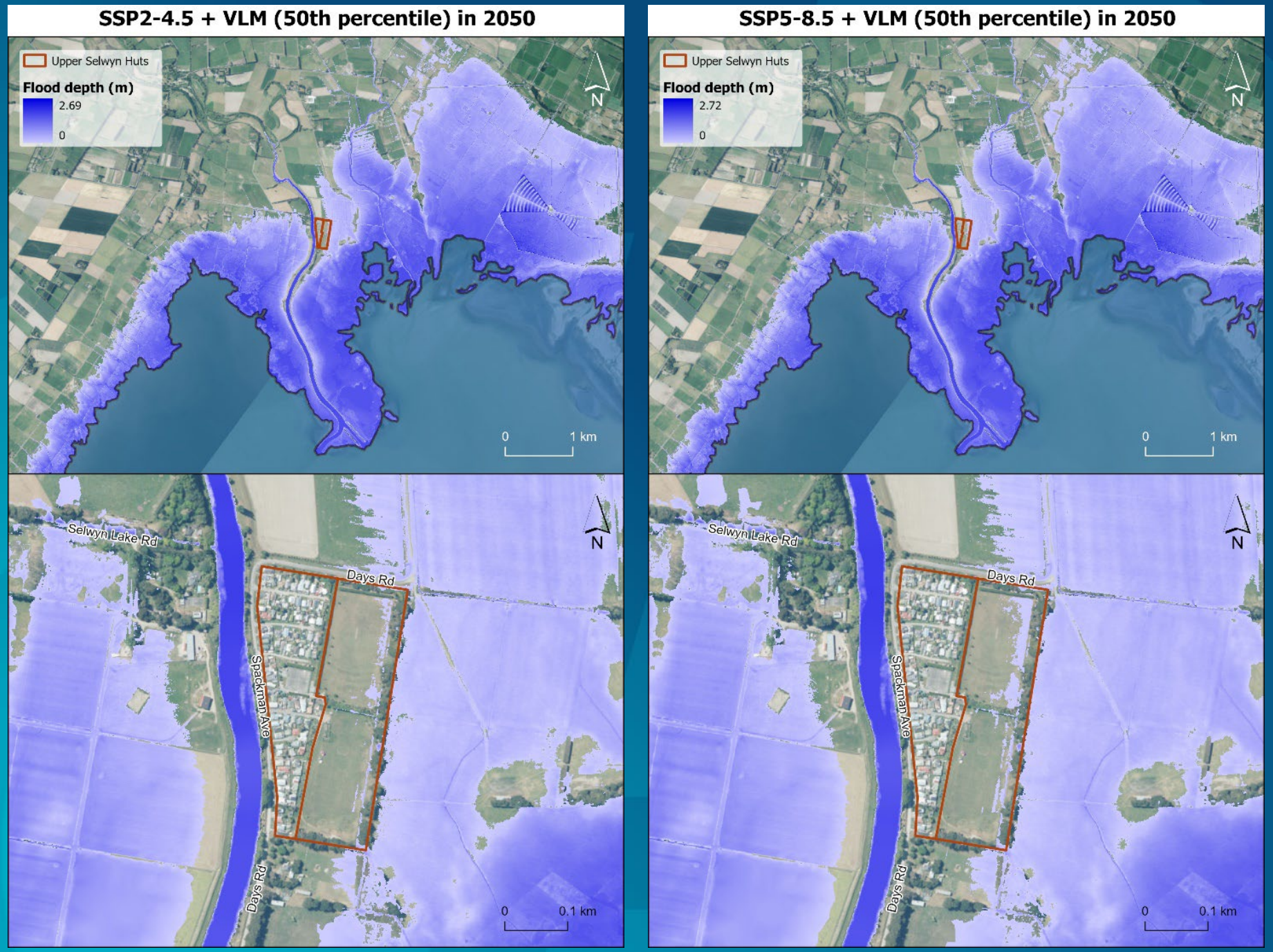
Mapping Results

- Inundation extent for SSP5-8.5
- More wide-spread flooding predicted



Mapping Results

- Water depth with 2050 sea level rise



Te Waihora levels: key messages

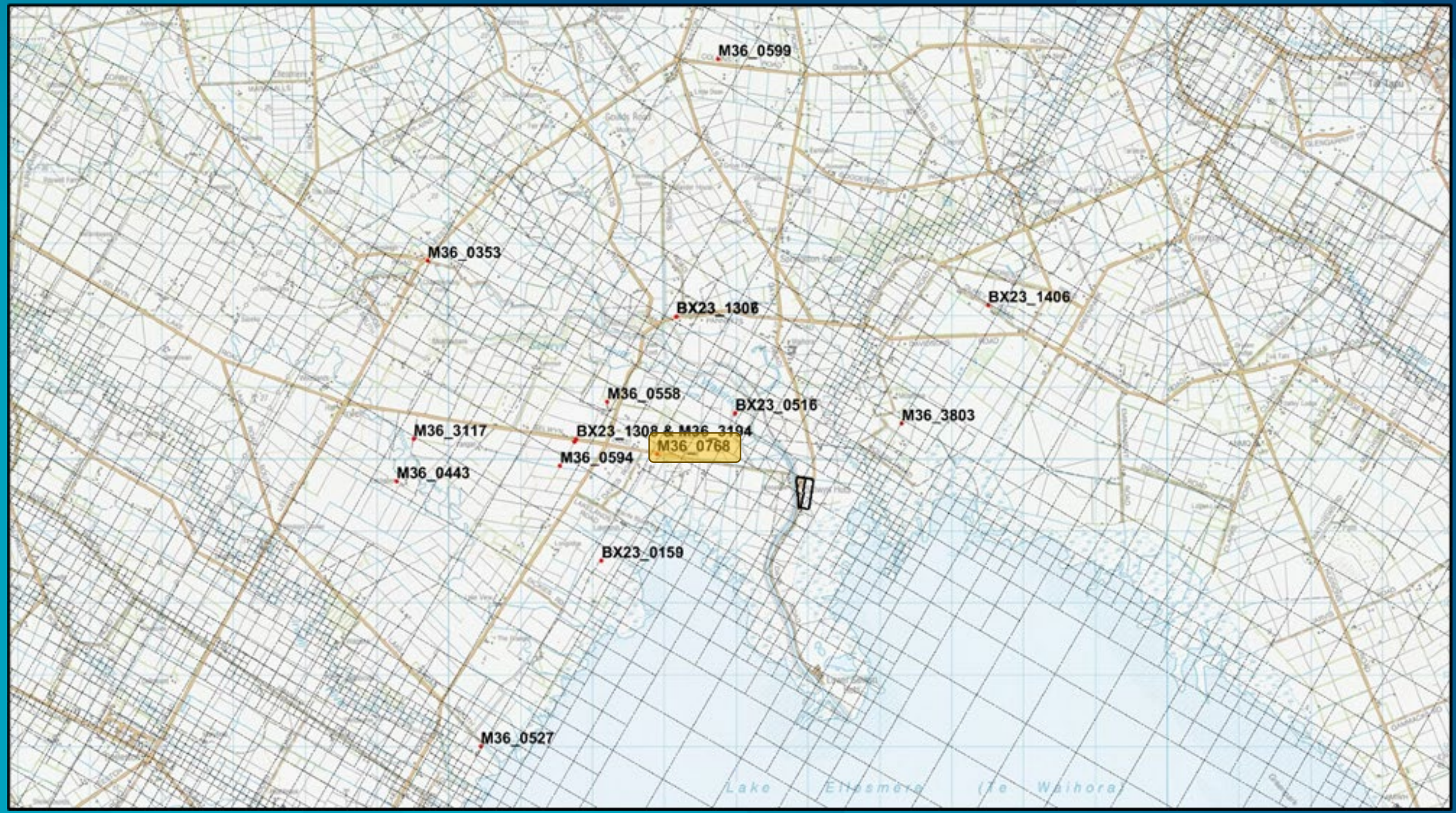
- A 2013-type event with higher sea levels will result in a greater extent and depth of flooding.
- Issues with access to Upper Selwyn Huts in scenarios where the huts themselves are not flooded.
- Climate change could result in worse impacts than those shown.

- Questions?

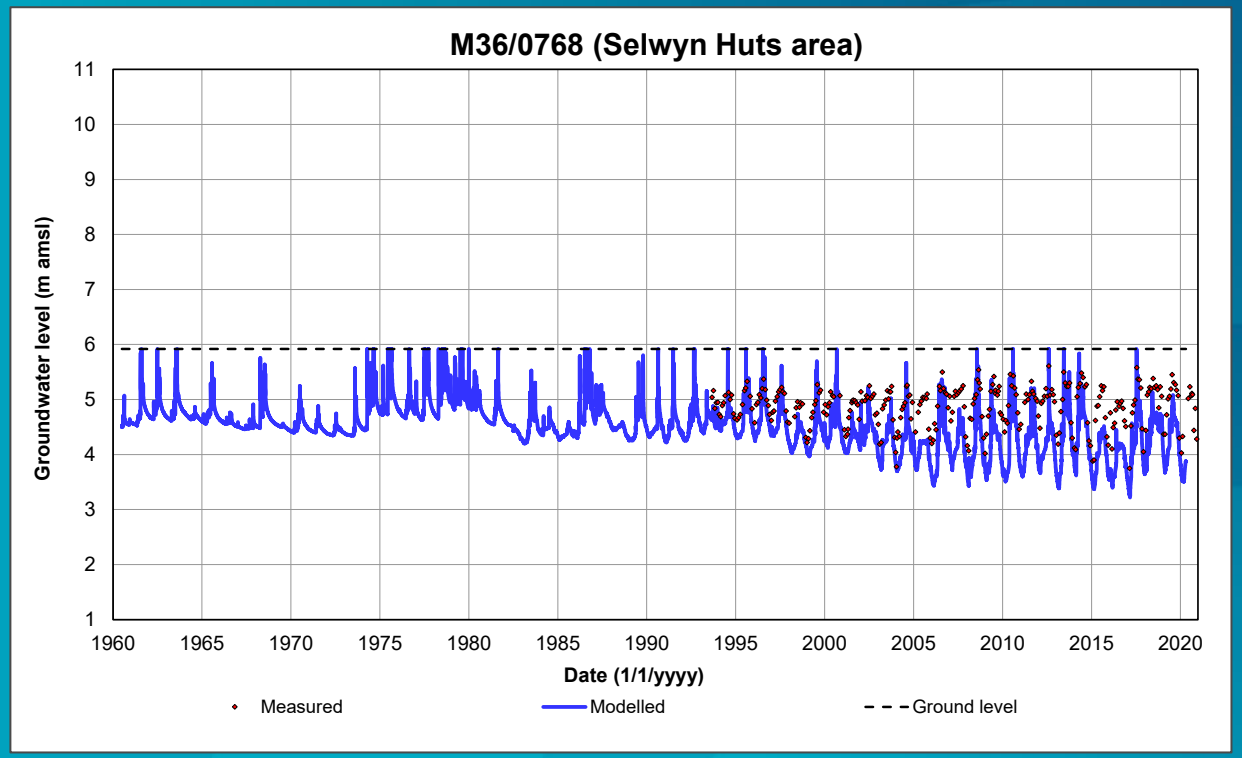
Groundwater

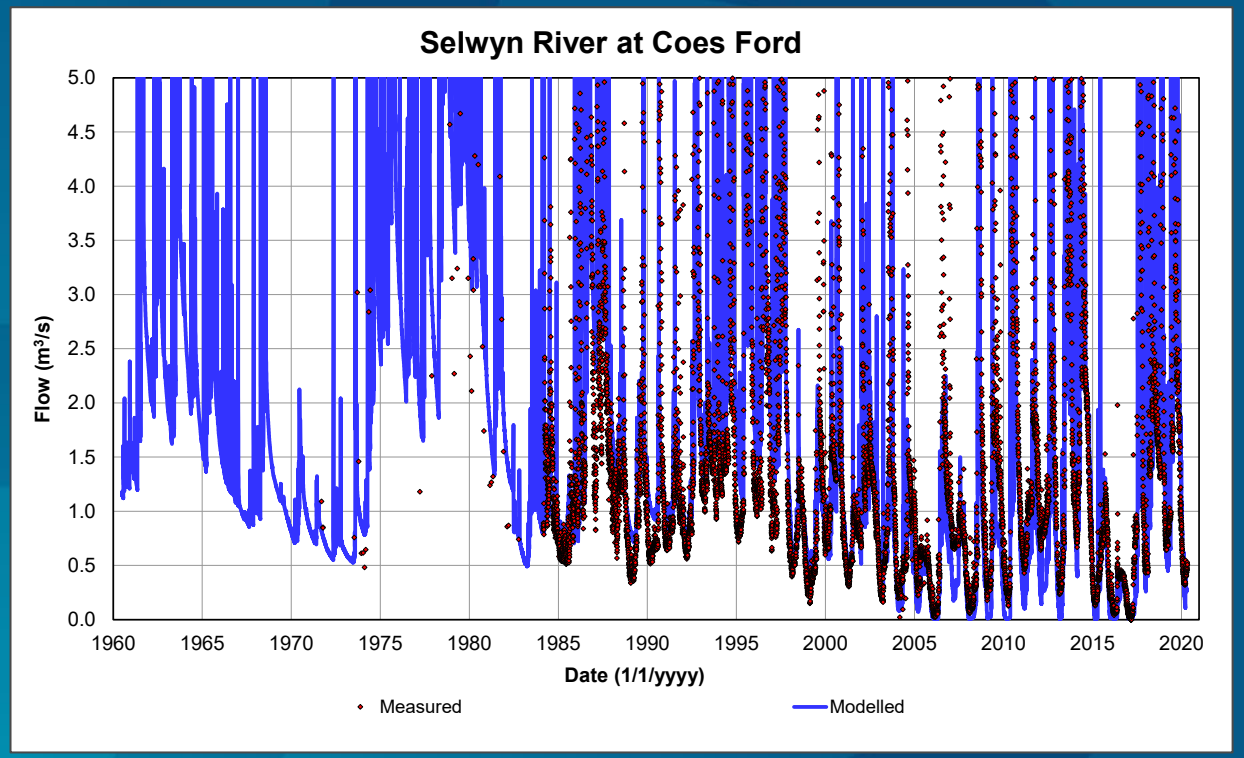
- Shallow groundwater as a hazard:
  - Groundwater flooding: can be longer-lasting than river floods
  - Damage to road materials and building foundations
  - Health issues from rising damp
  - Damage to crops and other plants

- Numerical simulation of the groundwater system
  - Model developed over 20+ years
  - Local refinement of the model for this project
  - Calibration to measured data, back to 1960
  - Simulation with projected future climate (from NIWA) to 2100


M36_0599
M36_0353
BX23_1306
BX23_1406
M36_0558
BX23_0516
M36_3803
M36_3117
BX23_1308 & M36_3194
M36_0768
M36_0594
M36_0443
BX23_0159
M36_0527
Lake Ellesmere (Te Waihora)

Model calibration to measured data





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Model scenarios

- Future climate
  - With and without sea level rise (using SSP5-8.5 median projection)
- Steady-state simulation:
  - Gives averaged water level surfaces – good for understanding spatial extent of impacts
- Long-term time-varying simulation:
  - Shows how groundwater levels vary at a point over time

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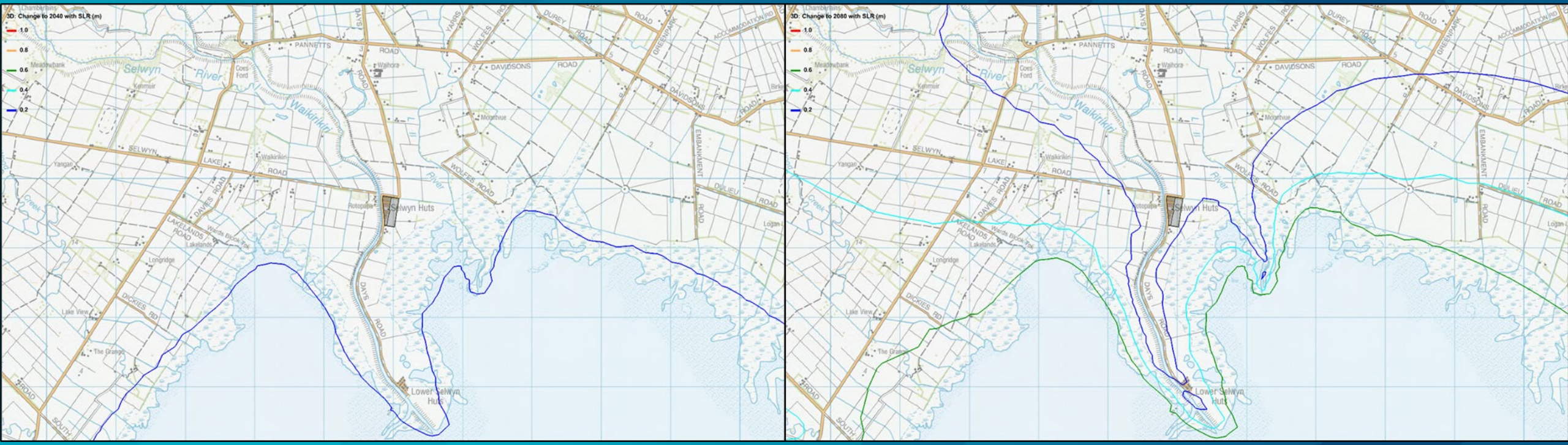
Historical modelled groundwater levels

- Areas where groundwater is within 0.3 m of ground level (on average).
- Note that levels vary over time.
- Areas outside of the shaded zone may also experience groundwater close to the surface at times.

Modelled changes to average groundwater levels



- Changes to the average result in changes to extremes: very high groundwater levels will occur more frequently, for longer.

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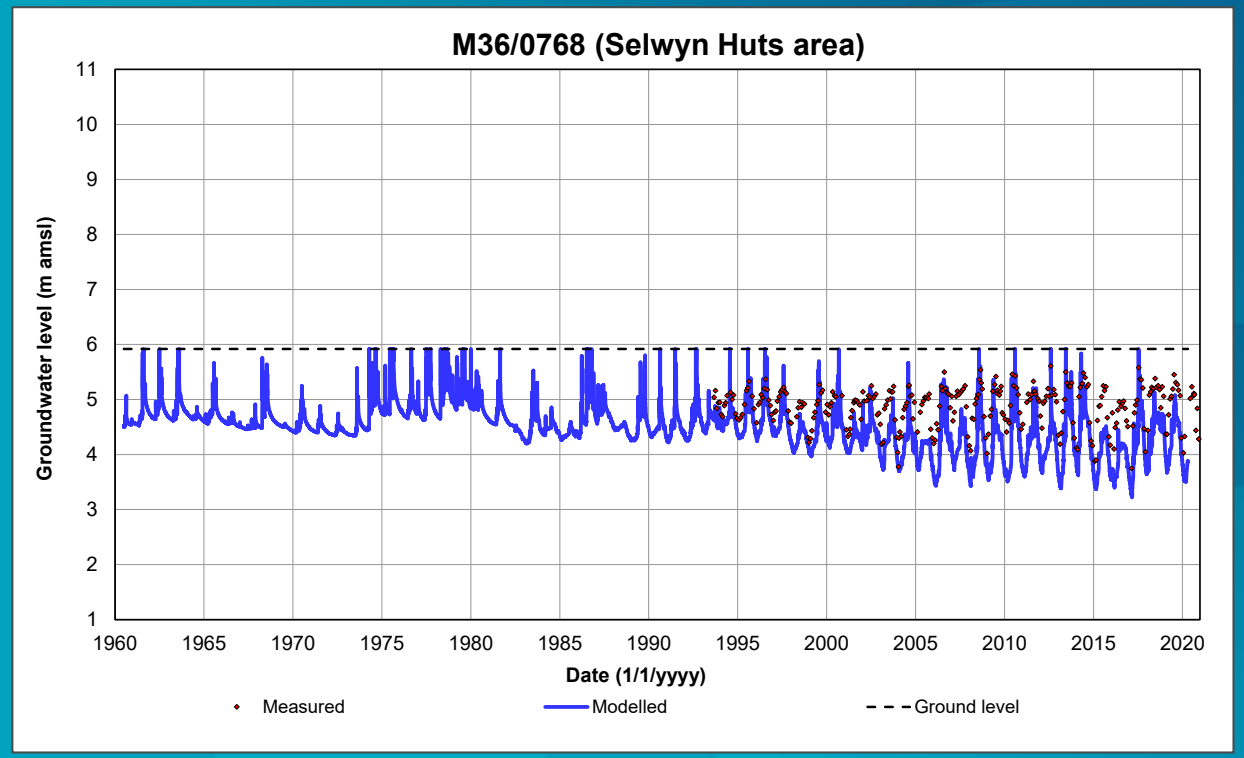
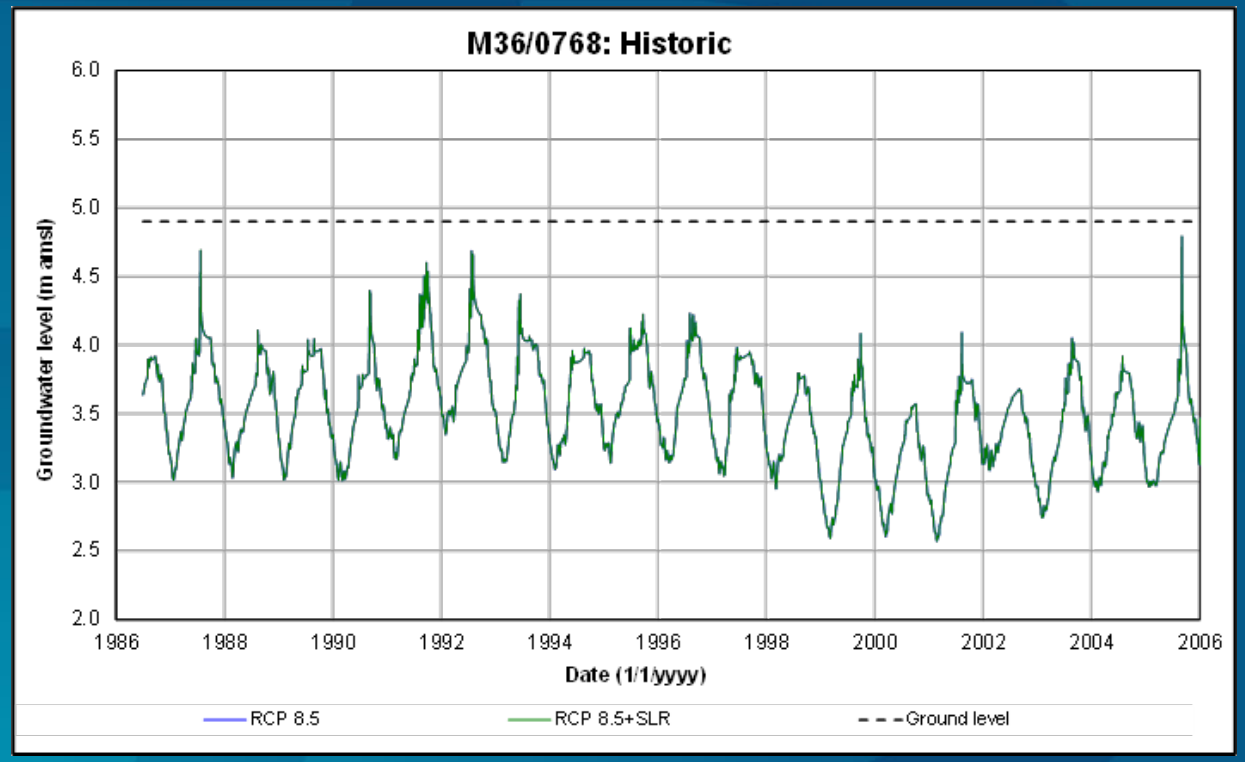
Modelled groundwater levels over time





- Simulation based on **modelled** historic climate gives lower levels overall than simulation with **measured** past climate (calibration scenario).
- **Changes** between scenarios are the key result

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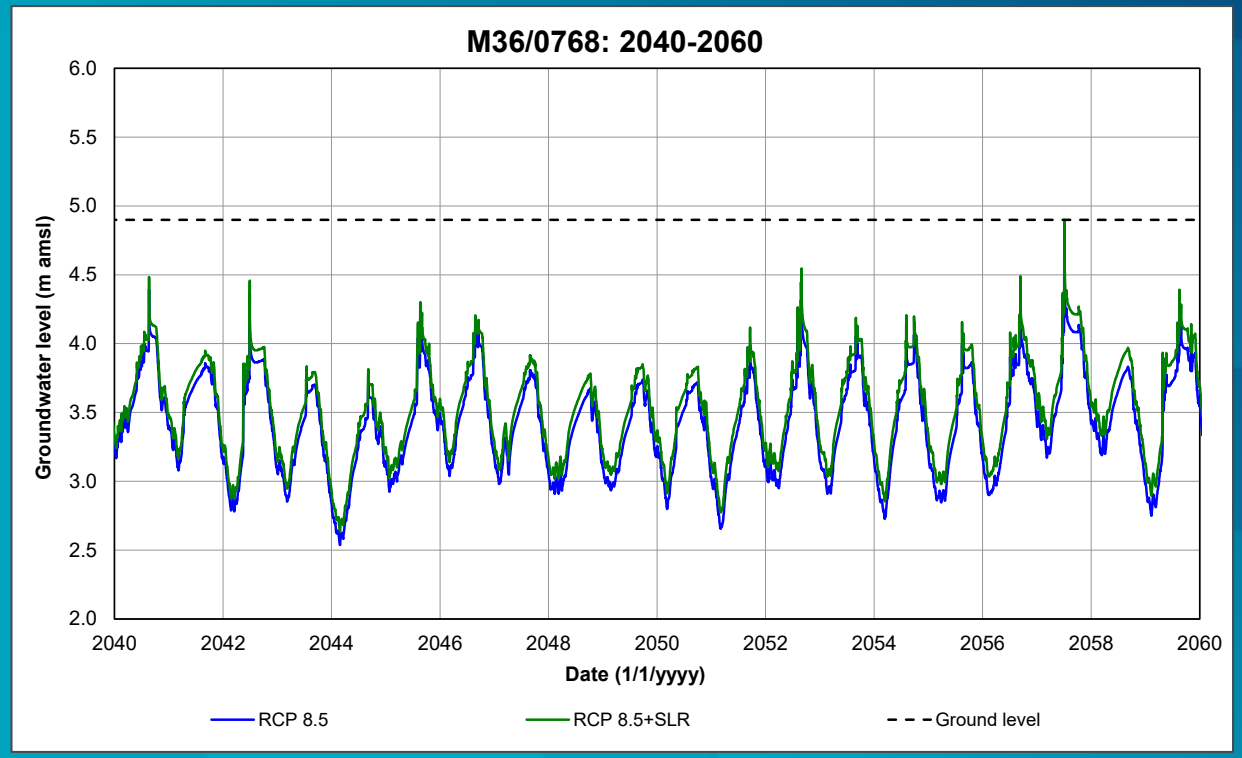
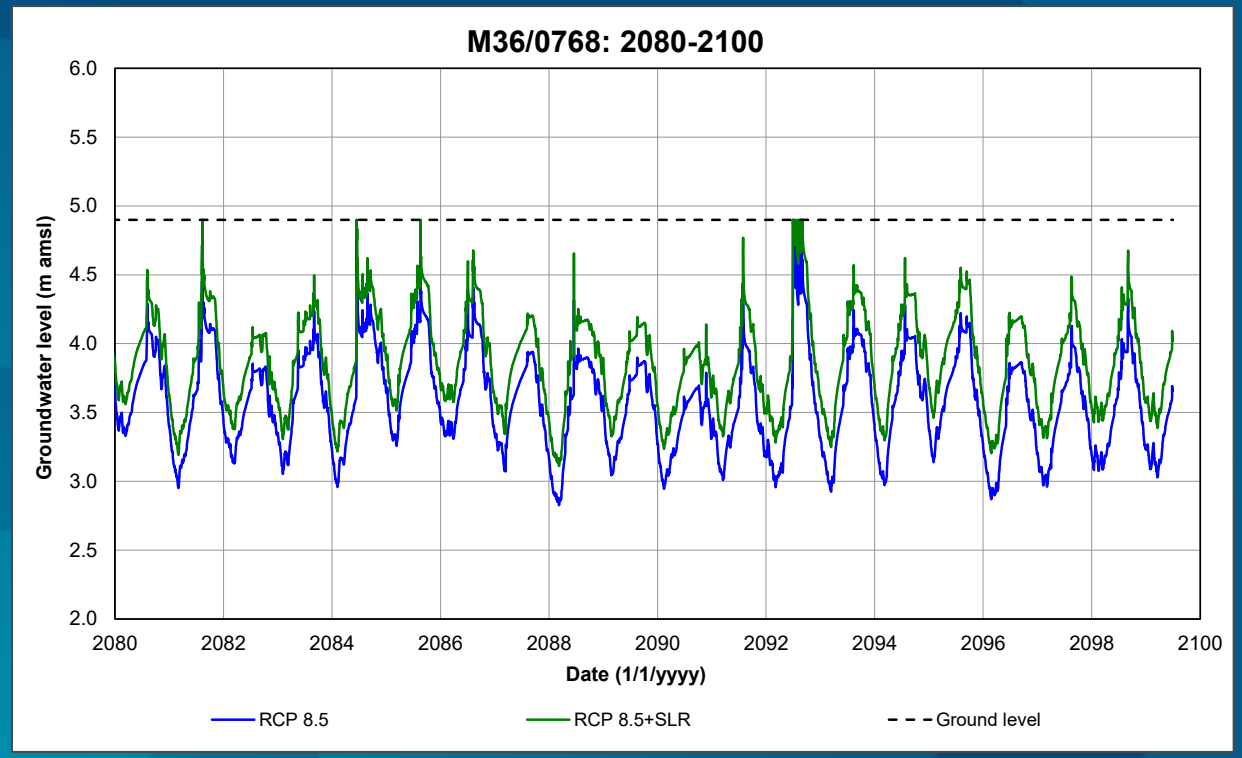
Modelled groundwater levels over time: historic period





- Slight reduction in water levels without sea level rise.
- Sea level rise results in overall rise: increased frequency and duration of high groundwater levels.

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Groundwater: key results

- Shallow groundwater on the lower plains is tightly linked to Te Waihora / Lake Ellesmere levels.
- Higher lake levels as a result of sea level rise will result in higher groundwater levels:
  - Higher frequency of very high groundwater levels
  - Longer duration of groundwater at very high levels
- Greater potential for hazard and nuisance impacts:
  - Groundwater flooding
  - Damage to infrastructure and buildings
  - Health impacts

- Questions?