

Understanding the subsurface hydrology of braided rivers: hyporheic exchange & leakage to groundwater



Overview

- MBIE Endeavour Fund - Research Programme
- Five year project from Oct 2019
- ~\$8M plus Regional Council support
- Three field areas, three councils:
 - Wairau River – MDC
 - Selwyn River – Ecan
 - Ngaruroro River – HBRC

Collaboration Team

- **Lincoln Agritech:** programme lead, modelling, fieldwork
- **NIWA:** Theme leads, hydrological modelling, fieldwork
- Regional Council staff (**HBRC, Ecan, MDC**)
- **Ngāti Kahungunu:** Ngaruroro mātauranga
- **Canterbury University:** fieldwork, lab work
- **Lincoln University:** economics
- **TU Dresden, Germany:** modelling
- **Aarhus University, Denmark:** geophysical methods
- **Flinders University, Australia:** field instrumentation

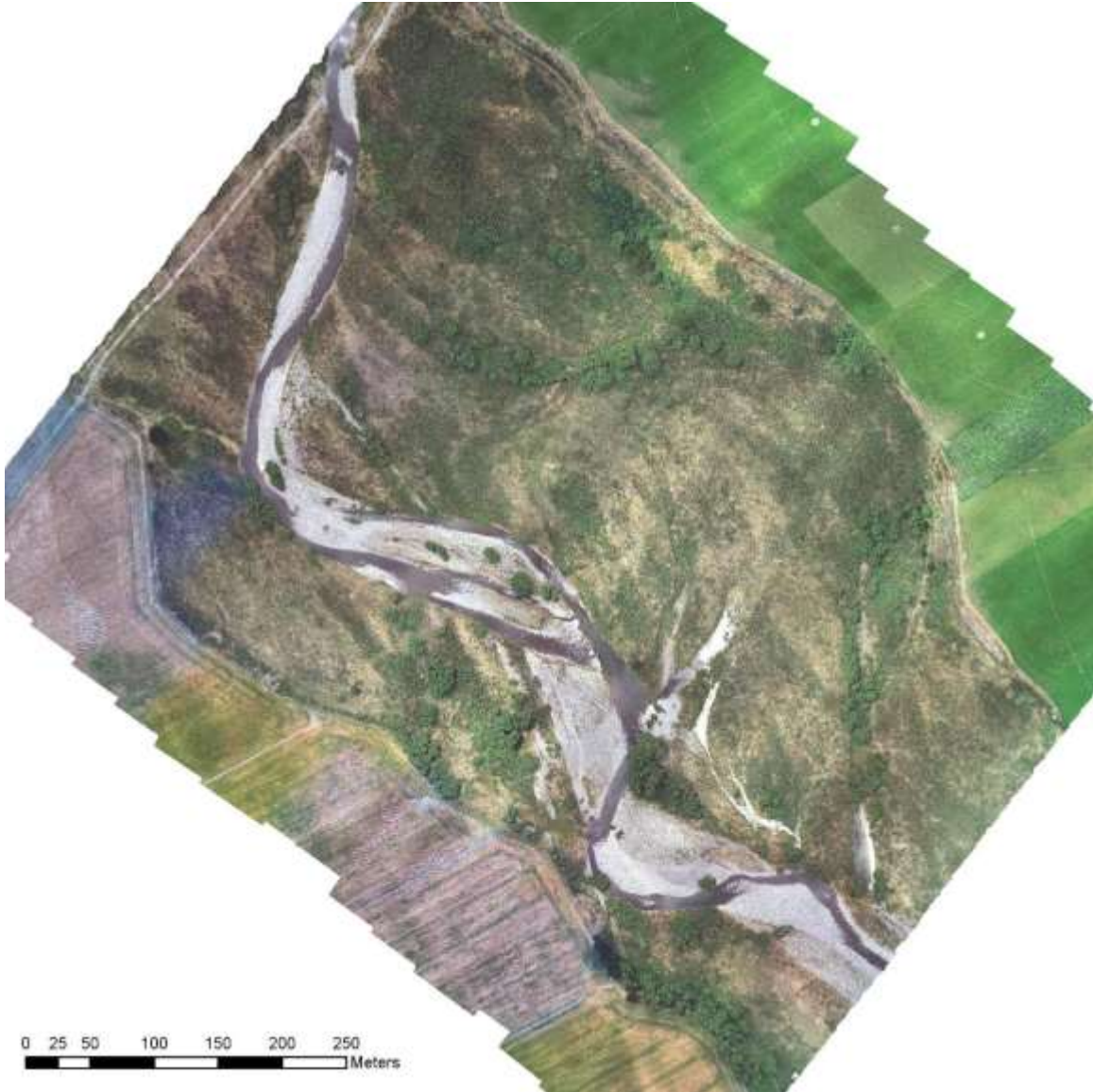
Stakeholder Advisory Group

- Four Regional Councils – GWRC, HBRC, Ecan, MDC
- Iwi - Ngāti Kahungunu
- Dept of Conservation
- Ministry for the Environment
- Ministry for Primary Industries
- NSC – Our Land & Water

Research Aims

1. Understand conceptually how braided rivers work in the subsurface
2. Quantify the components of river exchanges
 - Storage in the riparian gravels (flow resilience)
 - Proportion of flow as hyporheic and parafluvial exchange
 - Leakage to groundwater
3. Understand which management factors influence these components
 - How does channel geometry influence low flow hydrology?
 - Scenario testing and economic implications

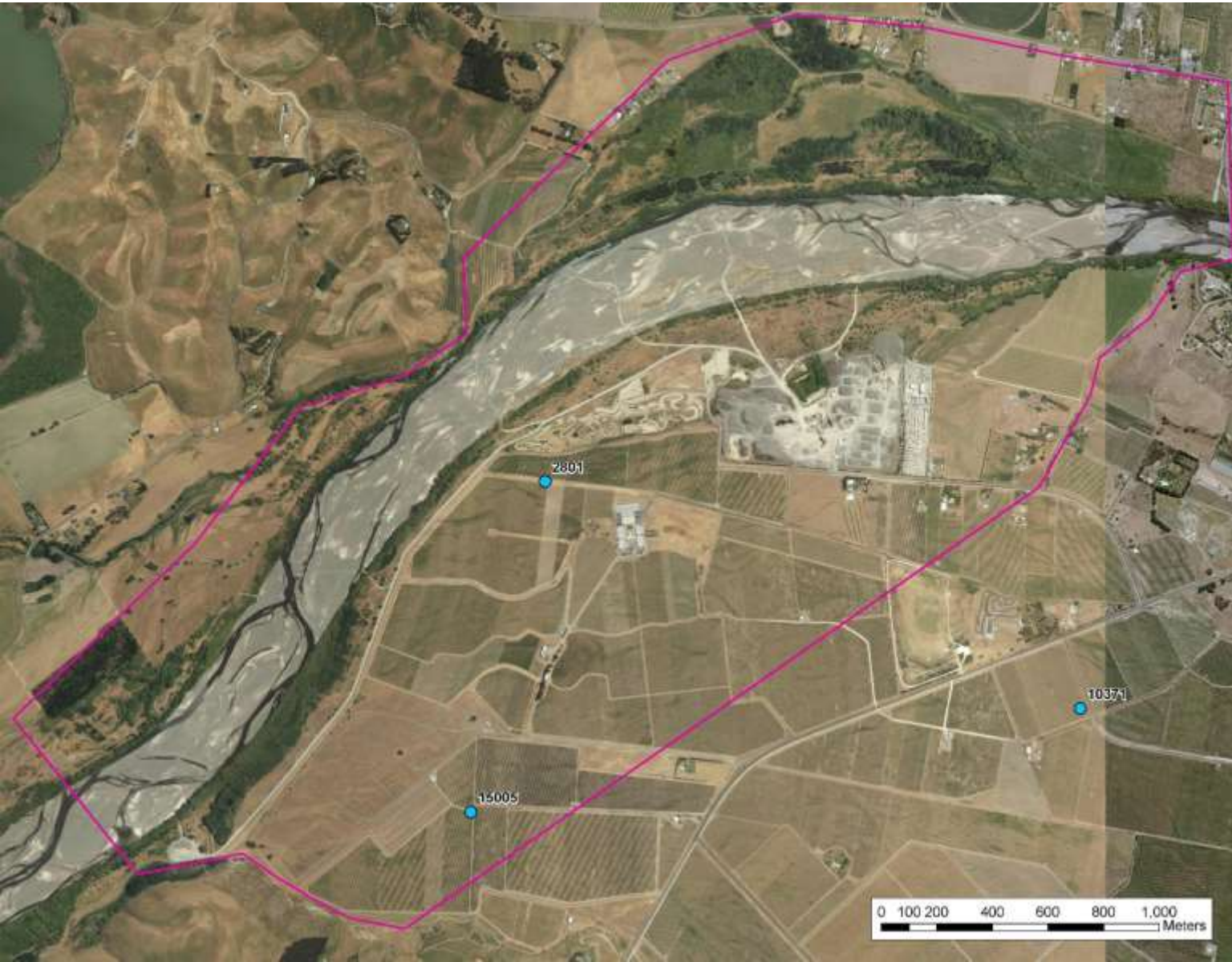
Case study 1: Selwyn River/Waikiriri at Scotts Rd



Case study 2: Wairau River d/s SH6



Validation study: Ngaruroro River d/s Roys Hill



Working concepts

- River and corridor gravels are a whole system
- Significant bed storage (reservoir/riparian aquifer)
- Braids provide an efficient distribution network for water in those gravels
- Braids are hydrologically perched (due to sediment stratification)
- Hyporheic exchange is significant, localised, and flow-dependent

Key Management Questions

- Many rivers have had >100 years of encroachment and/or flood engineering, and perhaps >50 years of gravel extraction
- What has been the impact of these practices on hydrology during the dry season?
- In addition to the environmental benefits of river restoration, is there an economic benefit? (ie via improved security of water supply)

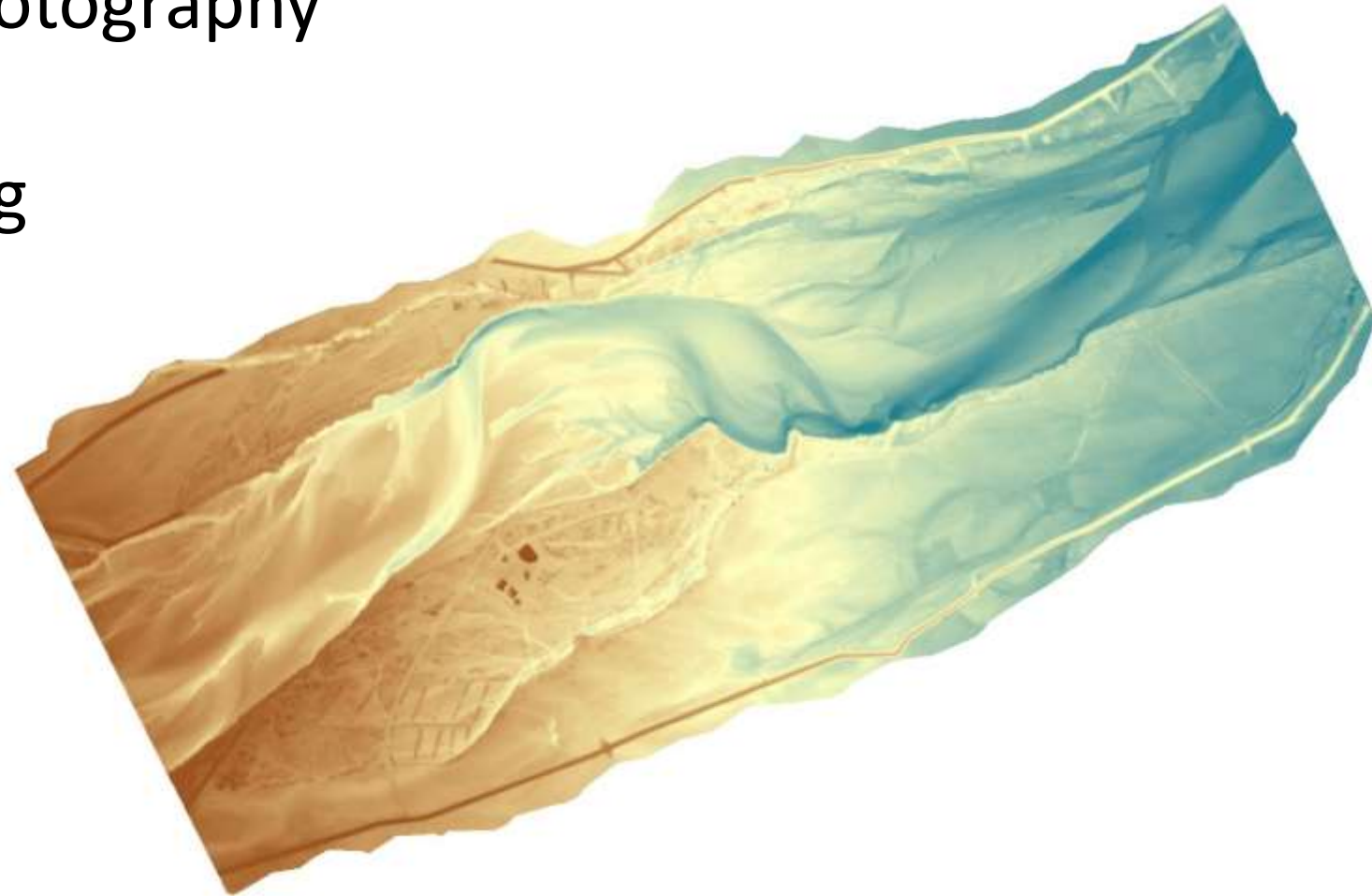
Work so far

- Establishing baseline data for Selwyn & Wairau
- Bulldoze tracks
- tTEM & DualEM surveys by Aarhus
- GPR soundings by Canterbury Uni



Work so far

- Flow recorder and climate station in Selwyn
- Field campaign:
 - Mini-lidar and aerial photography
 - Bathymetry
 - Concurrent flow gauging

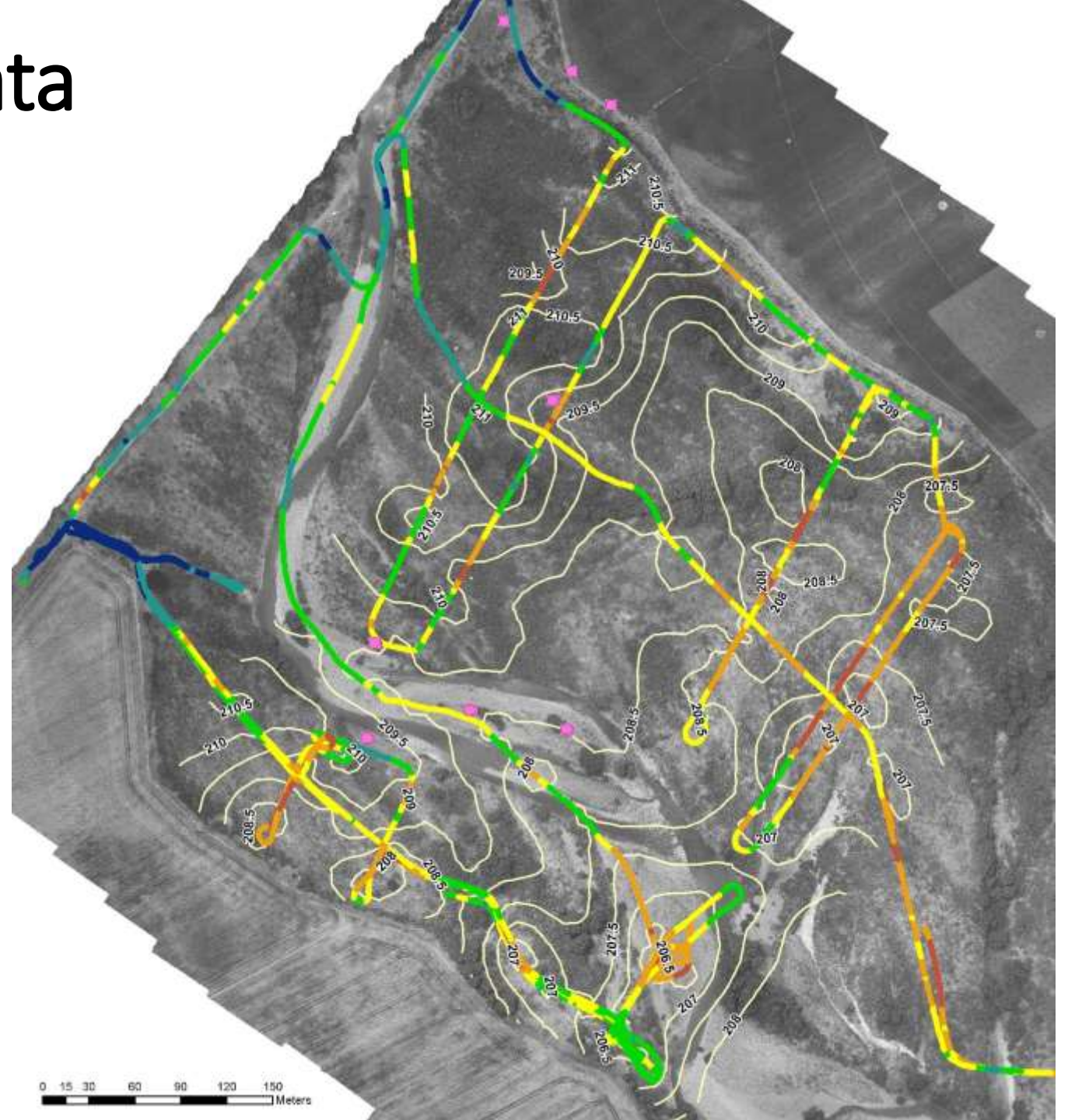


Work so far

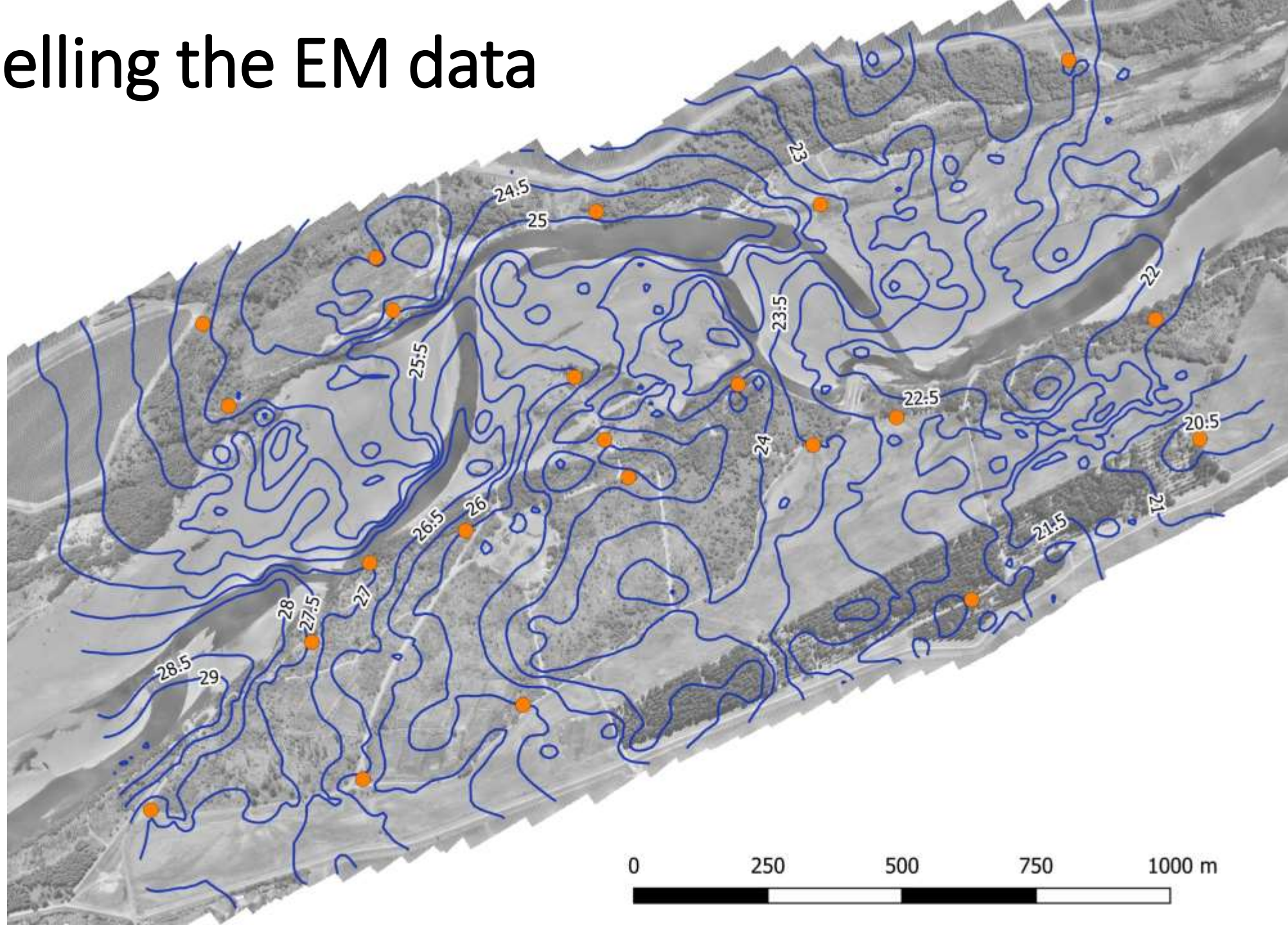
- Drilling in Selwyn:
 - Five sets of paired peizos (shallow/deep) sampled for GSA
 - Two horizontal holes across river (fibre optic & ERT)



Modelling the EM data



Modelling the EM data



Thankyou!

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