ROSELLA ROAD BUSHLAND, BULLSBROOK

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

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 380 **Area (ha)** bushland 8001.6

Map no. 9, 10, 11, 15, 16, 21, 22

Map sheet series ref. no. 2034–I NW, 2034–I SW, 2035–II SW

Other Names: Submission Area 288, part Department of Defence Muchea Air Weapons Range, part State Forest 65, part Yeal Nature Reserve, part of proposed Gnangara Park

Local Authorities (Suburb): Shire of Wanneroo (Pinjar, Yanchep), Shire of Chittering (Muchea), Shire of Gingin (Yeal)

Includes CALM Managed Land: Reserve 42450 (Conservation of Flora and Fauna and Water), State Forest 65

System 6 (1983): Part M5, part C13 area of bushland goes beyond System area boundaries, all bushland described

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Bassendean Dunes

Bassendean Sands (Qpb: S8)

Bassendean Dunes/Pinjarra Plain

Bassendean Sands over Guildford Formation (Qpb/Qpa: S10)

Wetlands (within the Spearwood and Bassendean Dunes)

Holocene Swamp Deposits (Qhw: Cps, S_4)

Lagoonal and Estuarine Deposits (within the Bassendean Dunes)

Lagoonal Deposits in Bassendean Dunes (Qpw: S9)

VEGETATION AND FLORA

Vegetation Complexes

Bassendean Dunes

Bassendean Complex — North

Bassendean Complex — North Transition (restricted complex, contains significant area)

Bassendean Complex — Central and South Transition (restricted complex, contains significant area, most southern occurrence)

Spearwood Dunes (revised vegetation complex boundaries exclude all Karrakatta except, possibly, on yellow sand north of Lake Pinjar, in the southwest corner of Site: McArthur and Mattiske 1985)

Karrakatta Complex — North (most southern occurrence)

Karrakatta Complex — North Transition (restricted complex, contains significant area, most northern occurrence)

Karrakatta Complex — Central and South (restricted complex, contains significant area)

Floristic Community Types

Supergroup 2: Seasonal Wetlands

5 Mixed shrub damplands

Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau

21c Low-lying *Banksia attenuata* woodlands or shrublands

22 *Banksia ilicifolia* woodlands

23a Central *Banksia attenuata* — *B. menziesii* woodlands

23b Northern *Banksia attenuata* — *B. menziesii* woodlands

REGIONAL WETLANDS

Wetland Types: sumpland, dampland, creek

Natural Wetland Groups: undefined areas included in boundary

Bassendean Dunes

Pinjar (B.1)

Jandakot (B.3)

Wetland Management Objectives: Conservation (319.3ha), Resource Enhancement

Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

ROSELLA ROAD BUSHLAND, BULLSBROOK

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

SECTION 1: CADASTRAL INFORMATION

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

Bushplan Site no. 380 **Map no.** 10, 11, 15, 16, 19, 20, 27 **Map sheet series ref. no.** 2034–I NW, 2034–I SW, 2035–II SW

System 6 (1983): Part M5, part M8, part C13 area of bushland goes beyond System area boundaries, all bushland described

Other Names
Submission Area 288, part Department of Defence Muchea Air Weapons Range, part State Forest 65, part Yeal Nature Reserve

Area (ha): total 8101.6; bushland 8001.6

Local Authorities (Suburb)
Shire of Wanneroo (Pinjar, Yanchep), Shire of Chittering (Muchea), Shire of Gingin (Yeal)

Zoning
MRS: Rural, State Forest, Public Purposes-Commonwealth Government, Public Purposes-State Energy Commission
TPS: Rural, Water Supply, Landscape

Ownership Categories
State Government, Not identified

Lot/Location/Reserve numbers (Purpose), Street name
12522 Payne St; 2425, 2592, 2634, 3414, 3415, 3516, 3417, 3418 Higgins Rd; 11191 Perry Rd; Crown; 5608, 5610, 10986, 11620, 12522 street not identified Crown Reserve

CALM Managed Land

Reserve 42450 (Conservation of Flora and Fauna and Water), State Forest 65

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Bassendean Dunes
Bassendean Sands (Qpb: S8)

Bassendean Dunes/Pinjarra Plain
Bassendean Sands over Guildford Formation (Qpb/Qpa:S10)

Wetlands (within the Spearwood and Bassendean Dunes)
Holocene Swamp Deposits (Qhw: Cps, S4)

Lagoonal and estuarine Deposits (within the Bassendean Dunes)
Lagoonal Deposits in Bassendean Dunes (Qpw: S9)

VEGETATION AND FLORA

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Bassendean Complex — North Transition (restricted complex, contains significant area)
Bassendean Complex — Central and South Transition (restricted complex, contains significant area, most southern occurrence)

Spearwood Dunes (revised vegetation complex boundaries exclude all Karrakatta except, possibly, on yellow sand north of Lake Pinjar, in the southwest corner of Bushplan Site: McArthur and Mattiske 1985)
Karrakatta Complex — North (most southern occurrence)
Karrakatta Complex — North Transition (restricted complex, contains significant area, most northern occurrence)
Karrakatta Complex — Central and South (restricted complex, contains significant area)

Floristic Community Types

Supergroup 2: Seasonal Wetlands
5 Mixed shrub damplands

Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
21c Low lying *Banksia attenuata* woodlands or shrublands
22 *Banksia ilicifolia* woodlands
23a Central *Banksia attenuata* — *B. menziesii* woodlands
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REGIONAL WETLANDS

Wetland Types: sumpland, dampland, creek

Natural Wetland Groups: undefined areas included in boundary

Bassendean Dunes

Pinjar (B.1)

Jandakot (B.3)

Wetland Management Objectives: Conservation (319.3ha), Resource Enhancement

Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: tall dunes, open water, vegetated wetland, creek, vegetated uplands

Vegetation and Flora: limited survey (McArthur & Mattiske 1985, Trudgen 1996; part Bushplan Site — DEP 1996 (Pinj 14), Gibson *et al.* 1994 (Pline 05–07, RAAF 02–03, Sint 01, Waterrd 01), Havel 1968 (Plots 2, 3, 32, 33, 39, 68, 82, 86; adjacent to Plots 1, 31, 36, 37, 38, 54))

Structural Units: mapping (McArthur and Mattiske 1985)

Uplands: *Banksia attenuata, B. menziesii* and *Eucalyptus todtiana* Low Open Forest to Low Woodland, with *Banksia ilicifolia, Eucalyptus calophylla* or *Nuytsia floribunda; Eucalyptus calophylla* and *E. marginata* Open Forest, with *Banksia grandis*; Closed Heaths to Low Shrublands dominated by *Eremaea pauciflora, Melaleuca* aff. *scabra, Xanthorrhoea preissii, Conospermum* species, *Verticordia nitens* and other species

Wetlands: Closed Forests to Low Woodlands of *Eucalyptus rudis, Melaleuca preissiana, M. rhaphiophylla, Banksia littoralis* or *B. ilicifolia* and combinations; Closed Tall Scrub to Low Shrublands dominated by *Agonis linearifolia, Astartea* aff. *fascicularis, Pericalymma ellipticum, Kunzea ericifolia, Melaleuca* species and others or combinations of these; Herblands dominated by *Phlebocarya ciliata* and other herbs such as *Patersonia occidentalis* often in combination with a variety of sedges; Sedgelands of *Baumea articulata, B.* species or *Lepidosperma longitudinale* or *Leptocarpus* species

Vegetation Condition: >90% Pristine to Excellent, <10% Very Good, with areas of localised disturbance along tracks

Total Flora: not known (estimated >200 native taxa and >30 weed species)

Significant Flora: the following are recorded from State Forest 65 and would be expected in the Bushplan Site — *Stachystemon axillaris* (4), *Conostephium minus* (4); *Verticordia nitens, Boronia purdieana, Astroloma xerophyllum, Stylidium crossocephalum, Leucopogon kingianus*

Fauna: no known information

Linkage: adjacent bushland to the south (BS382 and BS96) and north/east outside of PMR; part of proposed Greenway 37 (Tingay, Alan & Associates 1997a); part of a regionally significant contiguous bushland/wetland linkage (Volume 2A, Map 8)

Other Special Attributes: contains the northernmost major stands of Jarrah (also smaller areas in adjacent Gingin Water Reserve) (McArthur and Mattiske 1985); contains the steepest area of Bassendean Dunes identified on the Plain, >10m in relief adjacent to the most eastern area of the Pinjar Complex (McArthur and Mattiske 1985); recommended for protection in study of City of Wanneroo bushland (Trudgen 1996); part Bushplan Site proposed to become State Forest in Forest Management Plan 1994-2003 (CALM 1994); included in Gnangara Park proposal (Bailey 1997)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Part Bushplan Site listed on the Register of the National Estate

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities, Rarity, Maintaining ecological processes or natural systems, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation

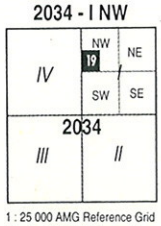
Opportunities and/or Constraints

Opportunities: Bushplan Site/part Bushplan Site subject to Gnangara Mound Crown Land EPP; location of conservation category wetlands; under TPS Landscape Zoning, Planning Control Area No. 29, Crown Reserve

Recommendation: The existing purpose, care, control and management of CALM managed lands (Reserve 42450 and State Forest 65) is endorsed. The most appropriate mechanism for the protection of the remainder of this Bushplan Site be considered through the public comment period in consultation with the land owner(s). This may include — in parts, the existing care, control and management intent of the reserve is endorsed. Long-term security and support for conservation management of the Bushplan Site to be enhanced by amending the purpose of the reserve to include conservation, and applying appropriate mechanisms in consultation with the reserve management body; For those parts that are Vacant Crown Land, the Bushplan Site be reserved for Parks and Recreation in the Metropolitan Region Scheme and be purchased for National Park, Conservation Park, Nature Reserve or Regional Park.

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



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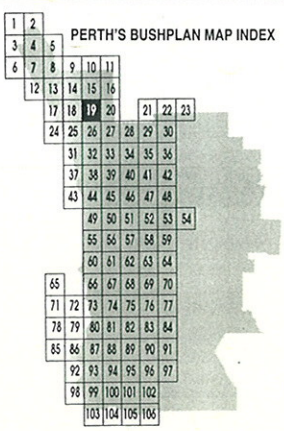

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Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw-map7//environ/bushplan//bushv2_19.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

LEGEND

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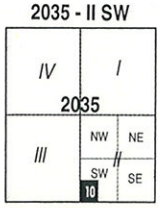

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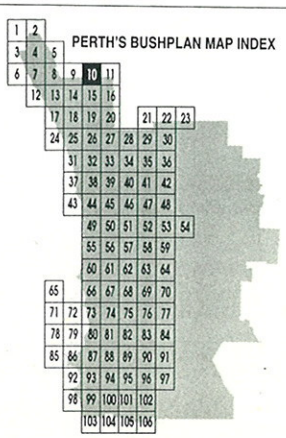
PERTH'S BUSHPLAN MAP INDEX



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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

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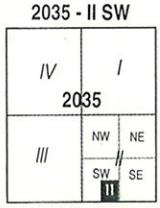

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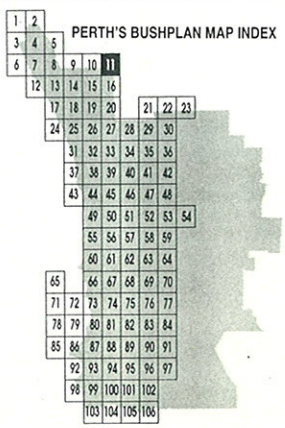

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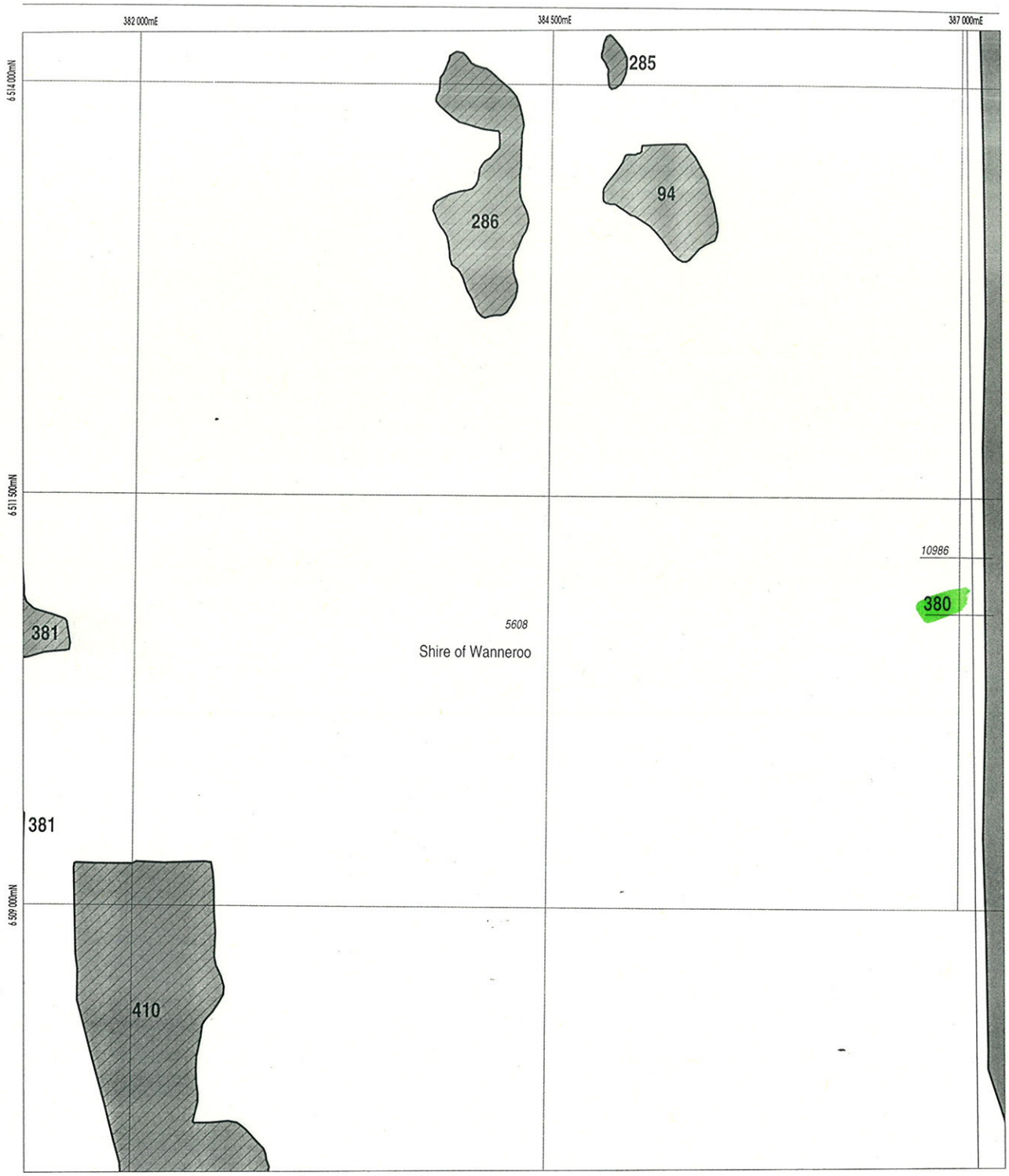

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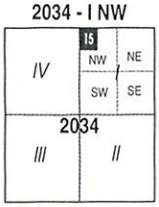

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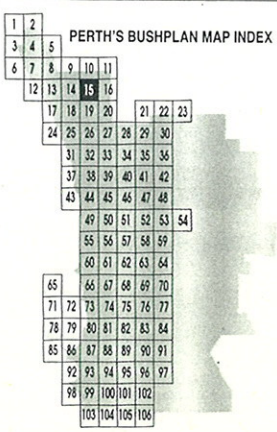

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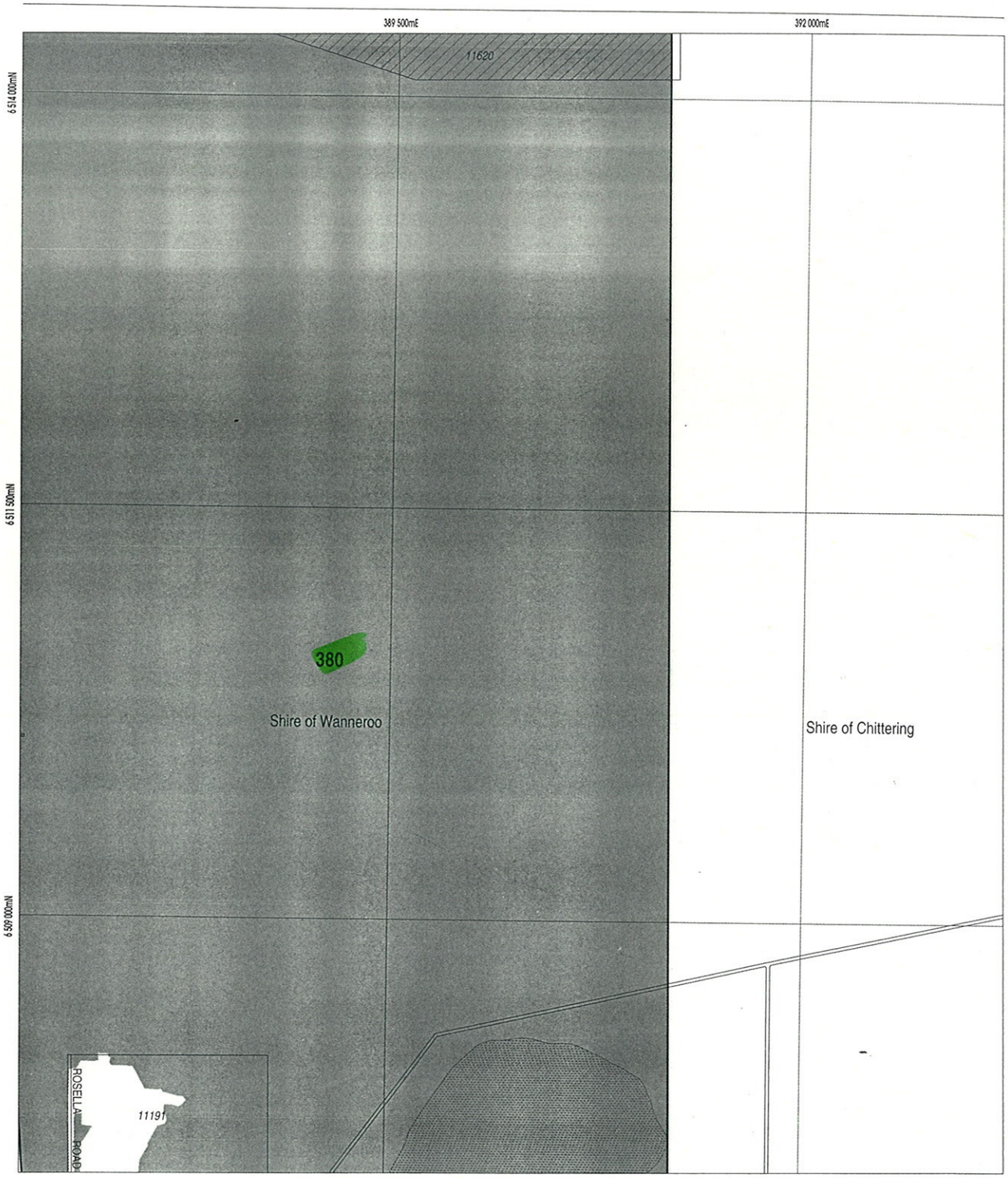
Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map



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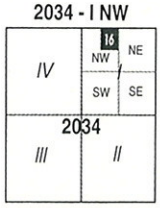

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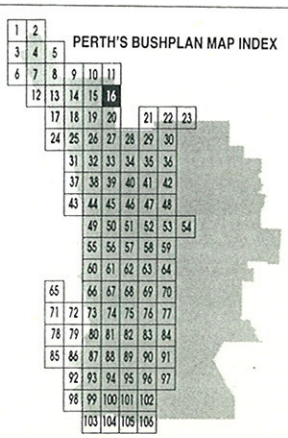

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Wetlands Data supplied by Water and Rivers Commission

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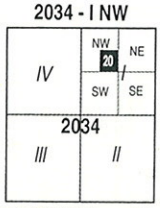

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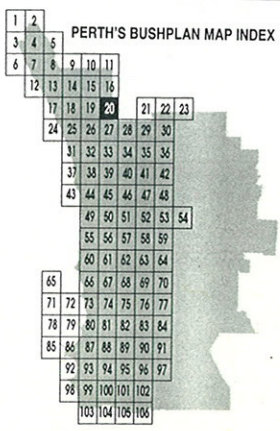

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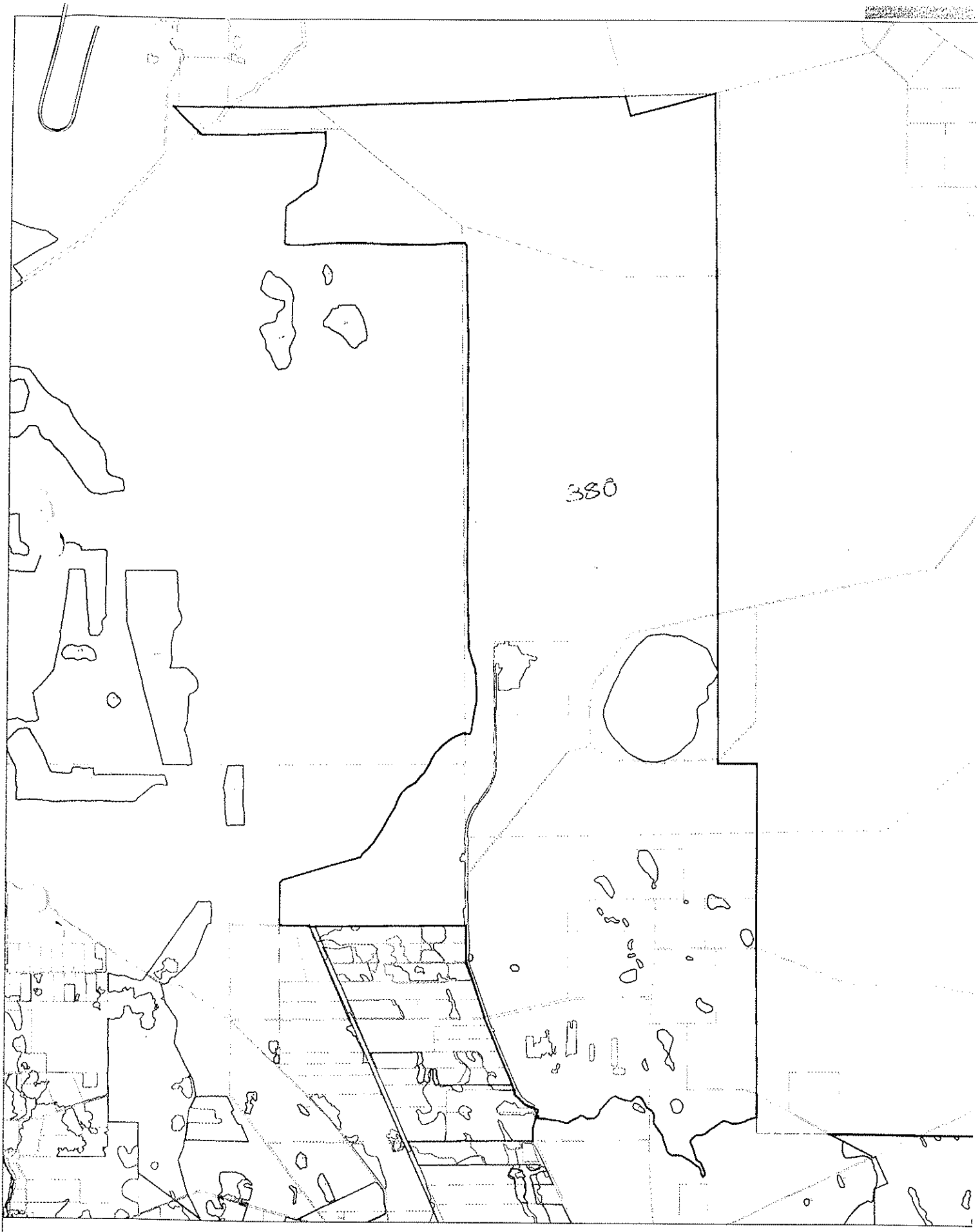

BUSHPLAN SITES CORRECTED

B 21/10/98

THE GOVERNMENT OF WESTERN AUSTRALIA

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS WESTERN AUSTRALIA

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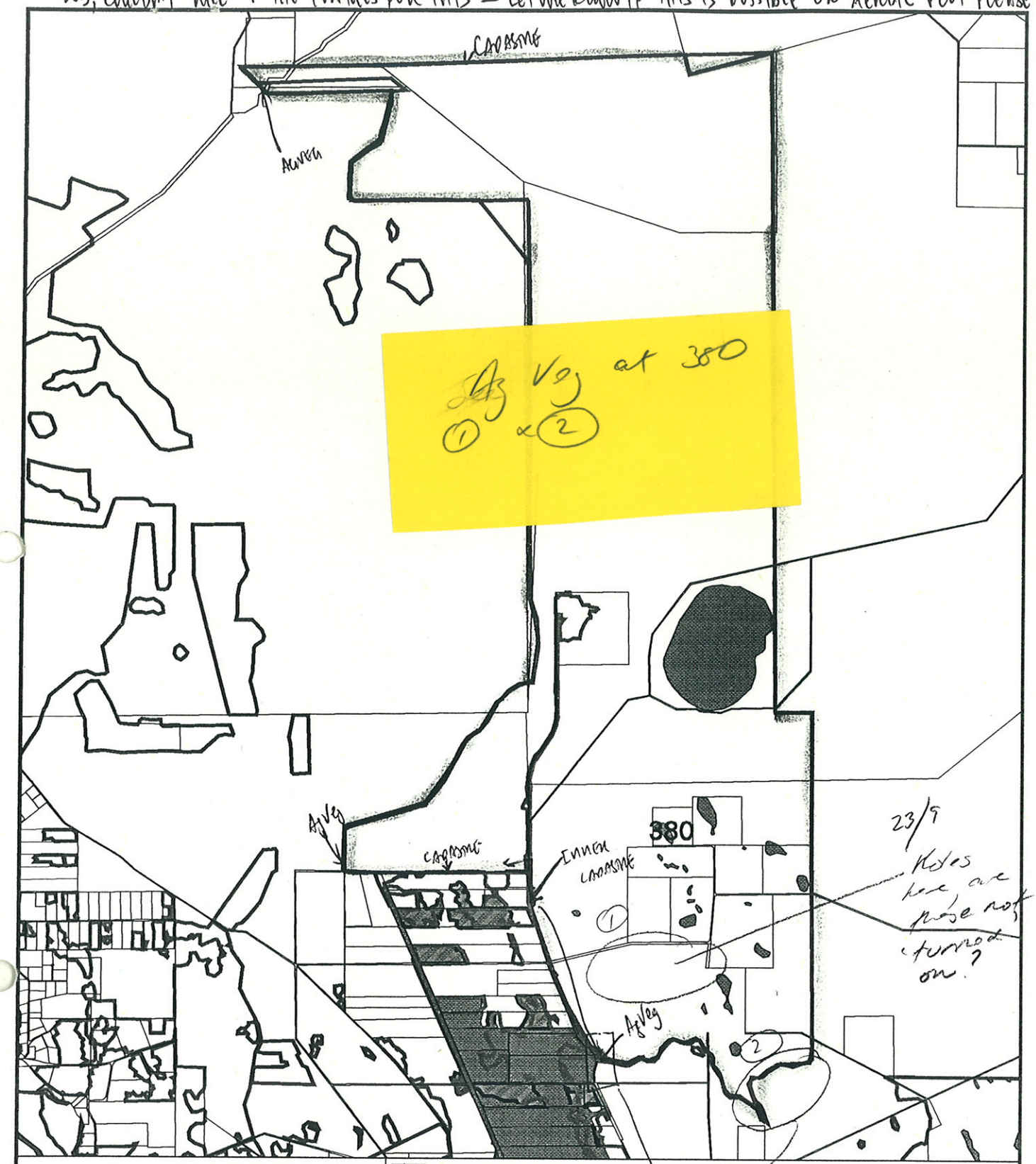
DEB, COULDN'T PULL UP THE IMAGES FOR THIS — LET ME KNOW IF THIS IS POSSIBLE OR AERIAL PLOT PLEASE



bp site 380

MFP INTERNAL USE ONLY	
Prepared By: Andrea Zappacosta	
Prepared For:	
Map Ident: plot980603_1	
Date: 03 Jun 98	
Scale 1:88422	

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

Looks like veg over not mapped

NEED boundary over veg photo

FOLLOW CADASTRE FOR TRIANGULAR SECTION ie THEN AGVEG TO EAST.

DEB, PLEASE SEE ME IF YOU HAVE PROBLEMS HERE

Bass N Subm 286 BS 380

We nominate the following areas for consideration in the System 6 Update. These areas include significant bushland and landscapes which warrant inclusion in a regional conservation network. The areas, shown on the attached maps, are noted below.

(a) • Moore River estuary and land to the south including Wilbinga and Caraban MPA. This covers vegetation and landforms of the Quindalup and Spearwood dunes and could be a large coastal conservation reserve forming a greenbelt north of the metropolitan region. It should link with Wabling MPA and Yeal Nature Reserve to form an east-west greenbelt across a number of soil and vegetation types on the coastal plain.

(b) • Bombing Range wetlands and Banksia woodlands north east of Pinjar, which includes RAAF Pearce Air Weapons Range and State Forest. Large, intact area of Banksia woodlands on Bassendean dunes with perched Paperbark damplands. Could form part of a major reserve network linking Yeal Nature Reserve and Melaleuca Park; the proposed Gnangara biological corridor. Situated on recharge area of the Gnangara groundwater mound.

✓(c) • Coastal bushland south of Yanchep townsite, in Yanchep/Eglinton. Quindalup dune vegetation that could link the coastal reserve and Yanchep National Park. An east-west belt of open space has been proposed in this area.

(d) • Limestone heathlands and Tuart-Banksia woodlands near Bernard Road, Carabooda. Cottesloe central and south complex vegetation in excellent to very good condition. Situated near Coogee Spring. Part of potential link between Yanchep National Park, western chain wetlands and Neerabup National Park. Historically important cave.

✓(e) • Remnant bushland between Yanchep and Neerabup National Parks; west of Wanneroo Road, north of Romeo Road. Includes Tuart, Jarrah and Banksia woodlands and limestone heathlands in excellent to very good condition. Forms a link between these conservation reserves. Limestone ridge is landscape feature.

✓(f) • Bushland between Wesco Road and Wattle Avenue including Shire View Hill. Diverse limestone heathlands including rare and uncommon mallee eucalypts (Yanchep Mallee, Rock Mallee and Fremantle Mallee), Limestone Marlock woodlands and merges to Marri-Banksia woodland. Number of vegetation types in very good condition. Carpet python seen near Shire View Hill, suggesting fauna habitat value. Includes high limestone ridges, important landscape feature.

(g) • Lake Neerabup and adjacent bushland. Linear sumpland including sedgelands; limestone ridge along eastern edge with Tuart and Cheesewood. Large, intact area of bushland to east including limestone heathlands and Tuart and Marri woodlands. Karst features include Orchestra Shell Cave; important Aboriginal heritage site. Adjacent Neerabup National Park and connects with Shire View Hill bushland.

✓(h) • Flynn Drive bushland, Neerabup. Large, intact remnant of Karrakatta central and south complex vegetation. Includes Banksia woodlands in pristine-excellent condition. Occurs between Neerabup National Park and eastern wetland chain and State Forest.

✓(i) • Coastal bushland north of Quinns Rocks. Vegetation in excellent to very good condition, associated with series of parabolic Quindalup dunes. Parrotbush heathland and Banksia woodlands on Cottesloe soils in swales. Recognised in North West Corridor environmental audit.

✓(j) • Coastal bushland between Burns Beach and Mindarie Keys. Significant Quindalup dune landforms and vegetation, includes cuspate foreland, parabolic dune and sandsheets. Addition of land north and south would consolidate existing System 6 area and add to vegetation types represented. Part of link between coast and Neerabup National Park. Recognised in several studies as an important area.

✓(k) • Jarrah-Banksia woodland north of Wanneroo Road works depot. Bushland in fair to good condition, with adjoining land west of Wanneroo Road it covers a transect of remnant vegetation from Lake Joondalup inland. Includes mature trees with hollows for birds, adds to bushland habitat in Yellagonga Regional Park.

19
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EPA

M9

Proposed Power Supply: Expansion of Pinjar Turbine Power Station

State Energy Commission of Western Australia

Report and Recommendations of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 501 March 1991

PB179/1

energy solutions

erm power

NewGenPower

330 MW GAS-FIRED POWER STATION NEERABUP

PROJECT REFERRAL

August 2007

To file: BFS 380 (PB179 Bio1)

with note: also refers to BFS 382 (PB 181 Bio1)

Document title	330 MW Gas-Fired Power Station Neerabup Project Referral
Reference	NPN-08127 Rev 2.0
Submitted to	WA Environmental Protection Authority
Proponent	NewGen Neerabup Pty Ltd Level 4 St George's Square 225 St George's Terrace Perth WA 6000

Contact Person

Mr Tony Petersen
Environment Manager
NewGen Power and ERM Power
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225 St George's Terrace
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INTRODUCTION

Overview

NewGen Power has identified a need for additional power generating capacity in the south west region and proposes to develop a 330 MW Gas-Fired Power Station to supply additional power into the South West Interconnected System (SWIS). The Project consists of a 330 MW power station in the Neerabup Industrial Estate in the City of Wanneroo; a 30km gas pipeline with a compressor station and a 2km 330 kV transmission line to Western Power's Neerabup terminal substation (Figures 1.1 and 1.2).

The power station consists of two 165 MW open cycle gas turbines (OCGT) units and will function as a peaking plant to provide additional capacity to the SWIS during periods of high demand.

Purpose of the Document

The purpose of this document is to assess the key potential environmental impacts associated with the project and propose management measures to mitigate or avoid them.

The environmental assessment of the project is discussed in Section 4 of this document.

1.3 Proponent Information

1.3.1 Proponent

NewGen Neerabup Pty Ltd (NewGen Power) is the proponent and is a wholly owned subsidiary of ERM Power. ERM Power has successfully managed the feasibility and development approval of a number of power station projects in Australia including; the Oakey Gas-fired Power Station (300 MW) and the Braemar Gas-fired Power Station (900 MW) in south-east Queensland, and the Uranquinty Gas-fired Power Station (600 MW) in New South Wales.

The Oakey plant has been operating since 2000 and the Braemar plant since 2006. The Uranquinty plant is currently under construction.

In Western Australia, ERM Power successfully developed the 320 MW Kwinana Gas-fired Power Station which is a combined cycle, gas-fired, base load power station that is currently under construction and will be operated by NewGen Power Kwinana.

1.3.2 Proposal Title

The title of this proposal is "330 MW Gas-Fired Power Station Neerabup".

1.3.3 Proponent Details

The proponent for the proposal is:

NewGen Neerabup Pty Ltd
Level 4 St Georges Square
225 St Georges Terrace
PERTH WA 6000

The key contact for this proposal is:

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Environment Manager
NewGen Power and ERM Power
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1.4 Environmental Assessment

1.4.1 Environmental Assessment Process

This document has been prepared as an environmental referral to the Environmental Protection Authority for the proposed 330MW Gas-fired Power Station at Neerabup.

Previously, NewGen Power has referred a proposal with a 660MW power station, a 330 kV transmission line and an alternative gas pipeline route. That proposal is currently undergoing assessment by the EPA at the level of Public Environmental Review.

This new proposal is significantly smaller in scope with a 330MW power station and a pipeline route that avoids or minimises impact on Bush Forever sites.

It is understood that the EPA will publish its advice on only one of these proposals.

1.4.2 Stakeholder Engagement

NewGen Power is committed to active stakeholder engagement in the development of its 330 MW Gas-fired Power Station. Formal meetings with stakeholders to discuss details of the Project have been ongoing since September 2006. This has involved providing sufficient information on the project to allow stakeholders to make informed decisions about, or arising from, the Project. NewGen Power is committed to responding to stakeholder concerns and suggestions.

Details of the stakeholder engagement process including how NewGen Power has responded to issues and suggestions raised are provided in Section 6.

1.4.3 Studies

Studies have been carried out to describe the important environmental factors for this proposal including noise, air quality, flora and fauna. A description of the work and results from these studies is presented in Section 4 of this document.

1.4.4 Relevant Legislation and Other Approvals

In addition to needing approval from the Minister for the Environment, the proposal will have to comply with a range of other legislative requirements including, but not limited to, the following:

- Works Approval is required for the construction of the project as it qualifies as a "prescribed premise" under Schedule 1 of the *Environmental Protection Regulations 1987*. The works approval is issued by the Department of Environment and Conservation (DEC).
- Licence to operate the facility, following construction, is required under the *Environmental Protection Act 1986*. The licence is issued by the DEC.

DO NOT SCALE

NEWGEN GAS PIPELINE

MUCHEA

PERRY ROAD

SHIRE OF CHITTERING

PARMELIA PIPELINE

DBNGP

CITY OF WANNEROO

OLD YANCHEP ROAD

CITY OF SWAN

NEWGEN POWER STATION SITE

WESTERN POWER NEERABUP TERMINAL

NEAVES ROAD

NEERABUP INDUSTRIAL ESTATE

PINJAR ROAD

N

Legend

- Proposed Gas Pipeline
- Existing Pipelines
- Shire Boundaries
- Neerabup Industrial Estate
- Western Power Neerabup Terminal
- NewGen Power Station
- Bush Forever / Parks and Recreation
- Priority 1 Water Reservation
- Transmission Line
- Compressor Station

No.	Date	REVISION	Drawn	Surv	Appd
K	16/08/07	POWER STATION SITE UPDATED	RH		
J	27/07/07	REV 12 ONC OPTION	CB		
I	17/07/07	REV 10 ONC OPTION	CB		
H	05/07/07	REV 9 ONC OPTION	RH		
G	25/06/07	REV 8 ONC OPTION, COMPRESSOR STATION REVISED	RH		
F	18/06/07	REV 7 ONC OPTION	C.B		
E	30/05/07	REV 6 ONC OPTION	C.B		
D	23/05/07	PINJAR OPTION REMOVED, REV 4 ONC, EPP WETLANDS REMOVED, TRANSMISSION LINE ADDED	C.B		

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NEWGEN POWER

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Metres

SCALE 1: 75 000

DRAWN	C.B.	15/12/06
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CHECKED		
APPROVED		

NewGen Power 330 MW Gas-fired Power Station

Figure 1.1
NewGen Power 330 MW Gas-fired Power Station
Overview Plan

DATUM GDA 94 ZONE 50

DRAWING NUMBER **07197-001**

REV K SIZE A3

LMK:

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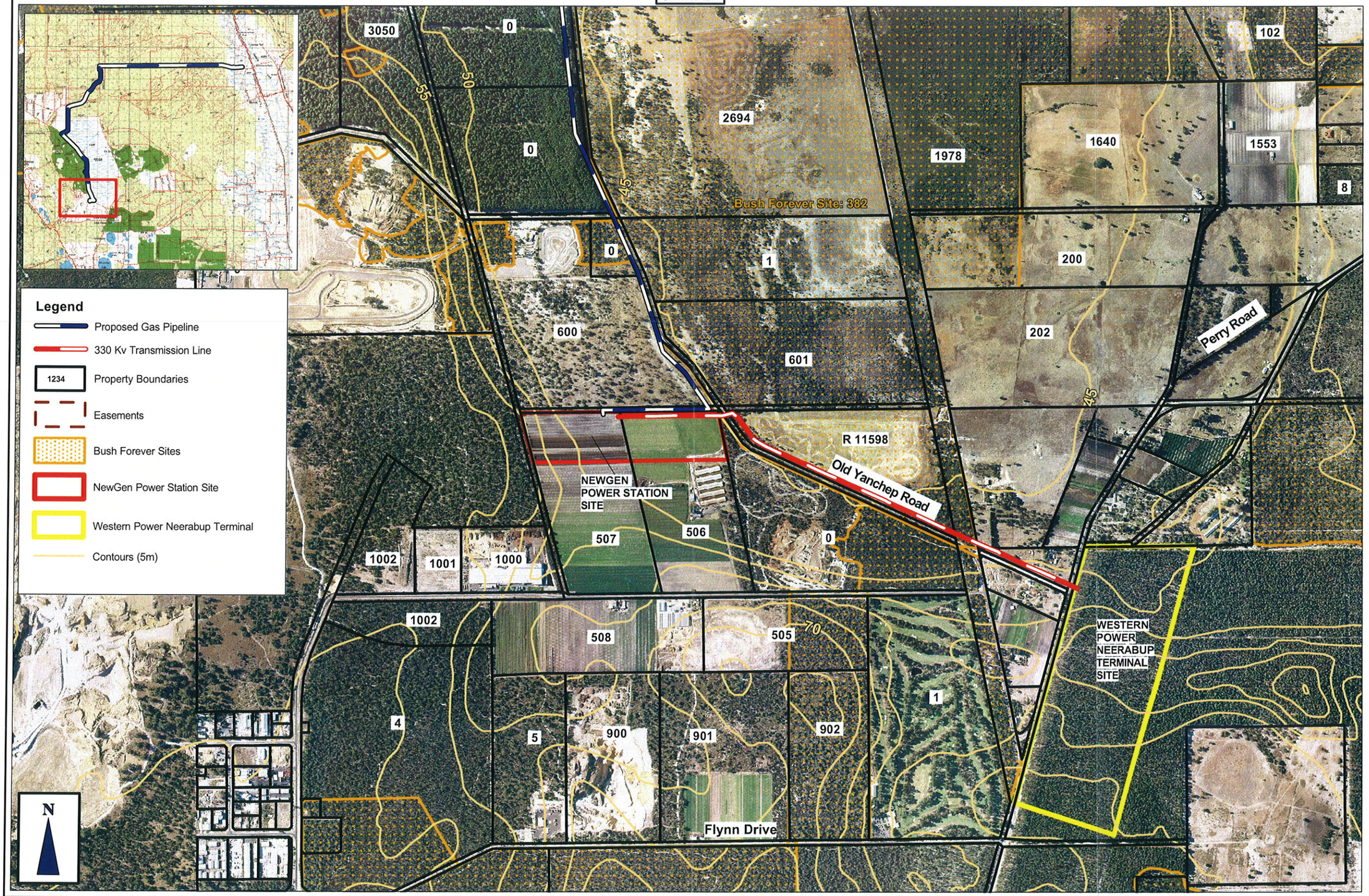

No	Date	REVISION	Drawn	Surv	Appd
C	19/06/07	Power Station Site Updated	RH		
B	12/02/07	Rev 10 ONC Option	CB		
A	18/06/07	ISSUED FOR CLIENT APPROVAL	CB		

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NewGen Power 330 MW Gas-fired Power Station

FIGURE 1.2

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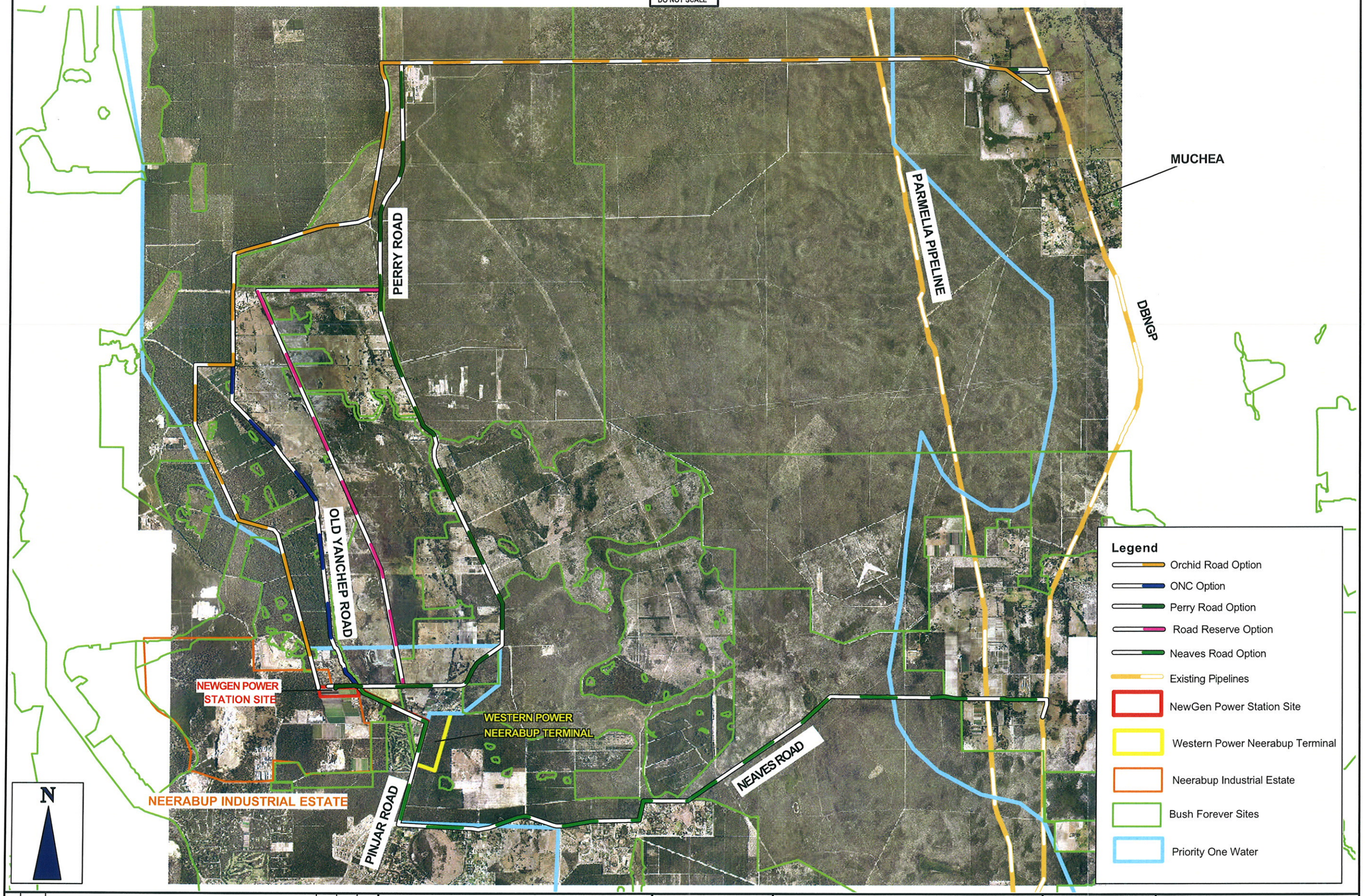

No.	Date	REVISION	Drawn	Surv	App'd
C	16/08/07	Updated Power Station Site	RH		
B	27/07/07	Addition of Bush Forever Sites and P1 Water	C.B		
A	17/07/07	ISSUED FOR CLIENT APPROVAL	C.B		

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APPROVED		

NewGen Power 330 MW Gas-fired Power Station

Figure 2.1
Gas Pipeline Route Options

DATUM GDA 94 ZONE 50 | DRAWING NUMBER 07197-042 | REV C | SIZE A3 | LMK:

- Pipeline licence for the gas lateral pipeline is required under the *Petroleum Pipeline Act 1969.* The licence is issued by the Department of Industry and Resources (DoIR).
- Transfer of water licence entitlement is required under the *Rights in Water and Irrigation Act 1914*. The licence is issued by the Department of Water (DoW).
- Planning approval for the project is required under the *Town Planning and Development Act 1928* and is administered by the City of Wanneroo (CoW).
- Compliance with the *Aboriginal Heritage Act 1972*.

1.5 Project Schedule

Construction for the project is scheduled to begin in Q4 2007 with commercial operations commencing in Q4 2009.

1.6 Life of the Project

The expected life of the project is approximately 30 years. At the end of this time, a decommissioning assessment will be undertaken, including a needs analysis to consider retaining the operation. At least one year prior to decommissioning, a Decommissioning Management Plan will be prepared.

PROJECT JUSTIFICATION AND EVALUATION OF ALTERNATIVES

2.1 Need for Proposed 330 MW Gas-Fired Power Station

The existing South-West Interconnected System (SWIS) supplies electricity to a large area from Perth in the west to Kalgoorlie in the east and from Kalbarri in the north to Albany in the south. This system incorporates transmission lines from a range of power stations and distribution lines to homes and businesses.

The population of south-west of WA has been growing rapidly in recent times. This growth together with a higher standard of living has resulted in an increasing demand for electricity that requires an increase in generating capacity, particularly at times of peak electricity use in the morning and evening.

With the increasing demand for electricity in the south-west of WA, particularly at peak times, NewGen Power has identified the need for additional power generating capacity. The advent of the Wholesale Electricity Market, which began operating in September 2006, allows independent operators to provide electricity generating capacity in accordance with processes set down by the Independent Market Operator.

NewGen Power's 330 MW Gas-Fired Power Station will provide some of the needed generating capacity for the SWIS during periods of high demand. It will also reinforce the electricity transmission and distribution network in the rapidly growing northern metropolitan region. This will also assist the development of the Neerabup Industrial Estate within which the power station will be located.

2.2 Evaluation of Alternatives

2.2.1 Energy Sources

Energy for power generation can be provided by renewable energy sources such as wind, biomass or solar or from other conventional sources such as coal based power stations or combined cycle gas turbines. The additional generation required into the SWIS is for periods of high demand and short duration. The energy source must therefore be able to respond rapidly to demand requirements and provide a capital return on a low capacity factor or time spent in operation.

Renewable sources such as wind or solar would not be suitable for this Project. The intermittent nature of their availability would not always be matched with the demand requirements and large scale storage technology is not commercially available.

Open cycle gas turbines (OCGT) are ideally suited for high demand situations of short duration as they have very fast start up times, typically less than fifteen minutes from start to

full load compared to 24 hours for coal-fired units. OCGT power stations also require minimal supporting infrastructure which results in a small footprint area and a lower capital cost. Combined cycle gas turbine (CCGT) power stations consist of a gas turbine coupled to a heat recovery steam generator driving a steam turbine. They provide better thermal efficiencies than OCGT stations but are more capital intensive and have longer start-up and shut down times. CCGT stations are more suited to intermediate and base-load operations.

It was therefore apparent that an OCGT configuration was the optimal choice for the Project based on consideration of factors such as demand requirements, fuel supply, capacity factor and capital costs.

2.2.2 Power Station Location

Alternative locations were considered for the site of the gas-fired power station.

The Kwinana Industrial Area was investigated for potential sites however Western Power advised that there was no spare capacity in the network in that area for a new power station of this capacity to connect.

Currently, most of Perth's power supply is generated from power stations south of the city. A new power station on the northern edges of the metropolitan area would therefore avoid network constraints and provide more immediate supply to the growing load in the northern suburbs of Perth.

Other constraints considered for the location of the power station included:

- Distance from sensitive receptors such as residences;
- Clearing of native vegetation; and
- Compatible land uses.

Sites close to Western Power's Northern Terminal at Malaga and at Verve's Pinjar power station were also considered. There was no available land near the Northern Terminal. The Pinjar site was considered too environmentally sensitive to locate a new power station, as it is located within the Gnangara Underground Water Pollution Control Area (Gnangara UWPCA) which has a priority 1 source protection classification and is nearly surrounded by undisturbed *Bush Forever* Site vegetation.

Western Power was in advanced planning for its new Neerabup terminal substation within the Gnangara pine plantation (Figure 1.1) and advised that locating the power station close to the terminal but at least one kilometre away would be supported. The terminal substation is a major interconnection point in the transmission network and is currently under construction. Electricity generated by the power station needs to be sent to the terminal for connection to the SWIS.

Being in close proximity to the substation will minimize the length of the high voltage (330 kV) transmission line that will transport electricity from the power station to the substation. A short line length is advantageous as the 330 kV transmission line structures are often regarded as being visually intrusive and also require a wide easement that restricts other uses. Proximity

to the substation will also reduce energy losses from the transmission line during transport of the electricity to the substation.

The Neerabup Industrial Estate provided an excellent location for the power station, as the land was near the Neerabup Terminal, zoned industrial and was not a Priority One Water Reservation area. Detailed discussions were held with relevant Government stakeholders including LandCorp, City of Wanneroo and the Department of Industry and Resources to locate a suitable site for the power station development complying with planning requirements and taking into accounting future urban growth.

The site selected for the location of the power station is a cleared area of former market garden that is within the Neerabup Industrial Estate and approximately 2 km's from the Western Power terminal substation. The industrial estate provides a buffer to sensitive receptors especially to the south and the industrial land use zoning is compatible with electrical power generation purposes.

2.2.3 Gas Pipeline Alignment

Natural gas is to be used as the source of fuel for the gas turbines at the power station. The source of the gas supply is the Dampier to Bunbury Natural Gas Pipeline (DBNGP) which runs from the north-west shelf gas production facilities through the metropolitan area to the south-west.

The selection of the route for the gas pipeline from the DBNGP to the power station took into account a wide range of constraints including:

- Environmental impacts such as clearing of native vegetation, impact on wetlands and impact on fauna;
- Land tenure and use; and
- Constructability of the pipeline.

Five alternative alignments were examined during the route selection process (Figure 2.1):

- Neaves Road option, which connected to the DBNGP near Bullsbrook and runs along Neaves Road then along Pinjar Road to the power station site. This option was rejected owing to the extensive clearing of native vegetation required, presence of threatened ecological communities, narrow road reserve widths and proximity to urban development.
- Perry Road option, which utilised the existing DBNGP infrastructure corridor (pipeline and powerline easement) from north of Muchea to the Verve Energy Power Station and containing the Pinjar gas lateral pipeline as well as several transmission lines. After the Pinjar power station the route heads south along Perry Road and across to the NewGen power station site. The potential impact of this option on Lake Pinjar, a conservation category wetland, was considered too high.
- Road Reserve option, which utilises the same alignment as the Perry Road option from north of Muchea to the Pinjar Power Station then runs along Perry Road and to a road reserve down the length of Lake Pinjar and then across to the NewGen power station

site. The potential impact of this option on Lake Pinjar, a conservation category wetland, was considered too high.

- ONC option, utilises the same alignment as the Perry Road option from north of Muchea to just west of the Pinjar power station, then traverses bushland along Water Road until it intersects with Cypress Road which it follows to Nisa Road. It then crosses into pine plantation and follows Nisa Road to Old Yanchep Road and then adjacent to Old Yanchep Road to the power station site. The potential impact of this option on *Bush Forever* sites was considered too high. This route also constrained future road planning options for Old Yanchep Road.
- Orchid Road option, utilises the same alignment as the Perry Road option from north of Muchea to just west of the Pinjar power station, then traverses bushland along Water Road until it intersects with Cypress Road which it follows to Tavira Road. It then crosses Old Yanchep Road and runs adjacent to a 50m corridor cleared in the pine plantation by Western Power in June 2007 for a 132kV transmission line. The route travels along Lisbon Road, Westco Road and Orchid Road to the power station site. Whilst the Western Power route has been cleared the pipeline would require its own clearing adjacent to this. The potential impact of this option on *Bush Forever* sites was considered too high and the route also placed constraints on future land use.

The route selected is known as the Old Yanchep Road option and is shown at Figure 1.1. The route utilises the same alignment as the Perry Road option from Muchea to just west of the Pinjar power station. It then crosses into the pine plantation and traverses through the pines adjacent to Cypress and Nisa Roads avoiding *Bush Forever* site 425 to cross and then parallel Old Yanchep still within the pine plantation. The route then crosses Old Yanchep Road heading east to skirt around *Bush Forever* site 293 and the conservation category wetland before crossing Old Yanchep Road once again into the pines and parallel to the road. It then avoids *Bush Forever* site 451 and continues in the pines adjacent to Old Yanchep Road to the power station site. This route is the preferred alignment as it minimises environmental impacts by using areas that are already cleared or disturbed or are under pine plantation, avoids three *Bush Forever* sites and conservation category wetlands and utilizes existing similar use easements.

2.2.4 Transmission Line Route

A 330 kV transmission line will be constructed to connect the power station to the Western Power Neerabup terminal substation. The preferred route for the transmission line to minimise visual and environmental impact and line length is adjacent to Old Yanchep Road and then Spence Road to the substation (Figure 1.2). Alternative routes such as being located within the Pederick Road reserve or Old Yanchep Road reserve were rejected due to road planning constraints and visual amenity impact. Traversing the area to the south of Old Yanchep Road was rejected as the vegetation in this Bush Forever site is relatively undisturbed when compared to the old rubbish tip site on the northern side of the road that forms part of the selected route.

2.2.5 No Development Option

If NewGen Power are unable to develop the 330 MW Gas-Fired Power Station the expansion of the electricity generating capacity in the SWIS could be compromised, particularly in the short term, leading to uncertainty of supply for electricity users in the South West of WA.

PROJECT DESCRIPTION

3.1 Location

3.1.1 Locality Details

The site for the OCGT power station is Lots 506 and 507 Pederick Road Neerabup (Figures 1.1 and 1.2) within the developing Neerabup Industrial Estate which is approximately 30 km north of Perth and approximately 10 km north of the Wanneroo town site.

The route of the 30km gas pipeline from the DBNGP to the power station site is shown on Figure 1.1.

The route for the 330kV transmission line connecting the power station to the Western Power Neerabup terminal substation is shown on Figures 1.1 and 1.2.

3.1.2 Land Tenure

The site for the power station will be held in freehold by NewGen Power. Access to the site will generally be from Old Yanchep Road. The site for the power station is within the Neerabup Industrial Estate which is zoned industrial in the Metropolitan Region Scheme.

The gas pipeline and transmission line will be covered by easements.

3.1.3 Surrounding Land Use

The Neerabup Industrial Estate is in the process of being developed for general industry. The Wesbeam Laminated Veneer Lumber factory is currently the nearest neighbour to the west. Other surrounding properties are market gardens and poultry sheds operated by Trandos Farms whilst to the north is cleared land that has been identified as a future addition to the Estate.

The route for the gas pipeline from the DBNGP to the power station covers a distance of approximately 30 km. The land use over the majority of this route is State Forest covered by native vegetation for that portion of the route to the east of Rosella Road and State Forest covered by pine plantations for the majority of the remainder of the route (Figure 1.1).

The majority of the pipeline route falls within the Gnangara Underground Water Pollution Control Area (Gnangara UWPCA) as priority 1 source protection classification (Figure 1.1).

The route for the 330 kV transmission line is approximately 2 km in length. The route runs adjacent to Old Yanchep Road. The land either side of the road is zoned for Parks and Recreation and then runs along the north side of Spence Road, which is surrounded by rural land. The land immediately to the north of Old Yanchep Road is the Lake Pinjar wetland, part of which is conservation category.

3.2 Description of Proposal

The NewGen 330 MW Gas-Fired Power Station consists of:

- An OCGT power station of nominal 330 MW capacity;
- A 30 km natural gas pipeline; and
- A 2 km 330 kV transmission.

A summary of the key proposal characteristics for the project are provided in Table 3.1.

3.2.1 Power Station

The power station comprises two 165 MW open cycle gas turbines (OCGT).

OCGT power stations consist of gas turbines directly coupled to electricity alternators. The alternators are linked to power transformers that convert the electrical voltage to the appropriate voltage for the transmission system.

Gas turbines can use a variety of fuels including natural gas, diesel, methanol and kerosene. NewGen Power's 330 MW OCGT Gas-Fired Power Station will only use natural gas as the fuel source. Diesel will not be used for generation. There are no facilities being constructed for the storage or use of diesel fuel on site. This is a significant and positive difference to every other major peaking power station in WA.

Power generation using natural gas has far lower atmospheric emissions than coal based power plants including less greenhouse gases, oxides of nitrogen and sulphur dioxide. Another advantage of gas-fired power stations is that the low emission natural gas fuel source can be piped directly to the site so that the power station can be located close to the centre of demand such as the metropolitan area. Thus, less energy is lost in the transmission of electricity than if the power station was located at the source of the fuel, as coal-fired power stations are.

OCGT units have a relatively fast start-up time typically less than fifteen minutes from start-up to full load compared to 24 hours for coal-fired units. Thus, OCGT units are ideal for operations to meet peak and high shoulder load demands.

Table 3.1 Key Proposal Characteristics

Element	Details
Project purpose	To construct, operate and maintain a 330 MW power station and associated infrastructure
Project life	30 years
Power generating capacity	330 MW (nominal)
Power station footprint	Site is 10 ha of cleared farming land of which approximately 4 ha used for infrastructure.
Pipeline footprint	Construction corridor 30m wide over 30km length. Approximately 30 ha of native vegetation to be cleared and rehabilitated after construction.
Transmission line footprint	Approximately 400 m^2 of native vegetation for construction of each of seven single-column power pole bases.
Fuel:	
Type	Natural gas
Source	North West Shelf
Method of transport	Dampier to Bunbury Natural Gas Pipeline and lateral to power station site
Major plant components	2x165 MW open cycle gas turbines fitted with low NOx burners
Plant operation	Intermittent operation to suit demand - peak and shoulder periods
Gas pipeline	A dedicated lateral from the Dampier to Bunbury Natural Gas Pipeline of approximately 30km
Transmission line	330 kV line to Western Power Neerabup terminal substation – approximately 2 km
Inputs:	
Natural gas	Approximately 11 PJ per year
Process water	Approximately 15 ML per year from on-site bore
Outputs:	
Waste water	No discharge of waste water
Oxides of nitrogen	<25 ppm @ 15% O_2
Carbon dioxide	Approximately 0.7 Mt CO_{2e} per annum
Carbon monoxide	<10 ppm @ 15% O_2
Noise	Comply with *Environmental Protection (Noise) Regulations 1997* <30 dB(A) at nearest residential property <65 dB(A) at nearest industrial property

Abbreviations

CO_{2e} carbon dioxide equivalent
dB(A) decibels (A weighted)
GL gigalitres (10^9 litres)
L litres
m metres
mg milligrams (10^{-3} grams)
ML megalitres
Mt megatonnes (10^6 tonnes)
MW megawatts (10^6 watts)
NOx oxides of nitrogen
PJ petajoules (10^{15} joules)
ppm parts per million
ppmv parts per million by volume
SWIS – South West Interconnected System
TJ terajoules (10^{12} joules)

OCGT power stations require minimal supporting infrastructure which result in smaller footprint areas than many other power generation plants. The total footprint for the 330 MW Gas-Fired Power Station will be approximately 4 hectares.

An artist's impression of the layout of the power station is shown in Figure 3.1.

Figure 3.1 Artist Impression of NewGen Power 330 MW Gas-Fired Power Station

3.2.2 Natural Gas Pipeline

A 30 km pipeline to transport the natural gas from the DBNGP to the power station will be constructed. The pipeline will be designed, constructed and operated to the requirements of Australian Standard *AS 2885 Pipelines – Gas and Liquid Petroleum* and in accordance with a pipeline licence issued under the *Petroleum Pipelines Act 1969*.

The steel pipeline will be 660 mm in diameter and buried to a depth between 900mm and 1200 mm as required by AS2885.1. The pipeline construction corridor will generally be required for safety reasons to be 30 m wide over the length of the pipeline alignment.

The pipeline will have an off-take from the DBNGP at a metering station adjacent to the DBNGP. A compressor station will be built to provide the required pressure in the pipeline. The compressor station will also need to be constructed adjacent to the DBNGP (Figure 1.1).

Typical construction activities for the pipeline are outlined in Table 3.2 and a diagram of the typical working corridor is illustrated at Figure 3.2.

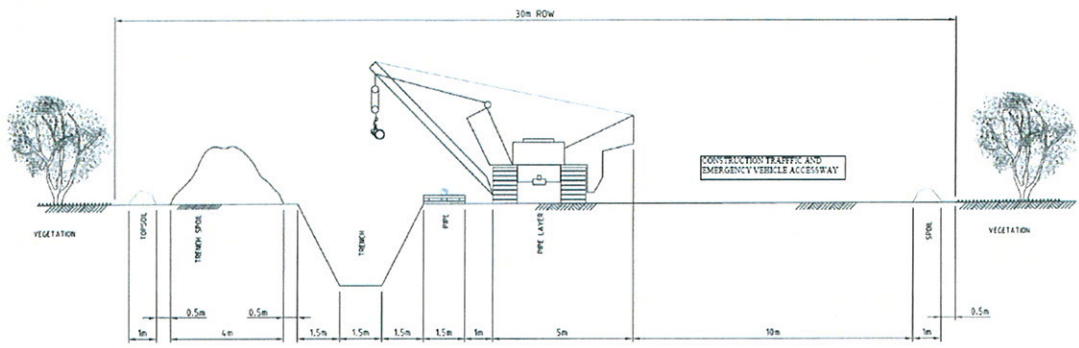


Figure 3.2 Typical Gas Pipeline Construction Layout in the Right of Way

The route for the pipeline is shown on Figures 8.1 to 8.7 and comprises:

- Commencing in private farmland north of Muchea and adjacent to the DBNGP and then travelling wholly within the existing shared services corridor and easement (containing the DBNGP Pinjar lateral gas pipeline and three transmission lines) approximately parallel to the existing lateral pipeline to the Pinjar Power Station - about 13 km. A separation of approximately 10m will be maintained between the pipelines. This part of the route is degraded native vegetation owing to past clearing and construction and on-going maintenance of the gas pipeline, three power lines and fire breaks.
- The pipeline will then cross into pine plantation and roughly follow the eastern edge of the plantation near Water Road, Cypress Road and Nisa Road until Tavira Road. This portion of the route parallels forestry roads and firebreaks which will be utilised wherever possible as part of the construction corridor. Clearing of pines will be required along the edge of the plantation on this part of the route. Forest Products Commission have advised that 30m of clearing is required from the pipeline to the nearest standing plantation tree.
- From Tavira Road the pipeline follows a firebreak between a young pine lot and a cleared area whilst heading towards Old Yanchep Road. This deviation avoids Bush Forever Site 425.
- The pipeline will cross under Old Yanchep Road about 300m south of the intersection of Old Yanchep Road and Tavira Road. From here most of the route is parrallel to Old Yanchep Road but the pipeline centreline will be set back 42m from the edge of the existing road reserve as City of Wanneroo have intentions to widen Old Yanchep Road from its existing 20m wide reserve to 52m wide in the direction of the pine plantations. As an isolated narrow row of pine trees is prone to wind throw, around 50m of clearing of pines will be required in the plantation along the sections of Old Yanchep Road.
- The route parallels Old Yanchep Road until it bends about 500m north of Westco Road at the start of Bush Forever Site 293. To avoid disturbance to this site the pipeline crosses Old Yanchep Road to the east and travels south on freehold land until just south of Westco Road when it crosses back across Old Yanchep Road into pine plantations again.
- The route travels south parallel to and set back from Old Yanchep Road for about 400m when a deviation around Bush Forever Site 451 is made before continuing the Old Yanchep Road alignment until reaching Wattle Road.

- The pipeline crosses Wattle Road and travels along the edge of this isolated portion of Bush Forever Site 382 which is managed by the City of Wanneroo as the Wattle Park Conservation Reserve. This edge of the Reserve is a firebreak dominated by the introduced weed Veldt grass. Pipeline construction will clear some shrubs but the opportunity will be taken to use selective herbicide on the aggressive Veldt grass to assist management of the native vegetation in the Reserve.
- The pipeline route continues south next to Old Yanchep Road requiring some clearing of isolated trees over weeds in a block that is likely to be zoned industrial land in the near future. The route then takes a right angle turn into Lots 506 and 507, the power station site.

The construction and burial of the pipeline is a temporary impact and will be carried out in accordance with a pipeline construction environmental management plan.

A draft of the CEMP is provided at Appendix E.

Table 3.2 Pipeline Construction Activities

Activity	Description
Detailed Survey	The pipeline route will be surveyed to mark the centre line of the pipeline.
Clearing	Up to 30 m of the pipeline corridor will be cleared where required. Existing cleared areas such as access roads and firebreaks will be used wherever possible to minimise clearing. Topsoil will be stockpiled separately. In State Forest, pine clearing will be done in accordance with Forest Products Commission requirements.
Trenching	Trenching will be carried out to pre-determined depth in accordance with AS 2885.1 risk assessment process. The pipeline will be buried to a depth of 1200mm in the shared easement. Trench spoil will be stockpiled separately to topsoil. The trench will be left open for the minimum time practicable and will be checked on a daily basis for fauna that may become trapped.
Pipe laying	Lengths of pipe will be laid adjacent to the trench and are welded, the weld is checked by x-ray and coated to prevent corrosion. The welded pipe will then be lowered into the trench.
Backfilling	The trench will be filled with the excavated spoil and compacted to minimise subsidence.
Pressure Testing	The completed pipeline will be subject to hydrostatic testing to check the integrity of the pipe. The on-site bore is likely to be used as the source of water for the testing. This water is of potable quality and is safe to discharge to the environment following testing. It is proposed a dam will be used to contain the water following testing.
Restoration and Rehabilitation	The working area is re-contoured to match the surrounding landform and topsoil is respread together will any stockpiled vegetation. Reseeding of the cleared area will be done using provenance species. In State Forest, rehabilitation will be done in accordance with Forest Product Commission and/or DEC requirements.
Signs	Information signs will be erected in accordance with AS2885.1

3.2.3 Transmission Line

A 330 kV transmission line will be built to connect the power station to the SWIS at the Western Power Neerabup terminal substation, a distance of 2 km.

The transmission line route is shown in Figure 1.2. The line travels from the power station site across Old Yanchep Road into crown land that has native vegetation on the perimeter with the majority of the Lot being a rubbish tip that has been covered with compacted clay and is now a popular motorbike riding location. The whole of the Lot is part of Bush Forever Site 382 and is also a conservation category wetland. Clearing will be minimised. Each of the seven poles will require around 400m^2 of clearing. Trees under the line will be pruned rather than cleared wherever practicable. The line then travels adjacent to Spence Road to Western Power's Neerabup terminal substation.

The transmission line structures will be a combination of lattice towers and steel poles. At the power station and the substation, lattice towers will be used whilst in between, at approximately 200 m spacing, steel poles will reduce the visual impact and footprint of the line. An example of the steel pole structure to be used is shown in Figure 3.3 with the conventional lattice tower structures also shown in the background.

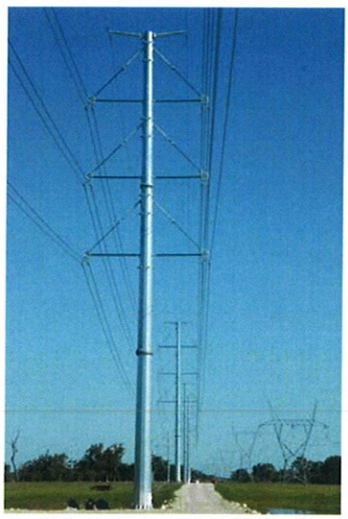


Figure 3.3 Example of Single Column Steel Poles for 330kV Transmission Line

3.2.4 Water Supply

Approximately 15 ML of water will be required for the operation of the power station, mainly for evaporative cooling of intake air. Water will also be required for construction, such as dust suppression, and commissioning. Water will either be obtained from an existing bore on site that is licensed by the Department of Water or from Water Corporation scheme water.

3.2.5 Hours of Operation

The power station will provide electricity in times of peak demand, generally during the morning and early evening.

3.2.6 Workforce

Construction workforce will peak at about 100, however, flow-on effects could create about 170 jobs for the two year construction period. Open cycle gas turbine power stations are modern, automated work places requiring a small but highly skilled operational team. Once commercial operations begin there are expected to be around 6 full-time-equivalent jobs, with additional contract work for maintenance as required.

ENVIRONMENTAL ASSESSMENT

4.1 Relevant Environmental Factors

The significant environmental issues relating to the 330 MW Gas-Fired Power Station, and the environmental factors associated with these issues, were identified utilising EPA guidelines and preliminary stakeholder engagement.

A summary of the potential environmental issues and environmental factors are given below:

- Air quality and greenhouse gas emissions;
- Vegetation flora and fauna;
- Water resources and wetlands;
- Noise;
- Acid sulphate soils;
- Heritage; and
- Public safety and risk.

The following sections present a detailed discussion of the potential environmental impacts and management strategies for each environmental factor.

4.2 Air Quality and Greenhouse Gas Emissions

4.2.1 Management Objective

Ensure that gaseous emissions from the proposed power station meet acceptable criteria for ambient ground level concentrations, and ensure that all reasonable and practical measures are taken to minimise these emissions.

4.2.2 Potential Impacts

An air quality assessment has been undertaken by Katestone Environmental for the NewGen Power 330 MW Gas-Fired Power Station (Katestone Environmental 2007). The assessment determined the power station emissions in isolation and also the cumulative effect of the emissions to local and regional air quality.

The assessment modelled ground-level concentrations of air pollutants such as nitrogen dioxide (NO_2), sulphur dioxide (SO_2),particulates (PM_{10}) and ozone as well as the annual greenhouse gas emissions.

Scope of Study

The air quality assessment study for the NewGen gas-fired power station investigated the following:

- The existing air quality in the region;
- An estimate of the levels of air pollutants likely to be emitted from the power station;
- Consideration of the meteorological and terrain conditions that could affect the transport and dispersion of air pollutants;
- An estimate of ambient air pollutant concentrations in the vicinity of the power station due to existing activities;
- An estimate, using suitable dispersion models, of local and regional impacts due to the proposed facility;
- An assessment of the predicted impacts against air quality goals and standards in use in Western Australia;
- An estimate of annual greenhouse gas emissions; and
- Conclusions on the acceptability of the proposal in terms of air quality.

A summary of the outcomes of these investigations is included in the following sections. A full copy of the reports is included as Appendix A1 and A2.

Air Quality Goals and Standards

National ambient air quality standards and goals are specified by the National Environment Protection Council (NEPC) with agreement from all state governments in the National Environmental Protection (Ambient Air Quality) Measure (NEPM (Air)). Compliance with the NEPM (Air) standards is assessed by each state jurisdiction through ambient air quality monitoring undertaken at locations that are representative of large urban populations. A summary of the NEPM (Air) standards and goals relevant to this project are presented in Table 4.1.

The NEPM has been applied to all sensitive locations in the vicinity of the power station.

Table 4.1 National Environment Protection (Ambient Air Quality) Measure, summary of current standards and goals

Pollutant	Averaging Period	NEPM (Air) Standards ($\mu g/m^3$)
Nitrogen dioxide	1-hour Annual	246 62
Sulphur dioxide	1-hour 24-hour	570 228
PM_{10}	24-hour	50
Carbon monoxide	1-hour	11,250
Ozone	1-hour	214 (100ppb)

Existing Air Quality

On an airshed wide basis, the Perth Airshed Inventory (DEP, 2002) found that the major sources of oxides of nitrogen are motor vehicles (42%) followed by industrial activities (32%). Sulphur dioxide emissions are dominated by industrial activities (86%).

An examination of the National Pollution Inventory (NPI) was conducted to obtain data on local significant industrial sources of air pollutants. All industries that exceed certain thresholds are required to report their annual emission rates of air pollutants in the NPI.

There are three significant industrial sources of air pollutants in the City of Wanneroo that report to the NPI, they are:

- Wanneroo Feedmill owned by Ingham's Enterprises Pty Ltd. Located approximately 8 km south of the proposed power station is a source of oxides of nitrogen, sulphur dioxide, PM_{10} and carbon monoxide.
- Tamala Park Power Station owned by Landfill Gas and Power Pty Ltd. Located approximately 8 km southwest of proposed power station and is a source of oxides of nitrogen and carbon monoxide
- Pinjar Gas Turbine Station operated by Verve Energy. Located approximately 12.5 km north-northwest of the proposed power station and is a source of oxides of nitrogen, sulphur dioxide, PM_{10} and carbon monoxide.

The Wesbeam Holdings Limited Laminated Veneer Lumber manufacturing facility, located nearby in the Neerabup Industrial Estate, does not report to the NPI. It is likely that emissions from the Wesbeam facility are not above the NPI reporting thresholds. It was confirmed with the DEC Air Quality branch that emissions of interest to this study from the Wesbeam facility are expected to be comparatively small and therefore unlikely to affect the outcomes of the modelling conducted.

The emission rates of oxides of nitrogen, PM_{10}, sulphur dioxide and carbon monoxide from each of the facilities reported to the NPI are reproduced in Table 4.2.

Table 4.2 Major sources of pollutants within the City of Wanneroo - 2006

Substance	Facility Name	ANZSIC Class Name	Total (kg)
Oxides of Nitrogen	Pinjar Gas Turbine Station	Electricity Supply	1900000
	Tamala Park Power Station	Electricity Supply	170000
	Wanneroo Feedmill	Poultry Farming (Meat)	1200
Particulate Matter as PM_{10}	Pinjar Gas Turbine Station	Electricity Supply	28000
	Wanneroo Feedmill	Poultry Farming (Meat)	4400
Sulphur dioxide	Pinjar Gas Turbine Station	Electricity Supply	8000
	Wanneroo Feedmill	Poultry Farming (Meat)	6.5
Carbon monoxide	Pinjar Gas Turbine Station	Electricity Supply	300000
	Tamala Park Power Station	Electricity Supply	51000
	Wanneroo Feedmill	Poultry Farming (Meat)	1000

Ambient air quality monitoring stations are operated by the DEC across the Perth airshed. The nearest monitoring station to the proposed 330 MW Gas-Fired Power Station is at Quinns Rocks. Table 4.3 below presents a summary of ambient air quality statistics from the DEC's Quinns Rocks monitoring station for the modelled year 2001.

Table 4.3 Summary of Quinns Rocks monitoring data for the year 2001

Substance	Units	Max. 1-hour average	Max. 24-hour average	Annual Average	95th percentile 1-hour average	95th percentile 24-hour average
Nitrogen dioxide	$\mu g/m^3$	74.6	–	8.4	32.2	–
Particulate Matter as PM_{10}	$\mu g/m^3$	36.9	57.4	18.0	25.2	23.7
Ozone	ppb	72.3	–	21.2	35.5	–

Emission Characteristics of the Power Station

The most important group of potential pollutants for the NewGen Power 330MW Gas-Fired Power Station are oxides of nitrogen (NO_x) because of their potential to affect urban air quality.

The EPA has issued guidelines for emissions of oxides of nitrogen from gas turbines, these are published in:

Emissions of Oxides of Nitrogen from Gas Turbines, Guidance for the Assessment of Environmental Factors No. 15, Preliminary Guidance, Environmental Protection Authority, Western Australia, March 1999.

The objective of this guideline is to prevent degradation of Western Australia's air quality by controlling excessive emissions of oxides of nitrogen from new gas turbines. The guideline recommends the use of the AEC/NH&MRC national guideline for oxides of nitrogen emissions from a gas turbine of 0.07 g/m^3 (dry, 273 °K, 101.3 kPa and 15% O_2) or 34 ppm (15% O_2).

NewGen's 330 MW Gas-Fired Power Station will incorporate low NO_x burners and will comply with the EPA's recommended emission limit of 34 ppm during normal operations. Under all normal operating loads the emission concentration of oxides of nitrogen will be less than 25 ppm (at 15% O_2).

Sulphur dioxide, carbon monoxide and particulate matter are produced in very small quantities by a gas-turbine using natural gas fuel. The magnitude of sulphur dioxide emissions is determined by the amount of sulphur in the fuel. The natural gas supplied by the Dampier to Bunbury gas pipeline has a specified sulphur concentration of less than 10 mg/m³.

A summary of the stack configuration and peak-load emission characteristics of the proposed NewGen 330 MW Gas-Fired Power Station are presented in Table 4.4.

The Station has been modelled assuming continuous operation at full load.

Table 4.4 Stack characteristics for the proposed power station

Parameter	Units	OCGT
Number of stacks	-	2
Location	AMG (mN, mE)	386502, 6495320, UNIT 1 386458, 6495320, UNIT 2
Stack height	m	35
Stack diameter	m	6.0
Volume flow	Nm^3/s	390.09
Exit velocity	m/s	41.34
Temperature	°C	545.0
NO_x emissions	ppmV, day, at 15%O_2	25
	g/s/stack	20.03
CO emissions	ppmV, day, at 15%O_2	10
	g/s/stack	4.88
SO_2 emissions[1]	g/s/stack	0.27
PM_{10} emissions	g/s/stack	3.90

[1] Sulphur content of fuel = 10 mg/m^3

Air Quality Modelling for NO_2, SO_2, CO and PM_{10} - Methodology

Dispersion modelling of the NewGen 330 MW Gas-Fired Power Station and surrounding region was undertaken using a methodology discussed with and approved by Air Quality branch representatives of Western Australia's Environmental Protection Authority Service Unit.

The prognostic meteorological model, TAPM (The Air Pollution Model) Version 3.0.7 was used in this assessment. TAPM was configured with data assimilation from monitoring stations operated by the Bureau of Meteorology within the modelling domain. This method was used to ensure representative local wind conditions were well defined within the model.

Dispersion modelling has been conducted for the short-term and long-term ground-level impacts for nitrogen dioxide, particulates (as PM_{10}), sulphur dioxide and carbon monoxide.

The proposed power station has been assessed running continuously with an operational load of 100%.

Background air quality was quantified using monitoring data provided by the DEC and collected at the DEC's Quinns Rock monitoring station and dispersion modelling of the Pinjar power station for the local air quality assessment of oxides of nitrogen.

The full Perth regional emissions inventory was included in the regional photochemical modelling assessment.

Air Quality Modelling Results

Nitrogen Dioxide

The maximum concentrations of nitrogen dioxide predicted using the TAPM model for the proposed NewGen Gas-Fired Power Station in isolation and in combination with existing local sources are presented in Table 4.5(a).

Table 4.5(a) **Predicted maximum concentrations of nitrogen dioxide due to the proposed NewGen Gas-Fired Power Station and background sources (units: µg/m^3).**

Sensitive Receptor Number	NewGen Gas-Fired Power Station only		NewGen Gas-Fired Power Station plus background sources	
	1-hour	Annual	1-hour	Annual
1	7.95	0.01	48.63	8.47
2	10.89	0.02	50.35	8.49
3	8.42	0.01	48.78	8.48
4	4.86	0.01	46.99	8.48
5	4.23	0.01	46.69	8.48
6	3.87	0.01	46.42	8.48
7	3.82	0.01	45.77	8.48
8	4.10	0.01	46.82	8.48
9	3.70	0.02	45.50	8.48
10	3.68	0.02	45.78	8.48
11	3.59	0.02	45.18	8.49
12	3.71	0.02	46.71	8.50
Maximum in modelling domain	18.44	0.04	96.35	9.01
Maximum at receptor locations	10.89	0.02	50.35	8.50
NEPM Standard	246	62	246	62

Relatively low concentrations of nitrogen dioxide are predicted for the proposed power station as the plume from the open-cycle gas-turbines are extremely buoyant and therefore rapidly disperse within the ambient air.

The maximum 1-hour nitrogen dioxide concentration predicted with the inclusion of background is 96 µg/m^3, well below the NEPM standard of 246 µg/m^3.

Presented in Figure 4.1 (a) and (b) is the maximum 1-hour average ground-level concentration and the annual average ground-level concentration of nitrogen dioxide for the proposed NewGen 330 MW Gas-Fired Power Station and existing industrial sources. For the 1-hour average concentrations of nitrogen dioxide in Figure 4.1 (a), highest concentrations are to the north-northeast of the NewGen Gas-Fired Power Station. This is predominantly from the contribution of the Pinjar Power Station located in the same vicinity. For the annual average concentrations of nitrogen dioxide, a concentration gradient exists with concentrations decreasing when moving north to south

Figure 4.1 (a) **Maximum predicted ground-level concentrations of nitrogen dioxide for the proposed NewGen Gas-Fired Power Station and existing industrial sources for (a) 1-hour average, and (b) annual average.**

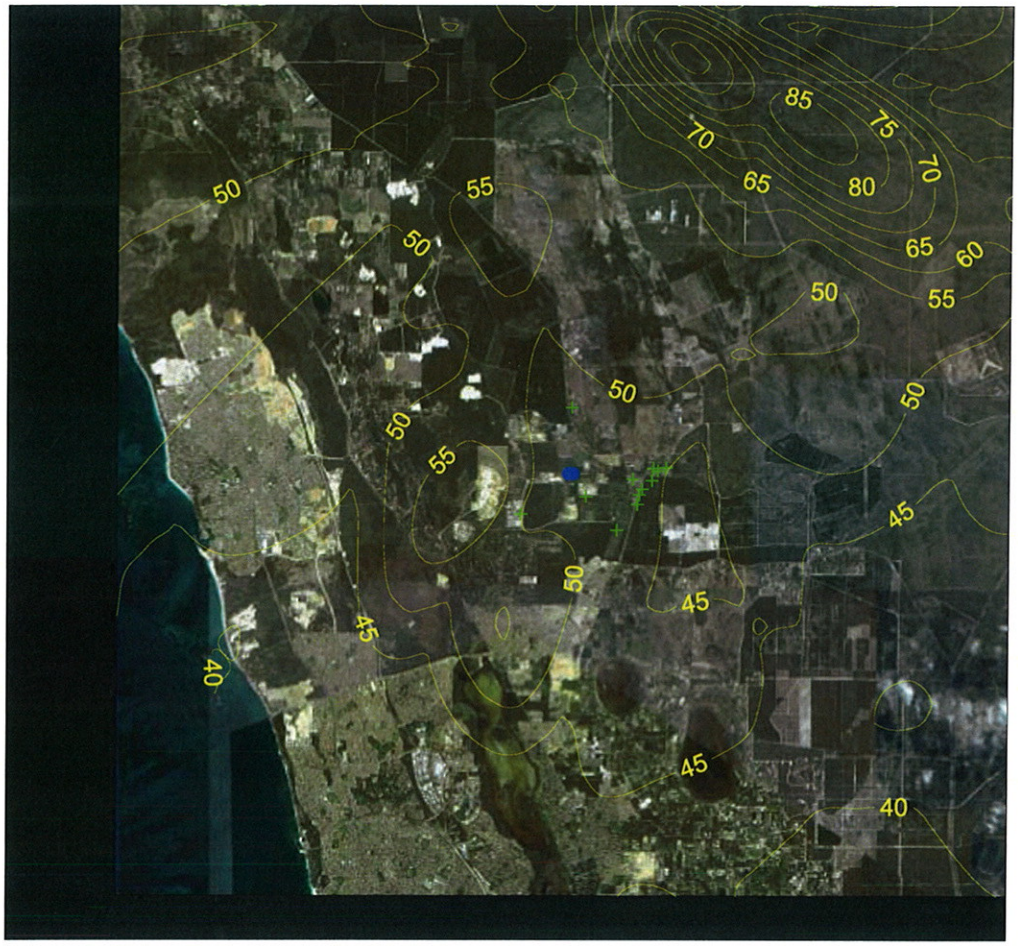
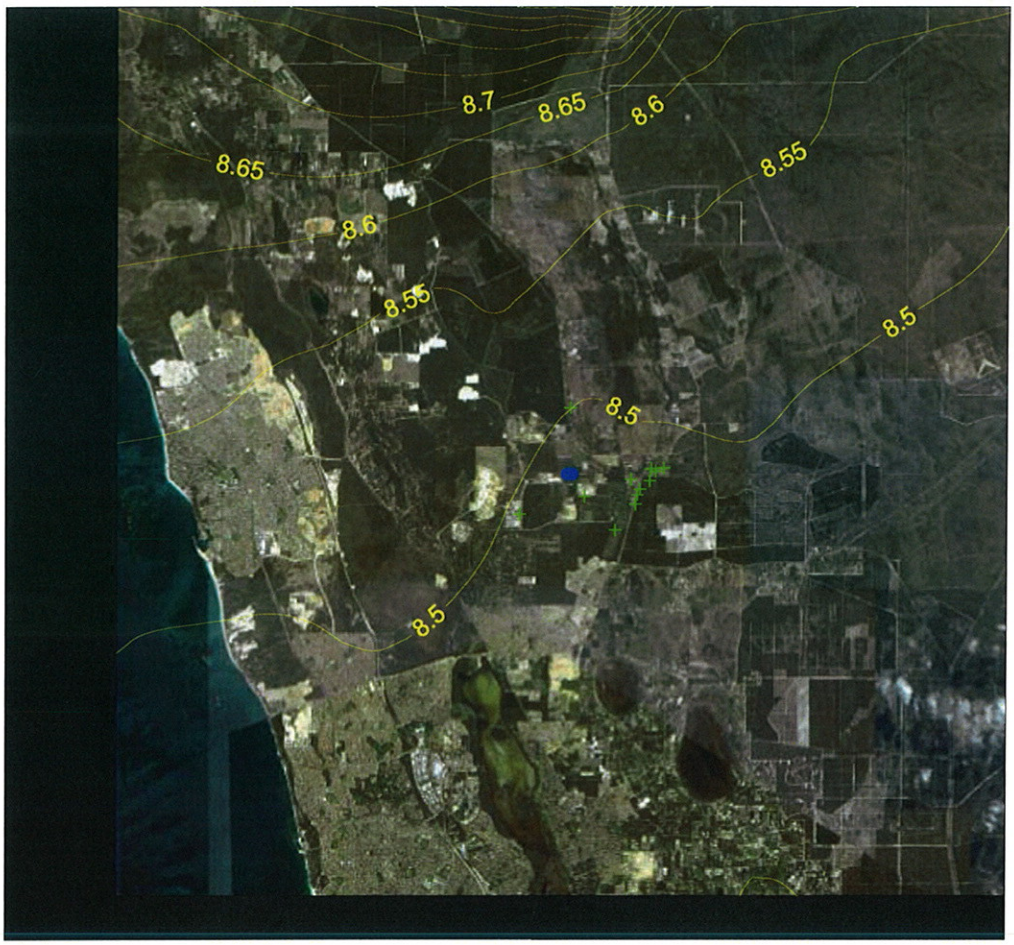


Figure 4.1 (b) **Maximum predicted ground-level concentrations of nitrogen dioxide for the proposed NewGen Gas-Fired Power Station and existing industrial sources for (a) 1-hour average, and (b) annual average.**



Particulates

Results for the annual average and maximum 24-hour ground-level concentrations of particulates for the proposed NewGen Gas-Fired Power Station in isolation and in combination with existing local sources are presented in Table 4.5(b).

Table 4.5(b) Concentrations of PM_{10} due to the proposed NewGen Gas-Fired Power Station and background sources (units: $\mu g/m^3$).

Sensitive Receptor Number	NewGen Gas-Fired Power Station only		NewGen Gas-Fired Power Station plus background sources	
	24-hour	Annual	24-hour	Annual
1	0.34	0.01	24.99	18.03
2	0.58	0.01	24.94	18.04
3	0.35	0.01	24.88	18.03
4	0.26	0.01	24.95	18.03
5	0.24	0.01	24.94	18.03
6	0.22	0.01	24.94	18.03
7	0.21	0.01	24.94	18.03
8	0.23	0.01	24.92	18.03
9	0.21	0.01	24.95	18.03
10	0.21	0.01	24.94	18.03
11	0.23	0.01	24.96	18.03
12	0.20	0.01	24.88	18.04
Maximum in modelling domain	0.83	0.03	28.28	18.37
Maximum at receptor locations	0.58	0.01	24.99	18.04
NEPM Standard	50	N/A	50	N/A

The maximum 24-hour particulate (PM10) concentration predicted with the inclusion of background is 28.8 $\mu g/m^3$, well below the NEPM standard of 50 $\mu g/m^3$.

Sulphur Dioxide

Results for the maximum 1-hour and 24-hour average ground-level concentration of sulphur dioxide for the proposed NewGen Gas-Fired Power Station in isolation and in combination with existing local sources are presented in Table 4.5(c).

Table 4.5(c) **Concentrations of sulphur dioxide due to the proposed NewGen Gas-Fired Power Station and background sources (units: µg/m^3).**

Sensitive Receptor Number	NewGen Gas-Fired Power Station only		NewGen Gas-Fired Power Station plus background sources	
	1-hour	24-hour	1-hour	24-hour
1	0.35	0.02	0.73	0.09
2	0.48	0.04	0.81	0.09
3	0.37	0.02	0.74	0.08
4	0.22	0.02	0.66	0.09
5	0.19	0.02	0.64	0.09
6	0.17	0.02	0.63	0.09
7	0.17	0.01	0.60	0.09
8	0.18	0.02	0.65	0.08
9	0.16	0.01	0.59	0.09
10	0.16	0.01	0.60	0.09
11	0.16	0.02	0.58	0.09
12	0.17	0.01	0.65	0.08
Maximum in modelling domain	0.82	0.06	2.85	0.31
Maximum at receptor locations	0.48	0.04	0.81	0.09
NEPM Standard	570	228	570	228

The maximum 1-hour sulphur dioxide concentration predicted with the inclusion of background is less than 3 µg/m^3, well below the NEPM standard of 570 µg/m^3.

The maximum 24-hour sulphur dioxide concentration predicted with the inclusion of background is around 0.3 µg/m^3, well below the NEPM standard of 228 µg/m^3.

Photochemical Smog Formation

An assessment of the potential contribution of the NewGen 330 MW Gas-Fired Power Station to regional photochemical smog (in particular ozone) has been conducted using the Carnegie Mellon/California Institute of Technology (CIT) photochemical model.

In general, the configuration of the CIT model was as supplied by DEC. The only modification by Katestone Environmental to the inventories supplied by DEC was the addition of the proposed NewGen 330 MW Gas-Fired Power Station as an elevated industrial emissions source.

The model generally assumes that an emissions source will emit pollutants 24 hours a day, 365 days per year. This may significantly overestimate impacts from the source. However, as the objective of an air quality assessment is to provide worst-case estimates of the potential for impacts this is a commonly adopted methodology for dealing with limited source information.

Using the inventories supplied with the addition of the 330 MW OCGT power station operating continuously, a total of 90 days has been simulated. From these 90 days, six days are presented in detail in the report (Appendix A) showing the predicted impact of the proposed power station on ground-level ozone concentrations. The six days were selected as they

represent worst case scenarios with elevated background levels of ozone above 75 ppb (the NEPM Air standard is 100 ppb).

Photochemical smog modelling has also been conducted for existing and future scenarios based on estimates of population and vehicle emissions for 2001 and 2021 respectively.

The photochemical smog assessment results include:

- Both a positive and negative impact on ground-level concentrations of ozone is predicted with a range of –2.5 ppb to +6.5 ppb.
- For the six study days presented in detail a maximum increase in ground-level concentrations of ozone of 4 ppb is predicted for the 1999 scenarios and a maximum of 6.5 ppb for the 2021 scenarios.
- That the proposed NewGen 330 MW Gas-Fired Power Station will therefore have an insignificant and immeasurable impact on the regional maximum ground-level concentration of ozone.

Greenhouse Emissions

The major activities at the NewGen 330MW Power Station that produce greenhouse gas emissions are:

- Gas combustion for electricity generation; and
- Production, transport and distribution of gas and electricity.

The anticipated quantity of gas likely to be consumed annually by the NewGen 330MW Gas-Fired Power Station is 11.2 petajoules.

Greenhouse gas emissions are reported as tonnes of carbon dioxide equivalent ($CO_{2\text{-}e}$). The emission factors for greenhouse gas emissions from natural gas combustion are provided in the Australian Greenhouse Office (AGO) Workbook (2006) and are given in Table 4.6.

Table 4.6 Predicted annual greenhouse gas emissions from the proposed NewGen 330MW OCGT Gas-fired Power Station.

Emissions	Direct emissions	Indirect emissions	Full fuel cycle	Units
Emission factor	52.7	7.4	60.1	kg CO_2-e/GJ
Greenhouse gas emissions	0.590	0.083	0.673	Mt CO_2-e

It is therefore estimated that annual greenhouse emissions will be around 0.7 million tonnes of carbon dioxide equivalent.

NewGen Power is committed to joining the Australian Government's Greenhouse Challenge Plus programme for the 330 MW Gas-Fired Power Station and to developing a Greenhouse Gas Abatement Plan prior to commencing commercial operation of the station.

Conclusions

Air quality assessments of the NewGen 330 MW Gas-Fired Power Station have been conducted. The studies conclude:

- The power station is not likely to have any adverse affects on local or regional air quality.
- Maximum concentrations of nitrogen dioxide, sulphur dioxide and particulates (PM_{10}) are predicted to be well below the required goals and standards for the power station operating at full load.
- The contribution to regional ozone levels is predicted to be insignificant.
- The greenhouse gas assessment indicates annual emissions of about 0.7 million tones of CO_2-e.

4.3 Flora, Vegetation and Fauna

4.3.1 Management Objective

To maintain the abundance, diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

4.3.2 Description of Vegetation, Flora and Fauna – Pipeline Route

A desktop review and field assessment of the flora, vegetation and fauna along the proposed pipeline and transmission line routes has been carried out by Mattiske Consulting and Aquila Wildlife Fieldwork for NewGen Power. A summary of the outcomes of the review is included in the following sections. A full copy of the review is contained at Appendix B.

Flora

A total of 33 families, 91 genera and 151 species were found in total at both the powerline and pipeline. Most of these were found along the proposed pipeline route, however as expected for disturbed areas, these counts are significantly less than observed in undisturbed adjacent areas. A recent botanical study on the Gnangara Mound, which covered a much broader area and combined a series of studies on the Gnangara Mound and the northern Swan Coastal Plain, highlighted some 963 vascular plant species from 91 families and 344 genera (Mattiske Consulting Pty Ltd 2003).

Of the species found, 13 are introduced but none of these are listed as Declared Plants under the Agriculture and Related Resources Protection Act 1976 (WA).

Rare, Priority and Threatened Flora

A range of rare and priority flora species have been recorded in studies on the wider Gnangara Mound and therefore could occur near the proposed pipeline route.

Although there appears to be the potential for their presence, on the basis of detailed studies in the area for a range of clients and state records (Department of Environment and Conservation 2007a and 2007b) no rare, priority or threatened flora are known to occur near

the proposed alignment. This includes; Declared Rare Flora species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WA), taxa pursuant to section 179 of the *Environment Protection Biodiversity Conservation Act 1999* (Cth) and Priority flora.

No rare, priority or threatened flora were located during the field survey, most likely due to the previous disturbance of the pipeline and powerline corridors.

It is proposed that prior to construction in 2008 a spring survey will be conducted on areas of native vegetation to be disturbed and management plans developed for any relevant species located.

not in CEMP

Vegetation

The proposed pipeline passes through a range of vegetation complexes as defined by Heddle et al. (1980). The vegetation complexes within the alignment on these dune systems are well represented in the State Forest and conservation reserve system on the northern Swan Coastal Plain with all but Yanga (18%) and Karrakatta Central and South (18%) above 20% representation (Bush Forever Government of Western Australia, 2000). The small area of the proposed alignment within the Yanga complex (at the eastern end of the proposed alignment) is completely degraded agricultural land supporting only the occasional tree over pasture. The section of the proposed alignment located west of Lake Pinjar is near sites with Karrakatta - Central and South that is largely within tracks and pine plantations. Consequently, the proposed alignment occurs on areas of disturbed native vegetation, tracks or in significantly cleared and degraded agricultural areas and therefore is of low value in protecting native species and communities.

On the basis of earlier studies by Havel (1968) and Mattiske Consulting Pty Ltd (2003) a series of site-vegetation types were defined for the Gnangara Mound. These site types, recent mapping by Mattiske Consulting Pty Ltd (2003), and the current field assessment were used to define the vegetation along the alignments. In assessing the values along the alignment (Appendix B, Figures 1.1 to 1.5) it must be recognized that much of the proposed pipeline and powerline alignments occurs along already disturbed tracks, service corridors and in areas adjacent to tracks and pine plantations, decreasing the value of these areas of vegetation.

A total of 13 community mapping units occur along the fringes of the proposed pipeline. None of these communities are listed as threatened ecological communities at the State or Federal levels (Department of Environment and Conservation 2007d, Department of Environment and Water Resources, 2007b).

Condition of Vegetation

The proposed pipeline and powerline corridors occur on mostly already disturbed areas, tracks and near current tracks from near Muchea and the southern end of Lake Pinjar (Appendix B, Figures 1.1 to 1.5). Disturbances range from clearing for agricultural uses, clearing for infrastructure to weed encroachment.

Areas where previous infrastructure has been installed have partially recovered from the disturbance as measured by Keighery (1994) vegetation condition scale (Figures 1.1 to 1.5, Appendix B). Careful management of the disturbance and rehabilitation of the pipeline and powerline corridors should not have a significant long-term impact on these areas.

The rest of the pipeline and powerline corridors occur on agricultural lands, pine plantations and areas close to roads. On the edges of pine plantations and road reserves the careful rehabilitation of these areas may improve their current condition. Parts of the Corridor that occur on completely degraded agricultural land will not improve with this proposal as the land will have to be restored back to its previous use. — does this mean ag land or to bushland

Significant Fauna

A range of threatened and priority fauna species were highlighted in database searches (Department of Environment and Conservation 2007). This search highlighted a range of bird species and invertebrate species that may occur in the area. These species were the Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) and Vulnerable under the Wildlife Conservation Act 1950 (WA), the White-tailed Black Cockatoo (Baudin's or Carnaby's) (*Calyptorhynchus sp.*), the Peregrine Falcon (*Falco peregrinus*), the Graceful Sunmoth (*Synemon gratiosa*), a cricket (*Austrosaga spinifer*) and two native bees (*Hylaeus globuliferus* and *Leioproctus contrarius*).

It is unlikely that any of these species will be influenced by the proposed development as they are dependent on Banksia woodlands and a range of species within the heaths and Banksia woodlands whereas the areas affected (30 ha of native vegetation clearing) are already disturbed and are much smaller and poorer habitats than surrounding sites., including *Bush Forever* Site 380 which is over 8000 ha.

Seven areas with fauna habitat were recognised as having an important part to play in the ecology of specific fauna. Between these differing habitats will be flowering and seeding periods that for the most of the year will provide food for various species of bird and other native animals. Ecological links will be maintained through proposed rehabilitation programs and trench monitoring during construction.

The Carnaby's Cockatoo is highly likely to be present in the Survey Area, and is of major conservation significance. Two other species that may occur are Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo although the area is generally considered to be out of their present range.

Carnaby's Cockatoo has undergone a dramatic decline in recent years due to the loss of either food resources, destruction of their habitat, or as a result of their low reproductive rate (Johnstone and Storr 1998).

Carnaby's Cockatoo feed on proteaceous plants including *Banksias* and pine plantations have also become an important food resource. Whilst sections of the pipeline alignment pass through *Banksia* woodland and Marri woodland which could be food sources for these birds, these sections are degraded by current and previous clearing and maintenance activities for the powerlines and pipeline in the infrastructure corridor. The areas to be cleared (30 ha) will be rehabilitated (29 ha). The areas to be disturbed are also adjacent to the Gnangara pine plantation (20,000 ha) and *Bush Forever* Site 380 (8000 ha) and therefore are not likely to represent a significant loss of food source for these birds.

The Carnaby's Cockatoo require large hollows (approximately 1m – 2.5m deep) to be suitable for breeding. Long periods of time (approximately 100-150 years) are needed to develop large hollows suitable for the black cockatoos. Two trees with potential hollows have been sighted along the alignment and will be retained if assessed by experts as suitable breeding hollows.

4.3.3 Potential Impacts – Pipeline Route

Approximately 30 ha of native vegetation will be cleared for construction of the pipeline. Potential impacts from this clearing include:

- Clearing and disturbance to vegetation and soils;
- Disturbance to rare and priority species of flora and fauna;
- Spread of weeds and dieback from movement of equipment; and
- Increased fire risk from construction activities.

Measures to avoid or minimise these impacts are detailed below.

4.3.4 Management Strategies - Pipeline Route

Clearing

The pipeline alignment has been selected as it minimises environmental impacts by using areas that are already cleared or disturbed or are under pine plantation, avoids three *Bush Forever* sites and conservation category wetlands and utilizes existing similar use easements. As a result the impacts on the native flora, vegetation and vertebrate fauna should be minimal.

Pipeline construction will generally be conducted within a 30m corridor to allow safe working of equipment, stockpile areas for vegetation and topsoil and lay down areas for pipes.

Within areas of native vegetation in the northern portion of the route between the connection with the DBNGP and the Pinjar Power Station (DBNGP corridor), the area to be cleared will be minimised wherever practicable. Construction activities in the DBNGP corridor will be restricted to within the existing easement boundaries. Less than 30m of clearing should generally be necessary as the existing clearing along this corridor associated with the Pinjar power station gas lateral and three (3) overhead power lines can be used for some construction activities. The NewGen gas pipeline will be located about 10m from the existing pipeline and between it and the power lines. Figure 8.8 is a typical pipeline alignment sheet at a scale of 1:5000 which shows the intended location of the pipeline and the disturbed areas already evident in this infrastructure corridor.

but don't have data/GDI alignment sheet for whole length

It has been estimated that the area of native vegetation cleared for construction of the pipeline is about 30 ha of mainly regrowth vegetation. These areas will be rehabilitated after construction to the satisfaction of the land owners. Clearing of plantation pine trees is required in other sections of the route.

Mechanisms to minimise clearing and protect fauna habitat will include:

- Keep clearing of native vegetation to a minimum by utilizing already established tracks and roads during construction of the pipeline;

not in CEMP

- Mature eucalypts shall be preserved wherever possible for fauna habitat;
- Daily inspections of the pipeline trench early in the morning and, if required, in the late afternoon to remove trapped fauna;
- Lay-down areas should be kept to a minimum and care taken for selection of sites not to include high quality vegetation;
- Disturbed areas will be rehabilitated and reseeded with local provenance species following construction; and
- Any water in the trench shall be pumped out via a mesh to adjacent vegetated areas.

Bush Forever

The *Bush Forever* policy was released by the Western Australian Government in 2000 and identified areas of regional conservation value within the Swan Coastal Plain portion of the Perth Metropolitan Region (Government of Western Australia, 2000).

A portion of the pipeline route will be within *Bush Forever* sites and these are identified in Table 4.7.

Table 4.7 Pipeline route within *Bush Forever* sites

Site no.	Bush Forever Site Name	Extent of Impact
380	Rosella Road Bushland	Clearing required of regrowing native vegetation in existing DBNGP easement for approximately 4 km of alignment. Areas previously cleared for the existing Pinjar power station pipeline and the 3 power lines will be utilised whenever possible to minimise clearing for the construction associated with the new pipeline.
382	Lake Pinjar and Adjacent Bushland	Clearing required for 200 m on edge of site adjacent to Old Yanchep Road in area degraded by exotic grasses. There will be minimal impact on native vegetation at the site.

The proposed pipeline alignment in part of *Bush Forever* Site 380 occurs mostly in already disturbed areas that are still recovering from previous disturbance for infrastructure (Appendix B - Figure1.1, 1.2). However, near the Pinjar Power Station an area of 1.2 ha may be cleared which is in very good to excellent vegetation condition and steps will be taken to retain the integrity of this area during and after the construction of the gas pipeline. This area will be rehabilitated and reseeded with local provenance species following construction and a weed management programme implemented if required..

In the area of the southern section of the pipeline alignment that occurs in *Bush Forever* Site 382 pipeline construction will be mainly restricted to the established firebreaks. This will result in clearing of the dominant introduced Veldt grass and an occasional tree or shrub.

The total area of disturbance in *Bush Forever* sites would be approximately 8 ha of mainly regrowth vegetation within the DBNGP corridor. An offset package is proposed for these areas.

Weeds and Dieback

Weeds and dieback can be introduced or spread by the movement of machinery in the pipeline corridor. Diseases of flora and weeds can also impact on fauna. NewGen Power will insist on clean machinery certificates before work begins to prevent the introduction of weeds and disease into the area. Hygiene measures will be specified in the CEMP.

Fire

The activities associated with pipeline construction such as welding, grinding and vehicle movement can result in an increased fire risk. NewGen Power will prepare and implement a fire management plan as part of the CEMP.

Offsets

To mitigate the effect of clearing native vegetation, NewGen Power has initiated an offset programme with the Department of Environment and Conservation to identify suitable land that can be added to the conservation estate.

4.3.5 Potential Impacts – Transmission Line and Power Station

A 2 km transmission line will conduct the electricity generated by the gas turbine power station to the Neerabup terminal sub-station. The route for the transmission line traverses City of Wanneroo Reserve 11598 which is an old refuse site (Figure 1.2) and retains its classification as part of *Bush Forever* site 382 and also as a conservation category wetland.

The refuse site is almost totally cleared except for a small patch of bushland in the south-east corner. The vegetation is mainly *Melaleuca preissiana* and *Eucalyptus rudis* over pasture grasses and weeds.

It is likely that seven of the steel poles for the transmission line (see Figure 3.3) will be placed within the *Bush Forever* site 382.

The power station site is completely cleared and there will be no impact on flora and fauna from work at the site.

4.3.6 Management Strategies – Transmission Line and Power Station

Clearing for the transmission line poles will be minimised with approximately 400 m^2 required for each pole. Existing cleared areas will be used for laydown areas and for stringing the conductor line. Some lopping of branches of taller trees may be required under the line so as not to interfere with the conductors. Disturbed areas will be rehabilitated where practicable. Weed infestation from the other sites will be avoided through the use of hygiene measures. The proposal should not breach the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992.

These measures will form part of a CEMP.

4.4 Water Resources and Wetlands

4.4.1 Management Objectives

To maintain the quality and quantity of water such that existing and potential environmental values, including ecosystem maintenance are protected. To maintain the integrity, ecological functions and environmental value of wetlands.

4.4.2 Potential Impacts – Power Station

The main water uses on site will be:

- Fire services and fire water storage;
- Water for evaporative coolers in gas turbines
- Site washdown water;
- Turbine blade washing;
- Potable water; and
- Landscaping.

Evaporative coolers fitted to the gas turbines help boost the power output from the power station when the ambient relative humidity is low. Also, operation of evaporative coolers is weather dependent and generally expected to run during summer, though it may run for short durations during winters.

Evaporative coolers need water to humidify and cool inlet air to the gas turbine. The process has a strict water chemistry requirement to ensure safe and efficient working of the gas turbines.

A demineralised water plant will typically have a capacity of 130m^3/day and will operate for up to 18 hours/day during summer to produce sufficient water. It will consist of two cylindrical vessels to store cation and anion resins. The process is controlled by a micro-processor based controller to monitor the process and quality. It requires the regeneration of resins with around 50 kg of 100% HCl and 60 kg of 100% NaOH per cycle of operation. The blowdown water from the regeneration is estimated at 12m^3 per regeneration (approximately 7.5KL/annum or 62 regenerations/annum) with a salt content of 15000 mg/L. The regeneration product from the demineralised water plant will be treated and stored in an impervious neutralisation pit prior to off-site disposal.

Construction water use is expected to be in the range 5-10 cubic metres/day with a monthly average of 250m^3.

The depth to groundwater below the power station site is approximately 13 m and has a depth of water of approximately 50 m (Department of Water, 1997). The water is expected to contain 500-1000mg/L total dissolved solids and contain some dissolved iron.

The site is adjacent to the western boundary of the Gnangara Underground Water Pollution Control Area (Gnangara UWPCA) and the Lake Pinjar conservation category wetland.

Groundwater movement beneath the site is generally in a westerly direction towards the ocean and away from the UWPCA.

The operation of the power station will require the transportation, storage and handling of hydrocarbons including lubricating oils and greases. Diesel will not be used for fuel in the power station so there will be no hydrocarbon bulk storage facilities.

Sewage would be produced from the septic system.

4.4.3 Management Strategies – Power Station

The water management system design is based on the following principles:

i. normal overland stormwater flows from around the site shall continue around site.
ii. a clean water catchment system from building roofs only, to be directed to a soakage pit.
iii. a dirty water catchment system, capturing stormwater runoff from the remainder of the site, for example roads, carparks and concrete areas. The dirty water shall be directed to silt/oil trap device prior to discharge to the soakage pit (to minimise the potential for any oil or chemical contamination entering the existing soakage pit).
iv. contaminated flows (eg containing oil or chemicals) to be collected in impervious storage for appropriate disposal.

General surface run-off will be managed in accordance with the DoW's *Water Quality Protection Note: Stormwater Management at Industrial Sites* (DoW, 2006). All of the water management systems shall be designed for storm surge events ranging from 30 minutes to 72 hour events. The stormwater systems and soakage pit systems shall be designed without overflow for 1:100 year ARI storm events.

All oil storage tanks and vessels in oil coolers and transformers shall be bunded so as to contain full volume of any possible oil spill. Hazardous materials shall also be bunded in accordance with the relevant standards.

4.4.4 Potential Impacts – Gas Pipeline and Transmission Line

The majority of the 30 km gas pipeline route for the 330 MW Gas-Fired Power Station falls within the Gnangara Underground Water Pollution Control Area (Gnangara UWPCA) which has a priority 1 source protection classification. The Gnangara UWPCA covers much of the Gnangara Mound which provides about 60% of Perth's drinking water (Water and Rivers Commission 2004). Priority 1 classification is for those areas where the provision of the highest quality public drinking water is the prime beneficial land use, and would typically include land under Crown ownership (Western Australian Planning Commission 2001).

The pipeline route and transmission line route traverse priority wetlands (conservation and resource enhancement categories). The pipeline route crosses a conservation category

dampland (Fig 8.3) for around 1.0 km and resource enhancement dampland (Fig 8.1) for around 0.6 km in the existing Pinjar Power Station pipeline corridor.

The pipeline route also runs adjacent to Lake Pinjar, a conservation category wetland (CCW), in the area of Nisa Road and Old Yanchep Road. This is within the 50 m buffer for the wetland but has roads between the wetland and the construction activity.

Construction activities associated with excavation and trenching have the potential to affect groundwater resources. Impacts on groundwater quality may result from minor spills of hazardous materials (such as fuel), dewatering or leachate from acid sulphate soils. The potential and management of acid sulphate soils along the pipeline route is discussed in Section 4.7.

The pipeline will be pressure tested with water once it is completed with the test water contained within a dam at one end of the pipeline. No test water will be directly discharged to the environment.

The transmission line will be routed across the southern boundary of Lake Pinjar. It is likely that seven of the transmission line poles will be sited along that boundary.

4.4.5 Management Strategies – Gas Pipeline and Transmission Line

The CEMP for the pipeline will contain measures to control potential sources of pollution from pipeline construction activities and measures to mitigate impacts from spills should they occur (Appendix E). Effects on water quality from these sources of contamination, if they occur, are expected to be temporary and not result in long term water quality impacts.

The route of the transmission line across the southern part of the Lake Pinjar CCW traverses an old rubbish tip that was utilised by the City of Wanneroo and now is part of Reserve11598. The area is completely cleared with the exception of a narrow disturbed band of vegetation along Old Yanchep Road and a remnant area of bushland in the south east corner. The impact on water resources, wetland vegetation and habitat from the transmission line will therefore be minimal.

4.5 Noise

4.5.1 Management Objective

Ensure that noise impacts emanating from the project comply with statutory requirements specified in the Environmental Protection (Noise) Regulations 1997.

4.5.2 Potential Impacts

The gas turbine power station and gas pipeline compressor station can generate high levels of noise that may impact on nearby noise sensitive premises.

Noise Assessment

NewGen Power commissioned SVT Engineering Consultants (SVT) to assess the noise impacts from the power station and compressor station. A summary of the report is provided here whilst a copy of the report is provided at Appendix C.

The objectives of the assessment were:

- Review of documentation provided including site plans, equipment lists, and topographical data;
- Calculation of noise levels at the nearest noise sensitive locations for the worst case meteorological conditions;
- Assessment of noise emissions from the plant for compliance with noise limits imposed under the *Environmental Protection (Noise) Regulations 1997* at the nearest noise sensitive locations;
- Inspection of the site and undertaking of spot measurements of existing noise levels in the area; and,
- Assessment of noise contribution from the main noise contributors (the power station exhaust stacks) and recommendation on the level of noise reductions required to satisfy the compliance standards.

Noise Criteria

Noise management in Western Australia is implemented through the *Environmental Protection (Noise) Regulations 1997,* which operate under the *Environmental Protection Act 1986*. The Regulations specify maximum noise levels (assigned levels) which are the highest noise levels that can be received at noise-sensitive, commercial and industrial premises. Assigned noise levels have been set differently for noise sensitive, commercial and industrial premises. For noise sensitive residences, the time of day also affects the assigned levels.

The regulations define three types of assigned noise levels:

- $L_{A\,Max}$ assigned noise level means a noise level which is not to be exceeded at any time;
- $L_{A\,1}$ assigned noise level which is not to be exceeded for more than 1% of the time; and
- $L_{A\,10}$ assigned noise level which is not to be exceeded for more than 10% of the time.

The L_{A10} noise limit is the most significant since this is representative of continuous noise emissions from the proposed power station.

The NewGen Power station location already contains significant existing noise sources, notably Wanneroo Raceway. To allow for the cumulative effect of the power station on the existing noise sources, the assigned level which cannot be exceeded at the nearest sensitive receptor is set at 5 dB less than the lowest assigned level in Table 4.8 (i.e. the limit for a residential location is 30 dB(A)).

Noise Modelling Results

Noise modelling of the power station has been undertaken using data from a typical 2x165 MW gas turbine arrangement.

Cumulative noise emissions from road traffic, rail, aircraft, domestic sources, entertainment, and other industrial sources are accounted for in accordance with the Environmental Protection (Noise) Regulations 1997 by using the assigned noise level methodology described above.

The nearest residence to the power station is on Spence Road Neerabup (shown as R8 on Figure 4.2). The nearest commercial and industrial premises are within the Neerabup Industrial Estate (shown as R6 and R9 respectively on Figure 4.2).

Table 4.8 Assigned Noise Levels at Nearest Residences

Type of Premises	Time of Day	Assigned Noise Level dB(A)		
		L_{A10}	L_{A1}	$L_{A\ Max}$
Noise sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 – 1900 hours – Monday to Saturday	45 + IF	55 + IF	65 + IF
	0900 – 1900 hours – Sunday and Public Holidays	40 + IF	50 + IF	65 + IF
	1900 – 2200 hours – All Days	40 + IF	50 + IF	55 + IF
	2200 – 0700 hours – Monday to Saturday and 2200 – 0900 hours – Sunday and Public Holidays	35 + IF	45 + IF	55 + IF
Noise sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use	All Hours	60	75	80
Commercial premises	All Hours	60	75	80
Industrial and utility premises	All Hours	65	80	90

NB: IF – influencing factor

Table 4-9 Expected Levels at the nearest noise sensitive receivers

Receiver	Expected L_{A10} Noise Level, dB(A)
R1	21.1
R2	17.6
R3	25.0
R4	27.2
R5	24.2
R6	**47.3**
R7	25.5
R8	28.9
R9	27.9
R10	23.9
R11	19.7

Power station noise modelling results

A summary of the predicted L_{A10} noise levels due to proposed power station emissions at the nearest noise sensitive receivers for the worst-case scenario is presented in Table 4.9. Positions R1 to R11 represent the nearest premises to the proposed power station.

The extent of the affected area due to the predicted noise emissions of the proposed power station is shown diagrammatically in Figure 4.2.

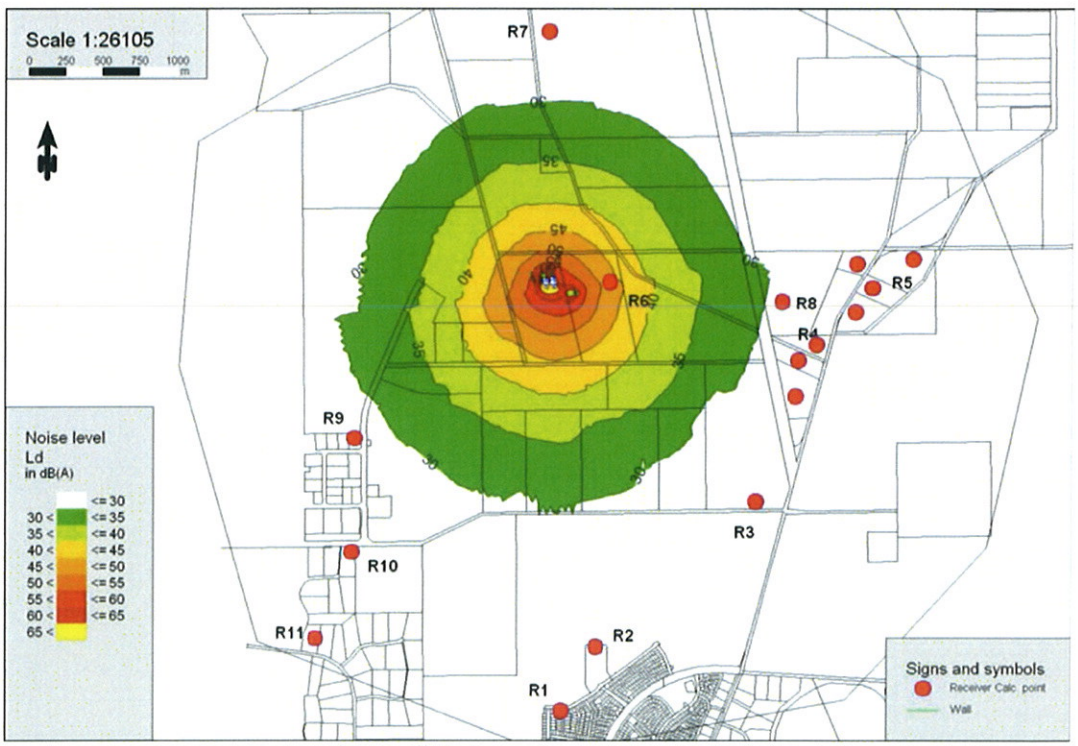


Figure 4-2 Predicted extent of noise affected area due to the proposed power station (worst case)

Receiver R8 has the highest potential noise impact of residential premises around the power station, for which the maximum night time allowable limit under the *Environmental Protection Regulations 1997* is 30 dB(A). The expected noise level at R8 due to the proposed power station is 28.9 dB(A), which is compliant with the *Environmental Protection Regulations 1997.*

Receiver R6 represents commercial premises for which the applicable *Environmental Protection Regulations 1997* limit is 60 dB(A). The expected noise level at R6 due to the proposed power station is 47.3 dB(A) which is compliant with the *Environmental Protection Regulations 1997.*

Modelling results indicate that compliance will be achieved at all locations. The modelling considered both units operating at full capacity.

The compressor station noise modelling results show it is also compliant with the *Environmental Protection (Noise) Regulations 1997* with the noise levels at the nearest noise sensitive premises predicted to be no greater than 25.6 dB(A).

4.5.3 Management strategies

NewGen Power will monitor noise levels from the power station following commissioning to validate the predictions of the modelling exercise.

Construction of the project will be carried out in accordance with noise control practices as set out in Section 6 of Australian Standard 2436-1981, *Guide to Noise Control on Construction, Maintenance and Demolition Sites*. These practices will form part of the construction environmental management plan for the project.

4.6 Acid Sulphate Soils

4.6.1 Management Objective

To maintain the integrity, ecological functions and environmental values of the soil and landform.

4.6.2 Potential Impacts

The project area has a relatively high risk of acid sulphate soils, particularly around lakes and wetlands (DEC 2007). Earthworks for the power station, transmission line and pipeline have the potential to disturb acid sulphate soils leading to acid generation and degradation of soil and water quality and release of metals.

4.6.3 Management Strategies

A field investigation has been carried out for acid sulphate soils along the pipeline route including the power station site. The investigation included 55 auger samples to a depth of at least 2m and testing of samples (pHf and pHfox) in line with DEC acid sulphate soil investigation guidelines.

The preliminary results indicate that the majority of the pipeline route has nil or low acid sulphate soil risk. Areas of moderate to high risk have been identified in and around the power station site. A series of representative samples have been submitted for laboratory analysis to validate the field testing. Results are not yet available. A report on the initial field investigation is attached as Appendix F.

The CEMP for the pipeline and power station will include provisions for management of this factor including minimising the oxidation potential and use of lime when required.

4.7 Aboriginal Heritage

4.7.1 Management Objective

To ensure that changes to the biophysical environment do not affect historical and cultural associations and comply with relevant heritage legislation.

4.7.2 Potential Impacts

Activities associated with the 330 MW Gas-Fired Power Station such as clearing and excavating have the potential to disturb archaeological sites and impact on ethnographic values.

Eureka Archaeological Research and Consulting and Fisher Research carried out the archaeological survey and ethnographic survey respectively for the power station site and pipeline route(s). Copies of these reports are included at Appendix D.

Searches of the Department of Indigenous Affairs' Register of Aboriginal Sites identified no sites within the project area.

The surveys carried out in the project area by the consultants, including Aboriginal consultants, found no evidence of new sites.

It was concluded, that the results of the survey are not surprising given that at least 90% of the survey area lies within heavily disturbed tracts of land with little or no remnant vegetation.

4.7.3 Management Strategies

A CEMP will be prepared for the project that will include measures to manage Aboriginal heritage such as:

- During initial ground disturbing activity aboriginal monitors will be employed;
- Employees will undergo heritage education as part of inductions; and

- Notification procedures will be developed for use if any archaeological material is encountered and will include the traditional owners.

A draft CEMP for pipeline construction is provided at Appendix E.

4.8 Public Safety and Risk

4.8.1 Management Objective

To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.

4.8.2 Potential Impacts

The construction and operation of the pipeline has the potential to create a risk to public safety. The highest risk in where the pipeline is in close proximity to residences and public roads.

The majority of the pipeline route is distant from residences and public roads, however, the latter part of the route runs adjacent to Old Yanchep road prior to entering the power station site.

4.8.3 Management strategies

The pipeline is required to be approved under the Petroleum Pipelines Act and this will require approval of a safety case and to be constructed according to Australian Standard 2885 as well as meet the safety and risk standards of the Department of Industry and Resources and the Department of Consumer and Employment Protection.

This will ensure a range of specifications and standards including measures such as depth of burial of the pipeline, inspection regimes and appropriate signage to advise the public of the location of the pipeline.

4.9 Principles of Environmental Protection

In 2003 the Environmental Protection Act 1986 was amended to include a core set of principles which are applied by the EPA in formal assessments.

In the assessment of the environmental impacts associated with the project consideration has been given to the principles contained in the EPA Position Statement No. 7 Principles of Environmental Protection 2004. This is summarised in Table 4.10.

Table 4.10 How the Principles of Environmental Protection have been considered

Principle	How the Project addresses the Principles
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by: (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options.	**Specialist studies (eg. Flora and fauna, air quality and noise) have been undertaken to assess potential impacts and management strategies developed to avoid or minimise damage to the environment.** **The pipeline route has been selected to minimise clearing native vegetation and traverses previously cleared or degraded areas or pine plantations.** **The environmental risks associated with options studied for the pipeline route and power station locations have been a paramount consideration.**
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	**The project utilises new efficient open cycle gas turbines to meet peak demand without the need for liquid fuel back-up. Environmental values are not being compromised with standards for air quality better than current requirements. Conservation offsets for clearing combined with rehabilitation of areas will result in a net benefit.**
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	**The project components (power station, pipeline, transmission line) have all been selected to minimise clearing native vegetation and utilize previously cleared or degraded areas or pine plantations.** **Conservation offsets for clearing combined with rehabilitation of areas will result in a net benefit.** **Biological surveys and studies have been undertaken. Potential impacts on listed or significant species will be avoided or minimised.**
4. Principles relating to improved valuation, pricing and incentive mechanisms a) Environmental factors should be included in the valuation of assets and services. (b) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. (c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. (d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	**The full life cycle costs of power generation, including the use of natural resources and assets and the ultimate disposal of any wastes and decommissioning and closure of operations has been considered in the project costs.** **The polluter pays principle is recognised and the project has been designed to avoid pollution and minimise emissions.** **The project has considered full life cycle costs including waste treatment or disposal.** **Environmental goals will be pursued in the most cost effective way.**
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	**Low NOx burners are part of station design. Closed water cycle used on site including use of evaporation pond. Construction Environmental Management Plan includes waste minimisation obligations on contractors. Liquid hydrocarbons will not be used as fuel and no bulk storage facilities are to be built on site.**

5 CONSTRUCTION ENVIRONMENTAL MANAGEMENT

5.1 Overview

A Construction Environmental Management Plan (CEMP) will be developed and implemented prior to construction. The CEMP will be developed to meet the requirements for pipeline construction under the *Petroleum Pipeline Act 1969.* Construction of the power station and the transmission line will also be addressed in CEMPs.

The CEMP has as its primary purpose the protection of the environment through minimisation of the effects of activities and the restoration and rehabilitation of areas disturbed by the activities. The CEMP will contain working information including specific management strategies and procedures necessary to manage the potential environmental impacts of construction of the power station, the gas pipeline, compressor station and transmission line.

A draft CEMP is included as Appendix E. It will be further developed as project designs become more detailed.

Table 5.1 provides a summary of objectives and performance criteria contained within the CEMP as a guide to the management of potential environmental impacts.

Pipe Stringing and Welding	Native fauna not trapped in open trench.	**Dust suppression will be conducted along all access tracks used by pipe trucks.** **Pipe shall be strung allowing gaps for vehicle, stock and wildlife access across the line of pipe. Gaps shall coincide with access tracks, boundary fences and gaps in stockpiled vegetation.** **The ingress of dust, wildlife and other objects into the trench and welded pipe sections, particularly at night, shall be prevented by appropriate means such as backfilling trench as soon as is appropriate and 'night caps' placed over the open pipe string ends.** **Pipe transport will be managed to ensure suitable arrival onto the ROW to enable construction to occur without undue storage requirements.** **Precautions shall be taken to minimise bushfire risk including the requirement of a spotter and water tank and/or fire extinguishers.** **The trench will need to be suitably shored in sandy terrain.**
Weeds and dieback management	Weeds minimized and effectively controlled.	**Prior to mobilisation all earthmoving and mobile equipment is to be washed down to ensure it is free from soil and vegetative material prior to arriving at the construction site.** **Equipment brought to site is to be inspected for evidence of vegetative material, soil or rock.** **Equipment that has been brought to site with evidence of vegetative material or soil is not to commence work but is to be taken to suitable washing facilities and be washed down.** **Any weed infestations noted during construction are to be reported to the Construction Manager. Upon being reported, action is to be taken to remove or treat weed infestations within the immediate construction area. Actions may include spraying, physical removal or changes to operational procedures.** **Ongoing landholder liaison regarding any known weed infestations.** **Vehicle hygiene inspections will be undertaken and recorded prior to mobilisation to site, with at least weekly visual vehicle inspections.**
Fauna management	No destruction of native fauna	**In densely vegetated areas, spoil material from the trench will also be formed up along one margin of the pit, potentially reducing the likelihood of fauna falling into the trench.** **Daily checking of the trench for fauna will be conducted prior to commencement of work.**

Table 5.1 **Summary of CEMP Commitments**

Aspect	Performance Indicator	Objective
Access	Public access controlled	**No public access to the ROW.**
Clearing	Topsoil managed. Dust nuisance minimised. Erosion and sedimentation controlled. Vegetation clearing minimised.	**Cleared vegetation may be stored off the ROW and raked back during reinstatement to maintain root stock.** **In the vicinity of the pine plantation which abut Perry Road between Kp 22.0 and 22.6; Kp 22.9 and Kp 23.7; and Kp 24.9 and Kp26.0, liaison will be undertaken in advance of any clearing with the Forest Products Commission and DEC.** **Mark limit of clearing and control clearing so that it does not occur outside the marked area.** **Older or habitat trees will be kept wherever possible.** **Graded soil shall be stockpiled separately from other materials (eg vegetation) where it can be readily recovered for respreading and where it will not be lost through wind or water erosion or other means.** **Soil and surface stability shall be maintained at all times.** **Graded soil shall not be stockpiled where it has the potential to result in sedimentation.** **Top soil containment measures such as sediment fencing shall be used as necessary, especially during wet weather.** **Stockpiled soil shall not impede the movement of stock and vehicles across the pipeline construction area. Stockpile beaks shall coincide with designated access tracks, fence lines and gapes in stockpile vegetation.** **Grading and stockpiling of soil shall not, as far as practicable, impede surface drainage or water flows.**

what is this?

Hygiene measures - diseases + weeds
Fire managmt
Trench fauna managmt eg p. 38

Table 6.1 **Summary of Stakeholder Engagement**

Landholder/ Stakeholder	Issues / Suggestions	NewGen Power (NGP) Strategy / Actions
Environmental Protection Authority	EPA issues likely to be impact on groundwater, clearing of native vegetation and cumulative impact on air quality and level of noise.	**NGP have carried out modelling for air quality and noise and an analysis of the extent of clearing, impact on wetlands and description of flora and fauna**
WA Planning Commission	WAPC would prefer that project be located in a power station precinct but recognised timing would not allow this to happen. Project needs to be compatible with structure plan. City of Wanneroo is likely to be determining authority but may refer to WAPC for comment. If pipeline crosses WAPC land would require approval.	**Discussions with City of Wanneroo and DOIR have indicated acceptance of this site for a power station. It is likely this site may be part of a power precinct in the future.** **Planning approval will be sought from City of Wanneroo and WAPC.**
Department of Water	DoW focussed on construction of pipeline. Want it to be well managed to prevent pollution of groundwater. Deviation of pipeline route in Reserve 45511 vested in the Water and Rivers Commission to avoid Bush Forever site and CCW. DoW would prefer that the pipeline traversed the degraded area on the edge of the Bush Forever site 293 and the CCW. Agreed that the route in R45511 can be carried forward as an option pending further discussion with DoW.	**NGP have prepared a draft pipeline construction environmental management plan that will be provided to DoW for comment prior to finalisation.** **NGP will pursue revised route and agree details of construction to minimise intrusion into the reserve and rehabilitate to DoW requirements.**
Local Member Dianne Guise	Dianne Guise raised compatibility with local structure plan and power line route and construction. Concern has been expressed about power lines from new Neerabup Terminal. Provided up-date of project. Discussed consultation on transmission line.	**The proposal is compatible with the structure plan for the Neerabup Industrial Estate. NGP have discussed the proposal with Western Power and local residents. Single column power poles will be used rather than lattice towers to reduce visual impact.**

Bushfire Management	Emergency response plan in place	**Fire fighting equipment such as fire extinguishers and water trucks are readily available for fighting fires should there be ignition.** **Permit to Work procedure for hot work requires a spotter in heavily vegetated areas.** **Construction activities to cease during lightening activity.**
Dust Management	Minimise dust nuisance or sand blast potential.	**Control generation of dust through application of water from water trucks or other suitable means as required.** **Clearing or excavation activities may need to be suspended during periods of high wind to minimize dust nuisance or sand blast.** **Conduct regular awareness talks at Toolbox Meetings. Ensure dust is considered as a potential hazard during all Job Hazard Analysis assessments.** **Keep to existing tracks to minimise the extent of clearing and exposure of soil surfaces. Adhere to speed limits on all roads and construction areas.**
Noise Management	No noise nuisance complaints	**Equipment shall be fitted with appropriate noise abatement devices maintained in good working order.** **Local landholders shall be informed of potential noise from construction, maintenance or project activities prior to the commencement of activities.** **Where practicable, excessively noisy activities shall be scheduled for periods that are less likely to result in noise nuisance. This decision will be made in consultation with the landholders.**
Waste Disposal	Waste minimized Recycling of waste promoted ROW maintained in a tidy state	**A waste skip or similar device will be placed at suitable locations within the work area to cater for the collection of all solid waste materials generated from the work. Arrangement will be made for the regular collection and servicing of the sites waste bins.**

Erosion and sediment control	Erosion and sedimentation effectively controlled.	**Monitoring of weather activities to ensure construction activities are conducted in a manner which will not increase the potential for impact on surface drainage.** **Construction works will cease during extreme weather conditions.** **In the vicinity of the Gnangara water mound, the trench shall be suitably shored and any pump-out of water from the trench shall be directed via a mesh over a vegetated area.** **Implement site specific erosion control measures such as diversion drains and silt mesh fencing.** **Construct control banks to divert storm-water away from disturbed areas.**
Fuel & Chemical Storage	Storage complies with AS1940. No fuel spills.	**The storage and handling of fuels and chemicals will comply with all relevant legislation and Australian Standards AS1940:1993 – The storage and handling of flammable and combustible materials.** **MSDS is maintained when purchasing chemicals and is available on site for all chemicals stored and handled.** **Appropriate fuel and chemical handling procedures are adopted which aim to avoid spills to land and water.** **Spill equipment, such as absorbent material etc will be contained on the refuelling trailer in order to immediately respond to any minor spillage.** **The contractor is responsible for ensuring all plant and equipment brought on to site has been serviced beforehand in order to minimise the amount of on-site servicing required. All equipment is to be inspected and tested prior to mobilisation to ensure it does not have oil leaks and is in suitable condition to be operated without causing excessive black smoke or failure of hydraulic hoses etc.** **Any chemicals or fuels in containers (i.e. 205 litre drums etc) required for the onsite work will be stored in self bunded containers or temporary bunding arrangements. All waste oils will be collected and stored in labelled drums for disposed offsite by an authorised liquid waste contractor.**

Acid sulphate soils management	No environmental damage from acid sulphate soils	**Trenches are not to be left open for more than 8 hrs as far as practical. If this is required and the soil in the trench is waterlogged, it can be assumed to be acid sulphate soil. A liberal dosing of the soil with agricultural lime is required before leaving the site for the day.** **If the trench is required to be dewatered, a check of pH should be undertaken, and the water neutralised with hydrated lime prior to discharge over grass and NOT into any storm water drain, gutter or watercourse.** **Any water logged soils/sand recovered from trenching will need to be checked for pH prior to disposal, as acid sulphate soils are located along the route. Where the soil pH is less than pH 5, the soil will need to be treated with agricultural lime at the rate of 20kg per cubic meter of soil prior to disposal.** **All spoil from underboring works to be neutralized and disposed to landfill following consultation with the local Council.**
Commissioning	Commissioning manual prepared	**Purging or venting gas shall be conducted under favourable local meteorological conditions which facilitate rapid atmospheric dispersion of the gas.** **Pre-commissioning and commissioning activities will be conducted in accordance with the Commissioning Manual.**
Consultation	**Liaison maintained**	**Liaison with landholders shall be maintained on relevant Potential Impacts including stock management, fencing, use of access roads and any construction activities. Liaison will also include general safety and awareness Potential Impacts and landholder obligations.**

6 STAKEHOLDER ENGAGEMENT

NewGen Power has undertaken a program to identify and engage a range of stakeholders including local residents and landholders affected by the proposal.

This engagement programme will continue to keep stakeholders informed of the details of the proposal and continue to respond to issues and suggestions communicated to NewGen Power staff.

6.1 Objectives

The engagement programme was developed to satisfy the following key objectives:

- To provide sufficient information to enable stakeholders to make an informed assessment of the nature and extent of the potential impacts from, and benefits of, the proposal;
- To provide opportunities for stakeholders to raise any particular concerns or suggestions regarding the proposal; and
- To ensure that NewGen Power has the opportunity to give appropriate consideration to the issues raised by stakeholders.

6.2 Stakeholders Identification

The key stakeholders for the proposal were initially identified from discussions with the Department of Environment and Conservation, Western Power and the City of Wanneroo.

NewGen Power has engaged with a wide range of stakeholders about the power station proposal since 2006. This has included:

- The Department of Environment and Conservation (DEC) – (including DEC Swan Region, Noise, Terrestrial Ecology, Wetlands and Air Quality Branches);
- The City of Wanneroo;
- The Environmental Protection Authority Services Unit (EPASU);
- Department for Planning and Infrastructure;
- Department of Industry and Resources;
- Landcorp;
- Department of Water;
- Forest Products Commission;
- Western Power;
- Members of Parliament;
- Wanneroo Golf Club; and
- Local residents.

Key elements of the consultation programme have included the following:

- Stakeholder briefings;
- Information handouts; and

- A community information day held in the Bansia Grove Community Hall in August 2007, attended by approximately 15 people from the local community;

A summary of the community engagement program, showing the stakeholders involved, issues or suggestions discussed and NewGen Power's response is provided in Table 6.1.

Landholder/ Stakeholder	Issues / Suggestions	NewGen Power (NGP) Strategy / Actions
Landowner (near compressor station)	Project was explained. Landowner comfortable with proposal provided the compressor station and pipeline does not compromise holding or operation of farm.	**Have considered different locations for compressor station to help minimise impact on farm property.**
Department for Planning and Infrastructure	Project was explained and discussed permission to access the DBNGP Corridor and DPI land. A formal application is to be made. DPI would prefer if the pipeline was contained in an easement.	**Formal application has been made.** **Have advised DPI of route and application made for Pipeline Licence.** **Pipeline will be contained within an easement.**
City of Wanneroo Statutory Planning Section	City of Wanneroo would prefer pipeline route not through Lake Pinjar as it is a Bush Forever site and Conservation Category Wetland. Would need development application for project. Development contributions may be required for upgrade of roads.	**Selected route does not go through Lake Pinjar. Preferred route has minimised impact on Bush Forever and CCW environment.** **Development application will be submitted when required.** **Road contributions to be discussed.**
City of Wanneroo Infrastructure Section	Discussed route of pipeline and use of the City's Reserve 11598 as an access for the pipeline to the site. City would consider the request but were concerned about sterilising the land. They also mentioned the likelihood of another power plant on that land. Discussed change of pipeline route to allow expansion of Old Yanchep Road reserve in the future and protection of *Bush Forever* sites. City provided plans of new road reserve which would mean the pipeline would need to be moved 32m west of current location in parts of its route along the road	**Preferred route traverses along the boundary of Reserve 11598 and is acceptable to City.** **Pipeline route changed to accommodate plans for expanded road reserve. Committed to on-going consultation with city as design is refined.**
Department of Environment and Conservation Air Quality Branch	Outlined project and explained that Katestone Environmental would be contacting DEC to seek advice on the scope and methods for air quality modelling for the project.	**Katestone discussed modelling with Anthony Stuart prior to undertaking work.**

Landholder/ Stakeholder	Issues / Suggestions	NewGen Power (NGP) Strategy / Actions
Department of Environment and Conservation Wetlands Section	Provided pipeline route options by email requesting comment on any wetland issues. The Pinjar Road option goes through the southern section of Lake Pinjar north of the site of an old rubbish tip.	**Pinjar Road option abandoned. Preferred route passes through degraded area of one CCW and one resource enhancement wetland within the DBNGP corridor.**
Department of Environment and Conservation Terrestrial Ecology Branch	DEC prefer route which minimises impact on Lake Pinjar and native vegetation. Offsets should be discussed with Swan Region Office. Discussed new pipeline route. DEC want information in assessment document on conservation significance of cleared vegetation outside of metropolitan region. Further information needed to support statement that no DRF would be impacted by proposal. Information needed on any threatened invertebrate species.	**Preferred route minimises impact on native vegetation and avoids Lake Pinjar.** **Offsets initiated with DEC Swan staff.** **Information included in referral.** **Ground surveys conducted. Information included in referral.** **Information included in referral.**
Department of Environment and Conservation Swan Region Office	Concerned with ONC route through pine plantation as it divides the plantation. Prefer all infrastructure to be in one corridor. Discussed off-sets for clearing.	**Pipeline route utilises existing corridors as much as possible such as the DBNGP corridor and adjacent to road corridors.** **NGP will work with Swan Region staff to either transfer land to DEC estate or provide conservation covenant on private land or rehabilitate an agreed portion of DEC estate.**

Landholder/ Stakeholder	Issues / Suggestions	NewGen Power (NGP) Strategy / Actions
EPA Service Unit	Discussed draft documentation provided to EPASU. Further information needed on: - cumulative impact of air and noise emissions; contribution to ozone levels and impact on Bush Forever sites.	**Additional assessment of cumulative impacts provided.** **Additional assessment of contribution to ozone levels provided.** **Pipeline route further revised to avoid impact on Bush Forever sites.**
Forest Products Commission	Discussed project with Forest Products Commission (FPC) and pipeline route in FPC plantations. FPC requested information including pipeline survey route and access protocols. FPC advised that approval was also required by DEC as landowners. Discussed FPC requirements for their logging operations and design of the pipeline. Compensation required includes for lost production Discussed pipeline route change to accommodate City of Wanneroo. FPC acknowledged changes.	**Access protocol provided. Survey of pipeline route has been undertaken.** **Provided requested information for FPC.** **DEC involved.** **FPC requirements included in design.** **Compensation will be agreed with FPC.** **Provided FPC with GIS information for new pipeline route.**
Western Power	Discussed consultation for 330 kV transmission line to connect with the terminal substation.	**Have consulted with local residents and council on transmission line route.**
Conservation Council	Spoke with Chris Tallentire and outlined proposal. Emailed project information and requested meeting.	**No response as yet.**
Landowner (near power station and transmission line)	Presented project and results of studies. Discussed noise levels and location of transmission line. Landowner said they were not opposed to the proposal. Wish to be kept informed.	**Provided copy of noise and air quality modelling reports.**

Landholder/ Stakeholder	Issues / Suggestions	NewGen Power (NGP) Strategy / Actions
Landowner (near power station and transmission line)	Presented project and results of studies. Discussed noise levels, air quality and location of transmission line. Landowner said they were not opposed to the proposal. Wish to be kept informed.	**Provided copy of noise and air quality modelling.**
Wanneroo Golf Club (WGC)	Presented project and results of studies. Discussed noise levels, air quality and location of transmission line. WGC said they were comfortable with proposal. Requested brochures for members.	**Provided copies of summary project report and brochures for distribution to members.**
Residents of Bansia Grove	Held public information day for residents after being advertised through a letter box drop. Approximately 15 people attended. Concerns were initially about potential air quality, noise levels, transmission lines and employment opportunities. Provided copies of Information for Public Comment document and Fact Sheets. Explained project including results of air and noise studies and single pole transmission line. Wished to be kept informed of progress.	**Banksia Grove Residents Association have own newsletter and NGP will advise future information sessions in this.** **No comments received from Information for Public Comment document.** **NGP have offered to attend any Residents Association meeting.** **NGP will conduct more public information days throughout the project.**
Capricorn Riding School for Disabled	Showed plans for power station and pipeline route including section of pipeline on Riding School land as part of deviation to avoid Bush Forever site and CCW. School would need construction area fenced and their fences repaired. Prefer no work on Saturday. Need to send details to School committee.	**Information sent on pipeline activities and timing to School committee with commitment to ensuring school paddock fences kept intact at all times and no Saturday work on School property.**

7 COMMITMENTS

Table 7.1 contains NewGen Power's commitments for environmental management of the 330 MW Gas-Fired Power Station at Neerabup.

Table 7.1 NewGen Power's Environmental Management Commitments

No.	Topic	Action	Objective	Timing	Advice
1	Construction Environmental Management	NewGen Power will develop a Construction Environmental Management Plan (CEMP) for the power station, pipeline and transmission line which will include, but not be limited to, the following plans: ■ Construction Noise Management ■ Construction Dust Management ■ Fauna and Flora Management ■ Weeds and dieback ■ Wetland crossing ■ Hazardous Materials Management ■ Waste Management ■ Water Management ■ Risk Management ■ Rehabilitation ■ Traffic Management ■ Fire management ■ Acid sulphate soils ■ Aboriginal heritage	Manage all relevant environmental factors associated with the construction phase of the project.	Pre-construction	DEC,DOIR
2	Construction Environmental Management	Implement the CEMP referred to in Commitment 1	To achieve outcomes of commitment 1	Construction	DEC

No.	Topic	Action	Objective	Timing	Advice
3	Construction Environmental Management	Employ an Environmental Officer to ensure implementation of all Commitments and Actions provided	To achieve outcomes of all commitments1	During Construction	DEC
4	Environmental off-set	NewGen will agree with DEC Swan Region an offset programme for the addition of land into the conservation estate either by purchase or rehabilitation of an area.	To mitigate the environmental impact of clearing around 30 ha required for the pipeline corridor and transmission line.	Within 12 months of start of pipeline construction.	DEC
5	Environmental off-set	Implement the purchase or rehabilitation strategy referred to in commitment 4.	To achieve outcomes of commitment 4.	Within 2 years of completion of pipeline construction.	DEC
6	Spring surveys	NewGen will carry out spring surveys in native bushland for Declared Rare Flora, Priority Flora and other species of conservation significance. The survey will also identify any Threatened Ecological Communities.	Identify flora species and communities of conservation significance.	Spring 2007.	DEC
7	Significant flora and vegetation management plan	NewGen will develop a management plan following the spring flora survey to manage the impact on any significant species and communities.	Manage the impact on identified species or communities.	Prior to construction.	DEC
8	Noise	NewGen will carry out noise monitoring to confirm modelling results within 12 months of commissioning of the compressor station and generator units at the power station.	Compliance with Noise Regulations.	Within 12 months of commissioning the compressor station and power station.	DEC
9	Noise	NewGen will implement noise monitoring referred to in Commitment 8.	To achieve outcomes of commitment 8.	On-going	DEC
10	Greenhouse	NewGen Power will develop a Greenhouse Gas Abatement Plan.	To minimise emissions of greenhouse gases.	Prior to commercial operation.	DEC

No.	Topic	Action	Objective	Timing	Advice
11	Greenhouse	NewGen Power will fund energy efficiency programs in conjunction with Synergy including employment for a Greenhouse Program Officer.	To minimise emissions of greenhouse gases.	Within 12 months of commercial operation.	DEC
12	Greenhouse	NewGen Power will join the Greenhouse Challenge Plus program.	To minimise emissions of greenhouse gases.	Prior to commercial operation.	DEH (Cth)
13	Complaints	A complaints register will be held at the site and any complaints from the community will be logged and investigated and, if appropriate, acted upon.	To engage positively with the local community.	On-going.	DEC
14	Operational Environmental Management	NewGen will develop a Operational Environmental Management Plan (OEMP) for the power station which will include, but not be limited to, the following plans: ■ Air Emissions Management and monitoring ■ Hazardous Materials Management ■ Waste Management ■ Water Management and Monitoring ■ Traffic Management	Manage all relevant environmental factors associated with the operational phase of the project.	Pre-commissioning	DEC
15	Operational Environmental Management	Implement the OEMP referred to in Commitment 14.	To achieve outcomes of commitment 14.	On-going	DEC
16	Decommissioning	NewGen will prepare a Decommissioning Management Plan (DMP).	Manage all relevant factors associated with decommissioning	12 months prior to decommissioning	
17	Decommissioning	Implement the DMP referred to in Commitment 16.	To achieve outcomes of commitment 16.	On-going	

8 REFERENCES AND MAPS

8.1 References

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DO NOT SCALE

Pipelines

- Proposed Gas Pipeline
- 1 Km Chainage Point

Tenure

- Property Boundaries
- Easements

General

- Vent
- Proposed Compressor Station
- 5 m Contour

Bush Forever Sites

- Bush Forever Sites

Wetlands

- Conservation
- Resource Enhancement

N

No.	Date	REVISION	Drawn	Surv	App'd
K	27/07/07	REV 12 ONC OPTION	CB		
J	17/07/07	REV 10 ONC OPTION	CB		
I	25/06/07	REV 8 ONC OPTION, COMPRESSOR STATION REVISED	RH		
H	18/06/07	REV 7 ONC OPTION, BUSH FOREVER SITES ADDED, TITLE UPDATED, WETLANDS ADDED	RH		
G	25/05/07	REV 6 ONC OPTION	LF		
F	21/05/07	PINJAR OPTION REMOVED, REV 4 ONC OPTION	RH		
E	10/05/07	ONC OPTION ADDED, REV 4 PINJAR ROAD OPTION	CB		
D	12/04/07	5M CONTOURS ADDED, PROPOSED COMPRESSOR STATION ADDED	RH		

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NewGen Power 330 MW Gas-Fired Power Station

FIGURE 8.1

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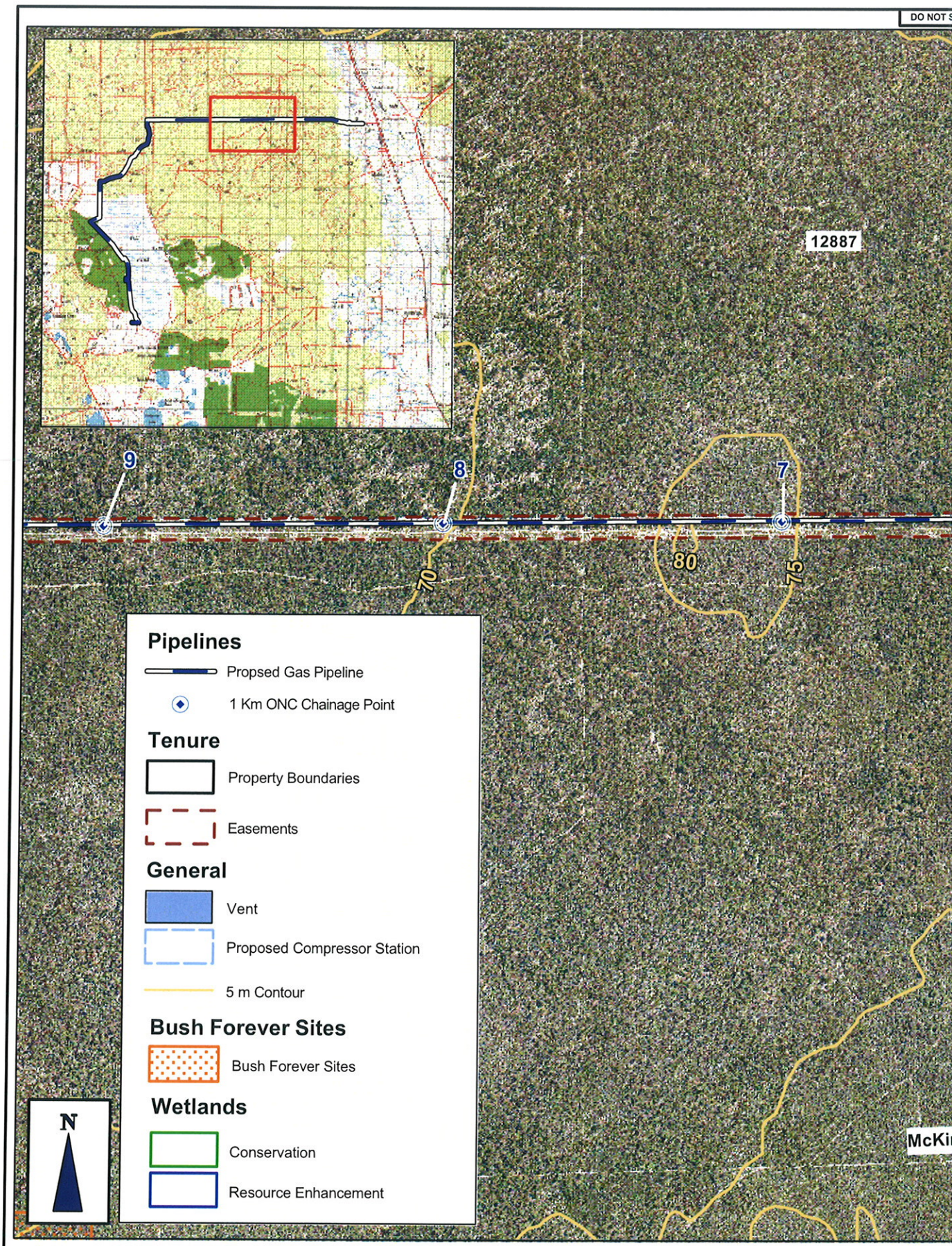

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I	17/07/07	REV 10 ONC OPTION	CB		
H	18/06/07	REV 7 ONC OPTION, BUSH FOREVER SITES ADDED, PLAN NUMBER UPDATED, WETLANDS ADDED	RH		
G	25/05/07	REV 6 ONC OPTION	LF		
F	21/05/07	PINJAR OPTION REMOVED, REV 4 ONC OPTION	RH		
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D	12/04/07	5M CONTOURS ADDED, PROPOSED COMPRESSOR STATION ADDED	RH		
C	11/04/07	1KM KP POINTS ADDED	RH		

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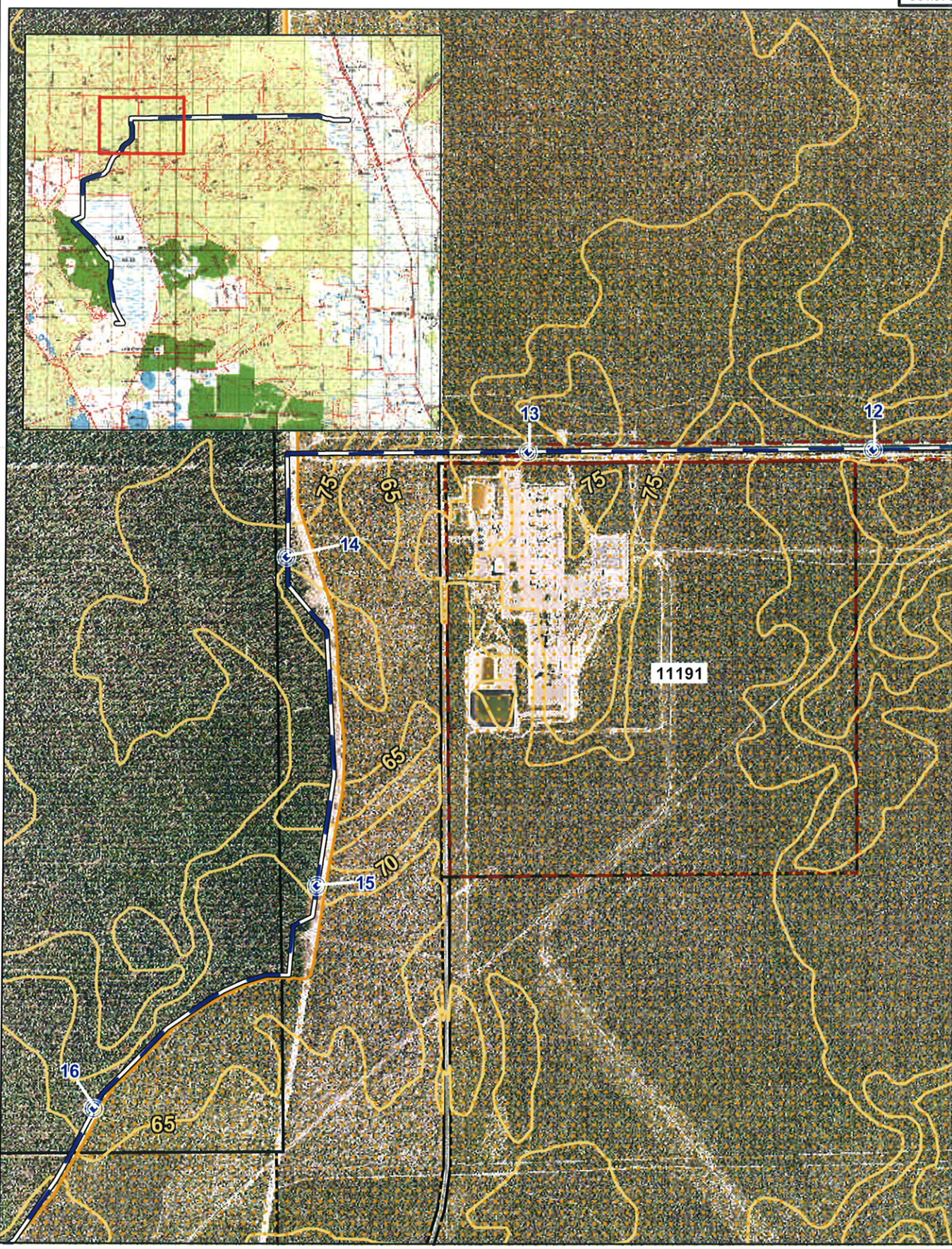

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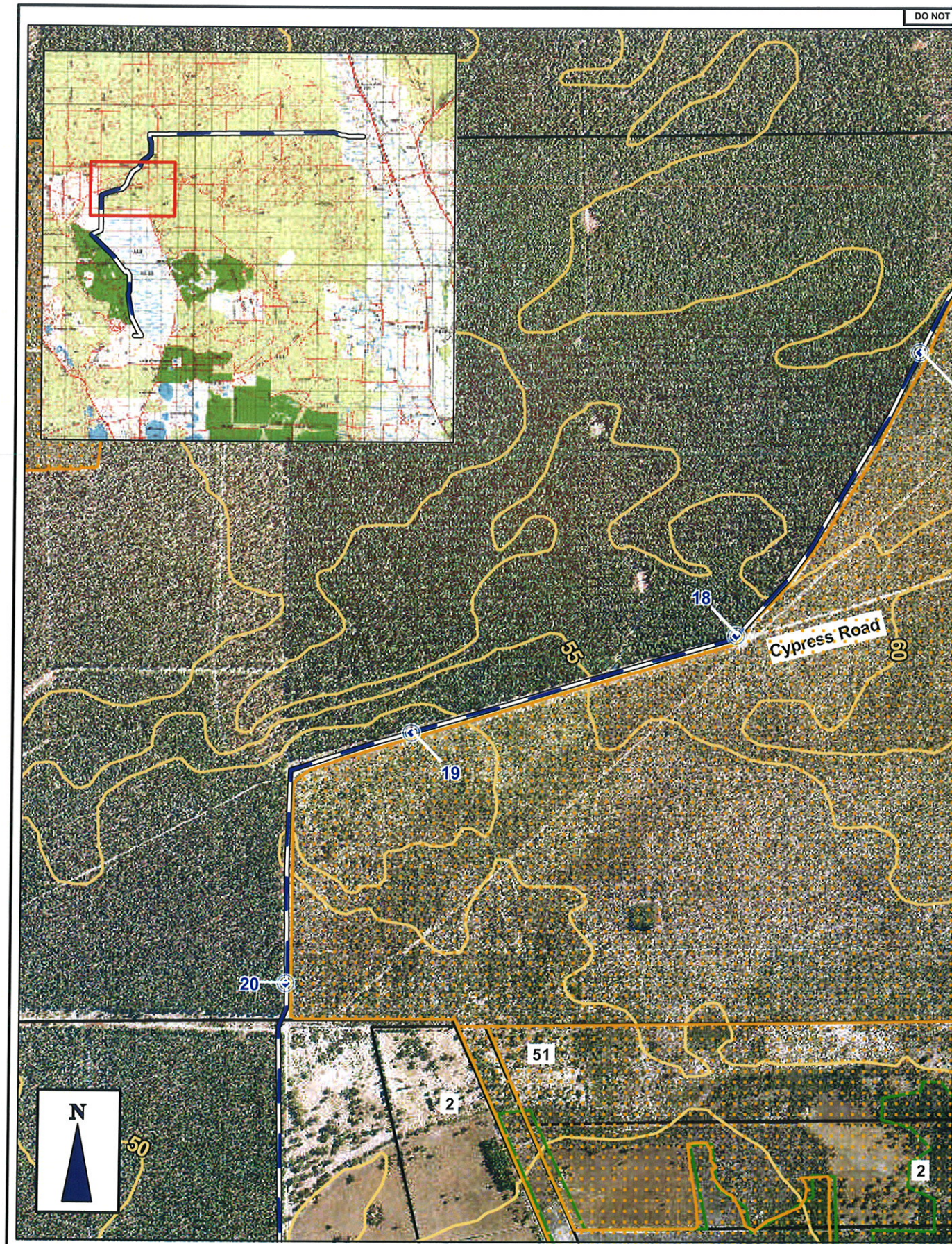

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G	26/05/07	REV 6 ONC OPTION	LF		
F	21/05/07	PINJAR OPTION REMOVED, REV 4 ONC OPTION	RH		
E	10/05/07	ONC OPTION ADDED, REV 4 PINJAR ROAD OPTION	CB		
D	12/04/07	5M CONTOURS ADDED, PROPOSED COMPRESSOR STATION ADDED	RH		
C	11/04/07	1KM KP POINTS ADDED	RH		

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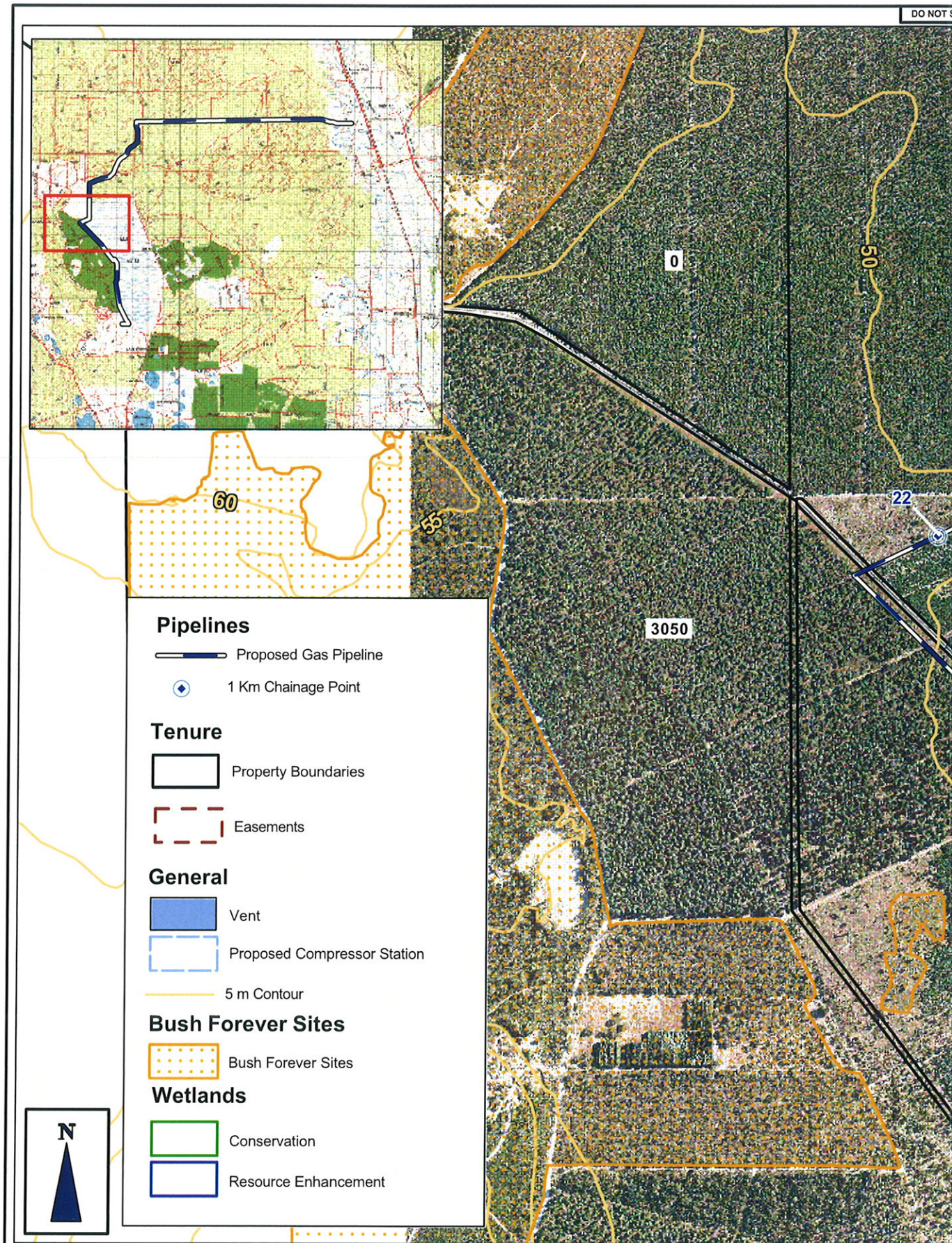

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DO NOT SCALE

Pipelines
- Proposed Gas Pipeline
- 1 Km Chainage Point

Tenure
- Property Boundaries
- Easements

General
- Vent
- Proposed Compressor Station
- 5 m Contour

Wetlands
- Conservation
- Resource Enhancement

Bush Forever Sites
- Bush Forever Sites

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G	25/05/07	REV 6 ONC OPTION	LF		
F	21/05/07	PINJAR OPTION REMOVED, REV 4 ONC OPTION	RH		
E	10/05/07	ONC OPTION ADDED, REV 4 PINJAR ROAD OPTION	CB		
D	12/04/07	5M CONTOURS ADDED, PROPOSED COMPRESSOR STATION ADDED	RH		
C	11/04/07	1KM KP POINTS ADDED	RH		

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100 0 100 200 Metres
SCALE 1:15000

DRAWN	CB	18/01/07
SURVEYOR		
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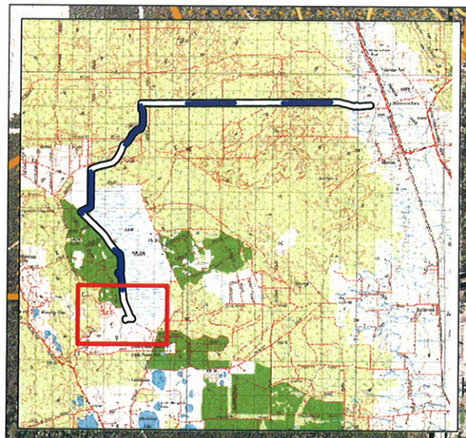
APPROVED		

NewGen 330 MW Gas-Fired Power Station

FIGURE 8.6

DATUM GDA 94 ZONE 50 | DRAWING NUMBER 07197 - 008 | REV J | SIZE A3 | LMK:

DO NOT SCALE



Tenure

- Property Boundaries
- Easements

General

- 5 m Contour
- Western Power Neerabup Terminal
- Newgen Power Site

Pipelines

- Proposed Gas Pipeline
- 1 Km Chainage Point

Wetlands

- Conservation
- Resource Enhancement

Bush Forever Sites

- Bush Forever Sites

N

3050 0 0 0 0 0 0 2694 1978 1640 1553 102 1 600 200 202 601 4 1002 1001 1000 507 506 508 505 1002 4 5 900 901 902 1

50 55 45 45 70

29 30 30.54

BUSH FOREVER SITE 428

NEWGEN POWER STATION SITE

WESTERN POWER NEERABUP TERMINAL SITE

Perry Road

Old Yanchep Road

Flynn Drive

No.	Date	REVISION	Drawn	Surv	Appd
N	16/08/07	POWER STATION SITE UPDATED	RH		
M	27/07/07	REV 12 ONC OPTION	CB		
L	12/07/07	REV 10 ONC OPTION	CB		
K	18/06/07	REV 7 ONC OPTION. Updated Plan Number. Wetlands added	LF		
J	29/05/07	TRANSMISSION LINE REMOVED	RH		
I	25/05/07	REV 6 ONC OPTION	RH		
H	23/05/07	POWER STATION & TERMINAL UPDATED	RH		
G	23/05/07	TRANSMISSION LINE ADDED. POWER STATION SITE ADDED. REV 5 ONC OPTION	RH		

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100 0 100 200
Metres
SCALE 1:15000

DRAWN	CB	18/01/07
SURVEYOR		
CHECKED		
APPROVED		

DATUM GDA 94
ZONE 50

NewGen 330 MW Gas-Fired Power Station

FIGURE 8.7

DRAWING NUMBER 07197 - 009

REV N SIZE A3
LMK

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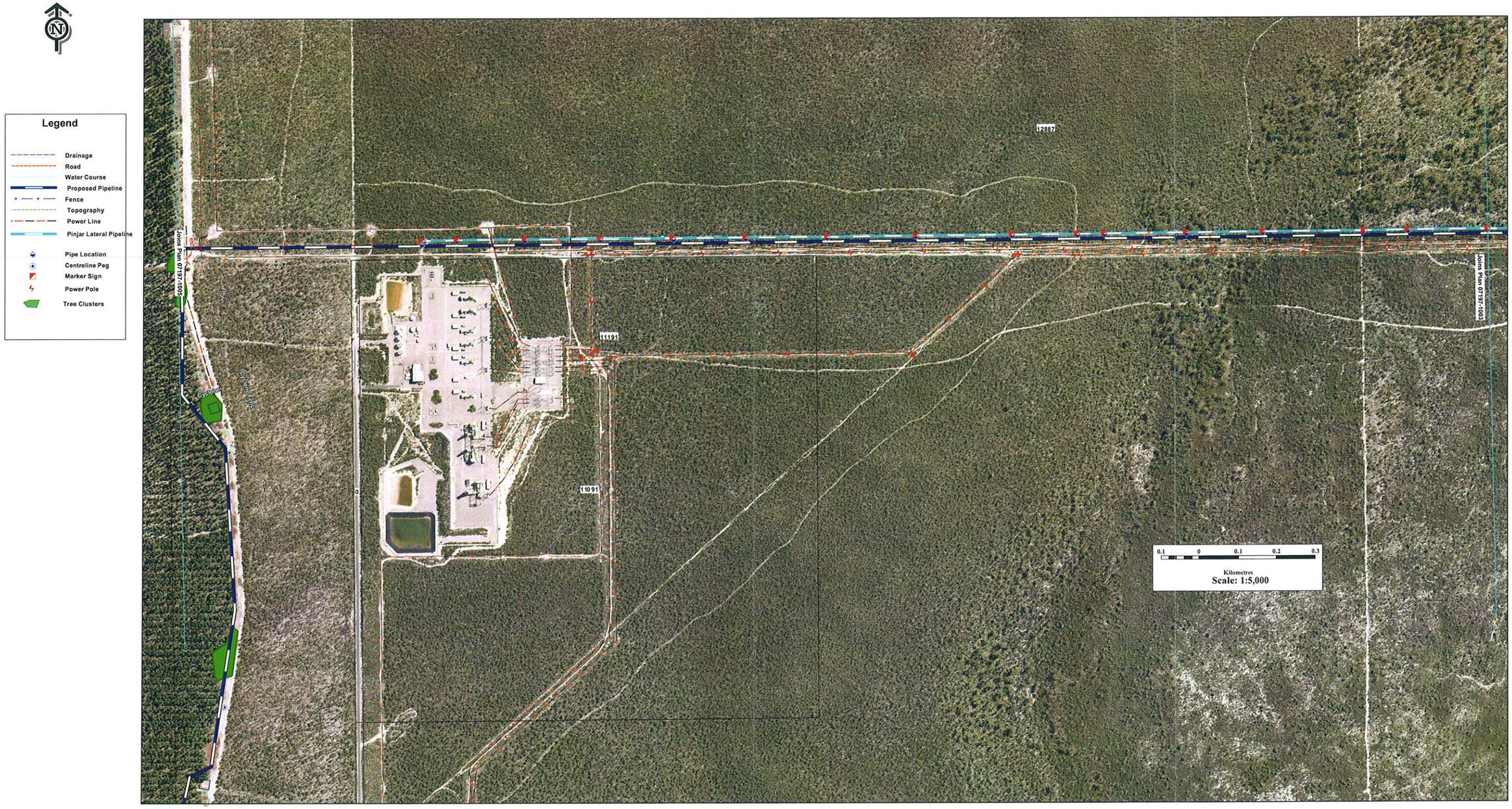
PIPARCEL	
TYPE	
LGA	



No.	Date	REVISION	DRN	CHKD	APPD
B	06/07/07	MINOR AMENDMENTS	C.M.		
A	03/07/07	ISSUED FOR CLIENT COMMENT	C.M.	CWK	

NOTES :

REF DRAWING NO	DRAWING TITLE

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HORIZ SCALE : 1:5000
VERT SCALE : 1:1000

PROJECT Gas Pipeline Lateral to to Neerabup Power Station

CHAINAGES : 10.343 - 13.886

CLIENT: NEW GEN POWER

ENGINEERING COMPANY	SURVEY COMPANY
New Gen Power	Warren King & Co.

DRAWING TITLE: Figure 8.8

DATUM	ZONE	DRAWING NUMBER	REV	SIZE
GDA 94	50	07197-1004	B	A1

APPENDIX A

Katestone Environmental

Air Quality Assessments of the Proposed NewGen 330 MW Gas-Fired Power Station

June 2007

Katestone Environmental

Air Quality Assessment of the Proposed NewGen 330 MW Gas-Fired Power Station

ERM POWER Pty Ltd

July 2007

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Rev 0.0	*D.Heuff, C.Killip & A. Schloss*	*Dr. Darlene Heuff*	*Simon Welchman*	*17/07/07*

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1. Introduction

Katestone Environmental has been commissioned by ERM Power Pty Ltd to prepare an air quality assessment and a greenhouse gas assessment of a proposed gas-fired power station at Neerabup in Western Australia. The proposed NewGen Gas-Fired Power Station is to consist of two open-cycle gas-turbines each with a nominal capacity of 165 MW and a total power station nominal capacity of 330 MW.

This report is structured to:

- Describe the existing air quality in the region;
- Estimate levels of air pollutants likely to be emitted from the power station;
- Consider meteorological and terrain conditions that could affect the transport and dispersion of air pollutants;
- Predict ambient air pollutant concentrations in the vicinity of the power station due to existing major industries;
- Use suitable dispersion models to estimate local and regional impacts due to the proposed facility;
- Assess the predicted impacts against air quality goals and standards in use in Western Australia;
- Estimate the predicted contribution to Australia's greenhouse gases; and
- Present conclusions on the acceptability of the proposal in terms of air quality.

2. Site activities

The NewGen Gas-Fired Power Station is proposed to consist of two 165 MW open-cycle gas-turbines. The NewGen Gas-Fired Power Station will have a total nominal capacity of 330 MW.

The two open-cycle gas-turbines will operate during peak load periods. The annual gas consumption of the NewGen Gas-Fired Power Station is estimated to be 11.2 PJ. The power station is not proposed to operate on any fuel other than natural gas.

Emissions to the atmosphere will occur during the following site activities:

- Normal and peak plant operations (turbines operating on gas);
- Startup and shutdown of the units (short-term varying emission rates); and
- Site traffic (including employees and delivery trucks).

Plant emissions have been estimated from information provided by ERM Power for similar gas-turbines to that proposed. The actual gas-turbine technology is yet to be determined; however, emission rates of air pollutants and gas flow rates are unlikely to differ by more than 10% from that contained in Table 1. Notwithstanding this, a revised assessment may be required if the technology chosen has substantially different emissions to that assumed in this assessment.

Table 1: Summary of plant performance provided by ERM Power

SSC5-2000E (33MAC) (simple cycle turnkey plant)		
PERFORMANCE DATA		**Design**
Net power	MW	154.5
Net efficiency	%	33.7
Net heat rate	kJ/kWh	10696
Gross power	MW	155.6
Gross efficiency	%	33.9
Gross heat rate	kJ/kWh	10621
EMISSION DATA		
NO_x emissions	ppmvd@15%O_2	25
	kg/h	72
CO emissions	ppmvd@15%O_2	10
	kg/h	17
AMBIENT CONDITIONS		
Air temperature	°C	27
Air humidity	%	60
Air pressure	mbar	1005.47
OPERATING DATA		
Evap. cooler status		on
Fuel type		Std. gas
Fuel LHV	kJ/kg	50012
Fuel mass flow	kg/s	9.18
Water/Steam injection		no
GT exhaust gas mass flow	kg/s	504
GT exhaust gas temperature	°C	545
Power factor	-	0.8

3. Local terrain and surrounding land use

The NewGen Gas-Fired Power Station is to be located in the Neerabup Industrial Estate in the City of Wanneroo, a northern suburb of Perth, Western Australia (Figure 1). The area surrounding the NewGen Gas-Fired Power Station is relatively flat with little significant terrain extending away for a radius of approximately 20 kilometers. The Indian Ocean is located approximately 10.5 kilometers to the west of the proposed power station. The land is relatively flat at the coast rising to a broad plateau of height 200 meters at approximately 20 kilometers from the coast.

4. Emission characteristics

The most important group of pollutants that are emitted from a gas-turbine are oxides of nitrogen (NO_x) due to their potential to affect urban air quality. Oxides of nitrogen in the plume of a gas-turbine just after emission, consists of nitrogen dioxide (NO_2) (usually less than 10 %), nitric oxide (NO, usually about 90 %) and minor quantities of nitrous oxide (N_2O).

The EPA has issued guidelines for emissions of oxides of nitrogen from gas turbines, these are published in:

Emissions of Oxides of Nitrogen from Gas Turbines, Guidance for the Assessment of Environmental Factors No. 15, Preliminary Guidance, Environmental Protection Authority, Western Australia, March 1999.

The objective of this guideline is to prevent degradation of Western Australia's air quality by controlling excessive emissions of oxides of nitrogen from new gas turbines. The guideline recommends the use of the AEC/NH&MRC national guideline for oxides of nitrogen emissions from a gas turbine of 0.07 g/m^3 (dry, 273 K, 101.3 kPa and 15% O_2) or 34 ppm (15% O_2). Other Australian states use this guideline (eg. QLD) or specify equivalent limits in policies or regulations (eg. Victorian SEPP (Air Quality Management) 2001 or the NSW Protection of the Environment Operations (Clean Air) Regulation 2002).

The proposed NewGen Gas-Fired Power Station will incorporate low NO_x burners and will comply with the EPA's recommended emission limit of 34 ppm during normal operations. Under all normal operating loads the emission concentration of oxides of nitrogen will be less than 25 ppm (at 15% O_2).

Sulphur dioxide, carbon monoxide and particulate matter are produced in very small quantities by a gas-turbine. The magnitude of sulphur dioxide emissions is determined by the amount of sulphur in the fuel. The natural gas supplied by the Dampier to Bunbury gas pipeline has a specified sulphur concentration of less than 10 mg/m^3.

A summary of the stack configuration and peak-load emission characteristics of the proposed NewGen Gas-Fired Power Station are presented in Table 2. The NewGen Gas-Fired Power Station has been modelled assuming continuous operation at full load.

Table 2: Stack characteristics for the proposed power station.

Parameter	Units	Open-cycle gas-turbines
Number of stacks	-	2
Location	AMG (mN, mE)	386502, 6495320, UNIT 1 386458, 6495320, UNIT 2
Stack height	m	35
Stack diameter	m	6.0
Volume flow	Nm^3/s	390.09
Exit velocity	m/s	41.34
Temperature	°C	545.0
NO_x emissions	ppmV, day, at 15%O_2	25
	g/s/stack	20.03
CO emissions	ppmV, day, at 15%O_2	10
	g/s/stack	4.88
SO_2 emissions[1]	g/s/stack	0.27
PM_{10} emissions	g/s/stack	3.90
Note: [1]Sulphur content of fuel = 10 mg/m^3		

5. Air quality goals and standards

National ambient air quality standards and goals are specified by the National Environment Protection Council (NEPC) with agreement from all state governments in the National Environmental Protection (Ambient Air Quality) Measure (NEPM (Air)). Compliance with the NEPM (Air) standards is assessed by each state jurisdiction through ambient air quality monitoring undertaken at locations that are representative of large urban populations. A summary of the NEPM (Air) standards and goals relevant to this project are presented in Table 3.

The NEPM has been applied to all sensitive locations in the vicinity of the power station.

Table 3: National Environment Protection (Ambient Air Quality) Measure, summary of current standards and goals

Pollutant	Averaging Period	NEPM (Air) Standards ($\mu g/m^3$)
Nitrogen dioxide	1-hour Annual	246 62
Sulphur dioxide	1-hour 24-hour	570 228
PM_{10}	24-hour	50
Carbon monoxide	1-hour	11,250
Ozone	1-hour	214 (100ppb)

6. Existing Air Quality

The air quality in the vicinity of the Neerabup Industrial Estate is dominated by industries, motor vehicles and domestic activities in the local area and air pollutants generated in the broader urban and industrial areas of Perth.

The National Pollution Inventory is compiled annually by the Federal Department of the Environment and Water Resources. All industries that exceed certain thresholds are required to report their annual emission rates of air pollutants. This information is published by the Department on an annual basis.

There are three significant industrial sources of air pollutants in the City of Wanneroo that report to the NPI, they are:

- Wanneroo Feedmill owned by Ingham's Enterprises Pty Ltd. Located approximately 8 kilometres to the south of the proposed power station and is a source of oxides of nitrogen, sulphur dioxide, PM_{10} and carbon monoxide.

- Tamala Park Power Station owned by Landfill Gas and Power Pty Ltd. Located approximately 8 kilometres to the southwest of proposed power station and is a source of oxides of nitrogen and carbon monoxide.

- Pinjar Gas Turbine Station owned by Western Power Corporation. Located approximately 12.5 kilometres north-northwest of the proposed power station and is a source of oxides of nitrogen, sulphur dioxide, PM_{10} and carbon monoxide.

The emission rates of oxides of nitrogen, PM_{10}, sulphur dioxide and carbon monoxide that each of these facilities has reported to the NPI are reproduced in Table 4. Wesbeam Holdings Limited, a company that manufactures Laminated Veneer Lumber products is also located in the area. Emissions information for the Wesbeam facility was unavailable, however emissions from such as facility are expected to be small and unlikely to adversely affect background air quality.

Table 4: Major sources of pollutants within the City of Wanneroo for the year 2006.

Substance	Facility Name	ANZSIC Class Name	Latitude	Longitude	Total (kg)
Oxides of Nitrogen	Pinjar Gas Turbine Station	Electricity Supply	-31.56	115.82	1,900,000
	Tamala Park Power Station	Electricity Supply	-31.71	115.73	170,000
	Wanneroo Feedmill	Poultry Farming (Meat)	-31.74	115.80	1,200
Particulate Matter as PM_{10}	Pinjar Gas Turbine Station	Electricity Supply	-31.56	115.82	28,000
	Wanneroo Feedmill	Poultry Farming (Meat)	-31.74	115.80	4,400
Sulphur dioxide	Pinjar Gas Turbine Station	Electricity Supply	-31.56	115.82	8,000
	Wanneroo Feedmill	Poultry Farming (Meat)	-31.74	115.80	6.5
Carbon monoxide	Pinjar Gas Turbine Station	Electricity Supply	-31.56	115.82	300,000
	Tamala Park Power Station	Electricity Supply	-31.71	115.73	51,000
	Wanneroo Feedmill	Poultry Farming (Meat)	-31.74	115.80	1,000

The Pinjar Gas Turbine Power Station is located approximately 12.5 kilometres to the north of the proposed NewGen Gas-Fired Power Station site. Peak emissions from the Pinjar Power Station supplied in the DEC emissions inventory indicate the station to be a significant source of oxides of nitrogen in the region. Therefore, the Pinjar Power Station was included in the modelling as a source of background emissions.

Table 5: Stack characteristics for the Pinjar Power Station.

Parameter	Units	Pinjar Station Fr 6 1-3	Pinjar Station Fr 6 4-7	Pinjar Station Fr 9 1&2
Easting	m	387.9	387.9	387.9
Northing	m	6508	6507.9	6507.7
Stack height	m	10.6	10.6	40
Stack diameter	m	4.45	5.08	6.01
Exit velocity	m/s	47.7	47.7	64.9
Temperature	°C	813	813	813
NOx emissions	g/s	60	81	100

On an airshed wide basis, the Perth Airshed Inventory (DEP, 2002) found that the major sources of oxides of nitrogen are motor vehicles (42%) followed by industrial activities (32%). Sulphur dioxide emissions are dominated by industrial activities (86%). However, inventory data shows that sulphur dioxide emissions have declined and this is supported by data from long-term ambient monitoring stations that show that sulphur dioxide has declined substantially since the 1970's.

The EPA operates ambient air quality monitoring stations across the Perth airshed. The nearest monitoring station to the proposed NewGen Gas-Fired Power Station is at Quinns Rock. Table 6 below presents a summary of ambient air quality statistics from the EPA's Quinns Rock monitoring station for the modelled year 2001.

Table 6: Summary of Quinns Rock monitoring data for the year 2001

Field Name	Units	Maximum 1-hour average	Maximum 24-hour average	Annual Average	95th percentile 1-hour average	95th percentile 24-hour average
Nitrogen dioxide	$\mu g/m^3$	74.6	–	8.4	32.2	–
Particulate Matter as PM_{10}	$\mu g/m^3$	36.9	57.4	18.0	25.2	23.7
Ozone	ppb	72.3	–	21.2	35.5	–

7. Meteorology

The NewGen Gas-Fired Power Station is located approximately 10 kilometres from the nearest meteorological monitoring station. For this assessment, meteorological data for the dispersion modelling was generated using the TAPM prognostic meteorological model for the year 2001. Comparison of TAPM meteorology at the Bureau of Meteorology stations located at the Pearce RAAF Base and GinGin Airport suggested that the existing TAPM meteorology for the region was not entirely representative of actual conditions. Assimilation of meteorological data from the Bureau of Meteorology locations was performed and integrated into the TAPM modelling to produce more representative conditions. The use of this model is described further in Section 8.

The wind speed, wind direction, temperature, mixing height and stability class data generated by the model has been analysed. To determine the suitability of the meteorological data generated by TAPM, an evaluation of the predicted and measured winds was conducted by comparing the data with measurements from the EPA monitoring station at Quinns Rock. Wind roses are presented in Figure 2 that compare the measured and predicted wind speeds and wind directions at Quinns Rock. The wind roses show that TAPM simulates the winds satisfactorily with the dominant flows being similar. TAPM differed from the measured data in minor ways, such as: slightly lower wind speeds and a lower proportion of winds from the southerly sector compared with the measured data.

7.1 Wind speed, wind direction and temperature

The seasonal, diurnal and all hours wind roses for the NewGen Gas-Fired Power Station as generate by TAPM are presented in Figure 3. The wind roses show that the NewGen Gas-Fired Power Station site is dominated by winds from the easterly and southerly sectors.

Figure 4 shows a box-whisker plot of temperature versus time of day. The highest temperatures are recorded between 12 pm and 3 pm. Average daytime temperatures are around 17 °C, and can reach up to 36 °C in summer. Early-morning temperatures can be as low as 2 °C in winter.

7.2 Stability class and mixing height

Atmospheric stability class and mixing heights have been extracted from the TAPM simulations for the NewGen Gas-Fired Power Station site. Stability classification is a measure of the stability of the atmosphere. The stability classes range from A Class, which represents very unstable atmospheric conditions that may typically occur on a sunny day to F Class stability, which represents very stable atmospheric conditions that typically occur during light wind conditions at night. Unstable conditions (Classes A-C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for Class D conditions are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface. During the nighttime the atmospheric conditions are generally stable (often Classes E and F).

Table 7 shows the percentage of stability classes determined from TAPM. The high proportion of F Class stability is due to the high frequency of light wind conditions at nighttime.

Table 7: Frequency of occurrence (%) of surface atmospheric stability conditions (Class A represents the most unstable conditions) for the NewGen Gas-Fired Power Station.

Pasquill-Gifford Stability Class	Frequency (%)	Classification
A	2.1	Extremely unstable
B	15.0	Unstable
C	12.6	Slightly unstable
D	27.0	Neutral
E	8.2	Slightly stable
F	35.1	Stable

The extent of the mixing height and the strength of the temperature inversion are very important features that can limit the degree of dispersion of pollutants. The height of the mixed layer changes with time of day and season. Shallow mixing heights occur at night under stable atmospheric conditions. Generally lower mixing heights occur during winter when stronger temperature inversions and reduced solar radiation restrict the growth of the mixing depth until later in the morning. The degree of dispersion or mixing within the mixed layer is determined by the atmospheric stability.

Under stable atmospheric conditions (most of the evening and night-time) a buoyant plume will rise until it reaches the inversion height and will remain elevated and will be unlikely to give rise to any impact at ground level except if the plume strikes elevated terrain. Similarly, a plume that is released above the inversion height (such as from a tall stack) or penetrates the inversion due to high buoyancy (such as an open-cycle gas-turbine) will remain elevated and unlikely to impact at ground level.

After daybreak the mixing height increases due to two processes. The first is solar radiation heating the ground and consequent heating of the air close to the ground causing the air to rise and secondly winds creating turbulence at the surface. Fumigation occurs for elevated plumes when the depth of the mixed layer grows to the height of the plume, causing the plume to be brought to ground. These events can typically be expected for a short period over the first few kilometres from the stack.

When the mixing height exceeds the height of the plume, the plume appears to have a sinuous vertical structure caused by strong convective heating of the air at ground level. The thermal elements take the plume alternatively upwards and to ground (with a typical period of 5-20 minutes). In this situation, maximum concentrations are experienced close to the stack and are usually the highest experienced throughout the day and night for stack sources. In the late afternoon the intensity of convection decreases, the plume regains a more coherent shape and any ground-level impact from stack sources is unlikely as the nighttime radiation inversion reforms.

Figure 5 shows the mixing heights versus hour of day generated by the TAPM model for the NewGen Gas-Fired Power Station. The mixing heights show a typical diurnal profile increasing from 9 am and reducing from 3 pm. The highest average mixing heights are predicted from 1 pm to 3 pm, which is typical of strongly convective conditions.

8. Dispersion modelling Methodology

8.1 TAPM

Dispersion modelling of the NewGen Gas-Fired Power Station and surrounding region was undertaken using a methodology approved by Western Australia's Environmental Protection Authority.

The prognostic meteorological model, TAPM (The Air Pollution Model) Version 3.0.7 was used in this assessment. TAPM was developed by the CSIRO and has been validated by the CSIRO, Katestone Environmental and others for many locations in Australia, in southeast Asia and in North America (see www.dar.csiro.au/TAPM for more details on the model and validation results from the CSIRO). Katestone Environmental has used the TAPM model throughout Australia as well as in parts of New Caledonia, Bangladesh and Vietnam. This model has generally performed well.

TAPM predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology provided by the synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at the mesoscale (20 kilometres to 200 kilometres) and at the local scale (down to a few hundred meters). TAPM includes parameterisations of cloud/rain micro-physical processes, urban/vegetation canopy and soil, and radiative fluxes.

TAPM requires synoptic meteorological information for the Neerabup region as input into the model. This information is generated by a global model similar to the large scale models used to forecast the weather. The data are supplied on a grid resolution of approximately 75 kilometres, and at elevations of 100 metres to 5 kilometres above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the likely meteorology of a region as well as at a specific location.

TAPM was configured with data assimilation from monitoring stations operated by the Bureau of Meteorology within the modelling domain (Section 7). This method was used to ensure representative local wind conditions were well defined within the model.

Dispersion modelling has been conducted for the short-term and long-term ground-level impacts for nitrogen dioxide, particulates (as PM_{10}), sulphur dioxide and carbon monoxide. The proposed power station has been assessed for an operational load of 100%.

TAPM was setup as follows:

- 30 x 30 grid point domain with an outer grid of 30 kilometres and nesting grids of 10 kilometres, 3 kilometres and 1 kilometre (with a 250 metre grid for the stack dispersion modelling);
- 25 vertical levels;
- Grid centred over the NewGen Gas-Fired Power Station site centred (latitude –31° 40', longitude 115°48');
- AUSLIG 9 second DEM terrain data;
- The TAPM defaults for sea surface temperature;
- Default options selected for advanced meteorological inputs;
- The synoptic data used in the simulation is for the year 2001;
- Data assimilation for winds at Pearce RAAF Base and GinGin Airport; and
- Building wakes included.

The TAPM vegetation information for the region surrounding the NewGen Gas-Fired Power Station was modified with the assistance of detailed aerial photos in Google Earth.

The TAPM land-use at a 1 kilometre resolution was mainly defined as low, sparse woodland from north to east of the NewGen Gas-Fired Power Station and urbanised to the south and west along the coastline. A large band running northwest to southeast across the area of interest was identified as tall forest within TAPM's land-use categories, upon closer inspection the land-use was sparse in places and also encroached on by urban activities. Subsequent modifications were made to more accurately represent the conditions. Refer to Figure 6. At a 3 kilometre resolution changes to low mid-dense vegetation were made to reflect the changes at the 1 kilometre resolution. The soils were defined as a mix of sand, sandy clay loams and clay, consistent with TAPM defaults.

The NewGen Gas-Fired Power Station was modelled in Lagrangian mode. Although more computationally intense, the Lagrangian mode is preferable for assessing near-field impacts that are most critical in this study.

8.2 Background air quality

Background air quality was quantified using monitoring data collected at the EPA's site at Quinns Rock and dispersion modelling of the Pinjar power station for the local air quality assessment of n\oxides of nitrogen.

The full Perth regional emissions inventory was included in the regional photochemical modelling assessment.

8.3 Nitric oxide to nitrogen dioxide conversion

After the plume is emitted from the stack, the proportion of the nitrogen dioxide (NO_2) contained within the plume will increase as the Oxides of nitrogen (NO_x) combines with ambient gases such as ozone (O_3) and volatile organic compounds (VOC) to form nitrogen dioxide. The relationship between nitrogen dioxide and oxides of nitrogen is complex, requiring detailed photochemical modelling to accurately determine the amount of nitric oxide (NO) and nitrogen dioxide within the plume at any time. Such an accurate picture is not usually critical for estimating nitrogen dioxide impacts because simpler methods have been found to be adequate in many situations.

There are a number of simple methods available for conservatively estimating ground-level concentrations of nitrogen dioxide. The simplest is to assume that all of the oxides of nitrogen emitted from the power station is nitrogen dioxide. This is an extreme case and is unlikely to occur in practice. It is a useful screening approach where ground-level concentrations are low.

The USEPA has developed the Ozone Limiting Method (OLM). This method assumes that all of the ozone in the ambient air can be consumed immediately by the photochemical reaction to produce nitrogen dioxide. Consequently, at times when there is a low concentration of ozone, only small amounts of nitrogen dioxide will be produced and when the ambient ozone concentration is high, larger amounts of nitrogen dioxide will be produced. Whilst this method will over-estimate the production of nitrogen dioxide, it provides a useful but simple means of obtaining a more realistic upper bound on the nitrogen dioxide concentration. The OLM equation is reproduced as Equation 1.

$$[NO_2]_{total} = \{0.1 \times [NO_x]_{pred}\} + MIN\{(0.9) \times [NO_x]_{pred}, or (46/48) \times [O_3]_{bkgd}\} + [NO_2]_{bkgd}$$

Equation 1

Empirical methods use measurements of nitric oxide and nitrogen dioxide to provide some basis for converting nitric oxide to nitrogen dioxide. Measurements around power stations in Central Queensland show, under worst possible cases, a conversion of 25-40% of the nitric oxide to nitrogen dioxide occurs within the first 10 kilometres of plume travel. During days with elevated background levels of hydrocarbons (generally originating from bush-fires, hazard reduction burning or other similar activities), the resulting conversion is usually below 50% in the first 30 kilometres of plume travel (Bofinger et al 1986).

Figure 7 presents two cumulative frequency distributions of nitrogen dioxide at the most affected point on the domain. The blue line represents the frequency of impacts using OLM and the red line shows the nitrogen dioxide concentrations for a fixed 30% conversion. Monitoring data from Quinns Rock EPA site has been used for the OLM assessment. This plot shows that by using OLM, concentrations of nitrogen dioxide are higher by 1.4 to 3.0 times than that obtained using the 30% conversion efficiency for 50% of predictions.

Applying either OLM or the 30% conversion rate results in maximum predicted ground-level concentrations of nitrogen dioxide that are below the relevant guidelines.

A 30% oxides of nitrogen to nitrogen dioxide conversion rate has been used in this assessment.

9. Modelling results

9.1 Nitrogen dioxide

The maximum concentrations of nitrogen dioxide predicted using the TAPM model for the proposed NewGen Gas-Fired Power Station in isolation and in combination with existing local sources are presented in Table 8.

Table 8: Predicted maximum concentrations of nitrogen dioxide due to the proposed NewGen Gas-Fired Power Station and background sources (units: µg/m^3).

Sensitive Receptor Number	NewGen Gas-Fired Power Station only		NewGen Gas-Fired Power Station plus background sources	
	1-hour	Annual	1-hour	Annual
1	7.95	0.01	48.63	8.47
2	10.89	0.02	50.35	8.49
3	8.42	0.01	48.78	8.48
4	4.86	0.01	46.99	8.48
5	4.23	0.01	46.69	8.48
6	3.87	0.01	46.42	8.48
7	3.82	0.01	45.77	8.48
8	4.10	0.01	46.82	8.48
9	3.70	0.02	45.50	8.48
10	3.68	0.02	45.78	8.48
11	3.59	0.02	45.18	8.49
12	3.71	0.02	46.71	8.50
Maximum in modelling domain	18.44	0.04	96.35	9.01
Maximum at receptor locations	10.89	0.02	50.35	8.50
NEPM Standard	246	62	246	62

Figure 8 presents the maximum 1-hour average ground-level concentration and the annual average ground-level concentration of nitrogen dioxide for the NewGen Gas-Fired Power Station. The highest 1-hour average ground-level concentrations of nitrogen dioxide, are predicted to the south west of the site at a distance of approximately 4.5 kilometres. The highest annual average concentrations of nitrogen dioxide, are predicted in regions to the west and to the northeast of the site.

Presented in Figure 9 is the maximum 1-hour average ground-level concentration and the annual average ground-level concentration of nitrogen dioxide for the proposed NewGen 330 MW Gas-Fired Power Station and existing industrial sources. For the 1-hour average concentrations of nitrogen dioxide in Figure 9, highest concentrations are to the north-northeast of the NewGen Gas-Fired Power Station. This is predominantly from the contribution of the Pinjar Power Station located in the same vicinity. For the annual average concentrations of nitrogen dioxide, a concentration gradient exists with concentrations decreasing when moving north to south

9.2 Particulates

Results for the annual average and maximum 24-hour ground-level concentrations of particulates for the proposed NewGen Gas-Fired Power Station in isolation and in combination with existing local sources are presented in Table 9.

Table 9: Concentrations of PM_{10} due to the proposed NewGen Gas-Fired Power Station and background sources (units: µg/m^3).

Sensitive Receptor Number	NewGen Gas-Fired Power Station only		NewGen Gas-Fired Power Station plus background sources	
	24-hour	Annual	24-hour	Annual
1	0.34	0.01	24.99	18.03
2	0.58	0.01	24.94	18.04
3	0.35	0.01	24.88	18.03
4	0.26	0.01	24.95	18.03
5	0.24	0.01	24.94	18.03
6	0.22	0.01	24.94	18.03
7	0.21	0.01	24.94	18.03
8	0.23	0.01	24.92	18.03
9	0.21	0.01	24.95	18.03
10	0.21	0.01	24.94	18.03
11	0.23	0.01	24.96	18.03
12	0.20	0.01	24.88	18.04
Maximum in modelling domain	0.83	0.03	28.28	18.37
Maximum at receptor locations	0.58	0.01	24.99	18.04
NEPM Standard	50	N/A	50	N/A

9.3 Sulphur dioxide

Results for the maximum 1-hour and 24-hour average ground-level concentration of sulphur dioxide for the proposed NewGen Gas-Fired Power Station in isolation and in combination with existing local sources are presented in Table 10.

Table 10: Concentrations of sulphur dioxide due to the proposed NewGen Gas-Fired Power Station and background sources (units: µg/m^3).

Sensitive Receptor Number	NewGen Gas-Fired Power Station only		NewGen Gas-Fired Power Station plus background sources	
	1-hour	24-hour	1-hour	24-hour
1	0.35	0.02	0.73	0.09
2	0.48	0.04	0.81	0.09
3	0.37	0.02	0.74	0.08
4	0.22	0.02	0.66	0.09
5	0.19	0.02	0.64	0.09
6	0.17	0.02	0.63	0.09
7	0.17	0.01	0.60	0.09
8	0.18	0.02	0.65	0.08
9	0.16	0.01	0.59	0.09
10	0.16	0.01	0.60	0.09
11	0.16	0.02	0.58	0.09
12	0.17	0.01	0.65	0.08
Maximum in modelling domain	0.82	0.06	2.85	0.31
Maximum at receptor locations	0.48	0.04	0.81	0.09
NEPM Standard	570	228	570	228

10. Greenhouse gas assessment

Greenhouse gases such as carbon dioxide have been implicated in gradual global climatic changes as they affect the balance between incoming solar energy and losses due to radiation from the earth and atmosphere. Australia is committed to monitor and report greenhouse gas emissions and has set a target level for emissions in 2010 to be no more than 8% higher than the emissions for 1990.

Pollutants of importance to global warming are water vapour (H_2O), nitrous oxide (N_2O), carbon dioxide (CO_2) and methane (CH_4). Indirect greenhouse gases such as carbon monoxide (CO), nitrogen oxides other than N_2O and non-methane volatile organic compounds (NMVOCs) do not have a strong radiative forcing effect in themselves, but influence atmospheric concentrations of the direct greenhouse gases.

Water vapour is the major contributor to the greenhouse effect but is not normally considered because fluxes are dominated by the day-to-day precipitation cycle (BTCE, 1995). Carbon dioxide is the next most significant greenhouse gas and the major anthropogenic contributor.

The relative importance of a greenhouse gas is measured in terms of its global warming potential (GWP), usually related to a GWP of 1 for carbon dioxide. Nitrous oxide and carbon dioxide are greenhouse gases that are associated with combustion activities, such as occur in diesel fuelled vehicles and the combustion of fossil fuels to generate electricity. Carbon dioxide tends to remain active for a lifetime of around 150 years and has a GWP of 1 on a 100 year time frame. Nitrous oxide has a lifetime of 120 years and a GWP of 310 on a 100 year time frame. Methane has a lifetime of 14.5 years and a GWP of 21 on a 100 year time frame. Whilst nitrous oxide and methane have a greater potential to cause global warming, carbon dioxide is produced in far greater quantities by anthropogenic activities than nitrous oxide and methane and consequently, carbon dioxide is the most important greenhouse gas.

Greenhouse gas emissions are reported in terms of tonnes of carbon dioxide equivalent ($tco_{2\text{-}e}$).

Greenhouse gases will be emitted as a result of various activities at the proposed NewGen Gas-Fired Power Station such as carbon dioxide generated by the combustion of gas.

10.1 Greenhouse Challenge Plus

The Greenhouse Challenge Plus programme is part of the Federal Government's climate change strategy and is managed by the Australian Greenhouse Office (AGO). The Greenhouse Challenge Plus programme is designed to:

- Reduce greenhouse gas emissions;
- Accelerate the uptake of energy efficiency;
- Integrate greenhouse gas issues into business decision making; and
- Provide more consistent reporting of greenhouse gas emission levels.

The AGO is a part of the Department of the Environment and Heritage. The AGO monitors and compiles databases on anthropogenic activities that produce greenhouse gases in Australia. The AGO has published greenhouse gas emission factors for a range of anthropogenic activities. The AGO methodology for calculating greenhouse gas emissions is published in the AGO Factors and Methods Workbook (AGO, 2005) and is based on Australian data. This workbook is updated regularly to reflect current compositions in fuel mixes and evolving information on emission sources.

The AGO Workbook defines three scopes of emission categories for calculating greenhouse gas emissions. These are as follows:

- Scope 1: This covers the direct emission sources within the boundary of an organisation such as the emissions from gas combustion.
- Scope 2: This covers indirect emissions from consuming purchased electricity, steam or heat that is produced by another organisation.
- Scope 3: This covers all other indirect emissions from sources that are not owned or controlled by an organisation but occur as a consequence of the organisations activities.

Members of the Greenhouse Challenge Plus programme are required to separately report Scope 1, Scope 2 and some of their Scope 3 emissions. Scope 3 emissions that are required to be reported are emissions from off-site waste disposal, emissions associated with production of fuels and emissions from transmission, distribution and generation of electricity. Members are encouraged to report on other Scope 3 emissions.

10.2 Greenhouse gas producing activities and emission factors

The major activities at the NewGen Gas-Fired Power Station that produce greenhouse gas emissions are:

- Scope 1: gas combustion for electricity generation.
- Scope 3: production, transport and distribution of gas and electricity.

The anticipated quantity of gas likely to be consumed annually by the NewGen Gas-Fired Power Station is 11.2 PJ. The emission factors for greenhouse gas emissions from natural gas combustion are provided in the AGO Workbook (2006) and are defined in Table 11.

Table 11: Greenhouse gas emissions from the proposed NewGen Gas-Fired Power Station with two open-cycle gas-turbines. with a total nominal capacity 330 MW.

Emissions	Scope 1	Scope 2	Scope 3	Full fuel cycle	Units
Emission factor	52.7	-	7.4	60.1	kg CO_2-e/GJ
Greenhouse gas emissions	0.590	-	0.083	0.673	Mt CO_2-e

The 2005 greenhouse gas emissions inventory for Australia is 559 Mt CO_2-e. This equates to an additional 0.1% of the national greenhouse gas emissions.

11. Conclusions

An air quality assessment of the proposed NewGen Gas-Fired Power Station that has a total proposed nominal capacity of 330 MW has been undertaken. The study makes the following conclusions:

- The proposed power station is not likely to have any adverse affects on local or regional air quality.
- Maximum concentrations of nitrogen dioxide are predicted to be well below the goals and standards at any location for the power station operating at full load.
- The contribution to regional ozone levels is predicted to be small, particularly at the location of maximum regional ozone.
- The greenhouse gas assessment indicates an incremental increase in greenhouse gas emissions that is equivalent to 0.1% of Australian emissions in 2005.
- Air pollutant emissions from the power station have been estimated from available emissions information because the actual gas turbine technology is yet to be determined. Air pollutant emission rates are unlikely to vary by more than 10% from what has been considered in this study and, consequently, the conclusions of this assessment are unlikely to change.

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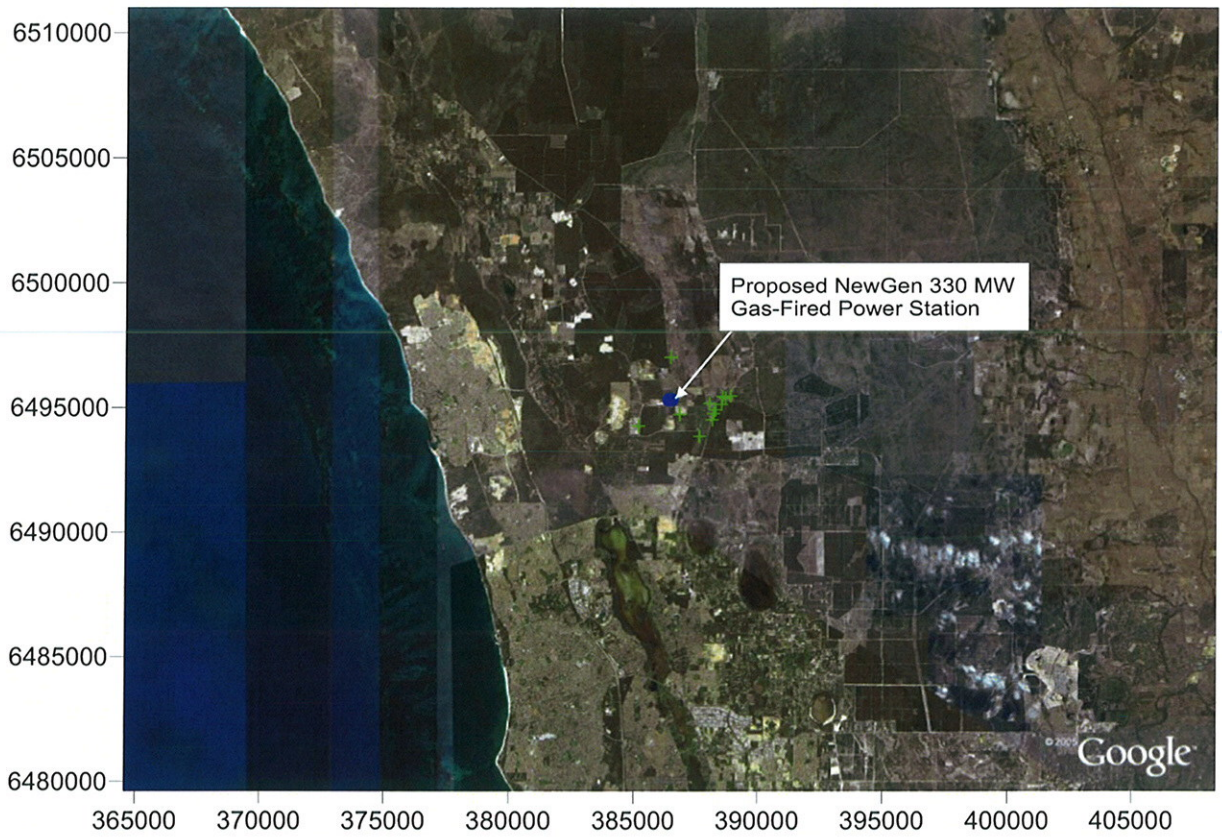
Figure 1: Location of NewGen Gas-Fired Power Station



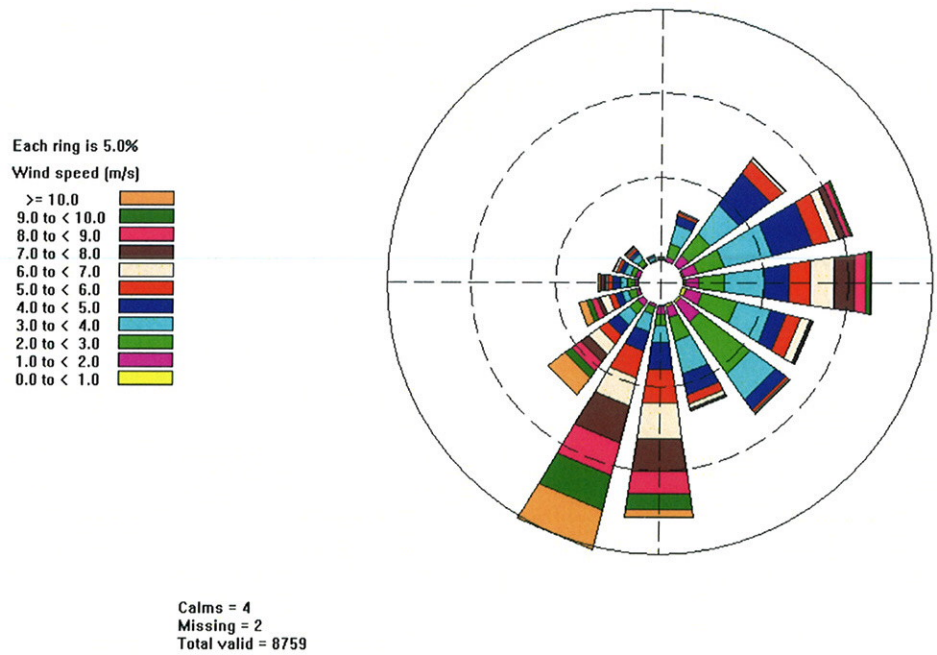
● NewGen 330 MW Gas-Fired Power Station

\+ Sensitive Receptors

Figure 2: Wind rose for (a) all hours, (b) seasonal and (c) diurnal for (i) the EPA Quinn's Rock monitoring station and (ii) TAPM predicted at the Quinn's Rock location for the year 2001.

(a)

(i) Measured



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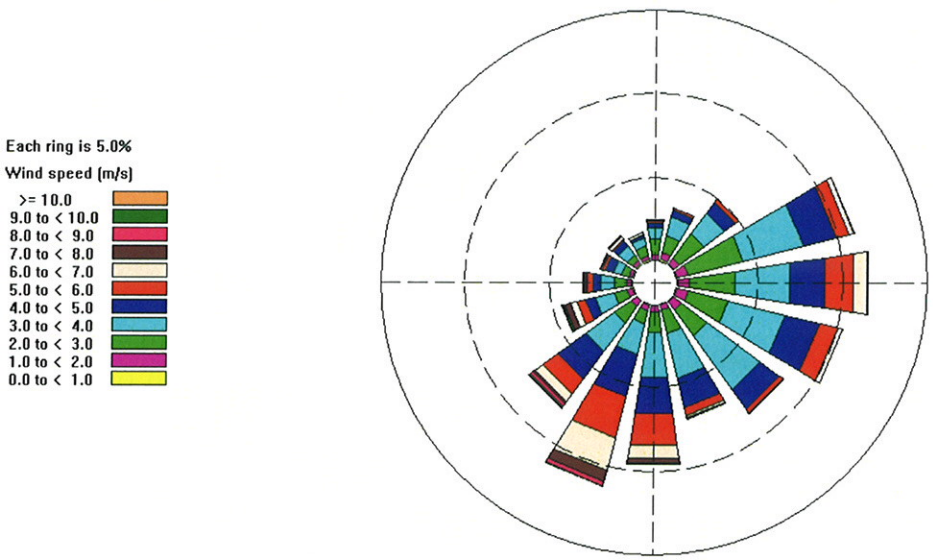
Total valid = 8759

(ii) TAPM



Calms = 1
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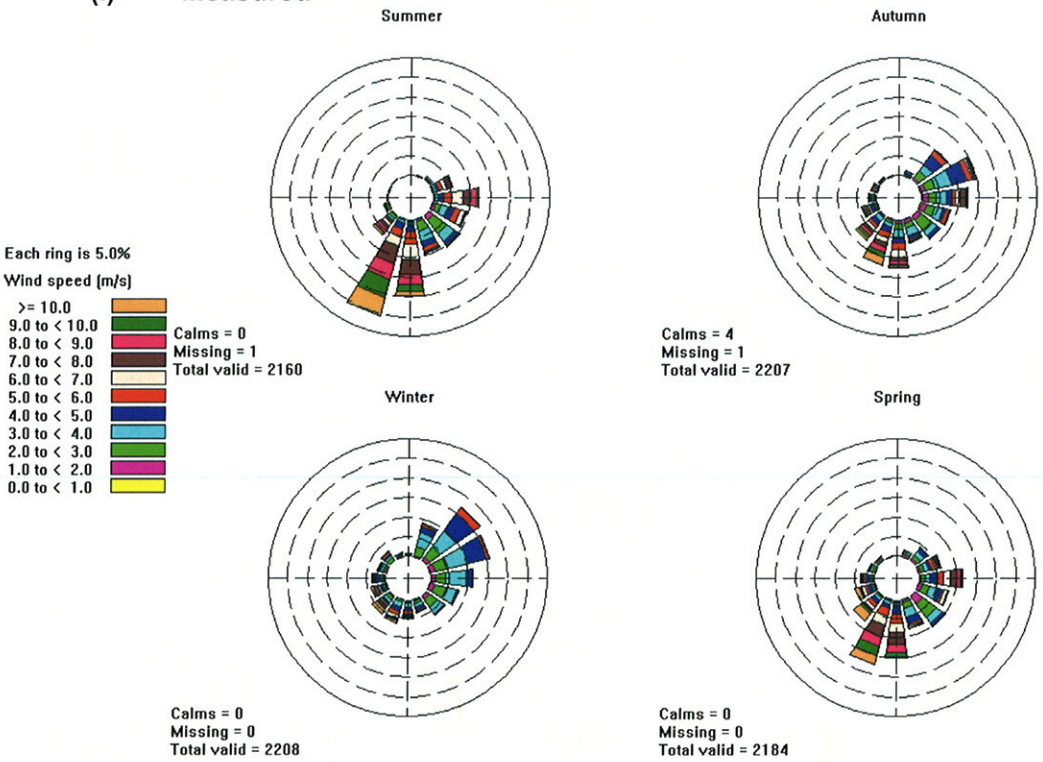
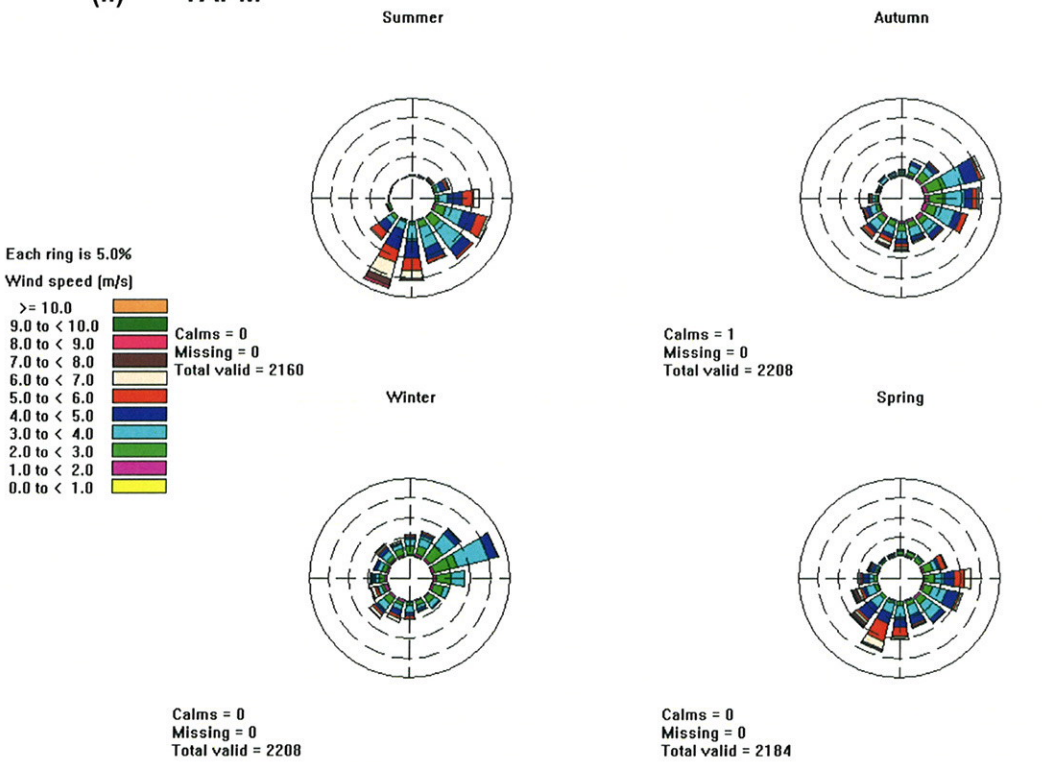
(b)

(i) Measured



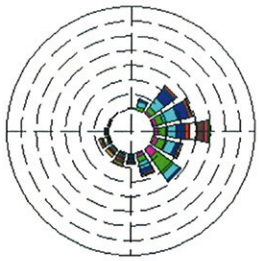
(ii) TAPM



(c)

(i) Measured

Midnight - 6am



Calms = 2
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Total valid = 2191

6am - midday

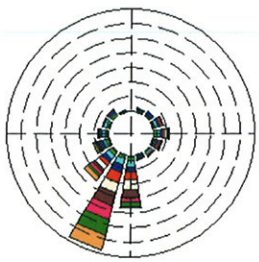
Calms = 0
Missing = 1
Total valid = 2189

Each ring is 5.0%

Wind speed (m/s)

>= 10.0
9.0 to < 10.0
8.0 to < 9.0
7.0 to < 8.0
6.0 to < 7.0
5.0 to < 6.0
4.0 to < 5.0
3.0 to < 4.0
2.0 to < 3.0
1.0 to < 2.0
0.0 to < 1.0

Midday - 6pm



Calms = 0
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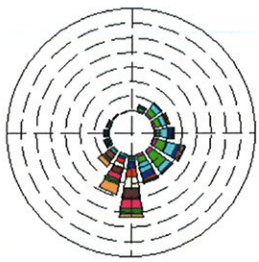
Total valid = 2189

6pm - midnight



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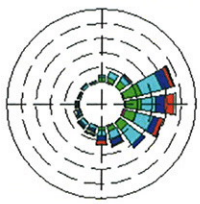
(ii) TAPM

Midnight - 6am



Calms = 0
Missing = 0
Total valid = 2190

6am - midday

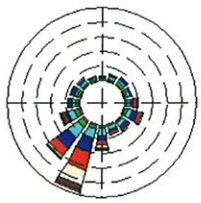
Calms = 0
Missing = 0
Total valid = 2190

Each ring is 5.0%

Wind speed (m/s)

>= 10.0
9.0 to < 10.0
8.0 to < 9.0
7.0 to < 8.0
6.0 to < 7.0
5.0 to < 6.0
4.0 to < 5.0
3.0 to < 4.0
2.0 to < 3.0
1.0 to < 2.0
0.0 to < 1.0

Midday - 6pm



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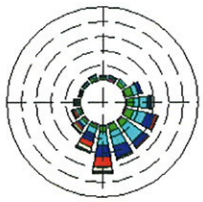
Total valid = 2190

6pm - midnight

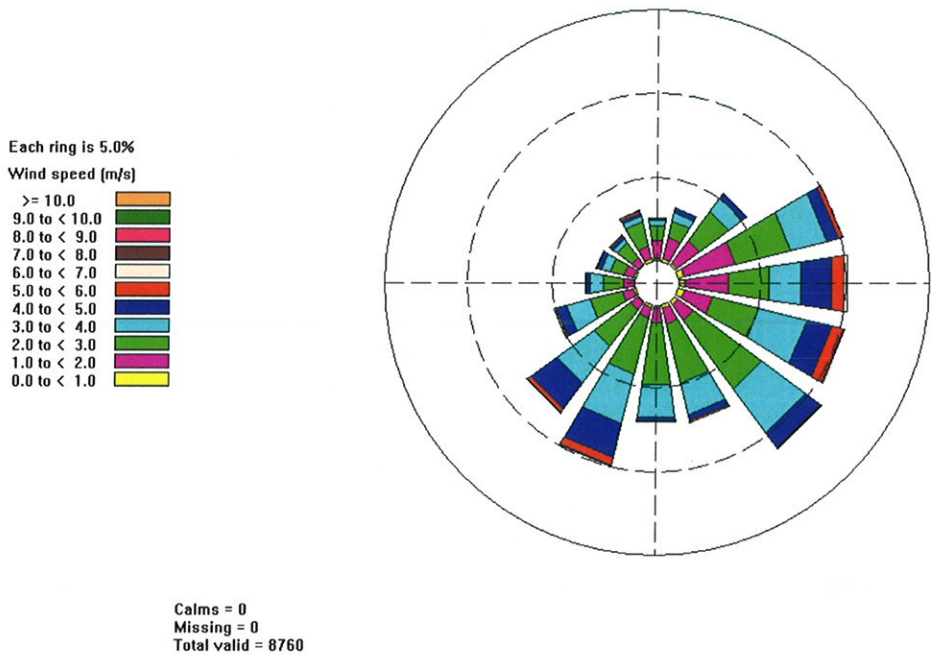


Calms = 0
Missing = 0
Total valid = 2190

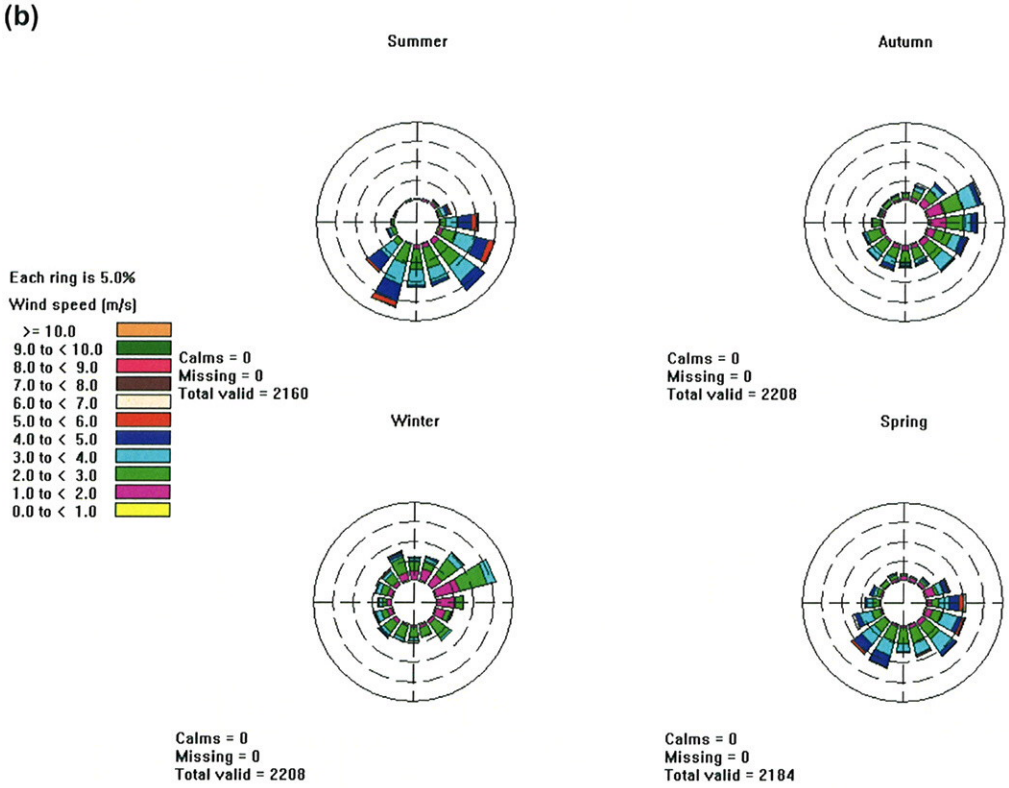
Katestone Environmental

Figure 3: Wind roses as predicted by TAPM for 2001 for the NewGen Gas-Fired Power Station site for (a) all hours, (b) seasonal and (c) diurnal variation.

(a)



(b)



(c)

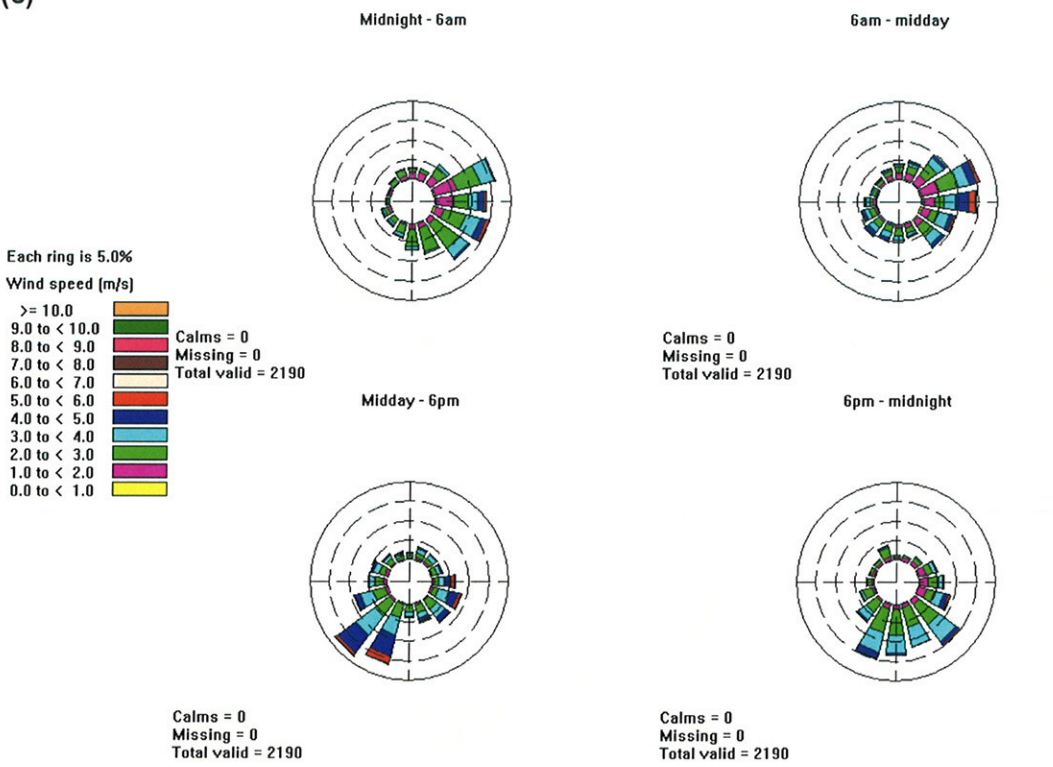


Figure 4: Temperature (°C) versus hour of day for the NewGen Gas-Fired Power Station for 2001 as predicted by TAPM.

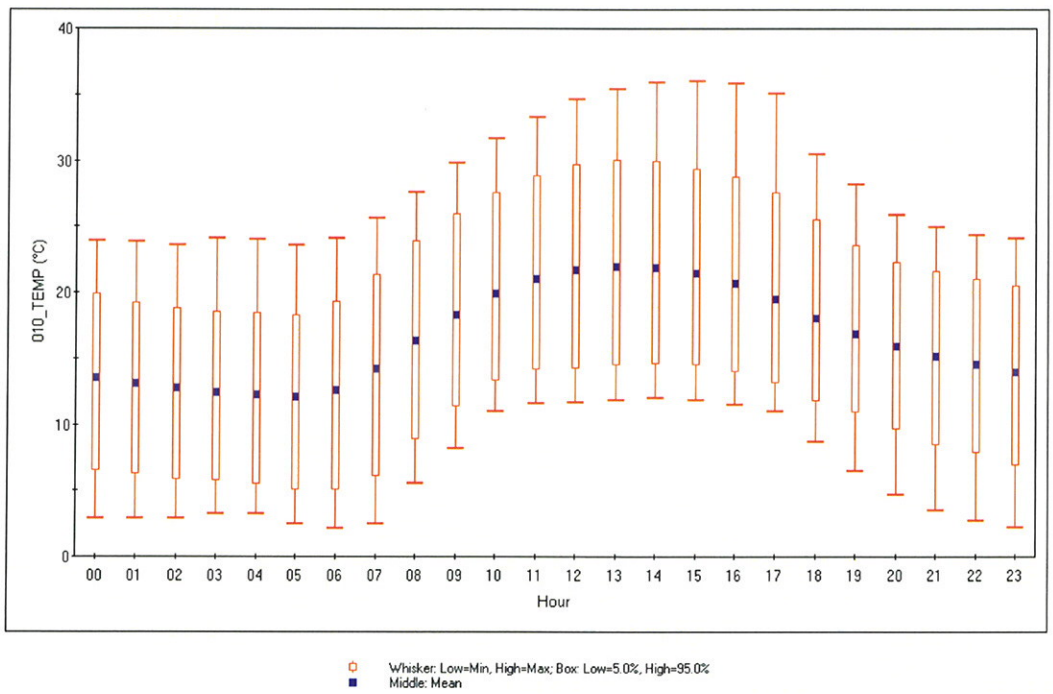


Figure 5: Mixing heights calculated from TAPM for the NewGen Gas-Fired Power Station site.

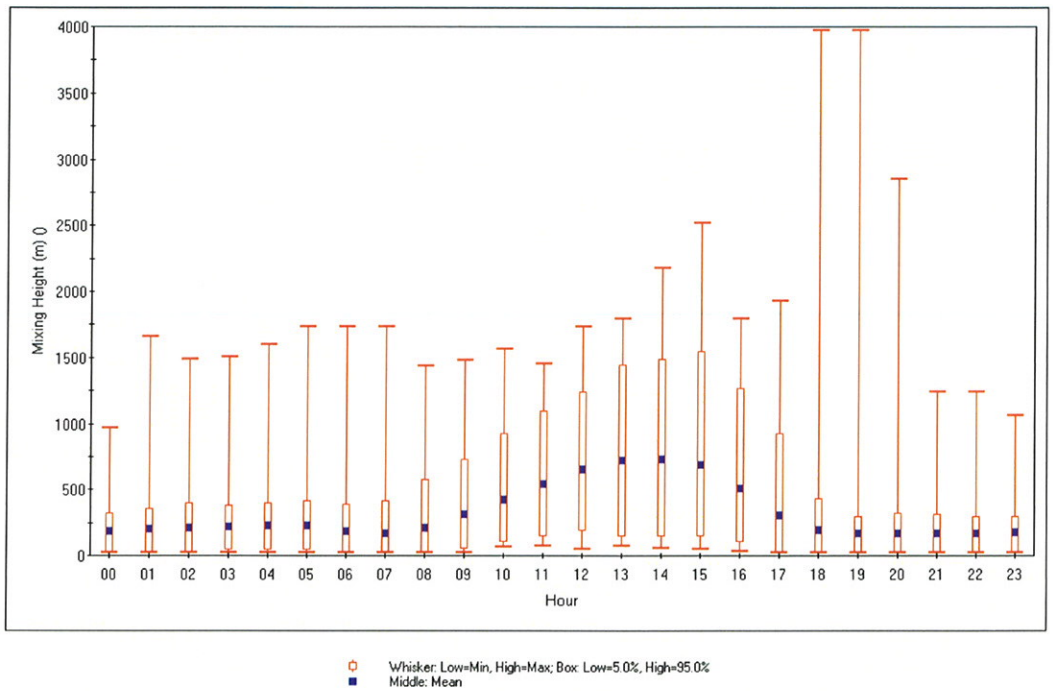
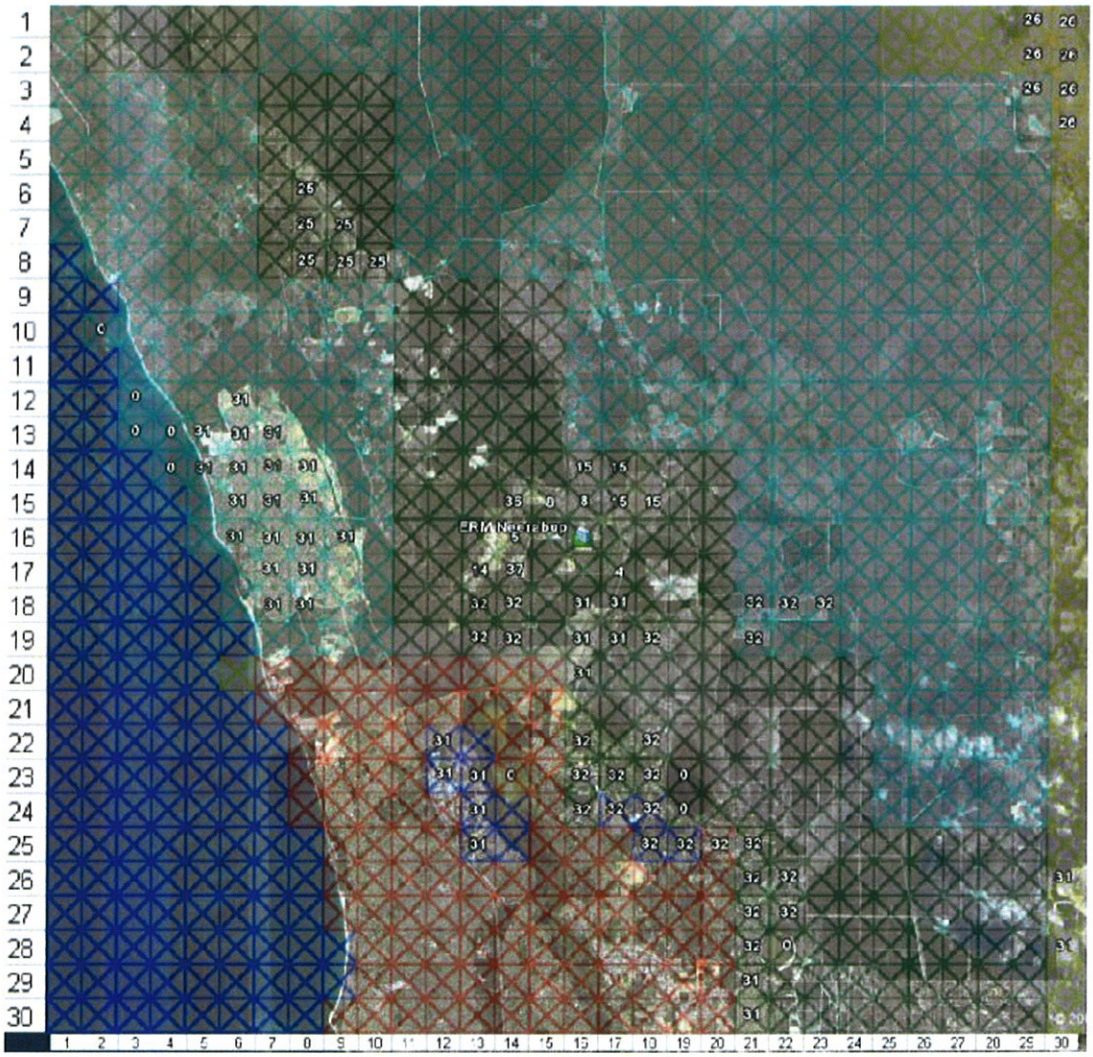


Figure 6: Vegetation land use modifications made to default TAPM setup (1km grid spacing)



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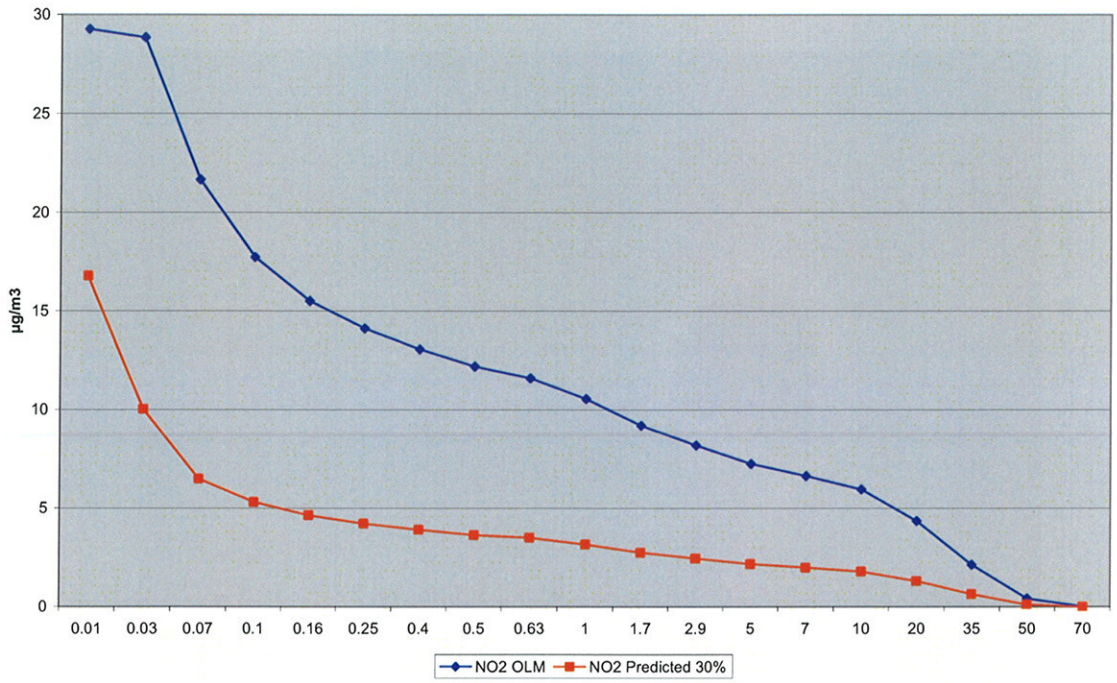

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(a) 1-hour average

(b) Annual average

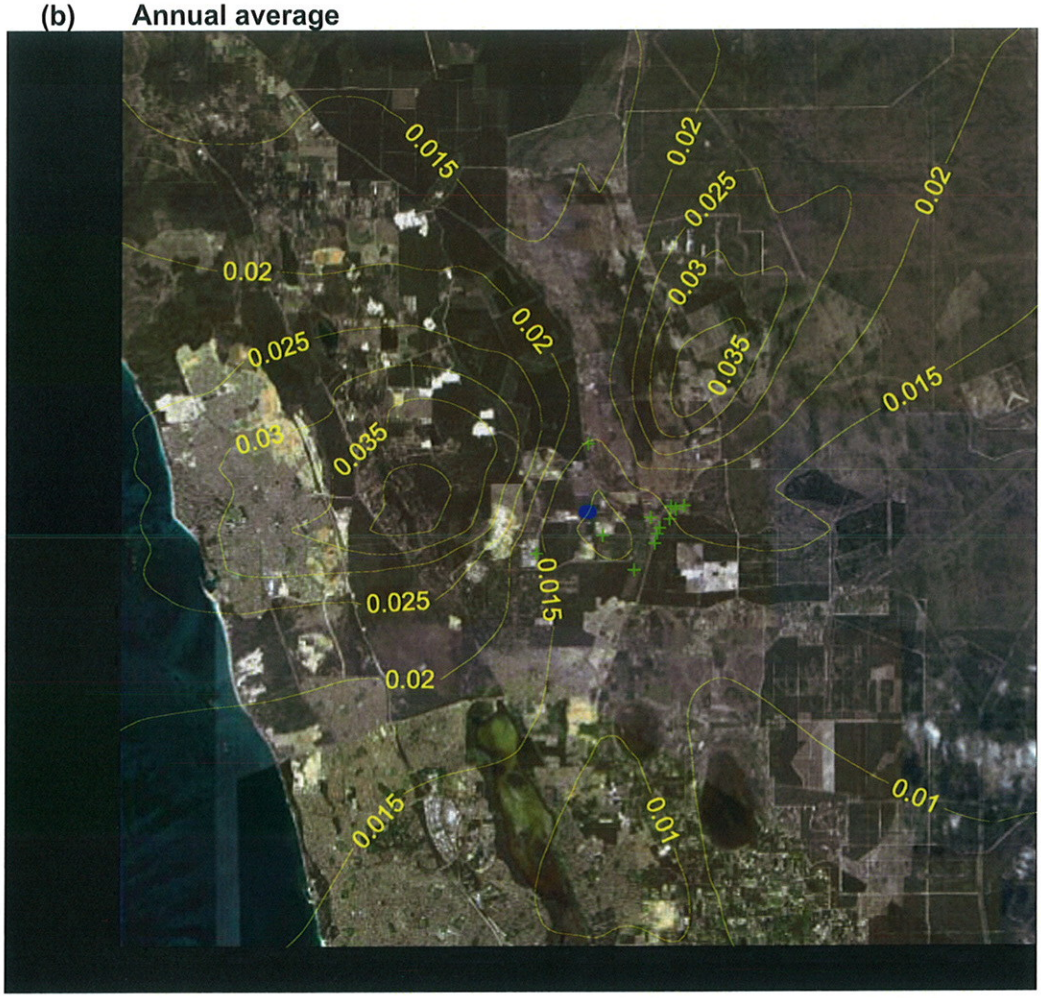
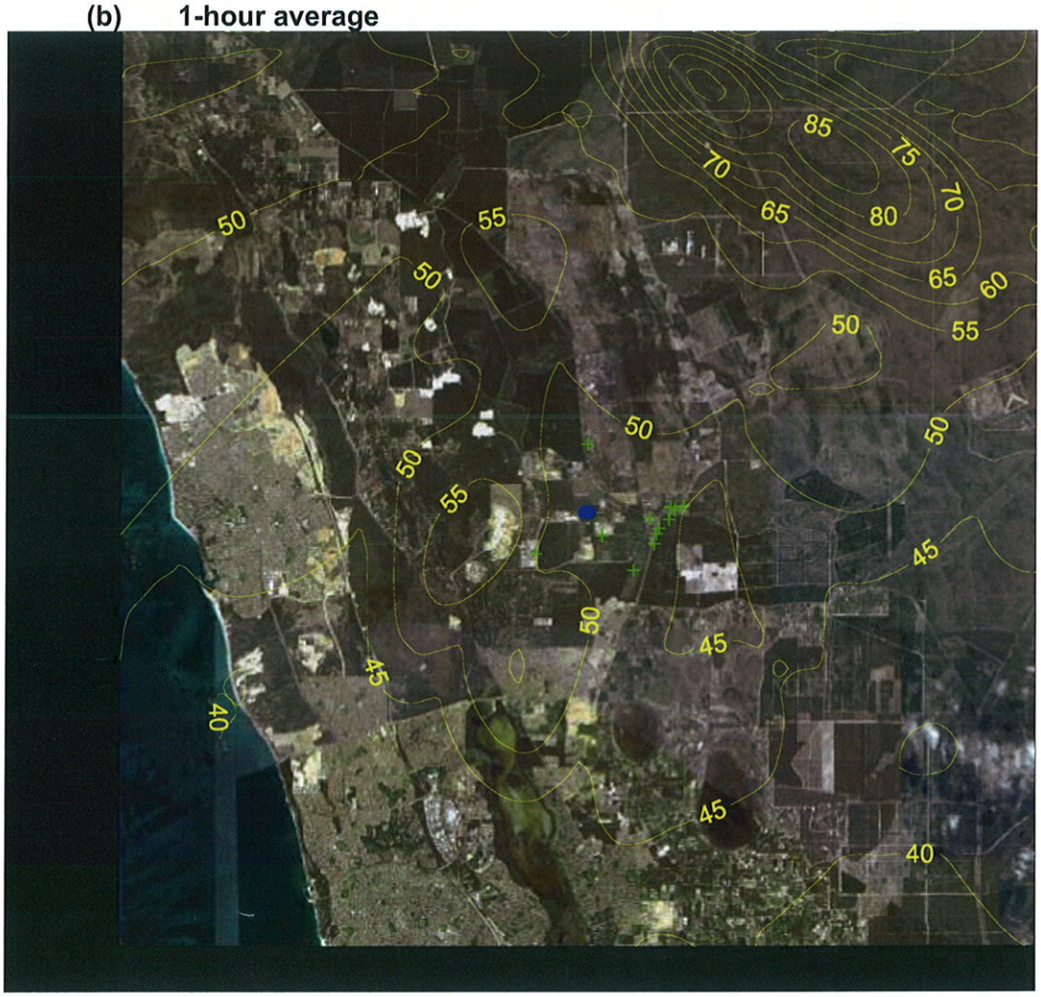
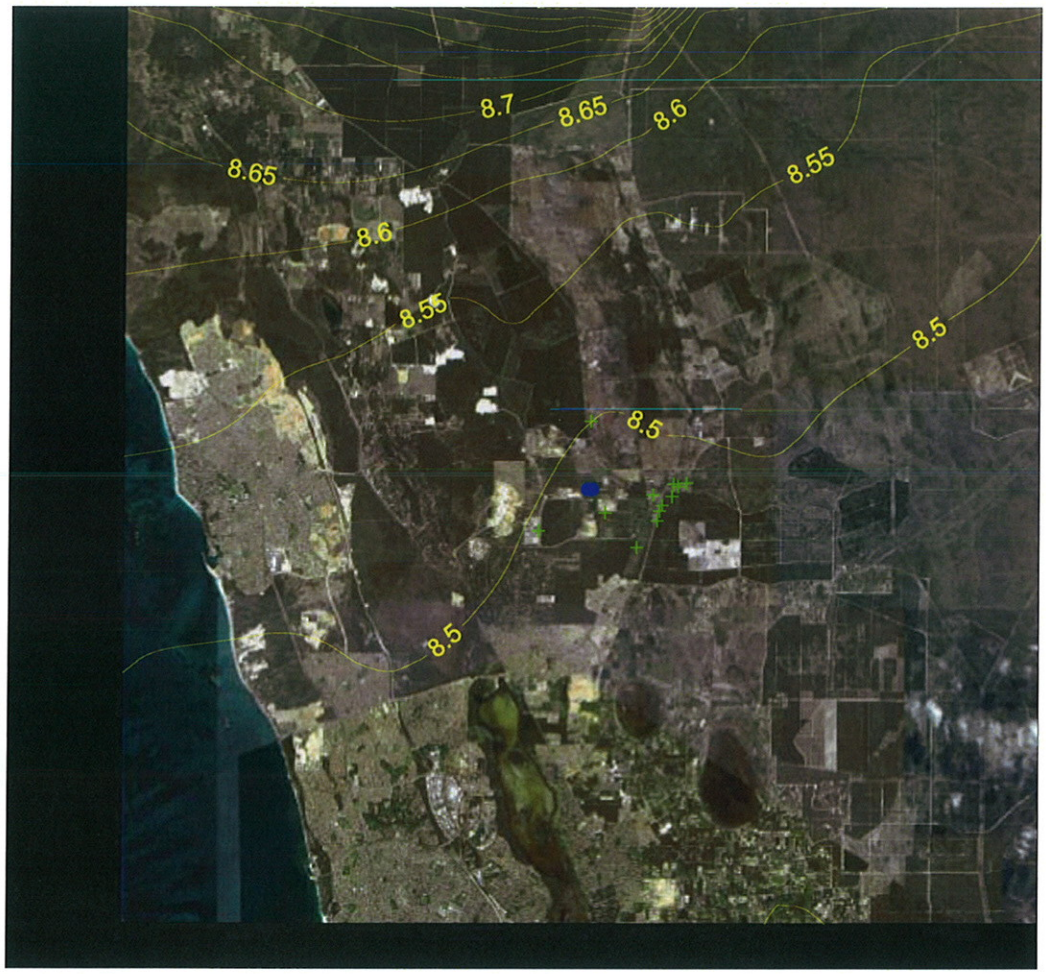


Figure 9: Maximum predicted ground-level concentrations of nitrogen for the proposed NewGen Gas-Fired Power Station and existing industrial sources for (a) 1-hour average, and (b) annual average.

(b) 1-hour average



(b) Annual average



Katestone Environmental

Air Quality Assessment of the Proposed NewGen 330 MW Gas-Fired Power Station - Photochemical Smog

ERM POWER Pty Ltd

July 2007

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1. Introduction

Katestone Environmental has been commissioned by ERM Power Pty Ltd to prepare an air quality assessment of a proposed gas-fired power station at Neerabup in Western Australia. The proposed NewGen 330 MW Gas-Fired Power Station is to consist of two open-cycle gas-turbines each with a nominal capacity of 165 MW and a total power station nominal capacity of 330 MW.

This report presents results of an investigation into the impact of the proposed power station on photochemical smog within Perth's regional airshed.

1.1 Background

The Perth Photochemical Smog Study (PPSS) identified two main classes of photochemical smog events that typically occur in this region. The first type, the inland event, corresponds to peak ozone concentrations in Perth's eastern suburbs. These events occur on days when the low-pressure trough moves inland, and recirculates the smog plume back across the metropolitan area where it receives a boost from fresh afternoon emissions.

The second, the coastal event, corresponds to peak ozone concentrations at the coast. These events occur on days when high concentrations of smog form in a warm, stable air mass offshore but disperse rapidly after the smog has returned to the coast by the sea breeze.

The assessment of the contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional photochemical smog (in particular ozone) has been conducted using the Carnegie Mellon/California Institute of Technology (CIT) photochemical model that was developed for the U.S. EPA. The performance of the CIT model during the Perth Photochemical Smog Study has lead to its acceptance by the Western Australian Department of the Environment as the preferred photochemical model for studies that focus on impacts within Perth's regional airshed.

1.2 Limitations of the current study

The current study relies on the accuracy of a wide range of information including (but not limited to):

- Emission rates of pollutants from existing sources;
- Existing source characteristics including frequency of operation;
- Numerically simulated meteorology;
- Topographic information; and
- Proposed industry characteristics.

It is important to note that in the absence of detailed emissions information it is generally assumed that an emissions source will emit pollutants 24 hours a day, 365 days per year. This may significantly overestimate impacts from the source. However, as the objective of an air quality assessment is to provide worst-case estimates of the potential for impacts this is a commonly adopted methodology for dealing with limited source information.

Finally, all numerical models that are based on approximating a governing set of equations will inherently be associated with some degree of error. The more complex a physical scenario a numerical model is meant to represent, typically, the greater the number of physical processes which must necessarily be parameterised. This frequently results in a large number of tune-able parameters within the model. There exists extensive in-house expertise in the use of sophisticated numerical models within Katestone Environmental and our modellers make every reasonable attempt to ensure that model results are of the highest possible quality.

2. Ambient air quality criteria

National ambient air quality standards and goals are specified by the National Environment Protection Council (NEPC) with agreement from all state governments in the National Environmental Protection (Ambient Air Quality) Measure (NEPM (Air)). Compliance with the NEPM (Air) standards is assessed by each state jurisdiction through ambient air quality monitoring undertaken at locations that are representative of large urban populations. A summary of the NEPM (Air) standard for ozone that is relevant to this project is presented in Table 1.

Table 1: National Environment Protection (Ambient Air Quality) Measure, summary of relevant standards

Pollutant	Averaging Period	NEPM (Air) Standard
Ozone	1-hour	214 $\mu g/m^3$ or 100 ppb

3. Project information

3.1 Study region

The domain used to asses the impact of the proposed NewGen 330 MW Gas-Fired Power Station on photochemical smog is depicted in Figure 1 and includes approximately 120 square kilometres centred around Perth.

3.2 Power station characteristics.

A summary of the stack characteristics of the proposed NewGen 330 MW Gas-Fired Power Station is presented in Table 2.

Table 2: Stack characteristics for the proposed power station.

Parameter	Units	Open-cycle gas-turbines
Number of stacks	-	2
Location	AMG (mN, mE)	386502, 6495320, UNIT 1 386458, 6495320, UNIT 2
Stack height	m	35
Stack diameter	m	6.0
Volume flow	Nm^3/s	390.09
Exit velocity	m/s	41.34
Temperature	°C	545.0

4. Emissions sources - existing and proposed

4.1 Existing sources

A wide variety of pollutant sources have been incorporated into the emissions inventory supplied by DEC that are used to run the photochemical model CIT. These sources include but are not limited to:

- Industrial;
- Domestic;
- Small industries such as dry cleaners;
- Service stations;
- Aircraft;
- Rail;
- Marine; and
- Traffic.

Depicted in Figure 2 are the locations of the industrial sources included in the emissions inventory. These include industrial sources whose emissions are released at or near the surface, industries that may be represented as an elevated source and those that are associated with fugitive emissions. The location of the proposed NewGen 330 MW Gas-Fired Power Station is also indicated in Figure 2. Both of the stacks associated with the proposed NewGen 330 MW Gas-Fired Power Station were included in the emissions inventory as elevated industrial sources.

4.2 Emissions from the proposed NewGen 330 MW Gas-Fired Power Station

Emission rates for the proposed NewGen 330 MW Gas-Fired Power Station were estimated from a variety of sources including:

- Information provided by ERM Power;
- The U.S. EPA AP-42 for stationary gas turbines; and
- The Australian Greenhouse Office's AGO Factors and Methods Workbook, August 2006.

Estimates of the emission rate of the chemical species used by the photochemical model, that will be emitted by the proposed NewGen 330 MW Gas-Fired Power Station are presented in Table 3.

Table 3: Estimates for the emission rate of pollutants for the proposed NewGen 330 MW Gas-Fired Power Station used in the photochemical study.

Chemical species	Emission rate [d] (kg/day/stack)
Nitrous oxide	1015.9[a,b]
Nitrogen dioxide	173.1[a,e]
Carbon monoxide	421.3[c]
Carbon dioxide	2,308,428.1
Particles	124.4
Sulphur dioxide	23.0[a]
Methane	162.1
Non-methane volatile organic compounds	39.6
Total - volatile organic compounds	207.4
Benzene	0.2
Toluene	2.5
Xylene	1.2
Formaldehyde	13.4
Acetaldehyde	0.8

[a] Estimated from information supplied by ERM Power Pty. Ltd.
[b] Assuming 90% of the oxides of nitrogen are of the form nitrous oxide.
[c] Estimated using the Australian Governments, AGO Factors and Methods Workbook (December, 2006)
[d] Estimated from the U.S. EPA AP-42 for stationary gas turbines.

5. Photochemical modelling methodology

The CIT photochemical model has been used to assess the potential impact of the proposed NewGen 330 MW Gas-Fired Power Station on regional photochemical smog. A total of 90 days covering the period from 1 January 1999 to 31 March 1999 has been simulated. From these 90 days, the predicted impact of the proposed power station on ground-level ozone concentrations for 6 days associated with elevated levels of ozone are presented in detail.

Four scenarios have been considered:

- 1999, existing sources;
- 1999, existing sources in combination with the proposed power station;
- 2021, existing sources; and
- 2021, existing sources in combination with the proposed power station.

All files required to run the CIT model for the 1999 base case (i.e. 1999, existing sources) were supplied by the DEC.

The inventory for the emission of pollutants from existing sources for the future scenario (2021) was also supplied by DEC. Photochemical modelling of the 'future' emissions scenario using CIT involved the use the 1999 meteorological fields combined with estimates of population and vehicle emissions for the year 2021 that were also provided by DEC. All other 'existing' sources (such as industrial sources) are the same for both the 1999 scenario and future scenario.

In general, the configuration of the CIT model was as supplied by DEC. The only modification to the inventories made by Katestone Environmental was the addition of the proposed NewGen 330 MW Gas-Fired Power Station as an elevated industrial emissions source.

Results of the photochemical model are compared with the NEPM (Air) standard of 100 ppb for the 1-hour average ground-level concentration of ozone.

A copy of the CIT model set up file is included in Appendix A.

5.1 Study period

CIT simulations covered the three month period of January, February and March 1999. Of the 90 days simulated, six case study days were selected for presentation. The choice of study days was based on model predictions of ground-level concentrations of ozone of over 75 ppb in the northeast region of the domain combined with confidence in model performance.

The case study days include:

- 11 January 1999;
- 13 January 1999;
- 28 January 1999;
- 12 February 1999;
- 24 February 1999; and
- 27 February 1999.

Results of the photochemical modelling for each of these six study days are presented in the following section for both the 1999 and the 2021 scenarios.

6. Assessment of air quality impacts

6.1 Interpretation of results

When considering the results presented in the following sections it is important to note that the objective of the air quality assessment is to estimate worst-case contributions of the proposed power station on ozone levels in Perth's regional airshed.

Since the accuracy of the existing sources inventory and CIT model validation has been assessed by the DEC, it is not the responsibility of the current study to verify the accuracy of either:

- The existing industries emissions inventory; or
- Estimates of ground-level concentrations of ozone that are associated with existing sources.

The current photochemical modeling study is designed however, to highlight regions within the domain where ground-level concentration of ozone are likely to be impacted upon as a result of emissions from the proposed power station.

6.2 Scenario: 1999.

Results from the CIT photochemical model for simulations conducted based on the emission inventory for 1999 are summarised in Table 4 and Table 5 as well as Figure 3 through Figure 8.

Included in Table 4 are the results for the maximum predicted ground-level concentration of ozone for the six case study days. Results for existing sources as well as existing sources in combination with the proposed power station are presented.

Results indicate that the proposed power station would have little impact on the regional maximum ground-level concentration of ozone with increases of -0.4 ppb to 0.1 ppb predicted.

Table 4: 1999. Maximum predicted ground-level concentration of ozone for existing sources and existing source in combination with the proposed NewGen 330 MW Gas-Fired Power Station (ppb). The NEPM(Air) standard is 100 ppb.

Date	Existing	Existing & NPS	Change in maximum due to NPS
11 January, 1999	82.8	82.8	0.0
13 January, 1999	106.4	106.4	-0.1
28 January, 1999	102.0	101.6	-0.4
12 February, 1999	105.4	105.4	0.0
24 February, 1999	76.2	76.2	0.0
27 February, 1999	94.9	95.0	0.1

However, the location of the regional maximum concentration of ozone and the region that is most affected by the proposed power station plume are not in typically co-located. Presented in Table 2 is the maximum contribution of the proposed power station anywhere in the model domain. Results suggest that the proposed power station will have both a positive and negative impact on ground-level concentrations of ozone, with a maximum of –1.6 ppb to +4.1 ppb predicted.

Table 5: 1999. Maximum predicted impact of the proposed NewGen 330 MW Gas-Fired Power Station on the ground-level concentration of ozone.

Date	Maximum change on grid	
	Decrease	Increase
11 January, 1999	-1.4	1.9
13 January, 1999	-1.3	1.5
28 January, 1999	-1.3	4.1
12 February, 1999	-1.1	2.5
24 February, 1999	-1.6	3.6
27 February, 1999	-0.5	2.6

Presented in Figure 3 through Figure 8 are the results from the CIT modelling.

Contours of the daily maximum predicted ground-level concentration of ozone for existing sources are presented.

The contribution of the proposed NewGen 330 MW Gas-Fired Power Station on ozone levels is depicted as a difference plot. The difference plot is constructed by subtracting the maximum predicted levels of ozone with the power station included from those for existing sources. Regions within the domain that experience a positive increase in value implies that the proposed power station will result in levels of ground-level ozone that are higher than without the development. Similarly, a negative value suggests that at these locations, the power station would lead to a reduction in ground-level concentrations of ozone.

6.3 Scenario: 2021.

Results from the CIT photochemical model for simulations conducted based on the emission inventory for 2021 are summarised in Table 6 and Table 7 as well as Figure 9 through Figure 14.

Presented in Table 6 is the maximum predicted ground-level concentration of ozone based on simulations of existing sources as well as existing sources in combination with the proposed power station.

Results indicate that the proposed power station would have little impact on the regional maximum ground-level concentration of ozone with impacts of -0.1 ppb to +0.6 ppb predicted.

Table 6: 2021. Maximum predicted ground-level concentration of ozone for existing sources and existing source in combination with the proposed NewGen 330 MW Gas-Fired Power Station (ppb). The NEPM(Air) standard is 100 ppb.

Date	Existing	Existing & NPS	Change in maximum due to NPS
11 January, 2021	81.3	81.3	0.0
13 January, 2021	98.3	98.2	-0.1
28 January, 2021	103.3	103.2	0.0
12 February, 2021	100.2	100.2	0.0
24 February, 2021	71.8	72.4	0.6
27 February, 2021	91.8	91.8	0.1

However, the location of the regional maximum concentration of ozone and the region that is most affected by the proposed power station plume are not in general co-located. Presented in Table 7 is the maximum contribution of the proposed power station anywhere in the model domain. Results suggest that the proposed power station will have both a positive and negative impact on ground-level concentrations of ozone, with a maximum of –2.5 ppb to +6.5 ppb predicted.

Table 7: 2021. Maximum predicted impact of the proposed NewGen 330 MW Gas-Fired Power Station on the ground-level concentration of ozone.

Date	Maximum change on grid	
	Decrease	Increase
11 January, 2021	-1.5	2.6
13 January, 2021	-1.7	6.2
28 January, 2021	-1.8	1.7
12 February, 2021	-2.1	6.5
24 February, 2021	-2.5	3.4
27 February, 2021	-0.8	3.3

Presented in Figure 9 through Figure 14 are the results from the CIT modelling. Contours of the daily maximum predicted ground-level concentration of ozone for existing sources are presented. The predicted contribution of the proposed NewGen 330 MW Gas-Fired Power Station on ozone levels highlighted using a difference plot consists of contours of the maximum predicted levels of ozone with the power station included minus those for existing sources. Regions within the domain that experience a positive increase in value implies that the proposed power station will result in levels of ground-level ozone that are higher than without the development. Similarly, a negative value suggests that at these locations, the power station would lead to a reduction in ground-level concentrations of ozone.

7. Conclusions

An air quality assessment of the impact of the proposed NewGen 330 MW Gas-Fired Power Station on the formation of photochemical smog with Perth's regional airshed has been conducted.

Results suggest:

- That the proposed NewGen 330 MW Gas-Fired Power Station will have an insignificant and immeasurable impact on the regional maximum ground-level concentration of ozone;
- Based on the study days considered, no additional exceedences of the NEPM(Air) standard of 100 ppb are predicted.
- The areas that are predicted to be most affected by emissions from the proposed power station are located in the north and northeast regions of the study area;
- Emissions from the proposed power station will have both a positive and negative impact on ground-level concentrations of ozone.
- For the six study days presented in detail a maximum increase in ground-level concentrations of ozone of 4 ppb is predicted for the 1999 scenarios and a maximum of 6.5 ppb for the 2021 scenarios.

8. References

Environmental Protection Agency (1997), Environmental Protection (Air) Policy. Subordinate Legislation 1997 No. 468 and amendments, Office of the Queensland Parliamentary Counsel, Queensland.

National Environment Protection Council (NEPM) (1998), "National Environment Protection Measure for ambient air quality".

Figure 1: Study region

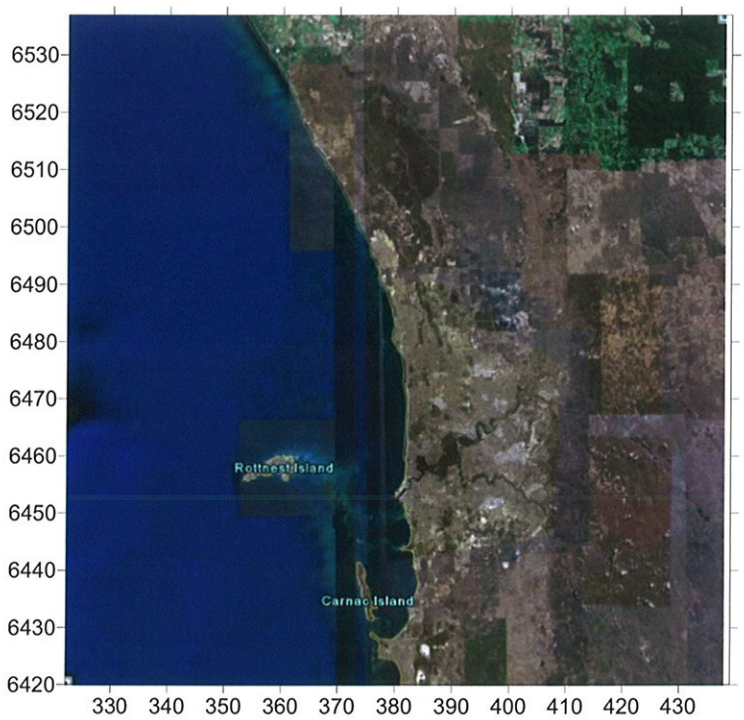


Figure 2: **Industrial sources: surface (blue), fugitive (green), elevated (red) and the proposed NewGen 330 MW Gas-Fired Power Station (gold).**

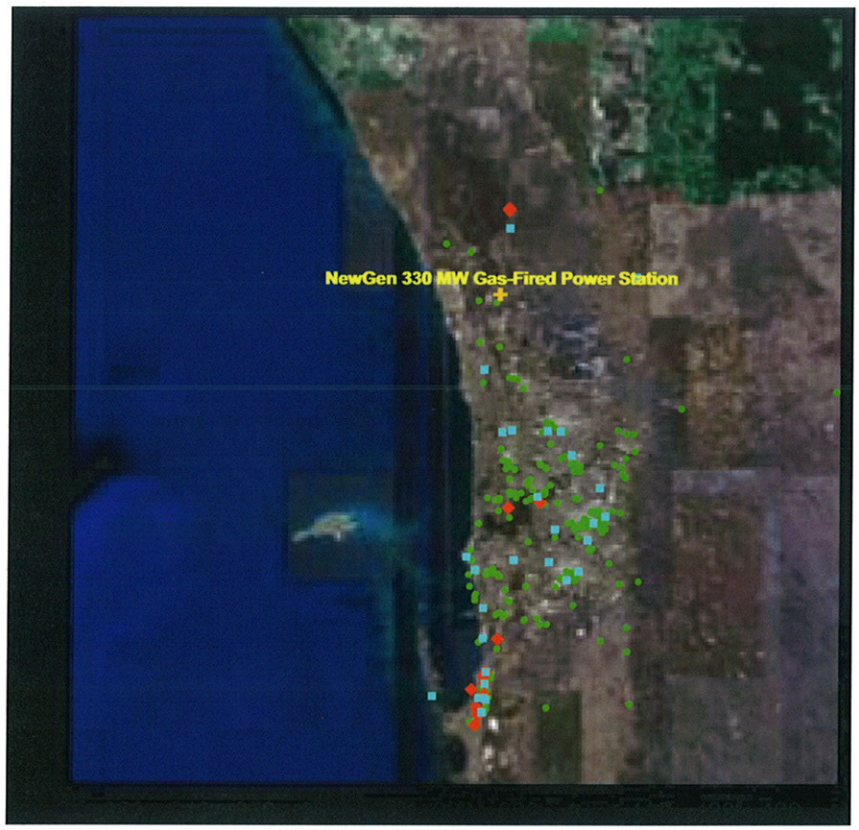


Figure 3: **11 January 1999. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).**

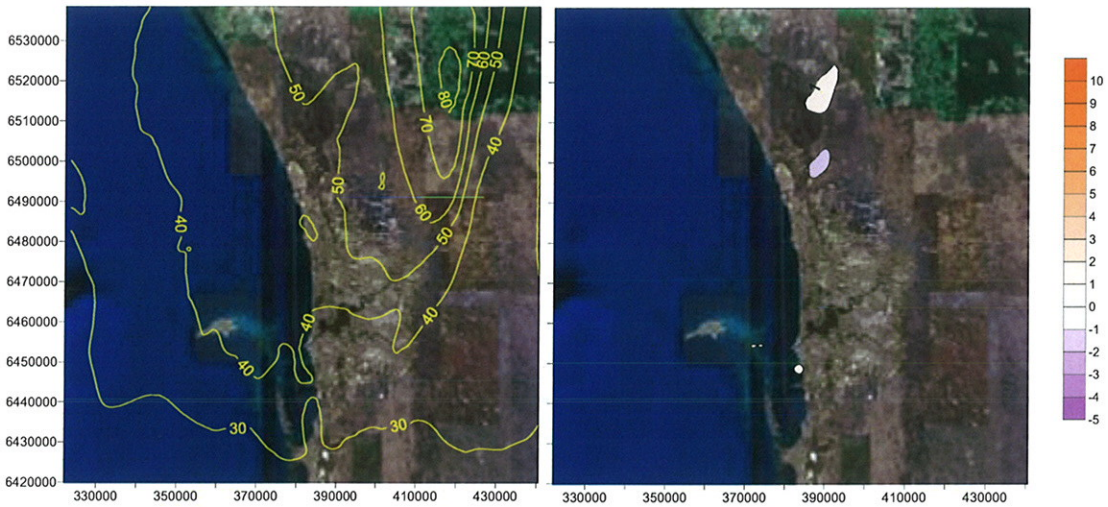


Figure 4: **13 January 1999. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).**

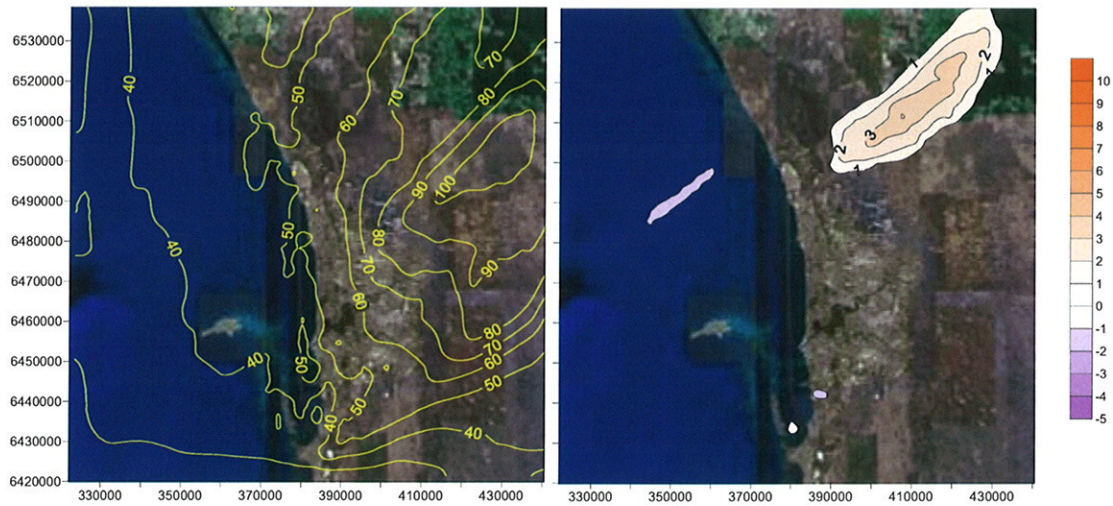


Figure 5: 28 January 1999. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

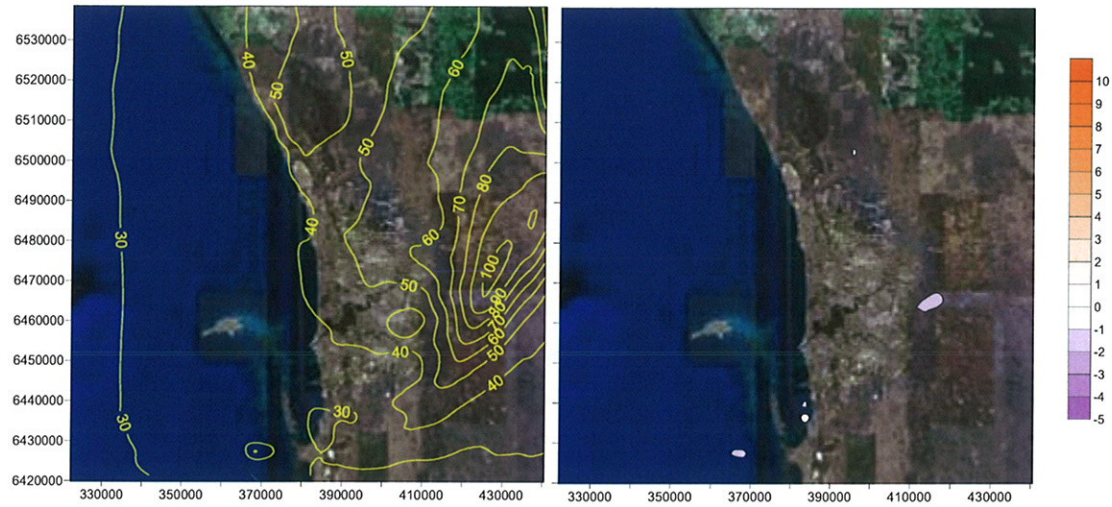


Figure 6: 12 February 1999. Maximum predicted average ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

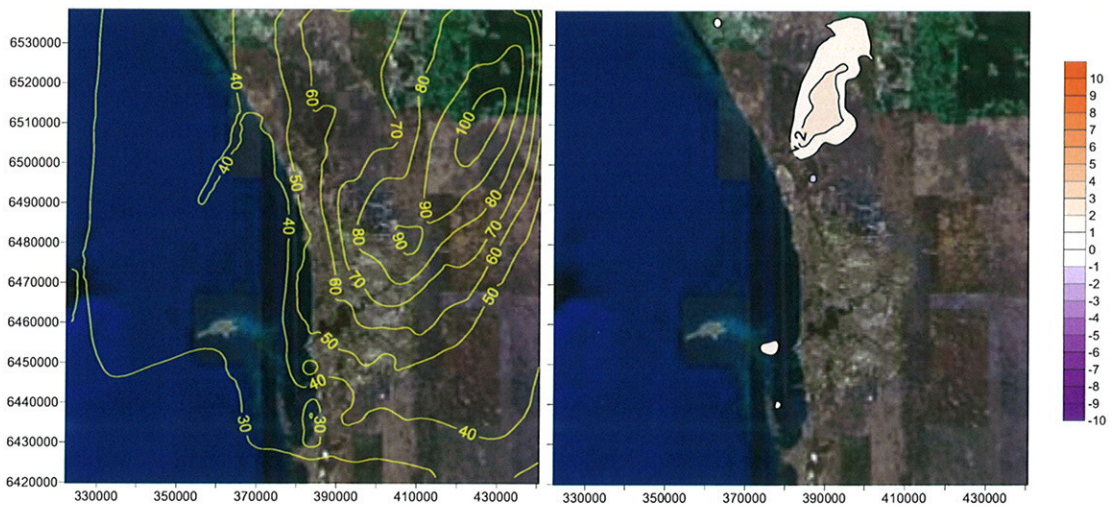


Figure 7: 24 February 1999. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

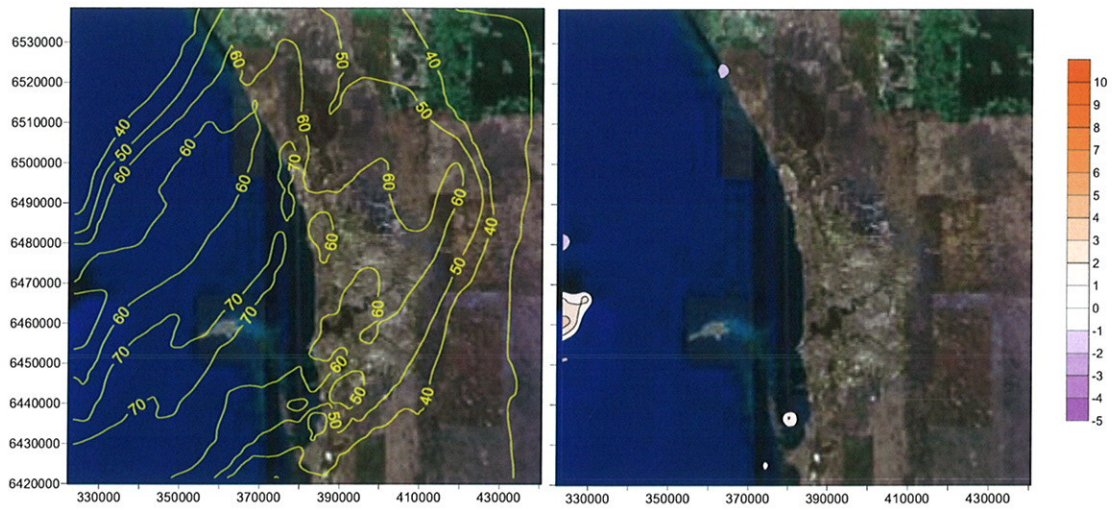


Figure 8: 27 February 1999, Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

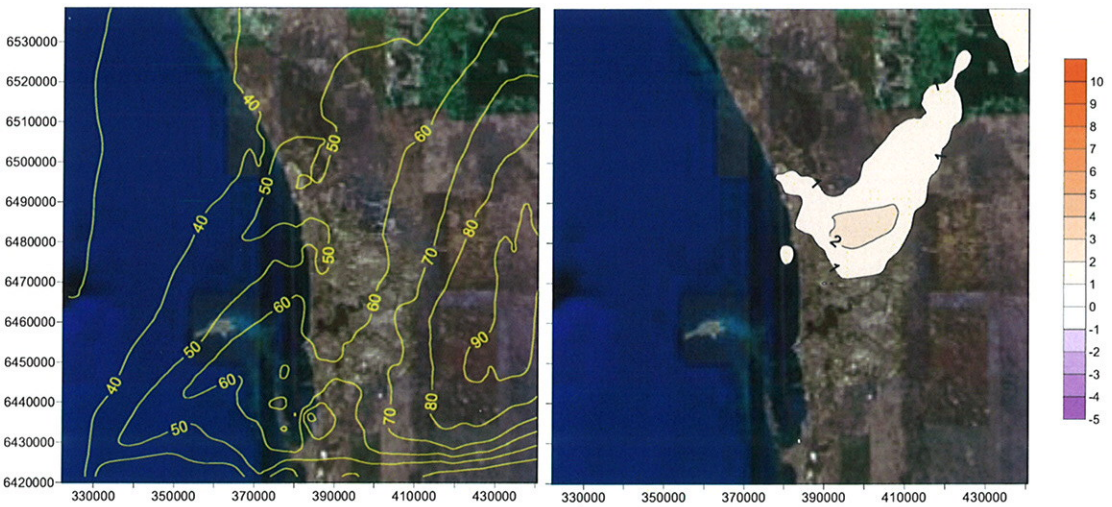


Figure 9: 11 January '2021'. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

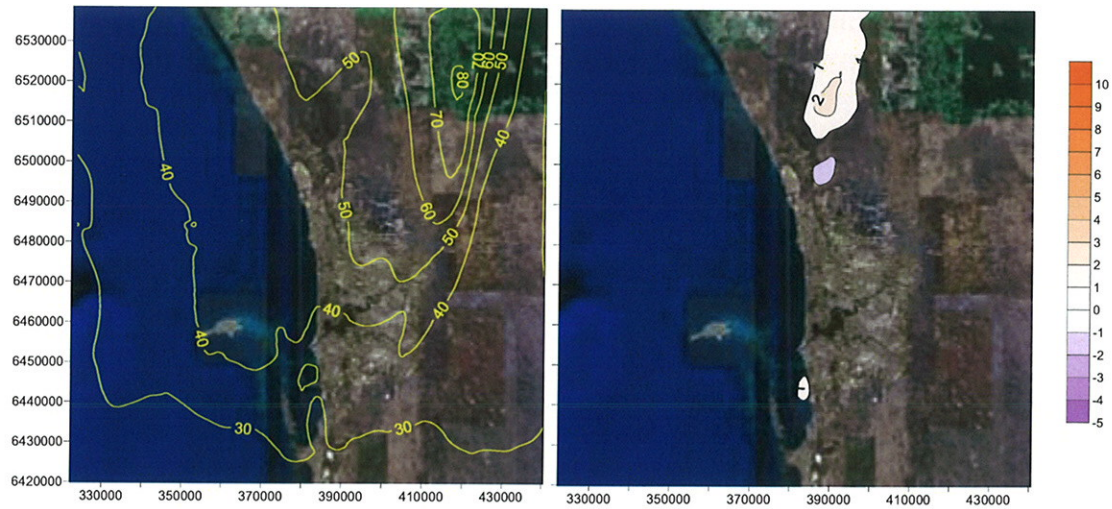


Figure 10: 13 January '2021'. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

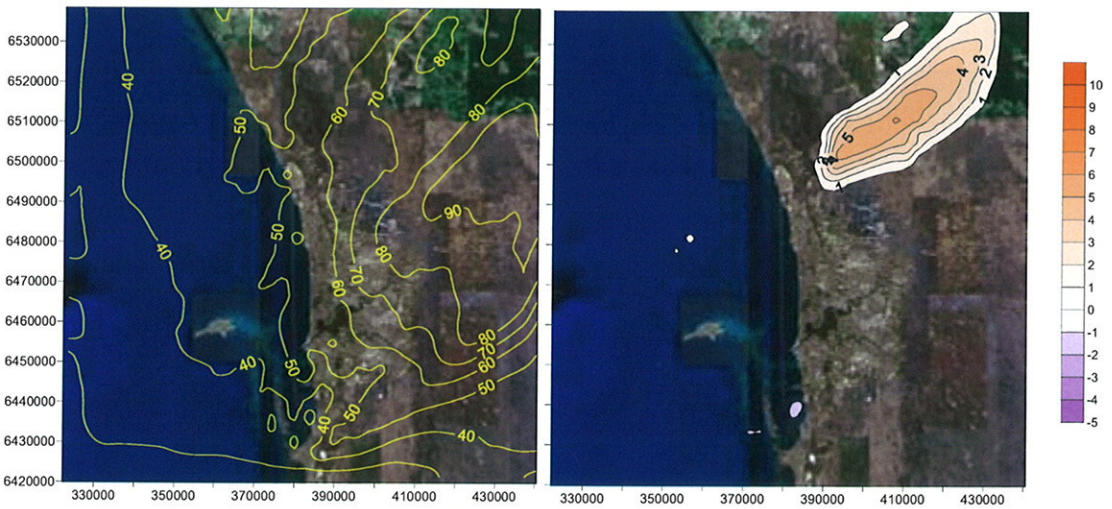


Figure 11: 28 January '2021'. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

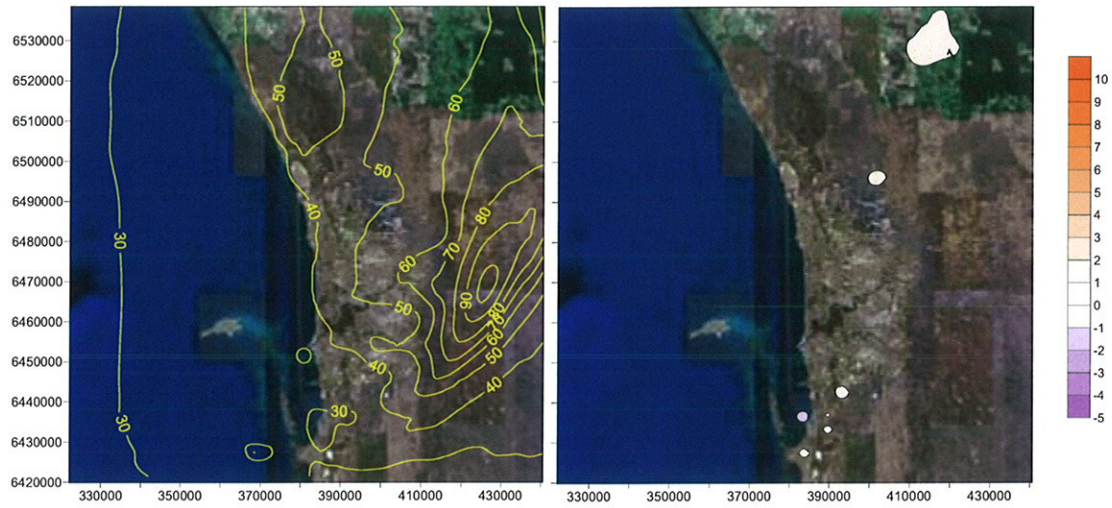


Figure 12: 12 February '2021'. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

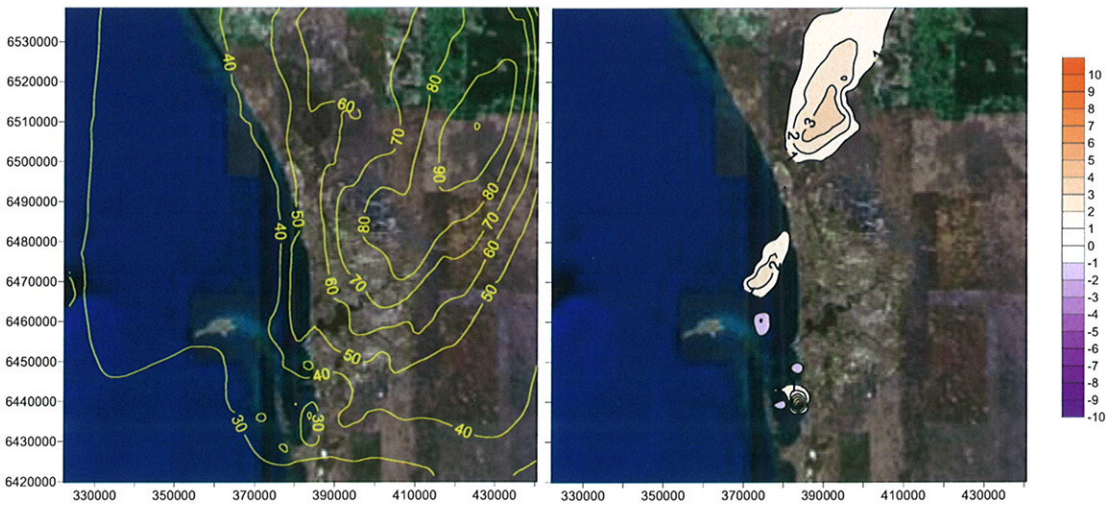


Figure 13: 24 February '2021'. Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).

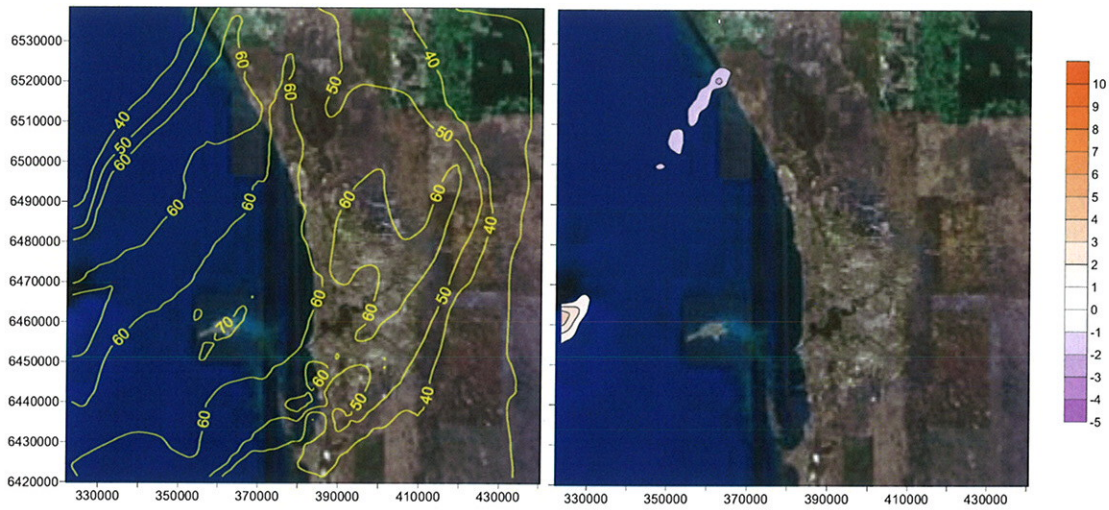
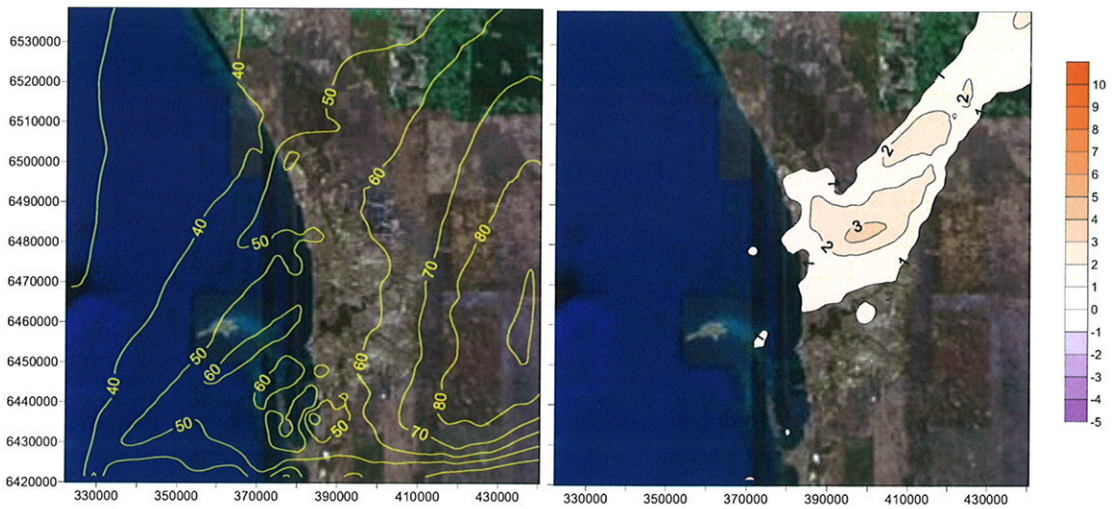


Figure 14: 27 February '2021', Maximum predicted ground-level concentration of ozone from existing sources (left). The contribution of the proposed NewGen 330 MW Gas-Fired Power Station to regional ground-level concentrations of ozone in ppb (right).



Appendix A: Model.config file for 1 January 1999

CIT Model Initialisation File
Run date 01/01/99
Start hour 0
End hour 23
X origin (AMG), m 322000
Y origin (AMG), m 6420000
X interval, m 3000
Y interval, m 3000
X-grid size 40
Y-grid size 40
No. of levels 8
Roughness length, m 0.1
Model top, m 2000
Layer fractions 0.020 .025 .030 .040 .050 .085 .250 .500
Species count 9

CO	0.0100	0.0100
SO2	0.0000	0.0000
NO2	0.0005	0.0005
NO	0.0000	0.0000
RHC	0.0400	0.0400
O3	0.0250	0.0250
HCHO	0.0040	0.0040
ALD2	0.0003	0.0003
MEK	0.0000	0.0000

APPENDIX B

Mattiske Consulting Pty Ltd and Aquila Fieldwork

Flora, Vegetation and Fauna Values of the Proposed NewGen Pipeline, Pinjar, Western Australia

August 2007

FLORA, VEGETATION AND FAUNA VALUES OF THE PROPOSED NEWGEN PIPELINE, PINJAR WESTERN AUSTRALIA 2007

Prepared for: NewGen Power

Prepared by: Mattiske Consulting Pty Ltd

August 2007

MATTISKE CONSULTING PTY LTD

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1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Newgen Power to determine the flora, vegetation and fauna values of a proposed gas and powerline corridor, situated on the northern Swan Coastal Plain, north of Perth, Western Australia.

The proposed pipeline corridor is approximately 30.45 km long and passes through sections of native bushland, rural areas, and pine plantation and mainly follows existing tracks and roads. This report integrates an earlier desktop review and a detailed field assessment creating a Level 2 assessment as defined by Guidance Statement No 51 (EPA 2004) and a Level 1 Reconnaissance Survey as defined in Guidance Statement No 56 (EPA 2004). The assessment aims to clarify information on the vegetation and flora values, as well as establishing potential fauna habitats.

A total of 33 families, 91 genera and 151 species of flora were recorded in total at both the powerline and pipeline (Appendix A). Of these species, 13 are introduced but none of these are listed as Declared Plants under the *Agriculture and Related Resources Protection Act 1976* (WA). A recent botanical study on the Gnangara Mound, which combined a series of studies on the Gnangara Mound and the northern Swan Coastal Plain, highlighted some 963 vascular plant species from 91 families and 344 genera (Mattiske Consulting Pty Ltd 2003). This study was over a much wider area than the proposed pipeline and powerline corridor.

No rare, priority or threatened flora were recorded or are known to occur near the proposed alignment. This includes; Declared Rare Flora species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WA), taxa pursuant to section 179 of the *Environment Protection Biodiversity Conservation Act 1999* (Cth) and Priority Flora.

The proposed pipeline passes through a range of vegetation complexes as defined by Heddle *et al.* (1980). The vegetation complexes within the alignment on these dune systems are well represented in the State Forest and conservation reserve system on the northern Swan Coastal Plain. The small areas of the proposed alignment within the Yanga complex, at the eastern end of the proposed alignment, is completely degraded agricultural land supporting only the occasional tree over pasture. The section of the proposed alignment within the Karrakatta - Central and South is located west of Lake Pinjar and is largely within tracks and pine plantations. Consequently, the proposed alignment occurs on tracks or in significantly cleared and degraded agricultural areas and so is of low value in protecting native species and communities.

On the basis of earlier studies by Havel (1968) and Mattiske Consulting Pty Ltd (2003) a series of site-vegetation types were defined for the Gnangara Mound. These site types, recent mapping by Mattiske Consulting Pty Ltd (2003) and the current field assessment were used to define the vegetation along the alignments. However in assessing the values along the alignment it must be recognized that much of the proposed pipeline and powerline alignments occurs along already disturbed tracks, service corridors and in areas adjacent to tracks and pine plantations, decreasing the value of these areas of vegetation.

A total of 13 mapping units occur along the fringes of the proposed pipeline and these include plant communities E1, G1, H1, I1, J1, J2, K1, K6, the disturbed or degraded versions of I1d, J1d, K1d, the disturbed areas (Dist) and the pine plantations (Pines). None of these communities are listed as Threatened Ecological Communities at the State or Federal levels (Department of Environment and Conservation 2007d, Department of Environment and Water Resources 2007).

The proposed pipeline and powerline corridors occur on mostly already disturbed areas, tracks and near current tracks from near Muchea and the southern end of Lake Pinjar. Disturbances range from clearing for agricultural uses, clearing for infrastructure, to weed encroachment. Careful management of the disturbance and rehabilitation of the pipeline and powerline corridors should not have a significant long-term impact on these areas. The rest of the pipeline and powerline corridors occur on agricultural lands, pine plantations and areas close to roads. On the edges of pine plantations and road reserves the careful rehabilitation of these areas may improve their current condition. Parts of the Corridor that occur on completely degraded agricultural land will not improve with this proposal as the land will have to be restored back to its previous use.

In the areas near the southern section of the proposed alignment, that occurs near Bush Forever sites, the pipeline construction will be restricted to the established firebreaks. The latter will result in clearing of the dominant introduced Veldt grass (**Ehrharta* sp.) and an occasional tree or shrub. The proponents propose an offset package in these areas. In areas to the north near the Pinjar Powerstation a 1.2 ha area of very good to excellent vegetation will be cleared. All care must be taken to prevent weed infestation, permanent loss of fauna habitat and permanent loss of the condition of the vegetation.

Five Bush Forever Sites and one Conservation Category Wetland are located either near or along the proposed pipeline and powerline corridors. The proposed corridors avoids Bush Forever Sites 293, 425 and 451, however the other sites will be impacted to varying degrees. At Bush Forever Site 380 the proposed corridors occur mostly in already disturbed areas that are still recovering from previous disturbance for infrastructure. However, near the Pinjar Power Station an area of 1.2 ha may be cleared in very good to excellent vegetation and steps will have to be taken to retain the integrity of this area during and after the laying of the gas pipeline. The proposed pipeline corridor will cross an area of Bush Forever Site 382. The vegetation that will be cleared that is of value will be less than 1 ha. The proposed powerline may clear a small amount (0.09 ha) of native vegetation at the southern end of this site, and care should be taken to minimise clearing to tower sites 9 and 10 and weed infestation from the other sites. At Lake Pinjar, a Conservation Category Wetland Listed under EPP (Swan Coastal Plain Lakes) 1992, the proposed pipeline and powerline occur in already degraded areas on the edge of the wetland or small areas of more pristine bushland, therefore the impact of the proposal will be minimal. The proposal should not breach the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992.

The fauna species predicted to potentially occur along the Survey Area are 122 bird species, 19 mammal species including 9 species of bat, 41 reptile species, and seven amphibian species. Ten introduced birds and five introduced mammals are likely to be present along the Survey Area.

A range of threatened and priority fauna species were highlighted in database searches (Department of Environment and Conservation 2007). This search highlighted range of bird species and invertebrate species that may occur in the area. These species were the Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and Vulnerable under the *Wildlife Conservation Act 1950* (WA), the White-tailed Black Cockatoo (*Calyptorhynchus* sp.), the Peregrine Falcon (*Falco peregrinus*), the Graceful Sunmoth (*Synemon gratiosa*), a cricket (*Austrosaga spinifer*) and two native bees (*Hylaeus globuliferus* and *Leioproctus contrarius*). It is unlikely that any of these species will be influenced by the proposed development as they are dependent on Banksia woodlands and a range of species within the heaths and Banksia woodlands whereas the areas affected are generally disturbed and are much smaller and poorer habitats than surrounding areas.

Three Priority mammal fauna species that could occur along the Survey Area route are the Western False Pipistrelle (*Falsistrellus mackenziei*) (Priority 4), Western Brush-tailed Wallaby (*Macropus irma*) (Priority 4) and Southern Brown Bandicoot or Quenda (*Isoodon obesulus fusciventer*) (Priority 5). It is also possible that the Chuditch (*Dasyurus geoffroii*), listed as Vulnerable on both the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and *Wildlife Conservation Act 1950* (WA), may be in the general area. One Priority reptile species could also occur along the Survey Area, the Carpet Python *Morelia spilota imbricata* (Priority 4).

Seven areas with fauna habitat were recognised as having an important part to play in the ecology of specific fauna:

- *Banksia* woodlands;
- Marri woodlands
- *Melaleuca* /damp-land
- Flooded Gums
- *Kunzea* flats
- Paddocks and degraded road verges
- Pine plantations

Between these differing habitats will be flowering and seeding periods that for the most of the year will provide food for various species of bird and other native animals. Ecological links will be maintained through proposed rehabilitation programs and trench monitoring during construction.

Potential habitat trees were inspected along the proposed alignment. As a consequence of the recent inspections two potential trees with hollows suitable for larger birds were identified, and should be avoided if possible until WA Museum experts can confirm the suitability of these trees.

In summary, the proposal disturbs a range of areas from pine plantation to native vegetation, in a range of conditions from very good to completely degraded (Keighery 1994, Government of Western Australia 2000). That said, areas that have higher conservation values are generally small, so that the overall impact of this proposal on flora, vegetation and fauna values should be minimal. Impacts will be further reduced if the recommendations are followed.

2. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned by Newgen Power to undertake a detailed flora and vegetation survey along the proposed gas pipeline corridor, situated on the northern Swan Coastal Plain, north of Perth, Western Australia. The proposed pipeline corridor is approximately 30.45 km long and passes through sections of native bushland, rural areas, and pine plantation and mainly follows existing tracks and roads. The proposed powerline consists of a series of nine towers south east of the end of the currently proposed gas pipeline.

This report comprises of a desktop review and detailed field assessment creating a Level 2 assessment as defined by Guidance Statement No 51 (EPA 2004a) and a Level 1 Reconnaissance Survey as defined in Guidance Statement No 56 (EPA 2004b). The assessment aims to test vegetation and flora values, as well as establishing potential fauna habitats.

2.1 Regional Physical Context

2.1.1 Climate

The proposed pipeline is located on the Gnangara Mound is described as having a Mediterranean climate of wet-mild winters and hot dry summers (Gentilli 1972). The long term climate averages data from the nearest weather station, RAAF Pearce (Table 1), show that most rainfall occurs during May to October. Long term temperatures also reflect the Mediterranean climate with maximum temperatures ranging from 33.1°C in February to 17.7°C in July, and minimum temperatures ranging from 17.4°C in February and 8.2°C in August.

Table 1: Long term climate averages for RAAF Pearce (Bureau of Meteorology 2007)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max Temp (°C)	33.0	33.1	30.5	26.4	21.8	18.8	17.7	18.2	19.9	23.2	27.0	30.0	25.0
Mean Min Temp (°C)	16.9	17.4	15.9	13.4	11.0	9.5	8.5	8.2	8.8	10.0	12.4	14.7	12.2
Mean rainfall (mm)	8.4	12.5	15.0	34.7	88.1	138.7	136.3	107.0	69.3	37.3	23.4	8.5	697.3

2.1.2 Landforms and soils

Churchward and McArthur (1980) mapped the landforms and soils of the proposed area as part of the "Atlas of Natural Resources, Darling System, Western Australia". The mapping they undertook suggests that the proposed pipeline will cross three different units (Table 2), from the Bassendean unit in the east (over areas with steep dunes), to the Cottesloe unit in the west.

Table 2: Landscape and soil units along the proposed pipeline (Churchward and McArthur 1980)

Unit	Description
Bassendean	Sand plains with low dunes and occasional swamps; iron or humus podzols; areas of complex steep dunes
Karrakatta	Undulating landscape with deep yellow sands over limestone
Cottesloe	Low hilly landscape with shallow brown sands over limestone, much exposed limestone

2.2 Definition of Conservation Values

The requirements of the desktop assessment are to provide an assessment of the regional and local conservation value of rare, threatened and vulnerable species and communities that could occur in the Survey Area as listed under:

1. the *Environment Protection and Biodiversity Act 1999* (Cth) (*EPBC 1999*);
2. the *Wildlife Conservation Act 1950* (WA) (*WCA 1950*);
3. Department of Environment and Conservation (DEC) Priority Flora and Fauna lists;
4. those sections of native bushland areas that have biodiversity values of a local and regional context as defined by the Bush Forever summaries (Government of Western Australia 2000);
5. Threatened Ecological Communities as defined by the Department of Environment and Conservation 2007d and the Department of Environment and Water Resources 2007b);
6. those birds that have special conservation significance on the Swan Coastal Plain as listed in Table 15 of Bush Forever Volume 2 (Government of Western Australia 2000)

2.2.1 Rare, Priority and Threatened Flora

Species of flora and fauna are defined as Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation recognises these threats of extinction and consequently applies regulations towards population and species protection.

Rare Flora species are gazetted under subsection 2 of section 23F of the *Wildlife Conservation Act 1950* (WA) and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the *Wildlife Conservation Act 1950* (WA) defines "to take" as " to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means.

Priority Flora are under consideration for declaration as 'rare flora', but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 3 presents the definitions of Declared Rare and the four Priority ratings under the *Wildlife Conservation Act 1950* (WA) as extracted from Department of Environment and Conservation (2007a, 2007b).

Listed threatened species are a matter of national environmental significance under the *Environment Protection and Biodiversity Conservation Act, 1999*. A person must not take an action that has, will have, or is likely to have a significant impact on a listed threatened species or ecological community, without approval from the Commonwealth Minister for the Environment and Heritage. Table 4 presents the definitions of the categories of threatened species under the EPBC Act 1999.

Table 3: Definition of Rare and Priority Flora Species (Department of Environment and Conservation, 2007a)

Conservation Code	Category
R	**Declared Rare Flora – Extant Taxa** "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such."
P1	**Priority One – Poorly Known Taxa** "Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P2	**Priority Two – Poorly Known Taxa** "Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey."
P3	**Priority Three – Poorly Known Taxa** "Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but need further survey."
P4	**Priority Four – Rare Taxa** "Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

Table 4: **Categories of Threatened Species (*Environment Protection and Biodiversity Conservation Act 1999*) (Cth)**

Category Code	Category
Ex	**Extinct** A native species is eligible to be included in the **extinct** category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** A native species is eligible to be included in the **extinct in the wild** category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** A native species is eligible to be included in the **critically endangered** category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria..
E	**Endangered** A native species is eligible to be included in the **endangered** category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** A native species is eligible to be included in the **vulnerable** category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** A native species is eligible to be included in the **conservation dependent** category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

2.2.2 Review of Significance of Flora and Vegetation

The Environmental Protection Authority (2004a) in Guidance Statement 51 stated that species, subspecies, varieties, hybrids and ecotypes may be significant other than as Declared Rare Flora or Priority Flora, for a variety of reasons, including:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status;
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution;
- being poorly reserved."

Plant communities or vegetation may be significant for a range of reasons, other than a statutory listing as a Threatened Ecological Community or because the extent is below a threshold level. The Environmental Protection Authority (2004a) in Guidance Statement 51 stated that significant vegetation may include communities that have:

- scarcity;
- unusual species;
- novel combinations of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution."

The application of the degree of significance may apply at a range of scales. Plant communities may be referred to as locally significant where the presence of Priority Flora species has been recorded, where they provide a range extension of particular taxa from previously recorded locations, or where they are very restricted to one or two locations or where they occur as small isolated communities. In addition, communities that exhibit unusually high structural and species diversity are also of local significance (Mattiske EM, pers. comm.). Plant communities may be referred to as regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of Declared Rare Flora (Mattiske EM, pers. comm.).

2.2.3 Vertebrate Fauna

Prior to any discussion of the significance of vertebrate fauna or their habitats a definition of terms is required. This section of the document describes the various Commonwealth and State Acts that cover rare, threatened and vulnerable vertebrate fauna species and was correct at the time of the preparation of this document. However, as changes are made to both State and Commonwealth legislation and new treaties are entered into, all current documentation regarding rare, threatened and vulnerable fauna should be periodically reviewed for any changes to the status of these animals in the Survey Area.

Additionally, in any discussion of rare, threatened or vulnerable species, several aspects require clarification before the significance of these species can be considered in context of the development of the proposed pipeline.

- Resident, habitat-specific rare fauna are much more susceptible to the influences of disturbance than nomadic or migratory species.
- Not all rare species are equally susceptible to disturbance. Some rare species such as the Peregrine Falcon can accommodate the high levels of disturbance present in urban and rural environments.
- The concept of species rarity is a dynamic process considerably influenced by the level of survey work carried out in a particular location.

2.2.4 Protected Species - Commonwealth

In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, an official list of endangered, vulnerable or presumed extinct species was constructed and was regularly updated under the *Endangered Species Protection Act 1992* (Cth).

In July 2000 this Act was replaced by *Environment Protection and Biodiversity Conservation Act 1999)*, which retained the schedule of threatened species of the Act it replaced.

The vertebrate fauna listed on the current schedule differs from the two State lists, although there are several species that appear on both, for example, the Chuditch, and Carnaby's and Baudin's Black-Cockatoos. There are six parts to the EPBC Act 1999 covering species that are:

- extinct;
- extinct in the wild;
- critically endangered;
- endangered;
- vulnerable;
- conservation dependent

2.2.5 Protected Species - Western Australia

Currently in Western Australia, rare or endangered species are protected by the *Wildlife Conservation Act 1950 (WCA 1950)*. The various schedules defined under this act are:

- Declared Threatened Fauna - fauna that is ranked as presumed extinct, critically endangered, endangered or vulnerable;
- Conservation Dependent Fauna; and
- Other Specially Protected Fauna.

This Act is periodically reviewed and the current list of protected fauna obtained from the Government Gazette.

2.2.6 Priority Species - Western Australia

The DEC, formerly the Department of Conservation and Land Management (CALM), Priority Fauna List classifies species as:

- 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.

The Priority Fauna List does not confer any additional legal protection to the species listed apart from the normal protection afforded to most native animals. It does, however, indicate the need for vigilance during the construction and commissioning of development projects to manage native vegetation and rehabilitation so that Priority species, should they occur, do not meet the criteria for listing on the Threatened Species List as a result of that development.

2.2.7 Significant Birds on the Swan Coastal Plain

A large number of birds have disappeared or have suffered serious declines in either abundance or geographic range on the Swan Coastal Plain (SCP) since European settlement (Government of Western Australia 2000). These birds are classified in this document as '*habitat specialists with a reduced distribution on the Swan Coastal Plain*' or '*wide-ranging species with reduced populations on the Swan Coastal Plain or locally extinct*' and therefore, require some discussion when remnant vegetation on the SCP may be considered for clearing.

2.2.8 International Agreements

A range of birds are listed under the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements. Most of the species listed on the JAMBA and/or CAMBA agreements are shorebirds associated with coastal shores or inland saline wetlands and most are not relevant to the current Survey Area. However, there is a small range of birds listed on these international treaties (Appendix C) that could occur within the Survey Area and these species are discussed later in this report.

2.2.9 Significant Fauna Habitats

Australia-wide, a small number of Threatened Ecological Communities (TEC) has been defined under Commonwealth legislation. However, while not defined under any legislation, some fauna habitats within a proposed development site may be locally significant because they:

- support rare or vulnerable species;
- support specialised or habitat specific fauna;
- are regionally or locally uncommon; or
- are restricted in area.

Although not protected under any State or Commonwealth legislation, in the interests of good project management, where possible, conservation of such locations within a project area will provide the basis for the fauna component of an environmental management plan to be put in place for the duration of a project. Much the Swan Coastal Plain has already been cleared below safe ecological limits (Environmental Protection Authority 2006) and therefore all remaining native bushland should be considered to be significant habitat for native fauna.

3. METHODS

3.1 Desktop Review

The detailed review consisted of the following components:

- a search of State and Commonwealth flora, vegetation and vertebrate fauna databases;
- a collation of previous datasets (Figures 1.1 to 1.5 and Appendices A to C); and
- a review of published literature on the vertebrate fauna of the general area.

Literature sources for the construction of the predicted species list shown in Appendix C included but were not limited to:

- flora and vegetation studies in the area by Havel (1968), Gibson *et al.* (1994), Keighery (1996), Department of Environment (1996), Heddle *et al.* (1980) and Mattiske Consulting Pty Ltd (2003);
- mammals, frogs and reptiles: Bush *et al.* (1995); Churchill (1998); Cogger (1992); Cronin (1991); How *et al.* (1996); Storr *et al.* (1999); Strahan (1998); Tyler *et al.* (2000); Wilson and Swann (2003);
- birds: Barrett *et al.* (2003); How *et al.*(1996); Johnstone and Storr (1998 and 2004); Storr and Johnstone (1988).

3.2 Field Assessment

4 people x 2days = 8 person days

Four Ecologists from Mattiske Consulting Pty Ltd undertook the more detailed flora and vegetation survey over the 3rd and 6th August 2007.This survey supplements earlier studies on the Gnangara Mound which have been undertaken in nearby sites since 1976. The survey area was traversed by vehicle and on foot where appropriate. For each survey site, the flora was systematically recorded and collections of plant specimens were made where further identification was required.

All plant specimens collected during the field survey were handled and identified in accordance with the requirements of the Western Australian Herbarium. Where necessary, specimens were compared with pressed specimens housed at the Western Australian Herbarium, and plant taxonomists with specialist skills were consulted. Nomenclature of recorded species follows that recommended by the Western Australian Herbarium (Department of Environment and Conservation 2007a, 2007b).

The plant communities occurring within the survey area were described in detail. The use of standard data collection forms ensured the data was collected in a systematic and consistent manner. At each site the following records were made: topography, percentage litter cover, soil type, percentage bare ground, outcropping rocks and their type, pebble type and size and number of years since fire. For each species recorded, the average height and percentage foliage cover of species both alive and dead was noted.

no plots

FCT type?

Condition of the vegetation using the scale devised by Keighery (1994) was determined at regular ? intervals along the proposed corridors.

The supplied aerial photographs were used to interpret and map the plant communities. Plant communities were based on previous definitions of communities completed on the Gnangara Mound (Mattiske Consulting Pty Ltd 2003).

Through the desktop review it was found that mature Eucalypts and *Corymbia*'s containing hollows should be kept as they may be or may become fauna habitats, especially for species such as Carnaby's Cockatoo (*Calyptorhynchus latirostris*). Possible habitat trees were searched for as part of the field assessment.

4. RESULTS

4.1 Flora

A total of 33 families, 91 genera and 151 species were found in total at both the powerline and pipeline (Appendix A). Most of these were found along the proposed pipeline, however as expected for disturbed areas, these counts pale into comparison when compared to recent studies. A recent botanical study on the Gnangara Mound, which combined a series of studies on the Gnangara Mound and the northern Swan Coastal Plain, highlighted some 963 vascular plant species from 91 families and 344 genera (Mattiske Consulting Pty Ltd 2003).

Of the species found, 13 are introduced but none of these are listed as Declared Plants under the *Agriculture and Related Resources Protection Act 1976* (WA).

4.2 Rare, Priority and Threatened Flora

A range of rare and priority flora species have been recorded in studies on the wider Gnangara Mound and therefore could occur near the proposed pipeline route. These species include:

- **Rare** flora species - *Eleocharis keigheryi, Grevillea curviloba* subsp. *incurva* and *Darwinia foetida* (formerly *Darwinia* sp. Muchea (B.J. Keighery 2458).
- **Priority 1** species - *Tripterococcus paniculatus* (ms).
- **Priority 2** species - *Schoenus griffinianus, Acacia benthamii, Isotropis cuneifolia* subsp. *glabra* and *Pithocarpa corymbulosa.*
- **Priority 3** species - *Cyathochaeta teretifolia, Conostylis pauciflora* subsp. *euryrhipis, Sarcozona bicarinata, Aotis cordifolia, Dillwynia dillwynioides, Lasiopetalum lineare, Hibbertia helianthemoides, Hibbertia spicata* subsp. *leptotheca, Haloragis tenuifolia, Myriophyllum echinatum, Stylidium longitubum, Stylidium maritimum, Blennospora doliiformis* and *Rhodanthe pyrethrum.*
- **Priority 4** species - *Schoenus natans, Jacksonia sericea, Stachystemon axillaris, Verticordia lindleyi* subsp. *lindleyi* and *Anthotium junciforme.*

Of the rare and priority species, *Grevillea curviloba* subsp. *incurva* is listed as Endangered and *Eleocharis keigheryi* is listed as Vulnerable pursuant to Schedule 1 of s179 of the EPBC Act 1999 (Department of Environment and Water Resources 2007).

A further range of rare and priority flora species have been recorded in the wider Swan Coastal Plain and the fringes of the escarpment to the east (Mattiske Consulting Pty Ltd 2003).

Although there appears to be the potential, on the basis of detailed studies in the area for a range of clients and state records (Department of Environment and Conservation 2007a and 2007b) no rare, priority or threatened flora are known to occur near the proposed alignment. This includes; Declared Rare Flora species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WA), taxa pursuant to section 179 of the *Environment Protection Biodiversity Conservation Act 1999* (Cth) and Priority flora.

The latter data has been supplied previously to the key agencies within the government agencies involved with the Gnangara Mound (Mattiske Consulting Pty Ltd 2003).

No rare, priority or threatened flora were located during the field survey, most likely due to the previous disturbance of the pipeline and powerline corridors.

4.3 Vegetation

The proposed pipeline passes through a range of vegetation complexes as defined by Heddle *et al.* (1980). The vegetation complexes within the alignment on these dune systems are well represented in the State Forest and conservation reserve system on the northern Swan Coastal Plain with all but Yanga (18%) and Karrakatta Central and South (18%) above 20% representation (Government of Western Australia 2000). The small areas of the proposed alignment within the Yanga complex (at the eastern end of the proposed alignment) is completely degraded agricultural land supporting only the occasional tree over pasture. The section of the proposed alignment within the Karrakatta - Central and South is located west of Lake Pinjar and is largely within tracks and pine plantations. Consequently, the proposed alignment occurs on tracks or in significantly cleared and degraded agricultural areas and so is of low value in protecting native species and communities.

On the basis of earlier studies by Havel (1968) and Mattiske Consulting Pty Ltd (2003) a series of site-vegetation types were defined for the Gnangara Mound. These site types, recent mapping by Mattiske Consulting Pty Ltd (2003), and the current field assessment were used to define the vegetation along the alignments. In assessing the values along the alignment (Figures 1.1 to 1.5) it must be recognized that much of the proposed pipeline and powerline alignments occurs along already disturbed tracks, service corridors and in areas adjacent to tracks and pine plantations, decreasing the value of these areas of vegetation.

A total of 13 mapping units occur along the fringes of the proposed pipeline and these include plant communities E1, G1, H1, I1, J1, K1, K6, the disturbed or degraded versions of I1d, J1d, K1d, the disturbed areas (Dist) and the pine plantations (Pines).

The E1 community occurs on the Spearwood dune system and the G1, H1, I1, J1, K1 and K6 occur on the Bassendean dune system. The communities K1 and K6 occur on the damplands and wetter swampy areas within the Bassendean and Pinjarra Plain systems.

The 13 mapping units include:

E1: Low Open Woodland of *Banksia attenuata - Banksia menziesii* over *Eremaea fimbriata, Xanthorrhoea preissii, Synaphea spinulosa* subsp. *spinulosa, Stirlingia latifolia* and *Melaleuca scabra.*

G1: Low Woodland to Low Open Woodland of *Banksia attenuata - Banksia menziesii - Eucalyptus todtiana - Nuytsia floribunda* with occasional *Allocasuarina fraseriana* and *Banksia grandis* over *Leucopogon conostephioides, Scholtzia involucrata, Eremaea pauciflora* var. *pauciflora, Melaleuca scabra, Boronia purdieana* subsp. *purdieana* and *Astroloma xerophyllum.*

H1: Low Woodland to Low Open Woodland of *Banksia attenuata - Banksia menziesii - Banksia ilicifolia - Nuytsia floribunda* over *Beaufortia elegans, Leucopogon polymorphus, Melaleuca systena, Calytrix angulata, Calytrix flavescens, Stirlingia latifolia, Dasypogon bromeliifolius, Leucopogon conostephioides, Lyginia barbata, Macrozamia riedlei* and *Xanthorrhoea preissii.*

I1: Low Open Woodland of *Banksia attenuata - Banksia menziesii* over *Verticordia nitens, Dasypogon bromeliifolius, Melaleuca seriata* and *Patersonia occidentalis.*

I1d: I1 community in degraded or disturbed state.

J1: Woodland of *Corymbia calophylla - Banksia attenuata - Banksia menziesii - Melaleuca preissiana* over *Xanthorrhoea preissii, Hypocalymma angustifolium, Pultenaea reticulata, Adenanthos obovatus, Regelia ciliata* and *Jacksonia furcellata.*

J1d: J1 community in degraded or disturbed state.

J2: Woodland of *Corymbia calophylla* over *Xanthorrhoea preissii, Hibbertia subvaginata* and *Gompholobium scabrum.*

K1: Open Forest of *Eucalyptus rudis* subsp. *rudis - Melaleuca preissiana - Banksia ilicifolia* with occasional *Banksia attenuata, Banksia menziesii, Nuytsia floribunda* and *Eucalyptus todtiana* over *Kennedia prostrata, Lyginia barbata, Xanthorrhoea preissii, Hypocalymma angustifolium, Dasypogon bromeliifolius, Pericalymma ellipticum* var. *ellipticum, Astartea scoparia, Lepidosperma tenue, Jacksonia furcellata, Kunzea ericifolia* subsp. *ericifolia* and *Bossiaea eriocarpa.*

K1d: K1 community in degraded or disturbed state.

K6: Open Forest of *Melaleuca rhaphiophylla - Eucalyptus rudis* subsp. *rudis* over *Baumea* and *Meeboldina* species.

Pines: Pine plantations

Dist: Disturbed and completely degraded areas.

None of these communities are listed as threatened ecological communities at the State or Federal levels (Department of Environment and Conservation 2007d, Department of Environment and Water Resources, 2007b).

how is this determined? no plot data, no inferred FCT's.

4.4 Conservation Estates

Five Bush Forever Sites and one Conservation Category Wetland are located either near or along the proposed pipeline and powerline corridors (Figures 1.1 to 1.5) and are summarised below (Western Australian Planning Commission 2000).

4.4.1 Bush Forever Site 293: Shire View Hill and Adjacent Bushland, Nowergup/Neerabup

Bush Forever site 293 is located within the Shire of Wanneroo (Nowergup/Neerabup). Located on the Spearwood dunes landform with Tamala limestone and derived sands, this site has an area of 268.1 ha and includes Department of Environment and Conservation managed State Forest 65. The Spearwood dunes vegetation complex includes the Karrakatta complex (central and south) and the Cottesloe complex (central and south). Floristic community types have not been sampled however two supergroups have been inferred. Supergroup 2 includes seasonal wetlands of mixed shrub damplands. Supergroup 4 includes uplands centered on the Spearwood and Quindalup dunes, and consists of Northern Spearwood shrublands and woodlands, Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands, *Melaleuca huegelii-Melaleuca acerosa* shrublands on limestone ridges and species poor mallees and shrublands on limestone. One wetland type, dumpland, was recorded at this site. Threatened ecological communities were not assessed however the floristic community type of *Melaleuca huegelii-Melaleuca acerosa* shrublands on limestone ridges is endangered. Flora of significance includes *Eucalyptus argutifolia* (Rare), *Stylidium maritimum* (Priority 3), *Podolepis canescens* and *Acacia alata* var. *tetrantha*. Typical Tamala limestone taxa include both *Stylidium maritimum* (Priority 3) and *Acacia alata* var. *tetrantha* along with *Eucalyptus petrensis*, *Grevillea preissii* and *Melaleuca huegelii*. Overall the vegetation is in excellent condition with some areas of localised severe disturbance.

The proposed corridors avoid this site.

4.4.2 Bush Forever Site 380: Rosella Road Bushland, Bullsbrook

Bush Forever site 380 is entered in the Register of the National Estate (Yeal Nature Reserve) and located within three Shires: the Shire of Wanneroo (Pinjar, Yanchep), Shire of Chittering (Muchea) and Shire of Gingin (Yeal). This site has an area of 8001.6 ha and includes Department of Environment and Conservation managed Reserve 42450 , State Forest 65 and System 6 (1983) parts M5 and C13. Bush Forever site 380 is located on four landforms; the Bassendean dunes with Bassendean sands, the Bassendean dunes/Pinjarra plain with Bassendean sands over the Guilford formation, the wetlands within the Spearwood and Bassendean dunes with Holocene swamp deposits and the Lagoonal and estuarine deposits within the Bassendean dunes. The vegetation complexes include the Bassendean dunes complex (north, north transitions and central/south transitions) and Spearwood dunes complex (north, north transitions and central/south transitions). Floristic community types include two supergroups. Supergroup 2 includes seasonal wetlands of mixed shrub damplands. Supergroup 3 includes uplands on Bassendean dunes and Dandaragan plateau and consists of low-lying *Banksia attenuata* woodlands or shrublands, *Banksia ilicifolia* woodlands and central and northern *Banksia attenuata-Banksia menziesii* woodlands. Three wetland types, slumpland, dumpland and creek, have been recorded at this site. Threatened ecological communities were not assessed however flora of significance includes S*tachystemon axillaris* (Priority 4), *Verticordia nitens*, *Boronia purdieana*, *Astroloma xerophyllum*, *Stylidium crossocephalum* and *Leucopogon kingianus*. Overall the vegetation is in excellent condition with some areas of localised disturbance.

The proposed corridors occur mostly in already disturbed areas that are still recovering from previous disturbance for infrastructure (Figure1.1, 1.2). However, near the Pinjar Power Station an area of 1.2 ha may be cleared which is in very good to excellent vegetation and steps will have to be taken to retain the integrity of this area during and after the laying of the gas pipeline.

4.4.3 Bush Forever Site 382: Lake Pinjar and Adjacent Bushland, Pinjar

Bush Forever site 382 is located within the Shire of Wanneroo (Pinjar, Neerabup) with a bushland area of 735.4 ha and includes System 6 (1983) part M8. Bush Forever Site 382 is located on four landforms; the Bassendean dunes with Bassendean sands, the Bassendean dunes/Pinjarra plain with Bassendean sands over the Guilford formation, the Spearwood dunes with Tamala limestone derived sands and the wetlands landform within the Spearwood and Bassendean dunes with Holocene swamp deposits. The vegetation complexes include the Bassendean dunes complex (north), Spearwood dunes Karrakatta complex (north) and wetlands Pinjar complex. Floristic community types include two supergroups. Supergroup 2 includes seasonal wetlands of mixed shrub damplands, shrublands on dry clay flats, *Melaleuca teretifolia* and/or *Astartea* aff. *scoparia* shrublands, *Astartea* aff. *scoparia /Melaleuca* species dense shrublands, northern *Pericalymma ellipticum* dense low shrubland and wet sedgelands on sandy clays. Supergroup 3 includes central *Banksia attenuata-Eucalyptus marginata* woodlands, *Banksia ilicifolia* woodlands and central *Banksia attenuata-Banksia menziesii* woodlands. Three wetland types, slumpland, creek and artificial channel, were recorded at this site. Threatened ecological communities were not determined however flora of significance includes *Tripterococcus paniculatus* (Priority 1), *Stylidum longitubum* (Priority 3), *Anthotium junciforme* (Priority 4), *Stylidium utricularioides*, *Burchardia bairdiae*, *Boronia purdieana*, *Hensmania turbinata*, *Stylidium crossocephalum*, *Verticordia nitens* and *Epiblema grandiflora*. Overall the vegetation is in excellent condition with some areas of localised severe disturbance.

Hill *et al.* (1996) list Lake Pinjar as being a Conservation Category Wetland as well as being listed under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992. The management aim of Conservation Category Wetlands is to preserve their natural attributes and functions.

The proposed pipeline corridor will cross in already degraded areas on the edge of this wetland or small areas of more pristine bushland. The vegetation that will be cleared that is of value (Figure 1.3,1.4) will be less than 1 ha. The proposed powerline may clear a small amount (0.09 ha) of native vegetation at the southern end of this site, and care should be taken to minimise clearing to tower sites 9 and 10 and weed infestation from the other sites. The proposal should not breach the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992.

4.4.4 Bush Forever Sites 425 and 451: State Forest 65 – Pinjar Plantation South Bushland, Nowergup/Yanchep/Neerabup

Bush Forever site 425 is located within the Shire of Wanneroo (Nowergup, Yanchep, Neerabup) with a bushland area of 61.5 ha and includes Department of Environment and Conservation managed State Forest 65. Bush Forever site 425 is located on two landforms, the Spearwood dunes landform with Tamala limestone and derived sands and the wetlands landform within the Spearwood dunes with Holocene swamp deposits. The vegetation complexes include the Spearwood dunes consisting of the Karrakatta complex (central and south) and the Cottesloe complex (central and south) and wetlands Pinjar complex. Floristic community types have not been sampled however two supergroups occur. Supergroup 2 includes seasonal wetlands and supergroup 4 includes uplands centered on the Spearwood and Quindalup dunes. Two wetland types, dumpland and slumpland, have been recorded within the Bassendean dunes at this site. Threatened ecological communities were not determined and no flora of significance has been recorded for this site. Overall the vegetation condition is very good. Both sites are considered Conservation Category Wetlands.

The proposal avoids Bush Forever Site 425 and 451.

4.5 Condition of Vegetation

The proposed pipeline and powerline corridors occur on mostly already disturbed areas, tracks and near current tracks from near Muchea and the southern end of Lake Pinjar (Figures 1.1 to 1.5). Disturbances range from clearing for agricultural uses, clearing for infrastructure to weed encroachment.

Areas where previous infrastructure has been installed have partially recovered from the disturbance as measured by Keighery (1994) vegetation condition scale (Figures 1.1 to 1.5). Careful management of the disturbance and rehabilitation of the pipeline and powerline corridors should not have a significant long-term impact on these areas.

The rest of the pipeline and powerline corridors occur on agricultural lands, pine plantations and areas close to roads. On the edges of pine plantations and road reserves the careful rehabilitation of these areas may improve their current condition. Parts of the Corridor that occur on completely degraded agricultural land will not improve with this proposal as the land will have to be restored back to its previous use.

In the areas near the southern section of the proposed alignment, that occurs near Bush Forever sites, the pipeline construction will be restricted to the established firebreaks. The latter will result in clearing of the dominant introduced Veldt grass and an occasional tree or shrub. The proponents propose an offset package in these areas. In areas to the north near the Pinjar Powerstation a 1.2 ha area of very good to excellent vegetation will be cleared. All care must be taken to prevent weed infestation, permanent loss of fauna habitat and permanent loss of the condition of the vegetation.

4.6 Fauna

The fauna species predicted to potentially occur along the Survey Area are 122 bird species, 19 mammal species including 9 species of bat, 41 reptile species, and seven amphibian species. Ten of these are introduced.

4.6.1 Birds

122 native bird species could be present in the Survey Area (Appendix C). Birds included in this list were those that do not require areas of open water as habitat, however, birds that can have temporarily inundated habitats were. Therefore ducks have been included because they will visit damp-lands and small areas of inundation and will readily leave the water to feed and rest. Other wading birds such as the herons, stilts, ibis and egrets were included because they will frequent open damp and inundated areas. It would unlikely for any waterbirds to be present during periods of dryness, and it would be preferable if the pipeline was to be laid then.

Some of the species listed in Appendix C may only occur seasonally or when specific conditions are met. For example, some of the honeyeaters may visit the area when particular plants are flowering.

Many of the species listed in Appendix C have become extremely scarce on the Swan Coastal Plain (SCP) although they may be common elsewhere. These birds are either habitat specialists with a reduced distribution on the SCP or are wide-ranging species with reduced populations on the SCP; some may be locally extinct (Government of Western Australia 2000). The birds that fit into these categories include many birds of prey such as the Square-tailed and Whistling Kites, Brown Goshawk, Collared Sparrowhawk, Little Eagle and Wedge-tailed Eagle. Birds such as these are wide-ranging and being predators, will never have been particularly common. Other small birds such as fairy-wrens and thornbills are less mobile and some are more territorial than the larger birds and many are dependent on remnants of native vegetation on the SCP (Government of Western Australia 2000).

4.6.2 Mammals

Appendix C shows that 19 native mammal species (including nine species of bat) could potentially occur. The Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) may be present if suitable dense understorey vegetation is present. While unlikely, the Chuditch (*Dasyurus geoffroii*) could potentially occur.

4.6.3 Amphibians

Seven species could occur in the Survey Area, (Appendix C) including some burrowing frogs. Some frog species are more reliant on permanent swamps and lakes and have been excluded here. Burrowing frog species may be unearthed during trench digging for pipeline emplacement. A management procedure should be put in place for their relocation.

4.6.4 Reptiles

Up to 41 species could occur along the Survey Area (Appendix C) including four species of venomous snake that would be harmful to humans. Education about the identification of these species should be provided to personnel involved in the construction of the pipeline. Care should be taken during the excavation period and an experienced snake handler should inspect the trench each day for snakes and other reptiles, and remove them to safety.

4.6.5 Introduced Species

Five introduced birds and five introduced mammals are likely to occur throughout the Survey Area (Appendix C). It is likely that all of the introduced species listed in Appendix C occur along this pipeline route.

4.7 Significant Fauna Species

A range of threatened and priority fauna species were highlighted in database searches (Department of Environment and Conservation 2007). This search highlighted a range of bird species and invertebrate species that may occur in the area. These species were the Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered under the EPBC (1999) Act and Vulnerable under the WCA (1950) (WA), the White-tailed Black Cockatoo (Baudin's or Carnaby's) (*Calyptorhynchus* sp.), the Peregrine Falcon (*Falco peregrinus*), the Graceful Sunmoth (*Synemon gratiosa*), a cricket (*Austrosaga spinifer*) and two native bees (*Hylaeus globuliferus* and *Leioproctus contrarius*). The bird species are discussed further in the following sections. The cricket is known from heath communities near Perth and Cervantes, whilst the native bees are dependent on a range of widespread native species. It is unlikely that any of these invertebrate species will be influenced by the proposed development as they are dependent on Banksia woodlands and a range of species within the heaths and Banksia woodlands whereas the areas affected are already very disturbed and are much smaller and poorer habitats than surrounding sites.

Three Priority mammal fauna species that could occur along the Survey Area route are the Western False Pipistrelle (*Falsistrellus mackenziei*) (Priority 4), Western Brush-tailed Wallaby (*Macropus irma*) (Priority 4) and Southern Brown Bandicoot or Quenda (*Isoodon obesulus fusciventer*) (Priority 5). It is also possible that the Chuditch (*Dasyurus geoffroii*), listed as Vulnerable on both the EPBC (1999) (WA) and WC Act (1950) (WA), may be in the general area. One Priority reptile species could also occur along the Survey Area, the Carpet Python *Morelia spilota imbricata* (Priority 4). These species are discussed further in the following sections.

4.7.1 Birds

The Carnaby's Cockatoo is highly likely to be present in the Survey Area, and is of major conservation significance. Two other species that may occur are Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo although the area is generally considered to be out of their present range.

Carnaby's Cockatoo, which is listed as Endangered under the EPBC (1999) Act (WA) and Vulnerable under the WCA (1950) (WA) is likely to occur along the Survey Area route especially in any of its preferred feeding habitat. This black-cockatoo species has undergone a dramatic decline in recent years due to the loss of either food resources, destruction of their habitat, or as a result of their low reproductive rate (Johnstone and Storr 1998).

The Survey Area could be considered to be within the breeding range of this species, and because of the result of changes to its preferred environment they may be expanding their normal range of breeding area. (Johnstone and Storr 1998).

Studies conducted by Birds Australia has proven that approximately 2,400 Carnaby's Cockatoo utilize the Northern SCP (Shah 2006) both to feed in the Gnangara Pine Plantation and the nearby native bushland. The Gnangara Pine Plantation is earmarked for clearing in the near future and this will put more pressure on the Carnaby's Cockatoo to seek further food sources and therefore, will require more reliance on the surrounding native bushland. Carnaby's Cockatoo feed on proteaceous plants including *Banksias*. A section of the Survey area passes through *Banksia* woodland and sections of Marri woodland which is another important food source for these birds (personal observations). The Marri woodland may also have hollows suitable for breeding. These birds require large hollows (approximately 1m – 2.5m deep) and evidence has shown that some now nest on the SCP (Johnstone and Storr 1998) Large mature Marri trees with suitable hollows may be present along the Survey Area. Given the number of these birds present in the northern SCP it is possible that the Marri woodland may be used for breeding. Carnaby's Cockatoo require a food source close to their breeding area and the Survey Area has the proteaceous food required.

Baudin's Cockatoo is listed as Vulnerable under both the EPBC (1999) Act (WA) and WCA (1950) (WA) but is unlikely to occur along the Survey Area. It is generally believed to avoid the SCP west of the Darling Range foothills. This species is known to breed in the deep South-west as far north as Lowden, almost 150 km south-east of the current Survey Area. Baudin's Cockatoos are endemic to the south-west of Western Australia and are thought to have declined greatly in the last 50 years, their slow rate of reproduction precluding them from replacing the large numbers being shot by orchardists (Johnstone and Storr 1998). Approximately one quarter of their original habitat has been cleared for Agriculture (Burbidge 2004) and as a result a northward movement on the SCP may occur. Should this species be recorded within the Survey Area in the future, it is most likely to occur in areas where fruiting Marri trees would provide their preferred food resource.

The Forest Red-tailed Black-Cockatoo is more commonly seen in the Jarrah forest of the Darling Range but has recently been noted in the Perth's eastern suburbs (personal observations) and therefore, may occur along the Survey Area. Johnstone and Storr (1998) state that the main impact on this species has been the destruction of forests with the subsequent loss of nesting hollows and feeding resources. This species is listed as Vulnerable under the WCA (1950) (WA).

The loss of black-cockatoo nesting hollows in mature eucalypts through invasion by feral Honey Bees and other birds such as Galahs and Australian Wood Duck has also had an impact on these large birds (R. Johnstone pers. comm.).

The Rainbow Bee-eater and the Fork-tailed Swift are listed either on the China/Australia Migratory Bird Agreement (CAMBA) or the Japan/Australia Migratory Bird Agreement (JAMBA) and could occasionally be present in the Survey Area (Appendix C). The Fork-tailed Swift rarely lands in Australia but may be seen overhead, often ahead of summer storm fronts. The Rainbow Bee-eater, however, is known to breed in the South-west, excavating a nesting burrow into flat sandy ground or sand banks, wherever the sand is able to support a burrow.

Two egrets, the Great and Cattle Egrets, are listed on CAMBA and may be observed occasionally within the Survey Area. While both may be observed in paddocks, the Great Egret is more usually observed in shallow wetland areas, both fresh and salt and may visit the small claypan area.

The Peregrine Falcon which is listed as Other Specially Protected Fauna on the *Wildlife Conservation Act (1950)* (WA) could occur in the Survey Area. This bird of prey may be seen hunting for ducks or pigeons over farmland and has taken advantage of disused quarries along the Darling Scarp.

No birds likely to occur are listed on the Department of Environment and Conservation's Priority Fauna list.

Thirty-two of the 122 bird species listed in Appendix C are either habitat specialists with a reduced distribution (RD) on the Swan Coastal Plain or are wide-ranging species with reduced populations (RP) on the Swan Coastal Plain (Government of Western Australia 2000). This includes many of the birds of prey (RP), a number of small insectivores such as the Splendid Fairy-wren and various thornbills (RD) and a relatively large number of honeyeaters (RP). Most of these birds are common in the remainder of their geographic distribution but are reliant on the often fragmented and sometimes small remnant areas of native vegetation on the Swan Coastal Plain.

4.7.2 Mammals

If suitable habitat is present then nineteen species of native mammal could potentially occur in the Survey Area.

Among these mammals it is possible that the Chuditch (*Dasyurus geoffroii*) and the Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) may be present within the general area.

The Chuditch (*Dasyurus geoffroii*) is listed as Vulnerable on both the EPBC Act 1999 (Cth) and WC Act 1950 (WA). This marsupial has been frequently captured in the Darling Range (Ninox Wildlife Consulting 2002, 2003), there are very few records from the northern Swan Coastal Plain. One young male was captured at Lowlands, on the Swan Coastal Plain near Serpentine in April 2000 (Ninox unpublished data).

Three species that could occur along the Survey Area route are shown on Department of Environment and Conservation's Priority Fauna list (Appendix C). These species are listed below with details on their Priority listing.

- Priority 4: Western False Pipistrelle (*Falsistrellus mackenziei*) - while this small bat has a widespread distribution in the South-west, it appears to be locally common in Karri (*Eucalyptus diversicolor*) forests (Start and McKenzie 1998). These authors also suggest that from recent captures this bat may be more common than it appears. As this species of bat may roost in tree hollows and hollow logs it is possible that they occur within the Survey Area. A section of woodland containing *Eucalyptus rudis* is along the Survey Area and this species of tree is known to contain hollows of varying sizes, some may be suitable for these bats to roost.
- Priority 4: Western Brush-tailed Wallaby (*Macropus irma*) may be present in the survey area if suitable habitat is available. This large wallaby species prefers to graze and will inhabit open forest and shrub-lands with grasses. They occur at Whiteman Park and could potentially occur along the Survey Area
- Priority 5: Southern Brown Bandicoot or Quenda (*Isoodon obesulus fusciventer*) can occur in highly disturbed areas especially where there is dense vegetation including weeds that can provide the cover these animals require and which could occur along the Survey Area.

The Government of Western Australia (2000) states that at least 33 native mammals once occurred on the Swan Coastal Plain. Only 18 were recorded during 1978. It is also stated that there has been further decline in the last 20 years. Therefore, it can be said that all native mammals remaining in these areas are of significance.

4.7.3 Amphibians

None of the seven frog species predicted to occur in the Survey Area route is listed on any of the Government rare, threatened or vulnerable species lists.

4.7.4 Reptiles

None of the 41 reptile species predicted to occur along the Survey Area route is listed on any of the Government rare, threatened or vulnerable species lists, however one species is listed on Department of Environment and Conservation's Priority List and could occur along the Survey Area.

- Priority 4: Carpet Python *Morelia spilota imbricata* may be found in extensive undisturbed native bushland. Clearing on the Swan Coastal Plain has reduced its numbers but it is found in Yanchep National Park, north-west of the Survey Area. (Bush *et al.* 1995).

4.8 Significant Fauna Habitats

The areas with fauna habitat are summarised below.

- *Banksia* woodlands;
- Marri woodlands
- *Melaleuca* /damp-land
- Flooded Gums
- *Kunzea* flats
- Paddocks and degraded road verges
- Pine plantations

Each of the fauna habitats summarised above has an important part to play in the ecology of specific fauna. For example, the Carnaby's Cockatoo now relies on Pine sp. seed, and especially the *Banksia* and Marri woodlands for food and perhaps breeding. Because all of these are in close proximity they provide an important ecological link for their feeding requirements. During the breeding period, food resources must be within 6km to 12km of the breeding hollow in order to feed the chick. It has been known for the chick to starve to death if the hollow is too distant. (Shah 2006)

Between these differing habitats will be flowering and seeding periods that for the most of the year will provide food for various species of bird and other native animals. Ecological links that provide a continuous and uninterrupted corridor for the movement of fauna between these differing habitats is vitally important. Tracks and cleared areas can cause an interruption to movement of some small ground fauna.

Flooded Gums (*Eucalyptus rudis*) provide excellent hollows of varying sizes for a range of hollow dependent native animals. Hollows throughout the metropolitan region are constantly being lopped because of their perceived danger of falling and injuring humans. This is leading to a shortage of breeding and shelter hollows for urban native wildlife. Hollows take long periods of time (approximately 100-150 years) to develop large hollows suitable for the black cockatoos, less time for smaller hollows but still a significant time period. Any hollows should be considered significant as fauna habitat.

Even paddocks and degraded road verges, during periods of invertebrate activity, have advantaged some birds like the ibis. Dense weeds on road verges can, in some cases, provide shelter and corridors for the Southern Brown Bandicoot.

The pine plantations have become an important food resource for Carnaby's Cockatoo, and Brush-tailed Possums could potentially occur there.

All of the habitats above will have significance to some species of native wildlife and all will be utilised by them in some form or at some time during seasonal changes.

Potential habitat trees were inspected along the proposed alignment. As a consequence of the recent inspections two potential trees with hollows (one was at (GDA94) 50J 391923 mE 6508374 mN and the other 50J 394042 mE 6508391 mN) suitable for larger birds were identified. These will be avoided in the design if confirmed by WA Museum experts.

Underlying any discussion on the value of the remnant vegetation of the Survey Area is the extent of clearing on the Swan Coastal Plain. Approximately 80% of native bushland has already been cleared (EPA 2006), a critical loss of fauna habitat. Any further clearing will impact on the already disrupted and reduced faunal ecosystems. All native bushland remnants are therefore considered significant. In this instance as a result of detailed work the impacts have been minimized. The proposal disturbs a range of areas from pine plantation to native vegetation, in a range of conditions from very good to completely degraded (Keighery 1994, Government of Western Australia 2000). That said, areas that have higher conservation values are generally small, so that the overall impact of this proposal on flora, vegetation and fauna values should be minimal. Impacts will be further reduced if the recommendations are followed.

5. CONCLUSIONS

The Swan Coastal Plain has been extensively disturbed and cleared after European settlement making any proposal to further disturb this area one that requires careful consideration. The size of the impact on native vegetation areas will be minimal as approximately 55% of the alignment occurs in Pine plantations and agricultural areas. The remaining 45% is proposed to use largely already disturbed sites (fire breaks, tracks and previously cleared infrastructure corridors with lower vegetation values), thus minimising impacts on vegetation, flora and vertebrate fauna.

The impacts that may occur include a temporary loss of previous regrowth areas, the loss of some vegetation (largely the small sections near the Pinjar power station) and the possible introduction of weeds. Some of these impacts can be reduced or avoided entirely if the recommendations are followed.

6. RECOMMENDATIONS

The following recommendations are made in relation to the proposed pipeline installation:

- Keep any clearing of native vegetation to an absolute minimum by laying the pipeline along already established tracks and roads. This should be achievable along the majority of the proposed alignment.
- Avoid trees at GPS Locations (GDA94) 50J 391923 mE 6508374 mN and 50J 394042 mE 6508391 mN if confirmed as significant hollows by the WA Museum experts.
- Avoid damage to mature Eucalypts and *Corymbia*'s outside clearing corridors.
- Disturbance of vegetation, including weeds, along the Survey Area should be kept to a minimum if evidence of Southern Brown Bandicoot is discovered.
- The assignment of an Environmental Officer for the duration of the project to supervise the actions set out below;
    - daily inspections of the pipeline trench early in the morning and, if required, in the late afternoon to remove trapped fauna;
    - release of healthy animals into suitable habitat nearby but sufficiently distant from the trench to prevent re-entrapment;
    - dead animals to be removed immediately from the trench to prevent attracting scavengers into the trench; and,
    - dead animals to be preserved and presented as voucher specimens to the WA Museum along with important data such as date, locality, adjacent habitat etc.

- Machinery should be cleaned prior to commencement of work to prevent disease to the flora of the area and the introduction of weeds. Diseases of flora and weeds will impact on fauna.
- Any cleared vegetation should be left intact in spoil heaps to create fauna habitat.
- Lay-down areas should be kept to a minimum and care taken for selection of sites not to include high quality vegetation.
- Heath areas should not be disturbed.
- Damp-lands and wetlands should not be disturbed.
- Limit the length of an open trench.
- Ramps should be installed at intervals to allow fauna to exit
- Any water in the trench shall be pumped out via a mesh to adjacent vegetated areas.
- The management shall implement a fire management plan.
- Clearing will be kept to a minimum at Tower sites 9 and 10, and in previously uncleared vegetation near Pinjar Power Station.

7. PARTICIPANTS

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but what spp. are in project area? p. 12 says 151 spp.

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

NB: * denotes introduced (weed) species

FAMILY		SPECIES
LYCOPODIACEAE		*Phylloglossum drummondii*
SELAGINELLACEAE		*Selaginella gracillima*
OPHIOGLOSSACEAE		*Ophioglossum lusitanicum*
DENNSTAEDTIACEAE		*Pteridium esculentum*
MARSILEACEAE		*Pilularia novae-hollandiae*
AZOLLACEAE		*Azolla filiculoides*
ZAMIACEAE		*Macrozamia riedlei*
PINACEAE	*	*Pinus radiata*
TYPHACEAE		*Typha domingensis*
	*	*Typha orientalis*
JUNCAGINACEAE		*Triglochin centrocarpa*
		Triglochin huegelii/linearis
		Triglochin linearis
		Triglochin muelleri
		Triglochin trichophora
		Triglochin sp.
POACEAE	*	*Aira caryophyllea*
	*	*Aira cupaniana*
	*	*Aira praecox*
	*	*Aira* sp.
		Amphibromus nervosus
		Amphipogon amphipogonoides
		Amphipogon laguroides
		Amphipogon turbinatus
		Amphipogon ?strictus
		Amphipogon sp.
		Austrodanthonia caespitosa
		Austrodanthonia occidentalis
		Austrodanthonia setacea
		Austrodanthonia sp.
		Austrostipa campylachne
		Austrostipa compressa
		Austrostipa flavescens
		Austrostipa macalpinei
		Austrostipa nitida
		Austrostipa semibarbata (group scps)
		Austrostipa tenuifolia
		Austrostipa sp.
	*	*Avellinia michelii*
	*	[illegible]

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

NB: * denotes introduced (weed) species

FAMILY		SPECIES
POACEAE (Continued)	*	*Avena fatua*
	*	*Briza maxima*
	*	*Briza minor*
	*	*Briza* sp.
	*	*Bromus diandrus*
	*	*Bromus rubens*
	*	*Bromus* sp.
	*	*Cynodon dactylon*
		Deyeuxia quadriseta
		Dichelachne crinita
	*	*Ehrharta calycina*
	*	*Ehrharta longiflora*
	*	*Ehrharta* sp.
	*	*Eragrostis curvula*
		Hemarthria uncinata var. *uncinata*
	*	*Holcus setiger*
		Lachnagrostis filiformis
		Lachnagrostis plebeia
		Lachnagrostis preissii
	*	*Lagurus ovatus*
	*	*Lolium multiflorum*
	*	*Lolium multiflorum* x *perenne*
	*	*Lolium rigidum*
		Microlaena stipoides var. *stipoides*
		Neurachne alopecuroidea
	*	*Pennisetum clandestinum*
	*	*Pentaschistis airoides*
	*	*Pentaschistis pallida*
	*	*Phalaris minor*
	*	*Poa annua*
		Poa drummondiana
		Poa poiformis
		Poa porphyroclados
	*	*Poa pratensis*
	*	*Polypogon monspeliensis*
		Polypogon tenellus
		?*Puccinellia* sp.
	*	*Rostraria cristata*
	*	*Vulpia bromoides*
	*	*Vulpia myuros*
	*	*Vulpia* sp.
		Poaceae sp.
CYPERACEAE		*Baumea acuta*
		Baumea arthrophylla
		Baumea articulata
		Baumea juncea
		Baumea preissii subsp. *preissii* (ms)
		Baumea ?*preissii*
		Baumea vaginalis

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

NB: * denotes introduced (weed) species

FAMILY	SPECIES
CYPERACEAE (Continued)	*Baumea* sp. (sthest)
	Baumea sp.
	Bolboschoenus caldwellii
	Carex appressa
	Caustis dioica
	Chorizandra enodis
	Cyathochaeta avenacea
	Cyathochaeta equitans
	Cyathochaeta teretifolia (P3)
	* *Cyperus eragrostis*
	* *Cyperus tenellus*
	Eleocharis acuta
	Eleocharis keigheryi (R)
	Eleocharis sp.
	Ficinia nodosa
	Gahnia decomposita
	Gahnia trifida
	?*Gahnia* sp.
	Isolepis cernua
	Isolepis cyperoides
	* *Isolepis marginata*
	Isolepis oldfieldiana
	Isolepis producta
	Lepidosperma gladiatum
	Lepidosperma leptostachyum
	Lepidosperma aff. *leptostachyum*
	Lepidosperma longitudinale
	Lepidosperma pubisquameum
	Lepidosperma scabrum
	Lepidosperma squamatum
	Lepidosperma squamatum (narrow form)
	Lepidosperma striatum
	Lepidosperma tenue
	Lepidosperma tetraquetrum
	Lepidosperma sp. (coastal terete) (B.J. Keighery and N. Gibson 231)
	Lepidosperma sp.
	Mesomelaena graciliceps
	Mesomelaena pseudostygia
	Mesomelaena stygia
	Mesomelaena tetragona
	Schoenus asperocarpus
	Schoenus breviculmis
	Schoenus brevisetis
	Schoenus aff. *brevisetis*
	Schoenus caespititius
	Schoenus clandestinus
	Schoenus curvifolius
	Schoenus discifer
	Schoenus efoliatus
	Schoenus grandiflorus

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

NB: * denotes introduced (weed) species

FAMILY		SPECIES
CYPERACEAE (Continued)		*Schoenus griffinianus* (P2)
		Schoenus lanatus
		Schoenus latitans
		Schoenus nanus
		Schoenus natans (P4)
		Schoenus odontocarpus
		Schoenus pedicellatus
		Schoenus plumosus
		Schoenus rigens
		Schoenus subfascicularis
		Schoenus tenellus
		Schoenus trachycarpus
		Schoenus aff. sp. *breviculmis* (sthcst)
		Schoenus sp.
		Tetraria capillaris
		Tetraria octandra
		Cyperaceae sp.
ARACEAE	*	*Zantedeschia aethiopica*
LEMNACEAE		*Lemna disperma*
RESTIONACEAE		*Alexgeorgea nitens*
		Anarthria gracilis
		Chaetanthus aristatus
		Chordifex microcodon
		Chordifex sinuosus
		Chordifex stenandrus
		Desmocladus asper
		Desmocladus fasciculatus
		Desmocladus flexuosus
		Dielsia stenostachya
		Ecdeiocolea monostachya
		Hypolaena exsulca
		Hypolaena pubescens
		Lepidobolus chaetocephalus
		Lepidobolus preissianus subsp. *preissianus*
		Lepidobolus sp.
		Lepyrodia muirii
		Loxocarya cinerea
		Lyginia barbata
		Lyginia imberbis
		Meeboldina cana
		Meeboldina scariosa
		Restio sp.

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NB: * denotes introduced (weed) species

FAMILY		SPECIES
CENTROLEPIDACEAE		*Aphelia cyperoides*
		Aphelia nutans
		Centrolepis aristata
		Centrolepis drummondiana
		Centrolepis glabra
		Centrolepis mutica
		Centrolepis polygyna
HYDATELLACEAE		*Trithuria bibracteata*
		Trithuria submersa
PHILYDRACEAE		*Philydrella pygmaea* subsp. *pygmaea*
JUNCACEAE		*Juncus amabilis*
		Juncus bufonius
	*	*Juncus capitatus*
		Juncus holoschoenus
		Juncus pallidus
		Juncus sp.
		Luzula meridionalis
ASPARAGACEAE	*	*Asparagus asparagoides*
DASYPOGONACEAE		*Acanthocarpus preissii*
		Acanthocarpus sp.
		Calectasia narragara
		Dasypogon bromeliifolius
		Dasypogon sp.
		Lomandra ?brittanii
		Lomandra caespitosa
		Lomandra hermaphrodita
		Lomandra maritima
		Lomandra micrantha subsp. *micrantha*
		Lomandra nigricans
		Lomandra preissii
		Lomandra sericea
		Lomandra sonderi
		Lomandra suaveolens
		Lomandra sp.
XANTHORRHOEACEAE		*Xanthorrhoea brunonis*
		Xanthorrhoea gracilis
		Xanthorrhoea preissii
PHORMIACEAE		*Dianella revoluta*
		Dianella revoluta var. *divaricata*
		Stypandra glauca

Not to be used for Commercial Purposes

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

NB: * denotes introduced (weed) species

FAMILY		SPECIES
ANTHERICACEAE		*Arnocrinum preissii*
		Caesia micrantha
		Caesia occidentalis
		Caesia sp.
		Chamaescilla corymbosa var. *corymbosa*
		Chamaescilla versicolor
		Corynotheca micrantha
		Corynotheca micrantha var. *elongata*
		Corynotheca micrantha var. *micrantha*
		Dichopogon capillipes
		Hensmania turbinata
		Johnsonia acaulis
		Johnsonia pubescens subsp. *pubescens*
		Laxmannia ramosa subsp. *ramosa*
		Laxmannia sessiliflora
		Laxmannia sessiliflora subsp. *australis*
		Laxmannia squarrosa
		Laxmannia sp.
		Sowerbaea laxiflora
		Thysanotus arbuscula
		Thysanotus arenarius
		Thysanotus dichotomus
		Thysanotus manglesianus
		Thysanotus manglesianus/patersonii
		Thysanotus multiflorus
		Thysanotus patersonii
		Thysanotus sparteus
		Thysanotus thyrsoideus
		Thysanotus triandrus
		Tricoryne elatior
		Tricoryne tenella
		Thysanotus sp.
ASPHODELACEAE		*Bulbine semibarbata*
HYACINTHACEAE	*	*Lachenalia reflexa*
COLCHICACEAE		*Burchardia bairdiae*
		Burchardia multiflora
		Burchardia umbellata
		Wurmbea dioica subsp. *alba*
		Wurmbea monantha
		Wurmbea pygmaea
		Wurmbea sp.
BORYACEAE		*Borya scirpoidea*
		Borya sphaerocephala

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY		SPECIES
HAEMODORACEAE		*Anigozanthos humilis* subsp. *humilis*
		Anigozanthos manglesii subsp. *manglesii*
		Anigozanthos viridis subsp. *viridis*
		Anigozanthos sp.
		Blancoa canescens
		Conostylis aculeata
		Conostylis aculeata subsp. *aculeata*
		Conostylis aculeata x *candicans* (scps)
		Conostylis aurea
		Conostylis candicans subsp. *candicans*
		Conostylis candicans subsp. *?calcicola*
		Conostylis caricina
		Conostylis festucacea subsp. *festucacea*
		Conostylis juncea
		Conostylis pauciflora
		Conostylis pauciflora subsp. *euryrhipis* (P3)
		Conostylis serrulata
		Conostylis setigera subsp. *setigera*
		Conostylis setosa
		Conostylis sp.
		Haemodorum laxum
		Haemodorum paniculatum
		Haemodorum simplex
		Haemodorum spicatum
		Haemodorum sp.
		Phlebocarya ciliata
		Tribonanthes australis
		Tribonanthes longipetala
IRIDACEAE	*	*Gladiolus caryophyllaceus*
	*	*Gladiolus* sp.
	*	*Hesperantha falcata*
	*	*Moraea flaccida*
		Orthrosanthus laxus var. *laxus*
		Patersonia occidentalis
		Patersonia occidentalis var. *occidentalis*
		Patersonia sp.
	*	*Romulea obscura*
	*	*Romulea rosea*
ORCHIDACEAE		*Caladenia arenicola*
		Caladenia bicalliata subsp. *bicalliata*
		Caladenia discoidea
		Caladenia flava
		Caladenia flava subsp. *flava*
		Caladenia hirta subsp. *hirta*
		Caladenia latifolia
		Caladenia longicauda subsp. *eminens*
		Caladenia longicauda subsp. *longicauda*
		Caladenia marginata

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

NB: * denotes introduced (weed) species

FAMILY	SPECIES
ORCHIDACEAE (Continued)	*Caladenia paludosa*
	Caladenia sp.
	Cyrtostylis huegelii
	Cyrtostylis robusta
	Cyrtostylis sp.
	* *Disa bracteata*
	Diuris longifolia
	Diuris sp.
	Elythranthera brunonis
	Epiblema grandiflorum var. *grandiflorum*
	Eriochilus dilatatus
	Eriochilus dilatatus subsp. *dilatatus*
	Leporella fimbriata
	Lyperanthus serratus
	Microtis alba
	Microtis media
	Pheladenia deformis
	Prasophyllum drummondii
	Prasophyllum ovale
	Prasophyllum regium
	Prasophyllum sp.
	Pterostylis aspera
	Pterostylis brevisepala (ms)
	Pterostylis aff. pyramidalis
	Pterostylis pyramidalis
	Pterostylis recurva
	Pterostylis sanguinea
	Pterostylis sp. limestone (B.J. Keighery & G.J. Keighery 65)
	Pterostylis sp. short sepals (W. Jackson BJ259)
	Pterostylis sp. Slender Snail Orchid (G.J. Keighery 14516)
	Pterostylis sp.
	Pterostylis vittata
	Pyrorchis nigricans
	Thelymitra antennifera
	Thelymitra benthamiana
	Thelymitra campanulata
	Thelymitra crinita
	Thelymitra flexuosa
	Thelymitra sp.
	Orchidaceae sp.
CASUARINACEAE	*Allocasuarina fraseriana*
	Allocasuarina huegeliana
	Allocasuarina humilis
	Casuarina obesa
URTICACEAE	*Parietaria debilis*

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY	SPECIES
PROTEACEAE	*Adenanthos barbiger*
	Adenanthos cygnorum subsp. *cygnorum*
	Adenanthos obovatus
	Adenanthos sp.
	Banksia attenuata
	Banksia grandis
	Banksia ilicifolia
	Banksia littoralis
	Banksia menziesii
	Banksia prionotes
	Banksia telmatiaea
	Conospermum acerosum subsp. *acerosum*
	Conospermum canaliculatum subsp. *canaliculatum*
	Conospermum incurvum
	Conospermum stoechadis subsp. *stoechadis*
	Conospermum triplinervium
	Dryandra lindleyana var. *lindleyana*
	Dryandra sessilis
	Dryandra sessilis var. *sessilis*
	Grevillea curviloba subsp. *incurva* (R)
	Grevillea obtusifolia
	Grevillea preissii subsp. *preissii*
	Grevillea vestita subsp. *vestita*
	Hakea costata
	Hakea erinacea
	Hakea lissocarpha
	Hakea prostrata
	Hakea ruscifolia
	Hakea trifurcata
	Hakea varia
	Isopogon sp.
	Persoonia comata
	Persoonia saccata
	Petrophile brevifolia
	Petrophile drummondii
	Petrophile linearis
	Petrophile macrostachya
	Petrophile rigida
	Petrophile seminuda
	Petrophile serruriae
	Petrophile sp.
	Stirlingia latifolia
	Synaphea petiolaris
	Synaphea spinulosa subsp. *spinulosa*
	Synaphea sp.

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY		SPECIES
SANTALACEAE		*Exocarpos aphyllus*
		Exocarpos sparteus
		Leptomeria cunninghamii
		Leptomeria empetriformis
		Leptomeria pauciflora
		Leptomeria preissiana
		Santalum acuminatum
OLACACEAE		*Olax benthamiana*
LORANTHACEAE		*Amyema miquelii*
		Nuytsia floribunda
POLYGONACEAE	*	*Acetosella vulgaris*
		Muehlenbeckia adpressa
		Muehlenbeckia polybotrya
	*	*Rumex crispus*
CHENOPODIACEAE	*	*Atriplex prostrata*
	*	*Chenopodium macrospermum*
		Halosarcia sp.
		Rhagodia baccata
		Rhagodia baccata subsp. *baccata*
		Rhagodia baccata subsp. *dioica*
		Threlkeldia diffusa
AMARANTHACEAE		*Ptilotus drummondii*
		Ptilotus drummondii var. *drummondii*
		Ptilotus humilis subsp. *humilis*
		Ptilotus manglesii
		Ptilotus polystachyus var. *polystachyus*
		Ptilotus stirlingii var. *stirlingii*
		Ptilotus sp.
GYROSTEMONACEAE		*Tersonia cyathiflora*
AIZOACEAE	*	*Carpobrotus edulis*
		Carpobrotus virescens
		Sarcozona bicarinata (P3)
	*	*Tetragonia decumbens*
MOLLUGINACEAE		*Macarthuria apetala*
		Macarthuria australis
PORTULACACEAE		*Calandrinia brevipedata*
		Calandrinia corrigioloides
		Calandrinia granulifera
		Calandrinia liniflora
		Calandrinia sp.

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY		SPECIES
CARYOPHYLLACEAE	*	*Cerastium glomeratum*
	*	*Petrorhagia dubia*
	*	*Sagina apetala*
	*	*Silene gallica*
	*	*Spergula arvensis*
	*	*Stellaria media*
		Caryophyllaceae sp.
RANUNCULACEAE		*Clematis linearifolia*
LAURACEAE		*Cassytha aurea*
		Cassytha flava
		Cassytha glabella
		Cassytha pomiformis
		Cassytha racemosa
		Cassytha sp.
BRASSICACEAE	*	*Brassica tournefortii*
		Brassica sp.
	*	*Heliophila pusilla*
		Lepidium rotundum
	*	*Lobularia maritima*
		Stenopetalum gracile
		Stenopetalum robustum
DROSERACEAE		*Drosera erythrorhiza*
		Drosera erythrorhiza subsp. *erythrorhiza*
		Drosera gigantea subsp. *gigantea*
		Drosera glanduligera
		Drosera leucoblasta
		Drosera macrantha (SCP form) (BJ Keighery & N Gibson 288)
		Drosera macrantha subsp. *macrantha*
		Drosera menziesii subsp. *menziesii*
		Drosera menziesii subsp. *penicillaris*
		Drosera neesii
		Drosera neesii (Pink flowered southern form) (BJ Keighery & N Gibson 96)
		Drosera neesii subsp. *neesii*
		Drosera nitidula
		Drosera nitidula subsp. *nitidula*
		Drosera paleacea subsp. *paleacea*
		Drosera pallida
		Drosera pulchella
		Drosera rosulata
		Drosera stolonifera
		Drosera sp.
		Drosera sp. (climbing)

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY	SPECIES
CRASSULACEAE	*Crassula colorata*
	Crassula colorata var. *acuminata*
	Crassula colorata var. *colorata*
	Crassula decumbens
	Crassula exserta
	* *Crassula glomerata*
	* *Crassula natans*
	* *Crassula natans var. minus*
	Crassula peduncularis
	Crassula sp.
PITTOSPORACEAE	*Billardiera fraseri*
	Pittosporum phylliraeoides
MIMOSACEAE	*Acacia alata var. tetrantha*
	Acacia applanata
	Acacia barbinervis subsp. *borealis*
	Acacia benthamii (P2)
	Acacia cochlearis
	Acacia cyclops
	Acacia huegelii
	Acacia lasiocarpa var. *lasiocarpa*
	Acacia pulchella
	Acacia pulchella var. *glaberrima*
	Acacia pulchella var. *pulchella*
	Acacia rostellifera
	Acacia saligna
	Acacia sessilis
	Acacia stenoptera
	Acacia truncata
	Acacia xanthina
	Acacia willdenowiana
	Acacia sp.
PAPILIONACEAE	*Aotus cordifolia* (P3)
	Aotus gracillima
	Aotus intermedia
	Aotus procumbens
	Bossiaea eriocarpa
	Bossiaea ornata
	Chorizema dicksonii
	Cristonia biloba
	Daviesia decurrens subsp. *decurrens* (ms)
	Daviesia divaricata subsp. *divaricata* (ms)
	Daviesia nudiflora subsp. *nudiflora*
	Daviesia physodes
	Daviesia podophylla
	Daviesia quadrilatera
	Daviesia triflora
	Dillwynia dillwynioides (P3)

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY	SPECIES
PAPILIONACEAE (Continued)	*Euchilopsis linearis*
	Eutaxia virgata
	Gastrolobium capitatum
	Gastrolobium ebracteolatum
	Gastrolobium nervosum
	Gompholobium aristatum
	Gompholobium capitatum
	Gompholobium confertum
	Gompholobium knightianum
	Gompholobium polymorphum
	Gompholobium scabrum
	Gompholobium shuttleworthii
	Gompholobium tomentosum
	Gompholobium venustum
	Gompholobium sp.
	Hardenbergia comptoniana
	Hovea pungens
	Hovea trisperma
	Hovea trisperma var. *trisperma*
	Isotropis cuneifolia
	Isotropis cuneifolia subsp. *cuneifolia*
	Isotropis cuneifolia subsp. *glabra* (P2)
	Isotropis sp.
	Jacksonia calcicola (ms)
	Jacksonia fasciculata
	Jacksonia floribunda
	Jacksonia furcellata
	Jacksonia hakeoides
	Jacksonia sericea (P4)
	Jacksonia sternbergiana
	Kennedia prostrata
	Kennedia sp.
	Latrobea tenella
	* *Lotus angustissimus*
	* *Lotus subbiflorus*
	* *Lupinus cosentinii*
	* *Medicago polymorpha*
	* *Medicago* sp.
	* *Melilotus indicus*
	Pultenaea reticulata
	Sphaerolobium aff. *macranthum* (G.J Keighery sn)
	Sphaerolobium vimineum
	Sphaerolobium sp.
	Templetonia retusa
	* *Trifolium arvense*
	* *Trifolium campestre* var. *campestre*
	* *Trifolium cernuum*
	* *Trifolium dubium*
	* *Trifolium subterraneum*
	* *Trifolium* sp.

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY		SPECIES
PAPILIONACEAE (Continued)	*	*Vicia sativa*
		Viminaria juncea
GERANIACEAE	*	*Erodium botrys*
	*	*Erodium cicutarium*
	*	*Erodium moschatum*
		Geranium retrorsum
		Geranium solanderi
	*	*Pelargonium capitatum*
		Pelargonium littorale subsp. *littorale*
OXALIDACEAE	*	*?Oxalis corniculata*
		Oxalis perennans
	*	*Oxalis pes-caprae*
RUTACEAE		*Boronia purdieana* subsp. *purdieana*
		Boronia ramosa
		Boronia ramosa subsp. *anethifolia*
		Boronia ramosa subsp. *ramosa*
		Diplolaena angustifolia
		Philotheca spicata
TREMANDRACEAE		*Platytheca galioides*
POLYGALACEAE		*Comesperma calymega*
		Comesperma confertum
		Comesperma flavum
		Comesperma integerrimum
		Comesperma virgatum
		Comesperma sp.
EUPHORBIACEAE		*Adriana quadripartita*
		Amperea ericoides
		Beyeria cinerea
	*	*Euphorbia peplus*
	*	*Euphorbia terracina*
		Monotaxis grandiflora
		Monotaxis occidentalis
		Phyllanthus calycinus
		Poranthera ericoides
		Poranthera microphylla
		Stachystemon axillaris (P4)
CALLITRICHACEAE	*	*Callitriche stagnalis*
STACKHOUSIACEAE		*Stackhousia monogyna*
		Stackhousia sp.
		Tripterococcus brunonis
		Tripterococcus paniculatus (ms) (P1)

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY	SPECIES
SAPINDACEAE	*Diplopeltis huegelii*
	Dodonaea ceratocarpa
RHAMNACEAE	*Cryptandra mutila*
	Cryptandra pungens
	Spyridium globulosum
	Stenanthemum notiale subsp. *chamelum*
	Trymalium floribundum
	Trymalium ledifolium var. *ledifolium*
MALVACEAE	*Alyogyne huegelii*
STERCULIACEAE	*Lasiopetalum lineare* (P3)
	Thomasia cognata
	Thomasia triphylla
DILLENIACEAE	*Hibbertia aurea*
	Hibbertia crassifolia
	Hibbertia cuneiformis
	Hibbertia desmophylla
	Hibbertia helianthemoides (P3)
	Hibbertia aff. *helianthemoides*
	Hibbertia aff. *helianthemoides* (Northern) (EA Griffin 6801)
	Hibbertia huegelii
	Hibbertia hypericoides
	Hibbertia pachyrrhiza
	Hibbertia aff. *pachyrrhiza*
	Hibbertia racemosa
	Hibbertia spicata
	Hibbertia spicata subsp. *leptotheca* (P3)
	Hibbertia stellaris
	Hibbertia subvaginata
	Hibbertia sp.
VIOLACEAE	*Hybanthus calycinus*
THYMELAEACEAE	*Pimelea argentea*
	Pimelea calcicola
	Pimelea ferruginea
	Pimelea floribunda
	Pimelea imbricata var. *piligera*
	Pimelea leucantha
	Pimelea rosea
	Pimelea suaveolens
	Pimelea sulphurea
	Pimelea sp.

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FAMILY	SPECIES
MYRTACEAE	*Agonis flexuosa*
	Astartea scoparia
	Astartea sp.
	Baeckea camphorosmae
	Baeckea robusta
	Baeckea sp.
	Beaufortia elegans
	Calothamnus lateralis
	Calothamnus quadrifidus
	Calothamnus sanguineus
	Calytrix angulata
	Calytrix flavescens
	Calytrix fraseri
	Calytrix sapphirina
	Calytrix strigosa
	Corymbia calophylla
	Darwinia foetida (ms) (R)
	Eremaea asterocarpa subsp. *asterocarpa*
	Eremaea beaufortioides
	Eremaea beaufortioides var. *beaufortioides*
	Eremaea brevifolia
	Eremaea pauciflora
	Eremaea pauciflora var. *pauciflora*
	Eremaea purpurea
	Eremaea sp.
	Eucalyptus decipiens subsp. *decipiens*
	Eucalyptus foecunda
	Eucalyptus gomphocephala
	Eucalyptus marginata
	Eucalyptus marginata subsp. *marginata*
	Eucalyptus petrensis
	Eucalyptus rudis subsp. *rudis*
	Eucalyptus todtiana
	Eucalyptus sp.
	Hypocalymma angustifolium
	Hypocalymma robustum
	Hypocalymma xanthopetalum
	Kunzea ericifolia subsp. *ericifolia*
	Kunzea glabrescens
	Kunzea recurva
	Kunzea aff. *recurva* (G.J Keighery 12828)
	Leptospermum spinescens
	Melaleuca cardiophylla
	Melaleuca huegelii subsp. *huegelii*
	Melaleuca incana subsp. *incana*
	Melaleuca lateriflora subsp. *acutifolia*
	Melaleuca lateritia
	Melaleuca parviceps
	Melaleuca preissiana
	Melaleuca rhaphiophylla

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

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FAMILY	SPECIES
MYRTACEAE (Continued)	*Melaleuca scabra*
	Melaleuca seriata
	Melaleuca systena
	Melaleuca aff. *systena*
	Melaleuca teretifolia
	Melaleuca trichophylla
	Melaleuca aff. *trichophylla*
	Melaleuca aff. *trichophylla* (scps)
	Melaleuca viminea subsp. *viminea*
	Melaleuca sp. B FPR (BJ Keighery & N Gibson 054)
	Melaleuca sp.
	Pericalymma ellipticum
	Pericalymma ellipticum var. *ellipticum*
	Pileanthus "septentrionalis" caperg
	Regelia ciliata
	Regelia inops
	Scholtzia involucrata
	Scholtzia laxiflora
	Scholtzia sp.
	Taxandria linearifolia (ms)
	Verticordia densiflora var. *densiflora*
	Verticordia lindleyi subsp. *lindleyi* (P4)
	Verticordia nitens
	Verticordia ovalifolia
	Verticordia plumosa
	Verticordia sp.
	Myrtaceae sp.
HALORAGACEAE	*Gonocarpus cordiger*
	Gonocarpus pithyoides
	Gonocarpus sp.
	Haloragis tenuifolia (P3)
	Myriophyllum drummondii
	Myriophyllum echinatum (P3)
APIACEAE	*Actinotus glomeratus*
	Actinotus leucocephalus
	Centella asiatica
	Daucus glochidiatus
	Eryngium pinnatifidum subsp. *palustre* (ms)
	Homalosciadium homalocarpum
	Hydrocotyle alata
	Hydrocotyle blepharocarpa
	Hydrocotyle callicarpa
	Hydrocotyle hispidula
	Hydrocotyle pilifera var. *glabrata*
	Hydrocotyle tetragonocarpa
	Hydrocotyle sp.
	Schoenolaena juncea
	Trachymene coerulea

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FAMILY		SPECIES
APIACEAE (Continued)		*Trachymene pilosa*
		Xanthosia candida
		Xanthosia ciliata
		Xanthosia huegelii
EPACRIDACEAE		*Andersonia heterophylla*
		Andersonia involucrata
		Andersonia lehmanniana subsp. *lehmanniana*
		Andersonia sp.
		Astroloma microcalyx (P3)
		Astroloma pallidum
		Astroloma xerophyllum
		Conostephium minus
		Conostephium pendulum
		Conostephium preissii
		Croninia kingiana
		Leucopogon australis
		Leucopogon conostephioides
		Leucopogon glabellus
		Leucopogon leptanthus
		Leucopogon nutans
		Leucopogon aff. *nutans* (scps)
		Leucopogon oldfieldii
		Leucopogon oxycedrus
		Leucopogon parviflorus
		Leucopogon polymorphus
		Leucopogon propinquus
		Leucopogon racemulosus
		Leucopogon sprengelioides
		Leucopogon sp. (indeterminant) M137-1
		Leucopogon sp. Moore River (M. Hislop 1695)
		Leucopogon sp.
		Leucopogon squarrosus
		Lysinema ciliatum
		Lysinema elegans
		Styphelia tenuiflora
		Epacridaceae sp.
PRIMULACEAE	*	*Anagallis arvensis*
	*	*Anagallis arvensis* var. *arvensis*
LOGANIACEAE		*Logania vaginalis*
		Phyllangium paradoxum
GENTIANACEAE	*	*Centaurium erythraea*
	*	*Cicendia filiformis*
MENYANTHACEAE		*Villarsia albiflora*
		Villarsia capitata

APPENDIX A: VASCULAR PLANT SPECIES RECORDED IN THE GNANGARA MOUND (Mattiske Consulting Pty Ltd 2003)

NB: * denotes introduced (weed) species

FAMILY		SPECIES
CUSCUTACEAE	*	*Cuscuta epithymum*
BORAGINACEAE		*Heliotropium curassavicum*
LAMIACEAE		*Hemiandra linearis*
		Hemiandra pungens
		Hemigenia ?incana
		Pityrodia bartlingii
		Westringia dampieri
SOLANACEAE	*	*Solanum americanum*
	*	*Solanum nigrum*
SCOPHULARIACEAE	*	*Bartsia trixago*
	*	*Cymbalaria muralis*
	*	*Dischisma arenarium*
	*	*Dischisma capitatum*
	*	*Dischisma* sp.
		Glossostigma diandrum
		Glossostigma drummondii
		Gratiola pubescens
	*	*Parentucellia latifolia*
	*	*Parentucellia viscosa*
OROBANCHACEAE	*	*Orobanche minor*
LENTIBULARIACEAE		*Utricularia multifida*
		Utricularia violacea
MYOPORACEAE		*Eremophila glabra*
		Eremophila glabra subsp. *albicans*
		Myoporum caprarioides
		Myoporum insulare
PLANTAGINACEAE		*Plantago debilis*
RUBIACEAE	*	*Galium murale*
		Opercularia echinocephala
		Opercularia hispidula
		Opercularia spermacocea
		Opercularia vaginata
		Opercularia sp.
CAMPANULACEAE	*	*Wahlenbergia capensis*
		Wahlenbergia preissii

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FAMILY	SPECIES
LOBELIACEAE	*Isotoma hypocrateriformis*
	Lobelia alata
	Lobelia heterophylla
	Lobelia tenuior
	Lobelia sp.
	* *Monopsis debilis*
GOODENIACEAE	*Anthotium junciforme* (P4)
	Dampiera alata
	Dampiera linearis
	Dampiera sp.
	Goodenia sp. (Gibson)
	Goodenia pulchella
	Lechenaultia biloba
	Lechenaultia expansa
	Lechenaultia floribunda
	Lechenaultia linarioides
	Scaevola canescens
	Scaevola crassifolia
	Scaevola crassifolia/nitida
	Scaevola nitida
	Scaevola phlebopetala
	Scaevola repens
	Scaevola repens var. *angustifolia*
	Scaevola repens var. *repens*
	Scaevola thesioides subsp. thesioides
	Scaevola sp.
	Velleia trinervis
	Verreauxia reinwardtii
STYLIDIACEAE	*Levenhookia pusilla*
	Levenhookia stipitata
	Levenhookia sp.
	Stylidium adpressum
	Stylidium amoenum
	Stylidium brunonianum subsp. *brunonianum*
	Stylidium bulbiferum
	Stylidium calcaratum
	Stylidium crossocephalum
	Stylidium cygnorum
	Stylidium dichotomum
	Stylidium diuroides subsp. *diuroides*
	Stylidium divaricatum
	Stylidium ecorne
	Stylidium guttatum
	Stylidium inundatum
	Stylidium junceum subsp. *junceum*
	Stylidium lateriticola
	Stylidium longitubum (P3)
	Stylidium macrocarpum

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FAMILY	SPECIES
STYLIDIACEAE (Continued)	*Stylidium maritimum* (P3)
	Stylidium mimeticum
	Stylidium miniatum
	Stylidium petiolare
	Stylidium piliferum
	Stylidium piliferum subsp. *piliferum*
	Stylidium repens
	Stylidium roseo-alatum
	Stylidium schoenoides
	Stylidium utricularioides
	Stylidium sp.
ASTERACEAE	* *Arctotheca calendula*
	Asteridea pulverulenta
	Blennospora doliiformis (P3)
	Blennospora sp.
	Brachyscome iberidifolia
	Brachyscome pusilla
	Brachyscome sp.
	* *Carduus pycnocephalus*
	* *Cirsium vulgare*
	* *Conyza bonariensis*
	* *Conyza sumatrensis*
	* *Conyza* sp.
	Cotula australis
	Cotula coronopifolia
	Euchiton sphaericus
	Gnephosis drummondii
	Gnephosis tenuissima
	Hyalosperma cotula
	Hyalosperma demissum
	* *Hypochaeris glabra*
	* *Hypochaeris* sp.
	Lagenophora huegelii
	Leptorhynchos scaber
	Millotia tenuifolia var. *tenuifolia*
	Myriocephalus helichrysoides
	Olearia axillaris
	Olearia rudis
	Ozothamnus cordatus
	Pithocarpa corymbulosa (P2)
	Pithocarpa pulchella
	Pithocarpa sp.
	Podolepis gracilis
	Podolepis gracilis (Swamp form) (GJ Keighery 13126)
	Podolepis lessonii
	Podotheca angustifolia
	Podotheca angustifolia/gnaphalioides
	Podotheca chrysantha
	Podotheca gnaphalioides

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FAMILY	SPECIES
ASTERACEAE (Continued)	*Podotheca* sp.
	Pogonolepis stricta
	* *Pseudognaphalium luteoalbum*
	Quinetia urvillei
	Rhodanthe citrina
	Rhodanthe corymbosa
	Rhodanthe manglesii
	Rhodanthe pyrethrum (P3)
	Rhodanthe spicata
	Rhodanthe sp.
	* *Senecio diaschides*
	Senecio hispidulus var. *hispidulus*
	Senecio lautus
	Senecio lautus subsp. *dissectifolius*
	Senecio lautus subsp. *maritimus*
	Senecio ramosissimus
	Senecio sp.
	Siloxerus humifusus
	* *Sonchus asper*
	* *Sonchus oleraceus*
	* *Tripteris clandestina*
	* *Urospermum picroides*
	* *Ursinia anthemoides*
	* *Vellereophyton dealbatum*
	Waitzia suaveolens var. *suaveolens*
	Waitzia sp.
	Asteraceae sp.

31.658 °S 115.7474 °E / 31.691 °S 115.8431 °E Proposed pipeline area (plus~1.5km buffer)

*	Date	Certainty	Seen	Location Name	Method

Schedule 1 - Fauna that is rare or is likely to become extinct

Calyptorhynchus latirostris — Carnaby's Black-Cockatoo — *4 records*

This species moves around seasonally in flocks to feeding areas in proteaceous scrubs and heaths and eucalypt woodlands as well as pine plantations. Breeding occurs in winter/spring, mainly in the eastern forests and wheatbelt where they can find mature hollow-bearing trees to nest in.

2003	1		Neerabup	Day sighting
2006	1	1	Pinjar	Day sighting
2006	1	1	Pinjar	Day sighting
2006	1	1	Pinjar	Day sighting

Calyptorhynchus sp — White-tailed Black Cockatoo — *1 records*

These records pertain to either Baudin's Black-Cockatoo or Carnaby's Black-Cockatoo.

2005	1	550	Pinjar	Day sighting

Synemon gratiosa — Graceful Sunmoth — *3 records*

This species has been recorded in a few locations from Wanneroo to Mandurah and is under great pressure from land development.

1995	1		Neerabup	Caught or trapped
1996	1	14	Neerabup	Caught or trapped
1996	1	7	Neerabup	Caught or trapped

Schedule 4 - Other specially protected fauna

Falco peregrinus — Peregrine Falcon — *1 records*

This species is uncommon and prefers areas with rocky ledges, cliffs, watercourses, open woodland or margins with cleared land.

2003	1	1	Pinjar/Banksia Grove	Caught or trapped

Priority Three: Taxa with several, poorly known populations, some on conservation lands

Austrosaga spinifer — Austrosaga spinifer — *2 records*

This species of cricket is known from heath habitats near Perth and Cervantes.

1981	1	1	Neerabup National Park
1982	1	1	Neerabup National Park

Hylaeus globuliferus — Hylaeus globuliferus — *4 records*

This species of native bee is known to feed on the flowers of Adenanthos cygnorum in particular but has also been collected from the flowers of Grevillea cagiana, Banksia grossa and Banksia attenuata.

1995	1		Neerabup
1995	1		Neerabup
1995	1		Neerabup
1996	1		Neerabup

Leioproctus contrarius — Leioproctus contrarius — *1 records*

This species of native bee is apparently dependent on flowers of Goodeniaceae and possibly Lechenaultia stenosepala. Recent surveys have shown that it is more widespread than previously thought.

1982	1	1	GNANGARA	Caught or trapped

Priority Four: Taxa in need of monitoring

Department of Environment and Conservation

31.658 °S 115.7474 °E / 31.691 °S 115.8431 °E Proposed pipeline area (plus~1.5km buffer)

*	*Date*	*Certainty*	*Seen*	*Location Name*	*Method*
Macropus irma				**Western Brush Wallaby**	*2 records*
This species occurs in areas of forest and woodland supporting a dense shrub layer.					
	2003	1		Neerabup	Day sighting
	2006	1	1	Pinjar	Day sighting
Priority Five: Taxa in need of monitoring (conservation dependent)					
Isoodon obesulus fusciventer				**Quenda**	*4 records*
This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses, that provides ample protection from predators.					
	2003	1	2	Wanneroo	Day sighting
	2003	2	0	Pinjar	Diggings
	2006	1	0	Pinjar	Diggings
	2006	1		Pinjar	Diggings

* Information relating to any records provided for listed species:-
Date: date of recorded observation
Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.
Seen: Number of individuals observed.
Location Name: Name of reserve or nearest locality where observation was made
Method: Method or type of observation

APPENDIX C: SUMMARY OF POTENTIAL VERTEBRATE FAUNA SPECIES

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		Critical	Vulnerable	Specicaly Protected		Vulnerable	Endangered	JAMBA	CAMBA					
BIRDS														
CASUARIIDAE	**Large Flightless Birds**													
Dromaius novaehollandiae	Emu												possible	needs to be within 20km of drinking water
PHASIANIDAE	**True Quail**													
Coturnix pectoralis	Stubble Quail										x	U	high	in paddocks
ANATIDAE	**Ducks**													
Oxyura australis	Blue-billed Duck										x	U	possible	in inudated claypan
Stictonetta naevosa	Freckled Duck										x	U	possible	in inudated claypan
Cygnus atratus	Black Swan										x	U	possible	in inudated claypan
Tadorna tadornoides	Australian Shelduck										x		possible	in inudated claypan
Chenonetta jubata	Australian Wood Duck										x	x	possible	in inudated claypan
Anas gracilis	Grey Teal										x	U	possible	in inudated claypan
Anas castanea	Chestnut Teal										x	U	possible	in inudated claypan
Anas superciliosa	Pacific Black Duck										x	U	possible	in inudated claypan
Anas rhynchotis	Australasian Shoveler										x	U	possible	in inudated claypan
Malacorhynchus membranaceus	Pink-eared Duck										x	U	possible	in inudated claypan
Aythya australis	Hardhead										x	U	possible	in inudated claypan
ARDEIDAE	**Herons, Egrets & Bitterns**													
Ardea pacifica	White-necked Heron										x		low	in paddocks and wet areas
Ardea novaehollandiae	White-faced Heron										x		high	in paddcks and inudated claypan
Ardea alba	Great Egret								x		x	x	high	in inudated claypan
Ardea garzetta	Little Egret										x		low	in inudated claypan
Ardea ibis	Cattle Egret								x		x		low	in inudated claypan
Nycticorax caledonicus	Rufous Night Heron									RP	x		low	in wet area with dense vegetation
THRESKIORNITHIDAE	**Ibises & Spoonbills**													
Plegadis falcinellus	Glossy Ibis								x		x		low	in paddocks and wet areas
Threskiornis molucca	Australian White Ibis										x		high	in paddocks and wet areas
Threskiornis spinicollis	Straw-necked Ibis										x		medium	in paddocks and wet areas
Platalea flavipes	Yellow-billed Spoonbill										x		possible	in inudated claypan

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ACCIPITRIDAE	**Kites, Eagles & Hawks**													
Elanus caeruleus	Black-shouldered Kite										x	x	high	particularly over paddocks
Hamirostra isura	Square-tailed Kite									RP	x	x	low	Over any part of the area
Haliastur sphenurus	Whistling Kite									RP	x	x	low	Over any part of the area
Accipiter fasciatus	Brown Goshawk									RP	x	x	high	Over any part of the area
Accipiter cirrhocephalus	Collared Sparrowhawk									RP	x	x	high	Over any part of the area
Aquila morphnoides	Little Eagle									RP	x		possible	Over any part of the area
Aquila audax	Wedge-tailed Eagle									RP	x	x	possible	Over any part of the area
Circus assimilis	Spotted Harrier										x		possible	Over any part of the area
Circus approximans	Swamp Harrier										x			Over any part of the area
FALCONIDAE	**Falcons**													
Falco berigora	Brown Falcon									RP	x		possible	Over any part of the area
Falco cenchroides	Australian Kestrel										x	x	high	particularly over paddocks
Falco longipennis	Australian Hobby										x		possible	Over any part of the area
Falco peregrinus	Peregrine Falcon			x						OP/RP	x		low	Over any part of the area
RALLIDAE	**Rails & Crakes**													
Gallirallus philippensis	Buff-banded Rail													Requires dense vegetation near water
Porzana fluminea	Australian Spotted Crake													Requires dense vegetation near water
Porzana tabuensis	Spotless Crake													Requires dense vegetation near water
Porphyrio porphyrio	Purple Swamphen													Grazes near water
Gallinula ventralis	Black-tailed Native-hen													Grazes near water
Gallinula tenebrosa	Dusky Moorhen													Grazes near water
TURNICIDAE	**Button-quail**													Open woodland
Turnix varia	Painted Button-quail													
RECURVIROSTRIDAE	**Stilts & Avocet**													
Himantopus himantopus	Black-winged Stilt										x	U	possible	in inundated claypan
Recurvirostra novaehollandiae	Red-necked Avocet										x	U	possible	in inundated claypan

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		Critical	Vulnerable	Specicaly Protected		Vulnerable	Endangered	JAMBA	CAMBA					
CHARADRIIDAE	**Wading Birds**													
Vanellus tricolor	Banded Lapwing										x		medium	Open damp areas and paddocks
Charadrius ruficapillus	Red-capped Plover													Open damp areas and paddocks
Charadrius melanops	Black-fronted Dotterel													Open damp areas and paddocks
Erythrogonys cinctus	Red-kneed Dotterel													
COLUMBIDAE	**Pigeons & Doves**													
Phaps chalcoptera	Common Bronzewing									RP	x	x	high	Open bushland
Ocyphaps lophotes	Crested Pigeon										x		high	Open bushland
PSITTACIDAE	**Parrots**													
Calyptorhynchus banksii	Red-tailed Black Cockatoo					x				V	x	x	possible	in cuc and banksia woodland
Calyptorhynchus latirostris	Carnaby's Cockatoo		x				x			E/VU	x		high	in cuc and banksia woodland
Calyptorhynchus baudinii	Baudin's Cockatoo		x			x				V/VU	x	x	medium	in cuc and banksia woodland
Cacatua roseicapilla	Galah										x			in cuc and banksia woodland
Glossopsitta porphyrocephala	Purple-crowned Lorikeet										x		high	in cuc and banksia woodland
Polytelis anthopephus	Regent Parrot										x		medium	in cuc and banksia woodland
Barnardius zonarius	Australian Ringneck										x	x	high	in cuc and banksia woodland
Purpureicephalus spurius	Red-capped Parrot										x	x	high	in cuc and banksia woodland
Platycercus icterotis	Western Rosella									RP	x	x	medium	in cuc and banksia woodland
Neophema elegans	Elegant Parrot										x		medium	in cuc and banksia woodland
CUCULIDAE	**Cuckoos**													
Cuculus pallidus	Pallid Cuckoo										x	x	high	seasonal
Cacomantis flabelliformis	Fan-tailed Cuckoo										x		high	seasonal
Chrysococcyx basalis	Horsfield's Bronze Cuckoo										x		medium	seasonal
Chrysococcyx lucidus	Shining Bronze Cuckoo										x	x	high	seasonal
STRIGIDAE	**Owls**													
Ninox novaeseelandiae	Boobook Owl										x		high	if habitat suitable
TYTONIDAE	**Owls**													
Tyto novaehollandiae	Masked Owl									RP	x	x	low	Uncommon
Tyto alba	Barn Owl										x	x	medium	if hollows present

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PODARGIDAE	**Frogmouths**													
Podargus strigoides	Tawny Frogmouth										x	x	high	In open woodland
AEGOTHELIDAE	**Owlet Nightjars**													
Aegotheles cristatus	Australian Owlet-nightjar										x	x	high	if hollows present
APODIDAE	**Swifts**													
Apus pacificus	Fork-tailed Swift							x	x		x		rare	seasonal vagrant
HALCYONIDAE	**Kingfishers**													
Todiramphus sanctus	Sacred Kingfisher										x		high	Requires hollow to breed
MEROPIDAE	**Bee-eaters**													
Merops ornatus	Rainbow Bee-eater							x			x		high	breeds in sand
MALURIDAE	**Wrens**													
Malurus splendens	Splendid Fairy-wren									RD	x	x	high	exists in dense native shrubland
PARDALOTIDAE	**Small Bush Birds**													
Pardalotus punctatus	Spotted Pardalote										x	x	possible	if habitat present
Pardalotus striatus	Striated Pardalote										x	x	high	Euc canopy required
ACANTHIZIDAE														
Sericornis frontalis	White-browed Scrubwren									RD	x	x	high	Dense vegetation required
Smicrornis brevirostris	Weebill									RD	x	x	high	Euc canopy required
Gerygone fusca	Western Gerygone										x		high	Euc canopy required
Acanthiza apicalis	Broad-tailed Thornbill (Inland Thornbill)									RD	x	x	high	Varied bushland
Acanthiza inornata	Western Thornbill									RD	x		high	Canopy feeder
Acanthiza chrysorrhoa	Yellow-rumped Thornbill									RD	x		high	Open bushland

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MELIPHAGIDAE	**Honeyeaters**													
Lichmera indistincta	Brown Honeyeater										x		high	flowering plants present
Lichenostomus virescens	Singing Honeyeater										x		high	flowering plants present
Lichenostomus ornatus	Yellow-plumed Honeyeater									RD	x		low	flowering plants present
Melithreptus brevirostris	Brown-headed Honeyeater										x		low	flowering plants present
Melithreptus chloropsis	Western White-naped Honeyeater									RD	x	x	low	flowering plants present
Phylidonyris novachollandiae	New Holland Honeyeater									RP	x	x	high	flowering plants present
Phylidonyris nigra	White-cheeked Honeyeater									RP	x		high	flowering plants present
Phylidonyris melanops	Tawny-crowned Honeyeater										x	U	probable	if heath present
Acanthorhynchus superciliosus	Western Spinebill										x	x	high	flowering plants present
Manorina flavigula	Yellow-throated Miner									RP	x		low	flowering plants present
Anthochaera hamulata	Western Little Wattlebird									RP	x		high	flowering plants present
Anthochaera carunculata	Red Wattlebird										x	x	high	flowering plants present
Ephthianura albifrons	White-fronted Chat										x		low	if chenopod heath present
PETROICIDAE	**Robins**													
Petroica multicolor	Scarlet Robin									RD	x	x	high	Open bushland
Petroica goodenovii	Red-capped Robin										x		low	Uncommon
Petroica cucullata	Hooded Robin									RD	x	x	low	Uncommon
NEOSITTIDAE	**Sittellas**													
Daphoenositta chrysoptera	Varied Sittella									RD	x		high	Eucalypt woodland required
PACHYCEPHALIDAE	**Whistlers & Shrike-thrushes**													
Pachycephala pectoralis	Golden Whistler									RD	x	x	high	Varied bushland
Pachycephala rufiventris	Rufous Whistler										x	x	high	Varied bushland
Colluricincla harmonica	Grey Shrike-thrush									RD	x		high	Varied bushland
DICRURIDAE	**Flycatchers**													
Myiagra inquieta	Restless Flycatcher									RD	x		low	Varied bushland
Rhipidura fuliginosa	Grey Fantail										x	x	high	Varied bushland
Rhipidura leucophrys	Willie Wagtail										x	x	high	Almost any habitat
Grallina cyanoleuca	Magpie-lark										x		high	

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CAMPEPHAGIDAE	**Cuckoo-shrikes & Trillers**													
Coracina novaehollandiae	Black-faced Cuckoo-shrike										x	x	high	Almost any habitat
Lalage tricolor	White-winged Triller										x		high	seasonal
ARTAMIDAE	**Woodswallows, Butcherbirds, Magpies & Currawongs**													
Artamus cinereus	Black-faced Woodswallow									RP	x		possible	Open bushland
Artamus cyanopterus	Dusky Woodswallow									RP	x		high	Open bushland
CRACTICIDAE														
Cracticus torquatus	Grey Butcherbird										x	x	high	Open bushland
Cracticus tibicen	Australian Magpie										x	x	high	Open bushland
Strepera versicolor	Grey Currawong									RP	x		possible	Open bushland
CORVIDAE	**Ravens & Crows**													
Corvus bennetti	Little Crow										x		low	Occassional
Corvus coronoides	Australian Raven										x	x	high	Eucalypt woodland
HIRUNDINIDAE	**Swallows & Martins**													
Hirundo neoxena	Welcome Swallow										x	x	high	Almost any habitat especially damp areas
Hirundo nigricans	Tree Martin										x		high	Hollows required
ZOSTEROPIDAE	**White-eyes**													
Zosterops lateralis	Grey-breasted White-eye										x	x	high	Heath and shrublands
SYLVIIDAE	**Reed Warbler, Grassbird, Songlarks & Cisticola**													
Cinclorhamphus mathewsi	Rufous Songlark													Open bushland
Cinclorhamphus cruralis	Brown Songlark													Open paddocks and grassed areas
DICAEIDAE	**Mistletoebird**													
Dicaeum hirundinaceum	Mistletoebird										x	x	high	if mistletoe present
MOTACILLIDAE	**Pipits & Wagtails**													
Anthus australis	Australian Pipit										x	x	high	if open areas present

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MAMMALS														
TACHYGLOSSIDAE	**Egg-laying Mammals**													
Tachyglossus aculeatus	Short-beaked Echidna										x		possible	needs ant colonies
DASYURIDAE	**Carnivorous Marsupials**													
Dasyurus geoffroii	Chuditch					x				V	x	x	low	Suitable food resources required
Sminthopsis gilberti	Gilbert's Dunnart											x	possible	Suitable habitat required
Sminthopsis g. griseoventer	Grey-bellied Dunnart											x	possible	Suitable habitat required
PERAMELIDAE	**Bandicoots & Bilby**													
Isoodon obesulus fusciventer	Southern Brown Bandicoot, Quenda				P4						x	x	possible	if thick understory present
MACROPODIDAE	**Kangaroos & Wallabies**													
Macropus fuliginosus	Western Grey Kangaroo										x	x	high	Common
PHALANGERIDAE	**Possums**													
Trichosurus v. vulpecula	Common Brushtail Possum										x	x	high	if shelter or hollows present
BURRAMYIDAE	**Pygmy-possum**													
Cercartetus concinnus	Western Pygmy-possum										x	x	high	Suitable habitat required
TARSIPEDIDAE	**Honey-possum**													
Tarsipes rostratus	Honey-possum										x		possible	if constant flowering present
VESPERTILIONIDAE	**Evening Bats**													
Chalinolobus gouldii	Gould's Wattled Bat												high	Roost sites and food available
Chalinolobus morio	Chocolate Wattled Bat											x		Roost sites and food available
Falsistrellus mackenzici	Western False Pipistrelle				P4								low	Roost sites and food available
Nyctophilus geoffroyi	Lesser Long-eared Bat											x		Roost sites and food available
Nyctophilus gouldi	Gould's Long-eared Bat												high	Roost sites and food available
Nyctophilus t. timoriensis	Greater Long-eared Bat													Roost sites and food available
Vespadelus regulus	Southern Forest Bat													Roost sites and food available
Mormopterus planiceps	Southern Freetail-bat													Roost sites and food available
Tadarida australis	White-striped Freetail-bat													Roost sites and food available

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AMPHIBIANS														
MYOBATRACHIDAE	**Ground Frogs**													
Heleioporus eyrei	Moaning Frog										x	x	possible	Usually sandy soils near damp areas, burrows
Heleioporus psammophilus	Marbled Burrowing Frog										x		possible	Usually fine sands and sandy clays, burrows
Limnodynastes dorsalis	Western Banjo Frog										x		possible	In vegetation near wet areas in winter, burrows during summer
Crinia georgiana	Quacking Froglet										x		possible	Ephemeral swamps
Crinia insignifera	Sandplain Froglet										x	x	possible	Ephemeral swamps
Myobatrachus gouldii	Turtle Frog										x		possible	In sand under rocks and logs - feeds on termites
Pseudophryne guentheri	Guenther's Toadlet										x		possible	Moist areas beneath rocks and logs
REPTILES														
AGAMIDAE	**Dragon Lizards**													
Pogona m. minor	Western Bearded Dragon										x		high	
GEKKONIDEA	**Geckos**													
Diplodactylus g. granariensis	Wheatbelt Gecko										x		low	Rare on the SCP
Diplodactylus polyophthalmus	Rusty Gecko										x	U	low	Euc Banksia woodland
Christinus marmoratus	Marbled Gecko										x	x	high	Prefers fallen trees in woodland areas
Heteronotia binoei	Binoe's Prickly Gecko										x	U	high	Almost any habitat
PYGOPODIDAE	**Legless Lizards**													
Aprasia repens	Yellow-chinned Worm-Lizard										x			habitat dependent
Delma fraseri	Fraser's Delma										x	x		habitat dependent
Delma grayii	Gray's Delma										x			habitat dependent
Lialis burtonis	Burton's Legless Lizard										x	x	high	Sandy areas
Pletholax g. gracilis	Southern Pletholax										x			habitat dependent
Pygopus lepidopodus	Southern Scaly-foot										x			habitat dependent
Strophurus s. spinigerus	Southwest Spiny-tailed Gecko										x			From coastal dunes to heavily timbered areas

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SCINCIDAE	**Skinks**													
Acritoscincus trilineatum	Western Cool Skink										x	x		habitat dependent
Cryptoblepharus plagiocephalus	Common Crypto										x		high	habitat dependent
Ctenotus fallens	West-coast Ctenotus										x			On tree trunks and logs
Ctenotus gemmula	Jewelled Ctenotus													habitat dependent
Egernia napoleonis	Southern Crevice Skink													scarce
Hemiergis quadrilineata	Two-toed Earless Skink										x	x		Prefers Banksia woodland on SCP
Lerista elegans	Elegant Four-toed Lerista										x	x	high	In damper soils
Lerista lineata	Perth Striped Lerista										x	x	high	In leaf litter of Banksia and Euc.
Lerista lineopunctulata	Line-spotted Lerista										x			Sands in Banksia and Euc woodland
Menetia greyii	Grey's Menetia										x			Sands in Banksia and Euc woodland
Morethia lineoocellata	Ocellated Morethia										x	x	high	In leaf litter
Morethia obscura	Dark Morethia										x	x		habitat dependent
Tiliqua occipitalis	Western Bluetongue										x		high	In leaf litter
Tiliqua r. rugosa	Western Bobtail										x		low	Coastal but found in Bullsbrook
											x		high	Most habitats
VARANIDAE	**Goannas, Monitors**													
Varanus gouldii	Gould's Monitor										x	x	medium	Throughout bushland with sandy soils
TYPHLOPIDAE	**Blind Snakes**													
Ramphotyphlops australis	Southern Blind Snake										x	x	high	Most habitats in soils
BOIDAE	**Pythons**													
Morelia spilota imbricata	Southwest Carpet Python				P4						x	U	low	Rare on the SCP is at Yanchep NP
ELAPIDAE	**Front-fanged Snakes**													
Demansia p. psammophis	Common Whip Snake											U		Banksia woodlands
Brachyurophis fasciolata fasciata	Narrow-banded Snake										x	U		
Brachyurophis semifasciatus	Southern Shovel-nosed Snake										x	U		
Echiopsis curta	Bardick										x	U	low	Banksia woodlands
Neelaps bimaculatus	Black-naped Snake										x			sands with banksia and euc woodland
Neelaps calonotus	Black-striped Snake										x	U		sands with banksia and euc woodland
Notechis scutatus	Western Tiger Snake										x	x		Common in damper areas with dense vegetation
Pseudechis australis	Mulga Snake										x	U	low	Found near Muchea
Parasuta gouldii	Gould's Snake										x	x		Banksia and euc woodlands
Parasuta nigriceps	Black-backed Snake										x	x		Uncommon on the SCP
Pseudonaja a. affinis	Dugite										x	x	high	Farmland and disturbed areas
Simoselaps bertholdi	Jan's Banded Snake										x			sands with banksia and euc woodland

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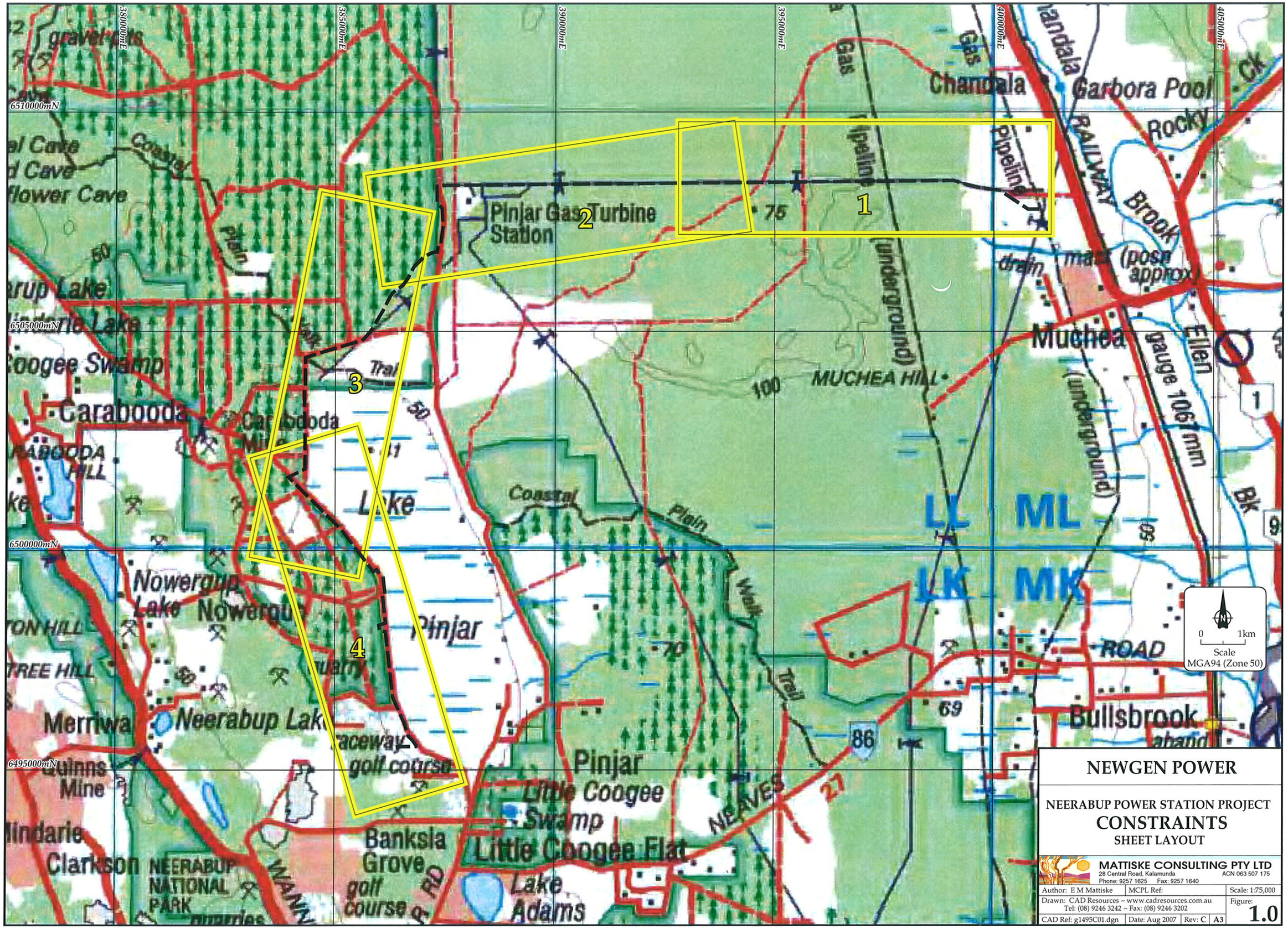
INTRODUCED SPECIES - BIRDS														
Columba livia	Domestic Pigeon										x		high	All habitats
Streptopelia senegalensis	Laughing Turtle-Dove										x		high	All habitats
Streptopelia chinensis	Spotted Turtle-Dove										x		high	All habitats
Trichoglossus haematodus	Rainbow Lorikeet										x		high	flowering plants
Dacelo novaeguineae	Laughing Kookaburra										x		high	requires hollow to nest
INTRODUCED SPECIES - MAMMALS														
Mus musculus	House Mouse										x		high	All habitats
Rattus rattus	Black Rat										x		high	All habitats
Oryctolagus cuniculus	Rabbit										x		high	All habitats
Vulpes vulpes	Fox										x		high	All habitats
Felis catus	Cat										x		high	All habitats



NEWGEN POWER

NEERABUP POWER STATION PROJECT
CONSTRAINTS
SHEET LAYOUT

MATTISKE CONSULTING PTY LTD
28 Central Road, Kalamunda ACN 063 507 175
Phone: 9257 1625 Fax: 9257 1640

Author: E M Mattiske	MCPL Ref:	Scale: 1:75,000
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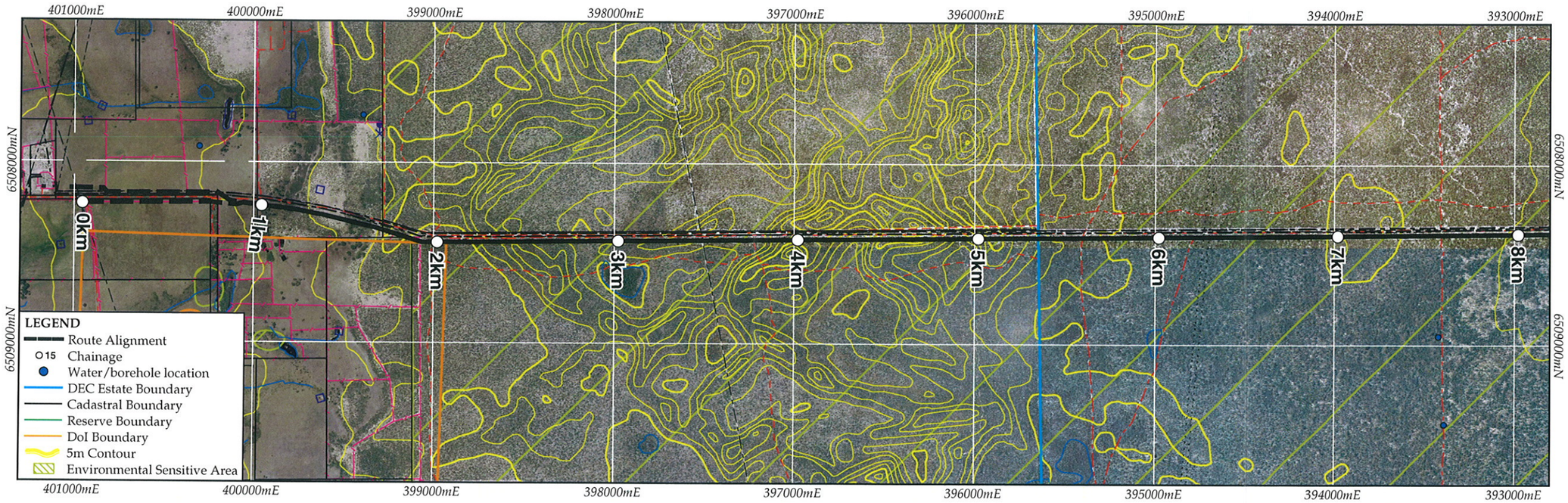
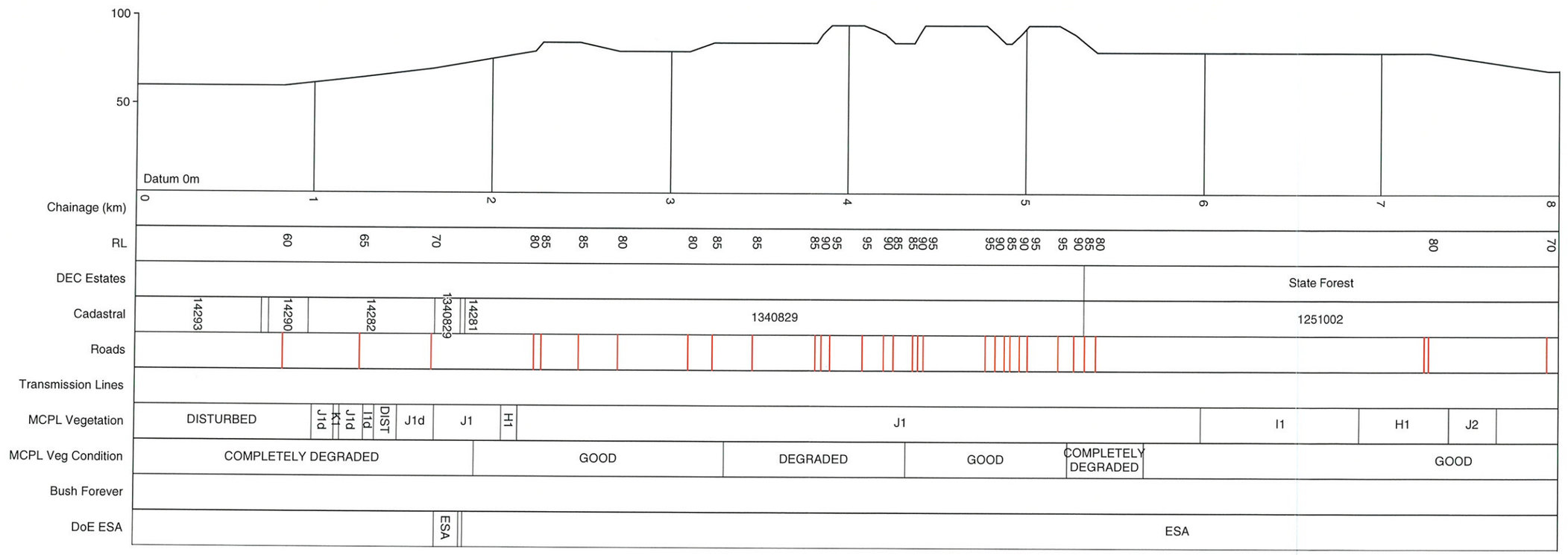
CAD Ref: g1495C01.dgn	Date: Aug 2007 | Rev: C | A3	





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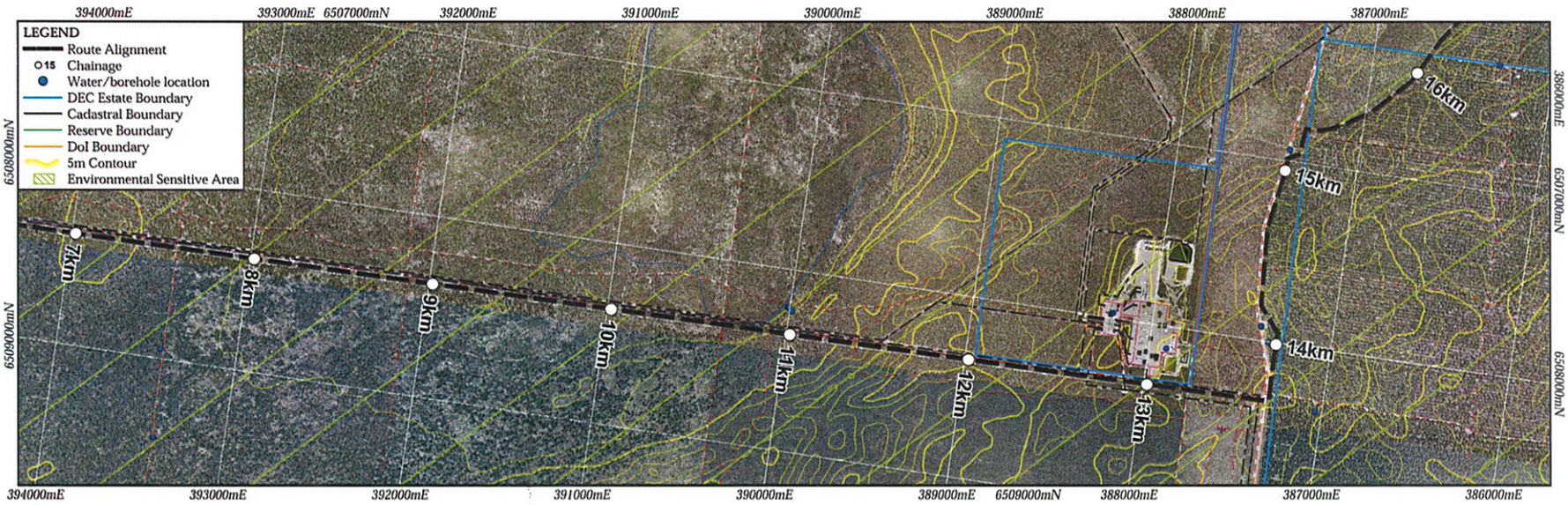
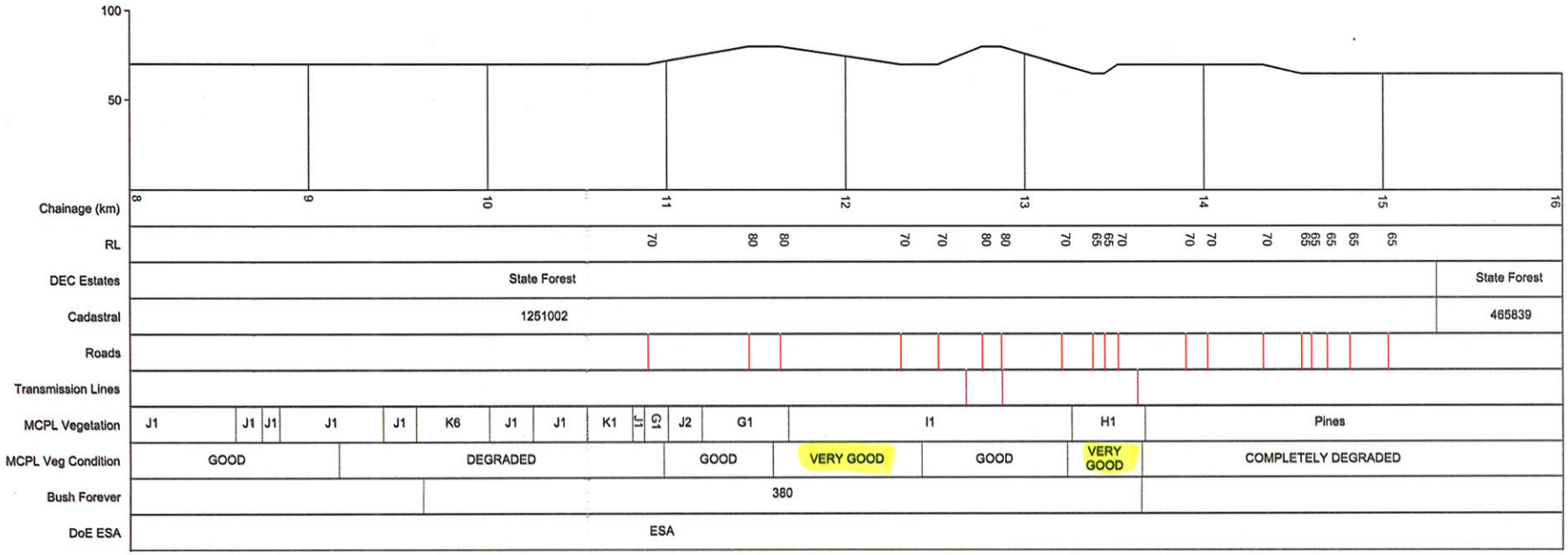
0 250 500m
Horizontal Scale
MGA (Zone 50)

0 25 50m
Vertical Scale
MGA (Zone 50)

NEWGEN POWER
NEERABUP POWER STATION PROJECT
CONSTRAINTS MAPPING - SHEET 1 OF 4

1.1





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0 250 500m
Horizontal Scale
MGA (Zone 50)

0 25 50m
Vertical Scale
MGA (Zone 50)

NEWGEN POWER
NEERABUP POWER STATION PROJECT
CONSTRAINTS MAPPING - SHEET 2 OF 4

1.2

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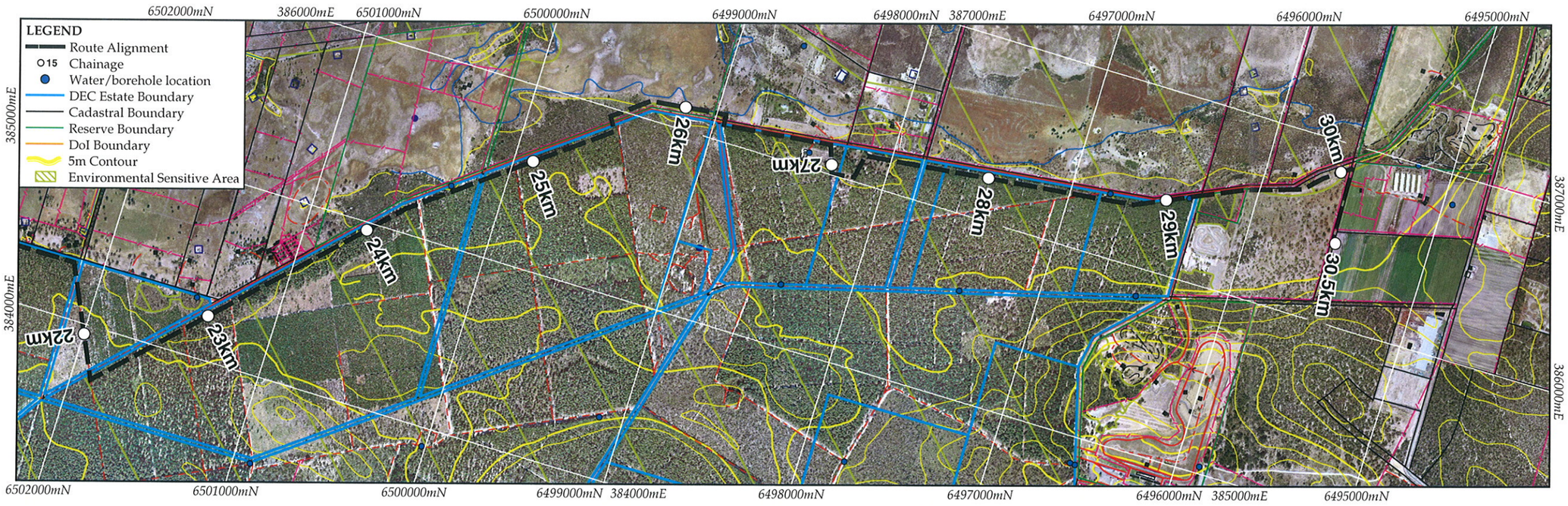
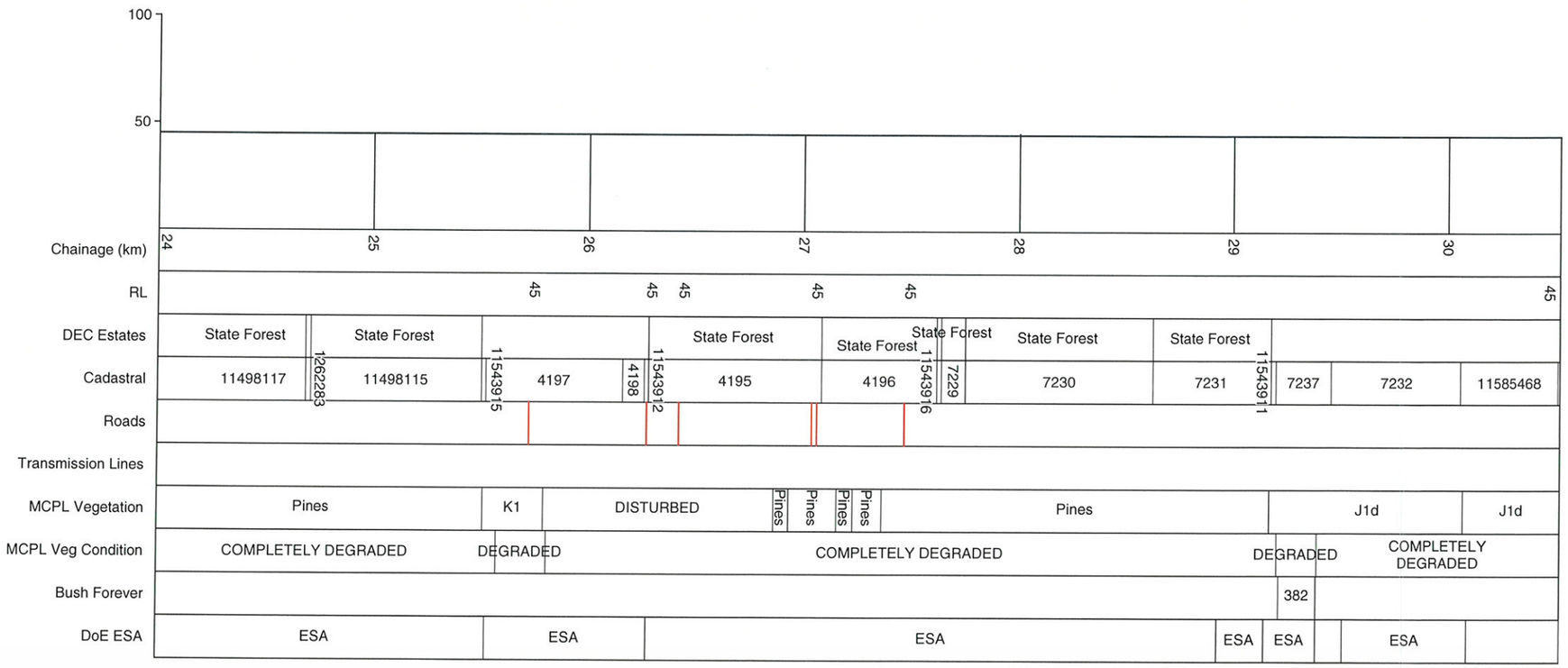
0 250 500m
Horizontal Scale
MGA (Zone 50)

0 25 50m
Vertical Scale
MGA (Zone 50)

NEWGEN POWER
NEERABUP POWER STATION PROJECT
CONSTRAINTS MAPPING - SHEET 3 OF 4

1.3





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0 250 500m
Horizontal Scale
MGA (Zone 50)

0 25 50m
Vertical Scale
MGA (Zone 50)

NEWGEN POWER
NEERABUP POWER STATION PROJECT
CONSTRAINTS MAPPING - SHEET 4 OF 4

1.4

NewGen Power
330MW PROJECT

Gas Pipeline
Construction Environmental Management Plan

June 2007

Commercial-In-Confidence

NewGen Power Pty Ltd

A.C.N. 117 443 035
AFSL No. 297578

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NPN – 08141	*Rev 2.0*	*R Griffiths*	*T Petersen*	*T Petersen*	*18/06/07*

1.6 OBJECTIVES

This CEMP documents the necessary procedures to enable NewGen to manage the environmental impacts of the construction of the NewGen Pipeline Project. This CEMP has as its primary purpose the protection of the environment through minimisation of the effects of activities and the restoration and rehabilitation of areas disturbed by the activities.

1.7 DESCRIPTION OF ACTIVITY

The NewGen Power 330MW Project consists of:

- A 330 MW gas-fired OCGT power station;
- A 2 km transmission line from the power station to the Neerabup terminal sub-station; and
- A 30 km gas pipeline.

Figure 1.1 shows the location of the project components. The transmission line and power station, including pressure reduction facilities and heating will be constructed by others.

1.8 ENVIRONMENTAL IMPACT ASSESSMENT

The NewGen Power 330MW Project is subject to environmental impact assessment by the Environmental Protection Authority. The assessment will result in environmental conditions set by the Minister for the Environment. These environmental conditions will take precedence over the requirements of this CEMP.

1.9 RELEVANT ENVIRONMENTAL ISSUES

Relevant environmental issues for the pipeline from the environmental impact assessment process include:

- Clearing of native vegetation and flora;
- Fauna;
- Topsoil management;
- Rehabilitation;
- Waste management;
- Water quality;
- Acid sulphate soils;
- Dust management; and
- Noise management.

These issues and others identified for the CEMP are set out in Table 2 with objectives, actions and performance indicators, for their management.

rehab actions
rehab maintenance
in sep item
see p. 13

Table 2. Summary of Environmental Objectives and Performance Criteria

Issue	Objective	Actions	Performance Indicator
Environmental impact	Comply with environmental approvals for project	Develop project specific CEMP and environmental work procedures	Number of breaches of environmental approvals
Clearing of native vegetation	Minimise clearing of native vegetation.	Clearing limited to designated area of ROW. Mature trees to be left where practicable.	All construction activities to remain within ROW.
Topsoil management	Minimise change to soil profile from construction activities.	Topsoil shall be stockpiled separately from other materials where it can be readily recovered for respreading and where it will not be lost through wind or water erosion or other means. Soil and surface stability shall be maintained at all times. Graded soil shall not be stockpiled where it has the potential to result in sedimentation. Top soil containment measures such as sediment fencing shall be used as necessary, especially during wet weather. Stockpiled soil shall not impede the movement of stock and vehicles across the pipeline construction area. Stockpile beaks shall coincide with designated access tracks, fence lines and gapes in stockpile vegetation. Grading and stockpiling of soil shall not, as far as practicable, impede surface drainage or water flows.	Topsoil placed as final layer following backfill.

p. 36 states Spring 06 survey for sig spp + manag plans if final any.

- need detail see also CEMP p. 17

Issue	Objective	Actions	Performance Indicator
Weeds and diseases	Prevent the introduction and spread of weeds and plant pathogens.	Prior to mobilisation all earthmoving and mobile equipment is to be washed down to ensure it is free from soil and vegetative material prior to arriving at the construction site. Equipment that has been brought to site with evidence of vegetative material or soil is not to commence work but is to be taken to suitable washing facilities and be washed down. Any weed infestations noted during construction are to be reported to the Construction Manager. Upon being reported, action is to be taken to remove or treat weed infestations within the immediate construction area. Ongoing landholder liaison regarding any known weed infestations. Vehicle hygiene inspections will be undertaken and recorded prior to mobilisation to site, with at least weekly visual vehicle inspections.	The presence of weeds and plant pathogens is no worse than adjacent land.
Fauna Impact	Minimise impact on fauna and their habitat.	Clearing limited to designated area of ROW. Mature trees to be left where practicable for fauna habitat. In densely vegetated areas, spoil material from the trench will also be formed up along one margin of the pit, potentially reducing the likelihood of fauna falling into the trench. Daily checking of the trench for fauna will be conducted prior to commencement of work.	Minimise clearing of fauna habitat Inspections of trench for fauna carried out daily.

Issue	Objective	Actions	Performance Indicator
Disturbance to significant wetlands	To minimise and manage disturbance to significant wetlands and their buffer areas.	Significant wetlands (conservation and resource enhancement categories) shall be demarcated and clearing minimised. Stockpiling and laydown areas to be out of wetland.	Minimum area of wetland disturbed.
Water quality	Water quality is protected in Priority 1 areas of Gnangara Mound.	In the vicinity of the Gnangara mound, the trench shall be suitably shored and any pump-out of water from the trench shall be directed on to a mesh and over vegetated area.	No long-term detrimental impact to the aquifer in comparison t pre-construction water quality.
Erosion and sediment control	Minimise erosion and sediment generation.	Construction works will cease during extreme weather conditions. Implement site specific erosion control measures such as diversion drains and silt mesh fencing. Construct control banks to divert storm-water away from disturbed areas.	No long term erosion or increased sedimentation due to pipeline construction.
Bushfire management.	To prevent bush fires as a result of construction activities	Fire fighting equipment such as fire extinguishers and water trucks are readily available for fighting fires should there be ignition. Permit to Work procedure for hot work requires a spotter in heavily vegetated areas. Construction activities to cease during lightening activity.	No fires as a result of construction activities.

Issue	Objective	Actions	Performance Indicator
Contamination	Prevent contamination of land and water.	The storage and handling of fuels and chemicals will comply with all relevant legislation and Australian Standards AS1940:1993 – The storage and handling of flammable and combustible materials. MSDS is maintained when purchasing chemicals and is available on site for all chemicals stored and handled. Spill equipment, such as absorbent material etc will be contained on the refuelling trailer in order to immediately respond to any minor spillage. The contractor is responsible for ensuring all plant and equipment brought on to site has been serviced beforehand in order to minimise the amount of on-site servicing required. All equipment is to be inspected and tested prior to mobilisation to ensure it does not have oil leaks and is in suitable condition to be operated without causing excessive black smoke or failure of hydraulic hoses etc. Any chemicals or fuels in containers (i.e. 205 litre drums etc) required for the onsite work will be stored in self-bunded containers or temporary bunding arrangements. All waste oils will be collected and stored in labelled drums for disposed offsite by an authorised liquid waste contractor.	Compliance with relevant legislation and Australian Standards. No significant spills of hydrocarbons (greater than 100 litres).

Issue	Objective	Actions	Performance Indicator
Dust management	Minimise dust nuisance and sand blast potential.	Control generation of dust through application of water from water trucks or other suitable means as required. Clearing or excavation activities may need to be suspended during periods of high wind to minimize dust nuisance or sand blast. Keep to existing tracks to minimise the extent of clearing and exposure of soil surfaces. Adhere to speed limits on all roads and construction areas.	No complaints from landholders. No dust related damage to vegetation.
Noise management	Minimise impact of noise from construction activities.	Equipment shall be fitted with appropriate noise abatement devices maintained in good working order. Local landholders shall be informed of potential noise from construction, maintenance or project activities prior to the commencement of activities. Where practicable, excessively noisy activities shall be scheduled for periods that are less likely to result in noise nuisance. Made in consultation with the landholders.	No reasonable noise complaints related to construction activities. Compliance with noise regulations.
Waste Management	Minimise the generation of waste during construction. Minimise the potential for environmental impact from disposal of waste.	A waste skip or similar device will be placed at suitable locations within the work area to cater for the collection of all solid waste materials generated from the work. Arrangement will be made for the regular collection and servicing of the sites waste bins.	Waste minimised Recycling of waste promoted ROW maintained in a tidy state Waste material is disposed of as per Environmental Protection Act.

Issue	Objective	Actions	Performance Indicator
Acid sulphate soils	No degradation of the surrounding natural environment by exposure to acid sulphate soils from pipeline construction activity.	Trenches are not to be left open for more than 8 hrs as far as practical. If this is required and the soil in the trench is waterlogged, it should be assumed to be acidic. A liberal dosing of the soil with agricultural lime is required before leaving the site for the day. If the trench is required to be dewatered, a check of pH should be undertaken, and the water neutralised with hydrated lime prior to discharge over mesh and NOT into any storm water drain, gutter or watercourse. Any water logged soils/sand recovered from trenching will need to be checked for pH prior to disposal, as acid sulphate soils are located along the route. Where the soil pH is less than pH 5, the soil will need to be treated with agricultural lime at the rate of 20kg per cubic metre of soil prior to disposal.	Groundwater not to be degraded by construction activities. No visual impact from oxidation of acid sulphate soils from construction activities.
Rehabilitation	Re-establish surface contours and vegetation to pre-construction condition.	Pre-construction surface contours will be re-established. Topsoil will be separately stockpiled replaced following backfill of subsoils. Site will be re-seeded with local provenance species.	Pre-construction surface contours re-established. Plant species mix re-established.

rehab monitoring

2 PIPELINE CONSTRUCTION

2.1 MANAGEMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

Potential Environmental Impacts from specific activities associated with the pipeline construction will be managed by the following strategies (the environmental objectives and performance indicators are summarised in Table 2).

2.1.1 Access

Potential Impacts

The following potential environmental impacts may result from access to the ROW:

- Increased safety hazard resulting from increases in traffic volume;
- Access track proliferation;
- Soil compaction, erosion and sediment release to land and water;
- Potential modification to surface water flows (drainage lines and streams);
- Incursion of disease, weeds, vermin or destructive influences to the site;
- Temporary disruption to landholders;
- Degradation of existing road infrastructure;
- Unauthorised third party access to previously inaccessible areas.

Objectives

The objectives of management of pipeline access during operation are:

- To minimise disturbance to flora;
- To minimise impacts to fauna;
- To minimise impacts to soil and water;
- To minimise impacts on visual amenity;
- To minimise disruption to land holders and third parties;
- To achieve satisfactory road and site rehabilitation.

Management Measures

- The ROW shall not be used as a general thoroughfare.
- Access to the pipeline ROW shall be via existing roads and tracks only.
- Public access along the ROW (outside designated public access areas, ie public roads) shall not be permitted.

- Soil erosion will be adequately controlled to allow continued access and safe navigation by vehicles.
- Where vehicles are required to cross existing utilities (e.g. pipelines, fibre optic cables, etc) protective measures such as berming or bridging may be necessary.
- Appropriate measures will be applied to ensure vehicles remain on designated access roads and tracks.
- Vehicles shall travel at safe speeds that minimize environmental impacts.
- The access routes will be adequately signed to manage direction and reinforce speed limits.

2.1.2 Clearing

Potential Impacts

The following potential environmental impacts may result from clearing the ROW and construction areas:

- Soil erosion;
- Sediment release to land or water;
- Removal of flora, vegetation and wildlife habitat;
- Fragmentation of wildlife habitat;
- Increased potential for weed introduction;
- Disturbance to heritage sites;
- Potential impacts to visual amenity;
- Unauthorised third party access to previously inaccessible areas;

Objectives

The objectives of management of pipeline access during construction are:

- To minimise clearing to "As Low As Reasonably Practical";
- To minimise disturbance to flora;
- To minimise impacts to fauna;
- To minimise impacts to soil and water;
- To minimise impacts on visual amenity;
- To minimise impacts on sites of cultural and historic heritage significance;
- To minimise disruption to landholders;
- To optimise rehabilitation success.

Management Measures

- Laydown areas will endeavour to be located at areas of existing sparse vegetation.
- All infrastructure will be identified and marked prior to clearing the ROW.
- Where necessary liaison will be undertaken in advance of any clearing with Forest Products Commission and / or DEC.
- Any surface rock removed from the ROW shall be disposed of as appropriate.
- Mark limit of clearing and control clearing so that it does not occur outside the marked area.
- Topsoil shall be stockpiled separately where it's protected from wind or water erosion and other materials (eg vegetation). for respreading.
- Top soil containment measures such as sediment fencing shall be used as necessary, especially during wet weather.
- Stockpiled soil shall not impede the movement of stock and vehicles across the pipeline construction area.
- Grading and stockpiling of soil shall not, as far as practicable, impede surface drainage or water flows.
- Soil and surface stability shall be maintained at all times. Drains and sediment barriers shall be installed as necessary and maintained until final construction clean up is completed.
- Vegetation and root stock will be cleared at ground level (shrubs and ground cover may be rolled), cleared vegetation will be stockpiled separately, strip and stockpile topsoil from all excavation and earthwork areas to a minimum depth of 100mm and respread over excavation areas following construction.
- Mature trees will be left wherever practicable to provide habitat for fauna.

2.1.3 Pipe Laying and Backfilling

Potential Impacts

The following potential environmental impacts may result from pipe laying and backfilling:

- Soil erosion and sedimentation of land and water;
- Entrapment of stock and wildlife in open trench;
- Temporary obstruction of other land uses.

Objectives

- Minimise adverse impacts to soil land water;
- Minimise impacts on stock and wildlife;
- Minimise disruption to landholders and third parties.

Management Measures

- Appropriate measures will be taken to protect the pipe coating from damage when in the trench, such as bedding and padding material.
- The open trench shall be limited to 1km and the time between trenching and backfilling will be limited to 5-6 days.
- The backfilled trench will be suitably compacted to prevent water flows and erosion along the backfilled trench.
- Where practicable soils shall be replaced in order of excavation, although additional clean fill may be required in some areas.

2.1.4 Pipe Stringing and Welding

Potential Impacts

- Dust and noise emissions;
- Temporary obstruction of other land uses;
- Damage to existing roads and infrastructure;
- Potential bushfire hazard associated with construction welding and grinding;

Objectives

The objectives of management of pipeline access during construction are:

- To minimise disruption to landholders and third parties;
- To minimise the risk of bushfire associated with construction activities;
- To minimise damage to existing roads and infrastructure.

Management Measures

- Pipe transport will be managed to ensure suitable arrival onto the ROW to enable construction to occur without undue storage requirements.
- Dust suppression will be conducted along all access tracks used by pipe trucks.
- Pipe shall be strung allowing gaps for vehicle, stock and wildlife access across the line of pipe. Gaps shall coincide with access tracks, boundary fences and gaps in stockpiled vegetation.
- All welding procedures and qualifications shall confirm with the relevant Australian Standard.
- Precautions shall be taken to minimise bushfire risk including the requirement of a spotter and water tank and/or fire extinguishers.
- The ingress of dust, wildlife and other objects into the welded pipe sections, particularly at night, shall be prevented by appropriate means such as 'night caps' placed over the open pipe string ends.
- Radiography of pipeline welds shall be performed in a manner which ensured that chemicals and other associated wastes are contained and appropriately disposed.
- The trench will need to be suitably shored in sandy terrain.

2.1.5 Protection of Native Fauna

Potential Impacts

The following potential fauna impacts may result from pipeline construction:

- Removal of wildlife habitat;
- Fragmentation of wildlife habitat;
- Increased potential for feral animal movement along new corridors;

Objectives

Minimise impact to native fauna and their habitat.

Management Measures

- In densely vegetated areas, spoil material from the trench will also be formed up along one margin of the pit, potentially reducing the likelihood of fauna falling into the trench.
- Daily checking of the trench for fauna will be conducted prior to commencement of work.
- The section of open excavated trench in heavily vegetated areas will have a ramp up, of less than 45° angle, at each end to allow any fauna that falls into the trench to exit out of it.
- Minimise disturbance to potential fauna habitats.
- Release trapped fauna from the trench.
- Drivers will be aware that there will be wildlife and stock on the roads especially at night and will drive accordingly.
- Dead animals will be removed from the road or ROW.
- Any stock injured or killed must be reported to the landowner, and the beast removed well off the road.
- Should a native animal be injured it will be handled gently to reduce stress.

2.1.6 Weed Control

Potential Impacts

- Invasion of weeds within the ROW following completion of the works;

Objectives

Prevent the introduction and spread of weeds and plant pathogens.

Management Measures

The following weed management measures to be applied during construction.

- Prior to mobilisation all earthmoving and mobile equipment is to be washed down to ensure it is free from soil and vegetative material prior to arriving at the construction site.
- Equipment brought to site is to be inspected for evidence of vegetative material, soil or rock.
- Equipment that has been brought to site with evidence of vegetative material or soil is not to commence work but is to be taken to suitable washing facilities and be washed down.
- All food scraps, including items which may contain seeds (eg melons, tomatoes), are to be removed from the construction site, to ensure that non-native vegetation does not become established.
- Any weed infestations noted during construction are to be reported to the Construction Manager. Upon being reported, action is to be taken to remove or treat weed infestations within the immediate construction area. Actions

may include spraying, physical removal or changes to operational procedures.

- Ongoing landholder liaison regarding any known weed infestations.
- Vehicle hygiene inspections will be undertaken and recorded prior to mobilisation to site, with at least weekly visual vehicle inspections.

2.1.7 Erosion Control

Potential Impacts

The following potential erosion impacts may result from pipeline construction:

- Soil erosion;
- Sediment release to land or water;
- Removal of priority flora and wildlife habitat;
- Increased potential for weed species introduction;
- Potential impacts to visual amenity;

Objectives

Minimise erosion and sediment generation..

Management Measures

Erosion by wind and water can have significant impacts on soil conservation on a disturbed site. We will minimise disturbance to vegetation and the soil surface and provide a stable surface to encourage regrowth. This is achieved through the following:

- Implement site specific erosion control measures such as diversion drains and silt mesh fencing.
- Construct erosion control banks on watercourse banks where erosion occurs.
- Stockpile topsoil, trench spoil or vegetation outside of watercourses.
- Construct control banks to divert storm-water away from disturbed areas.
- Report significant erosion restoration failures and recommend corrective action.

2.1.8 Hydrostatic Testing

Potential Impacts

The following potential impacts may result from hydrostatic testing:

- Soil erosion;
- Sediment release to land or water;
- Increased potential for weed species introduction;
- Contamination of soils and vegetation.

Objectives

Minimise potential for erosion and contamination of soil and water.

Management Measures

- The majority of pipe work will be hydrotested off-site prior to transport to site. Any pipe tested on site will be flushed to remove any mill scale, dust and loose material, followed by a foam pig to ensure it is clear of any items left inside the pipe work.
- No chemicals will be utilised in the hydrotest water.
- Pre-fill potable water may be used to flush out any dirt or debris in the line. This involves only filling the piping volume with potable water. This water is then discharged to collect any entrained oversize material contained within the pipe from construction activities.
- Potable water will then be pumped into the pipe work and pressured up to test the completed pipeline for any leaks as per the hydrotest procedure. Should the pipe work fail the hydrotest, it is depressurised resulting in the discharge of some of the treated water, and then repairs will be undertaken as required and the pipe work will then undergo another hydrotest.
- Once the pipe work has passed the hydrotest it is required to be drained.

2.1.9 Bushfires

Potential Impacts

There is a potential impact of bushfire resulting from pipeline construction which may cause:

- Soil erosion and sedimentation of soil and water;
- Damage to, or loss of, flora and fauna;
- Damage to, or loss of, wildlife habitat;
- Damage to, or loss of third party infrastructure.

Objectives

To prevent bush fires as a result of construction activities

Management Measures

- Fire fighting equipment such as fire extinguishers and water trucks are readily available for fighting fires should there be ignition, including existing operational emergency equipment on site, including fire extinguishers, mobile water tank and emergency trailer. There is to be one permanent water cart on site.
- All vehicles will have fire extinguishers.
- Permit to Work procedure for hot work requires a spotter.
- Liaison with local emergency personnel for assistance in the event of a bushfire.
- Construction activities to cease during lightening activity.

2.1.10 Dust

Potential Impacts

The following potential impacts may result from pipeline construction:

- Dust nuisance or sand blast to neighbouring land uses during clear and grade or trenching works.

Objective

Minimise dust nuisance and sand blast potential.

Management Measures

- Control generation of dust through application of water from trucks or other suitable means as required.
- Adhere to speed limits on all roads and construction areas.
- Keep to existing tracks to minimise the extent of clearing and exposure of soil surfaces.
- Ensure personnel where appropriate Personal Protective Equipment correctly.
- Conduct regular awareness talks at Toolbox Meetings.
- Ensure dust is considered as a potential hazard during all Job Hazard Analysis assessments.
- Clearing and excavation activities may need to be suspended during periods of high wind to minimize dust nuisance or sand blast.

2.1.11 Waste Management

Potential Impacts

The following potential impacts may result from pipeline construction:

- Contamination of soil or groundwater;
- Damage to vegetation and habitat.

Objective

- Minimise the generation of waste during construction.
- Minimise the potential for environmental impact from disposal of waste..

Management Measures

- All necessary steps shall be taken to control and clean up litter on and off the ROW and associated facilities and work sites.

- Solid waste material from all work sites will be disposed of to the local approved townsite rubbish tip.

- A waste skip or similar device will be placed at suitable locations within the work area to cater for the collection of all solid waste materials generated from the work. Arrangement will be made for the regular collection and servicing of the sites waste bins.
- It is not expected that a large volume of wastes would be generated from the project, with likely solid wastes being restricted to scrap steel, pipe end covers, grinding discs, welding butts and general waste. No liquid wastes will be co-mingled with these wastes.
- All welding electrodes and other consumable wastes are to be collected for disposal to an approved landfill site.
- No disposal of any rubbish in the pipeline trench is permitted.
- In the vicinity of the old Wanneroo Council rubbish dump through to Old Yanchep Road, disposal of any uncovered waste material and reinstatement of the trench shall be as directed by the Wanneroo Council.

2.1.12 Fuel and Chemical Storage

Potential Impacts

The following potential environmental impacts may result from fuel and chemical storage:

- Contamination of land and water, including ground water;
- Safety hazards to the workforce and the public; and
- Air and odour emissions.

Objective

Prevent contamination of land and water.

Management Measures

- The storage and handling of fuels and chemicals will comply with all relevant legislation and Australian Standards AS1940:1993 – The storage and handling of flammable and combustible materials.
- MSDS is maintained when purchasing chemicals and is available on site for all chemicals stored and handled.
- Fuels, lubricants and chemicals are stored and handled, where practicable, within containment facilities (eg bunded areas, leak proof trays) designed to prevent the release of spilt substances to the environment.
- Appropriate fuel and chemical handling procedures are adopted which aim to avoid spills to land and water.
- Appropriate spill response equipment, including containment and recovery equipment, is available on site.
- Refuelling will be undertaken from a self bunded mobile refuelling trailer that will be used to refill generators and other mobile plant and equipment on the project site.

- Seeding will be implemented where necessary using locally sourced seed, if available.
- Maintain the through flow, integrity of banks and vegetation on watercourses.

2.1.16 Commissioning

Potential Impacts

The following potential environmental impacts may result from pre-commissioning and commissioning activities:

- Creation of safety hazard by venting gas;
- Potential release of greenhouse gases;
- Noise associated with gas release.

Objectives

- Minimise the creation of safety hazards;
- Minimise atmospheric emissions;
- Minimise noise disturbance.

Management Measures

- The gas vents are located at appropriate distances from residential areas in accordance with regulatory and Australian Standard requirements.
- Purging or venting gas shall be conducted under favourable local meteorological conditions which facilitate rapid atmospheric dispersion of the gas.
- Pre-commissioning and commissioning activities will be conducted in accordance with the Commissioning Manual.

2.1.17 Social Management

Potential Impacts

Major Landholder and Third Party potential Impacts are:

- Spread of weeds;
- Depth of cover over the pipeline;
- Notification of required access to property; and
- Notification of major works.

Objectives

Avoid or minimise impact on local communities and landholders.

Management Measures

- Liaison with landholders shall be maintained on relevant Potential Impacts including stock management, fencing, use of access roads and any construction activities general safety and awareness Potential Impacts and landholder obligations.
- Consultation with relevant mining tenement holders will be undertaken on proposed mining activities.

Key Landholder and Third Party management actions are:

- Notify affected landholders when property access is required;
- Obtain a project release from each affected landholder and authority at the end of any major operational works.

2.2 MONITORING, ASSESSMENT AND REPORTING

2.2.1 Environmental Audits

Project environmental audits will be conducted at intervals based on the project schedule. Audit Objectives will be to assess the level of compliance with the Construction Environmental Management Plan. Audits will follow up on outstanding corrective actions, will assess for significant changes in agreed systems or procedures for environmental management and review records of significant incidents.

The scope of each audit will be to assess all construction and field activities for effective implementation of applicable statutes and the Construction Environmental Management Plan, including supporting procedures.

A documented Environmental Audit Protocol will be prepared prior to each audit. The Audit Protocol will address the key aspects of the Construction Environmental Management Plan.

A formal audit report will be submitted to the Project Manager within two weeks of the audit being conducted. A Corrective Action Request will be prepared and signed off by the Project Coordinator and the Lead Auditor at the audit closeout meeting. The Corrective Action Request will identify irregularities found during the audit and recommend suitable improvements. Each item on the Corrective Action Request will be closed-out and signed off within an agreed time frame.

The results of the Audit and Corrective Action Request will be communicated to the Health and Safety Representative and site personnel through Toolbox meetings.

2.3 REVIEW AND IMPROVEMENT

The CEMP will be reviewed when significant environmental hazards or incidents occur.

2.4 TRAINING, INDUCTION AND ENVIRONMENTAL AWARENESS

There is a requirement that all personnel, contractors and sub-contractors be provided with induction training prior to commencement of work. This induction program covers all relevant environmental potential impacts pertaining to the work activity which they will be involved.

2.5 INCIDENT REPORTING

All environmental incidents will be reported in the first instance to the Construction Manager. All incidents are to be reported immediately once any first response actions have been undertaken. This information is to be forwarded to the NewGen Power Project Manager who will be responsible for reporting all environmental incidents to the DoIR as the responsible Designated Authority for the project.

All incidents will be reported in accordance with Part II Division 4 – Reporting of the *Schedule of Onshore Petroleum Exploration and Production Requirements 1991*. See Appendix A.

All incidents will be recorded in the Project Incident/Hazard database and the Project Hazard Register. Where required an investigation will be undertaken to determine the route cause of the incident and to determine if additional control measures are required.

Where an incident has occurred that requires an emergency response, the Construction Manager will coordinate the on scene response as per the Project Emergency Response Plan.

2.5.1 Accident/Incident Investigation

An incident investigation must be carried out and Incident Report initiated for all first aid or medical treatment injuries by the employees supervisor.

Any incident requiring submission of a report to a Statutory Authority will be investigated by a suitably qualified investigation team nominated by the Construction Manager who will develop terms of reference and the composition of the investigating team.

In the event of a serious injury, or serious incident, written signed and dated statements will be recorded as soon as practicable. The original copy of any statement will be attached to the original Incident Report and duplicate copies distributed as appropriate.

Unless a significant hazard exists, the scene of any serious injury or incident will not be disturbed until all evidence drawings, photographs etc have been prepared or taken and necessary details have been accurately recorded.

In the event of a serious incident, unless a significant hazard continues to exists, the scene will remain undisturbed until authorisation has been received from the Project/Construction Manager in consultation with the Government Authority and in the case of a fatality, the police.

The Construction Manager will ensure investigation forms are accurately completed and closed out and involved employees have been informed. Consultation will be through Toolbox Talk or Individual Consultation with the HS&E Officer as appropriate.

2.6 REFERENCES

APIA Environmental Code of Conduct

3 ENVIRONMENTAL PERFORMANCE INDICATORS

Environment	Project Target	Project Actual
Number of Environmental Hazards Reported	**0**	
Number of Environmental Near Misses	**0**	
Number of Environmental Incidents	**0**	
Number of Spills	**0**	
Percentage of (Weekly) Site Environmental Inspections completed on time *(Number of documented weekly site inspections over number of project site activity weeks as %)*	**100%**	
Percentage of contractor / subcontractor employees attending Project HS&E Inductions *(Number of documented site induction records over number of personnel engaged on project site including visitors as %)*	**100%**	
Number of HS&E Toolbox Talks/Team Briefs conducted *(Documented weekly Toolbox meetings over number of project site activity weeks as %)*	**100%**	
Percentage of Project Progress Meetings where HS&E issues are actively addressed on Agenda *(Number of documented project progress meetings over number of project site activity weeks as %)*	**100%**	

Appendix A - Environmental Aspects of Part II, Division 4 Schedule of Onshore Petroleum Exploration and Production requirements 1991

DIVISION 4 - Reporting	
S287	**Reporting Serious Damage**
	(1) In this clause and clauses 288 and 289 a reference to serious damage to property is a reference to - (a) the loss or destruction of property with a value exceeding $20,000; (b) damage to property, the repair of which damage would cost an amount exceeding $20,000; and (c) the loss or destruction of any property, or any damage to property, by reason of which any person dies or suffers serious injury. (2) Where serious damage to property occurs - (a) a report of each occurrence shall forthwith be made to an Inspector; and (b) a report in writing of such occurrence shall be submitted to the Director as soon as practicable specifying - (i) the date, time and place of such occurrence; (ii) particulars of the damage; (iii) the events so far as they are known or suspected that caused or contributed to the occurrence; (iv) particulars of repairs carried out or proposed to be carried out to damaged property; and (v) measures taken, or to be taken, to prevent a possible recurrence.
S288	**Reporting a Potentially Hazardous Event**
	Where an event occurs which is not in the normal or ordinary course of a particular operation and which is professionally considered to be likely to cause injury to a person or serious damage to property, but such event does not cause injury or serious damage - (a) a report of the event shall forthwith be made to an Inspector; and (b) a report in writing of the event shall be submitted to the Director as soon as practicable specifying measures taken or to be taken to prevent a possible recurrence.

S289	**Reporting Damage Less Than $20,000**
	Where damage to property occurs which is not serious damage to property but which result is a significant loss of structural integrity or load bearing capacity in the property damaged or results in some other significant unsafe condition - (a) a report of the damage shall forthwith be made to an Inspector; and (b) a report in writing of the damage shall be submitted to the Director as soon as practicable specifying measures taken or to be taken to prevent a possible recurrence.
S290	**Reporting Escape or Ignition of Petroleum and Other Material**
	(1) A report shall forthwith be made to an Inspector upon the occurrence of - (a) a significant spillage of hydrocarbons which in areas of inland waters is in excess of 80 litres and in other areas is in excess of 500 litres. A significant quantity of petroleum in a gaseous form is in excess of 500 m3. (b) any uncontrolled escape or ignition of petroleum or any other flammable or combustible material causing a potentially hazardous situation. (2) A report in writing of any occurrence referred to in sub-clause (1) shall be submitted to the Director as soon as practicable after the occurrence specifying - (a) the date, time and place of the occurrence; (b) the estimated quantity of liquid that escaped or burned; (c) particulars of damage caused by the escape of ignition; (d) the events so far as they are known or suspected that caused or contributed to the escape or ignition; (e) particulars of methods used to control the escape or ignition; (f) particulars of methods used or proposed to be used to repair property damaged by the escape or ignition; and (g) measures taken, or to be taken, to prevent a possible recurrence of the escape or ignition.
S291	**Reporting of Emergencies**
	Any emergency shall be reported forthwith to an Inspector.
S292	**Reporting Radiation Monitoring**
	Where, as a requirement of any relevant legislation relating to radiation control, a report is prepared in respect of the monitoring of radiation in connection with petroleum operations, a copy of that report shall be sent to the Director as soon as practicable.

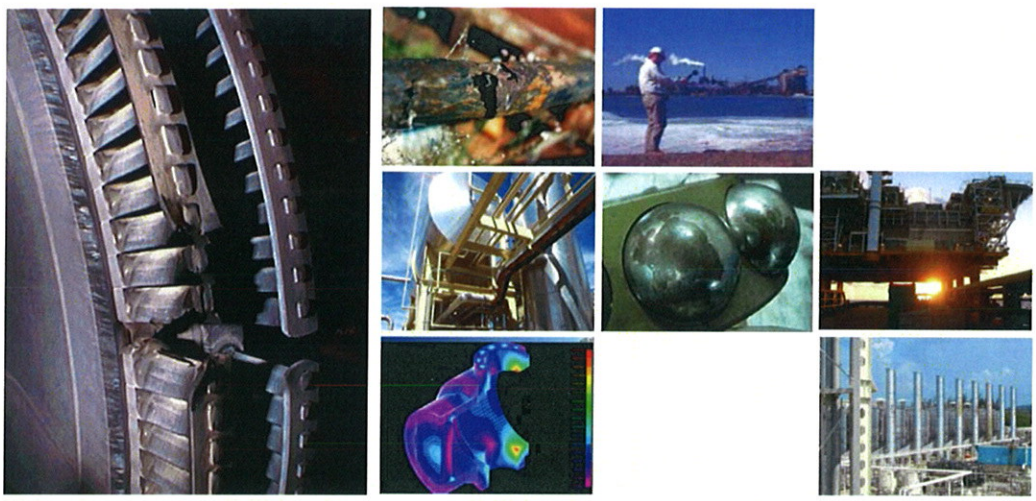
APPENDIX C

SVT Engineering Consultants

Environmental Noise Impact Assessment of the Proposed 330 MW Gas-Fired Power Station June 2007

ENGINEERING CONSULTANTS

ENVIRONMENTAL NOISE IMPACT ASSESSMENT OF THE PROPOSED NEWGEN 330MW POWER STATION



ERM & NEWGEN POWER

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1.0	Update Drawings	Alessandro Ghiotto	Paul Keswick	19-Jul-07
B	Updated Power Station and Compressor Station	Alessandro Ghiotto	Jim McLoughlin	18-Jul-2007
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EXECUTIVE SUMMARY

SVT has undertaken an environmental noise assessment of the proposed gas fired power station and compression station to be located at Neerabup, WA.

Noise Modelling Results

Noise modelling of the power station has been undertaken based on the noise level estimates of the Peaker Project NewGen 330 MW Gas Turbine Power Station, including two 165 MW Gas generator turbines and two 35 m exhaust stacks.

Noise modelling has also been undertaken for the proposed compression station. The noise output estimates for the compression station have been derived from ERM data obtained from Enerflex.

The model output indicates that in worst case sound propagation conditions the noise emissions from the proposed power station and compression station will be 47.3 dB(A) at the nearest commercial premises and 28.9 dB(A) at the nearest residential location.

Compliance Review

When undertaking a compliance review of the power station, it has been assumed that noise emission from the plant will be a significant contributor of noise along with other industries in the study area, and hence the target noise level for achieving compliance has been set at 5 dB(A) below the allowable assigned noise levels under the *Environmental Protection (Noise) Regulations 1997*, at 60 dB(A) for commercial premises and 30 dB(A) for residential properties.

The noise levels from the NewGen 330MW Power Station and compressor station are shown to be compliant with the *Environmental Protection (Noise) Regulations 1997*.

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1. INTRODUCTION

SVT were commissioned by ERM Power and NewGen Power to undertake an Environmental Noise Impact Assessment of the proposed Power Station and Compressor Station near Neerabup, WA.

This study is based on the plant design as of May 2007.

1.1 Scope of Work

The following outlines the major activities undertaken during the course of the study:

- Review of documentation provided by ERM Power including site plans, equipment lists, and topographical data;
- Calculation of noise levels at the nearest commercial and noise sensitive locations for the worst case meteorological conditions;
- Assessment of noise emissions from the plant for compliance with noise limits imposed under the Environmental Protection (Noise) Regulations 1997 at the nearest commercial and noise sensitive locations;
- Inspection of the site and undertaking of spot measurements of existing noise levels in the area; and,
- Assessment of noise contribution from the main noise sources (the power station exhaust stacks) and recommendation on the level of noise reductions required to satisfy the compliance standards.

1.2 Brief Description of Facility

The proposed NewGen 330 MW power station consists of two 165 MW gas-fired generator turbines and utilises two 35 m exhaust stacks. The proposed site is located approximately 1.8 km North-East of the Neerabup Industrial area, Western Australia.

The layout of the proposed power station is shown in Figure A 2, in Appendix A.

2. METHODOLOGY

An acoustic model of the power station has been developed and used to calculate noise levels at the plant boundaries and nearby residences for typical operating scenarios and meteorological conditions.

Field data from noise logging equipment that has been deployed at nearby residences has been used to determine the current ambient noise levels and a variety of meteorological conditions.

3. NOISE MODELLING

An acoustic model has been developed using the SoundPlan noise modelling software. The SoundPlan software is widely used for acoustic propagation modelling throughout the world and is approved by the Environmental Protection Authority (EPA) for the purposes of environmental noise modelling. The SoundPlan program calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. The inputs required are noise source data, ground topographical data, meteorological data and receiver locations.

The model includes noise emissions from the proposed power station and compression station. Cumulative noise emissions from road traffic, rail, aircraft, domestic sources, entertainment, and other industrial sources are accounted for in accordance with the *Environmental Protection (Noise) Regulations 1997* by using the assigned noise level methodology described in Section 6.1.

3.1 Modelling Scenarios

Two noise modelling scenarios have been investigated: one for the proposed power station, and one for the proposed compressor station associated with the power station.

Noise modelling has been predicted for the worst case meteorological conditions, as defined by the *EPA draft guidance Note No 8*, with the plant operating under normal conditions.

3.2 Input Data

3.2.1 Noise Sources – Power Station

The major noise source contributors from the proposed power station are based on the estimated sound power levels for the Peaker Project NewGen 330 MW gas-fired power station. The estimated sound power levels of the major noise components are included in 7.2Appendix B :

Directivity of the exhaust stacks has been modelled as per the Noise Prediction Guidelines for Industrial Gas Turbines[1]. Walls (2 m high reflective barriers) have been incorporated to reduce the noise from each transformer, and a 2 m reflective barrier also surrounds the Gas Metering and Gas Pressure reducing station. The reflectivity of these walls have been set to 0.1.

Barrier effects of individual power station components has been incorporated by nominating only the relevant building facades and component planes as sources.

3.2.2 Noise Sources - Compressor Station

The major noise source contributors from the proposed compressor station here are based on ERM data obtained from Enerflex for the proposed compressor station. One compressor station, with sources as defined in Table 3-1, has been included in the acoustic model.

[1] *"Noise Prediction Guidelines for Industrial Gas Turbines"*, Solar Turbines Inc, 2004

Table 3-1 : Sound Power Levels for the Proposed Compressor Station

Description	Octave Band dB (Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	O/A dB(A)
Compression Station - total	65.1	115.2	111.1	106.9	105.4	103.5	102.8	103.5	102.6	110.7
Compressor House	64.5	115.0	110.9	106.7	105.1	102.8	102.1	102.8	101.9	110.0
Exhaust	50.4	100.9	96.8	92.6	91.0	88.7	88.0	88.7	87.8	95.9
Engine Radiator Fans	53.7	86.5	78.4	79.2	84.6	89.3	88.6	89.3	88.4	95.5
Process Piping	39.4	76.2	68.1	68.9	74.3	79.0	78.3	79.0	78.1	85.2
Control Valve	47.4	90.2	82.1	82.9	88.3	93.0	92.3	93.0	92.1	99.2

3.2.3 Meteorological Conditions

For the noise modelling SVT has used the worst case meteorological conditions suggested by the EPA (*Environmental Protection Act 1986*) Guidance note No 8 for assessing noise impact from new developments as the upper limit of the meteorological conditions investigated. These conditions are presented in Table 3-2.

Table 3-2: EPA Default Worst-Case Meteorological Conditions

Parameter	Day (0700 – 1900)	Eve / Night (1900 – 0700)
Wind Speed	4 m/s	3 m/s
Temperature inversion rate	Nil	2 °C/100m
Temperature	20 °C	15 °C
Relative humidity	50 %	50 %

4. RESULTS

4.1 Noise modelling results

4.1.1 Power station noise modelling results

A summary of the predicted L_{A10} noise levels due to proposed power station emissions at the nearest noise sensitive receivers for the worst-case scenario is presented below in Table 4-1. Positions R1 to R11 are representative of the nearest residences to the proposed power station

The extent of the affected area due to the predicted noise emissions of the proposed power station and the locations of the nearest residences is shown in Figure 4-1.

Table 4-1 Expected Levels at the nearest noise sensitive receivers. Positions as marked in Figure 4-1

Receiver	Expected L_{A10} Noise Level, dB(A)
R1	21.1
R2	17.6
R3	25.0
R4	27.2
R5	24.2
R6	47.3
R7	25.5
R8	28.9
R9	27.9
R10	23.9
R11	19.7

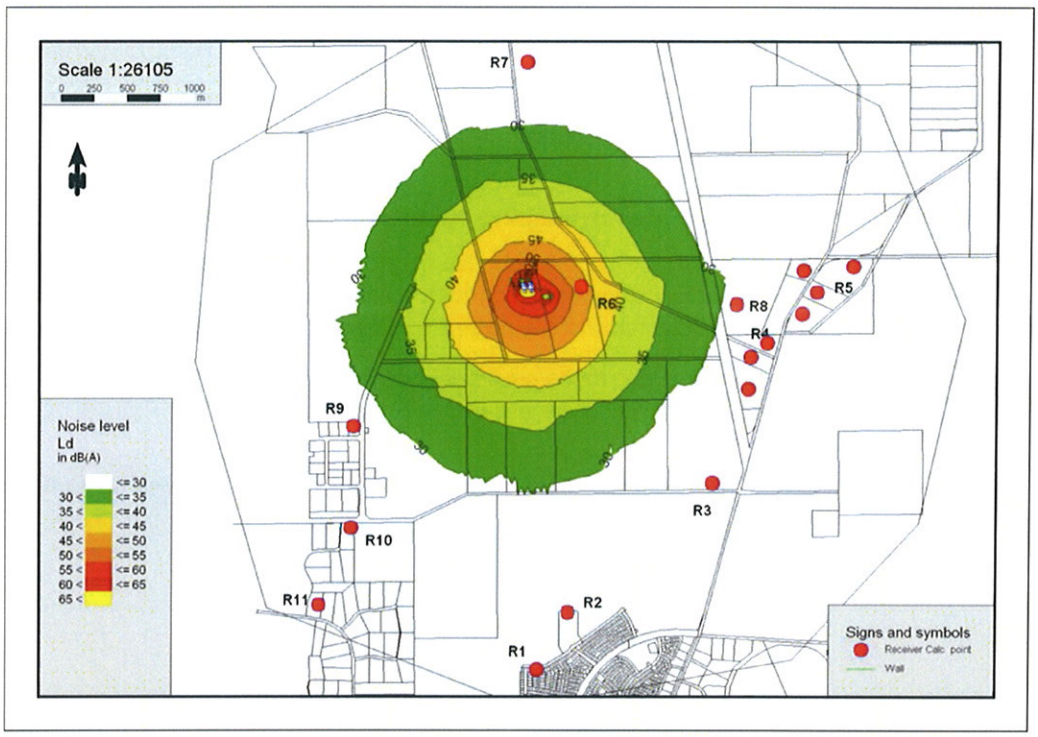

Figure 4-1 Predicted extent of noise affected area due to the proposed power station (worst case)

In Figure 4-1, the noise sensitive receivers closest to the power station are marked including points R1 to R11, for which the applicable *Environmental Protection Regulations 1997* limit is 30 dB(A). The residential location that has potential to be most affected by the proposed power station is R8, where the predicted level is 28.9 dB(A).

Receiver R6 represents commercial premises for which the applicable *Environmental Protection Regulations 1997* limit is 60 dB(A). The expected noise level at R6 due to the proposed power station is 47.3 dB(A).

4.1.2 Compression station noise modelling results

A summary of the predicted noise levels due to the proposed compression station emissions at the nearest noise sensitive receivers for the worst-case scenario is presented below in Table 4-2. Positions R12 and R13 represent the nearest residences to the proposed compression station.

Table 4-2 Expected Levels at the nearest noise sensitive receivers

Receiver	Expected Level dB(A)
R12	21.3
R13	25.6

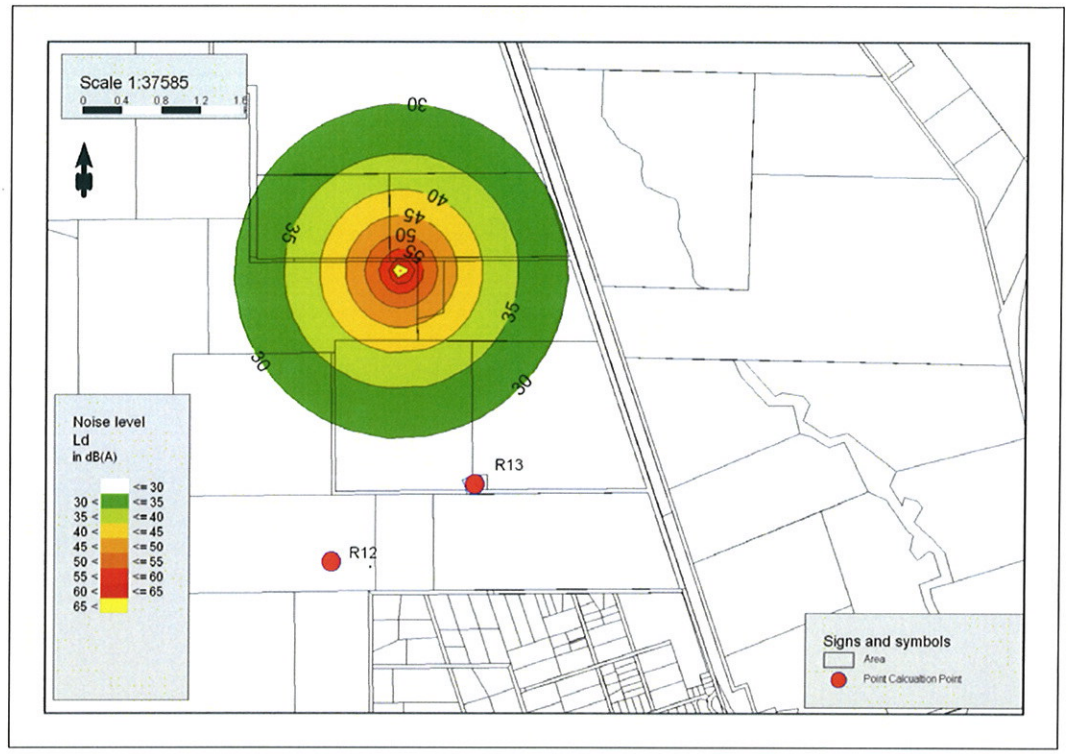

Figure 4-2: Predicted extent of noise affected area due to the proposed compression station (worst case)

Figure 4-2 shows the noise sensitive receivers closest to the proposed compression station, marked as points R12 and R13. At both of these receiver points the expected worst case noise level is less than 30 dB(A).

5. BASELINE AMBIENT NOISE MEASUREMENT RESULTS

The following plots show the ambient noise levels measured at receiver location R2, which was approximately 20 m away from the rear fence of the local primary school.

Daytime (L_{10}) levels were generally between 50 and 60 dB(A), and night (L_{10}) levels were typically around 25 dB(A). The monitoring data collected suggests that the inputs to the model scenarios are reasonable and do not need to be modified.

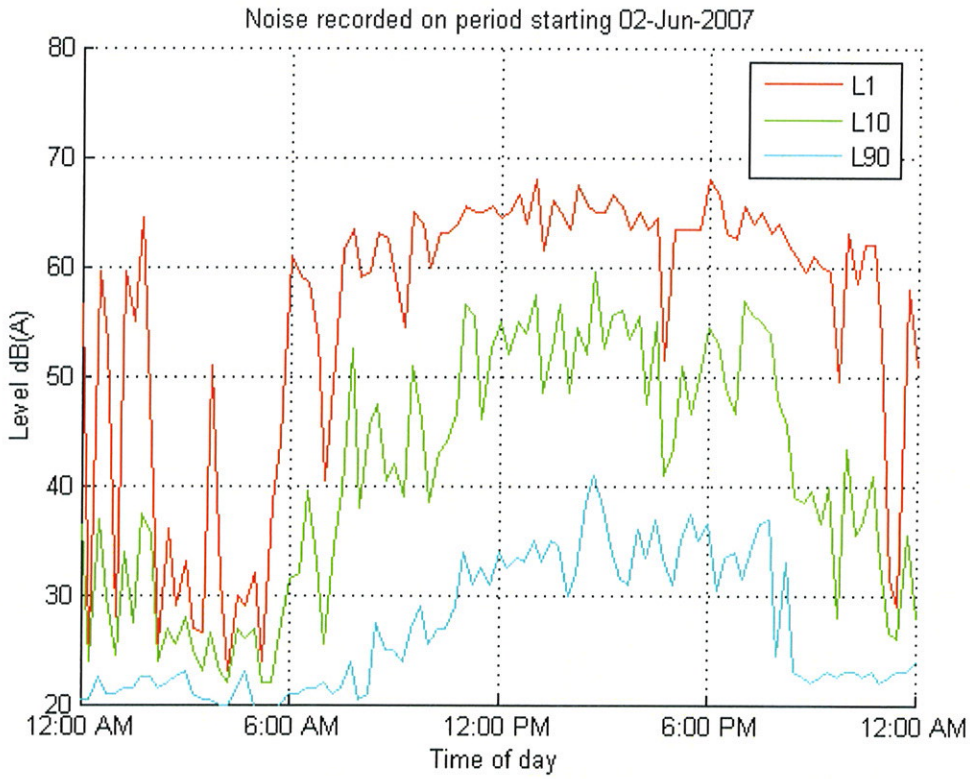

Figure 5-1: Ambient noise levels for a 24 hour period at receiver location R2.

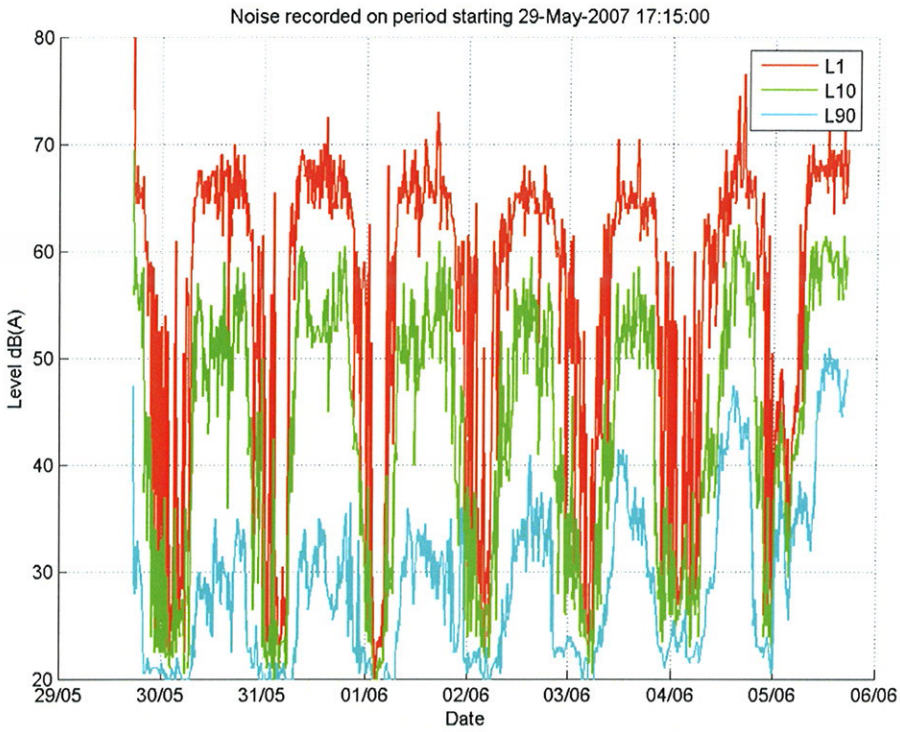

Figure 5-2: Ambient noise levels over a 1 week period at receiver location R2.

Figure 5-2 shows the ambient noise levels recorded at receiver location R2, for 1 week commencing on the 29-May 2007.

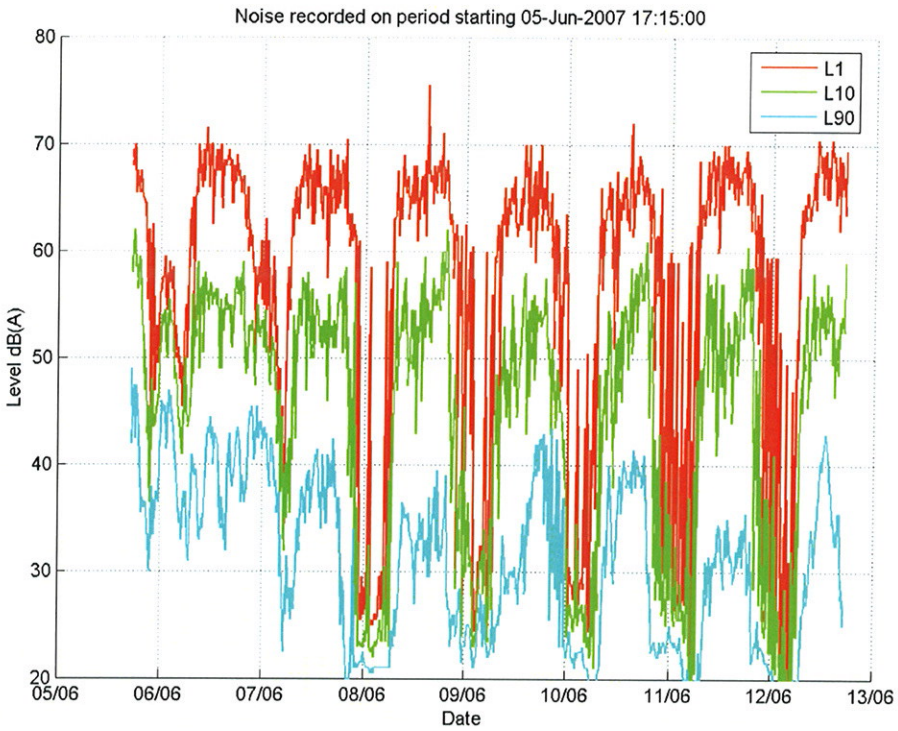

Figure 5-3: Ambient noise levels over a 1 week period at receiver location R2.

Figure 5-3 shows the ambient noise levels recorded at receiver location R2, for 1 week commencing on the 5-June 2007.

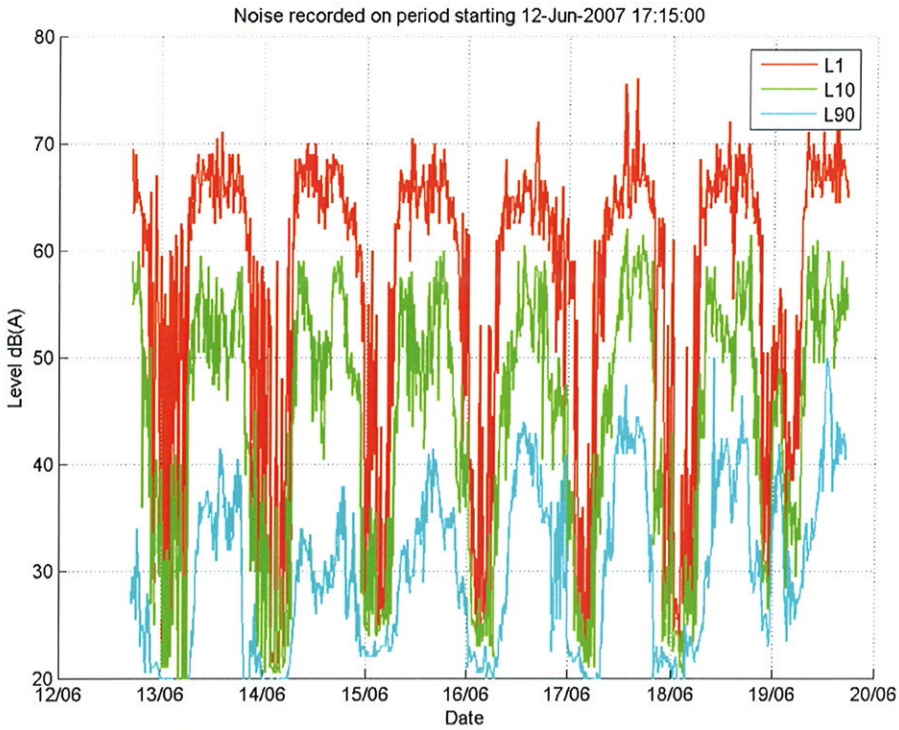

Figure 5-4: Ambient noise levels over a 1 week period at receiver location R2.

Figure 5-4 shows the ambient noise levels recorded at receiver location R2, for 1 week commencing on the 12-June 2007.

6. ENVIRONMENTAL NOISE IMPACT ASSESSMENT

6.1 Assigned Noise Levels

Table 6-1, reproduced from the *Environmental Protection (Noise) Regulations 1997* shows the allowed noise emission levels, as measured at a noise sensitive receiver.

However, the *Environmental Protection (Noise) Regulations 1997, part 2* regulation 7 subregulation (2) states,

*"For the purpose of subregulation (1) (a), a noise emission is taken to "**significantly contribute to**" a level of noise if the noise emission as determined under subregulation (3) exceeds a value which is 5 dB below the assigned noise level at the point of reception."*

The location in which the power station is proposed to be situated already contains significant noise sources, therefore, the assigned level which cannot be exceeded at the nearest residential location is 5 dB less than the lowest value in bold type in Table 6-1. I.e., the limit is 30 dB(A).

Table 6-1 Environmental Protection (Noise) Regulations 1997 Assigned Noise Levels

Type of premises receiving noise	Time of day	Assigned Level dB(A)		
		LA 10	LA 1	LA max
Noise sensitive premises at locations within 15 metres of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45+ IF	55+ IF	65+ IF
	0900 to 1900 hours Sundays and public holidays	40+ IF	50+ IF	65+ IF
	1900 to 2200 hours all days	40+ IF	50+ IF	55+ IF
	22 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	**35+ IF**	**45+ IF**	**55+ IF**
Noise sensitive premises at locations further than 15 metres from a building directly associated with a noise sensitive use	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

6.2 Compliance Assessment for normal operations

The results presented in this report are based on power station sound power levels as indicated in 7.2Appendix B : , and with two units running at full operation continuously. The predicted levels at all nearby residential locations is below 30 dB(A) and the noise level at the nearest commercial

premises is below 60 dB(A) and therefore compliant with *Environmental Protection (Noise) Regulations 1997.*

SVT believes that tonality will not be evident at the closest residences of interest because the noise emission from the proposed Power station is very low. However, to ensure that the station remains free of tonal noise emission, SVT is working with NewGen Power and the power station designers to remove to remove all of its tonal noise components at critical receiving locations, eg noise sensitive premises and the boundary of the station.

6.2.1 Compliance Assessment for Abnormal operation

Noise from emergency gas venting could result in excessive noise levels at both the site boundary and at the nearest residences unless adequate noise controls are put in place (ie vent silencers need to be installed on the gas venting system). However, at this stage of the review details of the venting system are not available. To ensure that noise emission from the site complies with the *Environmental Protection (Noise) Regulations 1997* LA_{max} level, it is recommended that a low noise vent silencer should be fitted to any emergency vents installed on either the power station or compressor station, with their sound powers restricted to 126 dB(A) for the power station, and 123 dB(A) for the compressor station.

7. CONSTRUCTION NOISE

As part of the construction of the power station, gas pipe line and compressor station, all construction noise emission needs to comply with clause 13 of the *Environmental Protection Noise Regulations 1997* which addresses the requirements for construction noise control and emission.

The Environmental Protection Noise Regulations 1997 (as amended) stipulates requirements for construction noise. These Regulations state that:

For construction work carried out between 7am and 7pm on any day, which is not a Sunday or public holiday:

- The construction work must be carried out in accordance with control of noise practices set out in Section 6 of *Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites*;
- The equipment used for the construction must be the quietest reasonably available; and
- The Chief Executive Officer (CEO) may request that a noise management plan be submitted for the construction work at any time.

For construction work done outside these hours:

- The construction work must be carried out in accordance with control of noise practices set out in Section 6 of *Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites*;
- The equipment used for the construction must be the quietest reasonably available;
- The contractor must advise all nearby occupants or other sensitive receptors who are likely to receive noise levels which fail to comply with the standard under Regulation 7, of the work to be done at least 24 hours before it commences;
- The contractor must show that it was reasonably necessary for the work to be done out of hours; and
- The contractor must submit to the CEO a Noise Management Plan at least seven days before the work starts, and the plan must be approved by the CEO. The plan must include details of:
    - Need for the work to be done out of hours;
    - Types of activities which could be noisy;
    - Predictions of the noise levels;
    - Control measures for noise and vibration;
    - Procedures to be adopted for monitoring noise emissions; and
    - Complaint response procedures to be adopted.

7.1 Noise control measures

To control noise emission from the construction activities the following measures should be undertaken.

The construction work will be carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites.

The following lists particular details that should be considered:

- An induction program covering noise management should be given to all site personnel.
- Where practicable, particularly noisy activities should be scheduled for times that will cause least annoyance i.e. during daylight hours.
- Plant items should be correctly maintained to manufacturer's specifications.
- Equipment should be subject to regular maintenance. This should include ensuring all noise control equipment is correctly fitted and operating at design performance.
- All noisy areas should be clearly identified as such.
- Noise checks should be undertaken on all machinery where practicable prior to mobilisation.
- Powered machines and combustion engines should be switched off and/or their speed reduced wherever possible.
- Noise screen walls should be set up around stationary workplaces for grinding and adjusting work, where practicable.
- Ensure existing noise protection hoods are not removed from machines and vehicles.
- Silencers and exhaust mufflers should be used on all equipment, so that noise levels are less than 85 dB(A) at 1 metre from the item.
- Acoustic enclosures should be located over compressors and generators so that noise levels are less than 80 dB(A) at 1 metre from the enclosure.
- Equipment used for the construction works should be the quietest reasonably available.
- Any unduly noisy item should be repaired, modified or replaced with a quieter item.
- All vehicles will follow approved haul routes off-site and on-site to minimise noise impacts.

7.2 Noise monitoring and complaints

It is not anticipated that monitoring of the construction noise levels would be required.

Provision should be made for the project's environmental officer to review and log all complaints lodged with the company. Where a complaint is made then all complaints should be logged and responded to in a manner satisfactory to the regulatory bodies.

Repeated complaints would be investigated through noise monitoring, and a report should be prepared to address the extent of any impacts and a range of practical and feasible mitigation measures that should be adopted.

APPENDIX A : PLANT LOCATION AND LAYOUT MAPS

Appendix A-1 : Proposed Power Station Location

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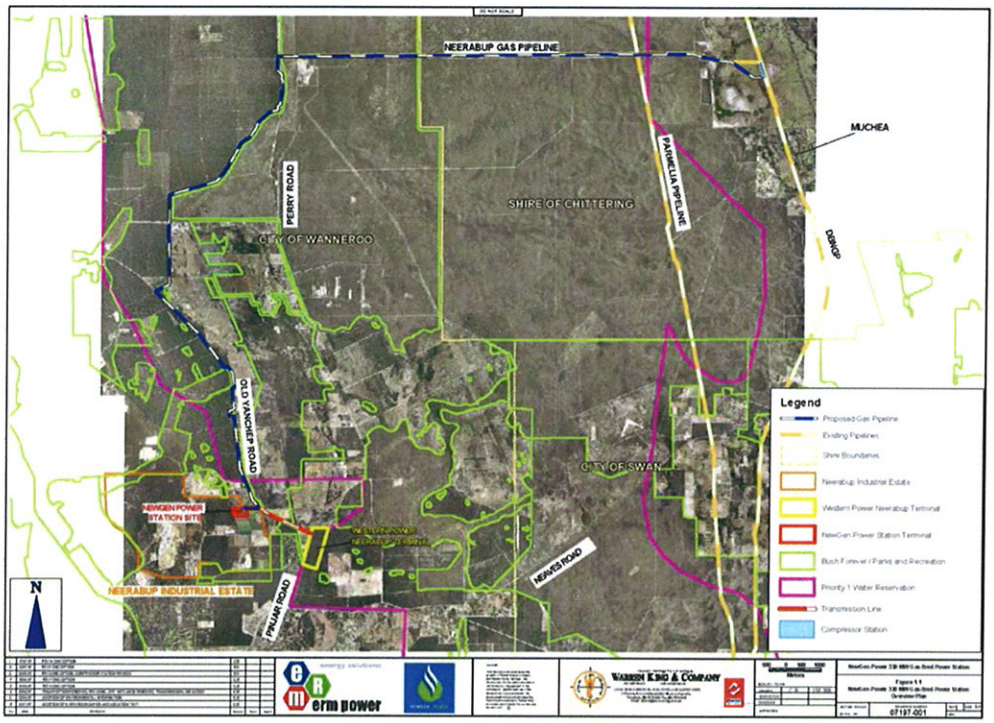


Figure A 1: The location of the proposed power station project area

Appendix A-2 : Power Station Layout and sources – as modelled

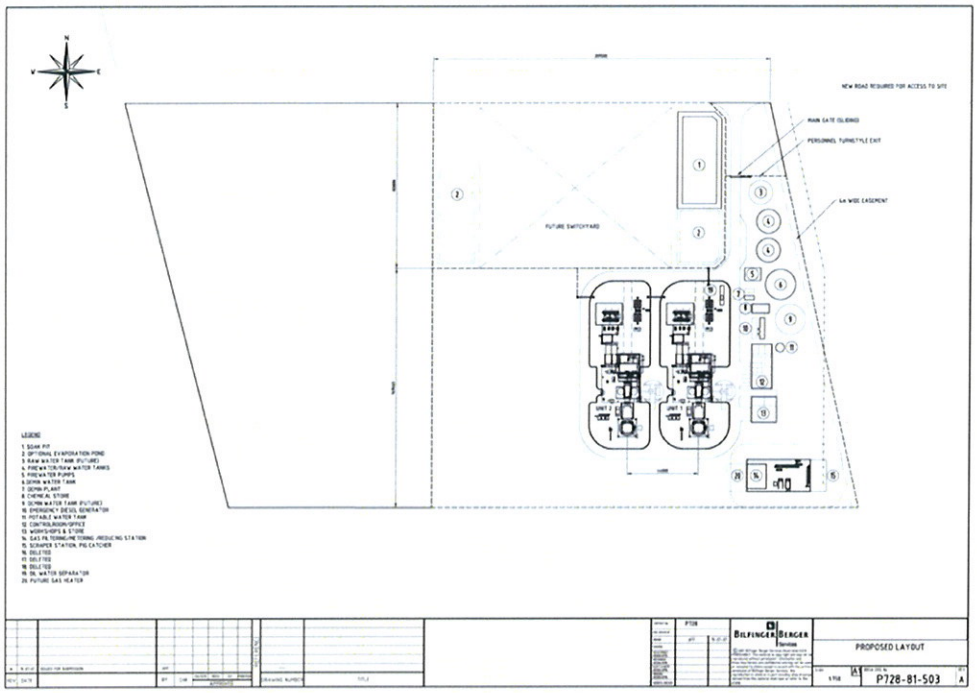


Figure A 2: Power Station layout.

Appendix A-3 : Compressor Station Layout

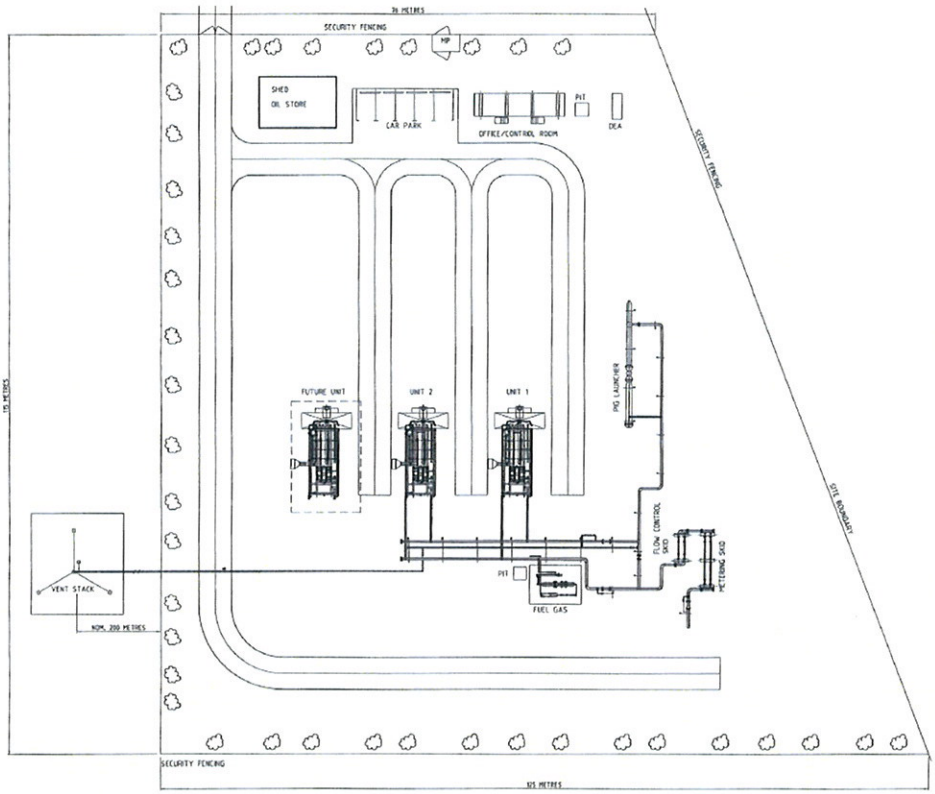


Figure A 3: Compressor Station layout. One compressor only is active at any time.

APPENDIX B : POWER STATION NOISE SOURCES

Source Number	Description	Octave Band Center Frequency, Hz									
		31.5	63	125	250	500	1000	2000	4000	8000	O/A dB(A)
1	Exhaust Stack - With Absorption Silencer - Each	129	123	105	99	98	95	93	96	101	105
2	Fin Fan Coolers - Low Noise Design - Each Gas Turbine	109	98	101	98	95	84	89	84	82	98
3	Dif fuser with Acoustical Enclosure - Each	87	83	89	92	83	84	95	85	79	97
4	Transformers - Standard design LV, MV, & Excitation and Low Noise Design GSU	100	109	110	102	95	90	85	77	71	99
5	Inlet Air Filterhouse - with Absorption Silencer- Each Gas Turbine	111	100	90	79	76	82	89	89	88	95

Source Number	Description	Octave Band Center Frequency, Hz									
		31.5	63	125	250	500	1000	2000	4000	8000	O/A dB(A)
6	Gas Turbine Building - UMB - Each - BBS Responsibility	119	105	97	79	70	61	55	45	41	85
7	Gas Turbine Building Ventilation - UMB - BBS Responsibility	109	107	103	88	79	68	70	72	71	89
8	Power Control Center - Each	75	76	77	79	79	78	73	71	65	82
9	Fuel Gas Metering Station - Low Noise Design - Each	76	79	84	84	85	88	89	92	82	96
10	Unidentified Sound Sources	97	94	94	95	93	91	90	89	85	97
11	Fuel Gas Pressure Reducing Station - with BBS Provided Building	87	90	90	91	93	94	97	98	94	103

Source Number	Description	Octave Band Center Frequency, Hz									
		31.5	63	125	250	500	1000	2000	4000	8000	O/A dB(A)
12	Fuel Oil Forwarding Pumps	79	90	98	97	96	94	91	89	80	99

APPENDIX D

Stuart Fisher Research
And
Eureka Consulting

Cultural Heritage Surveys

22nd May 2007

Tony Petersen
Environment Manager
ERM Power and NewGen Power
Level 4, 225 St George's Terrace
Perth, WA 6850

Dear Mr Petersen,

As you are aware, an Archaeological Work Program Clearance survey of the proposed ONC Option Pipeline route situated in Neerabup was undertaken by Ian Ryan and Viviene Brown of Eureka Archaeological Research and Consulting UWA, and four representatives (Peter Wilkes, Lynley Wilkes, Vanessa Corunna and Trina Corunna) of the Combined Metropolitan Working Group on the 22nd of May 2007.

The proposed ONC Option Pipeline route is approximately 16 km long and extends north from the proposed Neerabup Power Station paralleling Old Yanchep Road, Nisa Road and Cypress Road before joining with a previously surveyed section of the proposed Perry Road Option Pipeline route (Table 1, Map 1). The route is predominantly located within the State Forrest Pine Plantation Reserves and has been heavily disturbed by the development and maintenance of the plantations. What little original vegetation remains along the route is dominated by Melaleuca and Banksia scrub and dense coastal heath sitting on top of sandy Bassendean Plain soils. Ground surface visibility along the surveyed route was very low ranging from no visibility to 20%.

Table 1. GPS Co-ordinates for the proposed ONC Option Pipeline route.

MGA 94, Zone 50	
mE	mN
386891	6495566
386362	6496459
386233	6497505
386087	6498510
385896	6499494
385263	6500272
384494	6501120
384308	6501426
384302	6503118
384269	6504121
385638	6504879
386166	6505684
387439	6507293
387304	6508281
387744	6508327
387329	6508348

The proposed ONC Option Pipeline route was inspected for archaeological materials by the survey team walking a series of transects 10 – 20 m apart and 1 km in length. In total approximately 40% of the surface area of the proposed ONC Option Pipeline route was inspected.

No archaeological sites or isolated artefactual materials were identified during the survey.

Following discussion with Aboriginal representatives it is **recommended** that

1. The construction of ONC Option Pipeline route will not impact on any archaeological sites or materials.
2. There is therefore, no archaeological reason why NewGen should not develop the proposed pipeline route as planned.
3. NewGen engage relevant Aboriginal monitors during any ground disturbing activity conducted during the ONC Option Pipeline development.

Please accept this letter as advice of the results of the archaeological survey of NewGen's proposed Neerabup Power Station ONC Option Pipeline route located in Neerabup, Western Australia. A full report detailing the methods and results of the survey can be provided if required.

Yours Sincerely,

Ian Ryan

Archaeologist

Eureka Archaeological Research and Consulting UWA

Archaeology M405

The University of Western Australia

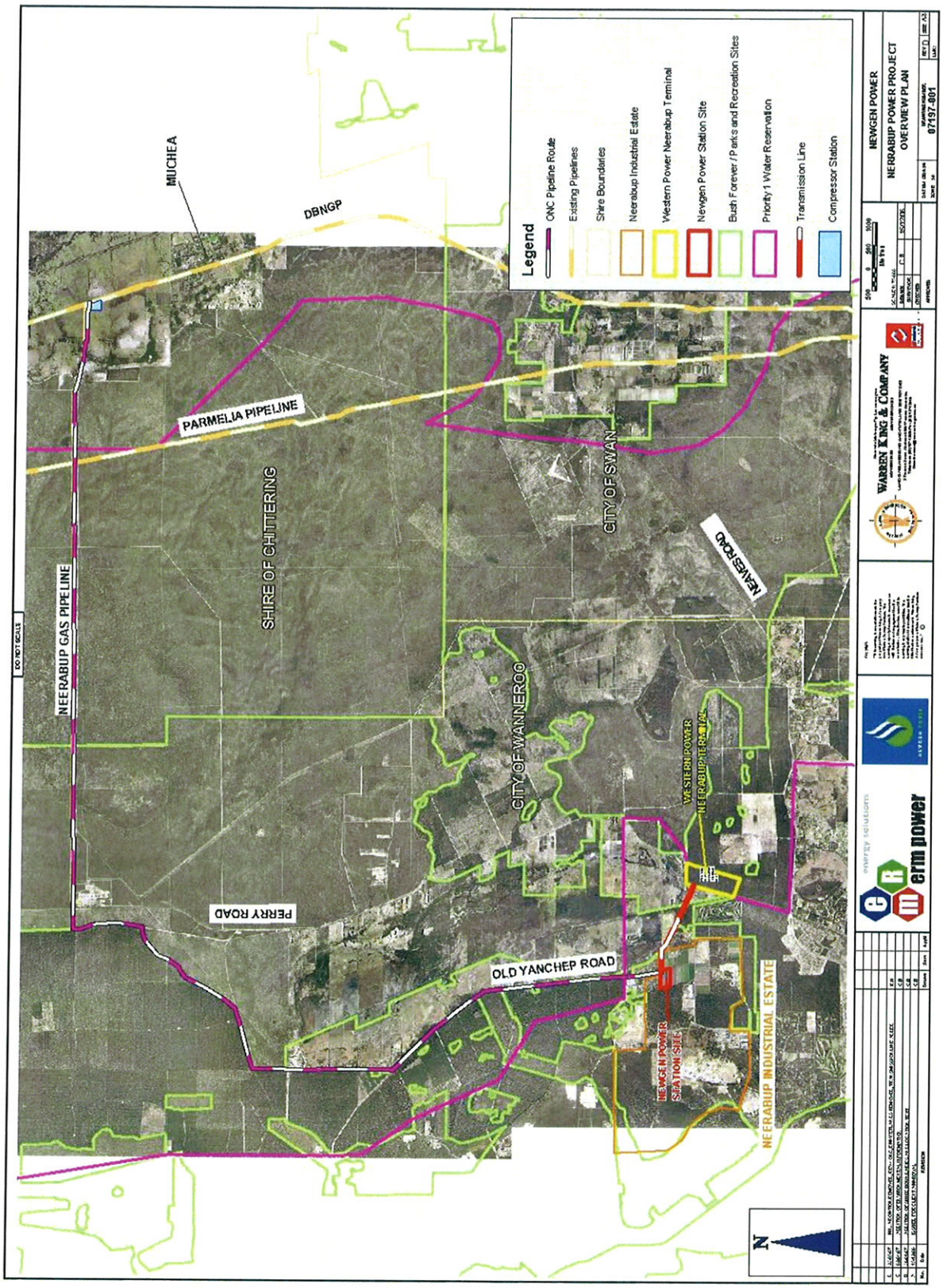
35 Stirling Highway

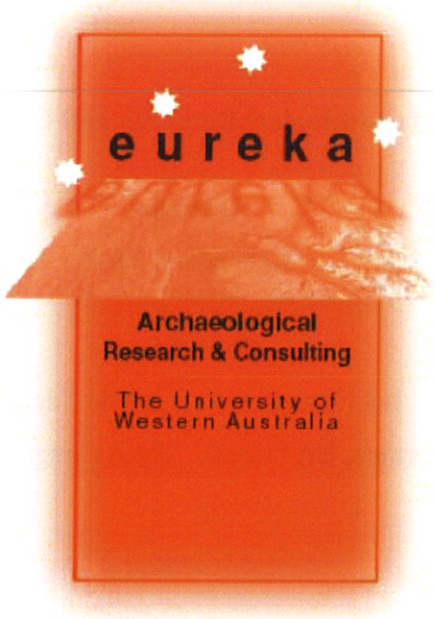
CRAWLEY, WA 6009

Ph: (08) 6488 3947

Fax: (08) 6488 1023

Map 1 The proposed ONC Option Pipeline route





Report

on the Results of an
Archaeological Work Program Clearance Survey of
the

Proposed NewGen Power Station Project, Neerabup, Western Australia

for

NewGen Power Pty Ltd

April 2007

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THE UNIVERSITY OF WESTERN AUSTRALIA

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Geographic Co-ordinate Information

Geographic co-ordinates in this report were obtained using a hand-held Garmin Global Positioning System device. The manufacturer states that these devices are accurate to within 15 m on average.

Geographic co-ordinates in this report are based on the WGS84 Coordinate system.

Disclaimer

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INTRODUCTION

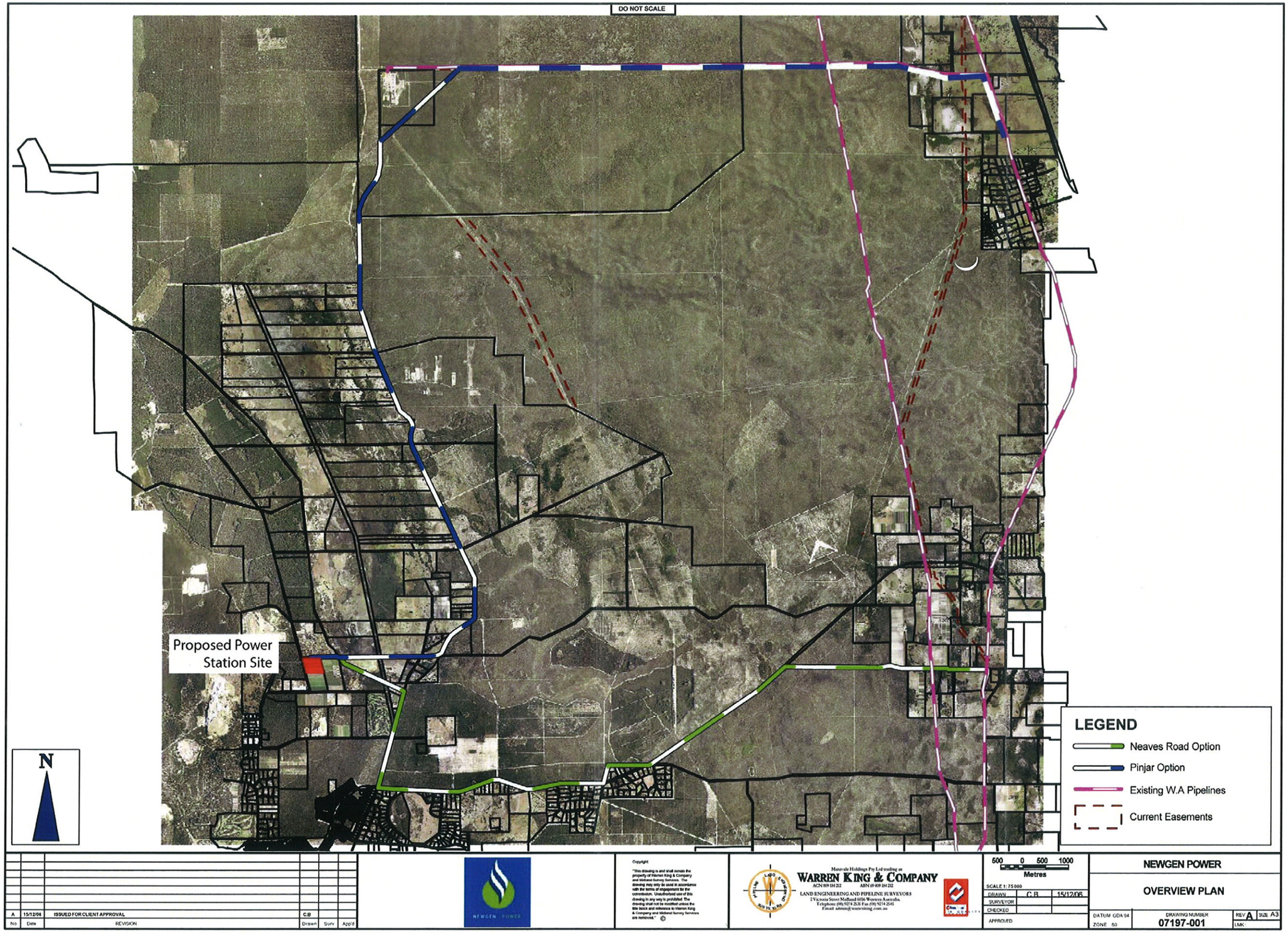
This report presents the results of an Aboriginal archaeological Work Program Clearance survey of the proposed Neerabup Power Station Project Area located in Neerabup, approximately 36 km north of the Perth CBD in Western Australia. NewGen Power Pty Ltd (NewGen) proposes to construct a gas-fired power station in the Neerabup Industrial Estate area, and one of two possible pipelines linking the station to the existing Dampier-Bunbury pipeline (Map 1).

The objectives of the survey were to:

- Investigate the proposed Neerabup power station site and gas pipeline routes nominated by NewGen and locate Aboriginal archaeological sites as defined by Section 5 of the *Aboriginal Heritage Act* 1972; and
- Provide advice on site avoidance and management strategies.

The survey of two proposed pipeline routes was carried out for NewGen between the 12th and 14th of February 2007 by Eureka Archaeological Research and Consulting UWA (Eureka). The survey of the proposed power station site was conducted on the 12th of April 2007. Representatives of the Combined Metropolitan Working Group (CMWG) participated in both surveys.

The structure and content of this report follow guidelines suggested by the Department of Indigenous Affairs in the *Guidelines for Aboriginal Heritage Assessment in Western Australia* and the *Aboriginal Heritage Procedures Manual* (DIA 2002). This report provides advice that complies with the *Aboriginal Heritage Act* 1972 and other relevant Acts.



Map 1. NewGen Neerabup Project Area showing two proposed pipeline routes (Pinjar and Neaves Rd Options) and proposed power station site

THE SURVEY

The Project Area

The NewGen Neerabup Project area comprises the proposed Power Station Site and two proposed pipeline routes.

The proposed Neerabup Power Station Site (NPSS) is located to the west of Old Yanchep Rd on the northern half of Lot 507 Neerabup (Map 2). The proposed site covers an area of approximately 10 hectares, or a 300 m x 300 m block. A 300 m long and 15 m wide access track leading from Old Yanchep Rd to the NPSS is also proposed, but may not necessarily be required by NewGen (Map 2). The land on which the proposed NPSS and temporary access track will be constructed is currently being used for commercial turf farming and is therefore heavily disturbed, although block 507 abuts native vegetation to the east. There is no native vegetation within the proposed NPSS. The ground surface is slightly undulating and consists of sandy topsoil with some limestone gravel. Ground visibility during survey averaged 95-100%.

NewGen are considering two alternative pipeline routes to link the power station with the existing Dampier-Bunbury pipeline situated to the east of the project area (Map 1). The Pinjar Rd pipeline route is approximately 31.2 km long and extends northeast from the proposed NPSS along Pinjar and Perry Roads. The proposed Neaves Rd pipeline route is approximately 19 km long and runs alongside Pinjar and Neaves Roads before cutting through the Melaleuca Nature Reserve to eventually connect with an existing pump station. The proposed disturbance corridor for either pipeline route will not exceed 20 m in width.

Both pipeline routes run parallel to existing gas pipeline routes and for the most part will be constructed within the existing pipeline easements and/or road reserves. The survey areas for both pipelines are therefore very highly disturbed, although in some areas the proposed pipeline corridors abut dense sections of remnant coastal vegetation. The most notable of these vegetated areas include the northern section of the Pinjar Rd route which runs east-west along an existing pipeline channel that cuts through dense coastal vegetation dominated by *Acacia sp.* and *Xanthorrhoea spp.* (grass trees) (Plate 1). Other areas of remnant vegetation that may be impacted on by the construction of either pipeline route include the Melaleuca Nature Reserve to the southeast of Neaves Rd, and some patches of remnant *Melaleuca sp.* and *Banksia sp.* scrub and coastal heath that begin at the edge of the developed housing estates. Some portions of the proposed pipeline corridors also traverse privately owned or leased land used for pastoral or commercial activities (Plate 2).

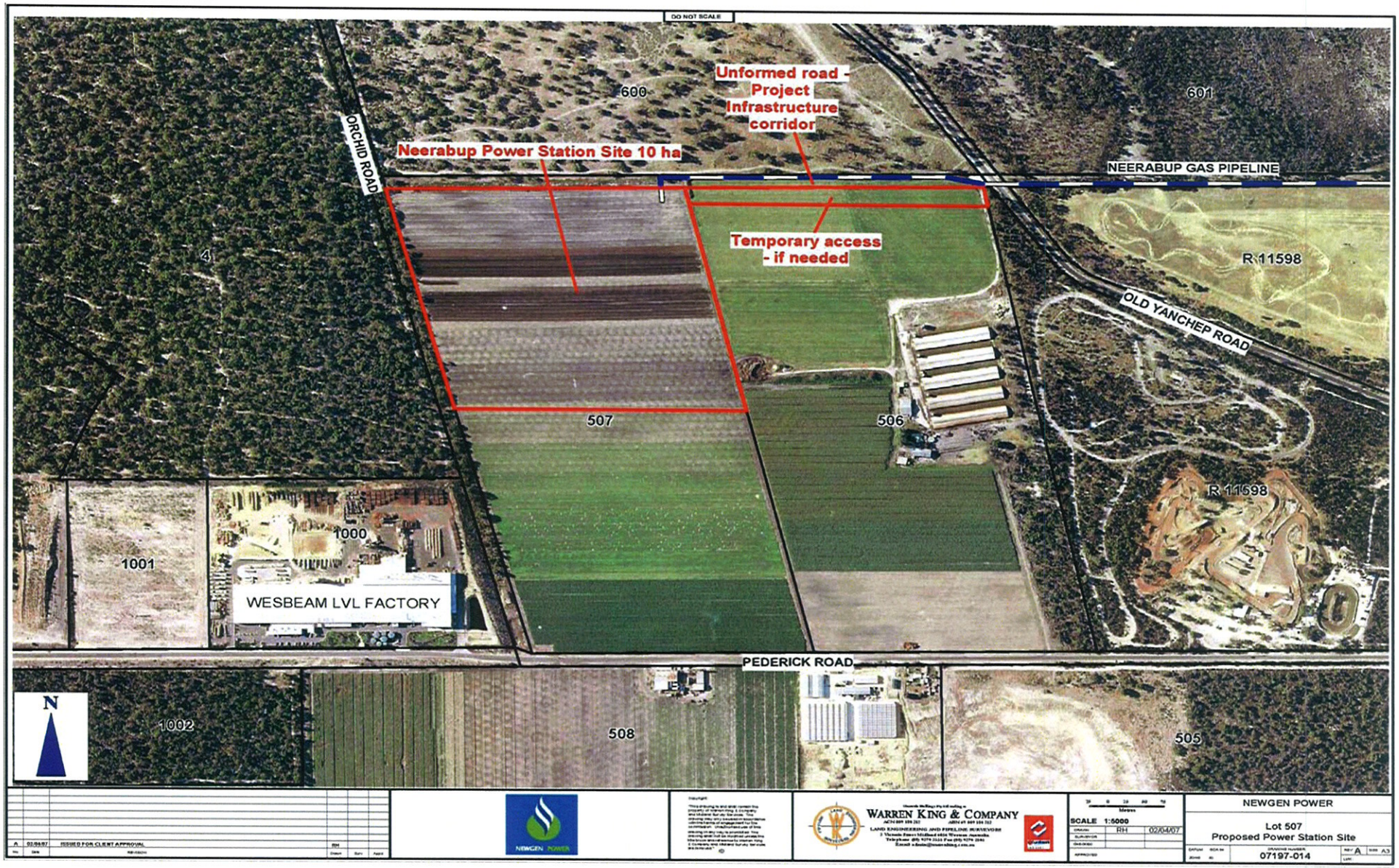
With the exception of one or two small ephemeral creeks, no semi-permanent or permanent water courses or sources of freshwater occur within the Project Area itself, although small lakes and creeks occur frequently around Neerabup and the surrounding suburbs. No sources of isotropic stone suitable for making stone tools occur in the Project Area. The natural topography and hydrology of

this area has been drastically modified over several decades by the expanding settlement of Perth and associated infrastructure.

The ground surface in the pipeline survey areas is slightly undulating and characterised by the sandy Bassendean Plain soils that extend across the Perth metropolitan area. Ground surface visibility in the survey area varied between 20 % in the Melaleuca Nature Reserve and 90% for the majority of the pipeline routes running alongside existing pipelines.

Plate 1. View West along the northern section of the proposed Pinjar pipeline route

Plate 2. View East along the proposed Neaves Rd pipeline route with pine plantation on left



Map 2. NewGen Proposed Power Station Site and temporary access track

Survey Participants

The following people and organisations participated in the archaeological survey.

Eureka Archaeological Research and Consulting, UWA

Annie Carson, Archaeologist	Ian Ryan, Archaeologist	Ryan Coughlan, Archaeologist

Combined Metropolitan Working Group

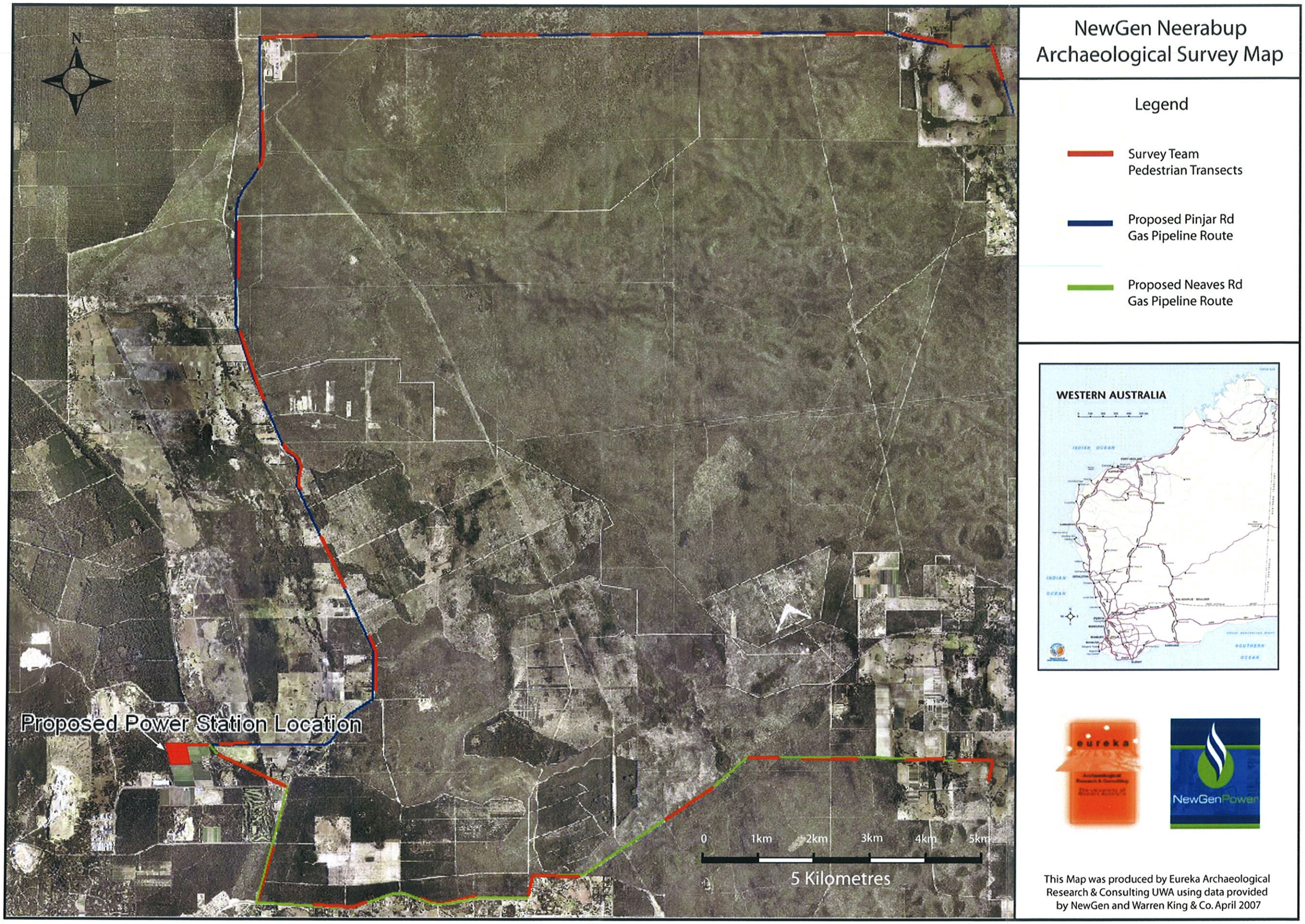
Harvey Bropho	Barry Parfitt	Lynley Wilkes
Peter Wilkes		

Survey Method

An Aboriginal archaeological Work Program Clearance Survey (WPCS) of the two proposed pipeline corridors was conducted between the 12th and 14th of February 2007. A survey of the NPSS was conducted during a separate field trip on the 12th of April, 2007. A WCPS aims to clear a specific work plan or infrastructure program as opposed to a larger work precinct. Information recorded on Aboriginal archaeological sites identified during the survey is limited to site boundaries and general descriptions.

The NPSS was inspected by the survey team walking a series of transects spaced 30 m apart and across the entire length and breadth of the 10 ha area. The proposed temporary access track was inspected by the survey team walking the length of the corridor spaced 5 m apart.

The pipeline routes were surveyed by the survey team walking a series of transects 10 – 20 m apart and between 500 m and 1.2 km in length along accessible sections of the proposed routes. Particular attention was paid to the least disturbed sections of the proposed routes and any areas of remnant vegetation. Sections of the Pinjar Rd route that traversed private land (approximately 5% of the total length) were not inspected. In doing this it is estimated that at least 45% of the proposed Pinjar Rd pipeline route and 50% of the Neaves Rd pipeline route were inspected (Map 3).



Map 3. NewGen Neerabup Project Area showing location areas surveyed for archaeological materials

ARCHAEOLOGICAL CONTEXT

Regional Archaeology-Swan Coastal Plain

An understanding of the regional archaeological context provides contextual information that allows new archaeological finds to be properly assessed.

The oldest known sites in the Perth metropolitan area are located near major river systems on the Swan Coastal Plain, with the earliest evidence for occupation some 38,000 years ago from Upper Swan Bridge and Helena River, in Midland (Pearce and Barbetti 1981; Schwede 1983). Other sites in the Perth metropolitan area have been dated to the last 10,000 years including Minim Cove, Mosman Park and Orchestra Shell Cave, Wanneroo.

More than 1,000 Aboriginal sites have been recorded in the Perth Metropolitan area. These range from large, complex sites with diverse stone assemblages including backed blades and retouched artefacts to small discrete artefact scatters dominated by unretouched quartz flakes. The majority of sites are found in close proximity to water sources in the Swan Coastal Plain, with the largest sites located near the Swan River, lakes and wetlands on elevated dunes and sandridges (Anderson 1984; Hallam 1972, 1975, 1987; Bowdler *et al* 1991; Strawbridge 1988).

Local Archaeology and Predictions of Site Location

The Register of Aboriginal Sites, which is maintained by the Department of Indigenous Affairs (DIA), contains information about objects and places that might reasonably be interpreted as Aboriginal sites according to Section 5 of the Aboriginal Heritage Act (1972). The Register may be searched using the Heritage Inquiry System to identify any existing Aboriginal sites within a nominated area, and provides information about known sites. This information may then be utilised in assessing the archaeological significance of newly identified sites where appropriate. The Register was searched to identify previous archaeological surveys undertaken and sites located within a 10 km boundary of the NewGen Neerabup Project Area.

Previous Archaeological Surveys and Recorded Sites

The DIA Register lists nineteen archaeological surveys that have been conducted within 10 km of the Project Area (Quartermaine & Heine 2004a, Quartermaine & Heine 2004b, Lantzke *et al.* 2002, Veitch *et al.* 2001, Lantzke *et al.* 2001a, Lantzke *et al.* 2001b, Hondros *et al.* 2001, de Gand *et al.* 2000, McDonald & Smith 1990, Murphy *et al.* 1989, Bodney *et al* 1988, Quartermaine & O'Connor 1988, Quartermaine & O'Connor 1987, Quartermaine 1986, Pickering 1981, Pickering 1980, Wright *et al.* 1979, Polach 1972, and Polach 1971). Six ethnographic surveys have also been undertaken within the same 10 km boundary searched (Coldrick *et al.* 2005, Parker 2003, Parker 2002, Fisher & Waite 2001, Machin 1994, and O'Connor 1992).

A total of 21 Aboriginal sites are registered within 10 km of the Project Area (Table 1). The majority of these (n=17) are ethnographic sites associated with wetlands and water courses. Of the four archaeological sites registered, details of only two were available. The remaining two site files were closed to public access or unavailable at the DIA. Additionally, one of these sites (DIA Site Id 3514) is listed on the site index as 'stored data'. This means that the Aboriginal Cultural Material Committee (ACMC) has assessed the sites and declared that they do not meet the requirements of a site as defined under sections 5 and 39 of the *Aboriginal Heritage Act* 1972 (DIA pers. comm.). No archaeological sites are situated within the survey areas identified within the NewGen Neerabup Project Area.

Table 1 below provides summary details of site location and cultural attributes retrievable from all site records. These results indicate that the most likely type of archaeological sites to be encountered in the survey area are small and localised low density surface scatters of stone artefacts. Previous research into surface sites on the Swan Coastal Plain indicates that sites are associated primarily with the wetland system in the Bassendean dunes (Hallam 1987). The site location pattern exhibited by archaeological sites registered in the search area would appear to support this observation. Available ethnographic information also suggests that the same freshwater sources are ethnographically significant to Aboriginal people.

The proposed Pinjar Rd Pipeline route currently impacts upon one registered ethnographic site, DIA Site Id 3930 (Fewster). The current boundaries of this site, described as a camping place, extend over the eastern most 2 km of the proposed Pinjar Rd pipeline route. This site and the implications for the NewGen Neerabup Project are discussed separately (Fisher in prep. 2007).

As described earlier, the Project Area has been subject to escalating disturbance with the increasing encroachment of the metropolitan area on the region. Within the last 50 years disturbance has intensified from agricultural land use to industrial development. Construction of infrastructure projects such as the Dampier to Bunbury Natural Gas Pipeline, water pipeline, power substations and road construction have left only limited undisturbed vegetation. As such, any archaeological sites which may have existed in the past are likely to have been disturbed or destroyed since European contact. As described above, no water sources are present in the project area and due to the disturbance it is considered unlikely that any archaeological material will be identified.

That said, the review of the local archaeology here indicates that any archaeological sites identified during the survey were most likely to be small, localised stone artefact scatters located near creeks or lakes.

Table 1. Aboriginal sites recorded within 10 km boundary of the survey area

Site Id. No.	Site Name	Site Type/Cultural Attributes	Geographical Context
3514	Payne Road	Artefact Scatter	Edge of swamp
3396	Lake Adams	Mythological	Lake
3503	Honey Possum Site	Mythological	Adjacent to Lake Adams
3741	Lake Mariginiup.	Hunting Place	Lake
3930	Fewster	Camp	Bush
4143	Natgas 122	Artefact Scatter	Edge of creek on a sandy exposure
19138	Wetlands & Watercourses Moore River to Bullsbrook	Mythological	Wetlands and Watercourses, River
19182	Muchea Pipeline Deviation 1	Mythological	Bush
19183	Red Gully Creek	Mythological	Creek
19589	Muchea Unnamed Lake (Mu5)	Mythological	Lake
20008	Gingin Brook Waggyl Site	Mythological/ Historical	Brook
20749	Moore River Waugal	Mythological	River
21615	Lennard Brook	Mythological	Brook
21616	Boonanarring Brook	Mythological	Brook
21617	Wallering Brook	Mythological	Brook
21618	Nullilla Brook	Mythological	Brook
21619	Breera Brook	Mythological	Brook
21620	Chandala Brook	Mythological	Brook
21994	Neaves Road Creek Field Site 1	Artefact Scatter	Edge of Brook
22160	Marrynginup	Artefact Scatter/Ceremonial/Mythological/Camp/Midden/Modified Tree	Adjacent to a series of Lakes

RESULTS

An Aboriginal archaeological Work Program Clearance survey of the proposed Neerabup Power Station Site and two pipeline routes has been completed.

No archaeological sites or isolated artefactual materials were identified during the survey.

The proposed Pinjar Rd pipeline route currently extends into the boundaries of registered ethnographic site DIA Site Id 3930 (Fewster). No archaeological material was identified in the area intersected by the site and the proposed pipeline route. A discussion of this site is provided separately (Fisher in prep. 2007).

CONCLUSIONS

No archaeological sites or isolated artefacts were identified during the survey. There is therefore, no archaeological reason why NewGen Power Pty Ltd should not develop the proposed Power Station Site and pipeline route/s as planned.

The results of the survey are not surprising given that at least 90 % of the survey area was situated within heavily disturbed tracts of land with little or no remnant vegetation. The NewGen Neerabup Project Area is similarly devoid of any natural features commonly associated with archaeological sites, such as sources of freshwater or outcropping stone material. Any potential archaeological materials associated with past Aboriginal use of the area is unlikely to have survived the extensive and prolonged ground development and growth of commercial activity in this part of the Perth Metropolitan area. NewGen Power Pty Ltd should be aware of the potential for sub-surface archaeological material to be uncovered during earthworks in the proposed Neerabup Power Station Project Area.

SUMMARY OF RECOMMENDATIONS

It is **recommended** that NewGen Power Pty Ltd ensure that its employees and contractors:

1. are advised of the existence of DIA Site Id. 3930 (Fewster); and

2. are informed that this location is currently registered with the Department of Indigenous Affairs and therefore constitutes an Aboriginal site to which the *Aboriginal Heritage Act 1972* applies.

It is further **recommended** that:

3. NewGen Power Pty Ltd engage Aboriginal monitors during any ground disturbing activity conducted during the Neerabup Power Station and Pipeline development; and

4. if any archaeological material is encountered during ground disturbing work, all work should be stopped and the Combined Metropolitan Working Group notified immediately. If skeletal material is uncovered the police should be notified immediately, as required by law. The Department of Indigenous Affairs and the Combined Metropolitan Working Group should also be notified.

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APPENDIX 1 - LEGISLATIVE OBLIGATIONS

Indigenous heritage sites in Western Australia are protected under the State *Aboriginal Heritage Act 1972 (AHA)*. In summary, Aboriginal heritage sites are defined under Section 5 of the Act as *any* place of importance and significance to Aboriginal people. This includes sacred, ritual or ceremonial sites and places with an Aboriginal historical, anthropological, archaeological or ethnographic association.

In accordance with Section 15 of the Act, any persons with knowledge of the existence of an Aboriginal site should report it to the police and the DIA. The relevant local Aboriginal representative body should also be notified. In addition to Aboriginal sites the AHA protects Indigenous human remains which, if encountered, should be reported to local police under Section 17 of the Coroner's Act 1996, and to the DIA under Section 15 of the AHA.

As detailed in Section 17 of the AHA it is an offence to knowingly disturb an Aboriginal site in any way without authorisation from the Department of Indigenous Affairs (DIA). If disturbing a site is unavoidable, consent to proceed may be given by the State Minister for Indigenous Affairs on recommendation of the Aboriginal Cultural Heritage Committee (ACMC).

Other legislation of relevance to Indigenous Heritage issues in Western Australia includes the Native Title Act 1993 and the Aboriginal and Torres Strait Islander Heritage Protection Act 1984.

Developers should ensure that they are familiar with their responsibilities under the AHA. A copy of the AHA is available from the DIA website at:

www.dia.wa.gov.au/Heritage/HeritageManual/default.aspx

APPENDIX 2 –DEFINITIONS OF ABORIGINAL SITES

As defined by the Department of Aboriginal Affairs, a diverse range of places can comprise Aboriginal sites. They fall into two basic overlapping categories:

Archaeological sites – these are places where material cultural remains associated with past Aboriginal occupation are present. The most commonly recognised archaeological site types are;

- Artefact Scatters: Stone artefact scatters are the most common archaeological component represented throughout Western Australia. In most cases they comprise a surface scatter of stone artefacts, although a sub-surface component may also be present, particularly in depositional environments such as those found in the coastal and sub-coastal areas. Such deposits are particularly significant in terms of the potential afforded for dating the site and examining change over time.

- Man-Made Structures: This is a generic label used to describe a range of archaeological features including what have been interpreted as lizard 'habitats', hunting blinds and stone arrangements (DIA file notes).

- Fishtraps: These can be broken down into two main groups; stone structures constructed in tidal estuaries, and wooden fences or weirs built across inland drainage features.

- Modified Trees: These are trees that show evidence of having been carved or scarred for the purpose of creating territorial markers, the extraction of raw material for the production of items of material culture (such as bowls or shields), or for the purpose of capturing animals such as possums.

- Painting: Aboriginal paintings were probably undertaken on a wide variety of media, but are best known from rockshelters, caves and overhangs where they are protected from the detrimental effects of the weather. A wide variety of motifs, including anthropomorphic, animal and geometric figures were used; stencilled objects are also common.

- Engraving: These are places at which designs have been carved, pecked or abraded into a rock surface, and are known to occur throughout much of the state.

- Grinding patches/grooves: These generally take the form of circular depressions found on rocky exposures. These features are thought to represent activities relating to the processing of food and materials used in the production and maintenance of other tools such as spears, grinding ochre and the production of 'burley' to be used in spear fishing.

- Quarry: These sites can take several forms. In most cases they comprise surface hardstone exposures, which were exploited as a raw material for the manufacture of stone artefacts. Ochre and other mineral pigments

were also exploited, usually being mined from naturally occurring deposits.

- Middens: Such sites consist of scatters of humanly deposited shell, usually with a stratified component.

Anthropological sites - places of spiritual importance and significance to Aboriginal peoples.

- Ethnographic sites: places of importance to Aboriginal people (for religious or other reasons). Such places may have no distinguishing characteristics that alert non-Aboriginal people to their existence.

- Ceremonial: These are places that have been used for ceremonial purposes. Although such sites can sometimes be identified by the presence of stone arrangements or modelling of the ground surface, many can only be located through consultation with people who have either direct or indirect knowledge of such sites.

- Mythological: These sites generally encompass some natural feature, such as a hill or waterway, which is considered significant to contemporary Aboriginal people.

- Art Sites: These may include paintings, engravings or petroglyphs of spiritual or ceremonial significance to Aboriginal people.

- Burials: These are generally difficult to identify unless explicitly distinguished by some sort of marker, are known to family and/or community members, or have been recorded in a documentary or oral format.

FISHER RESEARCH

1 June 2007
Ref: 3097

Mr Tony Petersen
ERM Power Environment Manager
Level 4, St George's Square
225 St George's Tce
Perth WA 6000

Dear Tony,

Re: Preliminary advice of an ethnographic survey at Neerabup, City of Wanneroo.

Fisher Research Pty Ltd has been engaged by NewgenPower WA Pty Ltd (NewgenPower) to conduct an ethnographic survey of the proposed ERM Power gas fired power station (GFPS) and associated infrastructure at Neerabup, in the City of Wanneroo (Map 1).

The proposed development

The proposed GFPS project comprises:

- construction of the Neerabup Power Station, at Orchid Road, Wanneroo
- construction of two kilometres of overhead power transmission line from the proposed GFPS to the new Western Power Neerabup terminal substation, which is currently under construction
- construction of a 30 kilometre lateral pipeline to connect the proposed GFPS to the Dampier to Bunbury Natural Gas Pipeline approximately one kilometre north of the township of Muchea. Two options for the gas lateral (Map 1) were considered by the Aboriginal consultants during the survey.

Archival research

A search of the Department of Indigenous Affairs' Register of Aboriginal Sites was undertaken by anthropologist Dirima Cuthbert on 30 May 2007 (UTM Zone 50, MGA, datum GDA94; GPS search polygon 6493497 mN - 6510147 mN; 384481mE - 403013mE). This research revealed that 14 Aboriginal sites are registered within two kilometres of the survey area (Appendix 1). These sites will not be impacted by the proposed development.

The ethnographic survey

The ethnographic survey took place on 31 May 2007 with three separate teams of Aboriginal consultants.

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Survey team 1 comprised members of the Bibbulmun group

Survey team 2 comprised members of the CMWG from the Bropho, Corunna, Garlett, Warrell and Wilkes family groups

Survey team 3 comprised members of the Ballaruks Aboriginal Corporation Inc. and members of the IAEG

Preliminary results of the survey

No registered Aboriginal sites will be impacted by the proposed development.

No new ethnographic sites were identified by Aboriginal consultants in the survey areas during the survey.

Aboriginal consultants on survey teams one and three recommended that the proposed development be allowed to proceed, subject to monitoring of ground disturbing activity by appropriate Aboriginal monitors and an archaeologist acceptable to the Aboriginal Elders consulted during the survey.

Aboriginal consultants on survey team two recommended that NewgenPower enter into a formal Nyoongar Heritage Protection Agreement with them as Traditional Owners of the Perth Metropolitan Area, including the survey areas.

Recommendations

It is recommended that planning for the proposed development proceed on the basis that there are no impediments to it in terms of the Aboriginal Heritage Act (1972).

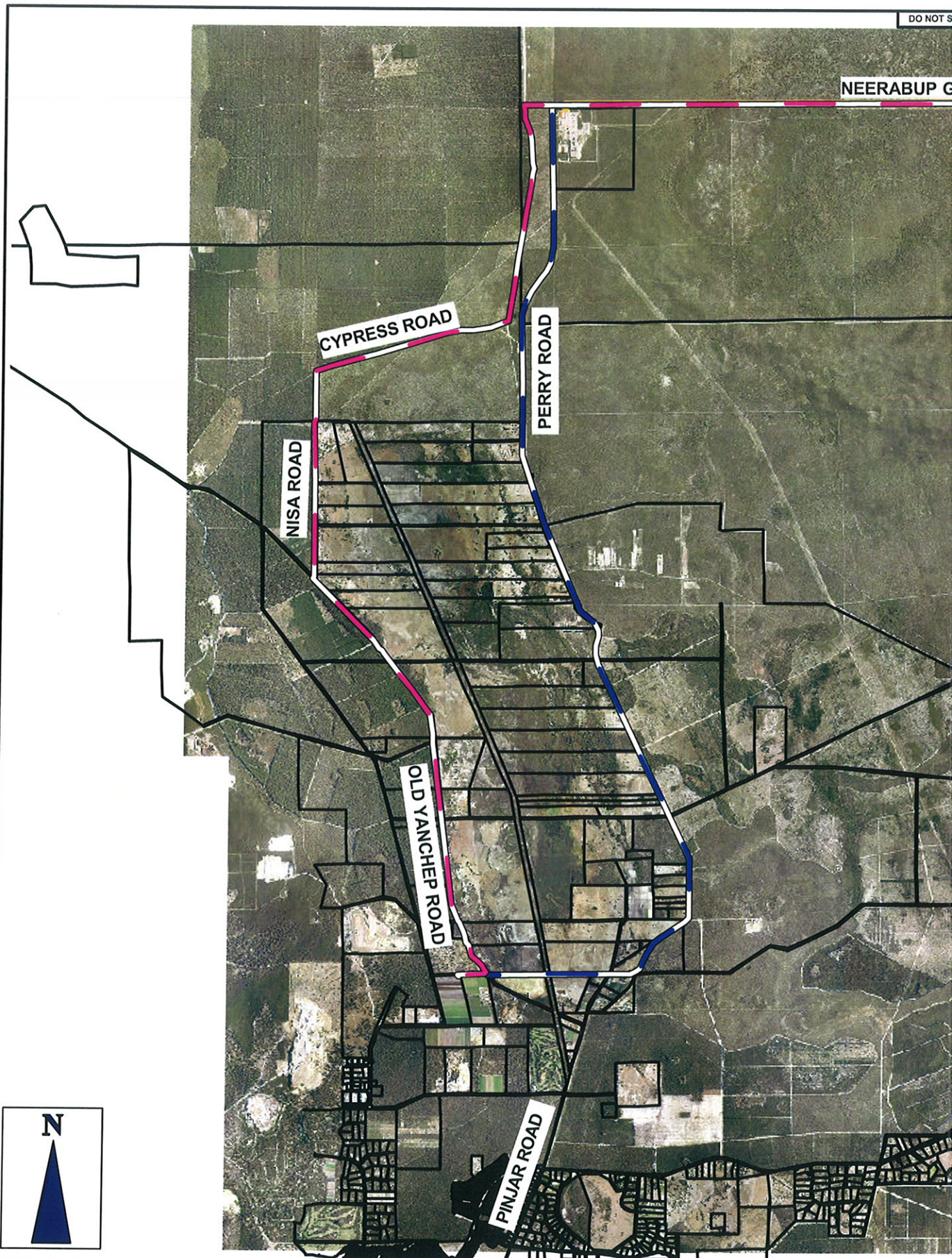
It is recommended that NewgenPower gives consideration to the request by the CMWG Elders for a further meeting to discuss a proposed Nyoongar Heritage Protection Agreement.

It is recommended that if the proposed development proceeds, a groundworks monitoring programme is implemented to prevent any inadvertent breaches of the terms of the Aboriginal Heritage Act (1972) during excavation activities.

Please do not hesitate to contact myself or Stuart Fisher should you require clarification of any of these points.

Yours sincerely,

Dirima Cuthbert
Anthropologist



No.	Date	REVISION	Drawn	Surv	App'd
B	14/05/07	REV 4 PINJAR OPTION, REV 3 ONC OPTION	C.B		
A	01/05/07	ISSUED FOR CLIENT APPROVAL	C.B		

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6493497	384481

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Legend

Restriction		Access		Status	
N	No restriction	C	Closed	I	Interim register
M	Male access only	O	Open	P	Permanent register
F	Female access	V	Vulnerable	S	Stored data

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
3525	P	C	N	Ellen Brook: Upper Swan	Mythological		*Registered Informant names available from DIA.	Not available for closed sites	S02516
3930	S	O	N	Fewster.		Camp		401368mE 6505795mN Zone 50 [Unreliable]	S01789
19138	S	O	N	Wetlands & Watercourses Moore River To Bullsbrook	Mythological		*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	
19182	I	C	N	Muchea Pipeline Deviation 1	Mythological		*Registered Informant names available from DIA.	Not available for closed sites	
19183	S	O	N	Red Gully Creek	Mythological	Plant Resource	*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	
19589	S	O	N	Muchea Unnamed Lake (Mu5)	Mythological		*Registered Informant names available from DIA.	400350mE 6508939mN Zone 50 [Reliable]	
20008	P	C	N	Gingin Brook Waggyl Site	Mythological, Historical	Plant Resource, Camp, Hunting Place, Water Source	*Registered Informant names available from DIA.	Not available for closed sites	
20749	P	O	N	Moore River Waugal	Mythological		*Registered Informant names available from DIA.	389582mE 6549648mN Zone 50 [Reliable]	
21615	I	O	N	Lennard Brook	Mythological		*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	
21616	I	O	N	Boonanarring Brook	Mythological		*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	

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Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
21617	I	O	N	Wallering Brook	Mythological		*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	
21618	I	O	N	Nullilla Brook	Mythological		*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	
21619	I	O	N	Breera Brook	Mythological		*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	
21620	I	O	N	Chandala Brook	Mythological		*Registered Informant names available from DIA.	396128mE 6561778mN Zone 50 [Reliable]	

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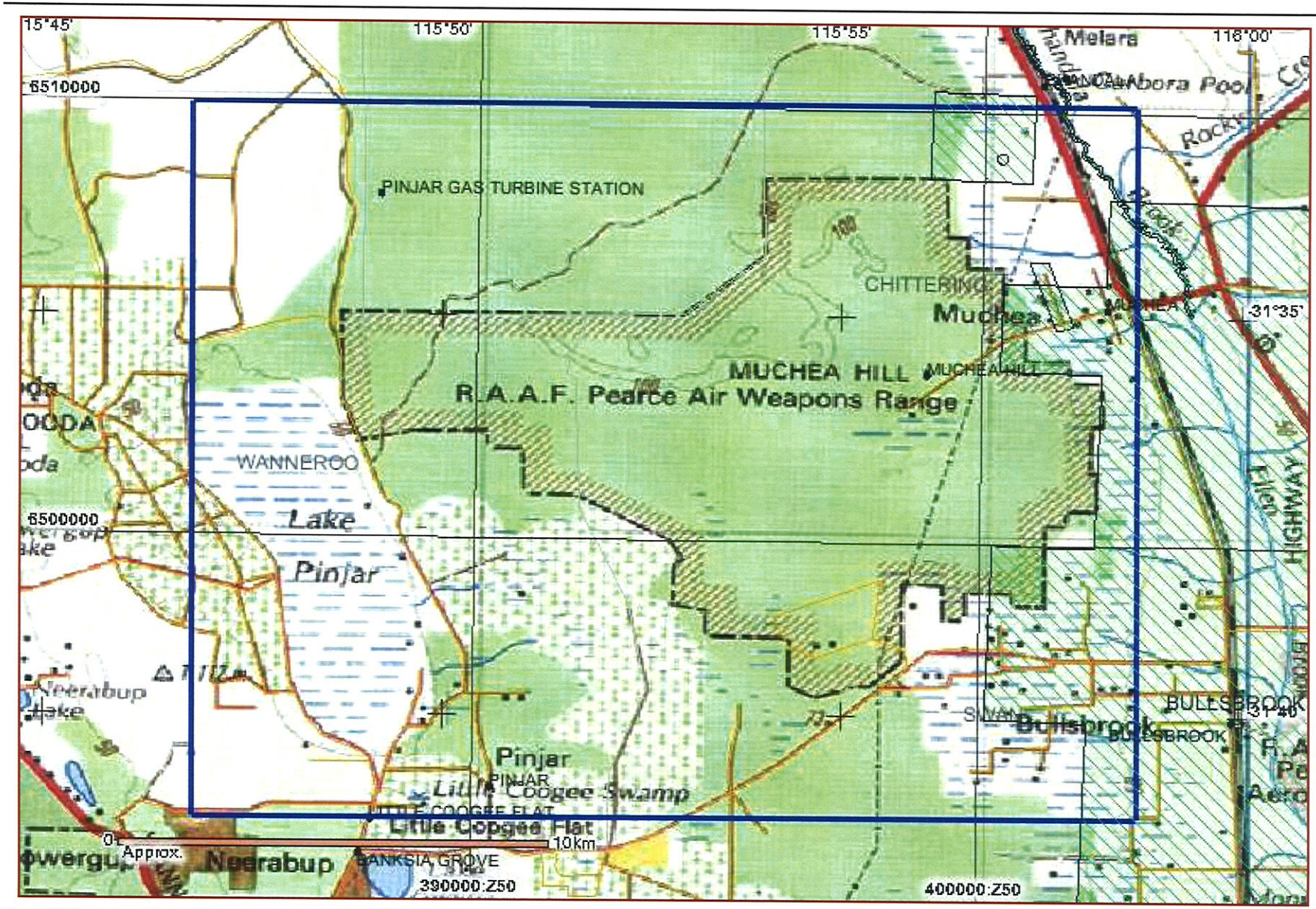

Legend

- Highlighted Area
- Town
- Map Area
- Search Area

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APPENDIX E

NewGen Power

Draft Construction Environmental Management Plan

1 INTRODUCTION

This Construction Environmental Management Plan (CEMP) documents the necessary procedures to enable NewGen Power to manage the environmental impacts of the construction of the NewGen Gas Pipeline. This CEMP has as its primary purpose the protection of the environment through minimisation of the effects of activities and the restoration and rehabilitation of areas disturbed by the activities. Contractors are expected to conform with the requirements of this CEMP.

The Project consists of a pipeline to provide natural gas for the NewGen Power 330MW Power Project which includes the pipeline, power station and transmission line. The power station is located within the Neerabup Industrial Estate in Perth, Western Australia. The power station, including pressure reduction facilities and heating and the associated transmission line will be constructed by others. Figure 1.1 shows the location of the project components

The pipeline is approximately 30km in length and originates at a hot tap on the DBNGP Stage 5A looping pipeline at KP1309.893 approximately, and terminates at the power station.

1.1 PURPOSE

This Construction Environmental Management Plan outlines and describes the activities to be carried out for the construction of the NewGen Gas Pipeline, and documents the necessary processes and procedures to manage the environmental impact of those activities.

The construction project will be managed by NewGen Power. Contracts will be awarded for the completion of construction works. Contractors are expected to conform with the requirements of this CEMP. Contractors will be required to develop and implement procedures, where necessary to ensure that an acceptable level of environmental performance is maintained at all times.

1.2 SCOPE

This CEMP provides guidance to NewGen Power and contractors for the key environmental issues associated with construction activities. Contractors will be required to comply with the CEMP and to develop their own environmental plans.

The CEMP provides an introduction and overview of the project, including the environmental approvals process. It outlines the key environmental issues associated with construction of the pipeline, sets objectives and performance indicators for environmental management and outlines actions to meet the objective (table 2).

The CEMP covers the key environmental issues associated with the pipeline project but does not detail all the daily activities to be undertaken. Contractors are required to develop a specific CEMP and environmental work procedures to manage the environmental aspects related to their activities. These are to comply with the environmental requirements of this CEMP.

NewGen will review and approve the contractor's CEMP and environmental work procedures to ensure they comply with the requirements set out in the CEMP.

1.3 REFERENCES

Legislation

Western Australian

Aboriginal Heritage Act 1972
Conservation and Land Management Act 1984
Dampier to Bunbury Pipeline Act 1997
Environmental Protection Act 1986 [and Administrative Procedures 1993]
Explosives and Dangerous Goods Act 1961
Heritage of Western Australia Act 1990
Land Administration Act 1997
Petroleum Pipelines Act 1969
Rights in Water and Irrigation Act 1914
Wildlife Conservation Act 1950

Commonwealth

Environment Protection and Biodiversity Conservation Act 1999
Native Title Act 1993

Industry and Agency Standards

ANZECC (1992) Australian Water Quality Guidelines for Fresh and Marine Waters
APIA Code of Environmental Practice
AS 1726-1993 Geotechnical Site Investigations
AS 1940-1993 Storage and Handling of Flammable and Combustible Liquids
AS 1978-1987 Pipelines - Gas and Liquid Petroleum - Field Pressure testing
AS 2885.1-1997 Pipelines - Gas and Liquid Petroleum - Design and Construction
AS 2885.2-1995 Pipelines - Gas and Liquid Petroleum - Welding
AS 2885.3-2001 Pipelines - Gas and Liquid Petroleum - Operation and Maintenance
AS 4360-1995 Risk Management
WA Environmental Protection Authority, 1997, *Environmental Protection (Noise) Regulations.*
WA Environmental Protection Authority 1993, Draft Western Australian Water Quality Guidelines for Fresh and Marine Waters.

Environmental Review

Neerabup Power Project, Environmental Assessment, NewGen Power June 2007

1.4 DEFINITIONS

"Contractor" means a supplier in a contractual situation

"DBNGP" means Dampier Bunbury Natural Gas Pipeline

"DEC" means Department of Environment and Conservation

"DoIR" means Department of Industry and Resources or its successor

"Emergency" means an incident which:

- Has the potential to cause major loss of people, equipment, materials process or the environment;
- Has caused or threatens to cause failure of gas supply to shippers;

- Is of sufficient magnitude to attract wide publicity and the responsibility and the response of the police, fire brigade or other emergency services; and
- Results in an uncontrolled release of gas.

"CEMP" means Construction Environmental Management Plan

"GHG" means Greenhouse Gases

"Hazard" means any unsafe act or condition that has the potential to injure people, result in harm to the environment, damage property, equipment or materials or lead to loss of process.

"Hazardous Substance" means a substance:

- Entered in the List of Designated Hazardous Substances; or
- If the substance is not entered in the List of Hazardous Substances determined in accordance with the Approved Criteria for Classifying Hazardous Substances whether the substance is a hazardous substance.

"Incident" means an undesired event or set of circumstances that did result in an undesired outcome through injury to people, harm to the environment, damage to property, equipment or materials or loss of process.

"JHA" (Job Hazard Analysis) means a method of identifying hazards with workplace tasks and the development of control measures to manage the identified hazards.

"Leader" means a person, i.e. a Supervisor, Manager or Team Leader, who directs the work of others.

"Management Plan" means a project or job specific management plan, which describes how a Contractor will manage QHS&E and quality activities and Potential Impacts on a project or job.

"Management System" means a framework that integrates quality, health, safety and environmental management activities and ensures compliance to specified requirements; contains objectives, performance standards and responsibilities, as well as specifying the methods of implementation in the context of the operations of the company.

"MIM" means Mandatory Inspection Manual

"Near Miss" means an undesired event or set of circumstances that did not result in any loss but had the potential to do so

"Organisational Rules" means generalised or specialised safety rules that shall be used for specific tasks, eg permits, isolations, danger tags

"Permit to Work" means a completed and authorised permit to carry out work within the compound fences at any site.

"QHS&E" means Quality, Health, Safety and Environment

"Relevant Authorities" means either one or all of DOIR, DoCEP, DEC, EPA as the case may be.

"ROW" (Right of Way/ROW/corridor) means the area located surrounding an infrastructure installation, eg road, or pipeline, legally recognised for access by the relevant authority.

"Risk" means the exposure to the chance of loss

"Risk Assessment" means the process used to determine risk priorities by evaluating and comparing the level of risk against program standards, pre-determined risk levels or other criteria

"Sub-contractor" means an organisation that conducts work for a Contractor, under contract to that Contractor

"System Improvement" means the corrective action required rectifying a situation. Corrective action encompasses three stages:

- Implementation of control;
- Facility for sign-off; and
- Follow-up to check effectiveness of control.

1.5 ROLES AND RESPONSIBILITIES

Environmental management will be undertaken by NewGen Power, its consultants, contractors and sub-contractors as the case may be. These responsibilities are set out in Table 1.

Table 1 - Environmental Responsibilities

Responsibility	Licensee	Project Manager	Project Leaders	Employees
Objectives	Approves objective	Approves and sets objectives	Advise on achievable objectives	Participate in meeting and setting objectives
Targets	Approves targets Approves timeframes for targets	Approves and sets targets Sets timeframes for targets	Advise on achievement objectives Provides advice on meeting targets	Participate in meeting and setting targets Aim to meet targets by participating in meeting objectives of EMP
Third Parties	Approves third party protocols	Identified interested third parties Discusses Potential Impacts with third parties	Interact with third parties Assist manager in interaction and discussion with third parties	Follow guidelines when work requires interaction with third parties Follow guidelines when work requires interaction with third parties
EMP	Approves EMP	Facilitated program update and review of program	Provide advice and feedback on EMP for program reviews	Participates in EMP. Provide feedback and collecting of raw data
Data Collection	Approves data collection program	Approves data collection program and methods	Collates data collected	Collects raw data
Monitoring	Approves monitoring activities	Approves monitoring activities	Supervise and implements monitoring program	Monitoring activities part of position description
Emergency response	Approves emergency response program	Coordinates emergency response program	Participates in development and implementation of emergency response program	Participate in development and implementation of emergency response program. Provide feedback after exercises

Responsibility	Licensee	Project Manager	Project Leaders	Employees
Training	Approves training program	Approves training program	Develop training program and carries out training	Participate in training and provide feedback on training carried out
Materials and services supplies	Approves program	Approves program	Develop and implement program	Follow guidelines to ensure objectives of EMP are met
Environmental Compliance Reporting	Approves reports	Approves release of reports	Collates relevant sections of report	Collect data and provide feedback in reports
Emissions measurement	Approves program	Approves program	Implement program	Collect raw data
Monitoring and sampling requirements	Approves program	Approves program	Suggestions on sampling regimes	Provide feedback and suggestions
Incident investigation	Approves major investigations	Initiates major investigations	Initiate routine investigations and participates in all investigations	Participate in investigations
Corrective actions	Approves corrective action reviews	Initiates corrective action reviews	Carry out corrective actions	Participate in corrective actions and provide feedback on effectiveness
Community relations	Approves program	Approves Community relations program	Participate in community relations program	Participate in community relations program

APPENDIX F

Pennington Scott

Preliminary Acid Sulphate Soil Results

PENNINGTON SCOTT
Lateral Resources

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MEMORANDUM

To	Stuart Thompson	cc	Don Scott
From	Rob Braaten	Project	07A1050 Neerabup Gas Pipeline Geotechnical and Acid-Sulfate Soil Assessment
Subject	Initial Field Results	Date	9 July 2007

Dear Stuart,

Please find enclosed an alignment drawing presenting the initial field results from the geotechnical and acid-sulfate soils assessment of the proposed Neearbup gas pipeline alignment.

Note that these are preliminary field results that will be confirmed via laboratory testing. The lab results should be received in about two weeks, after which a full report containing methodology, results and interpretation will be provided.

Basis of the Study

The study is based on the alignment bend points provided in ERM Power drawings 07197-001 to 009, Rev E, for the ONC Option.

Desktop study consisted of review of existing geoscience datasets including surface geology, bedrock geology, airborne radiometrics, magnetics, gravity, Landsat, digital elevation, topography and water table mapping. This study provided a broad understanding of the likely range of material types likely to be encountered along the pipeline, and was used to target the field investigation.

Field investigation took place from 25-29 June and consisted of:

- 55 auger holes to a depth of 2+m;
- Geotechnical logging of drill samples to AS1726;
- Acid-sulfate testing of samples (pHf and pHfox) according to the DoE investigation guidelines; and
- Submission of a series of representative samples to the laboratory for SPOCAS (acid-sulfate soil), particle size distribution, shrink-swell index and compaction testing.

Figure 1 below shows the locations of the sample sites.

Based on the desk study and field results, soils along the pipeline alignment were then classified to 2m depth in terms of:

- Soil type;
- Rock strength (i.e. excavatability);
- Groundwater depth (i.e. buoyancy);
- Fill suitability;
- Swelling clays; and
- Acid-sulfate soils

Soil type, rock strength and groundwater depth classifications are final and not subject to lab results. Fill suitability, swelling clays and acid-sulfate soils classifications are preliminary pending the results of the lab testing. The classification systems for each of these parameters are described below.

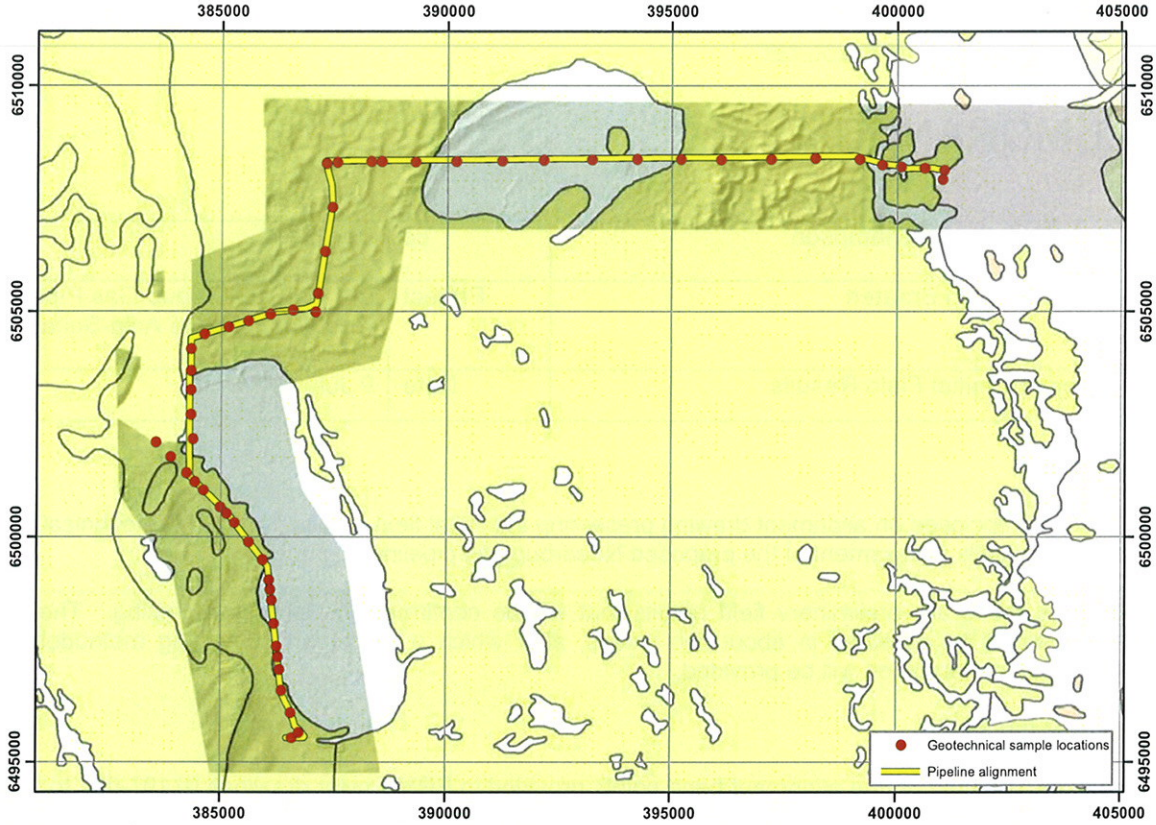


Figure 1 – Geotechnical sample locations (over geology map)

Soil Type

Soil type has been classified as per the AS1726 classes as follows:

Soil Group	Code	Description
Gravels	GW	Well graded gravels with little or no fines
	GP	Poorly graded gravels with little or no fines
	GM	Silty Gravels, gravel sand mixtures
	GC	Clayey Gravels, gravel sand mixtures
Sands	SW	Well graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines, uniform sands
	SM	Silty Sands, sand silt mixtures
	SC	Clayey Sands, sand-clay mixtures
Silts/clays (Liquid limit less than 50%)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or silts with slight plasticity
	CL,CI	Inorganic clays of low to medium plasticity
	OL	Organic Silts and organic silty clays of low plasticity
Silts/clays (Liquid limit more than 50%)	MH	Inorganic micaeous or diatomatious fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils	Pt	Peat or other highly organic soils

Rock Strength (Excavatability)

Excavatability assessment was based on the rock strength classes provided in AS1726. Specific definitions of rock strength in terms of point load index (MPa) are provided in the standard which can be related to earthmoving equipment capability. Descriptions of the rock strength classes are as follows:

Rock Strength Code	Description
EH	extremely high
VH	very high
H	high
M	med
VL	low
EL	extremely low

Fill & Embedment Materials

Fill and embedment material suitability and compaction requirements have been assessed based on the AS1726 soil classes and the fill requirements given in AS2566 and AS2885. Fill classes are as follows:

Fill Code	Key	Description	Fill Suitability & Compaction Requirements
HS	Highly Suitable	Gravel, sand & coarse grained soil with <5% fines	Suitable for all scenarios, often with little compaction aside from dumped placement and reworking.
S	Suitable	Gravel, sand & coarse grained soil with 5-12% fines	Suitable for all scenarios provided suitable compaction method is used, i.e. hand tampers, suface plate vibrators, vibratory rollers, internal vibrators, depending on materials. Dumped placement alone may be suitable with <5% fines.
LS	Limited Suitability	Fine grained soil (LL<50%) with medium to no plasticity with > 30% coarse-grained particles OR Coarse-grained soils with >12% fines	Only for shallow pipelines not subject to imposed live loads Cannot be used where water is in trench Compaction in 150mm layers using impact tampers or sheepsfoot rollers Moisture content needed within 2% of optimum for satisfactory compaction
NS	Not Suitable	Fine grained soil (LL>50%), medium to high plasticity OR Fine-grained soil (LL <50%), medium to no plasticity with <30% coarse-grained particles	Not suitable under any circumstances

Note that these categories are preliminary field classifications. Following laboratory results, the particle size distribution of the soils will be confirmed and definitive fill suitability classes determined.

Swelling Clays

The risk of the presence of swelling clays has been classified based on expert interpretation of geology and soils into the following classes:

Swelling Clay Code	Description
VH	Definite - Laboratory data
H	Probable - Clay rick soils with mafic source rocks present
M	Possible - Clay rich soils and/or saline felsic areas or with wash from mafic rock areas
L	Low - No risk factors present

Note that these categories are preliminary field classifications. Following laboratory results, the presence of swelling clays in the soils can be definitively determined.

Acid-Sulfate Soils

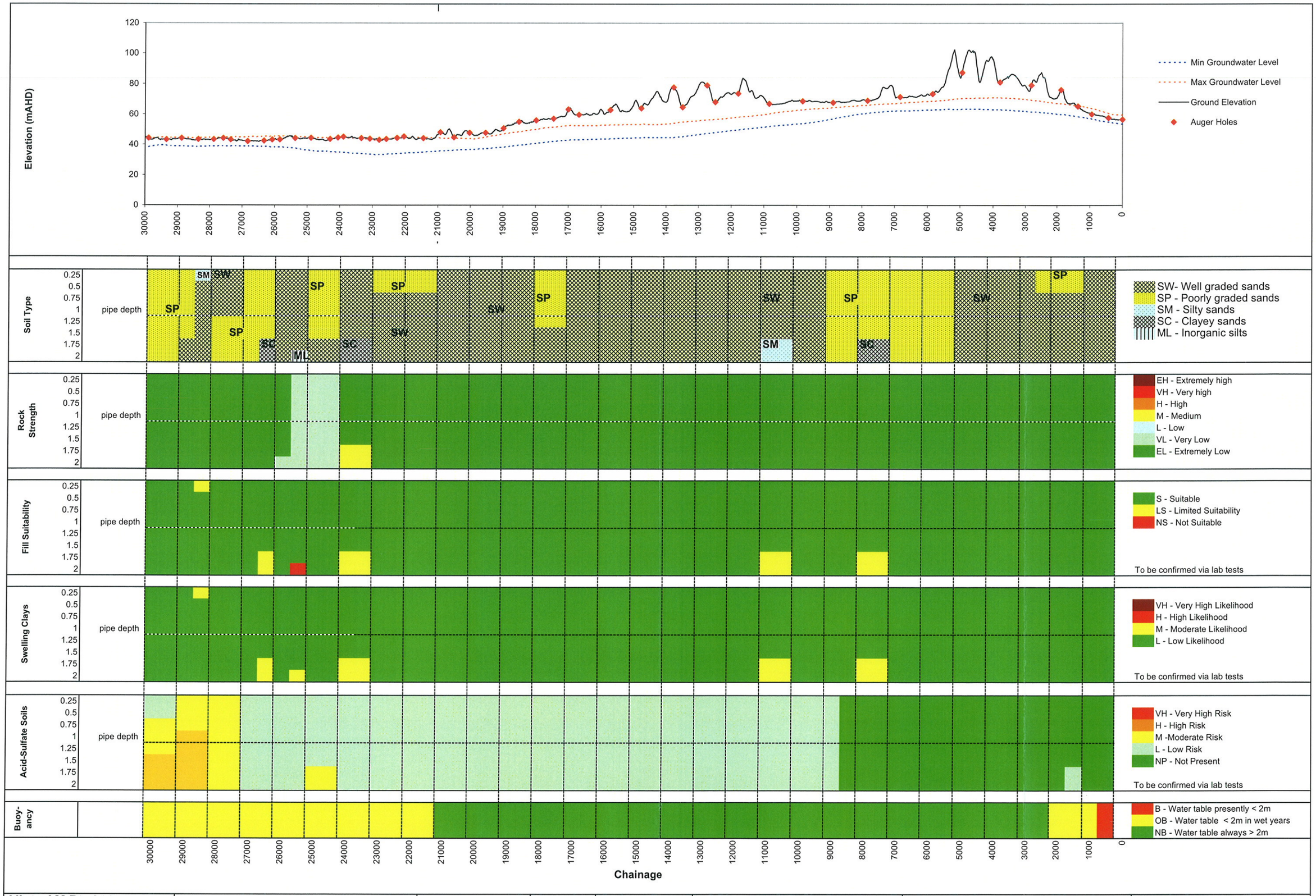
Acid-sulfate soils risk categories have been defined based on the Department of Environment acid-sulfate soil investigation guidelines, as follows:

ASS Code	Key
VH	Very high risk - pHf < 3.7 and/or pHfox <3, strong reaction with peroxide, and large ΔpH
H	High risk - pHf < 4.5 and/or pHfox <4.0 and strong reaction to peroxide
M	Moderate risk - pHf > 4.5 and pHfox > 4.0 and pHfox value at least two units below field pHF
L	Low risk - pHf > 4.5 and pHfox > 4.0 and pHfox value at least two units below field pHF and pHfox value at least one unit below field pHF
NP	Likely not ASS - no risk indicators present

Buoyancy Risk

Buoyancy risk was assessed based on observations of the water table in drill holes and water table mapping information from the Department of Water. Classes are as follows:

Buoyancy Code	Key
B	Buoyant - Water table regularly < 2m from surface
OB	Occassionally Buoyant - Water table potentially < 2m from surface in wet years
NB	Not Buoyant - Low risk of water table being < 2 m from surface



Alinta AM Pty Ltd **Neerabup Gas Pipeline**	Project: Neerabup Gas Pipeline Geotechnical & Acid-Sulfate Soil Assessment	Client: Alinta AM Pty Ltd Proj No: 07A1050	Revision A Drawn: RB	Date: 9 July 2007 Reviewed: DS	The figure presents preliminary field results only. Results are subject to confirmatory lab testing	**Field Geotechnical Assessment**

PENNINGTON SCOTT
Lateral Resources

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Table 7.1 NewGen Power's environmental management commitments

EXECUTIVE SUMMARY

NewGen Neerabup Pty Ltd (NewGen Power) proposes to develop a 330 MW Gas-Fired Power Station to supply additional power into the South-West Interconnected System (SWIS) during period of peak demand. The Project consists of a 330 MW gas-fired power station in the Neerabup Industrial Estate in the City of Wanneroo; a 30km gas pipeline with a compressor station and a 2km 330 kV transmission line to Western Power's Neerabup terminal (Figure 1.1).

The Proposal

NewGen Power's 330 MW Gas-Fired Power Station Project consists of:

- 330 MW open-cycle gas turbine (OCGT) power station;
- 30 km gas pipeline to provide fuel; and
- 330 kV transmission line around 2km long to connect to the SWIS.

Benefits of the Project

Benefits of the 330 MW Gas-Fired Power Station Project include:

- Provide additional generating capacity into the SWIS for periods of high demand;
- Reduce the greenhouse gas intensity of the SWIS;
- Bring new commercial energy products to the electricity market;
- Reinforce and improve the electricity transmission and distribution network in the rapidly growing northern metropolitan region; and
- Facilitate the development of the Neerabup Industrial Estate.

Community Engagement

NewGen Power has sought input about the Project from a range of stakeholders. Stakeholders have included State and Local Government agencies, local community and adjacent residents.

The major environmental issues raised have been:

- Air quality and greenhouse gas emissions;
- Vegetation, flora and fauna;
- Water resources and wetlands;
- Noise;
- Acid sulphate soils;
- Aboriginal heritage; and
- Public safety and risk.

These issues have been investigated and addressed by proper design or management measures to eliminate or reduce potential impacts. NewGen Power has committed to ongoing community engagement initiatives.

Environmental Assessment

Air Quality

An air quality assessment of the 330 MW Gas-Fired Power Station has been undertaken that models emissions from the power station and the cumulative impact of these emissions. The assessment concludes:

- The power station is not likely to have any adverse affects on local or regional air quality.
- Maximum concentrations of nitrogen dioxide, sulphur dioxide and particulates for the power station operating at full load are predicted to be well below the goals and standards at any location.
- The contribution to regional ozone levels is predicted to be insignificant and immeasurable.

- Greenhouse gas emissions are estimated to be about 0.7 million tonnes per annum.

Vegetation, Flora and Fauna

The proposed pipeline route utilises previously disturbed areas of native vegetation and the fringes of pine plantations.

Field surveys have been conducted to supplement previous studies of the native vegetation, flora and fauna in the project area. No listed species of flora and fauna have been sighted or are known to occur on or near the Project areas.

About 30 ha of native vegetation will be cleared for construction of the gas pipeline and transmission line. About 29 ha will be rehabilitated following construction.

The majority of native vegetation disturbed is within the Pinjar lateral of the Dampier to Bunbury Natural Gas Pipeline (DBNGP) corridor, from near Muchea to the Pinjar power station. This corridor has been extensively cleared for pipeline and power line construction and remains disturbed by access and maintenance activities. Around 8 ha of native vegetation will be cleared and rehabilitated in *Bush Forever* Site 380, of which 1.2 ha is bushland in very good condition. Rehabilitation will include measures to prevent weed infestation, permanent loss of fauna habitat and permanent loss of vegetation condition.

As the listed species Carnaby's Cockatoo is highly likely to be present in areas adjacent to the project area a search for potential nesting sites was conducted. Two trees have been identified as potential sites and will not be cleared during pipeline construction if the hollows are further assessed as suitable. The temporary loss of potential feeding resources is not significant compared to adjacent food sources such as the rest of *Bush Forever* Site 380 (8000 ha) and the Gnangara pine plantation (20,000 ha). Therefore the Project will not impact the Carnaby's Cockatoo.

In summary, the proposal disturbs a range of areas from pine plantation to native vegetation, in a range of conditions from very good to completely degraded. That said, areas that have higher conservation values are generally small, so that the overall impact of the project on flora, vegetation and fauna values should be minimal. To mitigate the effect of clearing native vegetation, NewGen Power has initiated an offset programme with the Department of Environment and Conservation to identify suitable land that can be added to the conservation estate.

Water Resources and Wetlands

The route for the gas pipeline is mostly within the Gnangara Underground Water Pollution Control Area (Gnangara UWPCA) which has a priority 1 source protection classification. Two conservation category and one resource enhancement category wetland will be slightly impacted by the proposal. The area of impact is small (around one hectare) and within existing highly disturbed areas of the wetlands and will not lead to further degradation.

The construction environmental management plan (CEMP) for the pipeline will include measures to control potential sources of water pollution and mitigate impacts from spills or incidents should they occur to ensure any effects would be temporary, and not result in long term water quality impacts.

All power station plant areas will be paved and hazardous materials located within bunded areas designed in accordance with Australian Standards. Wastewater will be contained in impervious pits or tanks. There will be no requirement

for licensed discharge of water from the site.

Noise

A noise modelling assessment has been carried out for the power station and for the compressor station on the gas pipeline.

The power station site is located within the Neerabup Industrial Estate. It is around 2 kilometers from noise sensitive residential dwellings. The compressor station is located on farm land and is also located away from residences.

Modelling results indicate that compliance with the *Environmental Protection (Noise) Regulations 1997* will be achieved at all locations.

Acid Sulphate Soils

Some sections of the project area have the potential to contain acid sulphate soils. Preliminary soil sampling shows the majority of the pipeline route has nil or low acid sulphate soil risk. Areas of moderate to high risk have been identified in and around the power station site. Management measures will be included in the CEMP to avoid or mitigate potential impacts in areas of high risk during construction.

Aboriginal Heritage

Archaeological surveys and ethnographic surveys have been conducted.

Searches of the Department of Indigenous Affairs' Register of Aboriginal Sites identified no sites within the project area. Surveys carried out in the project area by consultants, including Aboriginal consultants, found no evidence of new sites.

The CEMP for the project will contain measures to ensure heritage is addressed including;

- During initial ground disturbing activity aboriginal monitors will be employed;
- Employees will undergo heritage education as part of inductions; and
- Notification procedures will be developed for use if any archaeological material is encountered and will include the traditional owners.

Public Safety and Risk

The pipeline will be constructed according to Australian Standard *AS 2885 Pipelines – Gas and Liquid Petroleum* to meet safety standards. The standard includes measures such as depth of burial of the pipeline to prevent damage and appropriate signage to warn the public of the location of the pipeline.

Construction Environmental Management

A Construction Environmental Management Plan (CEMP) will be developed and implemented prior to construction. The CEMP will be developed to meet all environmental obligations and requirements for pipeline construction including the *Petroleum Pipeline Act 1969.* Construction of the power station and the transmission line will be similarly addressed.

Conclusion

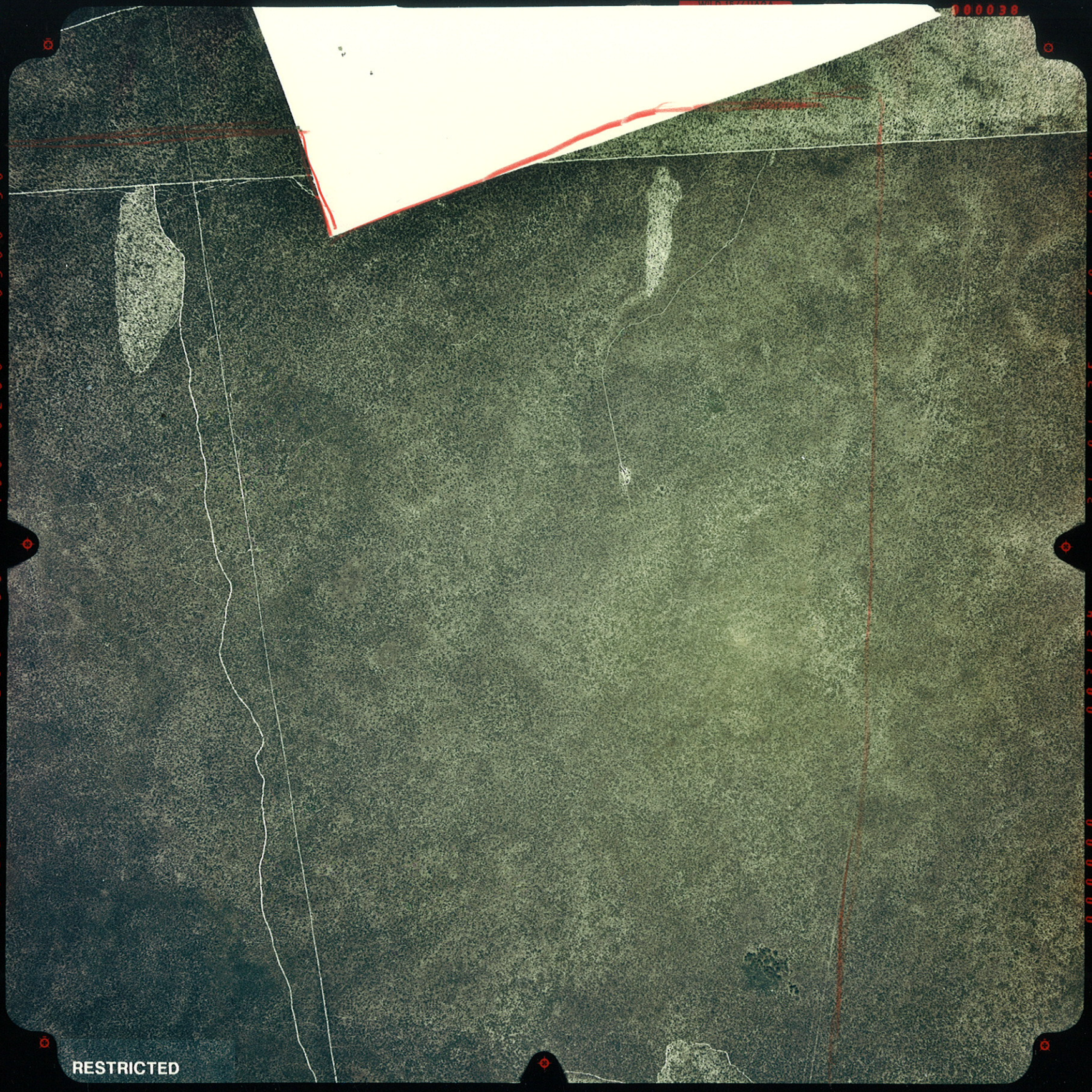
NewGen Power is developing a modern 330 MW gas-fired peaking power station in the Neerabup Industrial Estate; a 30km gas pipeline with a compressor station and a 2km 330 kV transmission line to Western Power's Neerabup terminal substation.

This document provides supporting information to demonstrate that:

- Air quality will meet the relevant criteria;

- Clearing of vegetation and impact on wetlands will be minimised and limited to degraded areas;
- Noise criteria will be met;
- Public safety will be managed;
- Acid sulphate soil risk will be minimized; and
- Water quality will be protected.

The proposal will comply with all WA legislative requirements and environmental impacts will be managed.



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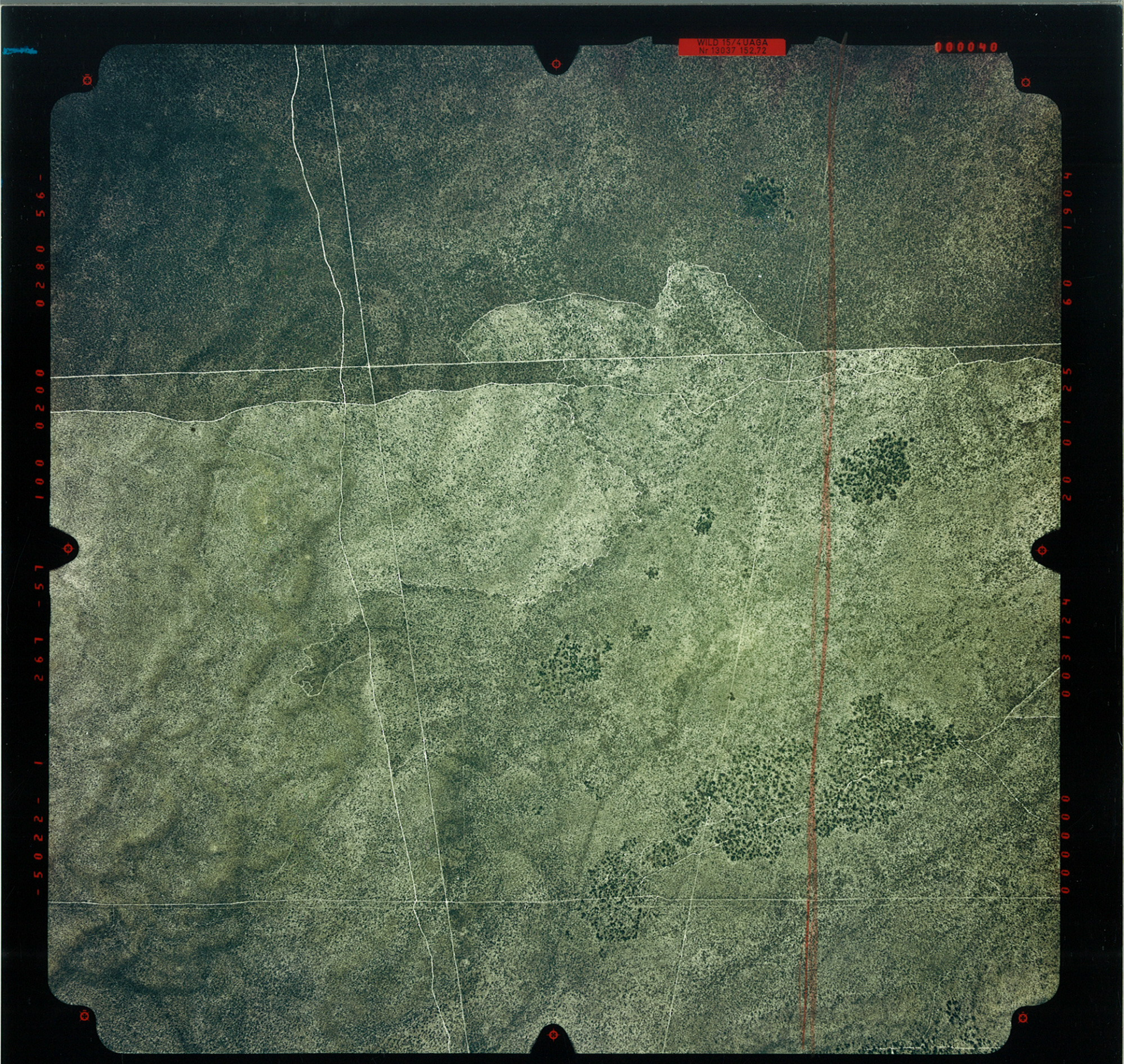

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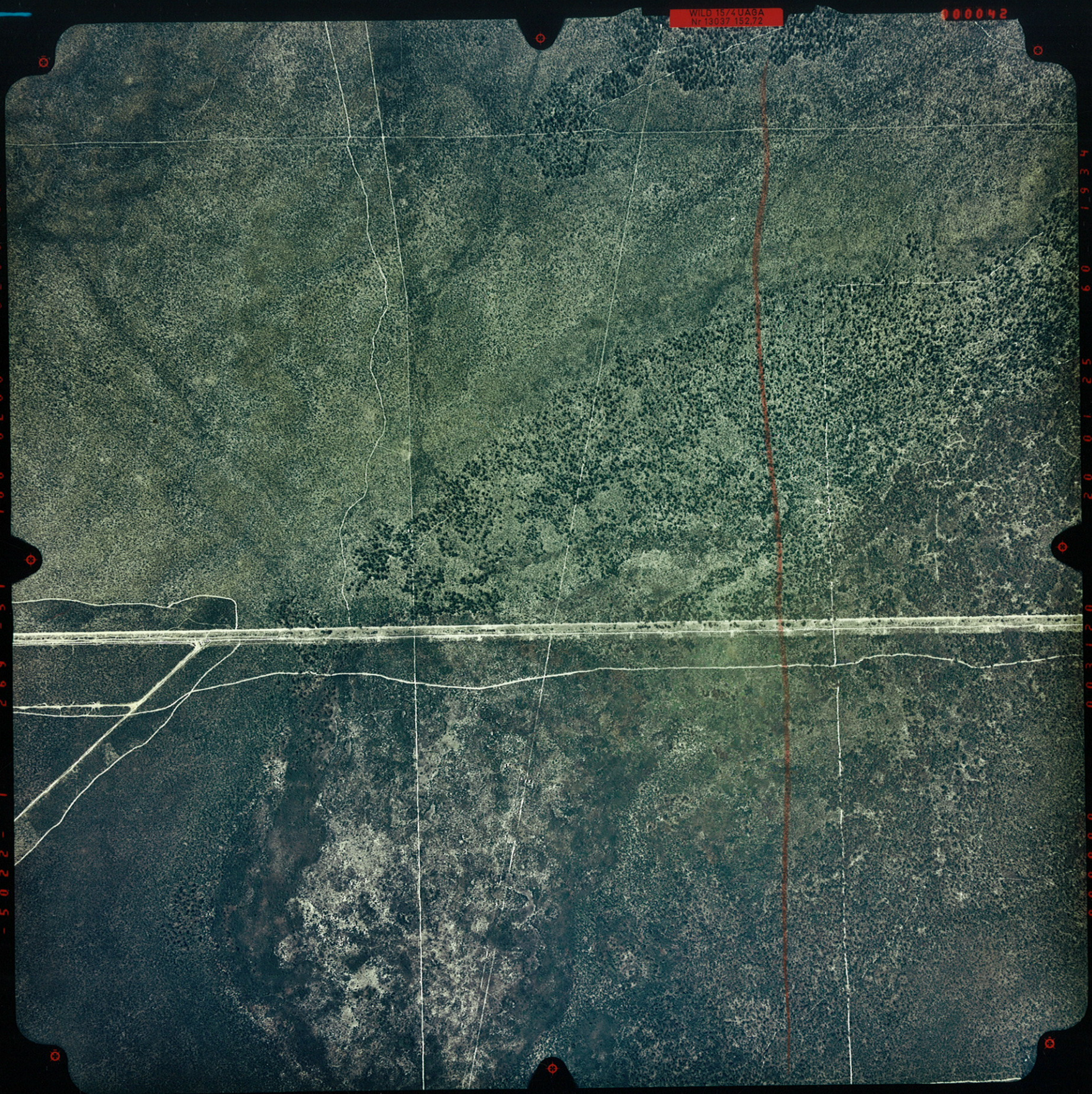
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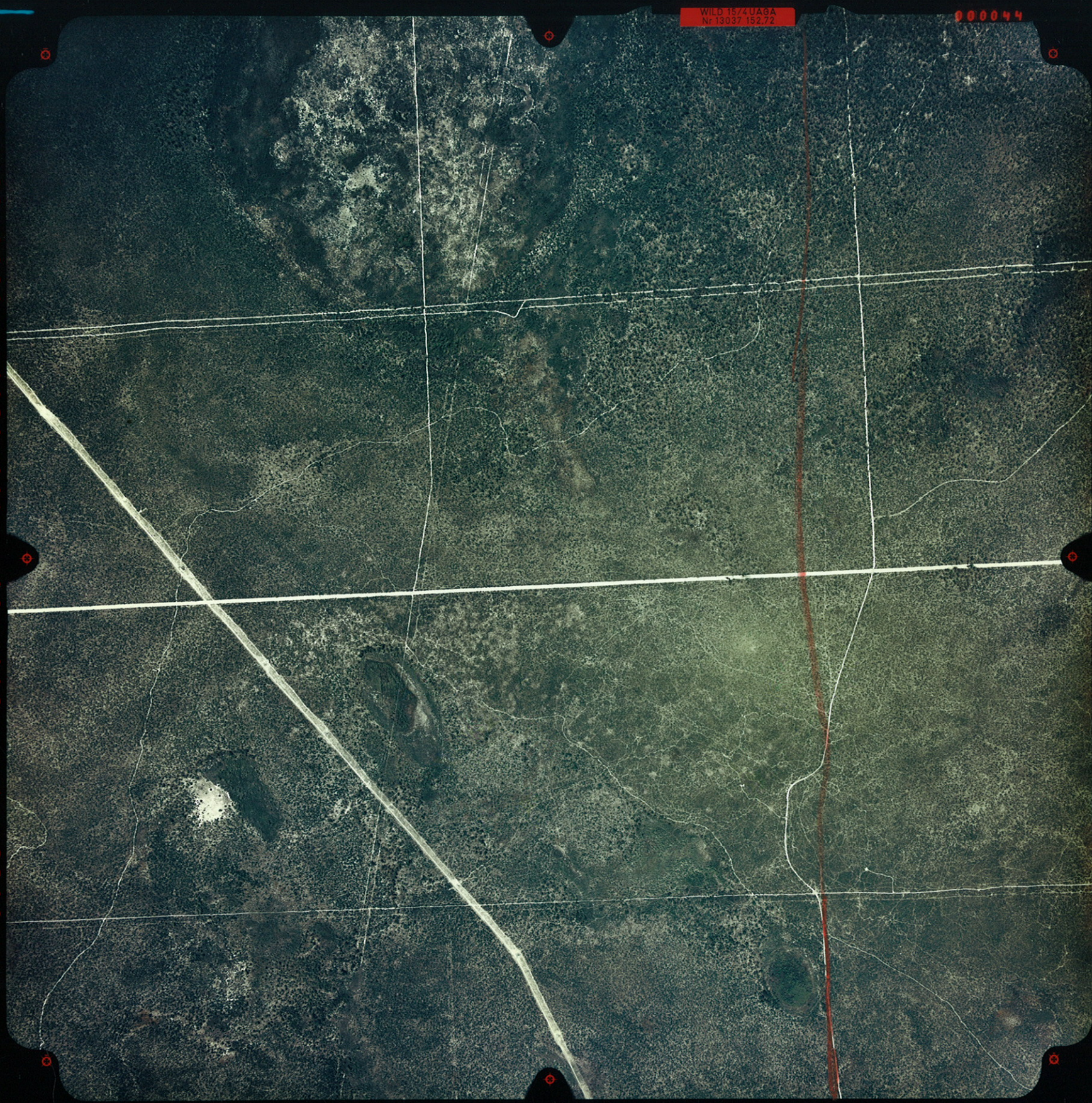

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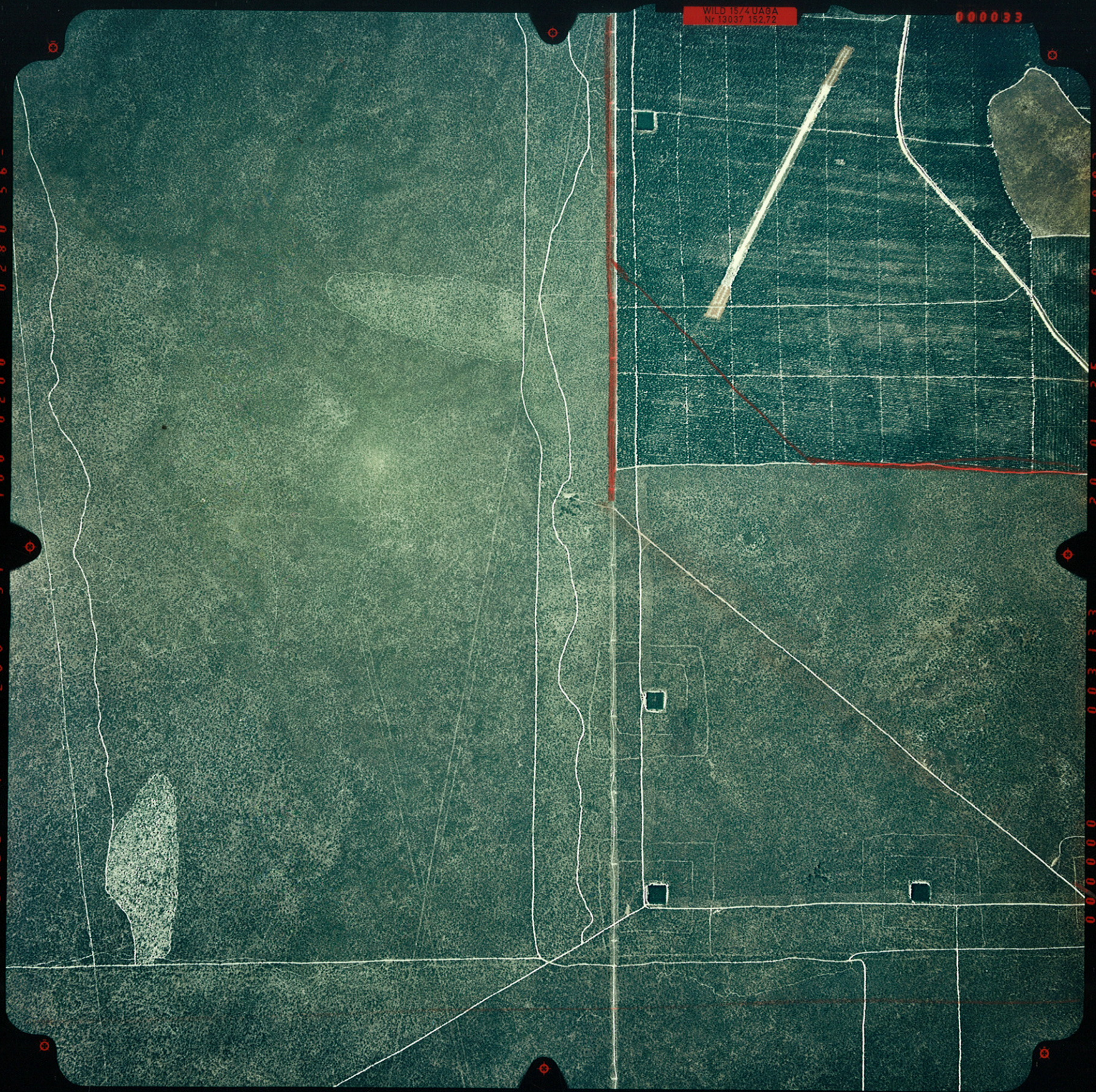

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