

AUCKLAND REGIONWIDE FLOOD MODELLING

Cheryl Bai, Principal Hydraulic Modelling Delivery
Auckland Council

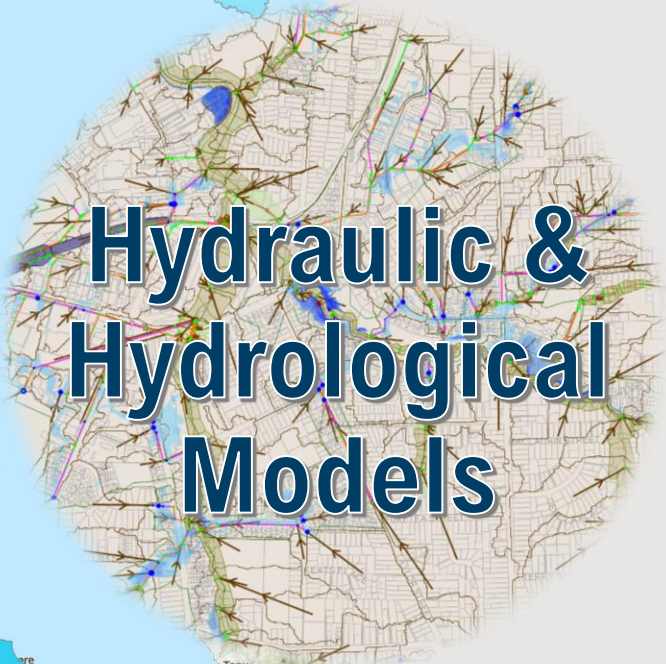
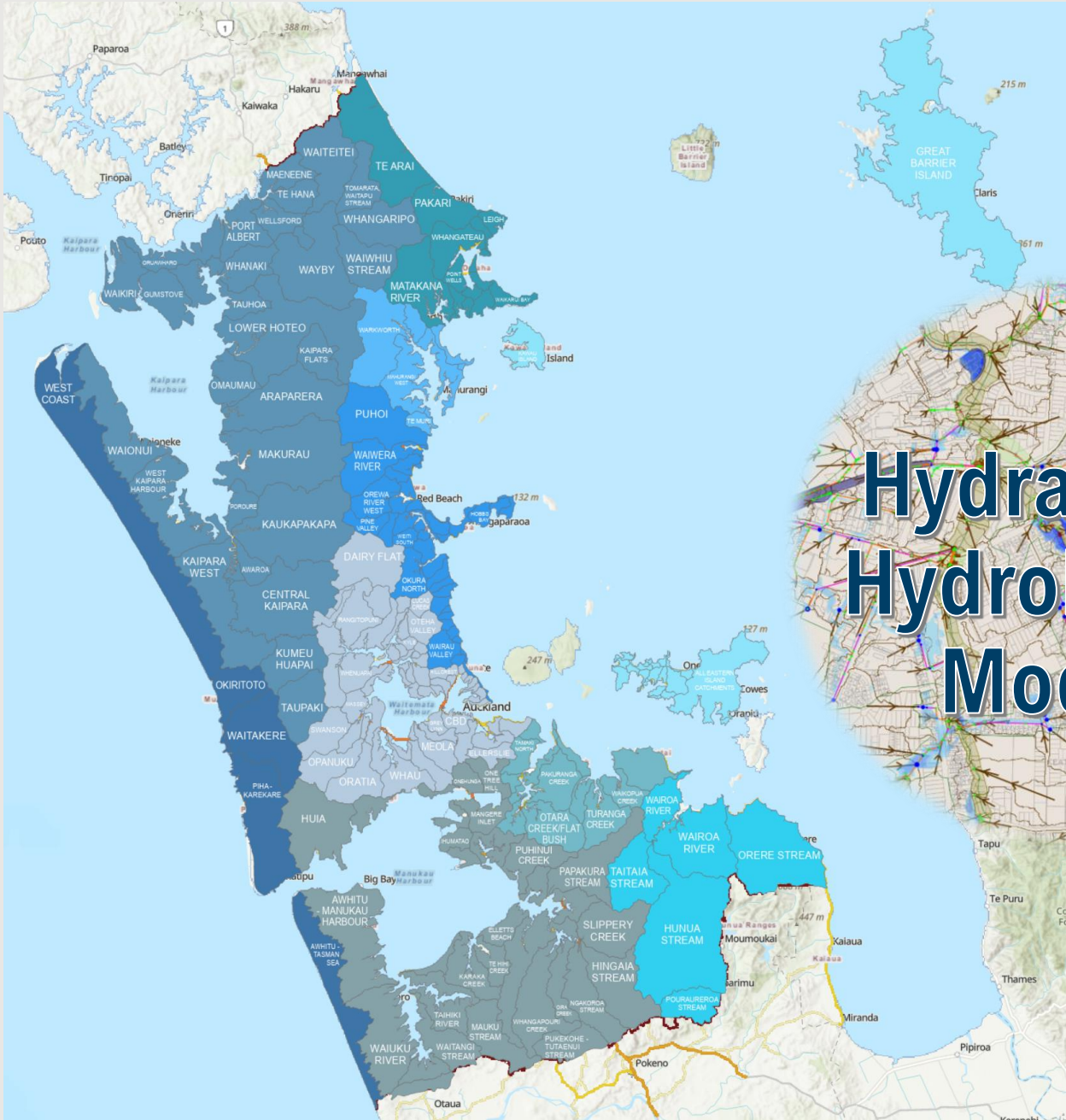


Content

- Why do we need a regional model
- The regional modelling project
- Technical considerations
- Data sharing



Auckland Stormwater Catchments



Support
Planning and
Policy

Support
Catchment
Management

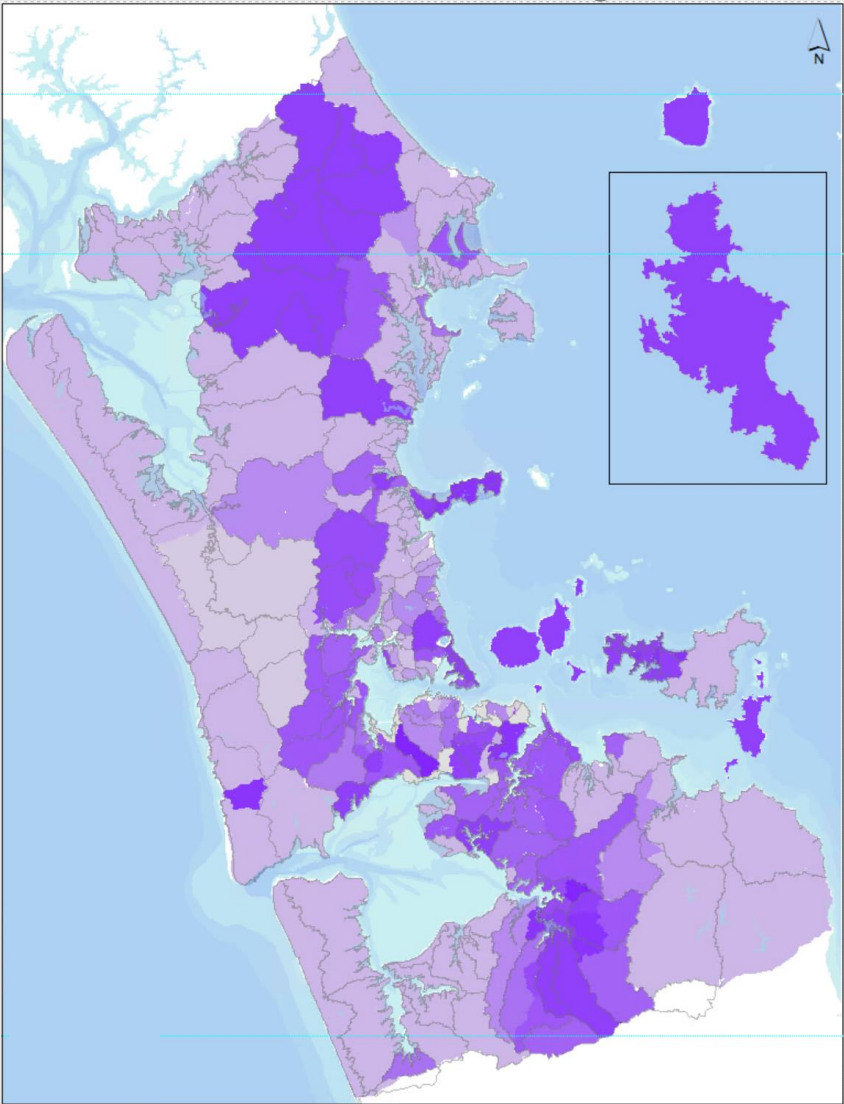
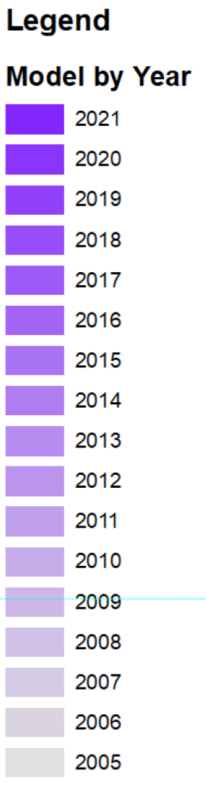
Support
Development

Support Design

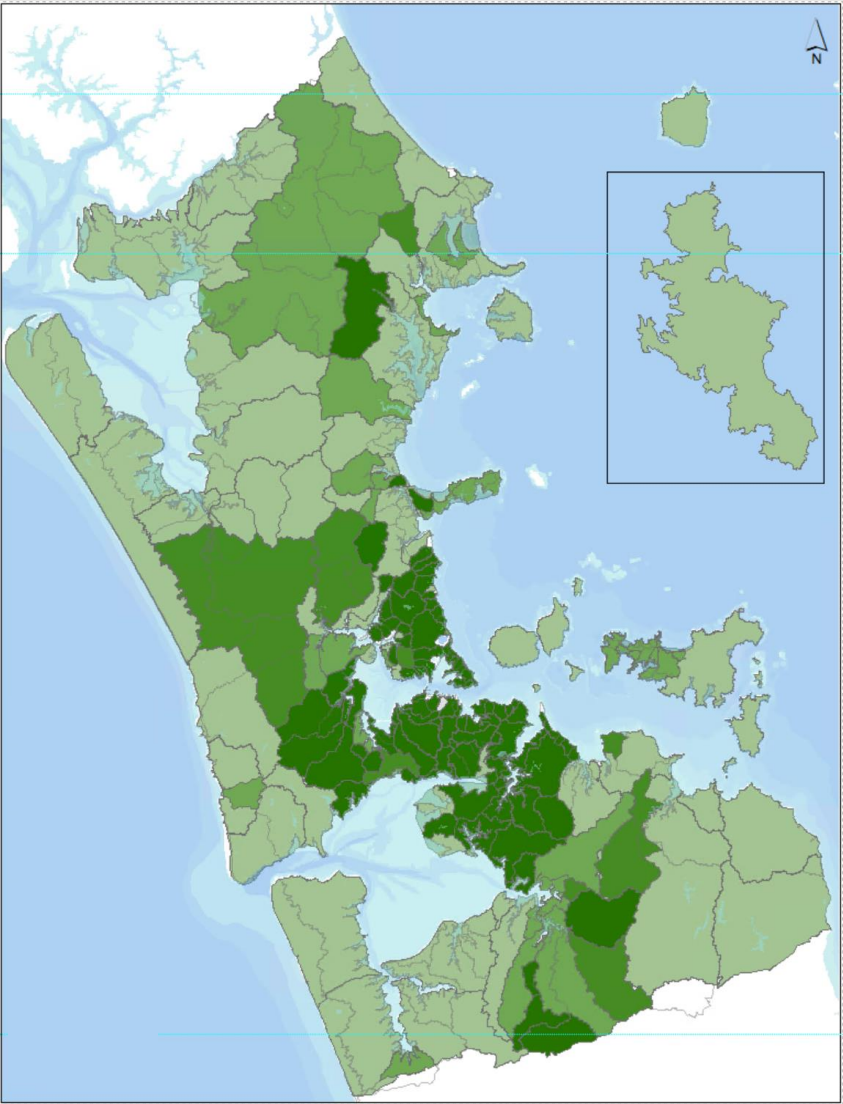
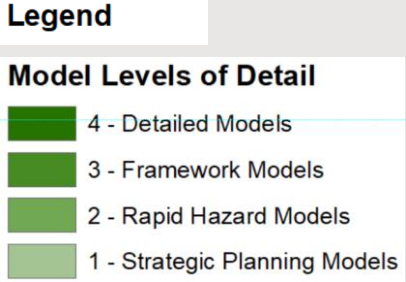


A Regionwide Picture of Our Models

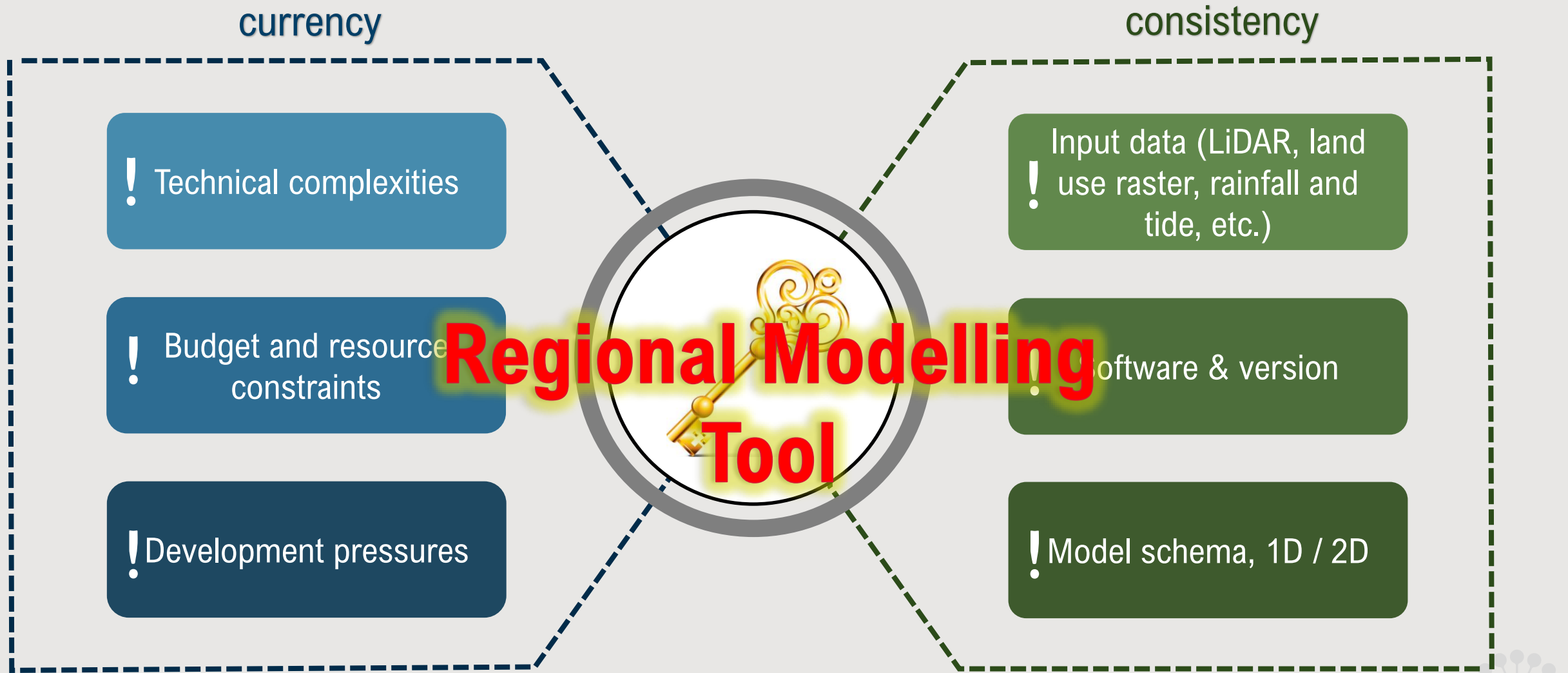
Model Currency



Model Precision

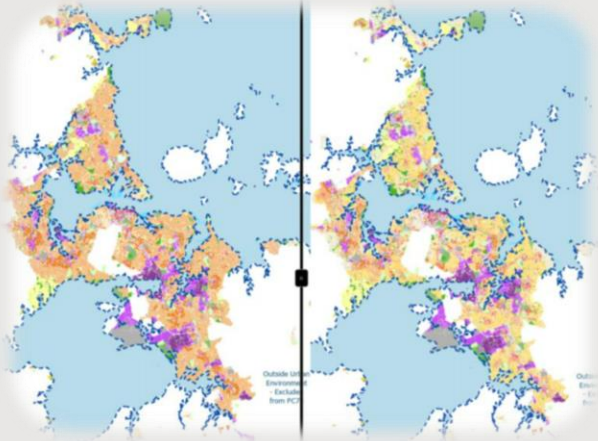


Current Challenges

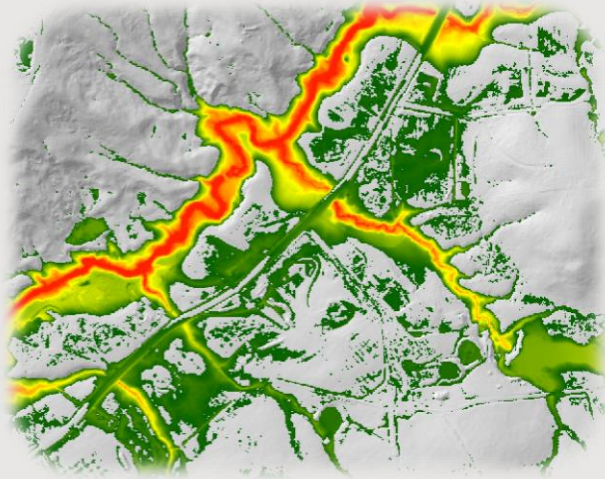


Regional Scale Analytics

Land use changes



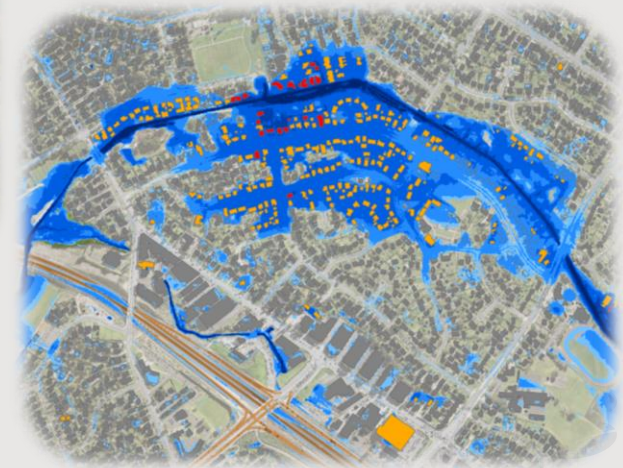
High flood hazard



Climate change



Flood Forecast



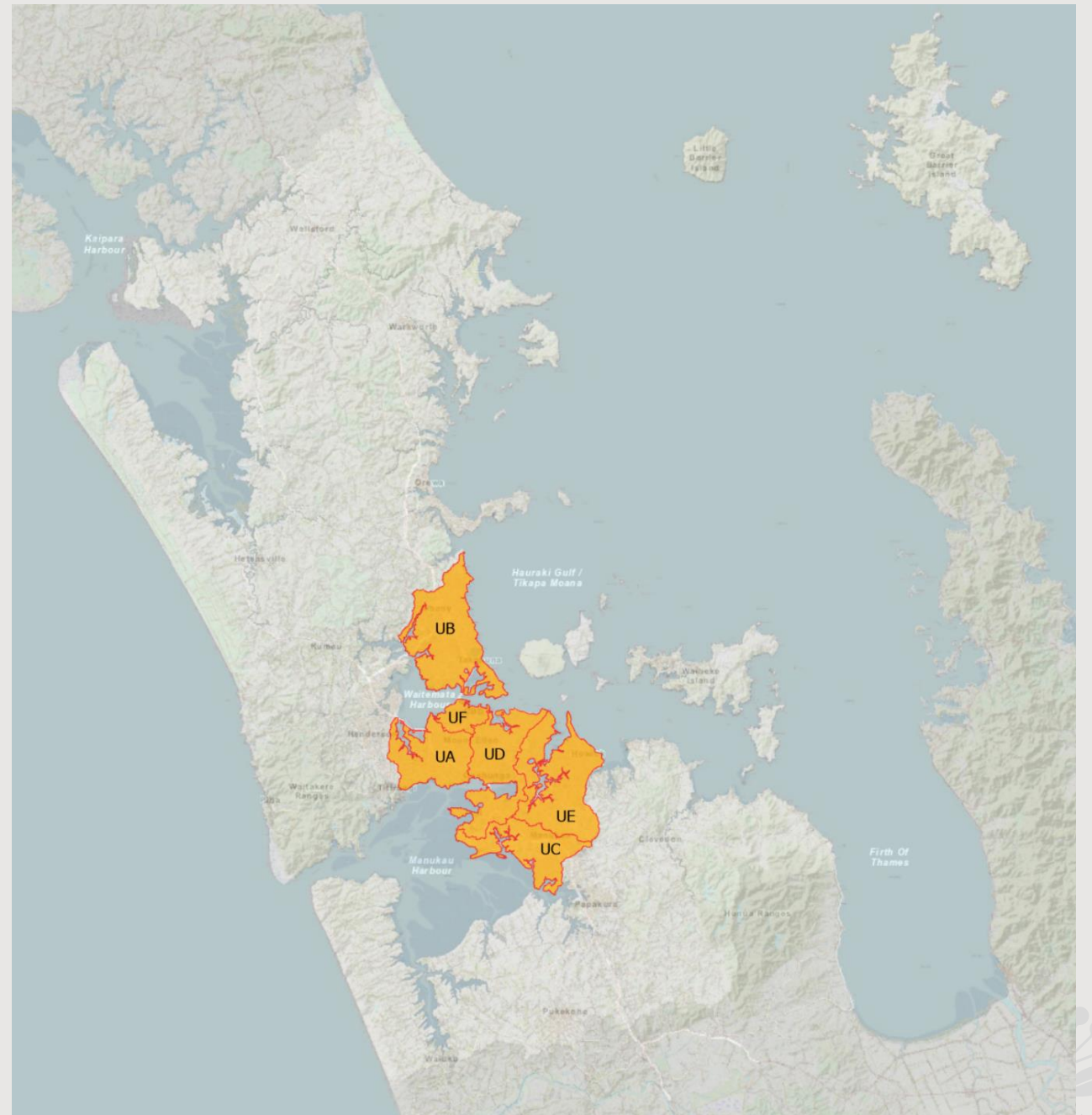
Content

- Why do we need a regional model
- **The regional modelling project**
- Technical considerations and model validation
- Data sharing



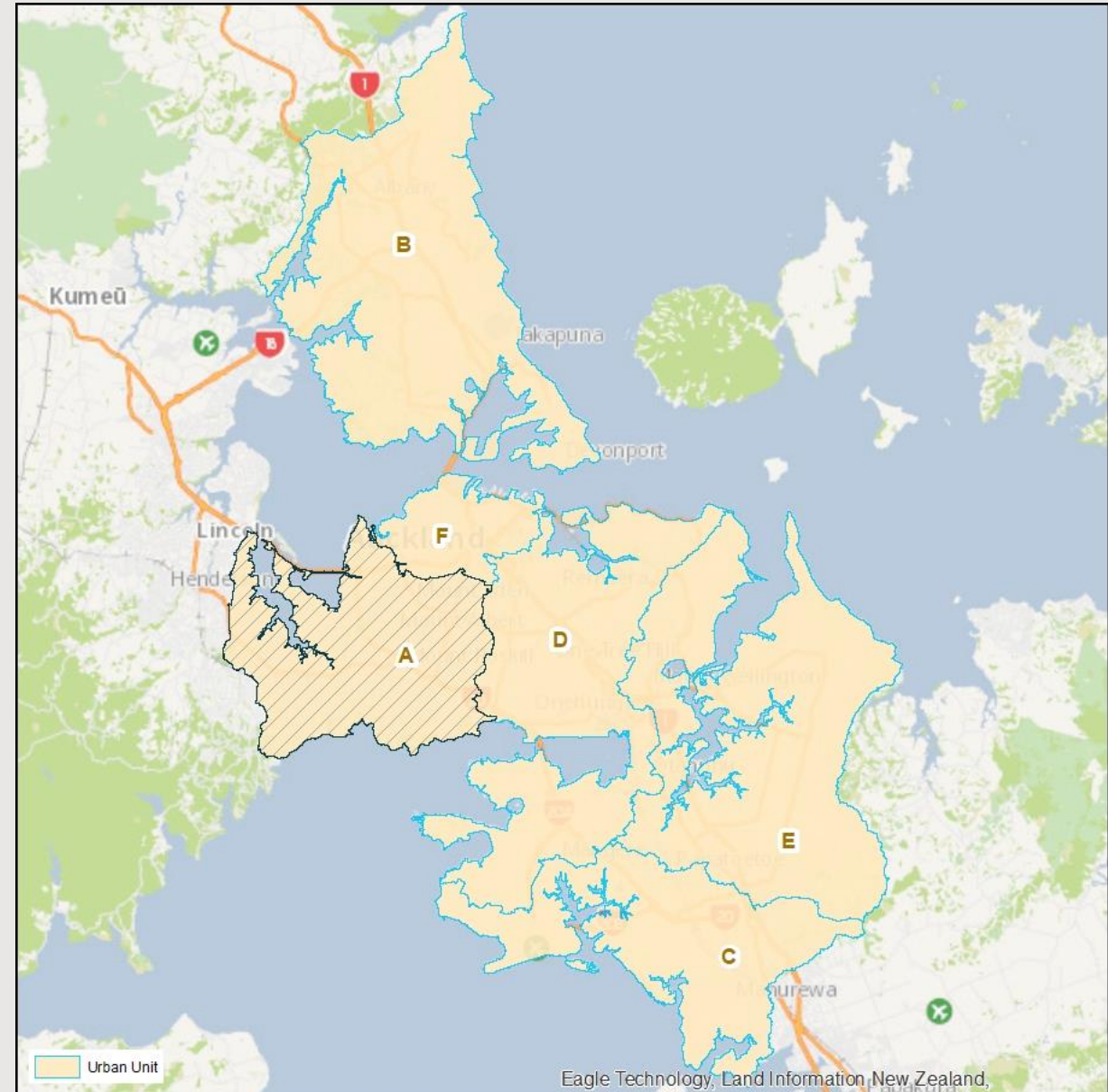
Model Schema

- ▶ The model schema
 - ▶ 2D rain on grid models using TP108 hydrology
 - ▶ Separate models for rural and urban areas
 - ▶ Regional Rural Rapid Model
 - ▶ 90% of the region, 4500km²
 - ▶ Fill flood data gaps and floodplain mapping
 - ▶ Main river channels and key hydraulic structures
 - ▶ Regional Urban Framework Model
 - ▶ Main metropolitan area
 - ▶ Data consistency (input & format) and accuracy
 - ▶ Trunk pipe network and urban streams



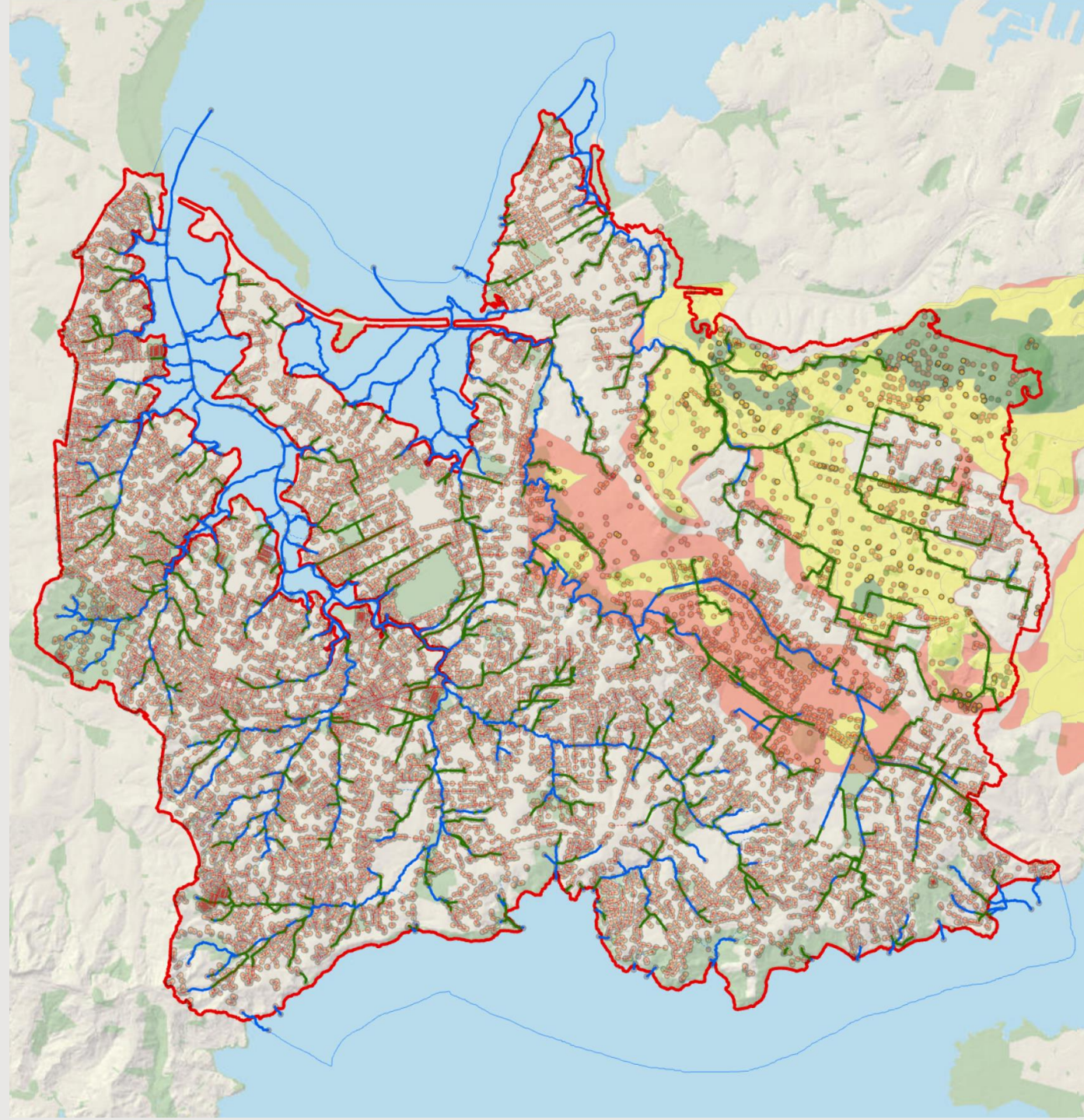
Two stage implementation

- ▶ Project implemented in 2 stages
 - ▶ Rural rapid model
 - ▶ Stage 1: piloting for the entire extent using 10x10m grids
 - ▶ Stage 2: production with much refined details
 - ▶ Urban framework model
 - ▶ Stage 1: piloting using a typical urban area to define constraints and detailed methodology
 - ▶ Stage 2: bulk production



The Scale

- ▶ Rural Rapid Model
 - ▶ 4x4m 2D grids covering 4500km²
 - ▶ 32,000km of stream network
 - ▶ 2,000 runoff profiles
 - ▶ Over 500 hydraulic structures
- ▶ Urban Framework Model
 - ▶ 2x2m 2D grids
 - ▶ 25ha rain zones based on RADAR grid size
 - ▶ 20% of the pipe network (>450mm)
 - ▶ 90% of the total GIS nodes



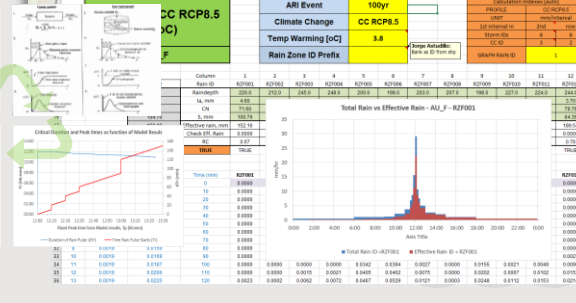
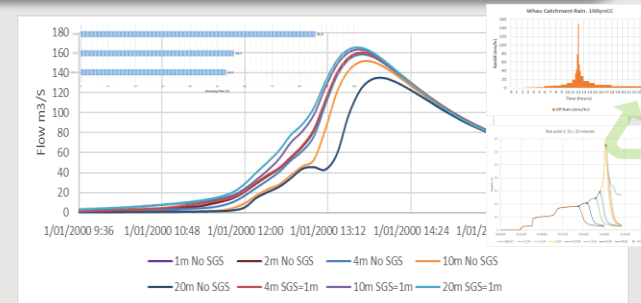
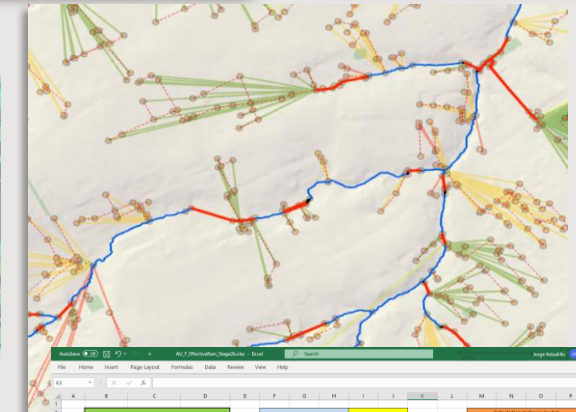
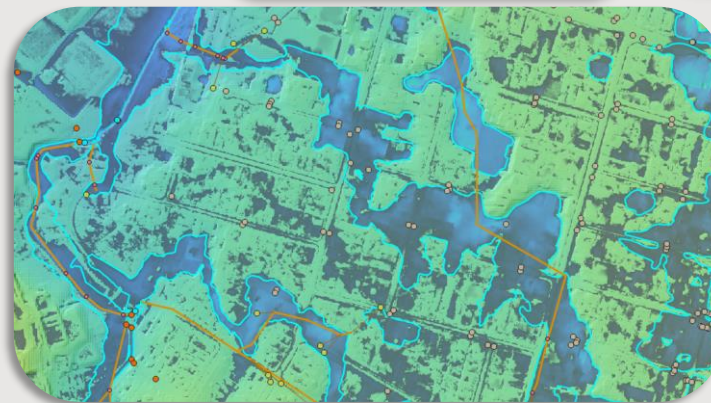
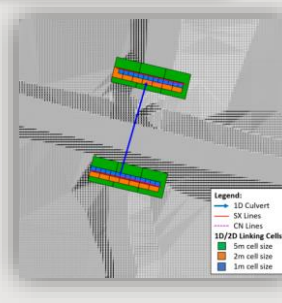
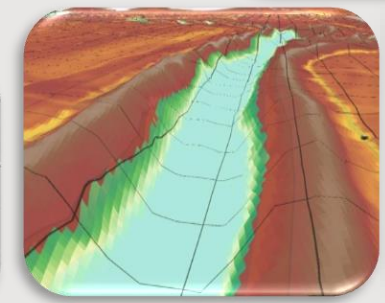
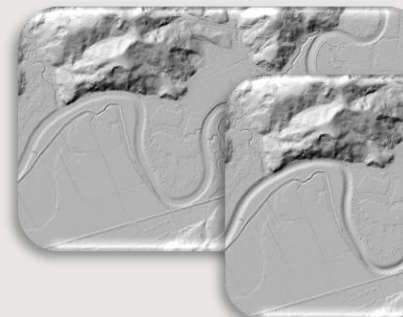
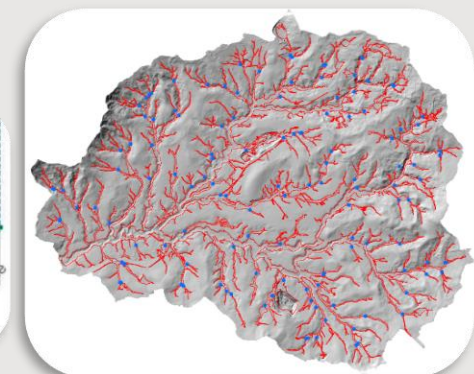
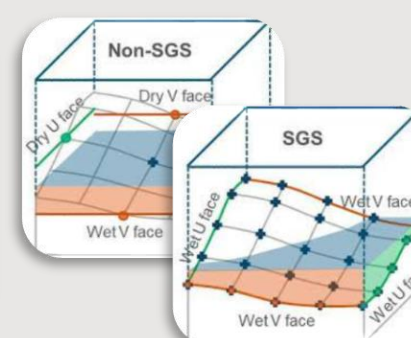
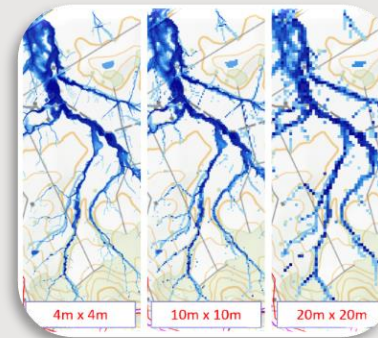
Content

- Why do we need a regional model
- The regional modelling project
- **Technical considerations and model validation**
- Data sharing



Methodology Development

- ▶ Model tests
 - ▶ Optimum grid size, sub-grid-sampling
 - ▶ Low flow channel and key hydraulic structures
 - ▶ Network extent and hydraulic connectivity
 - ▶ 1D/2D interaction where network is trimmed
- ▶ Key model methodology considerations
 - ▶ Speed vs Accuracy
 - ▶ Consistency vs Specifics
 - ▶ Automation vs Manual Checks



Model Validation

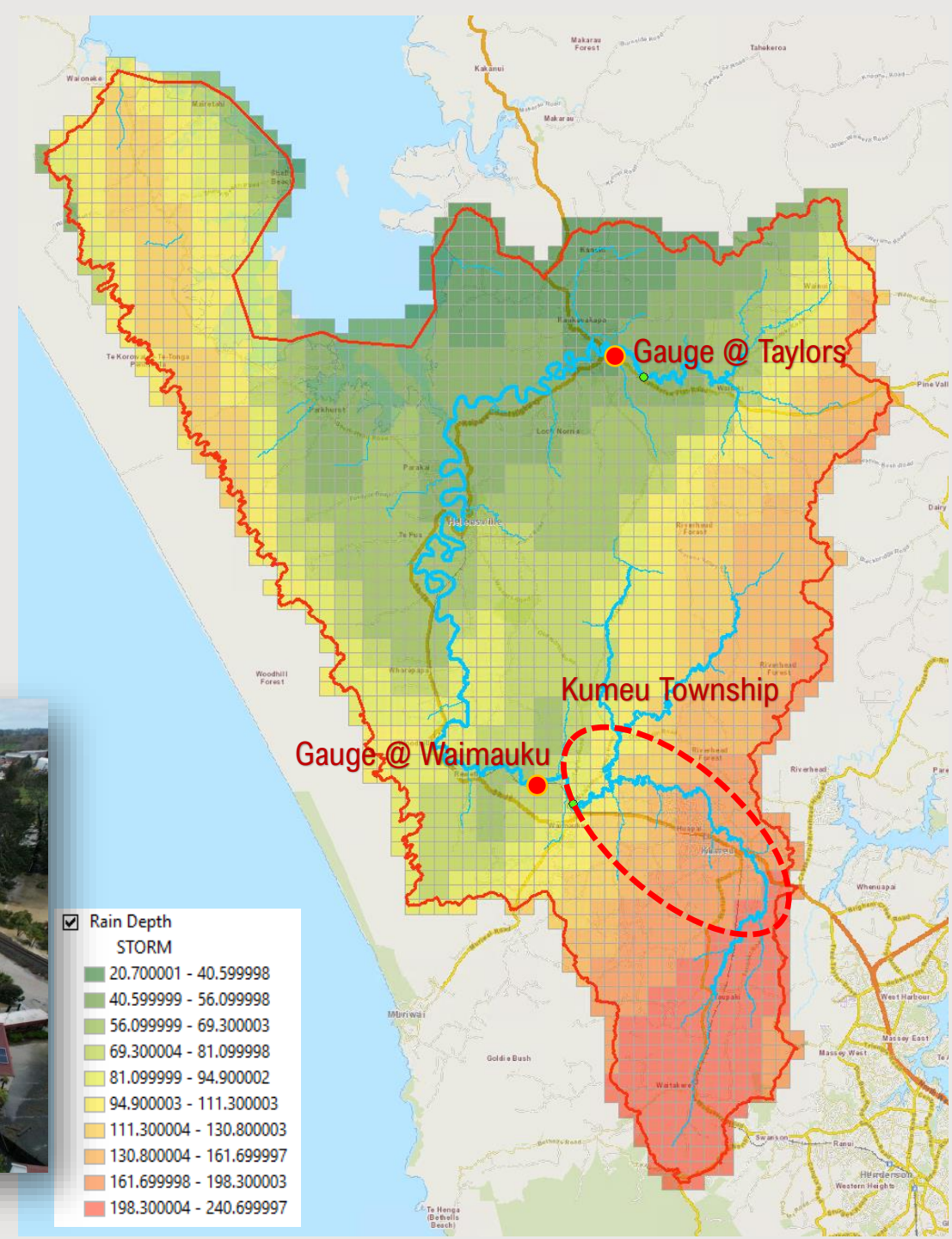
- Rural Model
 - Existing tool: TP108 Graphical Method
 - Storm Event: Aug 2021 Kumeu flooding



Flooding at Kumeu in West Auckland. Photo / Brett Phibbs

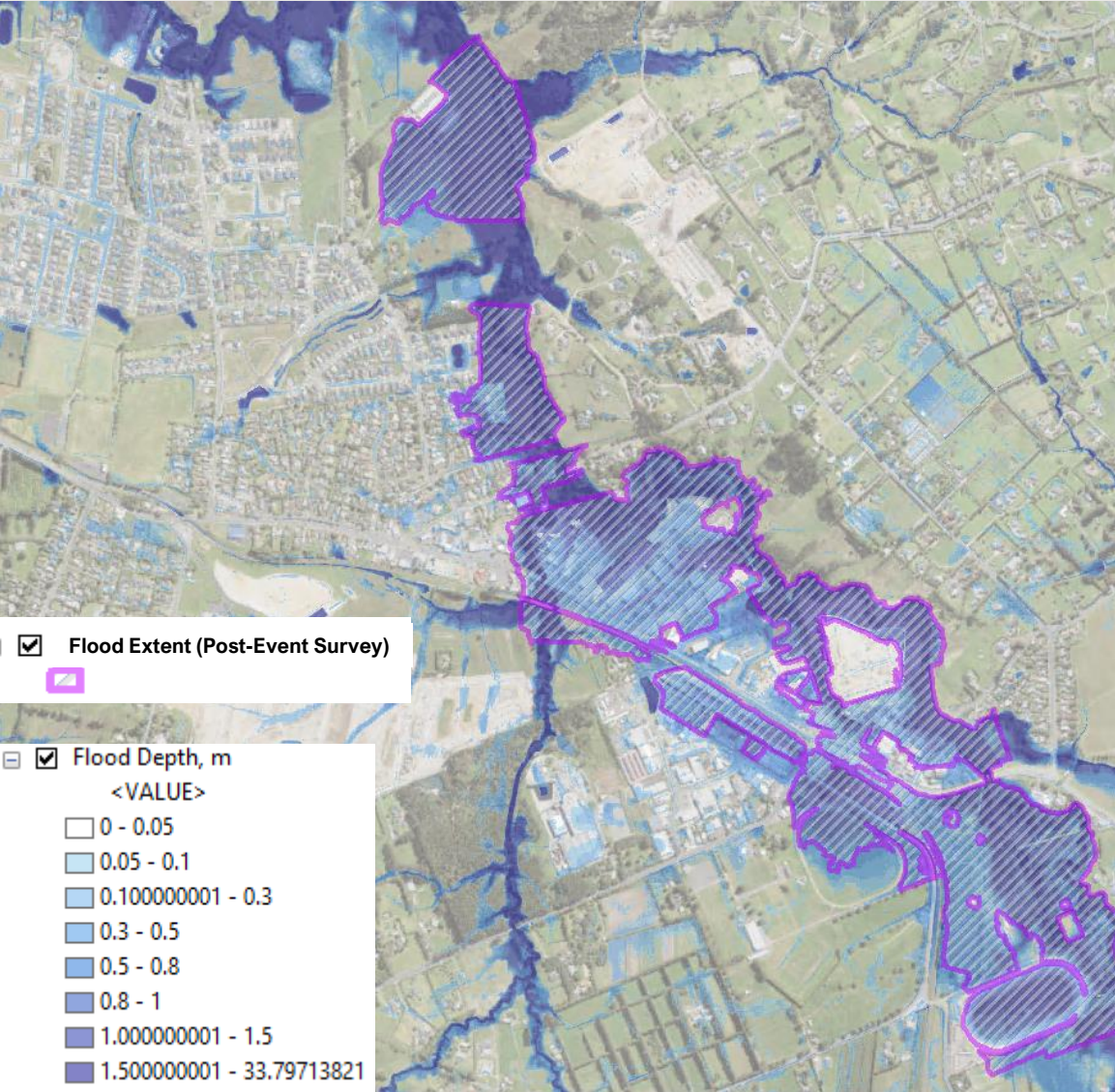


Flooding at Kumeu in West Auckland. Photo / Brett Phibbs

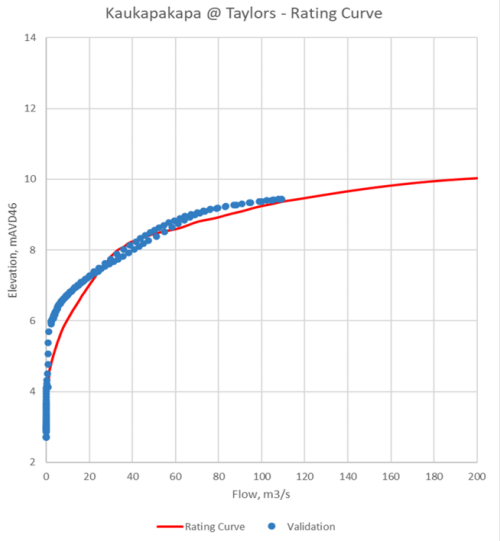
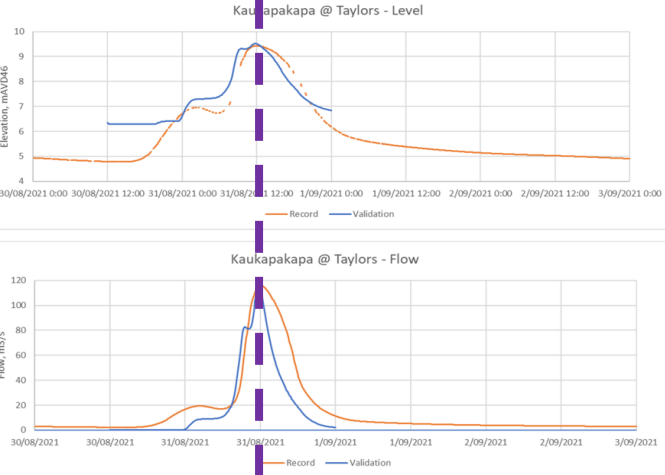


☒ Rain Depth
STORM
20.700001 - 40.599998
40.599999 - 56.099998
56.099999 - 69.300003
69.300004 - 81.099998
81.099999 - 94.900002
94.900003 - 111.300003
111.300004 - 130.800003
130.800004 - 161.699997
161.699998 - 198.300003
198.300004 - 240.699997

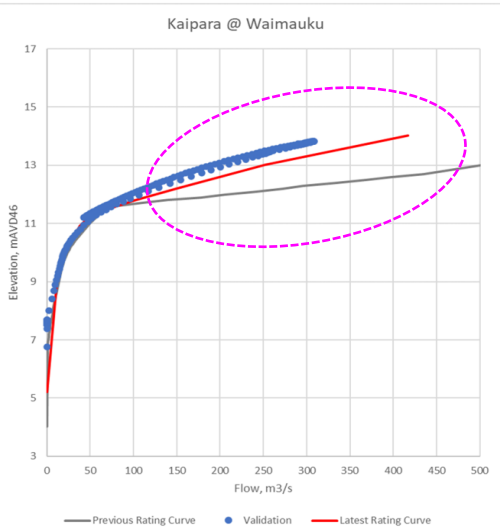
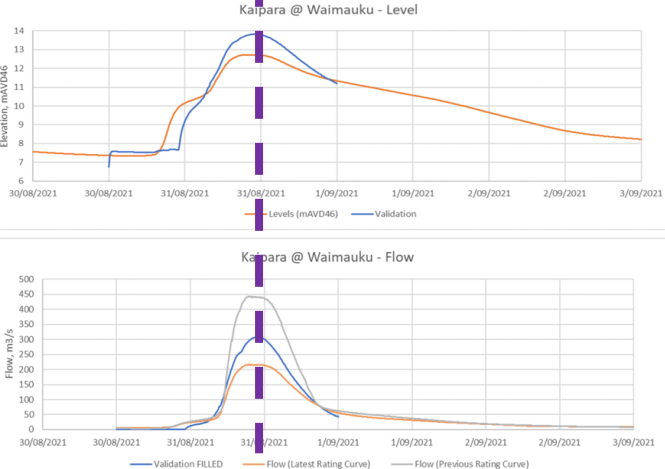
Aug 2021 Event – Kumeu Township & Gauge Sites



Validation – Kaukapakapa River Gauge

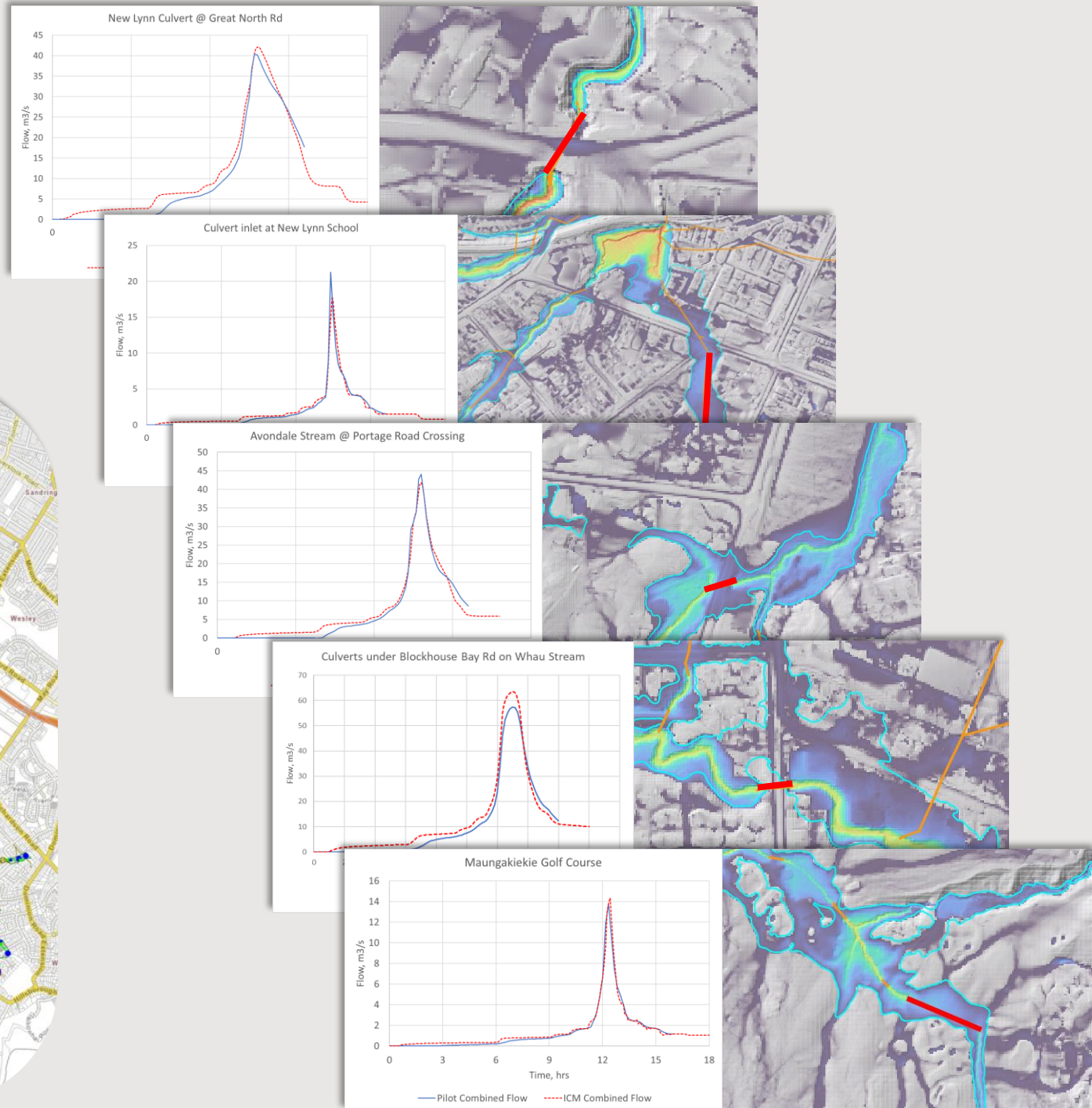
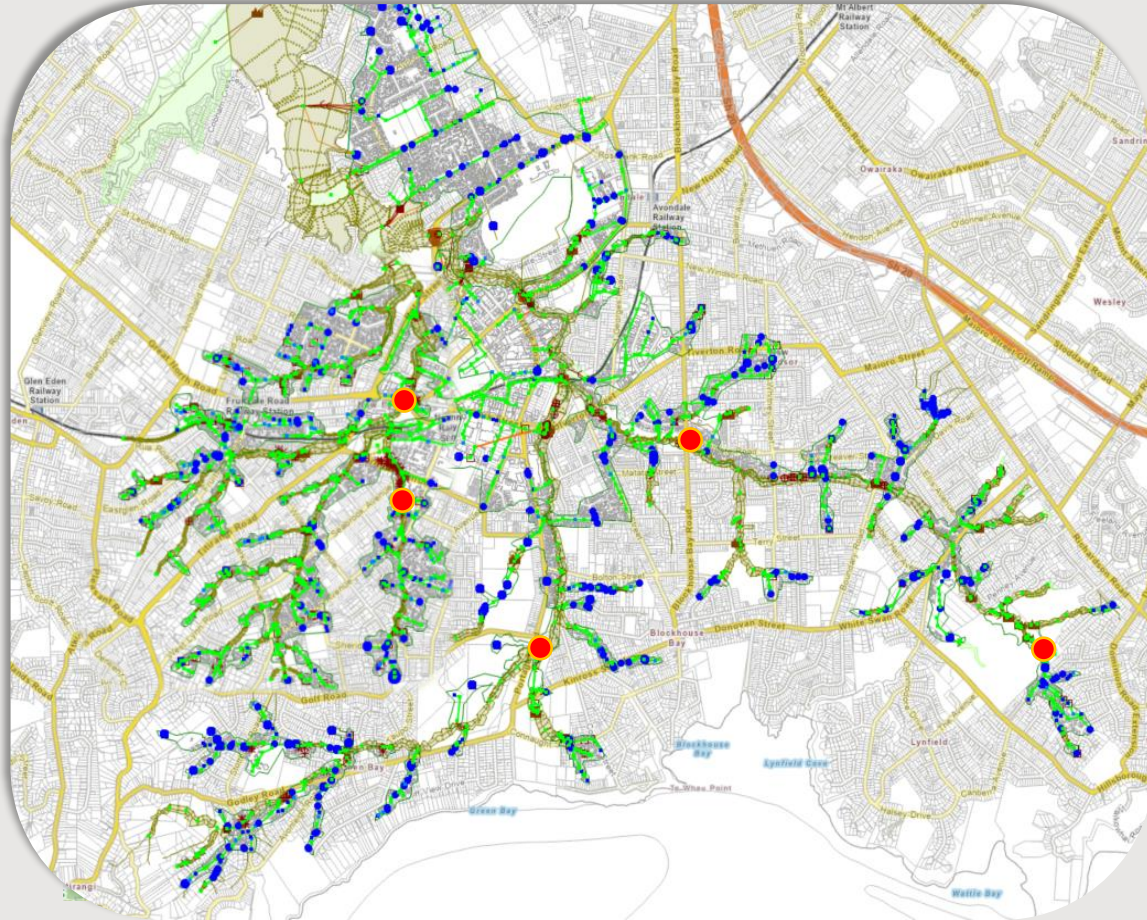


Validation – Kaipara River Gauge



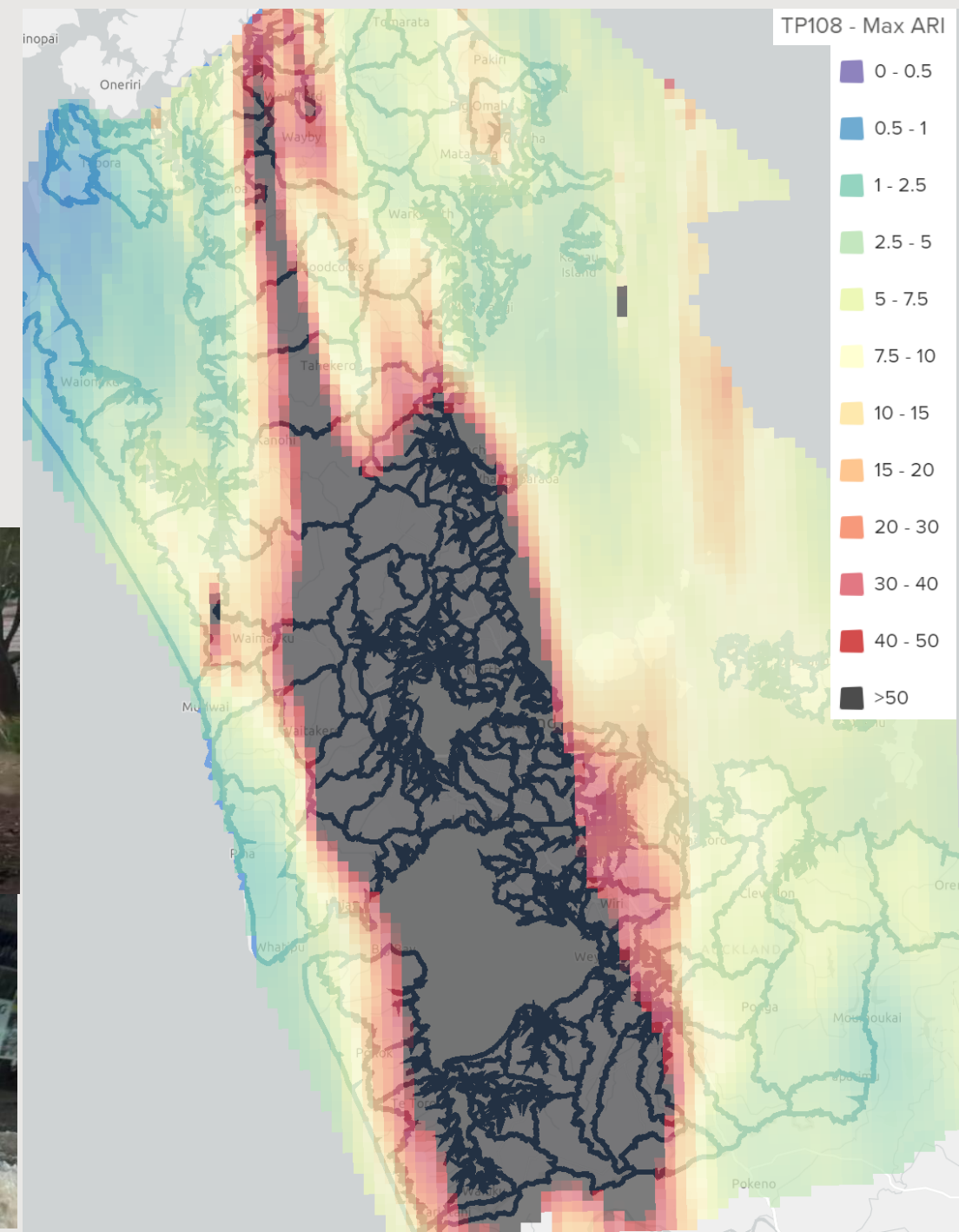
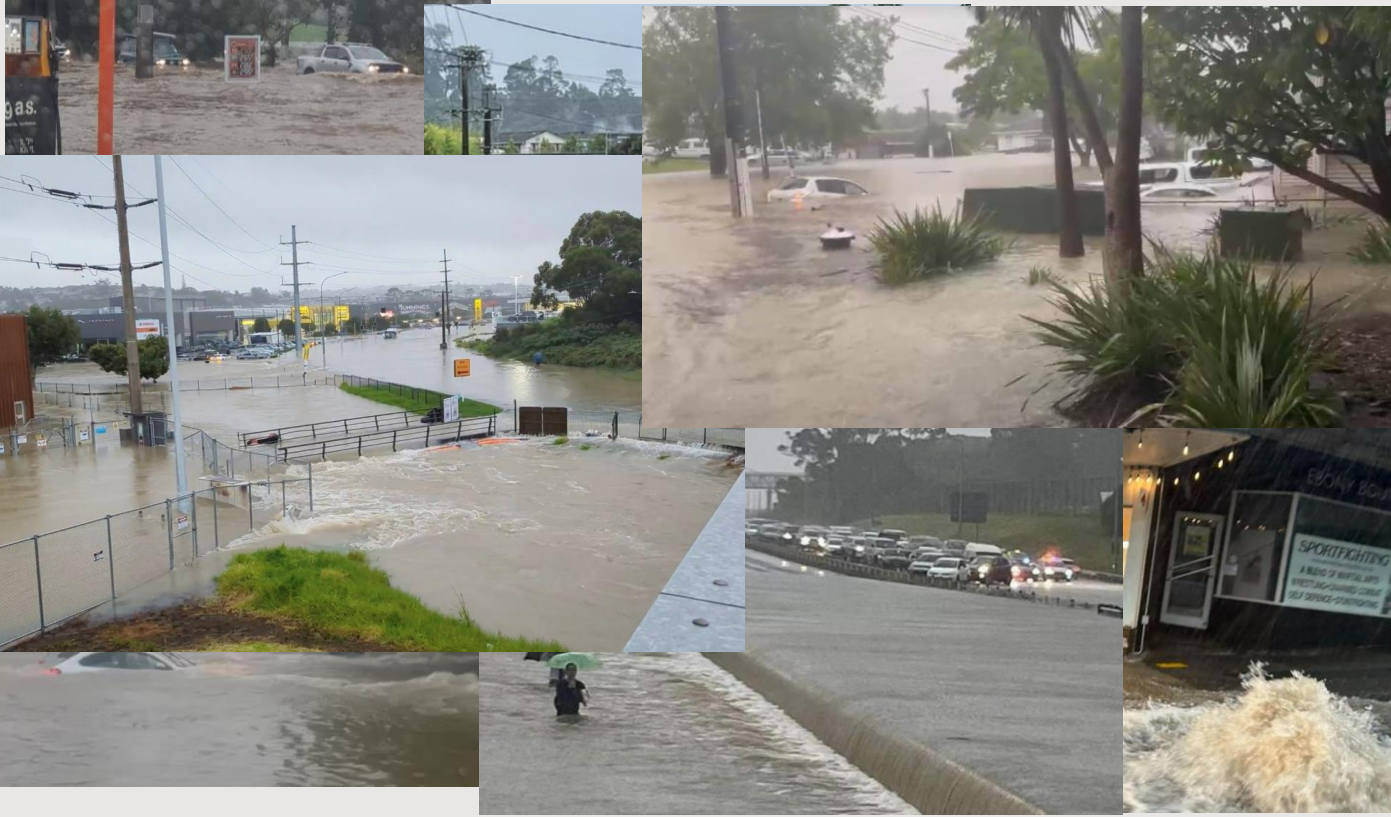
Model Validation

- ▶ Urban Framework Model Validation
 - ▶ Existing tool: detailed catchment models



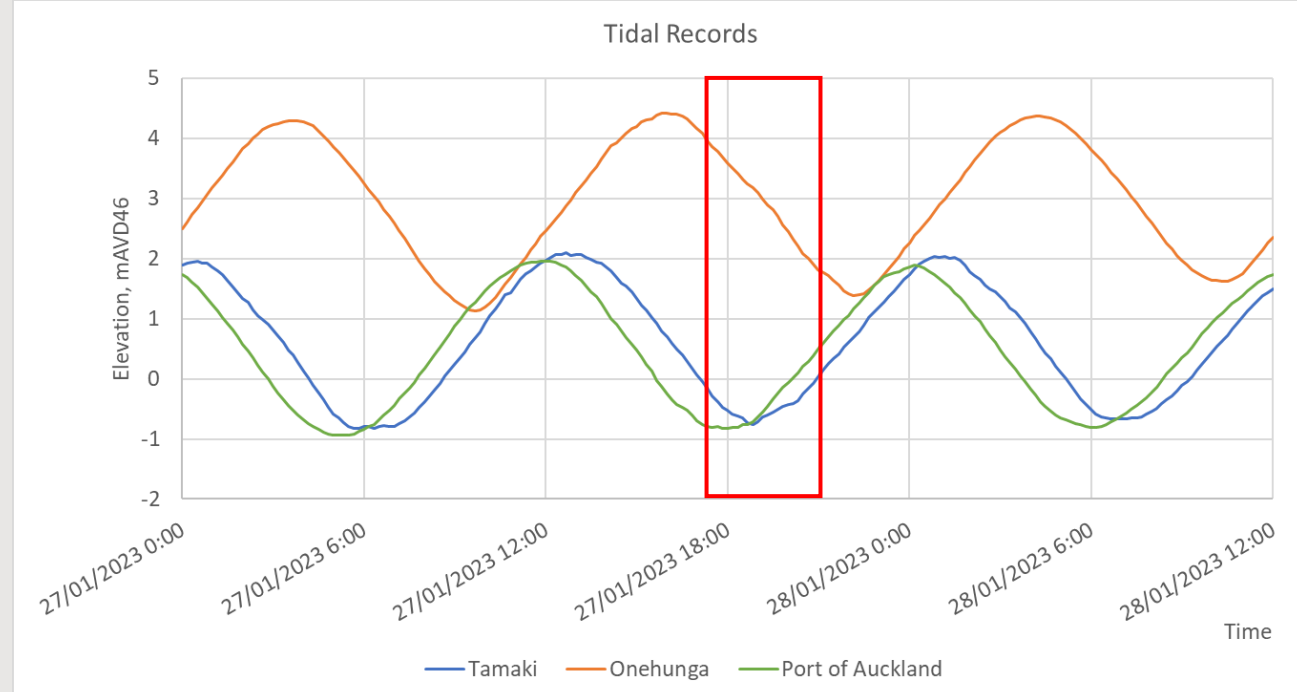
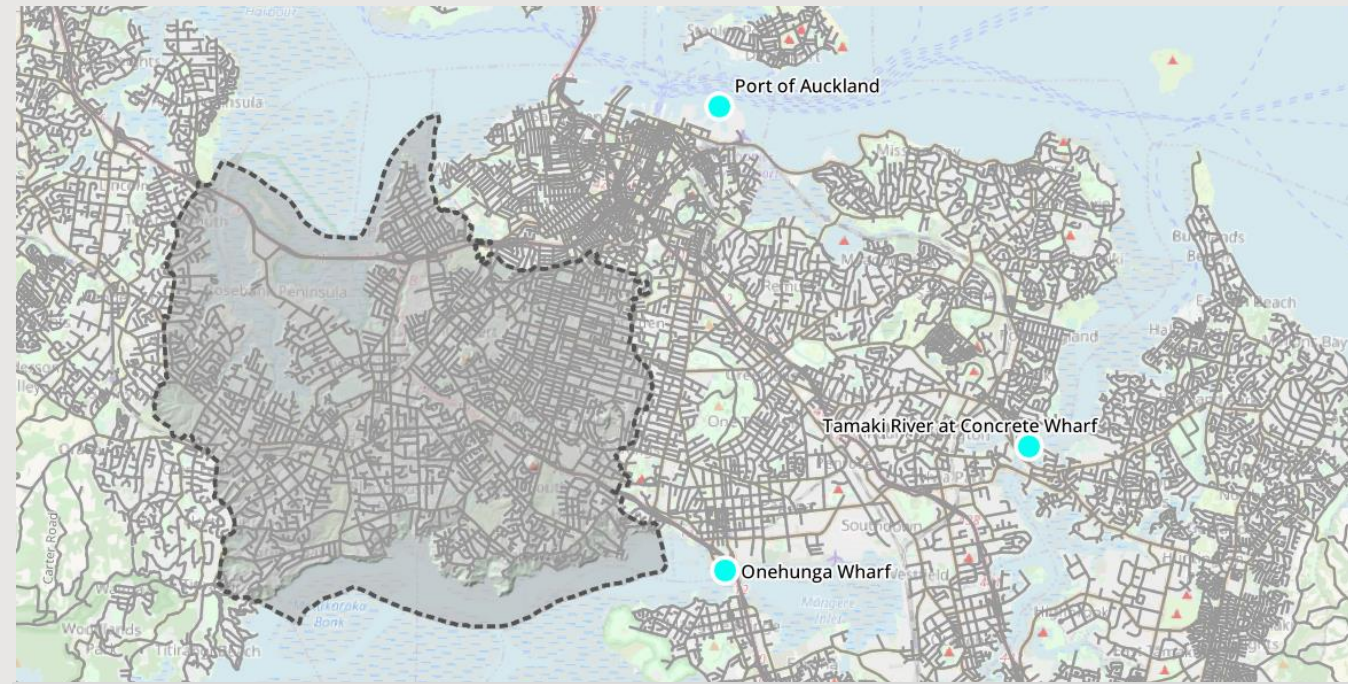
Model Validation

- Urban Framework Model Validation
 - Existing tool: detailed catchment models
 - Storm event: Jan 2023 Auckland flooding

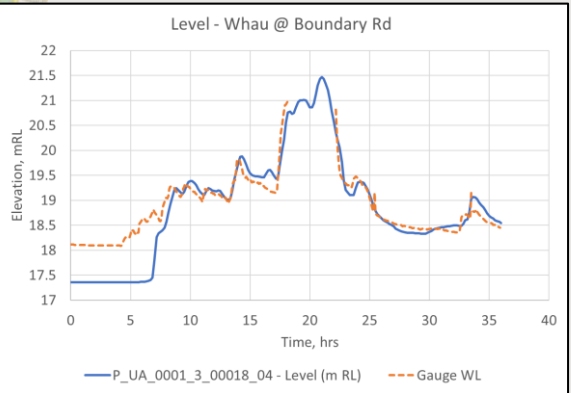
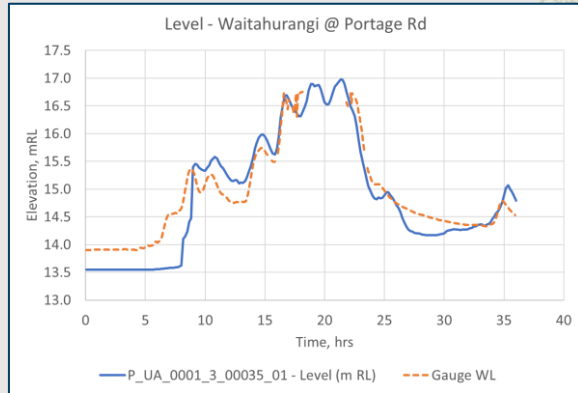
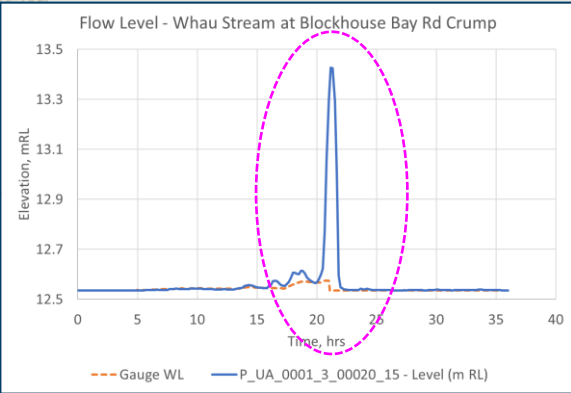
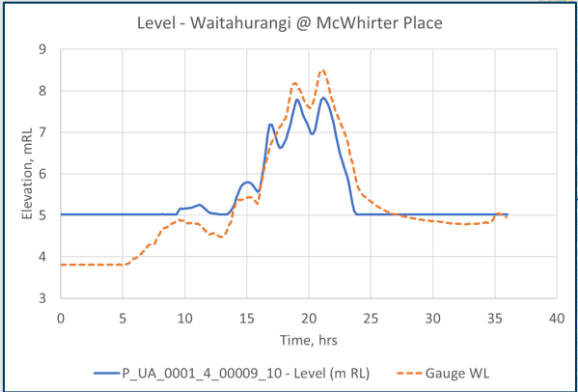
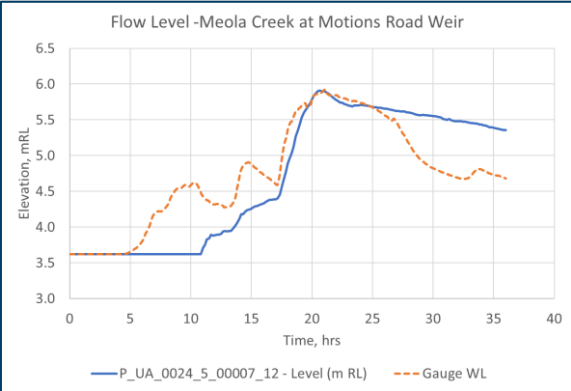


Model Validation

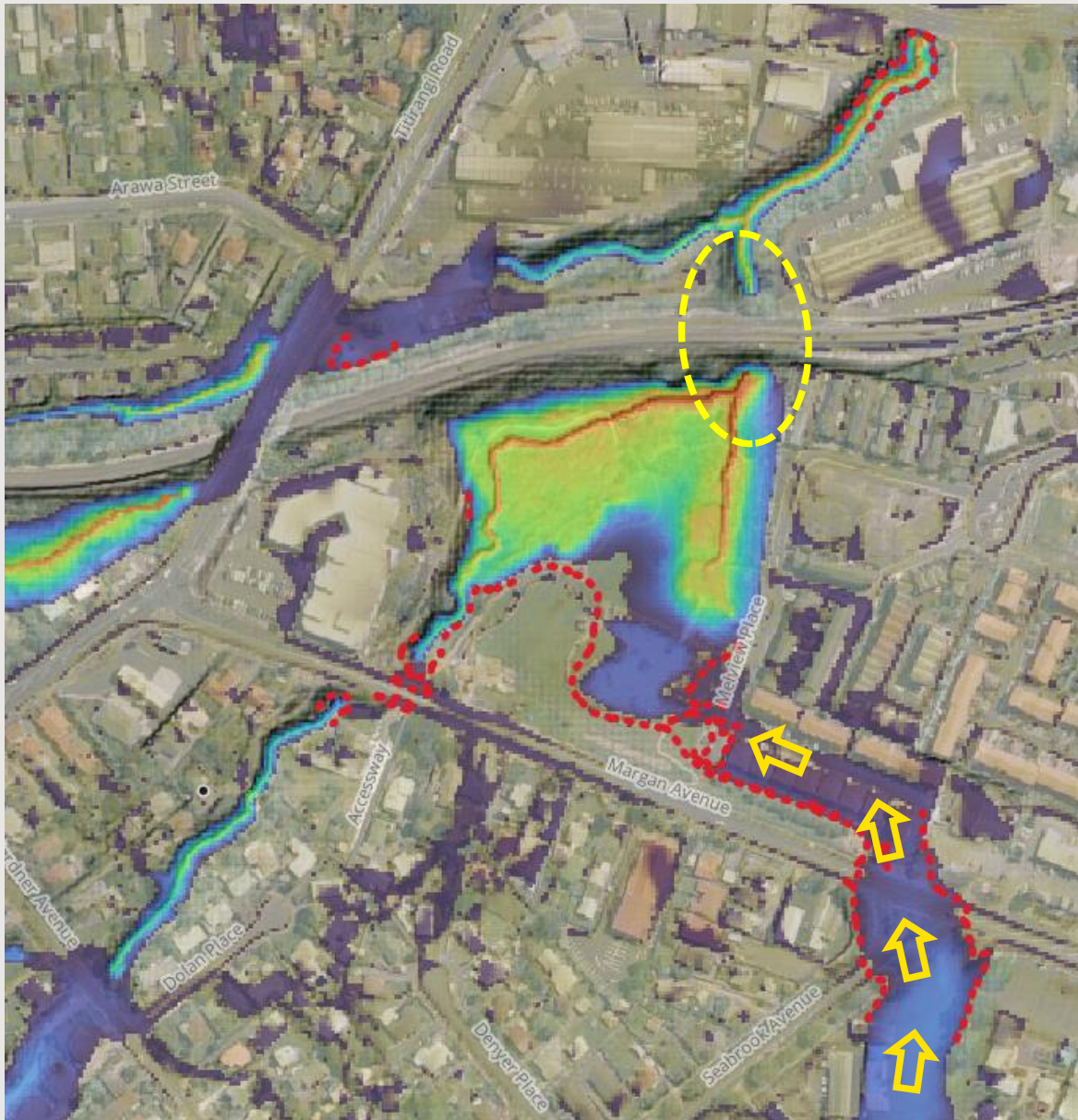
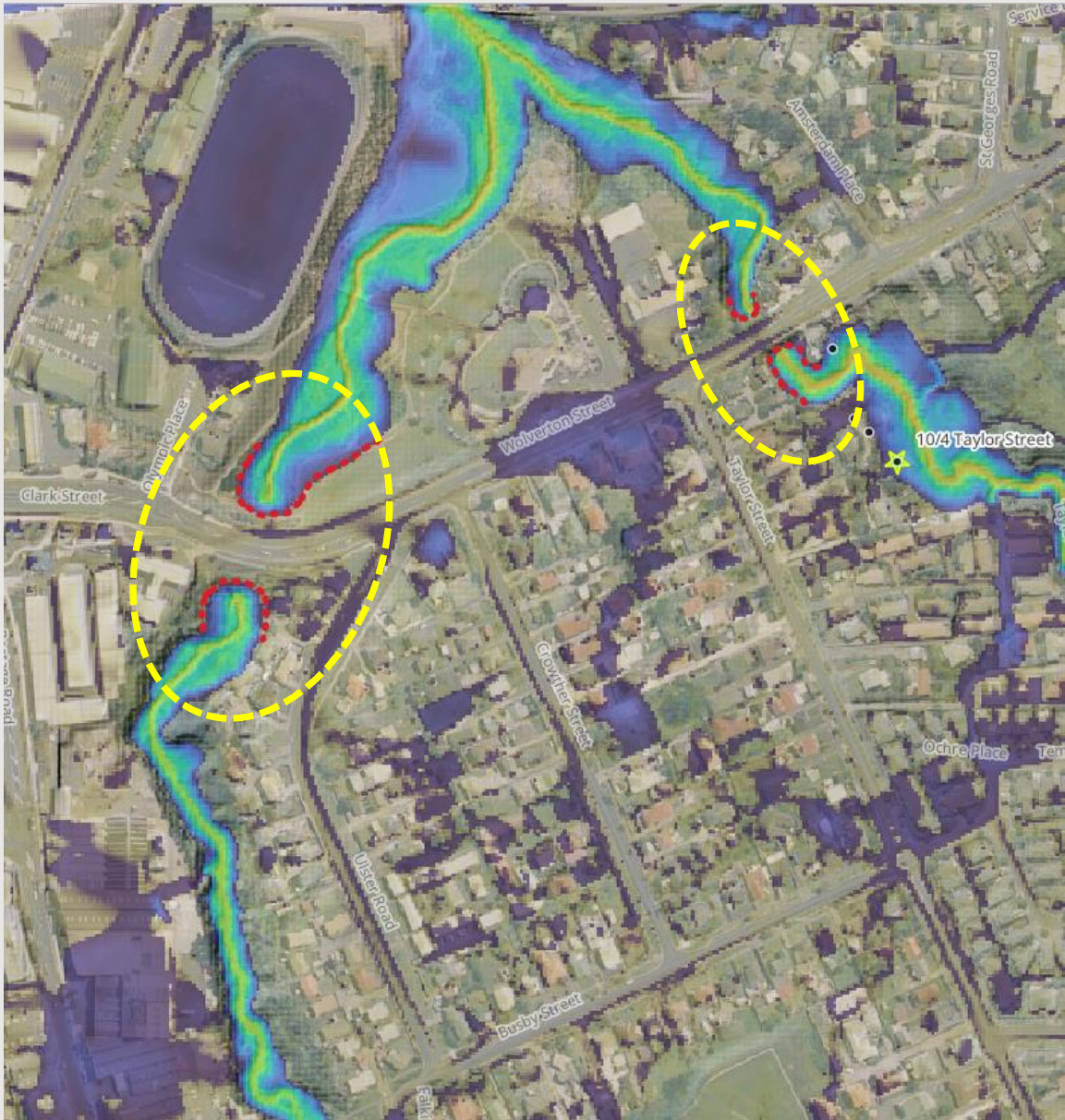
- Urban Framework Model Validation
 - Existing tool: detailed catchment models
 - Storm event: Jan 2023 Auckland flooding
 - Gauge recorded 234 – 285mm rain within 24hrs
 - Most rain fell 5 – 9pm
 - Max 1hr depth 50 – 70mm
 - Tide gauge (POA and Onehunga)



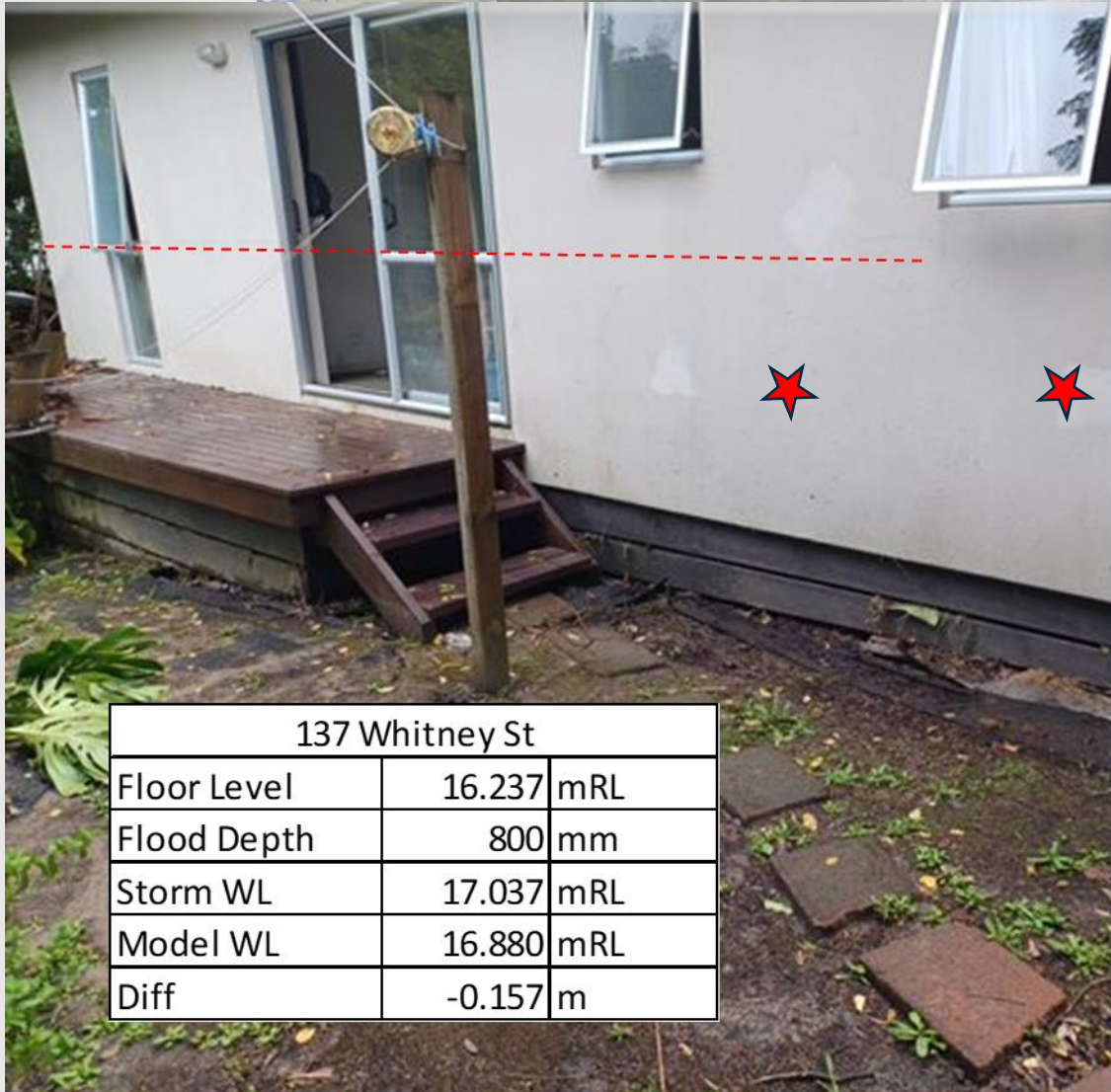
Jan 2023 Event - Level Gauge



Jan 2023 Event - Flood Extent Comparison



Jan 2023 Event - Flood Level Comparisons



137 Whitney St		
Floor Level	16.237	mRL
Flood Depth	800	mm
Storm WL	17.037	mRL
Model WL	16.880	mRL
Diff	-0.157	m



Model WL	18.681	mRL
Diff	0.135	m

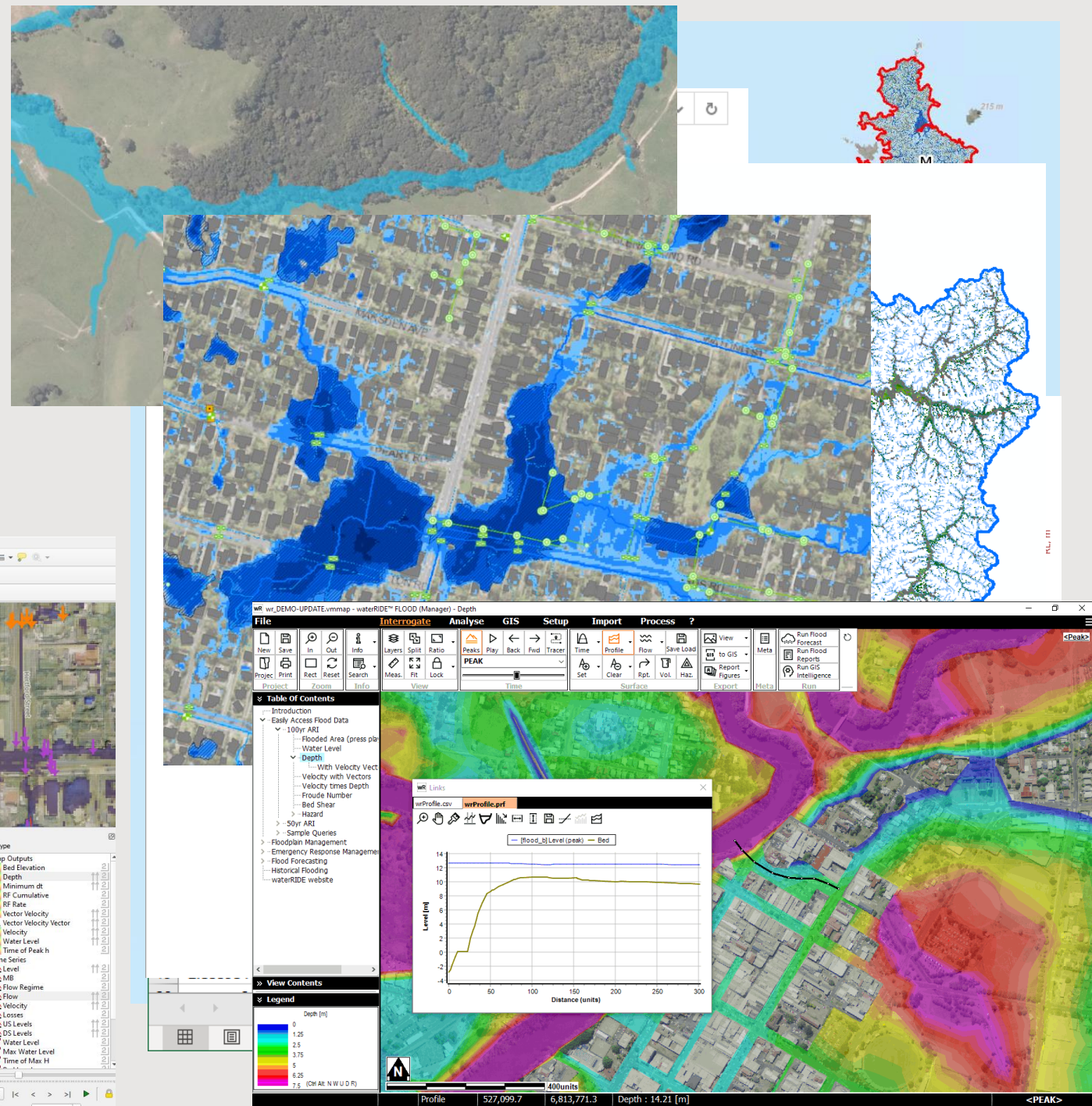
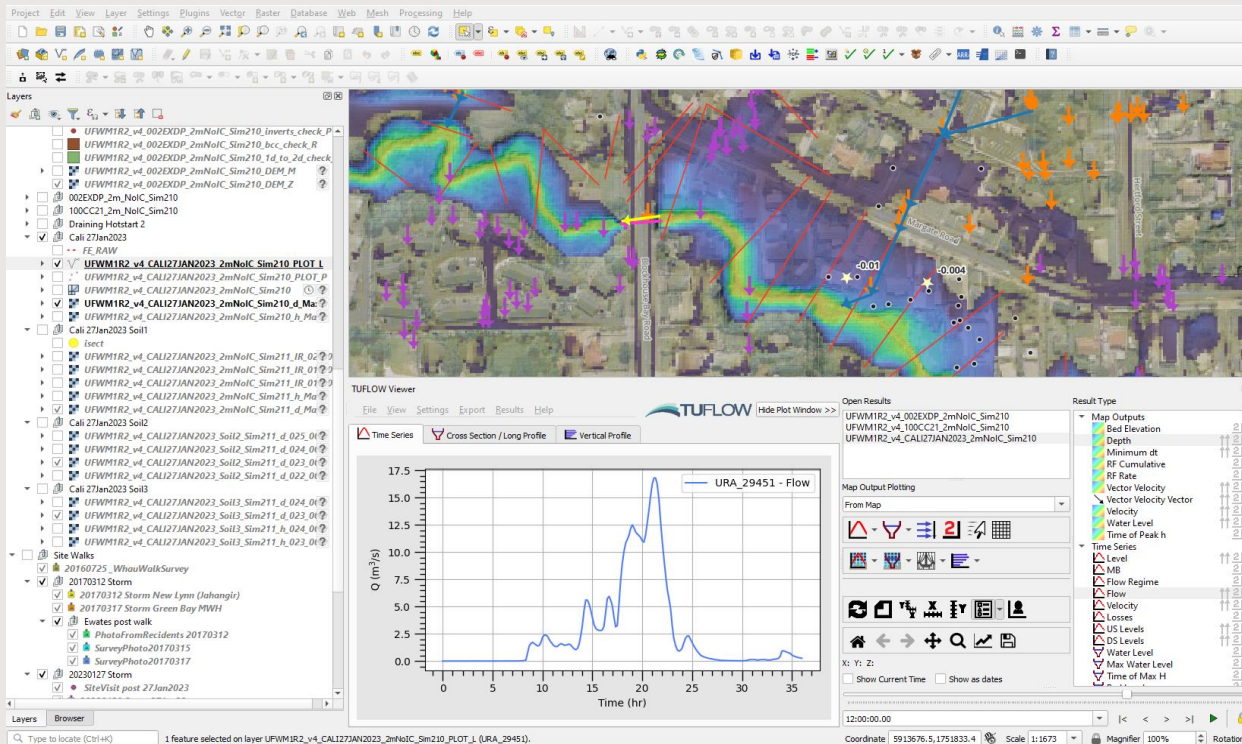
Content

- Why do we need a regional model
- The regional modelling project
- Technical considerations and model validation
- **Data sharing and Next Steps**

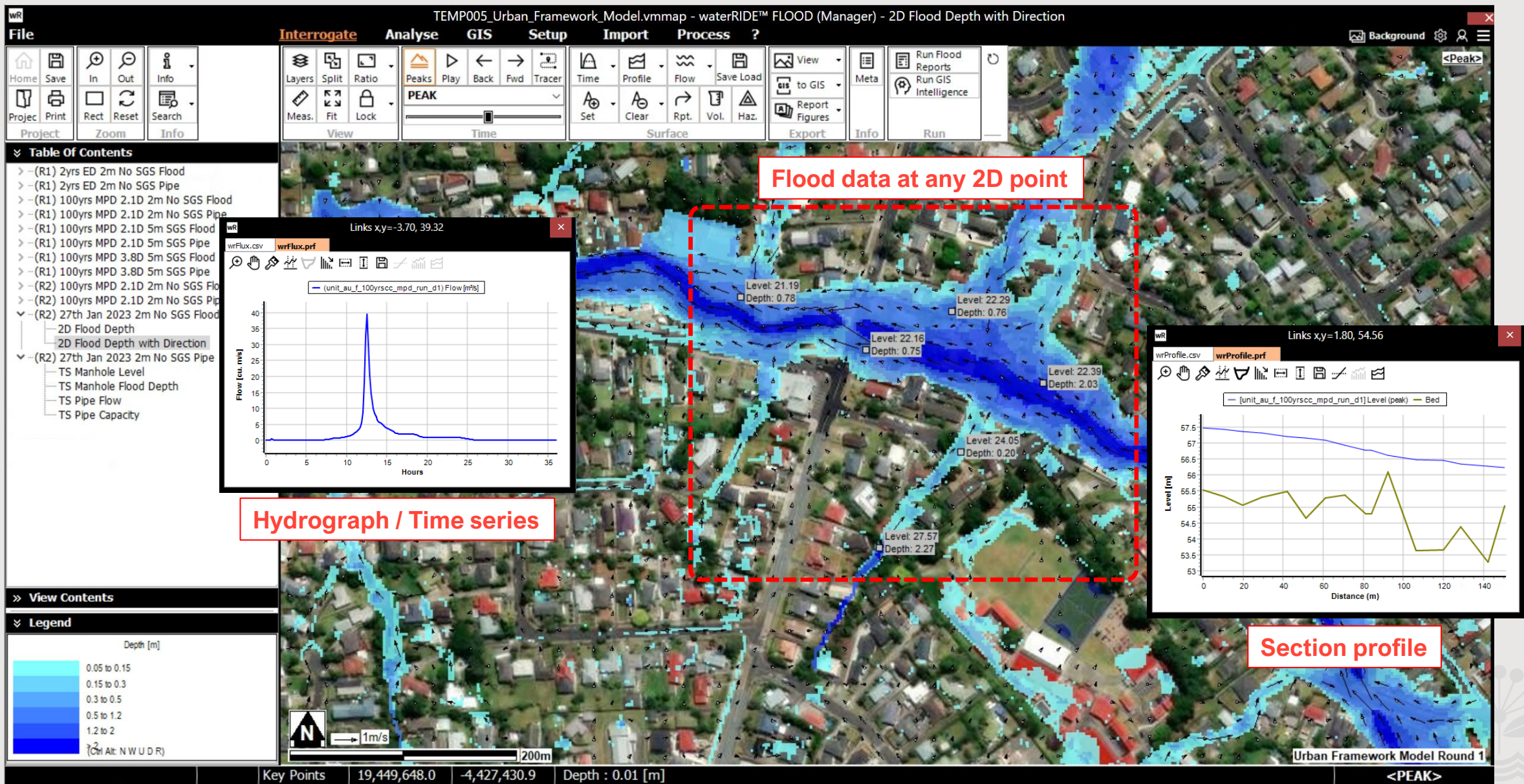


Regionwide Model Data

- Model files are data rich and large in size
 - Tuflow models (18 rural units, 6 urban units)
 - Reports and data sheets
 - GIS layers including model inputs and outputs
 - Flood data in various formats



Time Series Model Outputs

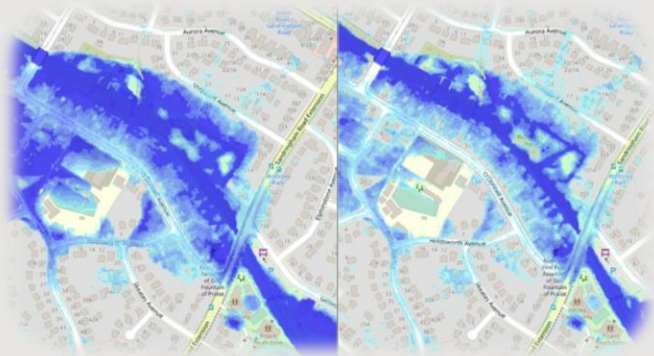


Key Model Outputs

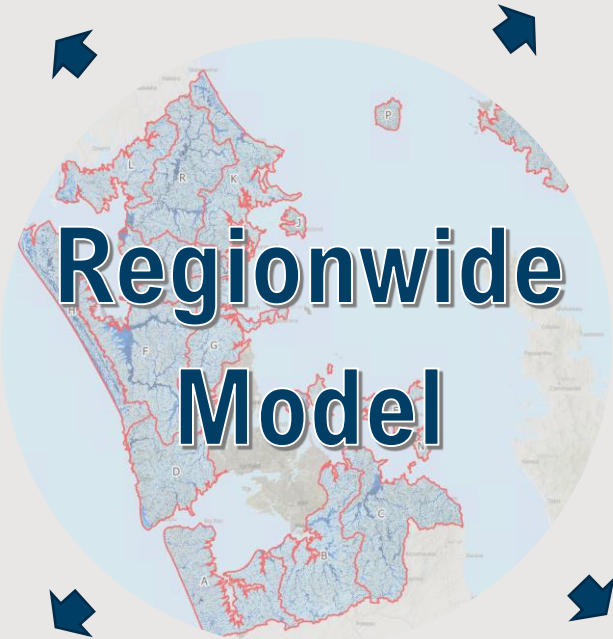
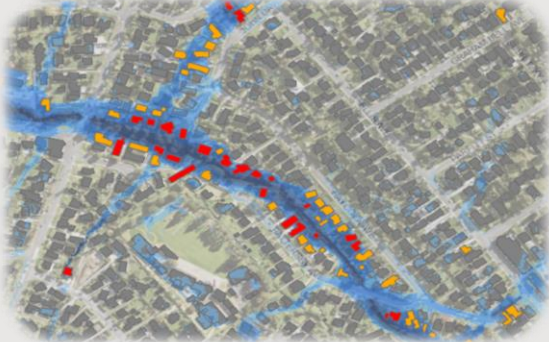
Catchment Management Tool



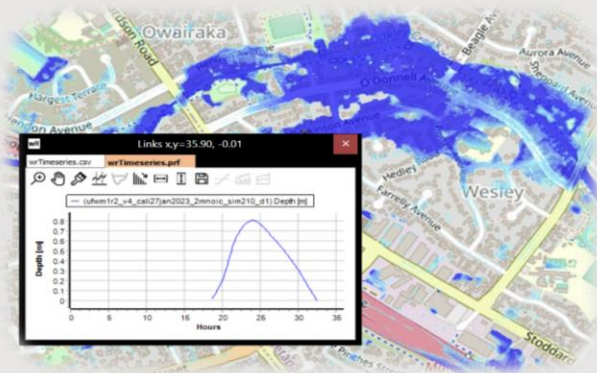
Event Verification



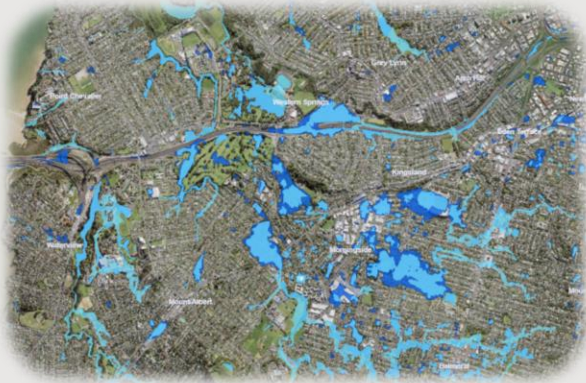
Flood Hazard Assessment



Time Series Data Interrogation



Floodplain Publication



Other Regional Initiatives

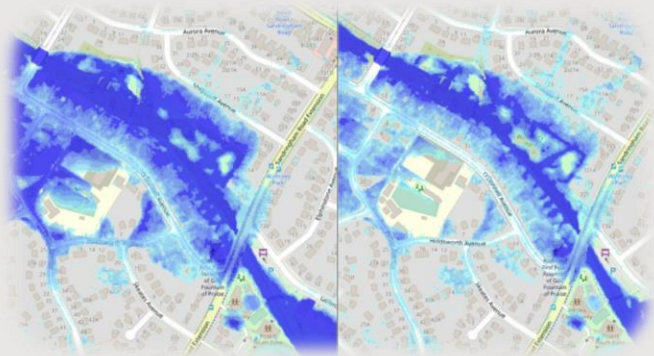


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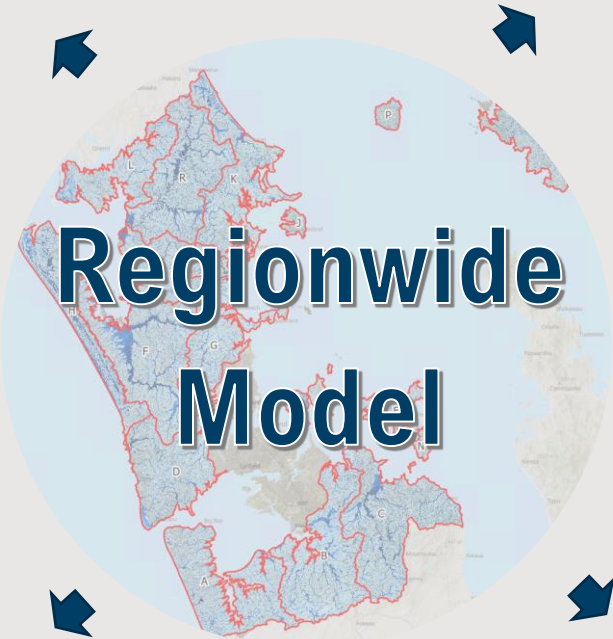
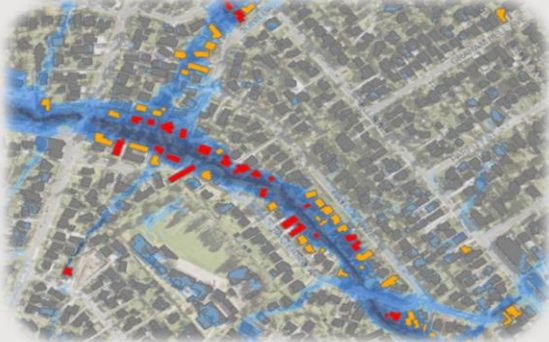
Catchment Management Tool



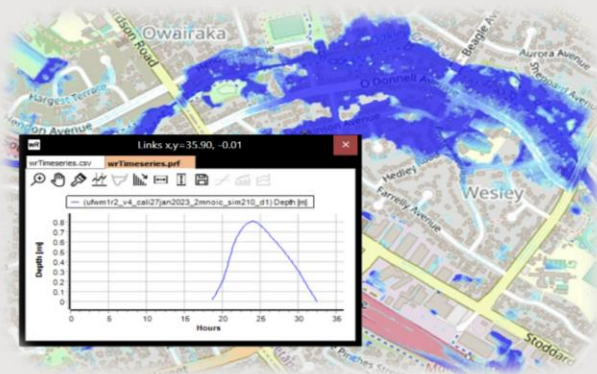
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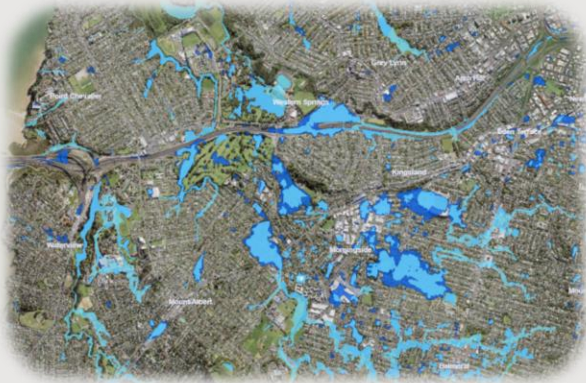
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Other Regional Initiatives



THANK YOU

