WORKSHOP MATERIAL

Workshop: Updated Waimea River Aquafer Model

Date: Tuesday, 13 July 2023

Item	Released Information
1.	Presentation – Waimea Plains Groundwater Model Status Update to Council July 2023

Modelling for Management:
Waimea Plains Groundwater Model

Status Update to Council: July 2023

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Based on work by:

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tasman district council | Te Kaunihera o te tai o Aorere

aqualinc water & soil intelligence

Manaaki Whenua Landcare Research

Overview

- Brief history of model development
- Latest model status
- Key scenarios
- Model asset management
- Where to next

- Model documentation:

  Weir, J (2023): *Waimea Plains Groundwater Model. Model Documentation.* Prepared for Tasman District Council. Report WL22006. 15/6/2023. Aqualinc Research Ltd. DRAFT.

Wairoa at Brightwater

Waimea at Appleby

Why TDC Needs Water Resource Models

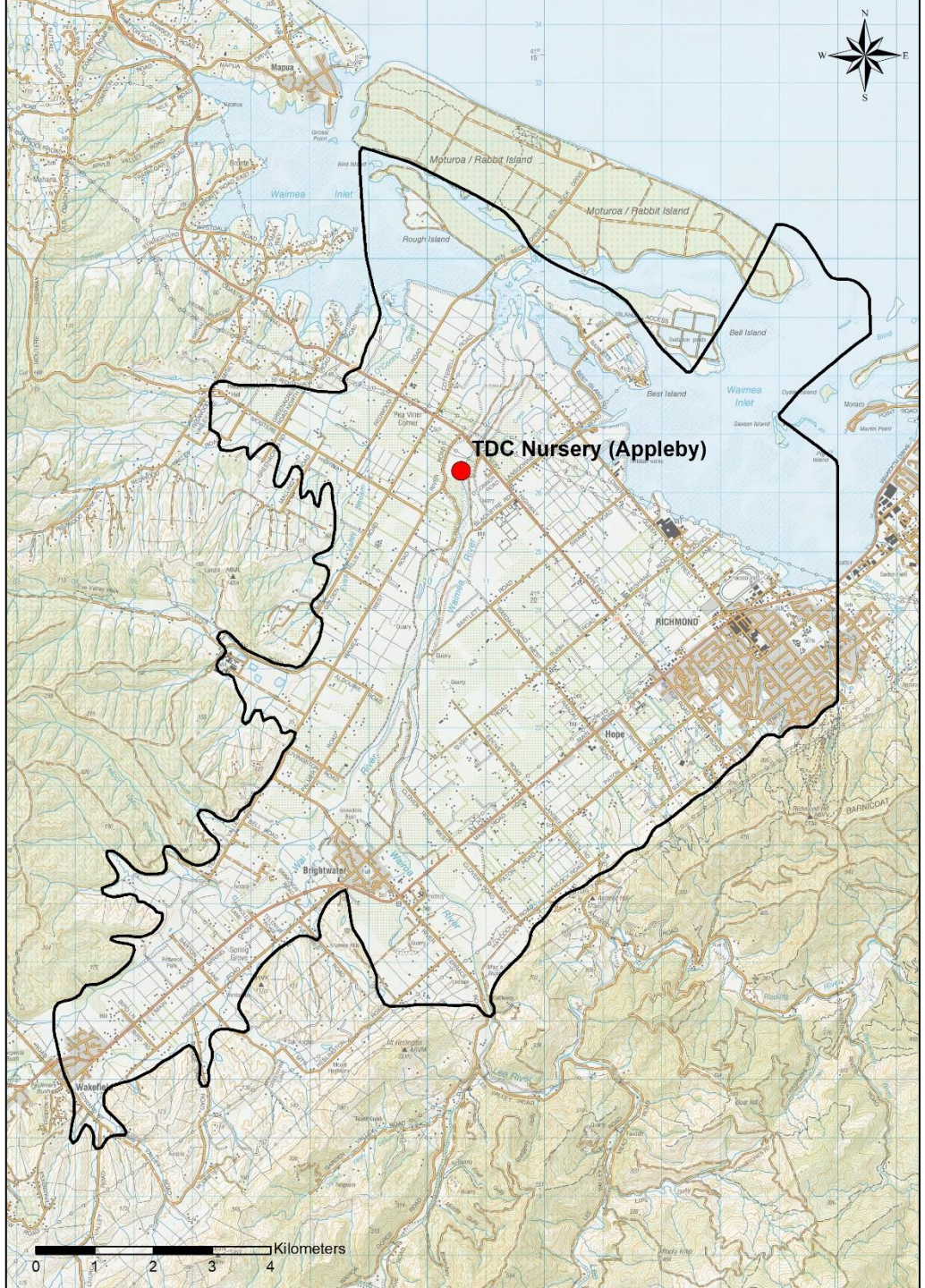
- To understand complex interactions between rainfall, river/spring flows and groundwater availability
- To predict groundwater levels and river/spring flows especially during drought scenarios
- To predict system responses to water augmentation (e.g. dams), climate change and land use change scenarios
- To apply this knowledge to set and adaptively update water take limits in policy (TEP) and plan ongoing water resource monitoring

Recent model developments: Waimea groundwater, Waimea nitrates, Upper Motueka groundwater, Motueka/Riuwaka Plains groundwater, Te Waikoropupū flows and nitrates

Waimea Plains

Model location and extent

~86 km^2



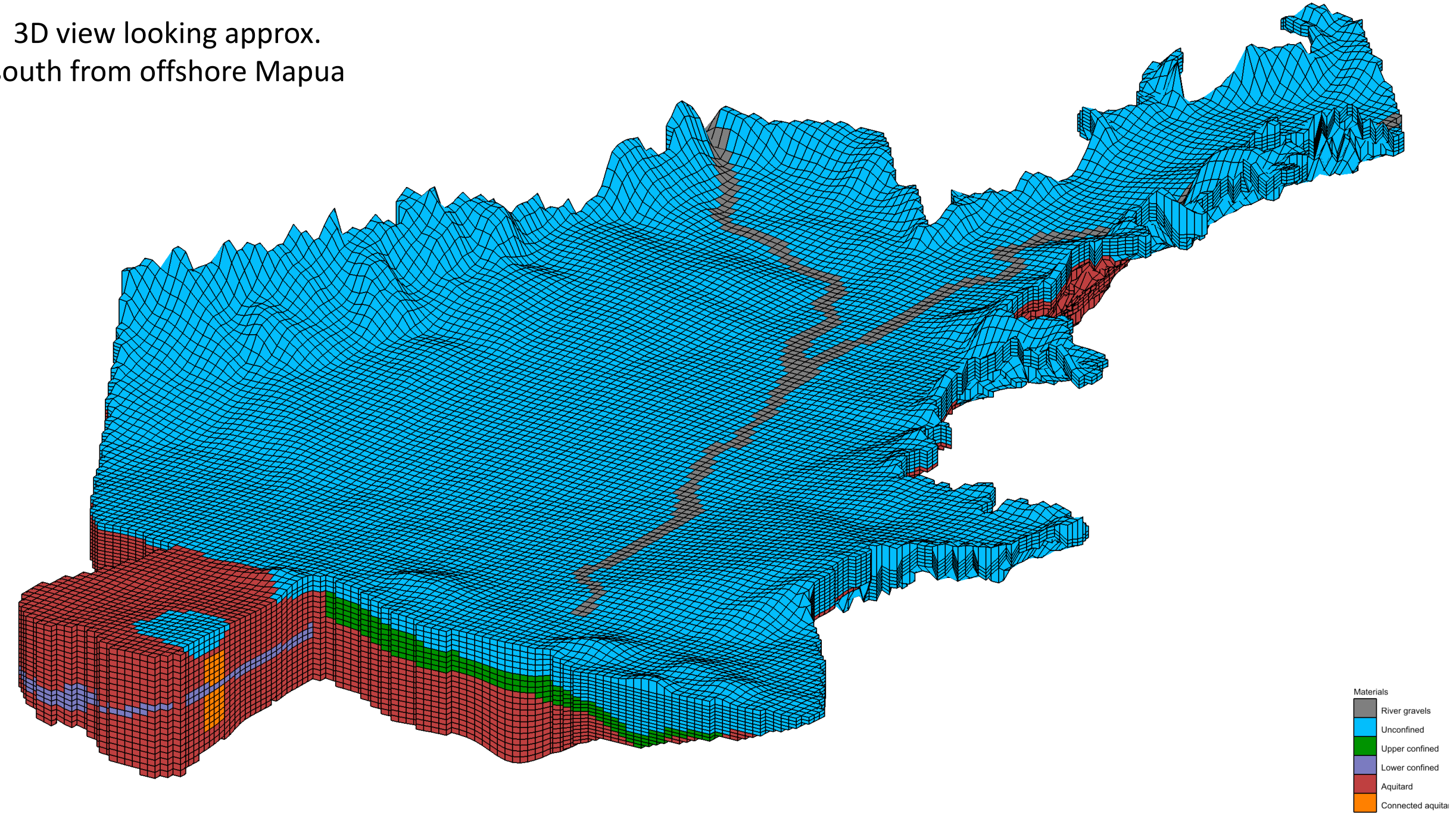
Brief History of Waimea Model Development

- Intensification of irrigated agriculture, industrial and urban use since early 1970's.
  - ✓ Increased water demand = concerns about sustainability (esp. summer GW levels, river low flows and saltwater intrusion)
- First-generation model developed in 1981-88 (MWD, Andrew Fenemor)
  - ✓ Set initial allocation limits (1986 Waimea Water Management Plan, with many zones at full allocation)
- Upgraded 2000-2009 (GNS Science, Timothy Hong)
  - ✓ Waimea Water Augmentation Study – maintain and enhance Appleby low flows (dam augmentation)
- Model updated 2012-2015 (Aqualinc, Julian Weir)
  - ✓ Verify Appleby low flows with dam releases
- Peer review of hydrology for dam consents 2016 (Andrew Fenemor & Julian Weir)
  - ✓ Science was sound

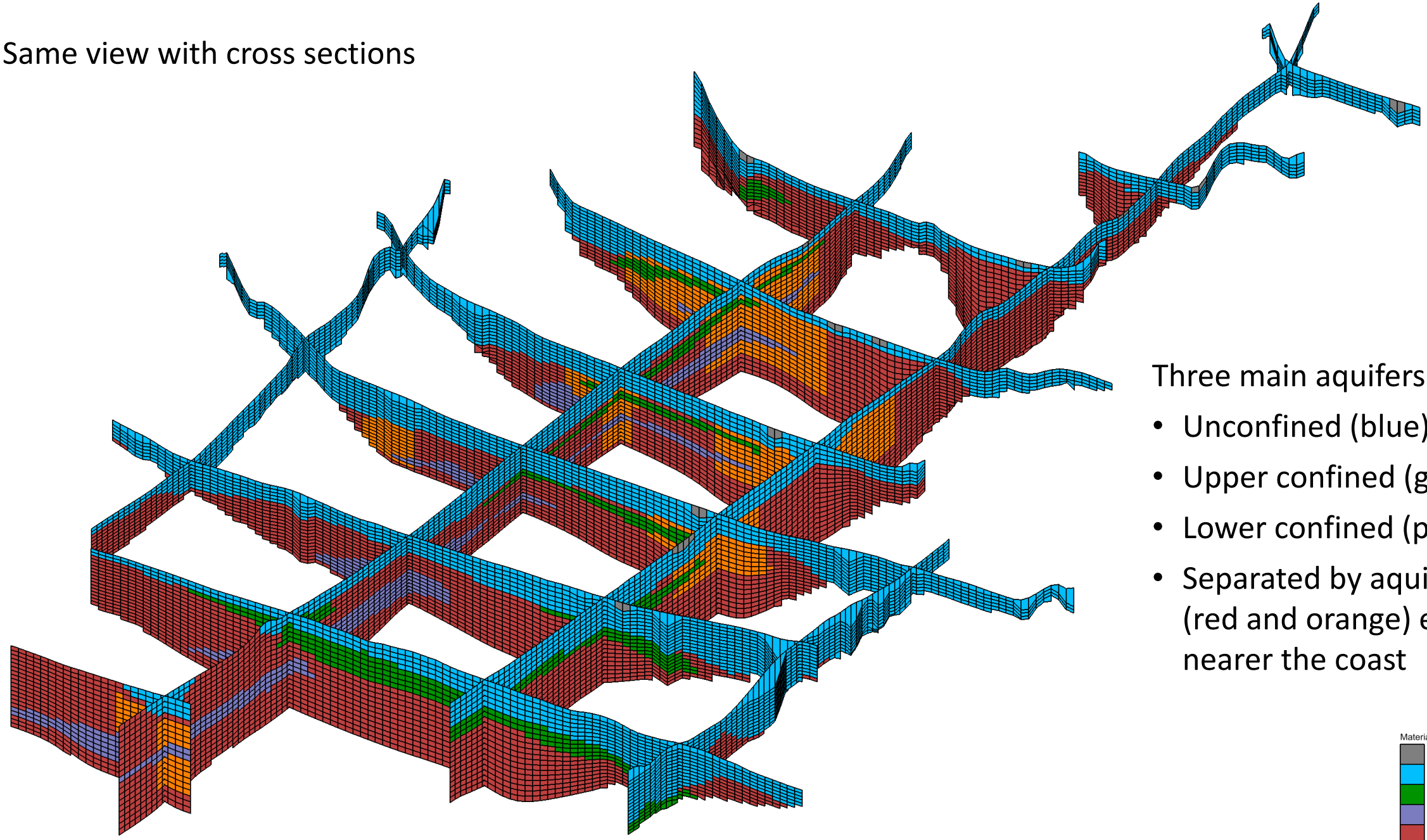
Latest Model

- Update and re-engineer model (2017-present) (Aqualinc, Julian Weir)
  - Technical review by Joseph and Andrew
  - Spans continuous period: July 1999-May 2020 (daily steps)
    - ✓Includes the extreme 2000/01 year as well as the more recent 2018/19 drought
  - Incorporates new data
    - ✓Groundwater levels, river flows, river cross sections
    - ✓Climate (rain and PET)
    - ✓Measured water use (both surface water and groundwater)
    - ✓Land use, irrigation methods, soil types
  - Used to test refined water management strategies (various scenarios, discussed later)

3D view looking approx.
south from offshore Mapua



Same view with cross sections

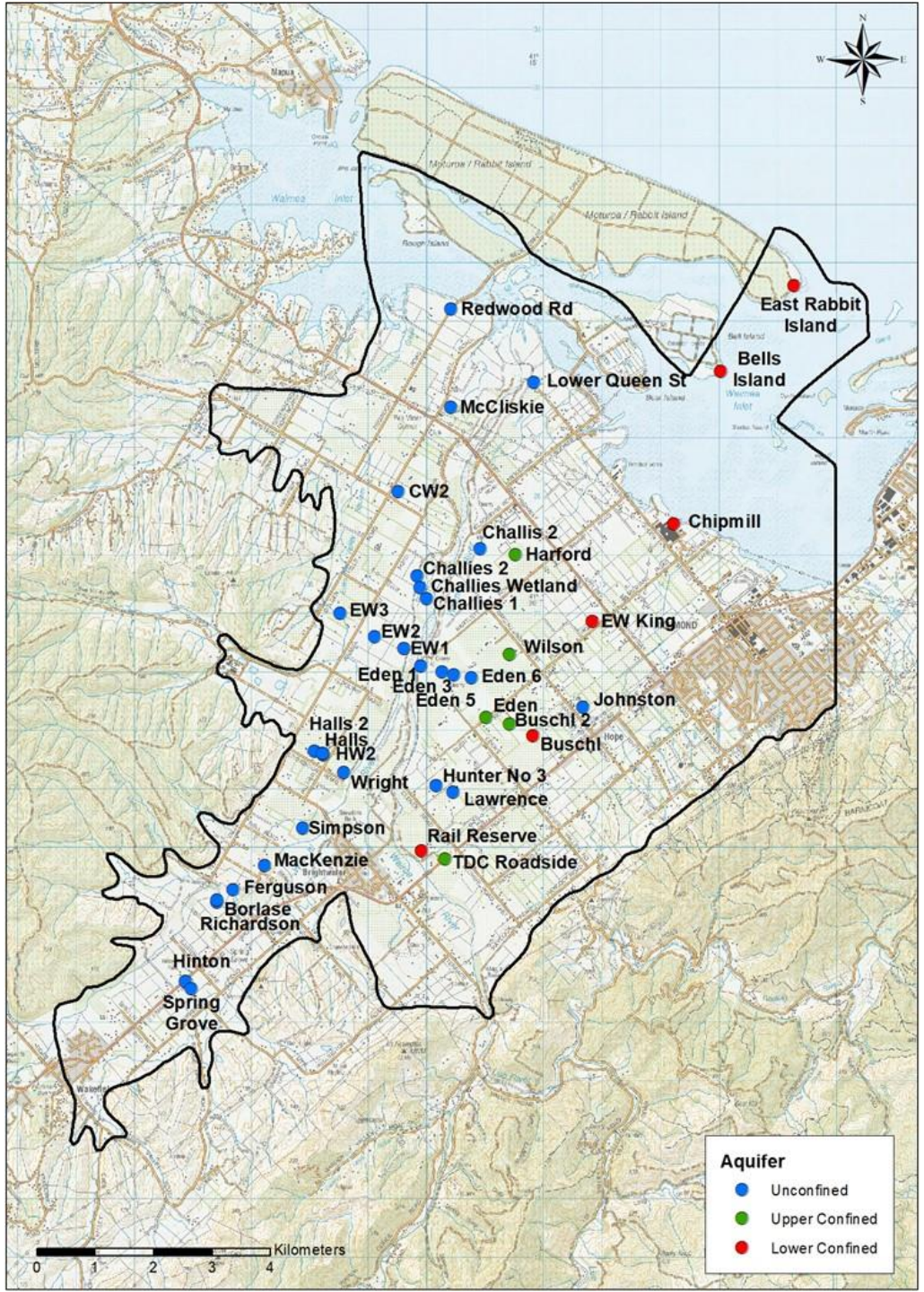


Three main aquifers:

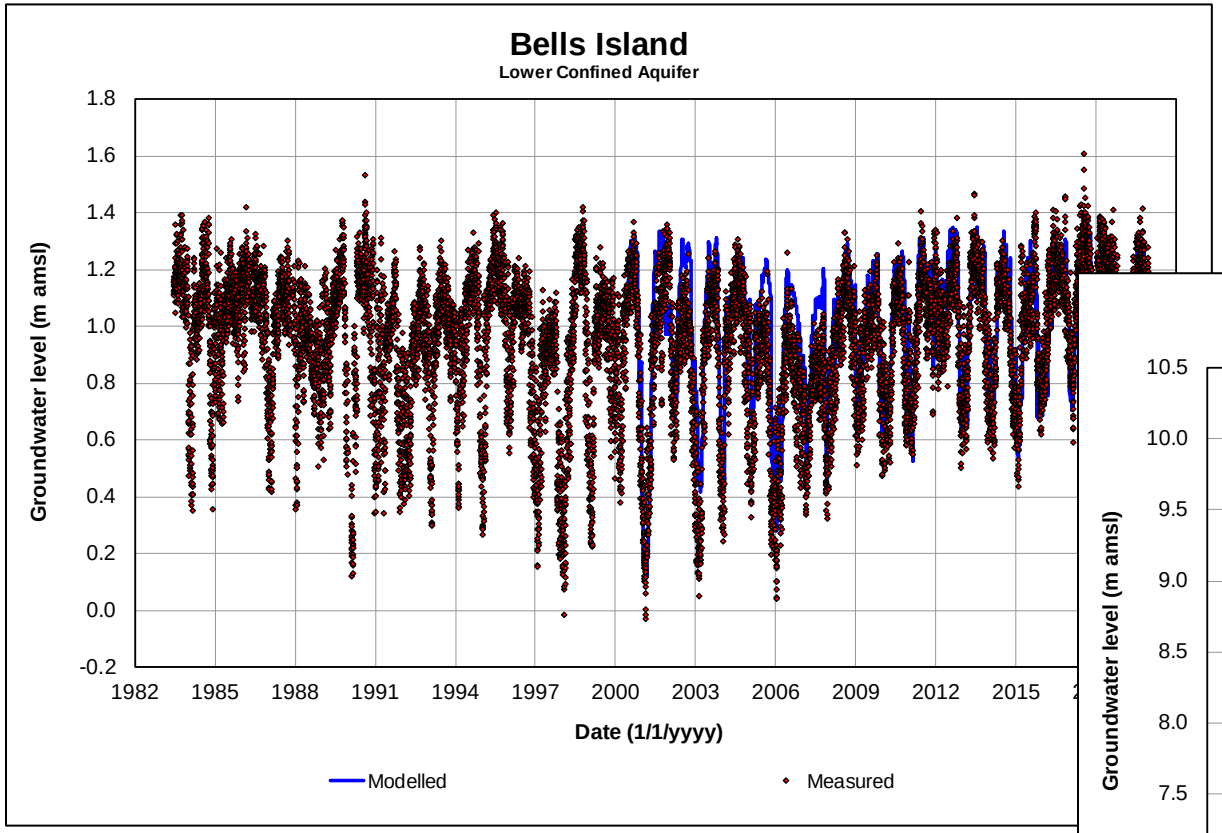
- Unconfined (blue)
- Upper confined (green)
- Lower confined (purple)
- Separated by aquitards (red and orange) except nearer the coast

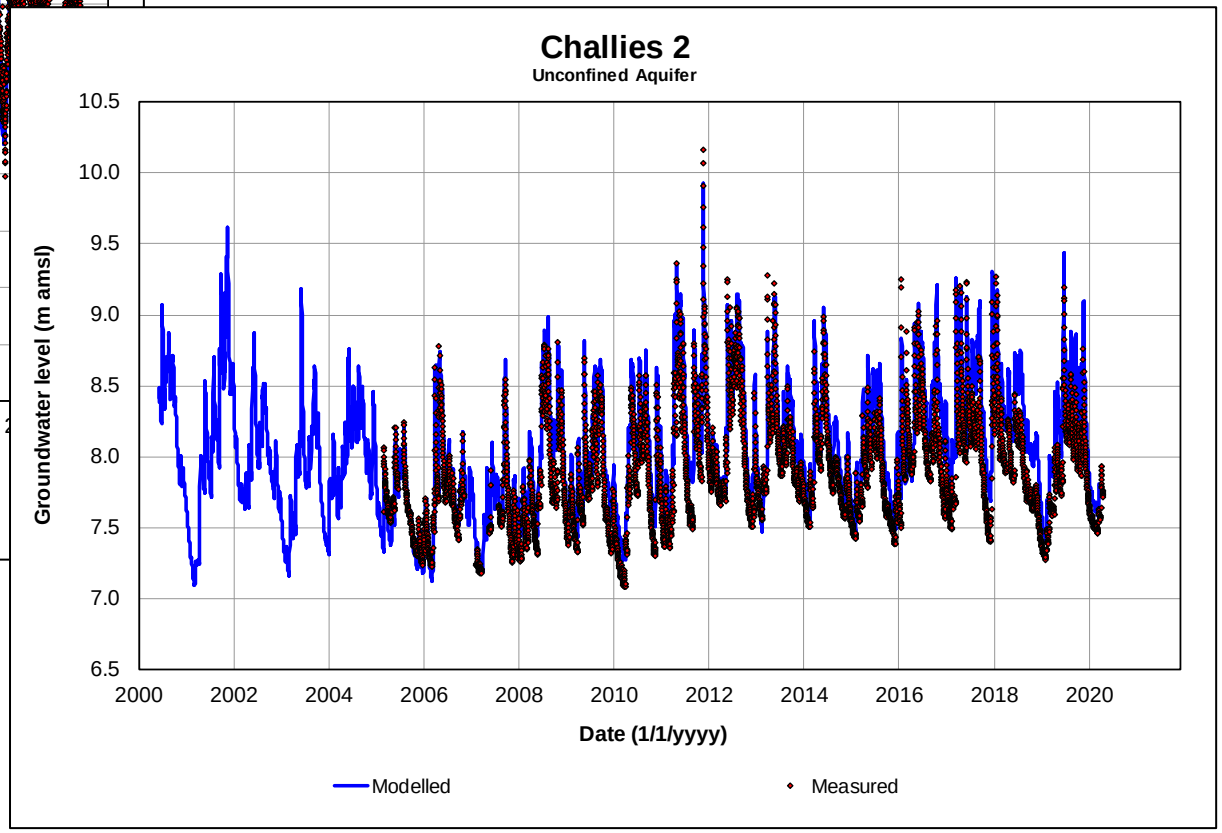
Bores used for groundwater level calibration

Mixture of currently open and closed sites spread over all three aquifers



Example of groundwater level calibration





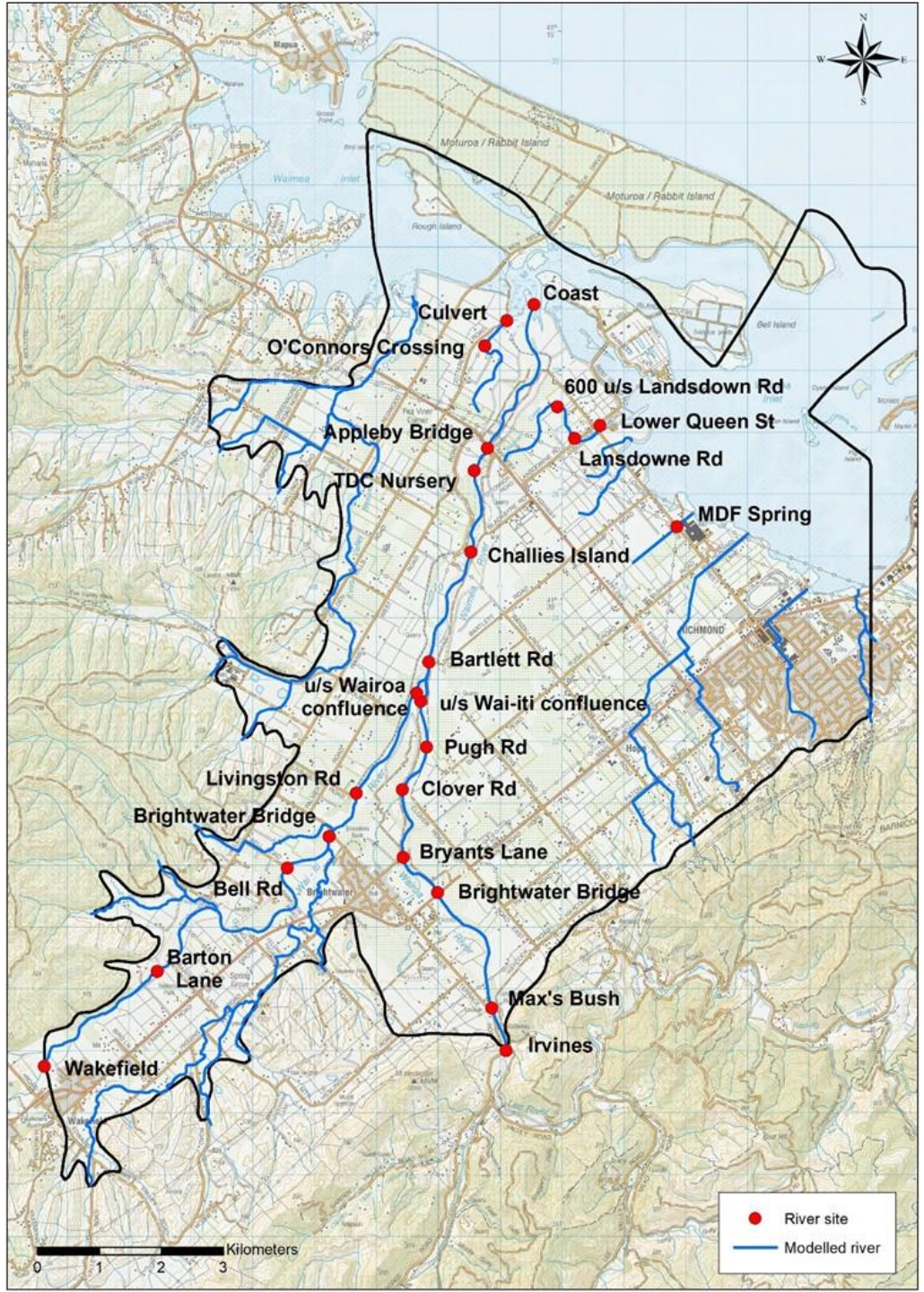
Excellent calibration achieved - good data and collective expert knowledge of TDC staff and consultants - take note of good match during dry summers

River flow calibration sites

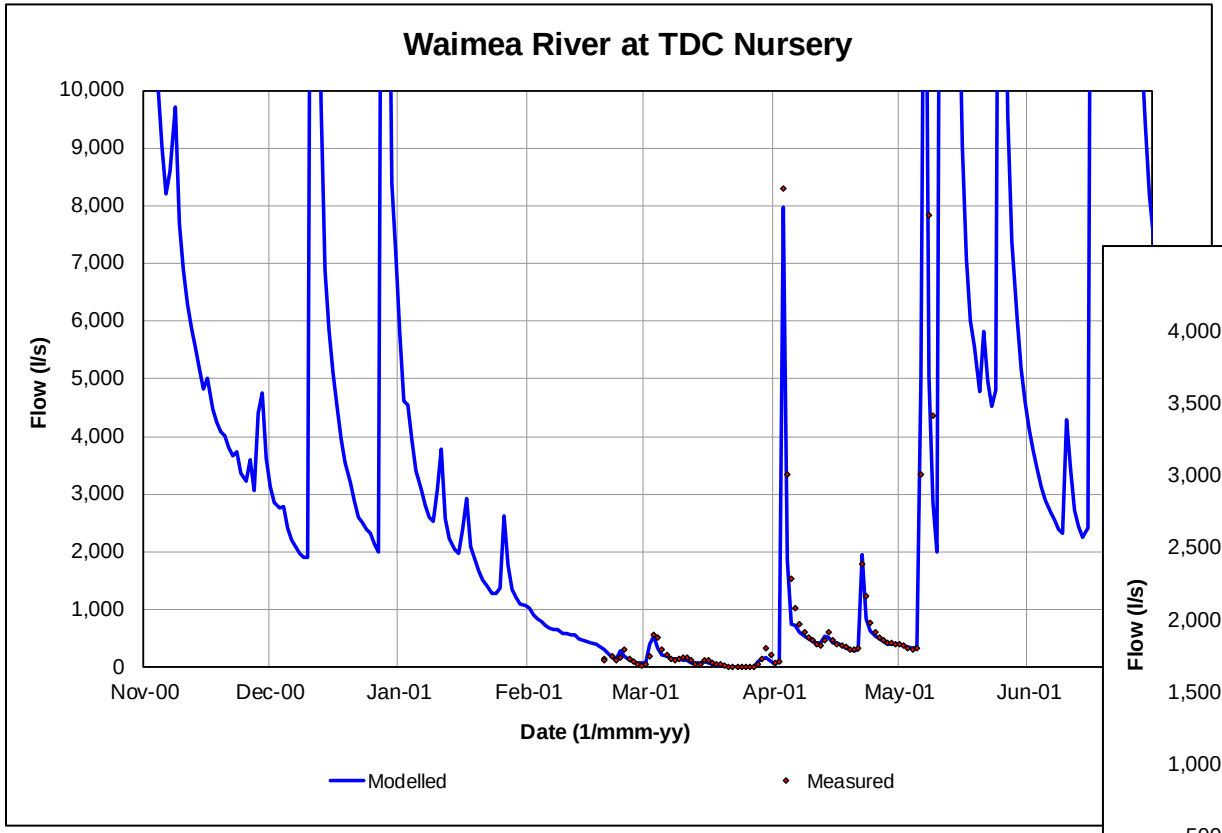
Recorder sites:

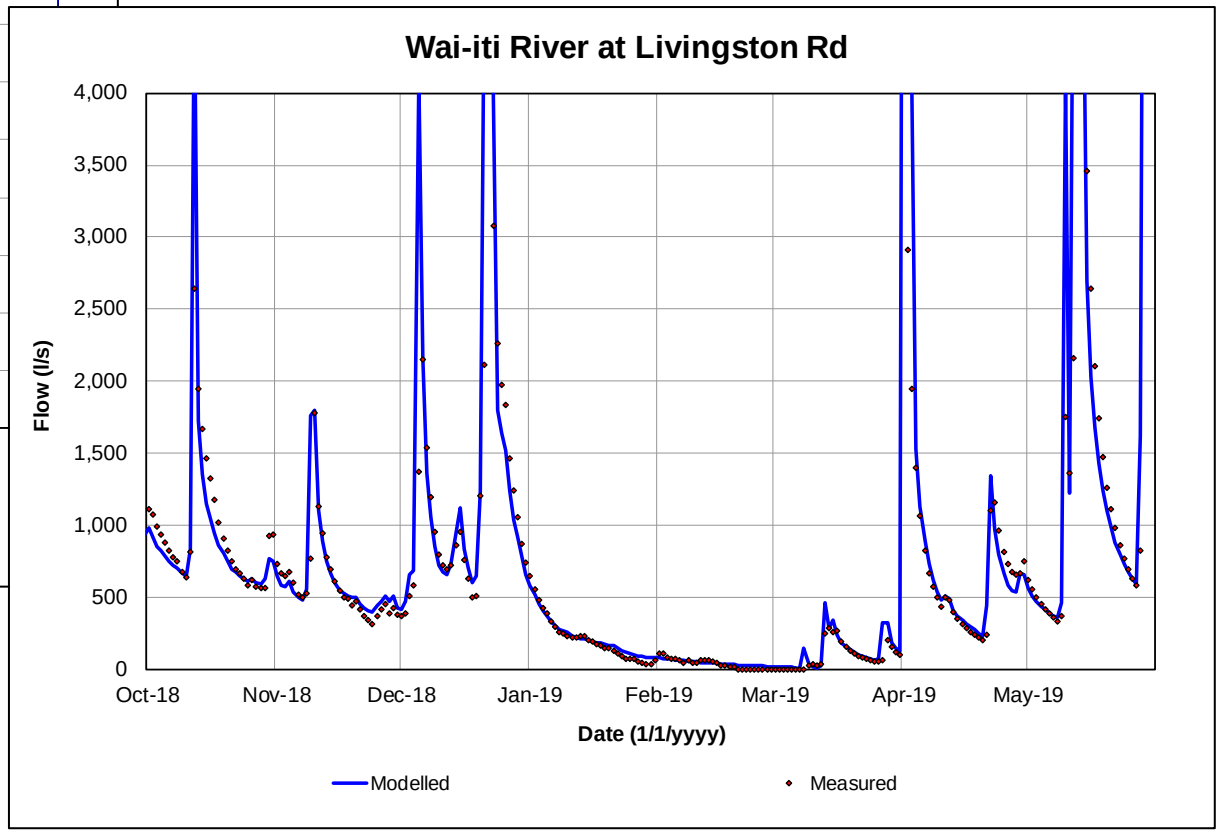
- ✓ Nursery
- ✓ Livingston Rd
- ✓ Irvines

Other sites are spot gaugings



Example of river flow calibration (2000/01 season)





Again, excellent calibration achieved, particularly for extreme dry periods (which was a focus of calibration)

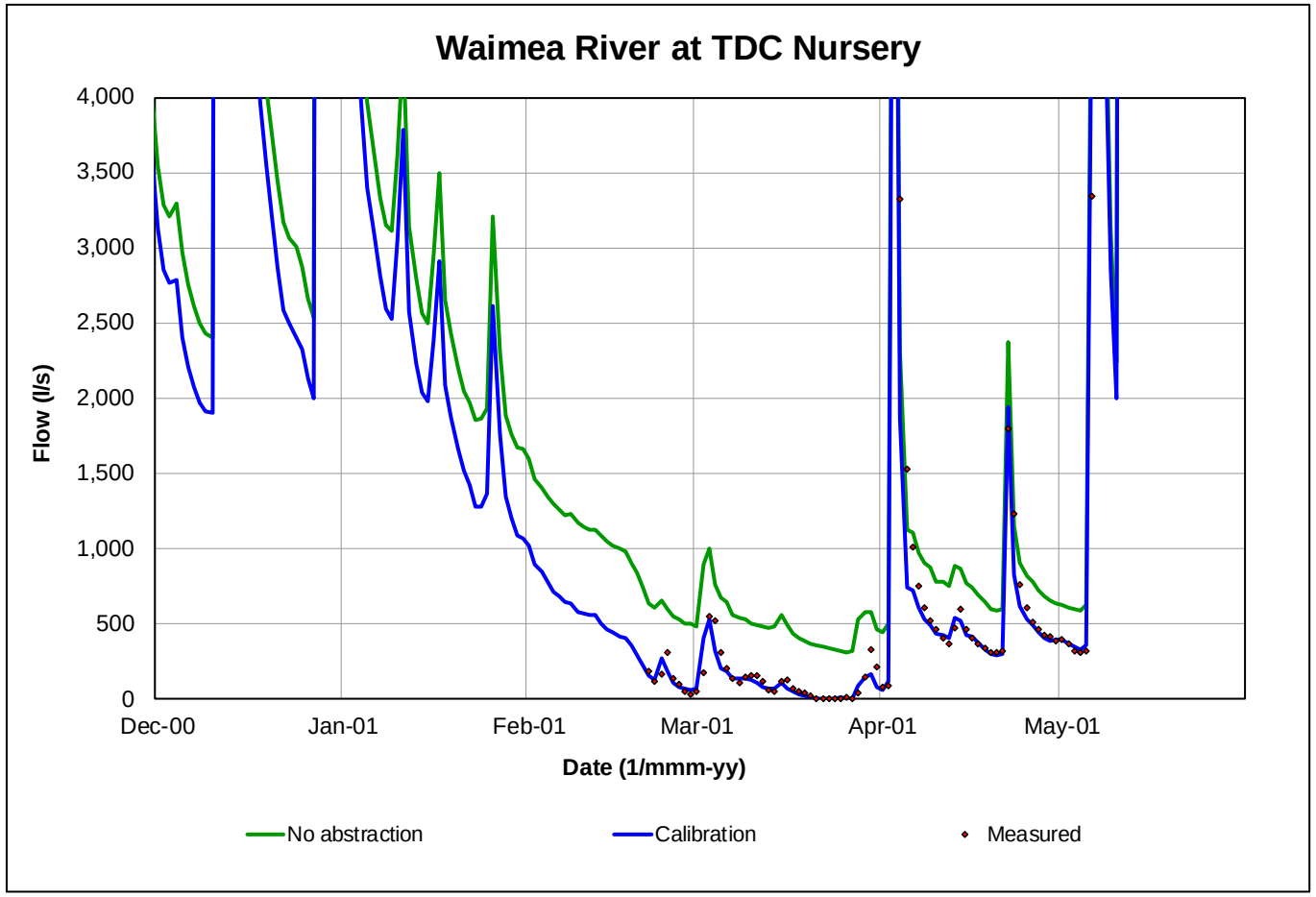
Key Scenarios for Water Management

- Calibration (history matched)
- No abstraction: No water use (incl. WEIS) and with only dryland recharge
  - ✓Quasi-natural state
- TDC's restrictions removed
  - ✓Test effectiveness of existing take restrictions
- Min. 1,100 l/s at Nursery (dam releases)
  - ✓Daily and weekly release decisions
  - ✓Current use and future (100-year projection)
- 1-in-50 year low flow (Wairoa River)
- Weirs:
  - ✓Existing Wai-iti
  - ✓Theoretical Wairoa/Waimea

(plus others)

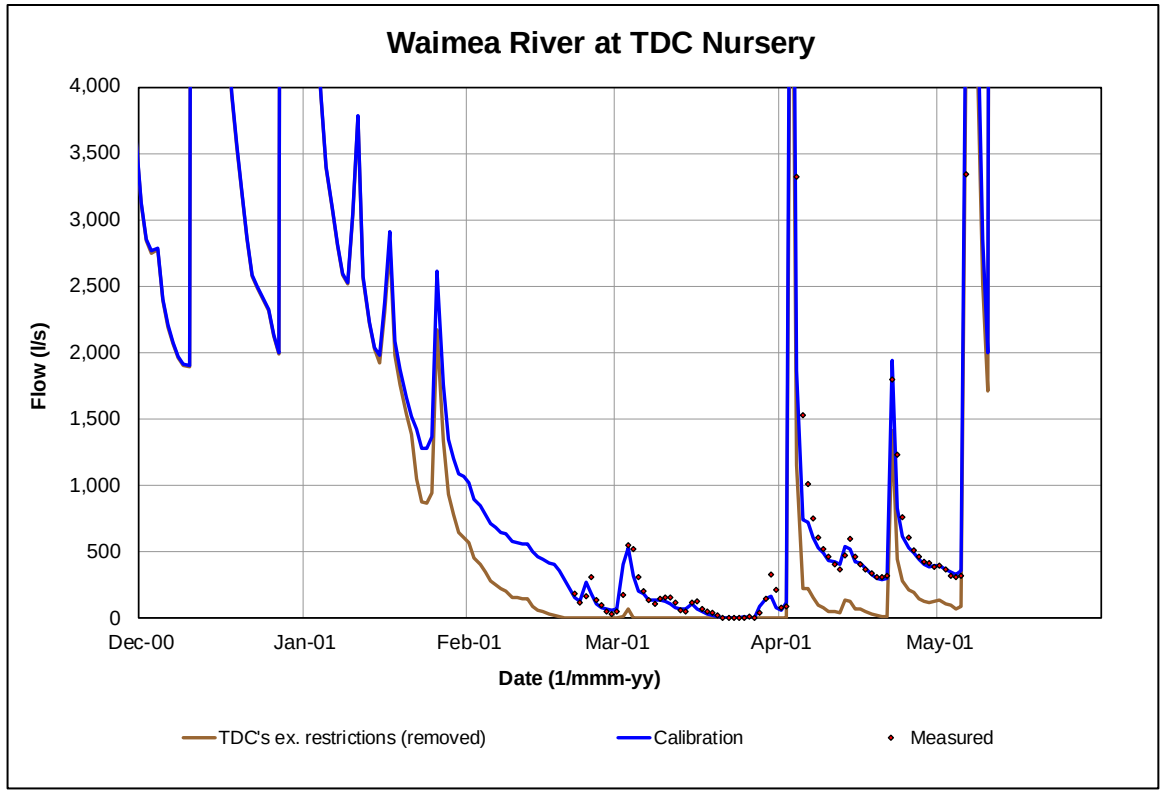
Scenario: No Abstraction

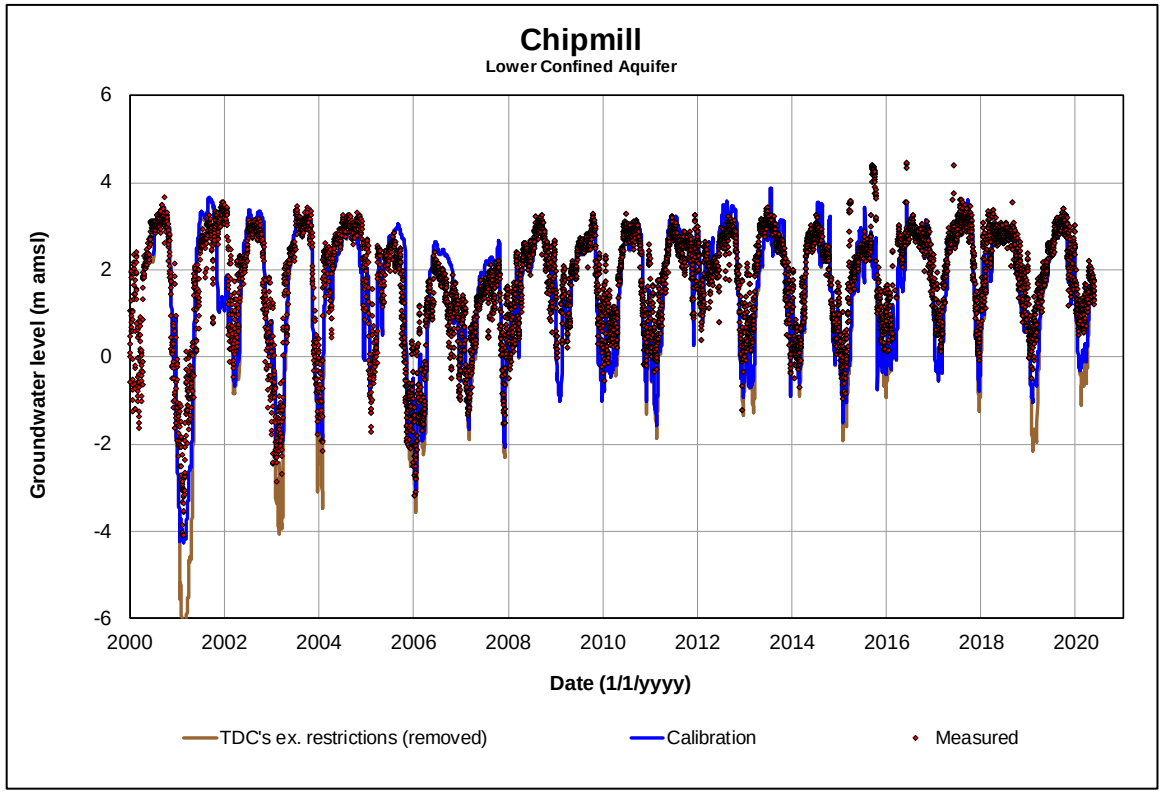
- Existing water use dries up the Waimea River during extreme dry periods
- Completely ceasing use returns min. flows to ~325 l/s
  - ✓Cannot reach min. 1,100 l/s without augmentation
- Groundwater levels and river flows are heavily influenced by abstraction



Scenario: TDC's Existing Restrictions

- Restrictions are effective in:
  - ✓Maintaining low flows
    ~ 300-400 l/s higher during recessions

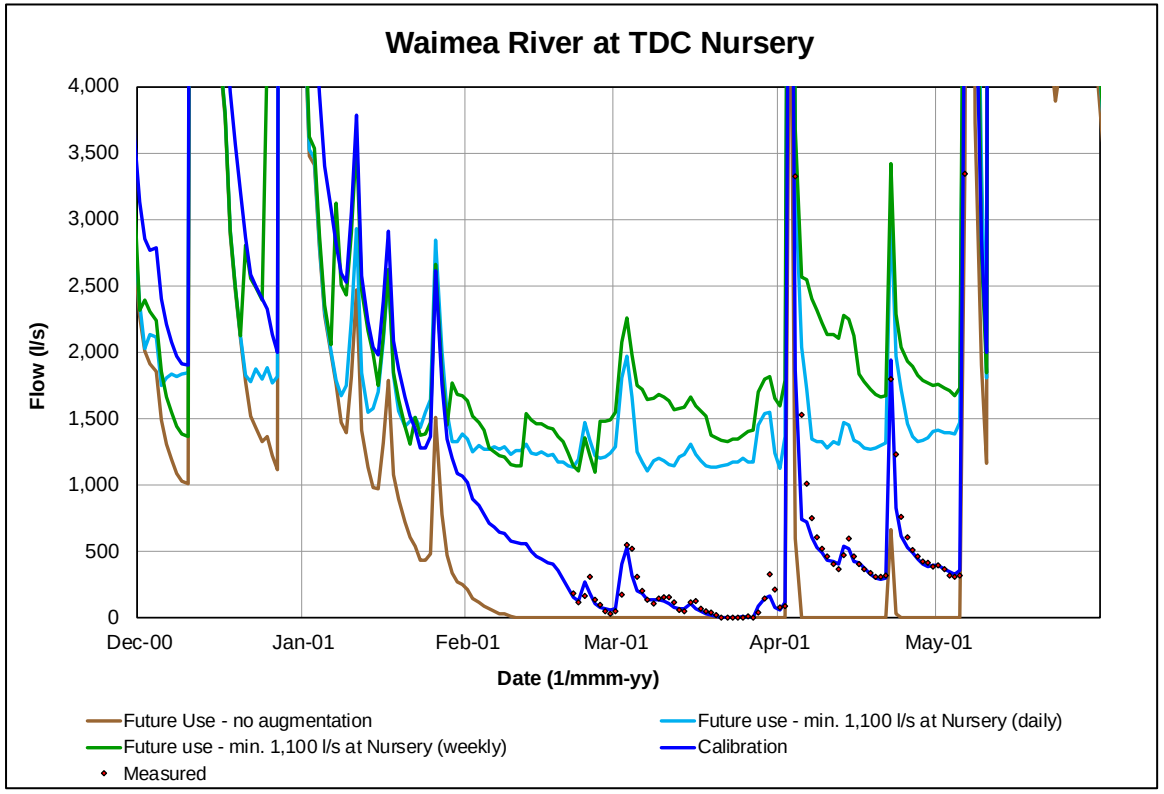


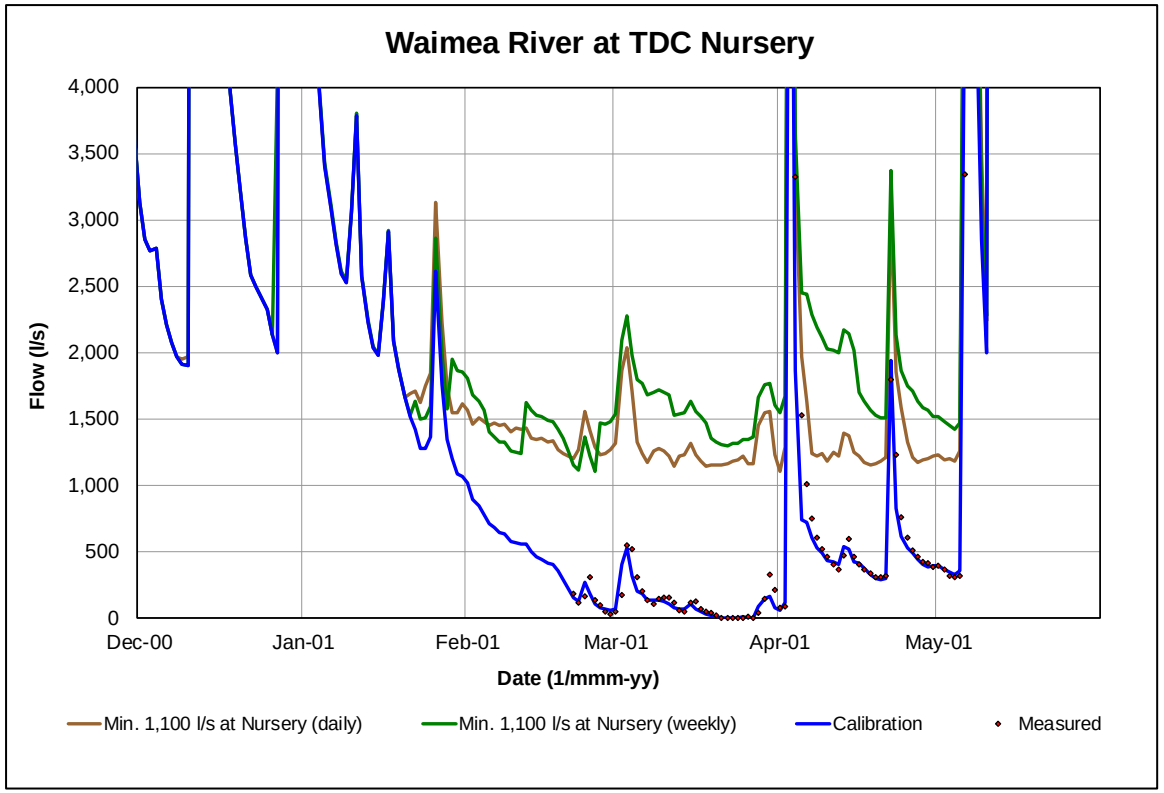


- ✓Delaying drying by ~1 month
- ✓Curtailing GW level declines, particularly in the deeper aquifers (up to 5 m higher)
- ✓Early restrictions can reduce the need for more severe restrictions later

Scenario: Dam Releases

- Dam releases to maintain min. 1,100 l/s at Nursery:
  - ✓Daily versus weekly release decisions are noticeably different



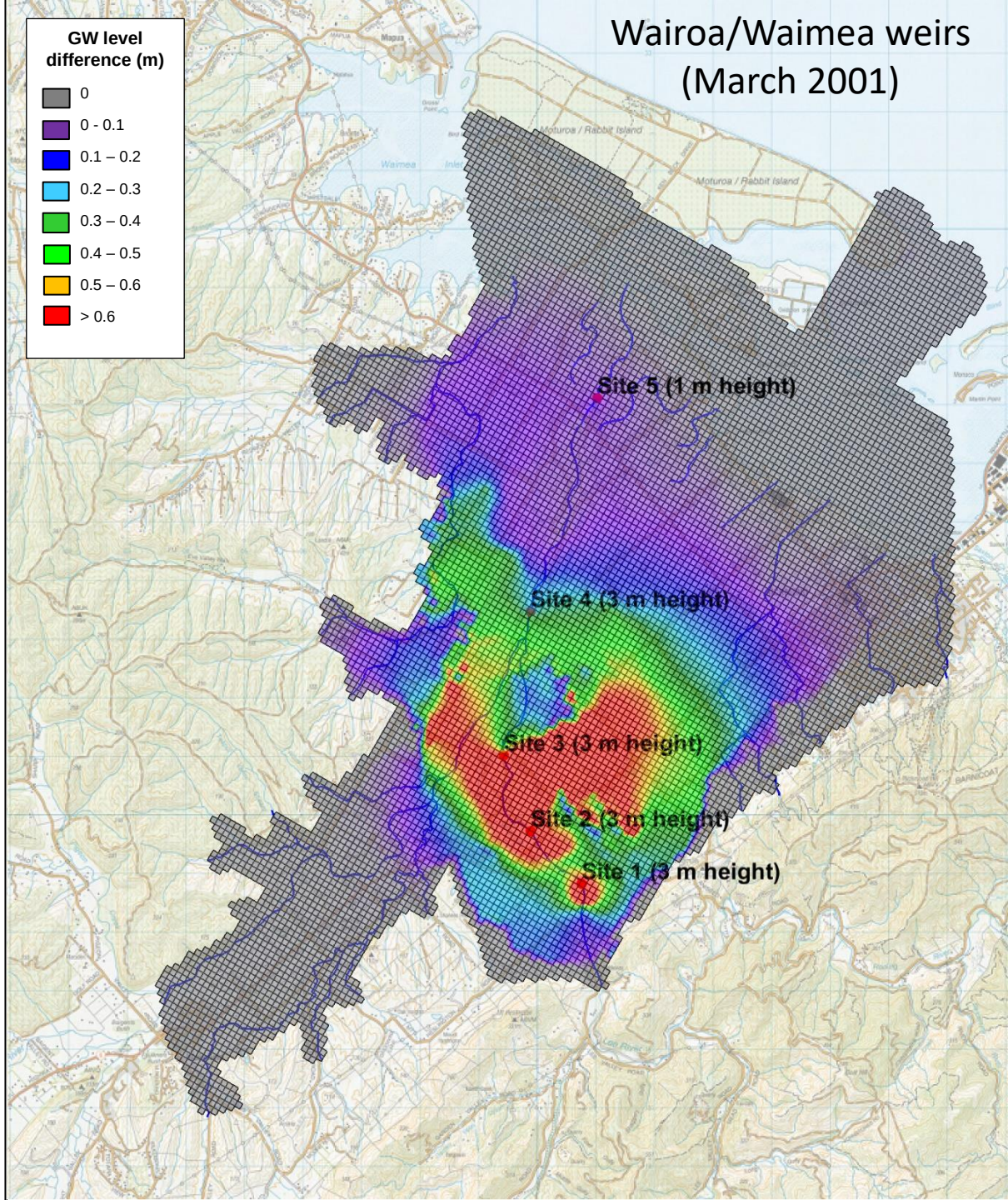


- ✓Weekly release decisions often over-compensate
- ✓Recommend automation for efficiency of water release (save water for later in very dry years)
- ✓But early releases can reduce the need for large releases later (GW storage buffer)

Scenarios: Weirs

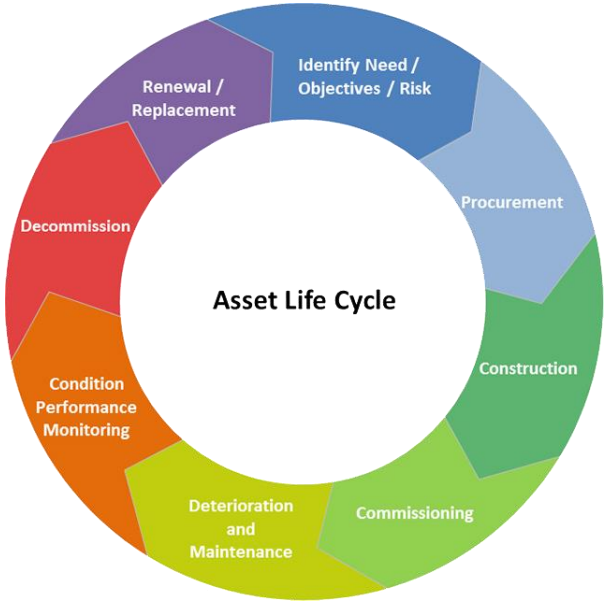
- Weirs (1-3 m high) on the Wairoa-Waimea rivers are predicted to:
  - ✓ Raise shallow GW levels by up to 1.2 m near the rivers
  - ✓ Raise shallow GW levels by at least 0.1 m over a distance of up to 5 km from the rivers
  - ✓ Raise deep GW levels by up to 0.8 m
  - ✓ Significantly increase GW storage
  - ✓ <u>But</u>, lower Nursery flows (with no augmentation) as more river water recharges GW
  - ✓ Nursery still dry in 2000/01 drought
  - ✓ Weirs work best WITH augmentation

- Positive effects from Wai-iti weirs remain largely local near the weir locations (not shown here)



Asset Life-Cycle Management

- The Waimea model is an asset
  - ✓ Maintain as such (similar to how infrastructure assets are managed)
  - ✓ Avoid last-minute scramble for plan changes, consents, hearings, or other important decision making



Where To Next?

- Model can be applied to develop dam flow release management guidance
  - ✓Guidance can be further developed with data collected post-dam operation
- Extend run period to recent seasons, and include newly collected data
  - ✓Begin to capture dam releases and test effectiveness
- Extend run period back to ~1979 to include the dry 1982/83 drought
- Additional management scenarios
  - ✓Further optimise dam releases
  - ✓Include climate change and sea level rise
  - ✓Hydrological effects of gravel extraction, and natural aggradation and degradation (incl. for TDC's Engineering Dept.)
- Incorporate nitrate transport
  - ✓Better links between land use, GW levels, river flows and water quality

Waimea Plains

(photo by Andrew Fenemor, 2018)