BROWNMAN SWAMP, MT BROWN LAKE AND ADJACENT BUSHLAND, HENDERSON/NAVAL BASE

Boundary Definition: protected area/bushland (part taken to cadastre)/conservation wetland boundary (Areas of bushland within the boundaries of the Bushplan Site are not accurately mapped. The boundary has been drawn to include any unmapped bushland.)

SECTION 1: CADASTRAL INFORMATION

(Lots, locations and derived information to be updated in the public submission period)

Bushplan Site no. 346 **Map no.** 73, 80 **Map sheet series ref. no.** 2033–I SW

System 6 (1983): M91 and part M92 Part System area bushland and part scattered native plants (canopy), all vegetation described

Other Names
Henderson Regional Open Space, Lake Mt Brown

Local Authorities (Suburb)
City of Cockburn (Henderson), Town of Kwinana (Naval Base)

Ownership Categories
Private (including commercial organisation), State Government, Local Government, Not identified

Area (ha): total 616.2 (includes open water); bushland 557.8

Zoning
MRS: Parks and Recreation, Industrial, Controlled Access Highways, Public Purposes-Special Uses, Important Regional Roads-subject to review
TPS: General Industry, Park, Recreation and Drainage, Landscape, Local Road, R.O.W., P.A.W.

Lot/Location/Reserve numbers (Purpose), Street name
1, 13, 14 Russell Rd; 15 Anderson Rd; 0, 5, 7, 16, 17, 99, 652, 1740, 1841, 1868, 2855, 3000 Rockingham Rd; 2132, 2133, 2802, 2842, 3015 Cockburn Rd; 225 Sutton Rd; 303, 2905 Crane St; 150 Possner Way; 2625 Gemma Rd; 2842, 2905, 2922, 2938, 40123 street not identified
Crown Reserve

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Tamala Limestone (Qtl: LS1)

Quindalup Dunes (Holocene dunes)
Safety Bay Sands (Qhs: S13)

Wetlands (within the Spearwood Dunes)
Holocene Swamp Deposits (Qhw: M6)

VEGETATION AND FLORA

Vegetation Complexes

Spearwood Dunes
Cottesloe Complex — Central and South

Quindalup Dunes
Becher (Qu.2)

Floristic Community Types

Supergroup 2: Seasonal Wetlands
16 Highly saline seasonal wetlands
17 *Melaleuca rhaphiophylla — Gahnia trifida* seasonal wetlands (in area of most northerly occurrence)

Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
24 Northern Spearwood shrublands and woodlands
29a Coastal shrublands on shallow sands

WETLANDS

Wetland Types: sumpland

Natural Wetland Groups

Spearwood Dunes
Coogee (S.3)
Stakehill (S.4)

Wetland Management Objectives: Conservation (95ha)

Swan Coastal Plain Lakes EPP: 26.6ha + 17.5ha + 17.4ha = 61.5 (total)

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: limestone ridge, tall dune, open water, vegetated wetland, vegetated uplands, limestone cliff — ocean

Vegetation and Flora: detailed survey (part Bushplan Site M91 — Keighery, GJ, and Keighery 1993c); limited survey (part Bushplan Site — Cockburn Wetlands Committee 1976, EPA and WAWA 1990, Gibson *et al.* 1994 (MTB 01–05) (Navb 01–04), Semeniuk, V&C Research 1997b)

Structural Units: mapping (part Bushplan Site — EPA and WAWA 1990, Semeniuk, V&C Research Group 1997a)

Uplands - Sands derived from Tamala Limestone: Mixed Open Woodland of *Eucalyptus gomphocephala, E. marginata* and *E. calophylla*; *E. marginata* Low Woodland over *Banksia attenuata* Low Open Woodland; *Banksia attenuata, B. menziesii* and *B. grandis* Low Woodland to Low Open Forest; *Acacia pulchella* and *Jacksonia furcellata* Open Shrubland to Tall Open Scrub

Uplands - Tamala Limestone: Tree Mallee dominated by *Eucalyptus foecunda* or *E. decipiens*; Shrublands dominated by *Acacia rostellifera* or *A. cyclops*; Tall Open Scrub to Closed Tall Scrub dominated by *Melaleuca huegelii* and/or *Dryandra sessilis* var. *cygnorum; Melaleuca acerosa, Hibbertia hypericoides* and *Acacia cochlearis* Open Heath; Mixed Closed Low Heath; Open Low Heath dominated by *Grevillea vestita, Frankenia pauciflora* or *Acanthocarpus preissii*; *Lepidosperma gladiatum* Sedgeland

Wetlands: *Melaleuca rhaphiophylla* Low Woodland to Low Closed Forest; *Melaleuca teretifolia* Low Open Forest; *Frankenia pauciflora* and *Sarcocornia quinqueflora* Closed Low Heath; Sedgelands dominated by *Gahnia trifida* or *Baumea juncea*

Scattered Native Plants: *Eucalyptus gomphocephala* Open Woodland

Vegetation Condition: >80% Very Good, <20% Good to Degraded, with areas of severe localised disturbance (Weston 1993)

Total Flora: 145 native taxa, 74 weeds (compiled from Keighery, GJ, and Keighery 1993c and Semeniuk, V&C Research Group 1997b) (estimated >75% of expected flora)

Significant Flora: Keighery, GJ, and Keighery 1993c—*Wilsonia backhousei* and *Lawrencia spicata* (normally associated with saline wetlands), *Lavatera plebeia* var. *tomentosa* and *Wilsonia humilis* (normally confined to offshore islands; *Lavatera plebeia* var. *tomentosa* is the only mainland record), *Kennedia coccinea* (becoming increasingly uncommon on the western margins of the Plain), *Hemigenia barbata* (uncommon on the Plain, associated with Tamala Limestones, most southern population known); typical Tamala Limestone taxa — *Melaleuca huegelii, Grevillea preissii, Eucalyptus foecunda, Pimelea calcicola, Trymalium ledifolium* subsp. *ledifolium, Hibbertia spicata* subsp. *leptotheca*

Fauna: no systematic survey. Significant mammal species: Quenda (Friend 1996 D)

Linkage: adjacent bushland to the south, east and west; part of proposed Greenways 90, 1 (Tingay, Alan & Associates 1997a); part of a regionally significant contiguous bushland/wetland linkage (Volume 2A, Map 8)

Other Special Attributes: majority included in Beeliar Regional Park Proposal (DPUD 1992a); Keighery, BJ, (1996) in an assessment of the Beeliar Wetlands recognised the importance of the Site in containing landscape, vegetation, flora and wetlands typical of the Spearwood Dunes in a contiguous sequence from the coast inland to the wetlands, the presence of vegetated limestone cliffs in this sequence being unique in the PMR; Semeniuk, V&C Research Group (1997b) in a study of 22 bushland reserves in the City of Cockburn found in relation to this Bushplan Site that the value of the four reserves (Coastal Reserve M91, Henderson Regional Open Space, Brownman Swamps, Lake Mt Brown) outweighed the value of the other separate reserves. Together the four reserves stand as an uncommon example of diversity of landforms and vegetation in the Spearwood Dunes — they illustrate the graduation of habitats in the Spearwood System from swale to ridge crest and from hinterland to coast, they provide a viable fauna refuge, the upland areas provide a buffer to the wetlands, and the two wetlands remain hydrologically linked; Brownman Swamp and Mt Brown Lake contain significant invertebrate fauna, Mt Brown Lake being the best example of its type (J. Davis pers. comm.).

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Interim List of the Register of the National Estate

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

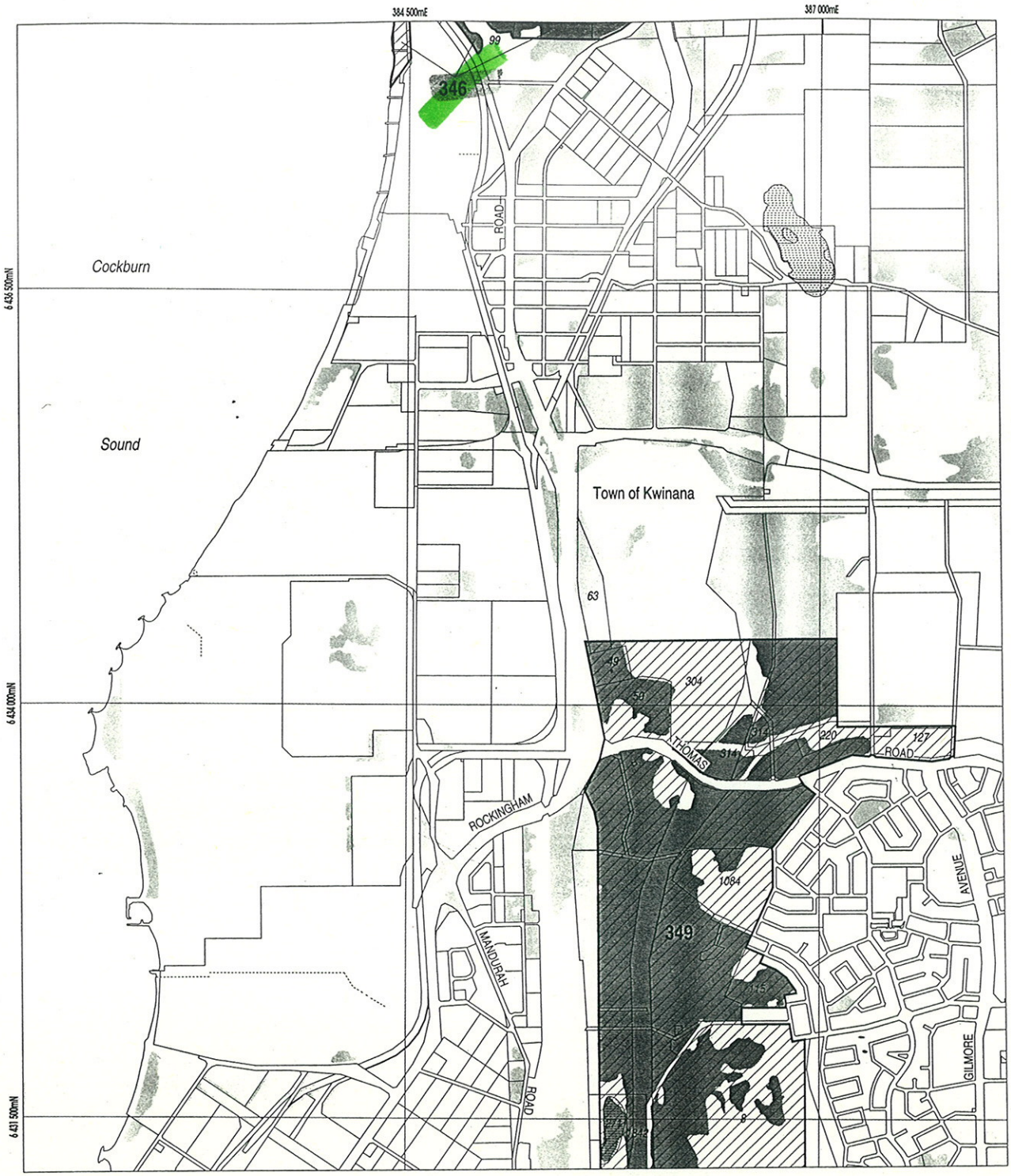
Criteria: Representation of ecological communities, Diversity, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation, Criteria not relevant to determination of conservation value, but which may be applied when evaluating areas having similar values

Opportunities and/or Constraints

Opportunities: Bushplan Site/part Bushplan Site subject to Swan Coastal Plain Lakes EPP; location of conservation category wetlands; under MRS Parks and Recreation Reservation, TPS Landscape Zoning, Park Recreation and Draining Zoning, Crown Reserve

Constraints: private land; under MRS Industrial Zoning, MRD regional road requirements, General Mineral Resource Area (limestone)

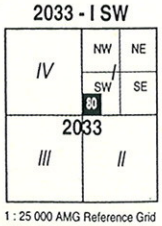
Recommendation: The care, control and management of parts of this area for conservation purposes within Beeliar Regional Park is endorsed. The most appropriate mechanism for the protection of the remainder of this Bushplan Site be considered through the public comment period in consultation with the land owner(s).



LEGEND

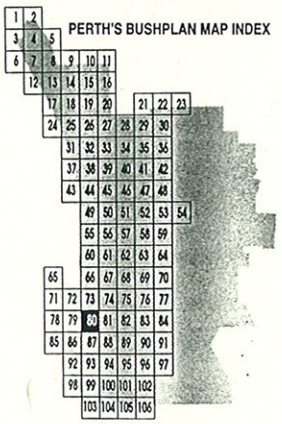
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2033 - I SW



1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX



N

SCALE

0 — 500 — 1000

Metres

Produced by Project Mapping Section
Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw-map9//environ/bushplan//bushv2_80.dgn

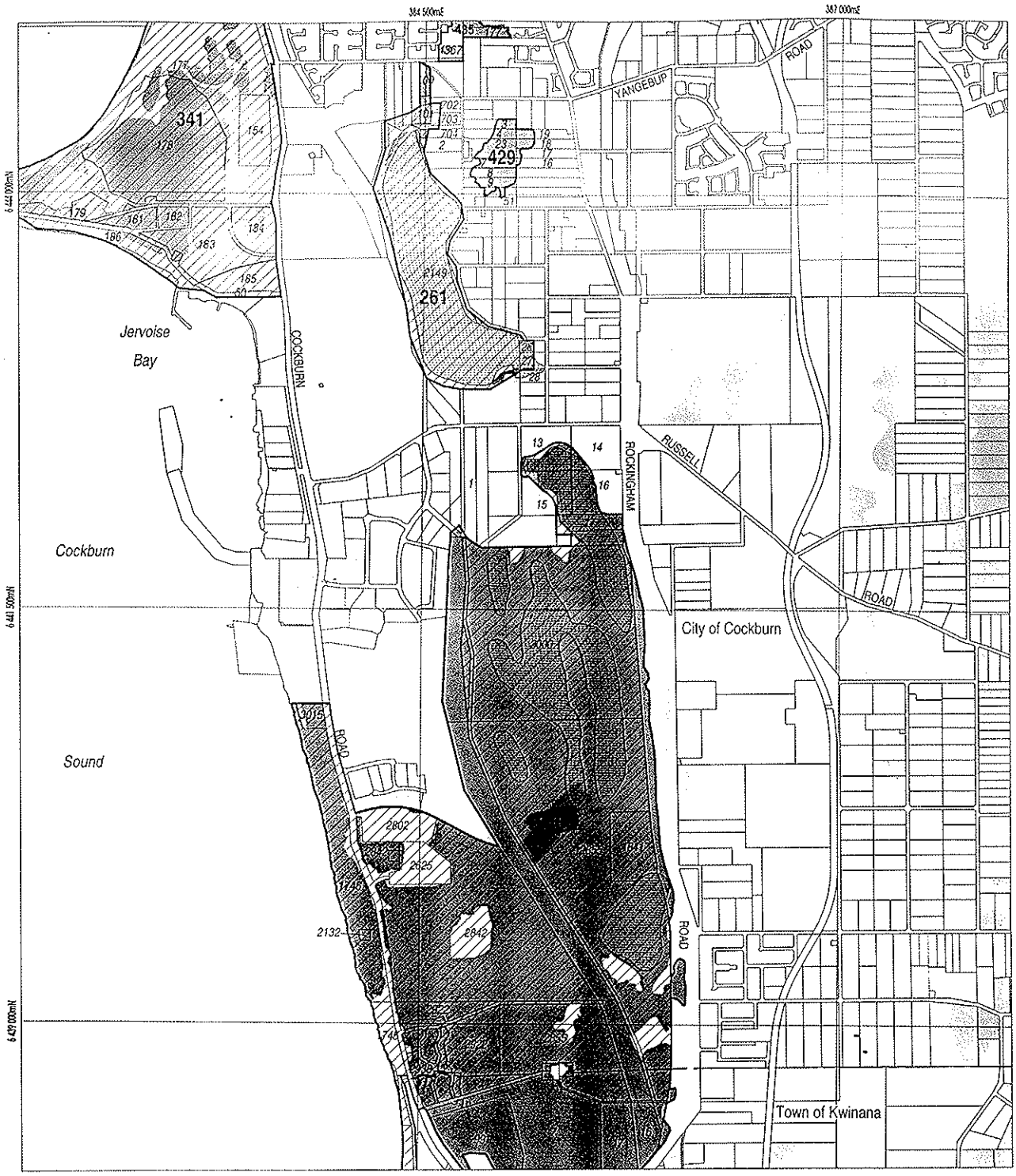
Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

Map 80



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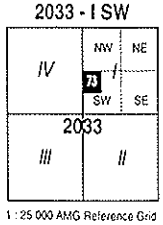
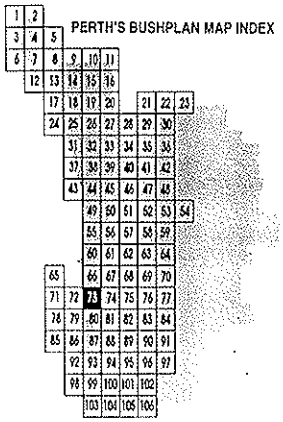
2033 - I SW



1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX



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SCALE

0 500 1000

Metres

Produced by Project Mapping Section
Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw-map9//environ/bushplan/bushv2_73.dgn

Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

Map 73

A24309 COOGEE BROWNMAN SWAMP MT BROWN LAKE

- ~~Wetzen 93 80% VG 15% G 5% D + same~~
- check ?? Long Swamp
- Industrial regarg. subdiv + dent, Henderson (EPA 480 '90)

-V. BIG.

check wider than surveys?

~~19. M. thach LCF - LOW~~

~~37 H_2O~~

~~35 Market gardens~~

~~10 Eg. Sw on Xp OH~~

~~22~~

~~29. Linedine heath~~ ~~Apatch. J.f~~ LH

~~27 A. rost Shrubland.~~

~~16 B. atl. Bm Bi Bl Bg~~ Ba Bm LW

~~36. H_2O~~

~~34. cleared~~

13 Gumph + Ba ow

4 Sedgland myrtle

~~11. E. gump ow~~

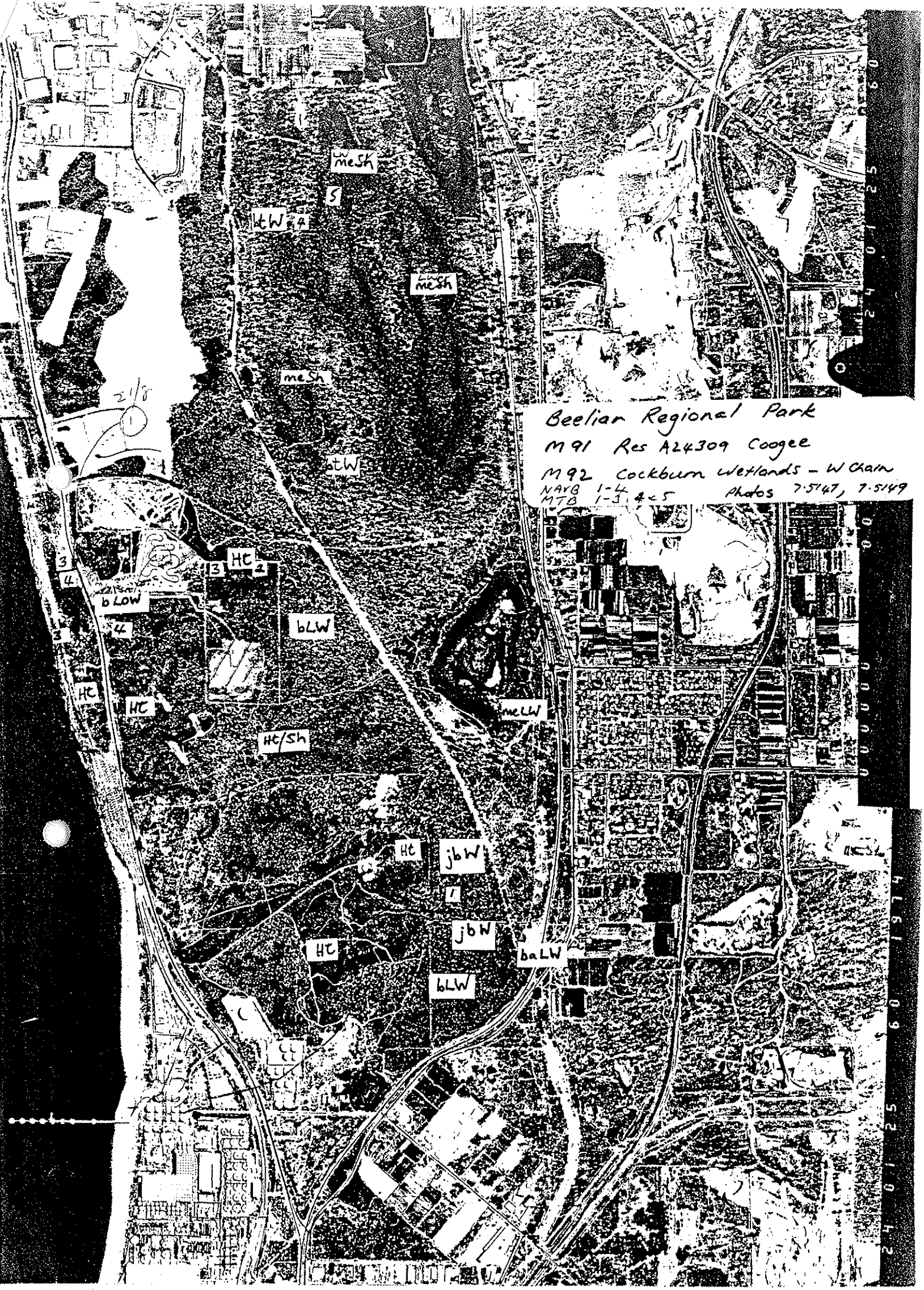
~~30. Ap Jf TO Scrub.~~

~~12 Eg Eo + Em ow 10-12m~~

NO RECORDS

NO. Metadata cadastral vested by Brownbuilt

↳ handwritten change made on document



Beeliar Regional Park

M91 Res A24309 Coogee

M92 Cockburn Wetlands - W Chain

NARB 1-4

MTB 1-3, 4 & 5

Photos 7.5147, 7.5149

A = Well above threshold

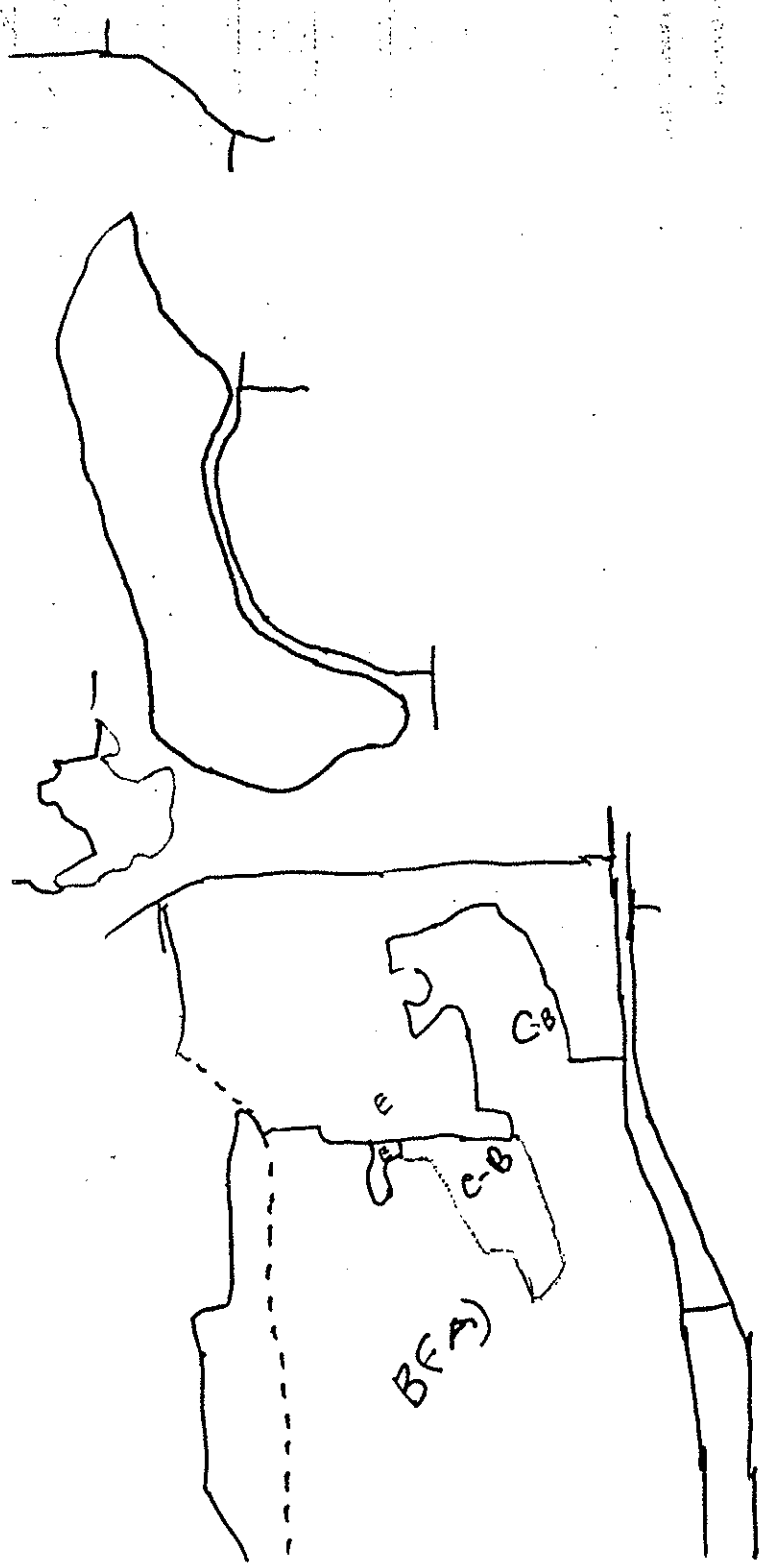
B = Above threshold

C = Threshold

D = Below threshold

E = Well below threshold

From: Weston, AS March 1993 Beelar wetlands Area condition assessment



From: Weston, AS March 1993
Beaver Wetlands Condition Assessment

Beeliar Regional Park
M91 Res A24309 Coogee
M92 Cockburn Wetlands – W Chain
NARB 1-4
MTB 1-3, 4 & 5 Photos 7-5147, 7-5149

B. J. Keighery. roughe
map 1992

M92

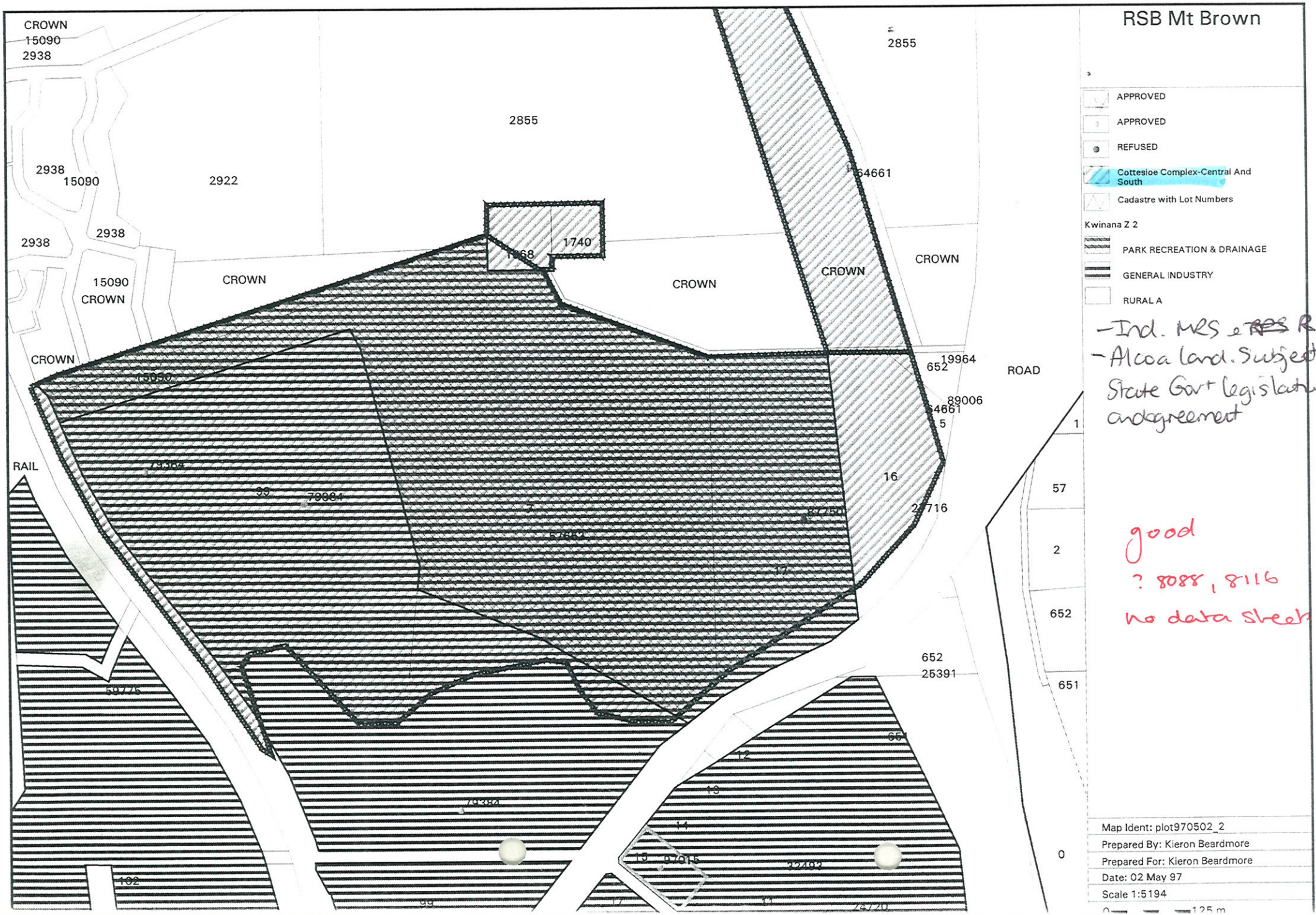
BUSHPLAN SITES CORRECTED

B TC/BK 22/10/98

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS

N

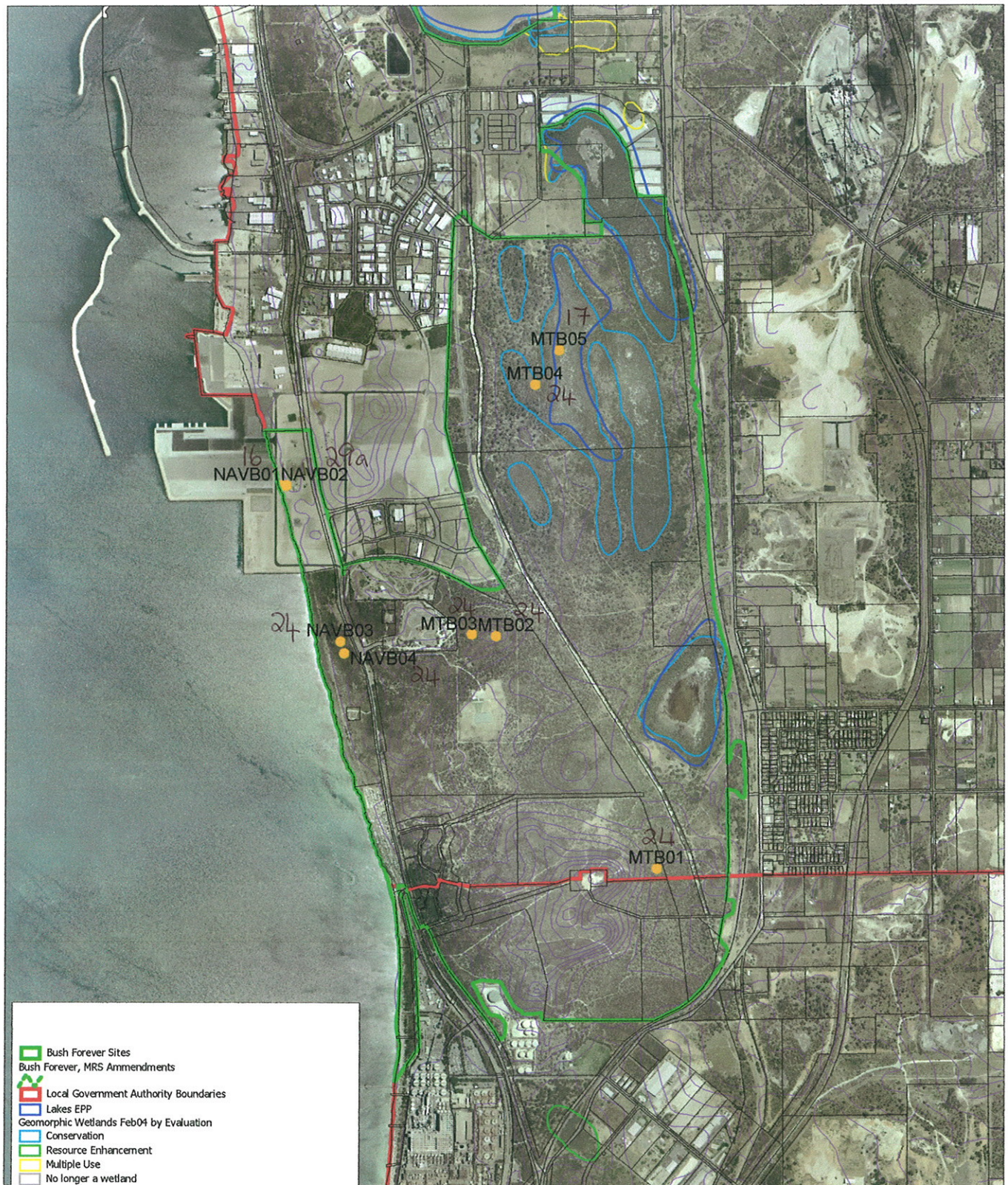


- Ind. MRS & ~~RPS~~ RSP.
- Alcoa land. Subject to State Govt legislation and agreement

good

? 8088, 8116

no data sheet



Bush Forever Site 346: Brownman Swamp, Mt Brown Lake and Adjacent Bushland, Henderson/ Naval Base

Jervoise Bay
Amendment

leave as per current
per sch currently
subject to EA

KB, EASTERN BOUNDARY - LOWER STONEY AND CAT VEGETATION?

CAN INCLUDE AS MUCH TO EXTENT OF CAT FOR THIS PORTION VEGETATION COMMON DEP ☐ Y/O good - include

DEP SPECIFIC AREAS PARTICULARLY NOT MAPPED AS BUSHLAND BY DEP DEP VEGETATION CONFIRMED ☐ NT/JA Y/O Tuart woodland keep

CAN INCLUDE AS MUCH AS CAN BE INCLUDED

TO BE RECTIFIED AS PER EPA

RETENTION INFRASTRUCTURE

INCLUDE TO EXTENT OF PER

NT/JA Y/O include

2) ~~PORT~~ EXTENSION OF PER?

JERVOIS BAY

~~PORT~~ CAMPBELL?

(1) Remove as per proposed Amendment

SW Dismds No. 30 - Jervois Bay

Y/O railways is veg include

TO BE EXCLUDE RAILWAY RESERVE (NOT VEGETATED) SHOULD THIS BE IN? NOT VEGETATED

Y/O YES include. is veg on aerial

DEP FILL VEG CHANNELS

1) BOWLEY ROAD EXTENSION

PREVIOUSLY MAPPED AS BUSHLAND

cleared

346

hole in veg

Follow Veg

Follow Cad's PER

Mech.

JA/NT Y/O aerial shows regood cond include

OK

1. Probably be removed Cadastre
2. Also, regclears in PER will be identified

AG VEG 1998 BOUNDARY THEME
Cadastre
Bushplan sites refno 1-500 SCP BOUNDARY THEME
cons category wetlands

2 Jun 98
For:
ERNAL USE ONLY

CAN AMEND.

JA/NT Y/O
See notes above

M Lane

N
Completely Degraded
7 (single cike)
24 (45 lbs)
Dead Wood
Cook
Note
??
BROWNMAN
SWAMPS
Mt Royal
Lake
M91
See props.
Not in System 6
Limestone

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
24	NAVB-4		Austrostipa	flavescens				
24	NAVB-4		Conostylis	aculeata				
24	NAVB-4		Crassula	colorata	var.	colorata		
24	NAVB-4		Dryandra	lindleyana				
24	NAVB-4		Grevillea	preissii	subsp.	preissii		
24	NAVB-4		Hakea	prostrata				
24	NAVB-4		Hardenbergia	comptoniana				
24	NAVB-4		Hibbertia	hypericoides				
24	NAVB-4		Hybanthus	calycinus				
24	NAVB-4		Isolepis	cernua				
24	NAVB-4		Lepidosperma	squamatum				
24	NAVB-4		Lomandra	maritima				
24	NAVB-4		Melaleuca	systena				
24	NAVB-4		Petrophile	serruriae				
24	NAVB-4		Rhagodia	baccata	subsp.	baccata		
24	NAVB-4		Solanum	symonii				
24	NAVB-4		Sonchus	hydrophilus				
24	NAVB-4		Thysanotus	manglesianus/patersonii complex				
24	NAVB-4	*	Anagallis	arvensis				
24	NAVB-4	*	Avellinia	michelii				
24	NAVB-4	*	Avena	barbata				
24	NAVB-4	*	Brassica	tournefortii				
24	NAVB-4	*	Briza	maxima				
24	NAVB-4	*	Bromus	diandrus				
24	NAVB-4	*	Cerastium	glomeratum				
24	NAVB-4	*	Conyza	bonariensis				
24	NAVB-4	*	Crassula	glomerata				
24	NAVB-4	*	Ehrharta	calycina				
24	NAVB-4	*	Ehrharta	longiflora				
24	NAVB-4	*	Galium	aparine				
24	NAVB-4	*	Hypochaeris	glabra				
24	NAVB-4	*	Moraea	flaccida				
24	NAVB-4	*	Pelargonium	capitatum				
24	NAVB-4	*	Petrorhagia	dubia				
24	NAVB-4	*	Solanum	nigrum				
24	NAVB-4	*	Sonchus	asper	subsp.	glaucescens		
24	NAVB-4	*	Urospermum	picroides				
24	NAVB-4	*	Vulpia	myuros				

(NC

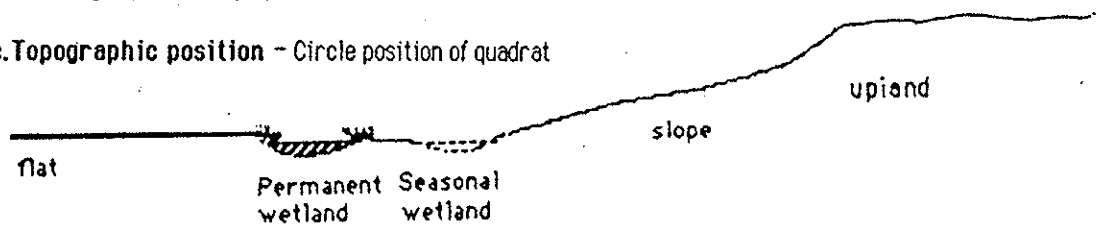
QUADRAT No. NAR 04 VEGETATION TYPE _____
DATE FIRST TRIP 7/9/92 VOLUNTEERS _____
DATE SECOND TRIP / / VOLUNTEERS _____
BOTANIST NG, BJK

1. LOCATION of the QUADRAT

a. **Mud Map** Draw a sketch of the location of the quadrat the back of this sheet →

b. **Photograph** Photographer's name _____

c. **Topographic position** – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground____ Drainage well mod poor Wet All year winter/spring

Litter (% cover)____ Surface soil_____ Sub-surface soil _____

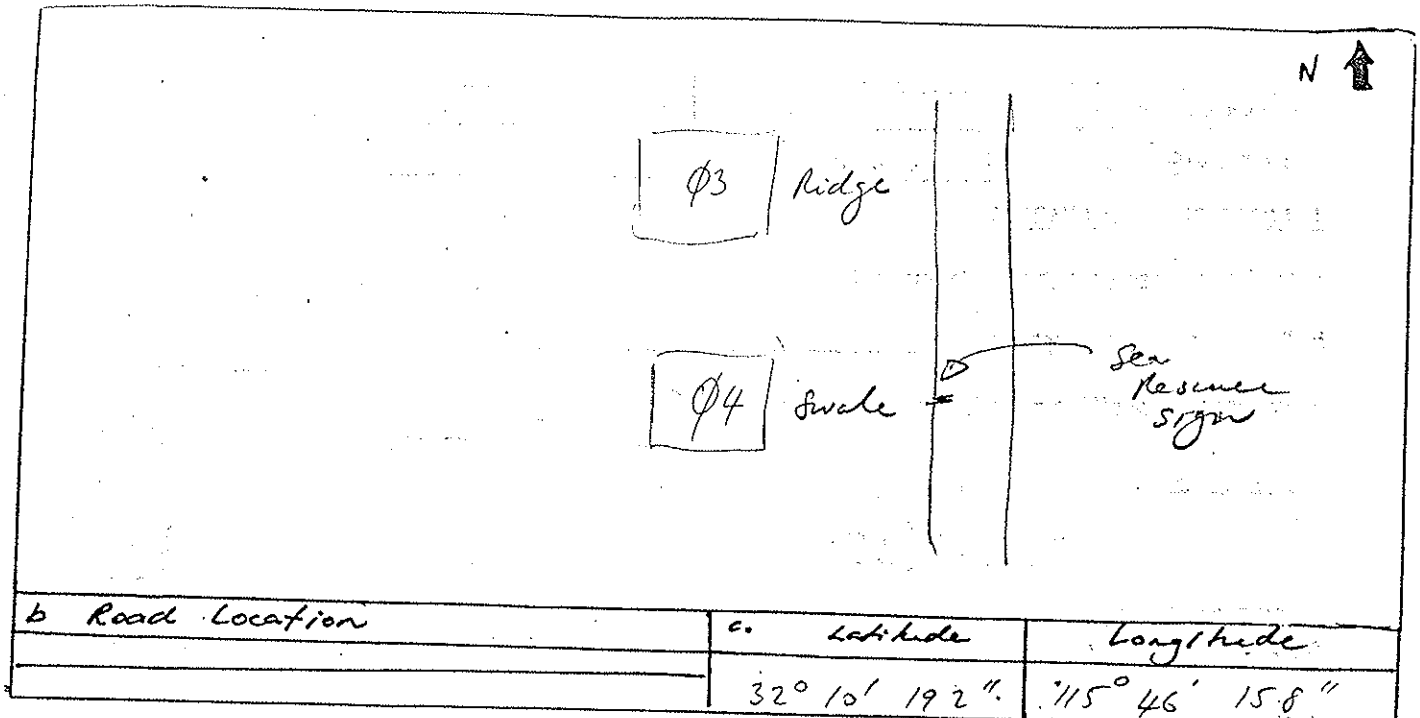
3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

LIFE FORM	TREES		MALLEES		Height (metres)
	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more	15m, 10m, 5m
COVER CLASS (%)	>15m 5–15m				

LIFE FORM	SHRUBS					
	over 2m	2.0–1.5m	1.5–1.0m	1.0m – .5m Hbb. hyp ket sal	under .5m	3m, 2m, 1m
COVER CLASS (%)				50 – 70%		

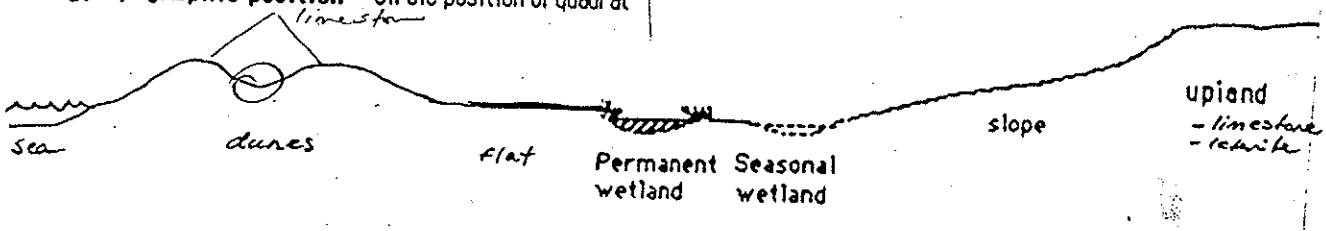
LIFE FORM	BUNCH GRASSES	HERBS Misc Exotic annuals	SEDGES		
	under .5m	under .5m (except creepers)	over .5m	under .5m	2.0m, 1.5m, 1.0m, .5m
COVER		30 – 50%			



b Road Location	c. Latitude	Longitude
	32° 10' 19.2"	115° 46' 15.8"

d. Photograph Photographer's name _____ Photo No ±300 m Altitude 5m

e. Topographic position – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat (gentle) steep

Aspect N NE E SE S SW (W) NW

Surface soil orange | brown sand

Sub-surface soil limestone

Environ Geol LS1

Drainage (well) mod poor

Dead petro =

Wet All year winter/spring

Litter (% cover) 20-40%

% Bare ground 2-10%

rabbit diggings

4. VEGETATION CONDITION

EXCELLANT	
VERY GOOD	
GOOD	
POOR	✓
VERY POOR	

Comments

All herb layer = exotic herbs

few natives

Rabbits, pothole diggings

SPECIES PRESENCE

QUADRAT No.
NAB 04

- **work systematically through the vegetation**; start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

Trees

	No	ID

Mallees

SHRUBS

- Hibb hyp
- Pet Serr 'pink'
- Solanum somnii — X
- Hak. prost
- Dry riv
- Rhag. bacc
- Melal. acerosa
- Grev. thel.
- Hyb. calyc.
- * Pelagonium cap

	No	ID
29/10		
* Ehrharta longiflora		
* Briza maxima		
* Vulpia myuroides	✓	
* Cynodon dactylon		
Arctotheca calendula		
Sonchus oleraceus		
* Solanum nigricans		
* Bromus diandrus GOT		
* Ehrharta calycina		
* Avena barbata.		
OK Sonchus ? aspilos = prorumpens		
NOT ABLE / DET most likely		

Bunch Grasses

* Ehrharta longiflora	✓	
Grass family (NE)		
Stipa flavescens	X	

Herbs

Thys. pat / mes		
Arctotheca calendula		
Hard. comp.		
* Hommalocalendula		
* Anagalis. arv.	X	
* Hyp glabra	X	
* Weed	✓	
* Romulea rosea		
Crassula glomerata	X	
Lomandra maritima		
— woods dry	✓	
* Brassica tournefortei	X	
* Sonchus asper	X	
* Solanum nigricans		
* Galium aparine		

Herbs

	No	ID
Crassula colorata		
Solanum nigrum		
? Arctotheca ? thistle		
? Plantago = 03		
* Petrorhag. velutina		
* Cerastium glom.		
29/10		
* Watsonia michellii		
S. hydrophilus.		

Sedges

- Isolepis cernua
- lepidosp. angust

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
24	NAVB-3		Acacia	rostellifera				
24	NAVB-3		Acanthocarpus	preissii				
24	NAVB-3		Austrostipa	flavescens				
24	NAVB-3		Caladenia	latifolia				
24	NAVB-3		Cassytha	racemosa				
24	NAVB-3		Comesperma	confertum				
24	NAVB-3		Cryptandra	mutila				
24	NAVB-3		Desmocladus	fasciculatus				
24	NAVB-3		Dryandra	sessilis	var.	sessilis		
24	NAVB-3		Gompholobium	tomentosum				
24	NAVB-3		Grevillea	preissii	subsp.	preissii		
24	NAVB-3		Hardenbergia	comptoniana				
24	NAVB-3		Hibbertia	spicata	subsp.	leptotheca		P3
24	NAVB-3		Hyalosperma	cotula				
24	NAVB-3		Lepidosperma	sp. (Coastal terete) (BJ Keighery and N Gibson 231)				
24	NAVB-3		Leucopogon	parviflorus				
24	NAVB-3		Lomandra	maritima				
24	NAVB-3		Melaleuca	huegelii	subsp.	huegelii		
24	NAVB-3		Melaleuca	systena				
24	NAVB-3		Petrophile	serruriae				
24	NAVB-3		Phyllanthus	calycinus				
24	NAVB-3		Pimelea	calcicola				
24	NAVB-3		Stylidium	bulbiferum				
24	NAVB-3		Thomasia	cognata				
24	NAVB-3	*	Aira	caryophyllea				
24	NAVB-3	*	Anagallis	arvensis				
24	NAVB-3	*	Arenaria	leptoclados				
24	NAVB-3	*	Briza	maxima				
24	NAVB-3	*	Briza	minor				
24	NAVB-3	*	Centaurea	melitensis				
24	NAVB-3	*	Centaurium	erythraea				
24	NAVB-3	*	Cerastium	glomeratum				
24	NAVB-3	*	Conyza	sumatrensis				
24	NAVB-3	*	Erodium	cicutarium				
24	NAVB-3	*	Euphorbia	peplus				
24	NAVB-3	*	Galium	aparine				
24	NAVB-3	*	Hypochaeris	glabra				
24	NAVB-3	*	Lagurus	ovatus				
24	NAVB-3	*	Lolium	rigidum				
24	NAVB-3	*	Sonchus	oleraceus				
24	NAVB-3	*	Trifolium	campestre	var.	campestre		
24	NAVB-3	*	Trifolium	cernuum				

(1)

QUADRAT No. NAKB 03 VEGETATION TYPE _____

DATE FIRST TRIP 7/9/92 VOLUNTEERS _____

DATE SECOND TRIP _____ VOLUNTEERS _____

BOTANIST NG, BJK.

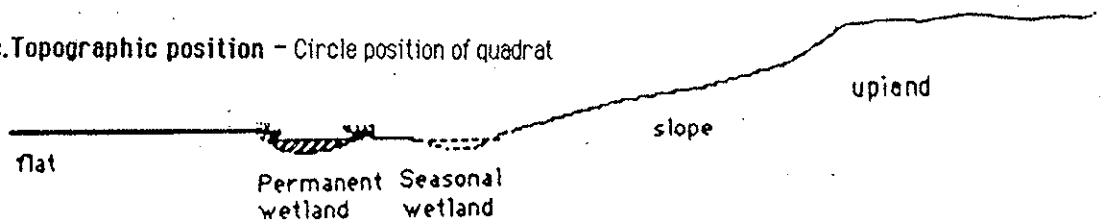
1. LOCATION of the QUADRAT

see over.

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name _____

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground____ Drainage well mod poor Wet All year winter/spring

Litter (% cover)_____ Surface soil_____ Sub-surface soil _____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: over 70% | 50–70% | 30–50% | 20–30% | 10–20% | 2–10% | under 2% | 0%

	TREES		MALLEES	
LIFE FORM	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m 5–15m			

15m
10m
5m

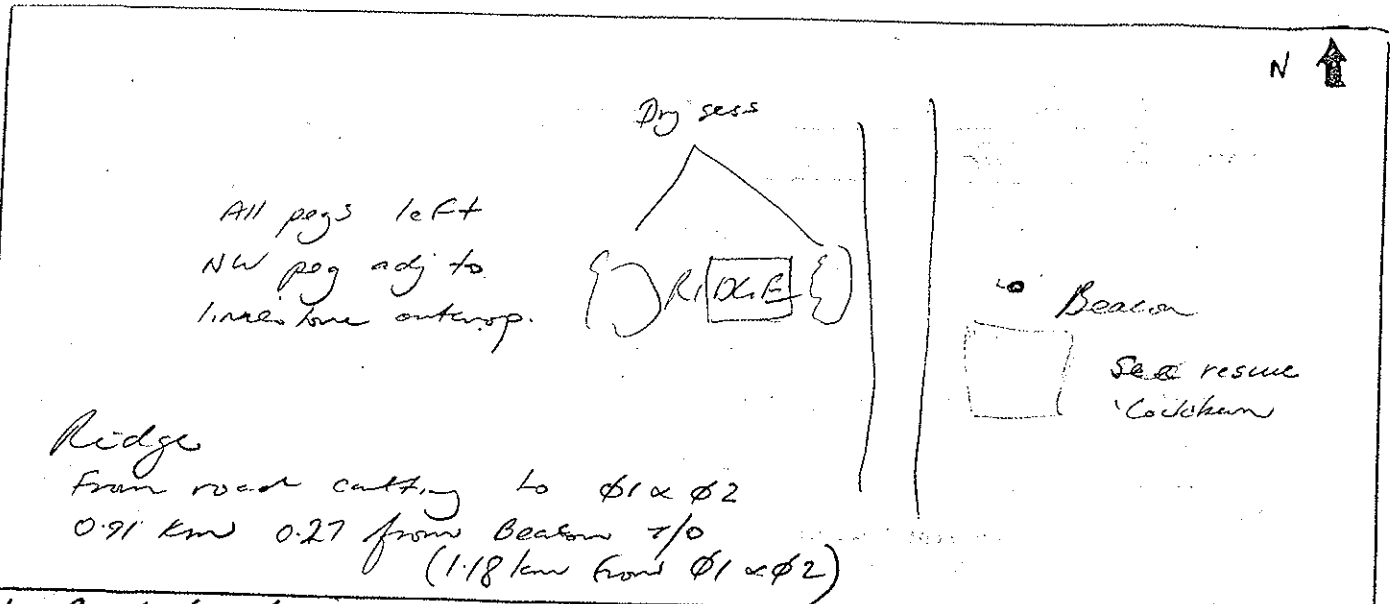
	SHRUBS					
LIFE FORM	over 2m	2.0–1.5m	1.5–1.0m	1.0m – .5m Dry sclero	under 5m mixed	
COVER CLASS (%)				<2%	50–70%	

3m
2m
1m

Height (metres)

	BUNCH GRASSES	HERBS mixed exotics	SEDGES	Low Hea
LIFE FORM	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER		2–10%		2–10%

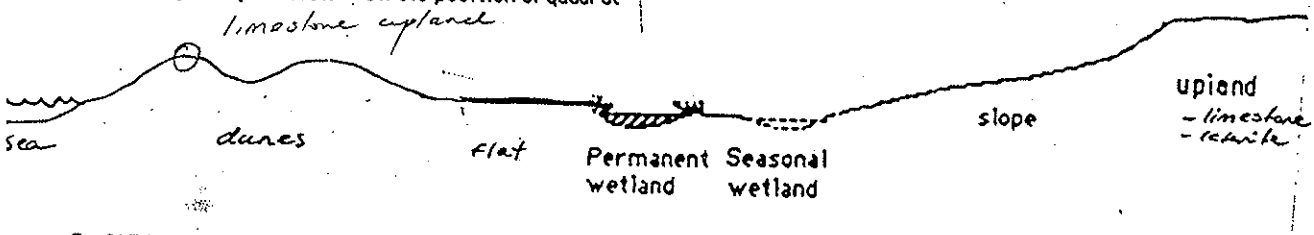
2.0m
1.5m
1.0m
.5m



b Road Location	c. Latitude	Longitude
	32° 10' 17.3".	115° 46' 15.7"

d. Photograph Photographer's name _____ Photo No _____ ± 30m Altitude 5m

e. Topographic position – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat gentle (steep)

Aspect (N NE E SE S SW W NW)

Surface soil brown sand, exposed limestone

Sub-surface soil limestone

Environ Geol LS 1

Drainage (well) mod poor

Wet All year winter/spring

Litter (% cover) 10%

% Bare ground limestone rubble patches 5-10%

4. VEGETATION CONDITION

		Comments
EXCELLENT		Annual weed
VERY GOOD		
GOOD		
POOR		
VERY POOR		

Adj areas with Dry sess pockets to 1.5m.

HB 091 27

% OF LOCAL FREQUENCY

QUADRAT No. 1
NAVB 03

31/92 within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees	No	ID
Mallees		
SHRUBS		
Dry sess		
Acac. rost		
Mela. hueg		
Leuc. part		
Dry sess		
Grev thel 'coastal'		
Hibb. spicata ssp lepto		
Phyll. baly		
Olea. serra ('pink')		
Thomasia (tryphylla) incognata	X	
Mela. acerosa		
? cryptandra mutica	✓	
Acanthocarpus preis		
very depauperate		

SHRUBS	No	ID
29/10/92		
Stylid. ? bulbo	✓	
* Centaurium erythraea		
Wattle - [illegible]	✓	
* Lolium ~~subulatum~~ rigidum		
Conospermum confertum = PB		
* Briza minor	✓	
* Aira cany	✓	
Pimelia calcicola	✓	
* Briza max		
Gom. trilobiens = lsmn		
Hyalosperma cotula	✓	
* Centaurea melalensis		
* Tritolium campestre		
Bunch Grasses		
Stipa flavescens		
* Lagurus ovatus	X	
Herbs		
Hard. comp.		
* Sonchus oleraceous		
* Hypo glabra		
* Briza arv.		
Lobelia mont		
* Romulea rosea		
Cassytha racemosa		
* Conyza albida		
* Euphorb. peplis		
* Galium aparine		
* Cerastium glom.	X	
~~* Euphorbia peplus~~		
Calad. latifolia	X	
* Trifolium cernuum		
Plantago sp (sterile)	VSP	
* Erodium cicutarium	X	
* Arrenaria serpyl.		

Herbs	No	I
* Lolium rigidum		
Sedges		
Loxo. Hec		
Lepid. angust 'coastal'		

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
16	NAVB-1		Atriplex	cinerea				
16	NAVB-1		Crassula	colorata	var.	colorata		
16	NAVB-1		Frankenia	pauciflora				
16	NAVB-1		Samolus	repens				
16	NAVB-1		Sarcocornia	quinqueflora				
16	NAVB-1		Sporobolus	virginicus				
16	NAVB-1		Threlkeldia	diffusa				
16	NAVB-1	*	Melilotus	indicus				
16	NAVB-1	*	Poa	annua				
16	NAVB-1	*	Tetragonia	decumbens				

QUADRAT No. 11-16 #1 VEGETATION TYPE

DATE FIRST TRIP 7/9/92 VOLUNTEERS

DATE SECOND TRIP VOLUNTEERS

BOTANIST NG, OJK

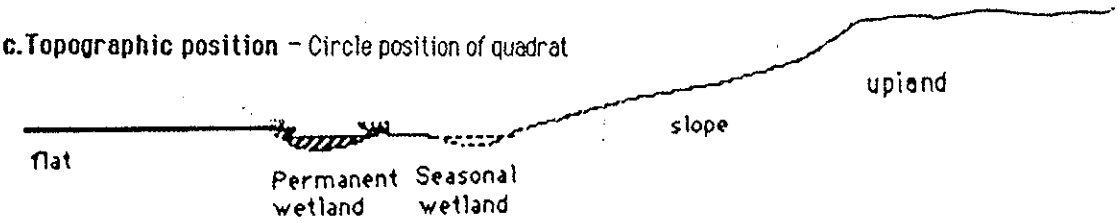
NAB

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep **Aspect** N NE E SE S SW W NW

% Bare ground____ **Drainage** well mod poor **Wet** All year winter/spring

Litter (% cover)____ **Surface soil**____ **Sub-surface soil**____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

Height (metres)

LIFE FORM	TREES	MALLEES		
	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m 5–15m			

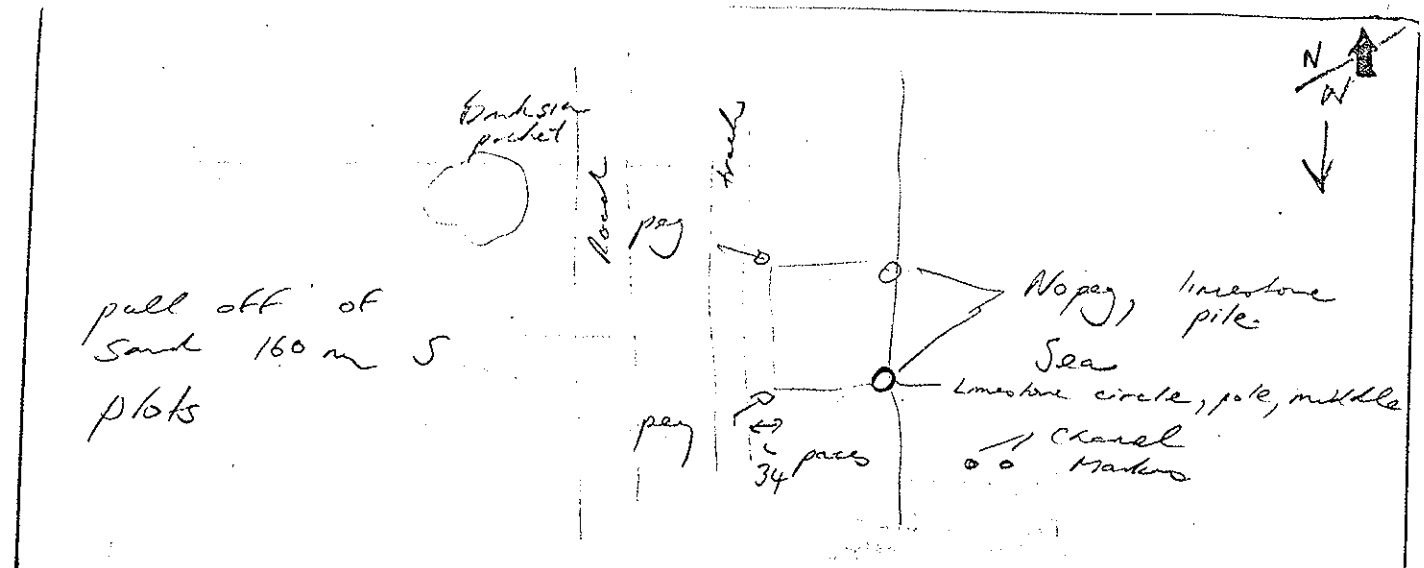
15m, 10m, 5m

LIFE FORM	SHRUBS				
	over 2m	2.0–1.5m	1.5–1.0m	1.0m – .5m	under 5m Frank. Salic.
COVER CLASS (%)					70%

3m, 2m, 1m

LIFE FORM	BUNCH GRASSES	HERBS	SEDGES	
	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER				

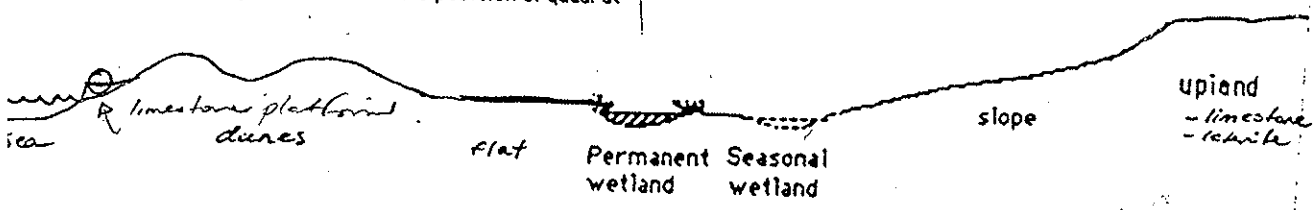
2.0m, 1.5m, 1.0m, .5m



b Road Location	c. Latitude	Longitude
	32° 09' 52.2"	115° 46' 04.3"

d. Photograph Photographer's name NG Photo No. ± 30m Altitude 5

e. Topographic position – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat (gentle) steep

Aspect N NE E SE S SW (W) NW

Surface soil grey sand, shell grit, outcropping limestone

Sub-surface soil limestone

Environ Seq LS 1

Drainage (well) mod poor

Wet All year winter/spring

Litter (% cover) 60%

% Bare ground 5-10%

4. VEGETATION CONDITION

EXCELLANT	
VERY GOOD	✓
GOOD	
POOR	
VERY POOR	

Comments

Rabbits burrow in site

? Thrush nest

2. SPECIES PRESENCE

QUADRAT No.
NAVB 1

- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees	No	ID

Mallees	No	ID

SHRUBS	No	ID
/ Frankenia pauci		
/ Sarcocornia quinqueflora	X	
/ Threlkeldia diffusa		
/ *Tetragonia decumbens		
/ Sanctus repens.		
/ Atriplex cinerea	X	

SHRUBS	No	ID

Bunch Grasses	No	ID
*? Poa annua	✓	
/ Sporobolus virginicus	X	

Herbs	No	ID
(NE) ? Seedling no Spec, Single sp		
~~*Trifolium~~		
/ Crassula colorata	X	
/ *Medicago indica	X	
= Melilotus indicus ?		

Herbs	No	ID

Sedges	No	ID

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
17	MTB-5		Baumea	juncea				
17	MTB-5		Gahnia	trifida				
17	MTB-5		Isolepis	cernua				
17	MTB-5		Meeboldina	coangustata				
17	MTB-5		Melaleuca	rhaphiophylla				
17	MTB-5		Melaleuca	teretifolia				
17	MTB-5		Samolus	junceus				

(2) ✓

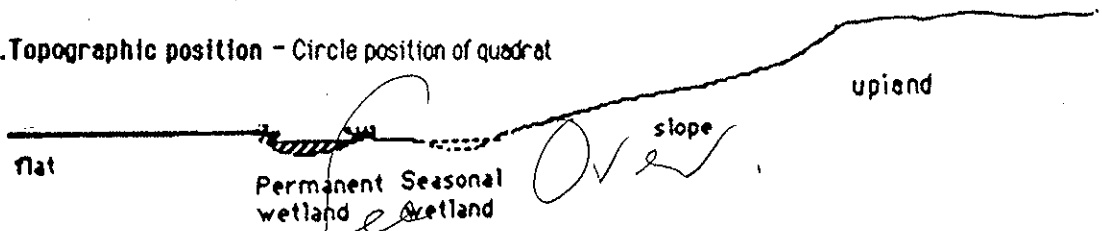
QUADRAT No. MTB 05 VEGETATION TYPE Mel raph Low'd Forest
DATE FIRST TRIP 27/10/92 VOLUNTEERS
DATE SECOND TRIP VOLUNTEERS
BOTANIST BJK, NG

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name

c. Topographic position – Circle position of quadrat



Over

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground____ Drainage well mod poor Wet All year winter/spring

Litter (% cover)____ Surface soil____ Sub-surface soil____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

	TREES: Mel raph	MALLEES		
LIFE FORM	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m 5–15m 30–50%			

15m · 10m · 5m

	SHRUBS				
LIFE FORM	over 2m	2.0–1.5m	1.5–1.0m	1.0m – .5m	under 5m
COVER CLASS (%)					

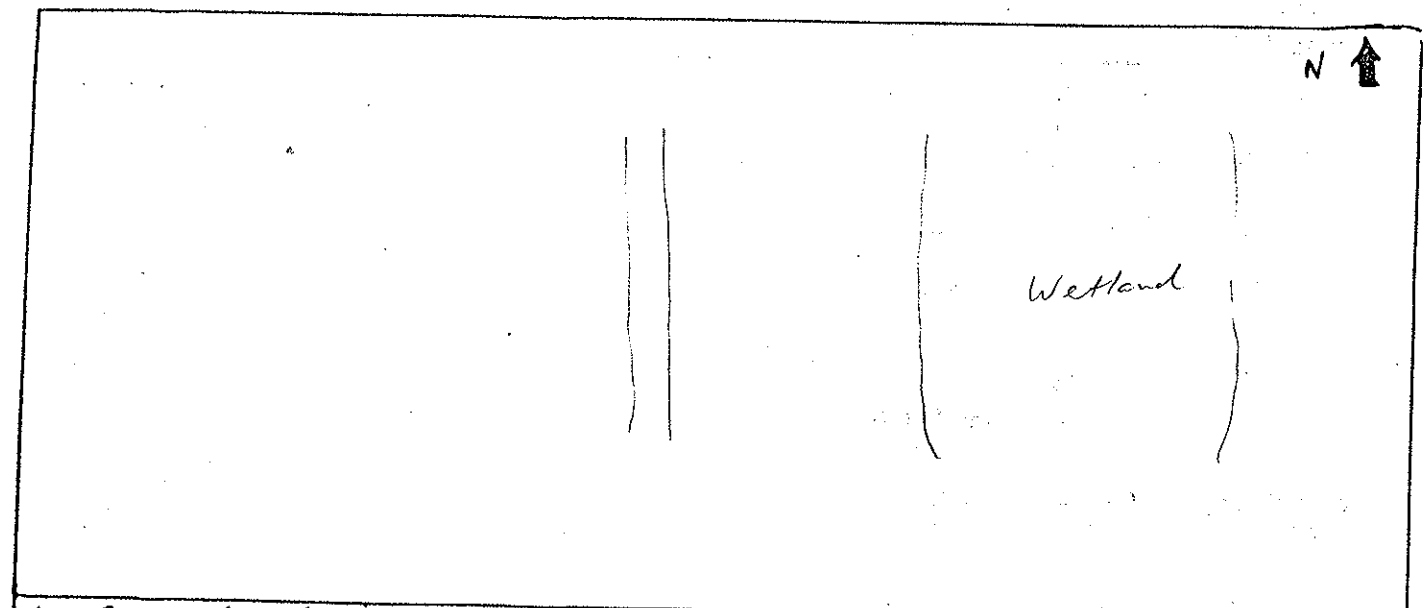
3m · 2m · 1m

Height (metres)

	BUNCH GRASSES	HERBS	SEDGES	
		Stenotus	Gahnia ← Baumea	
LIFE FORM	under .5m	under .5m (except creepers)	over .5m >70%	under .5m
COVER		2–10%	~~20–30%~~	~~50–70%~~

2.0m · 1.5m · 1.0m · .5m

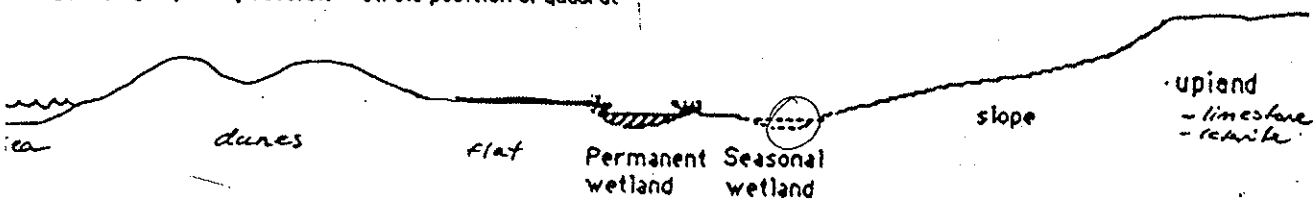
a. **Mud Map** Draw a sketch of the location of the quadrat :



b Road Location	c. Latitude	Longitude
Brownman Swamp	32° 09' 31.0"	115° 46' 56.5

d. **Photograph** Photographer's name NG Photo No ± 1/200m Altitude 20m

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope (flat) gentle steep

Aspect N NE E SE S SW W NW

Surface soil Brown ~~sandy~~ Clayey Sand

Sub-surface soil ? clay Enviro Geol M5

Drainage well mod (poor)

Wet All year (winter/spring)

Litter (% cover) 50%

% Bare ground 40% 0%

4. VEGETATION CONDITION

EXCELLANT	
VERY GOOD	✓
GOOD	
POOR	
VERY POOR	

Comments

inundated winter, no opportunities weeds.

Frequently burnt, paperbark black.

SPECIES PRESENCE

- **work systematically through the vegetation**, start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. MTB 05

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

MTB 05

Trees

	No	ID
Mel. rapt		

Mallees

	No	ID

SHRUBS

	No	ID
Mel. lanceolata		

SHRUBS

	No	ID

Bunch Grasses

	No	ID

Herbs

	No	ID
Samolus junceus		
→ ADJ Algae. (NE)		

Herbs

	No	ID

Sedges

	No	ID
Gahnia lasbda		
Baumea juncea		
Leptocarpus co-angust.		
Isolepis kermadec. J.I		

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
24	MTB-1		Arthropodium	capillipes				
24	MTB-1		Banksia	attenuata				
24	MTB-1		Burchardia	congesta				
24	MTB-1		Caladenia	flava	subsp.	flava		
24	MTB-1		Centrolepis	drummondiana				
24	MTB-1		Chamaescilla	corymbosa	var.	corymbosa		
24	MTB-1		Conostylis	aculeata				
24	MTB-1		Crassula	colorata	var.	colorata		
24	MTB-1		Daviesia	triflora				
24	MTB-1		Drosera	erythrorhiza	subsp.	erythrorhiza		
24	MTB-1		Drosera	pallida				
24	MTB-1		Dryandra	lindleyana				
24	MTB-1		Eucalyptus	marginata	subsp.	marginata		
24	MTB-1		Gastrolobium	capitatum				
24	MTB-1		Hardenbergia	comptoniana				
24	MTB-1		Hibbertia	hypericoides				
24	MTB-1		Hibbertia	racemosa				
24	MTB-1		Homalosciadium	homalocarpum				
24	MTB-1		Isolepis	cernua				
24	MTB-1		Lepidosperma	squamatum				
24	MTB-1		Lyginia	barbata				
24	MTB-1		Macrozamia	riedlei				
24	MTB-1		Microlaena	stipoides				
24	MTB-1		Petrophile	linearis				
24	MTB-1		Sowerbaea	laxiflora				
24	MTB-1		Stirlingia	latifolia				
24	MTB-1		Tetraria	octandra				
24	MTB-1		Thysanotus	patersonii				
24	MTB-1		Wahlenbergia	preissii				
24	MTB-1		Xanthorrhoea	preissii				
24	MTB-1	*	Aira	caryophyllea				
24	MTB-1	*	Anagallis	arvensis				
24	MTB-1	*	Arenaria	leptoclados				
24	MTB-1	*	Avena	fatua				
24	MTB-1	*	Briza	maxima				
24	MTB-1	*	Briza	minor				
24	MTB-1	*	Bromus	diandrus				
24	MTB-1	*	Cerastium	glomeratum				
24	MTB-1	*	Crassula	glomerata				
24	MTB-1	*	Ehrharta	longiflora				
24	MTB-1	*	Galium	murale				
24	MTB-1	*	Hypochaeris	glabra				
24	MTB-1	*	Petrorhagia	dubia				
24	MTB-1	*	Poa	annua				
24	MTB-1	*	Sagina	apetala				
24	MTB-1	*	Sagina	maritima				
24	MTB-1	*	Sonchus	oleraceus				
24	MTB-1	*	Trifolium	campestre	var.	campestre		
24	MTB-1	*	Trifolium	cernuum				
24	MTB-1	*	Vellereophyton	dealbatum				
24	MTB-1	*	Vulpia	myuros				

(N)

QUADRAT No. MTB 01 VEGETATION TYPE Jarrah over Bank
DATE FIRST TRIP 7/9/92 VOLUNTEERS
DATE SECOND TRIP / / VOLUNTEERS
BOTANIST

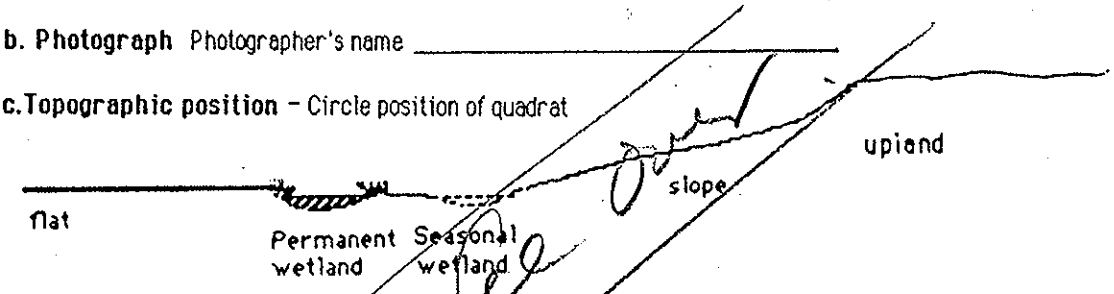
MTB

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet.

b. Photograph Photographer's name

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground Drainage well mod poor Wet All year winter/spring

Litter (% cover) Surface soil Sub-surface soil

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

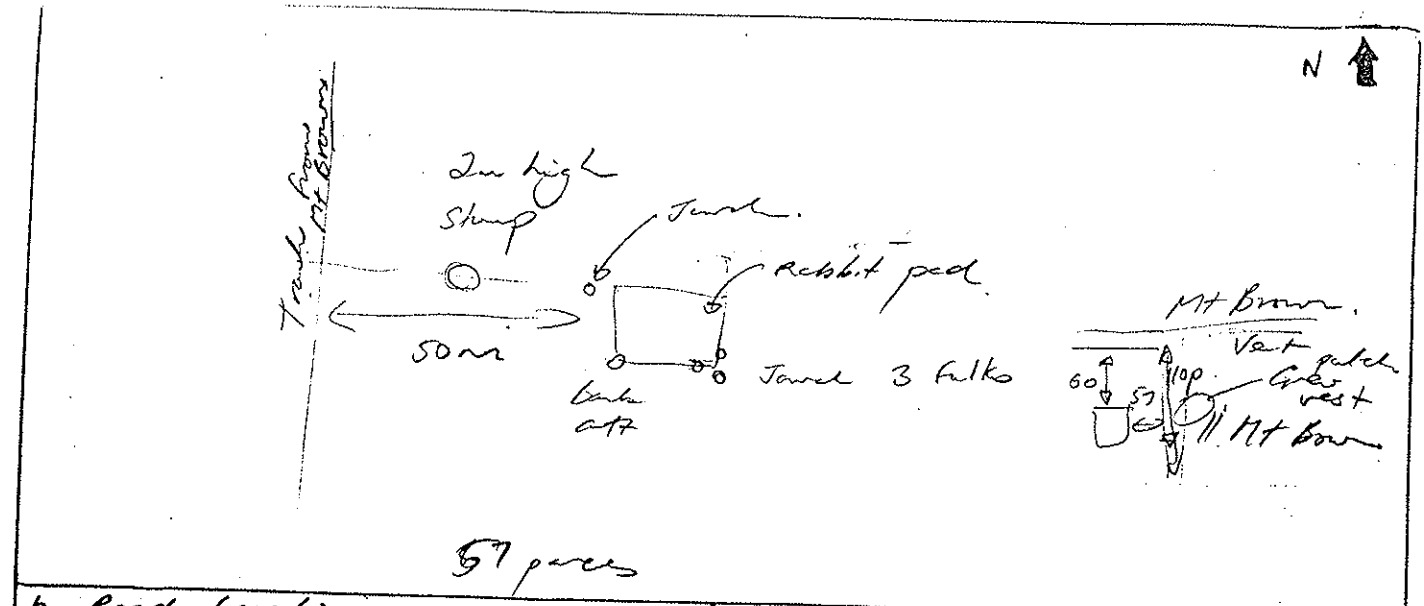
Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

LIFE FORM					
TREES			MALLEES		15m
	>15m or 5–15m (Jarrah Bank alt)	under 5m (Bank alt)	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more	10m 5m
COVER CLASS (%)	>15m 5–15m 20–30%	2–10%			

LIFE FORM						
SHRUBS						
	over 2m	2.0–1.5m	1.5–1.0m (Xanth Mayo)	1.0m – .5m (Hibb typ Shir Yalt)	under .5m	3m 2m 1m
COVER CLASS (%)			2–10%	30–50%		Height (metres)

LIFE FORM				
	BUNCH GRASSES	HERBS	SEDGES	
		Misc exotics & natives		
	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER				2.0m 1.5m 1.0m .5m

2–10%

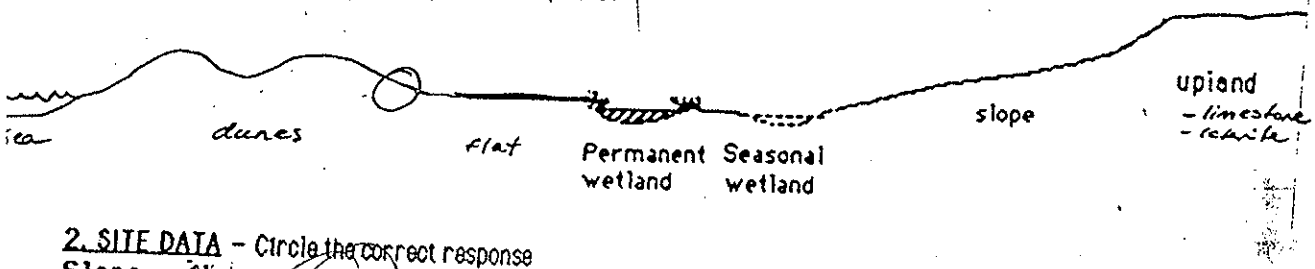


57 paces

b Road Location	c. Latitude	Longitude
	32° 10' 58.0"	115 47 12.8

d. Photograph Photographer's name _____ Photo No _____ Altitude _____

e. Topographic position – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat (gentle) steep

Aspect N NE (E) SE S SW W NW

Surface soil thin rich brown sand

Sub-surface soil yellow sand

Environmental Code 57

Drainage (well) mod poor

Wet All year winter/spring

Litter (% cover) 40%

% Bare ground 20%

Bare patches invaded by annuals

4. VEGETATION CONDITION

EXCELLANT	
VERY GOOD	
GOOD	↓
POOR	
VERY POOR	

Comments

rabbit grazing – past fire grazing led to invasion bare patches, ? reduced spring

Rabbit pad 2m²

MTB 01

4. SPECIES PRESENCE 7/9/92

- work systematically through the vegetation, start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. MTB #1

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees	No	ID
/ Jarrah		29/10
/ Bank sp.		
Mallees		
SHRUBS		
/ Macrozamia reidii		
/ Xanthorrhoea preissii		
/ Hibbertia hypericoides		
/ Stirlingia latifolia		
/ Petrophile linearis		
/ Hibbertia racemosa		
/ Dryandra nivea		
/ Daviesia triflora		
/ Nemcia ? capitata	X	

SHRUBS	No	ID
X * Bromus diandrus		
X Microlaena stipoides		
X * Briza minor		
X * Carrichtera glomerata		
X Caladenia flava GOT		
X Gnephalium ~~subtilis~~	✓	
X ~~Hardenbergia comp.~~		
X Thysanotus		
X * Avena fatua		
X * ~~Hard~~ Velleiophyton cordis		
X Wahlenbergia preissii	X	
X * Sagenaea apetala		
Bunch Grasses		
~~Annual Grasses stocks~~		
X * Eharhata long.	X	
X * Vulpia myuros		
X * Poa annua.	X	
X * Aira caryophyllea	X	
Herbs		
X Crassula colorata		
X Thysanotus patersonii (small & tall)	X	
X Borya nitida		
X Chamaescilla corymbosa		
X Drosera erythrorhiza		
X * Anagallis arvensis		
X * Hypochaeris glabra		
X * ~~Arctotheca~~ Arctotheca calendula		
X Hardenbergia comptoniana		
X * Trifolium campestre.		
X * Sonchus oleraceus	✓	
X * Briza maxima		
X * Caladenia flava		
X Drosera macrantha pallida	✓	

Herbs	No	I.
X Crassula colorata		
X * Petrorhagia velutina		
X Sowerbaea laxiflora		
X * Carrichtera glomerata	X	
X Honal. Honal		
X Crassula glomerata	X	
X Centrolepis drummondiana		
X * Trifolium campestre	X	
X * Galium ~~spp~~ murale	X	
X * Arenaria serpyllifolia		
X Arthropodium capillipes	✓	
X * Anagallis arvensis	X	
X * Sagina maritima	✓	
Sedges		
X Lepid. angustatum		
X Hypolaena exsulca		
X * Tetraria octandra		
X Centrolepis drummondiana	X	
X Isolepis cernua		

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
24	MTB-2		Acacia	lasiocarpa				
24	MTB-2		Cassytha	flava				
24	MTB-2		Conostylis	candicans	subsp.	candicans		
24	MTB-2		Daucus	glochidiatus				
24	MTB-2		Desmocladus	fasciculatus				
24	MTB-2		Drosera	pallida				
24	MTB-2		Grevillea	preissii	subsp.	preissii		
24	MTB-2		Hardenbergia	comptoniana				
24	MTB-2		Isolepis	cernua				
24	MTB-2		Lepidosperma	squamatum				
24	MTB-2		Lomandra	maritima				
24	MTB-2		Melaleuca	systena				
24	MTB-2		Millotia	tenuifolia	var.	tenuifolia		
24	MTB-2		Olearia	axillaris				
24	MTB-2		Opercularia	vaginata				
24	MTB-2		Phyllanthus	calycinus				
24	MTB-2		Rhodanthe	citrina				
24	MTB-2		Thysanotus	manglesianus/patersonii complex				
24	MTB-2		Trachymene	pilosa				
24	MTB-2	*	Anagallis	arvensis				
24	MTB-2	*	Arenaria	leptoclados				
24	MTB-2	*	Avellinia	michelii				
24	MTB-2	*	Bromus	diandrus				
24	MTB-2	*	Cerastium	glomeratum				
24	MTB-2	*	Conyza	sumatrensis				
24	MTB-2	*	Crassula	glomerata				
24	MTB-2	*	Desmazeria	rigida				
24	MTB-2	*	Dischisma	arenarium				
24	MTB-2	*	Galium	murale				
24	MTB-2	*	Heliophila	pusilla				
24	MTB-2	*	Hypochaeris	glabra				
24	MTB-2	*	Lagurus	ovatus				
24	MTB-2	*	Minuartia	mediterranea				
24	MTB-2	*	Petrorhagia	dubia				
24	MTB-2	*	Sonchus	asper	subsp.	glaucescens		
24	MTB-2	*	Stellaria	media				
24	MTB-2	*	Trifolium	campestre	var.	campestre		
24	MTB-2	*	Vulpia	myuros				

QUADRAT No. MTBQ7 VEGETATION TYPE

DATE FIRST TRIP 7/9/92 VOLUNTEERS

DATE SECOND TRIP / VOLUNTEERS

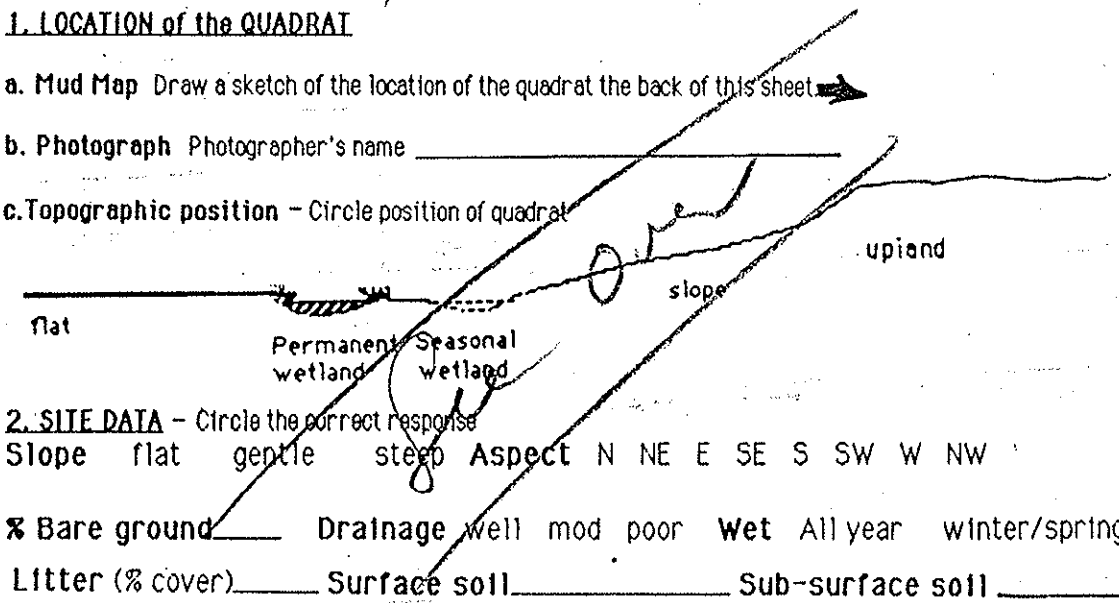
BOTANIST NG, BJK

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep **Aspect** N NE E SE S SW W NW

% Bare ground Drainage well mod poor **Wet** All year winter/spring

Litter (% cover) Surface soil Sub-surface soil

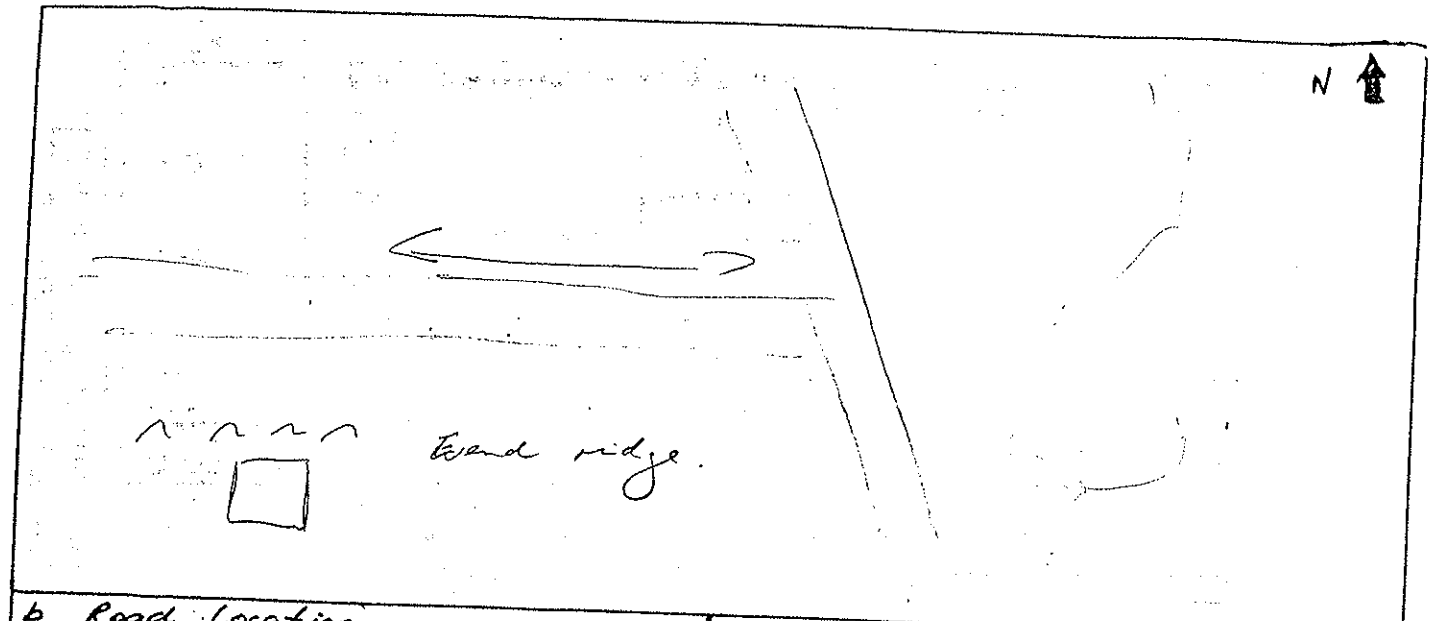
3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

LIFE FORM	TREES		MALLEES		Height (metres)
	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more	15m / 10m / 5m
COVER CLASS (%)	>15m / 5–15m				

LIFE FORM	SHRUBS					
	over 2m	2.0–1.5m	1.5–1.0m	1.0m – .5m	under .5m	3m / 2m / 1m
					Mel ac / Phyl cal	
COVER CLASS (%)					50–70%	

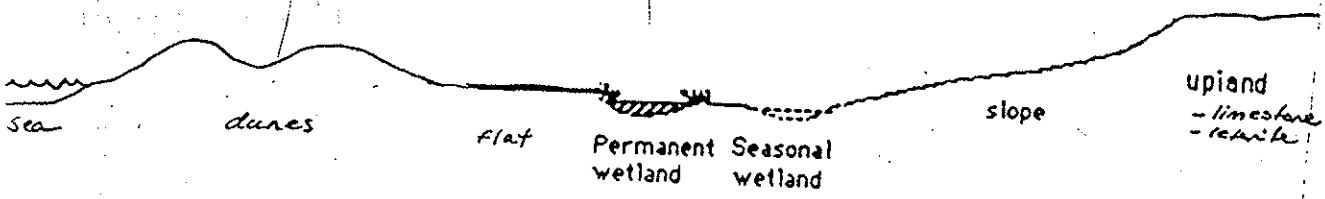
LIFE FORM	BUNCH GRASSES	HERBS	SEDGES		Height (metres)
	Stipa	Misc ex			
	under .5m	under .5m (except creepers)	over .5m	under .5m	2.0m / 1.5m / 1.0m / .5m
COVER	<2%	30–50%		<2%	



b Road Location	c. Latitude	Longitude
	32° 10' 16.6".	115° 46' 44.3

d. **Photograph** Photographer's name _____ Photo # No _____ Altitude _____

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat (gentle) steep

Aspect N NE E SE S SW W NW

Surface soil grey sand, broken limestone

Sub-surface soil limestone Environ Geol LS1

Drainage (well) mod poor

Wet All year winter/spring

Litter (% cover) _____

% Bare ground rocks 2–10%

4. VEGETATION CONDITION

EXCELLANT	
VERY GOOD	
GOOD	
POOR	✓
VERY POOR	

Comments

Heavy rabbit grazing, herbs

1. SPECIES PRESENCE

- **work systematically through the vegetation**; start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. MTB 02

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees	No	ID
Mallees		
M.		
SHRUBS		
Mel acerosa		
Myall rahy.		
Cakes Nelsonii ssp preiss.		
Acacia lasiocarpa.		

SHRUBS	No	ID
29/10		
~~Carpobrotus edulis~~		
Crassula glomerata		
Waitzia ~~suaveolens~~ citrina		
Opercularia Var.		
Olearia axillaris (Seddiq)		
* Petrophyta velut		
* Bromus diandrus.		
Cassytha flava		
* Dichisandra aren.		
* Trifolium campestre		
* Avalina michelii		
* Vulpia myuros		
* Catapodium rigidum		
Bunch Grasses		
Stipa 'glaucous' ? Hordeum leporinum		
* Lagurus ovatus		
Misc annual grasses		
Herbs		
Conostylis candicans		
Hard. comp.		
Lom. maritima		
* Anagalis arv		
Dampiera glochidea		
* Hypochaeris sp.	✓	
* Helichrysum pusillum	✓	
Thysanotus pat/many		
Trachymene pilosa		
* Millotia tenuifolia	✓	
Drosera		
* Romulea rosea		
Drosera pallida = Φ1		
* ~~Fumaria~~		
* Mimulus hybrida.		
* Cerastium glom		
* Stellaria media		

Herbs	No	ID
* Galium ~~aparine~~ murale	✓	
* Sonchus asper	✓	
* Arctotheca calend.		
* Conyza albida	✓	
Sedges		
Lepidosperma angust		
Ibaxocarpus flavi		
Isolepis cernua	✓	

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
24	MTB-3		Acacia	cochlearis				
24	MTB-3		Caladenia	latifolia				
24	MTB-3		Calandrinia	corrigioloides				
24	MTB-3		Cassytha	flava				
24	MTB-3		Cassytha	racemosa				
24	MTB-3		Crassula	colorata	var.	colorata		
24	MTB-3		Drosera	erythrorhiza	subsp.	erythrorhiza		
24	MTB-3		Drosera	pallida				
24	MTB-3		Dryandra	lindleyana				
24	MTB-3		Eucalyptus	decipiens	subsp.	decipiens		
24	MTB-3		Gompholobium	tomentosum				
24	MTB-3		Grevillea	preissii	subsp.	preissii		
24	MTB-3		Hardenbergia	comptoniana				
24	MTB-3		Hibbertia	hypericoides				
24	MTB-3		Hybanthus	calycinus				
24	MTB-3		Isolepis	cernua				
24	MTB-3		Lepidosperma	squamatum				
24	MTB-3		Lyginia	barbata				
24	MTB-3		Macrozamia	riedlei				
24	MTB-3		Melaleuca	systena				
24	MTB-3		Mesomelaena	pseudostygia				
24	MTB-3		Millotia	tenuifolia	var.	tenuifolia		
24	MTB-3		Petrophile	serruriae				
24	MTB-3		Phyllanthus	calycinus				
24	MTB-3		Stylidium	bulbiferum				
24	MTB-3		Trachymene	pilosa				
24	MTB-3		Xanthorrhoea	preissii				
24	MTB-3	*	Aira	caryophyllea				
24	MTB-3	*	Anagallis	arvensis				
24	MTB-3	*	Arenaria	leptoclados				
24	MTB-3	*	Briza	maxima				
24	MTB-3	*	Bromus	diandrus				
24	MTB-3	*	Cerastium	glomeratum				
24	MTB-3	*	Crassula	glomerata				
24	MTB-3	*	Dischisma	arenarium				
24	MTB-3	*	Ehrharta	longiflora				
24	MTB-3	*	Galium	murale				
24	MTB-3	*	Hypochaeris	glabra				
24	MTB-3	*	Lagurus	ovatus				
24	MTB-3	*	Minuartia	mediterranea				
24	MTB-3	*	Petrorhagia	dubia				
24	MTB-3	*	Urospermum	picroides				

QUADRAT No. MTB 03 VEGETATION TYPE _____

DATE FIRST TRIP 7/9/92 VOLUNTEERS _____

DATE SECOND TRIP _____ VOLUNTEERS _____

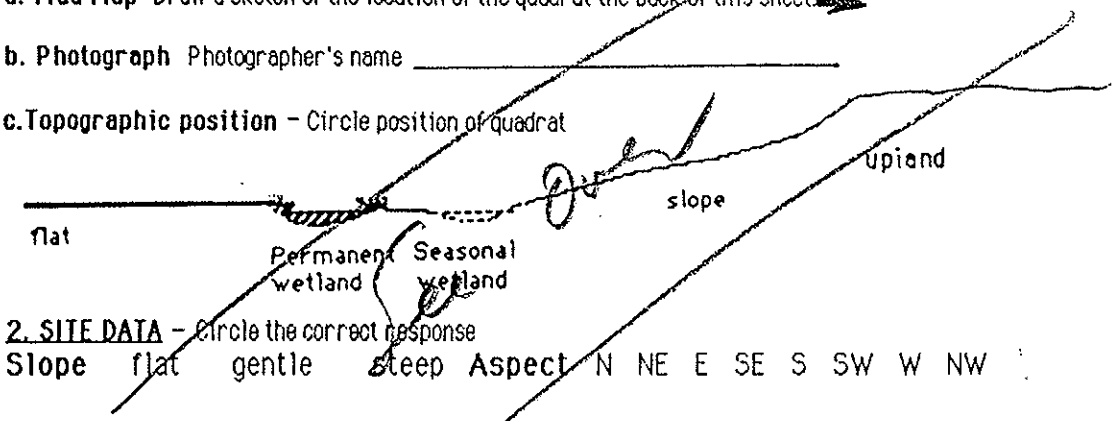
BOTANIST _____

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name _____

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground____ Drainage well mod poor Wet All year winter/spring

Litter (% cover)____ Surface soil_____ Sub-surface soil _____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

	TREES		MALLEES		15m
LIFE FORM	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m Euc. decip.	MALLEE TREE 8m or more	10m 5m
COVER CLASS (%)	2 15m 5–15m		10–20%		

	SHRUBS					
LIFE FORM	over 2m	2.0–1.5m	1.5–1.0m Melac Hibb hugo Acacia	1.0m – .5m	under 5m	3m 2m 1m
COVER CLASS (%)			50–70%			

Height (metres)

	BUNCH GRASSES	HERBS	SEDGES	
LIFE FORM	under .5m	under .5m (except creepers)	over .5m	under .5m	2.0m 1.5m 1.0m .5m
COVER				

30–50%

MTB03

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat :

N

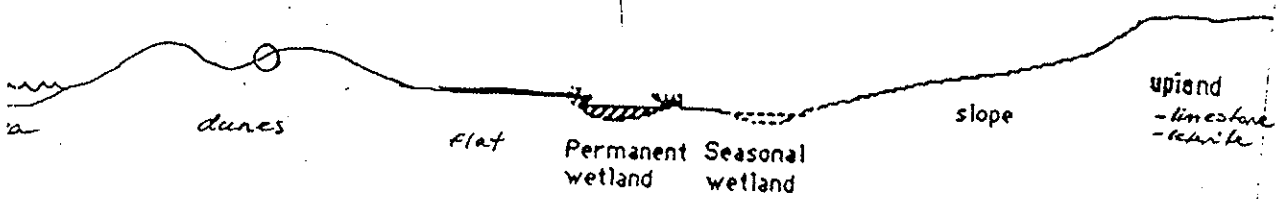
Just to E
of Go kart Track.

Mallee Woodland.

b Road Location	c. Latitude	Longitude
	32° 10' 16.3"	115 46 39.8

d. **Photograph** Photographer's name NG Photo No Altitude

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat (gentle) steep

Aspect N NE E SE S SW (W) NW

Surface soil Brown sand – small amount of limestone

Sub-surface soil limestone + bright orange-yel sand

Environ Creek LS 1

Drainage (well) mod. poor

Wet All year winter/spring

Litter (% cover) 20-30%

% Bare ground 21-40%

VEGETATION CONDITION

EXCELLANT	
VERY GOOD	
GOOD	↑
POOR	
VERY POOR	

comments
Exotic & native herbs
rabbits dung; rabbit
yard.

1. SPECIES PRESENCE

- **work systematically through the vegetation**; start with the tallest sratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

QUADRAT No. MTB 03

Trees

	No	ID
Mallees		
Euc decipiens		

SHRUBS

	No	ID
Acac. cock.		
Hibb hyp		
Mela lacerosa		
Macrozamia reid		
Phyl. calv		
Dry. nivea		
Eucs. melemacrocarpa ssp preiss.		
ADJ Xanth preissii		

SHRUBS

	No	ID
29/10		
✓ *B ramosa dracomontana		
✓ *Dichisma aren. GOT		
✓ *Acac cary		
✓ Cassytha flava		
✓ *Ericaria longi		
✓ Gompholobium tom. ssp	X	
✓ *Pretaxia serpy GOT C		

Bunch Grasses

	No	ID
✓ *Lagurus ovatus		
✓ *Briza max		

Herbs

	No	ID
X Hard Comp.		
X Hyb. daly.		
X Cassytha racemosa		
X Calothamnia corrigan		
X Milotha tenuifolia		
X Trachymene pilosa		
— Calandrinia coring GOT	✓	
X Crassula colorata	X	
X Crassula glom	X	
X Drosera pallida = Ø1x92		
X Drosera erythr.		
— X ? Dipsophyllum sp		
X Caladenia latifolia		
— X Caladenia (leaf only too young to ID	✓SP	

Herbs

	No	ID
✓ *Anagalis arv.	X	
✓ *Hyp glabra	X	
✓ *Erastium glom	X	
✓ *Galium ~~aparine~~ murale	X	
✓ *Petrohagia velut.	X	
✓ * Dichisma arenaria		
✓ * Urospermum = ADVØ4		
✓ * Minuartia hybrida	X	
✓ * Arenaria serpyllifolia	X	
ON N edge = ADJ?		
✓ Petrophila seric.		
✓ Conostylis aurea		
✓ Stylid bulb		

Sedges

	No	ID
✓ Isolepis cernua		
✓ Mesomelaena pseudo		
✓ Tetraria bark.		
✓ Lepid angust.		

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
24	MTB-4		Acacia	rostellifera				
24	MTB-4		Acacia	saligna				
24	MTB-4		Austrostipa	flavescens				
24	MTB-4		Baumea	juncea				
24	MTB-4		Clematis	pubescens				
24	MTB-4		Comesperma	confertum				
24	MTB-4		Eucalyptus	gomphocephala	var.	gomphocephala		
24	MTB-4		Hardenbergia	comptoniana				
24	MTB-4		Hibbertia	racemosa				
24	MTB-4		Hydrocotyle	diantha				
24	MTB-4		Leucopogon	parviflorus				
24	MTB-4		Pelargonium	littorale	subsp.	littorale		
24	MTB-4		Xanthorrhoea	preissii				
24	MTB-4	*	Aira	caryophyllea				
24	MTB-4	*	Anagallis	arvensis				
24	MTB-4	*	Arenaria	leptoclados				
24	MTB-4	*	Avellinia	michelii				
24	MTB-4	*	Centaurium	erythraea				
24	MTB-4	*	Cerastium	glomeratum				
24	MTB-4	*	Conyza	bonariensis				
24	MTB-4	*	Euphorbia	peplus				
24	MTB-4	*	Galium	murale				
24	MTB-4	*	Hypochaeris	glabra				
24	MTB-4	*	Moraea	flaccida				
24	MTB-4	*	Petrorhagia	dubia				
24	MTB-4	*	Pseudognaphalium	luteoalbum				
24	MTB-4	*	Veronica	arvensis				
24	MTB-4	*	Vulpia	myuros				

1/7/92
(2)

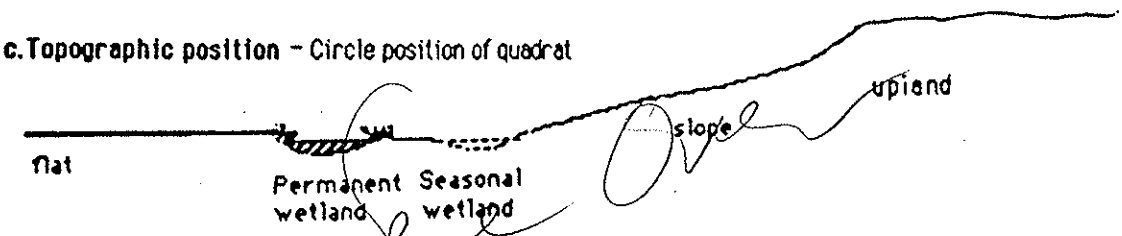
QUADRAT No. MTB 04 VEGETATION TYPE _____
DATE FIRST TRIP 29/10/92 VOLUNTEERS _____
DATE SECOND TRIP 7/9/93 VOLUNTEERS _____
BOTANIST FIND NOTES 2 NG BJK

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name _____

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep **Aspect** N NE E SE S SW W NW

% Bare ground____ **Drainage** well mod poor **Wet** All year winter/spring

Litter (% cover)____ **Surface soil**_____ **Sub-surface soil** _____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

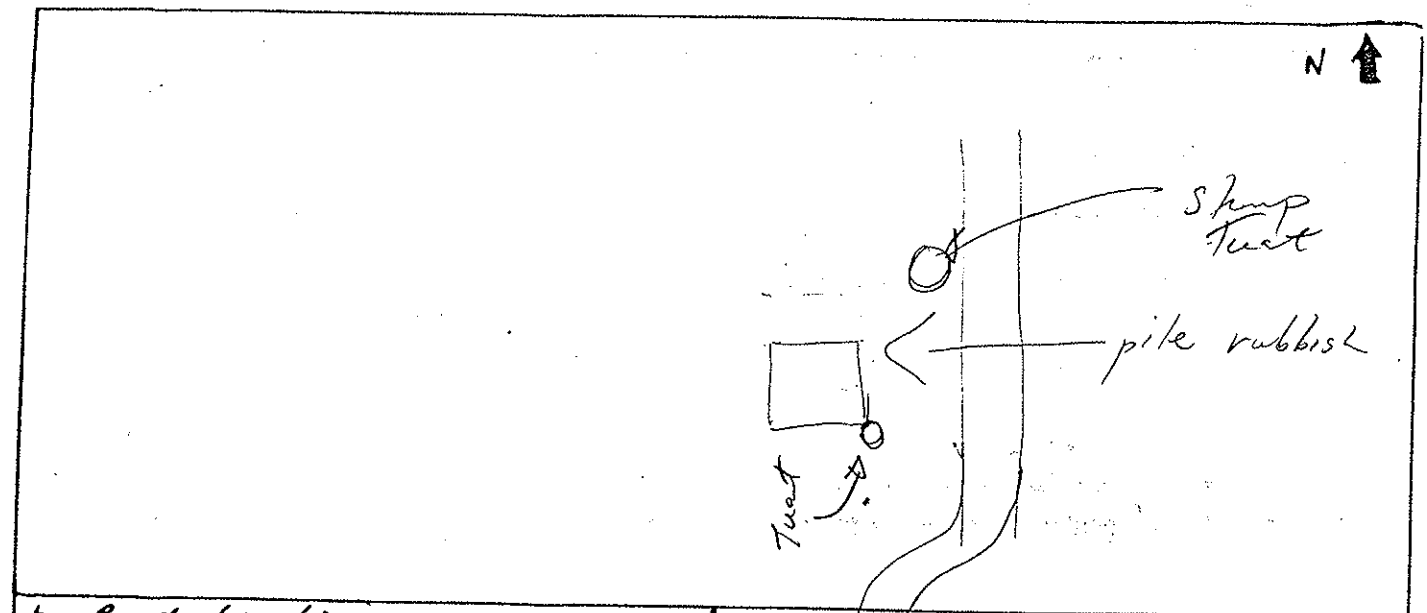
	TREES	MALLEES		
LIFE FORM	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m 10–20 5–15m	20–30%		

	SHRUBS					
LIFE FORM	over 2m	2.0–1.5m	1.5–1.0m	1.0m – .5m	under .5m	
COVER CLASS (%)	>70% from 1m to 2m		2–10%		2–10%	

	BUNCH GRASSES	HERBS	SEDGES	
LIFE FORM	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER	2–10%	2–10%		

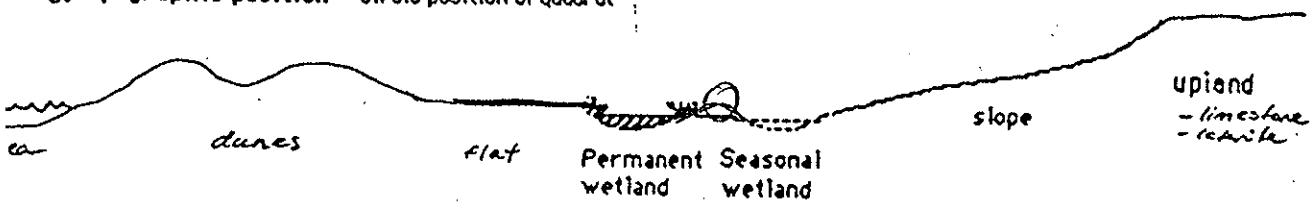
Height (metres): 3m, 2m, 1m; 2.0m, 1.5m, 1.0m, .5m

a. **Mud Map** Draw a sketch of the location of the quadrat :



b Road Location	c. Latitude	Longitude 52.0
	32° 09' 35"	115° 66' ~~69~~"
d. Photograph Photographer's name NG Photo No ± 300m		~~Altitude~~ 20m

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil grey | sand

Sub-surface soil grey sand. limestone exposed in patches

Environ cook 57

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 90%

% Bare ground 5%

4. VEGETATION CONDITION

		Comments
EXCELLANT		Animals = weeds.
VERY GOOD		
GOOD	✓	
POOR		
VERY POOR		

SPECIES PRESENCE
7/9/92

QUADRAT No.
MTB 04

- **work systematically through the vegetation**, start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

Trees

	No	ID
Euc gomph.		
Acacia saligna		

Mallees

SHRUBS

	No	ID
Xanth prei		
Ac rostel		
Hibb racemosa		
Leucop. parvi		
Conosperm confertum = PB ØX!		
ADJ Stipa flavescens (NE) Com		

SHRUBS

	No	ID
29/10/92		
* Centaurium erth		
✓ Pelargon littorale ✓		
* Conyza bon		
* Avellera michellii		
→ Unknown ? dive (NE)		
* Arrenaria serpyllifolia		
→ * Veronica (arvensis)?		
Vulpia muros		

Bunch Grasses

	No	ID
* Aira car		
Poa		

Herbs

	No	ID
* Euphorb peplus		
* Chaphalotum lutea		
* Anagallis arvensis		
* Hordeum glaucum		
→ * Petrorhagia		
* Galium ~~aparine~~ murale		
Hardenbergia comp		
Velasonekia littoralis		
Clethera ~~micrantha~~ pub.		
* Cerastium g/bud		
* Lupercl-ddh glabra		

Herbs

	No	ID
ADJ Hydrocotyle diantha		

Sedges

	No	ID
Baumea juncea		

FCT	Plot Name	*	Genus	Species	Infrasp Rank	InfraspName	Informal	Consv Code
29a	NAVB-2		Acanthocarpus	preissii				
29a	NAVB-2		Apium	annuum				
29a	NAVB-2		Apium	prostratum	var.	prostratum		
29a	NAVB-2		Austrostipa	flavescens				
29a	NAVB-2		Calandrinia	calyptrata				
29a	NAVB-2		Cassytha	racemosa				
29a	NAVB-2		Crassula	colorata	var.	colorata		
29a	NAVB-2		Desmocladus	fasciculatus				
29a	NAVB-2		Dryandra	lindleyana				
29a	NAVB-2		Eremophila	glabra	subsp.	albicans		
29a	NAVB-2		Ficinia	nodosa				
29a	NAVB-2		Frankenia	pauciflora				
29a	NAVB-2		Grevillea	preissii	subsp.	preissii		
29a	NAVB-2		Isolepis	cernua				
29a	NAVB-2		Kennedia	coccinea				
29a	NAVB-2		Leucopogon	parviflorus				
29a	NAVB-2		Lomandra	maritima				
29a	NAVB-2		Melaleuca	huegelii	subsp.	huegelii		
29a	NAVB-2		Nemcia	reticulata				
29a	NAVB-2		Rhagodia	baccata	subsp.	baccata		
29a	NAVB-2		Senecio	lautus	subsp.	maritimus		
29a	NAVB-2		Threlkeldia	diffusa				
29a	NAVB-2	*	Anagallis	arvensis				
29a	NAVB-2	*	Avena	fatua				
29a	NAVB-2	*	Bartsia	trixago				
29a	NAVB-2	*	Briza	maxima				
29a	NAVB-2	*	Bromus	diandrus				
29a	NAVB-2	*	Bromus	hordeaceus				
29a	NAVB-2	*	Carpobrotus	edulis				
29a	NAVB-2	*	Centaurium	erythraea				
29a	NAVB-2	*	Cerastium	glomeratum				
29a	NAVB-2	*	Crassula	glomerata				
29a	NAVB-2	*	Desmazeria	rigida				
29a	NAVB-2	*	Disa	bracteata				
29a	NAVB-2	*	Euphorbia	peplus				
29a	NAVB-2	*	Galium	murale				
29a	NAVB-2	*	Lagurus	ovatus				
29a	NAVB-2	*	Lolium	rigidum				
29a	NAVB-2	*	Melilotus	indicus				
29a	NAVB-2	*	Orobanche	minor				
29a	NAVB-2	*	Parentucellia	viscosa				
29a	NAVB-2	*	Petrorhagia	dubia				
29a	NAVB-2	*	Sagina	maritima				
29a	NAVB-2	*	Silene	gallica				
29a	NAVB-2	*	Sonchus	asper	subsp.	glaucescens		
29a	NAVB-2	*	Sonchus	oleraceus				
29a	NAVB-2	*	Stellaria	media				
29a	NAVB-2	*	Tetragonia	decumbens				
29a	NAVB-2	*	Vellereophyton	dealbatum				

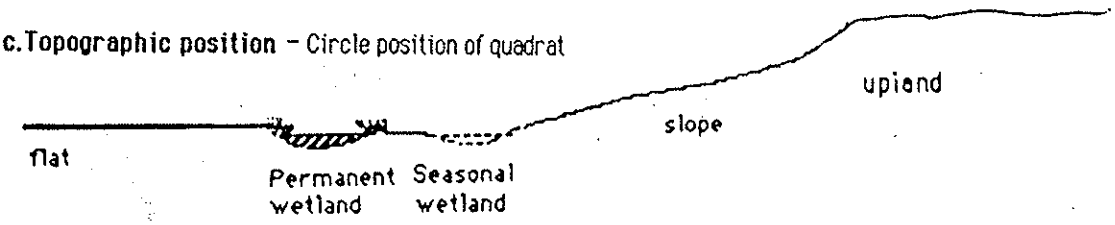
QUADRAT No. NAVB 04 VEGETATION TYPE _____
DATE FIRST TRIP 7/9/92 VOLUNTEERS _____
DATE SECOND TRIP _____ VOLUNTEERS _____
BOTANIST NC, BJC

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name _____

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep **Aspect** N NE E SE S SW W NW

% Bare ground____ **Drainage** well mod poor **Wet** All year winter/spring

Litter (% cover)____ **Surface soil**_____ **Sub-surface soil** _____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2–10% | 10–20% | 20–30% | 30–50% | 50–70% | over 70%

LIFE FORM	TREES		MALLEES	
	>15m or 5–15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m 5–15m			

15m
10m
5m

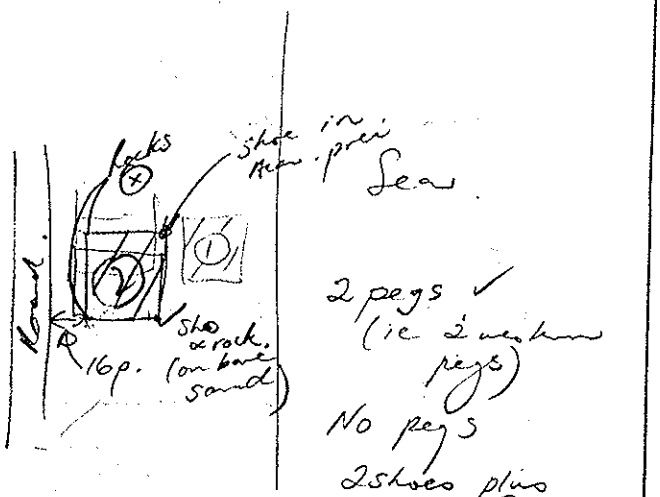
LIFE FORM	SHRUBS					
	over 2m	2.0–1.5m	1.5–1.0m	1.0m – .5m	under .5m	
COVER CLASS (%)						50–70%

3m
2m
1m

Height (metres)

LIFE FORM	BUNCH GRASSES	HERBS	SEDGES	
	Poa / Stipa / under .5m	Low Kennedia under .5m (except creepers)	Isolep over .5m	under .5m
COVER	2–10%	2–10%	2–10%	

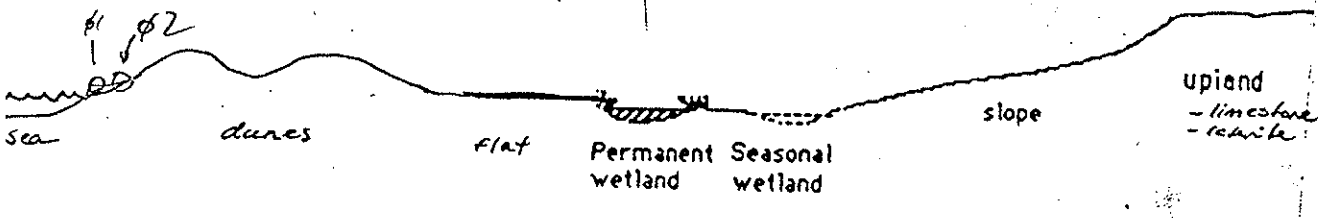
2.0m
1.5m
1.0m
.5m



b Road Location	c. Latitude	Longitude
See NAVG Ø1	See Ø1.	

d. **Photograph** Photographer's name NA Photo No Altitude

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil grey/brown calcareous sand / limestone outcrop. Environ Geol LS1

Sub-surface soil limestone

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) <5%

% Bare ground 2-10%

4. VEGETATION CONDITION

		Comments
EXCELLANT		Annual weeds in bare patches more prolific
VERY GOOD	↑	
GOOD	✓	Adj area ann
POOR		
VERY POOR		

4. SPECIES PRESENCE

- work systematically through the vegetation, start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. NAB 02

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees

	No	ID

Mallees

SHRUBS

- Acanth pressus
- Dryandra nivea
- *Tetragonia decumbens X
- Rhagod. baccata
- Frankenia pauci.
- Eremoph. glabra
- Melal. huegelii
- Leucopogon parvi.
- Nemcia reticulata (pink) ✓
- Threlkeld. diffusa

SHRUBS

	No	ID
29/10/92		
X ¥ Bromus diandrus		
~~* Lolium = Catapodium rigidum~~	VSP	X
X * Billardiera fraseri		
X * Centaurium Verthr.		
X ¥ Avena fatua		
X Crassula glomerata		
X Orevi filiformis ssp preis		
X Apium prostratum		
X * Poa major		
X ¥ Orobanche minor		
X * Bromus hordeaceus	VSP	X
X Apium annum		
X * Melilotus indica		

Bunch Grasses

X Stipa flavescens	X	
X Stipa 'thin leaves' = Poa	VSP	
~~Avena sterilis~~		
X *Lagurus ovatus	X	

Herbs

X Kennedia coccinea	VSP	
X Lom. micrantha		
X Apium prostratum		
X *Trifolium = VSP 29/10		
X *Anagallis arvensis		
X *Sonchus oleraceus	X	
X * Romulea rosea	X	
X Crassula glomerata		
~~Catapodium rigidum~~	X	
X * Cerastium glomeratum (H. die)	X	
X Senecio pectinatus ssp mar.		
X * Petrorhagia velutina	✓	
X * Euphorbia peplus	✓	
X ? Sonchus asper	VSP	
X Apium annum	X	VSP
X Carpobrotus edulis		
X Crassula exserta	X	
X Cassytha racemosa	✓	

Herbs

	No
✓ * Monadenia bracteata	
✓ * Parentucellia viscosa	
✓ * Sagina maritima	X
✓ * Stellaria media (Chickweed)	X
✓ * Galium ~~tricorne~~ murale	X
✓ Calandrinia polypetala	V.
29/10/92	
✓ * Catapodium rigidum = (small Lolium)	
✓ * Lolium rigidum	
✓ * Silene gallica	
✓ * Centaurium erythraea GOT	
✓ * Velleriophytum cardissimum	
✓ * Bromus hordaceus	VSP
✓ * Lolium rigidum 'fine'	VSP

Sedges

- ✓ Isolepis nodosus
- ✓ Isolepis cernua ~~fluitans~~
- ✓ Laxoleg Flex

BS 3460

TO BE FOR M91 / Mt Brown / Brown Range

Appendix 1: Flora of M 91, M 106 and M46

Records from opportunistic collecting, 1990-93. Families in alphabetical order and according to Marchant et al., (1987). An * indicates a non-native taxon.

TAXON	M 91	M 106	M46
+ Vic Semmler 1992 Henderson / Mt Brown			
FERNS			
DENNSTAEDIACEAE			
Pteridium esculentum		+	
GYMNOSPERMS			
ZAMIACEAE			
Macrozamia riedlei	+ 1	+	+
CUPRESSACEAE			
Callitris preissii		+	
ANGIOSPERMSS			
AIZOACEAE			
*Carpobrotus edulis	+ 1	+	+
C. edulis x virescens	+ 2		
Carpobrotus virescens		+	+
*Tetragonia decumbens	+ 3	+	+
Tetragonia implexicoma			+
Tetragonia tetragonioides		+	+
AMARANTHACEAE			
Ptilotus drummondii	+ 2		
ANTHERICAEAE			
Arthropodium capillipes	+ 3	+	
Caesia micrantha		+	
Corynotheca micrantha		+	
Sowerbaea laxiflora		+	
Thysanotus arenarius		+	+
Thysanotus manglesianus		+	
Thysanotus patersonii	+ 4	+	
Thysanotus sparteus		+	
Tricoryne elatior	+ 5	+	
APIACEAE			
Apium annuum	+ 6	+	+
Apium prostratum		+	
Centella cordifolia		+	
Daucus glochidiatus	+ 7	+	+
*Foeniculum vulgare	4 + 8		
Hydrocotyle diantha		+	
Hydrocotyle hispidula		+	
Trachymene coerulea			+
Trachymene pilosa		+	
APOCYNACEAE			
Alyxia buxifolia		+	

ANACARDIACEAE
76 *Schinus terbinthifolius + 5
ASPARAGACEAE
* Asp sp + 6

TAXON	M 91	M 106	M46
Lepidosperma scabrum			+
Lepidosperma ?tenue		+	
Mesomelaena pseudostygia	+ 1	+	+
Schoenus clandestinus	+ 2	+	
Schoenus grandiflora	+ 3	+	+
Schoenus nitens		+	
Tetraria octandra		+	
DASYPOGONACEAE			
Acanthocarpus preissii	+ 4	+	+
Lomandra hermaphrodita		+	
Lomandra maritima	+ 5	+	+
DILLENIACEAE			
Hibbertia acerosa	+ 6		
Hibbertia cuneiformis		+	
Hibbertia hypericoides	+ 7		
Hibbertia racemosa/scabra	+ 8		+
Hibbertia spicata ssp. leptotheca	+ 9		
EPACRIDACEAE Leu. pap	+ 10		
Acrotriche cordata	+ 11	+	
Leucopogon australis	+ 12		
Leucopogon parviflorus	+ 13	+	+
Con. pend	+ 14		
EUPHORBIACEAE			
*Euphorbia peplus	3 + 5	+	+
*Euphorbia terracina	4 + 6	+	+
Phyllanthus calycinus	+ 7	+	+
Poranthera microphylla		+	+
Ricinocarpus glaucus		+	
Acc. gnaa	+ 8		
FABACEAE (PAPILIONACEAE)			
Daviesia decurrens	+ (Mal obs) 9		
Daviesia nudiflora			
Daviesia triflora	+ 20		
Gompholobium tomentosum	+ 1	+	+
Hardenbergia comptoniana	+ 2	+	+
Jacksonia furcellata	+ 3	+	
Kennedia coccinea	+ 4		
Kennedia prostrata		+	+
*Lotus angustissimus		+	+
*Lupinus consentinii			+
*Medicago polymorpha		+	+
*Meliotis indica	5 +	+	+
Nemcia reticulata/ecp	+	+	+
*Trifolium angustifolium			+
*Trifolium campestre	6 +		+
*Trifolium cernuum	7 +	+	+
*Vicia sativa			+
Jack. Stem	+		
FRANKENIACEAE			
Frankenia pauciflora	+ 5		

Droseraceae

Drosera sp.	+	
Drosera hyb	+	
D. pallida	+	

TAXON	M 91	M 106	M46
FUMARIACEAE			
*Fumaria capreolata			+
*Fumaria muralis			+
GENTIANACEAE			
*Centaurium erythraea		+	+
*Cicendia filiformis		+	
GERANIACEAE	6 +		
*Erodium botrys		+	
*Erodium cicutarium	7 +	+	+
*Geranium molle			+
Geranium solanderi		+	+
*Pelargonium capitatum	8 +	+	+
Pelargonium littorale		+	+
Ger retrorsum	+		
GOODENIACEAE			
Lechenaultia linearoides			+
Scaevola canescens			+
Scaevola crassifolia	+ 6	+	+
Scaevola holosericea		+	
Scaevola nitida		+	
Scaevola thesioides			+
GYROSTEMONACEAE			
Tersonia cyathifolia			+
HAEMODORACEAE			
Anigozanthos humilis		+	
Anigozanthos manglesii		+	+
Conostylis aculeata	+ 7	+	+
Conostylis candicans	+ 8	+	+
Haemodorum laxum			+
Haemodorum spicatum		+	+
Haemodorum paniculatum			+
Phlebocarya ciliata		+	
HYACINTHACEAE			
*Ornithogalum ?caudatum			+
IRIDACEAE			
*Freesia leichtlinii		+	
*Gladiolus caryophyllaceus	9 +		
*Homeria flaccida	40 +	+	
*Homeria ?flaccida 'yellow'	1 +		
Patersonia occidentalis		+	
*Romulea rosea	2 +	+	+
*Watsonia sp	3 +		
JUNCACEAE			
Juncus bufonius		+	
Juncus krausii		+	
Juncus pallidus		+	
JUNCAGINACEAE			
Triglochin calcitrapa	+ 9	+	+

Onagrac
* Oen europ +

TAXON	M 91	M 106	M46
ONAGRACEAE			
Epilobium billardierianum		+	
Epilobium hirtigerum		+	
*Oenothera drummondii		+	+
ORCHIDACEAE			
Acianthus reniformis		+	+
Caladenia flava		+	
Caladenia latifolia	+ 9	+	+
Caladenia longicauda		+	
Microtis media		+	
*Monadenia bracteata	6 +		
Prasophyllum calcicola			+
Prasophyllum fimbria		+	
Pterostylis nana	+ 90	+	
Pterostylis vittata		+	
Pleno recurva	+ 1		
OROBANCHACEAE			
*Orobanche minor	7 +	+	+
OXALIDACEAE			
Oxalis perennans		+	+
*Oxalis pes-cap	8 +		
PHORMIACEAE			
Dianella divaricata	+ 2	+	+
Styp. glauca	+ 3		
PHYTOLACCACEAE			
*Phytolacca octandra	+		
PLANTAGINACEAE			
Plantago ?exilis	+ 4		
POACEAE			
+Agropyron racemosus			+
Agrostis avenacea		+	
*Aira caryophyllea	9 +	+	+
Amphipogon turbinatus		+	
*Avellina michelii		+	
*Avena barbata	50 +	+	+
*Briza maxima	1 +	+	+
Bromus arenarius		+	+
*Bromus diandrus	2 +	+	+
*Bromus hordeaceus	3 +	+	
*Bromus madritensis		+	
*Catapodium rigidum	4 +	+	+
*Cynodon dactylon		+	+
Danthonia occidentalis	+ 5	+	+
*Ehrharta calycina	5 +		+
*Ehrharta longiflora	6 +	+	
*Eragrostis curvula		+	
*Holcus lanatus		+	
*Lagurus ovatus	7 +	+	+
*Lolium multiflorum	8 +	+	+
*Phalaris minor	9 +		
*Poa annua	60 +		

Pittosporaceae

Pit phyl + 6

Pron tres + 7

TAXON	M 91	M 106	M46
RUBIACEAE			
*Galium aparine	7 +		
*Galium murale		+	+
Opercularia vaginata		+	+
Opercularia aff. vaginata		+	
RUTACEAE			
Diplolaena dampieri		+	
SANTALACEAE			
Exocarpus sparteus		+	+
Santalum acuminatum	+ 8	+	+
SAPINDACEAE			
Diplopeltis huegelii			+
SCROPHULARIACEAE			
*Bellardia trixago		+	
*Dischisma arenaria		+	+
*Parentucellia viscosa	8 +	+	
*Verbascum virgatum	9 +		
SOLANACEAE			
Anthocercis ilicifolia			+
Anthocercis littorea		+	
*Lycium ferocissimum			+
*Nicotiana glauca	10 +		
*Solanum nigrum	1 +	+	+
*Solanum sodomaeum	2 +	+	
Solanum symonii	3 + 9	+	+
* Nicotiana glauca	4 +		
STACKHOUSIACEAE			
Stackhousia pubescens		+	
STERCULIACEAE			
Thomasia cognata	+ 100	+	
THYMELAEACEAE			
Pimelea calcicola	+ 1		
TYPHACEAE			
Typha domingensis		+	
*Typha orientalis		+	
STYLIDIACEAE			
Stylidium bulbiferum	+ 2		
URTICACEAE			
Parietaria debilis	+ 3	+	+
VALERIACEAE			
*Centranthus macrosiphon			+

System 6 Update - Floristic Community Type Mapping Information **DRAFT ONLY**

AREA INFORMATION

System 6 Area (C or M) or Update Area (Update) M92

Conservation Area	
Nature Reserve	
Reserve No	
National Park	
Reserve No	
Local Government	
Reserve No	
Other	
Proposed Conservation Areas	
Local Government	City of Cockburn C30861 Recr.
Reserve No	C26870 Recr. not vested, C22227 drainage not vested
Other	OPUD, PRIVATE, CROWN

Conservation Area

Nature Reserve	
Reserve No	
National Park	
Reserve No	
Local Government	
Reserve No	
Other	

NOT COMPLETE AREA

TOTAL AREA

~~Bushland~~ Area	475.751	hectares
Completely Degraded	59.5 ha	
rabbit grazing, annual weeds, freq burnt		

AREA MAPPED FLORISTIC UNITS

Units	Site (Condition)	Code G : MTB	Bound	Area (ha)
17	Ø5 (2)		B	75.25
24	Ø1 (3.5) Ø2 (3.5) Ø3 (3.5)		B	134.188
	Ø4 (3.5)			
degraded woodland			B	157.938
limestone heath			B	41.25
lake			B	7.625

Boundaries determined by use of

aerial photograph	Metro Street Directory run 7 5143-49 5/1/91
orthophoto	2033 1 SW Aug 1991
vegetation map	
soil map	

BS346

R. A. O. U. TRACKING DATABASE

23/06/96 PARK SIGHTINGS REPORT Page No. 1

Lake Coogee (M92)

ORDER:	REF:	BIRD NAME	NO. SIGHTINGS
0019	0217	Musk Duck 3	4
0022	0203	Black Swan	3
0025	0207	Australian Shelduck	3
0032	0208	Pacific Black Duck	5
0033	0212	Australasian Shoveler 3	2
0035	0211	Grey Teal	3
0041	0061	Australasian Grebe	1
0042	0062	Hoary-headed Grebe	3
0128	0101	Darter	2
0129	0100	Little Pied Cormorant	5
0132	0097	Little Black Cormorant	3
0133	0096	Great Cormorant	1
0135	0106	Australian Pelican	3
0139	0188	White-faced Heron	5
0145	0187	Great Egret	4
0165	0232	Black-shouldered Kite	4
0170	0228	Whistling Kite 4	1
0172	0226	White-bellied Sea-Eagle	1
0174	0219	Swamp Harrier	3
0175	0221	Brown Goshawk 4	4
0181	0225	Little Eagle 4	3
0183	0235	Australian Hobby	2
0187	0240	Nankeen Kestrel	3
0204	0058	Purple Swamphen	3
0205	0056	Dusky Moorhen 3	1
0208	0059	Eurasian Coot	5
0282	0144	Black-fronted Dotterel	2
0297	0125	Silver Gull	5
0316	0110	Whiskered Tern	1
0324	0957	Rock Dove	3
0326	0988	Laughing Turtle-Dove	5
0330	0034	Common Bronzewing	1
0356	0794	Short-billed Black-Cockatoo 1	2
0359	0273	Galah	3
0362	0271	Little Corella	1
0385	0289	Western Rosella 4	1
0386	0294	Australian Ringneck	5
0387	0290	Red-capped Parrot	5
0408	0338	Fan-tailed Cuckoo	1
0410	0342	Horsfield's Bronze-Cuckoo	1
0411	0344	Shining Bronze-Cuckoo	2
0446	0322	Laughing Kookaburra	5
0451	0326	Sacred Kingfisher	3

0453	0329	Rainbow Bee-eater	1
0471	0532	Splendid Fairy-wren	4
0492	0976	Striated Pardalote	4
0500	0488	White-browed Scrubwren	2
0512	0465	Weebill	4
0517	0463	Western Gerygone	4
0524	0476	Inland Thornbill	3
0531	0486	Yellow-rumped Thornbill	3
0537	0638	Red Wattlebird	5
0539	0637	Little Wattlebird	1
0561	0608	Singing Honeyeater	5
0583	0597	Brown Honeyeater	5
0587	0631	New Holland Honeyeater	3
0588	0632	White-cheeked Honeyeater	3
0653	0401	Rufous Whistler	1
0671	0415	Magpie-Lark	5
0673	0361	Grey Fantail	4
0676	0364	Willie Wagtail	5
0678	0424	Black-faced Cuckoo-shrike	5
0695	0702	Grey Butcherbird	5
0698	0705	Australian Magpie	5
0706	0930	Australian Raven	5
0725	0647	Richard's Pipit	2
0761	0358	White-backed Swallow	2
0763	0357	Welcome Swallow	5
0765	0359	Tree Martin	5
0772	0522	Little Grassbird	1
0781	0574	Silvereye	5

*** END OF REPORT ***

(1) 1
(2)
(3) 8
(4) 7

SUMMARY REPORT

TOTAL BIRDS SIGHTED	:	71
TOTAL NUMBER OF CARDS	:	5

*** END OF SUMMARY ***

M92 Cockburn Wetlands, Western Chain
Bulletins 355 (Res C39584 Limestone Quarry, rejected), 480 (Industrial , approved), 586 (Landfill),
636 (Beeliar Catholic School)

M93 Cockburn Wetlands-Eastern Chain
Bulletins 179 (Farrington Rd), 277-388-429 (Thompsons Lake Urban Structure Study), 475 (Yangebup Rd change)
517 (Farrington Rd duplication)

Friends Advocate Management

Other Names. Beeliar Regional Pk

(Specific Study/studies) (Miscellaneous studies)

Flora
- (Vegetation Map) 1 2 3
- (Flora list) 1 2 3 (4) needs collation
- Significant Taxa done / suitable / doubtful

Fauna
- Mammals 1 2
- Birds 1 2 (RAOU) various
- Reptiles and Amphibia 1 2
- Invertebrates 1 2

Vegetation Condition (Map) (Sites) (Comment)

Disturbance Factors (Comment) (Management)

(Swan Coastal Plain Floristic Survey) various areas

AHC: National Estate- Listed / Interim / Nominated / Notified NT (WA): Heritage Classification

Notes
Beeliar Regional Park
Wetlands Conservation Society – P. Jennings

M92 Cockburn Wetlands, Western Chain Bulletins 355 (Res C39584 Limestone Quarry, rejected), 480 (Industrial , approved), 586 (Landfill), 636 (Beeliar Catholoc School)		
M92.1 Regional park recommendations be applied to this area.	Implemented	The Minister for Planning has approved the final planning review of Beeliar Regional Park which contains this area. The Regional Parks Task Force report lists Beeliar Regional Park as a proposed regional park.
M92.2 DPUD consider reserving areas not already reserved for Parks and Recreation under Metropolitan Region Planning Scheme.	Implementation Progressing	DPUD is dealing with this through implementation of the regional park report recommendations. Unresolved issue of industrial land under Agreement Act. Wetlands Conservation Society and Waterbird Conservation Group have an interest in this area.
M93 Cockburn Wetlands-Eastern Chain Bulletins 179 (Farrington Rd), 277-388-429 (Thompsons Lake Urban Structure Study), 475 (Yangebup Rd change) 517 (Farrington Rd duplication)		
M93.1 Regional park recommendations be applied to this area.	Implemented	The Minister for Planning has approved the final planning review of Beeliar Regional Park which contains this area. The Regional Parks Task Force report lists Beeliar Regional Park as a proposed regional park.
M93.2 DPUD consider reserving areas not already reserved for Parks and Recreation under Metropolitan Region Planning Scheme.	Implementation Progressing	DPUD is dealing with this through implementation of the regional park report recommendations. Thomson Lake has been listed under the RAMSAR Treaty, recognising its international significance.
M93.3 Recommendations of Cockburn Wetland Study (that Farrington Road should not be extended around north of North Lake and that Roe Highway be modified to reduce its impact on wetlands) are endorsed.	Implemented	Endorsement. Wetlands Conservation Society and Waterbird Conservation Group have an interest in this area.

LM - Beeliar Regional Pk CALM.
- MP 1984 (Hons List)
- Yangebup Lake 1987 } Environ Mgmt
North Lake 1984 } Course Murdoch Uni

SHEET 2: System 6 - VERBAL Information Search

Date 12/5/94 RP.

Area M6(93) Name	Piney Lake (not included in M93 but part of Beelier)			
Source				
Purpose (why was the study done?)				
Government				
Corporate				
Community Group				
Management Plan				
Publication Planned		Yes	No	Date
Planned Location				

Soils		
Units	described	referenced

Landscape		
Features	described	referenced

Flora					
Vegetation Map					
Units				Site based (no)	
Mapped					
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al*	Unit not mapped by Heddle et *al*	
Flora list					
Timing	%completion	Comments		Significant Taxa	
Feb	(Trees) (Shrubs) Herbs (Sedges)		Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegetation Condition			
Site based	Mapped	Units	
Disturbance Factors			
Phytophthora	observed	Other	Incidental
	tested		Itemised

Notes

SHEET 2: System 6 - VERBAL Information Search Date 6/94

Area M92/93 Name	P70 Areas and No sites			
Source	Swan Coastal Plain Floristic Survey (see general)			
Purpose (why was the study done?)				
Government				
Corporate				
Community Group				
Management Plan				
Publication Planned	Yes	No	Date	
Planned Location				

Soils		
Units	described	referenced

Landscape		
Features	described	referenced

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*			Compared Heddle *et al.*	Unit not mapped by Heddle et *al.*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs	Herbs	Sedges	Weeds	DRF	CALM Priority	Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegetation Condition				
Site based	Mapped	Units		
Disturbance Factors				
Phytophthora	observed	Other	incidental	
	tested		itemised	

Notes

SHEET 2: System 6 - VERBAL Information Search Date 3/5/94

Area M 93 Name	Thompsons Lake.			
Source	CALM	Lyndon Mutter (1994)		
Purpose (why was the study done?)	Management			
Government				
Corporate				
Community Group				
Management Plan				
~~Publication~~ Planned Rep	(Yes)	No	Date	
Planned Location				

Soils			
Units	described	referenced	

Landscape			
Features	described	referenced	

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al*		Unit not mapped by Heddle et *al*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna	site based (pit traps) back up to area fishing MP			
Timing	%completion			Significant Taxa
	(Mammals)	Birds see below		Sched1 Sched2 Other
	(Reptiles) Amphibs	Invertebrates		

Vegetation Condition		
Site based	Mapped	Units

Disturbance Factors				
Phytophthora	observed	Other	incidental	
	tested		itemised	

Notes Fauna Survey - monitoring - mokare
additions reptiles /
- bats

Jenny Davis - invertebrates

Bird banding project RAOU
Pauline Clay (working HW & Thomp Lake)

SHEET 2: System 6 - VERBAL Information Search

Date 3/5/94

Area M92 Name	Thompsons Lake				
Source	Gary Hartnett				
Purpose (why was the study done?)	Management				
Government					
Corporate					
Community Group					
Management Plan					
Publication Planned	Yes	No	Date		
Planned Location					

Soils					
Units	described	referenced			

Landscape					
Features	described	referenced			

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al*		Unit not mapped by Heddle et *al*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna				
Timing	%completion		Significant Taxa	
	Mammals	Birds	Sched1	Sched2 Other
	Reptiles	Invertebrates		

Vegetation Condition				
Site based	Mapped	Units		
INTENTION				
Disturbance Factors	for hygiene plan			
Phytophthora	observed	Other	Incidental	
	tested		Itemised	

Notes

SHEET 1: System 6 - REPORT Information Search Date 3/5/94 BPK

Please circle the appropriate response or respond in the space provided.

Area M93 Name North Lake

Title North Lake Draft Management Plan
By the Students of Environmental Management

Published/Unpublished Date May, 1986

Author/s Students Environmental Management, Murdoch Uni

Location of Publication CALM (Wan), Murdoch Uni

Purpose (why was the report prepared?) Student exercise, management

Government

Corporate

Community Group

Management Plan

Soils

Units (mapped) (described) (referenced) 25 bore holes

Landscape

Features described referenced

Flora

Vegetation Map

Units Site based (no)

(Mapped) Backshall 1985, Newman 1976 compared to see changes

Veg Units Comparable Heddle *et al* Compared Heddle *et al*. Unit not mapped by Heddle *et al*.

Flora list

Timing %completion Significant Taxa

Trees Shrubs Herbs Sedges Weeds DRF CALM Priority Other

Fauna literature

Timing %completion (Significant Taxa)

(Mammals) 90% (Birds) 90% Sched1 Sched2 Other

50% (Reptiles & Amphib) (Invertebrates) aquatic

Vegatation Condition compared historically

Site based Mapped Units

Disturbance Factors

Phytophthora observed Other incidental

tested (Itemised) detailed for management

Notes

- Newman 1976, 79 Murdoch Uni - The Cockburn Wetlands
  Backshall 1984 (1985) Rehab wetlands, Shire Cockburn
  used for veg maps and some checking for
  this study
- Aboriginal data / info

SHEET 1: System 6 - REPORT Information Search Date 5/5/94 DJK

Please circle the appropriate response or respond in the space provided.

Area M 93 Name	~~La~~ Yangebup Lake, Little Rush Lake
Title	Management Proposal for Yangebup Lake. Students of N319 Environmental Management Murdoch University. May 1988
(Published)/Unpublished	Date May 1988
Author/s	Students of N319 (see title)
Location of Publication	CALM (Wanneroo) Murdoch
Purpose (why was the report prepared?)	Management
Government	
Corporate	
Community Group	
Management Plan	

Soils	12 bore holes for study		
Units	(mapped)	(described)	(referenced)

Landscape		
Features	described	referenced

Flora					
Vegetation Map	general descriptions, no detail of transects				
Units transects (?) 'Jarrah Woodland'			Site based (no) transects ? (not indicated)		
Mapped 11 units, short descriptions					
Veg Units	(Comparable Heddle *et al*)		Compared Heddle *et al.*	Unit not mapped by Heddle *et al.*	
Flora list	*from transect data				
Timing	%completion ? 30%			Significant Taxa	
9/1987	(Trees) (Shrubs) Herbs	Sedges	(Weeds)	DRF	CALM Priority Other

Fauna	literature, AROC, (*) unpublished data, ?area			
Timing	%completion		(Significant Taxa)	
	(Mammals) 90-%	(Birds) 50%	Sched1	Sched2 Other
	(Reptiles & Amphib 60%	(Invertebrates)	Water J. Davis 1987 Students	

Vegatation Condition			
Site based	Mapped	Units	
Disturbance Factors			
Phytophthora	observed	Other	(Incidental)
	tested		itemised Fire

Notes
* D. Kaeshagen list not available (material sighted) Water Studies; sampling, pollutants
(*) D. Mead-Hunter (Herpet.); L. Thomas & D. Mead Hunter (Mammals)

SHEET 2: System 6 - VERBAL Information Search Date 3/5/94

Area M 93 Name	Yanchep Lake					
Source	Proposed Management Plan (Murdoch one not adopted by Council)					
Purpose (why was the study done?)						
Government						
Corporate						
Community Group						
Management Plan						
Publication Planned	Yes	No	Date			
Planned Location						

Soils		
Units	described	referenced

Landscape		
Features	described	referenced

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al*		Unit not mapped by Heddle et *al*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegetation Condition			
Site based	Mapped	Units	
Disturbance Factors			
Phytophthora	observed	Other	Incidental
	tested		Itemised

Notes City of Cockburn

SHEET 1: System 6 - REPORT Information Search Date 31/5/94

Please circle the appropriate response or respond in the space provided

Area M92/93	Name Cockburn Wetlands
Title	The Cockburn Wetlands An Environmental Study
(Published) / Unpublished	Date March 1976
Author/s	P. Newman (director)
Location of Publication	Murdoch University, DPUD Lib.
Purpose (why was the report prepared?)	
Government	DPUD - Cockburn Wetlands Committee
Corporate	
Community Group	
Management Plan	

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora							
Vegetation Map							
Units	descriptions	broad strata		Site based (no)			
Mapped	31 'natural units'	(maps missing)					
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al.*		Unit not mapped by Heddle *et al.*		
Flora list							
Timing	%completion 50%,				Significant Taxa		
2 months	(Trees)	(Shrubs)	Herbs	Sedges	Weeds	DRF	CALM Priority	Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	(Birds)	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition		
Site based	Mapped	Units
Disturbance Factors		
Phytophthora	observed	Other incidental
	tested	itemised

Notes

SHEET 1: System 6 - REPORT Information Search Date 25/5/94

Please circle the appropriate response or respond in the space provided.

Area M93(P) Name Cockburn Wetlands - Eastern Chain

Title Thomsons Lake Nature Reserve
WA Nature Reserve Management Plan no 2

Published/Unpublished Date 1981

Author/s I.G. Crook & T. Evans

Location of Publication CALM (Woodvale)

Purpose (why was the report prepared?) Management

Government CALM

Corporate

Community Group

Management Plan ✓

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora

Vegetation Map

Units		Site based (no)	
Mapped			
Veg Units	(Comparable Heddle *et al*)	Compared Heddle *et al*	Unit not mapped by Heddle *et al*

Flora list ✓

Timing	%completion				Significant Taxa		
	Trees	Shrubs	Herbs	Sedges	Weeds	DRF	CALM Priority	Other

Fauna ✓

Timing	%completion		Significant Taxa		
	Mammals	Birds	Sched1	Sched2	Other
	Reptiles	Invertebrates			

Vegatation Condition

Site based	Mapped	Units

Disturbance Factors

Phytophthora	observed	Other	incidental
	tested		itemised

Notes

System 6 - VERBAL Information Search

Date 18/5/94

Area M92 Name	MOUNT BROWN (Cockburn Wetlands, Western Chain)						
Source	Swan Coastal Plain Floristic Survey (see general sheet)						
Purpose (why was the study done?)							
Government							
Corporate							
Community Group							
Management Plan							
Publication Planned		Yes	No	Date			
Planned Location							

Soils		
Units	described	referenced

Landscape		
Features	described	referenced

Flora							
Vegetation Map							
Units	MUIR / FLORISTIC			Site based (no)	5	(10 x 10m quad)	
Mapped	rough map						
Veg Units	(Comparable Heddle *et al*)			Compared Heddle *et al.*		Unit not mapped by Heddle *et al.*	
Flora list	complete for each site						
Timing	%completion					Significant Taxa	
	Trees	Shrubs	Herbs	Sedges	Weeds	DRF	CALM Prority	Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegetation Condition				
Site based	Mapped	Units		
Disturbance Factors				
Phytophthora	observed		Other	incidental
	tested			itemised

Notes

SHEET 1: System 6 - REPORT Information Search Date 6/94

Please circle the appropriate response or respond in the space provided.

Area M 93 Name

Beeliar Park Catholic school development : consultative environmental review / Alan Tingay & Associates

Published/Unpublished	Date		
Author/s			
Location of Publication			
Purpose (why was the report prepared?)			
Government			
Corporate			
Community Group			
Management Plan			

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora					
Vegetation Map					
Units			Site based (no)		
Mapped					
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al.*	Unit not mapped by Heddle *et al.*	
Flora list					
Timing	%completion			Significant Taxa	
	Trees Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition				
Site based	Mapped	Units		
Disturbance Factors				
Phytophthora	observed		Other	incidental
	tested			itemised

Notes

+ got 2

SHEET 1: System 6 - REPORT Information Search Date 31/5/94

Please circle the appropriate response or respond in the space provided.

Area M93/92	Name Beeliar Wetlands
Title	Australian Heritage Commission (AHC) boundaries for Beeliar Regional Park
Published/Unpublished	Date 1992
Author/s	A. Weston
Location of Publication	AHC, A. Weston
Purpose (why was the report prepared?)	
Government	
Corporate	
Community Group	
Management Plan	

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al.*		Unit not mapped by Heddle *et al.*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition		
Site based	Mapped	Units
Disturbance Factors		
Phytophthora	observed	Other incidental
	tested	itemised

Notes

DEPARTMENT OF PLANNING AND URBAN DEVELOPMENT
PERTH ENVIRONMENT PROJECT : BIBLIOGRAPHY OF ENVIRONMENTAL TOPICS

PIC:
EPARED FOR: M 93

Date prepared:
04/14/94

BEELIAR PARK CATHOLIC SCHOOL DEVELOPMENT : CONSULTATIVE ENVIRONMENTAL REVIEW / Alan Tingay & Associates -- [South Perth] Alan Tingay & Associates, 1992.

1. BEELIAR PARK. 2. SCHOOL DEVELOPMENT. 3. ENVIRONMENTAL REVIEW.
PEP TOPIC: 1. MISCELLANEOUS.

Location(s) : EPA 711.55(941) ALA

BEELIAR REGIONAL PARK / Department of Planning and Urban Development -- PERTH:

1. DARLING. 2. PERTH REGION. 3. VEGETATION. 4. WETLANDS. 5. BEELIAR REGIONAL PARK.
PEP TOPIC: 1. HYDROLOGICAL FEATURES.

Location(s) : CALM

✓
BEELIAR REGIONAL PARK : DRAFT PROPOSALS FOR ESTABLISHMENT, ADMINISTRATION AND USE. / Western Australia. Dept. of Planning and Urban Development. -- Western Australia. Australia. Bibliographies. Government publication, state. English.

1. PARKS. 2. BEELIAR REGIONAL PARK. 3. PLANNING. 4. WETLANDS.
5. LAND USE URBAN.
PEP TOPIC: 1. HYDROLOGICAL FEATURES.

ISBN: 0730932109 (pbk.).

Location(s) : ANL NLpf 333.78409411 W527 WCU {4} Q 333.783 WES <006537901> WCX =JOONDALUP...Q333.78409941 WES copies:1 <685038> WLB Q333.784 <604525> WMDU M/Y/333.7840941/WES<676749J>A/1(INA) WU Q333.78409941 1990 BEE...REID <685038> K

✓
BEELIAR REGIONAL PARK : PROPOSALS FOR ESTABLISHMENT, ADMINISTRATION AND USE : FINAL. / Western Australia. Dept. of Planning and Urban Development. -- Western Australia. Australia. Bibliographies. English. 1992.

1. PARKS. 2. PLANNING. 3. WETLANDS. 4. LAND USE URBAN. 5. BEELIAR REGIONAL PARK.
PEP TOPIC: 1. HYDROLOGICAL FEATURES.

ISBN: 0730932826.

Location(s) : ANL NLq 333.78409941 W527 WCX =JOONDALUP...Q333.78409941 WES copies:1 <836663> WLB Q333.784 <674857> WMDU M/Y/333.7840941/WES<691770F>A/1(IEB) WU Q333.78409941 1992 BEE...REID <836663> R

SHEET 1: System 6 - REPORT Information Search Date 5/94

Please circle the appropriate response or respond in the space provided.

Area M93 Name	Lake Coogee			
Title	Lake Coogee Environmental Management Plan			
Published/Unpublished	Date			
Author/s	R. O'Brien Consulting			
Location of Publication				
Purpose (why was the report prepared?)				
Government				
Corporate				
Community Group				
Management Plan				

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora					
Vegetation Map					
Units			Site based (no)		
Mapped					
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al.*	Unit not mapped by Heddle *et al.*	
Flora list					
Timing	%completion			Significant Taxa	
	Trees Shrubs Herbs Sedges		Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition				
Site based	Mapped	Units		
Disturbance Factors				
Phytophthora	observed		Other	incidental
	tested			itemised

Notes

DEPARTMENT OF PLANNING AND URBAN DEVELOPMENT
PERTH ENVIRONMENT PROJECT : BIBLIOGRAPHY OF ENVIRONMENTAL TOPICS

PIC:
EPARED FOR: M93 - Bibra Lake

Date prepared:
04/14/94

BIBRA LAKE: CONCEPT AND MANAGEMENT PLAN / Riggert Consulting Ecologists

(Unpublished Report.)

1. BIBRA LAKE. 2. FAUNA. 3. FLORA. 4. MANAGEMENT. 5. PERTH REGION. 6. SWAN. 7. VEGETATION. 8. WETLANDS.
PEP TOPIC: 1. HYDROLOGICAL FEATURES. 2. FAUNA SPECIES. 3. FLORA SPECIES.

Location(s) : CALM

BIBRA LAKE GROUNDWATER APPRAISAL / Davidson, W. A. -- (Perth) Geological Survey of WA, 1983.

1. GROUNDWATER. 2. BIBRA LAKE. 3. APPRAISAL.
PEP TOPIC: 1. HYDROGEOLOGICAL FEATURES.

Location(s) : EPA 551.481.1(941.1) DAV

THE HYDROGEOLOGY OF NORTH AND BIBRA LAKES, PERTH, WESTERN AUSTRALIA / Megirian, Dirk -- Thesis: BSc. Hons Univ. of Western Australia, 1982.

1. HYDROGEOLOGY. 2. NORTH LAKE. 3. BIBRA LAKE.
PEP TOPIC: 1. HYDROGEOLOGICAL FEATURES.

Location(s) : EPA 551.481.1(941) MEG

NORTH AND BIBRA LAKES: AN ENVIRONMENTAL STUDY / Murdoch University

(Unpublished Report Environmental Science, Murdoch University.)

1. BIBRA LAKE. 2. DARLING. 3. FAUNA. 4. FLORA. 5. LAKE NORTH. 6. PERTH REGION. 7. SWAN. 8. WETLANDS.
PEP TOPIC: 1. HYDROLOGICAL FEATURES. 2. FAUNA SPECIES. 3. FLORA SPECIES.

Location(s) : CALM

NORTH AND BIBRA LAKES : AN ENVIRONMENTAL STUDY, CONDUCTED BY THE STUDENTS OF N212 ENVIRONMENTAL MANAGEMENT -- Murdoch, WA: Environmental Science Murdoch Univ. . 1979.

1. LAKE NORTH. 2. LAKE BIBRA. 3. ENVIRONMENTAL.
PEP TOPIC: 1. MISCELLANEOUS. 2. HYDROLOGICAL FEATURES.

Location(s) : EPA 551.481.1(941) NOR

System 6 - REPORT Information Search Date 5/94

Please circle the appropriate response or respond in the space provided.

Area M92/93	Name Beeliar Wetlands
Title	

Author: Crook I.G. Evans T.
Date: 1981
Title: Thompsons Lake Nature Reserve
Source: Western Australian Nature Reserve Management Plan No. 2

Author: Clay P.A. Clay B.T. Ambrose S.J.
Date: 1989?
Title: A guide to the birds on Harry Waring Marsupial Reserve and Thompson's Lake Nature Reserve.
Source: UWA Dept. Zoology Unpublished Report not at EPA 3-10-96

Author: Cockburn Wetlands Committee
Date: 1976
Title: The Cockburn wetlands - an environmental study
Source: Unpublished report for DPUD

EPA 903493
551.48 (941) cgc

Features	described	referenced

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al.*		Unit not mapped by Heddle *et al.*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Prority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition		
Site based	Mapped	Units
Disturbance Factors		
Phytophthora	observed	Other incidental
	tested	itemised

Notes

NAME OF PLACE: BEELIAR WETLANDS
COCKBURN WETLANDS
014862 5/12/007/0027/01
NOMINATION - DEFERRED AT A MEETING

LOCATION/BOUNDARIES:

About 2700ha, comprising the proposed Beeliar Regional Park as depicted in Map 4 of the final report on its establishment, Department of Planning and Urban Development, Perth, June 1992, modified as follows:
. exclude the whole of the area surrounding Manning Lake (Spearwood/Hamilton, including that area between Spearwood Avenue and the Robb Jetty-Spearwood railway line), except Manning Lake itself and its immediate surrounds, being the area bounded by the alignment of the southern side of Janson Road in the north, the boundary of the proposed Beeliar Regional Park in the east, the alignment of the northern side of Azelia Road in the south and the eastern side of a private road joining Janson and Azelia Roads in the west;
. exclude all areas in the vicinity of Henderson/Naval Base which lie west of the Fremantle-Rockingham Highway;
. exclude, in the vicinity of Lake Yangebup, Lot 6 (Location 391), Lots 3-6 (Location 541), Lot 8 and those parts of Lots 1 and 7 (Location 677) which lie north of the alignment of the southern boundary of Lot 8;
. exclude, in the vicinity of South Lake, the area between the Lake and Hatch Place that lies east of AMG easting (Zone 50H): 388930mE;
. exclude the area in the suburb of North Lake which lies east of Bibra Drive;
. add Market Garden Swamp No 3 (Munster) to the extent of the level of the perennial swamp;
. add Watttleup Swamp (Mandogalup) to the extent of the level of the perennial swamp;
. add Branch Circus Wetland (Jandakot) being the area enclosed by straight lines joining the following AMG points: 50HLK90264373, 90544347, 90744372, 90694398, 90524400 and the commencement point;
. add an area to the west of Lake Kogolup bounded by the eastern alignment of Henderson Road on the west, the southern boundary of the road reserve extending between approximate AMG points: 87734450 and 88964468 on the north, the western boundary of the proposed eastern section of the Beeliar Regional Park on the east and a line joining Henderson Road and the boundary of the proposed park along AMG northing: 6443040mN in the south;
. add the area west of Little Rush Lake (Yangebup) bounded on the north by the railway reserve on the southern side of South Lake, on the south by the railway reserve on the north-western side of Yangebup and on the west by a line joining AMG points: 88244694 and 88484540;
. add the area, excluded from the proposed park, between Hope and Farrington Roads, North Lake, which lies west of Bibra Drive and east of AMG easting: 389300mE;
. add Murdoch University Swamps being the whole of the two swamps (one centrally located in the grounds and the other in the south-east) to the level of perennial inundation.

TITLE INFORMATION:

CROWN LAND , LAND ACT RESERVES, PRIVATE LAND

STATEMENT OF SIGNIFICANCE:

THE BEELIAR WETLANDS ARE AN IMPORTANT NATURAL COMPONENT OF THE SWAN COASTAL PLAIN IN AN AREA NEAR FREEMANTLE WHICH IS BEING RAPIDLY DEVELOPED. IT HAS BEEN ESTIMATED THAT BY 1964, 75% OF THE SWAN COASTAL PLAIN WETLANDS HAD BEEN DRAINED OR FILLED. AS A RESULT, THE BEELIAR WETLANDS ARE IMPORTANT AS A REMNANT OF ECOSYSYTEMS WHICH WERE PREVIOUSLY MORE WIDESPREAD.

THE WETLANDS FORM AN INTERDEPENDENT SYSTEM OF VARIED ELEMENTS WHICH SUPPORTS A DIVERSE RANGE OF PLANTS AND ANIMALS AND SERVES A NUMBER OF ECOSYSTEM MAINTENANCE FUNCTIONS. SOME OF THE WETLANDS ARE SALINE, SOME FRESH; SOME PERMANENT, SOME EPHEMERAL; SOME ARE OPEN WHILE OTHERS ARE CROWDED WITH SEDGES OR RUSHES; SUME ARE SURROUNDED BY FOREST OR WOODLAND, OTHERS ARE FRINGED BY SCRUB OR HERBLANDS. THE WETLANDS AND SURROUNDING AREAS ARE AN IMPORTANT NESTING AND FEEDING HABITAT FOR A RANGE OF BIRDS AND ANIMALS. BECAUSE THE WETLANDS OF THE SWAN COASTAL PLAIN ARE THE ONLY EXTENSIVE VARIED WETLAND HABITAT AND PERMANENT SUMMER FRESH WATER IN WESTERN AUSTRALIA SOUTH OF THE KIMBERLEY, THE BEELIAR WETLANDS ARE OF CONSIDERABLE IMPORTANCE TO MIGRATORY WATERBIRDS, INCLUDING A NUMBER OF SPECIES SUCH AS THE GREENSHANK, WOOD SANDPIPER, LONG-TOED STINT AND ORIENTAL PRATICOLE WHICH ARE RECOGNISED UNDER THE JAPAN AUSTRALIA MIGRATORY BIRDS AGREEMENT.

THE BEELIAR WETLANDS SUPPORT A NUMBER OF PLANTS AND ANIMALS OF CONSERVATION SIGNIFICANCE INCLUDING THE RARE HACKETTS HOPBUSH AND THE LINED SKINK. THE WETLANDS ARE IMPORTANT FOR SCIENTIFIC RESEARCH AND TEACHING PURPOSES.

THE WETLANDS ALSO HAVE ABORIGINAL SIGNIFICANCE. IT IS KNOWN THAT NORTH LAKE AND BIBRA LAKE ARE IMPORTANT TO ABURIGINAL PEOPLE. IT IS BELIEVED THAT A WAUGAL INHABITS THESE LAKES AND MAINTAINS THE FLOW OF SPRINGS THAT FEED THEM. THE LAKES WERE USED AS A CAMPING AREA AND A NUMBER OF ARCHAEOLOGICAL SITES HAVE BEEN RECORDED. THE AREA IS KNOWN TO HAVE BEEN AN IMPORTANT SOURCE OF TURTLE AND WILDFOWL, AND WAS USED AS A CAMPING AREA IN THE HISTORIC PERIOD. IT HAS ALSO BEEN RECORDED THAT AN ABORIGINAL TRACKWAY OR ACCESS ROUTE PASSED THROUGH THE R REGION.

DESCRIPTION:

THE BEELIAR WETLAND SYSTEM CONSISTS OF TWO CHAINS OF LAKES RUNNING ROUGHLY PARALLEL TO THE COAST FOR A DISTANCE OF 25 KM SOUTH OF THE SWAN RIVER. THE WESTERN CHAIN IS WITHIN 5 KM OF THE COAST AND IS MOSTLY SALINE. THE EASTERN CHAIN LIES 5 KM FURTHER INLAND ALONG THE BOUNDARY OF THE SPEARWOOD AND BASSENDEAN DUNE SYSTEMS, AND CONTAINS SEVERAL LARGE PERENNIAL FRESHWATER LAKES. THE WETLANDS, WHICH FORM A COMPLEX OF SWAMPS AND SWAMPY WATERWAYS WHICH ARE PERMANENT OR EPHEMERAL, SALINE OR FRESH, AND CONTAIN SEDGES AND RUSHES OR ARE OPEN, ARE SURROUNDED BY FOREST, WOODLAND, SCRUB AND HERBLANDS, AND HAVE DIFFERING GEOMORPHOLOGY, HISTORY, SOILS, VEGETATION AND WATER CHARACTER. TOGETHER, THESE WETLANDS AND SURROUNDING AREAS FORM AN ECOSYSTEM WHICH SUPPORTS A WIDE VARIETY OF NATIVE FLORA AND FAUNA. MANY OF THE WATERBIRDS AND WADERS THAT USE THE WETLANDS MIGRATE FROM

INLAND AND FROM ABROAD, WITH THE GREAT EGRET, WOOD SANDPIPER, WHITE-WINGED TERN AND GREENSHANK BEING SPECIES RECOGNISED UNDER THE JAPAN AUSTRALIA MIGRATORY BIRDS AGREEMENT.

THE RANGE OF WETLAND HABITATS IS IMPORTANT FOR THE SPECIES UTILISING THEM AND WATERBIRDS MAY USE SEVERAL WETLANDS AT DIFFERENT TIMES AS CONDITIONS BECOME FAVOURABLE. A SPECIES MAY FEED, REST AND BREED AT DIFFERENT WETLANDS ACCORDING TO FOOD AVAILABAILITY, SHELTER AND FREEDOM FROM DISTURBANCE. THE ABUNDANCE OF INVERTEBRATES FOUND IN THE WETLANDS IS BELIEVED TO BE RELATED TO THE CYCLE OF LAKES DRYING AND FILLING AND IS IMPORTANT IN MAINTAINING THE BIRD POPULATIONS OF THE WETLANDS.

THE SURROUNDING FOREST, WOODLAND AND SCRUB SUPPORT BREEDING POPULATIONS OF A NUMBER OF BUSH BIRDS, MAMMALS AND REPTILES. BIRD SPECIES INCLUDE THE WESTERN WARBLER, RUFOUS WHISTLER, SACRED KINGFISHER, GREY FANTAIL AND PORT LINCOLN PARROT. THE BLACK-GLOVED WALLABY (Macropus irma), GREY KANGAROO (M. fuliginosis), BRUSH-TAILED POSSUM (Trichosurus vulpecula), AS WELL AS THE POTENTIALLY VULNERABLE SOUTHERN BROWN BANDICOOT (Isoodon obesulus) AND ENDANGERED LINED SKINK (Lerista lineata) ARE FOUND AROUND THE WETLANDS.

ABORIGINAL PEOPLE UTILIZED THE WETLAND ENVIRONMENT AND ABORIGINAL SITES ARE FOUND THROUGHOUT THE REGION. A VARIETY OF SITES ARE RECORDED FROM HERE INCLUDING MYTHOLOGICAL SITES, ARCHAEOLOGICAL SITES, PLACES USED AS CAMPING AREAS IN HISTORIC TIMES, AND AREAS USED AS TRACKWAYS OR ACCESS ROUTES.

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INDIVIDUAL WETLAND DESCRIPTIONS: EASTERN CHAIN

NORTH LAKE

NORTH LAKE, A SHALLOW PERMANENT LAKE, IS MOSTLY OPEN WATER. THE LAKE IS ONE OF A SERIES OF WETLANDS IN AN INTERBARRIER DEPRESSION BETWEEN THE SPEARWOOD AND BASSENDEAN DUNE SYSTEMS. IN THE NORTHERN SECTION OF THE LAKE THERE ARE A FEW SMALL PATCHES OF JOINTED TWIG RUSH AND OF PAPERBARK. AROUND THE WESTERN AND SOUTHERN SIDES THERE IS A BAND OF FLOODED GUM (E. rudis) WOODLAND ASSOCIATED WITH PAPERBARK FRINGING THE LAKE. CLEARING TO THE LAKE EDGE HAS ONLY OCCURRED IN THE SOUTHEAST. THE LAKE IS A LATE SUMMER REFUGE FOR DUCKS AND SWANS AND IS WIDELY USED BY MIGRATORY WADERS. THE LAKE IS OCCASIONALLY VISITED BY YELLOW-BILLED AND ROYAL SPOONBILLS. THE LAKE AND SURROUNDING AREA SUPPORTS AT LEAST 123 SPECIES OF BIRDS INCLUDING ONE HUNDRED SPECIES OF BUSH BIRD, MANY OF WHICH BREED THERE. THE SOUTHERN BROWN BANDICOOT (Isoodon obesulus), WHICH HAS DISAPPEARED FROM MUCH OF THE METROPOLITAN AREA IS ALSO FOUND AROUND NORTH LAKE. FRESH WATER SPONGES HAVE BEEN FOUND IN NORTH LAKE, THE ONLY WETLAND IN THE URBAN WETLAND SYSTEM KNOWN TO SUPPORT SPONGES. THE AREA SUPPORTS THREE SPECIES OF FISH, THE LONG-NECKED TORTOISE (Chelodina oblongata) AND 36 SPECIES OF OTHER REPTILES. NORTH LAKE IS OF SIGNIFICANCE TO ABORIGINAL PEOPLE AND HAS BEEN USED AS A CAMPING AREA. A NUMBER OF ARCHAEOLOGICAL SITES HAVE BEEN FOUND IN THE AREA.

ROE SWAMP

ROE SWAMP HAS A RICH AND DIVERSE FLORA OF HEATHS, SEDGES AND A MIX OF Eucalyptus rudis, Agonis linearifolia AND Melaleuca SPECIES AND INCLUDES THE MOST WESTERLY EXTENSION OF M. lateritia. THE VEGETATION IS DENSE AND PROVIDES REFUGE AND NESTING SITES FOR

WATERFOWL AND SMALL MAMMALS.

HOPE ROAD SWAMP

HOPE ROAD SWAMP IS A SMALL DEGRADED WETLAND WHICH IS IMPORTANT AS A LINK IN THE NORTH-BIBRA CHAIN OF WETLANDS, AND AS A WADER BIRD HABITAT. A HIGH DENSITY OF DUCKS, GREBES AND WADERS USE THE LAKE.

BIBRA LAKE

BIBRA LAKE IS MOSTLY OPEN WATER. IN THE EAST THERE ARE EXTENSIVE AREAS OF PAPERBARK, WHILE IN THE NORTH AND SOUTH-WEST THERE ARE SEDGELANDS OF JOINTED TWIG RUSH AND BULLRUSH. IN THE WEST THERE IS A FRINGING BELT OF FLOODED GUM (Eucalyptus rudis) AND PAPERBARK, WITH AN OPEN WOODLAND OF JARRAH (E. marginata) AND BANKSIA AND AN UNDERSTOREY CONTAINING LARGE NUMBERS OF BLUEBOY (Stirlingia latifolia), PRICKLY MOSES (Acacia pulchella), ZAMIA (Macrozamia riedlei) AND BLACKBOY (Xanthorrhoea preissii) IN THE NORTH-WEST. AN EXTENSIVE LITTORAL ZONE IN THE EAST PROVIDES A GOOD HABITAT FOR LARGE POPULATIONS OF MIGRATORY WADERS. LARGE NUMBERS OF SWANS AND DUCKS UTILISE THE LAKE. THE PAPERBARKS ARE A HABITAT FOR A NUMBER OF BUSH BIRDS, INCLUDING THE WILLY WAGTAIL, SILVEREYE, SPLENDID BLUE WREN AND WESTERN THORNBILL. BIBRA LAKE IS CONSIDERED TO BE OF REGIONAL TO INTERNATIONAL SIGNIFICANCE AS A WETLAND BECAUSE OF ITS SIZE AND THE VARIETY OF HABITATS IN AND AROUND THE LAKE. THE MARGINS OF THE LAKE HAVE BEEN SUBSTANTIALLY MODIFIED BY LANDFILL ON THE WESTERN AND SOUTHERN SIDES. THE AREA AROUND THE LAKE CONTAINS SOME PICNIC GROUNDS. BIBRA LAKE IS OF SIGNIFICANCE TO ABORIGINAL PEOPLE AND HAS BEEN USED AS A CAMPING AREA. A NUMBER OF ARCHAEOLOGICAL SITES HAVE BEEN FOUND.

SOUTH LAKE

SOUTH LAKE IS A SMALL, SHALLOW, PERMANENT LAKE WHICH IS EXTENSIVELY COVERED BY REED BEDS. IT IS SURROUNDED BY A DIVERSITY OF DENSE VEGETATION WHICH PROVIDES A HABITAT FOR A WIDE VARIETY OF BIRDS. IN THE OPEN WATER, AQUATIC PLANTS ATTRACTS LARGE WADING BIRDS. THE LAKE IS A POPULAR BIRD FEEDING AREA AND IS USED BY LARGE NUMBERS OF MIGRATORY WATERBIRDS. PAPERBARK-BANKSIA WOODLAND IN GOOD CONDITION SURROUNDS THE LAKE.

LITTLE RUSH LAKE

A PERMANENT LAKE, LITTLE RUSH LAKE IS MOSTLY SURROUNDED BY NATURAL VEGETATION, WITH A FARM ON ONE SIDE. THE LAKE CONTAINS MELALEUCAS AND SEDGES AS WELL AS EXTENSIVE REED BEDS WHICH PROVIDE A HABITAT FOR REED WARBLERS, COOTS AND GREBES. THE LAKE IS AN IMPORTANT REFUGE AND NESTING AREA. FLOODED GUM - PAPERBARK LITTORAL WOODLAND, WITH Acacia saligna, Melaleuca rhaphiophylla AND Eucalyptus rudis SURROUNDS THE LAKE.

YANGEBUP LAKE

YANGEBUP IS A LARGE PERMANENT LAKE, WHICH IS LARGELY SURROUNDED BY PASTURE AND HAS AN INDUSTRIAL DEVELOPMENT AT ONE END. HUMAN ACTIVITY AROUND THE LAKE HAS LED TO INCREASED SALINITY, BUT THE LAKE IS STILL USED AS A HABITAT AND LATE SUMMER REFUGE BY WATERBIRDS. THE LAKE IS AN IMPORTANT HABITAT FOR THE UNCOMMON PINK EARED DUCK AND IS USED BY THE BLUE-WINGED SHOVELLER. RED-NECKED STINTS, RED-NECKED AVOCETS, GREY TEAL, BLACK DUCK AND WHITE EYED DUCK ARE ALSO FOUND ON THE LAKE. FLOODED GUM - PAPERBARK LITTORAL WOODLAND SURROUNDS THE LAKE AND IS SURROUNDED BY TUART-JARRAH-MARRI WOODLAND WITH A SMALL AREA OF JARRAH WOODLAND IN THE SOUTH-WESTERN CORNER.

KOGOLUP LAKE

KOGOLUP LAKE CONSISTS OF TWO SEPARATE EXPANSES OF WATER, LINKED BY A LOW-LYING AREA WHICH IS SUBJECT TO WINTER FLOODING. THE AREA SUPPORTS A WIDE RANGE OF VEGETATION TYPES, WITH ALL OF THE VEGETATION TYPES OF THE COCKBURN WETLANDS (THAT PART OF THE BEELIAR WETLANDS IN THE TOWN OF COCKBURN) BEING REPRESENTED. THE WATERS OF THE LAKE CONTAIN SEDGELANDS, MOSTLY OF BULRUSH, BUT WITH SMALLER AREAS OF JOINTED TWIGRUSH AND SPIKE RUSH. THE SURROUNDING WOODLAND VEGETATION IS VARIED, SINCE THE LAKE IS SITUATED AT THE JUNCTION OF TWO MAJOR SOIL ASSOCIATIONS. BORDERING THE LAKE ARE AREAS OF OPEN FOREST AND WOODLAND OF FLOODED GUM, ASSOCIATED WITH PAPERBARKS OR WITH AN UNDERSHRUB ACACIA. THE UNDERSTOREY CONTAINS THE RARE HACKETT'S HOPBUSH (Dodonaea hackettiana), BROOM BALLART (Exocarpos sparteus), STINKBUSH AND NATIVE BROOM. OLD GROWTH TUART (E. marginata) AND JARRAH (E. gomphocephala) FORESTS ARE ALSO FOUND AROUND THE LAKE. THE AREA SUPPORTS SIX SPECIES OF FROG, 14 LIZARD, 2 SNAKE AND FOUR OF INDIGENOUS MAMMAL INCLUDING THE BLACK-GLOVED WALLABY (Macropus irma). KOGOLUP IS AN IMPORTANT PART OF THE THOMPSON LAKE WETLAND COMPLEX AND WAS IDENTIFIED BY THE COCKBURN WETLANDS STUDY AS THE MOST IMPORTANT CONSERVATION AREA IN THE COCKBURN WETLANDS.

THOMPSON LAKE

THOMPSON LAKE CONTAINS ABOUT 150 HA OF SEMI-PERMANENT OPEN WATER. THE LAKE OCCUPIES A DEPRESSION BETWEEN TWO SERIES OF SAND DUNES, AEOLIAN DEPOSITS OF PLEISTOCENE ORIGIN (BASSENDEAN) AND THE YOUNGER SPEARWOOD DUNES. AROUND THE MARGIN OF THE LAKE IS A NARROW BELT OF SEDGELAND DOMINATED BY JOINTED TWIG RUSH. IN THE EAST THE SEDGELAND IS FLANKED BY OPEN SCRUB OF STINKBUSH AND PRICKLY MOSES, AND IN THE SOUTH AND WEST IT IS FLANKED BY EPHEMERAL VEGETATION ON MUD FLATS WHICH PROVIDES AN IMPORTANT FOOD SOURCE FOR SOME SPECIES OF MIGRATORY BIRDS. ON LOW-LYING LAND TO THE NORTH AND EAST OF THE LAKE IS A WOODLAND OF FLOODED GUM AND PAPERBARK. IN THE NORTH, FLOODED GUM ALSO FORMS AN OPEN FOREST WITH ORANGE WATTLE AS AN UNDERSHRUB. THE LAKE IS SITUATED AT THE JUNCTION OF TWO MAJOR SOIL - LANDFORM UNITS, THE KARRAKATTA AND BASSENDEAN, THIS HAS LED TO THE NORTH AND EAST OF THE LAKE HAVING DIFFERENT VEGETATION TO THE SOUTH AND WEST. THE AREA HAS GREAT PLANT DIVERSITY WITH AT LEAST 200 PLANT SPECIES AND 13 OF THE 23 TREE SPECIES FOUND ON THE SWAN COASTAL PLAIN. THE LAKE HAS AN ABUNDANCE OF BIRD LIFE, BOTH WATERFOWL (INCLUDING MUSK DUCKS, COOTS, HOARY-HEADED GREBES, SPOTLESS CRAKES AND WHITE-EYED DUCKS) AND BUSH BIRDS (INCLUDING WESTERN WARBLERS, THORNBILLS, RUFOUS WHISTLERS AND SACRED KINGFISHERS). THE LAKE SUPPORTS A VARIETY OF INVERTEBRATES, WHICH ARE AN IMPORTANT FOOD FOR WATERFOWL AND AMPHIBIANS. THE WOODLAND AROUND THE LAKE SUPPORTS GREY KANGAROOS, BRUSH WALLABIES, BRUSH-TAILED POSSUMS AND SHORT NOSED BANDICOOTS. THOMPSON LAKE IS A VALUABLE SCIENTIFIC RESEARCH SITE.

BANGANUP LAKE

BANGANUP LAKE IS A SMALL EPHEMERAL SWAMP WHICH IS LEASED TO THE UNIVERSITY OF WESTERN AUSTRALIA FOR STUDIES ON NATIVE FAUNA. THE AREA'S VEGETATION TYPES ARE SIMILAR TO THOSE OF THOMPSON LAKE AND INCLUDES RELATIVELY UNDISTURBED BANKSIA WOODLAND AND CLOSED WETLAND. THE WETLAND IS LARGELY A FENLAND OF Baumea articulata WITH MATURE Melaleuca preissiana FORMING A CLOSED WOODLAND ON THE

EASTERN SIDE. THERE ARE AT LEAST THREE HUNDRED AND FIFTY SPECIES OF PLANTS IN THE RESERVE, INCLUDING TWO UNCOMMON SPECIES; BABE-IN-A CRADLE ORCHID (Epiblema grandiflorum) ON THE SWAMP MARGIN AND HACKETT'S HOP BUSH (Dodonaea hackettiana) ON THE SANDY RISE NEAR THE SWAMP. THE AREA CONTAINS ONE OF THE FEW KNOWN POPULATIONS OF THE UNCOMMON RELICT ANIMAL PERIPATUS.

MANDOGALUP SWAMP (WATTLEUP LAKE)

MANDOGALUP SWAMP IS A SMALL PERMANENT WETLAND USED BY BIRDS FOR SUMMER LOAFING. MOST OF THE SURROUNDING VEGETATION HAS BEEN CLEARED AND THE LAND IS USED FOR FARMING. THE LAKE PROVIDES A LINK BETWEEN THE NORTHERN AND SOUTHERN BEELIAR WETLANDS.

SPECTACLES WETLANDS

THE SPECTACLES ARE LARGE PERMANENT WETLANDS IN SPEARWOOD DUNES AND ARE A GOOD EXAMPLE OF LARGE DIVERSE FRESHWATER WETLANDS. THE SPECTACLES CONSIST OF TWO LAKES: LARGE EYE AND SMALL EYE WHICH ARE LARGELY COVERED WITH PAPERBARKS (Melaleuca SPP.) BORDERING THE LAKES ON THE WESTERN AND EASTERN SIDES ARE RELATIVELY UNDISTURBED JARRAH-BANKSIA WOODLANDS. BETWEEN THE LAKES AND THE WOODLAND IS A TRANSITION ZONE DOMINATED BY Eucalyptus rudis. THE AREA IS IMPORTANT AS A REFUGE AND BREEDING SITE FOR NATIVE FAUNA, SUPPORTING BREEDING POPULATIONS OF SCARLET ROBIN, WEEBILL, WESTERN THORNBILL, SILVEREYE, PACIFIC BLACK DUCK AND RUFOUS NIGHT HERON. THE BLACK-GLOVED WALLABY (Macropus irma), SHORT-NOSED BANDICOOT (Isoodon obesulus) AND SKINKS Lerista lineata AND Hemiergis peronii, ALL SPECIES OF CONSERVATION SIGNIFICANCE, ARE FOUND AROUND THE WETLANDS.

BLUE GUM SWAMP

BLUE GUM SWAMP LIES IN A HOLLOW AT THE JUNCTION OF THE BASSENDEAN AND SPEARWOOD DUNE SYSTEMS. ON THE SOUTHERN SIDE OF THE SWAMP ARE REMNANTS OF THE ORIGINAL JARRAH, BANKSIA AND TUART WOODLAND, WITH SOME FRESHWATER PAPERBARKS AND REED BEDS ALONG THE BANK. THE REST OF THE SWAMP IS SURROUNDED BY LAWNS AND EXOTIC SPECIES. THE LAKE IS A PERMANENT WATERBODY, AND IS A POPULAR FEEDING AND NESTING AREA FOR BIRDS. THE SWAMP SUPPORTS A WIDE VARIETY OF WATERBIRD SPECIES IN AN AREA OF HIGH HUMAN POPULATION DENSITY AND THEREFORE PROVIDES EXCELLENT RECREATIONAL AND EDUCATIONAL OPPORTUNITIES.

BOORAGOON LAKE

BOORAGOON LAKE'S SURROUNDS ARE WELL COVERED WITH NATURAL VEGETATION. THE CENTRE OF THE LAKE CONTAINS DENSE THICKETS OF Melaleuca teretifolia AND AROUND THE MARGIN IS A LOW WOODLAND AND LOW OPEN FOREST OF FLOODED GUM AND PAPERBARK. THE LAKE PROVIDES A HABITAT FOR COOT, CRAKE, RAIL AND SWAMPHEN. DUCKS NEST ON THE LAKE PROTECTED BY ITS GOOD VEGETATION COVER. THE LAKE IS A ROOKERY FOR FOUR SPECIES OF CORMORANT, THE DARTER, AND THE SACRED IBIS AS WELL AS COOT, PURPLE SWAMPHEN AND DUSKY MOORHEN. THE WATER LEVEL OF THE LAKE IS MAINTAINED BY MELVILLE CITY COUNCIL.

PINEY LAKE

THE PINEY LAKE OCCUPIES THE FLOOR OF A STEEPLY SIDED NATURAL AMPHITHEATRE AT THE JUNCTION OF THE BASSENDEAN AND SPEARWOOD DUNE SYSTEMS. THE VEGETATION OF THE AREA CONSISTS OF TWO DISTINCT UNITS, AN UPLAND UNIT AND A WETLAND UNIT. THE UPLANDS ARE HIGHLY DISTURBED. IN THE NORTH WEST IS A LOW SHRUBLAND UP TO TWO METRES TALL WITH PROLIFIC INTRODUCED PLANTS. IN THE SOUTH IS A LOW OPEN SHRUBLAND WITH ABUNDANT EXOTICS AND OCCASIONAL JARRAH (E.

marginata), MARRI (E. calophylla) AND ACACIAS. THE LAKE IS SURROUNDED BY STANDS OF Acacia saligna, Melaleuca raphiophylla AND M. preissiana. ON THE HIGHER GROUND THERE IS Eucalyptus gomphocephala AND E. calophylla. THE EPHEMERAL WETLANDS TO THE EAST ARE COVERED BY A DENSE CLOSED FOREST WITH PROMINENT SPECIMENS OF Banksia littoralis AND M. preissiana WITH AN UNDERSTOREY MOSTLY OF SEDGE (Lepidosperma SPP.). THE WETLANDS PROVIDE A DIVERSE RANGE OF HABITATS WHICH ARE COMMONLY USED BY BIRDS.

MURDOCH SWAMP

MURDOCH SWAMP WAS DEEPENED BY 2 METRES IN THE 1930S. IT IS SURROUNDED BY HIGH QUALITY BANKSIA WOODLAND. THE LONG-NECKED TORTOISE (Chelodina oblongata) AND SHORT-NOSED BANDICOOT (Isoodon obesulus) USE THE RESERVE.

THE WESTERN CHAIN

MANNING LAKE

MANNING LAKE IS AN EPHEMERAL, SALINE LAKE WHICH IS PART OF THE SPEARWOOD DUNE SYSTEM. THE LAKE IS SURROUNDED BY SWAMP PAPERBARKS, TUART AND LARGE Melaleuca rhaphiophylla WITH AN UNDERSTOREY MAINLY OF SALTMARSH REEDS. SAMPHIRE COVERS THE NORTHERN END OF THE LAKE BED. THE AQUATIC PLANT Ruppia OCCURS ON THE LAKE. THERE HAS BEEN SIGNIFICANT WEED INCURSION INTO THE FRINGING VEGETATION. NATIVE VEGETATION HAS BEEN CLEARED TO WITHIN 20 METRES OF THE LAKE AND PICNIC GROUNDS CONTAINING HISTORIC BUILDINGS ADJOIN THE LAKE.

LAKE MOUNT BROWN

LAKE MOUNT BROWN IS A SHALLOW SALINE WETLAND WHICH USUALLY DRIES OUT IN SUMMER. IT IS ONE OF THE FEW REMAINING UNDISTURBED WETLANDS IN THE SPEARWOOD DUNE SYSTEM. THE LAKE IS FRINGED BY STANDS OF PAPERBARK AND TUSSOCK SEDGE. A WOODLAND OF TUART (E. gomphocephala) AND BANKSIA, AND SHRUBLAND DOMINATED BY CHENILLE HONEY MYRTLE (Melaleuca huegelii) SURROUND THE WETLAND VEGETATION. THE VEGETATION ON THE SURROUNDING LIMESTONE HILLS CONTAINS THE UNCOMMON SPECIES BUTTON RUNNER (Tersonia cyathophora) AND Hemigenia sericea AS WELL AS TUART, WHICH IS IN THE NORTHERN PART OF ITS RANGE. THE LAKE SUPPORTS WATER BIRDS SUCH AS THE WHITE-HEADED STILT, WHITE-FACED HERON AND GREENSHANK. THE AREA IS REPUTED TO BE THE SITE OF THE EARLIEST EUROPEAN SETTLEMENT IN WESTERN AUSTRALIA.

BROWNMAN SWAMPS

BROWNMAN SWAMPS ARE LARGE SECLUDED SWAMPS WHICH SUPPORT MUCH OF THE WILDLIFE OF THE WESTERN CHAIN OF THE BEELIAR WETLANDS. SEASONAL PAPERBARK SWAMPS IN LOW LEVEL INTERBARRIER DEPRESSIONS IN THE SPEARWOOD DUNE SYSTEM ARE SURROUNDED BY EXTENSIVE OPEN FORESTS OF GOOD QUALITY TUART. MASSIVE LIMESTONE OUTCROPS OCCUR ON THE RIDGES BETWEEN THE SWAMPS. TO THE WEST IS A WOODLAND OF TUART AND BANKSIA AND THERE IS OPEN HEATH AND SHRUBLAND ON LOW LIMESTONE HILLS. THE SWAMPS ARE RELATIVELY UNDISTURBED, AND ARE CONSIDERED THE MOST IMPORTANT IN THE WESTERN CHAIN.

LAKE COOGEE

LAKE COOGEE WAS FORMED AT THE END OF THE LAST ICE AGE (10 000 YEARS BP), AND IS A SHALLOW HIGHLY SALINE LAKE. LITTLE NATIVE VEGETATION REMAINS AROUND THE LAKE EXCEPT FOR A STRIP OF SALT-WATER PAPERBARK (Melaleuca cuticularis) WHICH IS UNCOMMON IN THE METROPOLITAN AREA AND HAS AN UNDERSTOREY OF SEDGE AND SAMPHIRE.

ALTHOUGH DEGRADED BY AGRICULTURAL ACTIVITIES, THE LAKE IS AN IMPURTANT SEA-BIRD HABITAT.

MARKET GARDEN SWAMPS

THE THREE MARKET GARDEN SWAMPS ARE SMALL, SALINE, SEASONAL AND EUTROPHIC. SWAMP 1 HAS A GOOD STAND OF FRINGING MELALEUCA. THE SMALLER SOUTHERN LOBE OF SWAMP 2 IS A GOOD EXAMPLE OF A SALT-WATER WETLAND CONTAINING IMPRESSIVE STANDS OF SALT-WATER PAPERBARK AND IS GOOD BIRD HABITAT. THE NORTHERN LOBE OF THE SWAMP IS A CABLE WATERSKI PARK. SWAMP 3 IS DEGRADED BUT STILL OF IMPORTANCE TO MIGRATORY BIRDS. THE SWAMPS ARE IN THE SPEARWOOD DUNE SYSTEM. IN THE NORTH Melaleuca rhaphiophylla (SWAMP PAPERBARK) IS DOMINANT, TO THE SOUTH THERE IS A TRANSITION TO SALTWATER PAPERBARK (M. cuticularis) WITH A SEDGELAND UNDERSTOREY AND SAMPHIRE. THE UPLAND VEGETATION HAS BEEN ENTIRELY REMOVED APART FROM A FEW REMNANT TUARTS. THESE SWAMPS, ALONG WITH LAKE COOGEE CONTRIBUTE A GREAT DEAL TO THE AMENITY OF THE COASTAL LANDSCAPE.

LONG SWAMP

LONG SWAMP IS AN EPHEMERAL WETLAND WHICH COVERS AN AREA OF ABOUT 10HA, MOST OF WHICH IS COVERED WITH REEDS AND PAPERBARKS (Melaleuca teretifolia AND M. rhaphiophylla). IT IS SURROUNDED BY A DENSE FRINGE OF SWAMP PAPERBARK (M. rhaphiophylla) ON THE SOUTHERN AND EASTERN SIDES AND A MIXED STAND OF SWAMP PAPERBARK AND M. teretifolia ON THE NORTHERN SIDE. THE CENTRAL OPEN AREA IS INUNDATED IN WINTER AND SPRING. AT THE MARGINS OF THE OPEN AREA SAMPHIRE OCCURS, ASSOCIATED WITH SWAMP PAPERBARK. A SMALL AREA OF Baumea articulata IS SITUATED IN THE DEEPEST, MOST PERMANENTLY WET, PART OF THE SWAMP. IT LIES WITHIN THE SPEARWOOD DUNE SYSTEM AT THE SOUTHERN END OF THE WESTERN CHAIN OF LAKES. IT IS A SUMMER FEEDING AREA FOR WATERBIRDS AND SUPPORTS A VARIETY OF BUSH BIRDS.

CONDITION:

SEVERAL OF THE LAKES ARE WELL-MANAGED AND ARE IN GOOD CONDITION. SOME LAKES AND SEVERAL SWAMPS ARE SUFFERING POLLUTION FROM INDUSTRIAL DEVELOPMENTS, AGRICULTURAL ACTIVITIES, HORSE-RIDING AND OFFROAD VEHICLES. GENERALLY, WETLANDS IN THE WESTERN CHAIN ARE MORE DEGRADED THAN THOSE OF THE EASTERN CHAIN. GROUNDWATER EXTRACTION MAY AFFECT WATER LEVELS OF THE WETLANDS, AND SOME ARE KEPT FULL BY ARTIFICIAL MEANS.

BIBLIOGRAPHY:

ARNOLD J. (1990). JENNY ARNOLD'S PERTH WETLANDS RESOURCE BOOK. EPA & WAWA BULLETIN 266. 396PP.

CLAY P. (1986). THE SPECTACLES AN APPRAISAL OF IT'S CONSERVATION VALUES. UNPUBLISHED REPORT. 40PP.

CROUK I.G. AND EVANS T. (1981). THOMPSONS LAKE NATURE RESERVE. WEST. AUST. NAT. RESERVE MANAGE. PLAN NO.2. DEPT. FISHERIES AND WILDLIFE, PERTH. 36 PP.

DAVIS J.A. AND ROLLS S.W. (1987). A BASELINE BIOLOGICAL MONITORING PROGRAMME FOR THE URBAN WETLANDS OF THE SWAN COASTAL PLAIN, WESTERN AUSTRALIA. SEASONAL VARIATION IN THE MACROINVERTEBRATE FAUNA AND WATER CHEMISTRY OF FIVE PERTH LAKES. E.P.A., PERTH W.A. BULLETIN

265. 80 PP.
ENVIRONMENTAL PROTECTION AUTHORITY (1981). THE DARLING SYSTEM WESTERN AUSTRALIA, PROPOSALS FOR PARKS AND RESERVES. THE SYSTEM 6 STUDY REPORT TO THE ENVIRONMENTAL PROTECTION AUTHORITY. DEPT. CONS. & ENVIRON. 347 PP.
ENVIRONMENTAL PROTECTION AUTHORITY (1986). DRAFT GUIDELINES FOR WETLAND CONSERVATION IN THE PERTH METROPOLITAN AREA. DEPT. CONS. & ENV., PERTH, W.A. BULLETIN 227. 25 PP.
LE PROVOST, SEMENIUK AND CHALMER (1987). ENVIRONMENTAL SIGNIFICANCE OF WETLANDS IN THE PERTH TO BUNBURY REGION. VOLUME 1: MAIN REPORT. REPORT TO WESTERN AUSTRALIAN WATER RESOURCES COUNCIL. 65 PP.
HALSE S.A. (1989). WETLANDS OF THE SWAN COASTAL PLAIN PAST AND PRESENT PP105-112.
HOPPER S.D. AND BURBIDGE, A.H. (1989). CONSERVATION STATUS OF BANKSIA WOODLANDS ON THE SWAN COASTAL PLAIN. J. ROY. SOC. W.A., 71 (4), 115-116.
KENNEDY M. (ED) (1990). A COMPLETE REFERENCE TO AUSTRALIA'S ENDANGERED SPECIES. SIMON AND SCHUSTER, AUSTRALIA 1990. PP 166-172.
TECHNIC 10 (WA) PTY LTD. (1975). NATIONAL ESTATE STUDY, A REPORT PREPARED FOR THE TOWN OF COCKBURN. JULY 1975.
MURDOCH UNIVERSITY, ENVIRONMENTAL SCIENCE (1986). NORTH LAKE DRAFT MANAGEMENT PLAN. PP 98-101.
TINGAY A. AND TINGAY S.R. (1977). BIOLOGICAL SURVEY FOR THE SHIRE OF ROCKINGHAM. 27 PP.
LAYTON GROUNDWATER CONSULTANTS (1976). THE LAKES REGIONAL OPEN SPACE HYDROLOGICAL AND GEOLOGICAL STUDY FOR THE SHIRE OF ROCKINGHAM. 29 PP.
MURDOCH UNIVERSITY (1988). MANAGEMENT PROPOSAL FOR YANGEBUP LAKE. 27 PP.
MURRAY F. AND MIDDLE G. (1989). A PRELIMINARY REPORT ON THE ECOLOGY AND CULTURAL SIGNIFICANCE OF LAKE KOGOLUP AND THE SURROUNDING AREA. A REPORT TO THE BEELIAR REGIONAL PARK COORDINATING COMMITTEE. ENVIRON. SCI. MURDOCH UNI. 47 PP.
DEPARTMENT OF PLANNING AND URBAN DEVELOPMENT (1990). BEELIAR REGIONAL PARK PROPOSALS FOR ESTABLISHMENT, ADMINISTRATION AND USE. 56 PP.
CITY OF MELVILLE (N.D.). BULL CREEK PARK MANAGEMENT PLAN. PP 14-24; 43-54.
O'CONNOR R, QUARTERMAINE G. AND BODNEY C. (1989). REPORT ON AN INVESTIGATION INTO ABORIGINAL SIGNIFICANCE OF WETLANDS AND RIVERS IN THE PERTH-BUNBURY REGION. STATE WATER PLANNING, WESTERN AUSTRALIAN WATER RESOURCES COUNCIL.
RAOU (1991). DATA PROVIDED TO THE AUSTRALIAN HERITAGE COMMISSION.
RODDA J. (1986). PINEY LAKE RESERVE, AN ECOLOGICAL STUDY WITH GUIDELINES FOR MANAGEMENT. WETLANDS CONSERVATION SOCIETY, OCTOBER 1986.
SEDDON G. (1972). SENSE OF PLACE. UNIVERSITY OF WESTERN AUSTRALIA PRESS, NEDLANDS. PP 226-232.
VAN DER LANDE V. (1978). THE OCCURRENCE, CULTURE AND REPRODUCTION OF PERIPATOIDES GILESII SPENCER (ONYCHUPHORA) ON THE SWAN COASTAL PLAIN. WA NATURALIST 14(2), 29-36.
WETLANDS CONSERVATION SOCIETY.
(1986). THE BEELIAR WETLANDS, PROPOSALS FOR THEIR CONSERVATION AND MANAGEMENT. UNPUBLISHED REPORT. SEPTEMBER 1986.
WESTERN AUSTRALIAN WATER RESOURCES COMMISSION. (1988). A STRATEGY FOR

WATER ALLOCATION IN THE PERTH-BUNBURY REGION. WORKING PAPER. JANUARY 1988. 130 PP.

Anchorage
Owen
Jervoise Bay
Cockburn Sound
Lake Coogee
Brownman Swamps
Beeliar Regional Park

Woodman Point Recreation Reserve
Woodman Point Caravan Park & Camping Resort
Woodman Point Recreation Camp
Woodman Pt
Woodman Point Wastewater Treatment Plant
Munster Wastewater Pumping Station
Beeliar Regional Park
Coastal Park Moto Cross
Cockburn International Raceway
Cockburn Volunteer Rescue
Saint Jeromes Sch
Santich Park
Poole Reserve
Loganesi Park
Radonich Park
South Coogee Res
South Coogee Prim Sch
Henderson Industrial Estate
Skate Park
rubbish tip
cement works
quarries
weighbridge
boat ramp CPBAA
shipyards
offshore construction yard
groyne
jetty
Wapet Groyne
JBSC

MUNSTER 6166
BEELIAR 6164
YANGEBUP 6164
HENDERSON 6166
WATTLEUP 6166

CITY CENTRE PERTH 22km

City of Cockburn

NYVERBURP CIR
CONSERVATION CL
MAGAZINE CT
WOODMAN POINT VIEW
O'KANE CT
JERVOISE BAY COVE
MAYOR RD
BEELIAR DR
HAMILTON RD
SOLOMON PL
GIUFFRE PL
KOTISINA CT
OKRA CT
GARBUN RISE
ASO BECKETT CL
THORNE PL
SHALLCROSS ST
STOREY PL
ARGONAUT RD
BEGONIA ST
CONGRAVE RD
BONITO PL
DOVER PL
CASSEL PL
SPEARWOOD AV
HONEYEATER DR
BLUEBUSH DR
BIRDWING CL
THE BINGEI
CATSPAW CL
TINDAL AV
MCLAREN AV
HOWE ST
EAST CHURCHILL AV
WEST CHURCHILL AV
HOBSONS AV
ALBION AV
FROBISHER AV
BRITANNIA AV
FANSTONE AV
FANCOTE AV
GARDINER AV
RUSSELL RD
ROCKINGHAM RD
STOCK RD
COCKBURN RD
BARTRAM RD
BIRCHLEY ST
WATSON VIEW
WELLS ST
JERVOIS ST
GORDON RD
HOLMES RD
HENDERSON RD
MOYLAN RD
TORGOYLE RD
CARATTI RD
MCLEOD RD
MORTIMER
WRIGHT RD
COOSEE RD
SPARKS RD
QUILL WY
STUART DR
ALACRITY PL
DUBLAMUNG WY
KEEL WY
EGMONT RD
POSSNER WY
REDEMPTORA RD
CRANE ST
ANDERSON RD
JESSIE LEE ST
ROSCOE ST
JAMES MATHEW LOOP
SUCCESS RD
GEORGE RD
CLARENCE BEACH RD
Dampier to Bunbury Natural Gas Pipeline Corridor

STREETSMART©

0 METRES 500

380 000mE
380 139mE

A 11 | B 12 | C 13 | D 14 | E 15

Joins 490

6440 000mN
6440 149mN

1 80
2 79
3 78
4 77
5 76
6 75
7 74
8 73
9 72
10 71

6435 000mN
6435 149mN

Joins 550

Cockburn Sound

STREETSMART©

A 16 | B 17 | C 18 | D 19 | E 20

Joins 491

Coastal Park
Moto Cross

Cockburn Motorsport Park Raceway

WA Radio Modellers Napier Field

HENDERSON
6166

Mt Brown Lake

Beeliar Regional Park

COCKBURN RD

caravan park

boat ramp

Challenger Beach

SUTTON RD

HOGG RD

jetty

alumina mill

chimney stacks

power station

Naval Base Hotel

ROCKINGHAM RD

HOPE VALLEY RD

HALLETT CV

HENRY ST

HOPE VALLEY RD

END

NAVAL BASE
6165

LIONEL ST

DOOLEY ST

FREDERIC ST

BURLINGTON ST

MACEDONIA ST

WESTON ST

BICKLEY ST

BARTER RD

BEARD ST

BROWN ST

MORLEY ST

LEATH RD

BHP Siding

steel rolling mill

KWINANA BEACH
6167

Kwinana Motorplex

tailing pond

Mt Brown
Category 1 ESL Boundary
Category 3 ESL Boundary

City of Cockburn
Town of Kwinana

DALISON AV

MUSSON RD

PHILLIPS RD

POWER RD

MCLEOD RD

COLLOVA RD

ROTHWELL CT

CORIN WY

LEES PK

MARBAN WY

WENLOCK RD

DEEPDENE RD

CHC Deepdene Park

WATTLEUP
6166

Wattleup VODICE ST

Srdaloy Res

Wattleup Prim Sch

USHER PL

HITCHCOCK PL

STANFORD WY

MOYLAN RD

LUSSKY RD

quarry

quarries

SAN MIGUEL RD

EVERETTE WY

HOPE VALLEY
6165

Long Swamp

MCLAREN AV

Hope Valley Prim Sch

HOYLE RD

HEARDER RD

HENDY RD

HONOR AV

GARDEN RD

ARMSTRONG RD

CONWAY RD

ANKETELL

ABERCROMBIE RD

Dampier to Bunbury Natural Gas Pipeline Corridor

CITY CENTRE PERTH 27km

POSTANS
6167

STREETSMART©

0 METRES 500

THE SPECTACLES WETLANDS

REHABILITATION AREAS

Some areas of the Spectacles Wetlands have been cleared, and introduced plants like veldt grass, cape weed and stinkweed, have become established. An introduced species of pigface, favoured by the activities of horses and cattle, has led to further degradation. Topsoil and the seed store have been adversely affected and the rejuvenation of the original plant species needs more than just the fencing of the area for rehabilitation to succeed.

With the community's help in regeneration and protection, it is hoped to increase the numbers of native animals that make their homes in the Spectacles Wetlands.

REMEMBER:

BE CAREFUL... Tread softly and stay on the tracks. Your enjoyment and safety is our concern but your responsibility.

BE CLEAN... Please take your litter with you when you leave.

BE COOL... Don't light fires.

The animals and plants of the Spectacles Wetlands are particularly vulnerable to fire.

BE WISE... Leave this natural environment as you found it for all to enjoy. Please don't pick the wildflowers.

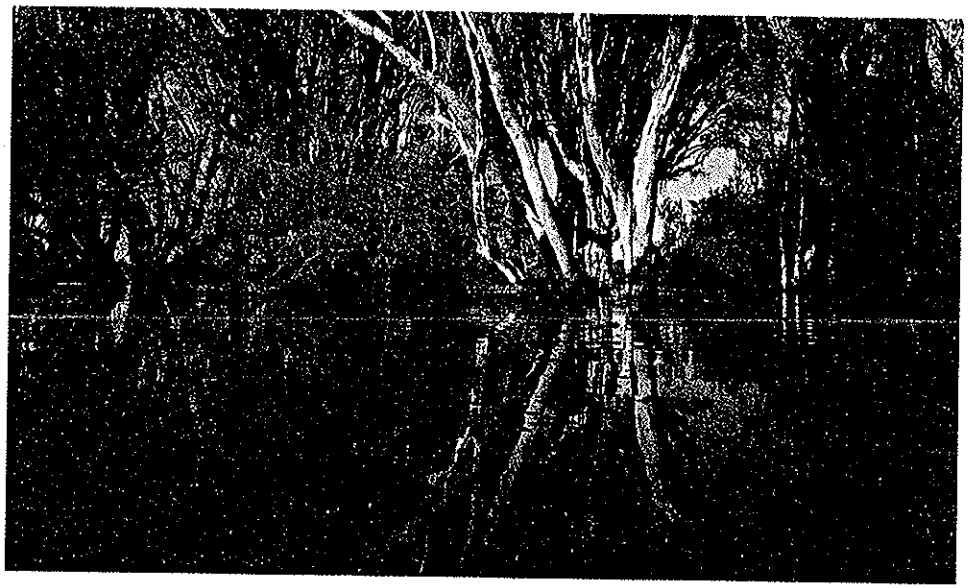
PROTECT WILDLIFE... No firearms are permitted in the Wetlands.

A.C.N. 004 879 298

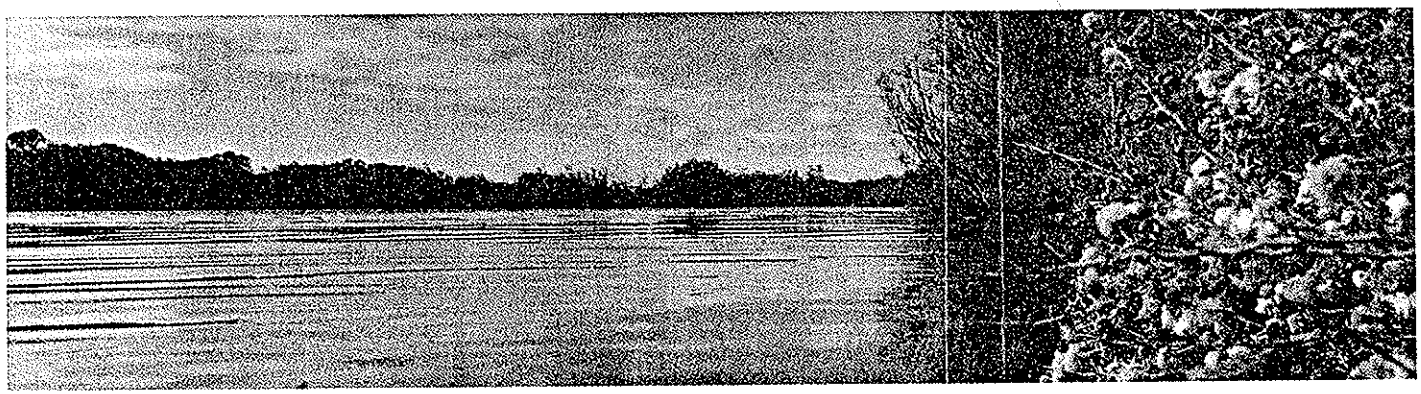
ALCOA
AUSTRALIA

Working Copy

THE SPECTACLES WETLANDS



THE SPECTACLES WETLANDS



and special bird hides to enable viewing of the many wonderful birds without disturbing them. Already community groups, schools, Alcoa employees and other volunteers have become involved in replanting and upgrading the area. As the project continues, the Spectacles Wetlands will become an outstanding environmental asset for the Kwinana area.

INTRODUCTION

Wetlands throughout the Swan Coastal Plain are becoming increasingly degraded as a result of the pressures of increased urbanisation, drainage, inappropriate land use and, in many cases, a lack of awareness within the community of the value and delicate balance of the wetland ecosystem.

The Spectacles Wetlands – named because it comprises two wetlands joined by a drain, giving it the appearance of a pair of spectacles – is the most southern of the Beeliar chain of freshwater lakes on the Swan Coastal Plain.

It is the only wetland of its kind in the metropolitan area to have an extensive cover of paperbark trees. It is also one of the few breeding grounds for the Rufous Night Heron, one of more than 100 species of birds which frequent the swamps.

A diverse range of plants and animals is found in the area, including a gazetted rare and endangered plant species and a population of rare frogs.

HISTORY

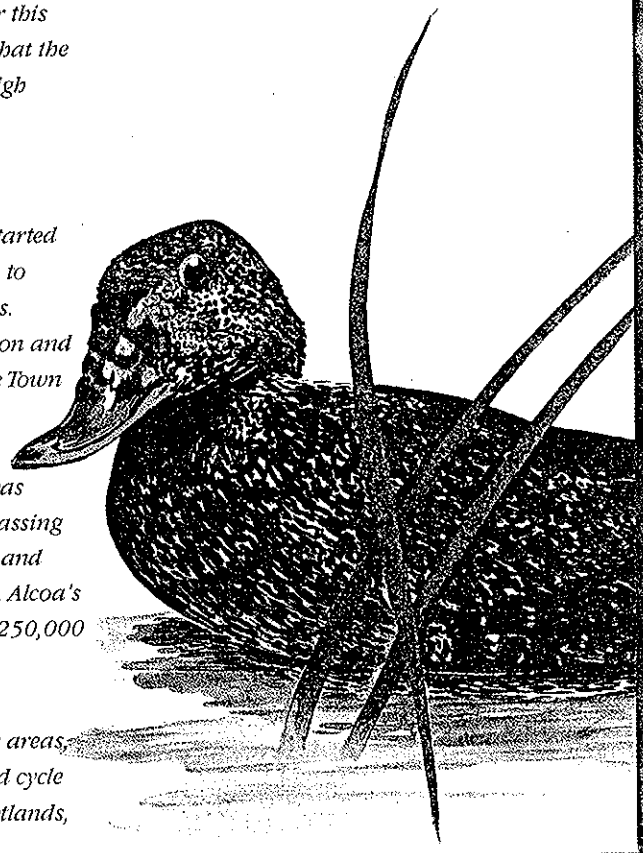
The 360 hectares of wetlands are located north-west of Kwinana, about 40km south of Perth. The area was part of the original Peel Settlement Scheme. However, the swamps in the centre of the land, and the infertile leached quartz sands which surround them, led to early settlers walking away from the area. It was only after World War II that the Spectacles again attracted settlers.

In the 1970s the Industrial Lands Development Authority and Alcoa of Australia purchased the land for future industrial use. However, when the land was evaluated for [illegible] disposal purposes, it became clear not only that the wetland nature of the property made it unsuitable for this particular industrial use, but that the Spectacles Wetlands area had high conservation value.

BACKGROUND

By the early 1980s Alcoa had started to develop a management plan to restore and protect the wetlands. The Department of Conservation and Land Management (CALM), the Town of Kwinana and the Wetlands Conservation Society provided additional advice. The result was a comprehensive plan encompassing the conservation, recreational and educational values of the area. Alcoa's Landcare Project committed $250,000 to development of the concept.

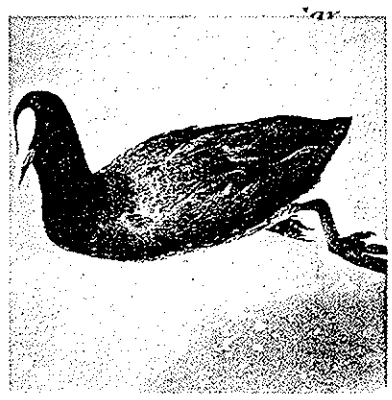
Included in the plan are [illegible] areas, a visitor centre, walk trails and cycle paths, board walks into the wetlands,



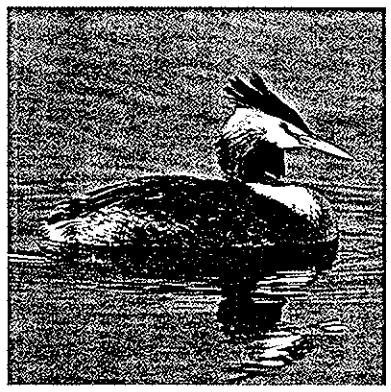
ALCOA AUSTRALIA

Black Swan (Cygnus atratus)
Black Swans are one of at least 7 waterbird species already breeding successfully at Wellard. Swans usually breed in Spring. They construct nests from available plant material and lay 5 or 6 eggs. For breeding, swans need an island protected from predators and also adequate nesting material. Adult swans feed on plants, while cygnets need a good supply of freshwater aquatic invertebrates and plants.

Great Egret (Egretta alba)
Egrets are often found wading in shallows near the island and shoreline. They quietly move through the water searching for prey which includes insects, small fish, crustaceans and frogs. When a tasty victim is spotted, the Egret quickly snaps it up with its long bill. A diverse aquatic fauna and large areas of shallow water provide suitable habitat for egrets and other herons.



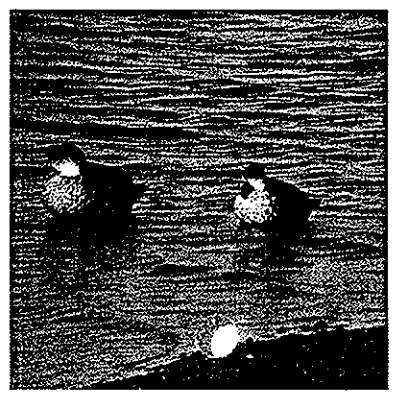
Coot (Fulica atra)
Coots are one of the most common bird species at Wellard. They feed mainly on plants which they obtain either by diving or pecking at shallow vegetation near the shoreline. They are thus dependent on suitable conditions for the establishment of these plants. Water quality, depth and soil type are some of the factors which affect plant establishment, and therefore suitability of the habitat for coots.



Great Crested Grebe (Podiceps cristatus)
Grebes are not very efficient at flying, but they more than compensate for this by being outstanding divers. The uncommon Great Crested Grebe can dive for more than 30 seconds while searching for fish, crustaceans and aquatic insects. Wellard provides suitable habitat for this and other Grebe species by having large areas of deeper water, and an adequate supply of aquatic life.

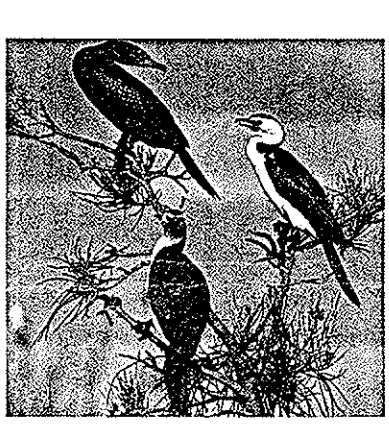
Blue-billed Duck (Oxyura australis)
This duck spends most of its time in areas of deeper water, where it dives for a wide variety of plant and animal food. It spends very little time on land apart from occasionally resting on islands, and during breeding. Because of these habits, deep, permanent wetlands such as Wellard are important for the species' long term survival.

Red-capped Plover (Charadrius ruficapillus)
Waders are a group of waterbirds which require large areas of shallow water to provide suitable feeding areas. They eat insects, small crustaceans, worms and molluscs. Some, such as the Greenshank, migrate to Australia each summer from as far away as Siberia. The Red-capped Plover and other waders can best be seen at Wellard in summer when lower water levels expose feeding mud flats.



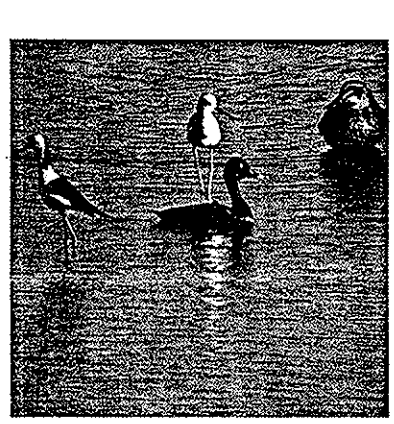
Grey Teal (Anas gibberifrons)
Grey Teals occur all over Australia. They are highly mobile and rapidly move into suitable habitat. Their diet is varied and includes plant seeds, swamp plants, aquatic insects and crustaceans. Being "generalists", they rapidly multiply when suitable habitat becomes available. However, during droughts, permanent coastal swamps such as Wellard become very important as refuges until extensive inland rains return.

Western Spinebill (Acanthorhynchus superciliosus)
Wetlands need surrounding vegetation to provide habitats for many species and protection from noise and excessive nutrient input. At Wellard, the surrounding woodland is becoming well established and already supports many bird and reptile species. Flowering trees and shrubs provide important food sources for honeyeaters such as this Western Spinebill.



Little Black Cormorant (Phalacrocorax sulcirostris), Little Pied Cormorant (Phalacrocorax melanoleucos)
Cormorants are diving birds. They feed on small fish, crustaceans and insects, and are particularly well adapted to catching their prey under water. Unlike most ducks, the cormorant's feathers are permeable to water. This greatly increases their mobility under water, but it also means that they must find a branch or stump to dry out when not feeding. At Wellard, suitable perching sites have been placed on three islands.

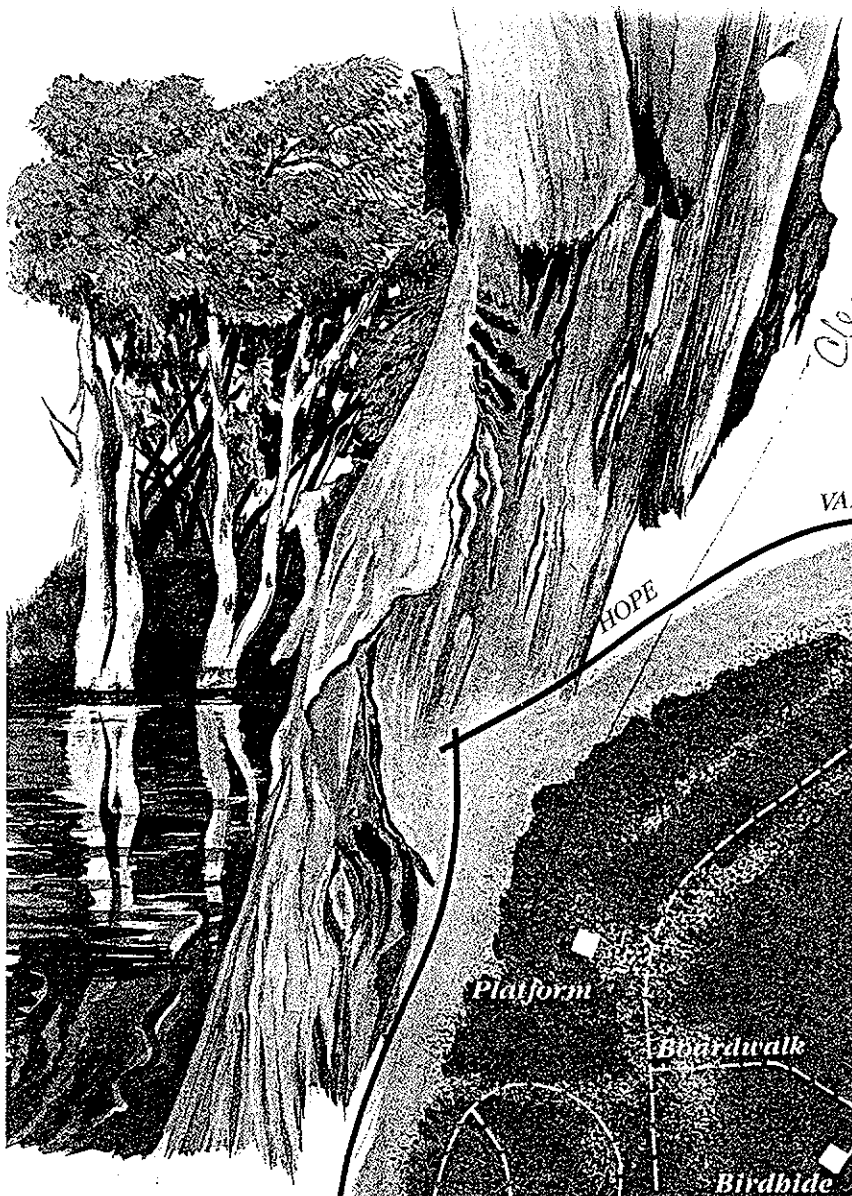
Marsh Harrier (Circus aeruginosus)
The presence of predators in an ecosystem is always a good sign; it indicates that other components of the food chain are also present. Nine species of predatory birds (raptors) have been recorded at Wellard including the rare Peregrine Falcon. Like most raptors, the Marsh Harrier has a varied diet which includes reptiles, insects, and small mammals and birds. The larger trees at Wellard provide useful resting and lookout sites for many raptors.



Black-winged Stilt (Himantopus himantopus)
Hardhead (Aythya australis)
Black Duck (Anas superciliosa)
These three species illustrate the importance of safe, shallow water for "loafing", or resting. Islands at Wellard sometimes have more than 10 species or 300 birds loafing between feeding sessions or flights from one wetland to another. Stilts wade in nearby shallows searching for aquatic plants and animals. Hardheads and Black Ducks dabble in the water for aquatic plant seeds, and small animals.

Clamorous Reed Warbler (Acrocephalus stentoreus)
This and several other species rely on tall rushes, in which they feed and nest. Although they can be detected by their melodious calls, Reed Warblers are almost never seen outside rush-beds. They use the rushes for cover, and for constructing nests, which are both supported by and built from rushes. Species such as Reed Warblers provide a good example of how the successful establishment of diverse rush and sedge vegetation creates habitat for a more diverse population of water

THE SPECTACLES PROPOSAL



Fringing Paperbark Woodland

Ducks, like the rare and endangered Freckled Duck, use the upturned roots of the fallen paperbarks for nesting sites. While most of the area is under water at times, for much of the year it is easy to walk over the spongy green vegetation carpet under the paperbarks.

This woodland is a good place to watch birds nesting or feeding and see bandicoots (gazetted rare and threatened) or some of the many reptiles.

VALLEY ROAD

HOPE

Moderate density use zone

Boardwalk

Birdhide

Platform

Low density use zone

Moderate density use zone

Tuarts

Boardwalk

Birdhide

Birdhide

ROAD

Specimen Planting

High density use zone

Low density use zone

McLAUGHLAN

JOHNSON

Nature Trail

To Kwinana

THOMAS

Low density use zone

ROAD

Open Water

The Spectacles has only a small area of open water, the largest being in the smaller of the two "eyes." The open water of the large "eye" is fragmented, with much of the remainder being inaccessible, making it suitable for the nesting and roosting of birds like the Rufous Night Heron. This feature adds to the conservation value of the wetlands.

Gilgies, water beetles and other aquatic insects, as well as native and introduced fish, form the diet of the water birds.

The Reed Beds

Extensive reed beds fringe the limited areas of open water of the large and small "eyes." They make access to the water difficult, but serve as screens for birds like the secretive crakes and rails, and nesting sites for a variety of the large number of birds that feed or nest at the Spectacles Wetlands.

Tiger snakes, legless lizards, swamp skinks and long-necked tortoises also frequent the reed beds.

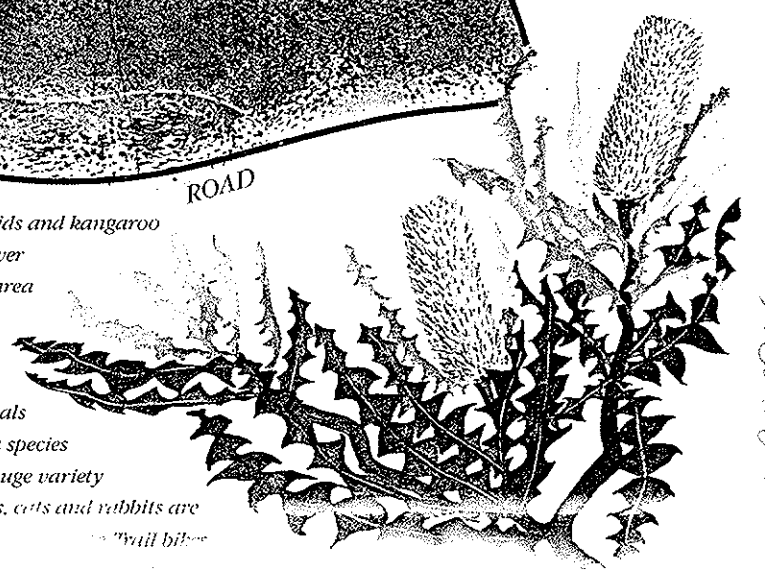
N

0 300m

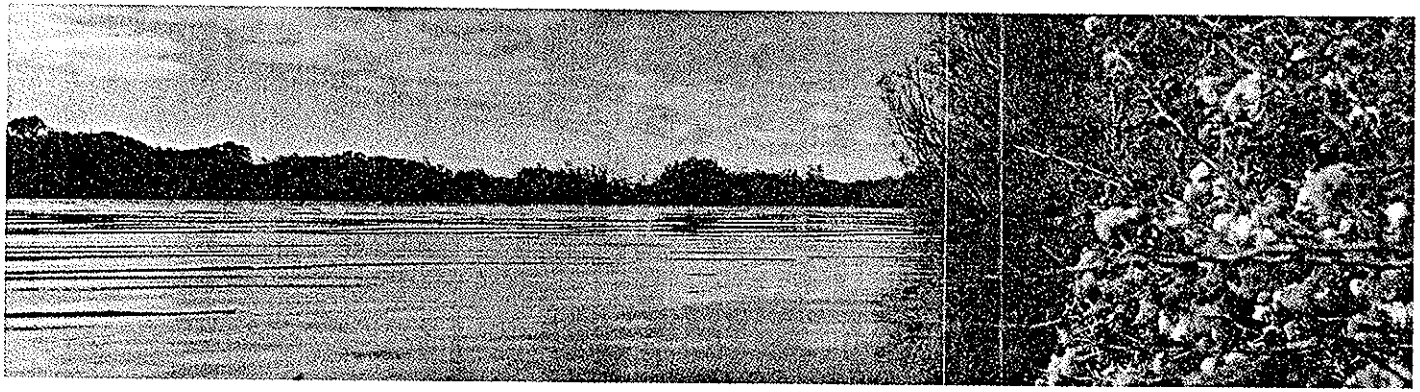
Banksia Woodland

The Banksia woodland, covering an area of about 103 hectares to the south-west of the large "eye," is rich in plant species. Jarrah, tuart, banksia and she-oak, along with orchids and kangaroo paws, are among the 86 plant species you will discover in this area. Few sites in the southern metropolitan area have such a rich and diverse number of plants.

The vegetation provides habitats and serves as breeding grounds for many different species of animals including brush-tailed possums, reptiles (including a species until recently declared rare and threatened), and a huge variety of land and water birds. Introduced species like foxes, cats and rabbits are



THE SPECTACLES WETLANDS



and special bird hides to enable viewing of the many wonderful birds without disturbing them. Already community groups, schools, Alcoa employees and other volunteers have become involved in replanting and upgrading the area. As the project continues, the Spectacles Wetlands will become an outstanding environmental asset for the Kwinana area.

INTRODUCTION

Wetlands throughout the Swan Coastal Plain are becoming increasingly degraded as a result of the pressures of increased urbanisation, drainage, inappropriate land use and, in many cases, a lack of awareness within the community of the value and delicate balance of the wetland ecosystem.

The Spectacles Wetlands – named because it comprises two wetlands joined by a drain, giving it the appearance of a pair of spectacles – is the most southern of the Beeliar chain of freshwater lakes on the Swan Coastal Plain.

It is the only wetland of its kind in the metropolitan area to have an extensive cover of paperbark trees. It is also one of the few breeding grounds for the Rufous Night Heron, one of more than 100 species of birds which frequent the swamps.

A diverse range of plants and animals is found in the area, including a gazetted rare and endangered plant species and a population of rare frogs.

HISTORY

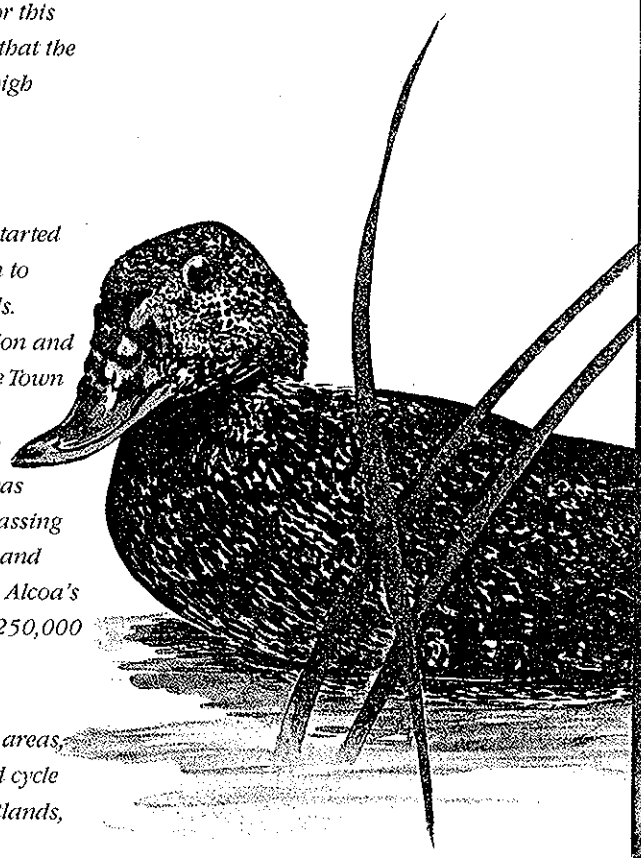
The 360 hectares of wetlands are located north-west of Kwinana, about 40km south of Perth. The area was part of the original Peel Settlement Scheme. However, the swamps in the centre of the land, and the infertile leached quartz sands which surround them, led to early settlers walking away from the area. It was only after World War II that the Spectacles again attracted settlers.

In the 1970s the Industrial Lands Development Authority and Alcoa of Australia purchased the land for future industrial use. However, when the land was evaluated for [illegible]lue disposal purposes, it became clear not only that the wetland nature of the property made it unsuitable for this particular industrial use, but that the Spectacles Wetlands area had high conservation value.

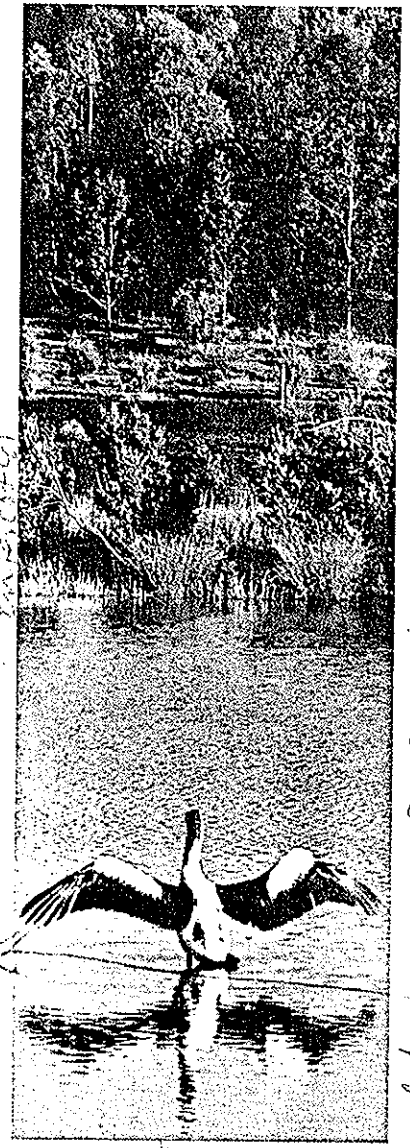
BACKGROUND

By the early 1980s Alcoa had started to develop a management plan to restore and protect the wetlands. The Department of Conservation and Land Management (CALM), the Town of Kwinana and the Wetlands Conservation Society provided additional advice. The result was a comprehensive plan encompassing the conservation, recreational and educational values of the area. Alcoa's Landcare Project committed $250,000 to development of the concept.

Included in the plan are picnic areas, a visitor centre, walk trails and cycle paths, board walks into the wetlands,



ALCOA AUSTRALIA



Design: Vince Viola
Text: Owen Nichols, Sue Sutton
Photography: Michael Morcombe, Jiri Lochman, Owen Nichols

A.C.N. 004 879 298

By working closely with the Royal Australasian Ornithologists Union and other specialist organisations, Alcoa has ensured that the Wellard Wetlands will become more than a revegetated clay pit. Recognition is given to the Australian Trust for Conservation Volunteers (W.A.) who have provided valuable advice and voluntary assistance, Murdoch University who studied water quality and aquatic fauna, and staff at the Department of Conservation and Land Management.

The Wellard project has been carefully designed to fulfil conservation, research, education and appropriate recreation objectives. More bird hides, islands and walk trails are being added, as is an orientation area where researchers, school groups and other special interest groups can congregate to facilitate use of the site - without disturbing the wildlife.

In the future, as more clay is required, further wetlands will be developed. The experience gained at Wellard will be utilised throughout Alcoa's operations. Already another new wetland has been created at Alcoa's Pinjarra Refinery.

It is hoped that projects like this will demonstrate that, with thought and effort, industry can make a significant contribution toward reversing the trend of wetland decline.

We hope you enjoy Wellard and all it has to offer.

ALCOA AUSTRALIA

THE WELLARD WETLANDS

CREATING A HABITAT

INTRODUCTION

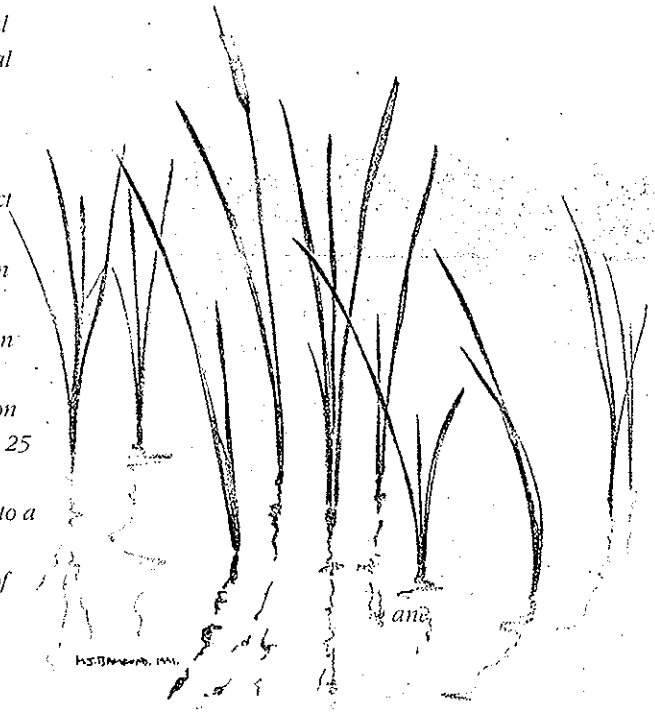
In 1990 Alcoa of Australia became the first mining company in the world to be listed on the United Nations Environment Programme's Global 500 Roll of Honour. This award recognised Alcoa's successful integration of environmental protection with industrial development.

The Wellard Wetlands project is one facet of Alcoa's environmental rehabilitation programme. The need for a raw material for construction led to a carefully planned excavation and rehabilitation programme, which turned a 25 hectare area of clay-based, non-productive farmland into a thriving wetland and bird sanctuary where hundreds of waterbirds live and breed in safety.

BACKGROUND

Since 1963, Alcoa of Australia has been operating alumina refineries in Western Australia. Residue from refinery operations is stored in lined impoundments which utilise clay in construction. In 1982 this clay was excavated from a 25ha area of farmland at Wellard, approximately 8km south-east of Kwinana.

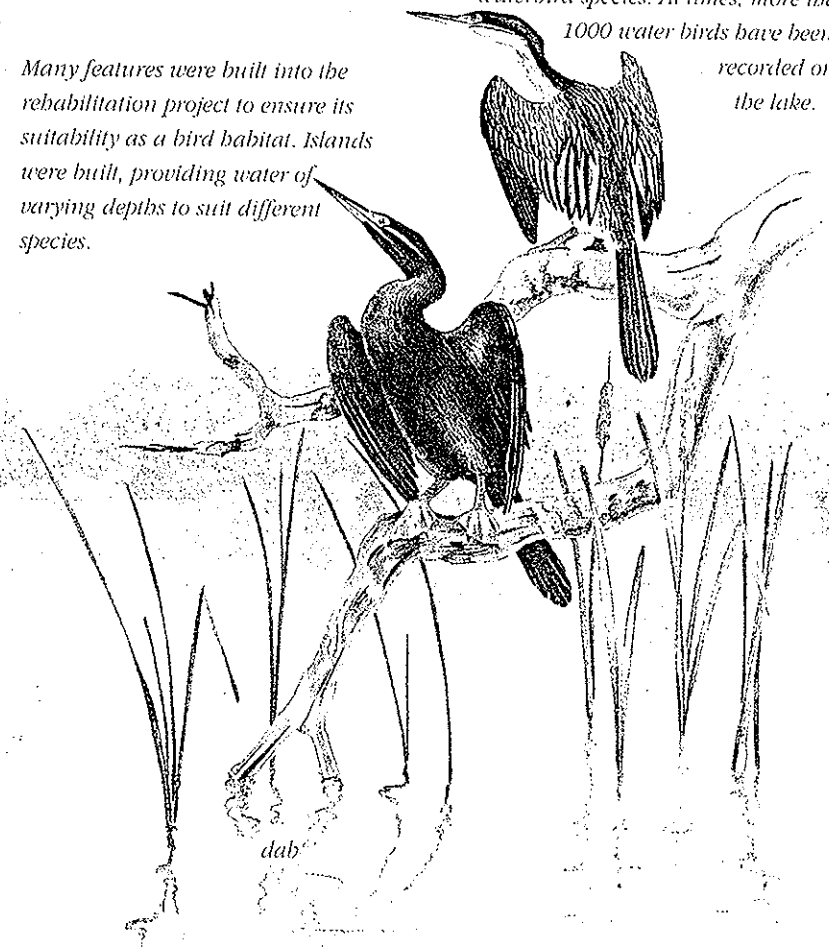
By combining the efforts of Alcoa's engineering and environmental staff, the project was carefully planned so that the resulting clay pit could be rehabilitated into a valuable wetland and bird sanctuary.



A flow-through drainage system protects the water quality and a continuing revegetation programme provides an ideal habitat for many species of birds, as well as other wildlife.

From a flat, almost treeless, farmland to a beautiful wetland, complete with the vegetation necessary to support its wildlife, Wellard is the host for more than 84 bird species, including 38 waterbird species. At times, more than 1000 water birds have been recorded on the lake.

Many features were built into the rehabilitation project to ensure its suitability as a bird habitat. Islands were built, providing water of varying depths to suit different species.



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ROWLEY ROAD EXTENSION.

ECOLOGICAL SURVEY.

Prepared by

Hart, Simpson and Associates Pty Ltd

for

Gutteridge Haskins and Davey Pty Ltd

December 2001

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1. SUMMARY.

Main Roads W.A. proposes to upgrade Rowley Road between the Kwinana Freeway and planned marine-based developments at Kwinana along the existing Cockburn Road. The alignment also includes provision for a railway at the western end. An ecological survey of the road alignment covering the landforms, flora, vegetation and vertebrate fauna of has been carried out.

The alignment passes through extensive areas of native vegetation on private property in the east, through largely cleared or degraded areas on private property in the centre, and through vegetation on private property in the southern edge of the Mt Brown Bush Forever site in the west. The central area includes part of the Wattleup Lake Bush Forever site but away from the lake in an area where there is poor quality vegetation and poor connection to other vegetation. The road should have no impact on the lake itself.

The eastern areas are on Bassendean dunes and have a natural vegetation of Jarrah-Banksia woodland with Sheoak over diverse shrubs and perennial herbs on deep sand. This vegetation is common and well conserved. No rare plant species were found and few if any are likely to be present. There are few rare animal species present or possibly present. None of these rare species would be affected significantly. The alignment misses the only vegetated reserve which is a recreation reserve vested in the Shire of Cockburn and used for conservation. This vegetation is well conserved and there are few constraints on the alignment in this area. These are mainly to limit the extent of clearing and to use native vegetation in rehabilitation as far as possible.

The central areas are Spearwood dunes which had an original vegetation of Tuarts over Jarrah/Banksia woodland but are now largely reduced to scattered remnant trees and little understorey, with only small remnants of better vegetation on private property. There are almost no constraints on the alignment in this area.

Wattleup Lake is part of the Beeliar chain at the junction of the two dune systems, but is severely degraded. The alignment crosses the Bush Forever site through a tenuous corridor to larger reserves to the north. It passes through poor quality vegetation separated from the lake by cleared pasture. The road will increase the separation of the lake from other vegetation but the degree of separation is already high and the additional impact will be small.

The western part is Spearwood dunes. The section in the Mt Brown Bush Forever site includes large areas of native vegetation, but not wetlands. The vegetation is Tuart-Jarrah-Banksia woodland over a shrub understorey on sand, or a limestone heath on more elevated shallow sand and limestone. Both these units are partly degraded due to past disturbance, grazing and excessive burning. Quantitative study shows they are relatively low in species diversity, possibly due to the degree of disturbance. Both these units are well conserved. These units occur elsewhere in the Bush Forever site, but the road will clear or cut off approximately 48ha of the 558ha total There are limited rare species present. There is one Priority 3 plant species which is scarce but widespread from Jurien to Yalgorup. It occurs in the heath vegetation. There are two rare birds (Carnaby's Black-cockatoo and Peregrine Falcon) which would make incidental use of the site, and a large population of the Bandicoot which is a Priority 4 species. The impact on all these rare species will be small in local and regional terms. No species listed under the federal Environmental Protection and Biodiversity Conservation (EPBC) Act will be affected significantly.

The alignment will effectively become the southern boundary of the final Bush Forever site south of the existing Beeliar Regional Park. There is an existing road reservation and the surrounding land is private property or owned by government agencies for industrial purposes. Some of this land is used for a major industrial facility. The main constraint is identified as limiting the impact as much as possible on the Bush Forever site by keeping the alignment as far south as possible and reducing the extent of the cut into the elevated land. This will minimise the impact on the landforms, flora, vegetation, fauna and aesthetics of the site. It is recognised that many other factors are involved in the final selection.

In total the impacts of the project are not severe and can be managed.

2. INTRODUCTION.

Main Roads W.A. proposes to upgrade Rowley Road between the Kwinana Freeway and planned marine-based developments at Kwinana. An ecological survey of the road alignment has been carried out.

Specifically the survey was designed to:

- Describe the landforms and soils.
- Examine the flora, vegetation and vertebrate fauna.
- Determine if any rare plant species are present or likely to be present.
- Record the condition of the vegetation.
- Review the conservation values of the site in both a local and regional context.
- Make recommendations for how the project could be managed to minimise the impacts.

The results of the study are given here.

3. METHODS.

A listing of rare flora species known from the site and region was obtained from the Department of Conservation and Land Management rare flora database and other information, and the habitats of species which might be present were examined from collections in the W.A. Herbarium.

The landforms, soils, flora, and vegetation were examined by making extensive traverses on foot and by vehicle, and describing typical sites. The condition of the vegetation was recorded by looking at disturbance, the diversity of species, dieback, weeds, grazing and other factors, and rated on the scale of Keighery (1994) which is a scale of 1 to 6:

1. Pristine or nearly so.

2. Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.

3. Vegetation structure altered, obvious signs of disturbance.

4. Vegetation structure significantly altered by very obvious signs of multiple disturbance, retains basic vegetation structure or ability to regenerate it.

5. Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.

6. The structure of the vegetation is no longer intact and the area is completely or almost without native species.

This scale tends to over-estimate the condition but is appropriate for urban situations where all remnant vegetation may be valuable.

All plants were identified as far as possible, but the survey was carried out in autumn/early winter so that some of the spring flora would not have been present. A specific watch was kept for rare species which might be present. The flora survey was concentrated on the area to be disturbed, with less attention to neighbouring areas. Species were identified in the field or collected and identified from keys and reference to material in the W.A. Herbarium. Weeds were recorded where they occurred in or around native vegetation and on roadsides but not if they occurred only in purely pasture or developed horticultural areas.

A quantitative study of the vegetation in the Mt Brown Bush Forever area was carried out by recording all species in plots of $100m^2$, to allow comparison with regional studies.

The vertebrate fauna was examined by limited cage and Elliott trapping (due to the unfavourable time of the year for pit trapping), extensive observations and opportunistic searching. Opportunistic searching included raking leaf litter, turning logs and rubbish, turning over bark, digging out burrows, and searching for tracks, diggings, droppings, bones, feathers and any other signs which could be identified. Direct observations were mainly related to birds and the larger mammals which were identified by sight or from calls. In addition all vertebrate fauna species which might occur in the site were listed from the habitats, local knowledge and general information on the habitat preferences of the species. This list was drawn up conservatively to detect all species of interest which might be present.

The field work was carried out in May and early June 2000 at about the break of season.

4. RESULTS.

4.1 Landforms and soils.

The site lies on the western part of the coastal plain and the present surface is the result of a series of dune movements as climatic conditions have changed with repeated ice ages. The site can be divided into Bassendean dunes on the eastern side and Spearwood dunes on the western side, with the Beeliar wetland chain at Wattleup Lake roughly forming the boundary.

The Bassendean dunes are older and consist of more leached grey sand over deep yellow sand. They are undulating with generally low slopes, and the original dune shapes are heavily modified. Low-lying areas may occur within these dunes but not in the road alignment.

The Spearwood dunes are younger and less leached. They have more yellow sands often over shallow limestone. The limestone is the cemented remains of wind-blown dunes which have become fixed. Limestone may be exposed, particularly towards the coast and on the upper slopes. These dunes can be divided into the inland Karrakatta unit with deeper sands and the more coastal Cottesloe unit with shallower sands.

The wetlands are due to ponding of water behind the dunes. They have a variety of soils regionally which are generally more humic or clayey than the surrounding dunes.

West of Cockburn Road there is a very narrow coastal strip of Quindalup dunes corresponding to the youngest beach dunes, which is not considered here.

4.2 Flora.

All plant species recorded are listed in Appendix 1. The weed species are also identified.

Appendix 1 lists a native flora of 178 species in 111 genera and 43 families. In addition there are 69 weed species listed in 61 genera and 32 families, giving a total flora of 247 species in 172 genera and 67 families. In the native flora the most diverse groups are the typical families of trees and woody shrubs: the Proteaceae (Banksia family, with 19 species), Myrtaceae (eucalypts and myrtles, with 18 species), Papilionaceae (legumes, with 14 species) and Mimosaceae (Acacias, with 10 species), and the less conspicuous but still diverse perennial herbs: the Cyperaceae (sedges, with 12 species), Dasypogonaceae (mainly Lomandras, with 11 species) and Anthericaceae (lilies, with 10 species). These are the typical dominant families of the coastal plain woodlands.

The weeds are diverse and include shrubs, succulents, herbs and grasses from many families.

Appendix 1 is not a complete list of the flora due to the seasonal constraint, but probably includes the great majority of the perennial native flora and a large part of the spring flora. Some small annual species would have been missed as at least some were present only as seedlings. Some bulbous species such as orchids may also have been missed. Relatively limited attention was given to weeds, and many other annual herb and grass species are present.

Most of the species in Appendix 1 are common or widespread. The only previously known occurrence of a rare flora species in or near the study area considered here was *Hibbertia spicata* ssp. *leptotheca* which is a Priority 3 species recorded in the Mt Brown Bush Forever site (W.A. Planning Commission 2000).

No Declared Rare Flora species were found. The only Priority species found was *Hibbertia spicata* ssp. *leptotheca* which is a Priority 3 species. It is a small shrub known from limestone areas from Jurien south to Yalgorup and may be more extensive. It is present as scattered plants in the limestone heath area.

In addition the following species of possible interest were found:

Hemigenia barbata which occurs mainly to the north and east of Perth as far north as Stockyard Gully but is rare on the coastal plain where it occurs on limestone. This population appears to be the southern edge of its range.

Petrophile serruriae is assumed to be the limestone variant which may be a different species. It is widespread.

There are no Declared Rare Flora species likely to be present. The nearest recorded species is the orchid *Caladenia huegelii* known from east of the Freeway. A few other Priority species have been recorded regionally of which the most likely to be present are *Jacksonia sericea* (Priority 3) found on sand and limestone and *Dodonaea hackettiana* (Priority 4) found on limestone and around wet areas.

Priority 3 species are defined by CALM as "Poorly known taxa. Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (ie. not currently endangered), either due to the number of populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey".

Priority 4 species are defined as "Rare taxa. Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa requiring monitoring every 5-10 years".

Weeds are a major element of the flora, with 69 species recorded and others will be present and identifiable in spring. These weeds are all common or widespread locally and regionally. Many other weed species were present in adjacent pasture and horticultural areas.

4.3 Vegetation.

The vegetation was mapped into convenient sections derived from the natural units present, blocks of vegetation in different condition and land boundaries (Map 1, next page). These are described here, and typical sites are illustrated. The flora recorded in each of the four major areas is listed in Appendix 1.

1. Jarrah-Banksia woodland with Sheoak on Bassendean dunes (Plate 1, page 11).

This is a widespread unit with a characteristic structure of scattered Jarrah and Sheoak trees over dense Banksia trees 5-8m tall with a diverse shrub and perennial herb stratum usually less than 1m tall. There are limited native grasses and annual species. Typical species are:

Trees: Jarrah, Sheoak, *Banksia attenuata* and *Banksia menziesii*.

Shrubs and woody herbs: *Hibbertia hypericoides*, *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Leucopogon conostephioides*, *Conostephium pendulum*, *Acacia pulchella*, *Acacia stenoptera*, *Calytrix flavescens*, *Calytrix fraseri*, *Eremaea pauciflora*, *Hypocalymma robustum*, *Scholtzia involucrata*, *Bossiaea eriocarpa*, *Daviesia triflora*, *Gompholobium tomentosum*, *Hardenbergia comptoniana*, *Hovea trisperma*, *Jacksonia furcellata*, *Nemcia capitata*, *Dryandra lindleyana* and *Petrophile linearis*.

Perennial herbs: *Dampiera linearis*, a wide variety of triggerplants, sundews, lilies, Lomandras, orchids, sedges and rushes.

This vegetation is noted for its diversity of species, and although it is apparently structurally homogeneous it is now recognised as including considerable variation which has been revealed by floristic study (Gibson *et al.* 1994).

2. Disturbed Tuart-Jarrah-Banksia woodland over a shrub understorey on Spearwood dunes (Plate 2).

This unit is probably heterogenous but has been distinguished because it is largely cleared or degraded and cannot be described in detail. The density of Tuart and Jarrah trees varies greatly, and either may be apparently absent. The original lower tree stratum of Banksias has been largely removed but in the best remaining remnants it is dominated by *Banksia attenuata* and *Banksia menziesii* with smaller numbers of *Banksia ilicifolia* and rarely *Banksia grandis*. Where the understorey is intact it may be reasonably diverse (see the species list in Appendix 1), but over most of the area it is either absent or reduced to the more resistant species such as *Xanthorrhoea preissii*, Melaleucas, Jacksonias and Dryandras, or is largely regrowth of Acacias and other opportunistic species.

2 (5-6)
2 (4-5)
2 (3-4)
2 (4)
2 (5)
1 (3)
1 (4-5)
1 (2)
1 (6)
2 (3-4)
POINT A
2 (4-5)
1 (3-4)
1 (2)
WATTLEUP LAKE
SAND QUARRY A
SAND QUARRY B
HAMMOND RD
KWINANA FREEWAY - THIRD DESIGN

4 (2-3)

4 (2-3)

3 (2-3)

2 (5)

2 (5)

2 (5)

2 (5)

2 (5-6)

2 (5-6)

2 (4-5)

2 (3-4)

2 (3-4)

2 (4)

2 (5)

POINT A

WATTLEUP

(4)

ROCKINGHAM RD STH DIRECTION

PROPOSED ROCKINGHAM WAY RAMP CONNECTION

ROCKINGHAM ROAD CLOSURE

PROPOSED ROCKINGHAM WAY RAMP CONNECTION

BUS TRANSITWAY

INDUSTRIAL HEAVY ACCESS

SEE PANEL

TRAFFIC SIGN GANTRY

RAIL UNDERPASS

EXISTING RAIL

ROCKINGHAM ROAD

BUS TRANSITWAY

INDUSTRIAL AREA

LIMESTONE QUARRY D

MIN R.L 6.8m

HIGH OPTION - MCH1

LOW OPTION - MCL1

SEE PANEL

POSTERS RD STH EXISTING

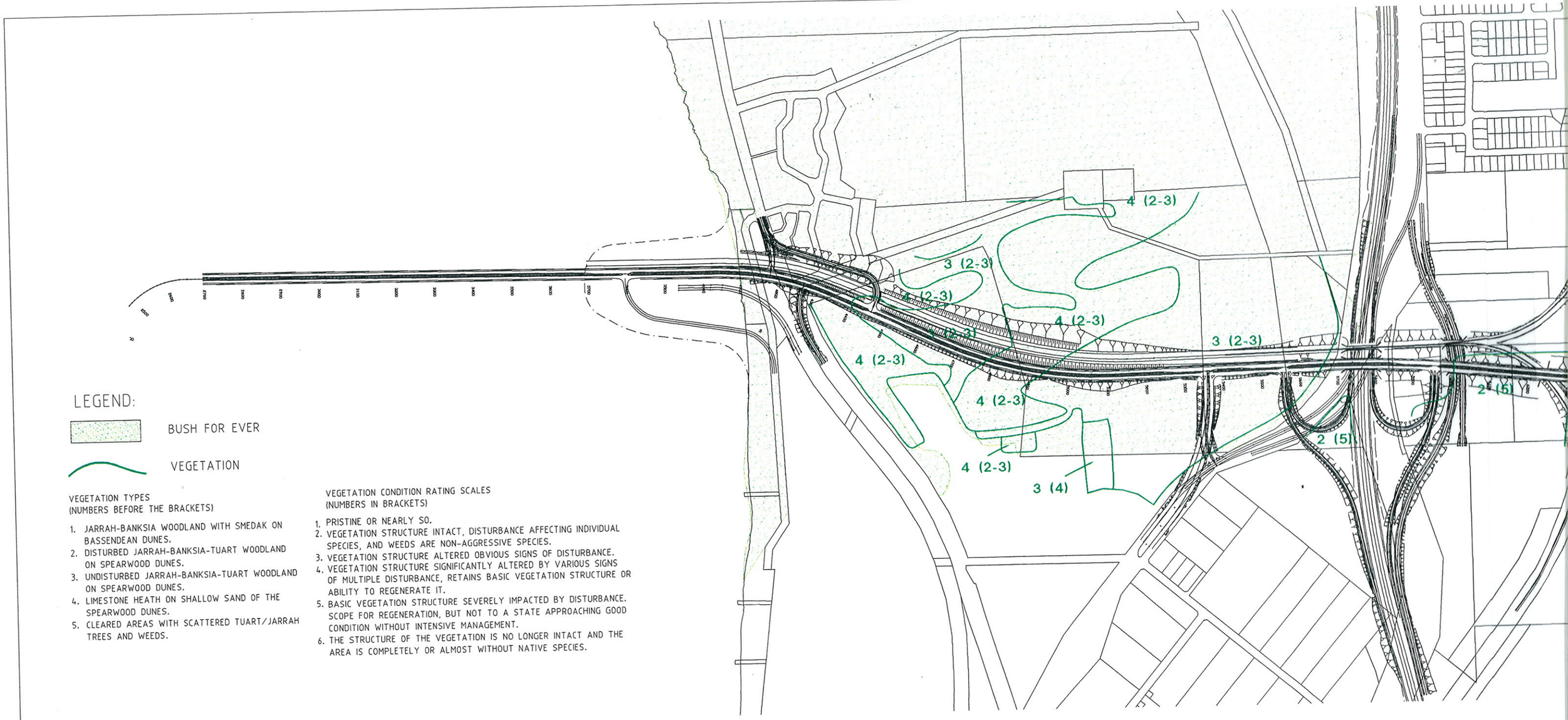
POSTERS RD STH RE-ALIGNMENT

LIMESTONE QUARRY C

MIN R.L 13.0m

ANKERSLIP RD STH

ANKERSLIP RD STH



LEGEND:

BUSH FOR EVER

VEGETATION

VEGETATION TYPES
(NUMBERS BEFORE THE BRACKETS)

1. JARRAH-BANKSIA WOODLAND WITH SMEDAK ON BASSENDEAN DUNES.
2. DISTURBED JARRAH-BANKSIA-TUART WOODLAND ON SPEARWOOD DUNES.
3. UNDISTURBED JARRAH-BANKSIA-TUART WOODLAND ON SPEARWOOD DUNES.
4. LIMESTONE HEATH ON SHALLOW SAND OF THE SPEARWOOD DUNES.
5. CLEARED AREAS WITH SCATTERED TUART/JARRAH TREES AND WEEDS.

VEGETATION CONDITION RATING SCALES
(NUMBERS IN BRACKETS)

1. PRISTINE OR NEARLY SO.
2. VEGETATION STRUCTURE INTACT, DISTURBANCE AFFECTING INDIVIDUAL SPECIES, AND WEEDS ARE NON-AGGRESSIVE SPECIES.
3. VEGETATION STRUCTURE ALTERED OBVIOUS SIGNS OF DISTURBANCE.
4. VEGETATION STRUCTURE SIGNIFICANTLY ALTERED BY VARIOUS SIGNS OF MULTIPLE DISTURBANCE, RETAINS BASIC VEGETATION STRUCTURE OR ABILITY TO REGENERATE IT.
5. BASIC VEGETATION STRUCTURE SEVERELY IMPACTED BY DISTURBANCE. SCOPE FOR REGENERATION, BUT NOT TO A STATE APPROACHING GOOD CONDITION WITHOUT INTENSIVE MANAGEMENT.
6. THE STRUCTURE OF THE VEGETATION IS NO LONGER INTACT AND THE AREA IS COMPLETELY OR ALMOST WITHOUT NATIVE SPECIES.

ROWLEY ROAD - NAVAL BASE PORT
VEGETATION CHARACTERISTICS
MCL1 & MCH1
DRG No : ROWLEY ENVIRONMENTAL PLAN.DWG

DRAWN - AN/SLB
JOB No 611 1800 0601
SCALE H 1:1000 V 1:100
DATE 01.02.92

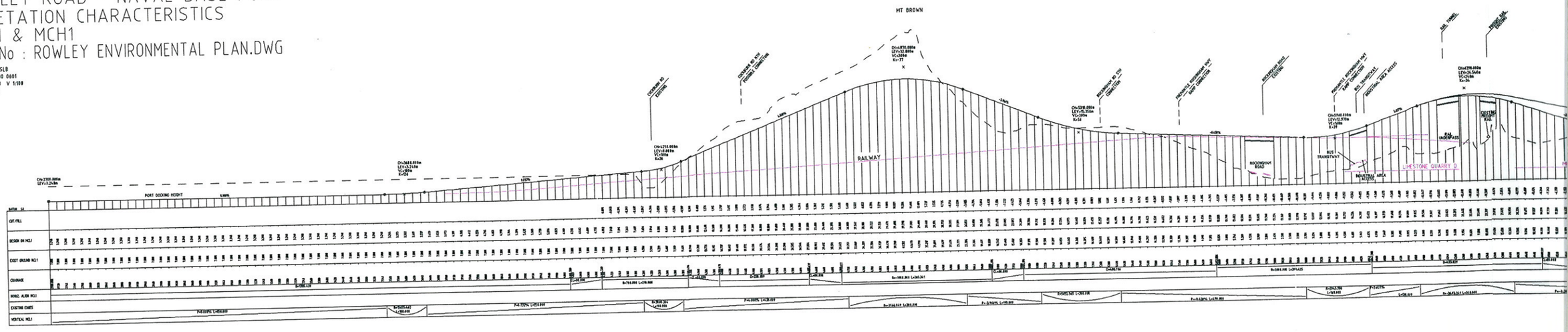


PLATE 1. Typical Jarrah-Banksia woodland on Bassendean dunes

PLATE 2 Typical view of highly disturbed Tuart-Jarrah-Banksia woodland area

In one location (Point A in Map 1) there is a tiny remnant of the outer edge of the original fringing vegetation around Wattleup Lake which has been cleared elsewhere. This remnant has been reduced to a few individuals of *Melaleuca preissiana*, *Eucalyptus rudis*, *Banksia littoralis* and a few understorey species, but is dominated by weeds. This remnant is in a block of private property with typical Tuart-Jarrah-Banksia woodland with a disturbed understorey heavily affected by weeds.

3. Tuart-Jarrah-Banksia woodland over a shrub understorey on Spearwood dunes in the Mt Brown Bush Forever site (Plate 3, next page).

Tuart is patchy and generally sparse, although it may have been reduced by tree cutting. Jarrah is more common but still sparse, and it has been severely affected by tree cutting. Sheoak is present but very rare. The lower tree stratum consists of *Banksia attenuata* and *Banksia menziesii*. *Banksia grandis* is rare and *Banksia ilicifolia* is absent.

The shrub and woody herb understorey is dominated by *Hibbertia hypericoides* with other common species being *Acacia pulchella*, *Melaleuca systena*, *Xanthorrhoea preissii* and *Macrozamia riedlei*. Perennial herbs are sparse at about 2% cover. Typical species are *Mesomelaena pseudostygia*, *Schoenus latitans*, *Burchardia congesta*, *Desmocladus flexuosus*, *Conostylis setigera* and *Dianella revoluta*. No native grasses and annual herbs were recorded but a few may be present.

This unit is conspicuously less diverse than the Jarrah-Banksia woodland on the Bassendean dunes.

This vegetation is variable, probably in response to the depth of soil over limestone. In some areas the eucalypts drop out and the woodland reduces to Banksias over an understorey dominated by *Melaleuca systena*. In places this could be described and mapped as Banksia woodland, particularly on the western side, but is regarded here as a reduced form of the unit because Jarrah is still occasionally present as a stunted small tree.

In the extreme forms where limestone is very shallow the Banksias may also drop out leaving a shrubland dominated by *Xanthorrhoea preissii*, *Melaleuca systena*, *Hakea prostrata*, *Allocasuarina humilis*, *Acacia pulchella*, *Hibbertia hypericoides* and *Dryandra lindleyana*, with limited perennial herbs dominated by *Mesomelaena pseudostygia*, *Drosera erythrorhiza*, *Desmocladus flexuosus*, *Schoenus latitans* and *Lomandra maritima*. This shrubland variant becomes transitional to the heath unit described below and the best developed area could be mapped as heath.

PLATE 3. Tuart-Jarrah-Banksia woodland on Spearwood dunes in the Mt Brown Bush forever site.

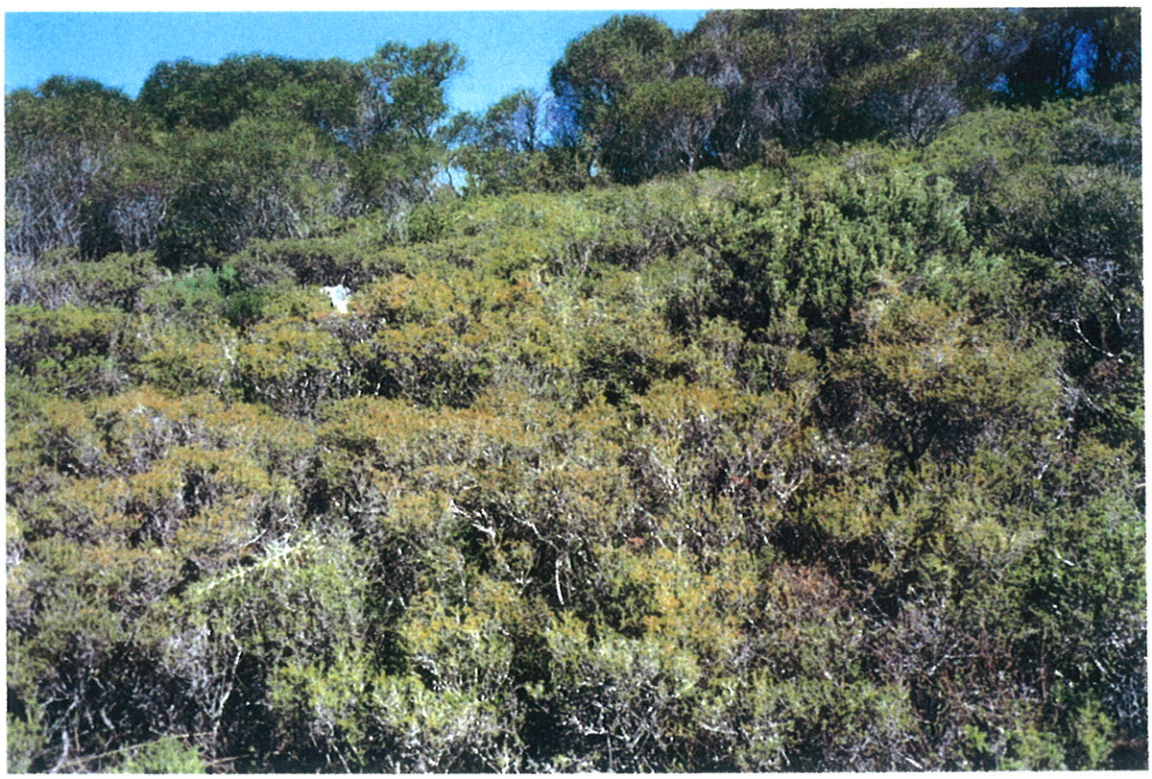


PLATE 4 The Limestone heath in the Mt Brown Bush Forever site, with largely *Melaleuca systena* in the foreground and *Acacia rostellifera* behind

4. Limestone heath on shallow sand and limestone (Plate 4).

This unit is dominated by low shrubs of *Melaleuca systena* and *Hibbertia hypericoides*, with a limited range of other shrub species such as *Hakea prostrata*, *Dryandra lindleyana*, *Allocasuarina humilis*, *Acacia pulchella*, *Calothamnus quadrifidus* and *Grevillea preissii*. There may be clumps of emergent *Acacia rostellifera*, *Melaleuca huegelii* or *Dryandra sessilis*.

There is a limited perennial herb stratum. Typical species are *Conostylis candicans*, *Lomandra maritima*, *Mesomelaena pseudostygia*, *Burchardia congesta*, *Acanthocarpus preissii*, *Desmocladus flexuosus* and *Schoenus grandiflorus*. Native grasses are rare, but some annual herbs may be present. Weeds are common.

There is sometimes a gradual change between the two units described above, and at their junction there may be extensive areas of woodland reduced to Banksia trees over an impoverished understorey, and occasional Banksia trees occur within the heath presumably where there is sufficient soil.

The results of the quantitative vegetation study of plots in the Mt Brown Bush Forever site are given in Appendix 2. Three replicate sites were recorded in each of the woodland and heath. The results are summarised in Table 1 (below). It should be noted that these plots were recorded in May and were recorded only once. They would not include the complete flora because some of the spring flora may have been missed, including annual native herbs, some bulbous species and some annual weeds. The results probably include almost the entire woody perennial flora.

TABLE 1. Numbers of species in plots of 100m^2 in Tuart-Jarrah-Banksia woodland and limestone heath.

	PLOTS					
	Woodland			Heath		
	1	2	3	4	5	6
SPECIES						
Trees	2	3	2			
Shrubs/woody herbs	8	6	7	5	11	12
Perennial herbs	8	5	14	7	8	9
Annual herbs/grasses				1	1	
Weeds	7	7	4	3	5	5
Total native species	18	14	23	13	20	21
Total weed species	7	7	4	3	5	5
Total species	25	21	27	16	25	26

Vegetation condition.

The condition of each block of vegetation is given in Map 1. In general much of the Bassendean dune vegetation in the east is in excellent condition, most of the central area has little or no native vegetation, and the Mt Brown Bush Forever site has vegetation in generally good condition but with significant disturbance. Large parts of the central area have been mapped as Condition 5 but much of this is little more than scattered Tuart trees over mainly weeds.

There were scattered tree deaths in many sites but no evidence was found for the presence of dieback due to *Phytophthora cinnamomi* anywhere in the study area. The eastern end is susceptible to infection but the central and eastern parts are weakly susceptible. Most of the damage seen was due to physical disturbance for a variety of reasons, a long history of grazing particularly in the central and western parts, considerable wood cutting over many years, rubbish dumping and excessive burning. This has resulted in extensive weed invasion in the central and western part including in the Mt Brown Bush forever site. Although grazing by stock has stopped there is continuing grazing by rabbits which is severe in places and is probably continuing the cycle of disturbance, weed invasion and excessive fires.

The area in the Mt Brown Bush Forever site is the most complex.

Much of the area in the south around the Alcoa facility has been completely disturbed and rehabilitated but with mainly non-indigenous species and the resulting vegetation does not qualify as native vegetation, and is shown in Map 1 as not vegetated although some of it is within the Bush Forever site.

There is the remains of an old house north of Mt Brown, and old aerial photographs show a considerable area of houses opposite the present Naval Base settlement. These have affected the surrounding areas and caused some localised severe disturbances.

The area in the west is the most disturbed. Apart from some excavations, much of the understorey appears to have been removed from some areas at some time in the past. Many of the Banksia trees may have been removed as well. This damage may have been caused by grazing many years ago but is localised and may also have been caused by rubbish dumping or some other direct disturbance.

There are areas of rehabilitation scattered throughout this western area, including evidence of hydro-mulching and tree planting. Much of the planting has been unsuccessful.

Although this area has been disturbed in part, it is now regenerating and in the long term can be expected to return to something like the original native vegetation.

4.4 Fauna.

Trapping was limited to Elliott and cage trapping carried out in the three main areas of extensive vegetation remaining: in the Banksia woodland near the Freeway, the woodland near Mt Brown and the heath near Mt Brown. The trapping produced only mammals, as would be expected in autumn/early winter. Table 2 (below) lists the sites, trap nights, captures and numbers of individuals caught. Only House Mice were caught in the Elliott traps, and Bandicoots in the cage traps. The House Mouse was caught in all sites and was most common in the Mt Brown area, which would be expected because it is more disturbed. The Bandicoots were marked before release so that the total number of individuals could be counted. The trapping of Bandicoots suggests that there is a large population in the Mt Brown area, but a sparse population near the Freeway. The animals in the woodland near Mt Brown were caught mainly in the areas with more heath in the understorey rather than the more open areas. A total of 21 individuals was caught, but the animals trapped were mainly males (Table 2) suggesting that the total population is much larger.

TABLE 2. Fauna trapping results. Results are shown as numbers of captures or number of different individuals as appropriate.

Site	Banksia woodland	Mt Brown, Woodland	Mt Brown, Heath	
Cage trap nights	32	32	32	
Bandicoot captures	3	20	9	
Bandicoot individuals, males	2	9	8	
Bandicoot individuals, females	1	3	1	
Total minimum number of individuals	3	12	9	
Elliott trap nights	120	160	160	
House Mouse captures	4	11	13	
Trap nights	152	192	192	
Total trap nights				536

Opportunistic searching produced a range of species, mainly lizards (Table 3, next page but numbers were low. The opportunistic searching supported the conclusion that there is a large population of Bandicoots in the Mt Brown area, particularly in the heath areas, but a sparse population near the Freeway. The Bandicoots near the Freeway may be mainly living in denser vegetation in wet areas further south. Conversely Kangaroos are common near the Freeway but apparently absent from the Mt Brown area. Halpern Glick and Maunsell (1997) found the Kangaroo to be present in small numbers in the Beeliar area to the north of Mt Brown, but it is not known if this species still survives there or ever occurs south of Mt Brown. It may be declining due to increasing development of the land.

The species of birds recorded are listed in Table 4 (page 19), with some indication of their abundance. A total of 34 native species was recorded, and three introduced species. In addition, three incidental aquatic species were observed overhead: the Pelican, White-faced Heron and Australian Shelduck.

Appendix 3 lists all the vertebrate fauna species which may occur in the study area, although the total number of species which actually occurs there is not known.

Most of the species listed in Appendix 3 are common or widespread. The following species with some classified conservation status are or may be present:

- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), which is gazetted under Schedule 1 of the Wildlife Act as "Rare or likely to become extinct" and is also a trigger under the federal Environmental Protection and Biodiversity Conservation (EPBC) Act. This species breeds primarily in the northern and eastern parts of its range and tends to move to the coastal belt when not breeding where it feeds on native shrubs and trees (particularly proteaceous species) as well as pine trees. It is threatened primarily by loss of tree hollows for breeding, particularly in the wheatbelt. This is probably the species recorded (Table 4) as groups moving past. It would be a casual visitor, but the site cannot be considered as essential to its survival in total.

- The Peregrine Falcon (*Falco peregrinus*), which is gazetted under Schedule 4 of the Wildlife Act as "In need of special protection". The Peregrine Falcon is a very widespread although uncommon species which was once thought to be threatened by egg-shell thinning due to pesticides, illegal hunting as a pest, and capture for falconry and the cage trade (Kennedy 1990, Garnett 1992), but has now been deleted from the latest national Action Plan for Australian birds (Garnett and Crowley 2000). In Western Australia this species is regarded as uncommon but secure, and it is mainly gazetted to protect it from illegal capture. It would make occasional but only incidental use of the site considered here, probably using the large trees as a convenient hunting platform when chasing other birds.

TABLE 3. Opportunistic fauna survey results. Results are shown as numbers of individuals or as present (P) where individuals could not be counted.

	Banksia woodland	Mt Brown Woodland	Mt Brown Heath
SPECIES			
FROGS			
Limnodynastes dorsalis		1	
LEGLESS LIZARDS			
Delma fraseri	3		
SKINKS			
Cryptoblepharus plagiocephalus			
Hemiergis quadrilineata			
Menetia greyi			
Morethia lineoocellata	1		
Tiliqua occipitalis			1
Tiliqua rugosa	3		
SNAKES			
Pseudonaja affinis		1	
Suta gouldii	1		
MAMMALS			
Bandicoot	P	P	P
Grey Kangaroo	P		
Rabbit	P	P	P
Fox	P	P	P
Cat			1

TABLE 4. Bird species recorded. Results are given as common or at least recorded routinely (XXX), occasional (XX) or scarce (X).

	Banksia woodland	Mt Brown, Woodland	Mt Brown, Heath
Black-shouldered Kite			XX
Whistling Kite			X
Little Eagle			X
Nankeen Kestrel			X
Common Bronzewing	XXX	X	
* Laughing Dove	XX	XX	
* Feral Pigeon		X	
Carnaby's Black-Cockatoo	X	X	
Australian Ringneck	XXX	XXX	
Red-capped Parrot	XXX	XXX	
Fan-tailed Cuckoo		X	
* Laughing Kookaburra	XX	XX	
Splendid Fairy-wren	X	X	XXX
Striated Pardalote	XXX	XXX	
White-browed Scrubwren			XXX
Weebill	XXX	XXX	
Western Gerygone	XXX	XXX	X
Inland Thornbill			XXX
Yellow-rumped Thornbill	XX	XX	X
Red Wattlebird	XXX	XXX	X
Little Wattlebird		XXX	X
Singing Honeyeater	XXX	XXX	XX
New Holland Honeyeater	XXX	XXX	XX
Western Spinebill	X		
Rufous Whistler	XX	XX	
Grey Shrike-thrush	X	X	
Magpie-lark	XX	XX	
Grey Fantail	XXX	XXX	X
Willie Wagtail	XX		X
Black-faced Cuckoo-shrike	XXX	XXX	XX
Grey Butcherbird	XXX	XXX	X
Australian Magpie	XXX	XXX	
Australian Raven	XXX	XXX	XXX
Richard's Pipit	X		
Welcome Swallow	XX	X	XX
Tree Martin			X
Silvereye	XXX	XXX	XXX

In addition to these species which have a formal gazetted conservation status, the Department of Conservation and Land Management also lists Priority species which are restricted, vulnerable or too poorly known to be considered for gazetting. These species have no special protection, but their presence is normally considered.

The only Priority species which occurs is:

- The Southern Brown Bandicoot (*Isoodon obesulus*), which is a Priority 4 species. The Bandicoot occurs widely in the South-West. It has declined greatly due to land clearing and fox predation, but is still common over much of the South-West. It is regarded as vulnerable because of the loss of many other mammal species of comparable size, but it has survived over a large part of its range and is not endangered. It has declined on the Swan Coastal Plain due to habitat clearing, and is now largely restricted to denser vegetation where it can survive fox predation. In this study it was found to be common in the Mt Brown Bush Forever site, and survives in smaller numbers around the Freeway.

Priority 4 species are defined as "Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands".

Other species which are migratory are protected in accordance with international treaties with China and Japan, and are triggers under the federal Environmental Protection and Biodiversity Conservation (EPBC) Act. The Fork-tailed Swift and Rainbow Bee-eater are listed in this category. These are both common and widespread species in Australia and require no specific protection. They would not be affected by the loss of small areas of habitat.

Introduced species are restricted to the Kookaburra, Pigeon and two doves, and a suite of mammals found in all areas. No control of these is possible on a local scale.

5. DISCUSSION.

The conservation values which could be given to the land derive from:

- The presence of rare species.
- The rarity and conservation status of the landforms, vegetation units and fauna habitats.
- The value of the land and vegetation in a local and regional context because of its position and regardless of its intrinsic values.

The flora survey was carried out in autumn and would therefore have missed some spring species, but it was comprehensive and adequate to assess the status of the flora. The present survey produced 98 native species, which is high given the small area, season and lack of wetlands. Other information is available from Keighery and Keighery (1993), Weston (1993), Keighery (1996), Semeniuk, V and C Research Group (1997) and Halpern Glick and Maunsell (1997).

The fauna survey was restricted to limited trapping because of the season, opportunistic searching and observations. This produced one frog species, nine reptile species, 34 native terrestrial birds and two native terrestrial mammals. Birds can be recorded with some confidence in such a survey, and the total of 34 species is reasonable for a single survey although others will certainly be recorded over time. However, this survey would have failed to detect many ground species because it is necessary to trap extensively to reveal all species (reviewed by How 1998). For this reason a list of all species which might be present was constructed so that all possible rare species could be considered. Halpern Glick and Maunsell (1997) describe a similar fauna survey but also using pit trapping and opportunistic searching in April 1997 in the Beeliar Regional Park to the north of Mt Brown, with similar results of no frogs, six species of reptiles, 51 species of birds (including aquatic species) and two native mammal species.

No Declared Rare Flora species were found on the site, and it is unlikely that any are present. The only Priority species found was *Hibbertia spicata* ssp. *leptotheca*, which is only a Priority 3 species and known from Jurien to Yalgorup. This species is present as scattered plants in the limestone heath and the impact on this species would not be significant in a local or regional context. There are limited other Priority plant species which might be present.

There are limited rare animals present or which might be present. The only Schedule 1 species, Carnaby's Black-Cockatoo, and the only Schedule 4 species, the Peregrine Falcon, would make only occasional and incidental use of the site. There is only one Priority 4 species present or possibly present, and again the impact on this species would not be significant in a local or regional context. The Bandicoot was found to be abundant in all habitats in a study of the Beeliar Regional Park to the north of Mt Brown (Halpern Glick and Maunsell 1997).

In total there are limited rare species present or potentially present, and the presence of these rare species is not sufficient to prevent any development of the site.

The landforms vary from typical Bassendean dunes to Spearwood dunes with a variety of sand over limestone and exposed limestone in places in the Karrakatta and Cottesloe units. The proposed road alignment impinges on a large hill to the south of Mt Brown. While these landform units are widespread along the coast, these hills are a major landscape feature because of their size and natural vegetation.

The vegetation units follow the landforms. According to the system of DCE (1980) the vegetation can be divided into the following Systems from east to west:
Bassendean Complex - Central and South
Karrakatta Complex - Central and South
Cottesloe Complex - Central and South.

More recently Gibson *et al.* (1994) have further refined the divisions of the regional vegetation by looking at floristics. In their analysis the vegetation described here would probably represent from east to west:
Bassendean dunes: Community Type 21a (Central *Banksia attenuata-Eucalyptus marginata* woodlands).
Spearwood dunes woodlands: Community Type 28 (*Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands).
Spearwood dunes heath: Community Type 24 (Northern Spearwood shrublands and woodlands).

It is difficult to identify some of these Community types precisely, and the sites in the Mt Brown area show low species diversity. From Table 1 the woodland sites have an average of 24 species including six weeds and the heath sites have an average of 22 species including four weeds. These numbers would under-estimate the totals because they were recorded only once and in autumn, but these numbers are well below the averages of 55 and 42 species given by Gibson *et al.* (1994). These lower numbers are consistent with the partly degraded state of the vegetation, although they may also reflect real variations.

There has been no regional mapping of these Community Types, but Gibson *et al.* (1994) classify Community Type 21a as both well reserved and at low risk, Community Type 28 as both well reserved and at low risk, and Community Type 24 as well reserved but susceptible presumably because this type is very prone to degradation by human activities.

In accordance with the abundance of the landform and vegetation units, the fauna habitats are common, and there are no unusual or unique features. Accordingly there are few rare species present or which might be present.

There are no threatened ecological communities in the area considered here.

In total there are limited conservation values attached to the land due to the landforms, flora, vegetation and fauna.

Although there are limited specific conservation values attached to the land, there are some high values due to the location of some of the land.

The eastern part is on private property. The alignment has been designed to miss the only vegetated reserve (Frankland Reserve) which is a recreation reserve vested in the Shire of Cockburn and used for conservation. The landforms, flora, vegetation and fauna in this area are conserved elsewhere and do not represent a major constraint on the development of the road.

The central area is mainly disturbed with little or no native vegetation and limited remnants of native vegetation on private property. The landforms, flora, vegetation and fauna do not represent a constraint on the development of the road. The road will result in the removal of a large number of Tuart trees but these are common locally and are mainly scattered trees in degraded land. Part of the proposed alignment passes through the Wattleup Lake Bush Forever site at a point where it has been extended to provide a tenuous link with much larger reserves to the north (see Map 1 and W.A. Planning Commission (2000) Bush Forever Map 64). Wattleup Lake is separated from the road alignment by a cleared paddock, the vegetated block where the alignment is placed is partly degraded, and the vegetated block is also isolated to the north by houses. The proposed alignment just falls within the 200m zone of secondary influence around Wattelup Lake (Hill *et al.* 1996) but with appropriate design the road need have no impact on the lake. The proposed alignment will increase the degree of separation of Wattleup Lake from the reserves to the north, but the connection is already very poor and the additional impact will be small. No specific remedial actions are required.

The western part is within the Mt Brown Bush Forever site. This includes the existing Beeliar Regional Park which extends from roughly Mt Brown north. The Bush Forever site extends south to include all vegetated land not part of previous recommendations for conservation (Map 1 and W.A. Planning Commission (2000) Bush Forever Maps 58 and 64). This land to the south is private property or held by government agencies for industrial purposes and includes the road reservation. This land includes a major industrial facility at the southern end.

The Bush Forever scheme is intended to be a whole of government approach to provide a comprehensive system of conserved land in the metropolitan area where there are many and strong competing interests and the potential for land reservation is either already severely constrained or has already been lost. Bush Forever has identified areas of regionally significant vegetation which provide an adequate and representative set of the ecological communities and habitats. This land is held in a variety of tenures and it is not practical for government to simply acquire control of all this land, and in recognition of the complexity of the issues Bush Forever allows for a wide variety of mechanisms to achieve the desired outcome. Specific allowance is made for existing landowner rights, for trade offs, and for the necessity for regional infrastructure. In all cases the emphasis is achieving the desired outcomes as far as possible.

Bush Forever identifies all of this land as regionally significant. Although the Cottesloe Complex - Central and South is extensive with 36% of the original vegetation remaining, the Bush Forever scheme will result in 19% of it being reserved and this does not necessarily cover all the variation within this vegetation complex (W.A. Planning Commission 2000).

Bush Forever and previous studies of the Beeliar Regional Park identify the following values attached to the land:

- A large limestone ridge.
- Limited rare species.
- A variety of vegetation types including vegetated limestone cliffs along the ocean.
- Significant wetlands (not relevant here).
- A complete sequence of vegetation across the Spearwood dunes from the coast to wetlands.
- An area large enough to provide viable vegetation and habitats, and a buffer to the wetlands.
- A partial corridor to the south although this has already been severely disrupted (see Bush Forever Map 64).

The proposed road alignment is on an existing road reservation, and is within land which is private property or held by government agencies for industrial purposes. The site has unresolved issues typical of those discussed by Bush Forever, and the mechanism for achieving the possible implementation of the Bush Forever scheme needs to be resolved. The road cannot be moved southward out of the Bush Forever site because of the existing industrial facility, and the major objective then becomes that the impacts of the proposed road need to be considered and minimised as far as possible.

The impacts of the proposed road alignment and associated roads will be (see Map 1):

- Direct removal of approximately 21ha of vegetation and the associated flora and fauna.
- Minimal impact on rare species.
- Creating a cut into a large hill south of Mt Brown, which will be visually highly intrusive at least from the south.
- Isolation of approximately 27ha of the Bush Forever site south of the road, most of it vegetated.
- Further severing of the corridor to the south, although this is already broken up and the additional impact will be small.

There will not be any impact on the sequence of vegetation across the Spearwood dunes from the coast to wetlands as only the southern edge of the Bush Forever site will be lost.

It is difficult to estimate the fraction of each vegetation type which will be removed from the total Bush Forever site because the entire site has not been mapped, but from the mapping in this study, Weston (1993), Halpern Glick and Maunsell (1997), and Semeniuk, V and C Research Group (1997) the road will remove or cut off less than 10% of the woodland and heath, and approximately 8.6% of the entire Bush Forever site of 558ha, disregarding condition.

This degree of impact will not result in the loss of any rare species or vegetation type and is acceptable, but the road alignment will effectively become the southern boundary of the final Bush Forever site. The main constraints are therefore identified as:

- Limiting the impact as much as possible by keeping the alignment as far south as possible.

- Reducing the extent of the cut into the elevated land.

It happens that part of the proposed alignment cuts into a large hill in the Bush Forever site on a steep slope, so the exact placement of the cut makes a great difference.

	B	D	W	H
GOODENIACEAE				
Dampiera linearis	X	X		
Lechenaultia floribunda		X		
Scaevola anchusifolia				X
Scaevola canescens	X	X	X	
GYROSTEMONACEAE				
Tersonia cyathiflora			X	
LAMIACEAE				
Hemigenia barbata				X
LAURACEAE				
Cassytha sp.			X	X
LOGANIACEAE				
Logania vaginalis		X		
LORANTHACEAE				
Nuytsia floribunda	X			
MALVACEAE				
* Malva sp.	X			
MIMOSACEAE				
Acacia cochlearis	X			X
Acacia cyclops			X	
Acacia huegelii	X			
Acacia lasiocarpa				X
Acacia pulchella	X	X	X	X
Acacia rostellifera	X	X	X	X
Acacia saligna	X	X	X	X
Acacia stenoptera	X	X	X	
Acacia truncata				X
Acacia wildenowiana	X			
MOLLUGINACEAE				
Macarthuria australis	X			
MYRTACEAE				
Agonis linearifolia		X		
Astartea fascicularis		X		
Calothamnus quadrifidus			X	X
Calytrix flavescens	X	X		
Calytrix fraseri	X			
* Chamelaucium uncinatum	X			
Eremaea asterocarpa ssp. asterocarpa	X			
Eremaea pauciflora	X			
Eucalyptus gomphocephala		X	X	
Eucalyptus marginata	X	X	X	
Eucalyptus rudis		X		

	B	D	W	H
Hypocalymma robustum	X	X		
Kunzea glabrescens	X	X		
* Leptospermum laevigatum	X		X	X
Melaleuca huegelii				X
Melaleuca preissiana		X		
Melaleuca rhaphiophylla		X		
Melaleuca systena			X	X
Melaleuca trichophylla	X			
Scholtzia involucrata	X			
OLEACEAE				
* Olea europea			X	
ONAGRACEAE				
* Oenothera sp.	X		X	
OROBANCHACEAE				
* Orobanche minor	X			X
OXALIDACEAE				
* Oxalis sp.	X	X	X	X
PAPAVERACEAE				
* Eschscholia californica		X		
PAPILIONACEAE				
Bossiaea eriocarpa	X	X		
* Chamaecytisus palmensis		X		
Daviesia nudiflora	X			
Daviesia triflora	X	X	X	
Gompholobium confertum	X			
Gompholobium tomentosum	X	X		X
Hardenbergia comptoniana	X	X	X	X
Hovea pungens			X	
Hovea trisperma	X		X	
Isotropis cuneifolia	X			
Jacksonia furcellata	X	X	X	
Jacksonia sternbergiana	X	X		
Kennedia prostrata	X	X		X
* Lupinus sp.	X	X		
Nemcia capitata	X	X	X	
Templetonia retusa				X
PHYTOLACCACEAE				
* Phytolacca octandra		X	X	
PITTOSPORACEAE				
Pronaya fraseri			X	
PORTULACACEAE				
* Portulaca oleracea	X			

In total the impacts of the project are not severe and can be managed. The following recommendations are made:

- In all areas the impact on native vegetation should be minimised, even to the level of isolated trees which may be significant to birds. Dieback should be controlled in the eastern end particularly near the Frankland Reserve, and in the Mt Brown Bush Forever site although it is very weakly susceptible.

- The road design and management will need to consider the presence of Wattleup Lake.

- Revegetation should be used to support the connections of native vegetation as far as possible, such as by replacing lost trees and maintaining the connection near Wattleup Lake as far as possible.

- The alignment at the western end should be examined to see if it can be moved southward to decrease the total impact and to reduce the extent of cut into the large hill. It is recognised that many other factors are involved in the final selection.

6. REFERENCES.

Department of Conservation and Environment (1980). Atlas of Natural Resources. Darling System, W.A. Department of Conservation and Environment, Perth.

Gibson, N., B.J. Keighery, G.J. Keighery, A.H. Burbidge and M.N. Lyons (1994). A Floristic Survey of the Southern Swan Coastal Plain. Report to the Australian Heritage Commission.

Garnett, S.T and G.M. Crowley (2000). The Action Plan for Australian Birds. 2000. Environment Australia, Canberra.

Hill, A.L., C.A. Semeniuk, V. Semeniuk and A. Del Marco (1996). Wetlands of the Swan Coastal Plain. Volume 2B. Wetland mapping, Classification and Evaluation. Wetland Atlas. Water and Rivers Commission.

Garnett, S. (Ed.) (1992). Threatened and extinct birds of Australia. Royal Australasian Ornithologists Union, Report No. 82.

Halpern Glick and Maunsell (1997). Industrial Infrastructure and Harbour Development, Jervoise Bay. Public Environmental Review for Department of Commerce and Trade in association with Landcorp and Main Roads W.A.

How, R.A. (1998). Long-term sampling of a herpetofaunal assemblage on an isolated urban bushland remnant, Bold Park, Perth. Journal of the Royal Society of W.A. 81, 143-8.

Keighery, B.J. (1994). Bushland Plant Survey. Wildflower Society of W.A., Perth.

Keighery, B.J. (1996). Objection Assessment of the Values of the Vegetation and Flora of the Beeliar Wetlands. Report to Australian Heritage Commission.

Keighery, G.J and B.J. Keighery (1993). Floristics of Reserves and Bushland Areas of the Perth Region (System 6). Part IX: The Flora of Three Coastal Bushland Areas (System 6 Areas M46, M91 and M106) in the Perth Metropolitan Area. Wildflower Society of W.A., Perth.

Kennedy, M. (Ed.) (1990). A complete reference to Australia's endangered species. Simon and Schuster, Sydney.

Semeniuk, V and C Research Group (1997). Natural Reserves Management Study. Report to City of Cockburn.

W.A. Planning Commission (2000). Bush Forever. Report, December 2000.

Weston, A.S. (1993). Beeliar Wetlands area condition assessment. Assessment of condition of non-wetland area in the proposed Beeliar wetlands National Estate area. Report to Australian Heritage Commission.

APPENDIX 1. Plant species recorded in the different areas of Bassendean Dunes (B), central disturbed areas (D), woodland in the Mt Brown Bush Forever site (W) and heath in the Mt Brown Bush Forever site (H)

Introduced species are identified by an asterisk (*)

	B	D	W	H
FERNS				
DENNSTAEDTIACEAE				
Pteridium esculentum		X		
CYCADS				
ZAMIACEAE				
Macrozamia riedlei	X	X	X	X
DICOTYLEDONS				
AIZOACEAE				
* Carpobrotus sp.	X	X	X	X
AMARANTHACEAE				
Ptilotus polystachyus		X	X	
APIACEAE				
Eryngium rostratum	X			
* Foeniculum vulgare	X			X
Platysace sp.	X			
Trachymene sp.				X
Xanthosia huegelii		X		
ASCLEPIADACEAE				
* Gomphocarpus fruticosus	X	X		X
ASTERACEAE				
* Arctotheca calendula	X	X		X
* Conyza sp.	X			X
* Dittrichia graveolens	X			
* Hypochaeris ?glabra	X	X	X	X
* Lactuca serriola			X	X
Olearia axillaris	X			X
Ozothamnus cordifolius			X	X
* Sonchus oleraceus	X	X		
* Ursinia anthemoides	X		X	
BRASSICACEAE				
* Sysimbrium irio	X			
CACTACEAE				
* Opuntia stricta		X	X	
CASUARINACEAE				
Allocasuarina fraseriana	X	X	X	
Allocasuarina humilis	X	X	X	X
CHENOPODIACEAE				
* Chenopodium album	X	X		
* Chenopodium sp. 2	X	X		
* Chenopodium sp. 3		X		
Rhagodia baccata		X		

	B	D	W	H
CRASSULACEAE				
Crassula sp.	X			
CUCURBITACEAE				
* Citrullus colocynthis	X	X		
* Cucumis myriocarpus		X		
DILLENIACEAE				
Hibbertia huegelii	X	X		
Hibbertia hypericoides	X	X	X	
Hibbertia racemosa	X	X	X	X
Hibbertia spicata ssp. leptotheca				X
DROSERACEAE				
Drosera sp. 1 climbing	X	X	X	X
Drosera sp. 2 climbing	X	X		
Drosera ?macrantha	X			
Drosera erythrorhiza	X		X	X
Drosera sp. tiny 1	X			
Drosera ?parvula	X			
EPACRIDACEAE				
Astroloma pallida	X		X	
Conostephium pendulum	X	X		
Leucopogon australis		X		
Leucopogon conostephioides	X			
Leucopogon parviflorus				X
Leucopogon propinquus	X	X	X	
Lysinema ciliatum	X			
EUPHORBIACEAE				
* Euphorbia peplus				X
* Euphorbia terracina	X	X		X
* Euphorbia sp.	X	X		
Monotaxis grandiflora	X			
Phyllanthus calycinus	X			X
* Ricinus communis	X			
FUMARIACEAE				
* Fumaria sp.			X	
GERANIACEAE				
* Erodium sp.	X		X	
* Geranium dissectum			X	
* Geranium molle				X
* Pelargonium capitatum	X	X	X	X

	B	D	W	H
PRIMULACEAE				
* Anagallis arvensis	X			
PROTEACEAE				
Adenanthos cygnorum	X			
Banksia attenuata	X	X	X	
Banksia grandis	X	X	X	
Banksia ilicifolia	X	X		
Banksia littoralis		X	X	
Banksia menziesii	X	X	X	
Dryandra lindleyana	X	X	X	X
Dryandra sessilis		X		X
Grevillea preissii			X	X
Grevillea vestita			X	X
Hakea lissocarpha		X		
Hakea prostrata	X		X	X
Hakea trifurcata			X	
Persoonia saccata	X	X		
Petrophile linearis	X	X	X	
Petrophile serruriae			X	X
Stirlingia latifolia	X	X	X	
Synaphea spinulosa	X			
Xylomelum occidentale		X		
RANUNCULACEAE				
Clematis pubescens		X		
RHAMNACEAE				
Spyridium globulosum				X
Stenanthemum pomaderrioides			X	
Trymalium ledifolium ssp. ledifolium				X
RUBIACEAE				
Opercularia hispidula		X		
Opercularia vaginata	X		X	X
SANTALACEAE				
Leptomeria empetriformis	X			
SCROPHULARIACEAE				
* Verbascum virgatum			X	
SOLANACEAE				
* Nicotiana glauca			X	X
* Solanum nigrum	X	X	X	X
STYLIDIACEAE				
Stylidium brunonianum	X			
Stylidium piliferum	X			
Stylidium repens	X			

	B	D	W	H
THYMELAEACEAE				
Pimelea calcicola				X
Pimelea rosea	X	X		
TROPAEOLACEAE				
* Tropolaeoum majus	X			
VIOLACEAE				
Hybanthus calycinus		X		
ZYGOPHYLLACEAE				
* Tribulus terrestris	X			
MONOCOTYLEDONS				
AGAVACEAE				
* Agave americana			X	
ANTHERICACEAE				
Arnocrinum preissii	X			
Chamaescilla corymbosa	X			
Corynotheca micrantha	X	X		X
Dichopogon capillipes		X	X	
Johnsonia pubescens	X			
Laxmannia squarrosa	X			
Thysanotus manglesii/patersonii	X	X	X	X
Thysanotus sparteus	X	X	X	
Thysanotus triandrus	X			
Tricoryne elatior		X		X
ASPHODELACEAE				
* Asphodelus fistulosus	X		X	X
* Trachyandra divaricata			X	X
ASPARAGACEAE				
* Asparagus asparagoides			X	X
COLCHICACEAE				
Burchardia congesta	X	X	X	X
COMMELINACEAE				
Cartonema philydroides		X		
CYPERACEAE				
Cyathochaeta equitans			X	
Isolepis nodosa				
Lepidosperma leptostachya	X			
Lepidosperma longitudinale		X		
Lepidosperma pubisquameum	X	X	X	X
Lepidosperma squamatum	X	X	X	
Mesomelaena pseudostygia	X		X	X

	B	D	W	H
Schoenus curvifolius	X			
Schoenus grandiflorus				X
Schoenus latitans	X		X	X
Schoenus subfascicularis		X		
Tetraria octandra	X	X	X	
DASYPOGONACEAE				
Acanthocarpus preissii				X
Calectasia cyanea	X			
Dasypogon bromeliifolius	X	X		
Lomandra caespitosa	X		X	X
Lomandra hermaphrodita	X	X	X	X
Lomandra maritima			X	X
Lomandra odora			X	
Lomandra preissii	X			
Lomandra sericea	X			
Lomandra sonderi			X	
Lomandra sp. purple				X
HAEMODORACEAE				
Anigozanthos manglesii	X	X		
Anigozanthos ?humilis	X			
Conostylis aculeata	X	X		X
Conostylis candicans				X
Conostylis setigera	X		X	
Haemodorum paniculatum			X	
Haemodorum spicatum		X		
Phlebocarya ciliata	X	X		
HYACINTHACEAE				
* Lachenalia reflexa		X		
IRIDACEAE				
* Ferraria crispa			X	
* Gladiolus caryophyllaceus	X	X	X	X
* Homeria sp.		X	X	
Patersonia occidentalis	X			
* Romulea rosea	X			X
* Sparaxis bulbifera			X	
* Watsonia sp.			X	
ORCHIDACEAE				
Caladenia flava			X	
* Disa bracteata			X	
Eriochilus dilatatus ssp. dilatatus	X		X	
Leporella fimbriata	X			
Microtis sp.			X	X

	B	D	W	H
Pterostylis ?pyramidalis				X
Pterostylis ?vittata	X		X	
Pyrorchis nigricans	X		X	X
PHORMIACEAE				
Dianella revoluta		X	X	X
POACEAE				
* Aira sp.	X			
Amphipogon turbinatus	X	X		
Austrostipa sp.	X			X
* Avena fatua	X		X	
* Briza maxima	X	X	X	X
* Briza minor	X		X	
* Bromus sp.			X	
* Cynodon dactylon	X	X		
* Ehrharta calycina	X	X	X	X
* Ehrharta longiflora			X	
* Eragrostis curvula	X	X		
* Lagurus ovatus	X	X	X	X
* Pennisetum clandestinum		X		
* Pennisetum setaceum			X	
* Stenotaphrum secundatum	X	X		
Poa drummondiana				X
RESTIONACEAE				
Alexgeorgea nitens	X			
Chordifex sinuosus	X			
Desmocladus flexuosus	X	X	X	X
Hypolaena exsulca	X			
Lyginia imberbis	X	X	X	
XANTHORRHOEACEAE				
Xanthorrhoea preissii	X	X	X	X

APPENDIX 2. Lists of species recorded in plots of $100m^2$.

Introduced species are identified by an asterisk (*).

Plot 1.

Date: 26/5/00

Vegetation: Tuart-Jarrah-Banksia woodland.

Species recorded:

Trees	Banksia attenuata Banksia menziesii
Shrubs/woody herbs	Acacia cyclops Acacia pulchella Dryandra lindleyana Hibbertia hypericoides Macrozamia riedlei Petrophile linearis Stirlingia latifolia Xanthorrhoea preissii
Perennial herbs	Burchardia congesta Dichopogon capillipes Drosera erythrorhiza Drosera sp. Eriochilus dilatatus ssp. dilatatus Lepidosperma squamatum Mesomelaena pseudostygia Pterostylis ?vittata
Native herbs/grasses	
Weeds	* Asparagus asparagoides * Briza maxima * Ehrharta calycina * Gladiolus caryophyllaceus * Hypochaeris glabra * Pelargonium capitatum * Grass

Plot 2.

Date: 26/5/00

Vegetation: Tuart-Jarrah-Banksia woodland.

Species recorded:

Trees	Banksia attenuata Banksia menziesii Eucalyptus marginata
Shrubs/woody herbs	Dryandra lindleyana Hardenbergia comptoniana Hibbertia hypericoides Macrozamia riedlei Petrophile linearis Xanthorrhoea preissii
Perennial herbs	Burchardia congesta Dichopogon capillipes Lepidosperma squamatum Lomandra caespitosa Mesomelaena pseudostygia
Native herbs/grasses	
Weeds	* Asparagus asparagoides * Avena fatua * Briza maxima * Ehrharta longiflora * Fumaria sp. * Gladiolus caryophyllaceus * Oxalis sp.

Plot 3.

Date: 26/5/00

Vegetation: Tuart-Jarrah-Banksia woodland.

Species recorded:

Trees	Banksia attenuata Banksia menziesii
Shrubs/woody herbs	Acacia pulchella Dryandra lindleyana Hibbertia hypericoides Macrozamia riedlei Petrophile linearis Stenanthemum pomaderrioides Xanthorrhoea preissii
Perennial herbs	Burchardia congesta Conostylis aculeata Cyathochaeta equitans Desmocladus flexuosus Dichopogon capillipes Drosera erythrorhiza Drosera sp. Lomandra caespitosa Lomandra sonderi Mesomelaena pseudostygia Pyrorchis nigricans Schoenus latitans Thysanotus manglesii/patersonii Thysanotus sparteus
Native herbs/grasses	
Weeds	* Briza maxima * Gladiolus caryophyllaceus * Hypochaeris glabra * Oxalis sp.

Plot 4.

Date: 26/5/00

Vegetation: Heath.

Species recorded:

Trees	
Shrubs/woody herbs	Acacia cochlearis Acacia pulchella Grevillea preissii Hibbertia hypericoides Melaleuca systena
Perennial herbs	Burchardia congesta Desmocladus flexuosus Drosera erythrorhiza Lepidosperma pubisquameum Mesomelaena pseudostygia Pyrorchis nigricans Thysanotus manglesii/patersonii
Native herbs/grasses	Trachymene sp.
Weeds	* Asparagus asparagoides * Briza maxima * Hypochaeris glabra

Plot 5.

Date: 26/5/00

Vegetation: Heath.

Species recorded:

Trees	
Shrubs/woody herbs	Dryandra lindleyana Dryandra sessilis Grevillea preissii Hibbertia hypericoides Hibbertia spicata ssp. leptotheca Kennedia prostrata Leucopogon parviflorus Melaleuca huegelii Melaleuca systena Phyllanthus calycinus Trymalium ledifolium
Perennial herbs	Acanthocarpus preissii Desmocladus flexuosus Drosera sp. Lomandra caespitosa Lomandra maritima Lomandra sp. Opercularia vaginata Tricoryne elatior
Native herbs/grasses	Poa drummondiana
Weeds	* Asparagus asparagoides * Briza maxima * Ehrharta calycina * Lagurus ovatus * Pelargonium capitatum

Plot 6.

Date: 26/5/00

Vegetation: Heath.

Species recorded:

Trees	
Shrubs/woody herbs	Acacia lasiocarpa Acacia rostellifera Cassytha sp. Dryandra lindleyana Gompholobium tomentosum Grevillea preissii Hibbertia spicata ssp. leptotheca Leucopogon parviflorus Melaleuca systena Phyllanthus calycinus Spyridium globulosum Templetonia retusa
Perennial herbs	Acanthocarpus preissii Conostylis candicans Desmocladus flexuosus Dianella revoluta Drosera sp. Lepidosperma pubisquameum Lomandra maritima Opercularia vaginata Tricoryne elatior
Native herbs/grasses	
Weeds	* Asparagus asparagoides * Briza maxima * Hypochaeris glabra * Lagurus ovatus * Pelargonium capitatum

APPENDIX 3. List of the vertebrate fauna species which might be expected to occur (X) in each habitat. The habitats are identified as:

1. Jarrah-Banksia woodland on Bassendean dunes.
2. Tuart-Jarrah-Banksia on Cottesloe dunes.
3. Heath on limestone.

Introduced species are identified by an asterisk (*).

		1	2	3
A. FROGS				
HYLIDAE				
Litoria adelaidensis	Slender Tree Frog		X	
MYOBATRACHIDAE				
Heleioporus eyrei	Moaning Frog	X	X	
Limnodynastes dorsalis	Western Banjo Frog	X	X	
Myobatrachus gouldii	Turtle Frog	X	X	
Pseudophryne guentheri	Guenther's Toadlet	X	X	
B. REPTILES				
CHELIDAE				
Chelodina oblonga	Oblong Snake-necked Turtle		X	
GEKKONIDAE				
Christinus marmoratus	Common Marbled Gecko	X	X	X
Diplodactylus polyophthalmus	Rusty Gecko			X
Strophurus s. spinigerus	Southwest Spiny-tailed Gecko	X	X	X
PYGOPODIDAE				
Aprasia repens	Yellow-chinned Worm-Lizard	X	X	X
Delma fraseri	Fraser's Delma	X	X	X
Delma grayii	Gray's Delma	X	X	X
Lialis burtonis	Burton's Legless Lizard	X	X	X
Pletholax g. gracilis	Southern Pletholax	X		
Pygopus lepidopodus	Southern Scaly-foot	X	X	X
AGAMIDAE				
Pogona m. minor	Western Bearded Dragon	X	X	X
Tympanocryptis a. adelaidensis	Western Heath Dragon	X		
SCINCIDAE				
Acritoscincus trilineatum	Western Cool Skink		X	
Cryptoblepharus plagiocephalus	Common Crypto	X	X	X
Ctenotus australis	Limestone Ctenotus	X	X	X
Ctenotus fallens	West-coast Ctenotus	X	X	X
Ctenotus gemmula	Jewelled Ctenotus	X	X	
Ctenotus impar	Eleven-striped Ctenotus		X	
Egernia kingii	King's Skink		X	
Egernia napoleonis	Southern Crevice Skink	X	X	X
Hemiergis quadrilineata	Two-toed Earless Skink	X	X	X
Lerista elegans	Elegant Four-toed Lerista	X	X	X
Lerista lineata	Perth Striped Lerista			X
Lerista praepedita	Paddle-footed Lerista	X		X
Menetia greyii	Grey's Menetia	X	X	X
Morethia lineoocellata	Ocellated Morethia	X		X
Morethia obscura	Dark Morethia		X	
Tiliqua occipitalis	Western Bluetongue	X	X	X
Tiliqua r. rugosa	Western Bobtail	X	X	X

		1	2	3
VARANIDAE				
Varanus gouldii	Gould's Monitor	X	X	X
Varanus rosenbergi	Rosenberg's Monitor		X	X
TYPHLOPIDAE				
Ramphotyphlops australis	Southern Blind Snake	X	X	X
ELAPIDAE				
Demansia p. psammophis	Common Whip Snake	X	X	X
Drysdalia coronata	Crowned Snake	X	X	X
Echiopsis curta	Bardick			X
Neelaps bimaculatus	Black-naped Snake	X	X	X
Neelaps calonotus	Black-striped Snake	X	X	X
Notechis scutatus occidentalis	Western Tiger Snake	X	X	X
Pseudonaja a. affinis	Dugite	X	X	X
Simoselaps bertholdi	Jan's Banded Snake	X	X	X
Simoselaps fasciolatus fasciata	Narrow-banded Snake	X	X	X
Simoselaps s. semifasciatus	Southern Shovel-nosed Snake	X	X	X
Suta gouldii	Gould's Snake	X	X	X
Suta nigriceps	Black-backed Snake		X	X
C. BIRDS				
PHASIANIDAE				
Coturnix pectoralis	Stubble Quail	X	X	X
ACCIPITRIDAE				
Elanus axillaris	Black-shouldered Kite	X	X	X
Haliastur sphenurus	Whistling Kite	X	X	X
Lophoictinia isura	Square-tailed Kite	X	X	X
Circus approximans	Swamp Harrier	X	X	X
Accipiter fasciatus	Brown Goshawk	X	X	X
Accipiter cirrhocephalus	Collared Sparrowhawk	X	X	X
Aquila audax	Wedge-tailed Eagle	X	X	X
Hieraaetus morphnoides	Little Eagle	X	X	X
FALCONIDAE				
Falco berigora	Brown Falcon	X	X	X
Falco longipennis	Australian Hobby	X	X	X
Falco peregrinus	Peregrine Falcon	X	X	X
Falco cenchroides	Nankeen Kestrel	X	X	X
COLUMBIDAE				
* Streptopelia senegalensis	Laughing Turtle-Dove	X	X	
* Streptopelia chinensis	Spotted Turtle-Dove	X	X	
Phaps chalcoptera	Common Bronzewing	X	X	
Ocyphaps lophotes	Crested Pigeon	X	X	

		1	2	3
CACATUIDAE				
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	X	X	
Cacatua roseicapilla	Galah	X	X	
PSITTACIDAE				
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	X	X	
Polytelis anthopeplus	Regent Parrot		X	
Barnardius zonarius	Australian Ringneck	X	X	
Purpureicephalus spurius	Red-capped Parrot	X	X	
Neophema elegans	Elegant Parrot	X	X	
Neophema petrophila	Rock Parrot			X
CUCULIDAE				
Cuculus pallidus	Pallid Cuckoo	X	X	
Cacomantis flabelliformis	Fan-tailed Cuckoo	X	X	X
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	X	X	X
Chrysococcyx lucidus	Shining Bronze-Cuckoo	X	X	X
STRIGIDAE				
Ninox novaeseelandiae	Southern Boobook	X	X	
TYTONIDAE				
Tyto alba	Barn Owl	X	X	
PODARGIDAE				
Podargus strigoides	Tawny Frogmouth	X	X	
APODIDAE				
Apus pacificus	Fork-tailed Swift	X	X	X
HALCYONIDAE				
* Dacelo novaeguineae	Laughing Kookaburra	X	X	
Todiramphus sanctus	Sacred Kingfisher	X	X	
MEROPIDAE				
Merops ornatus	Rainbow Bee-eater	X	X	
MALURIDAE				
Malurus splendens	Splendid Fairy-wren	X	X	X
PARDALOTIDAE				
Pardalotus punctatus	Spotted Pardalote	X	X	
Pardalotus striatus	Striated Pardalote	X	X	
ACANTHIZIDAE				
Sericornis frontalis	White-browed Scrubwren	X	X	X
Smicrornis brevirostris	Weebill	X	X	
Gerygone fusca	Western Gerygone	X	X	
Acanthiza apicalis	Inland Thornbill	X	X	X
Acanthiza inornata	Western Thornbill	X	X	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	X	X	

		1	2	3
MELIPHAGIDAE				
Anthochaera carunculata	Red Wattlebird	X	X	
Anthochaera chrysoptera	Little Wattlebird	X	X	
Lichenostomus virescens	Singing Honeyeater	X	X	X
Lichenostomus ornatus	Yellow-plumed Honeyeater		X	
Melithreptus lunatus	White-naped Honeyeater	X	X	
Lichmera indistincta	Brown Honeyeater	X	X	X
Phylidonyris melanops	Tawny-crowned Honeyeater	X		X
Acanthorhynchus superciliosus	Western Spinebill	X	X	X
Ephthianura albifrons	White-fronted Chat			X
PETROICIDAE				
Petroica multicolor	Scarlet Robin	X	X	
Petroica goodenovii	Red-capped Robin	X	X	
NEOSITTIDAE				
Daphoenositta chrysoptera	Varied Sittella	X	X	
PACHYCEPHALIDAE				
Pachycephala pectoralis	Golden Whistler		X	
Pachycephala rufiventris	Rufous Whistler	X	X	
Colluricincla harmonica	Grey Shrike-thrush	X	X	
Grallina cyanoleuca	Magpie-lark	X	X	
Rhipidura fuliginosa	Grey Fantail	X	X	
Rhipidura leucophrys	Willie Wagtail	X	X	X
CAMPEPHAGIDAE				
Coracina novaehollandiae	Black-faced Cuckoo-shrike	X	X	
Lalage sueurii	White-winged Triller	X	X	
ARTAMIDAE				
Artamus cinereus	Black-faced Woodswallow	X	X	
Artamus cyanopterus	Dusky Woodswallow	X	X	
Cracticus torquatus	Grey Butcherbird	X	X	X
Gymnorhina tibicen	Australian Magpie	X	X	X
CORVIDAE				
Corvus coronoides	Australian Raven	X	X	X
MOTACILLIDAE				
Anthus novaeseelandiae	Richard's Pipit			X
HIRUNDINIDAE				
Cheramoeca leucosternum	White-backed Swallow	X	X	X
Hirundo neoxena	Welcome Swallow	X	X	X
Hirundo nigricans	Tree Martin	X	X	X
Hirundo ariel	Fairy Martin	X	X	X
SYLVIIDAE				
Cinclorhamphus mathewsi	Rufous Songlark	X		X
ZOSTEROPIDAE				
Zosterops lateralis	Silvereye	X	X	X

		1	2	3
MAMMALS				
TACHYGLOSSIDAE				
Tachyglossus aculeatus	Echidna	X	X	X
PERAMELIDAE				
Isoodon o. obesulus	Southern Brown Bandicoot	X	X	X
TARSIPEDIDAE				
Tarsipes rostratus	Honey-possum	X	X	X
MACROPODIDAE				
Macropus fuliginosus	Western Grey Kangaroo	X	X	X
MOLOSSIDAE				
Mormopterus planiceps	Southern Freetail-bat	X	X	X
Nyctinomus australis	White-striped Freetail-bat	X	X	X
VESPERTILIONIDAE				
Nyctophilus geoffroyi	Lesser Long-eared Bat	X	X	X
Nyctophilus gouldi	Gould's Long-eared Bat	X	X	X
Nyctophilus timoriensis	Greater Long-eared Bat	X	X	X
Chalinolobus gouldii	Gould's Wattled Bat	X	X	X
Chalinolobus morio	Chocolate Wattled Bat	X	X	X
Vespadelus regulus	Southern Forest Bat	X	X	X
MURIDAE				
* Rattus rattus	Black Rat	X	X	X
* Mus musculus	House Mouse	X	X	X
CANIDAE				
* Vulpes vulpes	Fox	X	X	X
FELIDAE				
* Felis catus	Feral Cat	X	X	X
LEPORIDAE				
* Oryctolagus cuniculus	Rabbit	X	X	X

Beeliar Wetlands Area

Condition Assessment

Assessments of Condition

of

Non-wetland Areas

in the proposed

Beeliar Wetlands National Estate Area

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1 Beeliar National Estate Areas (proposed)

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a AHC Attachment E Maps

b 1991 Perth Street Maps (in roll)

3 Piney Lakes

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1. INTRODUCTION

The Australian Heritage Commission (AHC), Canberra, stated in its Attachment B (Terms of Reference) to a letter dated 8 September 1992 and addressed to Dr Arthur Weston, that the purposes of the 1992 Beeliar Wetlands assignment being reported upon here were:

> 1. to determine whether the condition of non-wetland areas included in the proposed Beeliar Wetlands national estate area is such that they meet the threshold for inclusion in the Register of the National Estate, and
>
> 2. to assess the values of woodland areas which are not included in the regional park, and to compare those areas with similar places in the park.

In addition, this report has notes on vegetation and where in the proposed national estate area Priority Flora species were found during the field work upon which, in part, this report is based.

The location and boundaries of the proposed Beeliar Wetlands national estate area are the same as those shown in Map 4 of the Beeliar Regional Park final proposals (BRPFP: Department of Planning and Urban Development [DPUD] 1992) but with the modifications (and other information) described in a ten-page AHC computer printout dated 12/08/92 and shown in maps of Attachment E to the letter (the Attachment E 1:20 000 scale maps showing the areas to be assessed are included in this report as Attachment 2a and in Attachment 1).

The AHC computer printout also has brief descriptions of the Beeliar wetlands and their importance in terms of vegetation, flora and fauna. Many of the descriptions are based upon descriptions of recommended conservation reserves in the System 6 Red Book (Environmental Protection Authority 1983). A recent update (Environmental Protection Authority 1993) gives the implementation staus for all of the recommended reserves and comments on most of them.

The BRPFP Map 4 is reproduced here, slightly reduced in scale, as Figure 1.2, while Attachment 6 is a photocopy of the AHC computer printout.

Figure 1.1 is a small scale map showing relative size and location of 30 named Beeliar lakes and swamps in two chains running parallel to the coast from south of the Canning River to north of Peel Inlet. It is a photocopy of the A3 size map of the Beeliar Wetlands in the Department of Conservation & Land Management (CALM) brochure *The Beeliar Wetlands: A Guide for Visitors*. The numbers used on the map to represent the wetlands are the same as the ones used in Section 3 of this report. The Beeliar national estate areas referred to in this report and the numbers representing them are listed in Table 1.

Semeniuk (1992) has classified and mapped Beeliar wetland types using the system she developed (Semeniuk 1987), along with other coastal wetlands between Wedge Island and Mandurah, at a scale of 1:200 000.

The AHC has other references listed in the bibliography section of its 12/08/92 computer printout on the Beeliar Wetlands.

References to reports not on the AHC list and which deal with particular Beeliar wetlands are made at appropriate points further along in this report.

2. METHODS

Preliminary assessments of condition were made from examination of 1991 Perth Street Map Sheets 5 and 7 (1:20 000 scale) and South Sheet (1:40 000 scale), from the 1993 StreetSmart Perth Street Directory, from stereoscopic pairs of 1:20 000 scale Metro Street Directory colour aerial photographs flown in January 1992 and from colour photocopies of some of the aerial photographs. The three map sheets and the photocopies of the aerial photographs are included with this report as Attachments 2b and 1, respectively. The photocopies and Beeliar national estate areas shown on them are listed in Table 1.

The preliminary assessments were checked on the ground and were, where warranted, modified. Colour print photographs were taken during the ground-truthing field work, on 8, 11, 14 and 15 October 1992, and the presence of Priority Flora species was noted. Diana Corbyn, a botanist who has done botanical studies in some of the northern wetlands, assisted with field work in wetlands and woodlands in the northern part of the eastern chain. Many of the areas were again checked in the field in February 1993.

3. RESULTS

The results, including condition assessments, are given below and on 1:20 000 scale transparent condition overlays which are in Attachment 1 along with photocopies of colour aerial photographs and transparent overlays of AHC Attachment E maps. The transparent condition overlays have condition symbols given in black, roads shown in brown, boundaries of lakes and many other wetlands shown in blue and vegetation boundaries shown in orange, green or, in some cases, blue. The sets of photocopies and overlays in Attachment 1, Beeliar national estate areas shown on them, their numbers, condition assessments of areas indicated on the AHC maps and the run and frame numbers of the aerial photographs are listed in Table 1.

Photographs of some areas referred to in the report are included as Attachment 5.

The assessments and other information for each unit in the chains of wetlands are given below in the same order, and with the same numbers, as in Figure 1. Units which are not shown in Figure 1 are given decimal numbers, e.g. Piney Lake is 2.1 and Murdoch University Swamps are 2.2. The numbers and units are listed in Table 1.

The same system of notation used in the Perth airport condition asssessment is used in this report: 'A' for well above threshold level, 'B' for above threshold level, 'C' for at threshold level, 'D' for below threshold level and 'E' for well below threshold level.

To some extent, more detailed descriptions and photographs are given of the additional areas highlighted in orange (Priority 1) and blue (Priority 2) on the Attachment 2a (=AHC Attachment E) maps.

1.0. Blue Gum Lake

The City of Melville's management plan for the Blue Gum Lake reserve (Street 1991a) has descriptions of vegetation, flora, fauna and history of disturbance, a large scale aerial photograph, a large scale vegetation map and partial lists of plant and animal species.

The reserve's native vegetation, south of the lake, ranges in condition from B to E. The Banksia woodland on higher ground in the southeast is given a condition rating of C, with a patch of B. A small patch of banksia woodland in the southwest is given a rating of C. The low-lying west-central area between the lake and the tennis courts is rated as D to E. The rest of the native vegetation, including that bordering the south side of the lake, is rated as D.

A large proportion of native vegetation in the reserve has been severely degraded by frequent fires in recent years (Street 1991a), by the spread and establishment of exotic species of plants and, most prominently in the case of jarrah trees, by dieback disease.

Plant species not included in the management plan's lists comprise both exotics and natives, including *Paraserianthes lophantha*, the Priority Three species *Daviesia physodes*, which is occasional to common in low-lying woodland in the southeastern part of the reserve, and the following species. Nearby and slightly higher in the landscape *Pimelea rosea* is locally, exceptionally abundant and very attractive when in flower. *Acacia longifolia*, *Pennisetum clandestinum* and *Salix* sp. are vigorous, abundant weeds in lower-lying parts of the reserve.

2.0. Lake Booragoon

The City of Melville's management plans for Booragoon Lake (Smith 1986; Street 1991b) have better descriptions of vegetation, flora and fauna and better vegetation map and lists of plant and animal species than the Blue Gum Lake management plan has.

The flooded gum (*Eucalyptus rudis*) - swamp paperbark (*Melaleuca rhaphiophylla*) forest, particularly on the east and south sides of the lake, and the belt of dense thickets of *Melaleuca teretifolia* inside them are rated as B to C (C where *Schinus terebinthifolia* and herbaceous alien species have invaded). The belts of bracken, *Centella cordifolia, Polygonum ? salicifolium* and rhizomatous grasses outside the forest belt are rated as E, with patches of D.

2.1. Piney Lakes

The City of Melville's Piney Lakes reserve concept plan (Ecoscape and Landmarc 1992) has descriptions and discussions of vegetation, flora, fauna, rare species, condition of vegetation and history of land use. The concept plan also has a map showing condition of vegetation and has lists of species of plants and birds. A photocopy of the map and associated description is included here as Attachment 3.

There was a fire through at least the western part of the reserve during the 1992-93 summer.

The condition of native vegetation around the lake and north, south and west of it is rated as E to D (D especially where there are a few paperbarks at the edge of the lake). The wetland east of the lake and west of Murdoch Drive is rated as B (with patches of A and smaller patches of C and D). The low-lying vegetation between that wetland and the lake is rated C to D.

The concept plan's statement that one species occurring in the reserve, *Paraserianthes lophantha*, is, in the reserve, at the northern and western extremity of its known range is not quite correct. I have found the species further north in the Blue Gum Lake reserve and north of Perth in the 'Ellenbrook Estate' wetlands, while Marchant *et al.* (1987) note that it also occurs in Indonesia. The species is apparently not, however, common on the coastal plain.

Two Priority species, *Aotus cordifolia* (P3) and *Daviesia physodes* (P2), were common in the wetlands (referred to in the concept plan as dampland) west of Murdoch Drive and occasional in native vegetation at the edge of Piney Lake.

2.2. Murdoch University

The map of the vegetation on the Murdoch University campus by Dell and Bennett (1986) shows two swamps, Upper Swamp, near the centre of the campus, and Melaleuca Swamp,

bordering Farrington Road. These two swamps and the campus's banksia woodland are separated from each other by pine plantation, farmland and other cleared areas.

2.2.1 Upper Swamp

Upper Swamp is described by Dell and Bennett (1986) as an important, artificially deepened wetland with long-necked tortoises, a dense tree-less [tall] shrub community [dominated by spearwood (*Kunzea ericifolia*)] and fringing swamp paperbark, Moonah paperbark (*Melaleuca preissiana*), flooded gum and swamp banksia (*Banksia littoralis*) trees. There are also exotic tea-trees (*Leptospermum laevigatum*) in the fringing vegetation. Trees further from the wetland were cleared at one time for the planting of pines; there is no banksia woodland surrounding the swamp.

The condition of fringing vegetation outside the swamp paperbark, including regrowth flooded gum, is assessed as D, with areas of C. The condition of vegetation outside the fringing vegetation is assessed as D (to E).

2.2.2 Melaleuca Swamp (on Farrington Road)

Melaleuca Swamp was part of the North Lake vegetation complex before it was separated from it by construction of Farrington Road. It is now a dense forest of swamp paperbark, Moonah paperbark, flooded gum and swamp banksia trees surrounded by cleared farmland and, on the south, Farrington Road. In October there were patches of open water and water under some of the forest. The forest understorey varied from dense kikuyu grass and other alien species to a tall sedge tentatively identified as *Lepidosperma* sp. to various shrubs including *Leucopogon australis* and various legumes.

The condition of the overstorey - and native vegetation as a whole - is rated B to C, and the understorey varies from E (kikuyu grass and weeds) to B.

The Priority Three species *Aotus cordifolia* occurs in the shrub understorey.

2.2.3 Banksia Woodland

The banksia woodland/forest on the Murdoch campus borders on Farrington Road west of Melaleuca Swamp. Jarrah, often with dead branches and often as suckers from stumps), is common in the overstorey and exotic pines are occasional. Native shrubs and herbaceous plants are well-represented in the understorey although *Gladiolus caryophyllaceous* and other weeds are also well-represented.

The woodland and its relatively unburnt understorey are rated C to B, with patches rated as D.

2.3 Woodlands East of Murdoch

East of Murdoch University, and outside the proposed regional park, there is banksia woodland/forest dominated by *Banksia attenuata* and *B. menziesii*. This woodland is between Murdoch Drive, South Street, Farrington Road and the Kwinana Freeway.

The woodland is, in general, in B to A condition although there are several tracks through it (revegetation of some of the widest tracks is under way). It is in better condition and less weedy than the nearby Murdoch campus and North Lake banksia woodlands and differs somewhat from them.

This woodland was described in a 1987 report on a 6.7 km strip of banksia woodland and associated native vegetation south of South Street (Dames & Moore 1987). A large proportion of the vegetation that was there in 1987 has since been cleared for construction of the Kwinana Freeway and other developments, including a large St. John of God Hospital

complex that is currently under construction on the south side of South Street. The site for the hospital was cleared after the January 1992 aerial photography.

This woodland and a degraded remnant wetland in the southeast corner of South Street and Murdoch Drive have value in the context of the regional park as a linkage between the North Lake vegetation complex (and Murdoch's Melaleuca Swamp) and the northern 'possible future linkage' (DPUD 1992).

3.0. North Lake

The North Lake complex of lakes, wetland vegetation and other native vegetation is bounded by Farrington Road on the north, Bibra Drive on the east, Hope Road on the south and Progress Road on the west. The complex has four lakes, which, for the sake of convenience, are referred to here as North Lake, South North Lake, East North Lake (='Roe Swamp'?) and Hope-Bibra Drive Lake (='Hope Road Swamp'?).

The condition of the west, south and southeast sides of North Lake is, with exceptions, rated as D (to E). The exceptions and most of the northeast side of the lake are rated C to B.

Along the water's edge at the north end there is an interrupted belt of swamp paperbark, *Baumea articulata* (jointed twig-rush), water couch (*Paspalum distichum*) and *Polygonum ? salicifolium*, with a few flooded gum trees. The belt is less interrupted and with more paperbarks on the east side. The west side is mainly grassy to the water's edge, with a few flooded gum trees and patches of paperbarks. Paperbarks in the water in the northwest corner are dead or almost dead. A clump of paperbarks in the southeast corner is large, healthy and popular with birds.

The small strip of largely cleared banksia woodland north and northwest of the fringing vegetation is rated D. It is severely degraded but has regenerating *Banksia attenuata* and plantings of species of *Banksia* which are not local.

The condition of native vegetation, both fringing and outside of it, on all sides of South North Lake ranges from E to D. Most of the native vegetation, particularly the understorey, in these areas has been cleared. There are a few remnant and, in the case of the first, regenerating flooded gums, Moonah paperbark trees and spearwood (*Kunzea ericifolia*) and a few other native shrubs in the western part of the area and mainly regenerating spearwood east of the area east of the lake.

A 150 m wide strip west of Bibra Drive, between Farrington Road and Hope Road, has largely been cleared of native vegetation, and is assessed as Condition E (and small patches of D). There are swards of *Paspalum* grass in the low-lying, wet south and scattered large marri trees in the north, flats of pigface (*Carpobrotus* sp.) and shrubs of *Jacksonia ulicina* (probably what is referred to by Marchant *et al.* (1987) as *J. stricta*), *Jacksonia* sp. nov. 43 (=*Jacksonia gracili*?) and *J. ? sericea*, a Priority Three species. The *Jacksonia* shrubs are in the central western part of the strip, and the pigface is mainly in the centre. A transmission line and cleared easement passes through the strip and the dense vegetation west of it.

The dense vegetation west of the strip is Moonah paperbark - flooded gum forest, with large swamp banksia trees to over 10 m tall and a dense, shrubby understorey. Other species include spearwood (*Kunzea ericifolia*), *Leucopogon australis, Agonis linearifolia, Xanthorrhoea preissii, Aotus cordifolia*, bracken, sedges, *Dampiera* sp. and, on lower ground, swamp paperbark. This vegetation is continuous from Farrington Road southward, as narrowing strips along the west and east sides of the Hope-Bibra Drive lake, to Hope Road. It is in A (-B) condition, but has a number of large fig trees in the southeast part.

The Hope-Bibra Drive lake is filled with *Typha ? orientalis* and *Baumea articulata*, with patches of *Melaleuca teretifolia*. The condition of the lake is rated C (more or less).

The condition of the banksia woodlands/forests north of Hope Road and bordering Farrington Road is B, although there are weeds and unhealthy jarrah trees in them.

The condition of the wetland vegetation and adjoining spearwood thicket in the western and north-central part of the North Lake complex is A (-B), although there are a few dense patches of arum lily (*Zantedeschia aethiopica*) under paperbark forests. The wetland and adjoining vegetation is predominantly forest and thicket dominated by swamp paperbark, Moonah paperbark, *Melaleuca teretifolia*, swamp banksia, flooded gum, spearwood (*Kunzea ericifolia*), *Acacia saligna, Agonis linearifolia* and *Astartea ? fascicularis*, with a range of native understorey species including those occurring in Murdoch University's Melaleuca Swamp.

Priority and other interesting species found in wetland and adjoining areas are:

Aotus cordifolia	a Priority Three species
Daviesia physodes	a Priority Two species
Jacksonia ? sericea	*Jacksonia sericea* is a Priority Three species
Jacksonia ulicina	unusual south of the Swan River
Villarsia ? violifolia	*Villarsia violifolia* is uncommon or rare though not a Priority or Declared Rare Flora species

4.0. Bibra Lake

The Bibra Lake complex of lakes, other wetlands and woodlands is bounded by Hope Road on the north, Bibra Drive on the east and south and Forrest and North Lake Roads on the west. Approximately half of the area is occupied by Bibra Lake and five or six much smaller lakes or pools.

The condition of the terrestrial vegetation around the margins of the lakes is E except in some cases where there are still paperbarks and flooded gums, such as on the south side of Bibra Lake, where the vegetation qualifies as D, and on the south eastern side, where the dense fringing forest of paperbarks and flooded gums qualifies as B. There is abundant *Typha ? orientalis and Melaleuca teretifolia* in the water in the southeastern part.

There is no banksia woodland south or southeast of the lake, but there is a patch of banksia - she-oak - jarrah woodland east of the northern arm of the lake, south of Hope Road and west of Bibra Drive. (There is an environmental centre being constructed north of the western part of this patch.) The woodland is mostly surrounded by weedy, cleared land and has been degraded by repeated and recent fire, clearing and weeds. It is rated D, except possibly a small area in the woodlands' southwest corner which might qualify as C.

The banksia - she-oak - jarrah woodland west of the northern arm of the lake, between Progress Drive and North Lake Road is, though infested with weeds, in much better condition. Most of it, particularly away from the roads, qualifies as C or higher.

The woodlands south of Progress Drive (and Forrest Road) and west of North Lake Road (and Forrest Road) have been severely disturbed and are rated as D, possibly with patches of C. Much of the disturbance is relatively recent, and the 1993 street directory shows patterns of proposed roads in these two woodlands. These woodlands are outside the proposed regional park and are inferior in value to the adjacent woodland which is in the park.

5.0. South Lake

South Lake, south of Forrest Road, has fringing flooded gum, with *Acacia saligna*, Moonah paperbark and a weedy, grassy understorey. There is dense forest of thin-trunked flooded gum trees (a pole stand) with grass understorey on the east side, particularly the northeast side, of the lake and dense, extensive stands of *Melaleuca teretifolia* shrubs in the lake. In the vegetation fringing the lake, particularly on the west side, there is also spearwood and, on drier ground, jarrah and marri.

The condition of fringing vegetation and flooded gum forest on the east side of the lake is C, with areas of B or better and D. The belt of bare and weedy ground west and south of the lake is D to E. Some of this bare ground is in the proposed regional park, but the bare ground west of the lake is not.

Outside the proposed regional park, west of the lake to as far as Sudlow Road and the railway next to it, there is a eucalypt - banksia woodland/forest on sloping land. It is separated from the lake by a belt of largely bare ground and scatterred clumps of *Hakea ? prostrata* and other native shrubs. The woodland/forest has both marri and jarrah trees, along with *Xanthorrhoea preissii*, *Macrozamia riedlei*, other native shrubs and weeds. It may also have a few tuart trees, but none were seen.

This eucalypt - banksia woodland/forest is in B to C condition. It is in better condition and has a higher value than comparable woodlands in the part of the proposed regional park north of the Thomsons Lake reserve.

5.1 **Railway Triangle** (between South Lake and Little Rush Lake)

Outside the proposed regional park there is a triangle of native vegetation, mainly woodland, which is between South Lake and the railway south of it and, on the west, the Cocos Drive sand-pit. It ranges from spearwood and *Regelia ciliata* thickets in the low-lying eastern corner, through banksia - jarrah - she-oak (*Allocasuarina fraseriana*) woodland over most of the area, to tuart (*Eucalyptus gomphocephala*) woodland in the highest, northwestern corner.

The condition of the vegetation in the triangle is generally C, with some areas of B and of D. The woodland is, however, degraded by tracks through it, by much relatively recent cutting of trees, particularly of jarrah trees, and by three or more fires having swept through the triangle within the last five years (one of them apparently in 1993). Veldt grass is abundant on margins of the triangle and under tuart trees in the northwest corner.

The triangle has value in having a small remnant of upland tuart woodland in better condition than any other tuart woodland in the part of the regional park north of Yangebup Road. Furthermore, the triangle's vegetation provides a link between South Lake's (and the woodland west of it) and Little Rush Lake's.

The 1993 street directory shows proposed roads in the triangle, suggesting that development is imminent.

The Priority Three species *Cartonema philydroides* and the Priority Two species *Daviesia physodes* occur in the eastern, lower-lying part of the triangle.

6.0. Little Rush Lake

Little Rush Lake, which is south of the railway line between Bibra Lake and Yangebup Lake, has jarrah - banksia woodland/forest (with few tuarts) on the west and north sides of the lake and tuart - banksia woodland south and southeast of the lake. Flooded gums and alien grasses are on the east side of the lake. There are Moonah paperbark trees near the lake and east of it.

Virtually all of the vegetation has been burnt by two fierce fires during the last three or four years.

The western and northern woodland has many dead trees and an understorey with much veldt grass. Its condition is rated as D. The southern tuart - banksia woodland is in better condition but still with lots of veldt grass in the understorey. It rates as C to D.

Southeast of the lake there are several large patches of the Priority Three species *Cartonema philydroides*, and north of the lake near the railway line there are a few plants of the Priority Four species *Dodonaea hackettiana.*

7.0. Yangebup Lake

There is open tuart - banksia woodland on the north side of Yangebup Lake, marri - banksia woodland west of it and open Moonah paperbark - flooded gum woodland on the northeast side, all with high proportions of grasses and other aliens in the understorey. There is jarrah - banksia woodland west of the lake, with better understorey but still with a large proportion of weeds and with many dead trees.

Condition rating on the north and northeast sides of the lake is D to E. On the west side it is D, or, where weed infestation and presence of dead trees are lowest, even C.

8.0. Kogolup Lake (condition assessed tentatively)

Kogolup Lake comprises two lakes almost completely separated from each other by a narrow peninsula which is almost an isthmus. The southern lake is apparently the deeper and more permanent of the two and is the one identified on maps as Kogolup Lake. The January 1992 aerial photographs, the 1993 street directory and the 1991 maps being provided with this report show that the native vegetation around the northern two-thirds of the northern lake has been cleared.

The southern lake borders the Thomson Lake reserve and has a beach which, at least on the south side of the lake, has been heavily trampled by horses and is bare sand, with patches of pigface. The Priority Four species *Dodonaea hackettiana* occurs at the southern edge of the sand. Horse trampling is also prominent east of the southern lake.

The western boundary of the Kogolup Lake 'reserve' is treated as being the very wide dog-leg firebreak.

Condition of Kogolup Lake woodlands, i.e. the woodlands east of the dog-leg firebreak, was tentatively assessed, mainly from interpretation of aerial photographs, as being C to D in the northwest, C (to B) in the southwest and D to C, with patches of D to E, in the east.

8.1 Branch Circus Wetlands (east of Kogolup Lake)

The Branch Circus wetlands area extends from Branch Circus eastward to Hammond Road and comprises lakes, seepages (springs), seasonally waterlogged damplands bordering the lakes and nearby non-wetland areas. The overstorey in the wetlands is a variable forest and tall shrubland dominated by flooded gum, Moonah paperbark, swamp paperbark, *Acacia saligna* and spearwood. On higher ground bordering the wetlands there are, in addition to flooded gum, a few marri trees. Shrubs in the understorey that are patchily prominent are *Astartea ? fascicularis, Agonis linearifolia* and an alien tea-tree (*Leptospermum laevigatum*). Native herbaceous plants include bracken, *Centella cordifolia* and sedges. The red floating aquatic fern *Azolla filiculoides* and other small floating aquatics cover large parts of the lake surfaces. The emergent aquatic *Triglochin procera* is locally common in the lakes.

For the most part the overstorey is in fine to excellent (B to A) condition, but most, if not all, of the understorey is grazed and trampled by horses and cattle and is infested with pasture grasses, arum lily and other exotics (E to D condition). Because the overstorey is in such good condition and there is potential for recovery of much of the understorey the overall condition rating is C (to B).

The Branch Circus wetlands area is a 'proposed landscape protection area' (DPUD 1992).

8.2 Henderson Road Woodlands (west of Kogolup Lake and north and east of the Thomsons Lake Nature Reserve)

The Henderson Road woodlands lie between the Thomsons Lake reserve and Kogolup Lake woodlands, on the east, and cleared and/or degraded native vegetation, on the west, north and south. The Henderson Road woodlands are separated from the woodlands to the east by a wide firebreak; the Kogolup Lake woodlands firebreak is exceptionally wide.

Considered this way, the Henderson Road woodlands have a relatively small eastern component which is in the proposed regional park and a much larger western component which is not.

The Henderson Road woodlands are, in general, diverse banksia woodlands, mainly *Banksia attenuata*, with varying proportions of jarrah, *Banksia menziesii, B. ilicifolia, B. grandis*, jarrah, tuart, she-oak and marri. The understoreys are also diverse.

The condition of the woodland varies but, due to frequent, often intense fires, cutting of jarrah and other trees, disease and invasion of weeds, the entire woodland, both inside and outside the regional park, is assessed as being around C, with some areas of B and others of D. The woodland is, however, valuable as a compliment to the Thomsons Lake woodland, from which parts of it appear to differ in some respects.

There are also a few small areas of woodland west of Henderson Road and south of Holmes Road. There are houses in some of the woodland blocks, while others tend to be degraded by tracks, grazing and clearing.

9.0. Thomsons Lake (condition of Thomsons Lake Nature Reserve not assessed)

The vegetation of the reserve is principally banksia woodlands, with wetland creek and fringing vegetation (e.g. paperbarks and flooded gums in the overstorey), especially bordering the lake and east of it.

The fence around the reserve that keeps vehicles out also helps to protect the vegetation from cutting, a plethora of vehicle tracks and rubbish dumping. Consequently, the reserve's woodlands are in significantly better condition than the adjoining Henderson Road woodlands.

Pauline Clay has described and mapped the vegetation of the reserve and listed species of plants and animals in it . This work is included in the Crook and Evans' 1981 reference in the AHC Beeliar Wetlands bibliography.

10.0. Banganup Lake (condition of Harry Waring Marsupial Reserve not assessed)

The vegetation of this University of Western Australia Zoology Department reserve is principally banksia woodland on the higher areas and a variety of wetland vegetation on the lower areas. In the 1970s Robert Whelan and Allan Burbidge prepared a draft vegetation map of the reserve (unpublished), I compiled a comprehensive plant species list and Jan Taylor compiled a list of invertebrates. All of us, Brian Clay and a number of university lecturers and students have carried out a range of research projects in the reserve.

The woodland southwest of the Banganup Lake swamp is outside the Harry Waring reserve but also has banksia woodland which is mostly in C or better condition. A fire burnt through this woodland in early January 1992.

10.1. Wattleup Road Wetland (north side of Wattleup Road and south of Harry Waring reserve)

Only a narrow block of native vegetation, narrower than indicated on the AHC Attachment E map, is left. The northern, higher end of the block is flooded gum and bracken, with swamp banksia, sedges and, in the higher, northwest corner, *Banksia ilicifolia, B. attenuata* and *Macrozamia riedlei*. There are weeds and evidence of recent felling of trees (probably in mid-1992). A fire burnt through this vegetation in early January 1992.

The lower, southern part of the native vegetation is swamp and lake, with swamp paperbark and Moonah paperbark being the dominant trees. There are sedges, *Cortaderia selloana* and other weeds and dense patches of *Typha ? orientalis* and *Baumea articulata*.

The condition of a small area of woodland in the northwest corner is C or slightly higher, but where there has been felling and where there is an abundance of weeds the condition is D or lower. The swamp area is C or lower, lower than it would be if it had native vegetation around it instead of abutting cleared farmland and pasture.

This area is part of the Watleup Lake 'proposed landscape protection area' (DPUD 1992).

11.0. Wattleup Lake (or 'Mandogalup Swamp', east of Mandogalup Road at Sayer Road)

Wattleup Lake has pasture on the north, south and west sides and, looking east, a sequence of *Melaleuca teretifolia*, swamp paperbark, Moonah paperbark, flooded gum and a species of *Pinus* at the eastern end.

Arum lilies and signs of grazing are beneath the trees and shrubs at the eastern end. There is probably summer grazing in any part of the lake which is not under water then.

The condition assessment of the vegetation north, south and west of the lake is E, and of the native wetland vegetation east of the lake is C (to D). As the lake and wetland appear to be on private land, the assessments were made using a pair of binoculars from Mandogalup Road and the east-west road or driveway north of the lake.

This area is part of the Wattleup Lake 'proposed landscape protection area' (DPUD 1992).

12.0. The Spectacles

Between the southern Spectacle swamp and Thomas Road and west from Johnson Road to the banksia woodland there is flooded gum woodland and spearwood thicket, with a few banksias, Moonah paperbarks and, at either end, banksia woodland. There is a ground layer of bare ground, weeds and a *Conostylis*. The western half of the strip is recovering after a fire earlier in 1992 or in late 1991.

Most of the area between the swamps and along Johnson Road to the north end of the reserve is open and weedy (and with pigface and sedges), with scattered trees and small groves of them. Many trees have been planted in the area, especially in the northeast corner. A short strip of flooded gum and spearwood between the eastern tip of the southern swamp and Johnson Road is regenerating after fire. This short strip of native vegetation is in much better condition than the cleared land south of it or any of the vegetation north of it.

North to northwest of the northern swamp there is banksia woodland with Moonah paperbarks and a weedy understorey, which changes to an open marri-banksia woodland at the northern end of McLaughlan Road. This, too, has an understorey which is largely weedy.

The southwestern one-quarter to one-third of the reserve is banksia woodland over, at least in part, a relatively low and open understorey of sedges and native shrubs, with jarrah, she-oak and, to a lesser extent, tuart and marri. There are weeds in the understorey, mainly near the roads, and a few trees that are dead or in poor condition.

The condition of the main body of banksia woodland is A to B, while the woodland to the west, across McLaughlan Road from it, is poorer, closer to C, due mainly to repeated fires through it and easier access into it. The southeast corner vegetation and the banksia woodland north of the northern swamp is rated as D (to C). The other areas are rated D and E.

A Priority Three species, *Cartonema philydroides*, was found along the boundary south of the southern swamp and in the banksia woodland north of the northern swamp. There were hundreds of *Cartonema* plants in the exceptionally large, banksia woodland population.

Alcoa staff (e.g. Owen Nicholls) and university staff and students have carried out a number of surveys and other studies and projects in the Spectacles reserve. Also, Alcoa has produced a Spectacles Wetlands brochure and map (a copy is included here as Attachment 4).

12.1 Woodland East of the Spectacles

The banksia woodland east of the Spectacles reserve, across Johnson Road from it, has areas with large tuart trees and, on its eastern side, important swamps. Much of the woodland was burnt by a hot fire during the 1991-92 summer and now has numbers of dead banksia trees.

The Kwinana Town Planning Scheme No. 2 proposes extending the area of landscape protection which now covers the Spectacles eastward across Johnson Road to include this banksia woodland (Harry de Jong pers. comm. 1992).

The condition of the woodland would be rated as B (possibly rated higher locally) if not for the effects of the fire and the dead banksias. Currently, the condition assessment is C (to D).

12.2 Woodland South of the Spectacles

The relatively extensive banksia woodland south of the Spectacles reserve, across Thomas Road from it, is of a type similar to the main body of banksia woodland in the Spectacles reserve (with banksia spp., jarrah, she-oak and tuart) but with more dead trees and a degraded, weedy understorey. Causes of degradation include a major fire in February 1991 (and other fires), motorcycles and other vehicles driven through the woodland, rubbish dumping and digging up of plants.

Condition of the woodland varies from C to D, with a few areas being in low B condition.

The 'possible future linkage' between the Spectacles and Bollard Bulrush Swamp passes through this woodland (DPUD 1992).

18.0. Manning Lake

The fringing vegetation of Manning Lake is swamp paperbark forest, with gaps and some *Melaleuca teretifolia*, and an understorey largely comprising *Juncus ? kraussii*, *Gahnia trifida*, water couch and various weeds. Manning Park comprises the lake and the maintained lawn all around the lake, with its planted trees and scatterred large, old tuart trees, many of which appear to be healthy.

West of the park is a sand and limestone ridge with degraded, patchy *Acacia rostellifera* scrub and carnation weed and other exotic species. There are tuart trees at the base of the ridge, also with weeds.

South of the park, also on limestone and sand, is a grove of *Eucalyptus decipiens* (limestone marlock), a tree or mallee which is uncommon or rare in the Perth area. The understorey is weedy, there are a few pines in the grove and at its northern end there are remains of old limestone walls.

The limestone ridge and grove of limestone marlocks are both in the proposed Beeliar regionmal park.

Condition of the park, outside the lake and its fringing vegetation, is rated D (to E), the condition of the limestone ridge vegetation D (to C) and the limestone marlock grove C.

19.0 Market Garden Swamps

Market Garden Swamp No. 1, south of Mell Road, has a fringing scrub and, to a large extent, cover of swamp paperbark, with an understorey of *Juncus ? kraussii*, kikuyu grass and other exotics. There are several patches of dead paperbarks.

Virtually all of the native vegetation outside of the paperbark scrub has been cleared, although south of the swamp there is an open grove of tuart trees. Most of the trees are in poor health and over a ground layer of weeds and very few native plants.

Between the tuarts and Market Garden Swamp No. 2 there are market gardens.

Market Garden Swamp No. 2 is crossed by Troode Road and has, south of Troode Road, been replaced in part by a Cable water-ski operation. The part of the swamp north of Troode Road and west of the ski park has an overstorey of swamp paperbark and *Melaleuca* sp., with *Acacia saligna* on the margins and a grove of *Xanthorrhoea preissi* on the west side south of Troode Road. Understorey species include *Gahnia trifida, Boloboschoenus caldwellii* (Marsh Club-rush), *Baumea ? juncea, Typha ? orientalis, Juncus ? kraussii* and *Cyperus ? tenuiflorus*. The paperbarks at the southern end of Swamp No. 2 are mainly saltwater ones.

The EPA's 1983 System 6 Red Book notes that saltwater paperbarks are found at all three Market Garden swamps, but during this survey they were not identified in Swamp No. 1 or the northern three-quarters of Swamp No. 2 (the survey could have missed it).

The condition of Market Garden Swamp No. 1 is rated C, of the tuart grove D and of what is left of Swamp No. 2 C to B.

19.1 West Churchill Avenue Lake (east of the northern end of Lake Coogee: referred to by the EPA as Market Garden Swamp No. 3)

The fringing, interrupted paperbark shrubby forest around the lake is mainly swamp paperbark, with a few tuart trees and a variable, largely weedy understorey. At the north end and northwest and northeast sides of the lake are thickets or patches of shrubby forest of swamp paperbark and saltwater paperbark, with more tuart trees.

The best-developed and most extensive saltwater paperbark woodland/forest is at the northeast corner of the lake. Much of the soil beneath the grove is bare, but some has samphire plants, *Samolus junceus* and *Sporobolus virginicus*. There are patches of dead paperbarks in the grove. East of the saltwater paperbarks are tuart trees, with swamp paperbarks and both native and exotic plants beneath them.

North of the saltwater paperbark grove there is a distorted/disturbed land surface with regenerating tuarts, swamp paperbarks, *Acacia saligna* and tussocks of *Gahnia* on the istorted surface and nearby.

There are *Acacia saligna* shrubs and sedges on the west side of the lake.

The condition of the fringing vegetation is, in general, C (more or less); of the saltwater paperbark forest B to C, of the NE tuart grove (in its centre) B to C; and of the northern tuart grove C. The relatively small swamp paperbark forest south of the northern tuart grove is B (to A).

20.0. Lake Coogee (condition not assessed)

The principal paperbark in Lake Coogee's fringing vegetation, by far, is saltwater paperbark, but swamp paperbarks are common. There are also, on the western side, a few tuarts trees.

There are a number of tuart trees west of the lake, over a weedy ground cover. Southwest of the lake there is an open grove of tuarts, pines and banksias, with a weedy ground cover.

21.0. Brownman Swamps

(Note: The lake/swamp shown on an Attachment E map - sent from Canberra - and on 1991 street directory map sheets as Brownman Swamp is, according to the 1993 street directory, Mt. Brown Lake. The suite of swamps a few hundred metres north of Mt. Brown Lake are Brownman Swamps.)

A broad, graded limestone track (shown on the street directory as a proposed road: the proposed Fremantle - Rockingham Highway) runs along the western side of the area. There have been inappropriate plantings of tuarts and other trees and shrubs along the track. There are banksia woodlands west of the track.

The Brownman Swamps woodlands are similar to those in the Mt. Lake Brown area, especially in the southern and eastern parts of the Brownman Swamps area. Elsewhere in the area the woodlands are denser and have more tuart and jarrah, some of which has been felled relatively recently, and fewer banksia trees. There is more *Banksia grandis* and less *Banksia attenuata*, more native understorey, and fewer weeds than in the Mt. Lake Brown area.

A large part of the Brownman Swamps area has swamp paperbark forest, which has *Gahnia* tussocks and native shrubs. West of the swamps and east of the limestone track there are a few small *Acacia rostellifera*, *Dryandra sessilis* and *Banksia grandis* thickets.

There are a lot of rubbish and many burnt abandoned cars through the area. The cars were probably stolen, then deliberately burnt, the fires then having spread through the bush.

The condition of the Brownman Swamps thickets and eucalypt woodlands are rated B, with some C and some A, and the swamps are rated A (to B).

22.0. Lake Mt. Brown (and the Mt Brown area and west to Cockburn Road and north)

(see note under 21.0)

The Mt. Brown area (indicated by 'X's on the AHC Attachment E map) has a mosaic-like diversity of limestone coastal vegetation on rolling hills, steep slopes and flats. The vegetation includes *Hakea prostrata - Dryandra sessilis* heath, *Banksia attentuata - B. menziesii* woodland and open forest, banksia - jarrah woodland, tuart, dense populations of *Xanthorrhoea preissii*, *Acacia saligna* thickets and possibly at least one occurrence of *Eucalyptus decipiens* (limestone marlock), a tree or mallee which is uncommon or rare in the Perth area.

The vegetation of this area and, in particular, the mosaic-like pattern of its elements are also rare in the Perth area. Much of the understorey is, however, sparse and weedy, the area is used for dumping rubbish and many of the tuart trees east of Mt. Brown (mostly in the Mt. Brown Lake area) are dead or markedly unhealthy.

The condition of most of the Mt. Brown vegetation is rated B to C, with a few areas rated A, D and E.

A broad, graded limestone track (shown on the street directory as a proposed road: the proposed Fremantle- Rockingham Highway) through the area separates the Mt. Brown area from the Mt. Brown Lake area. There have been inappropriate plantings of trees and shrubs along the track. and there are abandoned cars and much rubbish along it.

The Mt. Brown Lake area is relatively flat and, in non-wetland parts, is covered by a three-tiered woodland dominated by tuart, jarrah and banksia trees, with abundant *Xanthorrhoes preissii* and weeds. Relative abundance of these plants varies through the area. Short distances northwest and south of the lake there are populations of *Melaleuca huegelii* on reddish soil onlow limestone hills.

Although there are numerous vehicle tracks into and through the area and although there has been rubbish dumping and cutting of trees, the condition of most of the Lake Mt. Brown woodland is rated as C.

23.0. Long Swamp

Long Swamp was, in October 1992, a forest of swamp paperbark over water. The understoey bordering the water was tussocks of *Gahnia* sedge, *Juncus* and aliens, especially kikuyu and cooch grass and, on the east side, *Ricinus communis*. There are also *Gahnia* tussocks within the water. Between the western edge of the swamp and Hope Valley Road there is barren, weedy land fill, with an arm of the swamp south of it. The arm has swamp paperbark, *Acacia rostellifera, Acacia saligna* and *Acacia cyclops* tall shrubs and the typical *Gahnia - Juncus* - weedy grass understorey. The east side of the swamp is similar to the west side but with more shrubs, including acacias, *Ricinus communis* and other species. It also has land fill.

North from the main swamp there is swamp paperbark forest, with some *Melaleuca teretifolia* and an understorey of *Gahnia trifida, Baumea ? juncea, ?Sporobolus virginicus, Juncus ? kraussii* and other species.

East of a bare adjoining strip and at the edge of the sand dump/fill there is a thicket of *Acacia saligna* and trees of *Banksia grandis* and tuart.

The condition of eastern and western, land-filled sides of the swamp is E, of the paperbark forest/shrubland north of the swamp, B, perhaps approaching A, and of the tuart - *Acacia - Banksia grandis* vegetation B.

4. DISCUSSION

The condition ratings given in Section 3 are based, as much as possible, upon the individual stands of vegetation without comparison with other stands or consideration of their place in a regional context. The value of many of these remnants of native vegetation in a broader context, in comparison with other vegetation in the area and as units in corridors of native vegetation is, however, much higher. If, when rating condition of many units, this value is taken into acount, then many of the units rated C should be raised to B and many rated D should be raised to C.

Across Cockburn Road from the western side of the Mt. Brown area (part of EPA System 6 recommended area M92) is the Coogee reserve (M91). The reserve's sculptured coastal limestone cliff and the heath on top of it (including *Frankenia* sp.) are very rare, if not unique, in the Perth area. The reserve is now part of proposed Beeliar Regional Park (Environmental Protection Authority 1993; Department of Planning and Urban Development 1992).

5. ACKNOWLEDGEMENTS

Diana Corbyn helped with the field work in northern areas in the eastern chain and provided published and unpublished information about some of them. Harry de Jong helped with field work in the banksia woodland south of the Spectacles and provided information about it, the Spectacles reserve and the banksia woodland east of it. Bronwen Keighery gave advice and suggestions.

6. REFERENCES

Dames & Moore. (1987). ***Flora and Fauna Study : Kwinana Freeway Extension (South Street to Yangebup Road) and Suggestions for Rehabilitation.*** Unpublished report to Main Roads Department.

Dell, B. and Bennett, I. J. (1986). ***The Flora of Murdoch University; A Guide to the Native Plants on Campus.*** Murdoch University, Murdoch. 130 pp.

Department of Planning and Urban Development (DPUD). (1992). ***Beeliar Regional Park Proposals for Establishment, Administration and Use: Final.*** Department of Planning and Urban Development, Perth. 48 pp.

Ecoscape Landscape Ecologists Environmental Consultants and Landmarc Consultancy. (1992). ***Piney Lakes Reserve Concept Plan.*** City of Melville. 56 pp.

Environmental Protection Authority. (1993). ***Red Book Status Report (1993).*** West. Austr. EPA Report 15.

Environmental Protection Authority. (1983). ***Conservation Reserves for Western Australia as recommended by the Environmental Protection Authority -- 1983: The Darling System -- System 6.*** Dept. Cons. and Environ. Report 13.

Marchant, N.G., Wheeler, J.R., Rye, B.L., Bennett, E. M., Lander, N.S. and Macfarland, T.D. (1987). ***Flora of the Perth Region.*** West. Aust. Herb., South Perth, W.A.

Semeniuk, C. A. (1992). ***Wetlands of the Perth to Bunbury Region: Coastal Wetlands from Wedge Island to Mandurah.*** Water Authority of Western Australia. Map, text, drawings and photographs.

Semeniuk, C. A. (1987). Wetlands of the Darling System - a geomorphic approach to habitat classification. ***J. Roy. Soc. West. Austr. 69***:95-112.

Smith, V. (1986). ***Booragoon Lake Management Plan.*** City of Melville.

Street, M. (1991a). ***Blue Gum Lake Reserve Management Plan (Reviewed Edition).*** City of Melville. 95 pp.

Street, M. (1991b). ***Booragoon Lake Management Plan (Reviewed Edition).*** City of Melville. 86 pp.

FIGURES

NAMES AND FACILITIES

1	Blue Gum Lake	
2	Lake Booragoon	
3	North Lake	
4	Bibra Lake	
5	South Lake	⊘
6	Little Rush Lake	
7	Yangebup Lake	
8	Kogolup Lake	
9	Thomson Lake	
10	Banganup Lake	⊘
11	Wattleup Lake	⊘
12	The Spectacles Swamps	⊘
13	Bollard Bulrush Swamp	⊘
14	Folly Pool	
15	Maramanup Pool	
16	Beenyup Pool	⊘
17	Geogrup Lake	
18	Manning Lake	M
19	Market Garden Swamps	⊘
20	Lake Coogee	
21	Brownman Swamps	
22	Lake Mt. Brown	
23	Long Swamp	⊘
24	Leda Swamps	
25	White Lake or Cooloongup Lake	
26	Salt Lake or Lake Walyungup	
27	Tamworth Hill Swamp	⊘
28	Anstey Swamp	
29	Madora Swamp	⊘
30	Lake Richmond	

LEGEND

- Bicycle Route
- Bird Watching
- Golf
- Heritage Trail
- Museum
- Picnic Area
- Walking Trails
- Not Accessible (Private Property)

N

0 2 4 6 8 10 12

Scale in Kilometres

INDIAN OCEAN

PERTH

SWAN RIVER

Fremantle

STOCK RD

Canning River

ALBANY HWY

Carnac Island

Woodman Point

COCKBURN SOUND

GARDEN ISLAND

KWINANA FWY

ROCKINGHAM ROAD

Armadale

Forrestdale Lake

JOHN FORREST ROAD

John Point

Rockingham

Penguin Island

WARNBRO SOUND

LAKE MANDURAH ROAD

HIGHWAY 1

Becher Point

Serpentine River

WESTERN POWERHOUSE ROAD

FREMANTLE ROAD

Mandurah

PEEL INLET

RIVER

Pinjarra

THINGS TO SEE AND DO

Picnic facilities are available at North, Bibra and Manning Lakes. The last two have ample grassed areas with barbeques, tables and amenities blocks.

Cycling — It is possible to cycle around Bibra Lake or to take extended cycle trips from Bibra Lake to North and Yangebup Lakes.

Golfing — There is a free, miniature golf course at Bibra Lake.

Hiking — There is a network of trails at Thomsons Lake and Limited walking trails at Bibra, North and Manning Lakes.

Heritage Trails — Manning Lake has a museum and heritage trail which provides fascinating insights into the history of the Cockburn district and panoramic views over Cockburn Sound.

Birdwatching — The Beeliar Wetlands are a birdwatcher's paradise, particularly in autumn when the lakes are full of loafing waterfowl. The best spots for casual birdwatching are Yangebup Lake, East Bibra Lake, Hope Road Swamp, Lake Booragoon, Thomson's Lake and Manning Lake. The more secluded wetlands offer many rewards for the serious birdwatcher. Transequatorial migratory waterbirds can be seen in summer at Thomson's Lake, White Lake, Lake Walyungup and Lake Mt Brown.

Nature Studies — The woodlands and wetlands of the Beeliar Regional Park are ideal for nature study. Lake Booragoon, Piney Lake, North Lake and Lake Mt Brown are popular sites for such activities.

THE FUTURE OF THE BEELIAR WETLANDS

In 1984 the Environmental Protection Authority recommended that the Beeliar Wetlands should be reserved for public use and managed for conservation and recreation because of:

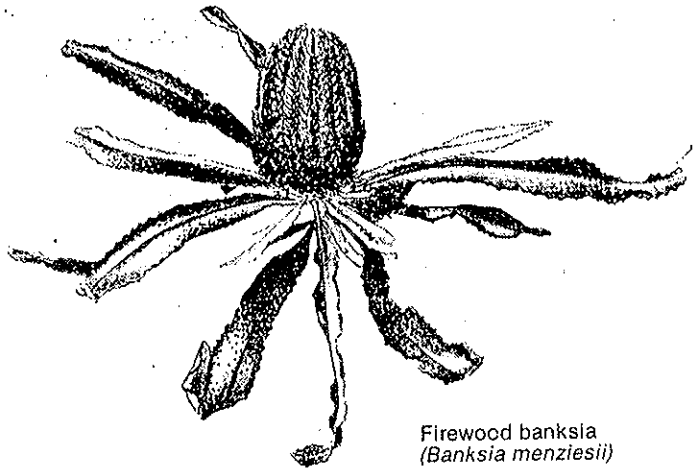
— their importance in the conservation of natural land and water values of the Swan Coastal Plain; and

— the potential for increased degradation of these values by urban development.

The State Government subsequently announced its intention to establish the Beeliar Regional Park. A Consultative Committee was set up to define park boundaries, determine land and water use and guide the preparation of a Planning Study of the area.

It is expected that the Department of Conservation and Land Management (CALM) will co-ordinate all management programs in Beeliar Regional Park. CALM's first task will be to prepare a management plan of the area which will require public input before it is approved by Government. The plan will identify areas for conservation management by CALM and areas for recreation management by the Cockburn and Kwinana Town Councils.

Much of Beeliar Regional Park is presently under interim management by these organisations and the State Planning Commission.

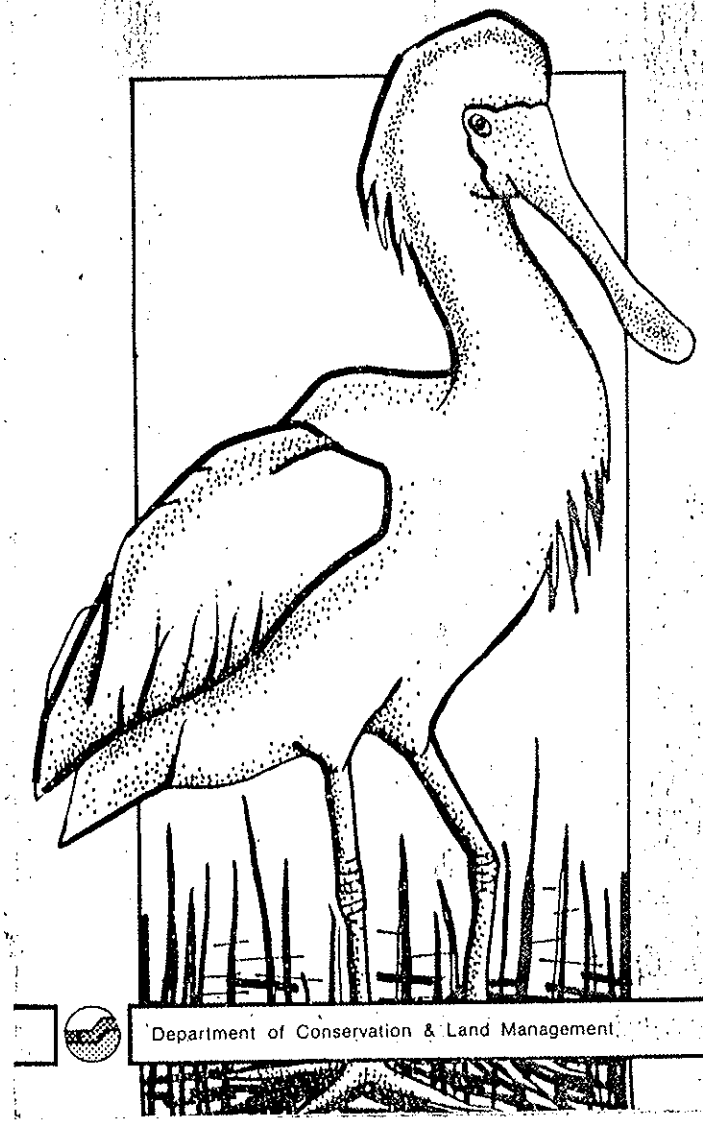


Firewood banksia
(Banksia menziesii)

Published by CALM
50 Hayman Rd
COMO 6152
(09) 367 0333

THE BEELIAR WETLANDS

A GUIDE FOR VISITORS



Department of Conservation & Land Management

The Beeliar Wetlands consist of two chains of lakes and swamps which run parallel to the coast within the South Western Corridor of the Perth Metropolitan Area.

The Western Chain lies about two kilometres inland from Cockburn Sound and extends from Manning Lake in the north to Anstey Swamp in the south. It includes Lake Coogee, White Lake and Salt Lake and smaller swamps such as the Brownman Swamps, the Market Garden Swamps and the Leda Swamps.

The Eastern Chain lies about five kilometres further inland and extends from Blue Gum Swamp in Mt Pleasant to Karnup Pool in Baldivis. This chain contains several large freshwater lakes such as Bibra Lake, Yangebup Lake and Thomsons Lake, and many other smaller lakes and swamps.

Beyond Kwinana the Eastern Chain merges with the Serpentine River valley, while the Western Chain continues on down to the Peel Inlet.

ABORIGINALS AND THE WETLANDS

Before the arrival of European settlers in 1829 the Beeliar Wetlands had a central role in the life of the Aboriginal inhabitants of the Swan Coastal Plain. The Beeliar tribe lived in the southern part of the Perth Metropolitan Area. They used the wetlands extensively for food and water supplies and regularly camped in the vicinity of North and Bibra Lakes. This area is also believed to have spiritual significance to the Aboriginal people.

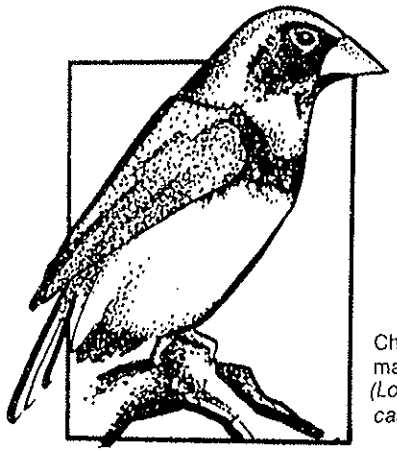
Over many millennia Aboriginal people used and managed the Beeliar Wetlands to provide sustainable food and water supplies. Since European settlers arrived, these wetlands have been greatly modified and many of the lakes and swamps degraded and destroyed. What remains today is an important fragment of this rich and beautiful ecosystem. With care and good management it can be conserved to provide future generations with a priceless natural asset. The Aboriginal people, with their rich cultural heritage so closely linked to these wetlands, have an important role to play in this conservation and management program.

WILDLIFE OF THE WETLANDS

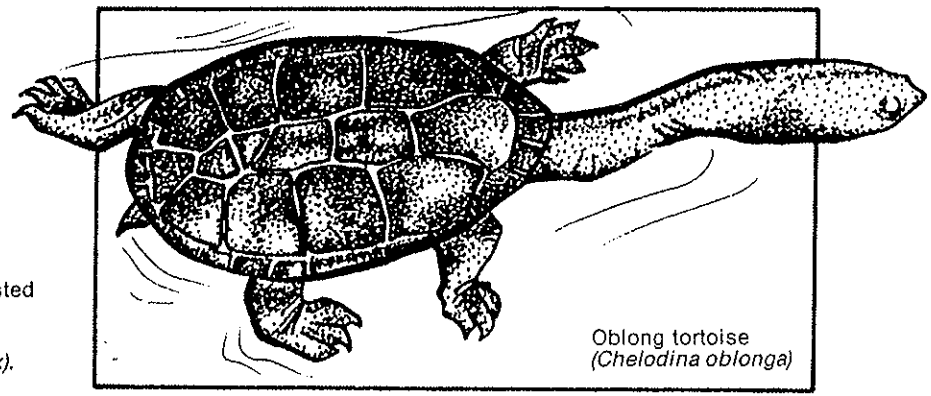
The wetlands are the most biologically productive areas of the Coastal Plain. They provide fresh water and abundant food supplies for wildlife.

The Beeliar Wetlands range from small seasonal swamps to large permanent lakes. Almost all of them are fringed by belts of rushes and freshwater paperbarks. Some of the more saline, such as Lake Coogee, also have well established stands of saltwater paperbark and areas of samphire and saltmarsh.

The lakes of the western chain lie within the Spearwood dunes and are surrounded by tuart forest with abundant grass trees and peppermints. The eastern chain lakes lie on the boundary of the Spearwood and Bassendean dunes. Their fringing woodlands contain stands of banksia, marri, Christmas trees, jarrah and a rich ground flora.



Chestnut breasted mannikin *(Lonchura castaneothorax).*



Oblong tortoise *(Chelodina oblonga)*

The lakes and swamps are a haven for many species of waterbird and the surrounding woodlands abound with bushbirds. More than 130 different bird species use the Beeliar Wetlands Park. The lakes are rich in invertebrate fauna and the Woodlands support a great diversity of insect and reptile species. The long-necked tortoise is also common in the lakes.

Occasionally larger mammals are seen in the fringing woodlands. They include bandicoots, kangaroos and possums, and feral species such as foxes and rabbits.

THE VALUE OF THE WETLANDS

The Beeliar Wetlands form an interdependent ecosystem which supports a diverse range of plants and animals. Many waterbirds and other fauna migrate from one wetland to another during the summer as the swamps and lakes gradually dry out. Wading birds use the shallow margins of the lakes for feeding during the summer months. The fringing woodlands around Kogolup, Thomsons and North Lakes are important breeding areas for many bush-birds, bandicoots, long-necked tortoises and other reptiles. Waterbirds breed in the reeds and paperbarks in many of the lakes.

The Beeliar Wetlands are an important habitat for many migratory waterbirds, some of which come to Western Australia from Siberia, China and Japan. They arrive here in October/November hungry and exhausted from their long flight, and they use the Beeliar Wetlands for feeding and resting before moving on to other lakes in the South-West. In autumn they return to the Northern hemisphere.

In the late summer most of the inland lakes in W.A. dry out and thousands of waterbirds migrate to the coastal wetlands to await the autumn rains. At such times the Beeliar Wetlands provide a vital habitat for thousands of ducks, swans and coots.

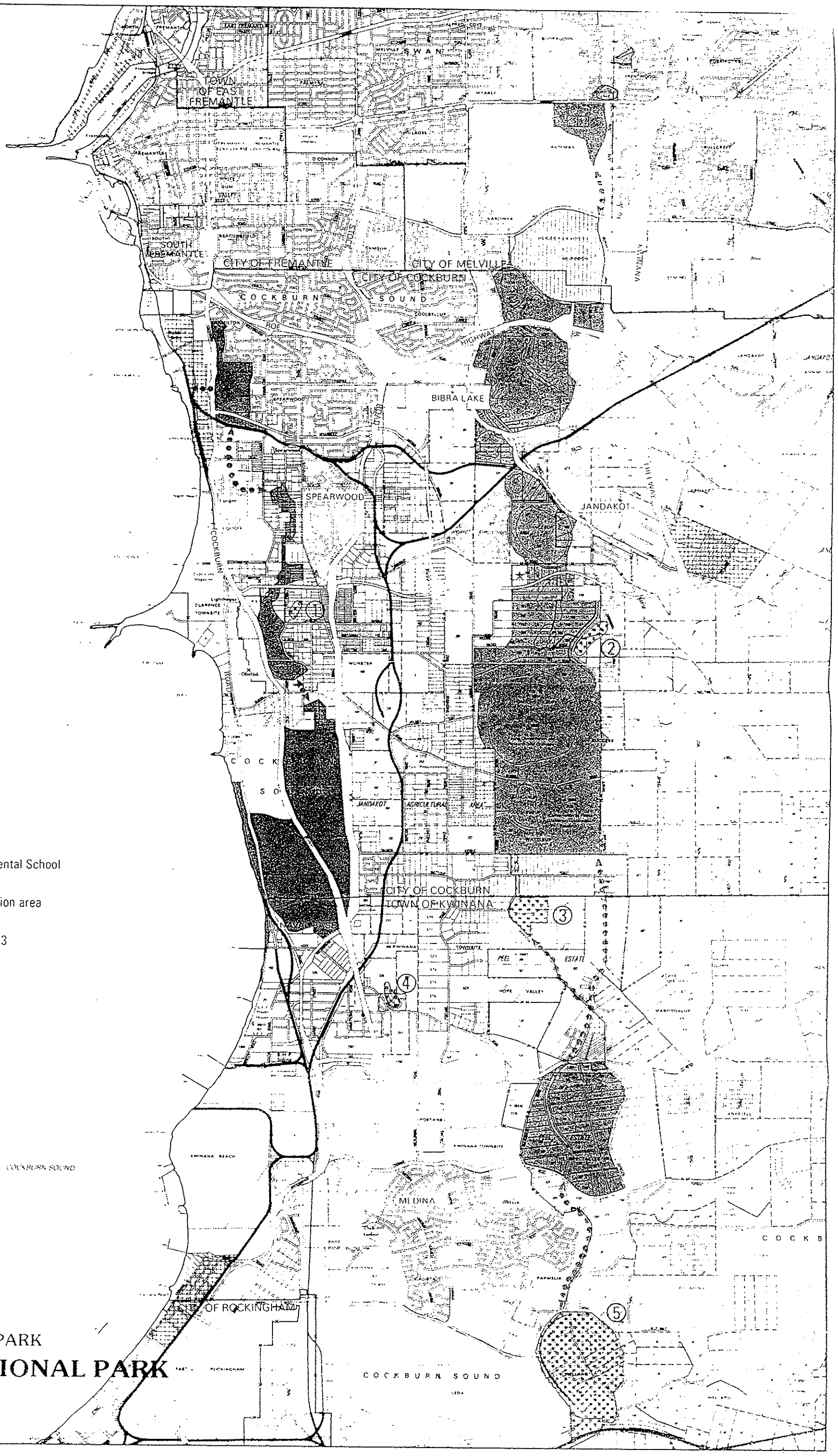
The Beeliar Wetlands are an important part of the landscape of the Coastal Plain. They provide a refuge for wildlife, they enhance the beauty of the suburban landscape and they give city dwellers the opportunity for outdoor recreation in a natural setting.

Prepared by the Department of Planning
and Urban Development Perth, Western Australia
May 1992

SCALE

0 1 7

Kilometres



LEGEND

- Beeliar Regional Park (approximate area 2700ha)
- Possible future linkages
- Murdoch University
- Proposed Beeliar Environmental School
- Proposed landscape protection area

① Market Garden Swamp No. 3
② Branch Circus Wetland
③ Wattleup Lake
④ Long Swamp
⑤ Bollard Bullrush Swamp

BEELIAR REGIONAL PARK

BEELIAR REGIONAL PARK

TABLE

Table 1

Beeliar National Estate Areas (proposed)

No.	Area	Condition of Non-wetland Areas indicated on AHC maps	Attachm. 1 Set(s)	Aerial Photo(s)
1.0.	Blue Gum Lake	--	1	9-5213
2.0.	Lake Booragoon	--	1	9-5213
2.1.	Piney Lake	E-D	1	9-5213
2.2.	Murdoch University	--	--	--
2.2.1	Upper Swamp	--	2	8-5038
2.2.2	Melaleuca Swamp	--	2	8-5038
2.2.3	Banksia Woodland	--	2	8-5038
2.3	Woodlands East of Murdoch	--	2	8-5038
3.0.	North Lake	D, E-D, A-B, C-B	2	8-5038
4.0.	Bibra Lake	C-B, D, E	3	8-5036
5.0.	South Lake	D (-E)	3	8-5036
5.1	Railway Triangle	C	3	8-5036
6.0.	Little Rush Lake	C-D, D	3	8-5036
7.0.	Yangebup Lake	D-C, D-E	4	8-5034
8.0.	Kogolup Lake	--	4	8-5034
8.1	Branch Circus Wetlands	C	5, 6	8-5032, 9-5218
8.2	Henderson Rd Woodlands	C	4, 6	8-5034, 5032
9.0.	Thomsons Lake	--	4, 6	8-5034, 5032
10.0.	Banganup Lake	--	6	8-5032
10.1.	Wattleup Road Wetland	C-D	7	8-5030
11.0.	Wattleup Lake	C(-D)	7	8-5030
12.0.	The Spectacles	D-C, D, E	8	9-5224
12.1	Woodland East of Spectacles	--	8	9-5224
12.2	Woodland South of Spectacles	--	8	9-5224
18.0.	Manning Lake	--	9	7-5116
19.0	Market Garden Swamps	E, D	10	7-5118
19.1	West Churchill Avenue Lake	B, B-C, C	10	7-5118
20.0.	Lake Coogee	--	10, 11	7-5118, 5119
21.0.	Brownman Swamps	B, C-B	11, 12	7-5119, 5121
22.0.	Lake Mt. Brown	C(-B)	12	7-5121
23.0.	Long Swamp	E(&C)	7	8-5030

ATTACHMENTS

1 Aerial Photographs and Transparent Overlays

Attachment 1 comprises 12 sets of

- colour photocopies of aerial photographs,
- transparent phtocopies of of the AHC Attachment E 1:20,000(+/-) scale maps enlarged to 117%, and
- condition assessments.

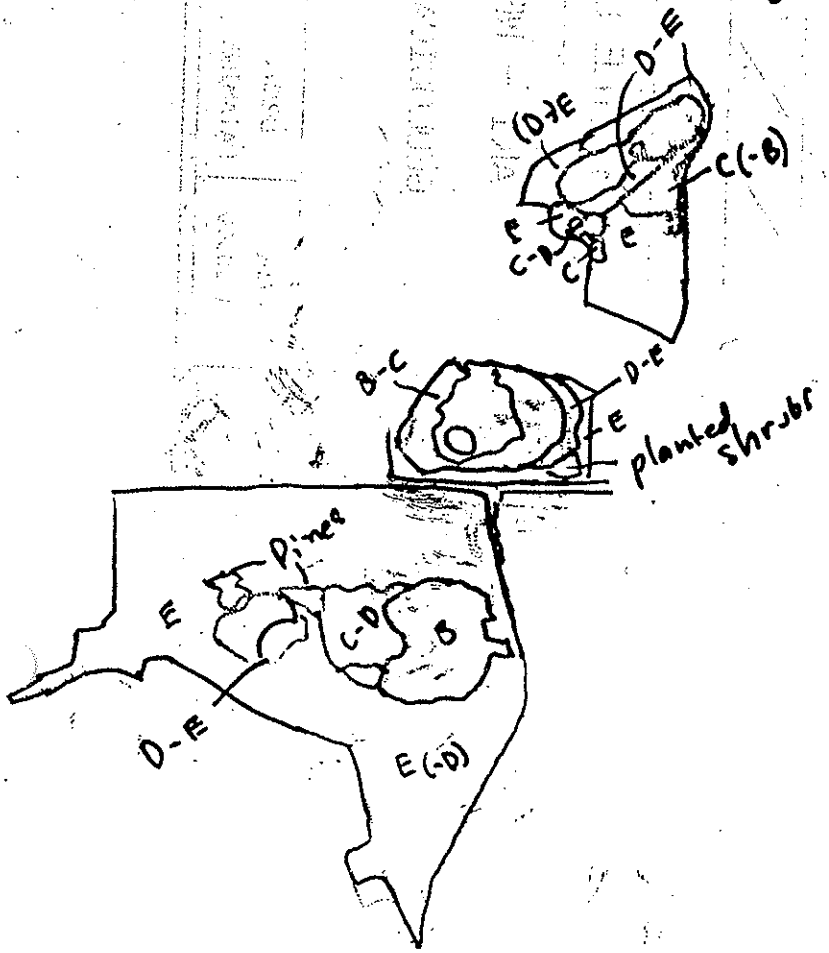
Areas covered by each set are indicated in Table 1.

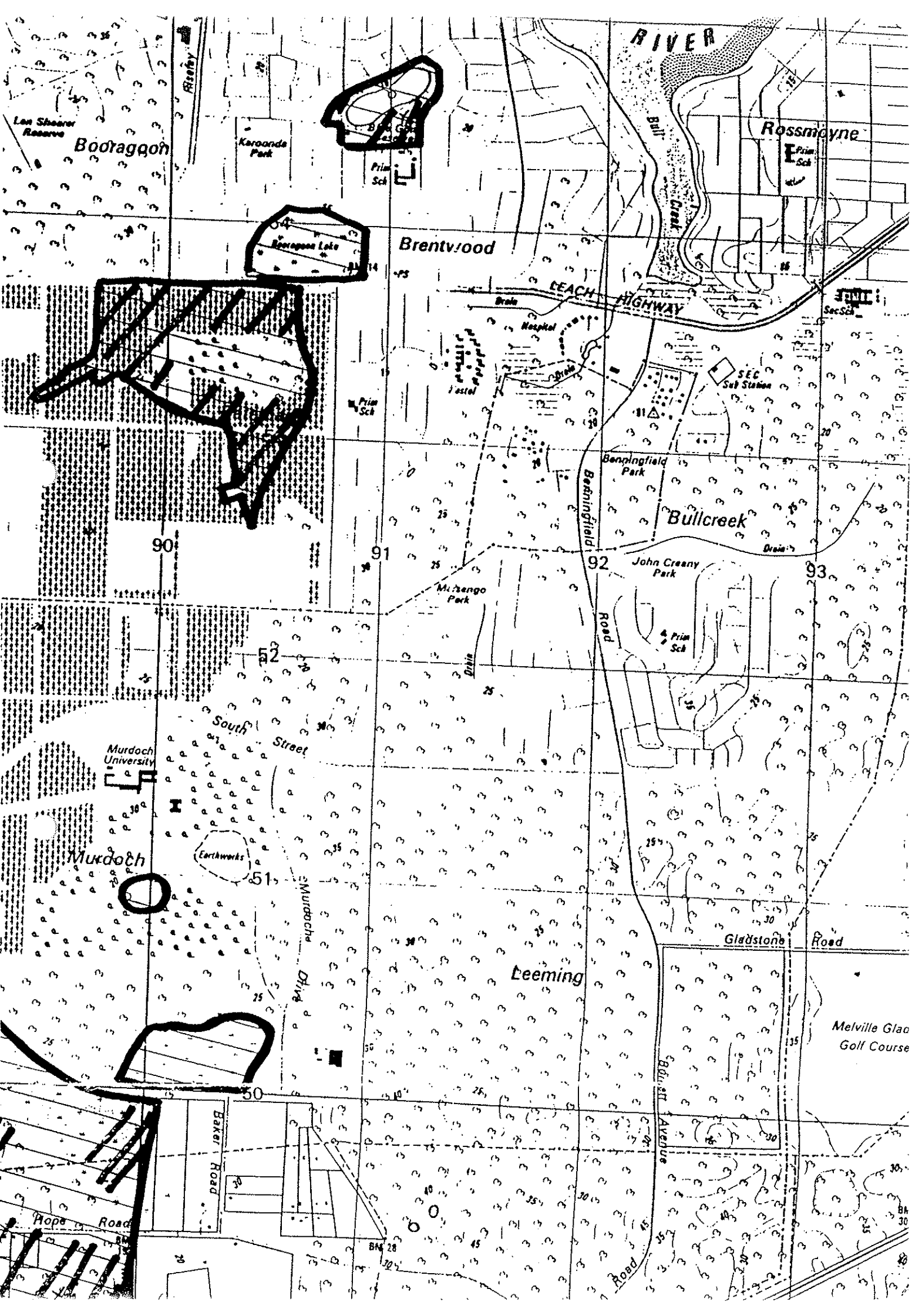
1.0. Blue Gum Lake

2.0. Lake Booragoon

2.1. Piney Lake

Set 1


(D-E
D-E
C(-B)
E
C-D
C
E
B-C
D-E
E
planted shrubs
Pines
E
C-D
B
D-E
E(-D)


RIVER
Booragoon
Lee Shearer Reserve
Karoonda Park
Prim Sch
Brentwood
Booragoon Lake
Ball Creek
Rossmoyne
Prim Sch
Sec Sch
BEACH HIGHWAY
Hospital
Drain
SEC Sub Station
Bennett Park
Bennett Park
Bullcreek
John Creany Park
Prim Sch
Road
Drain
90
91
92
93
52
51
South Street
Murdoch University
Murdoch
Earthworks
Murdoch Drive
Leeming
Gladstone Road
Melville Glad
Golf Course
Baker Road
Hope Road
Road
50
BM 28

2.2. Murdoch University Swamps

2.2.1 Upper Swamp

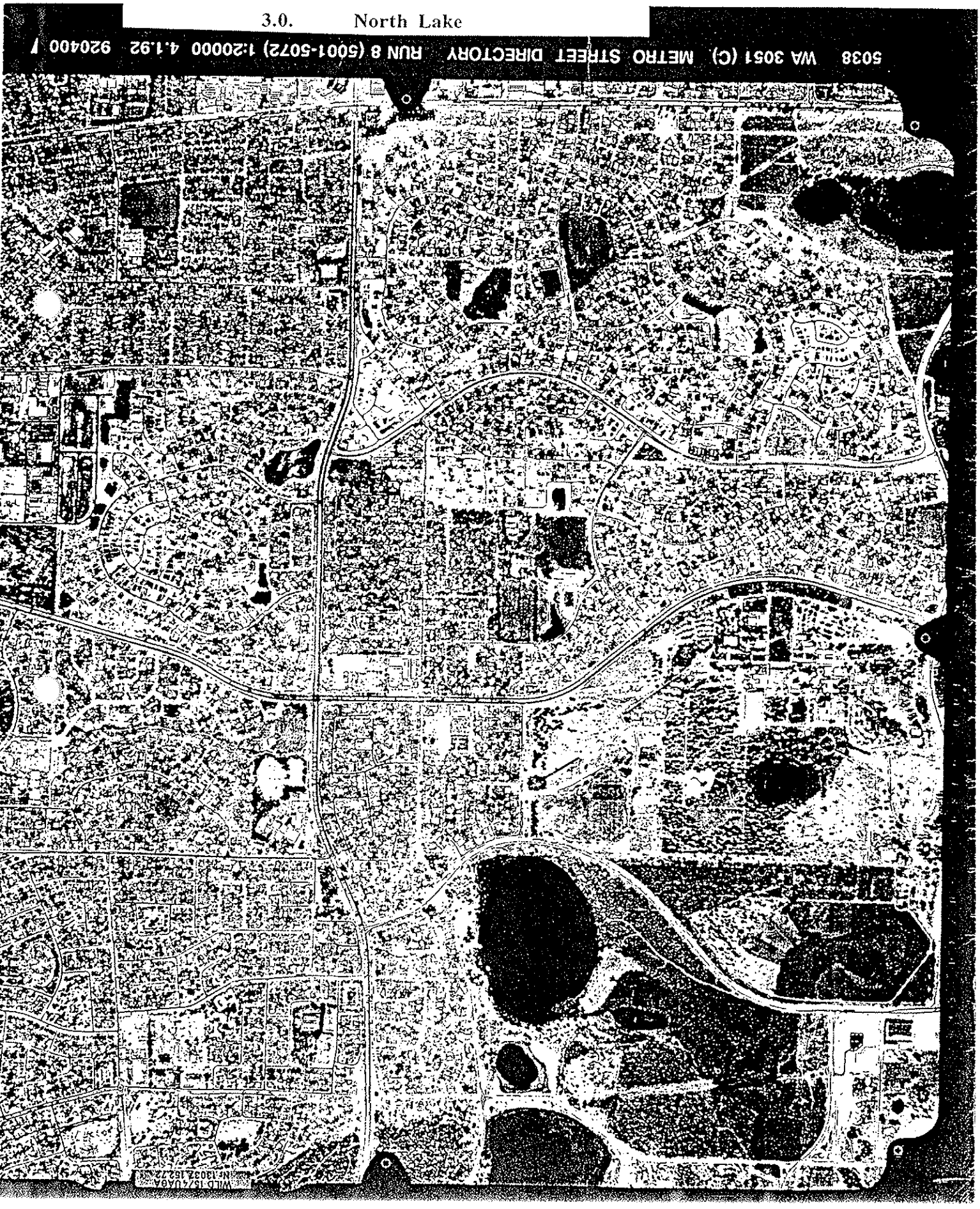
2.2.2 Melaleuca Swamp

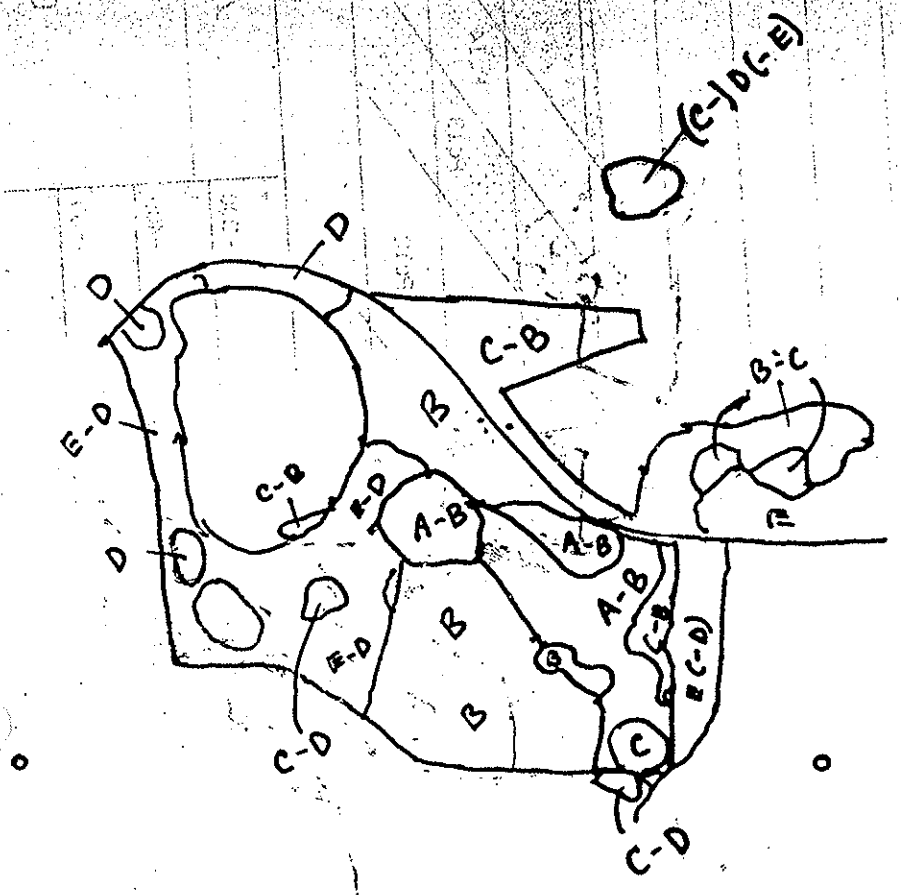
2.2.3 Banksia Woodland

2.3 Woodlands East of Murdoch

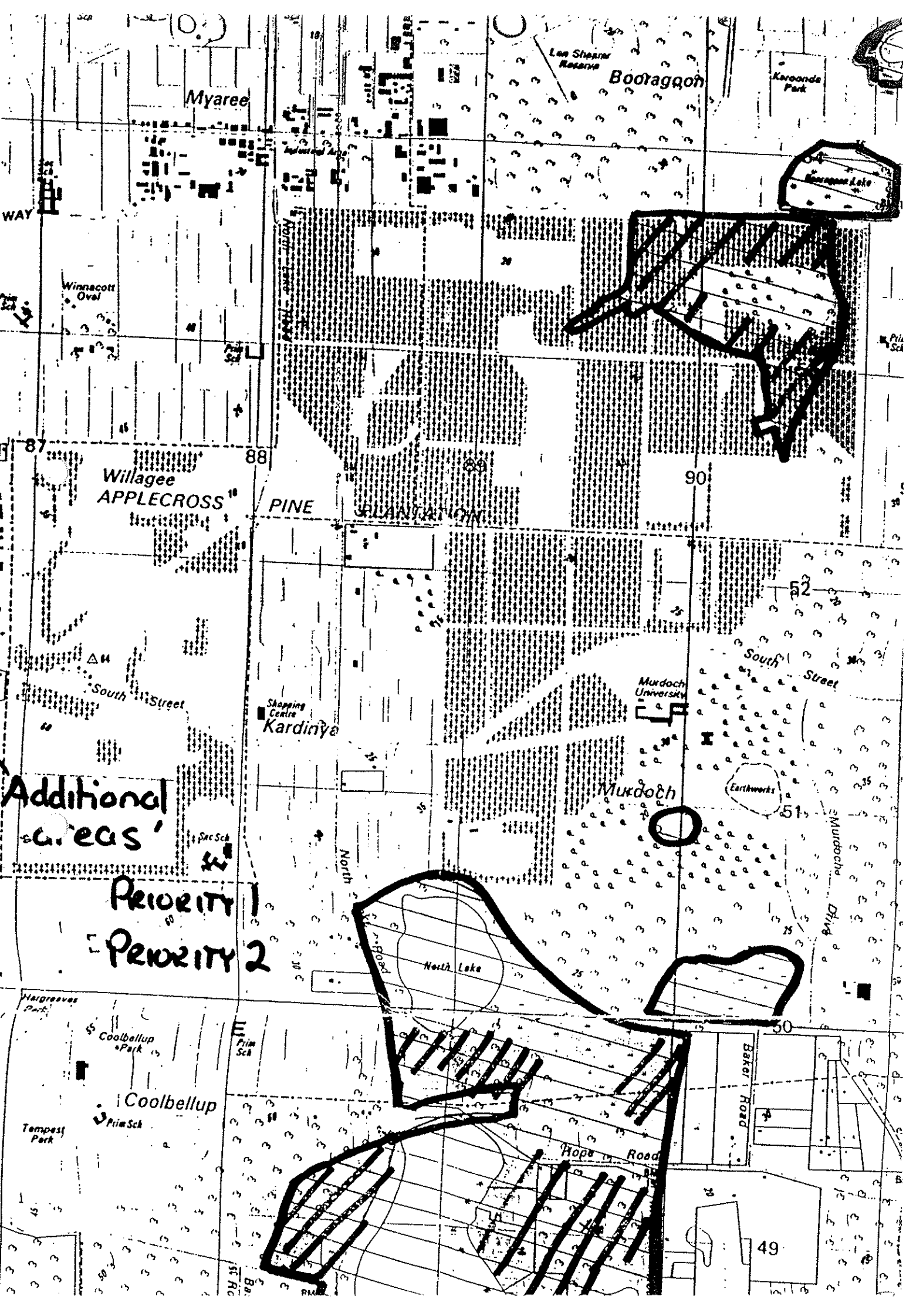
3.0. North Lake

Set 2





8- 5038 - North Lake Complex

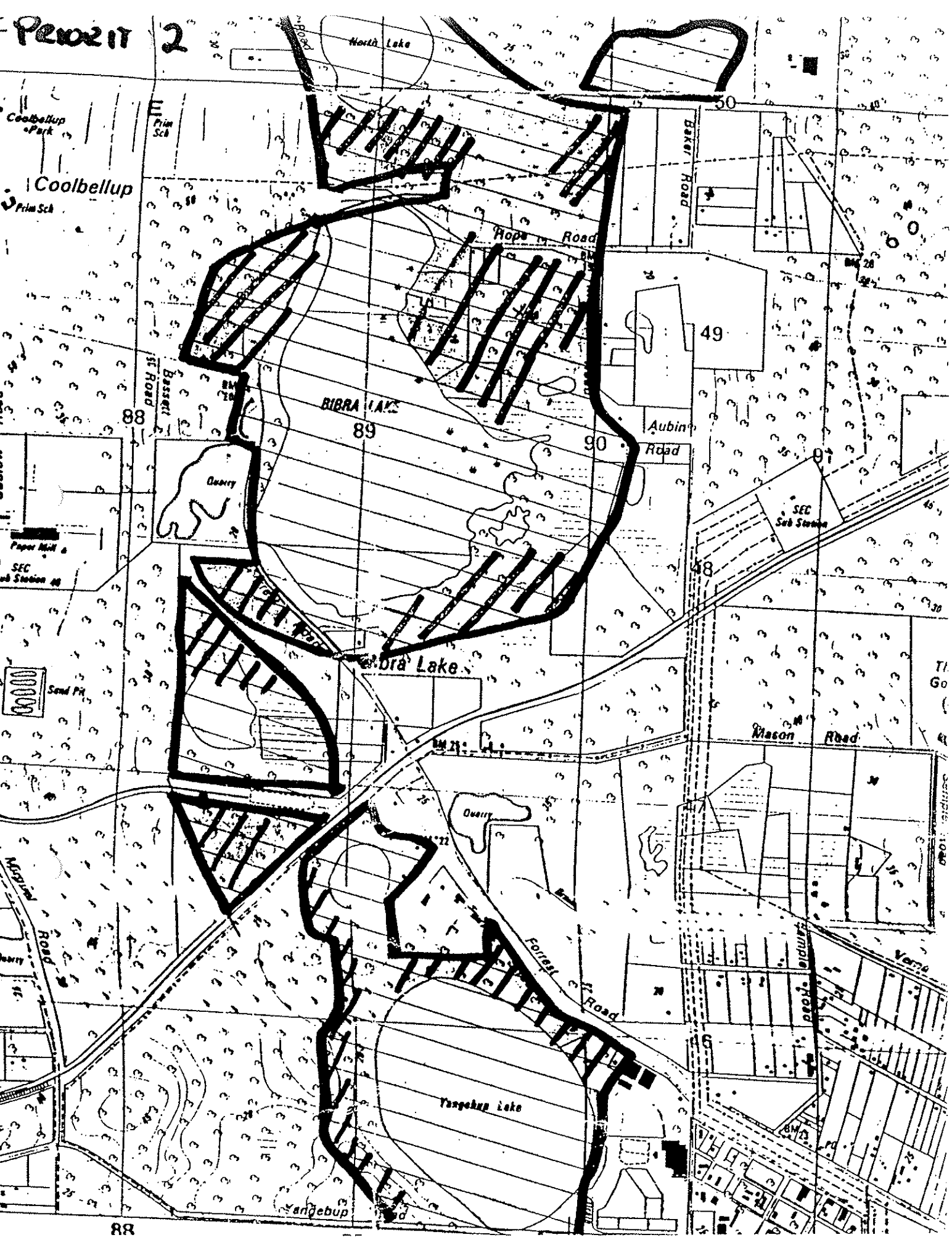

Myaree
Bootaggon
Lee Shearer Reserve
Karoonda Park
Boorgoon Lake
WAY
Winnacott Oval
North Lake Road
87
88
89
90
Willagee
APPLECROSS
PINE
PLANTATION
52
South Street
Murdoch University
Shopping Centre
Kardinya
Murdoch
Earthworks
51
Additional areas
Priority 1
Priority 2
North Lake Road
North Lake
Murdoch Drive
Hargreaves Park
Coolbellup Park
Prim Sch
Coolbellup
Tempest Park
50
Baker Road
Hope Road
49

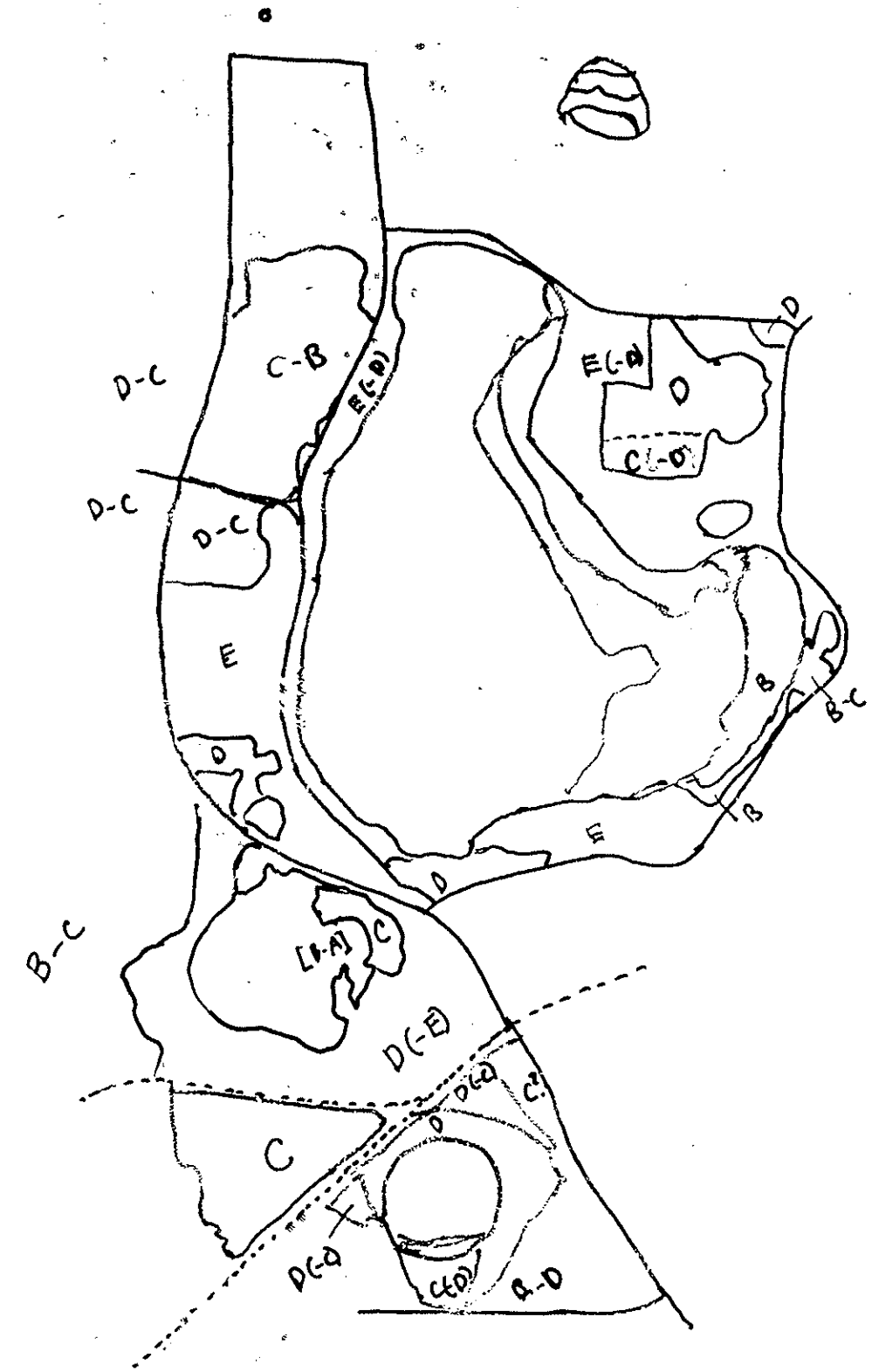
4.0. Bibra Lake

5.0. South Lake

5.1 Railway Triangle

6.0. Little Rush Lake


Coolbellup
Coolbellup Park
Prim Sch
North Lake
Baker Road
Hope Road
Bassett Road
BIBRA LAKE
Aubin Road
Quarry
Paper Mill
SEC Sub Station
Sand Pit
Bibra Lake
Mason Road
Forrest Road
Yangebup Lake
Yangebup Road
88
89
90
91
49
50
58

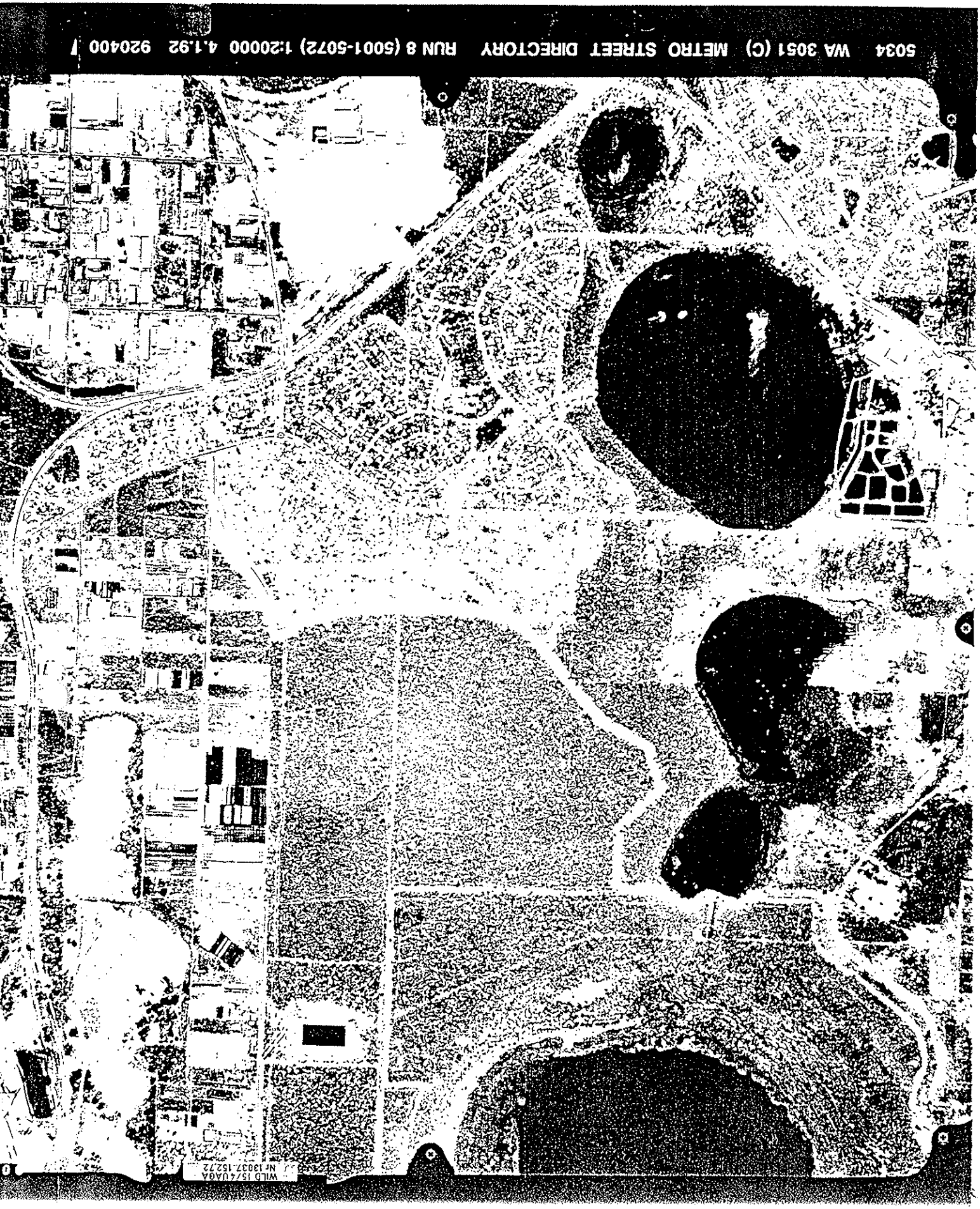

D-C
C-B
E(-D)
D
E(-D)
D
C(-D)
D-C
D-C
E
D
B
B-C
B
E
D
B-C
L(-A)
C
D(-E)
D(-C)
C
D
C
D(-C)
C(-D)
B-D

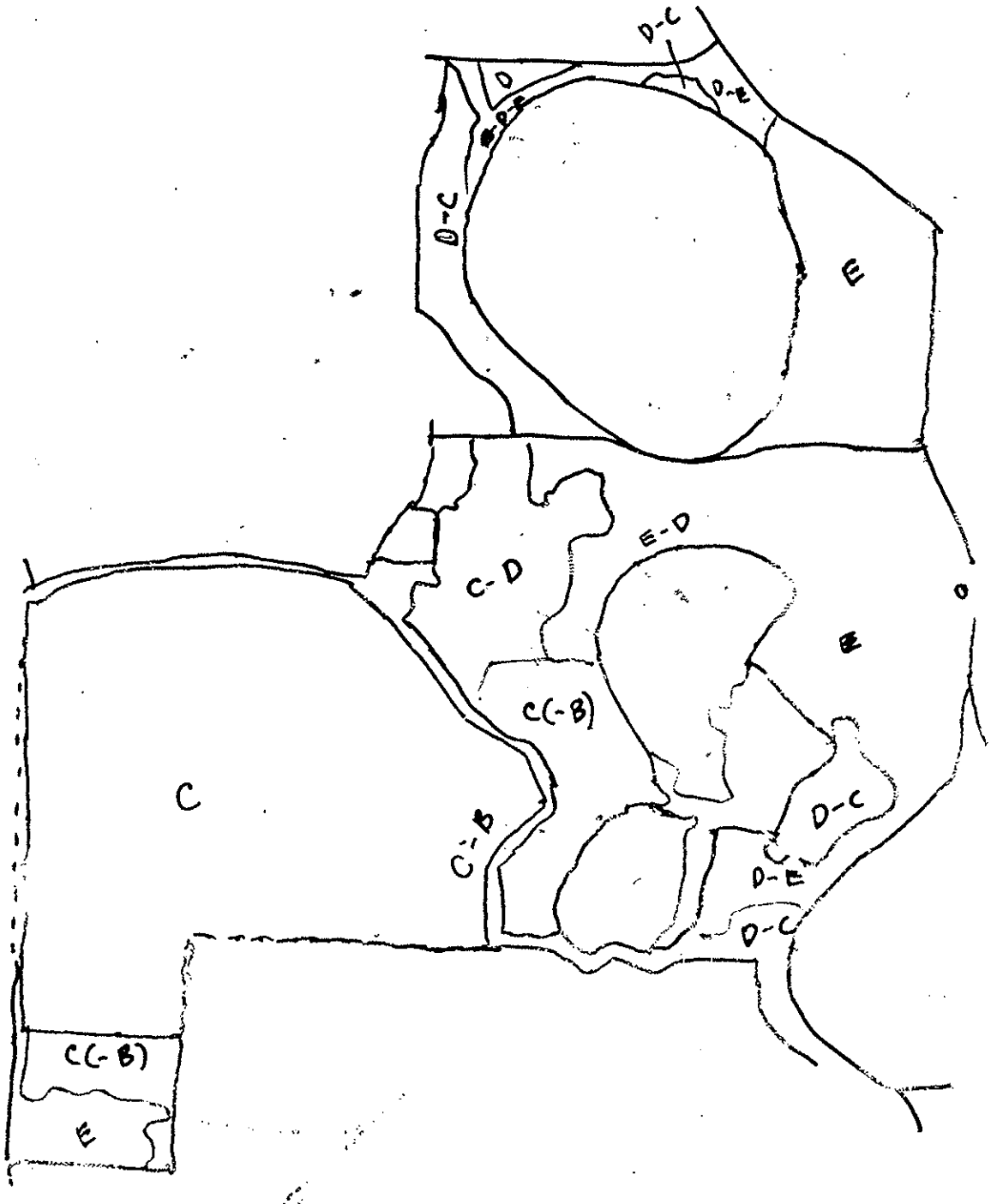
7.0. Yangebup Lake

8.0. Kogolup Lake

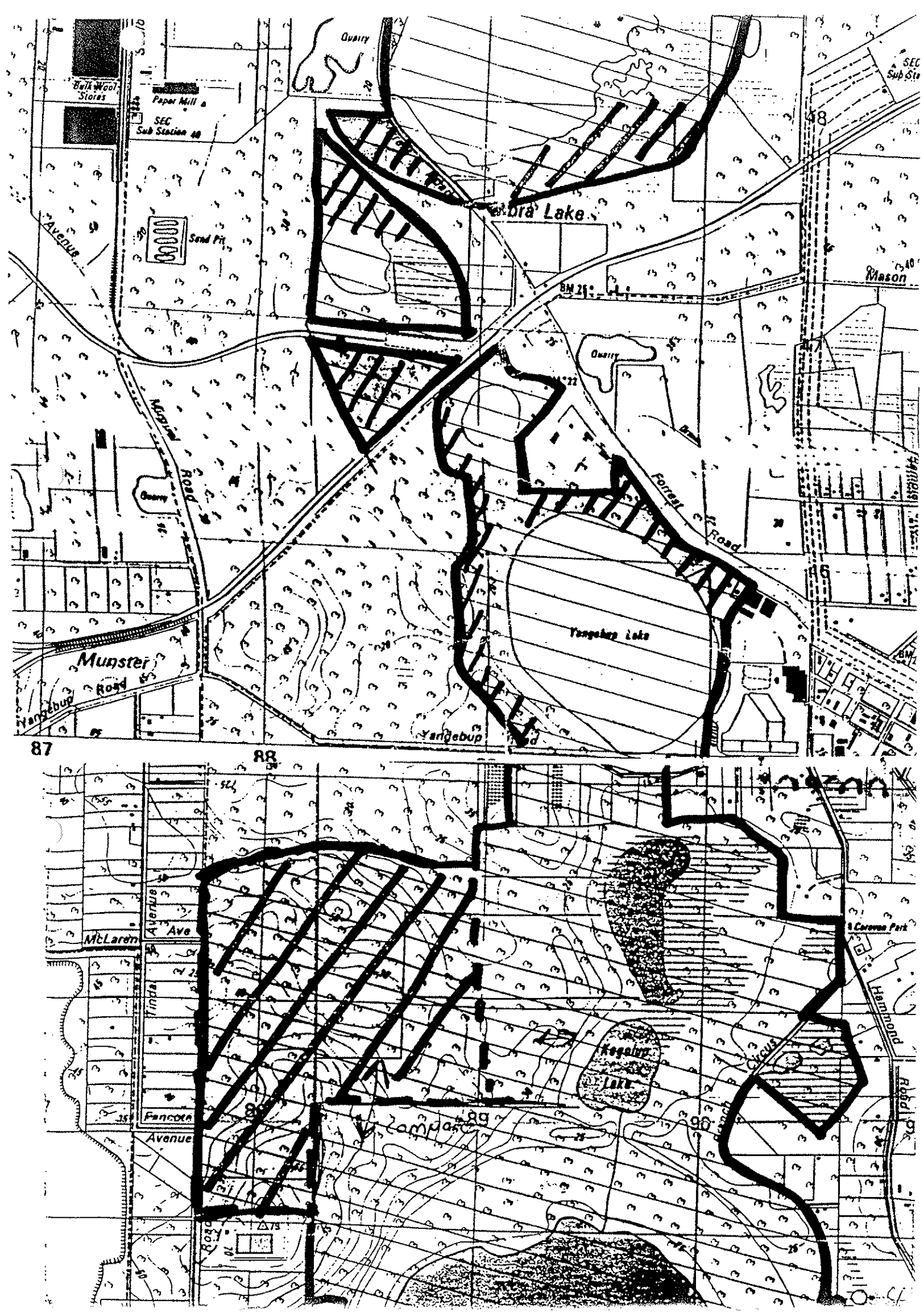
8.2 Henderson Rd Woodlands

9.0. Thomsons Lake





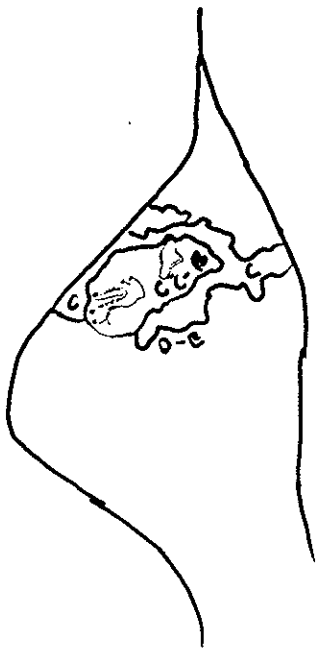
8-50


Quarry
Bulk Wool Stores
Paper Mill
SEC Sub Station
Sand Pit
Avenue
Dra Lake
Mason
BM 25
Quarry
Marginal Road
Forrest Road
Munster
Road
Yangebup
Yangebup Lake
Yangebup Road
87
88
89
90
Avenue
Ave
McLaren
Fancote
Avenue
Lampard
Road
Kogolup Lake
Hammond
Road
Caravan Park

8.1 Branch Circus Wetlands

5

Set 5



8.1 Branch Circus Wetlands

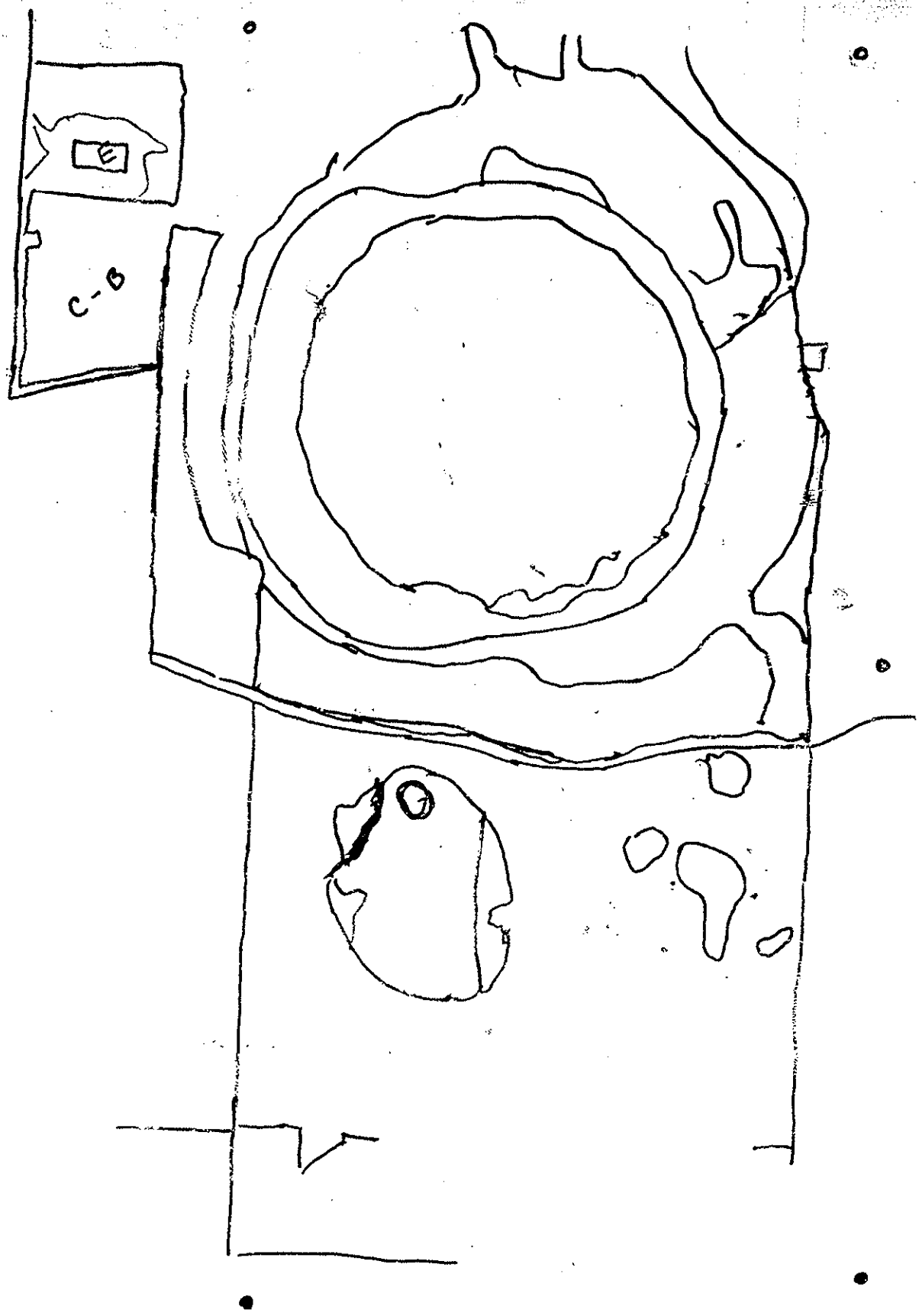
8.2 Henderson Rd Woodlands

9.0. Thomsons Lake

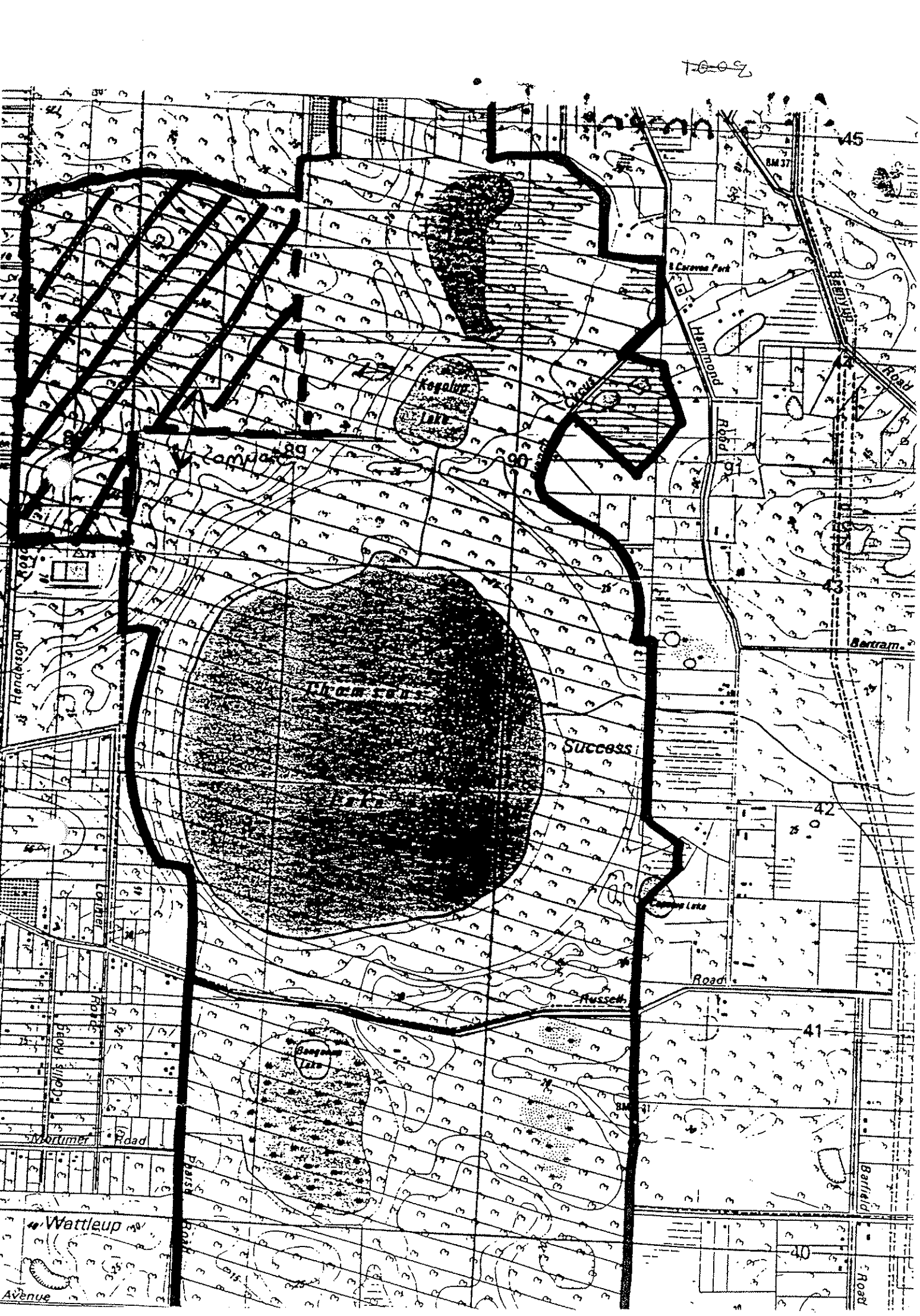
10.0. Banganup Lake

Set 6

6



8-5032 Thompson Lake or Georgia Lake


Kogolup Lake
Thomsons Lake
Success Lake
Hammond Road
Beenyup Road
Bartram Road
Russell Road
Mortimer Road
Wattleup
Avenue
Parish Road
Barfield Road
Lot 90
Lot 91
45
43
42
41
40

10.0. Banganup Lake

10.1. Wattleup Road Wetland

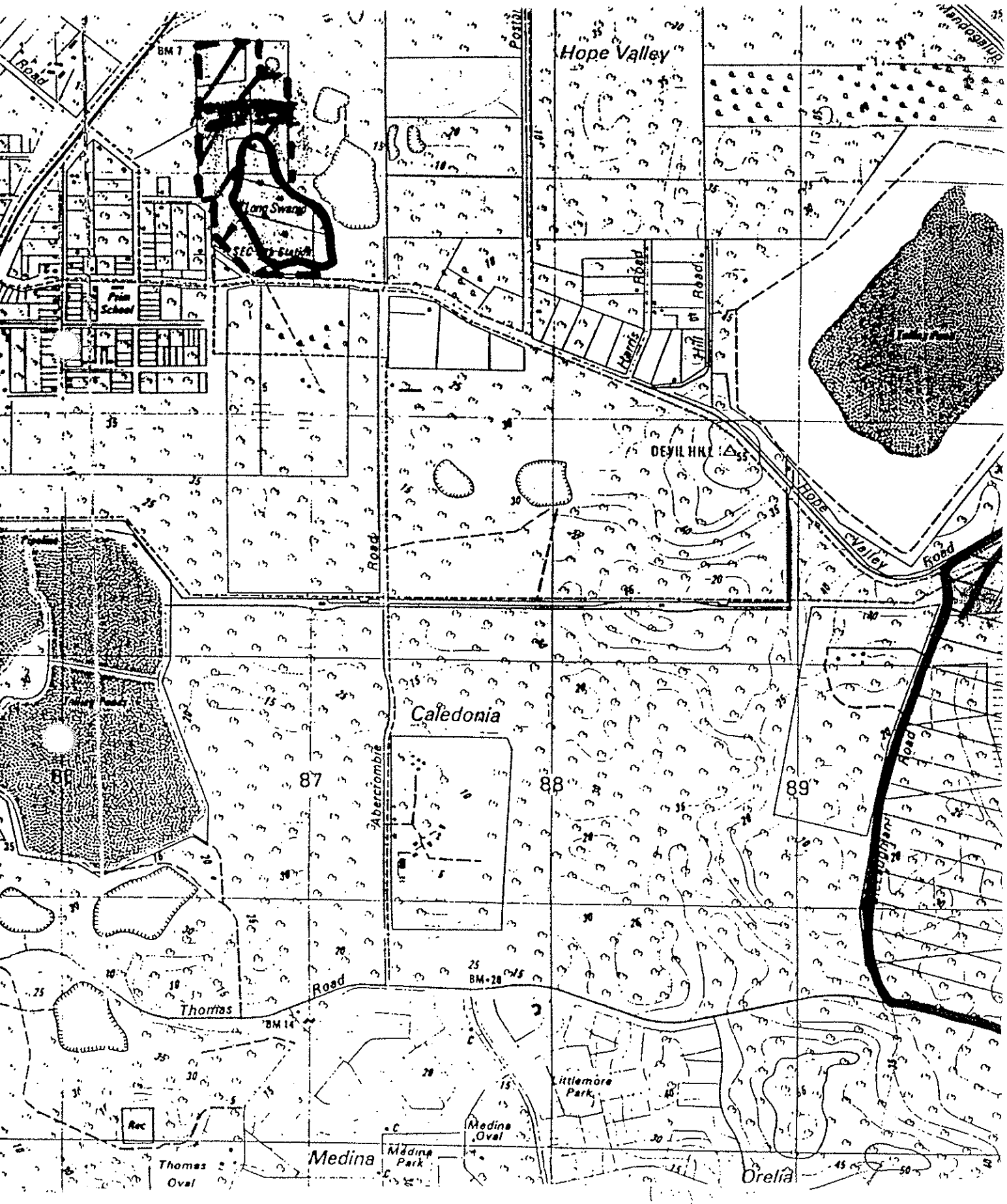
11.0. Wattleup Lake

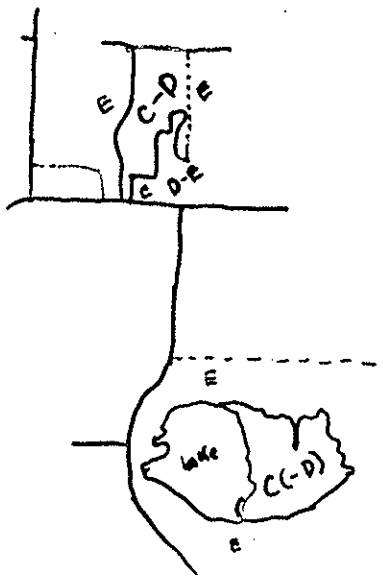
23.0. Long Swamp

Set 7

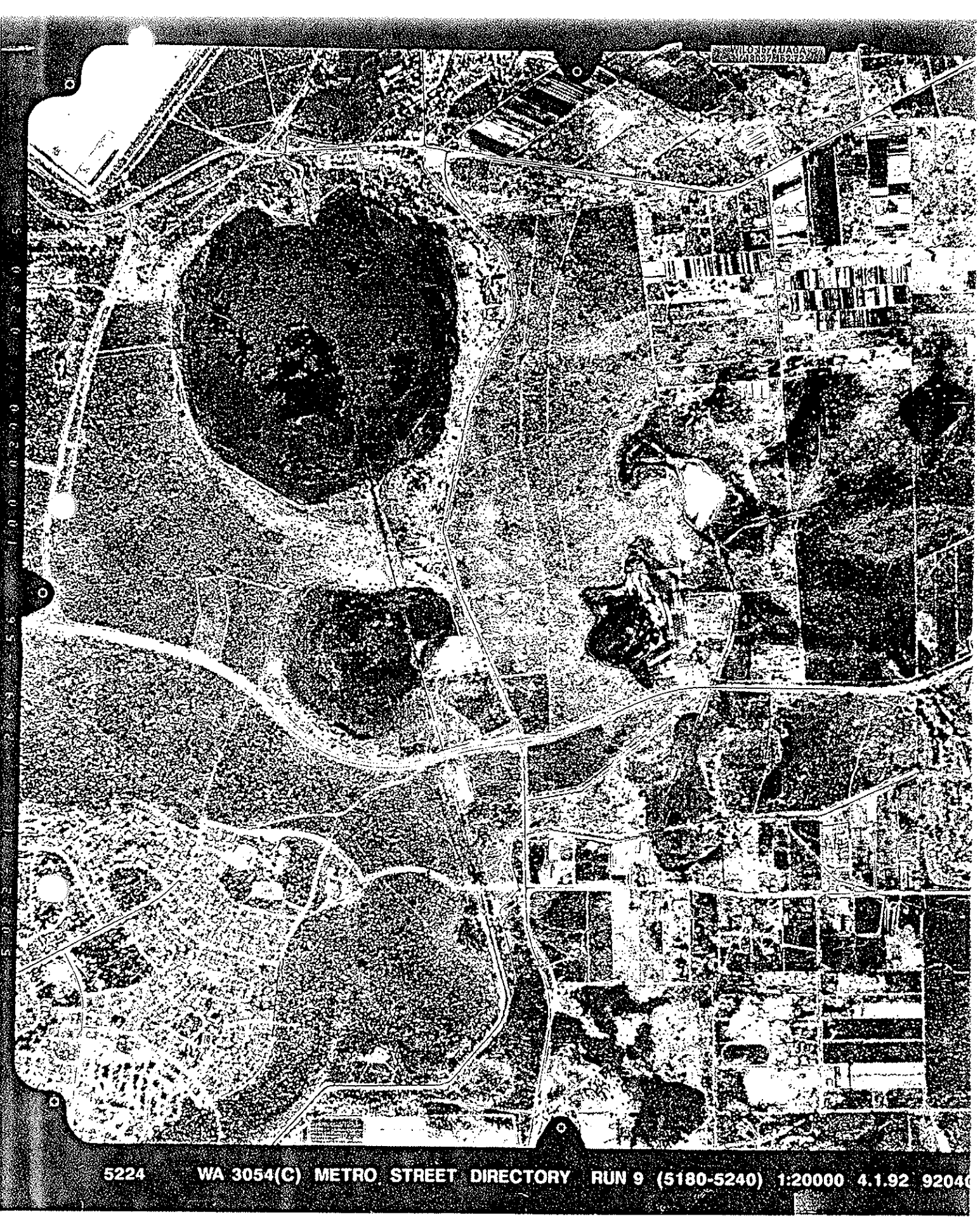
7

Success
Russell
Road
Avenue
Wartleup
Franklind
Dalison
Sewer
91
90
88


Hope Valley
Long Swamp
Caledonia
Abercrombie
Thomas
Road
Medina
Medina Park
Medina Oval
Thomas Oval
Littlemore Park
Orelia
Hope Valley Road
Rec
87
88
89


E
C-D
E
E
D-E
E
lake
C(-D)
E

E
E
E
E-D

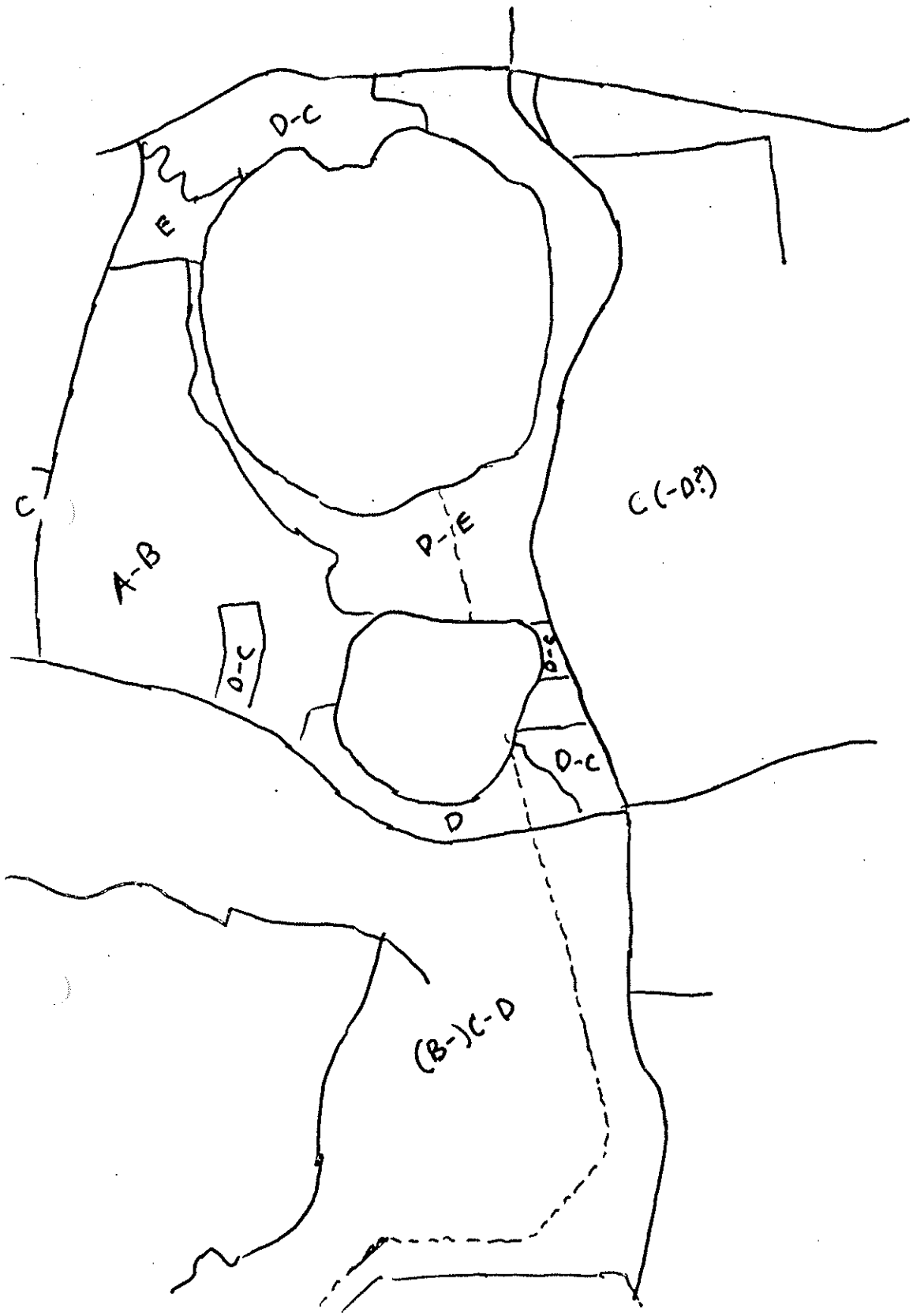


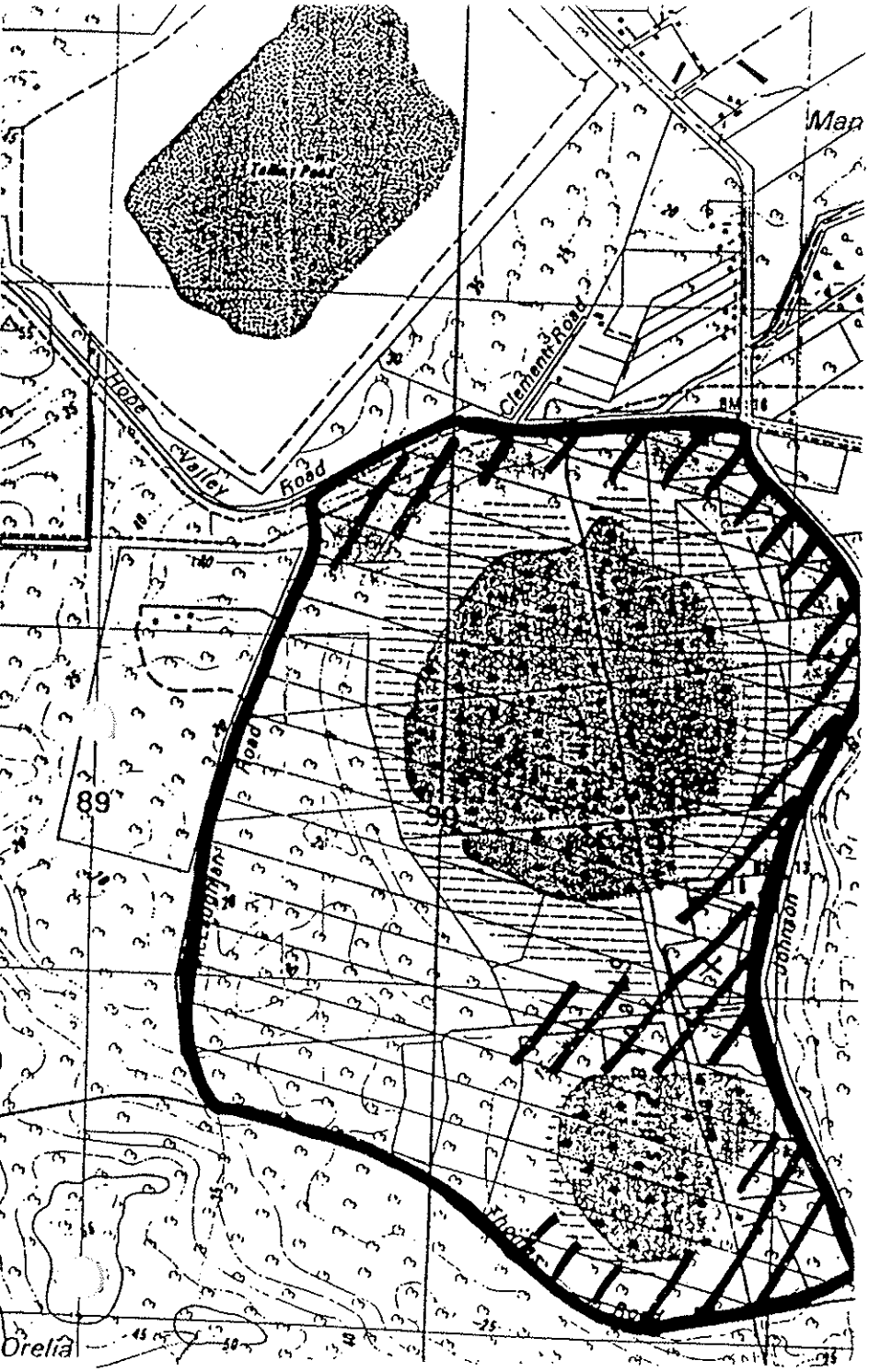
12.0. The Spectacles

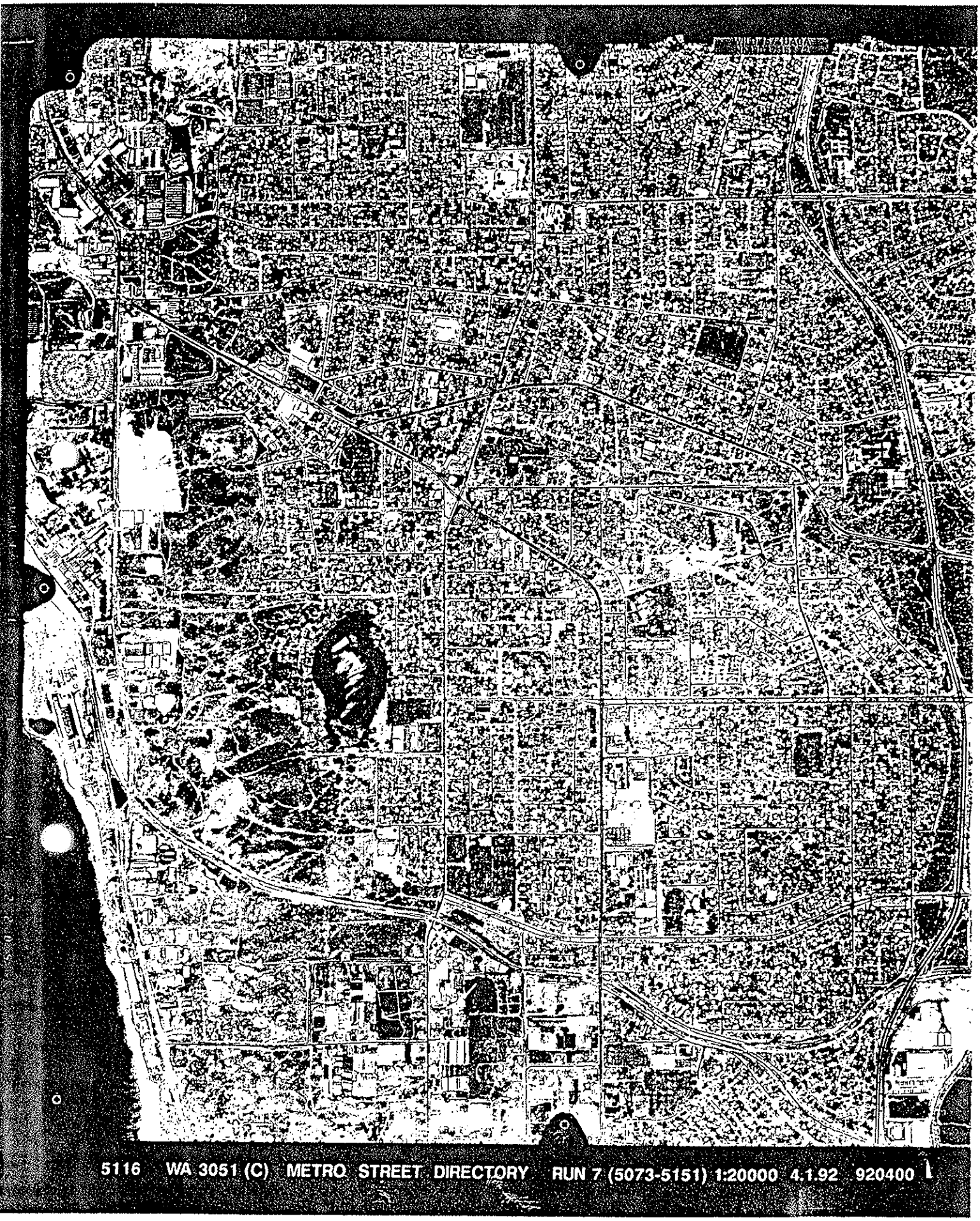
12.1 Woodland East of Spectacles

12.2 Woodland South of Spectacles

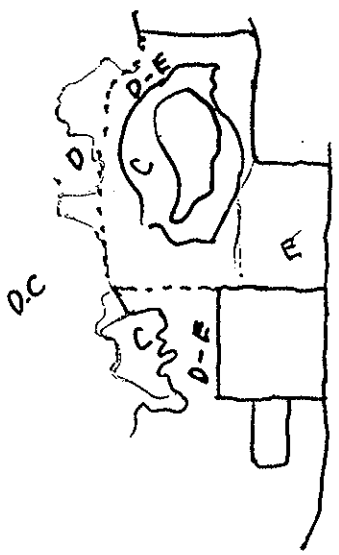
Set 8

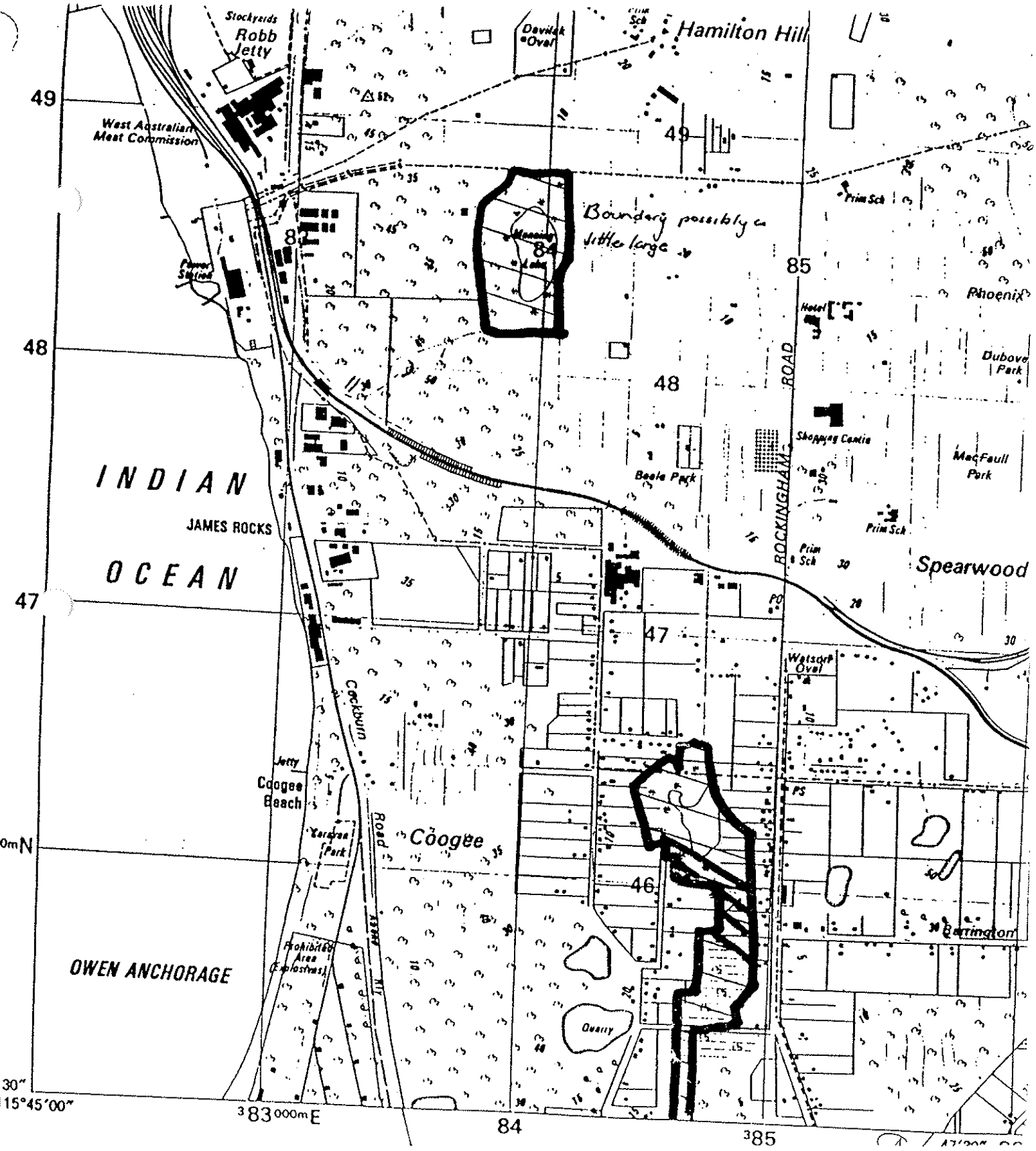

D-C
E
C
A-B
D-C
D-E
C(-D?)
D-C
D-C
D
(B-)C-D

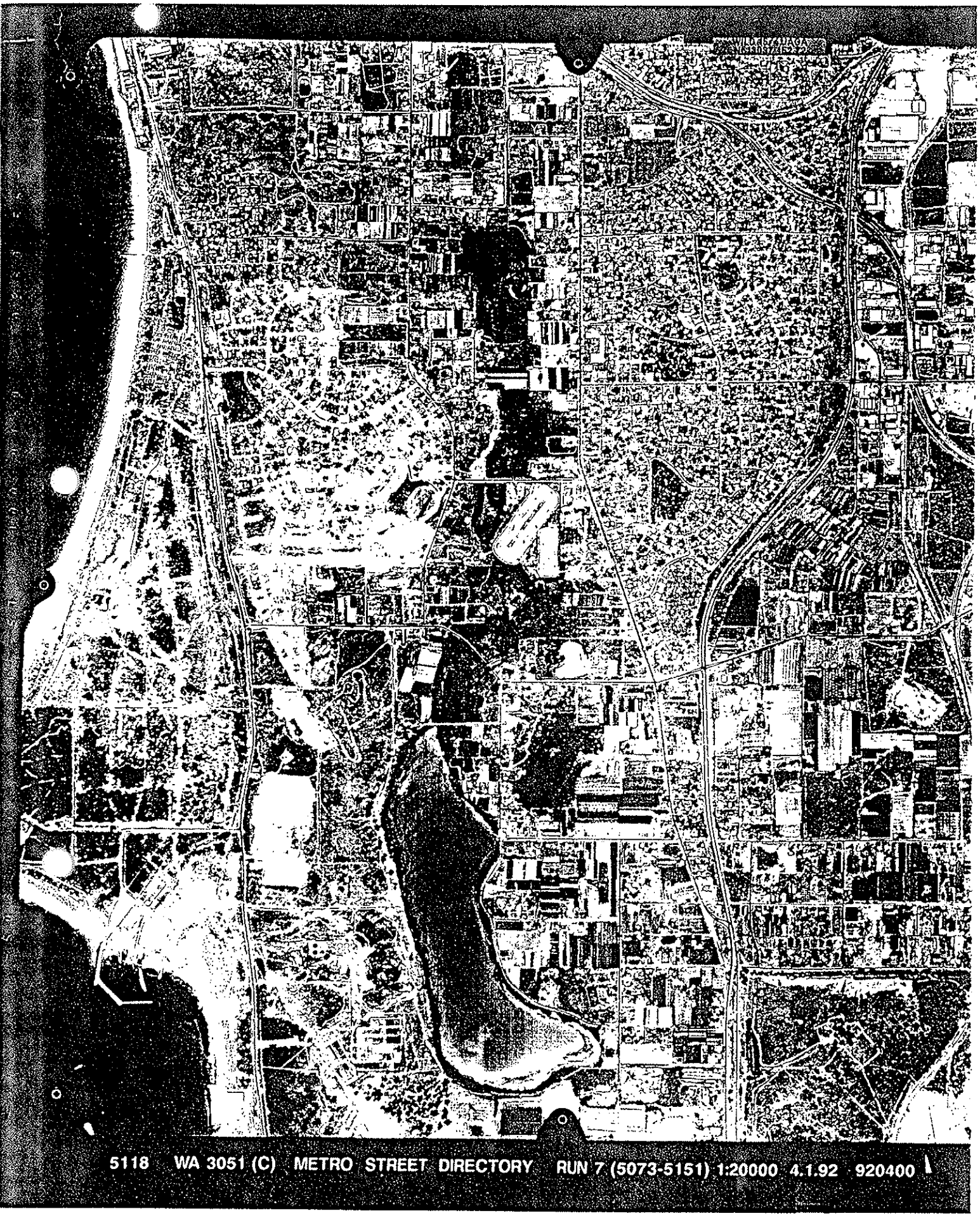

Hope Valley Road
Clements Road
Map
89
90
Orelia


5116 WA 3051 (C) METRO STREET DIRECTORY RUN 7 (5073-5151) 1:20000 4.1.92 920400

Set 9


D-E
D
C
E
D.C
C
D-E

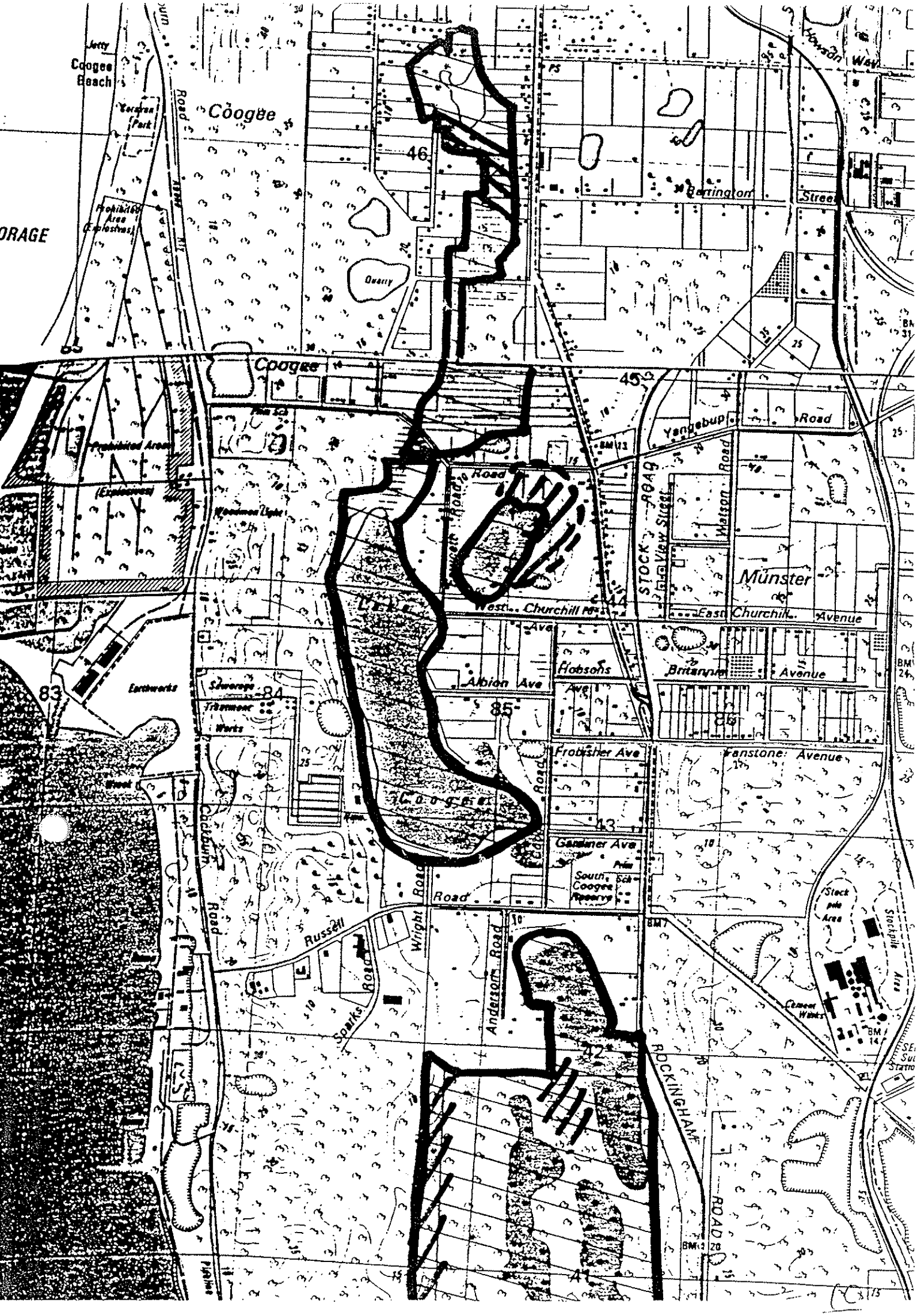

Hamilton Hill
Robb Jetty
Stockyards
West Australian Meat Commission
Boundary possibly a little large
Phoenix
Dubove Park
Shopping Centre
MacFaull Park
Beale Park
ROCKINGHAM ROAD
Spearwood
Watson Oval
INDIAN
OCEAN
JAMES ROCKS
OWEN ANCHORAGE
Cockburn Road
Coogee
Coogee Beach
Jetty
Quarry
Prohibited Area (Explosives)
Barrington
49
48
47
46
85
84
383 000mE
385

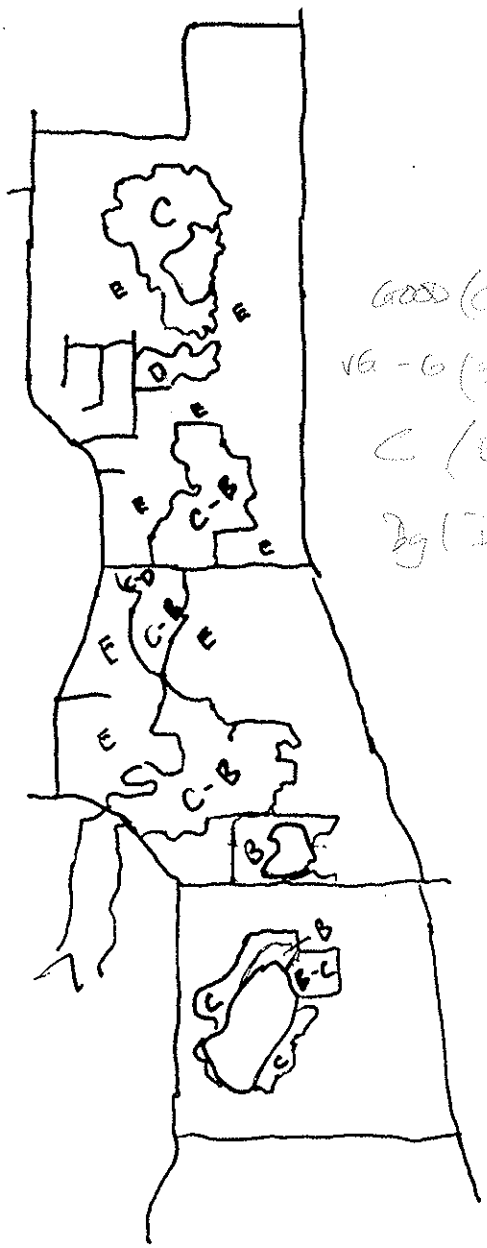


19.0 Market Garden Swamps

19.1 W. Churchill Ave. Lake

Set 1C

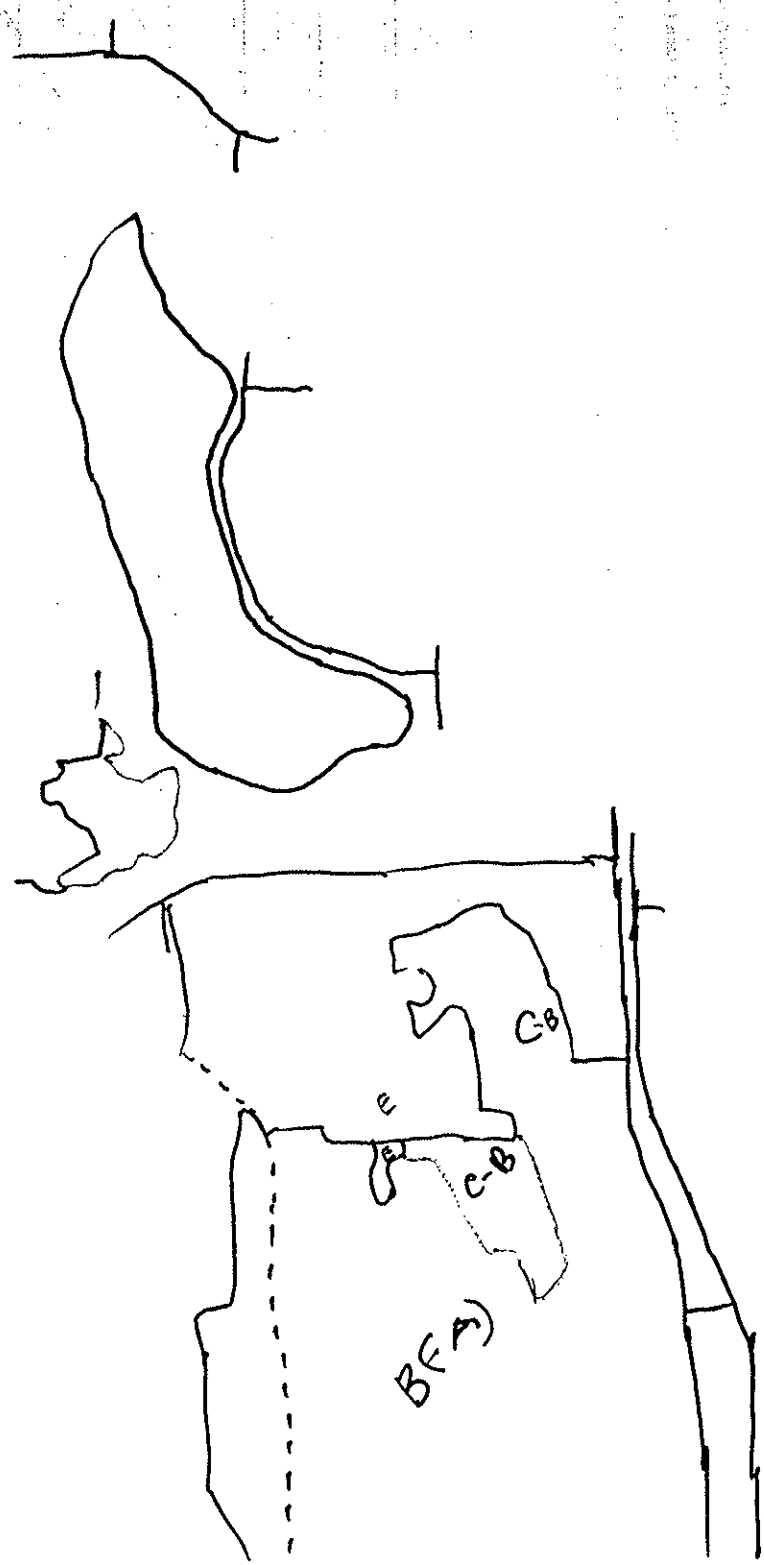

Coogee Beach
Coogee
Quarry
Coogee
Munster
Yangebup Road
Watson Road
Stock A949
Albion Ave
Hobsons Ave
Frobisher Ave
Gardiner Ave
Cockburn Road
Russell Road
Wright Road
Anderson Road
Sparks Road
ROCKINGHAM ROAD
Earthworks
Prohibited Area
Explosives
Quarry
Cement Works
Stock pile Area
46
45
44
43
42
41
83
84
85

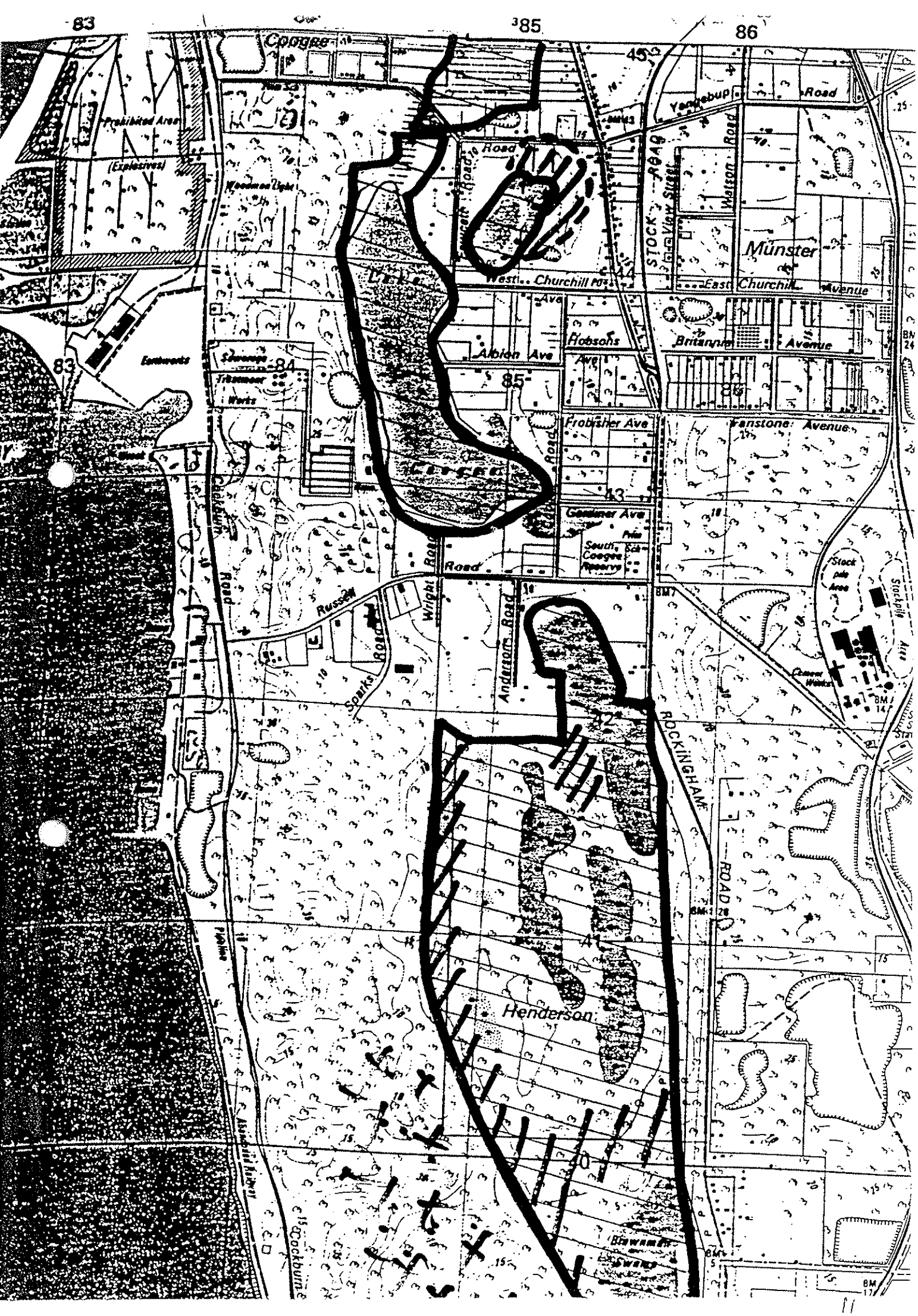

C
E
E
D
E
E
C-B
E
E
C-B
E
E
C-B
B
B
B-C
C
C

20.0. Lake Coogee

21.0. Brownman Swamps

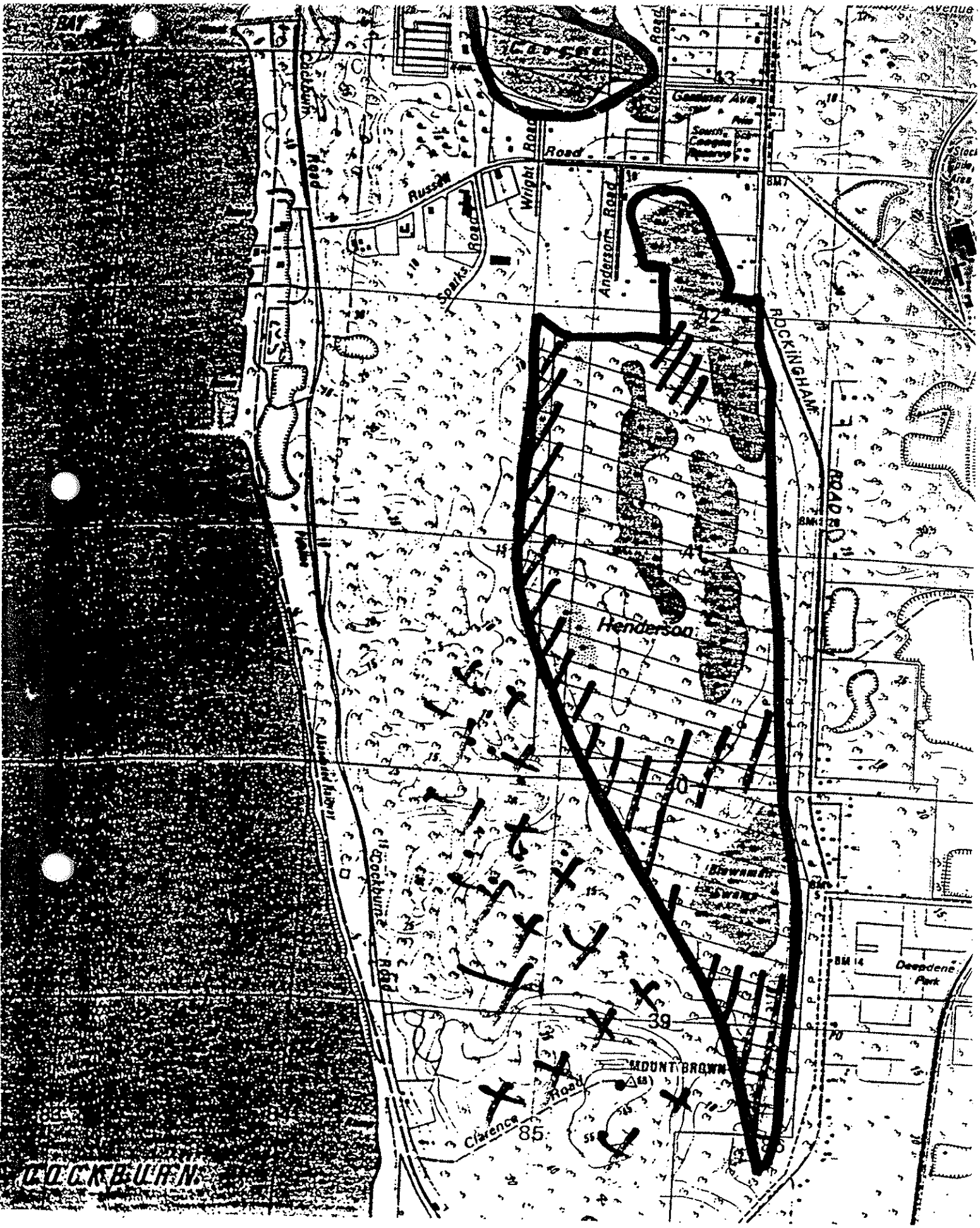
Set 11


C-B
E
C-B
B(A)


83
85
86
Coogee
Prohibited Area
(Explosives)
Woodmans Light
Emmanuel Road
Road
Yangebup
Watson Road
STOCK ROAD
View Street
Munster
Lake
West... Churchill Pde
East Churchill... Avenue
Hobsons Ave
Britannia Avenue
Albion Ave
Explosives
Tilbrook Ave
Works
Frobisher Ave
Fenstone Avenue
Road
Gemmer Ave
South Coogee Reserve
Stock pile Area
Stockpile
Cement Works
Russell Road
Wright Road
Anderson Road
Sparks Road
Road
ROCKINGHAM
ROAD
Henderson
Pipeline
Cockburn
Aboriginal Reserve
Swamp
BM 7
BM 14
BM 17
BM 5
BM 1
BM 2
BM 3
BM 24

21.0. Brownman Swamps

22.0. Lake Mt. Brown


BAY
Road
Russell
Wright Road
Sparks Road
Anderson Road
ROCKINGHAM
ROAD
Henderson
Gardiner Ave
Reserve
Cockburn Road
Clarence
Road
MOUNT BROWN
Deepdene Park
COCKBURN
13
22
41
40
39
85

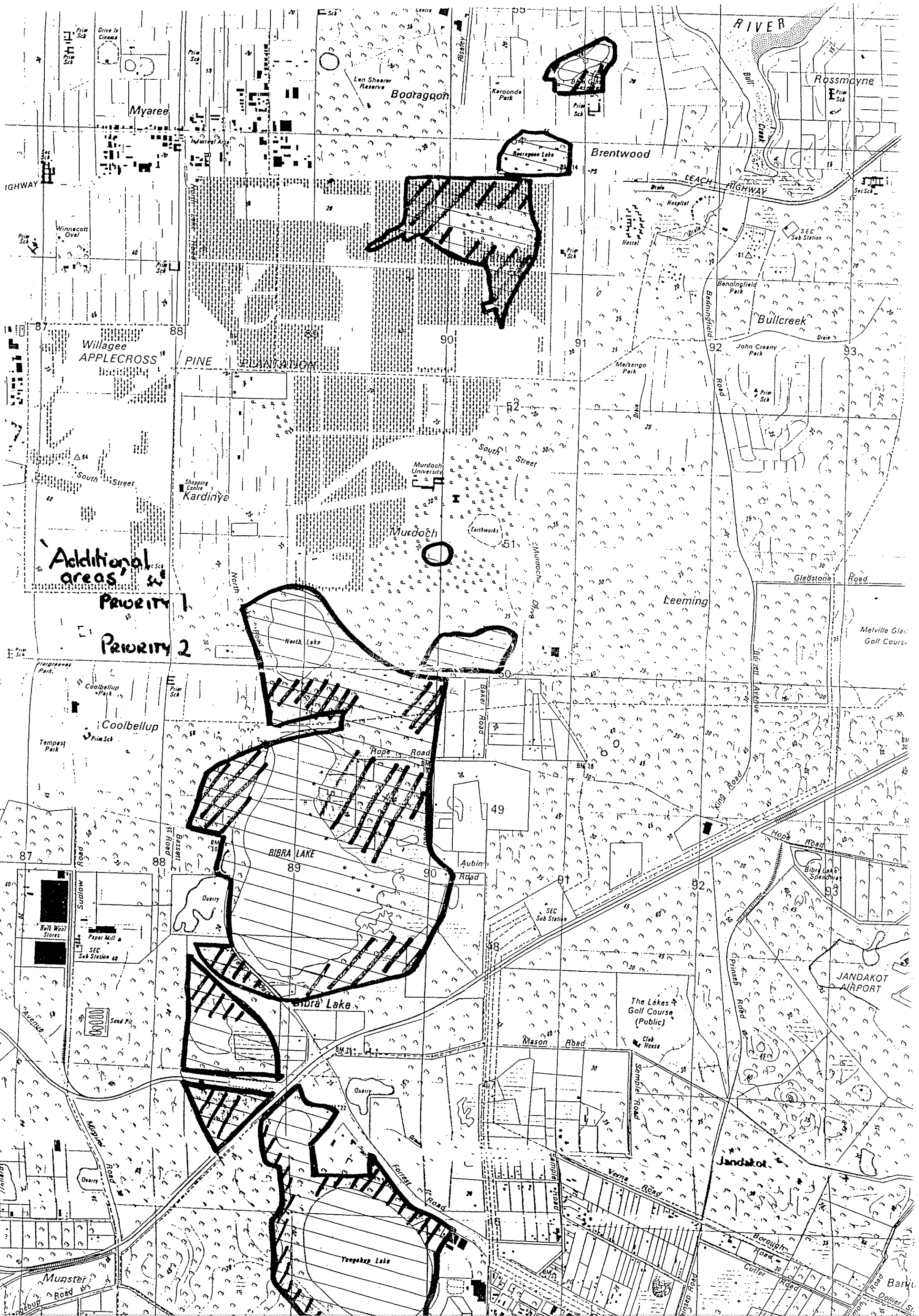
E
E
E
E
B(-A)
C
E
B
E
B-C
(+some
A+D)
E
E
C(-D)
(+B)
D-C
E
E
E(+D)

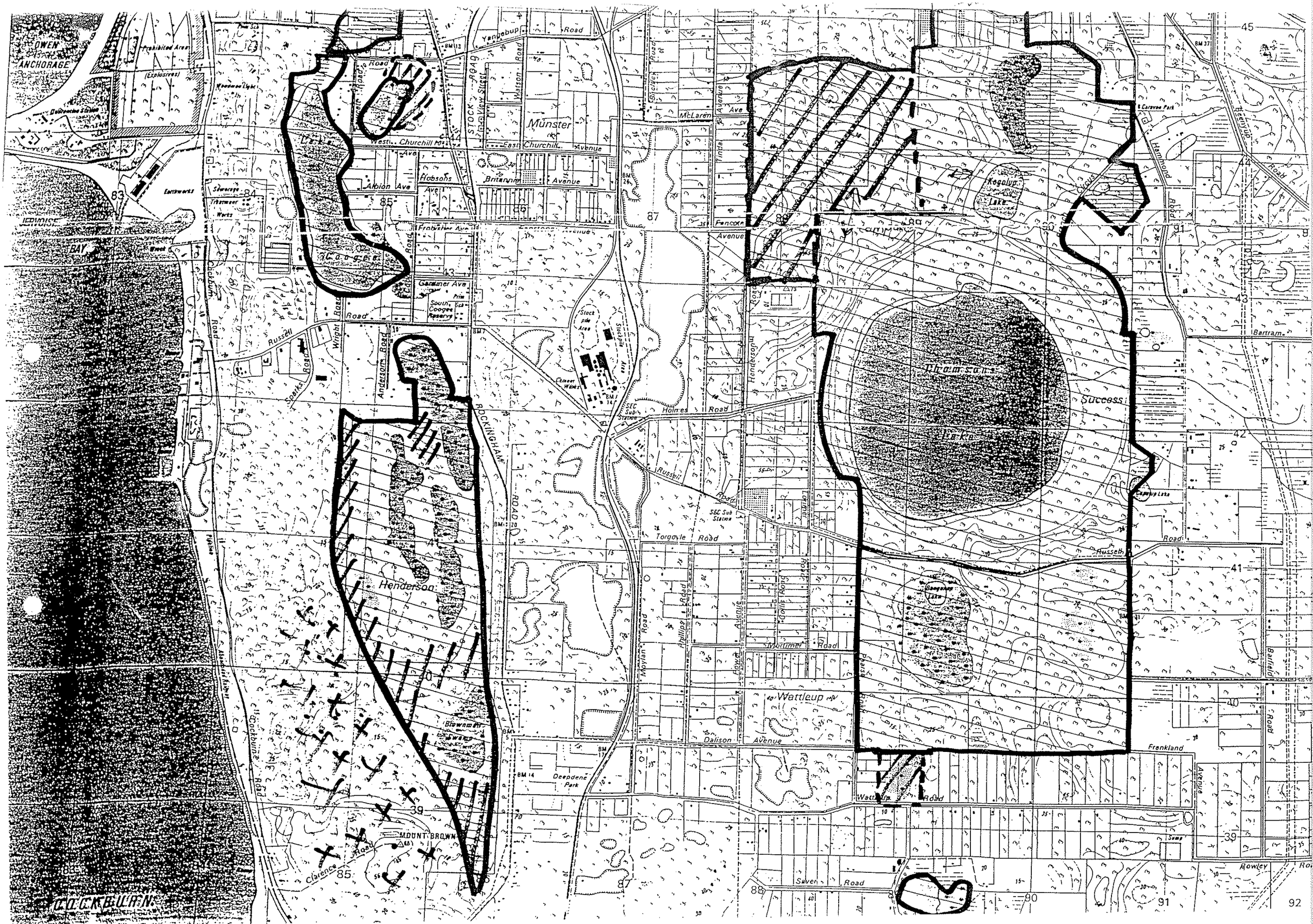
2 Maps

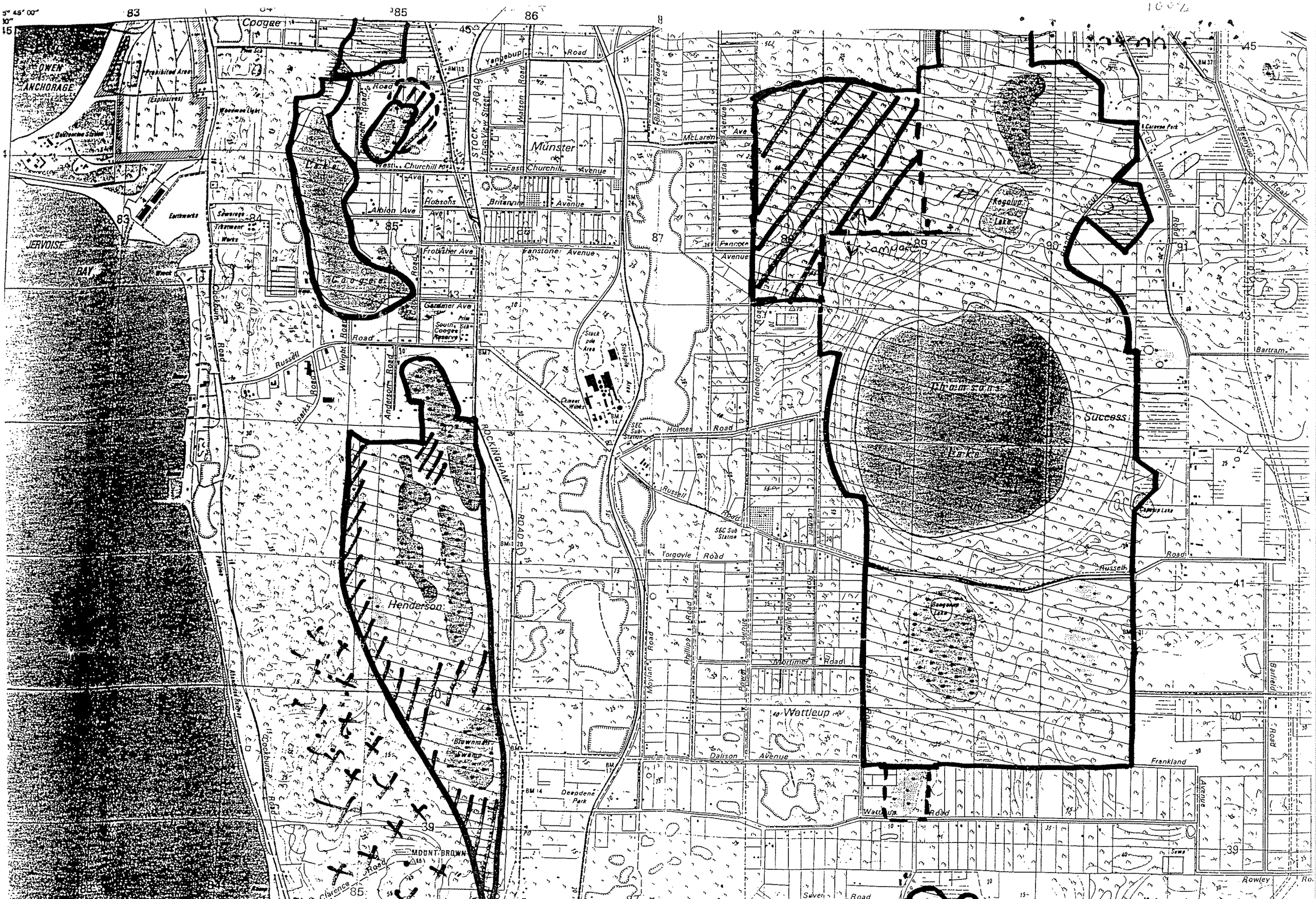
2a AHC Attachment E Maps

2b 1991 Perth Street Maps

(in separate roll)


Additional areas
PRIORITY 1
PRIORITY 2
Myaree
Bodragoon
Brentwood
Rossmoyne
RIVER
Willagee
APPLECROSS
PINE PLANTATION
Kardinya
Murdoch
Leeming
Coolbellup
Bullcreek
BIBRA LAKE
Jandakot
JANDAKOT AIRPORT
Munster
Len Shearer Reserve
Karoonda Park
Boraggoon Lake
Winnacott Oval
Hargreaves Park
Coolbellup Park
Tempest Park
North Lake
Yangebup Lake
Banningfield Park
John Creany Park
Mahogany Park
The Lakes Golf Course (Public)
Melville Glades Golf Course
Murdoch University
Earthworks
Shopping Centre
Hospital
Hostel
SEC Sub Station
Paper Mill
Bull Wool Stores
Quarry
Sand Pit
Club House
Beach Highway
South Street
North Road
Rope Road
Baker Road
Aubin Road
Bassett Road
Mason Road
Verna Road
Forrest Road
King Road
Hope Road
Gladstone Road
Banningfield Road
Bull Creek
Prinsep Road
Semple Road
Cutler Road
Borough Road
Dollier Street
Bibra Lake Speedway
Industrial Area
Drive In Cinema
Prim Sch
Sec Sch
BM 28
BM 25
87
88
89
90
91
92
93
48
49
51
52


OWEN ANCHORAGE
Prohibited Area
(Explosives)
Earthworks
JERVOISE BAY
Cockburn Road
Russell Road
Wright Road
Anderson Road
Sparks Road
Coogee
South Coogee Reserve
Gardiner Ave
Albion Ave
Hobsons Ave
Britannia Avenue
Munster
East Churchill Avenue
West Churchill Ave
Yangebup Road
Watson Road
Stock Road
Rockingham Road
Stock pile Area
Clover Weirs
SEC Sub Station
Holmes Road
Torgoyle Road
Moylan Road
Abellino Road
Davis Road
Gaskin Road
Mortimer Road
Dalison Avenue
Wattleup
Wattleup Road
Deepdene Park
Henderson
Blowaway
Mount Brown
Clarence Road
Cockburn Rd
Fremantle-Rockingham Highway
COCKBURN
McLaren Avenue
Pencock Avenue
Kogolup Lake
Caravan Park
Hammond Road
Thomsons Lake
Success
Lake
Beenyup Road
Bertram
Frankland Avenue
Rowley Road
Seven Road
Sewer
Treatment Works
Stockpile
Prison
Pipeline
BM 11
BM 20
BM 14
BM 17
BM 37
83
84
85
86
87
88
90
91
92
45
44
43
42
41
40
39


Coogee
OWEN ANCHORAGE
Prohibited Area
(Explosives)
Woodman Light
Deepening Station
Earthworks
JERVOISE BAY
Sewerage Treatment Works
Cockburn Road
Russell Road
Wright Road
Anderson Road
Spanks Road
Coogee Road
Prohibited Area
Yangebup Road
Watson Road
STOCK ROAD
Beeliar Drive
Fairview Street
Munster
West Churchill Park
East Churchill Avenue
Albion Ave
Hobsons Ave
Britannia Avenue
Prohibited Area
Frobisher Ave
Fanstone Avenue
Gardiner Ave
South Coogee Reserve
Stockpile Area
Cement Works
SEC Sub Station
Holmes Road
Russell Road
ROCKINGHAM ROAD
Henderson
Brownman Swamp
Deepdene Park
MOUNT BROWN
Clarence Road
Forgotten Highway
Mayfair Road
Phillips Avenue
Rollis Road
Mortimer Road
Dalison Avenue
Wattleup
Wattleup Road
McLaren Avenue
Fancote Avenue
Kogolup Lake
Hammond Road
Beeliar Road
Thomsons Lake
Success
Frankland Avenue
Rowley Road
Barfield Road
Bartram Road
Swamp Lake
Caravan Park

1.0.	Blue Gum Lake	
2.0.	Lake Booragoon	
2.1.	Piney Lake	1 - Pines opposite; Paperbarks on right
2.2.	Murdoch University Swamps	
2.2.1	Upper Swamp	
2.2.2	Melaleuca Swamp	
2.2.3	Banksia Woodland	1 - (4-1?)
2.3	Woodlands East of Murdoch	
3.0.	North Lake	1 - Corner of Tamma Rd & Bibra Dr, 2 - (1-17) Kunzea, Banksia, Melaleuca, 3 - (1-20) Myrtle, Marsh, E end, Right, seedlings behind, 4 - (1-23) Myrtle (?), Right, Zantedeschia, figs, 5 - (1-24) crnr. lake: Typha, Banksia
4.0.	Bibra Lake	#1 (1-26) Burnt wetland Bibra
5.0.	South Lake	1 - (4-3)
5.1	Railway Triangle	1-(4-2)
6.0.	Little Rush Lake	
7.0.	Yangebup Lake	1 - (3-6)
8.0.	Kogolup Lake	1 - (3-8)
8.1	Branch Circus Wetlands	1 - (3-10), 2 - (3-13)
8.2	Henderson Rd Woodlands	1 - (3-21), 2 - (3-22), 3 - (3-23)
9.0.	Thomsons Lake	1 - (3-
10.0.	Banganup Lake	
10.1.	Wattleup Road Wetland	1 - (3-18)
11.0.	Wattleup Lake	1 - (3-15), 2 - (3-17)
12.0.	The Spectacles	
12.1	Woodland East of Spectacles	
12.2	Woodland South of Spectacles	
18.0.	Manning Lake	1 - (4.4) Manning Lake (dry), 2 - (4.5) Jarrah, Karri, 3 - (4.6) E. dam-
19.0	Market Garden Swamps	1 - Karri, 2 - Karri (4.7,8), 3 - (4.9) Swamp upp. Cobbs Rd
19.1	W. Churchill Ave. Lake	1 - 2 - (4 - 13, 14)
20.0.	Lake Coogee	
21.0.	Brownman Swamps	1 - Karri, 2 - (4-) dam Access & Dispersal, 3 - (3-0) swamp
22.0.	Lake Mt. Brown	1 - NE from Mt Brown, 2 - NW from Mt. Brown, 4 - Cut Jarrah
23.0.	Long Swamp	1 - (4-)

3 Piney Lakes

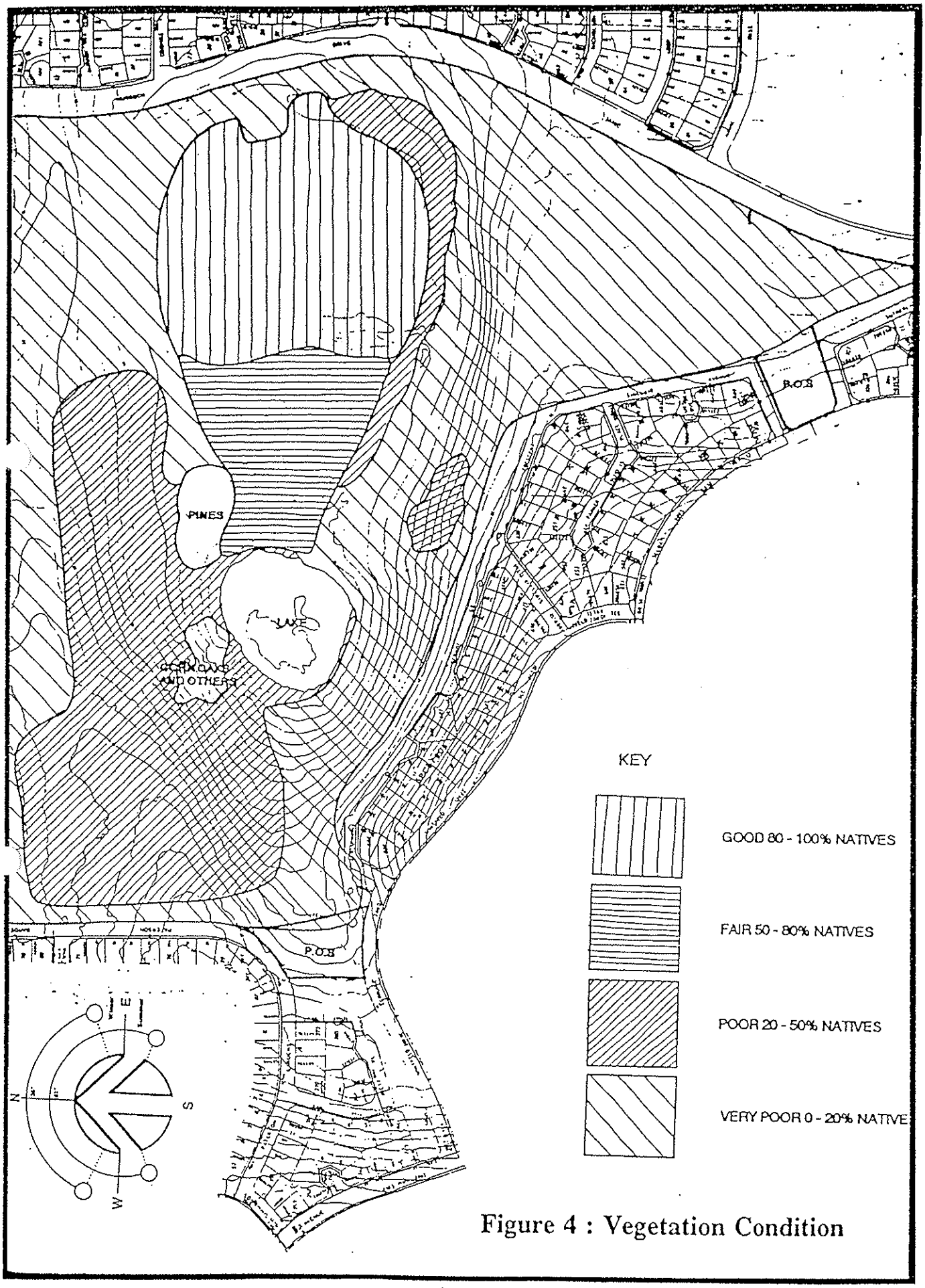
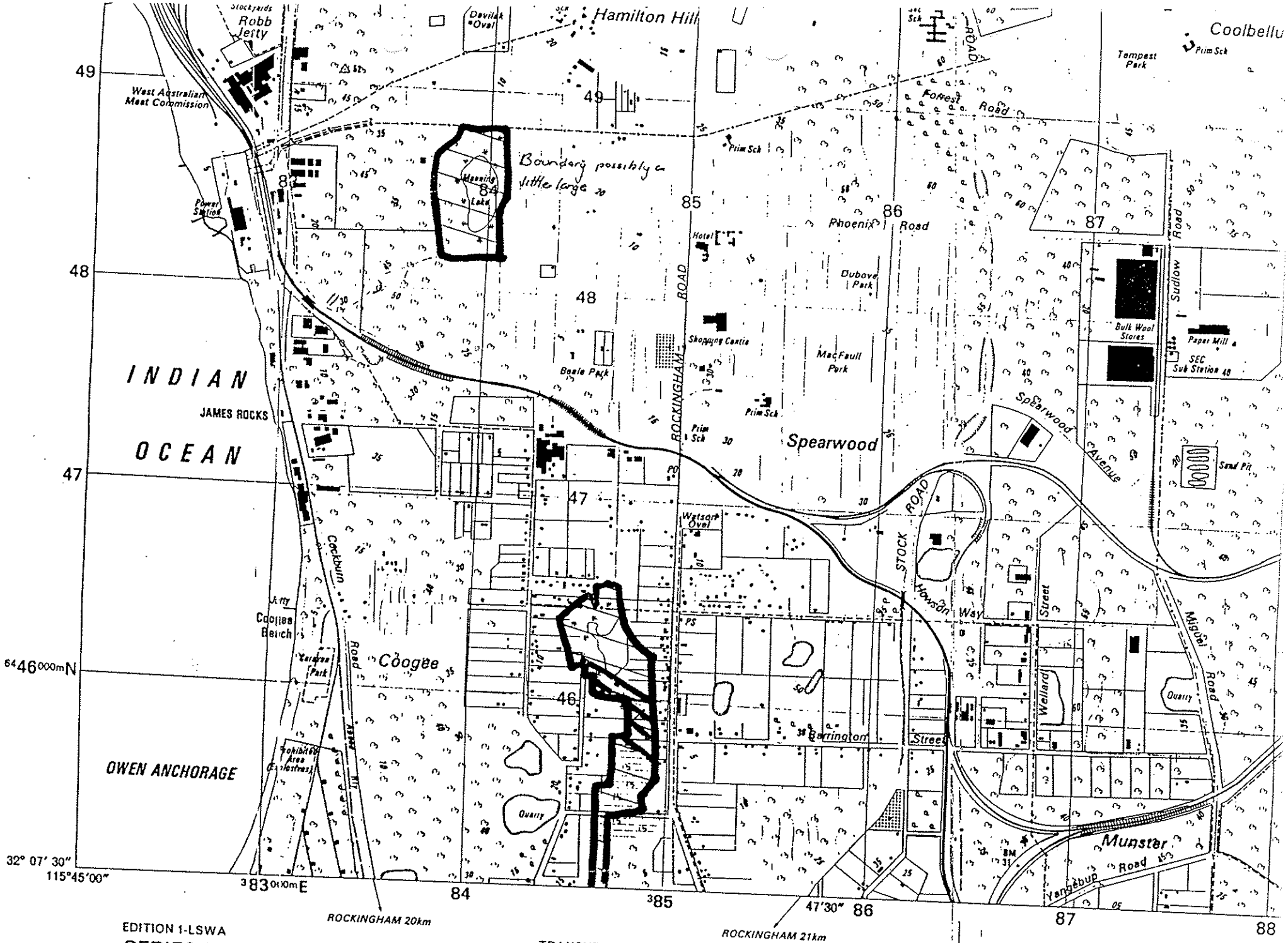


Figure 4 : Vegetation Condition

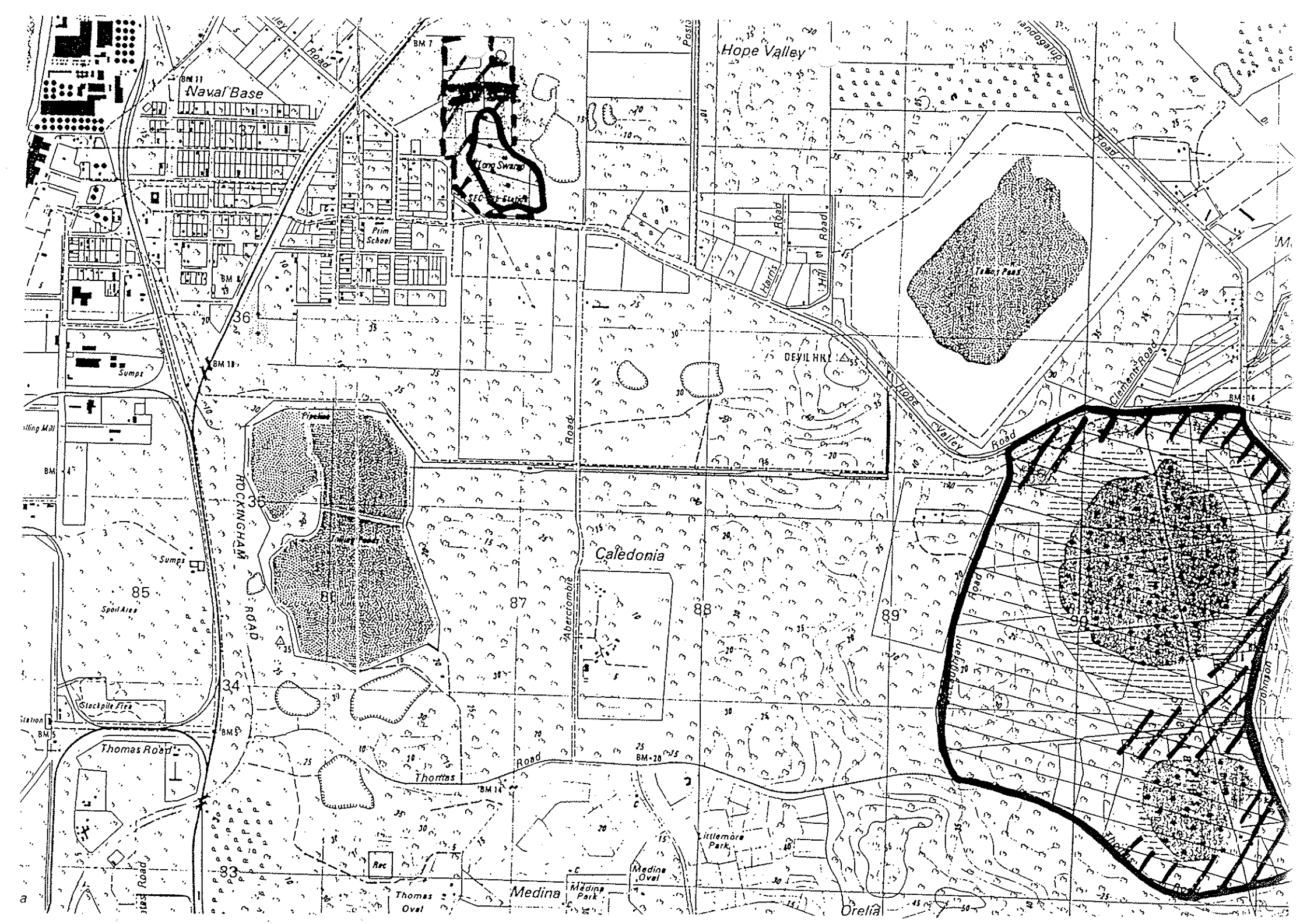
4 The Spectacles Wetlands



EDITION 1-LSWA
SERIES R 811

TRANSVERSE MERCATOR PROJECTION
HORIZONTAL DATUM: AUSTRALIAN GEODETIC DATUM 1966

SCALE 1


Hope Valley
Naval Base
Long Swamp
Prim School
Sumps
Pipeline
Spoil Area
Stockpile Fire
Caledonia
Medina
Orelia
Thomas Road
Thomas Oval
Medina Oval
Medina Park
Littlemore Park
Rec
DEVIL HILL
ROCKINGHAM ROAD
Hope Valley Road
Clements Road
Abercrombie Road
Thomas Road
Johnson Road
Harris Road
Hill Road
Post
Road
Valley
Road
Station
Milling Mill
BM 1
BM 4
BM 5
BM 6
BM 7
BM 11
BM 14
BM 16
BM 18
BM 20
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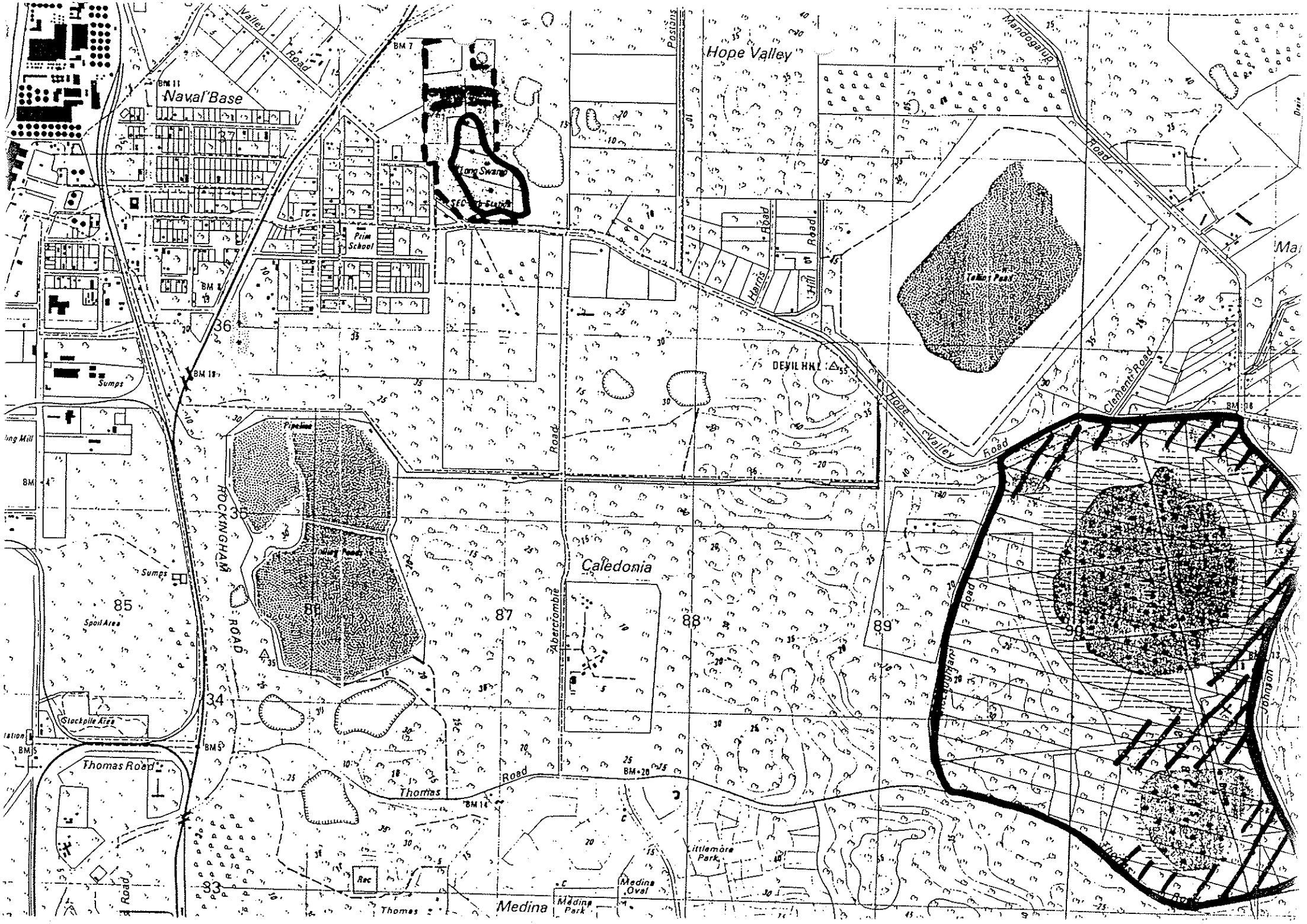
Naval Base
Hope Valley
Long Swamp
Prim School
Sumps
Pipeline
Spoil Area
Stockpile Area
Caledonia
Thomas Road
Medina
Littlemore Park
Medina Oval
Medina Park
Rec
DEVIL HILL
Tellier Park
Rockingham Road
Hope Valley Road
Clements Road
Mandogalup Road
Abercrombie Road
Thomas Road
Harris Road
Hill Road
Johnson Road
Valley Road
Road
36
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34
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87
88
89
90

5 Photographs

(in separate folders)

Attachment 5

A Selection of Photographs

The number of each photograph is listed below and is given on the back of each photogaph in and on a removable label on the front.

1.0. Blue Gum Lake

2.0. Lake Booragoon

2.1. Piney Lake

1. From southwest side; pines on opposite shore; paperbarks on right.

2.2. Murdoch University Swamps

2.2.1 Upper Swamp

2.2.2 Melaleuca Swamp

2.2.3 Banksia Woodland

1. Banksia woodland

2.3 Woodlands East of Murdoch

3.0. North Lake

1. Trees and alien pigface in corner of Farrington Road and Bibra Drive.
2. Dense [fringing] wetland banksia, paperbark, flooded gum, spearwood a *Regelia* vegetation west of Photo 1.
3. Interior of paperbark-sedge swamp west of Photo 2.
4. Paperbarks and arum lily west of Bibra Drive and Hope Road.
5. *Baumea, Typha* and *Melaleuca teretifolia* in Hope-Bibra Drive Lake.

4.0. Bibra Lake

1. Frequently burntwoodland east of north end of Bibra Lake, and veldt gr

5.0. South Lake

1. Relatively bare strip or band west of South Lake, with flooded gums and paperbarks on right and banksia-eucalypt woodland on left.

5.1 Railway Triangle

1. Tall tuart trees and recently burnt banksia woodland in northwest corner.

6.0. Little Rush Lake

7.0. Yangebup Lake

1. Banksia woodland, with veldt rass and other weeds, on west side of lak

8.0. Kogolup Lake

1. Priority species *Dodonaea hackettiana* and horse-trampled south shore of southern Kogolup Lake.

8.1 Branch Circus Wetlands

1. Looking eastward into lake along channel
2. Looking eastward across red, *Azolla*-covered lake.

8.2 Henderson Rd Woodlands

1. Open, relatively recently burnt banksia woodland in southern part.
2. Jarrah - banksia woodland in southeast corner in relatively good conditic with many green, weedy grasses.
3. Woodland in central part regenerating after burns and cutting down of tr

9.0. Thomsons Lake

10.0. Banganup Lake

10.1. Wattleup Road Wetland

1. Looking southeastward into recently burnt swamps from northeastern cc Flooded gums are prominent.

11.0. Wattleup Lake

1. Looking across the western and central part of the lake from the south si
2. The east end of the lake, and paperbarks, from the north.

12.0. The Spectacles

12.1 Woodland East of Spectacles

12.2 Woodland South of Spectacles

18.0. Manning Lake

1. The dry lake and fringing vegetation (looking southeast) in summer.
2. Tuart trees, lawn and fringing paperbarks on west side of lake.
3. *Eucalyptus decipiens* south of lake.

19.0 Market Garden Swamps

1. Market gardens, tuart grove and end of swamp.
2. Tuart grove and understorey of a few native shrubs and many weeds.
3. Swamp northwest of Cable ski oval, with paperbarks and native sedges.

19.1 West Churchill Avenue Lake

1. Grove of saltwater paperbarks, dead on lake side, and tuarts, paperbarks other species behind - in the northeast corner of lake.
2. Tuarts, a few native shrubs and many weedy grasses and other weeds be (northeast of) the saltwater paperbarks.

20.0. Lake Coogee

21.0. Brownman Swamps

1. Typical tuart forest and grass trees (blackboys).
2. Rare (for the area) thicket of wattles and parrotbush.
3. Swamp paperbarks at end of one of numerous swamps.
4. Jarrah tree which has recently been sawn down, possibly for firewood.

22.0. Lake Mt. Brown

1. Looking northeast, across banksia woodland, tuart woodland, an end of Mt. Brown and a thicket of *Melaleuca huegelii*, from the limestone top of Brown.
2. Looking northwest from Mt. Brown across coastal ridges of mixed heatl and woodlands.

23.0. Long Swamp

1. Looking eastward along a raised trail through paperbark thickets in the northern part of Long Swamp, across a wattle thicket of low forest to tall remnant tuart trees.

6 AHC Computer Printout

M92

PROPOSED LIMESTONE EXTRACTION RESERVE C39584 - COCKBURN ROAD, HENDERSON

CLUB HEAD AUSTRALIA

Report and Recommendations
of the
Environmental Protection Authority

Full document available on request

Environmental Protection Authority
Perth, Western Australia
Bulletin 355 September 1988

MT. BROWN LAKE et al
SPEAR
BS 346

BS 246
BASS. STH
NTH LAKE

BS 247
SPEAR. S.
MANNING

BS 248
BASS. S.
BIBRA

BS 254
BASS. S.
STH. LK.

BS 256
BASS. S
YANGEB.

BS 261
SPEAR S
L. COOGEE

BS 262
BASS. S
PIARRA

BS 263
BASS. S
W. GIBBS

BS 269
SPEAR. S.
SPECTACLS

BS 273
+BS 404
SPEAR S.
CASUARINA

BS 342
BASSEND S.
ANST. KEAN

BS 344
BASS. S
DE YOUNG

BS 346
SPEAR. S.
COOGEE

BS 347
BASS. S.
WANDI

BS 353
BASS S
BANKSIA

BS 388
BASS. S.
JANDAKOT

BS 389
BASS. STH
EAST of JAND

BS 390
BASS S
FORREST &

BS 39
BASS. S.
THOMPSON

SPEAK. S
HARRY WAF

BS 435
BS 429
SPEAR S
MARKE

22

Proposals for the

Jandakot Botanic Park

Final

Full document available on request

Prepared for the Western Australian Planning Commission
by the Ministry for Planning
Albert Facey House
469 Wellington Street
Perth 6000 Western Australia

Ministry for Planning

March 1995

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ENVIRONMENTAL PROTECTION AUTHORITY
WESTRALIA SQUARE
38 MOUNTS BAY ROAD, PERTH

PROPOSED HENDERSON GOLF COURSE

RESERVES 39584 & 39752

COCKBURN ROAD

HENDERSON

PUBLIC ENVIRONMENTAL REPORT

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MH BROWN LAKE
et al
Lyndon
SPEAR
SPIT.
BS 346

BS 346 Spear . S .

THE COCKBURN WETLANDS : AN ENVIRONMENTAL STUDY

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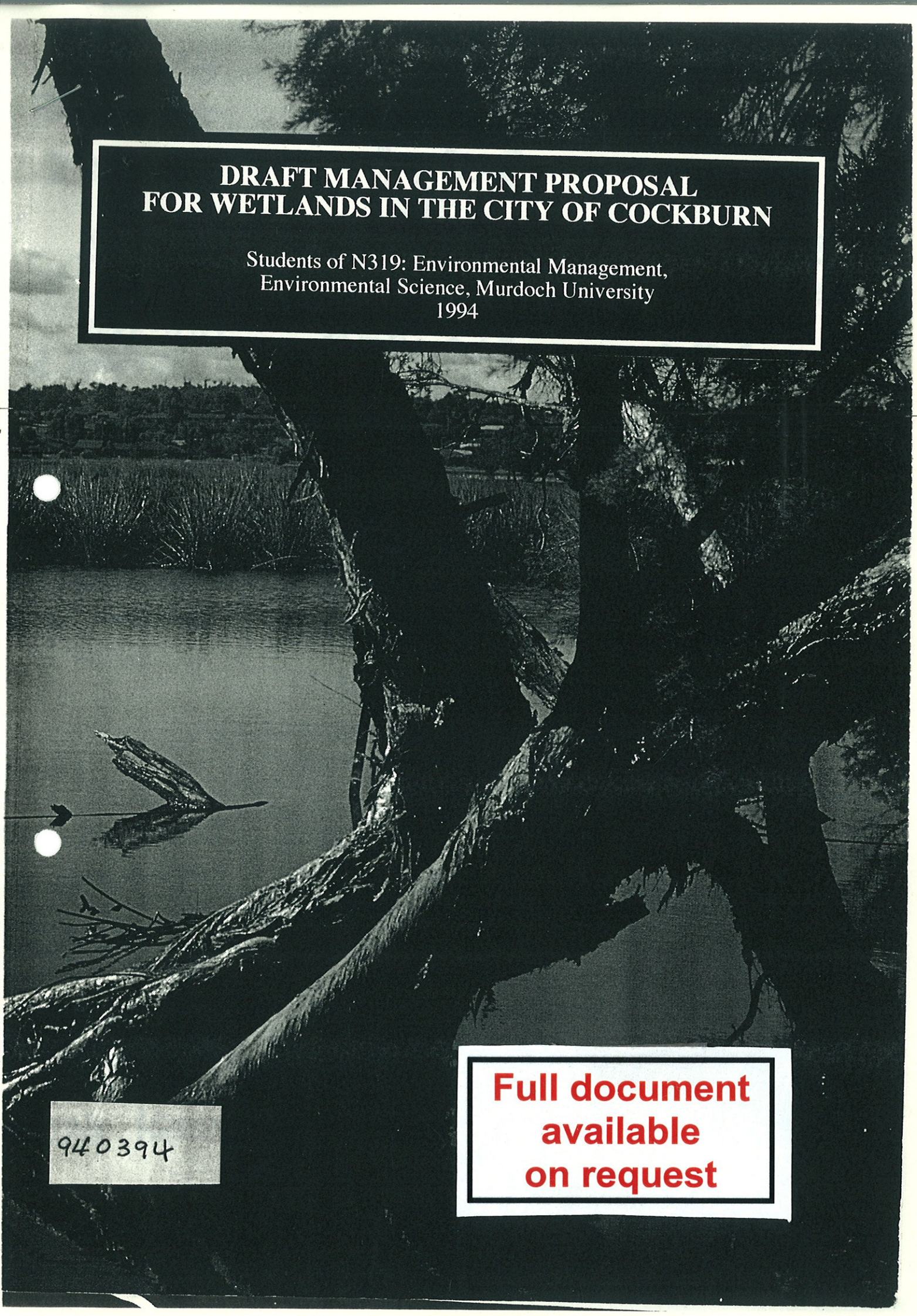

DRAFT MANAGEMENT PROPOSAL FOR WETLANDS IN THE CITY OF COCKBURN

Students of N319: Environmental Management,
Environmental Science, Murdoch University
1994

940394

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M92

Industrial rezoning, subdivision and development, Henderson

Cnr Russell and Rockingham roads, Henderson, City of Cockburn

G Caratti, J Anderson, S Sawle

Report and recommendations of the Environmental Protection Authority

Full document available on request

Environmental Protection Authority
Bulletin 480
December 1990

266
Vol. 5

Full document
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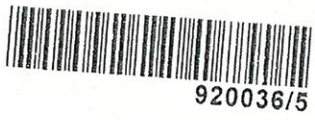
JENNY ARNOLD'S
PERTH WETLANDS RESOURCE BOOK

CHAPTERS 9 - 11

EAST BEELIAR WETLANDS

WETLANDS OF THE SOUTH WEST CORRIDOR
AND OF THE ROCKINGHAM PLAIN

py A Vol 5



920036/5

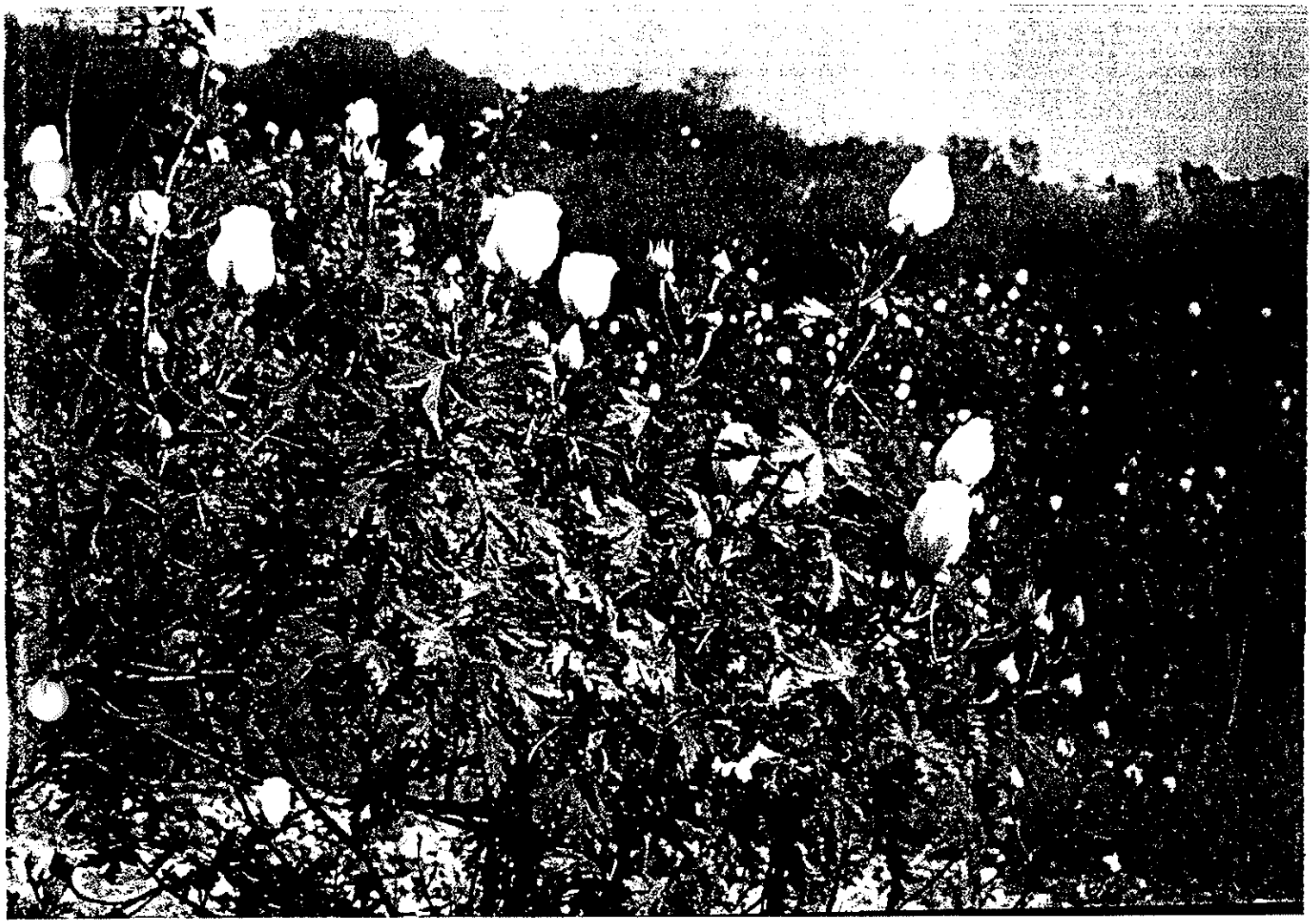
VIRONMENTAL PROTECTION AUTHORITY
WATER AUTHORITY OF WESTERN AUSTRALIA

BULLETIN 266 DECEMBER 1990

artment of Environmental Protection Library

Part Report:
Value identification
not objection
assessment section
(Contact Heritage
Commission, Melinda
Brown for complete
report) 13/5/96

Objection Assessment of the values of the vegetation and flora of the Beeliar Wetlands



Alogyne huegelii var. *glabrescens* to the west of Manning Lake

Prepared for the Australian Heritage Commission

by Bronwen Keighery, Consultant Botanist
November 1995 and February 1996

Table 2: Bushland Areas listed on the National Estate or being considered for listing.

Bushland Areas listed/interim listed on the National Estate

Bushland Area	Area (ha)	Native Flora	Flor. Com[10].	Veg. Assoc#.	Veg. Comp.[18]
Hepburn Heights/Pinnaroo	90	230*[1]	3*	19[11].	3
Trigg/Karrinyup Reserves	120	175[2]	4		2
Banksia Road Nature Reserve	33	150[3]	3		1
Marangaroo (Res 20091)	30*	130 *[4]	1		1
Neerabup National Park	1,111	242[5]	2		?2
Star Swamp	100	191[6]	3	13[11].	?2
Woodvale Nature Reserve	44	170[7]	1		1
Beeliar Wetlands	2700	406[22]	7	31[18]	4
Thompsons Lake NR	509	199[14]		15[14] 12[18]	3
Baganup Lake	254	279[15]	4	10[15]	3
Murdoch University	?	200[13]		5[13]	2
Yangebup Lake	103*	140[16]		5[16] 7[18]	2
Piney Lake	68	96[10]		6[10]	1
Booragoon Lake	13	34[12]		3[12]	1
Market Garden Lake	38	21[17]		7[17]	1

Unlisted areas subject to current nominations

Kings Park	400	290[20]	1	5[20]	1
Bold Park	221	221[21]	4		3
M91	56	86[23]	2		1

\# these are not directly compatible as they are based on variety of approaches to describing vegetation associations

* estimate of area, flora or floristic community types

1 estimate based on Keighery (1991), Tingay (1991), Foulds (1988) and AHC Listing Document

2+ G. Keighery pers. comm.

3+ G. Keighery pers. comm.

4 estimate from knowledge of the area

5+ G. Keighery pers. comm.

6 Bell *et al.* (1984)

7 Keighery and Langley (1994)

8 Gibson et al.(1994) and System 6 Update

9 Tingay (1991)

10 Rodda (1986)

11 Weston and Clay (1980)

12 Smith (1985)

13 Dell and Bennett (1986)

14 Crook and Evans (1981)

15 Clay (1986)

16 Ecoscape (1994)

17 Ecoscape (1995)

18 Newman *et al.* (1976)

19 Heddle *et al.* (1980)

20 Bennet in Kings Park Bushland Draft Management Plan (1993)

21 Keighery, Harvey and Keighery (1991)

22 Appendix Flora

23 Keighery and Keighery 1993

+ Reserve flora lists for bushland areas on the Swan Coastal Plain are being compiled by G.J. Keighery with assistance from B.J. Keighery and N. Gibson to establish a better knowledge of the flora of these areas and to address species conservation status for the Swan Coastal Plain.

Table 3: Floristic Community Types found in the study area
Each site is located Map 1. Study site codes refer to the following areas:
Thom - Thomson Lake Nature Reserve (Gibson *et al.* 1994)
Harry - Banganup Lake and adjacent bushland, Harry Waring Marsupial Reserve or Jandakot Research Station (Gibson *et al.* 1994)
MTB - Lakes Mount Brown and Brownman Swamps and adjacent bushland (Gibson *et al.* 1994)
NAVB - M 91 (Gibson *et al.* 1994)
Beel - 1 & 2 North Lake and adjacent bushland (System 6 Update 1995)
- 3 Murdoch University

Floristic Community Type (site)	Generalised Description	Predominant Landform Type (after Churchward and McArthur 1980)
Wetland Super Group		
5 (Map 2a) Harry 3	Mixed shrub damplands Mean species richness per site: 38.4 Av.Cond: 2.1, Cons status: Low risk	Bassendean/Pinjarra
11 (Map 2a) Harry 6 Beel 3	Wet forests and woodlands Mean species richness per site: 27.2 Av.Cond: 2.7, Cons status: Low risk	Bassendean/Pinjarra
16 (Map 2a) *NAVB 1	Highly saline seasonal wetlands Mean species richness per site: 13.5 Av.Cond: 2.9, Cons status: Vulnerable	coastal and esturine
17 (Map 2a) MTB 05	*Melaleuca rhaphiophylla - Ghania trifida* seasonal wetlands Mean species richness per site: 13.6 Av.Cond: 2.3, Cons status: Low risk	Quindalup/ Spearwood
Bassendean Dune Super Group		
21a (Map 2b) Harry 05	Central *Banksia attenuata - E. marginata* woodlands Mean species richness per site: 54.6 Av.Cond: 2.5, Cons status: Low risk	Bassendean/ Spearwood
23a Map 2b) Harry 04 #Beel 02	Central *Banksia attenuata - B.menziesii* woodlands Mean species richness per site: 62.8 Av.Cond: 2, Cons status: Low risk	Bassendean
Spearwood/Quindalup Dune Super Group		
24 (Map 2b) Thom 02 MTB 1, 2, 3 & 4 *NAVB3 &4	Northern Spearwood shrublands and woodlands Mean species richness per site: 41.8 Av.Cond: 3, Cons status: Susceptible	Spearwood
28 (Map 2b) #Beel 1 Harry 1 & 2	Spearwood *Banksia attenuata* or *Banksia attenuata - Eucalyptus* woodlands Mean species richness per site: 55.2 Av.Cond: 2.5, Cons status: Low risk	Spearwood
29a (Map 2b) *NAVB 2	Coastal shrublands on shallow sands Mean species richness per site: 40.7 Av.Cond: 2.3, Cons status: Susceptible	Quindalup

Appendix 1

This list was compiled from a series of published and unpublished lists for the study area. The principle references are cited in the key to column 4. Records were also extracted from the text of Environmental Science Murdoch University (1986) and Newman et al (1980). As most of these lists date from the 1980's there was a need to update the nomenclature.

Some additions have also been made from field visits in October and November 1995 for this study.

Key

Column 1: Taxon
Taxa are listed alphabetically in family, genera and species. Nomenclature is after Gibson *et al.* (1994). A * preceding a the genus name indicate a non-native taxon, these may be naturalised taxa or planted taxa.

Column 2: Priority Code (Department of Conservation and Land Management 1995)

Column 3: Gegraphical Range/Significant Taxa
N = Populations at the northern limit of their known range
S = Populations at the southern limit of their known range
W = Populations at the western limit of their known range
Geographic Limit - Location of limits as defined above.
= Significant taxa (see Sections 3.3.1 and 3.4.1.2 for details of significance)

Column 4: Areas

P Piney Lake Reserve (Rodda 1986)
Ba Banganup Lake (Weston and Clay 1980)
Bo Booragoon (Lake Smith 1985)
M Murdoch University (Dell and Bennett 1986)
T Thompson's Lake Nature Reserve (Crook and Evans 1981)
S The Spectacles (Clay 1986)
Y Yangebup Lake (Ecoscape 1994)
Ma Manning Lake (this report)
MG Market Garden Swamps (Ecoscape 1995)
MB Floristic Database for Swan Coastal Plain (Gibson *et al.*1994) and System 6 Update
F Floristic Database for Swan Coastal Plain (Gibson *et al.*1994) and System 6 Update.
91 System 6 area M91 (Keighery and Keighery 1993)

Taxon	Prio Code	Geographic Range	Recorded Areas
Aizoaceae			
*Carpobrotus aquilaterale			P, Ba, T, S
*Carpobrotus edulis			Ba, Bo, M, T, Y, F, 91
Carpobrotus virescens			91
Carpobrotus virescens X edulis			91
*Tetragonia decumbens			F, 91
Amaranthaceae			
Ptilotus drummondii			Ba, T, Y, 91
Ptilotus ?manglesii			P
Ptilotus polystachyus			M, Y
Anredaceae			
*Anredera cordifolia			MG
Anthericaceae			
Arnocrinum preissii			Ba, T, Y
Caesia micrantha			Ba, M, T
Caesia occidentalis			F
Chamaescilla corymbosa			Ba, M, T, S, F
Corynotheca micrantha			Ba, M, T, S, Y
Dichopogon capillipes			Ba, T, Y, F
Laxmannia ramosa			Ba
Laxmannia squarrosa			P, Ba, T, M, F
Sowerbaea laxiflora			P, Ba, M, T, S, Y, F
Thysanotus arenarius			Y
Thysanotus asper			M
Thysanotus manglesianus/patersonii complex			P, Ba, T, Y,F, 91
Thysanotus multiflorus			M
Thysanotus sparteus			Ba, T, Y, F
Thysanotus thyrsoideus			F
Thysanotus triandrus			Ba, M, Y, F
Tricoryne elatior			Ba, Bo, M, T, S, Y
Tricoryne tenella			F
Amaryllidaceae			
*Narcissus tazetta			
Apiaceae			
Apium annuum			F, 91
Apium prostratum			F
Centella cordifolia			Ba, Bo, M, T, S, Y
Daucus glochidiatus			F, 91

Taxon	Prio Code	Geographic Range	Recorded Areas
Eryngium pinnatifidum subsp. pinnatifidum			Ba, M, T, Y, F
*Foeniculum vulgare			T, Y, Mg, Ma, 91
Homalosciadium homalocarpum			Ba, Y, F
Hydrocotyle diantha			F
Hydrocotyle scutellifera			F
Platysace compressa			Ba, M, T, F
Trachymene pilosa			M, Y, F
Xanthosia huegelii			Ba, M, , S, Y, F
Araceae			
*Zantedeschia aethiopica			S, Y, H, MG, F
Asclepidaceae			
*Gomphocarpus fruticosus			MG
Asparagaceae			
*Myrsiphyllum asparagoides			Ma
Asphodelaceae			
*Asphodelus fistulosus			Ba, M, T, 91
*Trachyandra divaricata			91
Asteraceae			
*Arctotheca calendula			Ba, T, S, Y, 91
*Aster subulatus			Ba, T, F
Asteridea pulverulenta			Ba, Y
Brachyscome iberidifolia			Ba, M
*Carduus pycnocephalus			Ba
*Centaurea melitensis			Ba, F, 91
*Cirsium vulgare			Ba, MG, 91
*Conyza albida			F, 91
*Conyza bonariensis			Bo, F, 91
Cotula coronopifolia			Ma
*Dittrichia graveolens			MG, 91
*Helianthus annua			MG
Helichrysum cordatum			M, 91
Hyalosperma cotula			Ba, T, F, 91
*Hypochaeris glabra			Ba, Bo, S, Y, MG, F, 9
Ixiolaena viscosa	N	North Lake	Bi, N, F
*Lactuca serriola			Y, F
Lagenifera huegelii			Ba, S, Y, F
Millotia myosotidifolia			Ba, M, t
Millotia tenuifolia			F

Taxon	Prio Code	Geographic Range	Recorded Areas
Olearia axillaris			Ba, M, T, F, 91
Olearia elaeophila			Y
Pithocarpa corymbulosa			Y
Podolepis canescens			Ba, T
Podolepis gracilis			Ba, M, T, Y, F
Podotheca angustifolia			Y, F
Podotheca chrysantha			Ba, M, T, F
Podotheca gnaphalioides			P
Pseudognaphalium luteoalbum			Ba, F
Quinetia urvillei			Y, F
Senecio hispidulus			Ba, T
Senecio lautus			Ba, M, T, Y, F, 91
Siloxerus humifusus			Ba, M, F
*Solidago canadensis			MG
*Sonchus asper			Ba, M, F, 91
Sonchus hydrophilus			F, 91
*Sonchus oleraceus			F, 91
*Taraxacum officinale			MG
*Urospermum picroides			F, 91
*Ursinia anthemoides			Ba, S, Y, F
*Vellereophyton dealbatum			Ba, T, F, 91
Waitzia citrina			T, F
Waitzia suaveolens			F
Azollaceae			
Azolla filiculoides			Y, H
Brassicaceae			
*Brassica oxyrrhina			Y
*Brassica tournefortii			Ba, MG, F, 91
*Heliophila pusilla			Ba, F, 91
*Lobularia maritima			MG
*Sisymbrium orientale			MG
*Raphanus raphanistrum			BO, MG
*Rorippa naturtium-aquaticm			Ba, T
Callitrichaceae			
*Callitriche stagnalis			Ba
Campanulaceae			
*Wahlenbergia capensis			Ba, Y
Wahlenbergia preissii			Ba, F

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Cannaceae			
	*Canna generalis			MG
	*Canna ochnoides			MG
	Caryophyllaceae			
	*Arenaria serpyllifolia			F
	*Cerastium glomeratum			Ba, F
	*Minuartia hybrida			F, 91
	*Petrorhagia velutina			Ba, T, Y, 91
	*Sagina apetala			Ba, F
	*Sagina maritima			F, 91
	*Silene gallica			Ba, T, Y, F, 91
	*Stellaria media			Ba, F, 91
	Casuarinaceae			
	Allocasuarina fraseriana			P, Ba, M,, T, S, Y, F
	Allocasuarina humilis			P, Ba, M,, T, S, F, 91
	Centrolepidaceae			
	Centrolepis aristata			Ba
	Centrolepis drummondiana			Ba, T, Y, F
	Chenopodiaceae			
	Atriplex cinerea			F, 91
	Atriplex hypoleuca			Ma
	*Atriplex prostrata			T
	*Chenopodium album			MG
	*Chenopodium ambrosioides			Ba, T
	*Chenopodium murale			91
	Chenopodium pumilio	N	Balangup L	Ba
	Rhagodia baccata			F
	Rhagodia baccata subsp. baccata			91
#	Rhagodia baccata subsp. dioica			91
	Sarcocornia quinqueflora			MG, Ma, F, 91
	Suaeda australis			MG, 91
	Threlkeldia diffusa			F, 91
	Colchicaceae			
	Burchardia congesta			P, Ba, Bo, M,, T, S, Y,F
	Commelinaceae			
	Cartonema philydroides			Ba, M, T
	*Tradescantia fluminense			Bo

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Convolvulaceae			
#	Wilsonia backhousei			91
#	Wilsonia humilis			91
	Crassulaceae			
	Crassula colorata			P, Ba, Y, F, 91
	Crassula exserta			F, 91
	*Crassula glomerata			Ma, F, 91
	Crassula pedicellosa			F
	Cucurbutaceae			
	*Citrullus lanatus			MG
	*Cucumus myriocarpus			S, MG
	Cuscutaceae			
	*Cuscuta epithymum			Ba
	Cyperaceae			
	Baumea arthrophylla			Ba, T
	Baumea articulata			P, Ba, M, T, S, F
	Baumea juncea			T, Y ,F
	Baumea preissi			Ba, T
	Baumea riparia			Ba, T
	Baumea rubigenosa			Ba, T
	Bolboschoenus caldwellii			Ba, T, MG
	Carex preissii			F
*	Cyperus congestus			Ba, T, S, Y, MG
*	Cyperus eragrostis			Y
	Cyperus polystachyos			Ba, T
	*Cyperus rotundus			Bo, MG
	*Cyperus tenellus			P
	*Cyperus tenuiflora			Bo, M
#	Eleocharis sphacelata			K
#	Fimbristylis vilata			M, S
	Gahnia trifida			Ma, MG, F, MB
	Isolepis cernua			F, 91
	Isolepis marginata			Ba, T, F
	Lepidosperma angustatum			M, S, Y, F, 91
	Lepidosperma costale			Ba, T
	Lepidosperma drummondii			M
#	Lepidosperma gracile			M
	Lepidosperma longitudinale			Ba, Bo, M, T, S, F

Taxon	Prio Code	Geographic Range	Recorded Areas
Lepidosperma scabrum			Ba, T, S
Lepidosperma sp. (Coastal terete BJK & NG 231)			F
Lepidosperma tenue			M, S
Lepidosperma squamatum			Y, F
Mesomelaena pseudostygia			P,Ba, M, T, S, Y, F
Mesomelaena tetragona			P
Schoenus aff. laevigatus			F
Schoenus brevisetis			F
Schoenus brevifolius			Ba, T
Schoenus clandestinus			Ba, Y, F
Schoenus curvifolius			Ba, M, T, S, Y, F
Schoenus grandiflorus			Ba, T, S, Y, 91
Schoenus rodwayanus			F
Schoenus subflavus			Ba, T
Tetraria octandra			P, M, Y, F
Dasypogonaceae			
Acanthocarpus preissii			F, 91
Calectasia cyanea			Ba, M, T, S
Dasypogon bromeliifolius			P, Ba, M, T, S, F
Lomandra caespitosa			F
Lomandra hermaphrodita			F
Lomandra integra			M
Lomandra maritima			Ma, F, 91
Lomandra micrantha			Ba
Lomandra nigricans			Ba, T, F
Lomandra preissii			F
Lomandra suaveolens			Ba, M, F
Dennstaedtiaceae			
Pteridium esculentum			Bo, T, S, P, H, N
Dilleniaceae			
Hibbertia acerosa			91
Hibbertia huegelii			Ba, M, T, Y, F
Hibbertia hypericoides			P, Ba, M, T, S, Y, Ma F, 91
Hibbertia racemosa			P, Ba, M, T, S, Y, F, 91
Hibbertia spicata subsp. leptotheca	3	S Yalgorup	F, 91
Hibbertia stellaris			P, M
Hibbertia subvaginata			M, T, F

Taxon	Prio Code	Geographic Range	Recorded Areas
Droseraceae			
Drosera erythrorhiza			Ba, M, T, S, Y, F
Drosera gigantea subsp. gigantea			P
Drosera glanduligera			Ba, M, T
Drosera macrantha			Ba, M, T, S, F
Drosera menziesii subsp. penicillaris			P, Ba, M, T, F
Drosera paleacea			Ba, M, Y, F
Drosera pallida			Ba, M, Y, F
Drosera stolonifera			M, Y, F
Epacridaceae			
Acrotriche cordata			91
Astroloma pallidum			Ba, M, T, S, Y, F
Brachyloma preissii			Ba, M, F
Conostephium pendulum			P, T, S, Y, F
Conostephium preissii			Ba, M, T, Y
Leucopogon australis			P, M, 91
Leucopogon conostephioides			Ba, M, T, Y
Leucopogon gracillimus			F
Leucopogon oxycedrus			Ba
Leucopogon parviflorus			M, Ma, F
Leucopogon propinquus			Ba, Bo, M, T, S, Y, F
Leucopogon racemulosus			M, F
Lysinema ciliatum			P, Ba, M, T, S
Euphorbiaceae			
* Euphorbia peplus			Ba, T, Y, Ma, MG, F, 91
* Euphorbia terracina			Y, Ma, 91
Monotaxis grandiflora			P, Ba, M
Monotaxis occidentalis			Ba, Y
Phyllanthus calycinus			Ba, M, T, S, Ma, F, 91
Poranthera microphylla			Ba, F
* Ricinus communis			Y, MG
Fagaceae			
* Quercus suberus			P
* Quercus sp.			S
Frankeniaceae			
Frankenia pauciflora			91
Fumariaceae			
* Fumaria capreolata			Ba, T

	Taxon	Prio Code	Geographic Range	Recorded Areas
*	Fumaria muralis			Ba, T
Gentianaceae				
*	Centaurium erythraea			F
*	Centaurium spicatum			Ba
Geraniaceae				
*	Erodium botrys			Ba, T
*	Erodium cicutarium			Ba, T, F, 91
*	Geranium molle			Ba, T, F, 91
*	Pelargonium capitatum			P, T, S, Ma, MG, F, 91
*	Pelargonium domesticum			Bo
	Pelargonium littorale			F
Goodeniaceae				
	Dampiera linearis			P, Ba, M, T, S, F
#	Dampiera triloba			M
	Goodenia ?pulchella			Ba, M, T
#	Lechenaultia biloba	W		M
	Lechenaultia expansa			Ba, T
	Lechenaultia floribunda			P, M, S, Y
	Lechenaultia linarioides	S	Spectacle	S
	Scaevola canescens			Ba, M, T, S, Y
	Scaevola crassifolia			91
	Scaevola globulifera			M
	Scaevola repens			M, Y
Haemodoraceae				
	Anigozanthos humilis			P, Ba, M, T, S, Y, F
	Anigozanthos manglesii			P, Ba, M, T, S, Y
	Anigozanthos viridis			T
	Conostylis aculeata			P, Ba, M, T, S, Y, F, 91
	Conostylis candicans			P, M, T, F
	Conostylis setigera			P, Ba, M, T, Y, F
	Haemodorum paniculatum			Ba, M, T, Y
	Haemodorum spicatum			Ba, Bo, T, Y
	Phlebocarya ciliata			P, Ba, M, T, S, F
	Tribonanthes ?uniflora			P
Gyrostemonaceae				
	Tersonia cyathiflora			MB
Haloragaceae				
	Glischrocaryon aureum			Ba

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Gonocarpus cordiger			Ba
	Gonocarpus pithyoides			F
	Myriophyllum crispatum			Ba
	Myriophyllum integrifolia			Ba
Iridaceae				
*	Chasmanthe floribunda			S
*	Gladiolus caryophyllaceus			P, Ba, M, T, S, Y, F, 91
*	Homeria flaccida			Ba, Y, F, 91
*	Ixia paniculata			Ba
	Patersonia occidentalis			P, Ba, M, T, S, Y, F
	Patersonia occidentalis (swamp form)			N
*	Romulea rosea			Ba, M, T, S, Y, F, 91
*	Tritonia sp.			B
Juncaceae				
*	Juncus acutus			MG, C
*	Juncus articulatus			Ba
*	Juncus bufonius			Ba
	Juncus caespiticius			Ba
	Juncus kraussii			MG, Ma
	Juncus pallidus			P, Bo, M, T, S,Y
	Luzula meridionalis			Ba, T
Juncaginaceae				
	Triglochin calcitrapum			91
	Triglochin procerum			Ba, M, T, F
Lamiaceae				
#	Hemigenia sericea			MB
	Hemiandra pungens			P, Ba, M, T
*	Stachys arvensis			Ba
Lauraceae				
	Cassytha flava			F, 91
	Cassytha glabella			M
	Cassytha pubescens			91
	Cassytha racemosa			Ba, M, T, F, 91
Lemnaceae				
	Lemna disperma			Ba
Lobeliaceae				
	Lobelia alata			F
	Lobelia tenuior			F

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Loganiaceae			
	Mitrasacme paradoxa			Ba
	Loranthaceae			
	Nuytsia floribunda			P, Ba, Bo, M, T
	Lythraceae			
*	Lythrum hyssopifolia			Ba
	Malvaceae			
	Allogyne huegelii var. glabrescens	S	Manning L.	Ma
*	Lavatera plebeia		in Mepo area in Yalgorup	MG, 91
	Lawrencia spicata			91
*	Malva parviflora			MG
	Menyanthaceae			
	Villarsia albiflora			Ba
	Villarsia ?capitata			Ba, T
	Mimosaceae			
	Acacia cochlearis			Ba, T, Y, F
	Acacia cyclops			Ba, M, T, Y, MG, 91
	Acacia huegelii			Ba, M, T, Y, MG, 91
	Acacia lasiocarpa var. lasiocarpa			F, 91
*	Acacia longifolia			Y, Bl
	Acacia pulchella			P, Ba, Bo, M, T, Y, MG, F, 91
	Acacia rostellifera			T, Ma, F, 91
	Acacia saligna			P, Ba, Bo, M, T, Y, MG, Ma, F, 91
	Acacia stenoptera			Ba, M, T, S, Y, F
	Acacia truncata			Ma, 91
	Acacia willdenowiana			P, M, T, Y
	Molluginaceae			
	Macarthuria australis			Ba, T
	Moraceae			
*	Ficus carica			MG, H, Ma
*	Morus nigra			MG, Ma, S
	Myoporaceae			
	Eremophila glabra			F, 91
	Myoporum insulare			91
	Myrtaceae			
	Agonis linearifolia			M, N, H
	Astartea aff. fascicularis			Ba, Bo, M, T, S, Y, F
	Baeckea camphorosmae			Ba, T, S

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Beaufortia elegans			M
	Calothamnus lateralis			P
	Calothamnus quadrifidus			Ma, 91
	Calytrix angulata			Ba, T, S
	Calytrix flavescens			Ba, M, T, F
	Calytrix fraseri			Ba, M, T, F
*	Chamelaucium uncinatum	S	Bold Park	P, M, Ma, Y
	Eremaea ?asterocarpa			Ba, T
	Eremaea pauciflora			Ba, M, T
	Eucalyptus calophylla			P, Ba, M, S, Y, F
*	Eucalyptus citriodora			P
	Eucalyptus decipiens			Ma, MB, 91
	Eucalyptus gomphocephala			Ba, M, T, S, Y, Ma, MG, MB, Ma, F
	Eucalyptus marginata			P, Ba, M, T, S, Y, F
	Eucalyptus rudis			P, Ba, Bo, M, T, S, Y, F
	Eucalyptus todtiana			Ba, T, Y, F
	Hypocalymma angustifolium			P, Ba, M, T, F
	Hypocalymma robustum			P,Ba, M, T, S, Y, F
	Kunzea ericifolia			Ba, M, T, S, Y, F
*	Leptospermum laevigatum			P, M, S, Y, MG
	Melaleuca acerosa			Ma, F, 91
	Melaleuca cuticularis			Co, MG
	Melaleuca huegelii			Ma, MB, 91
	Melaleuca incana			S
*	Melaleuca lanceolata			Ma
	Melaleuca lateritia			P, M, Ro, S, F
	Melaueca preissiana			Ba,Bo, M, T, S, Y, F
	Melaleuca rhaphiophylla			P, Bo, M, S, Y, Ma, MG, Co, Ma, F
	Melaleuca seriata			Ba, M
	Melaleuca teretifolia			P,Ba, Bo, M, T, S,MG, F
	Melaleuca thymoides			P,Ba, M, T, F
	Melaleuca viminea			MG
	Pericalymma ellipticum			P, Ba, M, F
	Regelia inops			M
	Scholtzia involucrata			Ba, M, T,S, F
	Verticordia drummondii			Ba, T
Oleaceae				
*	Olea europea			MG

	Taxon	Prio Code	Geographic Range	Recorded Areas
Onagraceae				
	Epilobium billardierianum			Ba, F
	Epilobium hirtigerum			Ba, F
*	Oenothera stricta			MG
Orchidaceae				
	Caladenia deformis			Ba, T, S, Y
	Caladenia denticulata			Ba, T
	Caladenia discoidea			Ba, T
	Caladenia flava			P, Ba, T, S, Y, F
	Caladenia gemmata			Ba, T
	Caladenia latifolia			Ba, T, Y, F, 91
	Caladenia longicauda			Ba, M, T
	Caladenia ?paludosa			Ba, M, T
	Diuris emarginata			Ba, T
	Diuris longifolia			P, Ba,M, T, F
	Elythranthera brunonis			P, Ba, M, T, F
	Elythranthera emarginata			M
#	Epiblema grandiflorum			Ba
	Leporella fimbriata			M
	Lyperanthus nigricans			Ba, M, Y
	Microtis media			Ba, M, T, Y, F
*	Monadenia bracteata			F, 91
	Prasophyllum fimbria			Ba
	Prasophyllum ovale			Ba, T
	Prasophyllum parvifolium			Ba
	Pterostylis aff. nana			M, T
	Pterostylis recurva			Ba
	Pterostylis scabra var. robusta			M
	Pterostylis vittata			M, S, Y
	Thelymitra benthamiana			F
	Thelymitra campanulata			Ba, M, T
	Thelymitra crinita			M
Orobanchaceae				
*	Orobanche minor			Ba, M, Y
Oxalidaceae				
*	Oxalis pes-caprae			Ba, T
*	Oxalis purpurea			Ba, T

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Papilionaceae			
	Aotus cordifolia			P, Ba, M
	Aotus gracillima			P, Ba, M, T
	Aotus procumbens			M, Y
	Bossiaea eriocarpa			P, Ba, M, , S, YTF
	?Callistachys lanceolata			P
*	Cystus prolifera			M
	Daviesia decurrens			Ba, M, T, Y
	Daviesia divaricata			P, M, Y, F
	Daviesia nudiflora			Ba, M, T, Y
	Daviesia physodes			P, BL, Ba, M, T, S
	Daviesia triflora			P, Ba, M, T, S, Y, F
	Eutaxia virgata			E, Ba, M
	Gompholobium confertum			M
	Gompholobium tomentosum			P, Ba, M, T, S, Y, F
	Hardenbergia comptoniana			P, Ba, Bo, M, T, S, Y, MG, , 91F
	Hovea pungens			P, Ba, M, T, S, F
	Hovea trisperma			Ba, M, T, S, F
	Isotropis cuneifolia			Ba, M, T, S, Y, F
	Jacksonia aff. sericea (swamp form)	eP		N
	Jacksonia furcellata			P, Ba, Bo, M, T, S, Y, 91
	Jacksonia sternbergiana			P, Ba, Bo, M, T, S, Y, F
	Kennedia coccinea			91
	Kennedia prostrata			P, Ba, Bo, M, T, S, Y, F
	Latrobea tenella			Ba, M
*	Lupinus angustissimus			Y, MG
*	Lupinus cosentinii			Ba, T, S, Y, MG
*	Medicago polymorpha			Ba, T
*	Melilotus indicus			Ba, T, MG, F, 91
	Nemcia capitata			P, Ba, M, T, S, Y, F
	Nemcia reticulata			F, 91
*	Ornithopus sativus			Ba
	Oxylobium lineare			P, M
	Pultenaea ochreata			Ba, M, T, S
	Pultenaea reticulata			P, Ba, T, S, F
	Sphaerolobium vimineum			Ba, M, F
	Templetonia retusa			Ma, MG
*	Trifolium angustifolium			Ba

	Taxon	Prio Code	Geographic Range	Recorded Areas
*	Trifolium arvense			MG
*	Trifolium campestre			Ba, T, Y, F, 91
*	Trifolium cernuum			Ba, F, 91
*	Trifolium dubium			Ba, T
*	Trifolium glomeratum			Ba
*	Trifolium pratense			Ba, t
*	Vicia hirsuta			Ba, T
*	Vicia sativa			P, Ba, M, T, M, F
	Viminaria juncea			Ba, M, T, S
Phytolaccaceae				
*	Phytolacca octandra			91
Phormiaceae				
	Dianella revoluta			P, Ba,.Bo, M, T, S, Y, MG, 9
Pinaceae				
*	Pinus pinaster			P, Ma
Pittosporaceae				
	Pittosporum phylliraeoides			MG
	Pronaya fraseri			Ba, M
	Sollya heterophylla			MG
Plantaginaceae				
*	Plantago lanceolata			MG
Poaceae				
*	Aira caryophyllea			Ba, Y, F, 91
*	Aira cupaniana			Ba
*	Aira praecox			Ba
	Amphipogon laguroides			Ba, M, T, F
	Amphipogon turbinatus			Ba, M, T, F
*	Arundo donax			Y, MG
*	Avellinia michelii			F
*	Avena barbata			P, Ba, T, F, 91
*	Avena fatua			Y, MG, F
*	Briza maxima			P, Ba, T, S, Y, F, 91
*	Briza minor			P, Ba, T, S, Y, MG, F, 91
*	Bromus diandrus			F, 91
*	Bromus hordeaceus			F, 91
*	Catapodium rigidum			91
*	Cortaderia selloana			T
	Cynodon dactylon			Bo, T, S, Y, MG

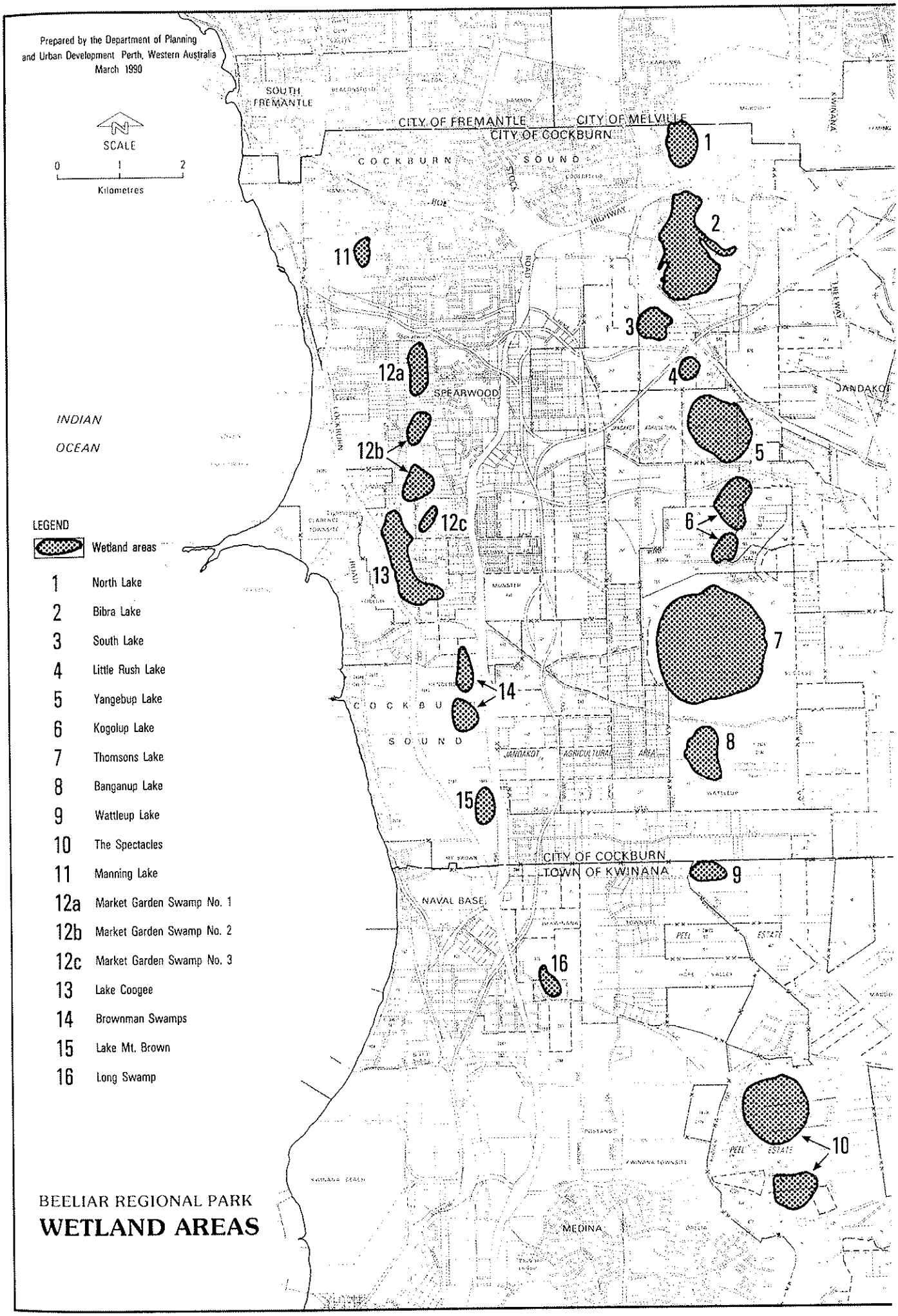
	Taxon	Prio Code	Geographic Range	Recorded Areas
	Danthonia occidentalis			Ba, T, F, 91
	Deyeuxia quadriseta			Ba, T, F
*	Diandrus gussonii			Ba, T
	Dichelachne crinita			F
*	Digitaria sanguinalis			Ba
*	Echinochloa crus-galli			MG
*	Ehrharta calycina			P, Ba, Bo, T, S, Y, MG, F, 91
*	Ehrharta longiflora			Ba, T, Y, F
	Hemarthria uncinata			Ba, T
*	Holcus setiger			F
*	Hordeum leporinum			Y
*	Lagurus ovatus			Ba, T, Y, MG, F, 91
*	Lolium multiflorum			91
*	Lolium perenne			Ba, T
*	Lolium rigidum			Y, F
	Microlaena stipoides			Ba, T, F
*	Paspalum dilatatum			MG
*	Paspalum distichum			Y, MG
*	Paspalum vaginatum			Ba, T, Y
*	Pennisetum clandestinum			Bo, S, Y, MG, Ma
*	Phalaris minor			91
*	Poa annua			F
	Poa drummondiana			Ba, T, 91
	Poa poiformis/porphyroclados			Ba, F, 91
*	Polypogon monspeliensis			Ba, T
*	Rhynchelytrum repens			Y
*	Secale cerale			MG
	Sporobolus virginicus			Y, F, 91
	Spinifex longifolius			91
*	Stenotaphrum secundatum			Ba, Bo, T, MG
	Stipa compressa			Ba, T, Y, F
	Stipa flavescens			Ba, T, Y, 91
	Stipa semibarbata			Ba, T
	Stipa variabilis			Ba, T
*	Vulpia bromoides			Ba, T, F
*	Vulpia myuros			Ba, F, 91
Polygalaceae				
	Comesperma calymega			Ba, M, T, F

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Comesperma confertum			F, 91
	Comesperma flavum			Ba
	Comesperma virgatum			Ba, M, T
Polygonaceae				
*	Emex austrlis			MG, Ma
	Muehlenbeckia polybotrya			Ba, T
*	Polygonum aviculare			MG, Ma
	Polygonum salicifolium			Bl, Bo, T
*	Rumex acetosella			Ba, T
*	Rumex crispus			Ba, T
Portulacaceae				
	Calandrinia calyptrata			F
	Calandrinia corrigioloides			Ba, T, F, 91
	Calandrinia granulifera			Ba
	Calandrinia liniflora			Y
	Portulaca oleracea			MG
Primulaceae				
*	Anagallis arvensis			P, Ba, M, T, S
	Samolus junceus			F, 91
	Samolus repens			F, 91
Proteaceae				
	Adenanthos cygnorum			P, Ba, M, T, S
	Adenanthos obovatus			S
	Banksia attenuata			P, Ba, Bo, M, T, S, Y, F, 91
	Banksia grandis			Ba, M, T, Y
	Banksia ilicifolia			P, Ba, Bo, M, T, Y, F
	Banksia littoralis			P, Ba, Bo, M, T, F
	Banksia menziesii			P, Ba, Bo, M, T, S, Y, F, 91
	Conospermum stoechadis			Ba
	Conospermum triplinervium			Ba, T
	Dryandra nivea			Ba, T, S, Y, Ma, F, 91
	Dryandra sessilis			M, T, Y, Ma, F, 91
	Grevillea preissii			Ma, F, 91
	Grevillea vestita			Ba, Y, 91
	Hakea lissocarpha			Ba, S, 91
	Hakea prostrata			Ba, M, T, Y, Ma, F, 91
	Persoonia saccata			P, Ba, T, S, Y
	Petrophile brevifolia			Y

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Petrophile linearis			P, Ba, M, T, S, Y, F
	Petrophile serruriae			F,91
	Stirlingia latifolia			P, Ba, M, T, S, Y, F
	Synaphea spinulosa			P, Ba, M, T, S, Y
	Xylomelum occidentale			Ba, M
Ranunculaceae				
	Clematis pubescens			Ba, M, T, Ma
*	Ranunculus muricatus			Ba, M, T
Restionaceae				
	Alexgeorgea nitens			Y
#	Empodisma gracillimum			M
	Hypolaena exsulca			Ba, M, T, F
	Leptocarpus aristatus			P, M, Y
	Leptocarpus coangustatus			F
	Leptocarpus scariosus			Ba
	Lepyrodia muirii			Ba, T
	Loxocarya flexuosa			M, S, Y F, 91
	Loxocarya pubescens			Ba, T, S
	Lyginia barbata			P, M, T, S, Y
	Restio stenostachyus			Ba, T
Rhamnaceae				
	Cryptandra mutila			F, 91
	Spyridium globulosum			Ma, 91
Rubiaceae				
*	Galium aparine			F, 91
*	Galium murale			F
	Opercularia hispidula			Ba, F
	Opercularia vaginata			Ba, M, S, Y, F, Ma
Rutaceae				
	Boronia crenulata			Ba, M, T, F
	Boronia ramosa			M
	Eriostemon spicatus			P, Ba, M, T, S, Y, F
Salicaceae				
*	Salix babylonica			Bl, Bo, MG
Santalaceae				
	Dodonaea aptera			Y
	Dodonaea hackettiana	4	eW	Ba, T, S
	Exocarpos sparteus			Ba, Bo, M, T, S

	Taxon	Prio Code	Geographic Range	Recorded Areas
	Leptomeria cunninghamii			F
	Leptomeria empetriformis			Ba, T
	Leptomeria spinosa			Ba
	Santalum acuminatum			Ba, 91
Scrophulariaceae				
*	Bellardia trixago			Ba, F
*	Cymbalaria muralis			Ba
*	Dischisma arenarium			Ba, F
	Gratiola peruviana			Ba
*	Parentucellia latifolia			Ba
*	Parentucellia viscosa			Ba, M, F, 91
*	Verbascum virgatum			M, T, 91
*	Veronica arvensis			F
Solanaceae				
*	Nicotiana glauca			Y, MG, 91
*	Solanum nigrum			Ba, T, S, MG, 91
	Solanum symonii			Y, MG, 91
Stackhousiaceae				
	Stackhousia monogyna			P, Ba, MG
Sterculiaceae				
	Thomasia cognata			F, 91
Stylidiaceae				
	Levenhookia pusilla			F
	Levenhookia stipitata			Ba, M, F
	Stylidium brunonianum			P, Ba, M, T, Y
	Stylidium bulbiferum			F, 91
	Stylidium calcaratum			Ba, M
	Stylidium junceum			P, Ba, T
	Stylidium piliferum			Ba, M, T, S, F
	Stylidium repens			Ba, M, T, F
	Stylidium schoenoides			Ba, M, T, Y, F
Thymelaeaceae				
	Pimelea angustifolia			Ba, M , T
	Pimelea calcicola			Ma, F, 91
	Pimelea rosea			P, Bo, M, T, S, Y, F
	Pimelea sulphurea			M, Y, F
Tropaeolaceae				
*	Tropaeolum majus			Y

	Taxon	Prio Code	Geographic Range	Recorded Areas
Tremandraceae				
	Platytheca galioides			Ba, M, T
Typhaceae				
	Typha domingensis			Ba, T, S
*	Typha orientalis			Y, MG
Urticaceae				
	Parietaria debilis			91
Verbenaceae				
*	Lantana camera			Y
Violaceae				
	Hybanthus calycinus			P, Ba, M, T, S, Y, F, 91
Vitaceae				
*	Vitus vinifera			MG
Xanthorrhoeaceae				
	Xanthorrhoea brunonis			S
	Xanthorrhoea preissii			P, Ba, Bo, M, T, S,Ma, MG, F
Zamiaceae				
	Macrozamia riedlei			Ba, Bo, M, S, Y, F, 91
Zygophyllaceae				
	Zygophyllum fruticulosum	S	Port Kennedy	91
*	Tribulus terrestis			MG


Prepared by the Department of Planning
and Urban Development Perth, Western Australia
March 1990
SCALE
0 1 2
Kilometres
SOUTH FREMANTLE
CITY OF FREMANTLE
CITY OF MELVILLE
CITY OF COCKBURN
COCKBURN SOUND
SPEARWOOD
JANDAKOT
INDIAN
OCEAN
CITY OF COCKBURN
TOWN OF KWINANA
NAVAL BASE
MEDINA
LEGEND
Wetland areas
1 North Lake
2 Bibra Lake
3 South Lake
4 Little Rush Lake
5 Yangebup Lake
6 Kogolup Lake
7 Thomsons Lake
8 Banganup Lake
9 Wattleup Lake
10 The Spectacles
11 Manning Lake
12a Market Garden Swamp No. 1
12b Market Garden Swamp No. 2
12c Market Garden Swamp No. 3
13 Lake Coogee
14 Brownman Swamps
15 Lake Mt. Brown
16 Long Swamp
BEELIAR REGIONAL PARK
WETLAND AREAS

Map

SOUTH COOGEE

PLANNING STUDY

FINAL DRAFT

PREPARED BY:

THE MADDESTRA ROWE PARTNERSHIP
Town Planners and Project Managers

BOWMAN BISHAW GORHAM
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MT. BROWN LK. et al SPEAR

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October, 1990

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BS 346

Natural Reserves Management Study

City of Cockburn
9 COLEVILLE CRESCENT, SPEARWOOD 6163

ATT: BRONWYN KEIGHERY

BRONWYN,

COPY OF FULL REPORT AS DISCUSSED. ALSO INCLUDED IS A MAP WHICH SHOWS OUR RESERVES THAT WE HAVE DESIGNATED FOR CONSERVATION.

DARREN WALSH

With Compliments

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WESTERN AUSTRALIA 6163

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Report to:

Environmental Division
City of Cockburn

Report by:

V & C Semeniuk Research Group

JUNE 1997

3.0 DESCRIPTION OF NATURAL FEATURES

The natural features of the reserves are described under categories of uplands and wetlands.

3.1 Uplands

Upland reserves are listed in an order corresponding to numbers assigned to them for this study. They are described in the following manner:

- location - in geographic terms
- geometrically in terms of size and shape;
- setting - in geomorphic terms;
- natural features in terms of landform, soils and vegetation.
- condition of vegetation
- functions

RESERVE #1 - M91 COASTAL RESERVE

The area of reserved remnant vegetation is located south of the Henderson Industrial Estate and west of Cockburn Road. It is a microscale area, linear in shape, approximately 200 m wide. This coastal reserve incorporates part of the western coastal edge of one of the Spearwood ridges. It is an undulating terrain incorporating several small scale geomorphic units: limestone pavements, low mounds, hollows and cliff tops. It is underlain by Tamala limestone and shallow brown soils. The vegetation cover forms a mosaic composed of five different assemblages and three different structures (Figure 3). They are: low closed heath (*Melaleuca acerosa, Grevillea thelemanniana, Hibbertia hypericoides, and Dryandra lindleyana*), closed scrub (*Acacia rostellifera, Spyridium globulosum),* sedgeland *(Lepidosperma gladiatum, Isolepis nodosa*), and two open low heaths (*Acanthocarpus preissii)* and *(Frankenia pauciflora*). Refer to Table 1 for a species list. The condition of the vegetation is good.

From information collected during this study, the functions of this reserve are mainly ecological, cultural (pertaining to heritage), and scientific. They are:

1. to preserve coastal heaths which function as important food sources to avifauna, especially honey eaters and wrens.

2. to maintain biodiversity by preserving the range of natural features and habitats described above

3. to maintain undisturbed representative examples of uncommon and poorly reserved remnant vegetation types particularly the low closed heath

4. to preserve this example of a now uncommon type of ecosystem (the coastal expression of a Spearwood Dune ridge), which is largely in its natural state

5. to preserve part of a linked system (the coastal expression of a Spearwood Dune ridge) which continues inland and incorporates wetlands

6. to preserve relationships evident here between landform/vegetation response and salt spray/species competition which are important to the study of natural ecology and the advancement of our understanding of ecological processes.

RESERVE #4 - HENDERSON REGIONAL OPEN SPACE

The area of reserved remnant vegetation is located south of the Cockburn International Raceway and east of Cockburn Road. It is a macroscale area, rectangular in shape, approximately 1 km wide. Henderson Regional Open Space incorporates part of the Spearwood ridges. It is an area of undulating hills incorporating several smallscale geomorphic units: interdune depressions, dunes, limestone hills (cemented Pleistocene parabolic dunes). It is underlain by Tamala limestone and shallow brown soils. The natural vegetation cover forms a mosaic comprising seven different assemblages and four different structures (Figure 4). These are: open woodland (*Eucalyptus.gomphocephala*), low woodland (*Banksia.attenuata*), low woodland (*E. decipiens*), closed heath (*Melaleuca acerosa, Grevillea thelemanniana, Hibbertia hypericoides*), closed scrub (*Acacia rostellifera*), closed scrub (*Dryandra sessilis*) and scrub (*Melaleuca huegelii, Dryandra sessilis*). A species list for the reserve is in Table 2. The vegetation is in good condition except for an area in the south west of the reserve where exotic species have been planted.

From information collected during this study, the functions of this reserve are mainly ecological, cultural (pertaining to heritage), and scientific. They are:

1. to preserve important habitats for avifauna (coastal heaths and *Banksia* woodlands), especially honey eaters and wrens, and to preserve marsupial populations.

2. to preserve biodiversity by maintaining habitat diversity.

3. to maintain undisturbed representative examples of uncommon and poorly reserved types of remnant vegetation such as the low closed heath and low woodland (*Eucalyptus. decipiens).*

4. to preserve the central and the best developed portion of a Spearwood Dune ridge in the City of Cockburn, including the isolated limestone hills and the dune topography formed by the blanketing of the ridge with yellow aeolian sand.

5. to preserve the clear relationship between the vegetation response and environmental factors such as the different geomorphic units, their different elevations and concomitant water availability, exposure to sea breezes, and insolation gradients.

RESERVE #2 - BROWNMAN SWAMPS RESERVE

Brownman Swamps is the local name given to a reserve which includes part of a chain of five wetlands and their surrounds. This chain of wetlands is located south of Russell Road and west of Rockingham Road. The wetlands are shallow leptoscale to mesoscale fresh water to hyposaline sumplands. They are recharged by rainfall which is ponded by the limestone, and by lateral groundwater flow. Water is discharged through evaporation and probable downward leakage into the limestone. The wetlands contain shallow muds and muddy sands (comprising peat and carbonate muds) and are underlain by quartz sand and limestone. The carbonate muds in the chain of wetlands of the Coogee Suite, to which this wetland belongs, are of calcitic and dolomitic mineralogy. The vegetation is maculiform and consists of forest to woodland (*Melaleuca rhaphiophylla*), open shrubland (*M. teretifolia*), sedgeland (*Gahnia trifida*), and sedgeland (*Baumea juncea*) (Figure 4). The low ridges between the sumplands are colonnised by forest dominated by *Eucalyptus gomphocephala*, which is gradually replaced by low forest dominated by species of *Banksia* nearer the coast. The condition of the wetland vegetation and its buffer zone is good.

The functions of this reserve are mainly ecological and cultural (pertaining to heritage). They are:

1. to maintain representative examples of this type of vegetated wetland (Semeniuk 1988), in an undisturbed state

2. to preserve this example of a rare type of ecosystem (i.e. vegetated by forest and two types of sedge communities which are largely in their natural state)

3. to preserve this wetland and swale portion of the Spearwood Dune ridge complex thus maintaining the ecological (faunal use and vegetation communities), geomorphological (dune/swale) and hydrological (water movement between dune and swale) linkages

4. the Brownman Swamps appear to be linked hydrologically to Lake Mt Brown in that they are a possible source of some of its groundwater input

5. to maintain a source of water to fauna, especially mammals, and amphibia.

6. to maintain protection and nesting sites for avifauna

7. to preserve the potentially globally significant scientific heritage of dolomite occurrence

RESERVE #3 - LAKE MOUNT BROWN RESERVE

Lake Mt. Brown is the name given to a reserve which includes one wetland and its surrounds. This reserve is located adjacent to the southern boundary of the Brownman Swamps Reserve, and west of Rockingham Road. The wetland is a shallow leptoscale fresh water to mesosaline sumpland (not a lake). It is recharged by rainfall which is ponded by the limestone and later discharged through evaporation. The wetland contains shallow muddy sands (peat, carbonate mud, and quartz) underlain by

limestone. Carbonate muds in the chain of wetlands of the Coogee Suite, to which this wetland belongs, are of calcitic and dolomitic mineralogy. The vegetation is concentriform and consists of low forest (*Melaleuca rhaphiophylla*), and sedgeland (*Gahnia trifida, Juncus kraussii, Baumea juncea*), with some invasion by the aggressive wetland weed Pampas Grass (**Cortaderia selloana)*). Also present are: *Acacia saligna, Apium prostratum, *Aster subulatus, Banksia litoralis, Centella cordifolia, *Cirsium vulgare, Lepidosperma longitudinale, Logania vaginalis, *Pennisetum clandestinum, Samolus repens, Sarcocornia quinqueflora, Sonchus hydrophilus, Sporobolus virginicus, *Stenotaphrum secundatum.* A vegetated buffer zone surrounds the northern, eastern and western side of the wetland. These surrounding ridges are vegetated by forest dominated by *Eucalyptus gomphocephala*, which is gradually replaced by scrub dominated by *Melaleuca huegelii* at higher relief and where limestone is exposed. The condition of the wetland vegetation is good (Figure 4).

The wetland Lake Mt Brown belongs to the same suite as the Brownman Swamps (Semeniuk 1988). Lake Mt Brown is part of a linked system, hydrologically and ecologically. The wetland changes from having permanent open water to seasonal open water in response to cyclic rainfall conditions but in either state it compliments the completely vegetated wetlands to the north.

The important functions of this reserve are mainly ecological, hydrological, and cultural (pertaining to heritage). They are:

1. as a waterfowl habitat; this more open wetland provides feeding and loafing sites complimenting the vegetated wetlands to the north which provide protection and cover for avifauna

2. as a receiving basin for groundwater from the north, effecting its hydroperiod and depth.

3. as an extension of wetland habitat types in the area; Lake Mt Brown is the wetter and more saline part of the suite of wetlands

4. as a site to preserve a potentially globally significant scientific heritage (dolomite)

RESERVE #8 - BUCKINGHAM RESERVE

Buckingham reserve includes portion of a wetland and no buffer zone. This reserve is located south of Gibbs Road and between Beenyup and Liddelow Roads. The wetland is a leptoscale fresh water sumpland. It is recharged by rainfall and groundwater rise and discharged through evaporation and local drawdown. The wetland contains shallow humic and iron oxide coated quartz sands and is underlain by Bassendean Sand. The vegetation is maculiform and consists of low forest and scrubland (*Melaleuca rhaphiophylla*), low woodland (*M.preissiana*), two types of scrubland (*M. viminea*) and (*M.rhaphiophylla, M.viminea, M.polygaloides*). The wetland vegetation is in good condition (Figure 7).

From on-site investigation, the most important functions are ecological and cultural (pertaining to heritage). They are:

6.0 MANAGEMENT RECOMMENDATIONS

In the management recommendations made here, there has been a concerted effort to consider long term management objectives over short term management constraints, cost effective over cost prohibitive mechanisms and, most importantly, preservation of wetland values and functions where warranted, given the importance of remnant vegetation in the study area in a regional context.

6.1 Uplands

The upland areas are grouped in descending order of importance as follows:

- Group 1 - M91 Coastal Reserve and Henderson Regional open space;
- Group 2 - Reserve 1820 - which was the focus of an independent and more detailed study, and although those results are not repeated herein, the current study concurs with the earlier conclusions and recommendations in Meney 1996;
- Group 3 - Sherbrooke Gardens, Holdsworth Park, Frankland Reserve, Cocos Park Reserve, and Manning Lake upland; and
- Group 4 - Hammond Road Reserve, Torgoyle Road Reserve, Redemptora Road Reserve, Fancote Reserve, and Coogee Beach Reserve.

Group 1

The most important functions of the M91Coastal Reserve and Henderson Regional open space are ecological and therefore are dependent on habitat preservation. Management of these areas and their values requires the following concepts to be incorporated into the management strategy:

1. Although the upland areas may be separately managed, the value of the area covered by the four reserves (Coastal Reserve M91, Henderson Regional open space, Brownman swamps, Lake Mt Brown) outweighs the values of the separate reserves. Together, the four reserves stand as an uncommon example of diversity of landforms and vegetation in the Spearwood Dunes, they illustrate the gradation of habitats in the Spearwood system from swale to ridge crest and from hinterland to coast, they provide a viable fauna refuge, the upland areas provide a buffer to the wetlands, and the two wetland reserves remain hydrologically linked.
2. Vegetation plays an important role in the ecological functions of the system.
3. Vegetation is vulnerable to disturbance such as fire, local clearing, and trampling.
4. Native fauna are vulnerable to fire and to feral species of animals.
5. The upland habitats provide an example of ecosystems and natural features which are only duplicated (and only to a limited extent), in the Burns Beach and Quinns Rocks regions in the Perth Metropolitan area.

Management of the four reserves as one entity with the objective of conservation of ecological values is a strategy which satisfies the criteria outlined above for best management practices in that it is viable in the long term, cost effective, and preserves recogniseable values. With this as the objective, it is now possible to formulate tasks appropriate to this strategy.

- The Authority responsible for fire management should be informed about the values of the reserve so that it is perceived to be a **valuable property** with a **high priority** for fire control.

- Some rehabilitation of vegetation is required in local patches in order to close the vegetation cover particularly in the Coastal Reserve M91. Open areas are vulnerable to weed invasion and to wind deflation.

- Some immediate weed control is recommended for both the M91 Coastal Reserve, because several alien species which have only begun to invade the area are known to be extremely virulent and resistant to removal once established. In addition, certain species directly cause the demise of the native vegetation. The most important species to eradicate is "bridal creeper" *Asparagus asparagoides* because it kills its support plant.

- Signs should be erected informing the community about what activities **are permitted** in the reserve.

- It is recommended that the area encompassing the four reserves be fenced to prevent random access and rubbish dumping.

Group 2

Reserve 1820 is ecologically part of a linked system in that it adjoins a much larger area of vegetated Bassendean Dunes and a wetland ecosystem to the north. These links enhance the importance of the reserve with regard to habitat diversity and faunal use. Both of these functions are important. For long term viability of fauna populations, two options are presented. The first option is that dividing fences be removed so that Reserve 1820 can incorporate the surrounding wetland and vegetated upland. The total area should then be vested in an appropriate Authority to be managed as a reserve. The second option is to modify the boundaries of Reserve 1820 so that it includes vegetated upland areas presently in the reserve and vegetated wetland areas to the north. This option would depend on the outcome of an enquiry into the feasibility of a land exchange, with the objective of reserving vegetated areas and releasing cleared areas for potential development (Figure 5b).

For other recommendations referring specifically to Reserve 1820 refer Meney (1996).

Group 3

The most important functions of the third group of upland areas (Sherbrooke Gardens, Holdsworth Park, Frankland Reserve, Cocos Park Reserve, and Manning Lake upland) are ecological and again are dependent on habitat preservation. Management of these

- Torgoyle Road Reserve and Hammond Road Reserve have been the sites for a series of activities such as clearing of vegetation, excavation, track development and infrastructure development. Both reserves would require extensive re-vegetation to try to restore ecological values. Hammond Road Reserve would be the preferred site for such an extensive programme because there is already a groundcover, the landform and soils are undisturbed, and wetland vegetation adjacent is relatively undisturbed.

- Torgoyle Road Reserve management depends on the type of uses to which it is assigned by the City of Cockburn. As these are variable, the general recommendation for the reserve is that these uses be compatible with the limestone terrain and the remaining endemic vegetation.

- The Coogee Beach Reserve is susceptible to aeolian and marine erosion, therefore the best way to preserve its integrity is to encourage the type of use which decreases the effect of erosion. Areas should be clearly marked where access is restricted. Pathways through Coogee Beach Reserve should be wooden to prevent sand mobilisation through these artificial wind corridors. Dune cliffs and wind scours should be covered with branches to restrict further removal of sand, and re-vegetation of endemic species should be undertaken.

- The major management issue for Redemptora Road and Fancote Road Reserves is currently the frequency of fire. The Authority responsible for fire management should be informed about the values of the reserve so that it is perceived to be a **valuable property** with a **high priority** for fire control. The Authority should also be encouraged to lengthen the period between fire episodes as the major result of the present fire regime is to diminish the biodiversity of the reserve.

6.2 Wetlands

The wetland areas are grouped in descending order of importance as follows:

- Group 1 - the Brownman Swamps and Lake Mt Brown which belong to the same suite;

- Group 2 - Buckingham Reserve and Bosworth Reserve;

- Group 3 - Bibra Lake and Manning Lake; and

- Group 4 - Gil Chalwell Reserve, Mather Reserve, Kraemer Reserve, and Emma Treeby Reserve.

Group 1

There are three important functions for the Brownman Swamps and Lake Mt Brown wetlands; these are: 1. their ecological role, which depends on habitat preservation; 2. their regional scientific significance as the predominantly freshwater end of the spectrum of a chain of wetlands that belong to the Coogee Suite of consanguineous

wetlands; and 3. their potentially globally significant heritage value in the occurrence of dolomite mud within the Coogee Suite of wetlands. The aspect of their ecological role requires maintenance of the hydrological and sedimentological mechanisms which induce the range of biological responses. The aspect of their representing the freshwater end of the Coogee Suite relates to the fact that the chain of Coogee Suite of consanguineious wetlands, located only in the seaward part of the Swan Coastal Plain between Fremantle and Leda, is saline to the north, grading to freshwater/brackish to the south. The Brownman Swamps and Lake Mount Brown uniquely represent the freshwater end of the spectrum of this suite in the City of Cockburn.

The aspect of the global significance of dolomite is amplified further here. Calcitic mud is a common mineral of freshwater wetlands in Western Australia and in general globally. Dolomite, however, is not so common, and in terms of geological heritage, its occurrence in modern near coastal wetland sediments is significant since it has been documented as a sedimentary deposit in modern wetlands only in a few locations globally, the best known occurrence being The Coorong, South Australia. Dolomite has been documented as a mud-sized mineral component in the carbonate muds of the Coogee Suite of wetlands in this region. Once the information on dolomite has been published and the hydrology and hydrochemistry underlying its occurrence are documented, it is likely that the wetlands of the Coogee Suite that contain this mineral will become classic examples of this type of mineral occurrence. If studies, currently underway, confirm their importance to science in the context of precipitation of carbonate minerals in the spectrum from saline to freshwater/brackish environments, these wetlands in the near future may assume ***international significance***. In this context, their hydrology, their buffer zones and their upland relationships cannot be compromised.

Management of these wetlands and their values, in the light of the information above, requires the following concepts to be understood and incorporated into the management strategy:

1. the wetlands behave as a hydrological and ecological linked system.
2. the wetland recharge and discharge processes extend into, are derived from and are linked to the surrounding upland areas
3. vegetation plays an important role in the ecological functions of the system
4. the system is vulnerable to water level alteration, water quality alteration, fire, vegetation clearing, and alienation
5. the wetlands and upland habitats combined, provide an example of ecosystems and natural features which are not duplicated in the Perth Metropolitan area
6. the hydrologic and hydrochemical environment of the wetlands and the terrain around the wetlands must not be compromised because this will alter the precipitation and maintenance of carbonate mud formation

The best way to preserve the integrity of each of the wetland components (Brownman swamps, and Lake Mt Brown)) is to preserve the system covered by the three reserves (Henderson Regional open space, Brownman swamps, and Lake Mt Brown). In this way hydrological processes are maintained, and the wetlands are surrounded by vegetated buffer zones. Decisions regarding any one of the reserves should be made in the best interest of maintaining the values of the integrated system

This strategy satisfies the criteria outlined above for best management practices in that it is viable in the long term, cost effective, and preserves recogniseable values. With this as the objective, it is now possible to formulate tasks appropriate to this strategy.

- The Authority responsible for fire management should be informed about the values of the reserve so that it is perceived to be a **valuable property** with a **high priority** for fire control.
- The community require information regarding reserve values. A community group may be initiated for purposes connected with reserve management and dissemination of information.

- Some immediate weed control is required at Lake Mt Brown because several virulent alien species have become established e.g., Pampas Grass - *Cortaderia selloana*.

- Vehicle access should be directed rather than unrestricted.

- Signs should be erected informing the community about what activities **are permitted** in the reserve.

- Directions to alternate localities should be circulated to residents for activities outside the scope of this reserve, so that people become aware of facilities suited to their recreational or other activities.

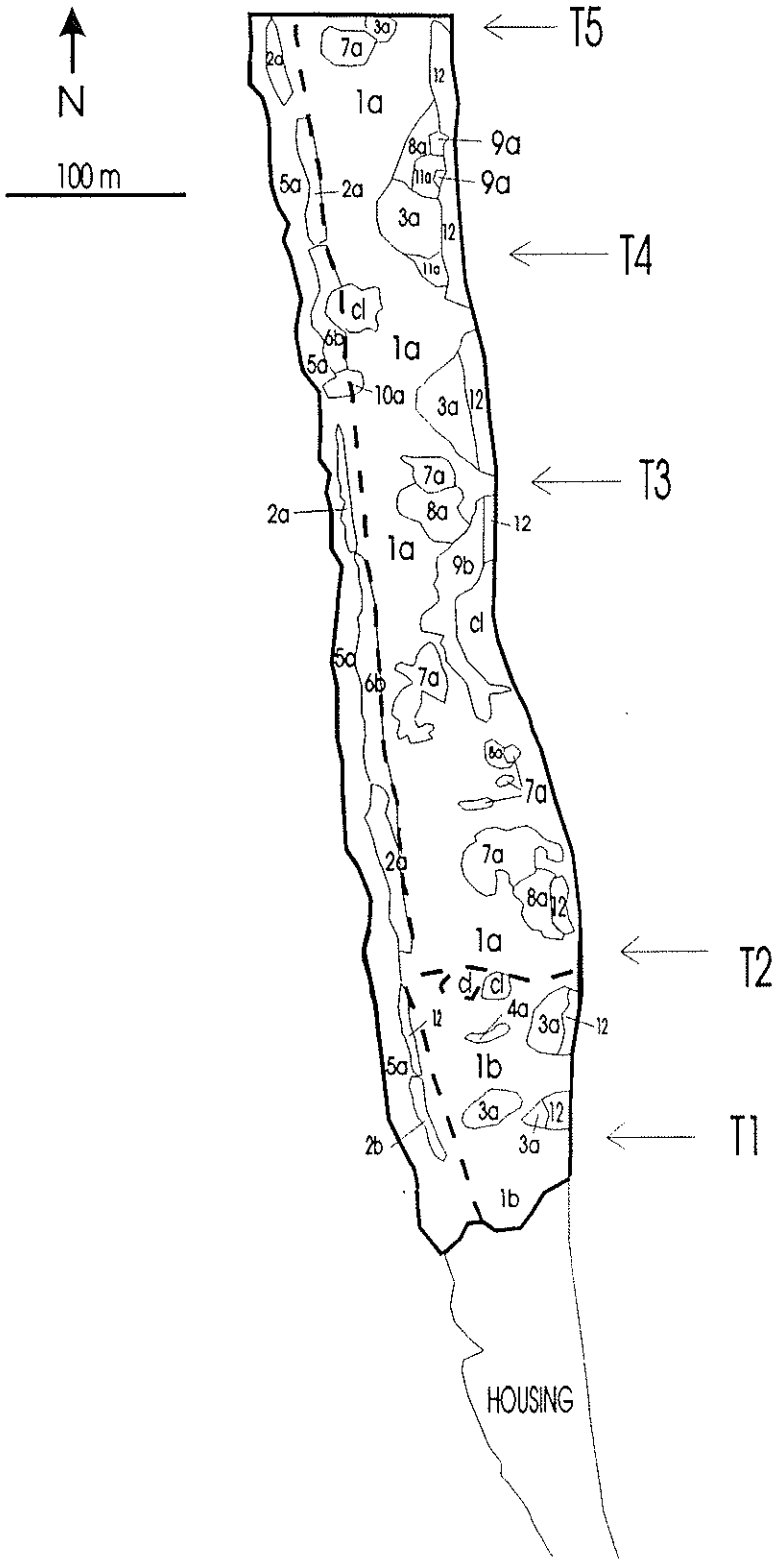
- Liaison with other planning and land management authorities should take place to ensure consistent management goals for wetlands which extend outside the City's reserve boundary and to decide on appropriate and beneficial future developments on the periphery of the reserve.

- Continual liaison with other Authorities should be undertaken to review and if necessary enter into negotiation on any planned development that may potentially contravene the documented and established purpose of the reserve, or degrade its ecological values. Such a development would be the proposed partitioning of the area by transport routes.

Group 2

The most important functions of the Buckingham and Bosworth Reserves are ecological and depend on habitat preservation. This requires maintenance of the mechanisms which induce the range of biological responses. Management of these wetlands and their values requires the following concepts to be understood and incorporated into the management strategy.

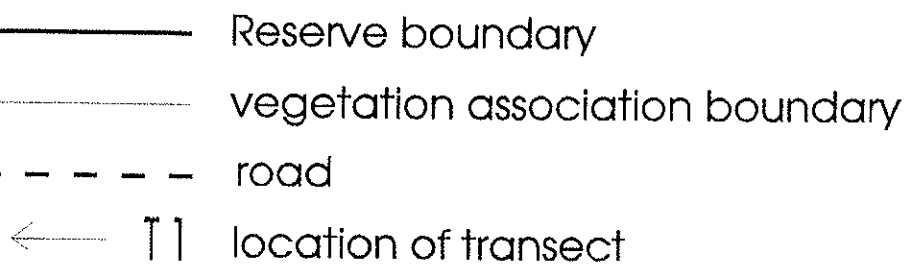
1. The wetlands in the reserves are only a portion of the natural wetland. The wetland recharge and discharge processes extend into, are derived from and are linked to the surrounding areas which are on land under freehold title.
2. Vegetation plays an important role in the ecological functions of the system.
3. The system is vulnerable to water level alteration, water quality alteration, fire, vegetation clearing, and alienation.



V & C Semeniuk Research Group 1997

Map of Coastal Reserve M91

Figure 3



VEGETATION ASSEMBLAGES

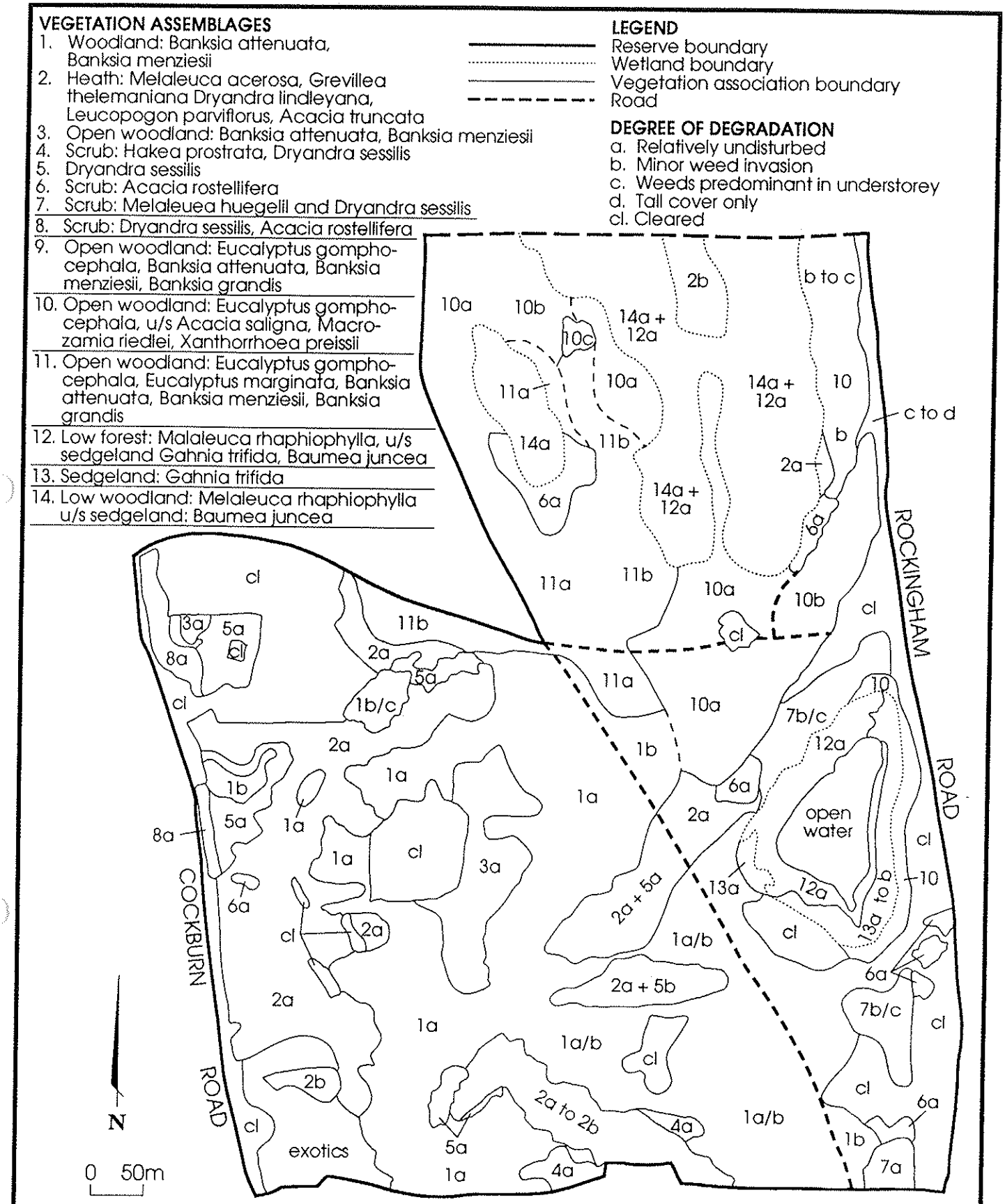
1. Low closed mixed heath: Grevillea thelemanniana; Melaleuca acerosa; Hibbertia hypericoides; Dryandra nivea; Melaleuca hueglii; Phylanthus calycinus; Acacia truncata; Petrophile serruriae; Leucopogon parviflorus; Lomandra maritma; Templetonia retusa; Calothamnus quadrifidus.
2. Sedgeland: Lepidosperma gladiatum.
3. Heath: Acacia rostellifera.
4. Scrub: Eucalyptus decipiens.
5. Low heath: Frankenia pauciflora.
6. Low heath: Acanthocarpus preissii.
7. Closed heath: Dryandra sessilis.
8. Low closed heath: Xanthorrhoea preisseii (dominant)
9. Remnant woodland: Banksia attenuata.
10. Open heath: Acacia cyclops.
11. Low heath: Grevillea vestita.
12. Planted exotics.

cl: Cleared areas.

DEGREES OF DEGRADATION

a. relatively undisturbed
b. minor weed invasion
c. weeds predominate in understorey
d. tree cover only
cl. cleared

V & C Semeniuk Research Group 1997	**Legend to Map of Coastal Reserve M91**	Figure 3



V & C Semeniuk Research Group 1997

Brownman Swamps, Lake Mt. Brown area and Henderson Regional Open Space

Figure 4

HENDERSON MANAGEMENT PLAN

PREPARED BY THE CITY OF COCKBURN

AUGUST 1990

Brown and the low limestone hill to the north are covered by low heath with many species typical of the coastal limestone. The understorey contains a good variety of species."

The Report recommended that the area be designated as a Regional Park (as part of the Cockburn Wetlands-Western Chain).

3.3.2 LIMNOLOGY

The wetland systems and their associated vegetation were analysed in the Cockburn Wetlands Study as being within three broad categories, young, mature or old. The wetland ecosystems are dynamic and move throughout a life cycle categorised above.

The life cycle is described in the following summary from the Wetland Study.

"A young lake has deep water that contains only few plant nutrients (mainly nitrogen and phosphorus) therefore little algae or other plant life is associated with the lake. As the lake develops more vegetation, the nutrient level begins to rise and the organic content increases. The deposition of organic materials slowly fills the lake bed. This process of maturing, called eutrophication, continues until the lake becomes a swamp dominated by reed and tree coverage, with only a few patches of open water. If the swamp fills in sufficiently it can dry out completely, leaving bushland growing on deep peat. This peat is susceptible to fire and if burnt the area is deepended and the process begins once again."

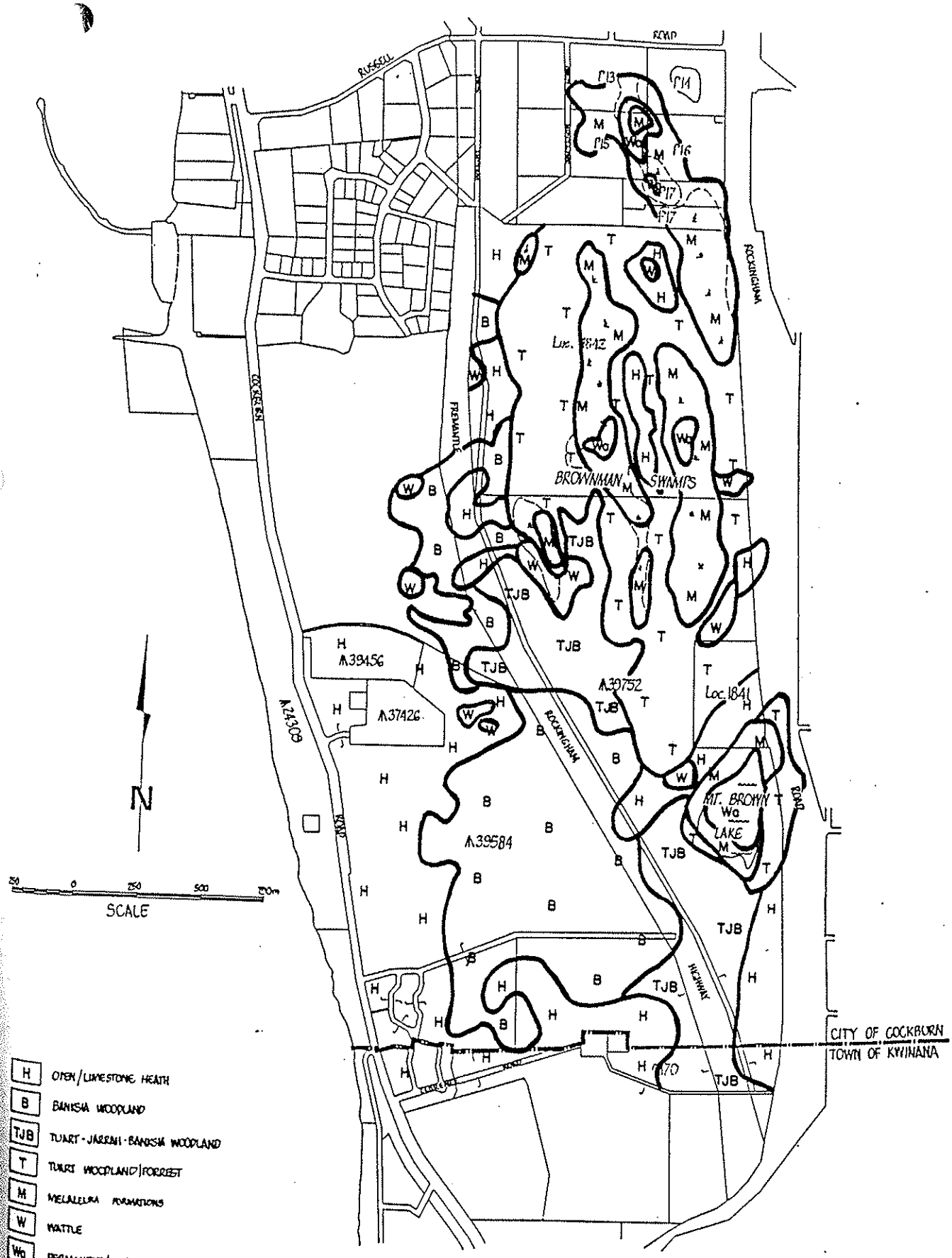
Mt Brown Lake has been classified as being in the young part of the life cycle, however, is severely threatened by man induced eutrophication.

Generally, if man allows nutrients into the lake the eutrophication process is greatly accelerated. This usually results in algae blooms, which are often toxic, and leads to an "anaerobic" lake. Such lakes have a reduced species diversity, foul odour, reduces bird life which results in limited human use.

3.3.3 VEGETATION

The Cockburn Wetlands Study conducted a comprehensive study of the area and noted that certain trees and plant species were particular to one chain only. These differences are an indication of the water salinity, differing soil types and geomorphic features.

Figure 5 shows the different vegetation patterns within the area. The vegetation species have been broken down into the following communities (adapted from Newman-1976):-


ROAD
RUSSELL
P13
P14
P15
P16
P17
ROCKINGHAM
COCKBURN
FRANKLAND
BROWNMAN SWAMPS
TJB
A39456
A37426
A24309
A39752
Loc.1841
A39584
MT. BROWN LAKE
ROAD
N
250 0 250 500 750m
SCALE
CITY OF COCKBURN
TOWN OF KWINANA
H OPEN/LIMESTONE HEATH
B BANKSIA WOODLAND
TJB TUART-JARRAH-BANKSIA WOODLAND
T TUART WOODLAND/FORREST
M MELALEUKA FORMATIONS
W WATTLE
Wa PERMANENT/SEASONAL WATER

VEGETATION

1. LIMESTONE/OPEN HEATHS - The heath formations are usually found on the limestone ridges within the Spearwood Dune System and consists of low, hardy or soft leaved shrubs. The heath formation also includes some Wattle communities and Chenille Honey Myrtle. The major limestone heath species are:- Wattle, Harsh Hakea, Spider Net Grevillea, some shrubs (Hibbertia Hypericoides, Grevillea Crithmifolia, Dryandra Falcata, D.Sessius, D.Nivea), and a small blue-green coastal shrub (Olearia Axillaris). Also present are two uncommon species, Button Runner and Hemigenia Sericea.

   The heath can be broken down into three major formations:-

   a) Closed Heath - these are low dense vegetation types, seldom exceeding 1.5 metres.

   b) Open Heath - this classification is similar to closed heath but the vegetation grows slightly higher and is more spread out. This may also be classified as scrub.

   c) Limestone Heath - these are low hardy shrubs growing on exposed limestone ridges.

2. TUART - JARRAH - BANKSIA WOODLAND The dominant tree species is Tuart, Jarrah and Banksia (B.Menziesii, B.Grandis, B.Attenliata and B.Littoralis). The woodland classification indicates the trees are more spread out (10 to 30% coverage). The Sheoak and Christmas trees are also common. The understorey of Blackboys, Zamia, Wattles, Prickly Moses, Bottlebrush and the dry land reed types are less dense than the Tuart open forest.

3. BANKSIA WOODLAND This is similar to the above woodland, but with the absence of Tuart and Jarrah, additional understorey species include Acacias, a leafy tussock (Dasypogon Bromeliaefolius) and a number of purple and white flowering shrubs (Regelia Decussata and Scholtzia Involucrata). The woodland is generally located between the swamps and coastal heath, up to 25m A.H.D.

4. TUART WOODLAND/FOREST Under this classification canopy cover varies between 30-70%. The Tuarts vary in height between 12-30 metres, with a dense understorey of Blackboys, Wattles and Dry-Land Reeds.

Tuarts indicate the presence of Spearwood Soils. Their growth is most abundant in the areas surrounding the salt lakes due to the presence of shallow limestone.

Newman (1976) noted that the Tuarts in the northern half of Brownman Swamp are extremely healthy. The understorey in the area is also very health and very diverse. Further south around Mt Brown Lake, and closer to Kwinana, the quality of forest was observed to deteriorate. The tuart have become "Stag-Headed" and many have died.

5. MELALEUCA FORMATIONS This classification includes the combination of the reed, shallow water thicket, saltmarsh and paperbark communities.

Mt Brown Lake is surrounded by a dense but narrow border of paperbarks and reeds. The area of Tussock Grass was noted by Newman as being of special interest, as it has adapted to the fluctuating water levels and saline conditions.

The central area of swamp has two long strips of swamp paperbark, with an unusual understorey of Gahnia Trifica and Cladium Vaginale.

The north west of Brownman Swamp bordering the Market Gardens has an exceptional stand of swamp paperbark (Melaleuca Rhaphiophylla), which form a closed woodland with a lush succulent grass and reed understorey.

The saltmarsh formation comprises of plants adapted to saline conditions, and consists mainly of low succulent plants (termed Halophytes). They have the ability to adapt to soils of a high mineral content and to seasonal water fluctuation. The common reeds are Juncus Caespititius, Gahnia Trifida, Lepidosperma Longitudinale and Cladium Viginale which is also a dominant part of woodland understoreys. It has been noted the salt marshes indicate that the swamps may have once been more saline than it is now. A fall in groundwater levels and intrusion of saltwater may lead to a change towards salt marsh.

6. WATTLE The two man Wattle communities are Acacia Cyanophylla and A.Rostellifera. A.Cyanophylla is found in low lying land and grows in dense clumps, growing up to five metres. A Rostellifera grows on limestone soils between the Banksia Woodland and limestone ridge and also in isolated clumps, usually in protected hollows.

3.3.4 HUMAN AFFECT ON VEGETATION QUALITY

The effect of pollution from Kwinana can best be summarised by Newman (1976).

"The effects of dust layers on vegetation are well documented. Photosynthesis is restricted and a gradual decline in the plants' health occurs, usually commencing at the crown, giving the tree a "stagheaded" look. An increase in the alkalinity of the limestone soils may alter the vegetation by reducing the numbers of the less tolerant plant, which would then allow the tolerant species (Acacia, etc.) to dominate the vegetation scheme. A combination of these factors may be causing the observed deterioration of the plant life."

Several ruins are situated to the west of Mt Brown Lake and the area is heavily scarred by offroad vehicle tracks. The surrounding vegetation is being encroached upon by the illegal dumping of rubbish and car bodies.

There is relatively little weed incursion throughout the study area but species such as Cape Tulip, Guildford Grass and Blue Pimpernel are widespread.

The Naval Base Townsite has been largely modified with many introduced species including Veldt Grass, Wild Oats, Aloe, Opituna and many "Domestic" bushes and trees.

3.3.5 FAUNA

Newman (1976) reported that the study area had a greater abundance and species in bird fauna than other wetlands in the western wetland chain. The entire Brownman Swamp Region provides an extensive area of vegetation for bush birds, however, bird numbers and species are characteristically lower than in the wetlands of the eastern chain.

The Murdoch Study theorised that air pollution from Kwinana had contributed to the absence of many species in the region. Interference from off-road vehicles could also result in the lack of diversity.

Vermin, especially rabbits, are becoming widespread and have added to the breakdown of the environment.

3.4 HUMAN USE

3.4.1 PRE EUROPEAN

In 1975 a report prepared for the Town of Cockburn entitled "National Estate Study" documented sixteen Aboriginal sites in Cockburn, of which only one had been both classified and protected. The Study added that nine sites are under threat ranging from total destruction through excavation and quarrying, and the remaining six have not, as yet, been classified.

BEELD 01

BEELD 02

BEELD 03

Lot south of Lot 501 M92 30/12/96
(West end of Okra Ct) Wetland

Lot 501 M92 (adjacent to Water Ski Park)

30/12/96 J. Tilleke looking at proposed sub ÷ in area.

Lot 501 M92 30/12/96

Lot 501 M92 30/12/96

Lot 501 M92 30/12/96

looking west (stood on northern boundary)

Lot 501 M92 20/12/96

Looking east

SW corner of Lot 501 M92 30/12/96

Lot 501 M92 30/12/96
looking east