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Tomago mineral sands mining revegetation assessment.
Tomago Mineral Sands Mining
Revegetation Assessment
The re-vegetation program at R. Z. Mines (Newcastle) Pty. Ltd. operations at Tomago has been in progress for 8 years and there are now obvious differences in vegetation recovery between older and more recently mined areas. In order to more clearly define these a simple but meaningful field assessment was undertaken. Tree height and density, estimates of understory composition and other relevant data were recorded from transects giving a sampling area of approximately 5 percent. Tree height was chosen as a key character for classifying the area into vegetation units, since it is easily assessed and provides perhaps the greatest visual impact. Permanent transects have been used so that future evaluations will be directly comparable.

The report, I believe, marks a significant step in the overall re-vegetation program. It provides a simple classification which illustrates progress to date, bearing in mind the complexity of plant communities involved. It will be of particular value to those involved in the program and others interested in post-mining re-vegetation.

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Canberra, A.C.T.
TOMAGO MINERAL SANDS MINING

REVEGETATION ASSESSMENT

THE HUNTER DISTRICT WATER BOARD
P.O. Box 5171B,
Newcastle West, N.S.W., 2302.

ERCON Australia
P.O. Box 707K,
Newcastle, N.S.W., 2300.

R.Z. MINES (NEWCASTLE) PTY. LTD.
Private Bag 32,
Newcastle Mail Exchange, 2301.

JULY, 1981.
FOREWORD

The revegetation assessment is an important, continuing monitoring function associated with mineral sands mining at Tomago, Newcastle, New South Wales.

One of the principal participants is the Hunter District Water Board, Trustees of the Tomago Sandbeds, and responsible for the development of the area as a major source of water supply following its gazettal in 1941 under a Catchment Area By-Law. The other participants are R.Z. Mines (Newcastle) Pty. Ltd., the New South Wales Department of Mineral Resources and ERCON Australia; the last mentioned being consultants to the Board for supervision of the mining operations, including the revegetation.

The Tomago Water Supply Scheme is the largest sandbed aquifer development in Australia and is a major source of water supply for Newcastle and the surrounding district. The sandbeds contain very valuable deposits of heavy minerals, principally rutile and zircon, together with ilmenite and monazite and are a national asset in this regard alone.

Mining of the area commenced in 1972 with the consent of the Department of Mineral Resources and the Hunter District Water Board, following agreement by R.Z. Mines (Newcastle) Pty. Ltd. to the extent of remedial measures necessary to preserve the environment in a situation centred around the exploitation of two natural resources, namely the water and the heavy minerals. The restoration of the vegetation forms one of the main activities of the environmental protection measures. The other is the preservation of the sandbeds aquifer as a major source of water supply.

The revegetation work has been time consuming and costly due to the relatively harsh environment of the coastal sandbeds and the extent of the mined area. However, there can be little doubt that the revegetation measures are showing considerable progress as a result of the application by the staff of R.Z. Mines (Newcastle) Pty. Ltd., the Hunter District Water Board and ERCON Australia. The overall efforts demonstrate an effective response to environmental and conservation issues.

The technical advice and assistance given by John Banks of the Department of Forestry of the Australian National University in Canberra is gratefully acknowledged.

(M.A. Hindley,)  
Chief Engineer  
Operations & Services  
Hunter District Water Board

(D.J. Hartwell,)  
Manager  
ERCON Australia

(R.J. Kelly,)  
Manager  
Planning & Development  
R.Z. Mines (Newcastle) Pty. Ltd.
Photo 1. Aerial view of Mining Operation at Tomago, looking north towards Grahamstown Dam. (Taken September 1980).

TOMAGO MINERAL SANDS MINING
REVEGETATION ASSESSMENT

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Figure 2. Index to Sheets and Locality Plan.
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1. OBJECTIVES

The assessment of revegetation following Mineral Sands Mining at Tomago has been undertaken jointly by the Hunter District Water Board, the Board’s Consultants, ERCON Australia and R.Z. Mines (Newcastle) Pty. Ltd., and has the following objectives:

(i) to measure the progress of vegetation and classify it with a readily understood system into a defined number of stages of revegetation;

(ii) to present the revegetation assessment as a report complete with plans showing the stages of revegetation for each year of mining indicated by a single colour code, together with supplementary information in the form of explanatory text and assessment sheets;

(iii) to submit the report in a manner which will form the basis for up-dating annually or biannually as appropriate.
2. BACKGROUND

About 20 kilometres north of the city of Newcastle, New South Wales, the Hunter District Water Board controls about 106 square kilometres of land known as the Tomago Sandbeds. The area is unique in that it contains large quantities of potentially potable water in the form of groundwater, as well as substantial deposits of heavy minerals, principally rutile and zircon.

The central area is covered by natural bushland and is generally of low relief with dunes forming an undulating landscape broken by interdune sand flats and swamps. Changing vegetation patterns occur principally with changes in landform. Peripheral areas have been largely cleared for urban and rural development as well as primary and secondary industry. An area of 16.5 square kilometres representing some 15% of the catchment area has been cleared for various land uses. Mineral sands exist in economic quantities in an ore body which, if completely mined, would result in disturbance of 8 - 9% of the catchment area.

In 1941 the Tomago Sandbeds catchment area was gazetted after the Board had decided to develop the sandbeds as a major source of water supply. The Board has endeavoured to carefully protect the environment of the sandbeds while developing the groundwater resource.

In July 1967 R.Z. Mines (Newcastle) Pty. Ltd. commenced the mining of mineral sands at Tomago on privately owned land adjacent to the catchment area. In June 1969 consent was given for the company to undertake limited mining in the same area, but within the catchment area, subject to strict controls by the Board over the mining operation. This operation ceased in June 1971 and in 1972 consent was given to undertake mining on a trial basis within the central region of the catchment area and subject to strict controls. The major controls are related to preservation and protection of the water resource and revegetation of the mined areas.

In September 1975 a second mining operation was commenced within the central region of the catchment area and again in February 1978 a further operation was commenced on the perimeter of the catchment area near Williamtown. Both additional operations are subject to similar strict controls as in the first operation.
3. **REVEGETATION POLICY AND METHODS.**

The primary objective of the revegetation programme is to return plant communities to the mined area which will have a similar species composition and structure, as far as practicable, to that existing before mining.

In general only species native to the area are planted. Some, Bangalay Gum (Eucalyptus Botryoides) and Spotted Gum (E. Maculata) native to surrounding areas have been included because of their good growth on the sites where other species have been less successful. A number of trial plots of local species were established early to assess regrowth on post-mined areas. As the environment has been altered by mining, mixed species are planted, keeping high water table species to low lying areas at high densities (up to 1000 trees per hectare) to allow the best locally adapted species to establish and eventually develop into new forest and woodlands, blending in with their surroundings.

Islands of vegetation are left where possible between the mineralized zones to assist in the protection and revegetation of the area. Where large areas are exposed, windbreaks of wattle and denser tree plantings are formed. The use of phosphorus as fertilizer has been restricted to the actual planted seedlings. Broadcasting of phosphorus encourages grasses and other exotics. Nurse cover crops have been found unnecessary for erosion protection and have been abandoned to encourage natural regrowth.

The progress of revegetation work is reported fortnightly in the form of detailed maps of areas and species planted. The revegetation policy is the subject of twice yearly review and has led to the development of the present system of revegetation indicated below.

Prior to mining, topographical and groundwater level surveys are undertaken as well as a vegetation survey including species counts. Heavy timber is cleared and burnt. Topsoil and remaining vegetation with its seed store is stripped and stored for replacement in the same area after mine tailings have been recontoured as far as practicable to pre-mining survey levels.

R.Z. Mines (Newcastle) Pty. Ltd. operates a nursery at its Tomago Mill and Administration Centre, where seedlings used in all revegetation programs are raised. For replanting on the sandbeds projects, suitable supplies of seeds are collected from the premined areas during the vegetation survey. Those species known to have irregular flowering cycles are collected, when in fruit, well in advance of stripping and burning. Seeds are obtained by the appropriate techniques for each species, from the collected fruit, at the nursery.

Seeds are germinated under complete cover with diffused sunlight and mist sprays. The seed boxes receive fungicidal treatments and protective blankets are used as required for the germination process.
When seedlings have developed two to three leaflets they are pricked out into nursery tubes. These are kept in a shaded cloth enclosure and are progressively moved into more sunlight as they grow. Mist irrigation is used on all enclosed seedlings. Tubed seedlings when robust enough are transferred to polyethylene bags of approximately 4 litres volume. These remain under cover for a short period to allow adaption to the new soil after transplanting.

The final nursery stage is a toughening process in full sunlight but protected from high winds, with daily watering by sprinkler or hand held hoses. Seedlings are planted out when required which is generally when tree seedlings are in the height range 0.4 to 0.6 metres. Irrigation by means of spray cannons is undertaken (when soil moisture is inadequate) prior to, at and again about 1 to 2 weeks after planting. Planting of upper storey seedlings, taller shrubs and small trees is undertaken on a 3 metre grid pattern with upper storey trees having a minimum density equivalent to a 6 m grid.

Revegetation commenced in 1973 and has been undertaken continuously since that time.
4. REVEGETATION ASSESSMENT

The primary parameter for assessing revegetation is tree height, since it is simple to measure and has great initial impact. It is, however, recognised that using tree height as a single parameter fails to take account of tree density and species composition as well as understorey development. In order to allow for this, the initial survey takes account of additional factors which are updated annually. Data from the revegetation survey is presented in Appendix I in a form which details relevant information on tree species frequency, understorey species and frequency, as well as supplementary data.

The mined area is divided into convenient units each representing one calendar year's operation for the mining plant. For practical and accurate assessment each unit is divided into zones 100 metres long, called Permanent Mark zones (P.M. zones), these being used to determine the frequency of species. The assessment is then made along a single 6 metre belt transect generally running the length of the P.M. zone. Repeat surveys are made using the same transect.

The following field data is collected:

- Tree height and numbers
- Tree species frequency
- Understorey species and frequency
- Special remarks

Trees are then grouped into different height ranges representing doubling of tree heights. These are then used as the basis for assigning an overall revegetation stage for each area as follows:

- **Current Mining** - cleared ground, mining pond, bare sand tailings.
- **Stage 1** - topsoil spread, natural regeneration, revegetation seedling height 0.5 metres (spray irrigation as required).
- **Stage 2** - first height doubling of tree seedlings to greater than 1.0 metres but less than 2.0 metres.
- **Stage 3** - second height doubling of saplings to greater than 2.0 metres but less than 4.0 metres.
- **Stage 4** - third height doubling of saplings to greater than 4.0 metres.

An area will be deemed to have reached a particular stage when the trees in the transect area exceed the minimum stage height and have reached a density of 250 trees per hectare for Stage 1, 200 trees for Stage 2, 150 trees for Stage 3, and 100 trees for Stage 4.

Typical specimens of trees associated with the different stages are shown on Plate 1.
Data on tree species performance is used for assessing potential success of individual species in the overall revegetation programme. Understorey data is used to provide an overview on initial recovery and long term reestablishment.
5. RESULTS

The results of the revegetation survey are presented in the following section on a series of plans where different stages of revegetation are depicted by four different colour tones. The key plan and legend to the survey maps is presented on one sheet as Figure 2. The colour coding for the different stages of revegetation is noted on this sheet.

The availability of moisture is a major factor limiting growth rate and so annual rainfall since 1968 is presented in Figure 1.

Supplementary data is presented for each plant mining year in Appendix 1 with the following included:

Year area was mined and overall stage of revegetation.
Tree density and height grouping - based upon stage heights.
Tree species - where tree specimens are mature the different species are recorded and their frequency of occurrence noted.
Understorey species and frequency.
Other comments relating to understorey, exposure, topography and special factors.

Each supplementary data sheet is cross-referenced to the revegetation survey plans by a number indicating year of mining, appendix and page number.

Overstorey tree and understorey frequency is fixed by the following procedure:

When a species occurs in more than 66% of the P.M.'s, it is considered to be very common (shown in the survey as **); when it occurs within 33% to 66% of the P.M.'s it is considered to be common (shown in the survey as *); and when it occurs in less than 33% of the P.M.'s it is considered to be occasional (an occasional species does not show an asterisk).
6. CONCLUSION

The assessment of revegetation has traditionally been undertaken on a subjective basis. This report outlines an objective assessment method which is being successfully applied to the revegetation at Tomago. The method takes account of tree height and density and a simple method of assessing and presenting results has been prepared. The method is amenable to annual/biannual review which will show the progress of revegetation.
PLATE 1.
Typical tree specimens associated with different stages of revegetation

STAGE 1  Height 0.5 - 1.0 m

STAGE 2  Height 1.0 - 2.0 m

STAGE 3  Height 2.0 - 4.0 m

STAGE 4  Height greater than 4.0 m
PLATE 2.

R.Z.M. NURSERY
RESULTS OF SURVEY UNDERTAKEN JULY 1981
NOTE: Annual Rainfalls were Determined for Periods Between 1st. July and 30th. June.

ANNUAL RAINFALL AT NO.1 PUMPING STATION TOMAGO

fig. 1
INDEX TO SHEETS

LEGEND

Boundaries of -
- Lands owned or controlled by The Hunter District Water Board
- Hunter District Water Board Access Roads
- Hunter District Water Board Water Supply Pipelines
- Powerlines - Overhead
- Powerlines - Underground
- Telephone Lines - Overhead
- Telephone Lines - Underground
- Swamps (Pre-Mining Condition)
- Edge of Dept Run (Current and Proposed)
- Direction of Mining
- Dredging Face at December, 1975
- Proposed Mining Areas
- Mined Areas to December, 1980

DETAIL SHEET COLOUR CODE

Proposed Mining Areas -  
- Revegetation Assessment of Mined Areas to December 1980 - See Appendix I
- Stage 1
- Stage 2
- Stage 3
- Stage 4

Unmined Islands of Vegetation

REVEGETATION ASSESSMENT
MINERAL SANDS MINING OPERATIONS
TOMAGO SANDBEDS WATER SUPPLY CATCHMENT AREA
NORTH OF NEWCASTLE N.S.W.
Private land not subject to normal revegetation conditions

DATE OF SURVEY
JULY, 1981

THE HUNTER DISTRICT WATER BOARD
ERCON Australia
R.Z. MINES (NEWCASTLE) PTY. LTD.
TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
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<th>Height</th>
<th>Count</th>
<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
<th>Species Identified</th>
</tr>
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</table>
| 0.5-1.0 | 81 | 166 | 492 | 250 | 1 | *Angophora costata*
| 1.0-2.0 | 80 | 164 | 326 | 200 | 2 | Banksia serratifolia
| 2.0-4.0 | 67 | 137 | 162 | 150 | 3 | Casuarina littoralis
| 4+ m. | 12 | 25 | 25 | 100 | 4 | *Eucalyptus amygdalina*

Transsect Width (TW) 6m. Transect Length (TL) 814m
Specified Minimum Planting Density 280 Trees/ha.
Density = Count x 10,000 / TL x TW

Mining Runs 1
P.M.'s 1 to 7

Comments
Pre mining low relief swamp zone devoid of trees existed in P.M.'s 6 & 7

UNDERSTOREY (Frequency asterisks refer to Section 5)

* Acacia botrycephala
* Acacia cyanophylla
* Acacia suaveolens
* Astroloma pinifolium
** Baeckea diosmifolia
** Baeckea ramosissima
* Bossiaea heterophylla
* Cassytha pubescens
* Conospermum taxifolium
** Coryza bonariensis
* Cymodon dactylon
* Daviesia acicularis
* Diameilla caerulea
* Dillwynia glabriffima
* Eupatotes australis
* Hardenbergia violacea
* Helichrysum dymofoliwm
** Leptocarpus tenax
** Loamandra glauca
* Macrozamia communis
* Melaleuca thymifolia
* Monotoca scoparia
** Persoonia levis
* Petrophile fucifolia
* Platysce Ericoides
* Pseudanthus orientalis
** Senecio lautus
* Acacia brownii
* Acacia longifolia var. sophorae
** Acacia ulicifolia
* Baeckea denticulata
* Baeckea linearis
* Bossiaea ensata
* Bossiaea rhombifolia
* Chloris gayana
* Conyza albiba
* Cortaderia sellowiana
* Dampiera stricta
* Daviesia ulicifolia
** Diameilla revoluta
* Dillwynia retorta
* Facelis retusa
* Helichrysum apiculatum
* Hibbertia scandens
* Leptospermum attenuatum
* Loamandra longifolia
* Melaleuca nodosa
* Melichrus procumbens
* Patersonia sericea
** Persoonia linearis
* Pimelea linifolia
** Pomax umbellata
* Restio pallens
REFER DETAIL SHEET 1 & 3
CODE 1974/A1/P2
REVEGETATION ASSESSMENT DATA

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<th>MINING YEAR</th>
<th>OVERALL REVEGETATION ASSESSMENT</th>
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<td>6</td>
<td>April '81</td>
<td>1974</td>
<td>STAGE 3</td>
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TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

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<th>Height</th>
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<th>Density (trees/ha)</th>
<th>Cumulative Density</th>
<th>Target Density</th>
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<td>540</td>
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<td>4+ m.</td>
<td>66</td>
<td>68</td>
<td>68</td>
<td>100</td>
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Species Identified:
- Angophora costata
- Banksia serratifolia
- Casuarina littoralis
- Eucalyptus botryoides
- Eucalyptus gunnifera
- Eucalyptus haemastoma
- Eucalyptus oblonga
- Eucalyptus parramattensis
- Eucalyptus pilularis
- Eucalyptus punctata
- Eucalyptus tereticornis
- Melaleuca quinquenervia

Transect Width (TW) 6m. Transect Length (TL) 1624m
Specified Minimum Planting Density 280 Trees/ha.
Density = Count x 10,000 Trees/ha.

Mining Runs 1, 2

P.M.'s 8 to 21

Comments
Post mining tree growth is very good in P.M.'s 9, 10 & 11

UNDERSTOREY (Frequency asterisks refer to Section 5)

- Acacia bottrecephala
- Acacia longifolia var. sophorae
- Acacia suaveolens
- Actinotus helianthi
- Actinotus ericoides
- Baeckea denticulata
- Baeckea linearis
- Banksia asplenifolia
- Bossiaea heterophylla
- Callistemon viminalis
- Cassytha pubescens
- Conoclinia cyanrea
- Conyza bonariensis
- Dampiera stricta
- Daviesia ulicifolia
- Dillwynia glaberrima
- Eriostemon australasius
- Eucalyptus latifolium
- Haloragis teucrioides
- Helichrysum drosophyllum
- Leptocarpus tenax
- Leucopogon ericoides
- Lamandra longifolia
- Melaleuca nodosa
- Melaleuca thymifolia
- Monotoca scoparia
- Persoonia levis

Acacia brownii
- Acacia myrtifolia
- Acacia ulicifolia
- Amperea xiphoclada
- Astroloma pinifolium
- Baeckea diosmifolia
- Baeckea ramossissima
- Bossiaea ensata
- Bossiaea rhombifolia
- Carpobrotus aequilaterus
- Chloris gayana
- Conospermum taxifolium
- Cynodon dactylon
- Daviesia acicularis
- Dianella caerulea
- Dillwynia retorta
- Facelis retusa
- Haemodorus planifolium
- Hardenbergia violacea
- Hibbertia scandens
- Leptospermum laevigatum
- Lamandra glauca
- Macrozamia communis
- Melaleuca sieberi
- Melichrus procumbens
- Patersonia sericea
- Persoonia linearis
**UNDERSTOREY (continued)**

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<th>Pimelea linifolia</th>
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<th>Platysace ericoides</th>
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<td>Pseudanthus orientalis</td>
<td>**</td>
<td>Pteridium esculentum</td>
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<td>*</td>
<td>Ricinocarpus pinifolius</td>
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<td>**</td>
<td>Senecio latus</td>
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<td>**</td>
<td>Trachymene incisa</td>
<td>**</td>
<td>Equisetum arvense</td>
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TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

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<th>Height</th>
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<th>Cumulative Density</th>
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Species Identified
- Angophora costata
- Banksia serratulifolia
- Casuarina littoralis
- Eucalyptus eugenioides
- Eucalyptus gummifera
- Eucalyptus parramattensis
- Eucalyptus punctata

Transect Width (TW) 6m. Transect Length (TL) 1210m
Specified Minimum Planting Density 280 Trees/ha.
Density = Count x 10,000 Trees/ha.

Mining Runs 3, 4  P.M.'s 22 to 32
Comments

UNDERSTOREY (Frequency asterisks refer to Section 5)

- Acacia botrycephala
- Acacia cyanophylla
- Acacia myrtifolia
- Acacia ulicifolia
- Ampera xiphoclada
- Astronia pinifolia
- Baeckea diosmifolia
- Banksia asplenifolia
- Boronia falcifolia
- Bossiæa heterophylla
- Cassytha pubescens
- Conospermum taxifolium
- Conyza bonariensis
- Cyperus polystachyos
- Daviesia acicularis
- Diélëlla caerulea
- Dillywnia glaberrima
- Entolasia stricta
- Gaúpholobium latifolium
- Hardenbergia violacea
- Hibbertia scandens
- Leptocarpus tenax
- Leptospium flavescens
- Leucopogon setiger
- Lamandra longifolia
- Melaleuca sieberi
- Melichrus procumbens
- * Acacia brownii
- * Acacia longifolia var. sophorae
- * Acacia suaveolens
- * Actinotus helianthi
- * Aotus ericoides
- * Baeckea denticulata
- * Baeckea ramosissima
- * Billardiera scandens
- * Bossiæa ensata
- * Bossiæa rhombifolia
- * Chloris gayana
- * Conyza albica
- * Cynodon dactylon
- * Dampiera stricta
- * Daviesia ulicifolia
- * Dianella revoluta
- * Dillywnia retorta
- * Epaltes australis
- * Haemodorus planifolium
- * Helichrysum diosmifolium
- * Lambertia formosa
- * Leptospermum attenuatum
- * Leucopogon ericoides
- * Lamandra glauca
- * Melaleuca nodosa
- * Melaleuca thymifolia
- * Persoonia levis
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<td><strong>Senecio lautus</strong></td>
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<td>* Sida rhombifolia</td>
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REFER DETAIL SHEET 1 & 3
CODE 1976/A1/P6
REVEGETATION ASSESSMENT DATA

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<td>6</td>
<td>April '81</td>
<td>1976</td>
<td>STAGE 2</td>
</tr>
</tbody>
</table>

TRANSECTION SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
<thead>
<tr>
<th>Height (m)</th>
<th>Count</th>
<th>Density Trees/ha</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>86</td>
<td>116</td>
<td>320</td>
<td>250</td>
<td>1</td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>78</td>
<td>105</td>
<td>204</td>
<td>200</td>
<td>2</td>
</tr>
<tr>
<td>2.0-4.0</td>
<td>67</td>
<td>90</td>
<td>99</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>4+ m.</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>100</td>
<td>4</td>
</tr>
</tbody>
</table>

Transect Width (TW) 6m. Transect Length (TL) 1235m
Specified Minimum Planting Density 280 Trees/ha.
Density = Count x 10,000 Trees/ha.

Mining Runs 4, 5, 5A
P.M.'s 33 to 43

Comments

UNDERSTOREY (Frequency asterisks refer to Section 5)

** Acacia botrycephala
Acacia cyanophylla
Acacia myrtifolia
** Acacia ulicifolia
Acetosella vulgaris
** Ampera xiphochlada
* Astroloma pinifolium
Baeckea dioxifolia
Baeckea ramosissima
** Billardiera scandens
** Bossiae a heterophylla
Carpobrotus aequilaterus
Chloris gayana
** Coryza bonariensis
Cyperus polystachyos
Dampiera stricta
Daviesia ulicifolia
Dianella revoluta
** Dillwynia retorta
** Epaltes australis
Eriostemon australasius
Compholobium latifolium
** Haloragis teucridoides
** Hibbertia scandens
Isopogon anemonifolius
Kunzea capitata
Leptospermum attenuatum

* Acacia brownii
Acacia longifolia var. sophorae
** Acacia suaveolens
Acanthospermum australe
Actinotus helianthi
** Aotus ericoides
Baeckea denticulata
Baeckea linearis
Banksia aspleniifolia
** Bossiaea ensata
** Bossiaea rhombifolia
Chenopodium ambrosioides
* Conospermum taxifolium
Cynodon dactylon
Cheilanthes tenuifolia
Daviesia acicularis
** Dianella caerulea
** Dillwynia globerrima
** Entolasia stricta
Eragrostis brownii s. lat
Eleusine indica
Haemodorum planifolium
** Hardenbergia violacea
Hemarthria uncinata
Juncus planifolius
* Leptocarpus tenax
Leptospermum flavescens
UNDERSTOREY (continued)

** Leucopogon ericoides
** Lomandra glauca
Melaleuca sieberi
* Melichrus procumbens
Opercularia varia
** Persoonia levis
Phytolacca octandra
** Platysace ericoides
Pseudanthus orientalis
Pultenaea elliptica
Schoenus brevifolius
Styphelia laeta
* Trachymene incisa

Leucopogon virgatus
** Lomandra longifolia
* Melaleuca thymifolia
Macarthuria neo-cambrica
Patersonia sericea
** Persoonia linearis
** Pimelea linifolia
* Poinax umbellata
Pultenaea blakelyi
Ricinocarpus pinifolius
** Senecio lautus
Tephrosia scariosa
* Zieria laxiflora
TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
<thead>
<tr>
<th>Height</th>
<th>Count</th>
<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
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<td>133</td>
<td>377</td>
<td>250</td>
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<td>1.0-2.0</td>
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<td>208</td>
<td>244</td>
<td>200</td>
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<tr>
<td>2.0-4.0</td>
<td>45</td>
<td>36</td>
<td>36</td>
<td>150</td>
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</tr>
<tr>
<td>4 + m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4</td>
</tr>
</tbody>
</table>

Species Identified
- *Angophora costata*
- *Eucalyptus eugenioides*
- *Eucalyptus gunnifera*
- *Eucalyptus haemastoma*
- *Eucalyptus oblonga*
- *Eucalyptus pilularis*
- *Eucalyptus punctata*
- *Eucalyptus robusta*
- *Eucalyptus tereticornis*
- *Melaleuca quinquenervia*

Transect Width (TW) 6m. Transect Length (TL) 2063m
Specified Minimum Planting Density 280 Trees/ha.
Density = \[
\text{Count} \times 10,000 \div \text{TL} \times \text{TW}
\]

Mining Runs 5A, 6, 7
P.M.'s 44 to 60

UNDERSTOREY (Frequency asterisks refer to Section 5)

- **Acacia botrycephala**
- **Acacia elongata**
- **Acacia myrtifolia**
- **Acacia ulicifolia**
- *Ampea xiphoclada*
- *Astroloma pinifolium*
- *Baeckea diosmifolia*
- *Billiardiera scandens*
- *Bossiaea ensata*
- **Bossiaea rhombifolia**
- *Banksia serratifolia*
- *Cassytha pubescens*
- *Chenopodium ambrosioides*
- **Conospermum taxifolium**
- *Cynodon dactylon*
- *Daviesia acicularis*
- *Dianella revoluta*
- **Dillwynia retorta**
- *Epilobites australis*
- *Haemodorus planifolium*
- *Hardenbergia violacea*
- *Hibbertia fasciculata*
- *Hypolaena fastigiata*
- *Imperata cylindrica*
- *Lepidosperma longitudinale*
- **Leptospermum attenuatum**
- **Leucopogon ericoides**
- *Acacia brownii*
- **Acacia longifolia var. sophorae**
- *Acacia suaveolens*
- *Actinotus helianthi*
- *Aotus ericoides*
- *Baeckea denticulata*
- *Baeckea ramosissima*
- *Boronia pinnata*
- **Bossiaea heterophylla**
- *Brachyloba daphnoides*
- *Callistemon viminalis*
- *Caustris recurvata*
- *Cremelina cyannea*
- **Conyza bonariensis**
- *Dampiera stricta*
- *Dianella caerulea*
- *Dillwynia glaberrima*
- **Entolasia stricta**
- *Camphalobium latifolium*
- *Haloragis teucrioides*
- *Helichrysum dossifolium*
- *Hibbertia scandens*
- *Hovea linearis*
- *Isopogon anemonifolius*
- **Leptocarpus tenax**
- *Leptospermum flavescens*
- *Leucopogon virgatus*
UNDERSTOREY (continued)

** Lamandra glauca
* Melaleuca decora
* Melaleuca sieberi
* Melichrus procumbens
* Monotoca scoparia
* Patersonia sericea
** Persoonia linearis
** Pimelea linifolia
** Pomax umbellata
* Pultenaea blakelyi
* Pultenaea retusa
* Ricinocarpus pinifolius
* Schoenus ericetorum
** Styphelia laeta
* Wahlbergia gracilis
* Zieria laxiflora

** Lamandra longifolia
* Melaleuca nodosa
* Melaleuca thymifolia
* Monotoca elliptica
* Patersonia glabrata
** Persoonia levis
** Phytolacca octandra
** Platysace ericoides
** Pteridium esculentum
* Pultenaea elliptica
* Restio tetrphyllus
* Schoenus brevifolius
** Senecio laetus
* Trachymene incisa
* Xanthorrhoea minor
<table>
<thead>
<tr>
<th>Height</th>
<th>Count</th>
<th>Density Trees/ha.</th>
<th>Cumulative Target Density</th>
<th>Target Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>184</td>
<td>217</td>
<td>340</td>
<td>250</td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>101</td>
<td>119</td>
<td>123</td>
<td>200</td>
</tr>
<tr>
<td>2.0-4.0</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>150</td>
</tr>
<tr>
<td>4 + m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

**Species Identified**
- Angophora costata
- Eucalyptus botryoides
- Eucalyptus eugenioides
- Eucalyptus gunnifera
- Eucalyptus haemastoma
- Eucalyptus oblonga
- Eucalyptus pilularis
- Eucalyptus punctata
- Eucalyptus robusta
- Eucalyptus tereticornis
- Melaleuca quinquenervia

**UNDERSTOREY** (Frequency asterisks refer to Section 5)

* Acacia botrycephala
* Acacia cyanophylla
** Acacia longifolia var. sophorae
** Acacia suaveolens
Actinotus helianthi
** Aotus ericoides
Baeckea denticulata
** Baeckea ramosissima
Blandfordia grandiflora
** Bossiaea heterophylla
Banksia serratifolia
Callistemon viminalis
* Cassytha pubescens
Chloris gayana
* Conospermum taxifolium
Cynodon dactylon
* Daviesia acicularis
Dianella revoluta
** Dillwynia retorta
** Entolasia stricta
Gompholobium pinnatum
** Haloragis tenuiroides
Helichrysum dismorfolum
Hibbertia scandens
Kennedia rubicunda
** Leptospermum attenuatum
Leptospermum laevigatum

* Acacia brownii
* Acacia elongata
* Acacia myrtifolia
** Acacia ulicifolia
Anaphea xiphocladla
Astroloma pinifolium
Baeckea diosmifolia
Billardiera scandens
* Bossiaea ensata
** Bossiaea rhombifolia
* Callistemon pachyphyllos
Carpobrotus aequilaterus
Caustis recurvata
Canna glauca
** Conyza bonariensis
Dampiera stricta
Dianella calurus
** Dillwynia glaberrima
Entolasia marginata
Gompholobium latifolium
* Haemodorus planifolium
* Hardenbergia violacea
** Hibbertia fasciculata
Imperata cylindrica
* Leptoporus tenax
** Leptospermum flavescens
** Leucopogon ericoides
Leucopogon setiger
** Lanandra glauca
Macrozamia communis
Melaleuca sieberi
Melaleuca armillaris
** Persoonia linearis
* Pimelea linifolia
* Pteridium esculentum
Pulicaria elliptica
* Ricinocarpus pinifolius
Schoenus ericetorum
** Senecio laetus
** Trachymene incisa

Leucopogon virgatus
* Lanandra longifolia
* Melaleuca nodosa
* Melaleuca thymifolia
** Persoonia levis
** Phytolacca octandra
** Platysace ericoides
Pteridium esculentum
Restio tetraphyllus
* Schoenus brevifolius
Selaginella uliginosa
Tephrosia scariosa
Zieria laxiflora
## TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
<thead>
<tr>
<th>Height</th>
<th>Count</th>
<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>386</td>
<td>775</td>
<td>869</td>
<td>250</td>
<td>1</td>
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<tr>
<td>1.0-2.0</td>
<td>46</td>
<td>92</td>
<td>94</td>
<td>200</td>
<td>2</td>
</tr>
<tr>
<td>2.0-4.0</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>4 - m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4</td>
</tr>
</tbody>
</table>

Transect Width (TW) 6m. Transect Length (TL) 830m

Specified Minimum Planting Density 280 Trees/ha.

Density = \( \frac{\text{Count} \times 10,000}{\text{TL} \times \text{TW}} \) Trees/ha.

### SPECIES IDENTIFIED

- *Angophora costata*
- *Eucalyptus botryoides*
- *Eucalyptus eugenioides*
- *Eucalyptus gunnifera*
- *Eucalyptus haemastoma*
- *Eucalyptus obluna*
- *Eucalyptus parramattensis*
- *Eucalyptus pilularis*
- *Eucalyptus piperita*
- *Eucalyptus punctata*
- *Eucalyptus tereticornis*

### UNDERSTOREY

(Frequency asterisks refer to Section 5)

- *Acacia cyanophylla*
- **Acacia longifolia var. sophorae**
- **Acacia ulicifolia**
- *Ampera xiphostylada*
- *Baeckea denticulata*
- *Baeckea ramosissima*
- *Bossiaea heterophylla*
- *Callistemmon citrinus*
- *Callistemmon viminalis*
- *Conya alibaba*
- *Daviesia acicularis*
- *Dillwynia retorta*
- *Gampholobium pinnastrum*
- *Haloragis teurridoide*
- *Hibbertia fasciiculata*
- *Kennedia rubicundu*
- *Leptospermum attenuatum*
- *Leptospermum laevigatum*
- *Melaleuca decora*
- **Melaleuca thymifolia**
- *Melaleuca armillaris*
- *Persoonia linearis*
- *Platysace ericoides*
- *Pultenaea elliptica*
- *Ricinocarpus pinifolius*
- *Xanthorrhoea minor*
- *Acacia elongata*
- *Acacia suaveolens*
- *Actinotus helianthi*
- *Aotus ericoides*
- *Baeckea diosmifolia*
- *Bossiea ensata*
- *Bossiea rhombifolia*
- *Callistemmon pachyphyllus*
- *Conospermum taxifolium*
- *Dampiera stricta*
- *Dillwynia glaberrima*
- *Entolasia stricta*
- *Haemodorum planifolium*
- *Hardenbergia violacea*
- *Hibbertia scandens*
- *Leptocarpus tenax*
- *Leptospermum flavescens*
- *Lamandra glauca*
- *Melaleuca sieberi*
- *Melichrus procumbens*
- *Persoonia levis*
- *Phytolacca octandra*
- *Platysace lanceolata*
- *Restio tetrathyllum*
- *Trachymene incisa*
- *Zieria laxiflora*
TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
<thead>
<tr>
<th>Height</th>
<th>Count</th>
<th>Density</th>
<th>Cumulative</th>
<th>Target</th>
<th>Stage</th>
<th>Species Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>243</td>
<td>466</td>
<td>466</td>
<td>250</td>
<td>1</td>
<td>* Angophora costata</td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200</td>
<td>2</td>
<td>** Eucalyptus eugenioides</td>
</tr>
<tr>
<td>2.0-4.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>3</td>
<td>* Eucalyptus gummifera</td>
</tr>
<tr>
<td>4 m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4</td>
<td>* Eucalyptus haemastoma</td>
</tr>
</tbody>
</table>

Transsect Width (TW) 6m. Transect Length (TL) 870m. Specified Minimum Planting Density 280 Trees/ha. Density = \( \frac{\text{Count} \times 10,000}{\text{TL} \times \text{TW}} \) Trees/ha.

Mining Runs 9, 10 P.M.'s 82 to 89

Comments

UNDERSTOREY (Frequency asterisks refer to Section 5)

- * Acacia cyanophylla
- * Acacia myrtifolia
- ** Acacia ulicifolia
- Callistemon viminalis
- Daviesia acicularis
- * Entolasia stricta
- Haemodorus planifolium
- * Hardenbergia violacea
- * Melaleuca sieberi
- Melaleuca armillaris
- * Ricinocarpus pinifolius
- Acacia longifolia var. sophorae
- ** Acacia suaveolens
- * Bossiaea rhamnifolia
- * Cynodon dactylon
- Dillwynia retorta
- Conocarpus micranthus
- Haloragis teuerioides
- Leptocarpus tenax
- ** Melaleuca thymifolia
- * Phytolacca octandra
- Senecio latus
## Transect Survey - Results for Overstorey Trees

<table>
<thead>
<tr>
<th>Height</th>
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<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
<th>Species Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>29</td>
<td>161</td>
<td>417</td>
<td>250</td>
<td>1</td>
<td>Eucalyptus eugenioides **</td>
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<tr>
<td>1.0-2.0</td>
<td>34</td>
<td>189</td>
<td>256</td>
<td>200</td>
<td>2</td>
<td>Eucalyptus gunnifera **</td>
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<tr>
<td>2.0-4.0</td>
<td>9</td>
<td>50</td>
<td>67</td>
<td>150</td>
<td>3</td>
<td>Eucalyptus parramattensis **</td>
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<tr>
<td>4 + m.</td>
<td>3</td>
<td>17</td>
<td>17</td>
<td>100</td>
<td>4</td>
<td>Eucalyptus tereticornis</td>
</tr>
</tbody>
</table>

** Transect Width (TW) 6m. Transect Length (TL) 300m **

Specified Minimum Planting Density 280 Trees/ha.

Density = \( \frac{\text{Count} \times 10,000}{\text{TL} \times \text{TW}} \) Trees/ha.

### Mining Runs
- 1 to 5

### P.M.'s
- 1 to 3

### Comments

---

## Understorey

(Frequency asterisks refer to Section 5)

- Acacia botrycephala
- Acacia suaveolens
- Acacia longifolia var. sophorae

- Acantospermum austrole
- Actinotus helianthi

- Ampelopsis xiphoclada
- Aotus ericoides

- Boronia falcifolia
- Bossiaea ensata

- Bossiaea heterophylla
- Bossiaea rhombifolia

- Callistemon viminalis
- Conospermum taxifolium

- Conyza bonariensis
- Dianella caerulea

- Dillwynia glaberrima
- Dillwynia retorta

- Entolasia stricta
- Eleusine indica

- Gonocarpus micranthus
- Haemodorus planifolium

- Haloragis teucridoides
- Hardenbergia violacea

- Helichrysum astrom wallum
- Hibbertia fasciculata

- Leucopogon ericoides
- Lamandra glauca

- Lamandra longifolia
- ** Persoonia levis

- Lonchocarpus linearis
- ** Phytolacca octandra

- Pimelea linifolia
- ** Platysace ericoides

- Pteridium esculentum
- Ricinocarpus pinifolius

- Senecio lautus
- Zieria laxiflora
REFER DETAIL SHEET 1
CODE 1977/A1/P15

REVEGETATION ASSESSMENT DATA

<table>
<thead>
<tr>
<th>MINING PLANT NO.</th>
<th>REVEGETATION SURVEY DATE</th>
<th>MINING YEAR</th>
<th>OVERALL REVEGETATION ASSESSMENT</th>
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<tbody>
<tr>
<td>8</td>
<td>July '81</td>
<td>1977</td>
<td>STAGE 1</td>
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TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

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<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
<th>Species Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>38</td>
<td>211</td>
<td>328</td>
<td>250</td>
<td>* Angophora costata</td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>20</td>
<td>111</td>
<td>117</td>
<td>200</td>
<td>Eucalyptus eugenioides</td>
</tr>
<tr>
<td>2.0-4.0</td>
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<td>6</td>
<td>6</td>
<td>150</td>
<td>Eucalyptus gurrumifera</td>
</tr>
<tr>
<td>4+ m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>** Eucalyptus haemastoma</td>
</tr>
</tbody>
</table>

Transect Width (TW) 6m. Transect Length (TL) 300m
Specified Minimum Planting Density 280 Trees/ha.
Density = Count x 10,000 Trees/ha.

Mining Runs 6 to 9
P.M.'s 4 to 6

Comments

UNDERSTOREY (Frequency asterisks refer to Section 5)

** Acacia suaveolens
* Acanthospermum australe
** Ampera xiphoclada
* Astroloma pinifolium
* Billardiera scandens
* Bossiaea rhombifolia
** Conyza bonariensis
* Diamea caerulea
** Dillwynia retorta
** Eleusine indica
** Haloragis teucridioides
** Helichrysum dlsomifolium
* Imperata cylindrica
Leucopogon virgatus
Opeularia vari
** Persoonia linearis
** Platysace ericoides
* Ricinocarpus pinifolius
* Styphelia laeta

* Acacia ulicifolia
Actinotus helianthi
Aotus ericoides
Baeckea ramosissima
* Bossiaea heterophylla
** Conospermum taxifolium
Daviesia acicularis
** Dillwynia laberrina
* Entolasia stricta
* Conocarpus micranthus
* Hardenbergia violacea
Hibbertia fasciculata
Leptospermum attenuatum
Lamandra glauca
** Persoonia levis
** Pimelea linifolia
* Pteridium esculentum
** Senecio lautus
### Overall Revegetation Assessment

<table>
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<tr>
<th>MINING PLANT NO.</th>
<th>SURVEY DATE</th>
<th>MINING YEAR</th>
<th>OVERALL REVEGETATION ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>July '81</td>
<td>1978</td>
<td>STAGE 1</td>
</tr>
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### Transect Survey - Results for Overstorey Trees

<table>
<thead>
<tr>
<th>Height (m)</th>
<th>Count</th>
<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>37</td>
<td>206</td>
<td>250</td>
<td>250</td>
<td>1</td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>8</td>
<td>44</td>
<td>44</td>
<td>200</td>
<td>2</td>
</tr>
<tr>
<td>2.0-4.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>4+ m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4</td>
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</tbody>
</table>

Transect Width (TW) 6m. Transect Length (TL) 300m

Specified Minimum Planting Density 280 Trees/ha.

Density = \( \frac{\text{Count} \times 10,000}{\text{TL} \times \text{TW}} \) Trees/ha.

### Mining Runs

10 to 14 P.M.'s 7 to 9

### Comments

### Understorey

(Frequency asterisks refer to Section 5)

- **Acacia suaveolens**
- *Acanthospermum australe*
- **Ampera rhiphoida**
- *Astroloma pinifolium*
- *Billardiera scandens*
- *Boronia pinnata*
- *Boscia heterophylla*
- **Banksia serratifolia**
- *Calytrix tetragona*
- **Conospermum taxifolium**
- **Dillwynia glaberrima**
- *Gompholobium latifolium*
- *Haemodorus planifolium*
- **Hardenbergia violacea**
- *Hibbertia scandens*
- **Leucopogon ericoide**
- *Lamandra glauca*
- *Opercularia varia*
- **Persoonia linearis**
- Pteridium esculentum
- **Ricinocarpus pinifolius**
- **Senecio lautus**
- **Acacia ulicifolia**
- **Actinotus helianthi**
- **Aotus ericoide**
- *Baeckea ramosissima*
- *Boronia falcifolia*
- *Bassiea ensata*
- *Bassiea rhombifolia*
- Callistemon viminalis
- *Caustis recurvata*
- *Dianella caerulea*
- **Dillwynia retorta**
- Gonocarpus micranthus
- **Haloragis teucrioides**
- *Hibbertia fasciculata*
- Imperata cylindrica
- Leucopogon virgatus
- **Melichrus proctembens**
- *Persoonia levias*
- **Platybos ericoides**
- Pultenaea elliptica
- *Schoenus ericetorum*
<table>
<thead>
<tr>
<th>Height</th>
<th>Count</th>
<th>Density</th>
<th>Cumulative</th>
<th>Target</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
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<td>0.5-1.0</td>
<td>40</td>
<td>222</td>
<td>172</td>
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<td>1.0-2.0</td>
<td>17</td>
<td>94</td>
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<td>200</td>
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</tr>
<tr>
<td>2.0-4.0</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>4+ m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4</td>
</tr>
</tbody>
</table>

Species Identified:
- Angophora costata
- Eucalyptus eugenioides
- Eucalyptus gunnifera
- Eucalyptus haemastoma
- Eucalyptus oblonga
- Eucalyptus parramattensis
- Eucalyptus pilularis
- Eucalyptus tereticornis

Transect Width (TW) 6m. Transect Length (TL) 300m
Specified Minimum Planting Density 280 Trees/ha.

Density = Count x 10,000

Mining Runs 15 to 18
P.M.'s 10 to 12

UNDERSTOREY (Frequency asterisks refer to Section 5)

- Acacia suaveolens
- Acanthospernum australe
- Arperea xiphoclada
- Bossiaea ensata
- Bossiaea rhombifolia
- Carpodotus eaequilaterus
- Daviesia acicularis
- Dillwynia retorta
- Conocarpus microans
- Hardenbergia violacea
- Leucopogon ericoides
- Monotoca elliptica
- Opercularia varia
- Persoonia linearis
- Pimelea linifolia
- Platysacce lanceolata
- Pteridium esculentum
- Schoenus ericetorum
- Trachymene incisa
- Acacia ulicifolia
- Actinotus helianthi
- Actinotus ericoides
- Bossiaea heterophylla
- Banksia serratifolia
- Conyza bonariensis
- Dillwynia glaberrima
- Entolasia marginata
- Haloragis teucroides
- Imperata cylindrica
- Lamandra glauca
- Monotoca scoparia
- Persoonia levis
- Phytolacca octandra
- Platysacce ericoides
- Pimelea linearis
- Pteridium esculentum
- Schoenus ericetorum
- Trachymene incisa
- Zieria laxiflora
### TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
<thead>
<tr>
<th>Height</th>
<th>Count</th>
<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
<th>Species Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>68</td>
<td>378</td>
<td>378</td>
<td>250</td>
<td>1</td>
<td><em>Angophora costata</em>&lt;br&gt;<strong>Eucalyptus botryoides</strong>&lt;br&gt;<strong>Eucalyptus eugenioides</strong>&lt;br&gt;<strong>Eucalyptus gunnifera</strong>&lt;br&gt;<strong>Eucalyptus haemastoma</strong>&lt;br&gt;<strong>Eucalyptus oblonga</strong>&lt;br&gt;<strong>Eucalyptus parramattensis</strong>&lt;br&gt;<strong>Eucalyptus pilularis</strong>&lt;br&gt;<strong>Eucalyptus tereticornis</strong></td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td><strong>Eucalyptus eugenioides</strong>&lt;br&gt;<strong>Eucalyptus gunnifera</strong>&lt;br&gt;<strong>Eucalyptus haemastoma</strong>&lt;br&gt;<strong>Eucalyptus oblonga</strong>&lt;br&gt;<strong>Eucalyptus parramattensis</strong>&lt;br&gt;<strong>Eucalyptus pilularis</strong>&lt;br&gt;<strong>Eucalyptus tereticornis</strong></td>
</tr>
<tr>
<td>2.0-4.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td><strong>Eucalyptus eugenioides</strong>&lt;br&gt;<strong>Eucalyptus gunnifera</strong>&lt;br&gt;<strong>Eucalyptus haemastoma</strong>&lt;br&gt;<strong>Eucalyptus oblonga</strong>&lt;br&gt;<strong>Eucalyptus parramattensis</strong>&lt;br&gt;<strong>Eucalyptus pilularis</strong>&lt;br&gt;<strong>Eucalyptus tereticornis</strong></td>
</tr>
<tr>
<td>4+m.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td><strong>Eucalyptus eugenioides</strong>&lt;br&gt;<strong>Eucalyptus gunnifera</strong>&lt;br&gt;<strong>Eucalyptus haemastoma</strong>&lt;br&gt;<strong>Eucalyptus oblonga</strong>&lt;br&gt;<strong>Eucalyptus parramattensis</strong>&lt;br&gt;<strong>Eucalyptus pilularis</strong>&lt;br&gt;<strong>Eucalyptus tereticornis</strong></td>
</tr>
</tbody>
</table>

**Note:** Density = \( \frac{\text{Count} \times 10,000}{\text{TL} \times \text{TW}} \) Trees/ha.

Transaction Width (TW) 6m. Transect Length (TL) 300m Specified Minimum Planting Density 280 Trees/ha.

### UNDERSTOREY (Frequency asterisks refer to Section 5)

- *Acacia cyanophylla*
- *Acacia suaveolens*
- *Actinotus helianthi*
- *Baeclea ramosissima*
- *Bossiaea rhambifolia*
- *Conza bonariensis*
- *Dampiera stricta*
- **Dillwynia retorta**
- *Entolasia stricta*
- *Haemodorus planifolium*
- *Hardenbergia violacea*
- *Leptospermum laevigatum*
- *Melaleuca sieberi*
- *Monotoca scoparia*
- *Persoonia levis*
- *Pimelea linifolia*
- *Pteridium esculentum*
- **Senecio lautus**

- *Acacia longifolia var. sophorae*
- **Acacia ulicifolia**
- *Aotus ericoides*
- *Billardiera scandens*
- *Callistemon viminalis*
- *Cynodon dactylon*
- *Daviesia acicularis*
- *Digitaria aequiglumis*
- *Conocarpus micranthus*
- **Haloragus teueroides**
- *Leptospermum attenuatum*
- *Lomandra glauca*
- *Melaleuca thymifolia*
- **Opercularia variata**
- *Phytolacca octandra*
- *Platysace ericoides*
- **Ricinocarpus pinifolius**
- *Trachymene incisa*
REFER DETAIL SHEET
CODE 1979/A1/P19
APPENDIX 1
PAGE 19

REVEGETATION ASSESSMENT DATA

<table>
<thead>
<tr>
<th>MINING PLANT NO.</th>
<th>REVEGETATION SURVEY DATE</th>
<th>MINING YEAR</th>
<th>OVERALL REVEGETATION ASSESSMENT</th>
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<tr>
<td>1C</td>
<td>July '81</td>
<td>1979</td>
<td>STAGE 1</td>
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TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
<thead>
<tr>
<th>Height (m)</th>
<th>Count</th>
<th>Density Trees/ha</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-1.0</td>
<td>268</td>
<td>263</td>
<td>265</td>
<td>250</td>
<td>1</td>
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<tr>
<td>1.0-2.0</td>
<td>2</td>
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<td>2</td>
<td>200</td>
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<tr>
<td>2.0-4.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>4+</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>4</td>
</tr>
</tbody>
</table>

Species Identified
- *Angophora costata*
- *Eucalyptus botryoides*
- *Eucalyptus eugenioides*
- *Eucalyptus gunnifera*
- *Eucalyptus haemastoma*
- *Eucalyptus oblonga*
- *Eucalyptus parramattensis*
- *Eucalyptus pilularis*
- *Eucalyptus tereticornis*

Transect Width (TW) 6m. Transect Length (TL) 1700m
Specified Minimum Planting Density 280 Trees/ha.
Density = \( \frac{\text{Count} \times 10,000}{\text{TL} \times \text{TW}} \) Trees/ha.

Mining Runs 1, 2, 3
Comments P.M.'s 1 to 17

UNDERSTOREY (Frequency asterisks refer to Section 5)

- *Acacia botrycephala*
- **Acacia suaveolens**
- **Actinotus helianthi**
- *Aotus ericoides*
- *Baeckea denticulata*
- *Boronia pinnata*
- *Bossiaea rhombifolia*
- *Conospermum taxifolium*
- *Dampiera stricta*
- *Dillwynia retorta*
- *Gamophyllum latifolium*
- *Hakea teretifolia*
- **Hardenbergia violacea**
- *Hibbertia scandens*
- *Hemarthria uncinata*
- *Leptospermum laevigatum*
- *Lamandra glauca*
- *Melichrus procumbens*
- *Phytolacca octandra*
- *Platysace ericoides*
- **Pteridium esculentum**
- *Ricinocarpus pinifolius*
- *Schoenus ericetorum*
- *Styphelia laeta*
- *Acacia cyanophylla*
- **Acacia ulicifolia**
- **Ampereaxiphocladia**
- *Astroloma pinifolium*
- *Boronia falcifolia*
- *Bossiaea heterophylla*
- *Callistemon viminalis*
- *Coryza bonariensis*
- *Dillwynia glaberrima*
- *Eriostemon australasius*
- *Haemodorus planifolium*
- *Haloragis teucroides*
- **Hibbertia fasciculata**
- *Hypolaena fastigiata*
- *Leptospermum attenuatum*
- *Leucopogon virgatus*
- *Macrozamia communis*
- *Melaleuca armillaris*
- *Pimelea linifolia*
- *Pomax umbellata*
- *Pultenaea elliptica*
- *Schoenus brevifolius*
- *Senecio laetus*
- *Zieria laxiflora*
THE HUNTER DISTRICT WATER BOARD EIS
604
Tomago mineral sands mining revegetation assessment
### TRANSECT SURVEY - RESULTS FOR OVERSTOREY TREES

<table>
<thead>
<tr>
<th>Height</th>
<th>Count</th>
<th>Density Trees/ha.</th>
<th>Cumulative Density</th>
<th>Target Density</th>
<th>Stage</th>
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<td></td>
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<tr>
<td>1.0-2.0</td>
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<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0-4.0</td>
<td></td>
<td>150</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 + m.</td>
<td></td>
<td>100</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transect Width (TW) 6m. Transect Length (TL) 1500m
Specified Minimum Planting Density 280 Trees/ha.
Density = \( \frac{\text{Count} \times 10,000}{\text{TL} \times \text{TW}} \) Trees/ha.

Mining Runs 4, 5, 6
P.M.'s 18 to 32

Comments
Part of this area is still in the process of being topsoiled and planted with seedlings. A count will be undertaken on completion of this current work.

### UNDERSTOREY (Frequency asterisks refer to Section 5)

- **Acacia botrycephala**
- **Acacia suaveolens**
- **Acacia ulicifolia**
- **Actinotus helianthi**
- **Boronia pinnata**
- **Hardenbergia violacea**
- **Pimelea linifolia**
- **Ricinocarpus pinifolius**
- **Senecio lautus**