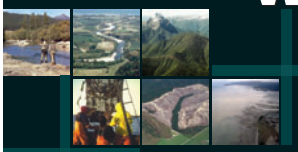
If Moutere groundwater is 20000 years old, why does current land-use matter?

Research into Moutere aquifer recharge mechanisms



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Introduction

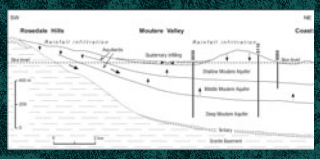
Groundwater in the Moutere Valley is an important resource; its use has increased from the middle 1980s, after deep wells revealed the hitherto unknown water resource. The present work investigates the age of the groundwater and how recharge to the aquifers may be occurring in order to improve understanding of the nature of the system. This will lead to better understanding of the patterns and rates of recharge to the deep Moutere Aquifers. Better understanding of the groundwater system and recharge will contribute to policy on future permitted land uses in the recharge areas.

All investigations carried out to date show a precipitation infiltration recharge to the deep Moutere Aquifers with the principal recharge coming from the southwestern sector of the area where the lower unit (tm1) Moutere Gravel outcrops. The surface boundary of the lower unit (tm1) Moutere Gravel was defined based on hydrogeological data (i.e. mapping and age datings).

Moutere groundwater zones.

Isotopes and Chemistry
(Dr Mike Stewart)

Recharge to the Moutere Gravel aquifer system in the Moutere Valley was investigated by means of isotopic and chemical measurements. Bores up to 500 m deep tap three Moutere Gravel aquifers underlying the area.



Recharge patterns for the Moutere aquifers

Results

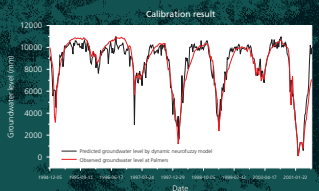
- Shallow bores (50-100 m) have isotope values expected for present-day rainfall and carbon-14 concentrations indicating modern ages, i.e. water residence times of up to hundreds of years.
- Deeper bores have more negative ä18O values and lower 14C concentrations resulting from input of much older water from depth in the western and eastern zones. This water is more than 20,000 years old.
- Recharge is provided by modern water penetrating the groundwater system at shallow levels. Young recharge is observed only on the hills west of the valley floor, but observations are lacking in the most probable recharge zone (the tm1 outcrop area in the Rosedale Hills).

Response to groundwater abstraction

An empirical model of groundwater response to abstraction and precipitation has been developed using neural networks and fuzzy logic. The model is able to predict aquifer response to abstraction and precipitation.

Results

- The borehole record and the modelled response suggests that rainfall recharge is likely to be the main recharge mechanism.
- Scenario modelling suggests that even with a greater extraction rate than has occurred over the last 10 years, the aquifer is likely to recover during the winter.
- In interpreting this result sit is important to note that this assumes the same recharge mechanisms occur, i.e. their no reduction in the amount of recharge.



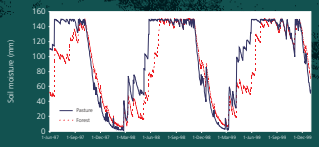
Observed groundwater levels at Palmers vs simulated results from a dynamic neurofuzzy model.

Surface recharge

Water use differences between pasture and forestry were studied in the Moutere aquifer recharge zone. A mixture of field instrumentation and water balance modelling has been used for study sites in the Waiwhero catchment area.

Results

- Forest cover shortens the length of the time during the winter and spring when the surface store is fully wet (and therefore able to recharge groundwater).
- This potentially does affect the amount of groundwater recharge during the winter.
- Modelling of possible recharge shows that the amounts are very small when shown as a depth of water but when converted into volume over an area have potentially large amounts of recharge.
- Analysis of streamflow from permanent structure gauges suggests that there may be a loss of flow from the Waiwhero streambed but the consistent nature of loss points to a calculation error rather than actual water loss.
- Spot gauging during the spring was not able to detect any losses



Modelled results of pasture vs forest soil moisture storage for the syudy period. N.B. potential aquifer recharge can occur when the soil moisture level reaches full storage (150mm of water).

Overall conclusion:

Although Moutere groundwater may be 20,000 years old current land-use does matter because:

- There are recharge mechanisms occurring that mean, even with high extraction rates, the aquifer is able to recover during the winter.
- The recharge is likely to be from surface infiltration throughout the Rosedale hills area.
- Although the water infiltrating from the surface may take many hundreds of years to reach the main Moutere aquifer it creates a sufficient pressure gradient to cause deep groundwater levels to recover during the winter.
- Replacement of pasture with tall vegetation on the recharge area affects the amount of surface infiltration.
- This impact is through delaying the autumn/winter onset of a wet soil mantle (when surface infiltration to groundwater can occur) and lessening the volume of water available for recharge.