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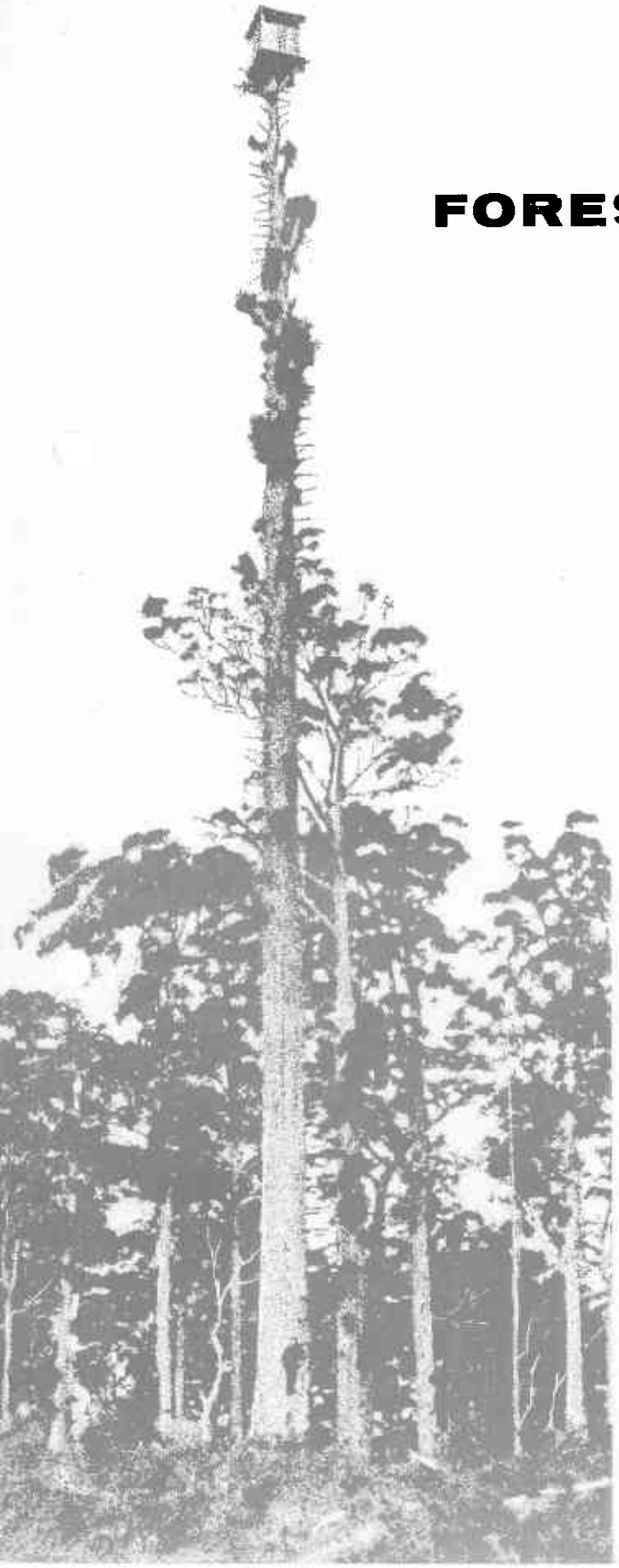

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FORESTS DEPARTMENT
OF WESTERN AUSTRALIA
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MINING IN STATE FOREST – A SITUATION REPORT, AUTUMN 1975

by

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SUMMARY

Environmental comment on mining in Western Australia has concentrated on the bauxite industry. This paper reviews bauxite operations, together with most of the other mining operations which occur within the main forest zone of the south-west of Western Australia.

In many instances, the total area affected and the quantities removed by these other mining operations will never be known with any accuracy, but their relative importance and their problems of site restoration are briefly reported.

INTRODUCTION

The Western Australian mineral exploration boom of the late 1960s and early 1970s has come and gone, but active mining continues.

Throughout most of its history since European settlement, Western Australia has been deeply involved with mining of one form or another. The discovery of gold at Coolgardie and Kalgoorlie was to cause the first mass of migration to the State, and mining in many other areas began very soon after this.

The first real mining in the main forest zone was for tin at Greenbushes, which commenced in about 1888 and has persisted into the mid 1970s.

Mining can take many forms, and for the purposes of this situation report it will be taken to include any activity that causes the physical removal of soil, rock or mineral from the forest. Forests occur on the coastal sand plains and the elevated Darling Plateau in the high-rainfall zone of the south-west of the State.

MINING ACTIVITIES

Peat

Deposits of black cladium peat, which contain up to 95% combustible organic matter, occur in swamps at two locations within the forest zone.

The southern occurrence is near Lake Muir, north-east of Manjimup (see Figure 1), but is not in State Forest. The northern occurrence is within the Gnangara district, Wanneroo Division, some 30 kilometres north-east of Perth. The northern deposits are in swampy depressions within the Bassendean Dune system, and mining tenements have been pegged over several of the swamps. By early 1975, only three mining tenements had been approved by the Mines Department, and, although several thousand tonnes were removed initially, there has been no active mining since 1971 at the Gnangara site.

There is provision for areas mined to be left in a tidy condition, but provision for revegetation is not feasible since most of the site is under water for long periods.

Sand

As in any other modern city, there is a continuing demand for clean sand for filling, concrete matrix, road building material and other uses in the Perth Metropolitan area. There is a small silica sand export industry in the State, but this is not centred on State Forest.

Removal of sand for industrial and civil engineering purposes occurs in small areas throughout the forest zone, the main operators being State Government and local government authorities.

Control of mining is usually by Forest Produce Licenses, and no provisions exist for site restoration or for revegetation. No estimate of extent of sand pits is known to exist.

Gravel

One of the many unique features of Western Australia's jarrah (*Eucalyptus marginata* Sm.) forest is its ability to grow on the residual, truncated, lateritic podsols, which in many instances have surface horizons of pisolitic gravel. This gravel is ferruginous and relatively hard, and has provided the foundation for most of the road systems in the south-west province. The gravel varies in size and occurs in a range of matrices from coarse sand to kaolinitic clay. Over much of this range it has an application for road building.

The Main Roads Department, local government, Forests Department and other public utilities have been, and still are, the principal users of this so-called "laterite gravel".

Estimates of the extent of gravel pits in State Forest are not easily made because of their variable size, great number and sporadic occurrence. However, it has been estimated (IFA Looks at Mining – unpublished report 1973), that the gross area exceeds 1275 hectares.

Until recently, no attempts were made at rehabilitation of pits, and much gravel was wasted by unplanned extraction techniques, which left standing trees on elevated "islands" within the pit. These trees eventually died, thus adding to the visual pollution caused.

Since 1967, by arrangement with the Main Roads Department, pit technique has greatly improved. Topsoil is stockpiled for re-spreading over the pit floor, and funds are made available for reforestation. Indications are that this programme is effectively revegetating denuded areas and improving the appearance of areas that were previously unattractive. Replanting is restricted to pits that are visible from well-used public roads, many of which may also have potential as roadside "Rest Areas". By June 1974, a total of 85 pits had been replanted, mainly in the central forest region.

Clay

The truncated podsols of the Darling Plateau are commonly underlain by kaolinitic clays in two zones – mottled zone and pallid zone. Much of the material in these zones can be used industrially for clay brick, refractory brick and as a flux in some mineral treatment processes.

Most clay pit workings are located within the Perth Metropolitan area or on private property in the north and eastern hinterland. There have been clay pits in the Gleneagle Forest some 50 kilometres south-east of Perth, and there are some clay pit

licenses issued by the Metropolitan Water Board over resumed farmland within the same general areas. There is no effective pit restoration within the forest zone, but one company at least has effectively restored a pit area on private land along the Toodyay road, 25 kilometres north-east of Perth.

Limestone

A relatively narrow zone of sand dunes, known as the Spearwood system, lies parallel with the coast and not more than 20 kilometres from it. The dunes comprise yellow or brown sands overlying coastal limestone at relatively shallow depths with frequent outcropping. Limestone from this source has been mined by open-cut, or quarry methods, ever since European settlement began in Western Australia, and has four principal uses – lime, cement, road foundation and house foundation.

Limestone pits have always been sited near the urban fringe, and many old pits are now within the expanded Metropolitan area. Restoration of pits has not been attempted until very recent times, and the public golf course project near Carrington Street, Fremantle, is an interesting contemporary attempt.

Quarry operations have been performed under a variety of licensing systems including Shire Permits, Forests Department Produce Licenses and mining tenements. All new pits are expected to be issued as mining tenements, and many of these have been pegged in the Wanneroo Division, especially near Yanchep National Park. Mining tenements have been approved by the Mines Department for only a few State Forest areas.

Granite, Diorite

The extraction of stone for buildings and road surfacing has resulted in significant scars on the western escarpment of the Darling Plateau. None of the large granite/diorite quarries currently lies within State Forest, but there has been limited removal of igneous rock from State Forest in the past. This extraction was facilitated by either a Forest Produce License or a Forest Lease, and in most instances the rock was required for monumental work. No such leases exist at early 1975, and those now lapsed are not sufficiently large to be considered for site restoration.

Tin

As mentioned previously, tin was discovered at Greenbushes, 265 kilometres south of Perth, in 1888, and production of tin and tantalite ores has been carried on, more or less continuously, ever since.

The whole district was declared the "Greenbushes Mineral Field" near the turn of the century, and, incredible though it may now seem, mining tenements were approved without any conditions for mine operation whatsoever. There is no provision or funding for restoration work, and, even if there were, the wide ranging and sporadic nature of mining and the repeated re-mining of land already treated would make any scheme of restoration unworkable. Mining methods have recently changed from a dredging pond system to a static treatment of ore with water, but the large artificial ponds remain.

Repeated mining complicates any calculation of areas mined since 1888, but an estimate for the period 1963-72 suggests 605 hectares of mine area and 520 hectares of forest cleared.

Reforestation is considered to be unwise at this stage, since it has never been possible to determine the end point of mining. Also, the operation is so marginally economic, pressure for site restoration would probably close the mines for ever.

Coal

The production of coal at Collie began in 1898, although low grade deposits had been found in the Irwin Valley, 330 kilometres north of Perth, as early as 1846. Collie remains the only commercial coal mine in Western Australia, and there are substantial reserves of the sub-bituminous deposit. Open-cut mining began in 1943, and production has reached one million tonnes per year, with 49% of this still coming from underground mining.

It is estimated that over the 80 odd years of coal production, some 500 hectares of natural forest have been destroyed as a result of surface operation, building etc., while heavy cutting for pit-props etc. has probably damaged regrowth in some sections of the forest.

The impending world energy crisis has made an impact on Collie, and long-term demand for its coal seems assured.

Site restoration of disused mine sites has occurred through natural procesess, the persistent problems being restricted to collapse of old shafts and drives, and prolonged smouldering of coal-dust deposits when fires occur.

Mineral Sands

The mineral sands industry was established at Capel, near Bunbury, in 1956, and has steadily expanded since then to become a large, highly profitable industry. Other viable operations now exist at Eneabba and Green Head, 240 kilometres north of Perth, and economic deposits are known at several other places, particularly at Augusta on the south-west tip of the State. None of these, however, is within State Forest.

Ilmenite, leucoxene, monazite, rutile, xenotime and zircon are the minerals extracted from the sands by processing at Bunbury and Capel, the annual value of production being more than $10 million.

Many mining tenements have been pegged on private property and on State Forest, and several operations have started on State Forest since 1970. All mineral-sand miners at Capel commenced operation on private land, and have worked progressively into State Forest.

The level and success of site restoration have varied over a wide range from almost nothing to a well-prepared programme. One company engaged an experienced firm of agricultural consultants in 1973-74, and is implementing the proposals put forward by them. Other companies are following this lead in 1975.

To date, reforestation of State Forest has not been studied in depth. The main areas affected fall into two categories. Western Titanium have tenements that contain maritime pine (*Pinus pinaster* Ait.) of poor strain and relatively low quality, while Westralian Sands' areas are marginal jarrah forest interspersed with bull banksia (*Banksia grandis* Willd.) heathland, which is seriously affected by the jarrah root rot disease caused by the fungus *Phytophthora cinnamomi* Rands. In both situations, the initial soils are infertile sands, which can be expected to be even more sterile after mining.

The agreement documents specify the need to stockpile topsoil for re-spreading after mining but, in practice, topsoil is virtually non-existent, and is invariably lost in the mining process. Of much greater potential is the re-mixing of sand and "fine" residues to produce a new "soil" with an improved moisture-holding capacity.

Decisions on both short and long-term objectives on sand-mined forest areas are needed in the near future as sand miners continue to expand into State Forest. Present estimates show that 220 hectares of State Forest have been cleared for mining up to early 1975.

Bauxite

There are known to be four potential bauxite mining areas in Western Australia.

ALCOA –	Central and western Darling Plateau (Jarrahdale and Del Park).
ALWEST –	Eastern Darling Plateau.
PACMINEX –	Northern Darling Plateau.
AMAX –	West Kimberleys, Mitchell Plateau

Of these four proposals, the first three would affect areas of State Forest, and only Alcoa of Australia are in production at February 1975. Alwest will probably begin operations next, with Pacminex not far behind.

Bauxite occurs generally throughout the uplands of the Darling Plateau, and intensive pattern drilling is required to define the "pods" of economic ore amid the extensive areas of non-economic material. Repetitive drilling on grid patterns commenced in the late 1950s, and there is evidence to show that this operation materially aided the spread of jarrah root rot in a number of areas. The occurrence of bauxite, generally above the 200 metre contour, creates an ideal situation for rapid, downhill spread of the fungus, should new infections occur.

Mining began at Jarrahdale, 60 kilometres south-east of Perth, in 1963, and at Del Park, 80 kilometres south of Perth, in 1972. Mining and ancillary operations to produce exportable alumina are carried out under a series of special agreements with the Government of Western Australia. Land tenure for mining is arranged outside the provisions of the Mining Act, and the agreements are administered by the Department of Industrial Development.

The scale of operations has escalated rapidly from a predicted maximum of 11 hectares per year to a level of ten times that amount. The estimated area of forest destroyed for bauxite mining to the end of 1974 is 800 hectares at Jarrahdale and 200 hectares at Del Park. Areas for which clearing is approved are 849 and 281 hectares respectively.

The agreements with Alcoa differ in some details, and while at Jarrahdale reforestation is done by the Forests Department, at Del Park the planting is done by Alcoa. There is close liaison between Alcoa, the Forests Department and other government agencies with respect to site restoration. A small action committee meets regularly on site to consider questions of drainage, dieback hygiene, soil erosion and revegetation, and there is continuing research into methods of soil stabilization, plant selection and nutrition.

Following initial plant selection trials with a wide variety of tree species at Jarrahdale, the choice has been narrowed down to three principal species:

red mahogany	*Eucalyptus resinifera* Sm.,
Sydney bluegum	*Eucalyptus saligna* Sm.,
tallow-wood	*Eucalyptus microcorys* F. Muell.

At the close of the season in 1974, a total of 454 hectares of mine site had been replanted.

It is expected that techniques that have been successful at Jarrahdale and Del Park will be generally applicable for Alwest and Pacminex bauxite pit reforestation. Nevertheless, there will be a need for continuing research, which will involve such topics as fertiliser studies, species trials and soil treatment trials, to name only a few.

Revegetation of the Mitchell Plateau sites, in the far north of the State, is expected to be extremely difficult, but, should mining occur, there is legislative direction to call on the expertise of the Mines Department, since this is not State Forest.

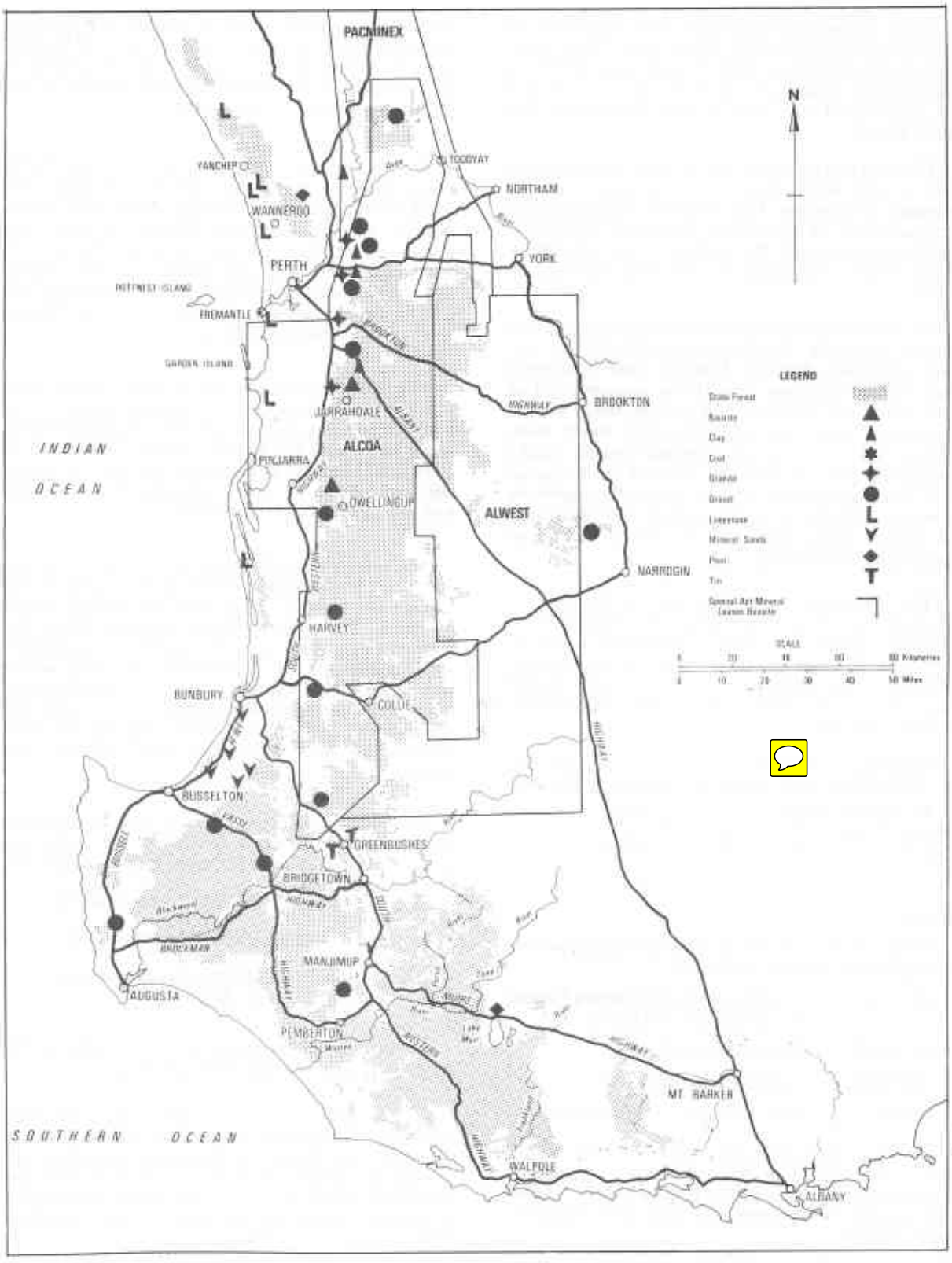

FIGURE 1: *Principal mining areas in relation to State Forest, Western Australia.*