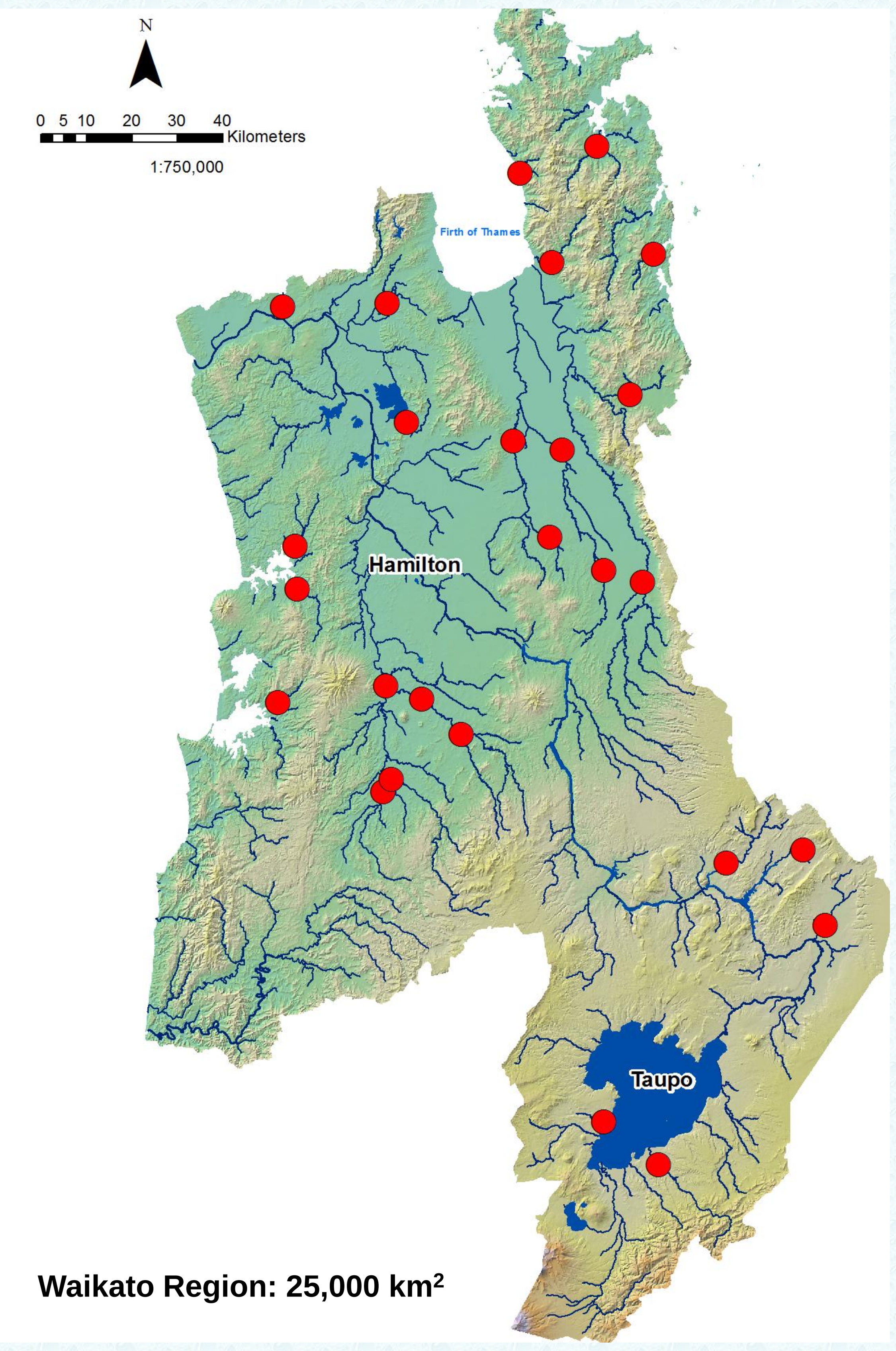
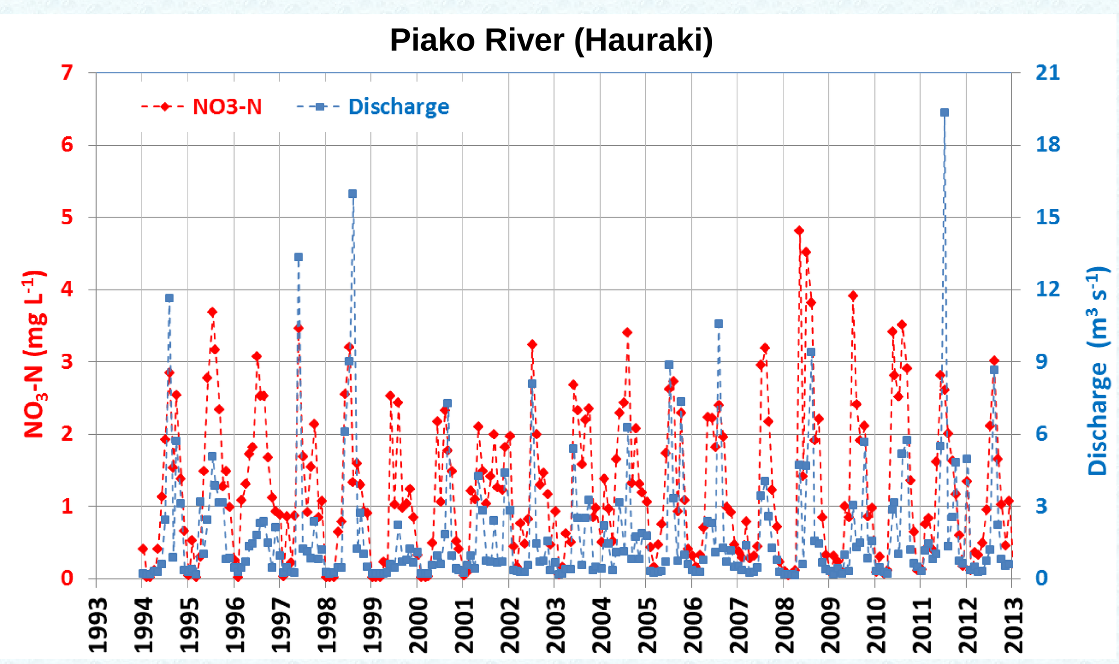
N AND P CONCENTRATION-DISCHARGE RELATIONSHIPS IN STREAMS: WHAT CAN THEY TELL US ABOUT TRANSFER PATHWAYS?

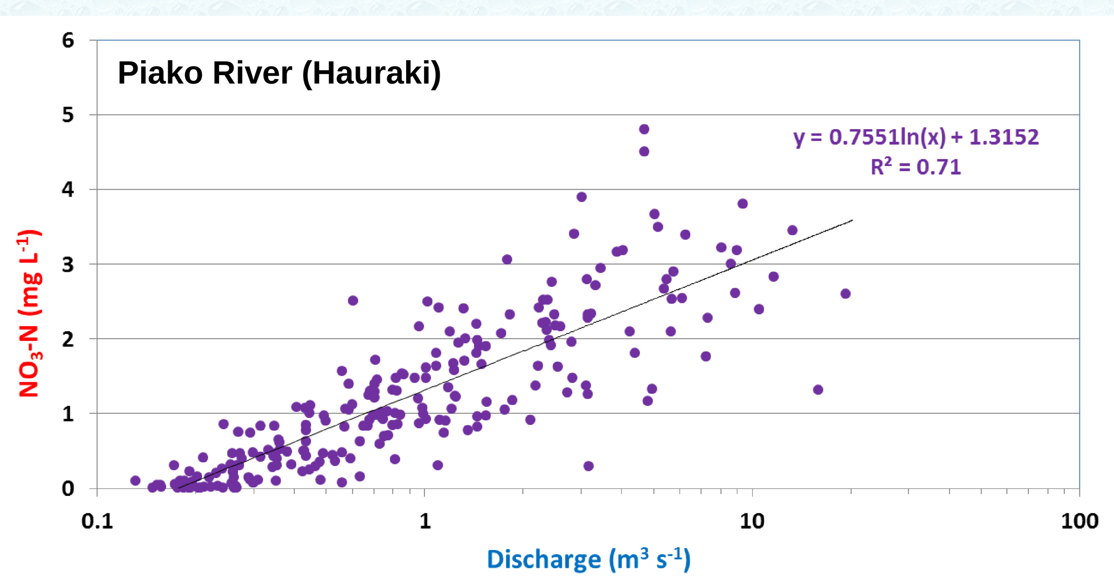
Roland Stenger[1], Simon Woodward[1], Reece Hill[2]
roland.stenger@lincolnagritech.co.nz, www.lincolnagritech.co.nz
[1]Lincoln Agritech Ltd., Private Bag 3062, Hamilton 3240, New Zealand
[2]Waikato Regional Council, Hamilton, New Zealand

Introduction



- Waikato Regional Council monitors contaminant concentrations (C) at > 100 stream and river monitoring sites (monthly ‘grab samples’)
- Discharge (D) data is available at or near 26 of these sites (●)
- Data available for up to 20-years (1993 – 2012)
- Example concentration (C) and discharge (D) time series and C-D relationship:





- Positive C-D relationship, i.e. NO_3-N concentration increases with increasing discharge

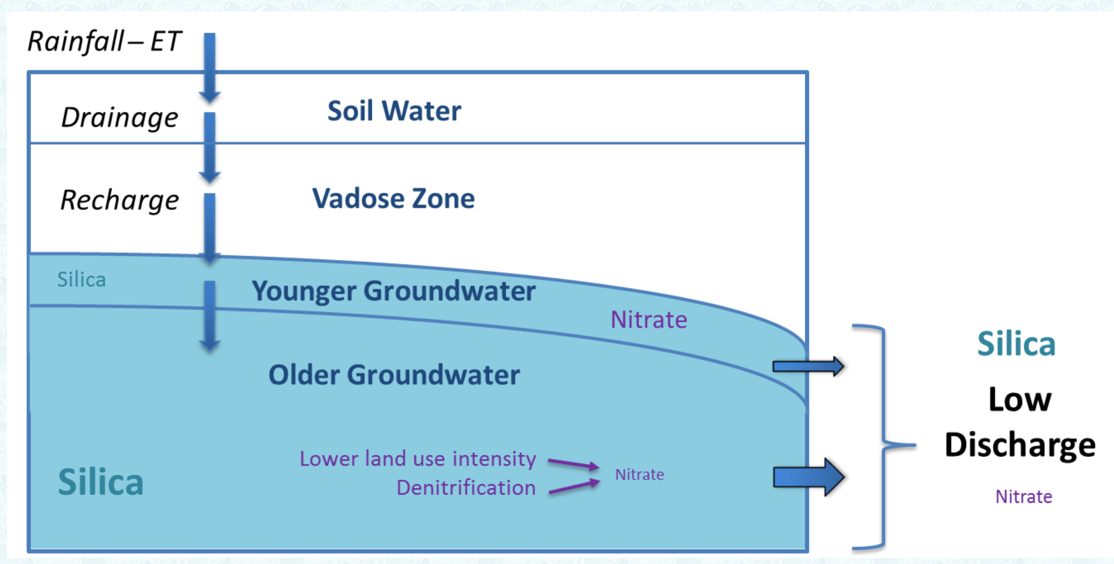
Concentration – Discharge (C-D) Relationships

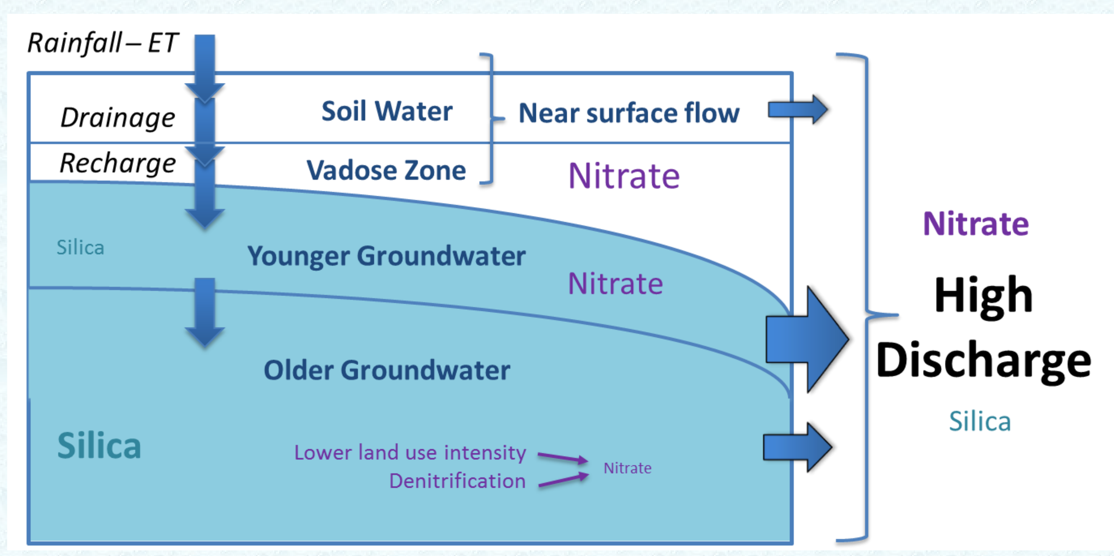
	Positive	Not significant	Negative
Total nitrogen (TN)	26	0	0
Nitrate nitrogen (NO_3-N)	25	1	0
Ammonia nitrogen (NH_4-N)	18	8	0
Total phosphorus (TP)	22	2	2
Dissolved reactive phosphorus (DRP)	5	12	9
Non-DRP phosphorus (TP-DRP)	25	1	0
Silica (SiO_2)	0	8	18
Electrical conductivity (EC)	0	4	22

Significance level α = 0.005, i.e. 'highly significant'

- N species: all significant relationships were positive
- Total Phosphorus: mainly positive relationships; two negative ones due to point-source discharges
- Dissolved Reactive Phosphorus: high number of non-significant relationships; more negative than positive ones

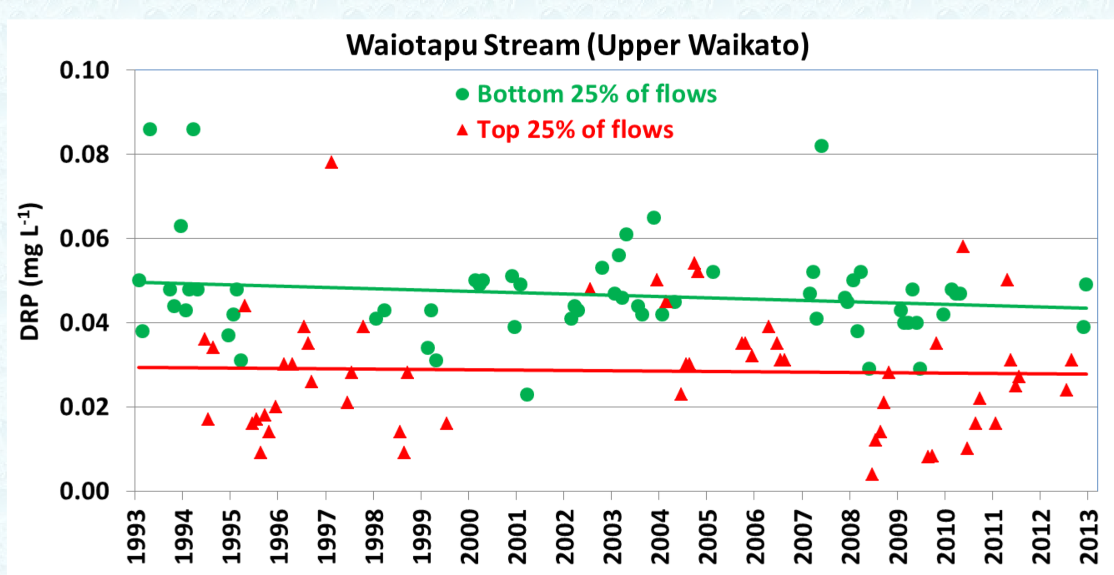
Do C-D relationships reflect shift in transfer pathways?





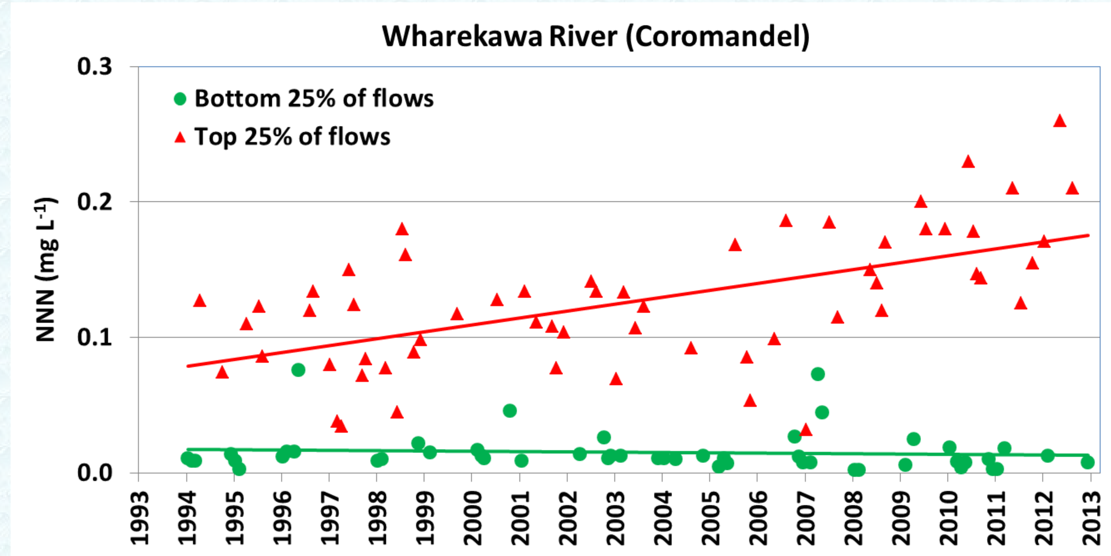
- Positive C-D relationships for N hypothesised to reflect shift towards shallower pathways with shorter residence times at high discharge

Concentration differences in flow-stratified time series

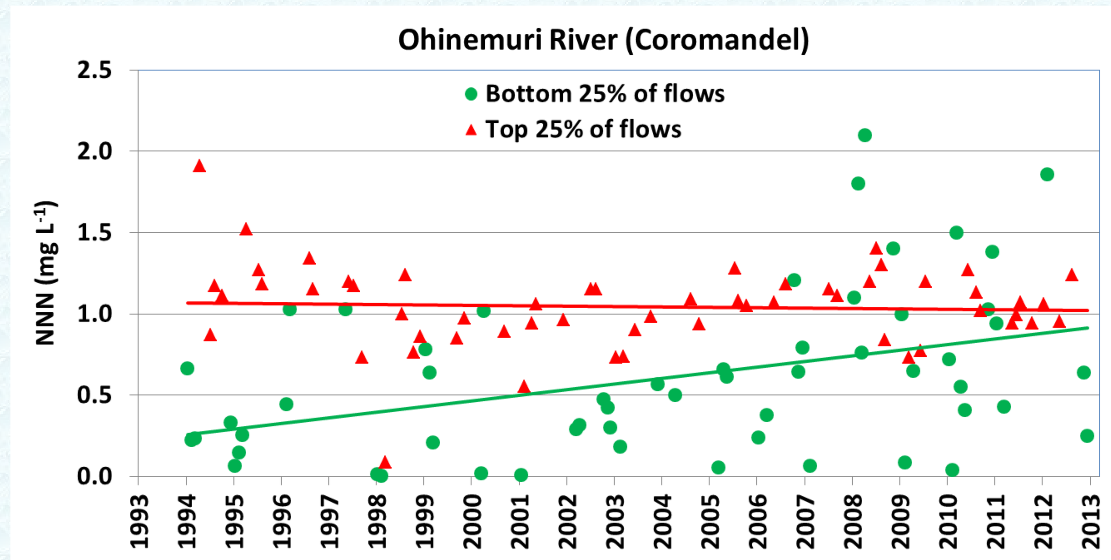


- Negative C-D relationship due to naturally enhanced DRP in Volcanic Plateau groundwater

Trends in flow-stratified time series

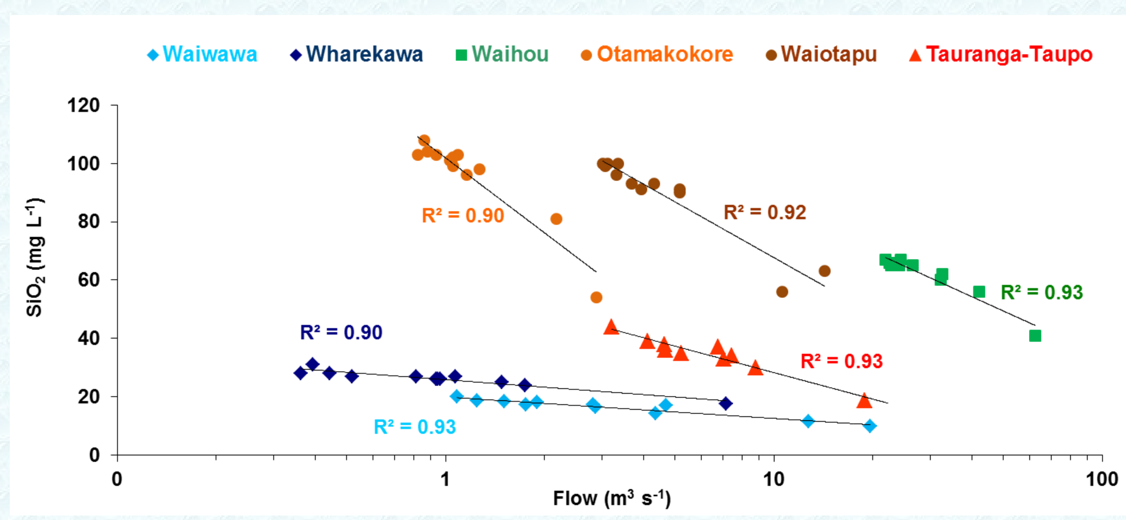


- Near-surface flows responsible for rising nitrate concentrations
- Early response to recent land use intensification

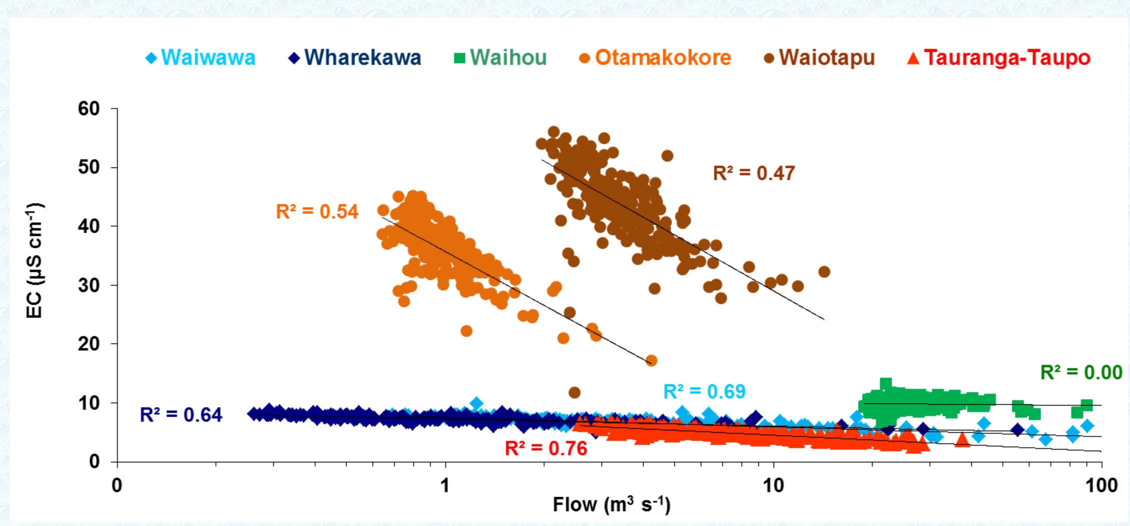


- Groundwater flows responsible for rising nitrate concentrations
- Gradual response to earlier land use intensification

Do natural tracers support the pathways hypothesis?



- Negative C-D relationships for silica corroborate the hypothesis that water residence time in the subsurface decreases with discharge



- EC data is more often available than silica, but EC C-D relationships are more strongly affected by land use, point-sources and in-stream processes

Reference

Woodward, SJR, Stenger, R, Hill, RB (2015) Flow stratification of river water quality data to elucidate nutrient transfer pathways in mesoscale catchments. *Transactions of the ASABE.*

Acknowledgements: This research was carried out under the Groundwater Assimilative Capacity Programme funded by MBIE with additional support by Waikato Regional Council.