Forest Flows Research Programme

SCION FORESTS PRODUCTS INNOVATION

Stream nitrate in planted forests

There are concerns that planted forests pollute waterways with large nutrient runoff. Water quality monitoring provides a snapshot in time, typically sampled once monthly. But how does water quality change throughout the month?

Scion's Forest Flows research programme details hourly stream nitrate levels, measured directly inside planted forests.

NICO sensor measures nitrate concentrations from streams.

Water quality monitoring

Throughout New Zealand, there is a local government monitoring network for water quality in planted forests. Only six of the 35 total locations are inside radiata pine forests[1]; water quality was mostly sampled monthly. There are different variables measured to assess water quality, including sedimentation, physicochemical properties, nutrients (phosphorous, nitrate) and microbial levels.

Forest Flows sampling

The Forest Flows programme looked at one aspect of water quality, stream nitrate concentration. This was measured at four forest catchments in New Zealand: Ashley Forest, Te Hiku, Mahurangi and Mawhera. Stream nitrate (NICO) sensors measured nitrate concentrations hourly over 18 months.

Table 1. *Stream nitrate concentrations weighted by the volume of streamflow during period of measurement.*

	Stream		
Site	Base flow nitrate*	Median flow volume (L/s)	Flow weighted nitrate*
Ashley	2.34	0.25	2.85
Te Hiku	0.63	2.16	0.73
Mahurangi	0.66	6.92	0.77
Mawhera	0.03	7.30	0.04

* Concentration (mg NO_3-N/L)

Stream nitrate concentration

During baseflow (time between rainfall events), the average stream nitrate concentration was low and relatively consistent throughout the year (Table 1). Ashley Forest was the exception, with the highest stream nitrate concentration. Overall, baseflow nitrate concentration was 0.44 mg NO_3-N/L (excluding Ashley Forest). A nitrate concentration of less than 1 mg NO_3-N/L is considered excellent.

Stream nitrate concentrations quickly rise and fall as streamflow volume changes during a rainfall event. When stream nitrate concentration was weighted for streamflow volume, the concentrations were similar to the baseflow for all sites (final column table 1). The average concentration was 0.51 mg NO_3-N/L (excluding Ashley Forest).

Unlike the other sites, Ashley Forest stream nitrate slowly dropped over several days after a rainfall event. This, in combination with the high baseflow levels of stream nitrate, indicates that this site may have additional stored nitrate from nitrogen-fixing gorse and broom.

At all Forest Flow sites (including Ashley Forest), weighted stream nitrate is lower than what was reported for other primary sector land uses.[1,2]

Summary

Stream nitrate concentrations measured in streams in planted forests are low.

The changes in stream nitrate concentrations during rainfall events show that mean stream nitrate concentration should be weighted by the volume of stream water.

Stream nitrate concentrations weighted by streamflow volume are lower than other primary sector land uses.[1]

Continuous nitrate monitoring has provided new insights that would not be possible with once-a-month water sampling.

References

[1] Whitehead, A.L., Fraser, C., Snelder, T.H., Walter, K., Woodward, S., & Zammit, C. (2021). Water quality state and trends in New Zealand rivers: analyses of national data ending in 2020. NIWA Client Report 2021296CH prepared for Ministry for the Environment. NIWA, Christchurch.

[2] Ministry for the Environment & Stats NZ (2022). New Zealand's Environmental Reporting Series: Environment Aotearoa 2022. Retrieved from http://environment.govt.nz/ on 23/04/2024.

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Scion's purpose is to create economic value across the entire forestry value chain, and contribute to beneficial environmental and social outcomes for New Zealand.

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