Using biosolids to supercharge plant growth

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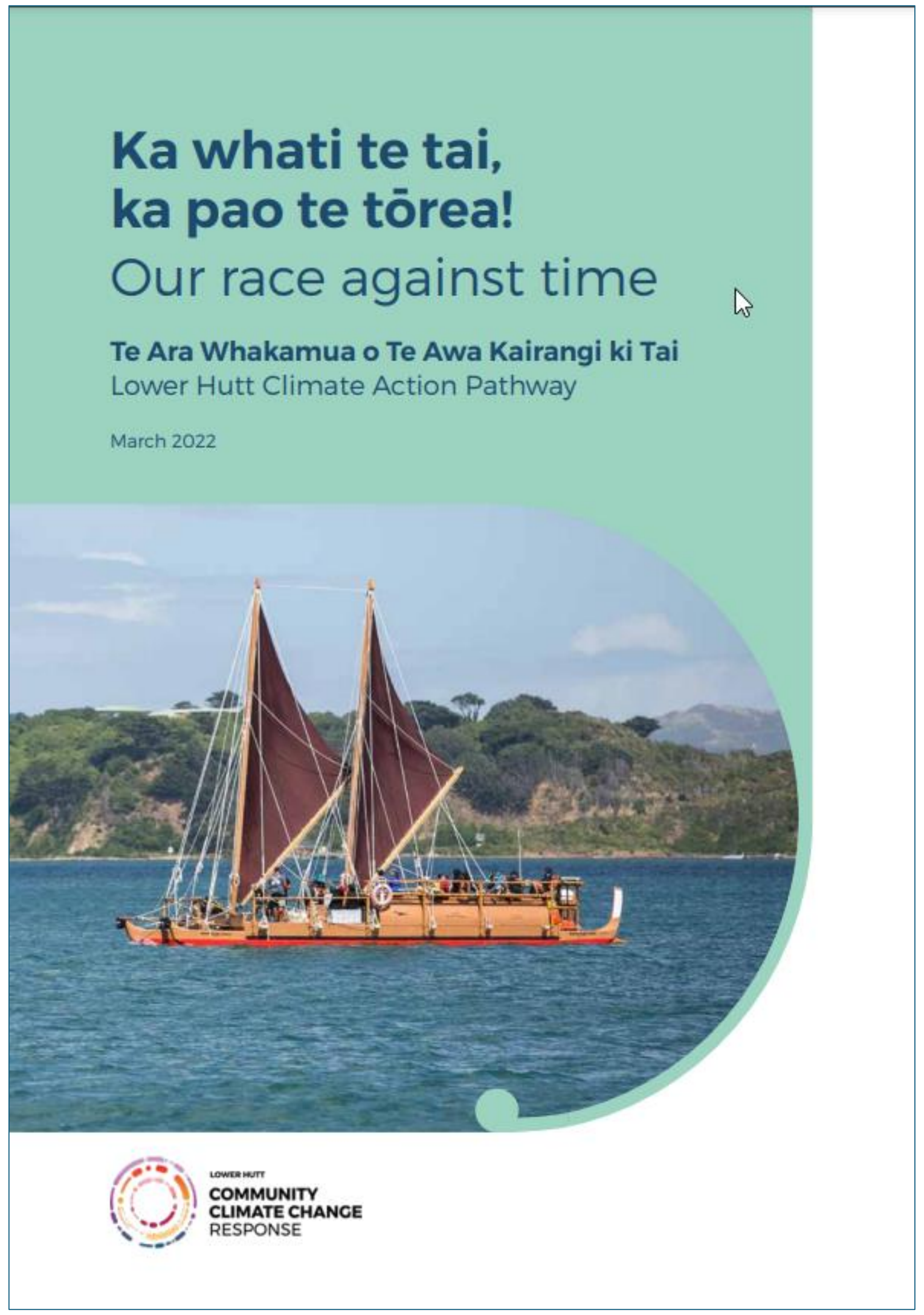
Mā te mahi tahi
Driving impact through **collaboration**

wasteMINZ ALGA

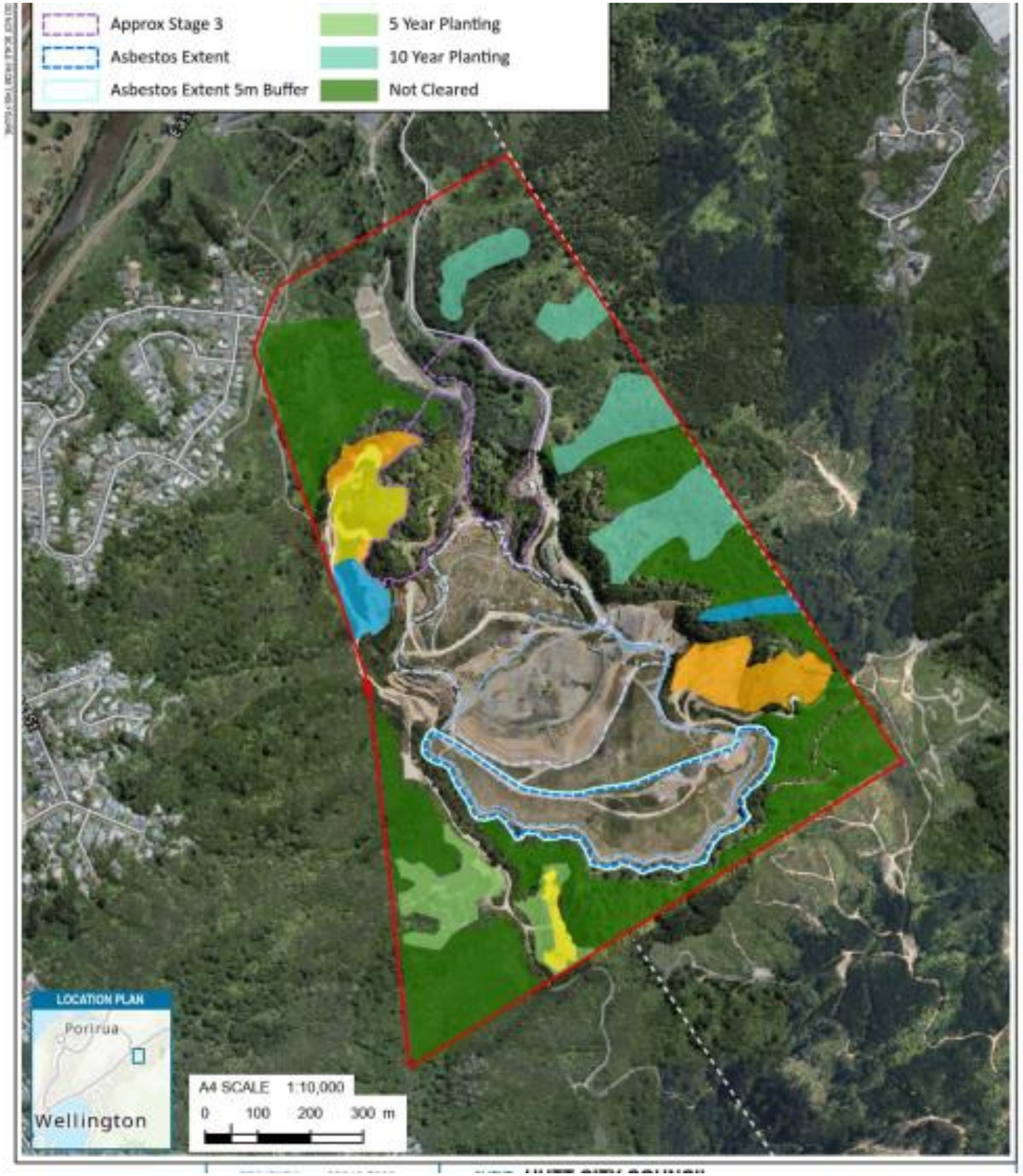
Strategic context



- Hutt City Council has both GHG emission and waste reduction targets
- Landfills are a significant GHG emission source, with biosolids a significant contributor. Silverstream receives about 5,000t per year.
- Council also has land that could sequester carbon if put into forest
- **Challenge:** Can we use biosolids for a more beneficial alternative use such as site remediation or re-establishment of native forest?

Silverstream landfill

- Earlier work looked at potential revegetation sites at Silverstream Landfill
- Soil extracted in borrow areas for landfill construction (also requires deforestation = lost carbon)
- There are a number of now depleted ex-borrow sites (inc. future borrows) as potential revegetation sites
- Looked at different revegetation strategies to maximise CO_2e sequestration



Revegetation site characteristics

- Poor or no soil due to clay mining
- Not suitable for revegetation due to lack of topsoil horizon
- Identified a reuse potential for ‘unsuitable’ soils to be salvaged from successive landfill developments
- The ‘unsuitable’ soil would be transported to the site and enhanced for vegetation establishment

Table 4.1: **Carbon stock per hectare for exotic species at 30 and 50 years (post 1989 forest, Look Up Table, MPI, 2017)**

Species	Stock (t CO_2e/ha) at 30 years	Stock (t CO_2e/ha) at 50 years	MAI* (t CO_2e /ha/yr) 30 yr	MAI* (t CO_2e /ha/yr) 50 yr
Radiata pine (Southern North Island)	852	1345	28.4	26.9
Douglas fir (NZ)	518	957	17.3	19.1
E. fastigata	663	661	22.1	13.2
Exotic softwoods[15] (NZ)	400	957	13.3	19.1
Exotic hardwoods (NZ)	685	No data	22.8	No data

Note: * = mean annual increment in CO_2 sequestration averaged over the current life of the stand.

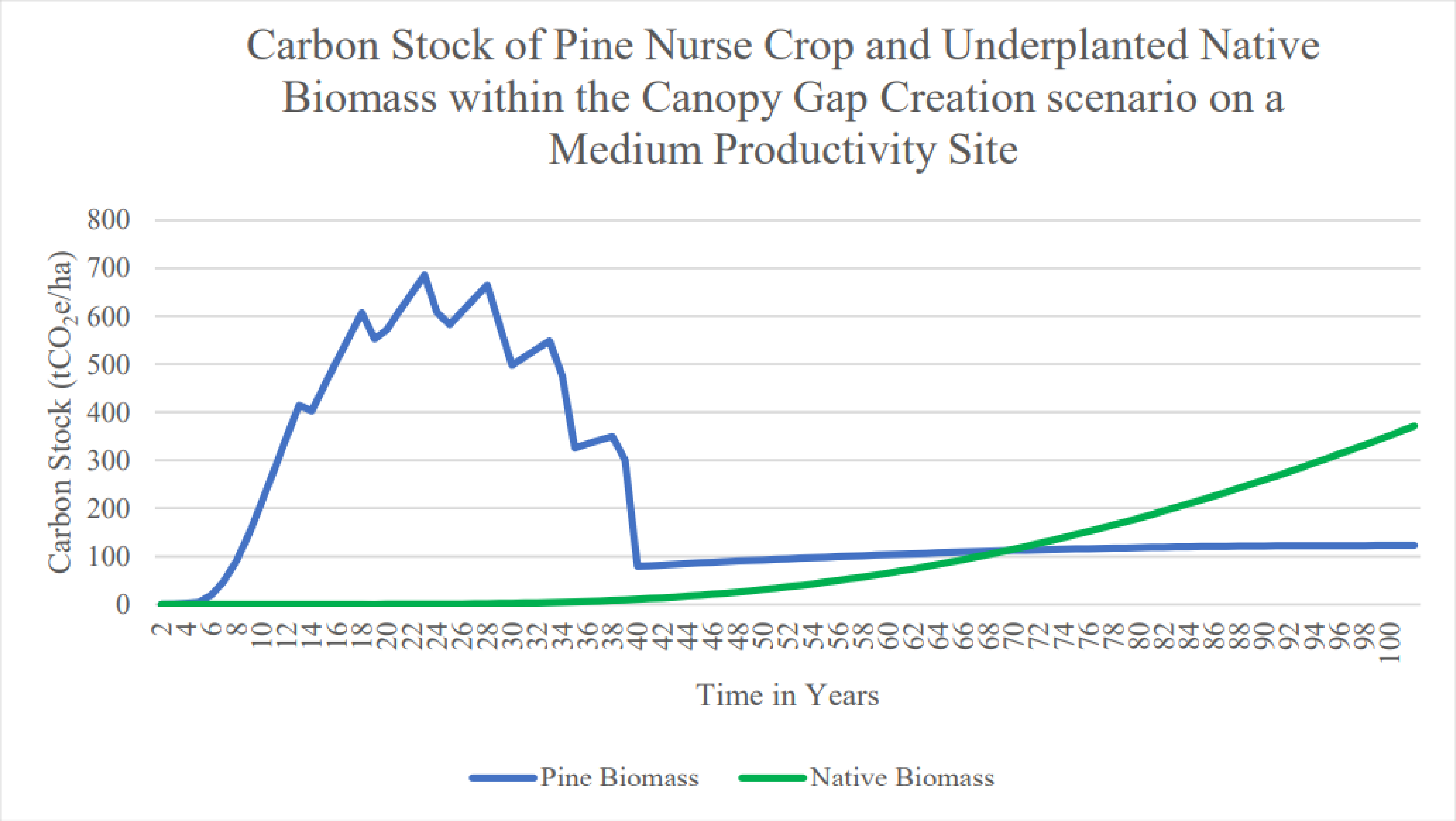
Table 4.3: **Carbon stock per hectare for native species (data derived from post 1989 forest, Look Up Table, MPI, 2017 and Kimberley et al., 2021)**

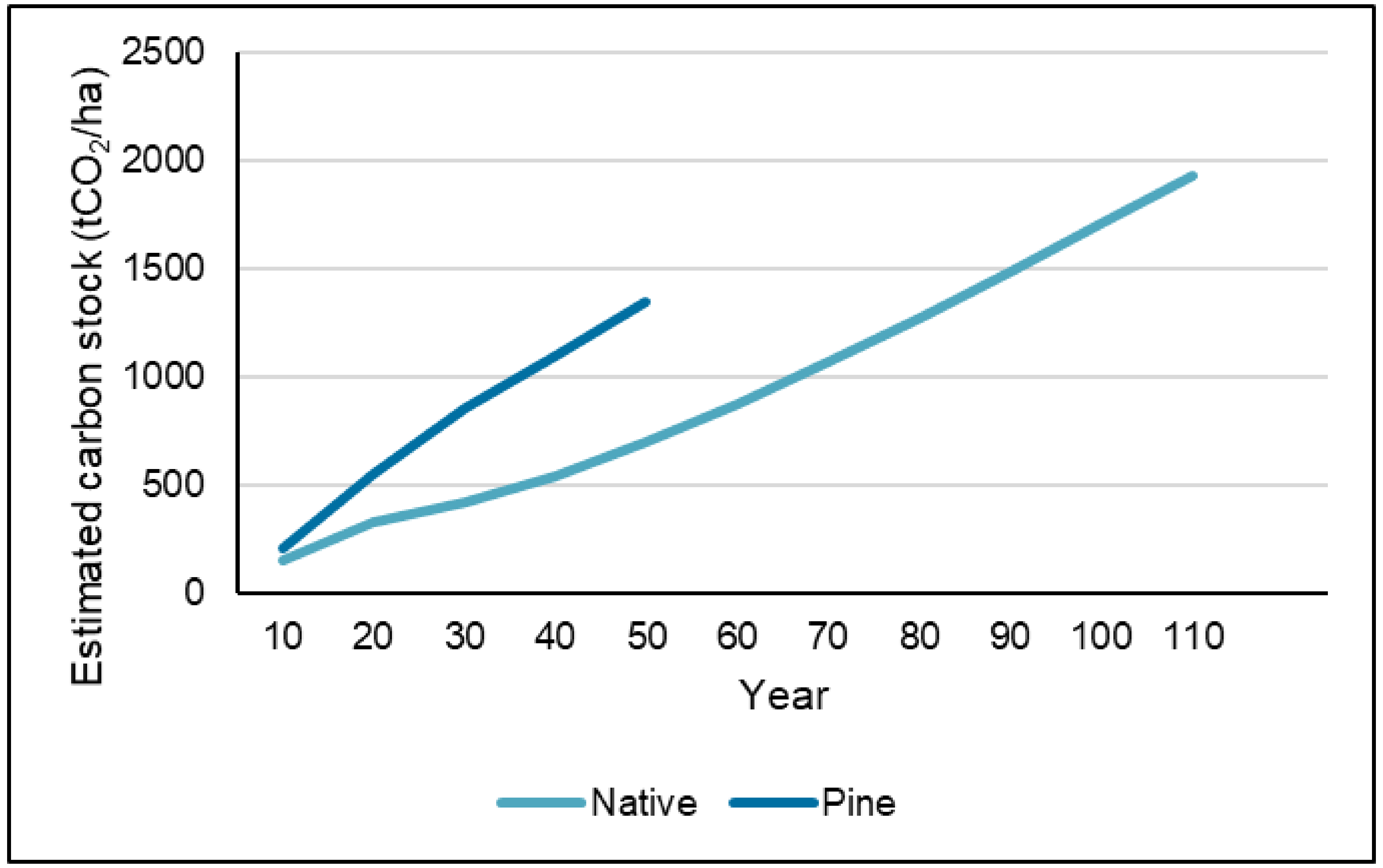
Species/ecosystem	Stock (t CO_2e/ha) at 30 years	Stock (t CO_2e/ha) at 50 years	MAI* (tCO_2e /ha/yr) 30 yr	MAI* (tCO_2e /ha/yr) 50 yr
Rimu	20	40	0.7	0.8
Tōtara^	183	500	6.1	10
Kahikatea^	213	635	7.1	12.7
Rewarewa	40	45	1.3	0.9
Other broadleaf species^	240	700	8	14
Hard beech	180	400	6	8
Black beech	50	180	1.7	3.6
Planted native shrubs^	356 (20 years)	N/A	17.8 (20-year MAI)	N/A

Note: *=mean annual increment in CO_2 sequestration averaged over the current life of the stand. ^= data from Kimberly et al., (2021).

Carbon stocking

- **Pine:** 1375 t CO2e/ha age 50 – then declines
- **Native:** 650 t CO2e/ha age 50 – continues to increase with age
- ~1400 t CO2e/ha age 80 (Species continue to increase CO2e/ha with age as long-lived forests >300 years.
- Native MAI speeds up
- Exotic MAI slows/reduces





Carbon stocking

- Pine: **1375 t** CO2e/ha age 50 – then declines
- Native: **650 t** CO2e/ha age 50 – continues to increase with age
- Exotic hardwoods ‘other’ – generally similar to pine

Scragg, M. T. (2020). *Under what circumstances will permanent carbon forestry with the added benefit of native restoration become more favorable than rotational carbon forestry.*

Tonkin & Taylor (2023). *Figure 3.6: Modelling pine forest vs native forest sourced from* Kimberley et al., (2021) (native vegetation data) and Scragg (2020) (pine data)

Using biosolids to supercharge growth

- HCC identified previous work on biosolid reuse
- Potential for biosolids to increase plant growth in revegetation sites
- Potential to increase CO2e
- Some risks needed to be managed

Biosolids Planting Trial

Risks associated with adding nitrogen and metals to a soil:

- Nitrogen drawdown (anaerobic process pulls N away from plants)

- Metal contaminants

Purpose of the trial:

to test the effect of the addition of nitrogen on plant health, survival and growth

Secondary purpose: to support resource consenting

Trial Design

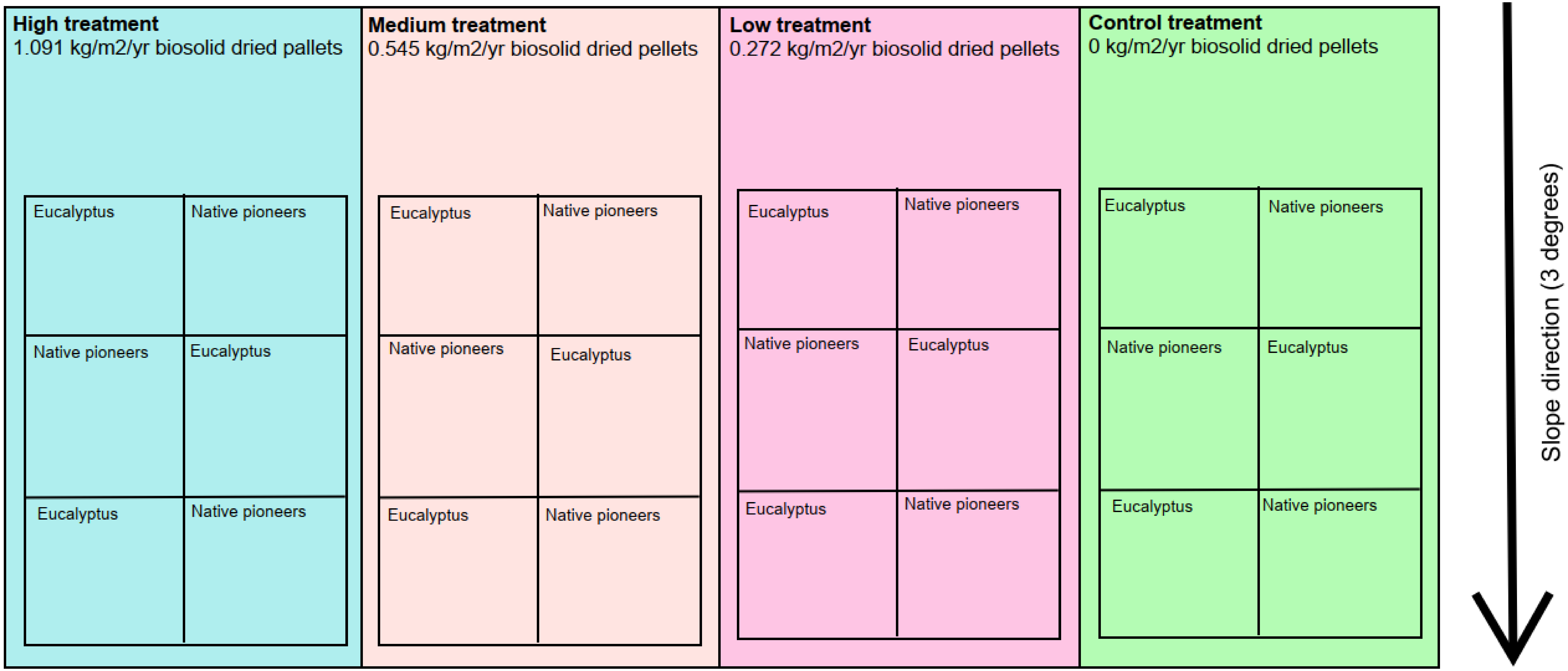


Figure 2.1: Trial plot design with treatments coloured and vegetation types randomised across plots

Biosolid treatments

- High treatment: 1.091 kg/m2/yr (Nitrogen - not weight of biosolids)
- Moderate treatment: 0.545 kg/m2/yr
- Low treatment: 0.272 kg/m2/yr
- Control treatment: 0.000 kg/m2/yr

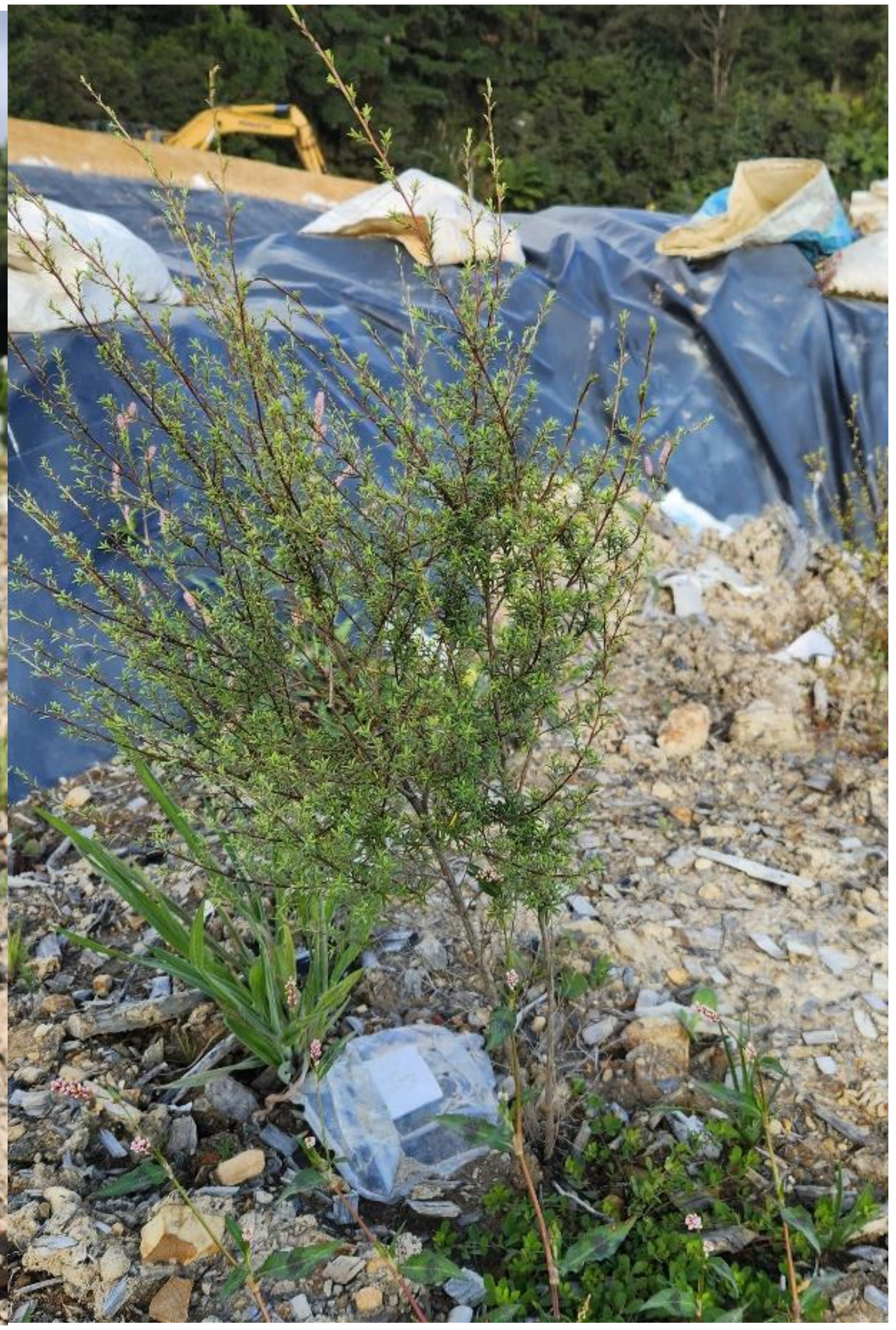
54 m2 area for each trial

e.g. 58.914 kg of Nitrogen applied to High treatment

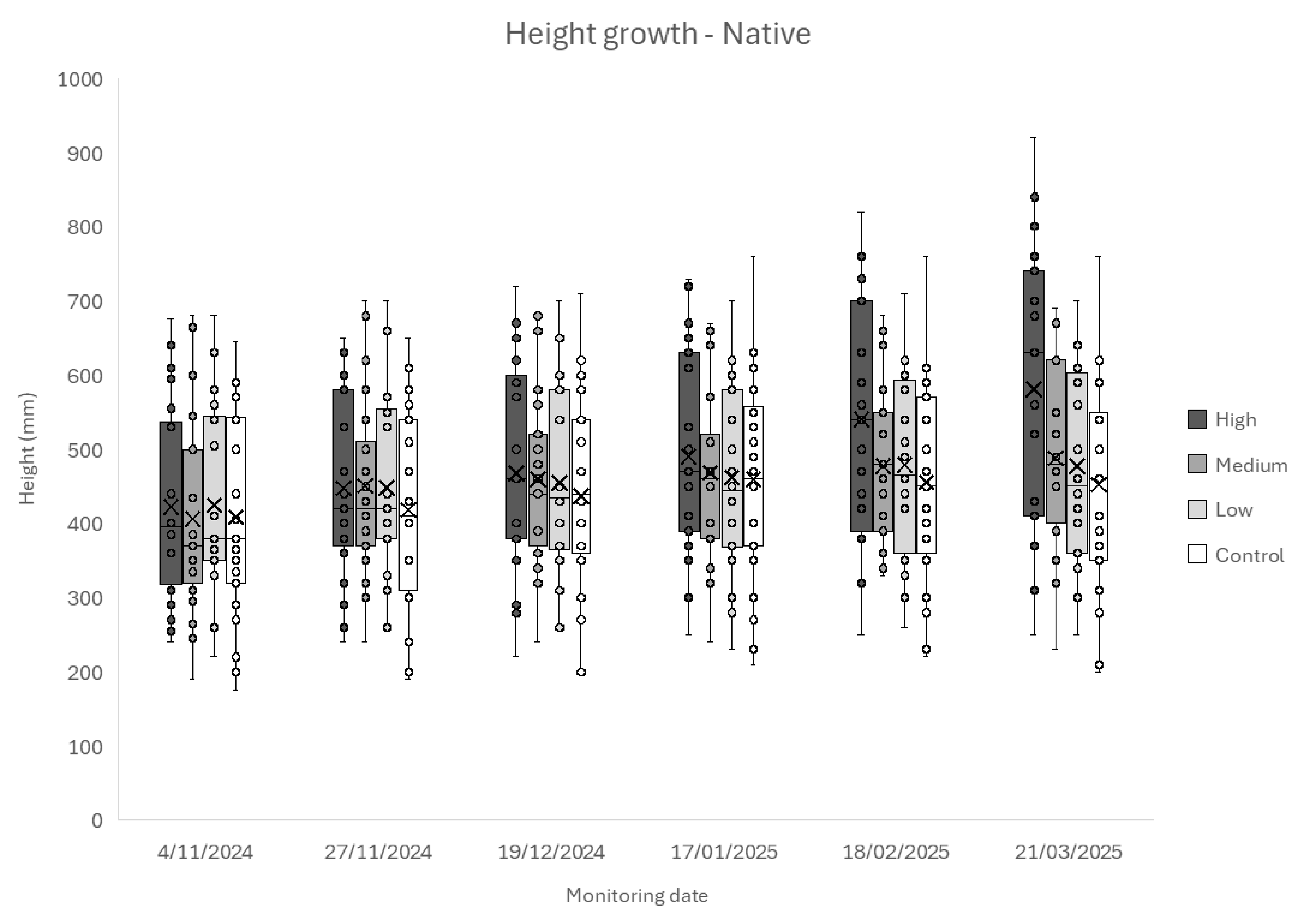
Biosolid Trial Results

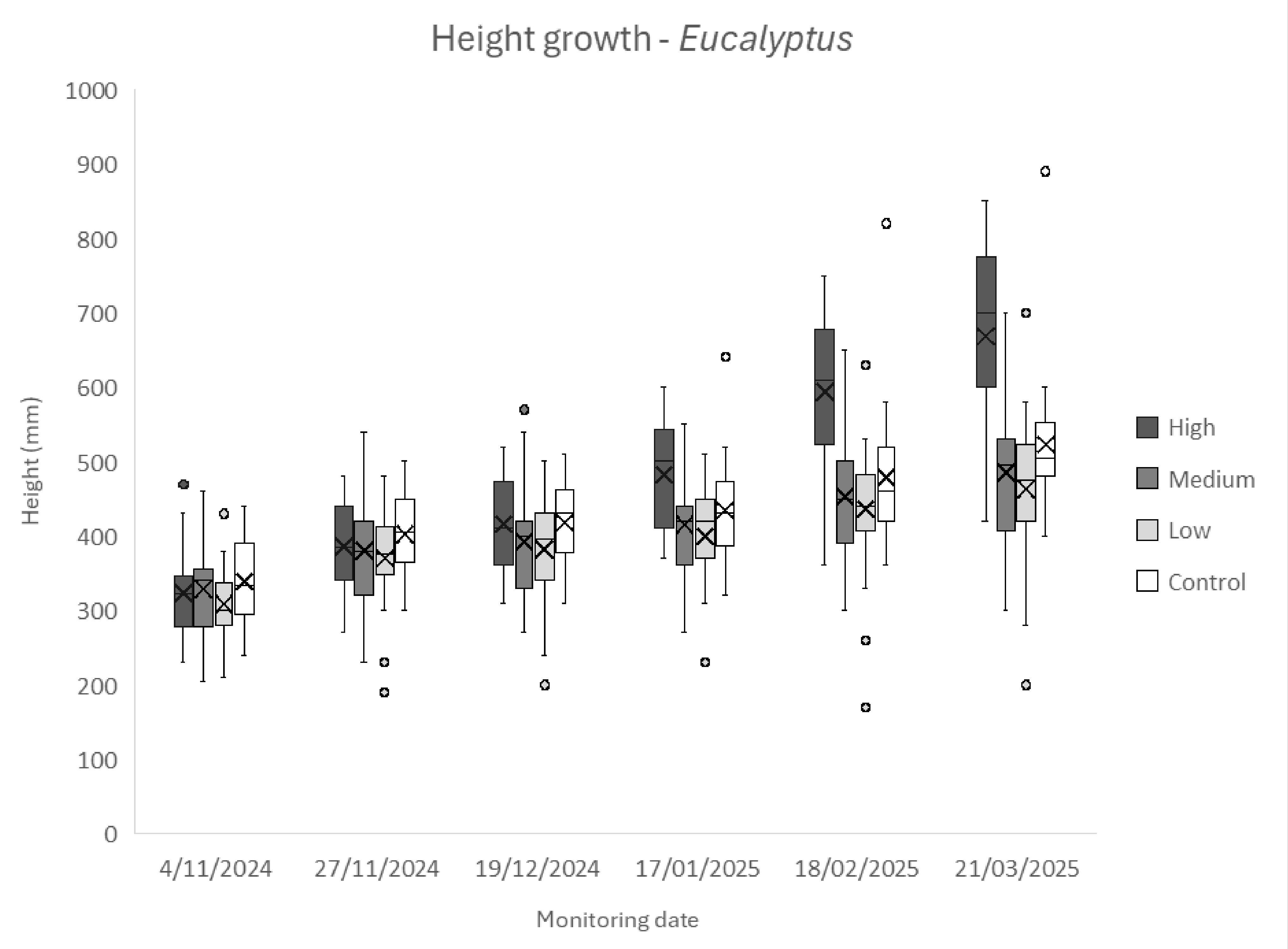
- High treatment – performed the best
- No difference between Medium, Low, and Control treatments
- Results here show Eucalyptus

Native plant growth

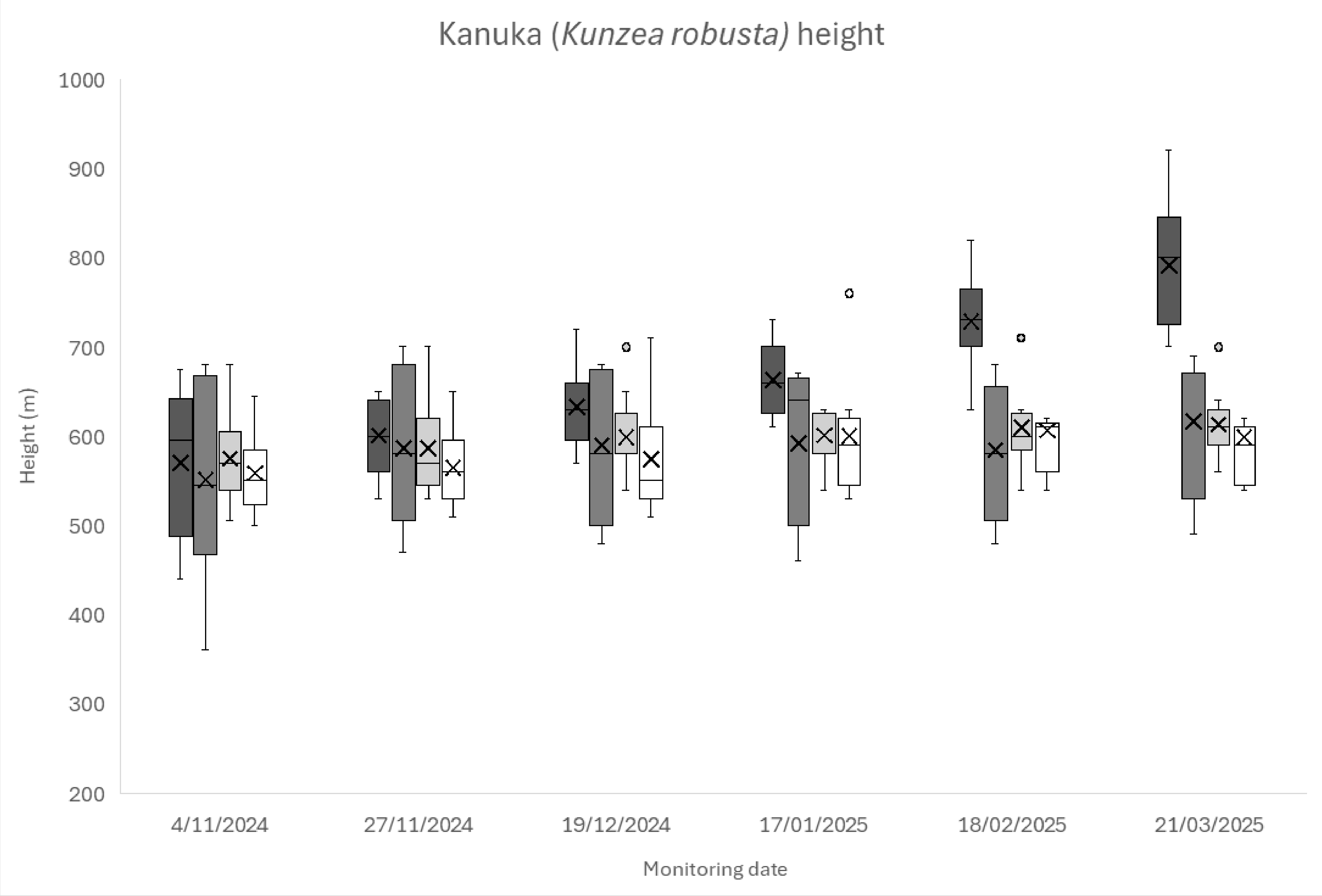


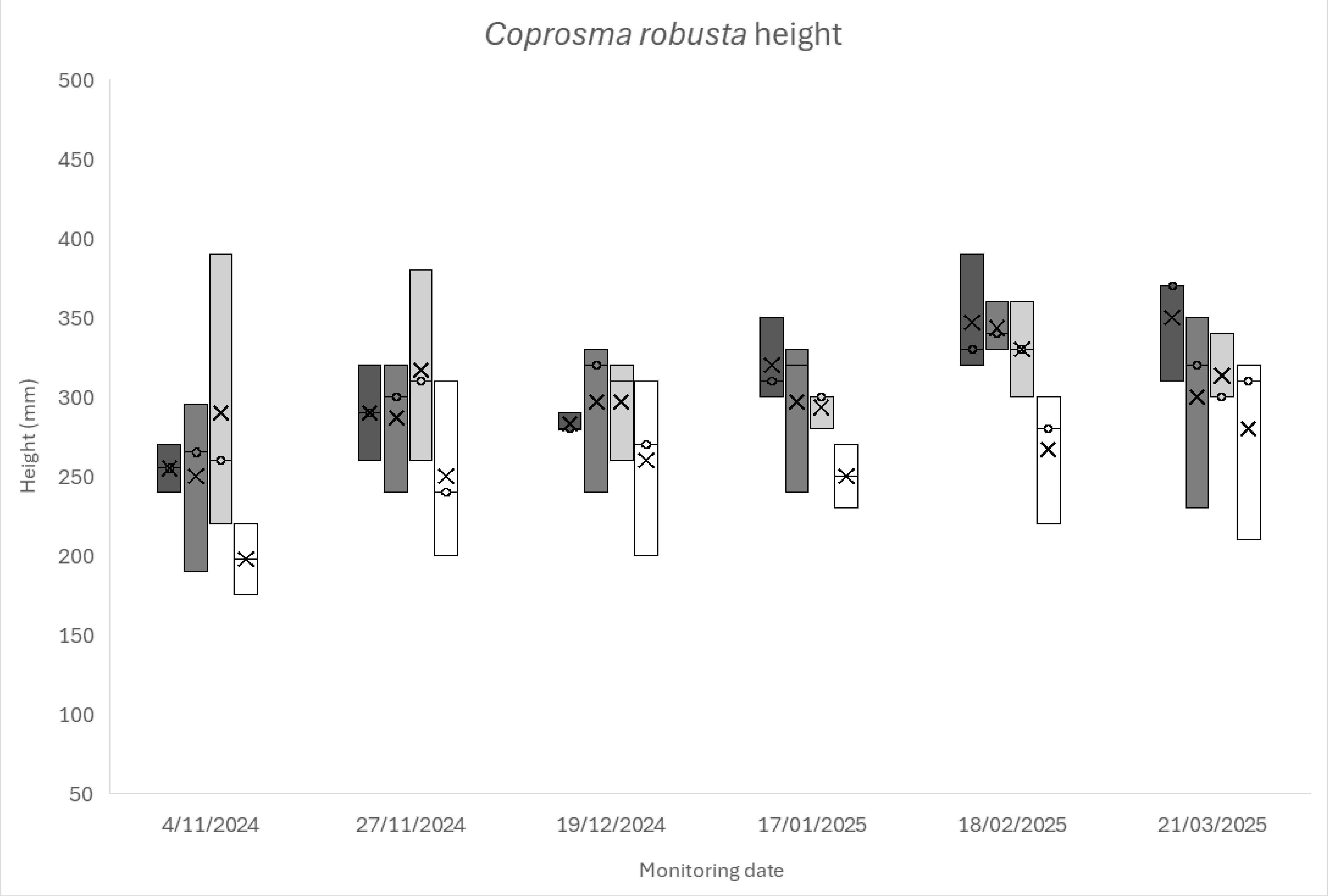
Native vs Exotic growth





Native growth in detail





Initial results from planting sites

Western Borrow: No Biosolids

Eastern Borrow: Biosolids

From moonscape to landscape

From moonscape to landscape

Benefits of biosolid application

- These actions saves 5-months landfill airspace (~12,000m3 capacity/month)
  - Diversion of ~100 – 120 tonnes of biosolids over 11.8 ha (single application)
  - Reuse 5,000 – 6,000 m3 woodchip
  - Reuse 5,000 – 6,000 m3 woody debris
  - Diversion of 47,080 m3 unsuitable soils

- Projected 17.57 t/COe/ha/yr once all site planted **(possibly much more)**
- Demonstrates that biosolids can be applied sustainably to restoration practices.
- We expect that higher amounts of biosolids would accelerate plant growth further.

Challenges

- Regulators are cautious:
  - Time delays
  - Consent conditions that may not be workable in a BAU context.

- Consenting costs were much higher than avoided landfill costs:
  - 10t/ha of material only equates to about $3k in avoided landfilling costs
  - Currently reliant on goodwill as the economics still favour landfilling

Future opportunities

- Additional planting areas could include other closed landfills and Belmont Park

  → potential diversion of over 2,000 tonnes of biosolids (but one-off)
- Further study effects to determine if higher quantum of biosolids can be safely applied in revegetation, and long term monitoring of CO_2e sequestration rates
- Find cost effective method of reapplication to increase biosolid diversion
  → could divert biosolids at Silverstream at an ongoing basis, up to 120t every three years

Summary

- Biosolids improve plant growth (native & exotic)
- Reuse of biosolids results in ecological benefits and increases carbon sequestration.
- There were challenges, but we worked through them to get results.
- More work needed to make this BAU, by working with regulators and reducing costs

Questions?