BAUXITE PIT REHABILITATION

AGREED ARRANGEMENTS BETWEEN

WORSLEY ALUMINA PTY. LTD. AND THE W.A. FORESTS DEPARTMENT

CONTENTS

1. PREAMBLE

The aim of this document is to outline the mechanisms by which the Forests Department and Worsley Alumina will provide for progressive mine-pit rehabilitation in State forest areas of the Worsley Project Principal Mineralised Area (i.e. Saddleback, Quindanning and Marradong Forest Blocks.)

To achieve this aim, the document sets out the responsibilities of both parties and develops a set of policies, objectives, strategies and review mechanisms for rehabilitation planning. These provide a framework from which a rehabilitation prescription will be prepared annually. The framework ensures that full advantage can be taken of the resources and experiences of both organizations, and that the prescription is responsive to new information from trials, research and operational experience. It is also anticipated that the regular process of review built into the mechanism will identify aspects of rehabilitation requiring trial and experimentation.

2. RESPONSIBILITIES

Under the provisions of the Forests Act 1918 (as amended), the Forests Department is charged with the responsibility for management of State Forest. In fulfilling this responsibility, the Forests Department ensures that forest resources are managed to give the maximum long term social and economic benefit. To this end, the Forests Department has adopted a multiple use management approach which, in the case of Saddleback, Quindanning and Marradong Forest Blocks, recognizes recreation as the primary use and bauxite mining as a tertiary use (Forests Dept Land Use Management Plan, 1980). As a transient land use, bauxite mining, with the appropriate rehabilitation strategies, need not permanently or seriously affect the potential for recreation.

Worsley Alumina is bound by the provisions of the Alumina Refinery (Worsley) Agreement (the Worsley Agreement) and the approved ERMP (October 1979). With specific reference to rehabilitation, the following obligations and undertakings are important:

(i) Clause 16(8) of The Worsley Agreement states:

> "As may reasonably be required by the Conservator, the Joint Venturers shall from time to time and at their expense take adequate measures -
>
> (i) for the progressive restoration and re-afforestation of the forest destroyed;
>
> (ii) for the prevention of soil erosion;
>
> (iii) for the prevention of the formation of deep water pools and other dangers to persons who may use the forest areas.
>
> PROVIDED THAT the Joint Venturers shall not be obliged to restore to its original contour land on which forest has been destroyed."

(ii) Clause 16(10) of the Worsley Agreement states:

> "The Joint Venturers after consultation with the Conservator of Forests will prepare and submit to the State not later than two years after 31st October, 1978, a plan in reasonable detail of their proposed mining operations upon areas of State Forest and Crown land during the succeeding ten years and such plan after like consultation shall be reviewed and resubmitted thereafter at yearly intervals."

(iii) The approved ERMP contains undertakings in several technical areas:

- Surface water control
- Disease management
- Topsoil/overburden handling
- Pit-floor ripping
- Revegetation
- Fertilizing
- Maintenance of rehabilitation
- Rehabilitation research (including the Trial Rehabilitation exercise: TRE-1)

(iv) The approved ERMP also contains a commitment to carry out biological studies, which have been and will be designed to provide data directly applicable to rehabilitation planning.

3. POLICIES AND OBJECTIVES

3.1 Land use plans in the Principal Mineralised Area

A small area within Saddleback Block has the primary use of scientific study. This area encompasses a hydrology research area designed to study the hydrologic impact of mining and rehabilitation. Worsley Alumina has made a specific commitment to support this study in terms of liaison with the appropriate authorities regarding the timing of mining operations in the research area.

The specified secondary uses, intermediate in priority between primary use of recreation and the tertiary use of mining, are conservation and protection.

Current recreational use of the area is minimal and only broadscale planning has been undertaken to develop its potential. This is outlined in the Northern Region Forest Recreation Framework Plan (Forests Department, 1982). In this plan, the area falls within the Monadnock Management Unit (grouped with other Monadnocks in the eastern forest). Since these areas are best suited to non-motorized, low-intensity recreational activities, the following management strategies are relevant:

(i) where practical, avoid road construction within the immediate vicinity of monadnocks to discourage vehicle use and to minimize problems of erosion and disease;

(ii) facilitate access by foot by providing facilities at the base of hills; and

(iii) provide written guides to flora, fauna and landscape characteristics.

In the Dwellingup Division recreation working plan (Forests Department, 1983), it is proposed that a long term development plan be written for the Saddleback Block. This plan can form the basis for developing recreation guidelines for rehabilitation prescriptions.

3.2 Rehabilitation Objective

The broad objective is to generate a stable forest ecosystem planned to maintain recreation, conservation and other nominated forest values.

Specific goals are:

- Recreation - where practicable, to provide or maintain recreational values in accordance with approved Forests Department plans.

- Conservation - to regenerate, in the long term, floral and faunal characteristics compatible with the jarrah forest.

- Landscape - to create a rehabilitated landscape compatible with the general landform and physiography.

- Protection - to minimise impacts on non-mined areas, to conserve the residual soils, to minimize dieback spread, and ensure that unacceptable fire hazards do not accumulate.

In seeking to meet these goals, the desired end result is a multiple-use forest in which rehabilitated and undisturbed stands are integrated to the maximum practical extent.

4. STRATEGIES AND PLANNING

4.1 Rehabilitation strategies

The following measures will be adopted to achieve the objective:

- The development of prescriptions for rehabilitation procedures for each mined area, in accordance with the designated land use priority and land use management plans;
- The conduct of trial and monitoring programmes into means of improving rehabilitation procedures;
- The monitoring of regenerated areas for their capacity to sustain long-term production of the forest values listed in the objective; and
- The development of remedial treatments should monitoring reveal that rehabilitation objectives are not being fulfilled.

4.2 Rehabilitation Planning

Rehabilitation planning occurs at two levels: The first is broad-scale regional minesite planning on a 10-year time scale. The second is the detailed operational annual planning on a pit-by-pit basis.

For broad-scale regional planning, Worsley Alumina consults with the Forests Department to produce an annually-updated 10-year Mining Plan for submission to the State. In the preparation of these plans, the following aspects of rehabilitation are considered:

- The sequence of mining and rehabilitation
- Access for mining and future management
- Location of mine facilities
- Dieback hygiene
- Water management systems and water-course protection
- Land use priorities
- Buffer zones for fire protection.

On a broad scale, the Forests Department will advise on perceived recreational values, so that Worsley Alumina Pty Ltd may take these values into account in developing rehabilitation proposals.

In terms of recreation, the draft proposal will address:

- Impacts on natural and cultural (i.e. man-made) landscape attractions and recreational features - large rock outcrops, prominent view points, historical sites, and existing recreation development which are considered important to the existing or potential recreational use of the area.

- Types of vegetation to be cleared for mining: this information will also be used in selecting species mixes for re-seeding following mining, in selecting treatments to provide faunal habitats, and in planning stocking rates and selecting vegetation structures and types for particular areas of rehabilitation.

- Assessment of the mining envelope and environs in terms of its existing significance for recreation at a regional and local level. The assessment should realistically identify the opportunities which exist for recreation activities, taking into account both the likely demand for such activities and the capability of the area to service those demands.

- Proposed action to re-establish or enhance recreation potential.

- Post-mining access requirements for recreational use of the area, for incorporation into planning the decommissioning of the mine road network.

- The scheduling of mining and rehabilitation in areas of high visibility, so that visual impacts are minimised to the extent that is practicable.

4.3 Prescription Development

As part of annual operational planning, detailed proposals for each mine pit will be prepared roughly 9 months in advance of actual rehabilitation.

Each detailed rehabilitation proposal will be prepared in draft by Worsley Alumina for joint assessment prior to submission seeking formal affirmation from the Conservator.

The proposal will address:

- Pit identity
- Dieback hygiene, drainage, erosion control and water management
- Management of "islands" of unmined forests
- Species to be used, and type of vegetation structure being aimed for
- Any special features to be incorporated or retained (e.g. pit walls) as part of the rehabilitated landscape
- Long-term management requirements (e.g. fire)
- Scheduling of operations in sensitive areas
- Recreational aspects
- Other relevant matters

A conceptual rehabilitation proposal will be prepared for each area, and must be initialled as "Agreed To" by both the Forests Department and Worsley Alumina.

Departures from the agreed conceptual plans may sometimes be desirable, but will only take place after consultation between Forests Department and Worsley Alumina staff and agreement by both organizations.

4.4 Documentation

Worsley Alumina will assume responsibility for the progressive graphic and descriptive documentation of rehabilitation efforts. The Forests Department will advise of its particular requirements for its internal recording; where practical, these requirements will be incorporated into the documentation programme.

5. REVIEW MECHANISMS

Regular liaison between Worsley Alumina and the Forests Department will demonstrate the results of continuing trials and monitoring. Findings for inclusion in operational practice will then be incorporated into planning and into the agreed prescription of operations. Priorities for experimentation will also be evaluated, and work programmes developed as appropriate.

1984 REHABILITATION PRESCRIPTION

1.0 SITE DESCRIPTION PRIOR TO CLEARING

The mid to upper-slope site in WOR/12/80 supported an open forest of Eucalyptus marginata with a few E. calophylla and Allocasuarina fraseriana; the second storey was dominated by Banksia grandis and the occasional Persoonia longifolia. The site was characterised by the presence of sandy gravels and shallow soils associated with cap-rock outcropping.

The mid to lower-slope site in WOR/7/81 supported a woodland of Eucalyptus marginata, with a few E. calophylla and Banksia grandis, in association with a heathland containing emergent E. drummondii. The deep pisolitic gravels of the woodland contrasted with the shallow silt-sand matrix with underlying cap-rock of the heathland.

Information gathered during the Worsley Alumina Phase Two Vegetation and Flora Studies shows that the average tree stem density for the jarrah forest communities within the Initial Mining Area is 240 stems per hectare for the upper layer tree species (E. marginata, E. calophylla and Allocasuarina fraseriana), and 330 stems per hectare when the second storey species such as Banksia grandis and Persoonia longifolia are included. [These results contrast sharply with those obtained further to the west in the Worsley Refinery Lease Area where stem numbers for the upper layer trees average about 540 per hectare (600 per hectare when second storey species are included)].

2.0 PREPARATION OF AREAS FOR PLANTING

When mining is completed, earthworks will be carried out in the following sequence :

2.1 The pit floor will be deep ripped on the contour to a depth of 1.5m at 1m intervals. Areas programmed for heath development may not be ripped.

2.2 Pit sides will be battered down and the entire area landscaped to enhance aesthetic and recreation land use values. Large boulders derived from deep ripping, or residual from the mining operation will be buried.

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2.3 Water management systems will be aimed at retention and infiltration. Prolonged ponding should not occur on these sites or at sub-surface levels.

This will be achieved by :

(i) infiltration and silt trapping in the contoured rip lines and

(ii) collection of overland flow either in a series of mid-slope contour banks and a pit bottom sump or by a system of grade discharge banks directing overland flow to predetermined sump areas within the pit.

Each sump must have the capacity to cope with the runoff from a 10 day 15 year storm event as calculated from meteorological records and mine pit characteristics.

Where contour interceptor banks are constructed these should be established at up to 10m vertical intervals. Such banks may not exceed 1m in height nor have steep sides which will present an obstacle to future access. Where specified, contour interception banks must be provided with suitably constructed overflows and non-erodable spillways. Construction of these devices must be completed before the first autumn rains.

Where grade discharge banks are used, these will comprise stabilised waterways which direct water to detention sumps within the pit. Sump and drain locations will be indicated on the conceptual rehabilitation plans.

2.4 Overburden will be replaced.

2.5 Top-soil, including forest litter and trash remaining after clearing, will be re-spread and the entire area lightly scarified on contour.

3.0 REVEGETATION

3.1 Tree Seedling Establishment

(i) **Planting Layout and Design**

- As a general rule, tree species are to be established as mixtures, however, pure stands may be planted in localised portions of the landscape.

In every mixture, species indigenous to Mount Saddleback are to be included. Species mixes will be determined in advance and confirmed in the agreed 1984 Rehabilitation Plan by the Forests Department.

- Plant spacing will be varied according to the detailed site rehabilitation objectives. In some areas such as at prominent view points or vistas and along selected areas of roadside, some areas may be left unplanted. In other instances, trees may be planted in small groups or clumps to minimise the rigid plantation effect created by row planting on a regular spacing.

- Aim to achieve an initial stocking of about 500 planted trees/ha.

- Do not plant trees on overflow channels.

- Commence planting when the soil is wet to depth exceeding 1m, after about 1st July. Cease planting by 15th August.

- Seedling sepcifications: plants in jiffy pots or paper pots, approximately 12cm in height with a minimum of 2-4 pairs of leaves. Pots and soil mix sterile. Jiffy pots to be broken open before planting.

- Where pits exceed 5 hectares, internal access for forest management will be provided.

(ii) Species Selection

- Seedlings of 3 Eucalypt species will be planted in areas WOR/12/80 and WOR/7/81, irrespective of landscape position in a mixture as follows :

Species	Ratio
E. wandoo	2
E. accedens	1
E. drummondii	1

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- In addition, the former forest and woodland sites are to be sown with E. marginata and E. wandoo seed, at the rate of 0.25kg and 0.10 kg/hectare, respectively.

(iii) Fertiliser Application

Each tree seedling is to receive 100g. of monommonium phosphate fertiliser at 3 weeks and 9 weeks following planting. Fertiliser to be speared in below ground surface up-slope, and within 15cms of the base of each plant.

(iv) **Success Criteria**

90% survival of planted species, at 9 months after planting, as determined by a 10% systematic sample.

3.2 **Understorey Establishment**

(i) Species Selection

- Species for understorey and ground-cover seeding have been selected from those known to be "indicator" or "associated" species of the vegetation communities represented in the areas prior to mining, from experience gained on the TRE-1 site, and to facilitate erosion control and soil nutrition-building.

- The base seeding mix for all prepared areas will consist of the following species. At least 4 genera will be utilised for understorey establishment.

A. pulchella
Bossiaea ornata
D. rhombifolia
Dryandra nivea
Kennedia prostrata
Macrazamia riedlei

- In addition, the area of former heathland within the WOR/7/81 site will receive seed of the following species. At least 4 genera will be utilised for heathland establishment.

  Acacia alata
  Allocasuarina humilis
  Calothamnus quadrifidus
  Dryandra carduacea
  Grevillea bipinnatifida
  H. undulata
  Hypocalymma angustifolium
  Kunzea recurva
  Melaleuca scabra
  Petrophile serruriae

- Mixed seed will be sown at the rate of 0.75 to 1.0kg/hectare.

(ii) **Fertiliser Application**

All areas will be broadcast with superphosphate at a rate of 450 kg/hectare.

(iii) **Success Criteria**

One plant established per square metre, 9 months after sowing, as determined by a sample quadrat survey of each pit.