GREAT NORTHERN HIGHWAY - BINDOON SOUTH SLK 54.6 TO SLK 62.1

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT PLAN

Prepared for:

MAIN ROADS WESTERN AUSTRALIA

Wheatbelt North Region
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Prepared by:

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Acknowledgments

Limitations Statement

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KBR derived the data in this report primarily from nominate examination of records in the public domain, interrogation of databases provided by MRWA and sourced by KBR, and interviews with individuals with information about the site. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, KBR has relied upon and presumed accurate certain information (or absence thereof) relative to Great Northern Highway - Bindoon South SLK 54.6 to 62.1 provided by government officials and authorities, the Client and others identified herein. Except as otherwise stated in the report, KBR has not attempted to verify the accuracy or completeness of any such information.

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Revision History

Revision	Date	Comment	Signatures		
			Originated by	Checked by	Authorised by
A	19/7/05	Issued for internal review	EM	MR	MR
B	28/07/05	Issued for internal review	EM	MR	MR
C	08/08/05	Issued to client as draft	EM	MR	MR
0	11/08/05	Issued incorporating clients comments	EM	MR	MR
1	30/08/05	Internal review	EM	JR	JR
2	28/10/05	Issued for internal review	EM	JR	JR
3	01/11/05	Issued to client	EM	JR	JR
4	5/12/05	Final issue to client	JR	HG	HG
5	10/03/06	Reissued with clarification of commitments			

CONTENTS

TABLES

FIGURES

Summary

Main Roads Western Australia is proposing to upgrade and realign a section of the Great Northern Highway (GNH) between SLK 54.6 (just north of Burroloo Well) and SLK 62.0 (half a kilometre south of the Bindoon townsite) in the Gingin district. The proposed works are designed to improve the safety of this section of road as it has a higher than average vehicle crash rate (T.Saraullo [MRWA], pers. comm., August 2005). The crash rate for this section is 15 crashes per 100 million vehicle kilometres compared with the WA average crash rate of 6.9 crashes per 100 million vehicle kilometres. It also has a high crash rate involving heavy vehicles.

The following state environmental approval requirements were identified for the proposed road works which are planned to be undertaken in the Bindoon South section of the Great Northern Highway (54.6 to 62.5 SLK):

- An application for amendment to the Shire of Chittering Town Planning Scheme No. 6 will be made to reflect the minor planning scheme amendment which is required as a result of the proposed realignment.

- Referral under Section 48A of the *Environmental Protection Act 1986* (EP Act) for amendment of the Shire of Chittering Town Planning Scheme No. 6 is required for those sections of the road which are outside the existing road reserve road upgrade (Priority areas 2, 3, 5 and 6).

An application for a native vegetation clearing area permit for the section south of Brockman Bridge (between 54.6 and 59.0) has been made to the Department of Environment.

Referral under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) is not required due to the relatively minor impact on the habitat of Carnaby's cockatoo, an EPBC Schedule 1 listed species. The projects impact on this species is the clearing of one hollow and some feeding areas. Informal advice was provided by Environment Australia that this project is unlikely to be assessed which concurs with the findings of the Carnaby's cockatoo assessment that the project is not a 'controlled action'.

Given the public consultation that has been undertaken, the environmental management measures proposed in this document and that Main Roads has applied for a project specific area permit, discussions with the Environmental Protection Authority Service Unit (EPASU) indicate

that the impacts associated with the project are not significant enough to require the EPA to formally assess the project.

Based on the informal advice provided it is expected that each of the EPA referral processes will take approximately two months, assuming that no additional information is required by the agencies involved and that the EPA decides not to assess the proposed works. Advice from the EPA service unit is that the EPA is unlikely to assess the proposal.

In addition to normal issues associated with road widening, realignment and intersection improvement works, the following issues have been identified for this section of the Great Northern Highway:

- The proposed realignment will result in disturbance of the Chittering Lakes Nature Reserve at three locations (areas of 80, 208 and 80 m^2);
- most of this section of the Great Northern Highway is dieback infected or has a high risk of infection which will require appropriate management;
- weeds are present along most of this section of the Great Northern Highway and will require appropriate management;
- two Priority three (P3) flora species *Acacia drummondii* subsp. *affinis* and *Adenanthos cygnorum* subsp. *chamaeophyton* have been identified in the area of proposed works;
- management of drainage from the highway to prevent pollution of the adjacent Chittering Lakes Nature Reserve by hydrocarbons (and to a lesser extent elevated turbidity and litter) is necessary;
- some of the works to be undertaken are adjacent to heritage sites 478 and 479 (within priority 1 and 5 areas respectively) and a pre construction dilapidation survey will be undertaken at each site; and,
- one Carnaby's cockatoo nesting site and several feeding sites will be impacted by the proposed road works. A field assessment has established the presence of one hollow and a number of feeding sites which will be impacted by the road works.

Additional management commitments for this project are outlined in Section 6 and summarised below.

INDUCTION AND TRAINING

Commitment	MRWA will ensure that all personnel and subcontractors receive a standardised environmental induction which addresses the requirements of the EMP and relevant legal requirements.
Action	• Provide induction, • Regular toolbox meetings will be held which include coverage of environmental issues.
Objective	Protect the environment through awareness and training.
Location	On-site -prior to work commencement
Timing	Prior to work commencement.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

IMPACT ON VEGETATION

Declared Rare Flora and Priority Species

Commitment	Disturbance to the Priority Species identified during the Flora survey (Section 5.1.2) will be avoided where practicable.
Action	• Parts of two populations of two P3 species, *A. drummondii* subsp. *affinis* (25 of 87 plants) and *A. cygnorum* subsp. *chamaeophyton* (45 of 75 plants) require removal; • Consultation with CALM Species and Communities Branch has been undertaken (November 2005); • The populations of two priority species have been mapped; • Specimens of each species are to be registered at the WA Herbarium; • Clearing will be minimised, clearly marked and communicated (refer to 6.3.4); • Revegetation with each species (using collected seed or return of topsoil as appropriate) will be undertaken where practicable (6.3.4). • **Vegetation clearing boundaries will be distinctly marked.** • **Ingress of equipment and personnel during the construction phase outside of the limit of clearing will not be permitted. This will form part of the Environmental Induction for construction personnel on this project** • **Following completion of construction, earthwork batters and areas of disused road reserve will be revegetated with a species list which includes the Priority 3 species.** • ***Adenanthos cygnorum* subsp. *chamaephyton* and Acacia drummondii subsp. affinis will be planted as tube stock.**
Objective	"to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"
Location	Where Priority Flora occur in the project area.
Timing	Prior to disturbance of P3 species and during construction.
Responsible party	MRWA Project Manager and Construction Manager
Requirement /	CALM, Species and Communities Branch

Threatened Ecological Communities

There are no Threatened Ecological Communities (TEC's) identified within the project area. There are no management recommendations for TEC's.

Weed Management

Commitment	Minimise the spread of existing weed species and the introduction of new weed species into the project area.
Action	• Identify key construction activities likely to spread weeds. • Implement a weed management plan including the following commitments: ▪ **The Weed Management Plan will form part of the road construction specifications under "Clearing- MRWA Specification No 301". The Weed Management Plan will include the identification and location of the three main weed species particularly watsonia within the Contract Area** ▪ **For each weed species, the timing of the herbicide spraying before earthworks begin and spraying methodology including pesticide operator's licence, measures to protect the existing vegetation, herbicide product to be used and dosage, use of a dye and monitoring of mortality rate will all be documented.** ▪ Brush down or clean down of vehicles, machinery and personnel working in identified infested areas prior to working in uninfested areas; ▪ The use of clean 'weed free' fill and road building material for construction. ▪ Disposal of weed infested topsoil through burial or off-site disposal; ▪ Discuss the design and implementation of a watsonia control program with EBCG and CALM for project areas which abut Chittering and Needoonga Lakes. • The weed management plan will be consistent with dieback management techniques
Objective (Flora)	"to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"
Location	Throughout the study area.
Timing	During construction.
Responsible party	Construction contractor.
Requirement / Consultation	Consultation with CALM regarding a watsonia control program.

Clearing

Commitment	Obtain clearing permit (area) from DoE, minimise the impacts associated with vegetation clearing. Obtain approval from Conservation Commission of Western Australia (CCWA) to clear land within the Chittering Lakes Nature Reserve.
Action	• Implementation of minimum clearing protocols, including the establishment of vegetation clearing limits, should occur as part of final design; • Where vegetation clearing occurs, removal of mature trees should be minimised; • Areas outside the project area will not be disturbed as part of the proposed works; • The construction contractor will be made aware of requirements for minimising the potential for the generation of wildfire; • **Purchase of part of two properties to help compensate for clearing within and outside of road reserve, namely:** ▪ **Part of Lot 1 Certificate of Title 1024/846 Perth Diocesan Trustees (Land Area =1.0 ha) Refer MRWA land dealings plan no. 0560-060-1** ▪ **Part of Lot 954 Certificate of Title 1849/74 R.W & B.R Donaldson (Land Area = 0.3 ha) Refer MRWA land dealings plan no. 0560-061-2** ▪ **Subject to successful negotiation with Mr Kaye a small section (1.2 ha) of his**

	property Lot 3078 between the widened road reserve boundary and the Needoonga Lake boundary will be revegetated with suitable local upper-storey species to provide an enhanced buffer between the Highway and the Nature Reserve. ▪ **The possibility of obtaining a conservation covenant over this area has been discussed with Mr Kaye and he has expressed interest in undertaking this.** ▪ **Revegetation of the widened road reserve and the possible conservation covenant area will consist of:** ▪ **Zone 1 species less than 600 mm high** ▪ **Zone 2 species less than 4 m height (and stem diameter less than 100mm)** ▪ **Zone 3 consisting of area in which there are no height restrictions for revegetation species.**
Objective	Flora: "to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge" Conservation Areas: "to protect the environment values of areas identified as having significant environmental attributes"
Location	Wherever vegetation clearing is required within the project area.
Timing	Prior to commencement of works and during construction.
Responsible party	MRWA Project Manager.
Requirement / Consultation	A clearing permit (area permit) application has been made to the DoE (CPS 900/1). Obtain approval from CCWA to disturb parts of the Chittering Lakes Nature Reserve.

Dieback

Commitment	Minimise the introduction and spread of dieback (*Phythopthora cinnamomi*) within the project area (as described in Section 6.1.5).
Action	• Implement the management practices as described in "Managing Dieback - Detection, Mapping and Hygiene Practices". • Implement control measures as described in Appendix C Phytophora cinnamomi - Assessment Results and Management recommendations: GNH SLK 54.6-62.0 Bindoon South Flora Survey PEC 199.
Objective (Flora)	"To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge".
Location	Throughout study area. Hygiene points for incoming vehicle inspection and cleaning will be located at site entry points.
Timing	During construction.
Responsible party	Construction contractor.
Requirement / Consultation	Additional consultation with CALM Mundaring office may be required to clarify location specific information on dieback free borrow/fill areas.

IMPACTS ON FAUNA

Commitment	**To minimise the effect on fauna in the area to be cleared, particularly the Carnaby's black cockatoo and the oblong tortoise**. Referral to DEH under the EPBC Act if required.
Action	• **Install five artificial hollows for use by Carnaby's cockatoo for nesting;** • Take any injured native fauna to a designated veterinary clinic or a CALM nominated carer; • Report the presence of all large bird nesting sites or colonies so that they can be assessed prior to disturbance; • Existing weed infestations along project route will be treated and only native species will be used for rehabilitation; • Any trenching will be kept open for only as long as necessary and suitable escape ramps and bridging provided if site is to be left unattended for extended periods; • Areas outside the project area will not be disturbed during the proposed works; • Where possible revegetation of land with Carnaby's cockatoo feed species; • Limit disturbance to wetland fringing vegetation to minimise the impact on the great egret and freckled duck populations. • Fauna fencing and underpasses will be installed at selected locations to improve ability of oblong tortoise to cross the GNH.
Objective	"to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"
Location	Throughout study area where clearing will occur.
Timing	Prior to clearing and construction.
Responsible party	MRWA Project Manger/consultant.
Requirement / Consultation	**Consultation with CALM will be required if Carnaby's cockatoo eggs or chicks are found during the construction phase.**

RESERVES AND CONSERVATION AREAS

Commitment	Obtain approval from CALM/CCWA to temporarily disturb two and permanently disturb one area of Chittering Lakes Nature Reserve. Minimise the impact of proposed works on Chittering Native Reserve.
Action	• Areas outside the proposed works will not be disturbed as part of the project without

	permission from CCWA/CALM. • Approval from the CCWA has been sought to disturb three areas in the Chittering Lakes Nature Reserve. • Revegetation of areas of the Chittering Lakes Nature Reserve and other areas disturbed during project construction with local plant and feed species for Carnaby's cockatoo.
Objective	"to protect the environmental values of areas identified as having significant environmental attributes"
Location	Chittering Lakes Nature Reserve - the area adjacent to the common boundary of Chittering Lakes Nature Reserve and the proposed road works.
Timing	Approval prior to construction;
Responsible party	MRWA Project Manager.
Requirement / Consultation	CCWA/CALM

SURFACE HYDROLOGY AND WETLANDS

Commitment	Minimise the impact of proposed works on surface drainage and quality of the Chittering and Needonga Lakes System.
Action	• Road runoff will be managed to avoid direct drainage into the Chittering and Needoonga Lakes to ensure that water borne sediment or pollutants such as hydrocarbons are not discharged into the Lakes. • Only fill used in low-lying areas, no excavation. • Geofabric curtain used during construction where fill is placed adjacent to lake. • Geotechnical investigations to include sampling and subsequent testing for ASS. • Roadside soakage swales will be constructed to filter pollutants from run-off • Overland flow that is intercepted by the new works will be directed via table drains and into culverts • Generally sheet flow from the road pavement surface will be directed into table drains and culverts. In instances where outflow is into the Chittering Lakes Nature Reserve, sheet flow will be directed into revegetated swales and allowed to settle prior to discharge into the reserve. • Hazardous chemicals or fuels and oils will be stored at least 100m from rivers, creeks and lakes to avoid drainage into the Chittering or Needoonga Lakes. • Should there be a need to stockpile road construction or landscaping materials, appropriate bunds and drains would be constructed to prevent run-off into drainage lines in the event of heavy rain. • Best practice management guidelines for stormwater management as prescribed by the DoE will be followed.
Objective	Wetlands: "to maintain the integrity, ecological functions and environmental values of wetlands"
Location	Study area, however particularly within close proximity to Chittering and Needoonga Lakes.
Timing	Prior to construction/During construction
Responsible party	MRWA Project Manager
Requirement / Consultation	Not required

GROUNDWATER

There are no impacts expected on groundwater in proximity to the proposed area of works. There are no management commitments required.

PUBLIC WATER SOURCE AREA

There are no public drinking water source areas in the proposed area of works. There are no management commitments required.

ACID SULPHATE SOILS

Commitment	Minimise impacts from Acid Sulphate Soils (ASS) during project.
Action	• Conduct Preliminary Site Assessment for Acid Sulphate Soils as described in the DoE guideline "Identification and Assessment of ASS, October 2004" • Implement any required actions as a result of conducting the Preliminary Site Assessment.
Objective (Land)	"To maintain the integrity, ecological functions and environmental values of the soil and landform".
Water (surface and ground)	"To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected"
Location	Areas of excavation or cutting
Timing	Prior to excavation.
Responsible party	MRWA Project Manager.
Requirement / Consultation	Consultation with Department of Environment.

SALINITY

No significant impacts from salinity will result from the project and therefore no environmental management commitments are recommended.

ABORIGINAL HERITAGE

Aboriginal sites

Commitment	Comply with the requirements of the *Aboriginal Heritage Act 1972*.
Action	• Minimise disturbance to sites and areas of Aboriginal heritage. Undertake consultation with traditional owners as required. • Employ aboriginal monitors during the ground disturbance activity, under an agreement to be determined in the future; • Consider the request by the Aboriginal representatives for the installation of signage that acknowledges the Aboriginal Heritage of the area; • Take steps to ensure that MRWA comply with both the *Aboriginal heritage Act 1972*, *Heritage of Western Australia Act 1990*, and the Shire of Chittering's municipal planning schemes; • Staff and contracting personnel will be made fully aware of their obligations under the above Acts.
Objective	Heritage: "To ensure that changes to be biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation".
Location	Throughout project area.
Timing	Prior to commencement of works, during construction
Responsible party	MRWA Project Manager - Construction Supervisor
Requirement / Consultation	Consultation with elders conducted 6th October 2004.

Native Title

Commitment	To take into account native title considerations for works within Chittering Lakes Nature Reserve. Comply with the requirements of the *Aboriginal Heritage Act 1972.*
Action	• Two Native Title Claims over the project area: ▪ Combined Metropolitan Working Group Claim (WAG0142/98;WC99/006) ▪ Yued Claim (WAG6192/98;WC97/071) • Consultation with NTC representatives from the two claimant groups (completed 6th October 2004).
Objective	Heritage: "To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation".
Location	Project area
Timing	Prior to and during construction
Responsible party	Main Roads Project Manager,
Requirement / Consultation	Comply with requirements of *Aboriginal Heritage Act 1972*.

EUROPEAN HERITAGE

Commitment	To preserve all sites of heritage significance where possible.
Action	• Conduct a dilapidation survey of the Holy Trinity Church and former Chittering Roads Board. • Exercise caution if blasting works are required near to the Holy Trinity Church and former Chittering Roads Board. • Avoid the Upper Chittering Primary School site where possible. • Avoid damage to heritage sites. Where this is not possible, photographically record sites prior to destruction in consultation with a qualified heritage consultant and in compliance with the Government Heritage Property Disposal Process (GHPDP).
Objective	Heritage: "to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.
Location	Throughout study area.
Timing	During detailed design and prior to construction.
Responsible party	Construction Contractor, Main Roads Project Manager
Requirement / Consultation	Consult with Shire of Chittering if any items of heritage are to be impacted by the proposed works.

NOISE, VIBRATION, DUST AND AIR EMISSIONS

Commitment	Minimise the impact of noise, vibration, dust and air emissions during construction.
Action	• Implement noise, vibration and dust minimisation as described in section 6.11. • Implement standard construction management techniques to minimise air emissions of machinery during construction.
Objective (Noise)	"To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards"
(Air Quality)	To ensure that emissions do not adversely affect environment values, or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
Location	All construction works.
Timing	During construction.
Responsible party	Construction contractor.
Requirement / Consultation	Not required.

VISUAL AMENITY

As there is minimal impact on visual amenity, no management commitments are required.

PUBLIC SAFETY AND RISK

Commitment	Minimise risk to the public associated with the proposed works
Action	• Implement an approved traffic management plan to ensure all temporary signage for roadworks in accordance with Australian Standard AS 1742.3-2002 and Main Roads Western Australia Traffic Management for Works on Roads Code of Practice March 2004 including all amendments. • Maintain a tidy work site;

	• Appropriate fencing; • The use of rigid barriers and supports where required; • Appropriate signage.
Objective	Minimise risk to public safety as a result of works.
Location	All construction works
Timing	During construction
Responsible party	Construction contractor
Requirement / Consultation	Not required

CONTAMINATED SITES

As no contaminated sites were identified there are no management commitments.

FIRE MANAGEMENT

Commitment	Ensure appropriate fire prevention measures are taken.
Action	• All machinery will have spark arrestors fitted to the exhaust system; • All vehicles and plant will be fitted with fire extinguishers; • Water tankers, equipment and project personnel trained to fight fires in the work areas, will be provided; • MRWA will ensure that the project conforms to the Local Government Authority, CALM and Bush Fires Board (BFB) requirements for fire prevention.
Objective	Protect project and surrounding areas from fire.
Location	All project areas.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering, CALM, Bush Fires Board

WASTE MANAGEMENT

Commitment	Manage waste in an approved manner in accordance with Local Government requirements.
Action	• No rubbish shall be burned or buried on site. • Recycle waste materials where possible.
Objective	Manage waste in an environmentally responsible and approved manner.
Location	All project areas where waste is generated.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering

EQUIPMENT

Commitment	Use and maintain equipment to eliminate the spread of weeds or hydrocarbon spills in accordance with Dieback Management requirements.
Action	• All vehicles, plant and equipment will be cleared prior to commencement of work on site; • Records of vehicle, plant and equipment inspections will be maintained; • All materials imported to site will be weed free; • All vehicle servicing will be undertaken in designated areas. These shall be at least 100 metres from any waterway or wetland; • Vehicle refuelling shall be undertaken at least 100 metres from any waterway or wetland; • Prestart checks including presence of leaks or spills shall be undertaken for all equipment and recorded; • All fuels, oils and chemicals are to be stored in accordance with AS1940 and at least 100 m from any waterway or wetland; • All hydrocarbon contaminated rags, filter cartridges and other material will be returned to the workshop; • These materials will be recycled or disposed of in a manner and at a location approved by the Local Government Authority; • In the event of a spill of fuel, oil or chemical it will be contained, removed and disposed

	of in a manner and location agreed in writing by the Local Government Authority.
Objective	Minimise the potential for degradation of the environment from spills or contamination.
Location	All vehicles, plant and equipment.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering

EMERGENCY PLANNING

Commitment	Ensure adequate emergency response measures are in place.
Action	• Implement an Emergency Response plan for proposed works
Objective	Protect personnel and the environment in emergency situations.
Location	Vehicles, plant, equipment, workshops and chemical storages.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

ENVIRONMENTAL INCIDENT MANAGEMENT

Commitment	Manage environmental incidents effectively and in a timely manner. Report spills as required. Leave site in clean and tidy condition after completion of site works.
Action	• Immediately report pollution events or other incidents impacting the environment to the DoE (08) 9222 7123 or after hours (free call) 1800 018 800; • Ensure incident reports are produced which include date, time, chemical name, volume, location, area affected, actions taken for clean up and preventative actions; • Clean up all areas and dispose of litter appropriately.
Objective	Leave project area in clean and tidy condition on completion of project. Manage incidents in an effective way which minimises harm to the environment. Meet legislative requirements for reporting of spills and environmental incidents.
Location	All areas of works.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Report incidents to the DoE as required.

MONITORING AND AUDITING OF PERFORMANCE

Commitment	Ensure all above requirements are met through appropriate monitoring and auditing of performance.
Action	• Develop and implement a documented monitoring and auditing schedule. • Maintain an incidents and complaints register. • Conduct weekly inspections of construction areas using a checklist and maintain records of inspections.
Objective	Monitor and audit performance to ensure compliance with requirements.
Location	All areas of works.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

REPORTING

Commitment	To meet all reporting requirements throughout the project.
Action	• Review compliance with requirements and report exceptions fortnightly.
Objective	Ensure that all reporting requirements are met.
Location	All areas of works.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

SOCIAL IMPACT

Commitment	Minimise social impact of works.
Action	• Ensure Great Northern Highway remains open during construction phase. • Submit an application for Town Planning Scheme amendment to the Shire of Chittering.
Objective	Ensure the social impact of works on nearby residents and the public is minimised.
Location	Great Northern Highway 54.8 - 62.0SLK
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering

1 Introduction

1.1 BACKGROUND

Kellogg Brown and Root Pty Ltd (KBR) was appointed by Main Roads WA (MRWA) to undertake an Environmental Impact Assessment (EIA) for a proposed project to upgrade and realign sections of the Great Northern Highway between Standard Linear Kilometre (SLK) 54.6 (just north of Burroloo Well) and 62.0 (half a kilometre south of Bindoon townsite). The proposed works are aimed at improving the safety of this section of the National Highway.

In March 2005, KBR completed an Environmental Approvals Strategy (EAS) for the proposed works. The EAS was based on information obtained from a desktop assessment of existing database records, information provided by MRWA, state and federal government departments, and literature available in the public domain.

The primary objective of the EAS was to determine the environmental constraints associated with the proposed works, establish preliminary level of assessments which are required for approvals at a state and federal level and establish the regulatory expectations for approvals. The report provided a basis for discussion with local state and federal agencies about the need to refer the proposal for statutory approval.

The key findings of the EIA in terms of the statutory approvals which are likely to be required by the proposed works are summarised in Table 2.1 below.

1.2 SCOPE OF REPORT

This EIA documents significant environmental aspects and management commitments for the proposed project to upgrade and realign sections of the Great Northern Highway between SLK 54.6 (just north of Burroloo Well) and 62.0 (half a kilometre south of Bindoon townsite).

2 Description of the proposal

2.1 PROPONENT INFORMATION

Main Roads Western Australia

Wheatbelt North Region

Peel Terrace,

PO Box 333, Northam WA 6401

2.2 PROPONENT CONTACT

Mr Tony Saraullo

Project Manager

Phone: 08 9622 4700

Fax: 9622 3940

Email: tony.saraullo@mainroads.wa.gov.au

2.3 CONSULTANT CONTACT

Mr Jamie Reilly

Senior Environmental Scientist/Engineer

Kellogg, Brown and Root Pty Ltd

Phone: 08 9278 4100

Fax: 08 9278 4200

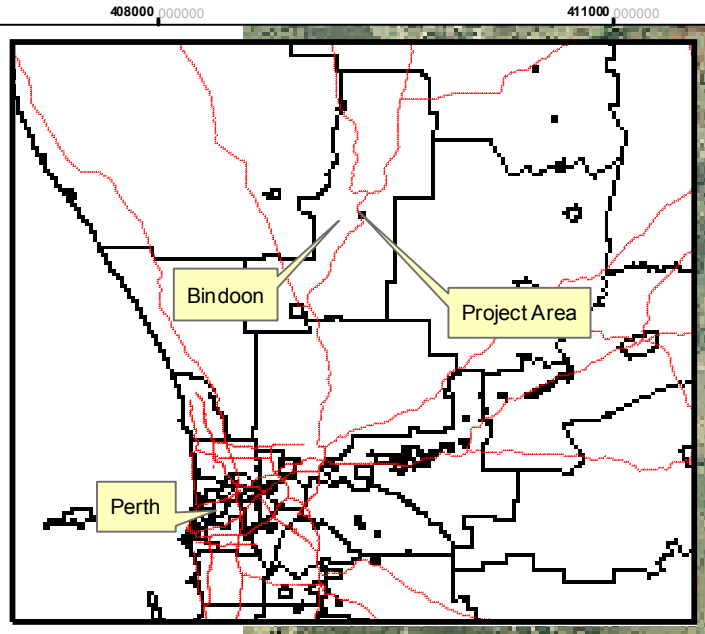
Email: jamie.reilly@halliburton.com

2.4 LOCATION

The project is located on Great Northern Highway (GNH) between SLK 54.6 (north of Burroloo Well) to SLK 62.1 (Bindoon Townsite) (Figure 2.1). It is located within the Shire of Chittering approximately 80 kilometres by road from Perth. The project is located to the NNE of Perth in the Brockman River valley.

2.5 JUSTIFICATION AND OBJECTIVES

The Great Northern Highway forms part of the Auslink National Network, previously known as the National Highway. As such any road improvements undertaken on this road must conform to minimum design standards.



408000 411000 414000 417000 420000

6532000 6528000 6524000 6520000

Mount Byroomanning Nature Reserve

Mount Byroomanning Nature Reserve

Bindoon

End of Project

extent of aerial photography

Chittering Lakes Nature Reserve

Julimar State Forest

Start of Project

Burroloo Well Nature Reserve

Legend

- SLK Markers
- Existing GNH
- GNH Proposed Design
- CALM Reserves

Prepared for
Main Roads
Western Australia

N

0 0.5 1 2 Kilometers

1:50,000 @A3

SOURCE All data supplied by Main Roads Western Australia, November 2004, (sourced through the relevant custodian)

GIS FILE	PROJECTION	FINAL APPROVAL	DATE
G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\EIA\REVD	GDA 1994 MGA Zone 50	REVD JR	18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

Drawn by K. Ross

TITLE

South Bindoon Site Location

FIGURE No. 2.1

PROJECT No. PEN414

The proposed works involve the upgrade and realignment of a part of the Great Northern Highway between SLK 54.6 (north of Burroloo Well) to SLK 62.1 (Bindoon Townsite). The GNH forms part of the National Highway linking Perth to the north of the State and the Northern Territory. The corridor for the highway has existed since the pioneering era in the late 1800's, with the last major upgrading works occurring during the early 1980's (T.Saraullo [MRWA], pers. comm., August 2005).

The Highway presents a continuous section of road with five side or local road intersections and private driveways and farm access, which will all be upgraded as part of the works. The width of the upgraded GNH varies from between 13 m and 18 m. For example the upgraded GNH is 17 m wide from the start of the project to SLK 55.8. From SLK 56.8 to Brockman River the width is approximately 18 m and near Flat Rocks Road it is typically 13m. The proposed upgrades and realignments are located in the Shire of Chittering

The upgrading of the highway between the parking bay 54.6SLK and to near the southern boundary of the Bindoon townsite 62.0SLK (refer to figure 3.1), is required to increase the road user safety of the existing highway. The existing highway deficiencies include:

- High vehicle crash rate (15 crashes per 100 million vehicle kilometres compared with the WA average crash rate of 6.9 crashes per 100 million vehicle kilometres);
- High crash rate involving heavy vehicles;
- Poor geometry that provides for poor forward approach sight distances;
- Narrow formation and seal width;
- Increasing rural sub divisions and tourism in the Chittering Bindoon area;
- Existing side road junctions such as Hart Drive, Chittering Road, Tea Tree Road, Spice Road and Flat Rocks Road are deficient in width and require turning lanes to cater for existing and future local traffic;
- Church and farm accesses require improvement;
- The highway borders the Class A Chittering Lakes Nature Reserve. This reserve is a Class A nature reserve and a critical asset as defined in the EPA 'Environmental Offsets" position statement (version 2);
- The existing side road intersections and private property accesses are inadequate to cater for current and future traffic (T.Saraullo [MRWA], pers. comm., August 2005).

The proposed improvements to the existing highway includes for general widening / reconstruction of the existing pavement with localised realignment of existing vertical and horizontal curves. The objective is to increase road user safety overall, in this section of the highway. The undulating nature of the existing ground and the restrictions to the nature reserve, waterways and private property will not allow the highway operating speed to change from the current operating speed.

The speed zoning on approach to the townsite after the proposed works will not change from the current operating speeds.

The provision of a future bypass around Bindoon has being determined as unviable due primarily to the development and implementation of the future Perth Darwin National Highway corridor located between Brand Highway and the existing GNH. A localised realignment option around the Bindoon townsite in the medium term to the west and east has been assessed as uneconomic due to the significant impacts on the Brockman River wetlands, and other associated complex environmental issues including extensive impacts on social community aspects and significant land severance issues (T.Saraullo [MRWA], pers. comm., August 2005).

2.6 LEGAL FRAMEWORK

The existing road reserve is documented in the Shire of Chittering Town Planning Scheme number 6, however some of the realignments will encroach on freehold land zoned agriculture which will require rezoning as road reserve (KBR, 2005) primarily at SLK 59.2 - 60.2. Amendment to the Shire of Chittering Town Planning Scheme will therefore be required (refer to Appendix I). The assessment of the town planning scheme amendment will trigger referral to the EPA by the Shire of Chittering for this project.

Resumption of land will be required and has been discussed with freehold land owners (T.Saraullo [MRWA], pers. comm., August 2005). The identified sections affected under the initial design are 56.75 to 57.9 and 59.4 to 60.5 SLK. Disturbance of land within the Chittering Nature Reserve is outlined in section 5.3.

The specific areas of freehold land to be resumed are the southeast corner of the Donaldson's property and the southeast corner of land belonging to the Perth Diocesan Trustees. The land is on the eastern side of the GNH and is to be resumed for the purposes of adding to the existing road reserve and for rehabilitation to increase the vegetation buffer between the Chittering Lakes Nature Reserve.

MRWA will be responsible for negotiations with land owners and for rehabilitation of acquired land on completion of the project.

Main Roads Western Australia, the Shire of Chittering, freehold land owners and the Environmental Protection Authority will be required decision making authorities for rezoning of the land.

The clearances required under legislative processes are discussed in table 2.1 below

Table 2.1 - Clearances required under legislative provisions

Act	Trigger Action	Approval required	Agency
Aboriginal Heritage Act 1972	Proposal may affect any Aboriginal heritage site	No aboriginal heritage sites in project area. Consultation with local custodians resulted in amicable agreement to proposed works.	Consultation with the Department of Indigenous Affairs
Environment Protection and Biodiversity Conservation Act 1999	Proposal will affect threatened fauna and flora recognised under the EPBC Act - "controlled action"	One hollow directly impacted by project. Advice received from DEH that impact is not significant.	Commonwealth Department of Environment and Heritage

Act	Trigger Action	Approval required	Agency
Environmental Protection Act 1986 Environmental Protection Clearing of Native Vegetation Regulations 2004	Clearing or destruction of native vegetation.	A Native vegetation clearing permit is required from DoE as the project will occur after the 8th of January 2006. This application has been submitted (ref. number CPS 900/1).	Department of Environment (Native Vegetation Protection Section)
Environmental Protection Act 1986	Part IV 48, Environmental Impact Assessment	Project requires assessment due to rezoning of freehold land to road reserve. Referral by Shire of Chittering.	Environmental Protection Authority
Heritage of Western Australia Act 1990	Proposal may affect a registered site or a place subject to a Heritage Agreement.	Not required. No state or national heritage sites within project area.	Heritage Council of Western Australia
Land Administration Act 1997	Part 4 – Reserves	Consultation with CALM and CCWA to disturb parts of Chittering Nature Reserve. Excision of land required.	Department of Land Administration
Rights in Water and Irrigation Act 1914 (Section 17)	Proposal will interfere with the bed or banks of a watercourse.	Area is proclaimed, however permit is not required as abstraction of groundwater or surface water will not occur and there will be no interference with beds or banks or a watercourse.	Department of Environment
	Proposal to take water from proclaimed groundwater or surface water areas	Licence under the RIWI Act is required if abstraction of groundwater is required. Not required for this project.	Department of Environment
Waterways Conservation Act 1976	Proposal is sited on specified waters and associated land that is subject to a management program.	Not required. A management program as defined by this act does not exist for the proposed project area.	Department of Environment
Western Australian Planning Commission Act 1985	Changing town planning schemes	Application to WA Planning Commission via Shire of Chittering to change the zoning on the land and Subsequent referral to EPA.	WA Planning Commission/ Shire of Chittering

2.7 ALTERNATIVE DESIGNS

2.7.1 Current Design

The design presented in this document is the third iteration as previous designs were not suitable due to problems with the horizontal and vertical geometry and encroachment of the road on the Chittering Lakes Nature Reserve.

The presence of the Nature Reserve and the associated wetlands has limited realignment options.

Many design changes have been made to reduce the impact on the environment and compromises to the relevant Austroads standards have been made due to the environmental sensitivity of the area and other constraints.

The Austroads standards were being compromised in order to minimise impact on the local environment. Changes included:

- Design speed reduced from 110 Km/hr to 100 Km/hr;
- New road embankment batters (fill batters) reduced to 1:2 and new road cut batters steeped in as much as possible, to the maximum ratio of 1:2 in order to decrease the overall width of vegetation clearing;
- Vertical profile of the new road does not conform to desirable geometry in order to maximise the use of existing road pavement;
- The horizontal alignment was amended three times to avoid the Chittering Lakes Nature Reserve boundary and also previous designs showed significant encroachment into the nature reserve;
- Horizontal and vertical alignment amended to maximise the distances from heritage buildings such as the Bindoon Arts and Crafts Centre, former Chittering Roads Board building and Holy Trinity Anglican Church;
- Following the Carnaby's cockatoo foraging and potential nesting sites survey, the alignment has avoided trees that have being identified as potential nesting sites. However one tree utilised during the 2005 nesting season and located near to the Brockman Bridge, requires removal due to safety reasons.
- The proposed design includes rehabilitation and revegetation of portions of disused road pavements;
- The design allows for revegetation with native species in sections of the road reserve that are being widened, which was previously open farmland;

2.7.2 Perth Darwin National Highway

Alternative designs which were considered included utilising the future Perth to Darwin Highway alignment, however this proposed route is too far to the west of the existing highway to be used by local residents and is not scheduled for construction for approximately 20 years (T.Saraullo [MRWA], pers. comm., August 2005).

Design of the realignment to the east of the existing road, north of Brockman Bridge was investigated, to increase the distance of proposed works from the wetlands and lake system, however it was not feasible to undertake as it required significant vertical as well as horizontal geometry modification (T.Saraullo [MRWA], pers. comm., August 2005).

2.7.3 Do Nothing

The do nothing alternative was considered, however given the high number of road accidents in the project area, this is not considered a viable option.

2.8 KEY PROJECT CHARACTERISTICS TABLE

Table 2.2 - Key Characteristics of Bindoon South realignment

Characteristic	Description
Road upgrade length	8.5 km
Clearing area	7 ha of vegetation and 8 ha of agricultural land (15 ha total)
Road pavement and surface	Asphalt with base course laterite/gravel, 360mm deep
Preliminary design	Single carriageway with one passing lane
Drainage features	Extension of existing culverts, installation of new culverts
Bores	NA
Borrow pits	Not required
Waterway	Lakes Chittering and Needoonga
Intersections	5 local intersections
Pedestrian/equestrian underpass	NA
Lights	NA
Signs	Aboriginal Heritage
Dual use paths	NA
Construction	Bitumen
Staging	Refer to table 3.2
Operation	Immediately after construction of each stage is completed.

2.9 BORROW PITS

There will not be a requirement for borrow pits in the scope of the proposed works as material from cuttings will be used as fill material where required. If additional fill material is required it will be purchased from a commercial supplier in accordance with MRWA specifications.

2.10 TIMING AND STAGING OF THE PROJECT

Table 2.3 - Timing and Staging of the Project

Task	Duration	Start	Finish
EIA Assessment	8 weeks	Dec 05	Feb 06
Construction Stage 1	8 weeks	Mid Feb 2006	Mid April 06
Brockman Bridge south, to south of Tea Tree Road intersection			
Construction Stage 2	14 weeks	Mid Feb 07	Mid May 07
Tea Tree Road Intersection to Hart Drive			
Construction Stage 3	14 weeks	Mid Feb 07	Mid May 07
Brockman Bridge north to Bindoon			

3 Existing environment

3.1 CLIMATE

Bindoon townsite is a small town surrounded by grazing and cropping ventures, located on the Great Northern Highway 80km north east of Perth. The region has a temperate or dry mediterranean climate characterised by hot dry summers and cool, wet winters. Median and mean annual rainfall at Bindoon are 673 mm and 691 mm respectively, mostly falling in May-August with an annual evaporation of approximately 2000 mm (Smith, 2002). Bindoon has slightly cooler temperatures than Perth although it is only located 80 km north of Perth. The cooler temperatures are influenced by the elevation of between 100 and 400m AHD and winter frosts in the valleys.

Extreme weather events are not typical of the mediterranean climate, with annual rainfall generally recorded across a series of rainfall events in the winter period. Some summer rain can also be recorded but is normally minimal. The section of the GNH with the proposed works is not subject to flooding apart from the section between the Brockman Bridge and 500m north.

3.2 LANDFORMS, SOILS AND GEOLOGY

The project area is located near the western edge of the Darling Plateau (Yilgarn Block) with the Darling Scarp situated approximately three kilometres to the west. Belts of schists are characteristic of the local geology and are referred to as the "Chittering Metamporphic Belt" (Goble-Garratt, 2005). These are part of the very old and stable Archaean rocks which form the Yilgarn Block.

Soils found in the project area are part of the Bindoon Unit (Churchward and McArthur, 1980) and are recognised as being those of the slopes of a major valley in the Darling Plateau. They comprise shallow red and yellow earths with much rock outcrop and little surface laterite.

The terraces of the Upper Brockman River are distinguished by yellow duplex soils and sandy deposits and are situated very close to the area of the proposed works over most of the length of the project (Goble-Garratt 2005). The Brockman soil unit is found on the valley floors of the region and consist of narrow terraced floor with red earths and brown alluvial soils. The Bindoon soil unit is found further up the valley on the major valley slopes and scarps and consists of steep irregular slopes with shallow red and yellow earths and much rock outcrop, sometimes a gently sloping apron at base.

The underlying geology, and the presence of a major river results in a markedly undulating landscape in the vicinity of the project area. The highway avoids major

hills in the region and follows the valley floor, crossing the Brockman River and then rising before entering the Bindoon Townsite.

3.3 HYDROLOGY

The Brockman River is classified as a non-perennial river, however the southern section now flows through summer. Rising groundwater levels are indicated by the changing flow patterns of the Brockman River and its tributaries. No summer flows have been measured for the northern section of the Brockman River. However, oral history recalls that 30 years ago the Udamung Brook flowed only after heavy rains; Udamung Brook now flows till early summer (Smith, 2002).

The only bore data that could be obtained from the Department of Environment is quite dated, with the most recent readings taken in 1996. The data suggest that the water level ranges between 2.0 m and 10.0 m below ground level in the immediate vicinity of the proposed works. In areas further away from the wetlands the groundwater level is around 5.0 to 7.0 m whereas closer to the Chittering and Needoonga Lakes, the water level rises to within 2 m of ground level. One bore near the project area and wetlands shows the groundwater at a depth of 9.1 m.

3.4 SIGNIFICANT ENVIRONMENTAL ASPECTS

3.4.1 Vegetation and Flora

General

The project area is located on the boundary between Beard's Darling and Chittering Vegetation Systems in the Darling Botanical District. The Darling system comprises marri-wandoo woodland on younger red soils of the scarp and the slopes of the deeply excavated Avon, Helena and Chittering Valleys and rivergums and paperbarks along the watercourses in these valleys (Beard, 1981). The Chittering system lies immediately to the North of the Darling system and the elements of the landscape are basically the same as in the Darling system. However the Chittering System comprises york gum in the lower valley slopes (Beard, 1981). No york gum (*Eucalyptus loxophleba*) woodland is present in the project area.

Vegetation found in the project area is predominantly *Corymbia calophylla* (marri)/*Eucalyptus wandoo* (wandoo) woodland on the slopes of the major valley systems, with flooded gum and paperbarks dominating the watercourses in these valleys (Beard, 1981).

The vegetation of the area belongs to the following Vegetation Complexes:

1. Murray and Bindoon Complex in Low to Medium Rainfall (Major valleys – combining slopes and floors). This complex occurs at the start of the project area and again immediately north of the Brockman River crossing where the valleys are only moderately incised.
2. Bindoon Complex (Major valley floors and scarps). This Vegetation Complex is represented for approximately two kilometres south of the Brockman River crossing, and again immediately south of the Bindoon Townsite. This coincides (approximately) with Beard's Chittering System, and is characterised by york

gum (Eucalyptus loxophleba) on lower valley slopes, flanked by wandoo higher upslope.

3. Nooning Complex. (Major valley floors and scarps). This complex is restricted to the upper valley floors of the Brockman River. This complex abuts the project area where it traverses the Brockman River valley, and also occurs where the highway crosses the river. The distinctive feature of this Complex is the presence of low open forest of swamp sheoak (*Casuarina obesa*) and of the presence of swamp sheoak with flooded gum and freshwater paperbark along streams.

The project area is a floristically rich area of Western Australia. In 1992 Griffin completed a detailed floristic survey and analysis of remnant vegetation in the Bindoon to Moora areas, including the project area. A total of 1032 native species were recorded along with a large variation in vegetation types; Griffin defined 45 major types all with a number of sub-types or variants. There are only remnants of native vegetation in the project which are in varying condition due to a long history of agricultural settlement in the area (Goble-Garrett, 2005).

There are two lakes located within the project area (Chittering and Needoonga) which are part of the Chittering Nature Reserve. This reserve is considered to be significant for the protection of the freshwater paperbark (Griffin, 1992).

FLORA SURVEY

A botanical investigation was undertaken in late spring to early summer of 2004/05 (Goble-Garratt, 2005). The survey covered the roadsides of the existing highway and areas immediately adjacent, extending 50 metres either side of the existing or proposed footprint, whichever was the greatest distance (Appendix A).

A systematic method was employed for the flora survey, consisting of 10 x 100 m^2 sites to comply with current survey method used by the Department of Conservation and Land Management. The dimensions of the sites were dependent on the width of the roadside area. Species were also recorded opportunistically throughout the survey.

3.5 PRE-EXISTING COMMITMENTS AND CLEARANCES

Table 3.1 - Pre-existing commitments and clearances

Clearance/Approval	Date Granted	Dept.	Documentation
Existing Highway	30/11/04	Shire of Chittering	Shire of Chittering Town Planning Scheme No. 6.

4 Environmental Aspects

Table 4.1 - Environmental Aspects, EPA Objectives and Outcomes

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Principles of Environmental Protection	1. The precautionary principle 2. The principle of intergenerational equity 3. The principal of the conservation of biological diversity and ecological integrity 4. Principles relating to improved valuation, pricing and incentive mechanisms 5.The principle of waste minimisation	Road was constructed before these principles were published so were not considered in design	Negative project impact on principles	1. Careful consideration has been made to minimising the project's potential impact on the environment within difficult design constraints. Five artificial Carnaby's Cockatoo hollows to replace one hollow removed. Carnaby's Cockatoo feeding species returned in revegetation where practicable. Fauna crossings and fencing to be incorporated in road design to encourage oblong tortoises to cross under the GNH. 2. Refer above. 3. Refer above. Also revegetation will utilise local native species where practicable. Improvements in road design should reduce vehicle crash rate and subsequent potential for pollution to enter Lakes Needonga and	Project will be managed to meet these principles where practicable

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
				Chittering. Revegetation along realignment in northern section of project will in time provide a corridor for fauna movement. 4. Disincentives i.e. penalties will be in place for unnecessary clearing etc. 5. Waste minimisation included in design by balancing cut and fill where possible.	
BIOPHYSICAL					
Flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	There are two priority 3 species in the project area. *Acacia drummondii* subsp. *affinis* and *Adenanthos cygnorum* subsp. *chamaeophyton*	Loss of priority 3 species and remnant vegetation.	Survey and demarcation of P3 populations. Consultation with CALM undertaken. Collection of seeds from *A. drummondii* subsp. *affinis* and use of soil from around *A. cygnorum* subsp. *chamaeophyton* for revegetation. Vegetation offsets of similar quality to cleared vegetation.	Flora will be managed to meet the EPA objective.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Carnaby's cockatoo feeding and nesting sites are present in the project area. Other priority fauna such as the chuditch may also be present. Chittering Lakes Nature Reserve (CLNR) provides habitat for the great egret and freckled duck populations. Tortoise population present in lake	There will be an impact on one (site 20) tree containing a hollow utilised by Carnaby's cockatoo for nesting in 2005. Loss of Carnaby's Cockatoo feeding areas. No significant impact on other species.	Install five man made hollows nearby. Revegetate disturbed areas with Carnaby's cockatoo feed species.	Hollow successfully relocated and or replacements installed. Minimal impact on Carnaby's cockatoo and other fauna. Fauna can be managed to meet EPA objective.
Wetlands	To maintain the integrity, ecological functions and environmental values of wetlands.	Lakes Needonga and Chittering are conservation category wetlands.	Contamination from run-off, spills, equipment servicing and refuelling causing pollution in the lakes. ASS discharging to lakes. Sediment generation where fill is placed adjacent to lake.	Only fill used in low-lying areas, no excavation. Geofabric curtain used where fill is placed adjacent to lake. Geotechnical investigations to include sampling and subsequent testing for ASS. Equipment maintenance and refuelling, hazardous chemicals and hydrocarbons storage to be at least 100m from any watercourse. Drainage swales will be installed to prevent contaminants from run off entering the lakes during normal road operations.	No significant impact on lakes and waterways in or adjacent to the project area. Aspect managed to meet EPA objective

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Water (Surface and Ground)	To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	Chittering and Needoonga Lakes are in close proximity to the project area. Groundwater is present in the area, however there will be no impact on it within the scope of the proposed works.	Contamination from run-off, spills, equipment servicing and refuelling causing pollution in the lakes.	Equipment maintenance and refuelling, hazardous chemicals and hydrocarbons storage to be at least 100m from any watercourse. Drainage swales will be installed to prevent contaminants from run off entering the lakes during normal road operations.	No impact on lakes and waterways in or adjacent to the project area. Aspect managed to meet EPA objective.
Land (terrestrial)	To maintain the integrity, ecological functions and environmental values of the soil and landform.	Most of the soils and some landforms in the project area are modified due to agricultural, residential and transport land uses.	Disturbance of soils and landforms as part of project	Minimise disturbance as far as practicable. Stockpile and return topsoils where practicable. Revegetate disturbances with local vegetation.	Some disturbance to soils and landforms. Satisfactorily managed by relevant management commitments.
Conservation Areas	To protect the environmental values of areas identified as having significant environmental attributes.	CNLR is adjacent to the project area.	Three small sections of the GNH encroach on the nature reserve. Two temporary (<0.002ha) disturbances and one permanent disturbance (<0.008ha) to the reserve are required. Approval will be sought from CALM	Minimise disturbance as far as practicable. Revegetate disturbances with local vegetation and feed species for Carnaby's cockatoo. Excision of area of permanent disturbance within the Nature Reserve.	Minimal disturbance to Nature Reserve. Reserve managed to meet EPA objective.
Acid Sulphate Soils (Land, terrestrial)	To maintain the integrity, ecological functions and environmental values of the soil and landform.	Areas near Chittering and Needoonga lakes have potential for acid sulphate soils to be present in the area.	Exposure of acid sulphate soils to oxygen, production of acid run-off. Possible impact on water ways if not properly managed.	Preliminary Site Assessment according to DoE guidelines to be undertaken prior to works commencing. Results will guide the need for further assessment and management strategies.	Investigations will determine appropriate management requirements. ASS will be managed to meet EPA objective.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
POLLUTION MANAGEMENT					
Air Quality	To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	The surrounding land-use consists of commercial farming, rural residential and residential subdivisions and a nature reserve.	Adverse air emissions not expected to occur due to proposed works.	Minimise air emissions by ensuring equipment is well maintained and serviced regularly	Air emissions can be managed to meet EPA's objective.
Water Quality (surface or ground)	To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	Increasing salinity in Lakes Needonga and Chittering over time. Groundwater in the Brockman River catchment area is utilised for domestic and agricultural applications.	Only impact on surface water quality if sediment leaves project footprint during construction or acid sulfate soils (ASS) are disturbed	Geotechnical investigations to identify potential ASS. Contractors to undertake the minimum clearing necessary.	Project can be managed to prevent adverse impact on marine
Noise and vibration.	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	The surrounding land-use consists of commercial farming, rural residential and residential subdivisions and a nature reserve.	Noise levels are expected to increase during construction works. Vibration may also be produced and be a nuisance to nearby residents. Noise may affect fauna in the CLNR.	Implement noise and vibration minimisation techniques during construction. Noise unlikely to affect fauna in the CLNR.	Noise and vibration can managed to meet EPA's objective.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Dust	Ensure that the dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards.	The surrounding land-use consists of commercial farming, rural residential and residential subdivisions and a nature reserve.	Dust is expected to be produced during construction, however dust mitigation practices will be used and should minimise the amount of dust generated.	Implement dust minimisation techniques.	Dust can be managed to meet EPA's objective.
SOCIAL SURROUNDINGS					
Aboriginal and European Heritage	To ensure changes in the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	No Aboriginal heritage sites identified within proposed area of works. Three European heritage sites identified within area of proposed works.	Proposed works will impact on church grounds. Vibration may adversely impact heritage sites.	A dilapidation survey will be undertaken on the Trinity Church and Old Road Boards Building site and consultation has been undertaken for land acquisition. Vibration reduction will be undertaken where possible and documented in a construction EMP.	Heritage sites can be managed to meet EPA's objective.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
Visual Amenity	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.	Surrounding land use is agricultural, residential and conservation. Most areas of remnant vegetation are disturbed.	Loss of vegetation may cause temporary impact, revegetation will reduce impact.	Revegetation on completion of project.	Visual amenity will not be impacted by proposed works.

4.1 IMPACT ON VEGETATION

The EPA Objective for Flora is *"to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"*

SURVEY RESULTS

A total of 117 taxa consisting of 67 native and 50 introduced taxa were recorded during two flora surveys. The checklist, including locations of plant species obtained from this survey is in Appendix A.

The Myrtaceae, Proteacea and Papillonaceae are the best represented native families. Grasses (including some annuals) dominate the exotics, however watsonia, veldt grass and african love grass are the most significant in terms of infestation.

As described by Beard (1981), the remnant vegetation primarily consists of low woodland, or low forest of varying density. Details of the sites along with photographs are provided in Appendix A.

Topography correlates well with different vegetation types (Goble-Garratt, 2005). Flooded gum (*Eucalyptus rudis*) dominates areas close to the valley floor and where tributaries to the lakes (Brockman River) cross, or run alongside the road. Flooded gum also fringes the lakes, occurring on the outside of a band of *Melaleuca raphiophylla* (freshwater paperbark) (Goble-Garratt, 2005). The most elevated areas are dominated by *Eucalyptus wandoo* (wandoo), with *Corymbia calophylla* (marri) occurring on the lower slopes. Near the lakes, *Casuarina obesa* (swamp sheoak) often occurs along with the paperbark or flooded gum, and in one small area formed a low closed forest. Griffin (1992) found that this species appeared to be increasing and spreading along parts of the Brockman River in response to increasingly saline drainage (Goble-Garratt, 2005).

Remnant vegetation coverage south of the river crossing is more substantial than that north of the river crossing, with around seventy percent of the area south of the crossing supporting native vegetation compared with around thirty percent north of the crossing supporting native vegetation (Goble-Garratt, 2005).

Eucalyptus marginata (jarrah) and *Eucalyptus accendens* (powderbark wandoo) were not recorded within the project area but occur immediately to the south where the influence of the valley system drops away and true lateritic duricrust occurs (Goble-Garratt, 2005).

The number of native species found during the flora survey is quite low in comparison with regional surveys. This is primarily due to the very small size and mostly disturbed condition of the remnants present (Goble-Garratt, 2005). However in one large upland site (sample site 10) supporting low wandoo woodland, 21 native species were recorded. This is compared to an average species richness of 24 for similar wandoo woodland sites from the Griffin (1992) survey. This indicates that the species list may be a good representation of the flora in the project area (Goble-Garratt, 2005).

4.1.1 VEGETATION CONDITION

The vegetation condition ranged depending on the elevation of the ground and the size of the remnant. In areas where the remnants were large and elevated areas, the condition ranged from "very good" to excellent". Where there was only a narrow strip of remnant vegetation the condition was "degraded" (refer to Appendix A).

The highly invasive weeds: watsonia (*Watsonia bulbifera*), veldt grasses (*Ehrharta longiflora and E. calycina*) and african lovegrass (*Eragrostis curvula*) have affected lower lying areas significantly. Vegetation and flora survey sample site 8 was the only site that contained wetland vegetation in good condition.

The high level of disturbance of the project area is demonstrated by approximately 50% of the species checklist comprising weeds.

The predominant "wetland" vegetation has considerable value in a regional context given that Griffin 1992 found that the communities of drainage lines in the Bindoon to Moora area are generally poorly preserved.

Table 4.2 - Vegetation Clearing and Offset areas

Clearing Types	**Area (ha)**	**Condition rating[1]**	**Revegetation/Offset location**	**Area (ha)**	
Native vegetation	6	Varies between 2/3 (excellent / very good) and 5 (degraded) 2 survey sites ranked 2/3 1 site - 3/ 4, 5 1 site - 3/ 4 3 sites - 4/5	Road Batters	2.8	
Scattered Individuals	1	6	Road reserve (if native vegetation is degraded)	4	
Cleared Agricultural land	8	6	**Acquisition of land for offsets for conservation area disturbance (ha)**		Condition rating
			Donaldson's Property	0.3	2-3
			Clearing mitigation area		
			Perth Diocesan Trust	1	2-3
			Kay's Property	1.2	4-5
Total Clearing	15		Total Rehabilitation and Offsets	9.3	

[1]Notes 1-Pristine, 2-Excellent, 3-Very Good, 4-Good, 5-Degraded, 6-Completely Degraded

Table 4.3 - Condition Indices and Comments for Areas of Disturbance to the Chittering Lakes Nature Reserve

Location (SLK)	Condition Index	Comment	Photo	Nature Reserve
56.9 – 57.2 Both sides	3/4	Flooded gum and freshwater Paperbark woodland. Close to the highway understorey is degraded, better away from highway. Excellent fauna habitat.	Plate 1	Site 1 (temporary disturbance)
57.3 – 57.7 South side	2/3	Vegetation retains much of original structure, although understorey is weedy. An old road runs through this area.	Plate 2	Location adjacent to site 2 (permanent disturbance)
58.5 – 58.8 Both sides	3/4	Vegetation on the western side of the highway and close to carriageway on the east has reduced canopy and degraded the understorey. Further from highway on the east condition appears to be "very good".	Plate 3	Site 3 (temporary disturbance)

The conservation value of the roadsides of both local government and Main Roads managed roads in the Shire of Chittering was assessed in the late 1980's by the Roadside Conservation Committee. The findings were that the Great Northern Highway at the southern end of the project area had 'medium' conservation value and the northern end of the project, closest to Bindoon townsite, had 'low' conservation value. Management goals for both of these categories of roadside included maintaining native vegetation wherever possible, and to encourage regeneration/replanting with native vegetation (Goble-Garratt, 2005).

4.1.2 Declared Rare Flora (DRF) and Priority Species

No declared rare flora were identified within the project area. Two Priority 3 (P3) taxa *Acacia drummondii* subsp. *affinis* and *Adenanthos cygnorum* subsp. *chamaeophyton* were identified during the survey. These species were listed on the Department of Conservation and Land Management's Priority Flora list.

Table 4.4 - Priority Species found in flora survey

Species / Taxon	Conservation Code
Acacia drummondii subsp. *affinis*	Priority 3
Adenanthos cygnorum subsp. *chamaeophyton*	Priority 3

Priority three taxa are described as poorly known taxa and are defined by CALM as:

'…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 population being large, and either widespread or protected. Such taxa are under consideration for declaration as "rare flora" but are in need of further survey'. P3 species do not require a permit for removal or destruction, however consultation with CALM Species and Communities Branch is required, prior to destruction of any P3 populations.

The flora survey undertaken in late Spring to early Summer 2004/2005 covered the roadsides of the existing highway and areas immediately adjacent extending 50 metres either side of the existing or proposed footprint, whichever was the greater distance.

Detailed sample sites were chosen to cover representative examples of all the vegetation types present after initial reconnaissance.

Adenanthos cygnorum subsp. *chamaeophyton,* is an understorey plant found within the proposed project area (Figure 4.1), is a subspecies of the widespread and common woollybush.

This population (SLK 56.45) was mapped and counted during the second flora survey. It consists of 75 plants and is present on both sides of the highway, although D. Goble-Garratt (2005) indicates that the population numbers may be slightly higher than recorded. This population will be impacted by the proposed works with forty five plants within project footprint (refer to figure 4.5).

There are known populations in the vicinity, on the road verge along Tea Tree Road, in a gravel pit along Tea Tree Road, and also on Great Northern Highway between 5.1 and 5.4 kilometres south of the Tea Tree Road intersection, all of which are outside of the project area. The latter population is registered in the Main Roads database at the same location that Muir identified a population of *Adenanthos cygnorum* subsp. *chamaeophyton*.

A subspecies of drummonds wattle, (*Acacia drummondii* subsp. *affinis*) was found within the project area (Figure 4.3) although there are no records of this species in the Main Road's database of Threatened flora for the Great Northern Highway (Goble-Garratt, 2005). An earlier report by Ecologia Environmental suggests that this species also occurs in the road reserve to the north of the project area.

Acacia drummondii subsp. *affinis* is distinguished by its bipinnate leaves (leaves divided into leaflets) and hairy foliage. It has distinctive yellow cylindrical flowering heads, and usually grows to less than one metre tall (Goble-Garratt, 2005). It occurs on lateritic soils with jarrah or wandoo and its distribution is from around Bullsbrook northwards close to New Norcia, with populations at Mogumber, Gingin and Muchea.

Plant numbers of *Acacia drummondii* supsp. *affinis* were not counted during the August 2004 survey, as it was not suspected as a priority species during the field inspection. A further survey undertaken in September 2005 counted 87 plants at the population at SLK 58.85 (sample site 7). Twenty five individuals of this population are expected to be require removal as a result of this project (refer to Figure 4.6).

One population of each of these species will be impacted by the proposed works, however D. Goble-Garratt (2005) states that "…The presence of these species lends added importance to the road reserve vegetation, but should not be an obstacle to the upgrading project." Consultation with CALM regarding disturbance of P3 species will be undertaken.

Other declared rare or priority species identified in the area by the database search undertaken by Ecologia Environmental (September 2004) were targeted in this flora survey of the proposed road realignment, no other declared rare flora or threatened flora were identified.

Consultation with Department of Conservation and Land Management Species and Communities Branch was undertaken regarding the disturbance of the two priority 3 flora species populations, *Adenanthos cygnorum* subsps. *chamaeophyton and Acacia drummondii* subsp. *affinis*. CALM stated 'that while both populations are being

severely impacted, both populations will nevertheless be retained with a reasonable number of plants. The two taxa are also relatively well represented in the local area. I therefore consider this proposed impact to be not significant to the conservation of the species, provided measures are put in place to ensure that the remaining plants and associated habitat are protected from disturbance. Impact minimization should therefore be employed, and preferably some amelioration measures put in place, such as using these species (local seed collection) in local revegetation works to enhance the populations at these sites' (Ken Atkins [CALM], pers. comm., November 2005).

For this project MRWA has made a number of commitments including minimising disturbance to priority species and other vegetation, and incorporating the priority species in revegetation programmes where practicable. Given that all the requirements described are met, the proposed works should not compromise the EPA's objectives for flora.

4.1.3 Threatened Ecological Communities

There were no threatened ecological communities identified in searches conducted of the project area.

4.1.4 Weed Management

There are no known Declared Plants as defined by the Agriculture and Related Resources Act 1976 (ARRP Act) as defined under the Agriculture and Related Resources protection Act 1976 in the project area (K. Talbot, pers. comm., Ag Dept, July 2005). Nuisance weeds are present in the area including extensive infestations of watsonia, african love grass and annual and perennial veldt grass in the lower-lying sections of the road reserve. A watsonia control program will be investigated as an opportunity to improve vegetation condition.

Table 4.5 shows the ratio of native species to introduced species found in each survey site.

Table 4.5 - Native and introduced species present in survey sites

Survey Site No. (Refer to App. A for site location and details)	Native sp.	Introduced sp.	Total	% native species
1	3	12	15	20
2	2	11	13	15
3	1	7	8	13
4	4	9	13	31
5	3	10	13	23
6	5	7	12	42
7	20	4	24	83
8	8	11	19	42
9	5	7	12	42
10	21	4	25	84

411600.000000 412000.000000 412400.000000 412800.000000

6522500.000000 6522000.000000 6521500.000000

Adenanthos cygnorum subsp. chamaephyton

Chittering Road

Hart Drive

Environmentally Sensitive Area

Legend

- Carnaby's cockatoo feeding sites (F)
- Carnaby's cockatoo nesting hollows (H)
- Declared Rare and Priority Flora
- SLK Markers
- GNH
- GNH Proposed Design
- CALM Reserves
- Environmentally Sensitive Areas
- European Heritage (Commonwealth)
- Conservation
- Multiple Use
- Cadastre

Prepared for
Main Roads
Western Australia

N

0 50 100 200 Meters

1:5,000 @A3

SOURCE All data supplied by Main Roads Western Australia, November 2004, (sourced through the relevant custodian)

GIS FILE	PROJECTION	FINAL APPROVAL	DATE
G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\EIA\REVD	GDA 1994 MGA Zone 50	REVD JR	18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

Drawn by K. Ross

TITLE

Environmental Constraints Great Northern Highway, 54.3-56.67 SLK

FIGURE No.	PROJECT No.
4.1	PEN414

412700.000000 413600.000000 414500.000000

6523500.000000 6523000.000000

Area likely to be excised from Chittering Lakes Nature Reserve (Site 2)

Holy Trinity Anglican Church and Cemetery (municipal heritage register)

Lake Chittering
Environmentally Sensitive Area
European Heritage (Commonwealth)
CALM Reserve
Conservation Wetland

Resumption of land (Perth Diocesan Trustees)

Resumption of land (Donaldson's property)

Temporary disturbance of Chittering Lakes Nature Reserve (to be rehabilitated) (Site 1)

Legend

- Carnaby's cockatoo feeding sites (F)
- Carnaby's cockatoo nesting hollows (H)
- Declared Rare and Priority Flora
- SLK markers
- GNH
- GNH Proposed Design
- CALM Reserves
- Environmentally Sensitive Areas
- European Heritage (Commonwealth)
- Conservation
- Multiple Use
- Cadastre

N

0 50 100 200 Meters

1:5,000 @A3

Prepared for
Main Roads
Western Australia

SOURCE All data supplied by Main Roads Western Australia, November 2004, (sourced through the relevant custodian)

GIS FILE	PROJECTION	FINAL APPROVAL	DATE
G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\EIA\REVD	GDA 1994 MGA Zone 50	REVD JR	18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

Drawn by K. Ross

TITLE

Environmental Constraints
Great Northern Highway, 56.42 - 58.42 SLK

FIGURE No. 4.2

PROJECT No. PEN414

414500.000000 415400.000000

6524500.000000 6524000.000000

Lake Needoonga
Environmentally Sensitive Area
European Heritage (Commonwealth)
CALM Reserve
Conservation Wetland

Former site of Upper
Chittering Primary School

Spice Road

Tea Tree Road

Temporary disturbance of
Chittering Lakes Nature Reserve
(to be rehabilitated)
(Site 3)

Lake Chittering
Environmentally Sensitive Area
European Heritage (Commonwealth)
CALM Reserve
Conservation Wetland

Chittering Road Board Office (former)
interim state heritage status

Acacia drummondii subsp. elliptic

60.17
59.92
59.67
59.42
59.17
58.92
58.67
58.42

11689
12714

Legend

- Carnaby's cockatoo feeding sites (F)
- Carnaby's cockatoo nesting hollows (H)
- Carnaby's cockatoo hollows impacted (I)
- Declared Rare and Priority Flora
- SLK markers
- GNH
- GNH Proposed Design
- CALM Reserves
- Environmentally Sensitive Areas
- European Heritage (Commonwealth)
- Conservation
- Multiple Use
- Cadastre

Prepared for
Main Roads
Western Australia

N

0 50 100 200 Meters

1:5,000 @A3

SOURCE All data supplied by Main Roads Western Australia, November 2004, (sourced through the relevant custodian)

GIS FILE	PROJECTION	FINAL APPROVAL	DATE
G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\EIA\REVD	GDA 1994 MGA Zone 50	REVD JR	18/11/05

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Drawn by K. Ross

TITLE

Environmental Constraints
Great Northern Highway, 58.42 - 60.17 SLK

FIGURE No.	PROJECT No.
4.3	PEN414

414000 000000 414500 000000 415000 000000

652 6500 000000

652 6000 000000

652 5500 000000

652 5000 000000

Legend

- Carnaby's cockatoo feeding sites (F)
- Carnaby's cockatoo nesting hollows (H)
- Declared Rare and Priority Flora
- SLK Markers
- GNH
- GNH Proposed Design
- CALM Reserves
- Environmentally Sensitive Areas
- European Heritage (Commonwealth)
- Conservation
- Multiple Use
- Cadastre

Lake Needoonga
Environmentally Sensitive Area
European Heritage (Commonwealth)
CALM Reserve
Conservation Wetland

61.92
61.67
61.42
61.17
60.92
60.67
60.42

N

0 50 100 200 Meters

1:5,000 @A3

Prepared for
Main Roads
Western Australia

SOURCE All data supplied by Main Roads Western Australia, November 2004 (sourced through the relevant custodian)

GIS FILE	PROJECTION	FINAL APPROVAL	DATE
G:\Projects\MRWA\1_ETS\PEN414South Bindoon\EIA\REVD	GDA 1994 MGA Zone 50	REVD JR	18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

Drawn by K. Ross

TITLE

Environmental Constraints Great Northern Highway, 60.0 - 62.7 SLK

FIGURE No.	PROJECT No.
4.4	PEN414

412480.000000 412560.000000

6522600.000000 6522500.000000 6522400.000000

Legend

- Individual Plant
- GNH Proposed Design
- Cadastre

Chittering Road

PP

ARP

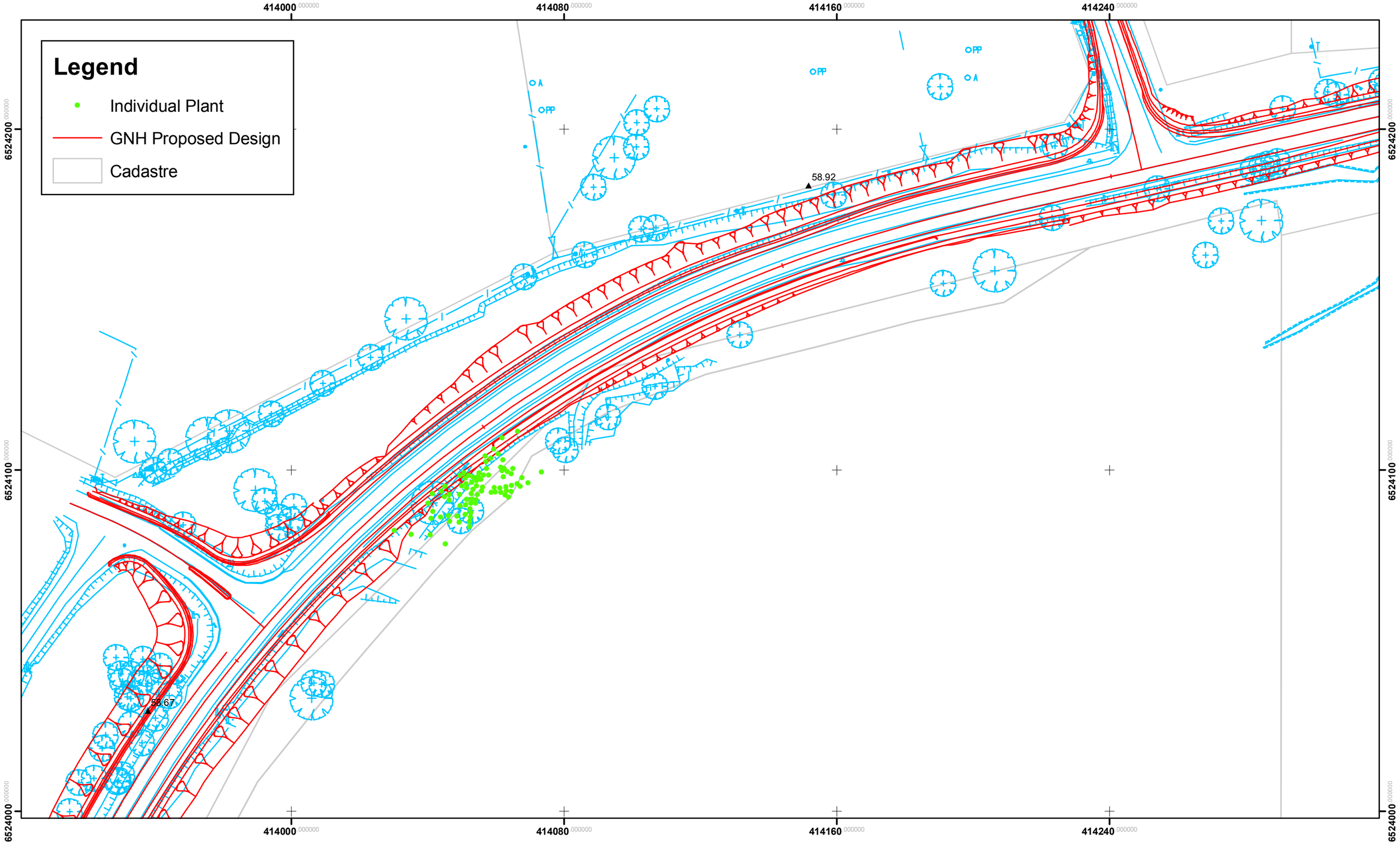
PP

A

56.17

412480.000000 412560.000000

Prepared for Main Roads Western Australia	N 0 5 10 20 Meters 1:750 @A3		Kellogg, Brown & Root Pty Ltd KBR Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317 *256 St Georges Terrace PERTH WA 6000* Drawn by K. Ross	TITLE Adenanthos cygnorum subsp. chamaephyton population on GNH near Chittering Road
	SOURCE All data supplied by Main Roads Western Australia and Goble-Garrat & Associates, Nov 2005			
	GIS FILE G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\Botantist MXDs\ChitteringRoadIntersection.mxd	PROJECTION GDA 1994 MGA Zone 50	FINAL APPROVAL JR DATE 18/11/05	FIGURE No. 4.5 PROJECT No. PEN414



Prepared for
Main Roads
Western Australia

N W E S

0 12.5 25 50 Meters

1:1,000 @A3

SOURCE All data supplied by Main Roads Western Australia and Goble-Garrat & Associates, Nov 2005

GIS FILE	PROJECTION	FINAL APPROVAL	DATE
G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\Botantist MXDs\TeaTreeRoadIntersectionRevA.mxd	GDA 1994 MGA Zone 50	JR	18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

256 St Georges Terrace PERTH WA 6000

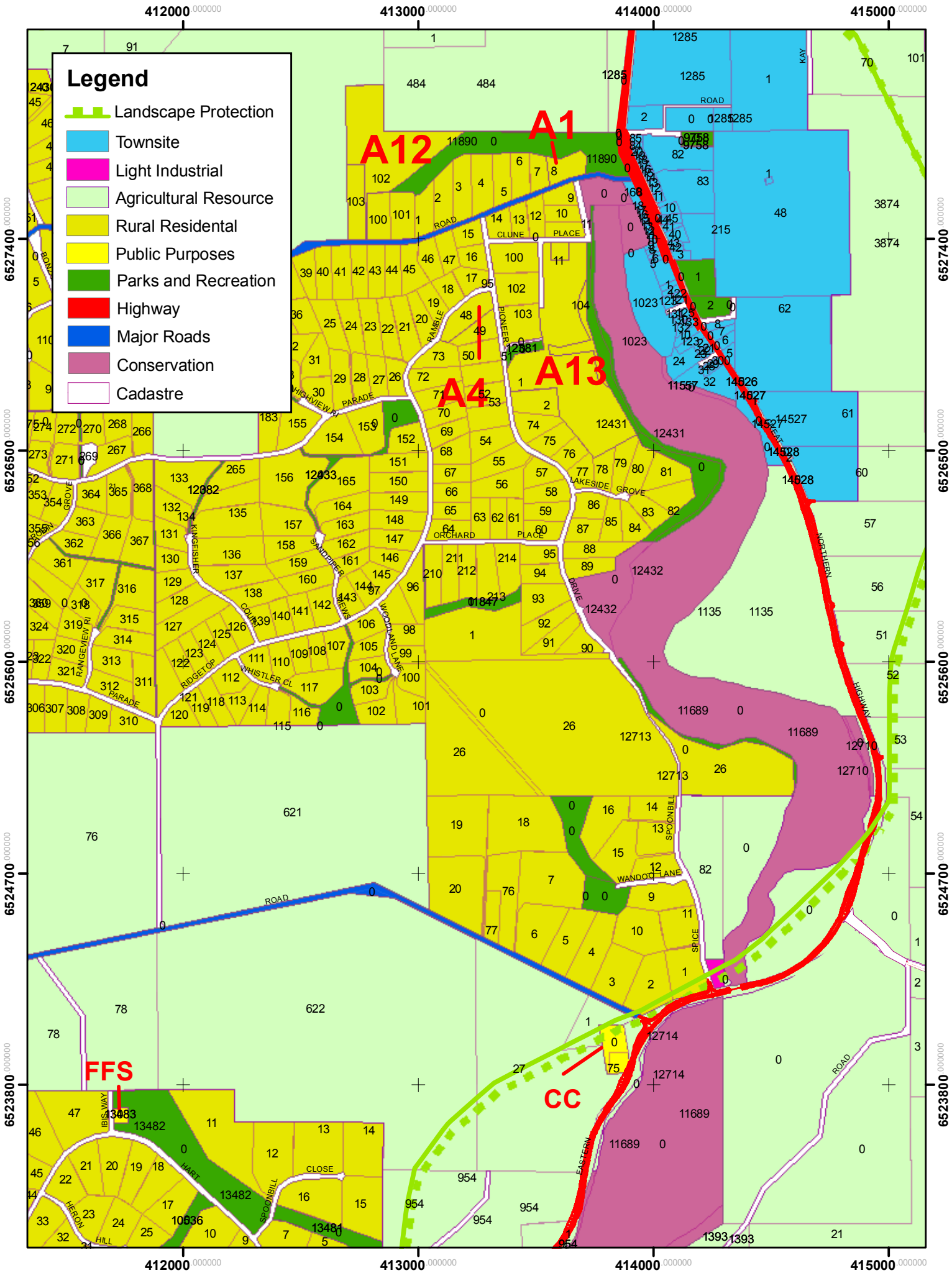
Drawn by K. Ross

TITLE

Acacia drummondii subsp. affinis population on GNH near Tea Tree Road

FIGURE No. 4.6

PROJECT No. PEN414



0 125 250 500 Meters

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SOURCE

GIS FILE G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\Town Planning Mxds\Town Planning 4 rev.mxd

PROJECTION GDA 1994 MGA Zone 50

FINAL APPROVAL JR

DATE 18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

256 St Georges Terrace PERTH WA 6000

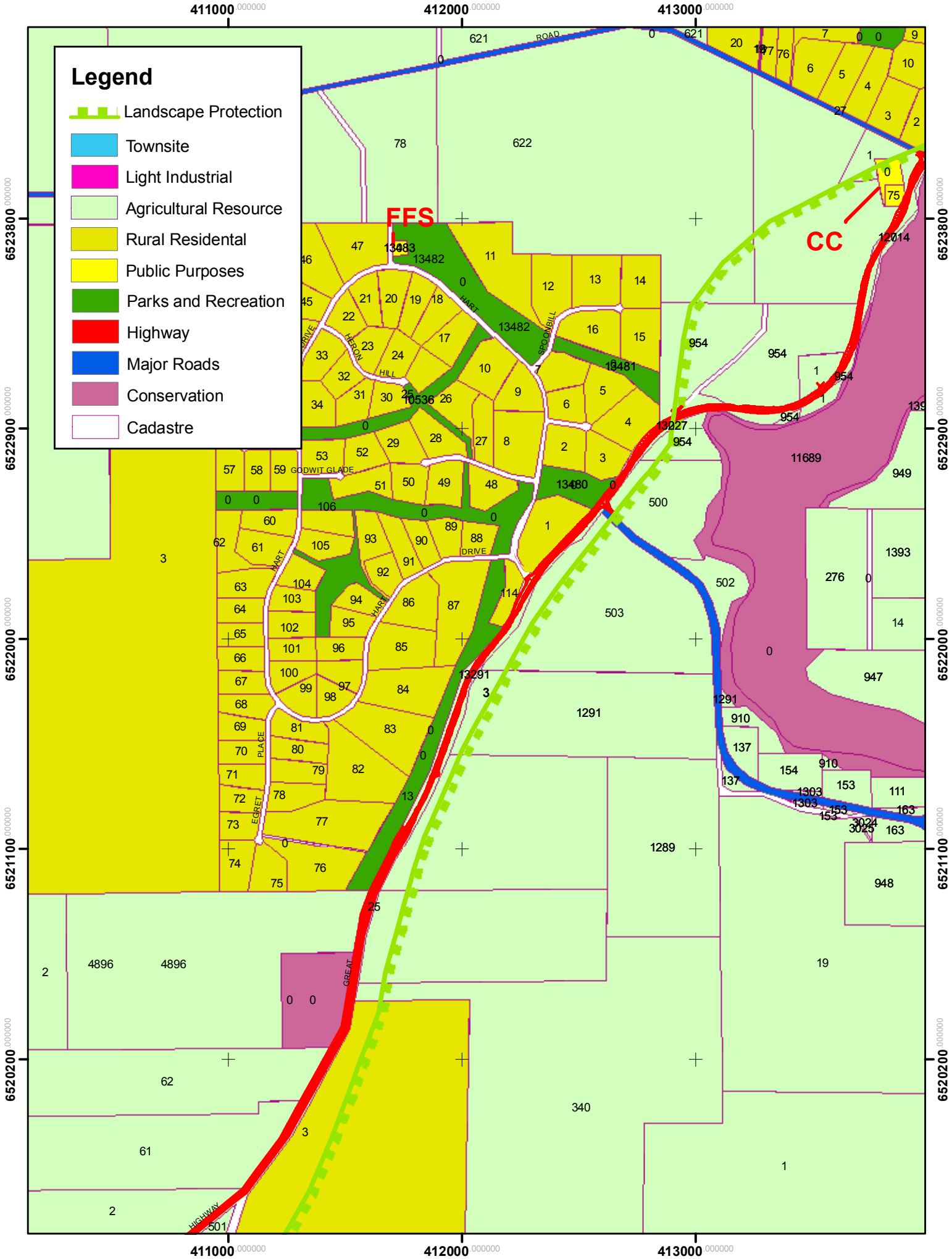
Drawn by GIS Specialist

TITLE

Shire of Chittering TPS No 6
Map 4 of 8 - Bindoon South

FIGURE No. 4.8

PROJECT No. PEN414



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SOURCE

GIS FILE G:\Projects\MRWA\1_ETS\PEN414SouthBindoon\Town Planning Mxds\Town Planning 5 rev.mxd

PROJECTION GDA 1994 MGA Zone 50

FINAL APPROVAL JR

DATE 18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

256 St Georges Terrace PERTH WA 6000

Drawn by GIS Specialist

TITLE

Shire of Chittering TPS No 6
Map 5 of 8 - Bindoon South

FIGURE No. 4.9

PROJECT No. PEN414

Soil movements during construction will also be managed where practical to avoid spread of weed species from areas where these are present (KBR, 2005).

4.1.5 Vegetation Clearing

Vegetation clearing presents one of the primary environmental impacts associated with the proposed works. Clearing of remnant vegetation will be required for the new alignment at Bindoon South. The amount of clearing required for the re-alignments will vary according to site specific characteristics. The total of revegetation and acquisition of land for offsets is approximately 9 ha (refer to table 4.2 and figures 4.1 - 4.4). The total area required to be cleared consists 7 ha of native vegetation and 8 ha of agricultural land, for a total footprint of 15 ha.

Vegetation clearing will be required in a range of habitats, from disturbed areas, to low closed forest to low open shrubland, as shown in Figures 1 - 3 of Appendix A. The loss of individual plants and vegetation units and loss of fauna habitat will be direct impacts of vegetation clearing. Secondary effects may include an increased risk of wildfire through movement of personnel and machinery. There is frequently a close correlation between increased human activity and changes in fire regimes, which may contribute to the degradation of natural ecosystems. Vegetation clearing also presents an increased risk of vegetation degradation through the introduction of weeds. Activities associated with construction such as disturbance, excavation and movement of personnel and machinery can provide ideal conditions for the colonisation of weed species.

Offsets and Mitigation measures

Environmental offsets aim to ensure that significant and unavoidable adverse environmental impacts are counterbalanced by a positive environmental gain, with an aspirational goal of achieving a 'net environmental benefit' (EPA, 2005).

Environmental Assets are classified as either critical, high value or low to medium value assets based on the environmental value associated with them. The Chittering Lakes Nature Reserve is classified as a critical asset and therefore on-site mitigation is required for any disturbances. The hierarchy of environmental mitigation is:

1. Avoid - avoid impact altogether
2. Minimise - limit the severity of impact
3. Rectify - repair the impacted site as soon as possible
4. Reduce - eliminate impact over time
5. Offset - offsetting residual impacts (EPA, 2005).

The severity of the environmental impact has been minimised by maintaining the new road structure as close as possible to the existing road pavement as much as possible. The design task had to be modified a number of times and the road design standards have been compromised in order to accommodate environmental aspects. Where possible, the impacted areas will be rectified through revegetation of disturbed areas according to MRWA standards based on the recommendations made in the flora and vegetation survey on completion of the project.

The vegetation clearing required for the proposed works will be offset according to the EPA preliminary position statement No. 9 Environmental Offsets (version 2). The offset package will include direct offsets including rehabilitation of disturbed areas where possible and contributing offsets, through the acquisition of land for conservation purposes. Land from the Donaldson's property (figure 4.2) will be acquired for conservation purposes. Land to be acquired from the Perth Diocesan trustees will be acquired to help mitigate the clearing of other areas. Land disturbed on the Kay's property will be revegetated and subject to negotiations with the landowner a conservation covenant may be placed on the land.

The 2.8 ha of cleared land that is required to be cleared for construction will be revegetated using local species incorporating feed species for Carnaby's cockatoo. Revegetation of the new road reserve will also be undertaken if the existing vegetation is degraded. The total of this revegetation is approximately 4 ha. The land to be acquired from the Donaldson's property (0.23 ha) and the Perth Diocesan Trustees (0.99 ha) is similar in quality and composition to the vegetation and land that is required to be cleared for road reserve. The vegetation is classified as Low Open Forest (Freshwater Paperbark/Swamp Sheoak) and consists of *Casuarina obesa* and three different *Melaleuca* species and is wetland dependent. Vegetation assessment of this area has not been undertaken, however a survey of the project area was conducted and a survey site was located in a similar vegetation type and condition to the vegetation to be cleared within the Chittering Lakes Nature Reserve (refer to Appendix A site 8). Photographs of the offset areas are provided in Appendix G.

4.1.6 Clearing impacts on vegetation

Clearing will impact on the two P3 species and other native vegetation, including feed species for Carnaby's Cockatoo (refer to figures 4.1 and 4.3).

Provided that the environmental management recommendations described in the section 6.1.4 are followed, it is expected that impacts of proposed works on vegetation can be effectively managed.

Parts of the proposed road realignment works are located within an Environmentally Sensitive Area (ESA).

4.1.7 Clearing permit

An application to clear native vegetation (reference number CPS 900/1) was made to the DoE in October 2005 as the clearing won't be completed before 8th January 2006. The application submitted to the DoE is for the area of works between the southern boundary of the proposed works and the southern boundary of Brockman Bridge.

The clearing permit application has been submitted to the DoE in order to expedite the approval process, although it was identified that this would not be required if the project was not assessed under part IV of the EP Act. However the project will be referred to the EPA under section 48A of the EP Act, and consultation undertaken with the EPA service unit has indicated that the EPA will liaise with the DoE Native Vegetation Protection Section regarding this project.

4.1.8 Dieback

Dieback is a significant disease in Australia, which has infected 15-20% of WA jarrah forest and around 60% of banksia and mallee woodlands of the Stirling Range National Park (CALM nature base). It is a disease which is caused by the soil borne pathogen *Phytophora cinnamomi* that kills a wide selection of plant species of the south west of Western Australia. The life cycle of *P. cinnamomi* depends on moist conditions that favour the survival, sporulation and dispersal of the spores. Environments suited to the survival of *P. cinnamomi* are areas which receive greater than 800mm of rainfall annually. The project site receives an average of 600mm and at this rainfall the disease is restricted to areas where localised hydrological effects cause the effective rainfall to substantially exceed the actual rainfall events (Glevan, 2004).

A survey of the presence of dieback in the area was undertaken by Glevan Consulting in November 2004. Of the seven sections assessed for dieback covering the extent of the project area, three sites were considered to be infected with the disease, and four sites uninterpretable but at a high risk of being infected.

The entire length of the assessed section did not appear to have any significant areas that could be assessed as being free of the disease caused by *P. cinnamomi*. The road alignment is generally uninterpretable, however some sections are at risk of being infected with the disease (Glevan, 2004). Best management practices for limiting the spread of *P. cinnamomi* will assist in meeting the EPA objectives for dieback.

Management recommendations are made in section 6.3.5 and given that these management commitments are carried out the spread of dieback should be effectively contained and managed in accordance with the EPA objective for dieback.

4.2 IMPACTS ON FAUNA

The EPA objective for fauna is *"to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"*.

A search of the CALM threatened and priority fauna databases undertaken in August 2004 identified nine fauna species which have been recorded in the section of the Great Northern Highway between 27.41 and 71.17 SLK. These are listed in Table 4.6 Species have been classified as being 'of concern' if the location of the record was within proximity of the road reserve and was more recent than 1990. Species identified as 'potential species of concern' are based on proximity to the road reserve with records older than 1990.

Table 4.6- Rare and Priority Fauna species recorded between SLK 27.42 and SLK 71 .14 GNH

Schedule	Species of concern	Potential species of concern
1	*Dasyurus geoffroii* – chuditch	None
	Calyptorhynchus sp – Two species of white-tailed black cockatoo	
2	*None*	*None*
3	*None*	*Falco peregrinus* – peregrine falcon
4	*None*	Priority 1: *Arbanitis inornatus – trap door s*pider Arbanitis inornatus;
		Priority 1: *Aspidites ramsayi* - woma (southwest pop)
		Priority 3: *Phascogale tapoatafa tapoatafa* – southern brush-tailed phascogale
		Priority 4: *Macropus irma* – western brush wallaby;
		Priority 4: *Charadrius rubricollis* – hooded plover

The Carnaby's (white-tailed black) cockatoo has been recorded regularly in the Chittering Lakes and Bindoon areas (Johnstone and Kirkby, 2004). One of the species it prefers for nesting hollows is the wandoo (*Eucalyptus wandoo*) which is present within the proposed road alignment. Four nest sites for Carnaby's cockatoos were located within or adjacent to the proposed road works during the survey by Johnstone and Kirkby (2004):

- wandoo (*Eucalyptus wandoo*) at UTM 411950 E, 6521569 N – Site number 9. Section 54.85 to 55.85. Initially this tree may have required removal, the final road design has eliminated the need for its removal;

- wandoo at UTM 412806 E, 6522813 N – Site number 11, Section 55.85 to 56.90. This tree will not be impacted and therefore does not require removal;

- flooded gum (*Eucalyptus rudis*) at UTM 413876 E, 6523969 N - Site number 18, Section 56.90 to 58.64. This tree is over 50 m from shoulder of the existing road and will be outside of the proposed works;

- a stag flooded gum at UTM 414291 E, 6524206 N site number 20, south end of Brockman River Bridge could not be avoided by the alignment. This tree is also partly burnt through at base and requires removal (Figure 4.3).

- another possible nest hollow at UTM 411611 E, 6520849 N is approximately 300 m south of the proposed road works area and will not require removal.

Subsequent investigation undertaken in 2005 identified that only one hollow was utilised during the 2005 breeding season. The conclusion is that the proposed road works will not have a significant impact on the survival of the Carnaby's cockatoo (Johnstone and Kirkby, 2005).

Field fauna survey

A desktop fauna review was conducted by KBR in 2004. An opportunistic fauna survey of the project area bounded by fifty metres beyond the boundary of the existing or new road design, whichever is wider, was conducted in August 2005 (Harewood, 2005).

The survey was carried out with reference to guidance and position statements published by the WA EPA on fauna surveys and environmental protection (EPA, 2002; EPA 2004), and Commonwealth Biodiversity Legislation (EPBC Act, 1999).

Specific attention was made to identify the likely habitats of conservation significant vertebrate species potentially occurring in the general area.

Potential impacts and management recommendations

Twenty two threatened and priority species potentially found in the area as found from CALM threatened and priority searches, EPBC threatened species searches and other specialist sources as listed in Harewood (2005) are listed in table 4.7 below. The following table outlines whether or not the species identified in desktop searches are likely to inhabit the area. This is a result of the opportunistic survey that was completed in August 2005.

Table 4.7 Likely presence of threatened and priority identified species in the project area

Identified Threatened Species	Likely presence in Project Area (after Kellogg, Brown and Root (2005) and Harewood (2005)
trap door spider *Arbaniris inornatus*	The species documented preference for jarrah/marri suggests it would not be utilising the majority of the study area,
woma *Aspidites ramsayi* **-**	The majority of the study area would be unsuitable for this species due to the lack of suitable habitat (logs, thick bush, sand, burrows) and food source.
southern carpet python *Morelia spilota impricata* **-**	The majority of the study area would be unsuitable for this species due to the lack of suitable habitat and food source.
great egret *Ardea alba*	Potentially an infrequent visitor to the general area. This species was not recorded in the project area during the most recent Birds Australia Atlas survey (Barrett, 2003) and there are also no WA Museum records in the region.
australasian bittern *Botaurus poiciloptilus*	Some small sections of the Chittering Lakes Nature Reserve may be suitable for this species. Very little suitable habitat occurs in the proposed works footprint.
little bittern *Ixobrychus minutes*	Some small sections of the Chittering Lakes Nature Reserve and some of the small vegetated creeks may be suitable for this species.
peregrine falcon *Falco perigrinus* **-**	The species potentially utilises some sections of the study area as part of a much larger home range.

Identified Threatened Species	Likely presence in Project Area (after Kellogg, Brown and Root (2005) and Harewood (2005)
white-bellied sea eagle *Haliaeetus leucogaster*	The EPBC Act database states that species or species habitat is likely to occur in the area but based on existing records (Johnstone and Storr 1998 and Barrett, G. *et al* 2003) the project area is outside its normal range.
common sandpiper *Tringa hypoleucos*	The species potentially utilises some sections of the wetland habits within the study area, particularly when waters recede in summer and shoreline is exposed.
bush stone curlew *Burhinus grallarius*	Potentially an occasional visitor to the general area.
Carnaby's black-cockatoo *Calyptorhynchus latirostris*	This species is know to feed and breed with the project area and as a consequence has been the subject of several detailed surveys (Johnstone and Kirkby, 2005). Most significantly five nest sites and a number of feeding areas for Carnaby's cockatoo were located within the works footprint or immediately adjacent during these surveys
baudin's black-cockatoo *Calyptorhynchus baudinii*	EPBC Act database states that species or species habitat is likely to occur in the area but based on existing records (Johnstone and Storr 1998 and Barrett, G. *et al* 2003) the project area is outside its normal range.
fork-tailed swift *Apus pacificus*	It is potentially to be an occasional summer visitor to the study area but is entirely aerial and largely independent of terrestrial habitats.
rainbow bee-eater *Merops ornatus*	A potential visitor to the general area. It is unlikely to breed in the study are due to the lack of suitable ground.
hooded plover *Charadrius rubricollis*	While the area falls within this species range its preference for salt lakes and beaches means that it is an unlikely visitor to the study area.
crested shrike tit *Falcunculus frontatus leucogaster*	Recorded in the nearby Julimar State Forest area (WRC, 2003) and therefore must be considered potential visitor or inhabitant of study site as suitable habitat (wandoo) exists.
chuditch *Dasyurus geoffroii*	As known populations exist within 20 kilometres of the site the potential exists for the species to utilise sections of the project area at times. A scat (dropping) located during the survey within the bounds of the Chittering Lakes Nature Reserve amongst relatively dense riparian vegetation, near GNH SLK 58, was potentially that of a Chuditch. A burrow located nearby could also be that of this species (no rabbits or rabbit droppings were observed at anytime during survey). The same area appears to support a significant population of quenda, a suitable food source for chuditch.
southern brush-tailed phascogale *Phascogale tapoatafa tapoatafa*	Potentially uses some areas at times as part of a larger home range. Most likely to be found in the southern section of the study site where vegetation is more continuous with larger tract of remnant bush.

Identified Threatened Species	Likely presence in Project Area (after Kellogg, Brown and Root (2005) and Harewood (2005)
quenda *Isoodon obesulus fusciventer*	Evidence of this species was found near the study area and within the Chittering Lakes Nature Reserve (See Figure 2 to 4). It appears (based on the density of diggings found) to be most abundant in dense vegetation within Flooded Gum woodland surrounding Lake Chittering. Evidence within the existing road reserve was limited to a few diggings just outside the southern end of the project site.
brush wallaby *Macropus irma*	As known populations exist within 20 kilometres of the site the potential exists for the species to utilise sections of the project area at times. However, because of the general narrowness and fragmented nature of the vegetation along the road reserve it unlikely that the species would persist in the study site for any significant length of time and is likely to favour larger, more continuous tracts of woodland, in reserves and private property.
water rat *Hydromys chrysogaster*	Potential inhabitant of the Chittering Lakes Nature reserve and individuals may move along the vegetated creek lines and seasonally inundated areas that are present in the project site.

The results of the opportunistic fauna survey indicate that some of the threatened and priority fauna species initially identified in desk top surveys may be found in the project area. However apart from Carnaby's cockatoo, the species will relocate to other surrounding areas of habitat and impact will be minimal. Harewood (2005) stated "apart from the presence of Carnaby's cockatoo nest sites and feeding areas, identified during previous studies, no specific habitats identified during the assessment appear to be spatially restricted to the area of impact or to be supporting important populations of significant species or fauna communities".

Harewood (2005) states "the proposed works will inevitably result in the localised loss of individual fauna as a result of habitat clearing. However, based on the information gained during this assessment the, impact of the proposed works is not considered significant enough to affect the conservation status of any of the species in the area".

The habitat assessment indicates that several threatened and priority species (refer Appendix C) are likely to use the project area and adjacent areas for foraging, roosting and possibly breeding. Most are wide ranging species and it is anticipated that with the implementation of suitable management procedures outlined in section 6.4, the impact will be minimal.

Displaced animals should be able to be absorbed into the surrounding unaffected habitat as considerable areas of similar habitats are available directly adjacent to the proposed site and populations will persist in these locations.

The oblong tortoise (*Chelodina oblonga*) crossing the GNH was raised as a concern by the local community. The destruction of the species' natural habitat, many road kills of tortoises searching for either a nesting site or a water body that does not dry out in summer, and natural predators are main causes of the *Chelodina oblonga* population's decrease in numbers (www.carettochelys.com, viewed 26 Oct 2005). As part of their breeding cycle, female oblong tortoises leave the lake each summer to lay their eggs in nearby areas. During this time many of them are killed on the roads. In fact, road deaths and predation are the major threat to the population of *Chelodina*

oblonga. Contributing factors to this are high roadside kerbs, which make it difficult for tortoises to leave the road, a lack of awareness of the movement of tortoises during the breeding season, and the presence of feral predators such as the fox. (Carettochelys.com, 2005). There is no kerbing along the length of the proposed works, however there may be predators in the area.

CALM indicated that oblong tortoises generally nest on the south side of a wetland in sandy areas with a northerly or north westerly aspect (Dr Peter Mawson [CALM], pers. comm., October 2005). This means that the area from just south of the Brockman Bridge (SLK 59.00) through to SLK 61.00 would be the highest traffic area for the oblong tortoise. Consequently if a crossing is to be installed it should be in this area to provide passage across the road in a southerly direction.

Other species found to possibly inhabit or known to inhabit the area are the chuditch and the quenda respectively, however the chuditch feeds on road sides and is unlikely to use underpasses. The quendas will use underpasses if they are sandy and have enough light.

Given that the Brockman Bridge is an underpass for access to the southern part of the wetland where tortoises breed and there are numerous culverts along the length of the roadway, it is not considered that "fauna underpasses" are installed. However, changing culverts from circular culverts to square culverts between SLK 59.00 and 61.00 would assist in the conservation of this species and is recommended.

CALM indicated that a wet passage is required for baby tortoises to return from their nest site to the wetland, as baby tortoises are subject to significant predation by crows when they are on dry land making their way back to the wetland (Jason Fules [CALM], pers. comm., October 2005). The Chittering and Needoonga Lakes provide a wet passage north and south for tortoises however, south of Chittering Lake which may be used as a breeding area is outside of the scope of this project.

Both quendas and baby tortoises can fit through ring lock farm fencing and chain mesh fencing although larger tortoises cannot fit through. However neither species climbs and therefore the installation of an apron of rabbit netting on fences to stop tortoises getting through can be used. It is most effective when the rabbit mesh is clipped to the existing fence at a height of 450mm and rolled out with the toe buried to form an apron.

National Significance

Johnstone and Kirkby (2005) state "at the national level, judging from information in the Storr - Johnstone Bird Data Bank, the Bindoon region is probably one of the most significant breeding areas (i.e. area of Critical Habitat for Carnaby's cockatoo in the south-west (i.e. covering the entire range of this species) and must be a major priority for conservation management."

However the impact of removal of the one impacted hollow (site 20) was compared against the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Administrative Guidelines on Significance July 2000 which defines whether an action will have a significant impact on a matter of national environmental significance. Matters of national environmental significance include listed threatened species, such as the endangered Carnaby's cockatoo.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- reduce the extent of a community; or
- fragment or increase fragmentation of the community, for example by clearing vegetation for roads or transmission lines; or
- adversely affect habitat critical to the survival of an ecological community which consists of, or includes, fauna species; or
- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting; or
- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
- assisting invasive species, that are harmful to the listed ecological community, to become established; and
- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or interfere with the recovery of an ecological community.

Potential Impact.

Johnstone and Kirkby (2005) state that "…clearing of small sections of roadside verge in this area will not cause population fragmentation or a reduction in the overall distribution of this species. Furthermore the clearing will not lead to a long-term decrease in the size of the population or interfere with the recovery of the species (there is very limited feeding and breeding sites within the areas to be cleared). Also the clearing and roadworks will not adversely impact or disrupt the breeding cycle of this local population."

It was determined that clearing of sections of the roadside verge will not have a significant impact on the survival of this endangered species under the guidelines of the EPBC Act (1999). Additionally, the sections to be cleared are not part of an important vegetation corridor and not considered to be habitat critical to the survival of this species. The clearing will not impact on the availability or quality of feeding and breeding habitat and will not cause a decline in the local population (Johnstone and Kirkby, 2005).

Therefore referral of this project to Environment Australia is not considered as necessary due to the highway's limited impact of the proposed realignment on the Carnaby's cockatoo.

Regional Significance

The proximity of the project area to the boundary of other bioregions means that the diversity of plant and fauna species can be expected to be higher than in more centrally located areas.

The site is also in the vicinity of the Central and Eastern Avon Wheatbelt biodiversity hotspot, one of 15 such areas identified around Australia. The 15 National Biodiversity Hotspots were identified to raise public awareness of our environmental heritage at risk, and to support strategic action to conserve it (Harewood, 2005).

The site includes a variety of habitats though overall the remnant vegetation within the works footprint has either been totally cleared or is degraded to some extent. As a consequence its regional significance has been greatly reduced (Harewood, 2005).

It is conservatively estimated that between 150 and 200 pairs of Carnaby's cockatoo breed within the Bindoon region. This is very high considering only around 50 pairs are recorded breeding in the Moora shire and 20 pairs in the Victoria Plains region.

Local Significance

Six nature reserves (Chittering, Burroloo Well, Unnamed Reserve 42743, Breera Road, Julimar and Mt Byroomanning) exist within 12 kilometres of the project site and it can be expected that all the local habitat types and fauna species present within the project site are well represented in these areas.

The area has local significance due to the presence of Carnaby's cockatoo and the potential presence of listed threatened species such as the chuditch (Harewood, 2005).

Several pairs of Carnaby's cockatoos have been recorded breeding in road verges between Bindoon and New Norcia. Two to three pairs have been located breeding within the project area which is a significant number considering the relatively few veteran and stag trees with hollows that remain in the verge vegetation (Johnstone and Kirkby, 2005).

Value as habitat and as a wildlife corridor

The general area contains small to medium hollows suitable for obligate hollow nesters in addition to some larger hollows known to be currently used for nesting by Carnaby's cockatoo (Harewood, 2005, Johnstone, 2005). Groundcover may provide for quenda habitat however the population is most likely to be concentrated outside the footprint of the proposal in the Chittering Nature Reserve.

Wandoo woodlands, as found south of Brockman Bridge, are significant habitat areas for many animals with high species richness and an abundance of birds, and the presence of relatively small sections of wetland habitat provide additional habitat variation that increased the diversity of species likely to utilise the project area.

However, the value of the project area as a corridor allowing movement between conservation areas is limited. A link in the road reserve may exist between Burroloo and Chittering Lakes Nature Reserve however this link is supplemented by native

vegetation along the creek line on private property to the west of the highway. If the vegetation of the creek line is maintained this corridor will remain intact.

Remnant vegetation within the project site north of Brockman Bridge has very limited value as a wildlife corridor (Harewood, 2005).

Fauna management recommendations are made in section 6.4.

Fauna thoroughfares

Fauna underpasses can be used as one method of providing access through the barriers that roads create. Ledges can be created within an existing culvert to allow land based fauna to cross while staying dry. The culvert located at SLK 61.1 is a suitable culvert for thoroughfare for fauna. The Brockman Bridge itself acts as a fauna thoroughfare allowing water based fauna access to both sides of the lakes. Over twenty culverts (600 mm in diameter) and one concrete box culvert (600 mm by 1200 mm) will potentially act as a thoroughfare for fauna in the proposed road design.

New fauna crossings may encourage also cats and wild dogs and other non-nature predators to enter into the nature reserve, therefore no new fauna crossings will be constructed for this section of road.

Fences will be provided along the length of the project area except on the eastern side of the GNH south of the Brockman bridge where the existing road reserve borders the Chittering Nature Reserve. This will act to prevent some fauna from crossing the road.

Provided that the management recommendations as stated above are implemented and given the existing habitat fragmentation, the impact of this road realignment and associated works on fauna in the area is likely to be negligible.

4.3 RESERVES AND CONSERVATION AREAS

The EPA objective for conservation areas is *"to protect the environmental values of areas identified as having significant environmental attributes"*.

The project area is located adjacent to the Chittering Lakes Nature Reserve which is listed on the Register of the National Estate. Two temporary and one permanent impact on three small areas of the Nature Reserve will be required to facilitate the road widening.

Site 1: SLK 57.1 - Area of temporary disturbance – 80 m^2

Site 2: SLK 57.9 - Area of permanent disturbance – 208 m^2

Site 3: SLK 58.8 - Area of temporary disturbance – 80 m^2

Entry is required during the construction phase to allow the road batter to be built. MRWA has committed to revegetating impacted areas of the Nature Reserve upon completion of the project, using local species and feed species for Carnaby's cockatoo.

All disturbance, including permanent road batters within the Chittering Lakes Nature Reserve will be revegetated with local plant species on completion of proposed works.

A letter was sent by MRWA to CALM to initiate discussions regarding disturbance in the Nature Reserve (refer Appendix B). CALM provided initial comments to MRWA

indicating that they "are not comfortable with either approving (the request) in house or tabling it with the Conservation Commission of Western Australia (CCWA)until the EPA has set the level of assessment and all the EIA documentation is available" and that MRWA "may need to present the project in front of the Conservation Commission". (T.Saraullo [MRWA], pers. comm., August 2005). A meeting with representatives of the EPASU, CCWA and CALM along with MRWA and KBR was held in October 2005. A subsequent presentation to the CCWA was made in November 2005. The outcome of these meetings are described in Section 8.

4.4 SURFACE HYDROLOGY AND WETLANDS

The EPA objective for wetlands is *"to maintain the integrity, ecological functions and environmental values of wetlands."*

The proposed works are located adjacent to the Chittering Needoonga Lakes which are listed on the Register of National Estate. The lakes are part of the Brockman River system and are divided into an upstream part (Needoonga Lake) and a downstream part (Chittering Lake). They are classified as 'permanent brackish/saline lakes B7' and 'freshwater swamp forest; seasonally flooded forest; wooded swamps; on inorganic soils B14' under *"A Directory of Important Wetlands in Australia"*

The Chittering - Needoonga Lakes are considered nationally important because:

- They are a good example of a wetland type occurring within a biogeographic region in Australia.
- They are wetlands which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex.
- They are wetlands which are important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.
- The wetlands support 1% or more of the national populations of any native plant or animal taxa.
- The wetlands are of outstanding historical or cultural significance.

The Chittering-Needoonga Lakes are a macroscale sinuous lake with low artificial levee and sluice gate at the downstream end and a mesoscale sinuous lake upstream. The lake system contributes to flood control in the Brockman Valley and is near-permanently inundated (DEH, 2005). Both lakes dry back to pools in summer-autumn but rarely dry out completely. Maximum water depth was recorded in June 1981 at 1.92m and the September mean depth is 1.30m. Historically, the lakes were deeper, however considerable siltation has occurred since development of the catchment.

The lakes are a major breeding area for the great egret (*Egretta alba*) and rufous night heron (*Nycticorax caledonicus*) in WA and supports one of the largest colonies of great egret in south-western Australia (DEH, 2005).

The lakes are also proclaimed under the *Rights in Water and Irrigation Act 1914* and a permit is required for certain activities in relation to proclaimed areas (pers. comm. M. Allen DoE, August 2005). There will be no interference with beds or banks and no abstraction of ground or surface waters within the scope of the project as water will be

purchased from the town for construction and dust suppression purposes. Therefore a permit is not required. However if changes to the scope occur which cause any of the above then a permit under the *Rights in Water and Irrigation Act 1914* will be obtained.

The Chittering - Needoonga Lakes are not subject to a management program under the Waterways Conservation Act 1976 (R. Hindmarsh [Brockman Integrated Catchment Group], pers. comm., August 2005) and (M. Allen [DoE], pers. comm., August 2005).

The Conservation Category Wetlands (CCW) were assessed where they intersected with the current road design for their function as a CCW. Photos of these areas were taken (refer to Appendix I). In all areas assessed, where there is existing road it was requested of the DoE to remap the boundary as "No longer a wetland" over the road. It was determined that all other areas assessed should retain the current boundaries and management categories.

A formal submission was made to the DoE in October 2005 to remap the boundaries of the CCW to show that the GNH is not classified as a CCW. A letter dated 26th October 2005 was received from the DoE which "…acknowledges that the areas of road are no longer functioning as wetland and will not be treated as such in the consideration of any proposal. However removal of roads from wetland mapping in the Geomorphic Wetlands Swan Coastal Plain dataset is considered to reduce the integrity of the dataset by isolating separate portions of a wetland system."

Hydrology impacts from the proposed works need to be managed so that water borne sediment or pollutants such as hydrocarbons are not discharged to the Lakes. This is particularly important given that the area of proposed works is notorious for motor vehicle accidents (T.Saraullo [MRWA], pers. comm., August 2005).

Management recommendations and commitments are described in section 6.6.

4.5 GROUNDWATER

The EPA objective for water (surface or ground) is *"to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected"* and for water quality (surface, marine or ground) is *"to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards"*

In the Brockman River catchment groundwater is used for domestic supplies, irrigation and livestock. Fresh groundwater is not readily found in the catchment but brackish groundwater can be used for livestock and for some irrigation (Australian Water Resources Council, 1988).

Groundwater supply within the Brockman River catchment is variable. Regional investigation suggests that the shallow regional aquifer beneath the Dandaragan Plateau has a saturated thickness of 40 m. From the limited information available the volume of supply could not be determined, due to the variable interbedded nature of the sediments.

Groundwater in the project area is unlikely to be impacted by the proposed works as there is no abstraction of groundwater or dewatering within the scope of the project.

Water for dust suppression will be purchased from the Shire of Chittering and therefore a permit is not required for abstraction of groundwater.

4.6 PUBLIC WATER SOURCE AREA

The EPA objective for water (surface or ground) is *"to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected"* and for water quality (surface, marine or ground) is *"to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards"*.

There is a Public Drinking Water Source Area (PDWSA) located approximately three kilometres to the west of the project area.

The area is proclaimed under the *Rights in Water and Irrigation Act 1914*. However as water for dust suppression will be purchased from the Shire of Chittering there will be no drilling into or use water from the PDWSA during the proposed works. Therefore there will be no impact on the PDWSA, and a permit under the RIWI Act is not required.

4.7 ACID SULPHATE SOILS

The EPA objective for land (terrestrial) is *"to maintain the integrity, ecological functions and environmental values of the soil and landform"*. Given that the effects of ASS can affect both land and waterways the EPA objective for water (surface and ground) is also relevant. The EPA objective for water (surface and ground) is *"to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected"*. The EPA objective for soil quality specifically relates to rehabilitation of areas and is not specifically related to ASS.

Acid sulphate soils (ASS) is the common name given to naturally occurring soil and sediment containing iron sulphides generally associated with soil units in wetland and estuarine areas. Iron sulphides form in a layer of waterlogged soil or sediment, and are benign in their natural state. Some rock types can also contain pyrite which forms acid, but is also benign in its natural state. When disturbed and exposed to air they oxidise and produce sulphuric acid, iron precipitates, and concentrations of dissolved heavy metals such as aluminium, iron and arsenic (Department of Environment, 2003; WAPC, 2003).

A change to zoning is required in this project in the above mentioned areas. Bulletin 64 of the WA Planning Commission "Acid Sulphate Soils" states that:

…any change of zoning that will lead to any intensification of land use on such land should be accompanied by a Preliminary Site Assessment (prepared in accordance with the Department of Environment's guidelines) that determines the presence or absence of acid sulphate soils on any part of the land where any of the following works are proposed (or likely to be undertaken):

- Where any dewatering works are proposed to be undertaken.
- Where the surface elevation is less than or equal to 5m AHD, and it is proposed to excavate greater than or equal to 100m^3 of soil (i.e. 10 standard dump truck loads).

- Where the surface elevation is greater than 5m AHD, and it is proposed to excavate greater than or equal to 100m^3 of soil (i.e. 10 standard dump truck loads), and the excavation depth is greater than or equal to 2m.

Areas depicted in vegetation mapping as mangroves or wetland dependent vegetation such as reeds and paperbarks are also classified as areas where acid sulphate soils are likely to occur in WA Planning Bulletin No. 64.

According to Bulletin Number 64 of the WA Planning Commission, the Shire of Chittering predominantly consists of areas of moderate to low risk of Actual Acid Sulphate Soils (AASS) and Potentially Acid Sulphate Soils (PASS) occurring generally at depths greater than 3m, with small pockets of high risk areas where AASS and PASS occur less than 3m from ground surface. Acidic springs and seeps with pyrite have been identified at Westdale, Wooroloo, and near Brookton, Bindoon and Capel. These soils are referred to as "inland acid sulfate soils" and can be found in some parts of the wheatbelt. They may represent a significant problem for remedial actions in landscape affected by salinity (DoE, 2004). The nearby Chittering and Needoonga Lakes are brackish and include swamp and low lying inundated areas.

The proposed project area is at an elevation of between 125m and 173m AHD and proposed works include cutting to a maximum depth of 5 metres in elevated areas and minor cutting to a maximum depth of 0.5m in low lying areas.

The proposed works meet the criteria for preliminary site assessment, as parts of the project area support wetland dependent vegetation. Additionally there may be alluvial sediments within the soil profile given that it is located within a valley. ASS has been found in the Bindoon area historically, with pyrite being present in the shale of the Leederville / Osborne formation. There are seeps and acid springs in the area and it is suspected that these have come from historic road cuttings (pers. comm. S. Appleyard, DoE, July 2005).

A preliminary site assessment as described in the DoE guideline "Identification and Assessment of ASS, October 2004" is required prior to works commencing (pers. comm. S. Appleyard, DoE, July 2005).

Further geotechnical investigations to assess the strength/stability and nature of the soils within the road excavation sites will be undertaken as part of the project. This will incorporate additional soil sampling as required by the DoE guidelines for ASS. The DoE guideline for ASS preliminary assessment states that 4 boreholes should be constructed and sampled at 0.5m intervals to the depth of proposed excavation or for linear projects every 100m for minor excavations. On this basis a total of four bore holes will be drilled for the project, being one for each of the areas of excavation.

If ASS are found in the preliminary assessment, management actions will be undertaken as described in "Treatment and management of disturbed acid sulphate soils" DoE 2004.

Management commitments are made in section 6.9.

4.8 SALINITY

The EPA objective for water (surface or ground) is *"to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance,*

are protected" and for water quality (surface, marine or ground) is *"to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards"*

Salinity is one of the key environmental issues within the Brockman River Catchment currently. There has been a trend of rising salinity in the recent past due to changing land uses and removal of deep rooted perennial vegetation.

The water balance in the Brockman River catchment has changed due to the clearing of native vegetation and the utilisation of the land for residential, agriculture, horticulture and light industry. It is difficult to quantify the history of land clearing in the Brockman River catchment, however Landsat imagery shows that most of the catchment was cleared of native perennial vegetation by 1988. Pastures, annual cereal crops and horticultural crops have replaced the native vegetation.

The catchment lies between average annual isohyets of 500 mm in the north and 900 mm in the south and, due to run-off accumulating more rapidly than it can be discharged, groundwater recharge has increased. As the groundwater has risen, salt that has been accumulating in the weathered-rock profile over many thousands of years is being mobilised and discharged at the surface as seeps or as base flow directly into creeks, streams or rivers, increasing the salinity of the waterways (WRC, 2002).

It is unlikely that the proposed works will impact the salinity of the land and waters in the surrounding areas, therefore no management commitments are required.

4.9 ABORIGINAL HERITAGE

4.9.1 Aboriginal sites

The EPA objective for heritage is *"to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation"*.

A desktop study of aboriginal sites was conducted in stage 1 of the project on the 8th September 2004 and presented in the Environmental Approvals Strategy. The area searched was contained within the following coordinates:

Easting 408500, Northing 6517000

Easting 414000, Northing 6525000

Easting 414000, Northing 6257000

Easting 415500, Northing 6527000

Easting 415500, Northing 6525000

Easting 410000, Northing 6517000

Two (2) previously reported sites were found in the general area and one (1) report related to Aboriginal heritage in the search area.

3422; S02712; Bindoon Hill

A reported burial site where people were buried facing west with their possessions (tobacco, tins, spears) on the ground. Proposed works may impact on this burial site as the boundaries of the site are unclear. This site has been deemed by the ACMC to have insufficient information and has been placed on the interim register of Aboriginal Sites (ACMC 13/06/00).

3528; S02524; Burroloo Well

A few pieces of quartz chips were noticed close to Burroloo Well and approximately 100 metres downstream on graded firebreaks. The DIA boundaries for this site are between 52.4 SLK and 54.6 SLK. This section of the GNH is not subject to the proposed road works and thus Site ID 3528 is unlikely to be impacted works. The ACMC have deemed this site to have insufficient information and has been placed on the interim register of Aboriginal Sites (ACMC 04/03/04).

Survey Results

A field inspection of the proposed works area was undertaken on Wednesday 6th October 2004 with Combined Metropolitan Working Group (CMWG) NTC representatives and Yued NTC representatives. The consultants and Aboriginal representatives drove by hire bus and car to a stop off point near the intersection of Tea Tree Road and Great Northern Highway stopping at various locations to inspect the site on foot.

Several sites and areas of aboriginal (and European) heritage significance were identified by the CMWG and Yued representatives including:

- a single scarred tree, opposite the Chittering Road House at 409436E and 6517219N;
- Burroloo Well and an associated creek, extending northwards from approximately 411316E and 6520333N;
- Brockman River and associated lakes, to the high water mark. The Great Northern Highway currently passes over/intersects this site (a bridge) at 414348E and 6524205N;
- Holy Trinity Church, 413565E and 6523133N;
- a cluster of marked trees. on the eastern side of Great Northern Hwy (opposite Tea Tree Road) at approximately 414022E and 6524031N (AIC, 2005).

The Elders also stated that the general area was significant to them, historically, spiritually, and as a place where some of them hunt and gather today. The rivers, waterways and hills in the area were identified as being of mythological significance and as forming part of a sites complex. The Elders noted that the Darling Scarp itself is significant to them however, site Id 3188/S00546/DARLING RANGE has been determined by the ACMC to be "not a site" under the Act (AIC, 2005).

The Elders raised concerns and requests regarding the proposed works which are documented in Appendix F. Recommendations from the report are summarised below:

- Sites identified by them during the survey be recorded with DIA and that the impact of the proposed works upon them be minimised;

- To protect the wildlife in the wetlands, there should be rubbish and oil traps or sumps along the road;
- That revegetation of disturbed areas includes only local indigenous flora;
- That consultation is needed with them if the Brockman River Bridge is to be widened in the future;
- Where possible, MRWA undertake roadworks on the opposite side of the road to where the wetlands are located;
- MRWA employ Aboriginal monitors during ground disturbance activity, under an agreement to be determined in the near future;
- MRWA consider the request by the Aboriginal representatives for the installation of signage that acknowledges the Aboriginal Heritage of the area.

Nyungah Elders stated that they did not oppose the works as described to them if the above conditions were met. Management commitments are made in section 6.9.

AIC endorsed and reiterated the recommendations of the Elders and in addition recommended that:

- AIC will lodge the necessary site recording forms with the Department of Indigenous Affairs for the places identified by the CMWG and Yued representatives;
- MRWA take steps to ensure that they comply with both the *Aboriginal Heritage Act 1972*, *Heritage of Western Australia Act 1990*, and the Shire of Chittering's municipal planning schemes.
- MRWA staff and contracting personnel be made fully aware of their obligations under the Act.

Management commitments are described in Section 6.11.1.

4.9.2 Native Title

There are two native title claims over the area, the Combined Metropolitan Working Group Claim (WAG0142/98; WC99/006) and the Yued Claim (WAG6192/98; WA97/071). It is most likely that native title is extinguished in the road reserve if the road was constructed prior to 1/1/1994. The section of the Great Northern Highway that is within the proposed works was constructed in pioneering years with the most recent works occurring prior to 1/1/1994 (T.Saraullo [MRWA], pers. comm., August 2005).

In the Chittering Nature Reserve native title may not be extinguished. Consultation with the claimant representatives from the Combined Metropolitan Working Group and the Yued people were undertaken on 6th October 2004. The representatives inspected the site as described in section 4.9.1 and it was concluded that they did not oppose the proposed works provided the conditions as described above were met.

Management commitments are outlined in Section 6.11.2.

4.10 EUROPEAN HERITAGE

The EPA objective for Heritage is *"to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation"*.

European heritage is important as it provides a shared history for many communities around the state and as such it is protected by the *Heritage of Western Australia Act 1990.* Chittering was one of the earliest places settled by Europeans in Western Australia in the 1830's and was home to many prominent families such as the Brockmans (AIC, 2004).

A first stage, desktop survey was undertaken in September 2004 to establish the number and nature of sites in the project area (Australian Interaction Consultants, 2004) and a second stage survey was undertaken and report supplied in October 2004.

The second stage survey was undertaken through a series of pedestrian transects through the area with the entirety of the proposed works being examined in this way. The field survey confirmed the results of the desktop study.

Survey Results

There is a high level of disturbance along the corridor which, combined with low surface visibility indicates that the archaeological potential of this area has not been properly ascertained and other sites may also exist along the route that are not currently registered or known such as homes of early settlers, roadhouses and other early structures.

During the survey, one potential scarred tree and two areas of potential historical archaeological significance were found during the survey:

- Holy Trinity Anglican Church and Cemetery (place ID 479) (Figure 4.2). This site is listed on the municipal heritage register; and,
- Chittering Road Board Office (former) (place ID 478) (Figure 4.3). This site is listed on the municipal heritage register and has an interim status on the state register of heritage places.

The two properties are in very close proximity to the proposed area of works. Neither of these sites are listed as National Heritage places.

The scarred tree is located on the road verge at the start of the proposed dual carriageway section of the survey area. The tree has two scars, one appears to have been the result of vehicle impact, the second scar is higher on the tree and oval in shape, but it is difficult to determine the nature and origin of the scarring.

It is proposed to take several metres of land inside the church property fence line (Figure 4.2), which was thought, may impact on graves in the church grounds. Contact was made with the Bindoon and Districts Historical Society and information sought on the potential impacts of works over any known historical sites in the area. All graves at the cemetery are located on the north and west side, rather than on the south side where the works are to occur (R. Lissett, [Bindoon and Districts Historical Society], pers. comm., July 2005). Concern was raised over the impacts of blasting

and vibration nearby on the building and this should be taken into consideration by MRWA.

The Upper Chittering School ground is marked with a sign from the Shire of Chittering indicating it is on the municipal heritage register. Its location could not be ascertained in the field initially owing to the thick grass cover, however Mr. Lissett indicated that a pile of mud bricks about 50m to the north west of a brick shed in Donaldson's paddock is the remains of the school building. The site is close to the proposed works and it was suggested by Mr. Lissett that impact on the site could be minimised by routing the road to the east of the shed rather than to the west which may also be preferable for safety reasons (AIC, 2004).

The location of the school site was later confirmed by Mr. Boyd Martin and is located on the De Campo property to the north west of the existing brick shed (B. Martin, pers. comm.., September 2005). This site is located outside the footprint of the works and will not be impacted. Therefore no further action is required.

In terms of the how this study fits with the broader context, more often than not these studies only examine archaeological materials visible of the ground surface with only speculation about what subsurface materials might be present. While they can be placed into regional contexts, and can be made to fit within a research framework, most of these types of surveys comprise stand alone studies.

It should be noted that the MRWA has mandatory heritage obligations under the Government Heritage Property Disposal Process (GHPDP) for properties in the event that either site may need to be destroyed. A dilapidation survey will be conducted on the church site prior to proposed works commencing.

Refer to section 6.12 for management commitments.

4.11 NOISE, VIBRATION, DUST AND AIR EMISSIONS

The EPA Objective for air quality is *"to ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards"*. The EPA objective for noise is *"to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards"*.

Noise levels along Great Northern Highway and in Bindoon townsite can be expected to increase during construction works. Road construction may also produce vibrations that may cause damage to nearby buildings and nuisance to local residents in Bindoon and properties along the proposed alignment. Compaction of soil and road building material, and heavy machinery movement are likely to be the main source of vibration.

The impact of air emissions from traffic on Bindoon following construction is predicted to be minimal. Traffic flows are not expected to increase significantly as a result of the proposed works.

Noise will be generated from the proposed works, which may affect fauna in proximity to the works. However it is probable that fauna in the area is accustomed to noise from the existing GNH and can differentiate between background noise, which

includes the GNH and predator/prey noises. An increase in the long term noise associated with the works is not anticipated, and therefore impact on fauna as a result of noise is not expected, however actions should be taken to minimise noise wherever possible.

Assessment against the criteria for completion of a preliminary air quality impact assessment as described in the MRWA Air Quality Guide was conducted. As described in MRWA Air Quality Guide, there are three criteria which would exempt a project from being subject to assessment. These are:

- A new road that is predicted to have traffic flow less than (or a major upgrade resulting in an increase of traffic flows less than) 10,000 vehicles per day in urban areas or 15,000 vehicles per day in rural areas;
- Residential or other sensitive receptors are not within 200 metres of the road centre; and
- Where background air quality (measured by the nearest DoE fixed monitoring site) does not exceed 25% of the NEPM for ambient air quality and has remained below this level for the 12 months ending at the time of the assessment.

The estimated traffic flow along this section of the GNH is approximately 2,500 per day (L. Dunstan [MRWA], pers. comm., July 2005)

The closest ambient air quality data available from the DoE is from Rolling Green monitoring station which is in the outer east rural area. This is the point where pollution from the city accumulates and readings here are generally elevated and are not applicable for this situation (A. Grieco [DoE], pers. comm., September 2005). It is expected that the number of vehicles and lack of large industry would not generate significant pollutants in Bindoon (pers. comm. A. Grieco, DoE, September 2005).

There are residential receptors within 200 m of the road centre, however given that the project is upgrade to an existing road it is not considered a significant project. A preliminary air quality assessment as outlined in 6707/007 MRWA Air Quality Environmental Guideline is not required.

Dust will be produced during the proposed works however will be managed as described in section 6.11 to reduce the impact.

Vibrations may cause damage to the two municipal heritage sites identified in proximity to the proposed works. The potential impact of vibration on the former Chittering Roads Board building has been identified as an issue by the Shire (M. Hipkins [Shire of Chittering], pers. comm., June/August 2005). A dilapidation survey will be undertaken of the Holy Trinity Church and Old Roads Board Office prior to works commencing.

Given that the above recommendations and management recommendations made in section 6.13 are implemented, it is expected it will be managed in accordance with the EPA objective for noise.

4.12 VISUAL AMENITY

The EPA objective for visual amenity is *"to ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practical"*.

The area in which the project is located is picturesque with a patchwork of agricultural land and remnant vegetation including on surrounding hills.

As the proposed works do not involve construction of a new alignment, rather consisting of minor realignment and widening permanent impact on visual amenity along this section of the GNH is negligible. Land use in the Chittering Shire is predominantly agriculture with some conservation and remnant vegetation sites. The proposed works will require removal of some remnant vegetation, of which a significant amount is degraded and temporary use of three small sections of the Chittering Lakes Reserve which will be revegetated on completion of the project. This may impact on short term visual amenity in the area however long term affects will be minimal and in accordance with the EPA's objective for visual amenity. Vegetation losses will be offset with revegetation where practicable so the overall impact on visual amenity of the project upon completion will be minimal.

4.13 PUBLIC SAFETY AND RISK

The proposed works will improve overall public safety and risk by creating improved pavement, road width, drainage and corner geometry on the section of road. The proposed project will ultimately reduce the risk to drivers, however a risk to the public could be posed during construction from machinery and vehicle movement, dust generation and traffic disruption. Provided traffic management and signage to Main Roads Western Australia standards is employed, none of the proposed works present significant hazards to public safety.

Management recommendations are made in section 6.15.

4.14 CONTAMINATED SITES

A DoE Contaminated Sites Freedom of Information search was initiated in July 2005. The results of this search indicate that there were no contaminated sites in the area of proposed works noted on the database.

4.15 SOCIAL IMPACT

A minor amendment is required to the Shire of Chittering Town Planning Scheme No. 6 with most of the change consisting of an amendment from 'agricultural resource' to' highway'. A planning scheme amendment application has been submitted at the same time that this was EIA was submitted to the EPA Service Unit.

No significant adverse social impact is expected as a result of this project. During construction there will be some delays expected as a result of the need to slow and at times stop traffic flow to allow the works to be undertaken. The utilisation of standard traffic management techniques should minimise these impacts.

Post construction there may be a positive social impact if the expected decrease in accident rates is achieved.

5 Environmental management

5.1 VEGETATION

5.1.1 Declared Rare Flora (DRF) and Priority Species

Two priority 3 taxa, *Acacia drummondii* subsp. *affinis* (drumonds wattle) and *Adenanthos cygnorum* subsp. *chamaeophyton* (woolly bush) were identified within the project area (refer to figures 5.1 and 5.3). There is no legal obligation to avoid these species, however, for conservation reasons it is recommended that impact on these species is avoided where practicable. No DRF were identified within the project area.

Both priority species will be impacted by the proposed works, with forty five of the 75 plant *Adenanthos cygnorum* subsp. *chamaeophyton* population and twenty five of the 75 plant *Acacia drummondii* subsp. *affinis* population requiring removal. The outcome of the consultation with the Species and Communities Branch of the Department of Conservation and Land Management (CALM) was that the branch representative considered the proposed impact to be not significant to the conservation of the species (Ken Atkins [CALM], pers. comm.., November 2005). Their advice regarding the need to implement impact minimisation measures and amelioration measures (i.e. local seed collection) has already been addressed by this proposal.

Revegetation of drummond's wattle will be undertaken in close proximity to the location of the existing population on completion of the works, using seed collected from the drummond's wattle population prior to clearing. Topsoil from around the woollybush population will be used in revegetation in order to maximise the possible return of the species by natural recruitment, relevant management commitments are outlined in Section 6.3.1.

5.1.2 Threatened Ecological Communities

As Threatened Ecological Communities (TECs) were not identified database searches or in the flora survey as being present in the proposed area of works, there are no associated management commitments.

5.1.3 Weed Management

There are no declared plants identified within the project area, however there are nuisance weeds present, primarily *Watsonia bulbifera* and *Rumex ?crispus*. A watsonia control program will be discussed with CALM for application where the project area abuts the lakes.

Soil movements will be managed to avoid the spread of weeds and any soil that is infested with weeds will not be used for rehabilitation and will be appropriately disposed of, either off-site or through burial.

Relevant management commitments are described in Section 6.3.3.

5.1.4 Clearing

As the proposed clearing will occur after 8th January 2005 clearing permit application has been made for the project area south of Brockman Bridge in October 2005. Clearing will be extremely limited through the ESA, with clearing limits surveyed, pegged and confirmed as being accurate by the Superintendent through a hold point in the Contract. The clearing permit will be obtained prior to any clearing activities commencing.

The implementation of minimum clearing protocols will be established as part of final design to minimise potential impacts associated with clearing. Where vegetation clearing occurs, removal of mature trees will be minimised and vegetation clearing limits will be clearly established as part of the final project design. Areas outside the project area will not be disturbed as part of the proposed road footprint works and the boundaries of clearing will be flagged in the field and outside of the prior to clearing. Revegetation of areas disturbed by the project will occur and parts of Section 7.3.4 outlines the management commitments relevant to clearing.

Due to the close proximity of the project area to the two lakes and the Brockman River only locally occurring native species will be used in revegetation.

Parts of several properties will be purchased to established permanent buffers between the Chittering Lakes Nature Reserve and the realigned GNH in several sections where this does not currently exist. **Revegetation of a section of the Kaye property will be undertaken and the use of a conservation covenant be investigated for this area.**

Section 6.3.4 outlines the management commitments relevant to clearing.

5.1.5 Dieback

A survey to determine the presence and extent of potential dieback infestation within the area of the proposed works was undertaken by Glevan Consulting in 2004. The survey concluded that there did not appear to be any significant areas that could be assessed as being free of the disease caused by *P. cinnamomi*. Therefore management practices as described in "*Managing Dieback - Detection, Mapping and Hygiene Practices"* (CALM 2003) will be followed to limit the spread of the disease throughout the project area. Management commitments for dieback management are outlined in Section 6.3.5.

More dieback management guidelines are outlined in Appendix C.

5.2 FAUNA

Four nest sites for Carnaby's cockatoo were located within or adjacent to the proposed works, one of which will be impacted by the proposed works. Johnstone and Kirby state that '…judging from recent surveys, the Bindoon region contains some of the most significant breeding areas (i.e. areas of critical habitat) for Carnaby's cockatoo in

the southwest of the State, and these areas should be a major priority for conservation management under the EPBC Act.' An opportunistic fauna survey and an additional survey and inspection of identified Carnaby's cockatoo nesting hollows was undertaken in August 2005.

Referral to the Department of Environment and Heritage is not required as the project is determined not to have significant impact on the species under the EPBC Act and is not a controlled action. Other management recommendations made in the fauna and cockatoo survey reports will be implemented as part of this project **including the installation of five artificial nesting hollows**. The management recommendations from these reports are contained in detail in Appendices D and E. Management commitments are contained in section 6.4.

Referral under the EPBC Act 1999 is not required as the impact on Carnaby's cockatoo will not impact the survival of these species at a regional or national level.

The Chittering and Needoonga Lakes and fringing vegetation support large populations of the great egret and freckled duck. Disturbance in these areas will be kept to a minimum, (refer to section 6.3.4) to minimise the impact on the birds and other wildlife using the lake system. Any loss of habitat should be mitigated by revegetation with feed species for Carnaby's cockatoo and other local plant species.

Between SLK 59.0 and 61.0 600 mm box culverts will be used to provide access for oblong tortoises to cross the road safely. Two additional culverts in this area are already part of the new road design and a rabbit mesh apron will be installed on the road reserve fencing in this area to guide the tortoises to the culverts for road crossing. The floor of each crossing will consist of a sandy substrate as quendas and oblong tortoises prefer a sandy substrate.

A wire netting apron fitting to the inside of the fence will be installed to prevent the enclosed fauna from pushing or digging beneath the fence.

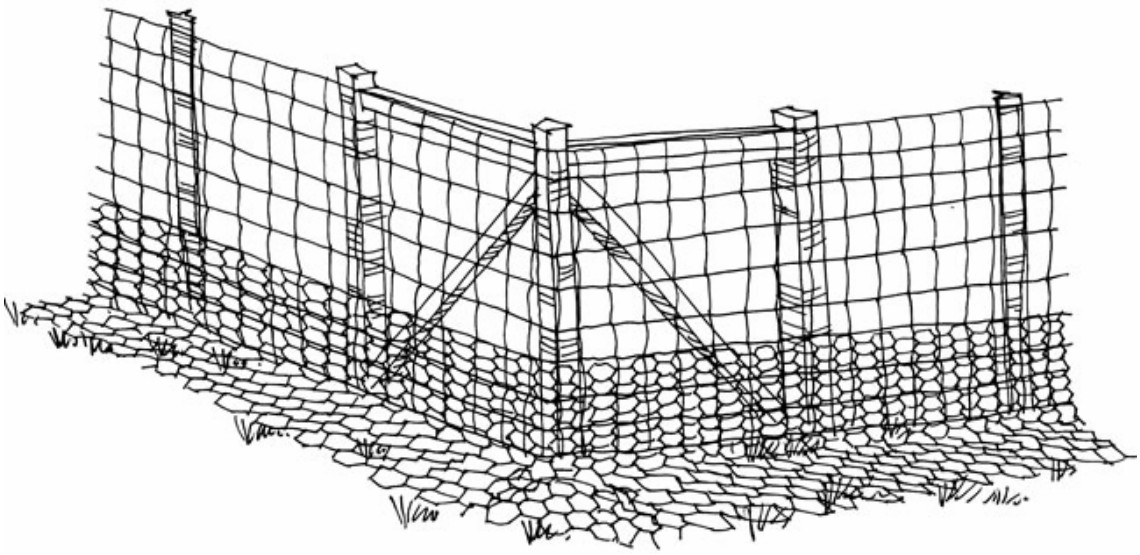

Figure 5 .1 - Picture of the type of apron that will be used.

The design of a thoroughfare on Ocean Reef Road servicing Joondalup Lake is a good example of a fauna thorough fare which accommodates both wet and dry crossing.

This design has shown to be very successful for oblong tortoises in this area (Jason Pules [CALM], pers. comm., October 2005) and will be the basis for the modified culverts used for this project.

5.3 RESERVES AND CONSERVATION AREAS

The project lies adjacent to the Chittering Lakes Nature Reserve which contains the Chittering-Needoonga Lakes system and is listed on the Register of National Estate. Entry into three small areas (0.008, 0.002 and 0.008 ha) of the nature reserve is required to facilitate construction of the road realignment batters. Approval is required from CALM and the Conservation Commission of Western Australia (CCWA) to clear vegetation and temporarily use parts of the Chittering Lakes Nature Reserve, (refer to Appendix A for further details).

One area (0.02 ha) will be used permanently for the road realignment and MRWA will consult with the CCWA to determine how this excision will be managed.

Section 6.5 outlines the relevant management commitments.

5.4 SURFACE HYDROLOGY AND WETLANDS

Hydrology impacts from the proposed works need to be managed so that litter, water borne sediment or pollutants such as hydrocarbons are not discharged to the Lakes. This is particularly important given that the area of proposed works is notorious for motor vehicle accidents (T.Saraullo [MRWA], pers. comm., August 2005).

Detention swells will be installed to limit such material entering the lake on a day to day basis, but will not contain a large spill. This will improve the level of protection given to prevent hydrocarbon spills and litter from entering the reserve and polluting the wetland.

A permit under the *Rights in Water and Irrigation Act 1914* will be obtained if interference with beds or banks of the lakes, or abstraction of ground or surface water is required.

Refer section 6.6 for detailed management commitments.

5.5 GROUNDWATER

Water for road construction and dust suppression purpose will be sourced from an existing standpipe operated by the Shire of Chittering.

The proposed works will not impact the groundwater in the area and therefore no management commitments are required.

5.6 PUBLIC WATER SOURCE AREA

The proposed works will not impact any public drinking water source area and therefore no management commitments are required.

5.7 ACID SULPHATE SOILS

The proposed works meet the criteria for preliminary site assessment for Acid Sulphate Soils (ASS). Additionally there have been ASS encountered in the past from

road cuttings (T.Saraullo [MRWA], pers. comm., August 2005). Therefore a preliminary site assessment as described in the DoE guideline "Identification and Assessment of ASS, October 2004" will be undertaken prior to works commencing.

Drilling will be undertaken for engineering purposes prior to construction and soil sampling for preliminary site investigation purposes will be incorporated into this drilling program. Refer to Section 6.9 for management commitments.

5.8 SALINITY

As there are no impacts associated with salinity arising from the proposed works, there are no management recommendations.

5.9 ABORIGINAL HERITAGE

5.9.1 Aboriginal sites

An ethnographic survey was conducted in the project area and several sites of significance to the CMWG and Yued representatives were identified, (refer to section 4.9).

Neither of the identified Aboriginal Heritage sites identified in section 4.9.1 will be impacted by the proposed works.

It was not feasible to alter the realignment design to the eastern side of the existing road north of the Brockman Bridge away from the wetlands. This was discussed with Aboriginal Elders during consultation and they did not object (T.Saraullo [MRWA], pers. comm., August 2005).

MRWA will employ aboriginal monitors to be present during all ground disturbing works in an agreement to be determined at a later date. MRWA have committed to erecting signage in the area highlighting the Aboriginal Heritage within the area. MRWA will liaise with Aboriginal representatives to determine the signage details at a later date, separate to this report (T.Saraullo [MRWA], pers. comm., August 2005).

Given the above management commitments, the Nyungah Elders do not oppose the project.

Refer to Section 6.11.1 for a description of relevant management commitments.

5.9.2 Native Title

The CMWG and Yued representatives expressed that, provided that the concerns and requests raised by them during the consultation are respected, they would not object to the planned project as described to them.

In the Chittering Nature Reserve native title may not be extinguished. Consultation with the claimant representatives from the Combined Metropolitan Working Group and the Yued people has been undertaken. The representatives inspected the site as described in section 5.9.1 and it was concluded that they did not oppose the proposed works provided the conditions specified in section 5.9.1 were met. Section 6.11.2 outlines management commitments for native title.

5.10 EUROPEAN HERITAGE

Two sites of European heritage are confirmed to be in very close proximity to the proposed area of works namely:

- Holy Trinity Anglican Church and Cemetery (place ID 479). This site is listed on the municipal heritage register; and,
- Chittering Road Board Office (former) (place ID 478). This site is listed on the municipal heritage register and has an interim status on the state register of heritage places.

Neither of these sites is listed as National Heritage places.

The Holy Trinity Church is unlikely to be adversely affected by development, although care will be taken by Main Roads during blasting works to avoid damage to this historic building. A dilapidation study of the Church and Chittering Road Board Office (former) will be undertaken prior to works commencing near the Church site.

The Upper Chittering Primary School site was identified by KBR as potentially being impacted by local resident works, and a possible change of route was suggested. However, the site was located by B. Martin and the site will not be impacted by the proposed works.

MRWA has mandatory heritage obligations under the Government Heritage Property Disposal Process (GHPDP) for properties in the event that either site may need to be destroyed, although this course of action is not anticipated. Management commitments for European heritage outlined in Section 6.12

5.11 NOISE, VIBRATION, DUST AND AIR EMISSIONS

The impact of air emissions from traffic on Bindoon following construction is predicted to be minimal. Traffic flows are not expected to increase significantly as a result of the proposed works. However during construction there will be increased noise, vibration and dust levels. The following management commitments will be used to minimise the impact of this on surrounding communities.

- Implement noise, vibration and dust minimisation techniques that may include, watering of construction areas, roads, streets and other areas immediately adjacent to works,

Standard construction management techniques to minimise air emissions of machinery during construction, such as regular machinery maintenance and inspection, is also recommended (refer to Section 6.13 for management commitments).

5.12 VISUAL AMENITY

There is unlikely to be any significant impact on visual amenity as a result of the proposed works. Removal of vegetation may impact slightly on the visual amenity of the area but this will only be temporary. The three small sections of the Chittering Lakes Reserve will be revegetated on completion of the project and vegetation losses will be offset with revegetation where practicable so the overall impact on visual amenity of the project upon completion will be minimal.

5.13 PUBLIC SAFETY AND RISK

The proposed works will improve overall public safety and risk by creating an improved pavement, road width, drainage and corner geometry. The proposed project will reduce the accident risk to drivers.

Work will be restricted to a standard 10 hour day, 6 days per week, day shift only. Provided traffic management and signage to Main Roads Western Australia standards is employed, none of the proposed works present significant hazards to public safety (Refer to Section 6.15 for management commitments).

5.14 CONTAMINATED SITES

A DoE Contaminated Sites Search was initiated in July 2005, results indicate that there are no contaminated sites within the project area. However, the road reserve could not be searched by the DoE so all affected and surrounding lots were searched.

5.15 FIRE MANAGEMENT

During the summer and autumn periods, fires can burn large areas if they are not controlled appropriately. The proposed works are located adjacent to a class A Nature Reserve and a fire could destroy native vegetation and fauna. As a result, actions should focus on fire prevention rather than mitigation.

Fire prevention measures will include:

- Water tankers present during road works;
- All machinery is to be fitted with spark arrestors fitted to the exhaust system;
- All vehicles and plant is to be fitted with fire extinguishers;
- Provision of water tankers, equipment and training of personnel to fight any fires that commence in the work areas;
- Operations will conform to the Local Government Authority, CALM and Bush Fires Board (BFB) requirements for fire prevention;

Refer to section 6.16 for management commitments.

5.16 WASTE MANAGEMENT

Waste generated will include construction waste, domestic waste, waste grease, oils, and septage waste (refer to Section 6.18 for management commitments).

5.16.1 Solid waste

Consideration shall be given to recycling waste materials where appropriate. Where this is not practicable all items of waste (rubbish) resulting from the works including plant maintenance, shall be disposed of at the nearest licensed waste disposal site or at a site agree by the Local Government Authority.

No rubbish shall be burned or buried on site.

5.16.2 Liquid waste

Waste oils will be captured and recycled.

5.17 EQUIPMENT

If not properly addressed, equipment which is brought to site can transport weeds or leak oils and greases to the environment.

5.17.1 Pre-start checks

To prevent the introduction of weed species and minimise the occurrence of hydrocarbon leaks all vehicles, plant and equipment shall be clean prior to commencement of work on the project.

Cleaning operations shall be conducted at a suitable location or locations nominated by the Contractor and approved by MRWA.

Records of vehicle, plant and equipment inspections will be kept.

Prestart checks which include presence of leaks or spills shall be undertaken for all equipment and the recorded. On discovery of a leak, vehicles will cease operation until repairs occur.

5.17.2 Equipment servicing

With the exception of breakdown maintenance, vehicle servicing will be undertaken at areas designed by the contractor. These areas will be at least 100 metres from any waterway or wetland. Vehicle refuelling will be undertaken at least 100 metres from any waterway or wetland.

All fuels, oils and chemicals will be stored in accordance with AS 1940.

All hydrocarbon contaminated rags, filter cartridges and other material shall be accounted for and returned to the workshop for disposal. These will be returned for recycling or disposed of in a location agreed by the Local Government Authority.

In the event of fuel or oil spillage, the spill will be contained and mopped up. Contaminated soils will be excavated and for removal and disposal in a manner and location agreed by the Local Government Authority.

Refer to section 6.19 for management commitments.

5.18 ENVIRONMENTAL INCIDENT MANAGEMENT

Pollution events or other incidents including spills, impacting on the environment shall be reported immediately to the appropriate authority by telephoning the DoE on (08) 9222 7123 or after hours (free call) 1800 018 800.

Incident reports will be produced which include: date and time of event, chemical name, volume, location, area affected, actions taken to clean up site and prevent recurrence

Refer to section 6.21 for management commitments. Fire management commitments are described in Section 6.17.

5.19 PUBLIC SAFETY AND RISK

Appropriate traffic management during construction to Main Roads standards will include; 'maintaining a tidy worksite', appropriate fencing, the use of rigid barriers and supports where required and appropriate signage. Refer to Section 6.15 for management commitments.

5.20 EMERGENCY PLANNING

Despite the control measures established for minimising spills and fire prevention which are outlined above, emergency plans and training are required to contain and minimise the impact of any emergency.

An emergency plan outlining the required response to potential emergency events which may impact on the environment will be established. This emergency plan will be tested within one month of project start up and the results recorded.

Material safety data sheets (MSDS) will be maintained for all chemicals adjacent to where they are stored.

Spill kits will be maintained on service/refuelling vehicles, major plant and within workshops. Contents shall include absorbent products and appropriate containers or bags. The spill kits will be inspected weekly and fire extinguishers six monthly.

Fire extinguishers shall be kept on all vehicles and in all workshops.

Personnel will be inducted in the location and use of spill kits and fire extinguishers.

Refer to Section 6.20 for management commitments.

5.21 MONITORING AND AUDITING OF PERFORMANCE

A monitoring and auditing schedule addressing the above requirements will be documented.

A complaints and incident register will be maintained.

Weekly inspections of construction areas will be undertaken utilising a checklist and all records will be kept.

Refer to Section 6.22 for management commitments.

5.22 REPORTING

Compliance with these requirements will be reviewed by the Main Roads Project Manager and unless otherwise specified exceptions will be reported fortnightly to Main Roads Environmental Branch.

Refer to Section 6.23 for management commitments.

5.23 SOCIAL IMPACT

Social impact shall be minimised by ensuring the existing Great Northern Highway remains open during the construction phase. It is anticipated that most construction activity will be undertaken in daylight hours. Dust resulting from construction activity will be suppressed as detailed in Section 6.13. Refer also to section Refer to section 6.13 and 6.24.

6 Environmental management commitments

Environmental management commitments outlined in this section are also summarised in section 1, Executive Summary.

6.1 INDUCTION AND TRAINING

Commitment	MRWA will ensure that all personnel and subcontractors receive a standardised environmental induction which addresses the requirements of the EMP and relevant legal requirements.
Action	• Provide induction; • Regular toolbox meetings will be held which include coverage of environmental issues.
Objective	Protect the environment through awareness and training.
Location	On-site - prior to work commencement
Timing	Prior to work commencement.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

6.2 VEHICLE ACCESS

Commitment	All vehicles to be restricted to existing tracks and area of works.
Action	• All vehicles to be restricted to existing tracks and area of works; • All vehicles will be cleaned prior to commencement of work on site in accordance with dieback management requirements.
Objective	Protect the environment from unnecessary degradation.
Location	All area of works
Timing	Construction.
Responsible party	Construction contractor/Site supervisor.
Requirement / Consultation	None

6.3 IMPACT ON VEGETATION

6.3.1 Declared Rare Flora and Priority Flora Species

Commitment	Disturbance to the Priority Species identified during the Flora survey (Section 5.1.2) will be avoided where practicable.
Action	• Parts of two populations of two P3 species, *A. drummondii* subsp. *affinis* (25 of 87 plants) and *A. cygnorum* subsp. *chamaeophyton* (45 of 75 plants) require removal; • Consultation with CALM Species and Communities Branch has been undertaken (November 2005); • The populations of two priority species have been mapped; • Specimens of each species are to be registered at the WA Herbarium; • Clearing will be minimised, clearly marked and communicated (refer to 6.3.4); • Revegetation with each species (using collected seed or return of topsoil as appropriate) will be undertaken where practicable (6.3.4). • **Vegetation clearing boundaries will be distinctly marked.** • **Ingress of equipment and personnel during the construction phase outside of the limit of clearing will not be permitted. This will form part of the Environmental Induction for construction personnel on this project** • **Following completion of construction, earthwork batters and areas of disused road reserve will be revegetated with a species list which includes the Priority 3 species.** • **Adenanthos cygnorum subsp. chamaephyton and Acacia drummondii subsp. affinis will be planted as tube stock.**
Objective	"to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"
Location	Where the identified Priority Flora occur in the project area.
Timing	Prior to disturbance of P3 species and during construction.
Responsible party	MRWA Project Manager and Construction Manager
Requirement / Consultation	CALM, Species and Communities Branch

6.3.2 Threatened Ecological Communities

There are no Threatened Ecological Communities (TEC's) identified within the project area. There are no management recommendations for TEC's.

6.3.3 Weed Management

Commitment	Minimise the spread of existing weed species and the introduction of new weed species into the project area.
Action	• Identify key construction activities likely to spread weeds; • Implement a weed management plan including the following commitments: ▪ **The Weed Management Plan will form part of the road construction specifications under "Clearing- MRWA Specification No 301". The Weed Management Plan will include the identification and location of the three main weed species particularly watsonia within the Contract Area** ▪ **For each weed species, the timing of the herbicide spraying before earthworks begin and spraying methodology including pesticide operator's licence, measures to protect the existing vegetation, herbicide product to be used and dosage, use of a dye and monitoring of mortality rate will all be documented.** ▪ An identification kit of key weed species to be provided to construction personnel; ▪ Undertake minimum disturbance and clearing where practicable to avoid suitable weed proliferation conditions; ▪ Brush down/wash down vehicles to remove vegetative matter and soil prior to entry for all incoming vehicles; ▪ Brush down/clean down of vehicles, machinery and personnel working in identified infested areas prior to working in non-infested areas; ▪ The use of clean 'weed free' fill and road building material for construction; ▪ Disposal of weed infested topsoil through burial or off-site disposal; • Discuss the design and implementation of a watsonia control program with CALM and Ellen Brockman Catchment Group (EBCG) for project areas which abut the Chittering Lakes Nature Reserve. • The weed management plan will be consistent with dieback management techniques.
Objective (flora)	"to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"
Location	Throughout the study area. Hygiene points for incoming vehicle inspection and cleaning will be established at site entry points.
Timing	During construction.
Responsible party	Construction contractor.
Requirement / Consultation	Consultation with CALM and EBCG regarding a watsonia control program.

6.3.4 Clearing

Commitment	Obtain clearing permit (area) from DoE, minimise the impacts associated with vegetation clearing. Obtain approval from Conservation Commission of Western Australia (CCWA) to clear land within the Chittering Lakes Nature Reserve.
Action	• Implementation of minimum clearing protocols, including the establishment of vegetation clearing limits, should occur as part of final design; • Where vegetation clearing occurs, removal of mature trees should be minimised; • Areas outside the project area will not be disturbed as part of the proposed works; • The construction contractor will be made aware of requirements for minimising the potential for the generation of wildfire; • **Purchase of part of two properties to help compensate for clearing within and outside of road reserve, namely:** ▪ **Part of Lot 1 Certificate of Title 1024/846 Perth Diocesan Trustees (Land Area =1.0 ha) Refer MRWA land dealings plan no. 0560-060-1** ▪ **Part of Lot 954 Certificate of Title 1849/74 R.W & B.R Donaldson (Land Area = 0.3 ha) Refer MRWA land dealings plan no. 0560-061-2** ▪ **Subject to successful negotiation with Mr Kaye a small section (1.2 ha) of his property Lot 3078 between the widened road reserve boundary and the Needoonga Lake boundary will be revegetated with suitable local upper-storey species to provide an enhanced buffer between the Highway and the Nature Reserve.** ▪ **The possibility of obtaining a conservation covenant over this area has been discussed with Mr Kaye and he has expressed interest in undertaking this.** ▪ **Revegetation of the widened road reserve and the possible conservation covenant area will consist of:** ▪ **Zone 1 species less than 600 mm high** ▪ **Zone 2 species less than 4 m height (and stem diameter less than 100mm)** ▪ **Zone 3 consisting of area in which there are no height restrictions for revegetation species.**
Objective	Flora: "to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge" Conservation Areas: "to protect the environment values of areas identified as having significant environmental attributes"
Location	Wherever vegetation clearing is required within the project area.
Timing	Prior to commencement of works and during construction.
Responsible party	MRWA Project Manager.
Requirement / Consultation	A clearing permit (area permit) application has been made to the DoE (CPS 900/1). Obtain approval from CCWA to disturb parts of the Chittering Lakes Nature Reserve.

6.3.5 Dieback

Commitment	Minimise the introduction and spread of dieback (*Phythopthora cinnamomi*) within the project area.
Action	• The site will be managed as being infected with dieback, or at high risk of infection with dieback. Implementation of best management practices as described in "Managing Dieback - Detection, Mapping and Hygiene Practices" will be followed. This includes but are not limited to: ▪ Source all fill materials from disease free areas; ▪ Implement hygiene measures for incoming vehicles and machinery. • Co-ordinate Dieback control measures with weed control measures. • Implement control measures as described in Appendix C.
Objective	Flora: "to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge".
Location	Throughout study area. Hygiene points for incoming vehicle inspection and cleaning will be established at site entry points.
Timing	During construction.
Responsible party	Construction contractor.
Requirement / Consultation	Additional consultation with CALM Mundaring office may be required to clarify location specific information on dieback free borrow/fill areas.

6.4 IMPACTS ON FAUNA

Commitment	**To minimise the effect on fauna in the area to be cleared, particularly the Carnaby's black cockatoo and the oblong tortoise**. Referral to DEH under the EPBC Act if required.
Action	• **Install five artificial hollows for use by Carnaby's cockatoo for nesting;** • Take any injured native fauna to a designated veterinary clinic or a CALM nominated carer; • Report the presence of all large bird nesting sites or colonies so that they can be assessed prior to disturbance; • Existing weed infestations along project route will be treated and only native species will be used for rehabilitation; • Any trenching will be kept open for only as long as necessary and suitable escape ramps and bridging provided if site is to be left unattended for extended periods; • Areas outside the project area will not be disturbed during the proposed works; • Where possible revegetation of land with Carnaby's cockatoo feed species; • Limit disturbance to wetland fringing vegetation to minimise the impact on the great egret and freckled duck populations. • Fauna fencing and underpasses will be installed at selected locations to improve ability of oblong tortoise to cross the GNH.
Objective	"to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge"
Location	Throughout study area where clearing will occur.
Timing	Prior to clearing and construction.

Responsible party	MRWA Project Manger/consultant.
Requirement / Consultation	**Consultation with CALM will be required if Carnaby's cockatoo eggs or chicks are found during the construction phase.**

6.5 RESERVES AND CONSERVATION AREAS

Commitment	Obtain approval from CALM/CCWA to temporarily disturb two and permanently disturb one area of Chittering Lakes Nature Reserve. Minimise the impact of proposed works on Chittering Native Reserve.
Action	• Areas outside the proposed works will not be disturbed as part of the project without permission from CCWA/CALM. • Approval from the CCWA has been sought to disturb three areas of the Chittering Lakes Nature Reserve. • Revegetation of areas of the Chittering Lakes Nature Reserve and other areas disturbed during project construction with local plant and feed species for Carnaby's cockatoo.
Objective	"to protect the environmental values of areas identified as having significant environmental attributes"
Location	Chittering Lakes Nature Reserve - the area adjacent to the common boundary of Chittering Lakes Nature Reserve and the proposed road works.
Timing	Approval prior to construction;
Responsible party	MRWA Project Manager.
Requirement / Consultation	CCWA/CALM

6.6 SURFACE HYDROLOGY AND WETLANDS

Commitment	Minimise the impact of proposed works on surface drainage and quality of the Chittering and Needonga Lakes System.
Action	• Road runoff will be managed to avoid direct drainage into the Chittering and Needoonga Lakes to ensure that water borne sediment or pollutants such as hydrocarbons are not discharged into the Lakes. • Only fill used in low-lying areas, no excavation. • Geofabric curtain used during construction where fill is placed adjacent to lake. • Geotechnical investigations to include sampling and subsequent testing for ASS. • Roadside soakage swales will be constructed to filter pollutants from run-off • Overland flow that is intercepted by the new works will be directed via table drains and into culverts • Generally sheet flow from the road pavement surface will be directed into table drains and culverts. In instances where outflow is into the Chittering Lakes Nature Reserve, sheet flow will be directed into revegetated swales and allowed to settle prior to discharge into the reserve. • Hazardous chemicals or fuels and oils will be stored at least 100m from rivers, creeks and lakes to avoid drainage into the Chittering or Needoonga Lakes. • Should there be a need to stockpile road construction or landscaping materials, appropriate bunds and drains would be constructed to prevent run-off into drainage lines in the event of heavy rain. • Best practice management guidelines for stormwater management as prescribed by the DoE will be followed.
Objective	Wetlands: "to maintain the integrity, ecological functions and environmental values of wetlands"
Location	Study area, however particularly within close proximity to Chittering and Needoonga Lakes.
Timing	Prior to construction/During construction
Responsible party	MRWA Project Manager
Requirement / Consultation	Not required

6.7 GROUNDWATER

There are no impacts expected on groundwater in proximity to the proposed area of works. There are no management commitments required.

6.8 PUBLIC WATER SOURCE AREA

There are no impacts expected on public drinking water source areas in proximity to the proposed area of works. There are no management commitments required.

6.9 ACID SULPHATE SOILS

Commitment	Minimise the impact exposure of ASS during proposed works.
Action	• Conduct preliminary site assessment for ASS as described in the DoE Guideline "Identification and Assessment of ASS, October 2004"; • Implement any actions arising from preliminary assessment.
Objective	As ASS has the potential to affect both land and water both objectives are stated. Land (terrestrial) "to maintain the integrity, ecological functions and environmental values of the soil and landform" Water (ground and surface) "to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected".
Location	Proposed area of works.
Timing	Prior to construction
Responsible party	MRWA Project Manager
Requirement / Consultation	Consultation with S. Appleyard of the DoE should be undertaken.

6.10 SALINITY

Impacts on salinity that may be associated with the proposed works are not considered significant and no environmental management commitments re recommended.

6.11 ABORIGINAL HERITAGE

6.11.1 Aboriginal sites

Commitment	Comply with the requirements of the *Aboriginal Heritage Act 1972*.
Action	• Minimise disturbance to sites and areas of Aboriginal heritage. Undertake consultation with traditional owners as required. • Employ aboriginal monitors during the ground disturbance activity, under an agreement to be determined in the future; • Consider the request by the Aboriginal representatives for the installation of signage that acknowledges the Aboriginal Heritage of the area; • Take steps to ensure that MRWA comply with both the *Aboriginal heritage Act 1972*, *Heritage of Western Australia Act 1990*, and the Shire of Chittering's municipal planning schemes; • Staff and contracting personnel will be made fully aware of their obligations under the above Acts.
Objective	Heritage: "To ensure that changes to be biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation".
Location	Throughout project area.
Timing	Prior to commencement of works, during construction
Responsible party	MRWA Project Manager - Construction Supervisor
Requirement / Consultation	Consultation with elders conducted 6th October 2004.

6.11.2 Native Title

Commitment	To take into account native title considerations for works within Chittering Lakes Nature Reserve. Comply with the requirements of the *Aboriginal Heritage Act 1972.*
Action	• Two Native Title Claims over the project area: ▪ Combined Metropolitan Working Group Claim (WAG0142/98;WC99/006) ▪ Yued Claim (WAG6192/98;WC97/071) • Consultation with NTC representatives from the two claimant groups (completed 6th October 2004).
Objective	Heritage: "To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation".
Location	Project area
Timing	Prior to and during construction
Responsible party	Main Roads Project Manager,
Requirement / Consultation	Comply with requirements of *Aboriginal Heritage Act 1972*.

6.12 EUROPEAN HERITAGE

Commitment	To preserve all sites of heritage significance where possible.
Action	• Conduct a dilapidation survey of the Holy Trinity Church and former Chittering Roads Board. • Exercise caution if blasting works are required near to the Holy Trinity Church and former Chittering Roads Board. • Avoid the Upper Chittering Primary School site where possible. • Avoid damage to heritage sites. Where this is not possible, photographically record sites prior to destruction in consultation with a qualified heritage consultant and in compliance with the Government Heritage Property Disposal Process (GHPDP).
Objective	Heritage: "to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.
Location	Throughout study area.
Timing	During detailed design and prior to construction.
Responsible party	Construction Contractor, Main Roads Project Manager
Requirement / Consultation	Consult with Shire of Chittering if any items of heritage are to be impacted by the proposed works.

6.13 NOISE, VIBRATION, DUST AND AIR EMISSIONS

Commitment	Minimise the impact of noise, vibration, dust and air emissions during construction.

Action	• Implement noise, vibration and dust minimisation techniques that may include, but not be limited to:
	  ▪ Watering of construction areas, roads, streets and other areas immediately adjacent to works;
	  ▪ Providing adequate signage of works in progress.
	• Standard construction management techniques to minimise air emissions of machinery during construction, such as regular machinery maintenance and inspection will be implemented.

Objective	Noise: "to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards" Air Quality: to ensure that emissions do not adversely affect environment values, or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
Location	All construction works.
Timing	During construction.
Responsible party	Construction contractor.
Requirement / Consultation	Not required.

6.14 VISUAL AMENITY

As there is minimal impact on visual amenity, no management commitments are required.

6.15 PUBLIC SAFETY AND RISK

Commitment	Minimise risk to the public associated with the proposed works
Action	• Implement an approved traffic management plan to ensure all temporary signage for roadworks in accordance with Australian Standard AS 1742.3-2002 and Main Roads Western Australia Traffic Management for Works on Roads Code of Practice March 2004 including all amendments. • Maintain a tidy work site; • Appropriate fencing; • The use of rigid barriers and supports where required; • Appropriate signage.
Objective	Minimise risk to public safety as a result of works.
Location	All construction works
Timing	During construction
Responsible party	Construction contractor
Requirement / Consultation	Not required

6.16 CONTAMINATED SITES

As no contaminated sites were identified there are no management commitments.

6.17 FIRE MANAGEMENT

Commitment	Ensure appropriate fire prevention measures are taken.
Action	• All machinery will have spark arrestors fitted to the exhaust system; • All vehicles and plant will be fitted with fire extinguishers; • Water tankers, equipment and project personnel trained to fight fires in the work areas, will be provided; • MRWA will ensure that the project conforms to the Local Government Authority, CALM and Bush Fires Board (BFB) requirements for fire prevention.
Objective	Protect project and surrounding areas from fire.
Location	All project areas.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering, CALM, Bush Fires Board

6.18 WASTE MANAGEMENT

Commitment	Manage waste in an approved manner in accordance with Local Government Authority requirements.
Action	• No rubbish shall be burned or buried on site; • Recycle waste materials where possible.
Objective	Manage waste in an environmentally responsible and approved manner.
Location	All project areas where waste is generated.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering

6.19 EQUIPMENT

Commitment	Use and maintain equipment to eliminate the spread of weeds or hydrocarbon spills in accordance with Dieback Management requirements.
Action	• All vehicles, plant and equipment will be cleared prior to commencement of work on site; • Records of vehicle, plant and equipment inspections will be maintained; • All materials imported to site will be weed free; • All vehicle servicing will be undertaken in designated areas. These shall be at least 100 metres from any waterway or wetland; • Vehicle refuelling shall be undertaken at least 100 metres from any waterway or wetland; • Prestart checks including presence of leaks or spills shall be undertaken for all equipment and recorded; • All fuels, oils and chemicals are to be stored in accordance with AS1940 and at least 100 m from any waterway or wetland; • All hydrocarbon contaminated rags, filter cartridges and other material will be returned to the workshop; • These materials will be recycled or disposed of in a manner and at a location approved by the Local Government Authority; • In the event of a spill of fuel, oil or chemical it will be contained, removed and disposed of in a manner and location agreed in writing by the Local Government Authority.
Objective	Minimise the potential for degradation of the environment from spills or contamination.
Location	All vehicles, plant and equipment.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering

6.20 EMERGENCY PLANNING

Commitment	Ensure adequate emergency response.
Action	• Maintain an emergency plan and ensure adequate training is provided; • Test emergency plan within one month of project start up and record results; • Maintain material safety data sheets (MSDS) for all chemicals adjacent to where they are stored • Maintain spill kits on servicing/refuelling vehicles, major plant and within workshops. These will include absorbents and appropriate containers or bags; • Fire extinguishers will be kept on all vehicles and workshops; • Spill kits will be inspected weekly and fire extinguishers six monthly • Personnel will be inducted in the location and use of spill kits and fire extinguishers.
Objective	Protect personnel and the environment in emergency situations.
Location	Vehicles, plant, equipment, workshops and chemical storage.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

6.21 ENVIRONMENTAL INCIDENT MANAGEMENT

Commitment	Manage environmental incidents effectively and in a timely manner. Report spills as required. Leave site in clean and tidy condition after completion of site works.
Action	• Immediately report pollution events or other incidents impacting the environment to the DoE (08) 9222 7123 or after hours (free call) 1800 018 800; • Ensure incident reports are produced which include date, time, chemical name, volume, location, area affected, actions taken for clean up and preventative actions; • Clean up all areas and dispose of litter appropriately.
Objective	Leave project area in clean and tidy condition on completion of project. Manage incidents in an effective way which minimises harm to the environment. Meet legislative requirements for reporting of spills and environmental incidents.
Location	All areas of works.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Report incidents to the DoE as required.

6.22 MONITORING AND AUDITING OF PERFORMANCE

Commitment	Ensure all requirements are met through appropriate monitoring and auditing of performance.
Action	• Develop and implement a documented monitoring and auditing schedule; • Maintain a complaints register; • Conduct weekly inspections of construction areas using a checklist and maintain records of inspections.
Objective	Monitor and audit performance to ensure compliance with requirements.
Location	All areas of works.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

6.23 REPORTING

Commitment	Ensure reporting requirements are met
Action	• Review compliance with requirements and report exceptions fortnightly.
Objective	Ensure all reporting requirements are met.
Location	All areas of works.
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	None

6.24 SOCIAL IMPACT

Commitment	Minimise social impact of works.
Action	• Ensure Great Northern Highway remains open during construction phase. • Road work activity shall be restricted to between 6.00am and 6.00pm. • Dust will be suppressed as detailed in Section 7.13. • Submit an application for a Town Planning Scheme amendment to the Shire of Chittering.
Objective	Ensure the social impact of works on nearby residents and the public is minimised.
Location	Great Northern Highway 54.8 - 62.0SLK
Timing	Construction/rehabilitation/revegetation.
Responsible party	Construction contractor/Site Supervisor.
Requirement / Consultation	Shire of Chittering

7 Public consultation

Potential stakeholders in the region are listed in table 7.1 below. MRWA has conducted public consultation with relevant groups as described below:

Table 7.1 - Stakeholders for Bindoon South GNH Realignment

Stakeholder Group	Contact Name	Address	Contact
Bindoon and Districts Historical Society	Joy Garden	PO Box 26 Bindoon WA 6502	Ph: (08) 9576 1471
Bindoon Community Progress Association - Safe Roads Sub-committee	Gavin Rutherford PA President 9576 0042 Ian Watson (SRC) President	C/o Lance Stagbouer (Secretary) 973 Wells Glover Rd Bindoon 6502	Ph: (08) 9576 2001 rutherfords@bigpond.com
Chittering Landcare Group	Sue Metcalf	PO Box 62 Muchea WA 6501	Ph: (08) 9571 0400 Mob: 0428 939 919
Ellen Brockman Integrated Catchment Group	Hartley Reid	PO Box 62 Muchea WA 6501	rosannah@iinet.net.au (08) 9571 0400
Shire of Chittering	Max Hipkins	Shire of Chittering	max@chittering.wa.gov.au

7.1 COMMUNITY CONSULTATION OUTCOMES

Initial contact was made with the Chittering Landcare Group (CLG) on 21st July 2005. KBR spoke with Sue Metcalf of CLG. Issues highlighted initially by Sue Metcalf were:

- That the road is in need of repair and that it is a very dangerous stretch of road;
- The area is classified as an Environmentally Sensitive Area due to the presence of the Class A Nature Reserve;
- There is a wetland crossing on 2nd bend (SLK 57.3) and road works in this area will need to be managed properly;
- Presence of an outcrop on 3rd bend (SLK 57.6) to the west of the existing road, which is why the original road curves so much in this location.

Initial contact was made with Joy Garden of the Bindoon and Districts Historical Society. KBR spoke with Joy and initial issues highlighted were:

- It was recognised as a very dangerous stretch of road which was in need of upgrade;

- Ms Garden wanted to ensure the inclusion of the Tea Tree road intersection in the upgrade as it is proposed that a new Museum site will be located near the existing Shire Offices.

Secondary contact was made with Joy Garden of the Historical Society regarding the location of the Upper Chittering Primary School location and if the Historical Society were interested in attending an information session on the road design. Ms Garden stated that she did not know the location of the Upper Chittering Primary School, and Bob Lissett was the best contact. However her friend attended a school on Chittering Road where there is now municipal signage and a stone bell marking the school site. Ms Garden was not clear whether this site is the historic Upper Chittering School site. It was subsequently established that the former Upper Chittering School site was outside of the road footprint.

Initial contact was made with Lance Stagbouer of the Road Safety Committee (RSC), a sub-committee of the Bindoon Community Progress Association on 22nd July 2005. Initial points raised were:

- The past and ongoing involvement the RSC has had in assisting with design and efforts to have road upgraded in the area.

- RSC has undertaken studies on the road within the project area and have completed a report which has been presented to MRWA.

- Ongoing contact with T. Saraullo in the design and campaigning for road upgrades. RSC believe T. Saraullo has a good understanding of RSC issues and suggestions. RSC president Ian Watson is planning to meet with T. Saraullo at a later date to discuss finalisation of report.

- The RSC do not specifically require a meeting with MRWA, however if there is one held due to interest by other stakeholders, then they would like to send a representative.

- School bus operators should be involved in consultation as there are three to four school bus trips each day on the corner of Tea Tree Road and it is quite dangerous.

- Contact was made with the Shire of Chittering planning section by KBR. Max Hipkins, Consultant Planner for the Shire of Chittering stated that “an area of concern for us (is the road) coming closer to the Chittering Road Board Office. This is an old building that could be damaged by vibrations from heavy traffic”.

- An alternative location for Flat Rocks Road was proposed by the Shire of Chittering and some community members however the MRWA preferred design was chosen as it was less likely to impact on drainage in this section of the GNH.

7.2 PRESENTATION TO SHIRE

On the Wednesday 17th August 2005 MRWA and KBR made a presentation to the Shire of Chittering Council Meeting on the proposed project. The primary outcome was the request for an additional community meeting to ensure that all stakeholders interested in the project could attend. This request was accommodated by MRWA.

7.3 COMMUNITY MEETINGS

Two community meetings were held, the first on Thursday 15th September 2005 at the Chinkabee Centre in Bindoon and the second on Monday 19th September at the Landcare Centre near Wannamal. Representatives from MRWA, KBR and the community met to discuss the proposed project.

The first meeting was attended by local community members and councillors primarily. The major issues of this meeting are highlighted below.

- The meeting attendees had concerns over time that it has taken to develop project. MRWA responded.
- The meeting attendees had concerns over the attention Teatree road has been given over other intersections such as Flat Rocks Road. It was responded to by Councillor Jan Stagbouer who stated that Teatree road had a higher traffic volume and was used by more people.
- A few attendees stated that the presence of a cockatoo nesting hollow should not stand in the way of the project.
- A statement was made that the small swales in the proposed road design would not contain a spill of a large volume. It was explained that upgrades to the GNH should reduce spills by making it much safer. It was also noted that currently there is no pollution control on the existing highway so the soakage swales will be an improvement on existing pollution controls.
- Attendees voiced concerns over the poor quality of road construction that had occurred in the region. MRWA responded by stating that construction contractors have to be certified to MRWA standards.
- Tortoises crossing the GNH were also raised by meeting attendees as an issue for consideration, and a request for investigation into the issue was made. This issue has been further investigated by KBR.

The second meeting was attended by members of the Ellen Brockman Integrated Catchment Group, MRWA, the Wildflower Society and other interested stakeholders. The major issues raised at this meeting are highlighted below.

- Positive feedback given by attendees regarding MRWA intention to purchase land between Chittering Lakes Nature Reserve and the upgraded Great Northern Highway.

- Attendees confirmed that acid sulphate soils (ASS) exist in the area and concern was raised over exposing ASS soils and the potential for acid run-off to impact wetland wildlife and affect pH of water. Previous earthworks in a nearby area (near Burroloo Well) resulting in low pH surface water discharges was given as an example of this occurring historically.
- Attendees raised concern about the impact of the proposed works on remnant vegetation and the poor success of some revegetation activities undertaken by MRWA in the region. Assistance with advice on revegetation was offered.
- Queries were raised about the possible establishment of fauna crossings and fauna fencing. KBR explained that CALM were to be consulted to determine the feasibility of crossings for smaller fauna. The limitations of the area and the road design does not allow for fauna crossings of sufficient height for larger fauna. The use of fauna fencing and existing culverts or modified culverts for small fauna will be investigated.
- Rosanna Hindmarsh raised the issue that the most heavily used turtle crossing locations on the GNH coincided with locations where the road was closest to Chittering Lakes Nature Reserve. This issue will be investigated by KBR.
- Attendees questioned figures for road traffic and thought they may perhaps be out of date. This was identified as the most recent data that MRWA has available.

Overall these community meetings were useful tools for determining and discussing stakeholder queries and concerns regarding the project. A suggestion was also made by attendees at the first meeting that the meeting was not consultation as the design was already completed.

Attendance lists for both of the community meetings are attached in Appendix H.

8 Consultation with regulatory stakeholders and approvals obtained

Environmental Aspects	Regulatory Stakeholder Contacted	Date	Outcome(s)
Declared Rare Flora and Priority Flora	Conservation and Land Management (CALM) Database Search	c. Aug 2004	Two priority 3 species found in the project area which will be impacted by proposed works.
Declared Rare Flora and Priority Flora	CALM Species and Communities Branch	30 November 2005	Advice provided that project impact not significant to the conservation of the species. Recommendations made to minimise and ameliorate impact.
Threatened Ecological Communities	CALM Database Search	c. Aug 2004	No TECs were identified within project area.
Weed Management	Department of Agriculture, Northam Regional Office	21st July 2005	No declared plants known in the project area (as defined by the *Agriculture and Related Resources Act 1976*)
Clearing	Department of Environment (DoE)	NA	Clearing permit required if project is not assessed under part IV of the *Environmental Protection Act 1986.*
Dieback	CALM, Head Office and Northam Regional Office	NA	Project specific dieback undertaken. Area generally uninterpretable but considered as infected.
Fauna	CALM Department of Environment and Heritage (DEH)		Carnaby's Cockatoo survey identified that one Carnaby's cockatoo nest will be removed. Referral under EPBC Act is not required.
Reserves and Conservation Areas	MRWA, Department of Industry and Resources Tenegraph database, Department for Planning and Infrastructure (DPI), Department of Land and Information (DLI), Conservation Commission of Western Australia (CCWA), CALM and the Public Transport Authority (PTA).	19th May 2005	Three disturbances of the Chittering Lakes Nature Reserve -submission to the CCWA is required. Request for excision or disturbance made.
Surface Hydrology and Wetlands	Northam Regional Department of Environment (DoE)	3rd Aug 2005	Proclaimed under RIWI Act however as no disturbance to beds or banks a permit for proposed works not required.
Groundwater	Northam Regional DoE, DoIR, Dept of Agriculture	Aug 2005	Permit for groundwater is required if abstraction of groundwater is required in the proposed works. However is not expected to be required for the project.
Public Water Source Area	Department of Environment (DoE)	Aug 2005	Permit for groundwater is required if abstraction of groundwater is required in the proposed works however not expected to be required.
Acid Sulphate Soils	Northam Regional DoE, DoIR, Dept of Agriculture	25th July 2005	A preliminary ASS assessment is required.

Environmental Aspects	Regulatory Stakeholder Contacted	Date	Outcome(s)
Salinity	Northam Regional DoE, DoIR, Dept of Agriculture	Aug 2005	There will be no impact on salinity as a result of proposed works.
Aboriginal Sites	Department of Indigenous Affairs (DIA)	6th Oct 2004	No identified aboriginal sites will be impacted by the proposed works.
Native Title	National Native Title Tribunal (NNTT), DIA	6th Oct 2004	A site visit and consultation with NTC representatives undertaken and an amicable agreement from NTC representatives for the proposed works was obtained.
Cultural Heritage	Shire of Chittering, Bindoon, Heritage Council of WA, National Trust of Australia (WA), Australian Heritage Commission	6th Oct 2004	A dilapidation survey is required to be conducted on the Holy Trinity Church and former Chittering Road Board offices.
Social	Shire of Chittering	July 2005	A minor amendment to the Shire of Chittering town Planning Scheme is required.
	Ellen Brockman Integrated Catchment Group	July 2005	Refer to section 7.1 and 7.3
	Historical Society	July 2005	Identified that site of former Upper Chittering Primary School was outside of the proposed realignment.
Noise, Vibration and Dust	MRWA	NA	MRWA standard techniques to be implemented.
Public Safety and Risk	MRWA	NA	MRWA standard techniques to be implemented.
Contaminated Sites	DoE Database search	August 2005	Preliminary site investigation identified that were no registered contaminated sites within land adjacent to proposed works.

A meeting was undertaken on Thursday 20th October 2005 with representatives from the EPA Service Unit, Conservation Commission of Western Australia (CCWA), CALM, MRWA and KBR regarding the disturbance to the Chittering Lakes Nature Reserve. The minutes and actions arising from the minutes are contained in Appendix I.

In summary, from the meeting it was indicated by the CCWA and CALM representatives that they did not oppose the excision of land from the Chittering Lakes Nature Reserve (Stefan De Haan [CALM}, pers. comm.., October 2005; William Carr [CCWA], pers. comm.., October 2005).

A formal presentation was made to the CCWA on 14th November 2005 by MRWA and KBR on the disturbance to the Chittering Lakes Nature Reserve.

Questions and comments made by the CCWA representatives covered:

- the water quality of Lakes Chittering and Needonga;
- the suitability of the of the proposed fauna crossings for the target fauna;
- a question regarding the presence of aboriginal sites in the area;
- an in principle objection to the location of the GNH with respect to it's closeness to the nature reserve.

A request for a formal response on the project was made to the CCWA, subsequent to this meeting.

9 Recommendations

9.1 REFERRAL TO EPA

It was identified that referral to the EPA is required due to the rezoning that is required. This document has been produced to meet those requirements.

9.2 REFERRAL TO DEPARTMENT OF ENVIRONMENT AND HERITAGE

Referral to Department of Environment and Heritage (DEH) is not required, as the impact on Carnaby's Cockatoo is not considered significant when impacts were compared against the EPBC Significant Impacts Guidance Statement.

9.3 OTHER AGENCY APPROVALS REQUIRED

A Clearing Permit application was made to the Department of Environment as the proposed clearing will take place after 8th January, 2005.

Approval is required from the Conservation Commission of Western Australia to disturb Chittering Nature Reserve.

Approval is required from the Shire of Chittering and the Western Australian Planning Commission for rezoning of land from freehold agricultural to road reserve.

As no aboriginal sites were identified within the project area, further consultation with the DIA is not required unless a site is discovered during road construction.

9.4 CONSTRUCTION EMP

MRWA will ensure that a construction EMP is prepared to address the relevant requirements of Section 6 of this document. Key areas to be addressed in this plan will include minimising clearing, weed management, dieback management, ASS management and chemical and hydrocarbons management.

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Appendix A

VEGETATION AND FLORA SURVEY

GREAT NORTHERN HIGHWAY UPGRADE – BINDOON SOUTH SECTION

(Hart Drive to Bindoon Townsite SLK 54.6 to 62.0)

FLORA AND VEGETATION SURVEY

Undertaken for
KBR

On behalf of
MAIN ROADS WESTERN AUSTRALIA

By

E. M. GOBLE-GARRATT
998 GREAT NORTHERN HIGHWAY
MILLENDON WA 6056

October 2005

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

GREAT NORTHERN HIGHWAY UPGRADE – BINDOON SOUTH SECTION
FLORA AND VEGETATION SURVEY

1. INTRODUCTION

1.1 Background and Purpose of the Survey

Main Roads Western Australia (MRWA) proposes to widen and reconstruct the section of Great Northern Highway immediately south of the Bindoon Townsite (54.6 to 62.0 SLK). A survey of the flora and vegetation likely to be impacted by the project is required to inform the project team and to contribute to the environmental assessment of the project. The findings will also assist in formulating environmental management commitments and actions.

MRWA has previously conducted a survey of the roadside vegetation along the section of the Great Northern Highway, which includes the Bindoon South section (Goble-Garratt and Ninox Wildlife Consulting 1989). This was however, a very broad-scale survey, covering 112 kilometres of roadside. As a preliminary planning exercise, the 1989 survey was recently reviewed, and information on Rare and Priority Flora was updated by *Ecologia* Environmental Consultants (*Ecologia* Environmental Consultants 2004).

1.2 Description of the Study Area

The study area is situated immediately south of the Bindoon Townsite between SLK 54.6 and SLK 62.0. As defined in the brief, the area of interest for the flora survey extends 50 metres either side of the existing footprint of the highway, or 50 metres from the proposed footprint, if this is the greater distance. A distance of approximately 200 metres along the major side roads is also included (See vegetation mapping in Figures 1, 2 and 3).

The section of the Highway proposed for upgrading in this project runs alongside Lakes Chittering and Needoonga, which are significant features of the local environment, protected in an A-Class Nature Reserve (Chittering Lakes Nature Reserve).

1.2.1 Geology, Landforms and Soils

The study area is situated near the western edge of the Darling Plateau (Yilgarn Block) with the Darling Scarp situated approximately three kilometers to the west. Biggs *et. al.* (1980) refer to the metamorphic belt of schists that characterize the local geology as the “Chittering Metamorphic Belt”. These are part of the very old, and stable Archaean rocks which form the Yilgarn Block.

According to Churchward and McArthur (1980) the soils in the project area are those of the Bindoon Unit. The Bindoon soils are recognised as being those of the slopes of a major valley in the Darling Plateau. These usually have very little surface laterite and consist of shallow red and yellow earths with much rock outcrop.

The Nooning soil unit, which distinguishes the terraces of the Upper Brockman River has yellow duplex soils and sandy deposits and is situated very close to the proposed works area over most of the length of the project.

The underlying geology, and the presence of a major river results in a markedly undulating landscape in the vicinity of the project area, although the highway successfully avoids the major hills. At the southern end of the project area the highway tends to drop slowly (more rapidly after 56.0 SLK to skirt Lake Chittering on the western side. Here the highway follows the edge of the lake along the valley floor for approximately 3 kilometres before crossing the Brockman River. Continuing northwards, the highway traverses a small rise before traveling close to the eastern edge of Lake Needoonga after which it climbs again before entering the Bindoon townsite.

1.2.2 Flora and Vegetation

Beard (1979, 1981, 1990) described the vegetation found in the project area as being predominantly *Corymbia calophylla* (Marri)/*Eucalyptus wandoo* (Wandoo) Woodland on the slopes of the major valley systems, with Flooded Gum and Paperbarks dominating the watercourses in these valleys. Beard comments that the habitat formed by the scarp and valley slopes is often less hospitable than the plateau surface itself, due to the stripping of weathered, water holding layers by geological processes. Also according to Beard, Marri prefers sandier soils, whilst Wandoo predominates where the soil is clayey.

The project area straddles the boundary between Beard's Darling and Chittering Vegetation Systems in the Darling Botanical District. These vegetation systems have the Marri/Wandoo Woodland in common, but in the Chittering System, lower valley slopes are vegetated with York Gum. No York Gum Woodland is present in the project area.

Heddle et al. (1978) mapped the vegetation of the area as belonging to the following Vegetation Complexes:

- Murray and Bindoon Complex in Low to Medium Rainfall (Major valleys – combining slopes and floors). This complex occurs at the start of the project area and again immediately north of the Brockman River crossing where the valleys are only moderately incised. The distinctive feature of this Complex is the presence of Wandoo Woodland on valley slopes and (*Eucalyptus rudis*) Flooded Gum and Freshwater Paperbark (*Melaleuca raphiophylla*) along water courses.

- Bindoon Complex. (Major valley floors and scarps). This Vegetation Complex is represented for approximately two kilometers south of the Brockman River crossing, and again immediately south of the Bindoon Townsite. This coincides (approximately) with Beard's Chittering System, and is characterised by York Gum (*Eucalyptus loxo*phleba) on lower valley slopes, flanked by Wandoo higher upslope.

- Nooning Complex. (Major valley floors and scarps). This complex is restricted to the upper valley floors of the Brockman River. This complex abuts the project area where it traverses the Brockman River valley, and occurs where the highway crosses the river. The distinctive feature of this Complex is the presence of low open forest of Swamp Sheoak (*Casuarina obesa*) and of the presence of Swamp Sheoak with Flooded Gum and Freshwater Paperbark along streams.

More recently Griffin (1992) completed a detailed floristic survey and analysis of remnant vegetation in the Bindoon to Moora areas, including the project area. His survey included sites at Lakes Chittering and Needoonga. This study showed that the area covered is one of the floristically rich areas of Western Australia, recording 1032 native species. Along with this rich floristic diversity is a large variation in vegetation types. Griffin defined 45 major types all with a number of sub-types or variants.

In and around the project area, only remnants in varying condition remain due to a long history of agricultural settlement.

1.2.3 Adjacent Land Use

The majority of the project area is adjacent to private property. Most of the land has been cleared (or partially cleared) for crops or grazing. In recent years a large area of farming land on the west of the highway has been subdivided for rural residential and "hobby farm" development.

The ***Chittering Lakes Nature Reserve*** abuts the highway reserve for some distance through the project area (approximately SLK 57.0 to 59.2). In two further sections (SLK 60.1 to 60.75 and SLK 61.8 to end of project area) the road reserve is within 50 metres of the Nature Reserve boundary. The two lakes (Chittering and Needoonga) are significant aspects of the local landscape. Griffin (1992) considers the reserve to be significant for the protection of Freshwater Paperbark woodland, one of his community types not well reserved in the region.

The two lakes have been registered on the National Heritage Register since 1978. The listing and registration was prompted by the significance these waterbodies and surrounding vegetation have for waterbirds. The lakes and fringing vegetation are in the top 4% of wetlands in the south-west of Western Australia for numbers of individuals overall, and in the top 1% for numbers of breeding species.

1.3 Proposed Works

The upgrading of the Great Northern Highway between Hart Drive and the Bindoon Townsite will include widening, overlay of existing pavement, some minor realignments, and bridgeworks at the Brockman River crossing.

The project has been divided into sections where works can be carried out independently of other sections. These are shown in the table below and designated Sections 1 through 7 in order to provide simple identification for the distribution information given in the Checklist of the Vascular Flora in Appendix A.

Table 1. Table of the Location, Length and Different proposals for Sections of the Project.

Section	Location (SLK)	Length (Km)	Description of Proposed Works
1	54.85 – 55.85	1.0	Widen and overlay including reconstruction of Parking Bay
2	55.85 – 56.90	1.05	Reconstruction and improve intersection with Hart Drive and Chittering Road
3	56.90 – 58.64	1.74	Reconstruction and realignment (Donaldson's section)
4	58.64 – 59.16	0.52	Improve intersections with Tee Tree Road and Spice Road
5	59.16 – 59.22	0.04	Brockman Bridge widening and pavement works
6	59.22 – 60.50	1.28	Reconstruction and realignment including intersection with Flat Rocks Road
7	60.50 – 62.04	1.54	Widen, overlay and construction of southbound passing lane

2. SURVEY METHODS AND LIMITATIONS

This report covers the findings of a general survey carried out in November 2004 and a follow-up survey of the two Priority species populations and selected sites in September 2005. The surveys covered the roadsides of the existing highway and areas immediately adjacent extending 50 metres either side of the existing or proposed footprint, whichever was the greater distance. The area covered by the survey is shown in the vegetation mapping in Figures 1 through 3.

Detailed sample sites were chosen to cover representative examples of all of the vegetation types present after an initial reconnaissance of the length of the highway included in the proposal. Notes were also made on aerial photographs to document changes in vegetation observed on the ground. At each sample site a nominal area of 100 m^2 was included to conform to current survey methodology used by the Department of Conservation and Land Management and others (e.g. Griffin 1992). The shape of the survey site varied dependant on the width of the roadside remnant. All species readily visible in the nominal 100 m^2 area were recorded. Where areas adjacent to the sample site supported notably different species, these were recorded separately. Species were also recorded opportunistically along the length of the project area.

The structural classes and condition rating indices used in the BushForever studies (Government of Western Australia 2000) were used to describe the vegetation present. These classes and indices are tabulated in Appendix C.

Photos were taken at each sample site, and at intervals along the project area. Where a plant could not be identified in the field, or appeared of interest, a voucher was taken for later verification/identification at the Western Australian Herbarium.

The November 2004 survey meant that very few ephemerals were recorded. Some annual grasses (especially in wetter areas) were still present and included in the checklist of vascular species for the project area given in Appendix A. Lack of flowering material also meant that some plants could not be confidently identified to species level.

The 2005 survey concentrated on determining the condition of a range of sites of particular interest to the project managers, and to census and map the two populations of Priority species. A number of additional species were recorded in 2005, and added to the checklist.

3. SURVEY RESULTS

3.1 Flora

A total of 117 taxa from 41 families of the vascular flora were recorded during the survey, comprising 67 native and 50 introduced taxa. The checklist obtained from this survey is in Appendix A, which also indicates in which section of the proposed works each of the plants is to be found. Of the native flora, the Families Proteaceae, Myrtaceae and Papilionaceae are best represented. Among the exotics, grasses (including some annuals) dominate the list. Lupins and other pea-flowered weeds are also significant. In terms of infestation levels however, it is Watsonia, Veldt Grass and African Love Grass that are of most importance from a management point of view.

3.2 Priority Species

Two taxa (*Adenanthos cygnorum* subsp. *chamaeophyton* and *Acacia drummondii* subsp. *affinis*) listed on the Department of Conservation and Land Management's Priority Flora list were recorded during the site survey. Both are Priority 3 taxa, which are defined as follows:

> ***P3 – Priority Three (Poorly Known Taxa)*** *These are 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 population being large, and either widespread or protected. Such taxa are under consideration for declaration as "rare flora" but are in need of further survey.*

Adenanthos cygnorum* subsp. *chamaeophyton is a subspecies of the widespread and common Woollybush. It is an understorey plant with small leaves that are divided into three fingers. Leaves are hairy and may be flushed pink/red when young. The flowers are small, solitary or in small groups and vary in colour from white through green to pink/red.

It is generally thought of as a procumbent plant, but a previous survey of the known populations (Muir Environmental 1997) suggested that there is a distinct north-south gradient in the expression of the habit of these plants. The northern populations, around Bindoon, have both erect and procumbent branches, and were noted to grow to 1.5 metres in height. Towards Chidlow, the proportion of procumbent stems (to around 0.3 metres high) tended to increase, with only a few upright stems per plant. The populations from around Sawyers Valley (Mundaring) and southwards to Muja form dense low mats around 0.1 metres high. Recognition in the field is assisted by the generally finer and denser foliage and darker (less silver-grey) foliage in *A. c*. subsp. *chamaeophyton*.

Department of Conservation and Land Management records show that there are around 13 discrete populations of this subspecies recorded. The imprecision is due to the fact that not all of the recorded populations have been verified, and some populations have not been monitored in recent years. In the vicinity of the project area there are known populations on the road verge along Teatree Road, in a gravel pit along Teatree Road, and also on Great Northern Highway between 5.1 and 5.4 kilometres south of the Teatree Road intersection. In 1997 there were estimated to be around 560 mature plants and many young seedlings (possibly stimulated to germination by recent disturbance) in these populations. The *Ecologia* Environmental Consultants' report (2004) gives grid references for two populations of this taxon, neither of which is indicated as occurring in the road reserve. A population of the taxon is registered in Main Roads's database of Threatened flora as being at SLK 53.46, the same population surveyed by Muir at 5.1 kilometres south of Teatree Road.

The population found during this survey is situated approximately 2.5 kilometres south of the Teatree Road intersection at SLK 56.45. This population is also recorded on mapping provided by KBR, but is shown as being outside of the road reserve.

The population at SLK 56.45 (sample site no. 10) occurs on both sides of the highway with approximately 75 plants in the population. The habit is semi-prostrate. Many branches at around 0.3 – 0.5 metres high spread widely around the main stem, and may possibly root where they touch the soil. Other branches are more upright, and some of the larger shrubs reach a total height of up to 1.5 metres, confirming the Muir Environmental description. A map showing plants located during this survey is shown in Figure 4.

Density of the foliage and the prostrate habit made it difficult to be certain of the numbers of individuals present in some cases. The population numbers may be slightly higher than recorded.

Acacia drummondii* supsp. *affinis is a subspecies of Drummonds Wattle distinguished by its bipinnate (leaves divided into leaflets) and hairy foliage. It is a low (usually less than one metre high), sometimes sparse understorey shrub. The distinctive yellow wattle flowers occur in cylindrical flowering heads.

The distribution of the subspecies is from around Bullsbrook northwards to near New Norcia, with populations at Mogumber, Gingin and Muchea. Outlying populations are also known from Regans Ford and Mullewa further north. It occurs on lateritic soils with Jarrah or Wandoo. Department of Conservation and Land Management records show that there are around 17 discrete populations of this subspecies recorded. The imprecision is due to the fact that not all of the recorded populations have been verified, and some populations have not been monitored in recent years.

There are no records of this species in the Main Road's database of Threatened flora for the Great Northern Highway, but the Ecologia Environmental Consultants' report indicates it as occurring in the road reserve to the north of the project area.

Figure 5 shows the location of the plants identified in the 2005 survey in the population at SLK 58.85 (sample site no. 7). This indicates that the population has 87 plants. The population includes several young plants and seedlings, and it is more than likely that some seedlings were not picked up in the survey, and that the population is somewhat larger than reported.

3.3 Vegetation

The remnant vegetation of the project area was found to be predominantly low woodland or low forest of varying density. Details of the vegetation at the sampling sites, along with the species recorded, and site photographs are given in Appendix B.

Differences in vegetation were found to correlate well with topography as has been described above for regional vegetation perspectives (Heddle et. al 1980, Griffin 1992). Close to the valley floor and where tributaries to the lakes (Brockman River) cross, or run alongside the road, the vegetation is dominated by *Eucalyptus rudis* (Flooded Gum). Flooded Gum also fringes the lakes, occurring on the outside of a band of *Melaleuca raphiophylla* (Freshwater Paperbark). *Corymbia calophylla* (Marri) tends to occur on the lower slopes, whilst *Eucalyptus wandoo* (Wandoo) dominates the highest areas. Near the lakes, *Casuarina obesa* (Swamp Sheoak) often occurs along with the Paperbark or Flooded Gum, and in one small area formed a low closed forest. Griffin (1992) found that this species appeared to be increasing and spreading along parts of the Brockman River in response to increasingly saline drainage.

Eucalyptus marginata (Jarrah) and Powderbark Wandoo (*Eucalyptus accendens*) were not recorded from the project area, but occur immediately to the south where the influence of the valley system drops away, and true lateritic duricrust occurs.

From the mapping in Figures 1 through 3 it can be seen that much of the project area is either completely devoid of native vegetation, or has only isolated specimens (mostly trees) remaining. Clearing is more substantial north of the Brockman River crossing with only about 30% of the area supporting native remnants. South of the crossing, the remnants are more substantial, and around 70% of the project area still supports native vegetation.

Vegetation Mapping Units

Seven vegetation units determined on the dominant canopy species were chosen to map the vegetation in the project area. These units:

- occur consistently;
- are meaningful in terms of changes in topography.
- are at scale which is practical to map, and not too fine to be of practical use during planning and/or construction;

The units are **1. *Wandoo (Ew), 2. Marri (Cc)*,** and **3. *Wandoo/Marri*** on higher ground and upper slopes. **4. *Sheoak (Co)*** and **5. *Freshwater Paperbark (Mr)*** are associated with the lake margins and the

Brockman River crossing. **6. *Flooded Gum (Er)*** occurs on smaller drainage lines and forms a band around the Paperbarks that fringe the lakes. Lower slopes support **7. *Marri/Flooded Gum***.

Vegetation Condition

The condition of the remnant vegetation in the project area varies from "very good" to "excellent" on higher ground and where the remnants are larger (see Sample Site 10) to "degraded" where there is only a very narrow strip of native vegetation in the road reserve (for example Sample Site 2). The large number of weedy species recorded (approximately 43% of the checklist) is indicative of the level of disturbance and weediness of the project area.

In general most of the lower lying areas are badly affected by highly invasive weedy species, which include large stands of Watsonia. Veldt Grasses (both annual and perennial) and African Lovegrass (*Eragrostis curvula*) are also significant in these areas. The areas around Sample Sites 8 and 9 (approximately SLK 57.0 to 58.7) support wetland vegetation that appears to be in relatively good condition.

The table below gives condition ratings (see Appendix C for definitions) and comment on the vegetation in the areas of special interest delineated by SLKs.

Table 2. Condition Indices and Comments for Designated Areas

Location (SLK)	Condition Index	Comment	Photo
56.9 – 57.2 Both sides	3/4	Flooded Gum and Freshwater Paperbark woodland. Close to the highway understorey is degraded, better away from highway. Excellent fauna habitat.	Plate 1
57.3 – 57.7 South side	2/3	Vegetation retains much of original structure, although understorey is weedy. See also Site 9 nearby. Old road runs through this area.	Plate 2
58.5 – 58.8 Both sides	3/4	Vegetation on the western side of the highway and cose to carriageway on the east has reduced canopy and degraded understorey. Further from highway on the east condition appears to be "very good".	Plate 3
59.2 – 59.6 South side	4/5	Remnant vegetation restricted to narrow band along roadside. Flooded Gums with weedy understorey	Plate 4
59.7 – New Access Road	5	Remnant vegetation restricted to narrow band along small creek. Flooded Gums in weedy understorey	Plate 5
61.8 – 62.0 West side	4/5	Paddock between Highway and Lake Needoonga. Remnant vegetation restricted to lake margin – appears to be in relatively good condition.	Plate 6

4. DISCUSSION AND CONCLUSIONS

The results of the current survey fit with the general descriptions of the regional vegetation given by Heddle et. al. (1980) and Griffin (1992). Mapping of the vegetation using canopy dominants also agrees largely with previous mapping carried out by Goble-Garratt and Ninox Wildlife Consulting (1992).

More scientific analysis of the data collected from the sample sites would not have yielded any more detailed interpretation. The small number of sample sites and depauperate nature of the flora at most of the wetter (lower lying) areas mean that any numerical manipulation of the data would be meaningless.

Compared to regional surveys, the number of native species recorded in this survey appears very low indeed. This is mainly due to the very small size and mostly disturbed condition of the remnants present. Other limitations of the survey that might contribute to a low number of species being recorded are the opportunistic nature of survey along much of the highway, and the fact that the regional data includes habitat and vegetation types not present in the survey area. It should be noted however, that at sample site 10 an upland site supporting Low Wandoo Woodland, 21 native species were recorded. This remnant is larger than most along the highway. A comparison with average species richness of 24 for similar Wandoo Woodland sites from the Griffin (1992) survey indicates that the species list may be a good representation of the flora in the project area.

Griffin (1992) confirmed after extensive survey that the regional vegetation includes a large number of significant species, including many Rare and Priority species and others that are at the ends of their known ranges. This diversity is partly a result of the varied geological history, and is despite extensive clearing. It is thus not surprising that the project area supports two taxa on the Department of Conservation and Land Management's Priority Flora lists. The presence of these species lends added importance to the road reserve vegetation. Removal of some, or all of the Priority species individuals is not generally considered to be an obstacle to project implementation. However, mitigation and remedial works (see Recommendations 4, 10 and 11 below) should be discussed with the Department of Conservation and Land Management.

Griffin (1992) mentions that the communities of drainage lines (fringing vegetation) in the Bindoon to Moora area generally are poorly preserved. In respect of the roadside vegetation in the project area this means that the predominant "wetland" vegetation has considerable value in a regional context.

Vegetation dominated by Wandoo or Wandoo/Marri similar to that found in the project area is better represented regionally. Similar vegetation (although there are many, small floristic differences) is reserved in Julimar State Forest to the east of the project area, and is also found at Mount Byroomanning Nature Reserve just east of Bindoon.

In the late 1980s the Roadside Conservation Committee assessed the conservation value of the roadsides of both local government and Main Roads managed roads in the Shire of Chittering. This assessment took into account other parameters (width of reserve, landscape value, adjacent landuse, presence of utilities) as well as the condition of remnant native vegetation. According to that assessment, the Great Northern Highway through the project area had "medium" conservation value at the southern end (including the section adjacent to Lakes Chittering and Needoonga, and "low" conservation value at the northern end closest to Bindoon townsite. Management goals for both of these categories of roadside include maintaining native vegetation wherever possible, and to encourage regeneration/replanting with native vegetation.

5. RECOMMENDATIONS

Planning and design

1. The regional significance of the fringing wetland vegetation such as the Paperbark and Flooded Gum communities around Lakes Chittering and Needoonga suggests that any additional clearing for stopping places/lookouts should be reconsidered.

2. Several issues relating to the flora and vegetation suggest that the road-upgrading proposal might require referral to the Environmental Protection Authority. These are:
   - Impacts on regionally significant vegetation;
   - Proximity of the Chittering Lakes Nature Reserve (National Heritage Place);
   - Presence of Priority Flora.

   The project and results of this survey should be discussed with the Environmental Protection Authority Service Unit to obtain their guidance on this issue.

3. Under the requirements of clearing regulations, an application should be made to the office of Vegetation Protection at the Department of Environment to clear native vegetation for the project. This application should proceed as soon as possible, as a permit to clear may take several months for approval. Granting of a clearing permit may negate the requirement for referral to the Environmental Protection Authority.

Construction Management

4. Clearing should be strictly limited through environmentally sensitive areas. These include all wetland vegetation and the populations of Priority flora. Clearing limits should be surveyed, pegged and confirmed as being accurate by the Superintendent through a hold point in the Contract.

5. Given the large infestations of serious weed species, especially in the low-lying areas, topsoil management and possible reuse must be carefully considered. Except for the upland areas topsoil might be best disposed of off site, or through burial.

6. Imported fill material must be clean, with respect to plant pathogens and also weeds in order to give any revegetation undertaken as part of the project the best chance possible of establishing well and thriving in the long term.

7. Proximity to the two lakes and the Brockman River along with undulating terrain and heavy soils mean that management of hazardous materials and site drainage during construction must be a priority. No siltation or pollution should be allowed to enter the lakes or river.

Rehabilitation and Landscaping

8. Because of the proximity of the Chittering Lakes Nature Reserve, only locally occurring native species should be used in revegetation works once the project is completed.

9. Revegetation plans should consider the present landscape character, which includes isolated tall trees and clumps of trees. Wherever safety setbacks allow, trees should be used in revegetation.

10. An attempt should be made to collect seed from the Drummond's Wattle population for use in revegetation in the vicinity of the current population. Also, topsoil from around this population should be used in revegetation.

11. Topsoil from around the Woollybush population should be used in revegetation in order maximize the possible return of the specie by natural recruitment.

Particular Opportunities

12. In an attempt to improve the environmental values of the fringing vegetation of Lakes Chittering and Needoonga, the possibility, and desirability of implementing a vigorous Watsonia control programme for the areas where the project area abuts the lakes should be discussed with the Department of Conservation and Land Management.

13. Consideration should be given to development of a specific management plan for the road reserves where they abut the Nature Reserve.

14. Clearing of native vegetation and impacts on wetlands may require that the project commit to mitigation in the form of offsets. Opportunities for the purchase of buffers to the Nature Reserve, or for contributions to the Department of Conservation and Land Management's existing rehabilitation efforts in and around the Nature Reserve should be considered.

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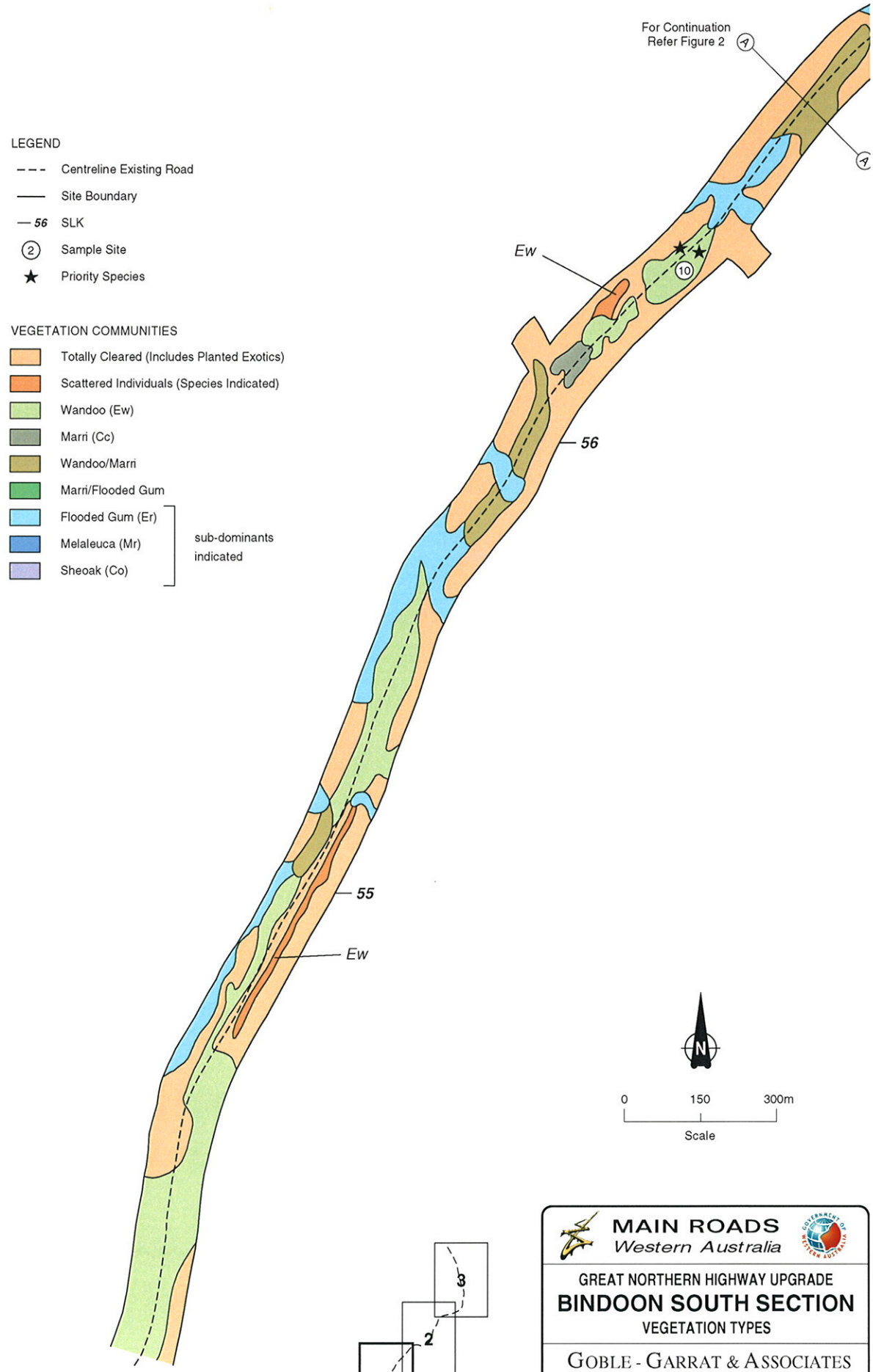
FIGURES



MAIN ROADS
Western Australia

GREAT NORTHERN HIGHWAY UPGRADE

BINDOON SOUTH SECTION

VEGETATION TYPES

GOBLE - GARRAT & ASSOCIATES
998 Great Northern Highway, Millendon WA 6056, Tel: 0427 822 383

Author: D. Goble-Garrat	Scale: 1:7 500
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202	Figure: 1
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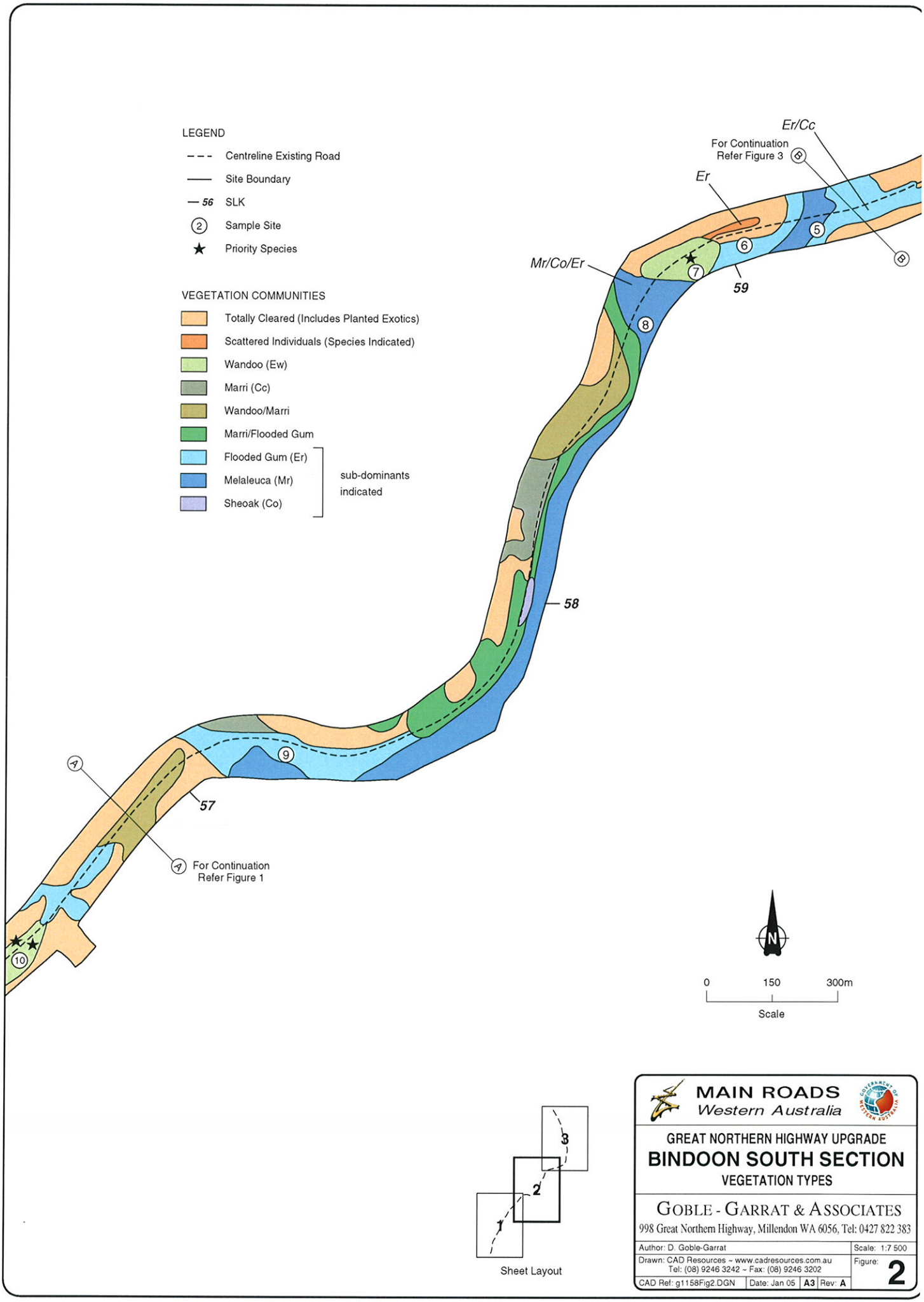
LEGEND
Centreline Existing Road
Site Boundary
56 SLK
2 Sample Site
Priority Species
VEGETATION COMMUNITIES
Totally Cleared (Includes Planted Exotics)
Scattered Individuals (Species Indicated)
Wandoo (Ew)
Marri (Cc)
Wandoo/Marri
Marri/Flooded Gum
Flooded Gum (Er)
Melaleuca (Mr)
Sheoak (Co)
sub-dominants indicated
Er/Cc
For Continuation Refer Figure 3
Er
Mr/Co/Er
59
58
57
For Continuation Refer Figure 1
N
0
150
300m
Scale
1
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3
Sheet Layout
MAIN ROADS
Western Australia
GREAT NORTHERN HIGHWAY UPGRADE
BINDOON SOUTH SECTION
VEGETATION TYPES
GOBLE - GARRAT & ASSOCIATES
998 Great Northern Highway, Millendon WA 6056, Tel: 0427 822 383
Author: D. Goble-Garrat
Scale: 1:7 500
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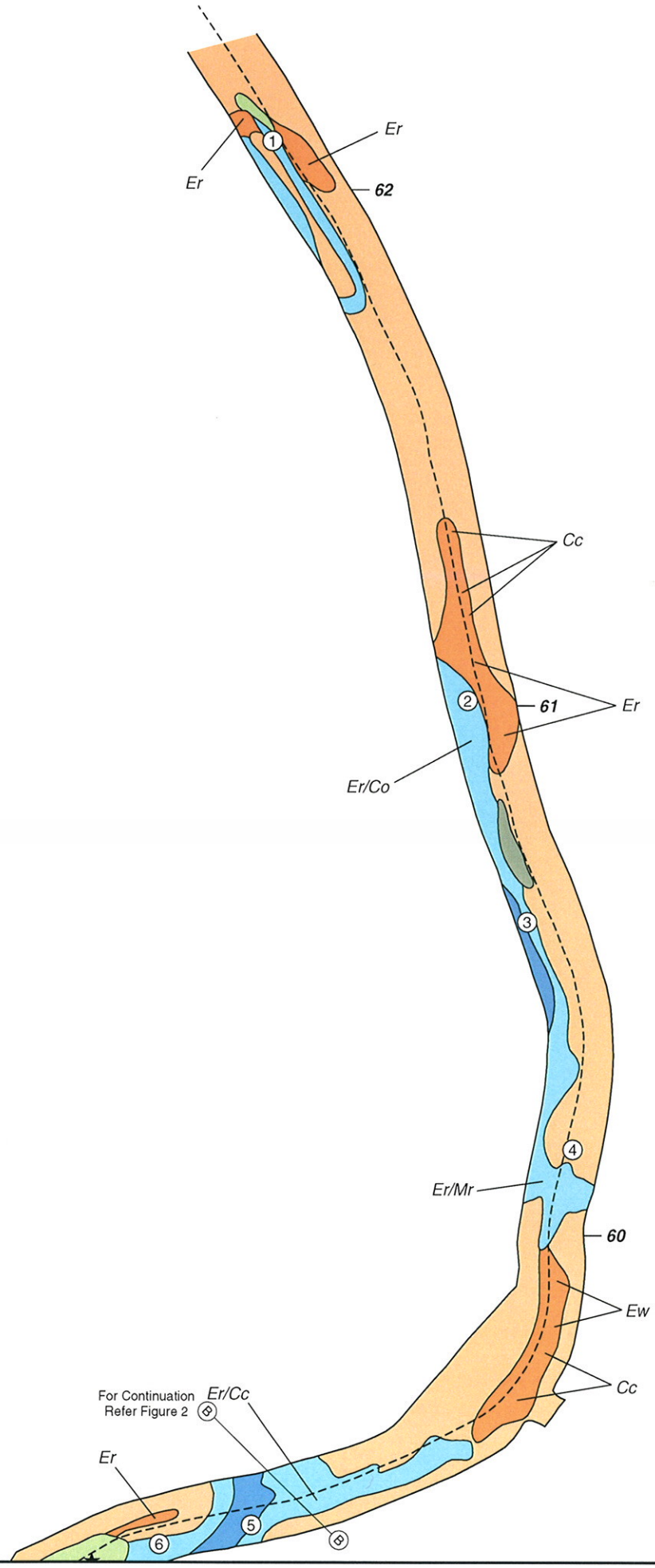
Date: Jan 05
A3
Rev: A



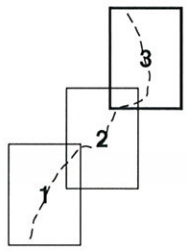
LEGEND

- Centreline Existing Road
- Site Boundary
- 56 SLK
- (2) Sample Site
- ★ Priority Species

VEGETATION COMMUNITIES

- Totally Cleared (Includes Planted Exotics)
- Scattered Individuals (Species Indicated)
- Wandoo (Ew)
- Marri (Cc)
- Wandoo/Marri
- Marri/Flooded Gum
- Flooded Gum (Er)
- Melaleuca (Mr)
- Sheoak (Co)

sub-dominants indicated



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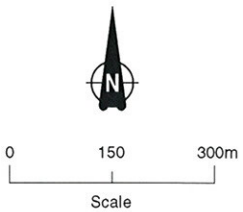

Scale

MAIN ROADS Western Australia

GREAT NORTHERN HIGHWAY UPGRADE

BINDOON SOUTH SECTION

VEGETATION TYPES

GOBLE - GARRAT & ASSOCIATES
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Author: D. Goble-Garrat	Scale: 1:7 500
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202	Figure: 3
CAD Ref: g1158Fig3.DGN | Date: Jan 05 | A3 | Rev: A	

PLATES

PLATE 1: North side of the Highway at approximately 57 SLK showing good canopy and disturbed understorey

PLATE 2: South side of the Highway at approximately 57.3 SLK showing dense woodland vegetation, some native understorey species and extent of weed problem, including Watsonias

PLATE 3: Looking east at approximately 58.5 SLK. Partially cleared (thinned canopy) and very weedy understorey

PLATE 4: View of southern verge immediately east of the Brockman River crossing showing narrow band of Flooded Gum in weedy understorey

PLATE 5: Southern side of new access road where alignment meets the small creek showing remnant Flooded Gum and paddock beyond

PLATE 6: View across paddock towards the remnant vegetation (Flooded Gum/Freshwater Paperbark woodland) fringing Lake Needoonga.

APPENDIX A

APPENDIX A

GREAT NORTHERN HIGHWAY UPGRADE – BINDOON SOUTH SECTION
CHECKLIST OF THE VASCULAR FLORA

Note: ***** = Non-native species
P = Priority species

FAMILY		TAXON	ROAD SECTION (Ref Table 1 of Text)						
			1	2	3	4	5	6	7
Family Zamiaceae		Macrozamia riedlei	x			x			x
Family Typhaceae	*	Typha orientalis							x
Family Poaceae	*	Andropogon distachys							x
	*	Avena sp.	x	x		x		x	x
	*	Briza maxima	x	x		x			
	*	Bromus hordeaceus					x	x	
	*	Cynodon dactylon				x	x	x	x
	*	Ehrharta calycina				x		x	
	*	Ehrharta longiflora			x	x			x
	*	Eragrostis curvula			x	x	x	x	x
	*	Hordeum leporinum						x	x
	*	Lagurus ovatus	x	x		x			
		Neurachne alopecuroidea		x					
	*	Paspalum dilatatum				x			
	*	Pennesetum clandestinum							x
	*	Phalaris aquatica					x	x	x
	*	Poa annua	x					x	
	*	Sorghum halepense							x
	*	Stenotaphrum secundatum			x		x		
Family Cyperaceae		Cyperus sp.				x			
		Lepidosperma gracile	x	x					
		Lepidosperma sp.				x			
Family Restionaceae		Alexgeorgia arenicola				x			
		Meboldinia coangustatus				x			
Family Juncaceae		Juncus pallidus							x
Family Dasypogonaceae		Acanthocarpos preissii	x	x					
Family Phormiaceae		Dianella revoluta	x	x		x			
		Stypandra glauca	x	x	x	x			
Family Anthericaceae		Agrostocrinum scabrum		x		x			
		Caesia parviflora				x			
		Thysanotus dichotomus						x	
		Xanthorrhoea preissii	x	x	x				x
Family Haemodoraceae		Haemodorum sp.				x			
Family Iridaceae		Orthrosanthus laxus				x			
	*	Romulea rosea	x	x		x		x	
	*	Watsonia bulbifera			x	x	x	x	
Family Casuarinaceae		Allocasuarina fraseriana	x	x	x				
		Casuarina obesa				x	x		x

APPENDIX A

FAMILY		TAXON	ROAD SECTION (Ref Table 1 of Text)						
			1	2	3	4	5	6	7
Family Proteaceae	**P**	Adenanthos cygnorum subsp. chamaeophyton		x					
		Banksia grandis				x			
		Banksia littoralis				x			
		Dryandra nivea				x			
		Dryandra sessilis	x	x	x				
		Dryandra squarrosa subsp. squarrosa				x			
		Grevillea synaphea			x	x			
		Hakea prostrata				x		x	
		Hakea undulata				x			
		Synaphea gracillima			x	x			
Family Polygonaceae	*	Muehlenbeckia adpressa		x		x			
	*	Rumex ?crispus					x	x	x
	*	Rumex sp.			x				
Family Amaranthaceae		Ptilotus drummondii	x	x					
		Ptilotus manglesii				x			
Family Ranunculaceae		Clematis pubescens	x	x					
Family Fumariaceae	*	Fumaria capreolata		x	x	x	x		
Family Brassicaceae	*	Raphanus raphanistrum				x		x	x
Family Droseraceae		Drosera erythrorhiza				x			
Family Pittosporaceae		Sollya heterophylla				x			x
Family Mimosaceae	**P**	Acacia drummondii ?subsp. affinis				x			
		Acacia lateriticola				x			
	*	Acacia podalyriifolia				x			
		Acacia pulchella	x	x	x	x			
		Acacia saligna			x		x	x	x
Family Papilionaceae		Bossiaea eriocarpa	x	x					
	*	Chamaecytisus palmensis	x			x	x	x	
		Daviesia longifolia			x	x			
		Daviesia preissii				x		x	
		Dillwynia sp. A (Marchant et. al.1987)			x	x			
		Gastrolobium capitatum			x	x			
		Gompholobium marginatum				x			
		Jacksonia sternbergiana			x				
		Kennedia prostrata	x	x		x			
		Kennedia stirlingii				x			
	*	Lupinus angustifolius				x			
	*	Lupinus cosentinii				x			
	*	Trifolium arvense	x				x	x	
	*	Vicia sativa			x				x
		Viminaria juncea						x	
Family Geraniaceae	*	Erodium sp.				x		x	
Family Oxalidaceae	*	Oxalis pes-caprae						x	x
	*	Oxalis purpurea						x	x

APPENDIX A

FAMILY		TAXON	ROAD SECTION (Ref Table 1 of Text)						
			1	2	3	4	5	6	7
Family Euphorbiaceae	*	Ricinus communis	x	x					
	*	Euphorbia sp.				x			
		Phyllanthus calycinus	x	x	x	x			
Family Anacardiaceae	*	Schinus terebinthifolius				x			
Family Rhamnaceae		Trymalium ledifolium				x			
Family Sterculiaceae		Thomasia foliosa	x	x					
Family Dilleniaceae		Hibbertia commutata	x	x	x	x			
		Hibbertia hemignosta (= H. enervia)				x			
		Hibbertia sp.		x					
Family Lythraceae	*	Lythrum hyssopifolia							x
Family Myrtaceae		Corymbia calophylla	x	x		x			x
		Eucalyptus rudis	x	x	x	x	x	x	x
		Eucalyptus wandoo	x	x		x			
		Hypocalymma angustifolium						x	
		Melaleuca lateriflora				x			
		Melaleuca preissiana							x
		Melaleuca raphiophylla			x	x	x	x	x
		Melaleuca teretifolia				x	x	x	
Family Apiaceae	*	Hydrocotyle ranunculoides				x	x		
Family Epacridaceae		Astroloma pallidum	x	x					
Family Primulaceae	*	Anagallis arvensis v. arvensis	x	x		x	x	x	x
Family Oleaceae	*	Olea europaea							x
Family Lamiaceae	*	Stachys arvensis				x		x	
Family Solanaceae	*	Solanum nigrum	x		x	x	x	x	x
Family Scrophulariaceae	*	Kickxia elatine	x			x		x	x
Family Rubiaceae		Opercularia vaginata			x	x			
Family Goodeniaceae		Dampiera trigona				x			
		Lechenaultia biloba	x	x		x			
Family Asteraceae	*	Arctotheca calendula				x		x	x
	*	Cotula coronopifolia				x			
	*	Hypochaeris glabra	x	x				x	x
	*	Lactuca serriola							x
	*	Senecio sp.				x			
	*	Sonchus oleraceus						x	x
	*	Ursinia anthemoides				x			

APPENDIX B

APPENDIX B

Site 1:	**Low Closed Forest (Flooded Gum / Marri)**
Location:	SLK 62.15 West.
Description / Condition:	Narrow remnant (approximately 3 metres wide) very close to existing carriageway. Cleared paddock adjacent, which separates the roadside vegetation from the fringing Forest on Lake Needoonga. Understorey dominated by exotic species. Only isolated Grass Trees remain. Condition is "good" to "degraded" (4/5). Significant management would be required to re-establish understorey.
Species Recorded:	Total 15 (3 native)

Corymbia calophylla
Eucalyptus rudis
Xanthorrhoea preissii

Immediately adjacent:
Juncus pallidus in paddock
Melaleuca raphiophylla fringing lake

* Anagallis arvensis v. arvensis
* Cynodon dactylon
* Ehrharta longiflora
* Eragrostis curvula
* Kickxia elatine
* Lactuca serriola
* Olea europaea
* Pennesetum clandestinum
* Raphanus raphanistrum
* Rumex ?crispus
* Solanum nigrum
* Vicia sativa

APPENDIX B

Site 2: **Low Woodland (Flooded Gum / Swamp Sheoak)**

Location: SLK 61.05 West.

Description / Condition: Narrow remnant (approximately 1 metre wide) very close to existing carriageway. Partially cleared woodland adjacent. Some natural recruitment of canopy species.

Understorey dominated by exotic species.

Condition is “degraded” (5). Significant management would be required to re-establish understorey and to rehabilitate canopy.

Species Recorded: Total 14 (2 native)

Casuarina obesa
Eucalyptus rudis

Immediately adjacent:
Eucalyptus rudis in partially cleared paddock
* Typha orientalis

* Anagallis arvensis v. arvensis
* Arctotheca calendula
* Avena sp.
* Cynodon dactylon
* Hordeum leporinum
* Kickxia elatine
* Lythrum hyssopifolia
* Phalaris aquatica
* Raphanus raphanistrum
* Rumex ?crispus
* Solanum nigrum
* Vicia sativa

APPENDIX B

Site 3: **Low Woodland – regrowth (Flooded Gum)**

Location: SLK 60.6 West.

Description / Condition: No mature native species present, but good recruitment of canopy species.

Understorey dominated by exotic species, especially grasses.

Condition is “degraded” (5). Significant management would be required to re-establish understorey and rehabilitate canopy species.

Species Recorded: Total 9 (1 native)

Eucalyptus rudis

* Avena sp.
* Ehrharta calycina
* Hypochaeris glabra
* Pennesetum clandestinum
* Rumex ?crispus
* Sorghum halepense
* Vicia sativa
* Andropogon distachys

Immediately adjacent:
(all fringing Lake Needoonga)
Cauarina obesa
Eucalyptus rudis
Melaleuca preissiana
Melaleuca raphiophylla

APPENDIX B

Site 4: **Low Open Shrubland/Open Shrubland – rehabilitation**

Location: SLK 60.15 East.

Description / Condition: Rehabilitation of cut batters, possibly with some natural recruitment or return or native species from topsoil or seed. Occurs on both sides of Highway. Totally cleared paddock adjacent.

Understorey dominated by exotic grasses.

Condition not rated (not remnant vegetation). Stability mostly provided by the exotic species.

Species Recorded: Total 13 (4 native)

Daviesia preissii
Hakea prostrata
Hypocalymma angustifolium
Thysanotus dichotomus

* Anagallis arvensis v. arvensis
* Avena sp.
* Bromus hordeaceus
* Ehrharta calycina
* Eragrostis curvula
* Hordeum leporinum
* Poa annua
* Romulea rosea
* Trifolium arvense

APPENDIX B

Site 5: **Low Open Woodland (Flooded Gum / Freshwater Paperbark)**

Location: SLK 59.25 East.

Description / Condition: Fringing low open woodland adjacent to the Highway contiguous with low forest at Brockman River crossing. Abuts cleared paddocks away from the river.

No native understorey remains – predominantly *Watsonia bulbifera*.

Condition is “degraded” (5) away from the river, but is “very good” to “good” (3/4) closer to the river.

Species Recorded: Total 13 (3 native)

Acacia saligna
Eucalyptus rudis
Melaleuca raphiophylla

Immediately adjacent:
Melaleuca teretifolia where water is more permanent
Chamaecytisus palmensis

* Anagallis arvensis v. arvensis
* Cynodon dactylon
* Ehrharta calycina
* Eragrostis curvula
* Phalaris aquatica
* Raphanus raphanistrum
* Rumex ?crispus
* Solanum nigrum
* Stachys arvensis
* Watsonia bulbifera

APPENDIX B

Site 6: **Low Woodland (Flooded Gum / Marri / Wandoo)**

Location: SLK 59.05 East.

Description / Condition: Remnant woodland on higher ground between Brockman River and a small tributary from the west. Contiguous with fringing vegetation on Lake Chittering.

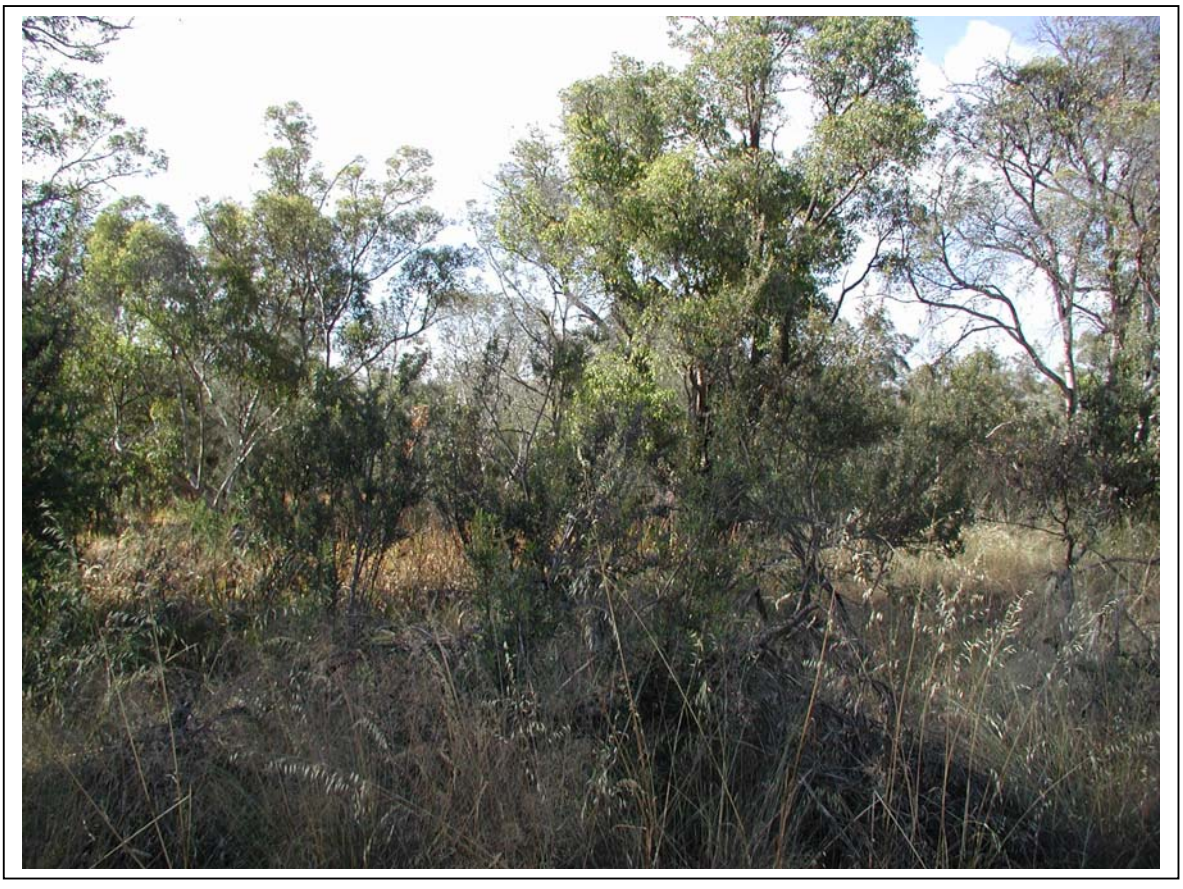
Understorey dominated by Watsonia and exotic grasses

Condition is “good” to “degraded” (4/5). Significant management would be required to re-establish understorey.

Species Recorded: Total 12 (5 native)

Corymbia calophylla
Eucalyptus rudis
Eucalyptus wandoo
Casuarina obesa
Dryandra squarrosa subsp. squarrosa

* Chamaecytisus palmensis
* Ehrharta longifolia
* Eragrostis curvula
* Watsonia bulbifera
* Avena sp.
* Briza maxima
* Lupinus cosentinii



APPENDIX B

Site 7: **Low Woodland (Wandoo)**

Location: SLK 58.85 East.

Description / Condition: Remnant woodland on high ground between the Highway and Lake Chittering. Contiguous with fringing vegetation on Lake Chittering.

Understorey varies from very open with few weeds to patches of thick Watsonia.

Condition is “very good” to “good” (3/4). Significant management would be required to eradicate the Watsonia infestation. It appears that part of this site has been rehabilitated in the past. Some understorey species may have been introduced.

Species Recorded: Total 30 (25 native)

Acacia drummondii subsp. affinis
Acacia lateriticola
Acacia pulchella
Alexgeorgia arenicola
Corymbia calophylla
Daviesia preissii
Dianella revoluta
Dillwynia sp. A (Marchant et. al.1987)
Dryandra nivea
Dryandra sessilis
Eucalyptus wandoo
Euphorbia sp.
Gompholobium marginatum
Haemodorum sp.
Hibbertia hemignosta (= H. enervia)
Kennedia prostrata
Kennedia stirlingii
Lechenaultia biloba
Macrozamia riedlei
Opercularia vaginata
Orthrosanthus laxus
Phyllanthus calycinus
Ptilotus manglesii
Sollya heterophylla
Stypandra glauca

* Briza maxima
* Eragrostis longiflora
* Oxalis purpurea
* Romulea rosea
* Watsonia bulbifera

APPENDIX B

Site 8: **Low Open Forest (Freshwater Paperbark / Swamp Seoak)**

Location: SLK 58.7 East.

Description / Condition: Dense wetland vegetation associated with Lake Chittering. The Highway is built above natural ground level with a steep, largely unvegetated embankment between the carriageway and the fringing vegetation.

Some weedy species, including Watsonia, occur above the water level. Also some exotic trees present.

Condition is “excellent” to “very good” (2/3).

Species Recorded: Total 19 (8 native)

Casuarina obesa
Cotula coronopifolia
Dampiera trigona
Eucalyptus rudis
Lepidosperma sp.
Melaleuca lateriflora
Melaleuca raphiophylla
Melaleuca teretifolia

* Cynodon dactylon
* Cyperus sp.
* Hydrocotyle ranunculoides
* Lagurus ovatus
* Paspalum dilatatum
* Raphanus raphanistrum
* Schinus terebinthifolius
* Senecio sp.
* Solanum nigrum
* Stachys arvensis
* Watsonia bulbifera

APPENDIX B

Site 9: **Low Open Forest (Flooded Gum)**

Location: SLK 57.3 East.

Description / Condition: Disturbed woodland at southern end of Lake Chittering. Contiguous with dense, less disturbed Low Forest of Freshwater Paperbark.

Understorey dominated by exotic species, including Watsonia. Isolated individuals of native species remain.

Condition is “good” to “degraded” (4/5). Significant management would be required to re-establish native understorey.

Species Recorded: Total 12 (5 native)

Acacia saligna
Eucalyptus rudis
Jacksonia sternbergiana
Melaleuca raphiophylla
Xanthorrhoea preissii

* Ehrharta longifolia
* Eragrostis curvula
* Rumex sp.
* Solanum nigrum
* Stenotaphrum secundatum
* Vicia sativa
* Watsonia bulbifera

APPENDIX B

Site 10: **Low Woodland (Wandoo)**

Location: SLK 56.45 East.

Description / Condition: Isolated remnant woodland on slope above the Highway, adjacent to totally cleared paddock.

Good understorey diversity remains. Weedy species are present but are not dominant.

Condition is “excellent” to “very good” (2/3).

Species Recorded: Total 25 (21 native)

Acacia pulchella
Acanthocarpos preissii
Adenanthos cygnorum subsp. chamaeophyton
Agrostocrinum scabrum
Allocasuarina fraseriana
Astroloma pallidum
Bossiaea eriocarpa
Clematis pubescens
Dianella revoluta
Dryandra sessilis
Eucalyptus wandoo
Hibbertia commutata
Hibbertia sp.
Kennedia prostrata
Lechenaultia biloba
Lepidosperma gracile
Phyllanthus calycinus
Ptilotus drummondii
Stypandra glauca
Thomasia foliosa
Xanthorrhoea preissii

* Anagallis arvensis v. arvensis
* Avena sp.
* Briza mazima
* Romulea rosea

APPENDIX C

GREAT NORTHERN HIGHWAY UPGRADE PROJECT
BINDOON SOUTH SECTION (54.6 TO 62 SLK)

APPENDIX C

Condition Rating Scale (from Department of Environmental Protection, 2000)

Scale	Descriptor	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

Vegetation Structural Classes (Adapted from Department of Environmental Protection (2000).

Life Form / Height Class	**Canopy Cover (Percentage)**			
	100 – 70 %	70 –30 %	30 – 10 %	10 –2 %
Trees > 30 m Trees 10-30 m Trees < 30 m	*Tall Closed Forest* *Closed Forest* *Low Closed Forest*	*Tall Open Forest* *Open Forest* *Low Open Forest*	*Tall Woodland* *Woodland* *Low Woodland*	*Tall Open Woodland* *Open Woodland* *Low Open Woodland*
Shrubs > 2 m Shrubs 1-2 m Shrubs < 1 m	*Closed Tall Scrub* *Closed Heath* *Closed Low Heath*	*Tall Open Scrub* *Open Heath* *Open Low Heath*	*Tall Shrubland* *Shrubland* *Low Shrubland*	*Tall Open Shrubland* *Open Shrubland* *Low Open Shrubland*
Sedges	*Closed Sedgeland*	*Sedgeland*	*Open Sedgeland*	*Very Open Sedgeland*

Appendix B

CALM CORRESPONDENCE

file
NOS# 4036

Enquiries: Tony Saraullo on (08) 9622 4711
Our Ref: 05/777
Your Ref:

19 May 2005

District Manager, Perth Hills District
Department of Conservation and Land Management
51 Mundaring Weir Road
MUNDARING WA 6073

Dear Sir

GREAT NORTHERN HIGHWAY BINDOON SOUTH – 54.6 TO 62 SLK
CHITTERING LAKES NATURE RESERVE

We refer to a meeting held on 22 April 2005 with Mr Stefan De Haan (District Nature Conservation Coordinator) and Main Roads Western Australia Representatives from Wheatbelt North Region regarding proposed road improvement works along the Great Northern Highway (GNH) from 54.6 – 62SLK, known as Bindoon South

CALM and the Conservation Commission have being identified as key project stakeholders that MRWA require to consult with in order to seek project approval

MRWA now wish to seek your comments on the project and obtain approval to enter into the Chittering Lakes Nature Reserve to undertake temporary construction works.

The GNH is a National Highway and operates double bottom road trains from Perth to Wubin and triple road trains from north of Wubin. The highway is also a major tourist route to the Mid West, Gascoyne, Pilbara and Kimberley regions.

The existing highway through the Bindoon South section does not conform to the National Highway standards, and requires improvements.
The existing road deficiencies are:

- Sub standard road geometry
- Narrow formation and seal width
- High crash rates involving heavy vehicles
- Located within a area which contains increasing rural sub divisions
- Borders the Chittering Lakes Nature Reserve and Brockman River waterway

The Chittering Lakes Nature Reserve is registered under the National Estate as a Class 3 Nature Reserve.

Road alignment studies undertaken to date have being extensive in an attempt to minimise in as much as possible impacts on the reserve.
The resultant design shows that impacts on the roadside environment cannot be avoided if the highway in this area is to achieve national standards.

The current design identifies 3 locations approximately 50m long each where the new road batters are in close proximity to the nature reserve and it will be necessary to temporarily enter the nature reserve during the construction phase such that the road batter can be built.

Wheatbelt North Region, Peel Terrace, Northam or PO Box 333, Northam Western Australia 6401
Telephone: (08) 9622 4777 Facsimile: (08) 9622 3767
Email: wbnthreg@mainroads.wa.gov.au Website: www.mainroads.wa.gov.au

Main Roads have undertaken a Preliminary Environmental Impact Assessment and have developed an Environmental Approvals Strategy for the project.
These studies have identified the following issues:

- Carnaby's Cockatoo nesting and feeding sites will be impacted Three nesting hollows will require relocation and replacement
- Most of the section of the GNH is dieback infected or has high risk of infection. The construction site will be required to incorporate dieback management practices in accordance with CALM requirements
- Weeds are present along the section and will be required to be managed in accordance with CALM guidelines.
- Two Priority 3 species have been identified located adjacent the proposed works
- Management of drainage from the highway to prevent pollution of the Chittering Lakes will form part of the project
- Identified the need to undertake pre construction dilapidation surveys for the Anglican Church and the Chittering Roads Board Building

The environmental studies undertaken have recommended that referral to the EPA /DEH is required and referral under Commonwealth's EPBC (1999) Act is necessary in regards to the Carnaby Cockatoo nesting sites.

MRWA is aware that this project will likely require environmental offsets as part of any mitigation and management strategy. To this end three areas have being identified that can potentially be used as offsets to the Commission to assist in consolidating the nature reserve.

As well as improving the buffer between the wetland system and the road, the offset will offer an opportunity to revegetate disturbed areas adjacent the Reserve. It is understood that this is in line with EPA's offset position.

Attached is a plan of the proposed road improvements with the cadastral background, which shows the extent of private property land requirement including additional buffer zones adjacent the Chittering Lakes Nature Reserve

Main Roads is in the process of engaging Environmental Consultants to undertake a detailed Environmental Impact Assessment (EIA) for the proposed road project. It is anticipated that the EIA report will be completed in July 2005 and it will be referred to the Environmental Protection Authority for their formal assessment. A copy of this report can be made available to your Department, on request.

The access into the Nature Reserve at the three locations to carry out the construction works will be temporary. Ground disturbance areas will be required to be kept to minimum and will be fully rehabilitated using locally occurring species and monitored against CALM revegetation standards.

If you require any further information please contact Tony Saraullo on (08) 9622 4711. In reply please quote file reference 05/777

Yours sincerely

Ian Fennell
Acting REGIONAL MANAGER

Attachment

Appendix C

GREAT NORTHERN HIGHWAY DIEBACK ASSESSMENT REPORT 2004

Phytophthora cinnamomi – Assessment Results and Management recommendations:

GNH SLK 54.6-62.0 Bindoon South Flora Survey, PEC199

Kellogg Brown and Root Pty Ltd, November 2004

GLEVAN CONSULTING

Executive Summary

A seven-kilometre section of the Great Northern Highway near Bindoon was assessed for the presence of the disease caused by *Phytophthora cinnamomi* (Dieback) on 10 November 2004.

The assessment was conducted by Evan Brown of Glevan Consulting. Mr Brown is accredited by the Department of Conservation and Land Management to provide this level of forest disease assessment.

The assessed section of Toodyay Road was defined as:

Location (SLK)	Length (Km)	Description of Proposed Works
54.85 –55.85	1.0	Widen and Overlay including reconstruction of Parking bay
55.85-56.90	1.05	Reconstruction and Improve intersection with Hart Drive and Chittering Road
56.90-58.64	1.74	Reconstruction and realignment (Donaldson's section)
58.64 – 59.16	0.52	Improve Intersection with Tee Tree Rd and Spice Road
59.16-59.22	0.06	Widen and overlay Brockman River Bridge
59.22-60.5	1.28	Reconstruction and Realignment including intersection with Flat Rocks Rd
60.5 – 62.04	1.54	Widen, Overlay and construction of southbound passing lane

Two soil and tissue samples were taken to assist the assessment process. These samples were analysed by Vegetation Health Services, Department of Conservation and Land Management. One sample proved the presence of the disease in the adjacent waterways, while the other sample returned a negative result.

The entire length of the assessed section did not appear to have any significant areas that would be assessed as being free of the disease caused by *P. cinnamomi*. The road alignment is generally uninterpretable, however some sections are also at risk of being infected with the disease. Some sections had no indicating species present at all, being either pasture of watercourses. Other sections were also considered to be uninterpretable despite the presence of some indicating species present. Generally these species were not of a sufficient density to confidently determine the presence of the disease.

The limited number of indicating species near the roadside may be indicative of the disease being present for some time, in which case the expression of the disease would be limited and cryptic.

Introduction to *Phytophthora cinnamomi* (Dieback)

Phytophthora cinnamomi is an introduced soil-borne pathogen (water mould) that kills a wide selection of plant species of the south west of Western Australia. Despite being a water mould, taxonomists advise that *Phytophthora* species be referred to as fungi.

The pathogen almost certainly entered Western Australia shortly after the European colonization and has since produced a complex mosaic of infested and uninfested areas in the southwest.

The spread of the pathogen accelerated after World War II with the use of heavy machinery being used for road building and logging activities and unknowingly spreading infected soil.

The life cycle of *P. cinnamomi* depends on moist conditions that favour the survival, sporulation and dispersal of the spores.

The pathogen is not capable of photosynthesis. Because it needs to extract food from living plant tissue, it does this via a mass of microscopic threadlike mycelium that forms the body of the organism that grows through host tissue. The mycelia continue to grow within the host tissue when the ambient moisture content is above 80%. The mycelia may be transported in soil and host tissue and then deposited where it may infect new hosts. The mycelium, given warm, moist conditions are capable of producing the millions of tiny spores that reproduce the pathogen. Two kinds of spores are likely to be found.

Zoospores

Zoospores are very small spores that can actively swim very short distances towards new hosts and initiate new infections. They are short-lived and fragile but produced in large numbers, and are the mode for the spread of the disease from one plant to the next. They can also be carried along in moving water over large distances. As they move through the soil zoospores lodge on plant roots, infect them, and in susceptible plants produce mycelia. The mycelium grows, feeding on the host, rotting the roots and cutting off the plant's water supply. The mycelium may grow from plant to plant via root-to-root contact points and/or root grafts.

Chlamydospore

Chlamydospores are larger spores that are tough and long-lived (within dead plants and the soil). They are produced under unfavourable conditions and are the resistant resting phase of the pathogen. They may be transported in soil or roots and then germinate to cause a new infection when they encounter favourable conditions. The chlamydospores produce mycelium and zoospores.

When conditions are warm and moist, microscopic spore sacks called sporangia and thick walled chlamydospores are produced vegetatively from mycelia strands that form the body of the pathogen in the soil or host tissue. The sporangia release motile zoospores in free water to infect host roots. Mycelia of different mating types may grow together inducing the production of thick walled sexual spores called oospores. The mating types are called A1 or A2. Only one mating type (A1) occurs in WA.

Currently the pathogen cannot reproduce sexually in WA and relies on vegetative reproduction for survival and dispersal.

After infection, the pathogen invades root bark and forms lesions that may extend in to the plants stem collar. In susceptible species, the infection of roots and collar will result in the death of the host.

Once dispersed, the spores may infect a wide range of resistant and susceptible hosts.

P. cinnamomi has a very wide host range. At least 1000 species from taxonomically diverse families have been reported as hosts for *P. cinnamomi* of which nearly half have been recorded from research in Australia. Indigenous species most affected belong to four families:

- Proteaceae
- Epacridaceae
- Papilionaceae/Fabaceae

• Myrtaceae

Not all genera within a family or all species within a genus are necessarily susceptible. E.g. some species of *Eucalyptus* are highly resistant (including Karri, Marri, Wandoo and Tuart) while some, such as Jarrah, are affected but have the ability to resist the invasion of the pathogen under certain conditions (Tissue moisture content < 80%).

Broad estimates are that perhaps 1500 to 2000 species of the estimated 8000 species of vascular plants in the South West of WA may be susceptible to the degree that successful infections result in the death of the host.

For any *Phytophthora* species to survive, it requires a combination of the pathogen, host and suitable environmental conditions.

The optimum temperature for the growth of the organism is between 15°C and 30°C while the optimum temperature for sporulation is considered to be 25°C to 30°C. Any temperatures less than 0°C and greater than 35°C are unfavourable to the survival of the spores and mycelium of *P. cinnamomi*.

Infertile soils are more compatible to *P. cinnamomi* where there is a good movement of water and little biomass with few antagonistic microflora. The soil texture allows for the easy lateral movement of the motile zoospores and the easy development of mycelium. Native vegetation that has adapted to the infertile soils by having a large surface area of root matter place these species at a significant risk of infestation.

Clay and laterite, significant components of some soil types of the southwest act as impeding layers and causes subsurface ponding, which facilitates the production of spores. These soils tend to drain laterally, further spreading the zoospores. The moisture content of the soil must be at a level to provide for an aerobic situation. Saturated soils become anaerobic and don't contain enough oxygen to favour the production of sporangia.

The colonization of *Phytophthora* infections has reached epidemic proportions in areas that are environmentally suited to the establishment, survival and reproduction of the pathogen. These areas are generally in areas receiving more than 800mm of rainfall annually. In areas receiving between 600-800mm, the occurrence of *P. cinnamomi* is less extensive and confined to water-gaining sites in the landscape.

In areas that receive less than 600mm, as at the Project Site, the disease caused by *Phytophthora cinnamomi* is restricted to areas where localised hydrological effects cause the effective rainfall to substantially exceed the actual rainfall events.

Glossary of common words.

Hazard a source of potential harm or a situation with the potential to cause loss.

Disease a combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.

Host the plant which is invaded by a pathogen and from which the pathogen derives its energy

Infested areas areas that accredited personnel have determined have plant disease symptoms consistent with the presence of the pathogen *P. cinnamomi*.

Pathogen any organism or factor causing disease within a host.

Protectable area areas, including areas of high conservation and/or socio-economic value (E.g. a small uninfested area which contain a known population of a susceptible species of threatened flora) within the vulnerable zone that:

- Are situated in zones receiving > 600 mm per annum rainfall or are water gaining sites (E.g. granite outcrops, impeded drainage or engineering works which aggregate rainfall) in the 400-600 mm per annum rainfall zone
- Do not have a calcareous soil (e.g. not a Quindalup dune system)
- Have been determined to be free of the pathogen *P. cinnamomi* by a qualified Disease Interpreter (all susceptible indicator plant species are healthy, no plant disease symptoms normally attributed to *P. cinnamomi* are evident)
- Are positioned in the landscape and are of sufficient size. (E.g. > 4 ha with axis > 100m) such that a qualified Interpreter judges that the pathogen will not autonomously engulf them in the short term (a period of a few decades)
- Consists of areas where human vectors are controllable (E.g. not an open road, private property)

Risk the chance of uninfested area becoming infested through the autonomous actions of the pathogen or the actions of people and animals or a combination of these factors, measured in terms of the magnitude of consequences of that event should it occur and the likelihood of the event and its consequences occurring, assessed in the context of existing controls.

Risk management the culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects.

Susceptible influenced or harmed by *P. cinnamomi*.

Uninfested areas areas that an accredited person has determined to be free of plant disease symptoms that indicate the presence of the pathogen *P. cinnamomi*.

Uninterpretable areas areas situated in areas receiving > 600+ mm per annum rainfall or are water gaining sites (eg. granite outcrops, impeded drainage or engineering works which aggregate rainfall) in the 400-600mm per annum rainfall zone where indicator plants are absent or too few to determine the presence or absence of disease caused by *P. cinnamomi*. (CALM – *Phytophthora cinnamomi* and the disease caused by it)

Management of the disease

The management of *P. cinnamomi* can be described in four parts, PATHOGEN, PROCESSES, PEOPLE and PERFORMANCE.

Pathogen.

Are *Phytophthora* species present in the vegetation? How do you know?

The assessment of the vegetation along the verges of Toodyay Road was conducted by Evan Brown of Glevan Consulting. All areas at a high risk of infections, eg tracks and water-gaining sites were scrutinised.

To determine if the disease caused by *P. cinnamomi* is present at a site, an assessment is made of any site where there exist deaths in plant species that are susceptible to the disease. By these visual indications, the site can be interpreted to determine if the deaths form a recognised pattern of movement of the disease. In the sites infested with Dieback, the deaths are generally fresher on the extremities of the infestation. This age range of deaths shows the rate and direction of the spread.

The field assessment was also supported by the laboratory analysis of two soil and plant tissue samples. These samples were tested by Vegetation Health Service, Department of Conservation and Land Management using standard techniques.

The assessment of the presence of the disease caused by *P. cinnamomi* is always limited upon the presence of plant species that can, by dying, show the symptoms of the disease presence. Any area where these indicating species are not present, are determined to be uninterpretable to the disease. In the case of this survey, some areas had indicating species present, however the density of the plant species was not sufficient to allow the determination of the disease presence.

The effect of *P. cinnamomi* upon the health of plant communities, and upon the species in them, varies greatly. This variability is caused by the considerable inconsistency that exists within and between native plant species in their responses to the presence of *P. cinnamomi*, and various environmental factors.

In many places, it destroys the structure of many native communities, reduces their floristic diversity, decimates their primary productivity and destroys habitat for much dependant native fauna, particularly its value as protection against feral predators. In some places the pathogen causes little damage at all.

The assessment for the presence or absence of *Phytophthora* sp. at all sites in the study is determined with consideration of the following:

- The presence of *Phytophthora* can only be deduced from the death of susceptible plants.
- A single death may be caused by *Phytophthora*. A more confident assessment may be made if more dead plants are seen and/or if the plants are of a differing species. A note is also made of any progression in the deaths (a range in the age of deaths) or the evidence of vehicle tracks nearby (or other potential vectors).
- The presence of *Phytophthora* can sometimes be determined by laboratory analysis. A negative result indicates that the *Phytophthora* was not recovered from the sample supplied, not that *Phytophthora* was not present at the sample site. An analysis of the site should always be conducted with the laboratory result and field experience.
- It is difficult to detect the presence of *Phytophthora* in areas that have been recently burnt or where there are too few indicator species present.
- Areas that have had recent disturbance may harbour cryptic infections. The time taken for any new infection to express as a disease may vary from six months to many years depending on environmental conditions.
- Many other agents may be responsible for a plant death, eg drought, frost, other pathogens, insects and mechanical activity.

If a sample of a site was required, the following procedure was performed:

- Ensure that the mattock (and all digging implements) had been thoroughly sterilized prior to use with methylated spirits. The implements were then allowed to dry so that the integrity of the sample was not compromised.
- The area around the base of the plant/s to be sampled was cleared of vegetative matter to aid the digging process.
- The plant was dug to a satisfactory depth so that the tissue with the highest moisture content was obtained.
- Sections of the roots and stem base from all sides of the plant were taken and placed in a plastic bag. If any lesion was noticed on the tissue, it was also placed in the bag. A few handfuls of sand from various depths were also deposited in the plastic bag.
- The sample bags were irrigated with distilled water to try and simulate the optimum conditions for the *Phytophthora* to survive.

Processes

Are there processes in place to ensure that the risk of spreading the pathogen is minimised throughout all operations?

Detailed processes should be enacted to manage the impact and non-autonomous spread of the disease caused by *Phytophthora.* Each specific operation may have a distinct set of procedures, however there are some overarching processes, such as:

- Ensuring that the active disease edge has been recently mapped and demarcated in the field.
- Strategic placement of vehicle clean-down points.
- Controlling unauthorised access.

People

Who owns the process? Who is responsible for ensuring the processes are followed?

Everybody plays a role in ensuring that the spread and subsequent impact of the disease is minimised. All personnel involved in any activity within the land management area should be informed as to the risk of their activity spreading the disease caused by *Phytophthora.*

Factors to consider should be:

- Do all personnel understand and comply with hygiene procedures? Is training required?
- Are all contractor vehicles clean prior to their entry to the site?

Performance

Are the processes working? How do you know? Can they be improved?

The procedures will offer strategies to reduce the spread of the disease. These strategies should offer indicators to measure the success of the procedures. These performance measures could include:

- The number of new diseased areas.
- Known breaches of hygiene regulations.
- The increased size of the diseased areas caused by external influences.

Hygiene implications

Risk reduction

Any area currently infested with *Phytophthora cinnamomi* needs to be treated with extreme caution. Each infested site has a high risk of vectored spread, which will require a degree of hygiene measures to reduce the risk of non-autonomous spread.

These risk reduction tactics may include;

- Restrict access to the sites to summer (dry soil) only.
- Plan as few access points as possible, which minimises the number of interfaces between infested and uninfested areas.
- Implement the seasonal closure of roads if possible and if the roads cannot be upgraded with suitable surfaces and drainage.
- Plan for, construct, manage, supervise and audit high quality clean-down points.
- Utilise enforcement patrols.

The following table should be adopted for the cleaning of machinery when transporting vehicles from the selected category (column) to the selected hygiene category (row), where the term Dieback is restricted to the *Phytophthora cinnamomi* specie only:

Moving from ↓ to →	Dieback	Uninterpretable	Uninfested
Dieback		**Clean on entry**	**Clean on entry**
Uninterpretable			**Clean on entry**
Uninfested			

Clean-down specifications

Clean-down points need to be constructed to the following standards:

- The clean-down point must provide a physical separation between the object being cleaned and the effluent being produced;
- The point must provide a physical separation from the object being cleaned and infested soil and plants; and
- The point must provide easy and safe access for both the placement of the object to be cleaned and the operator conducting the clean down.

When placing the clean-down point in the field, the following considerations must be taken into account:

- The site must allow the effluent to fall directly onto infested soil or in a construction able to capture the effluent for the later transportation and disposal;
- Any cleaned objects must be allowed to enter the uninfested area without coming into contact with infested materials; and
- The clean down must be situated to allow a turn-around point for vehicles that cannot satisfy the hygiene guidelines.

An object is considered to be clean if it is free of soil and plant tissue and slurry consisting of soil and water.

Note that a clean-down point is not necessarily a wash-down point. It would be pertinent in dry-soil conditions to brush down vehicles to ensure that mud was not created at the site.

Results

All maps in this section have been produced at the scale of 1:15000, with background cadastral and topographic data used under license, and with permission, from Department of Conservation and Land Management.

The roadside verge has been classified into the disease categories of Infected, Uninterpretable and High Risk.

The infected areas show symptoms of the disease, with fresh deaths in susceptible species present in the vegetation.

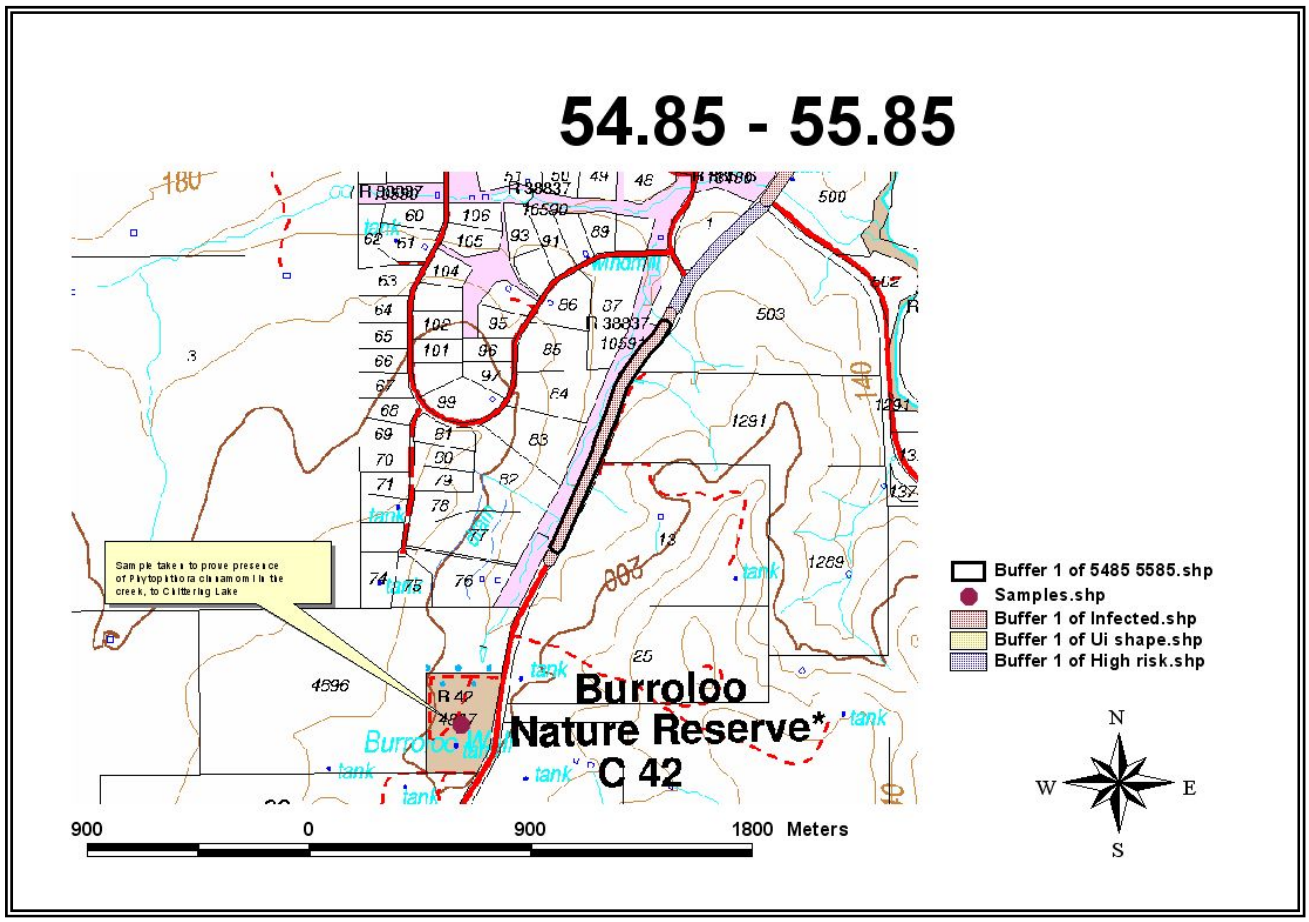
Uninterpretable areas are sections where there are no species present that will indicate the presence of the disease. High Risk areas have few indicators present, but are not showing symptoms. These areas do not have a sufficient density of indicating species to determine if the disease is not present.

Section 54.85 – 55.85

Scattered deaths were noted in the creek that runs along the western side of the highway in this section. These deaths were noted in the *Xanthorrhoea preissii* species. Some deaths were also noted in the *Dryandra sessilis* and *Hakea prostrata* but no deaths were found in the *Patersonia* species present.

Many deaths were noted in the *Eucalyptus wandoo* population adjacent to the road. These species are not susceptible to the disease caused by *p. cinnamomi* and may suggest that other pathogens may be present. A possible cause would be the *Armillaria luteobubalina* fungus, to which the *E. wandoo* are reasonably susceptible. This pathogen can also cause deaths in the *Xanthorrhoea, Dryandra* and *Hakea* species.

One sample was taken outside of the area, upslope in the Burroloo Reserve (411375E 6520435N GDA94) and proved the presence of the disease. The sample was taken at this site as the vegetation within the Reserve was of a sufficient density to display the pattern of deaths normally associated with the presence of *P. cinnamomi.* With this Reserve being affected by the disease, it should be assumed that the creek is also affected. This is shown on the map as the purple buffer showing the presence of the disease, assuming a buffer of twenty-five metres each side of the creek.



This entire section should be considered to be infected with *P. cinnamomi.*

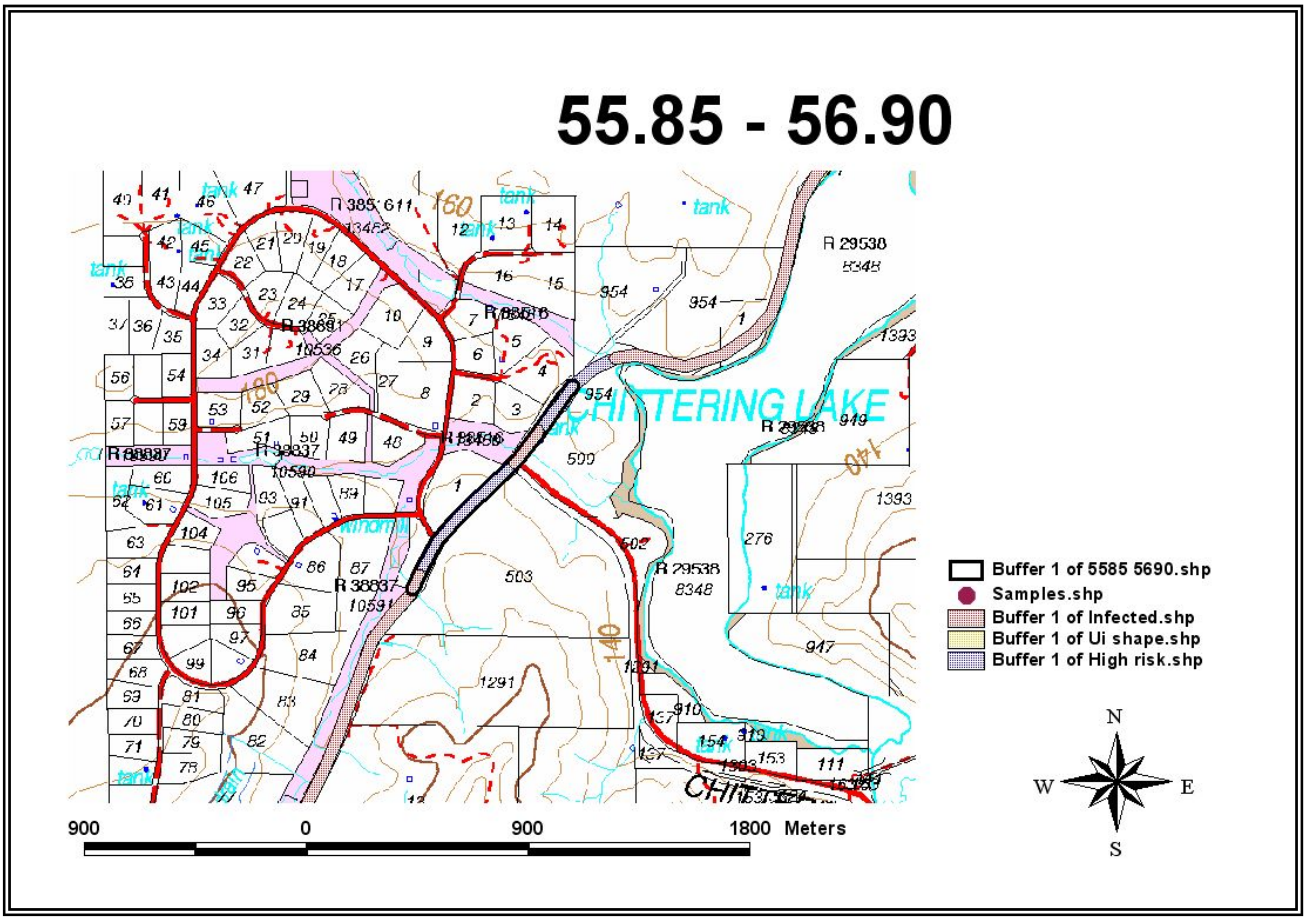
GLEVAN CONSULTING

Section 55.85 – 56.90

The vegetation within this section was very similar to the vegetation in the previous section. Despite the infected creek generally being further from the road alignment, the vegetation within the road alignment was very sparse and no portion of this section could be determined to be free of the disease.

The amount of disturbance along the edges of the roadway has made it difficult to accurately determine the disease status in this section.

This section should therefore be considered to be uninterpretable to the disease, however the section is at a high risk of being infected.



Where the creek crosses the road, just north of Chittering Road, would be classified as being infected.

GLEVAN CONSULTING

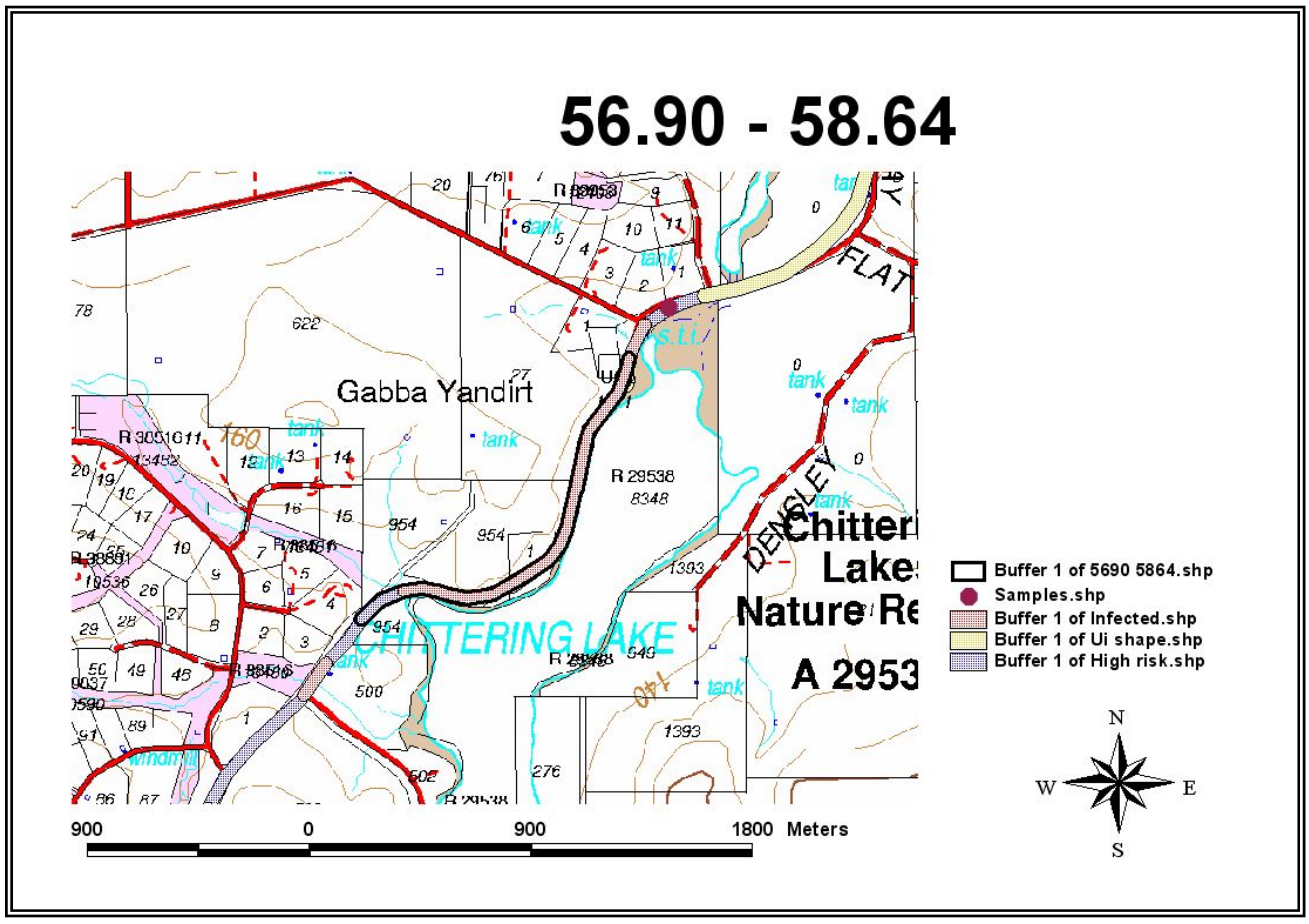
Section 56.90 – 58.64

For the majority of this section, the highway road alignment closely follows the borders of Chittering Lake. It would be expected that the vegetation on the edge of the lake is mostly affected by the disease.

In this section also, the old alignment can be seen just on the eastern side of the current alignment, closer to the lake.

Although some remnant vegetation exists surrounding the lake, some scattered deaths were noted in the *X. preissii* and *D. sessilis.* There was no vegetation to display the symptoms of the disease on the western side of the current alignment.

This section should be considered to be affected by the disease caused by *P. cinnamomi.*



GLEVAN CONSULTING

Section 58.64 – 59.16

A sample (414089E 6524138N GDA94) was taken in this section in an area of scattered *Dryandra* species and *D. sessilis* deaths. Some deaths were also noted in the *E. wandoo* species.

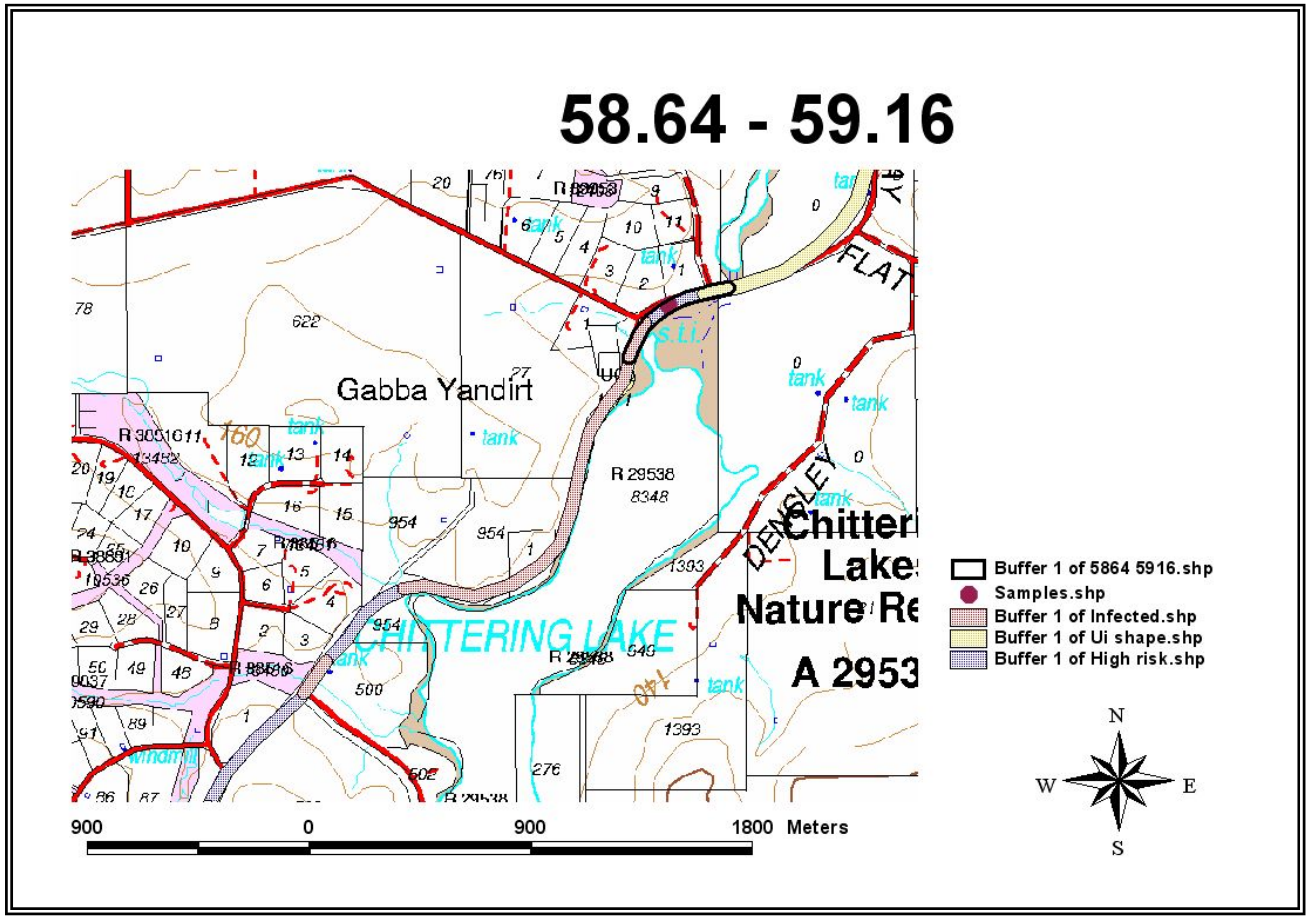
The site appeared to have very shallow soil, with floating rock noted at the crest of the rise. The plants sampled had shallow and stunted root systems, indicating that the site is probably suffering from drought symptoms.

This site also appeared to have the most densely populated indicating species present, with the area probably free of the disease. This area is also quite small, making it difficult to be managed separately in the road construction process.

The landform slopes down reasonably quickly, with the vegetation appearing quite stressed and denuded closer to the lake. This area has also seen a considerable amount of disturbance, with evidence of old tracks in the area.

The vegetation on the western side of the highway, near the old settlement just south of Tea Tree Road also has some vegetation (mainly *Xanthorrhoea* and *Dryandra* species) but not of a density to confidently determine the disease status of the area.

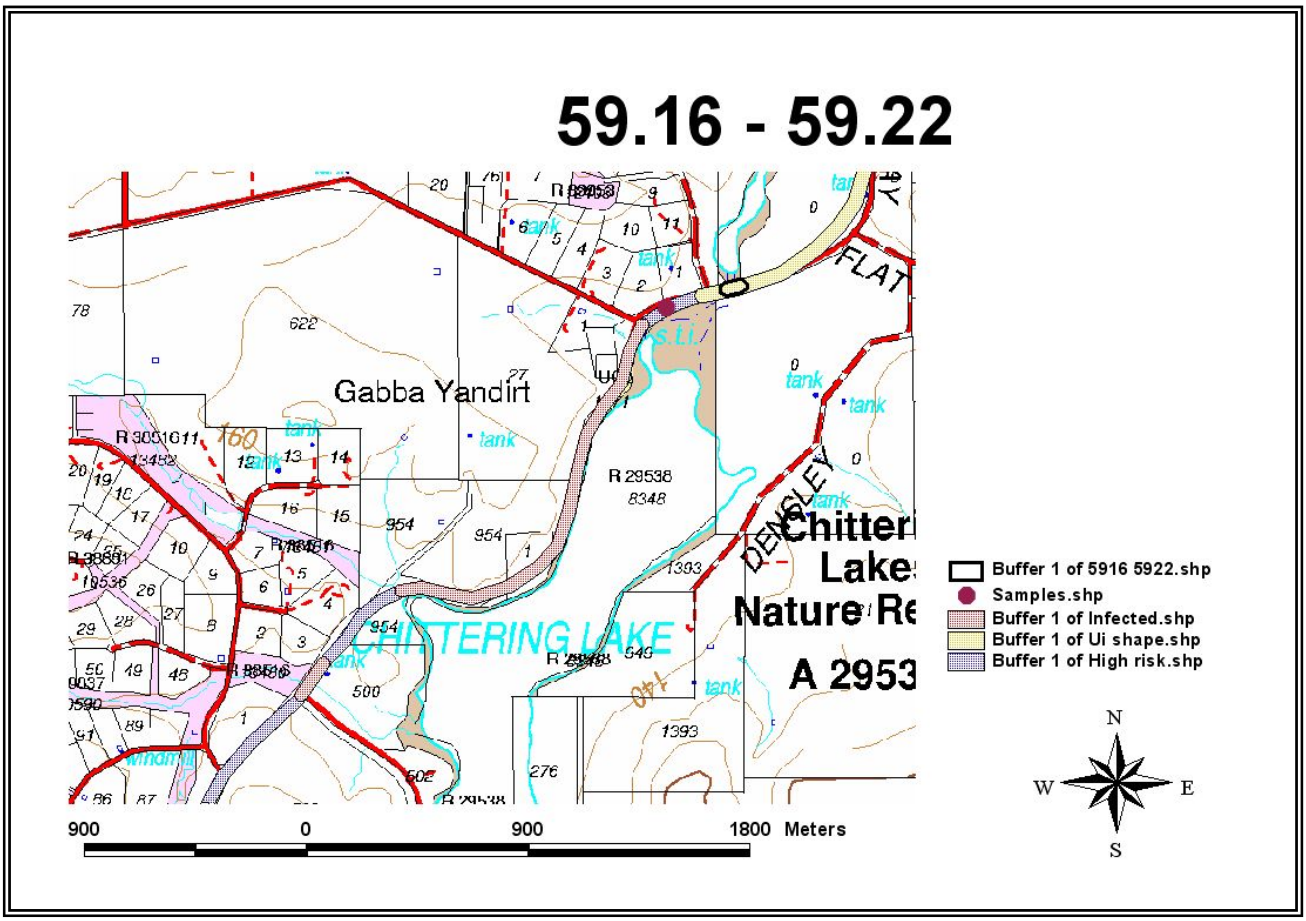
This section should be considered to be affected by the disease caused by *P. cinnamomi.*



GLEVAN CONSULTING

Section 59.16 – 59.22

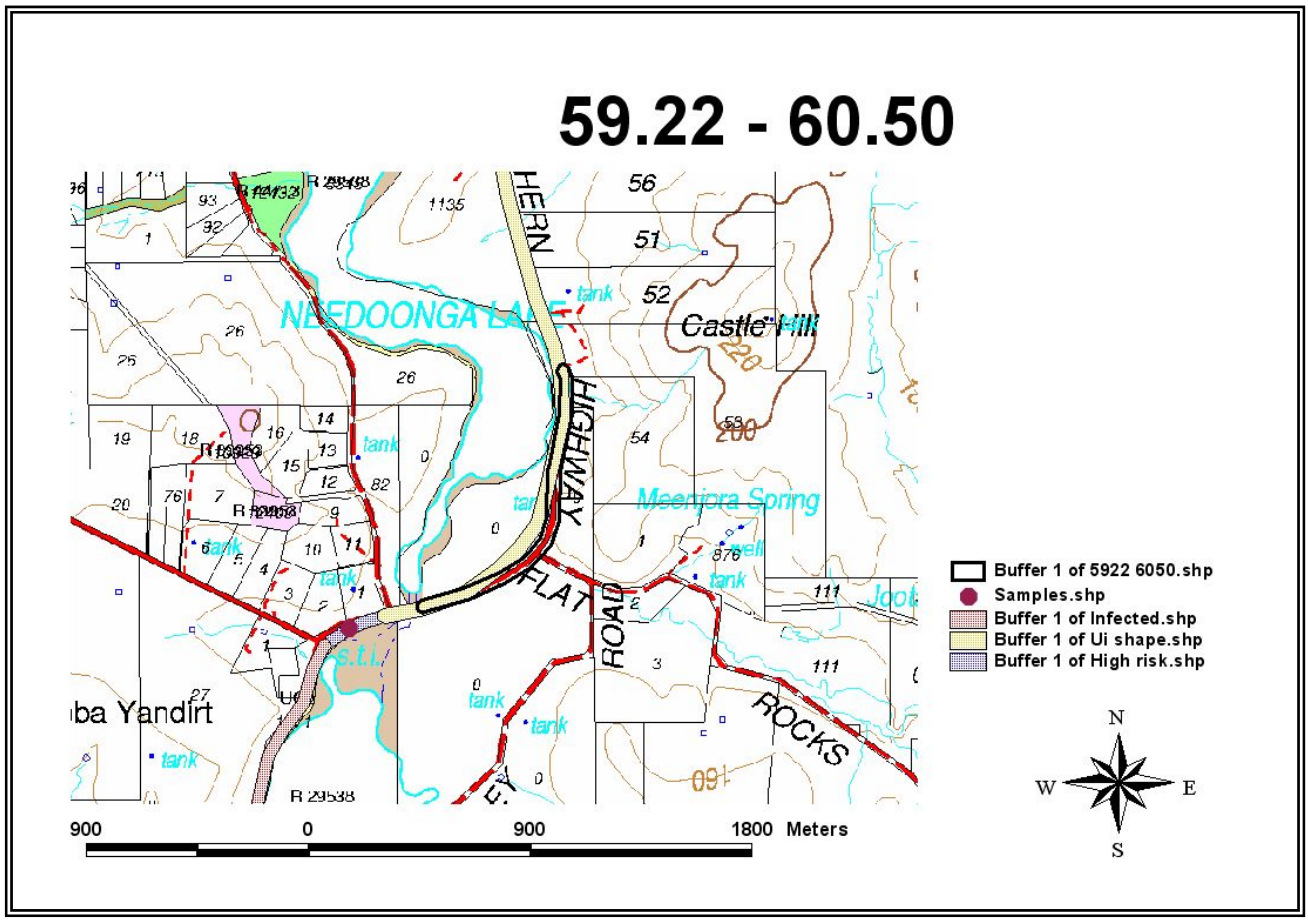
This section does not contain any vegetation that would display the presence of the disease, but should be considered to be at a very high risk of being affected by the disease.



GLEVAN CONSULTING

Section 59.22 – 60.50

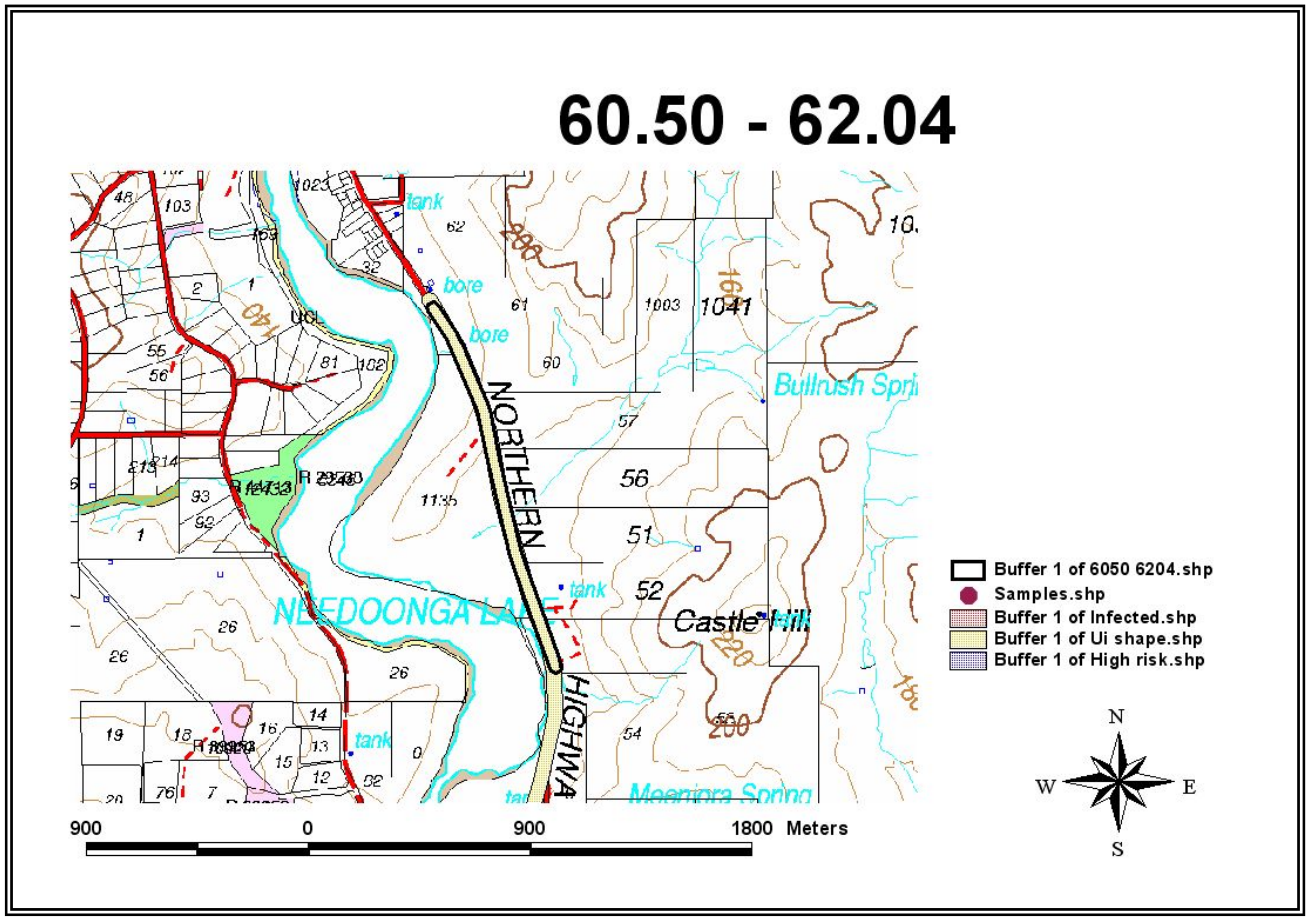
This section contained few indicating species, with only the occasional *Xanthorrhoea* specimen noted. This section is considered to be uninterpretable, however the western side of the alignment would be at a high risk of being affected by the disease.



GLEVAN CONSULTING

Section 60.50 – 62.04

This section contained few indicating species, with only the occasional *Xanthorrhoea* specimen noted. This section is considered to be uninterpretable, however the western side of the alignment would be at a high risk of being affected by the disease.



GLEVAN CONSULTING

Recommendations

The following best management practises have been drawn from Department of Conservation and Land Management, "*Phytophthora cinnamomi* and the disease caused by it Volume 1 Management Guidelines".

While the majority of the management practises have been copied in full, some additions, and some irrelevant sections, have been deleted by the author of this report.

Although it is noted that many of these management guidelines are already in-situ, it is recommended that these practises be implemented into the management plan for the disease on Toodyay Road.

Detection, diagnosis, demarcation and mapping of infested 'protectable' areas

Although the pathogen is now widely distributed throughout the South West Land Division many areas have not yet been infested. The first step in minimising the human assisted spread of the pathogen into the remaining uninfested areas is to conduct a survey using suitably qualified people to identify and demarcated them in the in the field and to record their location on a map.
The survey by trained observers will discriminate between areas that exhibit the visible symptoms of plant disease in native vegetation attributable to the pathogen *Phytophthora. cinnamomi,* from those areas that appear to be free of visual disease symptoms. Confirmation of the presence of the pathogen may often be made by the laboratory analysis of soil samples and root tissue taken from dead and dying plants.

Analysis of the effect on conservation and socio-economic values

The impact of *Phytophthora cinnamomi* upon conservation and socio-economic values is problematic since its effect on the health of plant communities, and upon the species in them, varies greatly. In many places, lethal root-disease destroys the structure of many native communities, reduces their floristic diversity, decimates their primary productivity and destroys habitat for much dependant native fauna, particularly its value as protection against feral predators. In some places the pathogen causes little damage at all. Unfortunately the extent of susceptible communities in vulnerable environments is much greater than that of communities that occur in environments that are inherently unfavourable to the pathogen.

No simple or single relationships exist between the presence of *Phytophthora. cinnamomi* and the development of disease because of:

- The considerable variability which exists within and between native plant species in their responses to the presence of *Phytophthora cinnamomi*; and
- The differential influence of temporal and spatial variation in environmental forces.

Despite this complexity it is evident that within the vulnerable areas a stratagem should be applied that will minimise the human assisted arrival of the pathogen into the remaining large uninfested 'protectable' areas.

Long-term management of uninfested 'protectable' areas – methods and standards

Best practice for the long-term management of uninfested ' protectable' areas will involve on a priority basis:

- Permanently closing and rehabilitating unwanted roads and walk trails within them;
- Controlling the hygienic use of roads and walk trails retained within them; and
- Directing drainage from infested areas away from them.

Permanent road and walk trail closure

When permanently closing a road or walk trail sufficient work must be done to ensure that unauthorised use of the old road does not continue. Ripping of the road surface and covering it with logs, branches and rocks etc .is often necessary. Where the past use of a road has been at high levels, signs warning of the closure should be installed.

Managing the use of roads and walk trails retained within uninfested 'protectable' areas

Temporary closure and the controlled use of roads and walk trails are best affected using a system of gates and signs. Gates must be designed to be highly visible to oncoming vehicles. Signs that provide clear information and guidance to potential users should be installed with all gates. The need for "gate ahead" warning signs to be installed must be evaluated. Vehicles, machines, equipment and in some cases foot-ware must be clean before using roads retained within uninfested 'protectable' areas or the bushland within them.

Managing drainage from infested areas

Water draining from road that are likely to be infested and drainage from known infested areas should be directed away from uninfested 'protectable' areas or taken to the lowest possible point in the landscape before being directed into areas on native vegetation.

Management of activities scheduled within the uninfested 'protectable' areas –methods and standards

Best practice management of activities scheduled within uninfested 'protectable' areas will involve:

- Ensuring, by visual inspection and/or cleaning, that vehicles, plant, equipment, and in some cases foot-ware are clean when entering uninfested 'protectable' areas;
- Minimising (and clearly signposting) the number of entry points into uninfested 'protectable' areas;
- Preventing cross contamination, often by the use of barrier systems, across the boundaries (of infested areas) during works in uninfested areas;
- Allowing only uninfested basic raw materials to be used for earthworks within uninfested 'protectable' areas.

Entry Points into Uninfested 'Protectable' Areas

Where possible only one entry point should be provided into each uninfested 'protectable' area. Entry points into uninfested 'protectable' areas that are effective in minimising the human assisted spread of *Phytophthora cinnamomi* will be characterised as appropriate by:-

- Signage;
- An inspection and/or cleandown point and cleaning equipment;
- A gate; and
- A safe place for large vehicles and equipment to turnaround and exit the area if on inspection are not clean or cannot be effectively cleaned in the field.

The timing of the installation of managed entry points is critical in minimising the probability to introducing the pathogen into uninfested 'protectable' areas. In the case of new roads being built into uninfested areas the entry point should be installed where practicable on the same day as the commencement of the clearing of the road alignment.

Preventing Cross Contamination during Works within Uninfested Areas

Vehicles, machinery, equipment and foot-ware can enter uninfested areas (e.g. nursery sterile areas, gravel pits, mining pods, logging coupes) when they are clean and be used to carry out a range of activities over time within that area without the need for further cleaning provided they do not come into contact with infested soil. Cross contamination can be prevented by:

- The use of barrier systems that ensure that the clean equipment within the uninfested area does not come into direct physical contact with infested soil or unclean equipment operating outside the uninfested area;
- The use of demarcation and barrier systems to ensure that vehicles and equipment do not cross inadvertently into infested areas;
- Ensuring that drainage, soil and plant material from the infested areas does not enter the uninfested areas; and
- Limiting entry to periods when the soil is not moist enough to be picked up and moved by vehicles and equipment.

Uninfested Basic Raw Materials

Accredited personnel are required to assess and certify that basic raw material (BRM) borrow pits are free of the pathogen. Borrow pits can only be certified as being free of the pathogen under the following circumstances :-

- For a new pit that is to be located in undisturbed areas where sufficient indicator plants are available for an assessment to be made or
- For an existing pit that has records confirming that it was originally free of the pathogen, and for which sufficient evident exists that an effective system of hygiene has been maintained to ensure that the pit has remained free of the pathogen.

Existing pits without a known history that can be effectively placed in quarantine and kept free of all living and dead plant material of all species for a period of three years may then have their status reviewed. *Phytophthora cinnamomi* requires plant tissue from which to derive its energy (food source) to survive in the long term. (I.e. the pathogen does not photosynthesise so it cannot survive free in soil in the long term without access to plant tissue.) A three year quarantine period, during which no new plant tissue (living or dead), mycelia, chlamydospores or zoospores are introduced into to pit either autonomous spread or human vectoring, in most cases will allow sufficient time for any previously introduced mycelium, chlamydospores and zoospores to desiccate and die.

Where BRM is being extracted from deep pits, such as mines and quarries, where there is no obvious source of inoculum (e.g. mixing of top-soil and plant material, sub-surface water flow from adjacent infested areas likely to be carrying zoospores or unhygienic entry of vehicle, machine or equipment into the area) this material may also be certified as free of the pathogen.

New road construction into 'protectable' areas

Managing hygiene when building a new road into a 'protectable' area is a critical element in the long-term protection of the area.

Where possible first 50 meters of the new alignment should be left un-cleared until after the remainder of the clearing has been completed. Light vehicle and machine tender vehicle access to the new alignment can be provided with appropriate attention to the hygiene requirements, provision of clean-down facilities and signage. The retained section should be maintained relatively undisturbed for as long as is practicable.

Often it will be necessary for the bull-dozer that clears the alignment to open up the retained section prior to the commencement of the road formation and gravelling works e.g. to allow logs in pushed trees to be cut and removed. The bulldozer should work from inside the 'protectable' area towards the boundary of the infested area.

At the time of opening up the retained section *Phytophthora cinnamomi* information signs need to be set-up and portable traffic control barriers placed across the road at the demarcated boundary of the 'protectable' area. If gravelling operations are to be delayed over substantial periods (e.g. winter) consideration should be given to temporarily blocking the new alignment with several substantial logs.

During the formation of the road the graders should work from inside the 'protectable' area up to the demarcated boundary working infested areas last.

Where possible to simplify the process on being clean on entry gravelling activities should work from the 'protectable' area into the infested area, e.g. especially where the gravel pit is within the 'protectable' area. The installation of permanent gates and signs is to be programmed to coincide with the completion of the surface gravelling activities and the removal of the temporary signs and barriers.

Water binding

Water binding should be kept to a level where run-off into does not occur. The early installation of correctly designed table drains will ensure that un-seasonal rainfall does not flush material from the road building operation across large areas of adjoining land.

Uninfested Nursery Stock

When undertaking rehabilitation works in uninfested 'protectable' areas that involve the supplementary planting of seedlings raised in nurseries it is essential that only uninfested (sterilised soil) planting stock is utilised and that care is taken during seedling transport to ensure that seedling trays do not come in contact with infested soil or plants.

Entry into uninterpretable areas

Areas that are uninterpretable and located higher in the landscape than any adjoining infested areas will be treated as uninfested 'protectable' areas. Unwanted roads between them will be closed and rehabilitated. Vehicles, machines, equipment and in some cases foot-ware must be clean when entering them.

Uninterpretable areas located below infested areas may have entry into them restricted for most activities to periods when vehicles, machines, equipment and in some cases foot-ware will not pick up and move soil (except for road works).

References

CALM (2003) *Phytophthora cinnamomi* and the disease caused by it. Volume 1 – Management guidelines. Department of Conservation and Land Management.

Shearer, B. L. The Problem of Plant Diseases. Department of Conservation and Land Management.

Kilgour, S. (1999) Managing Dieback in Bushland. Dieback Action Group.

Erwin, D. C. and Ribeiro, O. K. (1996) Phytophthora Diseases Worldwide. ABS Press, St Paul, Minnesota.

Appendix D

FAUNA SURVEY

FAUNA ASSESSMENT

GREAT NORTHERN HIGHWAY

BINDOON SOUTH

(SLK 54.8 TO SLK 62.1)

AUGUST 2005

On behalf of:
KELLOGG BROWN & ROOT PTY LTD
(PEN 414)

Prepared by:

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TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

STATEMENT OF LIMITATIONS

Scope of Services

This fauna assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Greg Harewood ("the Author"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, the Author has not verified the accuracy of completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

Environmental Conclusions

In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. The Author assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of the Author or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

1. INTRODUCTION

This report has been prepared in response to an invitation from Kellogg, Brown & Root Pty Ltd (KBR) to carry out a fauna assessment over sections of the Great Northern Highway in the Bindoon South area, specifically SLK 54.8 to SLK 62.1 (Figure 1). As the project passes through the Chittering Lakes Nature Reserve an assessment of sections of this reserve were also conducted.

The objectives of the fauna assessment reported on here were identified by KBR as being:

- Undertake an opportunistic fauna survey within an area bounded by fifty metres of the existing or new road alignment whichever is wider.
- Opportunist fauna and fauna habitat assessment of an area of the Chittering Nature Reserve adjacent to proposed road works
- Consult with CALM regarding threatened fauna habitats in the area;
- Undertake a review of pest, declared or vermin animals;
- Undertake a review of the zoogeographic region as a whole and an assessment of the regional and local conservation status of the roadside fauna;
- An assessment of the value of the roadside in providing habitat and facilitating movement between any conservation areas;

In addition the following were carried out:

- Desktop analysis to determine the fauna composition of the area with specific reference to government listed threatened and priority species.
- Document the impacts on fauna as a result of the proposed works.
- Recommend best practice management techniques to minimise impacts on endemic or protected fauna.

The assessment was carried out with reference to guidance and position statements published by the WA Environmental Protection Authority on fauna surveys and environmental protection (EPA, 2002; EPA 2004), and Commonwealth Biodiversity Legislation (EPBC Act, 1999).

2. METHODOLOGY

2.1 FAUNA HABITAT ASSESSMENT

2.1.1 Great Northern Highway Realignment

All the vegetation communities present along the road alignment were examined (within an area bounded by fifty metres of the existing or new road alignment whichever is wider) on foot and used as the basis for its classification into broad fauna habitats. To maintain consistency the vegetation types identified during the Flora and Vegetation Survey were used as the base for the habitat mapping (Goble-Garratt, 2005). In addition details on specific habitat components such as significant trees with hollows, loose bark, fallen hollow logs, and the amount of leaf litter were recorded.

Specific attention was made to identify the likely habitats of conservation significant vertebrate species potentially occurring in the general area. The aim of this facet of the habitat assessment was to determine if it was likely that any threatened species would be utilising the areas that will be impacted on as a consequence of the proposed works.

The initial phase of the assessment involved the review of available information on the habitats of the threatened species listed as possibly occurring in the area. During the field survey the habitat along the road verge and adjacent areas was examined and specific elements searched for to determine the potential that any of the listed threatened species maybe utilising the area and its significance to them. Habitat information obtained was also used to aid in the compilation of a potential fauna list.

2.1.2 Chittering Lakes Nature Reserve

The fauna habitat assessment was extended to areas of the Chittering Nature Reserve directly adjacent to proposed road works. This additional work was carried out due to the significance of the reserve and its close proximity to the project site. The methodology employed during the assessment was the same as for the road realignment, though existing vegetation mapping was not available for some areas.

Other areas of accessible remnant vegetation surrounding the reserve, but well away from the project site were also examined where possible. Access to most of the perimeter of the lake system is limited due to the presence of private landholdings, and during the wetter months, extensive flooding and so opportunities to gain access to some areas was limited.

2.2 FAUNA INVENTORY

2.2.1 Opportunistic Fauna Surveys

During the course of the habitat mapping non-systematic opportunistic observations of fauna species were made and recorded. Secondary evidence of fauna such as tracks, diggings and scats were also noted. Some active searching was undertaken in specific areas with the aim of locating the more elusive frog and reptile species that may inhabit the site. Invertebrate fauna species were not recorded.

2.2.2 Potential Fauna

A list of all vertebrate fauna potentially occurring within the study area (and including the Chittering Lakes Nature Reserve) was compiled from searches done on the WA Museum Database, the Department of Conservation and Land Managements Threatened Fauna Database (provided by KBR), Department of the Environment and Heritage Departments Commonwealth Environment Protection and Biodiversity Conservation Database, published and unpublished reports and specialist books detailing fauna of the general area. Species observed during field work have also been included. The results of the habitat assessment also provided valuable information on the potential fauna assemblage.

Taxonomy and nomenclature for fauna species used in this report generally follow Allen *et al.* (2003) for fishes, Aplin and Smith (2001) for amphibians and reptiles, How *et al*. (2001) for mammals and Johnstone (2001) for birds. Some names, including common names recommended for national and international use by Christidis and Boles (1994) for birds, are also used. Common names for reptiles and amphibians come from a variety of sources and are not necessarily generally accepted. Sources include Tyler *et al.* (2000) and Glauret (1961).

2.2.3 Fauna of Conservation Significance

The conservation status of fauna species in Western Australia is assessed under the federal *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian Government administered *Wildlife Conservation Act 1950* (WC Act).

Under the EPBC Act threatened fauna may be listed in any one of the following categories as defined in Section 179 of the Act:

- Extinct;
- *Extinct in the wild;
- *Critically endangered;
- *Endangered;
- *Vulnerable; and
- Conservation dependent.

*Only species in those categories marked with an asterix are matters of national environmental significance under the EPBC Act.

The WC Act uses a set of schedules (see Table 1) in addition to utilising the categories defined by the EPBC Act.

Table 1: Western Australian Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct
Schedule 2	S2	Fauna which is presumed extinct
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction
Schedule 4	S4	Fauna that is otherwise in need of special protection

In Western Australia, the Department of Conservation and Land Management (CALM) also produce a supplementary list of priority fauna. The species listed are not considered threatened under the WC Act, but due to lack of knowledge or where species are poorly represented in secure conservation reserves some concern for there long term survival exists. The five classifications levels are shown in Table 2.

Table 2: CALM Priority Fauna Categories

Category	Code	Description
Priority 1	P1	Taxa with few, poorly know populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring (Not currently threatened or in need of special protection, but could be if present circumstances change)
Priority 5	P5	Taxa in need of monitoring (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 EPBC Act also requires the compilation of a list of migratory species that are recognized under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals). Species listed under JAMBA are also protected under Schedule 3 of the WC Act.

The conservation status of all the vertebrate fauna species listed as occurring or possibly occurring in the vicinity of the study area have been assessed using the most recent lists published in accordance with the above-mentioned Acts and CALM's priority fauna list.

It should be noted that there are discrepancies between the Western Australian and Commonwealth threatened species lists. In an attempt to address this issue CALM and the Commonwealth Department of Environment and Heritage (DEH) have initiated an "alignment of lists" project where CALM provides advice on threatened species to the DEH so specific species can be assessed under the EPBC Act and the DEH database updated. This project is still in progress and subsequent changes in the DEH database may result in variations to the listings and classifications used for the Bindoon South project reported on here.

2.2.4 Other Species of Significance

A number of other species not listed in official lists can also be considered of conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range. While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of bird species have been listed as of significance on the

Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998 and 2000). The bird species are often referred to as Bush Forever Decreaser Species. The two categories used for birds within the Bush Forever documents are:

- Habitat specialists with reduced distribution on the Swan Coastal Plain (code Bh)
- Wide ranging Species with reduced population's on the Swan Coastal Plain. (code Bp)

Some species listed as not common in the Perth region are still commonly seen in areas of the Darling Range as development has not, as yet, been as extensive and intensive. The species listed should, however still be taken into consideration to ensure actions are taken that will aid in their continued existence in the region. Bush forever decreaser species are indicated within the species list.

2.3 REVIEW OF PEST, DECLARED OR VERMIN ANIMALS

A review of pest, declared or vermin animals likely to be present at the site and in surrounding areas was compiled from searches done on the Agriculture Department declared vertebrate fauna lists, published and unpublished reports and specialist books detailing fauna of the general area.

2.4 ZOOGEOGRAPHICAL REGION: REGIONAL AND LOCAL CONSERVATION SIGNIFICANCE AND STATUS OF THE ROADSIDE FAUNA

The vertebrate fauna of Western Australia can be broadly classified as having affinities to one of three biogeographical zones that have been defined across the continent. These are the Torresian (Northern), Eyrean (Central) and Bassian (Southern) divisions. The Interim Biogeographical Regionalisation for Australia (IBRA, Thackway & Cresswell, 1995) has taken a more detailed approach and categorises the Australian continent into 85 regions of similar geology, landforms, vegetation, fauna and climate.

These biogeographical patterns of fauna distribution have arisen due to interactions between fauna species and communities and the components of their environment over time. The zoogeographical status of the Bindoon South area has been assessed by reference to IBRN data.

2.4.1 Regional Significance

The regional significance of the study area has been determined by the degree of representation of species and habitats at a biogeographical regional level (using IBRN classifications).

2.4.2 Local Significance

The local significance of the study area has been determined by applying site specific criteria such as:

- Fauna species and/or habitat present that is poorly represented in the general study area;
- Fauna habitat within the general study area supporting species of conservation or other significance;
- Fauna habitat in better condition than other similar locations in general study area.

2.5 VALUE OF THE ROAD SIDE VEGETATION AS HABITAT AND AS A WILDLIFE CORRIDOR

Corridors of native vegetation can be very important for the dispersal of species in otherwise cleared landscapes. In some areas road reserves represent the only remaining remnant vegetation. As a consequence these areas have great value in linking other patches of remnant vegetation and allow the dispersal of species that cannot utilise cleared land.

During the field survey and by examination of plans and air photos of the Bindoon area, the value of the site as habitat and as a corridor allowing movement between any conservation areas present was assessed.

3. LIMITATIONS OF THE STUDY

The fauna assessment has been limited to a desktop analysis aimed at providing a list of expected species and a site visit aimed at general habitat assessment targeting listed threatened species. Opportunistic observations at the site, made during a four day period, have been included but no fauna trapping or seasonal sampling has been conducted.

In recognition of these survey limitations a precautionary approach has been adopted for this assessment. Any species that would potentially occur within the study area as identified through ecological databases, publications and the habitat knowledge of the Author has been assumed to potentially occur in the study area. The discussion of potential impacts and mitigation measures also reflect this precautionary approach.

4. RESULTS

4.1 FAUNA HABITAT ASSESSMENT

A site survey and habitat assessment was conducted on foot over the length of the project area and sections of the Chittering Lakes Nature Reserve between the 3rd and 6th of August 2005 by Greg Harewood.

All the vegetation communities present along the road alignment were examined on foot and used as the basis for its classification into broad fauna habitats. To maintain consistency the vegetation types identified during the Flora and Vegetation Survey were used as the base for the habitat mapping (Goble-Garratt, 2005). In addition details on specific habitat components such as significant trees with hollows, loose bark, fallen hollow logs, and the amount of leaf litter were recorded

4.1.1 Habitats within the Bindoon South Study Area

The distributions of habitats within the study area are shown in Figures 2 to 4, and a description of each is given below. Overall the remnant vegetation within the works footprint has either been totally cleared or is degraded to some extent. Habitat elements such as large logs, dense groundcover and understorey are largely absent. The most significant elements still present included trees (dead and alive) containing hollows (some suitable for Carnaby's Cockatoo) and the wetland habitats with associated dense fringing vegetation (in some cases dominated by weeds). The wetland habits included The Brockman and unnamed steams that pass under the GNH and small sections of Lake Needoonga that appear to extend into the works footprint area

1. **Cleared Pasture:** Cleared farmland with a mixture of introduced pasture grasses, clovers, weeds and degraded sedgelands. Some areas of the cleared pasture are inundated during winter and provide foraging habitat for waterbird species and breeding grounds for frogs. No tree hollows, logs or understorey are present.

2. **Scattered Trees in Cleared pasture:** Scattered trees of various species (principally the Eucalypt species, Marri *Corymbia calophylla* and *Melaleuca* sp.). While scattered and limited in number, the remaining trees provide roosting, foraging and breeding opportunities for fauna.

2. **Watercourses (Including Dams/Soaks) –** A number of water courses are present within and adjacent to the study area and all ultimately flow into the Lake Chittering Reserve. The majority have small catchments and were dry at the time of the field work with water flow only occurring for short periods of time after significant rainfall events. A large percentage fall within cleared pasture and did not have any significant fringing vegetation. Those with fringing vegetation generally pass through areas of Flooded Gum and/or Melaleuca.

One of the most significant water courses (besides the Brockman River, Lake Chittering and Lake Needoonga) is a small creek located within the southern section of the project area. The creek appears to originate within the Burroloo Nature Reserve and then parallels the GNH on its western side for about 1.5km (see Figure x). The creek line is characterised by fringing Melaleuca, Flooded Gum and areas of dense sedges and *Typha* sp. Dams have been built at a number of locations along its length providing areas of deeper open water. This and other creek lines provide refuge and foraging opportunities for a variety of fauna species.

3. **Open Woodland - Wandoo (*Eucalyptus wandoo*) and/or Marri (*Corymbia calophylla)*:** Wandoo is the most common eucalypt species within the study area. The species is confined to the drier upper slopes where it is often found in association with the Marri. The amount of grown cover, understorey and leaf litter varies considerably from area to area and ranges from non-existent to dense. Significant sized fallen logs are very rare. Hollows are relatively common, particularly with the Wandoo. Marri also provides an important food source for Carnaby's Cockatoo in the area. Where present some understorey species also provide a food source for the Carnaby's Cockatoo and a number of other fauna species. Important understorey species present, typically under Wandoo, included *Dryandra sessilis*, *Hakea undulata* and *Hakea prostrata.* Banksia species are also present in some areas.

4. **Open Woodland - Flooded Gum (*Eucalyptus marginata*):** Flooded gums are typically found in the lower lying areas and form a fringe around watercourses and areas subject to inundation. Melaleuca species replace the Flooded Gum in areas subject to more lengthy periods of inundation. As with other areas of the study site the amount of grown cover, understorey and leaf litter varies considerably from area to area and ranges from non-existent to dense. The most common ground cover observed was the introduced *Watsonia meriana* subsp. *bulbillifera* and a variety of unknown grass species. *Watsonia* is particularly prevalent within the Chittering Nature Reserve abutting the GNH between SLK 57.0 and 59.0. Despite its weed status the dense ground cover provides potential habitat for some fauna species that require refuge from predators and evidence of Quenda's (*Isoodon obesulus fusciventer*) were found in this area. Hollows within the Flooded Gums were not common but a number were observed and a cockatoo nest hollow has been identified in one specimen (Johnstone and Kirkby, 2005)(See Figures 2 to 4). In some areas where the density of Flooded Gums is higher it should be classified as a Woodland or Closed Woodland.

5. **Woodland – Swamp Paperbark (*Melaleuca rhaphiophylla*):** Within the study area the Swamp Paperbark forms a dense fringe on both sides of the Brockman River and also along the edges of some of the smaller water courses that come in close proximity to or pass under the GNH. It is also present where sections of Lake Needoonga and Lake Chittering are immediately adjacent to or within the

study site. This Melaleuca species favours areas that are normally inundated for significant periods. The vegetation provides important roosting and refuge habitat for waterbirds, owls and raptors. In the more dense occurrences of Swamp Paperbark it could be classified as a Closed Woodland/Forest.

6. **Woodland of Swamp Sheoak (*Casuarina obesa*):** Areas of vegetation dominated by Swamp Sheoak are rare within the study site and it is more commonly found as a mid-storey species in the open woodland habits discussed above.

4.1.2 Habitats within the Chittering Lakes Nature Reserve

Information on the habitats present within the Chittering Lakes Nature Reserve was obtained during the reconnaissance survey conducted between the 3rd and 6th of August 2005, from consultation with CALM personnel and from published information on the area. Published material is principally sourced from CALM and includes Halse *et al* (1993) and Jaensch and Lane (1993).

Lake Needoonga and Chittering Lake, which together constitute the Chittering Lakes Nature Reserve, are two connected, sinuous lakes contained with the Chittering Valley. The lakes are permanent and brackish, though sometimes drying to weakly saline pools. The lakes are principally supplied by inflow from the Brockman River. The river enters Lake Needoonga at its northern end and leaves the system at the southern end of Lake Chittering. Various unnamed creeks also contribute water to the system from the surrounding hills. The lakes range in depth from about 0.5m in autumn to 1.5m in spring.

Outflow from the lakes system is artificially controlled using a levee and sluice gate at the southern end of Lake Chittering, principally to control winter flooding of pastures downstream. In the wet season (late autumn) the first, more saline flow of water is allowed to pass out of the lake system. Thereafter the flow is controlled to minimise flooding of pasture in the valley below. The gate is closed in early spring to maximise the water depth through spring and summer. At present water levels are managed to optimise opportunities for waterbirds to use the lakes in the dry season. Inflow to the system is increasingly saline. Siltation of the lakes has occurred as a consequence of clearing within the catchment (CALM, 2003).

1. **Open Water:** A large percentage of the reserve is made up of open water which and, in particular, provides a valuable habitat for a wide range of waterbird species. Open water habitat is more expansive in Chittering Lake.

2. **Closed Forest - Woodland – Swamp Paperbark (*Melaleuca rhaphiophylla*):** At Lake Chittering the Swamp Paperbark forms a dense fringe almost completely surrounding the central open water area. There are also some isolated “islands” of Melaleuca within the areas of open water. The majority of Lake Needoonga is vegetated and in part forms a closed paperbark swamp.

The vegetation provides important roosting and refuge habitat for waterbirds, owls and raptors.

3. **Open Woodland - Flooded Gum (*Eucalyptus marginata*):** Flooded gums form a fringe on slightly higher ground surrounding the inundated areas. The trees provide roosting opportunities and hollows for a variety of fauna species. Sections of the Flooded Gum woodland has a dense ground cover of introduced weeds, principally *Watsonia meriana* subsp. *bulbillifera* and/or a variety of unknown grass species. As mentioned in the previous section the dense ground cover provides potential habitat for some fauna species that require refuge from predators and evidence of Quenda's (*Isoodon obesulus fusciventer*) were found in this section of the nature reserve (see Figures 2 to 4). In some areas where the density of Flooded Gums is higher it should be classified as a Woodland or Closed Woodland. Marri is found in association with Flooded Gum in some of the higher upslope areas.

4. **Open Woodland - Wandoo (*Eucalyptus wandoo*) and/or Marri (*Corymbia calophylla)*:** As these species are confined to the drier upper slopes their distribution within the nature reserve appears to be limited to small sections adjacent to GNH SLK 57.00 to 59.00 with some overlap with areas investigated as part of the main study. The amount of grown cover, understorey and leaf litter varies considerably from area to area and ranges from non-existent to dense. Significant sized fallen logs are very rare. Hollows are relatively common, particularly with the Wandoo. Significant understorey species include *Dryandra sessilis*, *Hakea undulata, Hakea prostrata and Banksia* sp.

5. **Closed Woodland of Swamp Sheoak (*Casuarina obesa*):** Areas of vegetation dominated by Swamp Sheoak are very prevalent within central and northern sections of Lake Needoonga.

4.2 FAUNA INVENTORY

4.2.1 Opportunistic Fauna Surveys

During the course of the site survey and habitat assessment opportunistic fauna observations were carried out. Total time during which opportunistic observations were made within the study area over the 4 day period were:

Wednesday 3rd August 2005: 3 hours - 2:30pm to 5:30pm – General reconnaissance of study area + SLK 61 to 62.

Thursday 4th August 2005: 10 hours – 7:30 am to 5:30pm – Approx. SLK 57 to 61 + sections of Chittering Lakes NR.

Friday 5th August 2005: 10 hours – 7:30 am to 5:30pm – Aprox SLK 54 to 57 + small section of Burroloo Well NR + sections of Chittering Lakes NR.

Saturday 7th August 2005: 7 hours – 7:30 am to 2:30pm – Sections of Chittering Lakes NR.

The results of the opportunistic fauna survey are shown in Appendix A and discussed in the following sections.

4.2.2 Potential Fauna

Table 3 summarises the numbers of potential species based on vertebrate class. A complete list of vertebrate fauna possibly inhabiting or frequently the study areas is held in Appendix A.

Details on specially protected and priority species expected and/or listed as potentially occurring in the general area are given in the section 4.2.3.

The species listed as potentially occurring are likely to represent an over estimation of the diversity of fauna present, particularly in areas of degraded habit within the Bindoon South project. The list reflects a broad range of potential species – more detailed investigations would be required to ascertain which species area actually present and their particular degree of habitat utilisation. A number of species, in particular mobile birds species may only visit the study area infrequently as they move to other more suitable nearby areas.

Table 3: Summary of Potential Fauna Species (As listed in Appendix A)

Group	Total number of potential species		Number of specially protected species		Number of Priority/Migratory Species		Number of species observed (August 2005)	
	Bindoon South	Chittering Lakes	Bindoon South	Chittering Lakes	Bindoon South	Chittering Lakes	Bindoon South	Chittering Lakes
Fish	6	6	0	0	0	0	1	1
Amphibians	14	14	0	0	0	0	5	4
Reptiles	52	52	2	2	2	2	0	1
Birds	136[A]	143[A]	2	3	7	8	38[B]	40[B]
Mammals	30[C]	28[D]	1	1	4	4	5[A]	2

Note: some species fall into more than one category of protection, A= includes three introduced species B= includes one introduced species, C = includes seven introduced species, D = includes five introduced species

4.2.3 Fauna of Conservation Significance

A search of EPBC Act's Threatened Fauna list, CALM's Threatened Fauna Database and Priority List and relevant specialist publications identified 22 specially protected, priority or migratory fauna species as potentially occurring in the general study area. Some species have been omitted from the actual list of potential species (as listed in Appendix A) due to lack of suitable habitat in study area or if the study area is outside of their accepted range. A brief account of these species with details on their distribution and habitat preferences are given below.

A Trap Door Spider – *Arbaniris inornatus*

Status and Distribution: *Arbanitis inornatus* is listed as Priority 1 by CALM. The species is found in forested areas of the south west of Western Australia.

Habitat: Typically found in Jarrah (*Eucalyptus marginata)* and Marri (*E. calophylla*) dominated forests.

Likely presence in study area: The species documented preference for jarrah/marri suggests it would not be utilising the majority of the study area, which is mostly cleared or dominated by other tree species though some small areas of woodland dominated by Marri are present.

Woma *Aspidites ramsayi*

Status and Distribution: The south western population is classified as Priority 1 by CALM. Overall known from four potentially disjunct populations - Southwestern: Yuna, Wialki & Menzies south to Boddington; Narembeen & Marvel Loch and E to western edge of Nullarbor Plain. Peron Peninsula. Arid northwestern: of Eighty-Mile Beach, west to Mundabullangana. Central: Tanami Desert in WA & arid E Australia. Womas were formally abundant in southwestern sandplain habitats, but the few recent records come from widely scattered localities in the wheatbelt and are old adults (Storr *et al*, 2002).

Habitat: Most sightings suggest a close association with banksia on deep sand where rabbit warrens occur (Pearson, 1993). Cogger (1975) states "A nocturnal, terrestrial snake which shelters in hollow logs, animal burrows or thick herbage during the day. Feeds on small mammals, ground birds and reptiles".

Likely presence in study area: The majority of the study area would be unsuitable for this species due to the lack of suitable habitat (logs, thick bush, sand, burrows) and food source. Greatest potential would be in the densely vegetated areas within the bounds of the Chittering Nature Reserve, areas that will be largely unaffected by the proposed road works.

Southern Carpet Python *Morelia spilota impricata*

Status and Distribution: The south western population is classified as Priority 4 by CALM and is also listed in Schedule 4 under the *WC Act (1950)*. This sub species has wide distribution within the south west but is uncommon. Occurs north to Geraldton and Yalgoo and east to Pinjin, Kalgoorlie, Fraser Range and Eyre (Storr *et al*, 2002).

Habitat: This species has been recorded from semi-arid coastal and inland habitats, Banksia woodland, Eucalypt woodlands, and grasslands. It commonly utilises hollow logs for shelter.

Likely presence in study area: The majority of the study area would be unsuitable for this species due to the lack of suitable habitat and food source. As with the Woma the greatest potential would be in the more densely vegetated areas. There are no recent W.A. Museum or CALM records from the immediate vicinity.

Great Egret *Ardea alba*

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. The Great Egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe, 2003).

Habitat: Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe, 2003).

Likely presence in study area: Sighted on one occasion during the field survey utilising shallow flooded melaleuca woodland in the vicinity of SLK 61. The Chittering Lakes Nature Reserve supports the second largest breeding colony of the Great Egret in Western Australia (Jaensch *et al*, 1993 and WRC 2003).

Cattle Egret *Ardea ibis*

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act 1999* and under international agreements to which Australia is a signatory. The Cattle Egret is common in the north sections of its range but is an irregular visitor to the better watered parts of the state (Johnstone and Storr 1998). The population is expanding (Morcombe, 2003).

Habitat: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe, 2003).

Likely presence in study area: Potentially an infrequent visitor to the general area. This species was not recorded in the project area during the most recent Birds Australia Atlas survey (Barrett, 2003) and there are also no W.A. Museum records in the region.

Australasian Bittern *Botaurus poiciloptilus*

Status and Distribution: Classified as Schedule 1 under the *WC Act (1950*) and as Vulnerable under the *EPBC Act (1999)*. The species is uncommon to rare (Morcombe, 2003), but locally common in wetter parts of south west (Johnstone and Storr 1998). Occurs north to Moora and east to Mt arid (Johnstone and Storr 1998).

Habitat: Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe 2003) such as beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps (Johnstone and Storr 1998).

Likely presence in study area: Some small sections of the Chittering Lakes Nature Reserve may be suitable for this species. Very little suitable habitat occurs in the proposed works footprint. This species is extremely difficult to observe due to its preferred habitat. There appears to be no recent W.A. Museum, CALM or Birds Australia records of this species from the area.

Little Bittern *Ixobrychus minutus*

Status and Distribution: Listed as Priority 4 by CALM. Occurs north to Moora and east to Two Peoples Bay (Johnstone and Storr 1998). It is unknown whether this species is a resident in the south west or mainly a spring–summer visitor. It is

locally common in wetter parts of south west but generally uncommon and rarely reported (Johnstone and Storr 1998).

Habitat: Beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps around lakes and along rivers (Johnstone and Storr 1998).

Likely presence in study area: Some small sections of the Chittering Lakes Nature Reserve and some of the small vegetated creeks may be suitable for this species. This species is difficult to observe due to its preferred habitat. There are no recent records of this species from the area.

Peregrine Falcon *Falco perigrinus*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act 1950*. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).

Habitat: Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe, 2003). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.

Likely presence in study area: The species potentially utilises some sections of the study area as part of a much larger home range.

White-bellied Sea Eagle *Haliaeetus leucogaster*

Status and Distribution: This species is listed as migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. White-bellied sea eagles are common in coastal and near coastal areas of Australia and are also found in New Guinea, Indonesia, China, southeast Asia and India.

Habitat: They nest and forage mainly near the coast but will also live near large rivers and lakes inland, often moving on a seasonal basis. White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession.

Likely presence in study area: The EPBC Act database states that species or species habitat is likely to occur in the area but based on existing records (Johnstone and Storr 1998 and Barrett, G. *et al* 2003) the project area is outside its normal range.

Common Sandpiper *Tringa hypoleucos*

Status and Distribution: This species is listed as migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. Visitor (all months, mostly September to March). Rare to moderately common (Johnstone and Storr 1998).

Habitat: Edge of sheltered waters salt or fresh, eg estuaries, mangrove creeks, rocky coasts, near coastal salt lakes, river pools, lagoons, claypans, drying swamps, flood waters, dams and sewerage ponds. Preferring situations where low perches are available (Johnstone and Storr 1998).

Likely presence in study area: The species potentially utilises some sections of the wetland habits within the study area, particularly when waters recede in summer and shoreline is exposed.

Bush Stone Curlew *Burhinus grallarius*

Status and Distribution: Listed as Priority 4 by CALM. Occurs over much of the western half of the state (and Kimberley) but rare to uncommon in the south of its range due to fox predation (Johnstone and Storr 1998).

Habitat: Lightly wooded country (including partly cleared forests) near daytime shelter e.g. thickets or long grass (Johnstone and Storr 1998).

Likely presence in study area: Potentially an occasional visitor to the general area.

Carnaby's Black- Cockatoo *Calyptorhynchus latirostris*

Status and Distribution: Carnaby's Black Cockatoo is listed as Scheduled 1 under the *WC Act (1950)* and as Endangered under the *EPBC Act (1999)*. Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Habitat: Forests, woodlands, heathlands, farms; feeds on banksia, hakeas, dryandras and Marri. Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2003).

Likely presence in study area: This species is know to feed and breed with the project area and as a consequence has been the subject of several detailed surveys (Johnstone and Kirkby, 2005). Most significantly five nest sites and a number of

feeding areas for Carnaby's Cockatoo were located within the works footprint or immediately adjacent during these surveys (see Figures 2 to 4).

Baudin's Black- Cockatoo *Calyptorhynchus baudinii*

Status and Distribution: Listed as Scheduled 1 under the *WC Act (1950)* and as Endangered under the *EPBC Act (1999)*. Confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury. (Johnstone and Storr 1998).

Habitat: Mainly eucalypt forests where it feeds primarily on the Marri seeds, (Morcombe, 2003) banksia, hakeas and *Erodium* sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr 1998).

Likely presence in study area: EPBC Act database states that species or species habitat is likely to occur in the area but based on existing records (Johnstone and Storr 1998 and Barrett, G. *et al* 2003) the project area is outside its normal range.

Fork-tailed Swift *Apus pacificus*

Status and Distribution: The Fork-tailed Swift is listed as migratory under the *EPBC Act 1999* and under international agreements to which Australia is a signatory. It is a summer migrant (Oct-Apr) to Australia (Morcombe, 2003).

Habitat: Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe, 2003).

Likely presence in study area: It is potentially to be an occasional summer visitor to the study area but is entirely aerial and largely independent of terrestrial habitats.

Rainbow Bee-eater *Merops ornatus*

Status and Distribution: This species is listed as migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. The Rainbow Bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe, 2003).

Habitat: Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe, 2003). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.

Likely presence in study area: A potential visitor to the general area. It is unlikely to breed in the study are due to the lack of suitable ground.

Hooded Plover *Charadrius rubricollis*

Status and Distribution: Listed as Priority 4 by CALM. Southern Coasts and saltlakes north to Port Gregory, Three Springs, Mt Gibson, Lake Brown, lake Barlee, Lake Cowan and Eyre (Johnstone and Storr 1998).

Habitat: Margins and shallows of saltlakes, sandy and seaweedy beaches and estuaries, also dams (Johnstone and Storr 1998).

Likely presence in study area: While the area falls within this species range its preference for salt lakes and beaches means that it is an unlikely visitor to the study area.

Crested Shrike Tit *Falcunculus frontatus leucogaster*

Status and Distribution: Listed as Priority 4 by CALM. Occurs mainly in southern subhumid and semiarid interior from Moora, Kodj Kodjin, Narembeen, Bank Rock and Newman Rock, south to Pemberton, Lake Muir, Porongurup Range, lower Fitzgerald River, Forrestania, Maggie Hays Hill and Little Jam Hill and west to Julimar, Christmas Tree Well, Mt Saddelback and Boyup Brook (Johnstone and Storr 1998).

Habitat: Woodlands, scrubs and more open forest of Eucalypts, including Wandoo, (Johnstone and Storr 1998).

Likely presence in study area: Recorded in the nearby Julimar State Forest area (WRC, 2003) and therefore must be considered potential visitor or inhabitant of study site as suitable habitat (Wandoo) exists.

Chuditch *Dasyurus geoffroii*

Status and Distribution: Listed as Scheduled 1 under the WC Act (1950) and as Vulnerable under the EPBC Act (1999). Formerly occurred over nearly 70 per cent of Australia. The Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of southwest Western Australia. Also occurs in very low numbers in the Midwest, Wheatbelt and South Coast Regions with records from Moora to the north, Yellowdine to the east and south to Hopetoun. Chuditch have been translocated to Julimar State Forest east of Bindoon (1992), Lake Magenta Nature Reserve (1996), Cape Arid National Park (1997), Mt Lindsay National Park (1999), and Kalbarri National Park (2000). A known population also exists in the Bindoon Defence Training Area, 20 Kilometres north east of the study site.

Habitat: Chuditch are known to have occupied a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts.

Riparian vegetation appears to support higher densities of Chuditch, possibly because food supply is better or more reliable and better cover is offered by dense vegetation. Chuditch appear to utilise native vegetation long road sides in the wheatbelt (CALM, 1994). The estimated home range of a male Chuditch is over 15 km^2 whilst that for females is 3-4 km^2 (Sorena and Soderquist, 1995).

Likely presence in study area: As known populations exist within 20 kilometres of the site the potential exists for the species to utilise sections of the project area at times. A scat (dropping) located during the survey within the bounds of the Chittering Nature Reserve amongst relatively dense riparian vegetation, near GNH SLK 58, was potentially that of a Chuditch (see Figure 3). A burrow located nearby could also be that of this species (no Rabbits or Rabbit droppings were observed at anytime during survey). The same area appears to support a significant population of Quenda, a suitable food source for Chuditch.

Southern Brush-tailed Phascogale *Phascogale tapoatafa tapoatafa*

Status and Distribution: Listed as Priority 4 by CALM. Present range is believed to have been reduced to approximately 50 per cent of its former range. Now known from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern Jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (CALM information pamphlet). Records are less common from wetter forests.

Habitat: This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites. The home range for a female Brush-tailed Phascogale is estimated at between 20 and 70 ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number (approximately 20) of different nest sites throughout their range (Soderquist, 1995).

Likely presence in study area: Potentially uses some areas at times as part of a larger home range. Most likely to be found in the southern section of the study site where vegetation is more continuous with larger tract of remnant bush.

Quenda *Isoodon obesulus fusciventer*

Status and Distribution: Listed as Priority 5 by CALM. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (CALM information pamphlet) and most recently Nambung National Park (CALM pers. coms.)

Habitat: Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quendas will thrive in more open habitat subject to exotic predator control (CALM information pamphlet).

Likely presence in study area: Evidence of this species was found near the study area and within the Chittering Lakes Nature Reserve (See Figure 2 to 4). It appears (based on the density of diggings found) to be most abundant in dense vegetation within Flooded Gum woodland surrounding Lake Chittering. Evidence within the existing road reserve was limited to a few diggings just outside the southern end of the project site.

Brush Wallaby *Macropus irma*

Status and Distribution: Listed as Priority 4 by CALM. The Western Brush Wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. A known population exists in the Bindoon Defence Training Area, 20 Kilometres north east of the study site (Govt Gazette No, S424, 2004).

Habitat: The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (CALM information pamphlet).

Likely presence in study area: As known populations exist within 20 kilometres of the site the potential exists for the species to utilise sections of the project area at times. However, because of the general narrowness and fragmented nature of the vegetation along the road reserve it unlikely that the species would persist in the study site for any significant length of time and is likely to favour larger, mor continuous tracts of woodland, in reserves and private property.

Water Rat *Hydromys chrysogaster*

Status and Distribution: Listed as Priority 4 by CALM. The water rat is widely distributed around Australia and its offshore islands, New Guinea and some adjacent islands. It occurs in fresh brackish water habitats in the south-west of Western Australia, but occurs in marine environments along the Pilbara coastline and offshore islands.

Habitat: The water rat occupies habitat in the vicinity of permanent water, fresh, brackish or marine.

Likely presence in study area: Potential inhabitant of the Chittering Lakes Nature reserve and individuals may move along the vegetated creeklines and seasonally inundated areas that are present in the project site

4.2.4 Other Species of Significance

Thirty nine bush forever decreaser species potentially utilises the general area and nine were sited during the survey, either within the project area or Chittering lakes Nature Reserve. Other species that can be considered of significance are several waterbird species that are know to breed within Chittering Lakes Nature Reserve. At least 21 waterbird species are know to breed within the reserve (Jaensch *et al* 1993).

4.3 REVIEW OF PEST, DECLARED OR VERMIN ANIMALS

Introduced and native birds and animals can cause problems to agriculture and the environment or social problems to the community. For these reasons they are considered vertebrate animal pests. There are already a number of such pests in Western Australia causing damage.

The Department of Agriculture is responsible for putting in place controls that aim to minimise the effect of vertebrate pests on Western Australia. Activities include preventing the entry of new pest species to the State, removing small populations of pests found here, minimising the impact of widespread pests, and raising awareness of the problems of and solutions for pest vertebrates.

Vertebrates that have a negative impact on agricultural production and the environment are declared as pests according to management categories in the declared animals list compiled by the Department of Agriculture. Any exotic vertebrate not included on this list is prohibited in Western Australia. It should be noted that a number of native species (e.g. Baudin's Black Cockatoo) are declared pests in certain agricultural areas. Native species are subject to management programs as opposed to, for example, eradication programs aimed at exotic introduced pest species.

Because the study area is small in size it is unlikely to be harbouring significant populations of any declared pest or vermin species and the proposed works will not result in any significant change it the status of these species in the general area.

Based on the field reconnaissance and upon reference to relevant publications the following table has been compiled and lists the introduced pest, declared or vermin animal species likely to inhabit or visit the study site on a regular basis. Native declared animals are not included.

Table 4: Introduced Declared Pest and Vermin Fauna in Study Area

Scientific Name	Common Name
MURIDAE	
Rattus rattus	Black Rat
Mus musculus	House Mouse
CANIDAE	
Vulpes vulpes	Red Fox
FELIDIAE	
Felis catus	Feral Cat
LEPORIDAE	
Oryctolagus cuniculus	Rabbit

4.4 ZOOGEOGRAPHICAL REGION: REGIONAL AND LOCAL CONSERVATION SIGNIFICANCE AND STATUS OF THE ROADSIDE FAUNA

The Interim Biogeographical Regionalisation for Australia (IBRA, Ver 5.1) recognises 85 bioregions. The IBRA is used as the common unit to compare biological and biophysical attributes. Bioregions represent a landscape based approach to classifying the land surface and each region is defined by a set of major environmental influences which shape the occurrence of flora and fauna and their interaction with the physical environment. Such attributes are; climate, lithology/geology, landform, vegetation, flora and fauna, and landuse.

The general study area around Bindoon South is likely to contain a strong Bassian element with species present being adapted to regular winter rainfall patterns with cool temperatures and infrequent summer droughts typical of South Western Australia. The project area is situated on the extreme northern margin of the Jarrah forest bioregion as defined by the Interim Biogeographical Regionalisation for Australia. This bioregion is described as

"*Duricrusted plateau of the Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and in the eastern part Marri-Wandoo woodlands on clayey soils. Eluvial and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich scrublands. Warm Mediterranean Climate."*

4.4.1 Regional Significance

The regional significance of the study area has been determined by the degree of representation of species and habitats at a biogeographical regional level. The sites proximity to the boundary of other bioregions means that the diversity of plant and fauna species can be expected to be higher that in more centrally located areas.

The site is also in the vicinity of the Central and Eastern Avon Wheatbelt biodiversity hotspot, one of 15 such areas identified around Australia.

The defining characteristics of the Central and Eastern Avon Wheatbelt biodiversity hotspot are:

"The dominant vegetation of this area includes woodlands of Wandoo, York Gum, Salmon Gum, Casuarina and some areas of proteaceous scrub heaths. The woodlands contain many of Western Australia's threatened plants and birds. The area is particularly rich in endemic plants - Grevilleas, Hakeas, Eucalypts, Acacias, Eriostemons, and the Asteracea family - and invertebrates, particularly ground-dwelling spiders.

Most of the native vegetation has been cleared for agriculture and grazing, leading to extensive salinity problems over one-third of the area. Remnant vegetation, wetlands, river systems, populations of species and ecosystems are in poor condition, and the fragmentation of vegetation means an increased threat of weeds, fire, and feral animals.

Sedimentation, salination and other pressures such as water diversion and water pollution threaten the area's nationally important wetlands."

The 15 National Biodiversity Hotspots were identified to raise public awareness of our environmental heritage at risk, and to support strategic action to conserve it. The National Biodiversity Hotspots were identified by the Australian Government's Threatened Species Scientific Committee, with input from recognised experts in the field of biodiversity conservation from each Australian State and Territory. Areas with many endemic species where the levels of stress or future threat were considered to be high were identified as hotspots.

The site includes a variety of habitats though overall the remnant vegetation within the works footprint has either been totally cleared or is degraded to some extent. As a consequence its regional significance has been greatly reduced. Habitat elements such as large logs, dense groundcover and understorey are largely absent. The wetland habits within the works footprint are also of regional significance as they form part of the Chittering Lakes System – a registered national heritage site

With respect to fauna the significance of the site is supported by the presence of breeding sites utilised by the endangered Carnaby's Black Cockatoo and the potential presence and utilisation of some areas of the remnant vegetation by other species of conservation significance such as the Chuditch and Quenda.

4.4.2 Local Significance

As discusses in section 4.4.2 the site includes a number of broad habitat types habitats though overall the remnant vegetation within the works footprint has either been totally cleared or is degraded to some extent and important habitat elements such as large logs, dense groundcover and understorey are absent from significant areas. Six nature reserves (Chittering Lakes, Burroloo, Unnamed Reserve 42743, Breera Road, Julimar and Mt Byroomanning) exist within 12 kilometres of the project

site and it can be expected that all the local habitat types and fauna species present within the project site are well represented in these areas.

As with the assessment of regional significance the site does have local significance due to the presence of and potential presence of listed threatened species such as Carnaby's Cockatoo and Chuditch.

4.5 VALUE OF THE ROAD SIDE VEGETATION AS HABITAT AND AS A WILDLIFE CORRIDOR

The uncleared areas within the study site, while relatively narrow and to a certain extent degraded, provide good habitat for a wide range of species. In particular the general area contains a number of "habitat" trees that contain small to medium hollows suitable for obligate hollow nesters in addition to some larger hollows know to be used or potentially suitable for Carnaby's Cockatoo (Johnstone and Kirkby, 2005). Some areas containing dense groundcover also appear to be utilised by Quenda though the greatest concentrations of this species are within the bounds of the Chittering Lakes Nature Reserve, in areas that will be unaffected by the proposal. A section of the Chittering Lakes Nature Reserve is also potentially being utilised by Chuditch though the evidence found was inconclusive. This species is wide ranging and therefore, if present, is likely to enter the project area at times.

Studies have found that Wandoo woodlands are significant habitat areas for many animals. High species richness and abundance of birds in Wandoo woodlands has been documented in several studies of the north-eastern section of the Jarrah forest (Ninox Wildlife Consulting 1992, 1997, 1998, 2001; Worsley Alumina Pty Ltd, 1985, 1999). The value of the majority of the site is however reduced by the fact that it is either cleared or lacks habitat elements such as large hollow logs, dense groundcover and understorey and is essentially "parkland" cleared.

The presence of relatively small sections of wetland habitat (e.g. inundated Melaleuca woodland) provide addition habitat variation that increases the diversity of species likely to utilise the project area.

The value of the study site as a corridor allowing movement between conservation areas is limited. Currently a link probably exists along the road reserve between the Burroloo Nature Reserve and The Chittering Lakes Reserve. The link within the road reserve is supplemented by vegetation along the creekline that is present within private property to the west of the highway. If the vegetation here is retained then the corridor, while reduced in width and continuity, will remain almost in its entirety.

The remnant vegetation with the project site, north of the Brockman River, has very limited value as a wildlife corridor. The remnant vegetation has a patchy distribution and does not facilitate connection to areas of more continuous vegetation. The main corridor in this northerly direction would be within the Chittering Lakes Nature Reserve.

One main effect of the proposed road works will be the widening of pre-existing gaps which will increase their barrier effect to fauna movement. Studies on the barrier effect of roads has been is summarised by Bennett (1991). Larger roads such as the Great Northern Highway have all three elements that can form a significant barrier to fauna movement: bare road surface, altered roadside habitat and the noise, movement and lights associated with traffic use. Apart from the barrier to animal movement caused by busy roads an increase in fauna mortality (particularly to the larger and more mobile species such as kangaroos, wallabies and monitor lizards) resulting from collision with vehicles can be expected.

5. POTENTIAL IMPACTS AND MANAGEMENT RECOMMENDATIONS

5.1 IMPACTS

The proposed works will require the clearing of vegetation and consequently the loss or degradation of potential fauna habitat. Indirect impacts to fauna habitat adjacent to the works footprint may also result as a consequence of changes to surface hydrology, increases in erosion, weed introduction/spread and changes to fire regimes. Apart from the presence of Carnaby's Cockatoo nest sites and feeding areas, identified during previous studies, no specific habitats identified during the assessment appear to be spatially restricted to the area of impact or to be supporting important populations of significant species or fauna communities

The proposed works will inevitably result in the localised loss of individual fauna as a result of habitat clearing. Based on the information gained during this assessment the impact of the proposed works is however not considered significant enough to affect the conservation status of any of the species in the area.

The most significant habitat components that maybe impacted on are hollow-bearing trees. The removal of mature hollow-bearing trees will result in the loss of perching, foraging and nesting resources for a variety of bird and mammal species that may be present in the area.

Construction at the river and stream crossings along the project route will result in the loss of some riparian vegetation. The removal or modification of riparian vegetation has the potential to increase erosion, scouring and may cause changes to channel morphology. Decreases in in-stream habitat may also occur with the loss of undercut banks, woody debris and leaves. The mobilisation of sediment may also affect downstream aquatic habits (i.e. Chittering Lakes Nature Reserve).

Based on the habitat assessment it would appear that a number of the listed threatened and priority species very likely use the project area and adjacent areas for foraging, roosting and possibly breeding. The potential impact on these species will vary depending on population densities and the quantity and quality of potential foraging and breeding sites. Most are wide ranging species and it is anticipated that

with the implementation of suitable management procedures the impact will be minimal. Displaced animals should be able to be absorbed into the surrounding, unaffected habitat.

In relation to the common endemic fauna species, the proposed works are unlikely to result in a significant impact on their status in the general area. Considerable areas of similar habitats are available directly adjacent to the proposed site and populations will persist in these locations.

5.2 MANAGEMENT RECOMMENDATIONS

The following proposed management plan specifically aims to reduce the chance of fauna being killed or injured during the course of the proposed project and to reduce as much as possible, the amount of fauna habit directly or indirectly affected.

It is recommended that:

- Areas requiring clearing for the various project components should be kept to a minimum. Areas to be cleared should be clearly marked and access to other areas restricted to prevent accidental clearing.
- Design additional project infrastructure, including access routes, vehicle and plant storage and turn around areas, borrow pits etc so that:
    - previously disturbed areas are used where possible; and
    - areas of sensitive vegetation are avoided.
- Avoid clearing of hollow bearing trees. These should be left undisturbed if possible. Potential habitat trees should be checked for fauna prior to clearing. No dead, standing or fallen timber should be removed unnecessarily.
- Rehabilitation plan should be developed for all non-permanent disturbed areas. This will serve to restore some areas of habitats lost or modified during construction activities. Rehabilitation plan should include fauna habitat construction eg Logs (hollow or not) and other debris resulting from land clearing should be used to enhance fauna habitat in untouched and rehabilitated areas.
- An erosion and sediment control plan should be developed and implemented. Undertake construction in the vicinity of water courses as early as possible in the drier seasons of the year and ensure that appropriate rehabilitation or erosion control structures are in place prior wetter periods.
- Fuel and chemical storage facilities should be located appropriate distance away from watercourses.
- A Construction and Operations Fire Management Plan should be prepared to reduce the risk of unplanned fires and provide contingency measures to minimise any associated impacts. The plan will include a contingency and response plan in the event of any bushfires that commence as a result of the construction works.
- All construction staff should be made aware that native fauna is protected. The importance of fauna habitat should also be highlighted. Personnel working on the project should not be allowed to bring firearms, other weapons or pets onsite.

- Native fauna injured during construction should if possible be taken to a designated veterinary clinic or a CALM nominated wildlife carer.
- Any trenching required should be kept open for only as long as necessary and suitable escape ramps and bridging provided if the site is to be left unattended for extended periods.
- Contractors should report the presence of all large bird nesting sites (eg large bird of prey nest sites or nesting colonies) so that they can be assessed prior to disturbance.
- Identify and treat existing weed infestations along the project route, along access routes and at borrow pits prior to construction activities.
- Only use species native to the area in rehabilitation and landscaping.

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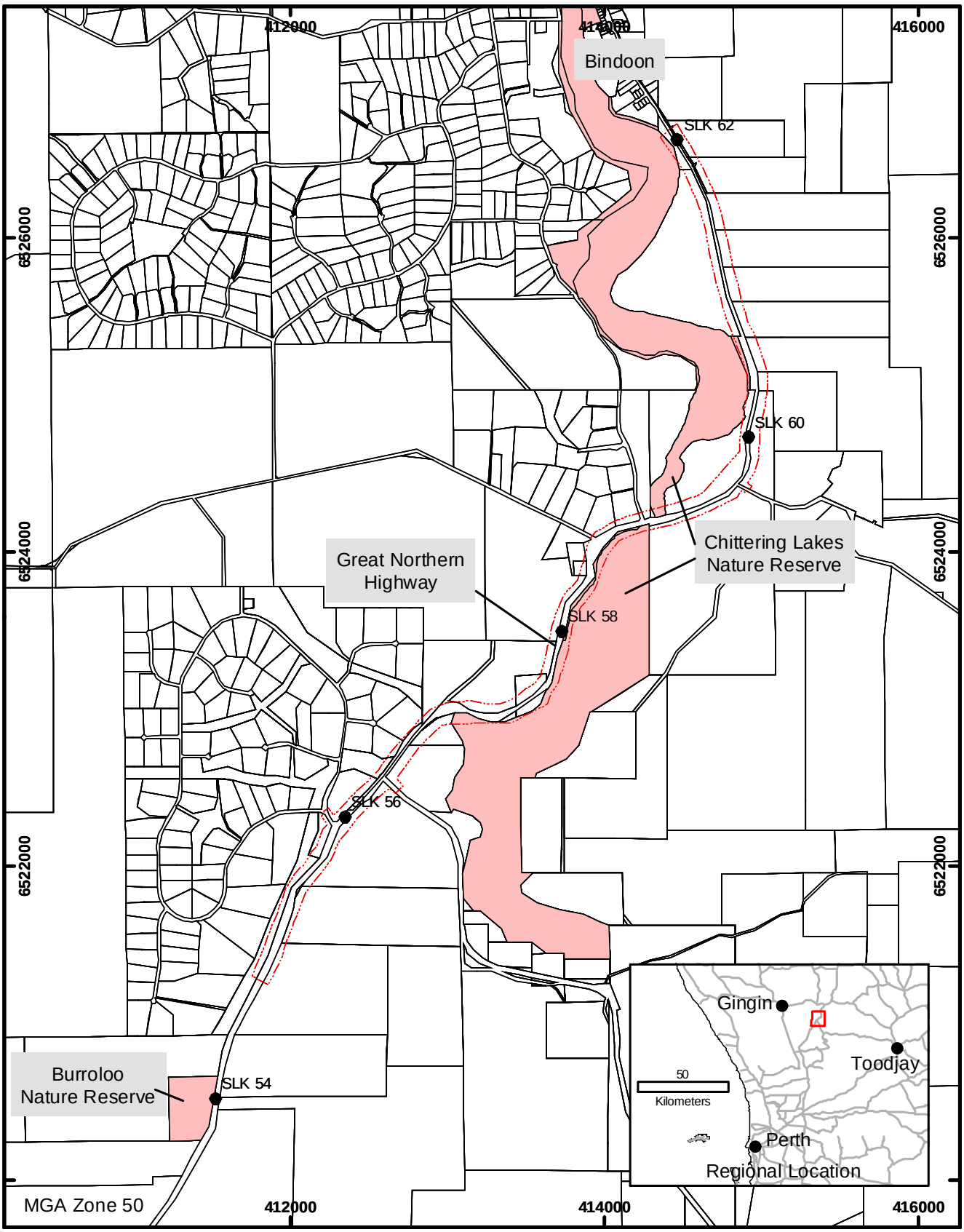
FIGURES



Legend

- Study Area
- Cadastral Boundaries
- Nature Reserves

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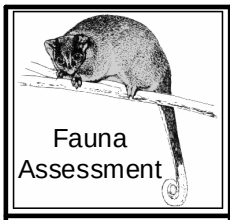

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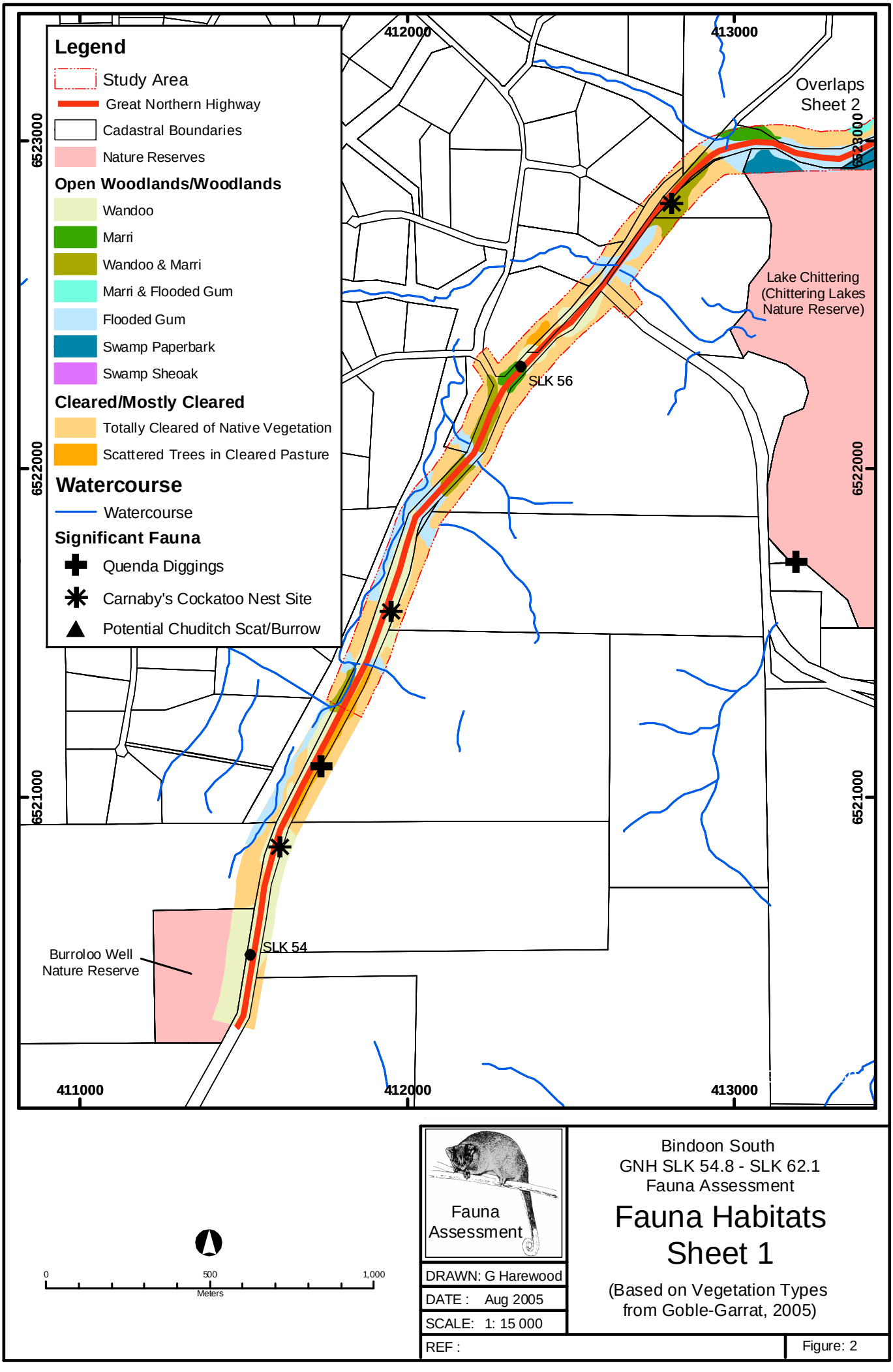
Bindoon South
GNH SLK 54.8 - SLK 62.1
Fauna Assessment

Study Area and Regional Location



Fauna Assessment

Bindoon South
GNH SLK 54.8 - SLK 62.1
Fauna Assessment

Fauna Habitats Sheet 1

(Based on Vegetation Types from Goble-Garrat, 2005)

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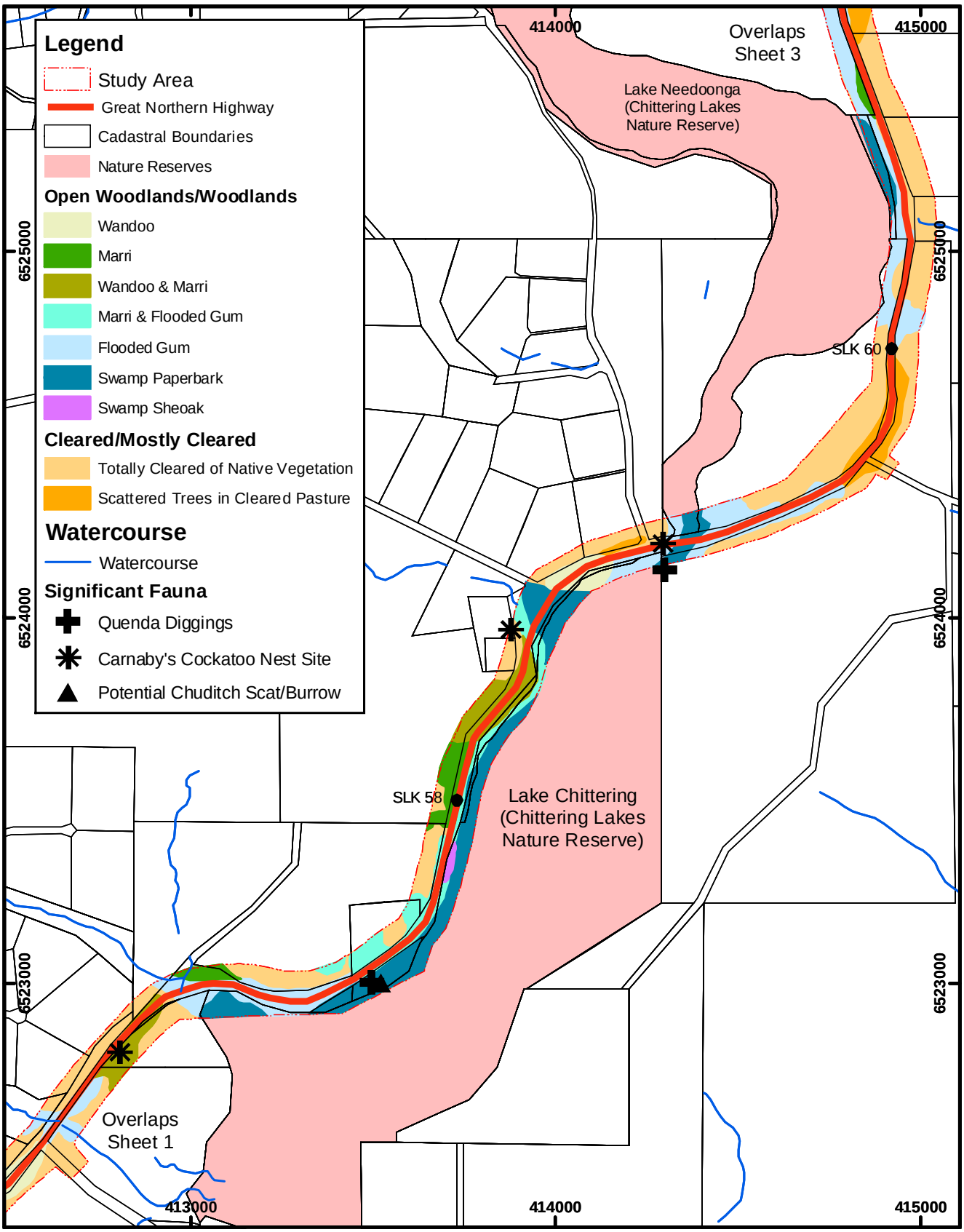

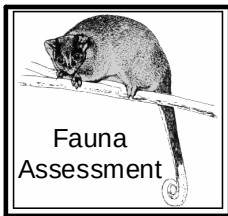

Bindoon South
GNH SLK 54.8 - SLK 62.1
Fauna Assessment

Fauna Habitats Sheet 2

(Based on Vegetation Types from Goble-Garrat, 2005)

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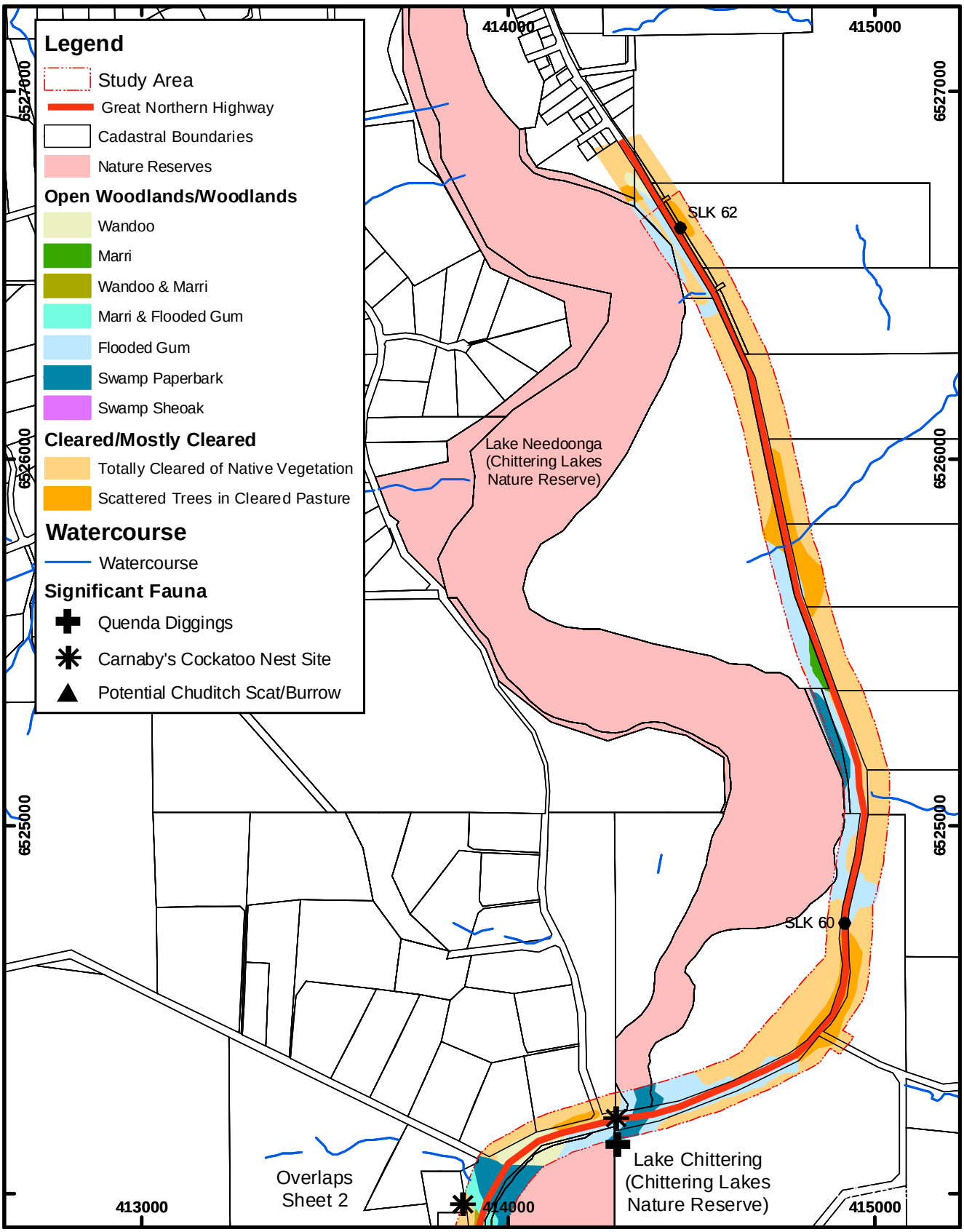

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Bindoon South
GNH SLK 54.8 - SLK 62.1
Fauna Assessment

Fauna Habitats Sheet 3

(Based on Vegetation Types from Goble-Garrat, 2005)

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DATE : Aug 2005	
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APPENIDIX A

POTENTIAL FAUNA SPECIES LIST

Fauna Potentially in Study Area

Potential = +
Sighted/Heard = ++

Bindoon South + Chittering Lakes Nature Reserve Compiled by Greg Harewood - August 2005

Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Fish				
Atherinidae Hardyheads or Silversides				
Leptatherina wallacei	Western Hardyhead		+	+
Gobidae Gobies				
Pseudogobius olurum	Swan River Gobie		+	+
Percichthyidae Basses and Cods				
Bostockia porosa	Nightfish		+	+
Galaxiidae Galaxiids				
Galaxias occidentalis	Western Minnow		++	+
Nannopercidae Pygmy Perches				
Edelia vittata	Western Pygmy Perch		+	+
Poeciliidae Livebearers				
Gambusia holbrooki	Mosquito Fish		+	++

* =Introduced, WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, CALM Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region.

Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Amphibians				
Myobatrachidae Ground or Burrowing Frogs				
Crinia georgiana	Quacking Frog		++	++
Crinia glauerti	Glauert`s Froglet		++	++
Crinia pseudinsignifera	Bleating Froglet		++	++
Geocrinia leai	Lea`s Frog		+	+
Heleioporus albopunctatus	Western Spotted Frog		+	+
Heleioporus eyrei	Moaning Frog		+	+
Heleioporus inornatus	Whooping Frog		+	+
Heleioporus psammophilus	Sand Frog		+	+
Limnodynastes dorsalis	Banjo Frog		++	+
Myobatrachus gouldii	Turtle Frog		+	+
Neobatrachus pelobatoides	Humming Frog		+	+
Pseudophryne guentheri	Güenther`s Toadlet		+	+
Hylidae Tree Frogs				
Litoria adelaidensis	Slender Tree Frog		++	++
Litoria moorei	Motorbike Frog		+	+
Reptiles				
Chelidae Side-necked Tortoises				
Chelodina oblonga	Long-necked Tortoise		+	++

* =Introduced, WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, CALM Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region.

Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Gekkonidae Geckoes				
Crenadactylus ocellatus	White-spotted Gecko		+	+
Diplodactylus granariensis			+	+
Diplodactylus polyophthalmus	Speckled Stone Gecko		+	+
Diplodactylus pulcher			+	+
Gehyra variegata			+	+
Oedura reticulata			+	+
Phyllodactylus marmoratus	Marbled Gecko		+	+
Strophurus spinigerus	South-western Spiny-tailed Gecko		+	+
Underwoodisaurus milii	Barking Gecko		+	+
Pygopodidae Legless Lizards				
Aprasia pulchella	Pretty Worm Lizard		+	+
Aprasia repens	Sandplain Worm Lizard		+	+
Delma fraseri	Fraser's Scale-footed Lizard		+	+
Delma grayii			+	+
Lialis burtonis	Common Snake Lizard		+	+
Agamidae Dragon Lizards				
Pogona minor	Bearded Dragon		+	+
Varanidae Monitor's or Goanna's				
Varanus gouldii	Goulds Sand Monitor		+	+
Varanus tristis	Black Goanna		+	+

* =Introduced, WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, CALM Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region.

Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Scincidae Skinks				
Acritoscincus trilineatum	Swamp Skink		+	+
Cryptoblepharus plagiocephalus	Fence Skink		+	+
Ctenotus catenifer			+	+
Ctenotus fallens			+	+
Ctenotus pantherinus			+	+
Ctenotus schomburgkii			+	+
Egernia kingii	King's Skink		+	+
Egernia multiscutata			+	+
Egernia napoleonis	Salmon-bellied Skink		+	+
Egernia pulchra	Spectacled Rock Skink		+	+
Lerista distinguenda	South-western Four-toed Lerista		+	+
Menetia greyii	Dwarf Skink		+	+
Morethia lineoocellata	Western Pale-faced Morethia		+	+
Morethia obscura			+	+
Tiliqua occipitalis	Western Blue Tongue Lizard		+	+
Tiliqua rugosa	Bobtail		+	+
Typhlopidae Blind Snakes				
Ramphotyphlops australis	Southern Blind Snake		+	+
Ramphotyphlops bituberculatus			+	+
Ramphotyphlops pinguis	Stout Blind Snake		+	+
Ramphotyphlops waitii			+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Boidae Pythons, Boas				
Antaresia stimsoni	Stimson`s Python		+	+
Aspidites ramsayi	Woma	S3 P1	+	+
Morelia spilota imbricata	Southern Carpet Python	S4 P4	+	+
Elapidae Elapid Snakes				
Brachyurophis semifasciata	Southern Shovel-nosed Snake		+	+
Demansia psammophis	Yellow-faced Whipsnake		+	+
Echiopsis curta	Bardick		+	+
Neelaps bimaculatus	Black-naped Snake		+	+
Notechis scutatus	Tiger Snake		+	+
Parasuta gouldii	Gould`s Snake		+	+
Parasuta nigriceps	Black-backed Snake		+	+
Pseudechis australis	Mulga Snake		+	+
Pseudonaja affinis	Dugite		+	+
Pseudonaja nuchalis	Gwardar		+	+
Simoselaps bertholdi	Jan`s Banded Snake		+	+

Birds

Casuariidae Emus, Cassowarries				
Dromaius novaehollandiae	Emu	Bp	+	+
Phasianidae Quails, Pheasants				
Coturnix pectoralis	Stubble Quail		+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Anatidae Geese, Swans, Ducks				
Anas gracilis	Grey Teal		+	++
Anas rhynchotis	Australasian Shoveler	Bh	+	+
Anas superciliosa	Pacific Black Duck		+	++
Aythya australis	Hardhead	Bh	+	+
Biziura lobata	Musk Duck	Bh	+	++
Chenonetta jubata	Australian Wood Duck		++	++
Cygnus atratus	Black Swan		+	++
Malacorhynchus membranaceus	Pink-eared Duck	Bh	+	+
Oxyura australis	Blue-billed Duck	Bh	+	+
Stictonetta naevosa	Freckled Duck	Bp		+
Tadorna tadornoides	Australian Shelduck		++	++
Podicipedidae Grebes				
Podiceps cristatus	Great Crested Grebe			++
Poliocephalus poliocephalus	Hoary-headed Grebe		+	++
Tachybaptus novaehollandiae	Australasian Grebe		+	++
Anhingidae Darters				
Anhinga melanogaster	Darter		+	+
Phalacrocoracidae Cormorants				
Phalacrocorax carbo	Great Cormorant			+
Phalacrocorax melanoleucos	Little Pied Cormorant		+	++
Phalacrocorax sulcirostris	Little Black Cormorant		+	++
Pelecanidae Pelicans				
Pelecanus conspicillatus	Australian Pelican			+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Ardeidae Herons, Egrets, Bitterns				
Ardea alba	Great Egret	Migratory CA JA	++	+
Ardea ibis	Cattle Egret	Migratory CA JA	+	+
Ardea pacifica	White-necked Heron		+	+
Botaurus poiciloptilus	Australasian Bittern	S1 VU Bp		+
Egretta novaehollandiae	White-faced Heron		++	+
Ixobrychus minutus	Little Bittern	P4 Bp		+
Nycticorax caledonicus	Rufous Night Heron	Bp	+	+
Threskiornithidae Iibises, Spoonbills				
Platalea flavipes	Yellow-billed Spoonbill		++	++
Threskiornis molucca	Australian White Ibis		++	++
Threskiornis spinicollis	Straw-necked Ibis		++	++
Accipitridae Kites, Goshawks, Eagles, Harriers				
Accipiter cirrocephalus	Collared Sparrowhawk	Bp	+	+
Accipiter fasciatus	Brown Goshawk	Bp	+	+
Aquila audax	Wedge-tailed Eagle	Bp	+	+
Aquila morphnoides	Little Eagle	Bp	+	+
Circus approximans	Swamp Harrier		+	++
Circus assimilis	Spotted Harrier		+	+
Elanus caeruleus	Black-shouldered Kite		+	+
Haliastur sphenurus	Whistling Kite	Bp	++	++
Hamirostra isura	Square-tailed Kite	Bp	+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Falconidae Falcons				
Falco berigora	Brown Falcon	Bp	+	+
Falco cenchroides	Australian Kestrel		++	+
Falco longipennis	Australian Hobby		+	+
Falco peregrinus	Peregrine Falcon	S4 Bp	+	+
Rallidae Rails, Crakes, Swamphens, Coots				
Fulica atra	Eurasian Coot		+	++
Gallinula ventralis	Black-tailed Native-hen		+	+
Gallirallus philippensis	Buff-banded Rail			+
Porphyrio porphyrio	Purple Swamphen		+	+
Porzana fluminea	Australian Spotted Crake			+
Porzana pusilla	Baillon`s Crake			+
Porzana tabuensis	Spotless Crake			+
Turnicidae Button-quails				
Turnix varia	Painted Button-quail	Bp	+	+
Turnix velox	Little Button-quail		+	+
Scolopacidae Curlews, Sandpipers, Snipes, Godwits				
Tringa hypoleucos	Common Sandpiper	Migratory CA JA	+	+
Burhinidae Stone Curlews				
Burhinus grallarius	Bush Stone-curlew	P4 Be	+	+
Recurvirostridae Stilts, Avocets				
Cladorhynchus leucocephalus	Banded Stilt		+	+
Himantopus himantopus	Black-winged Stilt		+	+
Recurvirostra novaehollandiae	Red-necked Avocet		+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Charadriidae Lapwings, Plovers, Dotterels				
Charadrius melanops	Black-fronted Dotterel		+	+
Vanellus tricolor	Banded Lapwing		+	+
Columbidae Pigeons, Doves				
*Columba livia**	Domestic Pigeon		+	+
Ocyphaps lophotes	Crested Pigeon		+	
Phaps chalcoptera	Common Bronzewing	Bh	+	+
Phaps elegans	Brush Bronzewing	Bh	+	+
*Streptopelia senegalensis**	Laughing Turtle-Dove		+	+
Cacatuidae Cockatoos, Corellas				
Cacatua pastinator butleri	Western Long-billed Corella		+	+
Cacatua sanguinea	Little Corella		++	+
Calyptorhynchus latirostris	Carnaby`s Cockatoo	S1 EN Bp	++	++
Eolophus roseicapilla	Galah		++	++
Psittacidae Parrots				
Glossopsitta porphyrocephala	Purple-crowned Lorikeet		+	+
Melopsittacus undulatus	Budgerigar		+	+
Neophema elegans	Elegant Parrot		+	+
Platycercus icterotis	Western Rosella	Bp	+	+
Platycercus spurius	Red-capped Parrot		++	+
Platycercus varius	Mulga Parrot		+	+
Platycercus zonarius	Twenty-eight Parrot		++	++
Polytelis anthopeplus	Regent Parrot		+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Cuculidae Parasitic Cuckoos				
Cacomantis flabelliformis	Fan-tailed Cuckoo		+	+
Chrysococcyx basalis	Horsfield`s Bronze Cuckoo		+	+
Chrysococcyx lucidus	Shining Bronze Cuckoo		+	++
Cuculus pallidus	Pallid Cuckoo		+	+
Strigidae Hawk Owls				
Ninox novaeseelandiae	Boobook Owl		+	+
Tytonidae Barn Owls				
Tyto alba	Barn Owl		+	++
Podargidae Frogmouths				
Podargus strigoides	Tawny Frogmouth		+	+
Caprimulgidae Nightjars				
Eurostopodus argus	Spotted Nightjar		+	+
Aegothelidae Owlet-nightjars				
Aegotheles cristatus	Australian Owlet-nightjar		+	+
Apodidae Swifts, Swiftlets				
Apus pacificus	Fork-tailed Swift	Migratory CA JA	+	+
Halcyonidae Tree Kingfishers				
*Dacelo novaeguineae**	Laughing Kookaburra		++	++
Todiramphus sanctus	Sacred Kingfisher		+	+
Meropidae Bee-eaters				
Merops ornatus	Rainbow Bee-eater	Migratory JA	+	+
Climacteridae Treecreepers				
Climacteris rufa	Rufous Treecreeper	Bh	+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Maluridae Fairy Wrens, GrassWrens				
Malurus pulcherrimus	Blue-breasted Fairy-wren		+	++
Malurus splendens	Splendid Fairy-wren	Bh	++	+
Pardalotidae Pardalotes, Bristlebirds, Scrubwrens, Gerygones, Thornbills				
Acanthiza apicalis	Broad-tailed Thornbill	Bh	++	++
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Bh	++	++
Acanthiza inornata	Western Thornbill	Bh	++	++
Gerygone fusca	Western Gerygone		++	++
Pardalotus punctatus	Spotted Pardalote		+	+
Pardalotus striatus	Striated Pardalote		++	++
Sericornis frontalis	White-browed Scrubwren	Bh	+	+
Smicrornis brevirostris	Weebill	Bh	++	+
Meliphagidae Honeyeaters, Chats				
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		+	+
Acanthorhynchus superciliosus	Western Spinebill		+	+
Anthochaera carunculata	Red Wattlebird		++	++
Anthochaera lunulata	Western Little Wattlebird	Bp	+	+
Certhionyx niger	Black Honeyeater		+	+
Epthianura albifrons	White-fronted Chat		+	
Lichenostomus virescens	Singing Honeyeater		++	++
Lichmera indistincta	Brown Honeyeater		++	++
Manorina flavigula	Yellow-throated Miner	Bp	+	+
Melithreptus brevirostris	Brown-headed Honeyeater		+	+
Phylidonyris nigra	White-cheeked Honeyeater	Bp	+	+
Phylidonyris novaehollandiae	New Holland Honeyeater	Bp	++	++

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Petroicidae Australian Robins				
Eopsaltria australis	Western Yellow Robin	Bh	+	+
Microeca fascinans	Jacky Winter		+	+
Petroica cucullata	Hooded Robin	Bh	+	+
Petroica goodenovii	Red-capped Robin		+	+
Petroica multicolor	Scarlet Robin	Bh	+	+
Pomatostomidae Babblers				
Pomatostomus superciliosus	White-browed Babbler		+	+
Neosittidae Sitellas				
Daphoenositta chrysoptera	Varied Sittella	Bh	+	+
Pachycephalidae Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers				
Colluricincla harmonica	Grey Shrike-thrush	Bh	+	+
Falcunculus frontatus leucogaster	Crested Shrike-tit	P4 Be	+	+
Oreoica gutturalis	Crested Bellbird		+	+
Pachycephala pectoralis	Golden Whistler	Bh	+	+
Pachycephala rufiventris	Rufous Whistler		++	++
Dicruridae Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo				
Grallina cyanoleuca	Magpie-lark		++	+
Rhipidura fuliginosa	Grey Fantail		++	++
Rhipidura leucophrys	Willie Wagtail		++	++
Campephagidae Cuckoo-shrikes, Trillers				
Coracina novaehollandiae	Black-faced Cuckoo-shrike		++	++
Lalage sueurii	White-winged Triller		+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Artamidae Woodswallows, Butcherbirds, Currawongs				
Artamus cinereus	Black-faced Woodswallow	Bp	+	+
Artamus cyanopterus	Dusky Woodswallow	Bp	++	+
Cracticus nigrogularis	Pied Butcherbird		+	+
Cracticus tibicen	Australian Magpie		++	+
Cracticus torquatus	Grey Butcherbird		++	+
Corvidae Ravens, Crows				
Corvus coronoides	Australian Raven		++	++
Strepera versicolor	Grey Currawong	Bp	+	+
Motacillidae Old World Pipits, Wagtails				
Anthus novaeseelandiae	Australian Pipit		+	
Dicaeidae Flowerpeckers				
Dicaeum hirundinaceum	Mistletoebird		+	+
Hirundinidae Swallows, Martins				
Cheramoeca leucosternus	White-backed Swallow		+	+
Hirundo ariel	Fairy Martin		+	+
Hirundo neoxena	Welcome Swallow		++	+
Hirundo nigricans	Tree Martin		++	+
Sylviidae Old World Warblers				
Acrocephalus stentoreus	Clamorous Reed Warbler			++
Cincloramphus cruralis	Brown Songlark		+	
Cincloramphus mathewsi	Rufous Songlark		+	
Megalurus gramineus	Little Grassbird			+
Zosteropidae White-eyes				
Zosterops lateralis	Grey-breasted White-eye		++	++

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Mammals				
Tachyglossidae Echidnas				
Tachyglossus aculeatus	Echidna		+	+
Dasyuridae Carnivorous Marsupials				
Antechinus flavipes	Yellow-footed Antechinus, Mardo		+	+
Dasyurus geoffroii	Chuditch	S1 VU	+	+
Phascogale tapoatafa tapoatafa	Southern Brush-tailed Phascogale	P3	+	+
Sminthopsis dolichura	Little Long-tailed Dunnart		+	+
Sminthopsis gilberti	Gilbert`s Dunnart		+	+
Sminthopsis griseoventer	Grey-bellied Dunnart		+	+
Peramelidae Bandicoots				
Isoodon obesulus fusciventer	Southern Brown Bandicoot	P5	++	++
Phalangeridae Brushtail Possums, Cuscuses				
Trichosurus vulpecula	Common Brushtail Possum		+	+
Burramyidae Pygmy Possums				
Cercartetus concinnus	Western Pygmy-possum		+	+
Tarsipedidae Honey Possum				
Tarsipes rostratus	Honey Possum		+	+
Macropodidae Kangaroos, Wallabies				
Macropus fuliginosus	Western Grey Kangaroo		++	++
Macropus irma	Western Brush Wallaby	P4	+	+
Molossidae Freetail Bats				
Mormopterus planiceps	Western Freetail Bat		+	+
Tadarida australis	White-striped Freetail-bat		+	+

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Class **Family** *Species*	Common Name	Status	Bindoon Sth	Chittering Lakes NR
Vespertilionidae Ordinary Bats				
Chalinolobus gouldii	Gould`s Wattled Bat		+	+
Chalinolobus morio	Chocolate Wattled Bat		+	+
Nyctophilus geoffroyi	Lesser Long-eared Bat		+	+
Nyctophilus gouldi	Gould`s Long-eared Bat		+	+
Nyctophilus timoriensis	Greater Long-eared Bat		+	+
Vespadelus regulus	Southern Forest Bat		+	+
Muridae Rats, Mice				
Hydromys chrysogaster	Water Rat	P4	+	+
*Mus musculus**	House Mouse		+	+
Rattus fuscipes	Western Bush Rat		+	+
*Rattus rattus**	Black Rat		+	+
Canidae Dogs, Foxes				
*Vulpes vulpes**	Red Fox		+	+
Felidae Cats				
*Felis catus**	Cat		++	+
Equidae Horses				
*Equus caballus**	Horse		++	
Bovidae Horned Ruminants				
*Bos taurus**	European Cattle		++	
Leporidae Rabbits, Hares				
*Oryctolagus cuniculus**	Rabbit		+	+

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Appendix E

COCKATOO SURVEY

ASSESSMENT AND MANAGEMENT PLAN FOR CARNABY'S COCKATOO ALONG SECTION OF GREAT NORTHERN HIGHWAY BINDOON SOUTH.

R.E. & C. JOHNSTONE & T. KIRKBY.

INTRODUCTION

A program of road widening for sections of the Great Northern Highway (with straight line kilometres SLKs listed below) is currently being assessed. Road widening will require the removal of some remnant vegetation along these sections including a number of large *Eucalyptus* and *Corymbia* trees and some lower vegetation including *Dryandra* scrubs. Some of this vegetation has significant conservation value since most of the surrounding area has been extensively cleared for farmland.

An assessment of the value of this vegetation to provide nesting and feeding sites for Carnaby's Cockatoos was carried out in March 2005. This species is protected under the *Environmental Protection and Biodiversity Conservation Act 1999.* Four trees with Carnaby's Cockatoo nest sites were located (see table), also one tree with a possible nest site, and a number of areas within the project site contain remnant vegetation that is being used as foraging habitat by Carnaby's Cockatoos.

GREAT NORTHERN HIGHWAY – SUMMARY DESCRIPTION OF PROPOSED DISTURBANCE FOR ENVIRONMENTAL BASELINE SURVEYS.

Location (SLK)	Length (km)	Description of Proposed works
54.85 – 55.85	1.0	Widen and overlay including reconstruction of Parking Bay.
55.85 – 56.90	1.05	Reconstruction and Improve intersection with Hart Drive and Chittering Road.
56.90 – 58.64	1.74	Reconstruction and realignment (Donaldson's section).
58.64 – 59.16	0.52	Improve Intersection with Tee Tree Road and Spice Road.
59.16 – 59.22	0.06	Brockman River Bridge, bridge widening, no change to on ground footprint.

Location (SLK)	Length (km)	Description of Proposed works
59.22 – 60.5	1.28	Reconstruction and Realignment including intersection with Flat Rocks Road.
60.5 – 62.04	1.54	Widen, overlay and construction of south bound passing lane.

The survey area included a 50 m. envelope from the edge of the existing or proposed earthworks whichever was greater.

BACKGROUND INFORMATION

Carnaby's Cockatoo *Calyptorhynchus latirostris*

Distribution

Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Status etc.

This species is a postnuptial nomad, tending to move west after breeding. It is uncommon to common in the subhumid zone and wetter parts of the semiarid zone, scarce and patchily distributed in drier parts of range (north of Arrowsmith Lake and east of Marchagee, New Norcia, Toodyay, Tarin Rock and Lake Magenta) and deep south-west (south of Margaret River, Nannup and Bridgetown and east of Albany). Usually in pairs or small flocks, also large flocks (up to 6000) in non-breeding season (late spring to mid-winter), especially at pine plantations. Because of the large-scale post-war clearing of semiarid sandplains, this species has declined in much of the wheatbelt. It is protected at both State and Federal level *(Environment Protection and Biodiversity Conservation Act 1999, Schedule 1 of the Wildlife Conservation (Specially Protected Fauna Notice 2003)*, as well as being included in 'Action Plan for Australian Birds' (Garnett and Crowley 2000).

Breeding

Breeding from early July to mid-December. Mainly in semiarid and subhumid interior from the Three Springs district south to the Stirling Range, west to Cockleshell Gully, Cataby, Regan's Ford, Gingin, Yanchep, Serpentine, Mandurah, Bunbury, Nannup and Tone River, and east to Manmanning, Kellerberrin, Woolundra and Lake Cronin.

Breeding requirements

Judging from information in the Storr – Johnstone Bird Data Bank and Saunders (1982), Carnaby's Cockatoo display strong pair bonds and mate for life. They nest mainly in hollows of smooth-barked eucalypts especially salmon gum *Eucalytpus salmonophloia* and wandoo *Eucalyptus wandoo* but nests have also been found in other eucalypts including York gum *Eucalyptus loxophleba,* flooded gum *Eucalytpus rudis,* tuart *Eucalytpus gomphocephala* and the rough-barked marri *Corymbia calophylla.*

This species is currently expanding its range westward and south into the jarrah – marri forests of the Darling Scarp and deep south-west.

Eggs are laid on wood chips at the bottom of a large hollow (usually top entry hollow) ranging from a few centimetres to 5 m. deep; clutch 1 – 2 (mostly 2 but only one young reared). Incubation last 29 days and only the female incubates and broods. The nestling is brooded by the female for about a week during which time both rely on the male for food. She then leaves the nest each day at dawn, sometimes returning mid-morning to feed the chick. After about 1 – 3 weeks she ceases to brood and the chick is fed by one or both parents in the morning and at late evening.

Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick.

Scope

The major scope requirements of this report are as follows:

1. Re-inspection of the hollows identified as nesting sites during the breeding season (July – September) as pairs return to breeding sites.

2. Locate and mark trees with affected hollows sufficiently for re-location works to be done and for construction personnel to avoid all other hollows not needing re-location.

3. Review of the location of the identified nesting and feeding areas in relation to current road design and re-confirm impacts to nesting sites.

4. Advise on whether the removal of the nesting hollows is a significant impact to the species.

5. Assess and confirm the significance of the nesting hollows within the project area at local, regional and national levels.

6. Advise on the other nesting hollows within the vicinity (within the 50 m. boundary of the project) and assess their significance.

7. Advise whether the installation of artificial nesting hollows will adequately offset the impact.

8. Advise whether the re-location of the nesting hollows is a viable option.

9. Advise what other management measures have been successful for other projects.

10. Recommend relocation measures in the form of work specifications and or work descriptions to be adopted (e.g. handling, construction and erection of artificial nest hollows etc.).

HOLLOWS IDENTIFIED AS NESTING SITES DURING MARCH 2005 SURVEY.

Four trees with Carnaby's Cockatoo nest hollows were located during the March 2005 survey and one other tree with a possible nest hollow was found just outside the project area.

North to South.

Nest 1, stag tree, Flooded Gum at UTM 414291 E, 6524206 N. South end of Brockman Bridge west side road. This tree is 4.8 m. from white line and is partly burnt through at base and with the proposed widening road and bridge works could pose a danger to traffic.

Nest 2, Flooded Gum at UTM 413876 E, 6523969 N. This tree is on west side of road and is over 50 m. from shoulder of road and should be beyond the impact area of roadworks.

Nest 3, Wandoo at UTM 412806 E, 6522813 N. This tree is on fenceline, east side of road at 8 m. from white line.

Nest 4, Wandoo at UTM 411950 E, 6521569 N. Tree on east side of road, 12 m. from white line.

Nest 5, Wandoo at UTM 411611 E, 6520849 N. Possible nest hollow in tree east side of road, 16.5 m. from white line. This tree should be just outside the proposed project area.

RE INSPECTION OF HOLLOWS IDENTIFIED AS NESTING SITES IN JULY, AUGUST AND SEPTEMBER 2005.

A re-inspection of the four nest hollows and one possible hollow was carried out on 31 July 2005, 21 August 2005 and 3 September 2005. Details of these inspections are as follows.

Nest 1, stag tree Flooded Gum at UTM 414291 E, 6524206 N. 31 July 2005 female Carnaby's Cockatoo in the nest hollow (photographed, see attached). Female remained in the hollow despite considerable noise from heavy traffic on road.
Tree flagged with yellow tape.

21 August 2005, female flushed to entrance of hollow probably incubating eggs.

3 September 2005, female not flushed but probably a chick in the nest or female possibly disturbed by bridge works. Extra yellow flagging tape placed around tree.

Nest 2, Flooded Gum at UTM 413876 E, 6523969 N. 31 July 2005 – nest hollow entrance had evidence of fresh chewing and some cockatoo down feathers at entrance, but no female flushed from hollow.

21 August 2005, additional fresh chewing on entrance to hollow but no female flushed.

3 September 2005, hollow entrance with clear evidence of fresh chewing but no female flushed. Tree flagged with yellow tape.

Nest 3, Wandoo at UTM 412806 E, 6522813 N. 31 July 2005 – nest hollow entrance had evidence of fresh chewing by cockatoos but no bird flushed.

21 August 2005, no female Carnaby's Cockatoo flushed but a Galah in this tree.

3 September 2005, no evidence of fresh cockatoo chewing on this hollow and no bird flushed. Tree flagged with yellow tape.

Nest 4, Wandoo at UTM 411950 E, 6521569 N. 31 July 2005 – nest hollow entrance showed no signs of fresh chewing and no bird flushed.

21 August 2005, hollow showed no signs of use by cockatoos.

3 September 2005, hollow showed no signs of use by cockatoos. Tree flagged with yellow tape.

Nest 5, Wandoo at UTM 411611 E, 6520849 N. 31 July 2005 – nest hollow showed no signs of fresh chewing by cockatoos and no bird flushed. Anne Graham (per.comm.) a local farmer informed us that a pair of Carnaby's Cockatoos were observed in adjacent trees around the 25 – 27 July 2005.

21 August 2005, this hollow showed no signs of use by cockatoos.

3 September 2005, this hollow showed no signs of use by cockatoos.

LOCATE AND MARK TREES WITH AFFECTED HOLLOWS.

Nest 1, stag tree, Flooded Gum at UTM 414291 E, 6524206 N at south end of Brockman Bridge.

Nest 2, Flooded Gum at UTM 413876 E, 6523969 N.

Nest 3, Wandoo at UTM 412806 E, 6522813 N.

Nest 4, Wandoo at UTM 411950 E, 6521569 N.

All of these trees have been clearly flagged with yellow tape. These trees were also photographed.

REVIEW OF LOCATION OF IDENTIFIED NESTING AND FEEDING AREAS IN RELATION TO CURRENT ROAD DESIGN AND RE-CONFIRM IMPACTS TO NESTING SITES.

Nesting Sites Priority Trees

The current road design will almost certainly have an impact on stag tree at UTM 414291 E, 6524206 N on south end of Brockman Bridge. This tree is only 4.8 m. from white line (shoulder of road) and is well within the proposed roadworks area. Carnaby's Cockatoos are currently nesting in this tree (eggs laid in early August and probably a chick in early September). If this tree has to be removed this should be carried out after the chick has fledged (October – November 2005). The tree could possibly be saved with repair and strengthening at the base, but ultimately because of its age and condition it may have to be removed.

Nest tree Flooded Gum at UTM 413876 E, 6523969 N is 56 m. from shoulder of road and is beyond the impact of the current road design.

Nest tree Wandoo at UTM 412806 E, 6522813 N is 8 m. from shoulder of road and should be beyond the impact of the current road design.

It should be noted however that there may be some impact on the latter two trees due to disturbance and noise of road construction.

Trees at UTM 411950 E, 6521569 N (12 m. from white line) and UTM 411611 E, 6520849 N (16.5 m. from white line) are both just outside the current roadworks design and are currently not being used by Carnaby's Cockatoos in 2005 breeding season.

ADVISE ON WHETHER THE REMOVAL OF THE NESTING HOLLOWS IS A SIGNIFICANT IMPACT TO THE SPECIES.

Only two nest sites could be affected by the roadworks. The stag tree on south end of Brockman Bridge at UTM 414291 E, 6524206 N and possibly tree at UTM 412806 E, 6522813 N. The removal of these trees would not have a significant impact to the species survival in this region. The limiting factor in the species population growth is the availability of breeding sites close to feeding habitat. Assuming there will be future hollow availability (by either retaining these trees or use of artificial hollows as offsets) and foraging habitat in the area (with revegetation etc.) the roadworks should not lead to any long-term decrease in the local population of Carnaby's Cockatoo.

Potential Impact of clearing Defined under Federal Criteria.

The *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999 Administrative guidelines on significance, July 2000* defines whether an action will have A significant impact on a matter of national environmental significance. Matters of National environmental significance include listed threatened species, such as the Endangered Carnaby's Cockatoo.

Critically endangered and endangered ecological communities.

Significant Impact Criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- reduce the extent of a community, or
- fragment or increase fragmentation of the community, for example by clearing vegetation for roads or transmission lines; or
- adversely affect habitat critical to the survival of an ecological community which consists of, or includes, fauna species; or

- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- cause a substantial change in the species composition of an occurance of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting; or
- cause a substantial reduction in the quality or integrity of an occurance of an ecological community, including, but not limited to:
    - assisting invasive species, that are harmful to the listed ecological community, to become established; and
    - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- interfere with the recovery of an ecological community.

Potential Impact.

Carnaby's Cockatoo has an extensive range in Western Australia occurring north to the lower Murchison, inland in the wheatbelt to Lake Cronin and east along the south coast to Cape Arid. Generally the species is a postnuptial nomad tending to move west to cooler coastal areas after breeding. It has considerable feeding and breeding areas within the Bindoon region (e.g. Julimar State Forest, Bindoon Defence Area and Udamung Reserve). Clearing of small sections of roadside verge in this area will not cause population fragmentation or a reduction in the overall distribution of this species. Furthermore the clearing will not lead to a long-term decrease in the size of the population or interfere with the recovery of the species (there is very limited feeding and breeding sites within the areas to be cleared). Also the clearing and roadworks will not adversely impact or disrupt the breeding cycle of this local population.

Conclusion

The clearing of sections of the roadside verge will not have a significant impact under the guidelines of the EPBC Act (1999), on the survival of this endangered species.

The sections to be cleared are not part of an important vegetation corridor and not considered to be habitat critical to the survival of this species. The clearing will not impact on the availability or quality of feeding and breeding habitat and will not cause a decline in the local population.

SIGNIFICANCE OF NESTING HOLLOWS WITHIN THE PROJECT AREA AT LOCAL, REGIONAL AND NATIONAL LEVELS.

Recent surveys have located 2 – 3 pairs of Carnaby's Cockatoos breeding within the project area. This is a fairly significant number considering the relatively few veteran and stag trees with hollows that remain in the verge vegetation. Trees with suitable hollows for cockatoos are scarce in much of the surrounding landscape. At the local level several pairs of Carnaby's Cockatoos are recorded breeding in road verges between Bindoon and New Norcia, also near Mooliabeenee and Walyunga National Park, however further surveys are needed to obtain more accurate breeding data. At the regional level it is conservatively estimated that between 150 – 200 pairs of Carnaby's Cockatoos breed within the Bindoon region (i.e. around Chittering, Bindoon and Julimar forest areas), this is very high considering only around 50 pairs are recorded breeding in the Moora shire and about 20 pairs in the Victoria Plains region. At the national level judging from information in the Storr – Johnstone Bird Data Bank the Bindoon region is probably one of the most significant breeding areas (i.e. area of Critical Habitat) for Carnaby's Cockatoo in the south-west (i.e. covering the entire range of this species) and must be a major priority for conservation management.

ADVISE ON THE OTHER NESTING HOLLOWS WITHIN THE VICINITY (WITHIN THE 50 M. BOUNDARY OF THE PROJECT) AND ASSESS THEIR SIGNIFICANCE.

Carnaby's Cockatoos often breed fairly close together and it is important to retain where possible any veteran and stag trees with suitable hollows within known breeding areas. Other nesting hollows in vicinity of project area are as follows:

> Nest site 2, flooded gum at UTM 413876 E, 6523969 N is over 50 m. from the shoulder of the road and should be safe from roadworks.
>
> Wandoo at UTM 411950 E, 6521569 N, 12 m. from shoulder of road. Although this hollow showed no recent signs of use by Carnaby's Cockatoos it could be used in the future.
>
> Wandoo with possible nest site at UTM 411611 E, 6520849 N. This tree is outside the roadworks area and should be retained. A pair of Carnaby's Cockatoos were recorded near this tree between 25 - 27 July 2005.

Conclusion

The roadworks will not fragment an existing important Carnaby's Cockatoo population, nor will it adversely affect habitat critical to the survival of the species, or lead to a decrease in

size of the population. The main objective here is to prevent further decline in nest hollows and ensure the persistence of Carnaby's Cockatoos in the area.

ADVISE WHAT OTHER MANAGEMENT MEASURES HAVE BEEN SUCCESSFUL FOR OTHER PROJECTS.

Artificial nest hollows have been used very successfully for the recovery of Glossy Black Cockatoos on Kangaroo Island in South Australia. Small numbers of artificial hollows have also been used successfully for Carnaby's Cockatoos in the wheatbelt at Moora and near Dandaragan. Maintaining nesting hollows and the repair of old damaged nest hollows is also important in the management of local populations as there is now a paucity of veteran and stag trees in the rural landscape. Ongoing monitoring of small local breeding populations combined with some management procedures (e.g. control of bees) and identification of priority breeding and feeding sites within the region will provide information on the health of these small isolated populations, this has been done with the Glossy Black Cockatoo.

ARTIFICIAL NEST HOLLOWS.

The loss or decrease in hollow bearing trees in the Western Australian wheatbelt is one of the most important factors to overcome in fauna conservation. Apart from the dwindling supply of hollows in some landscapes, hollow users must also compete with the introduced feral European Honey Bee that is infesting hollows throughout the entire south-west region at a very rapid rate. The use of artificial nest boxes and pipe hollows has been used very successfully for the recovery of Glossy Cockatoos on Kangaroo Island and for Carnaby's Cockatoos in parts of the Western Australian wheatbelt. Artificial nest hollows are however not a panacea, they can attract introduced species (such as feral Honey Bees) and invading superabundant species such as Galahs and Corellas and can be relatively expensive to erect and monitor. Further research into size, shape and placement of artificial hollows needs to be undertaken and with it a responsibility to discourage introduced and feral species from using the hollows. We have no doubt however that a small number of PVC pipe hollows (specifically constructed for black cockatoos and unattractive to bees, Galahs and Corellas, see below) could be used effectively as an adequate offset for the loss of one or two habitat trees in this project area. The Brockman Bridge tree at UTM 414291 E, 6524206 N is a dead stag tree, in poor condition and the roadworks will almost certainly impact on this tree. The tree and the nest hollow section of the tree are probably not robust enough to allow for re-location. As there are other pairs of Carnaby's Cockatoos breeding and prospecting for hollows nearby, a small number (4 – 6) of PVC pipe hollows could be erected in this general area and would adequately offset the loss of this hollow. Even if this tree is retained there is obviously a lack of suitable hollows in adjacent areas and some artificial hollows would be of

benefit. A small number of PVC pipe hollows could also be offered to local landholders (e.g. Chittering Landcare Group and local farmer Anne Graham) and erected in trees or on poles where they could be monitored each year. Overall the erection of 4 – 6 artificial hollows in the Brockman Bridge area, combined with some habitat enhancement of tree planting and revegetation of new verge areas would offset the loss of the Brockman Bridge nest tree.

Re-location of Nest Hollows

The re-location of nest trees is generally only possible with relatively small pole type veteran or stag trees. The stag nest tree, near south end of Brockman Bridge is already quite frail and would no doubt break up once pushed over or lifted. The nest hollow section could possibly be used as an entrance on an artificial PVC pipe hollow.

FEEDING SITES.

The current road design will also have a direct impact on a number of remnant patches of vegetation that had evidence of Carnaby's Cockatoos feeding in March, August and September 2005, especially sites with *Dryandra*, *Hakea* and *Corymbia* (e.g. map sites 13 – 19, 22 – 23, 25 – 26 and 28 – 31). Some of these sections of road verge contain vegetation ranging from 3.2 – 8 m. from the white line and the current road design will impact on a number of these feeding sites.

In August and September 2005 the area between map sites 22 – 23 at UTM 414839 E, 6525476 N and south to UTM 414864 E, 6525402 N (13 Marri trees) was an important feeding site for Carnaby's Cockatoos with considerable evidence that large numbers of birds had been foraging here for some time. There was also evidence that small numbers of birds had been feeding in the *Dryandra* at map sites 13 – 14 at UTM 413737 E, 6523636 N to UTM 413850 E, 6523743 N. If at all possible the vegetation in these two verge areas should be retained.

Sections of road verge vegetation that contained fairly extensive feeding sites.

Map site 13 – 14	UTM 413737 E, 6523636 N to UTM 413850 E, 6523743 N, west side of road, groves of *Dryandra sessilis.*
Map site 15	UTM 413916 E, 6523861 N, east side of road groves of *Dryandra spp.*
Map site 16 – 17	UTM 413889 E, 6523858 N, west side of road, *Dryandra sessilis, Hakea undulata* and *Hakea prostrata.* UTM 413901 E, 6523913 N, west side of road, grove of 3 Marri trees.
Map site 19	UTM 414202 E, 6524167 N, east side of road Marri and *Dryandra*

	spp.
Map site 22 – 23	UTM 414864 E, 6525402 N and UTM 414839 E, 6525476 N, west side of road, grove of Marri trees.
Map site 25	UTM 414720 E, 6525918 N, west side of road, grove of Marri trees.
Map site 28 & 29	UTM 414899 E, 6524504 N, east side of road, grove of Marri trees.

Conclusion

The clearing of some of this remnant verge vegetation will not have a significant impact on the survival of Carnaby's Cockatoo in the Bindoon region. It should be noted however that although these areas are small and may not be significant individually, as foraging habitat collectively and combined with other roadside verge vegetation in the region it could be important in the preservation of this local breeding population. We would suggest that the effects of clearing could be ameliorated by revegetation of sites of at least the equivalent area. The loss of some of this feeding habitat could be offset by regeneration of new verge to the north of the Brockman Bridge, regeneration of patches of degraded vegetation and protection of some sections of existing habitat especially the area between map sites 22 – 23 and 13 - 14. The impact of clearing of verge vegetation could also be reduced by revegetating new verges with plants that will provide a future food resource for Carnaby's Cockatoos. Local food plants such as *Corymbia, Dryandra, Hakea, Grevillea, Allocasuarina, Banksia* and *Eucalyptus* could also be donated to local landcare groups, schools, community facilities and local landowners to increase food supply for the cockatoos.

WORK SPECIFICATIONS (HANDLING, CONSTRUCTION AND ERECTION OF ARTIFICIAL NEST HOLLOWS).

PVC pipe hollows (R.E. Johnstone & T. Kirkby design). These have been designed specifically for black cockatoos and judging from studies so far are excellent for Carnaby's Cockatoos and unsuitable to European Honey Bees, Galahs and Corellas.

1. PVC industrial pipe, black, external diameter 350 mm, internal diameter 300 mm, depth or length of pipe 1 – 1.2 m.

2. Entrance – top entry (these cockatoos back into hollows), a lid or cap would partly weatherproof the hollow but it is not necessary and the open pipes are unattractive to feral bees, Galahs and Corellas.

3. Galvanized weldmesh or heavy wire mesh internal ladder 100 mm wide (about 20 mm square) or heavy chain bolted through the pipe with 2 -3 galvanized gutter bolts.

4. Two sacrificial chewing posts ca. 70 x 50 mm of hardwood i.e. Marri, Wandoo or Jarrah etc, fixed to sides of internal ladder. Pre-drill and attach through pipe with galvanized gutter bolts.

5. Floor, heavy duty stainless steel or galvanized mesh or possibly thick hardwood timber with drainage, shaped to fit internally with sharp or rough edges curled inwards. Fixed with galvanized or stainless steel tech screws.

6. Post or tree attachment, galvanized bracket (see photo) or galvanized 6 – 8 mm chain bolted to PVC pipe with internal washers and fixed to a tree or post with galvanized coach bolts in vertical or near vertical position.

Hollows should be erected facing away from prevailing weather and at a similar height to natural nests. Although these hollows are heavy they can be lifted into position with a rope and pulley by one person and held in place while being attached to a tree or post. A portable winch could also be used to position the hollow.

Position. Sites should be chosen near current breeding areas and where they can be monitored but preferably not conspicuous to the general public. If erected on private property they could be held in position by a cable to enable maintenance. The floor space filled to about 100 – 150 mm with charcoal and hardwood wood chips or wood debris to create a dry egg mat.

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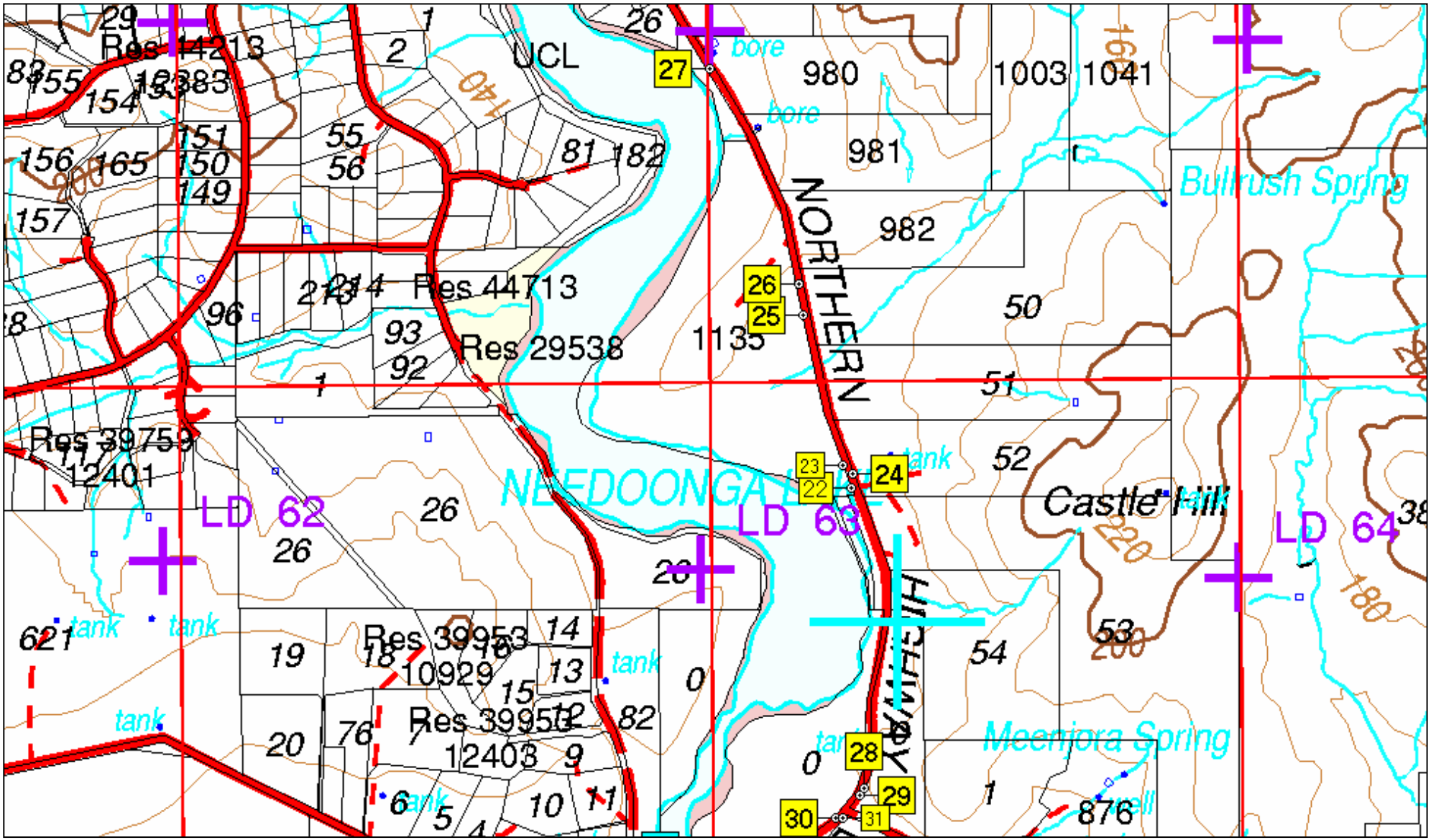
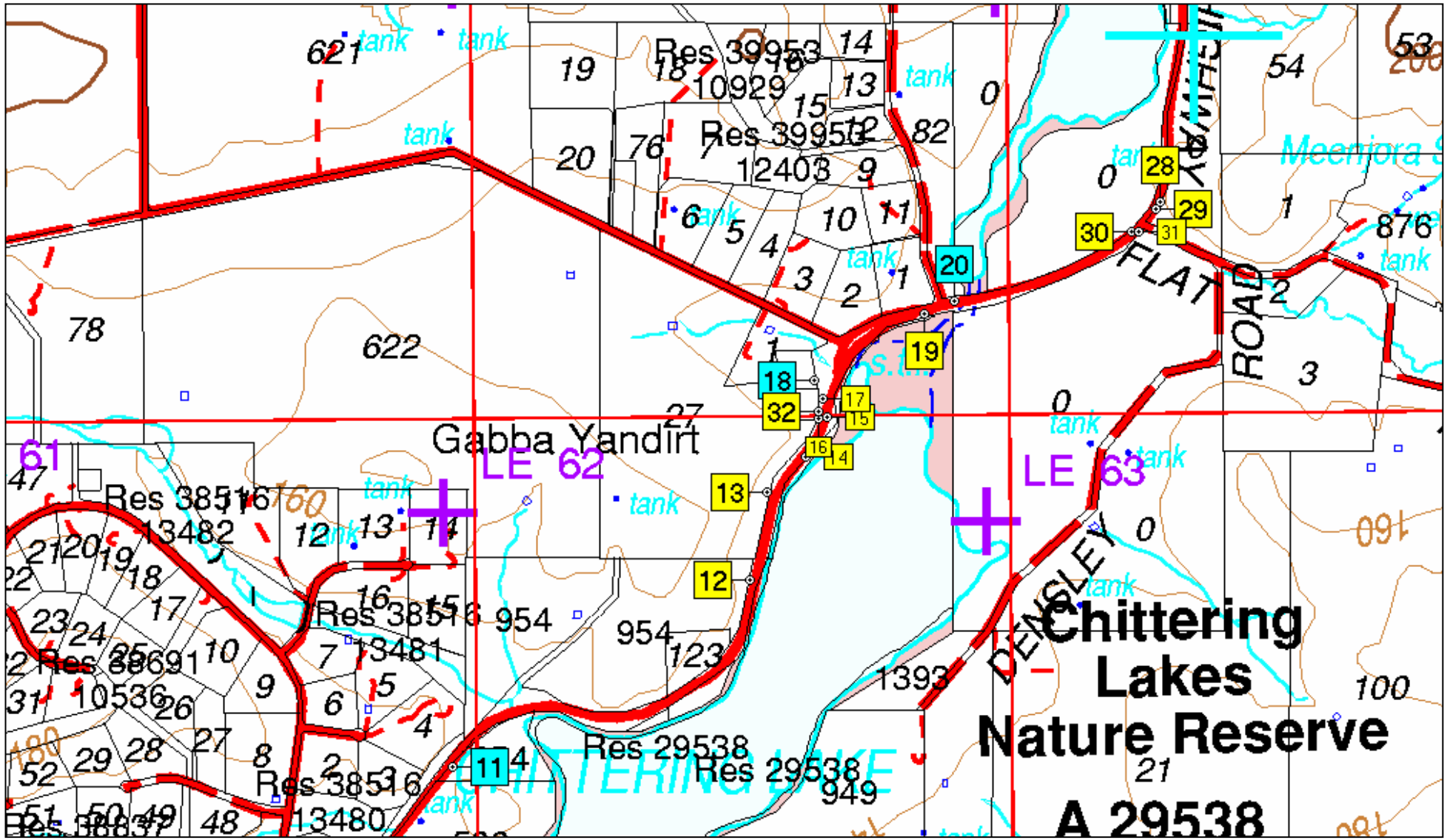
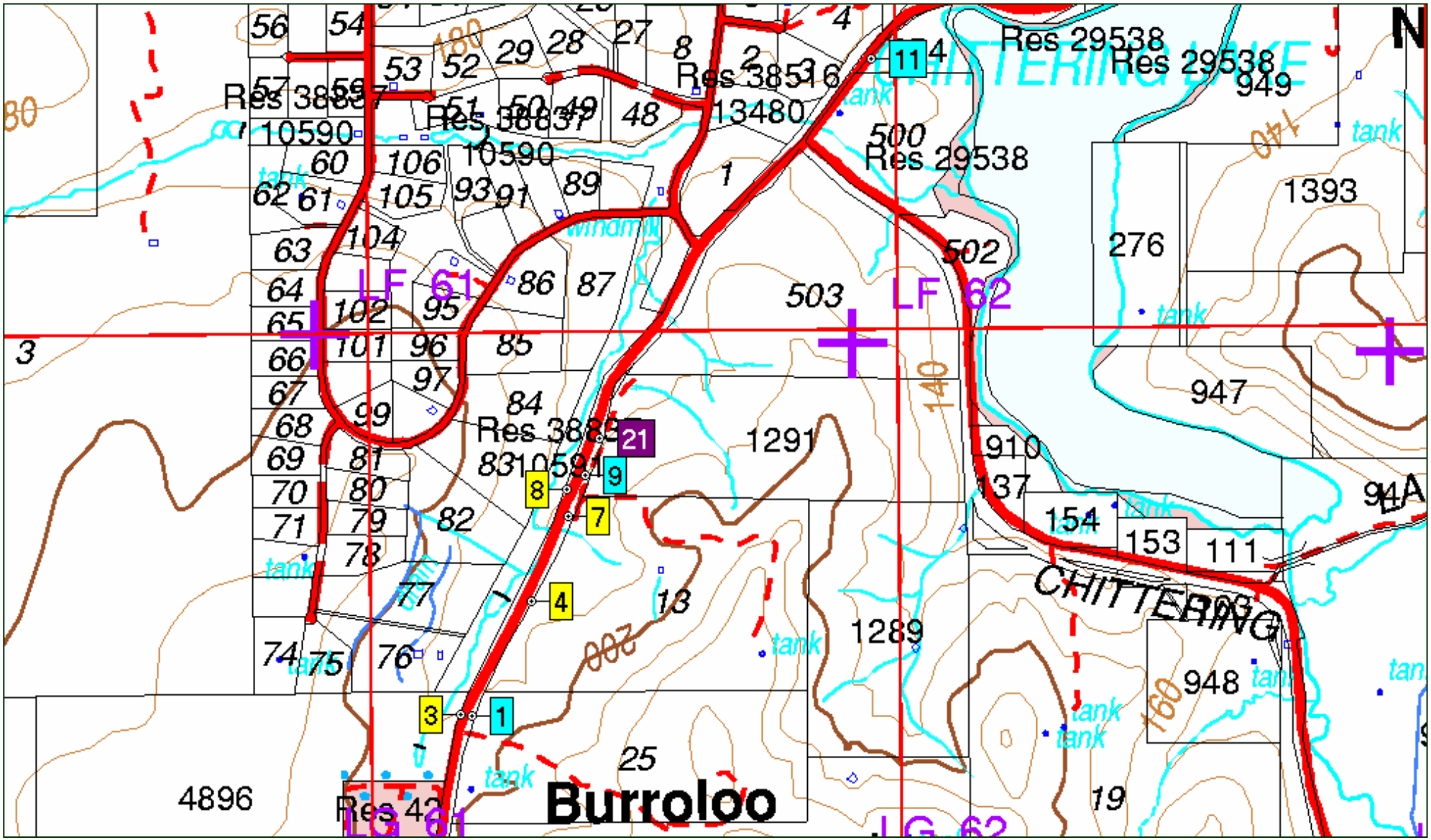
Carnaby's Cockatoo Survey, Bindoon.



Carnaby's Cockatoo Survey, Bindoon



Carnaby's Cockatoo Survey, Bindoon.



Appendix F

ABORIGINAL HERITAGE REPORT

Stage 2: Report on an archaeological, ethnographic and European heritage survey of proposed road works between 49.9SLK and 62.0SLK, at Bindoon, Western Australia

Prepared for Main Roads Western Australia

By
Australian Interaction Consultants
October 2004

CONTENTS

This report is a result of the combined efforts of the AIC team:

Claire Allen *BA (Hons) Archaeology*	Research, reporting, European heritage
Sarah Ibbitson *BA (Hons) Archaeology*	Fieldwork
Donald Lantzke *BSc (Hons) Archaeology*	Fieldwork, reporting
Jeremy Maling *BA (Hons) Anthropology*	Fieldwork, reporting
Ron Parker *BA (Hons) Anthropology*	Fieldwork
Damien Lyndon *BA Media*	Report redaction

EXECUTIVE SUMMARY

Main Roads Western Australia is proposing road works along the Great Northern Highway between 49.9SLK and 62.0SLK, south of Bindoon, Western Australia.

AIC was engaged to undertake an Aboriginal Heritage Survey of the proposed road works area. AIC has previously completed Stage 1 of the Survey - the Desktop Preliminary Review.

Below are the results of Stage 2 of the Survey – Surveys (Archaeological and Ethnographic).

AIC engaged heritage consultants Donald Lantzke and Sarah Ibbitson to undertake an archaeological investigation of the proposed road works area. This was done on Tuesday the 5th of October.

The archaeological investigation identified one possible marked tree and two areas of potential historical heritage value. The two potential historical areas are the Upper Chittering primary school site and the Holy Trinity Anglican Church. As a result of these two sites being located within the project area, this study was extended to include a European heritage survey.

The European heritage survey was completed by historical archaeologist Claire Allen, and included research into primary and secondary records, Heritage Council records and assessments, and discussion with the Bindoon and Districts Historical Society. Two sites of European heritage are located within the project area, with the Upper Chittering Primary School likely to be impacted by works. Avoidance of this site is preferable but not necessary under legislation.

Two Native Title Claims were identified over the area of proposed development. The Combined Metropolitan Working Group Claim (WAG0142/98; WC99/006) and the Yued Claim (WAG6192/98; WC97/071) were the identified groups. AIC contacted Iva Hayward Jackson and William Warrell to organise the CMWG and Yued NTC representatives respectively and to make arrangements for the ethnographic field inspection.

The CMWG representatives consulted were Richard Wilkes, Warren Wilkes, Olive Wilkes, Alison Wilkes, Albert Corunna, Trina Corunna, Leroy Corunna, Vanessa Corunna, Greg Garlett, Ray Garlett, Kelvin Garlett, Annette Garlett, Robert Bropho, Bella Bropho, Mena Bropho, and Iva Hayward-Jackson. Toopy Bodney was also consulted but did not attend the meeting. The Yued representatives consulted were William Warrell, Jenny Mogridge, Alice Warrell and Fred Mogridge.

AIC engaged heritage consultants Ron Parker and Jeremy Maling to complete a field inspection of the proposed works with representatives of the abovementioned groups.

The field inspection of the proposed works area was undertaken on Wednesday the 6th of October 2004 with the listed CMWG NTC representatives and Yued NTC representatives. MRWA representatives Tony Saraullo and Karen Chiang were present to meet with the party and explain the details of the project.

The project proposal was detailed and discussed with the assistance of maps. The party inspected the proposed road works by vehicle, stopping at various points along the way to discuss the project and heritage concerns in further detail.

Several sites and areas of cultural heritage significance were identified by the CMWG and Yued representatives during the field inspection including, a single marked tree, Burroloo Well and an associated creek, Brockman River and associated lakes, Holy Trinity Church, and a cluster of marked trees. The Elders also stated that the general area was significant to them, historically, spiritually, and as a place where some of them hunt and gather today. The rivers, waterways and hills in the area were identified as being of mythological significance and as forming part of a sites complex. The Elders also stated that the Darling Scarp itself is significant to them as a site.

The CMWG and Yued representatives raised the following concerns and requests regarding the proposed road works:

- That the sites identified by them be recorded with DIA and that the impact of the proposed works upon them be minimised.
- That, in order to protect the wetlands in the area, the proposed road works take place on the opposite side of the road to where wetlands are located.
- That, given the potential for subsurface material to exist in the area, MRWA employ Aboriginal monitors during ground disturbance activity.
- That MRWA construct signage in the proposed car bays illustrating the Aboriginal Heritage of the area.

The CMWG and Yued representatives stated that, given that their requests are met, they would not object to the planned project as described to them.

AIC will lodge the necessary site recording forms with the Department of Indigenous Affairs for the places identified by the CMWG and Yued representatives.

Given the results of the archaeological, ethnographic and European heritage surveys, AIC recommends that:

- There are no obvious archaeological impediments to the proposed development proceeding.
- Main Roads exercise caution during blasting works around the Holy Trinity Church.
- Main Roads avoid the Upper Chittering Primary School site where possible.

- Where possible, MRWA undertake road works on the opposite side of the road to where wetlands are located.
- MRWA employ Aboriginal monitors during ground disturbance activity, under an agreement to be determined in the near future.
- MRWA consider the request by the Aboriginal representatives for the installation of signage that acknowledges the Aboriginal Heritage of the area.
- MRWA take steps to ensure that they comply with both the Aboriginal Heritage Act (1972), Heritage of Western Australia Act (1990), and the Shire of Chittering's municipal planning schemes.
- MRWA staff and contracting personnel be made fully aware of their obligations under The Act.

Given that the above conditions are met, the Nyungah Elders have not presented any reason why the project cannot proceed.

ACKNOWLEDGEMENTS

AIC acknowledges the input and participation of Richard Wilkes, Warren Wilkes, Olive Wilkes, Alison Wilkes, Albert Corunna, Trina Corunna, Leroy Corunna, Vanessa Corunna, Greg Garlett, Ray Garlett, Kelvin Garlett, Annette Garlett, Robert Bropho, Bella Bropho, Mena Bropho, Iva Hayward-Jackson, Toopy Bodney, William Warrell, Jenny Mogridge, Alice Warrell and Fred Mogridge, who have contributed by providing information about the culturally significant attributes and features of the survey area. Bob Lissett of the Bindoon and Districts Historical Society also assisted by providing information about European heritage issues in the area.

Our appreciation for the input and participation of the staff of Main Roads is also expressed, in particular Tony Saraullo and Karen Chiang.

ABBREVIATIONS

The Act	*Aboriginal Heritage Act (1972)*
ACMC	*Aboriginal Cultural Material Committee*
AIC	*Australian Interaction Consultants*
CMWG	*Combined Metropolitan Working Group*
DIA	*Department of Indigenous Affairs*
NTCs	*Native Title Claimants*
MRWA	*Main Roads Western Australia*

DISCLAIMER

AIC attempts to give voice to the Indigenous people who take part in surveys such as the one reported here. As such, we neither claim the knowledge revealed to us, nor can we necessarily vouch for the veracity of the information given. We do, however, consult with those people who we consider to have the best knowledge of the area subject to the enquiry. In those instances where no ethnographic information is presented, it should not be presumed that no heritage values are present. Often, we are told by Indigenous people of how they have not known the consultant sufficiently well, or they have not been in the appropriate company, and have claimed ignorance of places that they may assert as a site at a different time, under different circumstances. Within the pages of this report we have intended that only the FACT of a site be recorded. This report is not designed to be the basis of the recording of sites – it is designed to advise the client of those places that may need to be accommodated under the Act. More elaborate details of the place or object will be provided in the site recording forms that AIC will submit to DIA to enable the site recording process to be completed.

GPS DATUM

The GPS datum used during this survey was either **WGS 84 or MGA 94**

LIMITATIONS

Whereas we endeavour to pin point geographical/site locations, the limitations of handheld GPS devices will create inaccuracies on occasion. Also, the potential for error from datum shift is ever present.

1. BRIEF AND REASON FOR STUDY

1.1 Main Roads Western Australia is proposing road works along the Great Northern Highway between 49.9SLK and 62.0SLK, south of Bindoon, Western Australia.

1.2 AIC previously completed Stage 1 of the survey for Main Roads in the form of a preliminary desktop. The desktop recommended that there was the potential for as yet unreported ethnographic and archaeological sites to exist in the area of the proposed road works area.

1.3 As had already been planned for Stage 2, ethnographic and archaeological surveys of the proposed road works area were deemed necessary to clarify and ascertain the Aboriginal heritage issues relevant to the project.

1.4 Two Native Title Claims were identified in the area, being the The Combined Metropolitan Working Group Claim (WAG0142/98; WC99/006) and the Yued Claim (WAG6192/98; WC97/071). Consultation with these groups was then undertaken.

2. METHODOLOGY

In the completion of this project AIC will follow the methodology set out below:

- Search the DIA sites database for known and recorded sites and the reports of previous surveys completed in, or near, the project area.
- Analyse the results of the above.
- Conduct an archaeological inspection of the project area.
- Identify people and groups that have a connection with the project area.
- Discuss the project with the indigenous people ascertained to have knowledge of the area.
- Conduct a field inspection of the project area with those people who wish to participate.
- Prepare a draft report of the proceedings of the research and consultation.
- Submit the draft report to all participating groups.
- Edit the report where necessary.
- Submit the final report to all groups including the Perth offices of the DIA.

3. CULTURAL AND PHYSICAL BACKGROUND

3.1 DIA research

3.1.1 Much of the relevant background has been presented in the AIC Stage 1 desktop analysis report and thus will only be repeated briefly in this report. AIC conducted a search of the Department of Indigenous Affairs Register of Aboriginal Sites database on the 8th of September 2004.

3.1.2 The area searched was contained within the following coordinates:
MGA Coordinates - MGA Zone: 50
Easting 408500, Northing 6517000
Easting 414000, Northing 6525000
Easting 414000, Northing 6527000
Easting 415500, Northing 6527000
Easting 415500, Northing 6525000
Easting 410000, Northing 6517000

3.1.3 Based on that search area, a print out of recorded sites was obtained and analysed. The search revealed two (2) previously recorded sites in the general area and one (1) report related to Aboriginal heritage in the search area.

3.1.4 The two previously recorded sites are in close proximity to the planned road works, and may be impacted upon by the undertaking.

3.1.5 A summary of these sites is given in Table 1, below.

SITE ID	SITE #	SITE NAME	Arc/Eth	TYPE	PROXIMITY
3422	S02712	BINDOON HILL	Arc/Eth	Burial	DIA defined boundary over proposed road works area.
3528	S02524	BURROLOO WELL.	Arc	Artefacts/Scatter	DIA defined boundary between 52.4SLK and 54.6SLK (that is, appears to be outside the proposed road works area).

Table 1: Synthesis of previously recorded sites identified during archival search

3.2 Site Details

3.2.1 3422; S02712; BINDOON HILL

3.2.2 Site Id 3422 was reported as a burial site in 1991 by Mrs D.J. Hughes, an elderly woman from Gosnells. On the related Site Reporting Form, Mrs Hughes reported the existence of a burial ground in the Bindoon Hill area where, "people were buried facing west with their possessions (tobacco tins, spears) on the ground". On a DIA memorandum (dated: 19/02/91) regarding the report, Peter Randolph writes that Mrs Hughes, "recalls a

burial ground on main north south road Bindoon to Wanamal at Devil's Elbow on top of hill… later the road was straightened at put right through the area". The map reference given on the Site Reporting Form was:

1:250,000 Mapsheet No:	SH50-14
Imperial Grid Reference:	41-.12-
Metric Grid Reference:	41-.52-

3.2.3 From further investigation (a search of http://www.whereis.com.au), the "main north south road Bindoon to Wanamal" is most likely a reference to "The Midlands Road", which is to the north, and outside, of the proposed road works area. However, DIA geographical data defines the boundaries of Site Id 3422 as encompassing the proposed road works from beyond 62.0SLK down to approximately 53.5SLK. Thus, although the location of the reported burial ground is unclear, the proposed road works may impact upon it. The DIA memorandum notes that Mrs Hughes mentioned the New Norcia Mission as a further source of information regarding the site, although the Site Reporting Form notes that Mrs Hughes had not talked with local Aboriginal people about the site.

3.2.4 This site has been deemed by the ACMC to have insufficient information and has been placed on the interim register of Aboriginal Sites (ACMC 13/06/00). Ethnographic and archaeological surveys of this site will be undertaken during Stage 2.

3.2.5 3528**; S02524; BURROLOO WELL.**

3.2.6 In 1989, L. Talbot of the Department of Conservation and Land Management reported site Id 3528 as a possible artefacts/scatter site. The related Site Reporting Form reports that a few pieces of quartz chips were noticed close to Burroloo Well and approximately 100 metres downstream on graded firebreaks. The location information given on the Site Reporting Form was:

1:250,000 Mapsheet No:	SH50-14
Imperial Grid Reference:	406.109
Metric Grid Reference:	411.520
Other Mapsheet No:	Julimar 1:50,000
Latitude:	31° 27′ -″S
Longitude:	116º 04′ -″E
A.M.G.:	112202E

3.2.7 The Site Reporting Form locates the quartz chips within a reserve 400m x 300m adjacent to, and on the western side of, Great Northern Highway. It appears that this area is adjacent to the Great Northern Highway between 52.4SLK and 54.6SLK, as are the DIA defined boundaries for Site Id 3528. The Great Northern Highway between 52.4SLK and 54.6SLK is

not subject to the proposed road works and thus Site Id 3528 is unlikely to be impacted by them. Burroloo Well was described as a permanent water source, and the surrounding area as overgrown with scrub and grass. The quartz chips had become visible as a result of disturbance. Talbot notes that, although little quartz material was visible, there was probably more in the vegetated, undisturbed areas. This site has been deemed by the ACMC to have insufficient information and has been placed on the interim register of Aboriginal Sites (ACMC 04/03/04). Ethnographic and archaeological surveys of this site will be undertaken during Stage 2.

3.3 Report Details

3.3.1 105699; HSR MW 2001 MAC [OWE]
Machin, B. (2001). *Aboriginal Heritage issues and cable crossings: upper Canning River downstream from Nicholson Road traffic bridge adjacent downstream from Canning Bridge and Narrows bridge utilizing internal bridge structure Swan River adjacent upstream to Causeway*.

3.3.2 This report was unavailable for viewing at DIA. Its title, however, suggests that it is not related to the proposed road works area. AIC is currently waiting for further information from DIA regarding this report.

3.3.3 AIC Desktop Report
Maling, J. and Lantzke, D. (2003). *Desktop Investigative Study of Aboriginal Heritage Issues relating to Proposed Intersection Improvements along Brand Highway at Dewar Road, Gingin Brook Road and at the Proposed Connection of Hoy Road between 29.3 SLK & 34.3 SLK Brand Highway in Western Australia*. Unpublished report prepared for Kellogg Brown and Root Pty Ltd (on behalf of Main Roads Western Australia).

3.3.4 This report did not cover the area of the currently proposed road works. However, it does review several sites and reports that cover the nearby area of Gingin and raises several Aboriginal heritage issues that may be pertinent to the current proposal. As this report was previously made available to MRWA its contents will not be covered in detail here. The report researched four reports (Parker and Sauman 1998; Parker 1999; Sauman, Parker, Parker, and Lantzke 2001; and Parker 2002) and three sites (16036/ HONEYCOMB ROAD, GINGIN; 20008/Gingin Brook Waggyl Site; and 20651/Moonda Brook). Ethnographic issues identified in the report (p.10-13) included:

- The ethnographic significance of a section of redgums along Honeycomb Road (Site Id 16036).
- The significance of waterways in the area. In 2001 Gingin Brook (Site Id 20008), Moonda Brook (Site Id 20651), and Lennard Brook (Site

Id 20650) were identified by Yued NTC representatives as being of mythological significance as Waggyl sites.

- The general significance of waterways and wetlands in the area, including as places of fauna habitat.
- Aboriginal people requested minimal disturbance to the aforementioned places.
- Concern for sub-surface archaeological materials, including skeletal remains, which may be disturbed during the excavation phase of projects.
- Request for the employment of Nyungah people as monitors.
- The possibility of Aboriginal employment on projects.

3.3.5 The report stated the archaeological significance of the area was unclear and concluded that, "the potential for unrecorded archaeological material to be present in the area may warrant an archaeological survey or monitoring of works when undertaken" (p.20).

3.4 Analysis

3.4.1 The two previously recorded sites are of both archaeological (Arc) and ethnographic (Eth) sites types, of which none are closed sites. The closed nature of a site indicates that culturally sensitive information is involved and written permission is required from the informant/recorder to gain access to the file.

3.4.2 The presence of the two previously recorded sites combined with an apparent lack of reported Aboriginal Heritage Surveys in the area of the proposed road works indicate that the Aboriginal heritage values of the area are largely unknown but have the potential to be significant. The two sites were reported on an ad hoc basis over thirteen years ago; while the one listed report does not appear to relate to the area of the proposed road works. This lack of any systematic reporting or research into the Aboriginal Heritage of the area may explain the low number of reported sites in the area of the proposed road works and serves to highlight the importance of the archaeological and ethnographic surveys planned for Stage 2.

3.4.3 The two previously recorded sites point to a number of potential Aboriginal heritage issues. The presence of a reported burial site (Site Id 3422) in the area of the proposed road works raises a number of potential heritage issues, namely the potential for skeletal material to exist in the area of the proposed road works. The precise location of the burial site is unclear and the site has been deemed to contain insufficient information but the fact that the DIA boundary covers the proposed road works raises the potential for skeletal material to be uncovered during the proposed road works. A nearby site (3929/S01788/LENNARD BROOK) has also

been reported as a burial site (as well as a man-made structure, meeting, camping, plant resource, and water resource site), lending further evidence to the potential for skeletal material to exist in the area of the proposed road works. This highlights the importance of conducting an archaeological survey of the proposed road works as planned in Stage 2. Dependent on the results of this survey, and the ethnographic survey, archaeological monitoring of the proposed road works may be necessary.

3.4.4 The potential presence of a burial site also raises a number of ethnographic issues. The site file for Site Id 3422 suggests that no ethnographic consultation has been undertaken regarding the reported burial ground. Consultation with the relevant Aboriginal groups may reveal further details regarding its location. Furthermore, the potential presence of burials within the bounds of nearby proposed developments has led to requests by Aboriginal people for archaeological and/or Aboriginal monitoring during ground disturbance activities (see for example Sauman, Parker, Parker, and Lantzke 2001; and Parker 1999). These ethnographic issues will be addressed during the ethnographic survey planned for Stage 2.

3.4.5 The other site previously recorded site in the area (Site Id 3528) was of an archaeological nature (possible artefacts) and indicates that archaeological material may exist within the proposed road works area. As detailed previously, Site Id 3528 itself appears to be outside the area of the proposed road works. However, the reporter of the site, L. Talbot, reported the potential for further quartz in surrounding vegetated and undisturbed areas and also noted the proximity of the site to Lake Chittering which, he writes, “it seems, was well used by Aborigines so it is a likely spot for a site”. Furthermore, another potential artefact site (3353/S00092/BROCKMAN RIVER CREEK) was reported in 1970 further north of the proposed road works. The potential for artefact material to be uncovered with the proposed road works may also lead to a request by Aboriginal people for archaeological and/or Aboriginal monitoring of associated ground disturbance activity. The potential for archaeological material to exist in the area will again be addressed during the archaeological and ethnographic survey planned for Stage 2.

3.4.6 Other potential ethnographic and archaeological issues in the area are outlined in the summary of the desktop report by Maling and Lantzke above (2003). Furthermore, since the introduction of the Native Title Act in 1993 and the subsequent Draft Guidelines 1994 to the Aboriginal Heritage Act, both archaeological and ethnographic surveys are undertaken on a routine basis as developers become more aware of their obligations and responsibilities under the Act with regard to proposed works. As a result, consultation with Aboriginal elders who have knowledge of an area has been included and often results in further sites

being identified. These issues will also be addressed during the archaeological and ethnographic survey planned for Stage 2.

3.4.7 The DIA database search results and a map showing the location of existing sites in relation to the proposed works are attached.

3.5 Physical Environment

3.5.1 Bindoon is located on the Northern Sandplain geophysical unit, which comprises an extension of the Swan Coastal Plain (Beard 1990). Climate is described as a dry warm Mediterranean type with an average annual rainfall of 300–500 mm (Beard 1990). The region has a similar geomorphology to the Swan Coastal Plain with leached sandy soils near the coast and yellow sands with an earthy fabric further inland.

4. ARCHAEOLOGY

4.1 Introduction

4.1.1 Archaeology seeks to provide an interpretation of the past by examining the material record of past events that have survived into the present (see Trigger 1989). In part, archaeologists achieve this by examining humanly created artefacts and their contexts and attempt to create temporal and spatial sequences of past human activities, typically employing inductive research methods. This practice is sometimes referred to as producing *Culture History* (Thomas 1979; Fagan 1985).

4.1.2 More detailed archaeological analyses build on *Cultural Histories* and attempt to understand the processes that created or encouraged changes in past human activities and thus provide us with an understanding of how humans in the past have adapted to adverse or changing environments (both their social and physical environments). Such studies attempt to be more scientific, ostensibly utilising hypothetical-deductive methods and generally fall under the banner of *processual archaeology* (Fagan 1985).

4.1.3 More recent developments in the discipline attempt to place archaeology within the social and cultural sciences are referred to as *post-processual* or *interpretive* archaeology (Thomas 2000). These types of studies often look at the political nature of archaeology or use archaeology as a medium for challenging prevailing views about how the past and the present are conceptualised and presented.

4.1.4 Archaeology provides an interpretation of the past and indeed different archaeologists can provide different interpretations from the same dataset (see for example the sometimes noticeably different interpretations made by Lourandos 1997 and Mulvaney and Kamminga 1999). The question of interpretation and crafting of facts forms a significant part of interpretative archaeology (see Hodder 1987, 2000; Shanks and McGuire 2000; Tilley 2000). Archaeological interpretations of cultural material may also be at variance with ethnographic interpretations of the same objects although this has been little studied in an Australian context. Despite this, the disciplines of archaeology and ethnography should be seen as complementary ones.

4.1.5 The relationship between archaeology and heritage consultancy studies is not well articulated and in Australia has undergone radical shifts in the past few years (see Colley 2002). For various reasons, a considerable gulf has arisen between those practising "pure" research and those practising cultural resource management (see Clarke and Smith 1994).

4.1.6 Heritage consultancy studies occur as a result of legislative and government agency policy requirements designed to ensure compliance with legislation. Archaeological research, on the other hand, is directed through a combination research interests, methodology and design. As a result, the objectives of heritage consultancies tend to have little or no relationship to archaeological research objectives beyond the fact that both groups of practitioners look at similar things**.**

4.1.7 Broadly speaking, cultural heritage management comprises the range of principles, strategies and processes that are implemented in order to conserve elements of the cultural environment (Clarke and Smith 1994). Cultural heritage management is governed by Federal and State legislation (see Parrott 1991) and administered by government agencies, who develop and implement policy. Heritage consultants, normally archaeologists and anthropologists, undertake survey and analysis in order to identify and assess various elements of the cultural environment including sites, places and artefacts of cultural, historical, social and scientific value and significance.

4.1.8 Thus, in applied cultural heritage management, there is an interrelationship between the tiers of legislation, policy and practise with the actual practise of "doing" heritage management falling across all three tiers and thus being the shared responsibility of politicians, bureaucrats and consultants. As discussed in Section 2.2 above, these overlapping tasks and responsibilities, together with a lack of guidelines and standards, makes it difficult to determine where the responsibility for different aspects of heritage management strategies actually lie.

4.1.9 In the Western Australian context, the key State legislation defining and managing Aboriginal Heritage is the *Aboriginal Heritage Act 1972*. The Department of Indigenous Affairs is the government agency responsible for administering the *Aboriginal Heritage Act 1972* and developing and implementing policy. Specific aspects of the *Aboriginal Heritage Act 1972* and DIA policy pertinent to the conduct and reporting of archaeological surveys is discussed in Section 6, below.

4.1.10 In a practical context, heritage consultancy studies are constrained by the level of data and analysis that can be achieved. More often than not, these studies only examine archaeological materials visible on the ground surface with only speculation about what subsurface materials might be present. Archaeological surveys undertaken under the aegis of a heritage consultancy are typically project and area specific and allow little opportunity for examining wider regional patterns. While consultancy surveys can be placed into regional contexts and can be made to fit within a research framework, most of these types of surveys comprise standalone studies.

4.1.11 Butler and Niquette (1980) discuss a number of factors that strongly influence, mostly in a negative aspect, the conduct and scope of Heritage consultancy studies. They describe constraints including tight time schedules, a lack of qualified archaeologists working in the field, difficulties related to bureaucratic policy and processes, the presence in many areas of what are termed "Pinball Wizard" attitudes, an absence of uniform fieldwork and reporting standards and the lack of peer review facilities. Although this paper discusses circumstances in North America in the 1970s, many of the issues are applicable and relevant in Western Australia today and need to be examined in more detail.

4.1.12 Applied cultural heritage management must factor these considerations into the analysis and interpretation of survey results. Long-term management strategies designed to assimilate the results of consultative surveys into broader regional research designs are decidedly lacking. Whilst some of these problems can, and have been, addressed the dearth of heritage management strategies, policy and guidance from the government agencies ultimately responsible for these issues has created a malaise in Aboriginal Heritage protection.

4.1.13 To a certain extent, though, it is unclear where the responsibility for developing and implementing such management strategies lie (see Bowdler 1981). However, ongoing dialogue and interaction between agencies and consultants is seen as imperative. It is also worth noting that these sorts of problems in applied heritage management are not just restricted to Western Australia or even Australia (see Butler and Niquette 1980). However, in stark contrast to Western Australia, heritage practitioners and government agencies in the UK, USA and other parts of Australia have at least made efforts to examine these issues and address them (King 1998; Neuman and Sanford 2001; Hunter and Ralston 1993; Clarke and Smith 1994; Ross and McDonald 1996).

4.2 Archaeological background

4.2.1 Despite the many geomorphological similarities between the Northern Sandplain and the Swan Coastal Plain, the regions are markedly different archaeologically. Where, the Swan Coastal Plain possesses a plethora of known archaeological sites, the Northern Sandplain contains a dearth of previously recorded sites.

4.2.2 It is not clear whether this is a reflection of the different levels of systematic research undertaken in the different areas or the result of some other factor. Much of the Bindoon area was utilised as farmland shortly after the settlement of the Swan River Colony. This is likely to have significantly altered the archaeological signature of the region. Unlike the

Perth metropolitan region little archaeological survey and virtually no systematic archaeological survey has been undertaken in this area.

4.2.3 It has been speculated by Ferguson (1985) that there is a transition in the patterns of resource utilisation and occupation between the Swan Coastal Plain and the Northern Sandplains, in which the emphasis shifts from interdunal swamps on the Swan Coastal Plain (e.g. Hallam 1972; 1977; 1987) towards the riverine systems such as the Chapman, Greenough and Murchison Rivers. While data are scarce, the limited archaeological information available would tend to support such a notion. The absence of archaeological data from the Bindoon area does, however, present some difficulties in confirming or denying this notion.

4.3 Survey methodology

4.3.1 Prior to the commencement of the archaeological survey, the archaeological survey team met with Karen Chiang and Tony Saraullo, representatives from Main Roads. The overall scope of the project was discussed with them. The pair also provided confirmation of the parameters of the archaeological survey.

4.3.2 The archaeological survey was undertaken through a series of pedestrian transects, with the entirety of the route being examined in this way. Surface visibility across most of the survey area was extremely low averaging at less than 10% cover throughout.

4.4 Survey results

4.4.1 One potential scarred tree and two areas of potential historical archaeological significance were noted in the course of the archaeological survey.

4.4.2 The scarred tree is located on the road verge at the start of the proposed dual carriageway section of the survey area. The tree is a large, relatively old, eucalyptus located at the base of the road batter. The tree has two scars on the roadside side- one appears to have been the result of vehicle impact. It is of a similar shape to the scarring of a tree located adjacent to a roadside cross. The second scar occurs higher on the tree and is more oval in shape. It is difficult to ascertain the nature and origin of this scarring.

4.4.3 The two areas identified as having potential historical archaeological significance were the Holy Trinity Church property and the Upper Chittering School grounds. It is proposed to take several metres of land inside the church property fence line and this may impact upon unmarked

burials in the church property. The Upper Chittering School ground is marked with a sign from the Shire of Chittering indicating it is on the municipal heritage register. Its precise location could not be ascertained owing to the thick grass cover in this area and therefore it is not possible to ascertain how this property might be impacted upon by the proposed development.

4.5 Discussion

4.5.1 The absence of archaeological material along the proposed road realignment route is not surprising given the high levels of disturbance sustained to most of the road corridor. Little of this area appears to be undisturbed and most of the native vegetation comprises regrowth. The areas of land adjacent to the waterways tend to be clogged with Watsonia. The section of paddock into which it is proposed to create a major road realignment was covered by a thick carpet of grasses and there was no surface visibility in this area.

4.5.2 This means that it is difficult to ascertain what the past and present archaeological signature of this area might have been. As a result it is not possible to provide any meaningful assessment of the likelihood of subsurface remains along the less disturbed portions of the proposed realignment.

5. EUROPEAN HERITAGE

5.1 Introduction

5.1.1 In most areas of Western Australia, the Aboriginal Heritage values of an area are considered first when development is to be undertaken. However, in some areas, historic European heritage may also be impacted by works.

5.1.2 European heritage is important, as it provides a shared history for many communities around the state. For this reason, it is protected by the Heritage of Western Australia Act (1990). The legal implications of the Act combine with the moral obligations garnered by a property being classified by the National Trust or listed on the local Shire Municipal Inventory of heritage places to require that European heritage is considered by developers, and protected where possible.

5.1.3 There are few legal obligations required of developers with regards to heritage places. Properties are only accorded legislated protection of they are placed on the Heritage Council Register of Places. In this instance, application must be made to the Heritage Council if works are to disrupt any aspect of the property. Conservation Orders are also made by the Heritage Council. These prevent any work from taking place without permission from the Heritage Council.

5.1.4 Places registered on the local Shire Municipal Inventory are usually included on the Town Planning Scheme, and local by-laws may also require consultation with the Shire before these properties are disrupted. However, only listing with the Heritage Council will protect a property. All other obligations are moral, and should be considered in the interest of maintaining a positive relationship with local communities.

5.2 Shire of Chittering History

5.2.1 Chittering was one of the earliest places settled by European in Western Australia in the 1830s. Many prominent early families, including the Brockmans settled in the area before moving on to other endeavours across the state (Buchanan 2000:5). The area has been continually utilised for agricultural purposes since that time. There has always been a strong sense of community in the area, as evidenced by the fundraising efforts that contributed to buildings such as the Holy Trinity Anglican Church and war memorials (Buchanan 2000).

5.3 Heritage Council Register of Places

5.3.1 The Shire of Chittering contains a total of 138 properties listed on the Heritage Council Places Database. There are only three properties listed in the database that are heritage listed and subject to the legislation. The same three properties are also heritage classified with the National Trust of Western Australia. These are the listed in the table below:

Reg. no.	Name	Location
3101	Catholic Agricultural College	Great Northern Highway and Dewar's Pool Road
478	Former Chittering Road Board Office	Great Northern Highway and Teatree Road
3569	Enderslea	Blue Plains Road and Chittering Road

5.3.2 Although two of the three properties are along Great Northern Highway, neither of these is within the survey area. Therefore, there is no European heritage impact posed by these sites over the development.

5.4 Municipal Inventory and other Heritage Considerations

5.4.1 Although there are no registered places of European heritage along the route of the proposed works, there are still heritage sites present that should be considered. Two sites in particular are notable along the route. These are the Holy Trinity Anglican Church, Bindoon, and the Upper Chittering Primary School site. Both of these places are on the Municipal Inventory of heritage places for the Shire of Chittering, although records for the school site were not located. The Church is also on the Heritage Council Places Database, and may be considered for registration in the future.

5.4.2 Other sites may also exist along the route that are not currently registered or known. These include the homes of the earliest settlers, roadhouses and other early structures. The ruins of these buildings are frequently visible along the Great Northern Highway and comprise part of the historic character of the area. Although many of the buildings on these sites are now partly or completely ruined, they may provide a useful archaeological resource for the future in terms of understanding the lives of early settlers to the Chittering area.

Holy Trinity Anglican Church and Cemetery

5.4.3 The Holy Trinity Anglican Church was constructed in 1885, consecrated in 1887, and now stands on a bend of the Great Northern Highway within the area of the proposed works. The Church was the first in the area, and serviced as many as 90 people every Sunday (Buchanan 2000:108).

Services continue in the same manner today, albeit with a reduced congregation.

5.4.4 The Church was initially funded by the Anglican Church, and the money provided to construct the building was considered a loan to the community, which was paid back over a number of years through fundraisers (Buchanan 2000:106). Marriages, christenings and funerals of many prominent families in the area have occurred at the church over the past 119 years.

5.4.5 The church is one of only a handful in Western Australia with an adjoining cemetery. The first burial took place in 1886 before the official consecration of the church. Over 100 people are buried in the small cemetery (Gray 2001).

5.4.6 The building has been assessed as significant by Gray (2001: 27-28)) for a number of reasons. The importance of the building over time to the local community renders it of high significance (Gray 2001:30). The style of the building itself is Victorian Free Gothic, and the church is one of few examples of this style across the state. The adjoining cemetery is a rarity in Western Australia, and the specific individuals buried there are in many instances members of important local families (Gray 2001:29).

5.4.7 Despite this, the building is not yet registered by the Heritage Council, or the National Trust. However, in accordance with the wishes of the Anglican Church (who still own the building and land) and the local community, the Municipal Inventory suggests the highest level of protection for the site. The fence surrounding the site is itself of some historical significance, having been constructed in 1926 following a fundraising competition (Buchanan 2000).

5.4.8 The Gray (2001) heritage assessment suggests that only the church and the area of the cemetery are of high significance. This leaves the area closest to the existing highway, that likely to be impacted by works, as an area of low significance. As long as works are limited to this area, it is unlikely that any heritage issues should arise. However, legend holds that the area was an Aboriginal burial ground before the church was constructed, and therefore a reasonable amount of care should be taken whilst cutting into the roadside banks in case skeletal remains are located.

Upper Chittering Primary School

5.4.9 Another property has been located along the route of the proposed changes. The exact location of the Upper Chittering Primary School is not known, but according to signage at the site, it is also on the Shire of Chittering Municipal Inventory. Records of the site were not located in

the Municipal Inventory when searched. This site is not considered significant at present, as the building itself no longer remains.

5.4.10 The school as an institution, however, is of some significance to the area. It was the first school constructed in the Chittering area, in 1894 after petitions from the local residents to the government (Buchanan 2000: 154). The school was built on the land of the prominent local Spice family, who had first settled in the area in the 1840s. It was attended until 1905 (Buchanan 2000: 154). The building itself is believed to have been demolished comparatively recently, and there is no indication of where it may have been on the property.

5.5 Bindoon and Districts Historical Society

5.5.1 Contact was made with the Bindoon and Districts Historical Society to determine whether any further European heritage issues may be encountered during works. Mr. Bob Lissett was forwarded as an appropriate contact. Mr. Lissett is a member of the Historical Society, and has lived in the area for sixty years. As a member of the local Safe Roads Board, Mr. Lissett is also familiar with the planned works on Great Northern Highway.

5.5.2 Information was sought from Mr. Lissett regarding the potential impact of works over any known historical sites in the area. He confirmed that the graves at the cemetery are all located on the north and west side, rather than on the south bank where works are to occur. There has been some community concern as to the potential impact of nearby blasting works on the building, and this may be a consideration for Main Roads. However, it does not appear likely that the proposed works will adversely affect the site.

5.5.3 Mr. Lissett was also able to shed light on the location of the Upper Chittering Primary School site. Local knowledge holds that a pile of mud bricks about 50 metres to the north-west of a brick shed in Donaldson's paddock is all that remains of the 1894 school building. This site is very close to the proposed route of works.

5.5.4 It is suggested that impact to this site could be minimized by directing the road to the east of the shed rather than the west. Although this would be more complicated in terms of construction, it has been noted to Mr. Lissett by truck drivers that this route may be preferable in terms of safety, as well as in preserving the Upper Chittering Primary School site.

5.5.5 Mr. Lissett can provide further information regarding the location of sites if required, and his contact details are available through AIC.

6. ETHNOGRAPHY

6.1 Consulting on Cultural Heritage in the Contemporary Context

6.1.1 Indigenous people in Western Australia have been adapting, out of necessity, to the European culture for some seven generations. That adaptation has taken many forms and has, to a large extent, resulted in a myriad of synthesised, in the Hegelian sense, local systems of role and identity construction. Those evolving constructions, whilst based to varying degrees on the traditional beliefs of the old people, today have an emphasis on social strata based on age and experience, and the care and preservation of the environment.

6.1.2 Pre-contact indigenous people had a well-developed system of kinship that located different responsibilities with various kinsfolk. These responsibilities included those that perpetuated and safeguarded all aspects of the pre-literate society; not the least of which were those relating to ceremony and places. Significant sites included those associated with conception, renewal, initiation, birth, camping, and the majority of the physical terrain concerning Dreaming activities of the creation beings, and ceremonial locations generally. The people, both in the past and in the present, relate to the land in a spiritual and symbiotic manner that is difficult for non-Aboriginal people to comprehend or empathise with. Within that system it was (and in many places still is) usual for the responsibility, or "ownership", of the correct and full story of any place to reside with few, or even solitary, individuals. However, as people progress through the various stages of their initiation into the Law (as decree and established by the Dreaming Beings) they were made aware of the activities of the Creators or Earth Formers as they progressed throughout the countryside. As an example, men from Central Australian areas would be taught of the earth creating exploits of the various Dreaming Beings as they had journeyed across the "soft" earth forming ridges, hills waterways, claypans, lakes etc.

6.1.3 To gain information about any site it is proper and important to consult with the person or people who are the "proper" or "traditional" custodians of the country, and the knowledge surrounding it – even though many others would be familiar with the story; there were those that had prime custody of that place. Sometimes the traditional custodian of a place would perish and the story would not have been passed down to his, or her, descendants and knowledgeable people from elsewhere would have to be consulted to revitalise the knowledge locally.

6.1.4 Under the Aboriginal Heritage Act (1972)[the Act] all sites that Aboriginal people consider important can be identified and protected. The draft ***Guidelines for Aboriginal Heritage Assessment in Western Australia (1994)*** suggests under its section *Ethnographic reporting requirements* (2)

> *All Aboriginal individuals and formal organisations which have a reasonable interest in the land in question or who might reasonably be expected to have an interest in the land that is subject to the survey, should be consulted and their views reported, or the reasons for their exclusion discussed.*

6.1.5 This report tells of all who have been approached, both the groups and the individuals, in an attempt to include all those who might have knowledge of the country covered by the project in question. However, for a number of reasons it sometimes happens that our best efforts to make contact are to no avail and those people do not take part in the survey.

6.1.6 In an attempt to gain an understanding of the contemporary Aboriginal world view and circumstance, we take an extract from the foreword of Elkin's ***Aboriginal Men of High Degree*** (1994):

> *Changes that have been forced on the tradition of Aboriginal men of high degree have caused contemporary Australian Aboriginal society to adapt to the forceful powers of colonial oppression. The dominant white culture in Australia is based on a historical belief that Aborigines must be assimilated into the Australian culture. In 200 years we have seen Aboriginal religions, customs, languages, land management, and social cohesion calculatedly forced out of Australian Aborigine society. The view of whites has been, and continues to be, that Australians are one people and that Aborigines must be assimilated to remove the indigenous consciousness from the "new nation". The assimilation program has failed, but it is still a covert objective in the minds of the majority of Australians.*
>
> *Aboriginal perspective's on spiritual knowledge in such areas as healing, death, punishment, magic, and interactive psychic and animistic beliefs are not clearly understood by white people. Even most Aboriginal people today do not understand them. Those who do have some grasp on Aboriginal spirituality to the depth of high degree are adapting that knowledge to a broader need in Aboriginal cultural maintenance.*
>
> *Contemporary Aboriginal society is changing at an incredible pace. Its amalgamation with Western technologies and its yielding to social and cultural pressures create an immense threat to indigenous relationships with the world ecological order. Aboriginal people are in the throes of a political struggle to have their land and rights restored. As modern society intrudes into indigenous minds, introducing different values and directions, Aborigines can be expected to lose sight of certain principles in the process.*
>
> *"Aboriginal land rights" does not mean that the people are simply entitled to land. Nor does the term mean that the land owes anything to the people. Aborigines do not justify land rights in terms of economy, accommodation, or possession. Rather, Aboriginal land rights represent a whole set of responsibilities, among which is the obligation to preserve the unique essence of their original law. Aborigines have*

the responsibility to be custodians of land, sea, and sky. They must remain accountable to the ecological world, which accepts indigenous intrusion and use of that ecology only on sound practices of interaction with the spirit of the land, manifested in strict rules of respect and protection.

Today, Aboriginal men and women of high degree, who understand their responsibilities as keepers of indigenous principles, can learn much from Professor Elkin's Aboriginal Men of High Degree—not about the tribal practice or mystical world of yesterday, but about the intangible accountability woven between the lines of this book. Elkin brings out the views but not the inner workings; Aboriginal people of high degree must seek the details for themselves, whether in the areas of healing, the law, the animistic meshing with people, or the rules of land management. In all those endeavours, the responsibilities of indigenous people of high degree can be carried with us as a symbol of human accountability in being allowed the right to participate in the planet's ecology.

Undoubtedly, failure to achieve recognition and practice of indigenous principles will end this era of human life on planet Earth.

Jim Everett
Aboriginal Writer in Residence
Riawunna
Aboriginal Student Services
University of Tasmania
June 1993

6.2 Preconsultation

6.2.1 Two Native Title Claims were identified over the area of proposed development. The Combined Metropolitan Working Group Claim (WAG0142/98; WC99/006) and the Yued Claim (WAG6192/98; WC97/071) were the identified groups.

6.2.2 The contact person for CMWG was Iva Hayward Jackson. The identified groups for consultation were the Garlett, Wilkes, Bropho and Corunna families. The CMWG representatives consulted were Richard Wilkes, Warren Wilkes, Olive Wilkes, Alison Wilkes, Albert Corunna, Trina Corunna, Leroy Corunna, Vanessa Corunna, Greg Garlett, Ray Garlett, Kelvin Garlett, Annette Garlett, Robert Bropho, Bella Bropho, Mena Bropho, and Iva Hayward-Jackson. Toopy Bodney was also consulted but did not attend the meeting.

6.2.3 The contact person for Yued was William Warrell. The Yued representatives consulted were William Warrell, Jenny Mogridge, Alice Warrell and Fred Mogridge.

6.2.4 AIC contacted the above persons, briefed them on the MRWA proposal, and made arrangements for CMWG and Yued representatives to undertake a field inspection of the proposal.

6.2.5 AIC engaged heritage consultants Ron Parker and Jeremy Maling to complete the field inspection of the proposed works with representatives of the aforementioned groups.

6.3 Fieldwork methodology

6.3.1 The field inspection of the proposed works area was undertaken on Wednesday the 6th of October 2004 with CMWG NTC representatives and Yued NTC representatives.

6.3.2 The consultants and Aboriginal representatives drove by hire bus and car to a stop off point near the intersection of Tee Tree Road and Great Northern Highway. With the assistance of maps, the MRWA proposal and results of the desktop study and archaeological survey were outlined on the way. At the stop off point they met with MRWA representatives Tony Saraullo and Karen Chiang. The MRWA representatives detailed the proposal further and a method for the field inspection was agreed upon. People were provided with high visibility vests.

6.3.3 Led out by the MRWA representatives, the party inspected the proposed road works by vehicle. The party stopped at various points along the way, where they inspected the proposed road works area by foot and discussed the project and heritage concerns in further detail. Initially, the party proceeded from the stop off point to Chittering Road House, approximately one kilometre north of the beginning of the proposed road works. They then stopped at Burroloo Well (Site Id 3528), followed by the intersection of Chittering Road. From there they drove to Bindoon (past the northern extent of the proposed road works area), turned around, and regathered at the stop-off point near the Tee Tree Road intersection. Following a final discussion the consultation concluded.

6.4 Results

6.4.1 During the field inspection, several sites and areas of cultural heritage significance were identified by the CMWG and Yued representatives including, a single marked tree, Burroloo Well and an associated creek, Brockman River and associated lakes, Holy Trinity Church, and a cluster of marked trees. The Elders also stated that the general area was significant to them, historically, spiritually, and as a place where some of them hunt and gather today. The rivers, waterways and hills in the area were identified as being of mythological significance and as forming part of a sites complex. The Elders also stated that the Darling Scarp itself is significant to them as a site.

6.4.2 The CMWG and Yued representatives raised the following concerns and requests regarding the proposed road works:

- The impact of the proposed works upon the environment in the area, particularly the wetlands. Specifically, the Aboriginal representatives raised concerns about the impact upon wildlife in the swamps, and pollution from road run-off. Richard Wilkes stated that there should be rubbish and oil traps or sumps along the road.
- That revegetation of disturbed areas include only local indigenous flora.
- That the sites identified by them be recorded with DIA and that the impact of the proposed works upon them be minimised. Richard Wilkes stated that run-off near Burroloo Well has got to be clean and the proposed works not cause erosion.
- That a consultation is needed with them if the Brockman River Bridge is to be widened in the future.
- That, in order to protect the wetlands in the area, the proposed road works take place on the opposite side of the road to where wetlands are located, and generally keep away from the wetlands as much as possible.
- That, given the potential for subsurface material to exist in the area, MRWA employ Aboriginal monitors during ground disturbance activity. This was stated as being particularly important in areas where trees are being removed and the ground is largely undisturbed.
- That MRWA construct signage in the proposed car bays illustrating the Aboriginal Heritage of the area.

6.4.3 The CMWG and Yued representatives stated that, given that their requests are respected, they would not object to the planned project as described to them. MRWA representative Tony Saraullo acknowledged the Aboriginal representatives' request for Nyungah monitoring of ground disturbance activity. Tony Sarullo also stated his agreement with the need to minimise the impact upon the wetlands and, in particular, that MRWA were "quite ok" with the request to keep the proposed road works take place on the opposite side of the road to where wetlands are located.

6.5 Discussion

6.5.1 The proposed road works are in an area that the Aboriginal consultants identified as being significant to them and as containing particular places of cultural significance. Several waterways in the area were held to be of significance mythologically, as important habitat places for indigenous fauna, and as places where Aboriginal people hunt and gather today. The area was also expressed as being spiritually significant as a place where Aboriginal people used to live. The general significance of the survey area was also asserted by Robert Bropho stating, "*I find it very hard that the whole area is not recognised as an Aboriginal place*" and the affirmation by the Elders that the Darling Range itself is a site (although

Site Id 3188/S00546/DARLING RANGE has been determined by the ACMC to be "not a site" under the Act). Furthermore, the Elders' made several references to the Aboriginal history of the area, affirmed that Aboriginal people would have lived and treasured the land in the past, and also mentioned the massacring of Aboriginal people and their removal from the area. These findings are consistent with previous consultations undertaken by AIC near Gingin (see desktop study) and also in the metropolitan area and serve to highlight the significance of the survey area to Aboriginal people today.

6.5.2 The Aboriginal people's concern for protecting this heritage was reflected in their requests and concerns regarding the proposed road works. This was evident in the Elders' request that the impact of the proposed works upon the identified sites be minimised, a request for Nyungah monitoring of ground disturbance activity, and a request for MRWA to install signage acknowledging the Aboriginal heritage of the area. Furthermore, the relevance of these concerns to the road works area was highlighted by the Elders concerns about development in general impinging upon the area, for example a proposed residential development in close proximity to the Lakes that the Elders had previously been unaware of and have not been consulted about. Again, the concerns raised by the Elders are consistent with previous consultations undertaken by AIC near Gingin (see desktop study) and also in the metropolitan area.

6.5.3 An acknowledgement and consideration of the Elders' concerns by Tony Saraullo, however, facilitated an amicable resolution to the consultation. Tony Saruallo acknowledged the Aboriginal representatives' request for Nyungah monitoring of ground disturbance activity and stated that MRWA were "quite ok" with the request to keep the proposed road works take place on the opposite side of the road to where wetlands are located. The consultation concluded with the CMWG and Yued representatives expressing that, given that the concerns and requests raised by them are respected, they would not object to the planned project as described to them.

7. CONCLUSIONS

7.1 The high level of physical disturbance together with low surface visibility indicates that the archaeological potential of this area has not been properly ascertained.

7.2 Two European heritage sites are located within the area of proposed development. The Holy Trinity Church is unlikely to be adversely affected by development, although care should be taken by Main Roads during blasting works to avoid damage to this historic building.

7.3 The Upper Chittering Primary School site may be impacted by works, and a possible change of route has been suggested. However, this change is a suggestion rather than a requirement. Mr. Bob Lissett of the Bindoon and Districts Historical Society is available to provide further information regarding the location of the Upper Chittering School if required.

7.4 Several places of significance to the CMWG and Yued representatives were identified during the field inspection.

7.5 AIC will lodge the necessary site recording forms with the Department of Indigenous Affairs for the places identified by the CMWG and Yued representatives.

7.6 The CMWG and Yued representatives expressed that, given that the concerns and requests raised by them during the consultation are respected, they would not object to the planned project as described to them.

8. RECOMMENDATIONS

AIC recommends that:

- There are no obvious archaeological impediments to the proposed development proceeding.

- Main Roads exercise caution during blasting works around the Holy Trinity Church.

- Main Roads avoid the Upper Chittering Primary School site where possible.

- Where possible, MRWA undertake road works on the opposite side of the road to where wetlands are located.

- MRWA employ Aboriginal monitors during ground disturbance activity, under an agreement to be determined in the near future.

- MRWA consider the request by the Aboriginal representatives for the installation of signage that acknowledges the Aboriginal Heritage of the area.

- MRWA take steps to ensure that they comply with both the Aboriginal Heritage Act (1972), Heritage of Western Australia Act (1990), and the Shire of Chittering's municipal planning schemes.

- MRWA staff and contracting personnel be made fully aware of their obligations under The Act.

Given that the above conditions are met, the Nyungah Elders have not presented any reason why the project cannot proceed.

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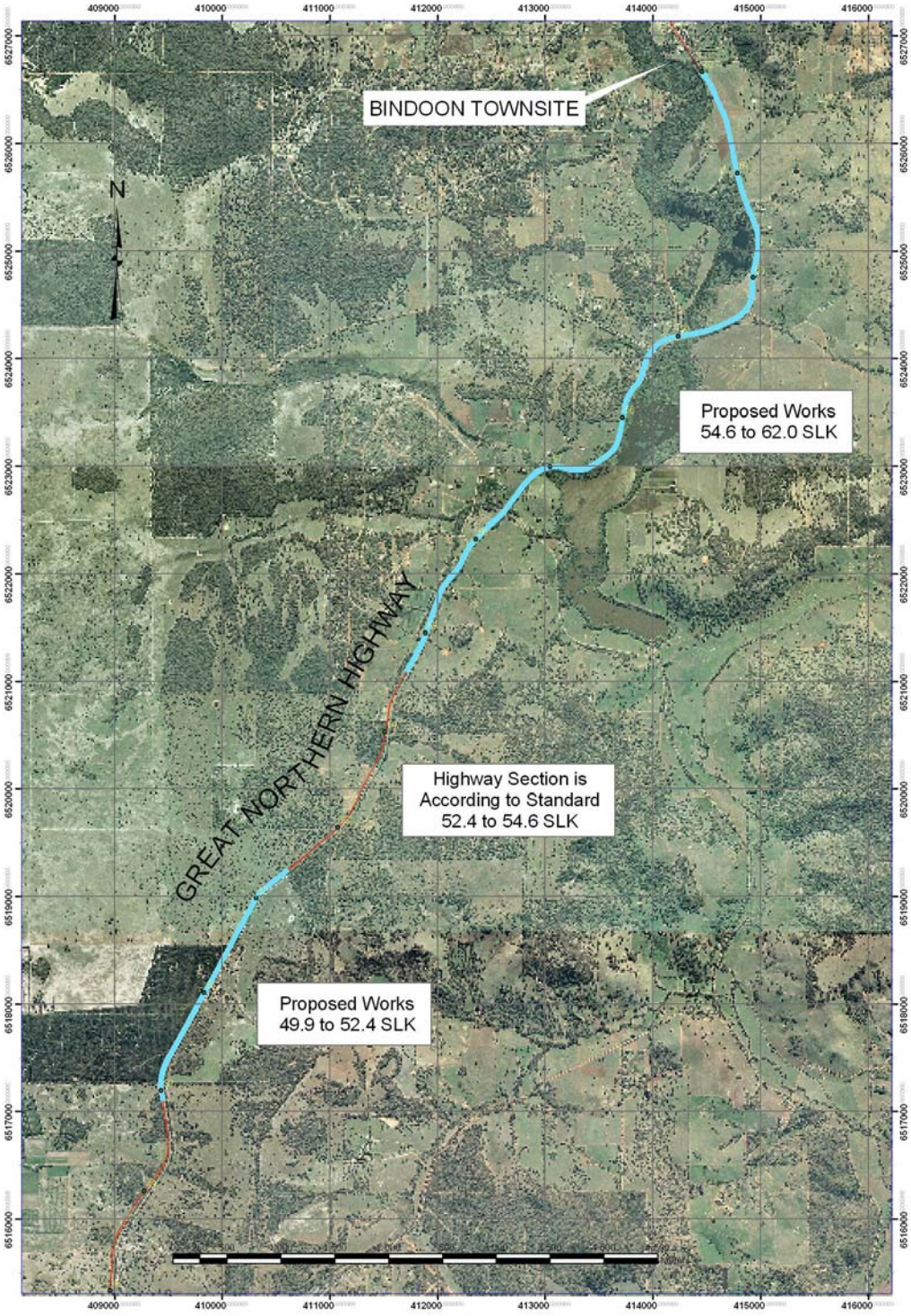
10. MAP OF GENERAL AREA

11. MAP OF PROJECT AREA



12. MAP OF EXISTING DIA SITES

13. RESULTS OF DIA RESEARCH

DEPARTMENT OF INDIGENOUS AFFAIRS

Register of Aboriginal Sites

Page 1
RPGSR V1.57
Reference No: IQ-RPGSR-6535

Report run onSeptember 8, 2004 4:20 PM

Selection Criteria

Site Search within specified polygon
Coordinates Type: MGA Coordinates - MGA Zone: 50
Coordinates: Easting: 408500 Northing: 6517000
Easting: 414000 Northing: 6525000
Easting: 414000 Northing: 6527000
Easting: 415500 Northing: 6527000
Easting: 415500 Northing: 6525000
Easting: 410000 Northing: 6517000

2 Site Records Found

Legend

Status
I Interim Register
P Permanent Register
S Stored Data

Restriction
F Female Access Only
M Male Access Only
N No Gender Restrictions

Access
C Closed
O Open
V Vulnerable

Reliability
R Reliable
U Unreliable

Site Types
C Ceremonial
RP Repository / cache
S Man-Made Structure
T Modified Tree
E Engraving
ART Artefacts / Scatter
HIST Historical
M Mythological
BUR Skeletal material/Burial
F Fish Trap
P Painting
Q Quarry
MD Midden / Scatter
G Grinding patches / grooves

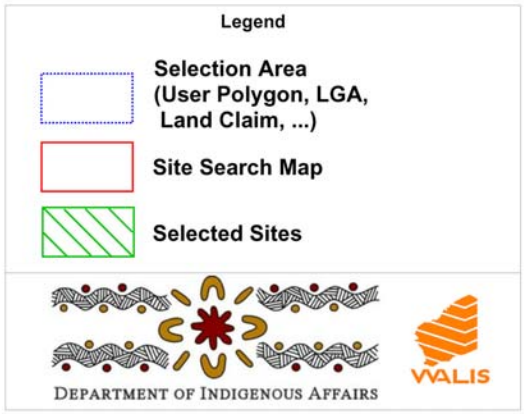
Map coordinates (Latitude / Easting & Longitude / Northing) are based on the GDA94 datum. Coordinates are indicative locations and may not necessarily represent the true centre of sites, especially if access to specific site information is tagged as "Closed" or "Vulnerable". The metric grid on Site Search Maps are for a specific MGA zone, and does not cater for MGA metric coordinates for a different MGA zone.

Site Id	Status	Access	Restriction	Latitude/ Easting	Longitude/ Northing	Reliability	Site Type	Site Name	Informants	Site No
3422	I	O	N	31°24'19"S	116°6'26"E	U	BUR	BINDOON HILL		S02712
		MGA Zone	50	415140 mE	6525149 mN					
3528	P	O	N	31°27'10"S	116°3'49"E	U	ART	BURROLOO WELL.		S02524
		MGA Zone	50	411039 mE	6519849 mN					

WESTERN AUSTRALIA

Aboriginal Sites Register

Site Search Overview Ma




Page 3
Site Search Map
N
CHITTERING
116°10'00"E
116°05'00"E
116°00'00"E
420000mE
415000mE
410000mE
405000mE
6526000mN
6520000mN
Kilometers

DEPARTMENT OF INDIGENOUS AFFAIRS

Gis Site Reports

RPGLR V1.3

Report run on: September 8, 2004 4:20 PM

Selection Criteria

Site Search within specified polygon
Coordinates Type: MGA Coordinates - MGA Zone: 50
Coordinates: Easting: 408500 Northing: 6517000
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Easting: 414000 Northing: 6527000
Easting: 415500 Northing: 6527000
Easting: 415500 Northing: 6525000
Easting: 410000 Northing: 6517000

Report Id	Catalogue No.	Title	Author(s)	Old Ref No.
105699	HSR MW 2001 MAC [OWE]	Aboriginal Heritage issues and cable crossings : upper Canning River downstream from Nicholson Road traffic bridge adjacent downstream from Canning Bridge and Narrows bridge utilizing internal bridge structure Swan River adjacent upstream to Causeway	Machin, Barrie	0781 01

Total No. of Reports Indentified: 1

14. ABORIGINAL HERITAGE ACT (1972)

The following information is from a heritage perspective only, and any binding legal advice must be sought from an appropriate legal source. This information is extracted from the DIA website at www.dia.wa.gov.au.

Developers must make a reasonable effort to find out if any sites exist in the development area. If a previously unrecorded site or any Aboriginal material is located the land owner or user must report them to the Registrar of Aboriginal Sites.

Under the Act it is an offence to disturb any Aboriginal site. If a development is likely to impact on a site, consent to proceed must be given by the Minister for Aboriginal Affairs in the form of a section 18 permit. Penalties include fines of up to $2000 and/or 12 months imprisonment. Sites or material can include burial grounds; symbols; objects; cave or rock paintings or engravings; stone structures; arranged stones; and carved trees.

The Minister for Indigenous Affairs is responsible for the administration of the Act. He or she ensures that all places in Western Australia which are of traditional or current sacred, ritual or ceremonial significance to Indigenous people are recorded and their importance evaluated.

A section 18 permit is required only if a development is likely to impact on an existing site. If no sites are located within an area, or if the development can avoid an existing site in a manner acceptable to relevant Aboriginal people, no section 18 is required. However, should a previously unrecorded site be located during works, then work must cease and a section 18 application must be made. For this reason it is recommended that a survey be conducted before development to assess the location of any sites and prevent delays to the proceedings.

If monitoring by Aboriginal people and a heritage consultant is to occur during development, a section 16 permit can also be obtained which allows study and removal of objects located in the development area. Consultation with Aboriginal people before development should indicate whether this is an appropriate possibility to mitigate the impact of development.

5. Application to places

This Act applies to:

(a) any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;

(b) any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;

(c) any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State;

(d) any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.

[Section 5 inserted by No. 8 of 1980 s. 2; amended by No. 24 of 1995 s. 6.]

6. Application to objects

(1) Subject to subsection (2a), this Act applies to all objects, whether natural or artificial and irrespective of where found or situated in the State, which are or have been of sacred, ritual or ceremonial significance to persons of Aboriginal descent, or which are or were used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people past or present.

(2) Subject to subsection (2a), this Act applies to objects so nearly resembling an object of sacred significance to persons of Aboriginal descent as to be likely to deceive or be capable of being mistaken for such an object.

(2a) This Act does not apply to a collection, held by the Museum under section 9 of the *Museum Act 1969*, which is under the management and control of the Trustees under that Act.

(3) The provisions of Part VI do not apply to an object made for the purpose of sale and which:

(a) is not an object that is or has been of sacred significance to persons of Aboriginal descent, or an object so nearly resembling such an object as to be likely to deceive or be capable of being mistaken for the same; or

(b) is an object of the kind referred to in paragraph (a) that is disposed of or dealt with by or with the consent of the Minister.

[Section 6 amended by No. 24 of 1995 s. 7.]

7. Traditional use

(1) Subject to subsection (2), in relation to a person of Aboriginal descent who usually lives subject to Aboriginal customary law, or in relation to any group of such persons, this Act shall not be construed:

(a) so as to take away or restrict any right or interest held or enjoyed in respect to any place or object to which this Act applies, in so far as that right or interest is exercised in a manner that has been approved by the Aboriginal possessor or custodian of that place or object and is not contrary to the usage sanctioned by the Aboriginal tradition relevant to that place or object; or

(b) so as to require any such person to disclose information or otherwise to act contrary to any prohibition of the relevant Aboriginal customary law or tradition.

(2) Nothing in subsection (1) authorises any person, or group of persons, to dispose of or exercise any right or interest, or any purported right or interest, in a

manner which is, in the opinion of the Minister, detrimental to the purposes of this Act.
[Section 7 amended by No. 24 of 1995 s. 8.]

16. Excavation of Aboriginal sites

(1) Subject to section 18, the right to excavate or to remove any thing from an Aboriginal site is reserved to the Registrar.

(2) The Registrar, on the advice of the Committee, may authorise the entry upon and excavation of an Aboriginal site and the examination or removal of any thing on or under the site in such manner and subject to such conditions as the Committee may advise.
[Section 16 amended by No. 8 of 1980 s. 5; No. 24 of 1995 s. 17.]

17. Offences relating to Aboriginal sites

A person who:

(a) excavates, destroys, damages, conceals or in any way alters any Aboriginal site; or

(b) in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom, or assumes the possession, custody or control of, any object on or under an Aboriginal site, commits an offence unless he is acting with the authorisation of the Registrar under section 16 or the consent of the Minister under section 18.
[Section 17 inserted by No. 8 of 1980 s. 6; amended by No. 24 of 1995 s. 18.]

18. Consent to certain uses

(1) For the purposes of this section, the expression "**the owner of any land**" includes a lessee from the Crown, and the holder of any mining tenement or mining privilege, or of any right or privilege under the *Petroleum Act 1967*, in relation to the land.

(1a) A person is also included as an owner of land for the purposes of this section if:

(a) the person;

(i) is the holder of rights conferred under section 34 of the *Dampier to Bunbury Pipeline Act 1997* in respect of the land or is the holder's nominee approved under section 34(3) of that Act; or

(ii) has authority under section 7 of the *Petroleum Pipelines Act 1969* to enter upon the land; or

(b) the person is the holder of a distribution licence under Part 2A of the *Energy Coordination Act 1994* as a result of which the person has rights or powers in respect of the land.

(2) Where the owner of any land gives to the Committee notice in writing that he requires to use the land for a purpose which, unless the Minister gives his consent under this section, would be likely to result in a breach of section 17 in respect of any

Aboriginal site that might be on the land, the Committee shall, as soon as it is reasonably able, form an opinion as to whether there is any Aboriginal site on the land, evaluate the importance and significance of any such site, and submit the notice to the Minister together with its recommendation in writing as to whether or not the Minister should consent to the use of the land for that purpose, and, where applicable, the extent to which and the conditions upon which his consent should be given.

(3) Where the Committee submits a notice to the Minister under subsection (2) he shall consider its recommendation and having regard to the general interest of the community shall either:

(a) consent to the use of the land the subject of the notice, or a specified part of the land, for the purpose required, subject to such conditions, if any, as he may specify; or

(b) wholly decline to consent to the use of the land the subject of the notice for the purpose required, and shall forthwith inform the owner in writing of his decision.

(4) Where the owner of any land has given to the Committee notice pursuant to subsection (2) and the Committee has not submitted it with its recommendation to the Minister in accordance with that subsection the Minister may require the Committee to do so within a specified time, or may require the Committee to take such other action as the Minister considers necessary in order to expedite the matter, and the Committee shall comply with any such requirement.

(5) Where the owner of any land is aggrieved by a decision of the Minister made under subsection (3) he may, within the time and in the manner prescribed by rules of court, appeal from the decision of the Minister to the Supreme Court which may hear and determine the appeal.

(6) In determining an appeal under subsection (5) the Judge hearing the appeal may confirm or vary the decision of the Minister against which the appeal is made or quash the decision and substitute his own decision which shall have effect as if it were the decision of the Minister, and may make such order as to the costs of the appeal as he sees fit.

(7) Where the owner of any land gives notice to the Committee under subsection (2), the Committee may, if it is satisfied that it is practicable to do so, direct the removal of any object to which this Act applies from the land to a place of safe custody.

(8) Where consent has been given under this section to a person to use any land for a particular purpose nothing done by or on behalf of that person pursuant to, and in accordance with any conditions attached to, the consent constitutes an offence against this Act.

[Section 18 inserted by No. 8 of 1980 s. 6; amended by No. 24 of 1995 s. 19 [2;] No. 58 of 1999 s. 39.]

62. Special defence of lack of knowledge

In proceedings for an offence against this Act it is a defence for the person charged to prove that he did not know and could not reasonably be expected to have known, that the place or object to which the charge relates was a place or object to which this Act applies.

15. DEFINITIONS OF SITES

Structure: 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; stenciled objects are also common. Whilst spectacular painting sites can be found across most of the state, particularly in the Kimberley region, very few have been recorded in the lower Southwest.

Engraving: These are places at which designs have been carved, pecked or abraded into a rock surface, are known to occur throughout much of the state although, in common with painting sites, they are rare in the Southwest.

Grinding patches/grooves: In the lower Southwest of Western Australia grinding patches/grooves generally take the form of small circular depressions found on rocky exposures along the coast. These features are thought to represent activities relating to 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.

Artefact Scatters: Stone artefact scatters are the most common archaeological component represented throughout Southwest 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.

Middens: Such sites consist of scatters of humanly deposited shell, usually with a stratified component.

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.

Appendix G

PHOTOGRAPHS OF VEGETATION IN AREAS OF DISTURBANCE OF CHITTERING LAKES NATURE RESERVE AND MITIGATION AREAS

Site 5 Offset Opposite Church east 0m

Site 5 Offset Opposite Church east 50m

Site 5 Offset Opposite Church east 100m

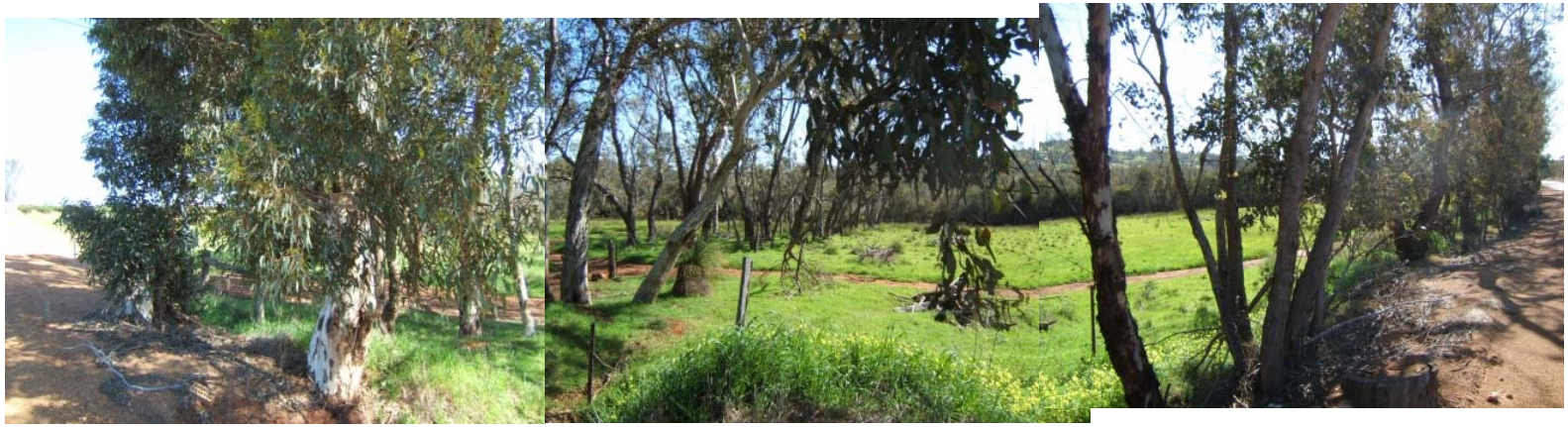
Site 5 Offset Opposite Church east 200m

Site 5 Offset Opposite Church east 250m

Site 5 Offset Opposite Church east 300m

Site 5 Offset Opposite Church east 350m

Site 7 (Offset near orchard) west 0m



Site 7 (Offset near orchard) west 50m

Site 7 (Offset near orchard) west 100m

Site 7 (Offset near orchard) west 150m

Site 7 (Offset near orchard) west 200m

Site 7 (Offset near orchard) west 250m

Temporary Disturbance of Chittering Lakes Nature Reserve site 1

1st bend after Chittering Road Eastern Side

50m to the north

Temporary Disturbance of Chittering Lakes Nature Reserve site 2.
(beginning parallel with northern cadastral boundary of Holy Trinity Church and extending north for approximately 100m)

Temporary Disturbance of Chittering Lakes Nature Reserve site 3.
(Tea tree road Eastern Side opposite intersection)

50m to the north

Appendix H

COMMUNITY CONSULTATION MEETINGS - ATTENDANCE LISTS

Government of Western Australia

MAIN ROADS Western Australia

ABN: 50 860 676 021

Fax

TO:	**KBR** **Elizabeth Mason Environmental Scientist**	FAX N°:	(08) 92784200
FROM:	Tony Saraullo Project Manager	TEL N°: FAX N°:	(08) 9622 4700 (08) 9622 3767
EMAIL:	tony.saraullo@mainroads.wa.gov.au		
YOUR REF:	nk	OUR REF:	
DATE:	20 September 2005	PAGES (including this):	3
SUBJECT:	**ETS CONTRACT 02/02. Project No 02-02-0129- GNH Bindoon South 54.8 – 62.1SLK Environmental Services**		

Elizabeth

Attached copy of Attendance List for the Meeting with Ellen Brockman Intergrated Catchment Group held at the Chittering Landcare Centre

For your information

Regards,

Tony Saraullo

ATTENDANCE LIST

GREAT NORTHERN HIGHWAY
BINDOON SOUTH PROJECT

Ellen Brockman Centre Meeting September 19 2005

NAME	ADDRESS	CONTACT DETAILS
Grant MacKinnon	City of Swan	9267 9203
Hartley Read	1695 Lower Chittering 6084	95718011
Norm Wallace	20 Weld ST Ginsin 6503	95752259 Fax 95752460
Sue Metcalf	126 Gray Rd Bindoon	042 8939919.
Brian Moyle	Wildflower Energy (WA (Pty) Ltd PO Box 64 Nedland 6909	93301754 (Home)
Nigel Howe	Main Roads Northam	
Polly Hammond	Chittering Landcare Centre	0429030790
Renae Thorpe	PO Box 62 Muchea 6501	9571 0200
David Gibb	" " " "	9571 0400
David Lown	2 TOAD PLACE CHITTERING	9576 1237 lawmy@iinet.net.au
Katerina Neve	PO Box 62 Muchea 6501	9571 4351

NAME	ADDRESS	CONTACT DETAILS
DANIEL JORDAN for Tinest	PO Box 22 Muchea 6501	95719243 0438775045 daniel.jordan@tinest.com.au
Amy Salmon		9571 1012
RoberT Marchesi	Lower Chittering	95714082
** Laurie Bush - weed Com-ttee - Anglican. Chch.	545 Chittering Valley Rd. Lower Chittering 6084	95718073

ROADSWEST
ENGINEERING GROUP PTY LTD
PROJECT MANAGERS & CONSULTING ENGINEERS

Form No. REG/02/04-01-F06

FACSIMILE TRANSMISSION

Suite 13 / 6 Leigh Street BURSWOOD WA 6100
Postal Address: P.O.Box 108 VICTORIA PARK WA 6979
Ph: (08) 9472 4122 Fax: (08) 9472 4102
Email: roadswest@roadswest.com.au
(ACN 070 988 706) (ABN 96 057 501 071)

To: **KBR**	**Customer Fax No** 92784200
Attention: Elizabeth Mason	**Roadswest Ref No:** R1361
From : **Tony Saraullo**	**Customer Ref. No: N/a**
Date: September 16 2005	**Pages:** 4 (Including Cover Sheet) 4

Subject: GNH Bindoon South- Public Meeting September 15 2005

Message:

Elizabeth
Attached copies of the attendance sheets of all people who attended.

This information to be used in your community reporting

Regards

Tony Saraullo

Signed:..... Date:.....

ATTENDANCE LIST

GREAT NORTHERN HIGHWAY
BINDOON SOUTH PROJECT

Community Meeting September 15 2005

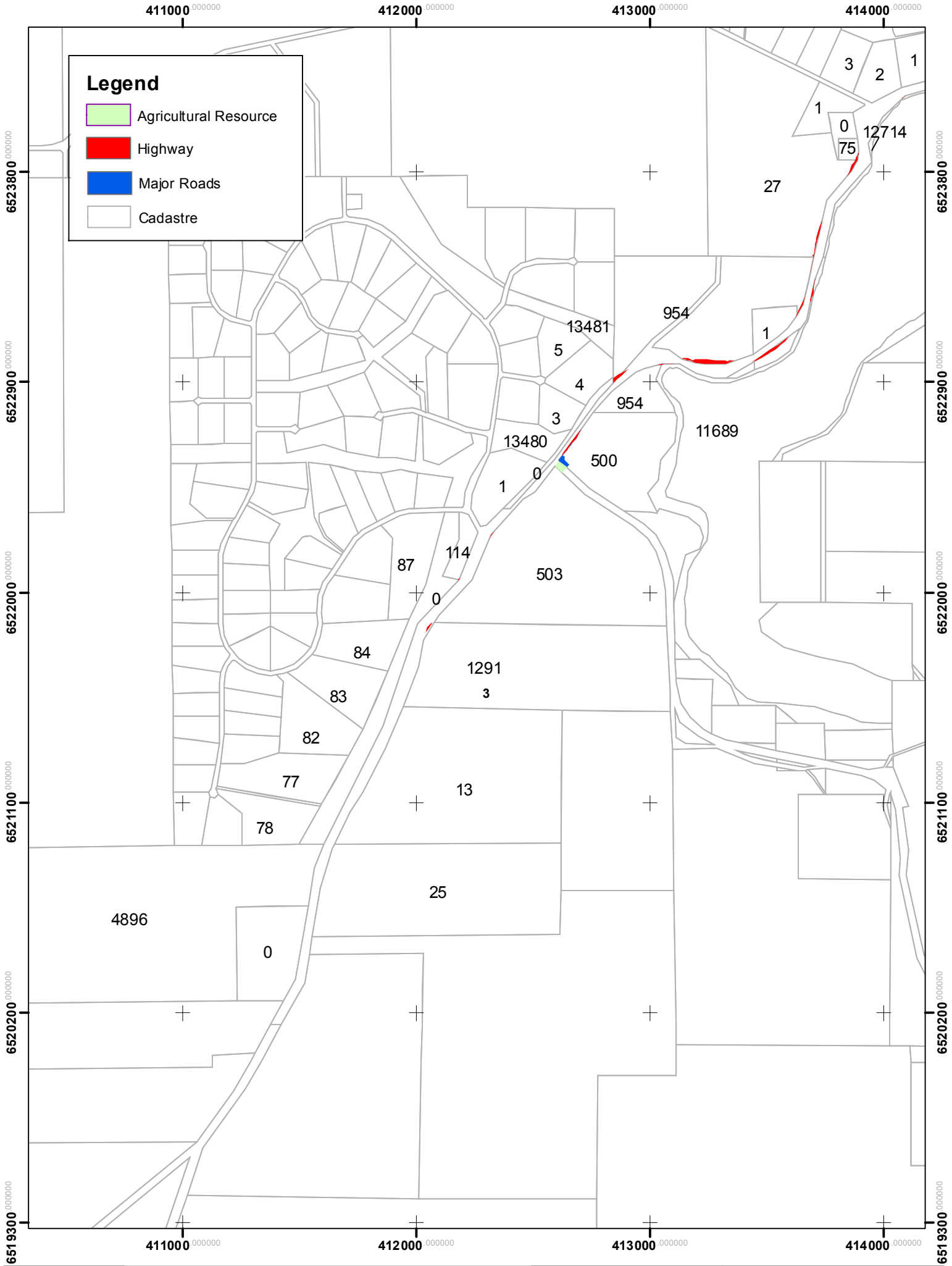
NAME	ADDRESS	CONTACT DETAILS
MAX HIPKINS	SHIRE OF CHITTERING.	
DENISE GOBBART - DEPUTY CEO	SHIRE of CHITTERING.	
JAN STAGBOUER - SHIRE PRESIDENT	973 WELLS GLOVER RD, MOOLIABEENIE	95762001 0428762100 minkton1@bigpond.com
LANCE STAGBOUER - Sec Bindoon Progress - Resident	973 WELLS GLOVER RD Mooliabeenie	As above 0428762100
JOHN THOMPSON	6058 GREAT NT. H/WAY BINDOON	9576 1421
JUNE FROM	P/O BOX 21 (Learmonth Way) Bindoon	95761247
FRED FROM	P/O BOX 21 (Learmonth Way) BINDOON	95761247
LES HOWARD	132 FORREST HILLS PD	95761248
ANNE PARROTT	183 FORREST HILLS PDE	9576 1063
TONY WHITBREAD	PO BOX 186 BINDOON 6502	95760900

NAME	ADDRESS	CONTACT DETAILS
J. SKEVINGTON	LOT 54 HART DRIVE LAKE CHITTERING 6084	95761204
GLENDA JEANS	60 PIONEER DRIVE BINDOON 6502	95761592.
PETER JEANS.	60 PIONEER DRIVE BINDOON .6502	95761592.
NORRIE MERRIFIELD	PO Box 116 BINDOON 6502	95760364
ANDY DRUMMOND	PO BOX 135 BINDOON 6502	042 747 9009
ANNE MERRIFIELD	PO BOX 116 BINDOON 6502	9576 0364
SHANE MARTIN	BOX 208 BINDOON 6502 142 FLAT ROCKS RD	95760390
SHANE KAY	58 CREST HILL RD BINDOON 6502	95761093
COLIN THOMPSON	31 EVERGREEN RISE BINDOON.	95760002
JANE RIGHTON	184 FORREST HILLS PDE BINDOON	95761532
Josephine Chick	1390 Tea Tree Rd.	95762073
Peter Chick	1390 TEA TREE RD BINDOON	95762073
DAVID PASSMORE-	875 BINDOON-MOORA ROAD	95762082.

Bob BLIZARD	8/11 Edmonds Place BINDOON.	95760085
VICKI HUMPHRY + PHILLIP HUMPHRY	450 HART DVE, CHITTERING (POSTAL) P.O. BOX 29, BINDOON	95761050
Ernie Parkinson	21 Chinkabee Road Bindoon. 6502.	95761087
LAURIE DON	4841 G.N.H. CHITTERING	95714076
BILL CARSON	10 PARKSIDE GDNS BNDOON	95761515
ANDY GOMERSALL BJS CONTRACTOR	581 BINDOON HOOKS RD	9576 2069
Lindsey Densley	52 EGRET PLC. Chittering	0417 908773.
Chem DENSLEY	169 DENSLEY RD BINDOON	95761080
EILEEN TAYLOR, SECRETARY BINDOON ARTS & CRAFTS - BROCKMAN CENTRE.	4/11 EDMONDS PL BINDOON.	95760395.
JEANNE LAWLER	MRWA - WBN	
GURDIP KUNDI	MRWA - WBN	
HILTON LOGAN	" "	

Appendix I

TOWN PLANNING MAPS SHOWING REZONING OF ROAD RESERVE



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1:20,000 @A4

SOURCE

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PROJECTION GDA 1994 MGA Zone 50

FINAL APPROVAL JR

DATE 18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

256 St Georges Terrace PERTH WA 6000

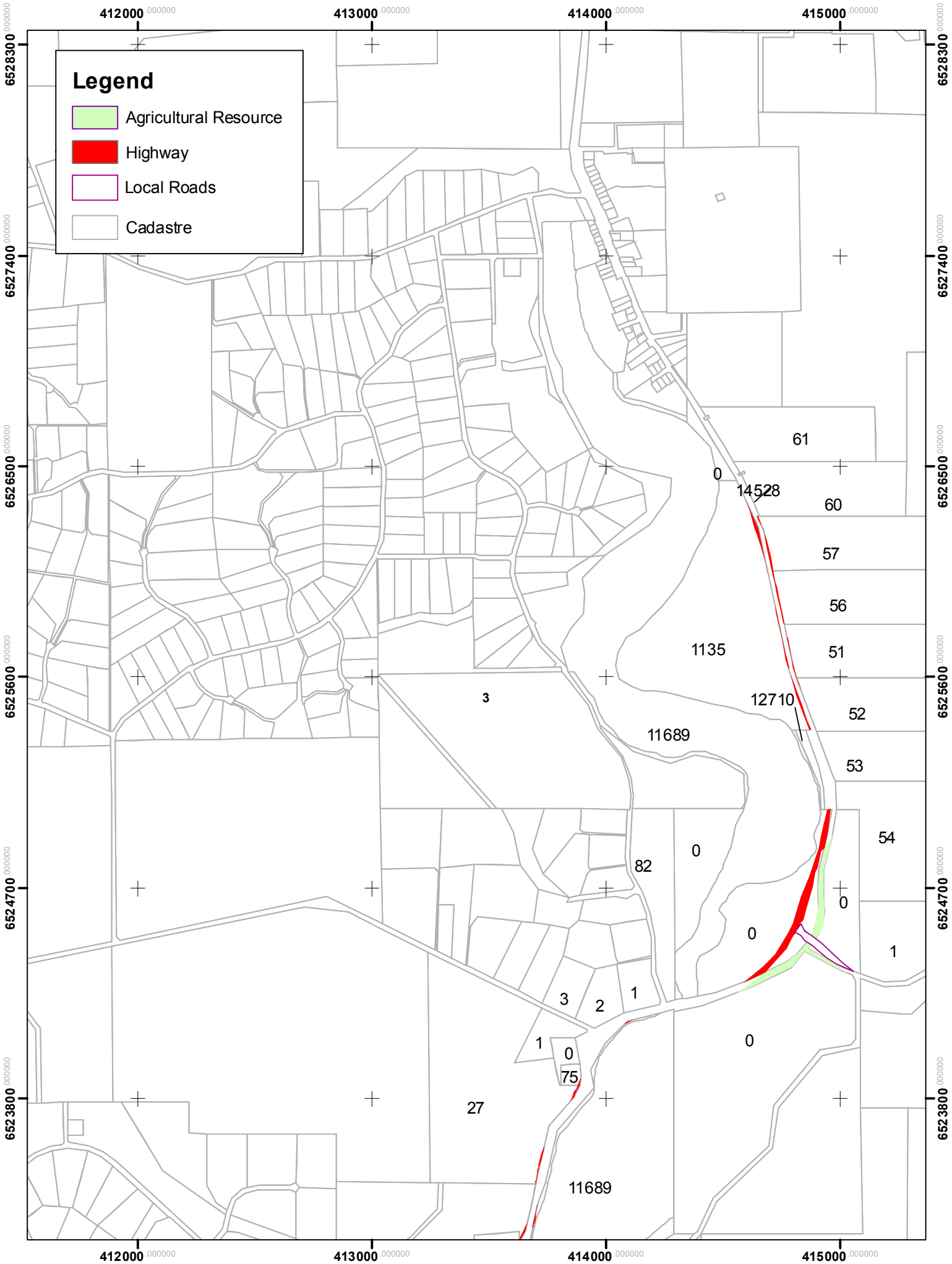
Drawn by GIS Specialist

TITLE

Proposed Rezoning
Shire of Chittering TPS No 6
Map 5 of 8 - Bindoon South

FIGURE No.

PROJECT No. PEN414



0 125 250 500 Meters

1:20,000 @A4

SOURCE

GIS FILE G:\Projects\MRWA\1_ETS\PEN414 SouthBindoon\Town Planning Mxds\newTPS_4.mxd

PROJECTION GDA 1994 MGA Zone 50

FINAL APPROVAL JR

DATE 18/11/05

Kellogg, Brown & Root Pty Ltd

KBR

Kellogg, Brown & Root Pty Ltd ABN 91 007 660 317

256 St Georges Terrace PERTH WA 6000

Drawn by GIS Specialist

TITLE

Proposed Rezoning
Shire of Chittering TPS No 6
Map 4 of 8 - Bindoon South

FIGURE No.

PROJECT No. PEN414

Appendix J

NATIVE VEGETATION CLEARING CORRESPONDENCE

Government of Western Australia

MAIN ROADS Western Australia

ABN: 50 860 676 021

Fax

TO:	**KBR** **Jamie Reilly Senior Environmental Scientist**	FAX N°:	(08) 92784200
FROM:	Tony Saraullo Project Manager	TEL N°: FAX N°:	(08) 9622 4700 (08) 9622 3767
EMAIL:	tony.saraullo@mainroads.wa.gov.au		
YOUR REF:	nk	OUR REF:	05/777
DATE:	18 October 2005	PAGES (including this):	4
SUBJECT:	**ETS CONTRACT 02/02. Project No 02-02-0129- GNH Bindoon South 54.8 – 62.1SLK Environmental Services**		

Elizabeth

Attached copy of letter received from D of E accepting the application for vegetation clearing on the Bindoon South project.

For your information

Should you have any queries regarding this matter please call me.

Regards,

Tony Saraullo
PROJECT MANAGER
GNH BINDOON SOUTH

Cc Paul West –MRWA DAC

Department of Environment

Your ref:
Our ref: CPS 900/1
Enquiries: K Faulkner
Direct tel: 9278 0300

MAIN ROADS
NORTHAM
18 OCT 2005
OFFICER- SARULLO
FILE No- 05/777
CORRESP No- N0545681

Mr Tony Saraullo
Main Roads Western Australia
Peel Terrace
Northam WA 6401

Dear Mr Saraullo

RE: APPLICATION TO CLEAR NATIVE VEGETATION UNDER THE *ENVIRONMENTAL PROTECTION ACT 1986*

In accordance with section 51E of the *Environmental Protection Act 1986* (the Act), I have accepted your application for the following:

Type of Permit:	Area Permit
Area (ha):	5.7
Purpose:	Road construction or maintenance
Applicable Period:	Jan 06 - Oct 07
Shire:	Shire Of Chittering
Property(s):	Lot 1 On Diagram 9344, Lot 114 On Plan 14449 Lot 11689 On Plan 240358, Lot 12714 On Plan 240358 Lot 13227On Diagram 94671, Lot 13291 On Diagram 95873 Lot 27 On Diagram 2750, Lot 500 On Diagram 78895 Lot 503 On Plan 19179, Lot 75 On Plan 1705 Lot 954 On Plan 246301

Please quote CPS 900/1 on all future correspondence and enquiries.

As required by sub-section 51E(4) of the Act, on behalf of the CEO I will invite any public authority or person which or who has a direct interest in the subject matter of the application to comment on it, and will advertise the application, inviting any person who wishes to comment on it to do so within the period specified in the advertisement.

The CEO shall, after having taken into account any comments received and subject to sections 51O and 51P, make a decision regarding your application. You will be notified of that decision in writing.

Westralia Square
Level 8 141 St Georges Terrace
Perth Western Australia 6000
PO Box K822 Perth Western Australia 6842
Telephone (08) 9222 7000 Facsimile (08) 9322 1598
E-mail info@environment.wa.gov.au
www.environment.wa.gov.au

Hyatt Centre
Level 2 3 Plain Street
East Perth Western Australia 6004
PO Box 6740 Hay Street East Perth Western Australia 6892
Telephone (08) 9278 0300 Facsimile (08) 9278 0301
National Relay Service (Australian Communication Exchange) 132 544
E-mail info@environment.wa.gov.au
www.environment.wa.gov.au

Attached is a digitised map indicating the area you propose to clear. Please advise Native Vegetation Protection on 9278 0300 or nvp@environment.wa.gov.au **within 7 days** if this plan is inaccurate.

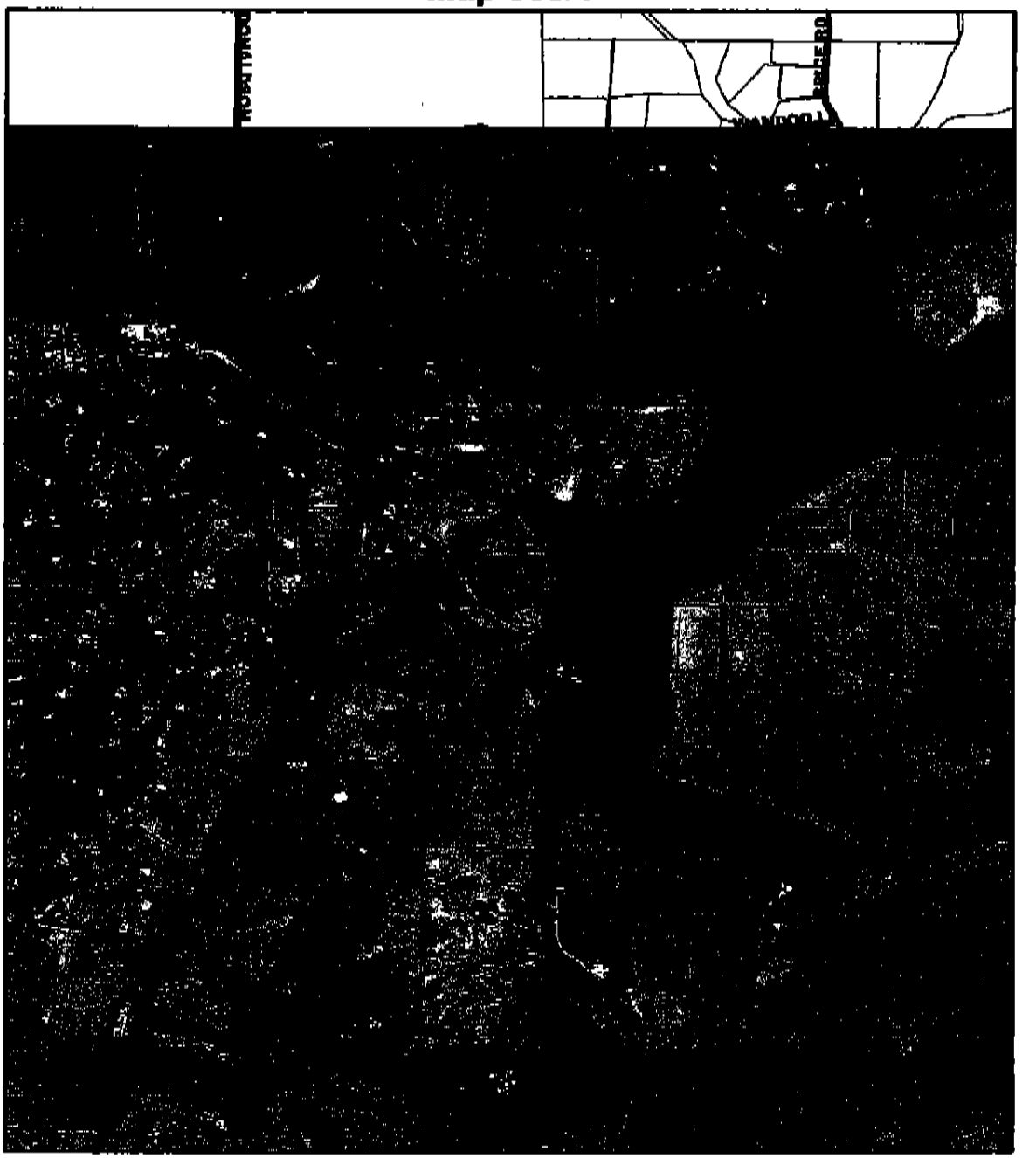
If you have any queries regarding the progress of your application, please do not hesitate to contact the Department's Swan Goldfields Agricultural Region on 6250 8000.

Yours sincerely

Kelly Faulkner
A/Section Manager, Regulatory Support

17 October 2005

Map 900/1



LEGEND

Clearing Instruments

- Areas Applied to Clear
- Areas subject to easements
- Areas Approved to Clear
- Road Centrelines - DLI 1/8/04

- Cadastre - DLI 1/08/05
- Swan Coastal Plain North 50cm Orthomosaic - DLI 05

N

0 425 m

Scale 1:2915@ (Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

Date .....

Information derived from this map should be confirmed with the data custodian acknowledged by the agency acronym in the legend.

Government of Western Australia