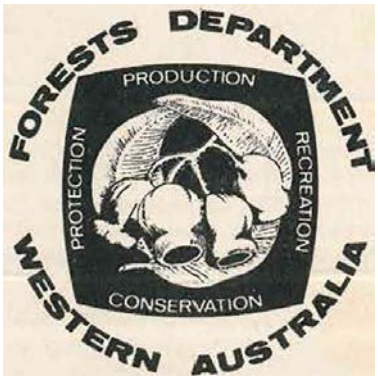
BAUXITE MINING

NORTHERN JARRAH FOREST

MINING OPERATIONS HANDBOOK 1



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Edition 2

January 1983

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1. INTRODUCTION

1.1 GENERAL

The purpose of this handbook is to assist F.D. staff in their management of bauxite mining operations, and in the regeneration of mined areas in State Forest.

Mining in the forest is taking place at a rapid pace. Consequently the information contained herein will need frequent review and update. The Responsibility for this is the Regional Leader (Operations).

The interface between the F.D. and bauxite mining has become very complex over the last 15 years. This is due to:

(1) The great expansion of mining in the forest from Jarrahdale to Del Park to Huntly and now Willowdale and Saddleback.

(2) The entry of a second major company (Worsley Alumina) to join Alcoa in bauxite mining in the forest.

(3) The need to manage according to land use requirements.

(4) Increased environmental awareness; and

(5) The expansion in number and complexity of inter-departmental liaison and working groups interest in land use, mine planning and rehabilitation.

Underlying all these developments, the Forests Department remains the authority basically responsible for the management of State Forest. It is our task to see that designated forest values are preserved in the long term. Mining itself is a brief transitional activity on any specific area of forest, but its impact and effects are very long term. Therefore each phase from planning through to regeneration must be meticulously organized and supervised, using the best information available at the time. As research is done, knowledge will expand and techniques will change. However, expectation of future change does not excuse acceptance of present mediocrity. We must aim for the best we can do on every hectare of forest at every stage of the operation.

This handbook has been prepared for the use and guidance of Departmental officers within the Northern Region. Extra copies must not be made, nor existing copies distributed outside the Forests Department.

1.2 OBJECTIVES, POLICY & STRATEGY

The objective, policies and strategies adopted for forest management in areas affected by bauxite mining operations are set out in General Working Plan No. 87 of 1982. They are:

1. Forest Management Objective

To guide mining operations to areas where there will be least conflict with other land uses, having regard to overall balanced development including economic considerations, and to ensure that mining operations proceed under appropriate safeguards which minimize adverse effects on other competing land uses, to minimize environmental damage and to rehabilitate areas affected by mining to best suit future land use.

2. Policy for Mining on State Forest

2.1 Advise Government of the effects of mining on forest values and current and future land uses.

2.2 Continue research into techniques aimed at minimizing environmental damage and land use conflict.

2.3 Liaise with mining companies to ensure they are aware of the effects of mining on the environment and other land uses and of rehabilitation techniques.

2.4 Liaise with authorities responsible for administering mining agreements and with other organizations authorized to study mining effects and rehabilitation techniques.

2.5 Rehabilitate areas affected by mining to suit the designated land use and in accordance with conditions imposed by State Government under the various mining agreements.

2.6 Liaise with the Mines Department, the Department of Resources Development, and the Department of Conservation and Environment to determine the conditions under which exploration for minerals or petroleum can occur in State forest.

3. Management Strategy

3.1 Minimize the area of State Forest cleared for mining operations.

3.2 Obtain realistic compensation from companies mining on State forests to cover loss of forest values, the continuing cost of management of areas affected by mining, and the acquisition of replacement areas.

3.3 Guide bauxite mining operations into areas where the salinity problem is minimized, into dieback disease affected areas and into low quality forest, where practicable. In achieving this strategy, it is recognized that some areas of healthy forest will be mined in a natural sequence having regard to the topography and the location of ore pods in relation to the optimum extraction routes.

3.4 Seek to direct other mining operations into areas where there will be least conflict with other land uses.

3.5 Seek the inclusion of appropriate conditions governing environmental protection into mineral leases issued under the Mining Act.

3.6 Ensure that exploration in State forest is conducted by companies or individuals in strict adherence to conditions stipulated by the departments responsible for forests and mining.

1.3 HISTORY

1. The biggest mining operation on State Forest is for the aluminium ore, bauxite.

2. In 1958 a temporary lease was made available to a prospecting group, Western Alumina N.L. to carry out a broadscale test drilling programme for bauxite ore.

3. Alcoa of Australia began mining bauxite near Jarrahdale in 1963. A second operation began near Dwellingup at Del Park and Huntly in 1972. A third refinery has been constructed at Wagerup and mining at Willowdale is due to commence shortly. The Worsley Alumina Project is expected to be commissioned in 1983, and will mine in Saddleback Block in Dwellingup Division and process the ore into alumina at the refinery site at Worsley near Collie. The level of clearing of State forest for mining at Jarrahdale, Del Park and Huntly is currently about 300 hectares per year.

4. Alcoa's lease number is MLISA (Mineral Lease 1, Special Agreement). This area is not covered by the temporary reserve 5487H created on July 1971 to prevent granting of reserves on State forest.

5. In 1978 Alcoa presented, and had ratified by Government, an Environmental Review and Management Programme (ERMP) for its Wagerup mining and refining project. This was required under Clause 6 in the Alumina Refinery Wagerup Agreement 1978 (called the Wagerup Agreement).

   This E.R.M.P. apart from detailing the various environmental management and financial programmes designed to reduce adverse impact from mining operations, contained the following significant points:

   (i) There will be no further expansion of Alcoa's production capacity without the submission and approval of a further E.R.M.P.

   (ii) Mining and management programmes would be submitted for areas covered by Alcoa's Jarrahdale and Pinjarra operations, as well as Willowdale (Wagerup).

(iii) Mining will not take place in the eastern low rainfall zone until it can be shown that operations can be conducted there without significantly increasing the salinity of water resources.

(iv) Alcoa will underwrite the upgrading of dieback forest adjacent to mining operations in accordance with Forests Department management requirements.

This treatment commenced in the Seldom Catchment at Jarrahdale in 1978 and is now carried out as an ongoing programme on all minesites. It is known as F.I.R.S. (Forest Improvement & Rehabilitation Scheme).

6. Long term planning for mining operations resulted from the provisions of the 1978 E.R.M.P. as did the setting up of the M.M.P. Liaison Group (Mining & Management Programme Liaison Group) which advises Government on the desirability of long term mining proposals and recommends amendments.

In 1979 the first set of 5 year mining proposals were submitted by Alcoa for approval and in 1980 25 year proposals were submitted for the Del Park, Huntly and Willowdale (Wagerup) mines.

Draft 10 year plans for mining at Saddleback by Worsley were submitted in 1982.

1.4 LEGISLATION

1. Bauxite mining is a major project and it has become normal practice in the past few decades to enact specific legislation for each venture. As a result there are agreement acts for several bauxite operations (active and proposed) on State Forests and Timber Reserves.

2. The Agreement Acts are:-

Alumina Refinery Agreement Act No. 3 of 1961 (Basic Act)
" " " " No. 48 of 1963
" " " " No. 76 of 1966
" " " " No. 61 of 1967
" " " " No. 47 of 1972
" " " " No. 34 of 1974
Alumina Refinery (Pinjarra) Agreement Act No. 75 of 1969
Alumina Refinery (Bunbury) Agreement Act No. 109 of 1970 (repealed).
Alumina Refinery (Pinjarra) Agreement Act No. 48 of 1972
Alumina Refinery (Muchea) Agreement Act No. 97 of 1972.
Alumina Refinery (Worsley) Agreement Act No. 67 of 1973
Alumina Refinery (Pinjarra) Agreement Act No. 116 of 1976.
Alumina Refinery (Wagerup) Agreement Act of 1978.

3. These Agreement Acts differ only in minor detail. Points of direct interest to the Forests Department are paraphrased below (consult the Act itself for detailed information if required):

   (a) The State acknowledges that Companies need to clear forest and remove overburden in order to mine bauxite.

   (b) The Companies are required to give six months notice of their intention to enter onto each specific piece of State Forest and to cut and remove forest produce from this area for the purposes of the Companies' operations.

   The Conservator will grant access to these areas unless:

   (i) he has good and sufficient reason not to grant access for mining.

   (ii) provided that forest produce has been removed before the Company commences mining operations.

   (iii) overburden and unmerchantable forest produce is disposed of without damage to adjacent forest.

   (iv) the area is left tidy, but not necessarily to the original contour.

   (c) In the case of the Pinjarra and Wagerup Agreements, the Company is required to take adequate measures, as determined by the Conservator, to progressively restore and reforest the mined areas, and to prevent erosion and formation of deep water pools.

   (d) The Divisional OIC may restrain the Companies' use of Forests Department roads and direct the routes by which ore may be carried. Any damage to Forests Department roads must be repaired at the Companies' expense to the satisfaction of the Divisional OIC.

   (e) All detours resulting from Companies' operations shall be disposed of to satisfaction of area OIC.

   (f) The Companies shall comply with Bush Fires Act. It shall also take all necessary precautions as indicated by the forest officer to prevent the occurence or spread within or adjacent to the leased area.

   (g) The Companies shall pay in advance to the Conservator of Forests, compensation for forest destroyed by, or as a result of, its mining. These payments are to be made each year in advance. The rate is to be reviewed each seven years from January 1970 and is currently $813.20/hectare.

The review of compensation rate is to take account relative differences of royalties for subsidies in each financial year preceding each seven year review date.

(h) Any dispute which arises in connection with these agreements may be settled by arbitration.

4. In many respects the special agreements have advantages over the Mining Act in that they can incorporate provisions specific to a particular venture.

Staff should be familiar with those sections dealing with forest activity, for relevant agreements.

5. Bauxite mining Agreement Acts are administered by the Department of Resources Development but as can be seen above there are certain responsibilities directly concerning the Conservator of Forests and his officers.

There are also several groups and committees which are directly concerned with, and report and recommend on, the practical and environmental aspects of bauxite mining operations. These are:

Bauxite Policy Committee (Departmental Rep: Mr Beggs)
Purity of Water Committee (Departmental Rep: Dr Hopkins)

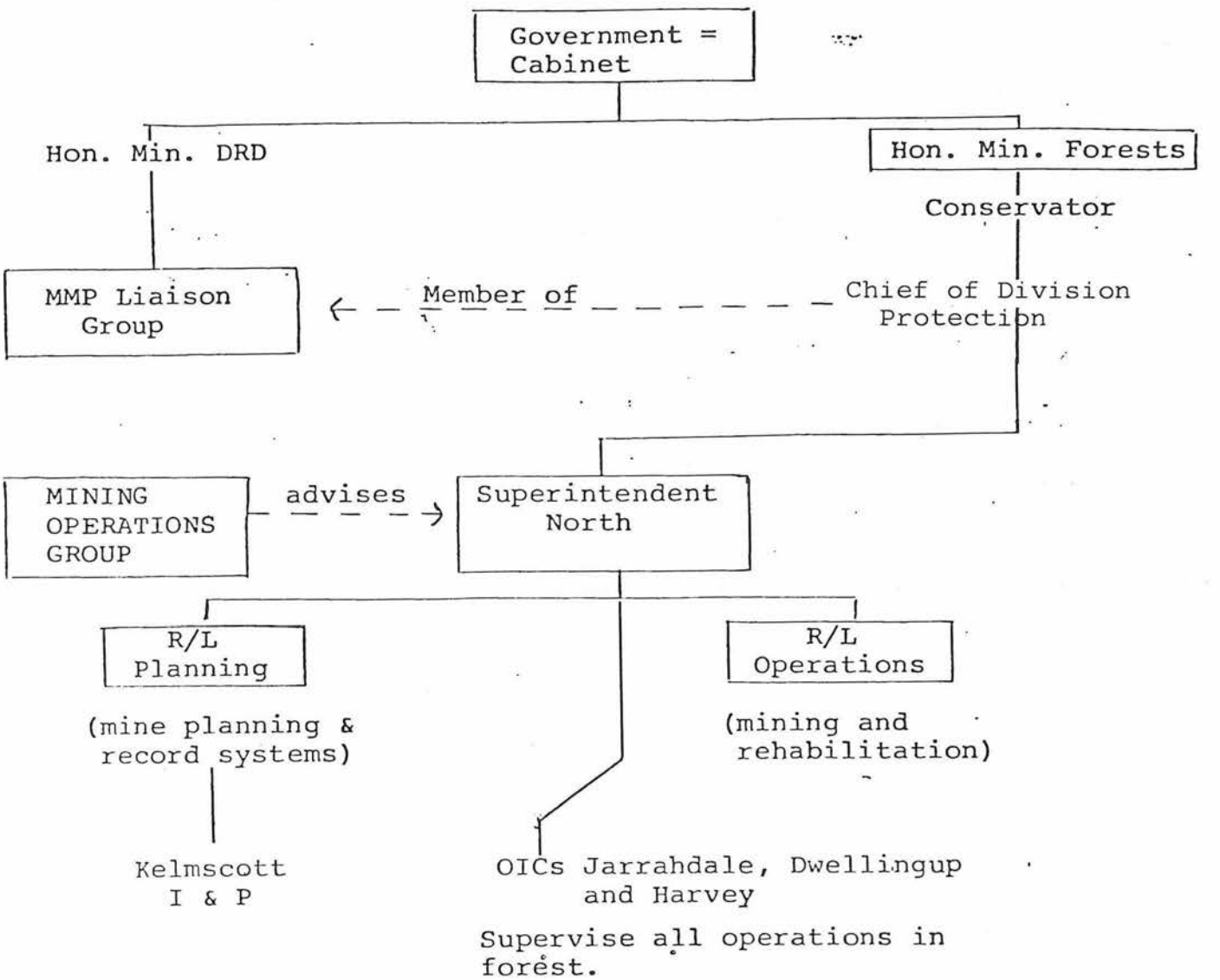
MMP Liaison Group (Mr McNamara)
Mining Operations Group (Mr Underwood).

6. Annoted copies of all the Agreement Acts are held in the Como Regional office.

PART 2 : ORGANIZATION

2.1 BASIC F.D.-GOVERNMENT INTERACTION

Basic relationships between F.D., Government and mine operations are shown below :-



The objective of the M.M.P. Group is to take input from Alcoa and advise and recommend to the Minister for Resources Development mining and rehabilitation strategies which will ensure a commerciall viable mining operation, whilst at the same time, maintain other competing land uses in the best short and long term interests of the community.

The role of the Mining Operations Group is to advise the Conservator on specific operational matters arising from annual clearing applications for mining amendments to rehabilitation prescriptions, and erosion control.

2.2 DIVISIONAL AND REGIONAL ORGANIZATION

The system used for control of the mining industry at divisional and regional level is analagous to that developed over 60 years for the Timber Industry, whereby responsibilities build up from coupes to permits to divisions to Region and to Head Office, with appropriate company liaison at each level.

Therefore, mining responsibilities will be :-

(i) for individual pits (i.e. D9/80) - a junior divisional field officer (e.g. F/G, F/R)

(ii) for mine sites (i.e. Jarrahdale No. 2) - a senior field officer (e.g. A/F,Forester)

(iii) for a division (i.e. Dwellingup) - the divisional OIC

(iv) for overall mine planning - R/L Planning

(v) for overall operations - R/L Operations

(vi) for coordination of planning and operations - North Region Superintendent (who is also Chairman of the Mining Operations Group with membership from other Government Departments).

(vii) for Departmental policy, top level Company and Interdepartmental liaison - Deputy Conservator and Chief of Division (Protection).

It is the responsibility for each officer at each level in this organization to :-

(a) clearly understand his role and tasks;

(b) thoroughly brief and train his subordinate staff and

(c) make regular contact to ensure that correct procedures are being followed.

2.3 COMPANY STRUCTURES

These vary from time to time, as do the personnel involved. It is essential that F.D. staff identify their opposite number in the mining structure and maintain close liaison with that person as the need arises.

ORGANIZATION CHART - ALCOA

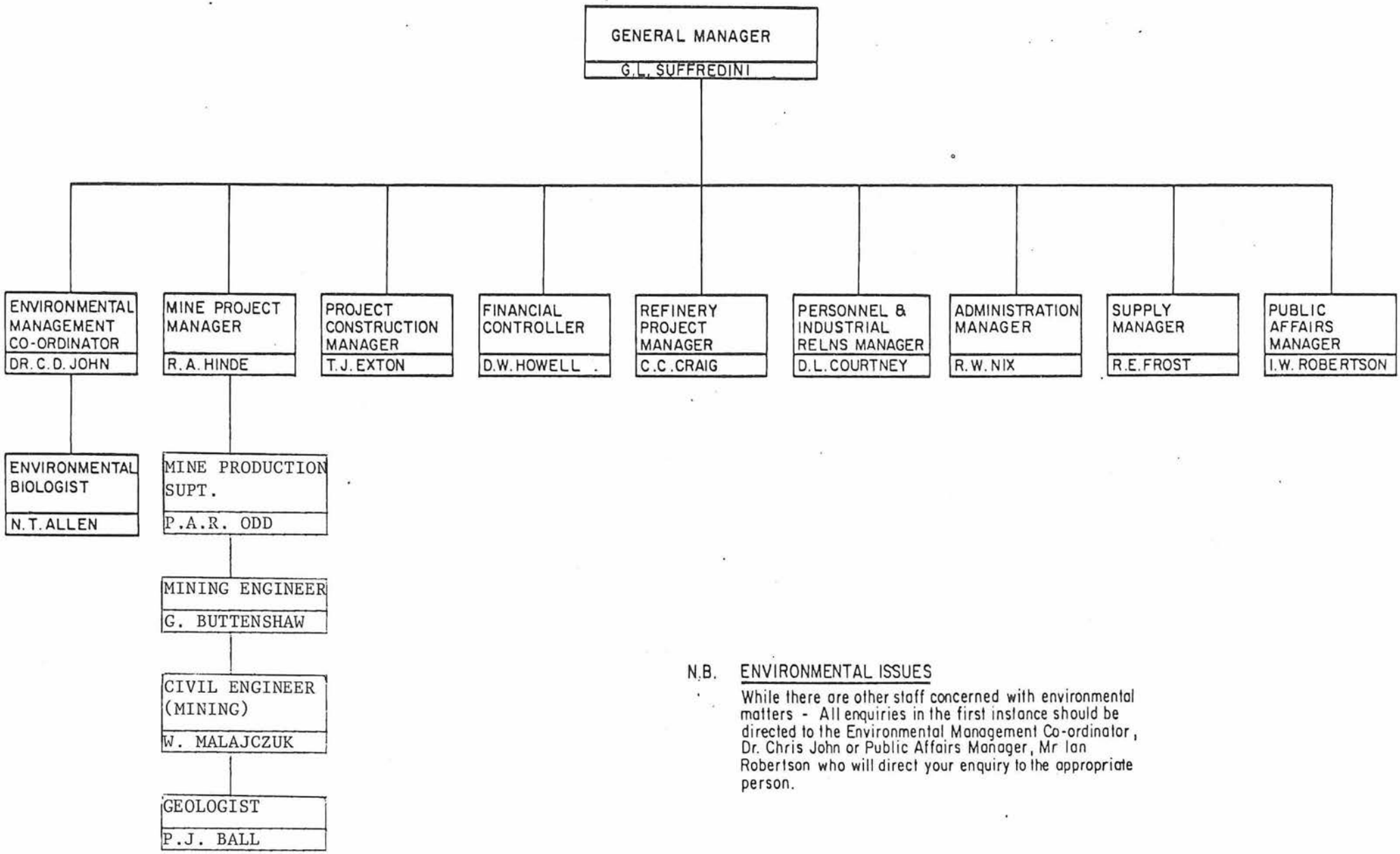
Mining Department		Location
Environmental Department - See chart		
Ore Development		
Ore Development Supt.	T. Barritt	Medina
Chief Cartographer	E. Miguel	Medina
Bauxite Drill Supervisor	G. Barritt	Del Park
Field Supervisor	T. Carter	Del Park
Minesite Jarrahdale		
Mine Supt.	J. Downie	Jarrahdale
Mine and Production Supervisor	R. Thompson	Jarrahdale
Minesite Del Park		
Mine Supt.	D. Ingle	Del Park
Mine Production Supervisor	A. Pivac	Del Park
Minesite Huntly		
Mine Supt.	G. McKenzie	Huntly
Mine Production Supervisor	P. Hallam	Huntly
Minesite Willowdale		
Mine Planning		
	S. Soderstrom	Medina
Engineering		
Chief Engineer	R. Renton	Medina
Supply		
Supply Supt.	P. Haines	Jarrahdale
Accounts		
Mining Chief Accountant	N. Fisher	Medina

ORGANISATIONAL CHART - ENVIRONMENTAL DEPARTMENT

	WORK RESPONSIBILITY
ENVIRONMENTAL MANAGER	**Barry A. Carbon**
— Secretary	Bridget Y. Denison
— Clerk/Typist	Denise Pratt
— ENVIRONMENTAL SCIENTIST (Communications)	
— SENIOR ENVIRONMENTAL SCIENTIST (REHAB).	**David (E) Kabay**
— Nursery Foreman	Don Webb
— Technical Officer	Bill Cooper
— Orchard Overseer	Peter Godridge
------ Minesite Environmental Scientist (Jarrahdale)	John Day
------ Minesite Environmental Scientist (Del Park/Huntly)	Bill Knight
— Environmental Assistant	Vernon Stanford
— SENIOR ENVIRONMENTAL SCIENTIST	**Owen Nichols**
— Ecologist	John Gardner
— Research Scientist (Graduate)	Glenda Pickersgill
— Technical Officer	Paul Rokich
— Environmental Assistant	F. Miller
— Technical Assistant	Alan Lewis
— SUPERINTENDENT - ENVIRONMENTAL RESEARCH	**Graham C. Slessar**
— Research Scientist (Plant Physiology)	Ian J. Colquhoun
— Hydrologist (Darling Range)	James T. Croton
— Research Scientist (Soil Physics)	Eugene Tsykin
— Technical Programmer	Andrew Tierney
— Technical Officers	Ian Green Tony Passchier
— Technical Assistants	Glen Ainsworth Stephanie Johnson
— Environmental Assistant	Mark Lamperd
— SENIOR STAFF ENVIRONMENTAL SCIENTIST (Planning & Assessment)	**John Quilty**
— Environmental Scientist	Neville Murray
— Environmental Scientist	Greg Kaeding
— SENIOR ENVIRONMENTAL SCIENTIST	**Warren Tacey**
— Environmental Scientist (Economics)	Graeme Olsen
— Research Scientist	Sam Ward
— Engineer	John Summers
— Technical Officer	Dan Michaelsen
— FARM MANAGER (Wagerup Farms)	**Ken Power**
— Farm Overseer	Brian Gledhill
— FARM MANAGER (Pinjarra Farms)	**John Devenish-Meares**
— Farm Overseer	Tom Broadhurst

WORSLEY ALUMINA PTY LTD

ORGANIZATION CHART



N.B. ENVIRONMENTAL ISSUES

While there are other staff concerned with environmental matters - All enquiries in the first instance should be directed to the Environmental Management Co-ordinator, Dr. Chris John or Public Affairs Manager, Mr Ian Robertson who will direct your enquiry to the appropriate person.

PART 3 : PLANNING

3.1 LAND USE

The Forests Department recognises bauxite mining as a temporary activity, and is listed in the L.U.M.P. as being:-

(a) largely compatible with areas designated for Water Production priority;

(b) permitted in areas designated for Recreation, Catchment protection, Scientific and Timber Production priority so long as there will be no significant harm to these primary uses; and

(c) incompatible with land use in areas designated as Conservation of Flora Fauna and Landscape M.P.A.s.

3.2 PLANNING PRIORITY

For planning purposes, the Department seeks to guide mining into areas of least conflict with other land uses.

In the overall planning process, the Forests Department is required to:-

1. Review and make recommendations on company 25 year plans. These depict overall mining strategy and sequence of operations.

2. Review and make recommendations on Company 5 year plans. These cover detailed operational proposals and sequence.

3. Approve the annual applications, which cover the specific areas of forest to be cleared.

There are 4 possible responses: opposition, deferment, modification and approval or simple approval.

Dealing with these in turn:

Opposition:

Proposals will be opposed when mining is wholly incompatible with land use classification, e.g.

Conservation MPA - core
Conservation MPA - buffer or part buffer
Some scientific MPA
"Sacred sites" - specific areas of special importance to forestry, society or science; e.g. Mundlimup regrowth, Deer road research area, townsite, etc.

3.2 Modify/Defer

Proposals to be modified, or mining deferred for areas where time is needed to study long-term effects, or because to mine elsewhere first is more sensible from State's viewpoint; e.g.

areas designated catchment protection, where salinity risk high;
quarantine areas;
zone around dams and reservoirs;
high quality, diebackfree forest.

Approve

Areas where there are none of the above problems.

NOTE: Final decisions on all these matters are taken by the Minister for Resources Development.

3.3 MINING PLANS

The following is the basic mining plan framework:-

25 Year Plans: Prepared by Alcoa for review by all interested parties. Shows broad "order of march" and involves basic strategic decisions on direction of operations for coming 25 years.

10 Year Plans: Prepared by Alcoa. Apply only to Willowdale. Based on 25 year plan. For review by F.D.

NOTE: Worsley Alumina also prepare 10 year plans.

5 Year Plans: (also known as Mining & Management Programmes, or MMPs). Prepared by Alcoa annually for each minesite for review by MMP Liaison Group, Government Department etc., and approval in principle by Minister for Resource Development.

1 Year Plans: (also known as "Annual Clearing Applications"). Prepared by Alcoa, based on 5 year plans, submitted to Conservator of Forests for approval to clear forest.

Copies of all plans are held at Head Office and Como; copies of the 5 year and 1 year plans are held at Divisional offices.

All plans are confidential.

Any enquiries from outside individuals or organizations regarding mine planning must be referred to the Company, other than approved 5 year plans, which are public.

3.4 OTHER PLANS

Annual rehabilitation plans and detailed plans for each pit are prepared each year in liaison between the Company and the Forests Department.

3.5 AERIAL PHOTOGRAPHS

The company takes aerial photographs of each mine site in February of each year and these are used for mapping and calculation of compensation.

Mosaics are issued to the Regional and Divisional offices.

3.6 PROCEDURE FOR REVIEW OF 5 YEAR PLANS

1. Check compliance with "approved" 25 year plan. By overlay, indicate discrepancies (i) by area and (ii) by sequence.

   Action: Drafting Branch

   Consider whether 5 year plan (e.g. crusher site locations) might pre-determine options for next 5 years in an undesirable direction.

   Action: Regional Leader (Planning)

2. Check compliance with existing 5 year plan. By overlay indicate discrepancies (i) by area and (ii) by sequence.

   Action: Drafting Branch

3. Check with specialist branches for possible problems with research plots etc.

   Action: DFO

4. Check forest values within proposed mining areas. Show on overlay, areas proposed for mining which have these characteristics:-

   (i) Diebackfree
   (ii) High in the landscape (i.e. protectable and above existing mines or mine access)
   (iii) JA or JA+ forest.

   Action: DFO

5. Check LUMP plan and influence zones for towns, recreation areas; buffer and core conservation MPAs etc. Indicate areas where mining is incompatible with priority land use.

   Action: R/L Planning

6. Check proposed haul roads, conveyor routes and powerlines to see that:-

   (i) Clearing will be minised
   (ii) Optimum use is made of mines, existing easements, PP.
   (iii) Routes are low in the profile
   (iv) diebackfree protectable forest avoided.

   Action: DFO

7. Check crusher site locations to ensure that they are located on ore body, low in profile, involve minimum clearing.

   Action: DFO

8. Check water points to ensure best location with respect to stream zone, location of access roads and power lines.

   Action: DFO

9. Check areas where ore exists, but is not proposed to be mined by the Company planners (e.g. "Buffers" adjacent to PP). Indicate whether forest is degraded, poor site etc.

   Action: DFO

10. Check public and F.D. access. Identify problems of road realignment and closure.

11. Consolidate reports as follows:-

    Division ----------→ R.L. Planning ----------→

    Supt. ----------→ H.O.

3.7 CHECLIST FOR ANNUAL CLEARING APPLICATIONS

1. At Regional Office

   1.1 Check compliance with approved 5 year plans.

   1.2 Check compliance with agreed buffer and F.I.R. plans.

2. At Divisional Office

   2.1 Check District Tenure plans for problem with

   - P.P
   - Other crown land
   - Gazetted roads
   - Forest leases
   - Apiary sites
   - Licence areas for forest produce

   2.2 Check Fire Plans

   - current burning plan
   - Alcoa envelope
   - access to high value/hazard areas.

   2.3 Check 1:50,000 maps and identify

   - road closure or detours
   - effects on streams, water points
   - effects on recreation facilities
   - research or permanent inventory plots.

2.4 Check photographs and dieback maps and identify dieback risk categories in proposals.

3. In the field

3.1 Confirm demarcation of ore bodies and mine access

3.2 Assess timber salvage requirements and allocate by resource class.

3.3 Confirm dieback information.

3.4 Check location of proposed roads/conveyors/ powerlines/crusher sites/water points.

3.5 Determine roads which must be closed.

3.6 Identify steep areas which may have future erosion problems.

4. Prepare report for Superintendent, highlighting sensitive or potentially contentious items for further field checking by Mining Operations Group.

5. Responsibilities are:

Regional Office: R/L Planning
Divisional Office: OIC Division
Field Work: OIC Minesite.

PROCEDURES FOR MINOR CLEARING APPLICATIONS

In the course of a year, the Company often submits minor clearing applications: i.e. small corners, ore pockets, haul road extension, minor clearing for safety or drainage purposes.

Minor clearing applications will be processed as follows:

(1) D.F.O. accepts application.

(2) Makes a decision.

(3) Consults with M.W.A. or P.W.D. if a gazetted catchment is involved.

(4) Modifies his decision if necessary.

(5) Advises Alcoa of decision.

Note that the D.F.O. acts on behalf of the M.W.A., and P.W.D. and does not ask Alcoa to consult with the M.W.A. or P.W.D.

PART 4: OPERATIONS

This section comprises:

1. Background on Exploration and Drilling
2. Dieback Hygiene Prescription for Alcoa's Field Operations (Drilling and Exploration)
3. Prescription for Hygienic Bauxite Mining
4. Forest produce salvage
5. Clearing and mining
6. Prescription for REHAB 83

4.1 BACKGROUND ON EXPLORATION AND DRILLING

4.1.1 Phases of Exploration

Phase 1: Magnetometer Survey: remote sensing to broadly outline areas of laterization. Completed many years ago for most of Lease.

Phase 2: Exploration drilling: Drilling at 400 foot grid to prove up best areas from magnetometer survey. Done with no dieback hygiene during the 1960's. Not permitted since 1972.

Phase 3: Development drilling: firming up of ore bodies by drilling at 200ft. centres, 2-5 years in advance of mining. Dieback hygiene conditions imposed since 1976.

Phase 4: Grade Control Drilling: Final ore definition by drilling at 15m centres 6 months-2 years before mining. Hygiene restrictions according to dieback category since 1976.

Phase 5: "Fill-ins": Anomalies or areas with assay problems drilled just prior to mining.

4.1.2 Ore Grades

Alcoa seeks bauxite ore capable of producing an average of 31.5% alumina. The lower cut-off grade is 27.5%.

All information on ore resource and grades is in the hands of the company, as are details of the economic calculations which determine average and cut-off grade acceptability.

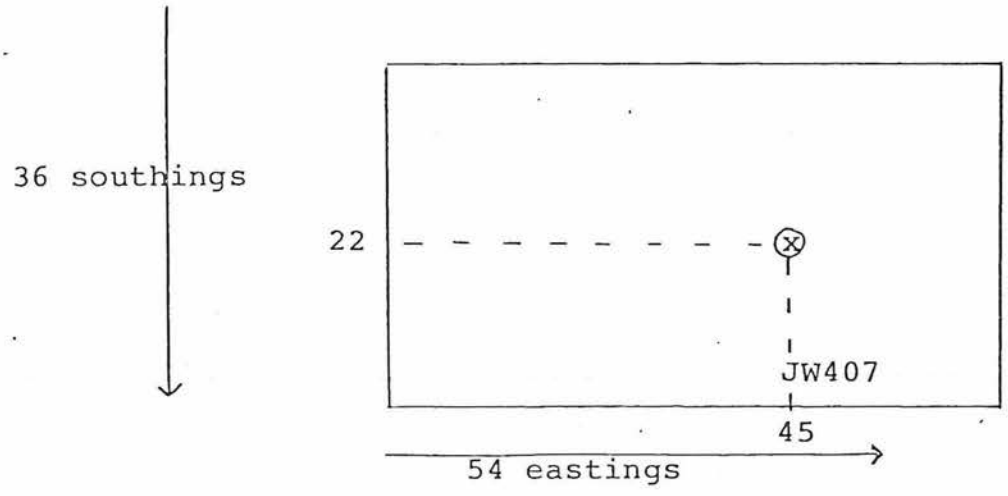
4.1.3 The Alcoa Mapping System

(1) Imperial map scale was used to early 1970.

Many imperial maps are still in use. The imperial grid system comprises "squares" of 830m x 600m, with 28 "squares" to a "block", of 3,300m x 3,600m.

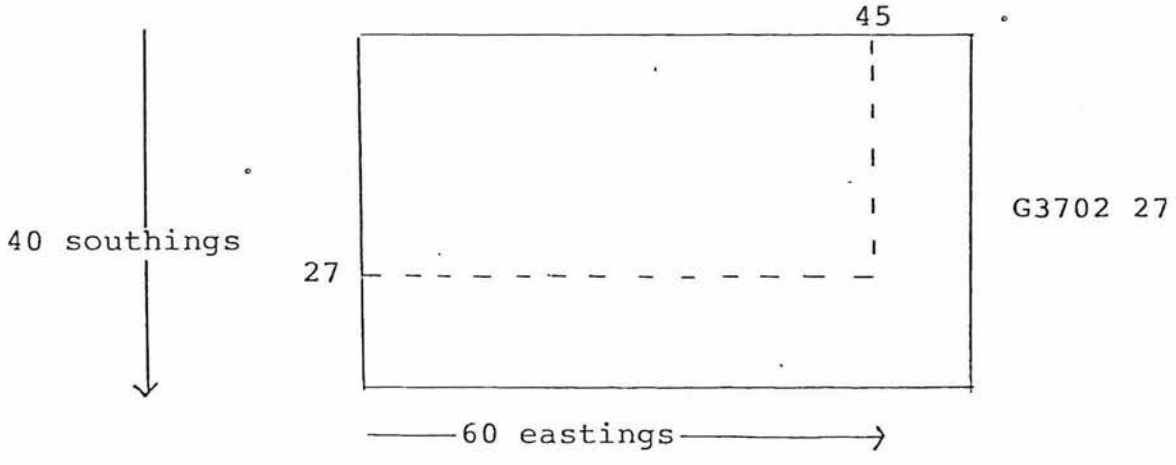
Within each "square" points are identified by southings and eastings. The southing axis has 36 digits and the eastings axis 54 digits.

For example, for square JW407, the point shown is JW407.22.45.



(2) Metric Maps are now coming into more general use.

The same grid system is used, except that 40 southings and 60 eastings are used and "Squares" are designated one letter and 2 digits, e.g.



DIEBACK HYGIENE PRESCRIPTION FOR ALCOA'S FIELD OPERATIONS

Introduction

Jarrah dieback is a serious forest disease of south-western Western Australia. It is caused by the soil borne fungus Phtyophthora cinnamomi. An effective means of controlling the disease is by the practice of "dieback hygiene". The aim of dieback hygiene is to prevent the transport of the fungus from infected to dieback-free forest.

Field operations are carried out under a range of soil moisture conditions over a wide area of forest which is either dieback-free or infected. This results in a high risk of spreading dieback over a considerable area.

Field operations for ore development is the first phase in mining and can take place several years in advance of mining.

Flexibility is required to best use the most recent knowledge of dieback and it's control.

1. Terms of Reference

1.1 The Forests Department dieback policy as outlined in General Working Plan No.86 and approved by the Government, requires the continual improvement and application of hygiene measures according to best current knowledge.

1.2 The Wagerup ERMP recognises that effective hygiene measures during bauxite mining operations are necessary to prevent the spread of jarrah dieback.

1.3 Alcoa is responsbile for implementing hygiene measures contained in this prescription.

2. Scope of Prescription

2.1 This prescription represents the best known practical

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hygiene methods as indicated by the most recent research o the physiology and ecology of jarrah dieback.

2.2 This prescription covers all field operations for ore development prior to mining which includes the following phases - geological work, surveying, field mapping, pegging of drill sites and the drilling of each site using drills mounted on rubber tyred tractors.

All types of drilling operations are covered and include grade control, developmental, exploratory and environmental drilling.

2.3 This prescription covers all aspects of field operations from the planning to the operational phase.

2.4 This prescription applies only to areas outside of quarantine within Alcoa's bauxite mining lease on State Forest and Timber Reserves set aside for Water Production, Timber Production and Recreation as the priority land use under Land Use Management Plans developed by the Forests Department.

2.5 This prescription is to have uniform implementation in all Forests Department divisions.

2.6 Terminology - See Appendix 1.

3. Objective of Hygiene

To carry out operations in a manner which does not spread jarrah dieback disease into dieback-free forest.

4. Current Knowledge of the Biology of Phytophthora Cinnamomi

4.1 Effective hygiene measures can only be developed if the biological interactions of the host, pathogen and environment are understood.

4.2 Phytophthora cinnamomi is an introduced, soil-borne pathog that has some saprophytic activity. That is, it mainly attacks living plant tissue, but can also survive for a time living on dead plant material.

4.3 Its principal method of attacking plants is through infection of their roots by zoospores; small spores which are able to move toward plant roots when soil-moisture levels are high. Extension of the disease through the soil, by the growth of fungal mycelium, is very slow and can be ignored for all practical purposes.

4.4 An infection expands by downslope movement of spores in overland waterflow at a rate which varies with soil type, steepness of slope, soil moisture conditions and presence of highly susceptible hosts. At present we have no way of preventing this. Upslope extension of an infection is very slow indeed.

4.5 During extended dry periods, few zoospores survive in the soil under Western Australian conditons, but fungal mycelium persists in the roots of infected plants. The infected host may be alive or dead. A special type of spore resistant to desiccation, called a chlamydospore, has not been found to be important in Western Australian soils.

4.6 The zoospores are produced by fruiting structures called sporangia. Sporangia can be very rapidly produced, but only under suitable conditions, that is, in warm, wet soil and when soil temperatures are in the range 15 - 27°C.

4.7 There is marked variation in the behaviour of the disease on different forest sites. On moisture-gaining sites, that is lowland areas and valley floors, soil moisture conditior are suitable for zoospore production for long periods in spring and early summer. On freely-drained upland sites, which constitute about 75% of the jarrah forest, conditions are suitable for zoospore production for a much shorter

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period of one to six weeks each year, depending on rainfall patterns. In certain soil types, such as the red loams found along major river valleys, the disease appears to be suppressed and susceptible plants are apparently unaffected.

4.8 Suitable conditions for zoospore production are found primarily during spring every year. The length of the suitable period varies from year to year with seasonal weather patterns. The build-up of fungal inoculum may also be significant in autumn, and the amount of build-up appears to be determined by the nature of early seasonal rainfall. Rains from the north-west maintain high soil temperatures and permit a rapid increase in inoculum, whereas the cold rains caused by Southern Ocean frontal activity cause a rapid drop in soil temperature which inhibits fungal activity. In autumn, after a build-up of the soil zoospore population, the spores may become encysted or go into a resting stage with the onset of cold weather. These spores become active as soon as soil temperatures rise sufficiently in the following spring.

4.9 New infections of the disease occur through the transport of soil or plant material from an infected site to an uninfected site. This can only be prevented by all forest users maintaining effective forest hygiene procedures.

4.10 Once a new infection is initiated, it is usually 18 months to three years before the presence of the disease is indicated by the death or decline of susceptible plants, which is the only external indicator of the presence of the disease.

5. Principles of Dieback Hygiene

5.1 Disease is spread by movement of overburden containing infected root material, clods of soil containing mycelium or zoospores, or by zoospores moving freely in a water medium.

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5.2 Because of the variable levels of the pathogen in soil particularly and in roots throughout the year there will be varying degrees or levels of risk associated with management activites in the forest. Hygiene prescriptions will need to reflect this.

5.3 The potential to spread disease by transporting infected root material is relatively high all year. In spring and autumn there is likely to be higher levels of inoculum in these roots than at other times of the year.

5.4 The transport of soil (+ roots) in spring (particularly) and autumn presents a risk of moving high amounts of inoculum and gives a greater chance or risk of starting new infections. This will also be a problem in any winter which follows an autumn which allowed rapid build-up of pathogen populations.

5.5 The unpredictability of autumn weather and the continued presistence of mycelium in the soil over winter in favourable seasons is an added complication which has significant planning implications.

5.6 At all times of the year infected lowland and moisture gaining sites are likely to contain high soil population levels of the pathogen.

5.7 Favourable conditions for rapid build-up of inoculum can be caused by unseasonable weather (e.g. extended summer rains).

5.8 The position of the field operation in the terrain affects the biological impact of introducing the disease. The fungus spreads downhill without assistance from man.

5.9 The biological impact of introducing dieback is most damaging in an area of dieback-free forest high in the terrain surrounded by high quality dieback-free forest.

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5.10 The impact decreases as the proportion of dieback increases and the field operation is situated lower in the terrain.

5.11 Dieback symptoms are complex and correct definition and demarcation of the disease on the ground is difficult. Hygiene precautions must take account of this difficulty.

5.12 Areas mapped as dieback-free may have sources of recent infection where symptoms have not shown. Frequent cleandowns in dieback-free forest reduces the probability of picking up dieback infections on areas which are not apparent or which have been incorrently mapped.

5.13 The probability of spreading dieback is reduced if the degree of hygiene is more intense and more frequent and the cleandown more thorough.

5.14 Small quantities of infected overburden down to 1 gram are sufficient as a source of infection.

6. Hygiene Strategy

6.1 All forest will be categorised into either dieback, suspect or dieback-free forest. In the field, management lines demarcated by the Forests Department will separate the three categories.

6.2 Field operations will be confined separately to each category. Transfer from one category to another requires specific hygiene conditions.

6.3 Access to each category will be defined in advance by the Forests Department.

6.4 Vehicle cleanliness is the basis for controlling dieback spread in the field operation. Cleanliness can be achieved by:

- fungicide treated water wash down using high pressure

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low volume pump.
- airhose to either suck or blow by use of vacuum pump or compressor.
- brushing down.

6.5 Soil moisture status will limit drilling operations:

6.5.1. All geological, surveying and drilling operations - exploratory, developmental, grade control - will be possible in all dieback categories during dry soil conditions when the probability of spread is lowest. These soil conditions must also prevail on access roads.

6.5.2. In the event of summer rainfall of 5mm or more, access into dieback-free forest for surveying, exploratory and developmental drilling may be temporarily suspended at the discretion of the local Divisional O.I.C. Where drill rigs are already inside a dieback-free area, drilling may continue provided overburden is not being picked up, however, support vehicles must be left outside the dieback-free boundary.

6.5.3. Grade control drilling is possible in dieback-free and suspect forest during moist soil conditions under the following restrictions:
- drill rigs do not pick up and transfer soil while operating in the drill area or travelling on access roads.
- support vehicles remain outside the dieback-free boundary.

6.5.4. Geological, surveying and drilling operations other than grade control are not possible in dieback-free forest during moist soil conditions.

6.5.5. All geological, surveying and drilling operations are possible during wet and moist soil conditions in dieback forest.

7. Planning for Drilling Operations

7.1 Alcoa will submit to the local office of the Forests Department by September each year proposals for the next 12 months drilling operations showing:

7.1.1 Broadscale plan of proposed drilling areas and type of drilling on 1:50,000 scale based on agreed twenty five year mining plans.

7.1.2 A programme for each area indicating times proposed for drilling.

7.2 Local divisional O.I.C. will confirm in writing approval or otherwise of the proposals.

7.3 Changes or additions to drilling operations will be possible throughout the year provided adequate notice is given to allow dieback demarcation to take place.

7.4 Drilling should aim to be sufficiently in advance of mining in order to allow for flexibility which takes into account periods of high probability to spread dieback.

7.5 Plan to minimise access and vehicle movements.

7.6 Prior to the commencement of drilling, Alcoa will provide the Divisional O.I.C. with 2 copies of a drill layout sheet indicating regular drilling information.

The divisional O.I.C. will show on these sheets:

- dieback managment lines.
- access routes.
- points for vehicle cleandown.

One copy of the sheet will be returned to Alcoa.

7.7 Alcoa will provide local divisional office with the location of drilling rigs and survey crews on a weekly basis.

8. Field Operations

8.1 Training - Vehicle operators must be trained in the techniques of inspection for vehicle cleanliness and vehicle cleandown, and hygiene principles.

8.2 Prior to departure from the base depot all vehicles must be in a clean condition.

8.3 Access is to be confined to routes approved by the Forests Department. This is important during wet or moist soil conditions.

Damage → See file 916.25

8.4 Dieback-free forest

8.4.1 Prior to entry into an area every vehicle is to be inspected to ensure no overburden has been picked up in transit. Cleandown is required at the dieback boundary or nominated cleandown point if the vehicle is not clean.

8.4.2. Each vehicle traversing an area must be continually checked to ensure that overburden is not being picked up. If soil conditions deteriorate so that soil is picked up, the operation must cease until soil conditions improve or transfer to dieback forest via an approved access road.

8.4.3 Do not cross moist, low lying flats or creeks. These are normally infected with dieback.

8.4.4 After drilling each hole prior to departure for the next hole, the drill rig must be inspected for cleanliness. If the vehicle is not clean of overburden, cleandown is required.

8.4.5 Cleandown should take place at least once a day as a safety measure. This is important where the biological impact of dieback spread is high.

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8.5 Suspect Forest

8.5.1 Conditions applying to drilling in suspect forest will be the same as those for dieback-free forest above (8.4.1-5).

8.5.2 Prior to leaving suspect forest vehicles are to be free of overburden.

8.6 Dieback Forest

8.6.1 Cleandown between holes is not necessary.

8.6.2 Do not cross moist low lying flats or creeks.

8.6.3 Prior to leaving dieback forest vehicles are to be free of overburden.

9. This prescription will be reviewed in July, 1983.

APPENDIX I.

Terminology

Cleandown: the process by which soil and other material is removed from vehicles and machinery. Water, air or brushing may be used as an agent for cleaning down, depending upon whether mud or dust is to be removed.

Dieback forest: forest in which dieback symptoms are present in the understorey and/or overstorey.

Dieback-free forest: forest apparently free of dieback.

Suspect forest: forest in which the evidence for dieback presence is inconclusive.

Dieback management line: a blazed and painted (yellow) line, in the field which separates dieback forest from dieback-free forest. (The line is blazed so that the yellow blazes face towards dieback forest)

Drilling operations: includes exploratory, developmental, grade control and environmental drilling. The surveying in of drill sites and pegging is also regarded as being part of the drilling operation.

Drilling area: area designated on the drill layout sheet including designated access routes.

Drill rigs: drill mounted, rubber tyred tractors.

Support vehicles: light vehicles (4 x 2 or 4 x 4), small trailer units, etc.

Field Operations: All ore development and environmental operations carried out in the field prior to mining.

Fungus: one of the lower forms of plant life which, lacking chlorophyll and being incapable of manufacturing its own food, derives its energy from dead or living plant or animal matter.

Forest hygiene: forest management activites designed to prevent

transport of fungal inoculum from an infected area to an uninfected area.

Inoculum: portions of any pathogen capable of being spread to uninfected areas and initiating a new infection of the disease.

Moisture-gaining site: an area, that due to local topographic or soil factors, tends to be more moist than the surrounding area.

Mycelium: the vegetative parts of a fungus, as distinct from the reproductive parts such as sporangia.

Overburden: soil and roots above the laterite but does not include ore material.

Pathogen: any living entity (in this case a fungus) capable of causing disease.

Sporangium: a plant organ that produces spores.

Zoospore: a mobile spore of some algae and fungi.

PRESCRIPTION FOR HYGIENIC BAUXITE MINING IN STATE FOREST

1. Introduction

1.1 The western high rainfall zone is potentially the most productive area for water and timber in the Northern Jarrah forest. A large proportion of this zone has been classified as dieback affected or dieback non-protectable.

1.2 The imposition of bauxite mining onto this disease situation has compounded the problem. In the past, hygiene within areas to be mined was regarded as a waste of time, and Drilling occurred throughout the forest in all seasons of the year.

1.3 Recent research into the biology of Phytophthora cinnamomi has shown it to be an ephemeral pathogen on freely drained upland sites. There is a possibility that the environment can be manipulated against P. cinnamomi on these sites which are predominantly dieback-free.

1.4 Experience and knowledge gained as a result of the 70mm mapping and interpretation has shown that indicator species deaths are caused by many factors including P. cinnamomi. Not all areas once called "dieback" are infected with the disease, particularly in the western jarrah forest.

1.5 More positive disease management is now required in the western high rainfall zone aimed at minimizing the spread of P. cinnamomi and the impact of mining in the jarrah forest.

1.6 In order to achieve this aim, it is necessary to implement dieback hygiene in mining areas. Hygiene will be designed to protect both the mined areas and the surrounding unmined forest from dieback infection.

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1.7 These guidelines form the basis for developing detailed hygiene prescriptions for all mine associated operations.

1.8 Responsibilities - See appendix.

2. Factors which Contribute to Spread of Disease

2.1 Geographic Dispersion

The pattern of mining is a mosaic of mine pods scattered through the forest with indented boundaries resulting in a high pit/forest interface. Pits and minesites/refineries are linked by a massive network of roads, conveyors and powerlines.

Mine pods are situated mainly on the middle and upper slopes of the forest.

The potential disease impact on the unmined forest is therefore very severe.

2.2 Access

2.2.1 Haul Roads

Haul roads have a high potential for dieback spread because of:

(a) Infected gravel movement during construction and maintenance and the movement of infected vehicles

(b) The large runoff from haul roads due to rain and artificial watering increases the moisture in the adjacent forest resulting in favourable moist conditions for pathogen survival.

(c) Location which can place at risk large areas of forest below the haul road.

(d) The dense network of haul roads.

(e) Operations during wet soil conditions.

2.2.2 Conveyor Lines

The impact on adjacent forest can be severe as a result of:

(a) The introduction of diseased gravel during construction.

(b) Wet soil operations.

(c) Movement of infected vehicles.

(d) Location which can place at risk large areas of forest below the conveyor line.

2.3 Scale

The scale of operations and activity is massive with large numbers of contractors, machinery and vehicles dispersed through the mining area with a high degree of vehicular movement through a dense access network, at all times of the year in all weather.

2.4 Production

Specific mining operations are undertaken on the basis of production. Company planning does not consider hygiene constraints other than at the most superficial level.

2.5 Season

Access construction and mining is continuous regardless of wet soil conditions.

2.6 Topsoil movement during rehabilitation. There is a high probability of disease spread with uncontrolled movement of topsoil.

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2.7 Removal of Forest Produce. Timing of the clearing applications has resulted in most of the forest produce removal taking place during moist soil conditions. Hygiene is not being practised within the area to be cleared.

3. The Objective of Hygienic Mining

The objective is to undertake mining and associated activities in a manner which does not spread P. cinnamomi into dieback-free forest.

4. Disease Management Proposals

Hygienic mining operations will be introduced on the following basis:

4.1 Priority Areas for Disease Management

It is recognised that hygiene in mining is a long term objective with many problems to be overcome before effective implementation.

Priority areas are the large areas of dieback-free protectable forest high in the landscape. When these areas are fully protected, other dieback categories may be considered.

Steps to be undertaken are:

4.1.1 Within each 5 year mining envelope define the major areas (>10ha) of dieback-free protectable forest before mining.

4.1.2 Superimpose approved mine pods, conveyors, access roads and contours to reveal major areas of dieback-free protectable forest likely to remain after mining.

4.1.3 Negotiate to protect the major unmined dieback-free protectable forest - for example by changing boundaries of pits, re-routing conveyors, haul roads etc.

The aim is to minimise the impact of mining and access in the unmined dieback-free protectable forest.

4.1.4 Consequently, identify:

PRIORITY 1... (i) Areas which must be protected by excluding mining activities. ie. Dieback-free protectable stands.

PRIORITY 2... (ii) Areas which can be protected if hygienic mining succeeds.

4.2 Principles of Disease Control

The four main principles to consider in limiting disease spread are:

1. Hygiene units (referred to as "coupes" in logging)
2. Access
3. Cleanliness
4. Timing

The first step is to classify the area.

4.3 Classification

Classify the area to be mined.
Use 1:25,000 Topographic plans with contour print as base map.

4.3.1 Identify Land Use Priority Area Boundaries, from LUMP.

4.3.2 Identify Disease Distribution, from latest Dieback maps and aerial photos updated by road traverses, ground survey and other relevant information so as to locate major areas of dieback-free forest.

Dieback Location Map

Further mapping effort must be concentrated into the predominantly dieback-free forest areas to produce a Dieback Location Map.

The "ground truth" information is delineated as follows:

-- Dieback-free protectable
-- Dieback
-- Suspect
-- Uninterpretable
-- Downslope of dieback or suspect.

4.4 Complete the Operation Map

Subdivide the Dieback Location Map into operation units and select access.

4.4.1 Hygiene Unit Selection

Each unit is a single dieback category namely;

-- Dieback
-- Suspect
-- Uninterpretable
-- Diebackfree Downslope of dieback
-- Diebackfree Downslope of suspect
-- Diebackfree protectable
-- parts of a single dieback category.

Subdivide areas of diebackfree forest into single microcatchments by using natural drainage and catchment boundaries.

4.4.2 Access System

This covers all access including haul roads, access for support vehicles and conveyor lines. Design the basic access system and mark on plan.
Observe these guidelines:

(i) Use as few access routes as possible;
(ii) Access routes to be as low in the profile as possible with minimum area of dieback-free forest below the road.
(iii) Categorise type of access e.g. haul road, light access.
(iv) Define unwanted access for closure;

(v) Avoid crossing dieback categories;

(vi) Work through the "Dieback Hygiene Guide" to cross-check decisions taken.

It is accepted that conflicts will frequently arise in this area. In this case point (ii) should take priority.

4.4.3 Identify and quantify dieback-free forest put at risk by mining and associated access. When testing alternatives, this figure can be used as a criterion.

4.5 Vehicle and Machinery Cleanliness

Plant cleanliness is required between hygiene units as follows:

Hygiene Unit	Status of Plant on entry	Status of Plant on exit
Diebackfree protectable	Must be clean	Need not be clean
Diebackfree downslope of Dieback	Must be clean	Must be clean
Suspect	Must be clean	Must be clean
Diebackfree downslope of Suspect	Must be clean	Must be clean
Dieback	Need not be clean	Must be clean at entry to Dieback-free forest
Uninterpretable	Must be clean	Must be clean

The Dieback Hygiene Guide must be used to cross-check each decision taken for each area.

Where cleanliness is prescribed on entry to or exit from a coupe, or sub-coupe, this applies to all plant and vehicles.

Washdown must be at the point of entry, if there is any risk of dieback pick-up en route to the forest.

If roads deteriorate, or free water lies on the road so that

there is a risk of soil pick-up and transport, travel through dieback-free forest must cease or a washdown at entry to dieback-free forest must be done.

4.6 Timing

Operations must be carried out when there is:

1. Least probability of spreading infected overburden.
2. Least amount of viable inoculum in the soil.

These conditions prevail during dry soil conditions following extended rain free periods in summer.

5. Mining Operations

Mining operations which require hygiene are those which are in contact with or affect the zone where Phytophthora is harboured ie. overburden or area above the lateritic layer.

The mine associated operations of most concern are:

-- Drilling and associated exploration activities prior to clearing.
-- Removal of forest produce
-- Clearing
-- Overburden stripping and replacement.
-- Access construction - roads and conveyor lines.
-- Rehabilitation
-- Access through unmined forest.

The system of hygiene units and access chosen on the Operation Map must be maintained throughout the mining phase.

Hygiene units and correct access location will form the basic control in limiting the impact of disease spread.

Cleanliness and timing will be aimed at limiting the amount of disease inoculum.

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5.1 Drilling and Exploration

5.1.1 A comprehensive prescription covering hygiene in drilling and surveying has been drawn up. See Dieback Hygiene Prescription for Alcoa's Field Operations.

5.1.2 Control of implementation and review is required.

5.1.3 A pre-requisite to hygiene being implemented in subsequent mining operations is the capability for drilling results to be available a number of years in advance of mining.

It is accepted that Alcoa are presently incapable of achieving this target. However, a priority for drilling in advance should be chosen to fit into the predominantly diebackfree areas planned to be mined in each approved 5 year mining plan.

5.2 Removal of Forest Produce - poles, mill logs, minor forest produce.

5.2.1 All operations are to follow the specific hygiene guidelines contained in Jarrah 81 and as modified by the Dieback Hygiene Guide.

This phase is solely the responsibility of the Forests Department.

5.2.2 Applications for clearing are required sufficiently in advance of mining to allow dry soil operations when applicable in order to minimise disease spread.

5.3 Clearing

5.3.1 Clearing follows closely behind the logging operations and involves pushing, windrowing and burning.

5.3.2 Hygiene restrictions are to be similar to the logging

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restrictions. Use the same hygiene map showing hygiene unit boundaries, cleandown points, access and timing of operations.

See 4.5 for vehicle and machinery cleanliness.

5.4 Overburden (includes topsoil)

5.4.1 Stripping and replacement of overburden must be based on the same hygiene units and hygiene restrictions for forest produce removal and clearing to ensure that:

a) there is no movement of infected material into previously dieback-free areas.
b) there is minimal movement of overburden over distances.
c) cleanliness of machinery and minimal movement of machinery.
d) season of operation must be concentrated in dry soil conditions.

5.4.2 Stockpiling of overburden to ensure the replacement area is the same as the area of origin results in the least probability of disease spread. Disease consideration should have a higher priority over maintaining a viable natural seed source.

Alcoa's objective at present is to maintain a maximum similarity of species after mining as existed before mining. This involves the immediate replacement of the entire overburden (direct whole return) or the top 5cm (double stripping). This in turn necessitates the geographical movement of overburden between pits. There is a high probability of disease spread inherent in this procedure and includes the return of susceptible species eg., banksia.

The Forests Department on the other hand favours dieback hygiene over species diversity and prefers to see minimum topsoil movement around the forest.

5.5 Access Construction

5.5.1 Roads and conveyor lines are to follow the access

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system indicated in the Operation Plan.

5.5.2 Initial road or conveyor formation using dozers, scrapers and graders must be restricted in movement with cleandown when required based on hygiene units.

5.5.3 Work to be restricted to dry soil conditions.

5.5.4 Gravel sources and movement to be controlled by dieback category and hygiene units.

Infected gravel not to be used in dieback-free forest.

5.5.5 Water used for watering of haul roads must be sterilised to ensure spread of zoo-spores in free water is prevented.

5.5.6 Drainage to be designed to enable rapid run-off to naturally occurring moist sites ie. gullies.

5.5.7 Specific operation prescriptions are required.

5.6 Rehabilitation

Engineering works which involve the use of machinery - ripping, sumps and contour banks must be planned to fit the original hygiene coupes based on dieback category and catchment, ie. no movement across coupes boundaries without clean down if required.

Specific operation prescriptions are required.

5.7 Access Through Unmined Forest

5.7.1 Aim is to (i) minimise or eliminate access into unmined forest other than haul roads or conveyor lines, and (ii) minimise impact on the unmined forest.

5.7.2 Divisional O.I.C., Alcoa and M.W.S. agree to the required access network based on the approved 5 year mining plan and related to individual crusher sites topography and dieback location.

5.7.3 Guidelines for basic access system

-- Identify the diebackfree forest requiring protectior
-- Maximise use of haul roads, conveyor lines
-- Do not allow access for convenience
-- Roads to be as low in the profile as possible
-- Unwanted roads to be closed to all of Alcoa's and F.D. vehicles.
-- Nominate dry soil access required for fire protectic
-- Entry other than along nominated access routes requires specific consideration such as drilling
-- Training of all personnel
-- Long term control of unwanted access.

IMPLEMENTATION OF PRESCRIPTION FOR HYGIENE BAUXITE MINING IN STATE FOREST

AREAS OF RESPONSIBILITY

TASK	F.D.	ALCOA	REMARKS
A. Planning			
1. Dieback Location Map	X		
2. Operation Map			
2.1 Hygiene Unit Selection	X		
2.2 Selection of Access system	X	X	
2.3 Washdown points	X	X	
3. Vehicle and Machinery cleanliness requiremts.	X	X	
4. Timing of operations.	X	X	
B. Operations			
1. Drilling and Exploration			
Prescription	X		
Implementation		X	
2. Removal of Forest Produce			
Prescription	X		
Implementation		x	
3. Clearing			
Prescription	X		
Implementation		X	
Overburden Removal			
Prescription & control of movement	X		
Implementation		X	
Access Construction			
Prescription	X		
Implmentation		X	

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TASK	F.D.	ALCOA	REMARKS
Rehabilitation			
Prescription	X		
Implementation	X	X	
Unmined Forest			
Prescription	X		
Implementation	X	X	

4.4.1 FOREST PRODUCE SALVAGE

1. Timing and Priority

The Mining Agreement Acts require 6 months notice of intention to access S.F. for mining purposes. Handling the applications and waiting for approval to commence salvage of forest produce may mean that this period is shortened considerably. Early planning is thus essential.

Mine clearings have 100% chance of being cleared and deadlines are generally firm. Forest produce not removed prior to clearing is thus likely to be lost completely. Mine clearing areas therefore receive highest priority as a source of forest produce.

Close liaison with the mining company for variations in deadlines is needed at the local level to ensure maximum utilization.

Following the approval of the clearing application, forest produce is removed in the following sequence poles, sawlogs, salvage logs, minor forest produce and firewood. Thus removal is carried out according to sawmilling permit and forest produce license conditions and using dieback hygiene procedures laid down in Jarrah 81.

Removal of minor forest produce can be followed up by a chipping (jarrah) operation carried out by Alcoa under a sawmilling license. The chips are used as mulch on rehabilitated mine pits.

Where possible, jarrah firewood should be stockpiled for future collection.

2. Utilization

The rate of removal is to be continually monitored by O.I.C. Division in order to obtain early warning of potential failure to meet deadlines for commencement of clearing. In such cases the O.I.C. Divisior is to negotiate with the field foreman and mine superintendent with a view to changing mining priorities and assistance with removal of forest produce. Wastage of marketable forest produce will not be permitted on any minesite.

3. Divisional Control

Supervise removal of the forest produce (including woodchips) and ensure that the relevant requirements of the Forests Act, T.I.R. Act and Bush Fires Act are met by all operators.

4. Mining company policy

Alcoa recognize the need for maximizing utilization and will where possible arrange for extra access to clearing areas and keep local officers up to date with priorities and deadlines.

Where very short notice has been given for accessing an area or if the demand is not sufficient to remove all the material, local arrangements may be made for Alcoa to assist. Options include:

(i) push mill logs to side and stockpile.

(ii) employ contractor to cut and stockpile material, local F.D. then receives royalty from post cutters and directs them to the stockpile.

(iii) employ contractor to cut material and donate to other organization such as local council for project works. Alcoa in this case holds a licence and pays royalty.

5. Supply of gravel to mining company

Gravel includes any fill material:-

- For use inside same pit or recycled from redundant Haul Road. No royalty payable.
- For use inside mine working area for purposes of constructing facilities for mining. Full royalty payable.
- For use outside minesite, on forest or public roads, on P.P., realignment of public roads within minesite or donation to outside bodies. Full royalty payable.
- Gravel licences are issued intermittently to mining companies to account for the above.

6. Mining company and forest produce

The mining company may not dispose of any forest produce.

Requests to the mining company for gravel, stone and timber should be referred to F.D.

7. F.D. access to gravel and stone

Local arrangements with the mining company may be made for F.D. access to a local surplus of gravel.

Stone for F.D. use can be arranged locally ex-crusher site.

F.D. may issue licences for any stone or gravel remaining after an area has been rehabilitated.

4.4.2 CLEARING AND MINING

1. Timing

To commence once OIC Division, satisfied that forest produce has been removed, gives his approval

2. Operation

Clearing and heaping of native forest into windrows is followed up by lighting and heaping of windrows until all debris is removed.

3. Dieback Hygiene

Dieback Hygiene procedures are laid down in the Prescription for Hygienic Bauxite Mining. See Section 4.3.

4. Divisional Control

Ensure that windrows in pits are placed no closer than 20 metres from the inside of the edge of the clearing. Windrows along haul roads should be aligned along the centre of the road.

Machines involved in the clearing operation are not to clear beyond, or trespass across, the clearing boundary for any reason.

5. Burning

Encourage the Company to burn the windrows in the same season they are pushed up.

Ensure the Company conforms with burning restrictions as defined under the Bush Fires Act and obtain approval from the Division to light windrows on a daily basis in the restricted burning period.

It is not necessary for a Divisional Officer to be present at a Company clearing burn or a prescription to be made out for the burn. However a check should be made to ensure they have allocated sufficient machinery at a clearing burn capable of suppressing an escape into adjoining forest.

6. Erosion Control

Steps to prevent erosion must be taken by the Company at every stage in the clearing process.

7. Closure of Access

Closure of major access roads is to be considered

at the time of submission of the clearing applications.

Closure of minor forest tracks is to be considered at any time following approval of clearing applications until commencement of blasting operations. Closure of the tracks should not conflict with bona fide forest users, e.g. forest produce operators, Forests Department.

Requests for closure of access roads on State Forest outside the approved clearing area is submitted by Alcoa to OIC Division. Recommendations for closure are based on safety reasons to keep public separated from the mining activities. Alcoa are to be advised in writing of approval of requests for closure and subsequent conditions.

Method of access closure are:

(i) placement of a log across the road where access is not required for duration of the mining operation.

(ii) realignment where public access is imperative

(iii) locked or chained gate where continued access is necessary for forest management purposes.

Divisional signs associated with access closure are to conform with Forests Department standards where the roads concerned are under control of this Department.

A plan of current road closures maintained in the Divisional office.

6. Mining

Ore removal commences as soon as clearing is finished. It is not necessary for the Forests Department to give approval for this operation.

The operation comprises:

(i) removal of overburden to a stockpile, or approved pit.

(ii) blasting of laterite cap.

(iii) digging and removal of ore to crusher.

(iv) removal of ore from crusher to refinery along conveyor.

Divisional Control

Overburden - Stockpile site is selected by the Company and approved by Forests Department at the

time of submission of clearing applications. Chec to ensure minimum area is used to support stockpil For dieback hygiene see prescription for Hygienic Bauxite Mining in section 4.3.

Ore removal - Check to be made on oil spills. Spill locations when noticed are to be recorded by the division and the company notified and requested to remove them (contact Senior Field Foreman). A record of reports is to be supplied to M.W.A. each quarter for their information, for their catchments.

Blasting - Officer in Charge of mining to ensure that staff and forest produce operators are aware of placement and timing of blasting activities on the minesite. The information is available at each minesite from the Security Officer.

Although the Companies are not subject to blasting requirements of Bush Fires Act, they are responsib for suppression of all fires caused by blasting.

Erosion Control - During every stage of the entire operation the obligation is squarely on the Compan to prevent the erosion of soils and turbid water entering streams.

This must be monitored by local F.D. staff and problem areas immediately brought to the attention of company staff.

"REHAB 83"

PRESCRIPTION FOR REHABILITATION OF BAUXITE MINES IN THE WESTERN JARRAH FOREST

1. INTRODUCTION

1.1 Environmental aspects of bauxite mine planning, operations and rehabilitation in the western jarrah forest are complex. Overlapping tenures and legislation are involved, together with interactions between land use and biological factors.

1.2 However, the complexity of the system must not deter the formulation and clear statement of objectives, strategies and most up-to-date techniques. This statement can then provide an agreed basis for review and up-date by all parties involved as well as operating guidelines for field personnel.

1.3 The first such statement of this nature in this field was titled "Rehab 80". It was produced by the Forests Department who co-ordinated input from a range of organizations and specialist workers.

1.4 Following a period of implementation and further research and analysis, previous prescriptions are to be withdrawn and replaced by this prescription.

Rehab 83 now represents the best current "State of the Art" describing techniques to be used in bauxite mine rehabilitati in the western jarrah forest.

1.5 New techniques (ie. departures from this prescription) may be introduced as research projects, so long as

- the location and timing is approved by the Forests Department; and

- accepted research procedures for experimental design, measurement and follow-up are fulfilled.

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1.6 The prescription will be reviewed at 12 monthly intervals, at which time new strategies or techniques may be considered for incorporation.

Input for this review will be considered from the various bodies interested or involved in the rehabilitation operation and the review will be co-ordinated by the Forests Department. Any changes to objectives, strategies or operational techniques will be subject to comment and acceptance by the appropriate government authorities, and mining company.

2. THE OBJECTIVE

An objective is a broad statement of what it is expected to achieve within known constraints.

The overall objective for rehabilitation of bauxite mines in the western jarrah forest is:-

"To regenerate a stable forest ecosystem, planned to enhance or maintain water, timber, recreation, conservation and/or other nominated forest values".

Specific goals (not listed in order of importance since priorities may vary with designated land use) are:-

2.1 Water Values: to ensure that mined areas provide acceptable water quality and quantity.

2.2 Timber: to grow a forest which has the potential for eventual sawlog production.

2.3 Recreation: to maintain existing recreational values where possible and to provide increased opportunities for forest-based recreational activities in accordance with Forests Department regional and divisional recreation plans.

2.4 Protection: to conserve the residual soils; to control dieback spread, and to ensure that unacceptable fire hazards do not accumulate.

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2.5 Landscape: to create a rehabilitated landscape visually compatible with the adjoining remnants of indigenous forest.

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

In seeking to meet goals for the rehabilitation of mined areas, it is important to remember that the desired end-result is a multiple-use forest in which rehabilitated and remnant stands are fully integrated.

3. REHABILITATION STRATEGIES

Strategies are the measures to be adopted in order to achieve the objective. These are:

3.1 The development of prescriptions for rehabilitation procedures for each mined area, in accordance with the designated land use priority and land use management plans.

3.2 The conduct of research programmes into means of improving rehabilitation procedures.

3.3 The monitoring of the regenerated areas for their capacity to sustain long-term production of the forest values listed in the objective, and

3.4 The development of remedial treatments should monitoring reveal that rehabilitation objectives are not being achieved.

4. REHABILITATION PLANNING

Rehabilitation planning occurs at two levels:

The first is broadscale regional minesite planning on a 5-year time-scale. The second is the detailed operational annual planning on a pit-by-pit basis.

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4.1 Broadscale Regional Planning

The mining company is required to produce each year an updated 5-year Mining and Management Plan for approval by Government. In the preparation of these plans, the following aspects of rehabilitation are to be considered:-

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

This prescription deals with Mining Operations only within Water Production M.P.A.s and Recreation M.P.A.s.
At this stage no mining is proposed for other M.P.A.s.

4.2 Special Preliminary Planning in Recreation M.P.A.s

Where mining is proposed in areas designated as Recreation M.P.A.s, preliminary survey and site analysis is required. Part of this work is the responsibility of the mining company and part is that of the forest officer-in-charge. However, best results will occur if a team approach is used.

Responsibility of the Company:

(i) Inventory natural and cultural (ie. man-made) landscape attractions and recreational features within the mining envelope. The purpose of the inventory stage is to identify those attractions or features such as water bodies, 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. Such attractions can be classified on the basis of various criteria such as uniqueness and opportunity for relocation elsewhere (in the case of man-made attractions).

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(ii) Record vegetation types which will be cleared as a resu of mining and identify any special elements worthy of special protection. Information on vegetation will be used in selecting species mixes for scrub re-seeding following mining.

Responsibility of the Forest Officer:

(i) Assess the mining envelope in terms of its existing and potential significance for recreation at a regional and local level. The assessment should identify the opportunities which exist for land and water-based recreation activities, taking into account both the likely demand for such activities and the capability of the area to service those demands.

(ii) Through reference to regional and divisional land use management plans, determine the areas suitability for post mining recreation development and use (the term suitability refers to capability as modified by other land use requirements and constraints). Proposed recreation development is to be specified in terms of location, type and extent of facilities required.

(iii) Decide on post mining access requirements for recreatior development and use of the area and design the mine road network to fit these requirements wherever practicable.

(iv) Examine proposed mining plans with respect to the location, extent and timing of operations in order to identify what impact these operations will have on landscape values and recreational features as determined in the inventory stage. Where practicable, operations will be planned so as to minimise visual impacts on the landscape resulting from mining. In this regard, attention should be paid to considerations such as the size and configuration of mining pods as they relate to the character of the surrounding landscape.

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4.3 Annual Operational Planning

Detailed proposals for each minepit are prepared roughly 12 months in advance of rehabilitation. (Note: when better information on proposed dates of mining for specific areas becomes available, an 18 months lead time should be aimed at).

Each detailed proposal is prepared jointly by Forests Department and mine company staff, and is to deal with the following factors:-

- Pit identity - nominated by F.D.
- Dieback hygiene, drainage, erosion control and water management - specify measures to be adopted from initial drilling through to completed rehabilitation.
- Management of "islands" of unmined forests;
- Species to be used;
- Any special features to be incorporated or retained (e.g. pit walls) as part of the rehabilitated landscape;
- Access, and location of mining facilities/structures.
- Scheduling in sensitive areas.

A conceptual rehabilitation proposal will be prepared for each area, and must be initialled as "Agreed To" by the local Forests Department officer in charge.

Contentious or unusual areas should be referred to the Mining Operations Group. This group contains representatives of the Forests, Mines and Public Works and Agriculture Departments and the Met. Water Authority.

Departures from the agreed conceptual plans are sometimes desirable. This should only happen after detailed field consultation between Forests Department and company staff.

4.4 Special Fire Protection Provision

When rehabilitation is scheduled within the boundaries of

the Jarrahdale or Dwellingup Townsite Protection Plans, refer to these plans for details of tree and shrub species permitted and access required.

5. DIEBACK MANAGEMENT

Because bauxite mining and rehabilitation involves massive soil and vehicular movement under all weather conditions, together with substantial modification to natural drainage patterns in the forest, close attention to dieback hygiene is essential.

The two key management aims are:-

(i) to minimise the spread of infection into diebackfree forests and minesites.

(ii) to manage access and drainage so as not to expand areas which favour the survival and pathogenicity of the disease.

Dieback hygiene measures are specified in detail in other prescriptions dealing with drilling, timber salvage, clearing and topsoil handling - i.e., operations not dealt with in this prescription.

Other dieback control requirements which are relevant to rehabilitation are listed below in sequence as they arise.

6. PREPARATION OF PITS FOR PLANTING

6.1 When mining is completed, pit walls will be battered and smoothed. In Recreation M.P.A.s, occasional retention of pit walls may be prescribed, subject to an approved plan and attention to the potential safety problems of perched boulders, and long-term stability of the cliff wall.

6.2 Overburden and topsoil will then be evenly respread over all areas to be regenerated. The distribution of this material from pit to pit will be in accordance with the following dieback hygiene requirements:

(i) no infected material to be carried to diebackfree areas.

(ii) minimise the movement of topsoil

(iii) clean plant and machinery before entry to diebackfree areas where required.

(iv) move soil mainly in dry conditions.

All soil movement must be agreed to by the Forests Department.

6.3 Islands or inliers of low grade ore often occur within a pit. It is desirable that these areas remain undisturbed. However, there will be occasions when they are both cleared and stripped.

When this occurs the unmined caprock will be "popped" with explosives to provide planting sites and ameliorate run-off. Blasted craters will be graded level prior to respreading overburden and topsoil.

6.4 Throughout the pit preparation work, care must be taken not to import, or bring to the surface, large boulders - i.e., those whose size and density renders the future forest floor untrafficable.

Special measures may be necessary to deal with this problem.

6.5 Ripping

Ripping is required to fracture the compacted pit floor so as to facilitate root penetration and drainage, and to provide an "anchor" for the returned topsoil.

In general: All compacted pit floors will be ripped along the contour.

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Battered banks and pit edges need not be deep ripped, but must be scarified to control erosion and prepare a seed bed.

The distance between parallel riplines is to be determined by the need to ensure a continuous fracture of the compacted subsoil.

Whever possible, ripping should be done when the soil is dry so as to maximise subsoil breakup and minimise compaction of the topsoil and overburden.

In areas where public access is to be encouraged, the ground surface will be levelled during and/or following the deep ripping operation.

7. WATER MANAGEMENT

7.1 Careful water management must be considered in every phase of the operation from initial clearing and road construction through to completion of rehabilitation.

7.2 A variety of water management systems may be adopted, depending on land use priority, site, and the nature of the particular catchment or storage facility involved.

7.3 Criteria for Success

Irrespective of the system which is used, it must satisfy the following basic criteria:-

- there must be minimum topsoil erosion within pits;
- the system must meet standards of stream turbidity, salinity and biological purity prescribed by the appropriate water supply authority;
- there must be no long term ponds of water lying either within or below pits or roads;
- the need for long term maintenace must be minimal.
- peak flood levels (as prescribed by the water authorities) must not emanate from mined over catchments.

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. the system must be acceptable in terms of costs, aesthetics and the land use priority.

7.4 Water Management Systems

Pits can be designed/constructed so as to (i) Retain and infiltrate water, (ii) discharge water or (iii) some conbination of retention and discharge.

7.5 In catchments where water retention and infiltration is prescribed, 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 characteristic This design will be based on an accepted hydrological model with an appropriate safety factor of 2.

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 stabilized waterways which direct water to detention sumps within the pit. Sump and drain locations will be indicated

on the conceptual rehabilitation plans.

Note: It is recognized that the use of a water retention system may give rise to prolonged pools or saturated zones within or just below pits, and this does not conform with one of the success criteria for water management.

7.6 In catchments where the discharge of water is prescribed, water management will be achieved by:

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

(ii) control of overland flow by grade banks and slow release detention ponds or filter systems.

Each slow release detention pond or filter system must have the capacity to handle the run-off from a 15 year storm event, as calculated from meteorological records and minepit characteristics. Stable overflow sections are to be provided so that more extreme run-off events will not cause severe erosion or damage.

This requires the installation of adequate grade banks approximately along each 10m vertical contour within each pit, and the construction of a discharge system at the bottom of the pit. This discharge system must adequately filter the water and must be so constructed to avoid saturation or erosion of jarrah forest downslope of the pit.

7.7 Drainage from mine access roads, haul roads or from pits must not flow into unmined jarrah forest, but must be channelled (via ponds or filters) directly into water courses.

7.8 All erosion control earth works must be completed and effective before the first Autumn rains (ie. generally before 30th April each year).

Standards will be monitored and remedial action specified using an Inspection and Action Checklist (APPENDIX II).

8. PLANTING

8.1 Planting Layout and Design

8.1.1 As a general rule, tree species will be established as mixtures. Pure stands may be planted in localised portions of the landscape.

In every mixture, favour species indegneous to the Darling Range and with roughly similar growth rates. Species mixes will be determined in advance and specified in the rehabilitation plan by the Forests Department.

8.1.2 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 road, 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.

8.1.3 Aim to achieve a stocking of about 600 planted trees/ha.

8.1.4 Do not plant trees on overflow channels.

8.1.5 Commence planting when the soil is wet to depth after about 10 June. Cease planting by 1 August.

8.1.6 Seedling specifications: 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.

8.2 Before planting commences, all pits will be inspected by the Forests Department. Pits which are deemed by the Forests Department to be inadequately prepared, will not be planted, but carried over for improved preparation and planting the following year.

8.3 Access for planting crews must be pre-planned and specified so as to minimise traffic through the unmined forest and across the prepared pit.

8.4 The forest officer in charge of each area must ensure a detailed record of species planted and treatments given is made at the completion of the job.

8.5 Selection of Tree Species for Planting

Criteria for selection of tree species to be used are:-

(i) Tolerance to dieback.
(ii) Fire resistance.
(iii) Capacity for roots to penetrate the compacted kaolin layer.
(iv) Useful timber.
(v) Proven longevity, and growth to maturity in the mine pit environment.
(vi) Visual compatibility with indigenous forest.
(vii) Useful nectar source.

There are currently no tree species with proven capacity to satisfy all these criteria. Pending continuing studies into a wide variety of species in pits and arboreta (and new arboreta establishment), the following species will be planted:

High in the original landscape (ie. the original jarrah forest uplands, or relatively free-draining sites):-

E. wandoo
E. laeliae
E. accedens
E. resinifera
E. maculata

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Low in the original landscape (ie. water-gaining sites):-

E. patens
E. saligna
E. calophylla

Swamps and pit sumps:-

E. patens
E. megacarpa
E. rudis

Other species which may be included as minor components on pit banks and edges where there is a reasonable soil depth:-

E. muellerana
E. microcorys
E. diversicolor

Jarrah (E. marginata) will be sown onto the upland sites at a rate of 0.25kg pure seed per ha. Blackbutt (E. patens) may be sown at a similar rate into the lowlying regions.

8.6 Seed Sources

E. marginata and E. patens seed to come from specifically designated stands and trees. Seed provenances for other tree species to be laid down by Forests Department.

8.7 Fertilizer

Apply 100 gms of Monommonium phosphate per plant at about 3 weeks and again at about 9 weeks after planting.

Fertilizer to be placed within 15cms of the base of the plant, in a spear hole or stamped depression.

8.8 Success Criterion for Planting/Fertilizer Operation

80% survival of planted species at 9 months after planting, as

determined by a 10% systematic sample of rows.

Areas of 0.5ha and above which fail to meet this criterion, to be rescheduled for replanting the next winter.

9. UNDERSTOREY ESTABLISHMENT

9.1 The aim of understorey establishment is to assist with erosion control and general site rehabilitation. Species to be used will be reviewed for each site each year. Criteria for species selection will be dieback tolerance, appearance and nutritional value.

9.2 Base species to be used will be selected from: Acacia pulchella, A. lateriticola, A. drummondii, Kennedya coccinea and K. prostrata. Where other species are included in the seed mix, Forests Department approval must be obtained.

9.3 Specific species should be added for particular sites - eg. ti-tree and sedges for sumps and swamps, wildflowers such as hovea, kangaroo paws, Hardenbergia etc., for road-sides and recreation sites, and other species endemic to the site if the rehabilitated pit is dieback-free.

Species of low flammability and height growth, or no understorey at all may be prescribed for special fire management zones.

9.4 Species not to be used are non-indigenous species, Proteacaea or large woody and inflammable species such as Albizzia.

9.5 Scrub seed mixes will be determined in advance and specified in the rehabilitation plan for each pit and for specific sites within pits.

9.6 Fertilizer: Areas to be seeded will be broadcast fertilized with 450 kg/ha of superphosphate before sowing.

9.7 Application Rate: mixed seed will be sown at the rate of 1 kg/ha.

Seeding is to be done by ground application and must be completed by 1 June each year.

9.8 Success criterion: 1 plant established per square metre, 9 months after sowing, as determined by stocked quadrat survey of each pit.

Areas of 0.5ha or greater not stocked at this rate to be reseeded the following autumn. Light scarification may be necessary to promote seed germination in areas re-seeded in Year 2.

10 ROADS

10.1 The road network which remains after rehabilitation must conform to a predetermined plan.

10.2 This plan will be drawn up from approved 5 year mining plans, and will cater for:-

(i) access for mining
(ii) access for rehabilitation
(iii) access for future forest management.

10.3 The basic planning principle is to aim for the minimum number of well surfaced, low profile roads, consistent with provision for public access and fire protection.

10.4 Unwanted roads will be rehabilitated by:-

(i) recovery of gravel for re-use elsewhere
(ii) ripping and erosion control
(iii) seeding and planting in harmony with surrounding forest.

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12. PRESCRIPTION REVIEW

Next date for review of this prescription: May 1983.

R.J. UNDERWOOD
SUPERINTENDENT

11th November, 1982

RJU:DH

4.7 Fire Control

4.7.1 Interagency Agreement

Prior to the commencement of each fire season one Interagency Agreement will be completed between the Forests Department and both Alcoa and Worsley.

Responsibility: R.L. Operations.

4.7.2 Specific Details which accompany the I.A.A. relevant to each minesite needs to be completed prior to the signing of the I.A.A.

Responsibility: O.I.C. Division.

4.7.3 Specific details required are:

-- jointly agreed boundaries of the area covered by the I.A.A. for each minesite. Plans to be held in the Divisional office and referred to in the Divisional Fire Control Working Plan.

-- F.D. to assist annual fire training for Alcoa.

-- Jointly agreed fire suppression details covering manpower, fire equipment, standing orders and communications to be contained in the Divisional F.C.W.P. and held by Alcoa.

PART 5: INVENTORY AND CONTROL

5.1 Bauxite Rehabilitation Monitoring Project

The aim of the project is to monitor the survival and growth of bauxite minesite rehabilitation plantings. The main features o: the project are as follows:-

- Each minesite (Jarrahdale, Del Park or Huntley) is considered separately.

- Rehabilitation plantings at each minesite are stratified into strata on the basis of such factors as year of plantings, site preparation method used, and quality of plantings.

- Permanent plots (20metres square) are established in strata greater than 2 years old. These plots are randomly located. The number of plots used is determined on the basis of such factors on expected cost of sampling and sampling error devised.

- Assessment takes place in each plot measuring species type, height, D.B.H.O.B., health, status, vigour, type and density of understorey species and amount of tree species regeneration

- Each plot will be reassessed periodically in the future. In addition, new plots will be established in young plantings that have attained the age of 3 years. These plots will also be subject to assessment and periodical reassessment.

- Assessment data will be analysed using a computer.

A booklet is being prepared to describe the project in detail.

5.2 Control

The hardwood Operations Control System (H.O.C.S.) is being extended to include details of the location, establishment and management of bauxite minesite rehabilitation plantings. Briefly:

- Rehabilitation plantings are being shown on 1/~~100,000~~ 10,000 scale H.O.C.S. prints.

- Each rehabilitation pit is being coded according to an abbreviated form of forest block name, followed by compartment and pit number e.g. G D/2/3 refers to pit 3 in compartment 2 of Gordon Block.

- Details of establishment and management are being indicated on the H.O.C.S. Prints.

  The planting register, currently used for rehabilitation plantings, is being, modified to account for the pit numbering system described above. This register will contain written details of the establishment and management of rehabilitation plantings.

THE FOREST IMPROVEMENT AND REHABILITATION SCHEME

PRESCRIPTION - F.I.R.S. 82

1. INTRODUCTION

1.1 In the Wagerup ERMP Alcoa gave a commitment to finance the rehabilitation of dieback affected State forests adjoining bauxite mines. This lead to the initiation of the Forest Improvement and Rehabilitation Scheme (FIRS) in 1978.

1.2 The scheme is funded by Alcoa. Work is prescribed and implemented by the Forests Department.

1.3 FIRS work is breaking new ground in the integration of site, land use and disease variables. Each annual prescription is therefore regarded as interim.

1.4 This prescription sets out objectives and guidelines for FIRS based on the best information available in October 1982.

2. OBJECTIVE

The objective of FIRS is:-

> "To improve the capacity of the forest for longterm production of water, timber, recreation, conservation and/or other forest values."

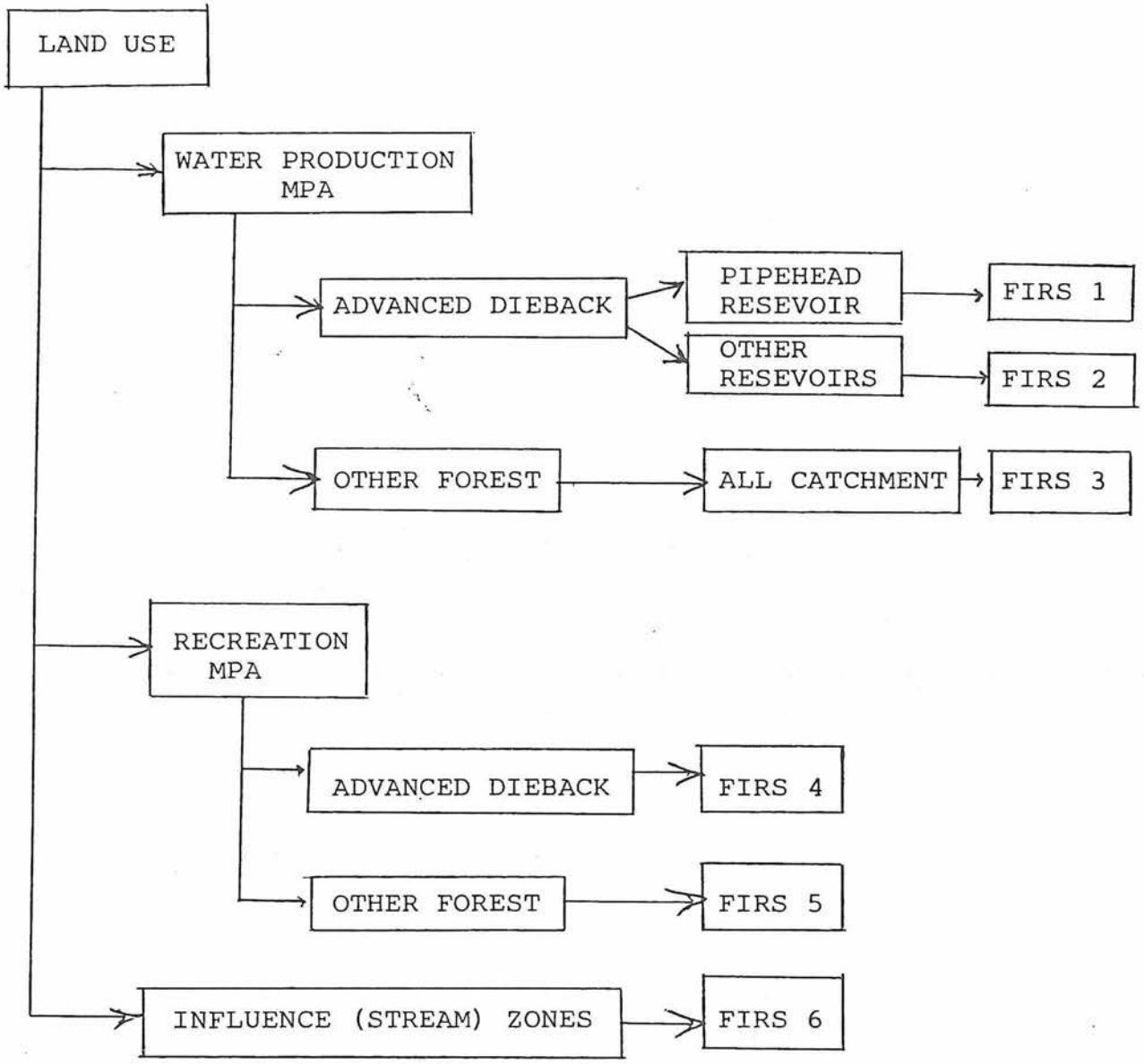
This objective implies two broad categories of treatment

(i) The rehabilitation of areas of advanced dieback forest, so as to regenerate its productive capacities, and

(ii) The improvement of the health and vigour of other stands so as to render them less susceptible to dieback disease impact.

The second of these treatment categories (which can be likened to "preventive medicine") is a field of rapidly growing and intricate knowledge. Consequently the work is largely regarded as a field extension of current ecological research.

3. FLOW CHART FOR PRESCRIPTION SELECTION



4. THE PRESCRIPTIONS

4.1 FIRS 1 - *Water Production MPA

*Advanced Dieback

*Pipehead or pumpback catchments only

For all sites except stream zone.

(i) Define according to field inspection and demarcation of areas where the jarrah overstorey is largely dead or dying.

(ii) Determine and specify hygiene requirements, as detailed in "Jarrah 81."

(iii) Mark for retention and ensure full protection of sound, healthy dieback tolerant species such as marri, wandoo or blackbutt. Retain advanced regrowth and saplings of dieback tolerant species. Retain sound healthy sheoak, particularly on sites which will not be planted.

(iv) Organize salvage of all saleable produce (e.g. sawlogs, poles, posts, firewood) from trees not marked for retention and from ground residues.

(v) Bulldoze or fell those trees not marketable or marked for retention, and stack into heaps at regular intervals to create ashbeds. Heaps should be made at roughly 12m centres and a minimum of 8m from retained trees.

Carry out erosion control on all unwanted roads, tracks, landings and pits. Drainage must not empty into DBF forest.

(vi) Scarify harsher compacted sites (to improve seed germination) prior to sowing.

(vii) Burn the heaps at the most convenient time.

(viii) Sow leguminuous understorey species in late May at rate of 0.5 kg per hectare bulked with 450 kg/ha of superphosphate.

(ix) Cultivate, and plant with tree species suitable for the site. Plant to achieve an initial stocking of 625 stems per hectare. Approximate a 4.0m x 4.0m spacing with preference for planting on ashbeds.

Tree species to choose from:

(a) On upland sites plant Euc. resinifera, Euc. maculata or Euc. wandoo.

(b) On other sites plant Euc. wandoo, Euc. patens and E. maculata.

Fertilize planted trees with 100 grams of monoammonium phosphate at time of planting, and again 9 weeks later.

The following autumn, carry out a survival count in planted areas. Success criteria for planting is 80% survival (counting natural regeneration) based on a 10% systematic sample of rows for tree seedlings. Assess the success of scrub seeding visually. Areas should be generally well covered.

Protect from fire for 8-10 years after planting.

(x) Future Management Optimum stocking for regrowth stands in water production MPAs are still to be determined. Where subsequent thinning is required, this treatment will be prescribed when data is to hand on stocking by age and species to be favoured.

4.2 FIRS 2 - *Water Production MPA

*Advanced Dieback

*All other catchments

(i) As for (i), (ii), (iii), (iv), (v), (vi), (vii) and (viii) in the FIRS 1 prescription.

(ii) Select promising sites (i.e. not massive ironstone or caprock) and plant small groves or clumps of E. wandoo, E. resinifera or E. patens. Each grove should comprise about 10 trees spaced roughly 3m apart. Leave 20 -20m spacing between groves.

Do not plant harsh, stony or compacted sites.

Fertilize seedlings and carry out survival counts as in FIRS 1.

4.3 FIRS 3 - *Water Production MPA

*Other forest (i.e. not advanced dieback).

These are stands where the overstorey has not suffered extensive mortality. They may be dieback free or understorey only infected.

General

The optimum means of treating jarrah forest so as to improve resistance to infection or disease intensification, is still to be proven. A number of variables are involved (e.g. thinning, banksia de-stocking, legume regeneration, special fire and water management) and the aim is to combine these in a treatment regime which will maximally disfavour the fungus while at the same time improving the natural health and vigour of the forest.

A wide range of treatments is currently being investigated. The "base" prescriptions, about which variations will be designed, is:

(i) Define according to field inspection and demarcate dieback categories. Demarcation is required in order to implement hygiene.

(ii) Determine and specify hygiene requirement as detailed in Jarrah 81.

(iii) If it is an even-aged "pole" stand:

- Mark crop trees for retention at a stocking of 150-250 sph depending on site and age.

  (Thinning guides based on height and basal area are to be used where available). The definition of a crop tree is as used in "Jarrah 81".

- Jarrah is the preferred species, but if absent or deficient, retain marri, blackbutt, wandoo or bullich.

- Harvest all marketable poles, logs and minor produce from trees not marked for retention. Crop trees must be protected from falling and snigging damage. Ensure erosion control, crop tree protection and landing rehabilitation measures are carried out.

(NOTE: Thinning of DBF stands only to be done if the silvicultural advantage is considered to be worthwhile and hygiene measures are of the highest order. Under these conditions, non-commercial thinning after M.F.P. harvest may also be prescribed.)

(iv) If it is not a "pole stand:

- Carry out standard selection mark as per J81. Do not retain merchantable trees over 60 cm D.B.H.

- Harvest for poles, sawlogs or minor forest produce all trees not marked for retention as crop trees. Crop trees to be protected from falling and snigging damage.

  Erosion control and crop tree protection to be carried out.

(v) Push over all banksia with rubber tyred machine. Ensure stems are pulled out by the roots.

(vi) Carry out crop tree protection around crop trees.

(vii) Erosion control works to be completed prior to autumn rains. It is essential to ensure that water from roads, pits, conveyors, etc. does not drain into the treated stand.

(viii) Conduct Autumn burn under dry soil conditions aimed at minimum scorch and maximum heat in soil. Timing of burn important in order to maximise banksia suppression. Burn only after banksia cones are dry or seed has germinated following pushdown. Burn Autumn after Spring pushdown. Allow one winter with Summer pushdown if sufficient drying time has not elapsed.

(ix) Legume seeding in these areas will not be done for the time being as this technique is under review.

(x) Close all unwanted roads. Upgrade drainage on existing roads to ensure no water flows into forest unaffected or only lightly affected by dieback.

4.4 FIRS 4 - *Recreation MPA

- *Advanced Dieback

Apply as for FIRS 1 except for the influence zone which will be areas surrounding or adjacent to a depth of about 100 metres, any major or tourist facility. These areas will be worked according to a landscape and rehabilitation plan which prescribes:

* planting pattern

* stocking

* species

* seed mix for understorey species.

Factors to be considered are: Plant trees in clumps, not lines; choose species which fit the natural landscape (e.g. E. patens okay in lowlands but not uplands; E. resinifera blends with jarrah); feather edges; do not create thickets of prickle bush.

Each DFO will compile an appropriate prescription for these areas, seeking specialist advice from the Departmental Landscape architects.

4.5 FIRS 5 - *Recreation MPA

- *Stand is Not Advanced Dieback

(i) Apply as for FIRS 3 except for the thinning. No thinning to waste will take place in a Recreation MPA.

(ii) Areas surrounding or adjacent to a depth of about 100m, any major or tourist road or existing tourist facility will be worked according to a landscape and recreation plan which prescribes:

*stocking
*species
*seed mix of understorey species

Each DFO will be responsible for definition of these special areas and for compiling an appropriate prescription. Specialist advice must be sought from the landscape architects during the preparation of plans, and final plans endorsed by R/L Operations.

4.6 FIRS 6 - Influcent (Stream) Zones

Steam Zones in Water Production MPA

(i) Define according to vegetation - e.g. adjacent to steam and carrying bullich, blackbutt with ti-tree understorey.

(ii) Demarcate with blazed or flagged line where required.

(iii) If specific fire treatment necessary, install temporary fireline.

(iv) Inspect for man-made features (such as gravel pits, roads, earth dumps) which may contribute to stream turbidity. If located prescribe erosion control measures - e.g. cross drains, sumps, seed bed preparation and apply seed.

(v) Protect from fire for 2 years before mining adjacent areas and at least 5 years subsequent.

Stream Zones in Recreation MPA

Apply all measures listed above. In addition, the following will be undertaken.

Survey recreation facilities within the stream zone (e.g. picnic site, walk trail) and ensure:

- Dead or dangerous overhanging trees are felled.
- Special attention is given to erosion control away from car parks and access roads.
- Limited hazard reduction burning is programmed to prevent dangerous hazard adjoining picnic areas.

5. IMPLEMENTATION

5.1 Annual FIRS works programmes will be drawn up each year in accordance with approved mining plans and available finance. The "FIRS Year" is regarded as running from the end of one planting season to the end of the next. Each annual plan will be subject to endorsement by Alcoa.

5.2 As soon as the areas to be treated are defined, each DFO must ensure that:

* The appropriate prescription is chosen or written.
* A detailed plan of proposals is prepared.
* A works programme covering manpower, machinery and season is drawn up and priorities assigned.
* Staff responsibilities are made clear.

5.3 The following priorities apply:

1. Carry-over areas from previous year.
2. Banksia control, autumn burn and drainage improvements in DB Free or lightly affected stands.
3. Rehabilitation of advanced dieback in pipehead catchments.
4. Other rehabilitation.

5.4 The Regional Leader will review progress monthly through the year in each Division to ensure that programmes are completed according to prescription and budgets not overspent.

5.5 The Regional Leader will prepare a report for Alcoa at the completion of each financial year which will describe: areas treated, costs and treatments used.

5.6 Completed work is to be recorded in detail in the H.O.C. system (or on 1:10,000 scale plans in the divisional office until the H.O.C.S. is operational).

5.7 Divisional staff will maintain fortnightly records of costs and work progress and forward these to the R/L at Como.

5.8 A joint Alcoa/FD inspection of works programmes will be made each quarter and written comments exchanged.

6. REVIEW AND CONTROL

This prescription will be reviewed in July each year and updated as necessary, on the basis of:

* Changes in emphasis
* New research findings
* The need to correct inadequacies in the existing prescriptic

R.J. UNDERWOOD
SUPERINTENDENT

12th October, 1982

RJU:DH

IMPLEMENTATION OF FIRS 82

AREAS OF RESPONSIBILITY

TASK	F.D.	ALCOA	REMARKS
Prescription	X		
Planning	X	X	Divisions and Alcoa Minesite Environment Scientist - RL and Alcoa Senior Environmental Scientist
Implementation			
3.1 FIRS 1, 2, 4			
Dieback			
Demarcation	X		
Mark Crop Trees	X		
Salvage saleable produce	X		
Create heaps for ashbeds	X		Contract machine to be used if required.
Erosion Control	X		
Burn	X		
Scarify	X		
Supply understorey seed + superphosphate		X	
Apply seed and super-phosphate.	X		Can combine with scarifying
Planting	X		
Supply plants	X	X	
Supply monoammonium phosphate (MAP)		X	
Apply MAP	X		
Survival count	X		
FIRS 3 + 5			
Dieback demarcation	X		
Mark crop trees	X		
Remove excess market-able produce.	X		
Banksia pushdown	X	X	Alcoa to supply Cat. 910. F.D. to supply contract machine if required
Crop Tree Protection	X		
Erosion Control	X		
Burn	X		
FIRS 6	X		

FOREST MANAGEMENT AFTER BAUXITE MINE REHABILITATION IN THE WESTERN JARRAH FOREST

Prescription 82 (INTERNAL FD USE ONLY)

1. RESPONSIBILITIES

1.1 Current techniques for the regeneration of forests destroyed by mining are dealt with in the Forests Department prescription "Rehab 83".

This new prescription deals with the subsequent management of these areas, comprising the regenerated stands on pits, roads, crusher sites and other areas disturbed by mining.

1.2 Pursuant to Para 7 page 15 of the Wagerup ERMP, the responsibilities for various facets of initial revegetation are shared, but subsequent forest management is solely the responsibility of the Forests Department. Mining Companies may not prescribe or undertake silvicultural or engineering work in the rehabilitated forest beyond agreed establishment programmes, unless directed to do so or otherwise approved by the Forests Department.

2. THIS PRESCRIPTION

2.1 Because there is no past experience to draw upon in the management of forests regenerated after mining, and because of uncertainty as to how these stands will develop, this prescription is regarded as interim, and will subject to regular review.

Nevertheless, it is the best "State of the Art" and must be strictly adhered to.

2.2 The next review of the prescription will be in October 1983.

3. OBJECTIVE

The objective of management after rehabilitation in the forests of the mining envelopes is: To sustain a site-adapted forest capable of resisting fire, disease and parasites, able to regenerate naturally and produce valued products.

In other words, the aim is to manage a healthy and productive forest ecosystem in accordance with designated management priorities.

Forest values recognised and accorded priorities may be water, wood, recreation, scientific study, education, flora, fauna, landscape and minor forest products such as honey and wild-flowers.

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4. STRATEGIES

The means to be adopted in order to achieve the objective are:-

4.1 Identify the areas to which this prescription will apply.

4.2 Specify treatment regime for each area, taking into account previous treatment history, protection requirements, costs and the land use priorities.

4.3 Establish criteria of success/failure against which the "present status" of any stand can be assessed.

4.4 Implement the prescriptions and monitor forest condition and development.

4.5 Develop and implement remedial treatments where assessment indicates that success criteria are not being met.

5. AREAS FOR APPLICATION

5.1 This prescription will apply to those areas of forest in and around which mining and rehabilitation has taken place.

The D.F.O. will mark these areas on a map, using existing and most convenient boundaries, in accordance with the sub-divisions of the H.O.C. system.

5.2 Maps should be updated on a 5 yearly basis, or as required.

6. BASIS FOR TREATMENTS

6.1 Treatments must be based on goals and needs. Goals are derived from the land use plans and needs from detailed field assessment, HOCS records and comparisons between actual and expected forest development.

6.2 Land Use: existing mining envelopes occur in areas designated as either Water Production or Recreation Management Priority and should do so for some years.

Management goals for these areas are:

(i) Water Production MPA - To establish a stable forest ecosystem with a high yield of water of an acceptable quality, which may also be manipulated for secondary land use priorities.

(ii) Recreation MPA - to establish a stable forest ecosystem capable of satisfying the diverse recreation and landscape needs as indicated in the Divisional Recreation Plan.

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6.3 Silvicultural History: HOCS records indicate for each stand the year of rehabilitation, method of site preparation, species used and any subsequent treatment.

The "as-constructed" Rehabilitation Plans for pits show location of engineered structures.

Additional detailed stand information is available from the Bauxite Rehabilitation Monitoring Programme.

These records must be consulted before treatment is prescribed.

6.4 Field Inspection: Each stand for which treatment is proposed must be inspected on the ground. The following attributes will be checked and/or measured:-

(i) Roads, tracks and drainage: Inspect and prescribe For upgrading, closure or maintenance of each road or track. The ultimate road network must conform with a regional plan which minimises the number of roads while providing adequate access for management.

(ii) Trees: Record mean top height by species, review tree health, condition, and nutritional status, and prescribe for tending, stand improvement or replacement as required.

(iii) Understorey: Record stocking, density, condition, unwanted species, weeds, and prescribe treatment.

(iv) Soil: Inspect and prescribe remedial treatment where possible for soils which are compacted, bare of topsoil or otherwise unsatisfactory for successful forest growth.

(v) Access: Determine need for removal or amelioration of impediments to access such as sumps, banks, rip-lines.

(vi) Fire Hazard: Check in relation to regional protection plan.

(vii) Water Management: Prescribe according to land use and water supply requirements.

(viii) Recreation and Tourist Facilities: Check need for upgrading, installation, closure or maintenance, in accordance with regional plans.

6.5 Success Criteria

In the long term, the desired forest ecosystem will have the following characteristics:-

*Capacity to withstand summer drought, windstorm, periodic fire and the presence of P.c. or parasites.

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*Capacity to produce water, timber and landscape values in the long term without heavy demands for inorganic fertilizer, or the necessity for constant engineering maintenance.

Research has not yet proceeded to the point to enable values to be placed on all these criteria, or in some cases to define how they are to be measured.

In the meantime the following will apply:

(i) Stocking

Failed Stands: Further rehabilitation to be considered in terms of the land use needs.

Eucalypts: thin to approximately 300 s.p.h. at about age 10 or earlier if subject to undue competition. An exact regime is not prescribed at this stage, pending further research trials.

Pine: As required in the Foresters Manual.

(ii) Hazard

All stands to be fully protected from fire at least until codominant heights exceed 10m. Thereafter fuels to be mananged in accordance with soil building requirements and local fire protection plans.

To increase levels of soil organic matter it may be necessary to slash and mulch the understorey at about age 5. This will be the subject of research trials.

(iii) P.c.

All stands to be banksia free, and periodically regenerated with predominantly legumenous understorey. Techniques are to be developed to ensure no ponds or free water lie on the forest floor. (See below).

Regeneration of understorey will be for the several purposes of aesthetics, nutrition, soil organic matter and fauna habitat. Processes are yet to be developed.

(iv) Growth Rates

Compare tree height growth with height/age graphs for each species. Remedial treatment (e.g. soil amendment, drainage) may be prescribed where actual growth is poorer than expected.

Where the regeneration has patently failed, the site must be analysed to determine:-

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(a) Reason for failure (chemical, physical or biological or combination).

(b) Significance of failure in terms of the land use.

If this analysis indicates the need, the rehabilitation process must be recommenced.

(v) Water

It is undesirable for permanent water to lie in the pits or the forest; water leaving pits or roads is to be non-turbid and discharging into streams; no possibility/opportunity for flash floods; water is to be chemically and biologically unpolluted.

(vi) Timber

Boles are to be straight and limb-free, but this is to be achieved by control of stocking in preference to pruning (other than pines). Early for pruning may be acceptable for some Eucalypt species, and this can be done at time of first thinning. Other pruning of Eucalypts is undesirable as it leads to stem cankers and rot.

(vii) Landscape

Forest to be attractive (i.e., green and leafy, with a legumenous shrub understorey) and easily accessible for walking, and fire control.

(viii) Soil Conservation

Minimum erosion gullies or transport of topsoil from hillsides to drains. No compacted soils or bare subsoil exposures.

(ix) Fauna

Experience has shown that site-matched fauna will colonise rehabilitated areas as the vegetation develops. No specific treatments are therefore recommended at this stage.

8. IMPLEMENTATION

8.1 The Forests Department will be responsible for assessment, inventory and for prescribing all treatments, and will generally carry out the work with its own personnel or contractors.

8.2 Each years work will be in accordance with a 5 year plan which is updated annually.

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9. CONTROL

9.1 All treatments will be prescribed and controlled according to the HOC system.

9.2 Records of treatments will be maintained at Divisional H.Q. and Kelmscott I & P.

9.3 Management of forests will be the responsibility of:-

At Jarrahdale	:	OIC Jarrahdale
At Del Park, Huntly and Saddleback	:	OIC Dwellingup
At Willowdale	:	OIC Harvey

9.4 Northern Region will be responsible for liaison and planning, setting standards and quality control.

9.5 This prescription will be reviewed and updated in October 1983.

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REGIONAL SUPERINTENDENT

27th October, 1982

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