Data Collection, Management, Quality Assurance and Control

Understanding the data and information is as important as the data itself. To mitigate any source of errors and or bias in our data, MHV has developed Standard Operating Procedures (SOP's) that are in keeping with the National Environmental Monitoring Standards (NEMS) for Water Quality – Parts 1 & 2. This ensures that samples are collected correctly and in a systematic fashion.

Water Quality

MHV measures Water Quality via a YSI Plus ProPlus portable water quality meter (**YSI Professional Plus Handheld Multiparameter Meter | ysi.com**) to measure chemical and physical characteristics such as:

- **Dissolved Oxygen** - a relative measure of the amount of oxygen (O_2) dissolved in water.
- **pH** - figure expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, 1 is acidic and 14 is alkaline
- **Conductivity** - a measure of the ability of water to pass an electrical current. Because dissolved salts and other inorganic chemicals conduct electrical current, conductivity increases as salinity increases.
- **REDOX Potential** - A chemical reaction that takes place between an oxidizing substance and a reducing substance. The oxidizing substance loses electrons in the reaction, and the reducing substance gains electrons.
- **Turbidity** the degree of cloudiness, opaqueness, or thickness with suspended matter
- **Water temperature**

The YSI meter is routinely checked with calibration solutions (i.e., premixed solutions of a known chemical composition), as well as sent for routine maintenance and servicing annually.

Nitrate Analysis

To keep costs down, and reduce turn around times, MHV uses an inhouse Hydrometrics GW50® Optical Nitrate Probe (**Home (hydrometrics.co.nz)**. This probe uses a pulse of light from a Xenon flash that passes through the water sample – the amount of UV light that is absorbed is correlated to a NO_3-N concentration.

MHV routinely sends between 10% - 15% of collected samples to Hills Laboratories (Hornby) as a cross check to quantify the bias due to the different analytical techniques. Additionally, the GW50 is returned to Hydrometrics on an annual basis for maintenance and calibration.

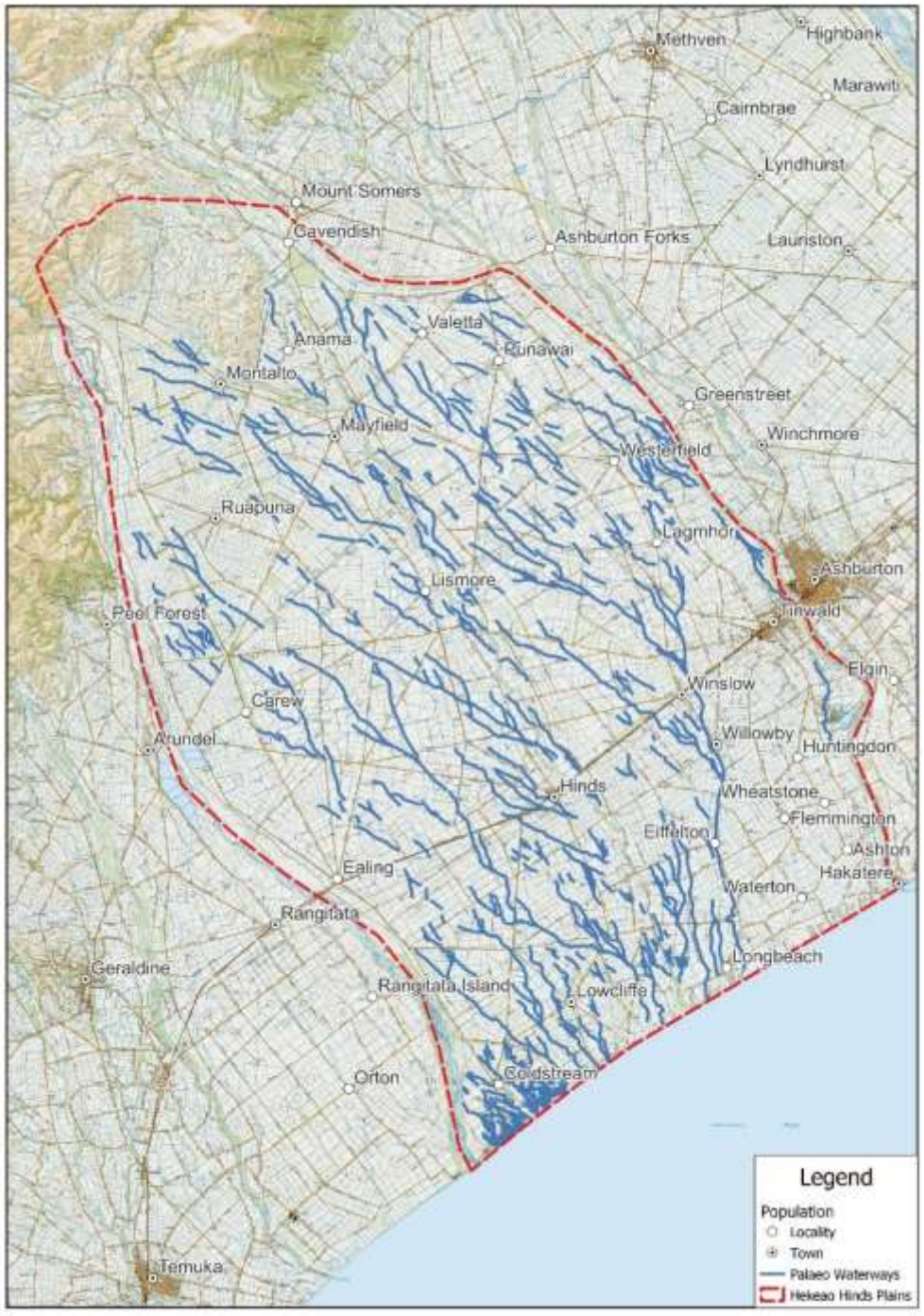
Data Management

All information collected by MHV is protected by the Privacy Act (2020). Access to this data is restricted to MHV staff only with raw uncredited data (i.e., the bore number and data) only provided to approved third parties as part of ongoing sanctioned research projects.

Palaeo Drain ways

It is common farm knowledge (often referred to as the *'wives' tale'*) that local near surface water runs from Tarahaoa Mt Peel towards the mouth of the Hakatere Ashburton River – except for the area stretching from Lagmhor to Waterton, where the ground is considered 'heavy' and prone to becoming waterlogged.

A high-level interpretation of LIDAR (laser imaging, detection, and ranging) data supports this assertion, whereby lineation's are immediately observable. These lineation's are interpreted to be paleo channels - associated with the migration of Hekeao / Hinds Plains waterways over time – which were mapped and presented as ephemeral sub-surface water pathways.



Soils play a big role

The Hekeao Hinds Plains has over twenty main soil types the most common being thin (<0.5 m) sequence of stony, free-draining loess and Lismore-type soils, with a low water holding capacity of less than 75 mm and hydraulic conductivities (i.e., the relative ease with which groundwater can move through a permeable layer of rock or soil) between 3.1mm to 5.2mm per day.

Closer to river margins, soils tend to be deeper and more varied in type, depth and quality. Notably, the area between from Lagmhor to Waterton, as well as the coastal margin of the plain, the area is dominated by Waterton gley soils and Wakanui deep silt loam soils with higher water holding capacities (>150 mm) and much lower hydraulic conductivities between 0.037mm to 0.0074mm per day). As these soils have reduced oxidation states, and are prone to water logging, denitrification and dissimilatory nitrate reduction to ammonium (DNRA) can occur reduced by anaerobic bacteria and/or fungi, especially during alternating wet and dry conditions.

Conversely, catchments dominated by subsurface flows have found that shallow groundwater is a key driver of NO3-N variability following storm events, with NO3-N concentrations being higher in areas with shallow groundwater and highly permeable soils

These two mechanisms have been observed and quantified on the Hekeao Hinds Plains.

Nitrate Responses to Rainfall

Following from the initial work done by MHV, Ms Sidinei Teixeira from Lincoln University as part of a Callaghan Innovation Fund identified four broad trends across the Hekeao Hinds, namely:

i. Group A: Marginal changes within ± 10%

ii. Group B: Significant short-term increase, with rapid decay

iii. Group C: Moderate but sustained increase

iv. Group D: Initial decrease then increase in later months

Role of Rivers

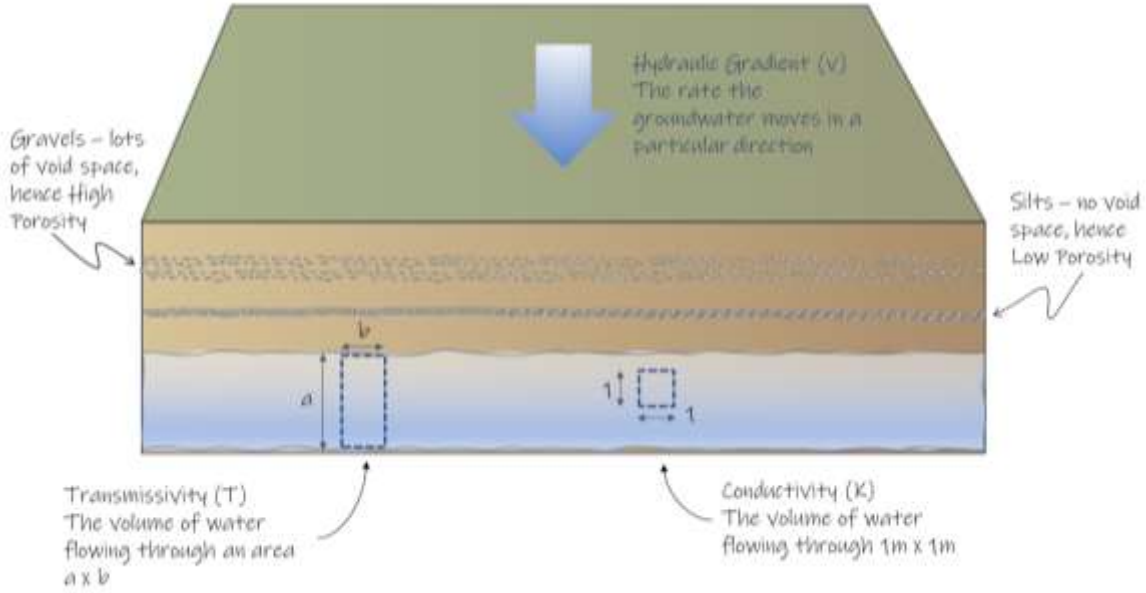
MHV postulated that increased river flows could act as a hydraulic piston which had a direct influence on temporal NO_3-N concentrations after a rainfall event. To test this idea, MHV installed a GW50 in a shallow bore in Lowcliffe in early 2022 to record real-time variations in NO_3-N and standing wate levels. Following a period of calibration, the probe started reporting data in May 2022.

The results from the probe as well as river flow and rainfall data confirmed this idea and indicate that river flow (lateral flow) is a primary driver of NO_3-N migration.

Faults and Transmissivity

Hydraulic conductivity (K) (aka coefficient of permeability) is a measure of how easily water can pass through soil or rock. High values indicate a permeable material through which water can pass easily; low values indicate that the material is less permeable.

Transmissivity is the rate of flow under a unit hydraulic gradient through a unit width of aquifer of given saturated thickness. It is measured in litres per-day per meter (l pd / m). Porosity is the proportion of solids to voids in a sedimentary formation



Based on this idea, MHV conducted a high-level desktop study of publicly available Hydrological Transmissivity (T) to ascertain to what extent it played a role in NO3-N distribution across the Hekeao Hind Plains.

The results for bores between 65 – 100m deep corresponded with known faults in the area suggesting a Horst and Graben system.

Groundwater levels

As part of the monitoring programme, MHV takes soundings of standing water level. Unfortunately, this is restricted to bores with an alkathene pilot tube, so we are unable to collect a comprehensive data set. Be that as it may, the data compiled has enabled us to illustrate how groundwater changes across the catchment.