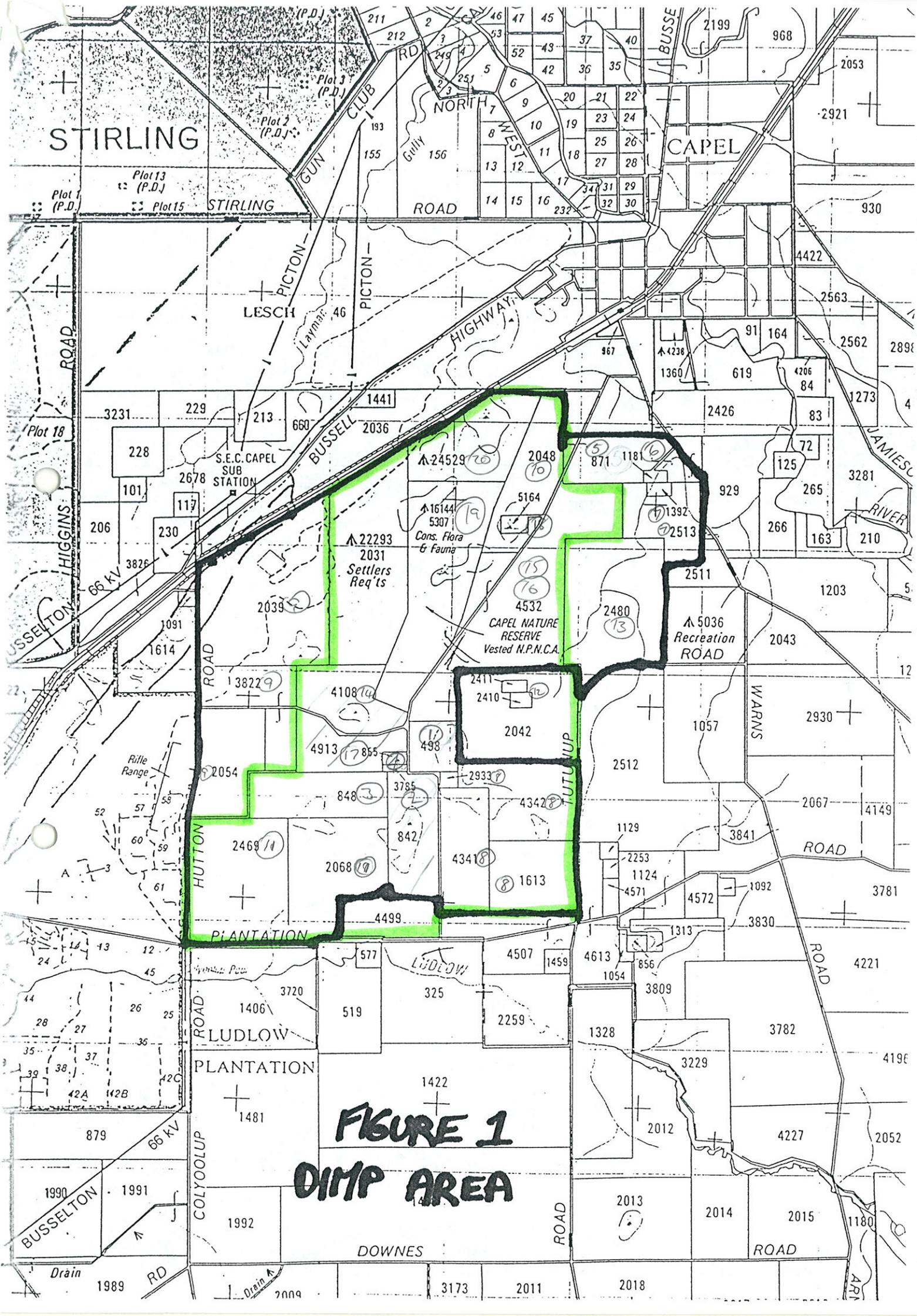

STIRLING
CAPEL
LESCH
NORTH WEST
GUN CLUB RD
BUSSELL HIGHWAY
PICTON
PICTON
STIRLING ROAD
Plot 1 (P.D.)
Plot 2 (P.D.)
Plot 3 (P.D.)
Plot 13 (P.D.)
Plot 15
Plot 18
Laymans
Gully
S.E.C. CAPEL SUB STATION
66 KV
HIGGINS ROAD
BUSSELTON
Cons. Flora & Fauna
Settlers Req'ts
CAPEL NATURE RESERVE
Vested N.P.N.C.A.
Recreation
ROAD
HUTTON ROAD
TUTUNUP
WARNS ROAD
JAMIESON
RIVER
Rifle Range
PLANTATION ROAD
LUDLOW
LUDLOW PLANTATION ROAD
COLYOOLUP ROAD
DOWNES ROAD
Drain
RD
FIGURE 1
DIMP AREA

272 474 Bernie Masters Consultant Integrated Dalyngup Management Plan

(118)

SYSTEM 6 BUSHLAND SUBMISSION FORM
FOR CONSIDERATION IN THE UPDATE PROGRAMME

If you wish to submit more than one area for consideration in the System 6 update, please use a separate form for each area.

Please fill in each section giving as much information as possible.

LOCATION, OWNERSHIP AND ZONING OF THE AREA

1. Location

Please give as accurate and detailed a description as possible of the site location

Please include either a hand drawn or copied map showing the area of the area

a) Bordering Roads: RAILWAY LINE, HUTTON RD, PLANTATION RD, TUTTONUP RD (INC. PROWSE RD), CAPEL.

b) Nearest Corner: N/A.

c) Lot Number: N/A. Street Number: N/A.

d) Town/Suburb/Location: WELLINGTON

e) Local Council: CAPEL SHIRE

f) Site Name (if any): DALYNGUP

g) Approximate size of the area (ha): 980 ha. approx.

h) Please locate the area on a map and give us map references if possible:
CAPEL N.W. 1:25000 (FIND ENCLOSED SECTION)

i) Map: .... Streetsmart /UBD/Other: ....

j) Map no.: ....

k) Grid Ref: AREA DELINEATED BROWN ON ENCLOSED MAP.

l) Please give any other information that may help us to find the location:
SOUTH CAPEL RURAL AND VARIOUSLY VESTED RESERVES.

m) Are you aware of any development proposals that are likely to affect the area?
NO.

NOTE: Areas that have already been given development APPROVAL should not be nominated

Please fill out those questions that you can answer

2. Who owns the area? (If owned by the person/s making the nomination please indicate) .....VARIOUS LANDOWNERS AND CAPEL NATURE RESERVE MANAGED BY C.A.L.M FOR N.P.N.C.A.....

3. If you own the area, and may be interested in participating in conservation on private land initiatives please indicate (and leave your name and address at the end of this submission form) .....✓.....

4 .What is the area zoned? (please indicate whether zoning is Town Planning Scheme or Metropolitan Region Scheme) .....RURAL.....SHIRE OF CAPEL.....

CAN YOU TELL US A LITTLE ABOUT THE PHYSICAL CHARACTERISTICS OF THE AREA

5. Why do you consider this area important? (Refer to Guiding Issues paper)
GOOD REMNANT VEGETATION..., JARRAH - BANKSIA WOODLANDS,
EPP PROTECTED WETLANDS, RARE FLORA, ENDANGERED FAUNA -

6. What is/are the soil type/s and colours ? .....

Type: Sand/~~Clay~~/Gravel/~~Loam~~/~~Silt~~
Colour: White/Grey/~~Brown~~/~~Orange~~/~~Yellow~~/~~Red~~/~~Black~~

7. Does the area have any special features such as unusual landforms / landscapes that still retain their natural vegetation? Yes/~~No~~

If yes, what are they? .....GOOD DIVERSITY OF NATURAL VEGETATION.

.....

.....

8. Is the area a wetland or does it include a wetland? .....YES.....

If yes, what kind of a wetlands is it?

a) lake ✓

b) river

c) stream

d) swamp ✓

e) estuary

f) seasonally wet ✓

g) other

OUT OF 5 PROTECTED WETLANDS, ABOUT

9. What percentage of the wetland is open water in summer? ..... 5%.

CAN YOU TELL US A LITTLE ABOUT THE VEGETATION /FAUNA ON THE NOMINATED AREA.

10. What percentage of the area is indigenous vegetation? ..... 70 - 80 %.....

11. If the area includes regions cleared of native bushland please indicate reasons for the inclusion. .....SOME FARMLAND IS INCLUDED IN GROUPS DESIGNATED AREA.....

12. Has any previous flora or fauna survey work been done on the area?
.....YES.....

If yes, please give details of the work • BROWN & KEIGHERY DOING ONGOING SURVEYS OF NATURE RESERVES • CALM BOTANIST FLORA SURVEY OF WHOLE AREA • CALM FAUNA SURVEY • TED GRIFFIN (AG. DEPT) FAUNA SURVEY.

13. How would you rate the condition of the native bushland? (see attached table)

a) pristine
b) excellent
c) very good ✓
d) good
e) degraded
f) completely degraded
g) don't know

14. Please indicate the disturbances affecting the area and where appropriate the percentage of the area disturbed.

a) Partial clearing ✓ 20 - 30%
b) fragmentation
c) Selective removal of species: timber cutting, wildflower picking, mowing dieback and other plant diseases ✓ 5 - 10%
d) Fire regime, including intensity, season and frequency ✓ SUMMER.
e) 'Enrichment plantings' that is plantings of species not found in that community 1% OR LESS.
f) Weed invasion ✓ ABOUT 25%,
g) Animal impact: horses, foxes, rabbits, cats, dogs, camels, goats etc (HORSES — EXCERCISED)
h) Soil movement, both removal and dumping SANDPIT ON ONE PROPERTY — 4% OF THE AREA.
i) Changes in water regimes; flooding, drainage and watering
j) Salinity
k) Fertiliser drift and along waterways nutrient influx ✓
l) Mining, including that for road works SAND MINING FOR YELLOW SAND.

MINERAL SAND MINING TENEMENT OVER MOST OF THE AREA.

m) Grazing: stock, overgrazing by feral or native mammals

n) Proliferation of tracks, fire breaks and walk trails

o) Off-road vehicle use Some

p) Use as service corridors by the SEC, Main Roads, Water Authority.

(Source: B Keighery. Bushland Plant Survey, September 1994)

15. Does the area contain any plant species of special interest that you know of? (eg. declared rare flora, priority taxa, outlier populations) ..YES..............................

Do you know what they are? ..YES.,...........DRAKEA ELASTICA..,.......................

APONAGETAN HEXATEPALUS..,...FRANKLANDIA triaristata.

16. Do you know of any native animals that use the area? ..YES.-...........................

Can you list those you know of? (birds, mammals, reptiles, amphibians etc)

app. 85 BIRD SPECIES,....9 MAMMALS.,..MANY REPTILES.,..MANY AMPHIBIANS,

17. Is the area used by any native animals of special interest? (eg. endangered species, large/important populations)...YES.........................

If yes, please name them and indicate source of information

SOUTHERN BROWN BANDICOOTS (TRAPPED)........................

BLACK GLOVED WALLABIES (SIGHTINGS)... RINGTAIL POSSUM (DREYS + FAECES)

CAN YOU TELL US A LITTLE ABOUT THE SURROUNDING AREA

18. Are there any bushland areas (including wetlands) near to this area?
........YES.'.....................................

If yes, how close are they ? ........ALL........INCLUDED....AS....SHOWN......ON...MAP.

....

....

Are they already conservation reserves? ..NO..

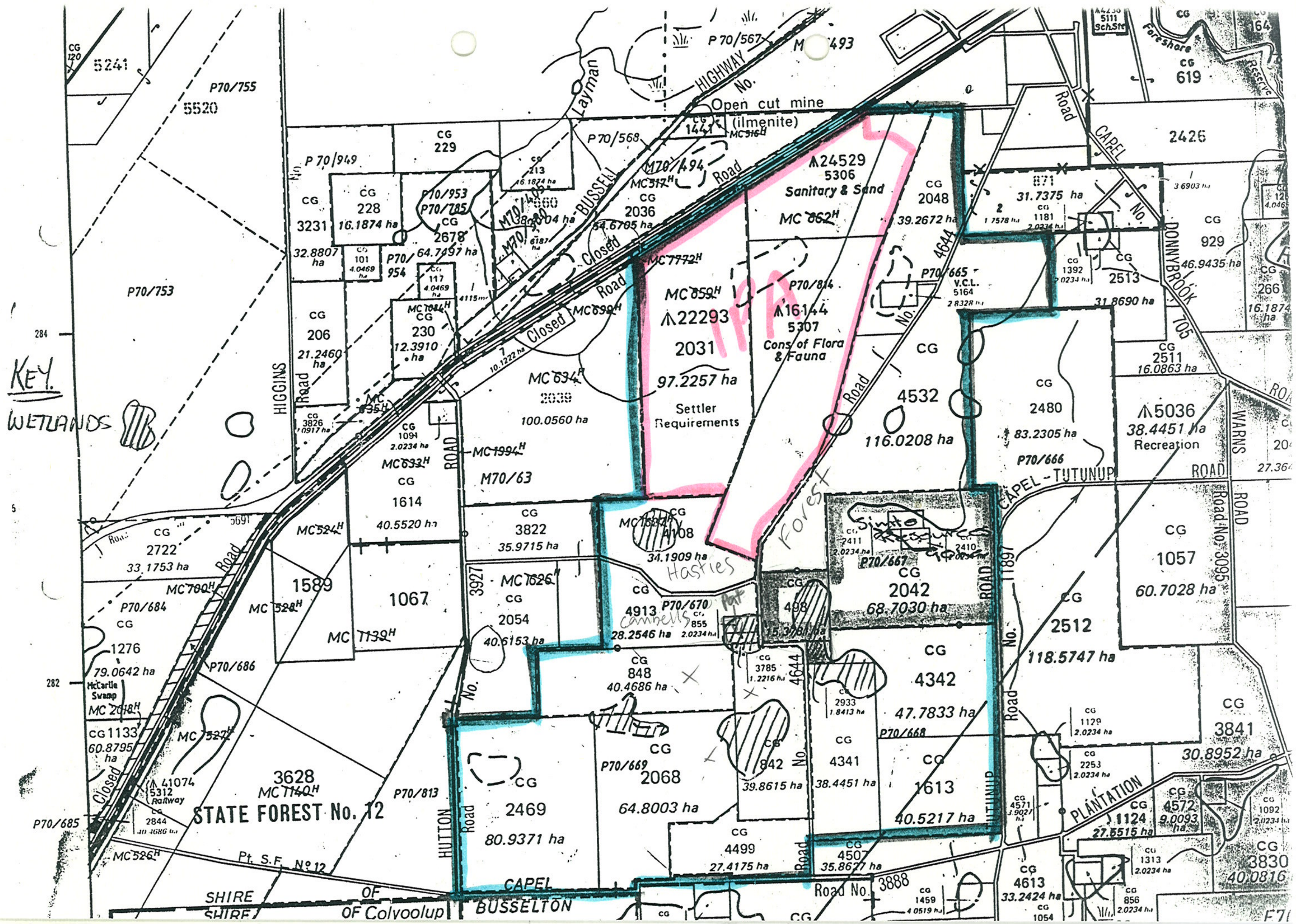
What is their approximate size? ...?...

19. Does the submitted area link other bushland areas? .....NO.......,............................

....

....

Please attach any additional information about the area which may be of use when assessing it.



KEY
WETLANDS
STATE FOREST No. 12
Open cut mine (ilmenite)
BUSSELL HIGHWAY No.
Layman
Sanitary & Sand
Settler Requirements
Cons of Flora & Fauna
IPA
Recreation
CAPEL - TUTUNUP ROAD
DONNYBROOK No. 705
HIGGINS Road
HUTTON Road No.
Road No. 3927
Road No. 4644
Road No. 11897
Road No. 3095
WARNS ROAD
PLANTATION
CAPEL Road
Closed Road
Railway
McCartle Swamp
Pt. S.F. No 12
SHIRE OF CAPEL
SHIRE OF BUSSELTON
OF Colvoolup
Road No. 3888
Forest
Hasties
Campbells
Foreshore Reserve
P70/755
P70/753
P70/949
P70/953
P70/785
P70/568
P70/567
P70/814
P70/665
P70/666
P70/667
P70/668
P70/669
P70/670
P70/684
P70/685
P70/686
P70/813
M70/63
M70/494
5520
5241
2426
619
24529
5306
22293
2031
97.2257 ha
16144
5307
2039
100.0560 ha
4532
116.0208 ha
2480
83.2305 ha
5036
38.4451 ha
2042
68.7030 ha
1057
60.7028 ha
2512
118.5747 ha
4342
47.7833 ha
1613
40.5217 ha
4341
38.4451 ha
842
39.8615 ha
2068
64.8003 ha
2469
80.9371 ha
4499
27.4175 ha
4507
35.8627 ha
848
40.4686 ha
4913
28.2546 ha
4108
34.1909 ha
3822
35.9715 ha
2054
40.6153 ha
1614
40.5520 ha
1589
1067
2722
33.1753 ha
1276
79.0642 ha
1133
60.8795 ha
3628
2048
39.2672 ha
871
31.7375 ha
2513
31.8690 ha
929
46.9435 ha
2511
16.0863 ha
3841
30.8952 ha
4613
33.2424 ha
3830
40.0816
1124
27.5515 ha
4572
9.0093 ha
2036
54.6705 ha
2678
64.7497 ha
3231
32.8807 ha
228
16.1874 ha
206
21.2460 ha
230
12.3910 ha
229
V.C.L.
5164

ENTERED ON GIS

Name: System Six Update Programme – Flora Survey Information - Dalungup
Date: 05/05/2006
Capture Author: Thomas Leong / Ian Steward

Comments:
Polygon
Created to match documented study area with high level of accuracy

Accuracy Levels:

- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual and or described spatial references with complex boundaries, resulting in minor boundary errors
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Attributes
Report Info – Captured without problems
Custodial/Contact – Captured without problems
Content – Captured without problems

Department of Environmental Protection

Head Office:
8th Floor, Westralia Square
141 St Georges Terrace
Perth, Western Australia 6000
Tel (09) 222 7000 Fax (09) 322 1598

Waste Management Division:
Ground Floor, 32 St Georges Terrace
Perth, Western Australia 6000
Tel (09) 222 0422 Fax (09) 222 0455
or PO Box Y3030, East, St Georges Terrace
Perth, Western Australia 6832

Regional Offices:
Bunbury • Karratha • Kalgoorlie • Kwinana

Mr J Hardwick & Ms M Leffaucher
C/o Post Office
CAPEL WA 6271

Your Ref
Our Ref 67/91
Enquiries N Thorning

Dear Mr Hardwick & Ms Leffaucher

SYSTEM SIX UPDATE PROGRAMME - FLORA SURVEY INFORMATION

Thank you for providing permission for our botanical team to survey the bushland on your property. As arranged between Ms Marjan Leffaucher and Miss Natalie Thorning of this Department, the bushland at Dalungup was visited on 17 October 1995.

The botanical survey provides us with information on the natural plant communities found in the area, and their condition. This information is needed to assist the Department of Environmental Protection in its programme to update the conservation recommendations for System 6 and the coastal plain portion of System 1. The main objective of the programme is to ensure that the proposed conservation estate is representative of the ecological communities extant in the region.

As part of this programme the Department has advertised for the public to submit areas of bushland that they consider to be of regional significance. Our botanical team is surveying these submitted areas as well as those it considers may be important based on other factors such as their location and soil type etc. The botanical survey provides us with information on the natural plant communities found in the area, and their condition. Please note that the area is one of many sites that we have surveyed. The fact that we visited and surveyed the site does not indicate that it will necessarily be included in the updated System Six Recommendations.

The update programme has employed the botanical survey methodology used in Gibson et al. (1994), 'A Floristic Survey of the Southern Swan Coastal Plain', to provide the main information base upon which to review the adequacy of the existing System recommendations and to assess other bushland areas.

A general description of the vegetation and an assessment of its condition was completed, however, survey sites were not located on your property.

The information collected during the visits will be used to assess the relative conservation values of the bushland areas. The final selections for inclusion in the updated System Six Recommendations will be the best possible examples of bushland containing plant community types that are either unrepresented or poorly represented in the current and proposed conservation system.

If you are interested in the information we have collected, the location of the survey sites or any other additional information on the System Six Update Programme please don't hesitate to contact Miss Natalie Thorning (222 7051) or Mr Kevin McAlpine (222 7055).

Once again, thank you very much for your support for this programme.

Yours sincerely

Colin Sanders
DIRECTOR
POLICY AND STRATEGIC STUDIES

28 December 1995

Department of Environmental Protection

Head Office:
8th Floor, Westralia Square
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or PO Box Y3030, East, St Georges Terrace
Perth, Western Australia 6832

Regional Offices:
Bunbury • Karratha • Kalgoorlie • Kwinana

Mr & Mrs Campbell
PO Box 54
CAPEL WA 6271

Your Ref
Our Ref 67/91
Enquiries N Thorning

Dear Mr & Mrs Campbell

SYSTEM SIX UPDATE PROGRAMME - FLORA SURVEY INFORMATION

Thank you for providing permission for our botanical team to survey the bushland on your property. As arranged between Mrs Cheryl Campbell and Miss Natalie Thorning of this Department, the bushland at Dalungup was visited on 17 October 1995.

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Perth, Western Australia 6832

Regional Offices:
Bunbury • Karratha • Kalgoorlie • Kwinana

Ms Pat Ligman
22 Wisbey Street
BUNBURY WA 6230

Your Ref
Our Ref 67/91
Enquiries N Thorning

Dear Ms Ligman

SYSTEM SIX UPDATE PROGRAMME - FLORA SURVEY INFORMATION

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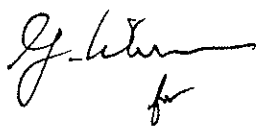
Yours sincerely



Colin Sanders
DIRECTOR
POLICY AND STRATEGIC STUDIES

28 December 1995

Loc 2933, 4341, 4342, 1613, 4499

Jean Hayes
Po Box 31
CAPEL 6271.

Loc 842

Jim + Cheryl Campbell
Po Box 54
CAPEL 6271

Loc 2068, 2469

Roger + Edith Hutton
Po Box 44
CAPEL 6271

Loc 848

Gary + Debra Hutton
Po Box 71
CAPEL 6271

~~Loc 855, 3785~~
097 913 089
~~dog~~

Pat Ligmen
22 Wisbey Street
BUNBURY 6230

~~Loc 4913~~
097 272 170

Algy Hutton + Jim Campbell
Po Box 54
CAPEL 6271

~~Loc 498~~
097 272 101

Jeffrey Hardwick + Marjan Leffaucher
C/- PO
CAPEL 6271
✓ Donnybrook Rd
Spurrst
Prouse Rd
4km Left

~~Loc 4108~~
097 272 527

Allen + Keryn Hastie
C/- PO
CAPEL 6271

✓ OK. don't need to report in
Dog won't bite
- just barks alot.
sites OK.

Bernie Masters 272 474

Loc 2031 ↑ 22293 Reserve : Settlers Requirements
DOLA. ✓ Assunta Dinardo 10-10-95

Loc ✓5307 ↑ 161444 Reserve vested in WA Wildlife Authority

Loc ✓5306 ↑ 24529 Reserve vested in Shire of Capel.

Loc 2048 Mr Ove Philipsen
24 Range Road
CAPEL 6271

Loc 5164 Vested Crown Lease.

LOT 1 Loc 4532 Wayne + Sophia SIDEBOTTOM
Po Box 63
CAPEL. 6271

Loc 4532 Joe Prowse
097 272111 Po Box 2
CAPEL 6271

hung up !!
Bernie rang to advise not to ring him back.
19/10/95

LOT 3 Loc 2042, 2410, 2411. Michael Doyle
Po Box 5
CAPEL 6271.

LOT 2 Loc 2042 Christopher + Marilyn WITHERS
Po Box 25
CAPEL 6271

LOT 1 Loc 2042 Roger + Noreen LIEBMANN
C/- PO
CAPEL. 6271.

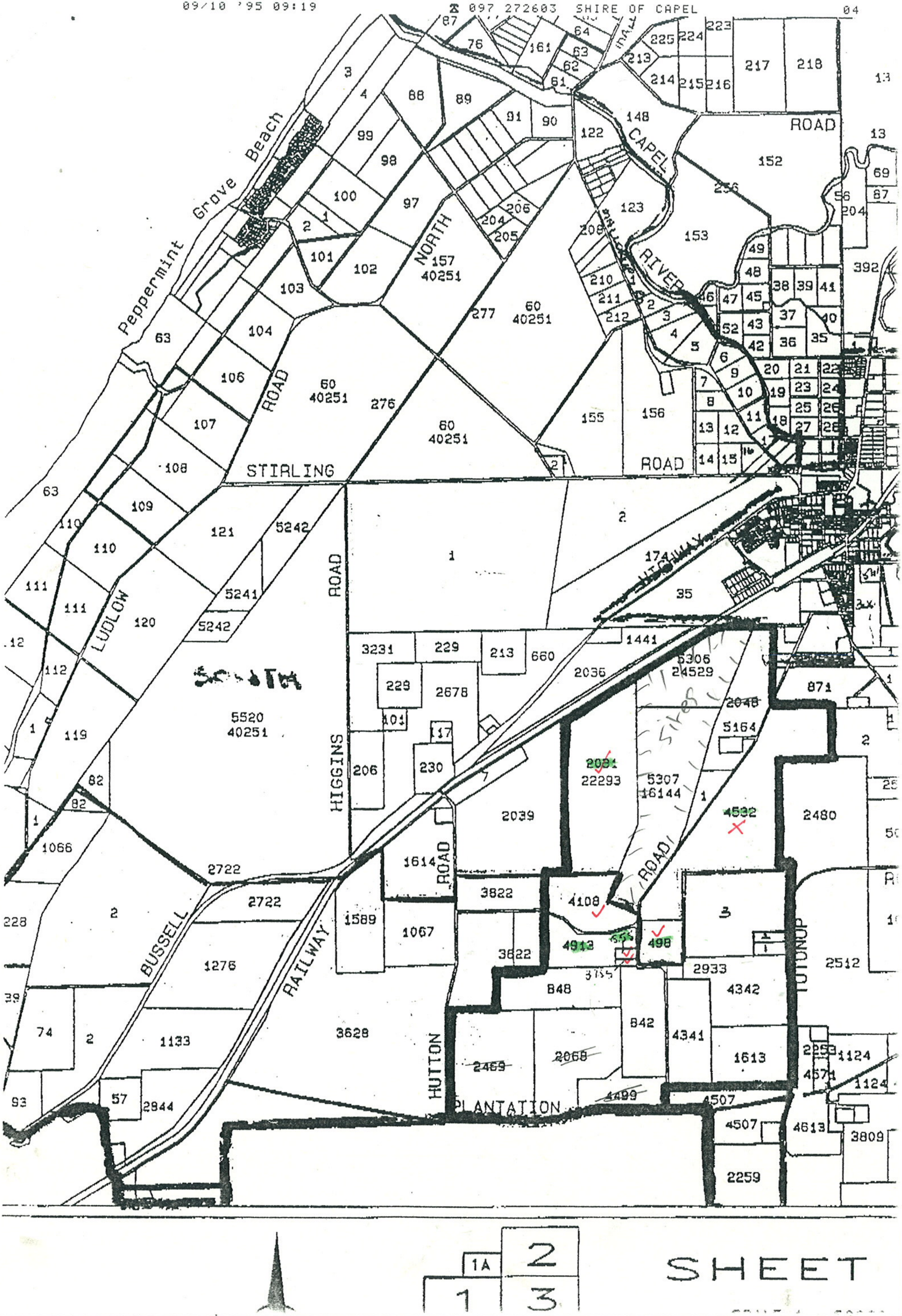
ENVIRONMENTAL & EARTH SCIENCE CONSULTANTS

B K Masters & Associates
P O Box 315
Capel
Western Australia 6271

Phone 097-272 474
Fax 097-272 670

October 10, 1995

Attention: Natalie Kearney
DEP


Peppermint Grove Beach
NORTH ROAD
CAPEL RIVER
STIRLING ROAD
LUDLOW
HIGGINS ROAD
HIGHWAY
BUSSELL
RAILWAY
HUTTON ROAD
PLANTATION
TOTONUP
SHEET
1A
2
1
3

Facsimile Message

Department of Environmental Protection

ATTENTION: ANITA

FROM: NATALIE THORNING (09)

TELEPHONE: 222 7051 **No. of sheets following** 1

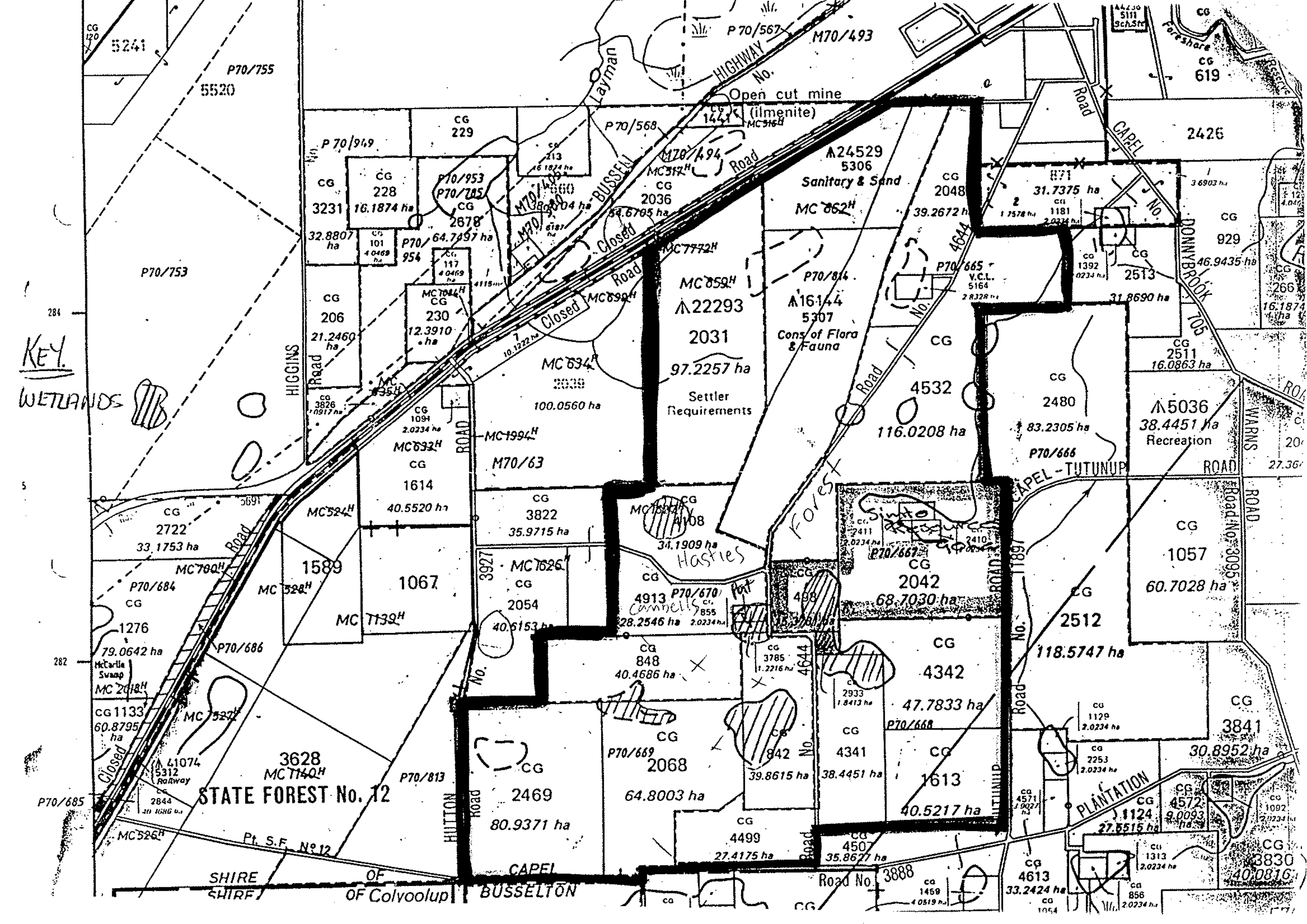
DATE: 3-10-95

MESSAGE

Could you please give me the ownership/vesting of the properties within the thick black line ASAP

Thankyou very much, Natalie.

Westralia Square, 141 St Georges Tce Perth, WA 6000. Fax: (09) 321 5184 Tel: (09) 222 7000



KEY.
WETLANDS
STATE FOREST No. 12
Open cut mine (ilmenite)
HIGHWAY No.
BUSSELL
Layman
Closed Road
Closed
HIGGINS Road
ROAD
Sanitary & Sand
Cons. of Flora & Fauna
Settler Requirements
Recreation
CAPEL - TUTUNUP ROAD
WARNS ROAD
DONNYBROOK 705
CAPEL Road No.
Road No. 3095
PLANTATION
HUTTON Road
Road No. 3888
SHIRE OF CAPEL
SHIRE OF BUSSELTON
OF Colvoolup
Pt. S.F. No 12
McCarlie Swamp
Railway
Forest
Hasties
Cannells
Foreshore Reserve
P70/755
5520
5241
P70/753
P70/949
P70/953
P70/785
P70/954
P70/568
P70/567
M70/493
M70/494
M70/63
MC 634
2039
100.0560 ha
MC 659
22293
2031
97.2257 ha
24529
5306
MC 662
P70/814
16144
5307
4532
116.0208 ha
2480
83.2305 ha
P70/666
5036
38.4451 ha
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848
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4913
228.2546 ha
P70/670
4108
34.1909 ha
3822
35.9715 ha
2054
40.6153 ha
MC 1626
1614
40.5520 ha
MC 632
1589
1067
MC 1139
MC 524
MC 528
3628
MC 1140
P70/813
P70/686
P70/684
MC 700
2722
33.1753 ha
1276
79.0642 ha
1133
60.8795 ha
MC 2018
MC 527
41074
5312
P70/685
MC 526
206
21.2460 ha
230
12.3910 ha
3231
32.8807 ha
228
16.1874 ha
229
2678
64.7497 ha
2036
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2048
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871
31.7375 ha
2513
31.8690 ha
929
46.9435 ha
2511
16.0863 ha
2426
619
P70/665
V.C.L.
5164
3841
30.8952 ha
1124
27.5515 ha
4572
9.0093 ha
3830
40.0816
4613
33.2424 ha
1469
1313
856

meeting at lot 498
Proure Rd
3km from Goodwood Rd
10am - 10-30
other invitations . 2 gate!

ENTERED ON GIS

Name: Draft – Dalungup Integrated Management Plan
Date: 05/05/2006
Capture Author: Thomas Leong / Ian Steward

Comments:
Polygon
Created to match documented study area with high level of accuracy

Accuracy Levels:

- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual and or described spatial references with complex boundaries, resulting in minor boundary errors
- Low = Document contained little or no visual and or described spatial references, resulting in polygon boundary errors

Attributes
Report Info – Captured without problems
Custodial/Contact – Captured without problems
Content – Captured without problems

DRAFT

DALUNGUP INTEGRATED MANAGEMENT PLAN

October 8, 1995

This is a draft document only.

Community input is required before the final plan can be presented to the Capel Land Conservation District Committee for their approval as a land management plan. This will then confer tax deducibility on the management actions recommended in this document plan.

At no stage does this management plan impose legal or other obligations on private landowners, the Shire of Capel or Department of Conservation and Land Management whose land falls within the Dalungup area.

Involvement in this plan is totally voluntary and land owners or managers can withdraw their properties from the plan at any time. Alternatively, they can simply choose not to undertake any or all of the recommended management actions.

However, the management problems within the Dalungup area are more easily and cheaply solved if there is voluntary cooperation between all land owners and managers. This plan suggests the best ways in which cooperative management can solve the area's soil, water and nature conservation problems.

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DALUNGUP INTEGRATED MANAGEMENT PLAN

PREAMBLE

This report encourages private and public landowners to work together on a cooperative basis to better manage land within the Dalungup area which lies immediately south west of the Capel townsite.

The area contains remnant bushland and wetlands of high conservation value, with rare and endangered plants and animals known to be present. Several landowners operate successful farming properties within the area, while other landowners have chosen to live close to nature on smaller blocks that have limited agricultural potential.

To maintain existing values and to improve some values that have been lost or degraded over time, a series of management actions are recommended in this report.

When this draft report has been adequately commented upon by the Dalungup community and other interested parties, it will be formally accepted (with or without modification) by the Capel Land Conservation District Committee. This acceptance will then confer tax deductibility on most (and possibly all) of the recommended management actions, such as fencing of remnant bush, fox and rabbit control and revegetation.

The landowners who have agreed to have their properties included within this study have done so on an entirely voluntary basis. They are under no legal obligation to have their properties remain in the study or to undertake any or all of the recommended actions.

This report should be seen merely as a general first step towards sustainable use of the Dalungup area's wide range of uses. It is a document that will need to change as community and landowner attitudes change and as new information about the area's values and uses comes to hand.

Residents of the Capel Shire are encouraged to join the Capel Land Conservation District Committee and work with other landowners to achieve improved land management within the Shire. Staff at the Shire are able to provide contact names, meeting times and other details.

Residents of the Dalungup area are encouraged to join the Dalungup Area Support Group Inc., whose members have a common goal of better land management for properties and reserves.

1.0 INTRODUCTION

In 1993, several land owners in the Dalungup area, immediately south west of the Capel townsite, sought advice from the Capel Land Conservation District Committee (LCDC) on how best to cooperatively manage their properties.

An application to the National Landcare Program for funding to prepare an integrated management plan for the Dalungup area was successful. Together with financial and moral support from the Shire of Capel, local environmental and geological consultant Bernie Masters of B K Masters and Associates was contracted to prepare the plan.

2.0 WHAT IS INTEGRATED MANAGEMENT

Integrated management of land is defined as a group of landowners and land managers cooperating together in order to implement best management practices on their combined land holdings. While these management practices will vary from area to area, depending on soil, climate, existing land uses and many other factors, the end result is a coordinated effort to protect and enhance the natural, social and economic values of the management area.

For example, integrated management in the wheat and sheep areas of the WA wheatbelt seeks to improve agricultural productivity while protecting soil and water quality and remnants of native vegetation.

In the northern pastoral zone, integrated management seeks to allow the sustainable grazing of stock on native or improved pastures, while controlling feral animals and preventing soil erosion and vegetation decline.

3.0 DEFINITION OF THE DALUNGUP AREA

Figure 1 shows the properties and reserves contained within the Dalungup Integrated Management Plan (DIMP) area. Initial area selection was based upon the desire to have properties on both side of Prowse Road included, but site surveys, willingness of landowners to be involved and drainage connections caused the final boundary to be expanded as shown.

The DIMP area extends from the south west corner of the Capel townsite for about 5.25 kilometres in a south westerly direction. It covers roughly 1,200 hectares or 12 square kilometres. Wetlands cover about 16% of its land surface, while remnant or higher quality regrowth vegetation (including vegetated wetlands) covers about 44% of the area.

Figure 2 is a vertical aerial photograph of the Dalungup area taken in January 1993.

4.0 BENEFITS OF AN INTEGRATED MANAGEMENT PLAN FOR THE DALUNGUP AREA

Integrating the management actions of landowners in a defined area will maximise the effectiveness of those actions.

For example, fox and rabbit control on just one property is unlikely to succeed if adjoining properties are untreated, allowing animals to survive and repopulate the controlled property. Preventing the spread of dieback onto a property being used to grow wildflowers is more difficult if the Shire uses infected gravel to maintain its roads.

Immediate financial benefits will result if an integrated management plan is put into action. For example, a single landowner wishing to add soil conditioning material to hungry sandy soil is unlikely to obtain as competitive a price for transport or spreading as a group of landowners who negotiate for a larger tonnage.

Taxation benefits apply to management plans that have been formally approved by an LCDC. Hence, drainage works to protect groundwater quality, fencing to protect remnant vegetation on erodable or highly leaching soils and weed/feral animal control all gain tax deductibility by virtue of the LCDC's approval of a management plan.

Finally, an integrated management plan opens up communication channels between landowners, land managers, regulatory authorities and other interested parties. In turn, communication allows common problems and solutions to be aired and shared, increasing the likelihood that better management will result.

5.0 METHODS

Consultation between the consultant and the Dalungup Area Support Group Inc., a voluntary association of landowners in the area, provided essential background information to the area and its various problems. The consultant provided a draft timetable and schedule of activities which were discussed and approved.

Discussions were held with Greg Voigt, Operations Officer with the Busselton office of the Department of Conservation and Land Management (CALM). Greg is responsible for preparing interim management plan guidelines. The consultant and members of the Dalungup Area Support Group assisted Greg in September, 1994, in a vertebrate trapping survey of the Capel Nature Reserve.

Each landowner was visited or contacted by phone to seek support for their property to be included in the DIMP study and to gain permission for a site visit to be made. While many landowners were cautious at first, only one declined to be involved in the study. A second landowner purchased a block within the study area in mid-1995 and, when contact was attempted, he was on a month's holiday away from the south west.

Most properties were surveyed in March and April, 1995. However, these initial surveys highlighted the importance of wetlands on certain properties, so further survey work was deferred until September, 1995, when wetlands would contain their maximum water levels and waterbird breeding would be at its peak. Surveys of properties owned by the remaining participating landowners were also completed at this time.

All surveys were carried out by Bernie Masters, many assisted by Lee-Anne Atkinson, a work experience student who was completing an environmental science degree. Lee-Anne carried out the survey of road verge vegetation quality within the DIMP area.

6.0 LAND OWNERSHIP AND EXISTING LAND USES

The following table contains the names of landowners who have voluntarily agreed to participate in the DIMP, together with the principal uses for which those properties or reserves are used:

LOCATION OR RESERVE NUMBER	OWNER as advised by the Shire of Capel	PRINCIPAL EXISTING LAND USES
498	JEFF HARDWICK MARJAN Le FAUCHEUR	PERMACULTURE, SUSTAINABLE AGRICULTURE, RESIDENTIAL
842	JIM & CHERYL CAMPBELL	NATURE CONSERVATION
848	GARY HUTTON	SAND QUARRYING

LOCATION OR RESERVE NUMBER	OWNER as advised by the Shire of Capel	PRINCIPAL EXISTING LAND USES
855	PAT LIGMAN	PLANT NURSERY, NATURE CONSERVATION
871	SUMMERLEA HOLDINGS NOEL GIBSON	AGRICULTURE
1181	GRAHAM & CAROLINE FAGAN	HORSE BREEDING
1392 + 2513, LOT 2	MARK & YVONNE MORRIS	AGRICULTURE
1613	JEAN HAYES	AGRICULTURE
2039	RGC MINERAL SANDS	MINERAL PROCESSING, NATURE CONSERVATION
2048	OVE PHILIPSEN	AGRICULTURE
2054	RGC MINERAL SANDS	AGRICULTURE
2068	V ROGER HUTTON	AGRICULTURE
2410 + 2411, LOT 2	CHRIS WITHERS	RESIDENTIAL
2469	V ROGER HUTTON	AGRICULTURE
2480	CLIVE REID	AGRICULTURE
2933	JEAN HAYES	AGRICULTURE
3785	PAT LIGMAN	NATURE CONSERVATION
3822	RGC MINERAL SANDS	AGRICULTURE
4108	WAYNE & KERYN HASTIE	RESIDENTIAL
4341	JEAN HAYES	AGRICULTURE
4342	JEAN HAYES	AGRICULTURE
4532 LOT 1	WAYNE S SIDEBOTTOM	RESIDENTIAL
4532 LOT 2	B JOE PROWSE	AGRICULTURE
4913	ALGIE HUTTON - CONTACT: JIM & CHERYL CAMPBELL	AGRICULTURE
5164	DOLA	NATURE CONSERVATION
16144	NATIONAL PARKS AND NATURE CONSERVATION AUTHORITY	CONSERVATION OF FLORA AND FAUNA
22293	SHIRE OF CAPEL	SETTLERS REQUIREMENTS
24529	SHIRE OF CAPEL	SANITARY AND SAND
42535	WATER AUTHORITY OF WESTERN AUSTRALIA	WASTEWATER TREATMENT SITE

7.0 DESCRIPTION OF THE DALUNGUP AREA

7.1 Climate

The Dalungup area receives approximately 1000 millimetres of rainfall each year, mostly in the winter months from June to September. Evaporation is approximately 1500 mm per year, giving a net evaporation of about 500 mm annually.

Strong winds come from three principal directions: cool, wet winds from the north west in winter, hot dry winds from the east in summer and cool dry winds from the south west in summer.

7.2 Geology

The study area is within the Swan Coastal Plain, which is the surface expression of the Perth Basin, a sequence of sediments extending to depths of over 8000 metres.

Repeated rises and falls in sea levels over the past two million years have created a subdued topography on the surface of the Swan Coastal Plain. At times, sea level remained stationary, allowing low sand dunes to form behind the fossil beaches. These ancient dunes today form the Bassendean Dune System and are widely distributed throughout the Dalungup area, rising to heights of up to five metres above the otherwise flat coastal plain.

Alluvial clays and silts derived from the Capel River and known as the Guildford Formation are found in places within the Dalungup area. Their exact distribution is unknown, due to large areas being covered by the above-mentioned dune sands or by thin veneers of sand left behind by retreating seas. Generally, they occur in the lowest topographic positions.

Underlying the Dalungup area are thick sequences of sand, silt and clay comprising the Leederville and Yarragadee Formations.

7.3 Soils

Because the surface sediments within the Dalungup area are geologically young (less than 100,000 years old) and annual rainfall has been high, soil development has been relatively minor or has been leached away.

The sides and crests of dunes are sandy, having low clay and nutrient matter contents.

Wetlands tend to have either clay soils, reflecting the presence of underlying alluvial sediments, or black sandy soils rich in organic matter where the leaching effects of rainfall have been offset by the production of high levels of plant material living in the wetlands.

Some large areas have sandy soils and, because of the presence of a shallow winter water table, they are able to support dense wetland vegetation or good quality pasture. Clay and organic matter contents remain low in these soil types.

7.4 Vegetation

The complex pattern of fossil sand dunes and underlying alluvial clays and silts has created a complex vegetation pattern.

Beard (1981) describes the area as being a mosaic of low (<10 m) Banksia trees, medium height (10 - 30 m) eucalypt trees and low Melaleuca species, all providing an incomplete canopy cover of 10 to 30%.

Smith's 1974 vegetation map of the Collie region shows the Dalungup area to contain the following major plant associations:

low open woodland (trees less than 10 m high and with less than 10% foliage cover) of Melaleuca species - mainly in winter-wet depressions, with *M. raphiophylla* as the dominant species

Jarrah-Banksia woodland (trees between 10 and 30 metres high with between 10 and 30% foliage cover) - mainly on lower dunes and on the edges of taller dunes, where the water table is closer to the ground surface in winter

Banksia low open forest (trees under 10 m high with 30 to 70% foliage cover) - mainly on the higher dunes where the water table is several metres deep, even in winter

Field surveys showed that Spearwood *Kunzea ericifolia* was the dominant species throughout much of the privately owned bushland, with Banksia and eucalypts widely scattered and only uncommonly forming more dense stands.

More detailed descriptions of the vegetation associations found on each of the surveyed properties is given in section 8.0.

Advice from the Department of CALM and local landowners confirms that declared rare flora exists on both public and private land within the DIMP area.

Terms used to describe the structural classes of different vegetation types within the DIMP area are taken from Smith (1973) and are contained in appendix 1.

Figure 3 shows the general extent of remnant vegetation, including vegetated wetlands, within the DIMP area.

7.5 Fauna

Trapping by CALM has shown the presence of at least one rare marsupial, the Southern Brown Bandicoot or Quenda *Isoodon obesulus* sub-species *fusciventer*. Although generally considered to prefer dense vegetation along the edges of wetlands, this is often the only remaining vegetation left in which the species can survive. Its preferred habitat is dense dryland vegetation and this is common throughout the Capel Nature Reserve, both Shire reserves and some private properties. As a result, the Quenda is both common and widely distributed through the DIMP area.

The Western Brush Wallaby *Macropus irma* has been reported from the Capel Nature Reserve and adjoining properties, and one was seen during surveys for this project. Although not officially listed as rare or endangered, its range has declined significantly in recent years and it is now uncommon in the more settled parts of the south west.

All other vertebrate species seen during the survey are common and do not have special conservation significance. However, the diversity of bird

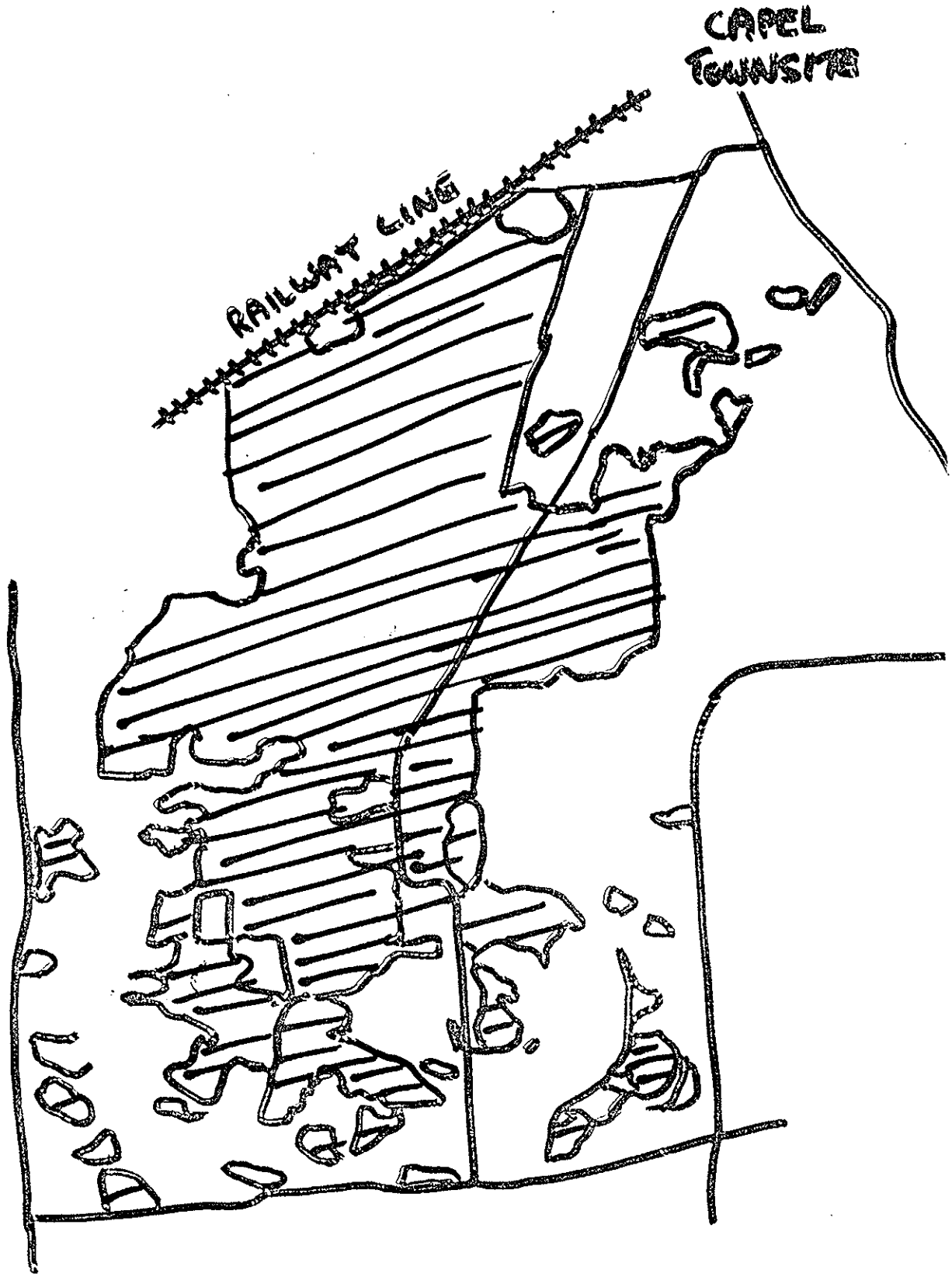

FIGURE 3
REMNANT VEGETATION

species, both bush birds and waterbirds, is high, adding to the overall conservation value of the higher quality bushland areas.

Rabbits were abundant through the entire DIMP area, with some areas of privately owned bushland devoid of young plants because of rabbit browsing. Foxes were not seen but were widely reported and are certain to be common.

7.6 Hydrology

7.6.1 Surface and Ground Water

No well defined streams or other watercourses flow through the Dalungup area. In wet winters, water flows through drains and broad wetland areas to the Capel and Ludlow Rivers.

Water entering the Dalungup area comes from two sources: rainfall, and groundwater moving upward from the underlying Leederville Formation.

Rain quickly soaks into the sandy soils of the Bassendean Dune System, where it forms the shallow groundwater. The lack of clay in the Bassendean sand means that water also flows rapidly sideways (laterally) out of the sand bodies, which explains why many farm dams are on the edges of larger sand hills.

Where rain falls onto clay-rich low lying alluvial soils, it accumulates to form a winter wetland, which also receive water from rain that has fallen into surrounding sandy areas and from which water moves sideways.

When these wetlands fill, overland flow occurs via natural drainage lines or along man-made drains. A small amount of water soaks deeper into the ground, replenishing the underlying groundwater aquifers within the Guildford and possibly the Leederville Formations.

Much rainfall returns to the atmosphere through direct evaporation from the surface of wetlands or by transpiration of plants.

Water quality was not analysed as part of the DIMP study. However, subjective assessments of water quality could be made visually (the presence of algae or other undesirable features) and by taste.

Figure 4 shows the extent of well defined wetlands within the DIMP area.

In 1992, the Environmental Protection Authority produced a draft Environmental Protection Policy for Lakes on the Swan Coastal Plain. Although containing many omissions and low conservation wetlands, the policy conferred protection to the wetlands shown in figure 5. Interference to these wetlands without prior approval of the EPA is not allowed.

7.6.2 Water Quality

Generally, water quality within the DIMP area is high, with low salinity and nutrient levels. Only on one property was excessive algal growth seen and this was likely to have been caused by high levels of nutrients released during a recent fire, not by excessive application of phosphorus-based fertiliser.

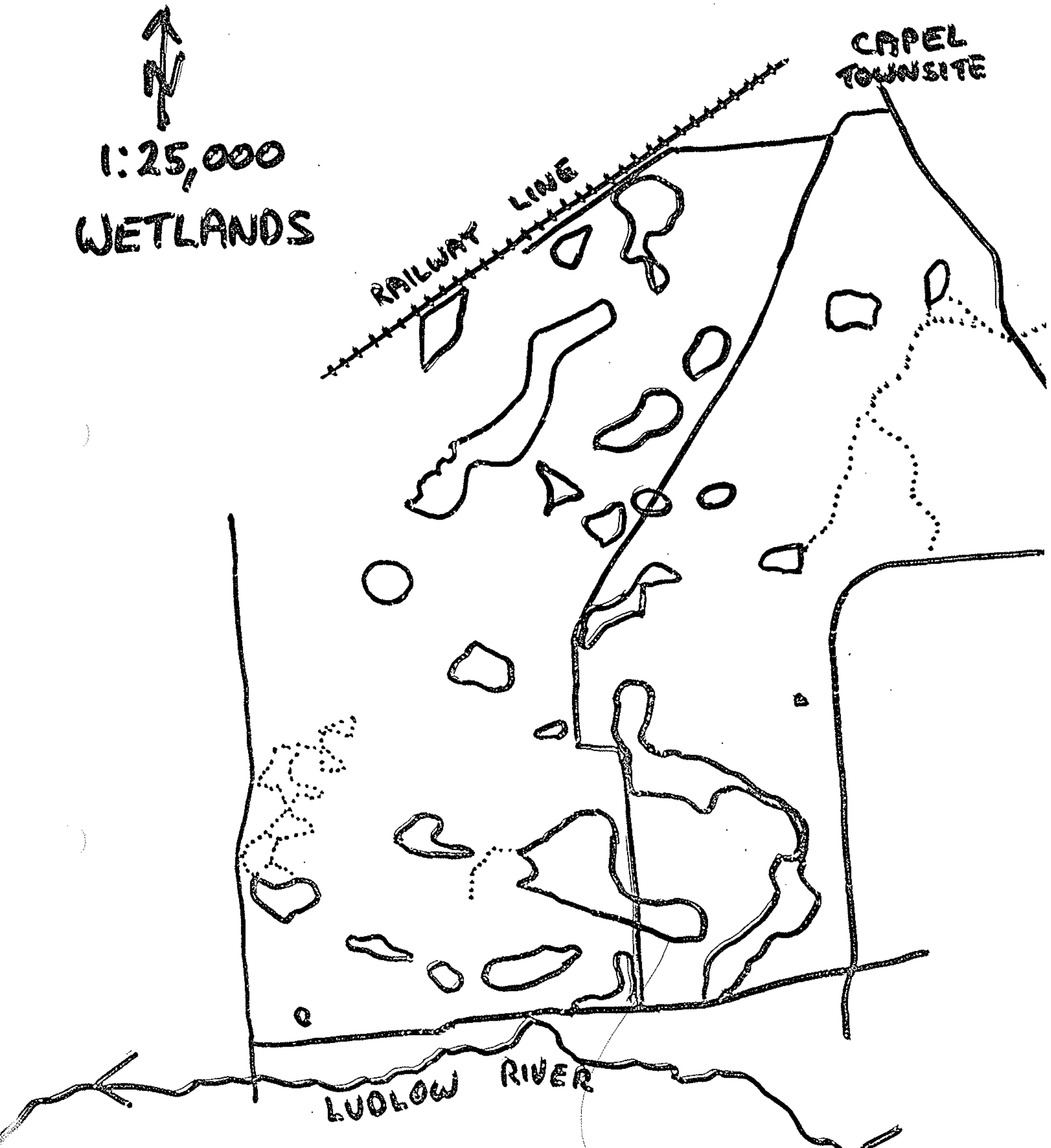
N
1:25,000
WETLANDS
RAILWAY LINE
CAPEL TOWNSITE
LUDLOW RIVER
D Boundary
disagrees with

FIGURE 4

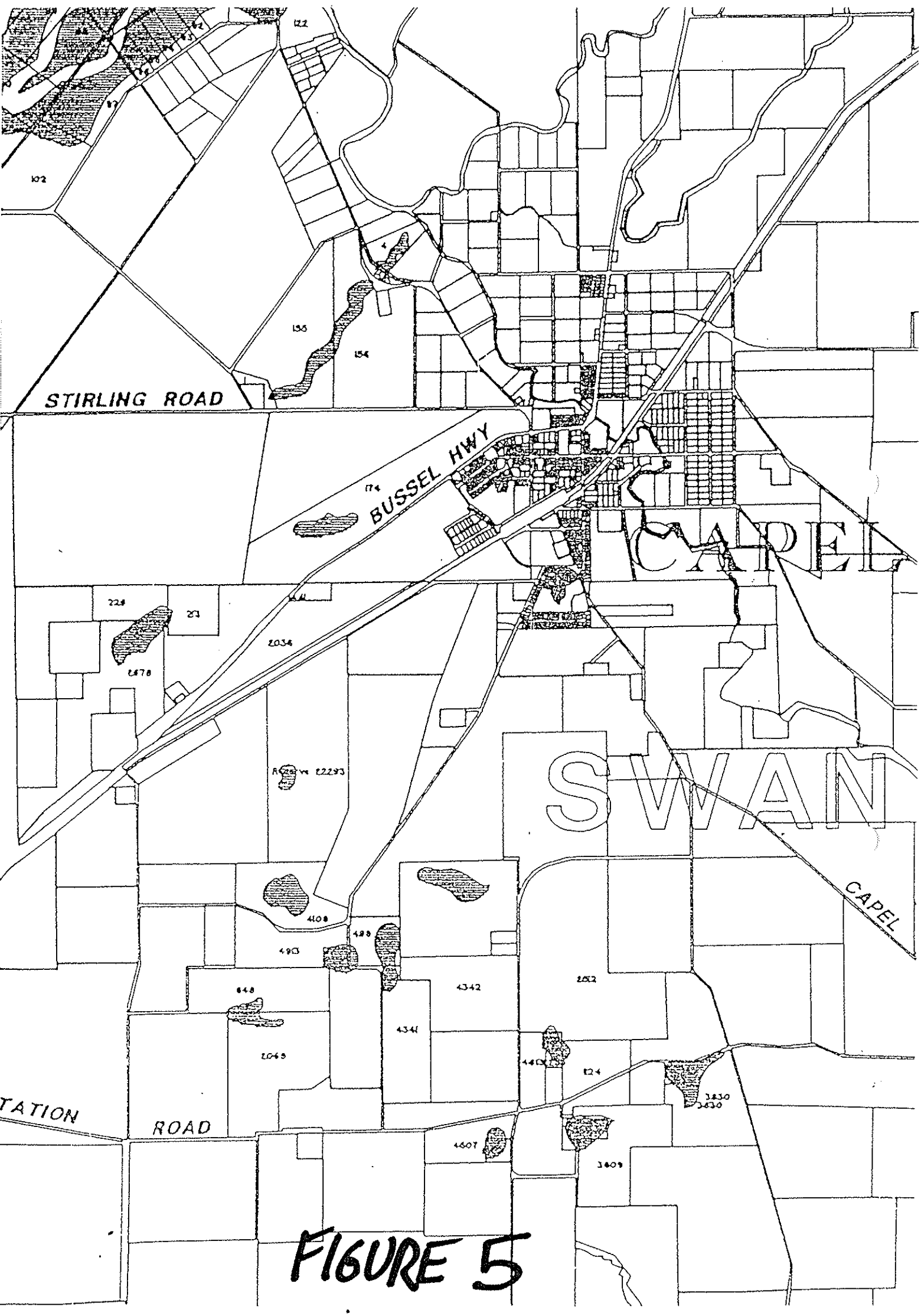

FIGURE 5

However, salinity is a significant potential problem. Regional investigations carried out by the Geological Survey of WA (Hirschberg 1989) show that most groundwater within the lowermost sections of the surface sands and clays has a salinity of between 1400 and 1700 milligrams per litre (parts per million), as shown in figure 6.

In the Busselton area (eg., the Cutbush/Hopkins properties near Four Mile Hill), excessive drainage of fresh water from low lying areas over winter and spring has prevented high quality water from soaking into the ground and pushing down the more saline layer at depth. In turn, this has allowed the saline layer to slowly rise through the underlying sediments.

In time, this process is likely to occur within the DIMP area and salt will be brought to the surface of susceptible areas.

7.7 Agriculture

Most agricultural activities relate to the breeding and fattening of cattle. Winter and spring rainfall is used to grow pastures for direct feeding of cattle or for hay and silage production for feeding over the summer and autumn months.

Most remnant vegetation provides little if any natural feed for stock, although many remnants provide stock shade and shelter.

Where clearing has occurred, the higher areas of sandy soils produce poor pasture growth due to the low nutrient- and moisture-retention capacity of the white, deep sands. Where these sands occur close to the winter water table, pasture growth provides good stock grazing and hay production.

Cleared wetlands that carry open water over winter sustain reasonable pasture growth around their outer edges and some summer grazing within the wetland, once surface water has disappeared.

Two properties are used for horse breeding or grazing, while several owners grow vegetables and raise chickens and other produce, mainly for their own personal consumption.

7.8 Industry

RGC Mineral Sands (WA) Ltd have used the north western corner of the DIMP area for mineral processing since 1957. It is an industrial site which has been cleared of most original vegetation and now contains a wide variety of facilities to service the company's mining and mineral processing needs.

A sand quarry operates on location 848, affecting a larger area than is shown on the aerial photograph of the DIMP area (see figure 2).

Most of the DIMP area is held under exploration or mining title by companies that are searching for mineral sand deposits.

The mineral processing site in the northwest corner of the DIMP area is covered by a Mining Act tenement, Mining Lease number 70/63 held in the name of Western Titanium Limited, a company owned by RGC Mineral Sands Ltd.

ML 70/659 covers Settler Requirements Reserve No. 22293 while ML 70/767 covers almost all of the private land within the DIMP area, both tenements being held by RGC.

Exploration License 70/1427 has been sought by Melita Mining N.L. over most of the private land within the DIMP area but it is still at the application stage.

Under the Mining Act, private land that is being used for a productive purpose cannot be mined or explored except with the explicit permission of the landowner. Where private land is covered in bush and not used for a productive purpose, explicit landowner permission is still required before mining can proceed within a 100 metre radius of any improvement (which includes any house, track, fence, water supply, etc).

7.9 Community Services

A sewage treatment facility is operated by the WA Water Authority on the northern edge of reserve 22293, under lease from the Shire of Capel. Although only a temporary facility, it may be expanded to at least twice its capacity as the Capel townsite grows.

The Shire of Capel operates a refuse disposal facility and sand quarry in the north eastern corner of reserve 24529. At present, the tip does not meet Division of Waste Management requirements for rural areas and the Shire is proposing to dispose of domestic, putrescible and similar refuse at the Boyanup tip which is in the process of being upgraded. However, sand extraction and disposal of inert materials will continue at the existing Capel site for some years.

(1)

8.0 GENERAL DESCRIPTION OF EACH PROPERTY

MARIAN

Location 498 - Geoff Hardwick and Marjan le Faucheur) 17/9/85

This 15.4 hectare property contains regrowth vegetation, except within Little Dalungup Swamp where clearing for potato growing occurred several decades ago.

Significant bushland clearing occurred more than 20 years ago but the current owners have allowed vegetation to regrow while they operate a permaculture farm on the western side of the wetland.

Dryland vegetation is dominated by Spearwood, WA Peppermint *Agonis flexuosa*, Narrow-leafed Banksia *Banksia attentuata* and Holly-leaf Banksia *B. ilicifolia* low woodland, with some areas carrying Jarrah *Eucalyptus marginata* and Marri *E. calophylla*. Understorey is reasonably diverse and dense, with a large patch of Orange Stars *Hibbertia stellaris* along the southern boundary. The Hammer Orchid *Drakea elastica*, a declared rare plant (also known as the Glossy Hammer Orchid), is reported by the owners to occur, along with up to 40 other species of orchid. Confirmed by Peter Lambert

Closed scrub occurs along the western edge of Little Dalungup Swamp. Species were not identified but probably include *Agonis linearifolia*, *Melaleuca thymoides* and *M. teretifolia*, with occasional emergent paperbarks *M. raphiophylla* or *M. preissiana*. Vegetation within the wetland itself is dominated by introduced grasses and herbs.

The owners report the presence of Western Brush Wallaby, while the Western Grey Kangaroo *Macropus fuliginosus* is common throughout the DIMP area, including this property. Diggings possibly made by the Quenda were noted, with suitable habitat for this species present in the south western corner of the property.

Also Frankland Area Western

The owners have been advised by long-time residents of the area that a wooden paling fence around Little Dalungup Swamp was erected to exclude large numbers of Quokka *Setonix brachyurus* from potato crops, but this species has not been seen for many years and is certain to be locally extinct.

Rabbits *Oryctolagus cuniculus* are abundant and widespread.

When surveyed on September 11, 1995, birdlife on Little Dalungup Swamp was abundant, with over 100 birds present. The following species were seen:

- Australian Shelduck with ducklings
- Grey Teal
- White-eyed Duck
- Blue-billed Duck
- Black Duck
- Black Swan
- Coot
- Musk Duck
- Hoary-headed Grebe

The Western Swamp Hen has been reported by the owners, while several species of unidentified passerines were heard calling in fringing Melaleuca heath.

The owners have created several islands for waterfowl breeding within the wetland. These have been used successfully in past years, but were flooded in the middle of the 1995 winter owing to an average rainfall occurring this year.

The owners have produced a permaculture plan for the property, retaining most dryland vegetation for nature conservation and sustainable uses such as seed collecting and firewood for personal use.

(2) Location 842 - Jim & Cheryl Campbell 17/10/95

Remnant bushland in the north west and south west sections of this property is typical of most dryland vegetation within the DIMP area. An open forest of Bull Banksia *Banksia grandis*, Narrow-leaf and Holly-leaf Banksia, Marri, Spearwood and WA Christmas Tree *Nuytsia floribunda* contains a relatively sparse understorey. The overstorey species appear to be over-mature, with many dead standing specimens and much fallen branches. (not so)

Understorey is only moderately diverse, with common species including Prickly Moses *Acacia pulchella* and several members of the Myrtaceae family.

Most vegetation fringing the wetland has been cleared but some paperbark trees remain.

The wetland is known as Dalungup Swamp and was cleared for agriculture many years ago. Only scattered paperbarks to five metres and unidentified aquatic plants remain from the original vegetation cover.

Faunal use of the remnant bushland is likely to be relatively low, with common birds and reptiles and Grey Kangaroos being the most frequent users. Birds using Dalungup Swamp during the September visit were limited to a family of Australian Shelducks (2 adults feeding on the edge of the wetland and 8 ducklings in the northern dam), two Black Ducks and one Large Egret.

The owners intend to use the property for a mixture of nature conservation and productive farming (primarily stock grazing) activities.

Aponogeton hexatepalus recorded from here, Specimens Eleocharis, Potamogeton and Marsilea from wetland!

Clay based pub, 17/10/95 Knee deep middle.

[illegible] precipitated clearing by grandfather.

Location 848 - Garry Hutton

Most of this property contains low open forest similar to adjoining land as described above. Understorey is sparse and lacking diversity, while the overstorey appears to be over-mature (see photo 1).

A sand pit has removed most original vegetation in the western half of the block, with recent quarrying having affected a larger area than is shown on the aerial photograph (figure 2) which was taken in January 1993. Only a small amount of revegetation has occurred within worked-out sections of the sand quarry to date.

West of the sandpit, the quality of the remnant bushland improves, with the low open Banksia forest containing a reasonably diverse understorey.

The central southern part of location 848 contains part of a wetland that was cleared of original vegetation many years ago but where regrowth is now occurring. Vegetation is dominated by members of the Myrtaceae family, mostly to about three metres height and forming a open to closed scrub.

The western portion of this wetland carries water up to one metre deep where sedges and similar plants have only partly recolonised.

The dryland component of this property probably has minimal faunal conservation values in its current state, while the wetland provides only limited habitat for waterbirds. The September 1995 visit showed the presence of three White-eyed Ducks, although usage during late spring and early summer before surface water disappears is expected to be moderately high.

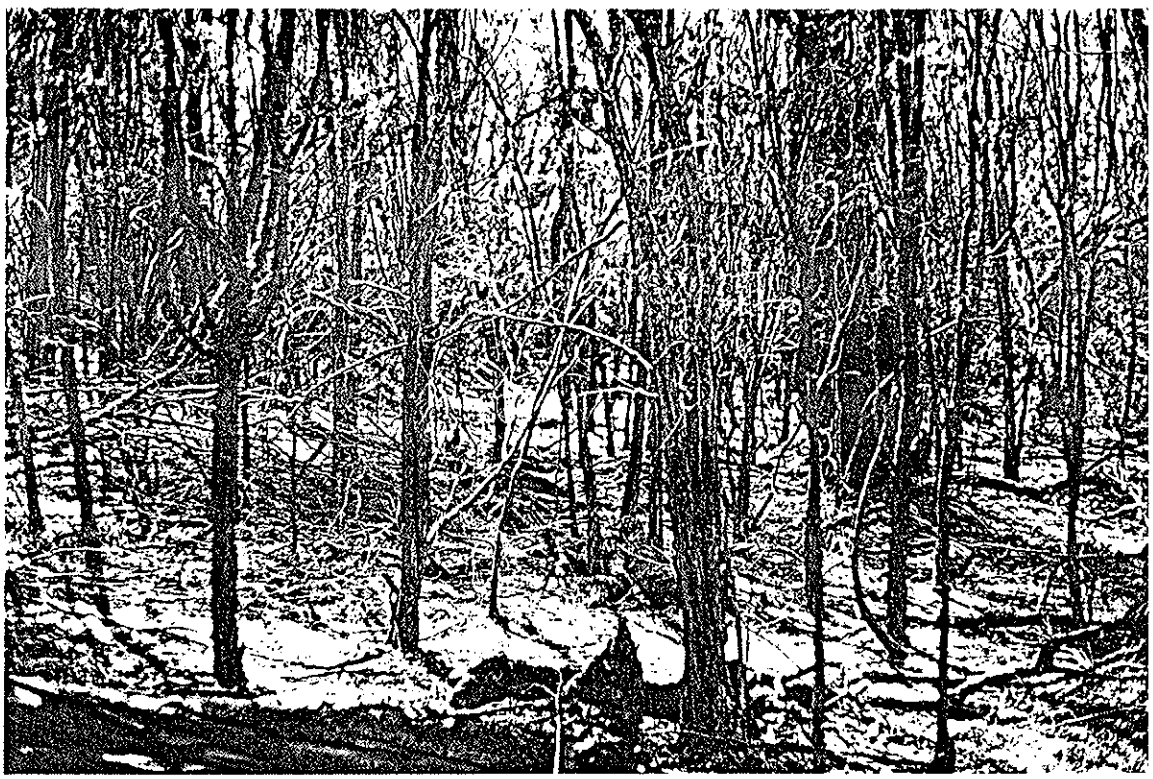

PHOTO 1 - Closed Spearwood scrub on location 848 but commonly found throughout the Dalungup area, showing lack of understorey and over-mature upper-storey.

Locations 855 and 3785 - Pat Ligman

Both blocks are low-lying, with location 855 having been partially cleared in the past, probably for potato growing. Location 3785 retains its original cover of low closed forest of Paperbark trees, probably *Melaleuca raphiophylla*, with very little understorey or aquatic plants.

Location 855 is mostly cleared, with some Flooded Gum *Eucalyptus rudis* along its eastern boundary and Paperbark trees in the centre of its northern boundary.

Location 855 contains sheds and greenhouses for propagation of native plants, while location 3785 is undeveloped apart from boundary fences.

A site visit in September 1995 showed the presence of small numbers of waterfowl, including Black Duck, Grey Teal, Coot and Musk Duck. The owner has reported the presence of Black Swan and Nankeen Night Heron, as well as Grey Teal ducklings.

Location 871 - Summerlea Holdings (Noel and Joy Gibson)

This mostly cleared block directly adjoins urban development within the Capel townsite.

The property retains four remnants of original dryland vegetation. In the south west, low woodland to low open forest of Spearwood, Narrow-leaf Banksia and Holly-leaf Banksia has a moderately sparse understorey without high species diversity. Paperbark trees are present but uncommon. The Jarrah root-rot fungus *Phytophthora cinnamomi* or Jarrah dieback is present in several places, as shown by extensive deaths of susceptible species such as Banksia.

West of the southern half of Howley Road is a low open forest of mostly over-mature Spearwood, with little understorey.

West of the northern end of Howley Road and along most of the eastern side of the road is a low closed forest of WA Peppermint. Apart from Bracken *Pteridium esculentum* and introduced pasture species and grasses, understorey diversity is low.

The remainder of the block west of Howley Road is cleared and pastured, but the poor quality sandy soils and elevation above water table creates a low agricultural productivity. East of Howley Road, the winter water table is high, with up to 30 cm of surface water present for several months. Although the soils are sandy, their productivity is moderately high due to the presence of high moisture levels until late spring or early summer.

An adjoining landowner has reported the presence of Ring-tailed Possums in the Peppermint forests adjoining Howley Road. This animal is officially classified as endangered and its normal habitat is Peppermint woodland or forest.

Location 1181 - Graham and Caroline Fagan

This property is mostly cleared, with several large remnant Peppermint trees along the north and west boundaries.

The south east section of the property contains part of a more extensive wetland that falls mostly within locations 1392 and 2513 to the south. A moderately diverse bird fauna was noted, comprising:

Black Duck
Australian Shelduck and ducklings
Black Swan
White-faced Heron
Little Black Cormorant
Little Pied Cormorant
Grey Teal

Mrs Fagan has also reported the presence of Yellow-billed Spoonbill, Large Egret, Ibis and an unidentified raptor eating young waterbirds in past years.

7

Locations 1392 and 2513 (Lot 2) - Mark and Yvonne Morris

This flat, low-lying property is mostly cleared of original vegetation, having one small remnant in its north west corner. Here, WA Peppermints along the crest of a sand ridge give way to a moderately dense cover of medium to large Paperbarks trees and lesser numbers of Flooded Gums. Many Paperbark trees were dead, but numerous smaller specimens were healthy and vigorous. Understorey is dominated by introduced grasses.

Large numbers of Grey Kangaroos use this patch of trees for shelter. During the April 1995 survey, up to 40 Wood Duck and one White-faced Heron were using the dam adjoining the remnant bush. Waterbirds seen during the September survey have been listed in the preceding property description.

The property has several efficient drains removing most winter rainfall from its flay-lying sections, including water flowing from properties to the south. Even so, surface water was generally present to a depth of up to 30 cm. The owners use the property for stock grazing and hay production.

8

Locations 1613, 2933, 4341 and 4342 - Jean Hayes

These four properties lie east of Prowse Road and west of Tutunup Road. Although mostly cleared in the past, the owners are allowing some elevated sandy areas to regrow, primarily because of the low agricultural productivity of the sandy soils.

In most places, the arcuate wetland is densely vegetated to two metres height with several members of the Myrtaceae family, including *Melaleuca teretifolia, M. laterita* and at least two species of sedge, with some large Paperbark trees along the wetland edges.

On drier sandy soils close to the wetlands, large Paperbarks to 12 metres are interspersed amongst WA Peppermints, Christmas Trees and Spearwood, with a diverse and often dense understorey that includes Blackboys and Hakea species. Large Marri trees are common in the south east corner of site, with some Jarrah and Woody Pear *Xylomelum occidentale* in remnants near the north east corner. Narrow-leaf and Bull Banksia are common in the bushland remnant along the western side of the area.

Some evidence for the presence of dieback was noted, although the expected large numbers of dead banksia and other susceptible species was absent.

Grey Kangaroos use the remnant bushland in moderate numbers, although most other vertebrate species probably occur in only moderate numbers. A brief sighting of what was believed to be a Western Brush Wallaby was made. Elegant Parrots were disturbed while feeding on seeds lying on the floor of the dry scrub-covered wetland during the April survey.

The September 1995 survey showed that the wetlands were generally too dense for waterbird use, although small numbers of Black Duck, Grey Teal and Musk

Duck were seen. However, water quality was high, with many tadpoles and small frogs observed.

Locations 2039, 2054 and 3822 - RGC Mineral Sands Pty Ltd

Most of location 2039 has been developed for mineral processing facilities. However, the south east corner contains most of its original vegetation and this has been included within the DIMP study.

Dryland vegetation within location 2039 consists of low open forest of Spearwood, various Banksia trees and Jarrah. In places, the understorey is patchy, possibly due to rabbit grazing, fire and/or the presence of dieback. However, some sections are dense and contain a moderately high diversity of species.

The circular wetland contains closed scrub containing several members of the Myrtaceae family, including Melaleuca and Agonis shrubs. Emergent Paperbark trees are common, reaching heights of 6 to 8 metres.

Location 3822 contains a central patch of high quality remnant vegetation similar to that on location 2039 to the north. However, the eastern third of the property is poor quality regrowth, suffering from heavy rabbit grazing pressure and dieback.

Location 2054 has been largely developed for agriculture, with remnant bushland of Jarrah, Marri, WA Christmas Tree, Banksia, Spearwood and Woody Pear having a sparse natural understorey with some pasture grass invasion.

Significant faunal use of RGC's properties is likely to be restricted to location 2039 and the central part of location 3822. Around the wetland on location 2039, suitable habitat for, and evidence of diggings by the Quenda was widespread.

Location 2048 - Ove Philipsen

This property has been parkland-cleared to form an open woodland of Jarrah, Marri, Bull Banksia and WA Peppermint. Snottygobbles *Persoonia longifolia* are scattered throughout.

Understorey is mostly pasture species but, in places, there is excellent one or two year old regrowth (see photo 2), with Grevillea sp., Blue Boy *Stirlingia latifolia*, Blackboys, members of the Fabaceae family and Marri.

The wetland in the south west corner contains closed heath of several members of the Myrtaceae, with several emergent Paperbark trees.

The wetland that is mainly contained within location 5164 is described below.

Locations 2068 and 2469 - V R (Roger) Hutton

Most of the remnant bushland patches on these two properties is low closed Spearwood forest similar to that described for location 848. Heavy rabbit and stock grazing and the lack of fire have prevented understorey regrowth.

However, some remnants are in better health than others. The small patch in the extreme south west corner of location 2068 contains half a dozen large, old Marri trees which provide nesting hollows and large amounts of nectar when in flower. Large number of Marri seedlings are successfully growing through the understorey cover of pasture plants.

PHOTO 2 - Excellent quality regrowth after fire beneath parkland cleared Jarrah and Marri on location 2048.

Similarly, the three remnants in the south west part of location 2469 have a larger variety of tree species than most other bush patches, including WA Christmas Tree, Bull Banksia, Marri, WA Peppermint, Narrow-leaf Banksia, Snottygobble, Jarrah, Spearwood and Woody Pear.

Several different types of wetland are present. Along the northern boundary of location 2068 is part of the open to closed scrub wetland extending south from location 848.

The large wetland in the northern section of location 2469 contains a fringe of Paperbarks, Marri, Jarrah and WA Christmas Trees, although the wetland itself is dominated by introduced pasture grasses. The owner advises that this wetland provides winter feed around its outer edge and summer feed from couch grass growing within the dried-out wetland.

An elongated wetland in the central eastern part of location 2469 contains a diverse mixture of overstorey species, including 2 species of Paperbarks, WA Peppermint, Marri and WA Christmas Trees above a moderately diverse understorey of Myrtaceae scrub. Cattle are removing bark from many of the Paperbark trees (see photo 3).

Western Grey Kangaroos and common bush birds are likely to be the fauna most frequently using the remnant bush areas within these two properties. The elongated wetland on location 2068 contains suitable habitat for Ring-tailed Possums, although no evidence of their presence was seen.

The September 1995 survey of the large wetland on location 2469 showed that a reasonable variety of birds were using it:

Little Pied Cormorant	Grey Teal
Black Duck	White Ibis
Yellow-billed Spoonbill	Great Egret

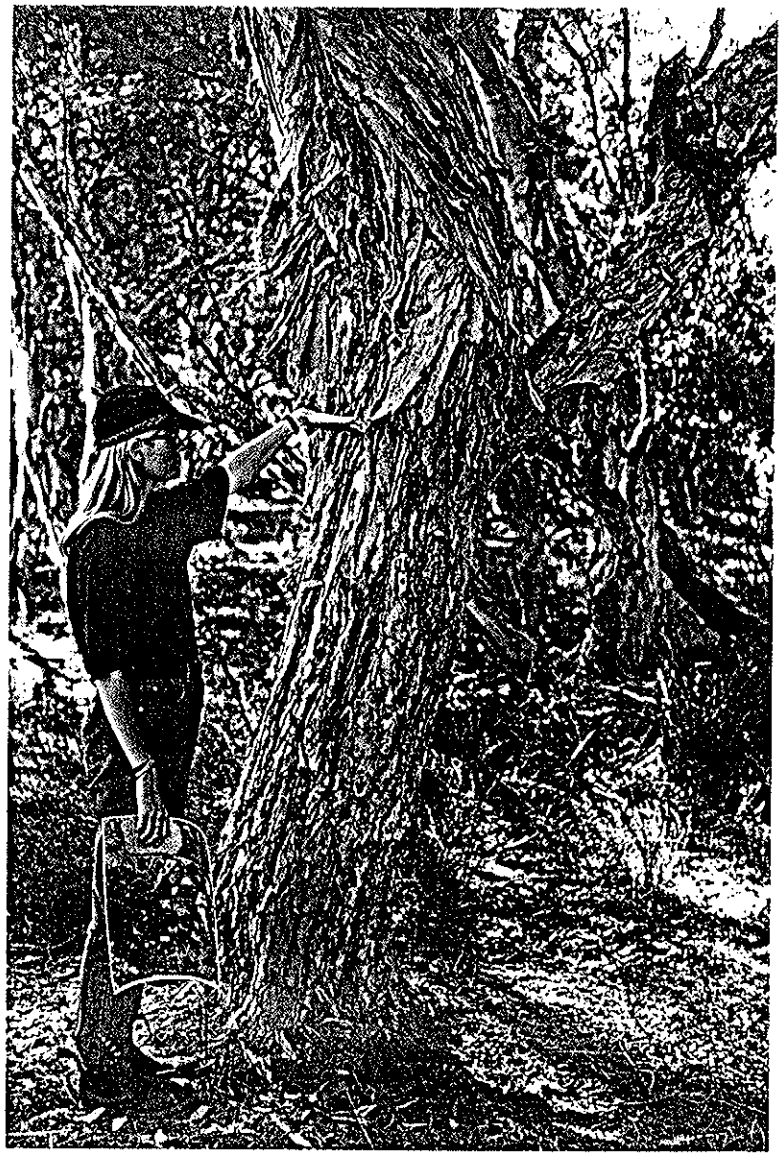

PHOTO 3 - Bark removed from a large Paperbark by cattle on location 2469.

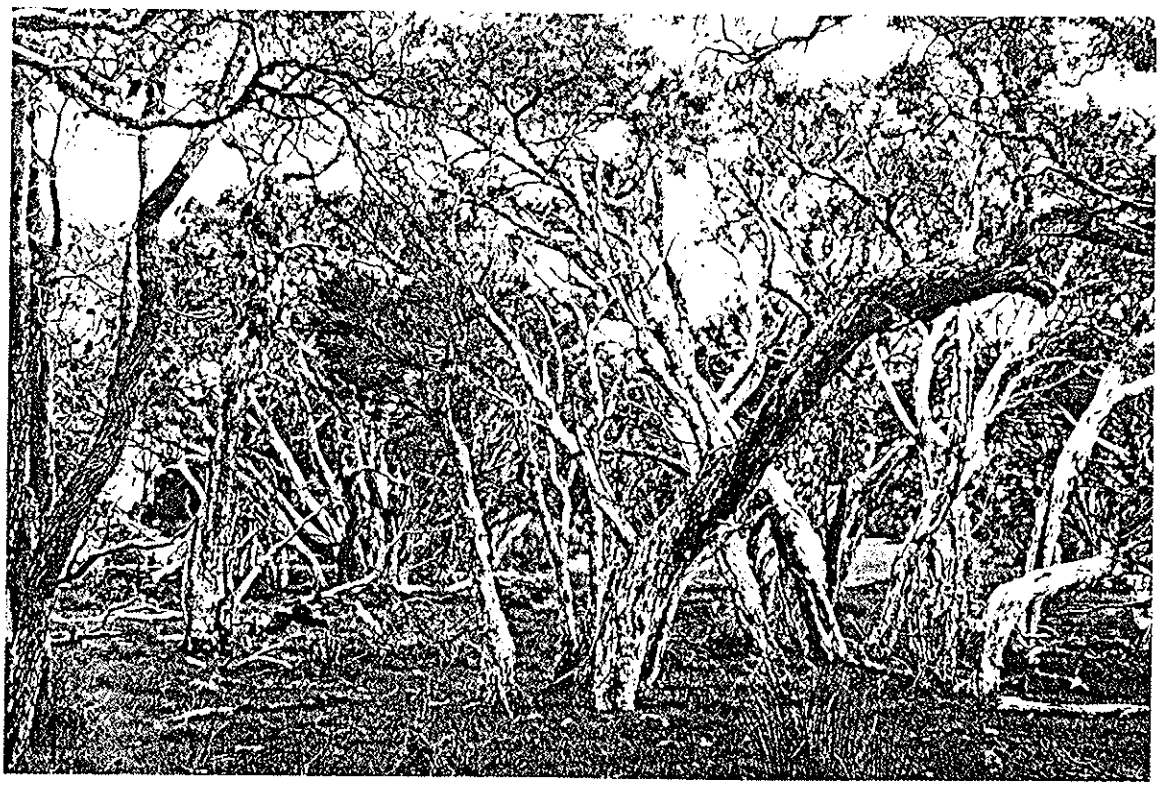

PHOTO 4 - Paperbarks trees on the north side of the large wetland on location 2469, in which cormorants nest.

Of some importance were the nests, probably made by cormorants, found in Paperbark trees on the north side of the wetland (see photo 4). A shallow, pastured wetland in the extreme south west corner of location 2469 was seen to be used by a pair of Australasian Shelduck with eight ducklings.

12

Location 2410 and 2411, Lot 2 - Chris Withers

This 2.02 hectare property is used as a rural residential block. It is mostly covered by a low woodland of Jarrah and Banksia, with a moderately diverse and high quality understorey. Several large, old Jarrah trees are likely to provide useful nesting hollows for birds and mammals such as Brush-tailed Possum and bats.

Some evidence of dieback was seen, although this was not conclusive.

The wetland in the south west corner of the property carried about 0.5 metres of water but was devoid of birdlife, probably due to a lack of fringing vegetation which would have provided shade and shelter. However, a moderate waterbird usage is expected if water is retained within the wetland during spring and early summer.

13

Location 2480 - Clive Reid

Apart from several small areas of remnant vegetation along its western boundary, this farming property is cleared and pastured, with only scattered Paperbark trees and eucalypts.

The dryland remnant in the north west corner is typical Spearwood, Banksia low open forest, with many dead Narrow-leaf Banksia but also many very large specimens. WA Peppermint and Jarrah occur on the higher parts of this remnant, but several of the eucalypts are dead, indicating the possible presence of dieback.

Understorey density and diversity are low, probably due to a combination of lack of fire and grazing pressure by rabbits and stock.

The wetland vegetation patch adjoining this dryland bush is a closed scrubland, consisting of members of the Myrtaceae family, in places with an open forest of Paperbark trees.

An open forest of WA Peppermints occurs downslope and to the east. Individual trees reach up to 14 metres in height. Elsewhere, small remnants of Marri, WA Christmas Trees, WA Peppermints and Paperbarks are found.

The September 1995 survey showed Black Duck and Wood Duck, both with ducklings, using the open wetlands on the western side of low-lying pasture. However, within the central pastured sections, over 40 Black Duck and 60 Australian Shelduck were foraging for food, along with small numbers of Wood Duck.

The open forest of WA Peppermints provides good habitat for Ring-tailed Possums, but no evidence of their presence was seen.

Photo 5 shows a typical clump of older trees growing as an isolated stand above pasture.

Location 4108 - Wayne and Keryn Hastie

This property retains much of its original vegetation cover, with the owners using it primarily for residential purposes. The potential to build a small number of rental chalets or similar has been considered in the past.

In uncleared areas, Banksia and WA Christmas Trees form a low open forest, with moderately diverse and dense understorey. Some cleared areas are regrowing, with moderately high diversity and density. Some very large, majestic Jarrah trees have been retained and these have high value for nesting by birds and animals.

The declared rare Hammer Orchid *Drakea elastica* is relatively common on this property.

Dieback is present immediately north of the house.

Cleared areas that have been sown to pasture have very poor quality sandy soils, resulting in a low agricultural productivity.

The central wetland contains several Myrtaceae species which form a closed scrub to 4 metres. Paperbark trees emerge from the dense scrub, mainly in the shallower sections of the wetland.

Large numbers of Western Brush Wallabies have been seen on this property, while Western Grey Kangaroos are common. A flock of at least 14 Elegant Parrots was seen during the March 1995 survey. No waterbirds were seen, although the owners report several species of waterfowl using the partly cleared western section of their wetland.

The owners have expressed concern about the bushfire risk on this property, especially since it adjoins the Capel Nature Reserve for which no fire plan has yet been prepared.

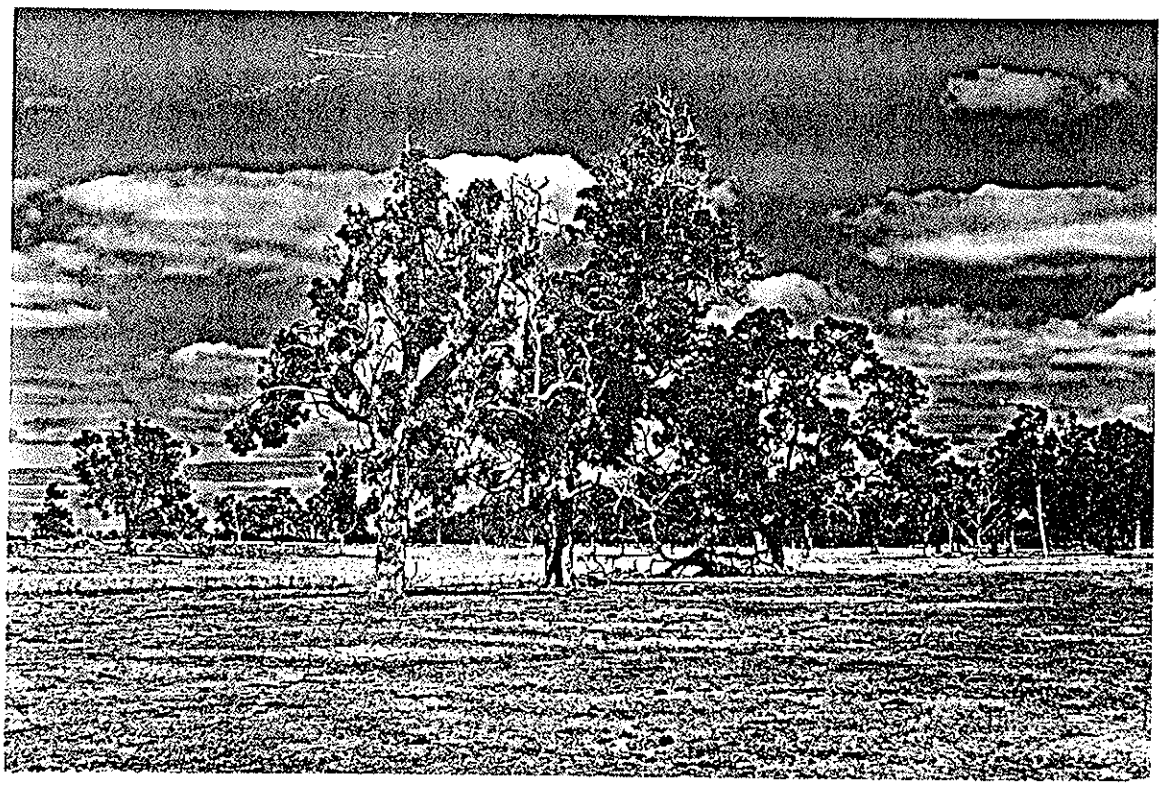

PHOTO 5 - These large, old Marri trees are reaching the end of their lives. They provide useful shade, shelter and wildlife habitats but have no seedlings underneath to replace them when they die.

Location 4532, Lot 1 – Wayne Sidebottom

The owner of this property is building a house and the property will eventually be used for residential purposes.

The central dryland is open woodland of Banksia and WA Peppermint, with a Spearwood understorey to 3.0 metres. Species diversity and density is relatively low, with large areas of bare sand showing that topsoil development has been poor.

Dieback is present along the south and east sections of the property.

The northern wetland contains a diverse and dense closed heath, some of which providing good quality habitat for the Quenda. The southern wetland was burnt some months previously and is largely devoid of foliage, but, in time, it can be expected to regrow to a similar condition as the northern wetland.

Location 4532, Lot 2 – B J (Joe) Prowse

This saw-toothed shaped property contains different sections carrying pasture, regrowth native vegetation and original native vegetation.

The pastured portions of the property occur in the northwest (poor quality pasture developed among Spearwood scrub), north east (high quality in the centre of a winter wet area), central west (moderate quality) and south east (moderate to high quality).

Remnant dryland vegetation occurs within a rectangular section in the middle of the property (Banksia, Spearwood low open forest with moderate diversity and density) and generally within the southern quarter of the property (open forest of Jarrah, Banksia, WA Peppermint, Woody Pear, Marri and Spearwood, with a healthy, diverse and dense understorey).

Several pockets of large, old Marri trees occur throughout the property, providing potentially useful nesting sites for native fauna.

Regrowth dryland vegetation occurs generally throughout the northern two thirds of the property. It contains similar species to uncleared native vegetation but with lower diversity and density and with several infestations of dieback.

The north eastern wetland has been largely cleared of original vegetation, but a fringe of Paperbarks to 12 metres occurs on the west and north sides of the now pastured wetland.

The central eastern wetland is very dense, with closed Myrtaceae scrub and emergent Paperbark trees. The south eastern wetland has been partly cleared to allow pasture development. Most wetlands in the southern quarter of the property have been unaffected by agricultural development and retain original closed heath.

Overall, regrowth dryland vegetation is of low conservation value, while parts of the uncleared dryland areas contain diverse and healthy native vegetation, including clumps of large Marri trees and other attractive features.

Location 4913 - A Hutton (Jim and Cheryl Campbell)

This property is being developed for residential purposes, with most of its existing vegetation to be retained. It has not been burnt or grazed by domestic stock since 1978.

Although mostly cleared in the 1950s and 1960s, dryland vegetation is typical for the DIMP area, being a low open forest of Banksia, WA Peppermint, WA Christmas Trees and Spearwood. Jarrah and Marri occur in places.

Understorey is generally diverse but fairly open, although several dieback infestations are obvious. In particular, an area planted with mostly non-local Banksias near the eastern boundary is being devastated by the fungus, although Spearwood and a species of Calytrix are resistant and providing reasonable vegetation cover.

Wetland vegetation is also typical of that found elsewhere in the DIMP area, comprising a closed heath with emergent Paperbark trees.

The property is home to Quenda, Western Brush Wallaby and Western Grey Kangaroo. Rabbits are common and, in combination with a lack of recent fire, are probably having a major impact on vegetation regrowth.

The owners intend to carry out small patch burning as part of their commitment to retaining and enhancing the natural values of this property.

Location 5164 - Department of Land Administration

This 2.8 hectare block covers the central part of a winter-wet depression. It is densely vegetated with a closed forest consisting of Paperbark trees (likely to be *Melaleuca preissiana* and *M. raphiophylla*). Some Spearwood grows around the outer edge, while Dodder (probably *Cassytha flava*) is extensive in places.

The September 1995 survey showed the presence of Coot, Australian Shelduck, Grey Teal and Black Duck. No evidence of breeding was seen, but the vegetation provides excellent nesting sites for a wide range of waterbirds, including Ibis and Egret. Photo 6 shows the variety of habitats created when this wetland fills after normal winter rains.

Reserve 16144 (Capel Nature Reserve) - National Parks and Nature Conservation Authority

This important reserve covers approximately 100 hectares. It is a mosaic of several wetland and dryland vegetation types, all of which are represented elsewhere in the DIMP area. Because of the size of the reserve, it was not fully surveyed. However, examination of the colour aerial photograph (figure 2) has allowed vegetation types to be readily determined, especially when they are compared with similar vegetation types on private property as described above.

The high conservation value of this reserve lies primarily in the fact that it forms a large, more easily manageable remnant of vegetation that once covered a much larger section of the southern Swan Coastal Plain. While it contains rare and endangered plants and animals (for example, Hammer Orchid and Quenda), the existence of such a large remnant of mostly high quality bushland and wetland vegetation is itself rare.

The reserve contains a number of dieback outbreaks and vegetation damage is being caused by frequent and extensive summer fires, including at least two major burns during the 1994/95 summer.

PHOTO 6 - The wetland on location 5164 expands when full to cover pasture which provides additional feeding habitat for a wide range of waterbirds.

Reserves 22293 and 24529 - Shire of Capel

These reserves adjoin the Capel Nature Reserve and, although impacted upon by mineral processing (22293) and sand extraction and refuse disposal (24529), they also contain high quality dryland and wetland vegetation.

Vegetation is generally similar to that found in the Nature Reserve, although dieback is more widely distributed in reserve 24529 which has also suffered from frequent fires escaping from the Capel refuse disposal site.

RGC has commenced revegetation of the small section of reserve 22293 that was impacted upon by sand disposal, while the Capel Shire will cease accepting domestic refuse at the Capel tip in the medium term, although sand extraction and disposal of clean fill will continue.

The reserves are known to contain rare species such as the Hammer Orchid and Quenda.

Reserve 42535 - Water Authority of Western Australia

This small reserve was recently excised from reserve 22293 to allow the construction and operation of the Capel townsite's wastewater treatment facility. Although containing habitat suitable for the Hammer Orchid, the reserve had been affected by clearing for mineral sand exploration drilling and a power line.

The wastewater treatment plant occupies almost the entire reserve, with a doubling of the facility likely in the medium term as Capel townsite expands.

While much of the reserve's vegetation is open Spearwood scrub, a vegetation type common in the DIMP area, a patch of open Jarrah forest south and south east of the treatment plant contains several large Jarrah trees which are uncommon in the DIMP area. These trees are likely to provide useful habitat value, including nesting sites, to several species of birds and animals.

Road Reserves

Most road verges were found to contain vegetation of moderate to high quality, except for small sections along Tutunup and Hutton Roads.

The Department of CALM has recently completed a similar survey, but did not map Prowse Road. They classified all of Tutunup Road as being low and medium-low conservation value, with all of Hutton Road being of high conservation value.

Both sets of survey results are available for examination from the consultant, the Dalungup Area Support Group and the Shire of Capel. CALM's survey appears to have been carried out with less attention to detail and hence is less accurate than the survey conducted as part of this study.

9.0 MANAGEMENT ISSUES

9.1 Control of Feral Animals

9.1.1 Fox and Cat

Numerous studies have shown that feral foxes and cats consume large numbers of native birds and animals, in addition to new-born lambs and other domestic animals. The fox will readily swim or wade through water to eat waterbirds and their eggs during nesting. They are reasonably proficient climbers and will take roosting birds, including domestic species. Foxes will also eat fruits and other parts of plants and are responsible for the spread of Blackberry, a noxious weed, through many parts of the south west.

The feral cat eats large numbers of native rodents and marsupials, such as Dunnarts, Wambengers and Possums, as well as birds such as Splendid Wrens. They are true omnivores, eating insects, reptiles and frogs and a wide range of vegetable matter. They are excellent climbers.

Hen eggs poisoned with 1080 and buried or hidden so as to be difficult to find by farm dogs and other domestic animals are the normal method used to control foxes and cats. Supplied by the Agriculture Protection Board, eggs are only effective if baiting occurs over a large area. Baiting just a small area simply creates a small population void which is quickly filled by animals moving in from adjoining unbaited areas.

Baiting over the entire DIMP area will be far more effective at reducing overall cat and fox populations than just baiting one or two individual properties. Cooperation between landowners will reduce the unit cost of preparing baits, since it is more cost effective to produce a large number of poisoned eggs than a small number.

Even if there is only a small number of volunteers to lay poisoned eggs, agreement between all Dalungup landowners that fox and cat control can extend throughout all farms in the area will make the volunteers' efforts less difficult and more effective.

9.1.2 Rabbit

Rabbits were very common throughout all dryland bush areas, with large numbers seen even during the middle of the day.

Large numbers of rabbits eat most newly emerging seedlings, thus preventing revegetation. They damage existing vegetation during times of low food availability by eating roots and bark, often killing the plants.

All surveys within the Dalungup area showed that there was very little natural regeneration beneath the most common vegetation association, namely, Spearwood and Banksia woodland and forest. While the absence of fire would have contributed to this, rabbit browsing on new seedlings is the primary cause.

As for fox and cat control, rabbit control efforts should be coordinated throughout the Dalungup area. This will lower the unit cost and increase the program's efficiency.

Appendix 2 contains the summary of recent CSIRO research on the most effective and cost-efficient methods of rabbit control. They recommend a combination of warren ripping, fumigation and poisoning.

9.2 Dieback

No effective cure for the dieback fungus is known. Aerial application of broad-spectrum fungicides is expensive but will also kill a wide range of natural fungi, most of which are beneficial and possibly essential for the continued health of native bushland.

Use of phosphorus acid is labour intensive and expensive. This chemical only provides short-term protection against dieback and must be reapplied at 3 to 5 year intervals.

A technique proposed by Dr Ray Hart is to sterilise (i.e., kill all plants) within a dieback-affected area and keep this area devoid of plants for 30 years. This will cause spores produced by the fungus to lose their viability, eventually forcing the fungus to disappear from the infected area. Revegetation can then occur. Except in special situations, this control method has limited application.

The Department of Conservation and Land Management has adopted a general policy of restricting or preventing the spread of the dieback fungus. This requires that infected soil and plant material (roots and lower trunks) are not moved into uninfected areas and that existing infestations are managed so that the fungus is not assisted in its natural spread, e.g. by increasing ground moisture levels through road construction.

The dieback fungus can kill every species of Banksia and up to 60% of the south west's diverse flora, including Jarrah. In turn, the insects, birds and animals that depend on those plants for shelter, food and nesting sites will also be affected. In some cases, animals

like Honey Possums which depend on Banksia nectar for much of their food supplies may become extinct.

The Shire of Capel has a major responsibility to manage its road making and other activities so that dieback-infected soil or vegetative matter is not spread. The Shire's road-making activities should be designed so that ponding of water or any action likely to impede drainage is not encouraged.

9.3 Fire

Although Australia's flora has evolved in association with frequent fires, improper use of fire can damage or permanently destroy vegetation associations. Many native plants take two or three years to set viable seed, so the fires at two yearly intervals will eventually deplete the seed bank contained within the topsoil, leading to the elimination of these species.

Fire also destroys the habitat of many birds and animals, for example, by consuming logs lying on the ground that provide shelter for reptiles, frogs and some marsupials. Extensive fire can destroy all the protective habitat for a species, e.g., low dense shrubs used by Quendas, allowing foxes and cats to eat the animals that survived the fire. The affected areas must then be recolonised from outside, a task made more difficult if the patch of bush is surrounded by cleared farming land.

Uncontrolled fire poses serious risks to life and property and the Dalungup area includes a number of homes that are surrounded by dense natural vegetation. Planting of fire-resistant vegetation (fruit and nut trees, for example) close to these houses, hand raking and removal of combustible ground litter, and cool controlled burns are recommended actions.

Fire management should occur on a cooperative planned basis. To protect the area's natural vegetation values, CALM's current research findings (see appendix 3) show that a six or eight year fire frequency is required on the following basis:

> **spring burn** to be followed 6 to 8 years later by a
> **spring burn** to be followed 6 to 8 years later by an
> **autumn burn** to be followed over the next 12 to 16 years by
> **no burning.**

To protect the area's natural faunal values, CALM recommends that small burn areas are preferred to large burns. Hence, individual properties within the Dalungup area which contain larger patches of bushland should be broken up into 6 to 8 sub-areas, each of which should then be subjected to a fire management program as described above.

The preparation of a detailed fire management plan for the Dalungup area will satisfy legal obligations with which the Shire must comply, while demonstrating to local bush fire brigades that the Dalungup community is prepared to act responsibly and in a cooperative manner with each other and with the brigades.

9.4 Water Quality

9.4.1 Salinity

Contrary to traditional beliefs, sections of the high rainfall agricultural areas of the south west are susceptible to salinity problems.

In the low rainfall wheatbelt, clearing of deep-rooted native vegetation has allowed more of the limited quantities of rainfall to enter the sub-soil. In turn, this causes groundwater levels to rise, bring salt to the surface.

On the southern Swan Coastal Plain, removal of deep-rooted vegetation is of far less consequence. Prior to European settlement, most of what is now agricultural land within the Capel and Busselton shires suffered from impeded drainage. Rainfall tended to be trapped within broad wetland areas, allowing some freshwater to soak into the sub-soil prior to the onset of summer and high evaporation rates.

Since the early 1900s, extensive drainage works have resulted in removal of most surface water from the formerly waterlogged agricultural areas. Many of these areas still flood, but to depths of less than 20 centimetres and for only four or five months of the year. In the 1930s, hay cutting was an activity undertaken in November. Today, most is completed a month earlier in October.

As figure 6 shows (taken from Hirschberg, 1989), the southern Swan Coastal Plain contains large areas of saline groundwater within the surface sedimentary formations. Fortunately, most of the Capel Shire and the entire Dalungup area is free of this surface salt, which has been left over from the sea level rises which occurred several times over the last 200,000 years.

However, bores 5, 6, 10 and 11 as shown on figure 6 contain moderately saline water (up to 1870 mg/l or ppm) within the sedimentary layers that immediately underlie the surface sediments. These salt-bearing layers are as little as 10 metres from the surface.

Excessive drainage of high quality rainfall from low-lying sections of the DIMP area poses a moderate, medium term risk that salinity will rise to the surface, prevent pasture growth and kill remnant vegetation. It is possible that salinity may be the cause of the death of large Paperbark trees in the north west corner of Location 2480.

Drainage of fresh surface water from selected wetlands should be reduced or stopped so that larger volumes of water are retained from late winter onwards, thus allowing more low salinity water to soak into the subsoil.

9.4.2 Nutrients

Use of fertilisers, both natural and artificial, can result in leaching of nutrients into ground and surface waters. Phosphorus and nitrogen are the most widely used fertilisers and both elements can cause adverse impacts on surface water. Algal blooms, fish deaths and destruction of aquatic vegetation result.

Leaching of fertilisers is certain to be occurring within the DIMP area wherever soils are sandy and lacking in clay and silt. This will

FIGURE 6

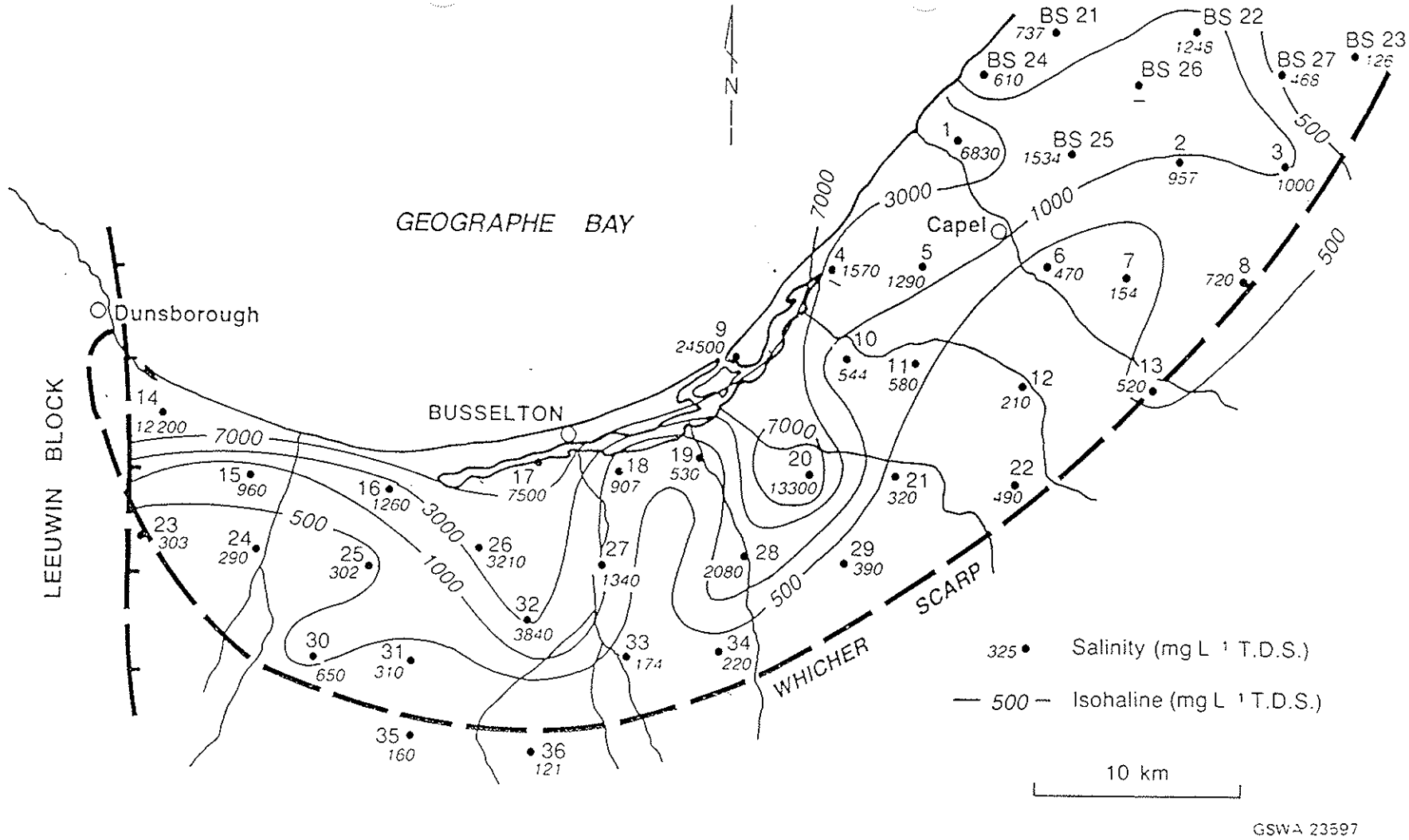

Figure 11. Salinity of groundwater in superficial formations

LEEDERVILLE FORMATION

Extent and Lithology

The Leederville Formation forms a multilayered, confined aquifer of interbedded sand and shale; its average thickness is between

The seasonal fluctuation of the potentiometric heads in the Leederville Formation is generally in the range of 1 m to 2 m (Fig. 14).

Discharge

Discharge occurs offshore and, over an area of

be occurring even where fertiliser application rates are not excessive, simply because sandy soils are incapable of retaining nutrients.

No evidence of adverse impacts of nutrient leaching is visible in the DIMP area, primarily because of the high levels of drainage which occur throughout most of the area's farming land. Even if surface water contains high levels of nutrients, most is drained away in winter and spring before summer evaporation is able to cause algal blooms and related problems to occur.

Even so, excessive fertiliser use is a waste of time and money, as is unnecessary nutrient leaching.

Before fertiliser applications are made, soil testing is highly recommended. Where phosphorus and nitrogen levels are sufficiently high to warrant no application, there is often a need to apply other highly leached elements, sulphur and potassium.

For sandy soils where nutrient retention capacity is low, landowners should investigate the use of soil conditioners or amendments that allow phosphorus and moisture to be better retained. Alcoa's gypsum-amended red mud has been shown by many trials in the Pinjarra area to significantly improve agricultural productivity, even at application rates as low as 20 tonnes per hectare.

In the Capel area, RGC Mineral Sands Ltd and Westralian Sands Limited operate synthetic rutile plants which produce large tonnages of waste products well suited for use as soil conditioners. Iron oxide solids is fine grained and capable of retaining moisture and phosphorus. Neutralised acid effluent solids is similar, but contains large amounts of sulphur as gypsum and useful trace elements.

The tax deductibility status of expenditures on adding soil conditioners such as these to highly leaching sandy soils is being investigated (FINAL ADVICE SHOULD BE RECEIVED IN TIME FOR THE FINAL DRAFT OF THIS REPORT).

9.5 Shade and Shelter

Adequate shade and shelter available to stock during cold or hot weather significantly lowers their metabolic rate, thus improving productivity and efficiency of their food intake. Shade and shelter around a farm dam reduces evaporation rates, while soil moisture over spring and summer is reduced by lowering the wind speed over plants using that moisture for their growth.

Most properties within the DIMP area provide adequate shade and shelter for stock due to the remnants of native vegetation retained on site. However, few remnants are fenced and managed. The trees which are currently providing benefits to farm animals are suffering from ring-barking, trampling and compaction of soil around their base and excessive nutrients from animals camping around individual trees.

Like all living organisms, trees and shrubs have a finite life and will eventually die. Without fencing, seedlings will be unable to grow beneath or close to the existing large trees as stock readily eat them. In time, the older plants will die, leaving gaps in the canopy and reducing the remnant's effectiveness for shade and shelter (see photo 7).

Selected areas of remnant bush should be fenced in order to allow regrowth of seedlings which will eventually take the place of the older trees as they die.

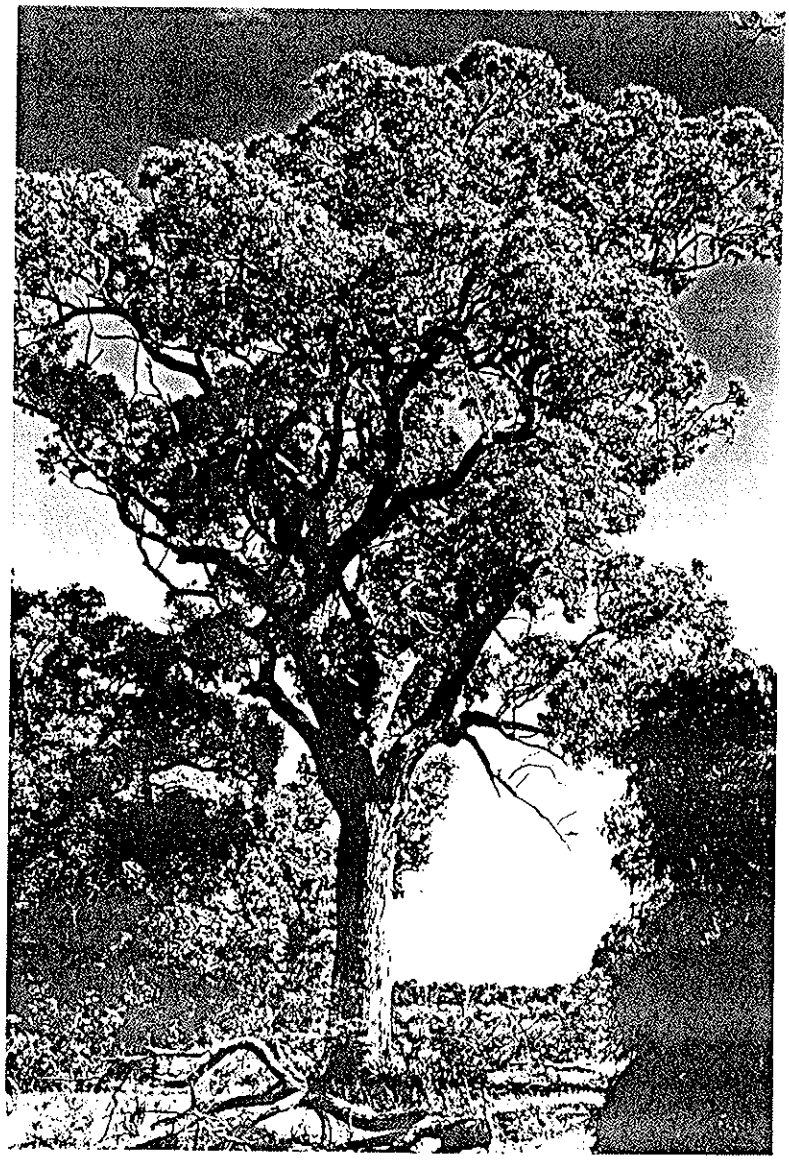

PHOTO 7 - A large Jarrah tree provides shade, shelter and wildlife values. Due to heavy grazing pressure, no seedlings are growing nearby and this tree will not be replaced when it dies.

9.6 Wildlife Conservation

9.6.1 Dryland Areas

Arguments in support of retaining bush for its aesthetic and conservation values cannot be defined in terms of their economic worth. While tourists may pay to walk through bushland and look at wildflowers or hear birds singing, the amount that they are willing to pay to examine the Dalungup area cannot be determined until someone constructs walking trails, undertakes advertising and tests the market.

Similarly, some residents of the Dalungup area may place a high value on maintaining the natural appearance of the view from their verandahs, but the amount cannot be accurately determined from theory alone.

Conservation of dryland bush areas will:

* improve the aesthetic beauty of the area

* protect habitat for rare and endangered plants and animals

* protect the genetic viability of wildlife which interbreeds with plants and animals protected within the Dalungup area

* provide sites from which plants and animals can recolonise other bushland sites

* provide sites where rehabilitated wildlife can be released

* allow for scientific study of the natural aspects of the area, and

* contribute to the overall conservation value of the Shire of Capel.

For these and many other reasons, representative sections of existing dryland vegetation should be protected within the Dalungup area. Fencing should be followed by preparation and implementation of a brief management plan for each protected area.

In general terms, light grazing by stock, removal of small volumes of timber for fences or firewood, collection of seeds, flowers and other vegetative products at a sustainable rate, tourist visits and other activities are possible and potentially acceptable uses of fenced-off remnants. The actual degree of use should be determined on a case-by-case basis, with each landowner balancing economic constraints against environmental and other benefits. The existing health of a fenced-off area and its natural characteristics will also assist in determining the amount of use to which it is to be subjected.

9.6.2 Wetland Areas

Many of the arguments in support of protecting wetland areas are identical to those used to justify protecting dry land areas. In addition, however, wetland protection enhances surface and groundwater quality, through mechanisms described above, and by removing nutrients from water through plant growth.

Wetlands generally add to the diversity of plants and animals in an area and they provide an enhanced, more complex view that increases the aesthetic appeal.

Although duck shooting has been banned as a sport in WA, this was a favoured activity of early settlers in the Capel area. Wetlands provide habitat where ducks and other waterbirds can breed and feed, maintaining the links with the first European residents, as well as with the pre-European Aboriginal inhabitants who regularly consumed waterbirds as an essential part of their diet.

It is important to note, however, that agricultural clearing has enhanced some wetland values. Dense wetland scrub or heath (see photo 8) prevents most waterfowl for using a wetland for breeding and feeding. Larger birds such as Black Swans and Pelicans need a large area of open water for landings and take-offs. Allowing more sunlight into wetlands raises water temperatures and encourages plant growth, providing better growing conditions for insects and other bird foods.

Removing some of this dense heath has improved the waterbird use of most wetland s within the DIMP area, although at a cost of reduced plant diversity.

Two general management goals are desirable for wetlands: in most cases, more and deeper surface water will create better waterbird habitat for a longer period; and management actions that protect the health of wetland trees will normally ensure that the wetland as a whole is being properly managed (Jim Lane, Department of CALM, *pers. comm.*)

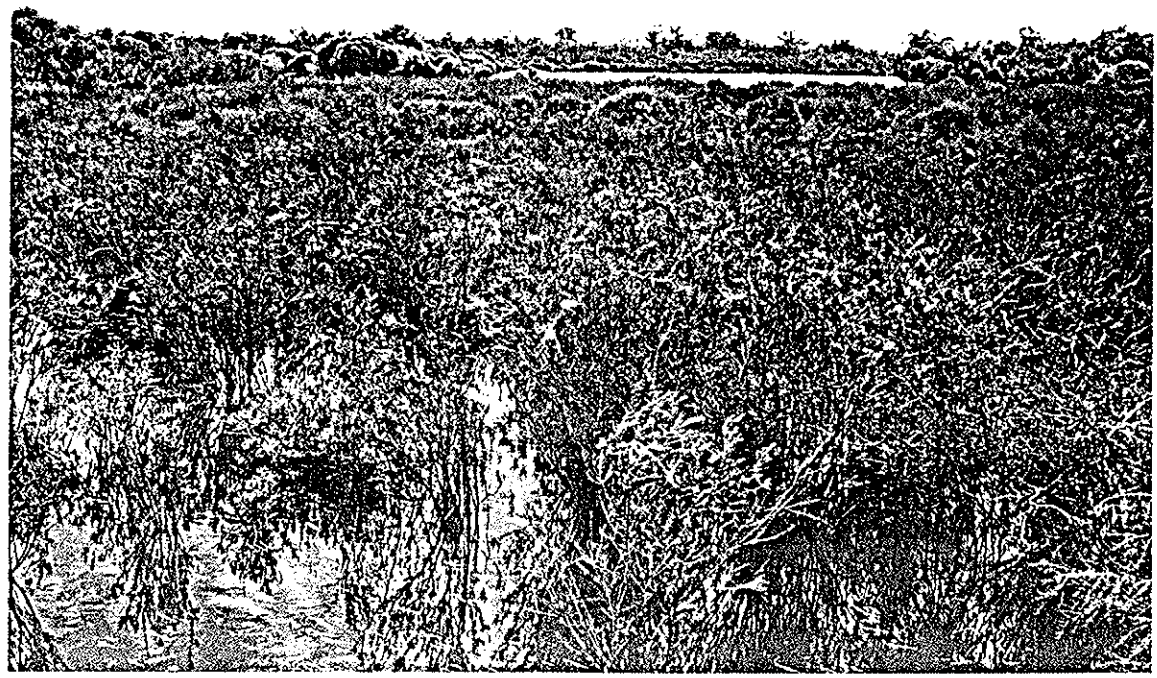

PHOTO 8 - Dense wetland scrub of limited value to waterbirds on location 2933, with Little Dalungup Swamp in the far distance.

10.0 RECOMMENDED MANAGEMENT ACTIONS

10.1 Recommendations for the General Dalungup Area

All landowners and land managers within the Dalungup Integrated Management Plan area should cooperatively carry out the following activities:

* using the advice and resources of the Agriculture Protection Board, prepare and carry out an integrated control program for foxes, cats and rabbits

* with technical advice from the Department of Conservation and Land Management, prepare a map of dieback infected sections of their properties and use this to prevent or control the further spread of dieback

* in conjunction with the local bushfires brigade and the Shire of Capel, prepare a strategic fire management plan for the entire Dalungup area and assist the brigade and each other to implement the plan

* working in conjunction with the Dalungup Area Support Group, the Capel Land Conservation District Committee and the Shire of Capel, seek funding from state and federal government sources to supplement their own funds for the preparation and implementation of whole of farm plans, so that the environmental and economic benefits of each property can be maximised to suit each landowners particular ambitions

* the Shire of Capel should introduce a differential rating system so that those properties with significant areas of retained bushland or biologically productive wetland can enjoy lower rates than properties that are essentially devoid of natural bushland or wetlands

* results from the road verge survey should be consulted during the planning stages of roadworks or other development activities that may affect road verges

* Shire Planning staff should investigate ways in which an owner of a larger, uncleared property can increase his or her income potential from that property without subdivision or significant additional clearing.

10.2 Recommendations for Individual Properties

In addition to the above general recommendations which apply to all properties in the Dalungup area, the following specific suggestions are made for individual properties.

Location 498 (Jeff Hardwick, Marjan le Faucheur)

This property has high conservation value, due to the presence of rare plants, Western Brush Wallabies and large numbers of waterbirds on Little Dalungup Swamp.

Accordingly, it is recommended that:

* as much existing vegetation should be retained as possible, especially fringing the wetland and where Quenda habitat exists

* a fire management plan should be prepared and implemented, using the guidelines suggested in section 9.3 and appendix 3

* the property should be surveyed for dieback and a dieback management plan prepared and implemented

* further islands should be created within Little Dalungup Swamp to enhance waterbird breeding potential

* sections of Little Dalungup Swamp should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers

* the owners should investigate the potential for re-introducing the Quokka to the property, although this would require fencing of suitable habitat to protect them from dogs, foxes and cats.

* the owners are encouraged to operate the property along permaculture principles, partly for their own satisfaction but also to act as a demonstration to other landowners that such principles are compatible with maintenance of an acceptable quality of life.

Location 842 - Jim & Cheryl Campbell

At present, this property has only moderate conservation values, due to the lack of fringing vegetation around Dalungup Swamp and the over-mature nature of the dryland vegetation.

The wetland can be managed to significantly improve its attractiveness for waterbirds. Remnant bushland in the north western section of the property adjoins higher quality vegetation to the west, north and north west. Its management for nature conservation purposes will create a larger bushland area of high value if all or some of these adjoining remnants can be similarly managed.

Accordingly, it is recommended that:

* remnant bushland in the north western section of the property should be retained and managed to protect and enhance its nature conservation values

* a detailed fire management plan should be prepared and implemented, using the guidelines suggested in section 9.3 and appendix 3

* the property should be surveyed for dieback and a dieback management plan be prepared and implemented

* suitable local species should be used to revegetate at least part of the outer edge of Dalungup Swamp, in order to enhance its use for waterbird breeding and roosting

* islands should be created within the wetland for use as nesting sites by waterbirds

* the hydrology of the wetland should be investigated and, if possible, the water level increased by a few centimetres each winter, with monitoring to ensure that only beneficial impacts are resulting from this water level control

* sections of the wetland should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

* suitable soil amendments could be added to the northern-most paddock, where the existing sandy soils are of low agricultural productivity and fertiliser application would be certain to result in nutrient leaching; alternatively, this paddock could be revegetated, using native or exotic species, possibly including productive crops such as Western Blue Gums

Location 848 - Garry Hutton

The western sections of remnant bushland are of moderate to high conservation value and are in good environmental condition. Remaining bushland varies from low to moderate conservation value and only a proportion should be protected from clearing.

The existing sand pit requires rehabilitation so that is can provide some productive use in time. There appear to be no conservation or

other reasons why the sand pit cannot be extended eastwards to affect most of the remaining dryland vegetation.

The southern wetland appears to offer limited potential for agricultural development but its waterbird values could be significantly enhanced with appropriate management.

Accordingly, it is recommended that:

* the western bushland remnant should be fenced off and managed for shade, shelter and nature conservation values

* the small wetland in the north eastern corner of the property and a suitable buffer zone of bushland (at least 30 metres wide) should be fenced off and managed for nature conservation purposes

* the sand pit should be rehabilitated, using artificial topsoil substitutes (such as sewage sludge, waste products from synthetic rutile production, etc), consistent with the owner's long-term ambitions for the site

* fringing vegetation should be regrown around the outer edge of the southern wetland in order to enhance its attractiveness for waterbird nesting and roosting

* the hydrology of this wetland should be investigated and, if possible, the water level increased by a few centimetres each winter, with monitoring to ensure that only beneficial impacts are resulting from this water level control

* sections of the wetland should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

* suitable soil amendments should be added to cleared land immediately east of the wetland, where the existing sandy soils are of low agricultural productivity and fertiliser application would be certain to result in nutrient leaching; alternatively, this paddock could be revegetated, using native or exotic species, possibly including productive crops such as Western Blue Gums

Locations 855 and 3785 - Pat Ligman

This property is an excellent rural retreat, where the many natural values of the Dalungup area can be enjoyed. The wetland is its most important natural component.

Accordingly, it is recommended that:

* islands should be created within the wetland for use as nesting sites by waterbirds

* the hydrology of the wetland should be investigated and, if possible, the water level increased by a few centimetres each winter, with monitoring to ensure that only beneficial impacts are resulting from this water level control

* sections of the wetland should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

* fencing wire not required for horse control or other purposes should be removed as it is a hazard to waterbirds in flight

* attention should be paid to the amount of animal feed brought onto the property as large amounts of nutrient-rich materials could increase the nutrient levels within the wetland and cause excessive algal growth.

Location 871 - Summerlea Holdings (Noel and Joy Gibson)

The low-lying portion of this property east of Howley Road provides moderate quality feeding habitat for waterbirds. The remnant forests of WA Peppermints provide excellent habitat for the endangered Ring-tailed Possum.

There appear to be no conservation or other reasons why the remainder of the property should not be considered suitable for eventual urban sub-division.

Accordingly, it is recommended that:

* no clearing of the dense Peppermint forests should take place and, when and if urban rezoning of the property is sought, they should be considered for inclusion into Public Open Space or other reserved land, with a primary purpose of nature conservation

* see recommendations for location 2513 relating to water level issues within the low-lying land east of Howley Road

* suitable soil amendments should be added to the cleared land immediately west of Howley Road, where the existing sandy soils are of low agricultural productivity and fertiliser application would be certain to result in nutrient leaching; alternatively, this land could be revegetated, using native or exotic species, but possibly excluding Western Blue Gums because of the potential fire hazard that this would create so close to existing urban subdivision.

Location 1181 - Graham and Caroline Fagan

This property is an excellent rural retreat, where the many values of the Dalungup area, both natural and artificial, can be enjoyed.

The wetland and the Peppermint trees are its most important natural components. The wetland could provide much improved habitat for waterbirds with more intensive management.

Accordingly, it is recommended that:

* as many of the existing Peppermint trees as possible should be protected in the long-term

* further plantings of Peppermint trees should be made, partly to improve shade and shelter for horses, but also to provide a

continuous belt of trees linking the Peppermint forest on location 871 to the north with remnant bushland to the south west on location 2513 and eventually location 4532

* suitable local species should be used to revegetate the outer edge of the wetland, in order to enhance its use for waterbird breeding and roosting; fencing will be required

* islands should be created within the wetland for use as nesting sites by waterbirds

* in cooperation with landowners to the south, the hydrology of the wetland should be investigated and, if possible, the water level increased by a few centimetres each winter, with monitoring to ensure that only beneficial impacts are resulting from this water level manipulation

* sections of the wetland should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

Locations 1392 and 2513 (Lot 2) - Mark and Yvonne Morris

This is a valuable farming property, providing large amounts of high quality pasture. Remnant bushland in the north west corner is of moderate conservation value and, if revegetated and slightly expanded, it could form an important link to adjoining bush.

The farm dam in the north west corner provides useful supplies of freshwater during summer for waterbirds and Western Grey Kangaroos.

The winter-flooded pastured land is likely to provide excellent feeding habitat for a reasonably large number of waterbirds. The wetland on the property's northern boundary provides useful feeding sites for a limited range of waterbirds. Management of both wetland areas could significantly improve their breeding and feeding values to waterbirds.

Accordingly, it is recommended that:

* the patch of bushland in the north west corner should be fenced and managed for multiple purposes, including stock shade and shelter and nature conservation

* additional small areas should be revegetated with native plants, especially WA Peppermints, to provide extra habitat for the endangered Ring-tailed Possum and to provide a wildlife corridor or linkage with remnant bush to the north east and west

* without causing more than a small reduction in pasture produced from the low lying sections of the property and in cooperation with landowners to the north and south, the hydrology of the wetland and the winter-flooded pasture should be investigated and, if possible, the water level increased by a few centimetres each winter, with monitoring to ensure that beneficial impacts are resulting from this water level manipulation without unacceptable impacts on pasture productivity

* suitable local species should be used to revegetate the outer edge of the northern wetland, in order to enhance its use for waterbird breeding and roosting; fencing will be required

* islands should be created within both the wetland and the flooded pasture for use as nesting sites by waterbirds

* sections of the wetland should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

* small, carefully chosen sections of the winter-flooded pasture should be planted to native trees and shrubs (and fenced) to provide roosting and nesting sites for waterbirds

Locations 1613, 2933, 4341 and 4342 - Jean Hayes

With most of these properties cleared of their dryland vegetation, the majority of remnants should be retained for shade, shelter and nature conservation purposes, including possible habitat for the Western Brush Wallaby.

The wetlands provide mixed conservation values, ranging from low to moderate, while high sandy sections of the property are unlikely to provide acceptable agricultural returns due to their inherently low nutrient- and moisture-retaining capacities.

Accordingly, it is recommended that:

* suitable soil amendments should be added to the higher, cleared land where the existing sandy soils are of low agricultural productivity and where fertiliser application would be certain to result in nutrient leaching; alternatively, this land could be revegetated, using native or exotic species, possibly including Western Blue Gums

* most remnant bushland areas should be fenced allow regrowth of seedlings

* the wetland on location 1613 should retain its part-cleared, part-vegetated character, so that it provides the fullest range of nature conservation values; development of pasture in sections of this wetland would create waterbird feeding areas and would be an acceptable land use

* fencing of some of the wetland fringing vegetation should be carried out to allow seedling regrowth, prevent damage by grazing stock and to provide dense nesting habitat for waterbirds and possibly Quendas.

* a small number of islands should be created within the various wetlands for use as nesting sites by waterbirds

* sections of the wetland should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

Locations 2039, 2054 and 3822 - RGC Mineral Sands Pty Ltd

Remnant vegetation on location 2039 and in the centre of location 3822 is in good condition and contains at least one population of the endangered Quenda. It adjoins a larger areas of natural vegetation within the Shire and CALM reserves and together they form a large and important conservation area of regional significance in WA.

Accordingly, it is recommended that:

* existing natural vegetation areas on locations 2039 and 3822 should be managed for their nature conservation values

* revegetation of cleared land in the north eastern corner of location 3822 should take place, in order to improve the link with bushland to the north and north east

* at least portions of the dryland remnants on location 2054 should be fenced off and managed for a combination of shade, shelter and nature conservation

* winter-flooded pasture areas, mostly on location 2054, should be managed to provide continued waterbird feeding areas, while also providing pasture for stock grazing

Location 2048 - Ove Philipsen

Parkland clearing of this property has provided good habitat for birds and should be encouraged. To provide habitat for ground-dwelling animals and allow understorey plants to regrow, several small, carefully selected areas of regrowth should be fenced off. These will also provide young trees which will replace the older trees as they die.

The main wetland provides useful waterbird habitat but regrowth of fringing vegetation would increase its breeding and feeding use significantly.

Accordingly, it is recommended that:

* the parkland cleared character of this property should be retained

* small areas where understorey regrowth is occurring should be fenced off and managed for shade, shelter and nature conservation

* the main wetland should be fenced, with fringing vegetation re-established using suitable local species

* the southern wetland should be fenced to prevent stock access and managed for nature conservation purposes

* suitable soil amendments should be added to the higher, cleared land where the existing sandy soils are of low agricultural productivity and where fertiliser application would be certain to result in nutrient leaching

Locations 2068 and 2469 - V R (Roger) Hutton

This well-managed farming property provides useful habitat for waterbirds, including nesting sites in Paperbark trees south of the main house. It also has the potential to provide more valuable habitat for dryland fauna.

The Spearwood Banksia forest in the northern half of location 2068 is commonly distributed throughout the Dalungup area and there are no major conservation reasons why all of it should be retained. However, the poor quality sandy soils will have a low agricultural productivity, suggesting that clearing should not take place just to grow more pasture.

Accordingly, it is recommended that:

* all existing wetlands within the two properties should be retained

* fringing vegetation around the large wetland in the north west corner of location 2469 should be fenced to allow regrowth of seedlings, although occasional light grazing will reduce the cover of grasses and pasture plants

* fringing vegetation should be regrown around the outer edge of the northern wetland on location 2068 in order to enhance its attractiveness for waterbird nesting and roosting

* the hydrology of this wetland should be investigated and, if possible, the water level increased by a few centimetres each winter, with monitoring to ensure that only beneficial impacts are resulting from this water level control

* sections of this wetland should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

* at least portions of the three remnants of dryland bush on location 2469 and especially the remnant in the south west corner of location 2068 should be fenced to protect shade, shelter and nature conservation values and to allow regrowth; in particular, large old Marri trees should be fenced off and protected to enhance their value as wildlife habitat trees

* the central elongated wetland should be fenced and managed for shade, shelter and nature conservation purposes, as it has a high diversity of trees and understorey plants

* sections of the Spearwood Banksia forest should be fenced into small plots and different management techniques (such as fire, clearing, revegetation) applied to them as an experiment to determine the best way to recreate a diverse understorey and vigorous overstorey; rabbit-proof fencing should be used on half the plots so that the impact of these animals on revegetation can be determined

Location 2410 and 2411, Lot 2 - Chris Withers

The diverse native vegetation on this small block should be managed so that it continues to provide a highly attractive environment for residential enjoyment.

Accordingly, it is recommended that:

* because most of the trees and understorey plants are susceptible to dieback, soil movements to and within the property should be very carefully managed to prevent the introduction or further spread of dieback

* a fire management plan should be prepared according to the general guidelines suggested in this report, with small patches being burnt and an eight year fire frequency for each patch of bush

* the south west wetland should be fenced if stock are likely to graze within in

* the wetland should have fringing vegetation re-established using suitable local species

* special protection should be offered to the old Jarrah trees which have habitat importance for birds and animals; in particular, they should be injected with phosphorus acid if dieback is confirmed as being present on the property

Location 2480 - Clive Reid

Remnant vegetation in the north west of the property is in good health and has moderate to high conservation value. With cooperative planning, the WA Peppermints within it should be linked with similar trees as far north as location 871, providing an extensive area of high quality habitat for the endangered Ring-tailed Possum.

Several of the patches of remnant trees in the western half of the property should be fenced, so that seedlings can become established to take the place of the older trees as they die.

Management of the winter-wet pastured areas should be investigated, so that they can provide enhanced values for waterbirds without reducing the property's agricultural productivity.

Accordingly, it is recommended that:

* the north west remnant bush area should be fenced and managed for shade, shelter and nature conservation values

* several of the small isolated pockets of trees should be fenced to allow regrowth to occur

* a small number of islands should be created within the winter-wet pastured area for use as nesting sites by waterbirds; however, they should be monitored to ensure that the islands do not simply serve as obvious sites for foxes to obtain food but that waterbirds are successful in their breeding efforts on them

* small, carefully chosen sections of the winter-wet pasture should be deepened by a sufficient depth so as to provide permanent water throughout even dry summers, although testing should be

carried out at the end of summer to ensure that the water table is within a reasonable distance from the base of the wetland

* the hydrology of the winter-wet pasture should be investigated and, if possible, the water level increased by a few centimetres each winter, with monitoring to ensure that only beneficial impacts are resulting from this water level control

* sections of the north west bushland should be fenced into small plots and different management techniques (such as fire, clearing, revegetation) applied to them as an experiment to determine the best way to recreate a diverse understorey and vigorous overstorey; rabbit-proof fencing should be used on half the plots so that the impact of these animals on revegetation can be determined

Location 4108 - Wayne and Keryn Hastie

This property contains bushland of high conservation value and, in combination with adjoining uncleared land and the Capel Nature Reserve, it forms part of a large natural area of regional significance that should be managed for its natural values.

The wetland provides only limited value to waterbirds and clearing of small sections within it would enhance waterbird usage and diversity.

The likely agricultural productivity of this property is low. There are good arguments against subdividing it, primarily so that management decisions can be made more readily by one landowner rather than several.

However, the Shire of Capel should be sympathetic to the owners' reasonable requests for alternative uses of this property, so that its natural values can be protected while still providing a reasonable level of income. For example, requests for chalet development on this property should be supported.

Accordingly, it is recommended that:

* most of the existing dryland vegetation should be retained, in order to protect nature conservation values

* limited clearing of parts of the dense wetland scrub should be considered to order to enhance waterbird diversity and usage

* sections of bushland should be fenced into small plots and different management techniques (such as fire, clearing, revegetation) applied to them as an experiment to determine the best way to recreate a diverse understorey and vigorous overstorey; rabbit-proof fencing should be used on half the plots so that the impact of these animals on revegetation can be determined

* suitable soil amendments should be added to the higher, cleared land where the existing sandy soils are of low agricultural productivity and fertiliser application would be certain to result in nutrient leaching; alternatively, this land could be revegetated, using native or exotic species, possibly including Western Blue Gums

* the potential for a network of walking trails being developed to link this property with adjoining bushland/wetland areas should be investigated

* special protection should be offered to the large, old Jarrah trees that provide important wildlife habitat values

* suitable control measures should be taken as soon as possible to prevent the further spread of dieback within the property

Location 4532, Lot 1 - Wayne Sidebottom

Bushland and wetlands on this property could form a useful linkage between the Capel Nature Reserve to the west and location 4532 Lot 2 to the east. Hence, protection of much of the existing native vegetation is encouraged.

In turn, this will enhance the property's habitat value for the endangered Quenda which is likely to be present.

Grazing and soil damage by horses is occurring and, if protection of the natural values of the block are considered to have a high priority, the owner should select a specific area for use by stock and develop it with better quality pasture, etc. Horses should then be restricted to this smaller area and natural vegetation should be allowed to regrow elsewhere.

Accordingly, it is recommended that:

* the property should be managed primarily to protect and enhance nature conservation values

* a suitable area should be chosen for exclusive use by horses and this should be fenced and otherwise developed specifically to cater to the needs of horses

* suitable soil amendments should be added to already cleared land where the existing sandy soils are of low agricultural productivity and fertiliser application would be certain to result in nutrient leaching; alternatively, this land could be revegetated, using native or exotic species

* soil amendments should be used in the area dedicated to horses, as this will allow better pasture to be grown

Location 4532, Lot 2 - B J (Joe) Prowse

This large property contains some of the highest quality privately owned bushland within the Dalungup area. It also contains much degraded bushland that has a relatively low conservation value and retention of this quality bushland is not well justified.

The property contains several small patches of large, old Marri trees that provide important habitats for birds and animals. Some of the dense wetland and fringing vegetation has the potential to provide good habitat for the endangered Quenda.

Accordingly, it is recommended that:

* the highest quality bushland, comprising approximately the southern third of the property and a rectangular section in the middle

of the property, should be fenced and managed for nature conservation purposes

* suitable soil amendments should be added to already cleared land or to partly cleared, degraded bushland where the existing sandy soils are of low agricultural productivity and fertiliser application would be certain to result in nutrient leaching; alternatively, this land could be revegetated, using native or exotic species; possibly including Western Blue Gums

* because dieback is already present on site, suitable measures should be implemented to ensure that infected soil is not moved that would allow the fungal disease to be spread into uninfected bushland

* for those wetlands where pasture has been developed in their central sections, fencing should be placed around the outer fringing vegetation to protect shade, shelter and nature conservation values

Location 4913 - A Hutton (Jim and Cheryl Campbell)

This property has high conservation value, containing rare and endangered plants and animals and the Western Brush Wallaby, which is considered to be at some risk in south west WA.

The owners should be encouraged to continue their efforts to protect the nature conservations of this block.

Accordingly, it is recommended that:

* because dieback is already present, a management plan should be prepared to ensure that infected soil is not spread to uninfected sites within the property and to provide a sensible plan of attack so that the impact of existing infestations can be kept under control, for example, through the use of phosphorus acid.

* sections of bushland should be fenced into small plots and different management techniques (such as fire, clearing, revegetation) applied to them as an experiment to determine the best way to recreate a diverse understorey and vigorous overstorey; rabbit-proof fencing should be used on half the plots so that the impact of these animals on revegetation can be determined

Location 5164 - Department of Land Administration

The waterbird conservation value of this property is high, but the surrounding landowner is, not surprisingly, unwilling to purchase the land: not only will it not provide additional income but management to protect nature conservation values will require additional private expenditure.

DOLA's inability to spend the necessary funds to fully manage this block is acknowledged, while the Deportment of CALM has a general policy against taking control of small, difficult to manage areas.

Accordingly, it is recommended that:

* the Shire of Capel should seek to gain ownership of Location 5164

* if successful, the Shire should request the Dalungup Area Support Group to accept management responsibility for the property, with some financial support from the Shire

* the outer perimeter of the wetland should be fenced in cooperation with the surrounding landowner

* management should include the retention of deep open water areas and shallow, flooded pasture, in order to provide as wide a range of feeding habitats as possible.

10.3 Recommendations for Individual Reserves

Reserve 16144 (Capel Nature Reserve) - National Parks and Nature Conservation Authority

The Department of CALM is in the process of preparing a management plan for this important nature reserve. In the meantime, a set of management guidelines adapted from those prepared for the Minninup block of state forest have been prepared.

In general terms, the following management recommendations and actions are expected to be similar to those that will be incorporated into the formal management plan:

General Management Objectives

a) conserve and where possible improve the conditions of the native flora and fauna, particularly Quenda habitat and declared rare flora

b) prevent or minimise the impact of unplanned fire on the reserve's conservation values and on neighbouring properties

c) through the planned use of fire to:
- reduce the incidence and impact of unplanned fire
- maintain the diversity of native flora and fauna

d) prevent the further spread and intensification of dieback disease

e) prevent where practical further encroachment of declared and environmental weeds, with control to complement similar actions taken by neighbours

f) carry out fox, cat and rabbit control to complement efforts by neighbours

g) minimise the impact of illegal activities with the cooperation of neighbours

h) oppose exploration and mining or minimise its impact on the conservation values of the reserve

i) control illegal firewood gathering

j) control illegal use of off-road vehicles

k) seek to expand the size of the reserve by incorporation of suitable adjoining Crown land, but only with support of the Shire of Capel and the local community

l) encourage the management of neighbouring properties that have moderate or high conservation values in ways that are consistent with these guidelines

m) erect suitable signs around the reserve so that people are aware of the nature conservation values of the reserve and of the behaviour that is expected of them.

Fire Protection

The fire management objectives are to:

1) prevent or minimise the impact of unplanned fire on the conservation values of the reserve and on life and property within neighbouring properties, by a combination of liaison, maintenance of fire breaks, planned burning, detection and suppression.

2) use planned fire to reduce the incidence of and impact from wildfire and to conserve a diverse community of native plants and animals

The strategies for achieving these objectives are to:

1) maintain close liaison with neighbours and the bushfires brigade in order to:-

   a) prevent accidental and deliberate lighting of fires that may threaten the reserve

   b) receive timely detection and advice of any fire threatening the reserve

   c) assist with rapid fire suppression of fire, if appropriate

2) suppression actions required are:

   a) wildfires in or threatening the reserve will be contained to the smallest possible area by direct attack or by backburning from established buffers or firebreaks, taking into account the likely threats to life and property and the impact of the suppression activity on the environmental management of the reserve

   b) priority will be given to suppression methods that are potentially less damaging (e.g. direct attack by ground crews with mild fires, or backburning from buffers or breaks). Heavy machinery will only be used where fire behaviour is intense and likely to lead to extensive damage to reserve values or property. Existing breaks and tracks will be used wherever possible.

   c) specific consideration is to be given to protecting rare and restricted flora species or habitat for fauna in need of special protection when wildfire suppression tactics are planned.

   d) all machinery and vehicles entering and working in the reserve will be free of plant propagules and soil.

3) maintain all external and some internal firebreaks, preferably with assistance from neighbours and in a manner that does not spread disease or weeds

4) prescribe burn the block according to a plan that will be developed for the reserve in consultation with neighbours and according to the recent research findings from the Department of CALM's fire ecology section (see appendix 3) but generally following the following criteria:

   a) litter fuels should not exceed an average of 8 tonnes per hectare

   b) fires should be of low intensity (less than 250 kilowatt per metre) and achieve a mosaic of burnt and unburnt patches, particularly in areas that contain habitat for the Quenda

   c) burning of each section no more frequently than six years apart

5) rapidly suppress wildfires

Disease Protection and Access Management

Dieback is present in several parts of the reserve. A dieback management plan will be prepared so that firebreaks and other management actions that may cause the movement of plant propagules or infected soil can be constructed and maintained without spreading the disease further throughout the reserve.

The plan will also identify key sections of the reserve's flora than may require special protection from the advance of nearby dieback infestations, so that they can be protected using suitable effective techniques.

Noxious Weeds and Ferals

The management plan will fully address issues relating to the control or elimination of noxious and environmental weeds within the reserve.

Feral animals pose a serious threat to several species of rare or endangered fauna. CALM will undertake a fox baiting program in cooperation with the reserve's neighbours.

Rabbit control by the Agriculture Protection Board will be authorised where unacceptable impacts from excessive numbers of rabbits are seen to be occurring within the reserve. If the reserve is harbouring large numbers of rabbits which are recolonising neighbouring land which has been subject to control, then appropriate action will be taken.

Human Impacts

Firewood gathering is common within the reserve. With the help of neighbours, CALM will control this illegal activity.

Off-road vehicles are known to be commonly using the reserve but their impacts on vegetation, fauna and dieback spread are unknown. CALM will act to prevent this activity or to restrict it to the outer

firebreak, should sufficient justification for this be shown to exist.

Recreation

CALM will encourage passive recreational use of the reserve. Consistent with its small size and aesthetic attractiveness, the reserve is well suited for bush walking and the general appreciation of its wildlife. However, dogs and other pets will not be permitted within the reserve.

Review

Once approved, the management plan (or set of interim guidelines) will be reviewed every five years unless events or new knowledge suggest that an earlier review is warranted.

Reserves 22293 and 24529 - Shire of Capel

These reserves have high conservation value, due to the presence of rare and endangered plants and animals. In addition, in combination with the Capel Nature Reserve and privately owned bushland/wetland areas, they forming a significantly larger natural area which, because of its size, increases the overall conservation value of the Dalungup area.

Accordingly, it is recommended that:

* the Shire of Capel should consider whether those sections of the reserves not needed for sand extraction, refuse disposal or other community use would be better placed under the control of the Department of CALM

* in the short term, or in the long-term if the reserves are to remain under Shire control, they should be managed in a similar way to, and consistent with CALM's management guidelines for the Capel Nature Reserve

* in the short term, the Shire should restrict or ban the use of off-road vehicles, especially motorbikes, except along existing tracks

* signs should be erected throughout the reserves, explaining their natural values and the threat posed by fire, dieback and other impacts, while generally indicating the type of behaviour that is expected from users of the reserves

* the Shire should undertake a community education campaign to advise its ratepayers of the importance of the high quality bushland and wetlands of these reserves

* the Shire should encourage and assist the development of these reserves for passive recreation, especially nature study, bush walking and similar low-key, non-impacting activities

* expansion of the wastewater treatment facility should not be allowed unless the environmental implications of the expansion are assessment and made known to the local community

Reserve 42535 - Water Authority of Western Australia

This reserve retains little remnant vegetation. However, its service road allows access for people wishing to view the northern part of the DIMP area and the wastewater treatment facility may be a source of educational interest to some people.

Accordingly, it is recommended that:

* the plant should be run efficiently, as at present, with an acceptably low risk of nutrient- and pathogen-rich water entering the groundwater beneath the facility

* WAWA should investigate the possibility of modifying the vehicle turn-around area at the end of the service road so that people can park their cars prior to exploring nearby bushland or wetland areas

* WAWA should provide suitable signs explaining the operation of the wastewater treatment facility

* expansion of the facility should not impact upon the clump of open Jarrah forest containing a large number of particularly large, attractive trees immediately south and south west of the existing treatment plant

* during normal maintenance and future expansions, special attention should be given to preventing the introduction or spread of dieback.

Bernie Masters
B K Masters and Associates

October 8, 1995

11.0 REFERENCES

Beard, J.S. (1981) - Vegetation Survey of Western Australia: Swan 1:1 000 000 Vegetation Series. University of Western Australia Press.

Hirschberg, K-J.B. (1989) - Busselton Shallow-Drilling Groundwater Investigation, Perth Basin. Report 25, Professional Papers. Geological Survey of Western Australia

Smith, F.G. (1973) - Vegetation Map of Busselton and Augusta. Western Australian Department of Agriculture.

Smith, F.G. (1974) - Vegetation Map of Collie. Western Australian Department of Agriculture.

APPENDIX 1

EXTRACT FROM: VEGETATION MAP OF BUSSELTON & AUGUSTA – F.G. SMITH 1973

Standard descriptions used for each structural class

Life-form and height of tallest stratum	Projective foliage cover of tallest stratum, per cent	Description	Reference code
Trees over 30 m	70–100	High closed forest	A1
	30–70	High open forest	A2
	10–30	High woodland	A3
	under 10	High open woodland	A4
Trees 10–30 m	70–100	Closed forest	B1
	30–70	Open forest	B2
	10–30	Woodland	B3
	under 10	Open woodland	B4
Trees under 10 m	70–100	Low closed forest	C1
	30–70	Low open forest	C2
	10–30	Low woodland	C3
	under 10	Low open woodland	C4
Shrubs over 2 m	70–100	Closed scrub	D1
	30—70	Open scrub	D2
	10–30	High shrubland	D3
	under 10	High open shrubland	D4
Shrubs up to 2 m	70–100	Closed heath	E1
	30–70	Open heath	E2
	10–30	Low shrubland	E3
	under 10	Low open shrubland	E4
Herbs	70–100	Closed herbland, grassland, sedgeland, etc.	F1
	30–70	Herbland, grassland, sedgeland, etc.	F2
	10–30	Open herbland, grassland, sedgeland, etc.	F3

APPENDIX 2

Wildl. Res., 1995, 22, 253–69

Effectiveness and Cost-efficiency of Control of the Wild Rabbit, *Oryctolagus cuniculus* (L.), by Combinations of Poisoning, Ripping, Fumigation and Maintenance Fumigation

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Abstract

An experiment compared effectiveness, cost and cost-efficiency of factorial combinations of the four commonly used methods of rabbit control on grazing properties in the Southern Tablelands of eastern Australia. Sixteen different treatment combinations were applied to 32 sites. The treatments comprised initial control, applied over four months, followed by repeated maintenance control on half the replicates, applied after intervals of 2, 6 and 12 months. Initial control comprised no treatment, or poisoning (P) with sodium monofluoroacetate (1080), or warren-ripping (R), or chloropicrin pressure fumigation (F), or combinations of these (P+R, P+F, R+F, P+R+F). Maintenance control consisted of phosphine-diffusion fumigation (M). Indices of rabbit abundance were compared one month before treatments were implemented. Treatment effects were assessed one month after completion of the initial control, and one and 5–6 months after the three maintenance controls, and additionally nine months after the second maintenance control.

Control combinations that were highly effective and cost-efficient included both warren-ripping and maintenance treatment. Poisoning prior to warren-ripping, or fumigating subsequently, or both, improved effectiveness and cost-efficiency. Warren-ripping interacted positively with one or more subsequent fumigations, improving effectiveness and cost-efficiency non-additively.

Control combinations that excluded warren-ripping were ineffective and cost-inefficient, and one combination interacted negatively. Single treatments of poisoning or fumigation were cost-inefficient, allowing rabbits to recolonise rapidly to densities higher than original.

Only multiple combination treatments or repeated applications were highly effective and cost-efficient; single applications of any method were inefficient and costly. The most effective and cost-efficient combination comprised the maximum six applications including ripping and maintenance treatment, namely P+R+F+M. The high effort and expenditure on the initial control resulted in high effectiveness and cost-efficiency, which maintenance control sustained at low cost.

Maintenance treatments sustained or achieved effective control of rabbits; the cost of maintenance treatments halved on each repetition.

Introduction

The wild rabbit, *Oryctolagus cuniculus* (L.), in Australia causes substantial losses to agriculture (Reid 1953; Croft 1990) and threatens natural ecosystems (Lange and Graham 1983; Foran *et al.* 1985; Friedel 1985; Morton and Pickup 1992). Wild rabbits are declared pests in all Australian states and legislation obliges landholders to control them. Landholders and government expend much effort, materials and money in trying to reduce losses (Saunders and Korn 1986; Henzell 1989, 1991). Therefore, any improvements in effectiveness and cost-efficiency of rabbit control would benefit primary industry, conservation interests and government.

Several prior studies have examined cost and/or effectiveness of aspects of rabbit control. In arid Australia, Parker *et al.* (1976), Wood (1985), and Martin and Eveleigh (1979) studied

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APPENDIX 3

FIRE ECOLOGY

NOTES TAKEN AT TALKS GIVEN BY DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT FIRE ECOLOGY STAFF

BUNBURY, AUGUST 28, 1995

Neil Burrows

85% of understorey species are spring flowering.
70% of species have their first major flowering (>50% of plants producing flowers) 20 months after a fire in higher rainfall forested areas, with 40% flowering after fire in low rainfall Jarrah/Marri first.
100% of understorey forest flower after 48 months.

However, the first seed set is normally not viable.
Of the small number of species that have been studied, the conclusion is that one should allow a period of two times the juvenile flowering period so that the amount of viable seed formed has reached viable levels (whether the seed be stored in the soil or in the canopy)

So, allow 93 months or 8 years for the driest forest site and
72 months or 6 years for the wetter forest sites.

CALM's policy of having a fire frequency of 6 to 8 years is generally acceptable.
Neil's data shows that a 7 year frequency for wetter forests and 8 year frequency for drier forests is acceptable.
(Note that a Lambertia requires 12 years to seed but this is a species restricted to creeklines.)

Neil's work showed: 110-115 seedlings and 110 species are found per square metre after an autumn burn
45 seedlings and 110 species/square metre after a spring burn
<5 seedlings and 20 species/square metre after no burning for an 18 year period.

Most declared rare flora occur around granite outcrops, *Melaleuca preissiana* wetlands and along creeklines. Here, intervals of no higher frequency than 12 years and preferably longer are desirable, but it is best not to burn at all. Being wet areas, they will normally only burn in autumn, so autumn prescribed burns will cause severe damage to these vulnerable species.

Neil's preferred burning regime is:
two low intensity spring burns followed by
one moderate intensity autumn (dry soil) burn, followed by
no burns for two rotations.

So, in higher rainfall Jarrah/Marri forest, the preferred fire management program should be:

Year 1	Spring Burn)	
Year 7	Spring)	
Year 13	Autumn)	9 burns in 61 years, with 24 years between autumn burns
Year 25	Spring)	
Year 31	Spring)	
Year 37	Autumn)	
Year 49	Spring)	
Year 55	Spring)	
Year 61	Autumn)	

Gordon Friend

South coastal heath should have a 15 to 20 year fire rotation to protect the Honey Possum and a 10 year rotation for lizards living in the leaf litter, although frogs are dependent upon moisture and generally will not survive a fire.

In the central forest area around Collie (Jarrah/Marri forest), Antechinus is not affected by fire, probably due to rapid recolonisation from unburnt wetland sites.

Conclusions:

Fauna is relatively resilient to single fire events of small scale and low intensity.
There is a gradient of increasing resilience from wet to dry habitats.
The frequency and scale of burning are most significant.
Post-fire responses of most small vertebrate groups are closely tied to shelter, food and breeding requirements.
Fauna can therefore be considered and grouped in terms of their Life Form Categories, based upon shelter and food requirements.
Fire sensitive species show a clear trend with post-fire age of vegetation, and bushland managers should set the frequency limits for a fire regime based upon these species' requirements.
Many variables other than fire are important for invertebrates.

Best to err on the side of conservation.

Protect areas from large scale, high intensity wildfires.

Gordon suggested having internal and external low fuel zones to prevent high intensity fires from burning out large bushland/forest areas or large proportions of smaller remnants.

BKM
7/9/95