BUSHMEAD BUSHLAND, SWAN

Boundary Definition: protected area/bushland (part taken to cadastre)/vegetation complex/management boundary (Boundary adjusted after negotiations.)

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 213
Area (ha): bushland 127.6 (Proposed boundary circumscribes 126.4ha bushland.)
Map no. 43, 44, 50
Map sheet series ref. no. 2134–III SW
Other Names: Submission Area 284; Location 89 (Keighery, BJ, and Trudgen 1992)
Local Authorities (Suburb): Shire of Mundaring (Helena Valley), Shire of Kalamunda (Gooseberry Hill)
System 6 (1983): part M34 area of bushland goes beyond System area boundaries, all bushland described

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS
Darling Plateau (Darling Range)/Darling Scarp
Laterite (Ql: G2, LA1)
Even-grained Granite (Ae, Aes: GR)
Foothills
Colluvial Deposits (Qc: Msg, Mgs2)
Yoganup Formation (Qpr: S12)
Ridge Hill Sandstone (Qph: SS)
Pinjarra Plain
Guildford Formation (Qpa: Mgs1)
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Bassendean Dunes/Pinjarra Plain
Bassendean Sands over Guildford Formation (Qpb/Qpa: S10)

VEGETATION AND FLORA
Vegetation Complexes
Foothills
Forrestfield Complex
Floristic Community Types: *not sampled, type inferred
Supergroup 1: Foothills/Pinjarra Plain
*3c *Eucalyptus calophylla — Xanthorrhoea preissii* woodlands and shrublands (areas within boundaries degraded, not suitable to be identified as threatened ecological community)
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
20a *Banksia attenuata* woodlands over species-rich dense shrublands
20c Eastern shrublands and woodlands (most southern representation but atypical)

WETLANDS
Wetland Types: creek
Natural Wetland Groups
Darling Plateau
Walyunga (D.1)
Bassendean—Pinjarra transition
Mungala (B/P.2)
Swan Coastal Plain Rivers
Swan River (R.2)
Wetland Management Objectives: Conservation (4019.8m)
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Critically Endangered (floristic community type 20c), Endangered (floristic community type 20a)

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: creek (Kadina Brook), vegetated uplands
Vegetation and Flora: limited survey (DEP 1996 (Bushm 01-03), Markey 1997 (Bush 01, in adjacent bushland); detailed survey (*ecologia* 1991)
Structural Units: mapping (*ecologia* 1991)

Uplands: *Eucalyptus wandoo* Woodland; *Banksia attenuata* and *Allocasuarina fraseriana* Open Woodland to Open Forest; *Eucalyptus calophylla* Woodland; *Lambertia multiflora* var. *darlingensis*, *Daviesia physodes* and *Isopogon drummondii* Shrubland

Wetlands: *Eucalyptus rudis* Woodland to Forest

Scattered Native Plants: Forest to Open Woodlands dominated by *Eucalyptus calophylla*, *E. rudis*, *E. marginata* and *Melaleuca rhaphiophylla* — regionally significant vegetation recognised as being included in the area of Site in need of protection

Vegetation Condition: >70% Excellent to Very Good, <30% Good to Degraded, with areas of severe localised disturbance

Total Flora: 305 native taxa (*ecologia* 1991) (estimated >75% expected flora)

Significant Flora: *Isopogon drummondii* (3), *Lambertia multiflora* var. *darlingensis* (3), *Persoonia sulcata* (3) (*ecologia* 1991); *Blancoa canescens*, *Eremaea fimbriata*, *Pityrodia bartlingii*, *Dasypogon obliquifolius*

Fauna: structured survey for birds (19 species), native mammals (1 species), reptiles (8 species) and amphibians (5 species) (Harvey *et al.* 1997). Significant bird species: category 3 (1) and category 4 (2). Significant mammal species: Quenda (*ecologia* 1991)

Linkage: adjacent bushland to the north (Site 216), south (Site 217) and west (Site 481); part of Greenway 49 (Tingay, Alan & Associates 1998a); part of a regionally significant fragmented bushland/wetland linkage (Part A, Map 7)

Other Special Attributes: one of a few areas in the PMR where the Plain and the Plateau meet through naturally vegetated areas (canopy and some bushland); contains plant communities representative of the eastern side of the Swan Coastal Plain; probably contains *Eucalyptus wandoo* Woodland from '*Eucalyptus wandoo* woodland of community 1a' which is part of the only known example of this community type on the Ridge Hill Shelf and 'therefore requires secure protection'. (Markey 1997)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Entered in the Register of the National Estate; subject to protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

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

Recommendation: Part A: Site with Some Existing Protection; Existing Parks and Recreation Reserve. Part B: Other Government Land Mechanism (see Table 3, Volume 1).

BUSHMEAD BUSHLAND, SWAN

Boundary Definition: protected area/bushland (part taken to cadastre)/vegetation complex management boundary

SECTION 1: CADASTRAL INFORMATION

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

Bushplan Site no. 213 **Map no.** 53, 59 **Map sheet series ref. no.** 2134–III SW

System 6 (1983): part M34 area of bushland goes beyond System area boundaries, all bushland described

Other Names
Submission Area 284; Location 89 (Keighery, BJ, and Trudgen 1992)

Area (ha): total 247.7; bushland 127.6

Local Authorities (Suburb)
Shire of Mundaring (Helena Valley), Shire of Kalamunda (Gooseberry Hill)

Zoning
MRS: Public Purposes-Commonwealth Government, Urban, Rural, Parks and Recreation, Controlled Access Highways
TPS: Rural, Rural Landscape Living

Ownership Categories
Commonwealth Government, State Government, Local Government

Lot/Location/Reserve numbers (Purpose), Street name
0, 9 Midland Rd; 20, 6726 Ridge Hill Rd; 7900 Zig Zag Scenic Dr
Crown Reserve

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Darling Plateau (Darling Range)/Darling Scarp
Laterite (Ql: G2, LA1)
Even-grained Granite (Ae, Aes: GR)
Foothills
Colluvial Deposits (Qc: Msg, Mgs2)
Yoganup Formation (Qpr: S12)
Ridge Hill Sandstone (Qph: SS)
Pinjarra Plain
Guildford Formation (Qpa: Mgs1)
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Bassendean Dunes/Pinjarra Plain
Bassendean Sands over Guildford Formation (Qpb/Qpa:S10)

VEGETATION AND FLORA

Vegetation Complexes
Foothills
Forrestfield Complex

Floristic Community Types: *not sampled, types inferred
Supergroup 1: Foothills/Pinjarra Plain
*3c *Eucalyptus calophylla — Xanthorrhoea preissii* woodlands and shrublands (areas within boundaries degraded, not suitable to be identified as threatened ecological community)
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
20a *Banksia attenuata* woodlands over species-rich dense shrublands
20c Eastern shrublands and woodlands (most southern representation but atypical)

WETLANDS

Wetland Types: creek
Natural Wetland Groups
Darling Plateau
Walyunga (D.1)
Bassendean—Pinjarra transition
Mungala (B/P.2)
Swan Coastal Plain Rivers
Swan River (R.2)
Wetland Management Objectives: Conservation (4019.8m)
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES

Critically Endangered (floristic community type 20c), Endangered (floristic community type 20a)

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: creek (Kadina Brook), vegetated uplands

Vegetation and Flora: detailed survey (Ecologia 1991); limited survey (DEP 1996 (Bushm 01–03), Markey 1997 (Bush 01, in adjacent bushland))

Structural Units: mapping (Ecologia 1991)

Uplands: *Eucalyptus wandoo* Woodland; *Banksia attenuata* and *Allocasuarina fraseriana* Open Woodland to Open Forest; *Eucalyptus calophylla* Woodland; *Lambertia multiflora* var. *darlingensis*, *Daviesia physodes* and *Isopogon drummondii* Shrubland

Wetlands: *Eucalyptus rudis* Woodland to Forest

Scattered Native Plants: Forest to Open Woodlands dominated by *Eucalyptus calophylla*, *E. rudis*, *E. marginata* and *Melaleuca rhaphiophylla* — regionally significant vegetation recognised as being included in the area of Bushplan Site in need of protection

Vegetation Condition: >70% Excellent to Very Good, <30% Good to Degraded, with areas of severe localised disturbance

Total Flora: 305 native taxa (Ecologia 1991) (estimated >75% expected flora)

Significant Flora: *Isopogon drummondii* (3), *Lambertia multiflora* var. *darlingensis* (3), *Persoonia sulcata* (3, Ecologia 1991); *Blancoa canescens*, *Eremaea fimbriata*, *Pityrodia bartlingii*, *Dasypogon obliquifolius*

Fauna: structured survey by Western Australian Museum of Natural Science (Harvey *et al.* 1997) for birds (19), native mammals (1), reptiles (8) and amphibians (5). Significant bird species: category 3 (1) and category 4 (2). Significant mammal species: Quenda (Ecologia 1991)

Linkage: adjacent bushland to the north (BS216), south (BS217) and west (BS481); part of proposed Greenway 50 (Tingay, Alan & Associates 1997a); part of a regionally significant fragmented bushland/wetland linkage (Volume 2A, Map 8)

Other Special Attributes: one of a few areas in the PMR where the Plain and the Plateau meet through naturally vegetated areas (canopy and some bushland); contains plant communities representative of the eastern side of the Swan Coastal Plain; probably contains *Eucalyptus wandoo* Woodland from '*Eucalyptus wandoo* woodland of community 1a' which is part of the only known example of this community type on the Ridge Hill Shelf and 'therefore requires secure protection'. (Markey 1997)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Listed on the Register of the National Estate

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

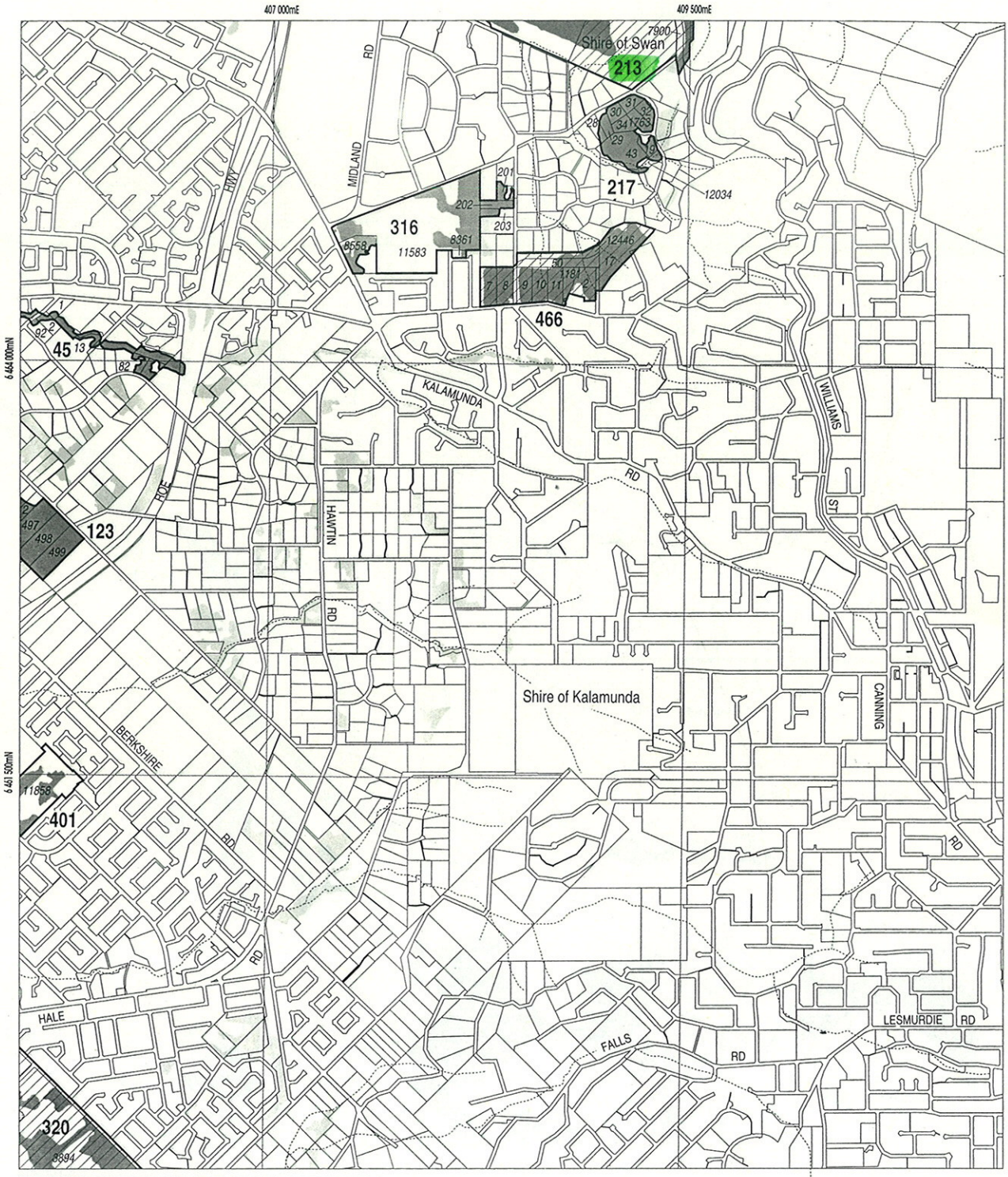
Criteria: Representation of ecological communities, Diversity, Rarity, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation, Criteria not relevant to determination of conservation value, but which may be applied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

Opportunities and/or Constraints

Opportunities: Bushplan Site/part Bushplan Site subject to Swan and Canning Rivers EPP; location of conservation category wetlands; under MRS Parks and Recreation Reservation, Crown Reserve

Constraints: under MRS Urban Zoning, MRD regional road requirements

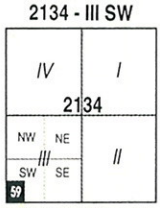
Recommendation: The most appropriate mechanism for the protection of this Bushplan Site be considered through the public comment period in consultation with the land owner(s).



LEGEND

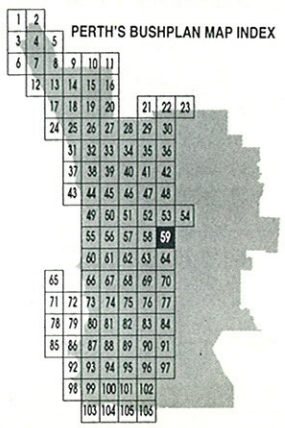
- **472** — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- *696* — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2134 - III SW



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

PERTH'S BUSHPLAN MAP INDEX



N

SCALE

0 — 500 — 1000

Metres

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

nwt-map11//environ/bushplan//bushv2_59.dgn

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

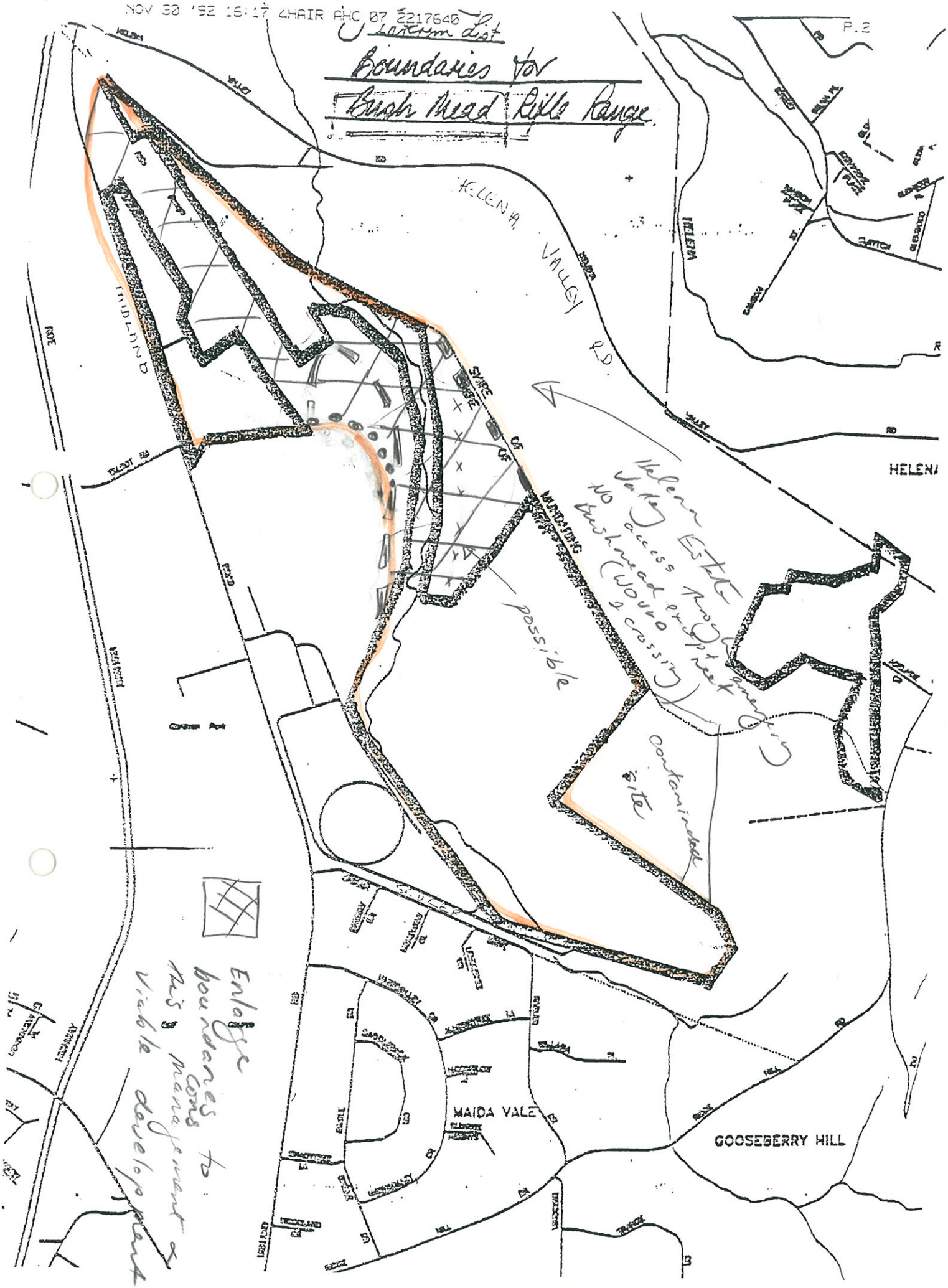
Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

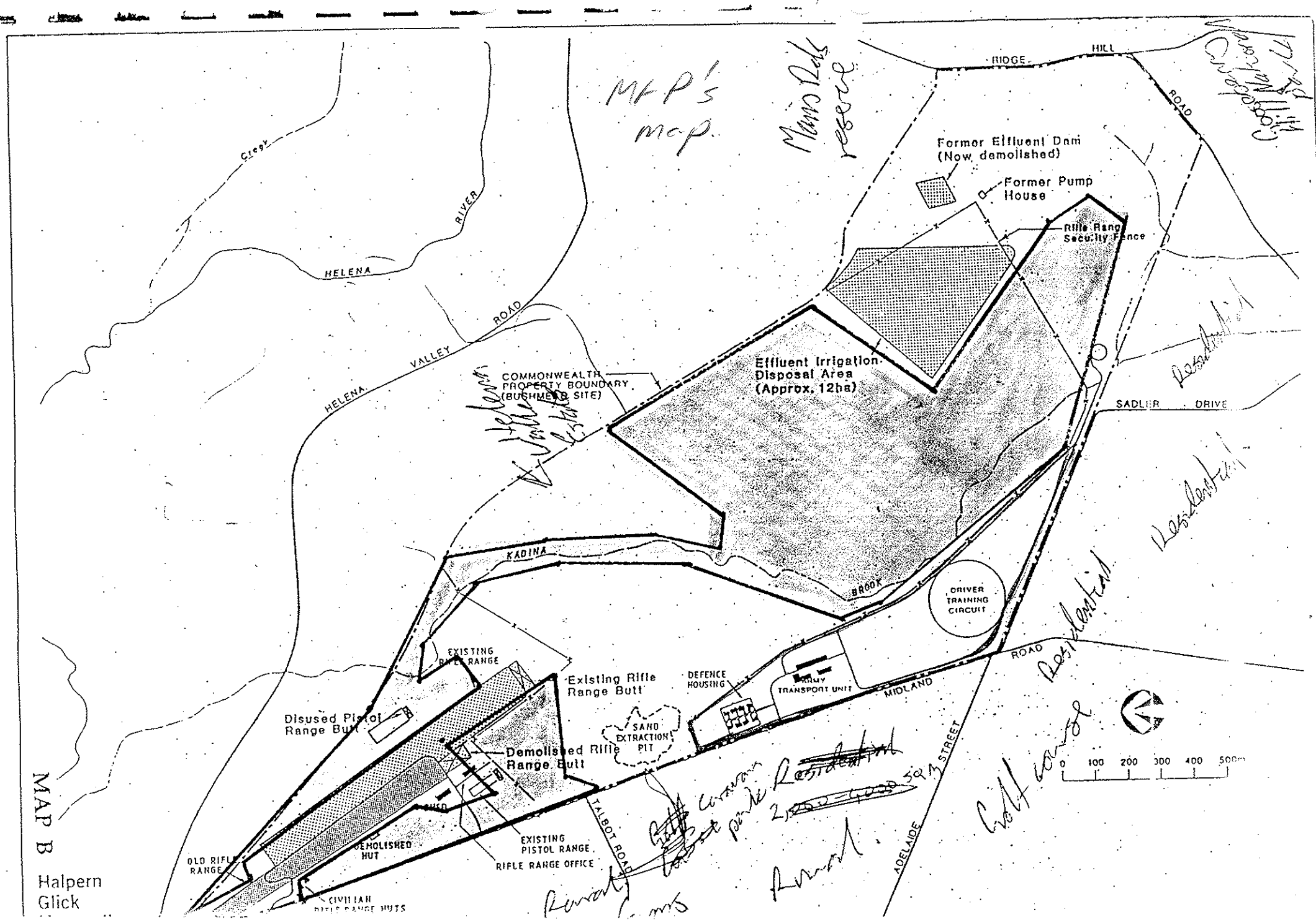
Bushplan Site Map

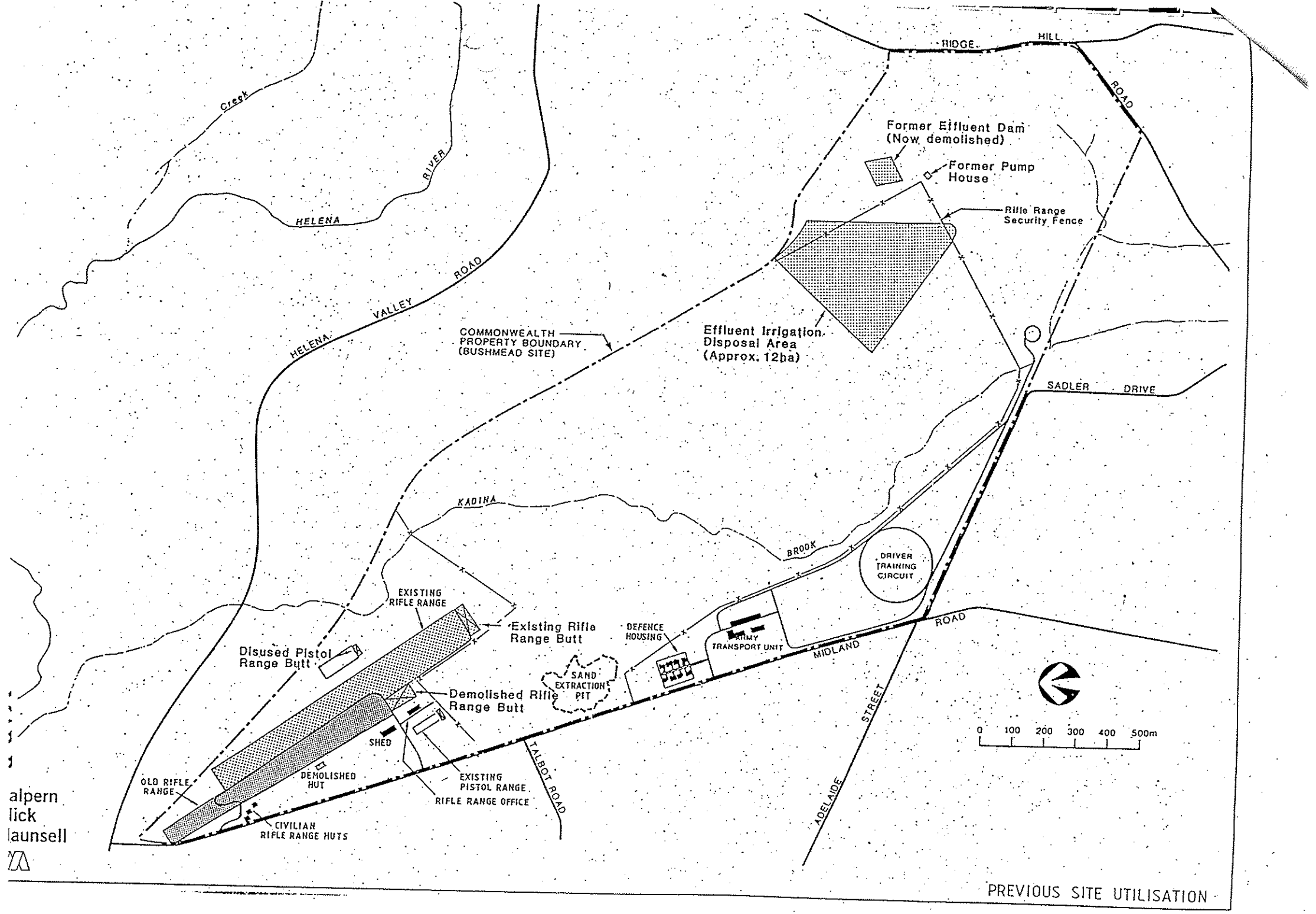
Lantern List

Boundaries for Bush Head Rifle Range



24/10/96


MAP B
Halpern Glick
Former Effluent Dam (Now demolished)
Former Pump House
Rifle Range Security Fence
Effluent Irrigation Disposal Area (Approx. 12ha)
COMMONWEALTH PROPERTY BOUNDARY (BUSHMEAD SITE)
HELENA VALLEY ROAD
HELENA RIVER
RIDGE HILL ROAD
SADLIER DRIVE
KADINA BROOK
DRIVER TRAINING CIRCUIT
ROAD
MIDLAND
ARMY TRANSPORT UNIT
DEFENCE HOUSING
SAND EXTRACTION PIT
Existing Rifle Range Butt
Disused Pistol Range Butt
Demolished Rifle Range Butt
EXISTING RIFLE RANGE
EXISTING PISTOL RANGE
RIFLE RANGE OFFICE
DEMOLISHED HUT
OLD RIFLE RANGE
CIVILIAN RIFLE RANGE HUTS
TALBOT ROAD
ADELAIDE STREET
0 100 200 300 400 500m



PREVIOUS SITE UTILISATION

ADDITIONS TO 213

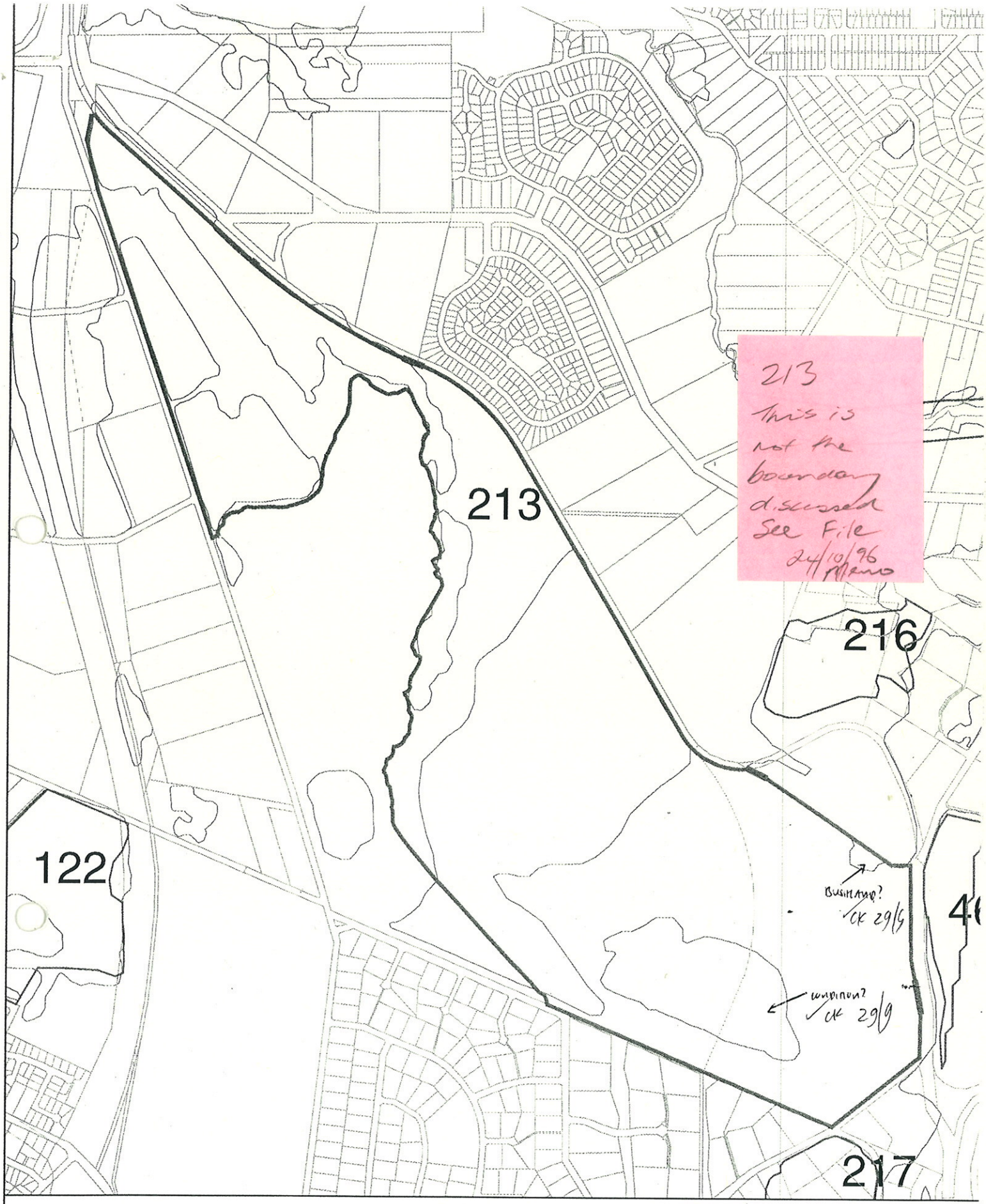
BUSHPLAN SITES CORRECTED

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS

B DK 27/10

N



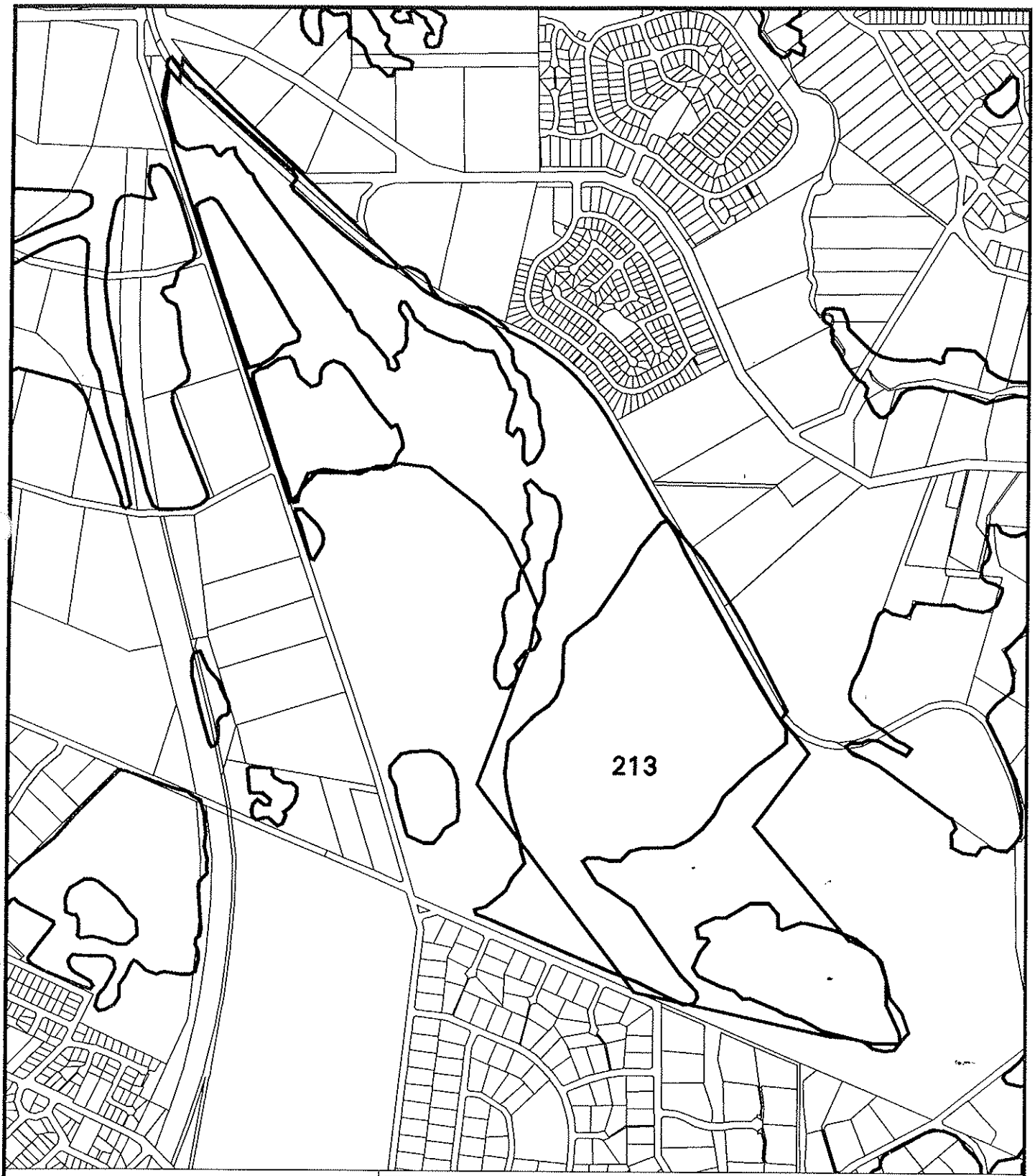
BUSHPLAN SITES CORRECTED

THE GOVERNMENT OF WESTERN AUSTRALIA

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS WESTERN AUSTRALIA

N



bp site 213

AG VEG 1998 - BOUNDARIES SCP

Bushplan sites refno 1-500 SCP BOUNDARY THEME

Cadastre

MFP INTERNAL USE ONLY

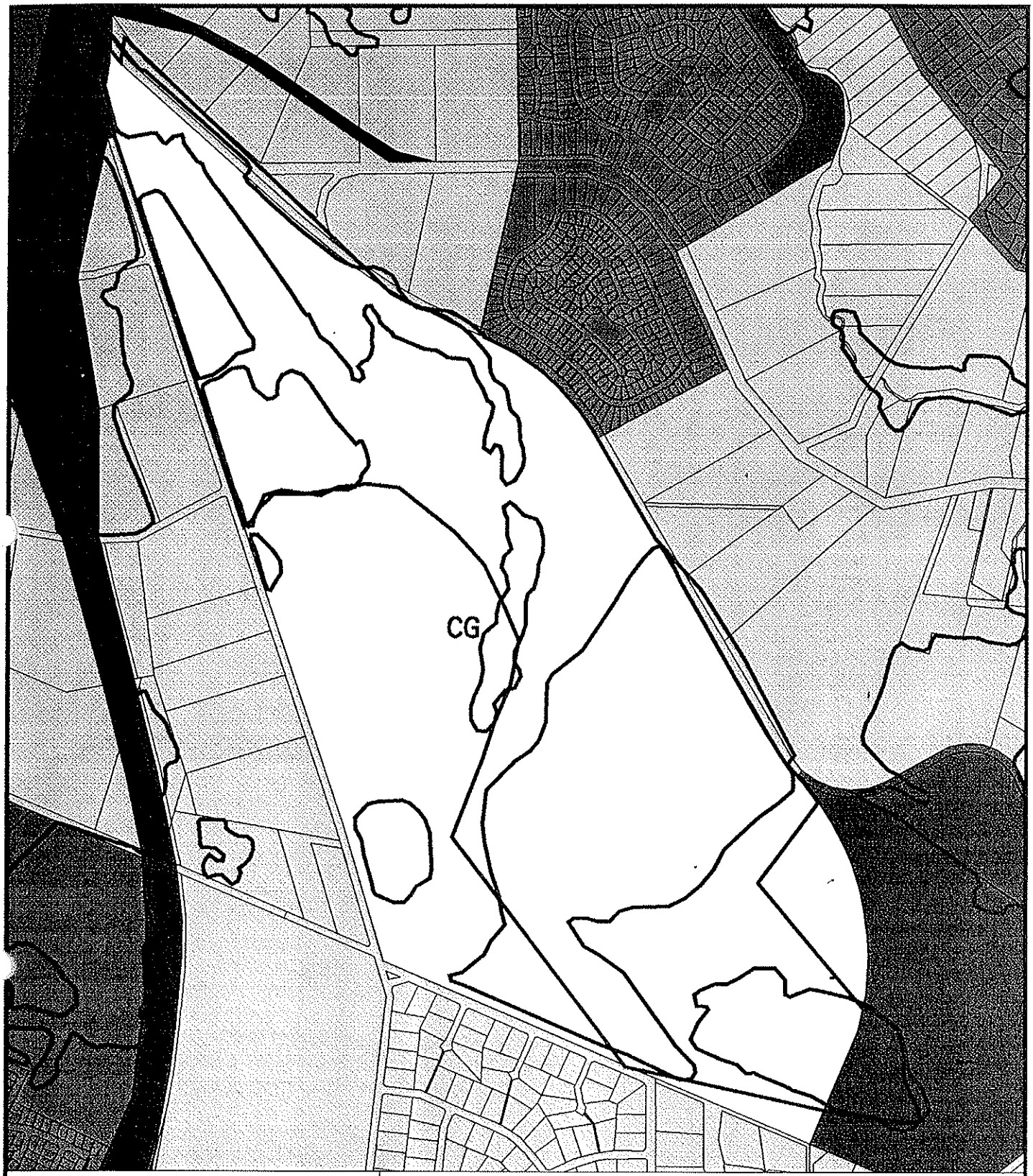
Prepared By: Andrea Zappacosta

Prepared For:

Map Ident: plot980921_1

Date: 21 Sep 98

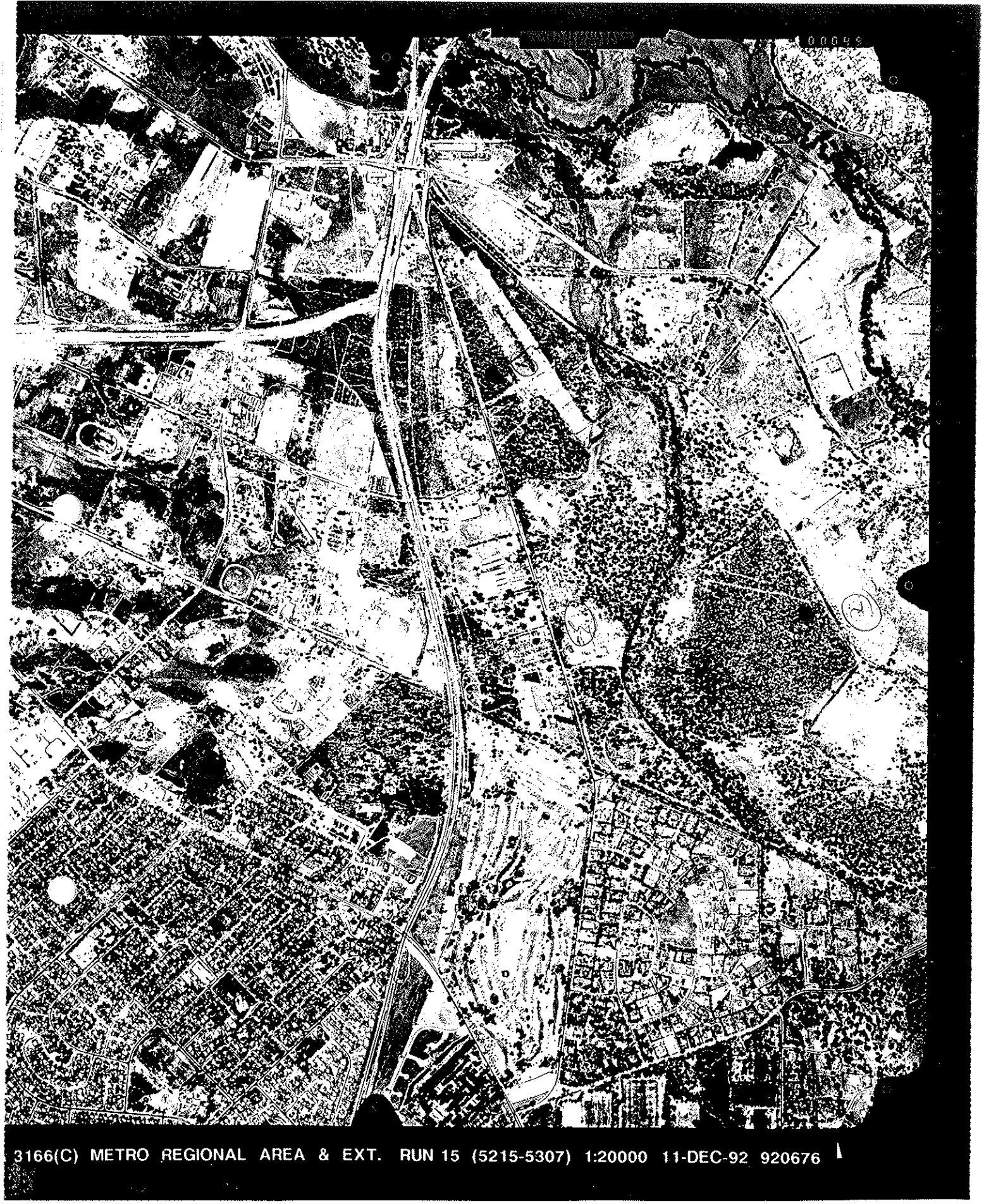
Scale 1:15950



bp site 213

MFP INTERNAL USE ONLY
Prepared By: Andrea Zappacosta
Prepared For:
Map Ident: plot980907_1
Date: 07 Sep 98
Scale 1:14468

- Bushplan sites refno 1-500 SCP BOUNDARY THEME
- Cadastre
- AG VEG 1998 - BOUNDARIES SCP
- URBAN
- INDUSTRIAL
- RURAL
- PARKS & RECREATION
- CONTROLLED ACCES
- PP - COMMONWEALT



Bushmead plots.

e.

SYSTEM 6 BUSHLAND SUBMISSION FORM
FOR CONSIDERATION IN THE UPDATE PROGRAMME

See Subm 174(K)

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: Ridge Hill Rd, Midland Rd, Sadler Drive

b) Nearest Corner: Midland Rd, Sadler Drive

c) Lot Number: ..... Street Number: .....

d) Town/Suburb/Location: Bushmead / Maida Vale / Gooseberry Hill

e) Local Council: Shire of Swan

f) Site Name (if any): Bushmead Rifle Range

g) Approximate size of the area (ha): 29.6 Ha

h) Please locate the area on a map and give us map references if possible:

.....

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

j) Map no.: 64

k) Grid Ref: E6

l) Please give any other information that may help us to find the location:
Abutts M34 on the west boundary, adjacent to Gooseberry Hill National Park

m) Are you aware of any development proposals that are likely to affect the area?
Abandoned proposal to sell for housing

.....

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

9. What percentage of the wetland is open water in summer? ....0..........

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

10. What percentage of the area is indigenous vegetation? ....75%..........

11. If the area includes regions cleared of native bushland please indicate reasons for the inclusion. One of the major areas of remnant vegetation in Perth. Abutts other major areas M34, Major population of greenda, Potential for restoration

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

If yes, please give details of the work ..Draft Environmental Impact Statement for Proposed Sale, HGM (1991); Supplement to Draft EIS, HGM (1992). Brooker, CSIRO, 1972 - 1992 Keighery et al (1992),

Anna Napier (1992) for Bowman Bishaw Gorham 103 species
WA Wildflower Society (1989) Field Survey 106 species (one day survey).
Ecologia (1991) 35 person days 375 species
See summary HGM (1991).

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

a) pristine
b) excellent
c) very good * 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 %
b) fragmentation 5 %
c) Selective removal of species: timber cutting, wildflower picking, mowing dieback and other plant diseases
d) Fire regime, including intensity, season and frequency
e) 'Enrichment plantings' that is plantings of species not found in that community
f) Weed invasion
g) Animal impact: horses, foxes, rabbits, cats, dogs, camels, goats etc
h) Soil movement, both removal and dumping
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

SITE LOCATION
Suggested name of area (1996)

System 6 (1984)

Some Other Commonly used Names:
Submission 284 Bushmead Rifle Range

Area (ha):
Total: 297.7ha Bushland >80ha (addition polygons of remant vegetation 78.8).
Zoning (MRS & town planning)

Local Authorities (Suburb)
Mundaring
Ownership categories: Street name, Lot number:
Commonwealth

LANDFORM, SOIL AND WETLAND TYPES
Foothills of the S12, S10, S8, G2, LA1, SS
Lake EPP Area: none recorded

REGIONAL VEGETATION AND FLORA
Vegetation Complex (Heddle et al 1983)
Forrestfield Complex
Floristic Communities:
Supergroup 1 - Ridge Hill Shelf/Pinjarra Plain
*3b *E. calophylla - E. marginata* woodlands on sandy clay soils

Supergroup 3: Uplands, centred on Bassendean Dunes
20a *Banksia attenuata* woodlands over species rich dense shrublands
Northern section of *Banksia* woodlands allied to 20c Eastern shrublands and woodlands

REGIONAL WETLAND:
Wetland Types: river, highland
Consanguineous suite: D1, B/P.2, R.2
Wetland Management Objective: conservation (river)

THREATENED COMMUNITIES/SPECIES (Draft Department of Conservation and Land Management)
*3b Vulnerable
20b Endangered

AREA DESCRIPTION:
Vegetation and Flora:
DRF/Priority:
GIS: P3 ID5700, 5698
Records from survey: Priority Taxa: Lambertia multiflora. var. darlingensis MS (3), Isopogon drummondii (3)
Significant Taxa: Dasypogon obliquifolius, Eremaea fimbriata, Pityrodia bartlingii

Fauna
Mammals: NA
Linkage: Linkage to Darling Range through tree canopy.between remnants in Bushmead (especially along river line) and adjacent
Special Attributes:
INTERNATIONAL AND NATIONAL SIGNIFICANCE
On the Register of the National Estate (120 hectares)
CONSERVATION RECOMMENDATIONS
Criteria met for inclusion: eg XX, XY Y
Constraints: Private land and MRS Urban zoning
Recommendation:

PART 2: BUSHPLAN SITE DESCRIPTIONS

INTRODUCTION

The XX Bushland Sites are described as outlined in Part 1 of this Volume. The Sites are grouped according to the landforms units on which they are located (see Part 1, Section 2, Landform and soils) namely:

Section 1: Foothills and Pinjarra Plain (eastern side of the Swan Coastal Plain)
Section 2: Bassendean Dunes
Section 3: Spearwood Dunes
Section 4 Quindalup Dunes.

Within each section the Sites are ordered from north to south of the PMA.. When a Site contains a series of landform units the Site is grouped with the major landform unit found in the Site.

DESCRIPTIONS

SECTION 1: FOOTHILLS and PINJARRA PLAIN

A brief description of the features of the landform unit is intended for the rest of this page.

Correct boundary definitions

ADELAIDE CR, HELENA VALLEY

Boundary Definition: bushland boundary

SECTION 1: CADASTRAL INFORMATION

Bushplan Site no.: 216 **Map no.:** **Map sheet series ref. no.:**

Some Other Commonly used Names:

Area (ha): Total: 11.283, Bushland: 11.283

Local Authorities (Suburb)
Shire of Mundaring (Helena Valley)

Zoning
MRS: Rural
TPS: Rural Landscape Living, Public Open Space

Lot/Location numbers, Street name
2, 6 Helena Valley Rd, 500 Alexander Av, 9 Adelaide Cr
10660 Alexander Av

Ownership Categories (Purpose)
Private Person
Multiple Owners

SECTION 2: REGIONAL INFORMATION

LANDFORM AND SOILS

Scarp
Darling Scarp - gravels and laterite (La1)

Foothills
Colluvial deposits (Qc : Msg)
Ridge Hill Sandstone (Qph: SS)

VEGETATION AND FLORA

Vegetation Complex

Foothills
Forrestfield Complex (Ridge Hill Shelf, Darling Plateau)

Floristic Community Types: not sampled types not inferred

WETLANDS

Wetland Types: creek

Consanguineous suite

Darling Plateau
Walyunga (D.1)

Wetland Management Objective: Conservation (445.617m), Resource Enhancement
Lake EPP: none identified

THREATENED COMMUNITIES
Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape features: creek, vegetated uplands
Vegetation and Flora limited survey (Mattiske and Associates 1997; Keighery & Trudgen 1992)
Structural units: *Eucalyptus wandoo* Open Woodland
Vegetation Condition: Good (MfP 1996)
Total Flora: not known
DRF priority and significant flora: none recorded

Fauna
No known information
Linkage: fragmented bushland linkage to north (Helena River), east (Darling Range Regional Park (DPUD 1993)), west (Bushmead Rifle Range (213)) available
Special Attributes:

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

SECTION 5: INCLUSION CRITERIA AND RECOMMENDATIONS
Criteria met for inclusion: Representation of ecological communities
Opportunities &/or constraints: Private land, .
Recommendation: The mechanism for the conservation of this Site be considered through the public comment period and specified in the final report

BUSHMEAD RIFLE RANGE

Boundary Definition: management boundary

SECTION 1: CADASTRAL INFORMATION

Bushplan Site no.: 213 **Map no.:** **Map sheet series ref. no.:**

Other Names: Submission 284; Location 89 (Keighery and Trudgen 1992)
Local Authorities (Suburb)
Shire of Swan (Helena Valley)

Area (ha): Total: 186.529, Bushland: 78.766

Zoning
MRS: PP - Commonwealth Government, Urban, Rural, Parks & Recreation
TPS: Rural, Rural Landscape Living
Ownership Categories (Purpose)
Private Person
Commonwealth Government
Commercial Organisation
State Government
Multiple Ownership

Lot/Location numbers, Street name
2, 230, 237, 238 Helena Valley Rd
9 Midland Rd
203, 231 Helena Valley Rd
0 ?
7894 ?, 6 Helena Valley Rd

SECTION 2: REGIONAL INFORMATION

LANDFORM AND SOILS

Scarp
Darling Scarp - gravels and laterite (Czl: G2)
Pinjarra Plain
Guildford formation (Qpa: Mgs1, Mgs2)
Foothills
Yoganup Formation (Qpr: S12)
Bassendean Dunes
Bassendean sands (Qpb: S8)
Bassendean Dunes/Pinjarra Plain
Bassendean sands over Guildford Formation (Qpb/Qpa: S10)

VEGETATION AND FLORA

Vegetation Complex
Foothills
Forrestfield Complex

Floristic Community Types: * not sampled type inferred
Supergroup 1 - Foothills/Pinjarra Plain
*3c *E. calophylla- Xanthorrhoea preissii* woodlands and shrublands (areas within boundaries degraded)
Supergroup 3 - Uplands, centred on Bassendean Dunes and the Dandaragan Plateau
20a *Banksia attenuata* woodlands over species rich dense shrublands
20c Eastern shrublands and woodlands (most southern representation but atypical)

WETLANDS

Wetland Types: creek
Consanguineous suite
Darling Plateau
Walyunga (D.1)
Bassendean - Pinjarra transition
Mungala (B/P.2)
Coastal Plain Rivers
Swan River (R.2)
Wetland Management Objective: Conservation (225m)
Lake EPP: none identified

THREATENED COMMUNITIES

Critically Endangered (floristic community type 20c), Endangered (floristic community type 20a)

SECTION 3: SPECIFIC SITE DETAIL

Landscape features: vegetated creek (Kadina Brook), vegetated uplands, foothills of the Darling Plateau
Vegetation and Flora: detailed survey (Ecologia 1991); limited survey (DEP 1996, Bushm01-03)
Structural units: mapping (Ecologia 1991)
Uplands: *Banksia attenuata* and *Allocasuarina fraseriana* Open Woodland to Open Forest; *Eucalyptus calophylla* Woodland; *Lambertia multiflora* var. *darlingensis*, *Daviesia physodes* and *Isopogon drummondii* Shrubland
Wetlands: *Eucalyptus rudis* Woodland to Forest
Remnant Vegetation (canopy only): >50% of Site Forest to Open Woodlands dominated by *Eucalyptus calophylla*, *E. rudis*, *E. marginata* and *Melaleuca rhaphiophylla*
Vegetation Condition: >70% Excellent to Very Good with <30% Good to Degraded with areas of severe localised disturbance
Total Flora: 305 native taxa (estimated >75% expected flora, Ecologia 1991)
DRF/Priority and significant flora: *Isopogon drummondii* (3), *Lambertia multiflora* var. *darlingensis* ms (3), *Persoonia sulcata* (3, Ecologia 1991); *Blancoa canescens*, *Eremaea fimbriata*, *Pityrodia bartlingii*, *Dasypogon obliquifolius*

Fauna

Site surveyed by multiple and structured surveys for birds (60), reptiles (41), amphibians (7) and mammals (5) (Halpern, Glick, Maunsell 1991). Site currently being surveyed by structured survey by WA Museum for birds (19), mammals (1), reptiles (8) and amphibians (5). Significant bird species: category 3 (1), cat 4 (2).
Linkage: canopy linkage to east available.
Special Attributes: One of a few areas in the PMA where the Plain and the Plateau meet through naturally vegetated areas (good canopy and some bushland)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
part Site on the Register of the National Estate

SECTION 5: INCLUSION CRITERIA AND RECOMMENDATIONS
Criteria met for inclusion: Representation of ecological communities, Diversity, Rarity, Maintaining ecological systems or natural processes, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation, Criteria not relevant to determination of conservation value, but which may be applied when evaluating areas having similar values
Opportunities &/or Constraints: Private land, MRS Urban zoning
Recommendation: The mechanism for the conservation of this Site be considered through the public comment period and specified in the final report

name?TALBOT RD, HAZELMERE

Boundary Definition: bushland boundary

SECTION 1: CADASTRAL INFORMATION
Bushplan Site no.: 120 **Map no.:** **Map sheet series ref. no.:**
Some Other Commonly used Names: **Area (ha):** Total: 1.392, Bushland: 1.392

Local Authorities (Suburb)
Shire of Swan (Hazelmere)

Zoning
MRS: Rural, Controlled Access Highways
TPS: Rural, General Rural

Lot/Location numbers, Street name
0 Stirling Cr
148 Talbot Rd

Ownership Categories (Purpose)
State Government
Private Person

SECTION 2: REGIONAL INFORMATION
LANDFORM AND SOILS
Bassendean Dunes
Bassendean sands (Qpb: S8)

VEGETATION AND FLORA
Vegetation Complex
Foothills
Forrestfield Complex (Ridge Hill Shelf, Darling Plateau)
Floristic Community Types: not sampled types not inferred

WETLANDS
No wetlands mapped

THREATENED COMMUNITIES
Not assessed

SECTION 3: SPECIFIC SITE DETAIL
Landscape features: vegetated uplands
Vegetation and Flora
Structural units: Not known
Vegetation Condition: Very Good (MfP 1996)
Total Flora: not known
DRF/Priority and significant flora: none recorded

Fauna
No known information
Linkage: fragmented bushland linkage to north then east to Bushmead Rifle Range (213) available
Special Attributes:

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

SECTION 5: INCLUSION CRITERIA AND RECOMMENDATIONS
Criteria met for inclusion: Representation of ecological communities
Opportunities &/or constraints: Private land, .

Department of Environmental Protection System 6 Update: Site Based Flora List for Bushmead Rifle Range (Subm no. 284)
(~~104~~ 87 taxa, Bushm01-02, B.J. Keighery, 11/6/96)

Anthericaceae

Johnsonia pubescens
Thysanotus sparteus
Thysanotus thyrsoideus
Tricoryne elatior

Apiaceae

Trachymene pilosa

Asteraceae

* Hypochaeris glabra
* Ursinia anthemoides
Waitzia paniculata
Waitzia suaveolens

Campanulaceae

Wahlenbergia preissii

Casuarinaceae

Allocasuarina fraseriana

Centrolepidaceae

Centrolepis aristata
Centrolepis drummondiana

Chloanthaceae

Pityrodia bartlingii

Colchicaceae

Burchardia congesta

Crassulaceae

Crassula colorata
Crassula pedicellosa

Cyperaceae

Caustis dioica
Lepidosperma eastern terete scps (BJK&NG 232)
Mesomelaena pseudostygia
Mesomelaena tetragona

Schoenus caespititius
Tetraria octandra

Dasypogonaceae

Calectasia cyanea
Dasypogon bromeliifolius
Dasypogon obliquifolius
Lomandra hermaphrodita
Lomandra nigricans

Dilleniaceae

Hibbertia aurea
Hibbertia huegelii
Hibbertia hypericoides

Droseraceae

Drosera erythrorhiza
Drosera stolonifera

Epacridaceae

Astroloma stomarrhena
Styphelia tenuiflora

Euphorbiaceae

Monotaxis grandiflora
Poranthera microphylla
Stachystemon vermicularis

Goodeniaceae

Dampiera linearis
Scaevola repens var. repens

Haemodoraceae

Anigozanthos humilis
Conostylis aurea
Conostylis juncea
Conostylis setigera
Conostylis setosa
Haemodorum sp. scps

Iridaceae

* Gladiolus caryophyllaceus
Patersonia occidentalis

Lamiaceae

Hemiandra pungens

Loganiaceae

Mitrasacme paradoxa

Mimosaceae

Acacia applanata

Molluginaceae

Macarthuria australis

Myrtaceae

Eremaea fimbriata
Eucalyptus marginata

Orchidaceae

Caladenia flava
Leporella fimbriata
Pterostylis recurva
Pterostylis vittata

Papilionaceae

Bossiaea eriocarpa
Daviesia nudiflora
Daviesia physodes
Hovea trisperma var. trisperma
Jacksonia restioides
Templetonia biloba

Pittosporaceae

Pronaya fraseri

Poaceae

Neurachne alopecuroidea

Proteaceae

Adenanthos cygnorum
Banksia attenuata
Banksia menziesii
Conospermum stoechadis
Dryandra nivea
Hakea ruscifolia
Isopogon drummondii
Lambertia multiflora var. darlingensis MS
Petrophile linearis

Stirlingia latifolia
Synaphea spinulosa

Restionaceae

Alexgeorgea nitens
Hypolaena exsulca
Loxocarya fasciculata
Lyginia barbata
Restio sinuosus MS

Rutaceae

Eriostemon spicatus

Stylidiaceae

Stylidium diuroides
Stylidium schoenoides

Thymelaeaceae

Pimelea sp. scps

Xanthorrhoeaceae

Xanthorrhoea preissii

AUSTRALIAN HERITAGE
COMMISSION

FACSIMILE MESSAGE

TO: Natalie Thoring - DEP

FAX: 09-321 5184

FROM: Melinda Brouwer

DATE:

PAGES FOLLOWING: 4

SUBJECT: Bushmead

MESSAGE

Listing info as requested.

If you would like values statutes for these places let me know. (They provide reference probably more clearly outlined significance)

Regards

Melinda

247 2172095
SHA HOUSE 39 BRISBANE AVENUE BARTON ACT 2600 PHONE (06) 274 2111 FAX (06) 273-3366
GPO BOX 1567 CANBERRA ACT 2601 AUSTRALIA

Register of the National Estate Database
Place Report

Identification

Name of Place: Bushmead Rifle Range Area
Other Names:
Database No: 017825
File No: 5/13/026/0072
Principal Group: Natural Environment

Status

Legal Status: 30/05/1995 — Registered
Admin Status: 30/05/1995 — Registered

Location

Nearest Town: Helena Valley
Distance (km):
Direction from town:
Area (ha): 120.00
Address: Midland Rd, Helena Valley WA 6056
Local authorities: Mundaring Shire
Swan Shire

Property Information
Commonwealth land - department of defence (rifle range and Driver training circuit) crown and Private land. C/t 1822/279 crown c/t 1822/280 Commonwealth.

Location/Boundaries
About 120ha, at Helena Valley, comprising: (1) the area bounded by a line commencing on the western boundary of the rifle range (Midland Road) at AMG northing (Zone 50J): 6467450mN, then via straight lines joining the latter point and following amg points consecutively: 07336754, 07646758, 07416791, 07316783, 07256793, 07276802 and 07046837, then directly to the western boundary of the rifle range at AMG northing: 6468330mN, then south-easterly via that boundary to the commencement point, (2) the area bounded by straight lines joining the northernmost point of the rifle range and the following AMG points consecutively: 06916872, 07056849, 07096852, 07396781, 07696789, 07636798, 07736797, 07886785, 07946759, 07926724, 07746673, 07806658, 08286604, 08966586, 09036599, 08986610 and 08466646, then directly to the northern boundary of the rifle range at AMG easting: 408730mE and approximate northing: 6466800mN, then north-westerly via that boundary to amg northing: 6467460mN, then via straight lines joining the latter point and following AMG points consecutively: 08096712, 08016712, 08056737 and 08036763, then directly to the northern boundary of the rifle range at AMG easting: 407970mE and approximate northing: 6467940mN, then north-westerly via that boundary to the commencement point. (3) the area bounded by straight lines joining the following amg points consecutively: 09396646, 09376706, 09436713, 09466723, 09356730, 09346721, 09226717, 09086719, 09066713, 09006715, 08896689, 09016681, 09126689, 09306684, 09236669, 09276653 and the commencement point.

AHC Official Statement of Significance

The Bushmead site is an important metropolitan bushland remnant with high geomorphic, vegetation and wildlife values. It also has significant aesthetic values as part of the view from the adjacent Gooseberry Hill National Park. The primary significance of the southern portion of the site is that it is one of the best remaining examples of the ridge hill shelf system and its associated Forrestfield vegetation complex, and the only large remaining area of this system in the Perth Metropolitan region. In addition, BANKSIA/ALLOCASUARINA woodland in good condition, as occurrs adjacent to the old railway reserve in the central portion of the site, is now rare. The northern portion of the site is important as an example of the Bassendean dunes system and its associated southern rivers vegetation complex in very good condition. This floristically diverse and structurally complex area contains several species of Flora of regional significance. the EUCALYPTUS RUDIS/MELALEUCA RHAPHIOPHYLLA association along Kadina brook is important, both because substantially unmodified examples of this association are now scarce in the metropolitan area, and because it provides habitat for a population of the endangered southern Brown bandicoot. The Bushmead site is also utilised by another endangered mammal, the churditch or Western quoll.

Description

The 120 hectare urban bushland remnant is located in the Perth suburb of Helena Valley at the foot of the Darling Scarp, 16km north east of the city centre. East of the Darling fault, which bisects the site in a north-south direction, the site forms part of the Forrestfield land unit of the ridge hill shelf system. West of the fault, the site roams part of the site, which falls some 65 metres from south to north, includes the headwaters and middle reaches of Kadina Brook. The Brook follows the line of the Darling fault. The vegetation of the ridge hill shelf system in the east of the site would have originally been open forest of the Forrestfield complex. It is now a mix of several woodland formations; Wandoo in the central eastern area, jarrah/marri and marri/jarrah in the south eastern area and a variety of marri/jarrah/banksia complexes nearer to Kadina Brook. EUCALYPTUS RUDIS open woodland is found along the upper creek line itself.

The western section of the site contains elements of the Southern River complex which is one of the five vegetation complexes associated with the Bassendean dune system. In the north-central portion of the site this consists primarily of marri/jarrah woodland, with E. RUDIS/MELALEUCA raphiophylla woodland along Kadina Brook. The far north west of the site supports a diverse and structurally complex BANKSIA/E. TODTIANA woodland east of the rifle range and BANKSIA/ ALLOCASUARINA/E. TODTIANA woodland to the west. more than 220 native species of vascular plants have been recorded at Bushmead. These include two regionally significant species, CONOSTYLIS CANESCENS and Anigozanthus MANGLESII x A. HUMILIS, which are found in woodland areas on Bassendean sand in the north-western corner of the site. Wildlife surveys have noted 5 species of native mammals, 60 species of birds, 11 species of reptiles and 7 species of amphibians.

However, given the vegetation associations at Bushmead and known habitat requirements of other wildlife which are found in the general area, it is expected that the site is likely to support a total of 17 species of native mammals, 100 species of birds, 41 species of reptiles and 11 species of amphibians. These species include five that are gazetted as schedule 1 of the WA wildlife conservation act, and four that are gazetted under schedule 2 of that act. There are definite indications of the presence of three of these species. These are the southern brown bandicoot (ISOODON OBESULUS), western quoll or churditch (DASYURUS GEOFFROII) and baudin' s black cockatoo (Calyptorhyncus BAUDINII). The most important habitat for both mammals and birds appears to be the vegetation associated with Kadina Brook. Regarding Aboriginal sites, traditionally the area around Perth was part of the territory of the whad jug. Nyungar people hold an interest in the area and some religious associations are known for the region of which Bushmead forms a part. There is a report from a Nyungar informant that a ceremonial site exists within

Description (continued)

Bushmead but despite a number of attempts to obtain more details about the site, its exact location and current status remain unknown (draft EIS 1991: 61-63, appendix b). A number of stone artefact scatters have been recorded within the Bushmead area but all have suffered varying degrees of disturbance.

Condition

Overall, the site is in good condition For aa urban bushland remnant. Only 10 hectares have been largely cleared, with a furhter 10 hectares partially cleared. The north-western portion of the site is in very good condition, with minimal weed Invasion and only isolated instances of tree-felling and rubbish dumping. The BANKSIA - ALLOCASUARINA woodland in the central portion of tthe site is in fair to good condition, with some evidence of grazing, sporadic Timber cutting and possible Phytopthera infection. The southern portion is a mix of jarrah/BANKSIA woodland in moderate condition and jarrah/marri woodlands with an understorey dominated by introduced grasses which appear to have been heavily grazes until recently. There are Some signs of Armillaria infection in individual E. CALOPHYLLA trees. the central eastern area is a mix of E. WANDOO woodland with very Little weed invasion, areas of dense shrubland with low to moderate weed invasion and patches of land Where rubbish dumping has occurred and introduced species dominate. This area also contains a former main roads department Gravel Pit.

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• • • End Of Report • • •

FS# 354 (Fi 6 164)

GROUND FAUNA OF BUSHLAND REMNANTS ON THE RIDGE HILL SHELF AND PINJARRA PLAIN LANDFORMS, PERTH

Report to the Australian Heritage Commission
NEP Grant N95/49

by

M. S. Harvey, J. Dell, R. A. How and J. M. Waldock

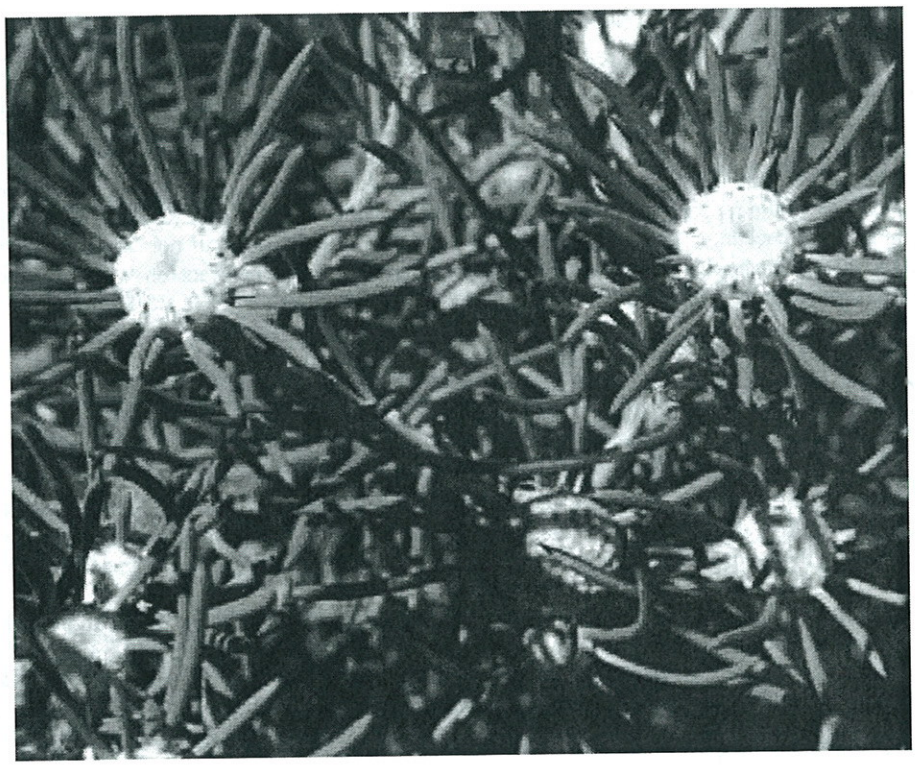
Western Australian Museum
Western Australian Naturalists' Club

July 1997

The project "Fauna of the Ridge Hill Shelf and Pinjarra Plain Bushland" was carried out with the assistance of funds made available by the Commonwealth of Australia under the National Estate Grants Program.

DRAFT

FLORA ASSESSMENT
BUSHMEAD RIFLE RANGE
HELENA VALLEY



Prepared for:
Environmental Resources Management Australia
PO Box 7338
CLOISTERS SQUARE 6854

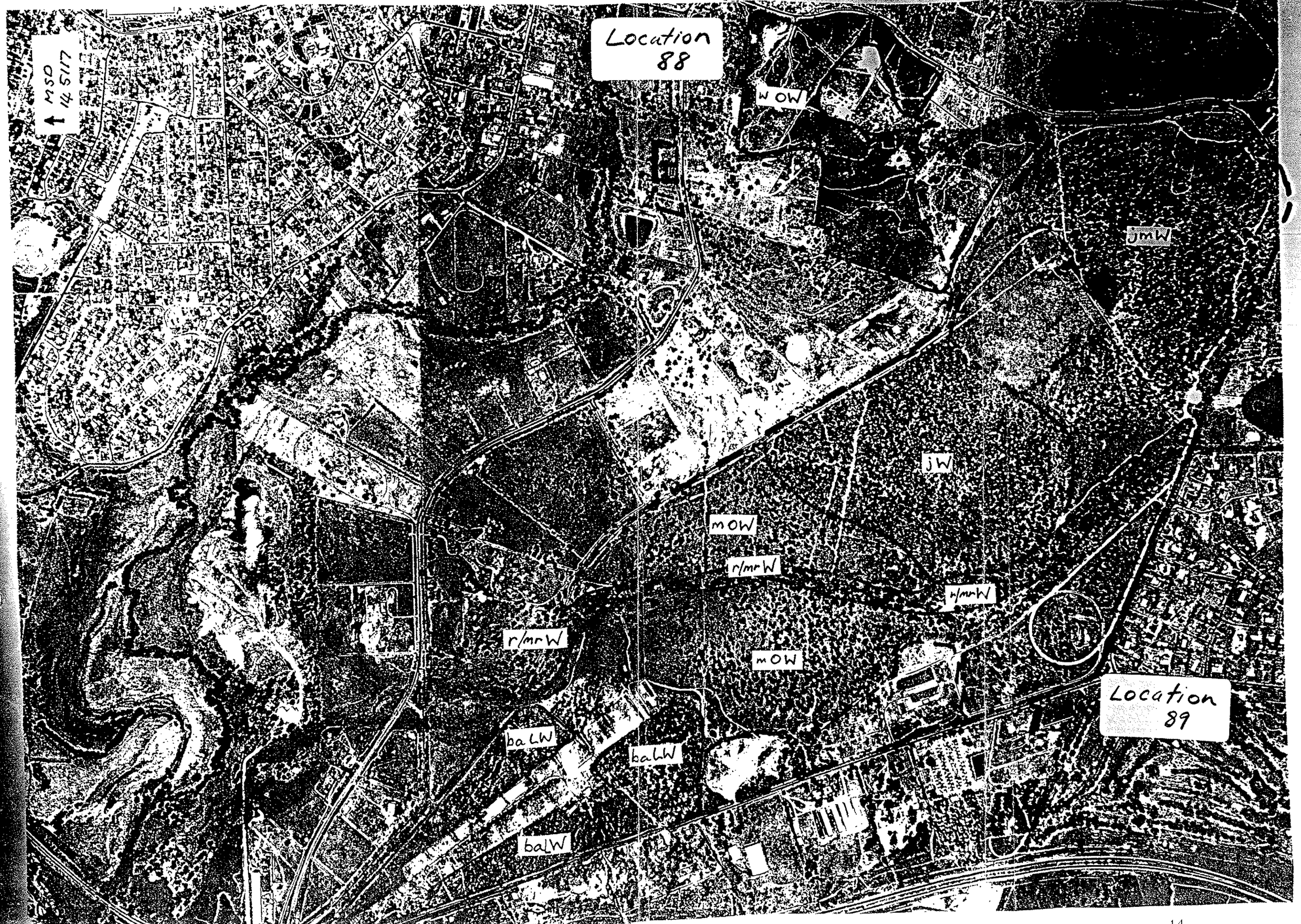
Prepared by:
Bennett Environmental Consulting Pty Ltd

Sollya heterophylla

PO Box 341
KALAMUNDA 6926

March 2006


5236 WA 3166(C) METRO REGIONAL AREA & EXT. RUN 15 (5215-5307) 1:20000 11-DEC-92 920676



Locations 88 and 89

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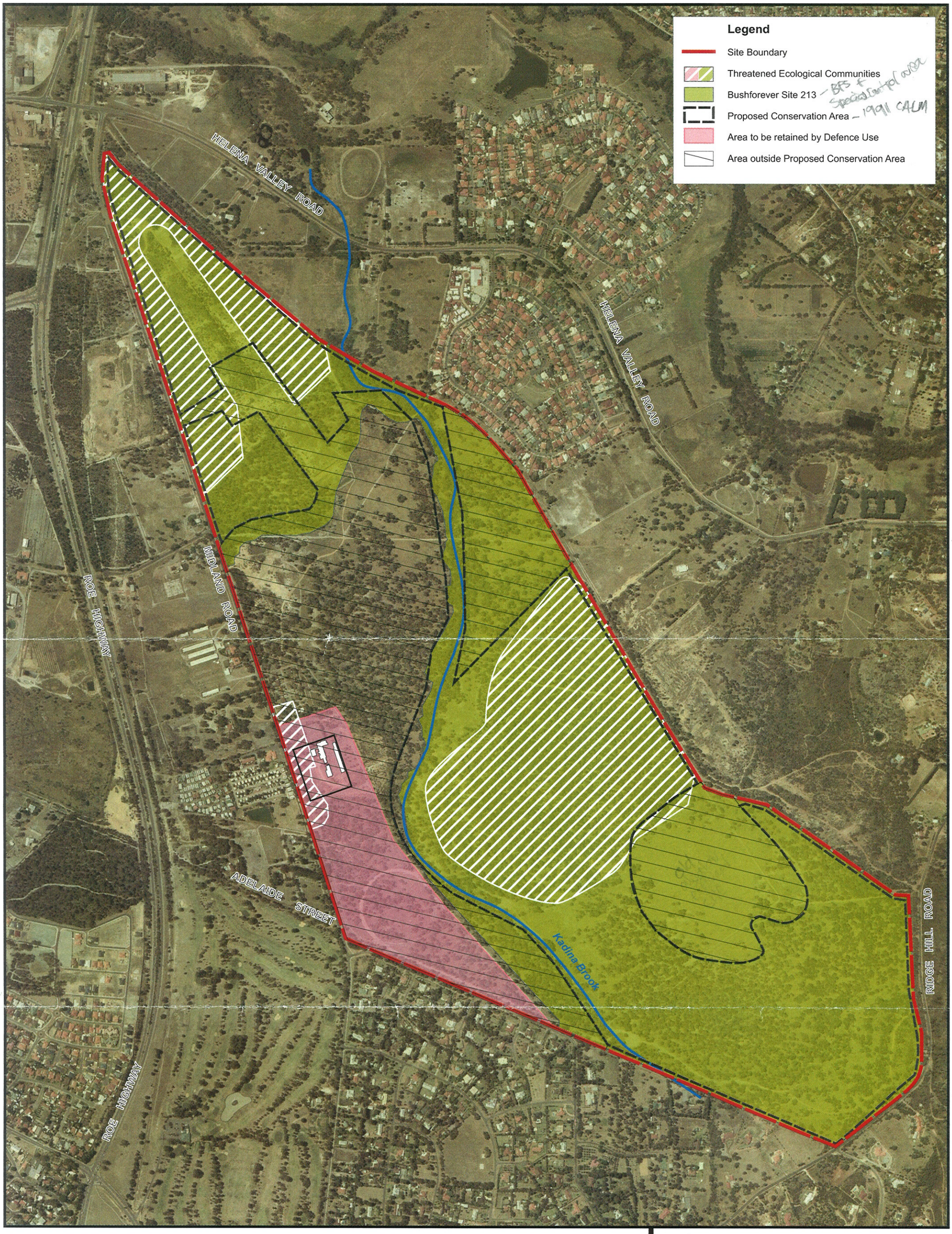

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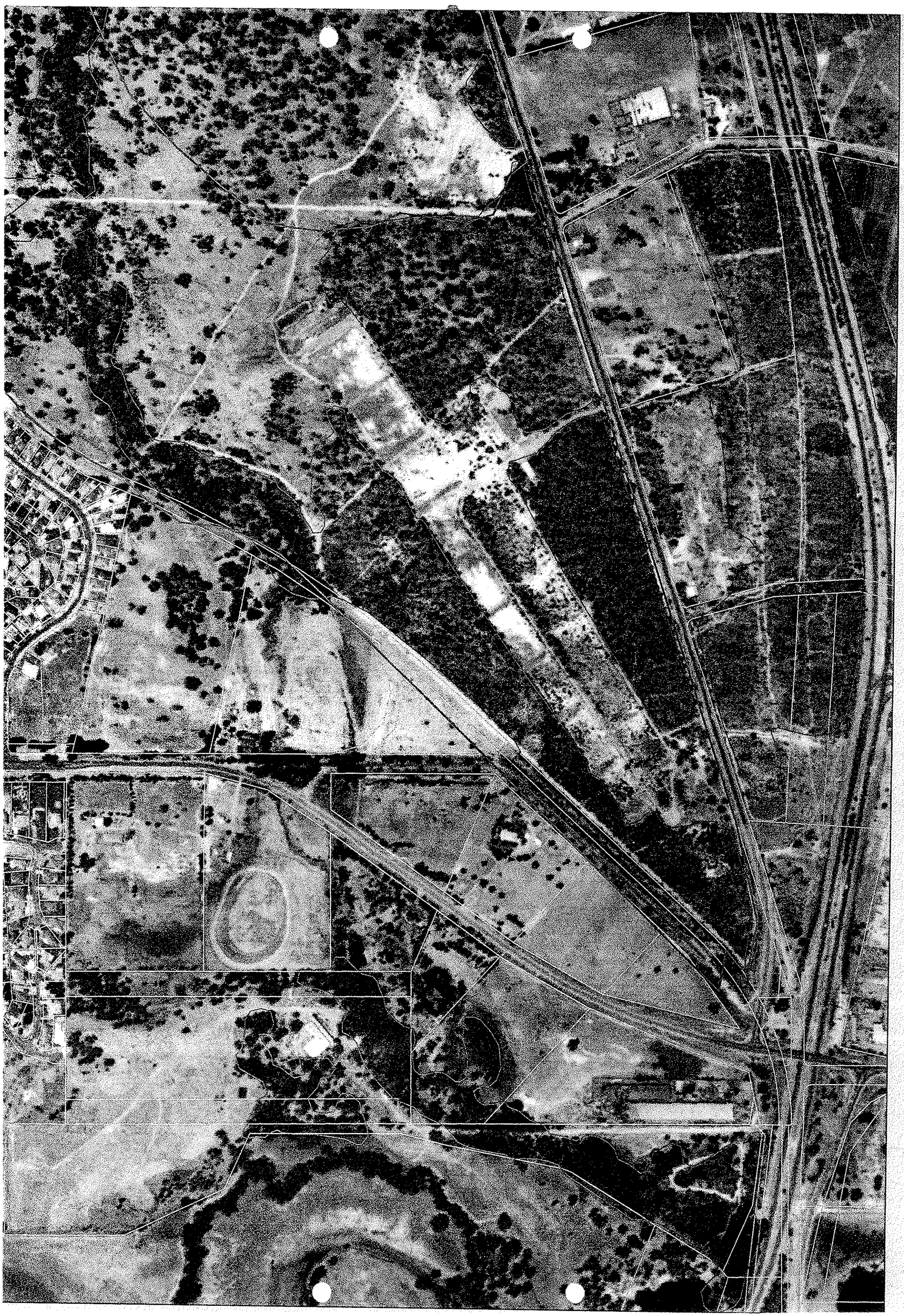
Bushmead Rifle Range Property Disposal
Helena Valley, Western Australia
March 2006

Provided by EKM @ Bushmead 20/4/06



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AERIAL PHOTOGRAPHY - ORTHO-RECTIFIED

ORIGINAL PHOTOGRAPHY - JANUARY 1990 SCALE 1:20000

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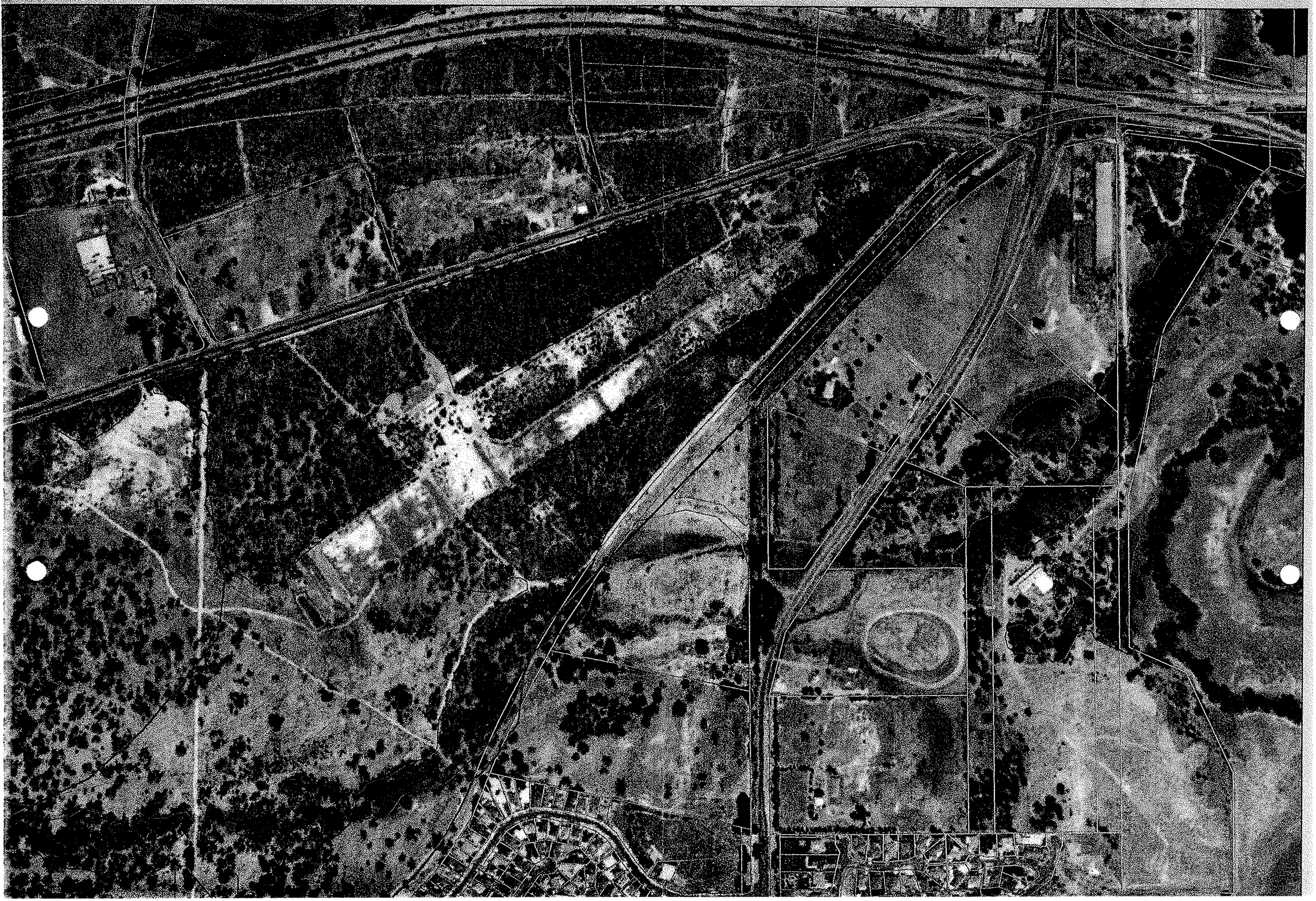
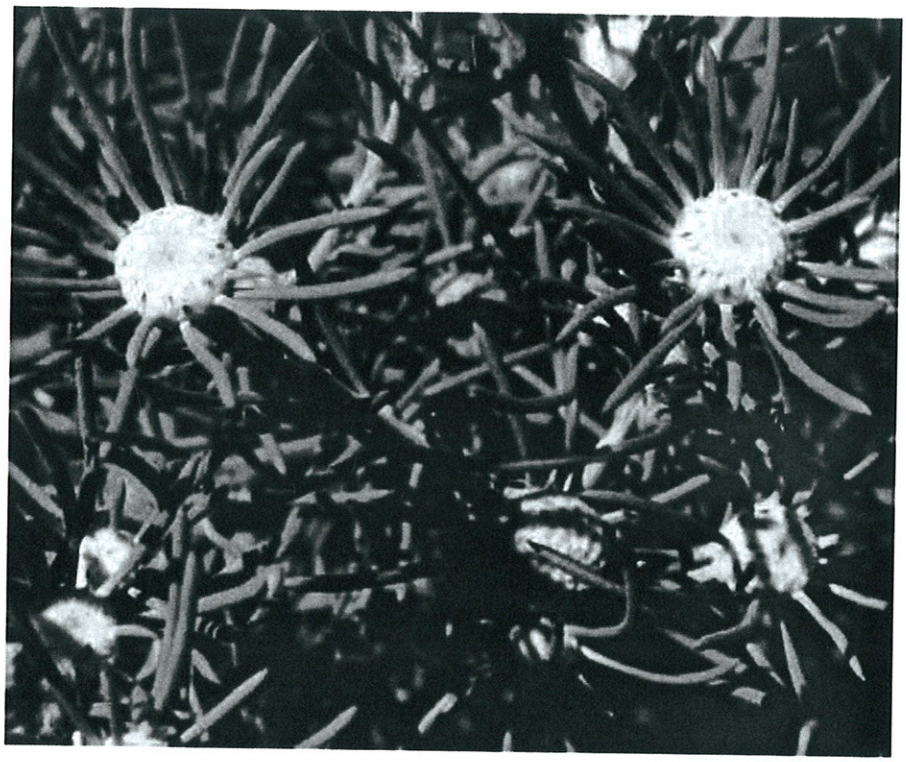


DRAFT

FLORA ASSESSMENT
BUSHMEAD RIFLE RANGE
HELENA VALLEY



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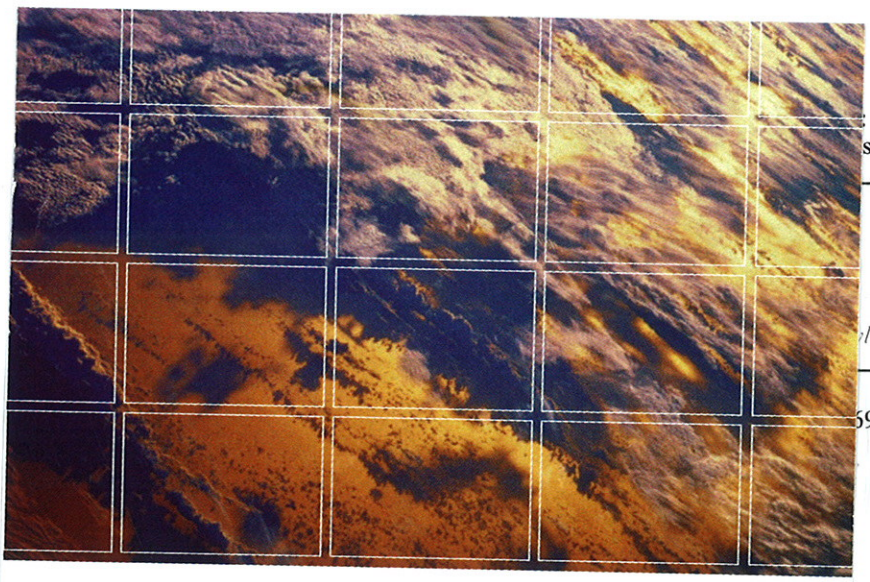

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lla

5926

Bushmead Draft
Flora and Fauna
for
Department of Defence
April 2006

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(284) BUSHM 02
Bushmead Rifle Range
27-9-95

Proposed sale of Commonwealth land at the Bushmead Rifle Range site for housing development

Commonwealth Department of Administrative Services

Advice of the Environmental Protection Authority
to the Commonwealth Environmental Protection Agency

Environmental Protection Authority
Perth, Western Australia
Bulletin 632
June 1992

DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED SALE OF COMMONWEALTH LAND AT THE BUSHMEAD RIFLE RANGE SITE WESTERN AUSTRALIA

for

AUSTRALIAN ESTATE MANAGEMENT

DEPARTMENT OF ADMINISTRATIVE SERVICES

DECEMBER, 1991

Halpern
Glick
Maunsell

LIST OF CONTENTS

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TABLES

LIST OF CONTENTS (contd)

FIGURES

Some areas exhibit significant levels of physical stress. The stress related to damage from previous fires, effluent contamination and the probable but unconfirmed presence of soil borne pathogens, "dieback".

5.10 FAUNA

5.10.1 Overview

The following provides a summary of the detailed fauna investigations conducted as part of this EIS, a further description is contained in Appendix A.

Fauna surveys were conducted during autumn, winter and spring 1991 and included four sampling periods of ten days each during these seasons. The objectives of this programme were to:

- refine and improve the faunal information for the project area,
- document the presence of any rare and endangered species,
- determine fauna habitat utilisation patterns, and
- provide an adequate database for the development of appropriate rehabilitation and management plans.

The survey programme combined detailed site/habitat assessments and species specific survey programmes for rare fauna. Data were collected by both observational surveys and trapping programmes totalling in excess of 2,000 trap days.

Faunal habitats were closely aligned with landform and vegetation associations. On the basis of literature searches and known habitat preferences, the project area may potentially support approximately 100 bird species, 17 native mammal species (including 9 bats), 5 introduced mammals, 41 reptiles and 11 amphibians. Of this potential the field survey recorded 60 species of birds, 5 native and 5 introduced mammals, 41 reptiles and 7 amphibians. The survey added an additional 39 bird, 6 frog, 9 reptile and 5 mammal species previously unrecorded for the Bushmead area.

One species, the western quoll or chuditch *(Dasyurus geoffroii)*, potentially present within the Bushmead area is listed by ANZECC (April 1991) (Australian & New Zealand Environment & Conservation Council; formerly CONCOM), as "Endangered - species in danger of extinction and whose survival is unlikely if the causal factors continue to operate". No species of migratory bird listed under the CAMBA (China & Australia Migratory Bird Agreement) is present. However one migratory species, the rainbow bee-eater *(Merops ornatus)*, is listed under the Annex of the JAMBA 1974 (Japan & Australia Migratory Bird Agreement).

5.10.2 Rare and Endangered Species

Potentially, five species gazetted as Schedule 1 on the 1990 CALM Rare and Endangered Fauna Schedule as "fauna that is likely to become extinct, or is rare", the southern brown bandicoot *(Isoodon obesulus)*, western quoll or chuditch *(Dasyurus geoffroii)*, numbat *(Myrmecobius fasciatus)*, barking owl *(Ninox connivens)* and crested shrike-tit *(Falcunculus frontatus)*, and four Schedule 2 species "fauna in need of special protection", the peregrine falcon *(Falco peregrinus)*, Baudin's

black cockatoo *(Calyptorhynchus baudinii)*, red-eared firetail *(Emblema oculata)* and carpet python *(Morelia spilota imbricata)* may occur in the project area.

Indications of the presence of two Schedule 1 species, the southern brown bandicoot and the western quoll, and one Schedule 2 species, Baudin's black cockatoo have been recorded from the project area. However, current data indicates that only the southern brown bandicoot is resident in the area while Baudin's black cockatoo is a regular transitory visitor.

No other sightings or indications of other gazetted species were recorded during the current survey or have been recorded from the project area in recent history.

The peregrine falcon, while not recorded during the current survey, is widely distributed throughout Australia. While potentially being transitory in the project area, none of the proposed options represent a significant impact to the species due to the extremely limited impact to widespread preferred habitats. The barking owl, crested shrike-tit and red-eared firetail are considered to be regionally extinct while the carpet python has declined markedly in the region and is unlikely to occur in the project area.

The nearest numbat *(Myrmecobius fasciatus)* sighting record is from the Mundaring area in ridge top jarrah-wandoo habitat during the mid 1980s. While within range of the northern jarrah forest population, the project area is considered by CALM to be unsuitable habitat and highly unlikely to support the species. Intensive searching during the current survey revealed no signs of the species presence.

Baudin's black cockatoo *(Calyptorhynchus baudinii)*: Small flocks of 10 to 20 individuals were present in the project area during autumn and spring, being confined primarily to the open marri woodlands and drainage line. The species is mainly a seed and nectar eater, especially of marri *(Eucalyptus calophylla)* and several Banksias such as the Bull Banksia *(Banksia grandis)*. Distributed over the mesic south-west, its range has diminished with habitat modification. While potentially nesting in large tree hollows in the project area, the species appears to be transitory at Bushmead, utilising the area for foraging.

The rainbow bee-eater *(Merops ornatus)* utilises the Bushmead area for foraging on a transitory basis. The species is an aerial forager exploiting the upper strata of large canopy trees. The species avoids dense forest preferring open woodlands and builds nesting tunnels in large earth embankments. The project area does not contain suitable nesting areas. In the metropolitan region the species is present from November to April.

(a) Southern Brown Bandicoot *(Isoodon obesulus)*

The southern brown bandicoot is a solitary living, rabbit-sized peramelid marsupial which occurs widely throughout southern Australia occupying a variety of habitats in dry sclerophyll forests, grasslands and heathlands. Currently four subspecies are recognised. The Western Australian sub-species *Isoodon obesulus fusciventer*, the western southern brown bandicoot or quenda, occurs throughout the wetter portions of the south

west of Western Australia from the Moore River to Walpole and in the Fitzgerald River area. The species has recently been declared by the Minister for Conservation & Land Management as "rare and endangered" and is listed in Schedule 1 of the Wildlife Conservation Act 1950 as "likely to become extinct, or is rare".

Formerly widespread over the entire Swan Coastal Plain the species is now restricted to areas of dense vegetation, fringing wetland areas which have remained relatively undisturbed. However even where the species still occurs, populations are generally at low densities due to the presence of introduced predators. The large reduction in numbers and range of the species within Western Australia coupled with increasing land degradation and a high susceptibility to introduced predators such as the fox, has lead to the current status of the species as "rare and endangered". The continued preservation of the species will only occur through appropriate management of both optimal bandicoot habitats and populations.

The species is nocturnal and prefers to stay close to cover when searching for food on the surface of the ground and digs characteristic shallow conical holes with its powerful foreclaws. It feeds opportunistically on a wide range of invertebrate and plant material including beetles, earthworms, spiders and grass root tubers. During the day it sleeps in a nest which is constructed on the ground from grass and other plant material mixed with earth. Some nests are extremely well concealed among litter and debris under dense vegetation. The breeding season begins in winter and usually lasts for 6 to 8 months. There are eight nipples in a rear opening pouch and the number of young per litter is one to six. Two or three litters may be produced each year, the weaning of one litter being quickly followed by the birth of another. The survivorship of weaned young depends upon the availability of suitable habitat in which to establish and defend a territory. The species is solitary and aggressively territorial with successful adults living for 3 to 4 years and holding a territory of up to 7ha.

A variety of data were collected during the course of the project to provide baseline information on the *Isoodon obesulus* population occurring within the Bushmead Rifle Range area. Field procedures carried out included a range of trapping, tracking, searching and observation techniques. This information enabled a profile of the demography, condition, reproductive status and habitat utilisation of the population to be constructed.

A total of 11 individual bandicoots were captured during the course of the survey. Based on the area of viable bandicoot habitat available (11.5ha), number of individuals known to be resident, and the normal home range of the species, the total population size was estimated to be in the order of 14-17 individuals. The population density within the project area is low to moderate for the species and probably close to maximum carrying capacity under current conditions of predation pressure, habitat quality and availability. The sex ratio is slightly skewed towards males and age classes weighted heavily towards older, large individuals. This type of population structure is frequently indicative of heavy mortality of juveniles and subadults, with feral cats and foxes being the likely agents. During the course of the survey, evidence directly implicated the domestic cat *(Felis cattus)* in the deaths of 3 individuals, 2 small females and 1 male. The impact of introduced predators upon the juvenile component of the population could not be directly assessed from the data collected, but is likely to be greater than that of the adult.

Breeding takes place over winter in this species and this pattern was evident in the Bushmead population. Pouch young or lactating teats, indicative of young having recently left the pouch, were detected from June through to November.

Home ranges vary from 1 to 6.8ha, with males maintaining larger territories than females. Size of home range in this species is variable, and is strongly influenced by population density and the distribution and particular variety of habitat type being utilised. From May to July bandicoot activity was largely restricted to the areas of dense vegetation and moist soils surrounding the northern two-thirds of the creekline. Primary autumn and winter habitat encompasses a corridor up to 60m wide straddling the creekline system. Individuals were most abundant in the creek mid section where a dense shrub layer of *Baeckea camphorosmae* and *Acacia* species coupled with dense stands of the exotic grass *Paspalum digitatum* areas and an overstorey of *Eucalyptus rudis* and *Melaleuca rhaphiophylla*. Spool and line tracking revealed that a major proportion of foraging was carried out in the open moist clay loam soil areas with abundant Guildford grass *Romulea* spp. Open grassland areas up to 25m adjacent to dense vegetation were utilised. Additionally some more remote dense sedge wetlands both within the project area and adjacent on the north-eastern side were utilised despite being up to 300m from the main core habitat.

Habitat utilisation within the project area appears to be highly seasonal. During mid to late winter the dense creekline areas become inundated. During this period the entire population vacated the central core area. The only exception was one large male with a territory on higher ground upstream which did not become inundated. In early spring two individuals were captured in the wandoo-heath MRD reserve in the south-eastern corner of the project area. The reserve consists of a very different assemblage of plant species, but the low, dense, nature of the scrub was similar, providing the essential cover required by the species. One individual, a large male, was previously captured from the creekline core habitat in June and further upstream in July. This data provides some evidence of patterns of small scale seasonal migration of bandicoots within the project area. Significantly, the data illustrates the dependence of the species on the existence of a range of habitats which are widely dispersed and the presence of contiguous relatively undisturbed areas for access to optimal habitats.

The Bushmead Rifle Range *Isoodon obesulus* population is essentially an isolate. The population does not appear to be contiguous with any other known population and access corridors are extremely limited. Access to the Helena River area in the north-east is blocked by the Helena Valley Road and the lack of vegetative cover along the creekline on the northern side of the road. Successful immigration or emigration via this route is considered to be highly unlikely. From the MRD reserve some exchange of bandicoots may occur with the adjacent Gooseberry Hill National Park, however Ridge Hill Road represents a significant barrier. Currently it is not known if bandicoots occur in Gooseberry Hill National Park, but populations are known to exist at Lesmurdie in similar habitat. The lack of bandicoot sighting records or road kills on Ridge Hill Road indicates that the incidence of crossings is extremely low, if they do occur.

(b) Chuditch or Western Quoll *(Dasyurus geoffroii)*

The chuditch, or western quoll is a large Dasyurid marsupial predator (up to 1.3kg). The species has undergone drastic range contractions since the arrival of European man, having previously been relatively abundant in every state in Australia. Many factors have contributed to this marked decline, including habitat alteration, competition for food with introduced predators, epidemic disease and poisoning campaigns. At present it now only occupies the south-west corner of Western Australia, and has been gazetted as "rare and endangered" Schedule 1 fauna in the WA Wildlife Conservation Act 1950 and as "endangered" in the ANZECC, April 1991 list.

Dasyurus geoffroii originally utilised a wide range of habitat types, but today occurs largely in densely vegetated Jarrah forest. It is an efficient predator and has a wide ranging diet. Prey items include small mammals, lizards, frogs, carrion, birds and large quantities of invertebrates. The species is largely nocturnal and forages mostly on the ground. During the day, the species occupies diurnal dens in horizontal hollow logs, or burrows beneath fallen trees. A chuditch may have as many as 18 such dens. Individuals of both sexes are basically solitary in nature and occupy a large home range, up to 15km^2 for males. This home range consists of a central "core" area defined by the den locations utilised by an individual and a large perimeter area utilised on a transient basis for foraging. The species breeds during winter with young dispersing in the November to January period.

No individuals of the species were recorded during the survey, nor were there any dens or any other signs of the species observed. However, there have been three sightings in the Bushmead area in recent years by local residents. Based on the pattern of habitat utilisation and home range development demonstrated by *D. geoffroii*, it is considered by CALM that the Bushmead Rifle Range area is a potential transient foraging ground for individuals living in the vicinity and not a "core" part of the home range. The lack of suitable sites for the numerous diurnal dens required by the species, makes the area of little use for a home range core, though the area may be utilised as an irregular foraging ground. The extent of chuditch utilisation of Bushmead area is impossible to determine without an extensive research programme. While a chuditch research programme has been undertaken in the vicinity of John Forrest National Park, no estimates of population size exist for the Gooseberry Hill-Bushmead area. Based on known territory sizes only two or three individuals at maximum would utilise the project area.

5.10.3 Other Fauna

Ten species of mammal were recorded during the course of the survey, five native and five introduced. Of the native species, the southern brown bandicoot *(Isoodon obesulus)*, occurs at significant levels of abundance, while the western grey kangaroo *(Macropus fuliginosus)* was represented by what was probably a single group of seven individuals that were sighted periodically in different parts of the project area. Only a single common brush-tail possum *(Trichosurus vulpecula)* was trapped during the survey, but some individuals are known to live in the buildings at the northern end of the rifle range.

The introduced mammal species were common in general with sheep *(Ovis aries)* and the house mouse *(Mus musculus)* being particularly abundant. The black rat *(Rattus rattus)* was also moderately common along the creekline system. The two introduced predators recorded during the survey, the fox *(Vulpes vulpes)* and the feral cat *(Felis cattus)*, were both only represented as a few individuals, but this is most likely an underestimate of true abundance. The presence of these two predators in even low density is sufficient to have a major impact on existing populations of native fauna, such as the bandicoot population in the project area.

The most important habitat to the mammal fauna of the project area was the creekline and its associated vegetation supporting all species. Most other habitats supported only introduced species such as *M. musculus* which are less discriminatory in their habitat requirements or wider ranging grey kangaroos and brush-tail possums. Two species of bat are wide ranging over the project area, the white-striped mastiff bat *(Tadarida australis)* and Gould's wattled bat *(Chalinolobus gouldii)*.

A total of 60 species of birds were recorded within the project area during the course of the survey, 25 of which were non-passerines, and 35 passerines. Species levels of abundance varied greatly from habitat to habitat, and season to season. The creekline habitat appears to be the most consistently important habitat to bird species throughout the year, having the greatest proportional utilisation during both winter and spring and remaining significantly used during autumn.

Analysis of vegetation strata utilisation by the avifauna present in the project area revealed distinct and significant patterns. Overall the upper canopy and branch strata of trees greater than 10m tall is utilised the most heavily in all habitats in both winter and spring. Consistently the upper canopy branch strata of trees 5-10m tall was the second major stratum employed. Few species utilised the trunks of trees, the exceptions being the trunk specialists like the rufous treecreeper *(Climacteris rufa)*. Activity on the ground, generally foraging, represented the third major bird microhabitat. Significant seasonal changes in the strata utilisation patterns were evident. The usage of the ground and small trees decreased in spring while a marked and significant increase in the utilisation of the shrub layer occurred. This increase coincided with the prolific flowering of shrubs, herbs and annuals in the *Banksia-Allocasuarina* and *Banksia-Eucalyptus todtiana* woodlands. Significant differences in utilisation patterns between vegetation associations-habitats are a reflection of physical structure differences. Degraded areas lacking understorey strata were depauperate in those species which commonly utilised shrub layer resources.

It is perhaps easiest to consider the habitat utilisation of birds on the basis of their ecological groupings rather than their taxonomic divisions. Functional feeding groups are quite distinct in birds, with each group occupying its own ecological niche and hence utilising its own specific set of resources and habitats. Insectivorous species made up almost half the avifauna of the project area, including species such as red-capped robins *(Petroica goodenovii)*, splendid fairy wrens *(Malurus splendens)*, and rainbow bee-eaters *(Merops ornatus)*. Carnivores were also well represented amongst the birds, with several species of birds of prey, such as the black-shoulder kite *(Elanus notatus)*, carnivorous waterfowl, such as the white-faced heron *(Ardea novaehollandiae)*, and

two species of kingfisher, the sacred kingfisher *(Halcyon sancta)* and the laughing kookaburra *(Dacelo gigas)*. The granivores were the other common group, with several species of parrot, dove and pigeon being present.

The relative representation of the avian functional groups in a community is closely related to features of the habitat type. Various factors will influence which dietary and foraging strategies are appropriate for a habitat, and hence which bird species may occur there. Density of vegetation, height of the canopy, plant species present, and other animal species present will all contribute to determining the bird species supported by a particular habitat. Time of year is also of great importance with respect to vagrant species which utilise different habitats only at certain times of the year.

The herpetofauna of the Bushmead Rifle Range project area total 17 species, comprised of 7 frogs, 2 snakes, and 8 lizard species. Of the lizard groups, the skinks made the greatest contribution with 4 species. The total species richness and the assemblage of animals present for the project area are comparable with that found for other work done in the Darling Scarp area.

The fence skink *(Cryptoblepharus plaglocephalus)* was the most common reptile observed, while large choruses of *Crinia glauerti* were heard along the creekline, making this the most abundant frog. The bobtail *(Tiliqua rugosa)* was also moderately common and was frequently observed during the spring phase of the project. Snakes were uncommon, with two blind snakes *(Rhamphotyphlops australis)* being caught and one dugite *(Pseudonaja affinis)* being observed. Seasonal variation in species richness, abundance and community composition was typical for the habitats present and locality. Frog numbers were greatest during the winter months when the creek was flowing and the maximum number of species was recorded at this time. By spring, only a few individuals of *Crinia glauerti* and *Crinia insignifera* were still calling. Conversely, the reptile community increased in activity as spring approached, and both varanid species detected were observed only at this time. The *Banksia-Eucalyptus todtiana/E. marginata* Low Woodland and creekline habitat proved to be the most significant for the herpetofauna of the project area. In the case of the creekline this is largely due to the fact that the habitat supports all the species of frogs occurring in the study area, while every species of skinks and varanids recorded for the area occurred in the *Banksia-E. todtiana* association.

The skink species occurring in the area were quite widespread and most species were found in all habitat types. The gecko species were more restricted, with *Gehyra variegata* occurring beneath dead bark on *Banksia attenuata* trees and beneath stones on a small granite outcrop at the eastern edge of the project area, while *Phyllodactylus marmoratus* was observed only under the bark of *Melaleuca* trees along the creekline. The varanid species *V. tristis* and *V. rosenbergi* are relatively large, wide-ranging animals, that would likely move through a number of habitat types within the project area.

Many reptile species such as the Pygopod *Aprasia repens* and the Agamid *Ctenophorus ornatus*, have distributions including the project area but were not recorded. These species are typically found on granite outcrops and rock faces, and this habitat type was poorly represented in the area.

DETAILED SURVEY SITE SPECIES LISTS

	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*Acacia alata*					x										
2	*Acacia colletioides*	x	x					x								
3	*Acacia decurrens*										x					
4	*Acacia huegelii*	x					x									
5	• *Acacia incrassata*															
6	*Acacia ?insolita*										x					
7	*Acacia longifolia										x					
8	*Acacia ?merrallii*										x					
9	*Acacia nervosa*											x				x
10	*Acacia podalyriifolia*										x					
11	*Acacia pulchella*	x	x	x	x	x	x	x	x		x	x		x	x	
12	*Acacia saligna*	x		x	x	x					x		x		x	
13	• *Acacia sessilis*										x					
14	*Acacia sp.*										x		x			
15	• *Acacia teretifolia*										x					
16	*Acacia willdenowiana*					x					x					
17	*Acanthocarpus preissii*	x					x									
18	• *Acianthus sp.*															
19	*Adenanthos cygnorum*	x	x				x	x								
20	*Agrostocrinum scabrum*						x	x			x		x	x		
21	*Aira caryophyllea*	x	x					x	x							
22	*Alexgeorgea arenicola*	x	x													
23	*Allocasuarina fraseriana*	x	x				x	x					x			
24	*Allocasuarina humilis*	x				x					x			x	x	
25	*Agapanthus inapterus										x					
26	*Amaranthus retroflexus				x											
27	*Amphipogon turbinatus*	x	x				x							x		
28	*Anagallis arvensis*				x						x					
29	*Andersonia lehmanniana*															
30	*Anigozanthos humilis*	x	x			x	x	x	x							
31	*Anigozanthos manglesii*	x	x		x		x	x	x				x			
32	*Anigozanthos manglesii x humilis*	x														
33	*Arctotheca calendula				x						x	x				
34	*Arnocrinum preissii*													x		
35	*Arundo donax										x					
36	*Astroloma glaucescens*										x					
37	*Astroloma pallidum*						x									
38	*Astroloma stomarrhena*	x														
39	•• *Astroloma xerophyllum*	x														
40	*Avena barbata				x											
41	*Avena fatua										x					
42	*Baeckea camphorosmae*	x		x		x	x	x			x			x		
43	*Banksia attenuata*	x	x				x	x	x							
44	*Banksia grandis*	x	x				x	x								
45	*Banksia ilicifolia*	x									x					
46	*Banksia menziesii*	x	x				x	x								
47	*Baumea sp.*														x	
48	*Bellardia trixago*										x					
49	• *Billardiera bicolor*															

Appendix D

	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14
50	*Bossiaea eriocarpa*	x	x				x				x				
51	*Bossiaea ornata*								x		x				
52	**Brassica tournefortii*				x										
53	**Briza maxima*	x			x			x			x		x	x	x
54	**Briza minor*	x			x						x		x		x
55	**Bromus diandrus*	x										x		x	
56	*Burchardia multiflora*	x											x	x	x
57	*Burchardia umbellata*	x	x				x		x				x	x	
58	*Burtonia scabra*										x				
59	*•• Caladenia discoidea*	x													
60	*Caladenia flava*	x					x	x							
61	*Caladenia huegelii*						x	x							
62	*•• Calandrinia sp.*	x													
63	*Calectasia cyanea*	x													
64	*Calothamnus quadrifidus*						x	x			x			x	
65	*•• Calytrix aurea*	x													
66	*•• Calytrix fraseri*	x													
67	*Carissa sp.*	x													
68	*Cassytha racemosa*	x	x			x	x	x	x		x				
69	*• Caustis dioica*														
70	**Centaurium erythraea*														
71	*Chamaescilla corymbosa*														x
72	*Chamelaucium uncinatum*							x							
73	*• *Chasmanthe sp.*										x			x	
74	*• Cheilanthes austrotenuifolia*														
75	**Chenopodium ambrosioides*														
76	*• Chloanthes coccinea*										x				
77	*Comesperma calymega*														
78	*Conospermum acerosum*	x					x				x				
79	*Conospermum polycephalum*														
80	*Conospermum stoechadis*	x	x								x				
81	*Conostephium pendulum*	x													
82	*Conostylis aculeata*	x	x								x				
83	*Conostylis canescens*	x	x				x								
84	*Conostylis candicans*	x					x								
85	*Conostylis juncea*						x								
86	*Conostylis setigera*	x					x								
87	*Conostylis setosa*	x					x	x							
88	**Conyza albida*	x													
89	**Cortaderia selloana*			x		x			x						
90	**Cucumis myriocarpus*				x										
91	**Cynodon dactylon*			x		x				x					
92	**Cyperus rotundus*							x							
93	**Cytisus proliferus*					x				x					
94	*Dampiera linearis*	x								x					
95	*Danthonia caespitosa*	x	x							x					
96	*Dasypogan bromeliifolius*	x	x			x				x					
97	*Daucus glochidiatus*					x		x		x					
98	*Daviesia decurrens*	x								x					
99	*Daviesia divaricata*	x	x					x		x					

	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
100	*Daviesia gracilis*	x														
101	*Daviesia horrida*										x					
102	•• *Daviesia incrassata*	x	x													
103	*Daviesia nudiflora*	x	x													
104	*Daviesia physodes*	x														
105	*Daviesia preissii*	x									x		x			
106	*Daviesia triflora*	x														
107	•• *Dianella revoluta*															
108	•• *Diuris longifolia*															
109	*Digitaria ciliaris														x	
110	*Drakaea sp.*						x	x	x							
111	*Drosera erythrorhiza*															
112	• *Drosera macrantha*						x	x								
113	*Drosera stolonifera*						x	x			x					
114	•• *Drosera sp.*	x														
115	*Dryandra armata*													x		
116	*Dryandra nivea*	x	x								x					
117	*Dryandra sessilis*				x		x	x			x		x	x		
118	*Echium plantagineum										x					
119	*Eragrostis curvula					x				x	x					
120	*Eremaea fimbriata*	x														
121	*Eremaea pauciflora*	x	x													
122	• *Eremaea violacea*	x														
123	*Erharta calycina	x	x		x		x	x	x		x	x	x			x
124	*Erharta longiflora	x	x		x		x	x	x	x	x	x				x
125	*Eriostemon nodiflorus*	x	x								x					
126	*Eriostemon spicatus*	x														
127	*Erodium botrys				x		x	x			x					
128	*Eucalyptus calophylla*	x	x		x	x	x	x	x	x	x	x	x	x		
129	*Eucalyptus marginata*	x	x		x		x	x	x	x	x	x	x			
130	*Eucalyptus rudis*			x		x									x	
131	*Eucalyptus todtiana*	x	x		x						x				x	
132	*Eucalyptus wandoo*			x						x	x				x	
133	•• *Euchilopsis linearis*	x														
134	*Fumaria capreolata										x					
135	*Freesia affin. leichtlinii										x					
136	• *Gastrolobium ilicifolium*															
137	*Gastrolobium spathulatum*															
138	*Gladiolus caryophyllaceus*	x				x	x	x	x		x					
139	*Gompholobium aristatum*										x					
140	•• *Gompholobium capitatum*	x											x			
141	*Gompholobium knightianum*															
142	*Gompholobium polymorphum*										x		x	x		
143	*Gompholobium shuttleworthii*						x									
144	*Gompholobium tomentosum*	x	x	x		x					x					
145	•• *Goodenia sp.*	x														
146	*Grevillea bipinnatifida*										x					
147	*Grevillea crithmifolia*										x					
148	*Grevillea pilulifera*							x			x					
149	*Grevillea vestita var. vestita*										x					

	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13
150	*Grevillea wilsonii*										x			
151	*Haemodorum laxum*	x									x			x
152	•• *Haemodorum paniculatum*	x												
153	•• *Haemodorum sp.*	x												
154	*Haemodorum spicatum*	x	x				x	x						
155	*Hakea erinacea var. erinacea*										x			x
156	*Hakea lissocarpha*			x	x	x					x	x		x
157	*Hakea marginata*	x						x						
158	*Hakea petiolaris*	x	x											
159	*Hakea prostrata*							x			x			
160	*Hakea ruscifolia*										x			
161	*Hakea sp.*										x			
162	*Hakea stenocarpa*							x			x			
163	*Hakea trifurcata*			x					x		x			
164	*Hakea undulata*				x		x				x			
165	*Hardenbergia comptoniana*	x									x			
166	*Helipterum sp.*	x	x								x			
167	• *Hemiandra ?linearis*													
168	*Hemiandra pungens*	x												
169	*Hemigenia incana*													
170	*Hemigenia sericea*													
171	*Hibbertia acerosa*													x
172	*Hibbertia commutata*					x					x			
173	*Hibbertia huegelii*	x	x		x		x	x			x	x	x	
174	*Hibbertia hypericoides*	x	x								x			x
175	*Hibbertia racemosa*	x						x						
176	*Holcus lanatus*				x									x
177	*Homeria flaccida*										x			
180	*Hordeum leporinum*				x			x				x		
181	*Hovea pungens*						x				x			x
182	*Hovea trisperma*	x				x					x			
183	*Hybanthus calycinus*	x	x				x	x	x		x		x	
184	*Hypocalymma angustifolium*					x								
185	*Hypochaeris glabra*	x												
186	*Hypolaena exsulca*	x												x
187	*Isolepis nodosa*	x												
188	• *Isopogon asper*													
189	*Isopogon divergens*													
190	*Isopogon sp.*	x									x			
191	*Isotoma hypocrateriformis*	x												
192	*Isotropis cuneifolia*	x									x			
193	*Jacksonia floribunda*	x	x				x							
194	*Jacksonia furcellata*				x		x							
195	*Jacksonia sternbergiana*	x												
196	*Johnsonia pubescens*	x	x				x				x			
197	*Juncus bufonius*						x							
198	*Juncus holoschoenus*													x
199	*Juncus kraussii*			x		x							x	x
200	*Juncus pallidus*			x		x					x			
201	*Kennedia prostrata*	x	x								x			

	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
202	*Kunzea ericifolia*		x													
203	**Lactuca saligna*	x														
204	*Lambertia multiflora*	x														
205	• *Laxmannia ramosa*															
206	•• *Laxmannia sp.*	x														
207	*Laxmannia squarrosa*					x					x					
208	*Lechenaultia biloba*										x					
209	*Lepidosperma angustatum*	x	x													
210	*Lepidosperma costale*										x					
211	*Lepidosperma effusum*															
212	*Lepidosperma leptostachyum*						x		x					x		
213	• *Lepidosperma longitudinale*					x										
214	*Lepidosperma scabrum*	x									x			x		
215	*Leptospermum erubescens*	x					x	x			x		x			
216	**Leptospermum laevigatum*						x	x			x					
217	*Levenhookia stipitata*	x					x	x			x					
218	*Leucopogan conostephioides*										x					
219	• *Leucopogan propinquus*															
220	• *Leucopogan racemulosus*	x									x					
221	• *Leucopogan ?sprengelioides*															
222	**Lolium perenne*	x	x				x	x			x					
223	*Lomandra caespitosa*	x														
224	*Lomandra hermaphrodita*	x					x	x	x							
225	*Lomandra nigricans*	x									x		x			
226	*Lomandra preissii*	x						x	x		x					
227	*Lomandra suaveolens*	x					x	x			x					
228	*Loxocarya fasciculata*	x	x			x	x	x	x		x					
229	*Loxocarya flexuosa*	x	x				x	x			x		x	x		
230	**Lupinus cosentinnii*				x	x			x	x		x				x
231	**Lupinus mutabilis*				x					x	x	x				x
232	*Luzula meridionalis*					x										
233	*Lyginia barbata*	x	x			x	x									
234	*Lyperanthus nigricans*	x					x				x					
235	*Lysinema ciliatum*	x														
236	*Macarthuria australis*	x	x				x	x								
237	*Macrozamia riedlei*								x		x			x		
238	**Medicago polymorpha*										x		x	x		
239	*Melaleuca acerosa*	x														
240	• *Melaleuca preissiana*															
241	*Melaleuca rhaphiophylla*			x		x									x	
242	*Melaleuca scabra*						x									
243	•• *Melaleuca seriata*															
244	*Mesomelaena pseudostygia*	x	x													
245	*Mesomelaena tetragona*	x	x				x	x			x					
246	*Mesomelaena stygia*	x	x	x				x	x		x					
247	*Melia azedarach*										x					
248	*Mirbelia ramulosa*										x					
249	**Monadenia bracteata*				x		x	x	x		x	x	x	x		x
250	*Monotaxis grandiflora*	x	x													
251	**Myrsiphyllum asparagoides*									x						

	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1
252	*Nemcia capitatum*	x		x		x					x					
253	*Nemcia cuneatum*										x					
254	*Neurachne alopecuroidea*	x	x	x			x	x			x			x		
255	*Neurachne sp.*										x					
256	*Nuytsia floribunda*				x											
257	*Olearia paucidentata*							x			x					
258	*Olearia sp.*			x							x					
259	*Opercularia vaginata*										x					
260	**Orobanche minor*										x	x				
261	**Oxalis pes-caprae*			x		x	x	x		x	x	x				
262	**Paspalum dilatatum*			x		x				x						
263	*• Patersonia juncea*															
264	*Patersonia occidentalis*	x	x	x		x	x		x		x			x		
265	*Patersonia pygmaea*	x														
266	*Persoonia elliptica*	x			x		x	x								
267	*Persoonia ?sulcata*										x					
268	**Pennisetum clandestinum*				x	x				x	x				x	x
269	**Pennisetum setaceum*										x					
270	**Pennisetum villosum*	x	x				x									
271	**Pentachistis thunbergii*										x					
272	*• Pericalymma ellipticum*															
273	*Petrophile biloba*								x					x		
274	*Petrophile linearis*	x	x													
275	*Petrophile macrostachya*										x					
276	*Petrophile media*	x														
277	*Petrophile seminuda var. seminuda*										x					
278	*Petrophile striata*										x					
279	*Petrophile velutina*	x														
280	**Petrorhagia velutina*	x														
281	*Phebalium calycinum*															
282	*Phyllanthus calycinus*	x									x			x		
283	*Plantago lanceolata*										x					
284	*Pimelea imbricata*													x		
285	*Pimelea leucantha*	x														
286	*Pimelea suaveolens*	x														
287	*Pimelea sulphurea*	x														
288	*Pityrodia bartlingii*	x	x								x					
289	*Plantago lanceolata*															
290	*Plantago major*					x										
291	*Poa drummondiana*															
292	*Poa porphyroclados*	x														
293	*Prasophyllum sp.*															
294	*Pronaya fraseri*	x														
295	*• Pterostylis vittata*										x					
296	*Ptilotus drummondii*															
297	**Raphanus raphanistrum*						x	x			x					
298	*Regelia aff. inops*				x						x					
299	**Romulea rosea var. australis*	x		x	x			x	x	x		x		x	x	x
300	**Rhynchelytrum repens*	x							x		x					
301	**Rumex crispus*			x								x				

	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
302	*Rumex obtusifolius				x											
303	Scaevola canescens	x	x													
304	Scaevola paludosa	x	x				x	x								
305	Scaevola sp.	x														
306	Schoenus brevisetis	x														
307	Schoenus curvifolius						x				x					
308	Schoenus spA						x									
309	•• Scholtzia involucrata	x														
310	Senecio lautus															
311	*Solanum nigrum				x						x					
312	*Solanum sodomaeum															
313	Sollya heterophylla										x					
314	*Sonchus oleraceus	x			x											
315	• Sowerbaea laxiflora															
316	Sphaerolobium sp							x								
317	• *Sporobolus ?indicus	x														
318	Spyridium tridentatum										x					
319	Stachystemon vermicularis	x														
320	Stackhousia pubescens										x					
321	Stipa compressa	x	x													
322	Stipa elegantissima	x				x										
323	Stipa flavescens	x	x													
324	Stirlingia latifolia	x	x				x	x	x							
325	Stylidium bulbiferum													x		
326	Stylidium brunonianum		x				x				x		x			x
327	Stylidium calcaratum	x														
328	Stylidium piliferum	x					x	x			x					
329	•• Stylidium repens															
330	Stylidium schoenoides										x					
331	Stylidium spA										x			x		
332	Stypandra sp.	x														
333	Stypandra imbricata															
334	• Styphelia tenuiflora															
335	•• Synaphea spinulosa	x														
336	Synaphea petiolaris	x									x			x		
337	*Taraxacum officinale										x					x
338	•• Templetonia biloba	x														
339	Tetraria octandra	x					x	x	x		x					
340	Thomasia grandiflora							x			x					
341	Thomasia foliosa										x					
342	Thysanotus multiflorus	x														
343	•Thysanotus patersonii															
344	•• Thysanotus sparteus	x														
345	Thysanotus triandrus		x			x	x	x			x					
346	Trachymene pilosa	x							x		x					
347	Trichocline spathulata							x								
348	Tricoryne elatior						x	x								
349	*Trifolium campestre				x						x	x				x
350	*Trifolium arvense	x			x			x			x	x				x
351	*Trifolium augustifolium										x					

	SPECIES	1	2	3	4	5	6	7	8	9	10	11
352	**Trifolium spA*										x	x
353	*Tripterococcus brunonis*	x									x	
354	**Trymalium ledifolium*					x					x	
355	**Tropaeolum majus*										x	
356	**Typha orientalis*											
357	**Urospermum picroides*										x	
358	**Ursinia anthemoides*	x	x		x						x	x
359	**Urtica sp.*				x							
360	*Verticordia densiflora*	x										
361	**Vicia hirsuta*										x	
362	**Vicia sativa*										x	
363	*Viminaria juncea*											
364	**Vulpia bromoides*	x					x					
365	**Vulpia myuros*	x	x	x				x				
366	**Wahlenbergia capensis*	x	x				x					
367	*Waitzia citrina*	x										
368	*Waitzia paniculata*	x										
369	**Watsonia bulbillifera*			x							x	
370	*Xanthorrhoea preissii*	x	x		x		x	x	x		x	
371	*Xanthorrhoea gracilis*	x	x					x				
372	*Xanthosia candida*										x	
373	*Xanthosia huegelii*	x							x			
374	•• *Xanthosia sp.*											
375	**Zantedeschia aethiopica*					x					x	

* = species not native to W.A.

= Dames & Moore survey

• = C.A.L.M. survey

•• = W.A. Wildflower Society survey

AREA FAUNA SPECIES LISTS

List of vertebrates recorded or expected to occur within the vegetation assemblages present in the Bushmead Rifle Range Project area.

KEY

X = Species recorded during field survey
S = Signs of presence recorded, nests, scats, diggings and tracks.
+ = Species expected to occur
* = Predominately aerial species

FAUNA HABITAT CODE	VEGETATION ASSOCIATION
1/2	*Banksia/Eucalyptus todtiana/E. marginata* on Bassendean Soils.
3/5	*Melaleuca/E. rudis* , creek system.
6/7	*Banksia/Allocasuarina* on sand.
8	*E. marginata/Banksia* on sandy-loam.
9/4	Open *E. marginata/E. calophylla* on sandy-loam.
10	*E. wandoo* on laterite.
0	Disturbed grasslands on mixture of soils.

MAMMAL SPECIES WHICH OCCUR OR ARE EXPECTED TO OCCUR IN THE BUSHMEAD RIFLE RANGE PROJECT AREA.

	Faunal Habitats:	1/2	3/5	6/7	8	9/4	10	0
MONOTREMATA								
TACHYGLOSSIDAE								
Tachyglossus aculeatus	Echidna	+		+	+	+	+	
MARSUPIALIA								
DASYURIDAE								
Antechinus flavipens	Yellow-footed Antechinus	+		+	+	+	+	+
Sminthopsis crassicaudata	Fat-tailed Dunnart	+		+	+	+	+	
Sminthopsis murina	Common Dunnart	+		+	+	+	+	
MYRMECOCIIDAE								
Myrmecobius fasciatus	Numbat	+			+	+	+	
PERAMELIDAE								
Isoodon obesulus	Southern Brown Bandicoot		x		+	+	x	
PHALANGERIDAE								
Trichosurus vulpecula	Common Brushtail Possum		x		+	+	+	
BURRAMYIDAE								
Cercartetus concinnus	Western Pygmy-possum	+		+	+			
TARSIPEDIDAE								
Tarsipes rostratus	Honey-possum	+		+	+			
MACROPODIDAE								
Macropus fuliginosus	Western Grey Kangaroo	+	x	x	x	x	x	x
CHIROPTERA								
MOLOSSIDAE								
Mormopterus planiceps	Little Mastiff Bat*	+	+	+	+	+	+	
Tadarida australis	White-striped Mastiff Bat*	+	+	+	+	+	+	
VERSPERTILIONIDAE								
Chalinolobus gouldii	Gould's Wattled Bat*	+	+	+	+	+	+	
Chalinolobus morio	Chocolate Wattled Bat *	+	+	+	+	+	+	+
Eptesicus regulus	King River Eptesicus*	+	+	+	+	+	+	
Nyctophilus geoffroyi	Lesser Long-eared Bat*	+	+	+	+	+	+	+
Nycticeius gouldii	Gould's Long-eared Bat*	+	+	+	+	+	+	+
Nycticeius timoriensis	Greater Long-eared Bat*	+	+	+	+	+	+	+
Pipistrellus tasmaniensis	Great Pipistrelle*	+	+	+	+	+	+	
RODENTIA								
MURIDAE								
Rattus fuscipes	Bush Rat	+	+	+	+	+	+	+
INTRODUCED MAMMALS								
Mus musculus	House Mouse	x	x	x	x	x	x	x
Ratus rattus	Black Rat		x					
Ovis aries	Sheep	x	x	x	x	x	x	x
Oryctolagus cuniculus	Rabbit	+	+	+	+	+	+	+
Vulpes vulpes	Fox	+	+	x	x	+	+	+
Felis catus	Cat	+	x	+	+	+	+	+
Expected Species Richness - native:		18	13	17	20	18	18	7
- introduced:		5	6	5	5	5	5	5

ecologia

BIRD SPECIES WHICH OCCUR OR ARE EXPECTED TO OCCUR IN THE BUSHMEAD RIFLE RANGE PROJECT AREA.

	Faunal Habitats:	1/2	3/5	6/7	8	9/4	10	0
ARDEIDAE								
Ardea novaehollandiae	White-faced Heron		x					x
PLATALEIDAE								
Threskiornis molucca	White Ibis		x					x
ANATIDAE								
Anas gibberifrons	Grey Teal		+					
Anas superciliosa	Black Duck		x	x				x
Chenonetta jubata	Australian Wood Duck		x				x	x
Tadorna tadornoides	Mountain Duck		x					
ACCIPITRIDAE								
Accipter cirrhocephalus	Collared Sparrowhawk*	+	+	+	+	+	+	+
Accipter fasciatus	Australian Goshawk*	+	+	+	+	+	+	x
Aquila audax	Wedge-tailed Eagle*	+	+	+	+	+	+	+
Circus assimilis	Spotted Harrier*	+	+	+	+	+	+	+
Elanus rotatus	Black-shouldered Kite *							x
Hamirostra melanosternon	Black-breasted Kite*	+	+	+	+	+	+	+
Hieraaetus morphnoides	Little Eagle*	+	+	+	+	+	+	+
Lophoictinia isura	Square-tailed Kite*	+	+	+	+	+	+	+
Milvus sphenurus	Whistling Kite*	+	+	+	+	+	+	+
FALCONIDAE								
Falco berigora	Brown Falcon*				x			x
Falco cenchroides	Nankeen Kestrel*							x
Falco longiipennis	Little Falcon *	+	+	+	+	+	+	+
Falco peregrinus	Peregrine Falcon*	+	+	+	+	+	+	+
PHASIANIDAE								
Coturnix pectoralis	Stubble Quail							+
TURNICIDAE								
Turnix varia	Painted Button-quail						x	
RALLIDAE								
Rallus philippensis	Banded Land Rail		x					
COLUMBIDAE								
Phas chalcoptera	Common Bronzewing	x	x		x	x	x	x
Streptopelia chinensis	Spotted Turtle-dove						x	+
Streptopelia senegalensis	Laughing Dove	x	x		x	x	x	+
CACATUIDAE								
Calyptorhynchus baudinii	White-tailed Black Cockatoo	+	x	+	x			
Cacatua roseicapilla	Galah	x	x	x	x	x	x	x
LORIIDAE								
Trichoglossus haematodus	Rainbow Lorikeet	+		+	x		+	
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	+			+	+	+	
PLATYCERIDAE								
Barnardius zonarius	Port Lincoln Parrot	x	x	x	x	x	x	x
Neophema elegans	Elegant Parrot					+	+	+
Nymphicus hollandicus	Cockatiel	+	+	+	+	+	+	+
Platycercus icterotis	Western Rosella	+	+	+	+	+	+	
Polytelis anthopeplus	Regent Parrot	+	+	+	+	+	+	
Purpureicephalus spurius	Red-capped Parrot	x	x	x	x	x	x	x
CUCULIDAE								
Chrysococcyx basalis	Horsefield's Bronze-cuckoo	x	+	+	x	x	+	
Chrysococcyx lucidens	Shining Bronze-cuckoo	+	+	+	+	+	+	
Cuculus pallidus	Pallid Cuckoo	+	+	+	x	x	+	
Cuculus pyrrhophanus	Fan-tailed Cuckoo	+	+	+	+	+	+	

	Faunal Habitats:	1/2	3/5	6/7	8	9/4	10	0
STRIGIDAE								
Ninox novaeseelandiae	Boobook Owl	+	+	x	+	+	+	
Tyto Alba	Barn Owl	x	+	+	+	+	+	+
PODARGIDAE								
Podargus strigoides	Tawny Frogmouth	+	+	+	+	+	+	
AEGOTHELIDAE								
Aegotheles cristatus	Owlet-nightjar			+	+	+	+	
ALCEDINIDAE								
Dacelo gigas	Laughing Kookaburra	x	x	x	x	x	x	x
Halcyon sancta	Sacred Kingfisher	x	x	+	x	x	x	
MEROPIDAE								
Merops ornatus	Rainbow Bee-eater		+		+	+	+	x
HIRUNDINIDAE								
Cecropis ariel	Fairy Martin		+				+	+
Cheramoeca leucosternum	White-backed Swallow		x					+
Hirundo neoxena	Welcome Swallow	x				x	x	x
Hirundo nigricans	Tree Martin	+			+	x	+	x
MOTACILLIDAE								
Anthus novaeseelandiae	Richard's Pipit							+
CAMPEPHAGIDAE								
Coracina maxima	Ground Cuckoo-shrike	+	+	+	+	+	+	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	x	x	x	x	x	+	x
Lalage sueurii	White-winged Triller	x	+	+	+	+	x	x
MUSCICAPIDAE								
Colluricincla harmonica	Grey Shrike-thrush	+	x	x	x	x	+	
Microeca leucophaea	Jacky Winter	+	+	+	x	+	+	
Pachycephalus pectoralis	Golden Whistler	+	x	x	x	x	x	
Pachycephalus rufiventris	Rufous Whistler	x	x	x	x	x	x	
Petroica cucullata	Hooded Robin	+	+	+	+	+	+	
Petroica goodenovii	Red-capped Robin	+	x	x	+	+	+	
Petroica multicolor	Scarlet Robin	+	x	+	x	x	+	
Ripidura fuliginosa	Grey Fantail	x	x	x	x	x	x	+
Ripidura leucophrys	Willie Wagtail	x	x	+	+	x	+	x
SYLVIIDAE								
Cinclorhamphus mathewsi	Rufous Songlark	+	+	+	+	+	+	
MALURIDAE								
Malurus splendens	Splendid Wren	+	x	+	+	+	x	
Malurus lamberti	Variegated Wren	+	+	+	+	+	+	
ACANTHIZIDAE								
Acanthiza apicalis	Broad-tailed Thornbill	+	x	+	+	x	x	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	x	x	x	x	x	x	x
Acanthiza inornata	Western Thornbill	+	+	+	x	+	x	
Gerygone fusca	Western Warbler	x	x	x	x	x	x	x
Sericornis frontalis	White-browed Scrubwren		+					
Smicrornis brevirostris	Weebill	+	+	+	x	+	x	
NEOSITTIDAE								
Daphoenositta chrysoptera	Varied Sittella	x	+	x	+	+	x	
CLIMACTERIDAE								
Climacteris rufa	Rufous Treekeeper	+	+	x	+	+	+	
MELIPHAGIDAE								
Anthochaera carunculata	Red Wattlebird	x	x	x	x	x	x	x
Anthochaera chrysoptera	Little Wattlebird	+	+	+	+	+	+	+
Acanthorhynchus superciliosus	Western Spinebill	x	x	x	x	+	+	
Lichenostomus indistincta	Brown Honeyeater	x	x	x	x	+	x	+
Lichenostomus penicillata	White-plumed Honeyeater	+	+	+	+	+	+	
Lichenostomus virescens	Singing Honeyeater	x	x				+	+
Melithreptus lunatus	White-naped Honeyeater	+	x	+	+	+	+	
Phylidonyris nigra	White-cheeked Honeyeater	+	x	+	+	+	x	

	Faunal Habitats:	1/2	3/5	6/7	8	9/4	10	0
MELIPHAGIDAE cont.								
Phylidonyris novaehollandiae	New Holland Honeyeater	+	+	+	+	+	+	
EPHTHIANURIDAE								
Ephthianura albifrons	White-fronted Chat						+	+
DICAEIDAE								
Dicaeum hirundinaceum	Mistletoe Bird	+	+	+	+	+	+	
PARDALOTIDAE								
Pardalotus punctatus	Spotted Pardalote	+	+	+	+	+	+	
Pardalotus striatus	Striated Pardalote	+	x	+	x	x	+	x
ZOSTEROPIDAE								
Zosterops lateralis	Grey-breasted White-eye	+	x	+	+	+	+	+
ARTAMIDAE								
Artamus cinereus	Black-faced Woodswallow					+	+	+
Artamus cyanopterus	Dusky Woodswallow				x	x	x	+
GRALLINIDAE								
Grallina cycanoleuca	Magpie-lark	x	+	+	x	x	x	+
CRACTICIDAE								
Cracticus nigrolgularis	Pied Butcherbird	x	+	+	+	+	+	+
Cracticus torquatus	Grey Butcherbird	x	+	+	+	+	+	+
Gymnorhina tibicen	Australian Magpie	x	x	x	x	x	x	x
CORVIDAE								
Corvus coronoides	Australian Raven	x	x	x	+	x	x	x
Expected Species Richness:		73	79	68	74	74	81	54

REPTILES AND AMPHIBIANS WHICH OCCUR OR ARE EXPECTED TO OCCUR IN THE BUSHMEAD RIFLE RANGE PROJECT AREA.

	Faunal Habitats:	1/2	3/5	6/7	8	9/4	10	0
Frogs								
LEPTODACTYLIDAE								
Crinia georgiana		x	x					
Crinia glauerti			x					
Crinia insignifera			x					
Crinia subinsignifera			x					
Heleioporus barycragus		+	+	+	+	x		
Heleioporus eyrei	Moaning Frog	x	x	x	+	x		
Limnodynastes dorsalis	Banjo Frog		x					
Myobatrachus gouldii	Turtle Frog	+	x	+	+	+		
Pseudophryne guentheri			+					
Ranidella glauerti			+					
Ranidella insignifera								
HYLIDAE								
Litoria adelaidensis	Slender Tree Frog		+					
Litoria moorei	Bell Frog		+					
Lizards								
GEKKONIDAE								
Crenadactylus ocellatus	Clawless Gecko	+	+	+	+	+	+	
Diplodactylus spinigerus	Spiny-tailed Gecko	+	+	+	+	+	+	
Diplodactylus polyophthalmus							+	
Gehyra variegata	Tree Dtella	+	+	x	+	x	+	
Phyllodactylus marmoratus	Marbled Gecko		x					
Underwoodisaurus milii	Barking Gecko						+	
PYGOPODIDAE								
Aprasia repens		+		+	+	+		
Delma fraseri		+		+	+	+	+	+
Lialis burtonis	Burton's Snake Lizard				+	+		
Pletholax gracilis		+		+	+			
Pygopus lepidopodus		+		+	+	+		+
AGAMIDAE								
Pogona minor	Western Bearded Dragon	+		+	+	+	+	
Tympanocryptis adelaidensis		+		+	+	+	+	
SCINCIDAE								
Cryptoblepharus plagiocephalus	Fence Skink	x	x	x	x	x	x	x
Ctenotus fallens		x		+	+	+	x	x
Ctenotus impar						+	+	
Ctenotus lesueurii		+	+	+	+	+	+	
Egernia napoleonis					+	+	+	
Hemiergis initialis		+	+	+	+	+		
Lerista distinguenda		+	+	+	+	+		
Lerista lineata						+		
Leiolopisma trilineatum		+	+	+	+	+	+	
Menetia greyii		x	x	+	+	+	x	x
Morethia lineocellata		+		+	+	+		
Morethia obscura		+		+	+	+		
Tiliqua occipitalis		+	+	+	+	+	+	+
Tiliqua rugosa	Bobtail	x	x	x	x	x	x	

SUPPLEMENT TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED SALE OF COMMONWEALTH LAND AT THE BUSHMEAD RIFLE RANGE SITE WESTERN AUSTRALIA

for

AUSTRALIAN ESTATE MANAGEMENT
DEPARTMENT OF ADMINISTRATIVE SERVICES

October 1992

Halpern
Glick
Maunsell

CONTENTS

FINAL REPORT

Department of Defence

Bushmead Rifle Range - Bush Forever Boundary Assessment

Preliminary Report

September 2006

Reference: 0042826

For and on behalf of Environmental Resources Management Australia

Approved by: Jackie Boyer

Signed:
Position: Partner

Date: 5 September 2006

CONTENTS

1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by the Department of Defence (Defence) to undertake a preliminary report (the report) for the Bushmead Defence Establishment (Bushmead), located in the Helena Valley, Perth, Western Australia (WA) (*Figure 1.1*).

This report proposes amendments to the Bush Forever boundary, provides justification and recommends future management techniques for the site.

1.1 PROJECT CONTEXT AND APPRECIATION

This report focuses on the Bush Forever aspects of the Bushmead site. It provides comprehensive flora and fauna information as background for proposing a revised boundary for Bush Forever Site 213, along with details of the issues that are associated with the site and the proposed management mechanisms to ameliorate potential impacts so that Bush Forever values of the site are protected.

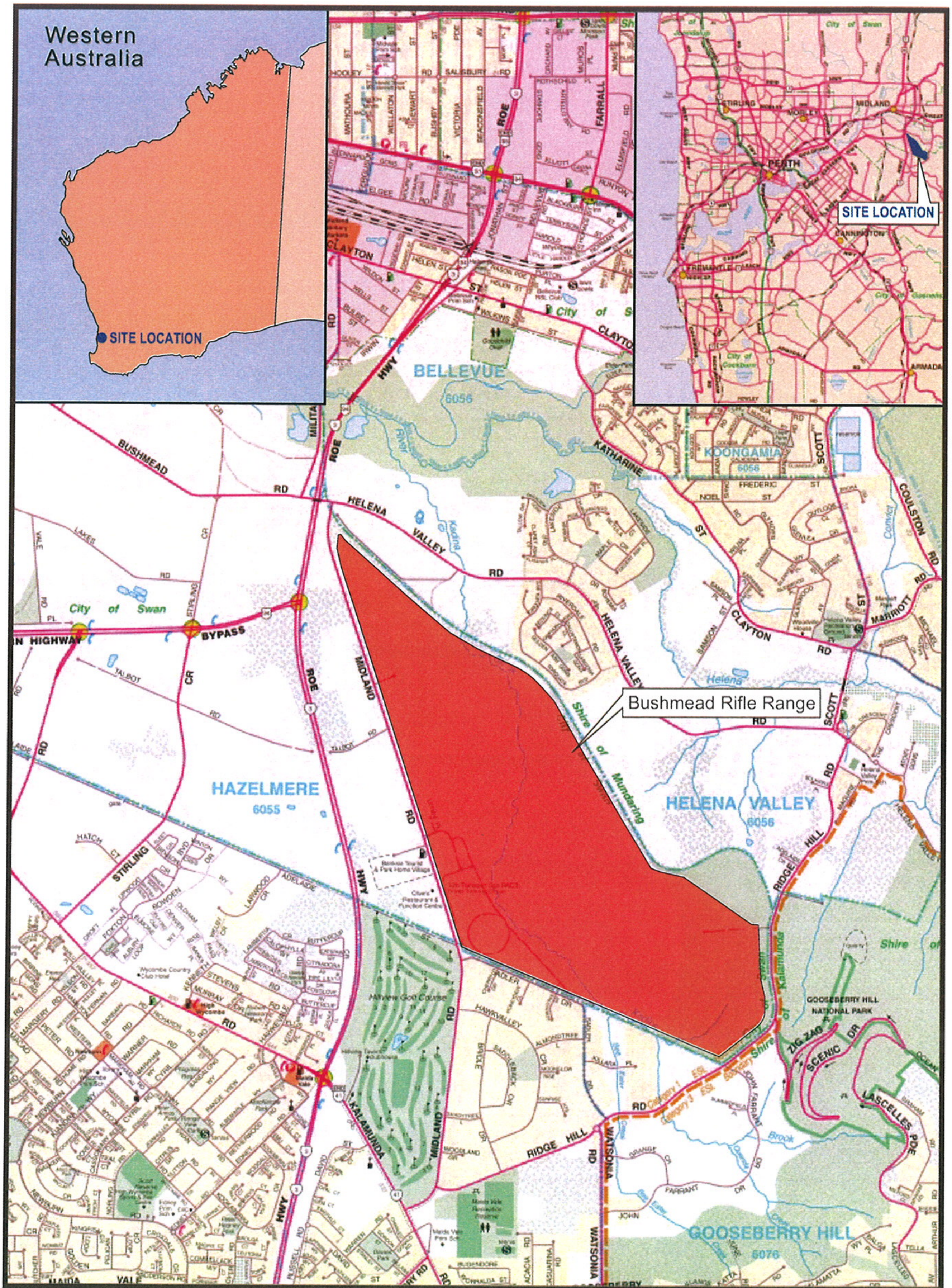
1.2 OBJECTIVE

The majority of the Bushmead site has been surplus to Defence requirements since the early 1990's, therefore Defence intends to dispose of most of the site. The Bushmead site contains remnant bushland areas that have been identified under the State Government's Bush Forever Policy (*Figure 1.2*).

Bush Forever is a Western Australian Government initiative that identifies regionally significant bushland to be retained and protected forever. The mechanism under the Bush Forever Program is 'Strategic Negotiated Planning Solutions' (NPS) that can be used to review the status of Bush Forever sites, and allow for a holistic approach for planning for remnant vegetation conservation. To facilitate the Bushmead NPS process an evaluation of the Bush Forever boundary was required.

An evaluation of existing flora and fauna data for Bushmead was undertaken by Bennett Environmental Consulting Pty Ltd and ERM to form the basis of this report, which outlines the findings that propose changes to the Bush Forever boundary to adequately protect remnant vegetation areas.

The reviewing of the Bush Forever Site 213 boundary has been documented in this report to allow the Department of Planning and Infrastructure (DPI) to assess proposed changes to the Bush Forever boundary and agree on a boundary that can be surveyed prior to site disposal.



0042826 Figure 1 Site Location Bushmead.cdr

Source: Courtesy of StreetExpress 2004.

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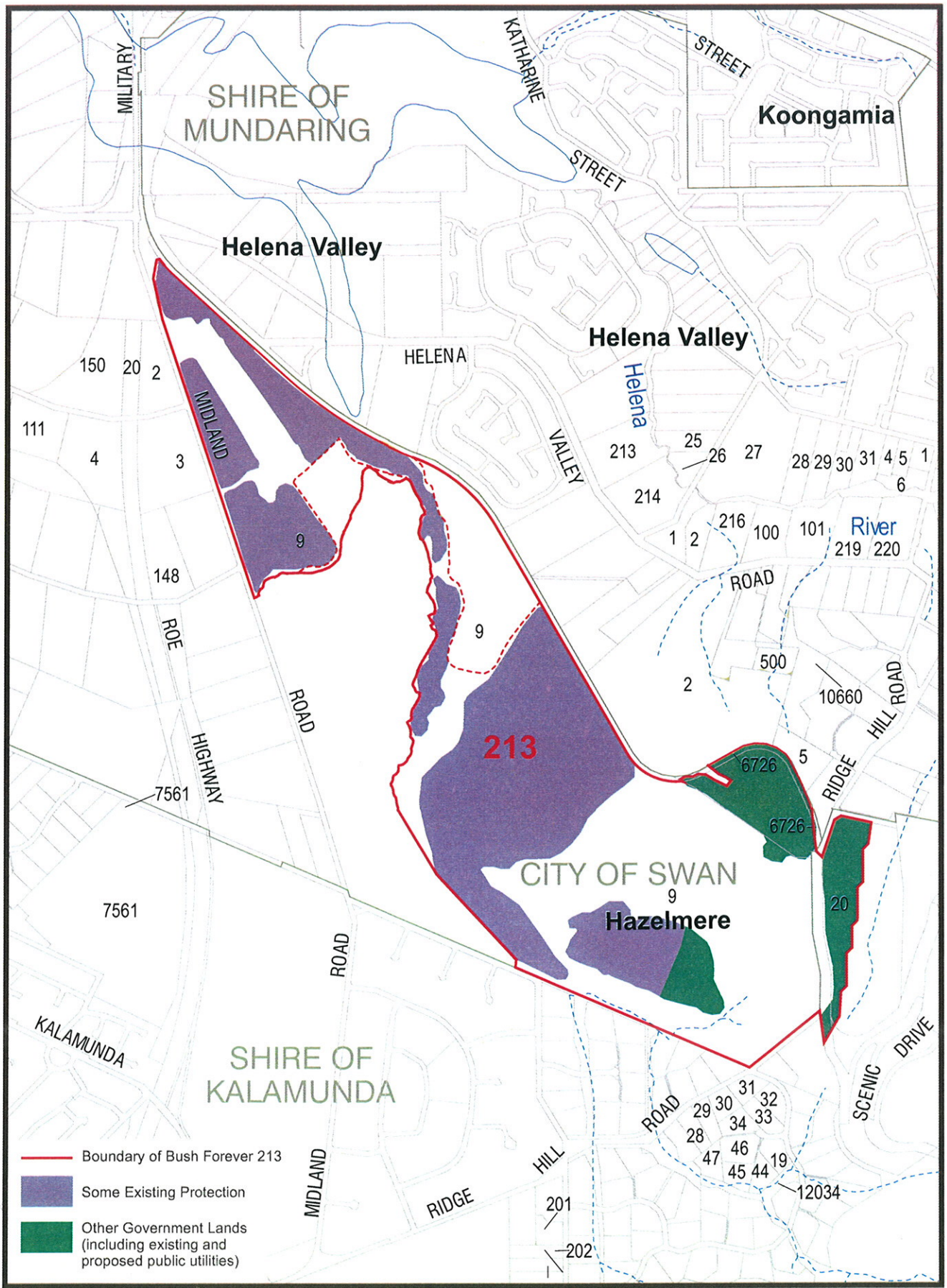
Figure 1.1 **Site Location**

Bushmead Rifle Range
Helena Valley, Western Australia



0042826 Figure 2.1 Bush Forever Site 213.cdr

Source: Bush Forever 2000 WAPC.

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Figure 1.2 **Bush Forever Site 213**

Bushmead Rifle Range
Helena Valley, Western Australia

2 BACKGROUND

2.1 HISTORICAL AND CURRENT USE OF SITE

2.1.1 Previous Use

The site was previously used for Defence purposes, including small arms and driver training.

Historically, the Army operated four firing ranges at the site:

1. existing rifle range - installed in 1984 and used until the early 1990's;
2. old rifle range - operated from 1912 to 1984;
3. existing pistol range - operated from 1984 to the early 1990's; and
4. old pistol range - operated from 1912 to 1984.

The existing ranges were also used by the Police Department, other government departments and civilian clubs.

Midland Abattoirs had a lease to operate an effluent disposal system at the south eastern portion of the site from 1970 to 1982. The storage dam, spray irrigation system and pumping house were demolished in 1984. Most of the vegetation within the effluent disposal area died within approximately 12 months of operations start-up as a result of the high nutrient levels (Dames and Moore, 1989).

2.1.2 Current Use

Current Defence uses of the site are confined to the transport depot and driver training area, which is located in the south-western potion of the site. The 10th Transport Squadron was relocated to Bushmead in approximately 1986 and uses the transport depot for training purposes.

There are eight residential dwellings that were previously occupied by Defence personnel but are currently leased to private individuals through a local real estate agent.

Members of the public regularly trespass on the site and use the area for recreational purposes, illegal dumping and burning vehicles. The fence surrounding the site is often cut to obtain access.

2.2 PREVIOUS STUDIES

A significant amount of work has already been undertaken at the Bushmead site, including:

- Ecologica Environmental Consultants (1991). *Biological Survey - Summary Report.*
- Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., Lyons, M.N. (CALM, 1994). *A Floristic Survey of the Southern Swan Coastal Plain.*
- Quadrat surveying that was undertaken in 1995 by B. Keighery.
- Listing of taxa for Floristic Community Type 20c - Eastern Shrubland and Woodlands. This data was provided by the Threatened Ecological Community Section of the Department of Environment and Conservation (DEC).
- Bennett Environmental Consulting Pty Ltd (2006). *Flora Assessment Bushmead Rifle Range Helena Valley.*

2.2.1 *Ecologica Consulting Pty Ltd (1991)*

Ecological Environmental Consultants undertook a detailed survey of the site and prepared a *Draft Environmental Impact Statement: Biological Survey* document in November 1991. The report detailed the various vegetation units at the site as well as the presence of threatened ecological communities (TECs) and other significant flora.

Ecologica undertook three surveys of the site in autumn, winter and spring 1991. They used two methods:

1. detailed site/association assessments; and
2. broad scale transect mapping.

The survey identified three Floristic Community Types (FCT), two of which are listed as Critically Endangered and a third community which is listed as Endangered (Department of Conservation and Land Management (CALM) listings).

The assessment was detailed, however it was undertaken prior to the Environmental Protection Authority (EPA - 2004) requirements for flora surveys and quadrats were not used. The survey was limited in extent and does not meet the requirements of EPA Guidance No. 51 - *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, (2004).*

2.2.2 *Department of Conservation and Land Management (CALM, 1994)*

A Floristic Survey of the Southern Swan Coastal Plain was prepared by the CALM and the Conservation Council of WA for the Australian Heritage Commission. The survey site consisted of surveying specific plots of vegetation and floristic communities along the Swan Coastal Plain.

2.2.3 *Bennett Environmental Consulting Pty Ltd (2006)*

Bennett Environmental Consulting prepared the *Flora Assessment for the Bushmead Rifle Range Helena Valley (March 2006) (Annex A).* Survey work comprised of a review of publicly available information and a limited site survey, which was completed on 3 February 2006. The purpose of the desk study review and survey was to improve understanding of the vegetation complexes at the site with a view to assessing the accuracy of the current Bush Forever Site 213 boundary. The survey report prepared by Ecological Consulting was made available to Bennett Consulting to provide information on the site prior to the site survey work commencing.

In August 2006, Bennett Environmental Consulting undertook a data evaluation, interpretation and revision of the *Flora Assessment for the Bushmead Rifle Range Helena Valley (March, 2006),* in order to incorporate the flora species list of all the known vegetation assessments, undertaken on the site. The data evaluation comprised an overview of the vegetation units at the site and their condition, in order to confirm the vegetation mapping completed by Ecologica Environmental Consultants in 1991.

3 BUSH FOREVER (SITE NO. 213)

Bush Forever is a ten year strategic plan which aims to protect regionally significant bushland in 287 Bush Forever sites, representing the regional 26 vegetation complexes of the Swan Coastal Plain portion of the Perth Metropolitan Region.

The Bushmead site is 297ha, of which 127.6ha is listed in Bush Forever as Bush Forever Site 213. Bushmead is recognised as a regionally significant fragmented bushland/wetland linkage, as part of several strategic bushland corridors within the Perth Metropolitan Region and is recognised for a number of significant values (DPI, Bush Forever Volume 1, 2000).

3.1 INTERNATIONAL AND NATIONAL SIGNIFICANCE

The Bushmead site is listed (as Bushmead Rifle Range) on the Register of the National Estate and is subject to protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The EPBC Act provides for the conservation of biodiversity and the protection of the environment, particularly those aspects that are considered to be matters of national environmental significance.

The 127.6ha area of remnant bushland is one of several strategic bushland corridors within the Perth Metropolitan Region where small flocks of the nationally threatened Baudin's black cockatoo occasionally visit the area (Australian Heritage Database, 2006).

The site is registered on the Australian Heritage Database (Department of Environment and Heritage 2006) and comprises a number of aspects, which contributed to this listing, including:

- the presence of regionally significant fragmented bushland;
- the presence of FCT 20c (Eastern Shrublands and Woodlands, Gibson et al, 1994) a remnant TEC. This community is listed as a Critically Endangered Community (CALM, 2006) and Endangered (Environment Australia, 2006);
- the presence of FCT 20A *Banksia attenuata* (listed as an Endangered Ecological Community (CALM, 2006); and
- the presence of *Eucalyptus rudis – Melaleuca rhaphiophylla* which fringes the Kadina Brook, which bisects the site and which is recognised as a wetland system of significant conservation value (Australian Heritage Database, 2006).

3.2 FLORA VALUES

3.2.1 *Vegetation Complex*

Bushmead provides a representative example of the broad vegetation unit that is associated with the Ridge Hill Shelf geomorphic unit, the Forrestfield vegetation complex. This complex has been extensively cleared for agriculture, mining, and urban development and it is estimated that of the 11,328ha of this complex which once occurred in the Perth Metropolitan Region only 1,020ha remains (9% of the vegetation).

Bushmead contains one of four remaining sizeable remnants of the Forrestfield complex and is the only one within the Perth Metropolitan Region. The bushland is also listed on the National Heritage Register and is protected under Commonwealth Heritage List.

3.2.2 *Threatened Ecological Communities*

Three TECs have been identified and recorded at the Bushmead Rifle Range site, which are protected under the EPBC Act. These include:

- FCT 20c

  The area of FCT 20c consists of eastern shrublands and woodlands and is one of the two remaining remnants of this TEC. This community is listed as critically endangered by the Department of Environmental Conservation (DEC);

- FCT 20a

  The area of FCT 20a consists of *Banksia attenuata* woodlands over species rich dense shrublands and is listed as Endangered by the DEC; and

- FCT 3c

  A small area of FCT 3c has been identified which consists of *Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrubland. It is too degraded to be considered a TEC, however is listed as Critically Endangered by the DEC.

3.2.3 *Declared Rare and Priority Flora*

Several plants of *Isopogon drummondii*, a Priority 3 flora, were recorded at the site, of the northern section within the TEC area.

No Declared Rare Flora have been recorded within the site.

3.2.4 *Landscape Feature*

Kadina Brook, a tributary of the Helena River runs through the site. This creekline is recognised as a wetland of significant conservation value (Australian Heritage Database, 2006).

the area along Midland Road was included in the study by the Museum (see title page appendix)

3.3 *FAUNA VALUES*

Western Wildlife (2006) undertook an investigation of the fauna at the site *(Annex B)*. The survey found that the site supports a range of vertebrate fauna including up to 12 species of amphibian, 57 species of reptile, 110 species of bird and 24 species of mammal.

It was identified that the site may support a number of species of Conservation Significance (Western Wildlife, 2006).

- Conservation Significance 1: Species listed under State or Commonwealth Acts.
- Conservation Significance 2: Species not listed under State or Commonwealth Acts, but listed in publications on Threatened Fauna or as Priority species by CALM.

These however were not necessarily observed, the areas most likely to support a relatively intact fauna are those with the least degraded native vegetation.

Table 1 ***Conservation Significant species that may occur at Bushmead Rifle Range***

Conservation Significance 1	Conservation Significance 2
Carpet Python	Southern Death Adder
Baudin's Black Cockatoo	Black-Striped Snake
Carnaby's Black-Cockatoo	Darling Range Ctenotus
Forest Red-tailed Black-Cockatoo	Barking Owl
Peregrine Falcon	Masked Owl
Rainbow Bee-eater	Quenda (Southern Brown Bandicoot)
Forktailed Swift	Brush Wallaby
Chuditch	Western False Pipistrelle

Conservation significant species should also include any of those species listed in Table 15 in Bush Forever as declining on the Coastal Plain and therefore regionally significant. 33 cons. sig. spp are included in fauna report.

4 BUSH FOREVER SITE 213 BOUNDARY

The DPI, Bush Forever Volume 1, 2000 has identified threats to bushland from the adverse effects of development as:

- fragmentation, creating ecological islands which reduce the movement of fauna and gene migration between isolated pockets;
- changes in hydrological regimes and soil nutrient status through urban runoff;
- increased erosion from increased runoff and site works, bringing suspended solids and causing saltation;
- alteration of natural fire regimes and frequency. Weed introduction through firebreaks and illegal dumping of wastes and garden clippings, stormwater discharge, irrigation and frequent fire;
- physical damage and soil compaction and erosion through overuse by humans, or inappropriate use and associated weed infestation;
- wildlife predation by domestic pets;
- disturbance and fragmentation through ancillary services such as powerlines, sewerage, water, gas, sporting facilities, transport corridors and associated works and maintenance; and
- removal of plants as source of landscaping and planting of exotic species.

The site was assessed against the Bush Forever criteria and a revised boundary which accurately reflects the site's Bush Forever values identified *(Figure 3.1 and Table 2)* is proposed.

The proposed revised boundary will improve the management of the Bush Forever site, protect the environmental values associated with Kadina Brook and areas of TEC and priority flora by minimising fragmentation. Three areas have been identified, which do not exhibit Bush Forever values and are proposed for exclusion from the Bush Forever boundary:

1. the old effluent disposal area - severely degraded (21.7ha);
2. the area immediately to the south of the rifle range - degraded quality and sparsely vegetated (10.8ha); and
3. the area extending to the eastern boundary of the site, with the exclusion of Kadina Brook and the proposed buffer area, this area is subjected to urban encroachment - good to degraded quality and sparsely vegetated (10.6ha).

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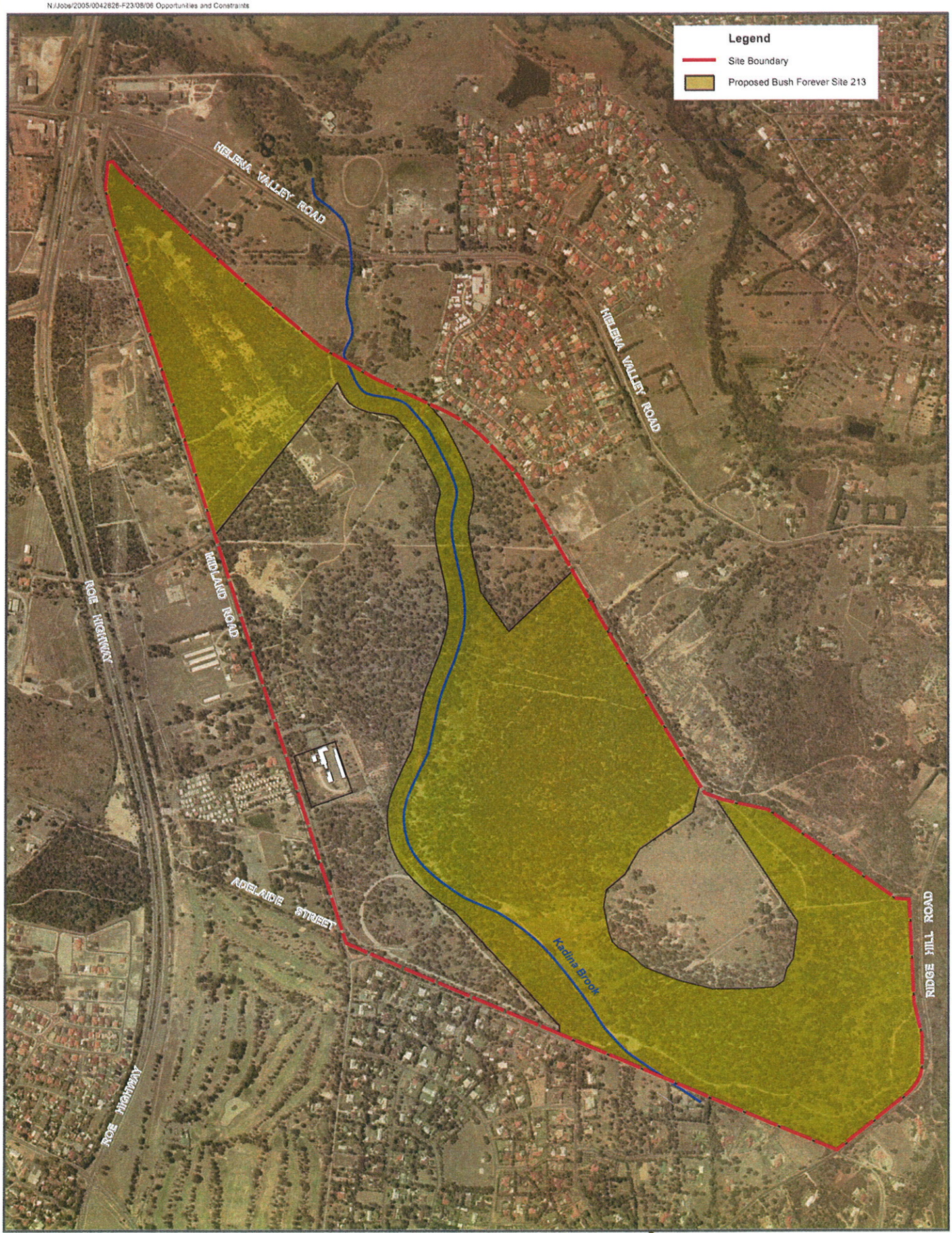

Source: Aerial Photograph December 2003.

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Figure 3.1 **Proposed Bush Forever Boundary**

Bushmead Rifle Range Property Disposal
Helena Valley, Western Australia
August 2006

50m

An enhanced buffer for Kadina Brook is proposed as an addition to Bush Forever Site 213 (*Figure 3.2*).

Table 2 below summarises areas associated with the proposed revised Bush Forever boundary.

Table 2 ***Summary of Bush Forever areas associated with revised boundary***

	Approximate Area (ha)
Bushmead Rifle Range	
Total area of Bushmead Site	297ha
Threatened Ecological Communities (Section 4.1.4, Fig 3.3)	
Area of TEC to be added under Defence management	0.32ha
Bush Forever Site 213 (Fig 3.2)	
Total area of Bush Forever Site 213	127.6ha
Area proposed for removal from Site 213 with revised boundary	
1. Effluent area	*21.7ha*
2. Area south of rifle range	*10.8ha*
3. Eastern boundary area	*10.6ha*
Total	43.1ha
Area of bushland proposed to be added to Bush Forever Site 213	4.58ha – along creekline
Total area of Bush Forever Site 213 with revised boundary	89.1ha

4.1 JUSTIFICATION

The key threats identified by DPI for the protection of the bushland were considered in the Bush Forever boundary location assessment. The proposed revised boundary is not considered to have a significant impact on the Bush Forever criteria as the quality of vegetation proposed for exclusion from the Bush Forever site is degraded or would be difficult to manage in the long term. Areas proposed for inclusion will improve the protection of the conservation values and linkage function for Kadina Brook.

Table 3 summaries the key threats to bushland at Bush Forever sites as discussed in more detail in the following sections.

not

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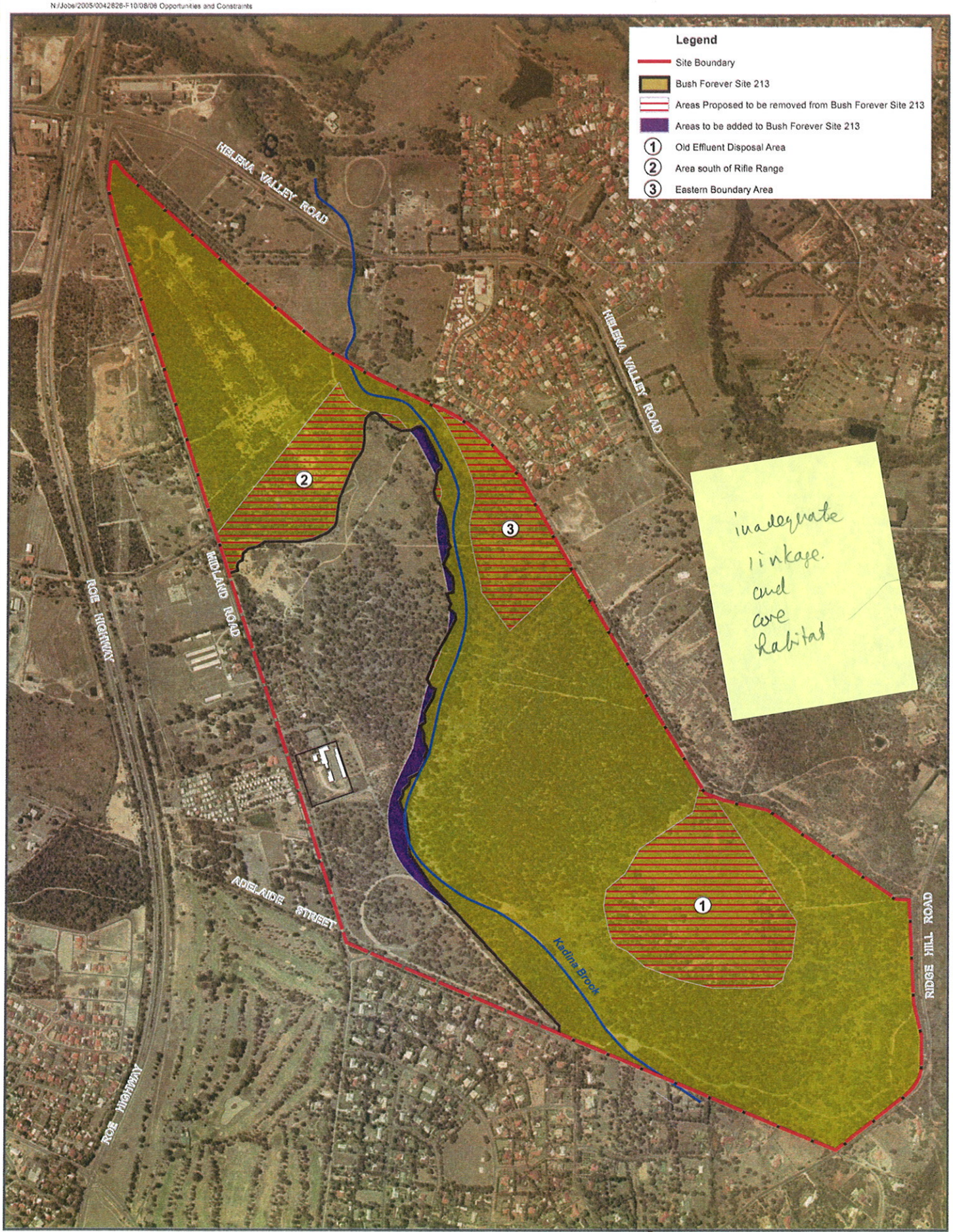

Source: Aerial Photograph December 2003.

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Figure 3.2 **Proposed Bush Forever Boundary with Areas of Inclusion and Exclusion**

Bushmead Rifle Range Property Disposal
Helena Valley, Western Australia
August 2006

Table 3 *Summary of key threats to bushland in Bush Forever sites*

Key Threats (identified by DPI)	Brief Summary of Potential Management Measures
Fragmentation	The provision of sufficient manageable buffers has been retained and improved around TEC areas and the Kadina Brook. This avoids fragmentation and the creation of ecological islands.
Changes in hydrological regimes	Hydrological regimes and runoff will be addressed through the subdivision phase if development occurs. Measures such as retention and treatment basins could be incorporated to ensure that no nutrient runoff filters into the Brook.
Increased erosion	Increased erosion from runoff and site works will be managed in the construction phase of any future development, and buffer zones between vegetation and development will assist in avoiding any disturbance.
Natural fire regimes	Illegal dumping currently occurs on the site, the revised boundary would allow some development, which may help prevent this occurring. Natural fire breaks already exist around the site.
Damage and soil compaction	The introduction of fences and walking tracks during the development phase would assist in managing potential physical damage to the site. Enhancement planting and weed control measures would also assist in the control of damage.
Predation by domestic pets	The erection of fences, signage and education of the community may contribute to the prevention of animals entering the vegetated areas.
Disturbance and fragmentation through ancillary services	Disturbance for ancillary services would only occur within the areas designated for development. The protected conservation areas would not be affected.
Removal of plants as source of landscaping	Covenants placed on the land by developers will enable plant species within the area to be controlled.

4.1.1 *Continuation of Vegetation Linkage*

To avoid fragmentation and the creation of ecological islands the area in the northern portion of the site, and to the east that are identified as TEC, along with a vegetation buffer 50m either side of the Kadina Brook, will be maintained allowing for movement of fauna and gene migration.

This buffer zone will ensure protection of the brook's environmental values and provide an adequate link from the northern Bush Forever sections to the southern areas.

Management measures including the placement of defined walking tracks along the edge of the reserve to control access and to provide a boundary would assist in protecting these environmental values and enhancing the vegetation links.

4.1.2 *Outside Linkages*

The revised boundary ensures that the TECs maintain their connectivity with the Gooseberry Hill National Park and remnant vegetation within the Bushmead site to outside areas, such as:

- Bush Forever Site 216 (Adelaide Crescent Bushland, Helena Valley) to the north;
- Bush Forever Site 217 (Ridge Hill Road Bushland, Gooseberry Hill) to the south;
- Bush Forever Site 481 (Stirling Crescent Bushland, Hazelmere) to the west; and
- part of the regionally significant fragmented bushland/wetland linkage to the Helena River.

The link formed by the 100m corridor around the brook is valuable in connecting the site and the Gooseberry vegetation complex, which lies east of the site. This connection enables a continuous link from the Swan Coastal Plain through to the Darling Scarp, which is unusual and therefore of ecological significance.

4.1.3 *Size and Shape*

Size is important in determining the viability of a bushland area. The approximate area of the revised Bush Forever Site 213 is 89.1ha, which is still considered a large remnant, minimising its susceptibility to disturbance. The bushland is linked throughout Bushmead, even if it is often via the canopy and degraded understorey.

The revised boundary is of a manageable shape, and the size and shape of the remnant vegetation at the site has been enhanced by incorporating a 20m buffer zone between the areas of TEC and 10m between areas where the ground is completely degraded (such as the effluent area).

4.1.4 *Rarity*

To ensure rarity is preserved within the site, a small area of TEC which is located north of the Defence buildings, just outside the Defence use area, is proposed to be included within the Defence area (*Figure 3.3).*

Defence originally intended to dispose of this area, however in order to manage and protect the conservation values of these TECs, Defence intend to retain the area.

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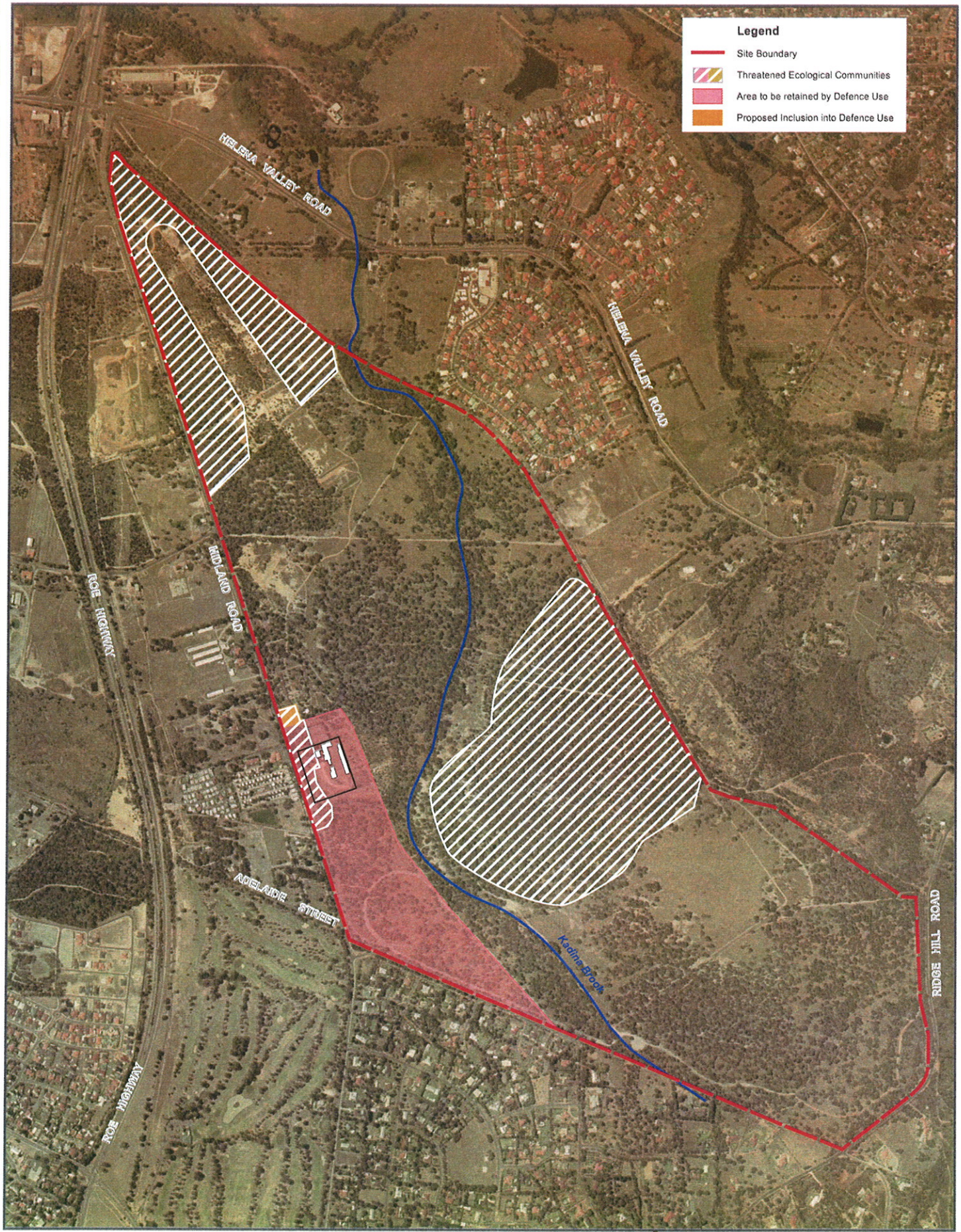

Source: Aerial Photograph December 2003.

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Figure 3.3 **Inclusion of TEC Area**

Bushmead Rifle Range Property Disposal
Helena Valley, Western Australia
March 2006

5 RECOMMENDATIONS

A significant amount of vegetation assessments have been undertaken at the Bushmead site and the most recent report by Bennett Consulting (2006) (*Annex A)* contains a very comprehensive vegetation list based on all relevant reports. On this basis, it is considered that no further work is required to characterise the vegetation on site.

bot cockatoes breeding? hollows?

5.1 FUTURE MANAGEMENT

To ensure Bush Forever values are protected the following recommendations for future management of the revised Bush Forever Site 213 include:

- fencing;
- access roads;
- weed control;
- rehabilitation planting;
- education of residents; and
- covenants.

These are discussed in more detail below. The management activities would occur after the property disposal phase, but potential purchasers can be made aware of these likely requirements during the disposal process.

5.1.1 *Fencing*

To ensure there is not a proliferation of tracks through the bushland, walking tracks should be constructed, including creek crossings. These tracks should follow current tracks or degraded areas through the bushland.

There must be continuous tracks so that residents can join the track at a convenient location and be able to return to their starting point. Fire breaks should also be utilised as walk tracks.

5.1.2 *Roads*

Access roads through vegetated areas should be located to minimise impacts on the vegetation.

5.1.3 *Weed Control*

There are a number of weeds that have been identified within the site, specifically within the Kadina Brook buffer area and within the TEC.

Weeds that need to be removed to improve site values include:

- *Watsonia meriana* subsp. *Bulbillifera;*
- *Cynodon dactylon* (Couch); and
- *Pennisetum clandestinum* (Kikuyu, plants from the creekline).

Spraying

Broad scale spraying for *Ehrharta calycina* and *Eragrostis curvula* and other weed grasses around the buffer zones and any tracks or roads that traverse the conservation areas would need to occur. Spot spraying of broad leaf weeds including *Oxalis* sp., *Trifolium* sp., would also assist in weed control.

Soil Movement

Contractor vehicles entering the site must be cleaned of soil and plant material to ensure there is no transportation of disease or weed seeds onto the site.

If soil is to be removed from areas of vegetation in good or better condition the topsoil should be stored and spread back over the site or spread onto a buffer area within the same vegetation unit.

5.1.4 *Rehabilitation Planting*

Once weed control has been undertaken rehabilitation of those sites should occur as follows

- Vegetation mapping has been prepared for the site and the taxa recorded from each unit listed. Using this information the correct taxa can be planted in each area.
- Vehicle tracks through the remnant bushland should be rehabilitated using taxa endemic for that vegetation unit.

- Any Grass trees (*Xanthorrhoea* species) or Zamias (*Macrozamia riedlei*) that are to be removed during development should be transplanted into one of the buffer areas or a conservation area in degraded condition. Within the Kadina Brook buffer zone if the area is degraded endemic species should be planted.

- Where plantings occur seeds will be collected from the site and/or seedlings propagated from these same seeds to ensure the genotype of the area is maintained.

- Where the ground is completely degraded there should be a dense planting of trees/shrubs and the other buffer zones may require enhancement plantings.

- Retainment of larger native trees should be part of the development. If plantings are to occur within private properties, plants endemic to the bushland should be encouraged. This will encourage the native animals at the site. Large trees with nesting holes should be retained as these may be nesting sites for the Black Cockatoos.

5.1.5 *Education of Residents*

If development does proceed it is essential that the residents understand the importance of the vegetation and habitat at the site. Signage providing environmental and historical information about the site may enhance the public's enjoyment and all purchasers in the area should be provided with a leaflet explaining the following:

- the location and listings of FCT 20c, FCT 20a and FCT 20c. Hopefully this will ensure pride in the conserved vegetation at the site;

- lawn clippings and prunings are not to be dumped in the bushland as this could introduce other weeds;

- no trail bikes are to be ridden on tracks and no structures to be built in the bushland;

- dogs must be kept on a lead when walking through the bushland;

- limited use of fertilizer on gardens is to be encouraged to ensure the health of Kadina Brook;

- a list of plants not to be grown in the home gardens could be provided. This would include several popular plants in plant nurseries including: Freesia, Ixia, Lachenalia, Veldt daisy, Gazania, Arctotis, Vinca, Victorian Teatree, Lantana, Eastern Australian Wattles, as these and other popular home garden plants are known to be invasive environmental weeds; and

- no cats are permitted in any future residential development.

5.1.6 *Covenants*

A covenant should be used as a restriction, registered on the titles that limits the landowner from using or developing the land in a particular way such as no native plants are to be removed from the bushland for home gardens.

Covenants are placed on the title by the developer at the time of subdivision. This may seem attractive to purchasers who are looking for a particular style and type of development in their future neighbourhood.

Annex A

Review of Vegetation Assessments Bushmead Rifle Range (Bennett Environmental Consulting, August 2006)

REVIEW OF VEGETATION ASSESSMENTS
BUSHMEAD RIFLE RANGE
HELENA VALLEY

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STATEMENT OF LIMITATIONS

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INDEX

SUMMARY

Bennett Environmental Consulting Pty Ltd was commissioned by Environmental Resources Management Australia to undertake an over view of biological studies undertaken at Bushmead and to list the conservation values of the site, constraints for development and potential areas where development could occur.

The conservation values included:

- Three Threatened Ecological Communities;
- One Priority Flora plus other taxa significant for the Perth Metropolitan area;
- Significant creekline, Kadina Brook which is a tributory of the Helena River;
- Vegetation Complexes where less than 10% remains vegetated of which less than 5% is protected reserves;
- Large number (362) of taxa; and
- Potential for significant fauna to occur at the site with the holes in the large trees being nesting sites for birds, including possibly the Black cockatoos.

The development constraints are discussed in the report but include:

- Threatened Ecological Communities
- Priority Flora
- Land Unit
- Vegetation Complex
- Kadina Brook
- Vegetation Condition
- Continuation of vegetation linkage
- Outside Linkages
- Size and Shape.
- Uplands and Wetlands.

Two areas are suggested for potential development provided buffers of sufficient size are retained around Kadina Brook.

1. INTRODUCTION

Several vegetation assessments have been undertaken at Bushmead Rifle Range. The aim of this report is to bring together all the known flora and vegetation assessments and to provide a potential decision on the long term development/conservation of the site.

The reports accessed are:

- ecologia Environmental Consultants (1991). *Biological Survey – Summary Report.* Prepared for Department of Defence.
- Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., Lyons, M.N. (1994). *A Floristic Survey of the southern Swan Coastal Plain.* Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).
- Data provided by B. Keighery for quadrats BUSHM01, BUSHM02 and BUSHM03 undertaken in 1995.
- Listing of taxa for Floristic Community Type 20c – Eastern Shrubland and Woodlands. This data was provided by the Threatened Ecological Community Section of the Department of Environment and Conservation.
- .Bennett Environmental Consulting Pty Ltd (2006). *Flora Assessment Bushmead Rifle Range Helena Valley.* Unpublished report for Environmental Resources Management Australia.

Two Threatened Ecological Communities have been identified at the site by the Department of Environment and Conservation. These are:

- Floristic Community Type 20c – Eastern Shrubland and Woodlands, and
- Floristic Community Type 20a – *Banksia attenuata* woodlands over species rich dense shrublands.

Floristic Community Type 20c is listed as a Critically Endangered Community by the Department of Environment and Conservation (2006) and Endangered by (Environment Australia, 2006). Floristic Community Type 20a is listed as an Endangered Ecological Community by the Department of Environment and Conservation (2006).

In addition Floristic Community Type 3c – *Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrubland was also recorded by Bennett Environmental Consulting Pty Ltd and previously by B. Keighery (pers. comm.). This is listed as Critically Endangered by the Department of Environment and Conservation and Endangered (2006) by Environment Australia (2006).

The assessments for BUSHM01, BUSHM02 and BUSHM03 were undertaken using 10m x 10m quadrats and recorded using "Bushland Plant Survey Recording Sheets" (B. Keighery, 1994). These sheets give a comprehensive description of each quadrat assessed and the results for these three quadrats.

Ecologia Environmental Consultants undertook three surveys of the site in autumn, winter and spring 1991. They used two methods:

1. detailed site/association assessments and
2. broad scale transect mapping.

The assessment undertaken was detailed but was undertaken prior to Environmental Protection Authority (2004) so quadrats were not used. The report lists all taxa recorded according to the 14 sites that were surveyed.

The listing of taxa in Gibosn *et al.* (1994) for Floristic Community Type 20c did not include BUSHM02 which was surveyed later. The survey undertaken by Bennett Environmental Consulting Pty Ltd (2006) was to determine the vegetation units at the site and to prepare maps for the vegetation units and vegetation condition at the site. It was not a detailed assessment as ecologia Environmental Consultants had undertaken the detailed assessment 15 years previously.

Mapping of the location of Floristic Community Type 20c was undertaken by the Department of Environment and Conservation. They did not do detailed quadrats but did map the four extremes of

this FCT as MYBUSHMNW, MYBUSHMSE, MYBUSHMSW and MYBUSHMNE. These corners delimit the extent of this FCT at the site.

2. VEGETATION UNITS

ecologia Environmental Consulting described the vegetation of 14 sites which were separated by structure and life form density into associations (units). The taxa associated with these 14 sites are listed in Appendix A where each unit is represented by an abbreviation. The abbreviation used in Table 1 and Appendix A follows the description for each site. Sixteen units were mapped. The 14 sites described are listed below in an abbreviated form.

Site 1: ***Banksia attenuata, Banksia menziesii/Eucalyptus todtiana/Allocasuarina fraseriana*** **Woodland. (BEA1)**

Site 2: ***Banksia attenuata, Banksia menziesii/Eucalyptus todtiana/Allocasuarina fraseriana*** **Woodland. (BEA2)**

This unit recorded a lesser proportion of *Allocasuarina fraseriana* in the canopy than in Site 1.

Site 3: ***Eucalyptus rudis*** **subsp.** ***rudis/Melaleuca rhaphiophylla*** **Woodland. (EM1)**

This unit was the downstream creekline.

Site 4: Open ***Eucalyptus marginata*** **subsp.** ***marginata/Corymbia calophylla*** **Woodland. (EC1)**

Site 5: ***Eucalyptus rudis*** **subsp.** ***rudis/Melaleuca rhaphiophylla*** **Woodland (EM2)**

This unit was along the creekline.

Site 6: ***Banksia attenuata, Banksia grandis, Banksia menziesii/Allocasuarina fraseriana*** **Woodland. (BA1)**

The northern portion of this site contained small stands of *Adenanthos cygnorum subsp. cygnorum.*

Site 7: ***Banksia attenuata, Banksia grandis, Banksia menziesii/Allocasuarina fraseriana*** **Woodland. (BA2)**

At the southern extreme of this unit *Adenanthos cygnorum subsp. cygnorum* formed a dense shrub stratum.

Site 8: ***Corymbia calophylla/Eucalyptus marginata*** **subsp.** ***marginata*** **Woodland. (EC2)**

This is medium density woodland with an open low understorey.

Site 9: ***Corymbia calophylla/Eucalyptus marginata*** **subsp.** ***marginata*** **Woodland. (EC3)**

Low numbers of *Eucalyptus wandoo* were recorded.

Site 10: ***Eucalyptus wandoo*** **Woodland (W)**

Site 11: ***Corymbia calophylla/Eucalyptus marginata subsp. marginata*** **Woodland. (EC4)**

Ground stratum consisted of weeds.

Site 12: ***Eucalyptus marginata*** **subsp.** ***marginata/Dryandra sessilis var. sessilis*** **Complex. (ED)**

Site 13: ***Corymbia calophylla*** **Lithic Complex. (C)**

Site 14: ***Eucalyptus rudis*** **subsp.** ***rudis/Eucalyptus wandoo/Melaleuca rhaphiophylla*** **Woodland (EE)**

This was the down stream site.

Another 2 areas mapped by ecological Environmental Consultants but not included as a site are: ***Eucalyptus marginata*** **subsp.** ***marginata/Banksia*** **species Woodland** (BA1) and **Lower Creekline Eucalyptus rudis subsp. rudis** (included under EM1).

The 14 sites can broadly be combined under 7 distinct units.

1. ***Banksia attenuata, Banksia menziesii/ Eucalyptus todtiana*** **Low Woodland.**
   This includes sites BEA1 and BEA2.
2. ***Banksia*** **species** ***Allocasuarina fraseriana*** **Woodland.**
   This includes sites BA1 and BA2.
3. ***Eucalyptus marginata*** **subsp.** ***marginata/Banksia*** **Low Woodland.**
   This includes sites EC1, EC2,EC3, EC4 and ED
4. ***Eucalyptus rudis*** **subsp.** ***rudis/Melaleuca rhaphiophylla*** **Woodland.** This includes sites EM1, EM2 and EE.
5. ***Corymbia calophylla*** **Lithic Complex.**
   This is site C.
6. ***Eucalyptus wandoo*** **Open Woodland.**
   This is site W.

7. Degraded Open Grassland.

This could include some areas of EC1, EC2, EC3 and EC4.

Site 10 *Eucalyptus wandoo* Woodland is the Main Road Reserve to the north of the site but adjacent to Ridge Hill Road. ecologia Environmental Consultants recommended that this site be included in the Bushmead conservation area.

Bennett Environmental Consulting Pty Ltd (2006) undertook an overview of the vegetation at the site and ensured that all the site variations recorded by ecologia Environmental Consultants were included. A total of 26 sites had the dominant taxa recorded. The vegetation mapping of the area undertaken by ecologia Environmental Consultants Pty Ltd (1991) was proven during the 2006 survey to be accurate. The differences between the *Eucalyptus marginata* subsp. *marginata/Corymbia calophylla* communities were not as obvious at the time of the current survey. The main differences noted between the 1991 survey and the overview undertaken in 2006 are:

- Some of the area indicated as *Banksia – Allocasuarina* Woodland had very few *Banksia* trees and would more accurately be referred to as *Allocasuarina* Woodland. The *Allocasuarina* trees were dense with a nearly complete canopy. With this density of canopy there were very few understorey species recorded.
- Some of the area indicated *as Banksia – Allocasuarina-Eucalyptus todtiana* Woodland had very few to no trees of *Eucalyptus todtiana* but several trees of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla.*
- A small area of the *Banksia attenuata, Banksia menziesii/Eucalyptus todtiana/ Allocasuarina fraseriana* Woodland included stands of *Banksia ilicifolia.*
- The shooting range is regenerating well. There are several of the surrounding species in the area plus others that are more adapted to the lower landscape of this area.
- Sections of the creek are in good or better condition but there are large stretches where the weeds **Watsonia meriana* subsp. *bulbillifera, *Pennisetum clandestinum* and **Cynodon dactylon* dominate.
- A small area of *Corymbia calophylla* Woodland over *Xanthorrhoea preissii* Open Shrubland was mapped by Bennett Environmental Consulting Pty Ltd (2006). This was only a small area but was also recognised by B. Keighery (pers. comm.), but was considered too small to map. This unit is abbreviated as CX in Table 1.

Quadrats BUSHM01 and BUSHM03 surveyed by B. Keighery are included in *Banksia attenuata, Banksia menziesii/ Eucalyptus todtiana/Allocasuarina fraseriana* Woodland, Site 2. Quadrat BUSHM02 is included in *Banksia attenuata, Banksia grandis, Banksia menziesii/Allocasuarina fraseriana* Woodland, Sites BA1 and BA2.

Using ecologia Environmental Consultants information as the base line mapping a comparison has been made between the other surveys conducted at the site. This is summarised in Table 1.

Table 1. Comparison of Bennett Environmental Consulting Pty Ltd (2006), B. Keighery and Department of Conservation and Environment surveys with the vegetation mapping units of ecologia Environmental Consultants (1991),

Vegetation Unit	Ecologia (1991)	Bennett (2006)	Other Surveys
BA1	Site 6	BM11, BM11a, BM14	BUSHM02, MYBUSHMNE
BA2	Site 7	BM13	
BEA1	Site 1	BM20, BM21, BM22	BUSHM01, BUSHM03
BEA2	Site 2	BM16, BM17, BM18, BM19	
C	Site 13	BM07	
CX	No site	BM01	
EB	No site	BM25	MYBUSHMNW
EC1	Site 4	BM23, BM24, BM26	MYBUSHMSE
EC2	Site 8	BM02	
EC3	Site 9	BM06,	
EC4	Site 11	BM04, BM09, BM10	MYBUSHMSW
ED	Site 12	BM03	

Vegetation Unit	Ecologia (1991)	Bennett (2006)	Other Surveys
EE	Site 14	BM05	
EM1	Site 3	No site	
EM2	Site 5	BM12, BM15, BM15a	
W	Site 10	BM08	

3. VEGETATION CONDITION

Bennett Environmental Consulting Pty Ltd recorded the vegetation condition at the site. The vegetation unit BEA1 was in excellent condition; vegetation unit BEA2, the eastern side of vegetation unit W and the area identified by the Department of Environment and Consulting as FCT20c was in very good to excellent condition; Vegetation unit CX was in very good condition; the western side of vegetation unit W and the area of vegetation unit EB to the south of vegetation unit BEA1 was in good to very good condition. The remainder of the site was in good to degraded to completely degraded condition.

4. FLORA

Appendix A lists all the taxa that have been recorded from the site. A total of 70 vascular plant families, 200 genera and 362 taxa, of which 81 are weeds, have been recorded from the site. The dominant plant families are:

- Proteaceae with 44 taxa none of which are weeds;
- Papilionaceae with 41 taxa of which 9 are weeds;
- Poaceae with 32 taxa of which 23 are weeds; and
- Myrtaceae with 22 taxa of which 2 are weeds.

The family Proteaceae includes the Priority Flora, *Isopogon drummondii* and *Persoonia sulcata.*

5. CONSERVATION VALUES

ecologia Environmental Consultants rated the site for its conservation value from both the flora and fauna aspects. Kadina Brook and the area of BEA1 and BEA2 was listed as having a very high conservation value. The area indicated by the Department of Environment and Conservation as being representative of FCT20c and the *Eucalyptus wandoo* Woodland was rated as high. The area to the south of the previous abattoir effluent irrigation area was rated as moderate to high, the cleared and degraded land as low and the remainder as moderate.

5.1 Threatened Ecological Communities (TEC)

With the survey work undertaken by Gibson *et al.* (1994) and the publication of Bush Forever (Western Australian Planning Commission, 2000) two threatened ecological communities were identified at the site. These are Floristic Community Type 20a represented by BEA1and BEA2 and Floristic Community Type 20c, represented by BA1, EB, EC1 and EC4.

The area of FCT20c at the site is one of the two remaining remnants of this Threatened Ecological Community. 79ha of this community remains, of which 38ha occurs within the Ridge Hill Shelf. This community is listed as a Critically Endangered Community by the Department of Environment and Conservation (2006) and Endangered (Environment Australia, 2006).

FCT20a is listed as an Endangered Ecological Community by the Department of Environment and Conservation (2006).

A small area of FCT3c – *Corymbia calophylla – Xanthorrhoea preissii* Woodlands and Shrublands has been identified at the site. It is regarded as too degraded to be considered a Threatened Ecological Community (Western Australian Planning Commission, 2000). This FCT is small in area and is located on the Midland Road side of the Transport sheds. This FCT is listed as Critically Endangered by the Department of Conservation and Land Management and Endangered by Environment Australia.

The areas occupied by these TEC's will limit development.

5.2 Priority Flora

Several plants of *Isopogon drummondii*, a Priority 3 Flora were recorded by B. Keighery and by Bennett Environmental Consulting Pty Ltd in BEA2. ecologica Environmental Consulting also tentatively recorded another Priority 3 Flora, *Persoonia sulcata* from the *Eucalyptus wandoo* Woodland. However the *Eucalyptus wandoo* area is Main Roads land and would need to be considered if this land is added to conservation areas at the site.

Other significant flora recorded from the site are *Lambertia multiflora* subsp. *occidentalis* and *Pityrodia bartlingii* (observed at BEA2 by Bennett Environmental Consulting Pty Ltd (2006)), *Blancoa canescens, Eremaea fimbriata, Pityrodia bartlingii* and *Dasypogon obliquifolius.*

5.3 Flora

A total of 362 taxa of which 77 were weeds, were recorded during the surveys of the site. The *Banksia attenuata, Banksia menziesii/Eucalyptus todtiana* Low Woodland, which is FCT20a recorded 194 taxa, *Eucalyptus wandoo* Woodland 56 taxa and *Banksia species/Allocasuarina fraseriana* Woodland which included FCT20c recorded 109 taxa. The flora diversity of the site is excellent. ecologica Environmental Consultants estimated from the 1991 assessment that the total flora of the site could exceed 400 taxa.

5.4 Kadina Brook

This Brook is a tributary of the Helena River and is recognised as a wetland of significant conservation value. Very few creeks occur within the Ridge Hill Shelf system and of those few remain unaffected by quarrying or urbanisation. Creeklines require a buffer of at least 20m on either side of the bank. Rehabilitation along the creek should occur. As there are some sections where several sedges occur it would be possible to propagate some of these for this use.

5.5 Vegetation Complexes

Bushmead is situated above the Darling fault, which bisects the site from north to south, and is included in the Forrestfield land unit of the Ridge Hill Shelf system. It occurs mainly on the transitional soils of the Ridge Hill Shelf on the Swan Coastal Plain but also extends onto the alluvial clay deposits on the eastern fringe of the Swan Coastal Plain. The Forrestfield land unit is a narrow transitional zone (1-3km wide) between the Swan Coastal Plain and the Darling Scarp. The vegetation communities associated with this landform reflect the soil zone between the Scarp and Swan Coastal Plain (Western Australian Planning Commission, 2000).

Bushmead Rifle Range is included in the Forrestfield complex (Heddle *et al.*, 1980). It is estimated that originally there were 11,328ha of this complex in the Perth Metropolitan Region, but now only 1,020ha remains (Western Australian Planning Commission, 2000). This represents 9% remaining vegetated. There is existing protection of 219ha, and it is anticipated another 354ha will be put into conservation, making a total of 573ha representing 5% protection. Bushmead is one of a few remaining sizeable remnants of the Forrestfield complex and is the only one within the Perth Metropolitan Region.

This is well below the 30% of that present pre-1750 conservation target as recommended by the Environmental Protection Authority (2003) and Commonwealth of Australia (2001). In addition it also provides a vegetated transitional zone between the Swan Coastal Plain and the Darling Scarp.

5.6 Fauna

Western Wildlife (2006) undertook an opportunistic survey of the fauna at the site. They stated that the site is expected to support a range of vertebrate fauna including: up to 12 species of amphibian, 57 species of reptile, 110 species of bird and 24 species of mammal. The site may support a number of species of Conservation Significance 1; the Carpet Python, Baudin's Black-Cockatoo, Carnaby's Black-Cockatoo, Forest Red-tailed Black-Cockatoo, Peregrine Falcon, Rainbow Bee-eater, Fork-tailed Swift and Chuditch. The site may also support species of Conservation Significance 2; the

Southern Death Adder, Black-striped Snake, Darling Range Ctenotus, Barking Owl, Masked Owl, Quenda (Southern Brown Bandicoot), Brush Wallaby and Western False Pipistrelle.

The areas of the site most likely to support a relatively intact fauna are those with the least degraded native vegetation, particularly the *Eucalyptus wandoo* woodland in the south-east of the site and the *Banksia/Allocasuarina/E. todtiana* Woodland in the north of the site. However, other parts of the site are likely to support species of conservation significance. For example, almost all of the native vegetation on the site (particularly areas containing Marri), may be used as feeding habitat for the Carnaby's Black-Cockatoo, Baudin's Black-Cockatoo and Forest Red-tailed Black-Cockatoo. In addition, areas around the creekline and areas with a dense understorey may be important for the Quenda.

6. DEVELOPMENT CONSTRAINTS

The Department of Defence proposes to develop some of the site for housing but also is aware there are several constraints on development. These are listed and discussed below and mapped in Appendix B.

i. Threatened Ecological Communities (TEC).

The areas of these TEC's must not be included in any development. In addition they must also include a buffer to ensure they are not impacted. These are

a) FCT20a is listed as an Endangered Ecological Community by the Department of Environment and Conservation (2006).

b) FCT20c and FCT3c are listed as Critically Endangered Communities by the Department of Environment and Conservation (2006) and Endangered (Environment Australia, 2006).

ii. Priority Flora

One Priority 3 Flora, *Isopogon drummondii* was recorded from FCT20a. A second Priority 3 Flora was recorded from the *Eucalyptus wandoo* Woodland which is not included in the Department of Defence land but in Main Roads land.

Other significant flora recorded from FCT20a and FCT20c include *Blancoa canescens, Eremaea fimbriata, Pityrodia bartlingii, Dasypogon obliquifolius*

BF sig flora

iii. Land Unit

The site is included in the Forrestfield land unit of the Ridge Hill Shelf system. It occurs mainly on the transitional soils of the Ridge Hill Shelf on the Swan Coastal Plain but also extends onto the alluvial clay deposits on the eastern fringe of the Swan Coastal Plain (Churchward and McArthur, 1980).

iv. Vegetation Complex

Bushmead occurs in the Forrestfield vegetation complex (Heddle *et al*, 1908). It is estimated that originally there were 11,328ha of the Forrestfield complex in the Perth Metropolitan Region, but now only 1,020ha remains (Western Australian Planning Commission, 2000). This represents 9% remaining vegetated.

v. Kadina Brook

This transects the site from north to south and is vegetated with *Eucalyptus rudis* subsp. *rudis/Melaleuca rhaphiophylla* Woodland and is in varying vegetation condition. It is listed as a significant creek in the Ridge Hill Shelf system as it is one of the few not developed or highly degraded due to urbanisation (ecologia Environmental Consultants, 1991).

vi. Vegetation Condition

There were only small areas at the site which were completely degraded or degraded. There was a relatively large area where the vegetation condition varied between good and degraded. Where the vegetation condition varied between good and degraded the tree canopy was often good, or there were tall mature trees but the understorey had mainly been replaced by weeds (Bennett Environmental Consulting Pty Ltd, 2006).

All areas recorded in good or better condition should be conserved.

vii. Continuation of vegetation linkage

It is possible with any proposed housing development to ensure there is a continuation of vegetation, both along the creek and in the higher ground.

viii. Outside Linkages

There are linkages (Western Australian Planning Commission, 2000) between the remnant bushland at Bushmead and:

- Bush Forever Site 216 (Adelaide Crescent Bushland, Helena Valley) to the north;
- Bush Forever Site 217 (Ridge Hill Road Bushland, Gooseberry Hill) to the south;
- Bush Forever Site 481 (Stirling Crescent Bushland, Hazelmere) to the west.
- Part of regionally significant fragmented bushland/wetland linkage to Helena River.

It is essential that remnant vegetation continue to link with these areas.

ix. Size and Shape.

Size is important in determining the viability of a bushland area. Elongated remnants are more susceptible to disturbances but do have an important role as connecting links (Environmental Protectino Authority, 2003). The total area of Bushmead is 297ha of which 127.6ha is listed in Bush Forever (Western Australian Planning Commission, 2000) as remnant bushland. It meets the following general principles:

- 127.6ha is a large remnant.
- There is linkage throughout the Bushmead area, even if often via the canopy and degraded understorey. At the eastern side there is a direct linkage with the Gooseberry Hill National Park. This linkage from the plain through to the Darling Scarp is unusual and therefore of ecological significance.

x. Uplands and Wetlands.

The site includes Kadina Brook which can be considered as a wetland category. The remainder of the site is higher ground increasing from the western to the eastern side, ie from the Coastal Plain to the Ridge Hill Shelf.

7. POTENTIAL AREAS FOR DEVELOPMENT

The potential areas that can be utilised for urban development comprise the degraded areas including:

- the former abattoir effluent irrigation area. The disadvantage to utilising this area is access from roads. Access from Midland Road would require crossing Kadina Brook which is to be avoided. Access from Adelaide Street or Ridge Hill Road would need to traverse vegetation in good to very good condition. Access along the boundary fence between the site and privately owned land from Ridge Hill Road would need to traverse the *Eucalyptus wandoo* Woodland which ecologia Environmental Consultants suggested should be included in Bushmead conservation. There is a housing development off Helena Valley Road so if this development continued to the east it may be possible to access the former abattoir effluent irrigation area by this means.
- The area including the current houses at the site and the degraded area immediately to the north east, but ensuring that a sufficiently wide buffer is retained between the development and remnant bushland. This area is currently accessed and could continue to be accessed from Midland Road.
- The remnant bushland to the east of the current houses varied in vegetation condition from good to degraded. The tree canopy of this section is relatively open and the area appears to have been subjected to many fires. If this area is proposed for development it is essential that a buffer of at least 50m is left along the bank of Kadina Brook.

8. RECOMMENDATIONS IF DEVELOPMENT PROCEEDS

If approval to proceed with the development of selected areas is given it is essential that some environmental management procedures be implemented. These include:

- **Buffer Zone**
  - As there are areas of Threatened Ecological Communities and Kadina Brook it is essential that buffer zones of endemic species either remain or where the area is degraded be planted. Where plantings occur it is essential these be seeds collected from the site and/or seedling propagated from these same seeds to ensure the genotype of the area is maintained. They must not be the same species from a plant distributor.
  - The buffer zone around Kadina Brook should be at least 50m and around the Threatened Ecological Communities at least 20m where there is remnant vegetation already in the buffer zone or 10m where the ground is completely degraded. Where the ground is completely degraded there should be a dense planting of trees/shrubs and the other buffer zones may require enhancement plantings.
  - If a road is required to traverse a conservation area it should ensure that as much of the natural vegetation as possible is retained.
- **Weed control**

  The weeds to be removed are:
  - **Watsonia meriana* subsp. *bulbillifera*, **Cynodon dactylon* (Couch) and **Pennisetum clandestinum* (Kikuyu) plants from the creekline.
  - Weeds in the buffer zone of the Threatened Ecological Communities and the creek.
  - Broad scale spraying for **Ehrharta calycina* and **Eragrostis curvula* and other weed grasses around the buffer zones and any tracks or roads that traverse the conservation areas.
  - Spot spraying of broad leaf weeds including **Oxalis* sp., *Trifolium* sp.,
- **Enhancement planting**
  - Once weed control has been undertaken rehabilitation of those sites should occur. Vegetation mapping has been prepared for the site and the taxa recorded from each unit listed. Using this information the correct taxa can be planted in each area. By referring to Appendix A the native taxa (not those with *) listed for EM1 and EM2 would be the taxa to plant in the creek.
  - Current vehicle tracks through the remnant bushland should be rehabilitated using taxa endemic for that vegetation unit.
  - With potential development as many of the native trees as possible should be retained. If plantings are to occur within the private properties, plants endemic to the bushland should be encouraged. This will encourage the native animals at the site.
  - Large trees with nesting holes should be retained as these may be nesting sites for the Black cockatoos.
  - Any Grass trees (*Xanthorrhoea* species) or Zamias (*Macrozamia riedlei*) that are to be removed with development, should be transplanted into one of the buffer areas or a conservation area in degraded condition.
- **Education of residents**
  - If development does proceed it is essential that the residents understand the importance of the vegetation at the site. All purchasers should be provided with a leaflet explaining the Commonwealth Government's listing of FCT20c and the Department of Environment and Conservation listing of both FCT20a and FCT20c. Hopefully this will ensure pride in the conserved vegetation at the site.
  - No native plants are to be removed from the bushland for home gardens.
  - No dumping of household rubbish is to occur.
  - Lawn clippings and prunings are not to be dumped in the bushland as this could introduce other weeds. There could be a policing of this by other residents.
  - No trail bikes are to be ridden on tracks and no cubbies to be built in the bushland.
  - It may be possible to develop a 'Friends of Bushmead' group that will undertake voluntary work in the bushland. If a school is built then the children should become involved in the rehabilitation of the area and the reporting of any animals observed.
  - Dogs must be kept on a lead when walking through the bushland.

- Cats must be brought in doors at dusk and not let out until it is light – that is if cats are allowed.
- Limited use of fertilizer on gardens is to be encouraged to ensure the health of Kadina Brook.
- A list of plants not to be grown in the home gardens could be provided. This would include several popular plants in plant nurseries including: Freesia, Ixia, Lachenalia, Veldt daisy, Gazania, Arctotis, Vinca, Victorian teatree, Lantana, Eastern Australian Wattles, as these and other popular home garden plants are known to be invasive environmental weeds.

- **Bushland Access**
  To ensure there is not a proliferation of tracks through the bushland, obvious walk tracks should be constructed, including over the creek. These tracks should follow current tracks or degraded areas through the bushland. There must be continuous tracks so that residents can join in at a convenient location and do a continuous walk back to their starting point. Fire breaks should be utilized as walk tracks. Signage providing environmental and historical information about the site may enhance the public's enjoyment.
- **Movement of soil**
  - Care must be taken with the movement of soil to ensure weeds are not spread.
  - Contractor vehicles entering the site must be cleaned of soil and plant material to ensure there is no transportation of disease or weed seeds onto the site.
  - If soil is to be removed from areas of vegetation in good or better condition the topsoil should be stored and spread back over the site or spread onto a buffer area within the same vegetation unit.
  - If soil is transported onto site it must be disease and weed free.

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APPENDIX A

Species listed in systematic order according to vegetation areas

EXPLANATION of colours used in table

Base data extracted from ecologia Environmental Consultants survey in **black** print with black crosses.

Words in **red** are BUSHM01, BUSHM03 and the taxon was also recorded by ecologia Environmental Consultants

Words in **purple** indicate the information was provided by the Threatened Ecological Unit of Department of Environment and Conservation and indicate that the taxon was also recorded by ecologia.

Words in **green** indicate that the taxon was recorded by all three of these surveys

Words in **blue** indicate that the taxon was recorded by more than one survey other than that of ecologia Environmental Consultants

Red crosses indicate that the taxon was recorded in that vegetation unit when surveying BUSHM01 AND BUSHM03 but not by ecologia for that unit.

Purple crosses indicate the taxon was recorded by the Department of Environment and Conservation but not by ecological for that unit.

Where there is a **red taxon and a red cross** and no other coloured cross for that taxon it indicates it was recorded during the BUSHM01 and BUSHM03 assessments only.

Where there is a **purple taxon and a purple cross** and no other coloured cross for that taxon it indicates it was recorded during the Department of Environment and Conservation assessments only

ABBREVIATION	VEGETATION DESCRIPTION
BA1	*Banksia attenuata, Banksia grandis, Banksia menziesii/Allocasuarina fraseriana* Woodland.
BA2	*Banksia attenuata, Banksia grandis, Banksia menziesii/* Woodland with few *Allocasuarina fraseriana.*
BEA1	*Banksia attenuata, Banksia menziesii/Eucalyptus todtiana/Allocasuarina fraseriana* Woodland.
BEA2	*Banksia attenuata, Banksia menziesii/Eucalyptus todtiana/Allocasuarina fraseriana* Woodland with dense stands of *Adenanthos cygnorum.*
C	*Corymbia calophylla* Lithic Complex.
EC1	Open *Eucalyptus marginata* subsp. *marginata/Corymbia calophylla* Woodland.
EC2	*Corymbia calophylla/Eucalyptus marginata subsp. marginata* Open Woodland.
EC3	*Corymbia calophylla/Eucalyptus marginata subsp. marginata* Woodland. Low numbers of *Eucalyptus wandoo* present.
EC4	*Corymbia calophylla/Eucalyptus marginata subsp. marginata* Woodland. Ground stratum of weeds.
ED	*Eucalyptus marginata subsp. marginata/Dryandra sessilis var. sessilis* Complex.
EE	*Eucalyptus rudis* subsp. *rudis/Eucalyptus wandoo/Melaleuca rhaphiophylla* Woodland.
EM1	*Eucalyptus rudis* subsp. *rudis/Melaleuca rhaphiophylla* Woodland. This was the downstream creekline vegetation.
EM2	*Eucalyptus rudis* subsp. *rudis/Melaleuca rhaphiophylla* Woodland.
W	*Eucalyptus wandoo* Woodland.
ABBREVIATION	**MEANING**
*	Weed
subsp.	Subsp.
var.	Variety
sp.	species
X	Indicates a hybrid
?	Unsure if the species name is correct

Family *Taxon*	**BA1**	**BA2**	**BEA1**	**BEA2**	**C**	**EC1**	**EC2**	**EC3**	**EC4**	**ED**	**EE**	**EM1**	**EM2**	**W**
Zamiaceae														
Macrozamia riedlei					+		+					+		
Typhaceae														
**Typha orientalis*												+		
Poaceae														
**Aira caryophyllea*		+	+	+			+						+	
Amphipogon turbinatus	+		+	+	+									
**Arundo donax*												+		
Austrodanthonia caespitosa			+	+								+		
Austrostipa compressa			+	+										
Austrostipa elegantissima			+											+
Austrostipa flavescens			+	+										
**Avena barbata*						+								
**Avena fatua*												+		
**Briza maxima*		+	+		+	+				+		+	+	
**Briza minor*			+			+				+		+	+	
**Bromus diandrus*			+		+				+					
**Cortaderia selloana*											+			+
							+							
**Cynodon dactylon*											+			+
**Digitaria ciliaris*										+				
**Ehrharta calycina*	+	+	+	+			+		+		+	+	+	
**Eragrostis curvula*												+		+
**Holcus lanatus*						+								
**Hordeum leporinum*		+				+			+					
**Lolium perenne*														+
Neurachne alopecuroidea	+	+	+	+	+						+	+		

Family *Taxon*	**BA1**	**BA2**	**BEA1**	**BEA2**	**C**	**EC1**	**EC2**	**EC3**	**EC4**	**ED**	**EE**	**EM1**	**EM2**	**W**
Proteaceae (cont.)														
Hakea lissocarpha					+	+			+		+	+		+
Hakea marginata		+	+											
Hakea petiolaris			+	+										
Hakea prostrata		+										+		
Hakea ruscifolia			+									+		
Hakea sp.														+
Hakea stenocarpa		+										+		
Hakea trifurcata							+				+	+		
Hakea undulata	+					+						+		
Isopogon divergens												+		
Isopogon drummondii			+											
Isopogon sp.			+											
Lambertia multiflora var. *darlingensis*			+											
Persoonia elliptica	+	+	+			+								
Persoonia ? sulcata														+
Petrophile biloba					+		+							
Petrophile linearis			+	+										
Petrophile macrostachya												+		
Petrophile media			+											
Petrophile seminuda												+		
Petrophile sp.			+											
Petrophile striata												+		
Stirlingia latifolia	+	+	+	+			+							
Synaphea petiolaris			+		+							+		

Family *Taxon*	BA1	BA2	BEA1	BEA2	C	EC1	EC2	EC3	EC4	ED	EE	EM1	EM2	W
Proteaceae (cont.)														
Synaphea spinulosa			+											
Loranthaceae														
Nuytsia floribunda						+								
Polygonaceae														
**Rumex crispus*									+		+			
**Rumex obtusifolius*						+								
Chenopodiaceae														
**Chenopodium ambrosioides*												+		
Amaranthaceae														
**Amaranthus retroflexus*						+								
Ptilotus drummondii	+	+										+		
Molluginaceae														
Macarthuria australis	+	+	+	+										
Portulacaceae														
Calandrinia sp.			+											
Caryophyllaceae														
**Petrorhagia dubia*			+											
Lauraceae														
Cassytha racemosa	+	+	+	+			+					+		+
Fumariaceae														
**Fumaria capreolata*												+		
Brassicaceae														
**Brassica tournefortii*						+								
**Raphanus raphanistrum*												+		+

Family *Taxon*	**BA1**	**BA2**	**BEA1**	**BEA2**	**C**	**EC1**	**EC2**	**EC3**	**EC4**	**ED**	**EE**	**EM1**	**EM2**	**W**
Papilionaceae														
Bossiaea eriocarpa	+		+	+								+		
Bossiaea ornata							+					+		
**Chamaecytisus proliferus*	+											+		
Daviesia decurrens			+									+		
Daviesia divaricata			+	+			+					+		
Daviesia gracilis			+											
Daviesia horrida												+		
Daviesia incrassata			+	+										
Daviesia mudiflora		+	+	+										
Daviesia physodes			+											
Daviesia preissii			+									+	+	
Daviesia triflora			+											
Euchilopsis linearis			+											
Gastrolobium capitatum			+								+	+		+
Gastrolobium cuneatum												+		
Gompholobium aristatum												+		
Gompholobium capitatum			+											
Gompholobium knightianum													+	
Gompholobium polymorphum					+							+	+	
Gompholobium scabrum												+		
Gompholobium shuttleworthii	+													
Gompholobium tomentosum		+	+	+							+	+		+
Hardenbergia comptoniana			+									+		
Hovea pungens	+											+		
Hovea trisperma			+									+		+
Isotropis cuneifolia	+		+											
Jacksonia floribunda	+		+	+										

Family *Taxon*	**BA1**	**BA2**	**BEA1**	**BEA2**	**C**	**EC1**	**EC2**	**EC3**	**EC4**	**ED**	**EE**	**EM1**	**EM2**	**W**
Papilionaceae (cont.)														
Jacksonia furcellata						+								
Jacksonia sternbergiana	+		+									+		
Kennedia prostrata			+	+								+		
**Lupinus cosentinii*						+	+		+					+
**Medicago polymorpha*					+							+	+	
Mirbelia ramulosa												+		
Sphaerolobium sp.		+												
Cristonia biloba			+											
**Trifolium angustifolium*												+		
**Trifolium arvense*		+	+			+			+			+		
**Trifolium campestre*						+			+			+		
**Trifolium* sp. A									+					+
**Vicia hirsuta*												+		
**Vicia sativa*												+		
Geraniaceae														
**Erodium botrys*	+	+				+						+		
Oxalidaceae														
**Oxalis pes-caprae*	+	+							+		+	+		+
Tropaeolaceae														
**Tropaeolum majus*												+		
Rutaceae														
Philotheca nodiflora			+	+										+
Philotheca spicatus			+											
Meliaceae														
**Melia azedarach*												+		
Polygalaceae														
Comesperma calymega	+											+		

Family *Taxon*	BA1	BA2	BEA1	BEA2	C	EC1	EC2	EC3	EC4	ED	EE	EM1	EM2	W
Euphorbiaceae														
Monotaxis grandiflora			+	+										
Phyllanthus calycinus			+		+							+		
Poranthera microphylla			+											
Stachystemon vermicularis			+											
Stackhousiaceae														
Stackhousia monogyna												+		
Tripterococcus brunonis			+									+		
Rhamnaceae														
Stenanthemum tridentatum												+		
Trymalium ledifolium												+		+
Sterculiaceae														
Thomasia foliosa												+		
Thomasia grandiflora		+										+		
Dilleniaceae														
Hibbertia acerosa												+		+
Hibbertia aurea			+											
Hibbertia commutata					+									
Hibbertia hucgelii	+	+	+	+		+			+			+	+	
Hibbertia hypericoides			+	+								+		
Hibbertia racemosa		+	+		+									
Violaceae														
Hybanthus calycinus	+	+	+	+			+					+		
Thymelaeaceae														
Pimelea imbricata					+									
Pimelea leucantha			+											
Pimelea sulphurea			+											
Pimelea suaveolens			+											

Family *Taxon*	**BA1**	**BA2**	**BEA1**	**BEA2**	**C**	**EC1**	**EC2**	**EC3**	**EC4**	**ED**	**EE**	**EM1**	**EM2**	**W**
Myrtaceae														
Baeckea camphorosmae	+	+	+		+						+	+		+
Calothamnus quadrifidus	+	+			+							+		
Calytrix aurea			+											
Calytrix fraseri			+											
**Chamelaucium uncinatum*					+							+		
Corymbia calophylla	+	+	+	+	+	+	+		+			+	+	+
Eremaea fimbriata			+											
Eremaea pauciflora			+	+										
Eremaea violacea			+											
Eucalyptus marginata subsp. *marginata*	+	+	+	+		+	+		+			+	+	
Eucalyptus rudis subsp. *rudis*										+	+			+
Eucalyptus todtiana			+	+		+				+		+		
Eucalyptus wandoo											+			
Hypocalymma angustifolium														+
Kunzea glabrescens				+										
Leptospermum erubescens			+		+							+		
**Leptospermum laevigatum*	+	+	+									+		
Melaleuca rhaphiophylla										+	+			+
Melaleuca scabra		+												
Melaleuca systena			+											
Scholtzia involucrata			+											
Verticordia densiflora			+											
Apiaceae														
Daucus glochidiatus	+								+					
Trachymene pilosa		+	+				+					+		
Xanthosia candida												+		
Xanthosia huegelii			+				+							

Family *Taxon*	**BA1**	**BA2**	**BEA1**	**BEA2**	**C**	**EC1**	**EC2**	**EC3**	**EC4**	**ED**	**EE**	**EM1**	**EM2**	**W**
Epacridaceae														
Astroloma glaucescens												+		
Astroloma pallidum		+												
Astroloma stomarrhena		+	+											
Astroloma xerophyllum			+											
Conostephium pendulum			+									+		
Leucopogon conostephioides			+									+		
Leucopogon racemulosus												+		
Leucopogon? sprengelioides			+											
Lysinema ciliatum			+											
Styphelia tenuiflora			+											
Primulaceae														
**Anagallis arvensis*						+						+		
Loganiaceae														
Phyllangium paradoxum			+											
Gentianaceae														
**Centaurium erythraea*										+				
Apocynaceae														
Carissa sp.			+											
Boraginaceae														
**Echium plantagineum*												+		
Lamiaceae														
Hemiandra pungens			+											
Hemigenia sericea					+									
Pityrodia bartlingii			+	+								+		
Solanaceae														
**Solanum nigrum*						+						+		

Family *Taxon*	**BA1**	**BA2**	**BEA1**	**BEA2**	**C**	**EC1**	**EC2**	**EC3**	**EC4**	**ED**	**EE**	**EM1**	**EM2**	**W**
Scrophulariaceae														
**Bartsia trixago*														+
Orobanchaceae														
**Orobanche minor*									+			+		
Plantaginaceae														
**Plantago lanceolata*												+		
**Plantago major*														+
Rubiaceae														
Opercularia vaginata												+		
Cucurbitaceae														
**Cucumis myriocarpus*														+
Campanulaceae														
**Wahlenbergia capensis*	+		+	+										
Wahlenbergia preissii			+											
Lobeliaceae														
Isotoma hypocrateriformis			+									+		
Goodeniaceae														
Dampiera linearis			+									+		
Goodenia sp.			+											
Lechenaultia biloba												+		
Scaevola canescens			+	+										
Scaevola repens	+	+	+	+										
Scaevola sp.			+											
Stylidiaceae														
Levenhookia stipitata	+	+										+	+	
Stylidium brunonianum	+			+								+	+	
Stylidium bulbiferum					+									
Stylidium calcaratum			+											

Family *Taxon*	BA1	BA2	BEA1	BEA2	C	EC1	EC2	EC3	EC4	ED	EE	EM1	EM2	W
Stylidiaceae (cont.)														
Stylidium diuroides			+											
Stylidium piliferum	+	+	+									+		
Stylidium schoenoides			+									+		
Stylidium sp. A														+
Asteraceae														
**Arctotheca calendula*						+			+			+		
**Conyza sumatrensis*			+				+							
**Hypochaeris glabra*			+		+									
**Lactuca saligna*			+											
Olearia paucidentata		+										+		
Olearia sp.			+											+
Rhodanthe citrina			+											
**Sonchus oleraceus*			+			+								
**Taraxacum officinale*												+		
Trichocline spathulata		+												
**Urospermum picroides*												+		
**Ursinia anthemoides*		+	+	+		+			+			+		
Pterochaeta paniculata			+											
Rhodanthe sp.			+	+										+
Waitzia suaveolens			+											

APPENDIX B

Maps

1. Vegetation Map , ecologia Environmental Consultants (1991)
2. Vegetation Map, Bennett Environmental Consulting Pty Ltd (2006)
3. Vegetatino Condition Map, Bennett Environmental Consulting Pty Ltd (2006)
4. Priority Flora Map, Bennett Environmental Consulting Pty Ltd (2006)
5. Location of Threatened Ecological Communities, Bennett Environmental Consulting Pty Ltd (2006)
6. Potential Development

Possible access

Areas for development

Map 6. Potential Development

Annex B

Bushmead Rifle Range: A Fauna Assessment (Western Wildlife, 2006)

Bushmead Rifle Range:

A fauna Assessment

Dr R.A. Davis and Ms J.A. Wilcox

Bushmead Rifle Range (foreground), showing proximity to Gooseberry Hill National Park (background).

Prepared for: Bennett Environmental Consulting Pty Ltd
PO Box 341
Kalamunda WA 6076

Prepared by: Western Wildlife
8 Ridgeway Pl
Mahogany Creek WA 6072

15th January 2006

Introduction

Environmental Resources Management Australia Pty Ltd (ERM) has been asked by the Department of Defense (DoD) to undertake a Property Disposal Study for the Bushmead Rifle Range in Helena Valley. As part of the Property Disposal Study, ERM has commissioned Western Wildlife to undertake a fauna assessment of the site.

Bushland on the Bushmead Rifle Range is listed as Bush Forever Site 213 (Department of Environmental Protection 2000). Previous studies on the fauna of the Bushmead Rifle Range have been carried out by Ecologia (1991), Dames and Moore (1989) and How and Dell (2000).

The aim of the fauna assessment was to characterise the fauna habitats available in the area, prepare lists of vertebrate fauna expected to occur in the area and identify species of conservation significance that may occur in the area.

Methods

This report is classified as a Level 1 survey (a background research or 'desk-top' study with a site visit) according to the EPA Position Statement No.3 (Environmental Protection Authority 2002) and Guidance Statement 56 (Environmental Protection Authority 2004). This was the level of assessment commissioned by the client. The Bushmead Rifle Range was visited on 3rd February 2006. The area was surveyed by vehicle and on foot.

Personnel

Ms Jenny Wilcox (*BSc.Biol./Env.Sci., Hons.Biol.*) and Dr Robert Davis (*BSc.Biol./Env.Sci., Hons.Biol., PhD. Zool.*) of Western Wildlife carried out the site visit and prepared the report.

Sources of Information

Lists of fauna expected to occur in the study area were produced using information from a number of sources. These included publications that provide information on general patterns of distribution of frogs (Tyler *et al.* 2000), reptiles (Storr *et al.* 1983, 1990, 1999 and 2002), birds (Barrett *et al.* 2003; Johnstone and Storr 1998; Johnstone and Storr 2004), and mammals (Menkhorst and Knight 2001; Strahan 1995). In addition, the databases listed below in Table 1 were searched for specimen or observational records.

A number of fauna studies have been undertaken on the Bushmead Rifle Range in the past, including a fauna survey in 1991 by Ecologia, and a fauna assessment in 1989 by Dames and Moore. The survey by Ecologia included autumn, winter and spring surveys involving trapping and bird surveys. The bushland on the site was also a study area in a more wide-ranging study of the vertebrate ground fauna in remnant vegetation in Perth (How and Dell 2000). The study by How and Dell (2000) used nine pitfall traps, with traps open for over 50 days in 1996.

These sources of information were used to create lists of species expected to occur in the study area. As far as possible, expected species are those that are likely to utilise the study area, or be affected by changes to the study area. The lists exclude species that have been recorded in the general region as vagrants or for which suitable habitat is absent.

Table 1. Databases used in the preparation of the fauna lists in Table 2 – 5.

Database	Type of records held on database	Area searched
Faunabase (WA Museum)	Records of specimens held in the WA Museum. Includes historical data.	31°53'S to 31°57'S and 116°00'E to 116°03'E
CALM's Threatened and Priority Fauna Database	Information and records on Threatened and Priority species in Western Australia	407032E to 409598E and 6468997N to 6465825N (zone 50)
Birds Australia Atlas Database	Records of bird observations in Australia, 1998-current.	31°50'S to 31°57'S and 115°55'E to 116°05'E
EPBC Protected Matters Search Tool	Records on matters protected under the EPBC Act, including threatened species.	31°50'S to 31°57'S and 115°55'E to 116°05'E

Taxonomy and nomenclature for fauna species used in this report generally follow the WA Museum (2001) with alternative bird taxonomy from Christidis and Boles given in parentheses.

Con. Sig. fauna. Con. Sig. 3 species not considered on p. 11 of report

Assessment of conservation significance

Three levels of conservation significance are recognised in this report:

Conservation Significance 1:
- Species listed under State or Commonwealth Acts.

Conservation Significance 2:
- Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by CALM.

Conservation Significance 3:
- Species not listed under State or Commonwealth Acts or in publications on threatened fauna or as Priority species by CALM, but considered of local significance because of their pattern of distribution.

At the highest level of conservation significance (Conservation Significance 1) are those species that are protected under State or Commonwealth legislation.

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) is the Commonwealth Government's primary piece of environmental legislation. Listed under Part 3 of the EPBC Act are 'matters of National Environmental Significance' that include threatened species and ecological communities and migratory species, among others. IUCN categories are used to categorise threatened species as 'extinct', 'extinct in the wild', 'critically endangered', 'endangered', 'vulnerable' and 'conservation dependent', with all categories except 'extinct' and 'conservation dependent' listed as matters of National Environmental Significance. A list of migratory species is also maintained, containing mostly bird and marine species. The migratory species listed are those recognised under China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA) or species listed under the Bonn Convention for which Australia is a range state. Species listed in JAMBA are also protected under Schedule 3 of the *Western Australian Wildlife Conservation Act* 1950.

The *Western Australian Wildlife Conservation Act* 1950 (WA Wildlife Conservation Act) is State legislation for fauna protection administered by the Department of Conservation and Land Management (CALM). The WA Wildlife Conservation Act lists species under a set of Schedules, where threatened species are listed as Schedule 1. Schedule 1 species are further categorised by CALM into the IUCN categories 'extinct', 'extinct in the wild', 'critically endangered', 'endangered', 'vulnerable' and 'conservation dependent' species. The schedules and categories are further described in Appendix 1.

At the second-highest level of conservation significance (Conservation Significance 2) are species that are listed under publications on threatened species, or are listed as Priority species by CALM.

Reports on the conservation status of most vertebrate fauna species have been produced by the Department of the Environment and Heritage (DEH) in the form of Action Plans. An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. Action Plans have been prepared for amphibians (Tyler 1998), reptiles (Cogger *et al.* 1993), birds (Garnett and Crowley 2000), monotremes and marsupials (Maxwell *et al.* 1996), rodents (Lee 1995) and bats (Duncan *et al.* 1999). These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

In Western Australia, CALM has also produced a list of Priority Fauna made up of species that are not considered Threatened under the *WA Wildlife Conservation Act*, but for which CALM feels there is cause for concern. Levels of Priority are described in Appendix One.

At the third-highest level of conservation significance (Conservation Significance 3) are species that are not recognised under Federal or State legislation, listed in publications by DEH or listed as Priority species by CALM. These are species

considered to be of local significance in the study area because they are at the limit of their distribution in the area, they have a very restricted range or they occur in breeding colonies (e.g. some waterbirds). This level of significance has no legislative or published recognition and is based on interpretation of information on the species patterns of distribution. The WA Department of Environmental Protection (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Bush Forever. Recognition of such species is consistent with the aim of preserving regional biodiversity

Site description

The Bushmead Rifle Range is situated between Midland Rd and Ridge Hill Rd in the Shire of Kalamunda. The site is mostly situated on the Ridge Hill Shelf system in the foothills of the Darling Scarp; a narrow band running from Bullsbrook to Harvey. The Ridge Hill Shelf system is poorly represented in reserves. The northern part of the site is on Bassendean sands and in the south-east the site intrudes onto the Darling Range.

Part of the bushland on the Bushmead Rifle Range is Bush Forever Site 213. It is described as one of the few areas in the Perth metropolitan region where the Coastal Plain and the Darling Plateau meet through a naturally vegetated area (Department of Environmental Protection 2000). The site contains vegetation characteristic of the plateau and of the plain (Department of Environmental Protection 2000).

Ecologia (1991) identified seven main vegetation associations on the site, as summarised below:

1. *Banksia – Eucalyptus todtiana / E. marginata* low woodland.
Areas dominated by *Eucalyptus todtiana* (Pricklybark), *Eucalyptus marginata* (Jarrah) and *Banksia* spp are found in the northern part of the site, near the Civilian Rifle Range. This vegetation is generally in good condition with a low understorey of mixed species. There are also areas with *Allocasuarina fraseriana* (similar to below) near the Civilian Rifle Range.

2. *Banksia – Allocasuarina* low woodland.
A large area of woodland dominated by *Allocasuarina fraseriana* (Sheoak), *Banksia attenuata* and *Banksia menzeisii* occurs in the central part of the site, to the east of the creekline. Within this woodland there are also areas of dense *Adenanthos cygnorum* (Woollybush).

3. *Eucalyptus wandoo* open woodland.
In the south-eastern part of the site there is an area of *Eucalyptus wandoo* (Wandoo) woodland. This area has an overstorey of moderate sized Wandoo, with a low, moderately diverse understorey. Thickets of *Dryandra sessilis* (Parrotbush) and *Hakea undulata* border this woodland.

4. *Eucalyptus rudis / Melaleuca rhaphiophylla* woodland.
The creekline (Kadina Brook) that runs through the site has an overstorey of *Eucalyptus rudis* (Flooded Gum) and *Melaleuca rhaphiophylla* (Freshwater Paperbark). The middle section of the stream has an understorey of both native and

introduced species, but upstream the understorey is dominated by *Watsonia bulbifera* and downstream the understorey is dominated by introduced grasses.

5. *Eucalyptus marginata* – *Banksia* low woodland.
There are some areas of *Eucalyptus marginata* (Jarrah) and *Banksia* woodland near the Civilian Rifle Range and in patches in the southern part of the site.

6. *Eucalyptus marginata* / *Corymbia calophylla* open woodland.
There is a large area of *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodland on the site. Much of the understorey of this area is degraded and dominated by introduced grasses.

7. Degraded grassland.
There are several degraded areas within the site, including a large area of introduced grasses within the Rifle Range Security Fence. There are also degraded areas near the Civilian Rifle Range.

The bushland on the Bushmead Rifle Range has links to other areas of bushland in the area, including the Helena River in the north, Gooseberry Hill National Park to the immediate east, Stirling Crecent Bushland (Bush Forever Site 481) to the west, and Darling Range Regional Park to the south. As such, the site is an important portion of a linkage corridor connecting several areas of regionally important vegetation.

Results

The amphibians, reptiles, birds and mammals that may occur in the study area are listed in Tables 2-5. In each table the species recorded in the area by the WA Museum (all taxa) and Birds Australia (birds only) are indicated. In addition, fauna recorded in the area by How and Dell (2000) and Ecologia (1991) are indicated in Tables 2-5. The results of the EPBC database search and the CALM Threatened and Priority Fauna Database search are given in Appendices 2 and 3 respectivley.

Amphibians

There are 12 species of frog that have the potential to occur in the study area, of which eight have previously been recorded on the Bushmead Rifle Range by Ecologia (1991) or How and Dell (2000) or both (Table 2). No frogs were recorded during the site visit, but the creekline was dry at this time.

The Turtle Frog *Myobatrachus gouldii* was recorded in the area by Ecologia (1991) and How and Dell (2000), and has the potential to occur anywhere on the site that has sandy soil, particularly *Banskia* woodland. This species is entirely terrestrial and does not require open water for breeding.

Species of the burrowing frog genus *Heleioporus* such as the Moaning Frog, *Heleioporus eyrei*, breed in autumn, laying their eggs in a burrow dug into a dry creek bank or other dry wetland. When the creek or wetland floods in winter, the tadpoles are flushed from burrows, into the rising water. During the non-breeding season, adult frogs can be found at considerable distances from wetlands. On the Bushmead

Rifle Range, the creekline is likely to be breeding habitat for this genus, and adult frogs may occur in sandy areas throughout the site, including relatively degraded areas. Other species of frog will be closely associated with the creekline, such as the Squelching Froglet *Crinia insignifera* and the Glauert's Frog *Crinia glauerti*.

None of the frogs that may occur on the site are of conservation significance. However, few species are likely to persist within urban developments in the long-term, except perhaps the Motorbike Frog *Litoria moorei*.

Reptiles

There are 57 species of reptile that have the potential to occur in the study area (Table 3). No reptiles were observed during the site visit. Nine species were recorded on the site by How and Dell (2000) and ten were recorded by Ecologia (1991), with a total of 14 species recorded between them (Table 3). The Bushmead Rifle Range is on the transition between the Darling Range and Coastal Plain, containing features of both. Consequently, the reptile list in Table 3 includes species that are generally only found in the Darling Range (e.g. the Tree Dtella *Gehyra variegata*, Southern Death Adder *Acanthophis antarcticus* and the Fat Blind Snake *Ramphotyphlops pinguis*) or only on the Coastal Plain (e.g. the dragon *Rankinia adelaidensis*, burrowing skink *Lerista elegans* and Black-striped Snake *Neelaps calonotus*).

The degraded parts of the site are likely to support common species of reptile such as the Fence Skink *Cryptoblepharus plagiocephalus*, Dwarf Skink *Menetia greyii*, Bobtail *Tiliqua rugosa* and Dugite *Pseudonaja affinis*. Most of the species recorded on the site by How and Dell (2000) and Ecologia (1991) are species that are able to cope with relatively high levels of habitat disturbance.

The creekline may support some species that favour or depend on wetland habitats, such as the South-west Cool Skink *Acritoscincus trilineatum* and Tiger Snake *Notechis scutatus*.

There are five reptiles of conservation significance that may occur on the Bushmead Rifle Range. Each species is listed and described below.

Conservation Significance 1

- **South-west Carpet Python** *Morelia spilota imbricata*

This python is listed under Schedule 4 (other specially protected fauna) of the Wildlife Conservation Act, as Priority 4 by CALM and as Vulnerable by Cogger *et al.* (1993).

The Carpet Python may occur anywhere in the study area where relatively large areas of native vegetation exist. It requires dense vegetation, rocks or tree hollows for shelter. This species is now very rare in the Perth Metropolitan Area and is considered unlikely to occur at the site.

Conservation Significance 2

- **Southern Death Adder** *Acanthophis antarcticus*

This snake is listed as Priority 3 by CALM.

- **Black-striped Snake** *Neelaps calonotus*

This snake is listed as Priority 3 by CALM.

- **Darling Range Ctenotus** *Ctenotus delli*

This skink is listed as Priority 4 by CALM and as Rare or Insufficiently Known according to Cogger *et al.* 1993.

The Southern Death Adder is a rare species near Perth, occurring only in the Darling Range. The Bushmead Rifle Range is on the western edge of its range. This snake is found in Jarrah woodland with dense leaf litter, often near granite outcrops or densely vegetated creeks (Bush *et al.* 1995). The Southern Death Adder is an ambush predator that hides beneath leaf litter. This species is considered highly unlikely to occur at the site due to the lack of suitable habitat and high level of disturbance.

The Black-striped Snake occurs only on the Swan Coastal Plain between Mandurah and Lancelin (Bush *et al.* 1995). This restricted distribution puts it at risk from increasing urban development in this coastal strip. This species inhabits *Banksia* and Eucalypt woodlands on the plain (Bush *et al.* 1995), so it may occur in sandy areas in the north of the Bushmead Rifle Range. If this area of bushland is retained, this species should persist in that area.

The Darling Range Ctenotus occurs on the Darling Scarp, inhabiting Jarrah and Marri woodlands with a shrubby understorey (Bush et al., 1995). This species may occur on the site where these habitats occur, particularly in the south-east of the site although due to the high level of disturbance it is considered unlikely to be present. This species may favour areas that retain native understorey. This species may persist in larger areas of bushland that are retained but will not persist within urban development.

Conservation Significance 3

- **Ornate Crevice Dragon** *Ctenophorus ornatus*

The Ornate Crevice Dragon is a habitat specialist that occurs in the Darling Range as well as further to the east. This species is generally restricted to granite outcrops although it may sometimes occur away from them (Bush *et al.* 1995). Although there are some rocky areas in the southern part of the site, the Bushmead Rifle Range is unlikely to be important for this species since areas of outcropping rock are not extensive enough to support this species, and the area lacks exfoliating slabs which provide essential shelter.

The degradation of the Bushmeads Rifle Range by fire, human activity and dieback are likely to have precluded the presence of the majority of the species of conservation signficance described above, although the area may still support a rich reptile fauna.

Although reptiles persist relatively well in bushland remnants (How and Dell 2000), few species would persist within an urban development. Those species that do persist are common and abundant species. Species with more restricted habitat requirements would be restricted to bushland areas. Reptiles in bushland adjacent to urban development are at risk from predation by domestic pets, particularly cats.

Birds

There are 110 species of bird that have the potential to occur in the study area (Table 4), of which 28 were recorded during the site visit. Sixty species were recorded on the site by Ecologia (1991) and these have been indicated in Table 4.

There are some waterbirds listed in Table 4. The creek is unlikely to be important waterbird habitat, although some species may use it during winter when water is present, and it is possible that some species may breed there in low numbers. Some species of duck, the Australian White Ibis, White-faced Heron and Buff-banded Rail were recorded using the area by Ecologia (1991). Some duck species nest in hollow trees, and may nest in areas away from the creek.

Some species on the list in Table 4 would favour the degraded areas, including the Stubble Quail, Crested Pigeon, Richard's Pipit and Australian Raven. Other species, particularly small insectivores such as the Western Thornbill, would be restricted to areas of good quality native vegetation.

Conservation Significance 1

- **Carnaby's (Short-billed) Black-Cockatoo** *Calyptorhynchus latirostris*

This cockatoo is listed as Endangered under the EPBC Act, as Schedule 1 (Endangered) under the WA Wildlife Conservation Act and as Endangered by Garnett and Crowley (2000).

- **Baudin's (Long-billed) Black-Cockatoo** *Calyptorhynchus baudinii*

This cockatoo is listed as Vulnerable under the EPBC Act, as Schedule 1 (Vulnerable) under the WA Wildlife Conservation Act and as 'near threatened' by Garnett and Crowley (2000).

- **Forest Red-tailed Black-Cockatoo** *Calyptorhynchus banksii naso*

This cockatoo is listed under Schedule 1 (Vulnerable) of the WA Wildlife Conservation Act and as 'near threatened' by Garnett and Crowley (2000).

- **Peregrine Falcon** *Falco peregrinus*

This falcon is listed under Schedule 4 (other specially protected fauna) under the WA Wildlife Conservation Act.

- **Rainbow Bee-eater** *Merops ornatus*

This species is classified as migratory under the JAMBA, CAMBA and Bonn Convention, and as such is protected under the EPBC Act. Its listing under JAMBA also means it is protected under the WA Wildlife Conservation Act.

- **Fork-tailed Swift** *Apus pacificus*

This species is migratory under JAMBA, CAMBA and the Bonn Convention, and as such is protected under the EPBC Act. Its listing under JAMBA also ensures it is protected under the WA Wildlife Conservation Act.

Baudin's Black-Cockatoo was observed by Ecologia (1991) foraging in small groups of 10 to 20 individuals, mainly in the Marri woodland and creekline. This species is notoriously difficult to identify from Carnaby's Cockatoo and is usually associated with the forested Darling Scarp further to the east. This cockatoo feeds mainly on Marri, but also on *Banksia* and *Hakea* species (Johnstone and Storr 1998). This species breeds in the south-west, moving into the northern Darling Range in winter. It has been recorded breeding as far north as Serpentine, with unconfirmed reports of breeding further north at Hovea and Christmas Tree Well (Johnstone *et al.* 2003). This cockatoo requires large hollows in eucalypts (generally Marri and Wandoo) for breeding, and the site had very few large trees. Most of the native vegetation on the Bushmead Rifle Range would be potential feeding habitat for the Baudin's Black-Cockatoo, but this species would be unlikely to nest there.

Carnaby's Black-Cockatoo is highly likely to forage on the site, feeding on Jarrah, Marri, *Banksia*, *Hakea*, *Allocasuarina* and *Dryandra* (Johnstone and Storr 1998). Although this cockatoo traditionally breeds in the wheatbelt, in recent times it has been recorded breeding in the northern Darling Range at Bindoon, Chittering, Karragullen and the upper Helena River (Johnstone *et al.* 2003). This cockatoo requires large hollows in eucalypts (generally Wandoo and Salmon Gum but sometimes Marri) for breeding, and the site had very few large trees. Most of the native vegetation on the Bushmead Rifle Range would be potential feeding habitat for the Carnaby's Black-Cockatoo, but this species would be unlikely to nest there.

The Forest Red-tailed Black-Cockatoo is also likely to forage on the site, feeding on Jarrah, Marri and *Allocasuarina* (Johnstone and Storr 1998). This species is usually found deeper into the forested zone of the Darling Scarp near Mundaring and Byford but may occasionally be seen foraging further afield near the study area. This cockatoo requires large hollows in eucalypts (generally Marri or Jarrah) for breeding, and the site had very few large trees. There are few breeding records of this species (Johnstone and Storr 1998). Most of the native vegetation on the Bushmead Rifle Range would be potential feeding habitat for the Forest Red-tailed Black-Cockatoo, and there is a small potential for this species to nest there.

Loss of bushland on the Bushmead Rifle Range would result in loss of feeding habitat for three threatened cockatoo species. As Baudin's Black-Cockatoo and Carnaby's Black-Cockatoo are both listed under the EPBC Act, changes to the bushland on the site may need to be referred for consideration as a controlled action.

The Peregrine Falcon is a wide-ranging bird of prey that may visit or be resident in the study area. The site would only be highly significant for this falcon if they were breeding on the site in tall trees.

The Rainbow Bee-eater is a migratory species that moves to southern Australia to breed during summer. The Rainbow Bee-eater nests in burrows dug into sandy ground or banks, including fire-breaks and cleared land. This species is likely to be a common breeding visitor to the site and was recorded during the site visit (Table 4). Changes to the bushland may destroy nesting sites, however, as the Rainbow Bee-eater is a common and widespread species it is unlikely to have a significant impact on the population. Any clearing should be undertaken outside of the Spring-Summer

nesting season of this species to mimimise the chances of young birds being killed in burrows.

The Fork-tailed Swift is largely aerial and is unlikely to be affected by changes to the Bushmead Rifle Range.

Conservation Significance 2

- **Barking Owl** *Ninox connivens*

This owl is listed as Priority 2 by CALM and as 'near threatened' by Garnett and Crowley (2000).

- **Masked Owl** *Tyto novaehollandiae novaehollandiae*

This owl is listed as Priority 3 by CALM and as 'near threatened' by Garnett and Crowley (2000).

The Masked Owl and Barking Owl both inhabit eucalypt forests and woodlands, and require large hollows in eucalypts for breeding. The Barking Owl has been recorded in the area by Birds Australia (Table 4). The Bushmead Rifle Range does not have many large old trees, so has a low potential to support breeding individuals of these species, but birds may forage over the site.

Conservation Significance 3

- **See 33 species indicated in Table 4.**

There are 33 species in Table 4 that have been listed as Conservation Significance 3. These species are those indicated in Bush Forever (Department of Environmental Protection 2000) as having reduced populations on the Swan Coastal Plain. Some of these species are habitat specialists and are locally extinct in many parts of the metropolitan area. Other species are more wide-ranging. Most of the Conservation Significance 3 species are likely to be adversely affected by further urban development in the area.

Most of the birds listed in Table 4 require bushland to meet most or all of their requirements (i.e. opportunities for feeding, breeding and shelter). These species will only persit on the site if bushland is retained. Some species will use urban developments, but these are usually generalist species that are common and widespread.

not considered in report. Many birds on this site fit this category

Mammals

There are 18 species of native mammal and six species of introduced mammal tha have the potential to occur in the study area (Table 4). Nine of the native mamma listed are bats. A greater diversity of mammal species was previously known fro the area, but most are now considered locally extinct or extinct.

The Western Grey Kangaroo was recorded in the Bushmead Rifle Range during the site visit as well as by Ecologia (1991) and Dames and Moore (1989). Ecologia (1991) made the observation that there was only one group of about seven individuals present on the site, but this may well have changed. The Brush-tailed Possum has

been recorded inhabiting buildings on the rifle range, and one was captured on the site in 1991 (Dames and Moore 1989; Ecologia 1991).

There are five mammals of conservation significance that may occur on the Bushmead Rifle Range. Each species is listed and discussed below.

Conservation Significance 1

- **Chuditch** *Dasyurus geoffroii*

The Chuditch is listed as Schedule 1 (Vulnerable) under the WA Wildlife Conservation Act and as Vulnerable under the EPBC Act, and by Maxwell *et al.* (1996).

There are records of Chuditch in the Hazelmere area in 1989, 1991 and 1999 (CALM's Threatened and Priority Fauna Database). It is possible that the Chuditch occurs on the Bushmead Rifle Range. The bushland may be used by individuals passing through, or as part of the larger territory of one or more individuals. The Chuditch maintains a relatively large territory, so if present, the site would not support many individuals.

Conservation Significance 2

- **Quenda (Southern Brown Bandicoot)** *Isoodon obesulus*

The Quenda is listed as Priority 5 by CALM and as lower risk (near threatened) by Maxwell *et al.* (1996).

- **Brush Wallaby** *Macropus irma*

This wallaby is listed as Priority 4 by CALM and as lower risk (near threatened) by Maxwell *et al.* (1996).

- **Western False Pipistrelle** *Falsistrellus mackenziei*

This bat is listed as Priority 4 by CALM and as lower risk (near threatened) by Duncan *et al.* (1999).

The Quenda was recorded on the Bushmead Rifle Range by Ecologia (1991) and was found to inhabit dense vegetation surrounding the creekline during autumn and early winter. When the area around the creek became inundated towards the end of winter, the Quenda left the creek and made more use of upland habitats with dense understorey (Ecologia 1991). There are also records of Quenda in Hazelmere and Helena Valley (CALM's Threatened and Priority Fauna Database). The Quenda is likely to be relatively common in areas with a dense understorey, but particularly favours areas of dense vegetation around the creekline. Little evidence of the distinctive conical diggings of the Quenda was noted during the site inspection with the exception of some near the creekline in the centre of the property.

It is possible that the Brush Wallaby occurs on the Bushmead Rifle Range, but there are no records for this species on CALM's Threatened and Priority Fauna Database. If present, this species favours areas with tall, dense understorey vegetation and suitable dense habitat may be lacking over much of the site.

The Western False Pipistrelle is endemic to the south-west of Western Australia. It inhabits Jarrah forests and Banksia woodlands. This bat roosts in groups of five to 50 in hollow trees, branches or stumps and forages under the tree canopy. (Churchill 1998). Although there are no records of this species for the area, bats are generally under-surveyed, and this species may occur on the site.

Conservation Significance 3

- **Western Pygmy Possum** *Cercartetus concinnus*

The Western Pygmy Possum is a mouse-sized native marsupial that inhabits eucalypt woodlands and mallee heathlands. This species is very uncommon in the Perth Metropolitan Area where it is now largely confined to the Darling Scarp. It may occur on the Bushmead Rifle Range, although it generally favours less degraded areas with an intact shrubby understorey.

Native mammals generally do not persist within urban developments, with the exception of some bat species and perhaps the Brush-tailed Possum. In addition, development of part of the site may restrict the movement of some species (e.g. Quenda, Chuditch or Brush-tailed Possum) between areas of remaining bushland including the surrounding national parks and reserves.

Threatened Invertebrates

This report discusses vertebrate fauna only. The invertebrate fauna of the Bushmead Rifle Range may include Threatened or Priority species, although no records were found on CALM's Threatened and Priority Fauna Database (Appendix 3).

Conclusions

The Bushmead Rifle Range has a variety of habitats, including woodlands of *Eucalyptus marginata* (Jarrah), *Corymbia calophylla* (Marri), *E. wandoo* (Wandoo), *E. todtiana* (Pricklybark), *Banksia*, *Allocasurina* and combinations of these. There is a creekline with associated *E. rudis* (Flooded Gum) and *Melaleuca rhaphiophylla* (Freshwater Paperbark) woodland. The vegetation ranges from that in good condition with an intact understorey (e.g. the Wandoo woodland in the south-east of the site and the *Banksia / Allocasuarina / E. todtiana* woodland in the north of the site) to open and degraded areas of introduced grasses.

The Bushmead Rifle Range is listed under Bush Forever, and is therefore considered to be bushland of regional significance (Department of Environment 2000).

The site is expected to support a range of vertebrate fauna, as listed in Tables 2-5. This includes up to 12 species of amphibian, 57 species of reptile, 110 species of bird and 24 species of mammal. The site may support a number of species of Conservation Significance 1; the Carpet Python, Baudin's Black-Cockatoo, Carnaby's Black-Cockatoo, Forest Red-tailed Black-Cockatoo, Peregrine Falcon, Rainbow Bee-eater, Fork-tailed Swift and Chuditch. The site may also support species of Conservation Significance 2; the Southern Death Adder, Black-striped Snake, Darling

Range Ctenotus, Barking Owl, Masked Owl, Quenda (Southern Brown Bandicoot), Brush Wallaby and Western False Pipistrelle.

The areas of the site most likely to support a relatively intact fauna are those with the least degraded native vegetation, particularly the Wandoo woodland in the south-east of the site and the *Banksia / Allocasuarina / E. todtiana* woodland in the north of the site. However, other parts of the site are likely to support species of conservation significance. For example, almost all of the native vegetation on the site (particularly areas containing Marri), may be used as feeding habitat for the Carnaby's Black-Cockatoo, Baudin's Black-Cockatoo and Forest Red-tailed Black-Cockatoo. In addition, areas around the creekline and areas with a dense understorey may be important for the Quenda.

If part of the site is developed for housing, some native vegetation is likely to be lost. This will result in some loss of habitat for native fauna. Of most concern is that this may result in some loss of habitat for species of conservation significance. Loss of native vegetation may also result in the further isolation of bushland remnants near the Bushmead Rifle Range.

In order to maintain or enhance some of the fauna values of the site, the following are recommended.

- The area of native vegetation to be cleared is minimised as much as possible and disturbance to surrounding areas is minimised during development.
- Where possible, development should be focussed on existing cleared and degraded areas and should avoid native vegetation.
- Linkages (corridors) of native vegetation to surrounding areas should be preserved and enhanced where necessary and careful attention should be paid to not severing any existing linkages (e.g. with Goosberry Hill National Park and various Bush Forever sites).
- Any hollow logs or trees removed during the construction process could be placed in surrounding areas of woodland to enhance the fauna habitats available.
- Control of introduced species (particularly rabbits and foxes) could be considered.
- Possible control of the Western Grey Kangaroo population may be required in order to prevent damage to native vegetation by overgrazing.
- Liaison with the Department of Environment is strongly recommended to determine the need for further studies and/or referrals regarding EPBC listed fauna species.

Table 1. Amphibians that are expected to occur in the study area.
HD = species recorded on the site by How and Dell (2000).
E = species recorded on the site by Ecologia (1991).
WAM = species recorded in the area by the WA Museum (see Table 1).

Species		Status	Recorded		
Hylidae (tree frogs and water-holding frogs)					
Slender Tree Frog	*Litoria adelaidensis*				WAM
Motorbike Frog	*Litoria moorei*				WAM
Myobatrachidae (ground frogs)					
Hooting Frog	*Heleioporus barycragus*			E	WAM
Moaning Frog	*Heleioporus eyrei*		HD	E	WAM
Sand Frog	*Heleioporus psammophilus*				WAM
Banjo Frog	*Limnodynastes dorsalis*		HD	E	WAM
Quacking Frog	*Crinia georgiana*			E	WAM
Glauert's Frog	*Crinia glauerti*		HD	E	WAM
Squelching Froglet	*Crinia insignifera*		HD	E	WAM
Bleating Froglet	*Crinia pseudinsignifera*				WAM
Turtle Frog	*Myobatrachus gouldii*		HD	E	WAM
Gunther's Toadlet	*Pseudophryne guentheri*		HD		WAM
	Number of frogs expected:		**12**		

Table 2. Reptiles that are expected to occur in the study area.
HD = species recorded on the site by How and Dell (2000).
E = species recorded on the site by Ecologia (1991).
WAM = species recorded in the area by the WA Museum (see Table 1).

Species		Status	Recorded		
Agamidae (dragon lizards)					
Ornate Crevice Dragon	*Ctenophorus ornatus*	CS3			WAM
Bearded Dragon	*Pogona minor*		HD		WAM
Western Heath Dragon	*Rankinia adelaidensis*				
Gekkonidae (geckoes)					
Marbled Gecko	*Christinus marmoratus*			E	
Clawless Gecko	*Crenadactylus ocellatus*				WAM
Wheatbelt Stone Gecko	*Diplodactylus granariensis*				WAM
Speckled Stone Gecko	*Diplodactylus polyophthalmus*				WAM
Western Saddled Ground Gecko	*Diplodactylus pulcher*				WAM
Variegated Dtella	*Gehyra variegata*			E	WAM
Spiny-tailed Gecko	*Strophurus spinigerus*		HD		WAM
Barking Gecko	*Underwoodisaurus milii*				WAM
Pygopodidae (legless lizards)					
Granite Worm Lizard	*Aprasia pulchella*				WAM
Sandplain Worm Lizard	*Aprasia repens*				WAM
Fraser's Legless Lizard	*Delma fraseri*				WAM
Gray's Legless Lizard	*Delma grayii*				WAM
Burton's Legless Lizard	*Lialis burtonis*				WAM
Keeled Legless Lizard	*Pletholax gracilis*				
Common Scaly-foot	*Pygopus lepidopodus*				WAM
Scincidae (skink lizards)					
South-west Cool Skink	*Acritoscincus trilineatum*				
Fence Skink	*Cryptoblepharus plagiocephalus*		HD	E	WAM
West Coast Limestone Ctenotus	*Ctenotus australis*		HD		WAM
Dell's Skink	*Ctenotus delli*	CS2			WAM
West Coast Ctenotus	*Ctenotus fallens*		HD	E	WAM
Odd-striped Ctenotus	*Ctenotus impar*				WAM
Red-legged Ctenotus	*Ctenotus labillardieri*				WAM
Salmon-bellied Skink	*Egernia napoleonis*				
Five-toed Earless Skink	*Hemiergis initialis*				WAM
Two-toed Earless Skink	*Hemiergis quadrilineata*				
	Lerista distinguenda				WAM
	Lerista elegans		HD		WAM
Dwarf Skink	*Menetia greyii*		HD	E	WAM
	Morethia lineoocellata				
Dusky Morethia	*Morethia obscura*				WAM
Western Blue-tongue	*Tiliqua occipitalis*				WAM
Bobtail	*Tiliqua rugosa*		HD	E	

Table 3. (cont.)

Species		Status	Recorded		
Varanidae (goanna or monitor lizards)					
Gould's Goanna	*Varanus gouldii*				WAM
Southern Heath Monitor	*Varanus rosenbergi*			E	
Black-tailed Monitor	*Varanus tristis*			E	WAM
Typhlopidae (blind snakes)					
Southern Blind Snake	*Ramphotyphlops australis*		HD	E	WAM
Fat Blind Snake	*Ramphotyphlops pinguis*				WAM
	Ramphotyphlops waitii				WAM
Boidae (pythons)					
Carpet Python (south-west)	*Morelia spilota imbricata*	CS1			WAM
Elapidae (front-fanged snakes)					
Southern Death Adder	*Acanthophis antarcticus*	CS2			
Narrow-banded Shovel-nosed Snake	*Brachyurophis fasciolata*				
Southern Shovel-nosed Snake	*Brachyurophis semifasciata*				WAM
Yellow-faced Whipsnake	*Demansia psammophis*				WAM
Bardick	*Echiopsis curta*				
Crowned Snake	*Elapognathus coronatus*				
Black-naped Snake	*Neelaps bimaculatus*				
Black-striped Snake	*Neelaps calonotos*	CS2			
Tiger Snake	*Notechis scutatus*				WAM
Gould's Hooded Snake	*Parasuta gouldii*				WAM
Black-backed Snake	*Parasuta nigriceps*				
Mulga Snake	*Pseudechis australis*				WAM
Dugite	*Pseudonaja affinis*			E	WAM
Gwardar	*Pseudonaja nuchalis*				WAM
Jan's Banded Snake	*Simoselaps bertholdi*				WAM
Number of reptile species expected:			**57**		

Table 3. Birds that are expected to occur in the study area.
+ = species recorded on the site during the site visit.
BA = species recorded in the area by Birds Australia (see Table 1).
E = species recorded on the site by Ecologia (1991).
WAM = species recorded in the area by the WA Museum (see Table 1).
Int = introduced species.

CS3 spp not included in spp

Species		Status	Recorded		
Phasianidae (quails)					
Stubble Quail	*Coturnix pectoralis*		BA		
Anatidae (ducks and swans)					
Australian Shelduck	*Tadorna tadornoides*		BA	E	
Australian Wood Duck	*Chenonetta jubata*		BA	E	
Pacific Black Duck	*Anas superciliosa*		BA	E	
Ardeidae (herons, egrets and bitterns)					
White-faced Heron	*Ardea (Egretta) novaehollandiae*		BA	E	
Cattle Egret	*Ardea ibis*		BA		
Nankeen Night-Heron	*Nycticorax caledonicus*	CS3	BA		
Threskionithidae (ibis and spoonbills)					
Australian White Ibis	*Threskiornis molucca*		BA	E	
Straw-necked ibis	*Threskiornis spinicollis*		BA		
Accipitridae (osprey, hawks, eagles and harriers)					
Black-shouldered Kite	*Elanus caeruleus (axillaris)*		BA	E	WAM
Square-tailed Kite	*Hamirostra (Lophoictinia) isura*	CS3	BA		WAM
Whistling Kite	*Haliastur sphenurus*	CS3	BA		
Brown Goshawk	*Accipiter fasciatus*	CS3	BA		
Collared Sparrowhawk	*Accipiter cirrocephalus*	CS3	BA		
Little Eagle	*Aquila (Hieraaetus) morphnoides*	CS3	BA		
Wedge-tailed Eagle	*Aquila audax*	CS3	BA		
Falconidae (falcons)					
Brown Falcon	*Falco berigora*	CS3	BA	E	
Nankeen Kestrel	*Falco cenchroides*		BA	E	WAM
Australian Hobby	*Falco longipennis*		BA		WAM
Peregrine Falcon	*Falco peregrinus*	CS1	BA		
Rallidae (crakes, rails and gallinules)					
Buff-banded Rail	*Gallirallus philippensis*		BA	E	
Purple Swamphen	*Porphyrio porphyrio*		BA		
Turnicidae (button-quails)					
Painted Button-Quail	*Turnix varia*	CS3	BA	E	WAM
Charadriidae (plovers, dotterels and lapwings)					
Banded Lapwing	*Vanellus tricolor*				
Columbidae (pigeons and doves)					
Feral Pigeon (Rock Dove)	*Columba livia*		BA		
Laughing Turtle-Dove	*Streptopelia senegalensis*		+ BA	E	
Spotted Turtle-Dove	*Streptopelia chinensis*		BA	E	WAM
Common Bronzewing	*Phaps chalcoptera*	CS3	+ BA	E	
Crested Pigeon	*Ocyphaps lophotes*		BA		

Table 4. (cont.).

Species		Status	Recorded		
Cacatuidae (cockatoos and corellas)					
Forest Red-tailed Black-Cockatoo	*Calyptorhynchus banksii*	CS1	BA		WAM
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*	CS1	BA		WAM
Baudin's Black-Cockatoo	*Calyptorhynchus baudinii*	CS1	BA	E	WAM
Galah	*Cacatua roseicapilla*		+ BA	E	
Western Long-billed Corella	*Cacatua pastinator*	CS3	BA		
Little Corella	*Cacatua sanguinea*		BA		
Psittacidae (parrots, lorikeets and rosellas)					
Rainbow Lorikeet	*Trichoglossus haematodus*	Int.	BA	E	
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*		BA		
Australian Ringneck	*Barnardius zonarius*		+ BA	E	
Red-capped Parrot	*Platycercus (Purpureicephalus) spurius*		+ BA	E	WAM
Western Rosella	*Platycercus icterotis*	CS3	BA		WAM
Elegant Parrot	*Neophema elegans*		BA		
Cuculidae (cuckoos)					
Pallid Cuckoo	*Cuculus pallidus*		BA	E	WAM
Fan-tailed Cuckoo	*Cacomantis flabelliformis*		BA		
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*		BA	E	WAM
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*		BA		WAM
Strigidae (hawk owls)					
Barking Owl (southern)	*Ninox connivens connivens*	CS2	BA		
Southern Boobook	*Ninox novaeseelandiae*		BA	E	WAM
Tytonidae (barn owls)					
Masked Owl	*Tyto novaehollandiae*	CS2			
Barn Owl	*Tyto alba*		BA	E	WAM
Podargidae (frogmouths)					
Tawny Frogmouth	*Podargus strigoides*		BA		
Aegothelidae (owlet-nightjars)					
Australian Owlet-Nightjar	*Aegotheles cristatus*				
Apodidae (swifts)					
Fork-tailed Swift	*Apus pacificus*	CS1	BA		
Halcyonidae (kingfishers)					
Laughing Kookaburra	*Dacelo novaeguineae*		+ BA	E	WAM
Sacred Kingfisher	*Todiramphus sanctus*		BA	E	WAM
Meropidae (bee-eaters)					
Rainbow Bee-eater	*Merops ornatus*		+ BA		
Climacteridae (treecreepers)					
Rufous Treecreeper	*Climacteris rufa*	CS3	BA	E	
Maluridae (fairy-wrens, grasswrens and emu-wrens)					
Splendid Fairy-wren	*Malurus splendens*		+ BA	E	WAM
Red-winged Fairy-wren	*Malurus elegans*	CS3	BA		
Southern Emu-wren	*Stipiturus malachurus*				

Table 4. (cont.)

Species		Status	Recorded		
Pardalotidae (pardalotes, thornbills, gerygones and allies)					
Spotted Pardalote	*Pardalotus punctatus*		BA		
Striated Pardalote	*Pardalotus striatus*		+ BA	E	WAM
White-browed Scrubwren	*Sericornis frontalis*	CS3	+ BA		
Weebill	*Smicrornis brevirostris*	CS3	+ BA	E	WAM
Western Gerygone	*Gerygone fusca*		+ BA	E	
Inland Thornbill	*Acanthiza apicalis*	CS3	+ BA	E	WAM
Western Thornbill	*Acanthiza inornata*	CS3	BA	E	WAM
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	CS3	+ BA	E	WAM
Meliphagidae (honeyeaters and chats)					
Brown Honeyeater	*Lichmera indistincta*		+ BA	E	
Singing Honeyeater	*Lichenostomus virescens*		+ BA	E	
Brown-headed honeyeater	*Melithreptus brevirostris*		BA		
White-naped Honeyeater	*Melithreptus chloropsis (lunatus)*	CS3	BA	E	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	CS3	BA		
White-cheeked Honeyeater	*Phylidonyris nigra*	CS3	+ BA	E	
Tawny-crowned Honeyeater	*Phylidonyris melanops*	CS3	BA		
Western Spinebill	*Acanthorhynchus superciliosus*		+ BA	E	
Yellow-throated Miner	*Manorina flavigula*	CS3	BA		
Western Wattlebird	*Anthochaera lunulata*	CS3	+ BA		
Red Wattlebird	*Anthochaera carunculata*		+ BA	E	WAM
White-fronted Chat	*Epthianura albifrons*		BA		
Petroicidae (robins)					
Jacky Winter	*Microeca fascinans*			E	
Scarlet Robin	*Petroica multicolor*	CS3	BA	E	
Red-capped Robin	*Petroica goodenovii*		+ BA	E	WAM
White-breasted Robin	*Eopsaltria georgiana*	CS3	BA		
Neosittidae (sittellas)					
Varied Sittella	*Daphoenositta chrysoptera*	CS3	+ BA	E	WAM
Pachycephalidae (shrike-tits, whistlers and allies)					
Golden Whistler	*Pachycephala pectoralis*	CS3	BA	E	
Rufous Whistler	*Pachycephala rufiventris*		+ BA	E	WAM
Grey Shrike-thrush	*Colluricincla harmonica*	CS3	BA	E	
Dicruridae (flycatchers, magpie-larks and fantails)					
Restless Flycatcher	*Myiagra inquieta*				
Grey Fantail	*Rhipidura fuliginosa*		+ BA	E	
Willie Wagtail	*Rhipidura leucophrys*		BA	E	
Magpie-Lark	*Grallina cyanoleuca*		+ BA	E	
Campephagidae (cuckoo-shrikes and trillers)					
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*		+ BA	E	
White-winged Triller	*Lalage tricolour (sueurii)*		BA	E	WAM

Table 4. (cont.)

Species		Status	Recorded		
Artamidae (woodswallows, butcherbirds, magpies)					
Black-faced Woodswallow	*Artamus cinereus*	CS3	BA		WAM
Dusky Woodswallow	*Artamus cyanopterus*	CS3	BA	E	
Pied Butcherbird	*Cracticus nigrogularis*		BA	E	
Grey Butcherbird	*Cracticus torquatus*		BA	E	
Australian Magpie	*Cracticus (Gymnorhina) tibicen*		BA	E	WAM
Grey Currawong	*Strepera versicolor*	CS3			
Corvidae (ravens and crows)					
Australian Raven	*Corvus coronoides*		+ BA	E	
Motacillidae (pipits and wagtails)					
Richard's Pipit	*Anthus australis (novaeseelandiae)*		BA		
Passeridae (grassfinches, sparrows and allies)					
Red-browed Finch	*Neochmia temporalis*	Int.	BA		
Red-eared Firetail	*Stagonopleura oculata*		BA		
Dicaeidae (flowerpeckers)					
Mistletoebird	*Dicaeum hirundinaceum*		BA		
Hirundinidae (swallows and martins)					
White-backed Swallow	*Cheramoeca leucosternus*			E	
Welcome Swallow	*Hirundo neoxena*		BA	E	
Tree Martin	*Hirundo nigricans*		BA	E	WAM
Sylviidae (old world warblers)					
Rufous Songlark	*Cincloramphus mathewsi*				
Brown Songlark	*Cincloramphus cruralis*		BA		
Zosteropidae (white-eyes)					
Silvereye	*Zosterops lateralis*		+ BA	E	
Number of bird species expected:			**110**		

Table 5. Mammals that are expected to occur in the study area.
+ = species recorded on the site during the site visit.
E = species recorded on the site by Ecologia (1991).
WAM = species recorded in the area by the WA Museum (see Table 1).
Int = introduced species.

Species		Status	Recorded		
Tachyglossidae (echidnas)					
Echidna	*Tachyglossus aculeatus*				WAM
Dasyuridae (dasyurid marsupials)					
Mardo	*Antechinus flavipes*				
Chuditch	*Dasyurus geoffroii*	CS1			WAM
Peramelidae (bandicoots)					
Southern Brown Bandicoot	*Isoodon obesulus*	CS2		E	WAM
Macropodidae (kangaroos and wallabies)					
Western Grey Kangaroo	*Macropus fuliginosus*		+	E	WAM
Western Brush Wallaby	*Macropus irma*	CS2			
Phalangeridae (possums)					
Brushtail Possum	*Trichosurus vulpecula*			E	WAM
Burramyidae (pygmy possums)					
Western Pygmy Possum	*Cercartetus concinnus*	CS3			WAM
Tarsipedidae (honey possums)					
Honey Possum	*Tarsipes rostratus*				WAM
Vespertilionidae (ordinary bats)					
Gould's Wattled Bat	*Chalinolobus gouldii*				WAM
Chocolate Wattled Bat	*Chalinolobus morio*				WAM
Western False Pipistrelle	*Falsistrellus mackenziei*	CS2			
Lesser Long-eared Bat	*Nyctophilus geoffroyi*				WAM
Gould's Long-eared Bat	*Nyctophilus gouldi*				
Greater Long-eared Bat	*Nyctophilus timoriensis*				
Southern Forest Bat	*Vespadelus regulus*				WAM
Molossidae (freetail bats)					
Southern Freetail Bat	*Mormopterus planiceps*				
White-striped Freetail Bat	*Tadarida australis*				
Muridae (rats and mice)					
House Mouse	*Mus musculus*	Int.		E	WAM
Black Rat	*Rattus rattus*	Int.		E	WAM
Leporidae (rabbits and hares)					
Rabbit	*Oryctolagus cuniculus*	Int.	+		WAM
Canidae (dogs and foxes)					
Fox	*Vulpes vulpes*	Int.		E	
Felidae (cats)					
Feral/House Cat	*Felis catus*	Int.		E	WAM
Suidae (pigs)					
Pig	*Sus scrofa*	Int.			WAM
Number of mammals expected:			**24**		

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Appendix 1. Categories used in the assessment of conservation status.

Environmental Protection and Biodiversity Conservation (EPBC) Act and/or the WA Wildlife Conservation Act

Schedule 1: Fauna that are rare or likely to become extinct.
Schedule 2: Fauna presumed to be extinct.
Schedule 3: Migratory birds that are listed under JAMBA.
Schedule 4: Other specially protected fauna.

Extinct: Taxa not definitely located in the wild during the past 50 years.
Extinct in the wild: Taxa known to survive only in captivity.
Critically Endangered: Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered: Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable: Taxa facing a very high risk of extinction in the wild in the medium-term future.
Near Threatened: Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent: Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient: Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern: Taxa that are not Threatened.

WA Department of Conservation and Land Management Priority species
(species not listed under the Conservation Act, but for which there is some concern).

Priority 1: Taxa with few, poorly known populations on threatened lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 2: Taxa with few, poorly known populations on conservation lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 3: Taxa with several, poorly known populations, some on conservation lands.
Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

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

Priority 5: Taxa in need of monitoring.
Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix 2. Species listed for the area 31°50'S to 31°57'S and 115°55'E to 116°05'E on the EPBC Protected Matters Search Tool, excluding marine species.

Species	Status
Baudin's Black-Cockatoo *Calyptorhynchus baudinii*	Vulnerable
Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*	Endangered
Chuditch *Dasyurus geoffroii*	Vulnerable
White-bellied Sea-Eagle *Haliaeetus leucogaster*	Migratory

Appendix 3. Species listed for the area 407032E to 409598E and 6468997N to 6465825N (zone 50) on the CALM Threatened and Priority Fauna Database.

Species	Status
Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*	Schedule 1: Endangered
Baudin's Black-Cockatoo *Calyptorhynchus baudinii*	Schedule 1: Endangered
Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii*	Schedule 1: Vulnerable
Chuditch *Dasyurus geoffroii*	Schedule 1: Vulnerable
Quenda *Isoodon obesulus*	Priority 5

Policy & Coordination

Memorandum

TO:	**GARY WHISSON**
FROM:	**BEC RYAN**
CC:	**KIERON BEARDMORE (BFO), DAVE MITCHELL (DEC SWAN REGION)**
DATE:	**21 SEPTEMBER 2006**
RE:	**BUSHMEAD BFS 213 BOUNDARY ASSESSMENT**
FILE NO:	**BFS 213**

Comments on the draft report ERM Sept 2006:

1. Values contained within the areas proposed to be removed from Bush Forever should be clearly demonstrated in the report. This is particularly the case for occurrence of conservation significant fauna, eg breeding cockatoos.

2. Ecological linkage: removal of areas 2 and 3 would result in reduction of linkage between north and south portions of the site to the creekline and buffer (40m corridor), which is insufficient for linkage functions to be maintained in long term. Adequate linkage requires a 'like to like' interface and minimal traverse of hostile environments for fauna movement. For example, the 40m corridor provides linkage function along the creekline, but there is no provision for movement from upland areas from north to south. At best, fauna movement would be forced along creekline or through development area.

3. Area 1: boundary appears to define an area larger than Bennett condition map suggests.
4. Area 2: Bennett mapped condition as G-VG for majority of this area. What is justification for removal from Bush Forever?

5. Additional fauna reference: Harvey et al (1997) Copy of front cover supplied by John Dell.

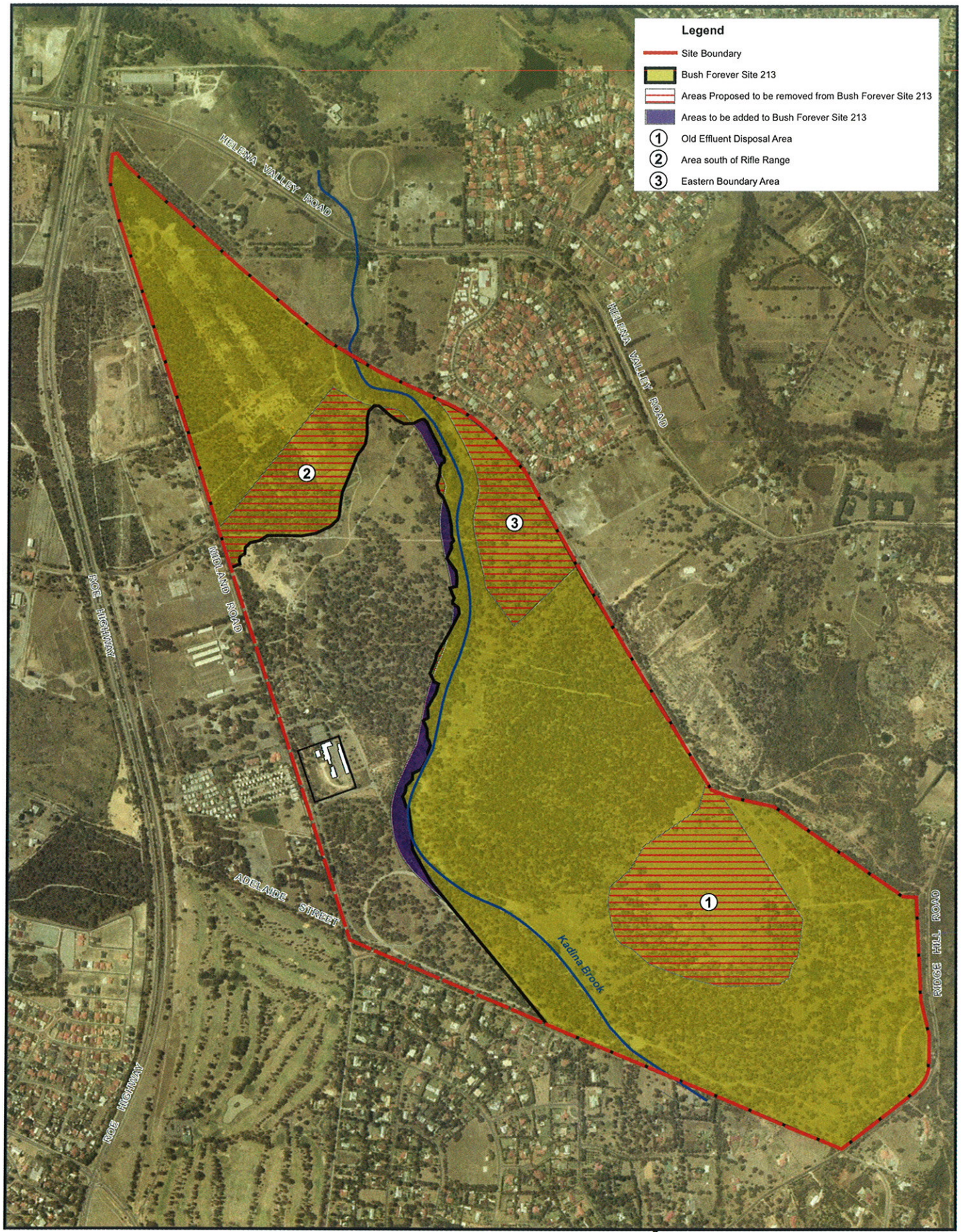
6. Conservation significant fauna: 33 species of conservation significance 3 are listed in Western Wildlife (2006) table 3-4 should be included in ERM 2006.

7. Retention of Good or better: Bennett (2006) p. 6 recommends that all vegetation in Good or better condition should be conserved.

50m buffer

BEC RYAN

N:\Jobs\2005\0042826-F10\08\06 Opportunities and Constraints



Source: Aerial Photograph December 2003.

ERM

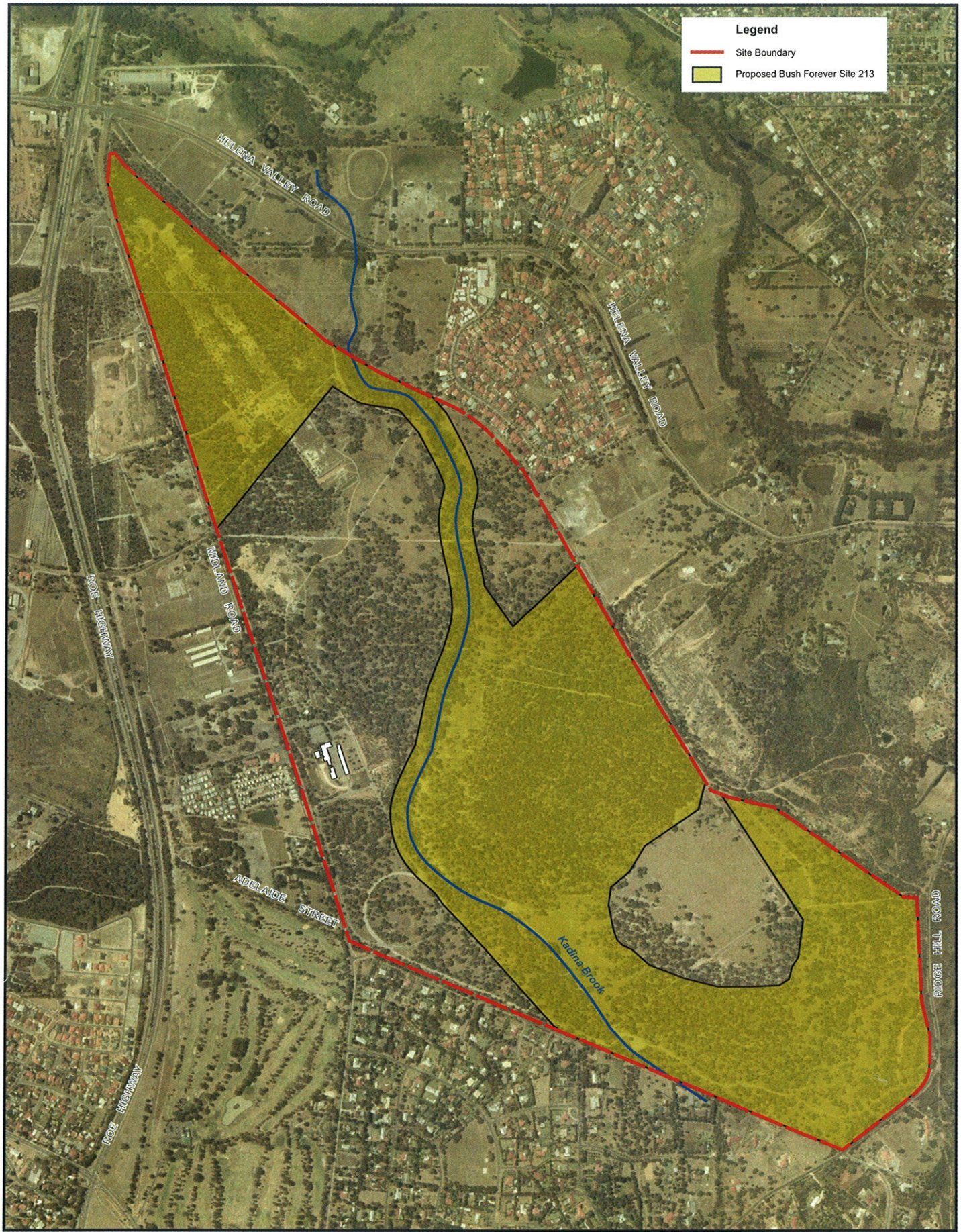
0 200m

1:10 000 @ A3

Figure 3.2 **Proposed Bush Forever Boundary with Areas of Inclusion and Exclusion**

Bushmead Rifle Range Property Disposal
Helena Valley, Western Australia
August 2006

N:/Jobs/2005/0042826-F23/08/06 Opportunities and Constraints



Source: Aerial Photograph December 2003.

ERM

0 200m

1:10 000 @ A3

Figure 3.1 **Proposed Bush Forever Boundary**

Bushmead Rifle Range Property Disposal
Helena Valley, Western Australia
August 2006

5236 WA 3166(C) METRO REGIONAL AREA & EXT. RUN 15 (5215-5307) 1:20000 11-DEC-92 920676