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
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
Buffer

Overburden

Beltana Highwall Mine

Bulga
Overburden establishment
Treatment Effect on the Overburden

Biosolids + Bottom Ash

Control
Growth – Rehabilitated Overburden

7 months

3 years
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

<table>
<thead>
<tr>
<th>Site</th>
<th>Land Type</th>
<th>Species</th>
<th>No.Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal &amp; Allied (HVO)</td>
<td>River</td>
<td>E.camaldulensis<em>E.grandis, E.camaldulensis</em>E.globulus</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Overburden</td>
<td>E.camaldulensis*E.grandis, C.maculata</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Buffer</td>
<td>E.camaldulensis*E.grandis, C.maculata</td>
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</tr>
<tr>
<td>Integra</td>
<td>River</td>
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<td>Overburden</td>
<td>E.camaldulensis*E.grandis, C.maculata</td>
<td>16</td>
</tr>
<tr>
<td>Macquarie Generation</td>
<td>Buffer</td>
<td>C.maculata, E.sideroxylon, E.mollucana, E.argophloia.</td>
<td>40</td>
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<tr>
<td>Rix’s Creek</td>
<td>Overburden</td>
<td>C.maculata</td>
<td>16</td>
</tr>
<tr>
<td>Xstrata-Narama</td>
<td>Overburden</td>
<td>E.camaldulensis*E.grandis, C.maculata</td>
<td>48</td>
</tr>
<tr>
<td>Xstrata-Bulga</td>
<td>Buffer</td>
<td>E.camaldulensis*E.grandis, C.maculata, E.camaldulensis</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Overburden</td>
<td>E.camaldulensis*E.grandis, C.maculata, E.camaldulensis</td>
<td>48</td>
</tr>
</tbody>
</table>

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 (m²/ha)
• Stand Volume (m³/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

Standing Volume (m³/ha)

Age (years)
E. camaldulensis x grandis – dominant DBH and height
Growth Projections

- **Standing Volume (m³/ha)**
  - C. maculata (Buffer, Control)
  - C. maculata (Buffer, Thinned)
  - C. maculata (Overburden, Control)
  - C. maculata (Overburden, Thinned)

- **DBH (cm)**
  - C. maculata (Buffer, Control)
  - C. maculata (Buffer, Thinned)
  - C. maculata (Overburden, Control)
  - C. maculata (Overburden, Thinned)

- **Height (m)**
  - C. maculata (Buffer, Control)
  - C. maculata (Buffer, Thinned)
  - C. maculata (Overburden, Control)
  - C. maculata (Overburden, Thinned)
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)
• Grazing the lowest risk
• Forestry/Agroforestry single crops “irregular”
• Annual planting regime $\rightarrow$ 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.