Logue Brook
Reservoir and Catchment Area
Management Plan
1990 – 2000

MANAGEMENT PLAN No. 20

Department of Conservation and Land Management

Water Authority of Western Australia

LOGUE BROOK

RESERVOIR AND CATCHMENT AREA

MANAGEMENT PLAN

1990-2000

PROJECT TEAM

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DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

in conjunction with

WATER AUTHORITY OF WESTERN AUSTRALIA

PREFACE

This management plan has been jointly prepared by the Water Authority of Western Australia and the Department of Conservation and Land Management (CALM), in accordance with the planning process established under the CALM Act, 1984.

Preparation of the plan was initiated by the Water Authority following public and local government representations regarding the future of Waroona Dam for irrigation and recreational use. Preliminary, long term planning of nearby sources for Perth's water supply identifies the alternative of an enlarged dam at Harvey. The supply pipeline from Harvey would pass near Waroona and Logue Brook Dams, which regularly overflow and it may be feasible to inject potable water, surplus to irrigation requirements into this pipeline. Current Water Authority planning confirms the use of Logue Brook Dam for irrigation and there is no intention to propose its use for public water supply for at least twenty (20) years. However, as the Water Authority believes it is desirable to keep all options open, it was decided that a catchment management plan should be prepared to provide for sustainable recreational use of the reservoir and its catchment, whilst maintenance of water quality in accord with long term objectives.

In the initial stages of this project, it was resolved that this plan should be given legal status under the CALM Act and hence it would be termed 'Area Management Plan. This formal arrangement arose from two principal factors

(i) the majority of the catchment area for the dam is part of a much larger tract of State Forest managed by CALM, and

(ii) there is no statutory mechanism under existing Water Authority legislation which allows implementation of a management plan on CALM land.

The main emphasis of this plan is management of recreational activities, because recreational use of the dam has increased significantly in recent years and, at present, is not adequately managed. Whilst land is used for other purposes in the catchment area, such as water and wood production, management prescriptions for these uses are adequately addressed in the Regional Management Plan for the Central Forest Region and in the document 'Timber Production in WA' (CALM, 1987 b-d).

The reader should be aware from the outset that, although recreation management is the primary focus of this plan, recreational use is not the priority land use of the catchment. Water and wood production have priority over recreation.

Finally, it is advised that a similar plan has been prepared for the Waroona reservoir and catchment. The plans have been prepared concurrently because the two reservoirs are focal points of recreational activity in the district and have similar uses, problems and management prescriptions.

This Management Plan was approved by the Hon. Minister for Conservation and Land Management on 18 December 1989.

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ACKNOWLEDGEMENTS

The contribution to this plan of those who attended the public workshop is gratefully acknowledged, as is the contribution of other members of the public who provided written submissions.

Steering Committee members also provided valuable advice and discussion. The members were Keith Lynch, Chairman (Water Authority), Ian Wood, Jeff Kite (Water Authority), Ron Golding (Shire of Waroona), Charles Lockwood (Shire of Harvey), Dane Smith (Marine and Harbours), Peter Murray (South West Development Authority), and Jim Williamson (CALM). Observers present at Steering Committee meetings included Burt Scott, Ross Doubikin

(Water Authority), Bob Chandler, Peter Henderson (CALM), Mike Stoner, Mike Bishaw, Martin Bowman consultant team).

Ian Wood was the main contributor from the Water Authority on the project team until he resigned and his place was filled by Jeff Kite with assistance from Naomi Arrowsmith. Valuable comments were received from several officers in the Water Authority and CALM. Word processing skills were supplied with diligence and cheerfulness by Debbie Bowra.

1.0 INTRODUCTION

1.1 Recreation on Reservoirs and Catchments in Western Australia

1. 1. 1 Regional Context

In recent years, there has been a significant increase in the demand for recreational use of water supply catchments, particularly near to, or on the water storages. Greater demand is partly reflected by the increasing number of requests for special access received by the Water Authority and partly by the pressure on existing facilities.

To put the present situation into a regional perspective, there is an enormous land area on the western edge of the Darling Range which is now affected by restrictions on public access and recreation due to declaration of areas for water production. A total of 7,150 square kilometres is contained within these catchments, and there is an additional 1,300 square kilometre declared as water reserves to identify those catchments which have potential for future water supply developments.

The existing controls on recreational use of water catchments, therefore, place a significant constraint on large areas of State Forest which are otherwise suited to a wide range of recreational activities. However, it should also be recognised that construction of water storages has increased recreational opportunity and must be partially responsible for the existing levels of demand.

1.1.2 Irrigation Water Storages and Catchments

South of Dwellingup, the Water Authority operates a number of reservoirs which store water principally for irrigation purposes. Fewer access restrictions are applied to these reservoirs in recognition of the less stringent water quality requirements in comparison to those for urban/domestic use. The overriding concern is to minimise potential salinity increases. However, as some of these reservoirs may be used for public water supply purposes in the future, other aspects of water quality maintenance are also important. A summary of the present access restrictions is given below:

- Vehicles (including trail bikes and off-road vehicles) are only permitted on public roads, open tracks and designated dam access roads.
- Pedestrian access to all of the catchment and dam wall is permitted. Access to the water area is also permitted, and activities such as marroning, fishing, canoeing and swimming are conducted on some water areas.
- Camping is not permitted outside designated areas.

- Motor boats are permitted on three reservoirs (Waroona, Logue Brook and Glen Mervyn) and water-skiing is a popular pastime.

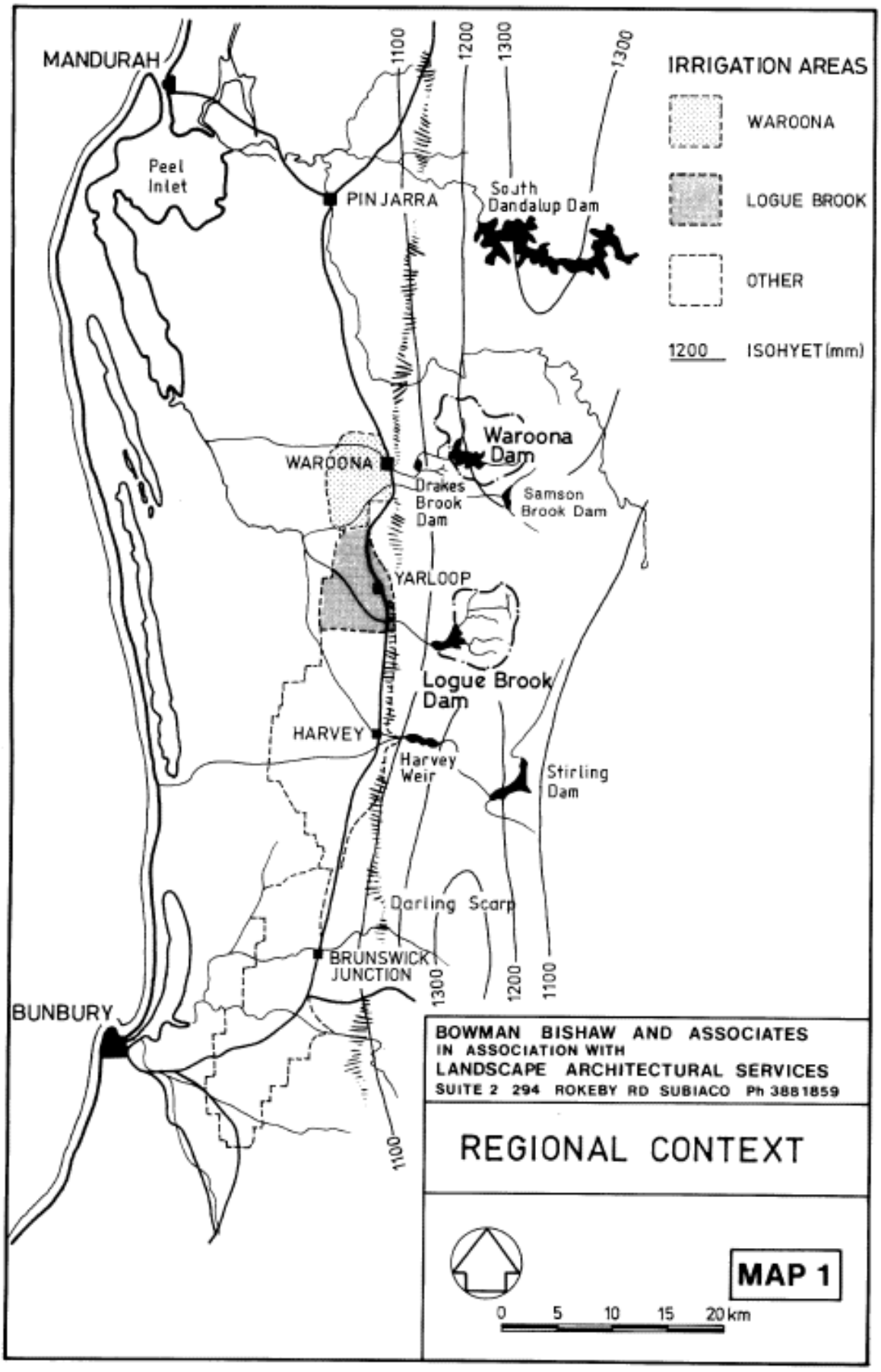
1.2 Logue Brook Reservoir and Catchment

1.2.1 Location and Historical Perspective

Logue Brook reservoir is located on the western edge of the Darling Range, lies wholly within the Shire of Harvey and is approximately 125 km south of Perth by road. The main access road to the dam intersects South-Western Highway approximately half-way between Yarloop and Harvey. Map 1 illustrates the regional location of the dam and its catchment.

The Logue Brook Dam catchment was proclaimed as part of the Harvey Irrigation District in 1945, under the provisions of the Rights in Water and Irrigation Act. The dam was constructed in 1963 to enable further improvement to the Harvey irrigation scheme. This scheme had been extended north to the Yarloop area in the late 1940's and, with completion of Logue Brook dam, provided irrigation to one in every three hectares.

The water storage area has always been open to water sports. It has been named 'Lake Brockman'.


MANDURAH
Peel Inlet
PINJARRA
1100
1200
1300
1300
South Dandalup Dam
IRRIGATION AREAS
WAROONA
LOGUE BROOK
OTHER
1200 ISOHYET (mm)
Waroona Dam
WAROONA
Drakes Brook Dam
Samson Brook Dam
YARLOOP
Logue Brook Dam
HARVEY
Harvey Weir
Stirling Dam
Darling Scarp
BRUNSWICK JUNCTION
1300
1200
1100
BUNBURY
1100
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 3881859
REGIONAL CONTEXT
MAP 1
0 5 10 15 20 km

1.3 The Need for a Management Plan

The preparation of this plan was initiated by the Water Authority, largely in response to the increased recreational demand on the reservoir and catchment. As 'people pressure' on the area increases, effective management will be required to ensure that water quality of the reservoir does not deteriorate and that the overall aesthetics of the area are not spoiled. The need for a management plan may be discussed both in terms of broader, regional land use issues and in terms of issues specific to Logue Brook reservoir.

Some of these issues are briefly summarized below to emphasize the requirement for management of recreation.

i. State forest is to be managed for multiple use. The major uses on the Western Scarp will be for water supplies, sustainable wood production, conservation and recreation. Wood production and water supply are compatible uses, whereas recreation and conservation are conditional on specific time, area or use constraints.

ii. Recent land use studies, which have addressed access to catchments and reservoirs, have consistently indicated that there is a need for improved planning and management to enable a gradual lifting of restrictions on recreational activities without compromising priority purposes.

iii. The Western Australian Water Resources Council has investigated this issue and recommended a number of guidelines to be followed in the planning process if increased recreational use of reservoirs and catchments is to be allowed (WAWRC, 1985). The guidelines include a recommendation that proposals for recreational activities be based on detailed management plans.

iv. Based on the WAWRC guidelines, a management plan for Logue Brook reservoir is long overdue as active water-based recreation has been allowed since the dam was constructed.

v. An effective management plan and associated monitoring programme for this reservoir may be used as a case study with reference to other reservoirs and catchments, particularly potable water storages.

vi. A principal requirement of this management plan is to co-ordinate the activities of the various management authorities involved in the area (eg. CALM, Water Authority, Department of Marine and Harbours, Shire of Harvey). Present recreational use traverses the boundaries of responsibility of these authorities.

1.4 Logue Brook Dam Catchment Management Plan

1.4.1 Scope

The aim of this plan is to formulate management prescriptions for the reservoir, foreshore, the complete catchment area and a small area of Crown land below the dam wall. The management prescriptions focus on recreational use, with due consideration to the priority land uses of water and wood production.

This document is intended to provide guidelines from which an annual works programme can be formulated.

1.4.2 Plan Structure

This document has five sections, as follows:

- Section A briefly describes the resource information on which the plan is based and evaluates the environmental resources with respect to compatibility of recreational pursuits.
- Section B outlines the management objectives for the major land uses in the catchment.
- Section C presents a range of alternative strategies to resolve the identifiable recreational issues and outlines the preferred administrative structure for management.
- Section D presents the management prescriptions.
- Section E describes the implementation and review of the plan.

SECTION A: BACKGROUND TO MANAGEMENT

2.0 DESCRIPTION OF RESOURCES AND LAND USE

2.1 Land Tenure

The Logue Brook reservoir has a catchment area of approximately 3780 hectares. Significant features of the land tenure, illustrated in Map 2, are described below:

i. Approximately 93% of the catchment is State forest, vested in the Lands and Forest Commission and managed by CALM. This includes most of the shoreline of the reservoir.

ii. An area of 18.8 hectares, on the southern side of the reservoir, is leased from CALM by the Shire of Harvey for a caravan park.

iii. Freehold land (approx. 47 hectares), partially cleared for agriculture in the north-eastern sector of the catchment.

iv. Water Authority Reserve.

2.2 Existing Access

There are four main roads to Logue Brook reservoir, providing excellent unrestricted access. These are shown on Map 3 and listed below:

- sealed Logue Brook Dam Road, which runs off South-Western Highway,

- unsealed secondary roads - Western Boundary Road from the north, Medway Road from the south and via Clarke Road, from the east.

There is a loop road which is located very close to the high water mark of the reservoir for most of its length, and numerous tracks have been pushed through the buffer of vegetation to gain access to the reservoir at specific points. This road is sealed for the majority of the northern perimeter.

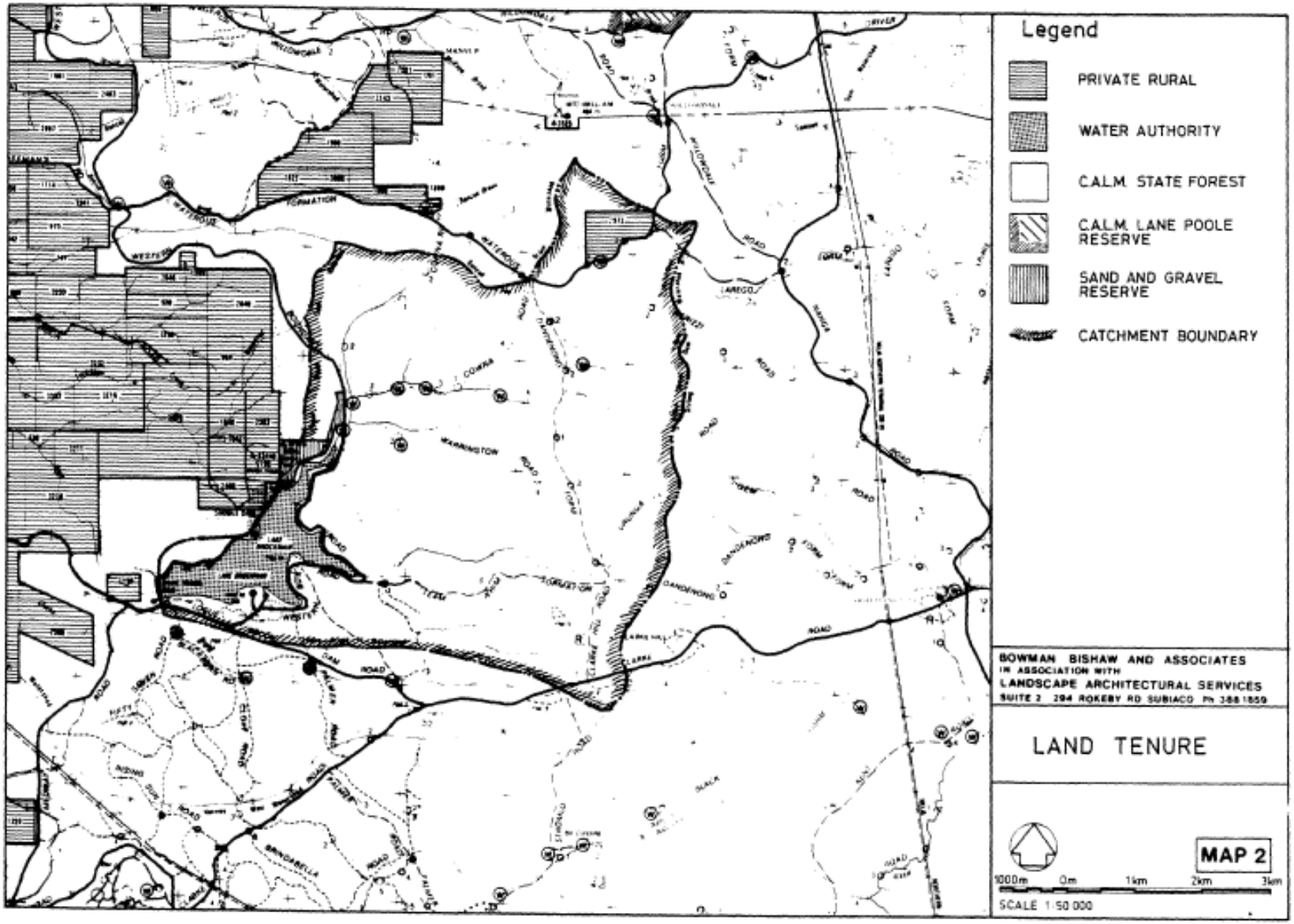
There is a profusion of minor tracks throughout the catchment, which tend to follow the feeder streams in most cases. Movement across the catchment boundary is unrestricted as a result of these tracks.

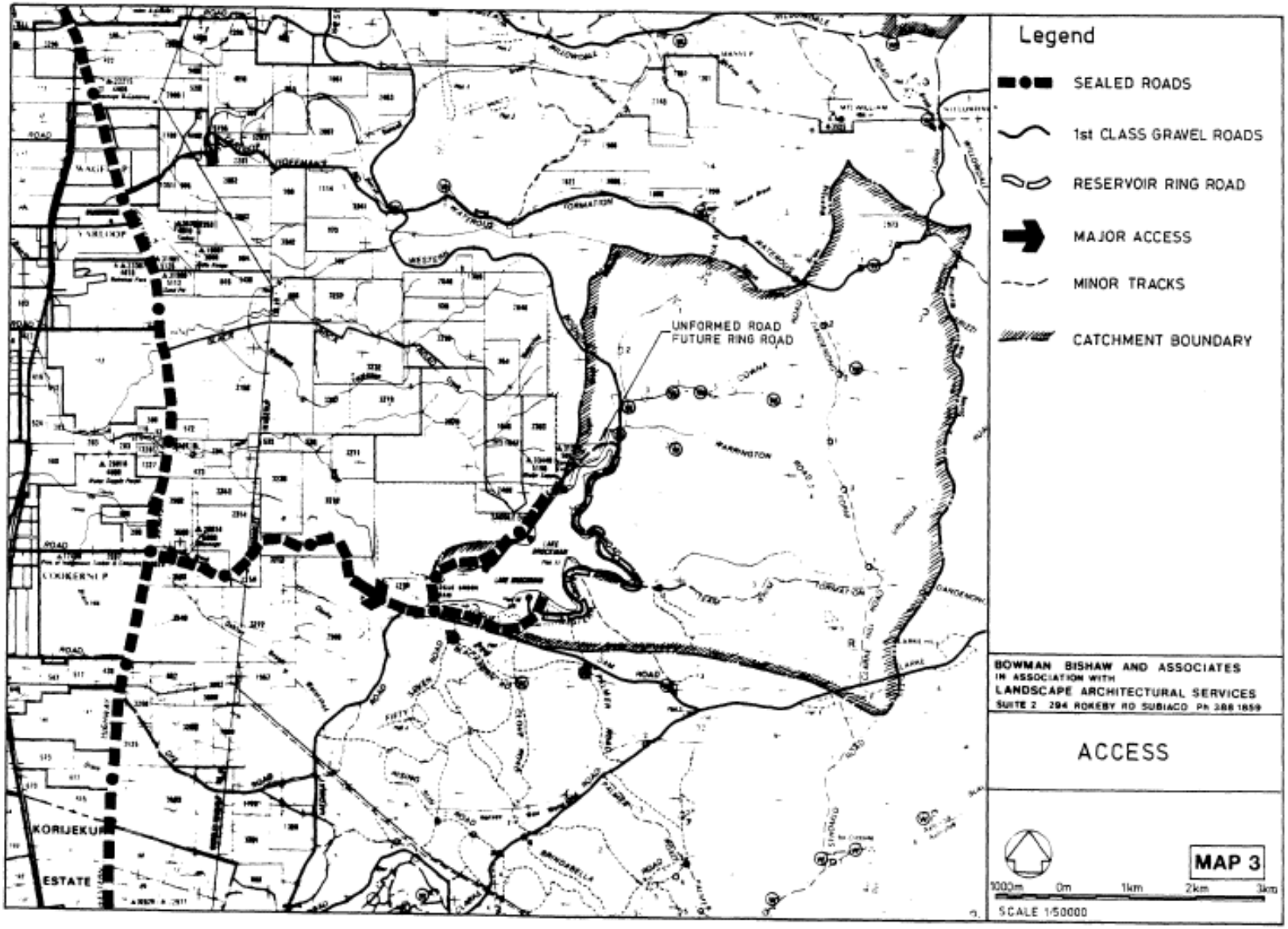
2.3 Physical and Biological Resources

2.3.1 Climate

The Logue Brook Dam area has a temperate climate characterised by warm, dry summers and cool, wet winters. Typical features of the climate are summarized as follows:

- The catchment is located in the high rainfall belt of the Darling Scarp, with an annual average rainfall of 1220 mm;
- Approximately 80% of the rainfall falls in the five month period May to September;
- Annual average evaporation (Class A pan) is about 1700 mm and generally exceeds rainfall for about seven months of the year;
- A guide to the likely temperature variations may be gained from records at the Dwellingup meteorological station, located approximately 30km NNE. Mean monthly maximum temperatures vary from 29.9°C in January to 14.8°C in July; mean monthly minimum temperatures vary from 14.9°C in February to 5.2°C in August;
- During summer, winds usually blow from the east in the morning and south-west and south-east in the afternoon. In winter, winds come from the western sector with highest occurrences from the north-west. The strongest winds occur mostly from the western sector.


Legend
PRIVATE RURAL
WATER AUTHORITY
C.A.L.M. STATE FOREST
C.A.L.M. LANE POOLE RESERVE
SAND AND GRAVEL RESERVE
CATCHMENT BOUNDARY
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 388 1859
LAND TENURE
MAP 2
1000m 0m 1km 2km 3km
SCALE 1:50 000


Legend
SEALED ROADS
1st CLASS GRAVEL ROADS
RESERVOIR RING ROAD
MAJOR ACCESS
MINOR TRACKS
CATCHMENT BOUNDARY
UNFORMED ROAD
FUTURE RING ROAD
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 388 1859
ACCESS
MAP 3
1000m 0m 1km 2km 3km
SCALE 1:50000

2.3.2 Geology

The main geological element is the Yilgarn Block and the dominant rock type is a coarse-grained porphyritic granite. Gneissic rock may occur along the western edge of the catchment. Dolerite dykes occur within areas of both granitic and gneissic rocks.

A map of the surface geology is given in Map 4. Note that laterite occupies approximately 50% of the land surface, whilst the next most common surficial deposit is pisolitic sandy gravel. This gravel is ferruginous and may be locally re-cemented to form an erosion resistant 'pseudo-caprock'. The gravelly silty sand is characteristic of the drainage lines.

2.3.3 Landform and Soils

The Logue Brook dam catchment lies within the broad physiographic unit known as the Darling Plateau, slightly to the east of the steep, rocky slopes which characterize the plateau's western edge (Darling Scarp).

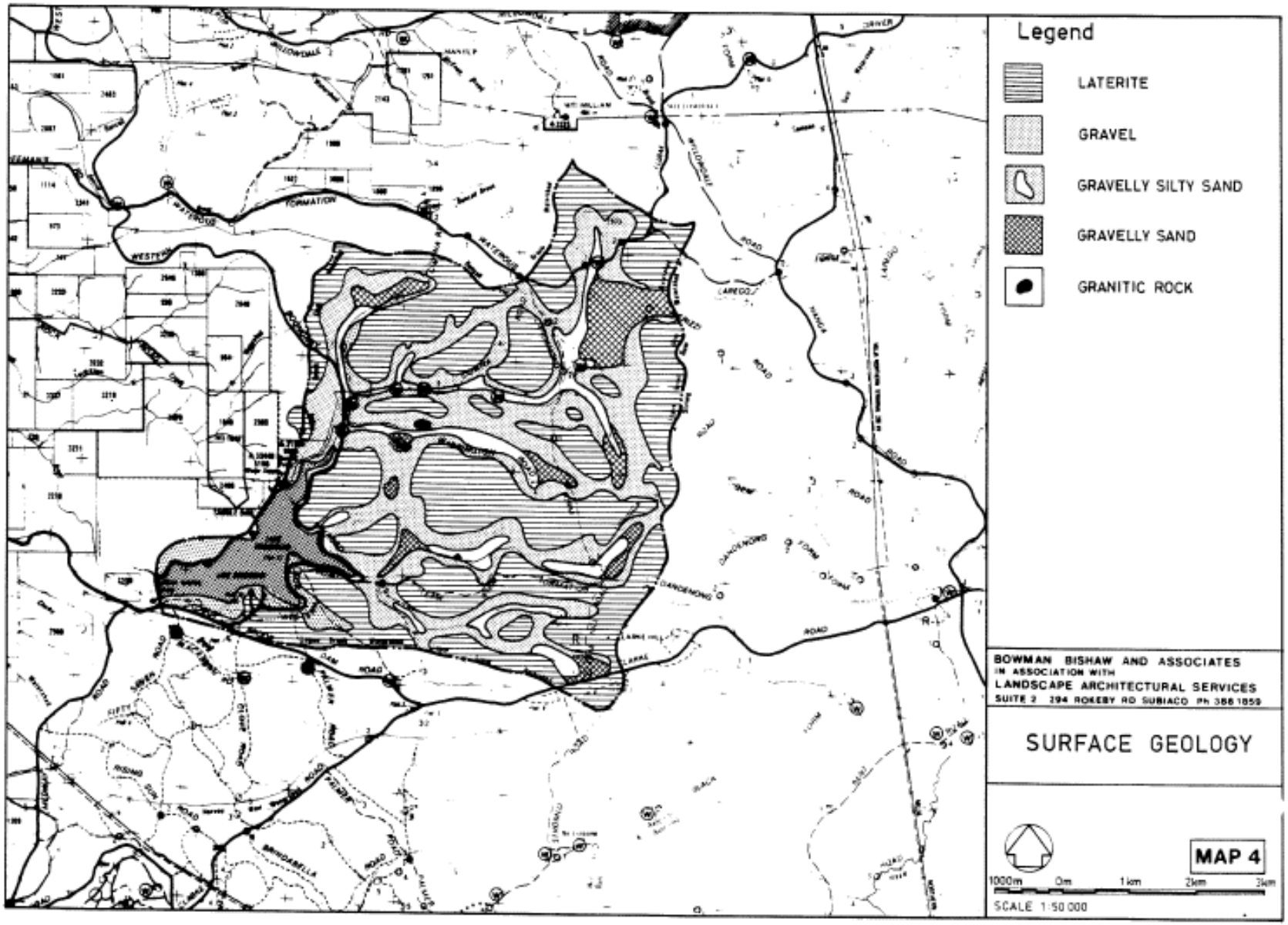
Three landform units are recognized in the area, and these are briefly described below along with the characteristic soils.

i. **Murray** (8% of the catchment): The reservoir is located in a deeply incised valley typical of the Murray Unit, with slopes between 3% and 15%. Red-brown earths are found on the slopes and gravels together with patchy pseudo-caprock.
ii. **Yarragil** (43%): The upstream extensions of the major reservoir valley are known as the Yarragil Unit. These upland valleys have more gentle slopes (less than 8%) characterised by sandy gravels, with swampy orange earths in the valley floor.
iii. **Dwellingup** (49%): The gently undulating, upland areas of the catchment are known as the Dwellingup Unit, which may have a duricrust 'caprock' on the ridges. The shallow depressions are generally sands and gravels.

2.3.4 Hydrology

The reservoir was formed by damming Logue Brook which forms part of the Harvey River Basin. The feeder streams have their headwaters in swampy areas located between the dissected laterite ridges. Of the two principal feeder streams, only the north-eastern drainage is perennial.

The average annual runoff of the catchment is 12.5 million cubic metres, giving a catchment yield equivalent to 25% of rainfall, though in some years it may be as high as 30%.


Legend
LATERITE
GRAVEL
GRAVELLY SILTY SAND
GRAVELLY SAND
GRANITIC ROCK
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 388 1859
SURFACE GEOLOGY
MAP 4
1000m 0m 1 km 2km 3km
SCALE 1:50 000

2.3.5 Vegetation

Map 5 show the vegetation of the catchment. This map was reproduced from the original mapping of vegetation complexes by Heddle et.al. 0 980).

The vegetation complexes that occur within the catchment relate closely to the landform units described in Section 2.3.3 and are summarised below:

- Dwellingup Complex - comprises primarily jarrah and jarrah-marri (*E. marginata and E. calophylla*) open forest, often with an understorey tree layer of sheoak (*Allocasuarina sp*.) and bull banksia (*Banksia grandis*).
- Yarragil Complex - mixed open forest of jarrah-marri with admixtures of yarri (*E.patens*) and bullich (*Emegacarpa*).
- Murray Complex - peripheral vegetation of the reservoirs, mostly jarrah-marri higher on the slopes with occasional yarri on the lower slopes. (There is very little of this complex remaining in the catchment as a result of construction of the dam).

There are swampy areas along the feeder streams which may have a fringing woodland of paperbark (*Melaleuca preissiana*) and swamp banksia (*B. littoralis*).

2.3.6 Fauna

A reasonably extensive inventory of fauna found in the jarrah forest has been compiled over the years. Surveys have been conducted in nearby areas, such as for the Willowdale bauxite mine (Alcoa, 1978) and the Harris River project (Water Authority, 1984). The reader is referred to these reports and to the resource document for the Lane Poole Reserve (CALM, 1986 a) for an indication of the fauna likely to be found in the catchment.

2.3.7 Landscape

The main visual appeal of the Logue Brook catchment is the reservoir itself. A large open water expanse with fringing forest has a high scenic value, particularly towards the end of winter when water levels are high. At low water level the exposed banks emphasize the artificial nature of the scenic environment. The gorge immediately below the dam wall is an area of interest.

Whilst much of the surrounding forest is affected by dieback, landscape value is provided by the undulating topography and open forest formation and the occasional stream drainage with distinctive wetland vegetation complex.

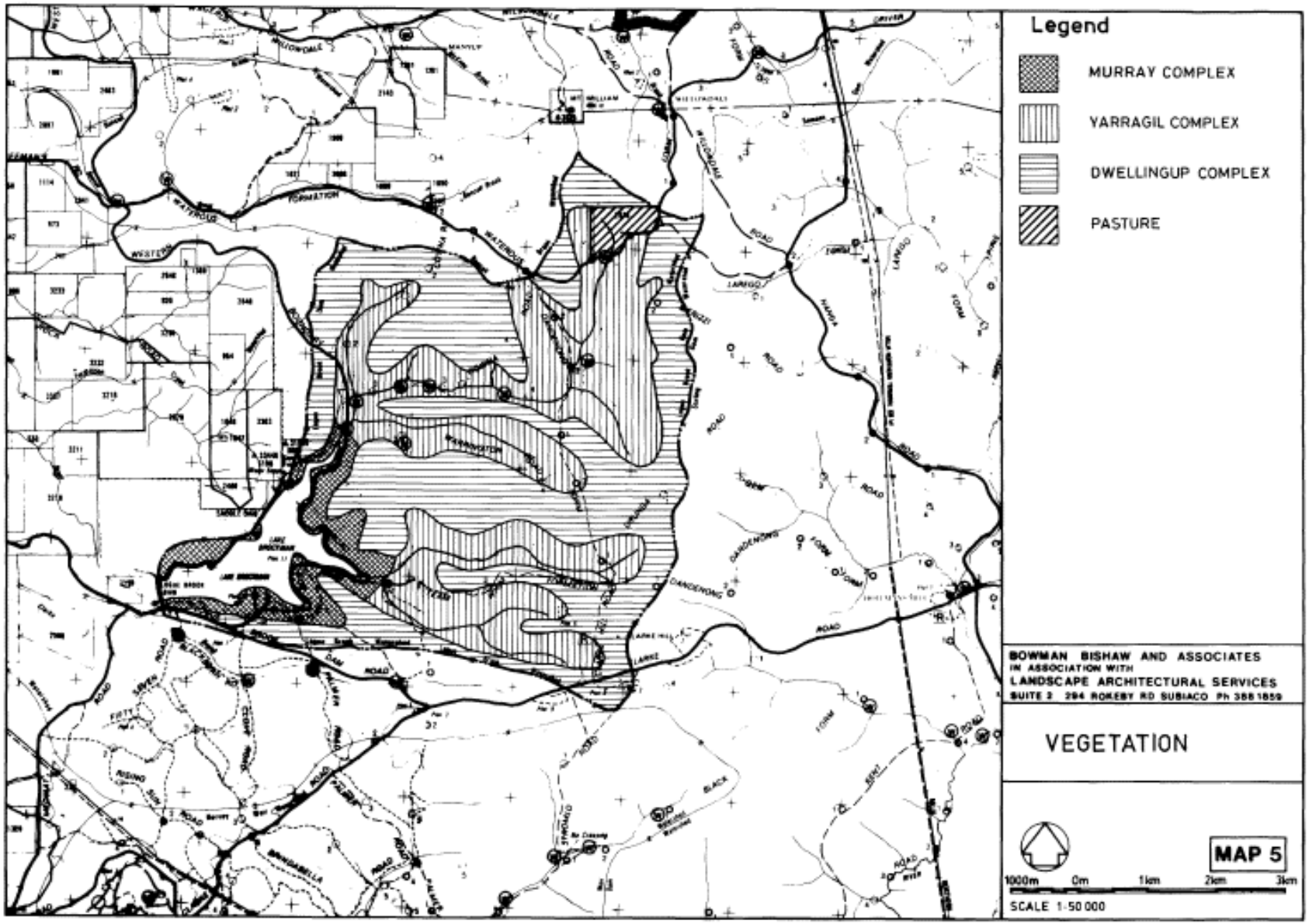
2.4 Characteristics of Recreational Use

2.4.1 Recreational Demand

The System 6 Tourism and Recreational Sub-committee Report DCE, 1979) predicted a trebling of demand for outdoor recreation in the System 6 area by the year 2000. Given that recreational activity will generally focus on sites near, or adjacent to a water body, then it is reasonable to assume that the recreational capacity of Logue Brook Dam will eventually be fully utilized. The Western Australian Water Resources Council predicted a similar trend of increasing demand for water based recreation (WAWRC, 1985).

This is supported also by a recent assessment of demand trends for the nearby Murray River valley and Land Poole Reserve, which gave a strong indication that there has been a significant increase in recreational use since the mid 1970's (CALM, 1986, a).

Other factors, such as the area's proximity to Perth and Bunbury, its ready accessibility and recreational attractions and facilities, combine to support heavy usage. Local anecdotal evidence collected- during the study suggests that the available facilities and recreational opportunities are already used to capacity (and beyond) at certain times of the year.


Legend
MURRAY COMPLEX
YARRAGIL COMPLEX
DWELLINGUP COMPLEX
PASTURE
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 388 1859
VEGETATION
MAP 5
1000m 0m 1km 2km 3km
SCALE 1-50 000

2.4.2 Water-based Activities

There is no doubt that the reservoir is the focal point of recreational activity in the catchment. Direct contact activities such as water-skiing, canoeing, sailing, windsurfing, swimming, marroning, and fishing are popular. Whilst the majority of these activities are pursued throughout the year, there is a definite peak season during the warmer months. (The relative location of existing recreational facilities is illustrated on Map 6).

At present, the only regulatory restrictions to recreation at Logue Brook Dam are as follows:

- there is a gazetted water-skiing area which does not allow skiing within 250m of the dam wall and outlet tower. A skiing route is also recommended on information signs.
- the reservoir is closed to marroning for a period determined by the Fisheries Department which may vary from year to year. In 1987/88 there was no open season, but in previous years it has been between December 15 to May 1.

The edge of the reservoir is also popular for a host of other activities. These do not involve direct contact with water, but result from the attractive 'natural' forest environment and the enhancement of this by the aesthetic features of the reservoir. Picnicking and sightseeing would be pursued by most visitors to the area. Trail bike riding is commonplace, particularly around the exposed reservoir banks.

'Wild camping' (ie. vehicle-based camping in non-designated areas), also occurs in the catchment but is discouraged by the Shire, particularly near the reservoir and campers are directed to the caravan park and camping ground.

It is obvious from the incompatible nature of some of the activities described above and the pressure of numbers during peak periods that conflicts will arise between different interest groups. Resolution of these conflicts is addressed in this management plan.

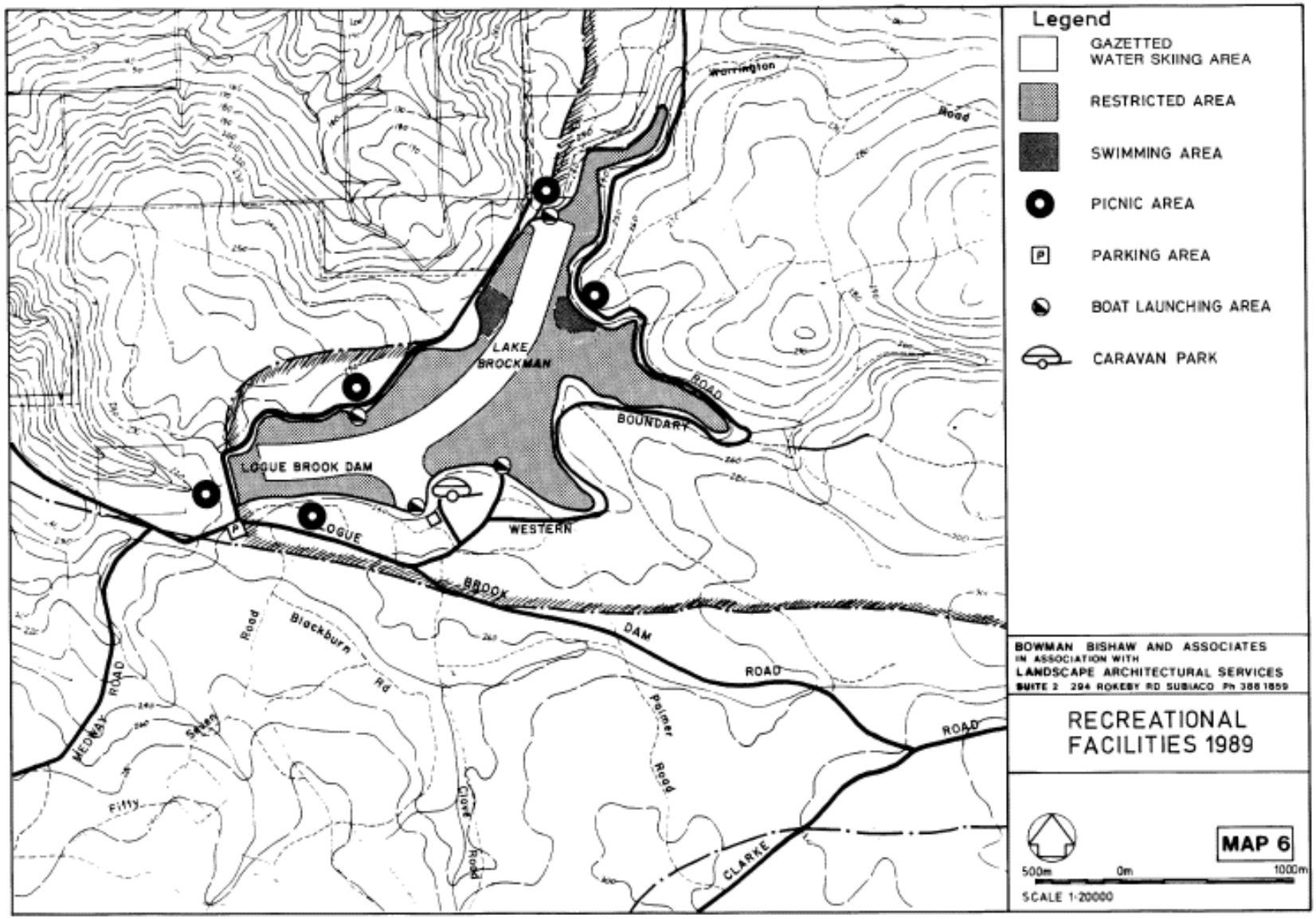
2.4.3 Land-based Activities

Whilst the majority of recreational use is concentrated on the reservoir and forest foreshore, there are a variety of activities conducted in the upper catchment which also require consideration.

The majority are represented by the following list:

- sightseeing (usually vehicle-based)
- driving off-road vehicles
- horse-riding
- bushwalking
- picnicking
- camping.

In addition, there may be occasional illegal hunting of feral pigs and kangaroos.


Legend
GAZETTED WATER SKIING AREA
RESTRICTED AREA
SWIMMING AREA
PICNIC AREA
PARKING AREA
BOAT LAUNCHING AREA
CARAVAN PARK
LAKE BROCKMAN
LOGUE BROOK DAM
LOGUE
WESTERN
BOUNDARY
ROAD
BROOK
DAM
ROAD
Blackburn Rd
Palmer Road
CLARKE
ROAD
MEDWAY ROAD
Clarke Road
Warrington Road
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 388 1859
RECREATIONAL FACILITIES 1989
MAP 6
500m 0m 1000m
SCALE 1:20000

2.5 Land Use (Other than Recreation)

The priority land uses for the catchment are water and wood production, which are recognised as highly compatible activities following the development of effective management prescriptions by CALM. The following section briefly describes these activities. Conservation is also discussed followed by a summary of other more minor land uses.

2.5.1 Water Production and Irrigation Use

The Logue Brook reservoir has a capacity of 24 million cubic metres when full. On average, about 30% of this volume is released for irrigation purposes on the nearby coastal plain during the summer season. The water storage is replenished each winter when rainfall on the catchment generates runoff. For average conditions, this is estimated to total about 12.5 million cubic metres. Runoff volume will vary from year to year, therefore the Water Authority must balance the demand for irrigation water with the actual volume in storage and anticipated rate of replenishment.

The economic livelihood of a large number of farmers in the Harvey Irrigation District depends on a reliable supply of good quality water from this reservoir. The current water allocation (ie. maximum volume allowed each season) is 14,000 m3 per rated hectare. An average of about 7 waterings are generally applied during the main irrigation period, (October to April). This water is predominantly utilized to support summer pasture for beef production and dairying. Land is also irrigated to produce fodder crops, vegetables and fruit.

2.5.2 Wood Production

The catchment has been cut over to supply jarrah sawlogs to local timber mills. The forest in the catchment is now in various stages of regrowth and sawlog production is not likely to occur for another 20-30 years. However, due to the widespread occurrence of dieback and the dynamic nature of this disease, small pockets of dieback affected forest may be logged. Logs may also be harvested to provide charcoal for a proposed silicon industry. This proposal has been subject to an Environmental Review and Management Plan as well as other specific investigations.

2.5.3 Conservation

The System Six Study did not identify any specific area of the catchment that should be set aside for conservation reserves. However, the feeder streams are considered to have high conservation value with respect to maintenance of water quality. It is fortunate that these have generally been protected by catchment management practices. In addition, CALM have developed an overall strategy for conservation, environmental protection and recreation which will be applied to this catchment (CALM, 1987, e).

2.5.4 Other Land Uses

There are a range of other land uses in the catchment which, although presently minor in extent or only sporadic in occurrence, should be mentioned. These are:

- gravel extraction
- firewood collection
- agriculture
- public utilities
- mineral exploration.

The Shire of Harvey occasionally extract gravel from areas between the high and low water levels of the reservoir. No other mining or exploration is currently in progress. The whole catchment is included in an approved bauxite mining lease held by Alcoa. The Willowdale bauxite mine lies just to the north of the catchment near Mount William. Whilst the current 25 year mine plan does not include the catchment, it must be recognised that changes to economic circumstances could lead to the approach of mining to the close vicinity of the catchment within the next ten years.

Opportunistic firewood gathering probably occurs in the catchment and licenced commercial firewood cutters also operate occasionally.

There is a single freehold allotment in the north-eastern sector of the catchment of which about 25 ha has been cleared and developed for pasture.

There is also a small SEC easement for the electricity supply to the Water Authority caretaker's residence and the caravan park.

3.0 EVALUATION OF RECREATION AND ENVIRONMENTAL COMPATIBILITY

Before management decisions are made, it is important to evaluate the acceptability of the present recreational uses within the catchment. This approach recognizes that direct contact recreation has been allowed on the reservoir since construction some 2 years ago. Therefore, this section gives a brief overview of the principal environmental issues, assesses the impact of recreation on water quality, identifies the environmentally sensitive areas in the catchment and discusses the major recreational issues which have emerged during the study.

3.1 Principal Environmental Issues

The principal environmental issues identified during the preparation of the draft management plan were as follows:

- reservoir water quality.
- catchment protection and
- public health.

Investigations of these issues provided the following key conclusions:

i. The present levels of activity do not appear to result in long term turbidity impact which would affect either irrigation or potable use of the water. The possibility that short term (i.e. days or weeks) increases in turbidity do occur requires further investigation.

ii. There is only a remote possibility of health risk to 'downstream' users while the water is predominantly utilized for irrigation purposes. However, there may be a health risk to recreational users themselves, particularly during peak season when water levels are low. This could not be confirmed without detailed bacteriological monitoring of the water. Supplementary epidemiological investigation of users would possibly also be required. (An appropriate water quality monitoring programme was commenced during preparation of the management plan. The data available at the time this document was prepared, was however insufficient to allow reliable comment to be made). Should water from the reservoir be used for domestic supply, chlorination at least, would be used to treat bacteriological contaminants.

iii. Occasional minor fuel spillages do not appear to provide the basis of a constraint to motor boat activity on the reservoir as they do not affect irrigation use of the water.

iv. Sensible management of sewage disposal in the catchment will minimize the risk of increasing nutrient inputs to the reservoir due to the influx of recreationists'.

v. Not withstanding that the catchment is relatively small, the existing database indicates that loss of vegetation due to logging, dieback infection and recreation impact has not resulted in sustained stream salinity increases. The high rainfall status of the catchment also tends to mitigate the effect of clearing.

vi. it is estimated that a minimum of 3 years of average rainfall would be required to flush the reservoir. The calculations show that the capacity of the reservoir is relatively small in relation to its catchment yield. This is reflected in the regular occurrence of overflow.

3. 1. 1 Implications for Management

No major changes to existing recreational use are considered necessary to maintain water quality in the reservoir to the standards required for irrigation purposes. However, evaluation of the available data base as identified some areas of uncertainty which need to be addressed before the effect of recreational activity on the suitability of the water for domestic supply can be determined.

Maintenance of water quality is recognized as the single most important management goal. If the source water to the reservoir is maintained at current quality, then it appears that the existing water-based activities may be permitted to continue without risk of long-term detriment to water quality.

3.2 Identification of Environmentally Sensitive Areas in the Catchment

Uncontrolled and intense pressure from recreational use has the potential to cause permanent degradation to the catchment. Whilst some impact from recreational use must be accepted, this can be minimized through careful planning and management. The primary aim is to maintain a good vegetation cover.

In practical terms, this means that there would be restrictions on access within certain broad zones in the catchment, identified as follows:

i. stream zone vegetation;
ii. areas which are protectable from dieback infection,
iii. areas which have steep slopes or soils with high erosion potential,
iv. in addition to these zones, the foreshore vegetation should be given special consideration because of the intensity of use in this zone.

3.2.1 Implications for Management

The overview of environmentally sensitive areas in the draft management may be used to guide the management of recreational use. Stream zones and areas protectable from dieback infection should be managed by keeping these areas closed to all forms of active recreation wherever possible. Closing of selected access tracks is considered the primary means by which this can be achieved.

SECTION B: MANAGEMENT OBJECTIVES

4.1 The CALM Act

Under the CALM Act, State forest is to be managed to ensure the multiple use and sustained yield of the forest resource for the satisfaction of long term social and economic needs.

The management objectives for this catchment reflect the priority use determined by CALM'S central forest region management plan. For the Logue Brook catchment area these are for production of water and wood.

4.2 Water Production

Provision of a reliable, good quality water supply to the Harvey Irrigation District is a primary objective of the reservoir and catchment. In determining the water quality standards which should be maintained, it is recommended that the reservoir is managed to provide water to potable standards.

This objective recognizes the following factors:

- initial testing indicates that the water is currently suitable for domestic use with simple chlorination as the only treatment required, however, further monitoring is required to confirm this;

- during winter months, when there is no irrigation, there is often an overflow from the dam;

- planning for Perth's long term water requirements identifies utilization of this excess water as a possible cost-effective supplement to the Metropolitan supply scheme.

4.3 Wood Production

Production of wood is another objective of the catchment. The majority of the catchment consists of jarrah-marri open forest in various stages of regeneration. Management of the forest includes the use of silvicultural techniques to maximize the production of harvestable sawlogs and other forest products.

Provided that existing forestry management techniques such as stream zone protection are maintained, wood production is considered compatible with water production.

4.4 Recreation

The recreation objective must recognize the primary land uses within the catchment and be consistent with the previously described objectives. To this end, both CALM and the Water Authority have formulated guidelines to assist recreational planning and management.

CALM management guidelines may be briefly reiterated as "Provide and allow for the widest range of recreational opportunities consistent with:

- the purpose and vesting of the land;
- the ability of the natural system to sustain the activity without impairment;
- the ability of the Department to supervise the activity where land values may be impaired (CALM, 1987, c).

In addition, the Water Authority guidelines in relation to tourism and recreation are to:

- ensure that developments are designed to minimize the risks of soil erosion, stream turbidity and bacteriological pollution;
- keep the affected area to the minimum size necessary to achieve the desired recreational goal and ensure that disturbed ground is stabilized;
- direct development away from the vicinity of the dam outlet works;
- prevent continuously disturbing activities such as trail bikes and off road vehicles, (Water Authority, 1987).

The overall thrust of these guidelines is that recreational use is endorsed but that the types of activities and level of use should not conflict with the primary land uses. Practical recreational management objectives within the catchment are a blend of the above guidelines.

SECTION C RESOLUTION OF ISSUES AND SELECTION OF PREFERRED OPTIONS

5.0 SUMMARY OF RECREATIONAL ISSUES AND STRATEGIES

A summary of recreational issues is given below, prior to presentation of the alternative recreation management strategies. Recreational issues have been considered from two perspectives:

- characterisation of the reservoir and catchment in terms of different recreational settings, followed by a broad assessment of the compatibility of all recreational activities with each particular setting;

- identification of conflicts between different activities and user groups.

The issues identified from the latter perspective are discussed in conjunction with the alternative management strategies for each activity that are presented in Sections 5.3 and 5.4.

5.1 Recreational Settings

To assist in assessing recreational issues, a brief description of recreational settings within the catchment is provided. These arise from the landscape assessment presented in the draft management plan.

5.1.1 Water-based Recreation Settings

Four distinct zones of water-based recreational settings have been identified.

i. Open Water: The expansive open stretches of water in the reservoir are the focal point for all land within its viewshed. From the open water, views of other recreational settings are plainly visible.

ii. Foreshores and Fingers: This setting includes the shallow water margins (particularly in the 'fingers' at the entry point of feeder streams), the exposed banks and a narrow band of foreshore supporting a fringe of Murray Complex vegetation. The interface of water and land is the most popular recreational setting.

iii. Dam Wall: The dam structure and impounded water is an impressive sight and a feature for the initial arrival experience. There are long views of the water body with a forest backdrop to the east, whilst to the west the outlet stream and the steep valley slopes are the main points of interest.

iv. Feeder Streams: These settings include some of the most interesting and dense vegetation associations. Difficulty of access within the streams results in a low level of use.

5.1.2 Land-based Recreational Settings

The overall forest setting varies with topography and vegetation type. Variation in these factors alter the appeal of the forest. For example, there are lower valley slopes with restricted viewsheds and relatively exposed ridges with occasional long sweeping views. In those areas of forest which do not have a view of the reservoir, the recreational settings and the opportunities provided are essentially no different to forest outside of the catchment.

5.2 Compatibility of Recreational Activities and Settings

The impact of each recreational activity on the various settings which were identified during the landscape assessment are described in the draft management plan. It is clear that there are both land-based and water-based activities which impinge on the setting in which they take place and even on adjoining settings.

The principal issues which arise are:

i. Land-based activities: off-road driving, off-trail horse-riding and hunting all have the potential to affect the inherent qualities of all other settings.

ii. Water-based activities: power boating affects the majority of settings near the reservoir by virtue of its noise and has the greatest impact on the most popular settings within the catchment, i.e. foreshores and fingers.

5.3 Water-based Management Strategies

Recreational development strategies for specific water-based activities are presented in this section. Water-skiing, swimming, canoeing/sailing, fishing and marroning are considered to be the main active recreational pursuits conducted.

5.3.1 Water Skiing

i. Issues

On a reservoir as small as Logue Brook Dam, it is inevitable that power boat and water-ski activity will somewhat limit opportunity for concurrent passive recreational pursuits, as well as other water-based activities such as fishing, canoeing, sailing and swimming. Availability of space, safety, noise and wave/wash disturbance are key factors.

Turbulence and wave action generated by the launching and operation of power boats clearly have potential to create some shoreline erosion and turbidity.

The available evidence suggests that whilst additional turbidity within near shore water does occur, particularly during peak periods, this is temporary. Boat wash has not resulted in obvious serious erosional damage to the shoreline.

ii. Alternative Strategies

Three alternative strategies for future management are evident:

- Maintain the status quo
- Permit skiing to continue but with new restrictions, routine policing and infringement penalties
- Prohibit all skiing.

Maintenance of the status quo would effectively mean that water-ski activity would be virtually unrestricted, apart from the minor areal restriction imposed by the gazetted water-skiing area. Due to the inherently intrusive nature of this activity on other users, maintenance of the status quo implies that water-skiing is the priority recreational activity on the reservoir.

The second alternative is to allow water-skiing to continue, but with additional constraints to improve the opportunity for concurrent alternate activities. A list of suggested conditions is given below. It is important to note that past experience has demonstrated that restrictions will be of little value unless they are routinely policed.

a) Time Constraints

- Skiing only permitted between sunrise and sunset, i.e. no twilight activity.
- Skiing prohibited on nominated weekends.

- Skiing prohibited for longer periods during the year (but in rotation with the nearby Waroona Dam).

b) Spatial Conditions

- Total ban on power boats in the vicinity of stream inflow zones and within 50 or loom of the shoreline, except near launching areas.
- Restriction on the number of boat launching areas.
- Adopt designated take-off and landing areas, remote from boat launching sites.

Prohibition of water-skiing is the third alternative that must be considered. Whilst it is understood that prohibition would receive support from some user groups, it would be a harsh judgement given the lack of alternative inland locations that are both suitable and available for this use. The significant demand for inland water-ski areas is demonstrable and well known.

In comparison, whilst the suitability of the reservoir for other activities such as fishing, picnicking, marroning and canoeing may be limited by boating and skiing, there are other localities nearby where these activities can be conducted.

Further, prohibition on the basis of perceived water quality impact potential would be difficult to justify.

5.3.2 Canoeing and Sailing

i. Issues

Canoeing and sailing are commonly practiced activities on many water supply storages overseas and in the Eastern States. These activities are also frequently allowed on potable supply reservoirs, without apparent adverse effects. Consequently, they are deemed to have high compatibility with this irrigation reservoir.

The reservoir is a relatively sheltered water body and is thus ideally suited to beginners at both canoeing and sailing and these activities have less compatibility with power boat use. Conflicts obviously arise with power boat operators, particularly in regard to safety.

ii. Alternative Strategies

There is an obvious need for some degree of separation between powered and non-powered craft.

At present, the gazetted water-ski area dominates the zoning of the reservoir. This area could be reduced to allocate more of the water surface to activities such as canoeing, sailing and trout fishing on a permanent basis.

Another alternative is to allow total access to the reservoir for certain periods of the year, without power boats. An assessment of relative demand and user attitudes would assist in clarifying this option. Priority for canoes during winter may be preferable because of the higher water levels which allow closer approaches to the foreshore vegetation.

5.3.3 Swimming

i. Issues

The attraction of such a large body of fresh water for swimming is undeniable and swimming is compatible with water quality requirements for irrigation. However, there are potential safety and public health conflicts which arise from:

- interaction between swimmers and power boats;
- bacteriological contamination affecting both swimmers and water-skiers.

To date, there have been no recorded accidents involving power boats and swimmers nor is there sufficient information yet on which to assess the bacteriological health risk.

ii. Alternative Strategies

There are three strategies that are available to manage swimming. These are:

1 Prohibit Swimming: This option would be difficult to justify on water quality grounds unless widespread and prolonged bacterial infection was detected and the reservoir was required for potable water.

A prohibition on swimming would also involve the prohibition of water-skiing.

2. Maintain the Status Quo: this option allows for swimming to occur entirely at the individual's discretion, anywhere on the reservoir.

3. Tolerate without encouragement: swimming may be conducted in relative safety outside the gazetted ski areas. Place 'at own risk' signs in these areas. Also discourage swimming in water-ski zones.

5.3.4 Fishing

i. Issues

Fishing is considered compatible with the water quality objectives. The principal conflict arises from other users of the reservoir, particularly the disruption by power boats in preferred fishing areas.

It is noted that there are about seven other dams within a 50 km radius which have been stocked with trout.

ii. Alternative Strategies

Apart from a total ban on power boats and water-skiing, there is limited scope to resolve the disruption to fishing enthusiasts. Active enforcement of gazetted ski areas is required. Some adjustment of these areas may help to provide a reasonable compromise. There is also the possibility of nominating selected periods during the year for priority fishing, i.e. temporary bans on water-skiing. However, enforcement of the proposal could be cumbersome.

Intensive management of the fishery may be required if trout stocks are seriously reduced. The present status of the fishery is not clearly defined. If a consistently high fishing effort were to cause a decline in the fishery, then the management alternatives would be to institute a closed season during the winter months or to prohibit boat fishing and fly fishing at night.

5.3.5 Marroning

i. Issues

Marroning is a popular pastime and is generally considered to be compatible with the irrigation water quality objective. Conflicts which have been identified include:

- occasional anti-social behaviour of some groups, sometimes late at night, creates a disturbance to other users.
- the creation of temporary stone fireplaces which are later inundated as water level rises, represents a hazard to skiers and swimmers.
- rotting animal carcasses and other organic material used as baits are often left in the shallows. These are unsightly and possibly result in bacteriological contamination.

ii. Alternative Strategies

- Prohibition: A total ban on marroning would be difficult to justify.

- Create marron fishing zones: This option could be introduced if the effects of marroners on other recreational ists becomes a significant issue. The aim of specific zoning would be to ensure that water-ski areas are free of makeshift fireplaces and that passive recreation areas are free of unsightly animal flesh baits.

- Additional controls and policing: Allow marroning to occur without areal restrictions, but actively discourage the use of animal flesh baits and makeshift fireplaces. More litter collection activity and/or enforcement of litter removal would be required.

5.4 Land-based Management Strategies

5.4.1 Overnight Accommodation

i. Issues

Camping is one of the principal issues which this management plan needs to address. The Logue Brook Dam caravan park is the only area where camping is allowed, but this has inadequate capacity and consequently, there is a demand for suitable additional locations. Wild camping - camping outside the caravan park or a designated site - is a common occurrence.

Present policy of the Water Authority and CALM with respect to camping is summarised as follows:

- The Water Authority does not permit camping within any domestic water supply catchments except with specific approval. Within catchments used for irrigation supplies, there is no specific provision precluding camping however activities associated with camping are controlled through bylaws. Camping is permitted in the Waroona Dam and Logue Brook caravan parks.

- CALM's recreation policy for State forest allows for vehicle-based camping at designated sites, whilst back pack camping is almost totally unrestricted. (There are presently no designated sites within the catchment other than at the caravan park, which is on land [eased from CALM). Because the Health Act specifically state that it does not bind the Crown, CALM can provide less sophisticated facilities on land entrusted to it, than would otherwise have been the case.

'Wild camping' throughout the catchment is generally considered to be incompatible with water quality objectives because of the uncertainty that toilet waste and potentially putrescent litter will be given adequate disposal.

In addition, the constant collection of firewood involves trampling and disturbance to the forest adjacent to camp sites, which may result in permanent degradation to the more intensely utilized areas such as the reservoir foreshore.

It is considered that suitable camping areas could be nominated to allow partial deregulation of camping, consistent with water quality objectives, if the areas are provided with appropriate toilets, such as the sealed vault systems, and a firewood supply. There may also be some scope to provide extra facilities and accommodation capacity at the existing caravan park site. However, this would require resolution of the operational efficiency of the sewage system, particularly at peak season.

ii. Alternative Strategies

- Retain the caravan park as is and continue regular policing of the catchment to send illegal campers elsewhere (e.g. Hoffmans Mill).
- Upgrade the caravan park to provide more capacity and a range of accommodation types, particularly isolated camping areas in natural settings to attract people who would otherwise avoid caravan parks.
- Develop designated camping sites within the catchment in accordance with CALM recreation policy. Integrate these sites with the caravan park to prevent conflict with commercial interests. Possible suitable locations are the gravel reserve north of the Saddle-back dam and a hilltop area north of the dam wall. Effluent disposal could be directed outside the catchment at both these locations.

5.4.2 Barbecue and Picnic Activity

Barbecuing and picnicking is a highly popular activity for both day trippers and overnight visitors. Developed sites which provide limited facilities such as barbecues, benches and tables, bins and, in select locations, shade structures and toilet facilities, are located at strategic sites around the water body. These sites are all located near the scenic roads, launching sites and in the caravan park.

i. Issues

Barbecue and picnic activities are compatible with the catchment at large, provided the activities are conducted in settings designed to cope with their effects. Currently, peak use exceeds the design capacity of the existing facilities.

Lack of toilet facilities causes the greatest conflict. Promiscuous defecation will create health and water contamination risk. Other conflicts relate to the conservation of existing vegetation and the regular collection of refuse.

ii. Alternative Strategy

- Provide adequate facilities for sustained acceptable peak period use of barbecue and picnic sites including:
  - suitably designed toilet facility
  - constant supply of firewood or coin operated gas barbecues
  - rubbish bins with regular collection or centralized bin area
  - provision of signs to encourage users to take their rubbish home or to a
  - central bin area.

5.4.3 Scenic Driving

The location of the area close to Harvey and Perth results in significant use of ring roads and other trails for scenic driving.

i. Issues

Scenic driving on the existing loop road and established forest tracks has few undesirable effects. The unsealed road acts to reduce vehicle speed, which is desirable, but there is need for upgrading of drainage. Signs are also inadequate and should be upgraded.

ii. Alternative Strategies

- Better control of drainage through routine earthworks and maintenance is necessary.

- Upgrading of signs should be conducted in accordance with CALM standards.

5.4.4 Off-Road Activity

Four wheel drive vehicles, trail bikes, and horses routinely traverse vegetated areas, but levels of use are perceived to be generally low, except possibly at peak periods and on specific occasions such as organised horse riding.

i. Issues

Off-road vehicle activities will inevitably cause some damage to vegetation. This may indirectly affect water quality; however, the available data do not indicate any unacceptable inputs resulting from previous off-road activities.

The noise produced by trail bikes in particular is a key issue. Also the fire and safety risk of off-road trail bike activity conflicts with both priority uses and alternative recreational pursuits.

ii. Alternative Strategies

- Prohibit and police all off-road vehicle activities
- Prohibit vehicles only from off-road activity but discourage horse riding except on trails. Monitor the condition of frequently used areas.
- Allow off road activities to continue as per present patterns of use.

5.4.5 Bushwalking

Bushwalkers routinely use the catchment area; however , specific details of the level of use have not been available. Generally, the level of use appears to be low except possibly at peak periods.

i. Issues

Whilst the impact of bushwalking is generally accepted to be low, there are locations within the catchment where some control and monitoring is appropriate, such as areas which are now free of dieback, stream zones and feeder stream inlets.

ii. Alternative Strategies

- Encourage the use of marked trails to reduce the general level of disturbance to vegetation in sensitive areas.
- Discourage bushwalkers from stream zone areas.

6.0 FUTURE ADMINISTRATION

Whilst development of management plans has been the primary concern of investigations, there has also been a need to examine how the implementation of management activity could be best achieved. It is clear from recent management activity that although particular current responsibilities are identifiably assigned to relevant authorities, there is no formal coordinating structure which enables adequate 'on-site' management on a day-to-day basis.

Three broad alternative strategies for improving administration were identified and evaluated in the draft management plan. These were:

1. Formalize the existing structure as a Consultative Committee, coordinated and chaired by the Water Authority.

2. Allocate administrative responsibility for co-ordination to CALM.

3. Allocate administrative responsibility to the Shire of Harvey.

A fourth consideration was that management responsibilities for specific recreational activities could be delegated to private user groups.

Evaluation, has lead to the selection of option 1 as the best approach to future management. CALM will conduct the primary components of day to day management of recreational activity on priorities agreed by the Consultative Committee, bearing in mind the availability of additional finance.

7.0 IDENTIFICATION OF THE PREFERRED DEVELOPMENT OPTION

The draft management plan evaluated three alternative development philosophies from which the following broad strategy for control of future development was selected.

"Maintain and cater for the present demand for recreational and environmental use. Provide recreational and environmental management prescriptions that resolve the identified problem areas."

When considered within the context of the designated priority uses of water production and wood production, and in view of the existing level of recreation and the ongoing need for recreational resources, the investigation concluded that this strategy should be adopted.

On the basis of available data the investigation concluded that the reservoir and catchment environment could sustain the present levels of recreational use provided that:

i. The existing administrative procedures are coordinated and formalized through a permanent Consultative Committee comprising representatives of the current administrative agencies. The Committee should be chaired by the Water Authority, at least for the duration of this Area Plan, as within this time frame water production will remain the dominant priority use.

ii. Recently initiated monitoring of water quality, should be continued. An environmental and user requirements monitoring programme needs to be commenced as soon as reasonably possible.

iii. Management prescriptions to resolve problem areas that have been identified require institution and policing.

iv. Management prescriptions must be flexible so that adjustments to patterns and type of use can be made if monitoring results indicate such needs exist.

There is also a fall back situation for water quality management that should be noted. If monitoring shows that active recreation on the reservoir is causing unacceptable water quality deterioration, drastic restriction or prohibition would enable recovery to desirable standards within a short time-frame. This is because the annual water yield from the catchment is high relative to the volume of the reservoir, enabling rapid dilution and displacement of contaminated water. Maintenance of the ability of the catchment to provide good quality water is implicit in this suggestion. The protection of stream zone stability in general, therefore, has paramount importance.

SECTION D FUTURE MANAGEMENT

8.0 MANAGEMENT PRESCRIPTIONS

8.1 Introduction

In this section, the prescriptions for each of the activities conducted on the reservoir or within the catchment are presented. Each prescription is preceded by a short statement of the objective of management and the rationale.

Effective management of the resource will depend to a large extent on how effectively people are managed. One effective tool for achieving this is through a zoning mechanism such as the creation of management units. Map 7 shows the management units that should form the basis for future management and provides an overview for the management prescriptions that follow. For example, the land adjacent to the reservoir is intensively used for recreation and has been identified as a restricted land zone. This implies that some activities may be restricted in specific areas, as management must take into account such factors as the high levels of recreational use, the capacity of existing facilities and the ability of an area to sustain particular uses.

8.2 Recreation

It is important to recognize that the development of management prescriptions for recreation has been constrained by two principal factors:

1 Budget limitations and scheduling of the investigation for completion during the winter months restricted the opportunities for the study team to directly observe recreational activity. This is particularly the case for peak use periods which normally occur during summer and at Easter.

2. The available water quality data base for assessment of recreational impacts was limited.

Much of the background data, on which management prescriptions are based, has been pieced together from anecdotal evidence obtained from discussions with recreational users and local administrators. A public workshop held at Waroona during the course of the investigation also provided useful information.

It is therefore recommended that management should be sufficiently flexible so that modifications to permitted recreational practice can be implemented if future monitoring indicates that such needs exist.

Prescriptions for the major recreational issues are listed below in approximate priority order. A conceptual strategy plan for recreational development is presented on Map 8, and this is referred to in the following sections where appropriate.

8.2.1 Power Boats and Water-Skiing

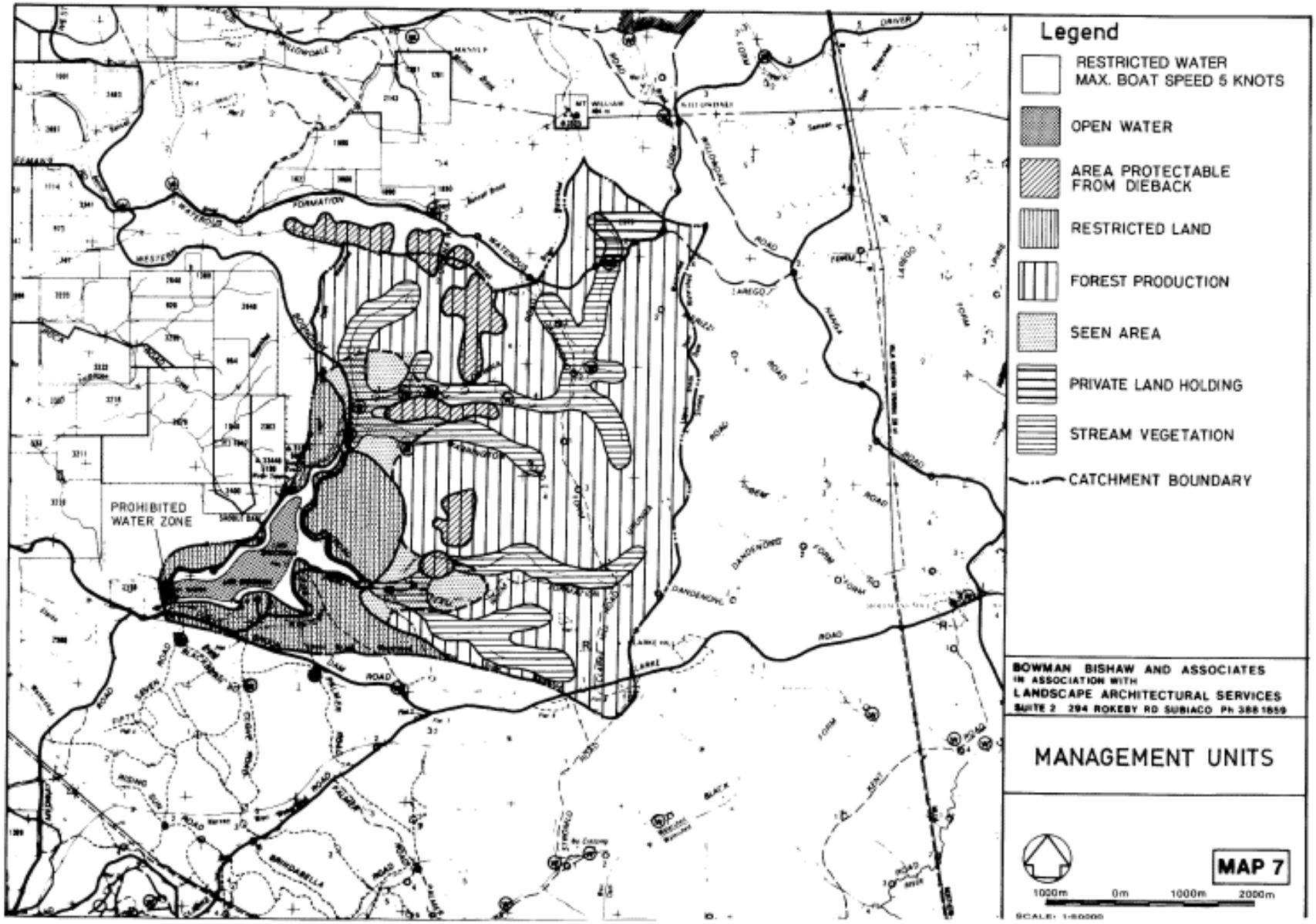
Objective: To ensure that power boat and water-ski activity is carried out in a safe manner with due regard to other users of the dam.

Rationale: There is both significant demand and limited resources for inland water-skiing in this region.

Whilst popular, passive recreational pursuits are often incompatible with water-skiing, there are a number of alternative venues in the locality where these activities can be pursued in isolation.

Further, there is no evidence to indicate that power boats and skiers have caused deterioration of water quality beyond the limits of its designated use.

Investigation indicates that the intensity of power boat use and water-skiing is largely self-regulating and is directly related to the available water area.


Legend
RESTRICTED WATER
MAX. BOAT SPEED 5 KNOTS
OPEN WATER
AREA PROTECTABLE
FROM DIEBACK
RESTRICTED LAND
FOREST PRODUCTION
SEEN AREA
PRIVATE LAND HOLDING
STREAM VEGETATION
CATCHMENT BOUNDARY
PROHIBITED
WATER ZONE
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 388 1859
MANAGEMENT UNITS
MAP 7
1000m
0m
1000m
2000m
SCALE: 1:50000

Prescriptions: Water-ski and power boat activity at Logue Brook Dam should be permitted with the following conditions and changes to current practice:

- A water-ski area as shown on Map 8 will be gazetted. This excludes the dam wall, outlet tower, areas within 60 metres of the shore, and the narrow arms of the reservoir.

- If approved by the Consultative Committee, part of the north east arm of the reservoir may be allocated for use by W.A. Water Ski Association members and not be available to the general public. This will generally be for slalom and ski jump purposes.

- Changes to the gazetted area must first be approved by the Consultative Committee.

- Power boat speed outside the gazetted area will be limited to 5 knots.

- Skiing and boat operation at speeds greater than 5 knots will only be permitted between sunrise and sunset, for safety reasons. This will also improve opportunities for night fishing and marroning.

- When the water level in the dam falls to 221 metres above the Australian height datum, water skiing must cease for safety reasons. Skiing can recommence when the water reaches the 223 metre level.

- Policing will initially be conducted as determined by the Consultative Committee.

- The water skiing fraternity will be encouraged to develop a code of ethics.

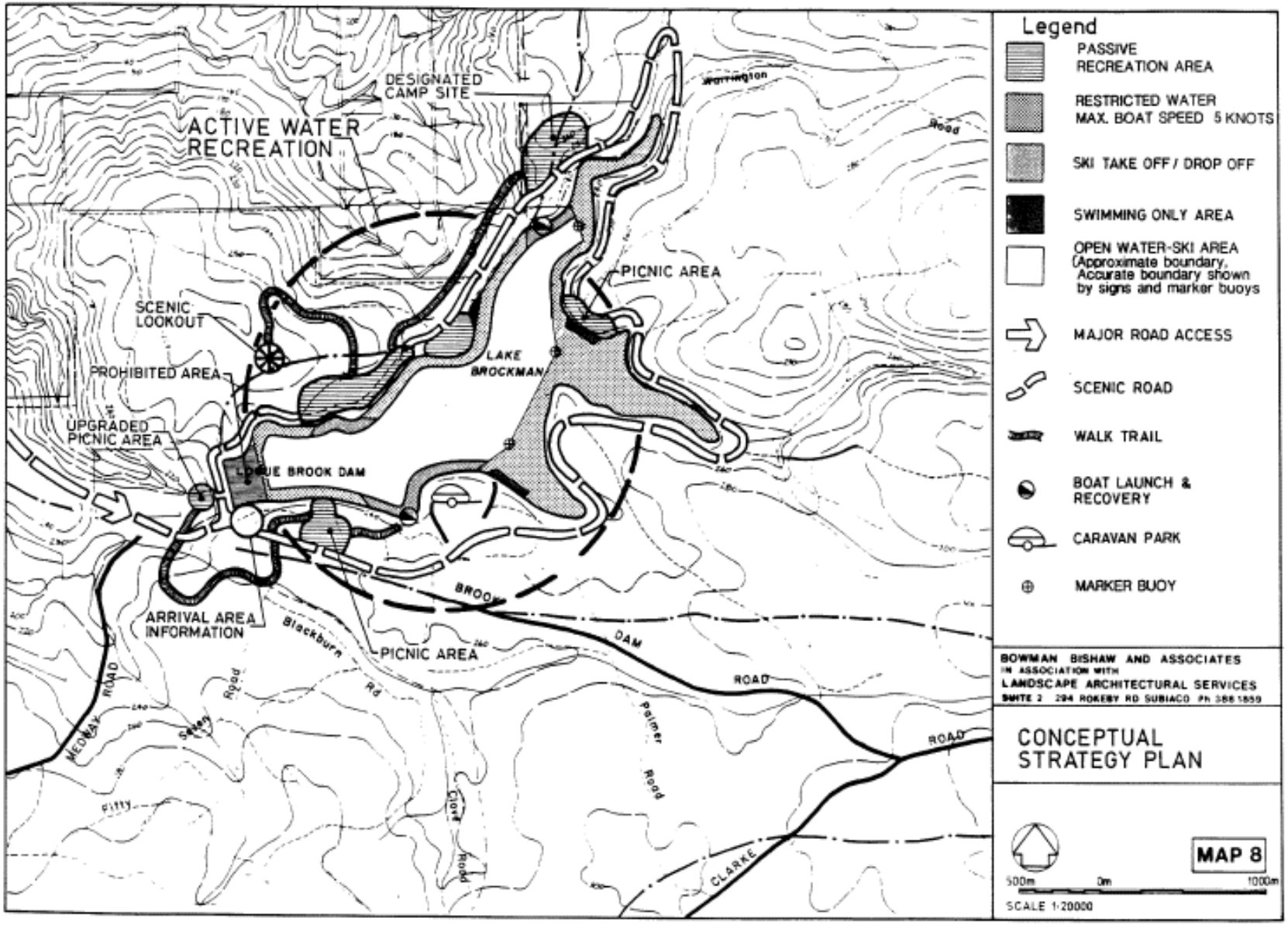
- Potential congestion at launching areas between boating, swimming, picnicking and barbecue activities, will be minimised by appropriate location and design of facilities.

- Launching and recovery of boats will only be conducted at the sites shown on Map 8. Public awareness and appropriate instruction signs will be necessary to assist acceptance of this procedure.

- Appropriate toilet facilities and adequate litter bins will be provided at each designated launching site, as funds become available.

8.2.2 Camping and Caravans

Objectives: To provide serviced caravan sites at suitable locations. To allow for camping areas at suitable locations.


ACTIVE WATER RECREATION
DESIGNATED CAMP SITE
SCENIC LOOKOUT
PROHIBITED AREA
UPGRADED PICNIC AREA
LAKE BROCKMAN
PICNIC AREA
ARRIVAL AREA INFORMATION
PICNIC AREA
DAM
ROAD
Blackburn Rd
Palmer Road
CLARKE
Legend
PASSIVE RECREATION AREA
RESTRICTED WATER MAX. BOAT SPEED 5 KNOTS
SKI TAKE OFF / DROP OFF
SWIMMING ONLY AREA
OPEN WATER-SKI AREA (Approximate boundary, Accurate boundary shown by signs and marker buoys
MAJOR ROAD ACCESS
SCENIC ROAD
WALK TRAIL
BOAT LAUNCH & RECOVERY
CARAVAN PARK
MARKER BUOY
BOWMAN BISHAW AND ASSOCIATES
IN ASSOCIATION WITH
LANDSCAPE ARCHITECTURAL SERVICES
SUITE 2 294 ROKEBY RD SUBIACO Ph 388 1859
CONCEPTUAL STRATEGY PLAN
MAP 8
500m 0m 1000m
SCALE 1:20000

Rationale: There is clear demand for further serviced caravan sites and designated camping areas within natural settings, as for a large portion of the year there are adequate facilities at the caravan park, but these are totally inadequate at peak periods.

Prescriptions:

- Further development of serviced accommodation within the Logue Brook caravan park will not be allowed unless sewage disposal is upgraded to the satisfaction of the Water Authority (see section 8.2.3).

- Vehicle based camping will only be permitted in designated areas. A designated camping area will be developed as indicated on Map 8. Sealed vault toilets will be used so that sewage can be recovered and disposed outside the catchment.

- Consideration will be given to development of further designated camping areas if demand increases.

- Development of facilities such as toilets and litter bins will be in accordance with the CALM Recreation Manual.

8.2.3 Effluent Disposal

Objective: To ensure that there is no opportunity for direct entry of sewage to the reservoir.

Rationale: A well-designed leach drain system could operate properly at most times with satisfactory attenuation of contaminants within the clay sub-soils. However, there will always be risk that peak period use will overload the infiltration capacity of the system, with consequent potential for direct entry of sewage to the reservoir.

Prescriptions:

- Disposal of washwater from shower and laundry facilities at the caravan park to leach drains will be allowed to continue, provided the system has adequate infiltration capacity.

- Appropriately designed toilet facilities will be installed at each designated barbecue site, designated camping area and boat launching site, and will be serviced and maintained as required

8.2.4 Parking and Vehicle Access at the Reservoir's Edge

Objectives: To provide parking that allows views of the reservoir but does not spoil those views or cause erosion.

To provide only essential access to the water's edge so that disturbance is minimised, erosion does not occur, and the scenery is not degraded.

Rationale: Management must balance an obvious demand for the seeking of isolated sites for parking and recreating near the waters edge, with the problems that arise. Factors which support a continuation of the present use include:

a) With the exception of feeder stream inlet areas, the clay/gravelly soils that form the reservoir banks are mostly stable and firm. The banks appear to be resilient to a high level of pedestrian and low speed vehicle access, as no erosional problems of major proportions are evident.

b) There is no available evidence that indicates vehicle access on the reservoir banks has permanent or significant undesirable effect on water quality.

c) Utilization of the banks will tend to reduce activity within the vulnerable forest foreshore zone.

In contrast, unruly vehicle activity poses a clear safety risk for pedestrian access to the water's edge and may result in some erosion and temporary turbidity. Continued, unrestricted access has potential to result in the development of more tracks through the forest foreshore zone and consequent undesirable vegetation disturbance.

Prescriptions:

- The use of exposed bank areas for vehicle circumnavigation and scenic pleasure driving will be discouraged.
- Movement between foreshore sites around the reservoir will only be allowed via the ring road.
- Parking on the water's edge near access track outlets will be allowed to continue so that further development of parking areas within the forest foreshore area can be minimized.
- Strict vehicle speed control will be introduced for bank areas.
- Unlicensed vehicle activity will continue to be prohibited.
- The existing access tracks will be rationalized so that only those with suitable slope, angle of approach and access to popular locations are retained.
- Unnecessary tracks and those exhibiting any significant erosion or excessive loss of adjacent vegetation will be closed off and revegetated.

- Storm water drains and silt traps will be constructed and properly maintained for the ring road and access tracks as required.
- Public education will be conducted to assist user adaptation to the new procedures, particularly in relation to use of the banks for vehicle transit between sites.
- Any new parking areas **will** be chosen in consultation with CALM, and will have a minimum level of development.

8.2.5 Picnic and Barbecue Sites

Objective: To provide adequate picnic and barbecue facilities while ensuring minimal impact on catchment values.

Rationale: Picnic and barbecue events are a popular activity, particularly during summer and in association with 'day trip' excursions to the reservoir and catchment.

Facilities are essentially adequate except possibly during peak demand periods, when the frequency of refuse collection may not cater for the large quantities that are generated.

Prescriptions:

- Firewood will be provided at existing designated sites to protect the foreshore zone from extensive wood removal.

- Future provision of more barbecue facilities will utilize available space at existing designated areas.

- Parking areas will be separated from the immediate vicinity of barbecue facilities and pedestrians given easy and well marked access from the ring road.

- Each designated area will be provided with an appropriate toilet. If necessary recovered sewage will be disposed at an approved location outside the catchment area.

- Refuse collection procedures will be coordinated and formalized and removal will be conducted as often as necessary to prevent excessive accumulation, particularly during peak periods.

- Makeshift fireplaces constructed on the banks of the reservoir during low water level will be removed at the end of each summer, before the water level rises. In the event that funds to conduct this work are unavailable, construction of fires on the reservoir shores will be prohibited.

8.2.6 Off-road Activity (including vehicles and horses)

Objective: To protect the biological, physical and scenic environment of the catchment by directing potential off-road activity to nominated roads and tracks.

Rationale: Whilst the catchment will have some capacity for sustaining off-road activity, it is not possible to predict with any certainty what this may be. As the priority use of the catchment is for water production, it is important that risk to vegetation coverage is minimized. Therefore, the capacity of the catchment for off-road vehicles of any type should be regarded as minimal.

Prescriptions:

- All vehicle activity outside gazetted roads and existing forest tracks will be prohibited.

- Horse riding will be restricted to forest tracks and existing roadways.

8.2.7 Bushwalking

Objective: To provide an opportunity for bushwalking consistent with catchment protection objectives.

Rationale: Bushwalking is generally agreed to have minimal unacceptable impact. However, there are some sensitive zones within the catchment where control measures may be required.

Prescriptions:

- Bushwalking will continue to be permitted throughout the catchment.

- Where appropriate, scenic walks will be marked out in the vicinity of picnic and barbecue areas to enhance these recreational facilities.

8.2.8 Non-Powered Water Craft

Objective: To ensure that non-powered water craft activity is carried out in a safe manner with due regard to other users of the dam.

Rationale: For most of the year, non-powered water craft, such as sail boats and canoes, could successfully share the water body with skiers and power boats. Protection from boat wash and collision risk would usually be possible outside the gazetted skiing area.

At peak periods, capacity for all craft will be limited by space and, therefore, largely self-regulating.

Prescription:

- Non-powered water craft will be permitted in all areas of the reservoir, except near the dam wall and outlet tower. Launching and recovery of trailable craft should occur at designated sites.

8.2.9 Swimming

Objective: To allow swimming in designated areas as long as there is no unacceptable degradation of water quality.

Rationale: Swimming has obvious popularity and should be permitted if possible in non water-ski areas, except near the dam wall. However, the lack of bacteriological water quality data, in relation to health risk, limits proper definition of management requirements.

Prescriptions:

- Intensive monitoring of bacteriological water quality at popular swimming areas needs to be conducted over the duration of a summer peak period week and over at least one year at monthly intervals.
- Swimming will be permitted as long as the results of monitoring are favourable.
- A suitable area will be made available exclusively for swimming.

8.2. 10 Fishing

Objective

1 To allow fishing for introduced and native aquatic fauna under the provisions of the Fisheries Act.

2. To allow stocking for fish species under the control of the Fisheries Department.

3. To minimise potential conflicts between fishing and other recreational users.

Rationale: The combination of a suitable aquatic environment for introduced and native aquatic fauna and attractive landscape has supported the development of a valuable recreational fishery within the reservoir. Both Water Authority and CALM management policies allow for encouragement

of recreational activities that can coexist with the nominated priority uses of the reservoir and catchment.

Prescriptions:

- Fishing will be permitted on the reservoir (Lake Brockman):

- during the day in the restricted zone except near the dam wall.

- and in addition at night in the open water zone (see Map 7) according to the Fisheries Regulations.

- Any restocking of fish species will only be carried out according to advice from the Fisheries Department.

8.2. 11 Marroning

Objective

1. To allow marron fishing under the provisions of the Fisheries Act.

Rationale: In recent years there has been a dramatic increase in marron fishing. The number of inland fishing licences issued has risen from 6862 in 1970/71 to 28765 in 1985/86. Most of these (90%) were issued to Marroners. In 1986/87, under the new Recreational Fisherman's Licence, 24,688 licences were issued to marroners. Although the species has a high reproductive capability, most marron populations are now being overfished to the point where it is difficult to catch specimens over the legal size.

Prescription:

- Marroning will be permitted on Lake Brockman and the waters of the catchment area subject to the Fisheries Regulations.

8.3 Information

Objectives: To provide an information program that incorporates public use, interpretation, resource protection and visitor safety.

Rationale: The protection of resource values and enhancement of the public's care and enjoyment of an area can only occur when both the user and the manager are aware of each other's objectives and needs. When this occurs, resource degradation is reduced, visitor satisfaction is increased, visitor safety is improved and management costs are reduced.

There are four categories of information that are important for visitors to the catchment:

1. Public use - descriptive information that provides visitors with an outline of recreational opportunities. This information can also help those planning a visit to the catchment.

2. Interpretation - information that assists visitors to understand the catchment area and the processes influencing it.

3. Resource Protection - information that describes the major resource features of the area and the management guidelines that have been adopted to protect them.

4. Visitor Safety - information that advises visitors of potential hazards particularly with respect to water-skiing.

Careful consideration must be given to the mechanisms used to distribute this information.

Prescriptions:

- Sign requirements will be identified and satisfied.
- Signposting will be undertaken according to the guidelines in the CALM Sign Manual.
- Regular liaison with known user groups and relevant commercial interests will be maintained by personal contact and written material.
- The information program will be linked to other regional and departmental programs to ensure that consistent standards are maintained and the area is not promoted beyond its capacity to cope with visitor use.

8.4 Resource Management

Whilst the primary aim of this plan is to develop effective management of recreational use, it also needs to consider management of other land uses in the area, particularly for the priority uses of water and wood production. Management prescriptions for both the priority land uses and other minor land uses are outlined below. In addition, prescriptions are given for landscape protection in relation to the possible impact that some land uses may have on landscape values.

8.4.1 Water Supply

Objective: To provide a reliable water supply to the Harvey Irrigation District and to prevent adverse long-term deterioration in water quality.

Rationale: For the duration of this ten year plan, water supplied by the reservoir will only be used for irrigation purposes. Therefore, the prescriptions detailed in this section only relate to management of the resource for this purpose. However, it should be noted that the overall emphasis of the management plan is on catchment protection and maintenance of water quality to ensure that options for domestic supply in the long term are not precluded. Specific prescriptions relating to the use of the resource for large scale domestic supply will be incorporated into subsequent revisions of this plan, if and when required.

Prescriptions:

- Irrigation waters will continue to be supplied to the Harvey Irrigation District as required by farmers and in accordance with current procedures e.g. subject to restrictions in drought years.

- Water quality monitoring will be conducted, as detailed in Appendix A, to enable greater understanding of the effect of recreation on water quality.

8.4.2 Forest Management

Objective: To enable a level of hardwood production from the area of State forest that is sustainable indefinitely, consistent with requirements such as protection of water catchment, conservation and provision of recreational opportunity.

Rationale: CALM has a suite of management prescriptions which deal specifically with forest management. Most of these are outlined in the Regional Management Plans (CALM, 1987, b). Existing policies cover areas such as harvesting techniques for forest products, dieback management, fire management, mining control, weed control, stream zone protection, feral animal control, forest track maintenance and rehabilitation. These policies deal adequately with the management issues which could arise within the State forest components of the catchment, and which are relevant to this management plan. Catchment management practices may be reviewed to allow for the demand for residue wood for charcoal, and the water and wood production benefits which may be gained from thinning the forest.

Prescriptions:

- CALM forest management prescriptions should be applied within the catchment area.

- Future logging activity will not visually impair recreational activities.

8.4.3 Landscape Management

Objective: To maintain the visual amenity of the areas of principal recreational activity so that the recreation experience is not adversely affected.

Rationale: Visual quality of the catchment landscape, particularly within the viewsheds available from the reservoir surface, foreshores and scenic drive, is a fundamental component of the recreational resource and, therefore, requires careful management.

Prescriptions:

- Recreation development will be undertaken according to a Recreation Framework Plan to be prepared by CALM in conjunction with the Consultative Committee.
- The visual effects of any works conducted within the catchment area will be evaluated by CALM prior to implementation. Particular attention will be paid to activities within the restricted land management unit (marked on map 7).
- Future forest product harvesting from within the restricted zone will utilize methods that have minimal visual effects on the reservoir viewshed.

8.4.4 Mining

Objective: To minimize the impact of bauxite mining in the catchment and exclude mining activity from the viewshed of the reservoir.

Rationale: Whilst the catchment area lies outside the current 25 year bauxite mining plan, changes to economic circumstances could result in the approach of mining to the close vicinity of the catchment within ten years.

The Consultative Committee will liaise with Alcoa and the Mining Management Programme Liaison Group regarding bauxite mining activity within the catchment.

Prescription:

- Any mining activity within the catchment will be conducted according to CALM management prescriptions and closely supervised. Particular attention will be given to minimization of turbid runoff from mine areas.

8.4.5 Gravel Extraction

Objective: To minimise the effect of the extraction of gravel on conservation values, landscape values, water quality and rehabilitation potential.

Rationale: Extraction of gravel from the banks of the reservoir is sometimes conducted but is considered to be incompatible with a number of other uses, principally in regard to visual acceptability and bank stability.

Prescription:

- The extraction of gravel will not be allowed within the viewshed from the foreshore or the reservoir surface when the dam is full. Gravel extraction will only be considered from the banks between low water and full water levels in special circumstances under strict conditions approved by the Consultative Committee and by CALM. Strict attention must be paid to timing of the operation, rehabilitation and the prevention *of* spread *of* dieback disease.

8.4.6 Beekeeping

Objective: To facilitate beekeeping subject to the need to minimise conflict with other land use objectives of the catchment area.

Rationale: Beekeeping has occurred on the catchment area for many decades; however, with increased recreational use, bees may be a potential hazard to visitors.

Prescription:

- Continue to manage beekeeping as outlined in CALM's regional management plan for the central forest region (CALM, 1987, b).

8.4.7 Public Utilities

Objective: To limit the development of public utilities to those considered essential by Government and for which there is no reasonable alternative location.

Rationale: Public utilities and landscape recreational values are generally considered to be incompatible.

Prescriptions:

- Liaise with and advise service authorities to ensure their operations are in sympathy with the environment and other land uses.

- Continue to manage public utilities as outlined in CALM's regional management plan for the central forest region (CALM, 1987, b).

8.4.8 Aboriginal Sites

Objective: To observe and comply with the provisions of the Aboriginal Heritage Act 1972-80.

Rationale: There is a possibility that Aboriginal sites exist along the creeks that flow into Lake Brockman but have never been identified and documented. These sites which are most often evidenced by scatters of stone flakes, are easily damaged.

Prescription:

- Any aboriginal sites that are discovered in the Catchment by management authorities will be reported to the WA Museum and will not be disturbed without prior approval.

8.5 Forest Resource Protection

CALM is responsible for the protection of State forest from such agencies as fire and disease which may have an adverse effect on the forest ecosystem.

8.5. 1 Fire

Objective: To use fire as a management tool to achieve land management objectives in accordance with land use priorities.

Rationale: CALM has a responsibility to protect community and environmental values from damage or destruction by wildfire on land it manages.

Prescription:

- Apply fire management principles consistent with CALM's regional management plan for the central forest region (CALM, 1987, b), bearing in mind the recreational value of the catchment.

8.5.2 Dieback

Objective: To minimise the damage caused by dieback disease.

Rationale: Although jarrah dieback disease occurs throughout the catchment there are still several areas that are apparently healthy, dieback free and hence protectable.

Prescriptions:

- Ensure that activities in the catchment do not spread dieback to these areas.

- Map the apparently healthy, protectable areas in the catchment.

8.6 Administration

Objective: To develop a workable structure to enable effective administration of this management plan and the successful initiation of management prescriptions as funds become available.

Rationale: Since the reservoir was constructed, recreational use of the area has occurred without a management plan. This recreational activity does not recognize the existing boundaries of responsibility of the various management authorities involved. In addition, there is no formal structure which correctly assigns responsibility for recreational management. Consequently, a number of inadequacies are apparent, particularly in regard to provision of facilities and policing of regulations on a day-to-day basis and on a "round the clock" basis as necessary.

Prescriptions:

i. Consultative Committee

- A Consultative Committee will be formed with membership drawn from the Water Authority, CALM, Marine and Harbours, Shire of Harvey, Shire of Waroona and two user group representatives and convened and chaired by the Water Authority. The same Consultative Committee will be responsible for both Waroona and Logue Brook management plan areas.

- It is the responsibility of the Consultative Committee to ensure satisfactory implementation of the management plan.

- Implementation will depend upon ratification by the responsible organizations.

- The Consultative Committee will clarify who is responsible for:
  i) coordinating recreational activity
  ii) policing regulations on a day to day basis.
  Their recommendations must be ratified by the responsible organisations.

- The Consultative Committee will investigate the potential for private involvement (e.g. club management) to supplement management of specific activities.

ii. **Finance**

- Funding of the annual works programme will be obtained jointly from the government and local government organisations represented on the Consultative Committee, subject to ratification by the organisations concerned.

- There will be a clear definition of priorities for each annual works programme to ensure efficient utilization of funds.

- As the availability of finance is anticipated to restrict implementation of the plan, the user pays principle will be introduced as a means of raising additional funds for management. Consideration will be given to introducing an entrance fee.

- Equitable design of a fee system will include determination of appropriate levels of discount for specific groups of people such as local Shire rate-payers, long-term users of the caravan park and adjacent land-holders who are regular users.

iii. Staff

- Site inspections by the local Shire ranger and personnel from the Water Authority Depot and CALM District Office will be coordinated whenever possible to maximize the on-site management presence.

- All government and local government personnel who routinely visit the area in the normal course of their duties (e.g. Fisheries and Marine and Harbours inspectors) will be familiarized with the management plan to ensure that advice to recreationalists is consistent.

- The Consultative Committee will investigate the methods by which rangers from each relevant management authority can be authorized to enforce all appropriate management regulations which are provided to individual management agencies through the relevant Statutes.

8.7 Surveys, Research, Monitoring

Objective: To plan and implement an integrated programme of survey, research and monitoring to provide information that will help manage the catchments and, where appropriate, to involve other organisations and volunteers in the programme.

Rationale: Meeting the survey, research and monitoring needs of this plan will require the integration of surveys and research in the catchment, involving specialist and regional or district staff. Where appropriate, other government departments and local groups may become involved, although no work in the catchment will be carried out without approval by CALM.

Prescriptions:

- An integrated programme of survey, research and monitoring will be designed and commenced during the period of the plan. This must be ratified by the relevant responsible organisations.

- Water quality monitoring has the highest priority and a programme will be maintained in accordance with the outline described in Appendix A.

SECTION E IMPLEMENTATION AND REVIEW

Implementation of this plan should commence immediately. Priority should be given to the prescriptions for recreational management, as long as they remain consistent with the overall management objectives for water supply and wood production.

Three broad phases of work are required to initiate the plan for its first year of operation:

i. Establish the Consultative Committee and schedule initial meetings. This is the responsibility of the Water Authority.

ii. The Consultative Committee is to determine plan priorities and draft an annual works programme in accordance with the available budget.

iii. The Consultative Committee is also to nominate responsibility for specific tasks and establish regular liaison as these are implemented.

The Water Authority have commenced an upgraded water quality monitoring programme. As the water quality data will be a valuable tool for management when the plan is implemented, this action is endorsed.

The duration of this plan is 10 years, however the CALM Act allows for earlier revision if necessary, provided the public participation procedures are followed.

Implementation of the plan will depend upon the availability of finance, staff and the continuing advice of the Consultative Committee.

BIBLIOGRAPHY

Alcoa of Australia (1978): Wagerup Alumina Project, Environmental Review and Management Programme.

Advisory Committee for the Purity of Water (1977): A Study of Catchments and Recreation in Western Australia.

Burton, J.R. (1979): Recreation Use of Water Supply Reservoirs, An Australian Case Study. In **Hydrology and Water Resource Symposium Perth.** pp 184-188.

Department of Conservation and Environment (1979): System Six Study - Tourism and Recreation Committee Report.

Department of Conservation and Environment (1980): Atlas of Natural Resources; Darling System, Western Australia.

Department of Conservation and Land Management (1986, a): Lane Poole Reserve; Draft Management Plan, Volume 1, 11, Ill.

Department of Conservation and Land Management (1986, b): Shannon Park and D'EntreCasteaux National Park; Draft Management Plan.

Department of Conservation and Land Management (1986, c): Beating About the Bush.

Department of Conservation and Land Management (1987, a): Northern Forest Region -Regional Management Plan 1987-1997.

Department of Conservation and Land Management (1987, b): Central Forest Region -Regional Management Plan 1987-1997.

Department of Conservation and Land Management (1987, c): Northern Central, Southern Forest Regions - Regional Management Plans 1987-1997; Supporting Papers.

Department of Conservation and Land Management (1987, d): Timber Production in Western Australia. A Strategy to take W.A.'s South-west Forests into the 21st Century.

Department of Conservation and Land Management (1987, e): Strategies for Conservation and Recreation on CALM Lands in Western Australia - the Conservation, Environmental Protection and Recreation Strategies of W.A.'s Department of Conservation and Land Management.

Havel, J.J. (1975, a): **Site-Vegetation Mapping in the Northern Jarrah Forest (Darling Range)** - Definition of Site-Vegetation Types. Forest Department, Western Australia Bull. No 86.

Havel, J.J. (1975, b): **Site-Vegetation Mapping in the Northern Jarrah Forest (Darling Range)** - Location and Mapping of Site Vegetation Types. Forest Department, Western Australia Bull. No 87.

Heddle, E.M., Havel, J.J., and Loneragan, O.W. (1980): Focus on Northern Jarrah Forest Conservation and Recreation Areas. Forest Focus 22.

Fabos, J and McGregor, A. (1979): Assessment of Visual/Aesthetic Landscape Qualities: Report to the Australian Heritage Commission.

Longworth & McKensie in Assoc with Kuring-Gai College - Centre for Leisure & Tourism Studies (1986): Survey of Existing & Potential Recreation Use of The Waterboards Catchment & Storage.

Melbourne Metropolitan Board of Works (1977): First Progress Report North Maroondah; Water Supply Catchment Hydrology Research.

Melbourne Metropolitan Board of Works (1980): A Case Study of Maroondah Catchment; Water Supply Catchment Hydrology Research.

Murdoch University (1985): Waroona and Logue Brook Reservoirs, Environment and Recreation Study.

National Health and Medical Research Council (1987): Guidelines for Drinking Water Quality in Australia.

Pitts, D.J. and Anderson, D.R. (1985): Lake Wivenhoe - An Example of Comprehensive Water Storage Planning; In **Proceedings of the Workshop on the Recreational Use of Urban Water Storages and Their Environs.** Australian Water Resources Council Conference Series 11. Canberra.

Polakowski, K.J. (1977): Maribyrnong Valley Metropolitan Park. Master Plan Development; University of Melbourne, Centre of Environmental Studies.

See, R (1984): Study of Recreational Uses for Graham's Town Dam; Port Stephens Shire Council.

Shorthouse, D. (1985): Googong Reservoir - A Controlled Experiment for

Multipurpose use of A Terminal Water Supply, **In Proceedings of the Workshop on the Recreational Use of Urban Water Storages and Their Environs.** Australian Water Resources Council Conference Series 11. Canberra.

Soil Conservation Association of Victoria (1985): Eppalock Catchment Project.

West Australian Silicon Trust (1986): Western Australian Silicon Project; Environmental Review and Management Programme.

Western Australian Tourism Commission (1986): Tourism Development Plan - South West Region.

Western Australian Water Authority (1984): Harris River - Environmental Review and Management Programme.

Western Australian Water Authority (1987): The Impact of Logging on the Water Resources of the Southern Forests, Western Australia; A Report by the Steering Committee for Research on Land Use and Water Supply. Report No. WH41.

Western Australian Water Authority (Unpublished): Wellington Dam and Collie Gorge -Tourism and Recreational Development. Position Paper - August 1987.

Western Australian Water Resources Council (1984): Recreation in the Darling Range Catchments; Publication No WRC 2/84.

Western Australian Water Resources Council (1985): Recreation on Reservoirs and Catchments in Western Australia; Publication No WRC 1/85.

Willersdorf, B.K. (1985): Planning and Legal Aspects of Recreational Use of Lake Eppalock, In **Proceedings of the Workshop on the Recreational Use of Urban Water Storages and their Environs.** Australian Water Resources Council Conference Series 11, Canberra, pp 189-213.

University of Melbourne. Faculty of Architecture, Building and Town Regional Planning. 0 979): Warringine Creek Catchments, Estuary A Landscape Assessment Study. Melbourne.

APPENDIX A Water Quality Monitoring Programme

The Water Authority has recently commenced a monitoring programme to assess in detail the impact of recreational activities on the water quality of both the reservoir and the feeder streams. The collection and analysis of water samples has been conducted on a monthly basis to date. However, this frequency may increase over the summer period if results indicate that the water quality is deteriorating. The parameters that are being measured are as follows:

Physical Characteristics

- Temperature
- Colour
- Turbidity
- Total filterable solids

Chemical Characteristics

(a) *Inorganic ions*

- Sodium
- Iron
- Manganese
- Sulphate

(b) *Nutrients*

- Ammonia
- Phosphate
- Nitrate

(c) Organic Chemicals

- Hydrocarbons (fuel oil)
- Chlordane (pesticide)
- Dieldrin (pesticide)
- D.D.T. (pesticide)

(d) Dissolved Gases

- Oxygen

(e) *Acidity*

- pH

(f) *Biological/Bacteriological Characteristics*

- Chlorophyll 'a' (microscopic plant matter)
- total coliform bacteria
- faecal coliform bacteria

The results and extent of monitoring will be reviewed and considered by the Consultative Committee at regular intervals. Where correlations can be recognised between recreational activities and deterioration of water quality, the Consultative Committee will consider and implement appropriate modifications to allowable recreational activity, as defined in the management prescriptions for the reservoir and catchment.