



Department of
Primary Industries

Eucalypt plantations for mine site rehabilitation, carbon and wood products

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Acknowledgements

ACARP (Project C20015)

NSW Department of Primary Industries

Coal & Allied (Rio Tinto/Yancoal)

Rixs Creek (Bloomfield Group)

Bulga Coal (Glencore)

Integra Coal (Vale)

Narama Coal (Ravensworth/Glencore)

Macquarie Generation (AGL Macquarie)

Forestry Corporation of NSW



Department of
Primary Industries

**COAL
&
ALLIED**

Managed by Rio Tinto Coal Australia

THE
Bloomfield
GROUP

GLENCORE



Introduction



- Coal mining has occurred for >200 years in the Hunter Valley, NSW
 - Central to economic development
 - 17 mines in Upper Hunter
 - >100 million tonnes p.a.
- Open cut:
- Topsoil removed, stockpiled and re-used in rehabilitation (20,000 ha required)
 - Traditionally, pastures established – low value
 - Eucalypt forests have been trialled as an alternative
 - Buffer land also planted

Previous Hunter Valley Research (1999-2010)

- Site preparation techniques for plantations:
 - ripping, contours, mounding, slopes...
 - Soil amendments e.g. biosolids, fly ash, bottom ash, MSWC, mulch...
- Species trials:
 - Established timber species
 - Clonal hybrids
 - Dryland (non-traditional forestry) situations





Bulga

Overburden establishment



Treatment Effect on the Overburden

Biosolids + Bottom Ash



Control



Growth – Rehabilitated Overburden



New Phase of Research

Objective:

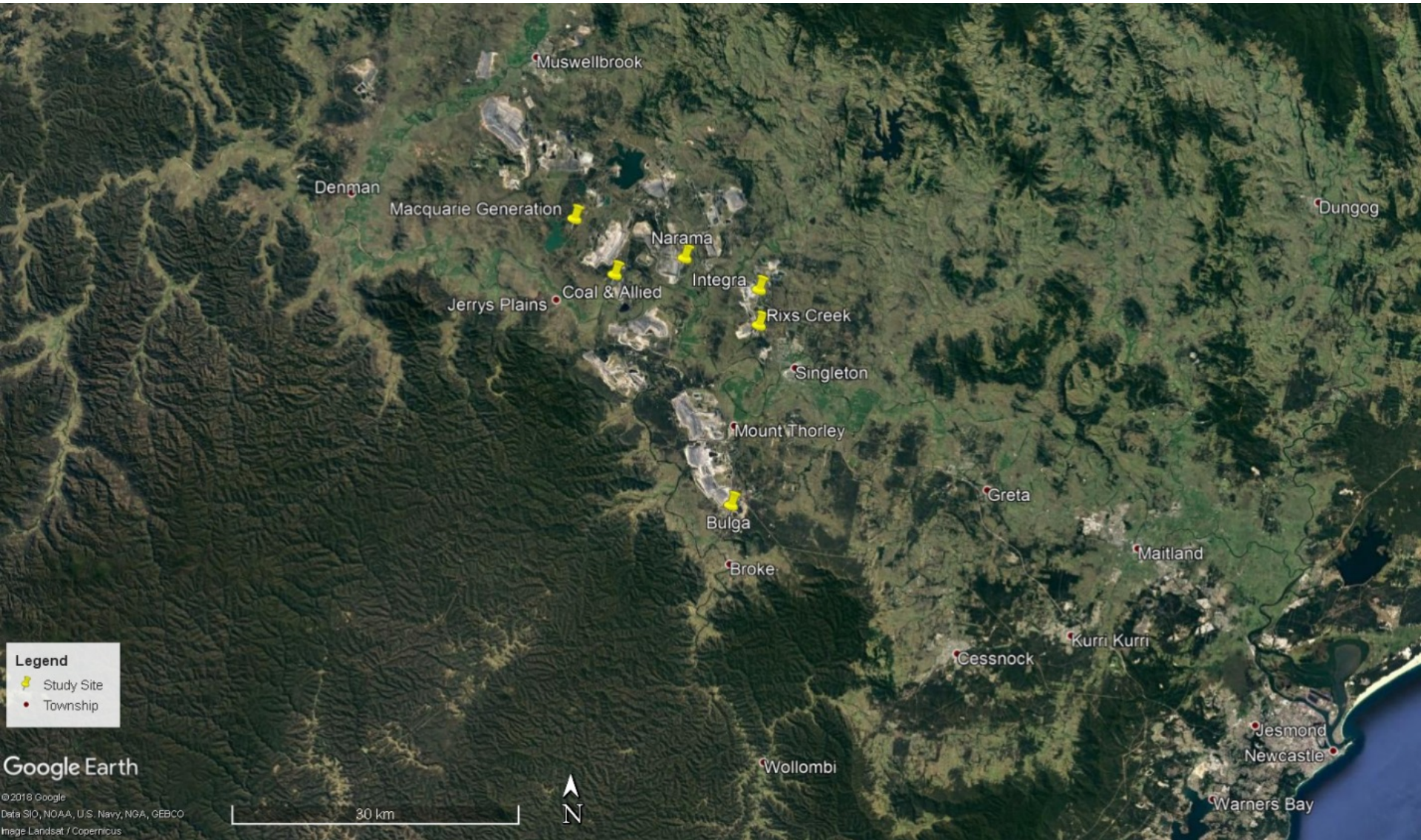
- Quantify the benefits of an early non-commercial thinning and pruning regime on dryland forest plantations in the Upper Hunter Valley

E. camaldulensis x *grandis*
(Bulga overburden)



Specific Aims

- Gather a Valley wide data base on most of the oldest tree plantations
- Apply thinning and pruning regimes to assess the benefit of early application in dryland plantations
- Manage existing stands via thinning to reduce risk of death and to maximise high value wood products and carbon returns
- Provide strongly-based full rotation projections (from yr 15 data) on performance of species, land type and the species/land type interaction
- To quantify the commercial costs and returns from carbon and timber from *Corymbia maculata* (Spotted gum) plantations; and
- To compare investment in plantation forestry with grazing and agroforestry options



Plot Measurement & Marking

Site	Land Type	Species	No.Plots
Coal & Allied (HVO)	River	<i>E.camaldulensis</i> * <i>E.grandis</i> , <i>E.camaldulensis</i> * <i>E.globulus</i>	8
	Overburden	<i>E.camaldulensis</i> * <i>E.grandis</i> , <i>C.maculata</i>	26
	Buffer	<i>E.camaldulensis</i> * <i>E.grandis</i> , <i>C.maculata</i>	22
Integra	River	<i>E.camaldulensis</i> * <i>E.grandis</i>	12
	Overburden	<i>E.camaldulensis</i> * <i>E.grandis</i> , <i>C.maculata</i>	16
Macquarie Generation	Buffer	<i>C.maculata</i> , <i>E.sideroxylon</i> , <i>E.mollucana</i> , <i>E.argophloia</i> .	40
Rix's Creek	Overburden	<i>C.maculata</i>	16
Xstrata-Narama	Overburden	<i>E.camaldulensis</i> * <i>E.grandis</i> , <i>C.maculata</i>	48
Xstrata-Bulga	Buffer	<i>E.camaldulensis</i> * <i>E.grandis</i> , <i>C.maculata</i> , <i>E.camaldulensis</i>	24
	Overburden	<i>E.camaldulensis</i> * <i>E.grandis</i> , <i>C.maculata</i> , <i>E.camaldulensis</i>	48



8900 trees were planted in the trial plots used in this project

Non-commercial Thinning & Pruning



Thinning occurred over a period of 2.5 months (Oct-Dec 2011)

Felled approx. 1350 trees across the 3 sites (Mac Gen, Integra & C&A) to a stocking of ~500 stems/ha

Approx. 1800 trees were pruned to a height of 3 metres.

Manual thinning of *E. camaldulensis* x *grandis* trees, Integra 2011



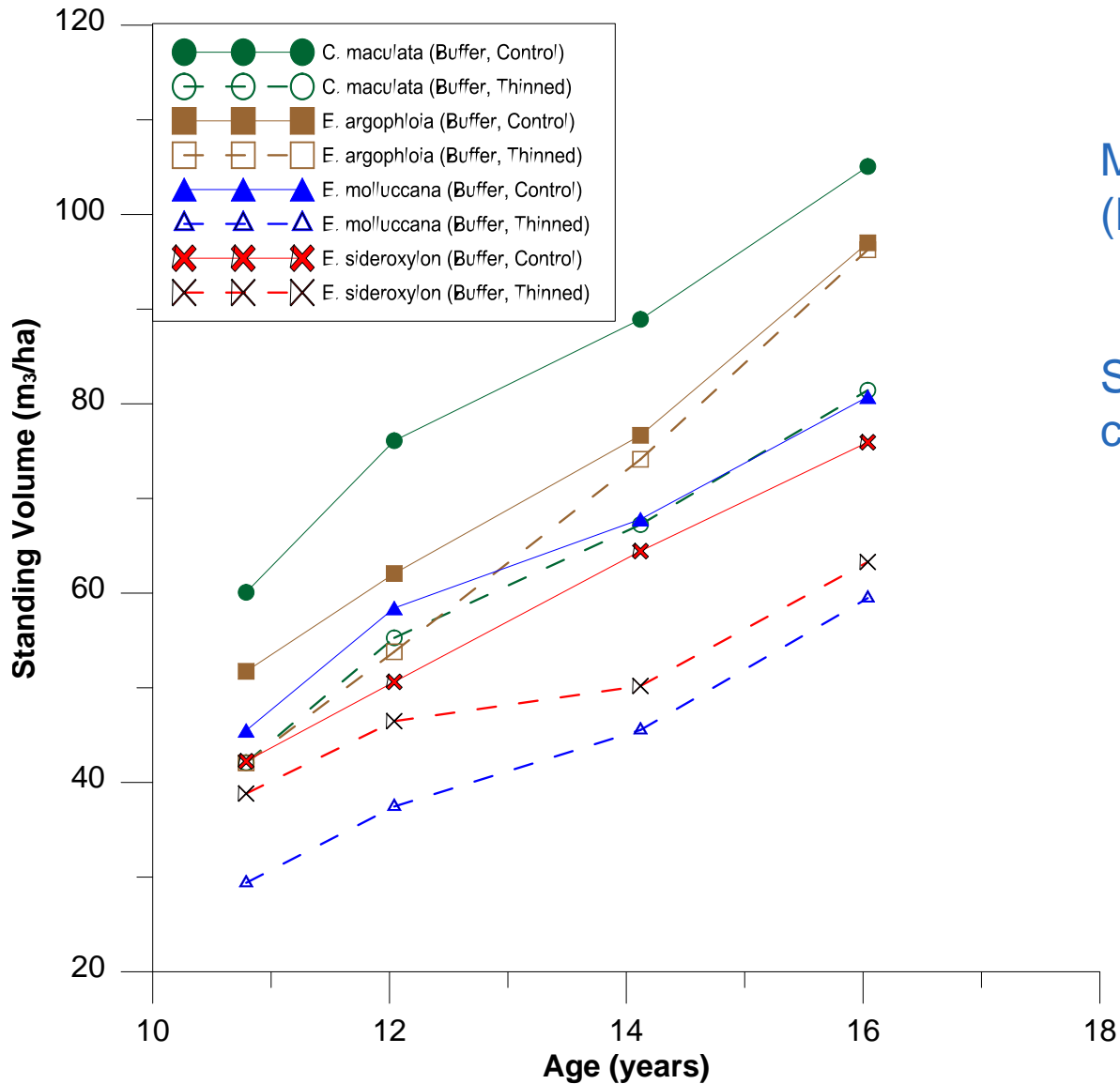
Regrowth or coppicing in the thinned plots were removed and the stumps treated with glyphosate in 2012

Plot Analysis & Calculations

- Survival
- Stocking (stems/ha)
- Basal Area (m^2/ha)
- Stand Volume (m^3/ha)
- Dominant Height (m) – mean height of the largest 100 stems/ha
- Dominant DBH (cm) – mean DBH of the largest 100 stems/ha.



Species Trial(s) Results



Macquarie Generation
(Buffer site)

Spotted Gum was a
consistent performer



Integra – rehabilitated Overburden



Rixs Creek – rehabilitated Overburden



E. camaldulensis (River red gum)
did not perform well (left of photo)

E. camaldulensis x *grandis*
hybrids (right) performed well at
some sites:

- similar height to *C. maculata*
- smaller diameter and volume

Bulga - Overburden

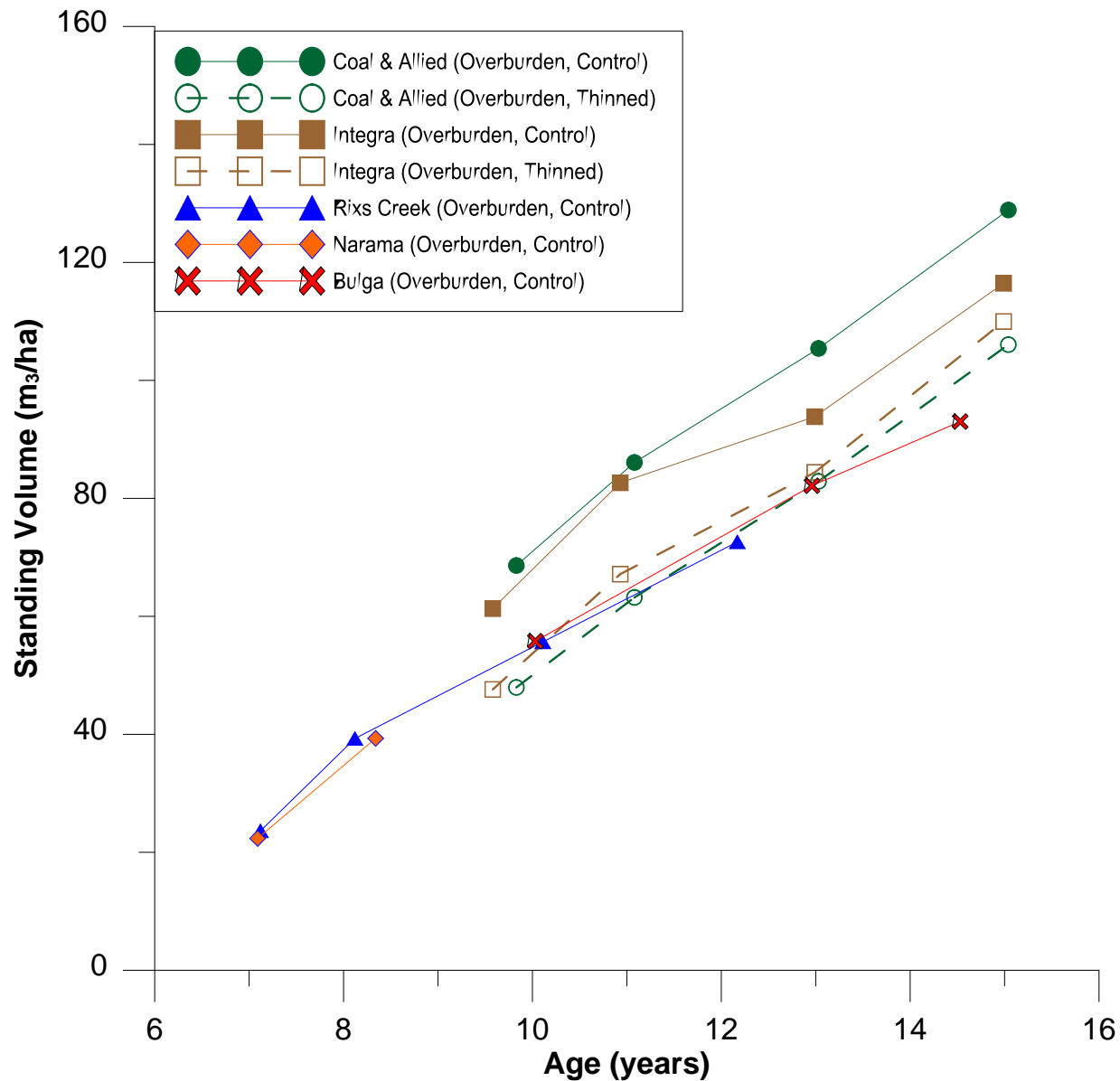
Valley-wide Results

- Two species were planted at multiple sites:
 - *Corymbia maculata* (Spotted gum)
 - *Eucalyptus camaldulensis* x *grandis* (Hybrid)

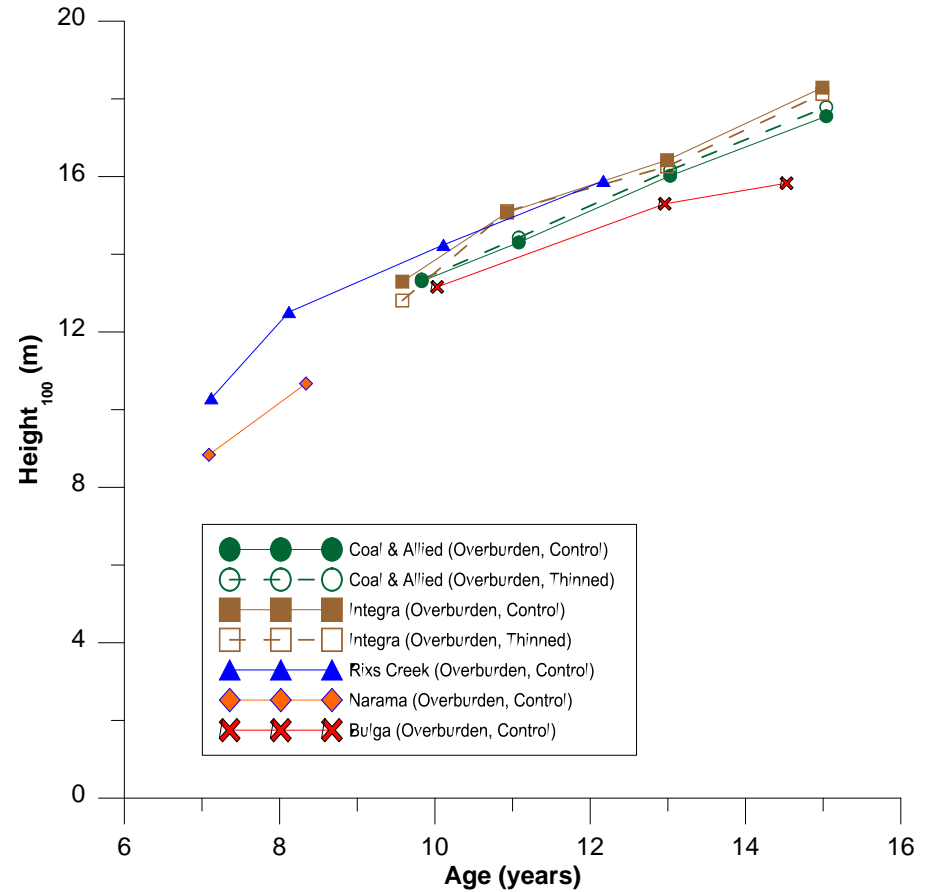
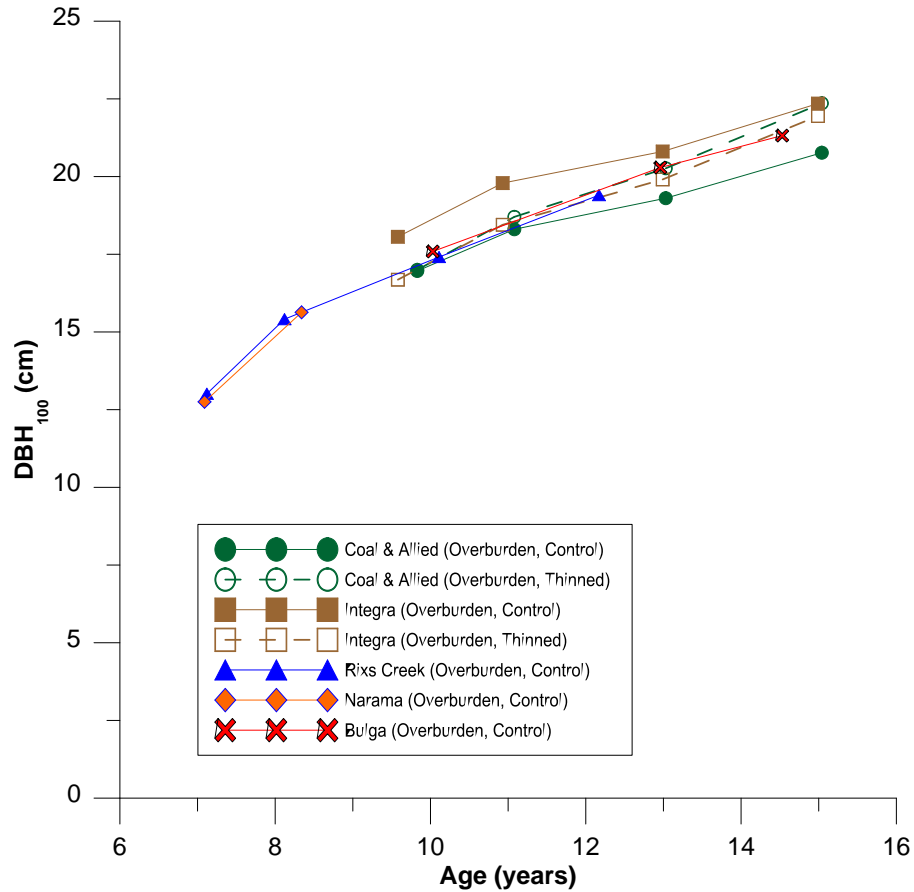
E. camaldulensis x *grandis*,
Integra River site



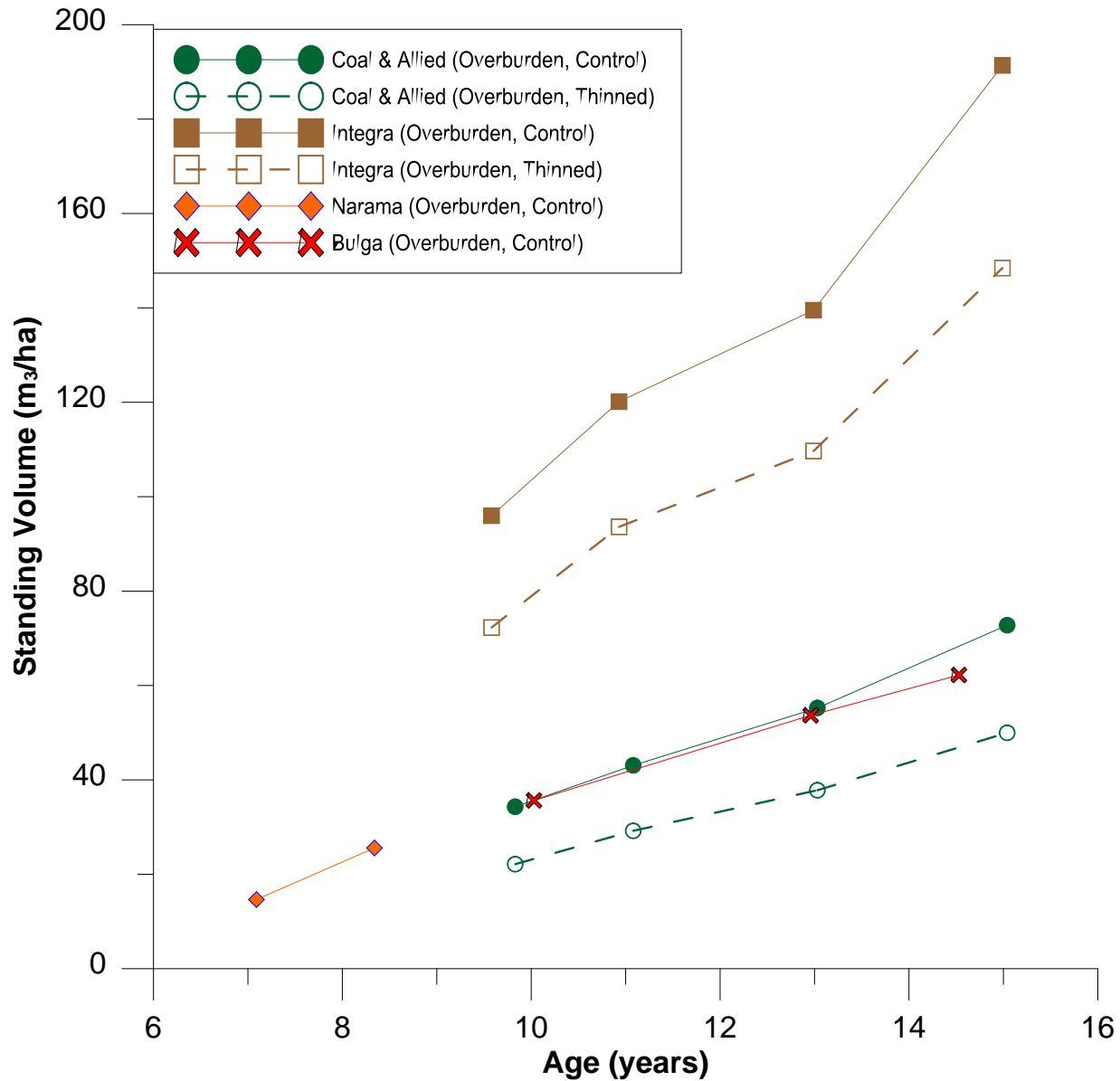
C. maculata (Spotted gum) on rehabilitated Overburden sites



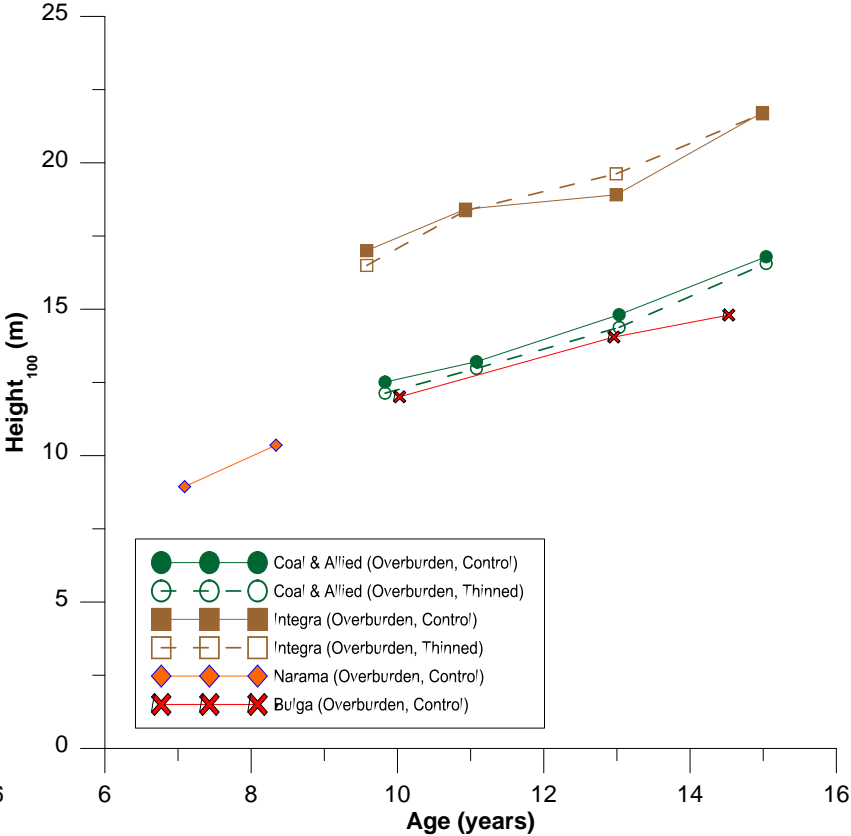
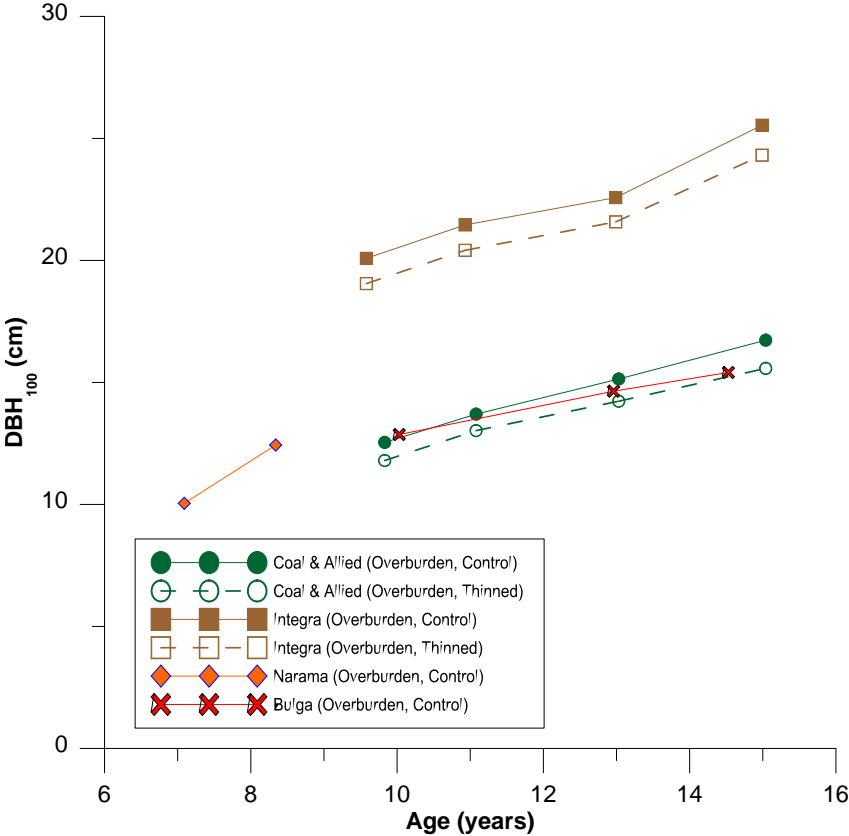
C. maculata (Spotted gum) – dominant DBH and height



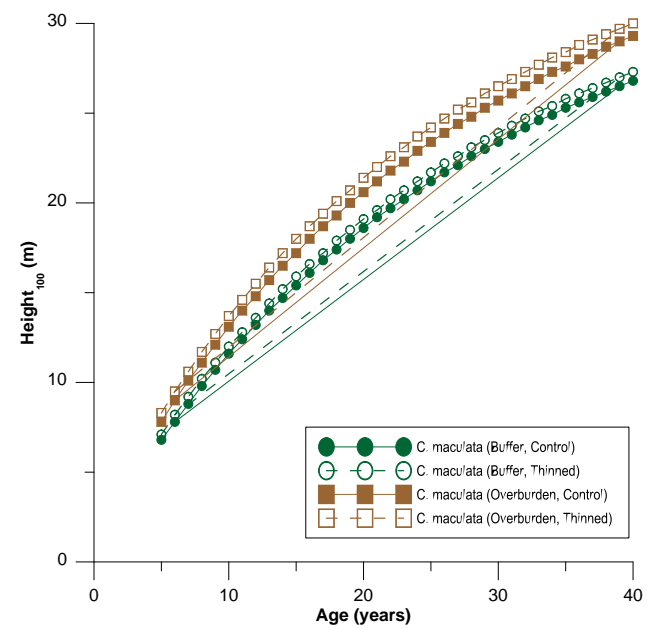
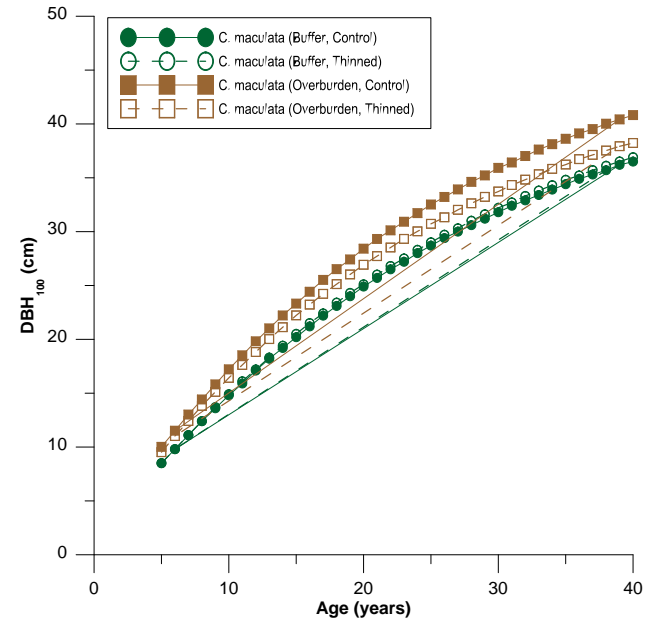
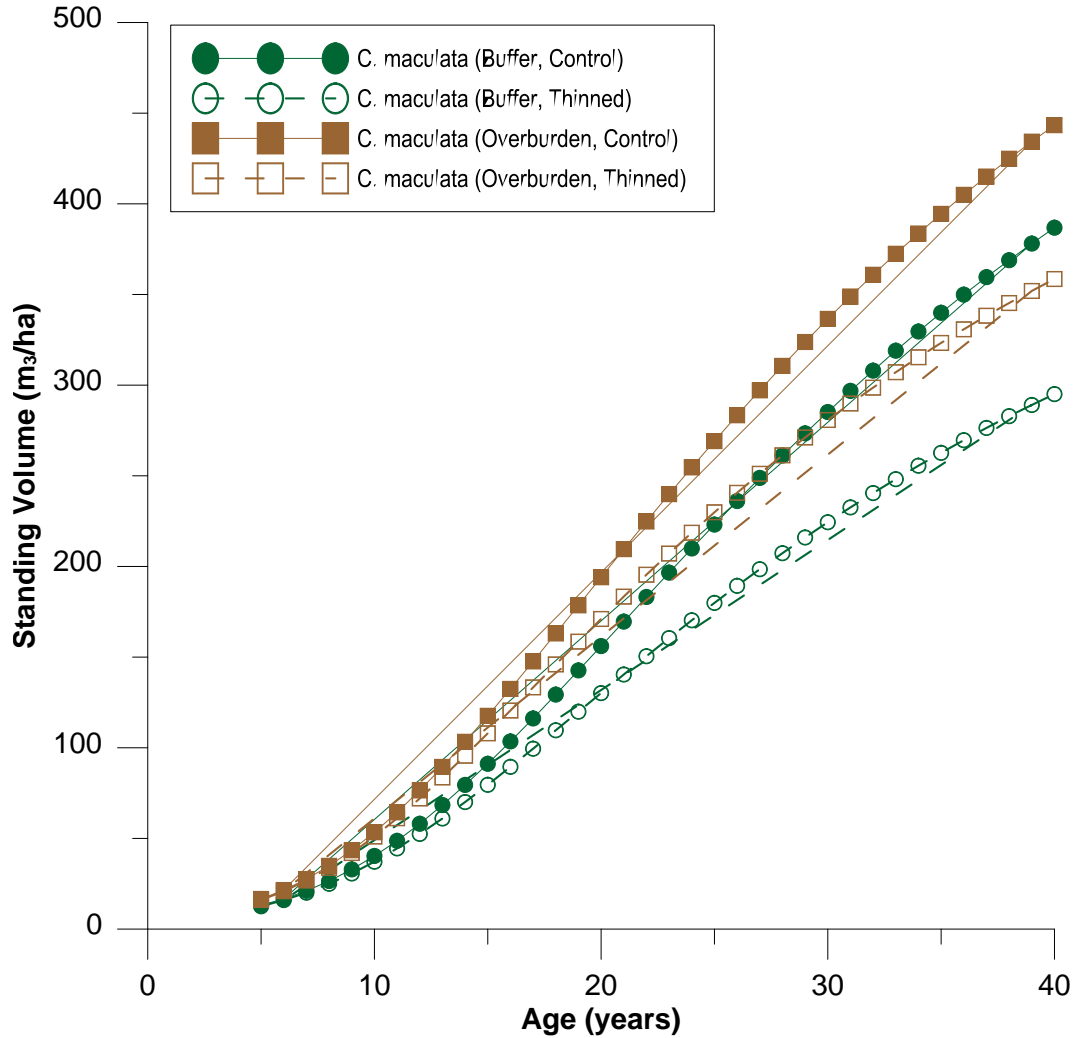
E. camaldulensis x *grandis* on rehabilitated Overburden sites



E. camaldulensis x *grandis* – dominant DBH and height



Growth Projections



Commercial Viability of Spotted Gum plantations

- Spotted Gum (*Corymbia maculata*) overall best performer
- Grows as well or better on Overburden
- Growth projections have been used in modelling but would benefit from future measurements and validation
- Superior growth performance and marketable wood qualities
- Aims:
 - Quantify the commercial costs and returns from Spotted gum plantations
 - Compare Forestry and Agroforestry with beef cattle Grazing (NPV & IRR)

“Old Blotchy” – DBH 3.4m, Height 59m



Grazing

- Default land use
- Grazing leases
- Following rehabilitation, mines fence the land
- Paddocks 20-100 ha (default 50 ha)
- Graziers supply stockyards; control weeds, pests; maintain fences



Forestry

- Mine owns land and trees
- Initial stocking 1000 stems/ha
- Timber value:
 - Single crop – 35 years on 50 ha
 - Multiple crop – 70 years planting 50 ha p.a. = 1750 ha total
 - Commercial hardwood prices
- Carbon credit value:
 - Full Carbon Accounting Model (FullCAM)
 - Prices as per Commonwealth Emission Reduction Fund
- Grazing value:
 - Stocking 25% of “Grazing” case after year 5
 - Rent from lease (agistment)

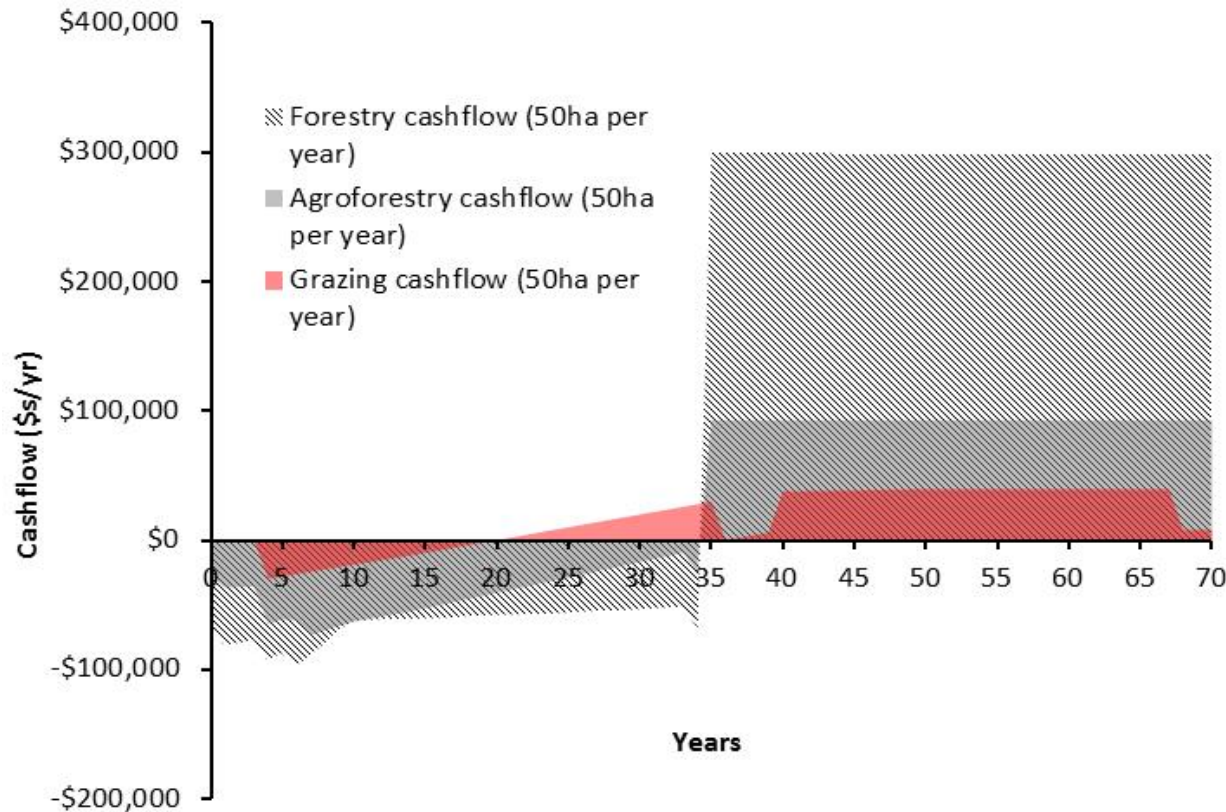


Agroforestry

- Silvo-pastoral systems -
~20 m rows, 200 stems/ha
- Income from Carbon, Grazing and Wood products
- Other benefits:
 - Reduced wind speed
 - Soil and water protection
 - Greater biodiversity
 - Shade and shelter for stock
 - Soil moisture retention (hot summers)



Cashflow results



- Grazing the lowest risk
- Forestry/Agroforestry single crops “irregular”
- Annual planting regime → sizeable and regular cashflow
- Carbon revenue generated in first 10 years offsets one-third of establishment costs
- Agroforestry a blend that mitigates some of the Forestry risk, but without losing all the revenue flow benefits

Conclusions

- Spotted Gum overall best performer
- Grows as well or better on Overburden
- Thinning has not yet led to an increase in stand volume
- Mean DBH and Height have increased, as has form, which should result in higher value timber products
- Growth projections have been used in modelling but would benefit from future measurements and validation
- Diversification of land use to include Forestry and Agroforestry investment requires mining companies to accept and embrace the associated risks of these investments.
- The rewards over the longer term are an increased revenue stream and the creation of a resource upon which new industry can be built.