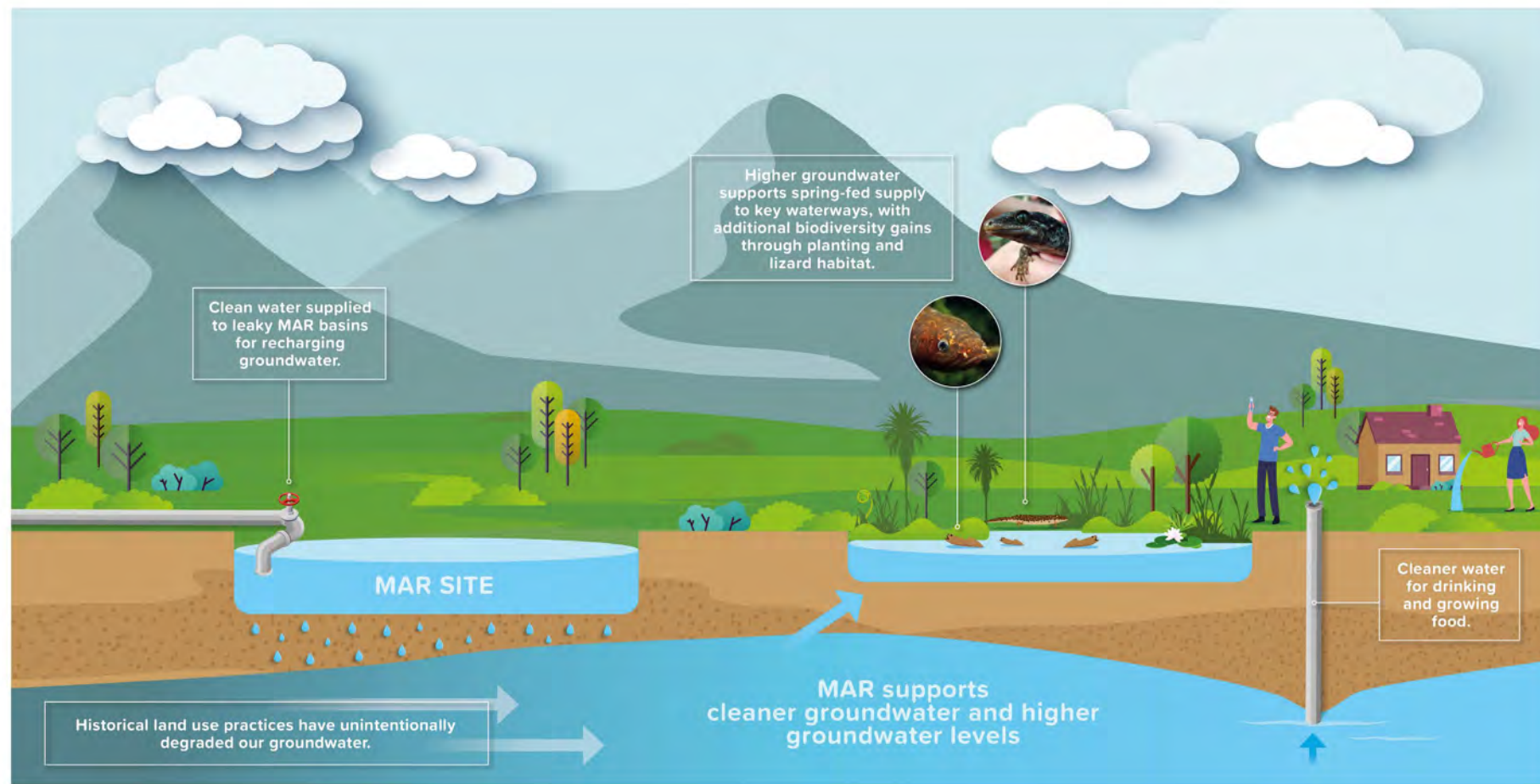


Hekeao/Hinds Managed Aquifer Recharge Trial



**June 2020 –
May 2021
Summary**

www.hhwet.org.nz



Definitions

- **Managed Aquifer Recharge (MAR)**

“an activity that is for the express purpose of improving the quality and/or quantity of water in a receiving groundwater aquifer or a hydraulically connected surface water body”

- **Near River Recharge (NRR)**

MAR conducted in the current flood plain of a river system, but not mixing with natural surface water

- **Targeted Stream Augmentation (TSA)**

Augmentation of a spring fed stream using groundwater

MAR, PC2 and Essential Freshwater Package

PC2 (Plan Change 2 to Canterbury's LWRP)

Annual median Nitrate-N of 3.8 mg/l in lower Hekeao Hinds River and 6.9 mg/l in shallow groundwater / spring-fed waterways by 2035, by:

- Reduced nutrient leaching from land use activities.
- MAR to target legacy groundwater issues.
- Improved management of water and irrigation.

Essential Freshwater -NPS FM 2020 -

Median Nitrate-N of 2.4 mg/l nitrate-N for rivers, achieved by:

- Stopping further degradation and loss – e.g., on-going nutrient leaching reductions.
- Reversing past damage – e.g., MAR, NRR, TSA, wetlands and bioreactors.
- Addressing water allocation issues – e.g., Hinds and Ashburton River consent reviews.

Hekeao Hinds water quality challenges

- Current groundwater contains a mixture of nitrate from recent (months to years) and legacy (years to decades) land use practices.
- Most groundwater travels via multiple layers of old braided channels from the historic Rangitata and Ashburton glaciers. These channels can be challenging to identify and trace.

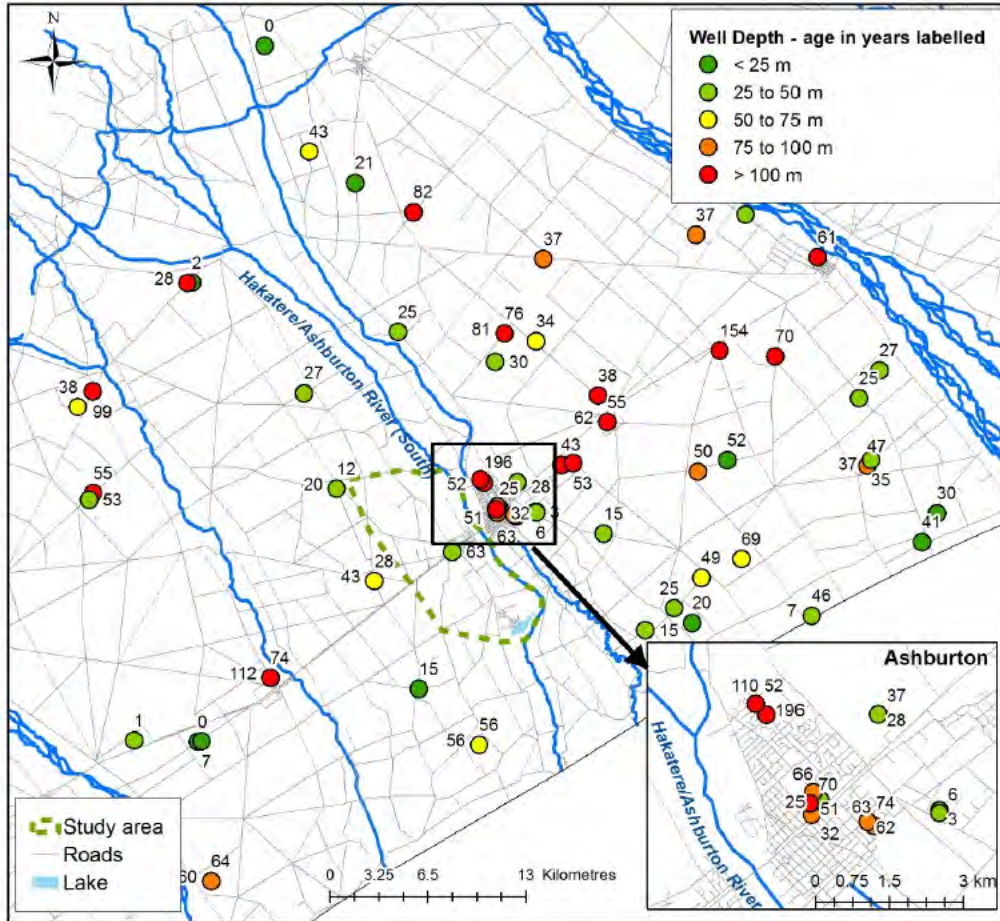


Figure 2-16: Groundwater ages (labelled) and well depths (coloured). Ages shown in labels are approximate. Where a well has been age dated more than once, both derived ages are shown. Ages are sourced from, (Stewart, *et al.*, 2002) Stewart (2006) and van der Raaij (2013) (Source: Aitcheson-Earl, 2019)

Water bearing lens in the lower Hekeao Hinds Plains
(Source: Davey 2006)



Ashburton ZIP Addendum (2014)

Complementary approach: on-farm nutrient leaching reductions plus MAR

Table 2: Indicative Timing of Implementing the Options Package

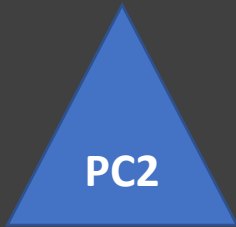
Key dates	2014/15	2017	2020	2025	2030	2035
Cumulative approximate area of new irrigation (ha) (assume converted to dairy/dairy support with 27 kg N/ha cap)	Potential irrigated area increases not in approved Plan Change 2					
Volume of MAR (m ³ /s)	0.5	1.0	2.0	3.8	3.8	3.8
Level of on-farm mitigation (as defined in Everest <i>et al.</i> , 2013)	Current Practices	GMP	AM1 (no DCD) ^a	AM1 ^b	AM1 ^b	AM2 Dairy
Percentage reduction target for nitrogen leaching across the catchment	0%	5%	15-20%	25-30%	35%	45%
Indicative average nitrate concentration in soil drainage (mg N/L)	12.4	12.2	11.3–11.0	11.0-10.5	9.4	9.2
Indicative average nitrate concentration in shallow aquifer and springs after MAR (mg N/L)	11.9	11.2	10.0 - 9.4	9.4 - 8.8	7.0	6.9

^a Assumes all Dairy and Dairy Support apply AM1 mitigations, excluding mixed pasture sward, short rotation ryegrass and white clover and nitrification inhibitor.

^b Assumes nitrification inhibitor is available for pasture

Goals of the Hekeao/Hinds MAR Trial

Improved nutrient management



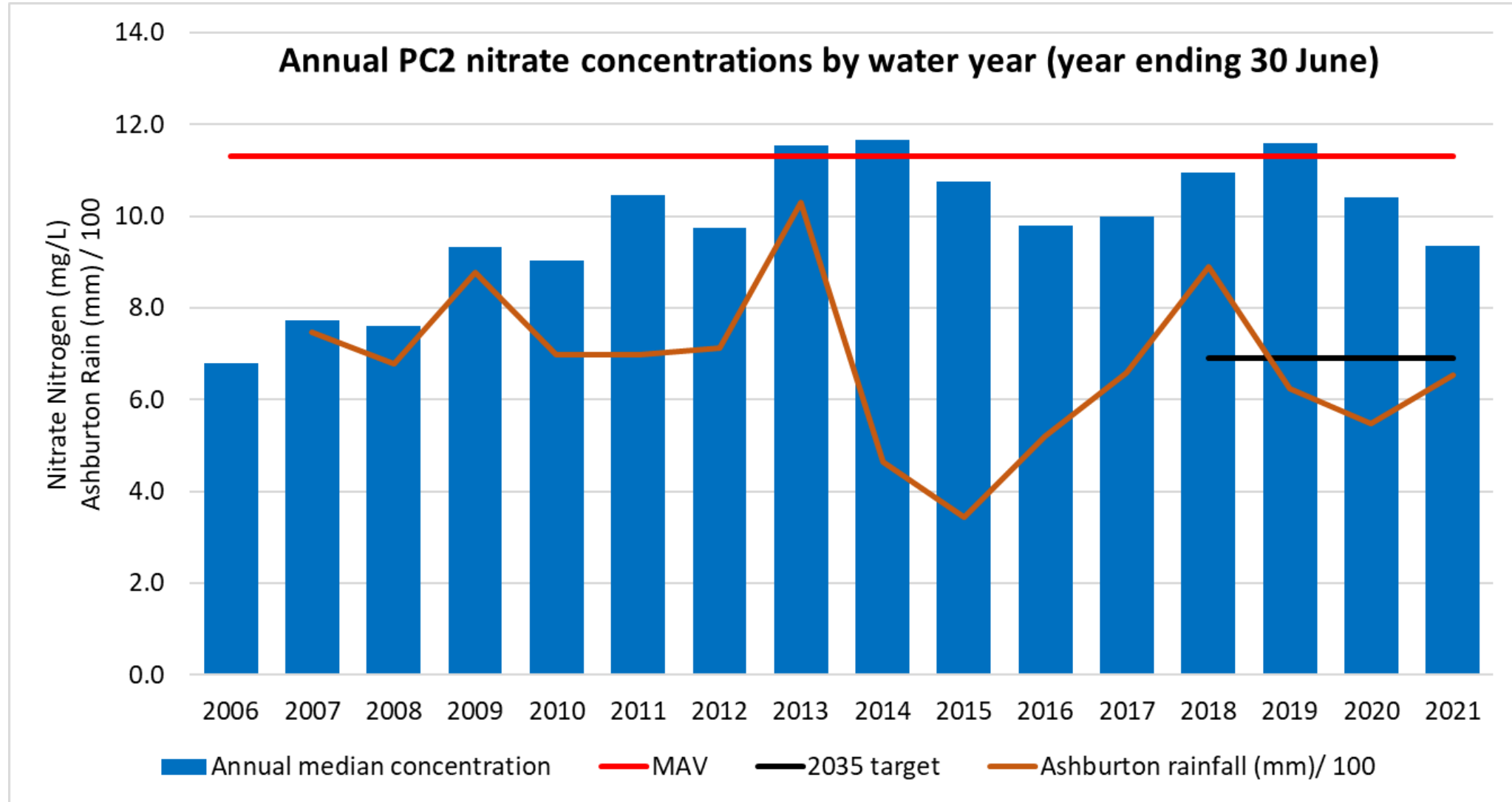
Manage abstraction and irrigated area

MAR

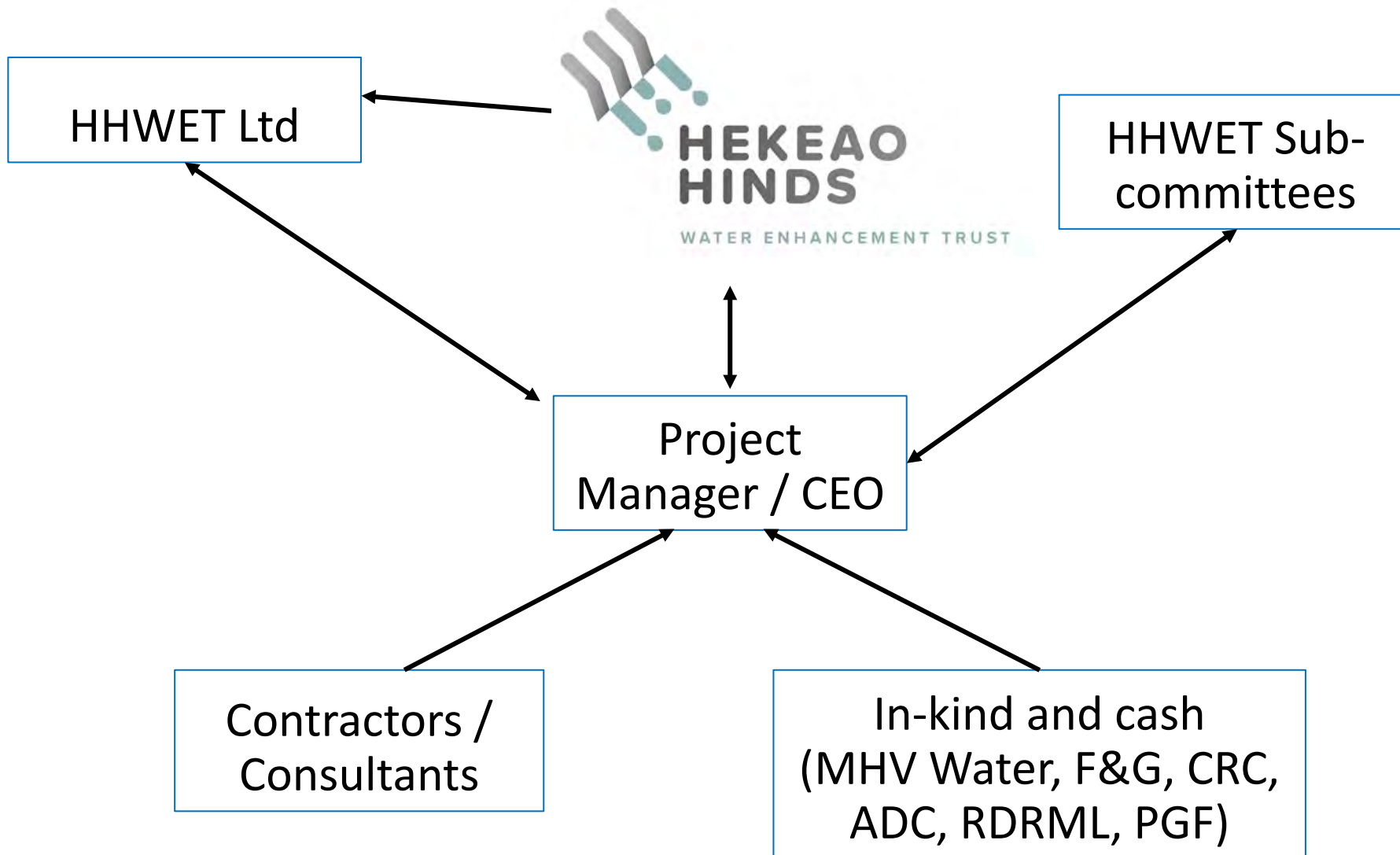
Target and protect	Target and protect drinking water supplies
Enhance	Enhance groundwater quality
Improve	Improve baseflows to spring-fed streams and rivers for ecological, cultural and social values
Improve	Improve and sustainably manage groundwater storage (levels)

How are the Hekeao Hinds Nitrate-N concentrations?

(Key contributing change factors – rainfall, land use management, MAR)



Who is leading the MAR Trial now?



Chair: Peter Lowe
Alister Argyle
Melanie Brooks
Neil Brown
Craig Fleming
Sir Graeme Harrison
Vince Lobb
Ian Mackenzie
Anne Marett
Rab McDowell
Michael McMillan

Mark Webb
(CSIF&G advisor to
HHWET)

How is the MAR Trial progressing?

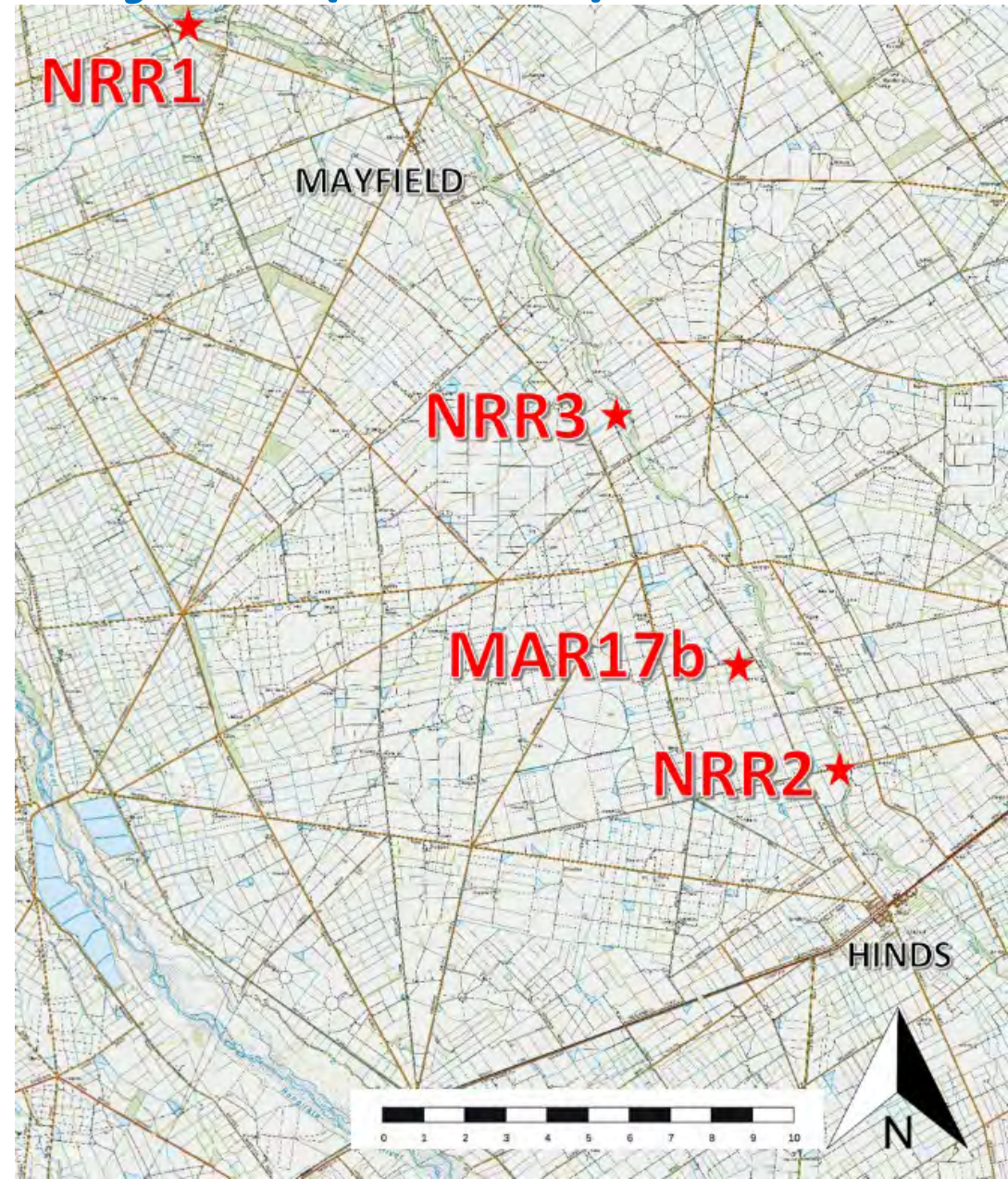
	Recharge Volume (M m ³)	Max total recharge flow (l/s)	Consented flow (l/s)	# tested sites	
Year 1 (June 2016 – May 2017)	2.4	100	500	1	11 week Pilot Site shutdown for maintenance and supply restrictions
Year 2 (June 2017 – May 2018)	2.2	220	500	7	11 week Pilot Site shutdown for maintenance and supply restrictions
Year 3 (June 2018 – May 2019)	5.5	485	500	12	11 week Pilot Site shutdown for construction
Year 4 (June 2019 – May 2020)	8.2	1195	500	17	13 week shutdown for Rangitata floods and COVID-19
Year 5 (June 2020 – May 2021)	13.8	1195	500	17	Winter 2021 shutdowns post-flooding and for distribution maintenance

The Hekeao Hinds River Project (HHRP)

AIM: To assist in improving the eco-system health of the whole Hekeao/Hinds River system, including assisting the PC2 2035 annual median target of 3.8 mg/l nitrate-N in the lower Hekeao Hinds River.

ACHIEVEMENTS:

- Two active sites and two more under development
- Increased flowing reaches with high quality water
- Increased fish populations
- DOC covenant for lizards
- DOC transfer permit for Kōwaro / Canterbury mudfish
- New native plantings



**Kōwaro / mudfish
wetland**



**Recharged 3.4 M m³
in Year 5**



**DOC Covenant
for lizards**



Fish surveys

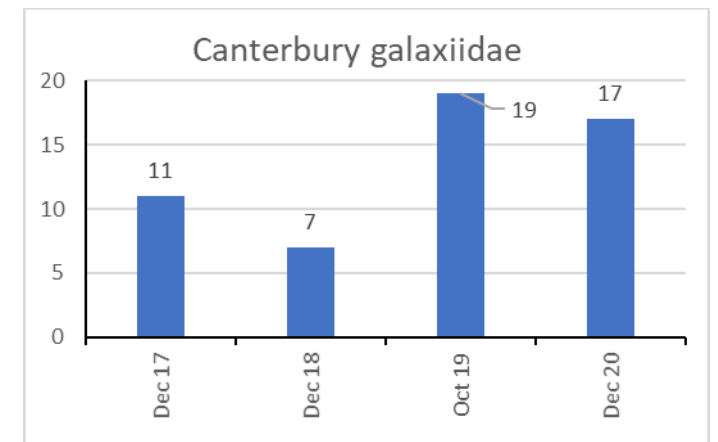
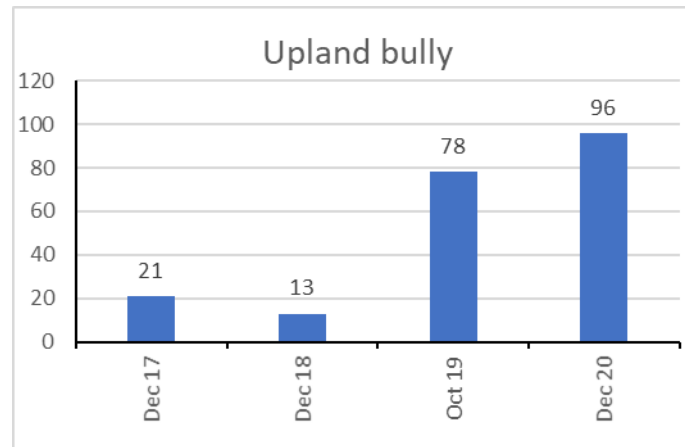


**NRR1 – South
Hinds
(Pre May 29-31 flood)**

NRR1 - South Branch Hekeao Hinds River

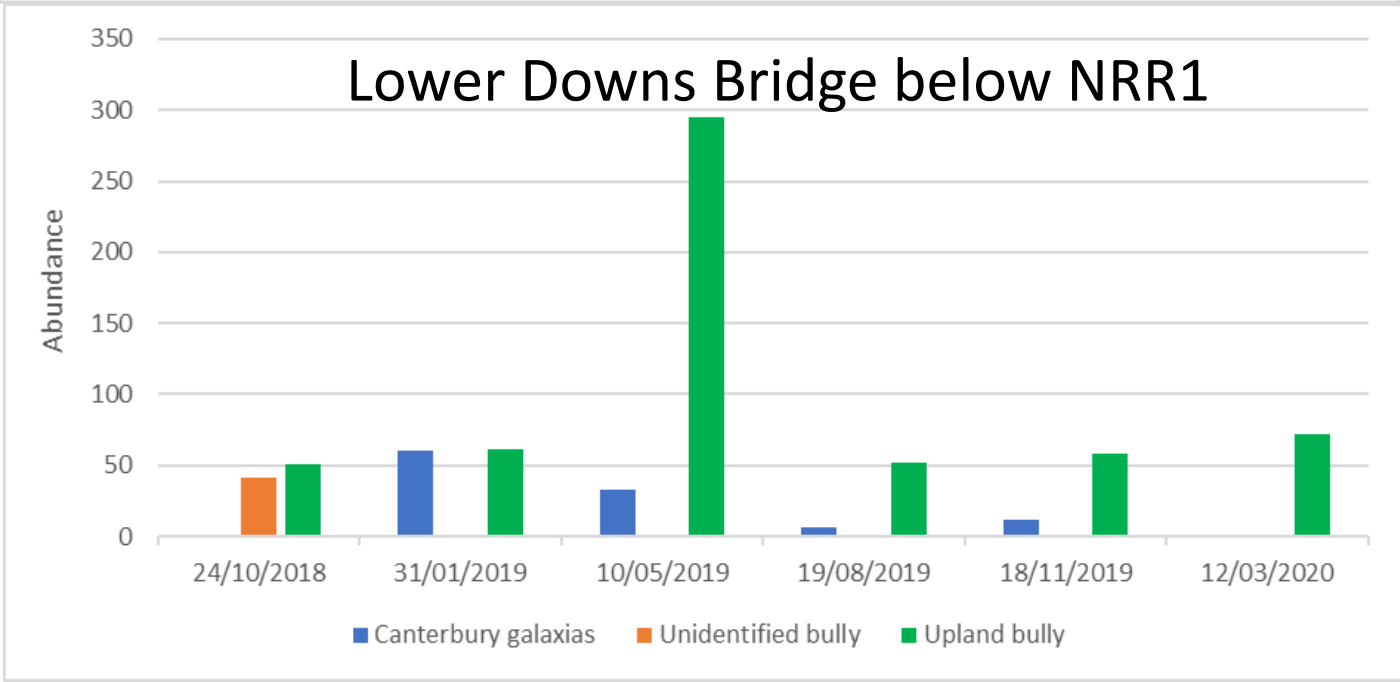
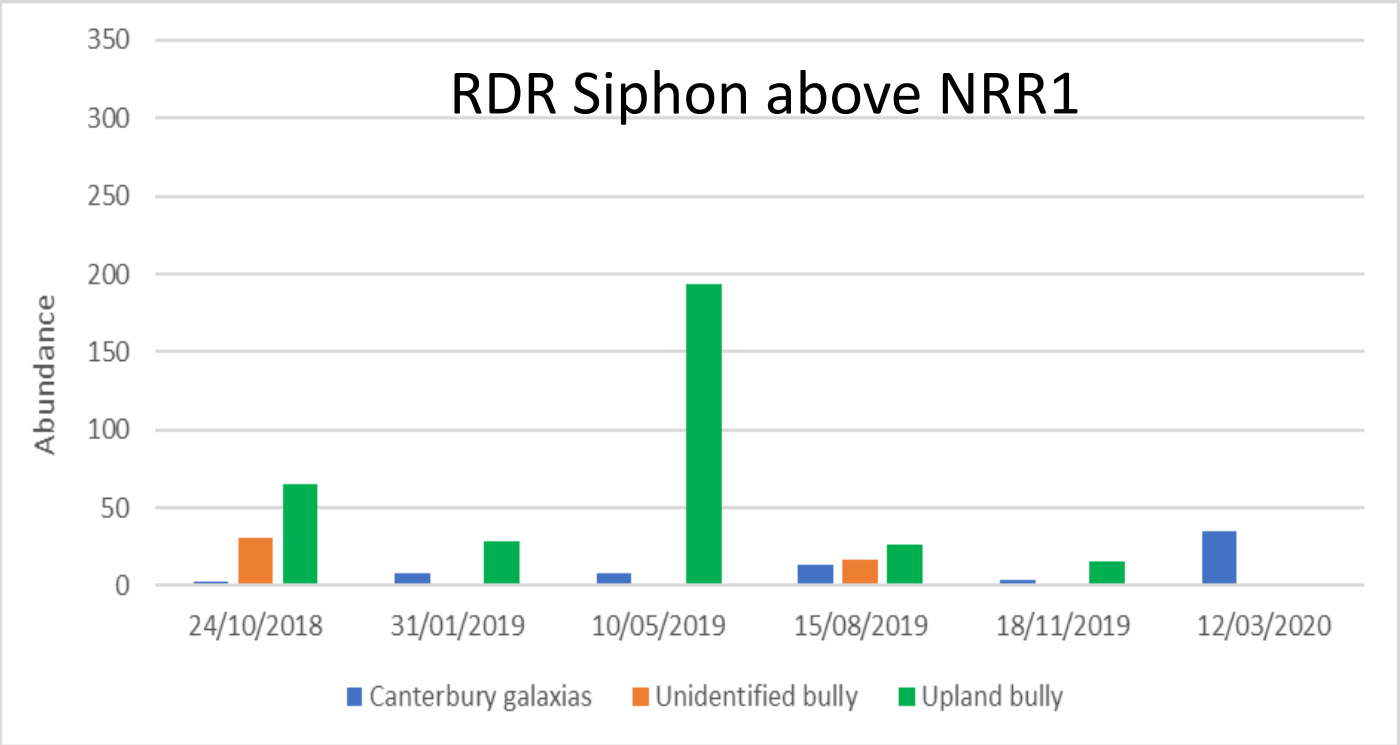
- 2018-2021: 68% increase in median flow of downstream river reach due to NRR1 recharge
- The proportion of time the reach is flowing at less than 50 l/s has also reduced from 33% to 6%
- Enhanced flows also in neighbouring Silverstream
- DOC Covenant plantings have completed their maintenance period with very high survival rates
- NRR1-supported wetland approved by DOC for Kōwaro / Canterbury mudfish when Wetland Management Plan has been actioned

**Lower Downs Rd Bridge
(downstream) annual fish
population estimates per 30
lineal metres, 2017 – 2020**
(1 longfin eel also found in 2018 survey
and 2 brown trout in separate 2019
survey)



Fish Abundance for South Branch Hekeao Hinds River

(Single pass Electric Fishing over 50 m reach)





**New high flow
channel and stopbank
– March 2021**



Flood damaged site



Wetland post-flood

**NRR1 –
South Hinds**
(May 29-31, 2021,
205 m³/s flood)



Surviving native plants

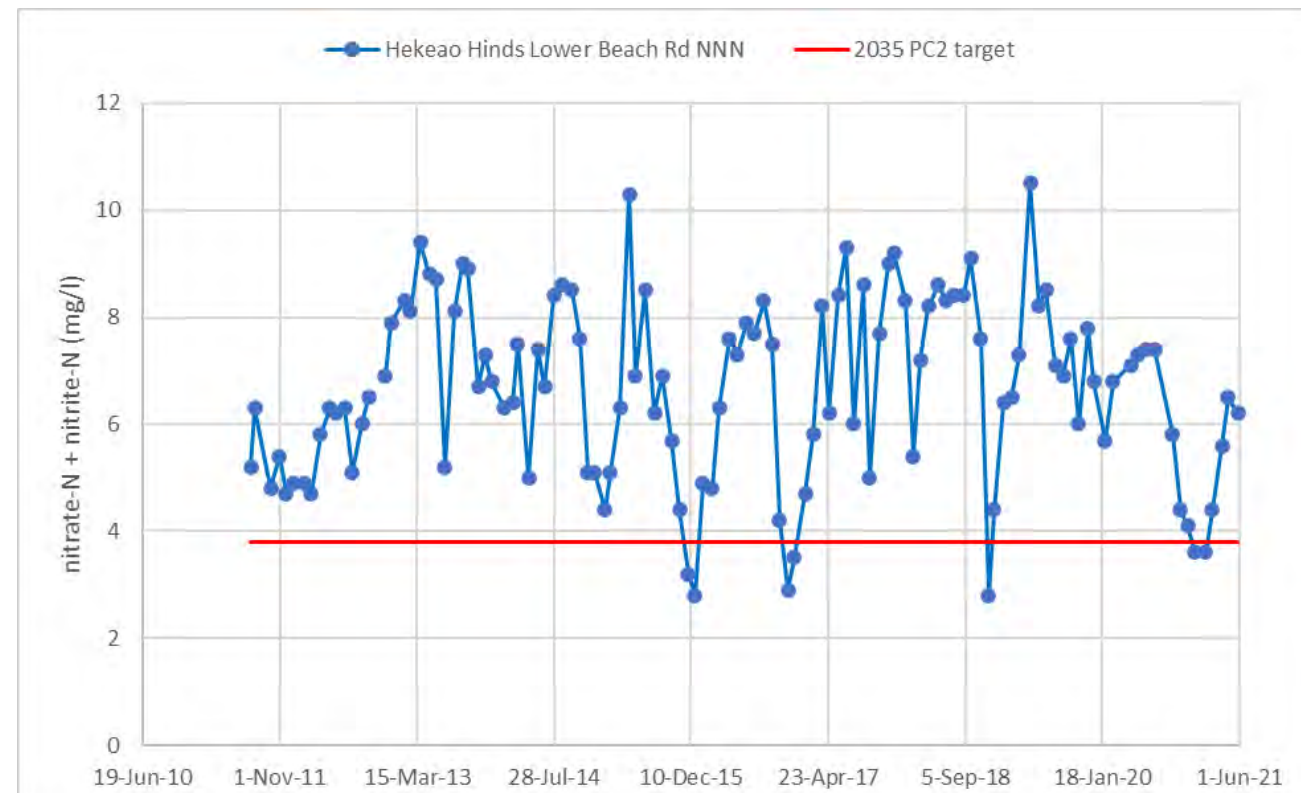
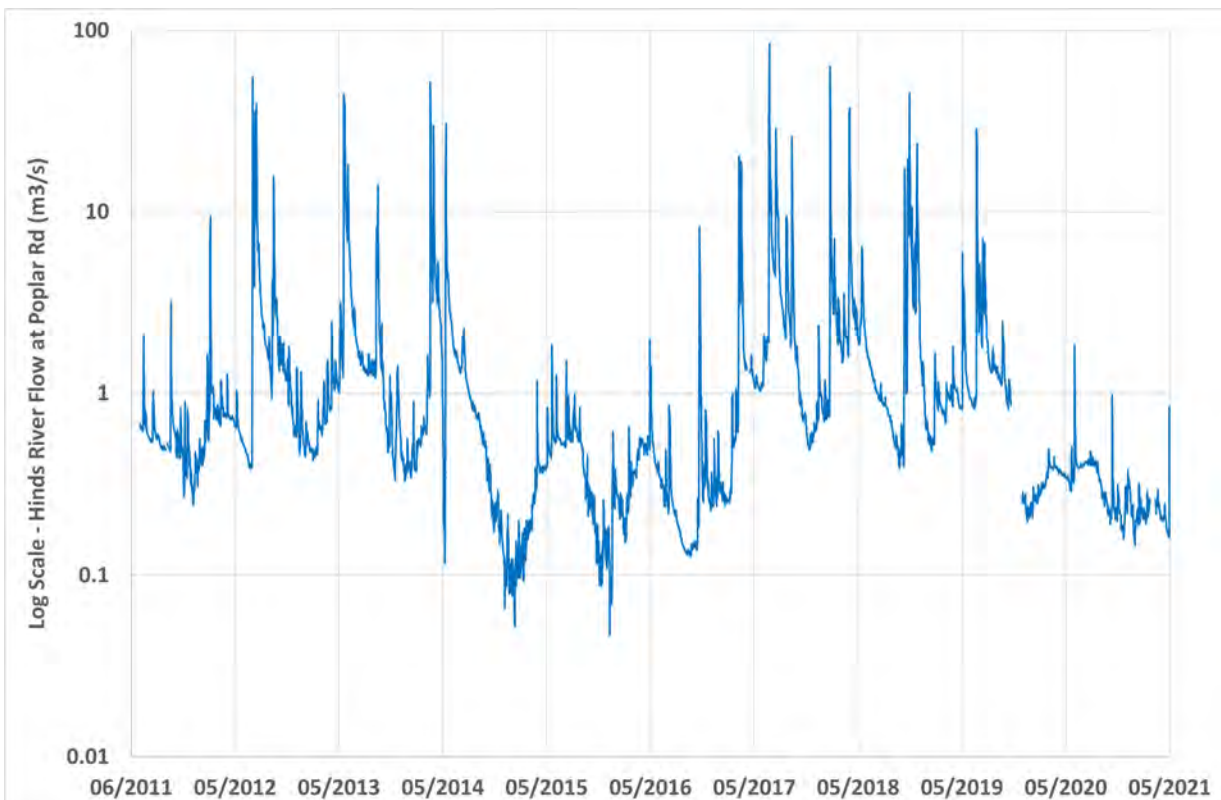
MAR17b, Lennies Rd

- Flow direction toward Hekeao Hinds River
- 1000 native plants donated by Synlait for Spring 2021
- December 2020 survey
 - No Hekeao Hinds River flow adjacent to Lennies Rd and low groundwater levels
 - Flow emerged down-gradient from Lennies Rd and continued for at least 6 km to below Winslow Rd



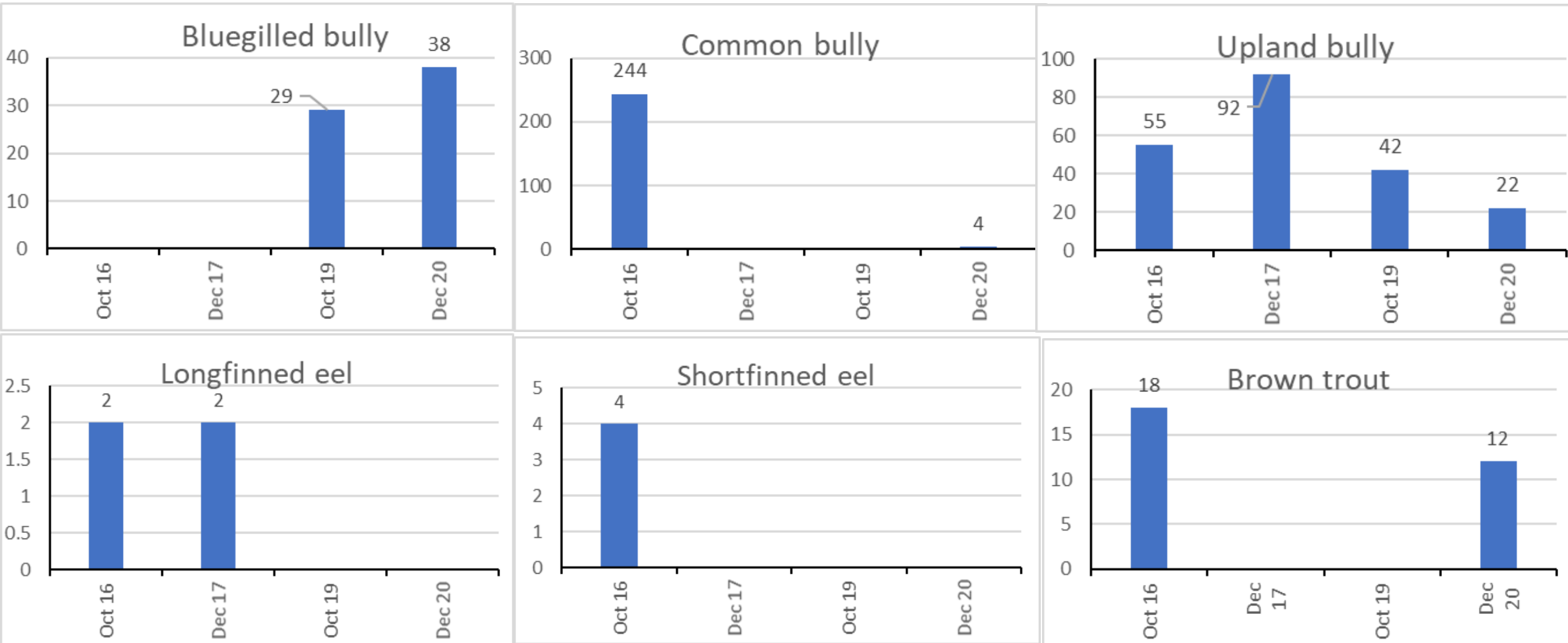
Lower Hekeao Hinds River flow and quality

- Measurable flow and quality connections between MAR / NRR sites and lower Hekeao monitoring sites will be challenging due to the distance up to MAR/NRR sites plus the baseflow dominance from drains.
- Enhanced flows to support fish habitat are expected to be most beneficial during extended dry periods.
- Water quality is historically only briefly below the 2035 target during low flow periods. However, early 2021 shows 5 months of water quality near the 2035 target. This follows MAR17b operations.



Lower Hekeao Hinds River (Poplar Rd) fish populations

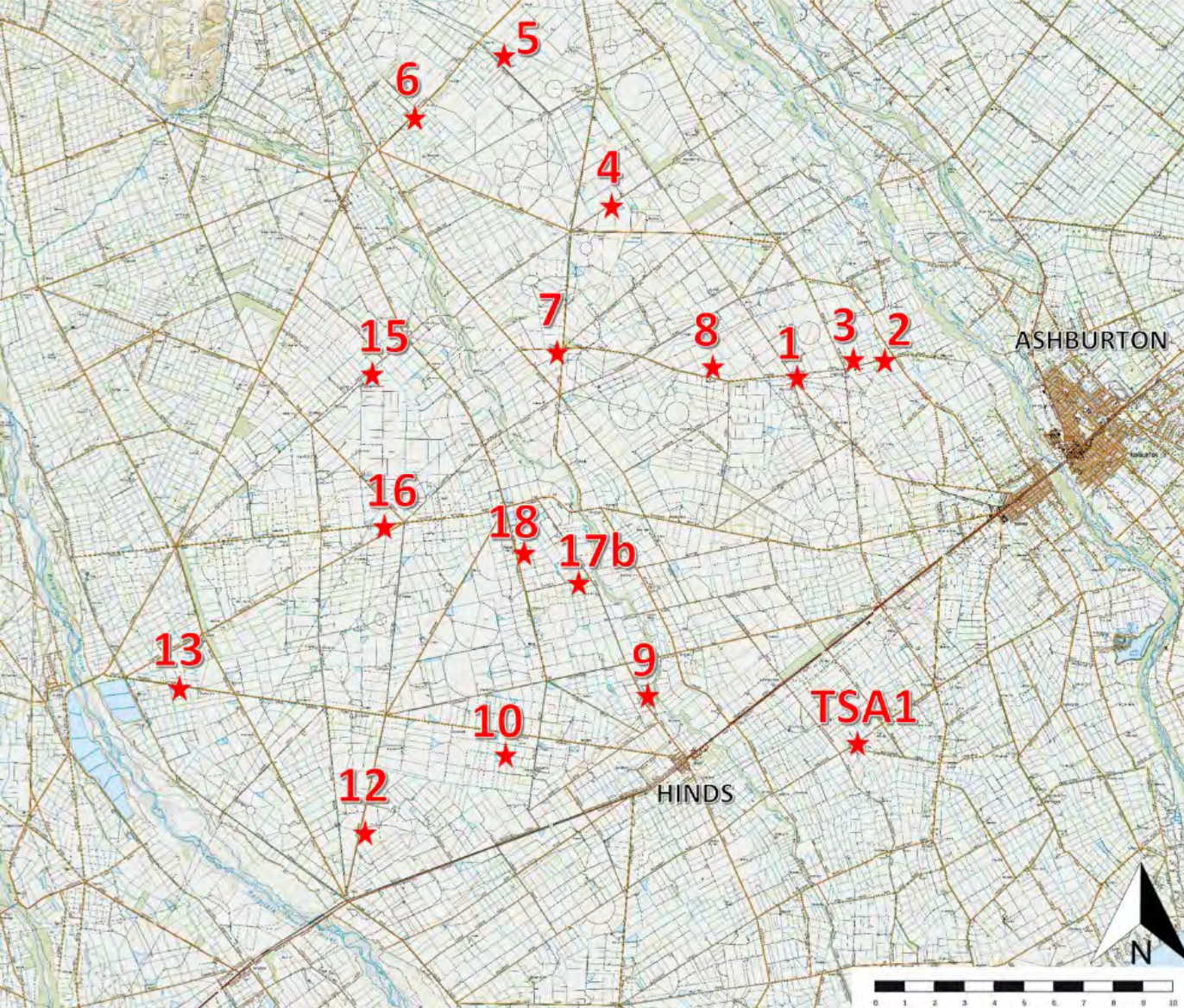
- Annual fish population estimates per 30 lineal metres (also 1 unidentified galaxiidae (Dec17) & 1 inanga (Dec 20))
- Timing of floods can significantly affect measured populations
- Poplar Road is >15 km downstream from MAR17b, with spring fed tributaries in between



MAR plains sites

Focus areas

1. Shallow groundwater up-gradient from lowland springs
2. High nitrate groundwater in the wider catchment (based on monitoring of >150 bores)
3. Targeted Stream Augmentation (TSA) for key lowland waterways
4. Additional sites planned for lower Hinds-Rangitata Plains



Eiffelton TSA1 solar panels

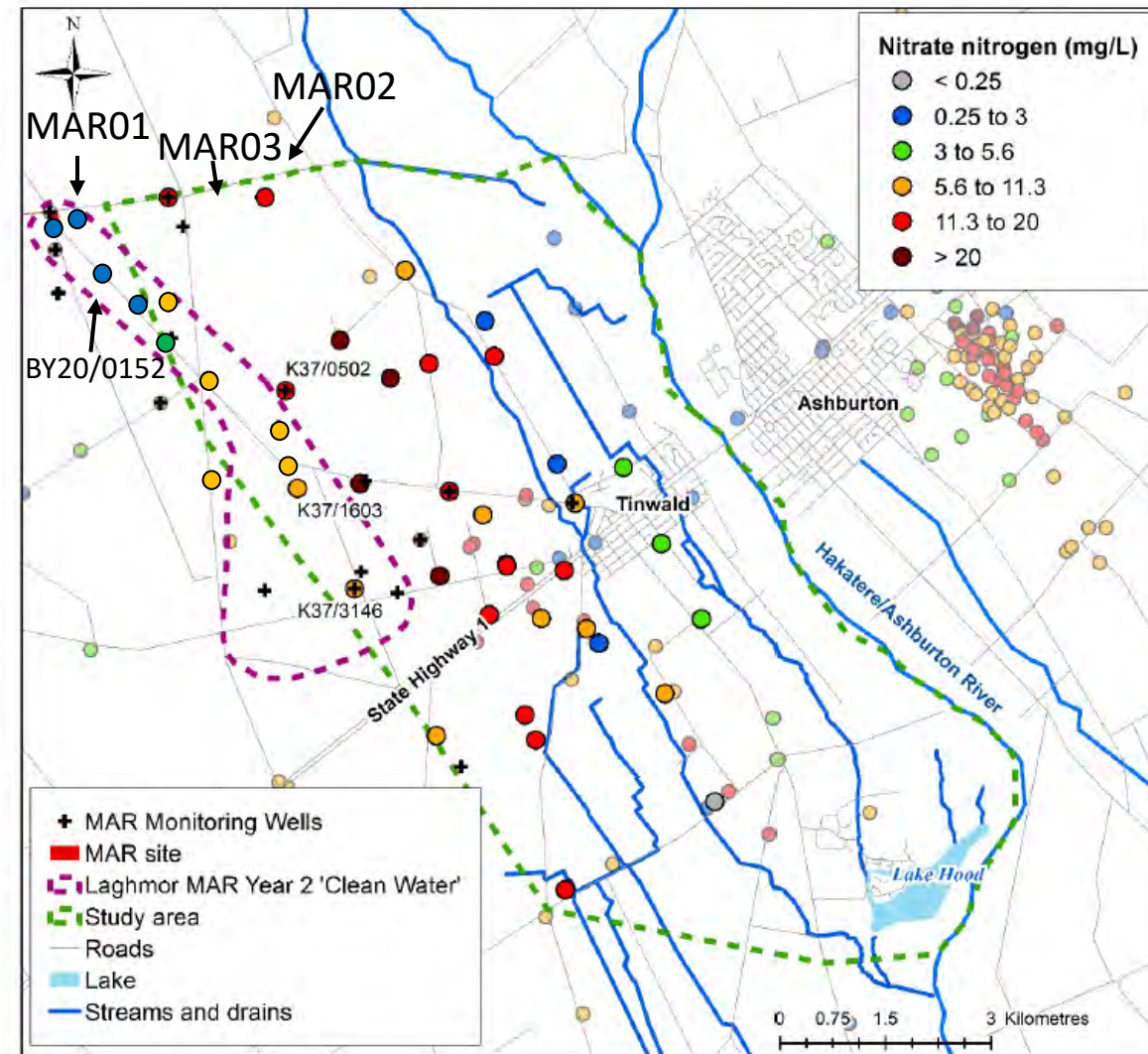
Case Study 1 – Tinwald “plume”

BACKGROUND:

- Elevated nitrate-N groundwater concentrations near Tinwald since monitoring began in the early 1980s.
- Stewart and Aitchison-Earl (2020) identified groundwater irrigation return flow as a significant contributor.

ACHIEVEMENTS:

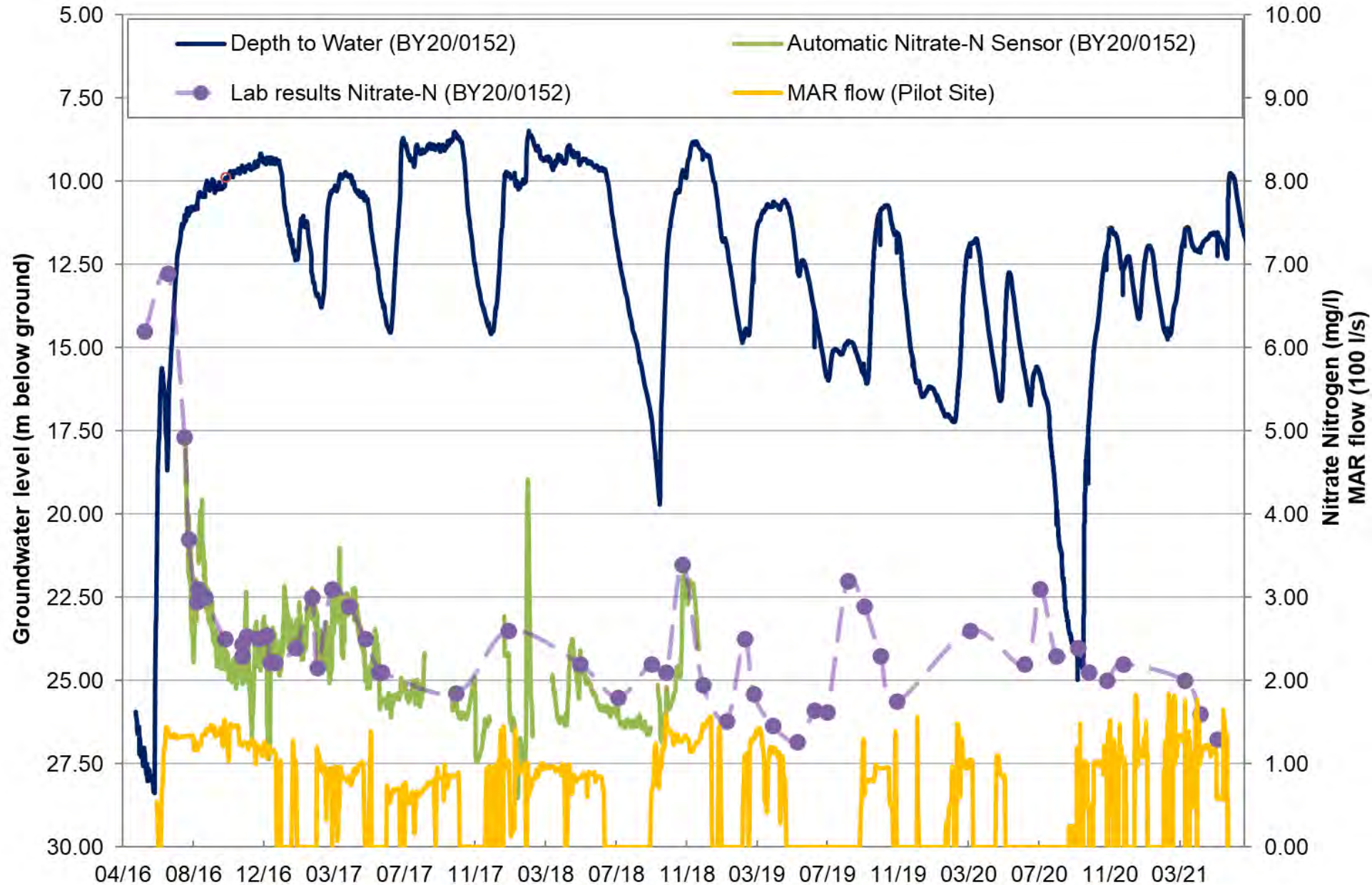
- 3 MAR sites now operational in this area.
- Analysis is underway to assist groundwater users to incorporate groundwater nitrogen in fertiliser management.



2017/18 nitrate-N concentrations and MAR Pilot Site area of influence (from Aitchison-Earl, 2019 and HHWET)

Case study 1b – MAR01 - Lagmhor Pilot Site

(monitoring bore BY20/0152, 29 m deep and 1 km down-gradient)



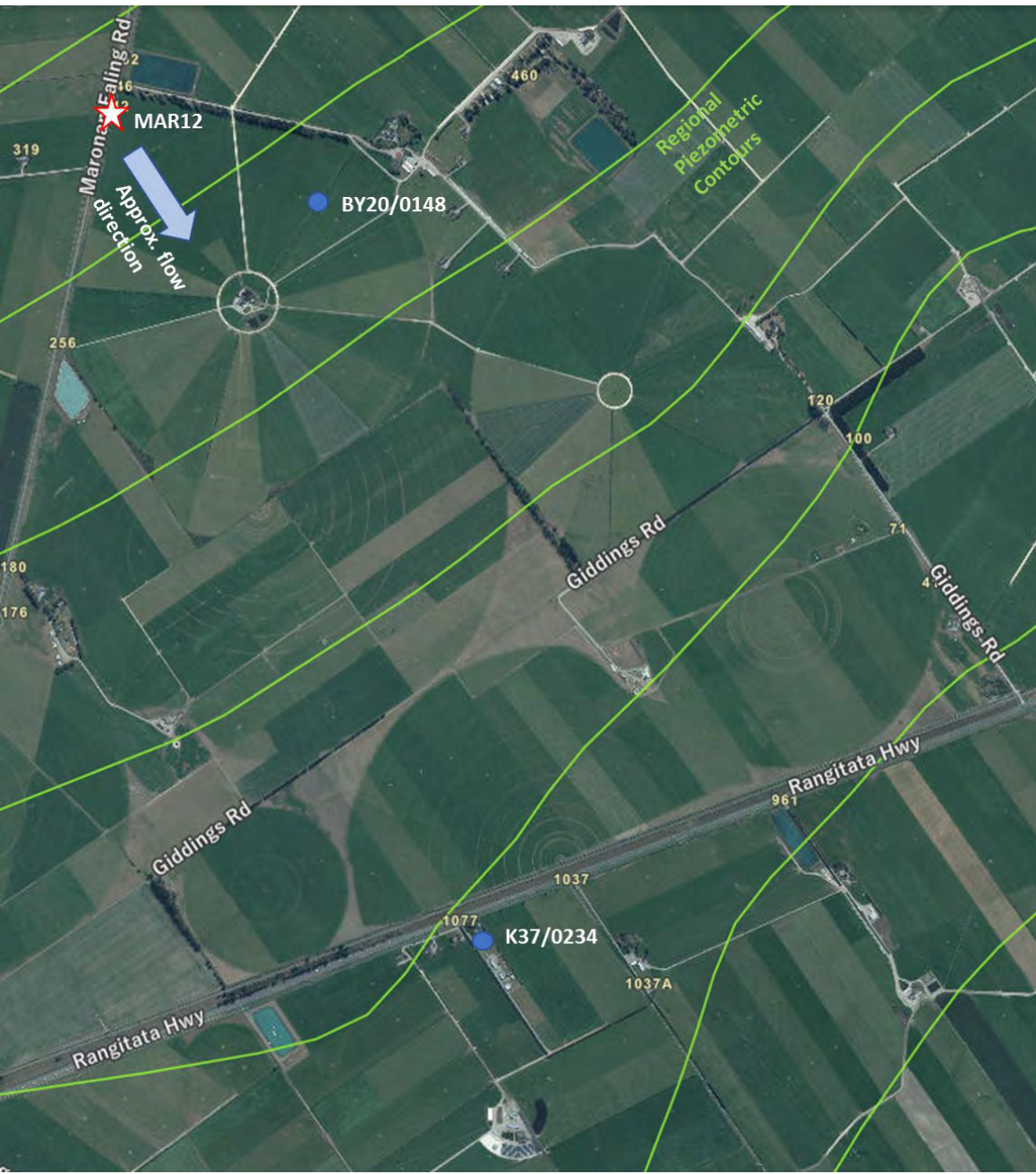
PRE-MAR:

- Groundwater nitrate-N 6-7 mg/l

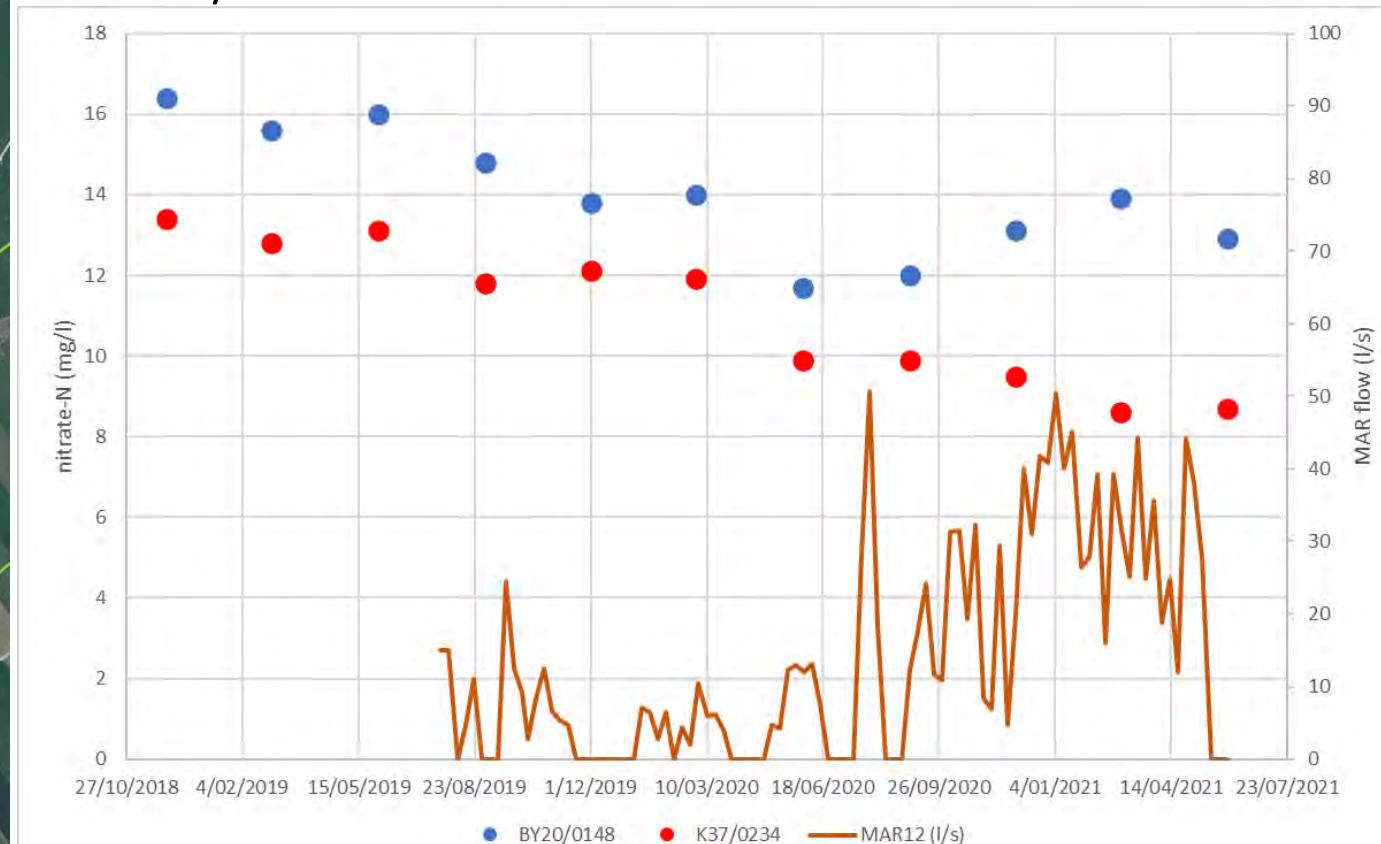
ACHIEVEMENTS:

- Fast groundwater level response to MAR
- Post MAR nitrate-N 1.2-2.2 mg/l when operational and up to 3.4 mg/l otherwise

Case Study 2 –MAR12 – Maronan Ealing Rd



- 2 monitoring bores: BY20/0148 cross-gradient and K37/0234 ~3km downgradient.
- <15 l/s MAR flow for first year using test site. No difference between nitrate-N changes in bores.
- Up to 50 l/s MAR flow for 2nd year using upgraded site. Nitrate-N at K37/0234 decreases while nitrate-N at BY20/0148 increases.



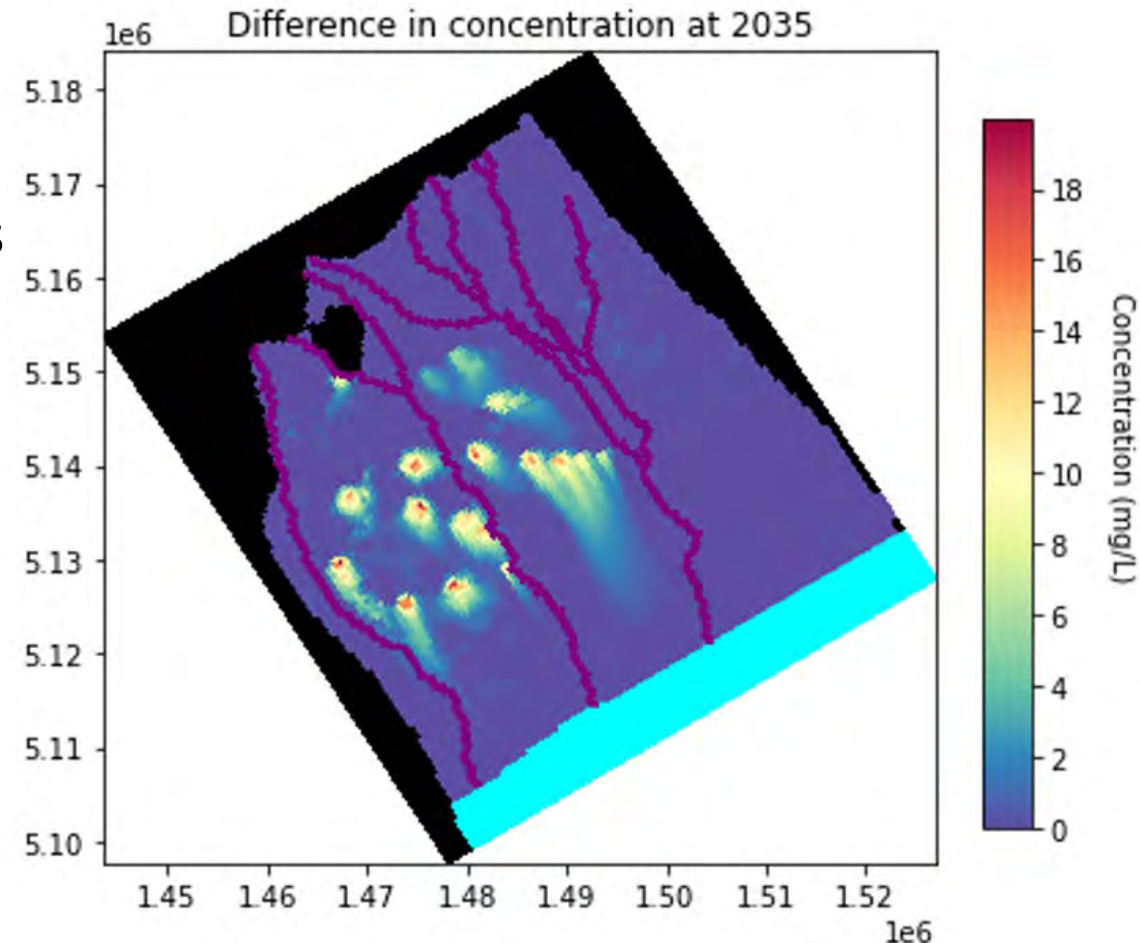
Catchment modelling and monitoring

MODELLING:

- 3D computer model created to run cumulative effects MAR scenarios (groundwater level and quality). Currently improving model by filling gaps in key input datasets.

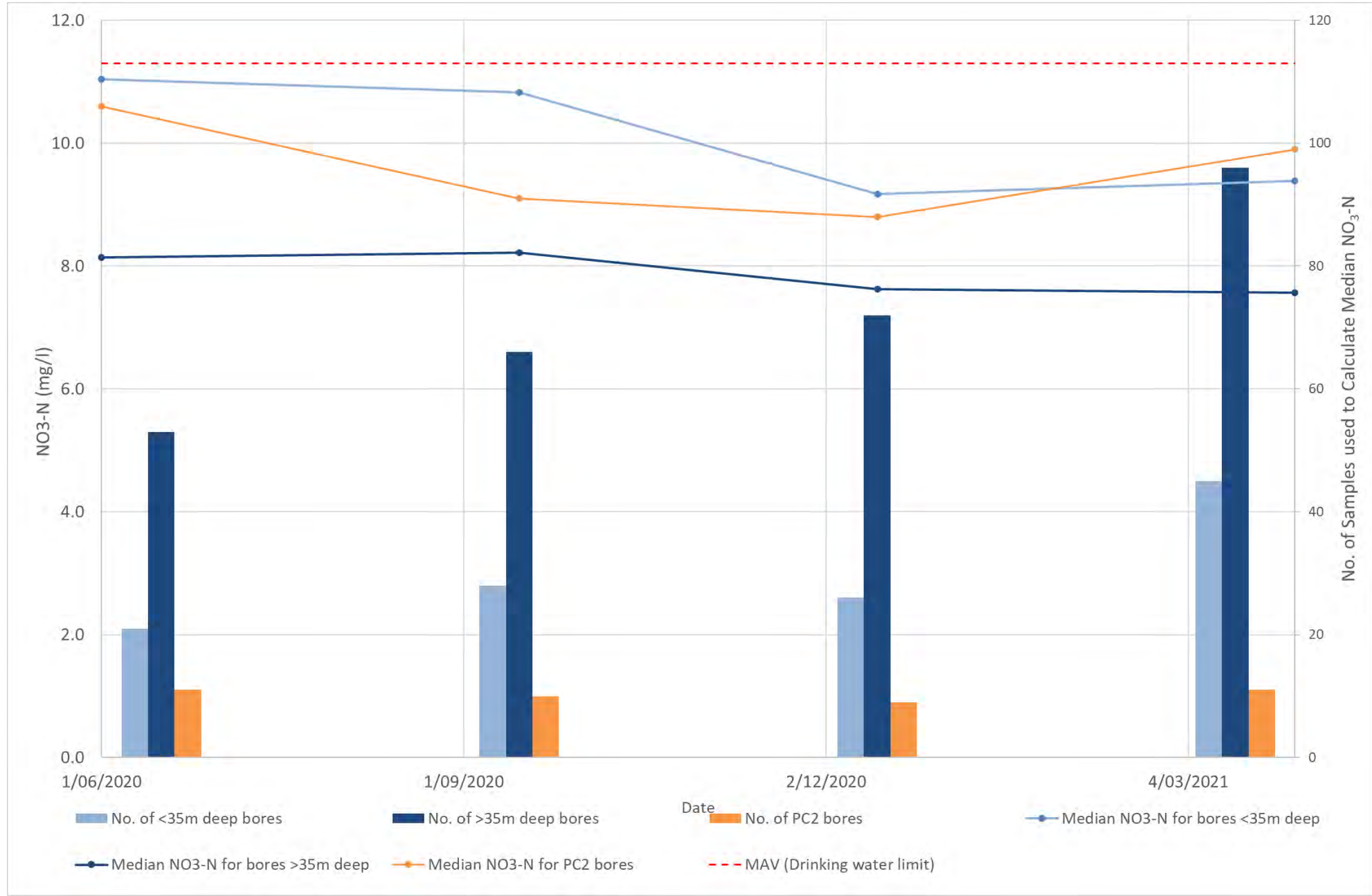
MONITORING:

- MHV Water-led surface and groundwater monitoring programme across catchment since 2016.
- Significant increase in number of bores monitored, from ~50 at the end of Year 4 to ~150 at the end of Year 5.
- This coverage increase provides improved modelling accuracy, MAR planning and MAR performance analysis.



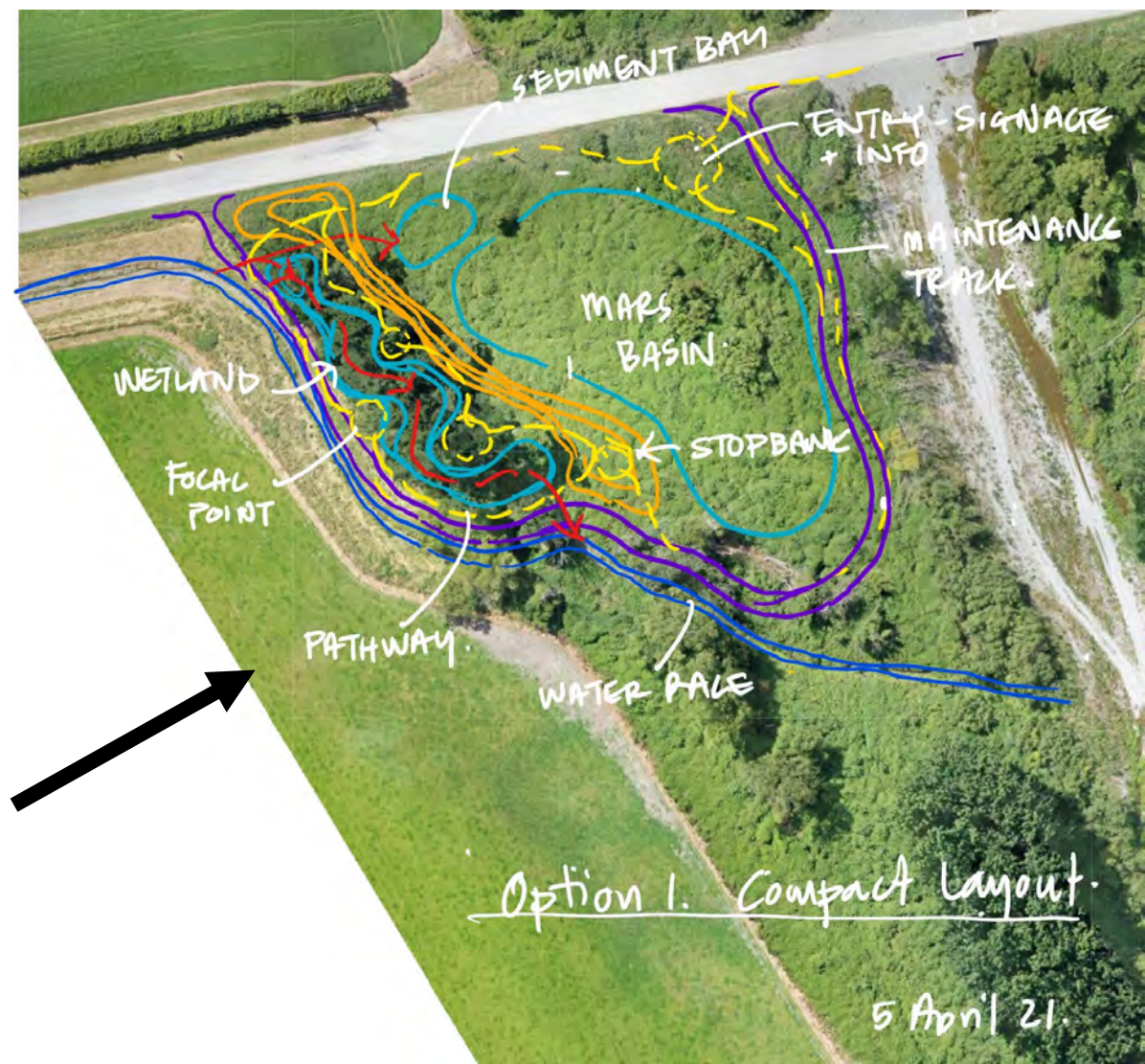
Example model output showing potential nitrate-N reductions from currently consented MAR sites

Year 5 Hekeao Hinds groundwater monitoring



What's Next for the MAR Trial?

- Long term consents
- Long term access to sufficient water (only supplementary access to existing consents)
- Additional sites and distribution
- Supporting further TSA sites and MHV Water's constructed wetland / bioreactor trial
- End of PGF funding (June 2022)
- Beginning of LTP Targeted Rate funding (July 2021) and changes to operational structure
- First combined Mahinga Kai / NRR site beside Fountains Rd, led by Michael McMillan (Arowhenua)



Thanks from



to

WATER ENHANCEMENT TRUST



ECGIS



TE RŪNANGA
O AROWHENUA

Tarbotton
Land & Civil



Ashburton
Zone Committee



Ministry for Primary Industries
Manatū Ahu Matua



Synlait

