



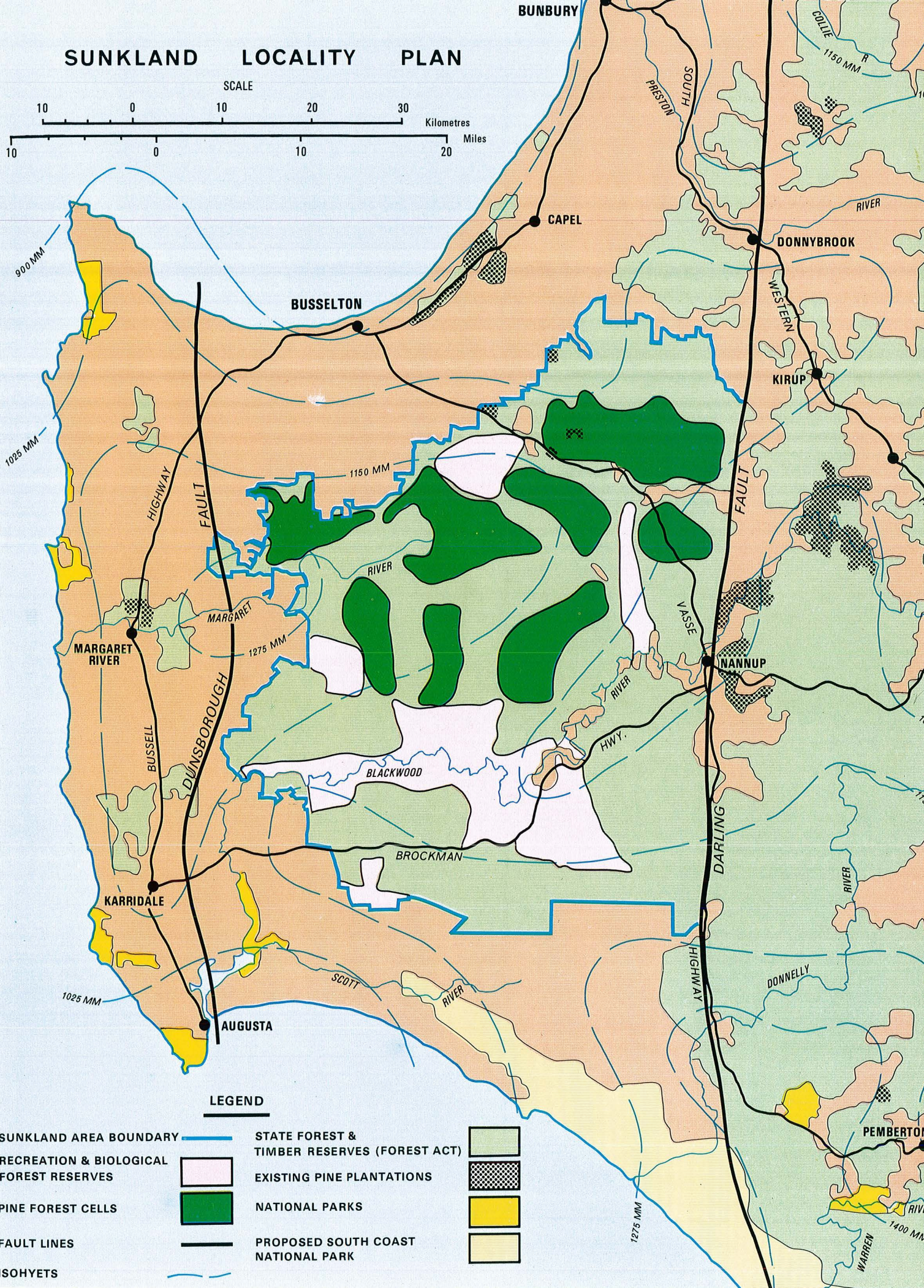
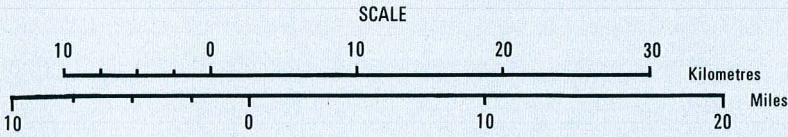
FOREST FOCUS

NUMBER 16

DECEMBER 1975



SUNKLAND LOCALITY PLAN



LEGEND

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| SUNKLAND AREA BOUNDARY | | STATE FOREST & TIMBER RESERVES (FOREST ACT) | |
| RECREATION & BIOLOGICAL FOREST RESERVES | | EXISTING PINE PLANTATIONS | |
| PINE FOREST CELLS | | NATIONAL PARKS | |
| FAULT LINES | | PROPOSED SOUTH COAST NATIONAL PARK | |
| ISOHYETS | | | |

FOREST FOCUS

Number 16, December 1975



Published for Mr. B. J. Beggs, Conservator of Forests, Forests Department of Western Australia, 54 Barrack Street, Perth.

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Photographic processing by Brian Stevenson.

Maps by Forest Department Drafting Branch.

Text (10 on 12 pt. Times) by Filmset.

Offset plates by Art Photo Engravers Pty. Ltd.

Printed in Western Australia by the Government Printing Office.

AT ISSN 0049-7320

Compiled and photographed by Dale Watkins (unless otherwise credited).



FOCUS on SUNKLANDS MULTIPLE USE LAND MANAGEMENT

A comprehensive forest land use plan announced earlier this year by the Minister for Forests, Mr. A. Ridge, involves the zoning of the 283 000 hectare Donnybrook Sunland into management priority areas (M.P.A.s) with priorities given to recreation, flora and fauna, ecology, pine plantations and hardwood production.

The Sunland is a compact area of state forest south of Busselton, as shown in the plan opposite. The new land use plan has been made necessary by a proposal to convert 60 000 hectares of this forest to pine plantation over the next thirty years, commencing in two years' time.

Initial plans for the project are set out in a "Statement of Intent" available for reading at the Forests Department library. Copies have been distributed to interested organisations, local shires in the area, scientific bodies and government departments. It must be stressed that the document is not an environmental impact statement. It is a land use proposal aimed at multiple use of the Sunland forest to provide what is considered to be the best balance of activities in the long term.

In 1977 a decision must be taken whether the proposed programme will go ahead.

In the meantime, interested groups and individuals can study the proposal and see the area. They could then offer constructive criticism and suggestions which should be valuable in helping the department make final decisions. The timing of last July's preliminary announcement of the Donnybrook Sunland improvement programme had been carefully considered. The department wants people to fully appreciate the planning and reasoning behind the proposal. In this way, much of the misunderstanding or lack of knowledge and subsequent controversy which arose over the woodchip proposal may be avoided, with greater mutual co-operation and satisfaction for all concerned.

Description of the area

The term Donnybrook Sunland was applied to the area by the geologist Jutson some sixty years ago. The name refers to a low plateau of sedimentary material situated between the Precambrian granite blocks of the Darling Plateau and the Leeuwin-Naturaliste Ridge. Most of the Sunland is state forest with only small areas of private property, mainly along the Blackwood River and in the Rosa Brook area.

The Sunland forest—predominantly poor quality open jarrah (*Eucalyptus marginata*)—has been utilised since the early years of the century by the hardwood sawmilling industry. The disadvantage of generally small log sizes was offset by cheap extraction operations. Sawmills are still operating at Jarrahwood, Nannup, Witchcliffe and Busselton.

The Sunland was unattractive to the early settlers who passed it by for more remote but more fertile land. Very little of it has been alienated for agriculture, due no doubt to its obvious poor soil fertility.

Cover

The cover symbolises the nature of the Sunland project: the combination of recreation, flora and fauna, biological M.P.A.s, soil and water monitoring activities in the field and laboratory, and growing and harvesting forest products.

Forest products are more important to the economy and society than most people believe. As the world's fossil and mineral resources are gradually depleted, the importance of timber, cellulose plastics, rayon and other reconstituted wood products as renewable resources will be recognised.

If we are to achieve and secure this renewable resource by the early twenty-first century, preparation must be started without further delay.

It is socially irresponsible to delay productive forests action until the demand is critical because the fastest growing plantations take thirty years to reach a satisfactory level of production.

Local softwood planting caters for the future needs of society and supplements indigenous hardwood timber supplies.

Production forestry—whether native or plantation—does cater for recreation values and does protect water catchments.



▲ Jarrah dieback has already affected about 45 000 hectares of the Sunkland forest.

Almost the entire Sunkland area was traversed by land classification teams from the Lands Department between 1918 and 1930. Alienation

was not proceeded with, possibly because of the sad experiences at the time with the Group Settlement Scheme.

Since 1950 the use of artificial fertilisers had made this type of land more attractive and there has been some pressure for alienation of forest land in the region. However, there appears to be no real shortage of farming land in the region as evidenced by the fact that in the adjoining Margaret River-Augusta Shire 39 000 hectares of the alienated land is still undeveloped. Current indications are that this undeveloped alienated land will be required for future farm development.

Dieback disease

A disturbing feature of the existing forest in the Sunkland is the extent of the jarrah dieback disease (*Phytophthora cinnamomi*). The disease made its appearance in the early 1950s and has since spread very rapidly, due to the particular combination of highly susceptible vegetation, gentle topography and moist, infertile soils. At the present time about 16 per cent of the total area, or about 45 000 hectares, is affected by the disease. It is likely that, even without any new infections, some 60 per cent of the native forest in the area will be destroyed by unavoidable extensions of the existing infections. There is, therefore, a massive ecological change in progress which cannot be arrested and which presents great land use problems.

Recreational use

The Blackwood River in its course across the Sunkland provides a valuable recreation area as it is the largest river in the south-west of the state. Due to its high salt content—the river rises in the drier inland areas cleared for farming—it is unlikely to be developed for water supply purposes.

After the river enters state forest at Nannup there is an infusion of fresh water from the forested part of its catchment, so its potential for fishing for the freshwater crayfish or marron as well as fish such as perch or black bream increases until the

tidal influence of the Hardy Inlet once again raises salt levels.

The river is increasingly used for canoeing and this activity seems likely to increase in the future, since this part of the Blackwood is relatively unspoilt by development activity. There are also few other rivers in the South-West which are available for canoeing virtually all year round.

The Margaret River is a much smaller stream and one which ceases to flow in summer. Nevertheless, part of the river near the junction of its north and south branches is a popular fishing and picnic area. Barabup Pool, on the St. John Brook, is another well-used picnic and swimming area near Nannup.

Flora

Extensive vegetation surveys carried out by a specialist team in the Forests Department have shown that, in general, the Sunkland contains the normal assembly of understorey vegetation associated with jarrah forest elsewhere in the state. There are, however, a number of species which are found more frequently, such as pineapple bush (*Dasyopogon hookeri*) and *Agonis parviceps*. There are several species, such as lanoline bush (*Franklandia triaristata*), *Lambertia rariflora*, short styled grevillea (*Grevillea brachystylis*), an unnamed *Hibbertia* species and needle leaved smoke bush (*Conospermum acerosum*) which are of restricted occurrence.

The Sunkland contains several forest types which are of great interest, such as the very high quality jarrah forest found on an outlier of Bunbury basalt at Milyeannup, the *Kingia* flats which are characterised by the combination of tall *Kingia australis* and a shrubby form of jarrah, and an outlier of karri (*E. diversicolor*).

One area, in the Whicher Range, on the north boundary of the Sunkland is of particular interest as it contains a number of plants which



▲ High quality jarrah forest found on an outlier of Bunbury basalt at Milyeannup.

are either relatively rare, such as *Lambertia rariflora*, or are well outside their usual range, such as dwarf cypress (*Actinostrobus acuminatus*) and *Conospermum acerosum*. The Whicher Range also contains one of the largest occurrences of mountain marri (*Eucalyptus haematoxylon*).

Fauna

Two extensive fauna surveys by specialist Forest Department teams have indicated that the range of mammal species represented in the Sunkland is almost identical to that found elsewhere in the jarrah forest. There are no rare species known to be in the area.

The range of bird species is likewise typical of jarrah forest associations with the exception of the southern emu wren (*Stipiturus malachurus*), and three heath-scrub species found in the *Kingia* flats.

Lizard species seem to be particularly numerous throughout the area

and especially in Whicher Block. One species of snake which is rather rare elsewhere appears to be present in the Sunkland—Mueller's snake (*Rhiniplocephalus bicolor*).

Hydrology

The water resource in the region is considerable, and will undoubtedly be utilised in the future. At present the only major utilisation of water from the area is the supply for Margaret River township from a dam on the Margaret River. All the streams rising in the Sunkland are fresh, including the tributaries of the Blackwood, Rosa Brook and St. John Brook. The Blackwood itself, which rises in agricultural areas to the east, is of high salinity.

Underground water is the major water resource in the Sunkland. The upper sections of the sedimentary strata contain very large quantities of potable water. The recharge rate of

these aquifers has been estimated by the W.A. Geological Survey to be 300000 cubic metres a day.

BROADSCALE LAND USE PROPOSALS

Pine forest

The draft broadscale land use plan proposes to convert a total of 60000 hectares, or 21 per cent of the area of the Sunkland, to pine forest. The proposed programme would take thirty years to complete and the main species to be planted will be radiata pine (*Pinus radiata*).

The pines will be established in a series of separate cells ranging in size from about 3000 to 12000 hectares and separated from each other by buffer areas of native forest at least 1.5 km in width.

Within each of the plantation cells only about 75 per cent of the original forest would be converted to pine.

▼ *Milyeannup Brook, just upstream from the crossing. This area is included in the biological M.P.A.s which total 12400 hectares.*



The lateritic ridge top soils are unsuitable for pine and there are extensive areas along creeks and swampy sites withheld from planting.

All the cells are located north of the Blackwood River. It is most unlikely there will ever be any extensive pine planting south of the river.

The cells have been selected following extensive site surveys to include the best proportion of plantable soils which are mainly very infertile sands and sandy loams. Large areas of plantable soil types exist outside the cells but will remain under hardwood forest.

Conversion of the native forest to pine involves complete clearing of the land after all merchantable timber has been removed. The site is then thoroughly ploughed and low mounds formed on which the pines will be planted.

The principal aim of plantation silviculture in this area will be to produce saw-logs in the shortest pos-

sible time and a combination of fertilisers and heavy thinning will be used to achieve this.

Recreation priority areas

It is proposed to set aside parts of state forest along the major watercourses—the Blackwood and Margaret Rivers—as hardwood forest to be managed with priority given to recreation. In practice this would amount to facilitating recreational usage of the waterways and maintaining the existing scenic values.

No pine forest development will be permitted although most of the area would still be used by the existing hardwood sawmill industry, with the proviso that a 200-metre strip along both rivers would not be cut over at all, even to salvage disease-affected forest.

Flora and fauna priority areas

Several special M.P.A.s are planned. These are areas set aside from

pine forest development and intended to conserve examples of vegetation types. The Whicher M.P.A., of about 6000 hectares, will contain the interesting flora referred to above and also has potential for recreation. This area was also recommended for reservation by the Conservation Through Reserves Committee. Along the St. John Brook a strip of forest about 1 km in width on each side is proposed as a flora and fauna M.P.A. to conserve interesting vegetation types, fauna habitats and some high quality regrowth forest resulting from mill operations early in the century. This would also contain Barrabup Pool, so scenic values at this popular site will be protected.

Further flora and fauna M.P.A.s to preserve examples of unusual vegetation types are planned for the Oasis swamp, an interesting area of swampy vegetation in Chester Block and a small outlier of karri in Chester.

▼ *The Blackwood River running through state forest is unspoilt by development activity and is increasingly used by canoeists.*



Biological priority areas

The whole of Milyeannup Block (about 5700 hectares) is to be given special status to ensure that it remains an undisturbed "benchmark" area. It is one of the least disturbed parts of state forest anywhere in W.A., having no interior roads at all.

The only entry by vehicles to the interior was along a seismic survey line some years ago. This exploration activity is thought to be responsible for the only occurrences of dieback disease in the block. Most of the forest is believed to be protectable from the disease. There have been some small gravel pits opened along the Brockman Highway, but these have been closed, and a small pine plot along the southern boundary will not be extended.

Milyeannup is particularly well suited for preservation as a biological M.P.A. as it contains a wide diversity of vegetation types from high quality jarrah forest to sedge-land.

The whole of Layman Block (6700 hectares) is also proposed as a biological M.P.A., although it has received more disturbance and has more dieback disease than Milyeannup.

Hardwood forest

The large and continuous area of natural forest not included in the

categories outlined above will include the full range of soil and ecological types in the Sunkland. This will receive similar management to jarrah forest elsewhere, with continued logging and regular prescribed burning for fire protection. Some rehabilitation work will be required on disease-affected areas. These will progressively be replanted with disease-tolerant eucalypts.

REASONS FOR PINE FOREST PROJECT

The need to supplement the indigenous hardwood timber supplies, as soon as possible, with locally grown softwoods is the major reason for the Sunkland pine forest project, together with the fact that large areas of Sunkland forest are badly affected by dieback disease and require rehabilitation.

The present yield of hardwood sawlogs from state forest cannot be sustained because of slow growth rates and the impact of dieback disease. It is likely the yield will have to be reduced to about half its present level before the end of the century. To avoid a major disruption to the rural economy of the South-West, and supply shortages, this reduction is planned to be accompanied by a progressive increase of



▲ The richest bird population is found in the dry Kingia/jarrah shrubby flats which appear unsuitable for pine planting.



▲ Open flats are a common sight in the Sunkland.

pine sawlog supplies. It is extremely unlikely that a sufficient reliable supply of timber products will be available from external sources in the future.

Fast growing plantations of softwood, in particular radiata pine, are the only way that a sufficient quantity of timber can be produced in the time scale necessary.

Eucalypts, such as red mahogany (*E. resinifera*), Tasmanian blue gum (*E. globulus*) and tallowwood (*E. microcorys*), which show promise in the Sunkland will require crop rotations twice as long as pine. They

◀ A pool in the Margaret River with its own natural "diving rock" just beneath the surface.

would also not produce timber of such general usefulness as the pine.

The department has had a programme of pine planting for many years but the limited area of good quality soils suitable for growing pine without fertiliser has been a major restriction on the programme. The department's policy has been to use repurchased farmland as far as possible rather than convert high quality native forest to pine. The prospects for repurchasing any further significant areas of suitable farmland are remote. Few properties are being offered for sale and the prices asked have become unrealistically high.

▶ Mountain marri (*E. haematoxylon*), named for the reddish colour of its new growth.

For radiata pine there is only about 6500 hectares of proven suitable soil available. Most of this is in the Blackwood Valley and on better class sandy soils on the coastal plain south of Perth. To maintain the present programme beyond 1980—and this is considered to be below the level required to provide for the state's future population—the Forests Department must purchase such farmlands as its restricted funds permit and proceed with the conversion of poorer quality hardwood forest to pine.

Of all the state forest which might be considered for conversion to pine, the Sunkland area offers the best compromise between concentration of suitable soil types, adequacy of area available, minimal reduction in area of high quality hardwood forest, occurrence and susceptibility to dieback disease and minimal environmental impact.

The project offers the advantages of cheaper establishment and maintenance than on repurchased land in the nearby Blackwood Valley—even if land were available. Favourable topography and geographic concentration of the plantings will generate a highly economic large scale integrated processing industry in the locality—thereby fostering the process of decentralisation.

From the social viewpoint, the

pine project will stabilise the existing departmental workforce at Nannup, Margaret River and Ludlow until 1978. After this a substantial expansion can be anticipated, either in the form of direct employment or of employment on a seasonal contract basis, to which the predominantly agricultural local workforce is ideally suited.

SUNKLAND RESEARCH PROGRAMME

In an area such as this, where the soils are very infertile and some soils are known to be quite unsuitable for pines, there are two essential prerequisites to the commencement of a pine planting programme; firstly, a detailed soil survey, and secondly, an intensive research effort to determine the fertiliser requirements of the desired pine species.

Soil and vegetation survey

Since early 1971 an officer has been engaged full time on site survey concerned basically with soil types, but with a considerable research content to determine to what extent native vegetation can be used as a rapid predictor of suitability for pine growth. This has enabled the department to accumulate an extensive knowledge of the vegetation types in the Sunkland.





▲ The need to supplement the indigenous hardwood timber supplies as soon as possible with locally grown softwoods is the major reason for the Sunkland pine forest project.

Soils have been mapped for the area north of the Blackwood River, using a technique which combines aerial photograph interpretation and ground traversing. The distribution of soil types is extremely variable and it is impossible to set out the plantations on a rectangular grid basis. Whatever planting layout is adopted the boundaries will inevitably be irregular and there will always be islands of native forest scattered throughout the pines and along the drainage lines.

Pine trial plots

Small areas of *radiata* and larger areas of *pinaster* were planted at Willcock plantation in 1952-54. This development was not proceeded with due to lack of soil survey information and inadequate nutritional research. Sufficient well-grown pine remains to justify the belief that given proper site selection, preparation and fertiliser treatment, *radiata* can be grown very satisfactorily. Because of its faster growth rate and greater productivity, *radiata* pine is the more desirable.

A number of small trial plots were established in the Sunkland between 1954 and 1969, but almost without exception, they consisted of *pinaster* only.

The first really comprehensive trial plot of *radiata* was planted in 1969 in a multi-species trial for the rehabilitation of a dieback site. This plot received good site preparation and phosphate fertiliser, and growth was exceptional from the start.

This success prompted the current phase of systematic nutrition and establishment research aimed at providing techniques for planting *radiata* on as wide a range of Sunkland sites as possible.

Plantings from 1970 extended the plots to cover all major soil types and the total area of plots established now stands at 120 hectares. The new series of plots contains at least 100 hectares of *Pinus radiata*, the remainder being *P. Pinaster*, *P. Taeda*,

P. elliotii, *P. muricata*, and *P. caribea*.

On all recent plots the early growth of radiata is extremely good. It is confidently expected that growth rates at later ages will be equivalent to the average for radiata pine in W.A. Initial survival is very high—never less than 95 per cent—and there are few problems from scrub competition. It is anticipated that large scale pine planting in this area will require very little, if any, weed control.

All trial plots have been located on dieback diseased sites to evaluate any possible impact of the disease on pine growth. It is known that radiata pine is susceptible to the disease in its young and old stages (say thirty years and older) in the open-grown situation. So far no problems have arisen and it is unlikely ever to be a serious problem, but the place of the disease in relation to pine is kept under constant observation.

Pine establishment research

Intensive research since 1970 has shown that phosphate is the principal major nutrient limiting pine growth in the Sunkland. A spot application of about 100 gm of superphosphate per tree is required at planting and it is likely that two more broadcast applications, each of 200-300 kg/ha will be required during a crop rotation. Several sources of phosphate are under study.

Most soils in the area are critically deficient in zinc and marginally deficient in manganese and copper, however these minor element deficiencies are readily cured by a foliar application of the sulphate salts of all three elements in water.

Research has now progressed to the stage of a pilot plantation area near Jarrahwood which is intended to provide facilities to develop more efficient establishment techniques and to enable studies of the environmental impact of the project to be made.



▲ A number of W.A. and eastern states eucalypts have shown promise in Sunkland dieback rehabilitation plots. This is a five-year-old plot.



▲ Hydrological studies in the area have been under way for some years.

▼ "Molloy 13" pine trial plot showing the four-year-old radiata pines on the right, and the type of diseased forest it replaced on the left.

Among the many aspects of research being pursued is the potential for the integration of livestock grazing and pine silviculture. Previous work in the Blackwood Valley and near Ludlow has shown that under certain conditions the two can be combined very successfully.

Eucalypt establishment

Active research is in progress to determine the nutritional requirements of a number of eucalypt species which might be used for the rehabilitation of diseased sites in the hardwood forest zones in the Sunkland. A number of species show considerable promise for the purpose, such as W.A. blackbutt (*E. patens*), tallowwood (*E. microcorys*), Tasmanian blue gum (*E. globulus*), red mahogany (*E. resinifera*) and mountain grey gum (*E. cypellocarpa*). Preliminary results suggest that the fertiliser requirements for satisfactory growth of these species are likely to be similar to those of pine, and that certain species might

be better suited to specific sites. For example, tallowwood for sawlog production might be restricted to the moister lower slopes, while pole-producing species such as red mahogany might be concentrated on the drier upper slopes.

Hydrological studies

The hydrology of the Sunkland has been under study for some years. In the first phase, all main streams in the area north of the Blackwood River were monitored for seasonal trends in salinity. As expected, it was found that the salinity levels of streams originating in the sedimentary basin were notably low, rarely rising above 250 p.p.m. at the worst time of the year. However, all streams originating in the Darling Plateau had markedly higher salt levels, especially those from areas cleared for farming. Salinity levels were of the order of 400 p.p.m. in the winter, rising to 1 000-1 800 p.p.m. in late spring.

In the second phase of this work,



research was restricted to the pilot plantation area near Jarrahwood to evaluate the effect of conversion to pines on such factors as water salinity, turbidity, amount and regularity of run-off, and the influence of pine management practices on soil moisture recharge. Several notch weirs have been constructed to measure run-off and a number of bores have been sunk to obtain information on subsurface soil conditions and to provide facilities for monitoring water table levels. These research projects will take some years to complete, however, they are already yielding valuable preliminary results.

ENVIRONMENTAL IMPACT OF PINE PLANTING

Effect on hydrology

The conversion of part of the Sunkland forest to pine forest is unlikely to have any serious effect on the hydrology of the area.

In the short term, clearing for pine planting is likely to produce an increased run-off compared with that under *healthy* hardwood forest. As the crop grows its water usage will increase and match or even exceed that of native forest. Forests Department studies at Wanneroo have indicated it is possible to manipulate water yield by varying the silviculture system within limits which still achieve the timber production goals. For water management it may be desirable to manipulate stand density to maximise evapotranspiration on certain dieback intensive areas.

Research in a small catchment which was 80 per cent cleared and planted with pines indicates that there has been no increase in salinity compared with the adjacent un-cleared catchment. In view of low

salt levels in the underlying sediments it is expected that this evaluation will also apply in the case of larger areas being converted to pine. Further confirmation of this has been obtained from water samples collected from farmland cleared for about ten years on Sunkland sites in the Rosa Brook area. Salinity levels in streams in that area are not signifi-

cantly higher than current levels in the Margaret River.

Much of the Margaret River catchment is severely affected by dieback and has been heavily cut over to salvage millable timber. This has not adversely affected water quality. Salinity levels now are on a par with other streams in the Sunkland which have had only slight disturbance.



Under certain conditions grazing can be very successfully combined with pine silviculture. This experimental area is at Busselton.

The destruction of the native vegetation by the disease has no doubt decreased evapotranspiration in the catchment and thus increased the run-off.

Rehabilitation of disease-affected areas with pines will minimise any undesirable influence of dieback on the quality or quantity of the run-off.

The major water resource in the

area, however, is underground (sub-artesian) water. It is probable that exploitation of these underground supplies will provide the cheapest and greatest yield of water in the future. Current research and limited experience with bores tapping aquifers in the Wanneroo area suggest the pine project is compatible with this activity.

No long-term detrimental effects such as a change in pH of the water originating from a predominantly pine catchment are expected. Such a change might be expected to have undesirable consequences for aquatic fauna.

Evidence from a forty-year-old plantation at Grimwade where the water pH in a pine catchment is currently the same as that of the adjacent hardwood catchment indicates the unlikelihood of such changes in the Sunkland.

Impact on fauna

Changes to vegetation within the 20 per cent of the area to be gradually converted to pines over thirty years will undoubtedly affect some fauna. The larger macropods are likely to be favoured by the pine planting project. Observations in pine plantations elsewhere in Western Australia suggest that the cover afforded by young pines and the fresh herbaceous understorey which develops after clearing lead to a build-up of populations of the grey kangaroo (*Macropus fuliginosus*) and the brush wallaby (*M. irma*).

Some smaller marsupials such as the quokka (*Setonix brachyurus*), the quenda (*Isoodon obesulus*) and the water rat (*Hydromys chryso-gaster*) will be little affected as their prime habitats will not be changed. Others such as the honey possum (*Tarsipes spencerae*) will probably be adversely affected. However, there are no rare mammal species in the Sunkland and all will be adequately catered for in the very large areas of hardwood forest which will remain. It should be noted that destruction of habitat and food source (especially plants of the family *Proteaceae*) by the dieback disease will result in a reduction in the numbers of some of the more specialised fauna.

◀ *Experimental pine silviculture and pasture establishment at Jarrahwood. The pine seedlings were planted several months before this photograph was taken.*



Category		Area (ha)	Total (ha)
Recreation M.P.A.s	Blackwood River	20 000	21 200
	Margaret River	1 200	
Flora and fauna M.P.A.s	Whicher	6 000	9 300
	St. John Brook	2 500	
	Chester (karri)	300	
	Oasis	500	
Biological M.P.A.s	Milyeannup	5 700	12 400
	Layman	6 700	
Pine Forest			60 000
Commercial Hardwood Forest			180 100
			<u>283 000</u>

Some birds, such as ducks, will be favoured by the water storages developed for fire-fighting purposes, while others such as honeyeaters will lose part of their food source. Some species will be favoured by the extensive forest edge situation which the plantation will create.

Possibly the richest bird population is found in the dry *Kingia*/jarrah shrubby flats which appear unsuitable for pine planting.

The aquatic fauna and the amphibians appear likely to be unaffected by the department's proposals, since there will be little change in their habitat. There is good evidence that water salinity and pH will not change, the stream reserves will prevent a significant rise in water temperature, and due to the generally coarse texture of the soils there will be minimal changes in water turbidity.

No information is yet available on the possible impact on the reptile population of the Sunkland.

Although the proposed plantation project may well have a detrimental effect on some native fauna in some respects, this should be put in perspective. Only about 20 per cent of the total area of the Sunkland will be

converted to pine. The approximate areas under each future land use category are shown in the table above.

Impact on recreation

Recreational use of the Sunkland forest is focussed mainly on the large watercourses. The broadscale land use plan outlined above makes full provision for preservation of recreational opportunities in these areas.

In summer, pools on the main water courses are used for marron fishing. The increased roading associated with pine planting might mean the marron population would be intensively fished. No other direct detrimental effect is foreseen.

The only other recreation—apart from illegal kangaroo shooting—is some wildflower viewing along main roads in spring. Since the pine forest cells border main roads only in a very minor way, this activity will not be reduced to any significant extent.

Apart from along the water courses, the Sunkland jarrah forest generally is rather poor and could be described as unattractive. Many people viewing the depredations of dieback within this situation would agree that the variety added by well-sited and well-managed pine forests can only improve the future aesthetic appeal of the area.



The difference in vigour between unmounded and mounded seedlings when planted in moist sites is obvious with these one-year-old seedlings.



