



# Use of pesticides and fertilisers in New Zealand's planted forests – implications for water quality

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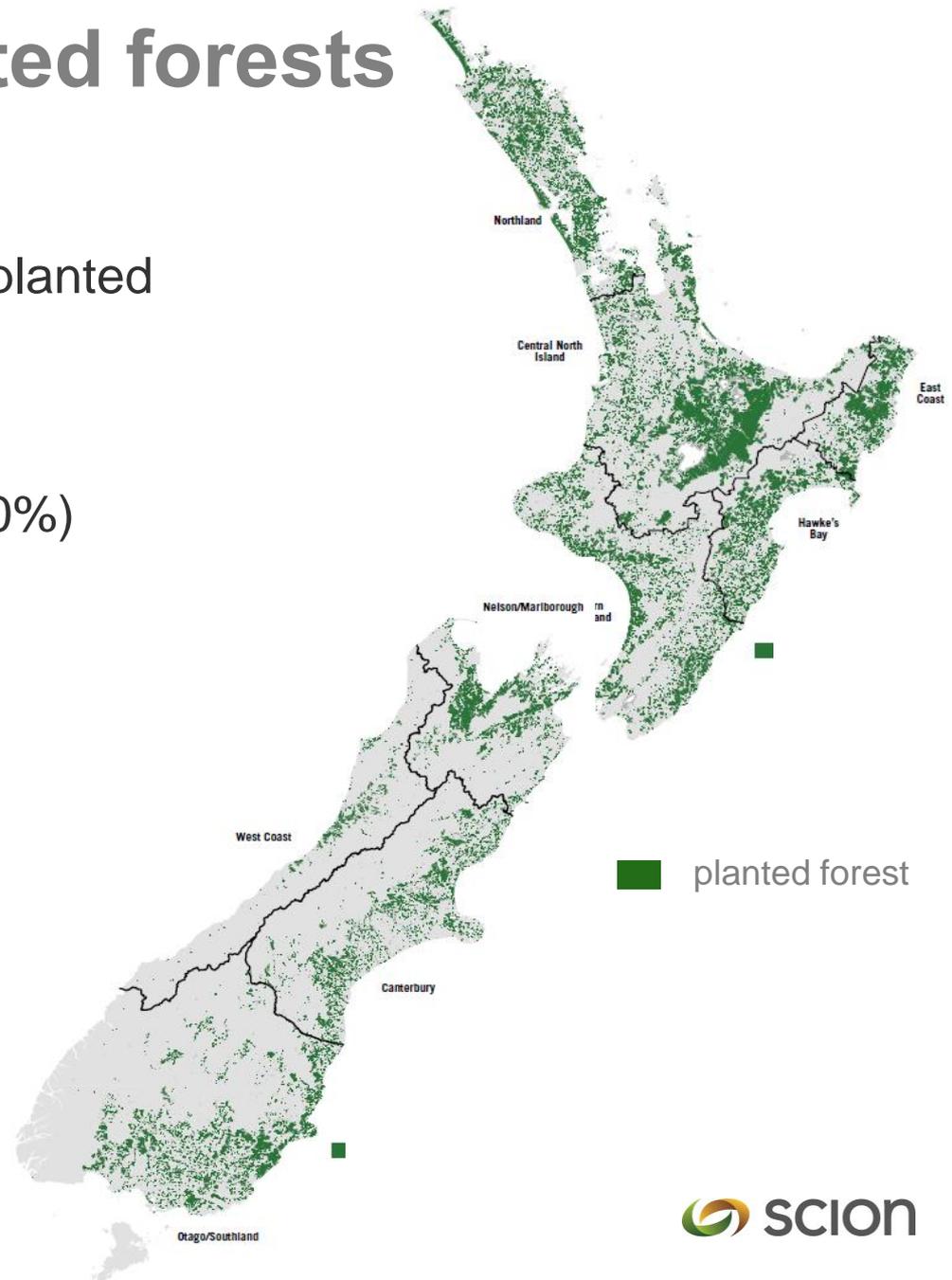
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# New Zealand's planted forests

- Currently 7% (1.7 million ha) planted forest cover
- Main species *Pinus radiata* (90%)
- Around 70% FSC certified





# Issues - chemical & fertiliser use in NZ planted forests

- Use of chemicals, cost effective & critical for viability of tree crop
- Increasing national & international pressure to reduce or eliminate use
  - FSC
  - NPS-freshwater management
  - Nutrient limit setting – water and land
- Forest industry wanting to increase productivity
- Needs to be within sustainable limits –  
impact on ‘social licence to operate’



## Objectives

- Research to date on impact of chemical use on water quality
- Outline research in progress on fertiliser use & water quality
- Research gaps

# Terbuthylazine & Hexazinone

- Aim: to evaluate the environmental fate of terbuthylazine and hexazinone under operational conditions
- Two field studies
  - Kaingaroa Forest – Pumice Soils, treated 2 consecutive years, 1<sup>st</sup> year data presented
  - Omaio Forest – steep land, Recent Soils, 1 year (data not presented)

## Kaingaroa Forest

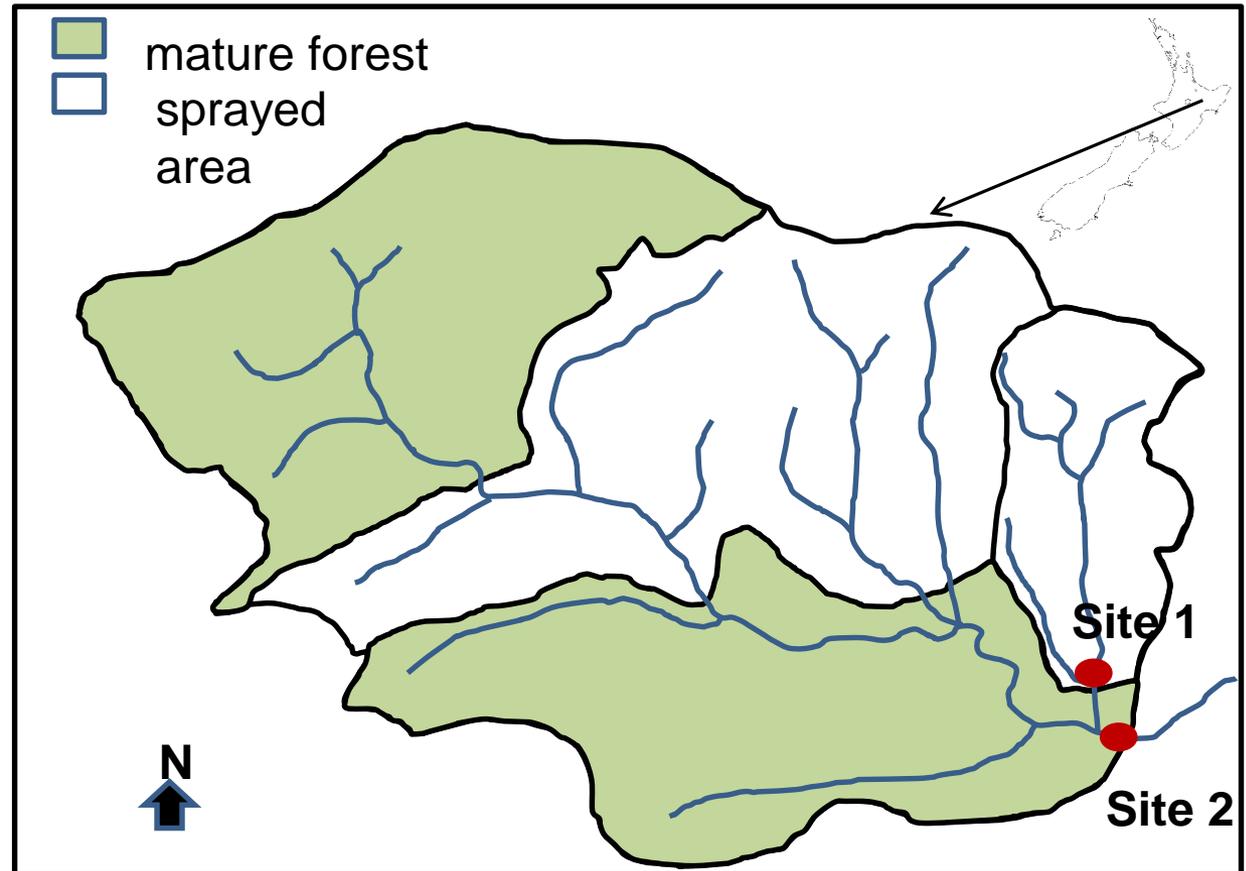
- aerially sprayed 1<sup>st</sup> November 2012, Release KT; 17 L ha<sup>-1</sup>; Terbuthylazine (43.5% w/v) and Hexazinone (6.5% w/v) & tracer
- 10m no-spray buffer along stream



# Kaingaroa Forest monitoring

- Site 1, 12.5ha (100% sprayed)
  - tracer plates along stream channel
  - pre-spray, spray day & post-spray monitoring water (herbicides & WQ), sediment and algae (herbicides) & flow

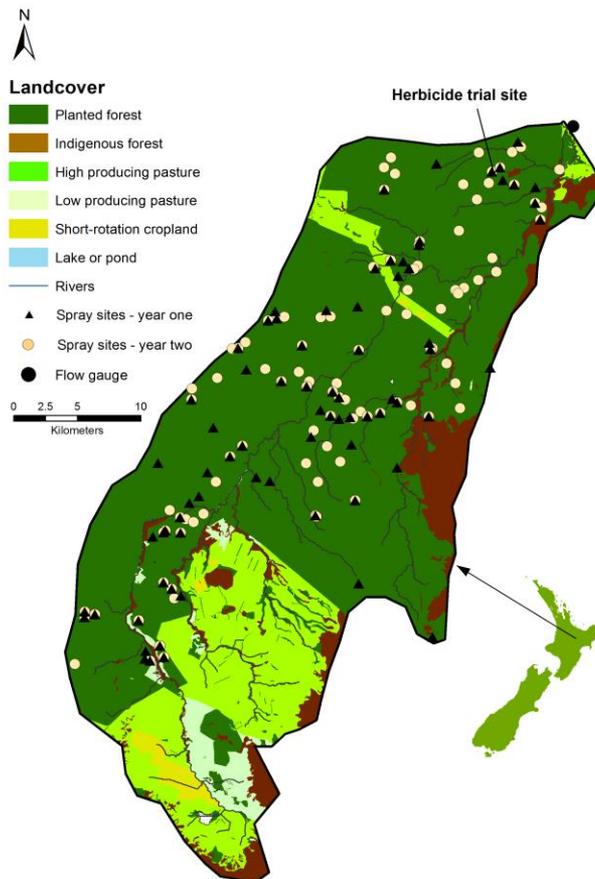
- Site 2, 51.8 ha (45% sprayed)
  - Spray day & post-spray monitoring water (herbicides & WQ) & flow





# Cumulative effects of herbicide use

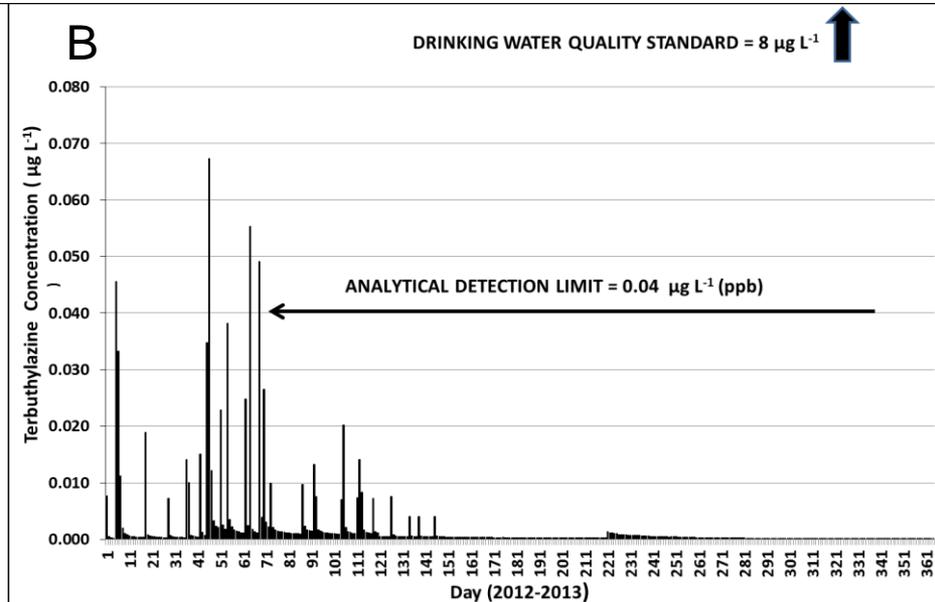
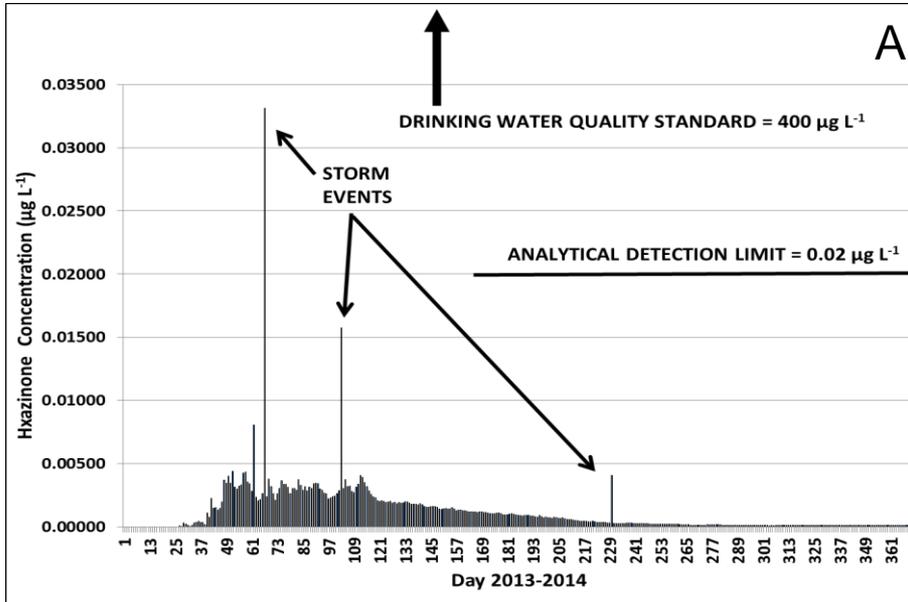
- Landscape scale (capture spatial & temporal variation in herbicide treatment programmes)
- Objective: model cumulative effects of hexazinone & terbuthylazine aerial applications on water quality over two successive seasons (2013–2014).



- Upper Rangitaiki Basin (118,345 ha)
- 71% in planted forest
- Flow gauge median flow of  $13.411 \text{ m}^3 \text{ s}^{-1}$  (c.f. long-term average  $21.446 \text{ m}^3 \text{ s}^{-1}$ )
- Prototype excel model routed herbicide residues from their point of entry into the river to the flow gauge on the Rangitaiki River

# Cumulative effects of herbicide use - results

- Some localized space & time crowding
- Modelling of chemical residue loadings and concentrations of terbuthylazine & hexazinone indicate herbicide residues in the river mainly below analytical detection limits
- Safety factors for drinking water quality standards, aquatic organisms, and human Acceptable Daily Intake levels were very large



Modelled daily average concentrations of (A) hexazinone (Yr 2) & (B) terbuthylazine (Yr 1)

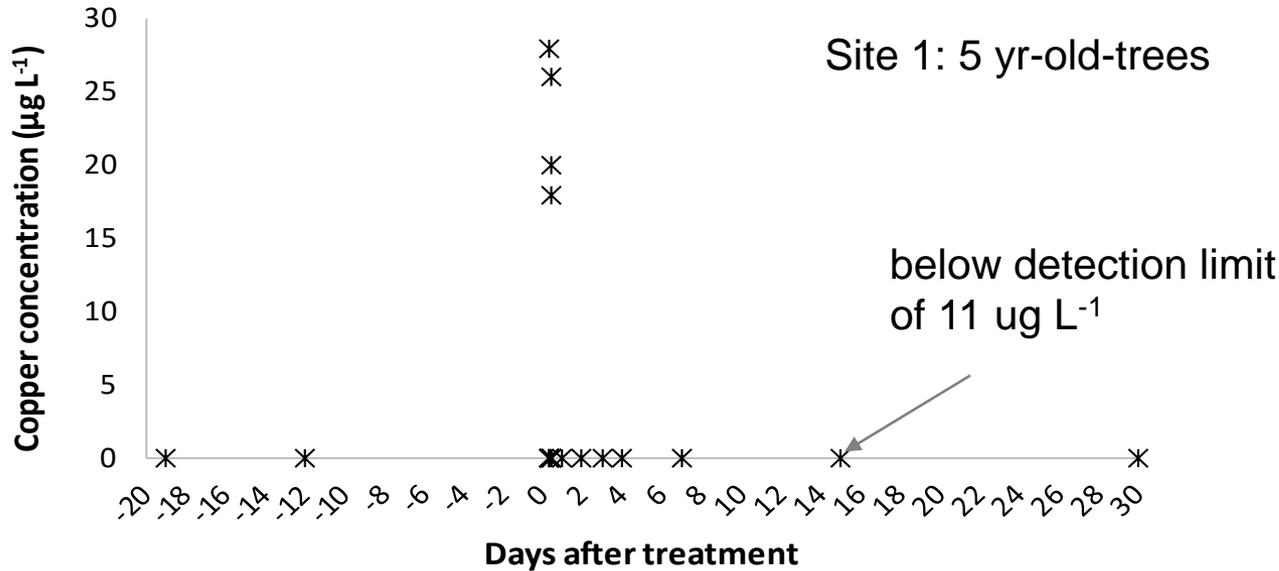
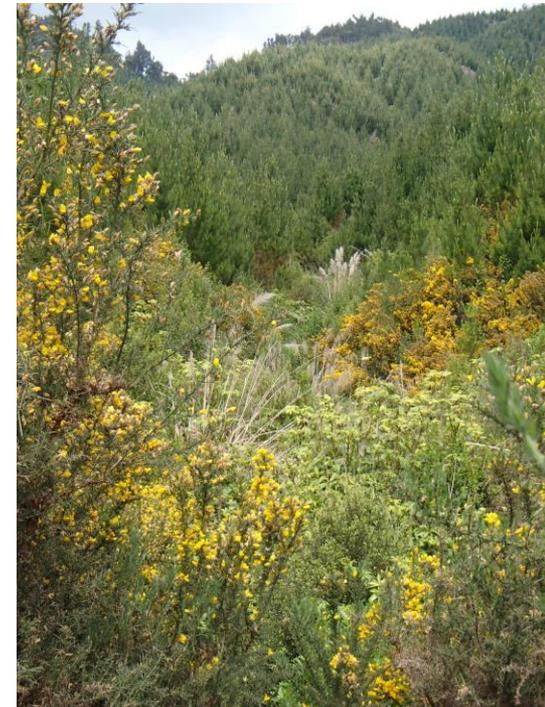
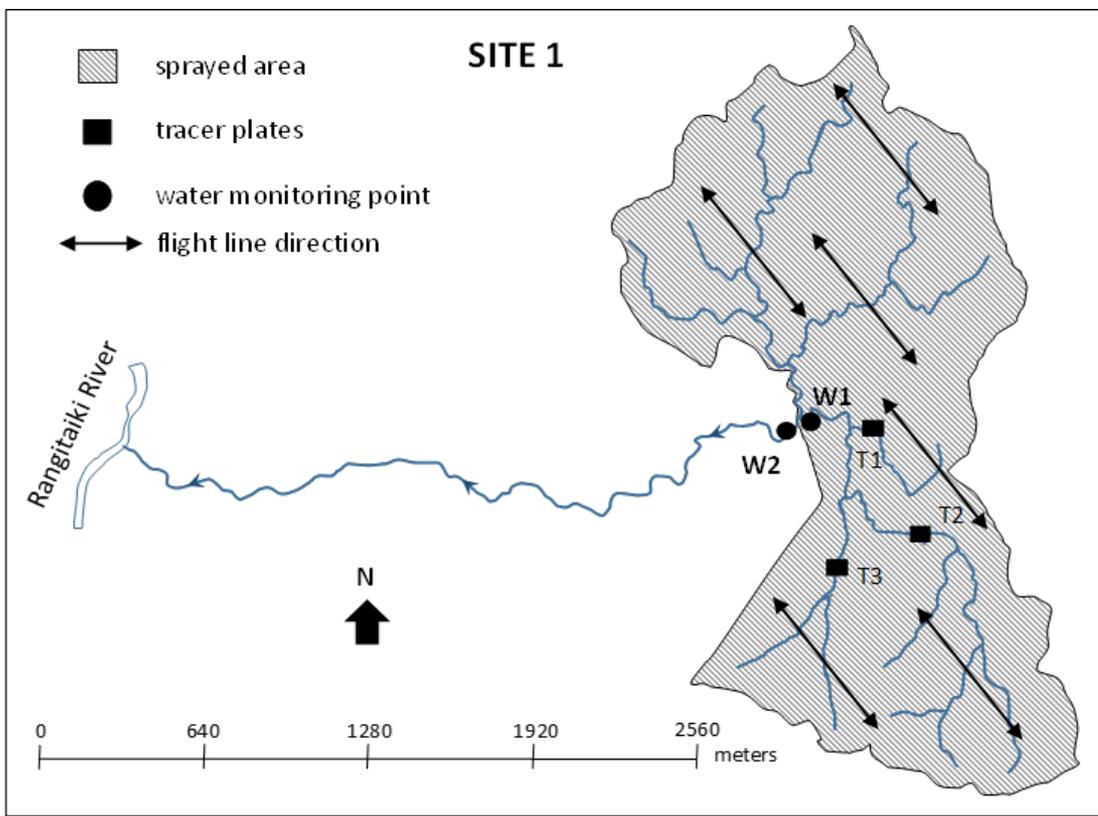
# Copper in waterways

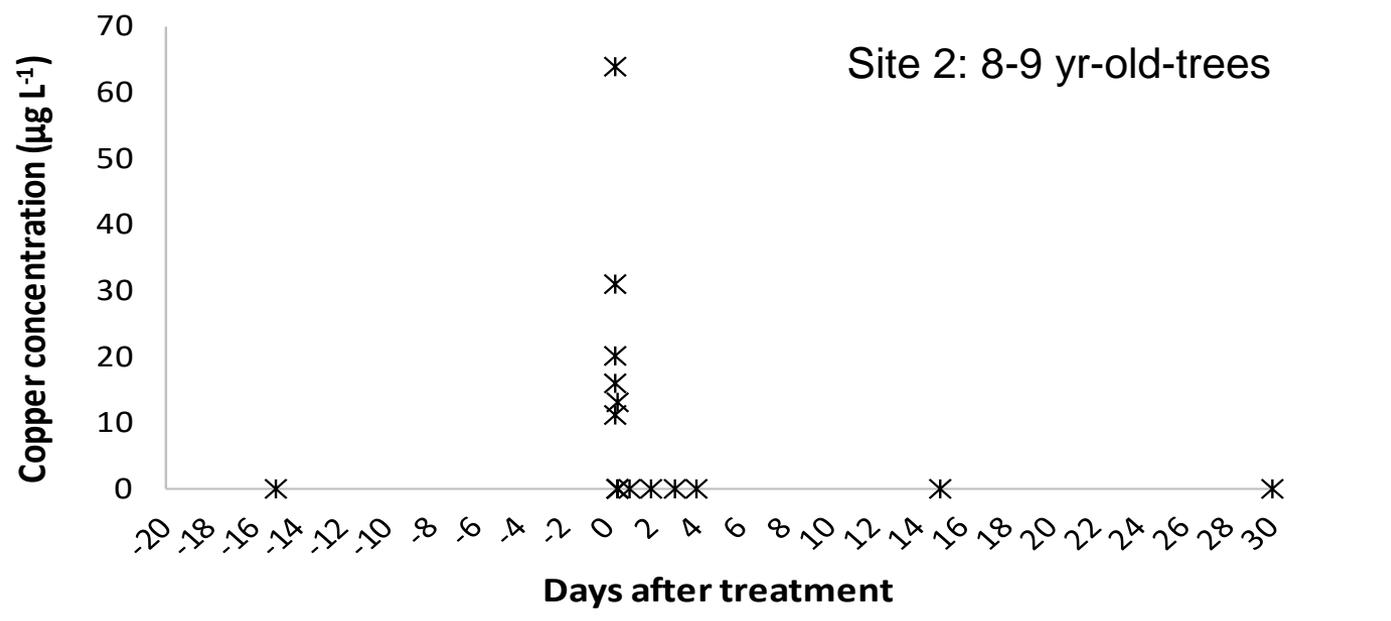
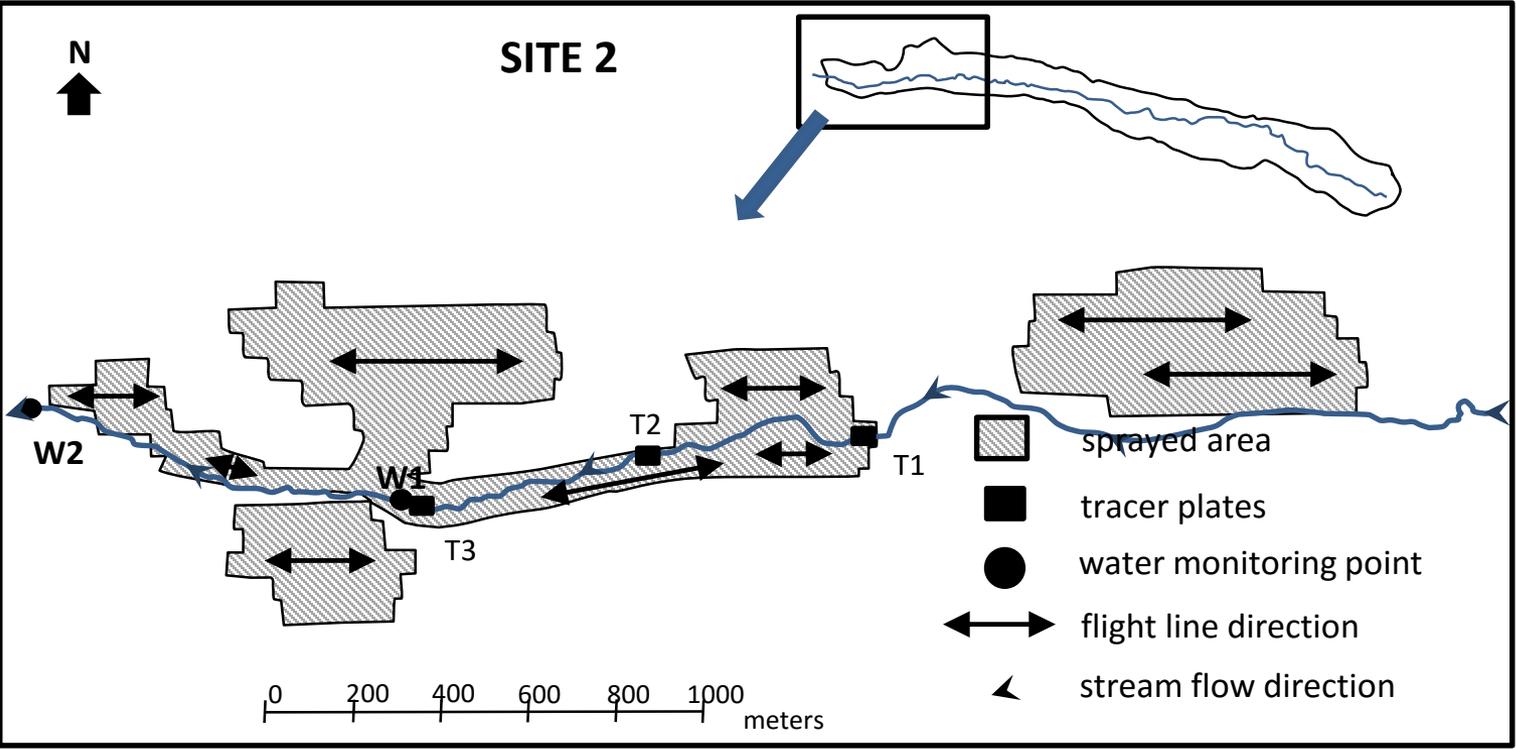
- Three sites in the central North Island
- Pumice soils
- Tree ages 4-15 years
  
- Aerial application mid-November
- 1.14 kg cuprous oxide (Sites 1 & 3), 1.125 kg cuprous oxide (Site 2) + 2 L mineral oil + water + 5 L solution
- Spray drift method

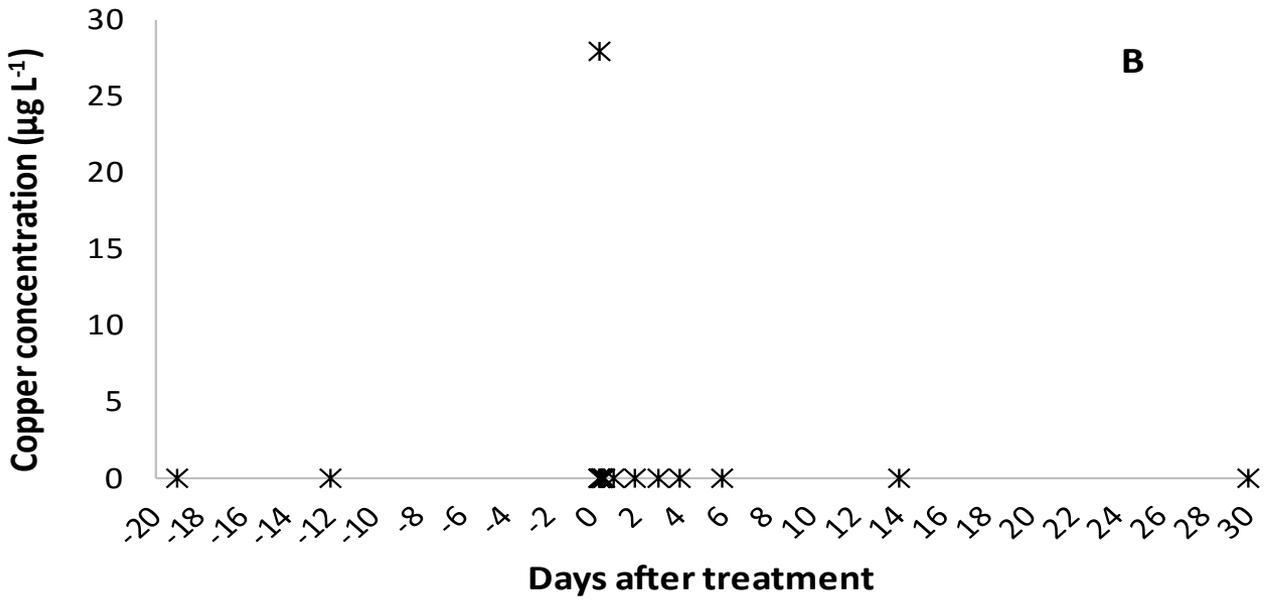
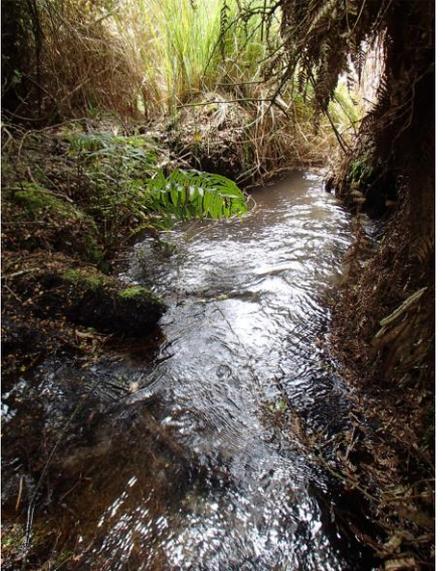
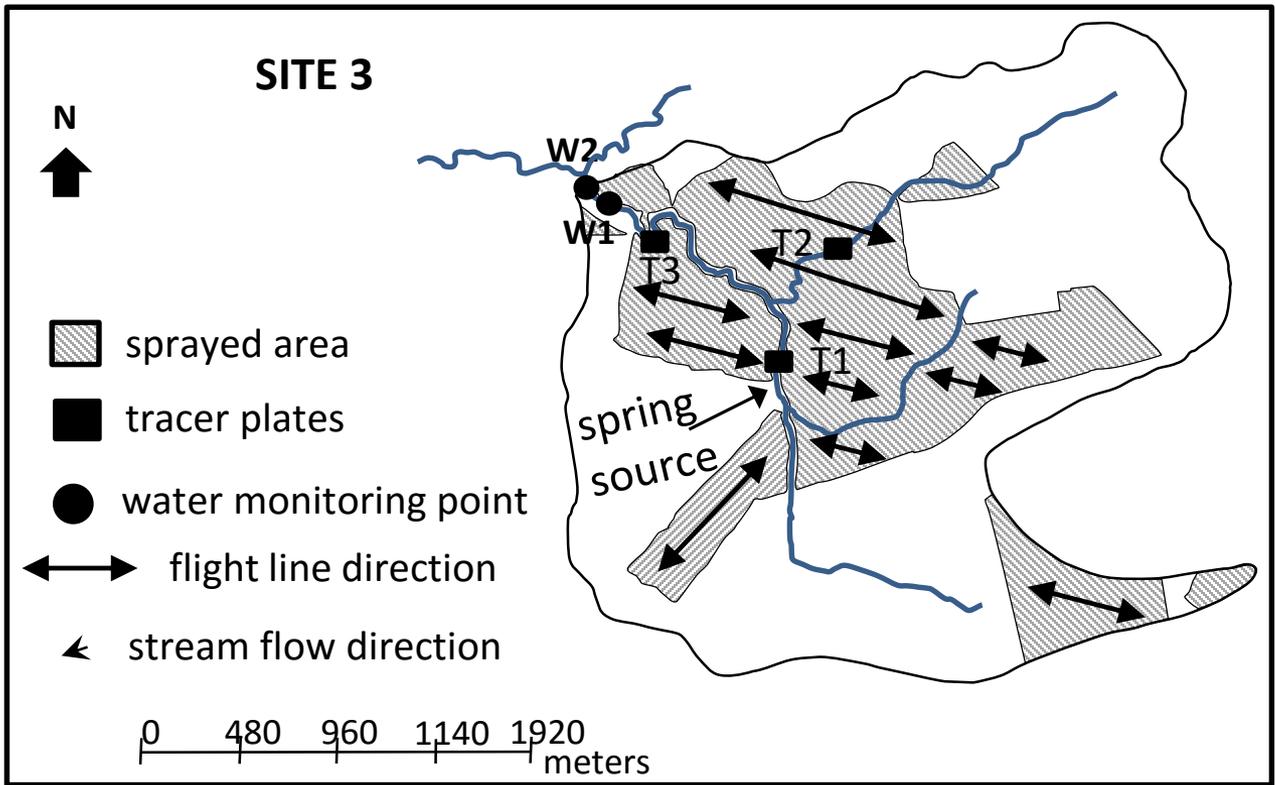


Photo courtesy of Timberlands Limited

# water quality





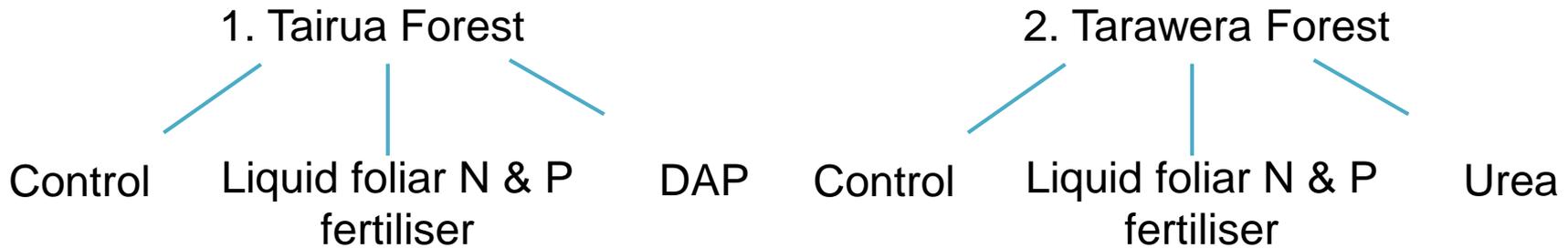


# Results

- Wide range of site conditions – copper detected for a few hours on the day of application, not detected in 1<sup>st</sup> rainfall event
- NZ drinking water standards (2,000 ug L<sup>-1</sup>) *not exceeded*
- FSC standard (LC<sub>50</sub> 18.9 ug L<sup>-1</sup> for 48 hours) – *concentrations exceeded but below time threshold*
- ANZECC guidelines - freshwater trigger value to protect 95% of species is 1.4 µg/L. This applies to waters of hardness of 30 mg/L as CaCO<sub>3</sub>, test duration (7-42 days) *concentrations exceeded but below time threshold (based on regression)*
- ANZECC interim sediment quality guideline trigger values (low- 65 mg kg<sup>-1</sup>; high-270 mg kg<sup>-1</sup>) *not exceeded*

# Fertiliser use

- Some studies but dated
- Current research – Growing Confidence in Forestry’s Future (GCFF) programme (increased productivity within sustainable limits)
- Research underway for mid-rotation water quality fertiliser trial



Site 3: Yet to be confirmed



# Key Results & conclusions

- Using latest technologies, GIS, GPS, boom & nozzle configurations, & following good management practices, label instructions, minimise risk to aquatic environment
- Highest risk on the day of application and rainfall events shortly thereafter
- Risk to human health low
- Risk to aquatic environment generally low, however impact where the threshold is exceeded but not the time frame is unknown



# Knowledge Gaps

## Chemical Use in NZ planted forests

- Glyphosate key chemical used but no NZ field data - but a literature review on its use in production forests
- Need to assess impacts on NZ aquatic organisms at concentrations and durations typically occur in planted forest streams under operational scenarios
- North Island sites – replication into other site conditions
- Further development of the cumulative effects model

## Fertiliser use

- Need to assess latest fertiliser treatments (operational & experimental) in the early part of the forest rotation on water quality

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